PLL stereo decoder and noise blanker — TDA1591/T

FEATURES

- Adjustment-free voltage controlled PLL oscillator for ceramic resonator (f = 456 kHz)
- Mono/stereo switching, dependent on pilot signal
- Analog control of mono/stereo change over (stereo blend, SNC)
- Adjacent channel noise suppression (114 kHz)
- Pilot canceller
- Analog control of de-emphasis (High Cut Control input, 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(T) 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 range (pin 5)	7.5	10	12	V
I_P	supply current	-	12	-	mA
V_o	audio output signal (RMS value)	-	900	-	mV
THD	total harmonic distortion	-	0.1	0.3	%
S/N	signal-to-noise ratio	-	76	-	dB
α	channel separation	-	40	-	dB
V_{trigg}	interference voltage trigger level	-	10	-	mV

ORDERING AND PACKAGE INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TDA1591	20	DIL	plastic	SOT146
TDA1591T	20	mini-pack	plastic	SOT163A

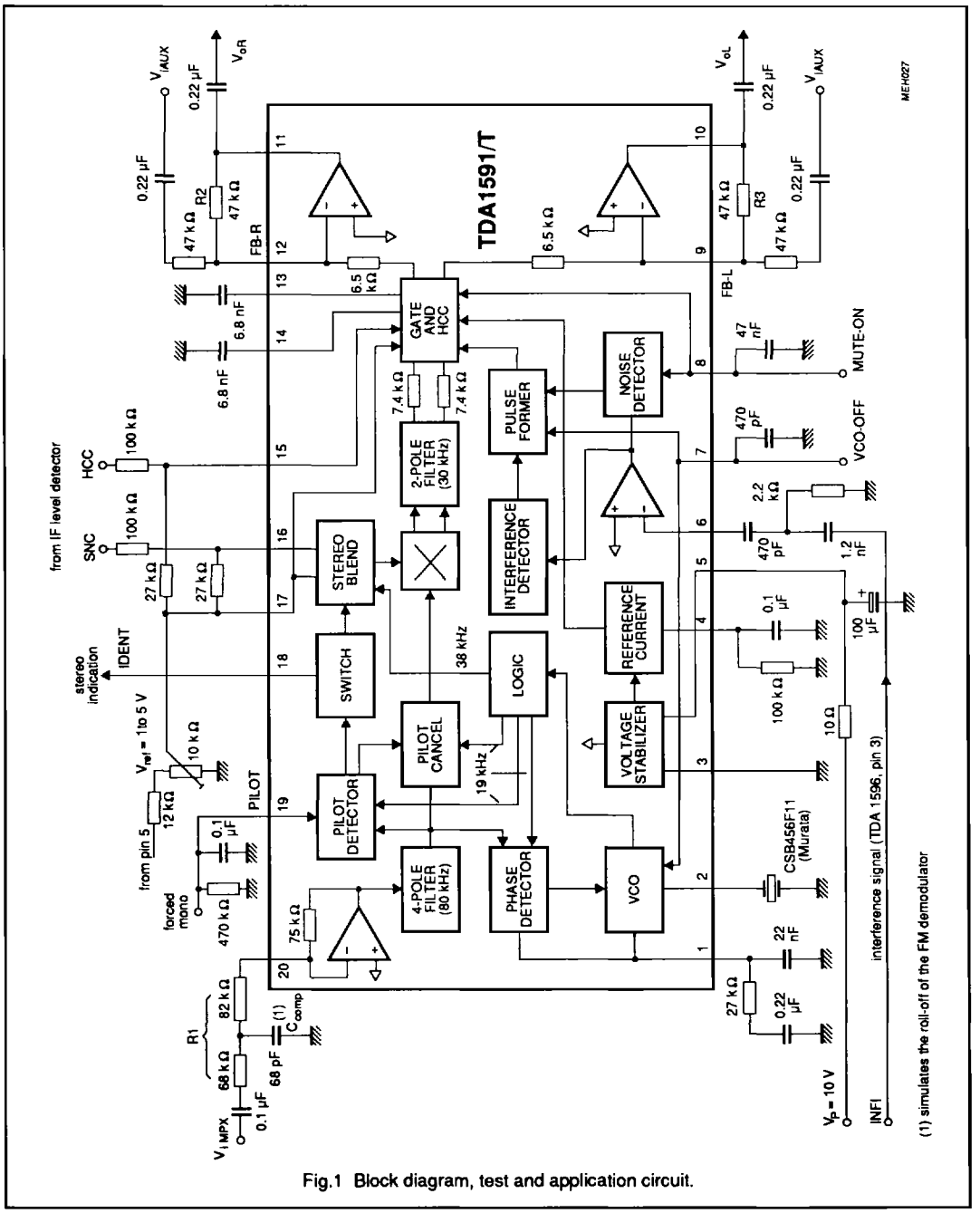

Fig.1 Block diagram, test and application circuit.

