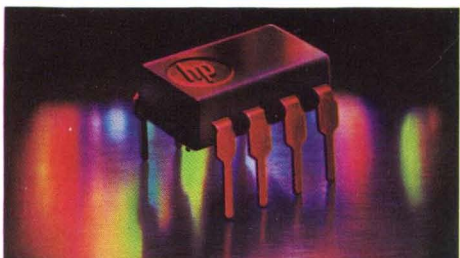
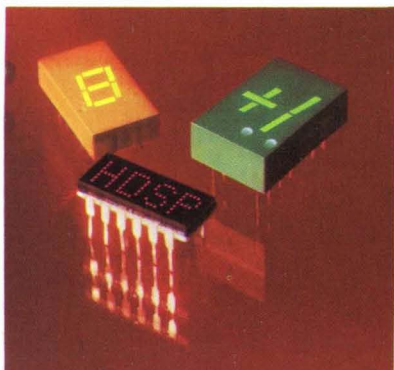
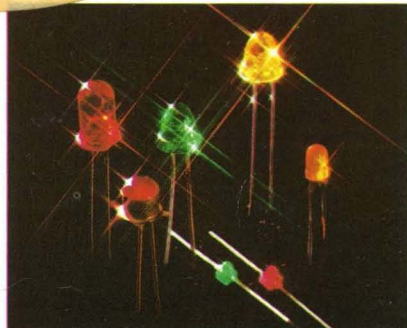


1978 OPTOELECTRONICS DESIGNER'S CATALOG



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HEWLETT **hp** PACKARD
COMPONENTS

A decade of intensive solid state research, the development of advanced manufacturing techniques and continued expansion has enabled Hewlett-Packard to become a high volume supplier of quality, competitively priced LED displays, LED lamps, optocouplers, and photo-detectors.

In addition to our broad product line, Hewlett-Packard also offers the following services: immediate delivery from any of our authorized stocking distributors, applications support, special QA testing, and a one year guarantee on all of our optoelectronic products.

This package of products and services has enabled Hewlett-Packard to become a recognized leader in the optoelectronic industry.

BRIEF A SKETCH



HP produces more than 3,500 products at 30 domestic divisions in California, Colorado, Oregon, Idaho, Massachusetts, New Jersey and Pennsylvania and at overseas

plants located in the German Federal Republic, Scotland, France, Japan, Singapore, Malaysia and Brazil.

Hewlett-Packard is one of the world's leading designers and manufacturers of electronic, medical, analytical, and computing instruments and systems, diodes, transistors, and optoelectronic products. Since its founding in Palo Alto, California, in 1939, HP has done its best to offer only products that represent significant technological advancements.

However, for the customer, Hewlett-Packard is no further away than the nearest telephone. Hewlett-Packard currently has sales and service offices located around the world.

To maintain its leadership in instrument and component technology, Hewlett-Packard invests heavily in new product development. Research and development expenditures traditionally average about 10 percent of sales revenue, and 1,500 engineers and scientists are assigned the responsibilities of carrying out the company's various R and D projects.

These field offices are staffed by trained engineers, each of whom has the primary responsibility of providing technical assistance and data to customers. A vast communications network has been established to link each field office with the factories and with corporate offices. No matter what the product or the request, a customer can be accommodated by a single contact with the company.

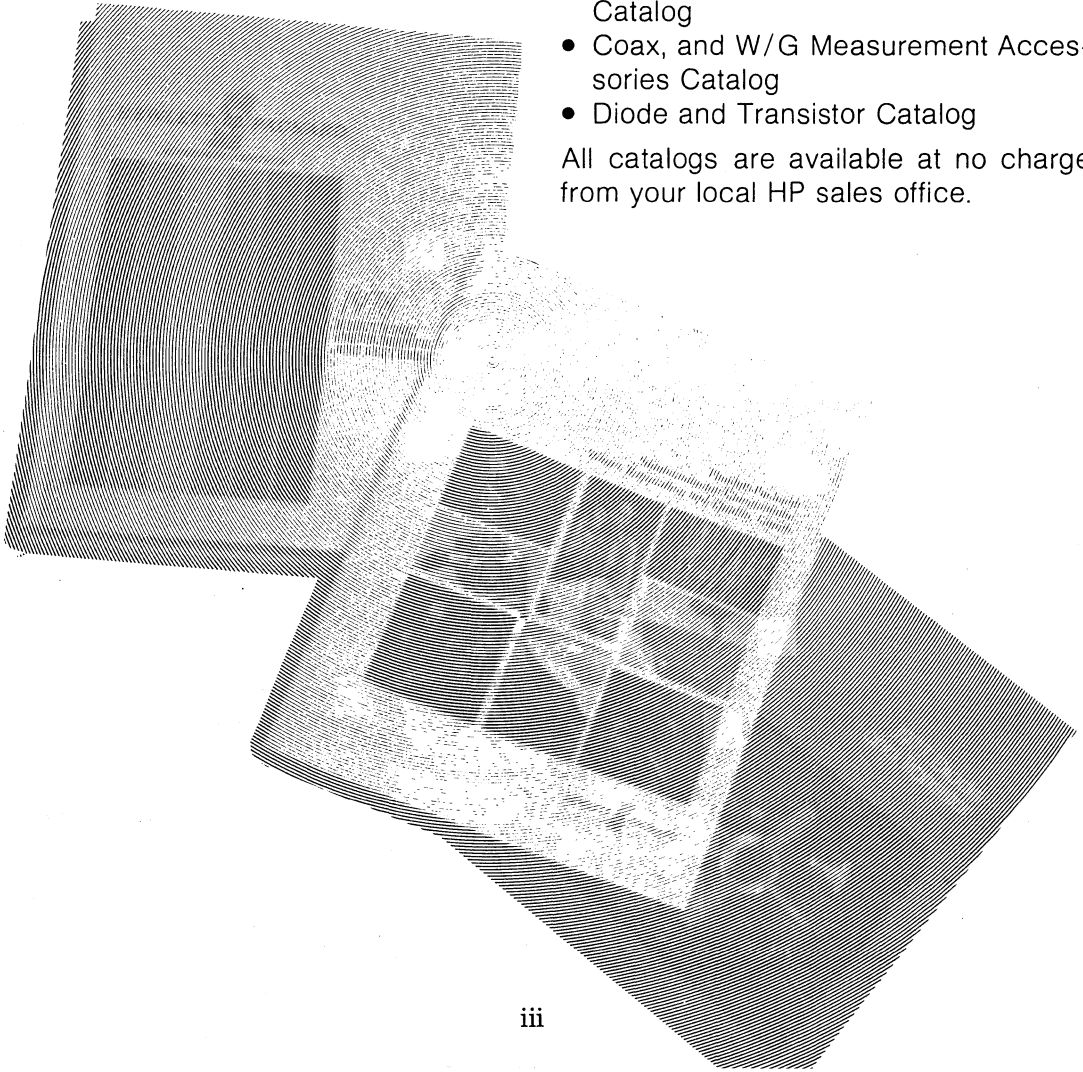
Hewlett-Packard is guided by a set of written objectives. One of these is "to provide products and services of the greatest possible value to our customers". Through application of advanced technology, efficient manufacturing, and imaginative marketing, it is the customer that the more than 30,000 Hewlett-Packard people strive to serve. Every effort is made to anticipate the customer's needs, to provide the customer with products that

will enable more efficient operation, to offer the kind of service and reliability that will merit the customer's highest confidence, and to provide all of this at a reasonable price.

To better serve its many customers' broad spectrum of technological needs, Hewlett-Packard publishes several catalogs. Among these are:

- Electronic Instruments and Systems for Measurement/Computation (General Catalog)
- DC Power Supply Catalog
- Medical Instrumentation Catalog
- Analytical Instruments for Chemistry Catalog
- Coax, and W/G Measurement Accessories Catalog
- Diode and Transistor Catalog

All catalogs are available at no charge from your local HP sales office.

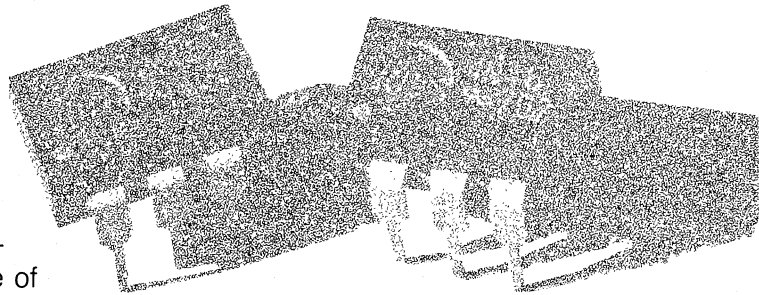


WHERE REPUTATION AND QUALITY COUNT

Hewlett-Packard's Optoelectronic Division offers a complete line of GaAsP and GaP discrete light emitting diodes (LED's), numeric, hexadecimal, and alphanumeric displays. These components provide solid state reliability to any visible readout. As status indicators, arrays, multi-digit or multi-character displays, these compact LED's are electrically compatible with monolithic integrated circuits, with a useful life greater than 100,000 hours.

Optocouplers

Hewlett-Packard's family of optocouplers provide economical, high performance solutions to problems caused



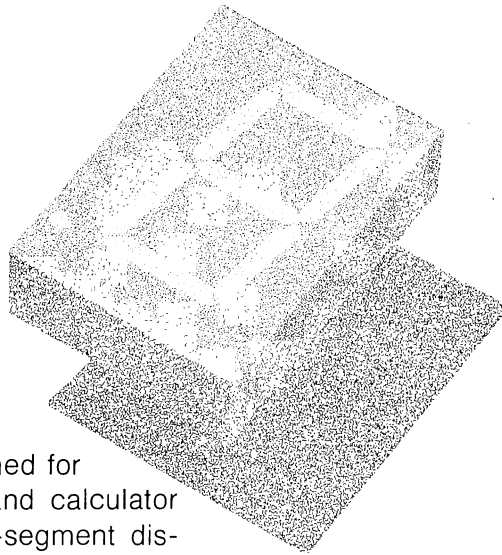
by ground loops and induced common mode noise for both analog and digital applications in commercial, industrial, and military products. Hewlett-Packard's original approach toward integrated output detectors provides performance not found in conventional phototransistor output optocouplers. With 3000 VDC isolation, the types of optocouplers available include high speed devices capable of 10M bits and high gain devices which are specified at 400% CTR at input currents as low as 0.5mA. In addition, highly linear optocouplers are useful in analog applications, and a new integrated input optically coupled line receiver can be connected directly to twisted pair wires without additional circuitry. Most of these devices are available in dual versions, as well as in hermetic DIP packages. For military users, Hewlett-Packard's established hi-rel capability facilitates economical, hi-rel purchases.

Displays

Low cost numeric displays, packaged single or clustered, are available in character heights from .11" to .8".

Low power small character displays have been designed for portable instrumentation and calculator applications. Other seven-segment display units are available in red, yellow, and green colors for use in instrumentation, point of sale terminals, and TV indicator applications. High power, sun-light viewable, large character displays are readily adapted to outdoor terminals, gas pumps and agricultural instrumentation. For these displays, Hewlett-Packard has successfully integrated a gray package design with untinted segments. This results in excellent bright ambient contrast enhancement.

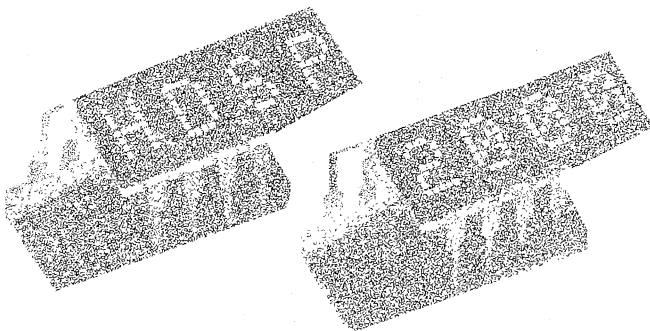
Integrated numeric and hexadecimal displays (with on-board IC's), available in plastic and hermetic packages, solve the designer's decoding/driving problem.



These displays have been designed for low cost and ease of application in a wide range of environments.

Alphanumeric displays are available in two attractive configurations. Small alphanumeric displays feature four 5 x 7 dot matrix characters and on-board shift registers for data storage. They are contained in 16-pin DIPs which are end-stackable for unlimited possibilities in alphanumeric display formatting.

The first 16-segment solid state LED alphanumeric displays from Hewlett-Packard are now available in four- and eight- character end-stackable modules. They are designed for use in computer peripheral products, automotive instrument panels, calculators, and electronic instruments and systems requiring low power consumption in an easy-to-read display. Magnification of the LED by an integral lens results in a character size of 3.8mm (0.150 in.). Drawing as little as 1.0 to 1.5mA average current per segment, this enhances character intensity while keeping power use at a minimum.



WHERE REPUTATION AND QUALITY COUNT

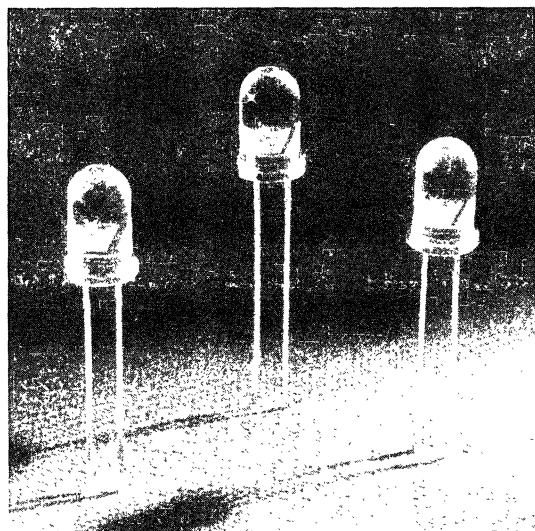
Solid State Lamps

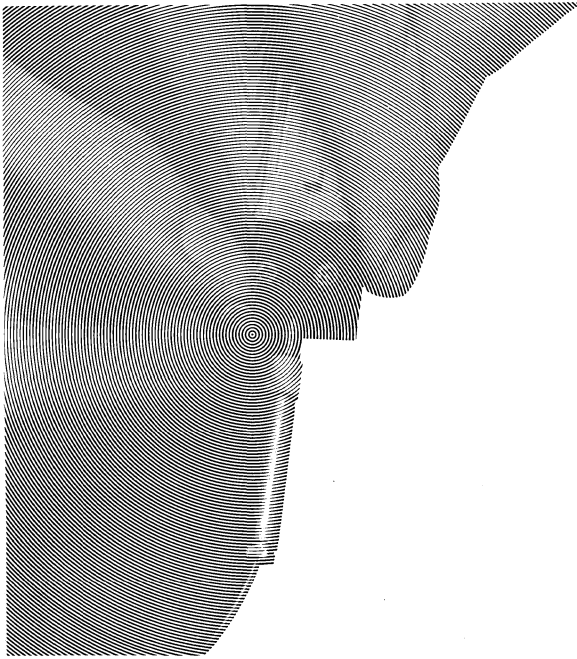
LED lamps are available in a wide variety of plastic and hermetic packages to satisfy almost any application. Many styles can be mounted on a front panel using clips and all are suitable for P.C. board mounting. Hewlett-Packard military screened hermetic lamps are very popular in applications demanding hi-reliability.

Products with wide or narrow viewing angles, and a range of brightnesses, are available in red, high efficiency red, yellow and green. Package styles include the traditional T-1-3/4, T-1, and TO-18 packages, as well as our own subminiature (stackable on 2.54mm [0.100 in.] centers), rectangular, and panel mountable hermetic packages.

Emitters

Hewlett-Packard offers high radiant intensity emitters near-IR in both floodlight and spotlight configurations. These emitters are ideally suited for use in optical transducers and encoders, smoke detectors, bar code scanners, paper-tape readers, and fiber optic drivers.





Fiber Optics

One of the pioneers in fiber optic technology, Hewlett-Packard is currently developing fiber optic systems for digital applications. Further details on this exciting new area of data communications is explained in the fiber optic section, page 215.

PIN Photodiodes

Hewlett-Packard PIN photodiodes are excellent light detectors with an exceptionally fast response of 1 ns, wide spectral response from near infrared to ultra-violet, and wide range linearity (constant efficiency over 6 decades of amplitude). With dark current as low as 250 pA at 10V, these detectors are especially well-suited for operation at low light levels. The device construction allows high speed operation at reverse voltages of 5 volts.

Applications include fiber optic receivers, laser scanners, rangefinders, and power monitors, radiometers and photometers, process control systems, and medical diagnostic equipment.

High reliability test programs are available.

ABOUT THIS CATALOG

This Optoelectronic Designer's Catalog contains detailed, up-to-date specifications on our complete optoelectronic product line. It is divided into five major product sections: Solid State Lamps, Solid State Displays, Optocouplers, Emitters, and PIN Photodiodes. A special introductory section on Fiber Optics is also included. This catalog also includes an Index on Optoelectronic Application Notes which are available from any of the Hewlett-Packard Sales and Service Offices listed on page 224 and from any of the Franchised Distributors listed on page 222.

How To Use This Catalog

Three methods are incorporated for locating components:

- a Table of Contents that allows you to locate components by their general description.
- a Numeric Index that lists all components by part number, and
- a Selection Guide for each product group giving a brief overview of the product line.

How To Order

All Hewlett-Packard components may be ordered through any of the Sales and Service Offices listed on page 224. In addition, for immediate delivery of Hewlett-Packard optoelectronic components, contact any of the world-wide stocking distributors listed on page 222.

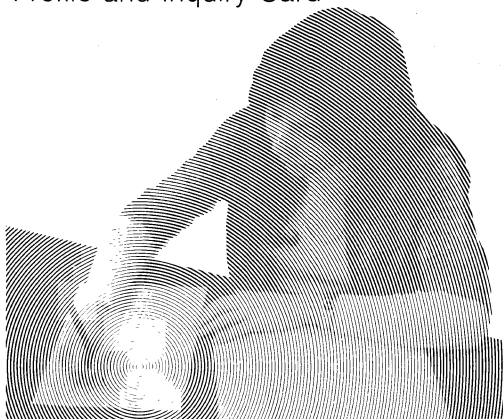
Warranty

HP's Components are warranted against defects in material and workmanship for a period of one year from the date of shipment. HP will repair or, at its option, replace Components that prove to be defective in material or workmanship under proper use during the warranty period. This warranty extends only to HP customers.

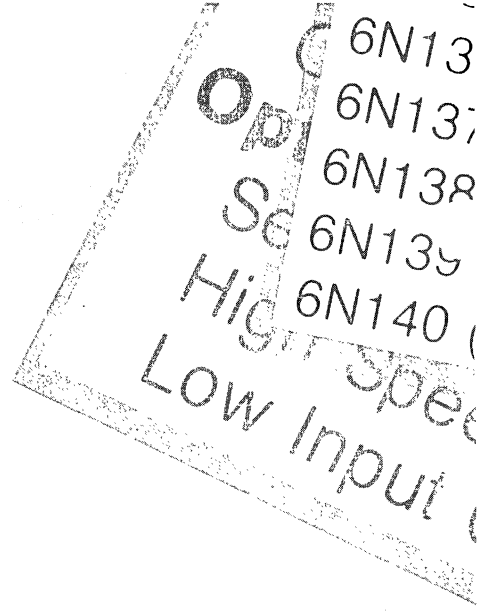
No other warranties are expressed or implied, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose. HP is not liable for consequential damages.

TABLE OF CONTENTS

Numeric Index	x	Emitters	
Solid State Lamps		Selection Guide	204
Selection Guide	2	Emitters	206
Red Lamps	6	PIN Photodiodes	
Red, High Efficiency Red, Yellow and Green Lamps	22	Selection Guide	205
Integrated Lamps	40	PIN Photodiodes	210
Hermetically Sealed Lamps	44	Fiber Optics	
Panel Mounting Kit	50	Introduction	216
Solid State Displays		Appendix	
Selection Guide	52	Application Note Index	218
Red, High Efficiency Red, Yellow and Green Seven Segment Displays	59	Distributor Stocking Locations ..	222
Red Seven Segment Displays ..	87	Hewlett-Packard Sales and Service Offices	224
Integrated Displays	111	Profile and Inquiry Card	
Hermetically Sealed Integrated Displays	120		
Alphanumeric Displays	132		
Chips	146		
Optocouplers			
Selection Guide	156		
High Speed Optocouplers	158		
Low Input Current/High Gain Optocouplers	184		
High Reliability Optocouplers ..	196		



NUMERIC INDEX



OPTOCOUPERS

TX-4365[1] _____	See 6N134 TXV
TXB-4365[1] _____	See 6N134 TXVB
5082-4350[1] _____	See 6N135
5082-4351[1] _____	See 6N136
5082-4352[2] _____	See HCPL-2502
5082-4354[2] _____	See HCPL-2530
5082-4355[2] _____	See HCPL-2531
5082-4360[1] _____	See 6N137
5082-4361[2] _____	See HCPL-2601
5082-4364[2] _____	See HCPL-2630
5082-4365[1] _____	See 6N134
5082-4370[1] _____	See 6N138
5082-4371[1] _____	See 6N139
HCPL-2502 (5082-4352) _____	158
HCPL-2530 (5082-4354) _____	162
HCPL-2531 (5082-4355) _____	162
HCPL-2601 (5082-4361) _____	170
HCPL-2602 _____	174
HCPL-2630 (5082-4364) _____	180
HCPL-2730 _____	188
HCPL-2731 _____	188
HCPL-2770 _____	200
4N45 _____	192
4N46 _____	192
6N134 (5082-4365) _____	196
6N134 TXV (TX-4365) _____	196
6N134 TXVB (TXB-4365) _____	196
6N135 (5082-4350) _____	158
6N136 (5082-4351) _____	158
6N137 (5082-4360) _____	166
6N138 (5082-4370) _____	184
6N139 (5082-4371) _____	184
6N140 (HCPL-2770) _____	200

DISPLAYS

* HDSP-2000 _____	132
* HDSP-3400 _____	59
* HDSP-3401 _____	59
* HDSP-3403 _____	59
* HDSP-3405 _____	59
* HDSP-3406 _____	59
* HDSP-3530 _____	63
* HDSP-3531 _____	63
* HDSP-3533 _____	63
* HDSP-3536 _____	63
* HDSP-3730 _____	63
* HDSP-3731 _____	63
* HDSP-3733 _____	63
* HDSP-3736 _____	63
* HDSP-4030 _____	63
* HDSP-4031 _____	63
* HDSP-4033 _____	63
* HDSP-4036 _____	63
* HDSP-4130 _____	63
* HDSP-4131 _____	63
* HDSP-4133 _____	63
* HDSP-4136 _____	63
* HDSP-6504 _____	136
* HDSP-6508 _____	136
5082-7010 _____	120
5082-7011 _____	120
5082-7100 _____	142
5082-7101 _____	142
5082-7102 _____	142
5082-7240 _____	103
5082-7241 _____	103
5082-7265 _____	107
5082-7275 _____	107

DISPLAYS (Cont.)

5082-7285 _____	107
5082-7295 _____	107
5082-7300 _____	111
5082-7302 _____	111
5082-7304 _____	111
5082-7340 _____	111
5082-7356 _____	115
5082-7357 _____	115
5082-7358 _____	115
5082-7359 _____	115
5082-7391 _____	126
5082-7392 _____	126
5082-7393 _____	126
5082-7395 _____	126
5082-7402 _____	87
5082-7403 _____	87
5082-7404 _____	87
5082-7405 _____	87
5082-7412 _____	87
5082-7413 _____	87
5082-7414 _____	87
5082-7415 _____	87
5082-7432 _____	91
5082-7433 _____	91
5082-7440 _____	95
5082-7441 _____	95
5082-7442 _____	95
5082-7444 _____	95
5082-7445 _____	95
5082-7446 _____	95
5082-7447 _____	95
5082-7448 _____	95
5082-7449 _____	95

DISPLAYS (Cont.)

5082-7610	69
5082-7611	69
5082-7613	69
5082-7616	69
5082-7620	69
5082-7621	69
5082-7623	69
5082-7626	69
5082-7630	69
5082-7631	69
5082-7633	69
5082-7636	69
5082-7650	74
5082-7651	74
5082-7653	74
5082-7656	74
5082-7660	74
5082-7661	74
5082-7663	74
5082-7666	74
5082-7670	74
5082-7671	74
5082-7673	74
5082-7676	74
5082-7730	79
5082-7732	79
5082-7736	79
5082-7740	79
5082-7750	83
5082-7752	83
5082-7756	83
5082-7760	83
5082-7811	146
5082-7821	146
5082-7832	146
5082-7833	150
5082-7837	150
5082-7838	150
5082-7842	146
5082-7843	150
5082-7847	150
5082-7848	150
5082-7851	146
5082-7852	146
5082-7853	146
5082-7856	150
5082-7861	146
5082-7862	146
5082-7863	146
5082-7866	150
5082-7871	146
5082-7872	150
5082-7881	146
5082-7882	150
5082-7890	146
5082-7892	146
5082-7893	146

EMITTERS

HEMT-3300	206
HEMT-6000	208

PHOTODETECTORS

5082-4203	210
5082-4204	210
5082-4205	210
5082-4207	210
5082-4220	210

LAMPS

HLMP-0300	32
HLMP-0301 (5082-4670)	32
HLMP-0400	32
HLMP-0401 (5082-4570)	32
HLMP-0500	32
HLMP-0501 (5082-4970)	32
HLMP-1300	36
HLMP-1301 (5082-4684)	36
HLMP-1302	36
HLMP-1400	36
HLMP-1401 (5082-4584)	36
HLMP-1402	36
HLMP-1500	36
HLMP-1501 (5082-4984)	36
HLMP-1502	36
HLMP-6203	14
HLMP-6204	14
HLMP-6205	14
* HLMP-6620	16
* HLMP-6600	16
1N5765 (5082-4420)	44
1N6092 (5082-4620)	44
1N6093 (5082-4520)	44
1N6094 (5082-4920)	44
JAN 1N5765	44
JANTX 1N5765	44
5082-4100	18
5082-4101	18
5082-4150	18
5082-4160	18
5082-4190	18
5082-4403	6
5082-4415	6
5082-4420	See 1N5765
5082-4440	6
5082-4444	6
5082-4468	42
5082-4480	8
5082-4483	8
5082-4484	12
5082-4486	8
5082-4487	10
5082-4488	10
5082-4494	12
5082-4520	See 1N6093
5082-4550	28

LAMPS (Cont.)

5082-4555	28
5082-4557	28
5082-4558	28
5082-4570	See HLMP-0401
5082-4584	See HLMP-1401
5082-4587	44
5082-4590	22
5082-4592	22
5082-4595	22
5082-4597	22
5082-4620	See 1N6092
5082-4650	28
5082-4655	28
5082-4657	28
5082-4658	28
5082-4670	See HLMP-0301
5082-4684	See HLMP-1301
5082-4687	44
5082-4690	22
5082-4693	22
5082-4694	22
5082-4695	22
5082-4707	50
5082-4732	40
5082-4787	44
5082-4790	22
5082-4791	22
5082-4850	12
5082-4855	12
5082-4860	42
5082-4880	6
5082-4881	6
5082-4882	6
5082-4883	6
5082-4884	6
5082-4885	6
5082-4886	6
5082-4887	6
5082-4888	6
5082-4920	See 1N6094
5082-4950	28
5082-4955	28
5082-4957	28
5082-4958	28
5082-4970	See HLMP-0501
5082-4984	See HLMP-1501
5082-4987	44
5082-4990	22
5082-4992	22
5082-4995	22
5082-4997	22

Notes: 1. EIA Registered. Part No. changed.
2. Part No. changed.










* New product. New to catalog.

Solid State Lamps

Selection Guide 2

- Clear or Red Lamps
- Red, High Efficiency Red, Yellow and Green Lamps
- Integrated Lamps
- Hermetically Sealed Lamps
- Panel Mounting Kit
- Chips

High Efficiency Red, Yellow, Green LED Lamps

Device		Description				Typical Luminous Intensity	2 θ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	4650	High Efficiency Red (635nm)[2]	GaAsP on GaP	Red Diffused	T-1 $\frac{3}{4}$; Plastic; Long, General Purpose Leads[3]	2.0mcd @10mA	90°	2.2 Volts @10mA	28
	4655					4.0mcd @10mA			
	4657			Red Non-Diffused		12.0mcd @10mA	35°		
	4658			24.0mcd @10mA					
	4690			Red Diffused	T-1 $\frac{3}{4}$ (Low Profile) Plastic; Long, General Purpose Leads	3.5mcd @10mA	50°		22
	4693					7.0mcd @10mA			
	4694			Red Non-Diffused		8.0mcd @10mA	45°		
	4695					11.0mcd @10mA			
	HLMP-1300			Red Diffused	T-1, Plastic, Long Leads[4]	1.5mcd @10mA	70°	36	
	HLMP-1301 (5082-4684)					2.0mcd @10mA			
	HLMP-1302					2.5mcd @10mA			
	4160			Red Diffused	Submin.; Plastic; Radial Leads	3.0mcd @10mA	80°	18	
	HLMP-0300			Red Diffused	Rectangular; Plastic; Long, Gen. Purpose Leads	1.0mcd @25mA	100°	2.5 Volts @25mA	32
	HLMP-0301 (5082-4670)					2.5mcd @25mA			
						1.5mcd @15mA			
	4550	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused	T-1 $\frac{3}{4}$; Plastic; Long General Purpose Leads[3]	1.8mcd @10mA	90°	2.2 Volts @10mA	28
	4555					3.0mcd @10mA			
	4557			Yellow Non-Diffused		9.0mcd @10mA	35°		
	4558					16.0mcd @10mA			
	4590			Yellow Diffused	T-1 $\frac{3}{4}$ (Low Profile) Plastic; Long, General Purpose Leads	3.5mcd @10mA	50°		22
	4592					6.0mcd @10mA			
	4595			Yellow Non-Diffused		6.5mcd @10mA	45°		
	4597					11.0mcd @10mA			
	HLMP-1400			Yellow Diffused	T-1; Plastic; Long Leads[4]	1.5mcd @10mA	60°	36	
	HLMP-1401 (5082-4584)					2.5mcd @10mA			
	HLMP-1402					4.0mcd @10mA			
	4150			Yellow Diffused	Submin.; Plastic; Radial Leads	2.0mcd @10mA	90°	18	

Notes: See page 5.

For Applications Information, see pages 218-221.









Device		Description				Typical Luminous Intensity	2 Θ /2 [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	HLM-0400	Yellow (583nm) [2]	GaAsP on GaP	Yellow Diffused	Rectangular; Plastic; Long, Gen. Purpose Leads	1.2mcd @25mA	100°	2.5 Volts @25mA	32
	HLM-0401 (5082-4570)					2.5mcd @25mA			
						1.5mcd @15mA			
	4950	Green (565nm) [2]	GaP	Green Diffused	T-1 $\frac{1}{2}$; Plastic; Long General Purpose Leads [3]	1.8mcd @20mA	90°	2.4 Volts @20mA	28
	4955					3.0mcd @20mA			
	4957			Green Non-Diffused		9.0mcd @20mA	30°		
	4958					16.0mcd @20mA			
	4990			Green Diffused	T-1 $\frac{1}{2}$ (Low Profile) Plastic; Long General Purpose Leads	4.5mcd @20mA	50°		22
	4992					7.5mcd @20mA			
	4995			Green Non-Diffused		6.5mcd @20mA	40°		
	4997					11.0mcd @20mA			
	HLM-1500			Green Diffused	T-1; Plastic; Long Leads [4]	1.2mcd @10mA	60°		36
	HLM-1501 (5082-4984)					2.0mcd @10mA			
	HLM-1502					3.0mcd @10mA			
	4190			Green Diffused	Submin.; Plastic; Radial Leads	1.5mcd @20mA	70°		18
	HLM-0500			Green Diffused	Rectangular; Plastic; Long, Gen. Purpose Leads	1.2mcd @25mA	100°	2.5 Volts @25mA	32
	HLM-0501 (5082-4970)					2.5mcd @25mA			
						1.5mcd @15mA			

Red LED Lamps

Device		Description				Typical Luminous Intensity	2 Θ /2 [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	4850	Red (655nm) [2]	GaAsP on GaAs	Red Diffused	T-1 $\frac{1}{2}$; Plastic; Long Wire Wrap. Leads [3]	0.8mcd @20mA	95°	1.6 Volts @20mA	12
	4855					1.4mcd @20mA			
	4484				T-1; Plastic; Long Leads [4]	0.8mcd @20mA	120°		
	4494					1.4mcd @20mA			
	4790			Red Diffused	T-1 $\frac{1}{2}$ (Low Profile) Plastic; Long, Gen. Purpose Leads	1.2mcd @20mA	60°	1.6 Volts @20mA	22
	4791					2.5mcd @20mA			

Notes: See page 5.





For Applications Information, see pages 218-221.

Device		Description				Typical Luminous Intensity	2θ [1]	Typical Forward Voltage	Page No.	
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package					
	4480	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	T-1; Plastic; Long Leads[4]	0.8mcd @20mA	120°	1.6 Volts @20mA	8	
	4483			Clear Diffused						
	4486			Clear Non-Diffused						
	4487			Clear Non-Diffused	T-1 (Low Profile); Plastic; Long Leads[4]	0.8mcd @20mA	120°	1.6 Volts @20mA	10	
	4488					Guaranteed Min. 0.3mcd @20mA				
	4100			Red Diffused	Submin.; Plastic; Radial Leads	0.5mcd @10mA	45°	1.6 Volts @10mA	18	
	4101					1.0mcd @10mA				
	HLMP-6203			Red Diffused	Array; Plastic Radial Leads	1.0mcd @ 10mA	45°	1.6 Volts @ 10mA	14	
	HLMP-6204									
	HLMP-6205									
 4403/4440	4403			Red Diffused	T-1¼; Plastic; Short, Leads[3]	1.2mcd @20mA	75°	1.6 Volts @20mA	6	
	4415				T-1¼; Plastic; Short, Bent Leads[4]					
	4440				T-1¼; Plastic; Short Leads[3]					
	4444				T-1¼; Plastic; Short, Bent Leads[4]					
 4415/4444	4880			Red Diffused	T-1¼; Plastic; Long Wire Wrap. Leads[3]	0.8mcd @20mA	58°	1.6 Volts @20mA	6	
	4883			Clear Non-Diffused			50°			
	4886			Clear Diffused			65°			
	4881			Red Diffused			58°			
	4884			Clear Non-Diffused			1.3mcd @20mA			50°
	4887			Clear Diffused			65°			
	4882			Red Diffused			1.8mcd @20mA			58°
	4885			Clear Non-Diffused			50°			
	4888			Clear Diffused			65°			









Notes: See page 5.

For Applications Information, see pages 218-221.

Integrated LED Lamps

Device		Description				Typical Luminous Intensity	2 Θ / ₂ [1]	Typical Forward Current	Page No.
Photo	Part No. 5082-	Color	Integration	Lens	Package				
	4732	Red (655nm) [2]	Voltage Sensing IC integrated with GaAsP LED chip	Red Diffused	T-1; Plastic; Long Leads[4]	0.7mcd @ 2.75V	95°	13mA @ 2.75V	40
	4860		Resistor chip integrated with GaAsP LED chip	Red Diffused	T-1 $\frac{1}{2}$; Plastic; Long Leads[3]	0.8mcd @ 5.0V	58°	16mA @ 5.0V	42
	4468		Clear Diffused	T-1; Plastic; Long Leads[4]	70°				
	HLMP-6620		Resistor chip integrated with GaAsP LED chip	Red Diffused	Submin., Plastic; Radial Leads	0.6mcd @ 5.0V	90°	3.5mA @ 5.0V	16
	HLMP-6600	2.4mcd @ 5.0V	9.6mA @ 5.0V						

Hermetically Sealed LED Lamps

Device		Description				Minimum Luminous Intensity	2 Θ / ₂ [1]	Typical Forward Voltage	Page No.
Photo	Part No.	Color	Emitting Material	Lens	Package				
	1N5765 JAN 1N5765[5] JAN TX 1N5765[5] (5082-4420)	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	Hermetic/TO-46; Long Leads[4]	0.5mcd @ 20mA	70°	1.6 Volts @ 20mA	44
	5082-4787[6]				Panel Mount				
	1N6092 [6] (5082-4620)	High Eff. Red (635nm)[2]	GaAsP on GaP	Red Diffused	Hermetic/TO-46 Long Leads[4]	1.0mcd @ 20mA		2.0 Volts @ 20mA	
	5082-4687[6]				Panel Mount				
	1N6093 [6] (5082-4520)	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused	Hermetic/TO-46 Long Leads[4]				
	5082-4587[6]				Panel Mount				
	1N6094 [6] (5082-4920)	Green (565nm)[2]	GaP	Green Diffused	Hermetic/TO-46 Long Leads[4]	0.8mcd @ 25mA		2.1 Volts @ 25mA	
	5082-4987[6]				Panel Mount				

- NOTES: 1. Θ /₂ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
 2. Peak Wavelength.
 3. Panel Mountable. For Panel Mounting Kit, see page 50.
 4. PC Board Mountable.
 5. Military Approved and qualified for High Reliability Applications.
 6. Military Approved and qualified JAN and JAN TX versions of this part are now available.

For Applications Information, see pages 218-221.

Features

- EASILY PANEL MOUNTABLE
- HIGH BRIGHTNESS OVER A WIDE VIEWING ANGLE
- RUGGED CONSTRUCTION FOR EASE OF HANDLING
- STURDY LEADS ON 25.4mm (0.10 in.) CENTERS
- IC COMPATIBLE/LOW POWER CONSUMPTION
- LONG LIFE

Description

The 5082-4403, -4415, -4440, -4444 and the -4880 series are plastic encapsulated Gallium Arsenide Phosphide Light Emitting Diodes. They radiate light in the 655 nanometer (red light) region.

The 5082-4403 and -4440 are LEDs with a red diffused plastic lens, providing high visibility for circuit board or panel mounting with a clip.

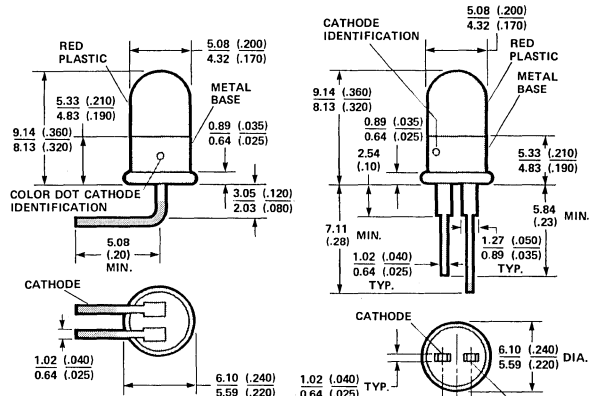
The 5082-4415 and -4444 have the added feature of a 90° lead bend for edge mounting on circuit boards.

The 5082-4880 series is available in three different lens configurations. These are Red Diffused, Clear Diffused, and Clear Non-Diffused.

The Red Diffused lens provides an excellent off/on contrast ratio. The Clear Non-Diffused lens is designed for applications where a point source is desired. It is particularly useful where the light must be focused or diffused with external optics. The Clear Diffused lens is useful in masking the red color in the off condition.

LED SELECTION GUIDE

MINIMUM LIGHT OUTPUT (mcd)	LONG LEAD (UNBENT)		
	Red Diffused Lens	Clear Non-Diffused Lens	Clear Diffused Lens
0.5	5082-4880	5082-4883	5082-4886
1.0	5082-4881	5082-4884	5082-4887
1.6	5082-4882	5082-4885	5082-4888
	SHORT LEAD		
0.3	5082-4440	UNBENT	
0.8	5082-4403	UNBENT	
0.3	5082-4444	BENT	
0.8	5082-4415	BENT	



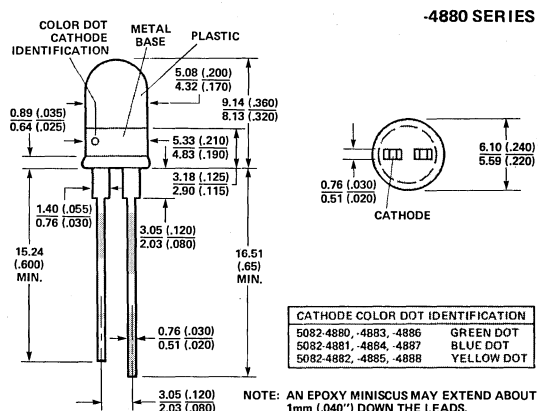
NOTE: AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.

5082-4415
5082-4444

CATHODE COLOR DOT IDENTIFICATION	
5082-4403	WHITE DOT
5082-4440	ORANGE DOT
5082-4415	WHITE DOT
5082-4444	ORANGE DOT

5082-4403
5082-4440

DIMENSIONS IN MILLIMETRES AND (INCHES).



-4880 SERIES

CATHODE COLOR DOT IDENTIFICATION	
5082-4880, -4883, -4886	GREEN DOT
5082-4881, -4884, -4887	BLUE DOT
5082-4882, -4885, -4888	YELLOW DOT

NOTE: AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.

Maximum Ratings at $T_A = 25^\circ\text{C}$

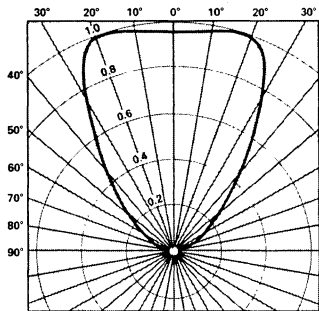
- DC Power Dissipation 100 mW
- DC Forward Current 50 mA
(Derate linearly from 50°C at 0.2mA/°C)
- Peak Transient Forward Current 1 Amp
(1µsec pulse width, 300 pps)
- Isolation Voltage (between lead and base) 300 V
Operating and Storage
- Temperature Range -55°C to +100°C
- Lead Soldering Temperature 230°C for 7 sec

Electrical Characteristics at $T_A = 25^\circ\text{C}$

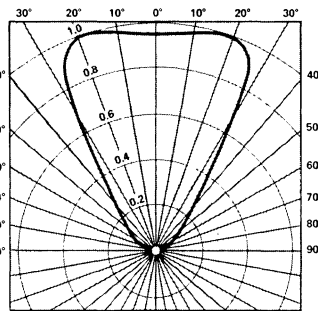
Symbol	Parameter	5082-4403 5082-4415	5082-4440 5082-4444	5082-4880 5082-4883 5082-4886	5082-4881 5082-4884 5082-4887	5082-4882 5082-4885 5082-4888	Units	Test Conditions
		Min. Typ. Max.	Min. Typ. Max.	Min. Typ. Max.	Min. Typ. Max.	Min. Typ. Max.		
I_V	Luminous Intensity	0.8 1.2	0.3 0.7	0.5 0.8	1.0 1.3	1.6 1.8	mcd	$I_F = 20\text{mA}$
λ_{PEAK}	Wavelength	655	655	655	655	655	nm	Measurement at Peak
τ_s	Speed of Response	15	15	15	15	15	ns	
C	Capacitance	200	200	200	200	200	pF	
θ_{JC}	Thermal Resistance	87	87	100	100	100	$^\circ\text{C/W}$	Junction to Cathode Lead
V_F	Forward Voltage	1.6 2.0	1.6 2.0	1.6 2.0	1.6 2.0	1.6 2.0	V	$I_F = 20\text{mA}$
BV_R	Reverse Break-down Voltage	3 10	3 10	3 10	3 10	3 10	V	$I_R = 100\mu\text{A}$

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT

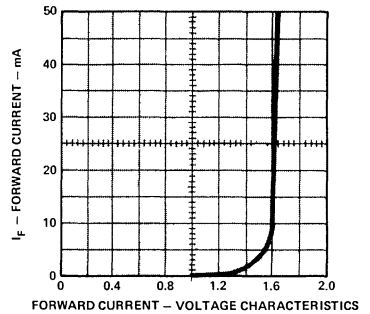
44XX



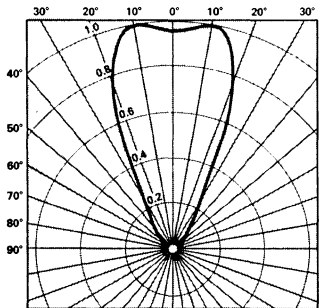
4880, 4881, 4882



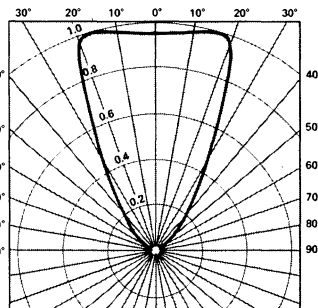
FORWARD CURRENT VS. VOLTAGE CHARACTERISTICS



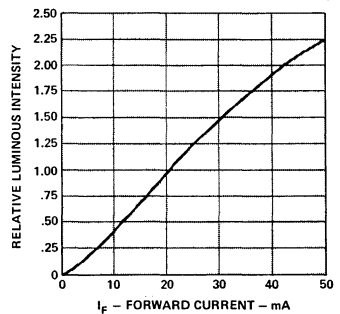
4883, 4884, 4885



4886, 4887, 4888



LUMINOUS INTENSITY VS. FORWARD CURRENT (I_F)



Features

- **HIGH INTENSITY: 0.8mcd TYPICAL**
- **WIDE VIEWING ANGLE**
- **SMALL SIZE T-1 DIAMETER 3.18mm (0.125")**
- **IC COMPATIBLE**
- **RELIABLE AND RUGGED**

Description

The 5082-4480 is a series of Gallium Arsenide Phosphide Light Emitting Diodes designed for applications where space is at a premium, such as in high density arrays.

The 5082-4480 series is available in three lens configurations.

5082-4480 – Red Diffused lens provides excellent on-off contrast ratio, high axial luminous intensity, and wide viewing angle.

5082-4483 – Same as 5082-4480, but Clear Diffused to mask red color in the "off" condition.

5082-4486 – Clear Non-Diffused plastic lens provides a point source. Useful when illuminating external lens, annunciators, or photo-detectors.

Maximum Ratings at $T_A = 25^\circ\text{C}$

DC Power Dissipation 100mW

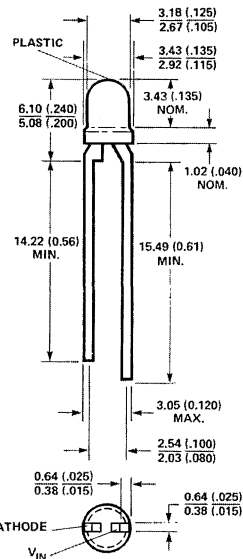
DC Forward Current 50mA
(Derate linearly from 50°C at $0.2\text{mA}/^\circ\text{C}$)

Peak Forward Current 1 Amp
(1 μsec pulse width, 300 pps)

Operating and Storage

Temperature Range -55°C to $+100^\circ\text{C}$

Lead Soldering Temperature 230°C for 7 sec.



NOTE: AN EPOXY MENISCUS MAY EXTEND ABOUT 1mm (0.040") DOWN THE LEADS.

DIMENSIONS IN MILLIMETRES AND (INCHES).

PART NO.	LENS CONFIGURATION
5082-4480	Red Diffused
5082-4483	Untinted Diffused
5082-4486	Clear Plastic

Electrical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Parameters	5082-4480 5082-4483 5082-4486			Units	Test Conditions
		Min.	Typ.	Max.		
I_V	Luminous Intensity	0.3	0.8		mcd	$I_F = 20\text{mA}$
λ_{PEAK}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		15		ns	
C	Capacitance		200		pF	$V_F = 0, f = 1\text{MHz}$
θ_{JC}	Thermal Resistance		270		$^\circ\text{C}/\text{W}$	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0	V	$I_F = 20\text{mA}$
BV_R	Reverse Breakdown Voltage	3	10		V	$I_R = 10\mu\text{A}$

5082-4480 AND 5082-4483

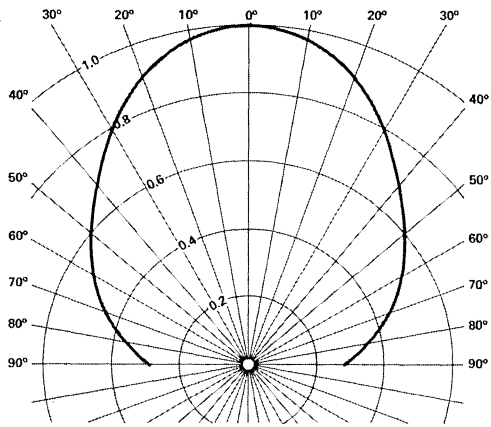


Figure 1. Relative Luminous Intensity vs. Angular Displacement.

5082-4486

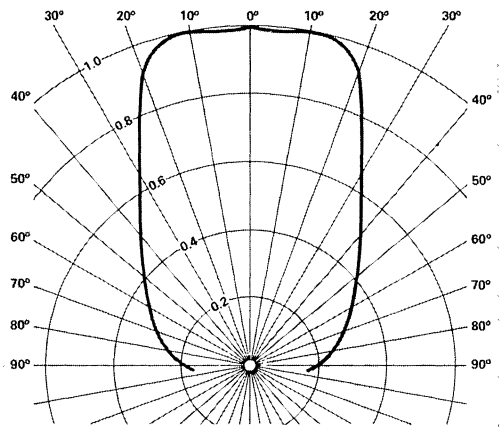
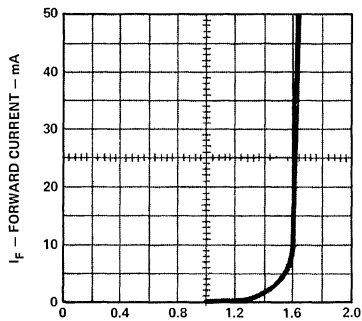
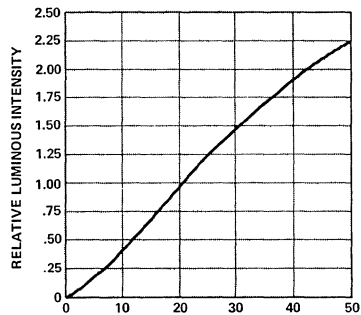


Figure 2. Relative Luminous Intensity vs. Angular Displacement.



FORWARD CURRENT - VOLTAGE CHARACTERISTICS

Figure 3. Forward Current vs. Voltage Characteristic.

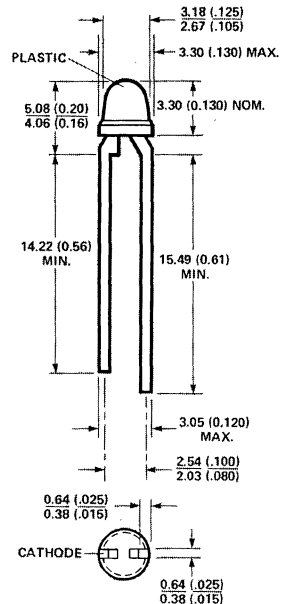


I_F - FORWARD CURRENT - mA

Figure 4. Luminous Intensity vs. Forward Current (I_F).

Features

- **LOW COST: BROAD APPLICATION**
- **LOW PROFILE: 4.57mm (0.18") LENS HEIGHT TYPICAL**
- **HIGH DENSITY PACKAGING**
- **LONG LIFE: SOLID STATE RELIABILITY**
- **LOW POWER REQUIREMENTS:
20mA @ 1.6V**
- **HIGH LIGHT OUTPUT: 0.8mcd TYPICAL**



NOTE: AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.
ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).

Description

The 5082-4487 and 5082-4488 are Gallium Arsenide Phosphide Light Emitting Diodes for High Volume/ Low Cost Applications such as indicators for calculators, cameras, appliances, automobile instrument panels, and many other commercial uses.

The 5082-4487 is a clear non-diffused lens, low profile T-1 LED lamp, and has a typical light output of 0.8 mcd at 20 mA.

The 5082-4488 is a clear non-diffused, low profile T-1 LED lamp, and has a guaranteed minimum light output of 0.3 mcd at 20 mA.

Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

DC Power Dissipation	100mW
DC Forward Current [Derate linearly from 50°C at $0.2\text{mA}/^\circ\text{C}$]	50mW
Peak Forward Current [1 μsec pulse width, 300pps]	1 Amp
Operating and Storage Temperature Range	-55°C to $+100^\circ\text{C}$
Lead Soldering Temperature	230°C for 7 sec.

Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Parameters	5082-4487			5082-4488			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Luminous Intensity		0.8		0.3	0.8		mcd	$I_F = 20\text{mA}$
λ_{PEAK}	Wavelength		655		655			nm	Measurement at Peak
τ_s	Speed of Response		10		10			ns	
C	Capacitance		100		100			pF	$V_F = 0, f = 1\text{MHz}$
V_F	Forward Voltage		1.6	2.0	1.6	2.0		V	$I_F = 20\text{mA}$
BV_R	Reverse Breakdown Voltage	3	10		3	10		V	$I_R = 100\mu\text{A}$

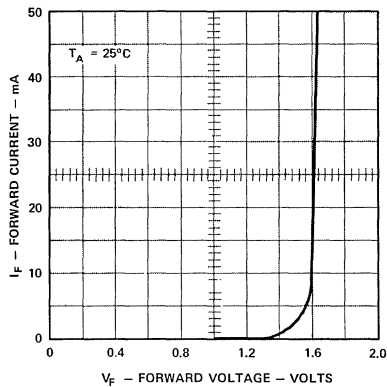


Figure 1. Typical Forward Current Versus Voltage Characteristic.

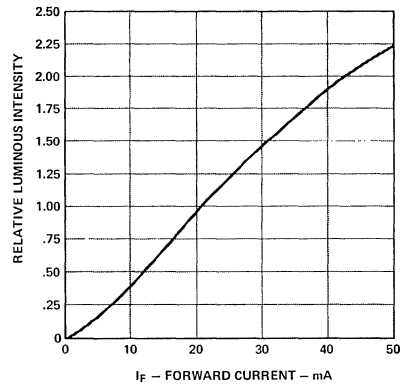


Figure 2. Typical Luminous Intensity Versus Forward Current.

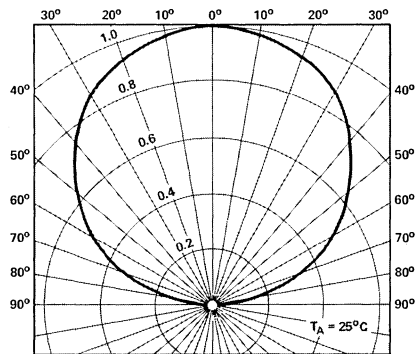


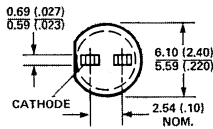
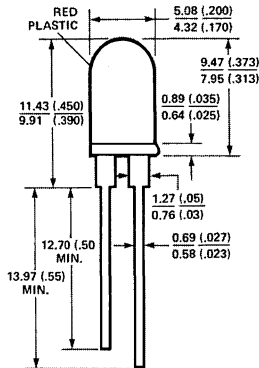
Figure 3. Typical Relative Luminous Intensity Versus Angular Displacement.

COMMERCIAL LIGHT EMITTING DIODES

5082-4850
5082-4855
5082-4484
5082-4494

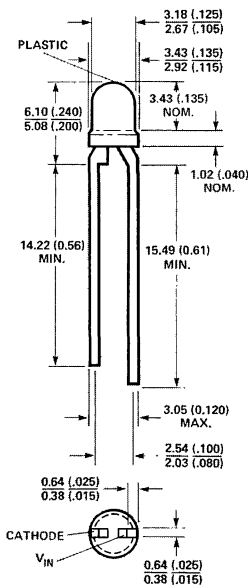
TECHNICAL DATA APRIL 1978

DIMENSIONS IN MILLIMETERS AND (INCHES)



NOTE: AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.

5082-4850/4855



5082-4484/4494

Features

- **LOW COST: BROAD APPLICATION**
- **LONG LIFE: SOLID STATE RELIABILITY**
- **LOW POWER REQUIREMENTS: 20mA @ 1.6V**
- **HIGH LIGHT OUTPUT**
0.8 mcd TYPICAL FOR 5082-4850/4484
1.4 mcd TYPICAL FOR 5082-4855/4494
- **WIDE VIEWING ANGLE**
- **RED DIFFUSED LENS**

Description

The 5082-4850/4855 and 5082-4484/4494 are Gallium Arsenide Phosphide Light Emitting Diodes intended for **High Volume/Low Cost** applications such as indicators for appliances, automobile instrument panels and many other commercial uses.

The 5082-4850/4855 are T-1¼ lamp size, have red diffused lenses and can be panel mounted using mounting clip 5082-4707.

The 5082-4484/4494 are T-1 lamp size, have red diffused lenses and are ideal where space is at a premium, such as high density arrays.

Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

Power Dissipation	100mW
DC Forward Current (Derate linearly from 50°C at 0.2mA/°C)	50mA
Peak Forward Current	1Amp (1µsec pulse width, 300pps)

Operating and Storage

Temperature Range

Lead Soldering Temperature

Electrical Characteristics at $T_A=25^\circ\text{C}$

Symbol	Parameters	5082-4850			5082-4855			5082-4484			5082-4494			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Luminous Intensity		0.8		0.8	1.4		0.8		0.8	1.4		mcd	$I_F = 20\text{mA}$	
λ_{PEAK}	Wavelength		655		655		655		655		655		nm	Measurement at Peak	
τ_s	Speed of Response		10		10		10		10		10		ns		
C	Capacitance		100		100		100		100		100		pF	$V_F = 0,$ $f = 1\text{MHz}$	
V_F	Forward Voltage		1.6	2.0	1.6	2.0		1.6	2.0	1.6	2.0		V	$I_F = 20\text{mA}$	
BV_R	Reverse Breakdown Voltage	3	10		3	10		3	10	3	10		V	$I_R = 100\mu\text{A}$	
θ_{JC}	Thermal Resistance		100		100		100		100		100		$^\circ\text{C/W}$	Junction to Cathode Lead	

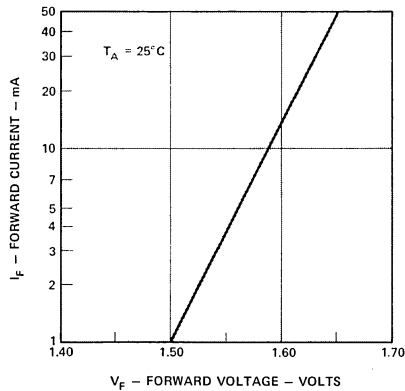


Figure 1. Forward Current Versus Forward Voltage Characteristic For 5082-4850/4855/4484/4494.

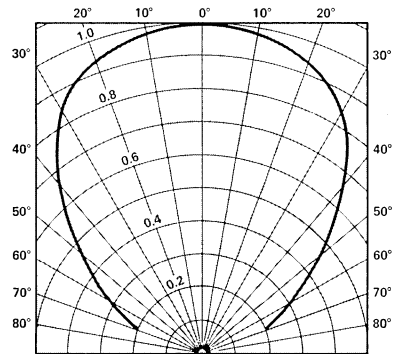


Figure 2. Relative Luminous Intensity Versus Angular Displacement For 5082-4850/4855.

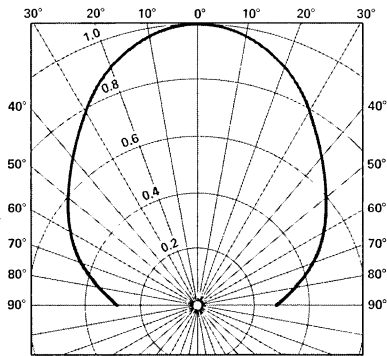


Figure 3. Relative Luminous Intensity Versus Angular Displacement For 5082-4484/4494.

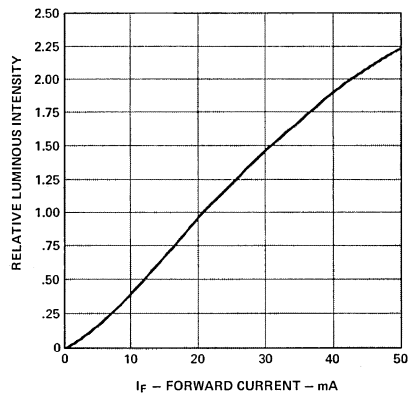


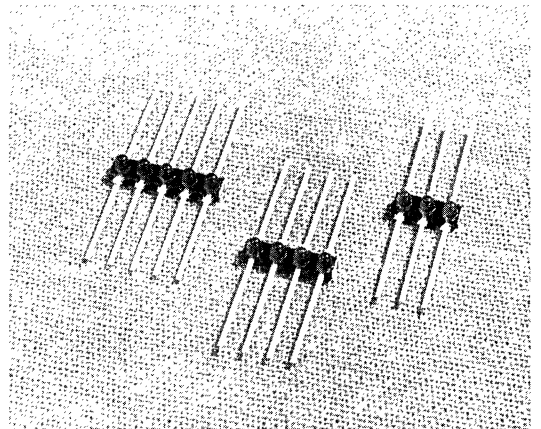
Figure 4. Relative Luminous Intensity Versus Forward Current For 5082-4850/4855/4484/4494.

Features

- EXCELLENT UNIFORMITY BETWEEN ELEMENTS AND BETWEEN ARRAYS
- EASY INSERTION AND ALIGNMENT
- VERSATILE LENGTHS — 3,4,5 ELEMENTS
- END STACKABLE FOR LONGER ARRAYS
- COMPACT SUBMINIATURE PACKAGE STYLE
- NO CROSSTALK BETWEEN ELEMENTS

Description

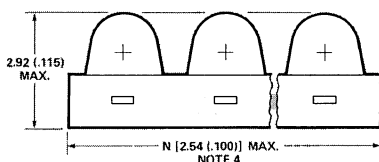
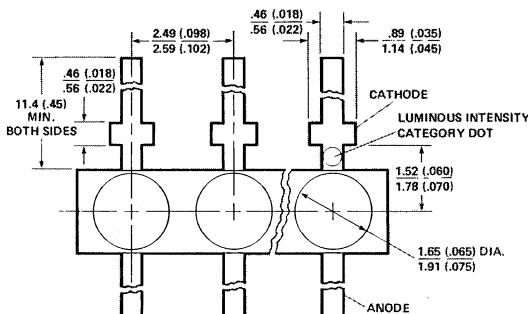
The HLMP-62XX Series arrays are comprised of several Gallium Arsenide Phosphide Red Solid State Lamps molded as a single bar. Arrays are tested to assure uniformity between elements and matching between arrays. Each element has separately accessible leads and a red diffused lens which provides a wide viewing angle and a high on/off contrast ratio. Center-to-center spacing is 2.54mm (.100 in.) between elements and arrays are end stackable on 2.54mm (.100 in.) centers.



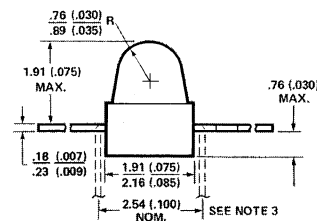
Absolute Maximum Ratings/Element at $T_A = 25^\circ\text{C}$

Power Dissipation	100 mW
Average Forward Current (Derate linearly from 50°C at 0.2mA/°C)	50 mA
Peak Forward Current (see Figure 4)	1000 mA
Operating and Storage Temperature Range	-55°C to +100°C
Lead Soldering Temperature [1.6 mm (0.063 in.) from body]	230°C for 3 sec.

Package Dimensions



- Notes:
1. All dimensions are in millimetres (inches).
 2. Silver-plated leads. See Application Bulletin 3.
 3. User may bend leads as shown.
 4. Overall length is the number of elements times 2.54mm (.100 in.).



Electrical Specifications/Element at $T_A=25^\circ\text{C}$

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Axial Luminous Intensity	.5	1.0		mcd	$I_F = 10 \text{ mA}$; Note 1	2
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		45		Deg.	Note 2	5
λ_{PEAK}	Peak Wavelength		655		nm	Measurement @ Peak	
λ_d	Dominant Wavelength		640		nm	Note 3	
τ_s	Speed of Response		15		ns		
C	Capacitance		100		pF	$V_F = 0$; $f = 1 \text{ MHz}$	
θ_{JC}	Thermal Resistance		125		$^\circ\text{C/W}$	Junction to Cathode Lead at .79mm(.031in) from the body	
V_F	Forward Voltage		1.6	2.0	V	$I_F = 10 \text{ mA}$	1
BV_R	Reverse Breakdown Voltage	3	10		V	$I_R = 100 \mu\text{A}$	
η_V	Luminous Efficacy		55		lm/W	Note 4	

Notes:

- Arrays are categorized for luminous intensity with the intensity category designated by a color dot located on the cathode side of the package.
- $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- Dominant wavelength, λ_d , is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
- Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

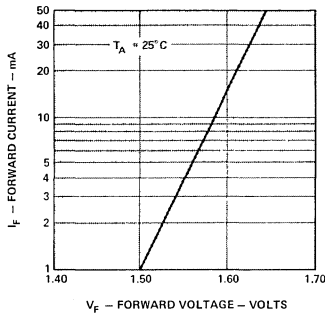


Figure 1. Forward Current vs. Forward Voltage.

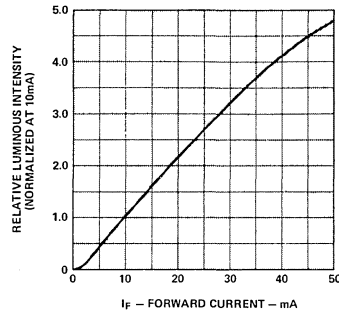


Figure 2. Relative Luminous Intensity vs. DC Forward Current.

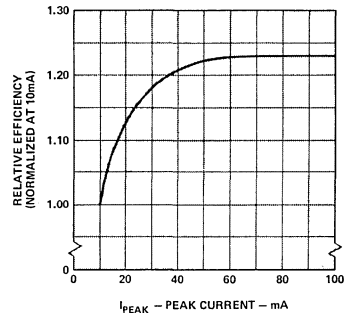


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

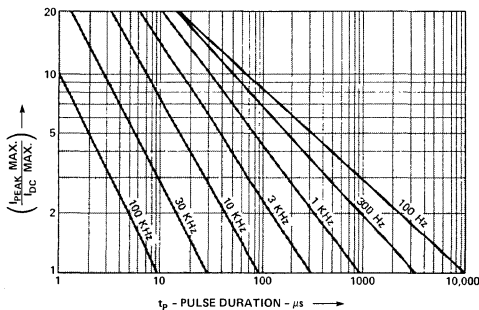


Figure 4. Maximum Tolerable Peak Current vs. Pulse Duration. ($I_{\text{DC MAX}}$ as per MAX Ratings).

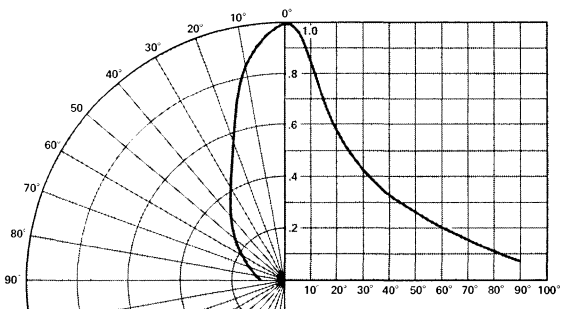


Figure 5. Relative Luminous Intensity vs. Angular Displacement.

SUBMINIATURE RESISTOR LAMPS

HIGH EFFICIENCY RED

5 VOLT, 4mA • HLMP-6620

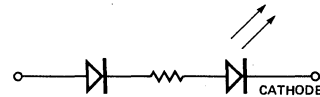
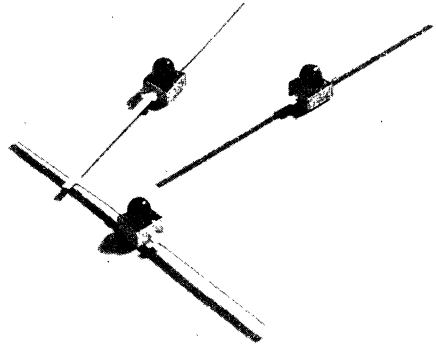
5 VOLT, 10mA • HLMP-6600



TECHNICAL DATA APRIL 1978

Features

- IDEAL FOR TTL AND LSTTL GATE STATUS INDICATION
- REQUIRES NO EXTERNAL RESISTORS WITH 5 VOLT SUPPLY
- SPACE SAVING SUBMINIATURE PACKAGE
- TWO CHOICES OF CURRENT LEVEL
- RUGGED INTEGRAL RESISTOR AND REVERSE PROTECTION DIODE
- EXCELLENT VIEWING ANGLE



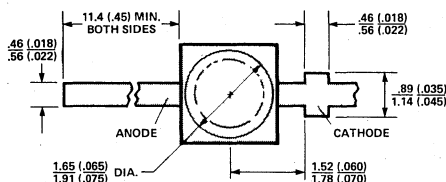
Description

The HLMP-6600 and HLMP-6620 provide a Red Gallium Arsenide Phosphide on Gallium Phosphide Light Emitting Diode together with an integral biasing resistor and reverse protection diode. The package has a red diffused lens and radial leads. Tape-and-reel mounting is available on request.

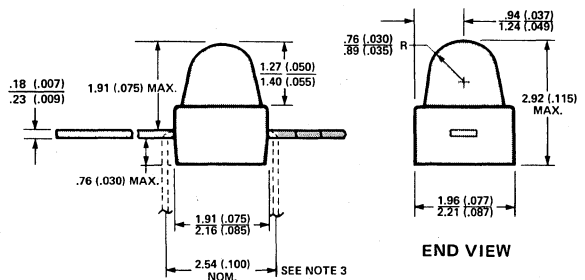
Absolute Maximum Ratings

	HLMP-6600	HLMP-6620
DC Forward Voltage	6 Volts	6 Volts
Reverse Voltage	15 Volts	15 Volts
Operating Temperature Range	-55°C to 70°C	
Storage Temperature Range	-55°C to 100°C	
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	230°C for 5 sec.	

Package Dimensions



TOP VIEW



SIDE VIEW

END VIEW

- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
 2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
 3. USER MAY BEND LEADS AS SHOWN.

Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Parameter	HLMP-6600			HLMP-6620			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Axial Luminous Intensity	1.0	2.4	—	0.2	0.6	—	mcd	$V_F = 5$ Volts (See Figure 1)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	90°			90°				Note 1 (See Figure 2)
λ_{PEAK}	Peak Wavelength	635			635			nm	Measurement at Peak
λ_d	Dominant Wavelength	628			628			nm	Note 2
θ_j	Thermal Resistance	120			120			$^\circ\text{C/W}$	Junction to Cathode Lead at 0.79mm (0.031 in.) From Body
I_F	Forward Current	9.6		13	3.5		5	mA	$V_F = 5$ Volts (See Figure 3)
I_R	Reverse Current	10			10			μA	$V_R = 15$ Volts
η_V	Luminous Efficacy	147			147			lm/W	Note 3

NOTES:

- $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
- Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e = I_V / \eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

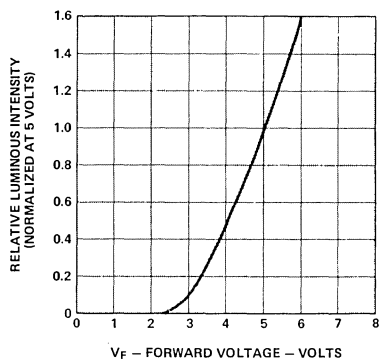


Figure 1. Relative Luminous Intensity vs. Forward Voltage.

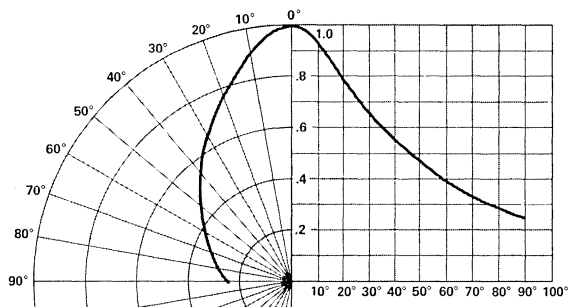


Figure 2. Relative Luminous Intensity vs. Angular Displacement.

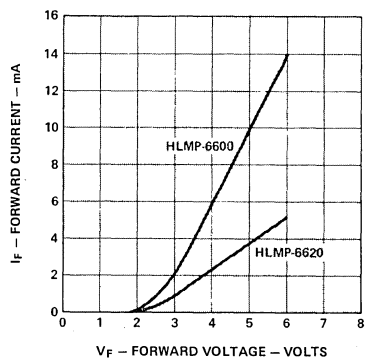


Figure 3. Forward Current vs. Forward Voltage.

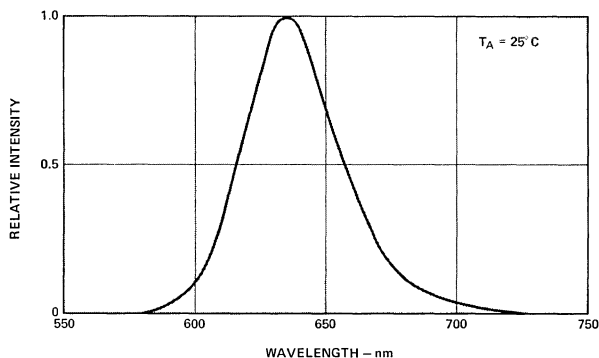


Figure 4. Relative Intensity vs. Wavelength.

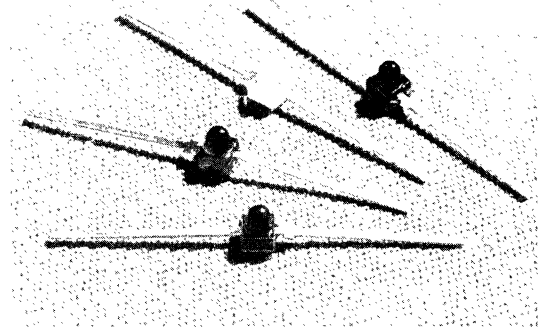
SUBMINIATURE SOLID STATE LAMPS

RED • 5082-4100/4101
HIGH EFFICIENCY RED • 5082-4160
YELLOW • 5082-4150
GREEN • 5082-4190

TECHNICAL DATA APRIL 1978

Features

- SUBMINIATURE PACKAGE STYLE
- END STACKABLE ON 2.21mm (0.087 in.) CENTERS
- LOW PACKAGE PROFILE
- RADIAL LEADS
- WIDE VIEWING ANGLE
- LONG LIFE — SOLID STATE RELIABILITY
- CHOICE OF 4 BRIGHT COLORS
 - Red
 - High Efficiency Red
 - Yellow
 - Green



Description

The 5082-4100/4101, 4150, 4160 and 4190 are solid state lamps encapsulated in a radial lead subminiature package of molded epoxy. They utilize a tinted, diffused lens providing high on-off contrast and wide-angle viewing.

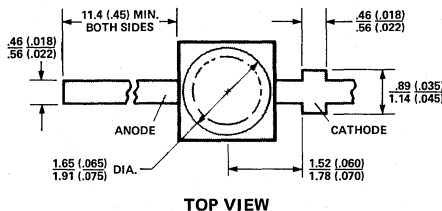
The -4100/4101 utilizes a GaAsP LED chip in a deep red molded package.

The -4160 has a high-efficiency red GaAsP on GaP LED chip in a light red molded package. This lamp's efficiency is comparable to that of the GaP red but does not saturate at low current levels.

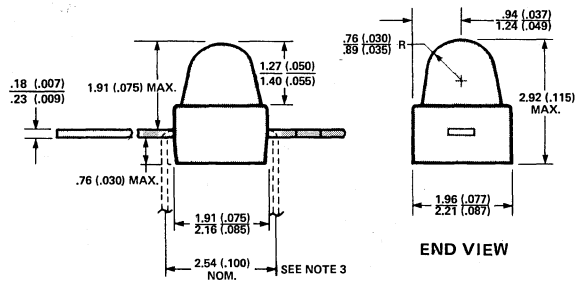
The -4150 provides a yellow GaAsP on GaP LED chip in a yellow molded package.

The -4190 provides a green GaP LED chip in a green molded package.

Package Dimensions



TOP VIEW



SIDE VIEW

END VIEW

- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
 2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
 3. USER MAY BEND LEADS AS SHOWN.

Absolute Maximum Ratings at $T_A=25^\circ\text{C}$

Parameter	Red 4100/4101	High Eff. Red 4160	Yellow 4150	Green 4190	Units
Power Dissipation	100	120	120	120	mW
Average Forward Current	50 ^[1]	20 ^[1]	20 ^[1]	30 ^[2]	mA
Peak Forward Current	1000 See Fig. 5	60 See Fig. 10	60 See Fig. 15	60 See Fig. 20	mA
Operating and Storage Temperature Range	-55°C to 100°C				
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	230°C for 3 seconds				

1. Derate from 50°C at 0.2mA/°C
2. Derate from 50°C at 0.4mA/°C

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

Symbol	Description	5082-4100/4101			5082-4160			5082-4150			5082-4190			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Axial Luminous Intensity	~0.5	.7 / 1.0		1.0	3.0		1.0	2.0		0.8	1.5		mcd	$I_F=10\text{mA}$, Figs. 3,8,13,18
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		45			80			90			70		deg.	Note 1, Figures 6, 11, 16, 21
λ_{PEAK}	Peak Wavelength		655			635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		640			628			585			572		nm	Note 2
τ_S	Speed of Response		15			90			90			200		ns	
C	Capacitance		100			11			15			13		pF	$V_F=0$; $f=1\text{MHz}$
θ_{JC}	Thermal Resistance		125			120			100			100		°C/W	Junction to Cathode Lead at 0.79mm (.031 in) from Body
V_F	Forward Voltage		1.6	2.0		2.2	3.0		2.2	3.0		2.4	3.0	V	$I_F=10\text{mA}$, Figures 2, 7, 12, 17
BV_R	Reverse Breakdown Voltage	3.0	10		5.0			5.0			5.0			V	$I_R = 100\mu\text{A}$
η_v	Luminous Efficacy		55			147			570			665		lm/W	Note 3

NOTES:

1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e=I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

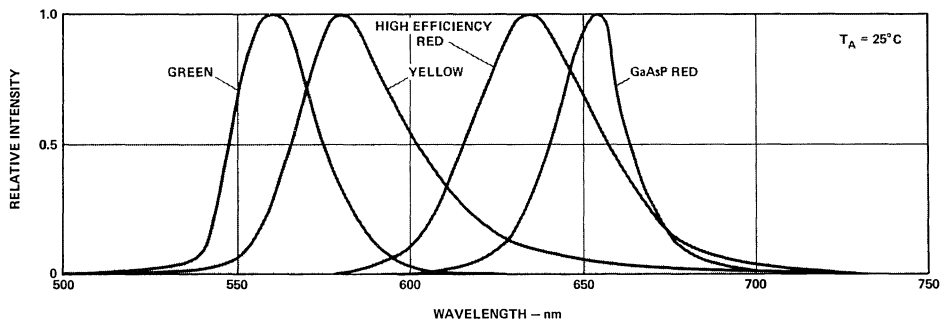


Figure 1. Relative Intensity vs. Wavelength.

Red 5082-4100/4101

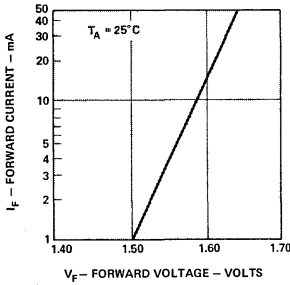


Figure 2. Forward Current vs. Forward Voltage.

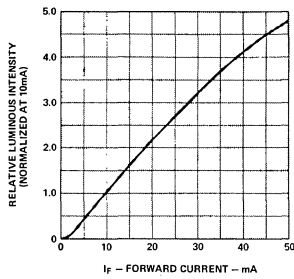


Figure 3. Relative Luminous Intensity vs. Forward Current.

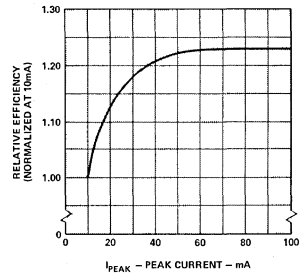


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

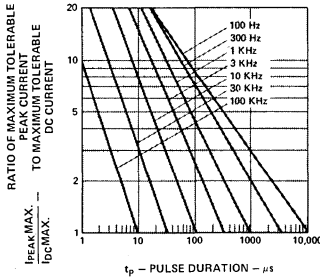


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

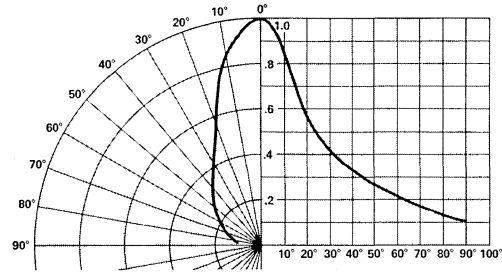


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

High Efficiency Red 5082-4160

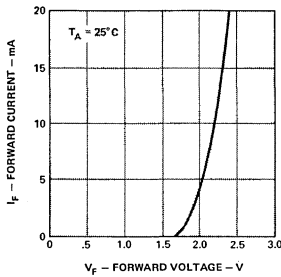


Figure 7. Forward Current vs. Forward Voltage.

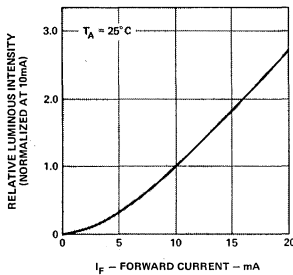


Figure 8. Relative Luminous Intensity vs. Forward Current.

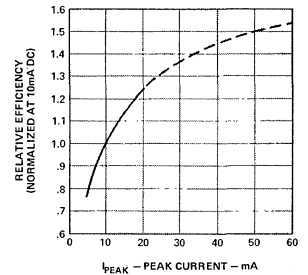


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

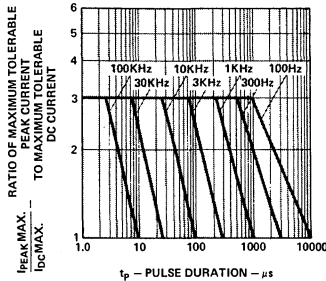


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

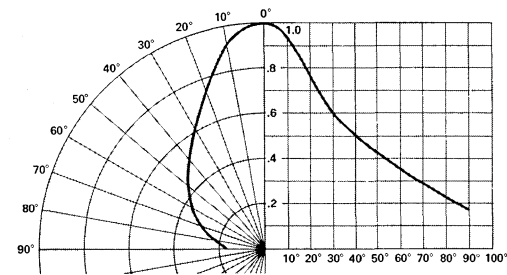


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4150

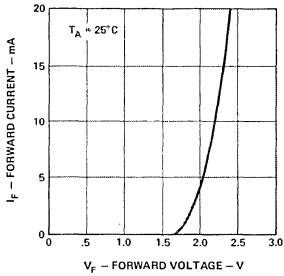


Figure 12. Forward Current vs. Forward Voltage.

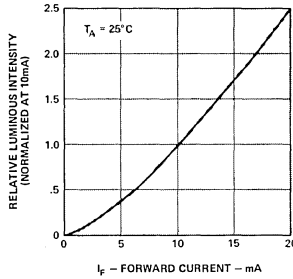


Figure 13. Relative Luminous Intensity vs. Forward Current.

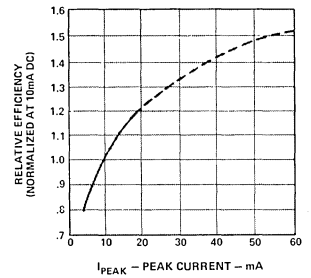


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

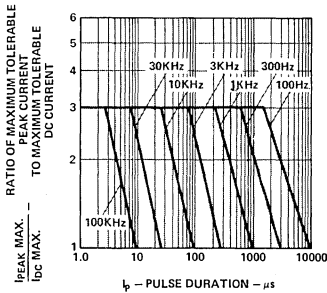


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

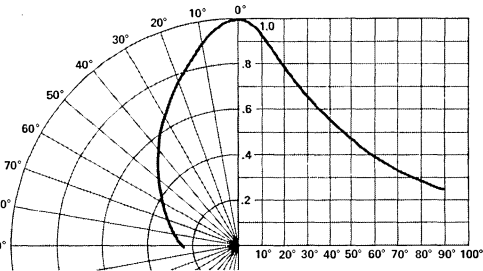


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

Green 5082-4190

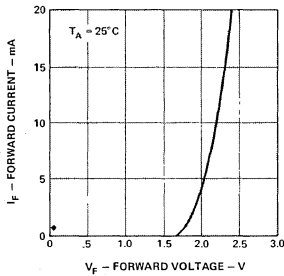


Figure 17. Forward Current vs. Forward Voltage.

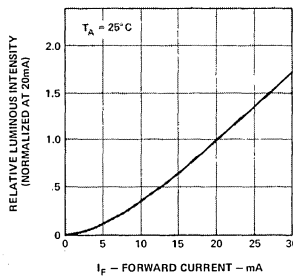


Figure 18. Relative Luminous Intensity vs. Forward Current.

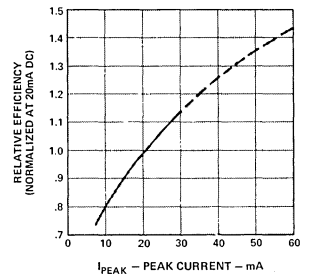


Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

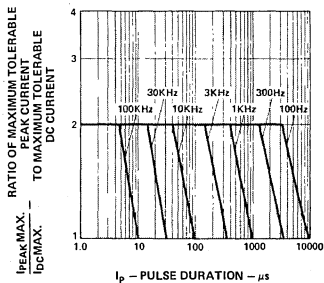


Figure 20. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

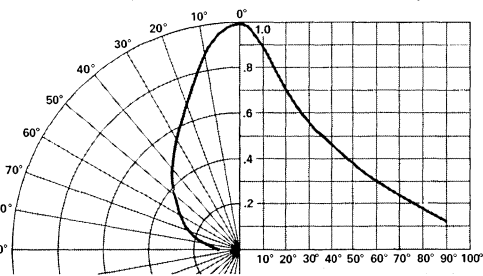


Figure 21. Relative Luminous Intensity vs. Angular Displacement.

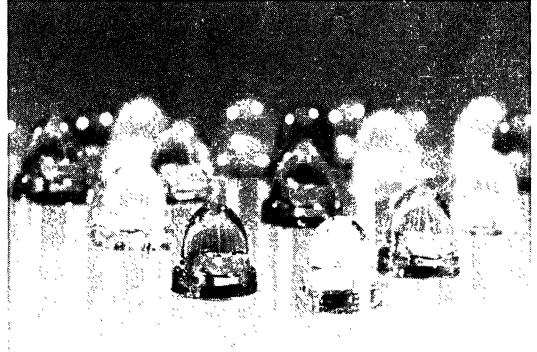
LOW PROFILE SOLID STATE LAMPS

RED • 5082-4790 SERIES
HIGH EFFICIENCY RED • 5082-4690 SERIES
YELLOW • 5082-4590 SERIES
GREEN • 5082-4990 SERIES

TECHNICAL DATA APRIL 1978

Features

- HIGH INTENSITY
- LOW PROFILE: 5.8mm (0.23 in) NOMINAL
- T-1 $\frac{3}{4}$ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- DIFFUSED AND NON-DIFFUSED TYPES
- GENERAL PURPOSE LEADS
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED
- CHOICE OF 4 BRIGHT COLORS
 - Red High Efficiency Red
 - Yellow Green



Description

The 5082-4790/4791 are Gallium Arsenide Phosphide Red Light Emitting Diodes packaged in a Low Profile T-1 $\frac{3}{4}$ outline with a red diffused lens.

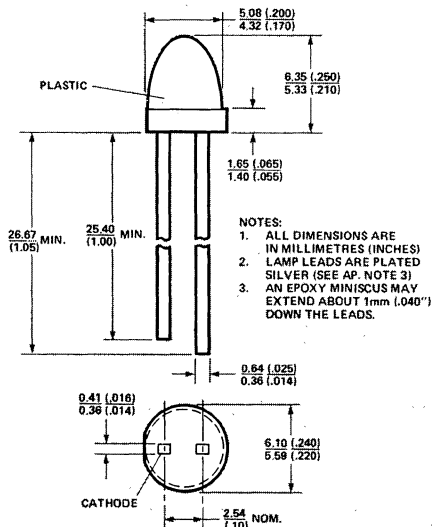
The 5082-4690 Series are Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diodes packaged in a Low Profile T-1 $\frac{3}{4}$ outline.

The 5082-4590 Series are Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diodes packaged in a Low Profile T-1 $\frac{3}{4}$ outline.

The 5082-4990 Series are Gallium Phosphide Green Light Emitting Diodes packaged in a Low Profile T-1 $\frac{3}{4}$ outline.

The Low Profile T-1 $\frac{3}{4}$ package provides space savings and is excellent for backlighting applications.

Package Dimensions



Part Number 5082-	Application	Lens	Color
4690	Indicator — General Purpose	Diffused	High Efficiency Red
4693	Indicator — High Brightness	Wide Angle	
4694	General Purpose Point Source	Non-diffused	
4695	High Brightness Annunciator	Narrow Angle	Yellow
4590	Indicator — General Purpose	Diffused	
4592	Indicator — High Brightness	Wide Angle	
4595	General Purpose Point Source	Non-diffused Narrow Angle	Green
4597	High Brightness Annunciator		
4990	Indicator — General Purpose	Diffused		Red
4992	Indicator — High Brightness	Wide Angle	
4995	General Purpose Point Source	Non-diffused	
4997	High Brightness Annunciator	Narrow Angle	Red
4790	Indicator — General Purpose	Diffused	
4791	Indicator — High Brightness	Wide Angle	

Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

Parameter	Red 4790 Series	Hi-Eff. Red 4690 Series	Yellow 4590 Series	Green 4990 Series	Units
Power Dissipation	100	120	120	120	mW
Average Forward Current	50 ^[1]	20 ^[1]	20 ^[1]	30 ^[2]	mA
Peak Forward Current	1000 See Fig. 5	60 See Fig. 10	60 See Fig. 15	60 See Fig. 20	mA
Operating and Storage Temperature Range	-55°C to + 100°C				
Lead Solder Temperature (1.6mm [0.63 inch] from body)	260°C For 5 Seconds				

1. Derate from 50°C at 0.2mA/°C
2. Derate from 50°C at 0.4mA/°C

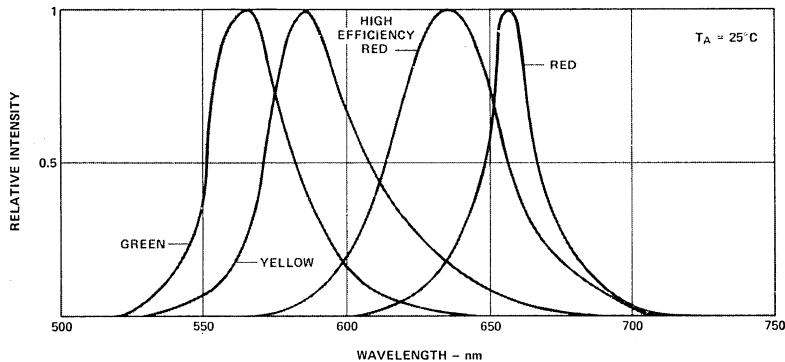


Figure 1. Relative Intensity versus Wavelength.

RED 5082-4790 SERIES

Electrical Specifications at $T_A = 25^\circ\text{C}$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4790	0.8	1.2		mcd	$I_F = 20\text{mA}$ (Fig. 3)
		4791	1.6	2.5			
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points			60		deg.	Note 1 (Fig. 6)
λ_{PEAK}	Peak Wavelength			655		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			648		nm	Note 2
τ_s	Speed of Response			15		ns	
C	Capacitance			100		pF	$V_F = 0$; $f = 1\text{ MHz}$
θ_{JC}	Thermal Resistance			125		$^\circ\text{C/W}$	Junction to Cathode Lead 1.6 mm (0.063 in.) from Body
V_F	Forward Voltage			1.6	2.0	V	$I_F = 20\text{mA}$ (Fig. 2)
BV_R	Reverse Breakdown Voltage		3	10		V	$I_R = 100\mu\text{A}$
η_V	Luminous Efficacy			55		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e , in watts/steradian may be found from the equation $I_e = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

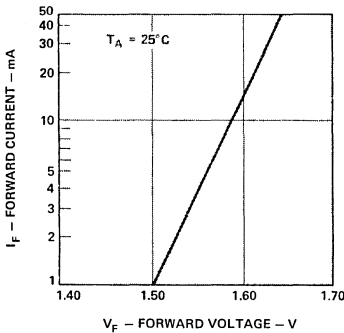


Figure 2. Forward Current versus Forward Voltage.

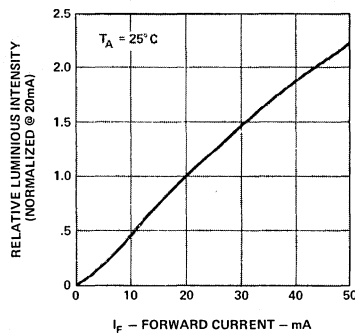


Figure 3. Relative Luminous Intensity versus Forward Current.

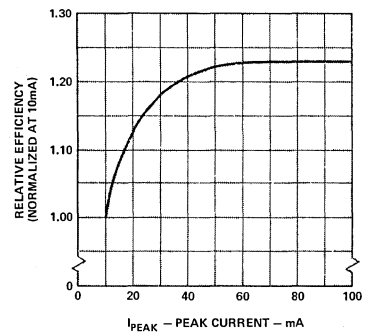


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

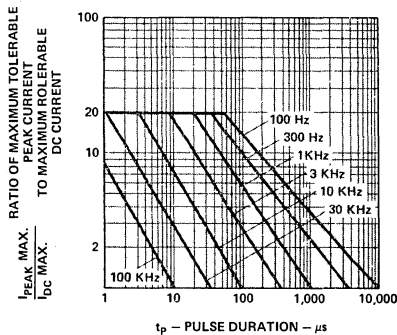


Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. ($I_{\text{DC MAX}}$ as per MAX Ratings)

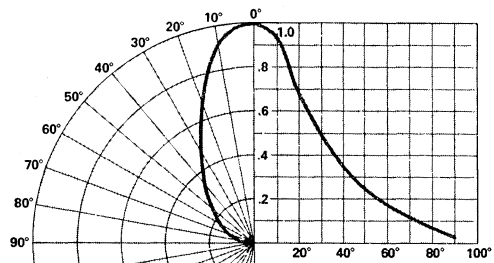


Figure 6. Relative Luminous Intensity versus Angular Displacement.

