Note

Title & Document Type: 10764B Fast Pulse Converter
Manual Part Number: 10764-90012
Serial Prefixes: 2140A
Revision Date: April 1982

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies.

Changes to this Manual

No changes have been made to this manual. All pages are scanned at 300 DPI or greater.

About this Manual

This manual is reproduced from scans of an original document and images OCR'd with Adobe Acrobat. OCR errors may exist and as such the user of this document should take care and use common sense when referencing this documentation.

Copyright Notice

OPERATING AND SERVICE MANUAL

10764B

FAST PULSE CONVERTER
(for 5501A Laser Transducer Systems)

SERIAL PREFIX 2140A

This manual applies directly to Hewlett-Packard Model 10764B Fast Pulse Converters with Series Prefix 2140A.

SERIES PREFIXES NOT LISTED

For series prefixes above 2140A, a Manual Change Sheet is included with this manual. For serial prefixes below 2140A, refer to Section 7, Manual Changes.

5305 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

Printed: APR 1982

MANUAL PART NO. 10764-90012
Microfiche No. 10764-90013

PRINTED IN U.S.A.

HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period of 90 days from date of installation. During the warranty period, HP will, at its option, either repair or replace products which prove to be defective.

Warranty service of this product will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other cases, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

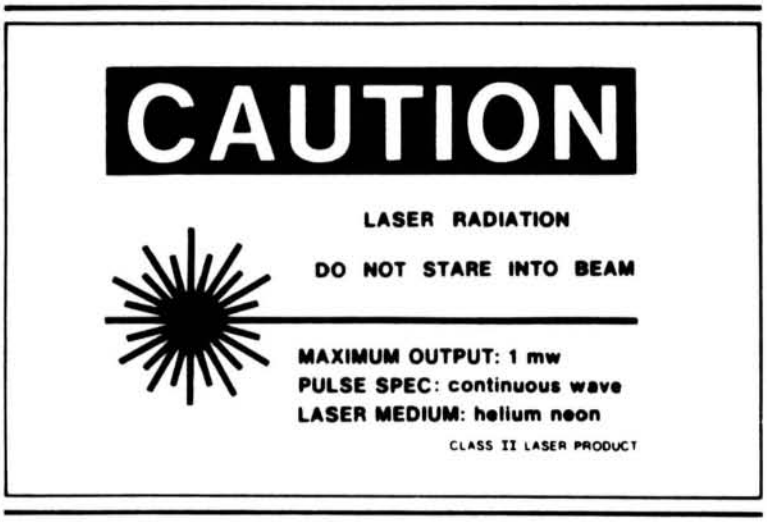
ASSISTANCE

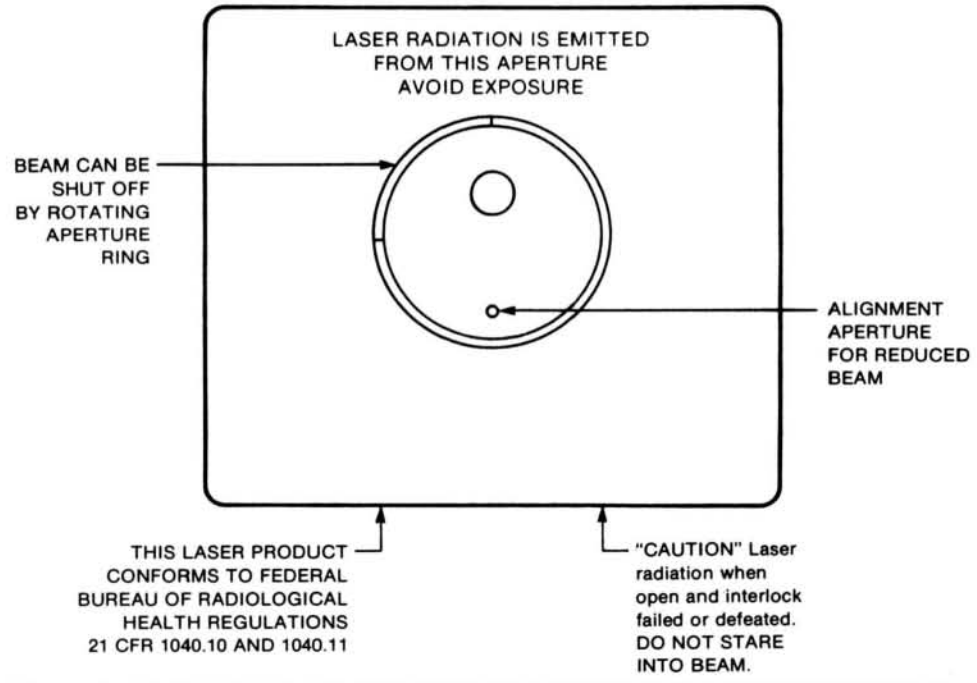
Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SAFETY PRECAUTIONS

This is a Safety Class I system. This system has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus". This product is also a Class II Laser Product conforming to Federal Bureau of Radiological Health Regulations 21 CFR 1040.10 and 1040.11.





CONTENTS

TABLES

TABLES (Continued)

FIGURES

10764B OPERATING AND SERVICE MANUAL
USER INFORMATION SUMMARY

The following list contains information that the user should be immediately aware of, especially those concerned with the differences between the 10764A and 10764B Fast Pulse Converters.

1. The 10764B draws 6 amperes from the 5-volt power supply as opposed to 2 amperes for the 10764A. This may require a change in power supplies, especially for 4-axis system configurations.

2. The 10764B requires the presence of 15-volts at the terminal strip on the rear of the 10740A Coupler while the 10764A could be supplied 15-volts either at the Coupler or pins 23, AA of the front edge connector J1. These pins may still be used for a binding post to distribute 15-volts to the 10780A Receiver.

3. The operating temperature of the 10764B is 0 to 40 degrees C. The 10764A operating temperature is 0 to 55 degrees C.

4. Some of the unused pins at the front edge connector J1 of the 10764A are used on the 10764B. Check to be certain that these pins are electrically free in your installation. Refer to Figure 2-1.

5. On the 10764A either MEAS 1 or MEAS 2 were available at pins 9, 10 of J1 depending on a jumper setting. These signals are now available at separate pins on the 10764B. See Figure 2-1.

6. The Up/Down pulses for axis 1 appear on the upper pair of cables on the 10764B. This is the reverse of the 10764A Layout.

7. If the Error 1 and Error 2 signals appearing on pins 2, 1 of J1 are wired OR'ed it may be necessary on the 10764B to remove one of its corresponding LEDs to ensure a proper logic 0 level.

8. The address and resolution extension of the 10764B are selectable by means of switches as opposed to the jumpers employed on the 10764A. See Section 3.

9. The typical value of the Up or Down pulse width from the 10764B is 67 nanoseconds as opposed to 80 nanoseconds for the 10764A.

10. Be especially careful not to touch the terminal of the Up/Down cables to 5-volts DC on the 10764A or 10764B. Also do not connect the hooded edge connector upside down.

SECTION 1
GENERAL INFORMATION

1-1. SCOPE OF THE MANUAL

1-2. This manual provides operating and service information for the 10764B Fast Pulse Converter. The 10764B is an optional card for the Hewlett-Packard 5501A Laser Transducer system. Refer to the 5501A Operating and Service manual for a description of the system. The 10764B is designed to be installed in the 10740A Coupler.

1-3. MANUAL MICROFICHE

1-4. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4 × 6-inch microfilm transparencies of the manual. The microfiche package also includes the latest Manual Change supplement as well as all pertinent Service Notes.

1-5. PRINTED CIRCUIT BOARD IDENTIFICATION AND MANUAL CHANGES

1-6. The 10764B printed circuit board has a four-digit series identification (e.g. 1504). The series number identifies a group of identical printed circuit boards. If the series number on your board is higher than the series number on the title page of this manual, your board differs from the documentation presented here. A change sheet should be included that has the correct series number, this change sheet describes the differences between series numbers. If the change sheet is missing, request one from the nearest Hewlett-Packard sales and service office listed at the back of this manual. For series numbers below the series number on the title page, refer to the backdating information in section VII.

1-7. DESCRIPTION

1-8. The 5501 Laser Transducer system provides the capability of determining the displacement of one or more retroreflectors. For each retroreflector, a doppler-shifted measurement signal is generated whose electrical phase, relative to a common reference, is proportional to the retroreflector displacement.

1-9. The 10764B generates pulses for each of two retroreflectors, the number of pulses being proportional to the phase difference between the reference signal and measurement signal and thereby proportional to the displacement measured.

1-10. Up pulses are produced when the phase of the measurement signal is leading relative to the reference signal from the 5501 Laser Head and down pulses are generated when the phase is lagging. When there is no relative motion of the retroreflector, the phase difference between the measurement and reference signals remains constant and neither up nor down pulses are generated.

1-11. The up/down pulses are used to increment or decrement a counter located in the 10762A Comparator board. The counter contents are a digital representation of the displacement of the retroreflector. One 10762A is required for each measurement axis.

1-12. A unique feature of the 10764B is the ability to electronically extend the measurement resolution allowing resolutions of up to X15 while maintaining high measurement velocities.

1-13. EQUIPMENT SUPPLIED

1-14. Table 1-1 lists equipment supplied.

Table 1-1. Equipment Supplied

DESCRIPTION	HP PART NUMBER
Interface Cable	10764-60005
Fast Pulse Converter	10764-60003

1-15. SPECIFICATIONS

1-16. Table 1-2 lists the specifications for the 10764B.

Table 1-2. 10764B Specifications

Pulse Rate Output: 9 MHz maximum; Pulse Width is 67 nanoseconds typical

ASCII:L Refer to 5501 System Manual for decimal representation

Instructions: 0X clears error bits, samples resolution switches; 2X loads error bits onto coupler data bus; Coupler bus reset, same as 0X.

Note: X, Y, Z, A, B, C same as X

ASCII: Refer to Table 4-11 of 5501 System Manual for Instruction Set Conversion from Alpha-numeric to Decimal.

Environmental:

Operating Temperature: 0°C to 40°C (32°F to 104°F)

Non-Operating Temperature: -40°C to +75°C (-40°F to +167°F)

1-17. SAFETY CONSIDERATIONS

1-18. The HP 10764B is a Safety Class 1 instrument. This instrument has been designed and tested in accordance with IEC Publication 348 Safety Requirements for Electronic Measuring Apparatus.

1-19. This manual contains information, cautions, and warnings which must be followed by the user to ensure safe operation and to retain the instrument in safe condition.

SECTION 2
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains instructions for unpacking, inspection, preparation for use, power requirements, operating environment, installation in the 10740A Coupler, interconnecting cables, operational check and warranty claims, packaging for reshipment, and storage.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the 10764B for visible damage (scratches, cracks, etc.). If the 10764B is damaged, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Keep the shipping carton and packing material for the carrier's inspection. The HP Sales and Service Office will arrange for repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. Warranty Claims

2-6. Contact the nearest HP Sales and Service Office (see manual back cover) for information relative to warranty claims.

2-7. PACKAGING FOR RESHIPMENT

2-8. Original Packaging

2-9. The same containers and materials used in factory packaging can be obtained through Hewlett-Packard Sales and Service Offices listed at the rear of this manual.

2-10. If the 10764B is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, model number and full serial number. Mark the container FRAGILE to assure careful handling.

2-11. In any correspondence refer to the instrument by model number and full serial number.

2-12. Other Packaging Methods

2-13. If it becomes necessary to reship an instrument, good commercial packing should be used. Contract packaging companies can provide dependable custom packaging on short notice. The following general instructions should be followed when repackaging with commercially available materials.

1. If shipping to a Hewlett-Packard Service Office or Center, attach a tag indicating the type of service required, return address, model number and full serial number.
2. Wrap the instrument in heavy paper or plastic.
3. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.
4. Use enough shock-absorbing material (three to four inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside the container.
5. Seal the shipping container securely.
6. Mark the shipping container FRAGILE to assure careful handling.

2-14. STORAGE

2-15. If the 10764B is to be stored for an extended period of time, it should be enclosed in a clean, sealed container.

