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INTEGRATED CIRCUITS

DATA SHEET

TDA1591

PLL stereo decoder and noise blanker

Product specification
Supersedes data of March 1992
File under Integrated Circuits, IC01

1996 Sep 02

Philips Semiconductors

PHILIPS

FEATURES

- Adjustment-free voltage controlled PLL oscillator for ceramic resonator (f = 456 kHz)
- Pilot signal dependent mono/stereo switching
- Analog control of mono/stereo change over [stereo blend, Stereo Noise Controller (SNC)]
- Adjacent channel noise suppression (114 kHz)
- Pilot canceller
- Analog control of de-emphasis; High Cut Control (HCC)
- Applicable as source selector for AM/FM/cassette switching
- Separate interference noise detector
- Integrated input low-pass filter for delayed noise blanking
- Noise blanking at MPX-demodulator outputs
- Internal voltage stabilization.

GENERAL DESCRIPTION

The TDA1591 is a monolithic bipolar integrated circuit providing the stereo decoder function and noise blanking for FM car radio applications.

The device operates in a power supply range of 7.5 to 12 V.

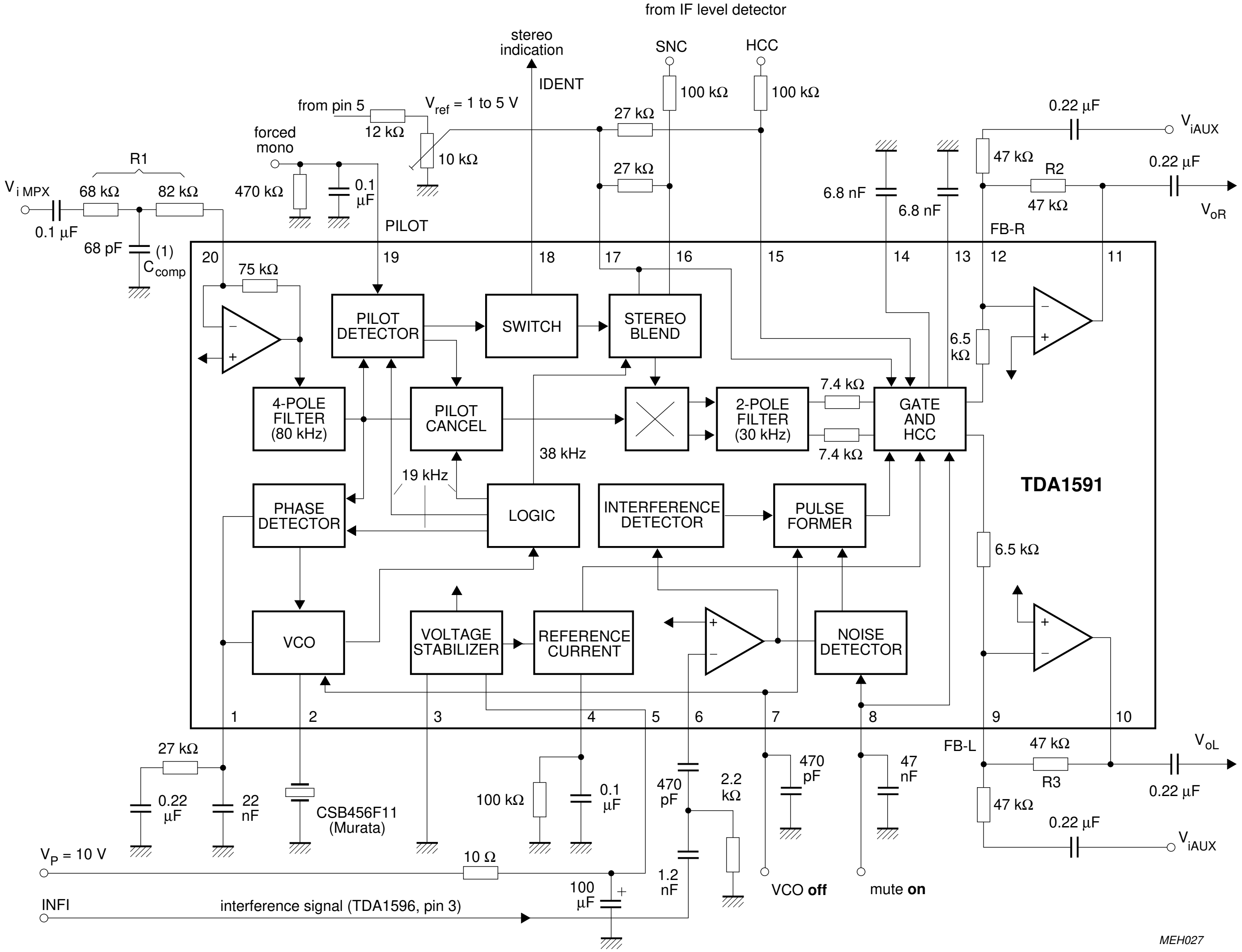
QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage (pin 5)	7.5	10	12	V
I_P	supply current	–	12	–	mA
$V_{o(rms)}$	audio output signal (RMS value)	–	900	–	mV
THD	total harmonic distortion	–	0.1	0.3	%
S/N	signal-to-noise ratio	–	76	–	dB
α_{cs}	channel separation	–	40	–	dB
V_{trigg}	interference voltage trigger level	–	10	–	mV

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA1591	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
TDA1591T	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1

BLOCK DIAGRAM



(1) Simulates the roll-off of the FM demodulator.