HIGH EFFICIENCY RED 5082-4690 SERIES

Electrical Specifications at $T_A=25^\circ\text{C}$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4690 4693 4694 4695	1.5 5.0 4.0 8.0	3.5 7.0 8.0 11.0		mcd	$I_F = 10\text{mA}$ (Fig.8)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4690 4693 4694 4695		50 50 45 45		deg.	Note 1 (Fig. 11)
λ_{PEAK}	Peak Wavelength			635		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			626		nm	Note 2
τ_s	Speed of Response			90		ns	
C	Capacitance			16		pF	$V_F = 0; f = 1\text{ MHz}$
θ_{JC}	Thermal Resistance			130		$^\circ\text{C/W}$	Junction to Cathode Lead 1.6mm (0.063 in.) from Body
V_F	Forward Voltage			2.2	3.0	V	$I_F = 10\text{mA}$ (Fig. 7)
BV_R	Reverse Breakdown Voltage		5.0			V	$I_R = 100\mu\text{A}$
η_V	Luminous Efficacy			147		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e , in watts/steradian may be found from the equation $I_e = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

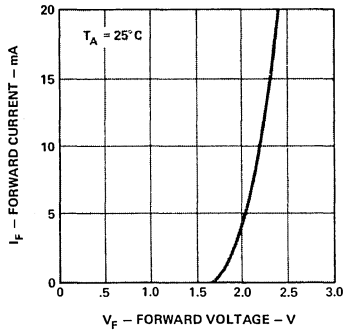


Figure 7. Forward Current versus Forward Voltage.

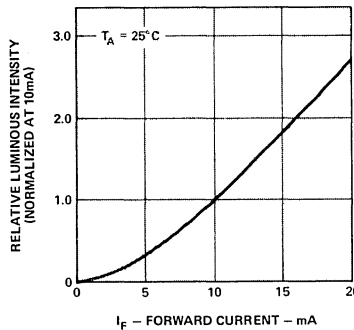


Figure 8. Relative Luminous Intensity versus Forward Current.

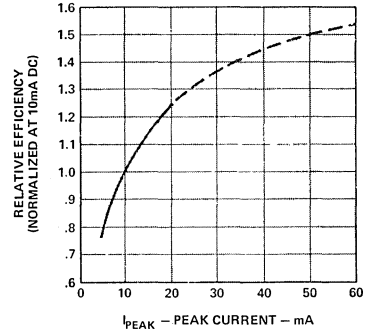


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

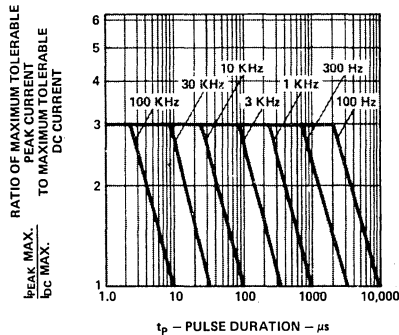


Figure 10. Maximum Tolerable Peak Current versus Pulse Duration. ($I_{\text{DC MAX}}$ as per MAX Ratings)

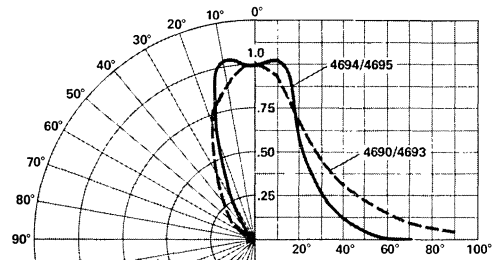


Figure 11. Relative Luminous Intensity versus Angular Displacement.

YELLOW 5082-4590 SERIES

Electrical Specifications at $T_A=25^\circ\text{C}$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4590 4592 4595 4597	1.5 4.5 4.0 8.0	3.5 6.0 6.5 11.0		mcd	$I_F = 10\text{mA}$ (Fig. 13)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4590 4592 4595 4597		50 50 45 45		deg.	Note 1 (Fig. 16)
λ_{PEAK}	Peak Wavelength			583		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			585		nm	Note 2
τ_s	Speed of Response			90		ns	
C	Capacitance			18		pF	$V_F = 0; f = 1\text{ MHz}$
θ_{JC}	Thermal Resistance			100		$^\circ\text{C/W}$	Junction to Cathode Lead 1.6mm (0.063 in.) from Body
V_F	Forward Voltage			2.2	3.0	V	$I_F = 10\text{mA}$ (Fig. 12)
BVR	Reverse Breakdown Voltage		5.0			V	$I_R = 100\mu\text{A}$
η_V	Luminous Efficacy			570		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_θ , in watts/steradian may be found from the equation $I_\theta = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

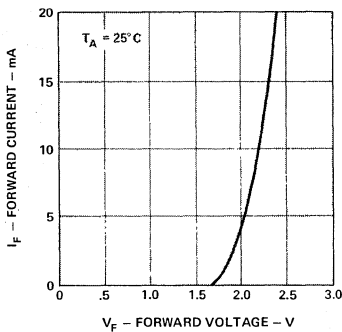


Figure 12. Forward Current versus Forward Voltage.

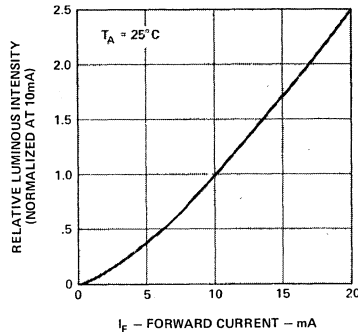


Figure 13. Relative Luminous Intensity versus Forward Current.

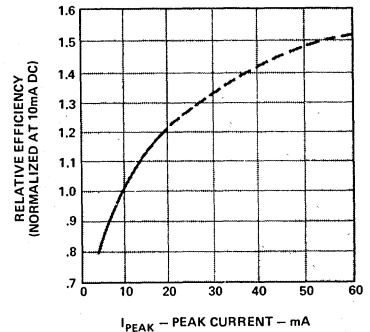


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

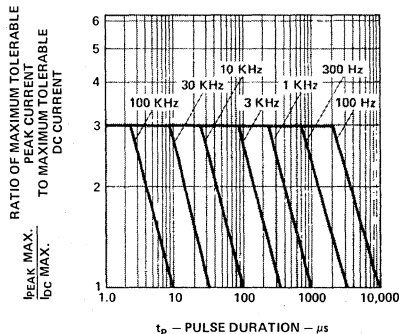


Figure 15. Maximum Tolerable Peak Current versus Pulse Duration. ($I_{DC\text{ MAX}}$ as per MAX Ratings).

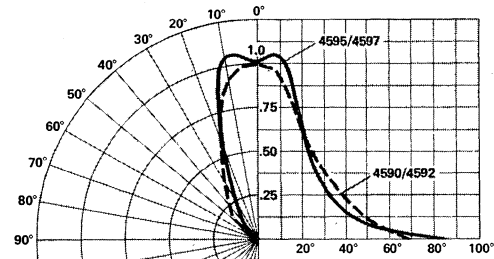


Figure 16. Relative Luminous Intensity versus Angular Displacement

GREEN 5082-4990 SERIES

Electrical Specifications at $T_A=25^\circ\text{C}$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4990 4992 4995 4997	2.0 6.0 3.5 8.0	4.5 7.5 6.5 11.0		md	$I_F = 20\text{mA}$ (Fig.18)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4990 4992 4995 4997		50 50 40 40		deg.	Note 1 (Fig.21)
λ_{PEAK}	Peak Wavelength			565		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			570		nm	Note 2
τ_s	Speed of Response			200		ns	
C	Capacitance			12		pF	$V_F = 0$; $f = 1\text{ MHz}$
θ_{JC}	Thermal Resistance			90		$^\circ\text{C/W}$	Junction to Cathode Lead 1.6mm (0.063 in.) from Body
V_F	Forward Voltage			2.4	3.0	V	$I_F = 20\text{mA}$ (Fig. 17)
BV_R	Reverse Breakdown Voltage		5.0			V	$I_R = 100\mu\text{A}$
η_V	Luminous Efficacy			665		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e , in watts/steradian may be found from the equation $I_e = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

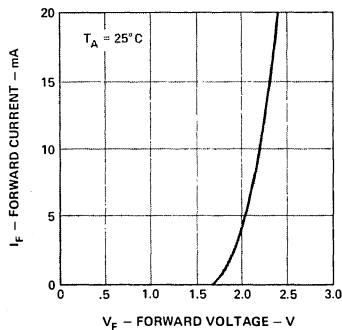


Figure 17. Forward Current versus Forward Voltage.

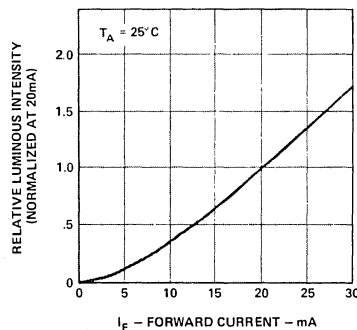


Figure 18. Relative Luminous Intensity versus Forward Current.

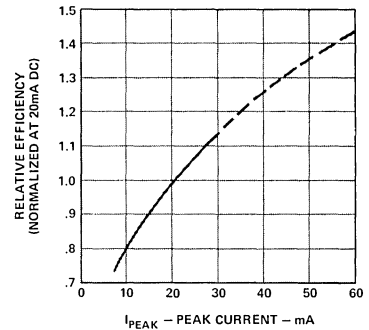


Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

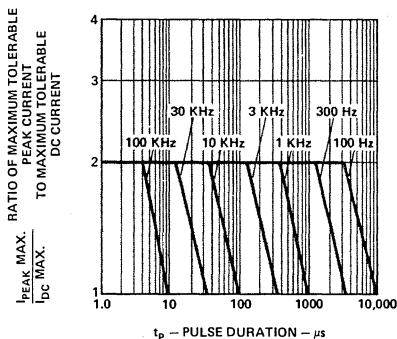


Figure 20. Maximum Tolerable Peak Current versus Pulse Duration. ($I_{\text{DC MAX}}$ as per MAX ratings).

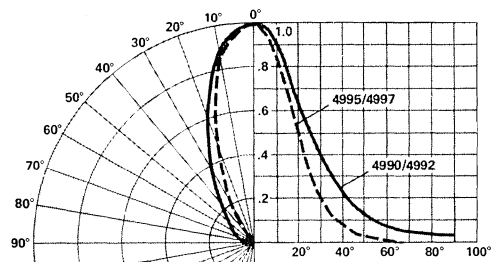


Figure 21. Relative Luminous Intensity versus Angular Displacement.

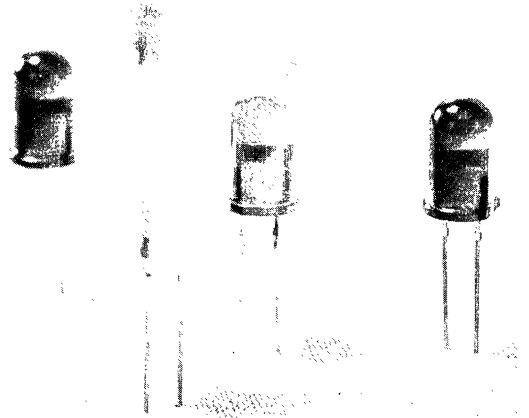
SOLID STATE LAMPS

HIGH EFFICIENCY RED • 5082-4650 Series
YELLOW • 5082-4550 Series
GREEN • 5082-4950 Series

TECHNICAL DATA APRIL 1978

Features

- HIGH INTENSITY
- CHOICE OF 3 BRIGHT COLORS
High Efficiency Red
Yellow
Green
- POPULAR T-1 $\frac{1}{4}$ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- WIDE VIEWING ANGLE AND NARROW VIEWING ANGLE TYPES
- GENERAL PURPOSE LEADS
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED

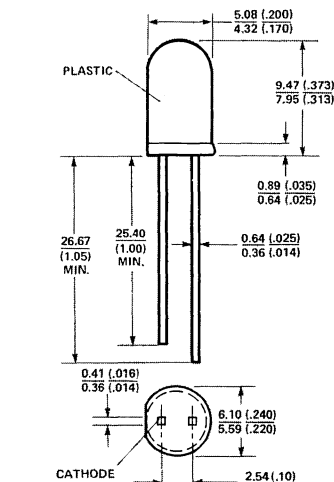


Description

The 5082-4650 and the 5082-4550 Series lamps are Gallium Arsenide Phosphide on Gallium Phosphide diodes emitting red and yellow light respectively. The 5082-4950 Series lamps are green light emitting Gallium Phosphide diodes.

General purpose and selected brightness versions of both the diffused and non-diffused lens type are available in each family.

Package Dimensions



- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. SILVER PLATED LEADS. SEE APPLICATION BULLETIN 3.
3. AN EPOXY MINUSCULUM MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.

Part Number	Application	Lens	Color
5082-4650	Indicator — General Purpose	Diffused	High Efficiency Red
4655	Indicator — High Ambient	Wide Angle	
4657	Illuminator/Point Source	Non Diffused	
4658	Illuminator/High Brightness	Narrow Angle	
5082-4550	Indicator General Purpose	Diffused	Yellow
4555	Indicator — High Ambient	Wide Angle	
4557	Illuminator/Point Source	Non-Diffused	
4558	Illuminator/High Brightness	Narrow Angle	
5082-4950	Indicator — General Purpose	Diffused	Green
4955	Indicator — High Ambient	Wide Angle	
4957	Illuminator/Point Source	Non-Diffused	
4958	Illuminator/High Brightness	Narrow Angle	

Electrical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Condions	
I_V	Luminous Intensity	4650	1.0	2.0		mcd.	$I_F = 10\text{mA}$ (Fig. 3)	
		4655	3.0	4.0				
		4657	9.0	12.0				
		4658	15.0	24.0				
			4550	1.0	1.8		mcd.	$I_F = 10\text{mA}$ (Fig. 8)
			4555	2.2	3.0			
			4557	6.0	9.0			
			4558	12.0	16.0			
			4950	1.0	1.8		mcd.	$I_F = 20\text{mA}$ (Fig. 13)
			4955	2.2	3.0			
			4957	6.0	9.0			
			4958	12.0	16.0			
$2\Theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4650		90		Deg.	$I_F = 10\text{mA}$ See Note 1 (Fig. 6)	
		4655		90				
		4657		35				
		4658		35				
			4550		90		Deg.	$I_F = 10\text{mA}$ See Note 1 (Fig. 11)
			4555		90			
			4557		35			
			4558		35			
			4950		90		Deg.	$I_F = 20\text{mA}$ See Note 1 (Fig. 16)
			4955		90			
			4957		30			
			4958		30			
λ_{PEAK}	Peak Wavelength	4650s		635		nm	Measurement at Peak (Fig. 1)	
		4550s		583				
		4950s		565				
λ_d	Dominant Wavelength	4650s		626		nm	See Note 2 (Fig.1)	
		4550s		585				
		4950s		572				
τ_S	Speed of Response	4650s		90		ns		
		4550s		90				
		4950s		200				
C	Capacitance	4650s		16		pF	$V_F = 0, f = 1 \text{ MHz}$	
		4550s		18				
		4950s		18				
Θ_{JC}	Thermal Resistance	4650s		135		$^\circ\text{C/W}$	Junction to Cathode Lead at Seating Plane	
		4550s		135				
		4950s		145				
V_F	Forward Voltage	4650s		2.2	3.0	V	$I_F = 10\text{mA}$ (Fig. 2, $I_F = 10\text{mA}$ Fig. 7, $I_F = 20\text{mA}$ Fig. 12)	
		4550s		2.2	3.0			
		4950s		2.4	3.0			
BV_R	Reverse Breakdown Volt.	All	5.0			V	$I_R = 100\mu\text{A}$	
η_V	Luminous Efficacy	4650s		147		lumens/watt	See Note 3	
		4550s		570				
		4950s		665				

NOTES:

- $\Theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
- Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e = I_V / \eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

Absolute Maximum Ratings

Parameter	High Efficiency Red 4650 Series	Yellow 4550 Series	Green 4950 Series	Units
Power Dissipation	120	120	120	mW
Average Forward Current	20 ^[1]	20 ^[1]	30 ^[2]	mA
Peak Operating Forward Current	60 (Fig. 5)	60 (Fig. 10)	60 (Fig. 15)	mA
Operating and Storage Temperature Range	-55°C to +100°C			
Lead Solder Temperature (1.6mm[0.063 inch] below package base)	260°C for 5 seconds			

1. Derate from 50°C at 0.2mA/°C
2. Derate from 50°C at 0.4mA/°C

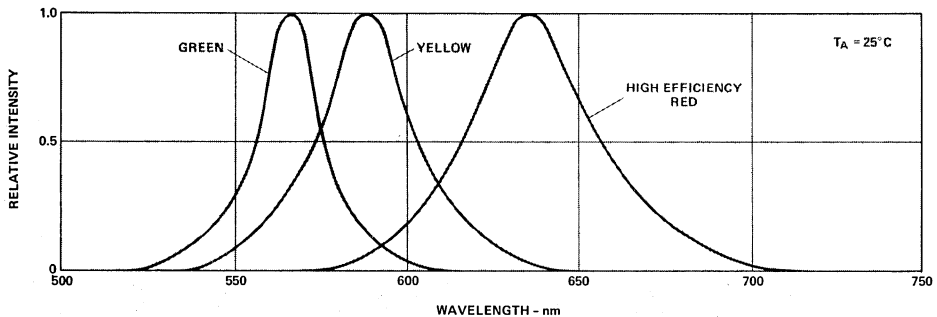


Figure 1. Relative Intensity vs. Wavelength.

High Efficiency Red 5082-4650 Series

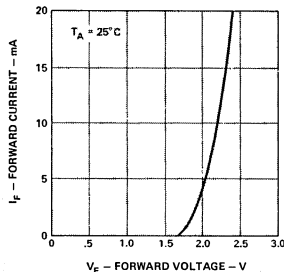


Figure 2. Forward Current vs. Forward Voltage

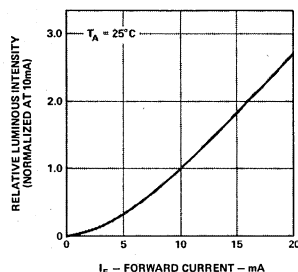


Figure 3. Relative Luminous Intensity vs. Forward Current.

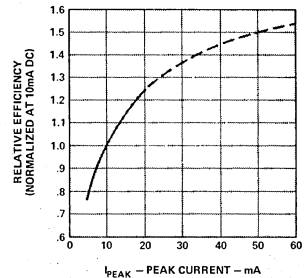


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

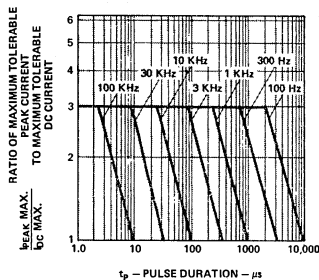


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

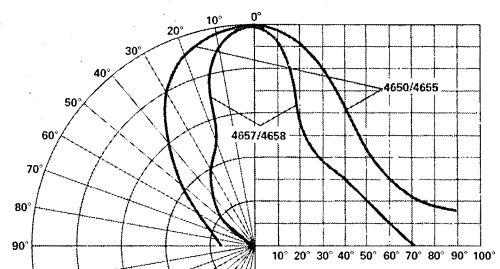


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4550 Series

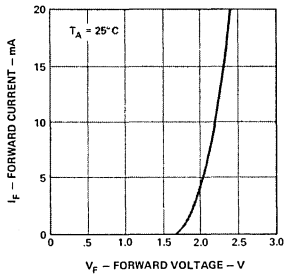


Figure 7. Forward Current vs. Forward Voltage.

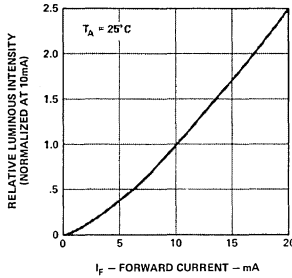


Figure 8. Relative Luminous Intensity vs. Forward Current.

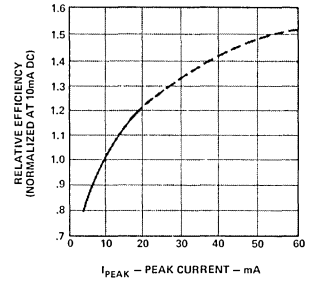


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

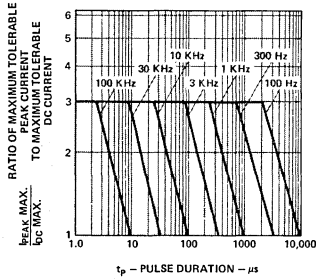


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

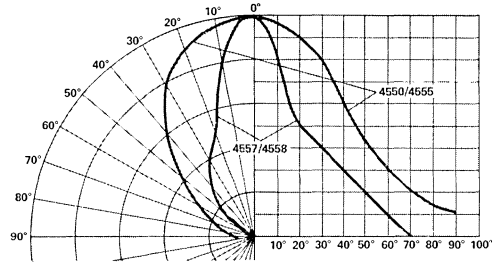


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Green 5082-4950 Series

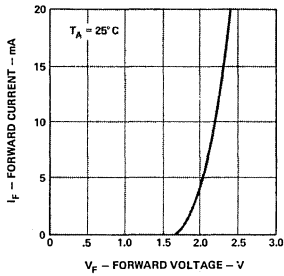


Figure 12. Forward Current vs. Forward Voltage.

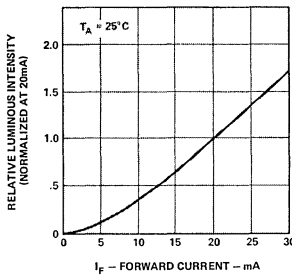


Figure 13. Relative Luminous Intensity vs. Forward Current.

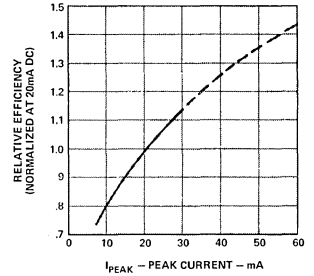


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

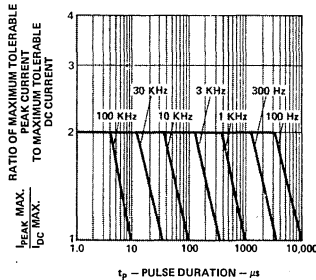


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

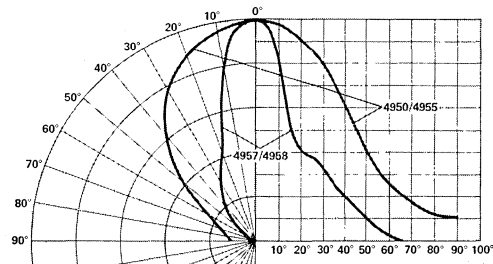


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

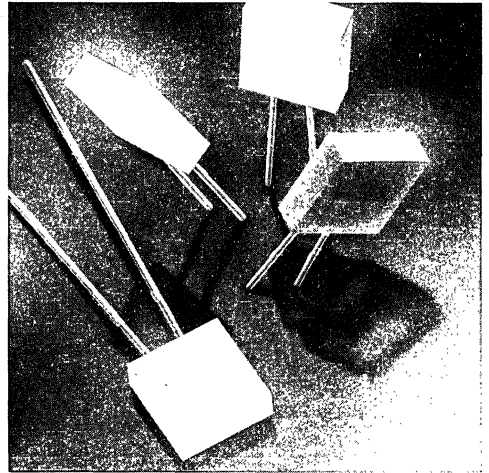
RECTANGULAR SOLID STATE LAMPS

HIGH EFFICIENCY RED HLMP-0300/0301 (5082-4670)
 YELLOW HLMP-0400/0401 (5082-4570)
 GREEN HLMP-0500/0501 (5082-4970)

TECHNICAL DATA APRIL 1978

Features

- RECTANGULAR LIGHT EMITTING SURFACE
- FLAT HIGH STERANCE EMITTING SURFACE
- STACKABLE ON 2.54 MM (0.100 INCH) CENTERS
- IDEAL AS FLUSH MOUNTED PANEL INDICATORS
- IDEAL FOR BACKLIGHTING LEGENDS
- LONG LIFE: SOLID STATE RELIABILITY
- CHOICE OF 3 BRIGHT COLORS
HIGH EFFICIENCY RED
YELLOW
GREEN
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS



Description

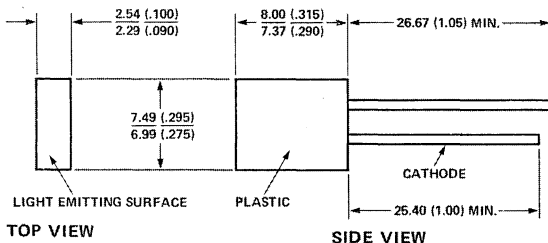
The HLMP-03XX, -04XX, -05XX are solid state lamps encapsulated in an axial lead rectangular epoxy package. They utilize a tinted, diffused epoxy to provide high on-off contrast and a flat high intensity emitting surface. Borderless package design allows creation of uninterrupted light emitting areas.

The HLMP-0300 and -0301 have a high-efficiency red GaAsP on GaP LED chip in a light red epoxy package. This lamp's efficiency is comparable to that of the Gap red, but extends to higher current levels.

The HLMP-0400 and -0401 provide a yellow GaAsP on GaP LED chip in a yellow epoxy package.

The HLMP-0500 and -0501 provide a green GaP LED chip in a green epoxy package.

Package Dimensions

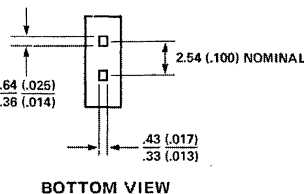


AXIAL LUMINOUS INTENSITY

	MIN.	TYP.	TEST CONDITIONS
RED	HLMP-0300	.8	1.0 mcd $I_F = 25mA$
	HLMP-0301	1.5	2.5 mcd $I_F = 25mA$
	(5082-4670)	.8	1.5 mcd $I_F = 15mA$
YELLOW	HLMP-0400	1.0	1.2 mcd $I_F = 25mA$
	HLMP-0401	2.0	2.5 mcd $I_F = 25mA$
GREEN	(5082-4570)	1.0	1.5 mcd $I_F = 15mA$
	HLMP-0500	1.0	1.2 mcd $I_F = 25mA$
	HLMP-0501	1.5	2.5 mcd $I_F = 25mA$
(5082-4970)	1.0	1.5 mcd $I_F = 20mA$	

NOTE: Luminous sterance, L_v , in foot lamberts, may be found from the equation $L_v = 18.7 I_v$, where I_v is the luminous intensity in millicandelas.

- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
 2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
 3. AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.



Absolute Maximum Ratings at $T_A=25^\circ\text{C}$

Parameter	High-Efficiency Red HLMP-0300/0301	Yellow HLMP-0400/0401	Green HLMP-0500/0501	Units
Power Dissipation	120	120	120	mW
Average Forward Current	30 ^[1]	30 ^[1]	30 ^[1]	mA
Peak Forward Current	60 See Figure 5	60 See Figure 10	60 See Figure 15	mA
Operating and Storage Temperature Range	-55°C to 100°C			
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	260°C for 5 seconds			

1. Derate from 50°C at 0.4mA/°C.

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

Symbol	Description	HLMP-0300/0301			HLMP-0400/0401			HLMP-0500/0501			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points, Both Axes		100			100			100		deg.	Note 1. Figures 6,11,16
λ_{PEAK}	Peak Wavelength		635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		626			585			571		nm	Note 2
τ_S	Speed of Response		90			90			200		ns	
C	Capacitance		17			17			17		pF	$V_F=0$; $f=1$ MHz
θ_{JC}	Thermal Resistance		130			130			130		°C/W	Junction to Cathode Lead at 1.6 mm (0.063 in.) from Body
V_F	Forward Voltage		2.5	3.0		2.5	3.0		2.5	3.0	V	$I_F=25\text{mA}$ Figures 2,7,12
BV_R	Reverse Breakdown Voltage	5.0			5.0			5.0			V	$I_R=100\ \mu\text{A}$
η_v	Luminous Efficacy		147			570			665		lm/W	Note 3

NOTES:

- $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
- Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e=I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

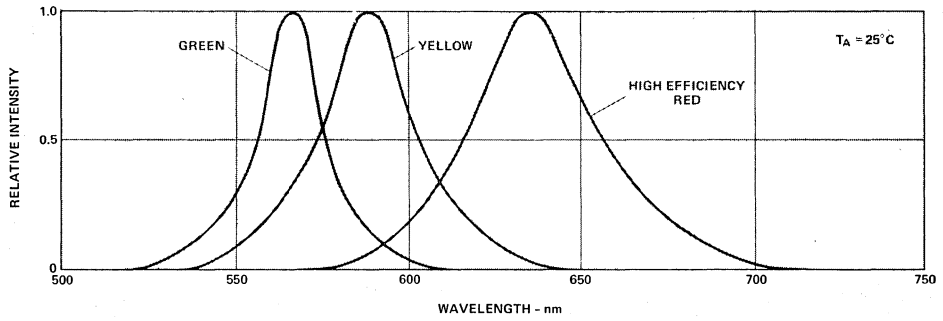


Figure 1. Relative Intensity vs. Wavelength.

HIGH EFFICIENCY RED HLMP-0300/0301 (5082-4670)

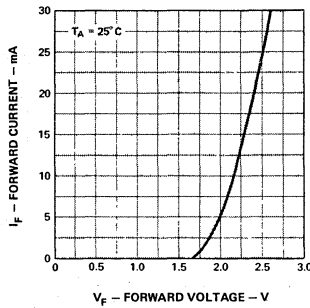


Figure 2. Forward Current vs. Forward Voltage.

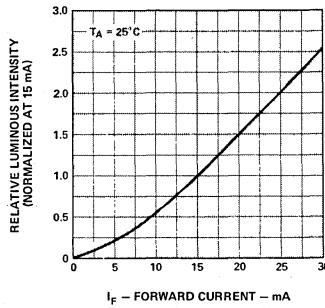


Figure 3. Relative Luminous Intensity vs. Forward Current.

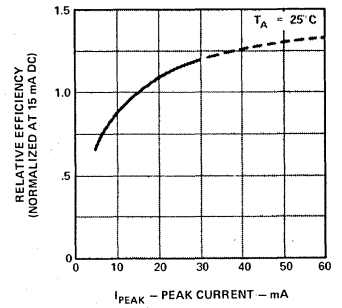


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

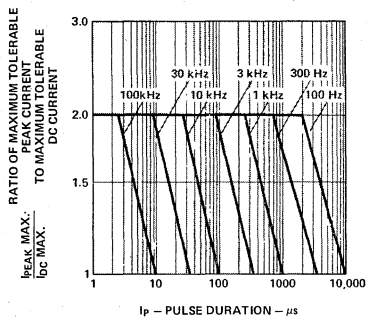


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. ($I_{DC\ MAX}$ as per MAX Ratings.)

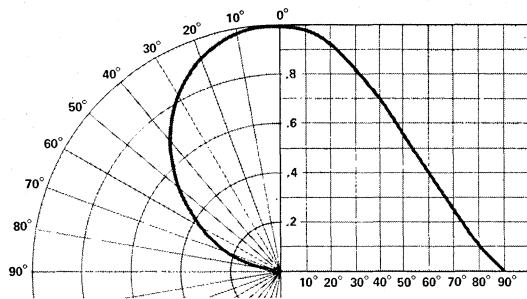


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

YELLOW HLMP-0400/0401 (5082-4570)

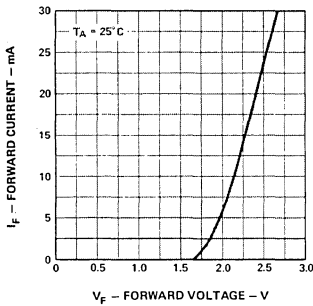


Figure 7. Forward Current vs. Forward Voltage.

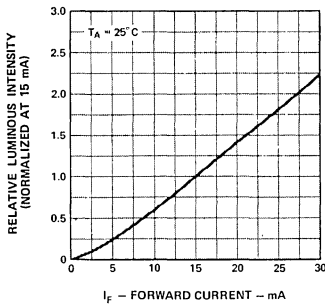


Figure 8. Relative Luminous Intensity vs. Forward Current.

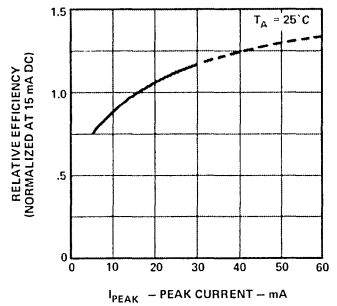


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

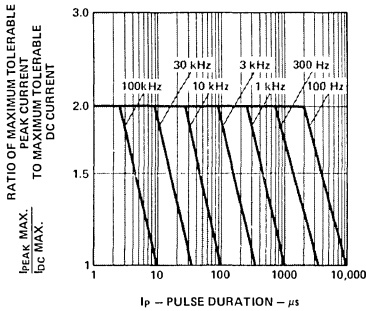


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

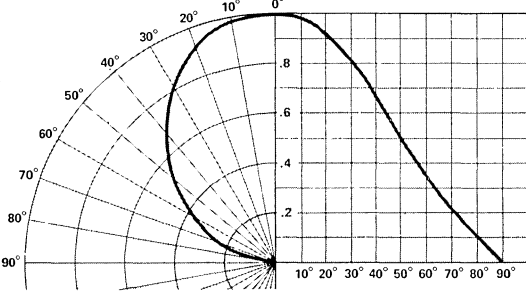


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

GREEN HLMP-0500/0501 (5082-4970)

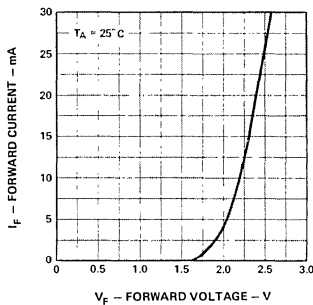


Figure 12. Forward Current vs. Forward Voltage.

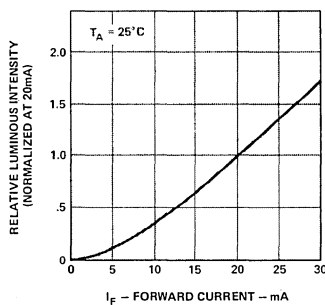


Figure 13. Relative Luminous Intensity vs. Forward Current.

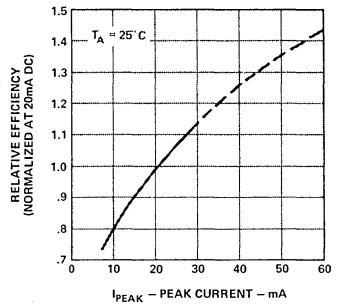


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

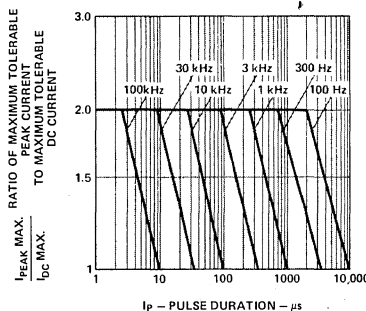


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

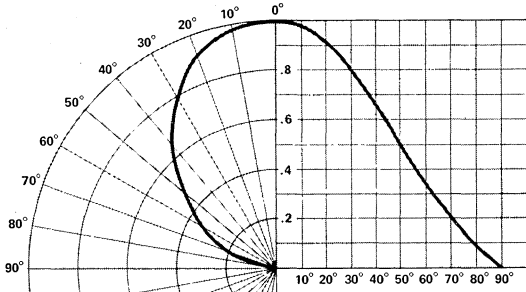


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

SOLID STATE LAMPS

HIGH EFFICIENCY RED • HLMP-1300, -1301(5082-4684), -1302
YELLOW • HLMP-1400, -1401(5082-4584), -1402
GREEN • HLMP-1500, -1501(5082-4984), -1502

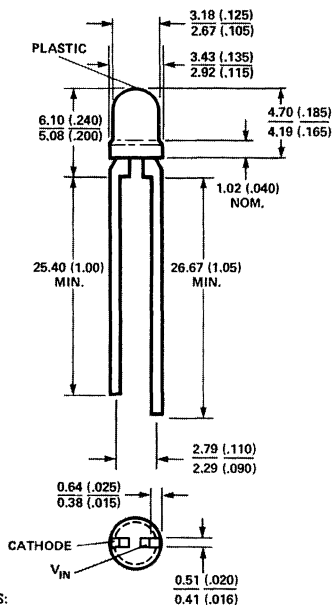
TECHNICAL DATA APRIL 1978

Features

- HIGH INTENSITY
- WIDE VIEWING ANGLE
- SMALL SIZE T-1 DIAMETER
3.18mm (0.125 inch)
- IC COMPATIBLE
- RELIABLE AND RUGGED
- CHOICE OF 3 BRIGHT COLORS
HIGH EFFICIENCY RED
YELLOW
GREEN



Package Dimensions



- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. SILVER PLATED LEADS. SEE APPLICATIONS BULLETIN 3.
3. AN EPOXY MINUSCUS MAY EXTEND ABOUT 1mm (.040") DOWN THE LEADS.

Description

The HLMP-1300, -1301, and -1302 have a Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diode packaged in a T-1 outline with a red diffused lens, which provides excellent on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The HLMP-1400, -1401, and -1402 have a Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diode packaged in a T-1 outline with a yellow diffused lens, which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The HLMP-1500, -1501, and -1502 have a Gallium Phosphide Green Light Emitting Diode packaged in a T-1 outline with a green diffused lens, which provides good on-off contrast ratio, high axial luminous intensity, and a wide viewing angle.

I_v — Axial Luminous Intensity at 25°C
(Figures 3,8,15)

	I_v (mcd)			Test Conditions
	Min.	Typ.		
High Efficiency Red				
HLMP-1300	0.5	1.5	$I_F=10$ mA	
HLMP-1301 (-4684)	1.0	2.0		
HLMP-1302	2.0	2.5		
Yellow				
HLMP-1400	0.5	1.5	$I_F=10$ mA	
HLMP-1401 (-4584)	1.0	2.5		
HLMP-1402	2.5	4.0		
Green				
HLMP-1500	0.5	1.2	$I_F=20$ mA	
HLMP-1501 (-4984)	0.8	2.0		
HLMP-1502	2.0	3.0		

Absolute Maximum Ratings at $T_A=25^\circ\text{C}$

Parameter	High Efficiency Red HLMP-1300,1301,1302	Yellow HLMP-1400,1401,1402	Green HLMP-1500,1501,1502	Units
Power Dissipation (Derate)	120	120	120	mW
Average Forward Current	20 ^[1]	20 ^[1]	30 ^[2]	mA
Peak Forward Current	60 See Figure 5	60 See Figure 10	60 See Figure 15	mA
Operating and Storage Temperature Range	-55°C to 100°C			
Lead Soldering Temperature [1.6mm (0.063 in.) from Body]	230°C for 7 Seconds			

1. Derate from 50°C at 0.2mA/°C
2. Derate from 50°C at 0.4mA/°C

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

Symbol	Description	HLMP-1300, -1301, -1302			HLMP-1400, -1401, -1402			HLMP-1500, -1501, -1502			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		70			60			60		Deg.	Note 1 (Figs. 6, 11, 16)
λ_{peak}	Peak Wavelength		635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		628			585			572		nm	Note 2
τ_s	Speed of Response		90			90			200		ns	
C	Capacitance		20			15			8		pF	$V_F=0$; $f=1$ MHz
θ_{JC}	Thermal Resistance		95			95			95		°C/W	Junction to Cathode Lead at 0.79mm (0.031 in.) From Body
V_F	Forward Voltage		2.2	3.0		2.2	3.0		2.4	3.0	V	$I_F=10\text{mA}$ (Figs. 2,7,12) at $I_F=20\text{mA}$
BV_R	Reverse Breakdown Voltage	5.0			5.0			5.0			V	$I_R=100\mu\text{A}$
η_v	Luminous Efficacy		147			570			665		lm/W	Note 3

1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e=I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

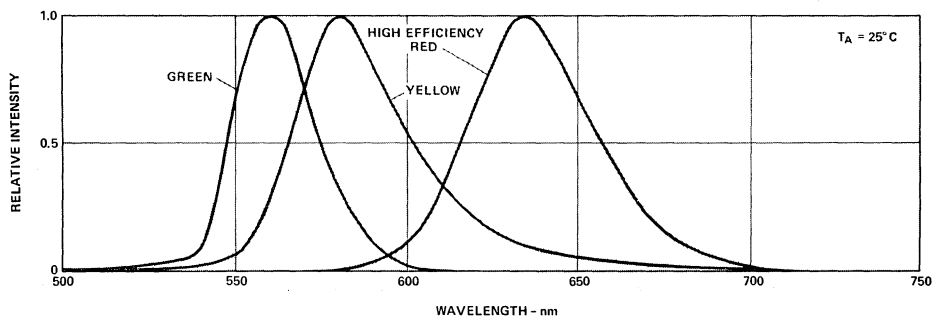


Figure 1. Relative Intensity vs. Wavelength.

High Efficiency Red HLMP-1300, -1301(5082-4684), -1302

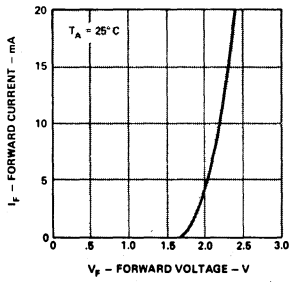


Figure 2. Forward Current vs. Forward Voltage.

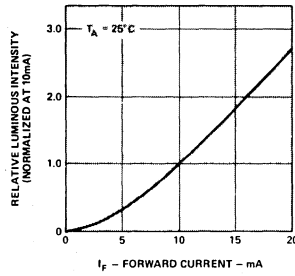


Figure 3. Relative Luminous Intensity vs. Forward Current.

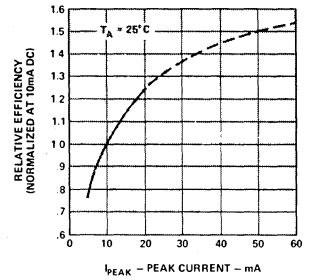


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

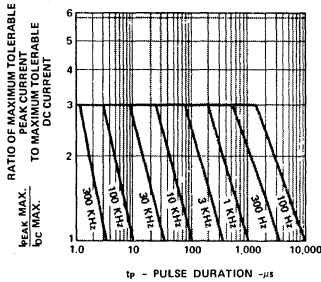


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DCMAX} as per MAX Ratings).

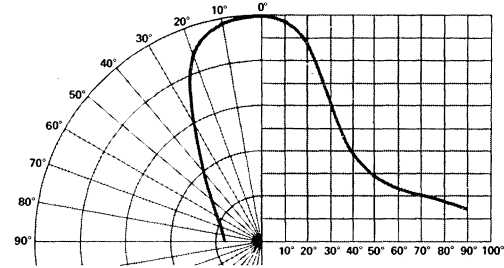


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

Yellow HLMP-1400, -1401(5082-4584), -1402

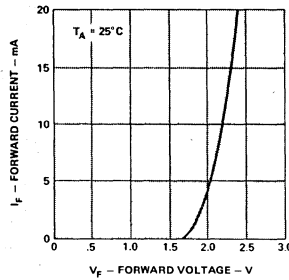


Figure 7. Forward Current vs. Forward Voltage.

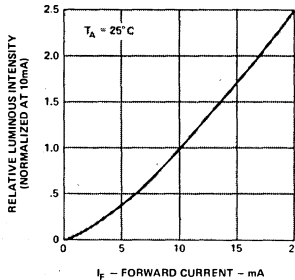


Figure 8. Relative Luminous Intensity vs. Forward Current.

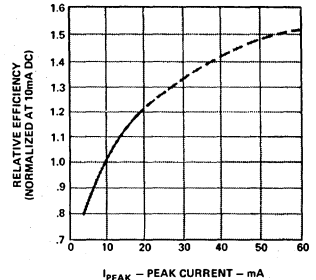


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

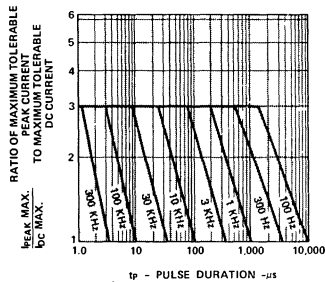


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DCMAX} as per MAX Ratings.)

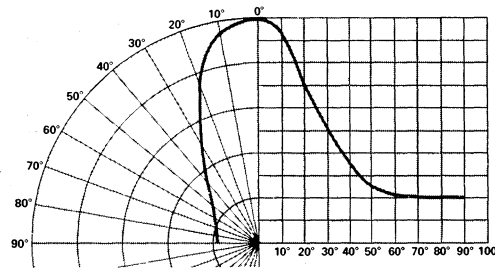


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Green HLMP-1500,-1501(5082-4984),-1502

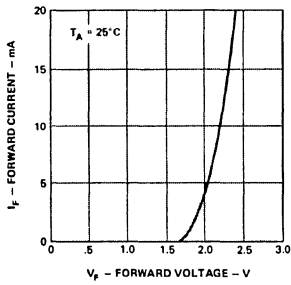


Figure 12. Forward Current vs. Forward Voltage.

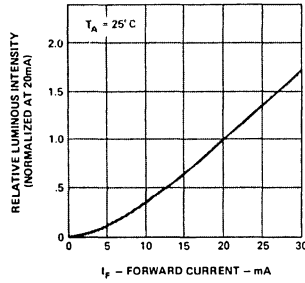


Figure 13. Relative Luminous Intensity vs. Forward Current.

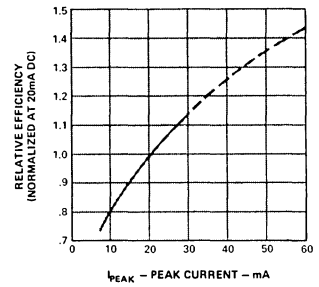


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

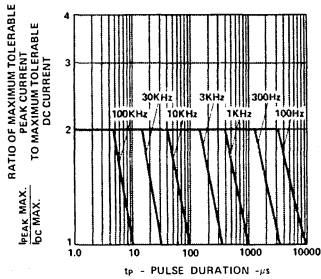


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. ($I_{DC\ MAX}$ as per MAX Ratings.)

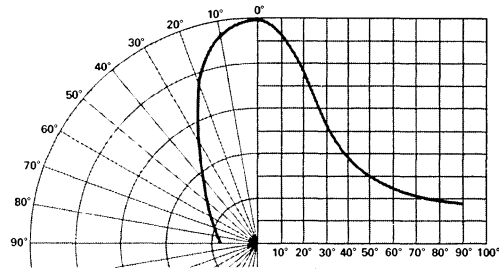
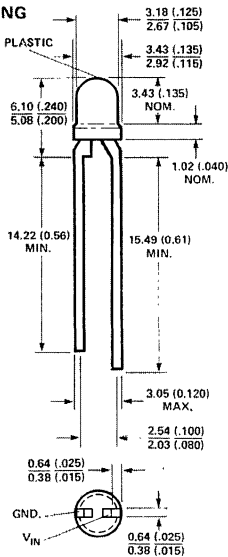


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

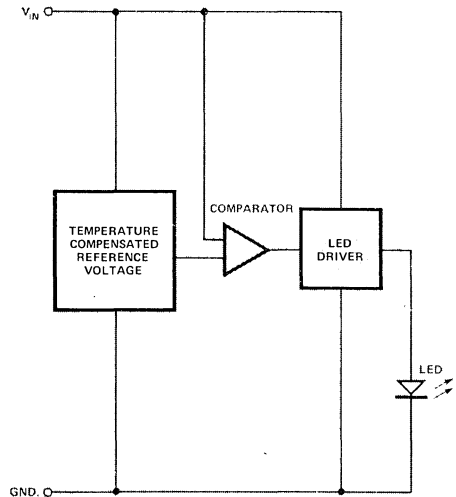
OUTLINE DRAWING



ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).

NOTE: AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (0.040") DOWN THE LEADS.

BLOCK DIAGRAM



Features

- **HIGH SENSITIVITY: 10mV ON TO OFF**
- **BUILT IN LED CURRENT LIMITING**
- **TEMPERATURE COMPENSATED THRESHOLD VOLTAGE**
- **COMPACT: PACKAGE INCLUDES INTEGRATED CIRCUIT AND LED**
- **GUARANTEED MINIMUM LUMINOUS INTENSITY**
- **THRESHOLD VOLTAGE CAN BE INCREASED WITH EXTERNAL COMPONENT**

Applications

- Push-to-test battery voltage tester (paggers, cameras, appliances, radios, test equipment. . .)
- Logic level indicator
- Power supply voltage monitor
- V-U meter
- Analog level sense
- Voltage indicating arrays — use several with different thresholds
- Current monitor

Description

The HP voltage sensing LEDs use an integrated circuit and a red GaAsP LED to provide a complete voltage sensing function in a standard red diffused T-1 LED package. When the input voltage (V_{IN}) exceeds the threshold voltage (V_{TH}) the LED turns "on". The high gain of the comparator provides unambiguous indication by the LED of the input voltage with respect to the threshold voltage. The V-I characteristics are resistive above and below the threshold voltage. This allows battery testing under simulated load conditions. Use of a resistor, diode or zener in series allows the threshold voltage to be increased to any desired voltage. A resistor in parallel allows the sensing LED to be used as a current threshold indicator.

The 5082-4732 has a nominal threshold voltage of 2.7V.

Absolute Maximum Ratings

Storage Temperature	-55°C to +100°C
Operating Temperature.	-55°C to +85°C
Lead Solder Temperature	230°C for 7 Sec
Input Voltage — V_{IN} [1]	+5V dc
Reverse Input Voltage — V_R	-0.5V

NOTES:

1. Derate linearly above 50°C free-air temperature at a rate of 37mV/°C.

Electro-Optical Characteristics at $T_A = 25^\circ\text{C}$

Parameter	Sym.	5082-4732			Units	Test Conditions	Fig.
		Min.	Typ.	Max.			
Threshold Voltage	V_{TH}	2.5	2.7	2.9	V		1,2
Temperature Coefficient of Threshold	$\frac{\Delta V_{TH}}{\Delta T_A}$		-1		$\text{mV}/^\circ\text{C}$		
Input Current	I_{IN}		13	50	mA	$V_{IN} = 2.75\text{V}$	2
			33		mA	$V_{IN} = 5.0\text{V}$	2
Luminous Intensity	I_V	0.3	0.7		mcd	$V_{IN} = 2.75\text{V}$	1
Wavelength	λ_{PEAK}		655		nm	Measurement at peak	
Dominant Wavelength	λ_d		639		nm	Note 1	

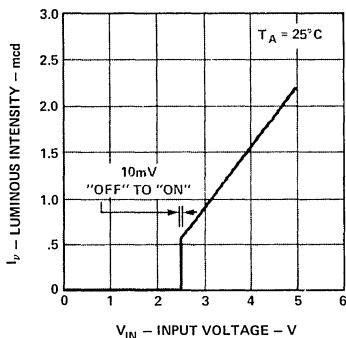


Figure 1. Luminous Intensity vs. Input Voltage.

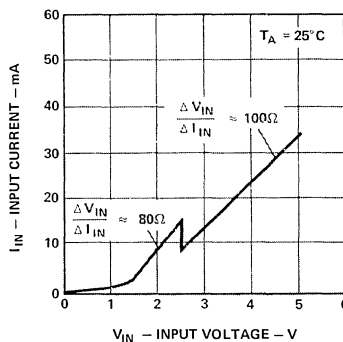


Figure 2. Input Current vs. Input Voltage.

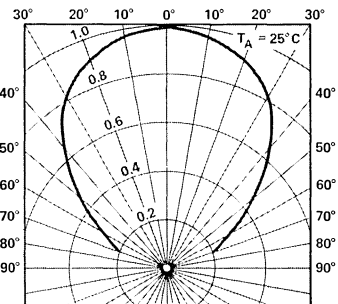
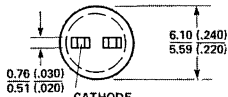
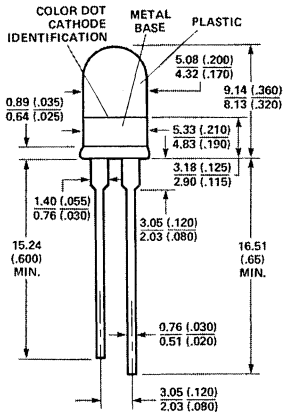


Figure 3. Relative Luminous Intensity vs. Angular Displacement.

Techniques For Increasing The Threshold Voltage

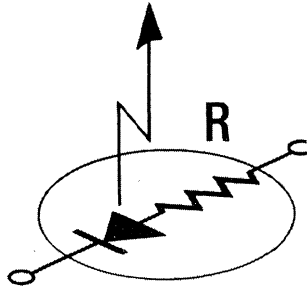
	External Component	V'_{TH}	$TC = \frac{\Delta V'_{TH}}{\Delta T_A}$ ($\text{mV}/^\circ\text{C}$)
		 Schottky Diode (HP 5082-2835)	$V_{TH} + 0.45\text{V}$	-2
 P-N Diode (1N914)		$V_{TH} + 0.75\text{V}$	-2.5
 LED (HP 5082-4484)		$V_{TH} + 1.6\text{V}$	-2.9
 Zener Diode		$V_{TH} + V_Z$	$-1 + \text{Zener TC}$

- Notes:
1. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
 2. I_{TH} is the maximum current just below the threshold, V_{TH} . Since both I_{TH} and V_{TH} are variable, a precise value of V_{TH} is obtainable only by selecting R to fit the measured characteristics of the individual devices (e.g., with curve tracer).
 3. The temperature coefficient (TC) will be a function of the resistor TC and the value of the resistor.

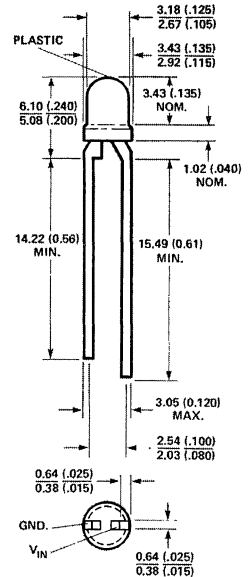


5082-4860

NOTE: AN EPOXY MINISCUS MAY EXTEND ABOUT 1mm (0.040") DOWN THE LEADS.



DIMENSIONS IN MILLIMETRES AND (INCHES)



5082-4468

Features

- **TTL COMPATIBLE: 16mA @ 5 VOLTS TYPICAL**
- **INTEGRAL CURRENT LIMITING RESISTOR**
- **T-1 DIAMETER PACKAGE, 3.18mm (.125 in.)**
T-1¼ DIAMETER PACKAGE, 5.08mm (.200 in.)
- **RUGGED AND RELIABLE**

Description

The HP Resistor-LED series provides an integral current limiting resistor in series with the LED. Applications include panel mounted indicators, cartridge indicators, and lighted switches.

The 5082-4860 is a standard red diffused 5.08mm (.200") diameter (T-1¼ size) LED, with long wire wrap-able leads.

The 5082-4468 is a clear diffused 3.18mm (.125") diameter (T-1 size) LED.

Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

DC Forward Voltage [Derate linearly to 5V @ 100°C]	7.5V
Reverse Voltage	7V
Isolation Voltage [between lead and base of the 5082-4860]	300V
Operating and Storage Temperature Range	-55°C to +100°C
Lead Soldering Temperature	230°C for 7 sec.

Electrical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Parameters	5082-4860/-4468			Units	Test Conditions
		Min.	Typ.	Max.		
I_V	Luminous Intensity	0.3	0.8		mcd	$V_F = 5.0\text{V}$
λ_{PEAK}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		15		ns	
I_F	Forward Current		16	20	mA	$V_F = 5.0\text{V}$
BV_R	Reverse Breakdown Voltage	3			V	$I_R = 100\mu\text{A}$

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT

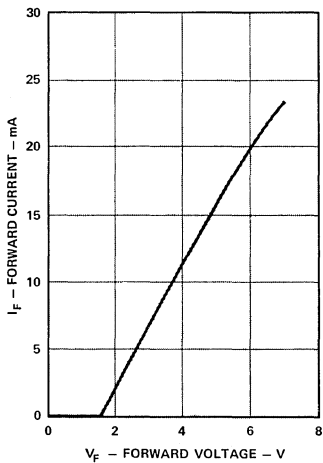
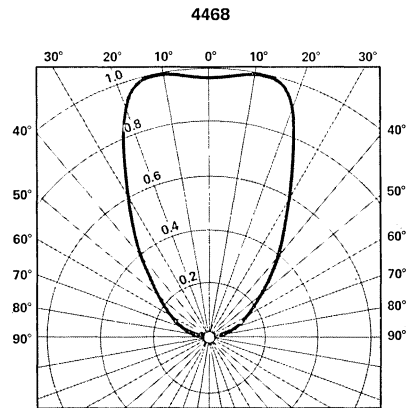
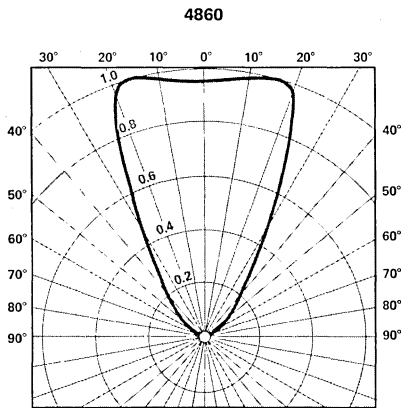


Figure 1. Typical DC Forward Current – Voltage Characteristic

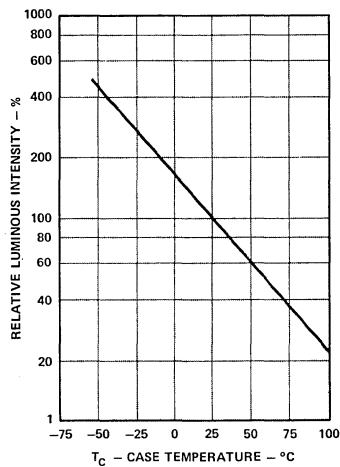


Figure 2. Relative Luminosity vs. Case Temperature

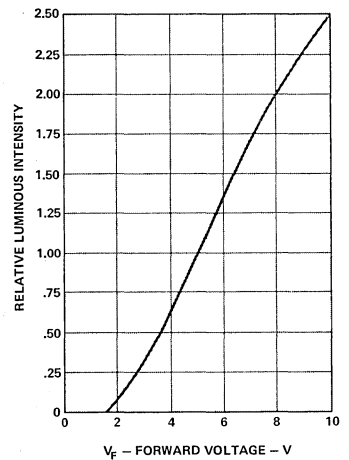


Figure 3. Relative Luminous Intensity vs. Voltage

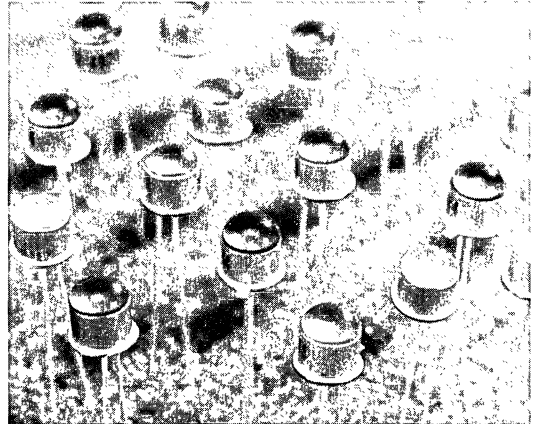
HERMETIC SOLID STATE LAMPS

TO-46		PANEL MOUNT
1N6092	(5082-4620)	5082-4687
1N6093	(5082-4520)	5082-4587
1N6094	(5082-4920)	5082-4987
1N5765	(5082-4420)	5082-4787
JAN 1N5765/1N6092/1N6093/1N6094		
JAN TX 1N5765/1N6092/1N6093/1N6094		

TECHNICAL DATA APRIL 1978

Features

- **CHOICE OF 4 COLORS**
 - Red
 - High Efficiency Red
 - Yellow
 - Green
- **DESIGNED FOR HIGH-RELIABILITY APPLICATIONS**
- **HERMETICALLY SEALED**
- **WIDE VIEWING ANGLE**
- **LOW POWER OPERATION**
- **IC COMPATIBLE**
- **LONG LIFE**
- **PANEL MOUNT OPTION HAS WIRE WRAPPABLE LEADS AND AN ELECTRICALLY ISOLATED CASE**



TO-46

Description

The 1N5765, 1N6092, 1N6093, and 1N6094 are hermetically sealed solid state lamps encapsulated in a TO-46 package with a tinted diffused plastic lens over a glass window. These hermetic lamps provide good on-off contrast, high axial luminous intensity and a wide viewing angle.

The 5082-4787, 4687, 4587 and 4987 are hermetically sealed solid state lamps encapsulated in a panel mountable fixture. The semiconductor chips are packaged in a hermetically sealed TO-46 package with a tinted diffused plastic lens over glass window. This TO-46 package is then encapsulated in a panel mountable fixture designed for high reliability applications. The encapsulated LED lamp assembly provides a high on-off contrast, a high axial luminous intensity and a wide viewing angle.

The 1N5765 and 5082-4787 utilize a GaAsP LED chip with a red diffused plastic lens over glass window.

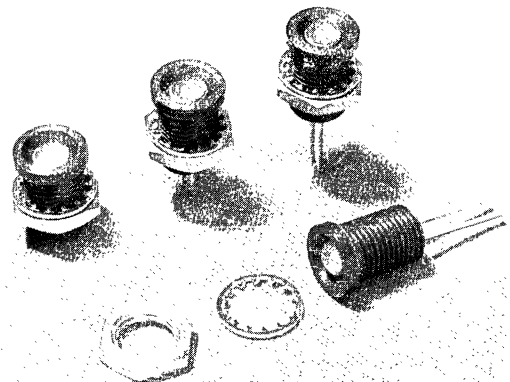
The 1N6092 and 5082-4687 have a high efficiency red GaAsP on GaP LED chip with a red diffused plastic lens over glass window. This lamp's efficiency is comparable to that of a GaP red but extends to higher current levels.

The 1N6093 and 5082-4587 provide a yellow GaAsP on GaP LED chip with a yellow diffused plastic lens over glass window.

The 1N6094 and 5082-4987 provide a green GaP LED chip with a green diffused plastic lens over glass window.

COLOR CODE IDENTIFICATION

RED	1N5765, 5082-4787
HIGH EFFICIENCY RED	1N6092, 5082-4687
YELLOW	1N6093, 5082-4587
GREEN	1N6094, 5082-4987



HERMETIC PANEL MOUNT

JAN 1N5765: Samples of each lot are subjected to Group A inspection for parameters listed in Table I, and to Group B and Group C tests listed below. All tests are to the conditions and limits specified by MIL-S-19500/467. A summary of the data gathered in Groups A, B, and C lot acceptance testing is supplied with each shipment.

JAN TX 1N5765: Devices undergo 100% screening tests as listed below to the conditions and limits specified by MIL-S-19500/467. The JAN TX lot is then subjected to Group A, Group B and Group C tests as for the JAN 1N5765 above. A summary of the data gathered in Groups A, B and C acceptance testing can be provided upon request. Serialized data can be gathered, but lead times will be increased accordingly.

Group B Sample Acceptance Tests	Method MIL-STD-750	Group C Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066	Low Temp Operation (-55°C)	
Solderability	2026	Breakdown Voltage	4021
Thermal Shock	1056A	Temperature Cycling	1051A
Temperature Cycling	1051A	Resistance to Solvents	*
Fine Leak Test	1071H	Temp. Storage (100°C, 1K hours)	1031
Gross Leak Test	1071C	Operating Life (50mAdc, 1K hours)	1026
Moisture Resistance	1021	Peak Forward Pulse Current	
Mechanical Shock	2016	TX Screening (100%)	
Vibration	2056	Temp. Storage (100°C, 72 hours)	
Constant Acceleration	2006	Temperature Cycling	1051A
Terminal Strength	2036E	Constant Acceleration	2006
Salt Atmosphere	1041	Fine Leak Test	1071H
Temp. Storage (100°C, 340 hours)	1032	Gross Leak Test	1071C
Operating Life (50mAdc, 340 hours)	1027	Burn-in (50mAdc, 168 hours)	
		Evaluation of Drift (I_{V1} , V_F , I_R)	

*MIL-STD-202 Method 215

Electrical / Optical Characteristics at $T_A = 25^\circ\text{C}$

(Per Table I, Group A Testing of MIL-S 19500/467)

Specification	Symbol	Min.	Max.	Units	Test Conditions
Luminous Intensity (Axial)	I_{V1}	0.5	3.0	mcd	$I_F = 20\text{mAdc}$, $\theta = 0^\circ$
Luminous Intensity (off Axis)	I_{V2}	0.3		mcd	$I_F = 20\text{mAdc}$, $\theta = 30^\circ$ [see Note 2]
Wavelength	λ_V	630	700	nM	Design Parameter
Capacitance	C		300	pF	$V_R = 0$, $f = 1\text{MHz}$
Forward Voltage	V_F		2.0	Vdc	$I_F = 20\text{mAdc}$
Reverse Current	I_R		1	μAdc	$V_R = 3\text{Vdc}$ [see Note 2]

NOTES:

- Derate 0.67 mAdc/°C for T_A above 25°C.
- These specifications apply only to JAN/JAN TX levels.

Absolute Maximum Ratings at $T_A=25^\circ\text{C}$

Parameter	Red 1N5765/4787	High Eff. Red 1N6092/4687	Yellow 1N6093/4587	Green 1N6094/4987	Units
Power Dissipation (derate linearly from 50°C at $1.6\text{mW}/^\circ\text{C}$)	100	120	120	120	mW
Average Forward Current	50 ^[1]	35 ^[2]	35 ^[2]	35 ^[2]	mA
Peak Forward Current	1000 See Fig. 5	60 See Fig. 10	60 See Fig. 15	60 See Fig. 20	mA
Operating and Storage Temperature Range	-65°C to 100°C				
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	260°C for 7 seconds.				

- Derate from 50°C at $0.2\text{mA}/^\circ\text{C}$
- Derate from 50°C at $0.5\text{mA}/^\circ\text{C}$

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

Symbol	Description	1N5765/5082-4787			1N6092/5082-4687			1N6093/5082-4587			1N6094/5082-4987			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Axial Luminous Intensity	0.5	1.0		1.0	2.5		1.0	2.5		0.8	1.6		mcd	$I_F = 20\text{mA}$ Figs. 3, 8, 13, 18
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		60			70			70			70		deg.	Note 1. Figures 6, 11, 16, 21
λ_{PEAK}	Peak Wavelength		655			635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		640			626			585			570		nm	Note 2
τ_S	Speed of Response		10			200			200			200		ns	
C	Capacitance		200			35			35			35		pF	$V_i=0$; $f=1\text{MHz}$
θ_{JC}	Thermal Resistance*		425			425			425			425		$^\circ\text{C}/\text{W}$	Note 3
θ_{JC}	Thermal Resistance**		550			550			550			550		$^\circ\text{C}/\text{W}$	Note 3
V_F	Forward Voltage		1.6	2.0		2.0	3.0		2.0	3.0		2.1	3.0	V	$I_F = 20\text{mA}$ Figures 2, 7, 12, 17
BV_R	Reverse Breakdown Voltage	4	5		5.0			5.0			5.0			V	$I_R = 100\mu\text{A}$
η_v	Luminous Efficacy		56			140			455			600		lm/W	Note 4

NOTES:

- $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
- Junction to Cathode Lead with 3.18mm (0.125 inch) of leads exposed between base of flange and heat sink.
- Radiant intensity, I_e , in watts/steradian, may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

*Panel mount.

**T0-46

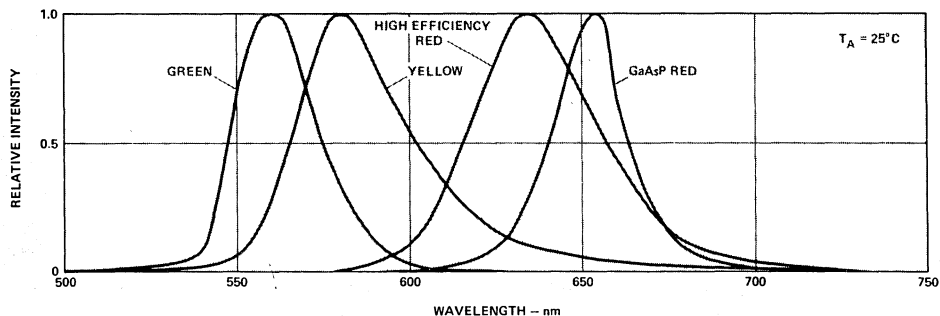
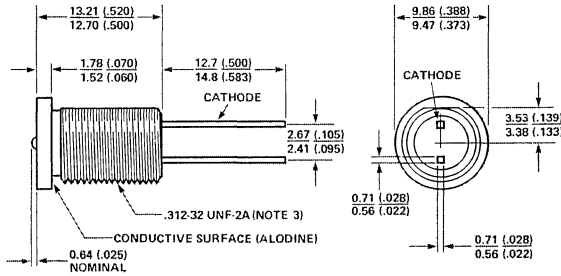


Figure 1. Relative Intensity vs. Wavelength.

Package Dimensions

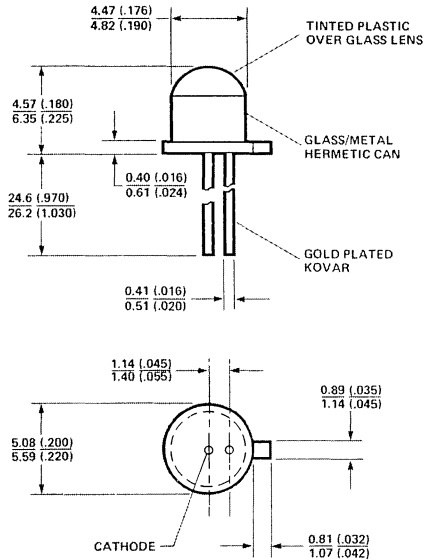
1N5765, 1N6092, 1N6093, 1N6094

5082-4787, 4687, 4587, 4987



NOTES:

1. ALL EXTERNAL METAL SURFACES OF THE PACKAGE ARE BLACK ANODIZED EXCEPT FOR THE ALODINE AREA OF THE FLANGE AND THE GOLD PLATED LEADS.
2. MOUNTING HARDWARE WHICH INCLUDES ONE LOCK WASHER AND ONE HEX-NUT IS INCLUDED WITH EACH PANEL MOUNTABLE HERMETIC SOLID STATE LAMP.
3. USE OF METRIC DRILL SIZE 8.20 MILLIMETRES OR ENGLISH DRILL SIZE P (0.323 INCH) IS RECOMMENDED FOR PRODUCING HOLE IN THE PANEL FOR PANEL MOUNTING.
4. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).



OUTLINE TO-46

- NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
 2. GOLD-PLATED LEADS.

RED 1N5765/5082-4787

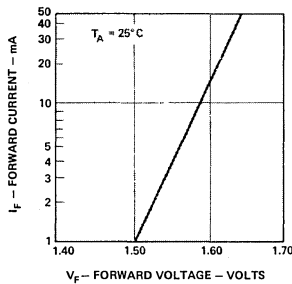


Figure 2. Forward Current vs. Forward Voltage.

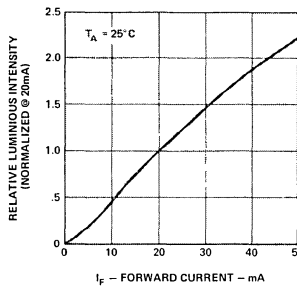


Figure 3. Relative Luminous Intensity vs. Forward Current.

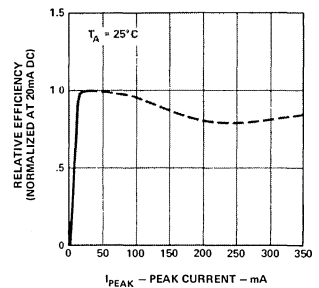


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

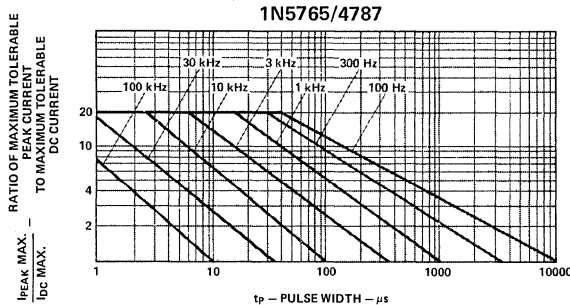


Figure 5. Maximum Tolerable Pulse Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

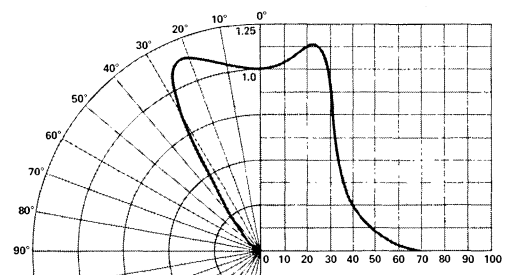


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

HIGH EFFICIENCY RED 1N6092 / 5082-4687

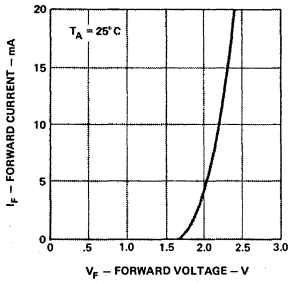


Figure 7. Forward Current vs. Forward Voltage.

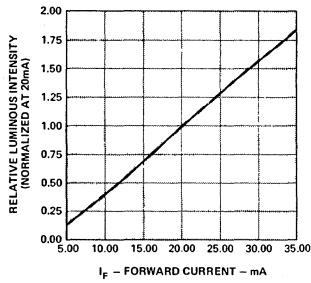


Figure 8. Relative Luminous Intensity vs. Forward Current.

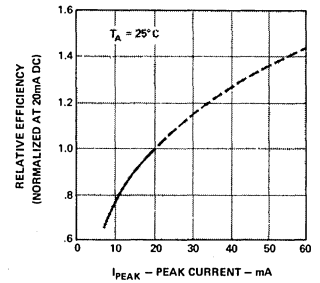


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

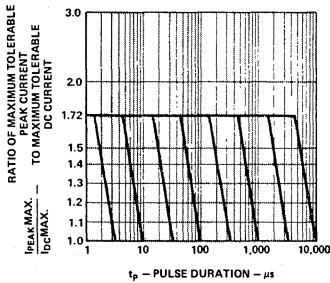


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. ($I_{DC\ MAX}$ as per MAX Ratings)

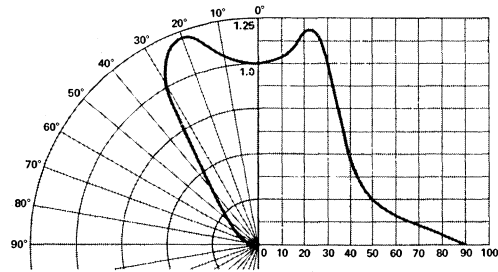


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

YELLOW 1N6093 / 5082-4587

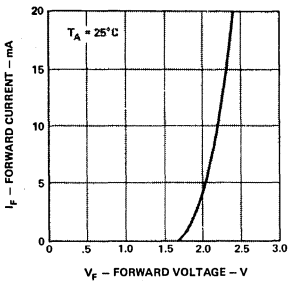


Figure 12. Forward Current vs. Forward Voltage.

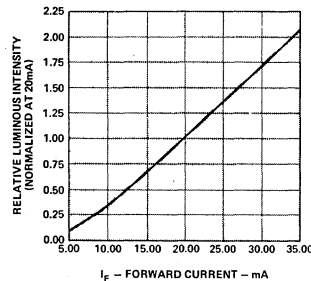


Figure 13. Relative Luminous Intensity vs. Forward Current.

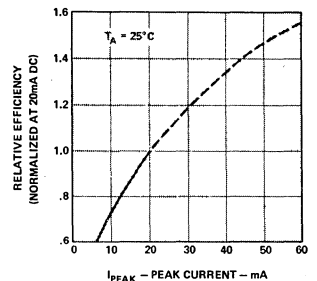


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

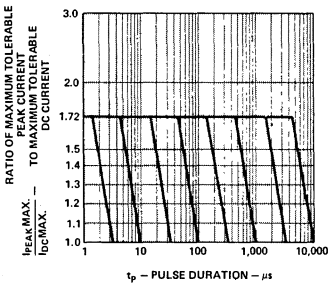


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. ($I_{DC\ MAX}$ as per MAX Ratings)

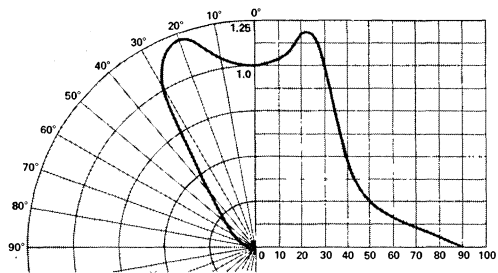


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

GREEN 1N6094/5082-4987

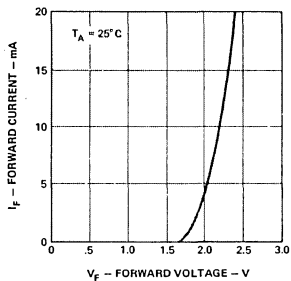


Figure 17. Forward Current vs. Forward Voltage.

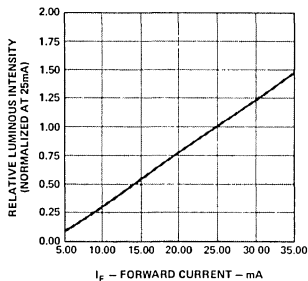


Figure 18. Relative Luminous Intensity vs. Forward Current.

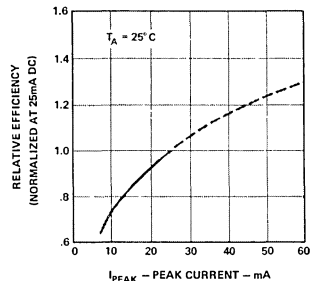


Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

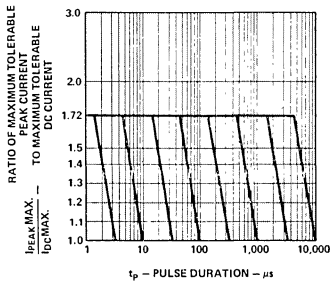


Figure 20. Maximum Tolerable Peak Current vs. Pulse Duration. ($I_{DC\ MAX}$ as per MAX Ratings)

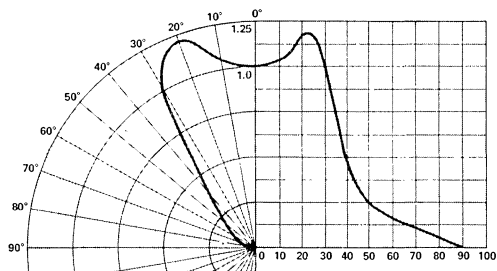


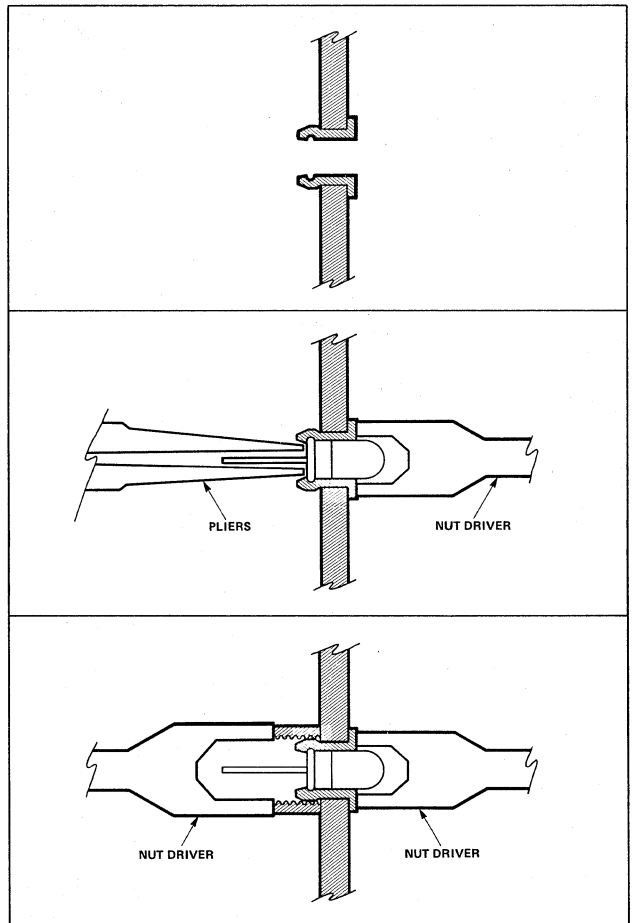
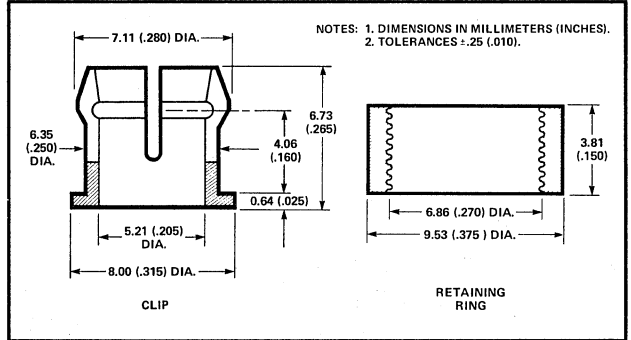
Figure 21. Relative Luminous Intensity vs. Angular Displacement.

Description

The 5082-4707 is a black plastic mounting clip and retaining ring. It is designed to panel mount Hewlett Packard Solid State T-1½ size lamps. This clip and ring combination is intended for installation in instrument panels up to 3.18mm (.125") thick. For panels greater than 3.18mm (.125"), counterboring is required to the 3.18mm (.125") thickness.

Mounting Instructions




1. Drill a 6.35mm (.250") dia. hole in the panel. Deburr but do not chamfer the edges of the hole.
2. Press the panel clip into the hole from the front of the panel.
3. Press the LED into the clip from the back. Use blunt long nose pliers to push on the LED. Do not use force on the LED leads. A tool such as a nut driver may be used to press on the clip.
4. Slip a plastic retaining ring onto the back of the clip and press tight using tools such as two nut drivers.


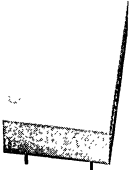
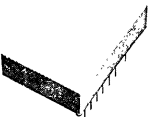


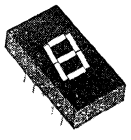
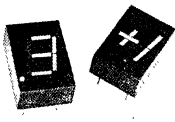
Solid State Displays

- Selection Guide 52
- Red, High Efficiency Red, Yellow and Green Seven Segment Displays
 - Red Seven Segment Displays
 - Integrated Displays
 - Hermetically Sealed Integrated Displays
 - Alphanumeric Displays
 - Chips



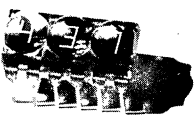
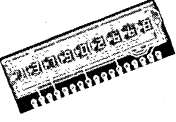
Red, High Efficiency Red, Yellow and Green Seven Segment LED Displays

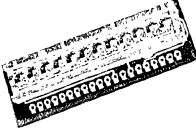
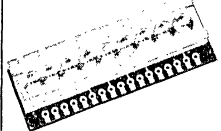

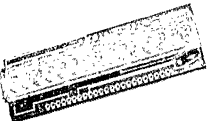
Device	Description	Package	Application	Page No.	
	5082-7610	7.62mm (.3") High Efficiency Red, Common Anode, LHDP	General Purpose Market • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments • Automobiles For further information ask for Application Note 941 and 964; Application Bulletins 1 through 4. (See page 218)	69	
	5082-7611	7.62mm (.3") High Efficiency Red, Common Anode, RHDP			
	5082-7613	7.62mm (.3") High Efficiency Red, Common Cathode, RHDP			
	5082-7616	7.62mm (.3") High Efficiency Red, Universal Polarity Overflow Indicator RHDP			14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D
	5082-7620	7.62mm (.3") Yellow, Common Anode LHDP			
	5082-7621	7.62mm (.3") Yellow, Common Anode RHDP			
	5082-7623	7.62mm (.3") Yellow, Common Cathode, RHDP			(Same as 5082-7613)
	5082-7626	7.62mm (.3") Yellow, Universal Polarity & Overflow Indicator RHDP			14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D
	5082-7630	7.62mm (.3") Green, Common Anode LHDP			
	5082-7631	7.62mm (.3") Green, Common Anode RHDP			
	5082-7633	7.62mm (.3") Green, Common Cathode RHDP			(Same as 5082-7613)
	5082-7636	7.62mm (.3") Green, Universal Polarity & Overflow Indicator RHDP			14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D
	HDSP-3530	7.62mm (.3") High Efficiency Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D 10 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D 14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D	63	
	HDSP-3531	7.62mm (.3") High Efficiency Red, Common Anode, RHDP			
	HDSP-3533	7.62mm (.3") High Efficiency Red, Common Cathode RHDP			
	HDSP-3536	7.62mm (.3") High Efficiency Red, Universal Polarity Overflow Indicator RHDP			
	HDSP-4030	7.62mm (.3") Yellow, Common Anode, LHDP			
	HDSP-4031	7.62mm (.3") Yellow, Common Anode, RHDP			
	HDSP-4033	7.62mm (.3") Yellow, Common Cathode, RHDP			
	HDSP-4036	7.62mm (.3") Yellow, Universal Polarity Overflow Indicator RHDP			
	5082-7650	10.92mm (.43") High Efficiency Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .5"W x .25"D	74	
	5082-7651	10.92mm (.43") High Efficiency Red, Common Anode, RHDP			

Device	Description	Package	Application	Page No.
	5082-7653	10.92mm (.43") High Efficiency Red, Common Cathode RHDP	General Purpose Market <ul style="list-style-type: none"> • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments • Automobiles For further information ask for Application Note 941 and 964; Application Bulletins 1 through 4. (See page 218)	74
	5082-7656	10.92mm (.43") High Efficiency Red Universal Polarity & Overflow Indicator RHDP		
	5082-7660	10.92mm(.43") Yellow Common Anode LHDP		
	5082-7661	10.92mm(.43") Yellow Common Anode RHDP		
	5082-7663	10.92mm(.43") Yellow Common Cathode RHDP		
	5082-7666	10.92mm(.43") Yellow Universal Polarity & Overflow Indicator RHDP		
	5082-7670	10.92mm(.43") Green Common Anode LHDP		
	5082-7671	10.92mm(.43") Green Common Anode RHDP		
	5082-7673	10.92mm(.43") Green Common Cathode RHDP		
5082-7676	10.92mm(.43") Green Universal Polarity & Overflow Indicator RHDP			
	HDSP-3730	10.92mm (.43") High Efficiency Red, Common Anode, LHDP		63
	HDSP-3731	10.92mm (.43") High Efficiency Red, Common Anode, RHDP		
	HDSP-3733	10.92mm (.43") High Efficiency Red, Common Cathode, RHDP		
	HDSP-3736	10.92mm (.43") High Efficiency Red, Universal Polarity Overflow Indicator RHDP		
	HDSP-4130	10.92mm (.43") Yellow, Common Anode LHDP		
	HDSP-4131	10.92mm (.43") Yellow, Common Anode RHDP		
	HDSP-4133	10.92mm (.43") Yellow, Common Cathode RHDP		
	HDSP-4136	10.92mm (.43") Yellow, Universal Polarity Overflow Indicator RHDP		
	HDSP-3400	20.32mm (.8") Red, Common Anode LHDP	General Purpose Market <ul style="list-style-type: none"> • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments For further information ask for Application Note 941 and 964; Application Bulletins 1 through 4. (See page 218)	59
	HDSP-3401	20.32mm (.8") Red, Common Anode RHDP		
	HDSP-3403	20.32mm (.8") Red, Common Cathode RHDP		
	HDSP-3405	20.32mm (.8") Red, Common Cathode LHDP		
	HDSP-3406	20.32mm (.8") Red, Universal Polarity Overflow Indicator RHDP		




Device		Description	Package	Application	Page No.	
	5082-7730	7.62mm(.3") Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm(.3") DIP .75"H x .4"W x .18"D	General Purpose Market <ul style="list-style-type: none"> • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments • Automobiles For further information ask for Application Note 941 and 964; Application Bulletins 1 through 4. (See page 218)	79	
	5082-7731	7.62mm(.3") Red, Common Anode, RHDP				
	5082-7736	7.62mm(.3") Red, Common Anode, Polarity & Overflow Indicator				
	5082-7740	7.62mm(.3") Red, Common Cathode, RHDP	10 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D			
	5082-7750	10.92mm(.43") Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .5"W x .25"D			83
	5082-7751	10.92mm(.43") Red, Common Anode, RHDP				
	5082-7756	10.92mm(.43") Red, Universal Polarity & Overflow Indicator, RHDP				
	5082-7760	10.92mm(.43") Red, Common Cathode, RHDP				

Red Seven Segment LED Displays



Device		Description	Package	Application	Page No.		
	5082-7402	2.79mm(.11") Red, 3 Digits Right, ^[1] Centered D.P.	12 Pin Epoxy, 7.62mm (.3") DIP	Small Display Market <ul style="list-style-type: none"> • Portable/Battery Power Instruments • Portable Calculators • Digital Counters • Digital Thermometers • Digital Micrometers • Stopwatches • Cameras • Copiers • Digital Telephone Peripherals • Data Entry Terminals • Taxi Meters For further information ask for Application Note 937. (See page 218)	87		
	5082-7403	2.79mm(.11") Red, 3 Digits Left, ^[1] Centered D.P.					
	5082-7404	2.79mm(.11") Red, 4 Digits Centered D.P.					
	5082-7405	2.79mm(.11") Red, 5 Digits, Centered D.P.	14 Pin Epoxy, 7.62mm (.3") DIP				
	5082-7412	2.79mm (.11") Red, 3 Digits Right, ^[1] RHDP	12 Pin Epoxy, 7.62mm (.3") DIP				
	5082-7413	2.79mm (.11") Red, 3 Digits Left, ^[1] RHDP					
	5082-7414	2.79mm(.11") Red, 4 Digit, RHDP					
	5082-7415	2.79mm(.11") Red, 5 Digit, RHDP	14 Pin Epoxy, 7.62mm (.3") DIP				
	5082-7432	2.79mm (.11") Red, 2 Digits Right, ^[2] RHDP	12 Pin Epoxy, 7.62mm (.3") DIP			91	
	5082-7433	2.79mm (.11") Red, 3 Digits, RHDP					
	5082-7440	2.67mm(.105") Red, 8 Digits, Mounted on P.C. Board	50.8mm(2") P.C. Bd., 17 Term. Edge Con.				95
	5082-7448	2.67mm(.105") Red, 8 Digits, Mounted on P.C. Board	60.3mm(2.375")PC Bd., 17 Term. Edge Con.				
	5082-7441	2.67mm(.105") Red, 9 Digits, Mounted on P.C. Board	50.8mm(2") PC Bd., 17 Term. Edge Con.				
	5082-7449	2.67mm(.105") Red, 9 Digits, Mounted on P.C. Board	60.3mm(2.375")PC Bd., 17 Term. Edge Con.				

