



# TDA7336

## STEREO PREAMP + AMS + DOLBY B\* NOISE REDUCTION PROCESSOR

- DUAL CHANNEL PROCESSOR FOR PLAY-BACK APPLICATIONS.
- STEREO DOLBY B NR SYSTEM
- LOW NOISE HEAD PREAMPLIFIER
- MUTE, AMS (AUDIO MUSIC SENSOR) FUNCTIONS
- INTERNAL SWITCHES FOR EQUALIZATION
- DOLBY REFERENCE LEVEL -6dBm (388.2mVRMS)
- MINIMUM NUMBER OF EXTERNAL COMPONENTS
- LOW SUPPLY CURRENT (18mA)
- MIXED BIPOLAR/CMOS TECHNOLOGY

### DESCRIPTION

The TDA7336 is a monolithic BICmos IC designed for use in stereo cassette player systems.

The device includes two separate audio channels composed by low noise preamplifier, Dolby B noise reduction system and Audio Music Sensor.

The dual preamplifier contains mute, metal/normal facilities for amplification of low level signal in applications requiring very low noise performances.

Each channel consists of two cascaded operational amplifiers.

The first one, AMP1, has a fixed gain of 36dB, and allows magnetic heads connection directly to ground. The second one, AMP2, is a standard operational amplifier whose equalizing external components fix the frequency response.

The Audio Music Sensor circuit detects the inter-program space and then the starting point of musical programs (the interprogram time and program detection time are externally selectable).

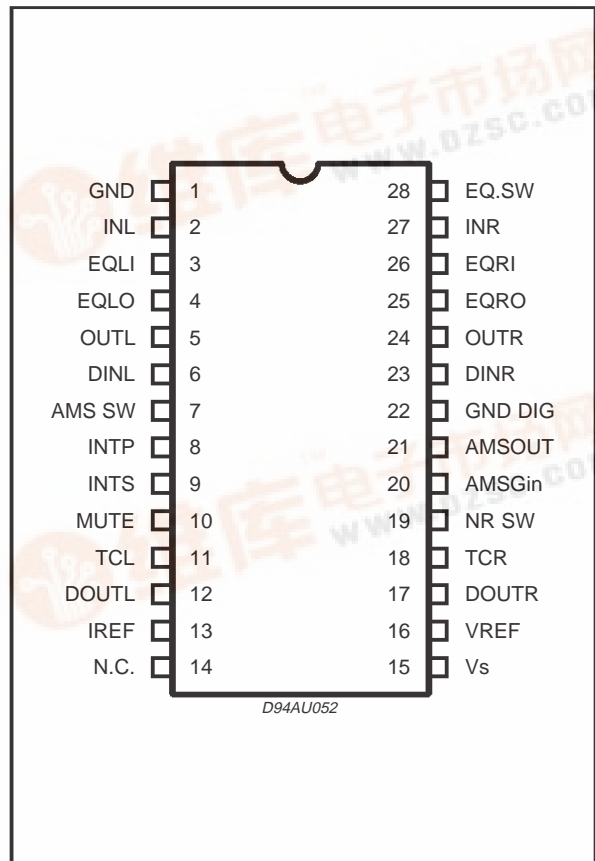
The device contains Dolby B decoder NR chains requiring very few external components and do not require coils.

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**This device is available only to Licensing and application information may be obtained from Dolby Lab.**



### PIN CONNECTION (Top view)



## TDA7336

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_S$	Supply Voltage	12	V
$P_{tot}$	Total Power Dissipation	1	W
$T_{op}$	Operating Temperature Range	-40 to 85	°C
$T_{stg}$	Storage Temperature Range	-40 to 150	°C

### THERMAL DATA

$R_{th\ j-pins}$	Thermal resistance junction-pins	85	°C/W
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### PIN FUNCTIONS

N.	Name	V <sub>bc</sub> (V)	Function
1	GND		Ground
2	IN L	0	Preamplifier Left Input
3,26	EQLI, EQRI	4.6	Equalizer Inputs
4, 25	EQLO, EQRO	4.6	Equalizer Outputs
5, 24	OUTL, OUTF	4.6	Preamplifier Outputs
6, 23	DINL, DINR	$V_{ref}$	Dolby NR Inputs
7	AMS SW	5.6	Audio Music Sensor Switch (ON/OFF) HIGH = ON
8	INTP		Interprogram Time Constant ("Signal Detection")
9	INTS		Interspace Time Constant ("Blank Detection")
10	MUTE		Mute Switch ON = LOW (2)
11, 18	TLC, TCR	0.4	Dolby Time Constants
12, 17	DOUFL, DOUFR	$V_{ref}$	Dolby Outputs
13	$I_{ref}$	1.2	Reference Current Source
15	$V_S$		Positive Power Supply
16	$V_{ref}$	$V_S/2$	Reference Voltage
19	NR SW		Noise reduction ON/OFF: HIGH =OFF (2)
20	AMS GIN	1.4	Audio Music Sensor Input Pin
21	AMS OUT		Audio Music Sensor Output Pin (open collector configuration, see Fig. 2)
22	GND DIG.	0	Digital Ground
27	IN R	0	Preamplifier Right Input
28	EQ SW	0	Equalizer Switch (Low = normal position High = metal position)

(2) Internal pull-up resistor (digital high level if pin left open)

Figure 1: Application Circuit

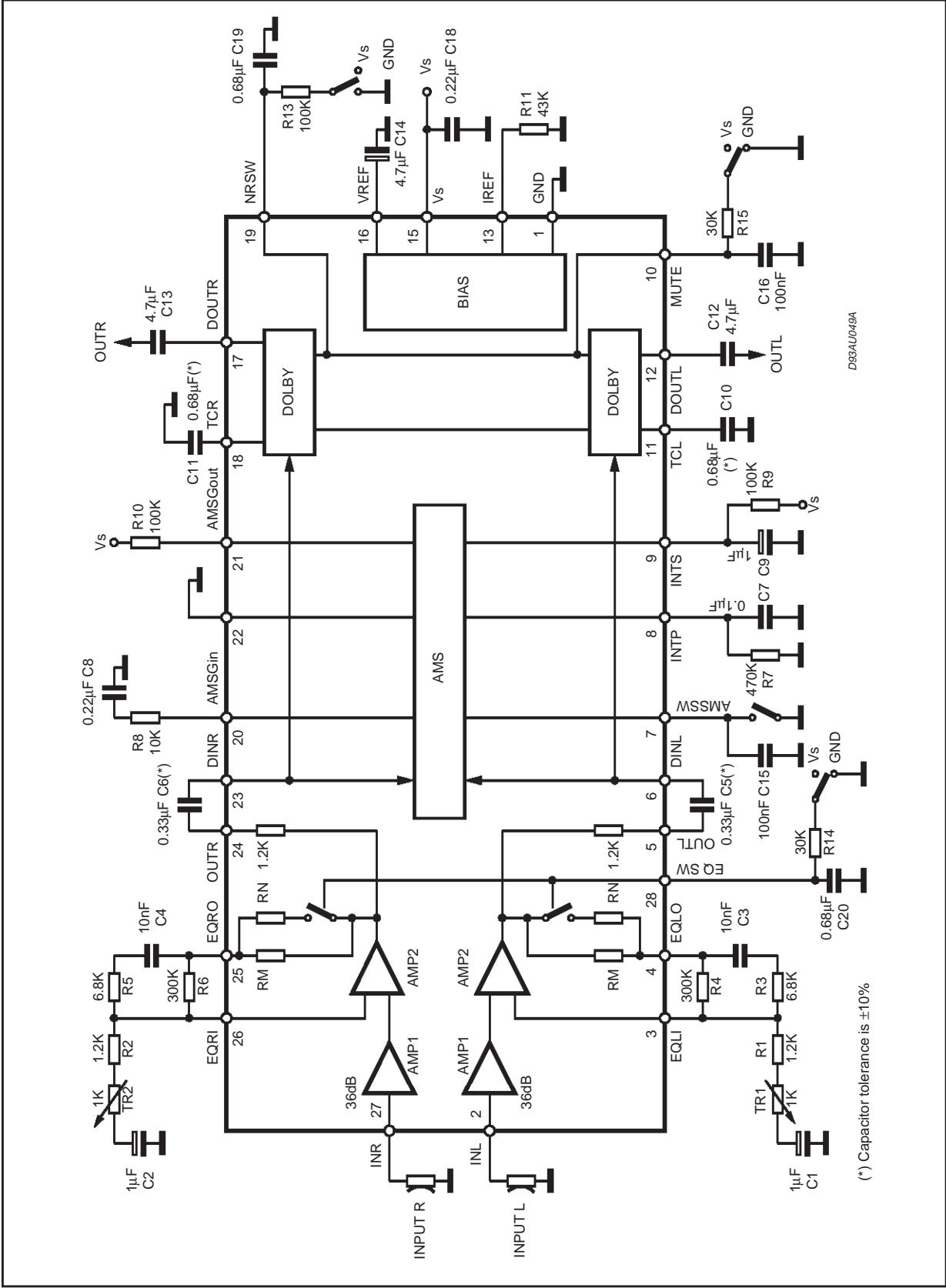


Figure 1a: Components & Top Copper Layer of the Fig. 1 (1:1 scale).