Fig.1 Block diagram with external components, also used as test circuit.

PINNING

SYMBOL	PIN	DESCRIPTION
PLL	1	phase locked loop filter
OSC	2	oscillator input/output pin for ceramic resonator
GND	3	ground (0 V)
I_{ref}	4	reference current
V_P	5	supply voltage (+10 V)
INFI	6	interference signal input
PUFO	7	pulse former time constant; VCO **off**
NDET	8	noise detector time constant; mute **on**
FB-L	9	AF feedback input for left audio signal
V_{oL}	10	AF output signal left
V_{oR}	11	AF output signal right
FB-R	12	AF feedback input for right audio signal
C_{DEEL}	13	de-emphasis capacitor for left channel
C_{DEER}	14	de-emphasis capacitor for right channel
HCC	15	HCC input for de-emphasis control
SNC	16	stereo blend input
V_{ref}	17	externally applied reference voltage of 1 to 5 V
IDENT	18	identification output (HIGH = pilot existing; stereo)
PILOT	19	pilot detector level (forced mono input)
$V_{i\,MPX}$	20	MPX input signal from IF demodulator

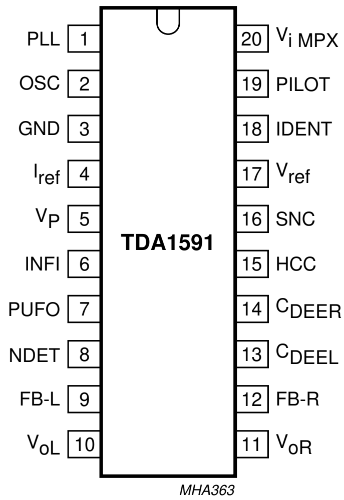


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

Adapting the MPX input to the level of the FM demodulator output is realized by the value of input resistor R1 (see Fig.3). The total gain of the stereo decoder is applicable by varying the feedback resistors R2 and R3 (see Figs 1 and 4).

In mute position and the VCO switched **off** (pin 7), the output amplifiers can be used for cassette playback, AM stereo purpose or other signal sources.

The Stereo Noise Controller (SNC) provides a smooth mono to stereo take-over (see Fig.5).

For High Cut Control (HCC), the de-emphasis time constant can be changed to higher values (see Figs 7 and 8). This function is controlled by an analog input signal.

The noise blanking facility is achieved by gating the stereo decoder output signal.

The interference detector generates a gating pulse preferable forced by the level detector voltage of the IF part.

LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	supply voltage (pin 5)	0	13.2	V
P_{tot}	total power dissipation	0	0.25	W
T_{stg}	storage temperature	–55	+150	°C
T_{amb}	operating ambient temperature	–40	+85	°C
V_{es}	electrostatic handling; note 1			
	pins 1 and 16	–400	+400	V
	pin 5	–300	+300	V
	all other pins	–600	+600	V