Device	Description	Package	Application	Page No.	
	5082-7442	2.54mm(.100") Red, 12 Digits, Mounted on P.C. Board	60.3mm(2.375")PC Bd., 20 Term. Edge Con.	Small Display Market <ul style="list-style-type: none"> • Portable/Battery Power Instruments • Portable Calculators • Digital Counters • Digital Thermometers • Digital Micrometers • Stopwatches • Cameras • Copiers • Digital Telephone Peripherals • Data Entry Terminals • Taxi Meters 	99
	5082-7445	2.54mm(.100") Red, 12 Digits, Mounted on P.C. Board	59.6mm(2.345")PC Bd., 20 Term. Edge Con.		
	5082-7444	2.54mm(.100") Red, 14 Digits, Mounted on P.C. Board	60.3mm(2.375") PC Bd., 22 Term. Edge Con.		
	5082-7446	2.92mm(.115") Red, 16 Digits, Mounted on P.C. Board	69.85mm(2.750")PC Bd., 24 Term. Edge Con.		
	5082-7447	2.85mm(.112") Red, 14 Digits, Mounted on P.C. Board	60.3mm(2.375") PC Bd., 22 Term. Edge Con.		
	5082-7240	2.59mm(.102") Red, 8 Digits, Mounted on P.C. Board	50.8mm (2") PC Bd., 17 Term. Edge Con.	For further information ask for Application Note 937. (See page 218)	103
	5082-7241	2.59mm(.102") Red, 9 Digits, Mounted on P.C. Board.			
	5082-7265	4.45mm(.175") Red, 5 Digits, Mounted on P.C. Board. Centered D.P.	50.8mm(2") PC Bd., 15 Term. Edge Con.		
	5082-7285	4.45mm(.175") Red, 5 Digits Mounted on P.C. Board. RHDP			
	5082-7275	4.45mm(.175") Red, 15 Digits, Mounted on P.C. Board. Centered D.P.	91.2mm(3.59") PC Bd., 23 Term. Edge Con.		
	5082-7295	4.45mm(.175") Red, 15 Digits, Mounted on P.C. Board. RHDP			


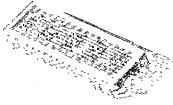
Integrated LED Displays

Device	Description	Package	Application	Page No.	
 	5082-7300	8 Pin Epoxy, 15.2mm (.6") DIP	General Purpose Market <ul style="list-style-type: none"> • Test Equipment • Business Machines • Computer Peripherals • Avionics For further information ask for Application Note 934 on LED Display Installation Techniques	111	
	5082-7302				7.4mm (.29") 4x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver/Memory
	5082-7340				7.4mm (.29") 4x7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory
	5082-7304				7.4mm (.29") Overage Character Plus/Minus Sign
	5082-7356	8 Pin Glass Ceramic 15.2mm (.6") DIP	<ul style="list-style-type: none"> • Medical Equipment • Industrial and Process Control Equipment • Computers • Where Ceramic Package IC's are required. 	115	
	5082-7357				7.4mm(.29") 4x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver/Memory
	5082-7359				7.4mm (.29") 4x7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory
	5082-7358				7.4mm(.29") Overage Character Plus/Minus Sign

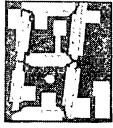




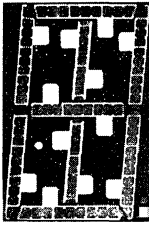
Hermetically Sealed Integrated LED Displays

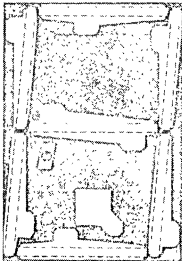
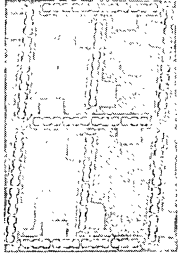


Device		Description	Package	Application	Page No.
	5082-7010	6.8mm (.27") 5x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver	8 Pin Hermetic 2.54mm (.100") Pin Centers	<ul style="list-style-type: none"> • Ground, Airborne, Shipboard Equipment • Fire Control Systems • Space Flight Systems 	120
	5082-7011	6.8mm (.27") Plus/Minus Sign			
	5082-7391	7.4mm (.29") 4x7 Single Digit Numeric, RHDP, Built-In Decoder/Driver/Memory	8 Pin Hermetic 15.2mm (.6") DIP with Gold Plated Leads	<ul style="list-style-type: none"> • Ground, Airborne, Shipboard Equipment • Fire Control Systems • Space Flight Systems • Other High Reliability Applications (TX Programs available, see page 126) 	126
	5082-7392	7.4mm (.29") 4x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver/Memory			
	5082-7395	7.4mm (.29") 4x7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory			
	5082-7393	7.4mm (.29") Overage Character Plus/Minus Sign			

Alphanumeric LED Displays

Device		Description	Package	Application	Page No.
	HDSP-2000	3.8mm (.15") 5x7 Four Character Alphanumeric Built-In Shift Register, Drivers	12 Pin Ceramic 7.62mm (.3") DIP, Redglass Contrast Filter	<ul style="list-style-type: none"> • Programmable Calculators • Computer Terminals • Business Machines • Medical Instruments • Portable, Hand-held or mobile data entry, read-out or communications <p>For further information ask for Application Note 966 and Application Bulletin 51</p>	132
	HDSP-6504	3.8mm (.15") Sixteen Segment Four Character Alphanumeric	26 Pin 15.2mm (.6") DIP	<ul style="list-style-type: none"> • Computer Peripherals and Terminals • Computer Base Emergency Mobile Units • Automotive Instrument Panels • Desk Top Calculators • Hand-held Instruments <p>For further information ask for Application Note 931 and Application Bulletin 53</p>	136
HDSP-6508	3.8mm (.15") Sixteen Segment Eight Character Alphanumeric	22 Pin 15.2mm (.6") DIP			
	5082-7100	7.4mm (.29") 5x7 Three Digit Alphanumeric	22 Pin Hermetic 15.2mm (.6") DIP	<p>General Purpose Market</p> <ul style="list-style-type: none"> • Business Machines • Calculators • Solid State CRT • High Reliability Applications <p>For further information ask for Application Note 931 on Alphanumeric Displays</p>	142
	5082-7101	7.4mm (.29") 5x7 Four Digit Alphanumeric	28 Pin Hermetic 15.2mm (.6") DIP		
	5082-7102	7.4mm (.29") 5x7 Five Digit Alphanumeric	36 Pin Hermetic 15.2mm (.6") DIP		

LED Chips

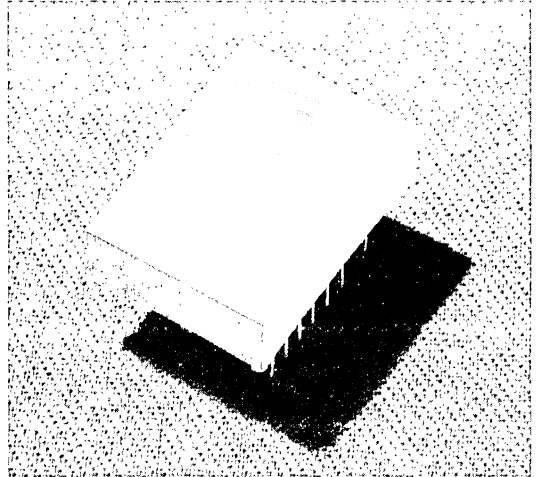
Device	Description	Shipping Carrier	Tilt Angle	Chip Size	Page No.	
	5082-7811	7 Seg. 53 mil Character Height Monolithic LED Chip in Scribed Wafer Form	6° (typical)	1.50x1.35mm (59x53mil)	146	
	5082-7821	7 Seg. 53 mil Character Height Monolithic LED Chip				Waffle Pack
	5082-7832	7 Seg. 80 mil Character Height Monolithic LED Chip in Scribed Wafer Form	5° (typical)	2.24x1.42mm (88x56mil)		
	5082-7842	7 Seg. 80 mil Character Height Monolithic LED Chip				Waffle Pack
	5082-7833	9 Seg. 80 mil Character Height Monolithic LED Chip in Scribed Wafer Form	5°	2.24 x 1.62mm (88 x 64mm)	150	
	5082-7843	9 Seg. 80 mil Character Height Monolithic LED Chip				Waffle Pack
	5082-7837	7 Seg. 88 mil Character Height Monolithic LED Chip in Scribed Wafer Form	5°	2.5 x 1.6mm (98 x 63mil)		
	5082-7847	7 Seg. 88 mil Character Height Monolithic LED Chip				Waffle Pack
	5082-7838	2 Seg. "ONE" 88 mil Character Height Monolithic LED Chip in Scribed Wafer Form	-	2.36 x 0.64mm (93 x 25mil)		
	5082-7848	2 Seg. "ONE" 88 mil Character Height Monolithic LED Chip				Waffle Pack
	5082-7851	7 Seg. 100 mil Character Height Monolithic LED Chip in Scribed Wafer Form	5°	2.27x1.91mm (107x75mil)	146	
	5082-7861	7 Seg. 100 mil Character Height Monolithic LED Chip				Waffle Pack
	5082-7852	9 Seg. 100 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	2.72x1.91mm (107x75mil)	
	5082-7862	9 Seg. 100 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7853	2 Seg. 100 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	2.72x0.89mm (107x35mil)	
	5082-7863	2 Seg. 100 mil Character Height Monolithic LED Chip	Waffle Pack			

Device	Description	Shipping Carrier	Tilt Angle	Chip Size	Page No.	
	5082-7871	7 Seg. 120 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	3.25x2.34mm (128x92mil)	146
	5082-7881	7 Seg. 120 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7872	9 Seg. 120 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	5°	3.25 x 2.34mm (128 x 92mil)	150
	5082-7882	9 Seg. 120 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7856	Dash Colon Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	5°	0.18 x 0.18mm (7 x 7mil)	
	5082-7866	Dash Colon Monolithic LED Chip	Waffle Pack			
	5082-7892	11 mil Discrete LED	Waffle Pack		0.38x0.38mm (15x15mil)	146
	5082-7893	11 mil Discrete LED	Glass Vial			



Features

- **20mm (0.8") DIGIT HEIGHT**
Viewing Up to 10 Metres (33 Feet)
- **EXCELLENT CHARACTER APPEARANCE**
Excellent Readability in Bright Ambients
Through Superior Contrast Enhancement
 - Gray Body Color
 - Untinted Segments
 Wide Viewing Angle
Evenly Lighted Segments
Mitered Corners on Segments
- **LOW POWER REQUIREMENTS**
Single GaAsP Chip per Segment
- **EASY MOUNTING ON PC BOARD OR SOCKETS**
Industry Standard 15.24mm (0.6") DIP with
Lead Spacing on 2.54mm (0.1") Centers
Industry Standard Package Dimensions
and Pinouts
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output from
Unit to Unit Within a Single Category
- **IC COMPATIBLE**
- **MECHANICALLY RUGGED**



Description

The HDSP-3400 Series are very large 20.32mm (0.8 in.) GaAsP LED seven segment displays. Designed for viewing distances up to 10 metres (33 feet), these single digit displays provide excellent readability in bright ambients.

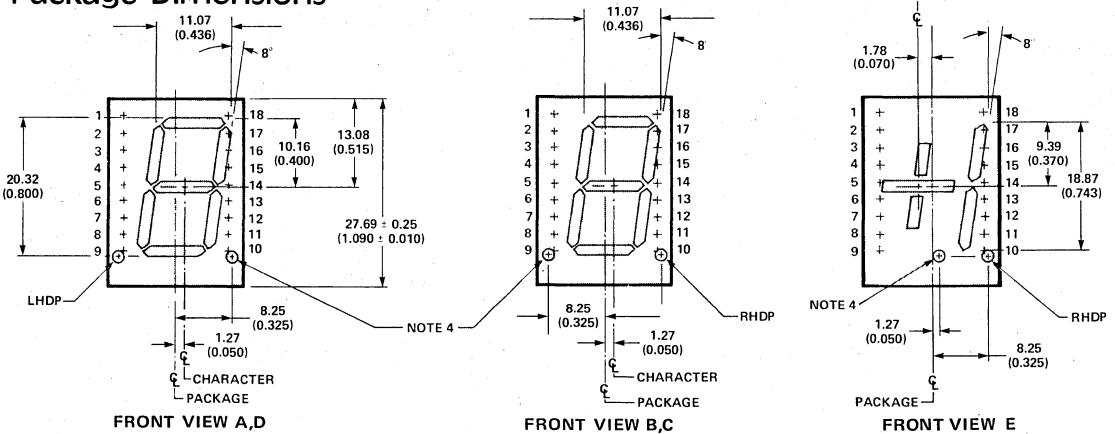
These devices utilize a standard 15.24mm (0.6 in.) dual in line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point-of-sale terminals, TVs, weighing scales, and digital clocks.

Devices

Part No. HDSP	Description	Package Drawing
-3400	Common Anode Left Hand Decimal	A
-3401	Common Anode Right Hand Decimal	B
-3403	Common Cathode Right Hand Decimal	C
-3405	Common Cathode Left Hand Decimal	D
-3406	Universal Overflow ± 1 Right Hand Decimal	E

Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins. See internal diagram E.

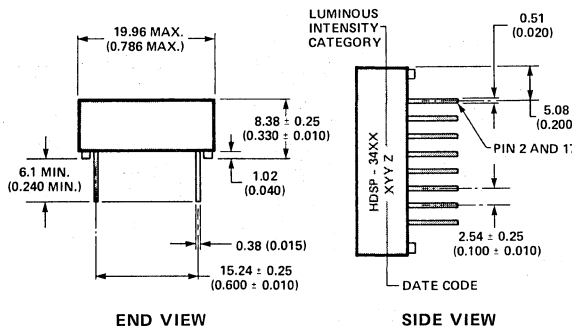
Package Dimensions



FRONT VIEW A,D

FRONT VIEW B,C

FRONT VIEW E



END VIEW

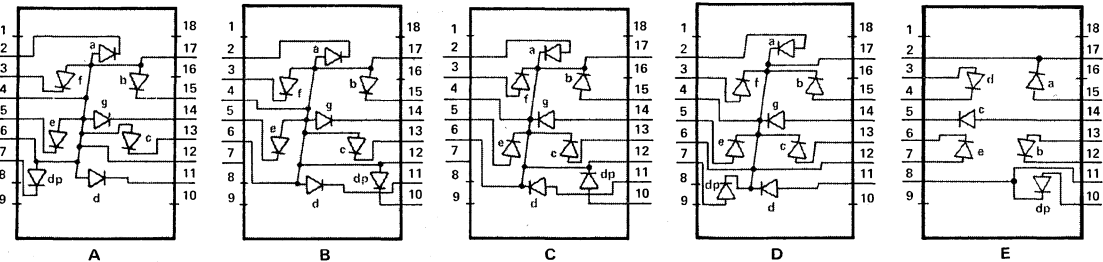
SIDE VIEW

Pin	Function				
	A -3400	B -3401	C -3403	D -3405	E -3406
1	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN
2	CATHODE a	CATHODE a	ANODE a	ANODE a	CATHODE a
3	CATHODE f	CATHODE f	ANODE f	ANODE f	ANODE f
4	ANODE ^[3]	ANODE ^[3]	CATHODE ^[6]	CATHODE ^[6]	CATHODE d
5	CATHODE e	CATHODE e	ANODE e	ANODE e	CATHODE c
6	ANODE ^[3]	ANODE ^[3]	CATHODE ^[6]	CATHODE ^[6]	CATHODE e
7	CATHODE dp	NO. CONNec.	NO. CONNec.	ANODE dp	ANODE e
8	NO PIN	NO PIN	NO PIN	NO PIN	CATHODE dp
9	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN
10	NO PIN	CATHODE dp	ANODE dp	NO PIN	ANODE dp
11	CATHODE d	CATHODE d	ANODE d	ANODE d	CATHODE dp
12	ANODE ^[3]	ANODE ^[3]	CATHODE ^[6]	CATHODE ^[6]	CATHODE b
13	CATHODE c	CATHODE c	ANODE c	ANODE c	ANODE b
14	CATHODE g	CATHODE g	ANODE g	ANODE g	ANODE c
15	CATHODE b	CATHODE b	ANODE b	ANODE b	ANODE a
16	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN
17	ANODE ^[2]	ANODE ^[3]	CATHODE ^[6]	CATHODE ^[6]	CATHODE a
18	NO PIN	NO PIN	NO PIN	NO PIN	NO PIN

NOTES:

- Dimensions in millimetres and (inches).
- All untoleranced dimensions are for reference only.
- Redundant anodes.
- Unused dp position.
- See Internal Circuit Diagram.
- Redundant cathodes.

Internal Circuit Diagram



Absolute Maximum Ratings

Average Power Dissipation per Segment or DP (T _A = 50°C) ^[1]	100mW
Operating Temperature Range	-20°C to +85°C
Storage Temperature Range	-20°C to +85°C
Peak Forward Current per Segment or DP (T _A = 50°C, Pulse Width = 1.2ms) ^[2]	200mA
DC Forward Current per Segment or DP (T _A = 50°C) ^[1]	50mA
Reverse Voltage per Segment or DP	6.0V
Lead Soldering Temperature (1.6mm [1/16 inch] Below Seating Plane)	260°C for 3 sec.

Notes:

- Derate maximum DC current above T_A = 50°C at 1mA/°C per segment, see Figure 2.
- See Figure 1 to establish pulsed operating conditions.

Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (Digit Average) ^[1]	I_V	$I_F = 20\text{mA}$	500	900		μcd
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength ^[2]	λ_d			640		nm
Forward Voltage, any Segment or DP	V_F	$I_F = 20\text{mA}$		1.6	2.0	V
Reverse Current, any Segment or DP	I_R	$V_R = 5\text{V}$		10	100	μA
Rise and Fall Time ^[3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F / ^\circ\text{C}$	$I_F = 20\text{mA}$		-1.5		$\text{mV}/^\circ\text{C}$

Notes:

- The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
- The dominant wavelength, λ_d , is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
- Time for a 10% - 90% change of light intensity for step change in current.

Operational Considerations

Electrical

The HDSP-3400 series of display devices are composed of eight light emitting diodes, with the light from each LED optically stretched to form individual segments and a decimal point. The LEDs have the P-N junction diffused into a GaAsP epitaxial layer on a GaAs substrate.

These display devices are designed for strobed operation at high peak currents. The typical forward voltage values, scaled from Figure 4, should be used for calculating the current limiting resistor values and typical power dissipation. Expected maximum V_F values for the purpose of driver circuit design may be calculated using the following V_F model:

$$V_F = 1.78\text{V} + I_{\text{PEAK}} (3.7\Omega)$$

$$\text{For: } 30\text{mA} \leq I_{\text{PEAK}} \leq 200\text{mA}$$

Temperature derated strobed operating conditions are obtained from Figures 1 and 2. Figure 1 relates pulse duration (t_p), refresh rate (f), and ratio of maximum peak current to maximum dc current ($I_{\text{PEAK MAX}}/I_{\text{dc MAX}}$). Figure 2 presents the maximum allowed dc current vs. ambient temperature. To most effectively use Figures 1 and 2, perform the following steps:

- Determine desired duty factor, DF.
Example: Four digits, DF = 1/4
- Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_p . Note: DF = $f \cdot t_p$.
Example: $f = 1\text{kHz}$, $t_p = 250\mu\text{s}$
- Enter Figure 1 at the calculated t_p . Move vertically to the refresh rate line and record the corresponding value of $I_{\text{PEAK MAX}}/I_{\text{dc MAX}}$.
Example: At $t_p = 250\mu\text{s}$ and $f = 1\text{kHz}$,
 $I_{\text{PEAK MAX}}/I_{\text{dc MAX}} = 3.2$
- From Figure 2, determine $I_{\text{dc MAX}}$. Note: $I_{\text{dc MAX}}$ is derated above $T_A = 50^\circ\text{C}$.
Example: At $T_A = 70^\circ\text{C}$, $I_{\text{dc MAX}} = 30\text{mA}$
- Calculate $I_{\text{PEAK MAX}}$ from $I_{\text{PEAK MAX}}/I_{\text{dc MAX}}$ ratio and calculate I_{AVG} from $I_{\text{PEAK MAX}}$ and DF.
Example: $I_{\text{PEAK MAX}} = (3.2)(30\text{mA}) = 96\text{mA peak}$.
 $I_{\text{AVG}} = (1/4)(96\text{mA}) = 24\text{mA average}$.

The above calculations determine the maximum allowed strobing conditions. Operation at a reduced peak current

and/or pulse width may be desirable to adjust display light output to match ambient light level or to reduce power dissipation to insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

The time average luminous intensity may be calculated using the relative efficiency characteristic of Figure 3, $\eta_{I_{\text{PEAK}}}$, and adjusted for operating ambient temperature. The time average luminous intensity at $T_A = 25^\circ\text{C}$ is calculated as follows:

$$I_V \text{ TIME AVG} = \left[\frac{I_{\text{AVG}}}{20\text{mA}} \right] \left[\eta_{I_{\text{PEAK}}} \right] \left[I_V \text{ DATA SHEET} \right]$$

Example: At $I_{\text{AVG}} = 24\text{mA}$ and $I_{\text{PEAK}} = 96\text{mA}$

$$I_V \text{ TIME AVG} = \left[\frac{24\text{mA}}{20\text{mA}} \right] [1.19] [900] = 1285 \mu\text{cd/Segment}$$

This time average luminous intensity may be adjusted for ambient temperature by the following exponential equation:

$$I_V (T_A) = I_V (25^\circ\text{C}) e^{[-0.0188/^\circ\text{C}] (T_A - 25^\circ\text{C})}$$

Example: $T_A = 50^\circ\text{C}$

$$I_V (T_A) = (1285 \mu\text{cd}) e^{[-0.0188/^\circ\text{C}] (50-25^\circ\text{C})} = 803 \mu\text{cd/Segment}$$

Optical and Contrast Enhancement

The color of the display emitted light is red. The light radiation pattern from each segment is essentially Lambertian.

The objective of contrast enhancement is to provide good display readability in the end use ambient light. The concept is to have the OFF-segments blend into the display background and to have the ON-segments stand out vividly against this same background. To achieve this goal the HDSP-3400 displays use a gray package and untinted segments to maximize readability in bright ambients.

Additional contrast enhancement is achieved by using a filter to reduce the luminous sterance of the display

background to a very low level, compared to the luminous sterance of the illuminated segments. These displays may be effectively filtered by using one of the following filter products: SGL Homalite H100-1605 RED or H100-1804 PURPLE; Panelgraphic RUBY RED 60, DARK RED 63 or PURPLE 90; Plexiglass 2423; 3M Light Control Film (louvered filters) in 80% Neutral Density, RED 655, VIOLET or PURPLE colors.

Mechanical

The HDSP-3400 series devices are constructed utilizing a lead frame in a standard DIP package. The LED dice are die attached directly to the lead frame. Therefore, the cathode leads are the direct thermal and mechanical stress paths to the LED dice. The absolute maximum allowed junction temperature, T_J MAX, is 100°C. The maximum power ratings have been established so that the worst case V_f device does not exceed this limit. For most reliable operation, it is recommended that the device pin-to-ambient thermal resistance through the PC board be less than 125°C/W segment. This will then establish a maximum thermal resistance LED junction-to-ambient to 500°C/W per segment.

These devices may be close-packed on 20mm (0.786 inch) centers on a PC board. Also, the large character height allows wider spacing options when desired. The package has a small tab at each corner to establish a 1.02mm (0.040 inch) seating plane.

To optimize device optical performance, specially developed plastics are used which restrict the solvents that may be used for cleaning. It is recommended that only mixtures of Freon (F113) and alcohol be used for vapor cleaning processes, with an immersion time in the vapors of less than two (2) minutes maximum. Some suggested vapor cleaning solvents are Freon TE, Genesolv DI-15 or DE-15, Arklone A or K. A 60°C (140°C) water cleaning process may also be used, which includes a neutralizer rinse (3% ammonia solution or equivalent), a surfactant rinse (1% detergent solution or equivalent), a hot water rinse and a thorough air dry. Room temperature cleaning may be accomplished with Freon T-E35 or T-P35, Ethanol, Isopropanol or water with a mild detergent.

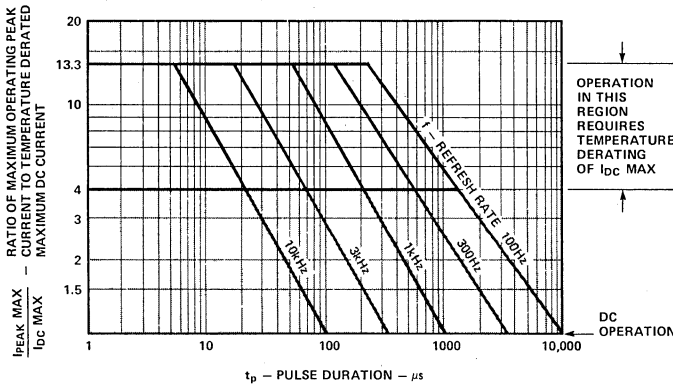


Figure 1. Maximum Allowable Peak Current vs. Pulse Duration.

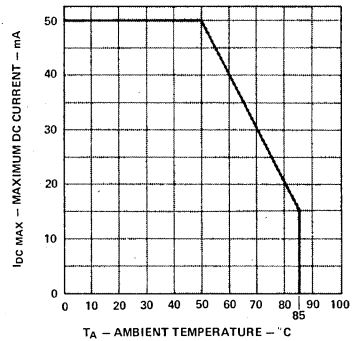


Figure 2. Maximum Allowable DC Current per Segment vs. Ambient Temperature.

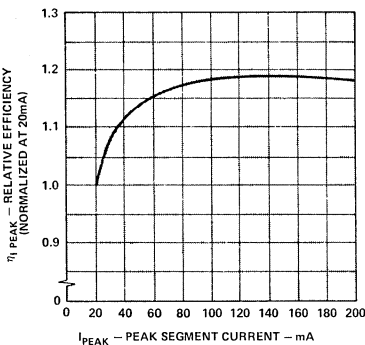


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

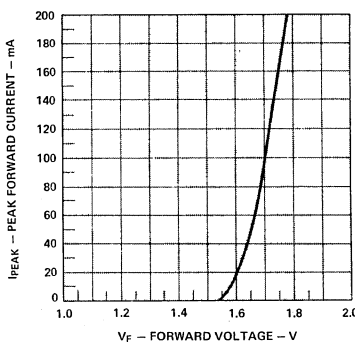


Figure 4. Peak Forward Segment Current vs. Peak Forward Voltage.

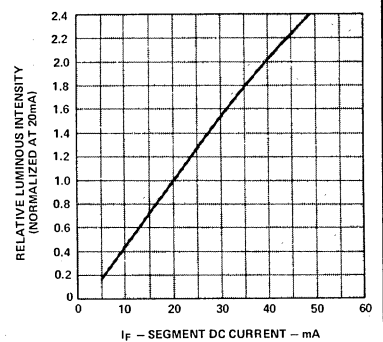


Figure 5. Relative Luminous Intensity vs. DC Forward Current.

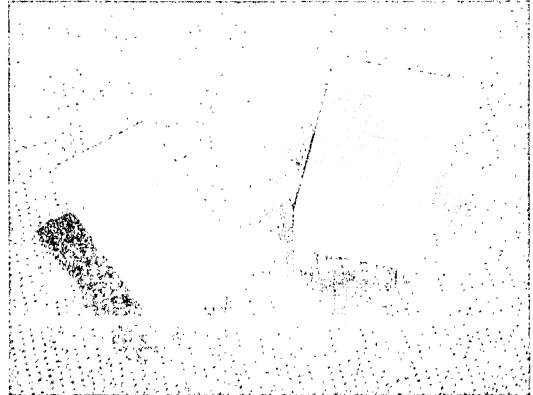


**7.6 / 10.9 mm (0.3/0.43 INCH)
SEVEN SEGMENT DISPLAYS FOR
HIGH LIGHT AMBIENT CONDITIONS
HIGH EFFICIENCY RED - HDSP-3530/3730 SERIES
YELLOW - HDSP-4030/4130 SERIES**

TECHNICAL DATA APRIL 1978

Features

- **HIGH LIGHT OUTPUT**
Typically 2300 $\mu\text{cd}/\text{Segment}$ at 100mA Peak,
20mA Average
Designed for Multiplex Operation
- **CHOICE OF TWO COLORS**
High Efficiency Red
Yellow
- **EXCELLENT CHARACTER APPEARANCE**
Evenly Lighted Segments
Wide Viewing Angle
Gray Body Color for Optimum Contrast
- **EASY MOUNTING ON PC BOARD OR SOCKETS**
Industry Standard 7.62mm (0.3 in.) DIP Leads
on 2.54mm (0.1 in.) Centers
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Use of Like Categories Yields a Uniform Display
- **IC COMPATIBLE**
- **MECHANICALLY RUGGED**



Description

The HDSP-3530/4030 and -3730/4130 series are 7.62/10.92mm (0.3/0.43 in.) high efficiency red and yellow displays designed for use in high light ambient conditions. These displays are designed for use in instruments, airplane cockpits, weighing scales, and point of sale terminals.

The HDSP-3530/4030 and -3730/4130 series devices utilize high efficiency LED chips, which are made from GaAsP on a transparent GaP substrate. The active junction area is larger than that used in the 5082-7610/7620/7650/7660 series to permit higher peak currents.

Devices

Part No. HDSP-	Color	Description	Package Drawing
3530	High Efficiency Red	7.6mm Common Anode Left Hand Decimal	A
3531	High Efficiency Red	7.6mm Common Anode Right Hand Decimal	B
3533	High Efficiency Red	7.6mm Common Cathode Right Hand Decimal	C
3536	High Efficiency Red	7.6mm Universal Overflow ± 1 Right Hand Decimal	D
4030	Yellow	7.6mm Common Anode Left Hand Decimal	A
4031	Yellow	7.6mm Common Anode Right Hand Decimal	B
4033	Yellow	7.6mm Common Cathode Right Hand Decimal	C
4036	Yellow	7.6mm Universal Overflow ± 1 Right Hand Decimal	D
3730	High Efficiency Red	10.9mm Common Anode Left Hand Decimal	E
3731	High Efficiency Red	10.9mm Common Anode Right Hand Decimal	F
3733	High Efficiency Red	10.9mm Common Cathode Right Hand Decimal	G
3736	High Efficiency Red	10.9mm Universal Overflow ± 1 Right Hand Decimal	H
4130	Yellow	10.9mm Common Anode Left Hand Decimal	E
4131	Yellow	10.9mm Common Anode Right Hand Decimal	F
4133	Yellow	10.9mm Common Cathode Right Hand Decimal	G
4136	Yellow	10.9mm Universal Overflow ± 1 Right Hand Decimal	H

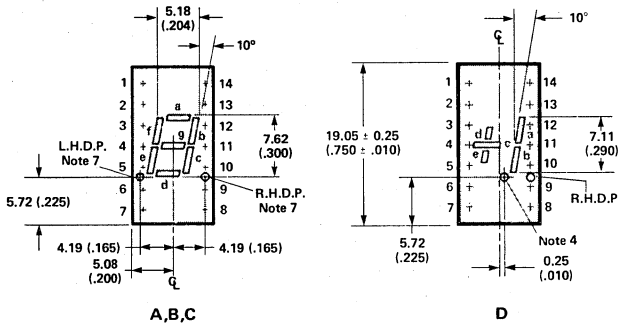
Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins. See internal diagrams D and H.

Absolute Maximum Ratings (All Products)

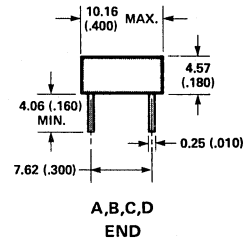
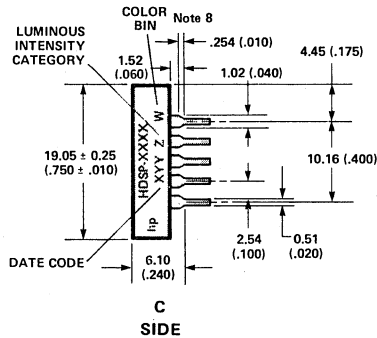
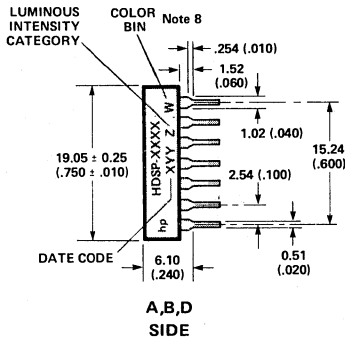
Average Power Dissipation Per Segment or DP (T _A =50°C)	83mW
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-40°C to +85°C
Peak Forward Current Per Segment or DP (T _A = 50°C) ⁽²⁾	120mA (Pulse Width = 1.25ms)
DC Forward Current Per Segment or DP (T _A =50°C) ⁽¹⁾	30mA
Reverse Voltage Per Segment or DP	6.0V
Lead Soldering Temperature (1.6mm [1/16 inch] below seating plane)	260°C for 3 Seconds

Notes: 1. Derate maximum DC current above T_A=50°C at 0.51 mA/°C per segment, see Figure 2.
2. See Figure 1 to establish pulsed operating conditions.

Package Dimensions (HDSP-3530/4030 Series)



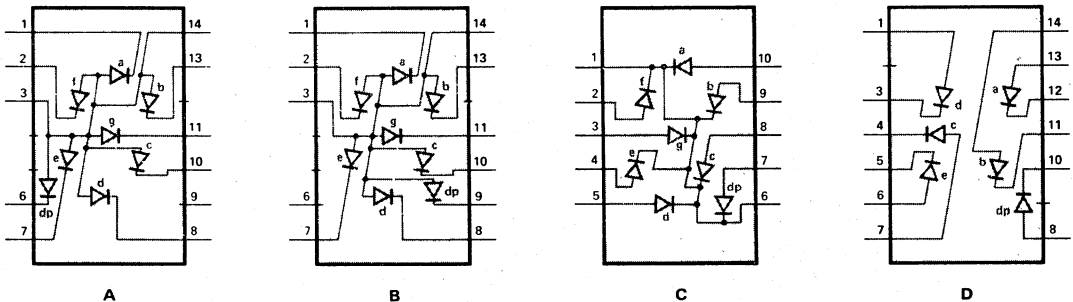
PIN	FUNCTION			
	A -3530/4030	B -3531/4031	C -3533/4033	D -3536/4036
1	CATHODE-a	CATHODE-a	CATHODE ^[6]	ANODE-d
2	CATHODE-f	CATHODE-f	ANODE-f	NO PIN
3	ANODE ^[3]	ANODE ^[3]	ANODE-g	CATHODE-d
4	NO PIN	NO PIN	ANODE-e	CATHODE-c
5	NO PIN	NO PIN	ANODE-d	CATHODE-e
6	CATHODE-dp	NO CONN. ^[5]	CATHODE ^[6]	ANODE-e
7	CATHODE-e	CATHODE-e	ANODE-dp	ANODE-c
8	CATHODE-d	CATHODE-d	ANODE-c	ANODE-dp
9	NO CONN. ^[5]	CATHODE-dp	ANODE-b	NO PIN
10	CATHODE-c	CATHODE-c	ANODE-a	CATHODE-dp
11	CATHODE-g	CATHODE-g		CATHODE-b
12	NO PIN	NO PIN		CATHODE-a
13	CATHODE-b	CATHODE-b		ANODE-a
14	ANODE ^[3]	ANODE ^[3]		ANODE-b



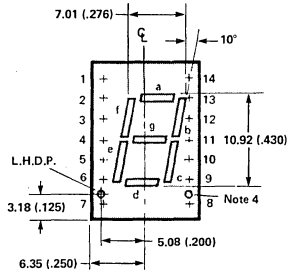
NOTES:

- Dimensions in millimeters and (inches).
- All untoleranced dimensions are for reference only.
- Redundant anodes.
- Unused dp position.
- See Internal Circuit Diagram.
- Redundant cathode.
- See part number table for L.H.D.P. and R.H.D.P. designation.
- For HDSP-4030 series product only.

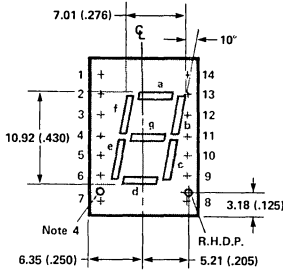
Internal Circuit Diagram (HDSP-3530/4030 Series)



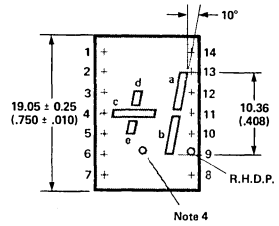
Package Dimensions (HDSP-3730/4130 Series)



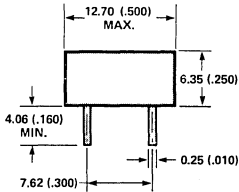
E



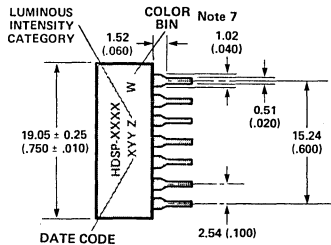
F,G
FRONT VIEW



H



E, F, G, H
END VIEW



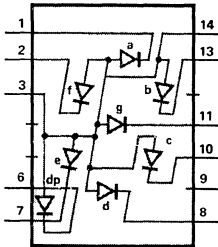
E, F, G, H
SIDE VIEW

PIN	FUNCTION			
	E 3730/-4130	F -3731/-4131	G -3733/-4133	H -3736/-4136
1	CATHODE-a	CATHODE-a	ANODE-a	CATHODE-d
2	CATHODE-f	CATHODE-f	ANODE-f	ANODE-d
3	ANODE ^[3]	ANODE ^[3]	CATHODE ^[6]	NO PIN
4	NO PIN	NO PIN	NO PIN	CATHODE-c
5	NO PIN	NO PIN	NO PIN	CATHODE-e
6	CATHODE-dp	NO CONN. ^[5]	NO CONN. ^[5]	ANODE-e
7	CATHODE-e	CATHODE-a	ANODE-e	ANODE-c
8	CATHODE-d	CATHODE-d	ANODE-d	ANODE-dp
9	NO CONN. ^[5]	CATHODE-dp	ANODE-dp	CATHODE-dp
10	CATHODE-c	CATHODE-c	ANODE-c	CATHODE-b
11	CATHODE-g	CATHODE-g	ANODE-g	CATHODE-a
12	NO PIN	NO PIN	NO PIN	NO PIN
13	CATHODE-b	CATHODE-b	ANODE-b	ANODE-a
14	ANODE ^[3]	ANODE ^[3]	CATHODE ^[6]	ANODE-b

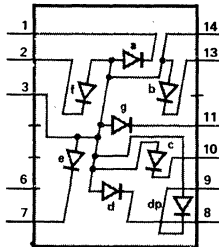
NOTES:

1. Dimensions in millimeters and (inches).
2. All untoleranced dimensions are for reference only.
3. Redundant anodes.
4. Unused dp position.
5. See Internal Circuit Diagram
6. Redundant cathode.
7. For HDSP-4130 series product only.

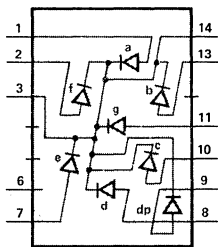
Internal Circuit Diagram (HDSP-3730/4130 Series)



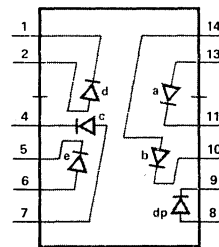
E



F



G



H

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

HIGH EFFICIENCY RED HDSP-3530/-3531/-3533/-3536/-3730/-3731/-3733/-3736

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ⁽³⁾ (Digit Average)	I_V	100mA Pk: 1 of 5 Duty Factor	1000	2300		μcd
		20mA DC		1800		μcd
Peak Wavelength	λ_{PEAK}			635		nm
Dominant Wavelength ⁽⁴⁾	λ_d			626		nm
Forward Voltage/Segment or D.P.	V_F	$I_F = 100\text{mA}$		2.55	3.1	V
Reverse Current/Segment or D.P.	I_R	$V_R = 6\text{V}$		10		μA
Response Time, Rise and Fall ⁽⁶⁾	t_r, t_f			300		ns
Temperature Coefficient of V_F /Segment or D.P.	$\Delta V_F/^\circ\text{C}$	$I_F = 100\text{mA}$		-1.1		$\text{mV}/^\circ\text{C}$

YELLOW HDSP-4030/-4031/-4033/-4036/-4130/-4131/-4133/-4136

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ⁽³⁾ (Digit Average)	I_V	100mA Pk: 1 of 5 Duty Factor	1000	2700		μcd
		20mA DC		2100		μcd
Peak Wavelength	λ_{PEAK}			583		nm
Dominant Wavelength ^(4,5)	λ_d			585		nm
Forward Voltage/Segment or D.P.	V_F	$I_F = 100\text{mA}$		2.6	3.1	V
Reverse Current/Segment or D.P.	I_R	$V_R = 6\text{V}$		10		μA
Response Time, Rise and Fall ⁽⁶⁾	t_r, t_f			200		ns
Temperature Coefficient of V_F /Segment or D.P.	$\Delta V_F/^\circ\text{C}$	$I_F = 100\text{mA}$		-1.1		$\text{mV}/^\circ\text{C}$

NOTES:

- The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
- The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and is that single wavelength which defines the color of the device.
- The HDSP-4030/-4130 series yellow displays are categorized as to dominant wavelength with the category designated by a number adjacent to the intensity category letter.
- The rise and fall times are for a 10%-90% change of light intensity to a step change in current.

Operational Considerations

ELECTRICAL

The HDSP-3530/3730/4030/4130 series of display devices are composed of eight light emitting diodes, with the light from each LED optically stretched to form individual segments and a decimal point. The LEDs have a large area P-N junction diffused into a GaAsP epitaxial layer on a GaP transparent substrate.

These display devices are designed for strobed operation at high peak currents. The typical forward voltage values, scaled from Figure 4, should be used for calculating the current limiting resistor values and typical power dissipation. Expected maximum V_F values for the purpose of driver circuit design and maximum power dissipation may be calculated using the following V_F models:

$$V_F = 2.0V + I_{PEAK} (11\Omega)$$

For $I_{PEAK} \geq 30mA$

$$V_F = 1.9V + I_{DC} (14\Omega)$$

For $10mA \leq I_{DC} \leq 30mA$

Temperature derated strobed operating conditions are obtained from Figures 1 and 2. Figure 1 relates pulse duration (t_p), refresh rate (f), and the ratio of maximum peak current to maximum dc current ($I_{PEAK MAX}/I_{DC MAX}$). Figure 2 presents the maximum allowed dc current vs. ambient temperature. To most effectively use Figures 1 and 2, perform the following steps:

1. Determine desired duty factor, DF.
Example: Five digits, DF = 1/5
2. Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_p . Note: DF = $f \cdot t_p$.
Example: $f = 1 \text{ kHz}$, $t_p = 200 \mu s$
3. Enter Figure 1 at the calculated t_p . Move vertically to the refresh rate line and record the corresponding value of $I_{PEAK MAX}/I_{DC MAX}$.
Example: At $t_p = 200 \mu s$ and $f = 1 \text{ kHz}$, $I_{PEAK MAX}/I_{DC MAX} = 4.0$
4. From Figure 2, determine $I_{DC MAX}$. Note: $I_{DC MAX}$ is derated above $T_A = 50^\circ C$.
Example: At $T_A = 60^\circ C$, $I_{DC MAX} = 25mA$
5. Calculate $I_{PEAK MAX}$ from $I_{PEAK MAX}/I_{DC MAX}$ ratio and calculate I_{AVG} from $I_{PEAK MAX}$ and DF.
Example: $I_{PEAK MAX} = (4.0)(25mA) = 100mA$ peak. $I_{AVG} = (1/5)(100mA) = 20mA$ average.

The above calculations determine the maximum allowed strobing conditions. Operation at a reduced peak current and/or pulse width may be desirable to adjust display light output to match ambient light level or to reduce power dissipation to insure even more reliable operation.

Refresh rates of 1 kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

The time average luminous intensity may be calculated using the relative efficiency characteristic of Figure 3, η_{IPEAK} , and adjusted for operating ambient temperature. The time average luminous intensity at $T_A=25^\circ C$ is calculated as follows:

$$I_V \text{ TIME AVG} = \left[\frac{I_{AVG}}{20mA} \right] \left[\eta_{IPEAK} \right] \left[I_V \text{ DATA SHEET} \right]$$

Example: For HDSP-4030 series

$$\eta_{IPEAK} = 1.00 \text{ at } I_{PEAK} = 100mA$$

$$I_V \text{ TIME AVG} = \left[\frac{20mA}{20mA} \right] \left[1.00 \right] \left[2.7mcd \right] = 2.7mcd/\text{segment}$$

The time average luminous intensity may be adjusted for operating ambient temperature by the following exponential equation:

$$I_V (T_A) = I_V (25^\circ C) e^{K(T_A - 25^\circ C)}$$

Device	K
-3530/3730 Series	-0.0131/ $^\circ C$
-4030/4130 Series	-0.0112/ $^\circ C$

$$\text{Example: } I_V (70^\circ C) = (2.7mcd) e^{[-0.0112(70-25)]} = 1.63mcd/\text{segment}$$

CONTRAST ENHANCEMENT

The objective of contrast enhancement is to provide good display readability in the end use ambient light. The concept is to employ luminance contrast techniques to enhance readability by having the off-segments blend into the display background and have the on-segments stand out vividly against this same background. Therefore, these display devices are assembled with a gray package and untinted encapsulating epoxy in the segments.

Contrast enhancement in bright ambients may be achieved by using a neutral density gray filter such as Panelgraphic Chromafilter Gray 10. Additional contrast enhancement may be achieved by using the neutral density 3M Light Control Film (louvered filter).

MECHANICAL

These devices are constructed utilizing a lead frame in a standard DIP package. The LED dice are attached directly to the lead frame. Therefore, the cathode leads are the direct thermal and mechanical stress paths to the LED dice. The absolute maximum allowed junction temperature, $T_J \text{ MAX}$, is $100^\circ C$. The maximum power ratings have been established so that the worst case V_F device does not exceed this limit. For most reliable operation, it is recommended that the device pin-to-ambient thermal resistance through the PC board be less than $320^\circ C/W$ per segment. This will then establish a maximum thermal resistance LED junction-to-ambient of $602^\circ C/W$ per segment.

To optimize device optical performance, specially developed plastics are used which restrict the solvents that may be used for cleaning. It is recommended that only mixtures of Freon (F113) and alcohol be used for vapor cleaning processes, with an immersion time in the vapors of less than two (2) minutes maximum. Some suggested vapor cleaning solvents are Freon TE, Genesolv DI-15 or DE-15, Arklone A or K. A $60^\circ C$ ($140^\circ F$) water cleaning process may also be used, which includes a neutralizer rinse (3% ammonia solution or equivalent), a surfactant rinse (1% detergent solution or equivalent), a hot water rinse and a thorough air dry. Room temperature cleaning may be accomplished with Freon T-E35 or T-P35, Ethanol, Isopropanol or water with a mild detergent.

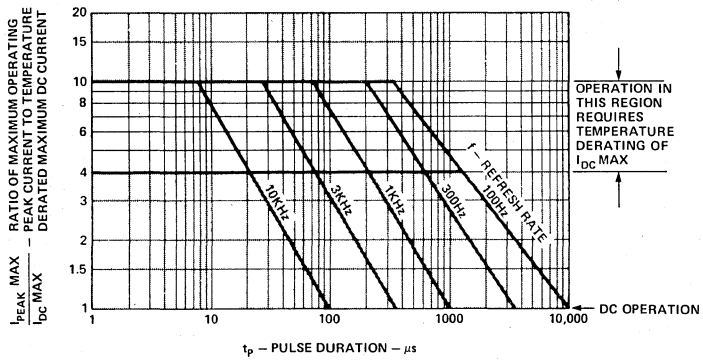


Figure 1. Maximum Allowed Peak Current vs. Pulse Duration.

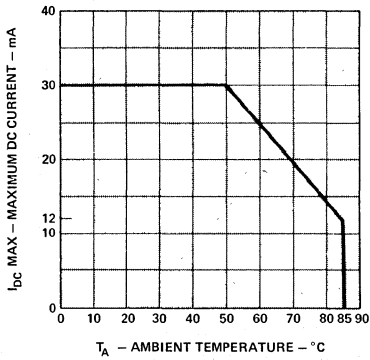


Figure 2. Maximum Allowable DC Current per Segment vs. Ambient Temperature.

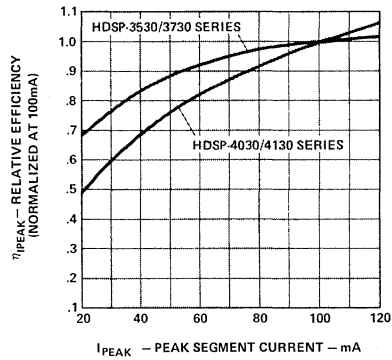


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

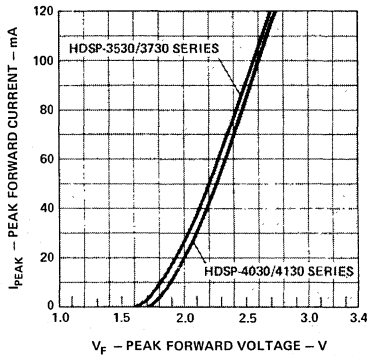


Figure 4. Peak Forward Segment Current vs. Peak Forward Voltage.

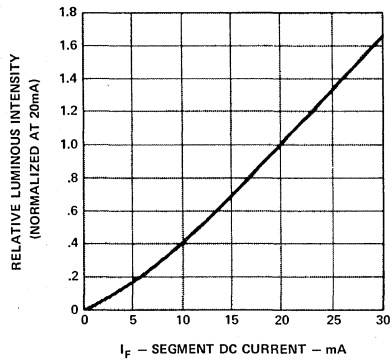


Figure 5. Relative Luminous Intensity vs. DC Forward Current.



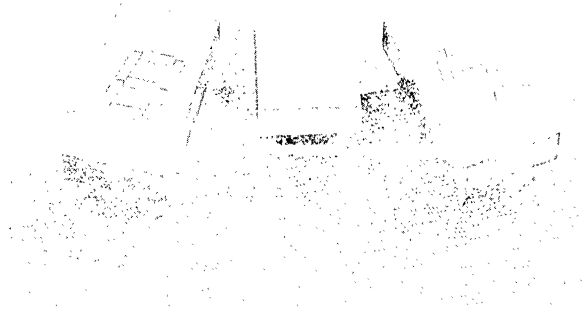
.3 INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED • 5082-7610 SERIES
YELLOW • 5082-7620 SERIES
GREEN • 5082-7630 SERIES

TECHNICAL DATA APRIL 1978

Features

- **COMPACT SIZE**
- **CHOICE OF 3 BRIGHT COLORS**
 High Efficiency Red
 Yellow
 Green
- **LOW CURRENT OPERATION**
 As Low as 3mA per Segment
 Designed for Multiplex Operation
- **EXCELLENT CHARACTER APPEARANCE**
 Evenly Lighted Segments
 Wide Viewing Angle
 Body Color Improves "Off" Segment Contrast
- **EASY MOUNTING ON PC BOARD OR SOCKETS**
 Industry Standard 7.62mm (.3 in.) DIP
 Leads on 2.54mm (.1 in.) Centers
- **CATEGORIZED FOR LUMINOUS INTENSITY**
 Use of Like Categories Yields a Uniform Display
- **IC COMPATIBLE**
- **MECHANICALLY RUGGED**



Description

The 5082-7610, -7620, and -7630 series are 7.62mm (.3 in.) High Efficiency Red, Yellow, and Green seven segment displays. These displays are designed for use in instruments, point of sale terminals, clocks, and appliances.

The -7610, and -7620 series devices utilize high efficiency LED chips which are made from GaAsP on a transparent GaP substrate.

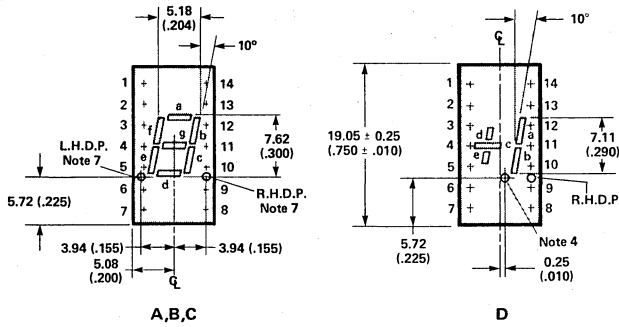
The -7630 series devices utilize chips made from GaP on a transparent GaP substrate.

Devices

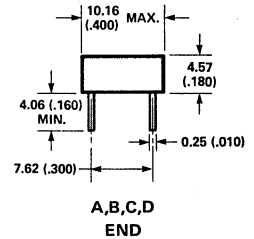
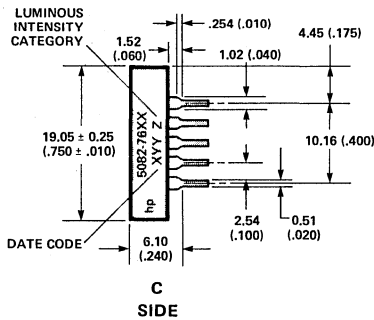
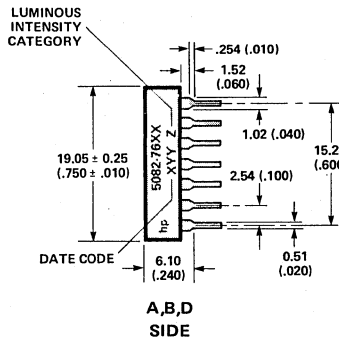
Part No. 5082-	Color	Description	Package Drawing
-7610	High Efficiency Red	Common Anode Left Hand Decimal	A
-7611	High Efficiency Red	Common Anode Right Hand Decimal	B
-7613	High Efficiency Red	Common Cathode Right Hand Decimal	C
-7616	High Efficiency Red	Universal Overflow ± 1 Right Hand Decimal	D
-7620	Yellow	Common Anode Left Hand Decimal	A
-7621	Yellow	Common Anode Right Hand Decimal	B
-7623	Yellow	Common Cathode Right Hand Decimal	C
-7626	Yellow	Universal Overflow ± 1 Right Hand Decimal	D
-7630	Green	Common Anode Left Hand Decimal	A
-7631	Green	Common Anode Right Hand Decimal	B
-7633	Green	Common Cathode Right Hand Decimal	C
-7636	Green	Universal Overflow ± 1 Right Hand Decimal	D

NOTE: Universal pinout brings the anode and cathode of each segment's LED out to separate pins. See internal diagram D.

Package Dimensions



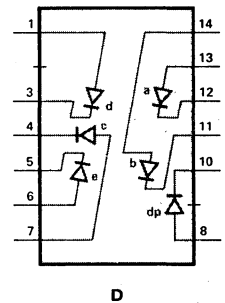
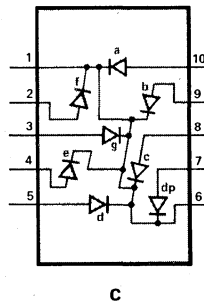
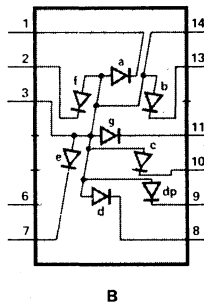
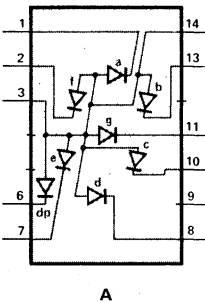
PIN	FUNCTION			
	A -7610/-7620/ -7630	B -7611/-7621/ -7631	C -7613/-7623/ -7633	D -7616/-7626/ -7636
1	CATHODE-a	CATHODE-a	CATHODE ^[6]	ANODE-d
2	CATHODE-f	CATHODE-f	ANODE-f	NO PIN
3	ANODE ^[3]	ANODE ^[3]	ANODE-g	CATHODE-d
4	NO PIN	NO PIN	ANODE-e	CATHODE-c
5	NO PIN	NO PIN	ANODE-d	CATHODE-e
6	CATHODE-dp	NO CONN. ^[5]	CATHODE ^[6]	ANODE-e
7	CATHODE-e	CATHODE-e	ANODE-dp	ANODE-c
8	CATHODE-d	CATHODE-d	ANODE-c	ANODE-dp
9	NO CONN. ^[6]	CATHODE-dp	ANODE-b	NO PIN
10	CATHODE-c	CATHODE-c	ANODE-a	CATHODE-dp
11	CATHODE-g	CATHODE-g		CATHODE-b
12	NO PIN	NO PIN		CATHODE-a
13	CATHODE-b	CATHODE-b		ANODE-s
14	ANODE ^[3]	ANODE ^[3]		ANODE-b



NOTES:

1. Dimensions in millimeters and (inches).
2. All untoleranced dimensions are for reference only
3. Redundant anodes.
4. Unused dp position.
5. See Internal Circuit Diagram.
6. Redundant cathode.
7. See part number table for L.H.D.P. and R.H.D.P. designation.

Internal Circuit Diagram



Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P. ⁽¹⁾ (T _A =25°C)	50mW
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-40°C to +85°C
Peak Forward Current Per Segment or D.P. ⁽³⁾ (T _A =25°C)	60mA
Average Forward Current Per Segment or D.P. ^(1,2) (T _A =25°C)	20mA
Reverse Voltage Per Segment or D.P.	6.0V
Lead Soldering Temperature	260°C for 3 Sec
	[1.59mm (1/16 inch) below seating plane ⁽⁴⁾]

Notes: 1. See power derating curve (Fig. 2). 2. Derate DC current from 50°C at 0.4mA/°C per segment. 3. See pulse width limitation curve (Fig. 2) and Duty Factor Curve (Fig. 5). 4. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

Electrical/Optical Characteristics at T_A = 25°C

HIGH EFFICIENCY RED 5082-7610/-7611/-7613/-7616

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(5,8) (Digit Average)	I _v	5mA D.C.	70	250		μcd
		20mA D.C.		1430		μcd
		60mA Pk: 1 of 6 Duty Factor		810		μcd
Peak Wavelength	λ _{PEAK}			635		nm
Dominant Wavelength ⁽⁶⁾	λ _d			626		nm
Forward Voltage/Segment or D.P.	V _F	I _F = 5mA		1.7		V
		I _F = 20mA		2.0	2.5	
		I _F = 60mA		2.8		
Reverse Current/Segment or D.P.	I _R	V _R = 6V		10		μA
Response Time ⁽⁷⁾	t _r , t _f			90		ns
Temperature Coefficient of V _F /Segment or D.P.	ΔV _F /°C			-2.0		mV/°C

YELLOW 5082-7620/-7621/-7623/-7626

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(5,8) (Digit Average)	I _v	5mA D.C.	90	200		μcd
		20mA D.C.		1200		μcd
		60mA Pk: 1 of 6 Duty Factor		740		μcd
Peak Wavelength	λ _{PEAK}			583		nm
Dominant Wavelength ⁽⁶⁾	λ _d			585		nm
Forward Voltage/Segment or D.P.	V _F	I _F = 5mA		1.8		V
		I _F = 20mA		2.2	2.5	
		I _F = 60mA		3.1		
Reverse Current/Segment or D.P.	I _R	V _R = 6V		10		μA
Response Time ⁽⁷⁾	t _r , t _f			90		ns
Temperature Coefficient of V _F /Segment or D.P.	V _F /°C			-2.0		mV/°C

GREEN 5082-7630/-7631/-7633/-7636

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(5,8) (Digit Average)	I _v	10mA D.C.	150	300		μcd
		20mA D.C.		765		μcd
		60mA Pk: 1 of 6 Duty Factor		540		μcd
Peak Wavelength	λ _{PEAK}			565		nm
Dominant Wavelength ⁽⁶⁾	λ _d			572		nm
Forward Voltage/Segment or D.P.	V _F	I _F = 5mA		1.9		V
		I _F = 20mA		2.2	2.5	
		I _F = 60mA		2.9		
Reverse Current/Segment or D.P.	I _R	V _R = 6V		10		μA
Response Time ⁽⁷⁾	t _r , t _f			90		ns
Temperature Coefficient of V _F /Segment or D.P.	ΔV _F /°C			-2.0		mV/°C

NOTES: 5. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.

6. The dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity Diagram and is that single wavelength which defines the color of the device.

7. Time for a 10% – 90% change of light intensity for step change in current.

8. Temperature coefficient of luminous intensity I_v/°C is determined by the formula:

$$I_{vT_A} = I_{v25^{\circ}C} e^{K(T_A - 25^{\circ}C)}$$

Device	K
-7610 series	-0.0131/°C
-7620 series	-0.0112/°C
-7630 series	-0.0104/°C

Operational Considerations

ELECTRICAL

The 5082-7600 series of display products are arrays of eight light emitting diodes which are optically magnified to form seven individual segments plus a decimal point.

The diodes in these displays utilize a Gallium Arsenide Phosphide junction on a Gallium Phosphide substrate to produce high efficiency red and yellow emission spectra and a Gallium Phosphide junction for the green. In the case of the red displays, efficiency is improved by at least a factor of 4 over the standard Gallium Arsenide Phosphide based technology. The use of Gallium Phosphide as the substrate does result in an internal dynamic resistance in the range of 12-48Ω. It is this resistance which causes the substantially higher forward voltage specifications in the new devices.

The user should be careful to scale the appropriate forward voltage from the V_F versus I_F curve, Figure 4, when designing for a particular forward current. Another way to obtain V_F would be to use the following formula:

$$V_F = V_{5mA} + R_S (I_F - 5mA)$$

where V_{5mA} and R_S are found in the following table:

Device	V_{5mA}	R_S
-7610 Series	1.65V	21Ω
-7620 Series	1.75V	25Ω
-7630 Series	1.85V	19Ω

Figure 1 relates refresh rate, f , and pulse duration, t_p , to a ratio which defines the maximum desirable operating peak current as a function of derated dc current, $I_{P\ MAX}/I_{DC\ MAX}$. To most effectively utilize Figure 1, perform the following steps:

- Determine desired duty factor.
Example: Four digit display, duty factor = 1/4
- Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_p .
Note: $t_p = \text{Duty Factor}$
Example: $f=1\ \text{kHz}$; $t_p=250\ \mu\text{sec}$
- Enter Figure 1 at the calculated t_p . Move vertically to the refresh rate line and then record the corresponding value of $I_{P\ MAX}/I_{DC\ MAX}$.
Example: At $t_p=250\ \mu\text{sec}$ and $f=1\ \text{kHz}$, $I_{P\ MAX}/I_{DC\ MAX} = 4.0$
- From Figure 2, determine the value for $I_{DC\ MAX}$.
Note: $I_{DC\ MAX}$ is derated above $T_A=50^\circ\text{C}$
Example: At $T_A=70^\circ\text{C}$, $I_{DC\ MAX}=12\text{mA}$
- Calculate $I_{P\ MAX}$ from $I_{P\ MAX}/I_{DC\ MAX}$ ratio and calculate I_{AVG} from I_P and duty factor.
Example: $I_P = (4.0) (12\text{mA}) = 48\text{mA peak}$
 $I_{AVG}=(1/4) (48\text{mA}) = 12\text{mA average}$.

The above calculations determine the maximum tolerable strobing conditions. Operation at a reduced peak current or duty factor is suggested to help insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

These displays may be operated in the strobed mode at currents up to 60mA peak. When operating at peak currents above 5mA for red and yellow or 10mA for green, there will be an improvement in the relative efficiency of the display (see Figure 3). Light output at higher currents can be calculated using the following relationship:

$$I_{V\ \text{TIME}\ \text{AVG}} = \left[\frac{I_{AVG}}{I_{AVG\ \text{SPEC}}} \right] \left[\frac{\eta_{I\ \text{PEAK}}}{\eta_{I\ \text{PEAK}\ \text{SPEC}}} \right] \left[I_{V\ \text{SPEC}} \right]$$

I_{AVG} = Operating point average current

$I_{AVG\ \text{SPEC}}$ = Average current for data sheet luminous intensity value, $I_{V\ \text{SPEC}}$

$\eta_{I\ \text{PEAK}}$ = Relative efficiency at operating peak current.

$\eta_{I\ \text{PEAK}\ \text{SPEC}}$ = Relative efficiency at data sheet peak current where luminous intensity $I_{V\ \text{SPEC}}$ is specified.

$I_{V\ \text{SPEC}}$ = Data sheet luminous intensity, specified at $I_{AVG\ \text{SPEC}}$ and $I_{PEAK\ \text{SPEC}}$.

Example: $I_P = 40\text{mA}$ and $I_{AVG} = 10\text{mA}$:

$$I_{V\ \text{TIME}\ \text{AVG}} = \left(\frac{10\text{mA}}{5\text{mA}} \right) \left(\frac{1.58}{1} \right) (300\mu\text{cd}) = 948\mu\text{cd/seg.}$$

CONTRAST ENHANCEMENT

The 5082-7600 series devices have been optimized for use in actual display systems. In order to maximum "ON-OFF" contrast, the bodies of the displays have been painted to match the appearance of an unilluminated segment. The emission wavelength of the red displays has been shifted from the standard GaAsP - 655nm to 635nm in order to provide an easier to read device.

All of the colored display products should be used in conjunction with contrast enhancing filters. Some suggested contrast filters: for red displays, Panelgraphic Scarlet Red 65 or Homalite 1670; for yellow displays, Panelgraphic Yellow 27 or Homalite (100-1720, 100-1726); for green, Panelgraphic Green 48 or Homalite (100-1440, 100-1425). Another excellent contrast enhancement material for all colors is the 3M light control film.

MECHANICAL

The 5082-7600 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 10.16mm (.4 in.) centers on a PC board. Also, the larger character height allows other character spacing options when desired. The leadframe has an integral seating plane which will hold the package approximately 1.52mm (.060 in.) above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only mixtures of Freon and alcohol be used for post solder vapor cleaning processes, with an immersion time in the vapors up to two minutes maximum. Suggested products are Freon TF, Freon TE, Genesolv DI-15 and Genesolv DE-15. Isopropyl, Ethanol or water may also be used for cleaning operations.

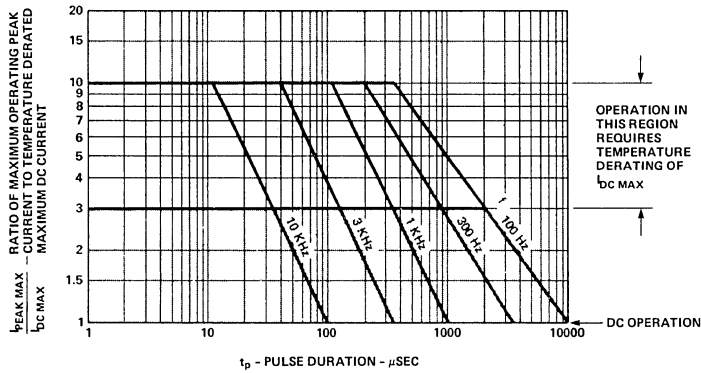


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

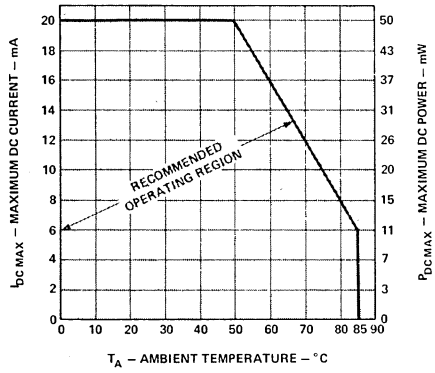


Figure 2. Maximum Allowable DC Current and DC Power Dissipation Per Segment as a Function of Ambient Temperature.

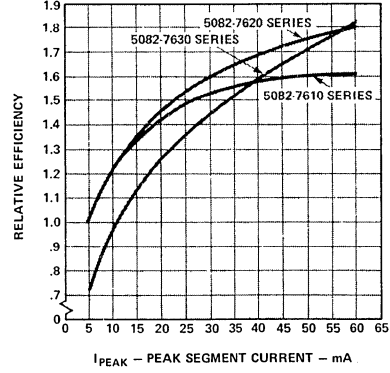


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

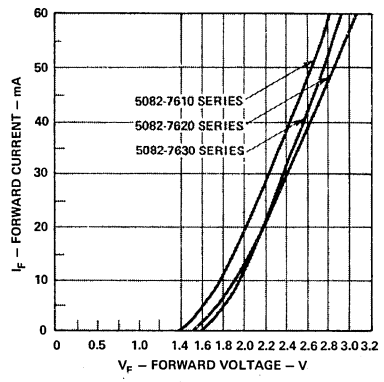


Figure 4. Forward Current vs. Forward Voltage Characteristic.

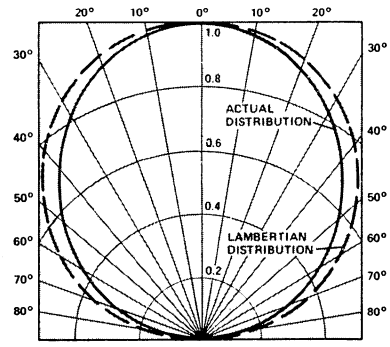


Figure 5. Normalized Angular Distribution of Luminous Intensity.

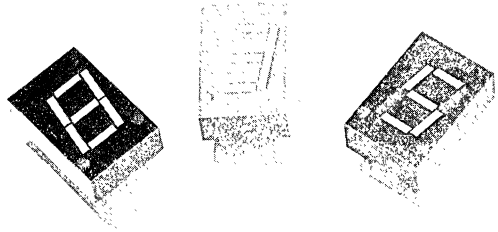
.43 INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED • 5082-7650 SERIES
YELLOW • 5082-7660 SERIES
GREEN • 5082-7670 SERIES

TECHNICAL DATA APRIL 1978

Features

- **LARGE DIGIT**
Viewing up to 6 meters (19.7 feet)
- **CHOICE OF 3 BRIGHT COLORS**
High Efficiency Red
Yellow
Green
- **LOW CURRENT OPERATION**
As Low as 3mA per Segment
Designed for Multiplex Operation
- **EXCELLENT CHARACTER APPEARANCE**
Evenly Lighted Segments
Wide Viewing Angle
Body Color Improves "Off" Segment Contrast
- **EASY MOUNTING ON PC BOARD OR SOCKETS**
Industry Standard 7.62mm (.3") DIP
Leads on 2.54mm (.1") Centers
- **CATERGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output from Unit to Unit within a Single Category
- **IC COMPATIBLE**
- **MECHANICALLY RUGGED**



Description

The 5082-7650, -7660, and -7670 series are large 10.92mm (.43 in.) Red, Yellow, and Green seven segment displays. These displays are designed for use in instruments, point of sale terminals, clocks, and appliances.

The -7650 and -7660 series devices utilize high efficiency LED chips which are made from GaAsP on a transparent GaP substrate.

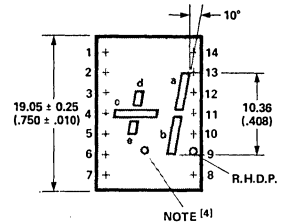
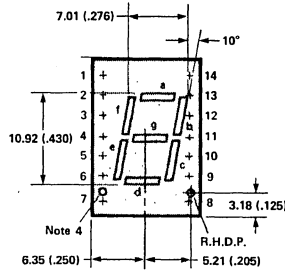
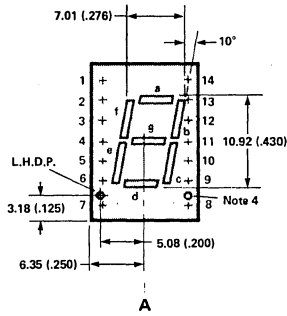
The -7670 series devices utilize chips made from GaP on a transparent GaP substrate.

Devices

Part No. 5082-	Color	Description	Package Drawing
-7650	High Efficiency Red	Common Anode Left Hand Decimal	A
-7651	High Efficiency Red	Common Anode Right Hand Decimal	B
-7653	High Efficiency Red	Common Cathode Right Hand Decimal	C
-7656	High Efficiency Red	Universal Overflow ± 1 Right Hand Decimal	D
-7660	Yellow	Common Anode Left Hand Decimal	A
-7661	Yellow	Common Anode Right Hand Decimal	B
-7663	Yellow	Common Cathode Right Hand Decimal	C
-7666	Yellow	Universal Overflow ± 1 Right Hand Decimal	D
-7670	Green	Common Anode Left Hand Decimal	A
-7671	Green	Common Anode Right Hand Decimal	B
-7673	Green	Common Cathode Right Hand Decimal	C
-7676	Green	Universal Overflow ± 1 Right Hand Decimal	D

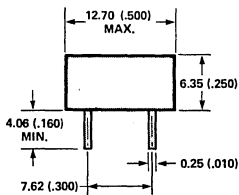
Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins, see internal diagram D.

Package Dimensions

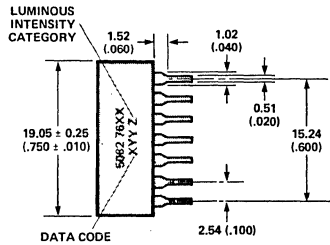


B,C
FRONT VIEW

D



END VIEW

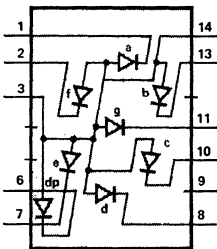


SIDE VIEW

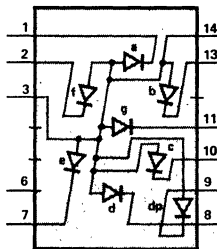
PIN	FUNCTION			
	A -7650/-7660/ -7670	B -7651/-7661/ -7671	C -7653/-7663/ -7673	D -7656/-7666/ -7676
1	CATHODE-a	CATHODE-a	ANODE-a	CATHODE-d
2	CATHODE-f	CATHODE-f	ANODE-f	ANODE-d
3	ANODE[3]	ANODE[3]	CATHODE[6]	NO PIN
4	NO PIN	NO PIN	NO PIN	CATHODE-c
5	NO PIN	NO PIN	NO PIN	CATHODE-e
6	CATHODE-dp	NO CONN.[5]	NO CONN.[5]	ANODE-e
7	CATHODE-e	CATHODE-e	ANODE-e	ANODE-c
8	CATHODE-d	CATHODE-d	ANODE-d	ANODE-dp
9	NO CONN.[6]	CATHODE-dp	CATHODE-dp	CATHODE-dp
10	CATHODE-c	CATHODE-c	ANODE-c	CATHODE-b
11	CATHODE-g	CATHODE-g	ANODE-g	CATHODE-a
12	NO PIN	NO PIN	NO PIN	NO PIN
13	CATHODE-b	CATHODE-b	ANODE-b	ANODE-a
14	ANODE[3]	ANODE[3]	CATHODE[6]	ANODE-b

- NOTES:**
- Dimensions in millimeters and (inches).
 - All untoleranced dimensions are for reference only.
 - Redundant anodes.
 - Unused dp position.
 - See Internal Circuit Diagram.
 - Redundant cathode.

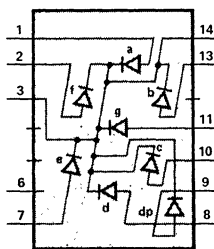
Internal Circuit Diagram



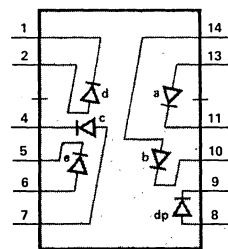
A



B



C



D

Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P. ⁽¹⁾ (T _A =25°C)	50mW
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-40°C to +85°C
Peak Forward Current Per Segment or D.P. ⁽³⁾ (T _A =25°C)	60mA
DC Forward Current Per Segment or D.P. ^(1,2) (T _A =25°C)	20mA
Reverse Voltage Per Segment or D.P.	6.0V
Lead Soldering Temperature	260°C for 3 Sec [1.59mm (1/16 inch) below seating plane ⁽⁴⁾]

Notes: 1. See power derating curve (Fig.2). 2. Derate average current from 50°C at 0.4mA/°C per segment. 3. See Maximum Tolerable Segment Peak Current vs. Pulse Duration curve, (Fig. 1). 4. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

Electrical/Optical Characteristics at T_A=25°C

HIGH EFFICIENCY RED 5082-7650/-7651/-7653/-7656

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(5,8) (Digit Average)	I _v	5mA D.C.	135	300		μcd
		20mA D.C.		1720		μcd
		60mA Pk: 1 of 6 Duty Factor		970		μcd
Peak Wavelength	λ _{PEAK}			635		nm
Dominant Wavelength ⁽⁶⁾	λ _d			626		nm
Forward Voltage/Segment or D.P.	V _F	I _F = 5mA		1.7		V
		I _F = 20mA		2.0	2.5	
		I _F = 60mA		2.8		
Reverse Current/Segment or D.P.	I _R	V _R = 6V		10		μA
Response Time ⁽⁷⁾	t _r , t _f			90		ns
Temperature Coefficient of V _F /Segment or D.P.	ΔV _F /°C			-2.0		mV/°C

YELLOW 5082-7660/-7661/-7663/-7666

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(5,8) (Digit Average)	I _v	5mA D.C.	100	250		μcd
		20mA D.C.		1500		μcd
		60mA Pk: 1 of 6 Duty Factor		925		μcd
Peak Wavelength	λ _{PEAK}			583		nm
Dominant Wavelength ⁽⁶⁾	λ _d			585		nm
Forward Voltage/Segment or D.P.	V _F	I _F = 5mA		1.8		V
		I _F = 20mA		2.2	2.5	
		I _F = 60mA		3.1		
Reverse Current/Segment or D.P.	I _R	V _R = 6V				μA
Response Time ⁽⁷⁾	t _r , t _f			90		ns
Temperature Coefficient of V _F /Segment or D.P.	V _F /°C			-2.0		mV/°C

GREEN 5082-7670/-7671/-7673/-7676

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(5,8) (Digit Average)	I _v	10mA D.C.	125	250		μcd
		20mA D.C.		640		μcd
		60mA Pk: 1 of 6 Duty Factor		450		μcd
Peak Wavelength	λ _{PEAK}			565		nm
Dominant Wavelength ⁽⁶⁾	λ _d			572		nm
Forward Voltage/Segment or D.P.	V _F	I _F = 10mA		1.9		V
		I _F = 20mA		2.2	2.5	
		I _F = 60mA		2.9		
Reverse Current/Segment or D.P.	I _R	V _R = 6V		10		μA
Response Time ⁽⁷⁾	t _r , t _f			90		ns
Temperature Coefficient of V _F /Segment or D.P.	ΔV _F /°C			-2.0		mV/°C

NOTES:

- The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
- The dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity Diagram and is that single wavelength which defines the color of the device.
- Time for a 10% - 90% change of light intensity for step change in current.
- Temperature coefficient of luminous intensity I_v/°C is determined by the formula: I_{vTA} = I_{v25°C} e^{K(T_A - 25°C)}.

DEVICE	K
-7650 Series	-0131/°C
-7660 Series	-0112/°C
-7670 Series	-0104/°C

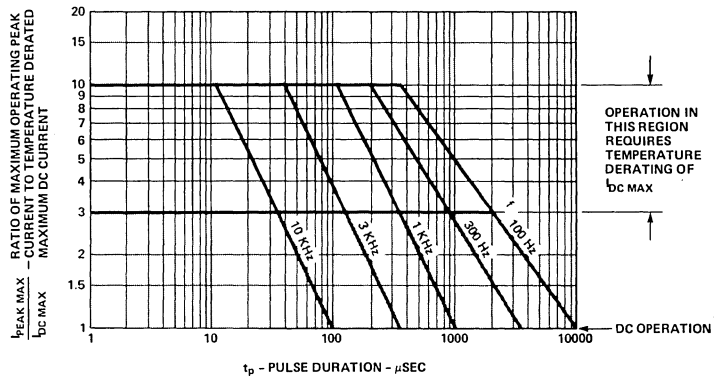


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

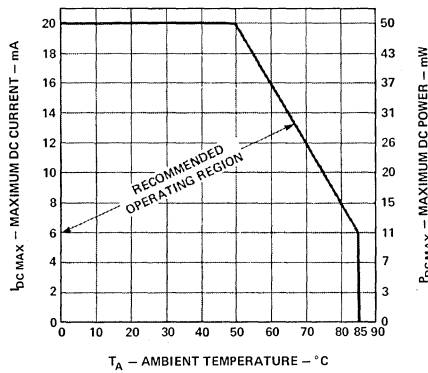


Figure 2. Maximum Allowable DC Current and DC Power Dissipation Per Segment as a Function of Ambient Temperature.

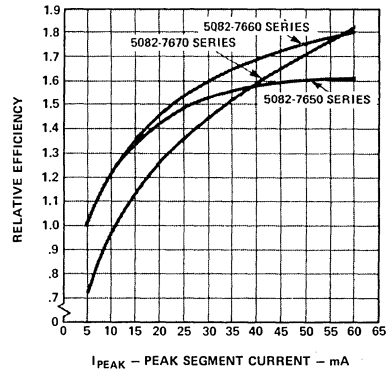


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

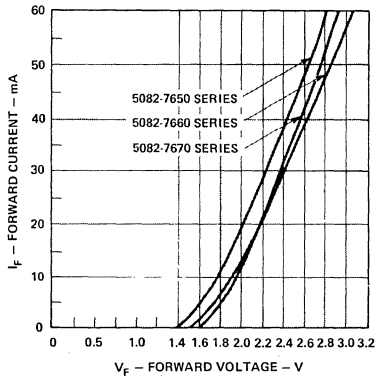


Figure 4. Forward Current vs. Forward Voltage Characteristic.

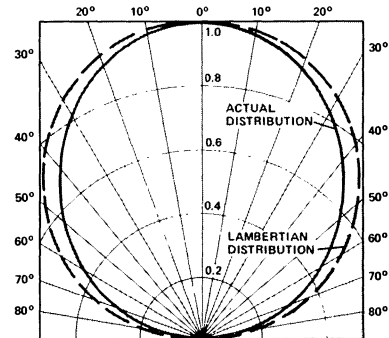


Figure 5. Normalized Angular Distribution of Luminous Intensity.

Operational Considerations

ELECTRICAL

The 5082-7600 series of display products are arrays of eight light emitting diodes which are optically magnified to form seven individual segments plus a decimal point.

The diodes in these displays utilize a Gallium Arsenide Phosphide junction on a Gallium Phosphide substrate to produce high efficiency red and yellow emission spectra and a Gallium Phosphide junction for the green. In the case of the red displays, efficiency is improved by at least a factor of 4 over the standard Gallium Arsenide Phosphide based technology. The use of Gallium Phosphide as the substrate does result in an internal dynamic resistance in the range of 12-48Ω. It is this resistance which causes the substantially higher forward voltage specifications in the new devices.

The user should be careful to scale the appropriate forward voltage from the V_F versus I_F curve, Figure 4, when designing for a particular forward current. Another way to obtain V_F would be to use the following formula:

$$V_F = V_{5mA} + R_S (I_F - 5mA)$$

where V_{5mA} and R_S are found in the following table:

Device	V_{5mA}	R_S
-7650 Series	1.65V	21Ω
-7660 Series	1.75V	25Ω
-7670 Series	1.85V	19Ω

Figure 1 relates refresh rate, f , and pulse duration, t_P , to a ratio which defines the maximum desirable operating peak current as a function of derated dc current, $I_{P\ MAX}/I_{DC\ MAX}$. To most effectively utilize Figure 1, perform the following steps:

- Determine desired duty factor.
Example: Four digit display, duty factor = 1/4
- Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_P .
Note: $t_P = \text{Duty Factor}$
Example: $f=1\ \text{kHz}$; $t_P=250\ \mu\text{sec}$
- Enter Figure 1 at the calculated t_P . Move vertically to the refresh rate line and then record the corresponding value of $I_{P\ MAX}/I_{DC\ MAX}$.
Example: At $t_P=250\ \mu\text{sec}$ and $f=1\ \text{kHz}$,
 $I_{P\ MAX}/I_{DC\ MAX} = 4.0$
- From Figure 2, determine the value for $I_{DC\ MAX}$.
Note: $I_{DC\ MAX}$ is derated above $T_A=50^\circ\text{C}$
Example: At $T_A=70^\circ\text{C}$, $I_{DC\ MAX}=12\text{mA}$
- Calculate $I_{P\ MAX}$ from $I_{P\ MAX}/I_{DC\ MAX}$ ratio and calculate I_{AVG} from I_P and duty factor.
Example: $I_P = (4.0)(12\text{mA}) = 48\text{mA peak}$
 $I_{AVG}=(1/4)(48\text{mA}) = 12\text{mA average}$.

The above calculations determine the maximum tolerable strobing conditions. Operation at a reduced peak current or duty factor is suggested to help insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

These displays may be operated in the strobed mode at currents up to 60mA peak. When operating at peak currents above 5mA for red and yellow or 10mA for green, there will be an improvement in the relative efficiency of the display (see Figure 3). Light output at higher currents can be calculated using the following relationship:

$$I_{V\ \text{TIME}\ \text{AVG}} = \left[\frac{I_{AVG}}{I_{AVG\ \text{SPEC}}} \right] \left[\frac{\eta_{I\ \text{PEAK}}}{\eta_{I\ \text{PEAK}\ \text{SPEC}}} \right] \left[I_{V\ \text{SPEC}} \right]$$

I_{AVG} = Operating point average current

$I_{AVG\ \text{SPEC}}$ = Average current for data sheet luminous intensity value, $I_{V\ \text{SPEC}}$

$\eta_{I\ \text{PEAK}}$ = Relative efficiency at operating peak current.

$\eta_{I\ \text{PEAK}\ \text{SPEC}}$ = Relative efficiency at data sheet peak current where luminous intensity $I_{V\ \text{SPEC}}$ is specified.

$I_{V\ \text{SPEC}}$ = Data sheet luminous intensity, specified at $I_{AVG\ \text{SPEC}}$ and $I_{PEAK\ \text{SPEC}}$.

Example: $I_P = 40\text{mA}$ and $I_{AVG} = 10\text{mA}$:

$$I_{V\ \text{TIME}\ \text{AVG}} = \left(\frac{10\text{mA}}{5\text{mA}} \right) \left(\frac{1.58}{1} \right) (300\mu\text{cd}) = 948\mu\text{cd/seg.}$$

CONTRAST ENHANCEMENT

The 5082-7600 series devices have been optimized for use in actual display systems. In order to maximum "ON-OFF" contrast, the bodies of the displays have been painted to match the appearance of an unilluminated segment. The emission wavelength of the red displays has been shifted from the standard GaAsP - 655nm to 635nm in order to provide an easier to read device.

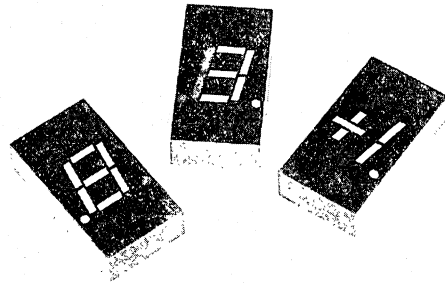
All of the colored display products should be used in conjunction with contrast enhancing filters. Some suggested contrast filters: for red displays, Panelgraphic Scarlet Red 65 or Homalite 1670; for yellow displays, Panelgraphic Amber 23 or Homalite (100-1720, 100-1726); for green, Panelgraphic Green 48 or Homalite (100-1440, 100-1425). Another excellent contrast enhancement material for all colors is the 3M light control film.

MECHANICAL

The 5082-7600 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 12.7mm (.5 in.) centers on a PC board. Also, the larger character height allows other character spacing options when desired. The leadframe has an integral seating plane which will hold the package approximately 1.52mm (.060 in.) above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only mixtures of Freon and alcohol be used for post solder vapor cleaning processes, with an immersion time in the vapors up to two minutes maximum. Suggested products are Freon TF, Freon TE, Genesolv DI-15 and Genesolv DE-15. Isopropyl, Ethanol or water may also be used for cleaning operations.

Features

- 5082-7730
Common Anode
Left Hand D.P.
- 5082-7731
Common Anode
Right Hand D.P.
- 5082-7736
Polarity and Overflow Indicator
Universal Pinout
Right Hand D.P.
- 5082-7740
Common Cathode
Right Hand D.P.
- EXCELLENT CHARACTER APPEARANCE
Continuous Uniform Segments
Wide Viewing Angle
High Contrast
- IC COMPATIBLE
1.6V dc per Segment
- STANDARD 0.3" DIP LEAD CONFIGURATION
PC Board or Standard Socket Mountable
- CATEGORIZED FOR LUMINOUS INTENSITY
Assures Uniformity of Light Output from
Unit to Unit within a Single Category



Description

The HP 5082-7730/7740 series devices are common anode LED displays. The series includes a left hand and a right hand decimal point numeric display as well as a polarity and overflow indicator. The large 7.62 mm (0.3 in.) high character size generates a bright, continuously uniform seven segment display. Designed for viewing distances of up to 3 meters (9.9 feet), these single digit displays provide a high contrast ratio and a wide viewing angle.

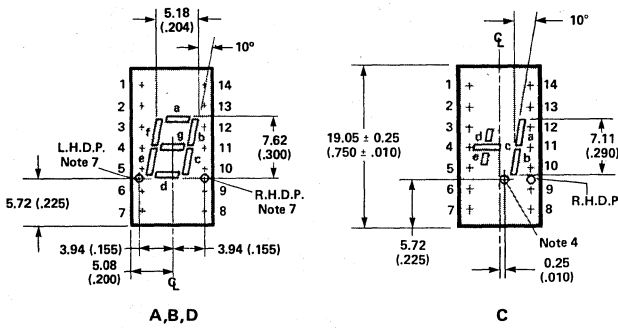
The 5082-7730 series devices utilize a standard 7.62 mm (0.3 in.) dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Devices

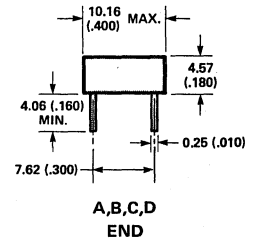
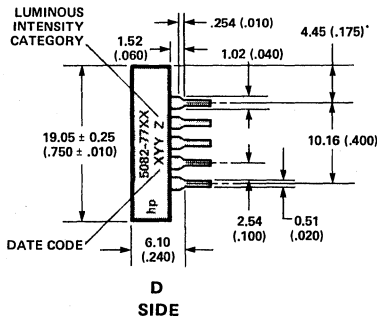
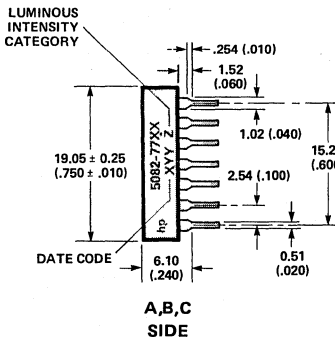
Part No. 5082-	Description	Package Drawing
7730	Common Anode Left Hand Decimal	A
7731	Common Anode Right Hand Decimal	B
7736	Universal Overflow ± 1 Right Hand Decimal	C
7740	Common Cathode Right Hand Decimal	D

Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins. See internal diagram C.

Package Dimensions



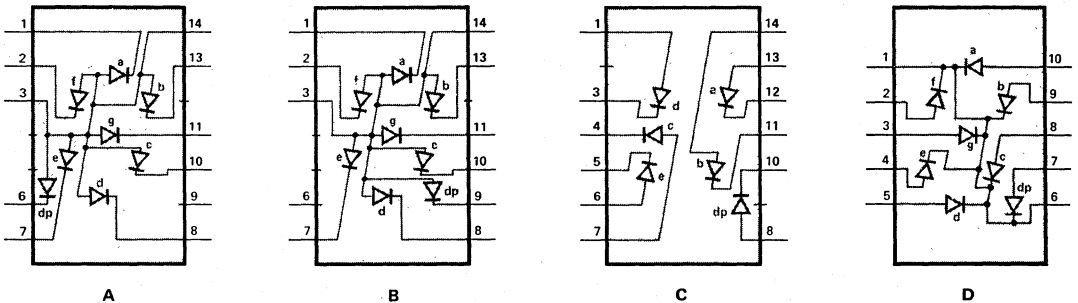
PIN	FUNCTION			
	A -7730	B -7731	C -7736	D -7740
1	CATHODE-a	CATHODE-a	ANODE-d	CATHODE ⁽⁶⁾
2	CATHODE-f	CATHODE-f	NO PIN	ANODE-f
3	ANODE ⁽³⁾	ANODE ⁽³⁾	CATHODE-d	ANODE-g
4	NO PIN	NO PIN	CATHODE-c	ANODE-e
5	NO PIN	NO PIN	CATHODE-e	ANODE-d
6	CATHODE-dp	NO CONN. ⁽⁵⁾	ANODE-e	CATHODE ⁽⁶⁾
7	CATHODE-e	CATHODE-e	ANODE-c	ANODE-dp
8	CATHODE-d	CATHODE-d	ANODE-dp	ANODE-c
9	NO CONN. ⁽⁵⁾	CATHODE-dp	NO PIN	ANODE-b
10	CATHODE-c	CATHODE-c	CATHODE-dp	ANODE-a
11	CATHODE-g	CATHODE-g	CATHODE-b	
12	NO PIN	NO PIN	CATHODE-a	
13	CATHODE-b	CATHODE-b	ANODE-a	
14	ANODE ⁽³⁾	ANODE ⁽³⁾	ANODE-b	



NOTES:

1. Dimensions in millimeters and (inches).
2. All untoleranced dimensions are for reference only.
3. Redundant anodes.
4. Unused dp position.
5. See Internal Circuit Diagram.
6. Redundant cathode.
7. See part number table for L.H.D.P. and R.H.D.P. designation.

Internal Circuit Diagram



Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P. ⁽¹⁾ (T _A =25° C)	42mW
Operating Temperature Range	-40° C to +85° C
Storage Temperature Range	-40° C to +85° C
Peak Forward Current Per Segment or D.P. ⁽³⁾ (T _A =25° C)	150mA
Average Forward Current Per Segment or D.P. ⁽¹⁾⁽²⁾ (T _A =25° C)	25mA
Reverse Voltage Per Segment or D.P.	6.0V
Lead Soldering Temperature	260° C for 3 Sec
	[1.59mm (1/16 inch) below seating plane ⁽⁴⁾]

Notes: 1. See power derating curve (Fig. 2). 2. Derate DC current from 50° C at 0.43mA/°C per segment. 3. See pulse width limitation curve (Fig. 2) and Duty Factor Curve (Fig. 5). 4. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(2,4) (Digit Average)	I_V	$I_{PEAK} = 100\text{mA}$ 10% Duty Cycle	50	200		μcd
			100	350		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength ⁽²⁾	λ_d			640		nm
Forward Voltage, any Segment or D.P.	V_F	$I_F = 20\text{mA}$		1.6	2.0	V
Reverse Current, any Segment or D.P.	I_R	$V_R = 6\text{V}$		10		μA
Rise and Fall Time ⁽³⁾	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F/^\circ\text{C}$			-2.0		$\text{mV}/^\circ\text{C}$

NOTES:

- The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
- The dominant wavelength, λ_d , is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
- Time for a 10% - 90% change of light intensity for step change in current.
- Temperature coefficient of luminous intensity $I_V/^\circ\text{C}$ is determined by the formula: $I_{V_{T_A}} = I_{V_{25^\circ\text{C}}} e^{[-(0.188/^\circ\text{C})(T_A - 25^\circ\text{C})]}$.

Operational Considerations

ELECTRICAL

The 5082-7730/7740 series display is composed of eight light emitting diodes optically magnified to form seven individual segments and decimal point.

The diodes are made of GaAsP (Gallium Arsenide Phosphide) junction on a GaAs substrate. Diode turn-on voltage is approximately 1.55 volts and typical forward diode resistance is 5 ohms. For strobing at peak currents a user should take this forward resistance into account.

Typical forward voltage may be scaled from Figure 4 or calculated from the following formula:

$$V_F = 1.55\text{V} + (3\Omega \times I_{PEAK})$$

Figure 1 relates refresh rate, f , and pulse duration, t_p , to a ratio which defines the maximum desirable operating peak current as a function of derated dc current, $I_{P\text{ MAX}}/I_{DC\text{ MAX}}$. To most effectively utilize Figure 1, perform the following steps:

- Determine desired duty factor.
Example: Four digit display, duty factor = 1/4.
- Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_p . Note: $t_p = \text{Duty Factor}$
Example: $f = 1\text{kHz}$; $t_p = 250\ \mu\text{sec}$.
- Enter Figure 1 at the calculated t_p . Move vertically to the refresh rate line and then record the corresponding value of $I_{P\text{ MAX}}/I_{DC\text{ MAX}}$.
Example: At $t_p = 250\ \mu\text{sec}$ and $f=1\text{kHz}$,
 $I_{P\text{ MAX}}/I_{DC\text{ MAX}} = 4.0$
- From Figure 2, determine the value for $I_{DC\text{ MAX}}$.
Note: $I_{DC\text{ MAX}}$ is derated above $T_A=50^\circ\text{C}$
Example: At $T_A=70^\circ\text{C}$, $I_{DC\text{ MAX}} = 16.4\text{mA}$.
- Calculate $I_{P\text{ MAX}}$ from $I_{P\text{ MAX}}/I_{DC\text{ MAX}}$ ratio and calculate I_{AVG} from I_P and duty factor.
Example: $I_P=(4.0) (16.4\text{mA}) = 65.6\text{mA}$ peak
 $I_{AVG}=(1/4) (65.6\text{mA}) = 16.4\text{mA}$ average.

The above calculations determine the maximum tolerable strobing conditions. Operation at a reduced peak current or duty factor is suggested to help insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

This display may be operated at various peak currents (see Figure 3). Light output for a selected peak current can be calculated as follows:

$$I_V \text{ TIME AVG} = \left[\frac{I_{AVG}}{I_{AVG\text{ SPEC}}} \right] \left[\frac{\eta_{IPEAK}}{\eta_{IPEAK\text{ SPEC}}} \right] [I_V \text{ SPEC}]$$

- I_{AVG} = Operating point average current
- $I_{AVG\text{ SPEC}}$ = Average current for data sheet luminous intensity value, $I_V \text{ SPEC}$
- η_{IPEAK} = Relative efficiency at operating peak current
- $\eta_{IPEAK\text{ SPEC}}$ = Relative efficiency at data sheet peak current where luminous intensity $I_V \text{ SPEC}$ is specified.
- $I_V \text{ SPEC}$ = Data sheet luminous intensity, specified at $I_{AVG\text{ SPEC}}$ and $I_{PEAK\text{ SPEC}}$

CONTRAST ENHANCEMENT

The 5082-7730/7740 series display may be effectively filtered using one of the following filter products: Homalite H100-1605: H 100-1804 (purple); Panelgraphic Ruby Red 60: Dark Red 63: Purple 90; Plexiglas 2423; 3M Brand Light Control Film for daylight viewing. For further information see Application Note 964.

MECHANICAL

The 5082-7730/7740 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 10.16mm (.4 in.) centers on a PC board. Also, the larger character height allows other character spacing options when desired. The lead frame has an integral seating plane which will hold the package approximately 1.52mm (.060 in.) above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only mixtures of Freon and alcohol be used for post solder vapor cleaning processes, with an immersion time in the vapors up to two minutes maximum. Suggested products are Freon TF, Freon TE, Genesolv DI-15 and Genesolv DE-15. Isopropanol, Ethanol or water may also be used for cleaning operations.

