TDA7336

STEREO PREAMP + AMS + DOLBY B* NOISE REDUCTION PROCESSOR

- DUAL CHANNEL PROCESSOR FOR PLAYBACK APPLICATIONS.
- STEREO DOLBY B NR SYSTEM
- LOW NOISE HEAD PREAMPLIFIER
- MUTE, AMS (AUDIO MUSIC SENSOR) FUNCTIONS
- INTERNAL SWITCHES FOR EQUALIZATION
- DOLBY REFERENCE LEVEL -6dBm (388.2mV$_{RMS}$)
- 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 interprogram 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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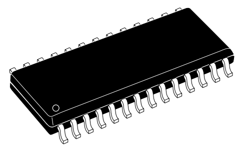
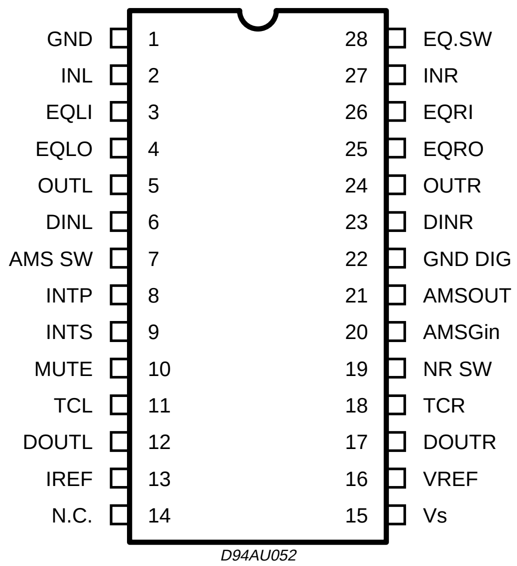
This device is available only to Licensing and application information may be obtained from Dolby Lab.



SO28

ORDERING NUMBER: TDA7336

PIN CONNECTION (Top view)



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

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

PIN FUNCTIONS

N.	Name	V_{DC} (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, OUTR	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	DOUTL, DOUTR	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

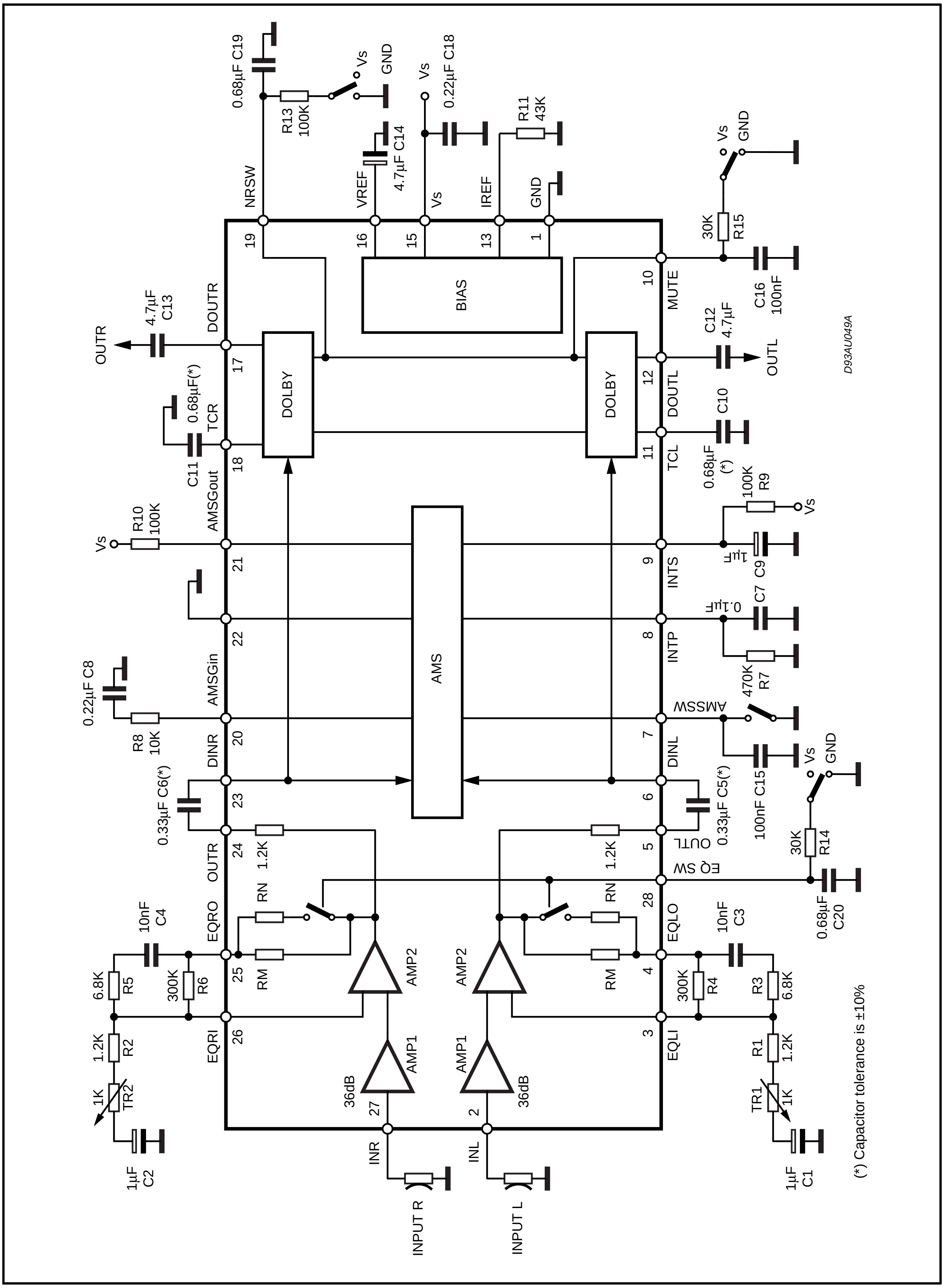


Figure 1a: Components & Top Copper Layer of the Fig. 1 (1:1 scale).