Note

1. Equivalent to discharging a 200 pF capacitor through a 0 Ω series resistor.

CHARACTERISTICS

V_P = 10 V; T_{amb} = 25 °C; input signal $V_{i\,MPX(p-p)}$ = 1.7 V; m = 100% (Δf = ±75 kHz, f_{mod} = 1 kHz); de-emphasis of 50 µs and series resistor at input R1 = 150 kΩ; measurements taken in Fig.1; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	supply voltage (pin 5)		7.5	10	12	V
I_P	supply current		–	12	–	mA
Stereo decoder						
$V_{i\,MPX(p-p)}$	MPX input signal on pin 20 (peak-to-peak value)		–	1.7	–	V
$\Delta V_{i\,MPX(p-p)}$	overdrive margin of MPX input signal	THD = 1%	3	–	–	dB
$V_{o(rms)}$	AF mono output signal at pins 10 and 11 (RMS value)	without pilot	–	900	–	mV
ΔV_o	overdrive margin of output signal	THD = 1%	3	–	–	dB
$V_{10\text{-}11}/V_o$	difference of output voltage levels		–	–	1	dB
$V_{o\,10,11}$	DC output voltage (pins 10 and 11)		3.3	3.8	4.3	V
$R_{o\,10,11}$	output resistance		–	130	–	Ω
α_{cs}	channel separation	pin 16 open-circuit; see Fig.6	–	40	–	dB
THD	total harmonic distortion		–	0.1	0.3	%
S/N	signal-to-noise ratio	f = 20 to 16000 Hz	–	76	–	dB
α_{19}	pilot signal suppression	f = 19 kHz	–	50	–	dB
α_{38}	subcarrier suppression	f = 38 kHz	–	50	–	dB
α_{57}		f = 57 kHz	–	46	–	dB
α_{76}		f = 76 kHz	–	60	–	dB
IM2	intermodulation for f_{spur} = 1 kHz	f_{mod} = 10 kHz; note 1	–	60	–	dB
IM3		f_{mod} = 13 kHz; note 1	–	58	–	dB
α_{57}ARI	traffic radio (ARI)	f = 57 kHz; note 2	–	70	–	dB
α_{67}	Subsidiary Communication Authorization (SCA)	f = 67 kHz; note 3	70	–	–	dB
α_{114}	Adjacent Channel Interference (ACI)	f = 114 kHz; note 4	–	80	–	dB
α_{190}		f = 190 kHz; note 4	–	70	–	dB
PSRR	power supply ripple rejection	f = 100 Hz; $V_{ripple(rms)}$ = 100 mV	–	35	–	dB
VCO (pin 2)						
f_{osc}	oscillator frequency (ceramic resonator)		–	456	–	kHz
	frequency range of free running oscillator		452	–	460	kHz
Δf/f	capture and holding range		–	1	–	%
V_7	VCO-**off** voltage (pin 7)		0	–	0.6	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Mono/stereo control (pins 16, 17 and 19)						
$V_{i\ pilot(rms)}$	pilot threshold voltage for automatic switching by pilot input voltage (RMS value)	stereo **on**	–	24	30	mV
		stereo **off**	8	20	–	mV
HYS	hysteresis of pilot threshold voltage		–	2	–	dB
V_{19}	switching voltage for external mono control (pin 19)		0	–	1	V
V_{ref}	reference input voltage range (pin 17)		1	–	5	V
$V_{16\text{-}17}$	control voltage for channel separation due to pin 17 (V_{ref})	α_{cs} = 6 dB; see Fig.5	–	–85	–	mV
		α_{cs} = 26 dB; see Fig.5	–	–32	–	mV
Pilot indicator logic level output (pin 18)						
V_{18}	LOW voltage	I_{18} = –200 μA	–	250	400	mV
I_{18}	HIGH current	V_{18} = 10 V	–	–	1	μA
Muting (pin 8)						
$MUTE_{att}$	mute attenuation (pin 8)	V_8 < 0.4 V	–	80	–	dB
		V_8 > 4 V	–	–	0.2	dB
$V_{O(offset)}$	DC offset voltage (pins 10 and 11)	after muting	–	–	±400	mV
HCC (pin 15)						
CR_{deem}	control range of de-emphasis	see Figs 7 and 8				
	for European standard	C_{deem} = 6.8 nF	50	–	150	μs
	for USA standard	C_{deem} = 10 nF	75	–	225	μs
$V_{15\text{-}17}$	control voltage (pin 15 due to pin 17) in both standards	lower value CR_{deem}	–	0	–	mV
		upper value CR_{deem}	–	–300	–	mV
Noise interference detector						
V_{trigg}	trigger threshold (pin 6)	f_{int} = 120 kHz				
		$V_{8(DC)}$ = 7.7 V	–	10	–	mV
		$V_{8(DC)}$ = 6.7 V	–	100	–	mV
ΔV_8	voltage offset as a function of V_{trigg}	$V_{6\ trigg}$ = 10 mV	–	200	–	mV
		$V_{6\ trigg}$ = 100 mV	–	2.3	–	V
t_{sup}	AF suppression time; pulse width		–	40	–	μs
$I_{13,14}$	input offset current (pins 13 and 14)	during AF suppression time	–	20	–	nA
V_{pulse}	trigger sensitivity (pin 6)	τ_{pulse} = 10 μs	–	10	–	mV

Notes

1. Intermodulation suppression [Beat Frequency Components (BFC)]:

$$IM2 = \frac{V_{o(signal)}\ (\text{at 1 kHz})}{V_{o(spurious)}\ (\text{at 1 kHz})};\ f_s = (2 \times 10\ \text{kHz}) - 19\ \text{kHz}$$

$$IM3 = \frac{V_{o(signal)}\ (\text{at 1 kHz})}{V_{o(spurious)}\ (\text{at 1 kHz})};\ f_s = (3 \times 13\ \text{kHz}) - 38\ \text{kHz}$$

measured with 91% mono signal; f_{mod} = 10 kHz or 13 kHz; 9% pilot signal.

2. ARI suppression:

$$\alpha_{57}ARI = \frac{V_{o(signal)}\ (\text{at 1 kHz})}{V_{o(spurious)}\ (\text{at 1 kHz} \pm 23\ \text{Hz})}$$

measured with 91% stereo signal; f_{mod} = 1 kHz; 9% pilot signal; 5% ARI subcarrier (f_s = 57 kHz; f_{mod} = 23 Hz; AM m = 0.6).