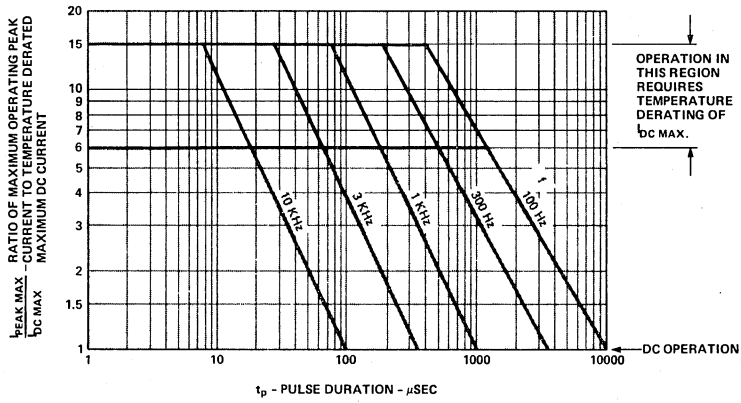


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

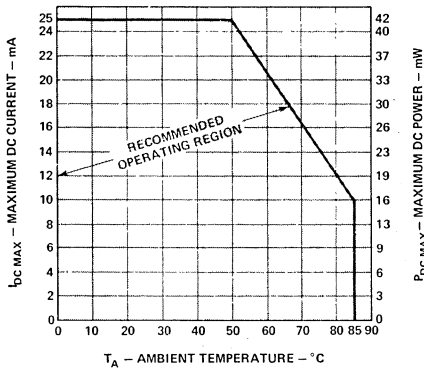


Figure 2. Maximum Allowable DC Current and DC Power Dissipation per Segment as a Function of Ambient Temperature.

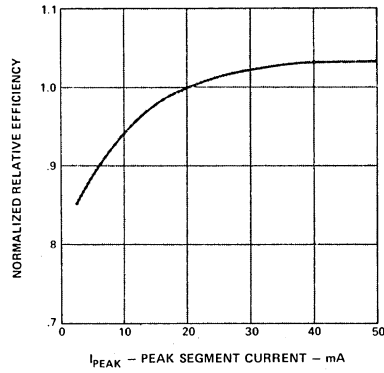
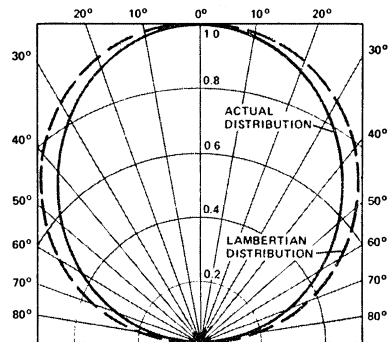
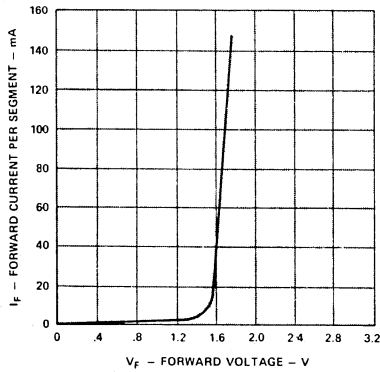


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.



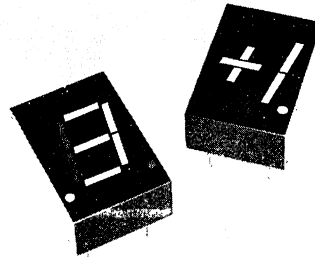
.43 INCH RED SEVEN SEGMENT DISPLAY

5082-7750 SERIES
5082-7760

TECHNICAL DATA APRIL 1978

Features

- **5082-7750**
Common Anode
Left Hand D.P.
- **5082-7751**
Common Anode
Right Hand D.P.
- **5082-7756**
Polarity and Overflow Indicator
Universal Pinout
Right Hand D.P.
- **5082-7760**
Common Cathode
Right Hand D.P.
- **LARGE DIGIT**
Viewing Up to 6 Meters (19.7 Feet)
- **EXCELLENT CHARACTER APPEARANCE**
Continuous Uniform Segments
Wide Viewing Angle
High Contrast
- **IC COMPATIBLE**
- **STANDARD 7.62mm (.3 in.) DIP
LEAD CONFIGURATION**
PC Board or Standard Socket Mountable
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output from
Unit to Unit within a Single Category



Description

The 5082-7750/7760 series are large 10.92mm (.43 in.) GaAsP LED seven segment displays. Designed for viewing distances up to 6 meters (19.7 feet), these single digit displays provide a high contrast ratio and a wide viewing angle.

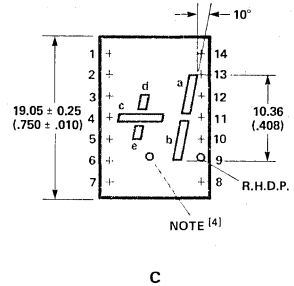
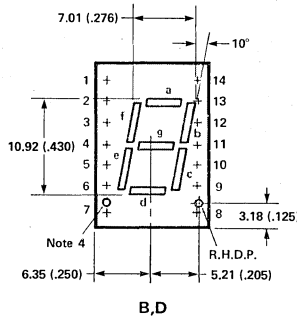
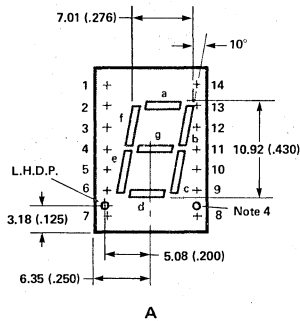
These devices utilize a standard 7.62mm (.3 in.) dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Devices

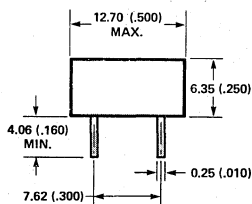
Part No. 5082-	Description	Package Drawing
-7750	Common Anode Left Hand Decimal	A
-7751	Common Anode Right Hand Decimal	B
-7756	Universal Overflow ± 1 Right Hand Decimal	C
-7760	Common Cathode Right Hand Decimal	D

Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins. See internal diagram C.

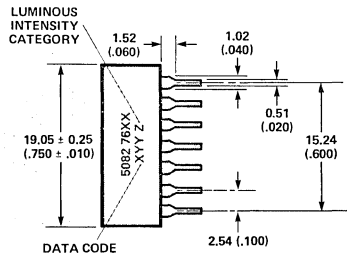
Package Dimensions



FRONT VIEW



END VIEW



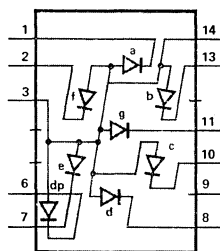
SIDE VIEW

PIN	FUNCTION			
	A -7750	B -7751	C -7756	D -7760
1	CATHODE-a	CATHODE-a	CATHODE-d	ANODE-a
2	CATHODE-f	CATHODE-f	ANODE-d	ANODE-f
3	ANODE[3]	ANODE[3]	NO PIN	CATHODE[5]
4	NO PIN	NO PIN	CATHODE-c	NO PIN
5	NO PIN	NO PIN	CATHODE-e	NO PIN
6	CATHODE-dp	NO CONN.[5]	ANODE-e	NO CONN.[5]
7	CATHODE-e	CATHODE-e	ANODE-c	ANODE-e
8	CATHODE-d	CATHODE-d	ANODE-dp	ANODE-d
9	NO CONN.[5]	CATHODE-dp	CATHODE-dp	ANODE-dp
10	CATHODE-c	CATHODE-c	CATHODE-b	ANODE-c
11	CATHODE-g	CATHODE-g	CATHODE-a	ANODE-g
12	NO PIN	NO PIN	NO PIN	NO PIN
13	CATHODE-b	CATHODE-b	ANODE-a	ANODE-b
14	ANODE[3]	ANODE[3]	ANODE-b	CATHODE[6]

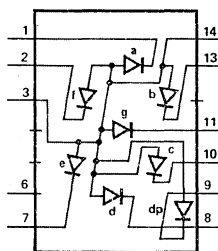
NOTES:

- Dimensions in millimeters and (inches).
- All untoleranced dimensions are for reference only.
- Redundant anodes.
- Unused dp position.
- See Internal Circuit Diagram.
- Redundant cathodes.

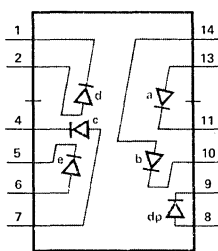
Internal Circuit Diagram



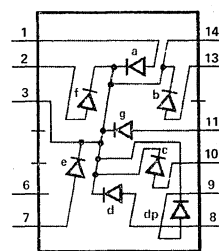
A



B



C



D

Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P. ⁽¹⁾ (T _A =25°C)	42mW
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-40°C to +85°C
Peak Forward Current Per Segment or D.P. ⁽³⁾ (T _A =25°C)	150mA
DC Forward Current Per Segment or D.P. ^(1,2) (T _A =25°C)	25mA
Reverse Voltage Per Segment or D.P.	6.0V
Lead Soldering Temperature	260°C for 3 Sec [1.59mm (1/16 inch) below seating plane ⁽⁴⁾]

Notes: 1. See power derating curve (Fig.2). 2. Derate average current from 50°C at 0.43mA/°C per segment. 3. See Maximum Tolerable Segment Peak Current vs. Pulse Duration curve, (Fig. 1). 4. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment ^(2,4) (Digit Average)	I_v	$I_{PEAK} = 100\text{mA}$ 12.5% Duty Cycle		350		μcd
		$I_F = 20\text{mA}$	150	400		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength ⁽²⁾	λ_d			645		nm
Forward Voltage, any Segment or D.P.	V_F	$I_F = 20\text{mA}$		1.6	2.0	V
Reverse Current, any Segment or D.P.	I_R	$V_R = 6\text{V}$		10		μA
Rise and Fall Time ⁽³⁾	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F / ^\circ\text{C}$			-2.0		$\text{mV}/^\circ\text{C}$

Notes:

- The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
- The dominant wavelength, λ_d , is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
- Time for a 10% - 90% change of light intensity for step change in current.
- Temperature coefficient of luminous intensity $I_v / ^\circ\text{C}$ is determined by the formula: $I_{vTA} = I_{v25^\circ\text{C}} e^{(-0.0188/^\circ\text{C})(T_A - 25^\circ\text{C})}$

Operational Considerations

ELECTRICAL

The 5082-7750/7760 series display is composed of eight light emitting diodes optically magnified to form seven individual segments and decimal point.

The diodes are made of GaAsP (Gallium Arsenide Phosphide) junction on a GaAs substrate. Diode turn-on voltage is approximately 1.55 volts and typical forward diode resistance is 5 ohms. For strobing at peak currents a user should take this forward resistance into account.

Typical forward voltage may be scaled from Figure 4 or calculated from the following formula:

$$V_F = 1.55\text{V} + (3\Omega \times I_{PEAK})$$

Figure 1 relates refresh rate, f , and pulse duration, t_p , to a ratio which defines the maximum desirable operating peak current as a function of derated dc current, $I_{P\text{ MAX}}/I_{DC\text{ MAX}}$. To most effectively utilize Figure 1, perform the following steps:

- Determine desired duty factor.
Example: Four digit display, duty factor = 1/4.
- Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_p . Note: $f t_p = \text{Duty Factor}$
Example: $f = 1\text{kHz}$; $t_p = 250 \mu\text{sec}$.
- Enter Figure 1 at the calculated t_p . Move vertically to the refresh rate line and then record the corresponding value of $I_{P\text{ MAX}}/I_{DC\text{ MAX}}$.
Example: At $t_p = 250 \mu\text{sec}$ and $f = 1\text{kHz}$,
 $I_{P\text{ MAX}}/I_{DC\text{ MAX}} = 4.0$
- From Figure 2, determine the value for $I_{DC\text{ MAX}}$.
Note: $I_{DC\text{ MAX}}$ is derated above $T_A = 50^\circ\text{C}$
Example: At $T_A = 70^\circ\text{C}$, $I_{DC\text{ MAX}} = 16.4\text{mA}$.
- Calculate $I_{P\text{ MAX}}$ from $I_{P\text{ MAX}}/I_{DC\text{ MAX}}$ ratio and calculate I_{AVG} from I_P and duty factor.
Example: $I_P = (4.0)(16.4\text{mA}) = 65.6\text{mA}$ peak
 $I_{AVG} = (1/4)(65.6\text{mA}) = 16.4\text{mA}$ average.

The above calculations determine the maximum tolerable strobing conditions. Operation at a reduced peak current or duty factor is suggested to help insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

This display may be operated at various peak currents (see Figure 3). Light output for a selected peak current may be calculated from the 20mA value using the following formula:

$$I_v = (I_{v\ 20\text{mA}}) \eta_{I_{PEAK}} \left(\frac{I_{F\text{ AVG}}}{20\text{mA}} \right)$$

Where: I_v = Luminous Intensity at desired I_{AVG}

$I_{v\ 20\text{mA}}$ = Luminous Intensity at $I_F = 20\text{mA}$

I_{AVG} = Average Forward Current per segment = $(I_{PEAK} \times \text{Duty Factor})$

$\eta_{I_{PEAK}}$ = Relative Efficiency Factor at Peak Operating Forward Current from Figure 3.

CONTRAST ENHANCEMENT

The 5082-7750/7760 series display may be effectively filtered using one of the following filter products: Homalite H 100-1605 or H 100-1804 Purple; Panelgraphic Ruby Red 60, Dark Red 63 or Purple 90; Plexiglas 2423; 3M Brand Light Control Film for daylight viewing.

MECHANICAL

The 5082-7750/7760 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 12.7mm (.5 in.) centers on a PC board. Also, the larger character height allows other character spacing options when desired. The lead frame has an integral seating plane which will hold the package approximately 1.52mm (.060 in.) above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only mixtures of Freon and alcohol be used for post solder vapor cleaning processes, with an immersion time in the vapors up to two minutes maximum. Suggested products are Freon TF, Freon TE, Genesolv DI-15 and Genesolv DE-15. Isopropanol, Ethanol or water may also be used for cleaning operations.

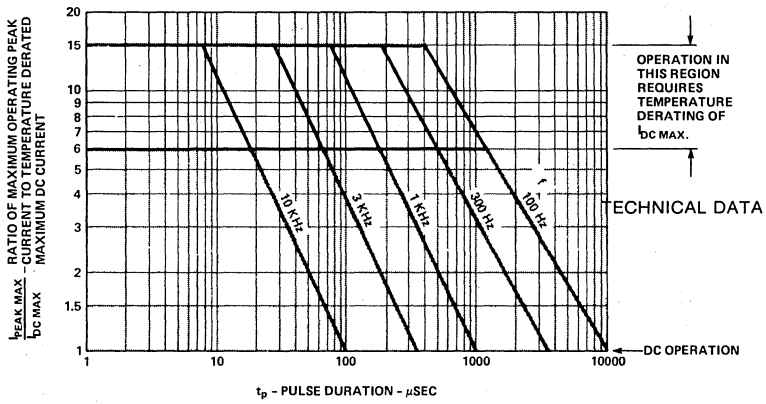


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

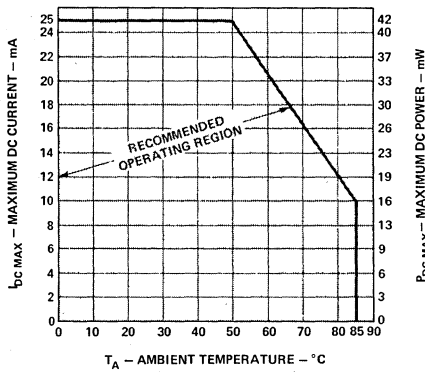


Figure 2. Maximum Allowable DC Current and DC Power Dissipation per Segment as a Function of Ambient Temperature.

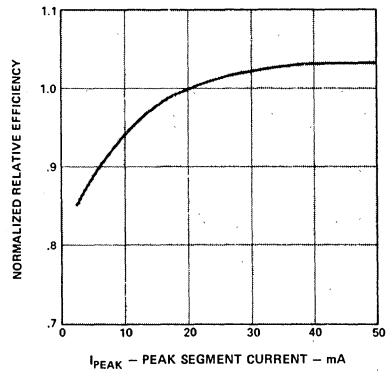


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.

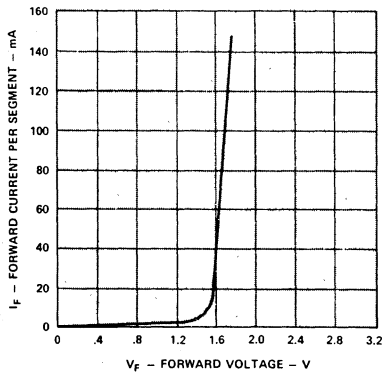


Figure 4. Forward Current versus Forward Voltage.

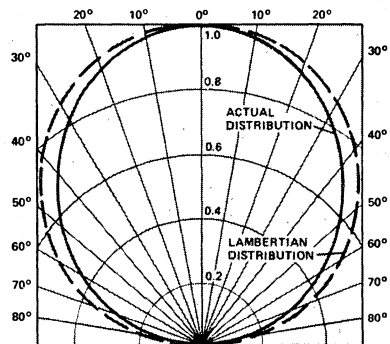


Figure 5. Normalized Angular Distribution of Luminous Intensity.

Features

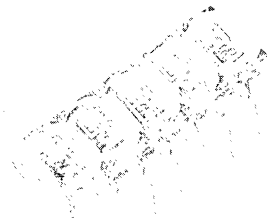
- **ULTRA LOW POWER**
Excellent Readability at Only 500 μ A
Average per Segment
- **CONSTRUCTED FOR STROBED OPERATION**
Minimizes Lead Connections
- **STANDARD DIP PACKAGE**
End Stackable
Integral Red Contrast Filter
Rugged Construction
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output from
Unit to Unit within a Single Category
- **IC COMPATIBLE**



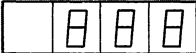


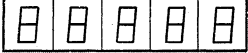
Description

The HP 5082-7400 series are 2.79mm (.11"), seven segment GaAsP numeric indicators packaged in 3, 4, and 5 digit end-stackable clusters. An integral magnification technique increases the luminous intensity, thereby making ultra-low power consumption possible. Options include either the standard lower right hand decimal point or a centered decimal point for increased legibility in multi-cluster applications.

Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.



Device Selection Guide

Digits per Cluster	Configuration		Part Number	
	Device		Center Decimal Point	Right Decimal Point
3 (right)			5082-7402	5082-7412
3 (left)			5082-7403	5082-7413
4			5082-7404	5082-7414
5			5082-7405	5082-7415

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment (Duration < 1 msec)	I_{PEAK}		110	mA
Average Current per Segment	I_{AVG}		5	mA
Power Dissipation per Digit ^[1]	P_D		80	mW
Operating Temperature, Ambient	T_A	-40	75	°C
Storage Temperature	T_S	-40	100	°C
Reverse Voltage	V_R		5	V

NOTES: 1. At 25°C; derate 1mW/°C above 25°C ambient. 2. See Mechanical Section for recommended flux removal solvents.

Electrical /Optical Characteristics at $T_A=25^\circ\text{C}$

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp ^[3,4] (Time Averaged)	I_V	$I_{AVG} = 1\text{mA}$ ($I_{PK} = 10\text{mA}$ duty cycle = 10%)	5	20		μcd
Peak Wavelength	λ_{PEAK}			655		nm
Forward Voltage/Segment or dp	V_F	$I_F = 10\text{mA}$		1.6	2.0	V
Reverse Current/Segment or dp	I_R	$V_R = 5\text{V}$			100	μA
Rise and Fall Time ^[5]	t_r, t_f			10		ns

NOTES: 3. The digits are categorized for luminous intensity. Intensity categories are designated by a letter located on the back side of the package. 4. Operation at Peak Currents less than 5mA is not recommended. 5. Time for a 10%-90% change of light intensity for step change in current.

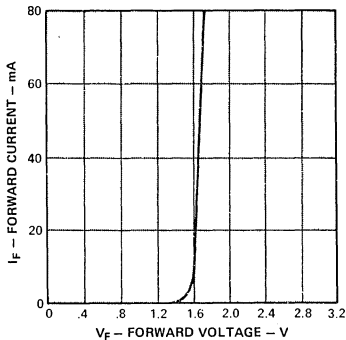


Figure 1. Forward Current vs. Forward Voltage.

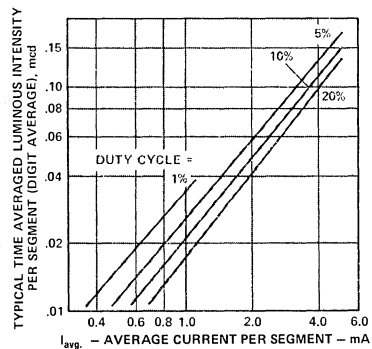


Figure 2. Typical Time Averaged Luminous Intensity per Segment (Digit Average) vs. Average Current per Segment.

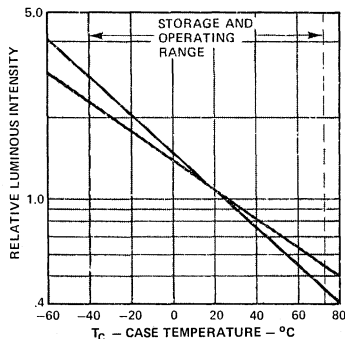


Figure 3. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.

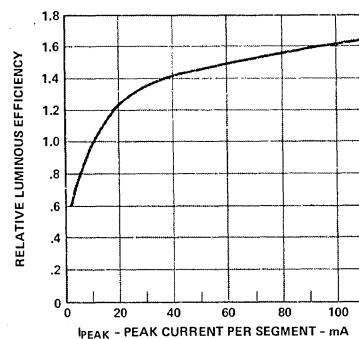
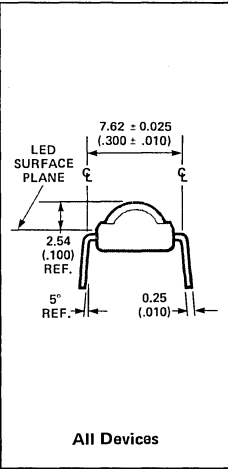
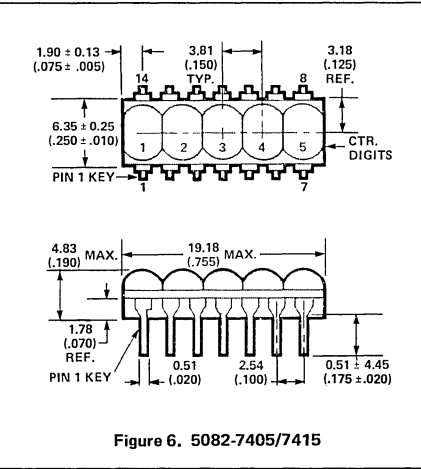
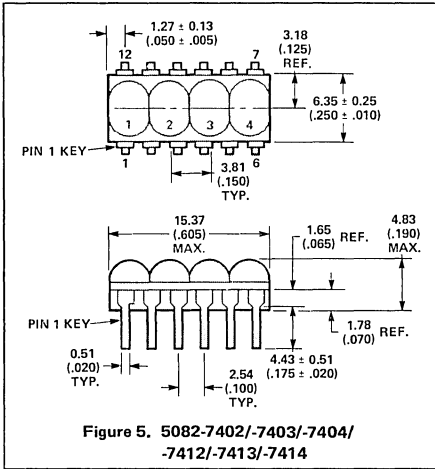


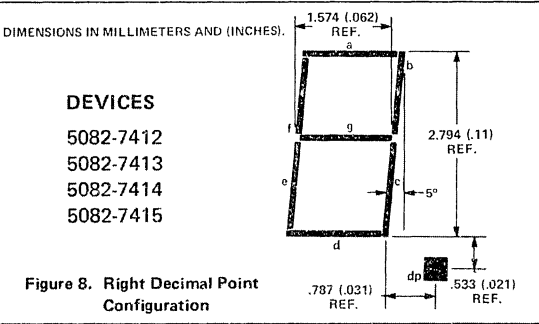
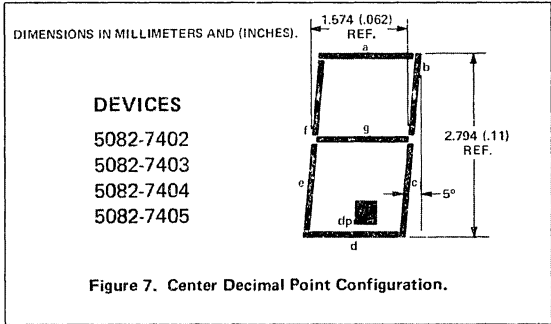
Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment.

Package Description

- NOTES: 1. Dimensions in millimeters and (inches).
 2. Tolerances on all dimensions are $\pm 0.038\text{mm}$ (± 0.015 in.) unless otherwise noted.



Magnified Character Font Description



Device Pin Description

PIN NO.	5082-7402/7412 FUNCTION	5082-7403/7413 FUNCTION	5082-7404/7414 FUNCTION	5082-7405/7415 FUNCTION
1	SEE NOTE 1.	CATHODE 1	CATHODE 1	CATHODE 1
2	ANODE e	ANODE e	ANODE e	ANODE e
3	ANODE c	ANODE c	ANODE c	ANODE c
4	CATHODE 3	CATHODE 3	CATHODE 3	CATHODE 3
5	ANODE dp	ANODE dp	ANODE dp	ANODE dp
6	CATHODE 4	SEE NOTE 1.	CATHODE 4	ANODE d
7	ANODE g	ANODE g	ANODE g	CATHODE 5
8	ANODE d	ANODE d	ANODE d	ANODE g
9	ANODE f	ANODE f	ANODE f	CATHODE 4
10	CATHODE 2	CATHODE 2	CATHODE 2	ANODE f
11	ANODE b	ANODE b	ANODE b	(See Note 1)
12	ANODE a.	ANODE a	ANODE a	ANODE b
13	—	—	—	CATHODE 2
14	—	—	—	ANODE a

NOTE 1. Leave Pin unconnected

Electrical

Character encoding can be performed by commercially available BCD-7 segment decoder/driver circuits. Through the use of a strobing technique, only one decoder/driver is required for each display. In addition, the number of interconnection lines between the display and the drive circuitry is minimized to $8 + N$, where N is the number of characters in the display.

Each of the segments on the display is "addressable" on two sets of lines — the "character enable" lines and the "segment enable" lines. Displays are wired so that all of the cathodes of all segments comprising one character are wired together to a single character enable line. Similarly, the anodes of each of like segments (e.g., all of the decimal points, all of the center line anodes, etc.) are wired to a single line. Therefore, a single digit in the cluster can be illuminated by connecting the appropriate character enable line, with the appropriate segment enable lines for the character being displayed. When each character in the display is illuminated in sequence, at a minimum of 100 times a second, flicker free characters are formed.

The decimal point in the 7412, 7413, 7414, and 7415 displays is located at the lower right of the digit for conventional driving schemes.

The 7402, 7403, 7404 and 7405 displays contain a centrally located decimal point which is activated in place of a digit. In long registers, this technique of setting off the decimal point significantly improves the display's readability. With respect to timing, the decimal point is treated as a separate

character with its own unique time frame.

A detailed discussion of display circuits and drive techniques appears in Application Note 937.

Mechanical

The 5082-7400 series package is a standard 12 or 14 Pin DIP consisting of a plastic encapsulated lead frame with integral molded lenses. It is designed for plugging into DIP sockets or soldering into PC boards. The lead frame construction allows use of standard DIP insertion tools and techniques. Alignment problems are simplified due to the clustering of digits in a single package. The shoulders of the lead frame pins are intentionally raised above the bottom of the package to allow tilt mounting of up to 20° from the PC board.

To improve display contrast, the plastic incorporates a red dye that absorbs strongly at all visible wavelengths except the 655 nm emitted by the LED. In addition, the lead frames are selectively darkened to reduce reflectance. An additional filter, such as Plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will further lower the ambient reflectance and improve display contrast.

The devices can be soldered for up to 5 seconds at a maximum solder temperature of 230°C ($1/16''$ below the seating plane). The plastic encapsulant used in these displays may be damaged by some solvents commonly used for flux removal. It is recommended that only Freon TE, Freon TE-35, Freon TF, Isopropanol, or soap and water be used for cleaning operations.

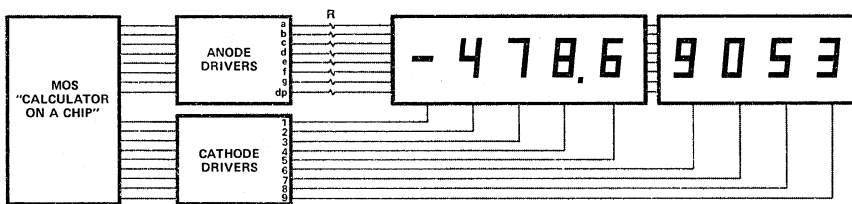


Figure 9. Block Diagram for Calculator Display Using Lower Right Hand Decimal Point.

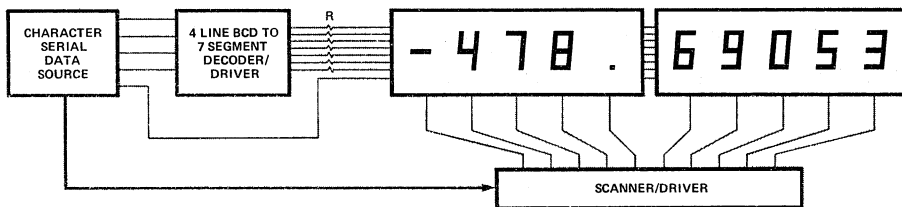
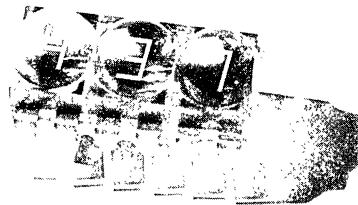
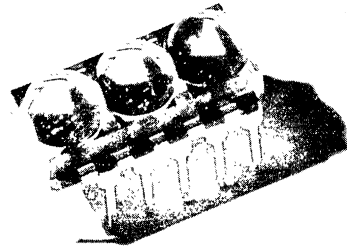


Figure 10. Block Diagram for Display Using Center Decimal Point.

Features

- **MOS COMPATIBLE**
Can be Driven Directly from many
MOS Circuits
- **LOW POWER**
Excellent Readability at Only 250 μ A Average
per Segment
- **CONSTRUCTED FOR STROBED OPERATION**
Minimizes Lead Connections
- **STANDARD DIP PACKAGE**
End Stackable
Integral Red Contrast Filter
Rugged Construction
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output from
Unit to Unit within a Single Category





Description

The HP 5082-7430 series displays are 2.79mm (.11 inch, seven segment GaAsP numeric indicators packaged in 2 or 3 digit end-stackable clusters on 200 mil centers. An integral magnification technique increases the luminous intensity, thereby making ultra-low power consumption possible. These clusters

have the standard lower right hand decimal points. Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.

Device Selection Guide

Digits per Cluster	Configuration		Part Number
	Device	Package	
2(right)		(Figure 5)	5082-7432
3		(Figure 5)	5082-7433

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500 μ s)	I_{PEAK}		50	mA
Average Current per Segment or dp	I_{AVG}		5	mA
Power Dissipation per Digit [1]	P_D		80	mW
Operating Temperature, Ambient	T_A	-40	75	$^{\circ}$ C
Storage Temperature	T_S	-40	100	$^{\circ}$ C
Reverse Voltage	V_R		5	V
Solder Temperature 1/16" below seating plane ($t \leq 3$ sec.) [2]			230	$^{\circ}$ C

NOTES: 1. Derate linearly @ 1 mW/ $^{\circ}$ C above 25 $^{\circ}$ C ambient. 2. See Mechanical section for recommended flux removal solvents.

Electrical/Optical Characteristics at $T_A=25^{\circ}$ C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp [3,4]	I_V	$I_{AVG} = 500\mu A$ ($I_{PK} = 5$ mA duty cycle = 10%)	10	40		μ cd
Peak Wavelength	λ_{PEAK}			655		nm
Forward Voltage/Segment or dp	V_F	$I_F = 5$ mA		1.55	2.0	V
Reverse Current/Segment or dp	I_R	$V_R = 5$ V			100	μ A
Rise and Fall Time [5]	t_r, t_f			10		ns

NOTES: 3. The digits are categorized for luminous intensity. Intensity categories are designated by a letter located on the back side of the package. 4. Operation at Peak Currents less than 3.5mA is not recommended. 5. Time for a 10%-90% change of light intensity for step change in current.

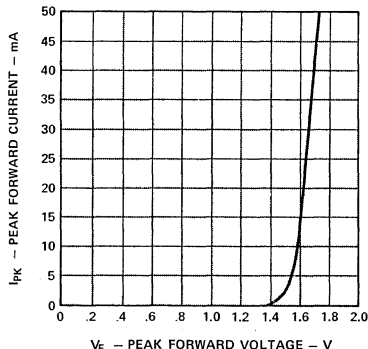


Figure 1. Peak Forward Current vs. Peak Forward Voltage

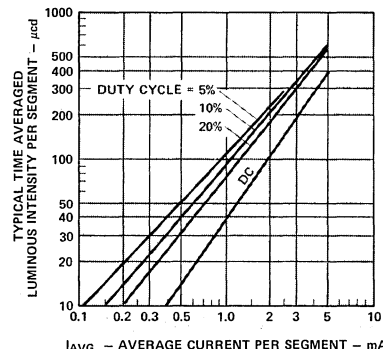


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

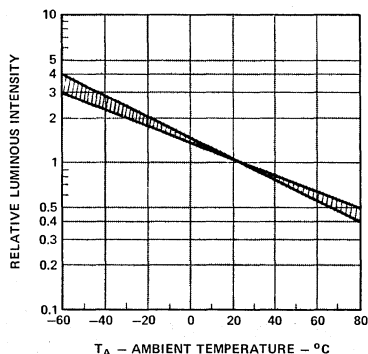


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

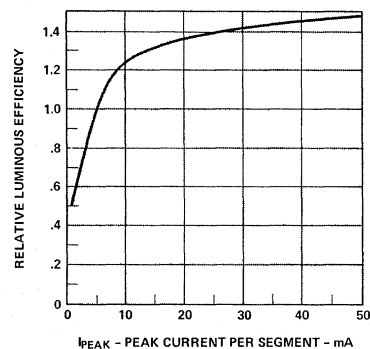


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

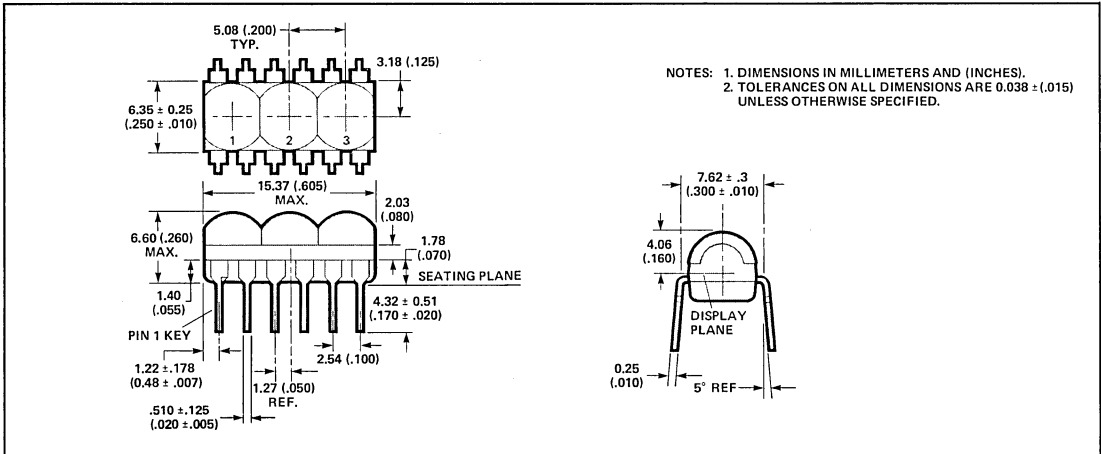


Figure 5.

Magnified Character Font Description

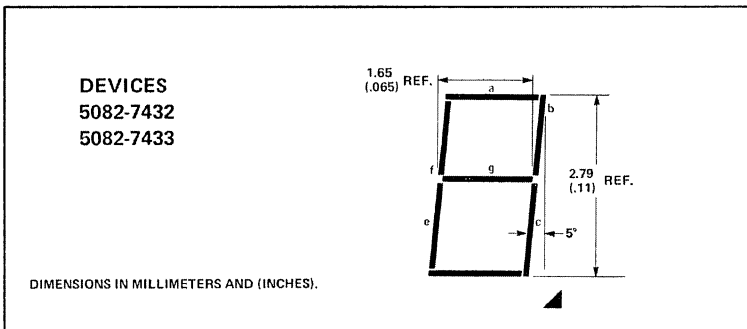


Figure 6.

Device Pin Description

PIN NUMBER	5082-7432 FUNCTION	5082-7433 FUNCTION
1	SEE NOTE 1.	CATHODE 1
2	ANODE e	ANODE e
3	ANODE d	ANODE d
4	CATHODE 2	CATHODE 2
5	ANODE c	ANODE c
6	ANODE dp	ANODE dp
7	CATHODE 3	CATHODE 3
8	ANODE b	ANODE b
9	ANODE g	ANODE g
10	ANODE a	ANODE a
11	ANODE f	ANODE f
12	SEE NOTE 1.	SEE NOTE 1.

NOTE 1. Leave Pin unconnected.

Electrical/Optical

The 5082-7430 series devices utilize a monolithic GaAsP chip of 8 common cathode devices for each display digit. The segment anodes of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under an integrally molded lens giving a magnified character height of 2.79mm (0.11) inches. Satisfactory viewing will be realized within an angle of approximately $\pm 20^\circ$ from the center-line of the digit.

To improve display contrast, the plastic encapsulant contains a red dye to reduce the reflected ambient light. An additional filter, such as Plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will further lower the ambient reflectance and improve display contrast.

Character encoding on the 5082-7430 series devices is performed by standard 7 segment decoder/driver circuits. Through the use of strobing techniques

only one decoder/driver is required for very long multidigit displays.

A discussion of display circuits and drive techniques appears in Application Note 946.

Mechanical

The 5082-7430 series package is a standard 12 Pin DIP consisting of a plastic encapsulated lead frame with integrally molded lenses. It is designed for plugging into DIP sockets or soldering into PC boards. Alignment problems are simplified due to the clustering of digits in a single package.

The devices can be soldered for up to 5 seconds at a maximum solder temperature of 230°C ($1/16''$ below the seating plane). The plastic encapsulant used in these displays may be damaged by some solvents commonly used for flux removal. It is recommended that only Freon TE, Freon TE-35, Freon TF, Isopropanol, or soap and water be used for cleaning operations.

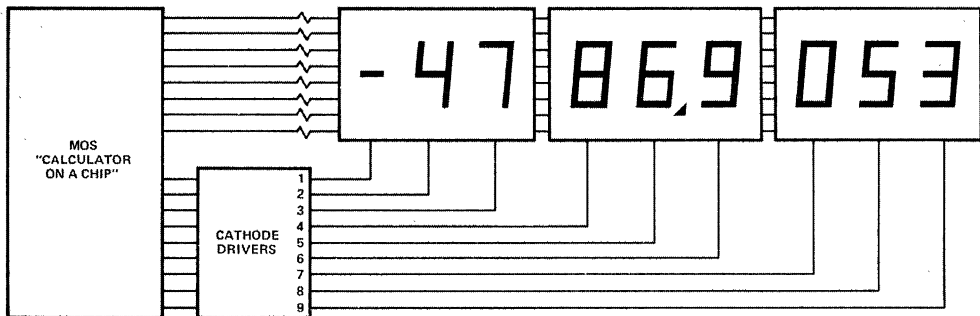
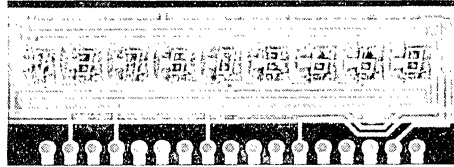


Figure 7. Block Diagram for Calculator Display

Features

- **MOS COMPATIBLE**
Can be driven directly from MOS circuits.
- **LOW POWER**
Excellent readability at only 250 μ A average per segment.
- **UNIFORM ALIGNMENT**
Excellent alignment is assured by design.
- **MATCHED BRIGHTNESS**
Uniformity of light output from digit to digit on a single PC Board.
- **AVAILABLE IN 50.8mm (2.0 inch) AND 60.325mm (2.375 inch) BOARD LENGTHS**



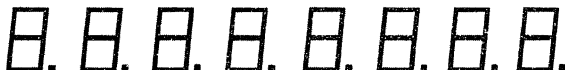

Description

The HP 5082-7440 series displays are 2.67mm (.105") high, seven segment GaAsP Numeric Indicators mounted in an eight or nine digit configuration on a P.C. Board. These special parts, designed specifically for calculators, have right hand decimal points and are mounted on

5.08mm (200 mil) centers. The plastic lens magnifies the digits and includes an integral protective bezel.

Applications are primarily portable, hand-held calculators and other products requiring low power, low cost and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Configuration		Part No.
	Device	Package	
8		(Figure 5)	5082-7440
			5082-7448
9		(Figure 5)	5082-7441
			5082-7449

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500 μ s)	I_{PEAK}		50	mA
Average Current per Segment or dp ^[1]	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	-20	+85	$^{\circ}$ C
Storage Temperature	T_S	-20	+85	$^{\circ}$ C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge ($t \leq 3$ sec.) ^[2]			230	$^{\circ}$ C

NOTES: 1. Derate linearly @ 0.1mA/ $^{\circ}$ C above 60 $^{\circ}$ C ambient. 2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at $T_A = 25^{\circ}$ C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp ^[3,4]	I_V	$I_{AVG} = 500\mu A$ ($I_{PK} = 5mA$ duty cycle = 10%)	9	40		μcd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp	V_F	$I_F = 5mA$		1.55		V

NOTES: 3. See Figure 7 for test circuit.
4. Operation at Peak Currents of less than 3.5mA is not recommended.

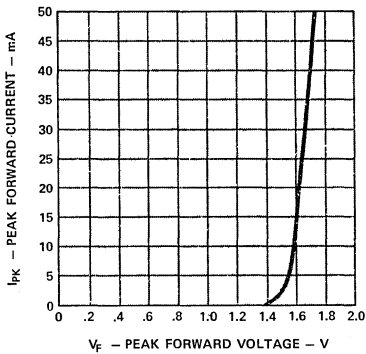


Figure 1. Peak Forward Current vs. Peak Forward Voltage

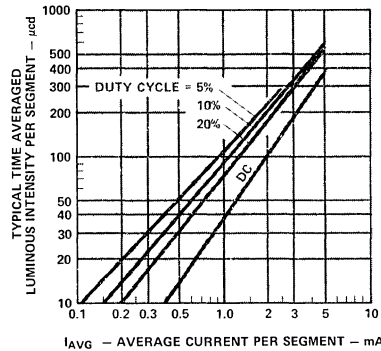


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

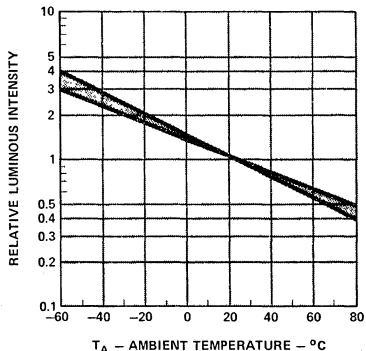


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

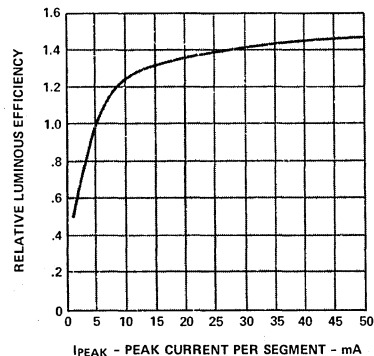


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

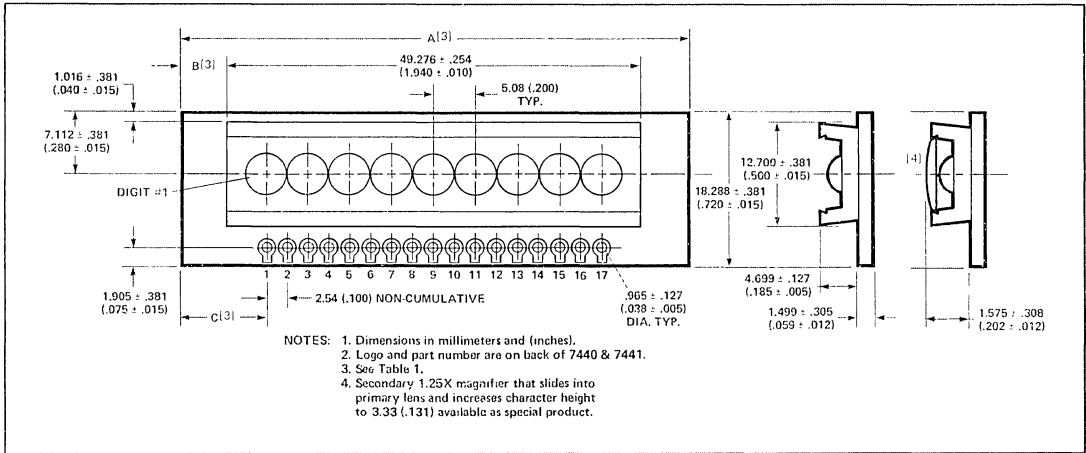


Figure 5.

Magnified Character Font Description

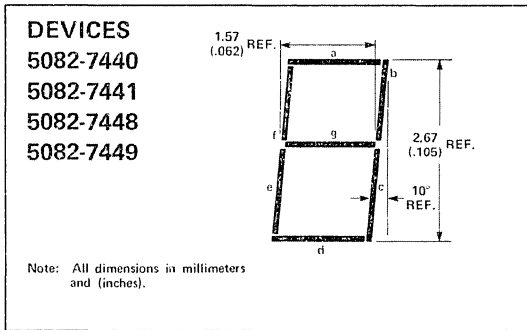


Figure 6.

Part No.	Dim. A	Dim. B	Dim. C
5082-7440	50.800(2.000)	0.760(.030)	5.08(.200)
5082-7441	50.800(2.000)	0.760(.030)	5.08(.200)
5082-7448	60.325(2.375)	5.512(.217)	9.830(.387)
5082-7449	60.325(2.375)	5.512(.217)	9.830(.387)

Tolerances: $\pm .381$ (.015)

Table 1.

Device Pin Description

Pin No.	5082-7440 5082-7448 Function	5082-7441 5082-7449 Function	Pin No.	5082-7440 5082-7448 Function	5082-7441 5082-7449 Function
1	N/C	Dig. 1 Cathode	10	Seg. d Anode	Seg. d Anode
2	Seg. c Anode	Seg. c Anode	11	Dig. 6 Cathode	Dig. 6 Cathode
3	Dig. 2 Cathode	Dig. 2 Cathode	12	Seg. g Anode	Seg. g Anode
4	d.p. Anode	d.p. Anode	13	Dig. 7 Cathode	Dig. 7 Cathode
5	Dig. 3 Cathode	Dig. 3 Cathode	14	Seg. b Anode	Seg. b Anode
6	Seg. a Anode	Seg. a Anode	15	Dig. 8 Cathode	Dig. 8 Cathode
7	Dig. 4 Cathode	Dig. 4 Cathode	16	Seg. f Anode	Seg. f Anode
8	Seg. e Anode	Seg. e Anode	17	Dig. 9 Cathode	Dig. 9 Cathode
9	Dig. 5 Cathode	Dig. 5 Cathode			

Electrical/Optical

The HP 5082-7440 series devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 0.105" (2.67mm). Satisfactory viewing will be realized within an angle of approximately $\pm 20^\circ$ from the centerline of the digit. The secondary lens magnifier that will increase character height from 2.67mm (0.105") to 3.33mm (0.131") and reduce viewing angle in the vertical plane only from $\pm 20^\circ$ to approximately $\pm 18^\circ$ is available as a special product. A filter, such as Plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will lower ambient reflectance and improve display contrast. Character encoding of the -7440 series devices is performed by standard 7 segment decoder driver circuits.

The 5082-7440 series devices are tested for digit to digit luminous intensity matching using the circuit depicted in Figure 7. Component values are chosen to give an I_F of 5mA per segment at a segment V_F of 1.55 volts. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby insuring excellent digit to digit matching. If the device is to be driven from V_{CC} potentials of less than 3.5 volts, it is recommended that the factory be contacted.

Mechanical

The 5082-7440 series devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens containing 9 individual magnifying elements is attached to the PC board over the digits. The device may be mounted either by use of pins which may be soldered into the plate

through holes at the connector edge of the board or by insertion into a standard PC board connector.

The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended: Wash display in clean liquid Freon TP-35 or Freon TE-35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for hand cleaning at room temperature. Water may be used for hand cleaning if it is not permitted to collect under display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

These devices are constructed on a silver plated printed circuit board. To prevent the formation of a tarnish (Ag_2S) which could impair solderability, the boards should be stored in the unopened shipping packages until they are used. Further information on the storage, handling and cleaning of silver-plated components is contained in Hewlett-Packard Application Bulletin No. 3.

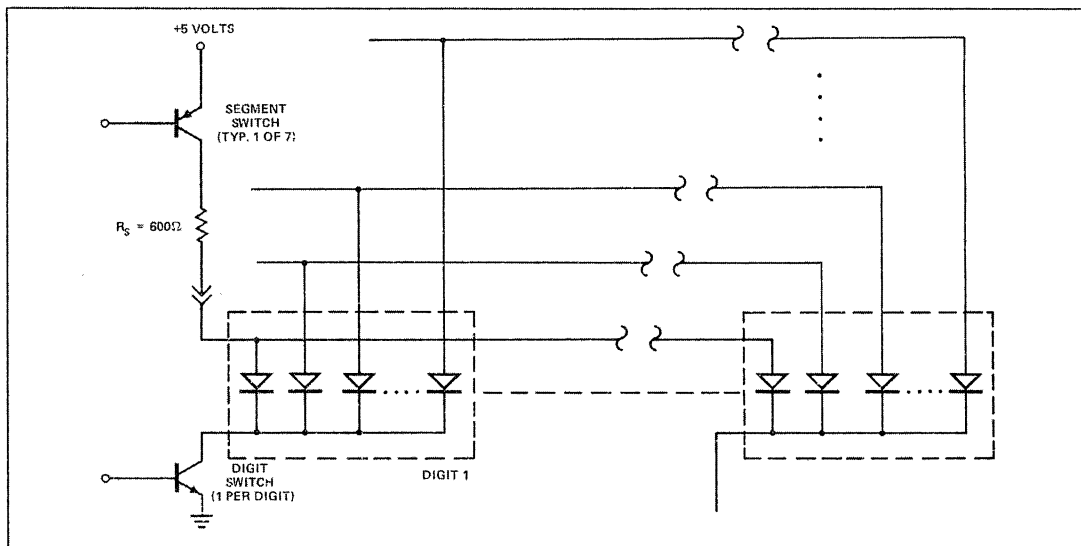


Figure 7. Circuit Diagram used for Testing the Luminous Intensity of the HP 5082-7440

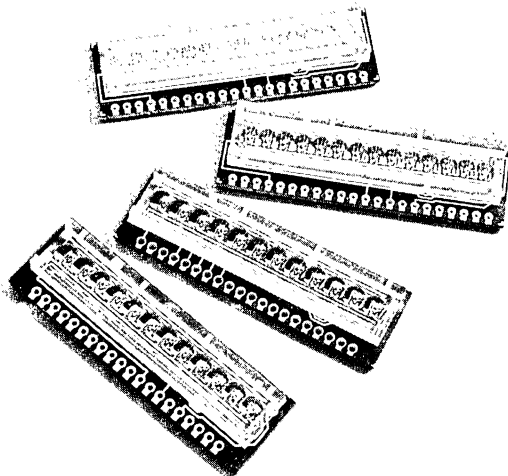
SPECIAL PARTS FOR SCIENTIFIC AND BUSINESS CALCULATORS

5082-7442
5082-7444
5082-7445
5082-7446
5082-7447

TECHNICAL DATA APRIL 1977

Features

- **12, 14, AND 16 DIGIT CONFIGURATIONS**
- **MOS COMPATIBLE**
Can be driven directly from most MOS circuits.
- **LOW POWER**
Excellent readability at only 250µA average per segment.
- **UNIFORM ALIGNMENT**
Excellent Alignment is assured by design.
- **MATCHED BRIGHTNESS**
Uniformity of light output from digit to digit on a single PC board.

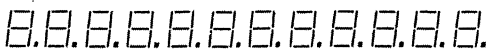
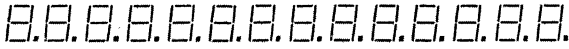
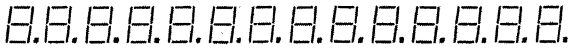
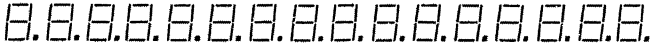


Description

The HP 5082-7442, 7444, 7446, and 7447 are seven segment GaAsP Numeric indicators mounted in 12, 14, or 16 digit configurations on a P.C. board. These special parts, designed specifically for scientific and business calculators, have right hand decimal points and are mounted on 175 mil (4.45mm) centers in the 12 digit configurations and 150 mil (3.81mm) centers in the 14 and 16 digit configurations. The plastic lens magnifies the digits and includes an integral protective bezel.

Applications are primarily portable, hand held calculators, digital telephone peripherals, data entry terminals and other products requiring low power, low cost, and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Digit Height mm (inches)	Configuration	Package	Part No. 5082-
		DEVICE		
12	$\frac{2.54}{(.100)}$		Figure 4	7442 and 7445
14	$\frac{2.54}{(.100)}$		Figure 5	7444
14	$\frac{2.84}{(.112)}$		Figure 5	7447
16	$\frac{2.92}{(.115)}$		Figure 6	7446

*5082-7447 is a 5082-7444 with a slide-in cylindrical lens to provide added magnification.

Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration <math>< 500\mu\text{s}</math>)	I_{PEAK}		50	mA
Average Current per Segment or dp ⁽¹⁾	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	-20	+85	°C
Storage Temperature	T_S	-20	+85	°C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge ($t \leq 3 \text{ sec.}$) ⁽²⁾			230	°C

NOTES: 1. Derate linearly at 0.1mA/°C above 60°C ambient.
2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

Part No.	Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Uni's
7442/7445	Luminous Intensity/ Segment or dp ⁽³⁾ (Digit Average)	I_V	5mA Peak 1/12 Duty Cycle	7	35		μcd
7444/7447			5mA Peak 1/14 Duty Cycle	7	35		μcd
7446			5mA Peak 1/16 Duty Cycle				
7442/7445	Peak Wavelength	λ_{PEAK}			655		nm
7444/7447 7446	Forward Voltage/ Segment or dp	V_F	$I_F = 5\text{mA}$		1.55		V

NOTE: 3. Operation at Peak Currents of less than 3.5mA is not recommended.

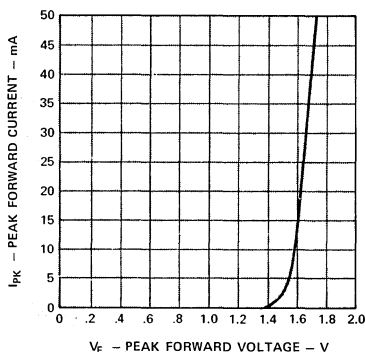


Figure 1. Peak Forward Current vs. Peak Forward Voltage

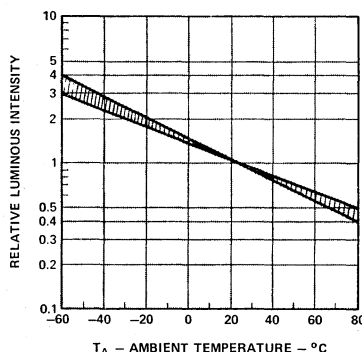


Figure 2. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level.

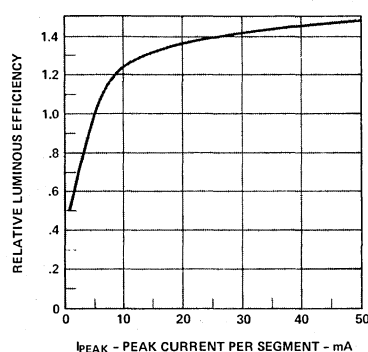


Figure 3. Relative Luminous Efficiency vs. Peak Current per Segment.

Electrical/Optical

The HP 5082-7442, 7444, 7445, 7446 and 7447 devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of digits in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character. Satisfactory viewing will be realized within an angle of approximately $\pm 20^\circ$ from the centerline of the digit. A filter, such as plexiglass 2423, Panelgraphic 60 or 63, and

Homalite 100-1600, will lower the ambient reflectance and improve display contrast. Digit encoding of these devices is performed by standard 7 segment decoder driver circuits.

These devices are tested for digit-to-digit luminous intensity matching. This test is performed with a power supply of 5V and component values selected to supply 5mA I_{PEAK} at $V_F = 1.55\text{V}$. If the device is to be driven from V_{CC} potentials of less than 3.5 volts, it is recommended that the factory be contacted.

Mechanical Specifications

The 5082-7442, 7444, 7445, 7446, and 7447 devices are constructed on a silver plated printed circuit board substrate. A molded plastic lens array is attached to the PC board over the digits to provide magnification.

These devices may be mounted using any one of several different techniques. The most straightforward is the use of standard PC board edge connectors. A less expensive approach can be implemented through the use of stamped or etched metal mounting clips such as those available from Burndy (Series LED-B) or JAV Manufacturing (Series 1255). Some of these devices will also serve as an integral display support. A third approach would be the use of a row of wire stakes which would first be soldered to the PC mother-board and the display board then inserted over the wire stakes and soldered in place.

The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the lens. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations. A solder containing approximately 2% silver (Sn 62) will enhance solderability by preventing leaching of the plated silver off the PC board into the solder solution.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended. Wash display in clean liquid Freon TP - 35 or Freon TE - 35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for cleaning at room temperature. Soap and water solutions may be utilized for removing water-soluble fluxes from the contact area but must not be allowed to collect under the display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

These devices are constructed on a silver plated printed circuit board. To prevent the formation of a tarnish (Ag₂S) which could impair solderability, the boards should be stored in the unopened shipping packages until they are used. Further information on the storage, handling and cleaning of silver-plated components is contained in Hewlett-Packard Application Bulletin No. 3.

Device Pin Description

Pin No.	5082-7442 5082-7444 5082-7447 Function	5082-7445 Function	5082-7446 Function
1	Cathode-Digit 1	Anode-Segment a	Cathode-Digit 1
2	Cathode-Digit 2	Anode-Segment f	Cathode-Digit 2
3	Cathode-Digit 3	Anode-Segment b	Cathode-Digit 3
4	Anode-Segment c	Anode-Segment c	Cathode-Digit 4
5	Cathode-Digit 4	Anode-Segment d	Cathode-Digit 5
6	Anode-DP	Anode-Segment DP	Anode-Segment e
7	Cathode-Digit 5	Anode-Segment e	Cathode-Digit 6
8	Anode-Segment a	Anode-Segment g	Anode-Segment d
9	Cathode-Digit 6	Cathode-Digit 3	Cathode-Digit 7
10	Anode-Segment e	Cathode-Digit 2	Anode-Segment a
11	Cathode-Digit 7	Cathode-Digit 4	Cathode-Digit 8
12	Anode-Segment d	Cathode-Digit 1	Anode-Segment DP
13	Cathode-Digit 8	Cathode-Digit 5	Cathode-Digit 9
14	Anode-Segment g	Cathode-Digit 12	Anode-Segment c
15	Cathode-Digit 9	Cathode-Digit 6	Cathode-Digit 10
16	Anode-Segment b	Cathode-Digit 11	Anode-Segment g
17	Cathode-Digit 10	Cathode-Digit 7	Cathode-Digit 11
18	Anode-Segment f	Cathode-Digit 10	Anode-Segment b
19	Cathode-Digit 11	Cathode-Digit 9	Cathode-Digit 12
20	Cathode-Digit 12	Cathode-Digit 8	Anode-Segment f
21	Cathode-Digit 13		Cathode-Digit 13
22	Cathode-Digit 14		Cathode-Digit 14
23			Cathode-Digit 15
24			Cathode-Digit 16

Package Dimensions

DEVICE	X	Y	Z
5082-7442	60.3 (2.375)	6.03 (.2375)	1.02 (.040)
5082-7445	59.6 (2.345)	5.70 (.2225)	1.42 (.056)

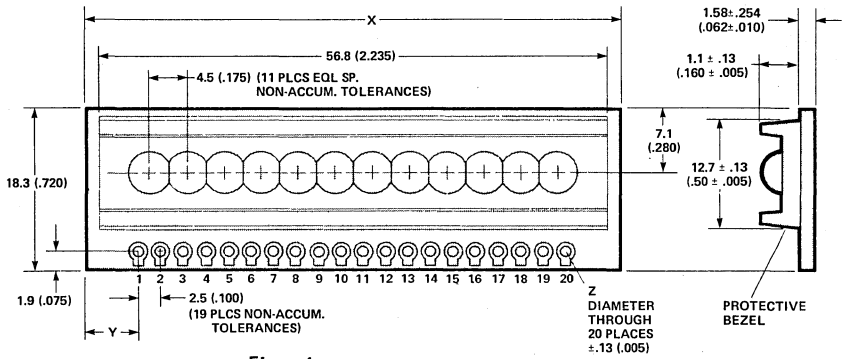


Figure 4.

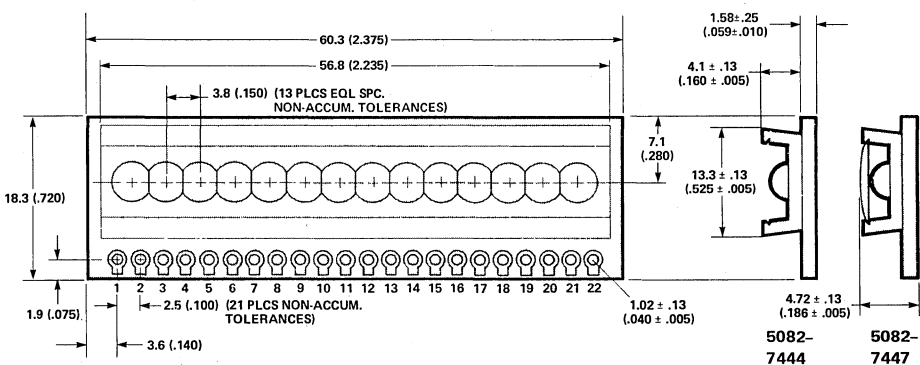


Figure 5.

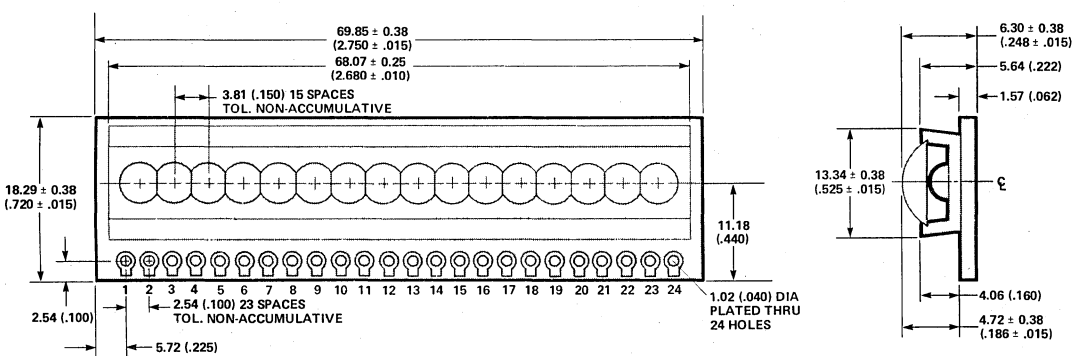
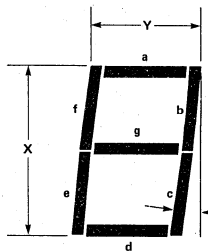


Figure 6.

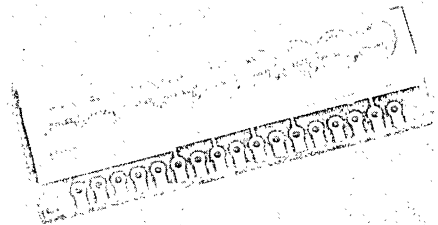


DEVICE	X	Y
5082-7442	2.54 (.100)	1.42 (.056)
5082-7444	2.54 (.100)	1.40 (.055)
5082-7445	2.54 (.100)	1.42 (.056)
5082-7446	2.92 (.115)	1.40 (.055)
5082-7447	2.84 (.112)	1.40 (.055)

- NOTES:
1. ALL DIMENSIONS IN MILLIMETRES AND (INCHES).
 2. TOLERANCES ON ALL DIMENSIONS ARE ±0.38 (.015) UNLESS OTHERWISE SPECIFIED.

Features

- **MOS COMPATIBLE**
Can be driven directly from MOS circuits.
- **LOW POWER**
Excellent readability at only 250 μ A average per segment.
- **UNIFORM ALIGNMENT**
Excellent alignment is assured by design.
- **MATCHED BRIGHTNESS**
Uniformity of light output from digit to digit on a single PC Board.
- **STATE OF THE ART LENS DESIGN**
Assures the best possible character height, viewing angle, off-axis distortion tradeoff.





Description

The HP 5082-7240 series displays are 2.59mm (.102") high, seven segment GaAsP Numeric Indicators mounted in an eight or nine digit configuration on a P. C. Board. These special parts, designed specifically for calculators, have right hand decimal points and are mounted on 5.08mm (200 mil) centers. The plastic lens over the digits has a magnifier and a protective bezel built-in. A

secondary magnifying lens, available on special request, can be added to the primary lens for additional character enlargement.

Applications are primarily portable, hand-held calculators and other products requiring low power, low cost and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Configuration		Part No.
	Device	Package	
8		(Figure 5)	5082-7240
9		(Figure 5)	5082-7241

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500 μ s)	I_{PEAK}		50	mA
Average Current per Segment or dp ^[1]	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	-20	+85	$^{\circ}$ C
Storage Temperature	T_S	-20	+85	$^{\circ}$ C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge ($t \leq 3$ sec.) ^[2]			230	$^{\circ}$ C

NOTES: 1. Derate linearly @ 0.1mA/ $^{\circ}$ C above 60 $^{\circ}$ C ambient. 2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at $T_A = 25^{\circ}$ C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp ^[3,4]	I_V	$I_{AVG} = 500\mu A$ ($I_{PK} = 5mA$ duty cycle = 10%)	12.5	50		μ cd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp	V_F	$I_F = 5mA$		1.6		V

NOTES: 3. See Figure 7 for test circuit. 4. Operation at Peak Currents of less than 3.0mA is not recommended.

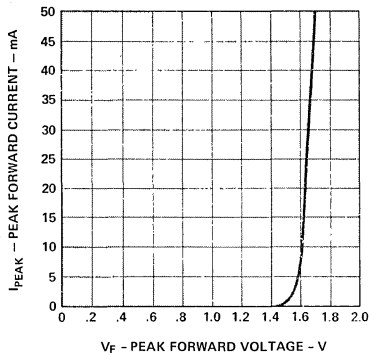


Figure 1. Peak Forward Current vs. Peak Forward Voltage

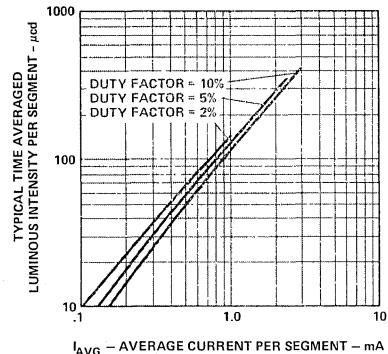


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

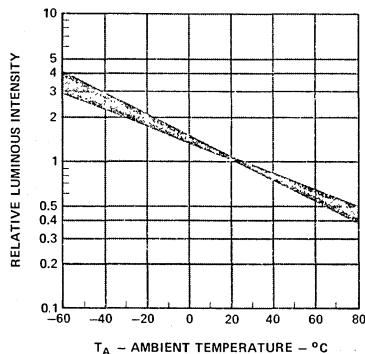


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

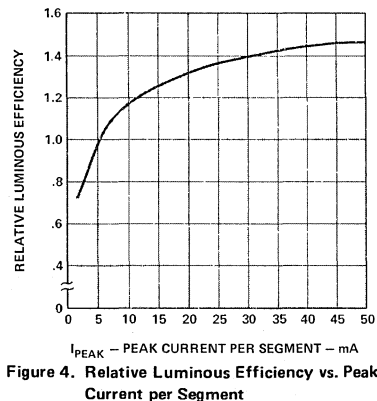


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

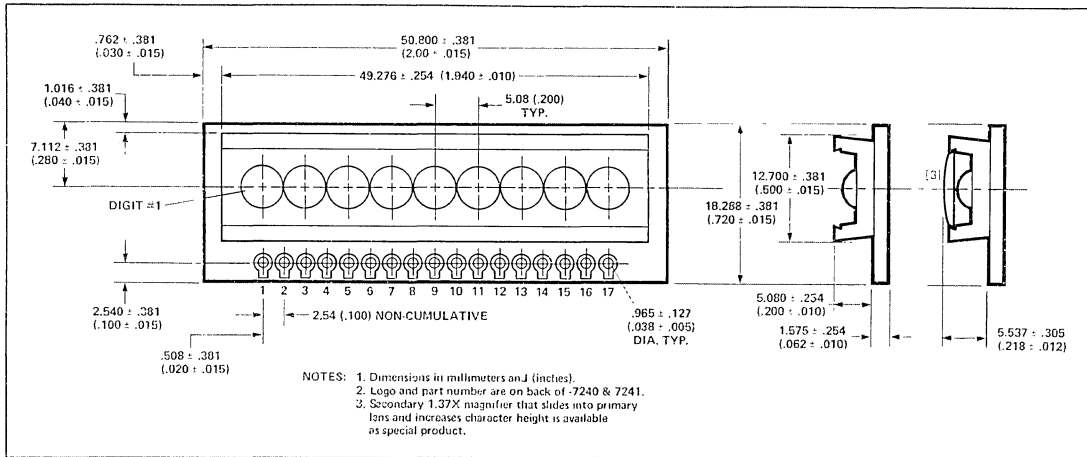


Figure 5.

Magnified Character Font Description

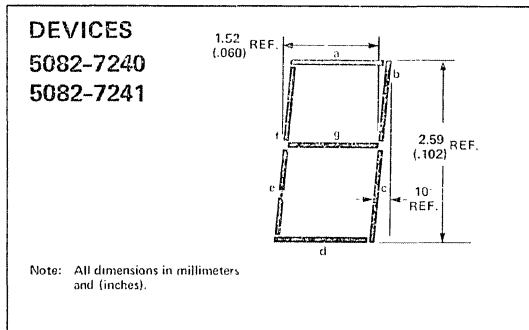


Figure 6.

Device Pin Description

Pin No.	5082-7240 Function	5082-7241 Function	Pin No.	5082-7240 Function	5082-7241 Function
1	NOTE 4	Dig. 1 Cathode	10	Seg. d Anode	Seg. d Anode
2	Seg. c Anode	Seg. c Anode	11	Dig. 6 Cathode	Dig. 6 Cathode
3	Dig. 2 Cathode	Dig. 2 Cathode	12	Seg. g Anode	Seg. g Anode
4	d.p. Anode	d.p. Anode	13	Dig. 7 Cathode	Dig. 7 Cathode
5	Dig. 3 Cathode	Dig. 3 Cathode	14	Seg. b Anode	Seg. b Anode
6	Seg. a Anode	Seg. a Anode	15	Dig. 8 Cathode	Dig. 8 Cathode
7	Dig. 4 Cathode	Dig. 4 Cathode	16	Seg. f Anode	Seg. f Anode
8	Seg. e Anode	Seg. e Anode	17	Dig. 9 Cathode	Dig. 9 Cathode
9	Dig. 5 Cathode	Dig. 5 Cathode			

NOTE 4: Leave pin 1 unconnected on the 5082-7240.

Electrical/Optical

The HP 5082-7240 series devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 2.59mm (0.102"). Satisfactory viewing will be realized within an angle of approximately $\pm 20^\circ$ from the centerline of the digit. A secondary lens magnifier that will increase character height from 2.59mm (.102") to 3.56mm (.140") is available as a special product. Character encoding of the 7240 series devices is performed by standard 7 segment decoder driver circuits.

The 5082-7240 series devices are tested for digit to digit luminous intensity matching using the circuit depicted in Figure 7. Component values are chosen to give an I_F of 5mA per segment at a segment V_F of 1.6 volts. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby insuring excellent digit to digit matching. If the device is to be driven from V_{CC} potentials of less than 3.5 volts, it is recommended that the factory be contacted.

Mechanical

The 5082-7240 series devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens bar containing 9 individual magnifying elements is attached to the PC board over the digits. The device may be

mounted either by use of pins which may be soldered into the plate through holes at the connector edge of the board or by insertion into a standard PC board connector.

The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended: Wash display in clean liquid Freon TP-35 or Freon TE-35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for hand cleaning at room temperature. Water may be used for hand cleaning if it is not permitted to collect under display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

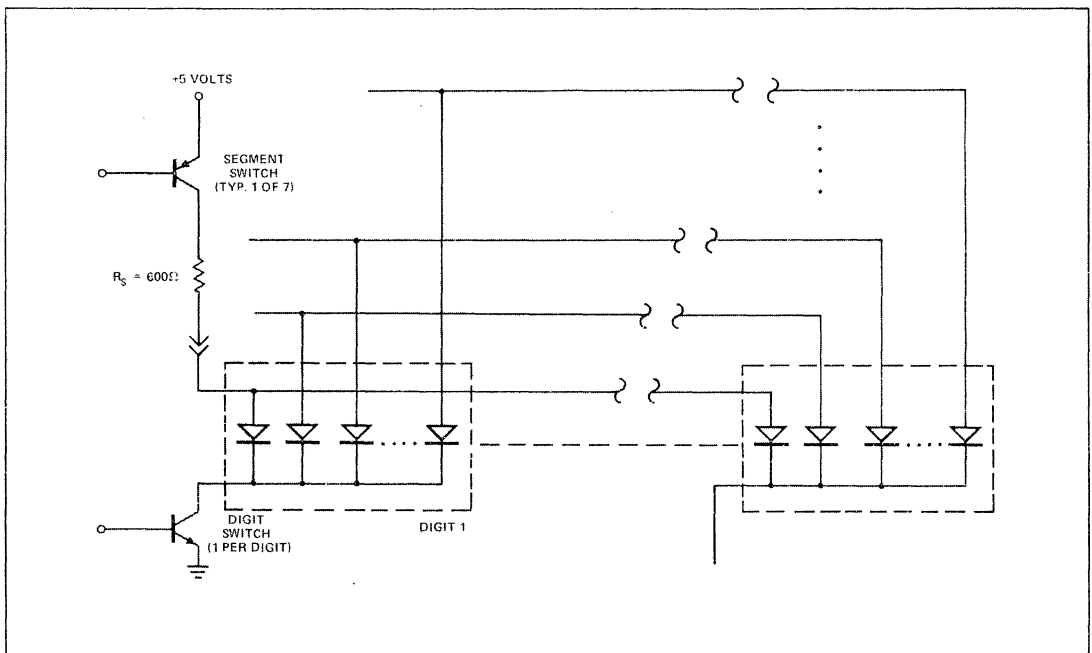
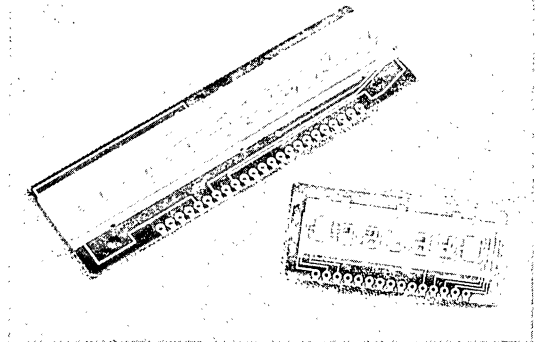


Figure 7. Circuit Diagram used for Testing the Luminous Intensity of the HP 5082-7240

Features

- **LARGE 4.45mm (.175") CHARACTER HEIGHT**
- **LOW POWER**
Satisfactory Readability can be Achieved with Drive Currents as Low as 1.0-1.5mA Average per Segment Depending on Peak Current Levels
- **MOS COMPATIBLE**
Can be Driven Directly from MOS Circuits
- **COMPACT INFORMATION DISPLAY**
5.84mm (.23") Digit Spacing Yields Over 4 Characters per Inch.
- **HIGH AMBIENT READABILITY**
High Sterance Emitting Areas Mean Excellent Readability in High Ambient Light Conditions
- **HIGH LEGIBILITY AND NUMBER RECOGNITION**
High On/Off Contrast and Fine Line Segments Improve Viewer Recognition of the Displayed Number
- **UNIFORM ALIGNMENT**
Excellent Alignment is Assured by Design
- **MATCHED BRIGHTNESS**
Provides Uniform Light Output from Digit to Digit on a Single PC Board
- **EASY MOUNTING**
Flexible Mounting in Desired Position with Edge Connectors or Soldered Wires

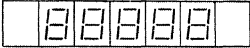
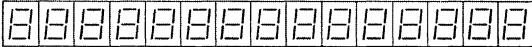
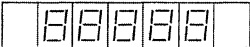



Description

The HP 5082-7265, 7275, 7285, and 7295 displays are 4.45 mm (.175") seven segment GaAsP numeric indicators mounted in 5 or 15 digit configurations on a PC Board. The monolithic light emitting diode character is magnified by the integral lens which increases both character size and luminous intensity, thereby making low power consumption possible. Options include both a right hand decimal point and centered decimal version for improved legibility. The digits are mounted on 5.84 mm (230 mil) centers.

These displays are attractive for applications such as digital instruments, desk top calculators, avionics and automobile displays, P.O.S. terminals, in-plant control equipment, and other products requiring low power, display compactness, readability in high ambients, or highly legible, long lifetime numerical displays.

Device Selection Guide

Digits Per PC Board	Configuration			Part No. 5082-
	Device	Package	Character	
5		(Figure 5)	Center Decimal Point (Figure 7)	7265
15		(Figure 6)	Center Decimal Point (Figure 7)	7275
5		(Figure 5)	Right Decimal Point (Figure 7)	7285
15		(Figure 6)	Right Decimal Point (Figure 7)	7295

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or DP (Duration <35 μ s)	I _{PEAK}		200	mA
Average Current per Segment or DP ⁽¹⁾	I _{AVG}		7	mA
Power Dissipation per Digit ⁽²⁾	P _D		125	mW
Operating Temperature, Ambient	T _A	-20	+70	°C
Storage Temperature	T _S	-20	+80	°C
Reverse Voltage	V _R		5	V
Solder Temperature at connector edge (t \leq 3 sec.) ⁽³⁾			230	°C

- NOTES: 1. Derate linearly at 0.12 mA/°C above 25°C ambient.
 2. Derate linearly at 2.3 mW/°C above 25°C ambient.
 3. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at T_A = 25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp (Time Averaged) 15 digit display 5082-7275, 5082-7295 ^(4,6)	I _v	I _{avg.} = 2 mA (30 mA Peak 1/15 duty cycle)	30	90		μ cd
Luminous Intensity/Segment or dp (Time Averaged) 5 digit display 5082-7265, 5082-7285 ^(4,6)	I _v	I _{avg.} = 2 mA (10 mA Peak 1/5 duty cycle)	30	70		μ cd
Forward Voltage per Segment or dp 5082-7275, 5082-7295 15 digit display	V _F	I _F = 30 mA		1.60	2.3	V
Forward Voltage per Segment or dp 5082-7265, 5082-7285 5 digit display	V _F	I _F = 10 mA		1.55	2.0	V
Peak Wavelength	λ _{PEAK}			655		nm
Dominant Wavelength ⁽⁵⁾	λ _d			640		nm
Reverse Current per Segment or dp	I _R	V _R = 5V			100	μ A
Temperature Coefficient of Forward Voltage	Δ V _F /°C			-2.0		mV/°C

- NOTES: 4. The luminous intensity at a specific ambient temperature, I_v(T_A), may be calculated from this relationship:

$$I_v(T_A) = I_v(25^\circ C) \cdot (.985)^{(T_A - 25^\circ C)}$$

 5. The dominant wavelength λ_d , is derived from the C.I.E. Chromaticity Diagram and represents the single wavelength which defines the color of the device.
 6. Operation at peak currents of less than 6.0 mA is not recommended.

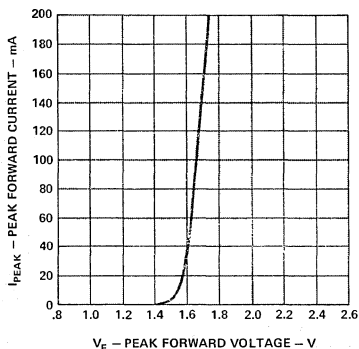


Figure 1. Peak Forward Current vs. Peak Forward Voltage.

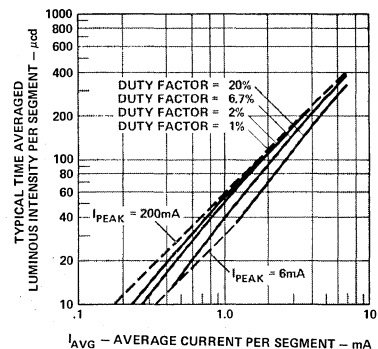


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment.

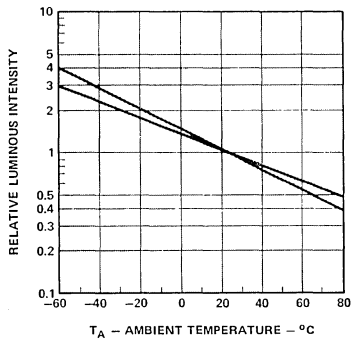


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level.

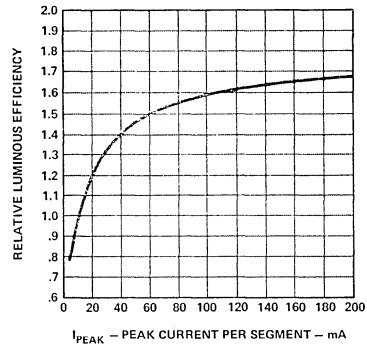


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment.

Electrical

The HP 5082-7265, 7275, 7285, and 7295 devices utilize a seven segment monolithic GaAsP chip. The 5082-7285 and 7295 devices use a separate decimal point chip located to the right of each digit. The 5082-7265 and 7275 devices use a centered decimal point on the monolithic seven segment chip. The centered decimal point version improves the displays readability by dedicating an entire digit position to distinguishing the decimal point. In the driving scheme for the centered decimal point version the decimal point is treated as a separate character with its own time frame.

The segments and decimal points of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Character encoding is performed by standard 7 segment decoder driver circuits. A detailed discussion of display circuits and drive techniques appears in Applications Note 937.

These devices are tested for digit to digit luminous intensity using the circuit depicted in Figure 8. Component values are chosen to give a Peak I_F of 10 mA per segment for the 5 digit displays and 30 mA per segment for the 15 digit displays. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby ensuring excellent digit to digit matching. If the device is to be driven at peak currents of less than 6.0 mA, it is recommended that the HP field salesman or factory be contacted.

For special product applications, the number of digits per display can be altered. It is also possible to provide a colon instead of the centered decimal point. Contact the HP field salesman or factory to discuss such special modifications.

Optical

Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 4.45mm (.175"). To increase vertical viewing angle the secondary cylindrical magnifier can be removed reducing character height to 3.86mm (.152"). A filter, such as Panelgraphic 60 or 63, or Homalite 100-1600, will lower ambient reflectance and improve display contrast.

Mechanical

These devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens is attached to the PC board over the digits. The lens is an acrylic styrene material that gives good optical lens performance, but is subject to scratching so care should be exercised in handling.

The device may be mounted either by use of pins which may be soldered into the plated through holes at the connector edge of the PC board or by insertion into a standard PC board connector. The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid wire solder be used in soldering operations.

The PC board is silver plated. To prevent the formation of a tarnish (Ag_2S) which could impair solderability the displays should be stored in the unopened shipping packages until they are used. Further information on the storage, handling, and cleaning of silver plated components is contained in Hewlett-Packard Application Bulletin No. 3.

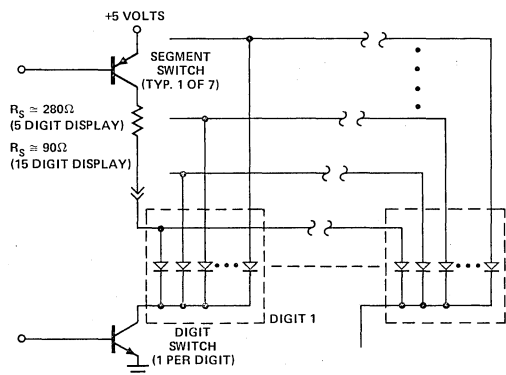


Figure 5. Circuit Diagram used for Testing the Luminous Intensity.

Package Dimensions

ALL DIMENSIONS IN MILLIMETERS AND (INCHES). TOLERANCES ARE ± 0.203 ($\pm .008$) UNLESS OTHERWISE NOTED

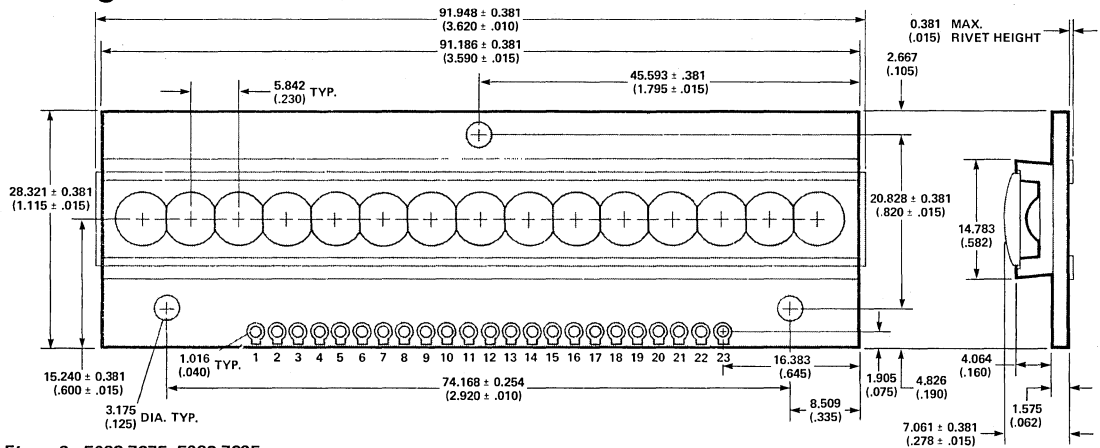


Figure 6. 5082-7275, 5082-7295.

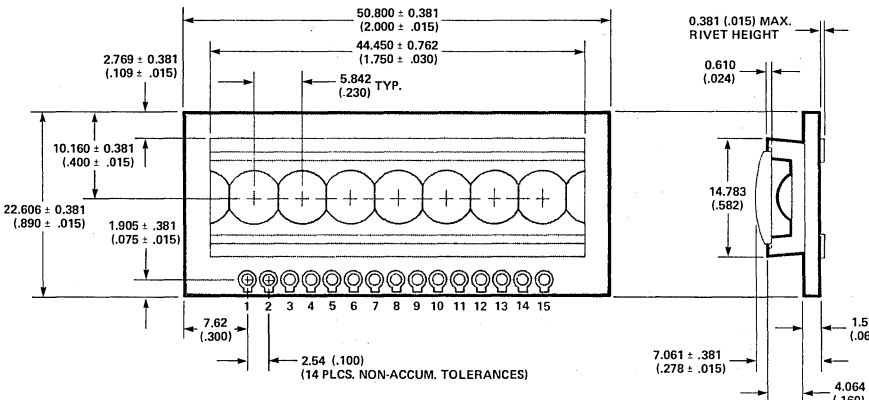
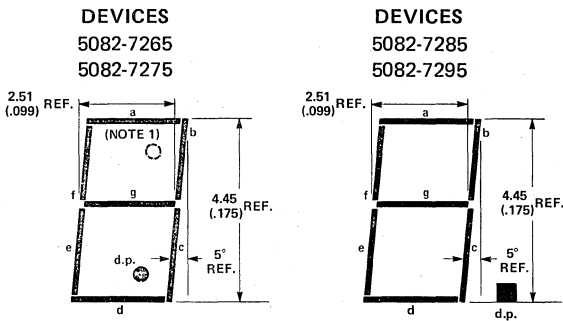


Figure 7. 5082-7265, 5082-7285.

Magnified Character Font Description



ALL DIMENSIONS IN MILLIMETERS AND (INCHES).

NOTE 1. Bonding Option for Colon Instead of Decimal Point. See Electrical Section.

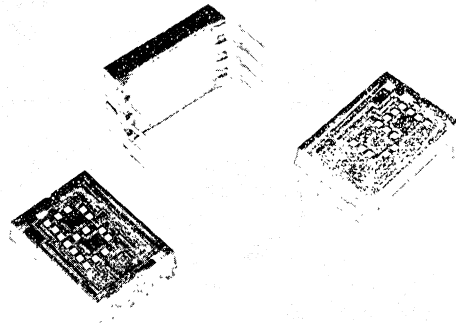
Figure 8.

Device Pin Description

Pin No.	5082-7265 5082-7285 Function	5082-7275 5082-7295 Function
1	Anode Segment b	Cathode Digit 1
2	Anode Segment g	Cathode Digit 2
3	Anode Segment e	Cathode Digit 3
4	Cathode Digit 1	Cathode Digit 4
5	Cathode Digit 2	Anode Segment dp
6	Cathode Digit 3	Cathode Digit 5
7	Cathode Digit 4	Anode Segment c
8	Cathode Digit 5	Cathode Digit 6
9	Cathode Digit 6	Anode Segment e
10	Cathode Digit 7	Cathode Digit 7
11	Anode Segment dp	Anode Segment a
12	Anode Segment d	Cathode Digit 8
13	Anode Segment c	Anode Segment g
14	Anode Segment a	Cathode Digit 9
15	Anode Segment f	Anode Segment d
16		Cathode Digit 10
17		Anode Segment f
18		Cathode Digit 11
19		Anode Segment b
20		Cathode Digit 12
21		Cathode Digit 13
22		Cathode Digit 14
23		Cathode Digit 15

Features

- **NUMERIC 5082-7300/-7302**
 - 0-9, Test State, Minus Sign, Blank States
 - 7300 Right Hand D.P.
 - 7302 Left Hand D.P.
- **HEXADECIMAL 5082-7340**
 - 0-9, A-F, Base 16 Operation
 - Blanking Control, Conserves Power
 - No Decimal Point
- **DTL/TTL COMPATIBLE**
- **INCLUDES DECODER/DRIVER WITH 5 BIT MEMORY**
8421 Positive Logic Input
- **4 x 7 DOT MATRIX ARRAY**
Shaped Character, Excellent Readability
- **STANDARD .600 INCH x .400 INCH DUAL-IN-LINE PACKAGE INCLUDING CONTRAST FILTER**
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output from Unit to Unit within a Single Category



Description

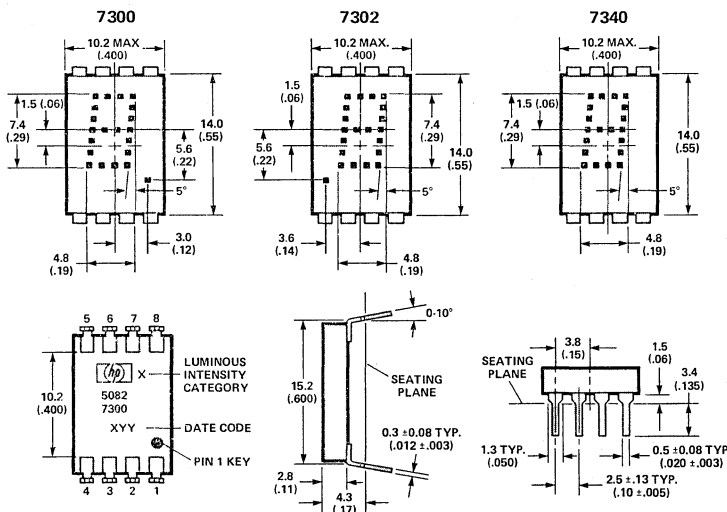
The HP 5082-7300 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory provide a reliable, low-cost method for displaying digital information. The 5082-7300 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a "-" sign, a test pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include point-of-sale terminals, instrumentation, and computer systems.

The 5082-7302 is the same as the 5082-7300, except that the decimal point is located on the left-hand side of the digit.

The 5082-7340 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7304 is a (± 1 .) overrange character, including decimal point, used in instrumentation applications.

Package Dimensions



PIN	FUNCTION	
	5082-7300 and 7302 Numeric	5082-7340 Hexadecimal
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V _{cc}	V _{cc}
8	Input 1	Input 1

NOTES:

1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is $\pm .38\text{mm}$ ($\pm .015''$)
3. Digit center line is $\pm .25\text{mm}$ ($\pm .01''$) from package center line.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient	T_S	-40	+100	°C
Operating temperature, case ^(1,2)	T_C	-20	+85	°C
Supply voltage ⁽³⁾	V_{CC}	-0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	-0.5	+7.0	V
Voltage applied to blanking input ⁽⁷⁾	V_B	-0.5	V_{CC}	V
Maximum solder temperature at 1.59mm (.062 inch) below seating plane; $t \leq 5$ seconds			230	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Operating temperature, case	T_C	-20		+85	°C
Enable Pulse Width	t_w	120			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	50			nsec
Enable pulse rise time	t_{TLH}			200	nsec

Electrical/Optical Characteristics ($T_C = -20^\circ\text{C}$ to $+85^\circ\text{C}$, unless otherwise specified).