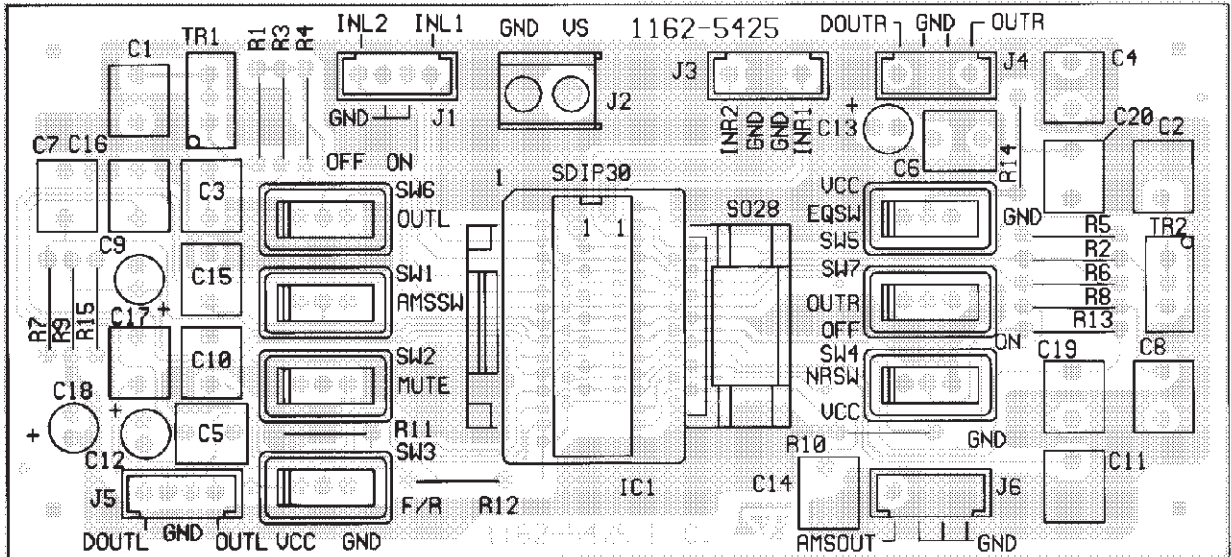
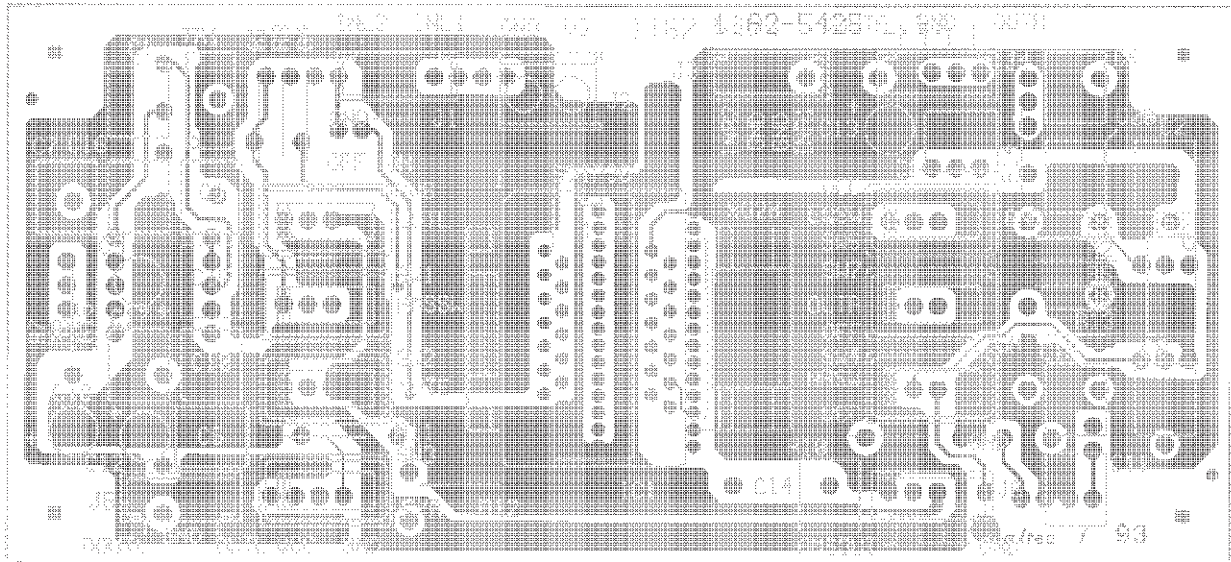
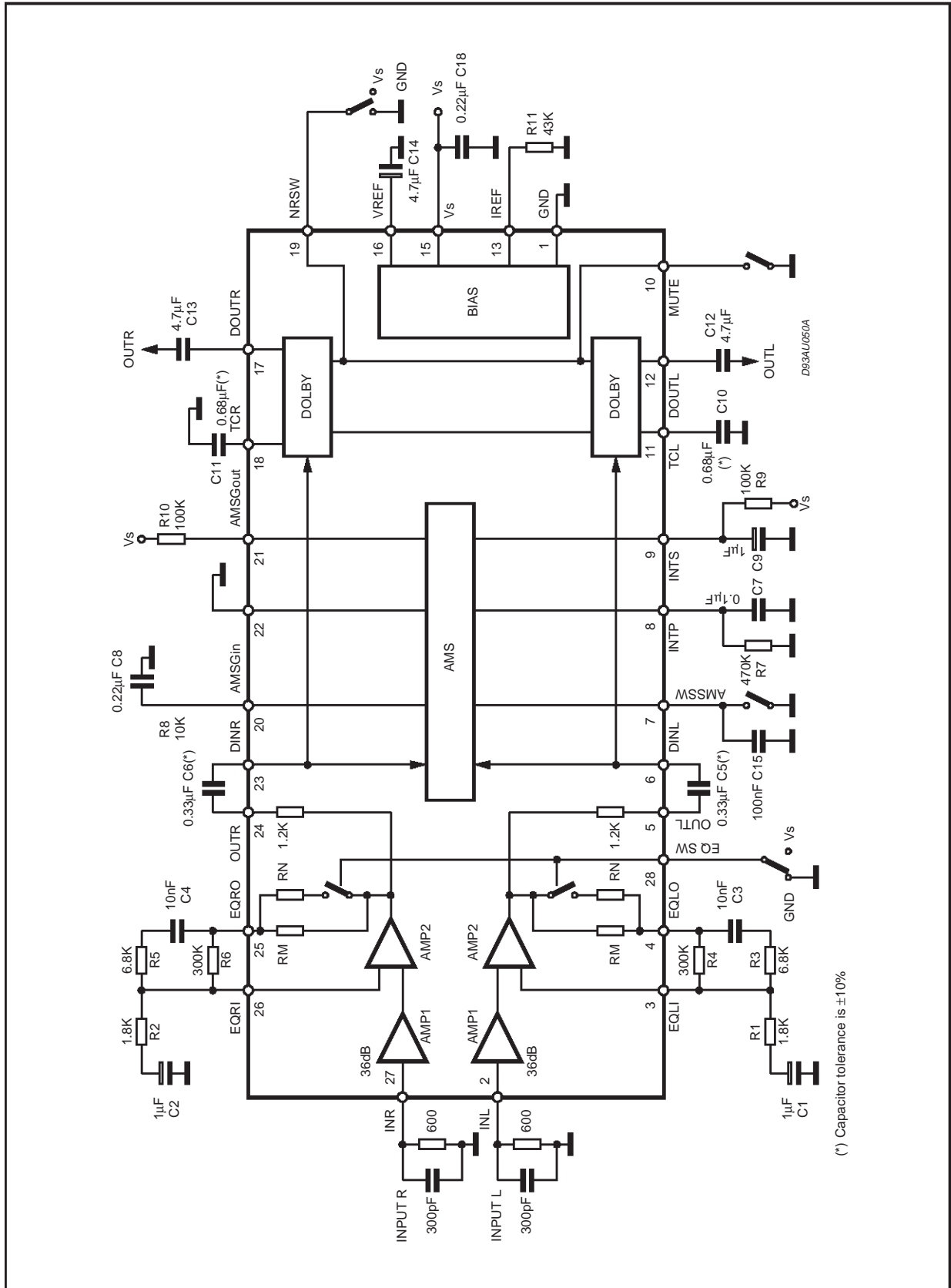


Figure 1b: Bottom Copper Layer of the Fig. 1 (1:1 scale).



TEST CIRCUIT



(\*) Capacitor tolerance is  $\pm 10\%$

## TDA7336

**ELECTRICAL CHARACTERISTICS** ( $V_S = 8.5V$ ;  $f = 1KHz$ ;  $R_g = 600\Omega$   $T_{amb} = 25^\circ C$ ;  $R_{11} = 43K\Omega$  all level referenced to  $-6dBm/400Hz$ , at  $D_{out}$  with NR SW OFF; unless otherwise specified see application circuit of Fig. 1) NAB METAL position.

### SUPPLY

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit	
$V_S$	Supply Voltage		8	8.5	10.5	V	
$I_S$	Supply Current		11	18	26	mA	
$V_{ref}$	Reference Voltage (pin 16)		4	4.3	4.6	V	
$V_{DC}$	DC Voltage pin 13 ( $R_{11} = 43K$ )		1.15	1.25	1.35	V	
SVR	Ripple Rejection (Input Referred)	$V_{ripple} = 0.3V_{rms}$ $f_{ripple} = 1KHz$	Dolby OFF	80	90		dB
			Dolby ON	85	95		dB
MUTE <sub>th</sub>	Mute Threshold Pin 10	ON	0		0.8	V	
		OFF	2.0		$V_S$	V	
$I_{MUTE}$	Mute Current			10	20	$\mu A$	
MUTE <sub>A</sub>	Mute Attenuation		55	65		dB	

### PREAMPLIFIER

$R_I$	Input Resistance	(pin 2, 27)	30	50	70	$K\Omega$
$I_i$	Input Bias Current				10	$\mu A$
$G_V$	Closed Loop Gain	pin 3, 4 and 25, 26 shorted	32.5	35.5	38.5	dB
$\Delta G_V$	Closed Loop Gain Match		-1		1	dB
$R_M$	Resistance Metal Position		4.35	5.8	7.25	$K\Omega$
$R_N$	Resistance Normal Position		50	160	300	$\Omega$
$e_N$	Total Input Noise	Unw. B=20Hz to 20KHz $R_g = 0\Omega$ ; A weighted $R_g = 600\Omega$ ; $R_g = 600\Omega$ ;		0.45		$\mu V$
				0.8		$\mu V$
				0.5		$\mu V$
$R_O$	Output Impedance	(Pin 5, 24)	0.9	1.2	1.7	$K\Omega$
$EQ_l$	Normal Low Level (pin 28)		0		1.5	V
$EQ_h$	Metal High Level (pin 28)		3.5		$V_S$	V
$\Delta R_M$	Metal Resistance Matching		-2	0	+2	%

### AUDIO MUSIC SENSOR

$I_{AMS_{OUT}}$	AMS Output Current				5	mA
$V_{AMS_{OUT}}$	AMS Output Low Level	$I_{AM_{OUT}} = 2mA$		200	800	mV
$R_{P20}$	Input Impedance		0.8	1.1	1.4	$K\Omega$
$AMS_{swl}$	AMS OFF Low Level		0		0.8	V
$AMS_{swh}$	AMS ON High Level		2		$V_S$	V
$V_{TH1}$	Interprogram Threshold Voltage	(pin 8)	1.2	1.45	1.7	V
$V_{TH2}$	Interspace Threshold Voltage	(pin 9)	4	4.3	4.6	V
$AMS_{th}$	AMS Threshold Level	see note (3)	0.6	1	1.4	V
$I_{AMS_{sw}}$	AMS Switch pin Current		5	10	15	$\mu A$

