

INTERFERENCE AND NOISE SUPPRESSION CIRCUIT FOR FM RECEIVERS

GENERAL DESCRIPTION

The TDA1001B is a monolithic integrated circuit for suppressing interference and noise in FM mono and stereo receivers.

Features

- Active low-pass and high-pass filters
- Interference pulse detector with adjustable and controllable response sensitivity
- Noise detector designed for FM i.f. amplifiers with ratio detectors or quadrature detectors
- Schmitt trigger for generating an interference suppression pulse
- Active pilot tone generation (19 kHz)
- Internal voltage stabilization

QUICK REFERENCE DATA

Supply voltage (pin 9)	V_p	typ.	12 V
Supply current (pin 9)	I_p	typ.	14 mA
A.F. input signal handling (pin 1) (peak-to-peak value)	$V_{i(p-p)}$	typ.	1 V
Input resistance (pin 1)	R_i	min.	35 k Ω
Voltage gain (V_{1-16}/V_{6-16})	G_v	typ.	0,5 dB
Total harmonic distortion	THD	typ.	0,25 %
Bandwidth	B	typ.	70 kHz
Suppression pulse threshold voltage (peak value); $R_{13} = 0$	$V_{i(tr)OM}$	typ.	19 mV
Suppression pulse duration	t_s	typ.	27 μ s
Supply voltage range (pin 9)	V_p		7,5 to 16 V
Operating ambient temperature range	T_{amb}		-30 to +80 $^{\circ}$ C

PACKAGE OUTLINE

TDA1001B: 16-lead DIL; plastic (SOT38).

TDA1001BT: 16-lead mini-pack; plastic (SO16; SOT109A).

TDA1001B
TDA1001BT

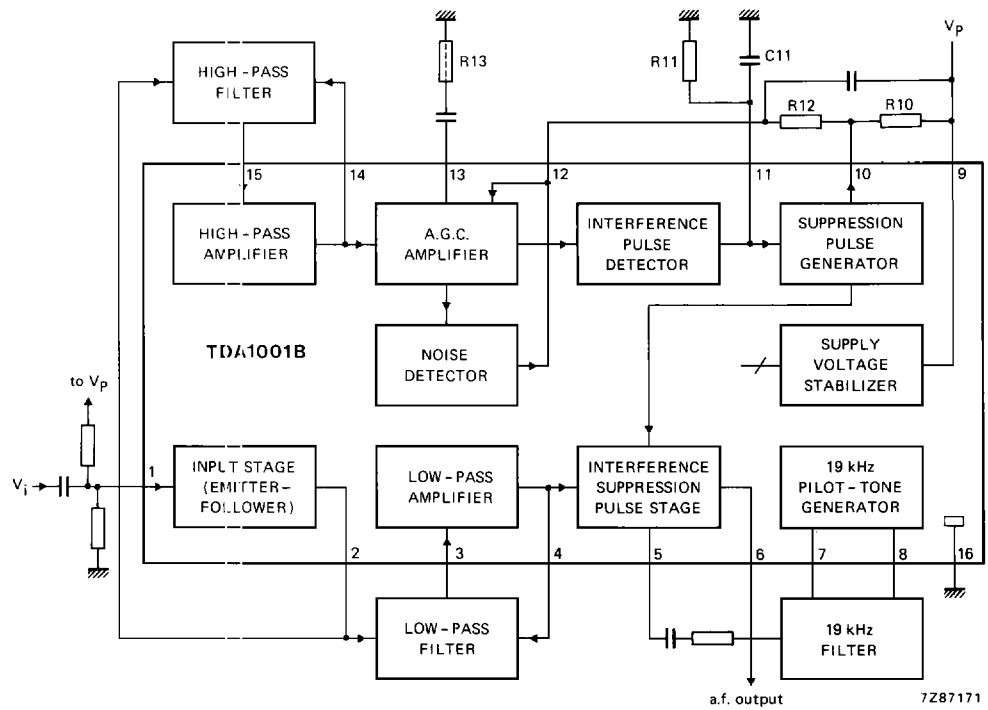


Fig. 1 Block diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage (pin 9)	V_p	max.	18 V
Input voltage (pin 1)	V_{1-16}	max.	V_p V
Output current (pin 6)	I_6	max.	1 mA
	$-I_6$	max.	15 mA
Total power dissipation			see derating curves Fig. 2
Storage temperature range	T_{stg}		-65 to +150 °C
Operating ambient temperature range	T_{amb}		-30 to +80 °C