Description	Symbol	Test Conditions	Min.	Typ. ⁽⁴⁾	Max.	Unit
Supply Current	I_{CC}	$V_{CC}=5.5\text{V}$ (Numeral)		112	170	mA
Power dissipation	P_T	5 and dp lighted)		560	935	mW
Luminous intensity per LED (Digit average) ^(5,6)	I_v	$V_{CC}=5.0\text{V}$, $T_C=25^\circ\text{C}$	32	70		μcd
Logic low-level input voltage	V_{IL}	$V_{CC}=4.5\text{V}$			0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}				0.8	V
Enable high-voltage; data not being entered	V_{EH}		2.0			V
Blanking low-voltage; display not blanked ⁽⁷⁾	V_{BL}				0.8	V
Blanking high-voltage; display blanked ⁽⁷⁾	V_{BH}		3.5			V
Blanking low-level input current ⁽⁷⁾	I_{BL}		$V_{CC}=5.5\text{V}$, $V_{BL}=0.8\text{V}$			20	$\mu\text{A}$
Blanking high-level input current ⁽⁷⁾	I_{BH}	$V_{CC}=5.5\text{V}$, $V_{BH}=4.5\text{V}$			2.0	mA
Logic low-level input current	I_{IL}	$V_{CC}=5.5\text{V}$, $V_{IL}=0.4\text{V}$			-1.6	mA
Logic high-level input current	I_{IH}	$V_{CC}=5.5\text{V}$, $V_{IH}=2.4\text{V}$			+250	μA
Enable low-level input current	I_{EL}	$V_{CC}=5.5\text{V}$, $V_{EL}=0.4\text{V}$			-1.6	mA
Enable high-level input current	I_{EH}	$V_{CC}=5.5\text{V}$, $V_{EH}=2.4\text{V}$			+250	μA
Peak wavelength	λ_{PEAK}	$T_C=25^\circ\text{C}$		655		nm
Dominant Wavelength ⁽⁸⁾	λ_d	$T_C=25^\circ\text{C}$		640		nm
Weight				0.8		gm

Notes: 1. Nominal thermal resistance of a display mounted in a socket which is soldered into a printed circuit board: $\theta_{JA}=50^\circ\text{C/W}$; $\theta_{JC}=15^\circ\text{C/W}$; 2. θ_{CA} of a mounted display should not exceed 35°C/W for operation up to $T_C = +85^\circ\text{C}$. 3. Voltage values are with respect to device ground, pin 6. 4. All typical values at $V_{CC}=5.0$ Volts, $T_C=25^\circ\text{C}$. 5. These displays are categorized for luminous intensity with the intensity category designated by a letter located on the back of the display contiguous with the Hewlett-Packard logo marking. 6. The luminous intensity at a specific case temperature, $I_v(T_C)$ may be calculated from this relationship: $I_v(T_C)=I_v(25^\circ\text{C}) e^{[-0.0188^\circ\text{C}^{-1}(T_C-25^\circ\text{C})]}$ 7. Applies only to 7340. 8. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

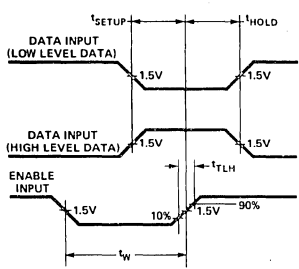


Figure 1. Timing Diagram of 5082-7300 Series Logic.

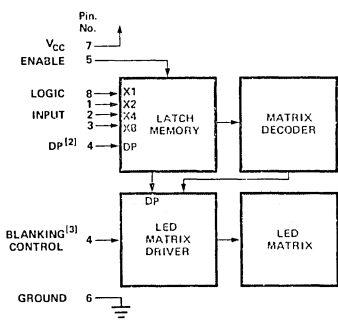


Figure 2. Block Diagram of 5082-7300 Series Logic.

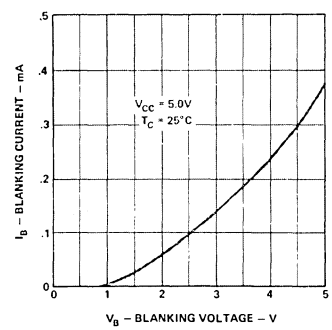


Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7340.

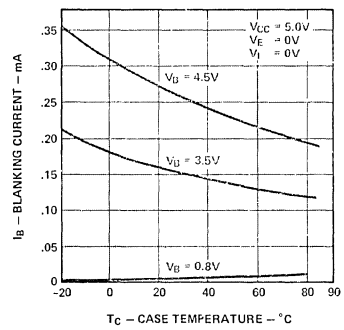


Figure 4. Typical Blanking Control Input Current vs. Temperature 5082-7340.

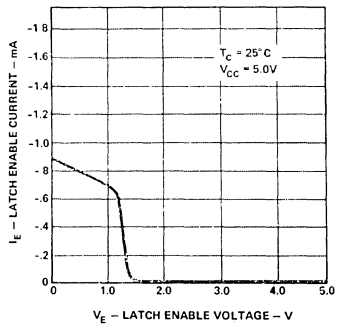


Figure 5. Typical Latch Enable Input Current vs. Voltage for the 5082-7300 Series Devices.

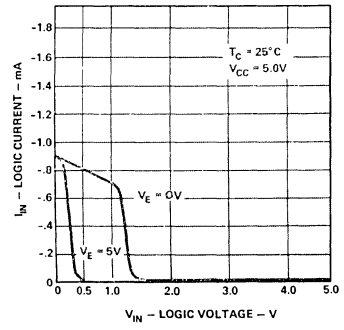


Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage for the 5082-7300 Series Devices, Decimal Point Applies to 5082-7300 and -7302 Only.

TRUTH TABLE					
BCD DATA ^[1]				5082-7300/7302	5082-7340
X ₀	X ₄	X ₂	X ₁		
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	A	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	---	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F
DECIMAL PT. ^[2]				ON	V _{DP} = L
				OFF	V _{DP} = H
ENABLE ^[1]				LOAD DATA	V _E = L
				LATCH DATA	V _E = H
BLANKING ^[3]				DISPLAY-ON	V _B = L
				DISPLAY-OFF	V _B = H

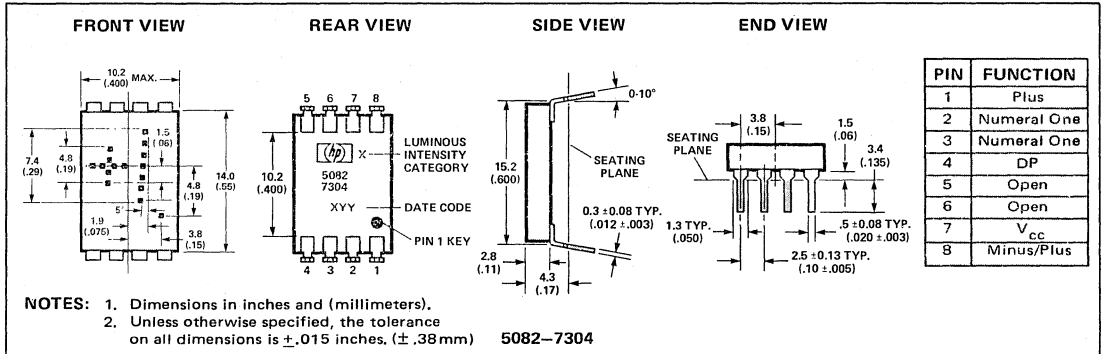
Notes:

- H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels or D.P. input have no effect upon display memory, displayed character, or D.P.
- The decimal point input, DP, pertains only to the 5082-7300 and 5082-7302 displays.
- The blanking control input, B, pertains only to the 5082-7340 hexadecimal display. Blanking input has no effect upon display memory.

Solid State Over Range Character

For display applications requiring a \pm , 1, or decimal point designation, the 5082-7304 over range character is available. This display module comes in the same package as the 5082-7300 series numeric indicator and is completely compatible with it.

Package Dimensions



TRUTH TABLE FOR 5082-7304

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
-	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Fig. 7 cutoff.
H: Line switching transistor in Fig. 7 saturated.
X: 'don't care'

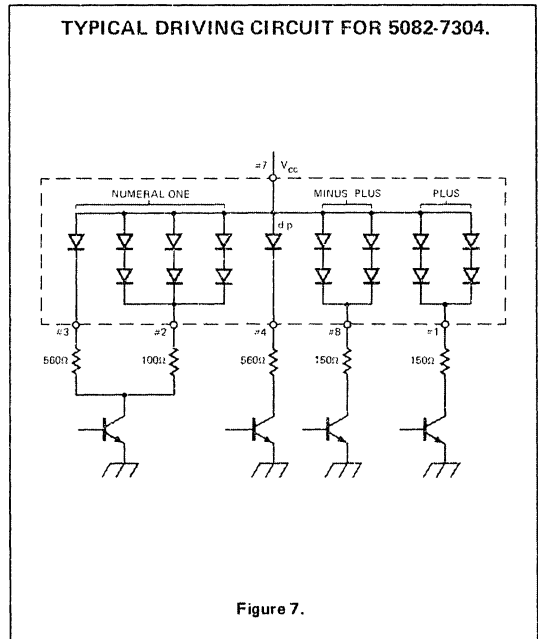
Absolute Maximum Ratings

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T _s	-40	+100	°C
Operating temperature, case	T _C	-20	+85	°C
Forward current, each LED	I _F		10	mA
Reverse voltage, each LED	V _R		4	V

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V _{CC}	4.5	5.0	5.5	V
Forward current, each LED	I _F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to figure 7 for recommended resistor values.

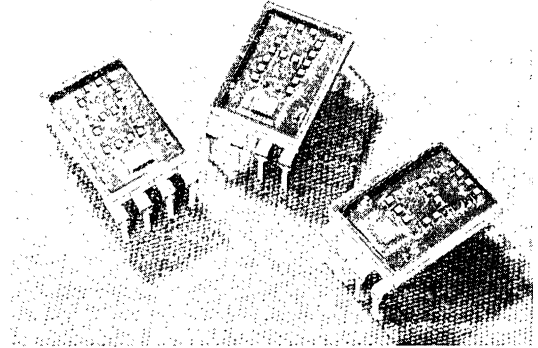


Electrical/Optical Characteristics (T_C = -20°C TO +85°C, UNLESS OTHERWISE SPECIFIED)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V _F	I _F = 10 mA		1.6	2.0	V
Power dissipation	P _T	I _F = 10 mA all diodes lit		250	320	mW
Luminous Intensity per LED (digit average)	I _v	I _F = 6 mA T _C = 25°C	32	70		μcd
Peak wavelength	λ _{peak}	T _C = 25°C		655		nm
Spectral halfwidth	Δλ _{1/2}	T _C = 25°C		30		nm
Weight				0.8		gm

Features

- CERAMIC/GLASS PACKAGE
- ADDED RELIABILITY
- NUMERIC 5082-7356/-7357
0-9, Test State, Minus Sign, Blank States
Decimal Point
7356 Right Hand D.P.
7357 Left Hand D.P.
- HEXADECIMAL 5082-7359
0-9, A-F, Base 16 Operation
Blanking Control, Conserves Power
No Decimal Point
- TTL COMPATIBLE
- INCLUDES DECODER/DRIVER WITH 5 BIT MEMORY
8421 Positive Logic Input and Decimal Point
- 4 x 7 DOT MATRIX ARRAY
Shaped Character, Excellent Readability
- STANDARD DUAL-IN-LINE PACKAGE
15.2mm x 10.2mm (.6 inch x .4 inch)
- CATEGORIZED FOR LUMINOUS INTENSITY
Assures Uniformity of Light Output from Unit to Unit within a Single Category



Description

The HP 5082-7350 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory provide 7.4mm (0.29 inch) displays for use in adverse industrial environments.

The 5082-7356 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a “-” sign, a test

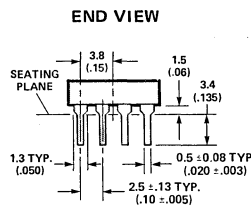
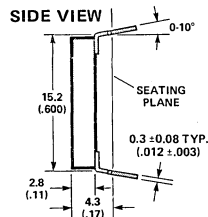
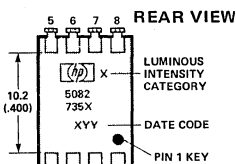
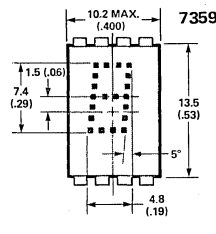
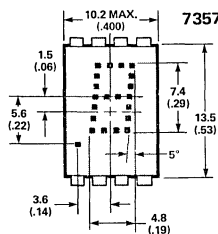
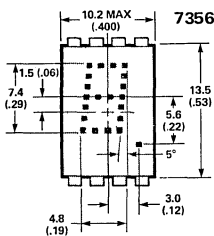
pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include control systems, instrumentation, communication systems and transportation equipment.

The 5082-7357 is the same as the 5082-7356 except that the decimal point is located on the left-hand side of the digit.

The 5082-7359 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7358 is a “±1.” overrange display, including a right hand decimal point.

Package Dimensions



PIN	FUNCTION	
	5082-7356 AND 7357 NUMERIC	5082-7359 HEXA-DECIMAL
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V _{CC}	V _{CC}
8	Input 1	Input 1

NOTES:

1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is $\pm .38\text{mm}$ ($\pm .015''$)
3. Digit center line is $\pm .25\text{mm}$ ($\pm .01''$) from package center line.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient	T_S	-65	+125	°C
Operating temperature, ambient ^(1,2)	T_A	-55	+100	°C
Supply voltage ⁽³⁾	V_{CC}	-0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	-0.5	+7.0	V
Voltage applied to blanking input ⁽⁷⁾	V_B	-0.5	V_{CC}	V
Maximum solder temperature at 1.59mm (.062 inch) below seating plane; $t \leq 5$ seconds			260	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Operating temperature, ambient	T_A	0		+70	°C
Enable Pulse Width	t_w	100			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	50			nsec
Enable pulse rise time	t_{RLH}			200	nsec

Electrical/Optical Characteristics ($T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$, unless otherwise specified).

Description	Symbol	Test Conditions	Min.	Typ. ⁽⁴⁾	Max.	Unit
Supply Current	I_{CC}	$V_{CC}=5.5\text{V}$ (Numeral 5 and dp lighted)		112	170	mA
Power dissipation	P_T			560	935	mW
Luminous intensity per LED (Digit average) ^(5,6)	I_v	$V_{CC}=5.0\text{V}$, $T_A=25^\circ\text{C}$	40	85		μcd
Logic low-level input voltage	V_{IL}	$V_{CC}=4.5\text{V}$			0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}				0.8	V
Enable high-voltage; data not being entered	V_{EH}		2.0			V
Blanking low-voltage; display not blanked ⁽⁷⁾	V_{BL}				0.8	V
Blanking high-voltage; display blanked ⁽⁷⁾	V_{BH}		3.5			V
Blanking low-level input current ⁽⁷⁾	I_{BL}		$V_{CC}=5.5\text{V}$, $V_{BL}=0.8\text{V}$			50	$\mu\text{A}$
Blanking high-level input current ⁽⁷⁾	I_{BH}	$V_{CC}=5.5\text{V}$, $V_{BH}=4.5\text{V}$			1.0	mA
Logic low-level input current	I_{IL}	$V_{CC}=5.5\text{V}$, $V_{IL}=0.4\text{V}$			-1.6	mA
Logic high-level input current	I_{IH}	$V_{CC}=5.5\text{V}$, $V_{IH}=2.4\text{V}$			+100	μA
Enable low-level input current	I_{EL}	$V_{CC}=5.5\text{V}$, $V_{EL}=0.4\text{V}$			-1.6	mA
Enable high-level input current	I_{EH}	$V_{CC}=5.5\text{V}$, $V_{EH}=2.4\text{V}$			+130	μA
Peak wavelength	λ_{PEAK}	$T_A=25^\circ\text{C}$		655		nm
Dominant Wavelength ⁽⁸⁾	λ_d	$T_A=25^\circ\text{C}$		640		nm
Weight				1.0		gm

Notes: 1. Nominal thermal resistance of a display mounted in a socket which is soldered into a printed circuit board: $\theta_{JA}=50^\circ\text{C/W}$; $\theta_{JC}=15^\circ\text{C/W}$; 2. θ_{CA} of a mounted display should not exceed 35°C/W for operation up to $T_A=+100^\circ\text{C}$. 3. Voltage values are with respect to device ground, pin 6. 4. All typical values at $V_{CC}=5.0$ Volts, $T_A=25^\circ\text{C}$. 5. These displays are categorized for luminous intensity with the intensity category designated by a letter located on the back of the display contiguous with the Hewlett-Packard logo marking. 6. The luminous intensity at a specific ambient temperature, $I_v(T_A)$, may be calculated from this relationship: $I_v(T_A)=I_v(25^\circ\text{C}) \cdot (0.985)^{[T_A-25^\circ\text{C}]}$. 7. Applies only to 7359. 8. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

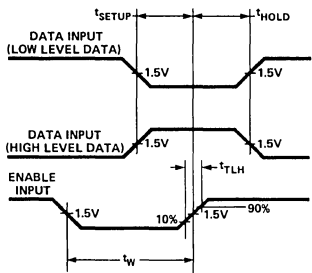


Figure 1. Timing Diagram of 5082-7350 Series Logic.

TRUTH TABLE					
BCD DATA ^[1]				5082-7356/7357	5082-7359
X _B	X ₄	X ₂	X ₁		
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	A	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	...	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F

DECIMAL PT. ^[2]	ON	V _{DP} = L
	OFF	V _{DP} = H
ENABLE ^[1]	LOAD DATA	V _E = L
	LATCH DATA	V _E = H
BLANKING ^[3]	DISPLAY-ON	V _B = L
	DISPLAY-OFF	V _B = H

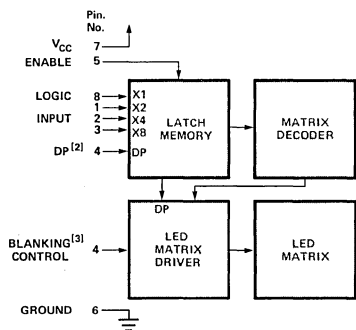


Figure 2. Block Diagram of 5082-7350 Series Logic.

Notes:

1. H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels or D.P. input have no effect upon display memory, displayed character, or D.P.
2. The decimal point input, DP, pertains only to the 5082-7356 and 5082-7357 displays.
3. The blanking control input, B, pertains only to the 5082-7359 hexadecimal display. Blanking input has no effect upon display memory.

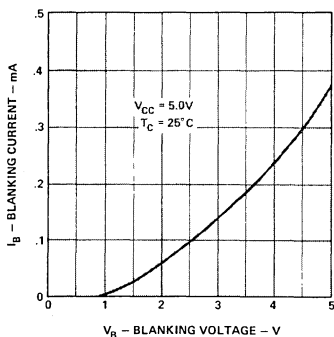


Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7359.

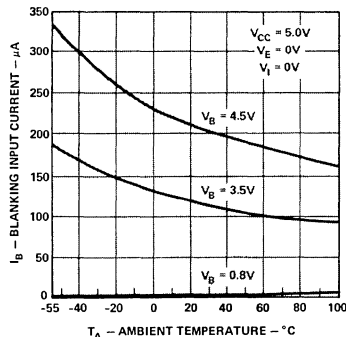


Figure 4. Typical Blanking Control Input Current vs. Ambient Temperature for 5082-7359.

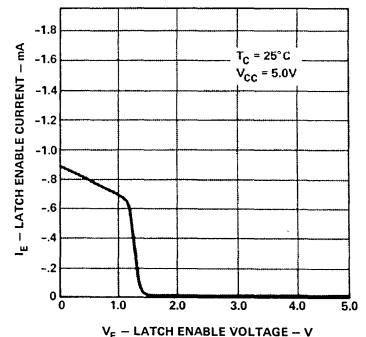


Figure 5. Typical Latch Enable Input Current vs. Voltage.

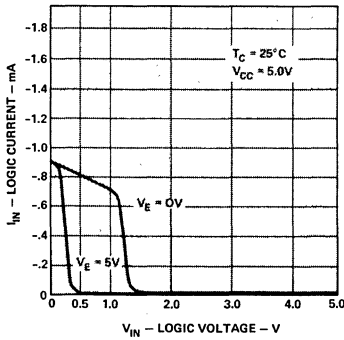


Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage.

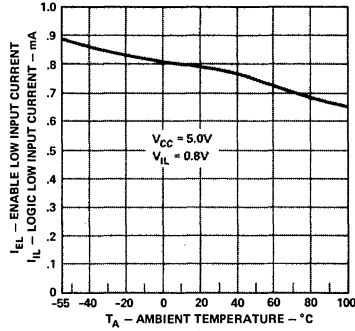


Figure 7. Typical Logic and Enable Low Input Current vs. Ambient Temperature.

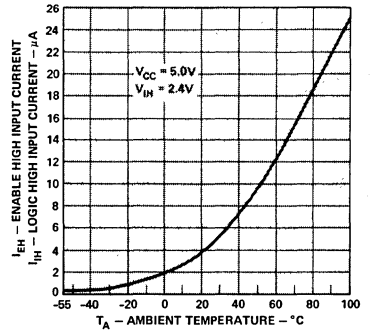


Figure 8. Typical Logic and Enable High Input Current vs. Ambient Temperature.

Operational Considerations

ELECTRICAL

The 5082-7350 series devices use a modified 4 x 7 dot matrix of light emitting diodes (LED's) to display decimal/hexadecimal numeric information. The LED's are driven by constant current drivers. BCD information is accepted by the display memory when the enable line is at logic low and the data is latched when the enable is at logic high. To avoid the latching of erroneous information, the enable pulse rise time should not exceed 200 nanoseconds. Using the enable pulse width and data setup and hold times listed in the Recommended Operating Conditions allows data to be clocked into an array of displays at a 6.7MHz rate.

The blanking control input on the 5082-7395 display blanks (turns off) the displayed hexadecimal information without disturbing the contents of display memory. The display is blanked at a minimum threshold level of 3.5 volts. This may be easily achieved by using an open collector TTL gate and a pull-up resistor. For example, (1/6) 7416 hexinverter buffer/driver and a 120 ohm pull-up resistor will provide sufficient drive to blank eight displays. The size of the blanking pull-up resistor may be calculated from the following formula, where N is the number of digits:

$$R_{\text{blank}} = (V_{\text{CC}} - 3.5\text{V}) / [N (1.0\text{mA})]$$

The decimal point input is active low true and this data is latched into the display memory in the same fashion as is the BCD data. The decimal point LED is driven by the on-board IC.

MECHANICAL

These hermetic displays are designed for use in adverse industrial environments.

These displays may be mounted by soldering directly to a printed circuit board or inserted into a socket. The lead-to-lead pin spacing is 2.54mm (0.100 inch) and the lead row spacing is 15.24mm (0.600 inch). These displays may be end stacked with 2.54mm (0.100 inch) spacing between outside pins of adjacent displays. Sockets such as Augat 324-AG2D (3 digits) or Augat 508-AG8D (one digit, right angle mounting) may be used.

The primary thermal path for power dissipation is through the device leads. Therefore, to insure reliable operation up to an ambient temperature of +100°C, it is important to maintain a case-to-ambient thermal resistance of less than 35°C/watt as measured on top of display pin 3.

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

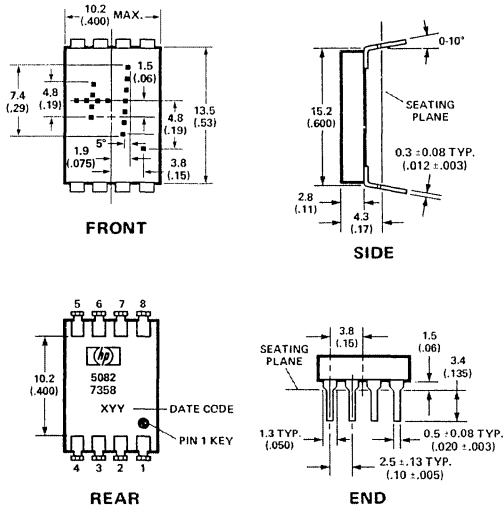
CONTRAST ENHANCEMENT

The 5082-7350 displays have been designed to provide the maximum possible ON/OFF contrast when placed behind an appropriate contrast enhancement filter. Some suggested filters are Panelgraphic Ruby Red 60 and Dark Red 63, SGL Homalite H100-1605, 3M Light Control Film and Polaroid HRCP Red Circular Polarizing Filter. For further information see Hewlett-Packard Application Note 964.

Solid State Over Range Character

For display applications requiring a ± 1 , or decimal point designation, the 5082-7358 over range character is available. This display module comes in the same package as the 5082-7350 series numeric indicator and is completely compatible with it.

Package Dimensions



NOTES:
 1. DIMENSIONS IN MILLIMETRES AND (INCHES).
 2. UNLESS OTHERWISE SPECIFIED, THE TOLERANCE ON ALL DIMENSIONS IS ± 0.38 MM (± 0.015 INCHES).

PIN	FUNCTION
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	V_{CC}
8	Minus/Plus

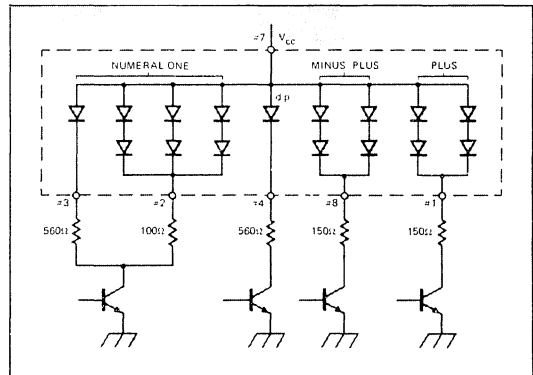


Figure 9. Typical Driving Circuit.

TRUTH TABLE

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
-	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Figure 9 cutoff.
 H: Line switching transistor in Figure 9 saturated.
 X: 'Don't care'

Electrical/Optical Characteristics

5082-7358 ($T_A = 0^\circ\text{C}$ to 70°C , Unless Otherwise Specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V_F	$I_F = 10$ mA		1.6	2.0	V
Power dissipation	P_T	$I_F = 10$ mA all diodes lit		280	320	mW
Luminous Intensity per LED (digit average)	I_v	$I_F = 6$ mA $T_C = 25^\circ\text{C}$	40	85		μcd
Peak wavelength	λ_{peak}	$T_C = 25^\circ\text{C}$		655		nm
Dominant Wavelength	λ_d	$T_C = 25^\circ\text{C}$		640		nm
Weight				1.0		gm

Recommended Operating Conditions

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{CC}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

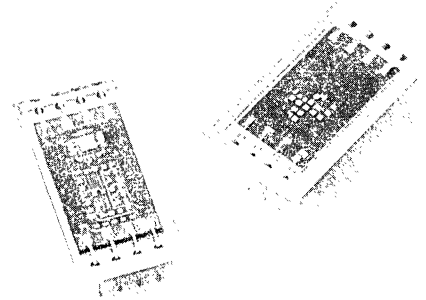
NOTE:
 LED current must be externally limited. Refer to Figure 9 for recommended resistor values.

Absolute Maximum Ratings

DESCRIPTION	SYMBOL	MIN.	MAX.	UNIT
Storage temperature, ambient	T_S	-65	+125	$^\circ\text{C}$
Operating temperature, ambient	T_A	-55	+100	$^\circ\text{C}$
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

Features

- RUGGED, SHOCK RESISTANT, HERMETIC
- DESIGNED TO MEET MIL STANDARDS
- INCLUDES DECODER/DRIVER
BCD Inputs
- TTL/DTL COMPATIBLE
- CONTROLLABLE LIGHT OUTPUT
- 5 x 7 LED MATRIX CHARACTER



Description

The HP 5082-7010 solid state numeric indicator with built-in decoder/driver provides a hermetically tested 6.8mm (0.27 in.) display for use in military or adverse industrial environments. Typical applications include ground, airborne and shipboard equipment, fire control systems, medical instruments, and space flight systems.

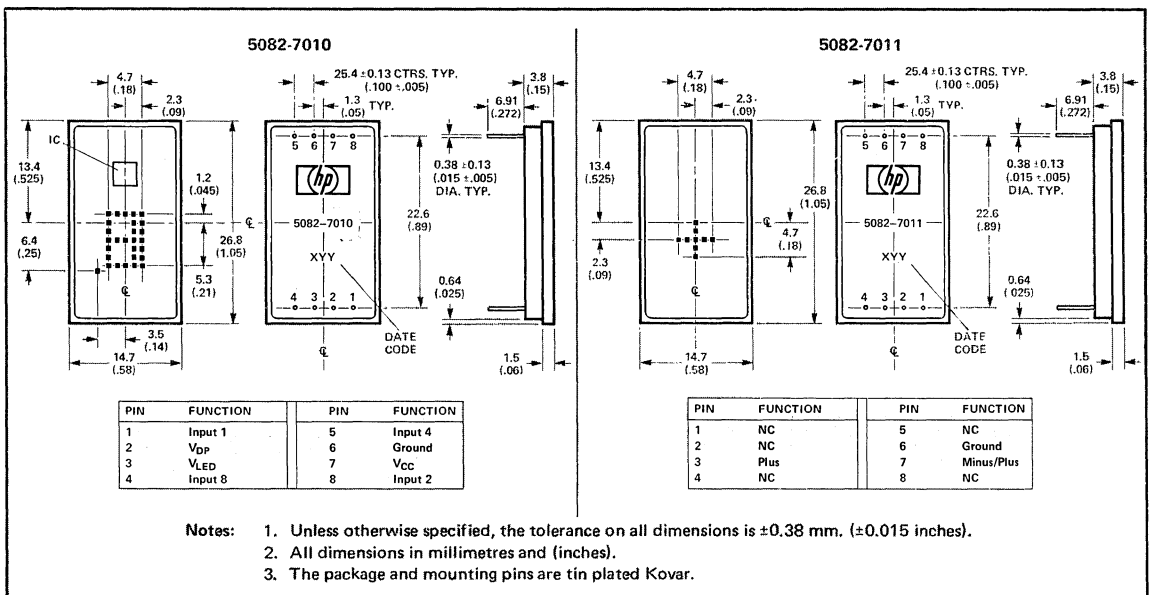
The 5082-7010 is a modified 5x7 matrix display that indicates the numerals 0-9 when presented with a BCD code. The BCD code is negative logic with blanks

displayed for invalid codes. A left-hand decimal point is included which must be externally current limited.

The 5082-7011 is a companion plus/minus sign in the same hermetically tested package. Plus/minus indications require only that voltage be applied to two input pins.

Both displays allow luminous intensity to be varied by changing the DC drive voltage or by pulse duration modulation of the LED voltage.

Package Dimensions



Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	-65	+100	°C
Operating Temperature, Case	T_C	-55	+95	°C
Logic Supply Voltage to Ground	V_{CC}	-0.5	+7.0	V
Logic Input Voltage	V_I	-0.5	+5.5	V
LED Supply Voltage to Ground	$V_{LED}^{[1]}$	-0.5	+5.5	V
Decimal Point Current	I_{DP}		-10	mA

Note: 1. Above $T_C = 65^\circ\text{C}$ derate V_{LED} per derating curve in Figure 10.

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Logic Supply Voltage	V_{CC}	4.5	5.0	5.5	V
LED Supply Voltage, Display Off	V_{LED}	-0.5	0	+1.0	V
LED Supply Voltage, Display On	V_{LED}	3.0	4.2	5.5	V
Decimal Point Current	$I_{DP}^{[2]}$	0	-5.0	-10.0	mA
Logic Input Voltage, "H" State	V_{IH}	2.0		5.5	V
Logic Input Voltage, "L" State	V_{IL}	0		0.8	V

Note: 2. Decimal point current must be externally current limited. See application information.

Electrical/Optical Characteristics

Case Temperature, $T_C = 0^\circ\text{C}$ to 70°C , unless otherwise specified

Description	Symbol	Test Conditions		Min.	Typ. ^[4]	Max.	Unit
		V_{CC}	V_{LED}				
Logic Supply Current	I_{CC}	$V_{CC} = 5.5\text{V}$			45	75	mA
LED Supply Current	$I_{LED}^{[3]}$ [5]	V_{CC}	V_{LED}		255	350	mA
		5.5V	5.5V		170	235	
		5.5V	4.2V				
		5.5V	3.5V		125		
Logic Input Current, "H" State (ea. input)	I_{IH}	$V_{CC} = 5.5\text{V}$ $V_{IH} = 2.4\text{V}$				100	μA
Logic Input Current, "L" State (ea. input)	I_{IL}	$V_{CC} = 5.5\text{V}$ $V_{IL} = 0.4\text{V}$				-1.6	mA
Decimal Point Voltage Drop	$V_{LED} - V_{DP}$	$I_{DP} = -10\text{mA}$			1.6	2.0	V
Power Dissipation	$P_T^{[3]}$ [5]	V_{CC}	V_{LED}		1.7	2.3	W
		5.5V	5.5V		1.0	1.4	
		5.5V	4.2V				
		5.5V	3.5V		0.7		
Luminous Intensity per LED (digit avg.)	I_ν	V_{LED}	T_C		60	115	μcd
		5.5V	25°C		40	80	
		4.2V	25°C				
		3.5V	25°C		50		
Peak Wavelength	λ_{peak}				655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$				30		nm
Weight					4.9		gram

- Notes:
3. With numeral 8 displayed.
 4. All typical values at $T_C = 25^\circ\text{C}$.
 5. $T_C = 0^\circ\text{C}$ to 65°C for $V_{LED} = 5.5\text{V}$.

Truth Table

Character	Logic				
	X8	X4	X2	X1	
0	H	H	H	H	0
1	H	H	H	L	1
2	H	H	L	H	2
3	H	H	L	L	3
4	H	L	H	H	4
5	H	L	H	L	5
6	H	L	L	H	6
7	H	L	L	L	7
8	L	H	H	H	8
9	L	H	H	L	9
Blank	L	H	L	H	
Blank	L	H	L	L	
Blank	L	L	H	H	
Blank	L	L	H	L	
Blank	L	L	L	H	
Blank	L	L	L	L	

$V_{IL} = 0.0$ to 0.8V
 $V_{IH} = 2.0$ to 5.5V

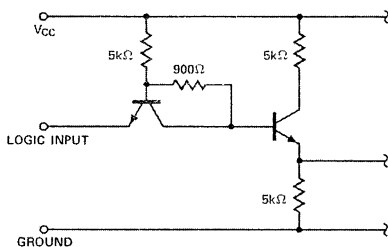


Figure 1. Equivalent input circuit of the 5082-7010 decoder.
Note: Display metal case is isolated from ground pin #6.

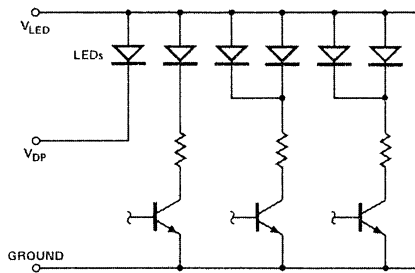


Figure 2. Equivalent circuit of the 5082-7010 as seen from LED and decimal point drive lines.

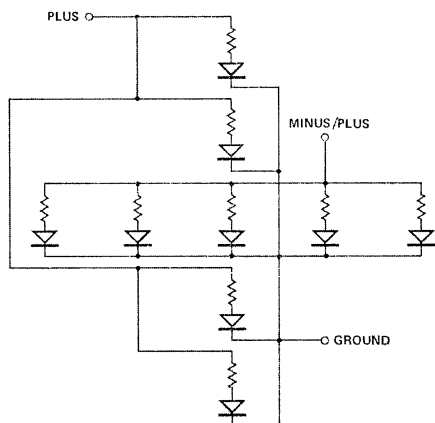


Figure 3. Equivalent circuit of 5082-7011 plus/minus sign. All resistors 345Ω typical. Note: Display metal case is isolated from ground pin #6.

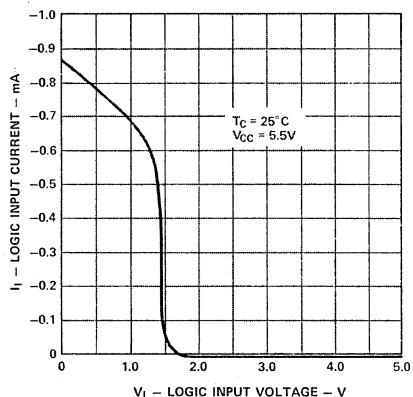


Figure 4. Input current as a function of input voltage, each input.

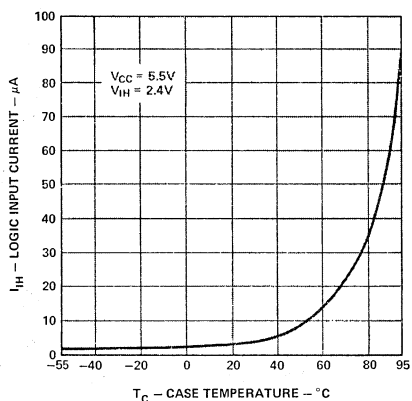


Figure 5. Logic "H" input current as a function of case temperature, each input.

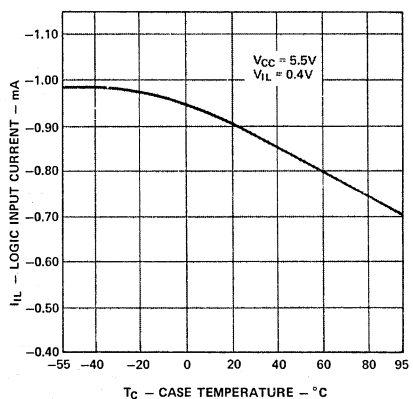


Figure 6. Logic "L" input current as a function of case temperature, each input.

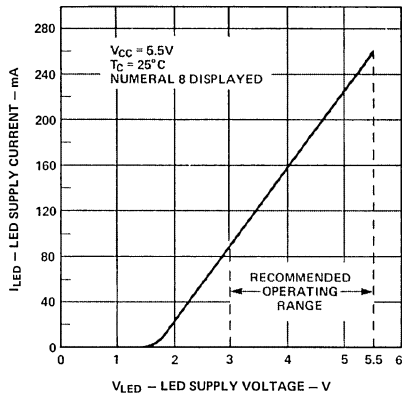


Figure 7. LED supply current as a function of LED supply voltage.

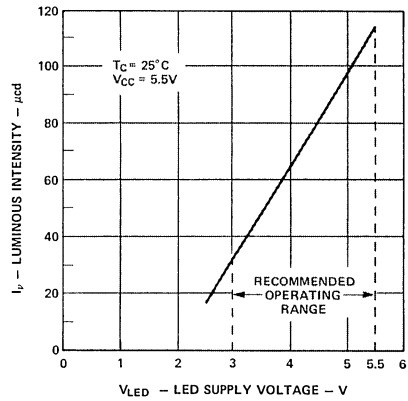


Figure 8. Luminous intensity per LED (digit average) as a function of LED supply voltage.

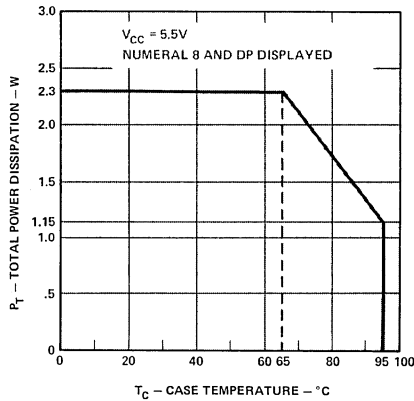


Figure 9. Maximum power derating as a function of case temperature.

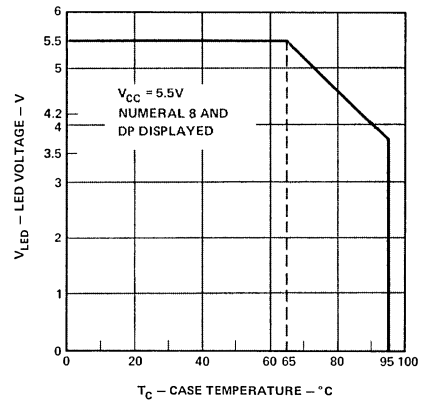


Figure 10. LED voltage derating as a function of case temperature.

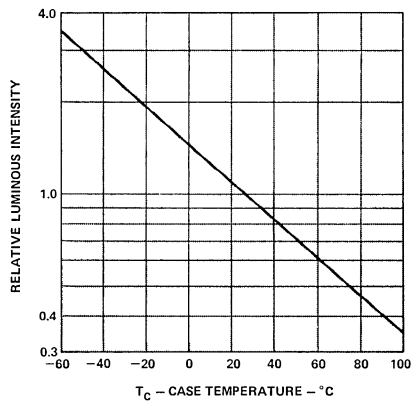


Figure 11. Relative luminous intensity as a function of case temperature at fixed current level.

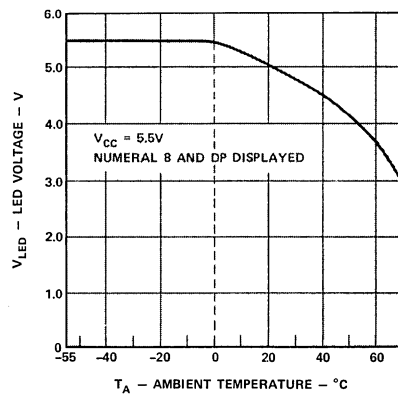


Figure 12. LED voltage derating as a function of ambient temperature, display soldered into P.C. board without heat sink.

Solid State Plus/Minus Sign 5082-7011

For display applications requiring \pm designation, the 5082-7011 solid state plus/minus sign is available. This display module comes in the same package as the 5082-7010 numeric indicator and is completely compatible with it. Plus or minus information can be indicated by supplying voltage to one (minus sign) or two (plus sign) input leads. A third lead is provided for the ground connection. Luminous intensity is controlled by changing the LED drive voltage. Each LED has its own built-in 345Ω (nominal) current limiting resistor. Therefore, no external current limiting is required for voltages at 5.5V or lower. Like the numeric indicator, the -7011 plus/minus sign is TTL/DTL compatible.

Truth Table

CHARACTER	PIN	
	3	7
+	H	H
-	L	H
Blank	L	L

$$V_L = -0.5 \text{ to } 1.0\text{V}$$

$$V_H = 3.0 \text{ to } 5.5\text{V}$$

Electrical/Optical Characteristics

Case Temperature, $T_C = 0^\circ\text{C}$ to 70°C , unless otherwise specified

Description	Symbol	Test Conditions	Min.	Typ. ^[1]	Max.	Unit
LED Supply Current	I_{LED}	$V_{LED} = 5.5\text{V}$		105	150	mA
		$V_{LED} = 4.2\text{V}$		70	100	
Power Dissipation	P_T	$V_{LED} = 5.5\text{V}$		0.6	0.9	W
		$V_{LED} = 4.2\text{V}$		0.3	0.6	
Luminous Intensity per LED (Digit Avg.)	I_v [2]	$V_{LED} = 5.5\text{V}$	60	115		μcd
		$V_{LED} = 4.2\text{V}$	40	80		
		$V_{LED} = 3.5\text{V}$		50		
Peak Wavelength	λ_{peak}			655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				4.9		gram

- Notes: 1. All typical values at $T_C = 25^\circ\text{C}$
2. At $T_C = 25^\circ\text{C}$

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	-65	+100	$^\circ\text{C}$
Operating Temperature, Case	T_C	-55	+95	$^\circ\text{C}$
Plus, Plus/Minus Input Potential to Ground	V_{LED}	-0.5	5.5	V

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
LED Supply Voltage, Display Off	V_{LED}	-0.5	0	1.0	V
LED Supply Voltage, Display On	V_{LED}	3.0	4.2	5.5	V

Applications

Decimal Point Limiting Resistor

The decimal point of the 5082-7010 display requires an external current limiting resistor, between pin 2 and ground. Recommended resistor value is 220Ω , 1/4 watt.

Mounting

The 5082-7010 and 5082-7011 displays are packaged with two rows of 4 contact pins each in a DIP configuration with a row center line spacing of 0.890 inches.

Normal mounting is directly onto a printed circuit board. If desired, these displays may be socket mounted using contact strip connectors such as Augat's 325-AGI or AMP 583773-1 or 583774-1.

Heat Sink Operation

Optimum display case operating temperature for the 5082-7010 and 7011 displays is $T_C = 0^\circ\text{C}$ to 70°C as measured on back surface. Maintaining the display case operating temperature within this range may be achieved by mount-

ing the display on an appropriate heat sink or metal core printed circuit board. Thermal conducting compound such as Wakefield 120 or Dow Corning 340 can be used between display and heat sink. See figure 10 for V_{LED} derating vs. display case temperature.

Operation Without Heat Sink

These displays may also be operated without the use of a heat sink. The thermal resistance from case to ambient for these displays when soldered into a printed circuit board is nominally $\theta_{CA} = 30^\circ\text{C/W}$. See figure 12 for V_{LED} derating vs. ambient temperature.

Cleaning

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

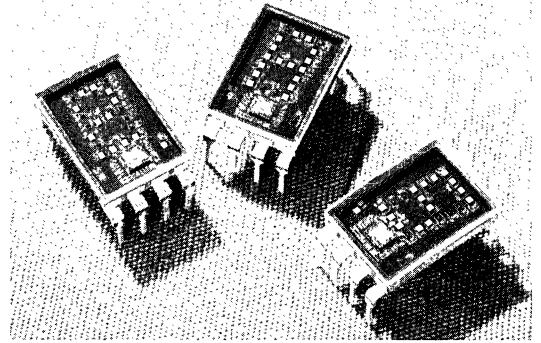
NUMERIC AND HEXADECIMAL DISPLAYS FOR HIGH RELIABILITY APPLICATIONS

5082-7391
5082-7392
5082-7393
5082-7395

TECHNICAL DATA APRIL 1978

Features

- PERFORMANCE GUARANTEED OVER TEMPERATURE
- HERMETICITY GUARANTEED
- TXV SCREENING AVAILABLE
- GOLD PLATED LEADS
- HIGH TEMPERATURE STABILIZED
- NUMERIC
5082-7391 Right Hand D.P.
5082-7392 Left Hand D.P.
- HEXADECIMAL
5082-7395
- TTL COMPATIBLE
- DECODER/DRIVER WITH 5 BIT MEMORY
- 4 x 7 DOT MATRIX ARRAY
Shaped Character, Excellent Readability
- STANDARD DUAL-IN-LINE PACKAGE
- CATEGORIZED FOR LUMINOUS INTENSITY
Assures Uniformity of Light Output from Unit to Unit within a Single Category



pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include control systems, instrumentation, communication systems and transportation equipment.

The 5082-7392 is the same as the 5082-7391 except that the decimal point is located on the left-hand side of the digit.

The 5082-7395 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

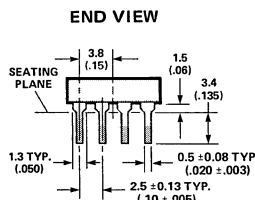
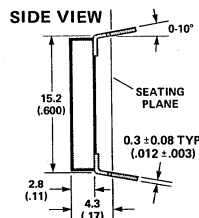
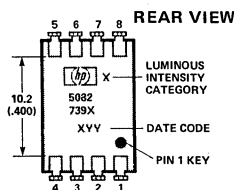
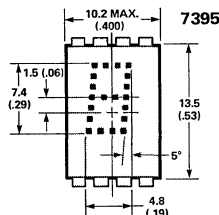
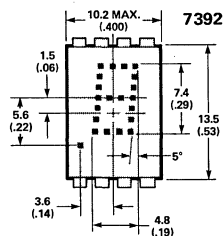
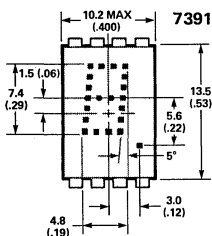
The 5082-7393 is a "±1." overrange display, including a right hand decimal point.

Description

The HP 5082-7390 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory are hermetically tested 7.4mm (0.29 inch) displays for use in military and aerospace applications.

The 5082-7391 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a "-" sign, a test

Package Dimensions



PIN	FUNCTION	
	5082-7391 AND 7392 NUMERIC	5082-7395 HEXA-DECIMAL
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V _{CC}	V _{CC}
8	Input 1	Input 1

NOTES:

1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is $\pm .38\text{mm}$ ($\pm .015''$).
3. Digit center line is $\pm .25\text{mm}$ ($\pm .01''$) from package center line.
4. Lead material is gold plated copper alloy.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient	T_S	-65	+125	°C
Operating temperature, ambient ^(1,2)	T_A	-55	+100	°C
Supply voltage ⁽³⁾	V_{CC}	-0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	-0.5	+7.0	V
Voltage applied to blanking input ⁽⁷⁾	V_B	-0.5	V_{CC}	V
Maximum solder temperature at 1.59mm (.062 inch) below seating plane; $t \leq 5$ seconds			260	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Operating temperature, ambient ^(1,2)	T_A	-55		+100	°C
Enable Pulse Width	t_w	100			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	50			nsec
Enable pulse rise time	t_{RLH}			200	nsec

Electrical/Optical Characteristics ($T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$, unless otherwise specified)

Description	Symbol	Test Conditions	Min.	Typ. ⁽⁴⁾	Max.	Unit
Supply Current	I_{CC}	$V_{CC}=5.5\text{V}$ (Numeral)		112	170	mA
Power dissipation	P_T	5 and dp lighted)		560	935	mW
Luminous intensity per LED (Digit average) ^(5,6)	I_l	$V_{CC}=5.0\text{V}$, $T_A=25^\circ\text{C}$	40	85		μCd
Logic low-level input voltage	V_{IL}	$V_{CC}=4.5\text{V}$			0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}				0.8	V
Enable high-voltage; data not being entered	V_{EH}		2.0			V
Blanking low-voltage; display not blanked ⁽⁷⁾	V_{BL}				0.8	V
Blanking high-voltage; display blanked ⁽⁷⁾	V_{BH}		3.5			V
Blanking low-level input current ⁽⁷⁾	I_{BL}		$V_{CC}=5.5\text{V}$, $V_{BL}=0.8\text{V}$			50	$\mu\text{A}$
Blanking high-level input current ⁽⁷⁾	I_{BH}	$V_{CC}=5.5\text{V}$, $V_{BH}=4.5\text{V}$			1.0	mA
Logic low-level input current	I_{IL}	$V_{CC}=5.5\text{V}$, $V_{IL}=0.4\text{V}$			-1.6	mA
Logic high-level input current	I_{IH}	$V_{CC}=5.5\text{V}$, $V_{IH}=2.4\text{V}$			+100	μA
Enable low-level input current	I_{EL}	$V_{CC}=5.5\text{V}$, $V_{EL}=0.4\text{V}$			-1.6	mA
Enable high-level input current	I_{EH}	$V_{CC}=5.5\text{V}$, $V_{EH}=2.4\text{V}$			+130	μA
Peak wavelength	λ_{PEAK}	$T_A=25^\circ\text{C}$		655		nm
Dominant Wavelength ⁽⁸⁾	λ_d	$T_A=25^\circ\text{C}$		640		nm
Weight				1.0		gm
Leak Rate					5×10^{-7}	cc/sec

Notes: 1. Nominal thermal resistance of a display mounted in a socket which is soldered into a printed circuit board: $\theta_{JA}=50^\circ\text{C/W}$; $\theta_{JC}=15^\circ\text{C/W}$. 2. θ_{CA} of a mounted display should not exceed 35°C/W for operation up to $T_A=+100^\circ\text{C}$. 3. Voltage values are with respect to device ground, pin 6. 4. All typical values at $V_{CC}=5.0\text{ Volts}$, $T_A=25^\circ\text{C}$. 5. These displays are categorized for luminous intensity with the intensity category designated by a letter located on the back of the display contiguous with the Hewlett-Packard logo marking. 6. The luminous intensity at a specific ambient temperature, $I_V(T_A)$, may be calculated from this relationship: $I_V(T_A)=I_V(25^\circ\text{C}) \cdot (985)^{(T_A-25^\circ\text{C})}$. 7. Applies only to 7395. 8. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

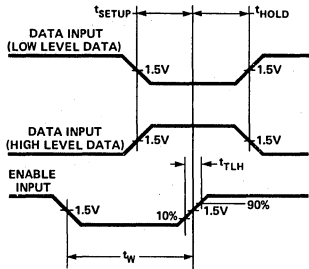


Figure 1. Timing Diagram of 5082-7390 Series Logic.

BCD DATA ⁽¹⁾				TRUTH TABLE	
X ₈	X ₄	X ₂	X ₁	5082-7391/7392	5082-7395
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	A	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	...	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F

DECIMAL PT. ⁽²⁾	V _{DP} = L
ON	V _{DP} = L
OFF	V _{DP} = H

ENABLE ⁽¹⁾	V _E = L
LOAD DATA	V _E = L
LATCH DATA	V _E = H

BLANKING ⁽³⁾	V _B = L
DISPLAY-ON	V _B = L
DISPLAY-OFF	V _B = H

Notes:

1. H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels or D.P. input have no effect upon display memory, displayed character, or D.P.
2. The decimal point input, DP, pertains only to the 5082-7391 and 5082-7392 displays.
3. The blanking control input, B, pertains only to the 5082-7395 hexadecimal display. Blanking input has no effect upon display memory.

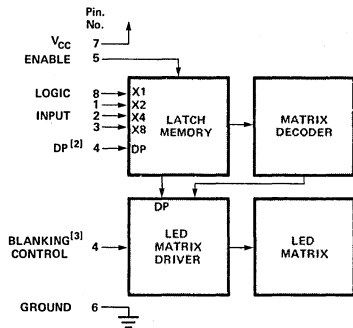


Figure 2. Block Diagram of 5082-7390 Series Logic.

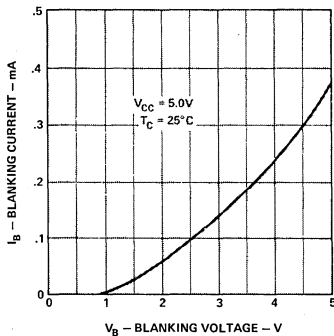


Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7395.

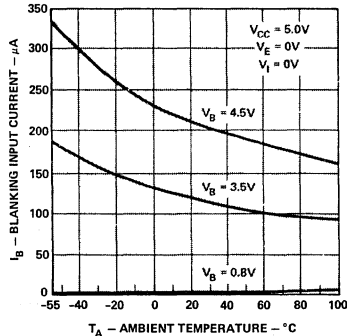


Figure 4. Typical Blanking Control Input Current vs. Ambient Temperature for 5082-7395.

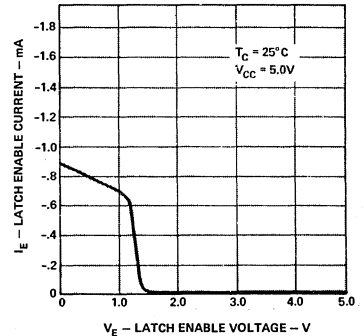


Figure 5. Typical Latch Enable Input Current vs. Voltage.

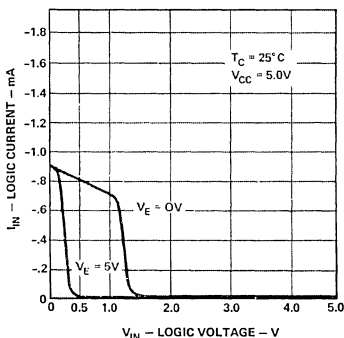


Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage.

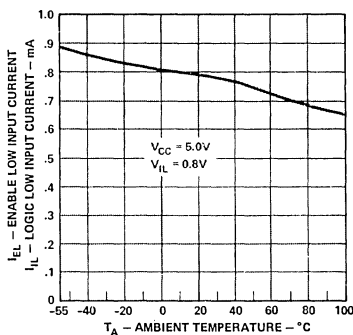


Figure 7. Typical Logic and Enable Low Input Current vs. Ambient Temperature.

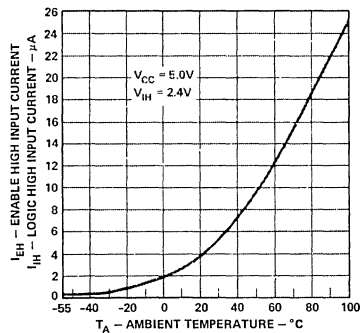


Figure 8. Typical Logic and Enable High Input Current vs. Ambient Temperature.

Operational Considerations

ELECTRICAL

The 5082-7390 series devices use a modified 4 x 7 dot matrix of light emitting diodes (LED's) to display decimal/hexadecimal numeric information. The LED's are driven by constant current drivers. BCD information is accepted by the display memory when the enable line is at logic low and the data is latched when the enable is at logic high. To avoid the latching of erroneous information, the enable pulse rise time should not exceed 200 nanoseconds. Using the enable pulse width and data setup and hold times listed in the Recommended Operating Conditions allows data to be clocked into an array of displays at a 6.7MHz rate.

The blanking control input on the 5082-7395 display blanks (turns off) the displayed hexadecimal information without disturbing the contents of display memory. The display is blanked at a minimum threshold level of 3.5 volts. This may be easily achieved by using an open collector TTL gate and a pull-up resistor. For example, (1/6) 7416 hexinverter buffer/driver and a 120ohm pull-up resistor will provide sufficient drive to blank eight displays. The size of the blanking pull-up resistor may be calculated from the following formula, where N is the number of digits:

$$R_{\text{blank}} = (V_{\text{CC}} - 3.5V) / [N (1.0\text{mA})]$$

The decimal point input is active low true and this data is latched into the display memory in the same fashion as is the BCD data. The decimal point LED is driven by the on-board IC.

MECHANICAL

5082-7390 series displays are hermetically tested for use in environments which require a high reliability device. These displays are designed and tested to meet a helium leak rate of 5×10^{-7} cc/sec and a standard dye penetrant gross leak test.

These displays may be mounted by soldering directly to a printed circuit board or inserted into a socket. The lead-to-lead pin spacing is 2.54mm (0.100 inch) and the lead row spacing is 15.24mm (0.600 inch). These displays may be end stacked with 2.54mm (0.100 inch) spacing between outside pins of adjacent displays. Sockets such as Augat 324-AG2D (3 digits) or Augat 508-AG8D (one digit, right angle mounting) may be used.

The primary thermal path for power dissipation is through the device leads. Therefore, to insure reliable operation up to an ambient temperature of +100°C, it is important to maintain a case-to-ambient thermal resistance of less than 35°C/watt as measured on top of display pin 3.

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

PRECONDITIONING

5082-7390 series displays are 100% preconditioned by 24 hour storage at 125°C.

CONTRAST ENHANCEMENT

The 5082-7390 displays have been designed to provide the maximum possible ON/OFF contrast when placed behind an appropriate contrast enhancement filter. Some suggested filters are Panelgraphic Ruby Red 60 and Dark Red 63, SGL Homalite H100-1605, 3M Light Control Film and Polaroid HRCP Red Circular Polarizing Filter. For further information see Hewlett-Packard Application Note 964.

High Reliability Test Program

Hewlett-Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

The TXV prefix identifies a part which has been preconditioned and screened per Table 1.

The TXVB prefix identifies a part which has been preconditioned and screened per Table 1, and comes from a lot which has been subjected to the Group B tests described in Table 2.

PART NUMBER SYSTEM

Standard Product	With TXV Screening	With TXV Screening Plus Group B
5082-7391	TXV-7391	TXVB-7391
5082-7392	TXV-7392	TXVB-7392
5082-7395	TXV-7395	TXVB-7395

Table 1. TXV Preconditioning and Screening — 100%.

Examination or Test	MIL-STD-883	
	Methods	Conditions
1. Internal Visual Inspection	HP Procedure 72-Q352	
2. Electrical Test: I_V , I_{CC} , I_{BL} , I_{BH} , I_{EL} , I_{EH} , I_{IL} , I_{IH} .	1008	Per Electrical/Optical Characteristics. 125° C, 168 hours.
3. High Temperature Storage	1010	-65° C to +125° C, 10 cycles.
4. Temperature Cycling	2001	2,000 G, Y_1 orientation.
5. Acceleration	1014	Condition A, limit pressure to 25psi for 1 hour.
6. Helium Leak Test	1014	Condition D, 40psi for 1 hour.
7. Gross Leak Test		
8. Electrical Test: Same as Step 2		
9. Burn-in	1015	$T_A=100^\circ\text{C}$, $t=168$ hours, at $V_{CC}=5.0\text{V}$ and cycling through logic at 1 character per sec.
10. Electrical Test as in Step 2		
11. Sample Electrical Test Over Temperature: I_{CC} , I_{BL} , I_{BH} , I_{EL} , I_{EH} , I_{IL} , I_{IH}		Per Electrical Characteristics, $T_A=55^\circ\text{C}$, $+100^\circ\text{C}$, LTPD=7
12. External Visual	2009	

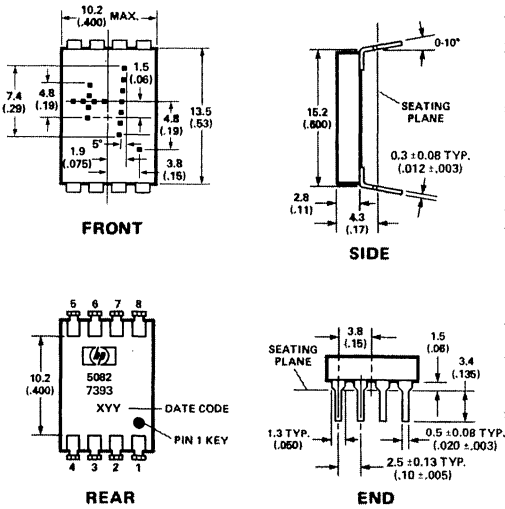
Table 2. Group B.

Examination or Test	MIL-STD-883		LTPD
	Method	Condition	
Subgroup 1 Physical Dimensions	2008	Package Dimensions per Product Outline Drawing.	20
Subgroup 2 Solderability	2003	Immersion within 0.062" of seating plane 260° C, $t=5$ sec., omit aging.	15
Temperature Cycling	1010	10 cycles -65° C to +125° C	
Thermal Shock	1011	Test Condition A	
Hermetic Seal	1014	Condition A, limit pressure to 25psi for 1 hour, and Condition D, 40psi for 1 hour.	
Moisture Resistance End Points: Electrical Test	1004	Omit initial conditioning. Same as Step 2, Table 1.	
Subgroup 3 Shock - Non-operating	2002	1500 G, $t=0.5\text{ms}$, 5 blows in each orientation X_1 , Y_1 , Y_2 .	15
Vibration Variable Frequency	2007	Non-operating.	
Constant Acceleration End Points: Electrical Test	2001	2,000 G, Y_1 orientation. Same as Step 2, Table 1.	
Subgroup 4 Terminal Strength	2004	Test Condition B2.	15
End Points: Hermetic Seal	1014	Condition A, limit pressure to 25psi for 1 hour, and Condition D, 40psi for 1 hour.	
Subgroup 5 Salt Atmosphere	1009	Test Condition A	15
Subgroup 6 High Temperature Life End Points: Electrical Test	1008	$T_A=125^\circ\text{C}$, non-operating, $t=1000$ hours. Same as Step 2, Table 1.	$\lambda=7$
Subgroup 7 Steady State Operating Life End Points: Electrical Test	1005	$T_A=100^\circ\text{C}$, $t=1000$ hours, at $V_{CC}=5.0\text{V}$ and cycling through logic at 1 character per second. Same as Step 2, Table 1.	$\lambda=5$

Solid State Over Range Character

For display applications requiring a \pm , 1, or decimal point designation, the 5082-7393 over range character is available. This display module comes in the same package as the 5082-7390 series numeric indicator and is completely compatible with it.

Package Dimensions



NOTES:
1. DIMENSIONS IN MILLIMETRES AND (INCHES).
2. UNLESS OTHERWISE SPECIFIED, THE TOLERANCE ON ALL DIMENSIONS IS $\pm .38$ MM ($\pm .015$ INCHES).

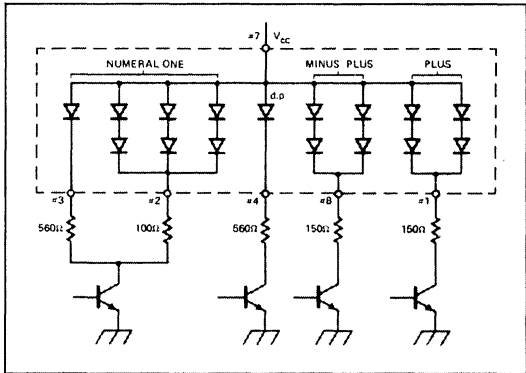


Figure 9. Typical Driving Circuit.

TRUTH TABLE

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
-	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Figure 9 cutoff.
H: Line switching transistor in Figure 9 saturated.
X: 'Don't care'

Electrical/Optical Characteristics

5082-7393 ($T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$, Unless Otherwise Specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V_F	$I_F = 10$ mA		1.6	2.0	V
Power dissipation	P_T	$I_F = 10$ mA all diodes lit		280	320	mW
Luminous Intensity per LED (digit average)	I_ν	$I_F = 6$ mA $T_C = 25^\circ\text{C}$	40	85		μcd
Peak wavelength	λ_{peak}	$T_C = 25^\circ\text{C}$		655		nm
Dominant Wavelength	λ_d	$T_C = 25^\circ\text{C}$		640		nm
Weight				1.0		gm

Recommended Operating Conditions

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{CC}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to Figure 9 for recommended resistor values.

Absolute Maximum Ratings

DESCRIPTION	SYMBOL	MIN.	MAX.	UNIT
Storage temperature, ambient	T_S	-65	+125	$^\circ\text{C}$
Operating temperature, ambient	T_A	-55	+100	$^\circ\text{C}$
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

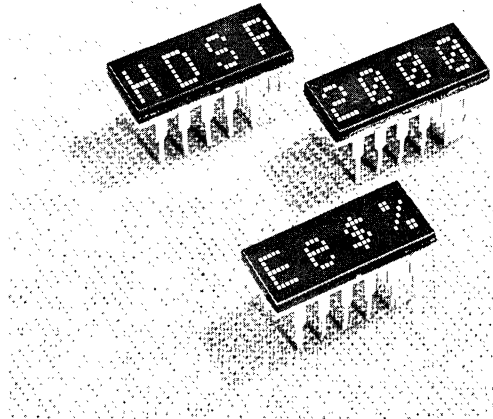
FOUR CHARACTER SOLID STATE ALPHANUMERIC DISPLAY

HDSP-2000

TECHNICAL DATA APRIL 1978

Features

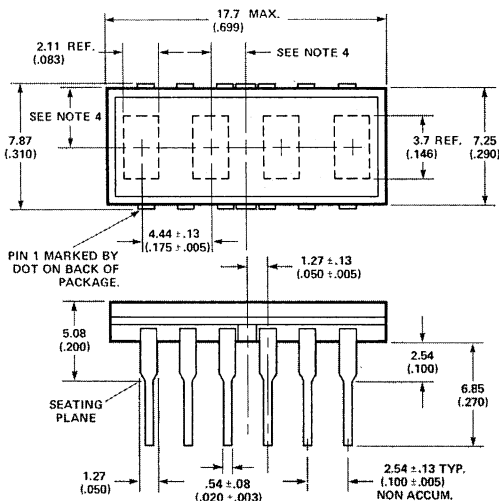
- INTEGRATED SHIFT REGISTERS WITH CONSTANT CURRENT DRIVERS
- CERAMIC 7.62 mm (.3 in.) DIP
Integral Red Glass Contrast Filter
- WIDE VIEWING ANGLE
- END STACKABLE 4 CHARACTER PACKAGE
- PIN ECONOMY
12 Pins for 4 Characters
- TTL COMPATIBLE
- 5x7 LED MATRIX DISPLAYS FULL ASCII CODE
- RUGGED, LONG OPERATING LIFE
- CATEGORIZED FOR LUMINOUS INTENSITY
Assures Ease of Package to
Package Brightness Matching



Description

The HP HDSP-2000 display is a 3.8mm (0.15 inch) 5x7 LED array for display of alphanumeric information. The device is available in 4 character clusters and is packaged in a 12-pin dual-in-line type package. An on-board SIPO (serial-in-parallel-out) 7 bit shift register associated with each digit controls constant current LED row drivers. Full character display is achieved by external column strobing. The constant current LED drivers are externally programmable and typically capable of sinking 13.5mA peak per diode. Applications include interactive I/O terminals, point of sale equipment, portable telecommunications gear, and hand held equipment requiring alphanumeric displays.

Package Dimensions



PIN	FUNCTION	PIN	FUNCTION
1	COLUMN 1	7	DATA OUT
2	COLUMN 2	8	V _q
3	COLUMN 3	9	V _{cc}
4	COLUMN 4	10	CLOCK
5	COLUMN 5	11	GROUND
6	INT. CONNECT*	12	DATA IN

*DO NOT CONNECT OR USE

NOTES:

1. DIMENSIONS IN mm (inches).
2. UNLESS OTHERWISE SPECIFIED THE TOLERANCE ON ALL DIMENSIONS IS $\pm .38$ mm ($\pm .015$ ").
3. LEAD MATERIAL IS GOLD PLATED COPPER ALLOY.
4. CHARACTERS ARE CENTERED WITH RESPECT TO LEADS WITHIN $\pm .13$ mm ($\pm .005$ ").

Absolute Maximum Ratings

Supply Voltage V_{CC} to Ground -0.5V to 6.0V
 Inputs, Data Out and V_B -0.5V to V_{CC}
 Column Input Voltage, V_{COL} -0.5V to +6.0V
 Free Air Operating Temperature
 Range, $T_A^{(2)}$ -20°C to +70°C

Storage Temperature Range, T_S -55°C to +100°C
 Maximum Allowable Package Dissipation
 at $T_A = 25^\circ\text{C}^{(1,2,6)}$ 1.70 Watts
 Maximum Solder Temperature 1.59mm (.063")
 Below Seating Plane $t < 5$ secs 260°C

Recommended Operating Conditions

Parameter	Symbol	Min.	Nom.	Max.	Units
Supply Voltage	V_{CC}	4.75	5.0	5.25	V
Data Out Current, Low State	I_{OL}			1.6	mA
Data Out Current, HighState	I_{OH}			-0.5	mA
Column Input Voltage, Column On	V_{COL}	2.6		V_{CC}	V
Setup Time	t_{cup}	70	45		ns
Hold Time	t_{hold}	30	0		ns
Width of Clock	$t_{w(Clock)}$	75			ns
Clock Frequency	f_{clock}	0		3	MHz
Clock Transition Time	t_{rHL}			200	ns
Free Air Operating Temperature Range	T_A	-20		70	°C

Electrical Characteristics Over Operating Temperature Range

(Unless otherwise specified.)

Description	Symbol	Test Conditions	Min.	Typ.*	Max.	Units	
Supply Current	I_{CC}	$V_{CC} = 5.25V$ $V_{CLOCK} = V_{DATA} = 2.4V$ All SR Stages = Logical 1	$V_B = 0.4V$	45	60	mA	
			$V_B = 2.4V$	73	95	mA	
Column Current at any Column Input	I_{COL}	$V_{CC} = V_{COL} = 5.25V$ All SR Stages = Logical 1	$V_B = 0.4V$		1.5	mA	
Column Current at any Column Input	I_{COL}		$V_B = 2.4V$	335	410	mA	
Peak Luminous Intensity per LED ^[3,7] (Character Average)	I_{PEAK}	$V_{CC} = 5.0V, V_{COL} = 3.5V$ $T_1 = 25^\circ\text{C}^{(4)}$ $V_B = 2.4V$	105	200		μcd	
V_B , Clock or Data Input Threshold High	V_{IH}	$V_{CC} = V_{COL} = 4.75V$		2.0		V	
V_B , Clock or Data Input Threshold Low	V_{IL}				0.8		V
Input Current Logical 1	V_B , Clock Data In	I_{IH} I_{IH}	$V_{CC} = 5.25V, V_{IH} = 2.4V$		20	80	μA
					10	40	μA
Input Current Logical 0	V_B , Clock Data In	I_{II} I_{II}	$V_{CC} = 5.25V, V_{II} = 0.4V$		-500	-800	μA
					-250	-400	μA
Data Out Voltage	V_{OH} V_{OL}	$V_{CC} = 4.75V, I_{OH} = -0.5mA, V_{COL} = 0V$ $V_{CC} = 4.75V, I_{OL} = 1.6mA, V_{COL} = 0V$	2.4	3.4		V	
				0.2	0.4	V	
Power Dissipation Per Package**	P_D	$V_{CC} = 5.0V, V_{COL} = 2.6V,$ 15 LEDs on per character, $V_B = 2.4V$		0.66		W	
Peak Wavelength	λ_{PEAK}			655		nm	
Dominant Wavelength ⁽⁵⁾	λ_d			639		nm	

*All typical values specified at $V_{CC} = 5.0V$ and $T_A = 25^\circ\text{C}$ unless otherwise noted.

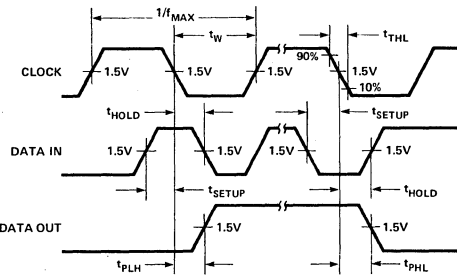
**Power dissipation per package with 4 characters illuminated.

- NOTES: 1. Maximum absolute dissipation is with the device in a socket having a thermal resistance from pins to ambient of 35°C/watt.
 2. The device should be derated linearly above 25°C at 16mW/°C (see Electrical Description on page 3).
 3. The characters are categorized for Luminous Intensity with the intensity category designated by a letter code on the bottom of the package.
 4. T_1 refers to the initial case temperature of the device immediately prior to the light measurement.
 5. Dominant wavelength λ_d , is derived from the CIE chromaticity diagram, and represents the single wavelength which defines the color of the device.
 6. Maximum allowable dissipation is derived from $V_{CC} = V_B = V_{COL} = 5.25$ Volts, 20 LEDs on per character.
 7. The luminous sterance of the LED may be calculated using the following relationships:

$$L_v (\text{Lux}) = I_v (\text{Candela})/A (\text{Metre})^2$$

$$L_v (\text{Footlamberts}) = \pi I_v (\text{Candela})/A (\text{Foot})^2$$

$$A = 5.3 \times 10^{-8} \text{ M}^2 = 5.8 \times 10^{-7} (\text{Foot})^2$$



Parameter	Condition	Min.	Typ.	Max.	Units
f_{max} Max. Clock Rate		3			MHz
t_{PLH}, t_{PHL} Propagation delay CLOCK to DATA OUT	$C_L = 15pF$ $R_L = 2.4K\Omega$			90	ns

Figure 1. Switching Characteristics. ($V_{CC} = 5V$, $T_A = -20^\circ C$ to $+70^\circ C$)

Mechanical and Thermal Considerations

The HDSP-2000 is available in a standard 12 lead ceramic-glass dual in-line package. It is designed for plugging into DIP sockets or soldering into PC boards. The packages may be horizontally or vertically stacked for character arrays of any desired size.

The -2000 can be operated over a wide range of temperature and supply voltages. Full power operation at $T_A = 25^\circ C$ ($V_{CC} = V_B = V_{COL} = 5.25V$) is possible by providing a total thermal resistance from the seating plane of the pins to ambient of $35^\circ C/W$ /cluster maximum. For operation above $T_A = 25^\circ C$, the maximum device dissipation should be derated above $25^\circ C$ at $16mW/^\circ C$ (see Figure 2). Power derating can be achieved by either decreasing V_{COL} or decreasing the average drive current through pulse width modulation of V_B .

The -2000 display has an integral contrast enhancement filter in the glass lens. Additional front panel contrast filters may be desirable in most actual display applications. Some suggested filters are Panelgraphic Ruby Red 60, SGL Homalite H100-1605 and Plexiglass 2423. Hewlett-Packard Application Note 964 treats this subject in greater detail.

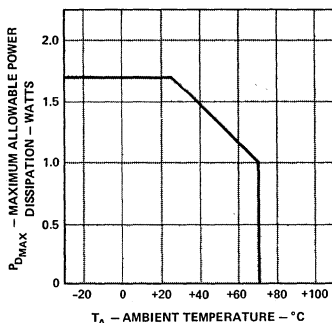


Figure 2. Maximum Allowable Power Dissipation vs. Temperature.

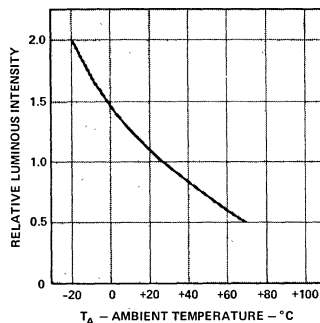


Figure 3. Relative Luminous Intensity vs. Temperature.

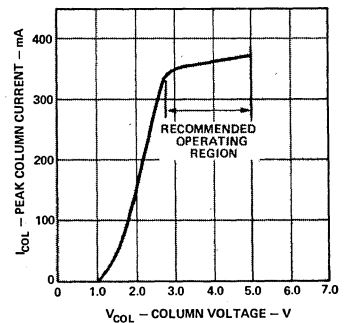


Figure 4. Peak Column Current vs. Column Voltage.

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

Electrical Description

The HDSP-2000 four character alphanumeric display has been designed to allow the user maximum flexibility in interface electronics design. Each four character display module features Data In and Data Out terminals arrayed for easy PC board interconnection such that display strings of up to 80 digits may be driven from a single character generator. Data Out represents the output of the 7th bit of digit number 4 shift register. Shift register clocking occurs on the high to low transition of the Clock input. The like columns of each character in a display cluster are tied to a single pin. Figure 5 is the block diagram for the HDSP-2000. High true data in the shift register enables the output current mirror driver stage associated with each row of LEDs in the 5x7 diode array.

The reference current for the current mirror is generated from the output voltage of the V_B input buffer applied across the resistor R. The TTL compatible V_B input may either be tied to V_{CC} for maximum display intensity or pulse width modulated to achieve intensity control and reduction in power consumption.

The normal mode of operation is depicted in the block diagram of Figure 6. In this circuit, binary input data for digit 4, column 1 is decoded by the 7 line output ROM and then loaded into the 7 on board shift register locations 1 through 7 through a parallel-in-serial-out shift register. Column 1 data for digits 3, 2 and 1 is similarly decoded and shifted into the display shift register locations. The column 1 input is now enabled for an appropriate period of time, T. A similar process is repeated for columns 2, 3, 4 and 5. If the time necessary to decode and load data into the shift register is t, then with 5 columns, each column of the display is operating at a duty factor of:

$$D.F. = \frac{T}{5(t+T)}$$

The time frame, t + T, allotted to each column of the display is generally chosen to provide the maximum duty factor consistent with the minimum refresh rate necessary

to achieve a flicker free display. For most strobed display systems, each column of the display should be refreshed (turned on) at a minimum rate of 100 times per second. With 5 columns to be addressed, this refresh rate then gives a value for the time $t + T$ of:

$$1/[5 \times (100)] = 2 \text{ msec.}$$

If the device is operated at 3.0 MHz clock rate maximum, it is possible to maintain $t \ll T$. For short display strings, the duty factor will then approach 20%. For longer display strings operation at column duty factors of less than 10% will still provide adequate display intensity in most applications. For further applications information, refer to HP Application Note 966, Application Bulletin No. 51 and Application Bulletin No. 55.

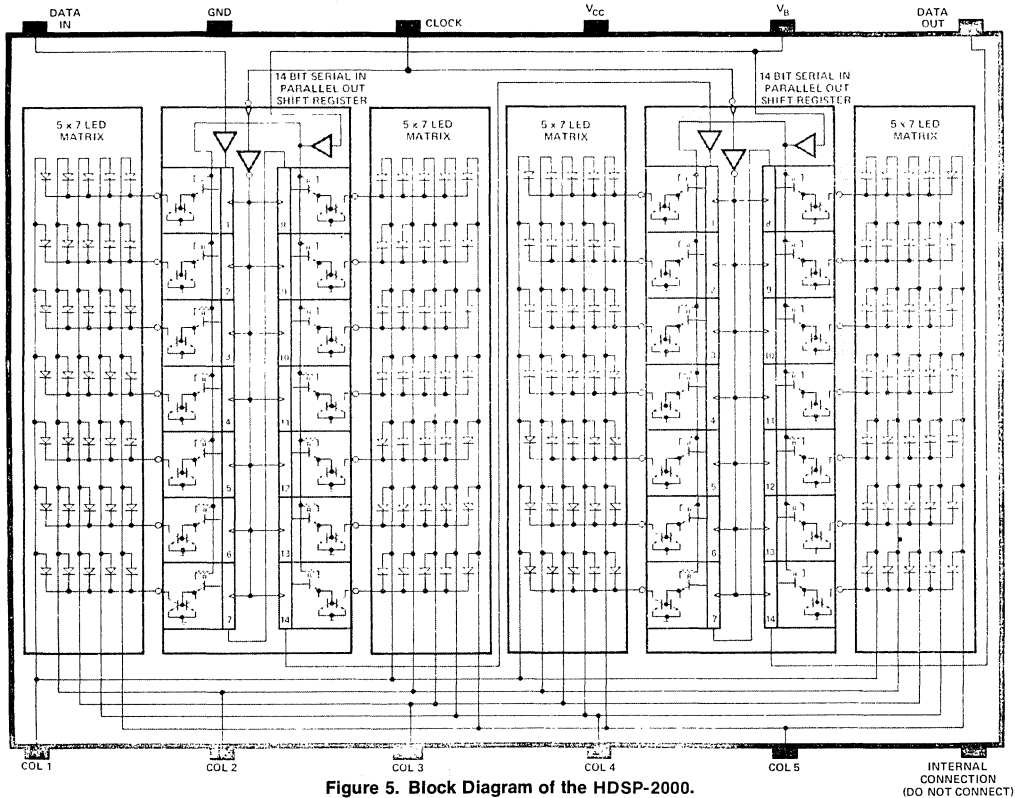


Figure 5. Block Diagram of the HDSP-2000.

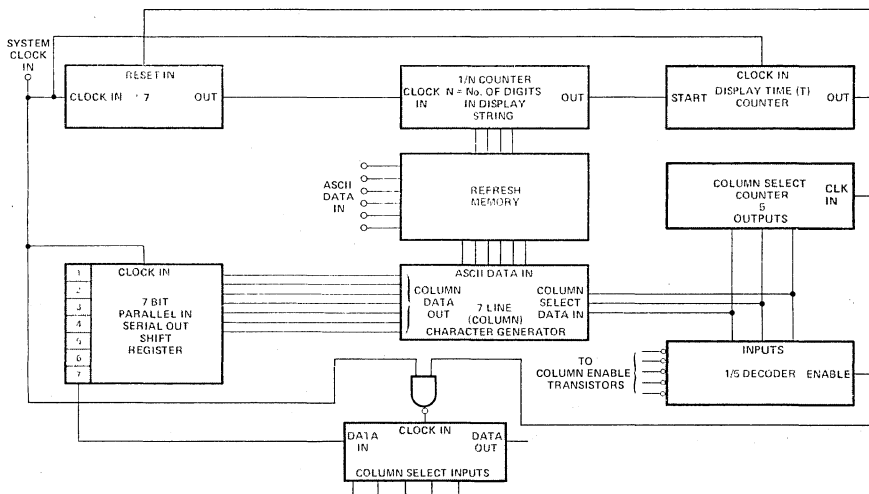


Figure 6. Block Diagram of a Basic Display System.



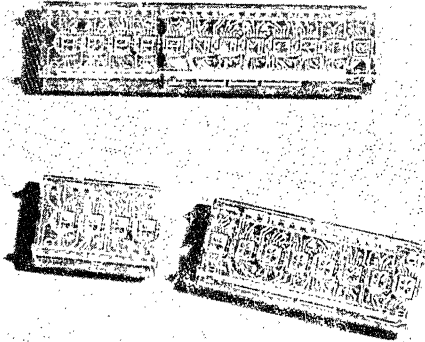
16 SEGMENT SOLID STATE ALPHANUMERIC DISPLAY

HDSP-6504
HDSP-6508

TECHNICAL DATA APRIL 1978

Features

- **ALPHANUMERIC**
Displays 64 Character ASCII Set and Special Characters
- **16 SEGMENT FONT PLUS CENTERED D.P. AND COLON**
- **3.81mm (0.150") CHARACTER HEIGHT**
- **APPLICATION FLEXIBILITY WITH PACKAGE DESIGN**
4 and 8 Character Dual-In-Line Packages
End Stackable-On Both Ends for 8 Character and On One End for 4 Character
Sturdy Gold-Plated Leads on 2.54mm (0.100") Centers
Environmentally Sealed Package
Common Cathode Configuration
- **LOW POWER**
As Low as 1.0-1.5mA Average
Per Segment Depending on Peak Current Levels
- **EXCELLENT CHARACTER APPEARANCE**
Continuous Segment Font
High On/Off Contrast
6.35mm (0.250") Character Spacing
Excellent Character Alignment
Excellent Readability at 2 Metres
- **SUPPORT ELECTRONICS**
Can Be Driven With ROM Decoders and Drivers
Easy Interfacing With Microprocessors and LSI Circuitry
- **CATEGORIZED FOR LUMINOUS INTENSITY**
Assures Uniformity of Light Output From Unit to Unit Within a Single Category



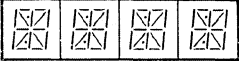
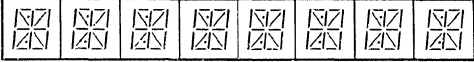
Description

The HDSP-6504 and HDSP-6508 are 3.81mm (0.150") sixteen segment GaAsP red alphanumeric displays mounted in 4 character and 8 character dual-in-line package configurations that permit mounting on PC boards or in standard IC sockets. The monolithic light emitting diode character is magnified by the integral lens which increases both character size and luminous intensity, thereby making low power consumption possible. The rugged package construction offers extended environmental capabilities compared to the standard PC board/lens type of display package. Its temperature cycling capability is the result of the environmentally sealed air gap which exists between the semiconductor chip/wire bond assembly and the lens. Moisture resistance is assured by the epoxy encapsulant on the bottom of the package. In addition to the sixteen segments, a centered D.P. and colon are included. Character spacing yields 4 characters per inch.

Applications

These alphanumeric displays are attractive for applications such as computer peripherals and terminals, computer base emergency mobile units, automotive instrument panels, desk top calculators, in-plant control equipment, hand-held instruments and other products requiring low power, display compactness and alphanumeric display capability.

Device Selection Guide

Characters Per Display	Configuration		Part No. HDSP-
	Device	Package	
4		(Figure 6)	6504
8		(Figure 7)	6508

Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Units
I _{PEAK}	Peak Forward Current Per Segment or DP (Duration ≤ 312μs)		200	mA
I _{AVG}	Average Current Per Segment or DP [1]		7	mA
P _D	Average Power Dissipation Per Character [1,2]		138	mW
T _A	Operating Temperature, Ambient	-40	85	°C
T _S	Storage Temperature	-40	100	°C
V _R	Reverse Voltage		5	V
	Solder Temperature at 1.59mm (1/16 inch) below seating plane, t ≤ 3 Seconds		260	°C

NOTES:

1. Maximum allowed drive conditions for strobed operation are derived from Figures 1 and 2. See electrical section of operational considerations.
2. Derate linearly above T_A = 50°C at 2.17mW/°C. P_D Max. (T_A = 85°C) = 62mW.

Electrical/Optical Characteristics at T_A = 25°C

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
I _v	Luminous Intensity, Time Average, Character Total with 16 Segments Illuminated [3,4]	I _{PEAK} = 30mA 1/16 Duty Factor	0.45	1.65		mcd
V _F	Forward Voltage Per Segment or DP	I _F = 30mA (One Segment On)		1.6	1.9	V
λ _{PEAK}	Peak Wavelength			655		nm
λ _d	Dominant Wavelength [5]			640		nm
I _R	Reverse Current Per Segment or DP	V _R = 5V		10		μA
ΔV _F /Δ°C	Temperature Coefficient of Forward Voltage			-2		mV/°C

NOTES:

3. The luminous intensity ratio between segments within a digit is designed so that each segment will have the same luminous sterance. Thus each segment will appear with equal brightness to the eye.
4. Operation at peak currents of less than 7mA is not recommended.
5. The dominant wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which defines the color of the device, standard red.

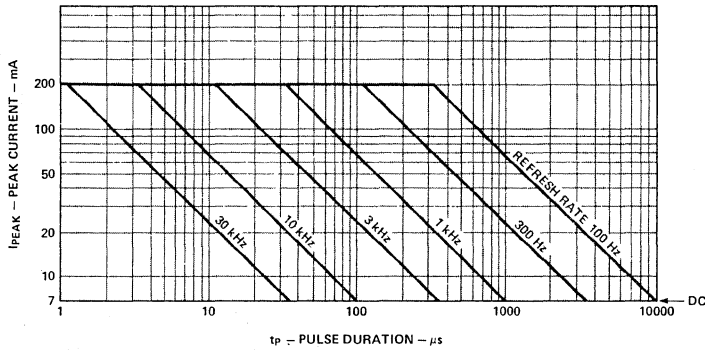
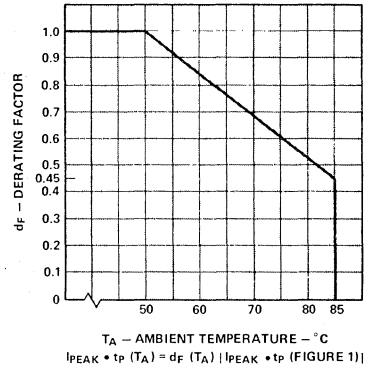


Figure 1. Maximum Allowed Peak Current vs. Pulse Duration, Derate derived operating conditions above $T_A = 50^\circ\text{C}$ using Figure 2.



T_A - AMBIENT TEMPERATURE - $^\circ\text{C}$
 $I_{PEAK} \cdot t_p (T_A) = df (T_A) | I_{PEAK} \cdot t_p$ (FIGURE 1)

Figure 2. Temperature Derating Factor For Operating Conditions When T_A Exceeds 50°C .

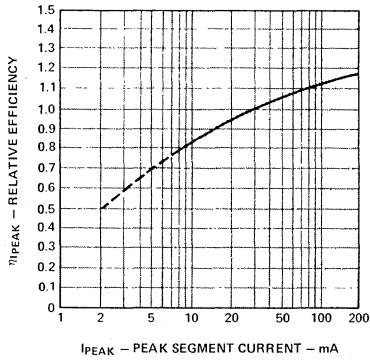


Figure 3. Relative Luminous Efficiency (Luminous Intensity Per Unit Current) vs. Peak Segment Current.

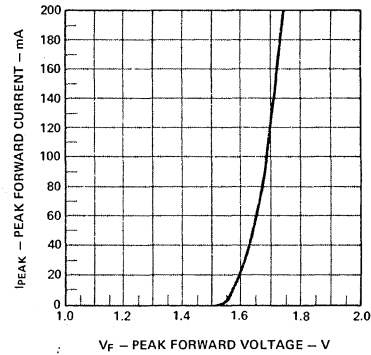


Figure 4. Peak Forward Segment Current vs. Peak Forward Voltage.

		A ₃	A ₂	A ₁	A ₀																
		→																			
A ₅	A ₄	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F				
0	0	␣	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O				
0	1	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	↗	↖				
1	0		!	"	#	\$	%	&	'	<	>	*	+	,	-	.	/				
1	1	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?				

Figure 5. Typical 64 Character ASCII Set.

⊠ | 2 3 4 5 6 7 8 9 √ ÷ Σ
 △ □ P V >

Additional Character Font

Package Dimensions

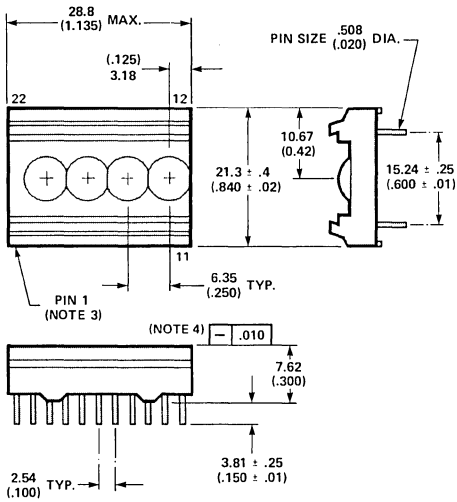


Figure 6. HDSP-6504

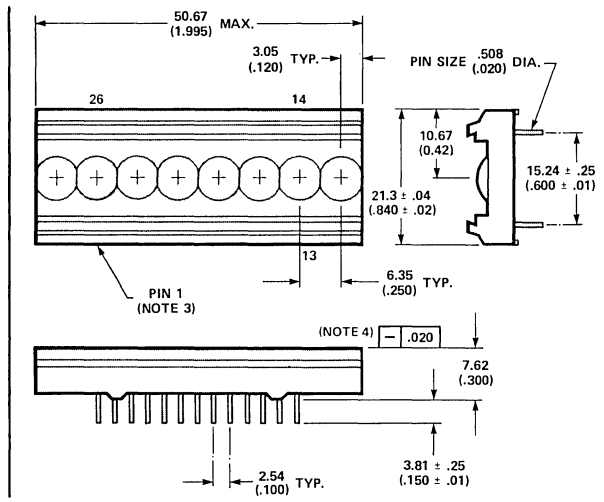


Figure 7. HDSP-6508

- NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES AND (INCHES).
 2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
 3. PIN 1 IDENTIFIED BY INK DOT ADJACENT TO LEAD.
 4. DEVICE PACKAGE IS STRAIGHT WITHIN INDICATED LIMIT.

Magnified Character Font Description

DEVICES
 HDSP-6504
 HDSP-6508

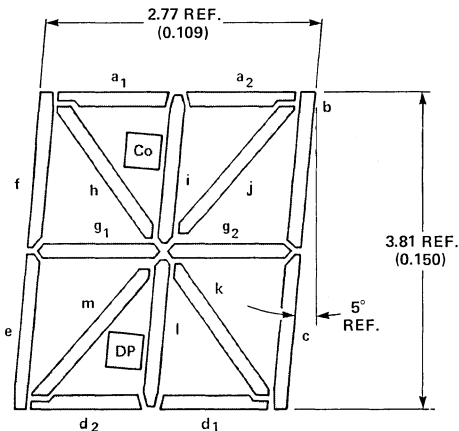


Figure 8.

Device Pin Description

Pin No.	Function	
	HDSP-6504	HDSP-6508
1	Anode Segment g ₁	Anode Segment g ₁
2	Anode Segment DP	Anode Segment DP
3	Cathode Digit 1	Cathode Digit 1
4	Anode Segment d ₂	Anode Segment d ₂
5	Anode Segment l	Anode Segment l
6	Cathode Digit 3	Cathode Digit 3
7	Anode Segment e	Anode Segment e
8	Anode Segment m	Anode Segment m
9	Anode Segment k	Anode Segment k
10	Cathode Digit 4	Cathode Digit 4
11	Anode Segment d ₁	Anode Segment d ₁
12	Anode Segment j	Cathode Digit 6
13	Anode Segment C ₀	Cathode Digit 8
14	Anode Segment g ₂	Cathode Digit 7
15	Anode Segment a ₂	Cathode Digit 5
16	Anode Segment i	Anode Segment j
17	Cathode Digit 2	Anode Segment C ₀
18	Anode Segment b	Anode Segment g ₂
19	Anode Segment a ₁	Anode Segment a ₂
20	Anode Segment c	Anode Segment i
21	Anode Segment h	Cathode Digit 2
22	Anode Segment f	Anode Segment b
23		Anode Segment a ₁
24		Anode Segment c
25		Anode Segment h
26		Anode Segment f

Operational Considerations

ELECTRICAL

The HDSP-6504 and -6508 devices utilize large monolithic 16 segment GaAsP LED chips with centered decimal point and colon. Like segments of each digit are electrically interconnected to form an 18 by N array, where N is the quantity of characters in the display. In the driving scheme the decimal point or colon is treated as a separate character with its own time frame. A detailed discussion of character font capabilities, ASCII code to 16 segment decoding and display drive techniques will appear in a forthcoming application bulletin.