### DOLBY SECTION

$G_V$	Voltage Gain	$f = 1KHz$ ;	OFF	-1	0	1	dB
$\Delta G_V$	Gain Matching		OFF	-0.5		0.5	dB
$R_{Di}$	Dolby Input Res.	(pin 6, 23)		46	63		$K\Omega$
S/H	Signal Handling	$V_S = 8V$ ; THD = 1%	OFF	12	13		dB
$R_{DO}$	Dolby Output Imp.	(pin 12, 17)		100	200	300	$\Omega$
B DEC 1	Decode Out	$f = 10KHz$ ; $V_i = 0.4dB$	ON	-1.5	0	1.5	dB

**ELECTRICAL CHARACTERISTICS** (continued)

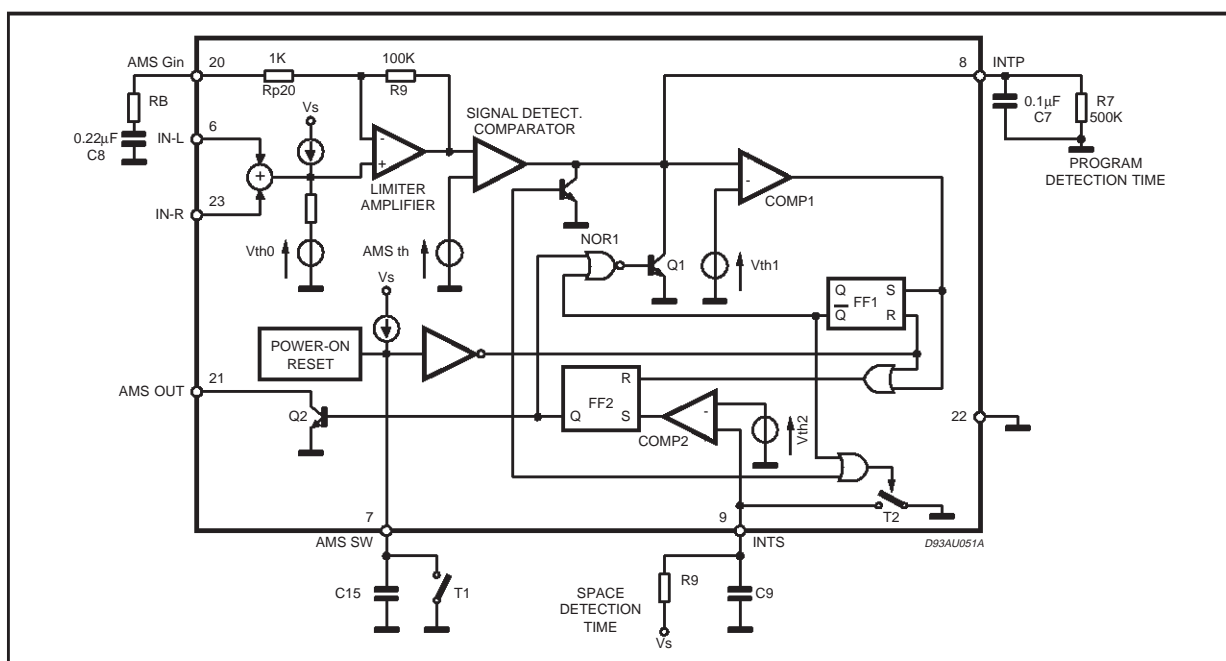
**DOLBY SECTION**

Symbol	Parameter	Test Condition	DOLBY	Min.	Typ.	Max.	Unit
B DEC 2	Decode Out	f = 500Hz; V <sub>i</sub> = -22.1dB	ON	-26.5	-25	-23.5	dB
B DEC 3	Decode Out	f = 2KHz; V <sub>i</sub> = -18dB	ON	-26.5	-25	-23.5	dB
B DEC 4	Decode Out	f = 5KHz; V <sub>i</sub> = -29.7dB	ON	-41.5	-40	-38.5	dB
B DEC 5	Decode Out	f = 10KHz; V <sub>i</sub> = -29.6dB	ON	-41.5	-40	-38.5	dB
NR <sub>i</sub>	Dolby ON Low Level Pin 19			0		0.8	V
NR <sub>h</sub>	Dolby OFF High Level Pin 19			2		V <sub>s</sub>	V

**GENERAL (PREAMPLIFIER + DOLBY)**

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
THD	Total Harmonic Dist.	V <sub>o</sub> = 0dB; f = 1KHz Dolby OFF		0.02	0.1	%
		V <sub>o</sub> = 0dB; f = 1KHz Dolby ON		0.05	0.1	%
		V <sub>o</sub> = 0dB; f = 10KHz Dolby OFF		0.03		%
		V <sub>o</sub> = 0dB; f = 10KHz Dolby ON		0.08		%
S/N	Signal to Noise Ratio	R <sub>g</sub> = 600Ω; V <sub>o</sub> = 0dB; Unweighted; Dolby OFF		63		dB
		R <sub>g</sub> = 600Ω; V <sub>o</sub> = 0dB; Unweighted; Dolby ON		70		dB
		R <sub>g</sub> = 600Ω; V <sub>o</sub> = 0dB; CCIR/ARM; Dolby OFF	54	63		dB
		R <sub>g</sub> = 600Ω; V <sub>o</sub> = 0dB; CCIR/ARM; Dolby ON	56	72		dB
C <sub>s</sub>	Channel Separation	R <sub>g</sub> = 600Ω; f = 1KHz Dolby OFF	50	64		dB
		R <sub>g</sub> = 600Ω; f = 1KHz Dolby ON		70		dB
C <sub>T</sub>	Channel Cross Talk	R <sub>g</sub> = 600Ω; f = 1KHz Dolby OFF	56	70		dB
		R <sub>g</sub> = 600Ω; f = 1KHz Dolby ON		75		dB

**Figure 2: Audio Music Sensor**





**AUDIO MUSIC SENSOR (See Figure 2)**

Aim of this section is to detect interprogram spaces present on a recorded tape.

Both the blanks (interprogram spaces) and the programs minimum detectable durations can be easily set by means of 2 external and independent time constants.

Also the minimum detectable input signal level can be externally adjusted, by a dedicated gain network.

Main blocks are:

- Variable gain limiter amplifier
- Signal detector circuitry
- Logic blocks able to avoid improper operations.

Operations Description (refer to the simplified schematic of Figure 2).

- a) The two channels left and right mean signal coming from the preamp chain (AC coupled) are added (current) at the AMS input and presented to the limiter amplifier. The limiter amplifier gain is internally fixed to 40dB, and it could be reduced by the R8 external resistor. The AMSVth threshold is fixed at 1V. The following signal detector comparator informs of the presence of music signal (High level out) and avoids the erroneous detection of very low signal (like noise) as real program.
- b) The system moves in blank detection mode everytime the supply is turned on or, with power supplied, the AMS On/Off pin (to be driven by an open collector output) is turned off (T1 open). Once this condition has happened, the capacitor C15 charges, defining a minimum reset time, long enough to reset the Flip-Flops FF1 and FF2 and to discharge the program detector external C7 capacitor. The charging current at the AMS SW pin is about 10µA. It follows that the reset time ( $C_{15} \times V_{pin7} / I_{C15}$ ) is given approximately by  $0.122 \times C_{15}$  ns where C15 is in µF.
- c) From now on where the sum input signal (left-right) amplified by the limiter exceeds the sig-

nal detector threshold (3) the capacitor C7 is forced to charge. When the voltage across this capacitor reaches the comparator COMP1 threshold voltage Vth1 (approx.  $2 V_{be}$ ) FF1 is set and FF2 is reset. (4) It follows that Q1 is turned on discharging the program detection capacitor (C7).

- d) Always when there is a recorded zone, Q1 is on; it becomes off only if a blank section is reached. When, with a time constant controlled by the R9, C9 network the voltage at space detection time pin reaches Vth2 threshold (comparator COMP2) a true blank section is detected and the FF2 is set. (The minimum charging time is approximately given by:

$$0.69 \times C_9 \times R_9 \text{ [sec]}$$

In this condition Q2 is on, forcing the open collector AMS output to go low, informing the user that a true blank section has been detected. The state is then able to start from the above point c). Figures 3-4 show the signal behaviour.

The device is able to prevent false interspace detection and the end of the tape. (see Fig. 4).

**Note:**

- (3): minimum RMS input signal is given by:

$$V_{in} = \text{AMSVth} \cdot \frac{1K + R_8}{101K + R_8} \cdot 0.6$$

where  $V_{in}$  is the mean of left and right channels::

$$V_{in} = \frac{V_{right} + V_{left}}{2}$$

- (4): the charging current at pin 8 is about 20µA (half input signal) so program detection time constant is given by:

$$\frac{C_7 \times 2V_{be}}{20\mu A} = 70 \times C_7 \text{ [}\mu\text{F]} = \text{[msec]}$$

It is recommended to insert a resistor (R7) high enough to prevent fast C7 capacitor discharging.