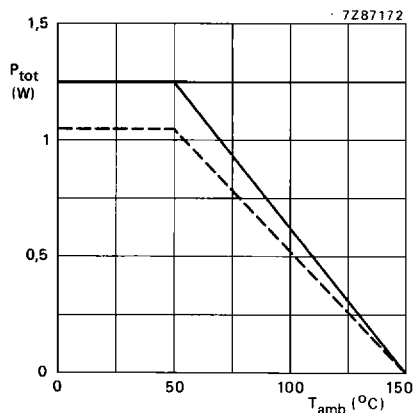


Fig. 2 Power derating curves.

- in plastic DIL (SOT-38) package (TDA1001B)
- - - - - in plastic mini-pack (SO-16; SOT-109A) package (TDA1001BT); mounted on a ceramic substrate of 50 x 15 x 0,7 mm.

CHARACTERISTICS

$V_P = 12\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$; measured in Fig. 4; unless otherwise specified

parameter	symbol	min.	typ.	max.	unit
Input stage					
Input impedance (pin 1) $f = 40\text{ kHz}$	$ Z_{i1} $	—	45	—	$k\Omega$
Input resistance (pin 1) with pin 2 not connected	R_{i1}	—	600	—	$k\Omega$
Input bias current (pin 1) $V_{1-16} = 4,8\text{ V}$	I_{i1}	—	6	15	μA
Output resistance (pin 2) unloaded	R_{o2}	low-ohmic			
Internal emitter resistance	R_{2-16}	—	5,6	—	$k\Omega$
Low-pass amplifier					
Input resistance (pin 3)	R_{i3}	10	—	—	$M\Omega$
Input bias current (pin 3)	I_{i3}	—	—	7	μA
Output resistance (pin 4)	R_{o4}	—	—	5	Ω
Voltage gain (V_4/V_3)	$G_{v4/3}$	—	1,1	—	
Suppression pulse stage					
Input offset current at pin 5 during the suppression time t_s	I_{io5}	—	50	200	nA
Output stage					
Output resistance (pin 6)	R_{o6}	low-ohmic			
Internal emitter resistance	R_{6-16}	—	6	—	$k\Omega$
Current gain (I_5/I_6)	$G_{i5/6}$	—	85	—	dB
Pilot tone generation (19 kHz)					
Input impedance (pin 8)	$ Z_{i8} $	—	—	1	Ω
Output impedance (pin 7) pin 8 open	$ Z_{o7} $	150	—	—	$k\Omega$
Output bias current (pin 7)	I_{o7}	0,7	1	1,3	mA
Current gain (I_7/I_8)	$G_{i7/8}$	—	3	—	
High-pass amplifier					
Input resistance (pin 15)	R_{i15}	10	—	—	$M\Omega$
Input bias current (pin 15)	I_{i15}	—	—	7	μA
Output resistance (pin 14)	R_{o14}	—	—	5	Ω
Voltage gain (V_{14}/V_{15})	$G_{v14/15}$	—	1,4	—	

