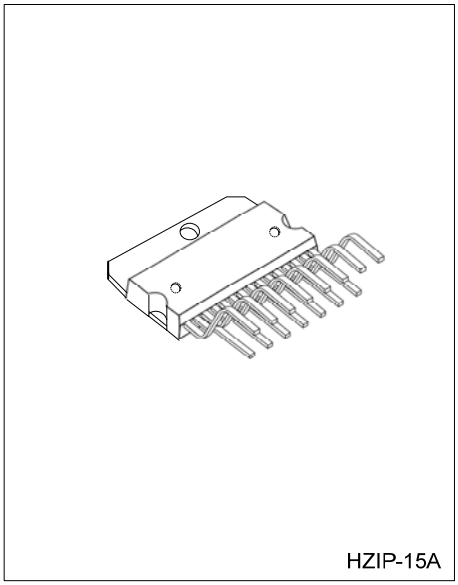
TDA7375

LINEAR INTEGRATED CIRCUIT

2 x 35W DUAL/QUAD POWER AMPLIFIER FOR CAR RADIO



Lead-free: TDA7375L
Halogen-free: TDA7375G

■ DESCRIPTION

The UTC **TDA7375** is a class AB car radio amplifier for car radio, it can work either in dual bridge or quad single ended configuration. The exclusive fully complementary structure of the output stage and the internally fixed gain guarantees the highest possible power performances with few external components. The on-board clip detector simplifies gain compression operation. The fault diagnostics makes it possible to detect mistakes during car radio set assembly and wiring in the car.

■ FEATURES

* High output power capability:
  – 2 x 40W Max. / 4Ω
  – 2 x 25W / 4Ω@14.4V, 1KHz, 10%
  – 2 x 35W / 4Ω EIAJ
  – 4 x 7 W / 4Ω@14.4V, 1KHz, 10%
  – 4 x 12W / 2Ω@14.4V, 1KHz, 10%
* Minimum external components:
  – No bootstrap capacitors
  – No Boucherot cells
  – Internally fixed gain (26dB BTL)
* Stand-by function (CMOS compatible)
* No audible pop during st-by operations
* Diagnostics facility for:
  – Clipping
  – Out to GND short
  – Out to V_S short
  – Soft short at turn-on
  – Thermal shutdown proximity

■ PROTECTIONS

* Output AC/DC short circuit
– to GND
– to V_S
– across the load
* Soft short at turn-on
* Overrating chip temperature with soft thermal limiter
* Load dump voltages urge
* Very inductive loads
* Fortuitous open GND
* Reversed battery
* ESD

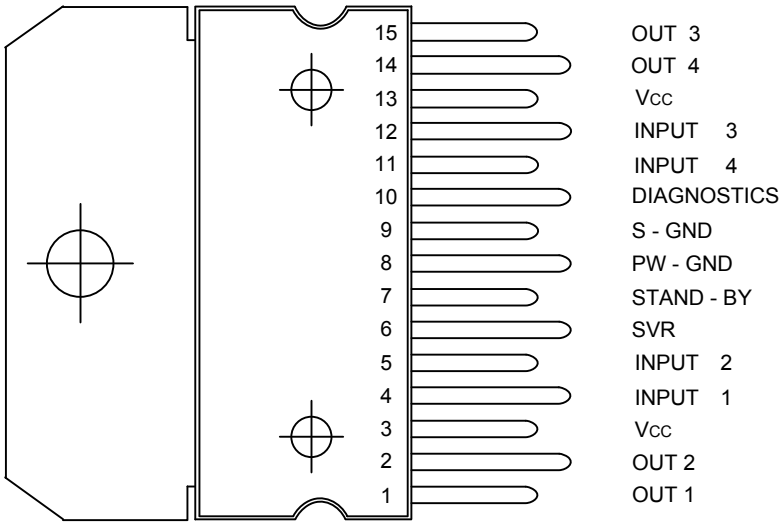
■ ORDERING INFORMATION

Ordering Number			Package	Packing
Normal	Lead Free Plating	Halogen Free		
TDA7375-J15-A-T	TDA7375L-J15-A-T	TDA7375G-J15-A-T	HZIP-15A	Tube