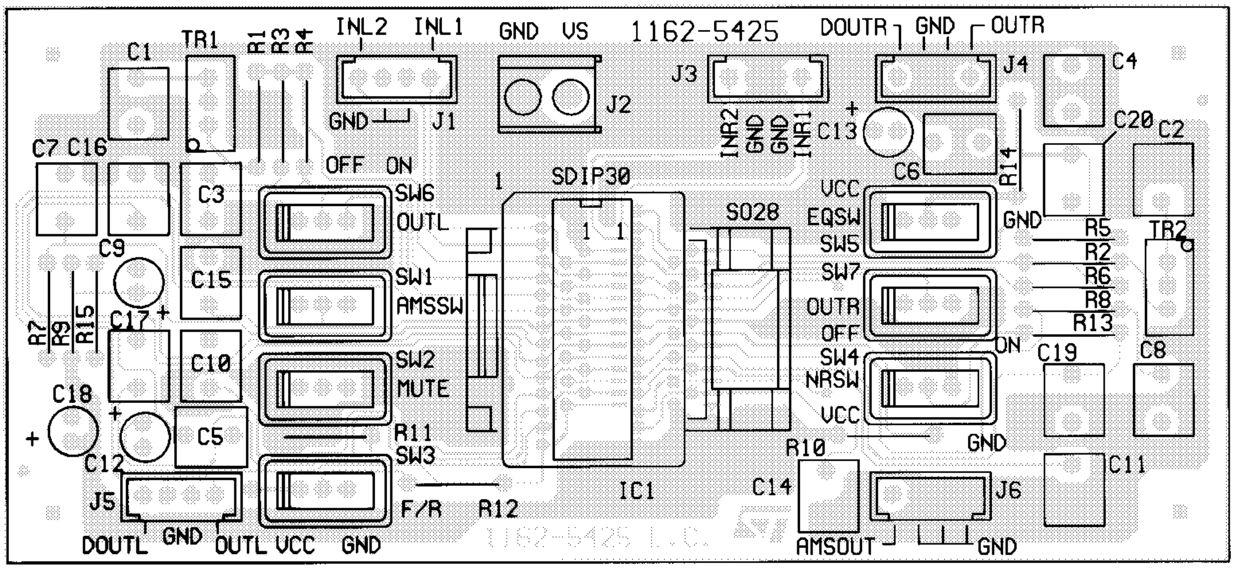
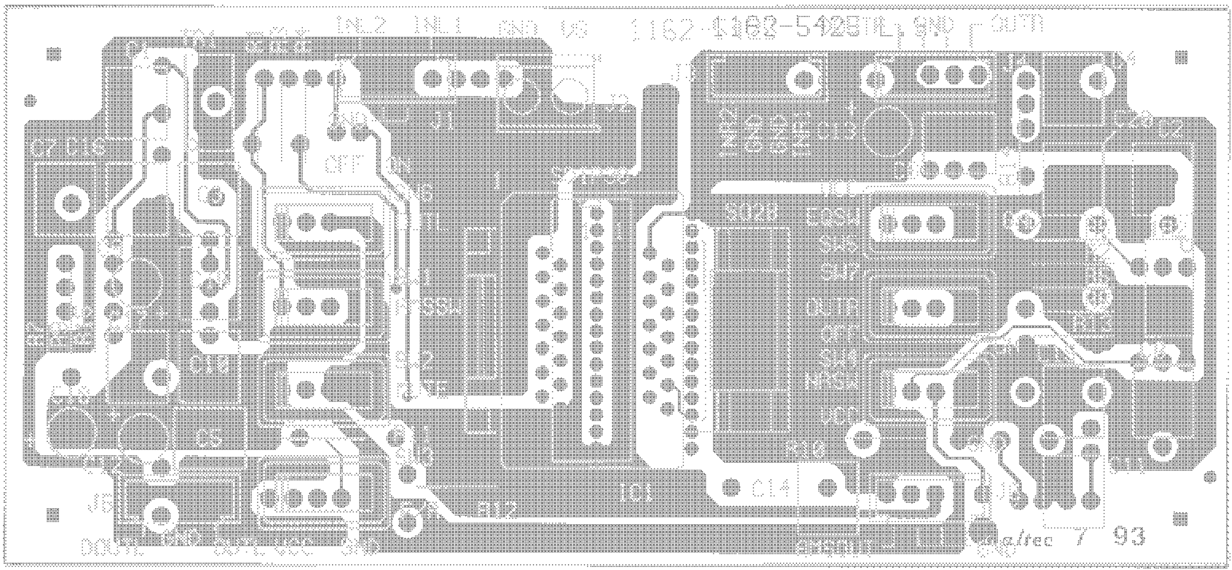
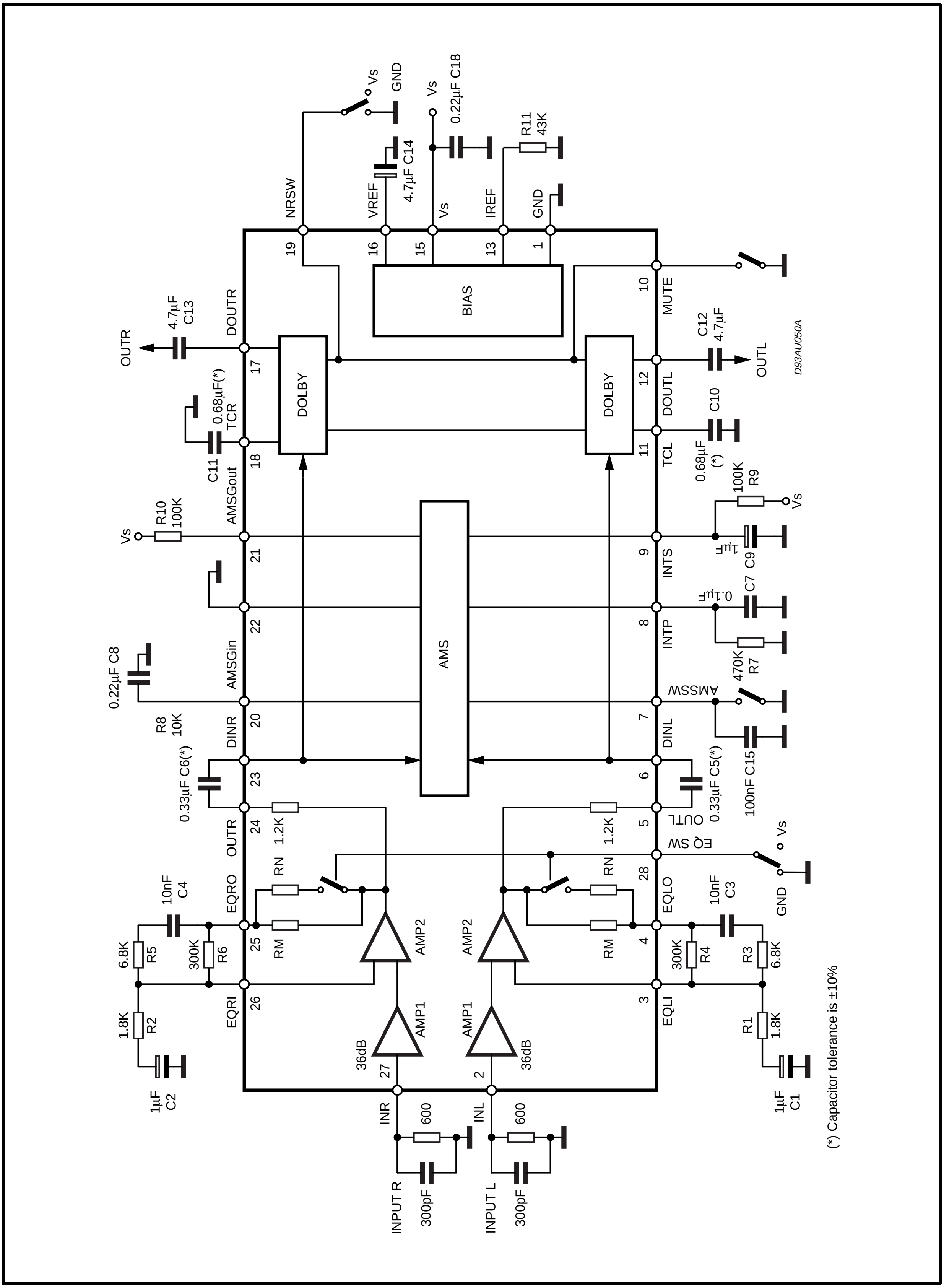


Figure 1b: Bottom Copper Layer of the Fig. 1 (1:1 scale).



TEST CIRCUIT



ELECTRICAL CHARACTERISTICS (V_S = 8.5V; f = 1KHz; R_g = 600Ω T_{amb} = 25°C; R11 = 43KΩ 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	V_{ripple} = 0.3Vrms	Dolby OFF	80	90		dB
	(Input Referred)	f_{ripple} = 1KHz	Dolby ON	85	95		dB
$MUTE_{th}$	Mute Threshold Pin 10	ON OFF		0 2.0		0.8 V_S	V V
I_{MUTE}	Mute Current				10	20	µA
$MUTE_A$	Mute Attenuation			55	65		dB

PREAMPLIFIER

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
R_I	Input Resistance	(pin 2, 27)	30	50	70	KΩ
I_I	Input Bias Current				10	µA
G_V	Closed Loop Gain	pin 3, 4 and 25, 26 shorted	32.5	35.5	38.5	dB
ΔG_V	Closed Loop Gain Match		-1		1	dB
R_M	Resistance Metal Position		4.35	5.8	7.25	KΩ
R_N	Resistance Normal Position		50	160	300	Ω
e_N	Total Input Noise	Unw. B= 20Hz to 20KHz R_g = 0Ω; R_g = 600Ω; A weighted R_g = 600Ω;		0.45 0.8 0.5		µV µV µV
R_O	Output Impedance	(Pin 5, 24)	0.9	1.2	1.7	KΩ
EQ_l	Normal Low Level (pin 28)		0		1.5	V
EQ_h	Metal High Level (pin 28)		3.5		V_S	V
ΔR_M	Metal Resistance Matching		–2	0	+2	%

AUDIO MUSIC SENSOR

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$IAMS_{OUT}$	AMS Output Current				5	mA
$VAMS_{OUT}$	AMS Output Low Level	IAM_{OUT} = 2mA		200	800	mV
R_P20	Input Impedance		0.8	1.1	1.4	KΩ
AMS_{swl}	AMS OFF Low Level		0		0.8	V
AMS_{swh}	AMS ON High Level		2		VS	V
V_{TH1}	Interprogram Threshold Voltage	(pin 8)	1.2	1.45	1.7	V
VTH_2	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
$IAMS_{sw}$	AMS Switch pin Current		5	10	15	µA

DOLBY SECTION

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
G_V	Voltage Gain	f = 1KHz;	OFF	-1	0	1	dB
ΔG_V	Gain Matching		OFF	-0.5		0.5	dB
RD_I	Dolby Input Res.	(pin 6, 23)		46	63		KΩ
S/H	Signal Handling	V_S = 8V; THD = 1%	OFF	12	13		dB
R_{DO}	Dolby Output Imp.	(pin 12, 17)		100	200	300	Ω
B DEC 1	Decode Out	f = 10KHz; V_I = 0.4dB	ON	-1.5	0	1.5	dB

ELECTRICAL CHARACTERISTICS (continued)