Figure 3: AMS Timing Diagram

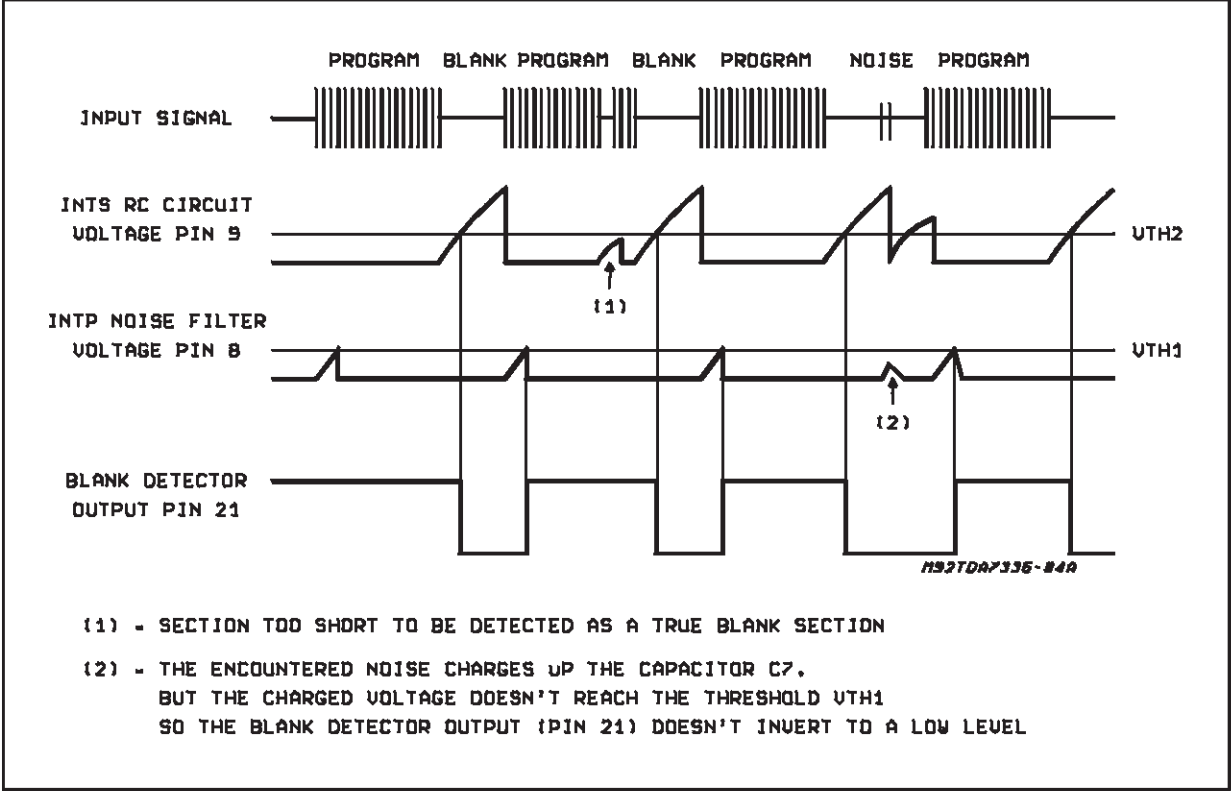
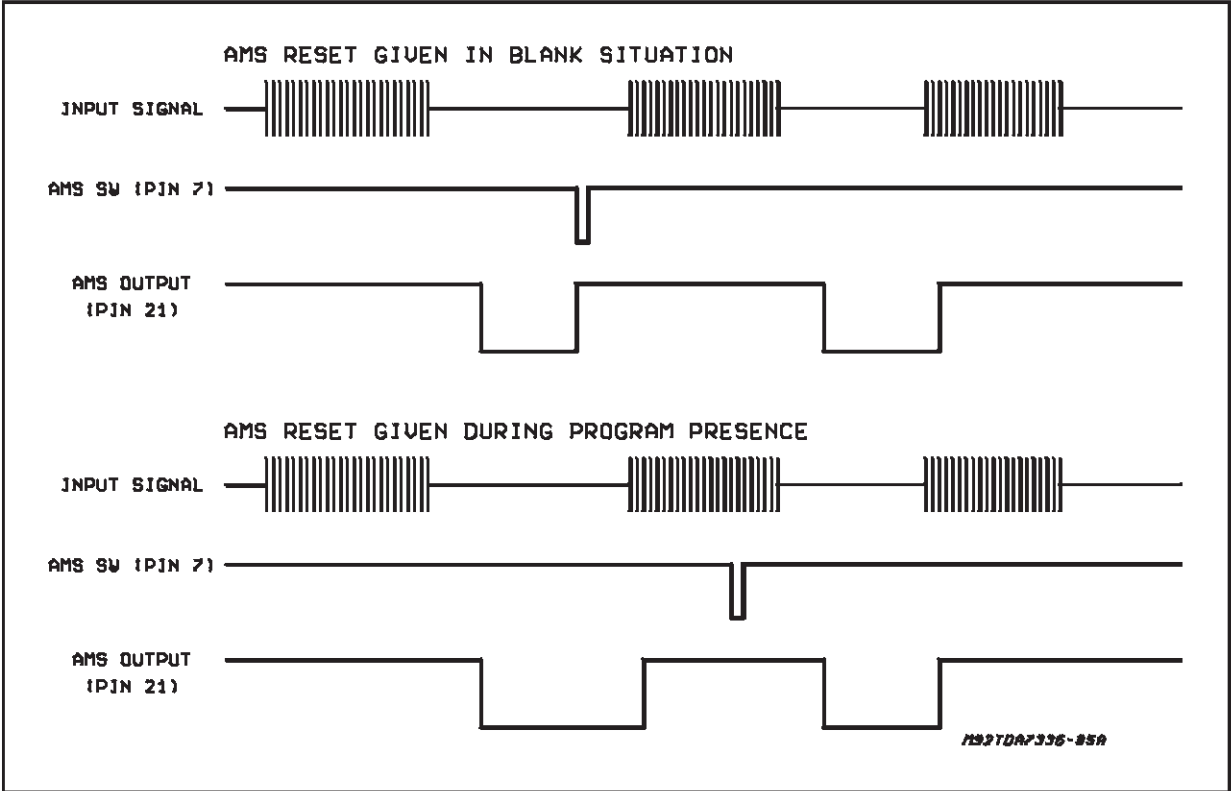


Figure 4



# TDA7336

## ELECTRICAL COMPONENT DESCRIPTION (see figure 1)

	COMPONENT	RECOMMENDED VALUE	PURPOSE
P R E A M P	TR <sub>1</sub> , TR <sub>2</sub> C <sub>1</sub> , C <sub>2</sub> C <sub>3</sub> , C <sub>4</sub> R <sub>1</sub> , R <sub>2</sub> R <sub>3</sub> , R <sub>5</sub> R <sub>4</sub> , R <sub>6</sub>	1KΩ 1μF 10nF 1.2KΩ 6.8KΩ 300KΩ	Left/Right Channel IN/OUT equalizer filter  TR fixes the gain 150msec NORMAL 70μsec METAL
	C <sub>5</sub> , C <sub>6</sub>	0.33μF ±10%	Preamplifier out to Dolby B input coupling capacitor
A M S	R <sub>8</sub> C <sub>8</sub>	10KΩ 0.22μF	Define the AMS input threshold level $V_{in} \cdot \frac{101K + R_8}{1K + R_8} \cdot 1.5 > 1V$ where $V_{in} = (V_{right} + V_{left})/2$
	R <sub>7</sub> C <sub>7</sub>	470KΩ 0.1μF	Set the interprogram detection time: $INTP = 70 \times 10^{-3} \times C_7[\mu F] = [sec]$
	R <sub>9</sub> C <sub>9</sub>	100KΩ 1μF	Set the interspace detection time: $INTS = 0.69 \times C_9 \times R_9 \text{ sec}$
	C <sub>15</sub>	100nF	It fixes music search reset time; $T_{res} = 0.122 \times C_{15}[\mu F] = [sec]$ if C <sub>15</sub> expressed in μF
D O L B Y	C <sub>10</sub> , C <sub>11</sub>	0.68μF ±10%	Dolby output coupling capacitors
	C <sub>12</sub> , C <sub>13</sub>	4.7μF ±10%	Dolby time constants
	C <sub>14</sub>	4.7μF	Reference voltage external capacitor
	R <sub>11</sub>	43KΩ	It fixes the I <sub>ref</sub> current
	C <sub>16</sub> R <sub>16</sub>	0.1μF 30KΩ	It fixes the mute time (typ 10msec).

### PINS DESCRIPTION: Internal Configuration

Figure 5: PINS: 2 - 27

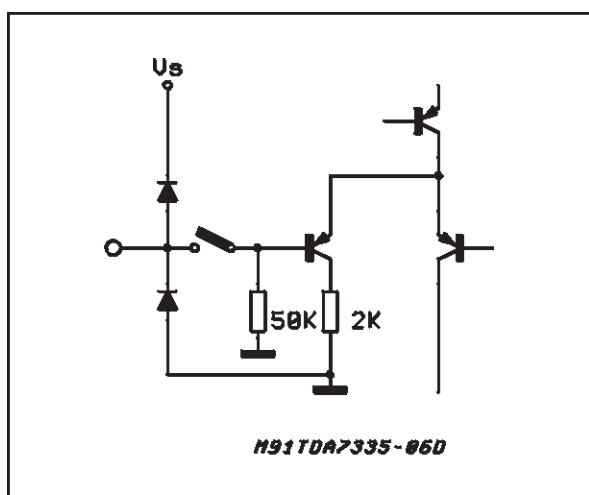
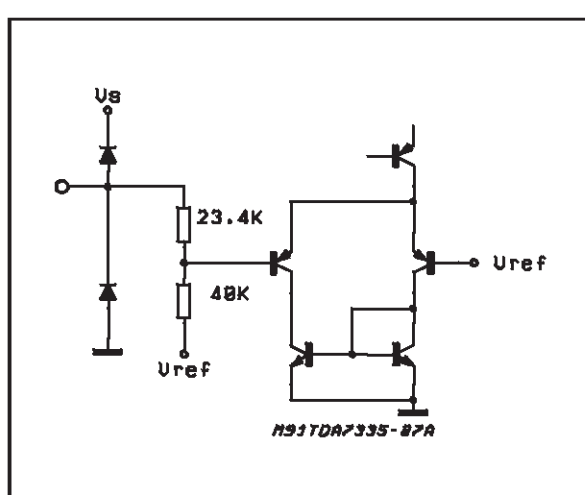
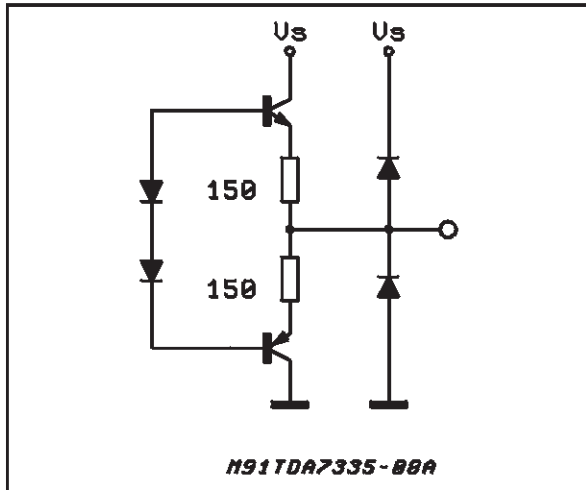


