DATA SHEET

TEA0678

Dual Dolby* B-type noise reduction circuit, automatic music search, with differential outputs and mute

Preliminary specification
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Philips
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TEA0678

FEATURES

- Dual noise reduction (NR) channels
- Head pre-amplifiers
- Reverse head switching
- Automatic Music Search (AMS)
- Mute position
- Equalization with electronically switched time constants
- Dolby reference level = 387.5 mV
- 32 pins
- Switch inputs TTL compatible
- Differential output stage has:
  - Capability to drive 1.2 nF capacitive load
  - Capability to drive 1 kΩ load
  - Short-circuit proof
  - Short-circuit proof to 16 V via coupling capacitor.
- Improved EMC behaviour.

GENERAL DESCRIPTION

The TEA0678 is a bipolar integrated circuit that provides two channels of Dolby B noise reduction for playback applications in car radios. It includes head and equalization amplifiers with electronically switchable time constants. Furthermore it includes electronically switchable inputs for tape drivers with reverse heads. This device also detects pauses of music in Automatic Music Search (AMS) mode, with a delay time fixed externally by a resistor. The short-circuit proof output stage of the TEA0678 is differential and provides muting. The device will operate with power supplies in the range of 7.6 to 12 V, output overload level increasing with increase in supply voltage. Current drain varies with supply voltage, noise reduction on/off and AMS on/off so it is advisable to use a regulated power supply or a supply with a long time constant.

.Current drain varies with these variables:

Supply voltage

Noise reduction on/off

AMS on/off.

Because of this current drain variation it is advisable to use a regulated power supply or a supply with a long time constant.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{CC}	supply voltage	7.6	10	12	V
I_{CC}	supply current	–	25	28	mA
$\frac{S+N}{N}$	signal plus noise-to-noise ratio	78	84	–	dB

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TEA0678	SDIP32	plastic shrink dual in-line package; 32 leads (400 mil)	SOT232-1
TEA0678T	SO32	plastic small outline package; 32 leads; body width 7.5 mm	SOT287-1

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TEA0678

BLOCK DIAGRAM

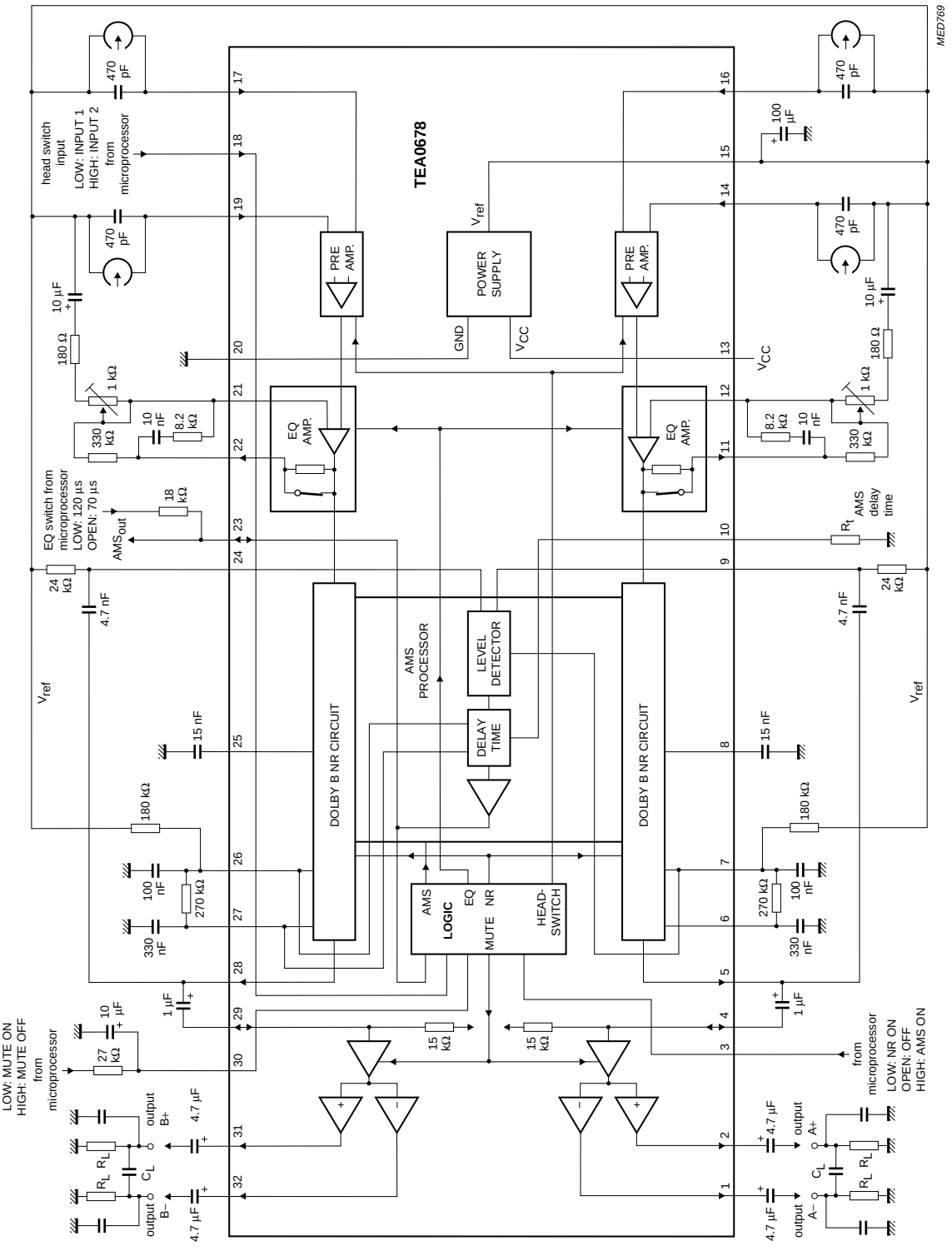


Fig.1 Block and application diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
OUTA–	1	negative output channel A
OUTA+	2	positive output channel A
NR/AMS	3	noise reduction/music search switch
INCA	4	input mute/output stage channel A
OUTCA	5	output Dolby B processor channel A
INTA	6	integrating filter channel A
CONTRA	7	control voltage channel A
HPA	8	high-pass filter channel A
SCA	9	side chain channel A
TD	10	delay time constant
EQA	11	equalizing output channel A
EQFA	12	equalizing feedback channel A
V_{CC}	13	supply voltage
INA1	14	input channel A1 (forward or reverse)
V_{ref}	15	reference voltage
INA2	16	input channel A2 (reverse or forward)
INB2	17	input channel B2 (reverse or forward)
HS	18	head switch input
INB1	19	input channel B1 (forward or reverse)
GND	20	ground
EQFB	21	equalizing feedback channel B
EQB	22	equalizing output channel B
AMSEQ	23	AMS output and EQ switch input
SCB	24	side chain channel B
HPB	25	high-pass filter channel B
CONTRB	26	control voltage channel B
INTB	27	integrating filter channel B
OUTCB	28	output Dolby B processor channel B
INCB	29	input mute/output stage channel B
MUTE	30	mute switch
OUTB+	31	positive output channel B
OUTB–	32	negative output channel B

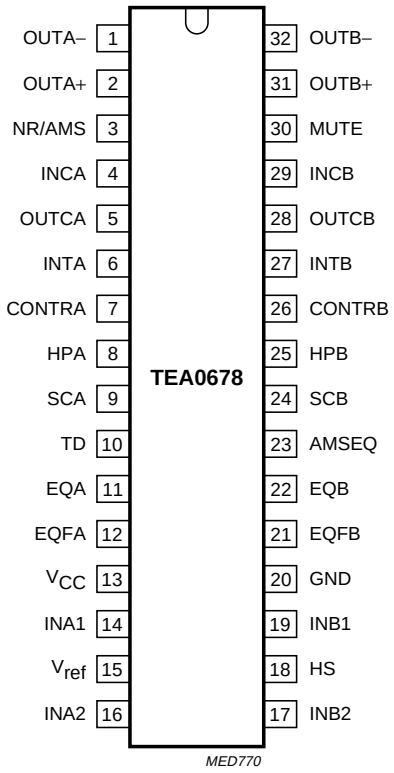


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

Noise Reduction (NR) is enabled when pin NR/AMS is connected to ground and disabled when open-circuit (left floating from a 3-state output).

Dolby noise reduction only operates correctly if 0 dB Dolby level is adjusted at 387.5 mV.

Automatic Music Search (AMS) is enabled when pin NR/AMS is connected to HIGH (5 V) and disabled when open-circuit (left floating from a 3-state output). In AMS mode the signal of both channels are rectified and then added. This means, even if one channel signal appears inverted to the other channel, with the TEA0678 the normal AMS function is ensured (see Figs 4, 5 and 6).

Equalization time constant switching (70 μs or 120 μs) is achieved when pin AMSEQ is connected to GND via an 18 kΩ resistor (120 μs), or left open-circuit (70 μs). This does not affect the AMS output signal during AMS mode (see Fig.1).