3. Subsidiary Communication Authorization (SCA):

$$\alpha_{67} = \frac{V_{o(signal)}\ (\text{at 1 kHz})}{V_{o(spurious)}\ (\text{at 9 kHz})};\ f_s = (2 \times 38\ \text{kHz}) - 67\ \text{kHz}$$

measured with 81% mono signal; f_{mod} = 1 kHz; 9% pilot signal; 10% SCA subcarrier (f_s = 67 kHz, unmodulated).

4. Adjacent Channel Interference (ACI):

$$\alpha_{114} = \frac{V_{o(signal)}\ (\text{at 1 kHz})}{V_{o(spurious)}\ (\text{at 4 kHz})};\ f_s = 110\ \text{kHz} - (3 \times 38\ \text{kHz})$$

$$\alpha_{190} = \frac{V_{o(signal)}\ (\text{at 1 kHz})}{V_{o(spurious)}\ (\text{at 4 kHz})};\ f_s = 186\ \text{kHz} - (5 \times 38\ \text{kHz})$$

measured with 90% mono signal; f_{mod} = 1 kHz; 9% pilot signal; 1% spurious signal (f_s = 110 kHz or 186 kHz, unmodulated).

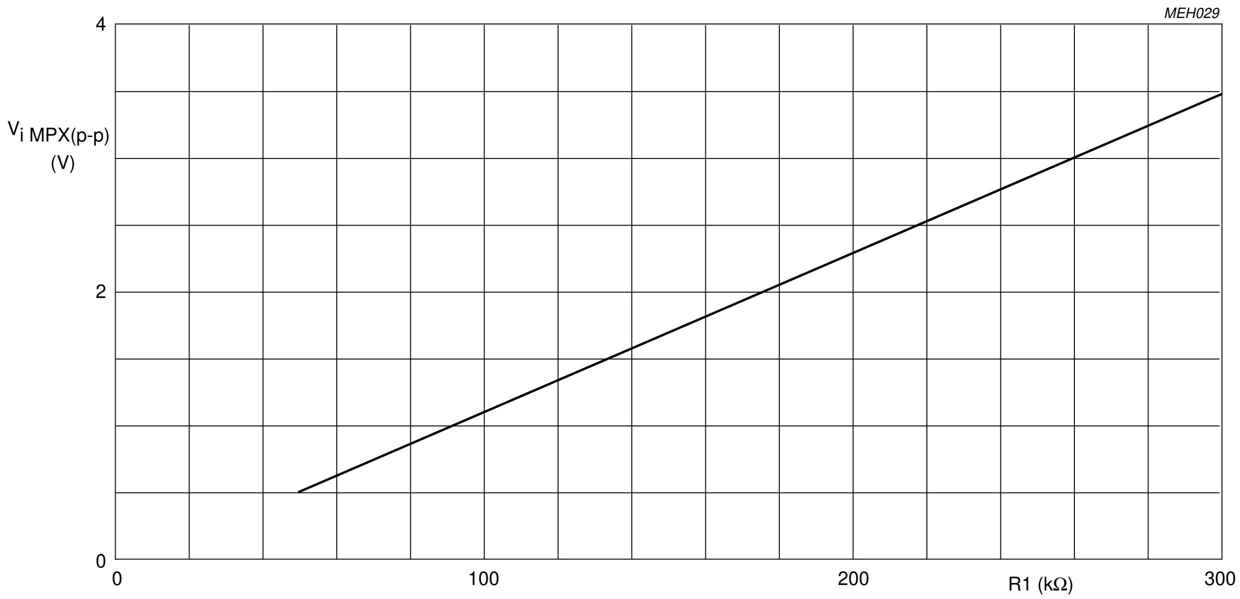


Fig.3 Input signal as a function of series input resistor R1.

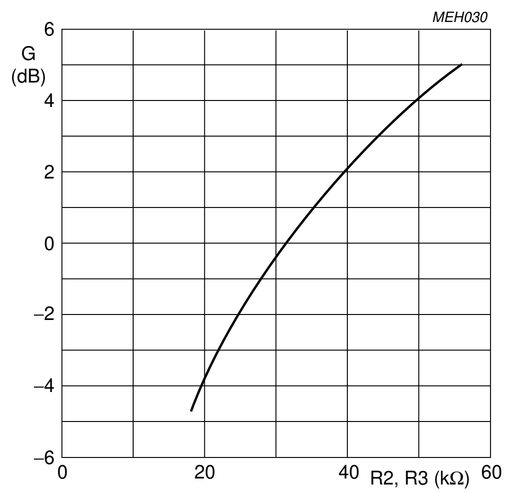


Fig.4 Overall signal gain as a function of feedback resistors R2 and R3 (R1 = 150 kΩ).