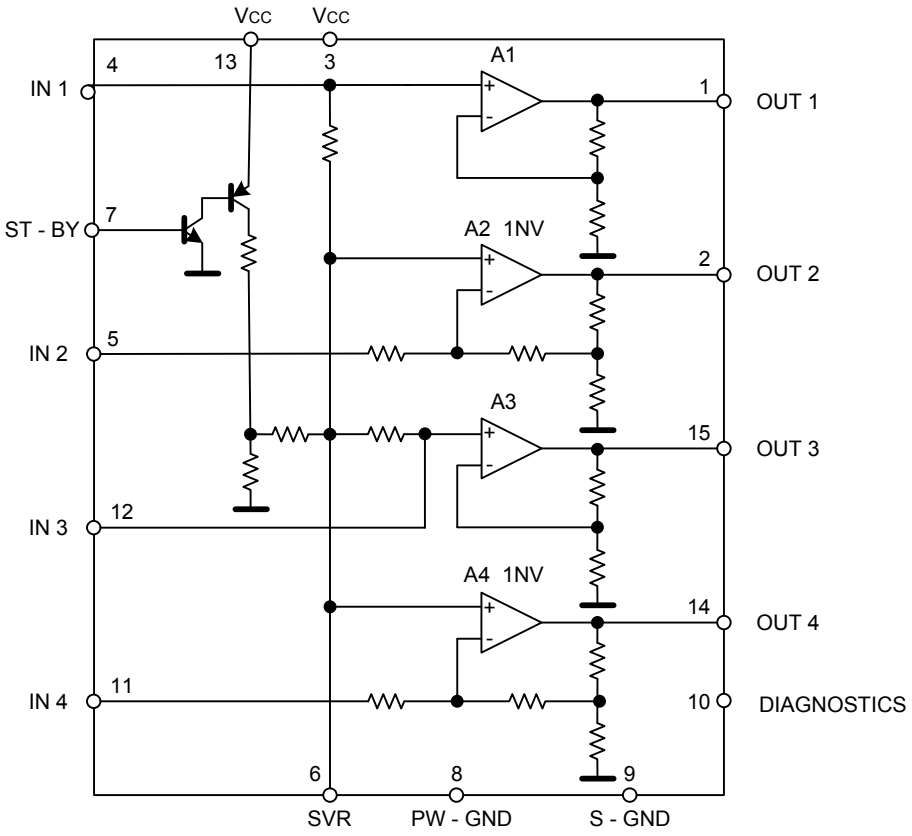
TDA7375L-J15-A-T
(1) Packing Type
(2) Package Type
(3) Lead Plating

(1) T: Tube
(2) J15-A: HZIP-15A
(3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn

■ PIN CONNECTION (Top view)



■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNIT
Operating Supply Voltage		V_{OP}	18	V
DC Supply Voltage		V_S	28	V
Peak Supply Voltage (for t = 50ms)		$V_{S(PEAK)}$	50	V
Output Peak Current	not repetitive t = 100µs	$I_{O(PEAK)}$	4.5	A
	repetitive f >10Hz		3.5	A
Power Dissipation (T_C= 85°C)		P_D	36	W
Junction Temperature		T_J	+150	°C
Storage Temperature		T_{STG}, T_J	-40~+150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Case	θ_{JC}	1.8	°C/W