Head switching is achieved when pin HS is connected to GND (input IN1 active) or connected to HIGH (5 V) level (input IN2 active). If left open-circuit IN1 is active.

Mute is enabled when pin MUTE is connected to ground and off when connected to HIGH (5 V) level. For smooth switching a time constant is recommended. If left open-circuit MUTE is active.

The **differential output stage** of each channel is connected via a provision to the Dolby and pre-amplifier part. This provision may be used for any processing of the tape signal or to add another signal. Each output drives a resistive load of nominal 10 kΩ and is capable of driving 1 kΩ, also a capacitive load of 1.2 nF to ground and between differential outputs. Each output can be short-circuited to a battery (16 V) via a coupling capacitor (4.7 μF).

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); note1.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage		0	16	V
V_i	input voltage (pins 1 to 32) except pin 15 (V_{ref}); pin 3 (NR/AMS), pin 18 (HS) and pin 30 (MUTE) to V_{CC}		–0.3	$+V_{CC}$	V
	input voltage at pin 3 (NR/AMS), pin 18 (HS) and pin 30 (MUTE)	note 2	–0.3	+6.5	V
t_{short}	pin 15 (V_{ref}) to V_{CC} short-circuiting duration		–	5	s
T_{stg}	storage temperature		–55	+150	°C
T_{amb}	operating ambient temperature		–40	+85	°C
V_{es}	electrostatic handling voltage for all pins	note 3	–2	+2	kV
		note 4	–500	+500	V

Notes

1. The device may not operate correctly when subjected to these ratings when the ratings exceed the electrical characteristics of the device as specified in Chapter “Characteristics”. The device will recover automatically when the environment is reduced to the requirements of the characteristics.
2. The TEA0678 allows a HIGH-level at switching pins without supply voltage (V_{CC} = 0; stand-by mode). This means a maximum input voltage of 6.5 V for the switching input pins.
3. Human body model (1.5 kΩ, 100 pF).
4. Machine model (0 Ω, 200 pF).

CHARACTERISTICS

V_{CC} = 10 V; f = 20 Hz to 20 kHz; T_{amb} = 25 °C; nominal load 10 kΩ; all levels are referenced to 775 mV (RMS) (0 dB) at differential outputs ($V_o = V_{o+} - V_{o-}$), this corresponds to Dolby level 387.5 mV (RMS) (0 dB) at test point (OUTC); see Fig.1; NR on/AMS off; EQ switch in the 70 μs position; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC}	supply voltage		7.6	10	12	V
I_{CC}	supply current	pins 14, 16, 17 and 19 connected to V_{ref}	–	25	28	mA
		f = 1 kHz; V_o = 0 dB at each output	–	26	37	mA
α_m	channel matching	f = 1 kHz; V_o = 0 dB; NR off; OUTA/OUTB	–0.5	–	+0.5	dB
G_v	voltage gain (output stage)	between OUT and OUTC; f = 1 kHz; NR off	5.5	6	6.5	dB
G_{mm}	voltage gain mismatch (output stage)	mismatch between OUT+ and OUT–; f = 1 kHz; NR off	–0.5	–	+0.5	dB
THD	total harmonic distortion (2nd and 3rd harmonic)	f = 1 kHz; V_o = 0 dB	–	0.08	0.15	%
		f = 10 kHz; V_o = 6 dB	–	0.15	0.3	%
H_R	headroom at output	V_{CC} = 9 V; THD = 1%; f = 1 kHz	13	–	–	dB
$\frac{S+N}{N}$	signal plus noise-to-noise ratio	internal gain 40 dB; linear; CCIR/ARM weighted; decode mode; see Fig.11	78	84	–	dB
$V_{no(rms)}$	equivalent input noise voltage in decode mode (RMS value)	NR off; unweighted; f = 20 Hz to 20 kHz; R_{source} = 0 Ω	–	–	1.4	μV
PSRR	power supply ripple rejection	$V_{i(rms)}$ = 0.25 V; f = 1 kHz; see Fig.7 for unsymmetrical signal at OUTC	52	57	–	dB
		at differential OUT; note 1	49	52	–	dB
f_o	frequency response measured in encode mode; referenced to TP	see Fig.11				
		V_o = –25 dB; f = 0.2 kHz	–22.9	–24.4	–25.9	dB
		V_o = 0 dB; f = 1 kHz	–1.5	0	+1.5	dB
		V_o = –25 dB; f = 1 kHz	–17.8	–19.3	–20.8	dB
		V_o = –25 dB; f = 5 kHz	–18.1	–19.6	–21.1	dB
		V_o = –35 dB; f = 10 kHz	–24.4	–25.9	–27.4	dB
α_{cs}	channel separation	V_o = +10 dB; f = 1 kHz; see Fig.8	61	67	–	dB
α_{cc}	crosstalk between active and inactive input	NR off; f = 1 kHz; V_o = +10 dB; see Fig.8	70	77	–	dB
R_L	load resistance at each output OUTA+, OUTA–, OUTB+ and OUTB– (corresponds to 2 kΩ at differential output)	AC-coupled f = 1 kHz; V_o = 12 dB; THD = 1%	10	–	–	kΩ
		THD = 1%; note 2	1	–	–	kΩ
C_L	capacitive load at each output (between OUT+ and OUT–) and ground	C_{Lmin} at each output to ground (pins 1, 2, 31 and 32)	0.3	–	1.3	nF
G_v	voltage gain of pre-amplifier	from pin INA1 or INA2 to pin EQFA and from pin INB1 or INB2 to pin EQFB; f = 1 kHz	29	30	31	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{I(offset)(DC)}$	DC input offset voltage		–	2	–	mV
$I_{i(bias)}$	input bias current		–	–	0.4	μA
R_{EQ}	equalization resistor		4.7	5.8	6.9	kΩ
R_I	input resistance head inputs		60	100	–	kΩ
$G_{v(ol)}$	open-loop amplification	pin INA1 or INA2 to pin EQA and pin INB1 or INB2 to pin EQB				
		f = 10 kHz	80	86	–	dB
		f = 400 Hz	104	110	–	dB
$V_{O(offset)(DC)}$	DC offset voltage at pins OUT+ to OUT–	pins INA1, INA2, INB1 and INB2 connected to V_{ref}	–10	–	+10	mV
$V_{mute(offset)}$	MUTE offset voltage at pins OUT+ to OUT–	pins INA1, INA2, INB1 and INB2 connected to V_{ref}	–10	–	+10	mV
$V_{ref} - V_{OUTC}$	DC output offset voltage at pins OUTCA and OUTCB	NR off; pins INA1, INA2, INB1 and INB2 connected to V_{ref}	–0.15	–	+0.15	V
I_O	DC output current	pins INA1, INA2, INB1 and INB2 connected to V_{ref}				
		pin OUTC to ground	–2	–	–	mA
		pin OUTC to V_{CC}	0.3	–	–	mA
		pin OUT± to ground	–2.5	–	–	mA
		pin OUT± to V_{CC}	2.5	–	–	mA
R_i	input resistance output stage at pins INCA and INCB		10	16	–	kΩ
Z_o	output impedance at each output OUTA+, OUTA–, OUTB+ and OUTB–		–	90	110	Ω
d_{mute}	mute depth at differential output	NR off				
		f = 1 kHz	–80	–	–	dB
		f = 10 kHz	–80	–	–	dB
AMSL	AMS threshold level at music to pause	NR off; f = 10 kHz; see Fig.9	–25	–22	–19	dB
AMSH	AMS threshold level at pause to music	note 3	–24	–21	–18	dB
t_d	AMS delay time range	f = 10 kHz; 0 dB burst; see Table 1	–	23 to 160	–	ms
t_r	AMS rise/delay time	f = 10 kHz; 0 dB burst	2	–	10	ms
EMC	DC offset voltage at pins OUTA–, OUTA+, OUTB+ and OUTB–	f = 900 MHz; V_i = 3 $V_{(RMS)}$; see Figs 11, 12 and13	–	100	–	mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching thresholds						
NR/AMS SWITCH (PIN 3)						
V_{IL}	LOW level input voltage	NR on	–0.3	–	+0.8	V
I_{IL}	LOW level input current	NR on	–10	–20	–40	μA
$I_{i(float)}$	allowed floating input current	pin left open-circuit; NR/AMS off	–10	0	+10	μA
V_{float}	floating voltage	pin left open-circuit; NR/AMS off	–	2.4	5	V
V_{IH}	HIGH level input voltage	AMS on	4	–	5.5	V
I_{IH}	HIGH level input current	AMS on	10	20	40	μA
EQUALIZATION (PIN 23)						
I_{EQ70}	floating leakage current	time constant 70 μs active	+0.002	–	–0.15	mA
V_{EQ70}	floating voltage	time constant 70 μs active	–	4.6	5	V
I_{EQ120}	input current	time constant 120 μs active	–0.25	–	–1	mA
AMS OUTPUT (PIN 23)						
V_{OH}	HIGH level output voltage	music present	4	4.6	5	V
I_{OH}	HIGH level output current	current capability	+0.01	–	–1	mA
I_{OH}	HIGH level output current	current capability; note 4	+0.01	–	–0.15	mA
V_{OL}	LOW level output voltage	music not present	–	–	0.8	V
I_{OL}	LOW level output current	current capability	–0.01	–	+1	mA
MUTE SWITCH (PIN 30)						
V_{IL}	LOW level input voltage	MUTE on	–0.3	–	+0.8	V
I_{IL}	LOW level input current	MUTE on	–	–4	–100	μA
V_{IH}	HIGH level input voltage	MUTE off	4	–	5.5	V
I_{IH}	HIGH level input current	MUTE off; smooth switching with a time constant is recommended	–	10	100	μA
HEAD SWITCH (PIN 18)						
V_{IL}	LOW level input voltage	INPUT 1 on	–0.3	–	+0.8	V
I_{IL}	LOW level input current	INPUT 1 on	–	–	–100	μA
V_{IH}	HIGH level input voltage	INPUT 2 on	4	–	5.5	V
I_{IH}	HIGH level input current	INPUT 2 on	–	30	100	μA