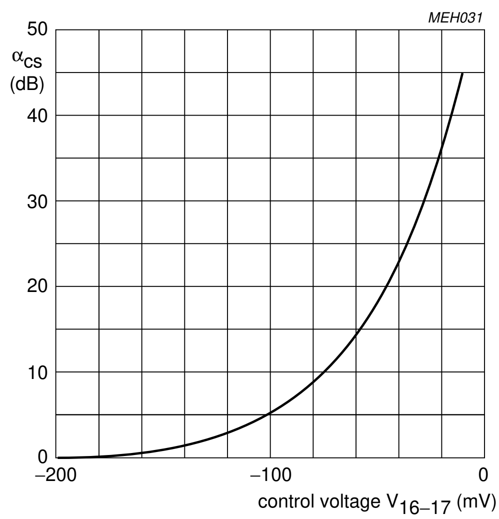
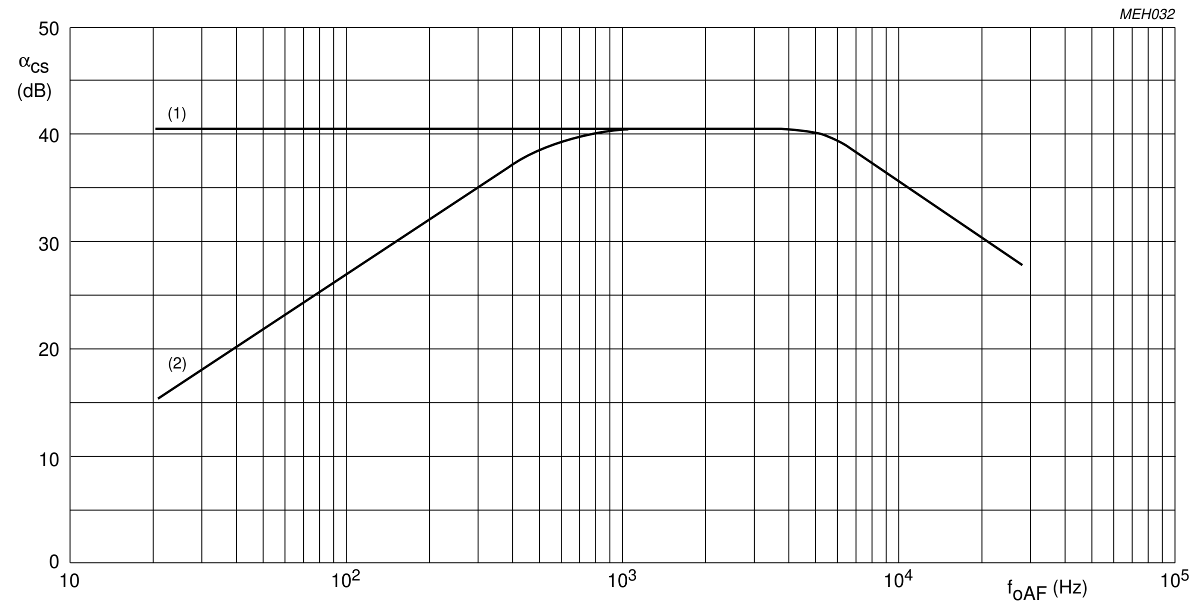
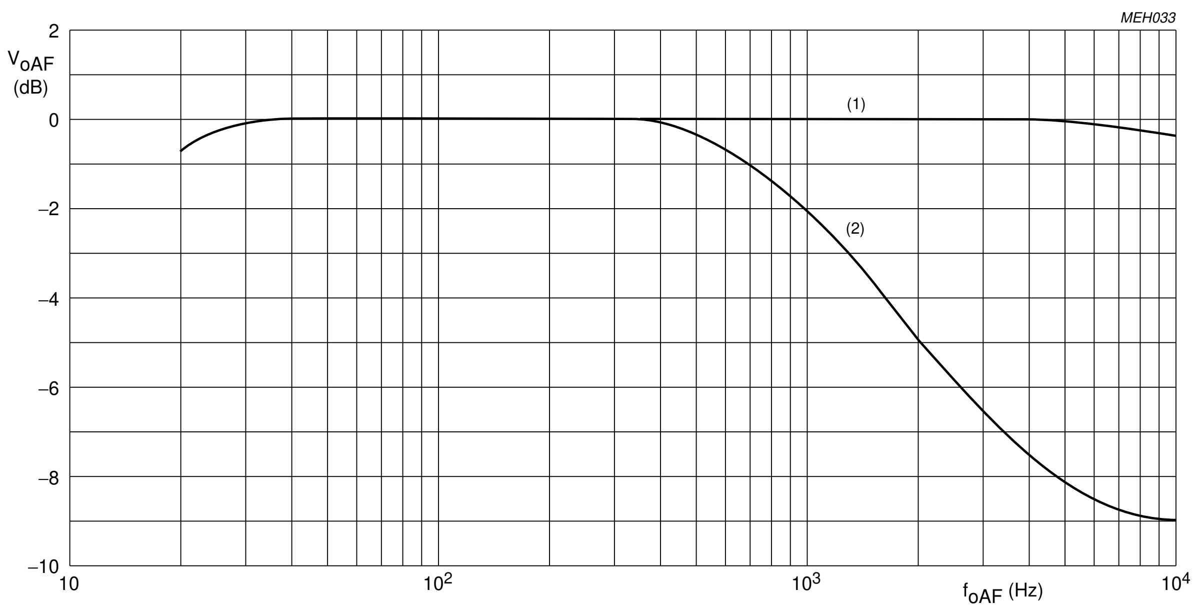


Fig.5 Stereo blend characteristic (SNC).