2-16. PREPARATION FOR USE

2-17. The following paragraphs provide information necessary to prepare the 10764B for use. Included are power requirements, operating environment, installation, interconnecting cables and warranty claims.

2-18. Power Requirements

2-19. The 10764B receives operating power via the 10740A Coupler. Power required by the 10764B is as follows:

Voltage	Current (Amperes)
5	6
15	0.02

2-20. Recommended Power Supplies

2-21. In a 4-axis system, the 5-volt current requirement is 12 amperes for 2 10764B cards and 22 amperes for the system. Hewlett-Packard recommends the Model HP 62605L power supply for this configuration.

2-22. For other configurations and power supply recommendations refer to the 5501 System Operating and Service Manual and the 5501 Ordering Guide.

2-23. 5- and 15-volt Return

2-24. The +5-volt return should be connected to the 15-volt return at the terminal strip on the rear of the 10740A Coupler only.

2-25. Power Line Noise

2-26. The 5501 system electronics are susceptible to noise on the power lines. HP power supplies used 5501 have special line filters installed to minimize the effects of line transients. When using other power supplies or if the 10764B exhibits unexplained error indications, the system power should be checked for line transients to determine if additional filtering is required.

2-27. ENVIRONMENTAL CONDITIONS

2-28. Operational and storage conditions for the 10764B are as follows:

OPERATION
Temperature: 0°C to 40°C (32°F to 104°F)
Relative Humidity: 0% to 95%

STORAGE
Temperature: -40°C to +75°C (-40°F to +167°F)
Relative Humidity: 0% to 95%

2-29. INSTALLATION

2-30. The 10764B is designed to be installed in the 10740A Coupler. Refer to the 5501 System Operating and Service Manual for details of installation.

NOTE

When installing a card, the card is inserted so that the components are on the right-hand side when facing the front of the coupler.

CAUTION

Before installing or removing a circuit board, switch off the power to the 10740A Coupler.

2-31. Recommended Installation of Cards in the 10740A Coupler

2-32. The recommended arrangement of cards in the 10740A for a 4 axis system, reading from left to right is:

Output Card (Binary or HP-IB)
10762A
10762A
10764B
10762A
10762A
10764B
10755A Compensation Interface

NOTE

If the above arrangement is not followed, do not locate two 10764B's in adjacent coupler slots.

2-33. This arrangement draws the maximum amount of power that the coupler can handle. It also keeps the largest IR drop in the back plane close to the input barrier strip and is the most suitable means of distributing the heat load.

2-34. Connectors

2-35. The dual 43-pin connector edge mates with rear coupler connector number 1251-3755. The dual 24-pin (48) connector edge mates with the 48-pin connector on Interface Cable 10764-60005. The 86 pins of the rear connector (P1) are connected in parallel to the coupler bus or backplane.

2-36. 10740A Coupler Bus

2-37. All of the printed circuit board units that plug in the 10740A Coupler interface are in parallel at the 10740A backplane by virtue of the 10740A Coupler Bus. The bus consists of 86 lines. Table 2-1 lists the pin numbers and names of the bus lines.

Table 2-1. 10740A Coupler Bus Lines

FUNCTION	PINS	NAMES	PINS	NAMES
POWER	1	+15 VOLTS	2	+15 VOLTS
	3	-15 VOLTS	4	-15 VOLTS
	5	±15 RETURN	6	±15 RETURN
INSTRUCTIONS	7	SPARE	8	SPARE
	9	CARD ADDRESS-A	10	CARD ADDRESS-B
	11	CARD ADDRESS-C	12	CARD ADDRESS-D
	13	CARD CMD-A	14	CARD CMD-B
	15	CARD CMD-C	16	CARD CMD-D
STATUS	17	$\overline{\text{DATA VALID}}$	18	$\overline{\text{DATA VALID}}$
	19	$\overline{\text{INSTRUCTION VALID}}$	20	$\overline{\text{INSTRUCTION VALID}}$
	21	$\overline{\text{OPERATION COMPLETE}}$	22	$\overline{\text{OPERATION COMPLETE}}$
	23	$\overline{\text{SAMPLE}}$	24	$\overline{\text{PWR-UP/SYSTEM RESET}}$
ERRORS	25	$\overline{\text{REF ERROR-BIT}}$	26	$\overline{\text{MEAS ERROR-BIT}}$
	27	$\overline{\text{V.O.L. ERROR-BIT}}$	28	$\overline{\text{OVFL-BIT}}$
DECIMAL POINT	29	D.P.-BIT-1	30	D.P.-BIT-0
	31	D.P.-BIT-3	32	D.P.-BIT-2
MODE-STATUS	33	λ-MODE BIT	34	SYSTEM NULLED
	35	SPARE	36	SPARE
	Key →		Key →	
POWER	37	+5V RETURN	38	+5V RETURN
	39	+5V RETURN	40	+5V RETURN
	41	+5 VOLTS	42	+5 VOLTS
	43	+5 VOLTS	44	+5 VOLTS
	45	+5 VOLTS	46	+5 VOLTS
	47	+5V RETURN	48	+5V RETURN
	49	+5V RETURN	50	+5V RETURN
	51	SPARE	52	SPARE
DATA	53	DATA BIT 1	54	DATA BIT 0
	55	DATA BIT 3	56	DATA BIT 2
	57	DATA BIT 5	58	DATA BIT 4
	59	DATA BIT 7	60	DATA BIT 6
	61	DATA BIT 9	62	DATA BIT 8
	63	DATA BIT 11	64	DATA BIT 10
	65	DATA BIT 13	66	DATA BIT 12
	67	DATA BIT 15	68	DATA BIT 14
	69	DATA BIT 17	70	DATA BIT 16
	71	DATA BIT 19	72	DATA BIT 18
	73	DATA BIT 21	74	DATA BIT 20
	75	DATA BIT 23	76	DATA BIT 22
	77	DATA BIT 25	78	DATA BIT 24
	79	DATA BIT 27	80	DATA BIT 26
	81, 83, 85	MAKE NO CONNECTION	82, 84, 86	MAKE NO CONNECTION

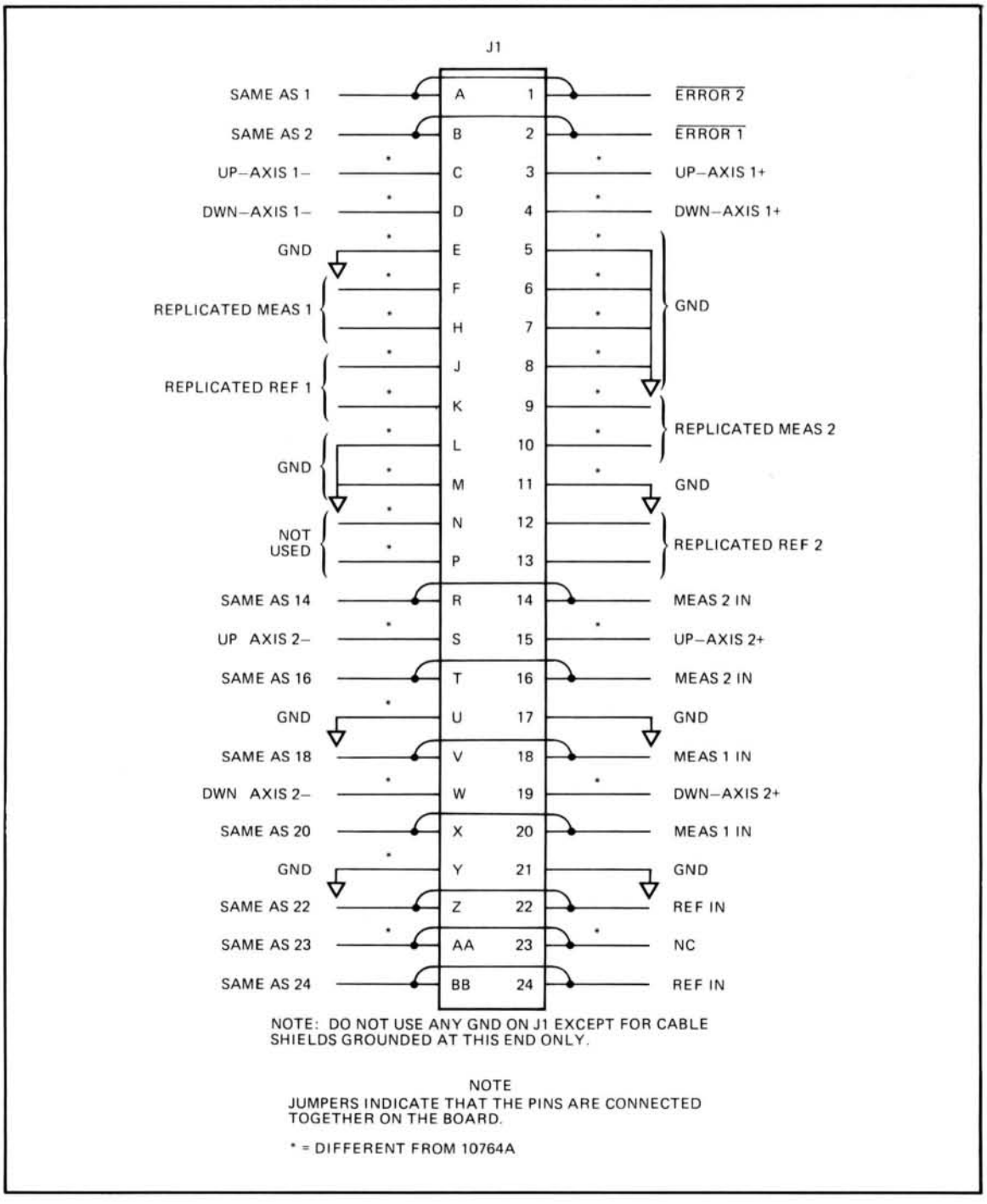
2-38. 10764B Front Edge Connector Signals

2-39. Figure 2-1 shows the front edge connector and signals.

CAUTION

Do not connect the hooded connector from the 10780A Receiver upside down on the front edge of the 10764B. Be sure that the pin numbers match on the mating connectors. If the connectors are mated improperly, damage to the circuit may result. Specifically, +15-volts can be applied to U82 and may result in its destruction.

Figure 2-1. Front Edge Connector and Signals



SECTION 3
OPERATION

3-1. INTRODUCTION

3-2. This section contains operation information for the 10764B Fast Pulse Converter. For system operation, see the 5501 System Operating and Service manual.

3-3. SWITCHES

3-4. Switches are provided to set the resolution and address selection of the 10764B.

3-5. Resolution Extension

3-6. Provision is made to select one of 32 resolution factors by means of three switches located on the 10764B. A 4-pole switch labelled P is common to both axes. Two 4-pole switches labelled Q are for the separate measurement axes. The Q switches must have only one switch set up (away from the dot) at any one time. Any combination that results in a number between 8 and 15 may be used on the P switch. The available combinations for the various modes are listed in Tables 3-1 through 3-5.

NOTE

System resolution = Q/P × λ/4 for linear interferometer and Q/P × λ/8 for plane mirror.

Table 3-1. Resolution Extension Factors

RESOLUTION EXTENSION = P/Q								
Q P	8	9	10	11	12	13	14	15
8	1	1.125	1.25	1.375	1.5	1.625	1.75	1.875
4	2	2.25	2.5	2.75	3.0	3.25	3.5	3.75
2	4	4.5	5.0	5.5	6.0	6.5	7.0	7.5
1	8	9	10	11	12	13	14	15

Table 3-2. Resolution of a Single Beam or Linear Interferometer with the 10764B

Q P	8	9	10	11	12	13	14	15
8	λ/4	λ/4.5	λ/5	λ/5.5	λ/6	λ/6.5	λ/7	λ/7.5
4	λ/8	λ/9	λ/10	λ/11	λ/12	λ/13	λ/14	λ/15
2	λ/16	λ/18	λ/20	λ/22	λ/24	λ/26	λ/28	λ/30
1	λ/32	λ/36	λ/40	λ/44	λ/48	λ/52	λ/56	λ/60

Table 3-4. Maximum Velocity for Non-Differential Mode Single Beam and Linear Interferometer (inches/sec)

Q \ P	8	9	10	11	12	13	14	15
8	15	15	15	15	13	10	8	6
4	15	15	15	15	13	10	8	6
2	11.2	9.4	9	7.5	7.4	6.5	6	5.5
1	5.5	4.7	4.4	3.8	3.5	3.2	3	2.8

Plane mirror interferometer specifications are one-half of these values.