Notes to the characteristics

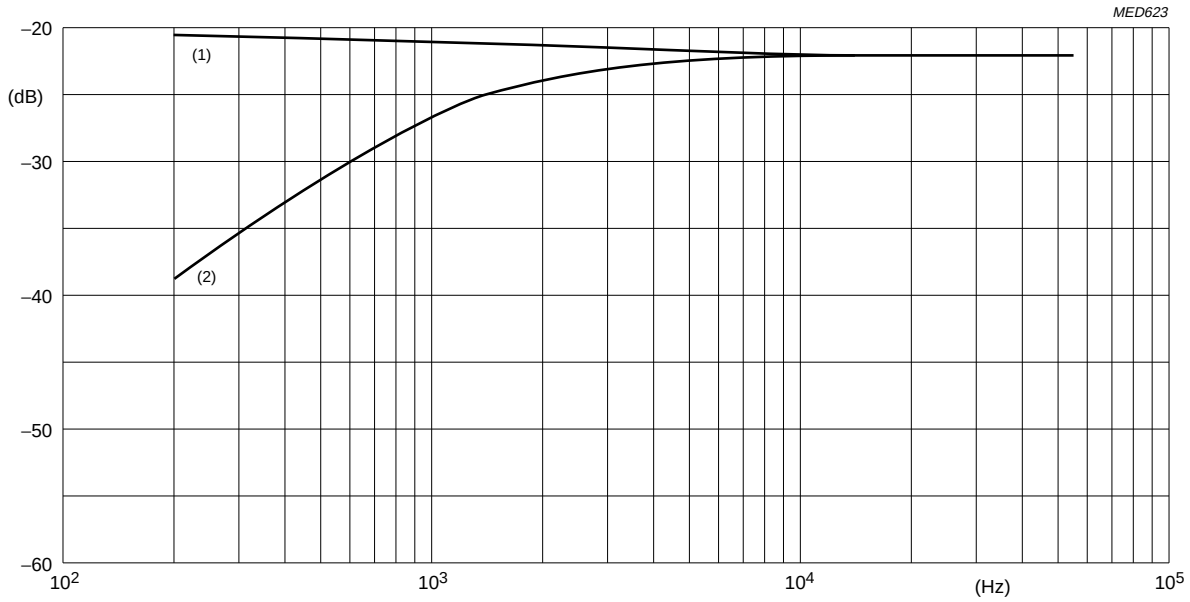
1. For the signal to be doubled (+6 dB) at differential output as a function of OUTC, the signal-to-ripple ratio is improved at differential output for approximately 3 dB.
2. By using the small load, the output voltage may be divided by –0.8 dB.
3. The high speed of the tape (FF, REW) at the tape head during AMS mode causes a transformation of level and frequency of the originally recorded signal. It means a boost of signal level of approximately 10 dB and more for recorded frequencies from 500 Hz up to 4 kHz. So the threshold level of –22 dB corresponds to signal levels in PB mode of approximately –32 dB. The AMS inputs for each channel are pin SCA and pin SCB. As the frequency spectrum is transformed by a factor of approximately 10 to 30 due to the higher tape speed in FF, REW, the high-pass filter (4.7 nF/24 kΩ) removes the effect of offset voltages but does not affect the music search function. In the application circuit (Fig.1) the frequency response of the system between tape heads input, e.g. pins INA2/INB2, to the AMS input pins SCA and SCB is constant over the whole frequency range (see Fig.3). The frequency dependence of threshold level is shown in Fig.3.
4. In AMS OFF mode, pin AMSEQ is HIGH level, the equalization time constant will be switched by pulling approximately 200 μA out of pin AMSEQ. This means for the device connected to pin AMSEQ, a restriction of input current at HIGH level less than 200 μA during AMS off; otherwise the switching of the time constants is disabled but fixed at 120 μs. If the following devices, input consumes more than 200 μA, this input has to be disconnected in AMS off mode. (To ensure switching the currents for the different switched modes are specified with a tolerance of ±50 μA in Chapter “Characteristics”.) For an application with a fixed EQ time constant of 120 μs the equalizing network may be applied completely external. Change 8.2 kΩ resistor to 14 kΩ the internal resistor R_{EQ} = 5.8 kΩ is short-circuited by fixing the EQ switch input at the 70 μs position (I_{EQ70}).

Table 1 Blank delay time set by resistor R_t at pin TD

RESISTOR VALUE R_t (kΩ)	DELAY TIME t_d TYP. (ms)	TOLERANCE (%)
68	23	20
150	42	15
180	48	15
220	56	15
270	65	10
330	76	10
470	98	10
560	112	10
680	126	10
820	142	10
1000	160	10

General note

It is recommended to switch off V_{CC} with a gradient of 400 V/s at maximum to avoid plops on tape in the event of contact between tape and tape head while switching off.



(1) AMS threshold level for application circuit (Fig.1).
(2) AMS threshold level for test circuit (Fig.9).

Fig.3 AMS threshold level.

General note on AMS

The speed of tape at the tape head during FF, REW depends on the diameter of the tape on the spindle. Depending on this speed, the recorded signal occurs transformed in frequency and magnitude as a function of the original signal in playback mode speed. For example: A recorded pause of 3 s passes the tape head at its highest speed in 111 ms, e.g. during FF mode near tape end. This time constant of 111 ms corresponds to a pause of 1.3 s at the beginning of the tape in playback mode.

Thus a pause T is uniquely defined outside the interval 1.3 s < T < 3 s. Inside this interval T will be recognized as a pause or not dependent on the local point of tape, respectively the speed of tape. Times of pauses described investigated for this document are valid for tape devices with a speed of its spindle (FF, REW): $\omega_r = 51\frac{1}{s}$ respectively 12 to 27 times of the playback speed.

Short description ‘music search’

A system for ‘music search’ mainly consists of a level and a time detection (see Fig.4). For adapting and decoupling the input signal will be amplified (A), then rectified (B) and smoothed with a time constant (C). So the voltage at (C) corresponds to the signal level and will be compared to the predefined pause level at the first comparator (D), the level detector. If the signal level becomes smaller than the pause level, the level detector(D) changes its output signal. Due to the output level of the level detector the capacitor of the second time constant (E) will be charged, respectively discharged. If the pause level of the input signal remains for a certain time, the voltage at the capacitor reaches a certain value, which corresponds to an equivalent time value due to the charging. The voltage at the capacitor will be compared to a predefined time-equivalent voltage by the second comparator (F), the time detector. If the pause level of the input signal remains for this predefined time, the time detector (F) changes its output level for ‘pause found’ status.

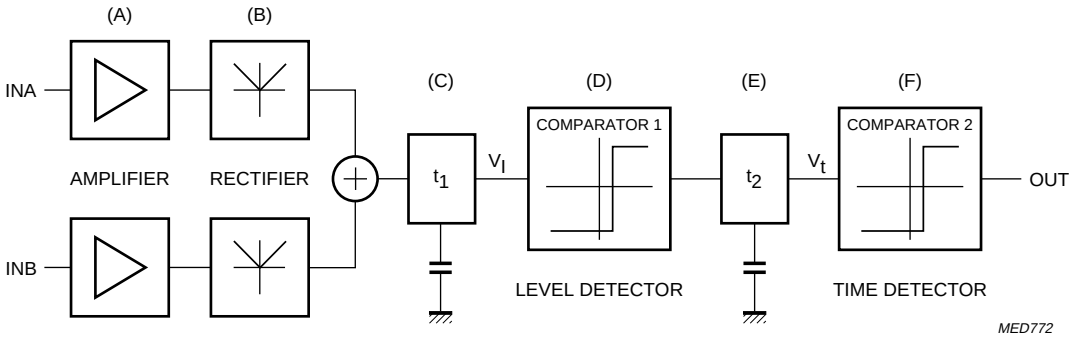


Fig.4 Integrated ‘music search’ function.