These displays are designed specifically for strobed (multiplexed) operation, with a minimum recommended time average forward current per segment of 0.875mA. Under normal operating situations the maximum number of illuminated segments needed to represent a given character is 10. Therefore, except where noted, the information presented in this data sheet is for a maximum of 10 segments illuminated per character.*

The typical forward voltage values, scaled from Figure 4, should be used for calculating the current limiting resistor values and typical power dissipation. Expected maximum V_F values for the purpose of driver circuit design may be calculated using the following V_F model:

$$\begin{aligned} V_F &= 1.85V + I_{PEAK} (1.8\Omega) \\ \text{For: } 30\text{mA} &\leq I_{PEAK} \leq 200\text{mA} \\ V_F &= 1.58V + I_{PEAK} (10.7\Omega) \\ \text{For: } 10\text{mA} &\leq I_{PEAK} \leq 30\text{mA} \end{aligned}$$

Pulsed operating conditions on a per segment basis are derived from Figure 1 and are temperature derated using Figure 2. Figure 1 relates maximum allowed segment peak current, I_{PEAK} , to the maximum allowed pulse duration, t_p , for various strobing refresh rates, f . To most effectively utilize Figure 1, perform the following steps:

1. Determine desired duty factor, DF.
Example: Sixteen characters, $DF = 1/16$
2. Determine desired refresh rate, f . Use duty factor to calculate pulse duration, t_p . Note: $DF = ft_p$
Example: $f = 1\text{kHz}$, $t_p = 62.5\mu\text{s}$
3. Enter Figure 1 at the calculated t_p . Move vertically to the refresh rate line and record the corresponding value of I_{PEAK} .
Example: At $t_p = 62.5\mu\text{s}$ and $f = 1\text{kHz}$, $I_{PEAK} = 100\text{mA}$
 $I_{AVG} = I_{PEAK} \cdot DF = (100\text{mA}) (1/16) = 6.25\text{mA}$
4. The maximum allowed operating conditions, not temperature derated, are now known. If the operating ambient temperature is above 50°C , the operating conditions derived from Figure 1 must be temperature derated.

Figure 2 derates the product $I_{PEAK} \cdot t_p$ with ambient temperature. The designer has the option of maintaining either t_p or I_{PEAK} and derating I_{PEAK} or t_p . The choice of derating I_{PEAK} results in a lower power

dissipation with the least loss of light output. To obtain the temperature derated operating conditions perform the following steps.

5. Determine maximum operating ambient temperature.
Example: $T_A = 70^\circ\text{C}$
6. Multiply $I_{PEAK} \cdot t_p$.
Example: $(100\text{mA}) (62.5\mu\text{s}) = 6250\text{mA} \cdot \mu\text{s}$
7. From Figure 2 determine derating factor, d_F . Multiply above $I_{PEAK} \cdot t_p$ product by d_F .
Example: At $T_A = 70^\circ\text{C}$, $d_F = 0.69$
 $d_F (I_{PEAK} \cdot t_p) = (0.69) (6250) = 4312.5\text{mA} \cdot \mu\text{s}$
8. Calculate derated operating conditions.
Example: Maintain $t_p = 62.5\mu\text{s}$ and derate I_{PEAK}

$$I_{PEAK} = \frac{4312.5\text{mA} \cdot \mu\text{s}}{62.5\mu\text{s}} = 69\text{mA peak current}$$

The maximum allowed operating conditions, temperature derated to an ambient of 70°C are now determined.

Example: $f = 1\text{kHz}$, $t_p = 62.5\mu\text{s}$, $I_{PEAK} = 69\text{mA}$ and $I_{AVG} = 4.31\text{mA}$.

The above calculations determine the maximum allowed strobing conditions. Operation at a reduced combination of peak current and pulse width may be desirable to adjust display light output to match ambient light levels and/or to insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible light output for long character strings.

The time average luminous intensity may be calculated using the relative efficiency characteristic of Figure 3, $\eta_{I_{PEAK}}$, and correcting for operating ambient temperature. The time average luminous intensity at $T_A = 25^\circ\text{C}$ is calculated as follows:

$$I_{V \text{ TIME AVG}} = \left[\frac{I_{PEAK} \cdot DF}{1.875\text{mA}} \right] [\eta_{I_{PEAK}}] [I_{V \text{ DATA SHEET}}]$$

$$\text{Example: } I_{V \text{ TIME AVG}} = \left[\frac{(69\text{mA}) (1/16)}{1.875\text{mA}} \right] [1.10] [1.65\text{mcd}]$$

$$I_{V \text{ TIME AVG}} = 4.17\text{mcd/digit, total for 16 segments, } T_A = 25^\circ\text{C}$$

This time average luminous intensity is corrected for temperature by the following exponential equation:

$$I_V (T_A) = I_V (25^\circ\text{C}) e^{[-0.0188^\circ/\text{C} (T_A - 25^\circ\text{C})]}$$

$$\begin{aligned} \text{Example: for } T_A = 70^\circ\text{C}, & \quad 1.79\text{mcd/digit} \\ I_V (70^\circ\text{C}) = (4.17\text{mcd}) e^{[-0.0188 (70 - 25^\circ\text{C})]} &= \text{total for 16 segments} \end{aligned}$$

OPTICAL AND CONTRAST ENHANCEMENT

Each large monolithic chip is positioned under a separate element of a plastic aspheric magnifying lens, producing a magnified character height of 3.810mm (.150 inch). The aspheric lens provides wide included viewing angles of 76 degrees horizontal and 80 degrees vertical with low off axis distortion. These two features, coupled with the very

*More than 10 segments may be illuminated in a given character, provided the maximum allowed character power dissipation, temperature derated, is not exceeded.

high segment luminous sterance, provide to the user a display with excellent readability in bright ambient light for viewing distances in the range of 2 metres. Effective contrast enhancement can be obtained by employing any of the following optical filter products: Panelgraphic: Ruby Red 60, Dark Red 63 or Purple 90; SGL Homalite: H100-1605 Red or H100-1804 Purple, Plexiglas 2423. For very bright ambients, such as indirect sunlight, the 3M Light Control Film is recommended: Red 655, Violet, Purple or Neutral Density.

For those applications requiring only 4 or 8 characters, a secondary barrel magnifier, HP part number HDSP-6505 (four character) and -6509 (eight character), may be inserted into support grooves on the primary magnifier. This secondary magnifier increases the character height to 4.45mm (.175 inch) without loss of horizontal viewing angle (see below).

MECHANICAL

These devices are constructed by LED die attaching and wire bonding to a high temperature PC board substrate. A precision molded plastic lens is attached to the PC board and the resulting assembly is backfilled with a sealing epoxy to form an environmentally sealed unit.

The four character and eight character devices can be end stacked to form a character string which is a multiple of a basic four character grouping. As an example, one -6504 and two -6508 devices will form a 20 character string. These devices may be soldered onto a printed circuit board or inserted into 24 and 28 pin DIP LSI sockets. The socket spacing must allow for device end stacking.

The absolute maximum allowed LED junction temperature, T_{jmax} , is 110°C. The maximum power ratings have been established so as not to exceed this limit. For most reliable operation, it is recommended that the PC board thermal resistance to ambient be less than 108°C/W/character. This will then establish a maximum thermal resistance LED junction-to-ambient of 340°C/W/character.

Optimum wave soldering is accomplished by using a good quality RMA rosin or organic acid flux and setting the solder wave temperature and dwell time at 245°C for 1-1/2 to 2 seconds. For device cleaning in a vapor cleaning process, only mixtures of Freon (F113) and alcohol is recommended with an immersion time in the vapors for less than 2 minutes. Suggested cleaning solvents are Freon TE, Genesolv DI-15 or DE-15, Arklone A or K. Room temperature cleaning may be accomplished with Freon T-E35 or T-P35, Ethanol, Isopropanol or water with a mild detergent.

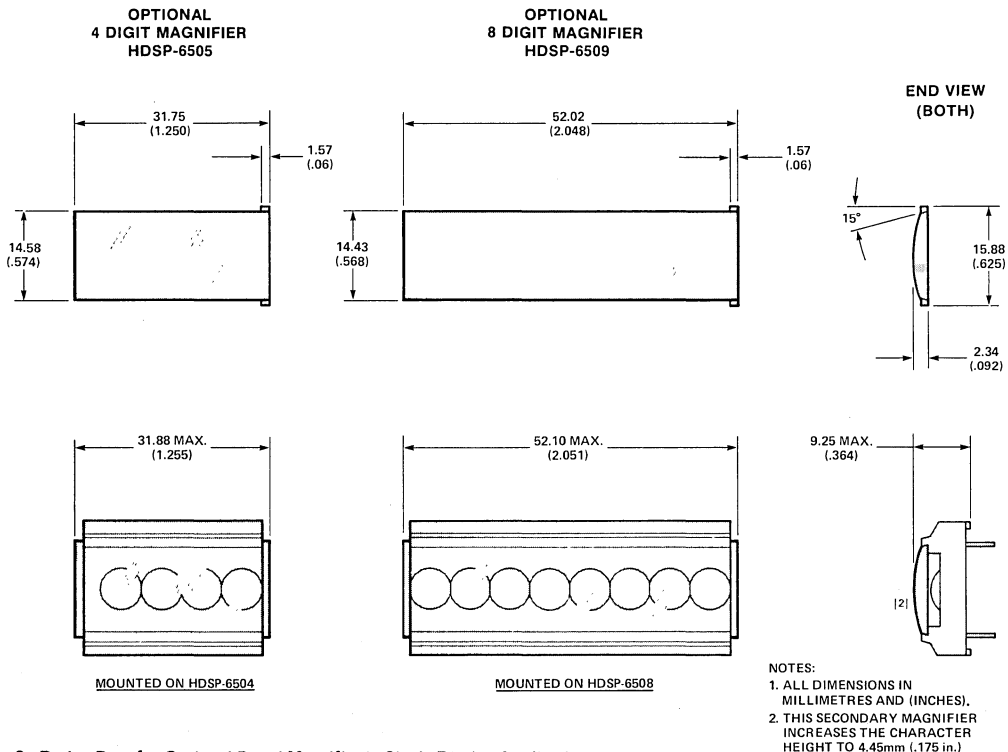
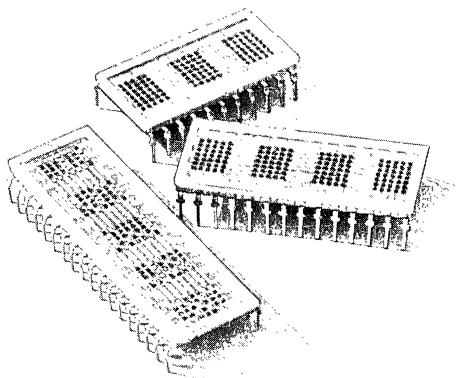


Figure 9. Design Data for Optional Barrel Magnifier in Single Display Applications.

Features

- **5 x 7 LED MATRIX CHARACTER**
Human Factors Engineered
- **BRIGHTNESS CONTROLLABLE**
- **IC COMPATIBLE**
- **SMALL SIZE**
Standard 15.24mm (.600 inch) Dual In-Line
Package; 6.9mm (.27 inch) Character Height
- **WIDE VIEWING ANGLE**
- **RUGGED, SHOCK RESISTANT**
Hermetically Sealed
Designed to Meet MIL Standards
- **LONG OPERATING LIFE**



Description

The Hewlett-Packard 5082-7100 Series is an X-Y addressable, 5 x 7 LED Matrix capable of displaying the full alphanumeric character set. This alphanumeric indicator series is available in 3, 4, or 5 character end-stackable clusters. The clusters permit compact presentation of information, ease of character alignment, minimum number of interconnections, and compatibility with multiplexing driving schemes.

Alphanumeric applications include computer terminals, calculators, military equipment and space flight readouts.

The **5082-7100** is a three character cluster.

The **5082-7101** is a four character cluster.

The **5082-7102** is a five character cluster.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current Per LED (Duration < 1 ms)	I_{PEAK}		100	mA
Average Current Per LED	I_{AVG}		10	mA
Power Dissipation Per Character (All diodes lit) ^[1]	P_D		700	mW
Operating Temperature, Case	T_C	-55	95	°C
Storage Temperature	T_S	-55	100	°C
Reverse Voltage Per LED	V_R		4	V

Note 1: At 25°C Case Temperature; derate 8.5mW/°C above 25°C.

Electrical / Optical Characteristics at $T_C = 25^\circ\text{C}$

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak Luminous Intensity Per LED (Character Average) @ Pulse Current of 100mA/LED	I_p (PEAK)	1.0	2.2		mcd
Reverse Current Per LED @ $V_R = 4\text{V}$	I_R		10		μA
Peak Forward Voltage @ Pulse Current of 50mA/LED	V_F		1.7	2.0	V
Peak Wavelength	λ_{PEAK}		655		nm
Spectral Line Halfwidth	$\Delta\lambda_{1/2}$		30		nm
Rise and Fall Times [1]	t_r, t_f		10		ns

Note 1. Time for a 10% - 90% change of light intensity for step change in current.

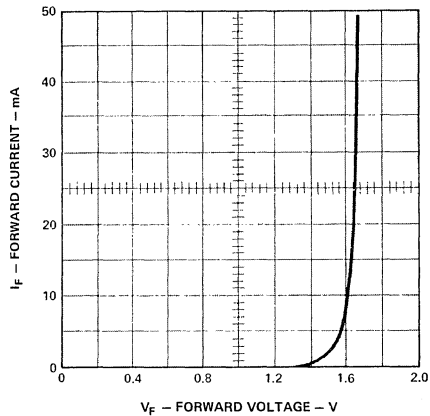


Figure 1. Forward Current-Voltage Characteristic.

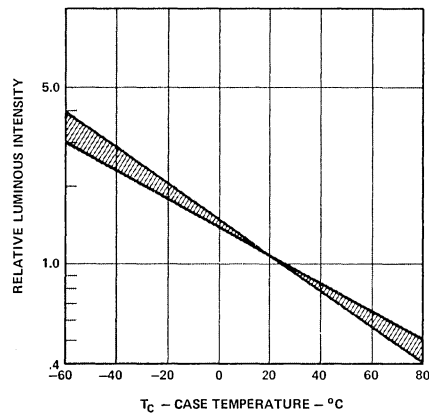


Figure 2. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.

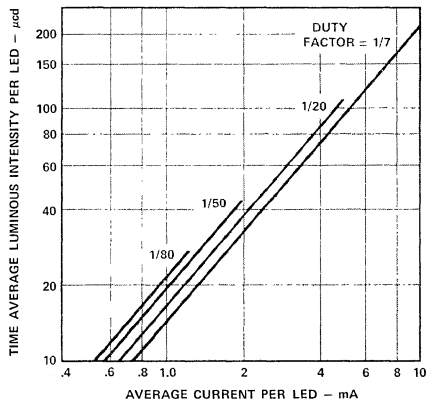


Figure 3. Typical Time Average Luminous Intensity per LED vs. Average Current per LED.

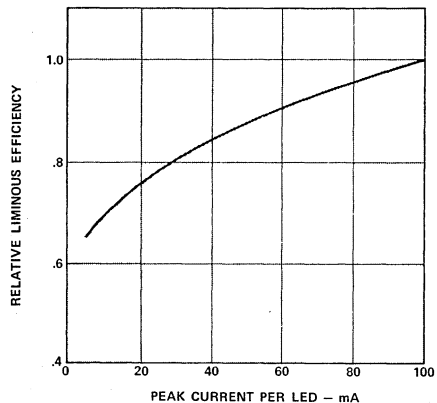
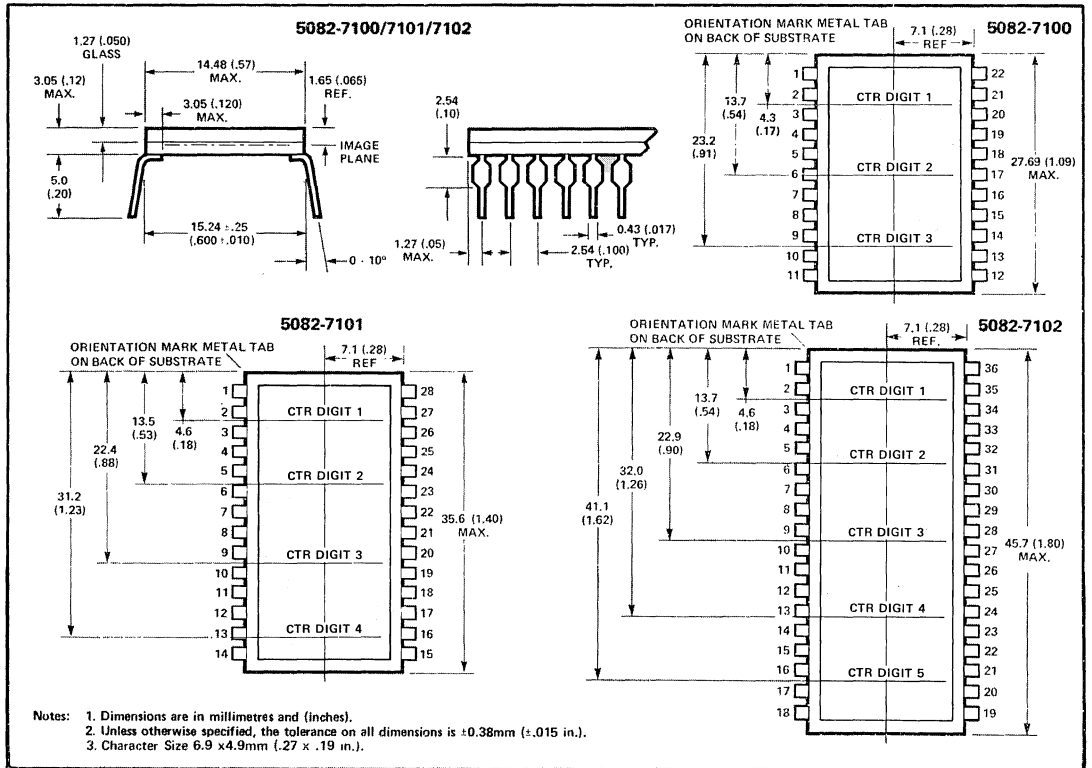


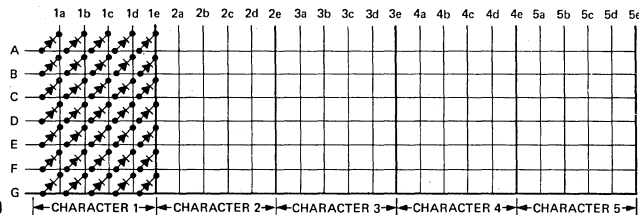
Figure 4. Typical Relative Luminous Efficiency vs. Peak Current per LED.

Package Dimensions and Pin Configurations



Device Pin Description

5082-7100				5082-7101				5082-7102			
Pin	Function	Pin	Function	Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	Anode G	12	Anode B	1	N/C	15	Anode C	1	N/C	19	5e
2	1c	13	3d	2	1c	16	4c	2	1c	20	5c
3	1d	14	3b	3	1e	17	4a	3	1e	21	5a
4	Anode F	15	Anode A	4	Anode G	18	Anode B	4	Anode F	22	Anode D
5	Anode E	16	2e	5	2b	19	3e	5	2b	23	4e
6	2b	17	2c	6	2d	20	3b	6	2d	24	4c
7	2d	18	2a	7	Anode D	21	3a	7	2e	25	N/C
8	Anode C	19	Anode D	8	Anode E	22	2e	8	Anode E	26	Anode C
9	3a	20	1e	9	3c	23	2c	9	3c	27	3d
10	3c	21	1b	10	3d	24	2a	10	3e	28	3b
11	3e	22	1a	11	Anode F	25	Anode A	11	Anode G	29	3a
				12	4b	26	1d	12	4a	30	Anode B
				13	4d	27	1b	13	4b	31	2c
				14	4e	28	1a	14	4d	32	2a
								15	N/C	33	Anode A
								16	5b	34	1d
								17	5d	35	1b
								18	N/C	36	1a



5082-7100/7101/7102
Schematic Wiring Diagram

Operating Considerations

ELECTRICAL

The 5 x 7 matrix of LED's, which make up each character, are X-Y addressable. This allows for a simple addressing, decoding and driving scheme between the display module and customer furnished logic.

There are three main advantages to the use of this type of X-Y addressable array:

1. It is an elementary addressing scheme and provides the least number of interconnection pins for the number of diodes addressed. Thus, it offers maximum flexibility toward integrating the display into particular applications.
2. This method of addressing offers the advantage of sharing the Read-Only-Memory character generator among several display elements. One character generating ROM can be shared over 25 or more 5 x 7 dot matrix characters with substantial cost savings.
3. In many cases equipments will already have a portion of the required decoder/driver (timing and clock circuitry plus buffer storage) logic circuitry available for the display.

To form alphanumeric characters a method called "scanning" or "strobing" is used. Information is addressed to the display by selecting one row of diodes at a time, energizing the appropriate diodes in that row and then proceeding to the next row. After all rows have been excited one at a time, the process is repeated. By scanning through all rows at least 100 times a second, a flicker free character can be produced. When information moves sequentially from row to row of the display (top to bottom) this is row scanning, as illustrated in Figure 5. Information can also be moved from column to column (left to right across the display) in a column scanning mode. For most applications (5 or more characters to share the same ROM) it is more economical to use row scanning.

A much more detailed description of general scanning techniques along with specific circuit recommendations is contained in HP Application Note 931.

MECHANICAL/THERMAL MOUNTING

The solid state display typically operates with 200mW power dissipation per character. However, if the operating conditions are such that the power dissipation exceeds the derated maximum allowable value, the device should be heat sunk. The usual mounting technique combines mechanical support and thermal heat sinking in a common structure. A metal strap or bar can be mounted behind the display using silicone grease to insure good thermal control. A well-designed heat sink can limit the case temperature to within 10°C of ambient.

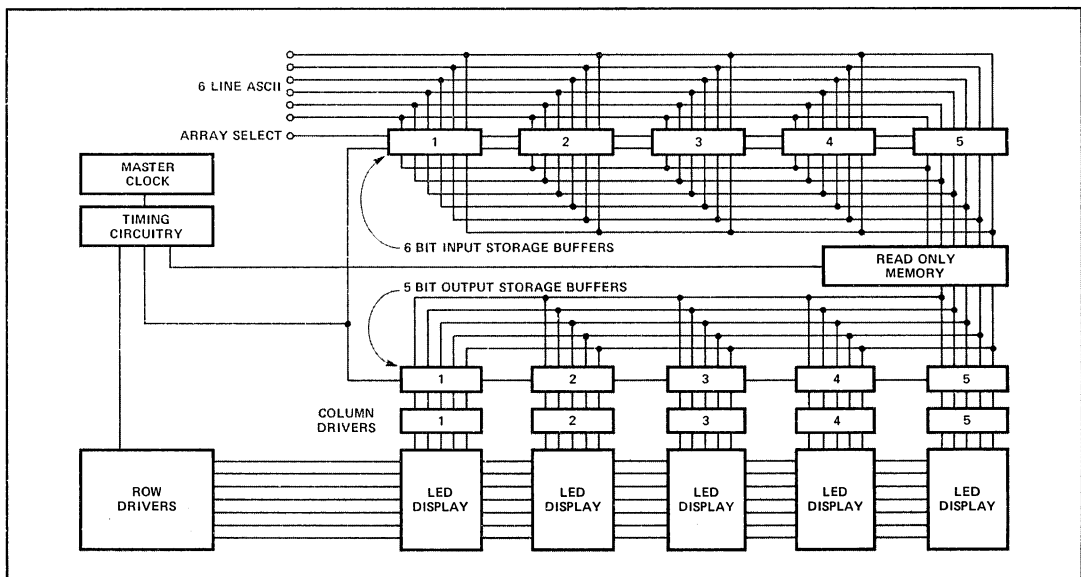
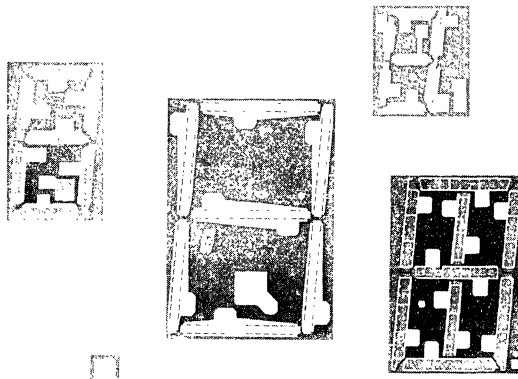


Figure 5. Row Scanning Block Diagram.

Features

- **FOUR CHARACTER SIZES, COMMON CATHODE**
53 mil, 80 mil, 100 mil, 120 mil.
- **DISCRETE AND MONOLITHIC COLON CHIPS**
- **AVERAGE LUMINOUS INTENSITY AND DISTRIBUTION SPECIFIED FOR EACH WAFER**
- **100% ELECTRICALLY TESTED AND VISUALLY INSPECTED**
- **LOW POWER**
MOS Compatible
- **CONTINUOUS SEGMENTS**
Excellent Aesthetic Appearance



Description

The HP 5082-7800 series are common cathode monolithic chips, specifically designed for hybrid applications. Chips are available in seven segment, nine segment and one digit fonts. Colons are available in discrete or monolithic form. All chips are made of GaAsP material and are suitable for die attach and wire bonding to appropriate substrates. Chips are 100% visually inspected to HP standard criteria.

Packaging

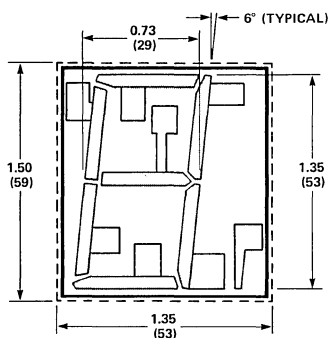
Hewlett Packard offers chips packaged on vinyl film or in waffle packages.

Device Selection Guide

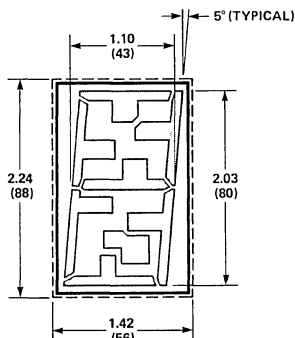
Character Height	Font	Chip Size	Tilt Angle Degrees	Stroke Width mm (mil)	Minimum Bonding Pad Size	Vinyl Film P/N 5082-	Waffle Pack P/N 5082-
1.35 mm (53 mil)	7 segment	1.50 x 1.35 mm (59 x 53 mil)	6 (Typical)	0.084 (3.3)	0.15 x 0.18 mm (6 x 7 mil)	7811	7821
2.03 mm (80 mil)	7 segment	2.24 x 1.42 mm (88 x 56 mil)	5 (Typical)	0.127 (5)	0.15 x 0.18 mm (6 x 7 mil)	7832	7842
2.54 mm (100 mil)	7 segment	2.72 x 1.91 mm (107 x 75 mil)	5	0.114 (4.5)	0.18 x 0.23 mm (7 x 9 mil)	7851	7861
2.54 mm (100 mil)	9 segment	2.72 x 1.91 mm (107 x 75 mil)	5	0.114 (4.5)	0.18 x 0.23 mm (7 x 9 mil)	7852	7862
2.54 mm (100 mil)	1 or colon	2.72 x 0.89 mm (107 x 35 mil)	5	0.114 (4.5)	0.18 x 0.23 mm (7 x 9 mil)	7853	7863
3.05 mm (120 mil)	7 segment	3.25 x 2.34 mm (128 x 92 mil)	5	0.102 (4)	0.20 x 0.30 mm (8 x 12 mil)	7871	7881
0.28 mm (011 mil) square	decimal point or colon	0.38 x 0.38 mm (15 x 15 mil)	—	—	0.12 mm (4.8 mil) diameter	7890*	7892*

*Standard packaging is a vial (P/N 5082-7893).

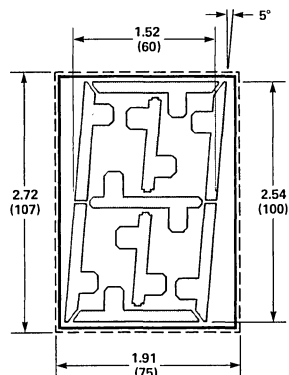
Device Dimensions



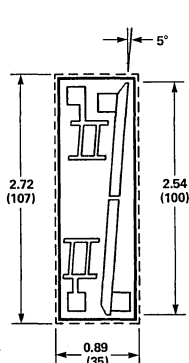
5082-7811/21



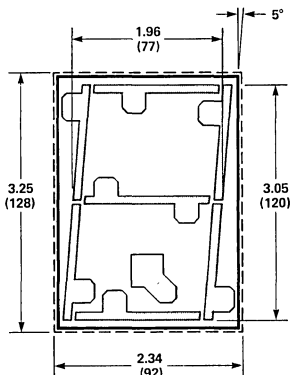
5082-7832/42



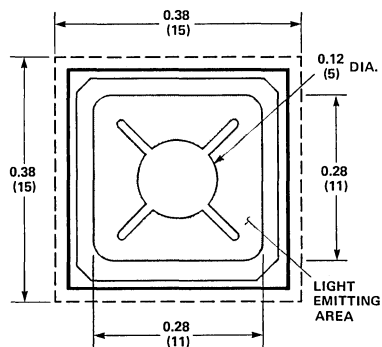
5082-7851/61, 5082-7852/62



5082-7853/63



5082-7871/81



5082-7890/93

All dimensions are in millimeters and (mils).
Detailed drawings of each chip are available upon request.

Absolute Maximum Ratings

Storage Temperature Range ⁽¹⁾	-40°C to +125°C
Reverse Voltage ⁽¹⁾	5V
Assembly Temperature (Duration ≤ 5 min.)	420°C
Operating Junction Temperature	125°C

Description	1.35 mm (53 mil)	2.03 mm (80 mil)	2.54 mm (100 mil)	3.05 mm (120 mil)	0.28 mm (11 mil)	Units
Peak Forward Current/Segment (pulse duration ≤ 500 μsec.)	50	100	25	25	100	mA
Average Forward Current/Segment	5	5	6	6	10	mA
Wire Bonder Force	125	125	125	125	95	gm

Note 1. Rating applies to chip only.

Electrical/Optical Characteristics at T_A = 25°C

Common Specifications for All Devices

I _R , Reverse Current/Segment	100 μA max. at V _R = 5V
λ _{PEAK} , Peak Wavelength	655 nm (typical)
λ _d , Dominant Wavelength ⁽¹⁾	640 nm (typical)
θ _{JC} , Chip Thermal Resistance (Junction to back contact)	
11 mil and 53 mil	85°C/W
80 mil, 100 mil and 120 mil	45°C/W

Electrical/Optical Characteristics at $T_A=25^\circ\text{C}$

5082-7811/21

1.35 mm (53 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	50	70	---	μcd	$I_F = 5\text{mA DC}$	2
	Segment to Segment Intensity Ratio (Within Each Digit)	---	1.2:1	1.7:1		$I_F = 5\text{mA DC}$	
$\frac{\sigma}{I_V}^{(2)}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	---	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	$I_F = 5\text{mA DC}$	1

5082-7832/42

2.03 mm (80 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	80	150	---	μcd	$I_F = 10\text{mA DC}$	2
	Segment to Segment Intensity Ratio (Within Each Digit)	---	1.2:1	1.7:1		$I_F = 10\text{mA DC}$	
$\frac{\sigma}{I_V}^{(2)}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	---	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	$I_F = 10\text{mA DC}$	1

5082-7851/61, -7852/62, -7853/63

2.54 mm (100 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	---	μcd	$I_F = 6\text{mA DC}$	3
	Segment to Segment Intensity Ratio (Within Each Digit)	---	1.2:1	1.7:1		$I_F = 6\text{mA DC}$	
$\frac{\sigma}{I_V}^{(2)}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	---	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	$I_F = 6\text{mA DC}$	1

5082-7871/81

3.05 mm (120 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	---	μcd	$I_F = 6\text{mA DC}$	3
	Segment to Segment Intensity Ratio (Within Each Digit)	---	1.2:1	1.7:1		$I_F = 6\text{mA DC}$	
$\frac{\sigma}{I_V}^{(2)}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	---	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	$I_F = 6\text{mA DC}$	1

5082-7890/92/93

0.28 mm (11 mil) Square

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity (Wafer Average)	45	80	140	μcd	$I_F = 6\text{mA}$	3
$\frac{\sigma}{I_V}^{(2)}$	Luminous Intensity Normalized Standard Deviation	---	0.10	0.15			
V_F	Forward Voltage	1.4	1.6	1.8	V	$I_F = 6\text{mA}$	1

Notes: 1. Dominant wavelength, λ_d , is derived from the C.I.E. chromaticity diagram and represents that single wavelength which defines the color of the device.
2. I_V is the mean value and σ is the standard deviation of the wafer luminous intensity.

Typical Characteristic Curves

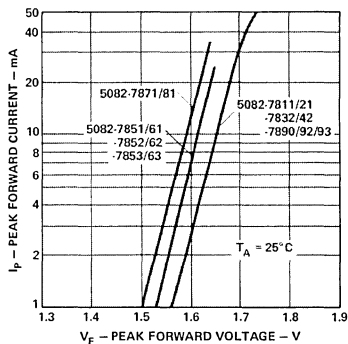


Figure 1. Peak Forward Current vs. Peak Forward Voltage.

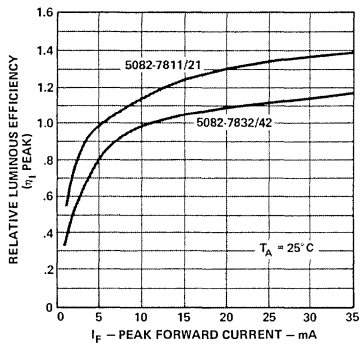


Figure 2. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

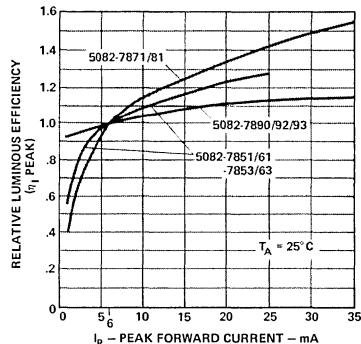


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

Strobing Considerations

The time average luminous intensity at $T_A = 25^\circ\text{C}$ may be calculated for any specific drive condition from the following formula:

$$I_V \text{ time avg} = \left[\frac{I_{\text{avg}}}{I_{\text{DC spec}}} \right] [\eta_{I \text{ PEAK}}] [I_{V \text{ spec}}]$$

Where: I_{avg} = average operating current

$I_{\text{DC spec}}$ = data sheet current at which $I_{V \text{ spec}}$ is measured

$I_{V \text{ spec}}$ = data sheet luminous intensity at $I_{\text{DC spec}}$

$\eta_{I \text{ PEAK}}$ = relative luminous efficiency at peak operating current (See Figures 2 and 3).

The luminous intensity at any chip operating temperature may be calculated using the following formula:

$$I_V (T_A) = I_V (25^\circ\text{C}) \exp [(-0.0188/^\circ\text{C})(T_A - 25^\circ\text{C})]$$

Assembly Information

The cathode metallization (chip back contact) is a gold/germanium alloy and the anode bonding pads are aluminum. Conductive silver epoxy for die attach is preferred. If eutectic die attach is used, gold/germanium preforms are recommended. Gold wire of .025 mm (1 mil) or .038 mm (1.5 mil) diameter should be used for lead bonding. The .025 mm diameter wire is recommended for the .28 mm (11 mil) decimal point die. The substrate temperature should be in the range of 275-330°C and the bonder capillary temperature should be set between 100°C and 350°C. Ultrasonic wire bonding may be used also.

For more detailed assembly information, refer to Hewlett-Packard Application Bulletin No. 8.

Visual Inspection

All chips are 100% visually inspected to HP specification. A copy of the visual inspection specification is available on request. Also available is a visual training manual.

Recommended Incoming Inspection Procedures

Hewlett-Packard guarantees all visual parameters. Customers should perform incoming inspection to the same levels. It is important that these chips be handled carefully. Excessive or rough handling of chips can cause scratched or broken units. All shipments must be accepted or rejected on a lot basis. Samples should be selected and tested for the visual specifications to the recommended AQL level. Before a lot will be authorized for return, the inspected units should be returned to Hewlett-Packard for our verification. Returns cannot be accepted after the entire lot has been removed from its shipping container. Returns must be made in the original shipping container.

Features

- **THREE CHARACTER SIZES, COMMON CATHODE**
80 mil, 88 mil, 120 mil
- **MONOLITHIC DASH AND COLON CHIP**
- **AVERAGE LUMINOUS INTENSITY AND DISTRIBUTION SPECIFIED FOR EACH WAFER**
- **100% ELECTRICALLY TESTED AND VISUALLY INSPECTED**
- **LOW POWER**
MOS Compatible
- **CONTINUOUS SEGMENTS**
Excellent Aesthetic Appearance



Description


The HP 5082-7800 series are common cathode monolithic chips, specifically designed for hybrid applications. Chips are available in seven segment, nine segment, "one" digit and dash colon fonts.

All chips are made of GaAsP material and are suitable for die attach and wire bonding to appropriate substrates. Chips are 100% visually inspected to HP standard criteria.

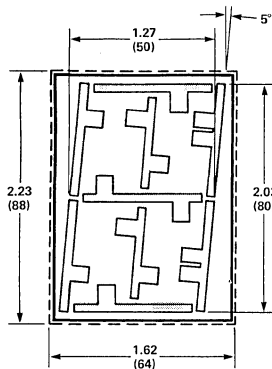
Packaging

Hewlett-Packard offers chips packaged on vinyl film or in waffle packages.

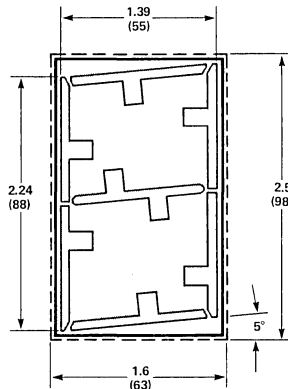
Device Selection Guide

Character Height	Font	Chip Size	Tilt Angle Degrees	Stroke Width mm (mil)	Minimum Bonding Pad Size	Vinyl Film P/N 5082-	Waffle Pack P/M 5082-
Dash Colon		1.70 x 1.45 mm (67 x 57 mil)	5	0.088 (3.5)	0.18 x 0.18 mm (7 x 7 mil)	7856	7866
2.03 mm (80 mil)	9 segment	2.24 x 1.62 mm (88 x 64 mil)	5	0.127 (5)	0.15 x 0.18 mm (6 x 7 mil)	7833	7843
2.24 mm (88 mil)	7 segment	2.5 x 1.6 mm (98 x 63 mil)	5	0.076 (3)	0.18 x 0.18 mm (7 x 7 mil)	7837	7847
2.24 mm (88 mil)	2 segment "ONE"	2.36 x 0.64 mm (93 x 25 mil)	—	0.076 (3)	0.18 x 0.18 mm (7 x 7 mil)	7838	7848
3.05 mm (120 mil)	9 segment	3.25 x 2.34 mm (128 x 92 mil)	5	0.102 (4)	0.20 x 0.30 mm (8 x 12 mil)	7872	7882

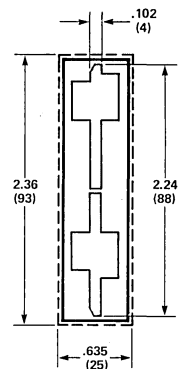
Device Dimensions



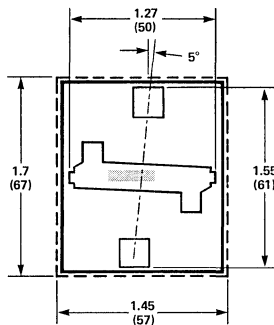
5082-7833/43



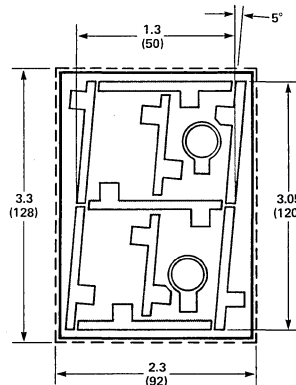
5082-7837/47



5082-7838/48



5082-7856/66



5082-7872/82

All dimensions are in millimeters and (mils).
Detailed drawings of each chip are available upon request.

Absolute Maximum Ratings

Storage Temperature Range ⁽¹⁾	-40°C to +125°C
Reverse Voltage	5V
Assembly Temperature (Duration ≤ 5 min.)	420°C
Operating Junction Temperature	125°C

Description	Dash Colon	2.03 mm (80 mil)	2.24 mm (88 mil)	3.05 mm (120 mil)	Units
Peak Forward Current/Segment (pulse duration ≤ 500 μsec.)	25	25	25	25	mA
Average Forward Current/Segment	10	10	10	10	mA
Wire Bonder Force (Thermo-compression)	125	125	125	125	gm

Note 1. Rating applies to chip only.

Electrical/Optical Characteristics at T_A = 25°C

Common Specifications for All Devices

I _R , Reverse Current/Segment	100 μA max. at V _R = 5 V
λ _{PEAK} , Peak Wavelength	655 nm (typical)
λ _d , Dominant Wavelength ⁽¹⁾	640 nm (typical)
θ _{JC} , Chip Thermal Resistance (Junction to back contact)	45°C/W

Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

5082-7856/66

Dash — Colon Chip

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	—	μcd	$I_F = 6 \text{ mA DC}$	2
	Segment to Segment Intensity Ratio (Within Each Digit)	—	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	—	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

5082-7833/43

2.03 mm (80 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	—	μcd	$I_F = 6 \text{ mA DC}$	2
	Segment to Segment Intensity Ratio (Within Each Digit)	—	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	—	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

5082-7837/47, -7838/48

2.24 mm (88 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	—	μcd	$I_F = 6 \text{ mA DC}$	2
	Segment to Segment Intensity Ratio (Within Each Digit)	—	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	—	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

5082-7872/82

3.05 mm (120 mil) Character Height

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	—	μcd	$I_F = 6 \text{ mA DC}$	2
	Segment to Segment Intensity Ratio (Within Each Digit)	—	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	—	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

Notes: 1. Dominant wavelength, λ_d , is derived from the C.I.E. chromaticity diagram and represents that single wavelength which defines the color of the device.

2. \bar{I}_V is the mean value and σ is the standard deviation of the wafer luminous intensity.

Typical Characteristic Curves

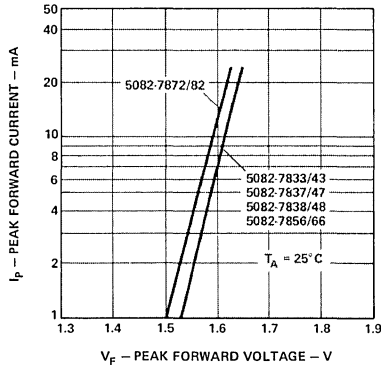


Figure 1. Peak Forward Current vs. Peak Forward Voltage.

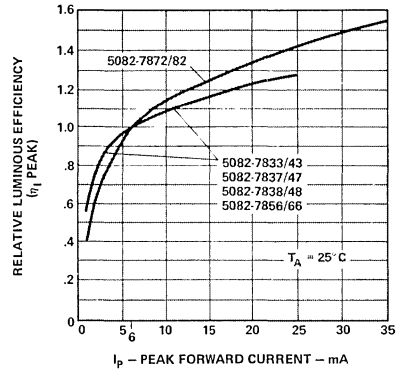


Figure 2. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

Strobing Considerations

The time average luminous intensity at $T_A = 25^\circ\text{C}$ may be calculated for any specific drive condition from the following formula:

$$I_V \text{ time avg} = \left[\frac{I_{\text{avg}}}{I_{\text{DC spec}}} \right] [\eta_l \text{ PEAK}] [I_V \text{ spec}]$$

Where: I_{avg} = average operating current

$I_{\text{DC spec}}$ = data sheet current at which $I_V \text{ spec}$ is measured

$I_V \text{ spec}$ = data sheet luminous intensity at $I_{\text{DC spec}}$

$\eta_l \text{ PEAK}$ = relative luminous efficiency at peak operating current (See Figures 1 and 2).

The luminous intensity at any chip operating temperature may be calculated using the following formula:

$$I_V = (I_V \text{ at } 25^\circ\text{C}) \exp [-0.018/^\circ\text{C} (T_A - 25^\circ\text{C})]$$

Assembly Information

The cathode metallization (chip back content) is a gold/germanium alloy and the anode bonding pads are aluminum. Conductive silver epoxy for die attach is preferred. If eutectic die attach is used, gold/germanium preforms are recommended. Thermocompression or ultrasonic bonding with gold wire as well as aluminum ultrasonic bonding may be used with typical IC bonding parameter settings.

For more detailed assembly information, refer to Hewlett-Packard Application Bulletin No. 8.

Visual Inspection

All chips are 100% visually inspected to HP specification. A copy of the visual inspection specification is available on request.

Recommended Incoming Inspection Procedures

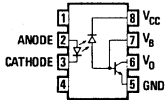
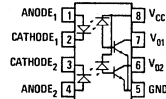
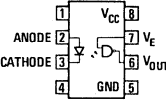
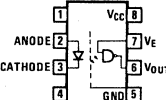
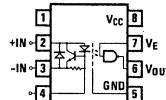
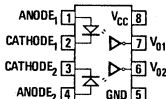
Hewlett-Packard guarantees all visual parameters. Customers should perform incoming inspection to the same levels. It is important that these chips be handled carefully. Excessive or rough handling of chips can cause scratched or broken units. All shipments must be accepted or rejected on a lot basis. Samples should be selected and tested for the visual specifications to the recommended AQL level. Before a lot will be authorized for return, the inspected units should be returned to Hewlett-Packard for our verification. Returns cannot be accepted after the entire lot has been removed from its shipping container.

Optocouplers

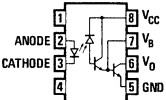
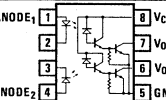
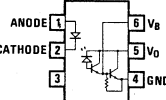
Selection Guide 156

- High Speed Optocouplers
- Low Input Current/High Gain Optocouplers
- High Reliability Optocouplers

High Speed Optocouplers

Device	Description	Application ^[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.	
	6N135 (5082-4350)	Transistor Output	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LSTTL Ground Isolation	1M bit/s	7% Min.	16mA	3000Vdc ^[3]	158
	6N136 (5082-4351)							
	HCPL-2502 (5082-4352)							
	HCPL-2530 (5082-4354)	Dual Channel Transistor Output	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LSTTL Ground Isolation	1M bit/s	7% Min.	16mA	3000Vdc ^[3]	162
	HCPL-2531 (5082-4355)							
	6N137 (5082-4360)	Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation	10M Bit/s	700% Typ.	5.0mA	3000Vdc ^[3]	166
	HCPL-2601 (5082-4361)	High Common Mode Rejection, Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation In High Ground or Induced Noise Environments	10M bit/s	700% Typ.	5.0mA	3000Vdc ^[3]	170
	HCPL-2602	Optically Coupled Line Receiver	Replace Conventional Line Receivers In High Ground or Induced Noise Environments	10M bit/s	700% Typ.	5.0mA	3000Vdc ^[3]	174
	HCPL-2630 (5082-4364)	Dual Channel Optically Coupled Gate	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	700% Typ.	5.0mA	3000Vdc ^[3]	180

Low Input Current/High Gain Optocouplers

Device	Description	Application ^[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.	
	6N138 (5082-4370)	Low Saturation Voltage, High Gain Output, $V_{CC}=7V$ Max.	Line Receiver, Low Current Ground Isolation, TTL/TTL, LSTTL/TTL, CMOS/TTL	300k bit/s	300% Min.	1.6mA	3000Vdc ^[3]	184
	6N139 (5082-4371)	Low Saturation Voltage, High Gain Output, $V_{CC}=18V$ Max.			400% Min.	0.5mA		
	HCPL-2730	Dual Channel, High Gain, $V_{CC}=7V$ Max.	Line Receiver, Polarity Sensing, Low Current Ground Isolation	300k bit/s	300% Min.	1.6mA	3000Vdc ^[3]	188
	HCPL-2731	Dual Channel, High Gain, $V_{CC}=18V$ Max.			400% Min.	0.5mA		
	4N45	Darlington Output $V_{CC}=7V$ Max.	AC Isolation, Relay-Logic Isolation	3k bit/s	250% Min.	1.0mA	3000Vdc ^[3]	192
	4N46	Darlington Output $V_{CC}=20V$ Max.			350% Min.	0.5mA		

High Reliability Optocouplers

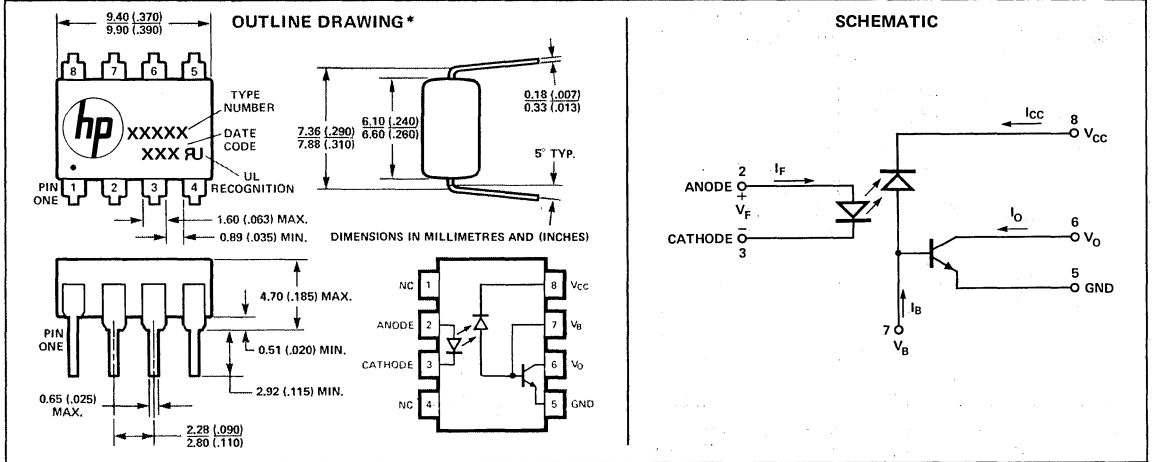
Device	Description	Application [1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.	
	6N134 (5082-4365)	Dual Channel Hermetically Sealed Optically Coupled Logic Gate. TXV – Screened TXVB – Screened with Group B Data	Line Receiver, Ground Isolation for High Reliability Systems	10M bit/s	400% Typ.	10mA	1500Vdc	196
	6N134 TXV (TX-4365)							
	6N134 TXVB (TXB-4365)							
	HCPL-2770 (6N140)	Hermetically Sealed Package Containing 4 Low Input Current, High Gain Isolators	Line Receiver, Low Power Ground Isolation for High Reliability Systems	300k bit/s	300% Min.	0.5mA	1500Vdc	200
	TXHCPL-2770							
	TXBHCPL-2770							

- Notes: 1. For further information ask for Application Notes AN939, AN947, AN948, AN951-1 and AN951-2 (See pages 218-221).
 2. The HCPL-2502 Current Transfer Ratio Specification is guaranteed to be 15% minimum and 22% maximum.
 3. Recognized under the Component Recognition Program of Underwriters Laboratories Inc. (File No. E55361).

HIGH SPEED OPTICALLY COUPLED ISOLATORS

6N135 (5082 - 4350)
6N136 (5082 - 4351)
HCPL-2502 (5082 - 4352)

TECHNICAL DATA APRIL 1978



Features

- **HIGH SPEED: 1 Mbit/s**
- **TTL COMPATIBLE**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)**
- **HIGH COMMON MODE TRANSIENT IMMUNITY: 1000V/μs**
- **3000Vdc INSULATION VOLTAGE**
- **2 MHz BANDWIDTH**
- **OPEN COLLECTOR OUTPUT**

Description

These diode-transistor optocouplers use a light emitting diode and an integrated photon detector to provide 3000V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collector improve the speed up to a hundred times that of a conventional photo-transistor isolator by reducing the base-collector capacitance.

The 6N135 is suitable for use in TTL/CMOS, TTL/LTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the 6N135 is 7% minimum at $I_F = 16$ mA.

The 6N136 is suitable for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6 kΩ pull-up resistor. CTR of the 6N136 is 19% minimum at $I_F = 16$ mA.

The HCPL-2502 is suitable for use in applications where matched or known CTR is desired. CTR is 15 to 22% at $I_F = 16$ mA.

Applications

- **Line Receivers** — High common mode transient immunity ($>1000V/\mu s$) and low input-output capacitance (0.6pF).
- **High Speed Logic Ground Isolation** — TTL/TTL, TTL/LTTL, TTL/CMOS, TTL/LSTTL.
- **Replace Slow Phototransistor Isolators** — Pins 2-7 of the -4350 series conform to pins 1-6 of 6 pin phototransistor isolators. Pin 8 can be tied to any available bias voltage of 1.5V to 15V for high speed operation.
- **Replace Pulse Transformers** — Save board space and weight.
- **Analog Signal Ground Isolation** — Integrated photon detector provides improved linearity over phototransistor type.

Absolute Maximum Ratings*

Storage Temperature	-55°C to +125°C
Operating Temperature	-55°C to 100°C
Lead Solder Temperature	260°C for 10s (1.6mm below seating plane)
Average Input Current — I_F	25mA [1]
Peak Input Current — I_F	50mA [2] (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F	1.0A ($\leq 1\mu s$ pulse width, 300pps)
Reverse Input Voltage — V_R (Pin 3-2)	5V
Input Power Dissipation	45mW [3]
Average Output Current — I_O (Pin 6)	8mA
Peak Output Current	16mA
Emitter-Base Reverse Voltage (Pin 5-7)	5V
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 6-5)	-0.5V to 15V
Base Current — I_B (Pin 7)	5mA
Output Power Dissipation	100mW [4]

*JEDEC Registered Data. (The HCPL-2502 is not registered.) 158

See notes, following page.

Electrical Specifications (T_A = 25°C)

Parameter	Sym.	Device	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR*	6N135	7	18		%	I _F = 16mA, V _O = 0.4V, V _{CC} = 4.5V	1,2	5
		6N136	19	24		%			
		HCPL-2502	15		22	%			
Logic Low Output Voltage	V _{OL}	6N135		0.1	0.4	V	I _F = 16mA, I _O = 1.1mA, V _{CC} = 4.5V		
		6N136 HCPL-2502		0.1	0.4	V	I _F = 16mA, I _O = 2.4mA, V _{CC} = 4.5V		
Logic High Output Current	I _{OH} *			3	500	nA	I _F = 0mA, V _O = V _{CC} = 5.5V	6	
Logic High Output Current	I _{OH} *				100	μA	I _F = 0mA, V _O = V _{CC} = 15V		
Logic Low Supply Current	I _{CCL}			40		μA	I _F = 16mA, V _O = Open, V _{CC} = 15V		
Logic High Supply Current	I _{CCH} *			0.02	1	μA	I _F = 0mA, V _O = Open, V _{CC} = 15V		
Input Forward Voltage	V _F *			1.5	1.7	V	I _F = 16mA	3	
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	I _F = 16mA		
Input Reverse Breakdown Voltage	BV _R *		5			V	I _R = 10μA		
Input Capacitance	C _{IN}			60		pF	f = 1MHz, V _F = 0		
Input-Output Insulation Leakage Current	I _{I-O} *				1.0	μA	45% Relative Humidity, t = 5 sec. V _{I-O} = 3000 Vdc	6	
Resistance (Input-Output)	R _{I-O}			10 ¹²		Ω	V _{I-O} = 500V dc	6	
Capacitance (Input-Output)	C _{I-O}			0.6		pF	f = 1MHz	6	
Transistor DC Current Gain	h _{FE}			150		-	V _O = 5V, I _O = 3mA		

Switching Specifications (T_A = 25°C)

V_{CC} = 5V, I_F = 16mA UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t _{PHL} *	6N135		0.5	1.5	μs	R _L = 4.1kΩ	5,9	8,9
		6N136 HCPL-2502		0.2	0.8	μs	R _L = 1.9kΩ		
Propagation Delay Time To Logic High at Output	t _{PLH} *	6N135		0.4	1.5	μs	R _L = 4.1kΩ	5,9	8,9
		6N136 HCPL-2502		0.3	0.8	μs	R _L = 1.9kΩ		
Common Mode Transient Immunity at Logic High Level Output	CM _H	6N135		1000		V/μs	I _F = 0mA, V _{CM} = 10V _{p-p} , R _L = 4.1kΩ	10	7,8,9
		6N136 HCPL-2502		1000		V/μs	I _F = 0mA, V _{CM} = 10V _{p-p} , R _L = 1.9kΩ		
Common Mode Transient Immunity at Logic Low Level Output	CM _L	6N135		-1000		V/μs	V _{CM} = 10V _{p-p} , R _L = 4.1kΩ	10	7,8,9
		6N136 HCPL-2502		-1000		V/μs	V _{CM} = 10V _{p-p} , R _L = 1.9kΩ		
Bandwidth	BW			2		MHz	R _L = 100Ω	8	10

- NOTES:
- Derate linearly above 70°C free-air temperature at a rate of 0.8mA/°C.
 - Derate linearly above 70°C free-air temperature at a rate of 1.6mA/°C.
 - Derate linearly above 70°C free-air temperature at a rate of 0.9mW/°C.
 - Derate linearly above 70°C free-air temperature at a rate of 2.0mW/°C.
 - CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
 - Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
 - Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., V_O > 2.0V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., V_O < 0.8V).
 - The 1.9kΩ load represents 1 TTL unit load of 1.6mA and a 5.6kΩ pull-up resistor.
 - The 4.1kΩ load represents 1 LSTTL unit load of 0.36mA and a 6.1kΩ pull-up resistor.
 - The frequency at which the ac output voltage is 3 dB below the low frequency asymptote.

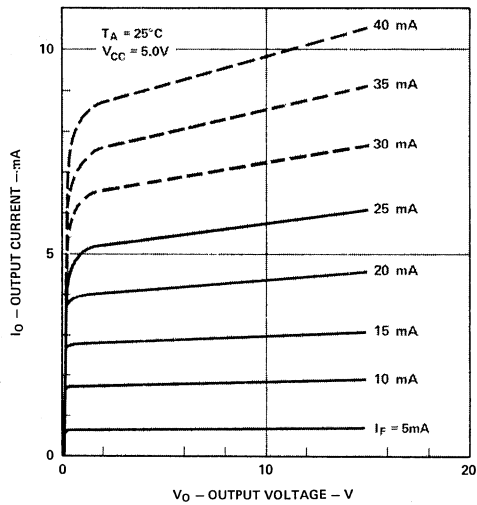


Figure 1. DC and Pulsed Transfer Characteristics.

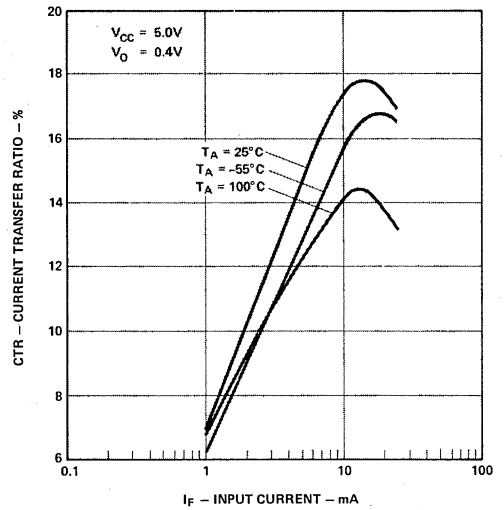


Figure 2. Current Transfer Ratio vs. Input Current.

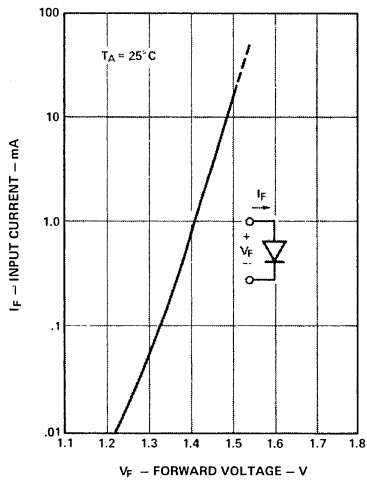


Figure 3. Input Current vs. Forward Voltage.

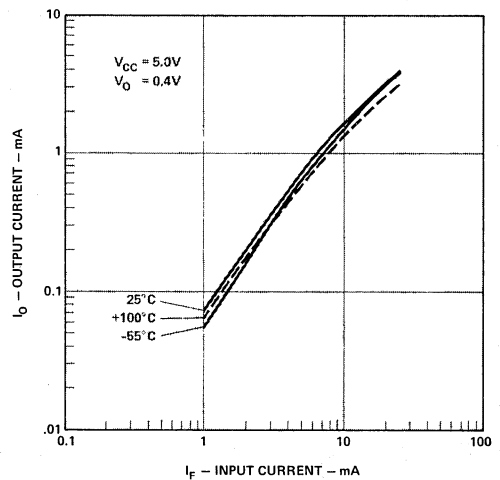


Figure 4. Output Current vs. Input Current.

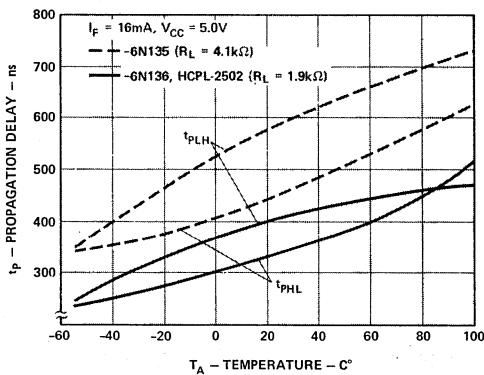


Figure 5. Propagation Delay vs. Temperature.

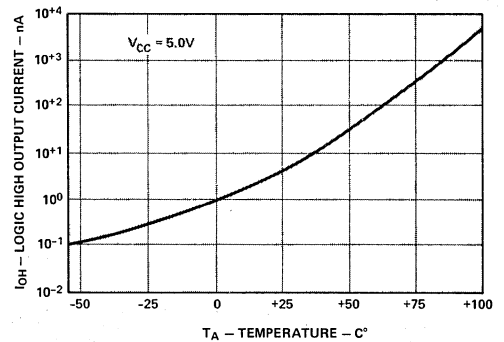


Figure 6. Logic High Output Current vs. Temperature.

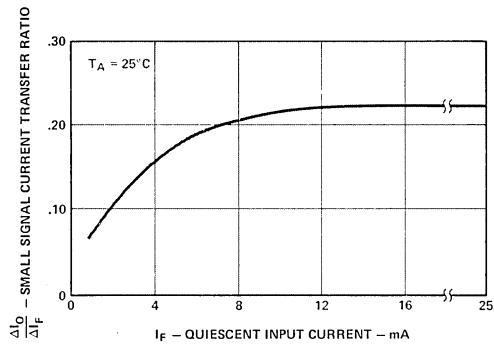


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

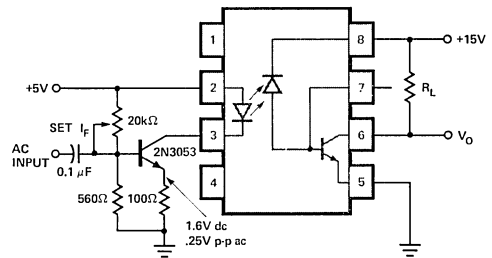
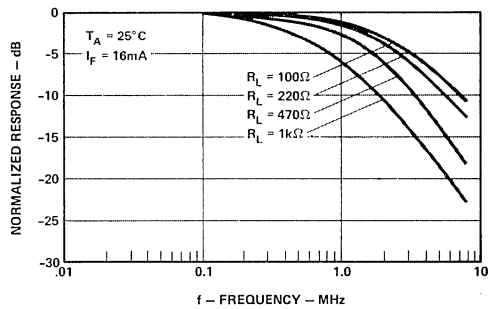


Figure 8. Frequency Response.

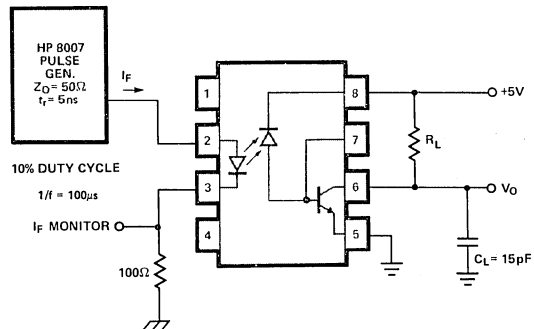
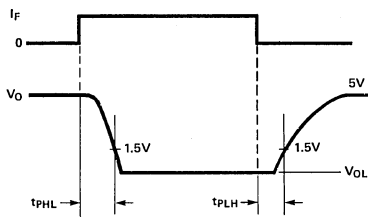


Figure 9. Switching Test Circuit.

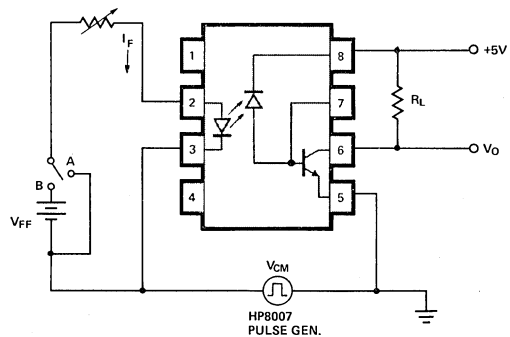
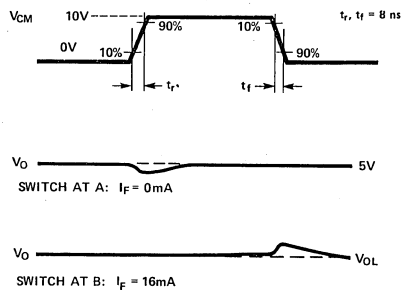


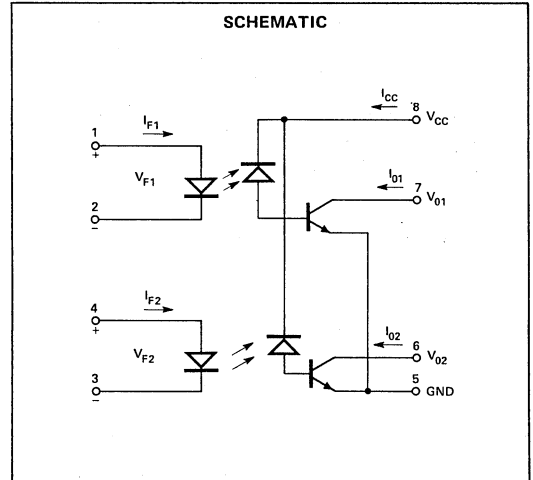
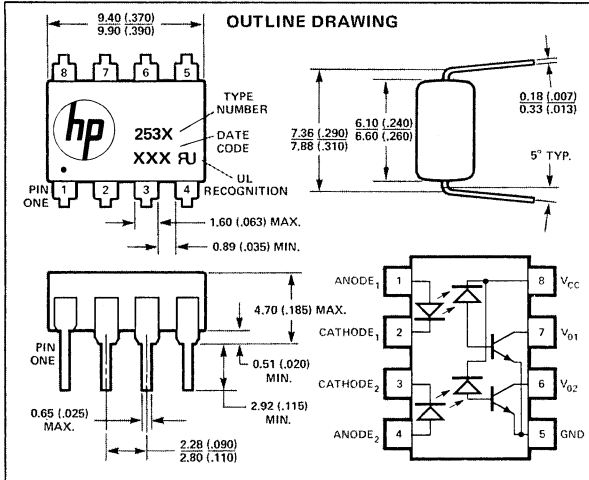
Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

DUAL HIGH SPEED OPTICALLY COUPLED ISOLATORS

HCPL-2530
(5082 - 4354)

HCPL-2531
(5082 - 4355)

TECHNICAL DATA APRIL 1978



Features

- **HIGH SPEED: 1 Mbit/s**
- **TTL COMPATIBLE**
- **HIGH COMMON MODE TRANSIENT IMMUNITY: >1000V/μs**
- **HIGH DENSITY PACKAGING**
- **3000Vdc INSULATION VOLTAGE**
- **3 MHz BANDWIDTH**
- **OPEN COLLECTOR OUTPUTS**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)**

Description

The HCPL-2530/31 dual isolators contain a pair of light emitting diodes and integrated photon detectors with 3000V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collectors improve the speed up to a hundred times that of a conventional photo-transistor isolator by reducing the base-collector capacitance.

The HCPL-2530 is suitable for use in TTL/CMOS, TTL/LSTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the -2530 is 7% minimum at $I_F = 16$ mA.

The HCPL-2531 is suitable for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6kΩ pull-up resistor. CTR of the -2531 is 19% minimum at $I_F = 16$ mA.

Applications

- **Line Receivers** — High common mode transient immunity (>1000V/μs) and low input-output capacitance (0.6pF).
- **High Speed Logic Ground Isolation** — TTL/TTL, TTL/LTTL, TTL/CMOS, TTL/LSTTL.
- **Replace Pulse Transformers** — Save board space and weight.
- **Analog Signal Ground Isolation** — Integrated photon detector provides improved linearity over phototransistor type.
- **Polarity Sensing.**
- **Isolated Analog Amplifier** — Dual channel packaging enhances thermal tracking.

Absolute Maximum Ratings

Storage Temperature	.....	-55°C to +125°C
Operating Temperature	.....	-55°C to +100°C
Lead Solder Temperature	.....	260°C for 10s (1.6mm below seating plane)
Average Input Current — I_F (each channel)	.....	25mA ^[1]
Peak Input Current — I_F (each channel)	.....	50mA ^[2] (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F (each channel)	.....	1.0 A (≤1μs pulse width, 300pps)
Reverse Input Voltage — V_R (each channel)	.....	5V
Input Power Dissipation (each channel)	.....	45mW ^[3]
Average Output Current — I_O (each channel)	.....	8mA
Peak Output Current — I_O (each channel)	.....	16mA
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 7,6-5)	.....	-0.5V to 15V
Output Power Dissipation (each channel)	.....	35mW ^[4]

Electrical Specifications AT $T_A = 25^\circ\text{C}$

Parameter	Sym.	Device HCPL-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	2530	7	18		%	$I_F = 16\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$	1,2	5,6
		2531	19	24		%			
Logic Low Output Voltage	V_{OL}	2530		0.1	0.4	V	$I_F = 16\text{mA}$, $I_O = 1.1\text{mA}$, $V_{CC} = 4.5\text{V}$		5
		2531		0.1	0.4	V	$I_F = 16\text{mA}$, $I_O = 2.4\text{mA}$, $V_{CC} = 4.5\text{V}$		
Logic High Output Current	I_{OH}			3	500	nA	$I_F = 0\text{mA}$, $V_O = V_{CC} = 5.5\text{V}$	6	5
Logic High Output Current	I_{OH}				100	μA	$I_F = 0\text{mA}$, $V_O = V_{CC} = 15\text{V}$		5
Logic Low Supply Current	I_{CCL}			80		μA	$I_{F1} = I_{F2} = 16\text{mA}$ $V_{O1} = V_{O2} = \text{Open}$, $V_{CC} = 15\text{V}$		
Logic High Supply Current	I_{CCH}			0.05	2	μA	$I_{F1} = I_{F2} = 0\text{mA}$ $V_{O1} = V_{O2} = \text{Open}$, $V_{CC} = 15\text{V}$		
Input Forward Voltage	V_F			1.5	1.7	V	$I_F = 16\text{mA}$	3	5
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		$\text{mV}/^\circ\text{C}$	$I_F = 16\text{mA}$		5
Input Reverse Breakdown Voltage	V_R		5			V	$I_F = 10\mu\text{A}$		5
Input Capacitance	C_{IN}			60		pF	$f = 1\text{MHz}$, $V_F = 0$		5
Input - Output Insulation Leakage Current	I_{I-O}				1.0	μA	45% Relative Humidity, $t = 5\text{s}$ $V_{I-O} = 3000\text{Vdc}$		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	$V_{I-O} = 500\text{V dc}$		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	$f = 1\text{MHz}$		7
Input-Input Insulation Leakage Current	I_{I-I}			0.005		μA	45% Relative Humidity, $t=5\text{s}$, $V_{I-I} = 500\text{Vdc}$		8
Resistance (Input-Input)	R_{I-I}			10^{11}		Ω	$V_{I-I} = 500\text{V dc}$		8
Capacitance (Input-Input)	C_{I-I}			0.25		pF	$f = 1\text{MHz}$		8

Switching Specifications AT $T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$, $I_F = 16\text{mA}$, UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device HCPL-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	2530		0.3	1.5	μs	$R_L = 4.1\text{k}\Omega$	5,9	10,11
		2531		0.2	0.8	μs	$R_L = 1.9\text{k}\Omega$		
Propagation Delay Time to Logic High at Output	t_{PLH}	2530		0.4	1.5	μs	$R_L = 4.1\text{k}\Omega$	5,9	10,11
		2531		0.3	0.8	μs	$R_L = 1.9\text{k}\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H	2530		1000		$\text{V}/\mu\text{s}$	$I_F = 0\text{mA}$, $R_L = 4.1\text{k}\Omega$, $V_{CM} = 10\text{V}_{p-p}$	10	9,10,11
		2531		1000		$\text{V}/\mu\text{s}$	$I_F = 0\text{mA}$, $R_L = 1.9\text{k}\Omega$, $V_{CM} = 10\text{V}_{p-p}$		
Common Mode Transient Immunity at Logic Low Level Output	CM_L	2530		-1000		$\text{V}/\mu\text{s}$	$V_{CM} = 10\text{V}_{p-p}$, $R_L = 4.1\text{k}\Omega$	10	9,10,11
		2531		-1000		$\text{V}/\mu\text{s}$	$V_{CM} = 10\text{V}_{p-p}$, $R_L = 1.9\text{k}\Omega$		
Bandwidth	BW			3		MHz	$R_L = 100\Omega$	8	12

- NOTES: 1. Derate linearly above 70°C free-air temperature at a rate of $0.8\text{mA}/^\circ\text{C}$.
 2. Derate linearly above 70°C free-air temperature at a rate of $1.6\text{mA}/^\circ\text{C}$.
 3. Derate linearly above 70°C free-air temperature at a rate of $0.9\text{mW}/^\circ\text{C}$.
 4. Derate linearly above 70°C free-air temperature at a rate of $1.0\text{mW}/^\circ\text{C}$.
 5. Each channel.
 6. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.
 7. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
 8. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.
 9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM} , to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0\text{V}$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8\text{V}$).
 10. The $1.9\text{k}\Omega$ load represents 1 TTL unit load of 1.6mA and the $5.6\text{k}\Omega$ pull-up resistor.
 11. The $4.1\text{k}\Omega$ load represents 1 LSTTL unit load of 0.36mA and $6.1\text{k}\Omega$ pull-up resistor.
 12. The frequency at which the ac output voltage is 3dB below the low frequency asymptote.

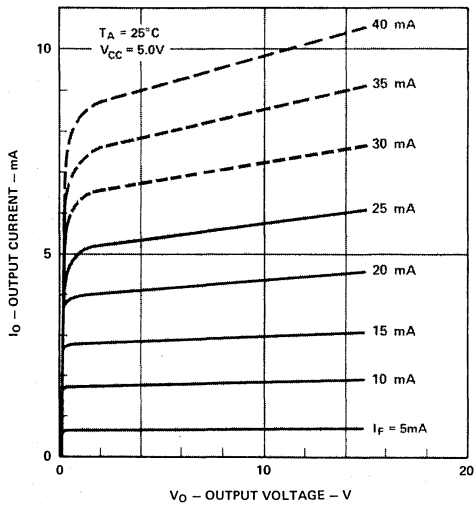


Figure 1. DC and Pulsed Transfer Characteristics.

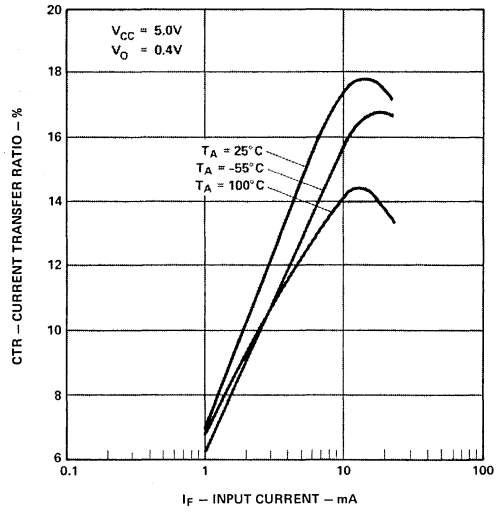


Figure 2. Current Transfer Ratio vs. Input Current.

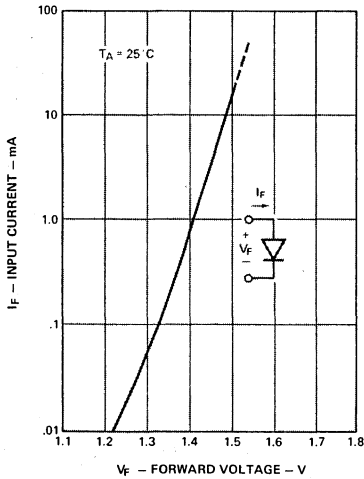


Figure 3. Input Current vs. Forward Voltage.

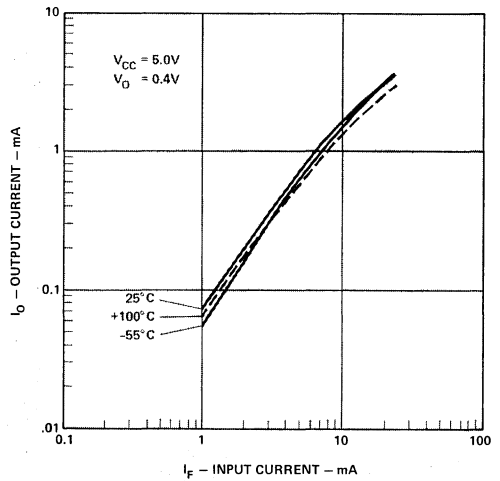


Figure 4. Output Current vs. Input Current.

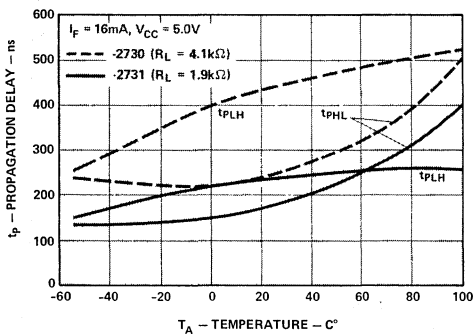


Figure 5. Propagation Delay vs. Temperature.

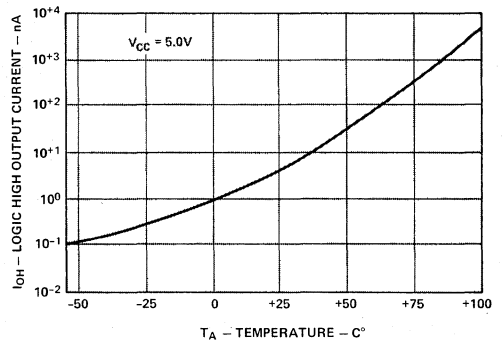


Figure 6. Logic High Output Current vs. Temperature.

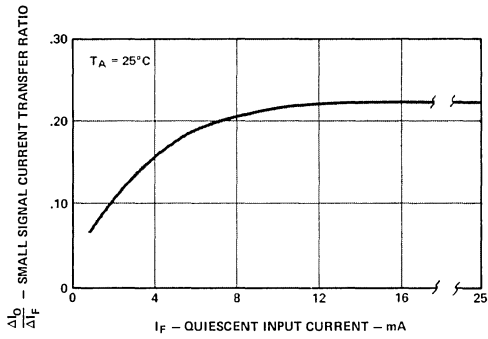


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

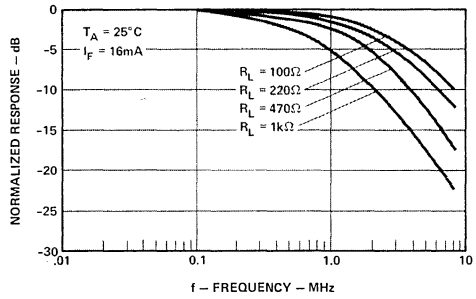


Figure 8. Frequency Response.

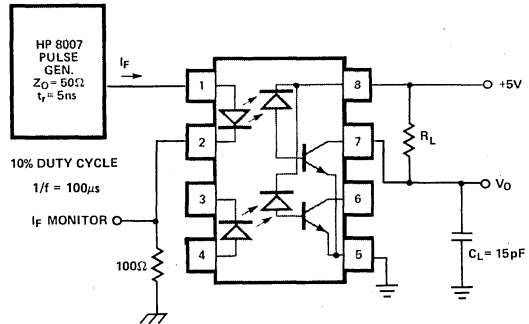
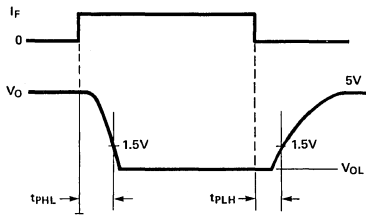
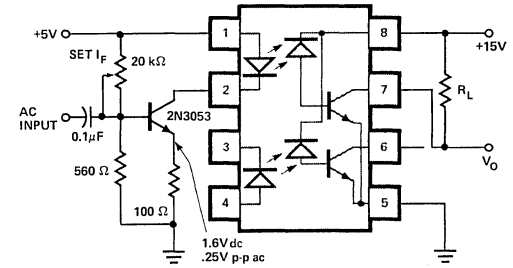


Figure 9. Switching Test Circuit.

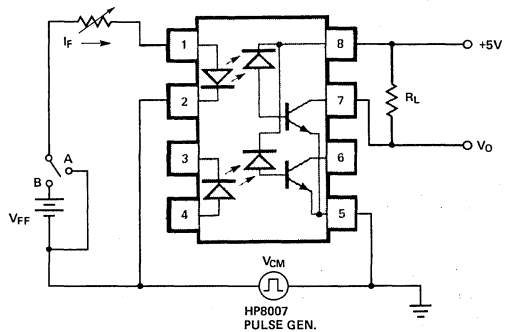
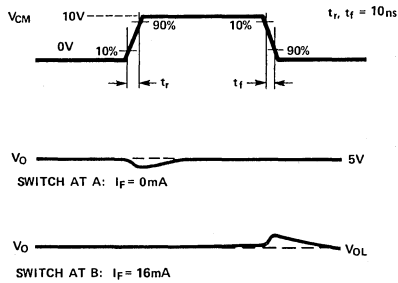
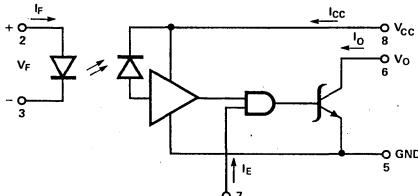


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.



NOTE:
A .01 to 0.1 μ F BYPASS CAPACITOR MUST BE
CONNECTED BETWEEN PINS 8 AND 5.

Figure 1.

Features

- DTL/TTL COMPATIBLE: 5V SUPPLY
- ULTRA HIGH SPEED
- LOW INPUT CURRENT REQUIRED
- HIGH COMMON MODE REJECTION
- GUARANTEED PERFORMANCE OVER TEMPERATURE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)
- 3000V dc INSULATION VOLTAGE

Description/Applications

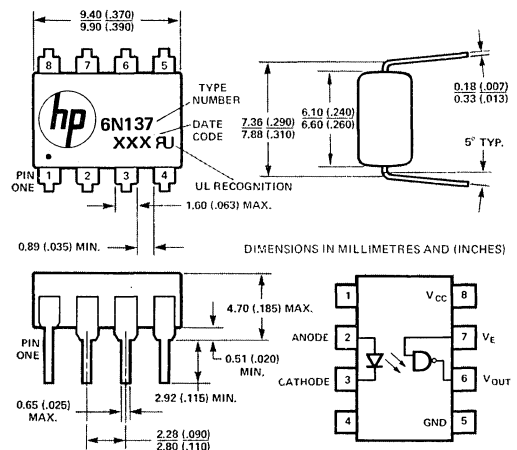
The 6N137 consists of a GaAsP photon emitting diode and a unique integrated detector. The photons are collected in the detector by a photodiode and then amplified by a high gain linear amplifier that drives a Schottky clamped open collector output transistor. The circuit is temperature, current and voltage compensated.

This unique isolator design provides maximum DC and AC circuit isolation between input and output while achieving DTL/TTL circuit compatibility. The isolator operational parameters are guaranteed from 0°C to 70°C, such that a minimum input current of 5mA will sink an eight gate fan-out (13mA) at the output with 5 volt V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 45nsec. The enable input provides gating of the detector with input sinking and sourcing requirements compatible with DTL/TTL interfacing and a propagation delay of 25 ns typical.

The 6N137 can be used in high speed digital interfacing applications where common mode signals must be rejected, such as for a line receiver and digital programming of floating power supplies, motors, and other machine control systems. The elimination of ground loops can be accomplished in system interfaces such as between a computer and a peripheral memory, printer, controller, etc.

The open collector output provides capability for bussing, OR'ing and strobing.

OUTLINE DRAWING*



Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level Each Channel	I _{FL}	0	250	μ A
Input Current, High Level Each Channel	I _{FH}	6.3**	10	mA
High Level Enable Voltage	V _{EH}	2.0	5.5	V
Low Level Enable Voltage (Output High)	V _{EL}	0	0.8	V
Supply Voltage, Output	V _{CC}	4.5	5.5	V
Fan Out (TTL Load)	N		8	
Operating Temperature	T _A	0	70	°C

Absolute Maximum Ratings*

(No derating required up to 70°C)

Storage Temperature -55°C to +125°C
 Operating Temperature 0°C to +70°C
 Lead Solder Temperature 260°C for 10s
 (1.6mm below seating plane)

Peak Forward Input

Current 20mA (\leq 1 msec Duration)
 Average Forward Input Current 10mA
 Reverse Input Voltage 5V
 Enable Input Voltage 5.5V
 (Not to exceed V_{CC} by more than 500mV)
 Supply Voltage - V_{CC} 7V (1 Minute Maximum)
 Output Current - I_O 50mA
 Output Collector Power Dissipation 85mW
 Output Voltage - V_O 7V

**6.3mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5mA or less.

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE ($T_A = 0^\circ\text{C TO } 70^\circ\text{C}$) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.**	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}^*		50	250	μA	$V_{CC}=5.5\text{V}, V_O=5.5\text{V}, I_F=250\mu\text{A}, V_E=2.0\text{V}$	6	
Low Level Output Voltage	V_{OL}^*		0.5	0.6	V	$V_{CC}=5.5\text{V}, I_F=5\text{mA}, V_{EH}=2.0\text{V}, I_{OL} \text{ (Sinking)} = 13\text{mA}$	3,5	
High Level Enable Current	I_{EH}		-1.0		mA	$V_{CC}=5.5\text{V}, V_E=2.0\text{V}$		
Low Level Enable Current	I_{EL}^*		-1.6	-2.0	mA	$V_{CC}=5.5\text{V}, V_E=0.5\text{V}$		
High Level Supply Current	I_{CCH}^*		7	15	mA	$V_{CC}=5.5\text{V}, I_F=0, V_E=0.5\text{V}$		
Low Level Supply	I_{CCL}^*		13	18	mA	$V_{CC}=5.5\text{V}, I_F=10\text{mA}, V_E=0.5\text{V}$		
Input-Output Insulation Leakage Current	I_{I-O}^*			1.0	μA	Relative Humidity=45% $T_A=25^\circ\text{C}, t=5\text{s}, V_{I-O}=3000\text{Vdc}$		5
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O}=500\text{V}, T_A=25^\circ\text{C}$		5
Capacitance (Input-Output)	C_{I-O}		0.6		pF	$f=1\text{MHz}, T_A=25^\circ\text{C}$		5
Input Forward Voltage	V_F^*		1.5	1.75	V	$I_F=10\text{mA}, T_A=25^\circ\text{C}$	4	8
Input Reverse Breakdown Voltage	BV_R^*	5			V	$I_R=10\mu\text{A}, T_A=25^\circ\text{C}$		
Input Capacitance	C_{IN}		60		pF	$V_F=0, f=1\text{MHz}$		
Current Transfer Ratio	CTR		700		%	$I_F=5.0\text{mA}, R_L=100\Omega$	2	7

**All typical values are at $V_{CC} = 5\text{V}, T_A = 25^\circ\text{C}$

Switching Characteristics at $T_A=25^\circ\text{C}, V_{CC}=5\text{V}$

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}^*		45	75	ns	$R_L=350\Omega, C_L=15\text{pF}, I_F=7.5\text{mA}$	7,9	1
Propagation Delay Time to Low Output Level	t_{PHL}^*		45	75	ns	$R_L=350\Omega, C_L=15\text{pF}, I_F=7.5\text{mA}$	7,9	2
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	$R_L=350\Omega, C_L=15\text{pF}, I_F=7.5\text{mA}$		
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	$R_L=350\Omega, C_L=15\text{pF}, I_F=7.5\text{mA}, V_{EH}=3.0\text{V}, V_{EL}=0.5\text{V}$	8	3
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns	$R_L=350\Omega, C_L=15\text{pF}, I_F=7.5\text{mA}, V_{EH}=3.0\text{V}, V_{EL}=0.5\text{V}$	8	4
Common Mode Transient Immunity at Logic High Output Level	CM_H		50		v/ μs	$V_{CM}=10\text{V}, R_L=350\Omega, V_O(\text{min.})=2\text{V}, I_F=0\text{mA}$	11	6
Common Mode Transient Immunity at Logic Low Output Level	CM_L		-150		v/ μs	$V_{CM}=10\text{V}, R_L=350\Omega, V_O(\text{max.})=0.8\text{V}, I_F=5\text{mA}$	11	6

Operating Procedures and Definitions

Logic Convention. The 5082-4360 is defined in terms of positive logic.

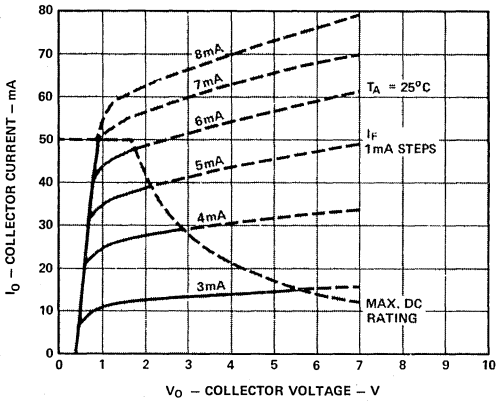
Bypassing. A ceramic capacitor (.01 to 0.1 μ F) should be connected from pin 8 to pin 5. Its purpose is to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching properties. The total lead length between capacitor and isolator should not exceed 20mm.

Polarities. All voltages are referenced to network ground (pin 5). Current flowing toward a terminal is considered positive.

Enable Input. No external pull-up required for a logic (1), i.e., can be open circuit.

NOTES:

1. The t_{PLH} propagation delay is measured from the 3.75mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The t_{PHL} propagation delay is measured from the 3.75mA point on the leading edge of the input pulse to 1.5V point on the leading edge of the output pulse.
3. The t_{ELH} enable propagation delay is measured from the 1.5V point of the trailing edge of the input pulse to the 1.5V point of the trailing edge of the output pulse.
4. The t_{EHL} enable propagation delay is measured from the 1.5V point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
5. Device considered a two terminal device: pins 2 and 3 shorted together, and pins 5, 6, 7, and 8 shorted together.
6. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM} , to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
7. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
8. At 10mA V_F decreases with increasing temperature at the rate of 1.6mV/ $^{\circ}$ C.



Note: Dashed characteristics - denote pulsed operation only.

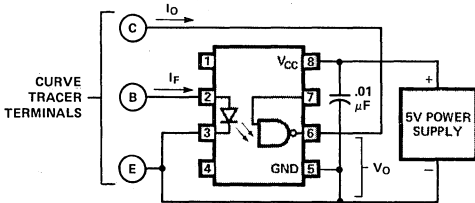


Figure 2. Isolator Collector Characteristics.

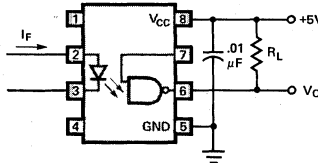
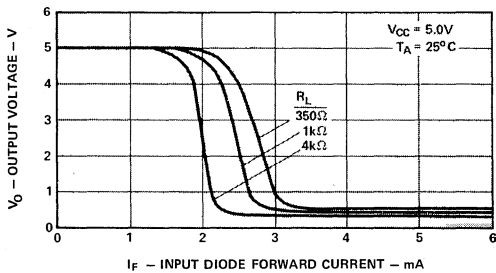


Figure 3. Input-Output Characteristics.

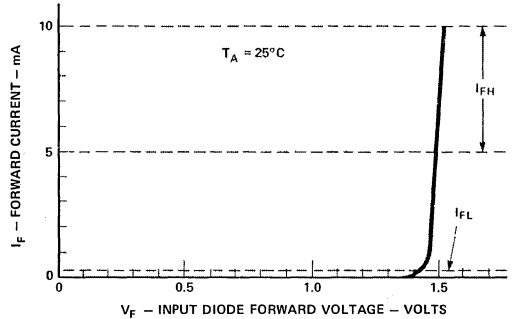


Figure 4. Input Diode Forward Characteristic.

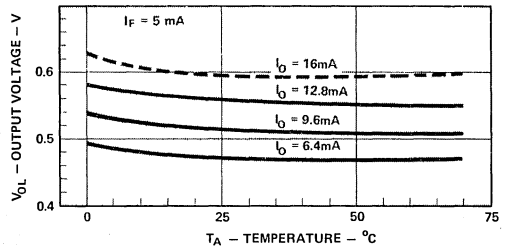


Figure 5. Output Voltage, V_{OL} vs. Temperature and Fan-Out.

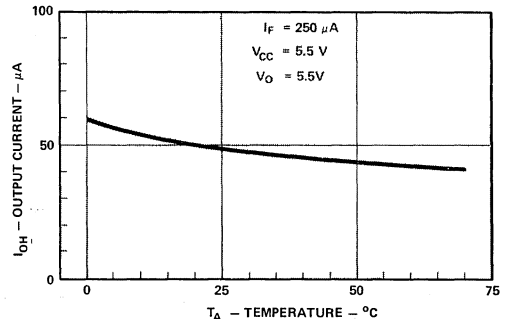
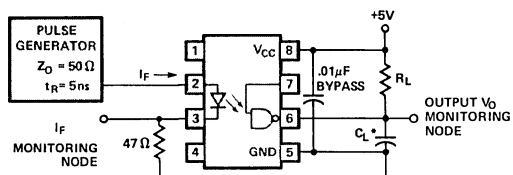


Figure 6. Output Current, I_{OH} vs. Temperature ($I_F=250\mu$ A).



* C_L is approximately 15 pF, which includes probe and stray wiring capacitance.

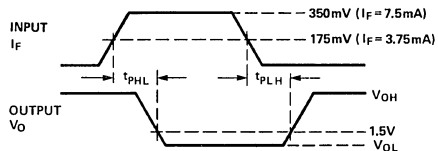
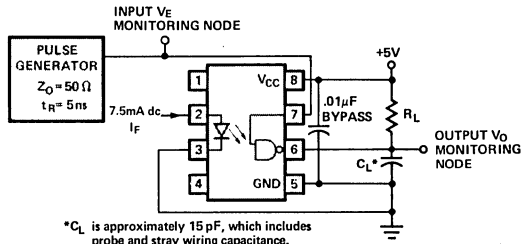


Figure 7. Test Circuit for t_{PHL} and t_{PLH} **



* C_L is approximately 15 pF, which includes probe and stray wiring capacitance.