Figure 6: PINS: 6 - 23

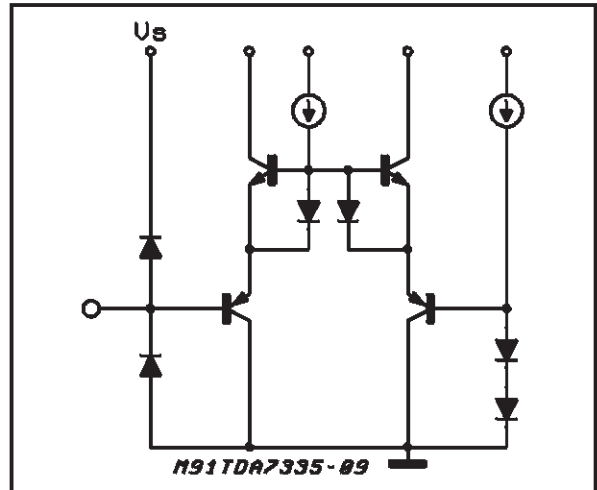


**PINS DESCRIPTION:** Internal Configuration

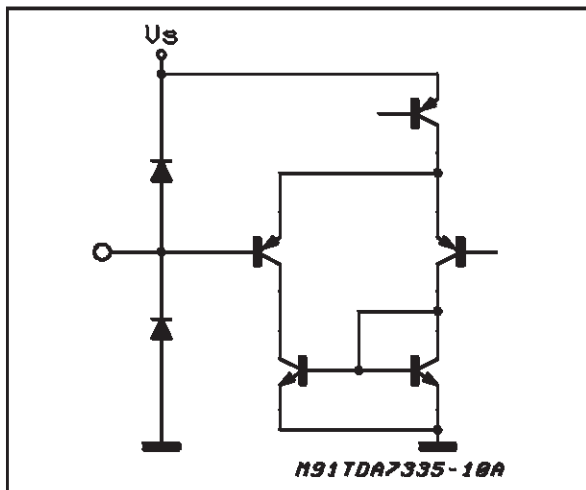
**Figure 7:** PINS: 12 - 17



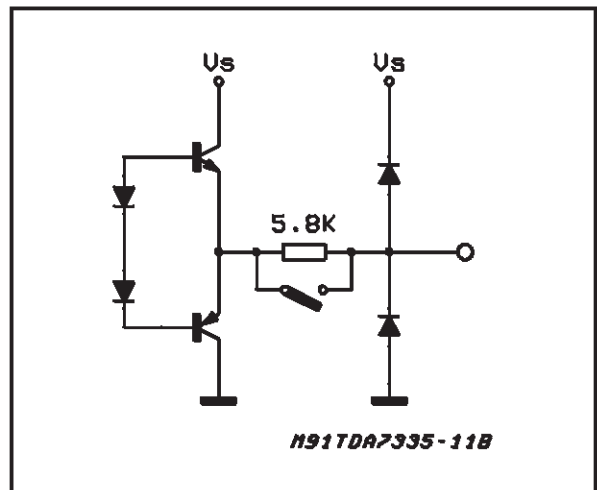
**Figure 8:** PIN: 8



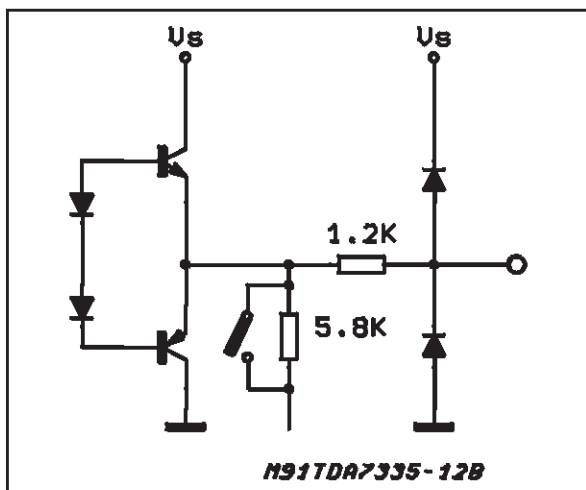
**Figure 9:** PINS: 3 - 26



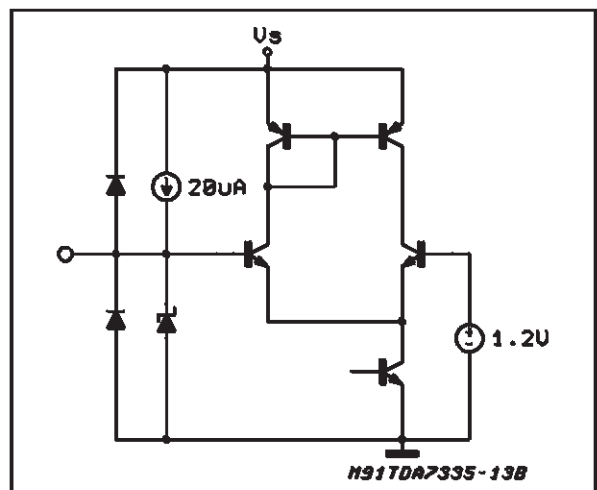
**Figure 10:** PINS: 4 - 25



**Figure 11:** PINS: 5 - 24



**Figure 12:** PINS: 7



PINS DESCRIPTION: Internal Configuration

Figure 13: PINS: 11 - 18

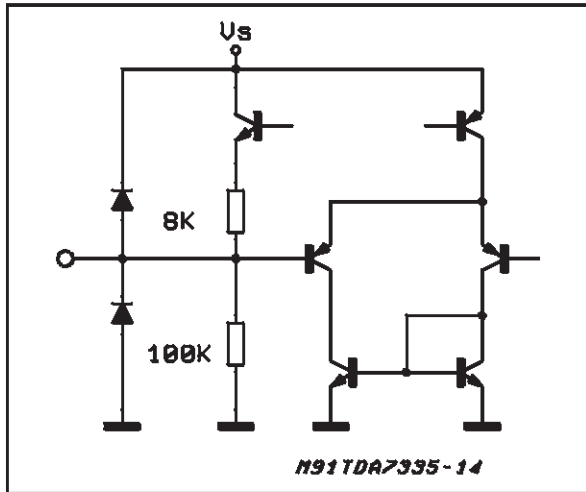


Figure 14: PIN: 13

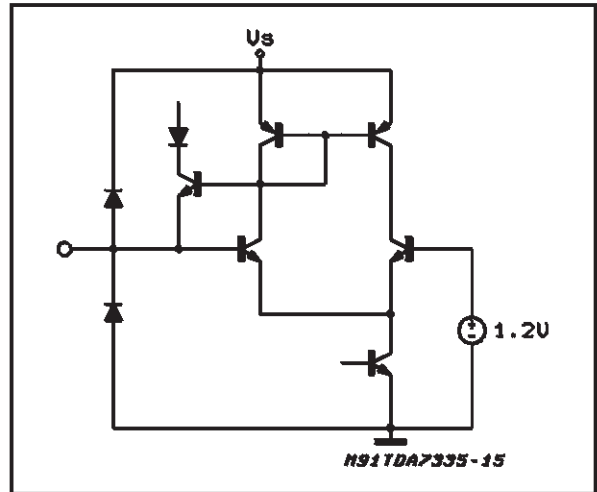


Figure 15: PIN: 9

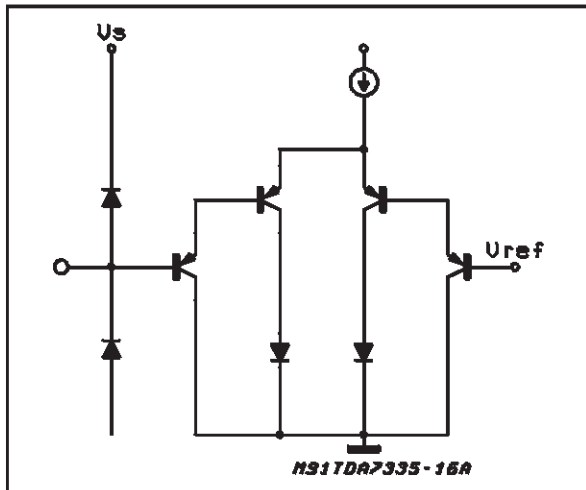


Figure 16: PIN: 21

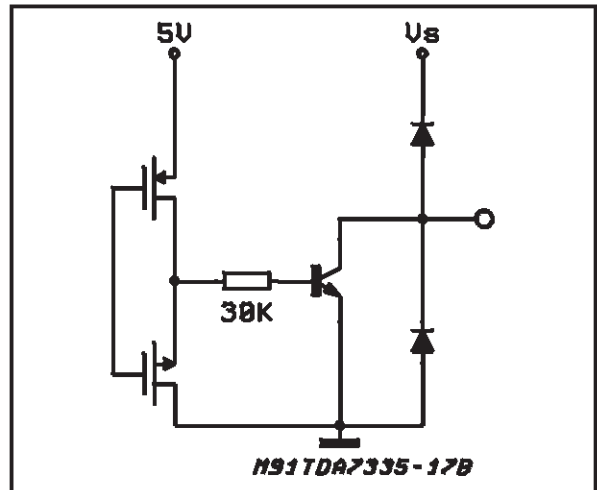


Figure 17: PIN: 20

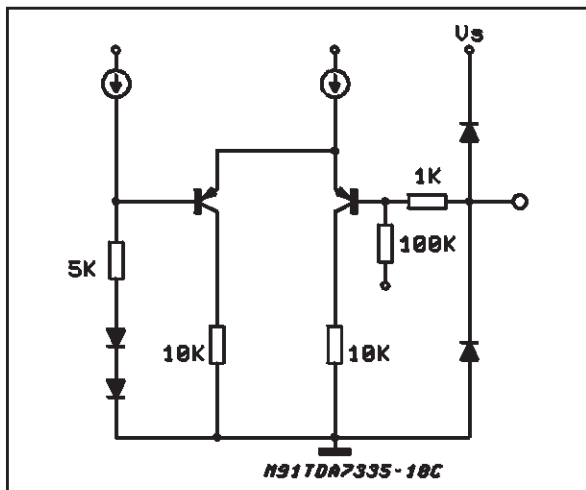
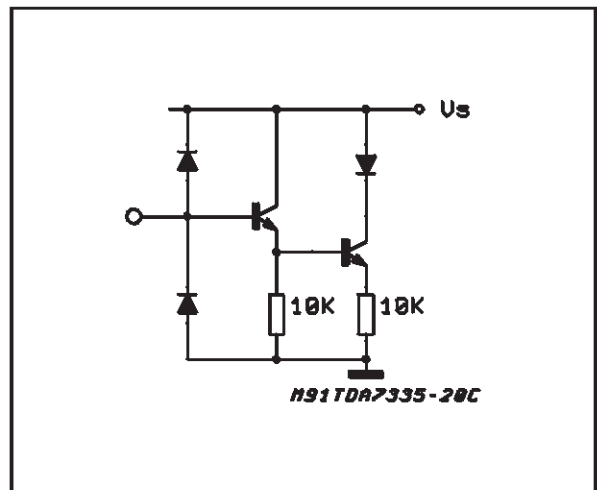
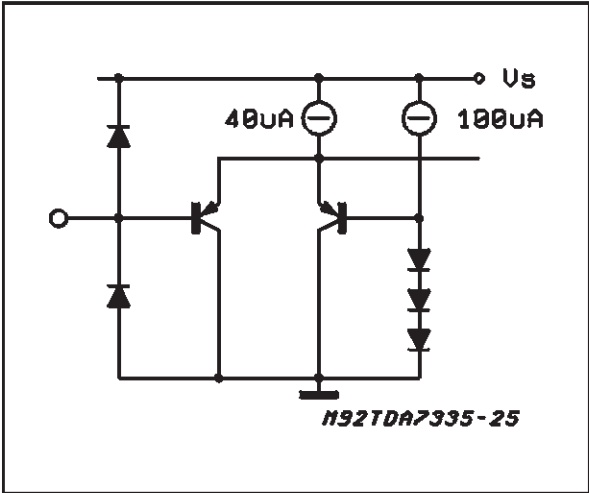