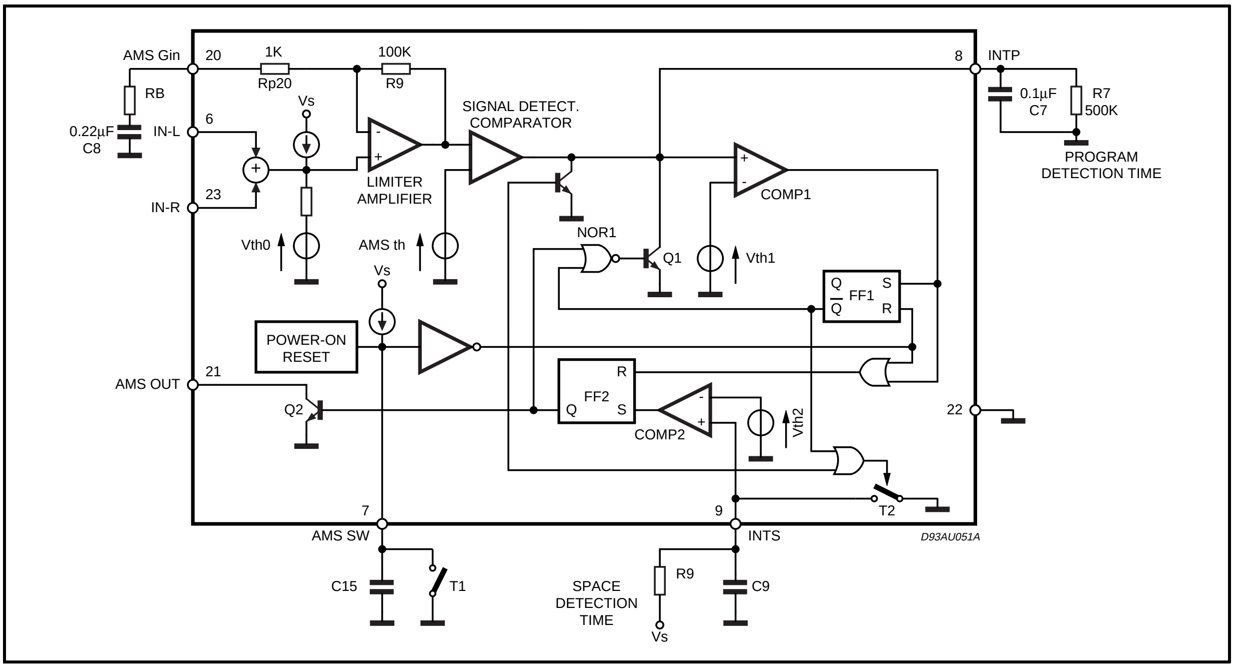
DOLBY SECTION

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

GENERAL (PREAMPLIFIER + DOLBY)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
THD	Total Harmonic Dist.	V_O = 0dB; f = 1KHz Dolby OFF		0.02	0.1	%
		V_O = 0dB; f = 1KHz Dolby ON		0.05	0.1	%
		V_O = 0dB; f = 10KHz Dolby OFF		0.03		%
		V_O = 0dB; f = 10KHz Dolby ON		0.08		%
S/N	Signal to Noise Ratio	R_g = 600Ω; V_O = 0dB; Unweighted; Dolby OFF		63		dB
		R_g = 600Ω; V_O = 0dB; Unweighted; Dolby ON		70		dB
		R_g = 600Ω; V_O = 0dB; CCIR/ARM; Dolby OFF	54	63		dB
		R_g = 600Ω; V_O = 0dB; CCIR/ARM; Dolby ON	56	72		dB
C_S	Channel Separation	R_g = 600Ω; f = 1KHz Dolby OFF	50	64		dB
		R_g = 600Ω; f = 1KHz Dolby ON		70		dB
C_T	Channel Cross Talk	R_g = 600Ω; f = 1KHz Dolby OFF	56	70		dB
		R_g = 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 unproper 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 (T_1 open). Once this condition has happened, the capacitor C_{15} charges, defining a minimum reset time, long enough to reset the Flip-Flops FF_1 and FF_2 and to descharge the program detector external C_7 capacitor. The charging current at the AMS SW pin is about 10µA. It follows that the reset time (C_{15} x V_{pin7})/I_{C15} is given approximately by 0.122 x C_{15} ns where C_{15} is in µF.

c)From now on where the sum input signal (left-right) amplified by the limiter exceeds the signal detector threshold (3) the capacitor C_7 is forced to charge. When the voltage across this capacitor reaches the comparator $COMP_1$ threshold voltage V_{th1} (approx. 2 V_{be}) FF_1 is set and FF_2 is reset. (4) It follows that Q_1 is turned on discharging the program detection capacitor (C_7).

d)Always when there is a recorded zone, Q_1 is on; it becomes off only if a blank section is reached. When, with a time constant controlled by the R_9, C_9 network the voltage at space detection time pin reaches V_{th2} threshold (comparator $COMP_2$) a true blank section is detected and the FF_2 is set. (The minimum charging time is approximately given by:

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

In this condition Q_2 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:

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

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:

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

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

Figure 3: AMS Timing Diagram

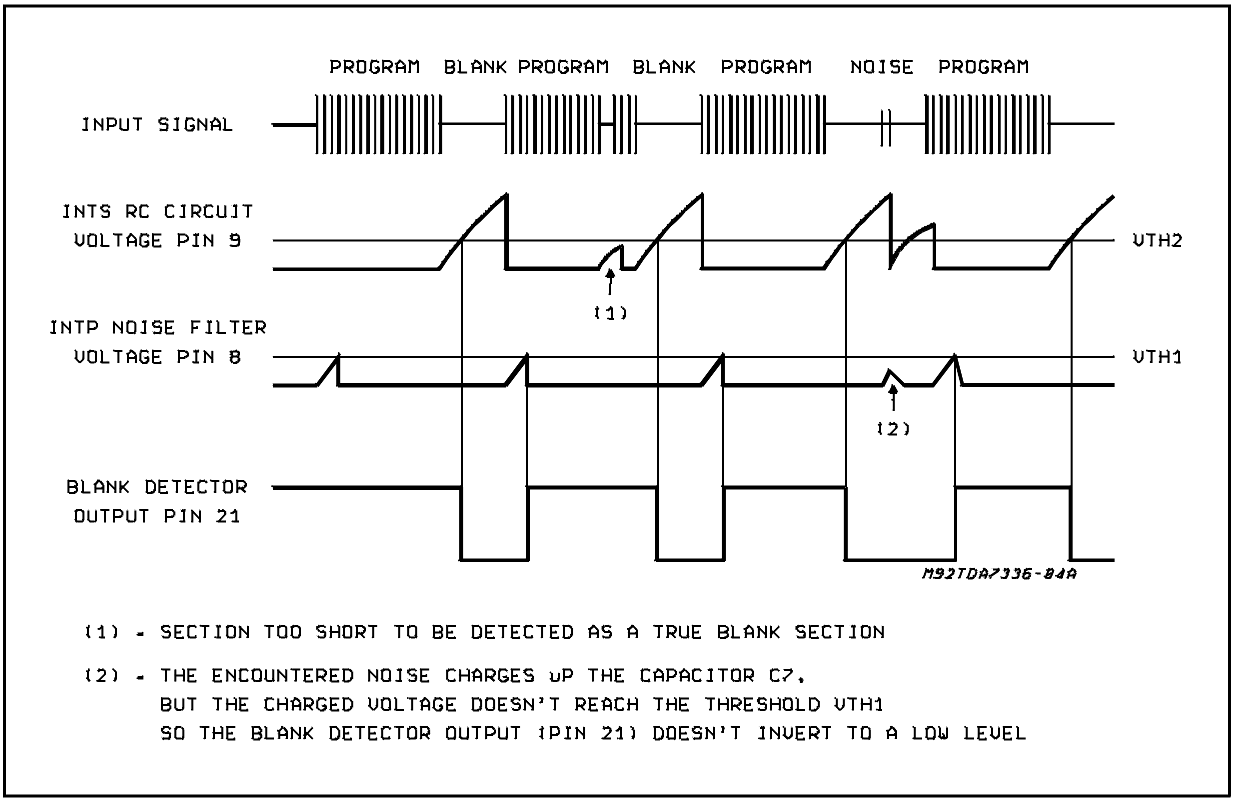
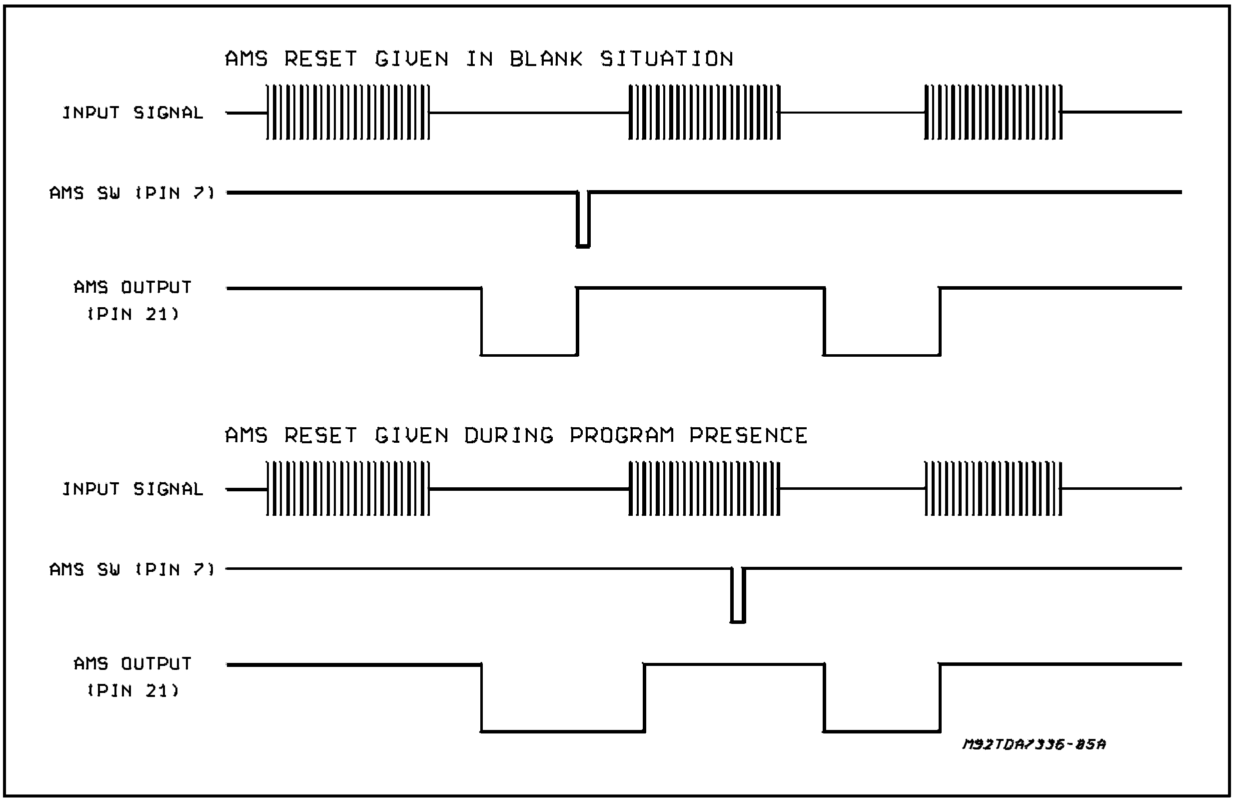