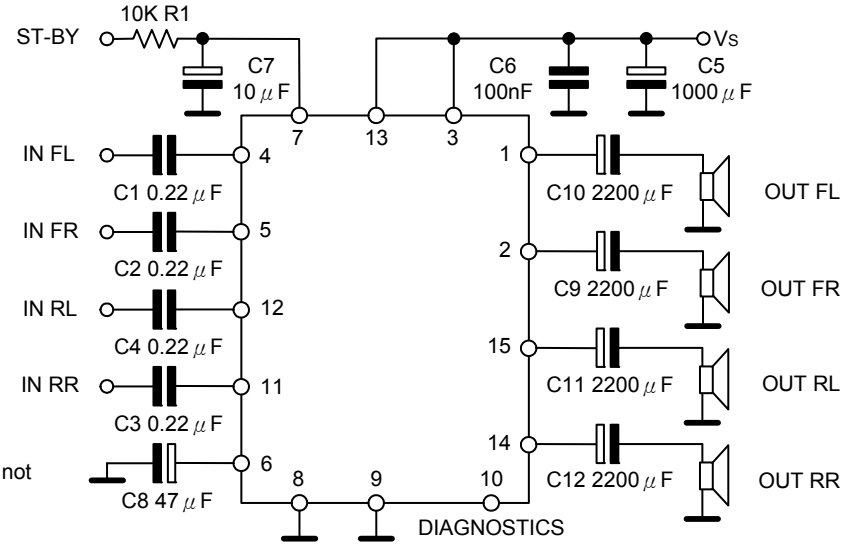
■ ELECTRICAL CHARACTERISTICS

(V_S = 14.4V; R_L = 4Ω; f = 1 KHz; Ta =25°C, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Supply Voltage Range		V_S			8		18	V
ST-BY Threshold Voltage	IN	$V_{I(ST-BY)}$					1.5	V
	OUT	$V_{O(ST-BY)}$			3.5			
Voltage Saturation on pin 10		V_{SAT}	Sink Current at Pin 10 = 1mA				0.7	V
Output Offset Voltage		$V_{O(OFF)}$					150	mV
Input Noise Voltage		eN	Rg = 0; S.E. ”A” weighted,	Non Inverting Channels		2		µV
				Inverting Channels		5		
			Bridge, Rg = 0; 22Hz ~ 22KHz			3.5		µV
Total Quiescent Drain Current		I_Q	R_L = ∞				200	mA
ST-BY Pin Current(pin 7)		I_{ST-BY}	Max Driving Current Under Fault				5	mA
			Play Mode Vpin7 = 5V				50	µA
ST-BY Current Consumption		I_{ST-BY}	V_{ST-BY} = 0 ~ 1.5V				100	µA
Clipping Detector Output Average Current	OFF	$I_{CD(OFF)}$	d = 1% (Note 2)			90		µA
	ON	$I_{CD(ON)}$	d = 5% (Note 2)			160		µA
Input Impedance		R_{IN}	Single Ended		20	30		KΩ
			Bridge		10	15		
Output Power		P_{OUT}	THD = 10%; R_L = 4Ω	Bridge	23	25		W
				Single Ended	6.5	7		
				Single Ended, R_L = 2Ω		12		
Output Power (Note 3)	Max.	$P_{O(MAX)}$	V_S = 14.4V, Bridge		36	40		W
	EIAJ	$P_{O(EIAJ)}$	V_S = 13.7V, Bridge		32	35		W
Distortion		THD	R_L = 4Ω	Single Ended, P_{OUT}=0.1~4W		0.02		%
				Bridge, P_{OUT} = 0.1 ~ 10W		0.03	0.3	
Cross Talk		CT	f = 1KHz Single Ended			70		dB
			f = 10KHz Single Ended			60		dB
			f = 1KHz Bridge		55			dB
			f = 10KHz Bridge			60		dB
Voltage Gain		G_V	Single Ended		19	20	21	dB
			Bridge		25	26	27	dB
Voltage Gain Match		G_V					0.5	dB
Supply Voltage Rejection		SVR	Rg = 0; f = 300Hz		50			dB
Stand-by Attenuation		A_{ST-BY}	P_O = 1W		80	90		dB

Notes: 1. See built-in S/C protection description
2. Pin 10 Pulled-up to 5V with 10KΩ; R_L = 4Ω
3. Saturated square wave output.

■ TYPICAL TEST AND APPLICATION CIRCUIT



Note:
C9, C10, C11, C12 could be reduced if the 2Ω operation is not required.