Table 3-5. Maximum Velocity for Differential Mode Single Beam and Linear Interferometer (inches/sec)

Q \ P	8	9	10	11	12	13	14	15
8	15 / –	15 / –	15 / –	15 / –	13 / –	10 / –	8 / –	6 / –
4	15 / 21	15 / 18.5	15 / 17	15 / 15	13 / 14	10 / 13	8 / 12	6 / 11.5
2	13.2 / 11.2	13.6 / 9.4	13.8 / 9	14 / 7.7	13 / 7.4	10.3 / 6.5	8 / 6	6 / 5.7
1	13.2 / 5.5	13.0 / 4.7	13.8 / 4.4	14 / 3.8	13 / 3.5	10.3 / 3.2	8 / 3	6 / 2.8

10764B

Max velocity for DIFFERENTIAL MODE SINGLE BEAM & LINEAR INTERFEROMETER. Upper numbers are limits for individual retroreflectors and lower numbers, if listed, place additional specs on relative velocity of retroreflectors.

3-7. Address Selection

3-8. Two 7-pole switches are provided to select the address, one for each axis. The address for any axis is selected by moving the appropriate switch up (away from the dot). Only one section of each switch may be up at a time.

3-9. VELOCITY LIMITATIONS, LED INDICATORS, AND SIGNALS

3-10. Velocity Limitations

3-11. The 10764B error circuits will detect errors resulting from velocities which exceed the limits listed in the tables above except in certain instances when measured signals are fed into both the REF and MEAS inputs (differential mode). In this mode, if the velocity limits in the table are exceeded, erroneous UP/DOWN pulses may be produced without activating the error circuitry. This occurs only when both retro-reflectors in the differential mode have velocities exceeding the specified limits and a low differential velocity.

3-12. LED Indicators and Signals

3-13. The green LED gives a visual indication that 5 volts is present on the board.

3-14. Three large red LED's indicate the presence of MEAS 1, MEAS 2, and the REF signal. These do not verify the presence of 5 volts.

3-15. Seven small red LED's are provided to indicate errors as follows:

1. Loss of lock MEAS 1
2. Loss of lock MEAS 2
3. Loss of lock REFERENCE

(1, 2, 3) — Indicates excess velocity or signal dropout.

4. Pulse Converter Overrun Axis 1
5. Pulse Converter Overrun Axis 2

(4, 5) — Indicates output pulses exceed 9 MHz capability of 10764B

6. ERROR 1
7. ERROR 2

3-16. The signals common to each axis are OR'd together to produce ERROR 1 and ERROR 2. For example, ERROR 1 activates whenever MEAS 1 loss of lock or axis 1 overrun or REF loss of lock occurs. Error 1 and 2 also have LED indicators and are available at the front edge connector as follows:

ERROR 1 — Pin 2
ERROR 2 — Pin 1

3-17. If ERROR 1 and ERROR 2 are wired OR'd, one of the associated LED's may have to be removed in order to not exceed the current capabilities of the driving gates.

3-18. SIGNALS

3-19. ECL Signals

CAUTION

The 10764B uses ECL circuitry. ECL signals must not be grounded at any time. Damage to the drivers will result. Use extreme care when connecting test equipment and probes on the board. Test probe ground connections should only be made to those pins marked with a ground symbol.

3-20. Replicated Signals

3-21. Replicated signals are available at the front edge connector of the board as follows:

Replicated Signal	Front Edge Pins
Reference	12, 13 and K, J
MEAS 1	H, F
MEAS 2	9, 10

NOTE

MEAS 1 is no longer available at 9, 10 via jumper selection as in the 10764A.

3-22. Signal Sense of Up and Down Pulses

3-23. When the MEAS frequency is greater than the REFERENCE frequency, the 10764B produces UP pulses.

3-24. 10764A and 10764B Axis Connections

3-25. The top pair of cables on the 10764B carries the UP, DOWN pulses for axis 1. On the 10764A, axis 1 appears on the bottom pair.

CAUTION

The metalic connectors on the UP/DOWN cables are driven by TTL signals. The drivers may be destroyed if they come in contact with the positive power supply voltage.

3-26. MEASUREMENT ON THE FLY

3-27. When the system I/O card issues a simultaneous sample command onto the backplane, each 10762A begins the sampling process, however, the counter sampling circuits are required to wait until no carries are propagated up the counter chain. This results in a variable delay between the command and the actual result. As the velocity and the resolution increase the counters are increasing speed and the probability of having to wait for carries to complete increases rapidly as the counters approach maximum speed.

3-28. The result is that when the retroreflector is approaching the velocity limit, there an be a relatively large difference in the counts recorded from several 10762A boards having the identical signals applied to the inputs of the 10764B (50 or more counts).

3-29. This is not a new characteristic of the 10764B but rather is inherent in the 10762A due to its speed limitations. From the users viewpoint this means that high precision data is not available when near the velocity limit specified for the particular resolution extension that has been selected. Note that no data is lost, it is just available later at higher speeds than at lower speeds.

SECTION 4
THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section contains theory of operation for the 10764B Fast Pulse Converter.

4-3. BLOCK DIAGRAM DESCRIPTION

4-4. The block diagram of the 10764B is shown in Figure 4-1. The card receives a reference signal and two measurement (doppler) signals and provides up or down pulse output signals for 2 axes. Since the MEAS 1 and MEAS 2 channels are identical, only one will be discussed in the following descriptions.

4-5. The measurement signals are in the form of TTL square waves received from the 10780A Receiver. The measurement signals are routed to a Line Receiver and Opto isolater which couples the signal into the 10764B without introducing ground loops, and provides immunity to cable transients. The Opto isolator output connects to the Frequency Multiplier Resolution Extender consisting of a phase locked loop whose output is an ECL signal of frequency 2P times that of the input MEAS signal.

4-6. The frequency-multiplied and phase-locked version of MEAS 1 is routed to the ÷2Q1 circuits for division by the factor of 2Q1. The overall result is a signal whose frequency is 2P/2Q1 (P/Q1) times the MEAS frequency. The values of P and Q1 are determined by switches on the 10764B and range from 1 through 15 as shown in table 3-1.

4-7. The reference signal from the 5501 Laser Head also arrives in TTL square wave form and is processed in the same way as the MEAS signals. This results in a signal that is phase-locked to the REF input and multiplied in frequency by a factor of P/Q1.

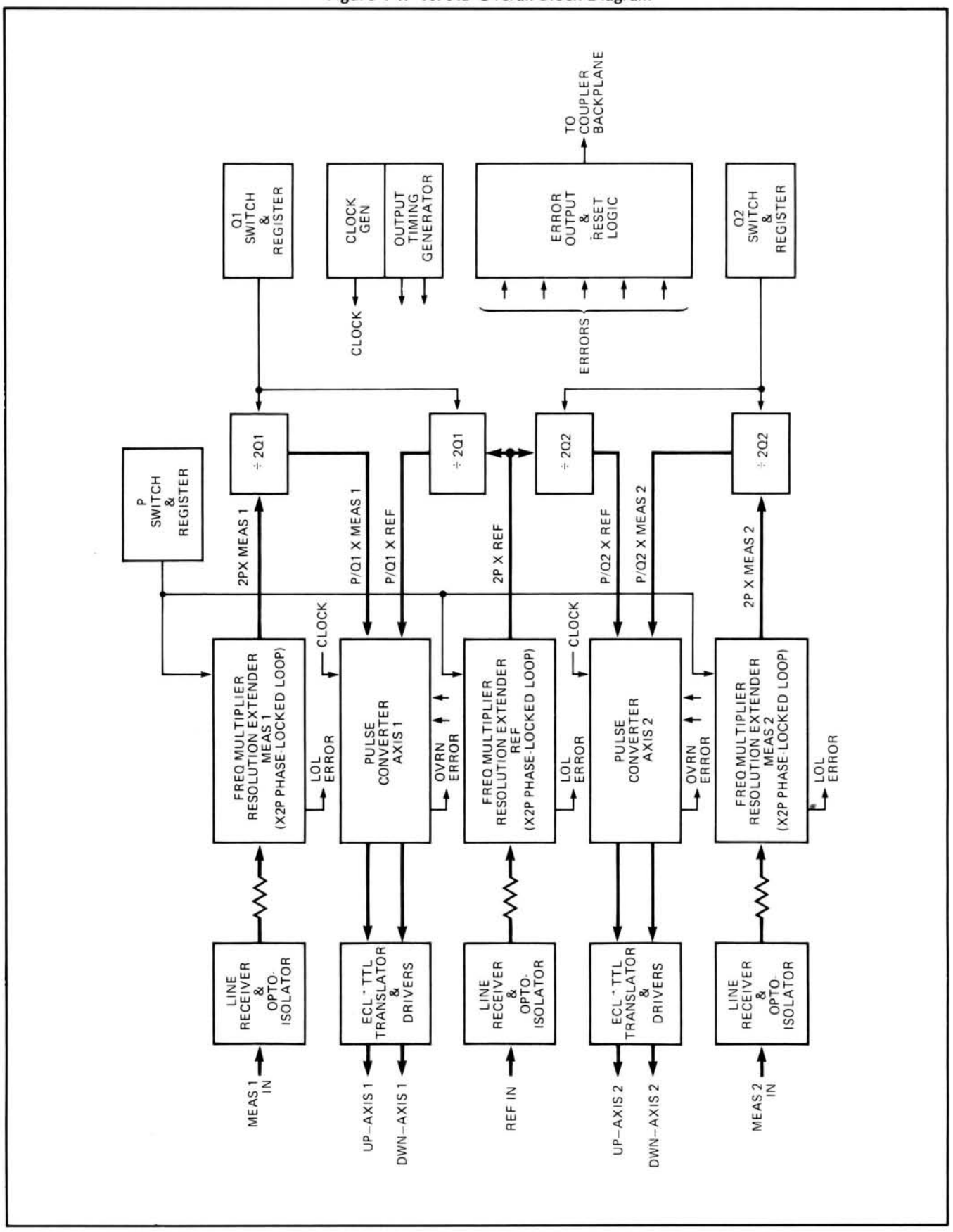
4-8. The frequency-multiplied versions of the REF and MEAS signals are applied to the Pulse Converter. When the frequency of the measurement signal exceeds the frequency of the reference signal a proportional number of up pulses are produced. Conversely, down pulses are produced when the MEAS frequency is lower than the REF. This is accomplished, in effect by subtracting the number of transitions, both positive and negative going, of the multiplied reference signal from that of the multiplied measurement signal. A number of pulses equal to the absolute value of this difference appears on the up axis output when the sign of the difference is positive. When the sign of the difference is negative, the pulses appear on the down axis output. By frequency multipling the MEAS and REF signals, up/down pulses are produced by the pulse converter for fractional cycles of phase shift between the input signals because the fractional cycles become whole cycles of the frequency-multiplied inputs. By this means, the resolution of the 5501 can be extended beyond counting half cycles of phase shift.

4-9. The Pulse Converters use emitter-coupled logic synchronized to a 90 MHz clock generated by the Clock Generator. The output of the Clock Generator is also divided down in the Output Timing Generator to produce signals ensuring that the up/down pulses from the 10764B are separated by sufficient time intervals to allow proper functioning of the counter in the 10762A circuits.

4-10. The Error and Reset Logic circuits output error bits onto the coupler backplane when improper conditions exist in the Pulse Converters or Frequency Multipliers. The Coupler backplane interfaces to the Controller. Error bit outputs occur in response to a command received by the 10764B from the Controller via the backplane. In addition, the controller can send a reset command to clear the Error Latches and initialize the Pulse Converters in order to prevent false pulses from being issued when the entire system is initialized and the counters in the 10762A are preset.