In this IC the signals of both channels are first rectified and then added. The signal behind the adder is described by $V_{add} = |V_{chanA}| + |V_{chanB}|$, where:

$|V_{chanA}|$: absolute value channel A

$|V_{chanB}|$: absolute value channel B

This means, even if one channel signal appears phase shifted to the other channel (at worst cases inverted), the TEA0678 will ensure the normal AMS function.

Description of the principle timing diagram for AMS-scan mode without initial input signal (see Fig.5)

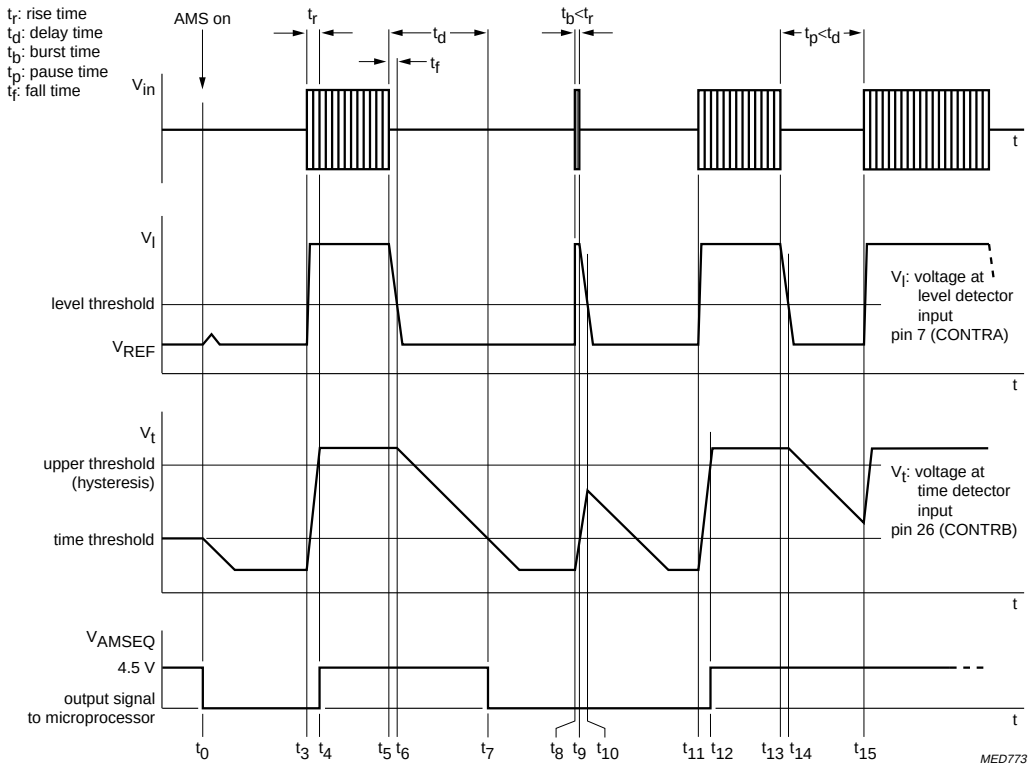


Fig.5 AMS-scan mode without initial input signal.

By activating AMS-scan mode, the AMS output level directly indicates whether the input level corresponds to a pause level (V_{AMSEQ} = LOW) or not (V_{AMSEQ} = HIGH). At t_0 the AMS-scan mode is activated. Without a signal at V_{in}, the following initial procedure runs until the AMS output changes to LOW level: due to no signal at V_{in} the voltage at the level detector input V_l (pin 7, CONTRA) remains below the level threshold and the second time constant will be discharged (time detector input V_t). When V_t passes the time threshold level, the time detector output changes to LOW level. Now the initial procedure is completed.

If a signal burst appears at t_3, the level detector input voltage rises immediately and causes its output to charge the second time constant, which supplies the input voltage V_t for the time detector. When V_t passes the upper threshold level after the rise time t_r (at t_4), the AMS output changes to HIGH. If the signal burst ends at t_5 the level detector input V_l falls to its LOW level. When passing the level threshold at t_6, the discharging of the second time constant begins. Now the circuit measures the delay time t_d, which is externally fixed by a resistor and defines the length of a pause to be detected. If no signal appears at V_{in} within the time interval t_d, the time detector output switches the AMS output to LOW level at t_7.

If a plop noise pulse appears at V_{in} (t_8) with a pulse width less than the rise time $t_r > t_b$, the plop noise will not be detected as music. The AMS output remains LOW.

Similarly the system handles ‘no music pulses’ t_p: when music appears at t_{11} with a small interruption at t_{13}, this interruption will not affect the AMS output for $t_p < t_d$.

Description of the principle timing diagram for AMS-scan mode with initial input signal (see Fig.6)

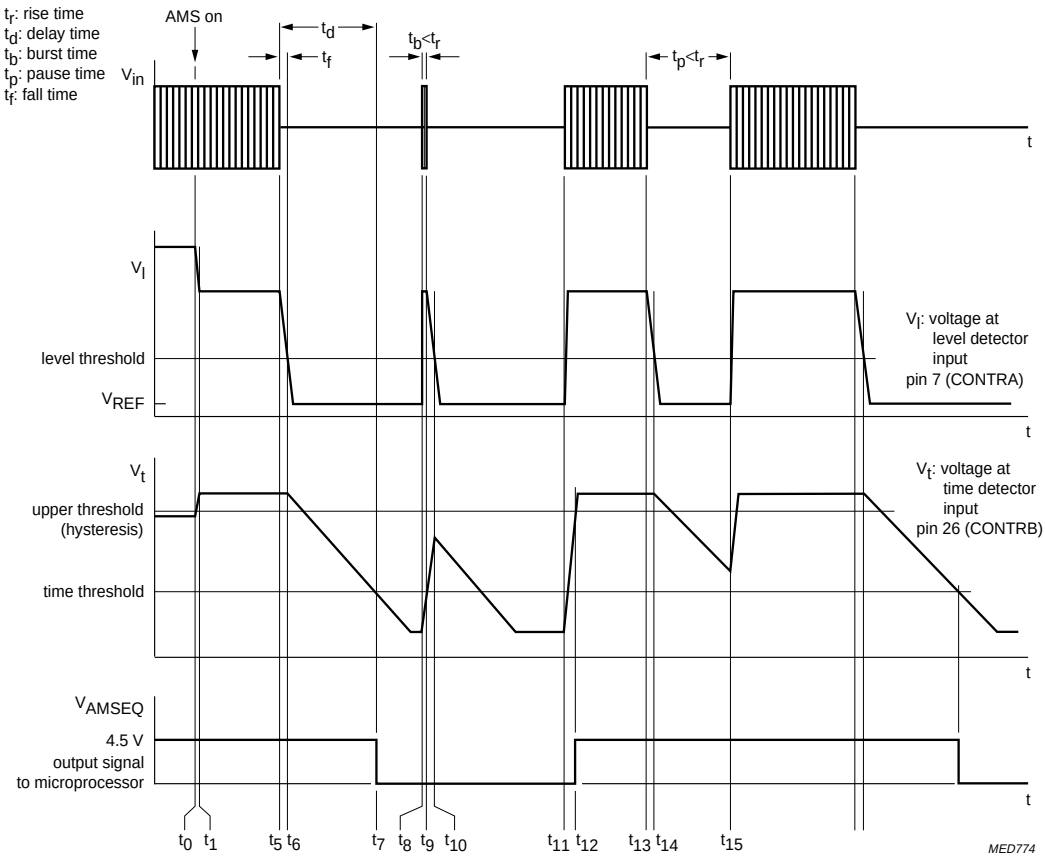


Fig.6 AMS-scan mode with initial input signal.

At t_0 the AMS-scan mode is activated. With an input signal at V_{in}, the following initial procedure runs until the circuit gets a steady state status.

Due to the signal at V_{in} the voltage at the level detector input V_l (pin 7, CONTRA) slides to a value which is defined by a limiter. This voltage causes the level detector output charging the second time constant (time detector input V_t) to its maximum voltage level at t_1. Now the initial procedure is completed.

The following behaviour does not differ from the description in Section “Description of the principle timing diagram for AMS-scan mode without initial input signal (see Fig.5)”.