Figure 1: Quad Stereo

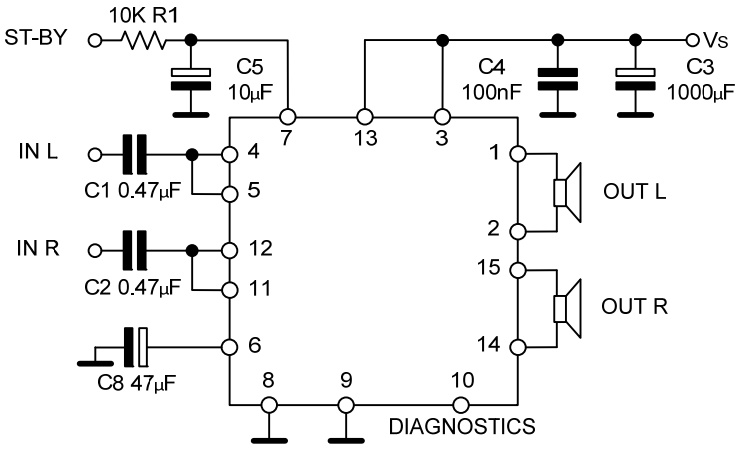


Figure 2: Double Bridge

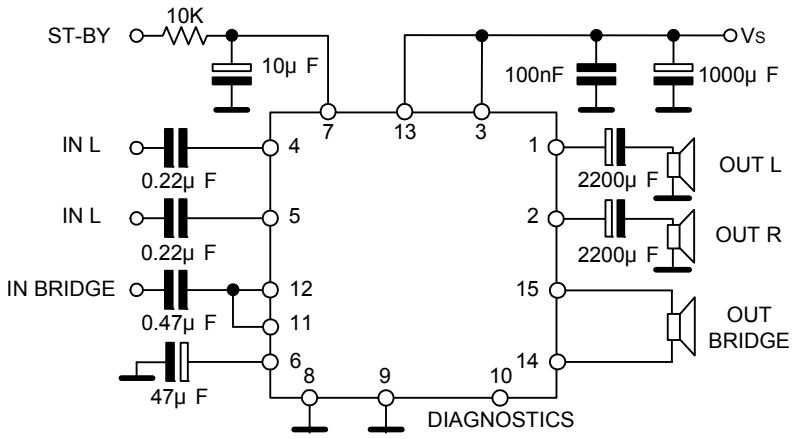


Figure 3: Stereo/Bridge

■ TYPICAL APPLICATION INFORMATION

1. High Application Flexibility

It is possible that accomplish several kinds of applications ranging from 4 speakers stereo (F/R) to 2 speakers bridge solutions with 4 independent channels

In order to avoid phase inconveniences causing sound alterations especially during the reproduction of low frequencies. When working in single ended conditions the polarity of the speakers driven by the inverting amplifier must be reversed respect to those driven by non inverting channels.

2. Easy Single Ended to Bridge Transition

The change from single ended to bridge configurations is made simply by means of a short circuit across the inputs, further external component is unnecessary.

3. Gain Internally Fixed to 20dB in Single Ended, 26dB in Bridge

The function advantages not only to save component, PCB space but also optimize output noise, supply voltage rejection and distortion

4. Silent Turn On/Off and Muting/Stand-by Function

The stand-by can be easily activated by means of a CMOS level applied to pin 7 through a RC filter. Under stand-by condition the device is turned off completely (Vs=1mA typ.; A_{ST-BY}= 80dB min.).

Every ON/OFF operation is virtually pop free. Furthermore, at turn-on the device stays in muting condition for a time determined by the value assigned to the SVR capacitor. While in muting the device outputs becomes insensitive to any kinds of signal that may be present at the input terminals.

5 .STAND-BY DRIVING (pin 7)

The definition of stand-by driving networks is most important that pin 7 cannot be directly driven by a voltage source whose current capability is higher than 5mA. In practical cases a series resistance has always to be inserted to limit the current at pin 7 and to smooth down the stand-by ON/OFF transitions - in combination with a capacitor - for output pop prevention. In any case, a capacitor of at least 100nF from pin 7 to S-GND, with no resistance in between, is necessary to ensure correct turn-on.