4-11. The following paragraphs describe the 10764B circuits in detail. Refer to the schematic diagram in Section 8.

Figure 4-1. 10764B Overall Block Diagram



4-12. LINE RECEIVER AND ISOLATOR

4-13. MEAS 1 enters the 10764B at pins 18,V and 20,X of the front edge connector J1 and connects to R8 and R9. These resistors form a balanced termination impedance whose magnitude is approximately equal to that of the balanced, shielded pair used to route the MEAS signal to the 10764B. MEAS 1 is a TTL square wave. When R8 is positive with respect to R9, current flows through LED CR4 and R7. CR4 gives a visual indication of the presence of MEAS 1. When the polarity of MEAS 1 changes, current flows through the emitter of the opto-isolator U6 and R6. CR10, Q2, and CR9, Q5 serve to limit the current through CR4 and the emitter LED by shunting current when the base-to-emitter junctions of the transistors turn on.

4-14. FREQUENCY MULTIPLIER RESOLUTION EXTENDER

4-15. The following paragraphs describe the Frequency Multiplier Resolution Extender circuits in detail.

4-16. Input TTL-ECL Converter and Shaper

4-17. Photons from the LED in the opto-isolator are directed to the base of the photo-transistor resulting in changing its state from off to on. The output of the isolator is the same structure as an open collector TTL gate. The output transistor drives R16, R14, R15 which serve to convert its on/off state to ECL voltage levels. C5 serves to provide immunity to sharp noise spikes. The signal ISOL OUT is then fed to an ECL differential line receiver U16-12, 13 which is configured to form a schmitt trigger via the positive feedback provided by R29, R26. The hysteresis of the schmitt gives added immunity to noise during the transitions of ISOL OUT. The output of the schmitt, PLL IN, is an ECL signal having transitions concident with MEAS 1. This signal is used to form the reference input to the phase detector at U27-6.

4-18. Phase Locked Loop

4-19. The phase locked loop consists of a phase comparator, amplifier/filter, VCO, and divide by 2P circuit. The phase comparator output drives the filter/amplifier which in turn drives a VCO. The VCO output drives a frequency divider whose output is returned to the other input of the phase comparator. When the phase of the fedback signal differs from the input signal, a voltage is generated, filtered, and used to change the VCO frequency so that the phase and frequency of the ÷2P output is equal to that of the input signal. When the loop is locked, the frequency of the VCO will be greater than that of the input signal by the modulus of the divider which is 2P.

4-20. At the phase detector, the divided-down output of the VCO feeds to the variable V input. Whenever the signal at the variable input lags the signal at the R input, pulses are produced at the U output. The width of these pulses is equal to the time interval between the positive-going transitions of the R and V inputs. In a similiar manner, pulses are produced at the D output whenever a leading phase relationship exists. These error pulses are converted to an analog output by a low pass filter composed of R55, C39, and R54, C37. Thus, the differential signal at C37, C39 is an analog of the phase difference between the digital signals at the R and V inputs of the phase detector U27.

4-21. An offset adjust circuit is included to compensate for any DC offset and to minimize AC ripple on the analog phase error signal. At lock, phase detector ripple tends to frequency-module the VCO.

4-22. Filter/Amplifier and VCO

4-23. The differential phase error signal connects to a differential amplifier consisting of U36, R77, R86, R84, C59, R85, and C60. This circuit amplifies and shapes the error signal to produce a single-ended output (AMP OUT) to drive the VCO. The AMP OUT signal drives the VCO through two paths; one consisting of R96, C83, R95, R93, and R94 which leads to the voltage-control input of the VCO U45; the other path is made up of R109 and varactor diode CR20 which also varies the frequency of the VCO.

4-24. The characteristics of the closed loop are such that there is no phase error at lock for any input frequency within the allowed range. During a constant rate of change of the input frequency there is a fixed steady-state phase error.

4-25. Divide by 2P Network

4-26. The output of the VCO at U45-6 is 2P × MEAS 1 and drives a ÷2P network consisting of two frequency dividers. The P divider consists of U67 and part of U66. The ÷2 division is performed by the other half of U66. The divided output of the VCO (PLL OUT) is returned to the phase detector U27 to close the loop.

4-27. Divide by 2Q1 Network

4-28. The 2P × MEAS 1 signal forms the output of the loop and drives the ÷2Q1 circuits. These circuits consist of a 4-bit divider capable of dividing by factors of 2, 4, 8, and 16 depending upon the setting of the Q1 switch. MEAS 1 has been multiplied by 2P in the PLL and, after this division, divided by 2Q1 to yield P/Q1 × MEAS 1. This signal drives the pulse converters.

4-29. Switch Registers

4-30. The value of P is common to axis 1 and 2 while Q1 and Q2 may be set independently. The switches determining P, Q1, Q2 are sampled when the system is reset and their value is stored in the switch registers U80 and U81. Whenever the switch settings are changed, or power is turned on, the system must be reset. Two or more resets should be applied to allow the phase locked loops to recover from the transients generated by the change in switch values or application of power.

4-31. Loss of Lock Detector

4-32. During normal operating conditions, the signals PLL IN and PLL OUT are phase locked by the feedback action of the loop so that their positive-going transitions are coincident in time. The phase detector U27 generates a pulse at either the U or D outputs according to the sign of the time interval between these transitions, and whose width is equal to the magnitude of the interval. Under locked conditions, these pulses are very narrow and would ideally be zero. However, if the VCO is unable to generate a signal which tracks PLL IN, then the width of the pulses at the U or D outputs increases until it equals the period of either PLL IN or PLL OUT resulting in the Loop Losing Lock. When lock is reacquired, a number of cycles will probably have been skipped between these signals resulting in erroneous pulses sent to the counters on the 10762A board. To detect this condition, one of the two flip-flops of U15 is latched into a 1 state and a loss-of-lock error signal is sent to the error logic circuitry.

4-33. Input Replicator

4-34. The MEAS and REF signals of the 5501 Laser Transducer system are capable of driving only one input. Some system configurations require the use of the same signal at more than one location. For this reason, a replicated version of MEAS 1, capable of driving one output is available at the front edge connector J1. The ECL version of MEAS 1 (PLL IN) is sent to a differential driver U16-6, 7 which in turn drives TTL differential line receiver U9. The TTL single ended output of U9 connects to the input of TTL differential line driver U2. Replicated versions of MEAS 2 and two replications of the reference signal are also available at J1.

4-35. PULSE CONVERTERS

4-36. The Pulse Converters receive the MEAS signal multiplied by P/Q and the REF signal multiplied by P/Q and subtracts the number of transitions, both positive and negative going, occurring on the multiplied reference input from that occurring on the multiplied measure input. If the result is a positive quantity, a number of pulses equal to the difference is produced on the UP output. If negative, the pulses are produced on the DOWN output. The subtraction process is performed by the very fast Micro Up/Down counter which is incremented by transitions of the multiplied MEAS signal and decremented by transitions of the multiplied REF signal. If these two signals are the same frequency (no relative motion of the retroreflectors) the counter will alternate between two states 0 and 1. If the MEAS signal has transitions at a greater rate than the reference signal, the counter will be driven to states >1, and conversely if the REF signal is the greater frequency, the counter will be driven to states <0.
4-37. The micro U/D counter has only 14 allowed states and would quickly overflow if its contents were not transferred to a larger counter. This is accomplished by sampling the counter every tenth pulse of the 90 MHz clock used to synchronize the pulse converter. If, when sampled, the state of the counter is found to be >1, an up pulse is sent to the 10762A's large, but relatively slow, up/down counter. A compensating pulse is sent back to the Micro UP/DOWN counter to keep the sum of both counters equal to the difference in transitions. Similiarly, if the state of the counter is found to be <0, a down pulse is sent to the 10762A and a compensating up pulse is fed back to the 10764B counter. If the state of the counter is found to be 0 or 1, no pulses are issued. The overall result is for the fast 10764B counter to track the rapid short-term fluctuations in the difference between the transitions of the multiplied MEAS and REF signals. The slower long-term effect is tracked by the large counter of the 10762A.

4-38. The following paragraphs describe the Pulse Converter circuits in detail. Figure 4-2 shows the Pulse Converter block diagram, also see Section 8 for the schematic diagram.

4-39. Synchronizer

4-40. The multiplied MEAS 1 and REF signals, P/Q × MEAS 1 and P/Q1 × REF 1 enter the axis 1 pulse converter at the synchronizer. This circuit consists of six D flip-flops configured as a shift register. The synchronizer synchronizes the transitions of the multiplied MEAS and REF signals to the 90 MHz clock. Six stages of synchronization are used to minimize "teeter" which can occur when the data at the D input is changing during the active transition of the clock, and results in the output hanging in a state between logical zero and one for considerable lengths of time. This would result in erronous outputs from the pulse converter.

4-41. For each transition of P/Q1 × MEAS 1, the output of the first stage of the shift register, U56-8, undergoes a corresponding transition at the next clock pulse. The output of the next stage of the shift register performs a similar action at the next clock pulse, and this is repeated throughout the chain.

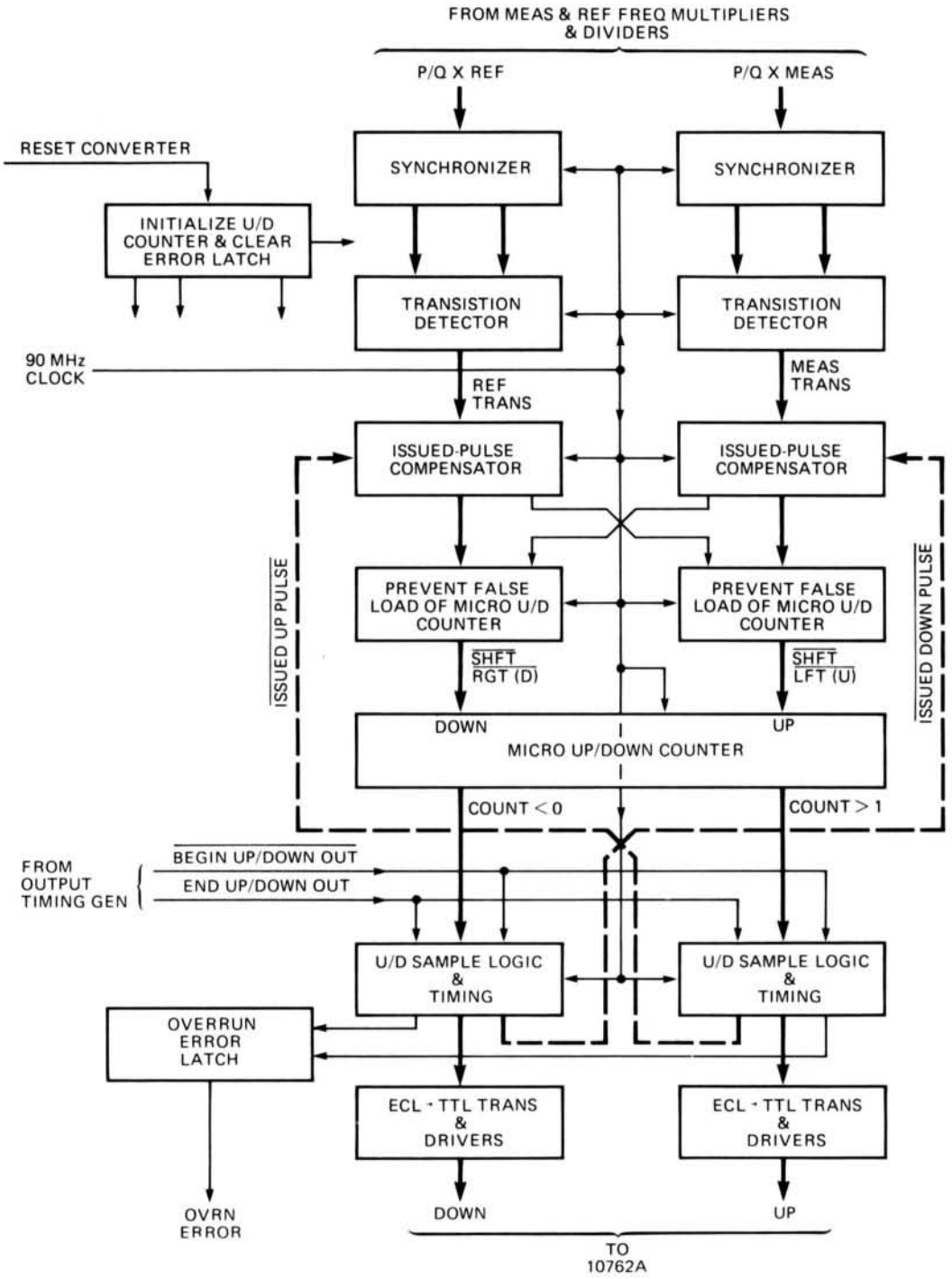
4-42. Transition Detector

4-43. For each transition of the MEAS AND REF signals, the final two stages of the respective synchronizers undergo corresponding changes but separated in time by one clock pulse. The signals from the final two stages are fed to exclusive-OR gates U47-10 and U47-3 which produce a positive level of one clock cycle duration for each positive or negative transition of the inputs to the synchronizer. The outputs of the exclusive-OR gates are synchronized by D flip-flops in U48 to form the signals MEAS TRANS and REF TRANS. The relationship between MEAS 1 IN and MEAS TRANS is: for each cycle of MEAS 1 IN, P/Q1 cycles appear at the input to the synchronizer, and for each cycle at the synchronizer there occurs two positive levels, each of one cycle duration, of MEAS TRANS. A similar relationship exists for REF IN and REF TRANS.