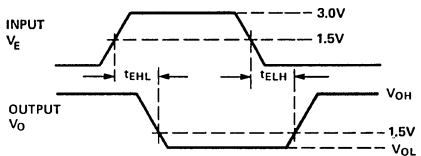


Figure 8. Test Circuit for t_{ELH} and t_{EHL} .

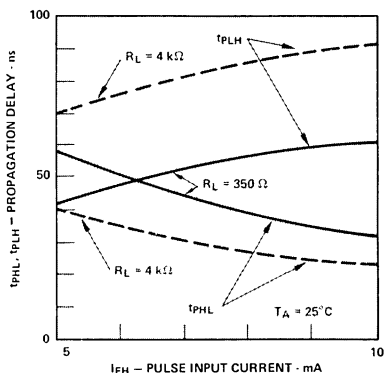


Figure 9. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH} .

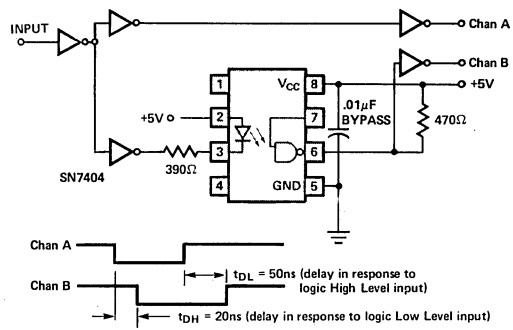


Figure 10. Response Delay Between TTL Gates.

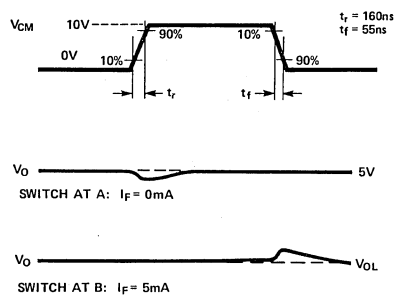
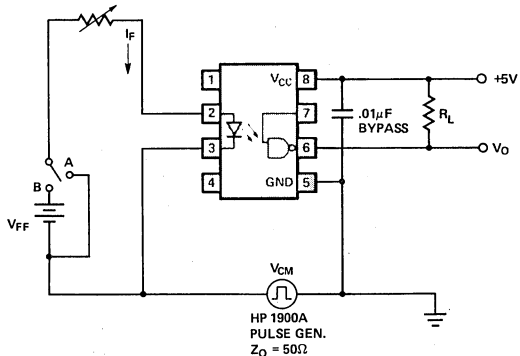
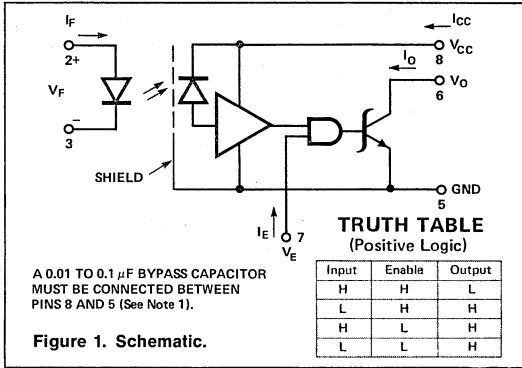


Figure 11. Test Circuit for Transient Immunity and Typical Waveforms.



** JEDEC Registered Data.



Features

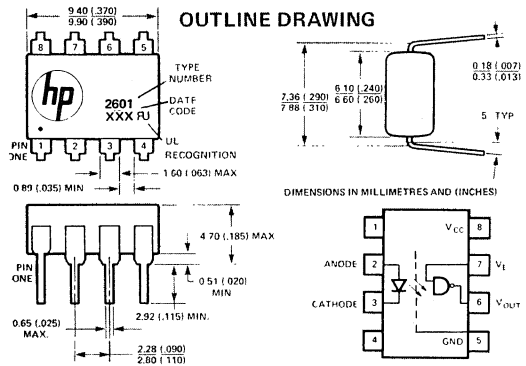
- INTERNAL SHIELD FOR HIGH COMMON MODE REJECTION (CMR)
- HIGH SPEED
- GUARANTEED MINIMUM COMMON MODE TRANSIENT IMMUNITY: 1000V/ μ s
- LSTTL/TTL COMPATIBLE
- LOW INPUT CURRENT REQUIRED: 5mA
- GUARANTEED PERFORMANCE OVER TEMPERATURE: 0°C to 70°C
- STROBABLE OUTPUT
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)
- 3000 Vdc INSULATION VOLTAGE

Description

The HCPL-2601 optically coupled gate combines a GaAsP light emitting diode and an integrated high gain photon detector. An enable input allows the detector to be strobed. The output of the detector I.C. is an open collector Schottky clamped transistor. The internal shield provides a guaranteed common mode transient immunity specification of 1000 volts/ μ sec., equivalent to rejecting a 300 volt P-P sinusoid at 1 MHz.

This unique design provides maximum D.C. and A.C. circuit isolation while achieving TTL compatibility. The isolator D.C. operational parameters are guaranteed from 0°C to 70°C allowing troublefree system performance. This isolation is achieved with a typical propagation delay of 35 nsec.

The HCPL-2601's are suitable for high speed logic interfacing, input/output buffering, as line receivers in environments that conventional line receivers cannot tolerate and are recommended for use in extremely high ground or induced noise environments.



Applications

- Isolated Line Receiver
- Simplex/Multiplex Data Transmission
- Computer-Peripheral Interface
- Microprocessor System Interface
- Digital Isolation for A/D, D/A Conversion
- Switching Power Supply
- Instrument Input/Output Isolation
- Ground Loop Elimination
- Pulse Transformer Replacement

Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level	I_{FL}	0	250	μ A
Input Current, High Level	I_{FH}	6.3*	20	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
High Level Enable Voltage	V_{EH}	2.0	5.5	V
Low Level Enable Voltage	V_{EL}	0	0.8	V
Fan Out (TTL Load)	N		8	
Operating Temperature	T_A	0	70	°C

Absolute Maximum Ratings

(No Derating Required up to 70°C)

Storage Temperature	-55°C to +125°C
Operating Temperature	0°C to +70°C
Lead Solder Temperature	260°C for 10 s (1.6mm below seating plane)
Forward Input Current - I_F (see Note 2)	20 mA
Reverse Input Voltage	5 V
Supply Voltage - V_{CC}	7 V
Enable Input Voltage - V_E	5.5 V (Not to exceed V_{CC} by more than 500 mV)
Output Collector Current - I_O	25 mA
Output Collector Power Dissipation	40 mW
Output Collector Voltage - V_O	7 V

*6.3mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5mA or less.

Electrical Characteristics

(Over Recommended Temperature, $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$, Unless Otherwise Noted)

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		7	250	μA	$V_{CC} = 5.5\text{V}$, $V_O = 5.5\text{V}$, $I_F = 250\ \mu\text{A}$, $V_E = 2.0\text{V}$	2	
Low Level Output Voltage	V_{OL}		0.4	0.6	V	$V_{CC} = 5.5\text{V}$, $I_F = 5\text{mA}$ $V_E = 2.0\text{V}$, I_{OL} (Sinking) = 13 mA	3,5	
High Level Supply Current	I_{CCH}		10	15	mA	$V_{CC} = 5.5\text{V}$, $I_F = 0$, $V_E = 0.5\text{V}$		
Low Level Supply Current	I_{CCL}		15	18	mA	$V_{CC} = 5.5\text{V}$, $I_F = 10\text{mA}$, $V_E = 0.5\text{V}$		
Low Level Enable Current	I_{EL}		-1.6	-2.0	mA	$V_{CC} = 5.5\text{V}$, $V_E = 0.5\text{V}$		
High Level Enable Current	I_{EH}		-1.0		mA	$V_{CC} = 5.5\text{V}$, $V_E = 2.0\text{V}$		
High Level Enable Voltage	V_{EH}	2.0			V			11
Low Level Enable Voltage	V_{EL}			0.8	V			
Input Forward Voltage	V_F		1.5	1.75	V	$I_F = 10\text{mA}$, $T_A = 25^\circ\text{C}$	4	
Input Reverse Breakdown Voltage	BV_R	5			V	$I_R = 10\ \mu\text{A}$, $T_A = 25^\circ\text{C}$		
Input Capacitance	C_{IN}		60		pF	$V_F = 0$, $f = 1\text{MHz}$		
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$		-1.6		mV/ $^\circ\text{C}$	$I_F = 10\text{mA}$		
Input-Output Insulation Leakage Current	I_{I-O}			1	μA	Relative Humidity = 45% $T_A = 25^\circ\text{C}$, $t = 5\text{s}$, $V_{I-O} = 3000\text{Vdc}$		3
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500\text{V}$		3
Capacitance (Input-Output)	C_{I-O}		0.6		pF	$f = 1\text{MHz}$		3

*All typical values are at $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$.

Switching Characteristics ($T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output level	t_{PLH}		35	75	ns	$R_L = 350\ \Omega$ $C_L = 15\text{pF}$ $I_F = 7.5\text{mA}$	6	4
Propagation Delay Time to Low Output Level	t_{PHL}		35	75	ns		6	5
Output Rise Time (10–90%)	t_r		25		ns			
Output Fall Time (90–10%)	t_f		15		ns			
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	$R_L = 350\ \Omega$, $C_L = 15\text{pF}$, $I_F = 7.5\text{mA}$, $V_{EH} = 3\text{V}$, $V_{EL} = 0\text{V}$	9	6
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns	$R_L = 350\ \Omega$, $C_L = 15\text{pF}$, $I_F = 7.5\text{mA}$, $V_{EH} = 3\text{V}$, $V_{EL} = 0\text{V}$	9	7
Common Mode Transient Immunity at High Output Level	CM_H	1000	10,000		V/ μs	$V_{CM} = 50\text{V}$ (peak), V_O (min.) = 2 V, $R_L = 350\ \Omega$, $I_F = 0\text{mA}$	12	8,10
Common Mode Transient Immunity at Low Output Level	CM_L	-1000	-10,000		V/ μs	$V_{CM} = 50\text{V}$ (peak), V_O (max.) = 0.8 V, $R_L = 350\ \Omega$, $I_F = 7.5\text{mA}$	12	9,10

NOTES:

- Bypassing of the power supply line is required, with a 0.01 μF ceramic disc capacitor adjacent to each isolator as illustrated in Figure 15. The power supply bus for the isolator(s) should be separate from the bus for any active loads, otherwise a larger value of bypass capacitor (up to 0.1 μF) may be needed to suppress regenerative feedback via the power supply.
- Peaking circuits may produce transient input currents up to 50 mA, 50 ns maximum pulse width, provided average current does not exceed 20 mA.
- Device considered a two terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.
- The t_{PHL} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5 V point on the trailing edge of the output pulse.
- The t_{PHL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
- The t_{ELH} enable propagation delay is measured from the 1.5 V point on the trailing edge of the enable input pulse to the 1.5 V point on the trailing edge of the output pulse.
- The t_{EHL} enable propagation delay is measured from the 1.5 V point on the leading edge of the enable input pulse to the 1.5 V point on the leading edge of the output pulse.
- CM_H is the maximum tolerable rate of rise of the common mode voltage to assure that the output will remain in a high logic state (i.e., $V_{OUT} > 2.0 \text{ V}$).
- CM_L is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (i.e., $V_{OUT} < 0.8 \text{ V}$).
- For sinusoidal voltages, $\left(\frac{dV_{CM}}{dt}\right)_{\text{max}} = \pi f_{CM} V_{CM} (P-P)$
- No external pull up is required for a high logic state on the enable input.

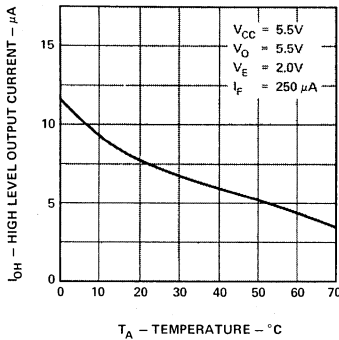


Figure 2. High Level Output Current vs. Temperature.

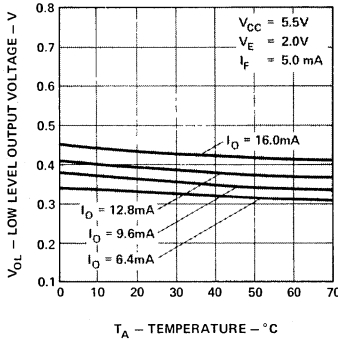


Figure 3. Low Level Output Voltage vs. Temperature.

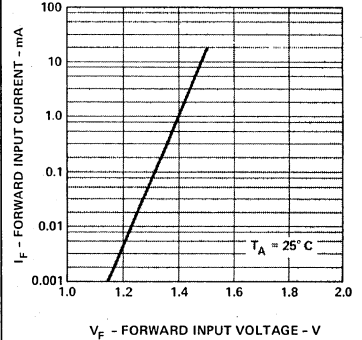


Figure 4. Input Diode Forward Characteristic.

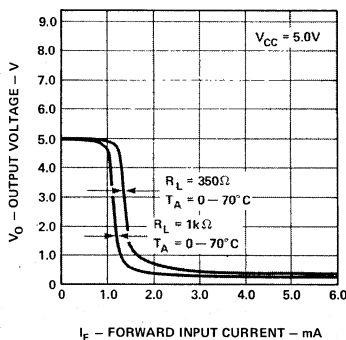


Figure 5. Output Voltage vs. Forward Input Current.

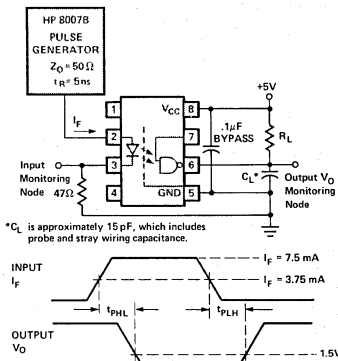


Figure 6. Test Circuit for t_{PHL} and t_{PLH} .

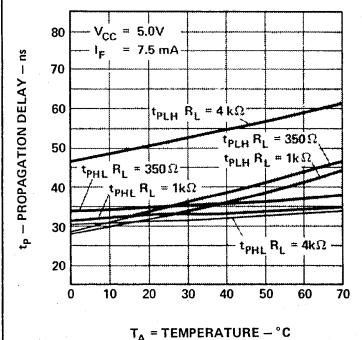


Figure 7. Propagation Delay vs. Temperature.

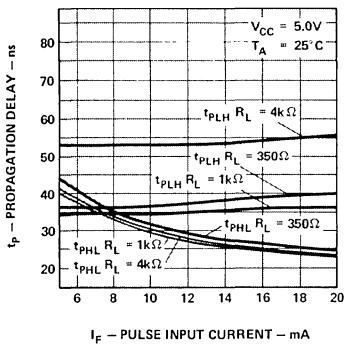


Figure 8. Propagation Delay vs. Pulse Input Current.

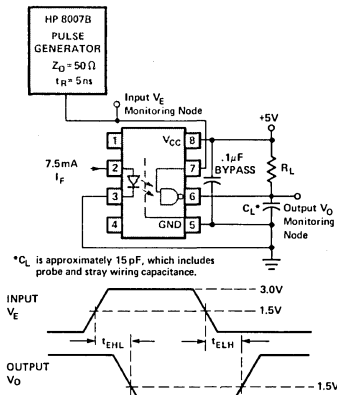


Figure 9. Test Circuit for t_{EHL} and t_{ELH} .

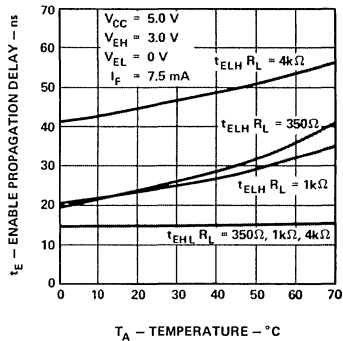


Figure 10. Enable Propagation Delay vs. Temperature.

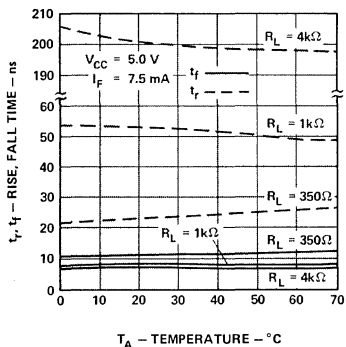


Figure 11. Rise, Fall Time vs. Temperature.

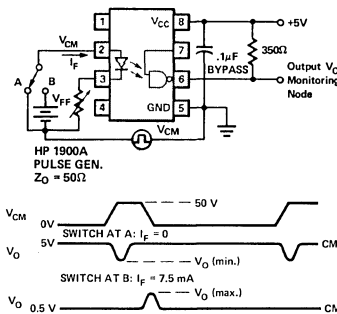


Figure 12. Test Circuit for Common Mode Transient Immunity and Typical Waveforms.

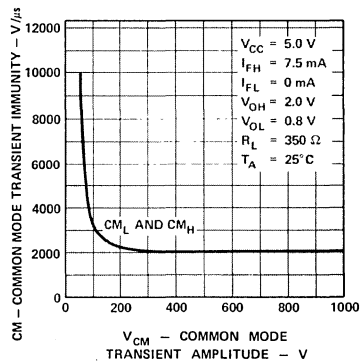


Figure 13. Common Mode Transient Immunity vs. Common Mode Transient Amplitude.

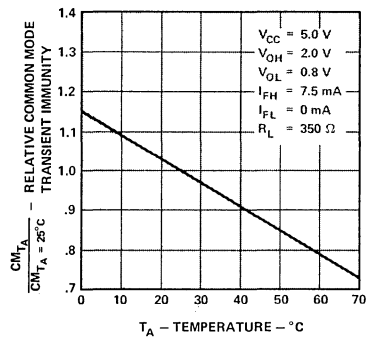


Figure 14. Relative Common Mode Transient Immunity vs. Temperature.

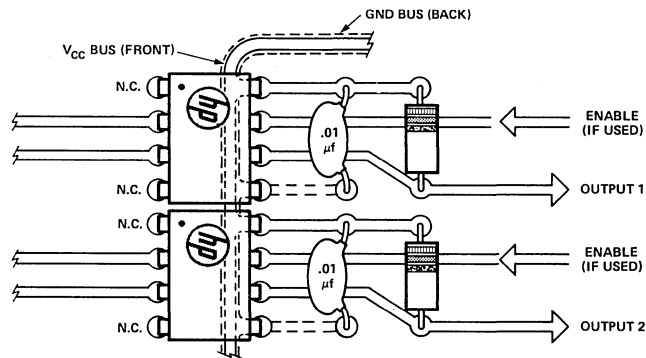
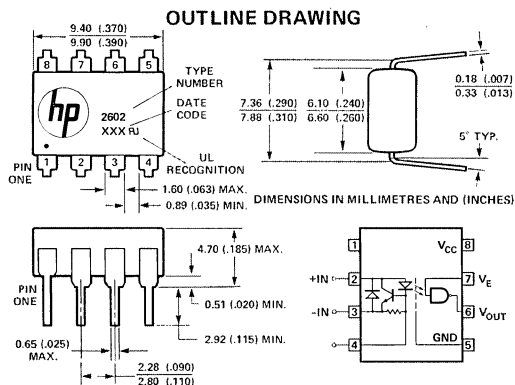
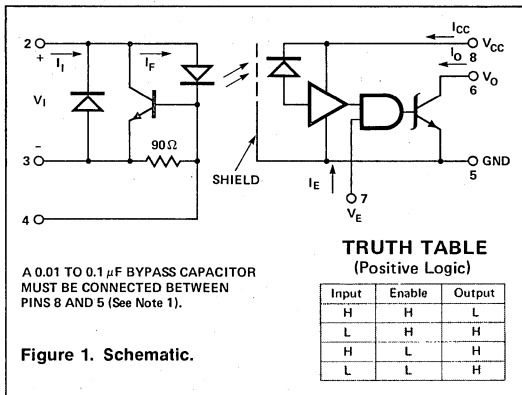


Figure 15. Recommended Printed Circuit Board Layout.



Features

- LINE TERMINATION INCLUDED — NO EXTRA CIRCUITRY REQUIRED
- ACCEPTS A BROAD RANGE OF DRIVE CONDITIONS
- GUARDBANDED FOR LED DEGRADATION
- LED PROTECTION MINIMIZES LED EFFICIENCY DEGRADATION
- HIGH SPEED — 10Mbps (LIMITED BY TRANSMISSION LINE IN MANY APPLICATIONS)
- INTERNAL SHIELD PROVIDES EXCELLENT COMMON MODE REJECTION
- EXTERNAL BASE LEAD ALLOWS "LED PEAKING" AND LED CURRENT ADJUSTMENT
- 3000 Vdc INSULATION VOLTAGE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)

Applications

- Isolated Line Receiver
- Simplex/Multiplex Data Transmission
- Computer-Peripheral Interface
- Microprocessor System Interface
- Digital Isolation for A/D, D/A Conversion
- Current Sensing
- Instrument Input/Output Isolation
- Ground Loop Elimination
- Pulse Transformer Replacement

Description

The HCPL-2602 optically coupled line receiver combines a GaAsP light emitting diode, an input current regulator and an integrated high gain photon detector. The input regulator serves as a line termination for line receiver applications. It clamps the line voltage and regulates the LED current so line reflections do not interfere with circuit performance.

The regulator allows a typical LED current of 8.5 mA before it starts to shunt excess current. The output of the detector IC is an open collector Schottky clamped transistor. An enable input gates the detector. The internal detector shield provides a guaranteed common mode transient immunity specification of 1000V/ μ sec, equivalent to rejecting a 300V P-P sinusoid at 1 MHz.

DC specifications are defined similar to TTL logic and are guaranteed from 0° C to 70° C allowing trouble free interfacing with digital logic circuits. An input current of 5 mA will sink an eight gate fan-out (TTL) at the output with a typical propagation delay from input to output of only 45 nsec.

The HCPL-2602's are useful as line receivers in high noise environments that conventional line receivers cannot tolerate. The higher LED threshold voltage provides improved immunity to differential noise and the internally shielded detector provides orders of magnitude improvement in common mode rejection with little or no sacrifice in speed.

Electrical Characteristics

(Over Recommended Temperature, $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$, Unless Otherwise Noted)

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		7	250	μA	$V_{CC} = 5.5\text{V}$, $V_O = 5.5\text{V}$ $I_I = 250\ \mu\text{A}$, $V_E = 2.0\text{V}$	4	
Low Level Output Voltage	V_{OL}		0.4	0.6	V	$V_{CC} = 5.5\text{V}$, $I_I = 5\ \text{mA}$ $V_E = 2.0\text{V}$, I_{OL} (Sinking) = 13 mA	2,5	2
Input Voltage	V_I		2.0	2.4	V	$I_I = 5\ \text{mA}$	3	
			2.3	2.7		$I_I = 60\ \text{mA}$	3	
Input Reverse Voltage	V_R		0.75	0.95	V	$I_R = 5\ \text{mA}$		
Low Level Enable Current	I_{EL}		-1.6	-2.0	mA	$V_{CC} = 5.5\text{V}$, $V_E = 0.5\text{V}$		
High Level Enable Current	I_{EH}		-1.0		mA	$V_{CC} = 5.5\text{V}$, $V_E = 2.0\text{V}$		
High Level Enable Voltage	V_{EH}	2.0			V			11
Low Level Enable Voltage	V_{EL}			0.8	V			
High Level Supply Current	I_{CCH}		10	15	mA	$V_{CC} = 5.5\text{V}$, $I_I = 0$, $V_E = 0.5\text{V}$		
Low Level Supply Current	I_{CCL}		16	19	mA	$V_{CC} = 5.5\text{V}$, $I_I = 60\ \text{mA}$ $V_E = 0.5\text{V}$		
Input Capacitance	C_{IN}		90		pF	$V_I = 0$, $f = 1\ \text{MHz}$, (PIN 2-3)		
Input-Output Insulation Leakage Current	I_{I-O}			1	μA	Relative Humidity = 45% $T_A = 25^\circ\text{C}$, $t = 5\ \text{s}$, $V_{I-O} = 3000\ \text{Vdc}$		3
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500\text{V}$		3
Capacitance (Input-Output)	C_{I-O}		0.6		pF	$f = 1\ \text{MHz}$		3

*All typical values are at $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$.

Switching Characteristics

($T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}		45	75	ns	$R_L = 350\ \Omega$ $C_L = 15\ \text{pF}$ $I_I = 7.5\ \text{mA}$	6	4
Propagation Delay Time to Low Output Level	t_{PHL}		45	75	ns		6	5
Output Rise Time (10-90%)	t_r		25		ns			
Output Fall Time (90-10%)	t_f		15		ns			
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	$R_L = 350\ \Omega$, $C_L = 15\ \text{pF}$, $I_I = 7.5\ \text{mA}$, $V_{EH} = 3\ \text{V}$, $V_{EL} = 0\ \text{V}$	10	6
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns		10	7
Common Mode Transient Immunity at High Output Level	CM_H	1000	10,000		V/ μs	$V_{CM} = 50\ \text{V}$ (peak), V_O (min.) = 2 V, $R_L = 350\ \Omega$, $I_I = 0\ \text{mA}$	12	8
Common Mode Transient Immunity at Low Output Level	CM_L	-1000	-10,000		V/ μs	$V_{CM} = 50\ \text{V}$ (peak), V_O (max.) = 0.8 V, $R_L = 350\ \Omega$, $I_I = 7.5\ \text{mA}$	12	9

Using the HCPL-2602 Optically Coupled Line Receiver

The primary objectives to fulfill when connecting an optoisolator to a transmission line are to provide a minimum, but not excessive, LED current and to properly terminate the line. The internal regulator in the HCPL-2602 simplifies this task. Excess current from variable drive conditions such as line length variations, line driver differences and power supply fluctuations are shunted by the regulator. In fact, with the LED current regulated, the line current can be increased to improve the immunity of the system to differential-mode-noise and to enhance the data rate capability. The designer must keep in mind the 60 mA input current maximum rating of the HCPL-2602, in such cases, and may need to use series limiting or shunting to prevent overstress.

Design of the termination circuit is also simplified; in most cases the transmission line can simply be connected directly to the input terminals of the HCPL-2602 without the need for additional series or shunt resistors. If reversing line drive is used it may be desirable to use two HCPL-2602's, or an external Schottky diode to optimize data rate.

Polarity Non-Reversing Drive

High data rates can be obtained with the HCPL-2602 with polarity non-reversing drive. Figure (a) illustrates how a 74S140 line driver can be used with the HCPL-2602 and shielded, twisted pair or coax cable without any additional components. There are some reflections due to the "active termination" but they do not interfere with circuit performance because the regulator clamps the line voltage. At longer line lengths t_{PLH} increases faster than t_{PHL} since the switching threshold is not exactly halfway between asymptotic line conditions. If optimum data rate is desired, a series resistor and peaking capacitor can be used to equalize t_{PLH} and t_{PHL} . In general, the peaking capacitance should be as large as possible; however, if it is too large it may keep the regulator from achieving turn-off during the negative (or zero) excursions of the input signal. A safe rule:

$$\text{make } C \leq 16t$$

where C = peaking capacitance in picofarads
 t = data bit interval in nanoseconds

Polarity Reversing Drive

A single HCPL-2602 can also be used with polarity reversing drive (Figure b). Current reversal is obtained by way of the substrate isolation diode (substrate to collector). Some reduction of data rate occurs, however, because the substrate diode stores charge, which must be removed when the current changes to the forward

direction. The effect of this is a longer t_{PHL} . This effect can be eliminated and data rate improved considerably by use of a Schottky diode on the input of the HCPL-2602.

For optimum noise rejection as well as balanced delays a split-phase termination should be used along with a flip-flop at the output (Figure c). The result of current reversal in split-phase operation is seen in Figure (c) with switches A and B both OPEN. The isolator inputs are then connected in ANTI-SERIES; however, because of the higher steady-state termination voltage, in comparison to the single HCPL-2602 termination, the forward current in the substrate diode is lower and consequently there is less junction charge to deal with when switching.

Closing switch B with A open is done mainly to enhance common mode rejection, but also reduces propagation delay slightly because line-to-line capacitance offers a slight peaking effect. With switches A and B both CLOSED, the shield acts as a current return path which prevents either input substrate diode from becoming reversed biased. Thus the data rate is optimized as shown in Figure (c).

Improved Noise Rejection

Use of additional logic at the output of two HCPL-2602's operated in the split phase termination, will greatly improve system noise rejection in addition to balancing propagation delays as discussed earlier.

A NAND flip-flop offers infinite common mode rejection (CMR) for NEGATIVELY sloped common mode transients but requires $t_{PHL} > t_{PLH}$ for proper operation. A NOR flip-flop has infinite CMR for POSITIVELY sloped transients but requires $t_{PHL} < t_{PLH}$ for proper operation. An exclusive-OR flip-flop has infinite CMR for common mode transients of EITHER polarity and operates with either $t_{PHL} > t_{PLH}$ or $t_{PHL} < t_{PLH}$.

With the line driver and transmission line shown in Figure (c), $t_{PHL} > t_{PLH}$, so NAND gates are preferred in the R-S flip-flop. A higher drive amplitude or different circuit configuration could make $t_{PHL} < t_{PLH}$, in which case NOR gates would be preferred. If it is not known whether $t_{PHL} > t_{PLH}$ or $t_{PHL} < t_{PLH}$, or if the drive conditions may vary over the boundary for these conditions, the exclusive-OR flip-flop of Figure (d) should be used.

RS-422 and RS-423

Line drivers designed for RS-422 and RS-423 generally provide adequate voltage and current for operating the HCPL-2602. Most drivers also have characteristics allowing the HCPL-2602 to be connected directly to the driver terminals. Worst case drive conditions, however, would require current shunting to prevent overstress of the HCPL-2602.

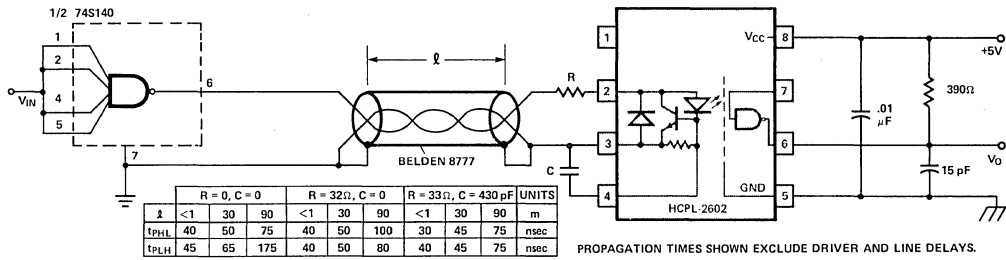


Figure a. Polarity Non-Reversing.

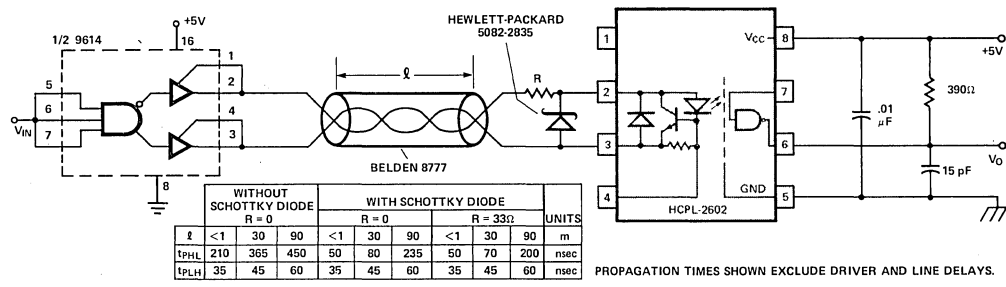


Figure b. Polarity Reversing, Single Ended.

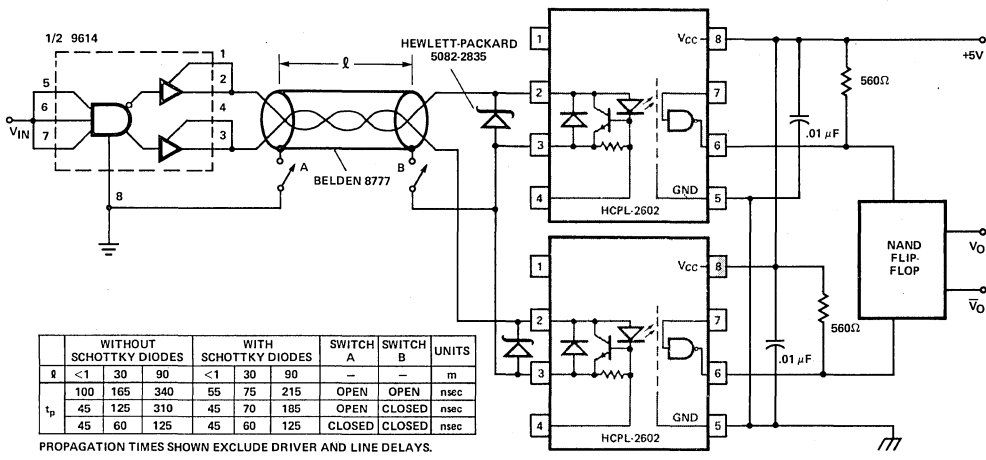
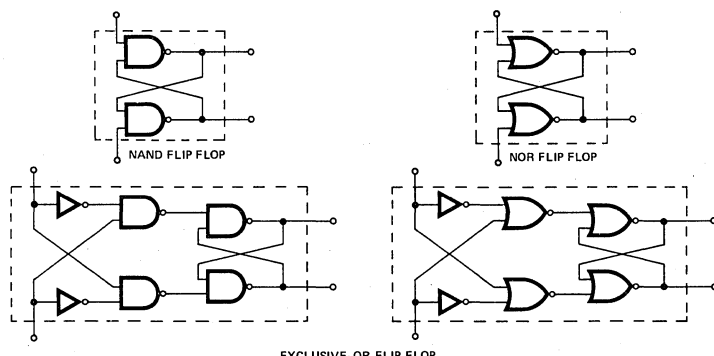


Figure c. Polarity Reversing, Split Phase.



NAND flip flop tolerates simultaneously HIGH inputs; NOR flip flop tolerates simultaneously LOW inputs; EXCLUSIVE-OR flip flop tolerates simultaneously HIGH OR LOW inputs without causing either of the outputs to change.

Figure d. Flip Flop Configurations.

Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level	I_{IL}	0	250	μA
Input Current, High Level	I_{IH}	5	60	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
High Level Enable Voltage	V_{EH}	2.0	5.5	V
Low Level Enable Voltage	V_{EL}	0	0.8	V
Fan Out (TTL Load)	N		8	
Operating Temperature	T_A	0	70	$^{\circ}\text{C}$

Absolute Maximum Ratings

Storage Temperature -55°C to $+125^{\circ}\text{C}$
 Operating Temperature 0°C to $+70^{\circ}\text{C}$
 Lead Solder Temperature 260°C for 10 s
 (1.6mm below seating plane)

Forward Input Current — I_I 60 mA
 Reverse Input Current 60 mA
 Supply Voltage — V_{CC} 7 V
 Enable Input Voltage — V_E 5.5 V
 (Not to exceed V_{CC} by more than 50 mV)
 Output Collector Current — I_O 25 mA
 Output Collector Power Dissipation 40 mW
 Output Collector Voltage — V_O 7 V
 Input Current, Pin 4 $\pm 10\text{ mA}$

NOTES:

- By-passing of the power supply line is required, with a $0.01\ \mu\text{F}$ ceramic disc capacitor adjacent to each isolator as illustrated in Figure 15. The power supply bus for the isolator(s) should be separate from the bus for any active loads, otherwise a larger value of bypass capacitor (up to $0.1\ \mu\text{F}$) may be needed to suppress regenerative feedback via the power supply.
- The HCPL-2602 is tested such that operation at I_I minimum of 5 mA will provide the user a minimum of 20% guardband for LED light output degradation.
- Device considered a two terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.
- The t_{PH} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5 V point on the trailing edge of the output pulse.
- The t_{PL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5 V point on the leading edge of the output pulse.
- The t_{ELH} enable propagation delay is measured from the 1.5 V point on the trailing edge of the enable input pulse to the 1.5 V point on the trailing edge of the output pulse.
- The t_{EHL} enable propagation delay is measured from the 1.5 V point on the leading edge of the enable input pulse to the 1.5 V point on the leading edge of the output pulse.
- CM_{HI} is the maximum tolerable rate of rise of the common mode voltage to assure that the output will remain in a high logic state (i.e., $V_{OUT} > 2.0\text{ V}$).
- CM_{LI} is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (i.e., $V_{OUT} < 0.8\text{ V}$).
- For sinusoidal voltages, $\left(\frac{dv_{CM}}{dt}\right)_{max} = \pi f_{CM} V_{CM} (p-p)$
- No external pull up is required for a high logic state on the enable input.

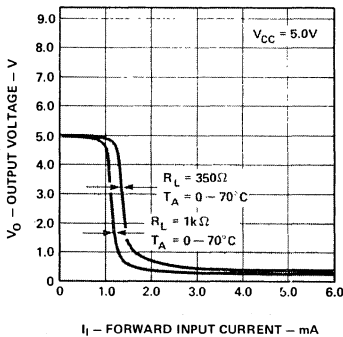


Figure 2. Output Voltage vs. Forward Input Current.

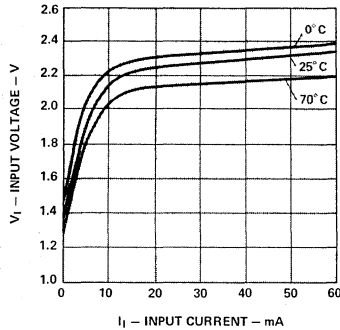


Figure 3. Input Characteristics.

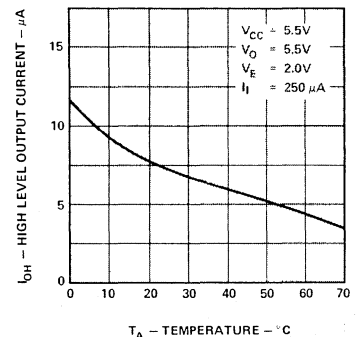


Figure 4. High Level Output Current vs. Temperature.

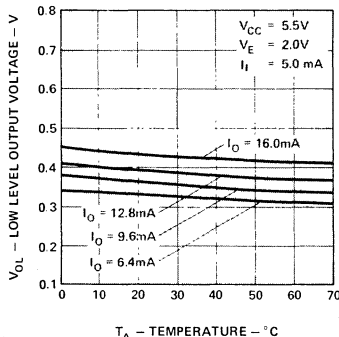


Figure 5. Low Level Output Voltage vs. Temperature.

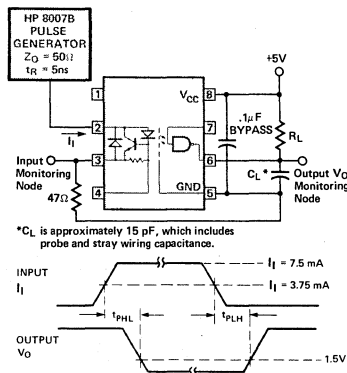


Figure 6. Test Circuit for t_{PHL} and t_{PLH} .

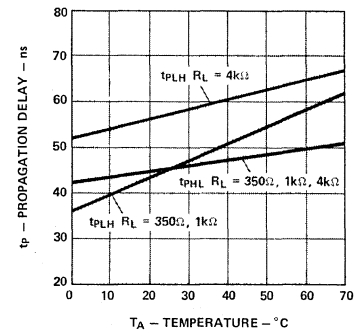


Figure 7. Propagation Delay vs. Temperature.

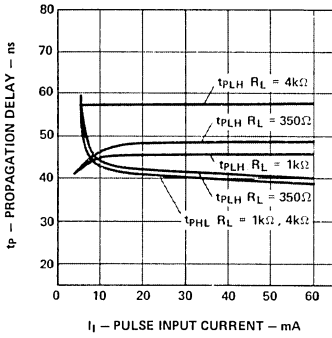


Figure 8. Propagation Delay vs. Pulse Input Current.

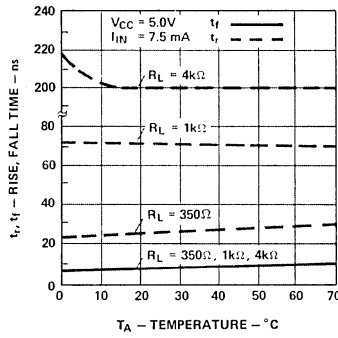


Figure 9. Rise, Fall Time vs. Temperature.

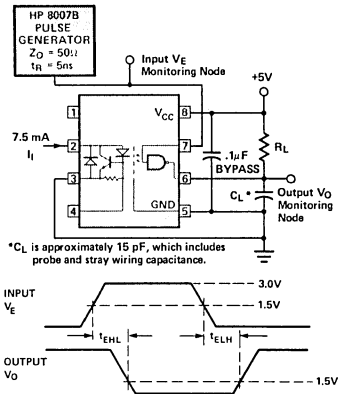


Figure 10. Test Circuit for t_{EHL} and t_{ELH} .

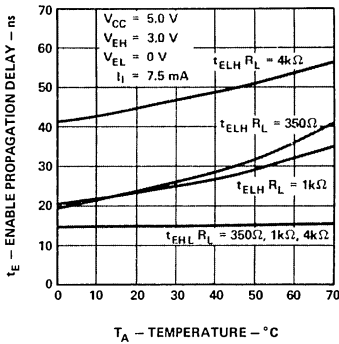


Figure 11. Enable Propagation Delay vs. Temperature.

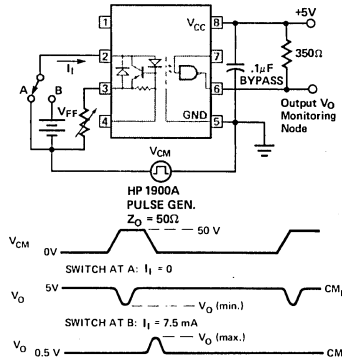


Figure 12. Test Circuit for Common Mode Transient Immunity and Typical Waveforms.

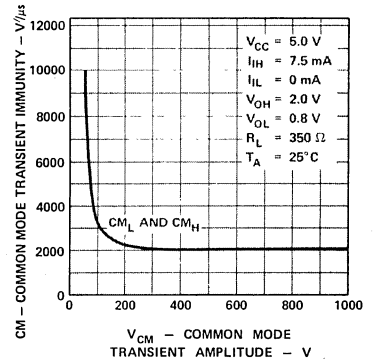


Figure 13. Common Mode Transient Immunity vs. Common Mode Transient Amplitude.

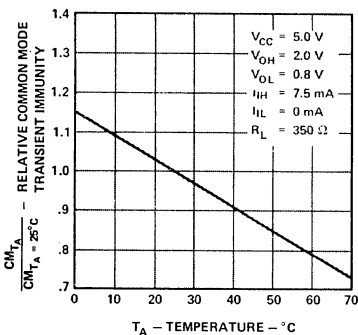


Figure 14. Relative Common Mode Transient Immunity vs. Temperature.

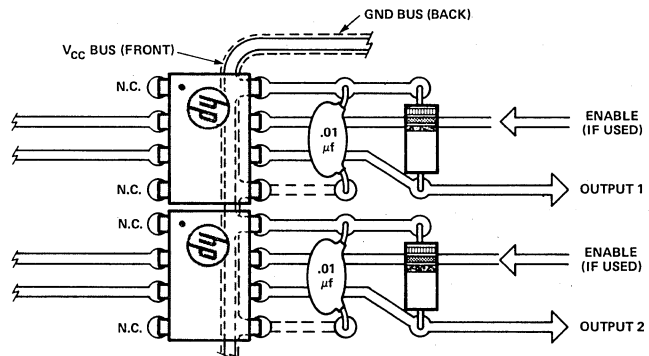
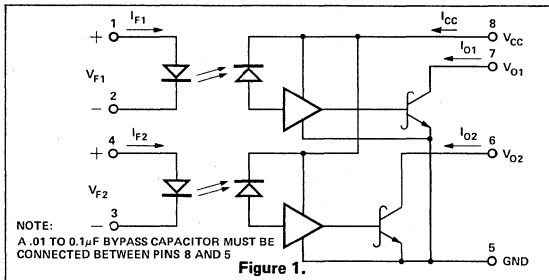


Figure 15. Recommended Printed Circuit Board Layout.

DUAL DTL/TTL COMPATIBLE OPTICALLY COUPLED GATE

HCPL-2630
(5082-4364)

TECHNICAL DATA APRIL 1978



Features

- HIGH DENSITY PACKAGING
- DTL/TTL COMPATIBLE: 5V SUPPLY
- ULTRA HIGH SPEED
- LOW INPUT CURRENT REQUIRED
- HIGH COMMON MODE REJECTION
- GUARANTEED PERFORMANCE OVER TEMPERATURE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)
- 3000Vdc INSULATION VOLTAGE

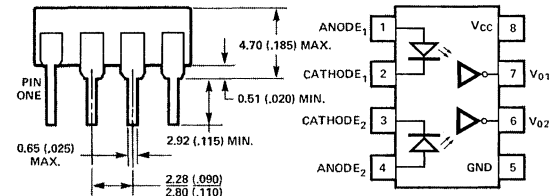
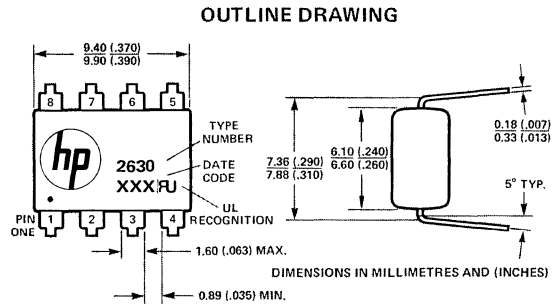
Description / Applications

The HCPL-2630 consists of a pair of inverting optically coupled gates each with a GaAsP photon emitting diode and a unique integrated detector. The photons are collected in the detector by a photodiode and then amplified by a high gain linear amplifier that drives a Schottky clamped open collector output transistor. Each circuit is temperature, current and voltage compensated.

This unique dual isolator design provides maximum DC and AC circuit isolation between each input and output while achieving DTL/TTL circuit compatibility. The isolator operational parameters are guaranteed from 0°C to 70°C, such that a minimum input current of 5 mA in each channel will sink an eight gate fan-out (13 mA) at the output with 5 volt V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 50 nsec.

The HCPL-2630 can be used in high speed digital interface applications where common mode signals must be rejected such as for a line receiver and digital programming of floating power supplies, motors, and other machine control systems. The elimination of ground loops can be accomplished between system interfaces such as between a computer and a peripheral memory, printer, controller, etc.

The open collector output provides capability for bussing, strobing and "WIRED-OR" connection. In all applications, the dual channel configuration allows for high density packaging, increased convenience and more usable board space.



Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level Each Channel	I _{FL}	0	250	μ A
Input Current, High Level Each Channel	I _{FH}	6.3*	10	mA
Supply Voltage, Output Fan Out (TTL Load)	V _{CC}	4.5	5.5	V
Each Channel	N		8	
Operating Temperature	T _A	0	70	°C

Absolute Maximum Ratings

(No derating required up to 70°C)

Storage Temperature	-55°C to +125°C
Operating Temperature	0°C to +70°C
Lead Solder Temperature	260°C for 10s (1.6mm below seating plane)

Peak Forward Input

Current (each channel)	20 mA (\leq 1 msec Duration)
Average Forward Input Current (each channel)	10 mA
Reverse Input Voltage (each channel)	5V
Supply Voltage - V _{CC}	7V (1 Minute Maximum)
Output Current - I _O (each channel)	16 mA
Output Voltage - V _O (each channel)	7V
Output Collector Power Dissipation	60 mW

*6.3mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5mA or less.

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE ($T_A = 0^\circ\text{C}$ TO 70°C) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		50	250	μA	$V_{CC} = 5.5\text{V}$, $V_O = 5.5\text{V}$, $I_F = 250\mu\text{A}$		3
Low Level Output Voltage	V_{OL}		0.5	0.6	V	$V_{CC} = 5.5\text{V}$, $I_F = 5\text{mA}$ I_{OL} (Sinking) = 13mA	3	3
High Level Supply Current	I_{CCH}		14	30	mA	$V_{CC} = 5.5\text{V}$, $I_F = 0$ (Both Channels)		
Low Level Supply	I_{CCL}		26	36	mA	$V_{CC} = 5.5\text{V}$, $I_F = 10\text{mA}$ (Both Channels)		
Input - Output Insulation Leakage Current	I_{I-O}			1.0	μA	Relative Humidity = 45% $T_A = 25^\circ\text{C}$, $t = 5\text{s}$, $V_{I-O} = 3000\text{Vdc}$		4
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500\text{V}$, $T_A = 25^\circ\text{C}$		4
Capacitance (Input-Output)	C_{I-O}		0.6		pF	$f = 1\text{MHz}$, $T_A = 25^\circ\text{C}$		4
Input Forward Voltage	V_F		1.5	1.75	V	$I_F = 10\text{mA}$, $T_A = 25^\circ\text{C}$	4	7,3
Input Reverse Breakdown Voltage	BV_R	5			-V	$I_R = 10\mu\text{A}$, $T_A = 25^\circ\text{C}$		
Input Capacitance	C_{IN}		60		pF	$V_F = 0$, $f = 1\text{MHz}$		3
Input-Input Insulation Leakage Current	I_{I-I}		0.005		μA	Relative Humidity = 45%, $t=5\text{s}$, $V_{I-I}=500\text{V}$		8
Resistance (Input-Input)	R_{I-I}		10^{11}		Ω	$V_{I-I} = 500\text{V}$		8
Capacitance (Input-Input)	C_{I-I}		0.25		pF	$f = 1\text{MHz}$		8
Current Transfer Ratio	CTR		700		%	$I_F = 5.0\text{mA}$, $R_L = 100\Omega$	2	6

*All typical values are at $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$

Switching Characteristics at $T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$

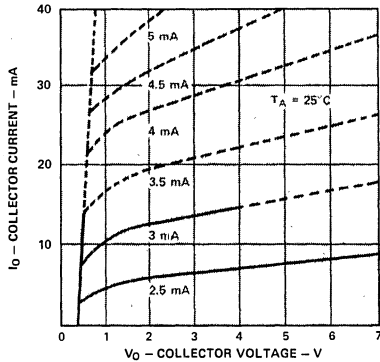
EACH CHANNEL

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}		55	75	ns	$R_L = 350\Omega$, $C_L = 15\text{pF}$, $I_F = 7.5\text{mA}$	5,6	1
Propagation Delay Time to Low Output Level	t_{PHL}		40	75	ns	$R_L = 350\Omega$, $C_L = 15\text{pF}$, $I_F = 7.5\text{mA}$	5,6	2
Output Rise-Fall Time (10-90%)	t_r , t_f		25		ns	$R_L = 350\Omega$, $C_L = 15\text{pF}$, $I_F = 7.5\text{mA}$		
Common Mode Transient Immunity at High Output Level	CM_H		50		V/ μs	$V_{CM} = 10\text{V}_{p-p}$, $R_L = 350\Omega$, V_O (min.) = 2V, $I_F = 0\text{mA}$	8	5
Common Mode Transient Immunity at Low Output Level	CM_L		-150		V/ μs	$V_{CM} = 10\text{V}_{p-p}$, $R_L = 350\Omega$, V_O (max.) = 0.8V $I_F = 7.5\text{mA}$	8	5

NOTE: It is essential that a bypass capacitor (.01 μF to 0.1 μF , ceramic) be connected from pin 8 to pin 5. Total lead length between both ends of the capacitor and the isolator pins should not exceed 20mm. Failure to provide the bypass may impair the switching properties.

NOTES:

1. The t_{PLH} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The t_{PHL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
3. Each channel.
4. Measured between pins 1, 2, 3, and 4 shorted together, and pins 5, 6, 7, and 8 shorted together.
5. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM} , to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
6. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
7. At 10mA VF decreases with increasing temperature at the rate of 1.9mV/°C.
8. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.



NOTE: Dashed characteristics indicate pulsed operation.

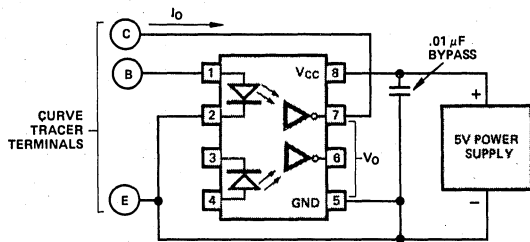


Figure 2. Isolator Transfer Characteristics.

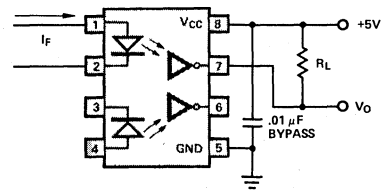
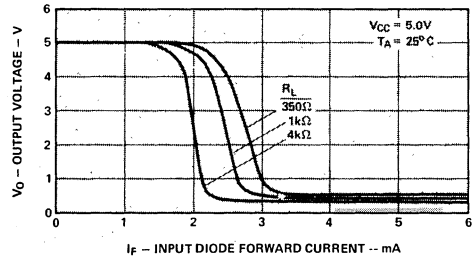


Figure 3. Input-Output Characteristics.

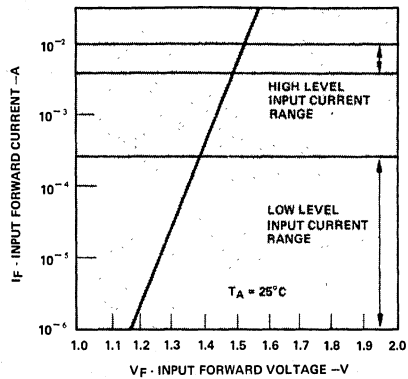
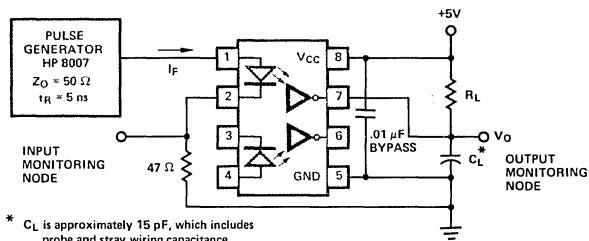


Figure 4. Input Diode Forward Characteristic



* C_L is approximately 15 pF, which includes probe and stray wiring capacitance.

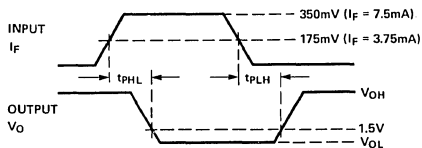


Figure 5. Test Circuit for t_{PHL} and t_{PLH} .

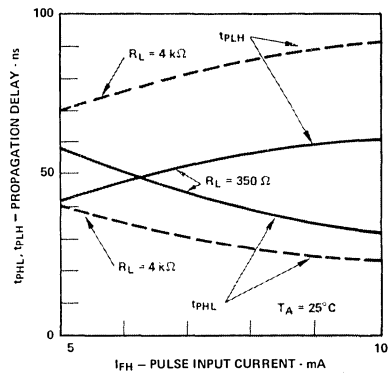


Figure 6. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH} .

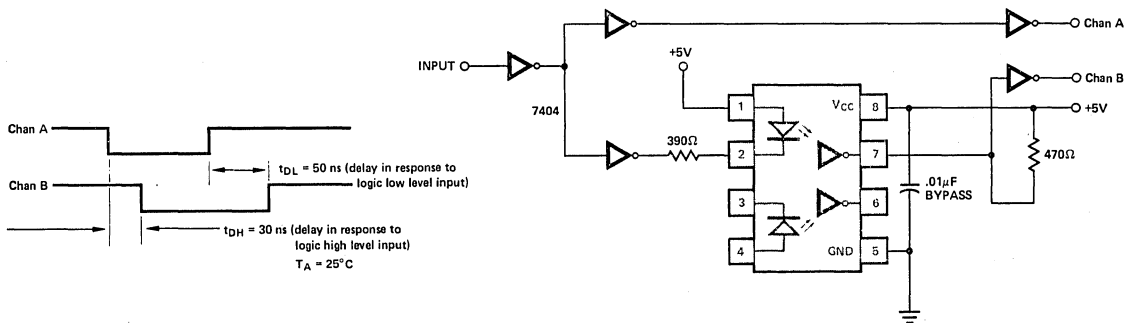


Figure 7. Response Delay Between TTL Gates.

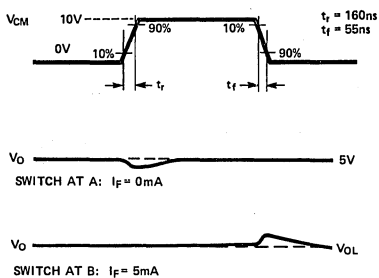
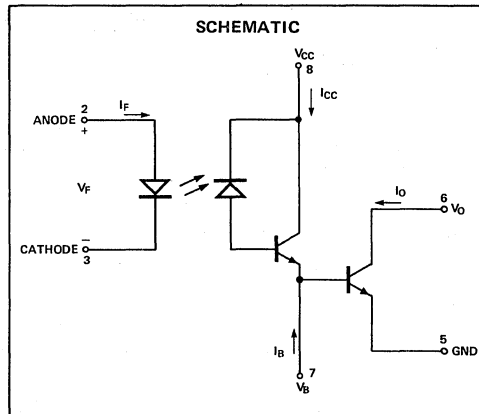
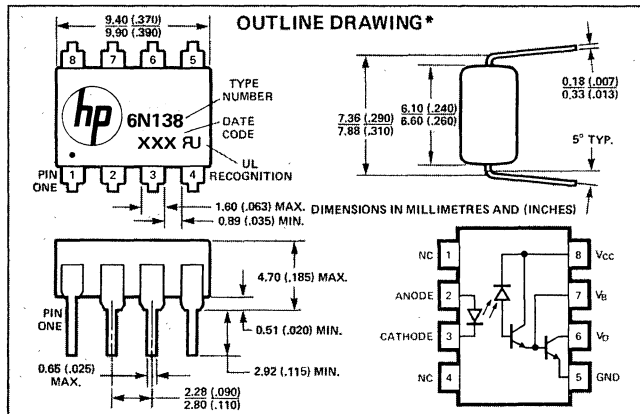


Figure 8. Test Circuit for Transient Immunity and Typical Waveforms.



Features

- HIGH CURRENT TRANSFER RATIO — 800% TYPICAL
- LOW INPUT CURRENT REQUIREMENT — 0.5mA
- TTL COMPATIBLE OUTPUT — 0.1V V_{OL}
- 3000 Vdc INSULATION VOLTAGE
- HIGH COMMON MODE REJECTION — 500V/ μ s
- PERFORMANCE GUARANTEED OVER TEMPERATURE 0°C to 70°C
- BASE ACCESS ALLOWS GAIN BANDWIDTH ADJUSTMENT
- HIGH OUTPUT CURRENT — 60mA
- DC TO 1M bit/s OPERATION
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)

Applications

- Ground Isolate Most Logic Families — TTL/TTL, CMOS/TTL, CMOS/CMOS, LTTL/TTL, CMOS/LTTL
- Low Input Current Line Receiver — Long Line or Partyline
- EIA RS-232C Line Receiver
- Telephone Ring Detector
- 117 V ac Line Voltage Status Indicator — Low Input Power Dissipation
- Low Power Systems — Ground Isolation

Description

These high gain series isolators use a Light Emitting Diode and an integrated high gain photon detector to provide 3000V dc electrical insulation, 500V/ μ s common mode transient immunity and extremely high current transfer ratio between input and output. Separate pins for the photodiode and output stage result in TTL compatible saturation voltages and high speed operation. Where desired the V_{CC} and V_O terminals may be tied together to achieve conventional photodarlington operation. A base access terminal allows a gain bandwidth adjustment to be made.

The 6N139 is suitable for use in CMOS, LTTL or other low power applications. A 400% minimum current transfer ratio is guaranteed over a 0-70°C operating range for only 0.5mA of LED current.

The 6N138 is suitable for use mainly in TTL applications. Current Transfer Ratio is 300% minimum over 0-70°C for an LED current of 1.6mA [1 TTL unit load (U.L.)]. A 300% minimum CTR enables operation with 1 U.L. in, 1 U.L. out with a 2.2 k Ω pull-up resistor.

Absolute Maximum Ratings*

Storage Temperature	.....	-55°C to +125°C
Operating Temperature	.....	0°C to +70°C
Lead Solder Temperature	.....	260°C for 10s (1.6mm below seating plane)
Average Input Current — I_F	.....	20mA [1]
Peak Input Current — I_F	.....	40mA (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F	.....	1.0A ($\leq 1\mu$ s pulse width, 300 pps)
Reverse Input Voltage — V_R	.....	5V
Input Power Dissipation	.....	35mW [2]
Output Current — I_O (Pin 6)	.....	60mA [3]
Emitter-Base Reverse Voltage (Pin 5-7)	.....	0.5V
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 6-5)	.....	5082-4370 -0.5 to 7V 5082-4371 -0.5 to 18V
Output Power Dissipation	.....	100mW [4]

*JEDEC Registered Data.

See notes, following page.

Electrical Specifications

OVER RECOMMENDED TEMPERATURE ($T_A = 0^\circ\text{C}$ to 70°C), UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device	Min.	Typ.**	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR*	6N139	400 500	800 900		%	$I_F = 0.5\text{mA}, V_O = 0.4\text{V}, V_{CC} = 4.5\text{V}$ $I_F = 1.6\text{mA}, V_O = 0.4\text{V}, V_{CC} = 4.5\text{V}$	3	5,6
		6N138	300	600		%	$I_F = 1.6\text{mA}, V_O = 0.4\text{V}, V_{CC} = 4.5\text{V}$		
Logic Low Output Voltage	V_{OL}	6N139		0.1 0.1 0.2	0.4 0.4 0.4	V	$I_F = 1.6\text{mA}, I_O = 6.4\text{mA}, V_{CC} = 4.5\text{V}$ $I_F = 5\text{mA}, I_O = 15\text{mA}, V_{CC} = 4.5\text{V}$ $I_F = 12\text{mA}, I_O = 24\text{mA}, V_{CC} = 4.5\text{V}$	1,2	6
		6N138		0.1	0.4	V	$I_F = 1.6\text{mA}, I_O = 4.8\text{mA}, V_{CC} = 4.5\text{V}$		
Logic High Output Current	I_{OH}^*	6N139		0.05	100	μA	$I_F = 0\text{mA}, V_O = V_{CC} = 18\text{V}$		6
		6N138		0.1	250	μA	$I_F = 0\text{mA}, V_O = V_{CC} = 7\text{V}$		
Logic Low Supply Current	I_{CCL}			0.2		mA	$I_F = 1.6\text{mA}, V_O = \text{Open}, V_{CC} = 5\text{V}$		6
Logic High Supply Current	I_{CCH}			10		nA	$I_F = 0\text{mA}, V_O = \text{Open}, V_{CC} = 5\text{V}$		6
Input Forward Voltage	V_F^*			1.4	1.7	V	$I_F = 1.6\text{mA}, T_A = 25^\circ\text{C}$	4	
Input Reverse Breakdown Voltage	BV_R^*		5			V	$I_R = 10\mu\text{A}, T_A = 25^\circ\text{C}$		
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		$\text{mV}/^\circ\text{C}$	$I_F = 1.6\text{mA}$		
Input Capacitance	C_{IN}			60		pF	$f = 1\text{MHz}, V_F = 0$		
Input - Output Insulation Leakage Current	I_{I-O}^*				1.0	μA	45% Relative Humidity, $T_A = 25^\circ\text{C}$ $t = 5\text{s}, V_{I-O} = 3000\text{Vdc}$		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	$V_{I-O} = 500\text{Vdc}$		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	$f = 1\text{MHz}$		7

**All typicals at $T_A = 25^\circ\text{C}$ and $V_{CC} = 5\text{V}$, unless otherwise noted.

Switching Specifications

AT $T_A = 25^\circ\text{C}$

Parameter	Sym.	Device	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}^*	6N139		5 0.2	25 1	μs	$I_F = 0.5\text{mA}, R_L = 4.7\text{k}\Omega$ $I_F = 12\text{mA}, R_L = 270\Omega$	9	6,8
		6N138		1	10	μs	$I_F = 1.6\text{mA}, R_L = 2.2\text{k}\Omega$		
Propagation Delay Time To Logic High at Output	t_{PLH}^*	6N139		5 1	60 7	μs	$I_F = 0.5\text{mA}, R_L = 4.7\text{k}\Omega$ $I_F = 12\text{mA}, R_L = 270\Omega$	9	6,8
		6N138		4	35	μs	$I_F = 1.6\text{mA}, R_L = 2.2\text{k}\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H			500		$\text{V}/\mu\text{s}$	$I_F = 0\text{mA}, R_L = 2.2\text{k}\Omega, R_{CC} = 0$ $|V_{cm}| = 10\text{V}_{p-p}$	10	9,10
Common Mode Transient Immunity at Logic Low Level Output	CM_L			-500		$\text{V}/\mu\text{s}$	$I_F = 1.6\text{mA}, R_L = 2.2\text{k}\Omega, R_{CC} = 0$ $|V_{cm}| = 10\text{V}_{p-p}$	10	9,10

NOTES:

- Derate linearly above 50°C free-air temperature at a rate of $0.4\text{mA}/^\circ\text{C}$.
- Derate linearly above 50°C free-air temperature at a rate of $0.7\text{mW}/^\circ\text{C}$.
- Derate linearly above 25°C free-air temperature at a rate of $0.7\text{mA}/^\circ\text{C}$.
- Derate linearly above 25°C free-air temperature at a rate of $2.0\text{mW}/^\circ\text{C}$.
- DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.
- Pin 7 Open.
- Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
- Use of a resistor between pin 5 and 7 will decrease gain and delay time. See Application Note 951-1 for more details.
- Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{cm} , to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0\text{V}$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8\text{V}$).
- In applications where dV/dt may exceed $50,000\text{V}/\mu\text{s}$ (such as static discharge) a series resistor, R_{CC} , should be included to protect the detector IC from destructively high surge currents. The recommended value is $R_{CC} \approx \frac{1\text{V}}{0.15 I_F (\text{mA})} \text{k}\Omega$.

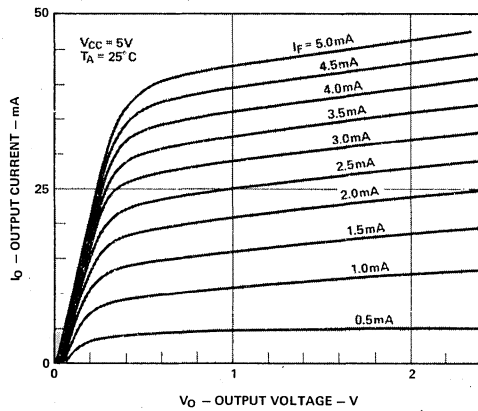


Figure 1. 6N139 DC Transfer Characteristics.

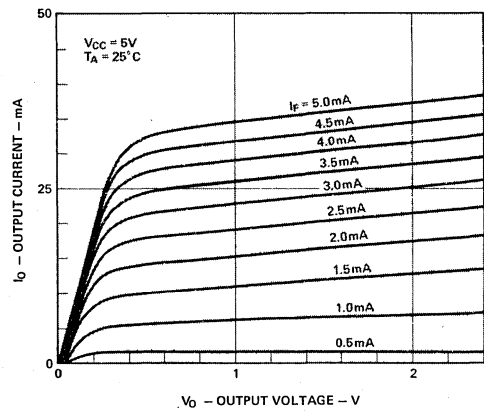


Figure 2. 6N138 DC Transfer Characteristics.

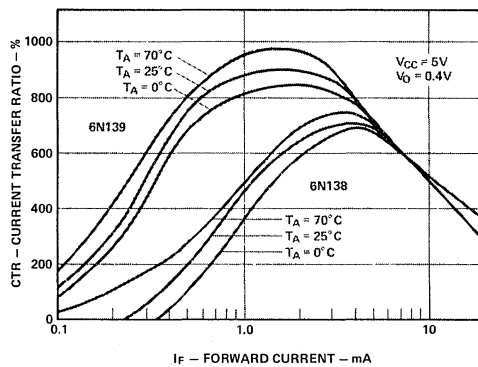


Figure 3. Current Transfer Ratio vs. Forward Current.

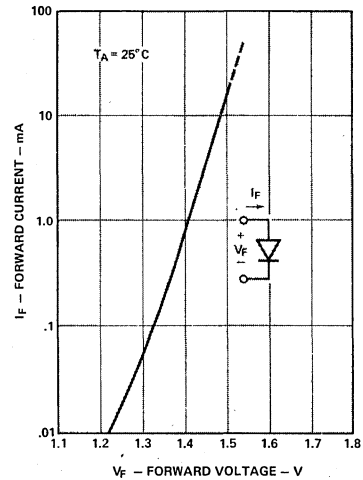


Figure 4. Input Diode Forward Current vs. Forward Voltage.

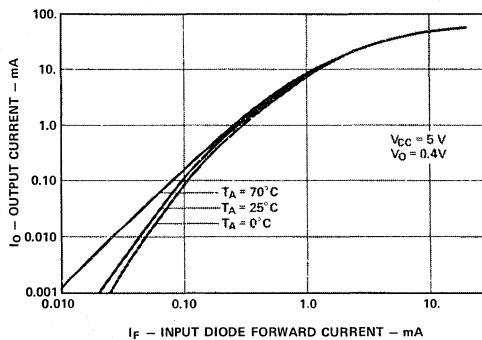


Figure 5. 6N139 Output Current vs. Input Diode Forward Current.

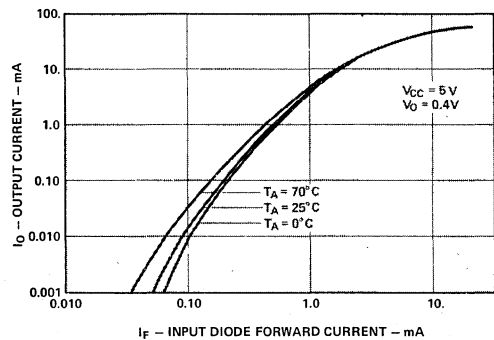


Figure 6. 6N138 Output Current vs. Input Diode Forward Current.

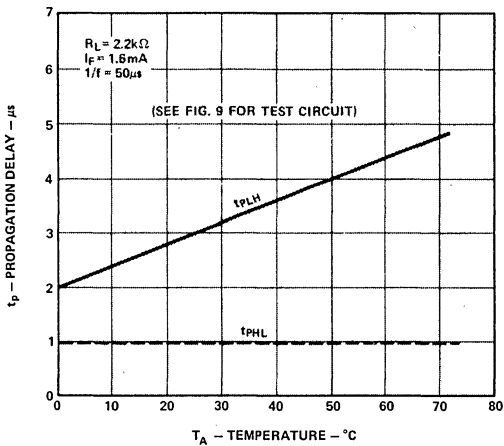


Figure 7. Propagation Delay vs. Temperature.

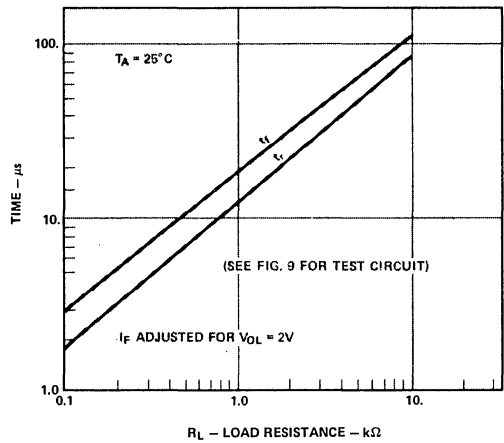


Figure 8. Non Saturated Rise and Fall Times vs. Load Resistance.

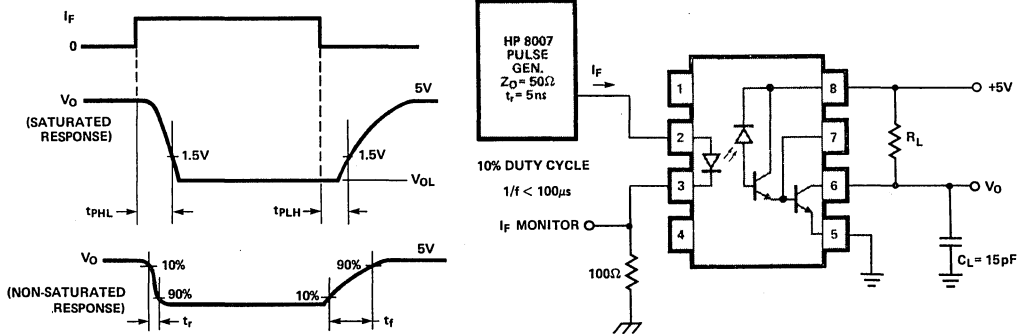


Figure 9. Switching Test Circuit.*

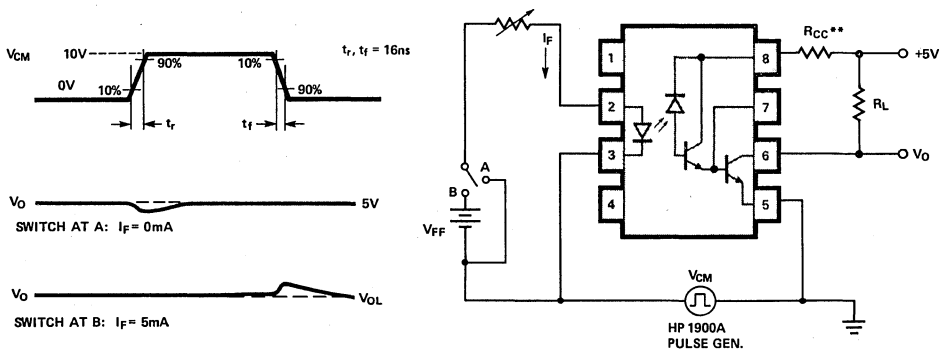
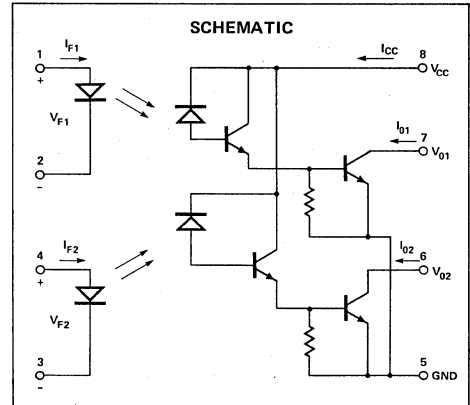
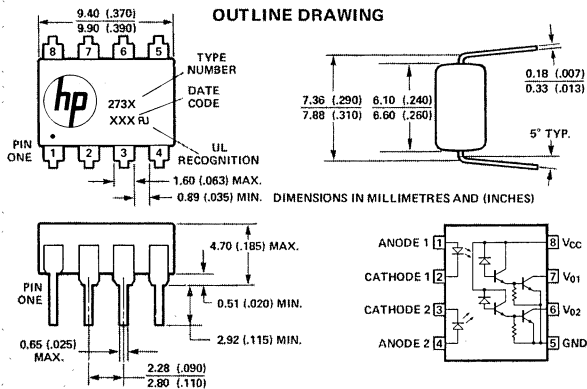


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

DUAL LOW INPUT CURRENT, HIGH GAIN OPTICALLY COUPLED ISOLATORS

HCPL-2730
HCPL-2731

TECHNICAL DATA APRIL 1978



Features

- HIGH CURRENT TRANSFER RATIO — 1000% TYPICAL
- LOW INPUT CURRENT REQUIREMENT — 0.5 mA
- LOW OUTPUT SATURATION VOLTAGE — 1.0V TYPICAL
- HIGH DENSITY PACKAGING
- 3000V DC INSULATION VOLTAGE
- PERFORMANCE GUARANTEED OVER 0°C TO 70°C TEMPERATURE RANGE
- HIGH COMMON MODE REJECTION
- DATA RATES UP TO 200K BIT/s
- HIGH FANOUT
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361).

Applications

- Digital Logic Ground Isolation
- Telephone Ring Detector
- EIA RS-232C Line Receiver
- Low Input Current Line Receiver — Long Line or Partyline
- Microprocessor Bus Isolation
- Current Loop Receiver
- Polarity Sensing
- Level Shifting
- Line Voltage Status Indicator — Low input Power Dissipation

Description

The HCPL-2730/31 dual channel isolators contain a separated pair of GaAsP light emitting diodes optically coupled to a pair of integrated high gain photon detectors. They provide extremely high current transfer ratio, 3000V dc electrical insulation and excellent input-output common mode transient immunity. A separate pin for the photodiodes and first gain stages (V_{CC}) permits lower output saturation voltage and higher speed operation than possible with conventional photodarlington type isolators. The separate V_{CC} pin can be strobed low as an output disable. In addition V_{CC} may be as low as 1.6V without adversely affecting the parametric performance.

Guaranteed operation at low input currents and the high current transfer ratio (CTR) reduce the magnitude and effects of CTR degradation.

The outstanding high temperature performance of this split Darlington type output amplifier results from the inclusion of an integrated emitter-base bypass resistor which shunts photodiode and first stage leakage currents to ground.

The HCPL-2731 has a 400% minimum CTR at an input current of only 0.5 mA making it ideal for use in low input current applications such as MOS, CMOS and low power logic interfacing or RS232C data transmission systems. In addition, the high CTR and high output current capability make this device extremely useful in applications where a high fanout is required. Compatibility with high voltage CMOS logic systems is guaranteed by the 18V V_{CC} and V_O specifications and by testing output high leakage (I_{OH}) at 18V.

The HCPL-2730 is specified at an input current of 1.6 mA and has a 7V V_{CC} and V_O rating. The 300% minimum CTR allows TTL to TTL interfacing with an input current of only 1.6 mA.

Important specifications such as CTR, leakage current and output saturation voltage are guaranteed over the 0°C to 70°C temperature range to allow trouble-free system operation.

Electrical Specifications

(Over Recommended Temperature $T_A = 0^\circ\text{C}$ to 70°C , Unless Otherwise Specified)

Parameter	Sym.	Device HCPL-	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	2731	400	1000		%	$I_F = 0.5\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$ $I_F = 1.6\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$	2	6,7
		2730	300	1000		%	$I_F = 1.6\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$	2	
Logic Low Output Voltage	V_{OL}	2731		0.1	0.4	V	$I_F = 1.6\text{mA}$, $I_O = 8\text{mA}$, $V_{CC} = 4.5\text{V}$ $I_F = 5\text{mA}$, $I_O = 15\text{mA}$, $V_{CC} = 4.5\text{V}$ $I_F = 12\text{mA}$, $I_O = 24\text{mA}$, $V_{CC} = 4.5\text{V}$	1	6
		2730		0.1	0.4	V	$I_F = 1.6\text{mA}$, $I_O = 4.8\text{mA}$, $V_{CC} = 4.5\text{V}$		
Logic High Output Current	I_{OH}	2731		0.005	100	μA	$I_F = 0\text{mA}$, $V_O = V_{CC} = 18\text{V}$		6
		2730		0.01	250	μA	$I_F = 0\text{mA}$, $V_O = V_{CC} = 7\text{V}$		
Logic Low Supply Current	I_{CCL}	2731		1.2		mA	$I_{F1} = I_{F2} = 1.6\text{mA}$, $V_{CC} = 18\text{V}$ $V_{O1} = V_{O2} = \text{Open}$, $V_{CC} = 7\text{V}$		
		2730		0.9		mA	$V_{CC} = 7\text{V}$		
Logic High Supply Current	I_{CCH}	2731		5		nA	$I_{F1} = I_{F2} = 0\text{mA}$, $V_{CC} = 18\text{V}$ $V_{O1} = V_{O2} = \text{Open}$, $V_{CC} = 7\text{V}$		
		2730		4		nA	$V_{CC} = 7\text{V}$		
Input Forward Voltage	V_F			1.4	1.7	V	$I_F = 1.6\text{mA}$, $T_A = 25^\circ\text{C}$	4	6
Input Reverse Breakdown Voltage	BV_R		5			V	$I_R = 10\ \mu\text{A}$, $T_A = 25^\circ\text{C}$		
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		$\text{mV}/^\circ\text{C}$	$I_F = 1.6\text{mA}$		6
Input Capacitance	C_{IN}			60		pF	$f = 1\text{MHz}$, $V_F = 0$		6
Input-Output Insulation Leakage Current	I_{IO}				1.0	μA	45% Relative Humidity, $T_A = 25^\circ\text{C}$ $t = 5\text{s}$, $V_{IO} = 3000\text{Vdc}$		8
Resistance (Input-Output)	R_{IO}			10^{12}		Ω	$V_{IO} = 500\text{Vdc}$		8
Capacitance (Input-Output)	C_{IO}			0.6		pF	$f = 1\text{MHz}$		8
Input-Input Insulation Leakage Current	I_{II}			0.005		μA	45% Relative Humidity, $t = 5\text{s}$, $V_{II} = 500\text{Vdc}$		9
Resistance (Input-Input)	R_{II}			10^{11}		Ω	$V_{II} = 500\text{Vdc}$		9
Capacitance (Input-Input)	C_{II}			0.25		pF	$f = 1\text{MHz}$		9

*All typicals at $T_A = 25^\circ\text{C}$

Switching Specifications at $T_A = 25^\circ\text{C}$

Parameter	Sym.	Device HCPL-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	2731		25	100	μs	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}\Omega$	9	
		2730/1		5	20	μs	$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}\Omega$ $I_F = 12\text{mA}$, $R_L = 270\Omega$		
Propagation Delay Time To Logic High at Output	t_{PLH}	2731		20	60	μs	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}\Omega$	9	
		2730/1		10	35		$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}\Omega$ $I_F = 12\text{mA}$, $R_L = 270\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H			500		$\text{V}/\mu\text{s}$	$I_F = 0\text{mA}$, $R_L = 2.2\text{k}\Omega$ $|V_{CM}| = 10\text{V}_{P-P}$	10	10,11
Common Mode Transient Immunity at Logic Low Level Output	CM_L			-500		$\text{V}/\mu\text{s}$	$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}\Omega$ $|V_{CM}| = 10\text{V}_{P-P}$	10	10,11

- NOTES: 1. Derate linearly above 50°C free-air temperature at a rate of $0.5\text{mA}/^\circ\text{C}$.
 2. Derate linearly above 50°C free-air temperature at a rate of $0.9\text{mW}/^\circ\text{C}$.
 3. Derate linearly above 35°C free-air temperature at a rate of $0.6\text{mA}/^\circ\text{C}$.
 4. Pin 5 should be the most negative voltage at the detector side.
 5. Derate linearly above 35°C free-air temperature at a rate of $1.7\text{mW}/^\circ\text{C}$. Output power is collector output power plus supply power.
 6. Each channel.
 7. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.
 8. Detector considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
 9. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.

10. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM} , to assure that the output will remain in Logic High state (i.e., $V_O > 2.0\text{V}$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM} dt on the trailing edge of the common mode pulse signal, V_{CM} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8\text{V}$).
 11. In applications where dV/dt may exceed $50,000\text{V}/\mu\text{s}$ (such as a static discharge) a series resistor, R_{CC} , should be included to protect the detector IC from destructively high surge currents. The recommended value is $R_{CC} = \frac{1\text{V}}{0.3 I_F (\text{mA})} \text{ k}\Omega$.

Absolute Maximum Ratings

Storage Temperature -55°C to +125°C
 Operating Temperature -40°C to +85°C
 Lead Solder Temperature 260°C for 10 sec
 (1.6mm below seating plane)
 Average Input Current — I_F
 (each channel) 20 mA^[1]
 Peak Input Current — I_F
 (each channel) 40 mA
 (50% duty cycle, 1 ms pulse width)
 Reverse Input Voltage — V_R
 (each channel) 5V

Input Power Dissipation
 (each channel) 35 mW^[2]
 Output Current — I_O
 (each channel) 60 mA^[3]
 Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 7,6-5)^[4]
 HCPL-2730 -0.5 to 7V
 HCPL-2731 -0.5 to 18V
 Output Power Dissipation
 (each channel) 100 mW^[5]

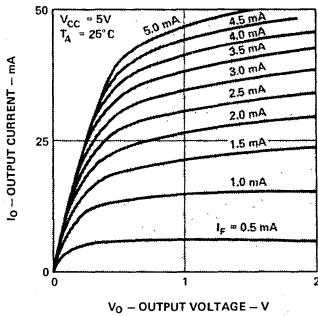


Figure 1. DC Transfer Characteristics.

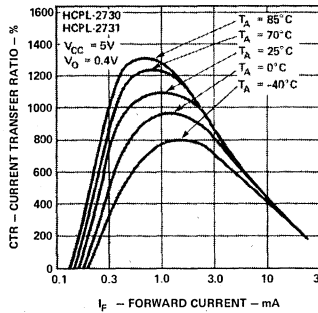


Figure 2. Current Transfer Ratio vs. Forward Current.

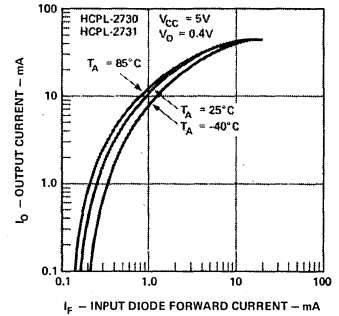


Figure 3. Output Current vs. Input Diode Forward Current.

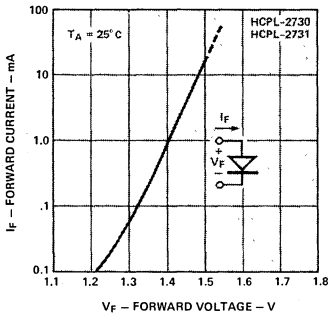


Figure 4. Input Diode Forward Current vs. Forward Voltage.

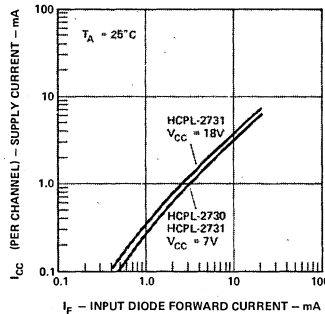


Figure 5. Supply Current Per Channel vs. Input Diode Forward Current.

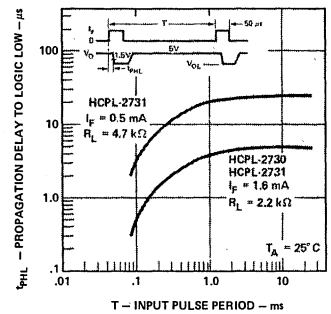


Figure 6. Propagation Delay to Logic Low vs. Pulse Period.

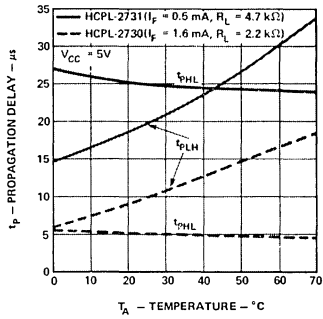


Figure 7. Propagation Delay vs. Temperature.

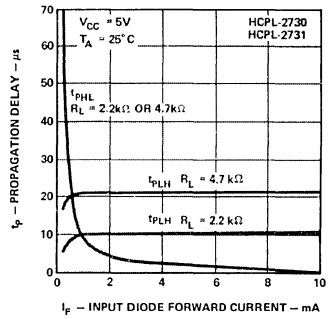


Figure 8. Propagation Delay vs. Input Diode Forward Current.

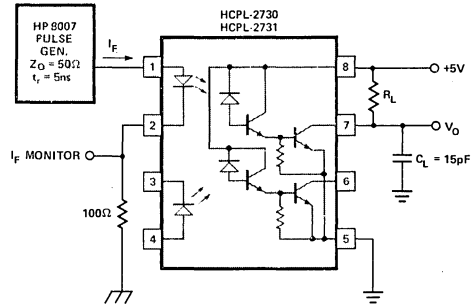
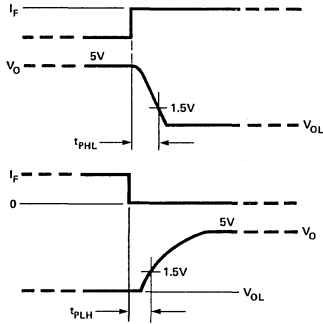
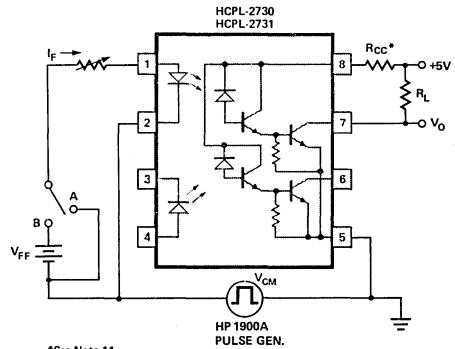
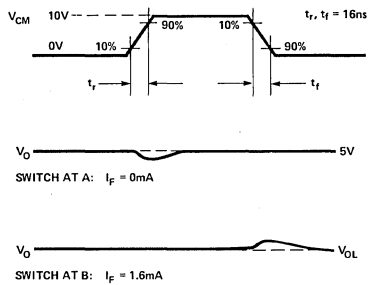
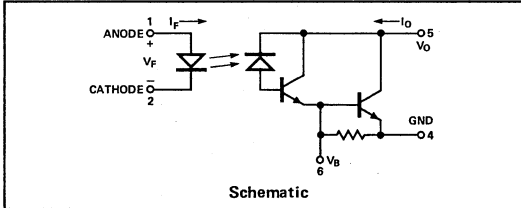


Figure 9. Switching Test Circuit.



*See Note 11.

Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.



Features

- HIGH CURRENT TRANSFER RATIO — 1000% TYPICAL
- LOW INPUT CURRENT REQUIREMENT — 0.5 mA
- 3000 Vdc INSULATION VOLTAGE
- PERFORMANCE GUARANTEED OVER 0°C TO 70°C TEMPERATURE RANGE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES INC. (FILE NO. E55361)
- INTERNAL BASE-EMITTER RESISTOR MINIMIZES OUTPUT LEAKAGE
- GAIN-BANDWIDTH ADJUSTMENT PIN
- HIGH COMMON MODE REJECTION

Description

The 4N45/46 optocouplers contain a GaAsP light emitting diode optically coupled to a high gain photodetector IC.

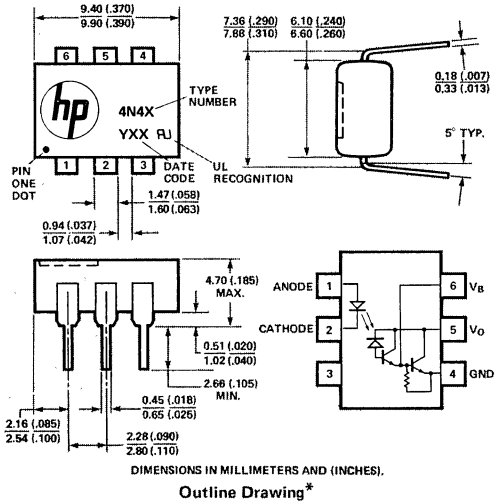
The excellent performance over temperature results from the inclusion of an integrated emitter-base bypass resistor which shunts photodiode and first stage leakage currents to ground. External access to the second stage base provides better noise rejection than a conventional photodarlington detector. An external resistor or capacitor at the base can be added to make a gain-bandwidth or input current threshold adjustment. The base lead can also be used for feedback.

The high current transfer ratio at very low input currents permits circuit designs in which adequate margin can be allowed for the effects of CTR degradation over time.

The 4N46 has a 350% minimum CTR at an input current of only 0.5mA making it ideal for use in low input current applications such as MOS, CMOS and low power logic interfacing. Compatibility with high voltage CMOS logic systems is assured by the 20V minimum breakdown voltage of the output transistor and by the guaranteed maximum output leakage (I_{OH}) at 18V.

The 4N45 has a 250% minimum CTR at 1.0mA input current and a 7V minimum breakdown voltage rating.

*JEDEC Registered Data.



Applications

- Telephone Ring Detector
- Digital Logic Ground Isolation
- Low Input Current Line Receiver
- Line Voltage Status Indicator — Low Input Power Dissipation
- Logic to Reed Relay Interface
- Level Shifting
- Interface Between Logic Families

Absolute Maximum Ratings*

Storage Temperature	.....	-55°C to +125°C
Operating Temperature	.....	-40°C to +70°C
Lead Solder Temperature	.....	260°C for 10 s. (1.6mm below seating plane)
Average Input Current — I_F	.....	20 mA ^[1]
Peak Input Current — I_F	.....	40 mA (50% duty cycle, 1ms pulse width)
Peak Transient Input Current — I_F	.....	1.0A ($\leq 1 \mu s$ pulse width, 300pps)
Reverse Input Voltage — V_R	.....	5V
Input Power Dissipation	.....	35mW ^[2]
Output Current — I_O (Pin 5)	.....	60 mA ^[3]
Emitter-Base Reverse Voltage (Pins 4-6)	.....	0.5V
Output Voltage — V_O (Pin 5-4)	.....
4N45	.....	-0.5 to 7V
4N46	.....	-0.5 to 20V
Output Power Dissipation	.....	100mW ^[4]

See notes, following page

Electrical Specifications

OVER RECOMMENDED TEMPERATURE ($T_A = 0^\circ\text{C}$ TO 70°C), UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device	Min.	Typ.**	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR*	4N46	350 500 200	1500 1500 600		%	$I_F = 0.5\text{mA}$, $V_O = 1.0\text{V}$ $I_F = 1.0\text{mA}$, $V_O = 1.0\text{V}$ $I_F = 10\text{mA}$, $V_O = 1.2\text{V}$	4	5,6
		4N45	250 200	1200 500		%	$I_F = 1.0\text{mA}$, $V_O = 1.0\text{V}$ $I_F = 10\text{mA}$, $V_O = 1.2\text{V}$		
Logic Low Output Voltage	V_{OL}	4N46		.90 .92 .95	1.0 1.0 1.2	V	$I_F = 0.5\text{mA}$, $I_{OL} = 1.75\text{mA}$ $I_F = 1.0\text{mA}$, $I_{OL} = 5.0\text{mA}$ $I_F = 10\text{mA}$, $I_{OL} = 20\text{mA}$	2	6
		4N45		.90 .95	1.0 1.2	V	$I_F = 1.0\text{mA}$, $I_{OL} = 2.5\text{mA}$ $I_F = 10\text{mA}$, $I_{OL} = 20\text{mA}$		
Logic High Output Current	I_{OH}^*	4N46		.001	100	μA	$I_F = 0\text{mA}$, $V_O = 18\text{V}$		6
		4N45		.001	250	μA	$I_F = 0\text{mA}$, $V_O = 5\text{V}$		
Input Forward Voltage	V_F^*			1.4	1.7	V	$I_F = 1.0\text{mA}$, $T_A = 25^\circ\text{C}$	1	
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		$\text{mV}/^\circ\text{C}$	$I_F = 1.0\text{mA}$		
Input Reverse Breakdown Voltage	BV_R^*		5			V	$I_R = 10\mu\text{A}$, $T_A = 25^\circ\text{C}$		
Input Capacitance	C_{IN}			60		pF	$f = 1\text{MHz}$, $V_F = 0$		
Input-Output Insulation Leakage Current	I_{I-O}^*				1.0	μA	45% Relative Humidity, $T_A = 25^\circ\text{C}$ $t = 5\text{ s}$, $V_{I-O} = 3000\text{VDC}$		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	$V_{I-O} = 500\text{VDC}$		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	$f = 1\text{MHz}$		7

Switching Specifications

AT $T_A = 25^\circ\text{C}$

Parameter	Symbol	Min.	Typ.**	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}		80		μs	$I_F = 1.0\text{mA}$, $R_L = 10\text{k}\Omega$	8	6,8
	t_{PHL}^*		5	50	μs	$I_F = 10\text{mA}$, $R_L = 220\Omega$		
Propagation Delay Time To Logic High at Output	t_{PLH}		1500		μs	$I_F = 1.0\text{mA}$, $R_L = 10\text{k}\Omega$	8	6,8
	t_{PLH}^*		150	500	μs	$I_F = 10\text{mA}$, $R_L = 220\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H		500		$\text{V}/\mu\text{s}$	$I_F = 0\text{mA}$, $R_L = 10\text{k}\Omega$ $|V_{cm}| = 10\text{V}_{p-p}$	9	9
Common Mode Transient Immunity at Logic Low Level Output	CM_L		-500		$\text{V}/\mu\text{s}$	$I_F = 1.0\text{mA}$, $R_L = 10\text{k}\Omega$ $|V_{cm}| = 10\text{V}_{p-p}$	9	9

*JEDEC Registered Data.