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	High Cut Control input for de-emphasis control
SNC	16	stereo blend input (Stereo Noise Controller)
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_{iMPX}	20	MPX input signal from IF demodulator

PIN CONFIGURATION

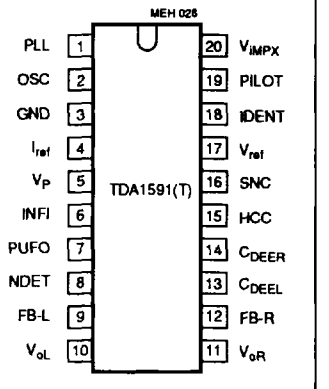

Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

By changing the value of the input resistor R1 the MPX input can be adapted to the level of the FM demodulator output (Fig.3). The total gain of the stereo decoder is applicable by variation of the feedback resistors R2 and R3 (Fig.1 and 4).

In mute and VCO-OFF position the output amplifier 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 (Fig.5).

For High Cut Control (HCC), dependent on an analog input signal, the de-emphasis time constant can be changed to higher values (Fig.7 and 8).

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

Limiting values in accordance with the Absolute Maximum 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 temperatur range	–55	150	°C
T_{amb}	operating ambient temperatur range	–40	+85	°C
V_{ESD}	electrostatic handling* for all pins	-	±800	V

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

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage range (pin 5)		7.5	10	12	V
I_P	supply current		-	12	-	mA
Stereo decoder						
V_i	MPX input signal at pin 20 (peak-to-peak value)		-	1.7	-	V
ΔV_i	overdrive margin of MPX input signal	THD = 1%	3	-	-	dB
V_o	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
$V_{10,11}$	DC output voltage (pins 10 and 11)		3.3	3.8	4.3	V
$R_{10,11}$	output resistance		-	130	-	Ω
α	channel separation, see Fig.6	pin 16 open-circuit	-	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
α_2	intermodulation for f_{spur} = 1 kHz	f_{mod} = 10 kHz, note 1	-	60	-	dB
α_3		f_{mod} = 13 kHz	-	58	-	dB
$\alpha_{57\ VF}$	traffic radio (VWF)	f = 57 kHz, note 2	-	70	-	dB
α_{67}	SCA (subsidiary communications authorization)	f = 67 kHz, note 3	70	-	-	dB
α_{114}	ACI (adjacent channel interference)	f = 114 kHz, note 4	-	80	-	dB
α_{190}		f = 190 kHz	-	70	-	dB
RR	ripple rejection with ripple on V_P	f = 100 Hz $V_{ripple\ (rms)}$ = 100 mV	-	35	-	dB
VCO (pin 2)						
f_{osc}	oscillator frequency (ceramic resonator)		-	456	-	kHz
f_{osc}	frequency range of free running oscillator		452	-	460	kHz
$\Delta f/f$	capture and holding range		-	1	-	%
V_7	VCO-OFF voltage (pin 7)		0	-	0.7	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Mono/stereo control (pins 16, 17 and 19)						
$V_{i\,pil}$	pilot threshold voltage for automatic switching by pilot input voltage (RMS value)					
	for stereo on		-	24	30	mV
	for stereo off		8	20	-	mV
H	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}), see Fig.5	α = 6 dB	-	–85	-	mV
		α = 26 dB	-	–32	-	mV
	pilot indicator logic level output					
V_{18}	LOW voltage (pin 18)	I_{18} = –1 mA	-	250	400	mV
I_{18}	HIGH current	V_{18} = 10 V	-	-	1	µA
Muting (pin 8)						
V_8	mute attenuation (pin 8)	V_8 < 0.4 V	-	80	-	dB
		V_8 > 4 V	-	-	0.2	dB
$V_{10,\,11}$	DC offset voltage	after muting	-	-	±500	mV
High Cut Control HCC (pin 15)						
T_{deem}	control range of de-emphasis	(Fig.7 and 8)				
	for European standard	C_{deem} = 6.8 nF	-	50	150	µs
	for US 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 T_{deem}	-	0	-	mV
		upper value T_{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_{suppr}	AF suppression time, pulse with		-	40	-	µs
$I_{13,14}$	input offset current (pins 13 and 14)	during AF suppression time	-	20	-	nA