Figure 4



ELECTRICAL COMPONENT DESCRIPTION (see figure 1)

	COMPONENT	RECOMMENDED VALUE	PURPOSE
PREAMP	TR_1,TR_2 C_1, C_2 C_3, C_4 R_1, R_2 R_3, R_5 R_4, R_6	1KΩ 1µF 10nF 1.2KΩ 6.8KΩ 300KΩ	Left/Right Channel IN/OUT equalizer filter TR fixes the gain 150msec NORMAL 70µsec METAL
	C_5, C_6	0.33µF ±10%	Preamplifier out to Dolby B input coupling capacitor
AMS	R_8 C_8	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_7 C_7	470KΩ 0.1µF	Set the interprogram detection time: $INTP = 70 \times 10^{-3} \times C_7[\mu F] = [sec]$
	R_9 C_9	100KΩ 1µF	Set the interspace detection time: $INTS = 0.69 \times C_9 \times R_9$ sec
	C_{15}	100nF	It fixes music search reset time; $Tres = 0.122 \times C_{15}[\mu F] = [sec]$ if C_{15} expressed in µF
DOLBY	C_{10}, C_{11}	0.68µF ±10%	Dolby output coupling capacitors
	C_{12}, C_{13}	4.7µF ±10%	Dolby time constants
	C_{14}	4.7µF	Reference voltage external capacitor
	R_{11}	43KΩ	It fixes the I_{ref} current
	C_{16} R_{16}	0.1µF 30KΩ	If fixes the mute time (typ 10msec).

PINS DESCRIPTION: Internal Configuration

Figure 5: PINS: 2 - 27

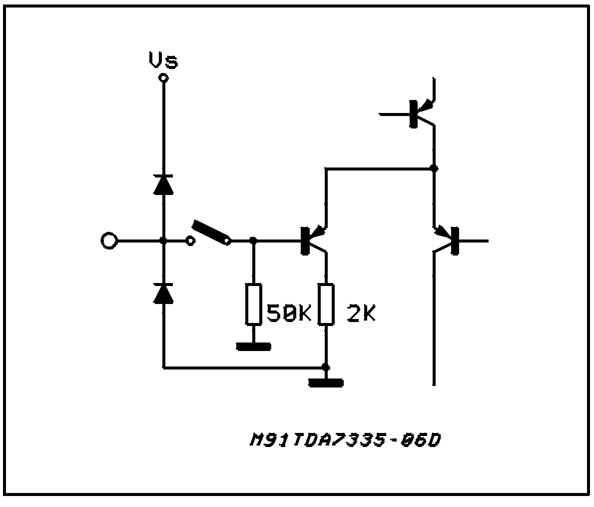
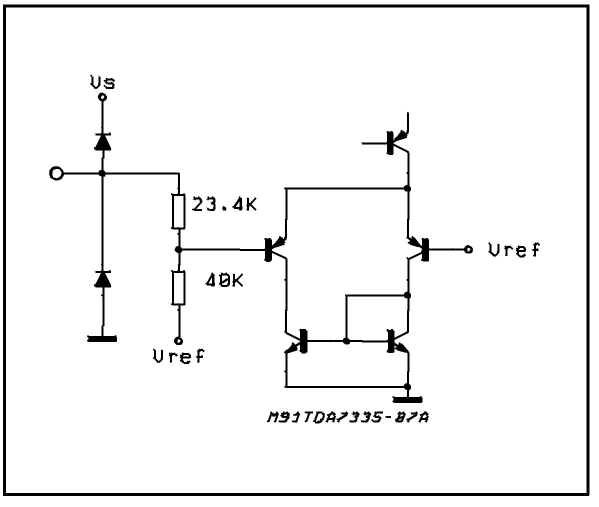