Figure 18: PIN: 28

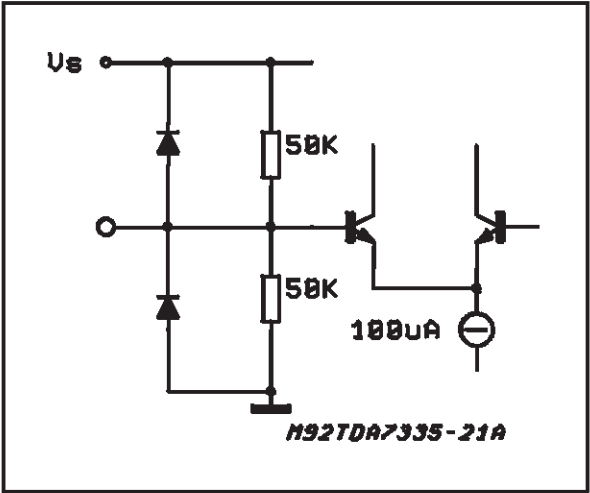


**PINS DESCRIPTION:** Internal Configuration

**Figure 19:** PIN: 19 - 10

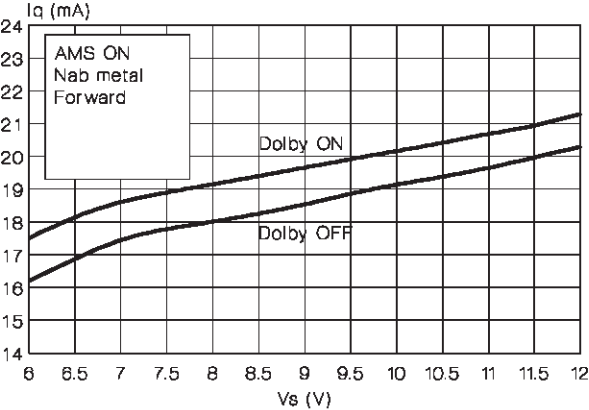


**Figure 20:** PIN: 16

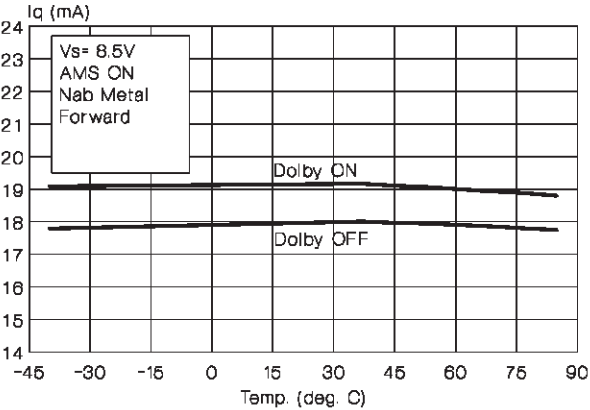


**DEVICE CHARACTERISTICS**

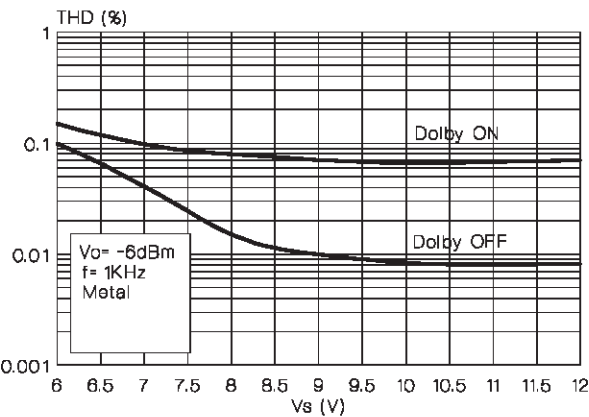
**Figure 21:** Quiescent Current vs. Supply Voltage



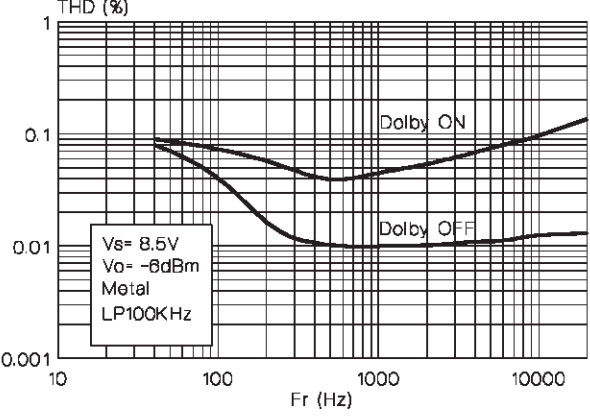
**Figure 22:** Quiescent Current vs. Temperature



**Figure 23:** THD vs Supply Voltage



**Figure 24:** THD vs Frequency



DEVICE CHARACTERISTICS (continued)

Figure 25: THD vs. Output Signal

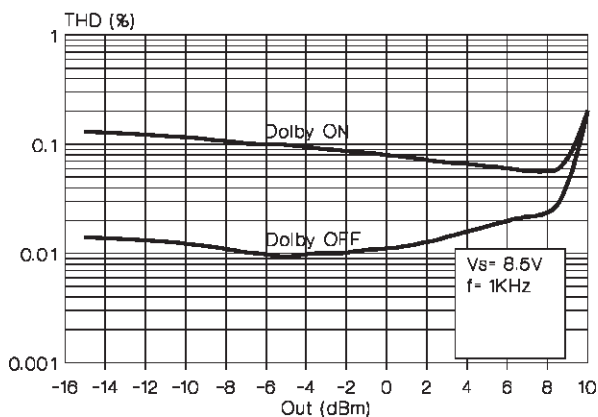


Figure 27: Channel Separation vs. Frequency

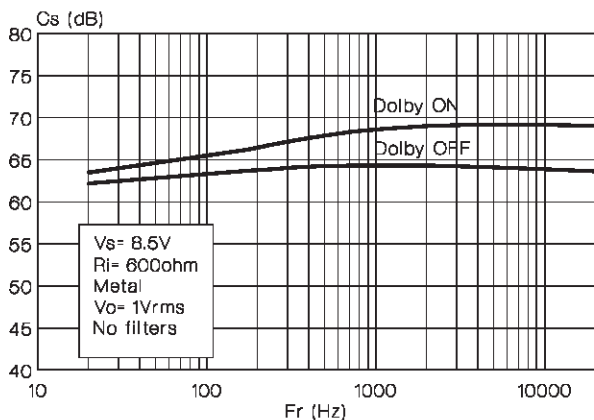


Figure 29: Ripple Rejection vs. Frequency

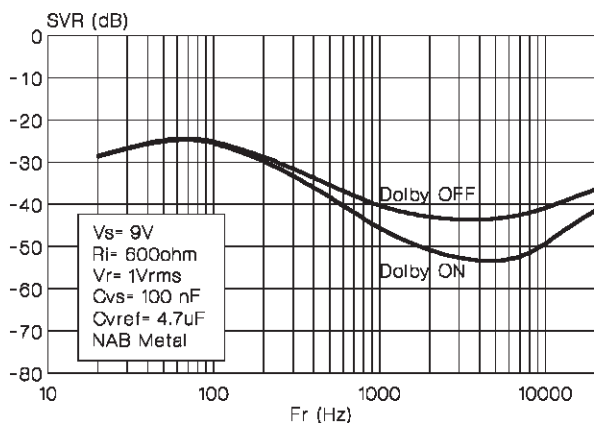


Figure 26: THD+N vs. Frequency

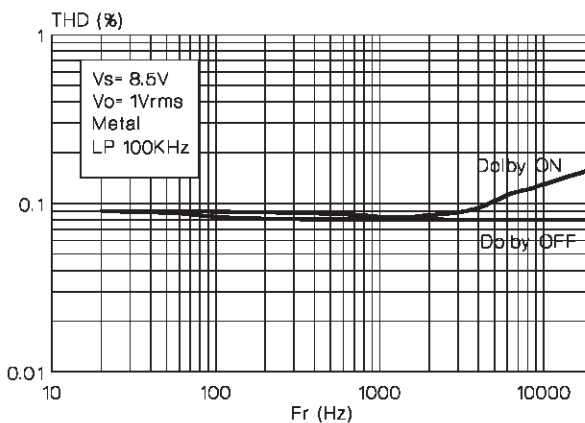


Figure 28: Cross Talk vs. Frequency

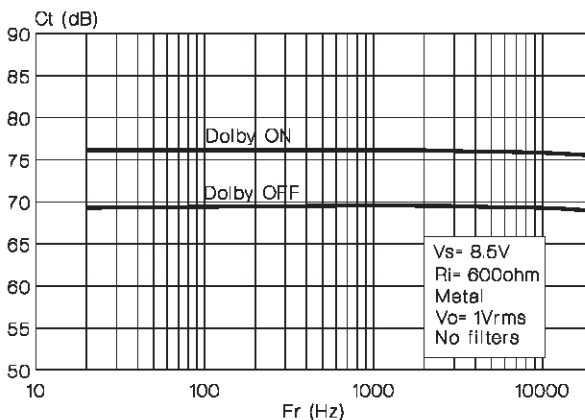
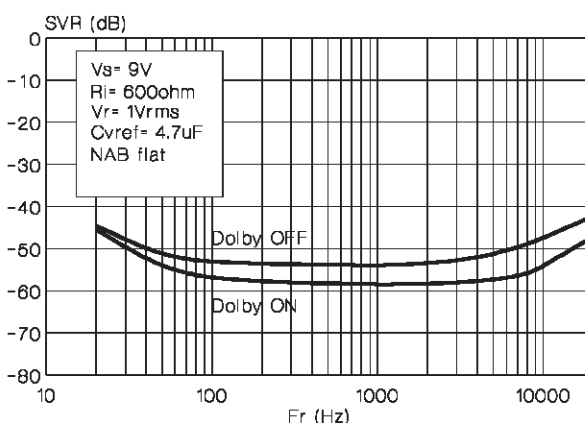