Notes to the characteristics

1. Intermodulation suppression (BFC: Beat Frequency Components)

$$\alpha_2 = \frac{V_{o(signal)}\ (\text{at } 1\ \text{kHz})}{V_{o(spurious)}\ (\text{at } 1\ \text{kHz})} \quad ; \quad f_s = (2 \times 10\ \text{kHz}) - 19\ \text{kHz}$$

$$\alpha_3 = \frac{V_{o(signal)}\ (\text{at } 1\ \text{kHz})}{V_{o(spurious)}\ (\text{at } 1\ \text{kHz})} \quad ; \quad f_s = (3 \times 13\ \text{kHz}) - 38\ \text{kHz}$$

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

2. Traffic radio (V.F.) suppression

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

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

3. SCA (Subsidiary Communication Authorization)

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

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

4. ACI (Adjacent Channel Interference)

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

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

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

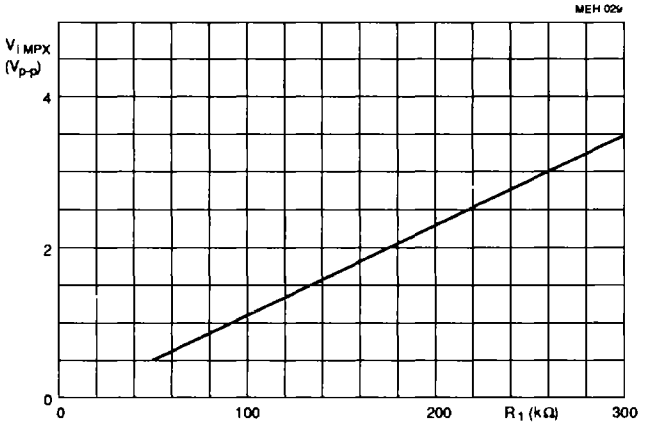

Fig.3 Input signal as a function of serial input resistor R1.

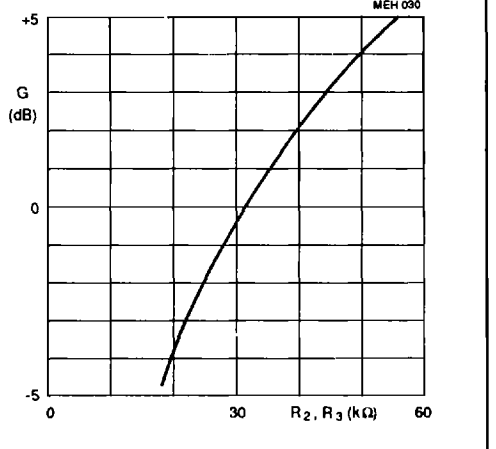

Fig.4 Over all signal gain as a function of feedback resistors R2 and R3 (R1 = 150 kΩ).

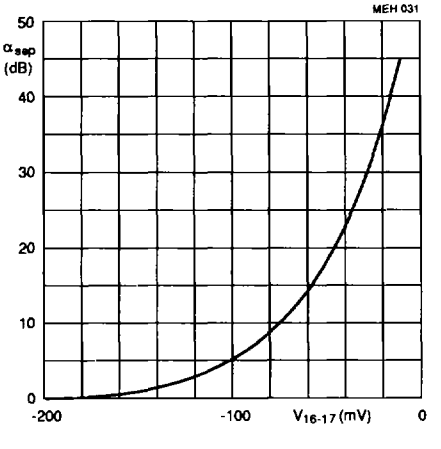

Fig.5 Stereo blend characteristic (SNC).

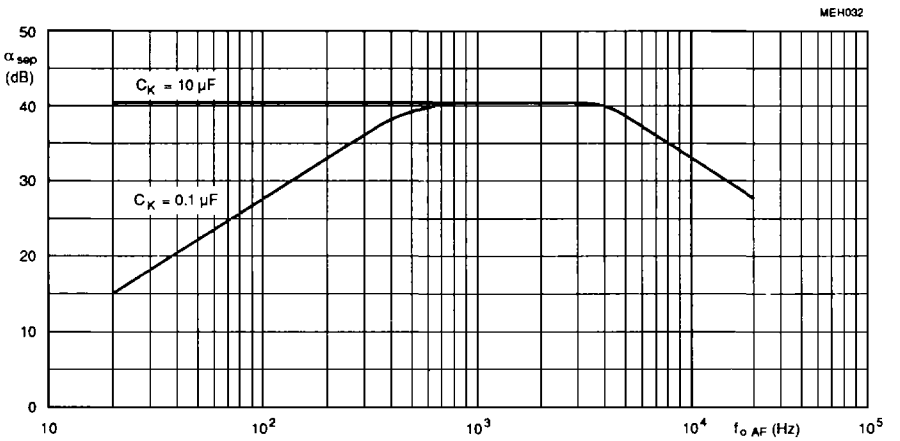

Fig.6 Channel separation as a function of audio frequency.