TEST AND APPLICATION INFORMATION

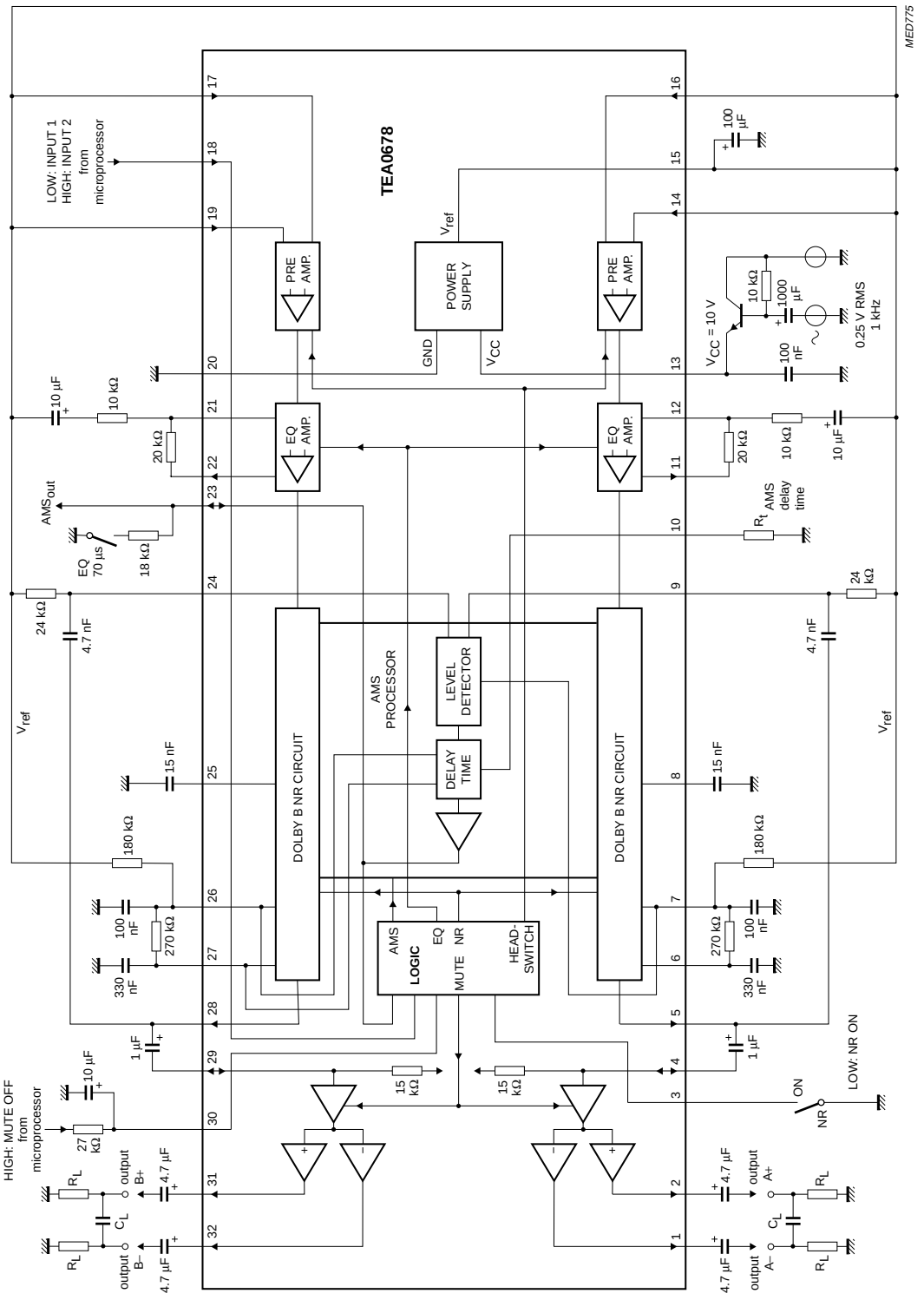


Fig.7 Test circuit for power supply ripple rejection.

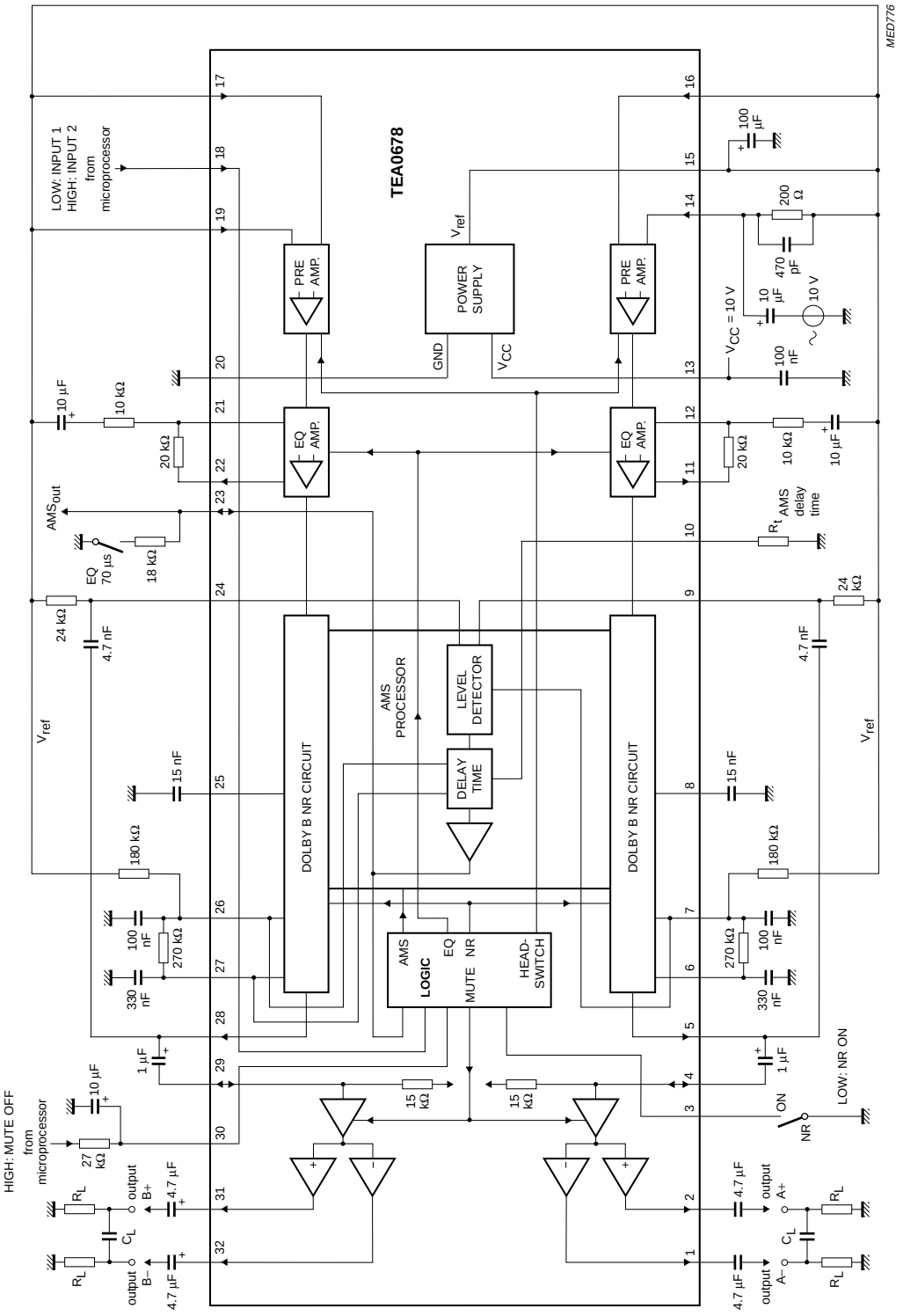


Fig.8 Test circuit for channel separation.