4-44. Issued-Pulse Compensator

4-45. For every up or down pulse issued by the pulse converter to the 10762A board, a compensating up or down pulse is fed back to the counter to prevent it from overflowing. This is accomplished by setting the appropriate JK flip-flop in U46 whenever an up or down pulse is issued by the pulse converter. The output of the flip-flop is then OR'ed with MEAS or REF TRAN and remains high until one clock cycle following the first absence of a high level on MEAS or REF TRANS as the case may be. The output of the OR gates is then synchronized by the D flip-flops in U38.

Figure 4-2. Pulse Converter Block Diagram



4-46. Prevent False Load of Counter

4-47. The control inputs of the shift registers comprising the Micro U/D counter respond to the presence of high levels on both the MEAS and REF TRANS path during the same clock cycle with an undesired loadn Since the desired response to this condition is for the counter to do nothing, the gates U37-14 and U37-15 are used to cancel the simultaneous presence of signals on both paths. The outputs are synchronized by the D flip-flops of U39 to produce the signals SHFT LFT (U), and SHFT RGT (D) which are used as the inputs to Micro U/D counter.

4-47a. MICRO U/D COUNTER

4-48. The Micro U/D counter consists of two 4-bit, universal shift registers U28, U29 configured to form a bidirectional, twisted ring counter. The 0 state of this counter corresponds to all 8 bits being in the high state. From this state, the first up pulse results in Q0 of U28 going low to produce the 1 state. The next up pulse causes Q1 to go low and so on around to Q0 of U29 and then to Q1, etc. of U29 going low. Down pulses reverse this sequence until the 0 state is again reached. Additional down pulses cause Q3 of U29 to go low and then Q2, etc. Note that the states >1 corresponds to Q1 of U28 being low, and the states <0 correspond to Q3 of U29 being low. When the MEAS and REF input signals are equal in frequency (no motion of the retroreflector), the counter alternates between the 0 and 1 states. No UP or down pulses will be issued by the pulse converter from these states.

4-49. UP/DOWN Sample Logic and Timing

4-50. On every tenth cycle of the 90 MHz clock, the Micro U/D counter is sampled via the signal BEG OUT and gates U18-14, U18-3. If the state of this counter is >1, the JK flip-flop U17-2 is set causing an up pulse to be issued to the 10762A counter. A compensating down pulse is also fed back to the counter to keep it from overflowing. In a similar manner, if the state is <0, a down pulse is issued to the 10762A counter and a compensating UP pulse is fed back to the Micro U/D counter. The signal END OUT is also a divided-by-ten version of the 90 MHz clock, but of different phase than BEG OUT, and is used to terminate the UP or DOWN pulses sent to the 10762A thereby defining the width of these pulses.

4-51. ECL-To-TTL Translator and Output Drivers

4-52. The UP and DOWN pulses sent to the 10762A appear in ECL form as the outputs of U17, and are labeled "UP-ECL" and "DWN-ECL". These pulses are routed to the TTL differential line receiver U8. The outputs of U8 are TTL single-ended (UP-TTL and DWN-TTL) and drive the TTL differential line drivers in U1. The outputs of U1 drive the shielded twisted-pair cables to the 10762A, and are also available at the front edge connector J1.

4-53. Overrun Error Latch

4-54. As the relative frequency between MEAS IN and REF IN increases, a point is reached where the micro U/D counter is being incremented (or decremented) at a rate faster than the 9 MHz sample rate can transfer its contents to the counter on the 10762A. This causes the Micro U/D counter to overflow and send erroneous pulses to the 10762A. The first improper state reached by the counter when overflowing is for both signals, COUNT >1 and COUNT <0, to become active. This condition is detected by gate U18-2 and used to set the latch U30-14 which is then converted to TTL to form the signal at U7-1 labelled "OVERRUN ERROR".

4-55. Initialize Counter and Clear Error Latch

4-56. When the pulse converter receives a reset command it is used to set flip-flop U30-2 which has two results; the overrun error latch is cleared, and the Micro U/D counter undergoes a parallel load resulting in its state being 0 or 1 depending upon whether the first transition to reach the counter after reset is released will be from the REF path or from the MEAS path. Exclusive OR gate U47-12 and gate U37-14 are used to make the decision. This arrangement ensures that no pulses are sent to the 10762A after reset until relative motion occurs between the input signals.

4-57. OPTIONAL OUTPUT

4-58. An output is available at U18-15 which may be jumpered to either the 90 MHz clock or to the signal U/D, the latter can be used to anticipate whether the next pulse to be issued by the pulse converter will be an UP or a DOWN pulse.

4-59. CLOCK GENERATOR AND OUTPUT TIMING GENERATOR

4-60. The 90 MHz system clock is generated by multivibrator U69. CR23 serves to partially compensate for output frequency temperature variations.

4-61. The output timing generator provides the BEG OUT and END OUT pulses used to sample the micro U/D counter and thus initiate and terminate UP/DOWN pulses for the 10762A. These pulses, each of one 90 MHz clock period duration, are generated by a 9 stage feedback shift register formed by U76, U77, U78. At power on, if any one of these stages contain a logical 1, then a logical 0 is fed back to the first stage U77-10. This results in all stages becoming a logic 0 which produces a logic 1 at the input of the first stage. This logic 1 will be shifted from stage to stage until the all 0 state is again reached, and then the entire sequence repeats. The output of each stage is a pulse of one clock cycle duration, but of different phases, which repeats every ten clock cycles. BEG OUT is the output of the first stage and END OUT is effectively the output of the seventh stage.

4-62. ERROR OUTPUT AND RESET LOGIC

4-63. There are five independent sources of error on the 10764B; each of the three phase-locked loops, and each of the two pulse converters. Each of these error sources is visible via a red LED. Phase-locked loop error (loss of lock) results either from dropout of the input (MEAS 1, MEAS 2, or REF) or excessive velocity of the retroreflector causing the input frequency to be either too large or too small. Pulse converter error, termed accumulator overrun error, results when the motion of the retroreflector is such that the pulse converters are required to output pulses at a rate >9 MHz which is beyond their capability. Conditions causing the activation of the phase-locked loop error often cause the pulse-converter error LED's to light but the converse is not usually true.

4-64. For each axis, all the independent error sources which affect that axis are OR'ed together to form signals for ERROR 1 and ERROR 2. Thus ERROR 1 is active if either the REF or MEAS 1 loop loses lock, or if pulse converter 1 overruns. Likewise, for axis 2. These two signals are available at the front edge connector J1 and are also indicated by two LED's located near the front of the board.

4-65. Also for each axis, the errors affecting that axis are made available to the system controller by means of the coupler backplane. An error in the REF phase-locked loop appears on backplane pin 25 (REF ERROR BIT) and an error in either the measure PLL or the pulse converter appears on pin 26 (MEAS ERROR BIT). These errors appear on the backplane in response to appropriate commands from the controller to that axis.

4-66. The 10764B can be reset in three different ways:

1. From the controller via the backplane signal POWER UP/SYSTEM RESET on pin 24.
2. From the controller via the software reset command directed to the specific axis.
3. By manually raising and lowering the reset section of switch 3.

4-67. The logic for both outputting and combining the independent error bits, and for generating internal reset signals is TTL and located in the lower right-hand section of the board.

SECTION 5
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains maintenance and service information for the 10764B.

5-3. MAINTENANCE AND TROUBLESHOOTING

5-4. The 10764B operates as an intergal part of the 5501 Laser Transducer System and a 10740A Coupler. Procedures to isolate system troubles to this assembly are contained in the 5501A System Manual. Schematics, component locators, and parts list are contained in this manual to aid in troubleshooting.

5-5. PREVENTIVE MAINTENANCE

5-6. The preventive maintenance procedures given in the following paragraphs are supplied to aid in prolonging the useful life of the unit.

5-7. VISUAL INSPECTION

5-8. Inspect the unit for indications of mechanical and electrical defects. Look for signs of overheating, corrosion, accumulation, of dust, oil, loose electrical connections, or broken parts.

5-9. REPAIR AND CLEANING

5-10. Repair any obvious defects; and if necessary clean the unit with a dry brush, suitable liquid solvent, or compressed clean dry air jet, or vacuum cleaner.

5-11. EXTENDER BOARD 10743A

5-12. A 10764B can be operated out of the 10740A Coupler front by using a Model 10743A printed-circuit extender board available from Hewlett-Packard. When plugged into the 10740A Coupler, the 10743A feeds all the 10740A backplane bus lines out to the front connector, which in turn accepts the 10764B.

5-13. TEST POINTS

5-14. Test points are provided on the board as an aid in troubleshooting. Refer to the schematic diagram and component locator for available test points.

5-15. OFFSET ADJUSTMENTS

5-16. The three offset adjust resistors R65, R67, and R69 are factory adjustments only. The nominal position is for the tab to point approximately straight down.

5-17. CLOCK FREQUENCY ADJUSTMENT

5-18. Variable capacitor C115 is also a factory adjustment and is used to set the clock frequency to 90 MHz.

SECTION 6
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists all replaceable parts in reference designation order. Table 6-2 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. REPLACEABLE PARTS LIST

6-4. Table 6-2 is a list of replaceable parts and contains the following information:

6-5. ORDERING INFORMATION

6-6. To order a part listed in the replaceable parts table, quote the HP part number, indicate the quantity desired, and address the order to the nearest Hewlett-Packard Sales and Service Office.

6-7. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard Sales and Service Office.

6-8. DIRECT MAIL ORDER SYSTEM

6-9. Within the U.S.A., Hewlett-Packard can supply parts through a direct mail order system. Advantages of using this system are as follows:

6-10. To provide these advantages, a check or money order must accompany each order. Mail order forms and specific ordering information is available through your local HP office.