Figure 30: Ripple Rejection vs. Frequency



DEVICE CHARACTERISTICS (continued)

Figure 31: Ripple Rejection vs. Frequency

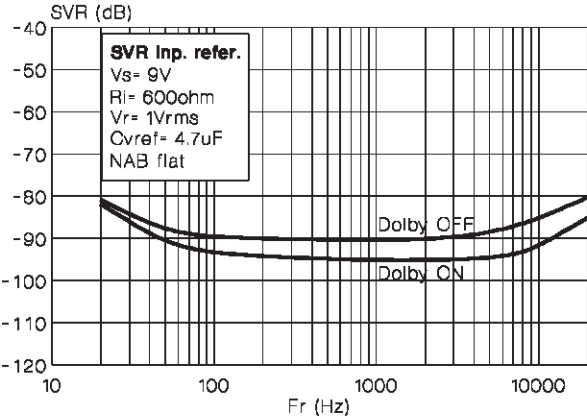


Figure 33: Mute Threshold

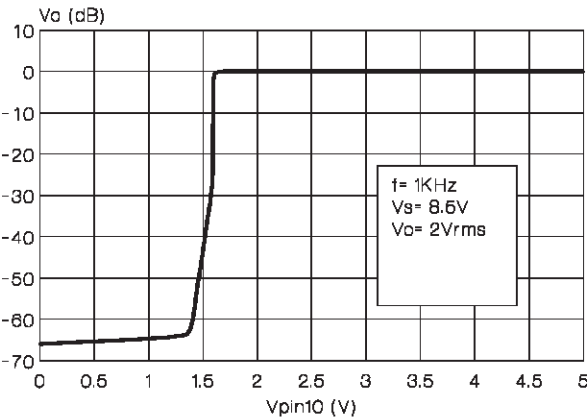


Figure 35: Vref & Iref vs Temperature

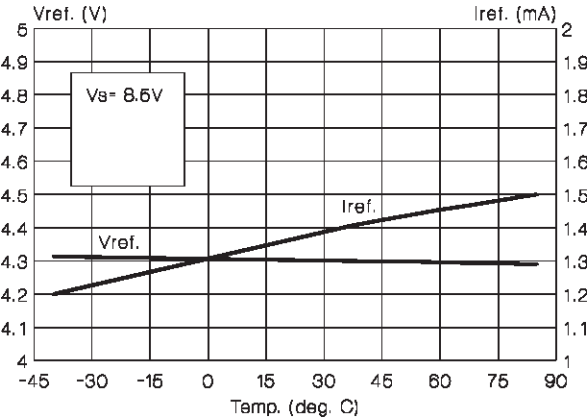


Figure 32: Mute Attenuation vs. Frequency

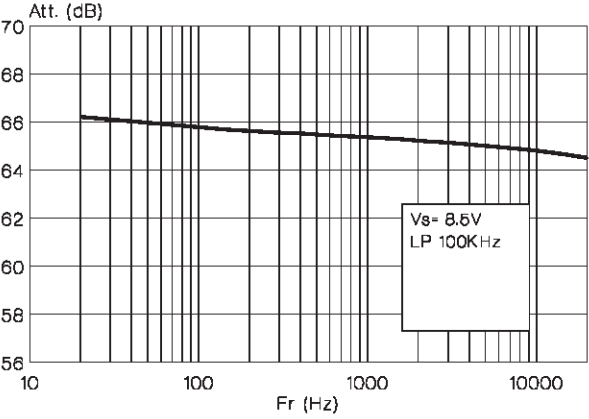


Figure 34: Vref & Iref vs Supply Voltage

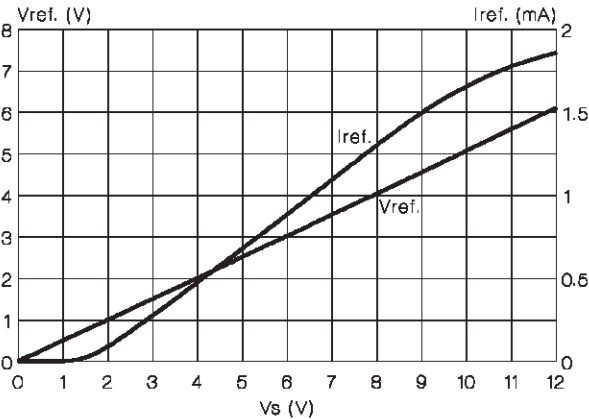
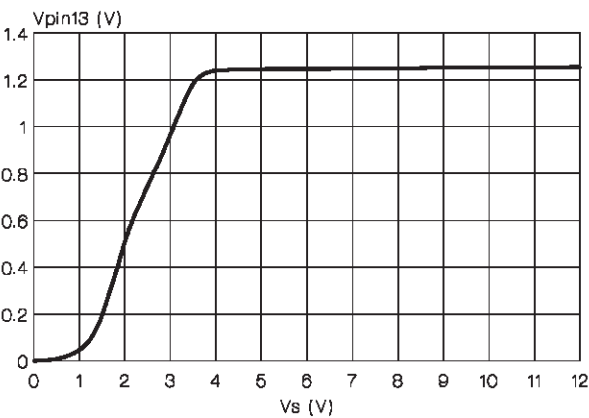


Figure 36: D.C. Voltage pin 13 vs. Supply Voltage





DEVICE CHARACTERISTICS (continued)

Figure 37: Equalizer Threshold

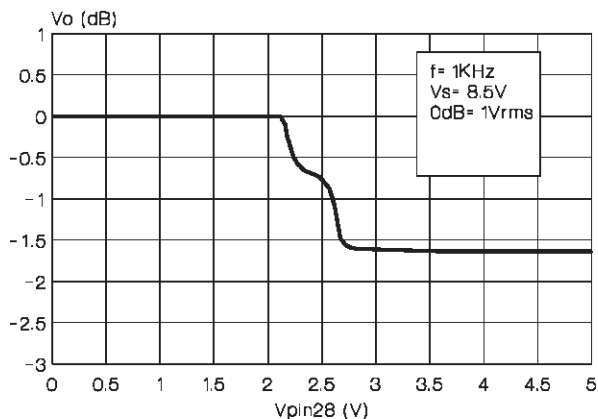


Figure38: Noise Reduction Threshold

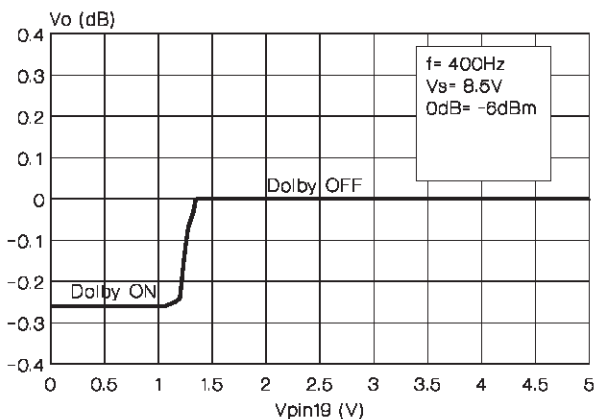


Figure 39: NAB Network

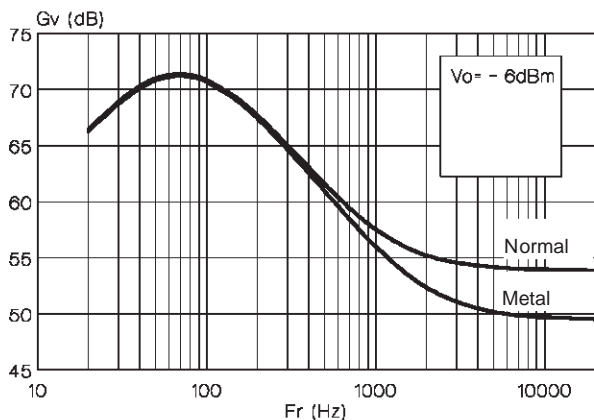


Figure 40: Load Characteristics

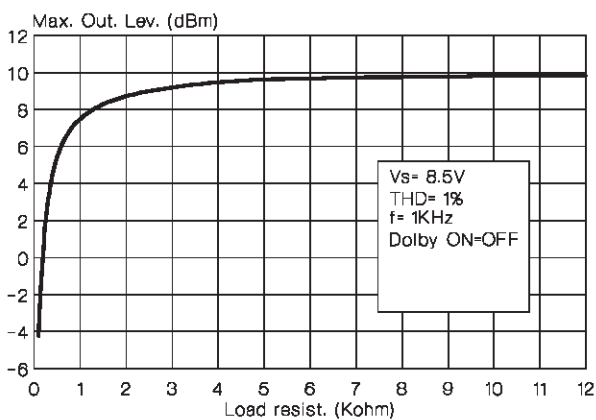


Figure 41: Signaling Handling vs. Supply Voltage

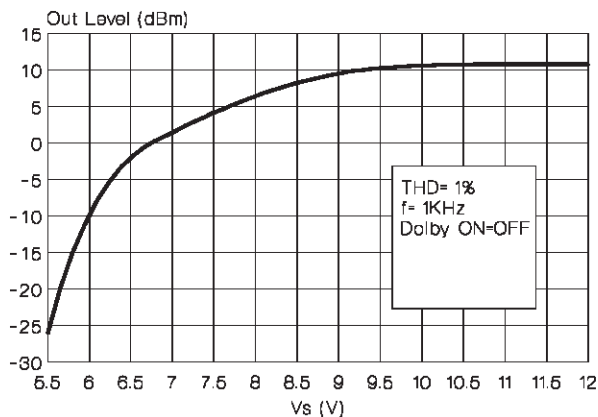
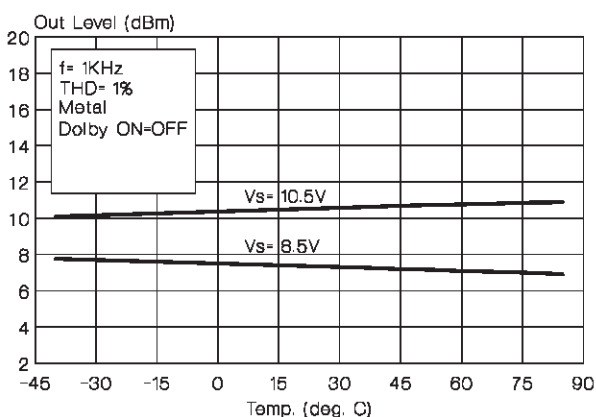


Figure 42: Signal Handling vs. Temperature



DEVICE CHARACTERISTICS (continued)