Figure 6: PINS: 6 - 23



PINS DESCRIPTION: Internal Configuration

Figure 7: PINS: 12 - 17

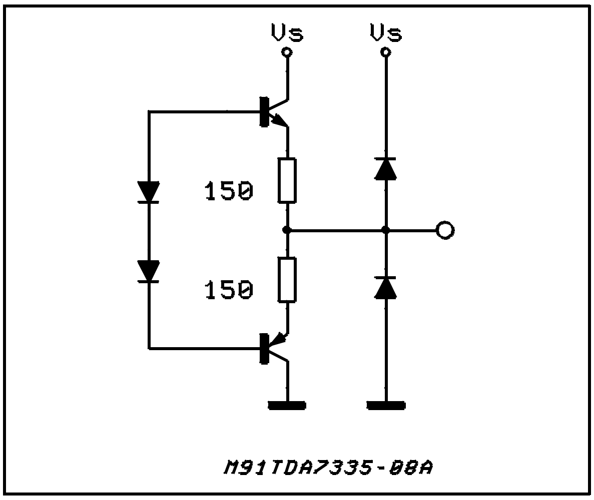


Figure 8: PIN: 8

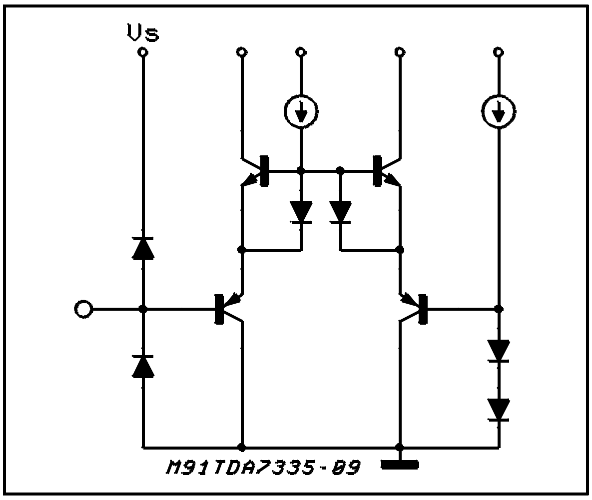


Figure 9: PINS: 3 - 26

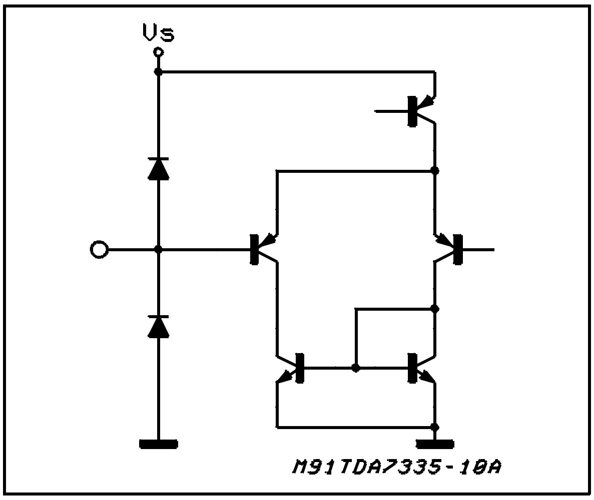


Figure 10: PINS: 4 - 25

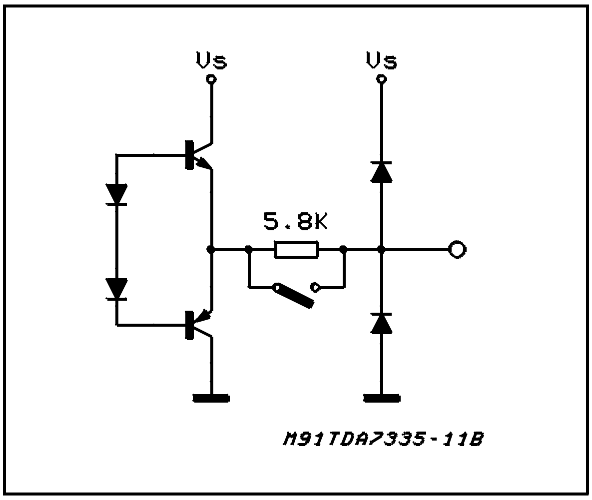


Figure 11: PINS: 5 - 24

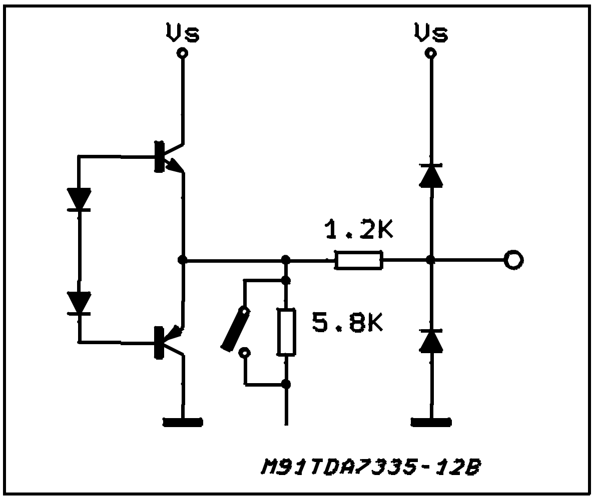
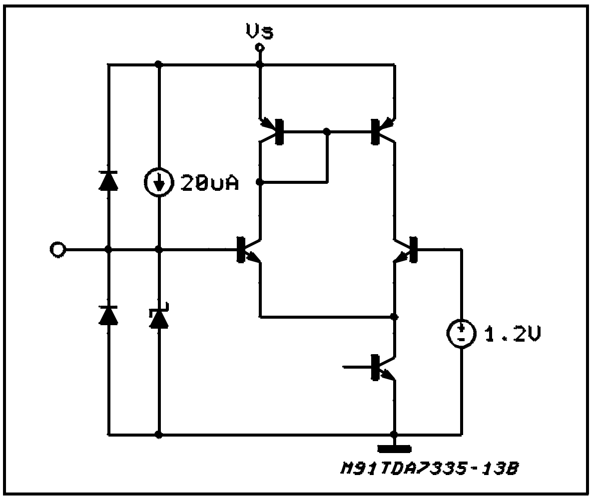


Figure 12: PINS: 7



PINS DESCRIPTION: Internal Configuration

Figure 13: PINS: 11 - 18

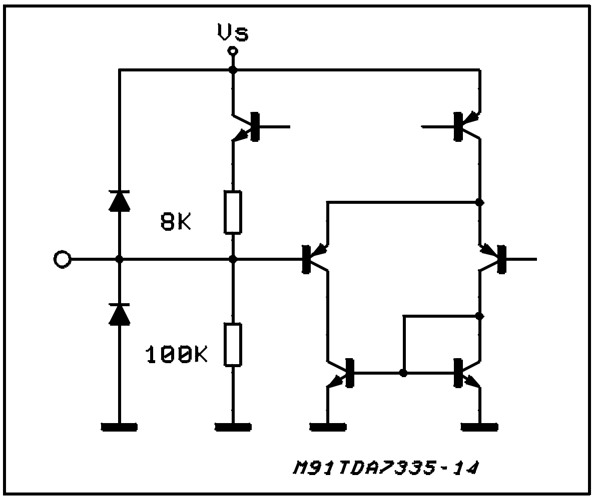


Figure 14: PIN: 13

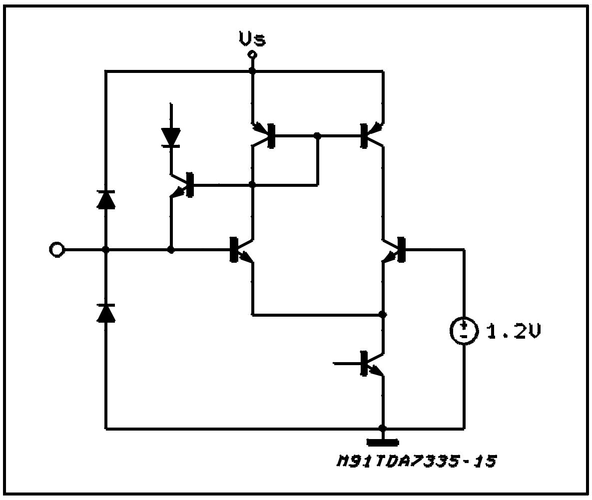


Figure 15: PIN: 9

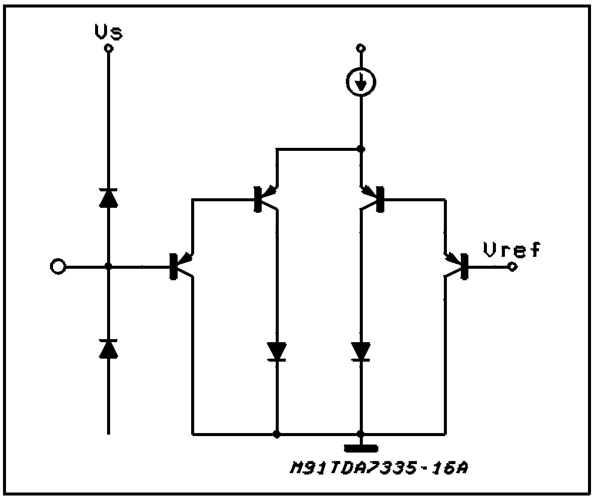


Figure 16: PIN: 21

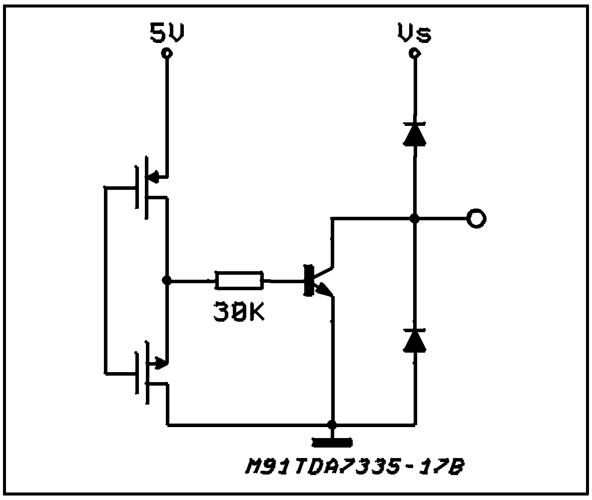


Figure 17: PIN: 20

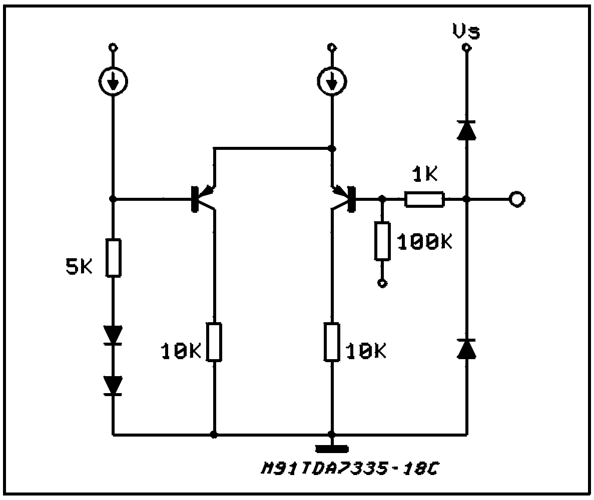
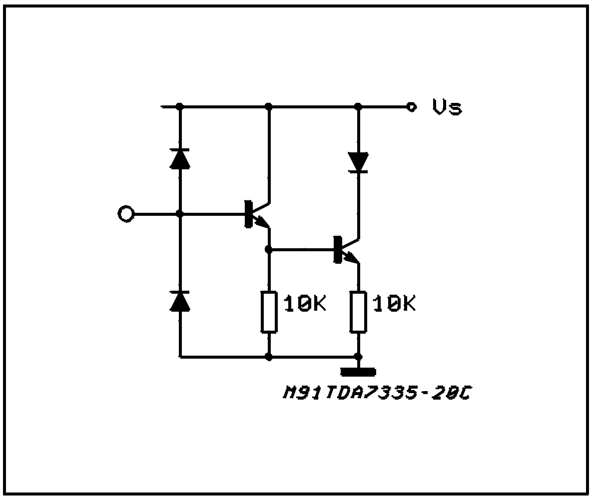