Table 6-1. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	10764-60003	9	1	FAST PULSE CONVERTER BOARD ASSEMBLY (SERIES 1852)	28480	10764-60003
C1	0160-0576	5	25	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C2	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C3	0160-3879	7	64	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C5	0160-3875	3	9	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C6	0160-2055	9	3	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C7	0180-2814	0	9	CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C8	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C10	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C11	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C18	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C20	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C22	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C23	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C25	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C26	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C28	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C29	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C30	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C31	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C33	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C34	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C35	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C36	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C37	0160-0573	2	6	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C38	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C39	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C40	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C41	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C42	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C43	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C44	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C45	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
C46	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C47	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C48	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C49	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C50	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C51	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C52	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C53	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C54	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C55	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C56	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C57	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C58	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C59	0160-0574	3	6	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
C60	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
C61	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
C62	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
C63	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
C64	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
C65	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C66	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C67	0180-0642	8	4	CAPACITOR-FXD 15UF+-20% 20VDC TA	25088	D15GS1B20M
C68	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C69	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C70	0180-0642	8		CAPACITOR-FXD 15UF+-20% 20VDC TA	25088	D15GS1B20M
C71	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C72	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C73	0180-0642	8		CAPACITOR-FXD 15UF+-20% 20VDC TA	25088	D15GS1B20M
C74	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C75	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
C76	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C77	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C78	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C79	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C80	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C81	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C82	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C83	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C84	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C85	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C86	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C87	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C88	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C89	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C90	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C91	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C92	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C93	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C94	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C95	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C96	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C97	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C98	0160-3878	6	3	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
C99	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C100	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
C101	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
C102	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C103	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C104	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C105	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C106	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C107	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C108	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C109	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C110	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C111	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C112	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C113	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C114	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C115	0121-0061	1	1	CAPACITOR-V TRMR-CER 5,5-18PF 350V	52763	304322 5,5/18PF NPO
C116	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C117	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C118	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C119	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C120	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C121	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C122	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C123	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C124	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C125	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
C126	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C127	0180-2814	0		CAPACITOR-FXD 22UF+-20% 10VDC TA	28480	0180-2814
C128	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C129	0180-0642	8		CAPACITOR-FXD 15UF+-20% 20VDC TA	25088	D15GS1820M
C130	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
CR1	1990-0646	0	7	LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR2	1990-0646	0		LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR3	1990-0416	2	3	LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4480, SEL IV
CR4	1990-0416	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4480, SEL IV
CR5	1990-0485	5	1	LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
CR6	1990-0416	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4480, SEL IV
CR7	1901-0040	1	9	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR13	1990-0646	0		LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR14	1990-0646	0		LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR15	1990-0646	0		LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR16	1990-0646	0		LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR17	1990-0646	0		LED-VISIBLE LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR20	0122-0095	3	3	DIODE-VVC 200PF C2/C10-MAX=10 BVR=12V	28480	0122-0095

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CR21	0122-0095	3		DIODE-VVC 200PF C2/C10-MAX=10 BVR=12V	28480	0122-0095
CR22	0122-0095	3		DIODE-VVC 200PF C2/C10-MAX=10 BVR=12V	28480	0122-0095
CR23	1901-0535	9	1	DIODE-SCHOTTKY	28480	1901-0535
CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
L1A	9170-0016	8	6	CORE-SHIELDING BEAD	28480	9170-0016
L1B			6			
L2A	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
L2B						
L3A	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
L3B						
L4	9170-1131	0	4		28480	9170-1131
L5	9170-1131	0			28480	9170-1131
L6	9170-1131	0			28480	9170-1131
L7A	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
L7B						
L8A	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
L8B						
L9A	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
L9B						
L10	9100-1788	6	1	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
L11	9170-1131	0			28480	9170-1131
Q1	1854-0215	1	6	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q2	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q3	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q5	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q6	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q7	1854-0221	9	3	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
Q8	1854-0221	9		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
Q9	1854-0221	9		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
R1	0698-7225	4	20	RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-T0-348R-G
R2	0698-7211	8	8	RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
R3	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
R4	0698-7188	8	10	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R5	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R6	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
R7	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
R8	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R9	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R10	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
R11	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
R12	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R13	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R14	0698-7257	2	7	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
R15	0698-7236	7	32	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R16	0698-7242	5	6	RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
R17	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R18	0698-7257	2		RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
R19	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R20	0698-7242	5		RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
R21	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R22	0698-7257	2		RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R24	0698-7242	5		RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
R25	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
R26	0698-7233	4	6	RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-G
R27	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-G
R28	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-G
R29	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R30	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R31	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R32	1810-0229	5	19	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R33	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R34	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R35	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R36	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R37	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R38	0698-7225	4		RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-T0-348R-G
R39	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R40	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R41	0698-7225	4		RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-T0-348R-G
R42	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R43	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R44	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R45	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R46	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R47	0698-7209	4	2	RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
R48	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R49	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R50	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R51	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
R52	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R53	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R54	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R55	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R56	0698-7215	2	6	RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
R57	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R58	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R59	0698-7215	2		RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
R60	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R61	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R62	0698-7260	7	16	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R63	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R64	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R65	2100-2216	0	3	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
R66	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R67	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
R68	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R69	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
R70	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R71	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R72	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R73	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
R74	0698-7257	2		RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
R75	0698-7257	2		RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
R76	0698-7257	2		RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-G
R77	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
R78	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R79	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
R80	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA1	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
RA2	1810-0229	5		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R330
RA3	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA4	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA5	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA6	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA7	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA8	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA9	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RA0	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RB1	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RB2	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
RB3	0698-7228	7	3	RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
RB4	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-G
RB5	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
RB6	0698-7274	3	3	RESISTOR 38.3K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3832-G
RB7	0698-7208	3	6	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
RB8	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
RB9	0698-7228	7		RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
RB10	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-G
RB11	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
RB12	0698-7274	3		RESISTOR 38.3K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3832-G
RB13	0698-7208	3		RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-68R1-G
RB14	0698-7211	8		RESISTOR 90.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-90R9-G
RB15	0698-7228	7		RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
RB16	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-G
RB17	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
RB18	0698-7274	3		RESISTOR 38.3K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3832-G
RB19	0698-7242	5		RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
RB10	0698-7203	8	12	RESISTOR 42.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-42R2-G
RB11	0698-7215	2		RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
RB12	0698-7215	2		RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
RB13	0698-7242	5		RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
RB14	0698-7203	8		RESISTOR 42.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-42R2-G
RB15	0698-7225	4		RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-T0-348R-G
RB16	0698-7215	2		RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
RB17	0698-7215	2		RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
RB18	0698-7242	5		RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-G
RB19	0698-7225	4		RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-T0-348R-G
R120	1810-0203	5	9	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	11236	750-81-R470

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
TP21	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP22	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP23	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP24	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP25	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP26	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP27	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP28	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP29	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP30	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP31	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP32	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP33	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP34	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP35	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP36	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP37	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP38	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP39	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP40	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP41	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP42	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP43	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP44	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP45	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP46	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP47	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP48	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP49	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP50	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP51	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP52	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP53	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP54	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP55	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP56	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP57	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP58	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP59	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP60	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP61	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP62	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP63	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP64	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP65	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP66	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP67	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP68	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP69	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP70	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP71	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP72	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP73	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP74	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP75	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP76	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP77	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP78	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ RND	28480	0360-0124
TP79	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP80	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP81	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP82	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
U1	1820-2199	0	4	IC DRVR TTL* LINE DRVR DUAL	07263	9638TC
U2	1820-2199	0		IC DRVR TTL* LINE DRVR DUAL	07263	9638TC
U3	1820-2199	0		IC DRVR TTL* LINE DRVR DUAL	07263	9638TC
U4	1820-2199	0		IC DRVR TTL* LINE DRVR DUAL	07263	9638TC
U5	1820-2198	9	7	IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U6	1990-0602	8	3	OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	28480	5082-4361
U7	1820-2198	9		IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U8	1820-2198	9		IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U9	1820-2198	9		IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U10	1990-0602	8		OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	28480	5082-4361
U11	1820-2198	9		IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U12	1820-2198	9		IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U13	1820-2198	9		IC RCVR TTL* LINE RCVR DUAL	07263	9637ATC
U14	1990-0602	8		OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	28480	5082-4361
U15	1820-0817	8	13	IC FF ECL D-M/S DUAL	04713	MC10131P

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U16	1820-0810	1	3	IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116P
U17	1820-0820	3	4	IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
U18	1820-1686	1	3	IC GATE ECL OR QUAD 2-INP	04713	MC10103P
U19	1820-0802	1	4	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
U20	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U21	1820-0810	1		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116P
U22	1820-0820	3		IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
U23	1820-1686	1		IC GATE ECL OR QUAD 2-INP	04713	MC10103P
U24	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
U25	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U26	1820-0810	1		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10116P
U27	1820-1344	8	3	IC PL LOOP 14-DIP-C	04713	MC12040L
U28	1820-0825	8	6	IC SHF-RGTR ECL D-TYPE PRL-IN PRL-OUT	04713	MC10141L
U29	1820-0825	8		IC SHF-RGTR ECL D-TYPE PRL-IN PRL-OUT	04713	MC10141L
U30	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U31	1820-1344	8		IC PL LOOP 14-DIP-C	04713	MC12040L
U32	1820-0825	8		IC SHF-RGTR ECL D-TYPE PRL-IN PRL-OUT	04713	MC10141L
U33	1820-0825	8		IC SHF-RGTR ECL D-TYPE PRL-IN PRL-OUT	04713	MC10141L
U34	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U35	1820-1344	8		IC PL LOOP 14-DIP-C	04713	MC12040L
U36	1826-0506	4	3	IC OP AMP 8-DIP-P	01928	CA3140E
U37	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
U38	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U39	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U40	1826-0506	4		IC OP AMP 8-DIP-P	01928	CA3140E
U41	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
U42	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U43	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U44	1826-0506	4		IC OP AMP 8-DIP-P	01928	CA3140E
U45	1826-0509	7	4	IC 16-DIP-P	04713	MC1658P
U46	1820-0820	3		IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
U47	1820-0805	4	2	IC GATE ECL EXCL-OR/NOR TPL 2-INP	04713	MC10107P
U48	1820-1225	4	2	IC FF ECL D-M/S DUAL	04713	MC10231P
U49	1826-0509	7		IC 16-DIP-P	04713	MC1658P
U50	1820-0820	3		IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
U51	1820-0805	4		IC GATE ECL EXCL-OR/NOR TPL 2-INP	04713	MC10107P
U52	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
U53	1826-0509	7		IC 16-DIP-P	04713	MC1658P
U54	1820-2066	3	3	IC CNTR ECL BIN ASYNCHRO POS-EDGE-TRIG	04713	MC10178L
U55	1820-2167	5	4	IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10576F
U56	1820-2167	5		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10576F
U57	1820-1400	7	4	IC GATE ECL AND QUAD 2-INP	04713	MC10104P
U58	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U59	1820-0821	4	3	IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
U60	1820-2066	3		IC CNTR ECL BIN ASYNCHRO POS-EDGE-TRIG	04713	MC10178L
U61	1820-2167	5		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10576F
U62	1820-2167	5		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10576F
U63	1820-1400	7		IC GATE ECL AND QUAD 2-INP	04713	MC10104P
U64	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U65	1820-0821	4		IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
U66	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U67	1820-0821	4		IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
U68	1820-1400	7		IC GATE ECL AND QUAD 2-INP	04713	MC10104P
U69	1826-0509	7		IC 16-DIP-P	04713	MC1658P
U70	1820-1686	1		IC GATE ECL OR QUAD 2-INP	04713	MC10103P
U71	1820-1830	7	1	IC GATE ECL OR DUAL 3-INP	04713	MC10210L
U72	1820-1400	7		IC GATE ECL AND QUAD 2-INP	04713	MC10104P
U73	1820-2066	3		IC CNTR ECL BIN ASYNCHRO POS-EDGE-TRIG	04713	MC10178L
U74	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U75	1820-1281	2	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS139N
U76	1820-0825	8		IC SHF-RGTR ECL D-TYPE PRL-IN PRL-OUT	04713	MC10141L
U77	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
U78	1820-0825	8		IC SHF-RGTR ECL D-TYPE PRL-IN PRL-OUT	04713	MC10141L
U79	1820-0803	2	1	IC GATE ECL OR-NOR TPL	04713	MC10105P
U80	1820-2193	7	2		28480	1820-2193
U81	1820-2193	7			28480	1820-2193
U82	1820-0513	1	1	IC GATE TTL AND QUAD 2-INP	01295	SN7409N
U83	1820-2024	3	1	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U84	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
W1	10764-60004	0	1	CABLE ASSEMBLY, PULSE ASSEMBLY	28480	10764-60004
W1P1	1250-0888	4	1	CONNECTOR-RF SMC FEM UNMTD 50-OHM	28480	1250-0888
				MISCELLANEOUS PARTS		
	0905-0111	4	3	O-RING .239-IN-ID .07-IN-XSECT-DIA SIL	28480	0905-0111
	0890-0029	0		TUBING-MS .187-D/.093-RCVD .02-WALL	28480	0890-0029
	1480-0059	8	2	PIN-ROLL .062-IN-DIA .25-IN-LG STL	28480	1480-0059
	5040-1464	3	2	EXTRACTOR, PC BOARD	28480	5040-1464
	10764-60005	4	1	INTERFACE CABLE	28480	10764-60005