(1) Coupling capacitor C_K at pin 20 = 10 μF.
(2) Coupling capacitor C_K at pin 20 = 0.1 μF.

Fig.6 Channel separation as a function of audio frequency.



(1) V_{15-17} = 0.
(2) V_{15-17} = −300 mV.

Fig.7 HCC as a function of audio frequency (pin 7 connected to GND; without pre-emphasis).

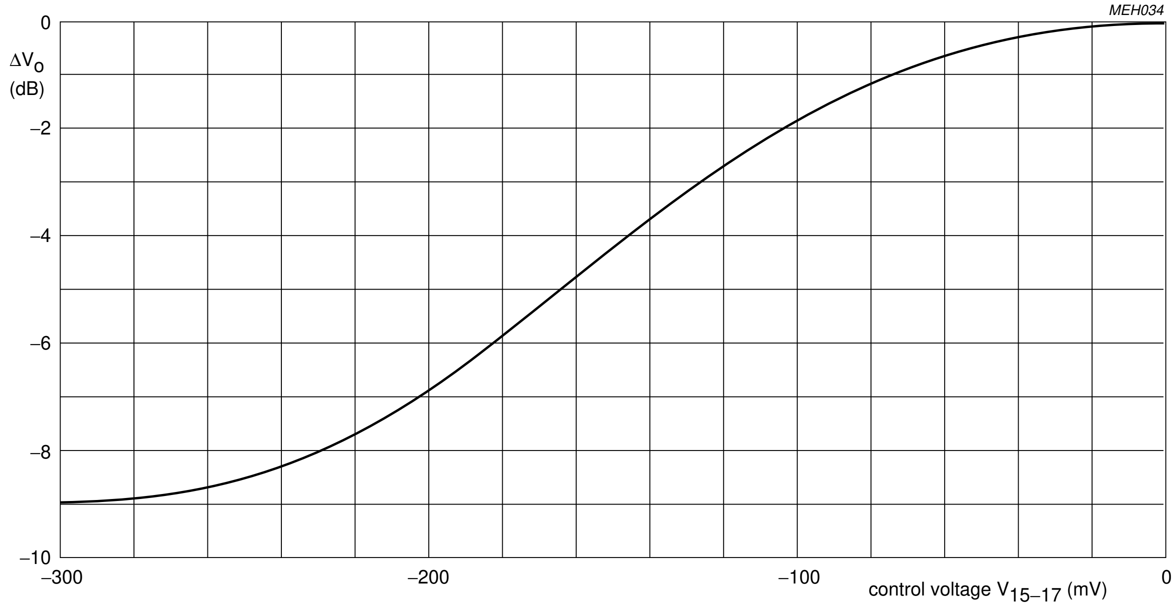
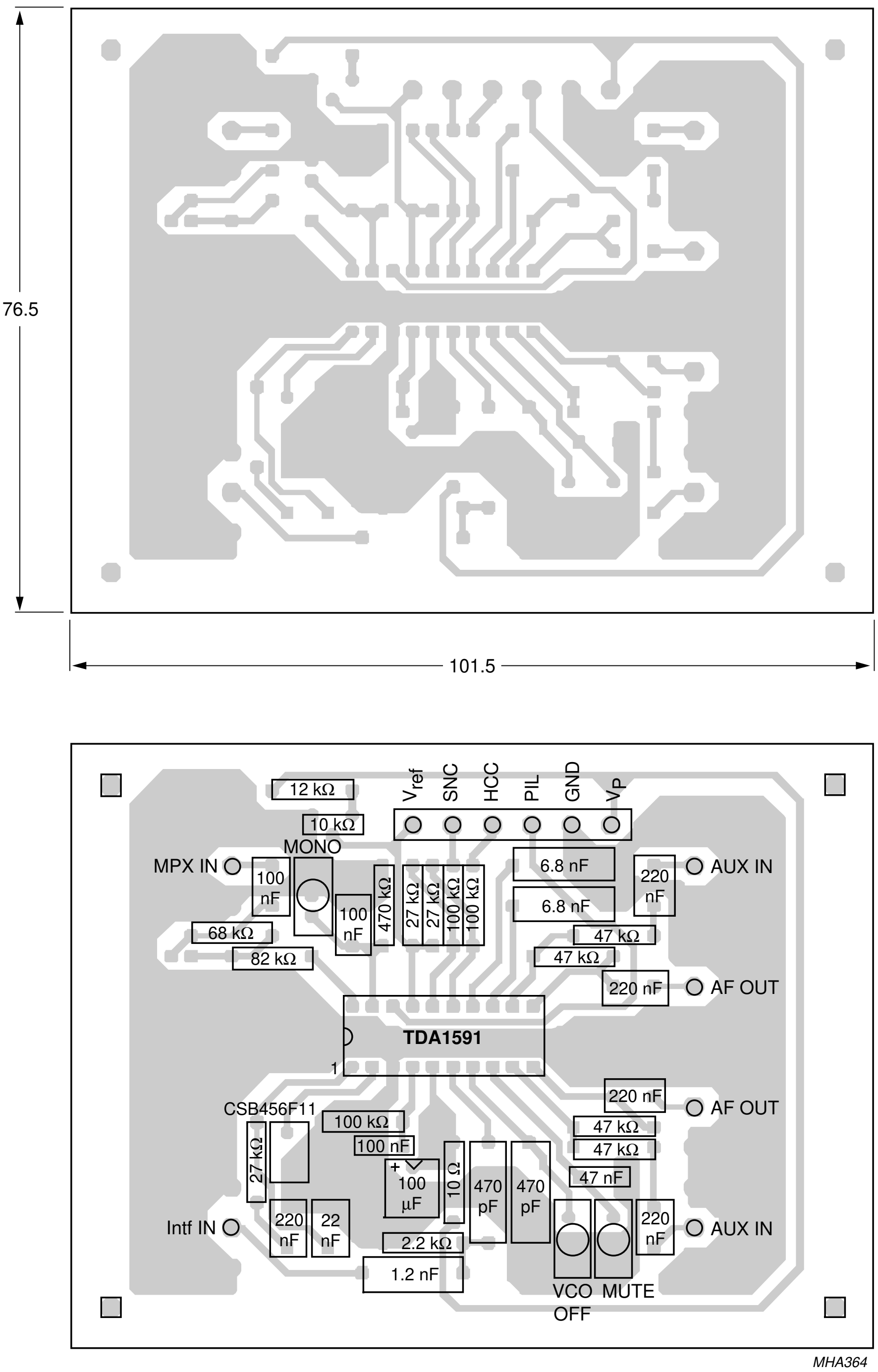