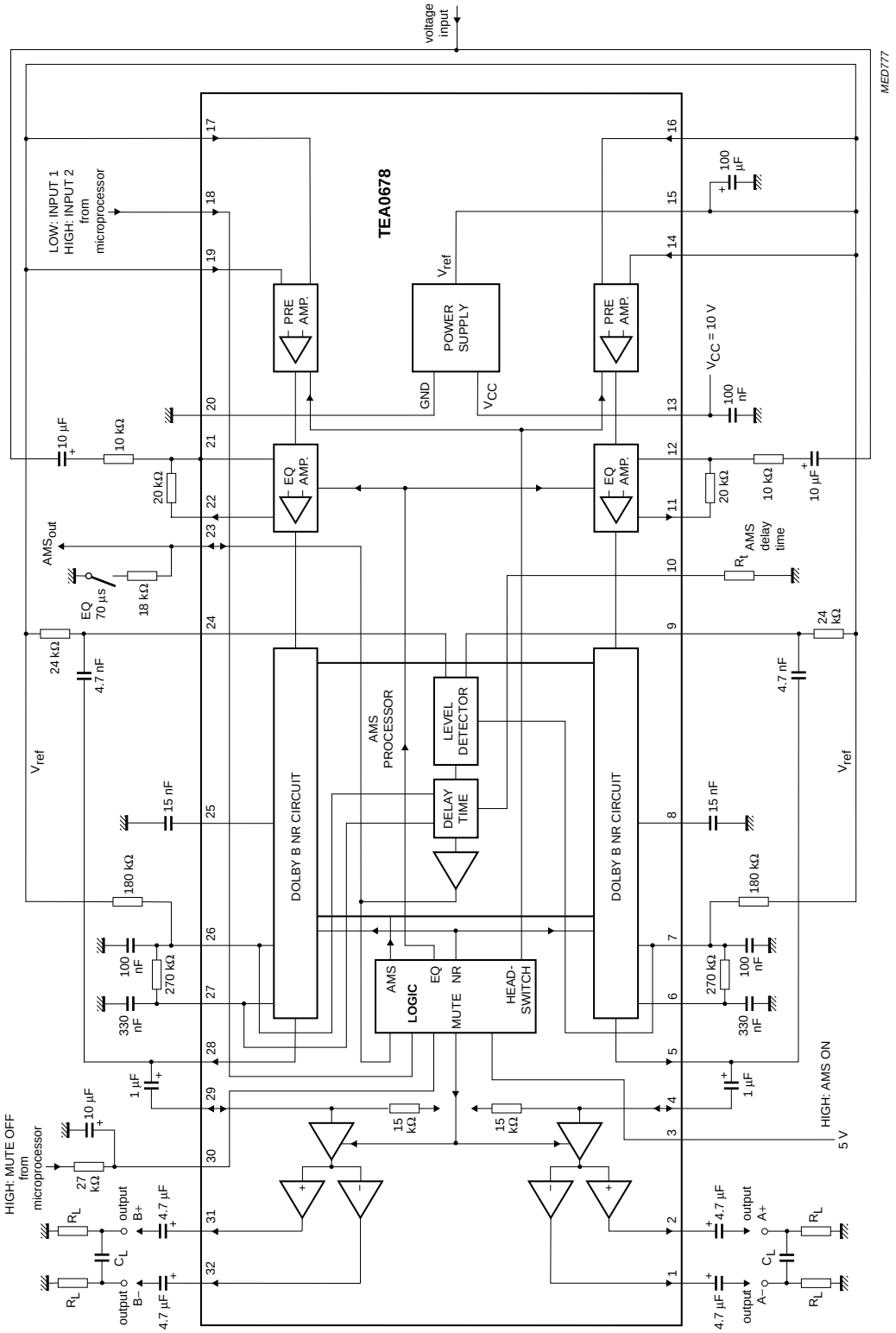


Fig.9 Test circuit for AMS threshold level.

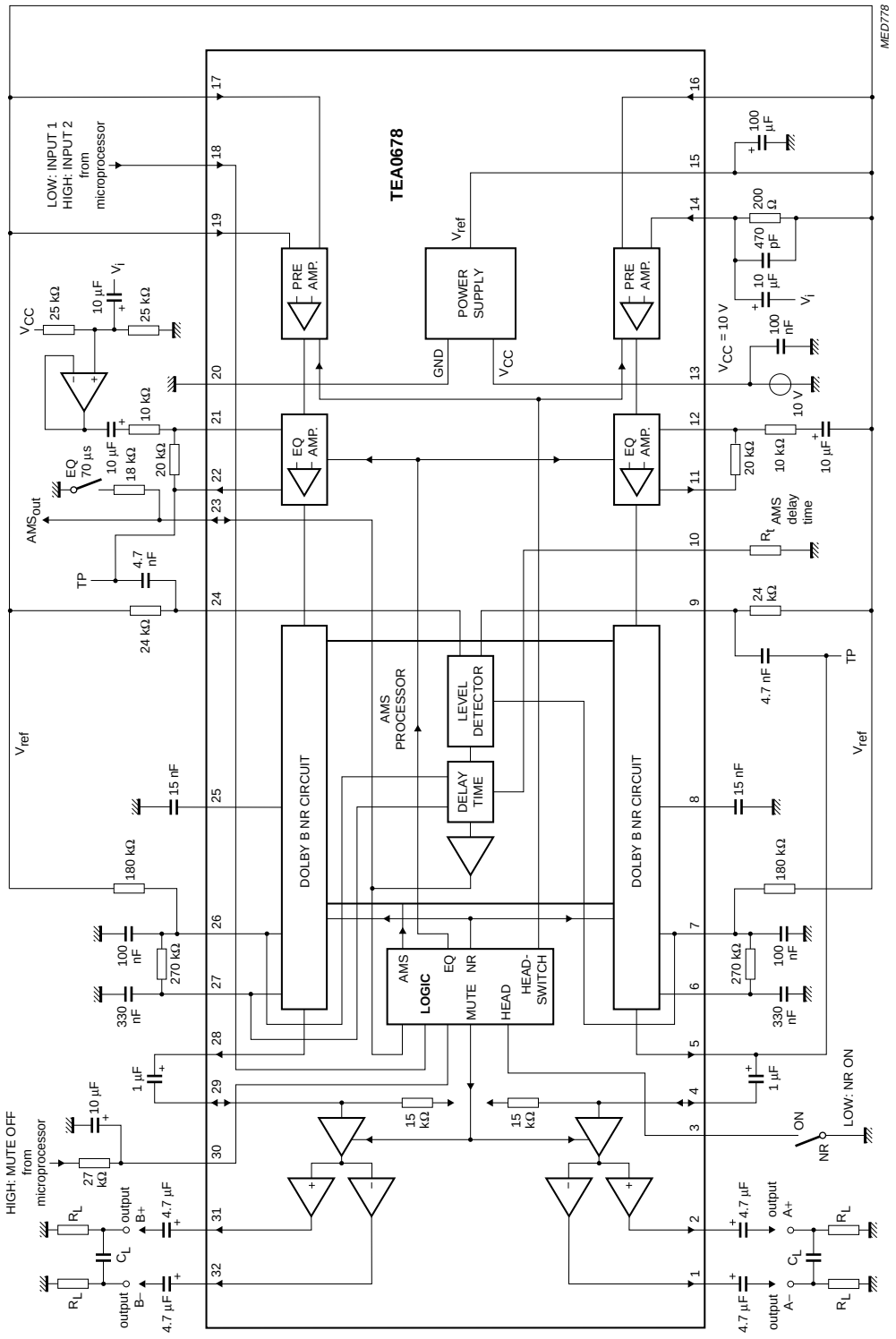


Fig.10 Test circuit for frequency response (channel B, encode mode).