6. BUILT–IN SHORTCIRCUIT PROTECTION

Reliable and safe operation, in presence of all kinds of short circuit involving the outputs is assured by BUILT-IN protectors. Additionally to the AC/DC short circuit to GND, to V_S, across the speaker, a SOFT SHORT condition is signaled out during the TURN-ON PHASE so assuring correct operation for the device itself and for the loudspeaker.
This particular kind of protection acts in a way to avoid that the device is turned on (by ST-BY) when a resistive path (less than 16 ohms) is present between the output and GND. As the involved circuitry is normally disabled when a current higher than 5mA is flowing into the ST-BY pin, it is important, in order not to disable it, to have the external current source driving the STBY pin limited to 5mA.
This extra function becomes particularly attractive when, in the single ended configuration, one capacitor is shared between two outputs (see Fig. 4).

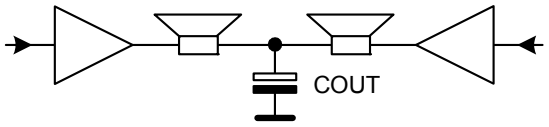


Figure 4.

Supposing that the output capacitor C_{OUT} for any reason is shorted, the loudspeaker will not be damaged being this soft short circuit condition revealed.

- Diagnostics Facility

  The IC is equipped with a diagnostic circuitry able to detect clipping in the output signal, thermal shutdown, and output fault including short to GND, short to V_S and soft short at turn on.
  The information is available across an open collector output (pin 10) through a current sinking when the event is detected.

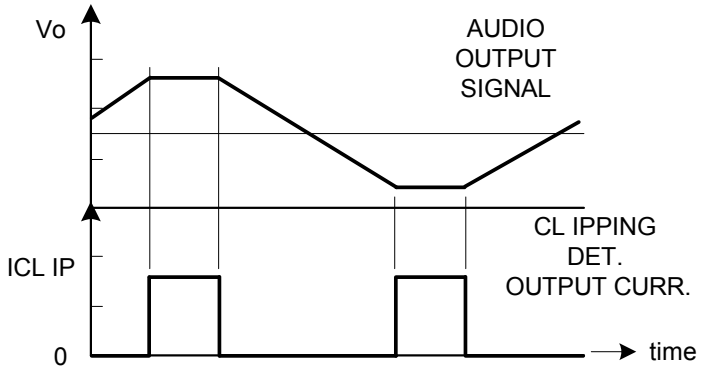


Figure 5: Clipping Detection Waveforms

A current sinking at pin 10 is triggered when a certain distortion level is reached at any of the outputs. This function allows gain compression possibility whenever the amplifier is overdriven.

- Thermal Shutdown
  In this case the output 10 will signal the proximity of the junction temperature to the shutdown threshold. Typically current sinking at pin 10 will start ~10°C before the shutdown threshold is reached.

7. HANDLING OF THE DIAGNOSTICS SIGNAL

Since various kinds of information is available at the same pin (clipping detection, output fault, thermal proximity), this signal must be handled properly in order to discriminate each event. This could be done by taking into account the different timing of the diagnostic output during each case.

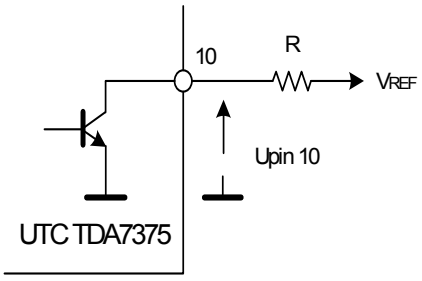


Figure 6: Output Fault Waveforms (see Fig. 7)