**All typicals at $T_A = 25^\circ\text{C}$, unless otherwise noted.

NOTES:

- Derate linearly above 50°C free-air temperature at a rate of $0.4\text{mA}/^\circ\text{C}$.
- Derate linearly above 50°C free-air temperature at a rate of $0.7\text{mW}/^\circ\text{C}$.
- Derate linearly above 25°C free-air temperature at a rate of $0.8\text{mA}/^\circ\text{C}$.
- Derate linearly above 25°C free-air temperature at a rate of $1.5\text{mW}/^\circ\text{C}$.
- DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.
- Pin 6 Open.
- Device considered a two-terminal device: Pins 1, 2, 3 shorted together and Pins 4, 5, and 6 shorted together.
- Use of a resistor between pin 4 and 6 will decrease gain and delay time. (See Figures 10 and 12).
- Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{cm} , to assure that the output will remain in a Logic High state (i.e., $V_O > 2.5\text{V}$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm} , to assure that the output will remain in a Logic Low state (i.e., $V_O < 2.5\text{V}$).

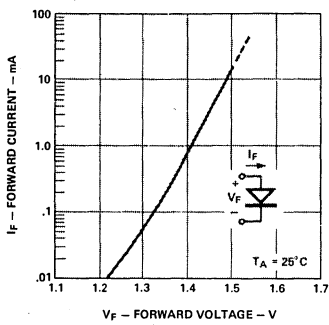


Figure 1. Input Diode Forward Current vs. Forward Voltage.

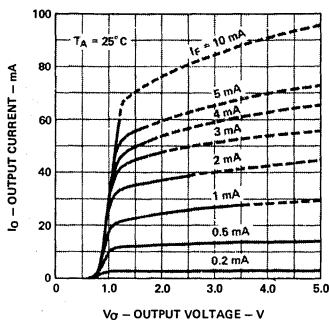


Figure 2. Typical DC Transfer Characteristics.

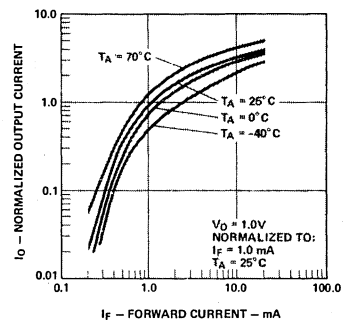


Figure 3. Output Current vs. Input Current.

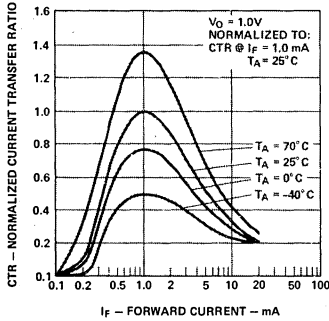


Figure 4. Current Transfer Ratio vs. Input Current.

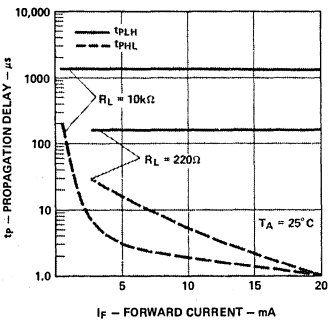


Figure 5. Propagation Delay vs. Forward Current.

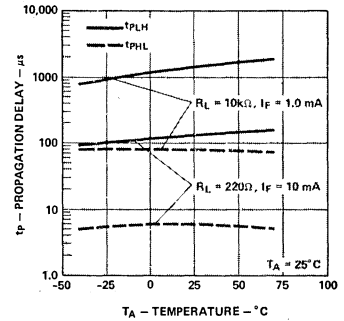


Figure 6. Propagation Delay vs. Temperature.

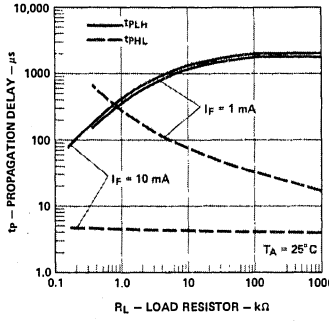


Figure 7. Propagation Delay vs Load Resistor.

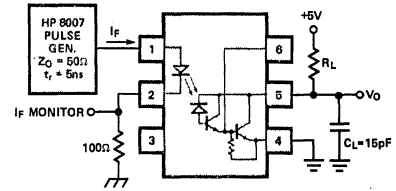
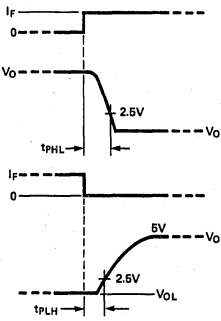


Figure 8. Switching Test Circuit

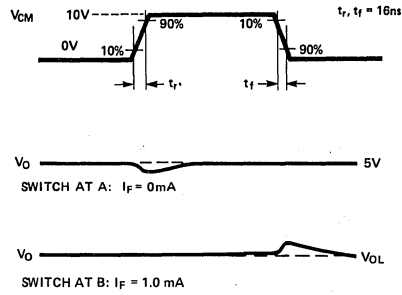
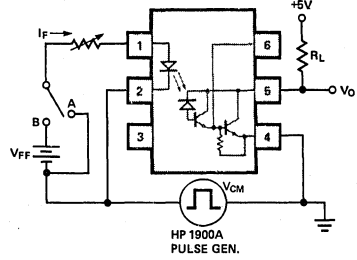


Figure 9. Test Circuit for Transient Immunity and Typical Waveforms.



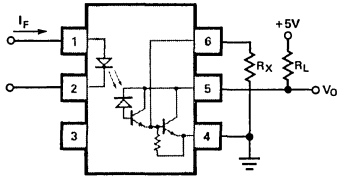


Figure 10. External Base Resistor, R_X

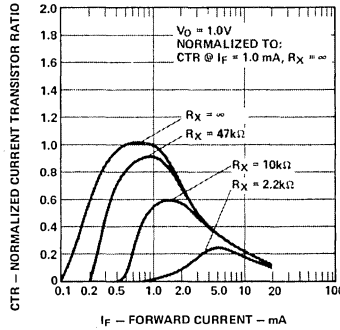


Figure 11. Effect of R_X On Current Transfer Ratio

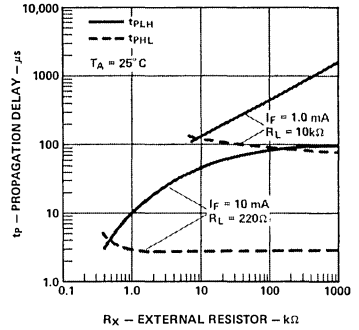
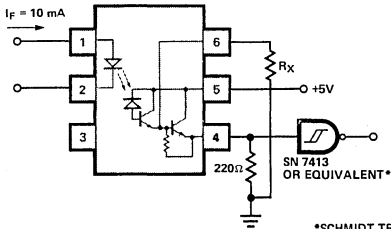


Figure 12. Effect of R_X On Propagation Delay

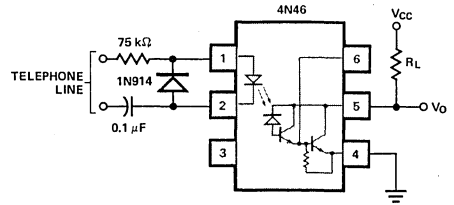
Applications



R_X (k Ω)	t_{PHL} (μ s)	t_{PLH} (μ s)
∞	5	320
100	5	200
47	5	140
20	6	80
10	6	45

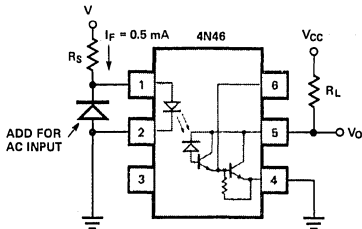
*SCHMITT TRIGGER RECOMMENDED BECAUSE OF LONG t_r , t_f .

TTL Interface



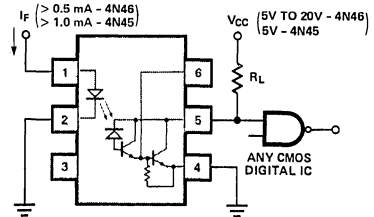
NOTE: AN INTEGRATOR MAY BE REQUIRED AT THE OUTPUT TO ELIMINATE DIALING PULSES AND LINE TRANSIENTS.

Telephone Ring Detector

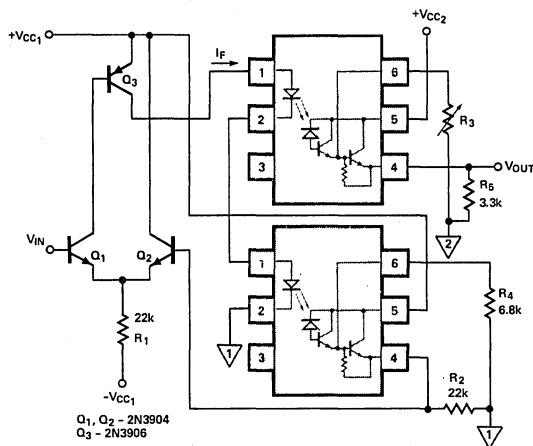


V (Vdc or Vrms)	R_S	V * I_F (mW)
24	47k Ω	11
48	100k Ω	22
115	220k Ω	62
230	470k Ω	113

Line Voltage Monitor



CMOS Interface



Q₁, Q₂ - 2N3904
Q₃ - 2N3906

Analog Signal Isolation

CHARACTERISTICS

$R_{IN} \approx 30M\Omega$, $R_{OUT} = 50\Omega$
 $V_{IN(MAX)} = V_{CC1} - 1V$, LINEARITY BETTER THAN 5%

DESIGN COMMENTS

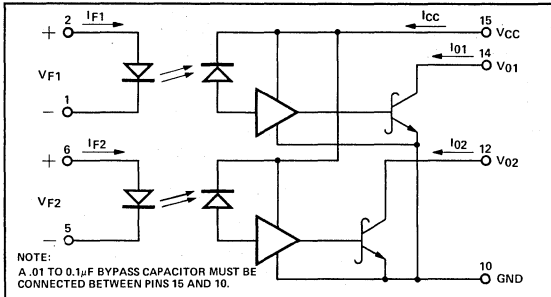
- R₁ - NOT CRITICAL ($\ll V_{IN(MAX)} - (-V_{CC1}) - V_{BE}$)_{HFE Q₃}
- R₂ - NOT CRITICAL (OMIT IF 0.2 TO 0.3V OFFSET IS TOLERABLE)
- $R_4 > \frac{V_{IN(MAX)} + V_{BE}}{1 \text{ mA}}$
- $R_5 > \frac{V_{IN(MAX)}}{2.5 \text{ mA}}$

NOTE: ADJUST R₃ SO $V_{OUT} = V_{IN}$ AT $V_{IN} = \frac{V_{IN(MAX)}}{2}$

DUAL CHANNEL HERMETICALLY SEALED OPTICALLY COUPLED ISOLATOR

6N134 (5082-4365)
6N134 TXV (TX - 4365)
6N134 TXVB (TXB - 4365)

TECHNICAL DATA APRIL 1978



Features

- HERMETICALLY SEALED
- HIGH SPEED
- PERFORMANCE GUARANTEED OVER -55°C TO $+125^{\circ}\text{C}$ AMBIENT TEMPERATURE RANGE
- STANDARD HIGH RELIABILITY SCREENED PARTS AVAILABLE
- TTL COMPATIBLE INPUT AND OUTPUT
- HIGH COMMON MODE REJECTION
- DUAL-IN-LINE PACKAGE
- 1500Vdc INSULATION VOLTAGE
- EIA REGISTRATION
- HIGH RADIATION IMMUNITY

Applications

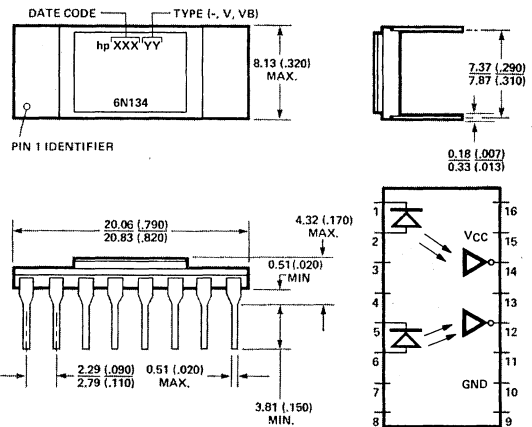
- Logic Ground Isolation
- Line Receiver
- Computer - Peripheral Interface
- Vehicle Command/Control Isolation
- High Reliability Systems
- System Test Equipment Isolation

Description

The 6N134 consists of a pair of inverting optically coupled gates, each with a light emitting diode and a unique high gain integrated photon detector in a hermetically sealed ceramic package. The output of the detector is an open collector Schottky clamped transistor.

This unique dual isolator design provides maximum DC and AC circuit isolation between each input and output while achieving TTL circuit compatibility. The isolator operational parameters are guaranteed from -55°C to $+125^{\circ}\text{C}$, such that a minimum input current of 10 mA in each channel will sink a six gate fanout (10 mA) at the output with 4.5 to 5.5 V V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 55 nsec.

OUTLINE DRAWING*



DIMENSIONS IN MILLIMETRES AND (INCHES).

Recommended Operating Conditions

TABLE I

	Sym.	Min.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0	250	μA
Input Current, High Level Each Channel	I_{FH}	12.5**	20	mA
Supply Voltage Fan Out (TTL Load) Each Channel	V_{CC}	4.5	5.5	V
Operating Temperature	T_A	-55	125	$^{\circ}\text{C}$

Absolute Maximum Ratings*

(No derating required up to 125°C)

Storage Temperature	-65°C to $+150^{\circ}\text{C}$
Operating Temperature	-55°C to $+125^{\circ}\text{C}$
Lead Solder Temperature	260°C for 10s (1.6mm below seating plane)

Peak Forward Input

Current (each channel)	40 mA (≤ 1 ms Duration)
Average Input Forward Current (each channel)	20 mA
Input Power Dissipation (each channel)	35 mW
Reverse Input Voltage (each channel)	5V
Supply Voltage - V_{CC}	7V
Output Current - I_O (each channel)	25 mA
Output Power Dissipation (each channel)	40 mW
Output Voltage - V_O (each channel)	7V
Total Power Dissipation (both channels)	350 mW

**12.5mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 10mA or less.

TABLE II

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE ($T_A = -55^\circ\text{C}$ TO $+125^\circ\text{C}$) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.**	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}^*		5	250	μA	$V_{CC} = 5.5\text{V}$, $V_O = 5.5\text{V}$, $I_F = 250\mu\text{A}$		1
Low Level Output Voltage	V_{OL}^*		0.5	0.6	V	$V_{CC} = 5.5\text{V}$, $I_F = 10\text{mA}$ I_{OL} (Sinking) = 10mA	4	1
High Level Supply Current	I_{CCH}^*		18	28	mA	$V_{CC} = 5.5\text{V}$, $I_F = 0$ (Both Channels)		
Low Level Supply Current	I_{CCL}^*		26	36	mA	$V_{CC} = 5.5\text{V}$, $I_F = 20\text{mA}$ (Both Channels)		
Input Forward Voltage	V_F^*		1.5	1.75	V	$I_F = 20\text{mA}$, $T_A = 25^\circ\text{C}$	1	1
Input Reverse Breakdown Voltage	BV_R^*	5			V	$I_R = 10\mu\text{A}$, $T_A = 25^\circ\text{C}$		
Input Capacitance	C_{IN}		60		pF	$V_F = 0$, $f = 1\text{MHz}$		1
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$		-1.9		mV/ $^\circ\text{C}$	$I_F = 20\text{mA}$		1
Input - Output Insulation Leakage Current	I_{I-O}^*			1.0	μA	$V_{I-O} = 1500\text{Vdc}$, Relative Humidity = 45% $T_A = 25^\circ\text{C}$, $t = 5\text{s}$		2
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500\text{V}$		3
Capacitance (Input-Output)	C_{I-O}		1.7		pF	$f = 1\text{MHz}$		3
Input-Input Insulation Leakage Current	I_{I-I}		0.5		nA	Relative Humidity = 45%, $V_{I-I} = 500\text{V}$, $t = 5\text{s}$		4
Resistance (Input-Input)	R_{I-I}		10^{12}		Ω	$V_{I-I} = 500\text{V}$		4
Capacitance (Input-Input)	C_{I-I}		0.55		pF	$f = 1\text{MHz}$		4

**All typical values are at $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$

TABLE III

Switching Characteristics AT $T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$ EACH CHANNEL

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}^*		65	90	ns	$R_L = 510\Omega$, $C_L = 15\text{pF}$, $I_F = 13\text{mA}$	2,3	5
Propagation Delay Time to Low Output Level	t_{PHL}^*		55	90	ns	$R_L = 510\Omega$, $C_L = 15\text{pF}$, $I_F = 13\text{mA}$	2,3	6
Output Rise-Fall Time (10-90%)	t_r , t_f		35		ns.	$R_L = 510\Omega$, $C_L = 15\text{pF}$, $I_F = 13\text{mA}$		
Common Mode Transient Immunity at High Output Level	CM_H		100		V/ μs	$V_{CM} = 10\text{V}$ (peak), V_O (min.) = 2V, $R_L = 510\Omega$, $I_F = 0\text{mA}$	6	7
Common Mode Transient Immunity at Low Output Level	CM_L		-400		V/ μs	$V_{CM} = 10\text{V}$ (peak), V_O (max.) = 0.8V, $R_L = 510\Omega$, $I_F = 10\text{mA}$	6	8

NOTES:

- Each channel.
- Measured between pins 1 through 8 shorted together and pins 9 through 16 shorted together.
- Measured between pins 1 and 2 or 5 and 6 shorted together, and pins 9 through 16 shorted together.
- Measured between pins 1 and 2 shorted together, and pins 5 and 6 shorted together.
- The t_{PLH} propagation delay is measured from the 6.5mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
- The t_{PHL} propagation delay is measured from the 6.5mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
- CM_H is the max. tolerable common mode transient to assure that the output will remain in a high logic state (i.e., $V_O > 2.0\text{V}$).
- CM_L is the max. tolerable common mode transient to assure that the output will remain in a low logic state (i.e., $V_O < 0.8\text{V}$).
- It is essential that a bypass capacitor (.01 to 0.1 μF , ceramic) be connected from pin 10 to pin 15. Total lead length between both ends of the capacitor and the isolator pins should not exceed 20mm.

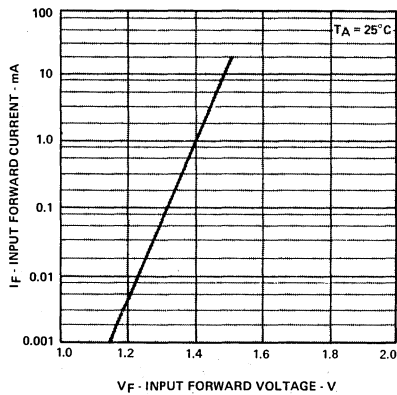
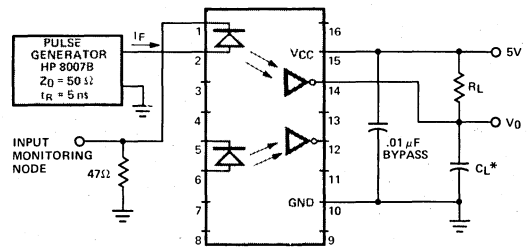


Figure 1. Input Diode Forward Characteristic



* C_L is approximately 15 pF, which includes probe and stray wiring capacitance.

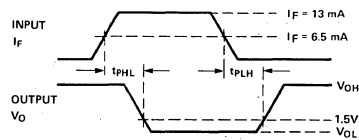


Figure 2. Test Circuit for t_{PHL} and t_{PLH} *

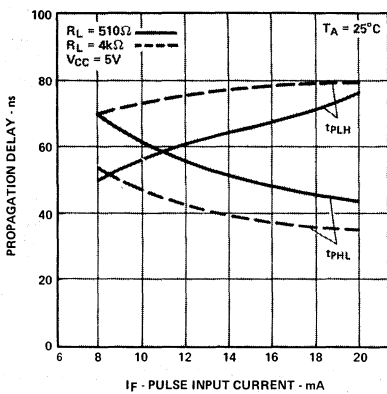


Figure 3. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}

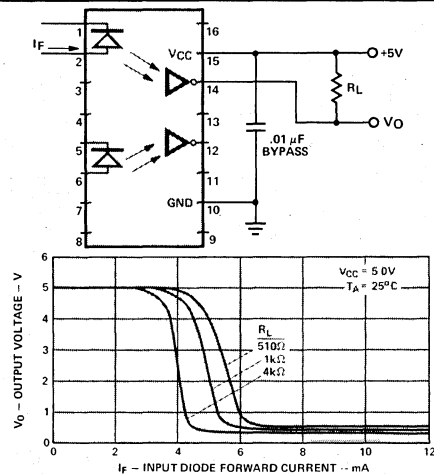


Figure 4. Input-Output Characteristics

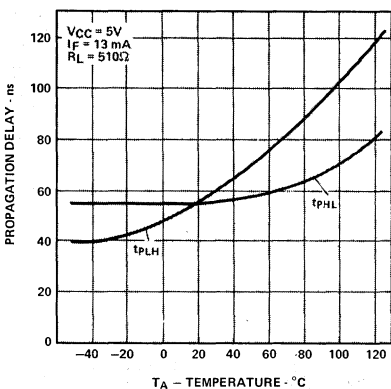


Figure 5. Propagation Delay vs. Temperature

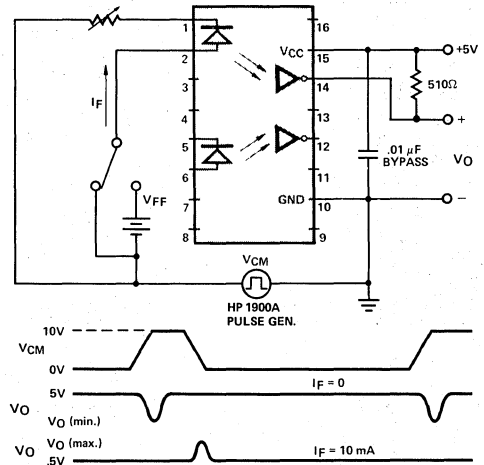


Figure 6. Typical Common Mode Rejection Characteristics/Circuit

High Reliability Test Program

Hewlett Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

- The TXV prefix identifies a part which has been preconditioned and screened per Table IV.
- The TXVB prefix identifies a part which has been preconditioned and screened per Table IV, and comes from a lot which has been subjected to the Group B tests detailed in Table V.

Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
6N134 (5082-4365)	6N134 TXV (TX-4365)	6N134 TXVB (TXB-4365)

TABLE IV TXV Preconditioning and Screening – 100%

Examination or Test	MIL-STD-883	Conditions
	Methods	
1. Pre-Cap Visual Inspection	HP Procedure 72-4063,4	
2. Electrical Test: I_{OH} , V_{OL} , I_{CCH} , I_{CCL} , V_F , BVR , I_{I-O}	1008	Per Table II, $T_A = 25^\circ C$ 168 hrs. @ $150^\circ C$
3. High Temperature Storage	1010	$-65^\circ C$ to $+150^\circ C$
4. Temperature Cycling	2001	$20KG$, Y_1
5. Acceleration	1014	Test Cond. A
6. Helium Leak Test	1014	Test Cond. C
7. Gross Leak Test	1014	Per Table II, $T_A = 25^\circ C$ 168 hrs., $T_A = 125^\circ C$, $V_{CC}=5.5V$, $I_F=13mA$, $I_O=25mA$
8. Electrical Test: V_{OL}	1015	
9. Burn-In	1015	
10. Electrical Test: Same as Step 2		Max. $\Delta V_{OL} = \pm 20\%$
11. Evaluate Drift		Per Table II, LTPD=7
12. Sample Electrical Test: I_{OH} , V_{OL} , I_{CCH} , I_{CCL}		$T_A = -55^\circ C$, $+125^\circ C$
13. Sample Electrical Test: t_{PLH} , t_{PHL}		Per Table II, $T_A=25^\circ C$, LTPD=7
14. External Visual	2009	

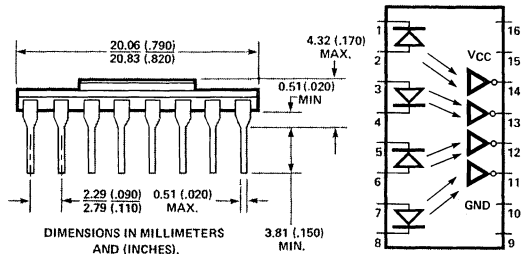
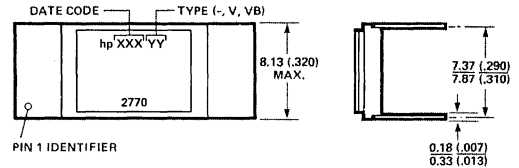
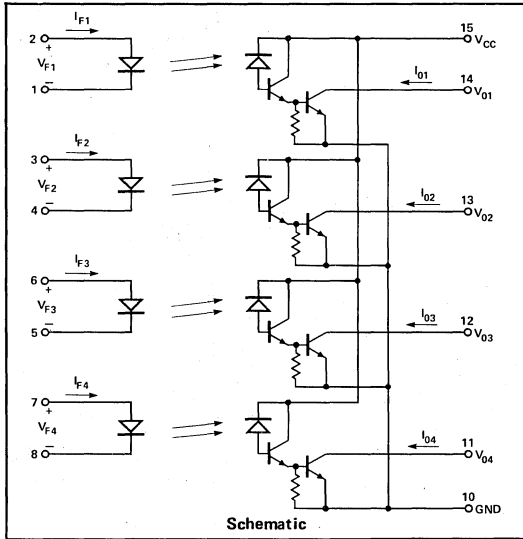
TABLE V, GROUP B

Examination or Test	MIL-STD-883		LTPD
	Method	Condition	
Subgroup 1 Physical Dimensions	2008	See Product Outline Drawing	15
Subgroup 2 Solderability	2003	Immersion within 2.5mm of body, 16 terminations	20
Subgroup 3 Temperature Cycling	1010	Test Condition C	15
Thermal Shock	1011	Test Condition A, 5 cycles	
Hermetic Seal, Fine Leak	1014	Test Condition A	
Hermetic Seal, Gross Leak	1014	Test Condition C,	
End Points: I_{OH} , V_{OL} , I_{CCH} , I_{CCL} , V_F , BVR , I_{I-O}		Per Table II, $T_A = 25^\circ C$	
Subgroup 4 Shock, non-operating	2002	$1500 G$, $t = 0.5 ms$, 5 blows in each orientation	15
Constant Acceleration	2001	X_1 , Y_1 , Y_2 $20KG$, Y_1	
End Points: Same as Subgroup 3			
Subgroup 5 Terminal Strength, tension	2004	Test Condition A, 4.5N (1 lb.), 15s	15
Subgroup 6 High Temperature Life	1008	$T_A = 150^\circ C$	$\lambda = 7$
End Points: Same as Subgroup 3			
Subgroup 7 Steady State Operating Life	1005	$V_{CC} = 5.5V$, $I_F = 13mA$, $I_O = 25mA$, $T_A = 125^\circ C$	$\lambda = 7$
End Points: Same as Subgroup 3			

HERMETICALLY SEALED, FOUR CHANNEL, LOW INPUT CURRENT OPTOCOUPLER

HCPL - 2770
(6N140)
TXVHCP - 2770
TXVBHCP - 2770

TECHNICAL DATA APRIL 1978



Outline Drawing

Features

- HERMETICALLY SEALED
- HIGH DENSITY PACKAGING
- HIGH CURRENT TRANSFER RATIO: 500% TYPICAL
- PERFORMANCE GUARANTEED OVER -55°C TO 100°C AMBIENT TEMPERATURE RANGE
- STANDARD HIGH RELIABILITY SCREENED PARTS AVAILABLE
- 1500 VDC INSULATION VOLTAGE
- LOW INPUT CURRENT REQUIREMENT: 0.5 mA
- LOW OUTPUT SATURATION VOLTAGE: 0.1V TYPICAL
- LOW POWER CONSUMPTION
- HIGH RADIATION IMMUNITY

Applications

- Isolated Input Line Receiver
- System Test Equipment Isolation
- Digital Logic Ground Isolation
- Vehicle Command/Control Isolation
- EIA RS-232C Line Receiver
- Microprocessor System Interface
- Current Loop Receiver
- Level Shifting
- Process Control Input/Output Isolation

Description

The HCPL-2770 contains four GaAsP light emitting diodes, each of which is optically coupled to a corresponding integrated high gain photon detector. A common pin for the photodiodes and first stage of each detector IC (V_{CC}) permits lower output saturation voltage and higher speed operation than possible with conventional photodarlington type optocouplers. Also, the separate V_{CC} pin can be strobed low as an output disable or operated with supply voltages as low as 1.6V without adversely affecting the parametric performance.

The outstanding high temperature performance of this split Darlington type output amplifier results from the inclusion of an integrated emitter-base bypass resistor which shunts photodiode and first stage leakage currents to ground.

The high current transfer ratio at very low input currents permits circuit designs in which adequate margin can be allowed for the effects of CTR degradation over time.

The HCPL-2770 has a 300% minimum CTR at an input current of only 0.5mA making it ideal for use in low input current applications such as MOS, CMOS and low power logic interfacing or RS-232C data transmission systems. Compatibility with high voltage CMOS logic systems is assured by the 18V V_{CC} and by the guaranteed maximum output leakage (I_{OH}) at 18V.

Important specifications such as CTR, leakage current, supply current and output saturation voltage are guaranteed over the -55°C to 100°C temperature range to allow trouble free system operation.

TABLE I

Recommended Operating Conditions

	Symbol	Min.	Max.	Units
Input Current, Low Level (Each Channel)	I_{FL}		2	μA
Input Current, High Level (Each Channel)	I_{FH}	0.5	5	mA
Supply Voltage	V_{CC}	1.6	18	V

Absolute Maximum Ratings

Storage Temperature $-65^{\circ}C$ to $+150^{\circ}C$
 Operating Temperature $-55^{\circ}C$ to $+100^{\circ}C$
 Lead Solder Temperature $260^{\circ}C$ for 10s.
 (1.6mm below seating plane)

Peak Input Current (each channel,
 ≤ 1 ms duration) 20 mA
 Average Input Current, I_F (each channel) 10 mA
 Reverse Input Voltage, V_R (each channel) 5V
 Output Current, I_O (each channel) 40 mA
 Output Voltage, V_O (each channel) -0.5 to $20V^{[1]}$
 Supply Voltage, V_{CC} -0.5 to $20V^{[1]}$
 Output Power Dissipation (each channel) ... 50 mW^[2]

TABLE II

Electrical Characteristics $T_A = -55^{\circ}C$ to $100^{\circ}C$, Unless Otherwise Specified

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Current Transfer Ratio	CTR	300 300 200	1000 750 400		% % %	$I_F=0.5mA, V_O=0.4V, V_{CC}=4.5V$ $I_F=1.6mA, V_O=0.4V, V_{CC}=4.5V$ $I_F=5mA, V_O=0.4V, V_{CC}=4.5V$	3	3,4
Logic High Output Current	I_{OH}		.005	250	μA	$I_F = 2\mu A$ $V_O = V_{CC} = 18V$		3,5
Logic Low Supply Current	I_{CCL}		2	4	mA	$I_{F1}=I_{F2}=I_{F3}=I_{F4}=1.6mA$ $V_{CC}=18V$		
Logic High Supply Current	I_{CCH}		.010	40	μA	$I_{F1}=I_{F2}=I_{F3}=I_{F4}=0$ $V_{CC}=18V$		
Input Forward Voltage	V_F		1.4	1.7	V	$I_F=1.6mA, T_A=25^{\circ}C$	1	3
Input Reverse Breakdown Voltage	BV_R	5			V	$I_R=10\mu A, T_A=25^{\circ}C$		3
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$		-1.8		mV/ $^{\circ}C$	$I_F = 1.6mA$		3
Input Capacitance	C_{IN}		60		pF	$f = 1MHz, V_F = 0, T_A = 25^{\circ}C$		3
Input-Output Insulation Leakage Current	I_{I-O}			1.0	μA	45% Relative Humidity, $T_A=25^{\circ}C$, $t = 5s, V_{I-O} = 1500Vdc$		6
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500Vdc, T_A = 25^{\circ}C$		3,7
Capacitance (Input-Output)	C_{I-O}		1.5		pF	$f = 1MHz, T_A = 25^{\circ}C$		3,7
Input-Input Insulation Leakage Current	I_{I-I}		0.5		nA	45% Relative Humidity, $V_{I-I}=500Vdc$, $T_A=25^{\circ}C, t=5s$		8
Resistance (Input-Input)	R_{I-I}		10^{12}		Ω	$V_{I-I} = 500Vdc, T_A = 25^{\circ}C$		8
Capacitance (Input-Input)	C_{I-I}		1		pF	$f = 1MHz, T_A = 25^{\circ}C$		8

TABLE III

Switching Characteristics $T_A = 25^{\circ}C, V_{CC} = 5V$ Each Channel

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time To Logic High At Output	t_{PLH}		25	60	μs	$I_F=0.5mA, R_L=4.7k\Omega$	8	
			10	20	μs	$I_F=5mA, R_L=680\Omega$	8	
Propagation Delay Time To Logic Low At Output	t_{PHL}		35	100	μs	$I_F=0.5mA, R_L=4.7k\Omega$	8	
			2	5	μs	$I_F=5mA, R_L=680\Omega$	8	
Common Mode Transient Immunity At Logic High Level Output	CM_H	500	1000		V/ μs	$I_F=0, R_L=1.5k\Omega$ $|V_{CM}| = 50V_{p-p}$	9	9,11
Common Mode Transient Immunity At Logic Low Level Output	CM_L	-500	-1000		V/ μs	$I_F=1.6mA, R_L=1.5k\Omega$ $|V_{CM}| = 50V_{p-p}$	9	10,11

NOTES:

- Pin 10 should be the most negative voltage at the detector side.
- Output power is collector output power plus one fourth of total supply power.
- Each channel.
- CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.
- $I_F=2\mu A$ for channel under test. For all other channels, $I_F=10mA$.
- Device considered a two-terminal device: Pins 1 through 8 are shorted together and pins 9 through 16 are shorted together.
- Measured between each input pair shorted together and all output pins.
- Measured between adjacent input pairs shorted together, i.e. between pins 1 and 2 shorted together and pins 3 and 4 shorted together, etc.
- CM_H is the maximum tolerable common mode transient to assure that the output will remain in a high logic state (i.e. $V_O > 2.0V$).
- CM_L is the maximum tolerable common mode transient to assure that the output will remain in a low logic state (i.e. $V_O < 0.8V$).
- In applications where dV/dt may exceed 50,000 V/ μs (such as a static discharge) a series resistor, R_{CC} , should be included to protect the detector IC's from destructively high surge currents. The recommended value is $R_{CC} \approx \frac{1V}{0.6 I_F (mA)} k\Omega$.

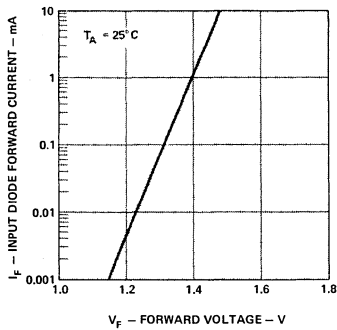


Figure 1. Input Diode Forward Current vs. Forward Voltage.

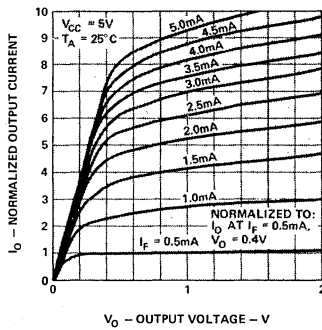


Figure 2. Normalized DC Transfer Characteristics.

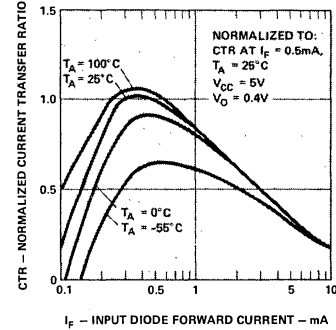


Figure 3. Normalized Current Transfer Ratio vs. Input Diode Forward Current.

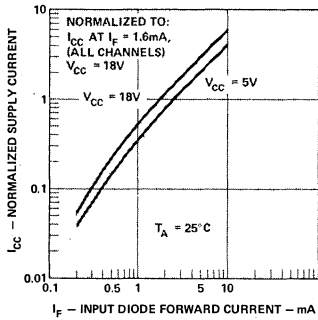


Figure 4. Normalized Supply Current vs. Input Diode Forward Current.

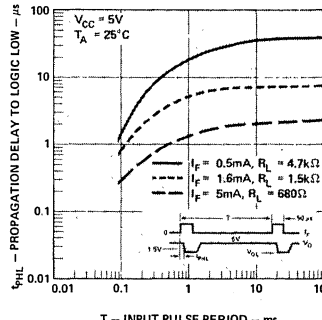


Figure 5. Propagation Delay to Logic Low vs. Input Pulse Period.

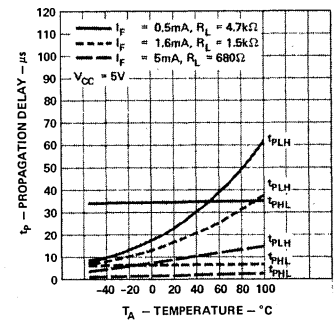


Figure 6. Propagation Delay vs. Temperature

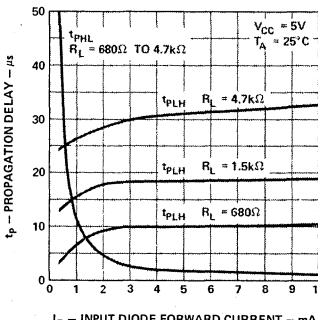


Figure 7. Propagation Delay vs. Input Diode Forward Current.

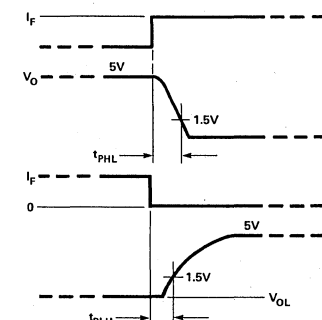


Figure 8. Switching Test Circuit.

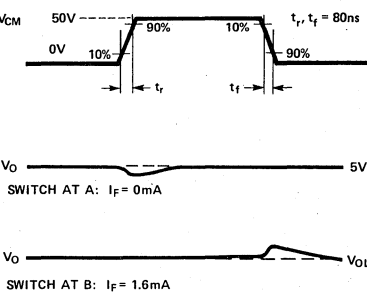
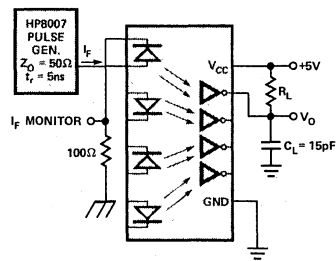


Figure 9. Test Circuit for Transient Immunity and Typical Waveforms.

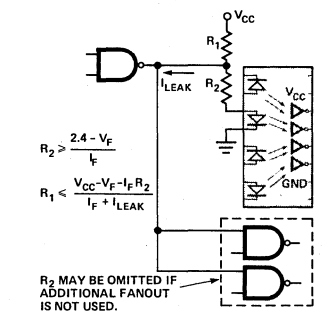
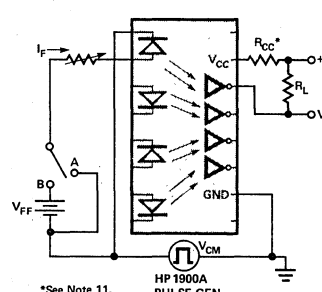


Figure 10. Recommended drive circuitry using TTL logic.

High Reliability Test Program

Hewlett Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

- The TXV prefix identifies a part which has been preconditioned and screened per Table IV.
- The TXVB prefix identifies a part which has been preconditioned and screened per Table IV, and comes from a lot which has been subjected to the Group B tests detailed in Table V.

Part Number System

Commercial Product	With TXV Screening	With TXV Screening Plus Group B
HCPL-2770	TXVHCPL-2770	TXVBHCPL-2770
(6N140)		

TABLE IV TXV Preconditioning and Screening – 100%

Examination or Test	MIL-STD-883	Conditions
	Methods	
1. Pre-Cap Visual Inspection	OED Procedure	72-4063, 72-4064
2. High Temperature Storage	1008	72 hrs. @ 150°C
3. Temperature Cycling	1010	-65°C to +150°C
4. Acceleration	2001	20KG, Y ₁
5. Helium Leak Test	1014	Cond. A
6. Gross Leak Test	1014	Cond. C
7. Electrical Test CTR, I _{OH} , I _{CCL} , I _{CC} H, V _F , B _V R: Burn-In		T _A = 25°C, per Table II
8. Electrical Test: Same as step 7 and I _L O	1015	V _{CC} = 18V, I _F = 5mA, I _O = 10mA t = 168 hrs. @ T _A = 100°C
9. Evaluate Drift		T _A = 25°C, per Table II
10. External Visual	2009	Max. ΔCTR = ±25% @ I _F = 1.6mA

TABLE V, Group B

Examination or Test	MIL-STD-883		LTPD
	Method	Condition	
Subgroup 1 Physical Dimensions	2016	See Product Outline Drawing	15
Subgroup 2 Solderability	2003	Immersion within 2.5mm of body, 16 terminations	20
Subgroup 3 Temperature Cycling Thermal Shock Hermetic Seal, Fine Leak Hermetic Seal, Gross Leak End Points: CTR, I _{OH} , I _{CCL} , I _{CC} H, V _F , B _V R	1010 1011 1014 1014	Test Condition C Test Condition A, 5 cycles Test Condition A Test Condition C	15
Subgroup 4 Shock, non-operating Constant Acceleration End Points: Same as Subgroup 3	2002 2001	1500 G, t = 0.5 ms, 5 blows in each orientation X ₁ , Y ₁ , Y ₂ 20KG, Y ₁	15
Subgroup 5 Terminal Strength, tension	2004	Test Condition A, 4.5N (1 lb.), 15s.	15
Subgroup 6 High Temperature Life End Points: Same as Subgroup 3	1008	T _A = 150°C, non-operating	λ = 7
Subgroup 7 Steady State Operating Life End Points: Same as Subgroup 3	1005	V _{CC} = 18V, I _F = 5mA, I _O = 10mA, T _A = 100°C	λ = 7

Emitters

• Features

Near IR emission

Functions with most silicon phototransistors and photodiodes

Plastic Package

HEMT 3300 uses isotropic LED chip

HEMT 6000 uses surface emitter LED chip

HEMT 6000 has offset wirebond

HEMT 6000 has reciprocal optical port

• Advantages

Visible

Easy to use

Low cost

Provides floodlight type beam

Provides bright spot of light

Active area of the chip is not masked or shadowed

Can function as an emitter or narrow band detector

• Benefits

Facilitates alignment

Cost effective implementation

Cost effective implementation

Well suited for applications that require a large area to be irradiated

Facilitates focusing light on active area of photodetector

Facilitates use with fiber optics

Single device performs two functions

PIN Photodiodes

• Features

Offset wirebond

All HP PIN photodiodes have anti-reflective coating

Wide spectral response (ultraviolet through IR)

Low junction capacitance

ULTRA Linear

• Advantages

Can be used with fiber optics

Converts more incident radiation (light) into photocurrent

A single device can cover the light spectrum plus UV and IR

Wide bandwidth

Permits operation over 10 decades

• Benefits

Fiber can be placed directly over active area

High Responsivity

Works with a variety of sources

Can detect high speed pulses

Eliminates the need for equalization

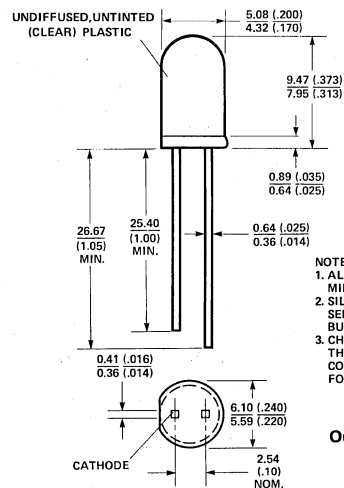
Features

- HIGH EFFICIENCY
- NONSATURATING OUTPUT
- NARROW BEAM ANGLE
- VISIBLE FLUX AIDS ALIGNMENT
- BANDWIDTH: DC TO 3 MHz
- IC COMPATIBLE/LOW CURRENT REQUIREMENT

Description

The HEMT-3300 is a visible, near-IR, source using a GaAsP on GaP LED chip optimized for maximum quantum efficiency at 670 nm. The emitter's beam is sufficiently narrow to minimize stray flux problems, yet broad enough to simplify optical alignment. This product is suitable for use in consumer and industrial applications such as optical transducers and encoders, smoke detectors, assembly line monitors, small parts counters, paper tape readers and fiber optic drivers.

Package Dimensions



Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_e	Axial Radiant Intensity	200	500		$\mu\text{W}/\text{sr}$	$I_F = 10 \text{ mA}$	3,4
K_e	Temperature Coefficient of Intensity		-0.009		$^\circ\text{C}^{-1}$	$I_F = 10 \text{ mA}$, Note 1	
η_v	Luminous Efficacy		22		lm/W	Note 2	
$2\Theta_{1/2}$	Half Intensity Total Angle		22		deg.	Note 3, $I_F = 10 \text{ mA}$	6
λ_{PEAK}	Peak Wavelength		670		nm	Measured at Peak	1
$\Delta\lambda_{\text{PEAK}}/\Delta T$	Spectral Shift Temperature Coefficient		0.089		$\text{nm}/^\circ\text{C}$	Measured at Peak, Note 4	
t_r	Output Rise Time (10% - 90%)		120		ns	$I_{\text{PEAK}} = 10 \text{ mA}$	
t_f	Output Fall Time (90% - 10%)		50		ns	$I_{\text{PEAK}} = 10 \text{ mA}$ Pulse	
C_O	Capacitance		15		pF	$V_F = 0$; $f = 1 \text{ MHz}$	
BV_R	Reverse Breakdown Voltage	5.0			V	$I_R = 100 \mu\text{A}$	
V_F	Forward Voltage		1.9	2.5	V	$I_F = 10 \text{ mA}$	2
$\Delta V_F/\Delta T$	Temperature Coefficient of V_F		-2.2		$\text{mV}/^\circ\text{C}$	$I_F = 100 \mu\text{A}$	
Θ_{JC}	Thermal Resistance		160		$^\circ\text{C}/\text{W}$	Junction to cathode lead at seating plane.	

Notes: 1. $I_e(T) = I_e(25^\circ\text{C}) \exp [K_e(T - 25^\circ\text{C})]$ 2. $I_v = \eta_v I_e$ where I_v is in candela, I_e in watts/steradian and η_v in lumen/watt.
3. $\Theta_{1/2}$ is the off-axis angle at which the radiant intensity is half the axial intensity. The deviation between the mechanical and optical axis is typically within a conical half-angle of five degrees. 4. $\lambda_{\text{PEAK}}(T) = \lambda_{\text{PEAK}}(25^\circ\text{C}) + (\Delta\lambda_{\text{PEAK}}/\Delta T)(T - 25^\circ\text{C})$.

Maximum Ratings at $T_A = 25^\circ\text{C}$

Power Dissipation 120 mW
 (derate linearly from 50°C at $1.6\text{ mW}/^\circ\text{C}$)
 Average Forward Current 30 mA
 (derate linearly from 50°C at $0.4\text{ mA}/^\circ\text{C}$)
 Peak Forward Current See Figure 5
 Operating and Storage
 Temperature Range -55°C to $+100^\circ\text{C}$
 Lead Soldering Temperature 260°C for 5 sec.
 (1.6 mm [0.063 inch] from body)

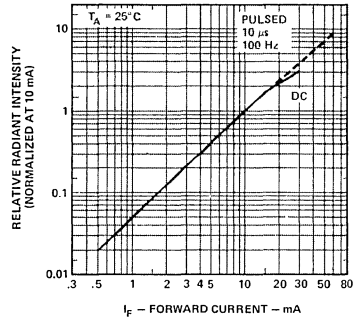


Figure 3. Relative Radiant Intensity versus Forward Current.

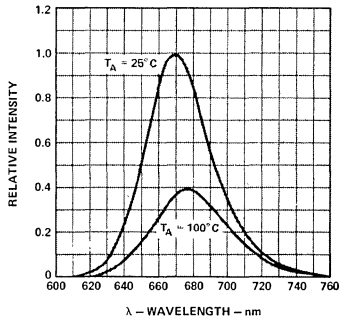


Figure 1. Relative Intensity versus Wavelength.

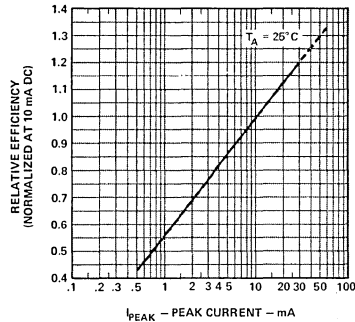


Figure 4. Relative Efficiency (Radiant Intensity per Unit Current) versus Peak Current.

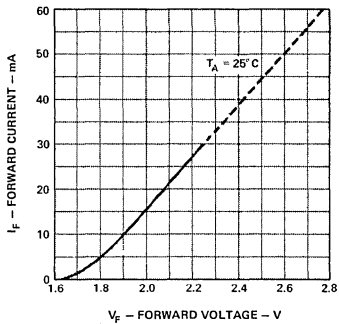


Figure 2. Forward Current versus Forward Voltage.

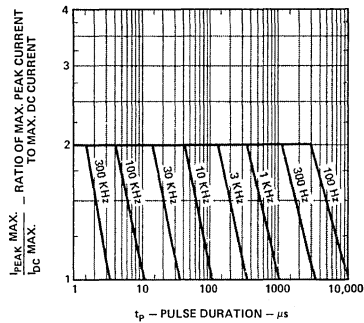


Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. ($I_{DC\text{ MAX}}$ as per MAX Ratings)

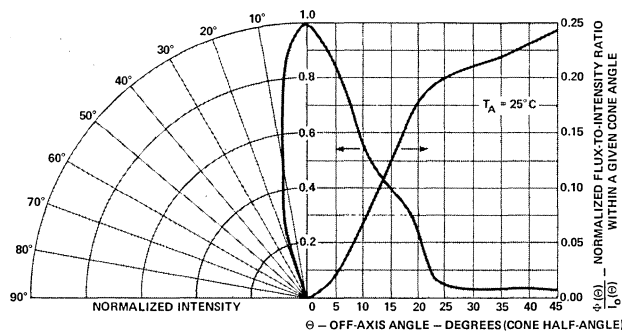


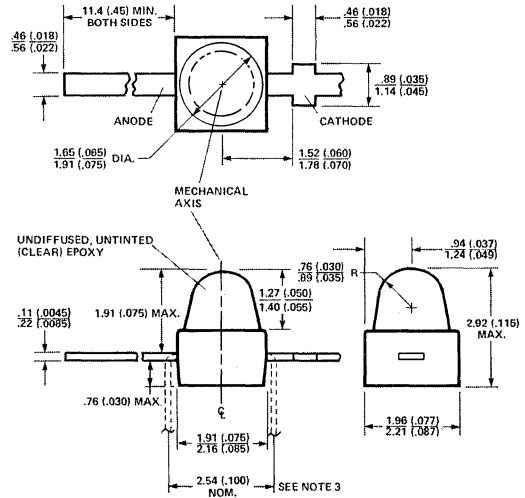
Figure 6. Far-Field Radiation Pattern.

Features

- HIGH RADIANT INTENSITY
- NARROW BEAM ANGLE
- NONSATURATING OUTPUT
- BANDWIDTH: DC TO 5 MHz
- IC COMPATIBLE/LOW CURRENT REQUIREMENT
- VISIBLE FLUX AIDS ALIGNMENT

Description

The HEMT-6000 uses a GaAsP chip designed for optimum tradeoff between speed and quantum efficiency. This optimization allows a flat modulation bandwidth of 5 MHz without peaking, yet provides a radiant flux level comparable to that of 900nm IREDs. The subminiature package allows operation of multiple closely-spaced channels, while the narrow beam angle minimizes crosstalk. The nominal 700nm wavelength can offer spectral performance advantages over 900nm IREDs, and is sufficiently visible to aid optical alignment. Applications include paper-tape readers, punch-card readers, bar code scanners, optical encoders or transducers, interrupt modules, safety interlocks, tape loop stabilizers and fiber optic drivers.



- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
 2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
 3. USER MAY BEND LEADS AS SHOWN.
 4. EPOXY ENCAPSULANT HAS A REFRACTIVE INDEX OF 1.53.
 5. CHIP CENTERING WITHIN THE PACKAGE IS CONSISTENT WITH FOOTNOTE 3.

Maximum Ratings at $T_A = 25^\circ\text{C}$

Power Dissipation	50 mW
(derate linearly from 70°C @ $1.0\text{mW}/^\circ\text{C}$)	
Average Forward Current	20 mA
(derate linearly from 70°C @ $0.4\text{mA}/^\circ\text{C}$)	
Peak Forward Current	See Figure 5
Operating and Storage	
Temperature Range	-55° to $+100^\circ\text{C}$
Lead Soldering	
Temperature	260°C for 5 sec.
	[1.6 mm (0.063 in.) from body]

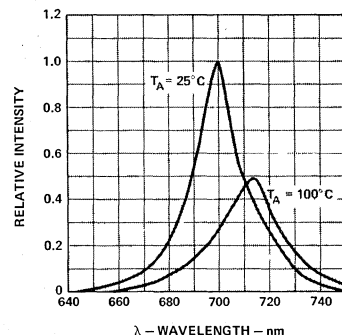


Figure 1. Relative Intensity versus Wavelength.

Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Fig.
I_e	Radiant Intensity along Mechanical Axis	100	250		$\mu\text{W}/\text{sr}$	$I_F = 10 \text{ mA}$	3,4
K_e	Temperature Coefficient of Intensity		-0.005		$^\circ\text{C}^{-1}$	Note 1	
η_v	Luminous Efficacy		2.5		lm/W	Note 2	
$2\Theta_{1/2}$	Optical Axis Half Intensity Total Angle		16		deg.	Note 3, $I_F = 10 \text{ mA}$	6
λ_{PEAK}	Peak Wavelength (Range)		690-715		nm	Measured @ Peak	1
$\Delta\lambda / \Delta T_{\text{PEAK}}$	Spectral Shift Temperature Coefficient		.193		$\text{nm}/^\circ\text{C}$	Measured @ Peak, Note 4	
t_r	Output Rise Time (10%-90%)		70		ns	$I_{\text{PEAK}} = 10 \text{ mA}$	
t_f	Output Fall Time (90%-10%)		40		ns	$I_{\text{PEAK}} = 10 \text{ mA}$	
C_o	Capacitance		65		pF	$V_F = 0; f = 1 \text{ MHz}$	
BV_R	Reverse Breakdown Voltage	5	12		V	$I_R = 100 \mu\text{A}$	
V_F	Forward Voltage		1.5	1.8	V	$I_F = 10 \text{ mA}$	2
$\Delta V_F / \Delta T$	Temperature Coefficient of V_F		-2.1		$\text{mV}/^\circ\text{C}$	$I_F = 100 \mu\text{A}$	
Θ_{JC}	Thermal Resistance		140		$^\circ\text{C}/\text{W}$	Junction to cathode lead at 0.79 mm (.031 in) from body	

- NOTES: 1. $I_e(T) = I_e(25^\circ\text{C}) \exp [K_e (T - 25^\circ\text{C})]$.
 2. $I_v = \eta_v I_e$ where I_v is in candela, I_e in watts/steradian, and η_v in lumen/watt.
 3. $\Theta_{1/2}$ is the off-axis angle at which the radiant intensity is half the intensity along the optical axis. The deviation between the mechanical and the optical axis is typically within a conical half-angle of three degrees.
 4. $\lambda_{\text{PEAK}}(T) = \lambda_{\text{PEAK}}(25^\circ\text{C}) + (\Delta\lambda / \Delta T) (T - 25^\circ\text{C})$

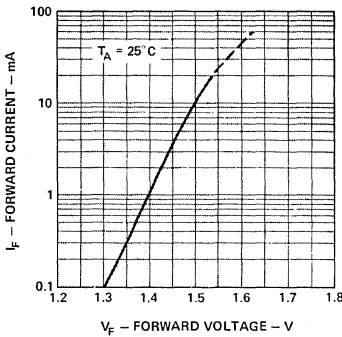


Figure 2. Forward Current versus Forward Voltage.

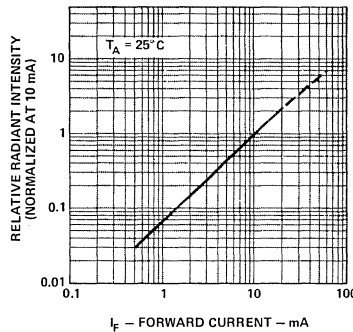


Figure 3. Relative Radiant Intensity versus Forward Current.

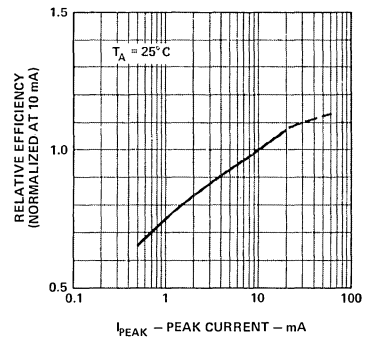


Figure 4. Relative Efficiency (Radiant Intensity per Unit Current) versus Peak Current.

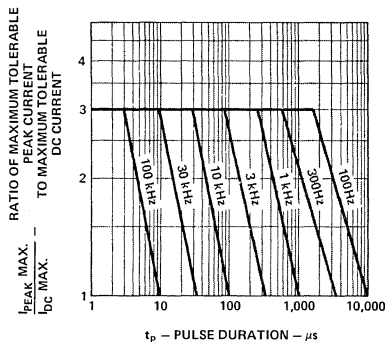


Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. ($I_{\text{DC MAX}}$ as per MAX Ratings)

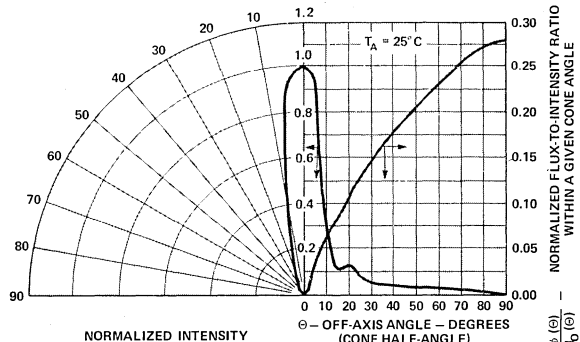


Figure 6. Far-Field Radiation Pattern.

Features

- HIGH SENSITIVITY (NEP < -108 dBm)
- WIDE DYNAMIC RANGE (1% LINEARITY OVER 100 dB)
- BROAD SPECTRAL RESPONSE
- HIGH SPEED ($T_r, T_f < 1\text{ns}$)
- STABILITY SUITABLE FOR PHOTOMETRY/RADIOMETRY
- HIGH RELIABILITY
- FLOATING, SHIELDED CONSTRUCTION
- LOW CAPACITANCE
- LOW NOISE

Description

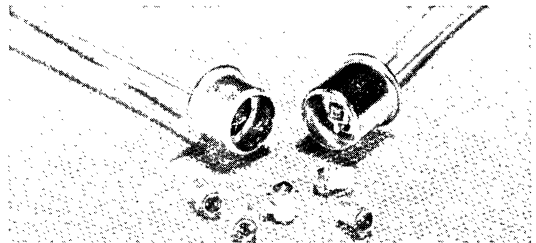
The HP silicon planar PIN photodiodes are ultra-fast light detectors for visible and near infrared radiation. Their response to blue and violet is unusually good for low dark current silicon photodiodes.

These devices are suitable for applications such as high speed tachometry, optical distance measurement, star tracking, densitometry, radiometry, and fiber-optic termination.

The speed of response of these detectors is less than one nanosecond. Laser pulses shorter than 0.1 nanosecond may be observed. The frequency response extends from dc to 1 GHz.

The low dark current of these planar diodes enables detection of very low light levels. The quantum detection efficiency is constant over ten decades of light intensity, providing a wide dynamic range.

Active area: 1mm Diam	5082-4207	TALL SIZE (TO-18)
	5082-4203	
0.5mm Diam	5082-4204	Short (TO-46)
	5082-4220	
0.25mm Magnified 2.5x	5082-4205	Subminiature



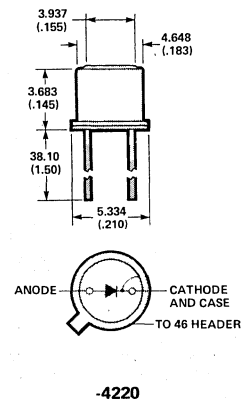
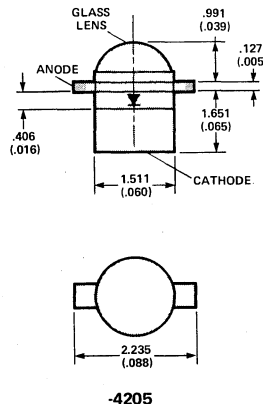
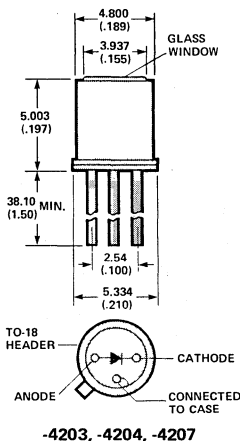
The 5082-4203, -4204, and -4207 are packaged on a standard TO-18 header with a flat glass window cap. For versatility of circuit connection, they are electrically insulated from the header. The light sensitive area of the 5082-4203 and -4204 is 0.508mm (0.020 inch) in diameter and is located 1.905mm (0.075 inch) behind the window. The light sensitive area of the 5082-4207 is 1.016mm (0.040 inch) in diameter and is also located 1.905mm (0.075 inch) behind the window.

The 5082-4205 is in a low capacitance Kovar and ceramic package of very small dimensions, with a hemispherical glass lens.

The 5082-4220 is packaged on a TO-46 header with the 0.508mm (0.020 inch) diameter sensitive area located 2.540mm (0.100 inch) behind a flat glass window.

Package Dimensions

DIMENSIONS IN MILLIMETERS (INCHES).



Absolute Maximum Ratings

Parameter	-4203	-4204	-4205	-4207	-4220	Units
P_{MAX} Power Dissipation ¹	100	100	50	100	100	mW
Peak Reverse Voltage ²	200	200	200	200	200	volts
Steady Reverse Voltage ³	50	20	50	20	50	volts

Electrical/Optical Characteristics at $T_A = 25^\circ C$

Symbol	Description	-4203			-4204			-4205			-4207			-4220			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
$R_E, 0 = R_\phi \cdot A$	Axial Incidence Response at 770nm[4]		1.0			1.0			1.5*			4.0			1.0	$\frac{\mu A}{mW/cm^2}$	
A	Active Area ⁴		2 x 10 ⁻³			2 x 10 ⁻³			3 x 10 ^{-3*}			8 x 10 ⁻³			2 x 10 ⁻³	cm ²	
R_ϕ	Flux Responsivity 770 nm ⁵ (Fig. 1, 3)		.5			.5			.5			.5			.5	$\frac{\mu A}{\mu W}$	
I_D	Dark Current ⁶ (Fig. 4)			2.0			0.6			.15			2.5			5.0	nA
NEP	Noise Equivalent Power ⁷ (Fig. 8)			5.1 x 10 ⁻¹⁴			2.8 x 10 ⁻¹⁴			1.4 x 10 ⁻¹⁴			5.7 x 10 ⁻¹⁴			8.1 x 10 ⁻¹⁴	$\frac{W}{\sqrt{Hz}}$
D*	Detectivity ⁸	8.7 x 10 ¹¹			1.6 x 10 ¹²			4.0 x 10 ¹²			1.5 x 10 ¹²			5.6 x 10 ¹¹			$\frac{cm\sqrt{Hz}}{W}$
C_j	Junction Capacitance ⁹ (Fig. 5)		1.5			2.0			0.7			5.5			2.0	pF	
C_p	Package Capacitance ¹⁰		2			2						2				pF	
t_r, t_f	Zero Bias Speed (Rise, Fall Time) ¹¹		300			300			300			300			300	ns	
t_r, t_f	Rev.-Bias Speed (Rise, Fall Time) ¹²			1			1			1			1			1	ns
R_S	Series Resistance			50			50			50			50			50	Ω

*see Note 4.

NOTES:

1. Peak Pulse Power

When exposing the diode to high level incidence the following photocurrent limits must be observed:

$$I_p \text{ (avg MAX.)} < \frac{P_{MAX} - P_\phi}{E_c} \text{ and in addition:}$$

$$I_p \text{ (PEAK)} < \frac{1000 A}{t \text{ (}\mu\text{sec)}} \text{ or } < 500 \text{ mA or } < \frac{I_p \text{ (avg MAX.)}}{f \times t}$$

whichever of the above three conditions is least.

I_p - photocurrent (A) f - pulse repetition rate (MHz)
 E_c - supply voltage (V) P_ϕ - power input via photon flux
 t - pulse duration (μ s) P_{MAX} - max dissipation (W)

Power dissipation limits apply to the sum of both the optical power input to the device and the electrical power input from flow of photocurrent when reverse voltage is applied.

- Exceeding the Peak Reverse Voltage will cause permanent damage to the diode. Forward current is harmless to the diode, within the power dissipation limit. For optimum performance, the diode should be reverse biased with E_c between 5 and 20 volts.
- Exceeding the Steady Reverse Voltage may impair the low-noise properties of the photodiodes, an effect which is noticeable only if operation is diode-noise limited (see Figure 8).
- The 5082-4205 has a lens with approximately 2.5x magnification; the actual junction area is $0.5 \times 10^{-3} \text{ cm}^2$, corresponding to a diameter of 0.25mm (.010"). Specification includes lens effect.
- At any particular wavelength and for the flux in a small spot falling entirely within the active area, responsivity is the ratio of incremental photodiode current to the incremental flux producing it. It is related to quantum efficiency, η_q in electrons per photon by:

$$R_\phi = \eta_q \left(\frac{\lambda}{1240} \right)$$

where λ is the wavelength in nanometers. Thus, at 770nm, a responsivity of 0.5 A/W corresponds to a quantum efficiency of 0.81 (or 81%) electrons per photon.

- At -10V for the 5082-4204, -4205, and -4207; at -25V for the 5082-4203 and -4220.
- For $(\lambda, f, \Delta f) = (770\text{nm}, 100\text{Hz}, 6\text{Hz})$ where f is the frequency for a spot noise measurement and Δf is the noise bandwidth, NEP is the optical flux required for unity signal/noise ratio normalized for bandwidth. Thus:

$$NEP = \frac{I_N \sqrt{\Delta f}}{R_\phi} \quad \text{where } I_N \sqrt{\Delta f} \text{ is the bandwidth - normalized noise current computed from the shot noise formula:}$$

$$I_N \sqrt{\Delta f} = \sqrt{2qI_D} = 17.9 \times 10^{-15} \sqrt{I_D} \text{ (A}\sqrt{\text{Hz)}} \text{ where } I_D \text{ is in nA.}$$

- Detectivity, D^* is the active-area-normalized signal to noise ratio. It is computed:

$$D^* = \frac{\sqrt{A}}{NEP} \left(\frac{\text{cm} \sqrt{\text{Hz}}}{W} \right) \text{ for } A \text{ in cm}^2,$$

- At -10V for 5082-4204, -4205, -4207, -4220; at -25V for 5082-4203.
- Between diode cathode lead and case - does not apply to 5082-4205, -4220.
- With 50 Ω load.
- With 50 Ω load and -20V bias.

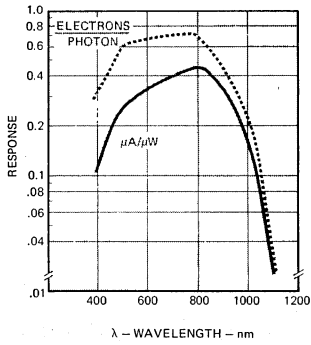


Figure 1. Spectral Response.

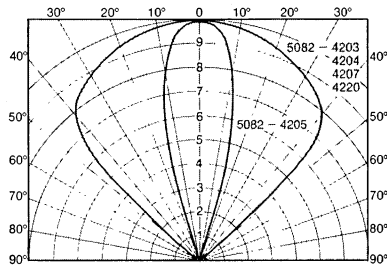


Figure 2. Relative Directional Sensitivity of the PIN Photodiodes.

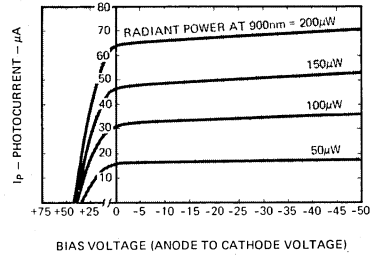


Figure 3. Typical Output Characteristics at $\lambda = 900\text{nm}$.

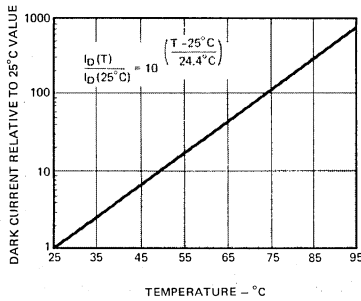


Figure 4. Dark Current at -10V Bias vs. Temperature.

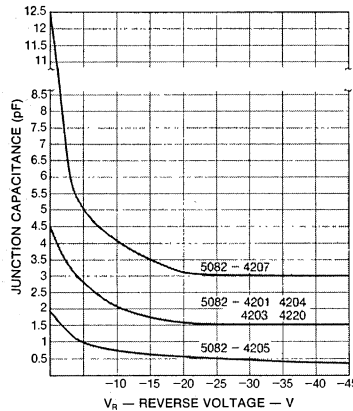


Figure 5. Typical Capacitance Variation With Applied Voltage.

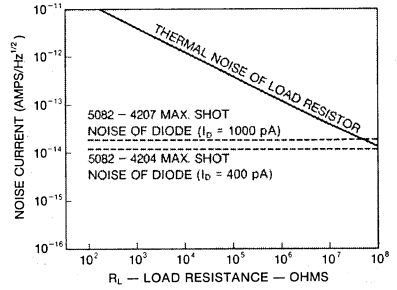


Figure 6. Noise vs. Load Resistance.

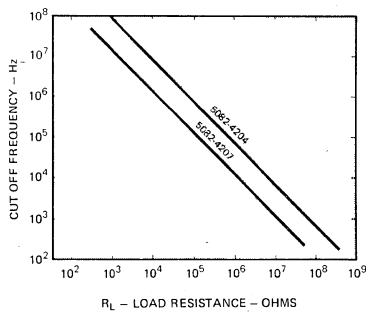


Figure 7. Photodiode Cut-Off Frequency vs. Load Resistance ($C = 2\text{pF}$).

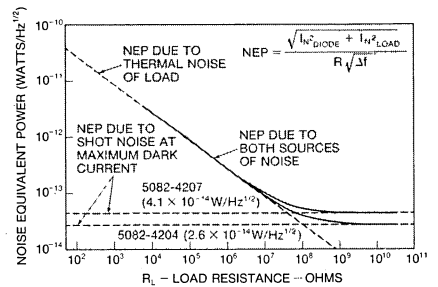


Figure 8. Noise Equivalent Power vs. Load Resistance.

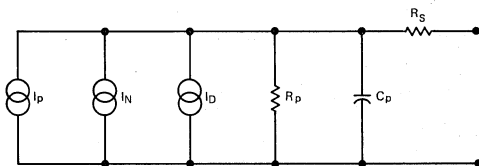


Figure 9. Photodiode Equivalent Circuit.

I_p = Signal current $\approx 0.5\mu\text{A}/\mu\text{W}$ x flux input at 770 nm
 I_N = Shot noise current
 $< 1.2 \times 10^{-14}$ amps/Hz $^{1/2}$ (5082-4204)
 $< 4 \times 10^{-14}$ amps/Hz $^{1/2}$ (5082-4207)
 I_D = Dark current
 $< 600 \times 10^{-12}$ amps at -10 V dc (5082-4204)
 $< 2500 \times 10^{-12}$ amps at -10 V dc (5082-4207)
 $R_p = 1011\Omega$
 $R_s < 50\Omega$

Application Information

NOISE FREE PROPERTIES

The noise current of the PIN diodes is negligible. This is a direct result of the exceptionally low leakage current, in accordance with the shot noise formula $I_N = (2qI_R\Delta f)^{1/2}$. Since the leakage current does not exceed 600 picoamps for the 5082-4204 at a reverse bias of 10 volts, shot noise current is less than 1.4×10^{-14} amp Hz^{-1/2} at this voltage.

Excess noise is also very low, appearing only at frequencies below 10 Hz, and varying approximately as 1/f. When the output of the diode is observed in a load, thermal noise of the load resistance (R_L) is $1.28 \times 10^{-10} (R_L)^{-1/2} \times (\Delta f)^{1/2}$ at 25°C, and far exceeds the diode shot noise for load resistance less than 100 megohms (see Figure 6). Thus in high frequency operation where low values of load resistance are required for high cut-off frequency, all PIN photodiodes contribute virtually no noise to the system (see Figures 6 and 7).

HIGH SPEED PROPERTIES

Ultra-fast operation is possible because the HP PIN photodiodes are capable of a response time less than one nanosecond. A significant advantage of this device is that the speed of response is exhibited at relatively low reverse bias (-10 to -20 volts).

OFF-AXIS INCIDANCE RESPONSE

Response of the photodiodes to a uniform field of radiant incidence E_e , parallel to the polar axis is given by $I = (RA) \times E_e$ for 770nm. The response from a field not parallel to the axis can be found by multiplying (RA) by a normalizing factor obtained from the radiation pattern at the angle of operation. For example, the multiplying factor for the 5082-4207 with incidence E_e at an angle of 40° from the polar axis is 0.8. If $E_e = 1 \text{ mW/cm}^2$, then $I_p = k \times (RA) \times E_e$; $I_p = 0.8 \times 4.0 \times 1 = 3.2 \mu\text{amps}$.

SPECTRAL RESPONSE

To obtain the response at a wavelength other than 770nm, the relative spectral response must be considered. Referring to the spectral response curve, Figure 1, obtain response, X, at the wavelength desired. Then the ratio of the response at the desired wavelength to response at 770nm is given by:

$$\text{RATIO} = \frac{X}{0.5}$$

Multiplying this ratio by the incidence response at 770nm gives the incidence response at the desired wavelength.

ULTRAVIOLET RESPONSE

Under reverse bias, a region around the outside edge of the nominal active area becomes responsive. The width of this annular ring is approximately 25μm (0.001 inch) at -20V, and expands with higher reverse voltage. Responsivity in this edge region is higher than in the interior, particularly at shorter wavelengths; at 400nm the interior, responsivity is 0.1 A/W while edge responsivity is 0.35 A/W. At wavelengths shorter than 400nm, attenuation by the glass window affects response adversely; hence UV detection is improved by removal of the glass or substitution of a sapphire window (available on special order). Speed of response for edge incidence is t_r , $t_f \approx 300\text{ns}$.

5082-4205 MOUNTING RECOMMENDATIONS

- The 5082-4205 is intended to be soldered to a printed circuit board having a thickness of from 0.51 to 1.52mm (0.02 to 0.06 inch).
- Soldering temperature should be controlled so that at no time does the case temperature approach 280°C. The lowest solder melting point in the device is 280°C (gold-tin eutectic). If this temperature is approached, the solder will soften, and the lens may fall off. Lead-tin solder is recommended for mounting the package, and should be applied with a small soldering iron, for the shortest possible time, to avoid the temperature approaching 280°C.
- Contact to the lens end should be made by soldering to one or both of the tabs provided. Care should be exercised to prevent solder from coming in contact with the lens.
- If printed circuit board mounting is not convenient, wire leads may be soldering or welded to the devices using the precautions noted above.

LINEAR OPERATION

Having an equivalent circuit as shown in Figure 9, operation of the photodiode is most linear when operated with a current amplifier as shown in Figure 10.

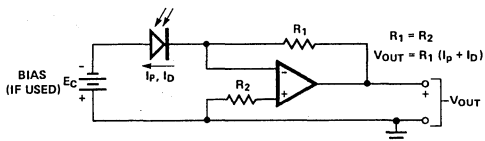


Figure 10. Linear Operation.

Lowest noise is obtained with $E_c = 0$, but higher speed and wider dynamic range are obtained if $5 < E_c < 20$ volts. The amplifier should have as high an input resistance as possible to permit high loop gain. If the photodiode is reversed, bias should also be reversed.

LOGARITHMIC OPERATION

If the photodiode is operated at zero bias with a very high impedance amplifier, the output voltage will be:

$$V_{OUT} = \left(1 + \frac{R_2}{R_1}\right) \cdot \frac{kT}{q} \cdot \ln \left(1 + \frac{I_p}{I_s}\right)$$

where $I_s = I_F (e^{\frac{qV}{kT}} - 1)^{-1}$ at $0 < I_F < 0.1\text{mA}$

using a circuit as shown in Figure 11.

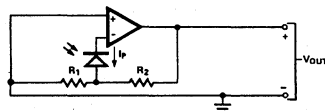


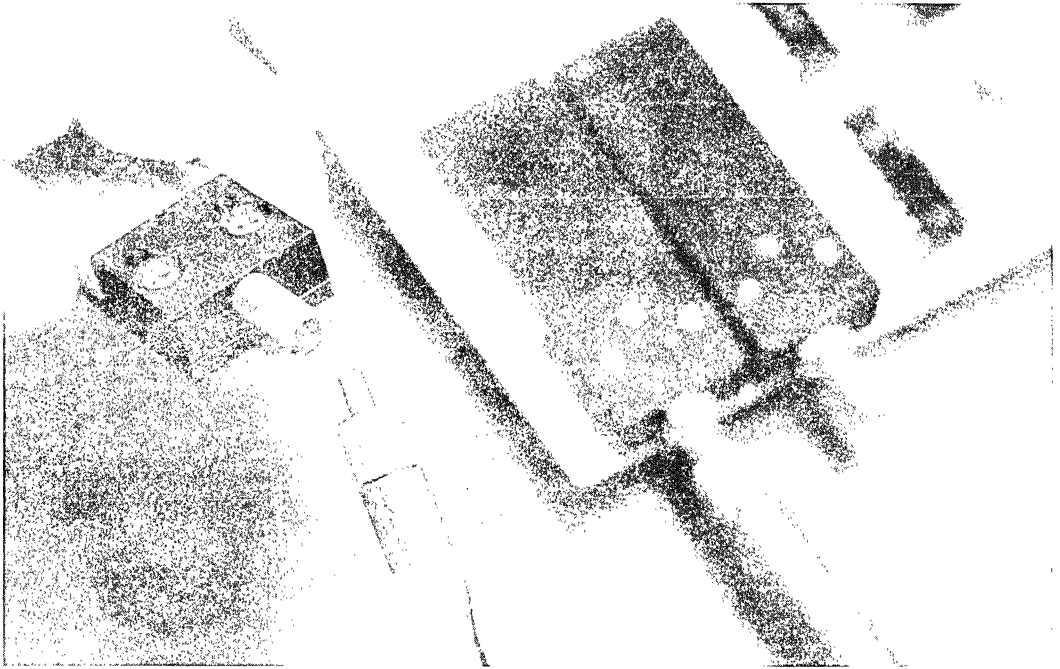
Figure 11. Logarithmic Operation.

Output voltage, V_{OUT} , is positive as the photocurrent, I_p , flows back through the photodiode making the anode positive.

Fiber Optics

Fiber optics is just beginning to emerge as a practical technology for data communications. Some important advantages of fiber optic data transmission are shown on the following pages.

Fiber Optics



Features

1. Optical transmission path
2. Light pulse "carrier" signals
3. Bandwidth independent of cable size

Advantages

- Complete input-output electrical isolation
- No EMI susceptibility or radiation
- Very high distance/bandwidth products achievable
- Light weight, small diameter cables possible.

Benefits

- Freedom from ground loops. Lightning safe.
- Freedom from induced noise. Freedom from crosstalk. Secure communications.
- Greater data rates at longer distances than wire/coax.
- Lower cost installation and maintenance. More bandwidth (channels) per unit area or unit weight.

In addition to the discrete emitters and detectors described in this catalog, Hewlett-Packard is developing integrated fiber optic systems for digital applications. The systems are ideal for point-to-point, processor-to-processor, and processor-to-peripheral interconnection in noisy environments, or at distances/bandwidths difficult to achieve with wire or coax systems.

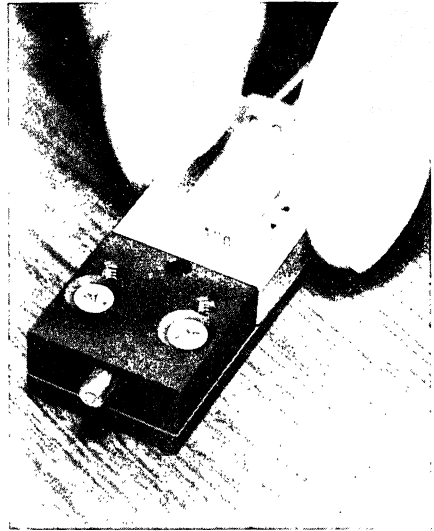
Applications

- Computer Installations
- Distributed Processing
- Hospital Systems
- Process Control
- Power Plant Communications
- Secure Communications

Elements of the HP System will include modular optical transmitters and receivers, single fiber optical connectors, and compatible optical fiber cables. Transmission capabilities will include distances to 1 kilometer and data rates to 20M bits NRZ (10 MHz clock rate).

HP System Features

- Compatible Modules, Connectors, and Cable
- Miniature PC Board Mount Packages
- TTL Electrical Interfaces
- Single 5V Power Supply
- Pre-aligned Emitter and Detector Interfaces
- Integral Optical Connectors
- Self-Checking "Link Monitor" Feature



Several cable alternatives are planned, including single and dual channel versions. All types will be reinforced and jacketed for industrial use. Compatible field installable connectors will be available for module-to-cable and cable-to-cable interconnections.

For more information on these new product developments contact your local Hewlett-Packard Components Field Engineer, or write Hewlett-Packard Optoelectronics Division, 640 Page Mill Road, Palo Alto, California.

APPLICATION INFORMATION INDEX

Application Notes

APPLICATION NOTE 931

Solid State Alphanumeric Display...Decoder/Driver Circuitry

Hewlett-Packard offers a series of solid state displays capable of producing multiple alphanumeric characters utilizing 5 x 7 dot arrays of GaAsP light emitting diodes (LED's). These 5 x 7 dot arrays exhibit clear, easily read characters. In addition, each array is X-Y addressable to allow for a simple addressing, decoding, and driving scheme between the display module and external logic.

Methods of addressing, decoding and driving information to such an X-Y addressable matrix are covered in detail in this application note. The note starts with a general definition of the scanning or strobing technique used for this simplified addressing and then proceeds to describe horizontal and vertical strobing. Finally, a detailed circuit description is given for a practical vertical strobing application.

APPLICATION NOTE 934

5082-7300 Series Solid State Display Installation Techniques

The 5082-7300 series Numeric/Hexadecimal indicators are an excellent solution to most standard display problems in commercial, industrial and military applications. The unit integrates the display character and associated drive electronics in a single package. This advantage allows for space, pin and labor cost reductions, at the same time improving overall reliability.

The information presented in this note describes general methods of incorporating the -7730 into varied applications.

APPLICATION NOTE 937

Monolithic Seven Segment LED Display Installation Techniques

The Hewlett-Packard series of small end-stackable monolithic GaAsP displays are designed for strobing, a drive method that allows time sharing of the character generator among the digits in a display.

This Application Note begins with an explanation of the strobing technique, followed by a discussion of the uses and advantages of the right hand and center decimal point products.

Several circuits are given for typical applications. Finally, a discussion of interfacing to various data forms is presented along with comments on mounting the displays.

APPLICATION NOTE 939

High Speed Optically Coupled Isolators

Often designers are faced with the problem of providing circuit isolation in order to prevent ground loops and common mode signals. Typical devices for doing this have been relays, transformers and line receivers. However, both relays and transformers are low speed devices, incompatible with modern logic circuits. Line receiver circuits are fast enough, but are limited to a common mode voltage of 3 volts.

In addition, they do not protect very well against ground loop signals. Now Optically Coupled Isolators are available which solve most isolation problems.

This Application Note contains a description of Hewlett-Packard's high speed isolators, and discusses their applications in digital and analog systems.

APPLICATION NOTE 941

5082-7700 Series Seven Segment LED Display Applications

The HP 5082-7700 series of LED displays are available in both common anode and common cathode configurations. These single digit displays have been engineered to provide a high contrast ratio and a wide viewing angle.

This Application Note begins with DC drive techniques and circuits. Next is an explanation of the strobe drive technique and the resultant increase in device efficiency. This is followed by general strobing circuits and some typical applications such as clocks, calculators and counters.

Finally, information is presented on general operating conditions, including intensity uniformity, light output control as a function of ambient light, contrast enhancement and device mounting.

APPLICATION NOTE 945 **Photometry of Red LEDs**

Nearly all LEDs are used either as discrete indicator lamps or as elements of a segmented or dot-matrix display. As such, they are viewed directly by human viewers, so the primary criteria for determining their performance is the judgment of a viewer. Equipment for measuring LED light output should, therefore, simulate human vision.

This Application Note will provide answers to these questions:

1. What to measure (definitions of terms)
2. How to measure it (apparatus arrangement)
3. Whose equipment to use (criteria for selection)

APPLICATION NOTE 946 **5082-7430 Series Monolithic Seven Segment Displays**

The HP 5082-7430 series solid state displays are common cathode, 2 and 3 digit clusters capable of displaying numeric and selected alphabetic data. These GaAsP displays employ an integral magnification technique to increase both the character size and the luminous intensity of each monolithic digit. The resultant 2.79mm (0.11") high character is viewable at distances of up to 5 feet when operated at as little as 0.5mW per segment.

These displays are designed for strobed operation. In strobing, the decoder is time-shared among the digits in the display, which are illuminated one at a time.

Typical applications, such as an Electronic Stopwatch, a battery operated Event Counter and a Four Function Calculator are discussed in this note.

APPLICATION NOTE 947 **Digital Data Transmission Using Optically Coupled Isolators**

Optically coupled isolators make ideal line receivers for digital data transmission applications. They are especially useful for elimination of common mode interference between two isolated data transmission systems. This appli-

cation note describes design considerations and circuit techniques with special emphasis on selection of line-drivers, transmission lines, and line receiver termination for optimum data rate and common mode rejection. Both resistive and active terminations are described in detail. Specific techniques are described for multiplexing applications, and for common mode rejection and data rate enhancement.

APPLICATION NOTE 948 **Performance of the 5082-4350/51/60 Series of Isolators in Short to Moderate Length Digital Data Transmission Systems**

Optically coupled isolators (opto-isolators) can function as excellent alternatives to integrated circuit line receivers in digital data transmission applications. Their major advantages consist of superior common-mode noise rejection and true ground isolation between the two sub-systems.

This application note describes the basic design elements of a data transmission link and presents examples of systems that will be useful at distances that range from 1 ft. to 300 ft. and have a moderate overall cost.

APPLICATION NOTE 951-1 **Applications for Low Input Current, High Gain Optically Coupled Isolators**

Optically coupled isolators are useful in applications where large common mode signals are encountered. Examples are: line receivers, logic isolation, power lines, medical equipment and telephone lines. This application note has at least one example in each of these areas for the 5082-4370 series high CTR isolators.

APPLICATION NOTE 951-2 **Linear Applications of Optically Coupled Isolators**

Optically coupled isolators can be used to transfer an analog signal between two isolated systems. In many instances, isolators can replace expensive transformers, instrumentation amplifiers, and A/D conversion schemes. This application note discusses several circuit techniques by which 5082-4350 series optically coupled isolators can be used to transmit analog information. The operation of each circuit is explained in detail and typical circuit performance is given.

APPLICATION INFORMATION INDEX

APPLICATION NOTE 964

Contrast Enhancement Techniques

This Application Note presents various criteria and techniques that a display engineer should consider to obtain optimum contrast enhancement for red, yellow and green LED displays. A representative list of filter manufacturers and available filters is given at the end of this discussion.

APPLICATION NOTE 966

The HDSP-2000 provides a unique yet simple and low cost method for addressing display data to a 5 x 7 alphanumeric display. This application note is intended to serve as a design and application guide for users of the HDSP-2000. The information presented will cover the theory of the device design and operation, considerations for specific circuit design, thermal management, power derating and heat sinking, and intensity modulation techniques.

Application Bulletins

APPLICATION BULLETIN 1

Construction and Performance of High Efficiency Red, Yellow and Green LED Materials

The high luminous efficiency of Hewlett-Packard's High Efficiency Red, Yellow and Green lamps and displays is made possible by a new kind of light emitting material utilizing a GaP transparent substrate. This application bulletin discusses the construction and performance of this material as compared to standard red GaAsP and red GaP materials.

APPLICATION BULLETIN 3

Soldering Hewlett-Packard Silver Plated Lead Frame LED Devices

Many of Hewlett-Packard's commercial LED devices use a silver plated lead frame. Soldering to a silver lead frame provides a reliable electrical and mechanical connection and is no more complicated than soldering to a gold lead frame. Some suggestions on how to handle and solder silver plated lead frame devices are presented.

APPLICATION BULLETIN 4

Detection and Indication of Segment Failures in Seven Segment LED Displays

The occurrence of a segment failure in certain applications of seven segment displays can have serious consequences if a resultant erroneous message is read by the viewer. This application bulletin discusses three techniques for detecting open segment lines and presenting this information to the viewer.

APPLICATION BULLETIN 50

Hewlett-Packard Watch Chip Drawings

As an aid to designers of hybrid devices using LED display chips and discrete LEDs, this bulletin provides detailed dimensional information on all Hewlett-Packard 5082-7800 series display chip products.

APPLICATION BULLETIN 51

Interfacing the HDSP-2000 Display to a Microprocessor

Interface of the HDSP-2000 alphanumeric display to a microprocessor involves the design of a relatively simple interface element. This bulletin briefly discusses the tradeoffs involved in the design of such an interface and provides a specific example of an interface to the 8080 microprocessor along with appropriate software.

APPLICATION BULLETIN 52

Large Monolithic LED Displays

The trend to incorporate more complex functions into smaller package configurations that are portable and battery powered is reaching a point where the limiting items are the space and power constraints imposed upon the display at the operator-to-machine interface. The large monolithic LED display has been designed to meet many of these constraints. This application bulletin describes the beneficial features of a large monolithic LED display and presents circuits which interface the display to CMOS logic and to a microprocessor.

APPLICATION BULLETIN 53

Interfacing the HDSP-6504/6508 16 Segment Alphanumeric Display

The man machine interface can most efficiently be bridged through the use of an Alphanumeric Display. Advances in monolithic LED manufacturing technology have permitted the introduction of an alphanumeric display using a sixteen segment font with a decimal and colon. The use of this new display is the topic of this application bulletin and it is intended to assist the designer in the following areas:

1. Electrical drive conditions;
2. Design of a standalone ASCII to eighteen segment decoder, and;
3. A 6800 microprocessor interface.

APPLICATION BULLETIN 54

Mechanical Handling of Subminiature LED Lamps and Arrays

The Need for Careful Mechanical Handling

Hewlett-Packard manufactures a series of individual LED lamps and lamp arrays that are very small epoxy encapsulated devices. These devices are classified as having a SUBMINIATURE package configuration. When carefully installed on a printed circuit board, these devices will reliably function with a long predictable operating life.

To obtain long operating life, these subminiature devices must be carefully installed on the printed circuit board in such a manner as to insure the integrity of the encapsulating epoxy. This will in turn maintain the integrity of the device by not permitting mechanical and thermal stresses to induce strains on the LED die attach and wire bonds which may cause failure.

This application bulletin describes the subminiature package assembly, the package's mechanical limitations and offers specific suggestions for proper installation.

APPLICATION BULLETIN 55

Low Cost Interface for a 32 Character HDSP-2000 Alphanumeric Display

The cost of the support electronics necessary to operate the HDSP-2000 can be reduced through the selection of cost-optimized rather than function-organized components. The

circuit depicted in this Bulletin is modeled on the circuit depicted in Figure 3 of Hewlett-Packard's Application Note No. 966. The advantages of this new circuit are realized by using predominantly TTL logic, a low cost 128 byte NMOS RAM, and a low cost, single supply NMOS character generator.

The circuit is ideal for interface to microprocessor type systems, since data load into the refresh memory is accomplished just as if it were any other RAM on the DATA BUS.

Books

OPTOELECTRONICS APPLICATIONS MANUAL (HPBK-1000)

The commercial availability of the Light Emitting Diode has provided electronic system designers with a revolutionary component for application in the areas of information display and photocouplers.

Many electronic engineers have encountered the need for a resource of information about the application of and designing with LED products. This book is intended to serve as an engineering guide to the use of a wide range of solid state optoelectronic products.

The book is divided into chapters covering each of the generalized LED product types. Additional chapters treat such peripheral information as contrast enhancement techniques, photometry and radiometry, LED reliability, mechanical considerations of LED devices, photodiodes and LED theory.

This book is available from a Hewlett-Packard franchised distributor or from the McGraw-Hill Publishing Company, at \$19.25. A complete listing of all HP Components franchised distributors can be found on pages 222 and 223.

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