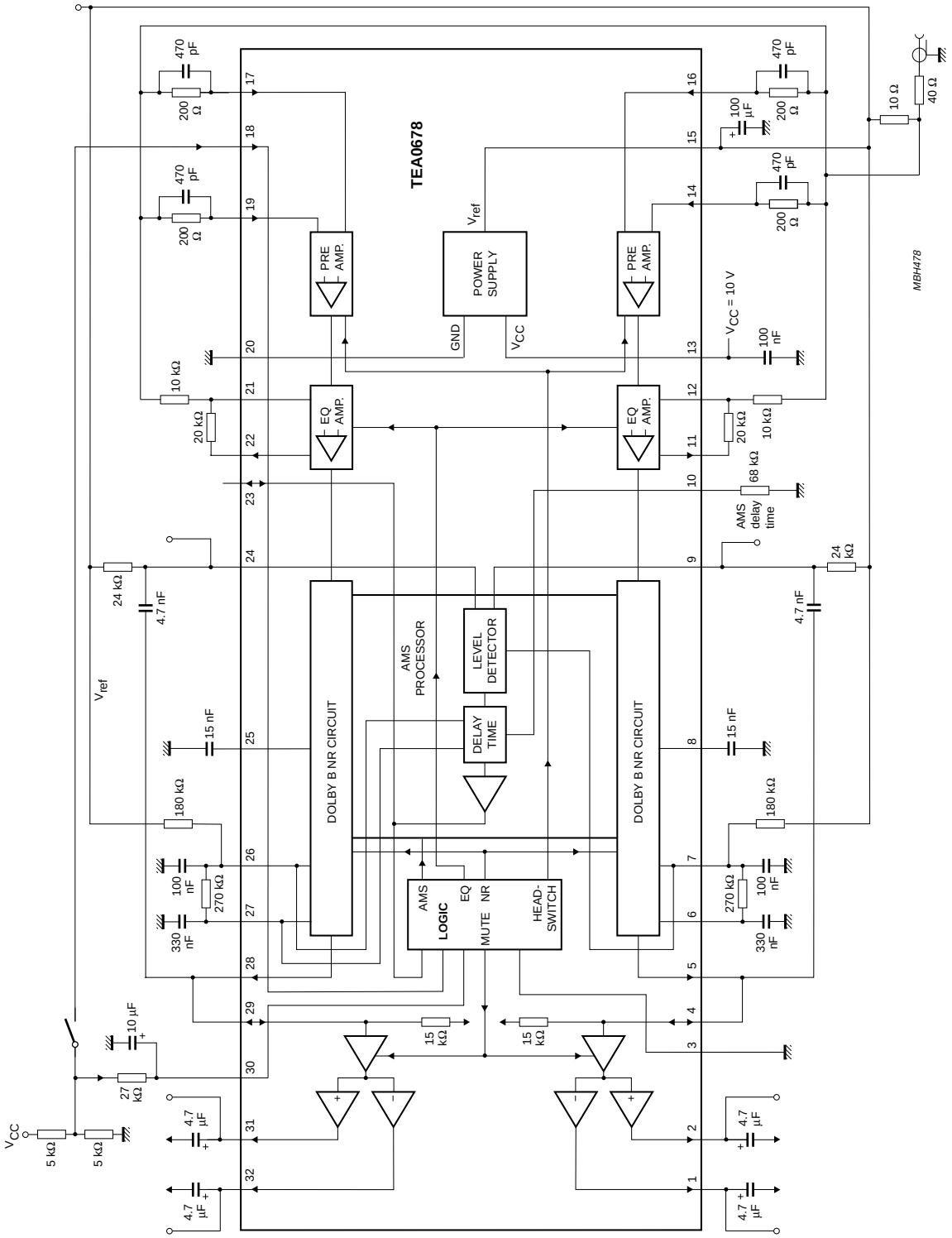
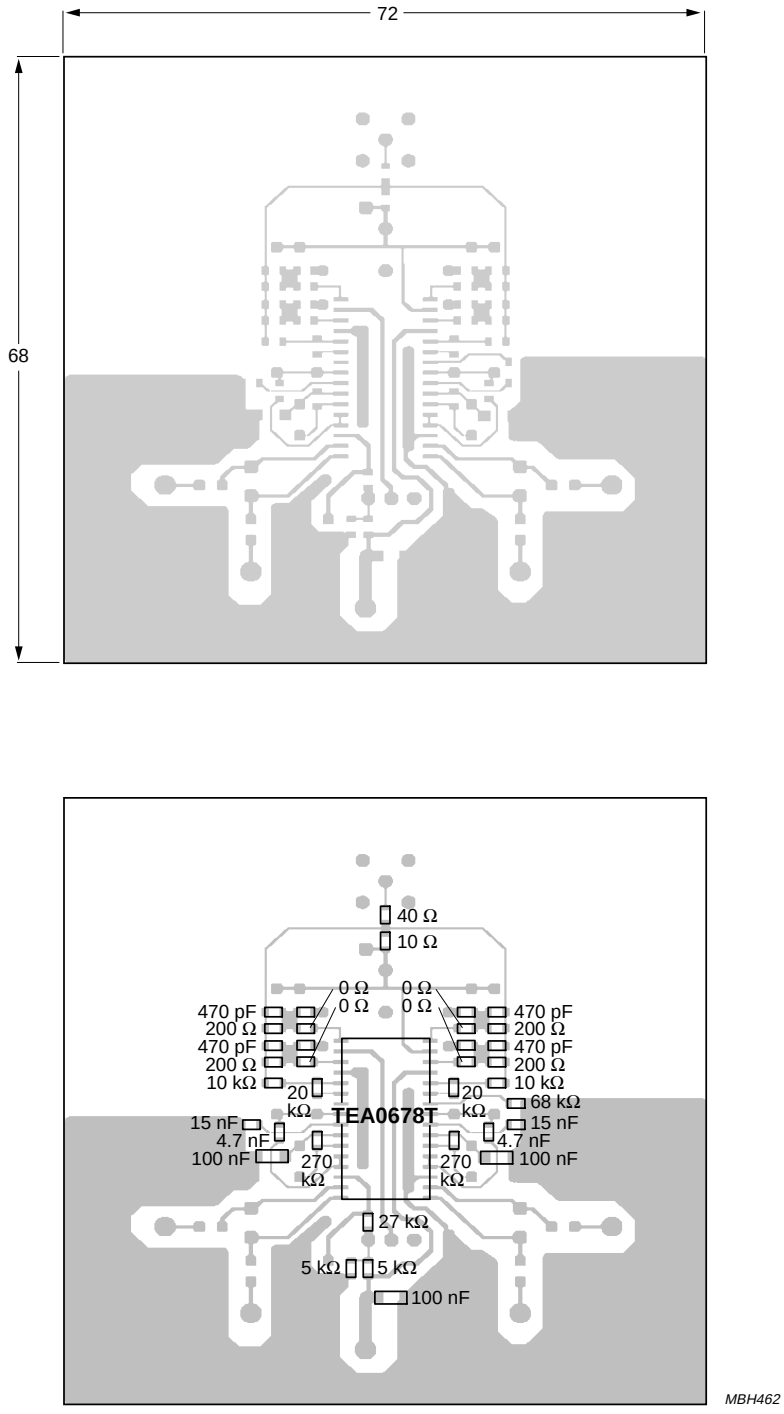


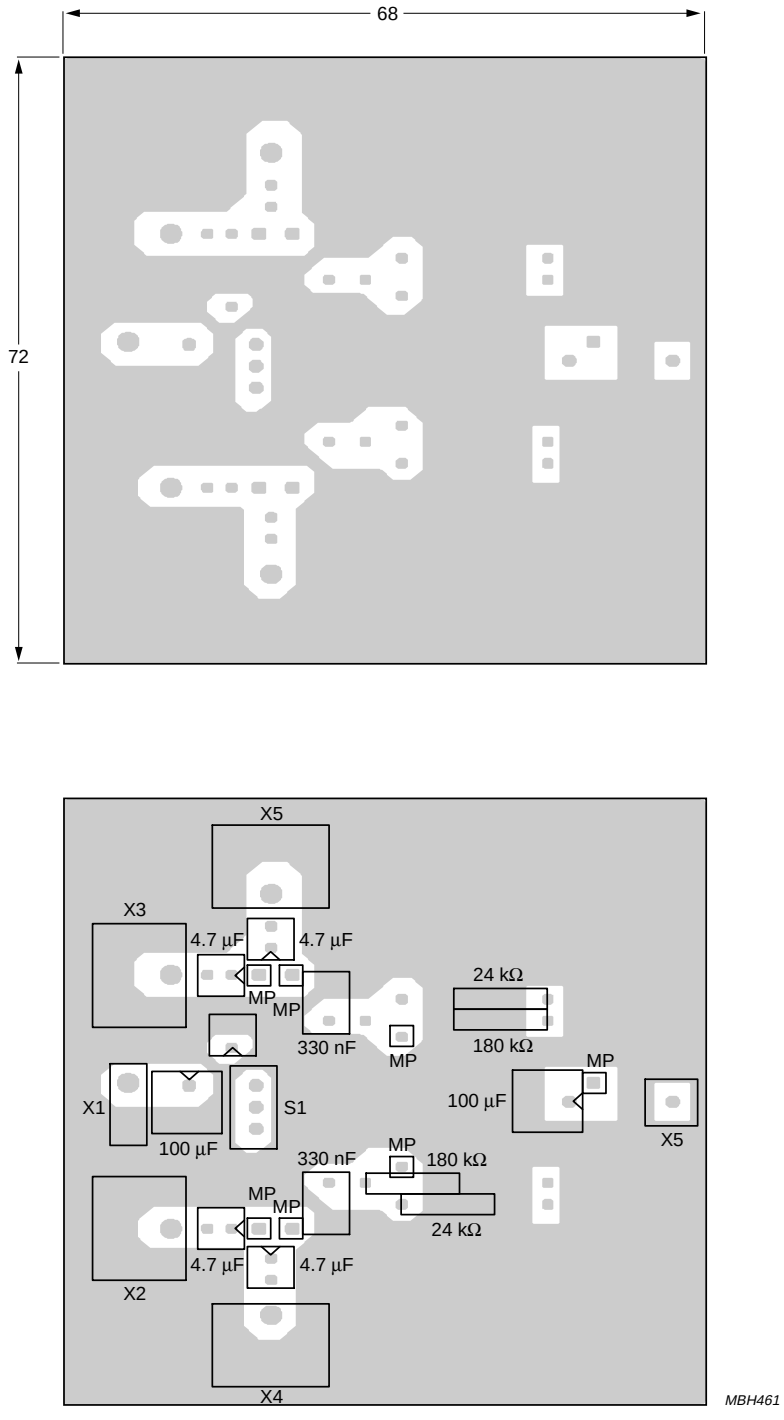
Fig.11 EMC test circuit.

LAYOUT OF PRINTED-CIRCUIT BOARD FOR EMC TEST CIRCUIT (FOR TEA0678T)



Dimensions in mm.

Fig.12 Top side with components.