parameter	symbol	min.	typ.	max.	unit
A.G.C. amplifier; interference and noise detectors					
Internal resistance (pins 13 and 14)	R_{13-14}	1,5	2,0	2,5	$k\Omega$
Operational threshold voltage (uncontrolled); peak value (pin 14) of the interference pulse detector	$\pm V_{14int m}$	—	15	—	mV
of the noise detector	$\pm V_{14n m}$	—	6,5	—	mV
Output voltage (peak value; pin 11)	V_{11-16M}	5,2	5,8	6,4	V
Output control current (pin 12) (peak value)	I_{12M}	150	200	250	μA
Output bias current (pin 12)	I_{o12}	—	2,5	6	μA
Input threshold voltage for onset of control (pin 12) ($V_{i(tr)O} + 3$ dB)	V_{12-9}	360	425	500	mV
	or:	—	$0,66V_{BE}$	—	mV
Suppression pulse generation (Schmitt trigger)					
Switching threshold (pin 11)					
1: gate disabled	V_{11-16}	—	3,2	—	V
2: gate enabled	V_{11-16}	—	2,0	—	V
Switching hysteresis	ΔV_{11-16}	—	1,2	—	V
Input offset current (pin 11)	I_{io11}	—	—	100	nA
Output current (pin 10) gate disabled; peak value	I_{o10M}	0,6	1	1,4	mA
Reverse output current (pin 10)	I_{R10}	—	—	2	μA
Sensitivity (pin 10)	V_{10-16}	2,5	—	—	V

APPLICATION INFORMATION

$V_p = 12\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$; $f = 1\text{ kHz}$; measured in Fig. 4; unless otherwise specified

parameter	symbol	min.	typ.	max.	unit
Supply voltage range (pin 9)	V_p	7,5	12	16	V
Quiescent supply current (pin 9)	I_p	10	14	18	mA
Signal path					
D.C. input voltage (pin 1)	V_{1-16}	—	4,5	—	V
Input impedance (pin 1); $f = 40\text{ kHz}$	$ Z_{i1} $	35	—	—	$k\Omega$
D.C. output voltage (pin 6)	V_{6-16}	2,4	2,8	—	V
Output resistance (pin 6)	R_{o6}	low-ohmic			
Voltage gain (V_6/V_1)	$G_{V6/1}$	0	0,5	1	dB
−3 dB point of low-pass filter	$f_{(-3dB)}$	—	70	—	kHz
Sensitivity for THD < 0,5% (peak-to-peak value)	$V_{i(p-p)}$	1,2	1,8	—	V
Residual interference pulse after suppression (see Fig. 3); pin 7 to ground; $V_{i(tr)M} = 100\text{ mV}$; (peak-to-peak value)	$V_{6-16(p-p)}$	—	—	3	mV
Interference suppression at $R_{13} = 0$; notes 5 and 6; $V_{i(rms)} = 30\text{ mV}$; $f = 19\text{ kHz}$ (sinewave); $V_{i(tr)M} = 60\text{ mV}$; $f_r = 400\text{ Hz}$	α_{int}	20	30	—	dB
Interference processing					
Input signal at pin 1; output signal at pin 10					
Suppression pulse threshold voltage; control function OFF (pin 9 connected to pin 12); r.m.s. value; note 1					
measured with sinewave input signal $f = 120\text{ kHz}$; $-V_{10-9} > 1\text{ V}$ at $R_{13} = 0\ \Omega$	$V_{i(tr)rms}$	8	11	14	mV
at $R_{13} = 2,7\text{ k}\Omega$	$V_{i(tr)rms}$	18	28,5	40	mV
voltage difference for safe triggering/ non-triggering (r.m.s. value)	$\Delta V_{i(rms)}$	—	1	—	mV
measured with interference pulses $f = 400\text{ Hz}$ (see Fig. 3); peak value at $R_{13} = 0\ \Omega$	$V_{i(tr)M}$	—	19	—	mV
at $R_{13} = 2,7\text{ k}\Omega$	$V_{i(tr)M}$	—	45	—	mV
Suppression pulse duration (note 2)	t_s	24	27	30	μs