Figure 18: PIN: 28



PINS DESCRIPTION: Internal Configuration

Figure 19: PIN: 19 - 10

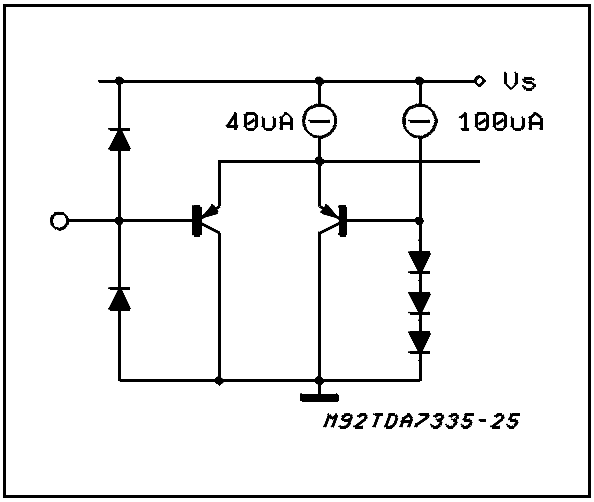
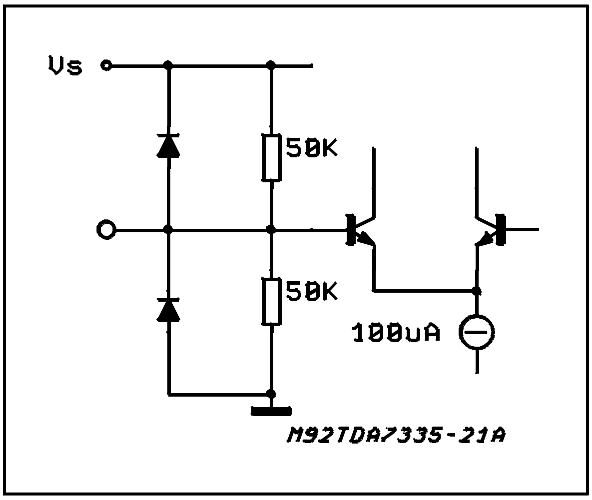


Figure 20: PIN: 16



DEVICE CHARACTERISTICS

Figure 21: Quiescent Current vs. Supply Voltage

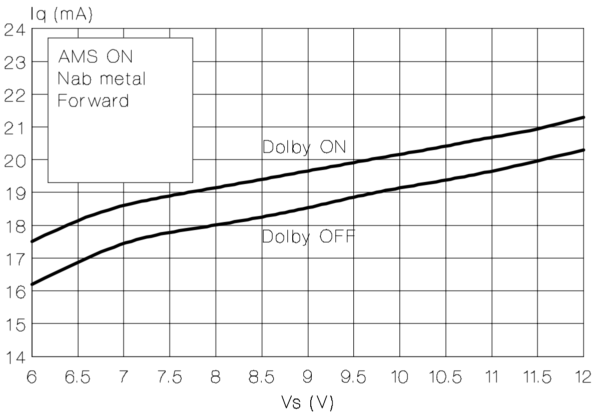


Figure 22: Quiescent Current vs. Temperature

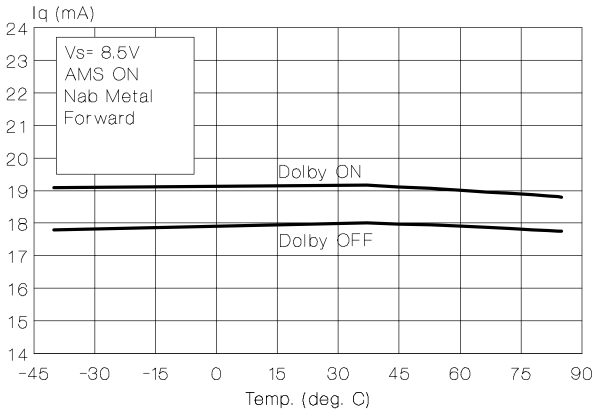


Figure 23: THD vs Supply Voltage

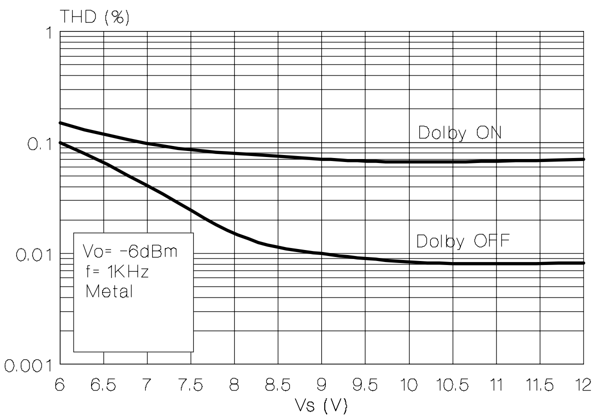
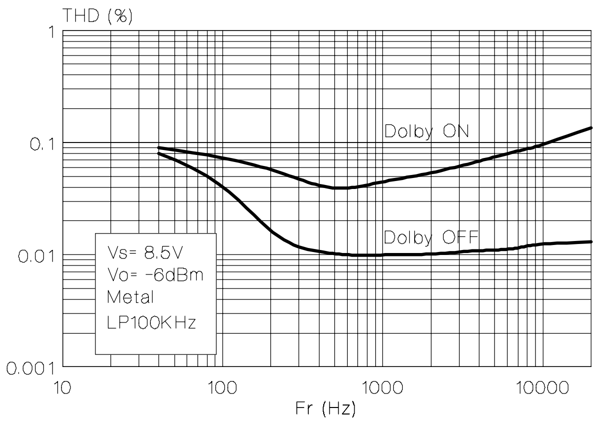


Figure 24: THD vs Frequency



DEVICE CHARACTERISTICS (continued)

Figure 25: THD vs. Output Signal

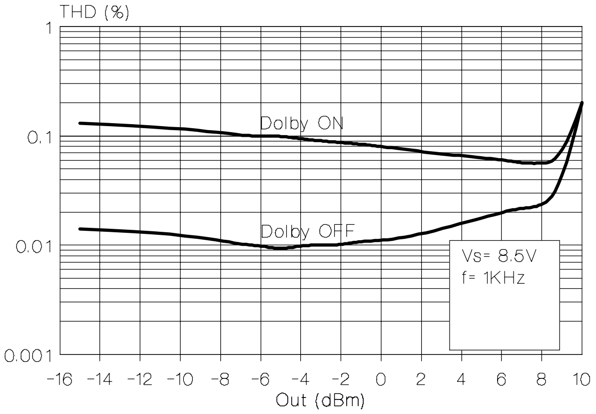


Figure 26: THD+N vs. Frequency

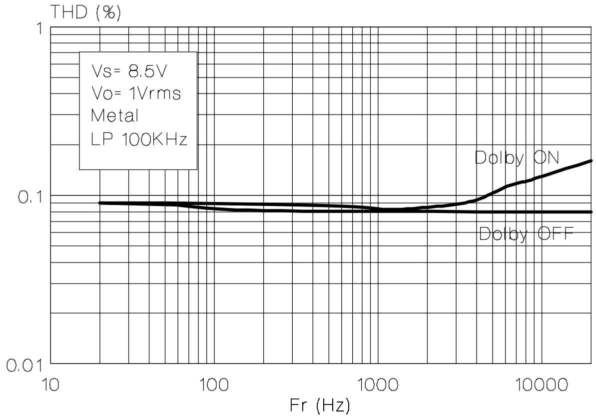


Figure 27: Channel Separation vs. Frequency

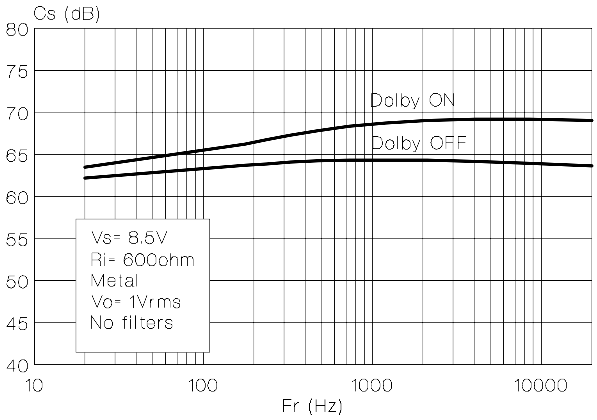


Figure 28: Cross Talk vs. Frequency

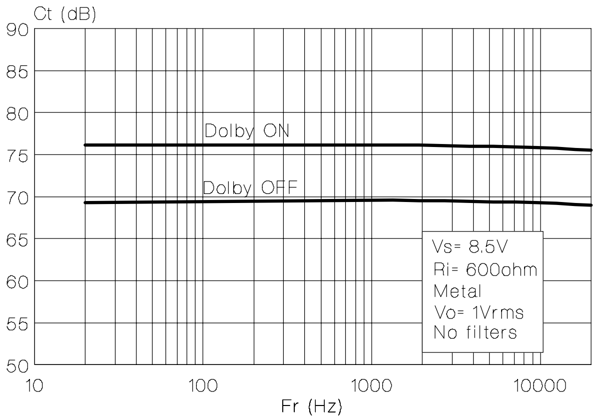


Figure 29: Ripple Rejection vs. Frequency

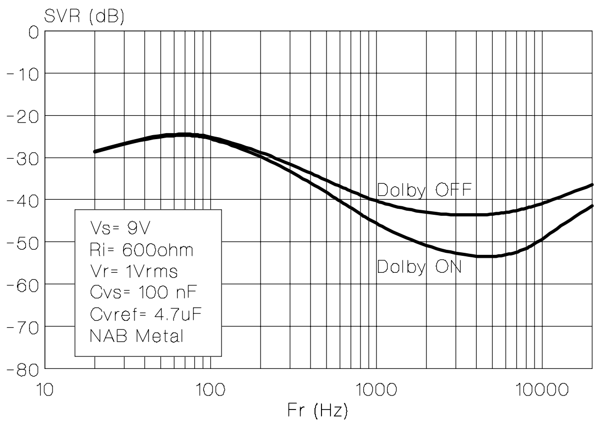
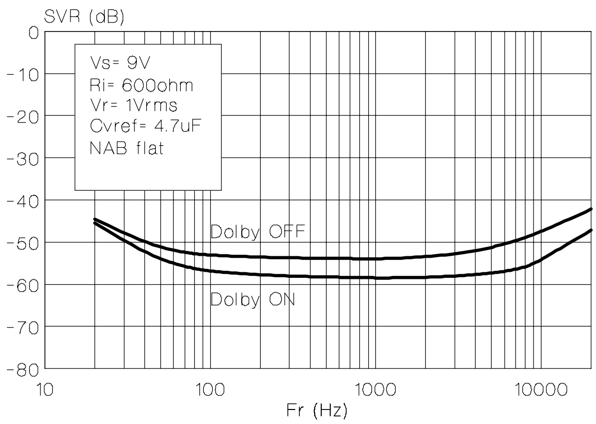