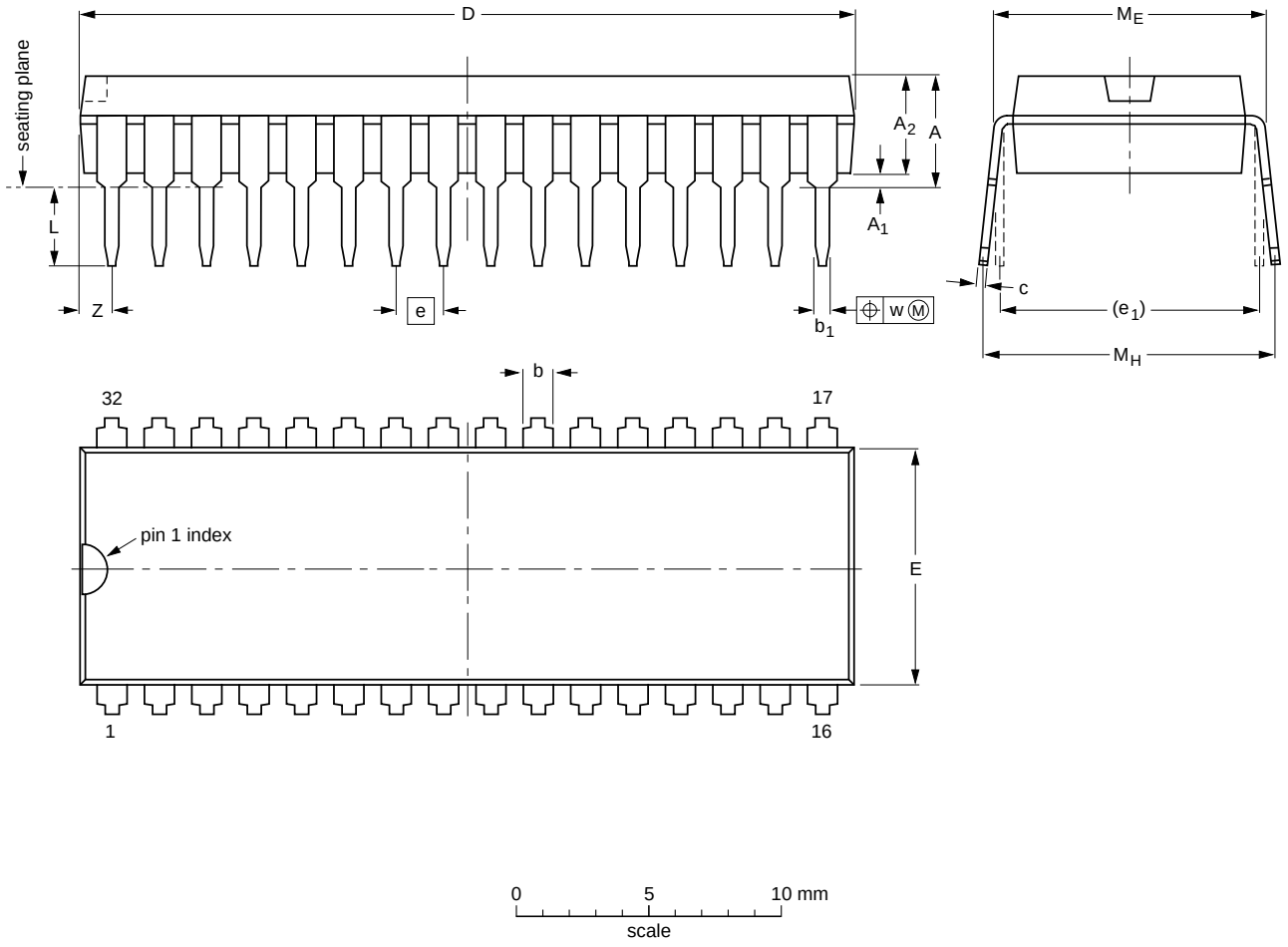


Dimensions in mm.

Fig.13 Bottom side with components.

PACKAGE OUTLINES

SDIP32: plastic shrink dual in-line package; 32 leads (400 mil) **SOT232-1**



DIMENSIONS (mm are the original dimensions)

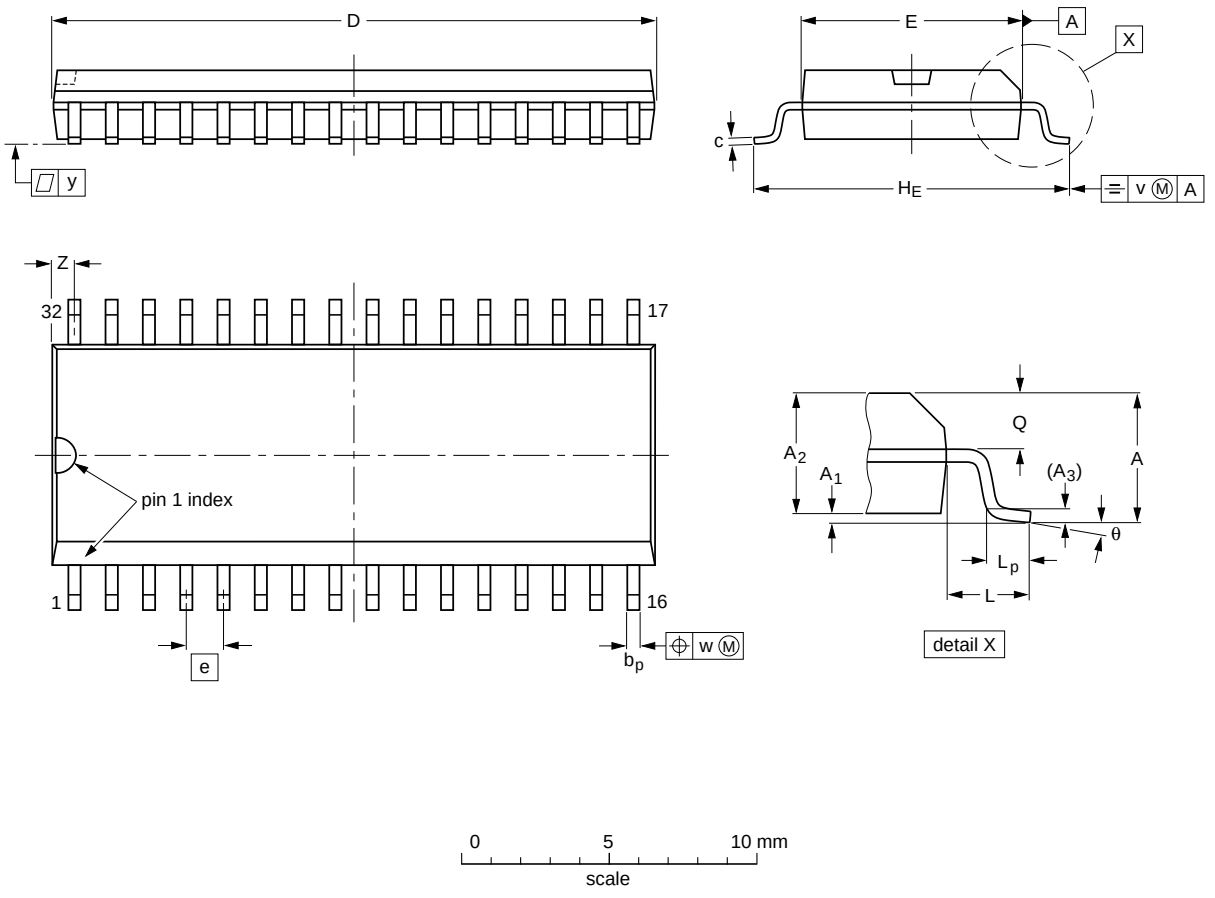
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	29.4 28.5	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT232-1						~~92-11-17~~ 95-02-04

SO32: plastic small outline package; 32 leads; body width 7.5 mm **SOT287-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.27 0.18	20.7 20.3	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.2 1.0	0.25	0.25	0.1	0.95 0.55	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.086	0.01	0.02 0.01	0.011 0.007	0.81 0.80	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.047 0.039	0.01	0.01	0.004	0.037 0.022	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT287-1						~~92-11-17~~ 95-01-25

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

SDIP

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

SO

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
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Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 805 4455, Fax. +61 2 805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 689 211, Fax. +359 2 689 102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381, Fax. +1 708 296 8556

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 1949

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 615 800, Fax. +358 615 80920

France: 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 52 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS,
Tel. +30 1 4894 339/911, Fax. +30 1 4814 240

Hungary: see Austria

India: Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

Indonesia: see Singapore

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, TEL AVIV 61180,
Tel. +972 3 645 0444, Fax. +972 3 648 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +1 800 234 7381, Fax. +1 708 296 8556

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 83749, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 926 5361, Fax. +7 095 564 8323

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Rua do Rocio 220 - 5th floor, Suite 51,
CEP: 04552-903-SÃO PAULO-SP, Brazil, P.O. Box 7383 (01064-970),
Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: PHILIPS TAIWAN Ltd., 23-30F, 66,
Chung Hsiao West Road, Sec. 1, P.O. Box 22978,
TAIPEI 100, Tel. +886 2 382 4443, Fax. +886 2 382 4444

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 2A Akademika Koroleva str., Office 165,
252148 KIEV, Tel. +380 44 476 0297/1642, Fax. +380 44 476 6991

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381, Fax. +1 708 296 8556

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Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 825 344, Fax.+381 11 635 777

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

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