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Manufacturer's Code List

Mfr. Number	Manufacturer Name	City	ZIP Code
01295	Texas Instruments, Inc. Semiconductor Component Div.	Dallas, TX	75222
1092B	RCA Corp., Solid State Division	Somerville, NJ	08876
02114	Ferroxcube Corp.	Saugerties, NY	12477
04713	Motorola Semiconductor Products	Photnix, AZ	85062
07263	Fairchild Semiconductor Division	Mountain View, CA	94042
11236	CTS of Berne, Inc.	Berne, IN	46711
24546	Corning Glass Works (Bradford)	Bradford, PA	16701
25088	Siemens Corp.	Iselin, NJ	08830
28480	Hewlett-Packard Company, Corporate Headquarters	Palo Alto, CA	94304
52763	Stettner-Trush, Inc.	Cazenovia, NY	13035
73138	Beckman Instruments, Inc., Helipot Division	Fullerton, CA	92634

SECTION 7
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information required to adapt this manual to be applicable to previous board configurations.

7-3. MANUAL APPLICABILITY

7-4. This manual applies to HP 10764B boards with series prefix 2140A.

7-5. MANUAL UPDATING

7-6. Newer instruments may have series numbers not listed in this manual. If necessary, a manual change sheet with new information to describe newer instruments should accompany this manual. If the change sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office as listed at the end of this manual.

7-7. MANUAL BACKDATING

7-8. The following contains information necessary to adapt this manual to older instruments. Refer to Table 7-1 and make the indicated changes.

Table 7-1. Manual Backdating

If your board has Series No.	Make Change
1948A	1
1852A	1, 2

CHANGE 1

Replace page 6-7 with backdating parts list Table 7-2.

Replace Figure 8-1 sheets 1 and 2, pages 8-3 and 8-5 with Figure 7-1.

CHANGE 2

Fast Pulse Converters with serial prefix 1852A were supplied with a connector kit 5060-8339 instead of Interface Cable 10764-60005.

Page 6-9, Table 6-2, Replaceable Parts:
At the bottom of the page, delete 10764-60005 and add 5060-8339; 1; Connector Kit, PC Board; 28480; 5060-8339.

Page 1-2, Table 1-1, Equipment Supplied:
Delete Interface Cable 10764-60005, add PC Board Connector Kit 5060-8339.

Page 2-3, Paragraph 2-35:
Change second sentence to read: "The dual 24-pin (48) connector edge mates with connector kit number 5060-8339.

BACKDATING
(Series 1948A and 1852A)

Table 7-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
TP21	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP22	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP23	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP24	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP25	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP26	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP27	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP28	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP29	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP30	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP31	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP32	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP33	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP34	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP35	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP36	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP37	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP38	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP39	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP40	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP41	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP42	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP43	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP44	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP45	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP46	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP47	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP48	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP49	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP50	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP51	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP52	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP53	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP54	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP55	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP56	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP57	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP58	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP59	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP60	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP61	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP62	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP63	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP64	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP65	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP66	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP67	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP68	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP69	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP70	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP71	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP72	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP73	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP74	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP75	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP76	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP77	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP78	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
TP79	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP80	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP81	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
TP82	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
U1	1820-2089	0	4	IC DRVR TTL* LINE DRVR DUAL	07263	9612TC
U2	1820-2089	0		IC DRVR TTL* LINE DRVR DUAL	07263	9612TC
U3	1820-2089	0		IC DRVR TTL* LINE DRVR DUAL	07263	9612TC
U4	1820-2089	0		IC DRVR TTL* LINE DRVR DUAL	07263	9612TC
U5	1820-2088	9	7	IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U6	1990-0602	8	3	OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	28480	5082-4361
U7	1820-2088	9		IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U8	1820-2088	9		IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U9	1820-2088	9		IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U10	1990-0602	8		OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	28480	5082-4361
U11	1820-2088	9		IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U12	1820-2088	9		IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U13	1820-2088	9		IC RCVR TTL* LINE RCVR DUAL	07263	9613TC
U14	1990-0602	8		OPTO-ISOLATOR LED-IC GATE IF=20MA-MAX	28480	5082-4361
U15	1820-0817	8	13	IC FF ECL D-M/S DUAL	04713	MC10131P

See introduction to this section for ordering information
*Indicates factory selected value

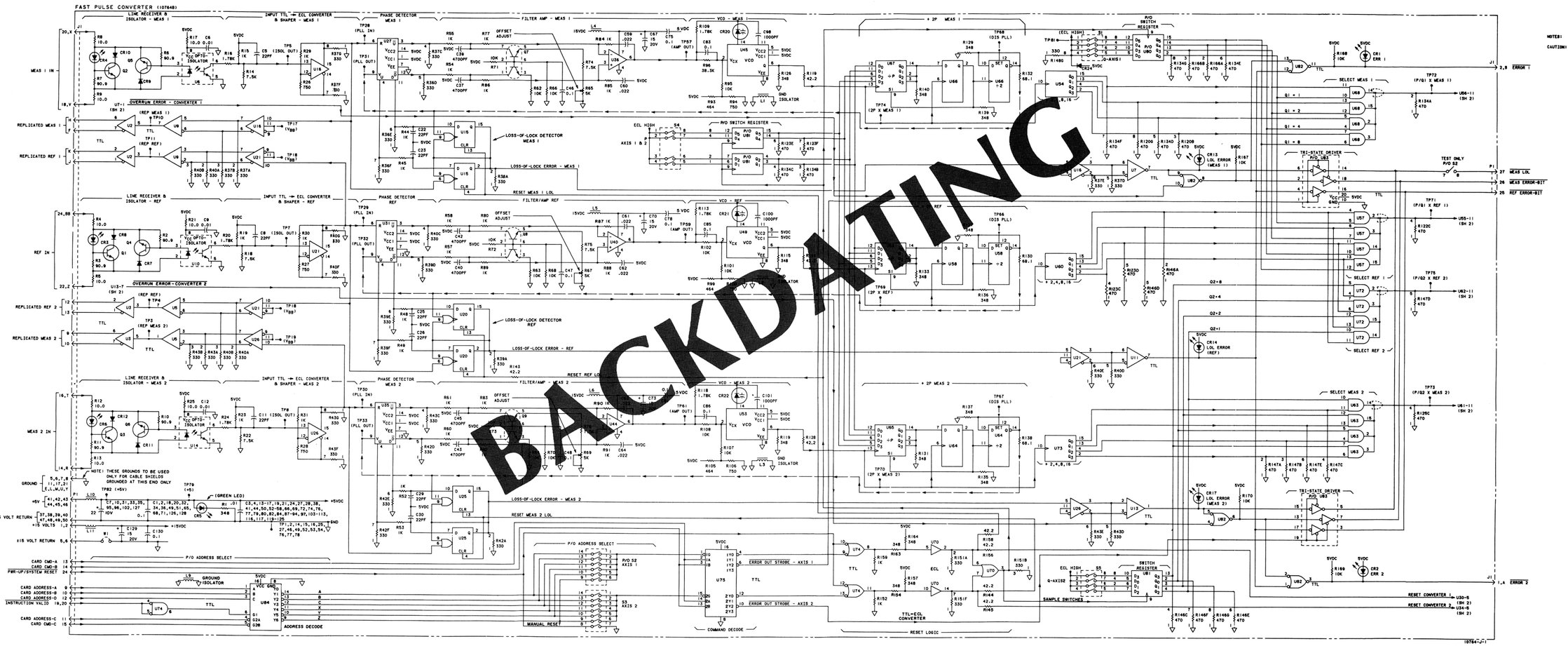
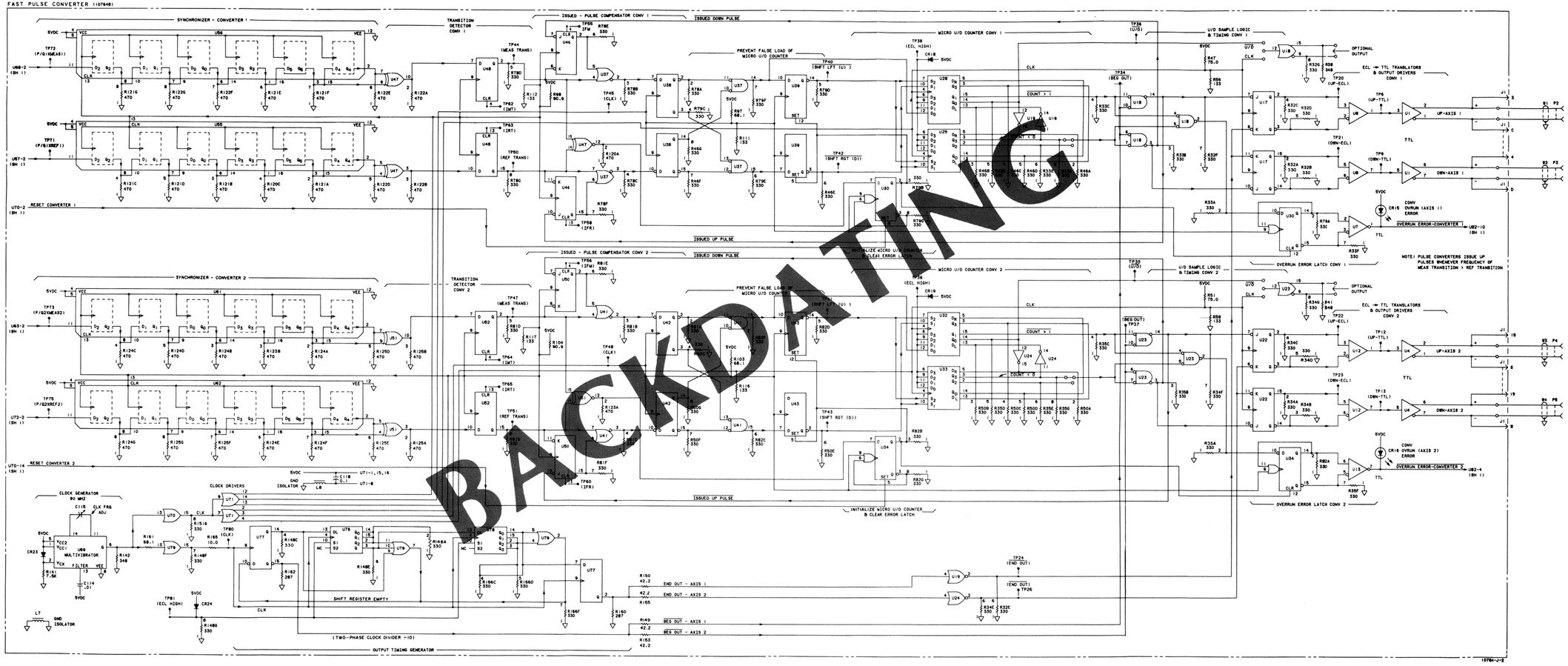


Figure 7-1
10764B FAST PULSE CONVERTER SCHEMATIC DIAGRAM
(Sheet 1 of 2)



NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE IN OHMS
2. CAPACITORS IN MICROFARADS
3. VCC, GND IC CONNECTIONS AS FOLLOWS:

PACKAGE	V_{CC}	GND
10G(F-ECL	16	8
10G(F-TTL	16	8
14G(F-TTL	14	7
8G(F-TTL	8	4

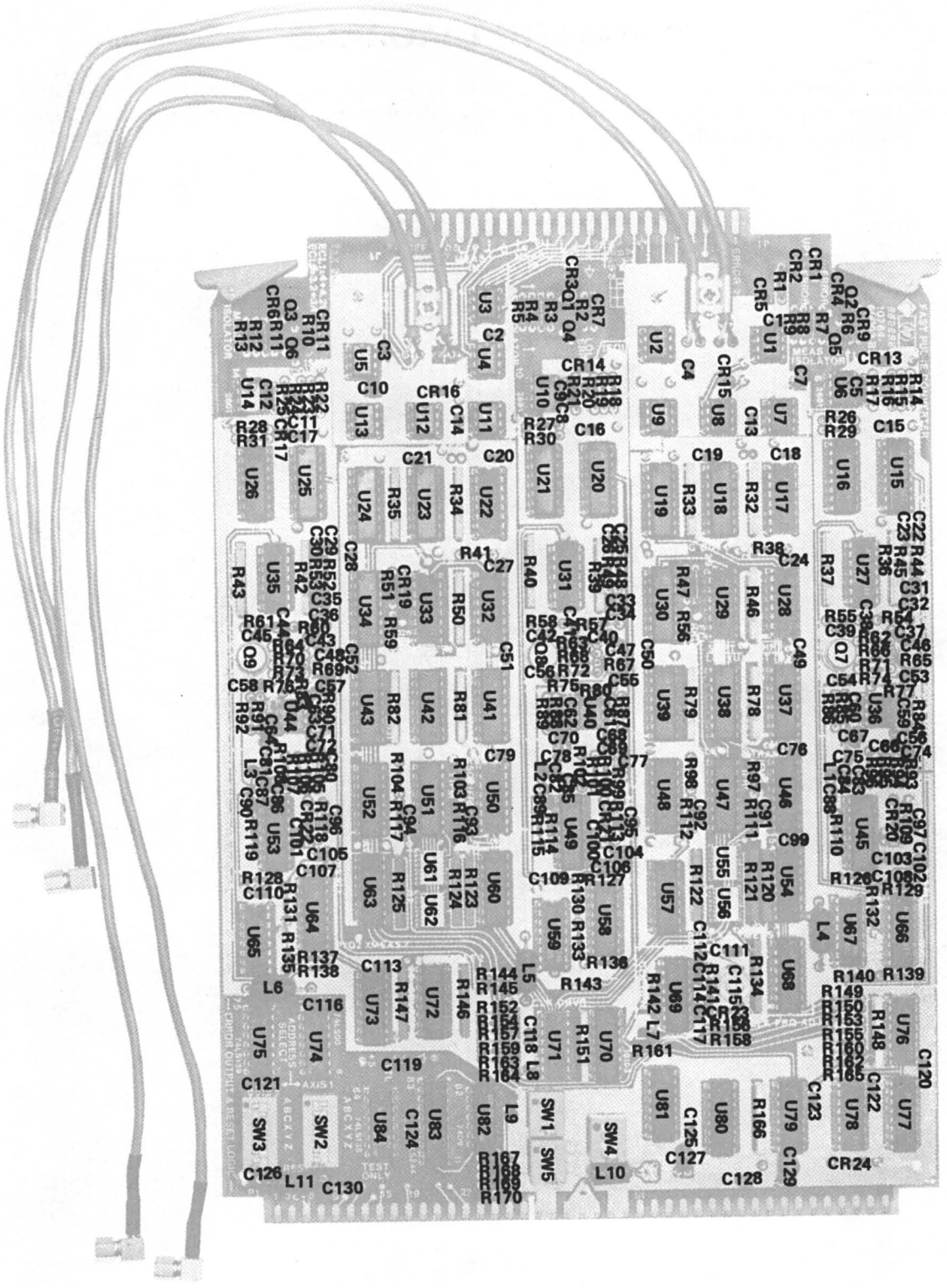
4. UNUSED GATES EXIST IN U18,U19, U23, U24, UT4

CAUTION: SHORTING ECL SIGNALS TO GROUND WILL PROBABLY DESTROY DRIVER !!!

Figure 7-1
10764B FAST PULSE CONVERTER SCHEMATIC DIAGRAM
(Sheet 2 of 2)

SECTION 8
SCHEMATIC DIAGRAMS

This section contains schematic diagrams for the 10764B. Refer to the Operating and Service Manual for the 10762A for explanations of schematic diagram notes, the reference designator system, and identification markings on pc boards.



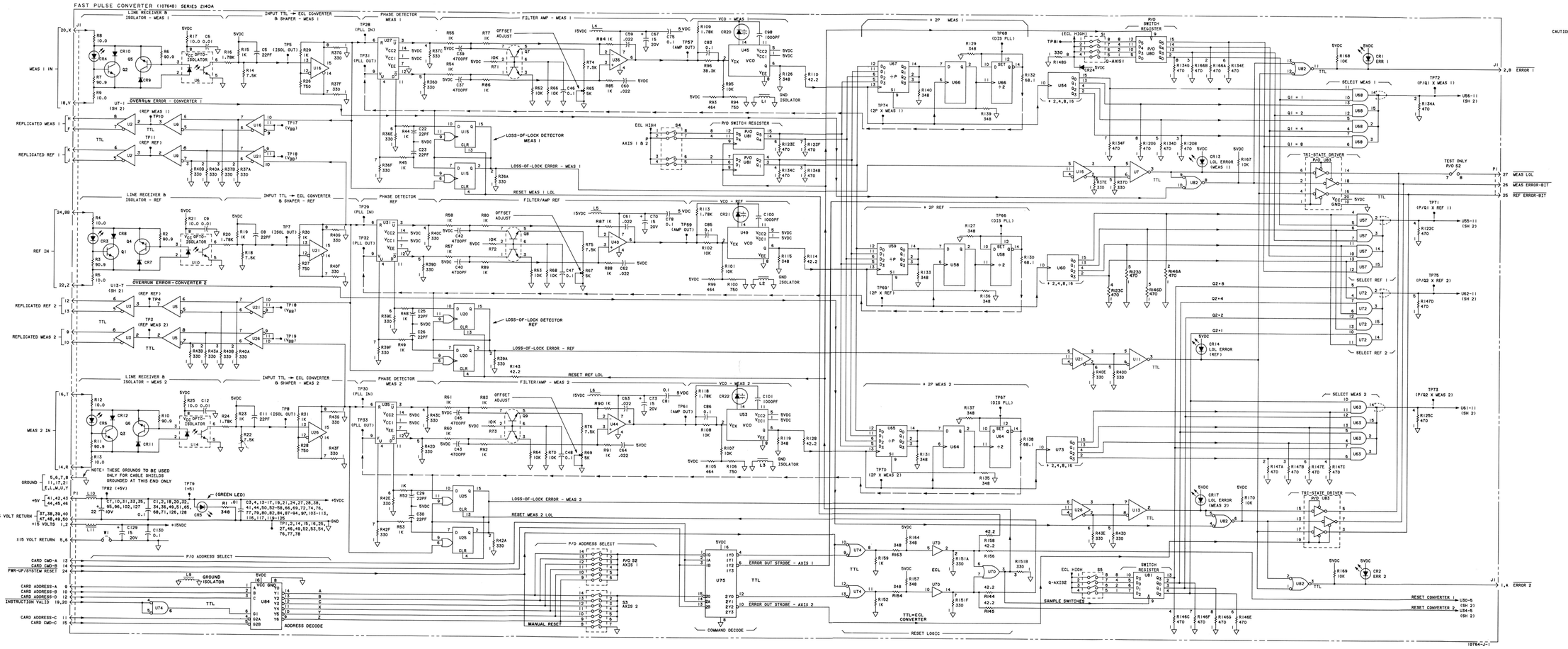
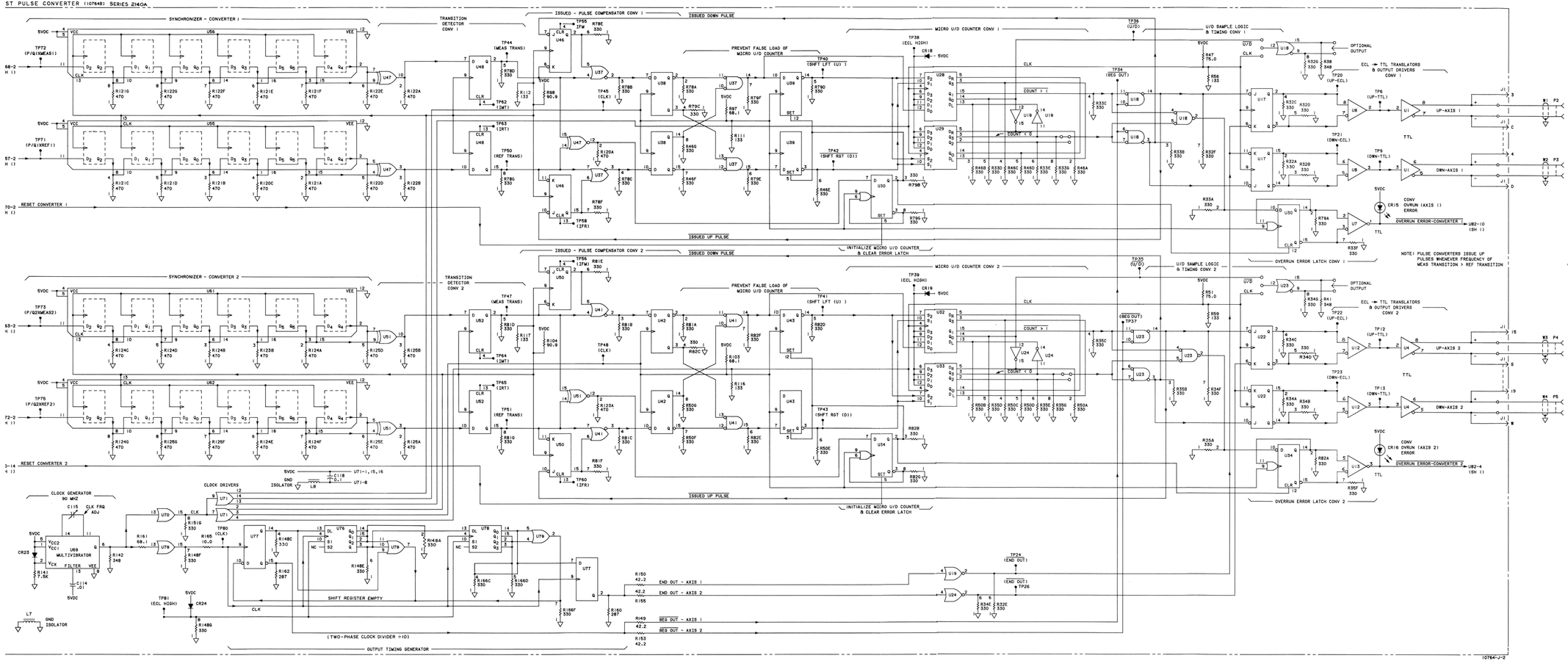


Figure 8-1
10764B FAST PULSE CONVERTER SCHEMATIC DIAGRAM
(Sheet 1 of 2)



NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE IN OHMS

2. CAPACITORS IN MICROFARADS

3. VCC, GND IC CONNECTIONS AS FOLLOWS:

PACKAGE	5VDC	GND
16DIP-ECL	16	8
16DIP-TTL	16	8
14DIP-TTL	14	7
8DIP-TTL	8	4

4. UNUSED GATES EXIST IN U18,U19, U23, U24, UT4

CAUTION: SHORTING ECL SIGNALS TO GROUND WILL PROBABLY DESTROY DRIVER !!!

Figure 8-1
10764B FAST PULSE CONVERTER SCHEMATIC DIAGRAM
(Sheet 2 of 2)

MANUAL PART NO. 10764-90012

PRINTED IN U.S.A.