Figure 30: Ripple Rejection vs. Frequency



DEVICE CHARACTERISTICS (continued)

Figure 31: Ripple Rejection vs. Frequency

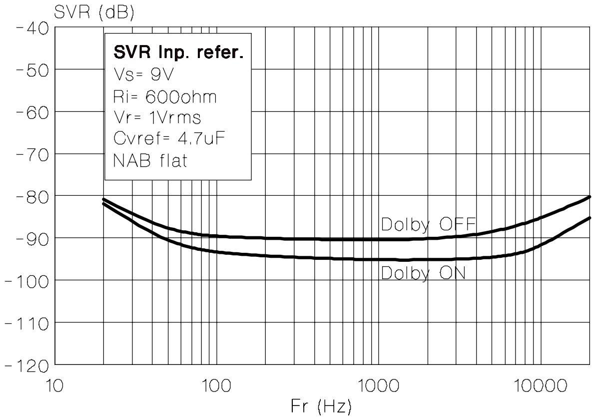


Figure 32: Mute Attenuation vs. Frequency

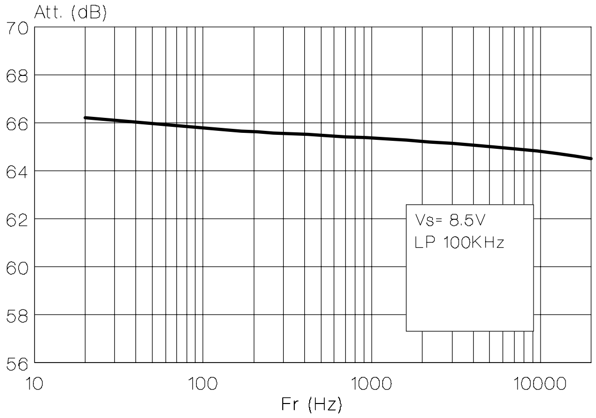


Figure 33: Mute Threshold

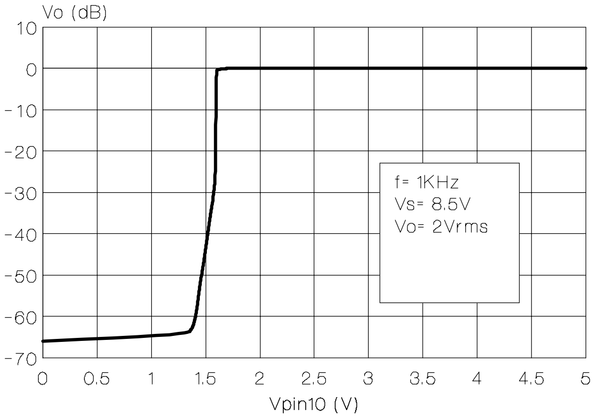


Figure 34: V_{ref} & I_{ref} vs Supply Voltage

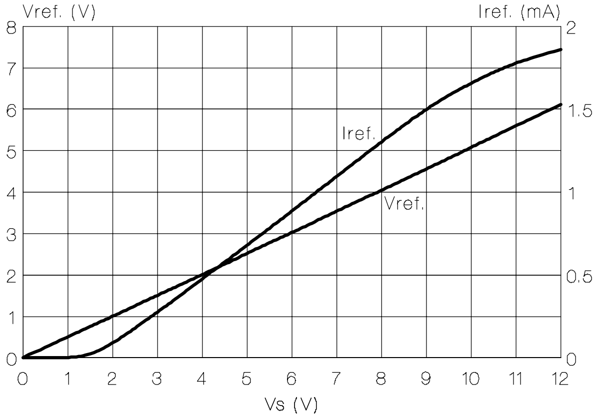


Figure 35: V_{ref} & I_{ref} vs Temperature

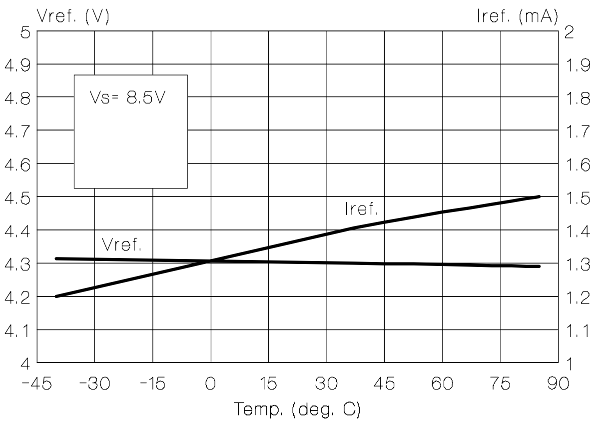
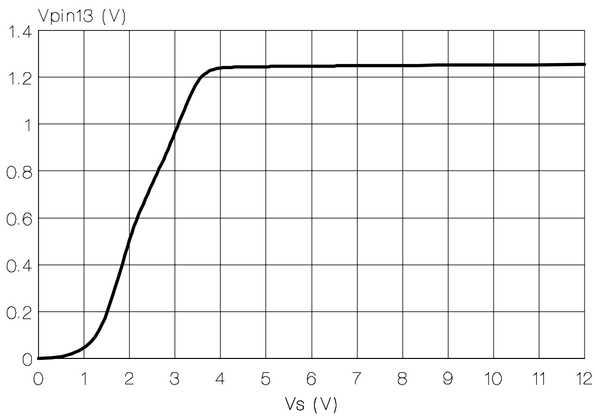


Figure 36: D.C. Voltage pin 13 vs. Supply Voltage



DEVICE CHARACTERISTICS (continued)