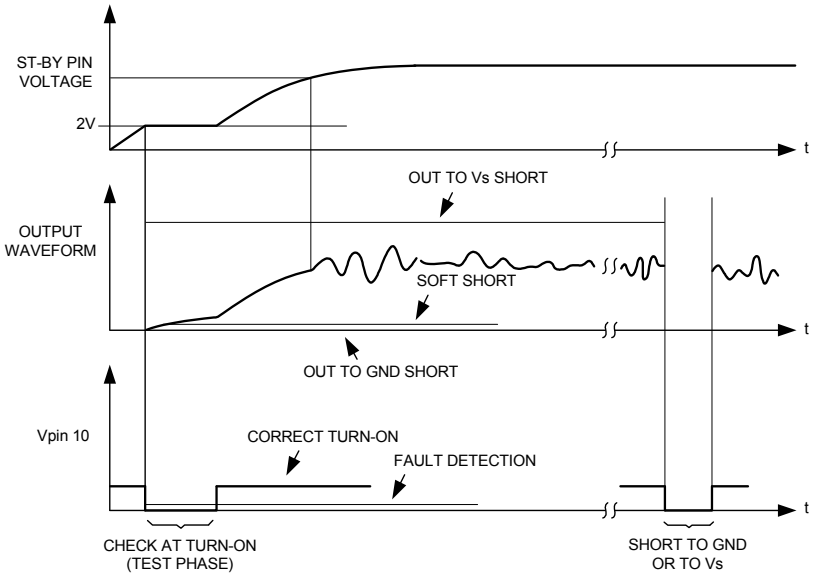


Figure 7: Fault Waveforms

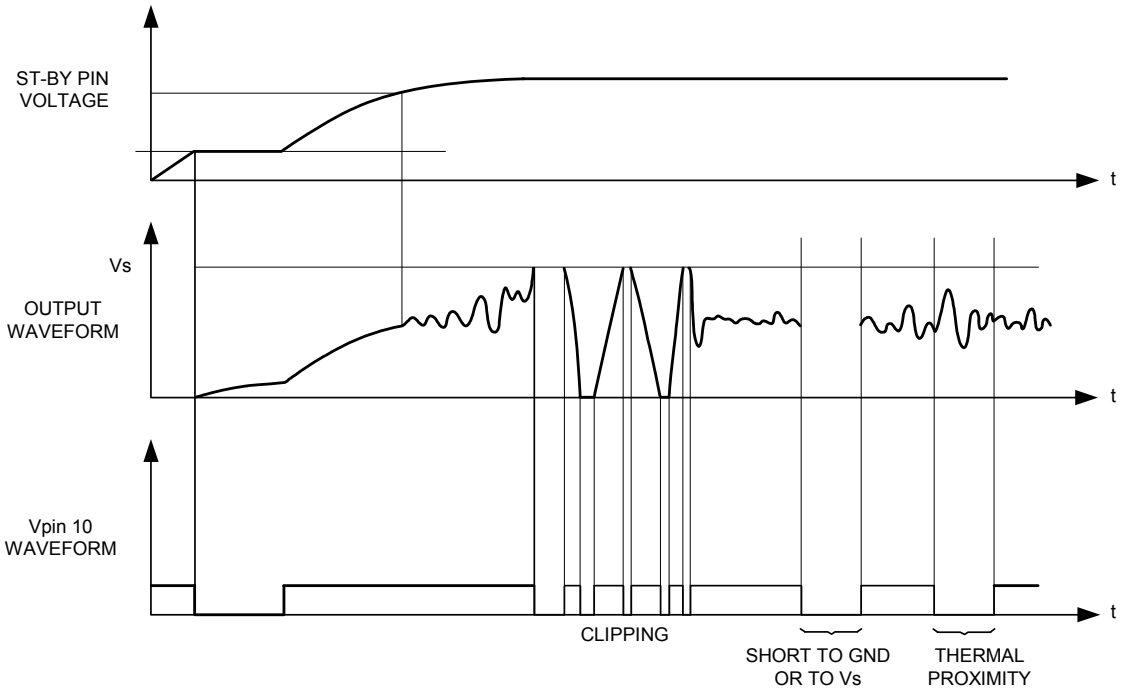


Figure 8: Waveforms

Normally the clip detector signalling produces a low level at pin 10 that is shorter than that present under faulty conditions; based on this assumption an interface circuitry to differentiate the information is represented in the schematic of Fig. 9.