Figure 43: AMS Threshold vs. Frequency

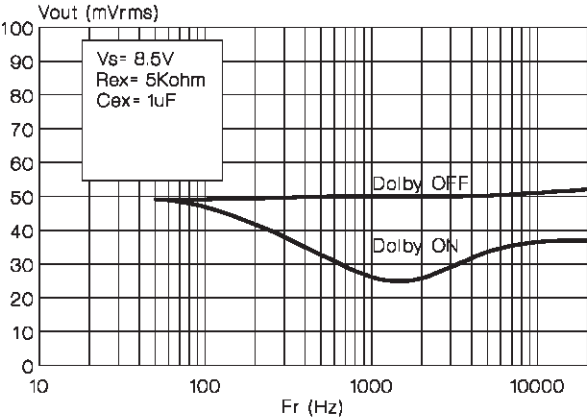


Figure 45: AMS Reset Time vs. Cex

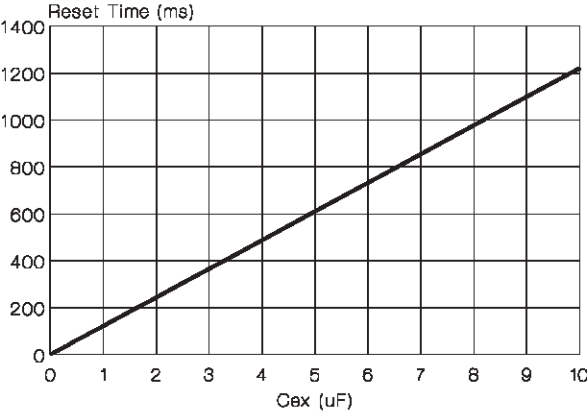


Figure 47: Interprogram Charging Current

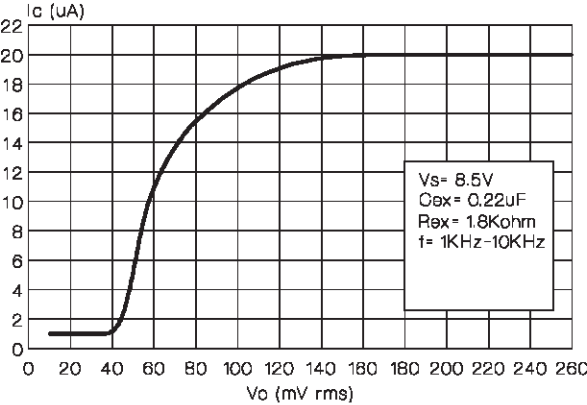


Figure 44: AMS Threshold vs. Rex

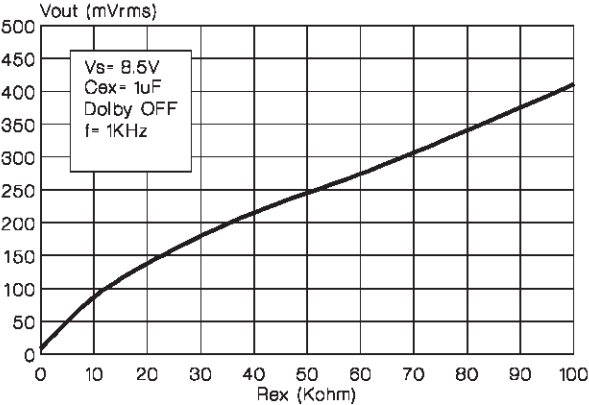


Figure 46: AMS Interprogram vs. C7

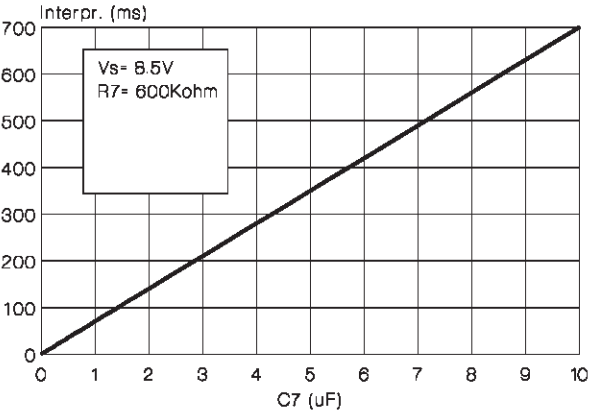
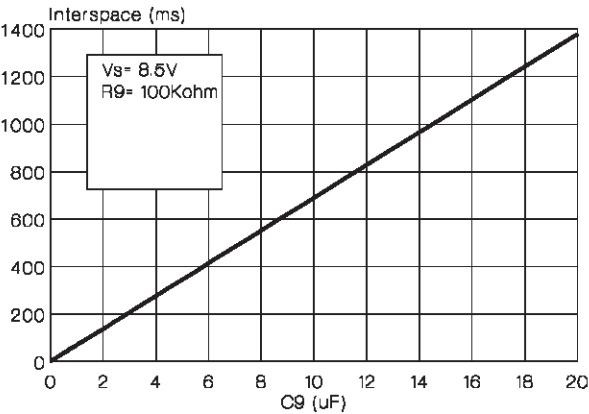
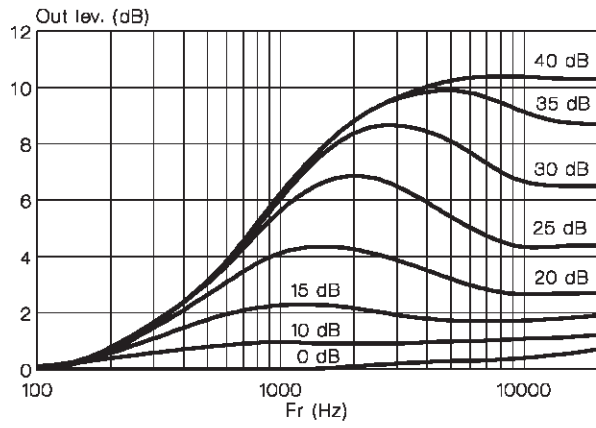


Figure 48: Interspace vs. C9



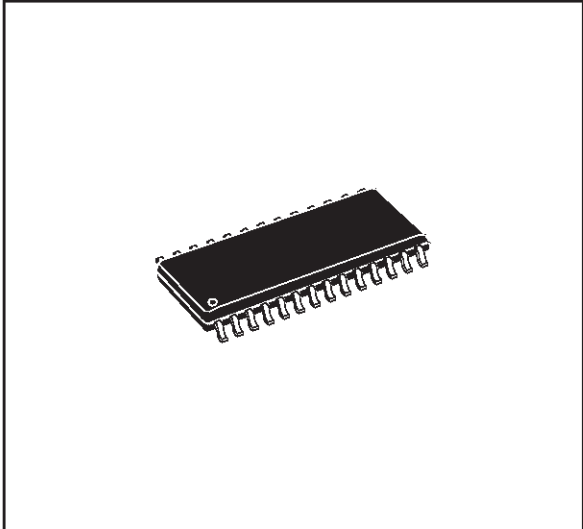
DEVICE CHARACTERISTICS (continued)

Figure 49: Dolby-B Table

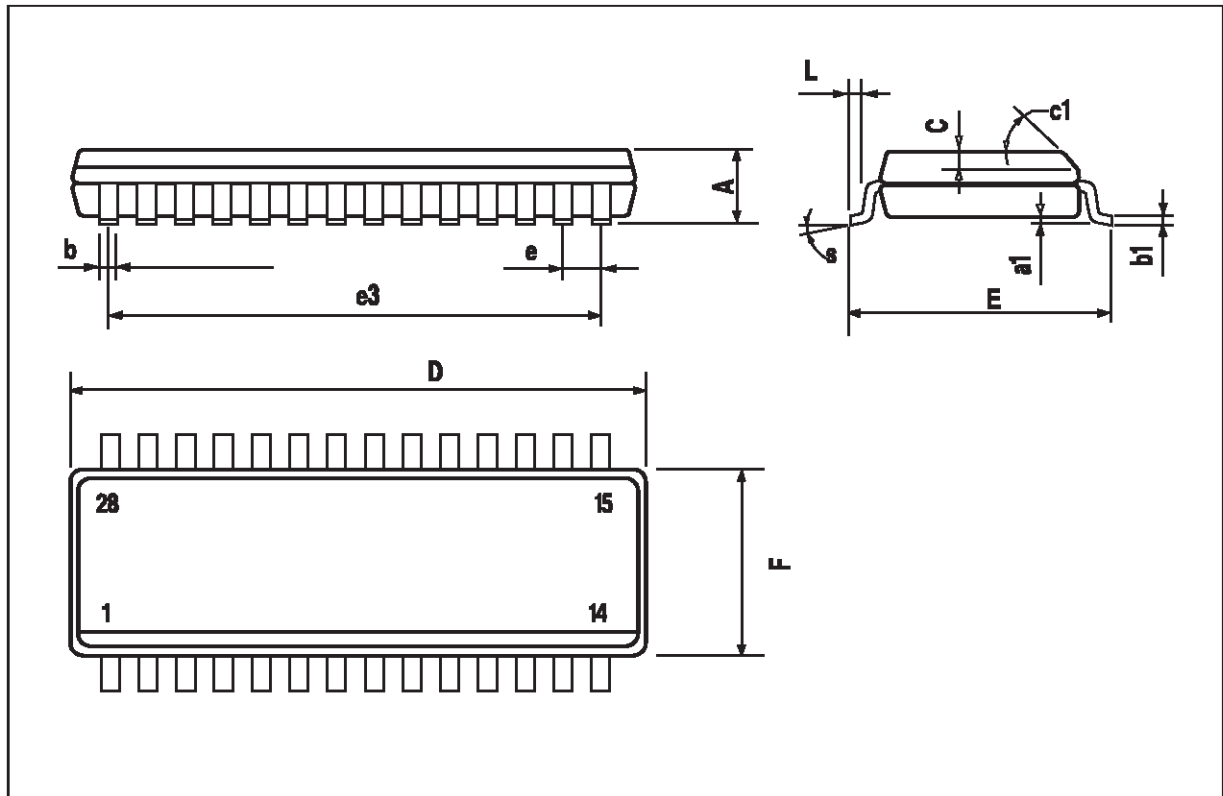


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.3	0.004		0.012
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.013
C		0.5			0.020	
c1	45° (typ.)					
D	17.7		18.1	0.697		0.713
E	10		10.65	0.394		0.419
e		1.27			0.050	
e3		16.51			0.65	
F	7.4		7.6	0.291		0.299
L	0.4		1.27	0.016		0.050
S	8° (max.)					

**OUTLINE AND MECHANICAL DATA**



**SO28**



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