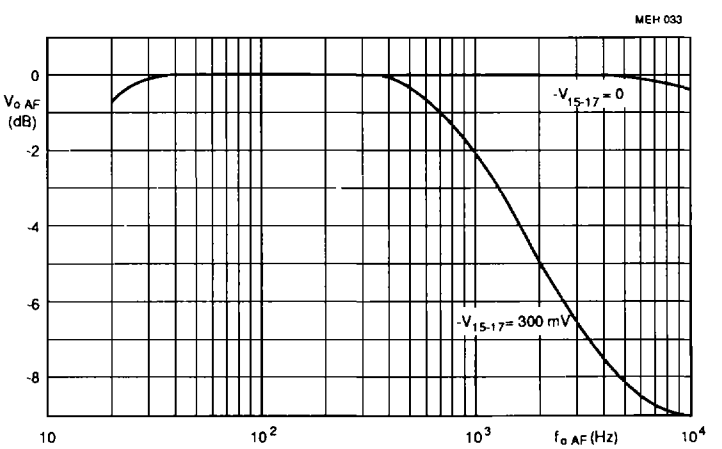

Fig.7 High Cut Control (HCC) as a function of audio frequency.

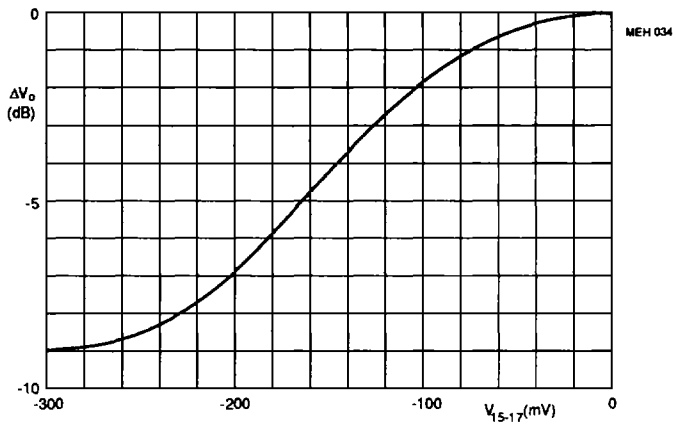

Fig.8 High Cut Control (HCC) at f_{mod} = 10 kHz.

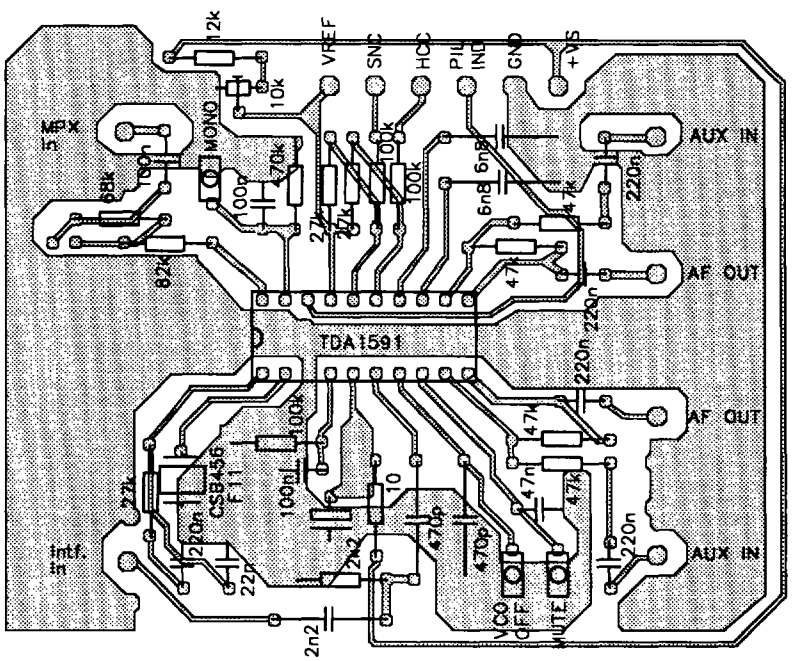

Fig.9 TDA1591(T) testboard (component side).