Fig.8 HCC with f_{mod} = 10 kHz.

TEST INFORMATION

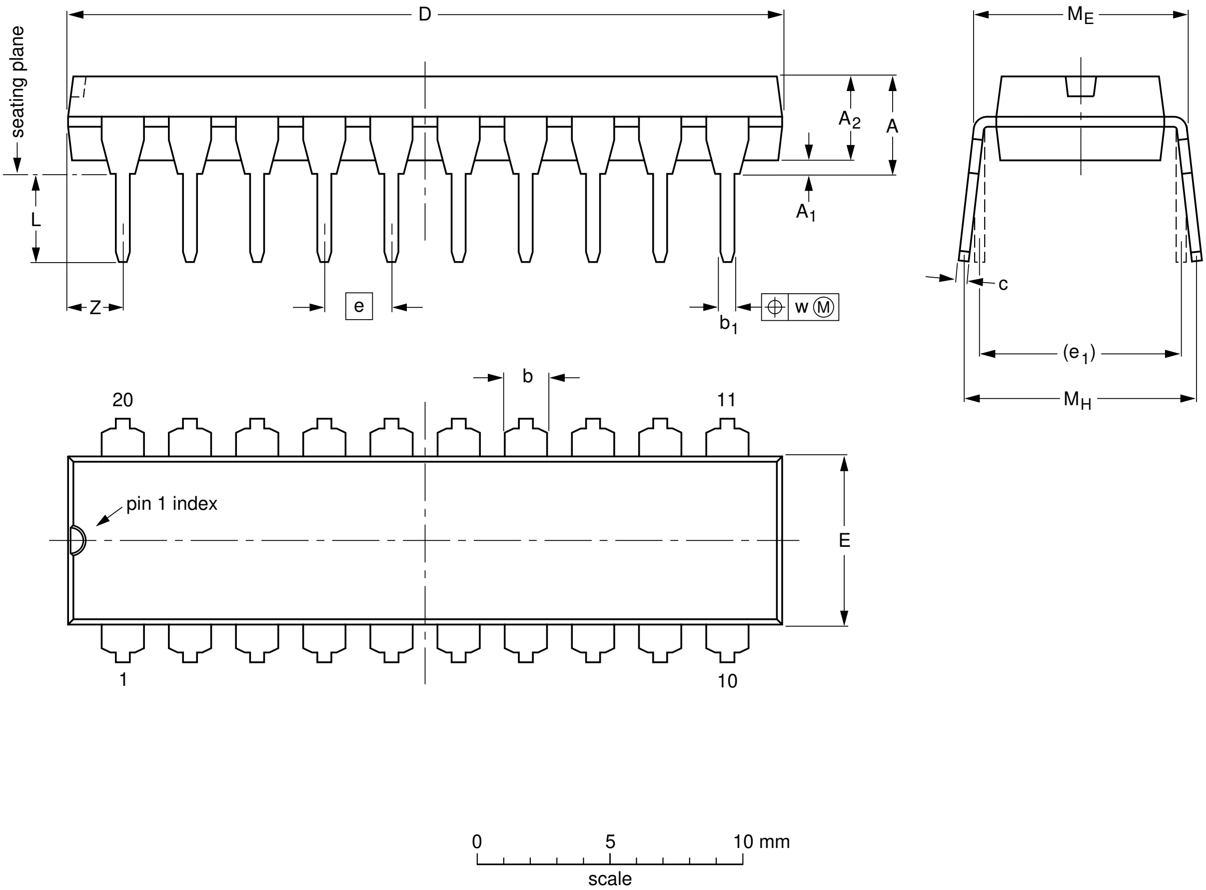


Dimensions in mm.

Fig.9 TDA1591 test board (component side).

PACKAGE OUTLINES

DIP20: plastic dual in-line package; 20 leads (300 mil) SOT146-1



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

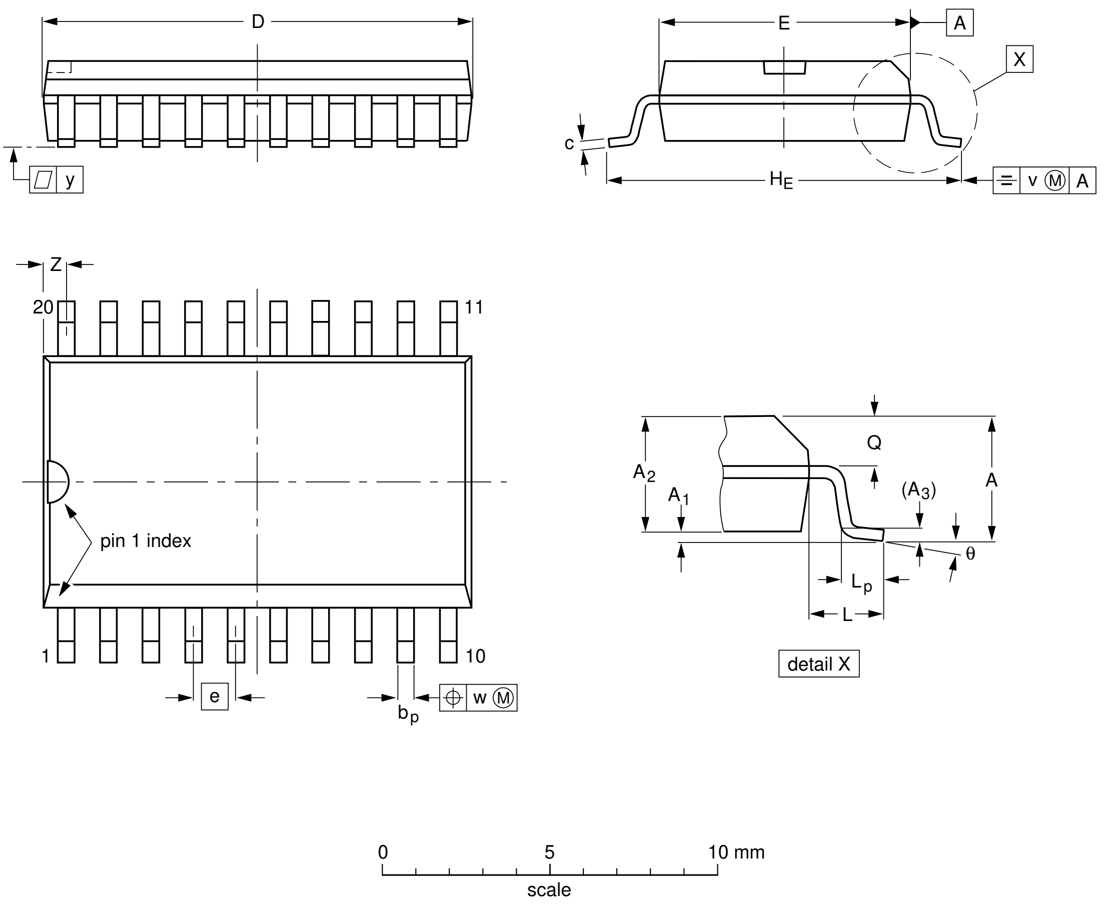
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

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			
SOT146-1			SC603			~~92-11-17~~ 95-05-24

SO20: plastic small outline package; 20 leads; body width 7.5 mm | **SOT163-1**



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	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

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			
SOT163-1	075E04	MS-013AC				~~92-11-17~~ 95-01-24

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).

DIP

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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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