Figure 37: Equalizer Threshold

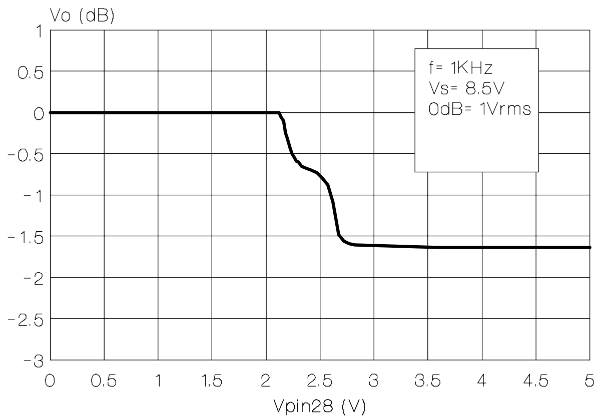


Figure38: Noise Reduction Threshold

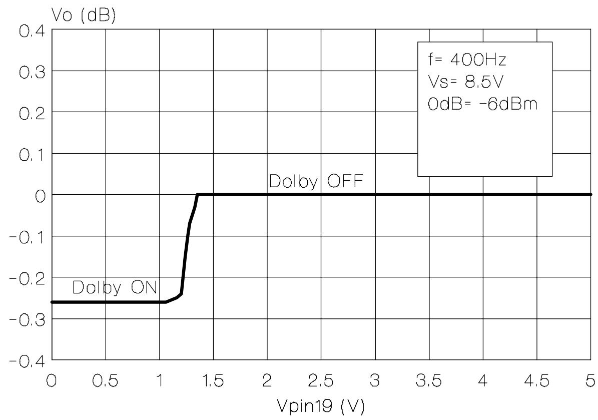


Figure 39: NAB Network

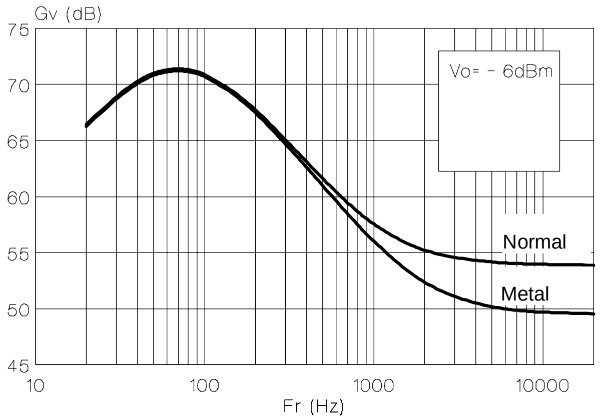


Figure 40: Load Characteristics

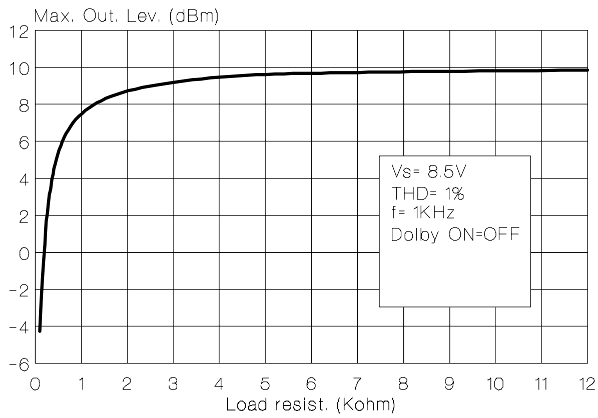


Figure 41: Signaling Handling vs. Supply Voltage

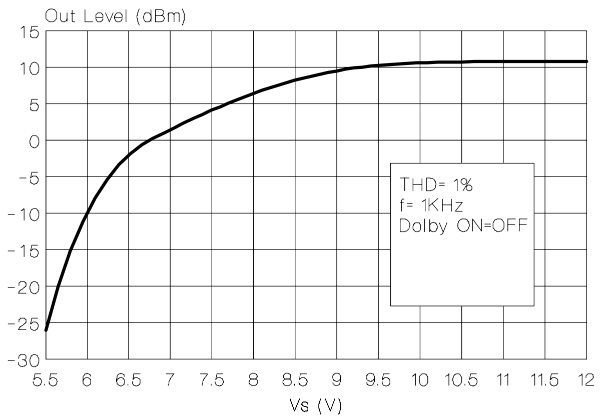
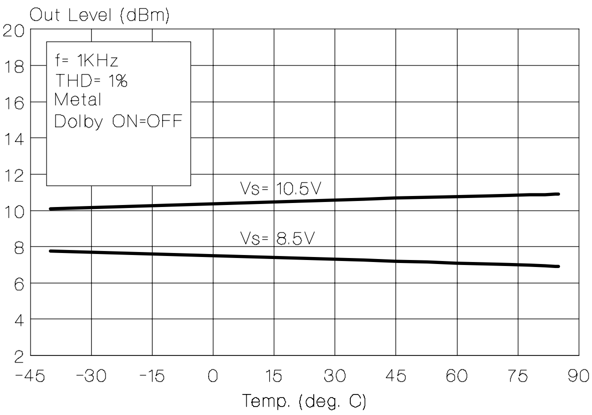


Figure 42: Signal Handling vs. Temperature



DEVICE CHARACTERISTICS (continued)

Figure 43: AMS Threshold vs. Frequency

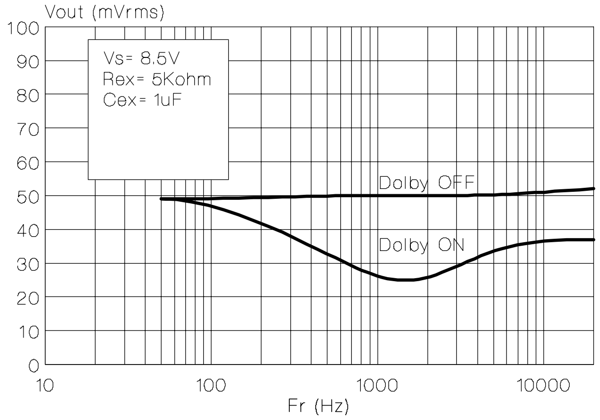


Figure 44: AMS Threshold vs. Rex

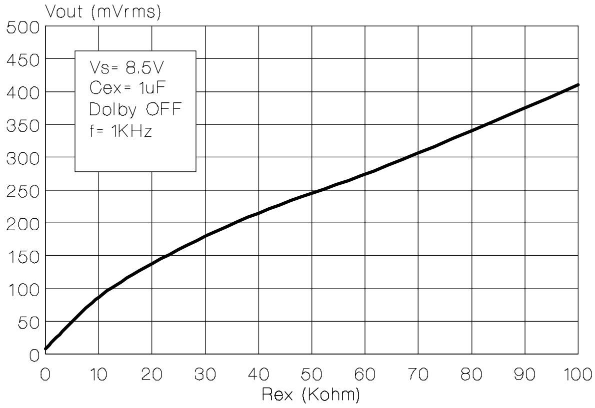


Figure 45: AMS Reset Time vs. C_{ex}

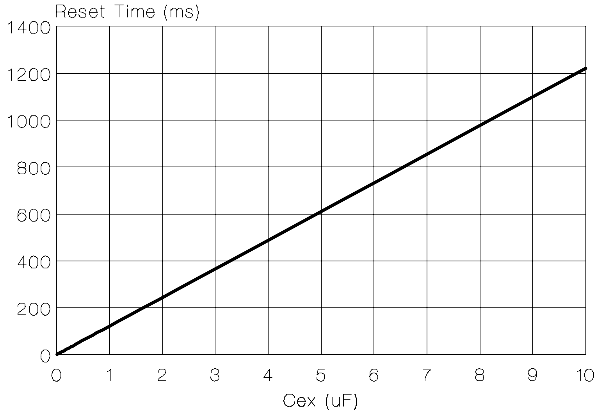


Figure 46: AMS Interprogram vs. C7

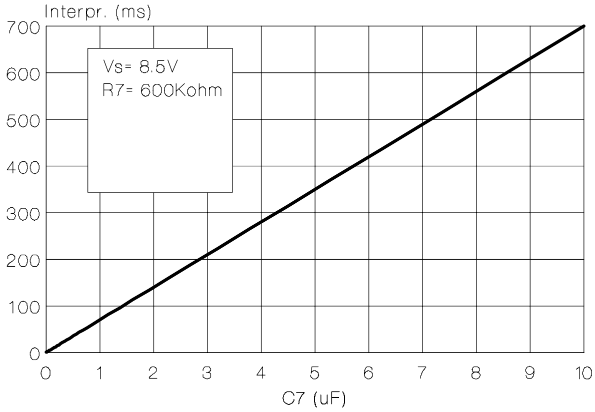


Figure 47: Interprogram Charging Current

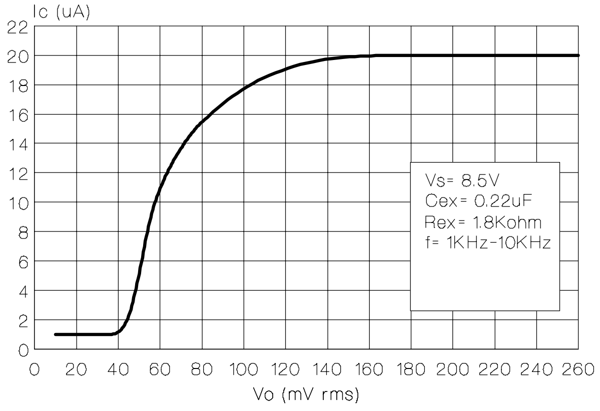
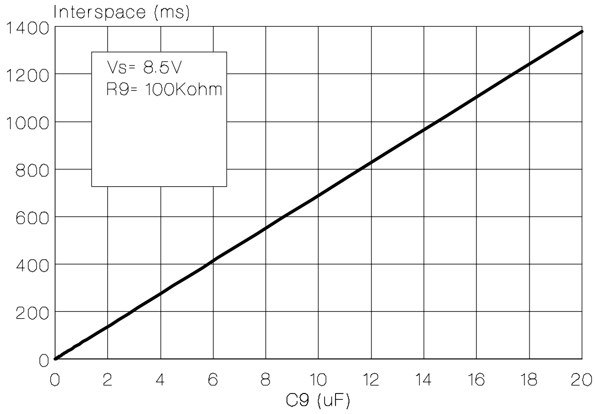
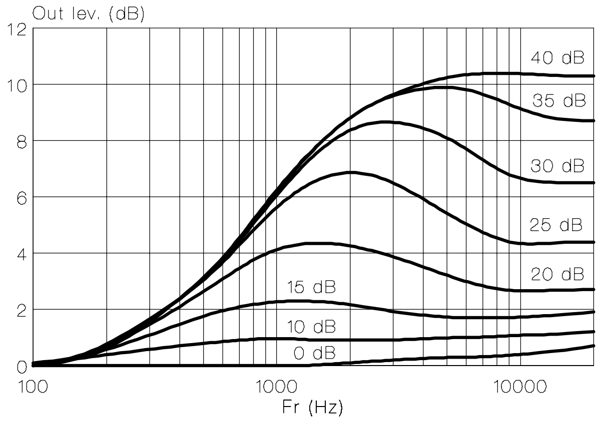


Figure 48: Interspace vs. C9



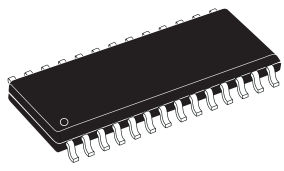
DEVICE CHARACTERISTICS (continued)

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



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