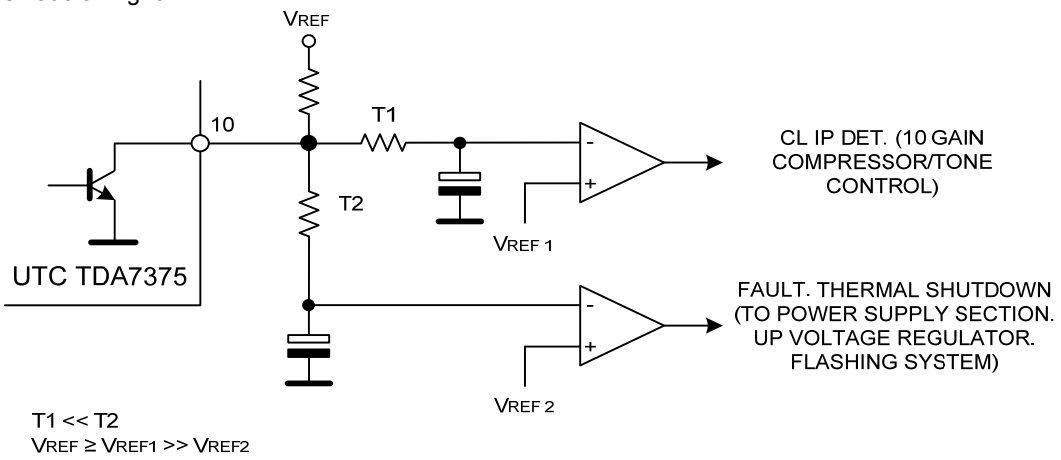


Figure 9.

8. PCB-LAYOUT GROUNDING

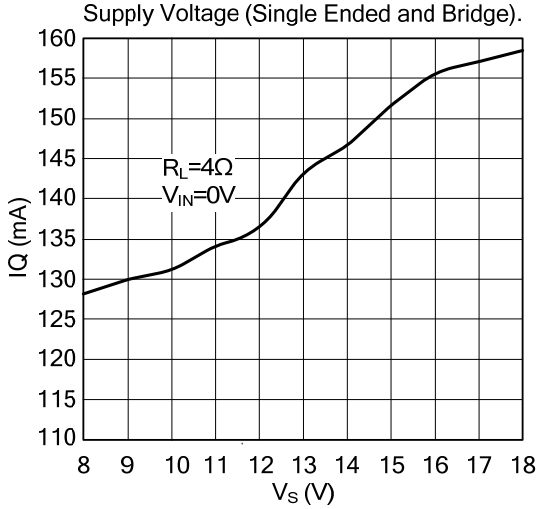
The device has 2 distinct ground leads, P-GND (POWER GROUND) and S-GND (SIGNAL GROUND) which are practically disconnected from each other at chip level. Proper operation requires that P-GND and S-GND leads be connected together on the PCB-layout by means of reasonably low-resistance tracks.

As to the PCB-ground configuration, a starlike arrangement whose center is represented by the supply-filtering electrolytic capacitor ground is highly advisable. In such context, at least 2 separate paths have to be provided, one for P-GND and one for S-GND. The correct ground assignments are as follows:

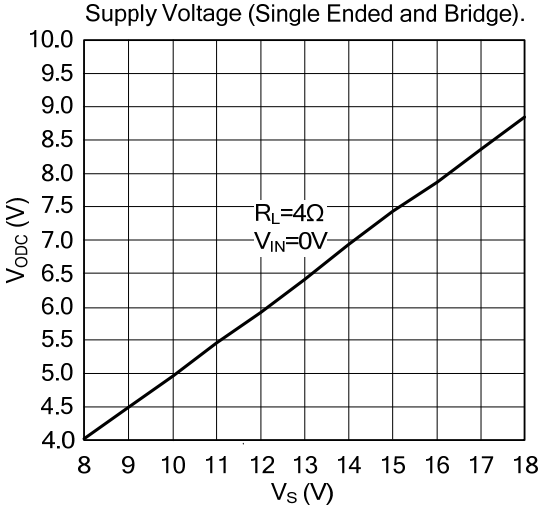
- STANDBY CAPACITOR(pin 7, or any other standby driving networks): on S-GND
- SVR CAPACITOR (pin 6): on S-GND and to be placed as close as possible to the device.
- INPUT SIGNAL GROUND (from active/passive signal processor stages): on S-GND.
- SUPPLY FILTERING CAPACITORS (pins 3,13): on P-GND. The (-) terminal of the electrolytic capacitor has to be directly tied to the battery (-) line and this should represent the starting point for all the ground paths.

■ TYPICAL CHARACTERISTICS

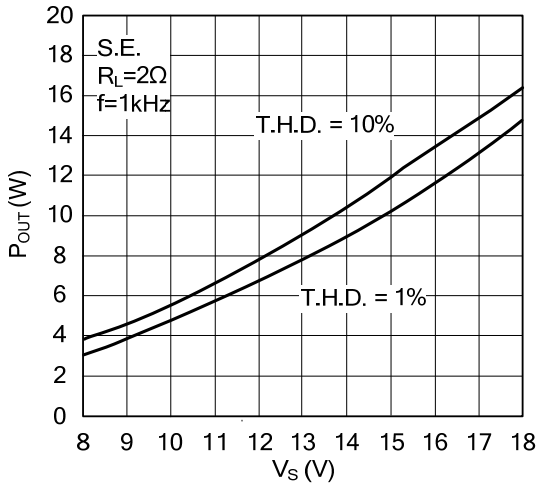
Quiescent Drain Current vs. Supply Voltage (Single Ended and Bridge).



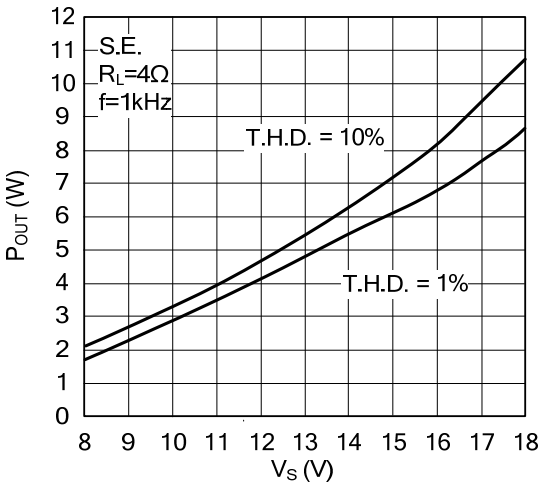
Quiescent Output Voltage vs. Supply Voltage (Single Ended and Bridge).



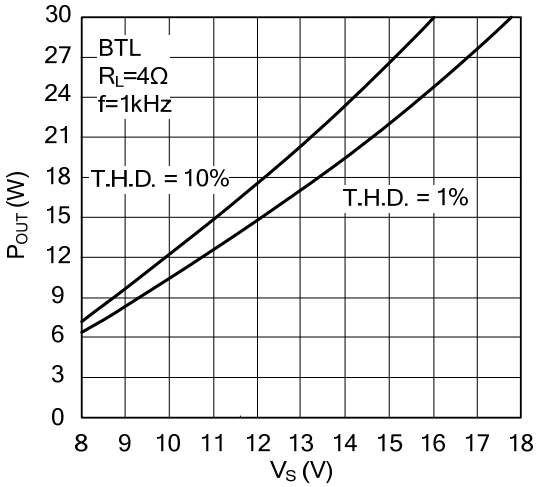
Output Power vs. Supply Voltage



Output Power vs. Supply Voltage



Output Power vs. Supply Voltage



Stand-by Attenuation vs. Threshold Voltage