parameters	symbol	min.	typ.	max.	unit
Noise threshold feedback control (notes 1 and 3)					
Noise input voltage (r.m.s. value) f = 120 kHz sinewave					
for $V_{12-g} = 300$ mV at $R_{13} = 0 \Omega$	$V_{ni(rms)}$	2,3	3,3	4,3	mV
at $R_{13} = 2,7$ k Ω	$V_{ni(rms)}$	—	3,2	—	mV
for $V_{12-g} = 425$ mV ($V_{i(tr)O} + 3$ dB) at $R_{13} = 0 \Omega$	$V_{ni(rms)}$	—	7,3	—	mV
at $R_{13} = 2,7$ k Ω	$V_{ni(rms)}$	—	16,5	—	mV
for $V_{12-g} = 560$ mV ($V_{i(tr)O} + 20$ dB) at $R_{13} = 0 \Omega$	$V_{ni(rms)}$	33	45	57	mV
at $R_{13} = 2,7$ k Ω	$V_{ni(rms)}$	—	107	—	mV
Amplification control voltage by interference intensity (note 4)					
$V_{i(rms)} = 50$ mV; f = 19 kHz;					
$V_{i(tr)M} = 300$ mV; r.m.s. value					
at repetition frequency $f_r = 1$ kHz	$V_{o6(rms)}$	49	—	56	mV
at repetition frequency $f_r = 16$ kHz	$V_{o6(rms)}$	45	—	65	mV

Notes to application information

1. The interference suppression and noise feedback control thresholds can be determined by R13 or a capacitive voltage divider at the input of the high-pass filter and they are defined by the following formulae:

$$V_{i(tr)} = (1 + R13/R_S) \times V_{i(tr)O} \text{ in which } R_S = 2 \text{ k}\Omega;$$

$$V_{ni} = (1 + R13/R_S) \times V_{niO} \text{ in which } R_S = 2 \text{ k}\Omega.$$

2. The suppression pulse duration is determined by C11 = 2,2 nF and R11 = 6,8 k Ω .
3. The characteristic of the noise feedback control is determined by R12 (and R10).
4. The feedback control of the interference suppression threshold at higher repetition frequencies is determined by R10 (and R12).
5. The 19 kHz generator can be adjusted with R7.16 (and R7.8). Adjustment is not required if components with small tolerances are used e.g. $\Delta R < 1\%$ and $\Delta C < 2\%$.
6. Measuring conditions:

The peak output noise voltage ($V_{no m}$, CCITT filter) shall be measured at the output with a de-emphasing time $T = 50 \mu s$ ($R = 5 \text{ k}\Omega$, $C = 10 \text{ nF}$); the reference value of 0 dB is V_{Oint} with the 19 kHz generator short-circuited (pin 7 grounded).

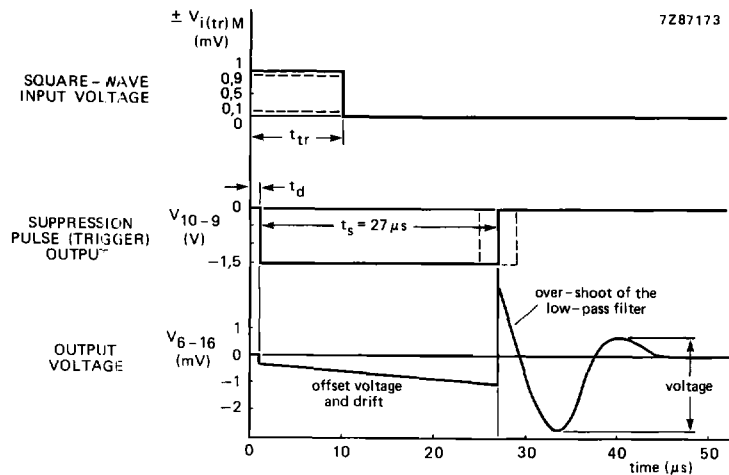


Fig. 3 Measuring signal for interference suppression; at the input (pin 1) a square-wave is applied with a duration of $t_{tr} = 10 \mu s$ and with rise and fall times $t_r = t_f = 10 \text{ ns}$.

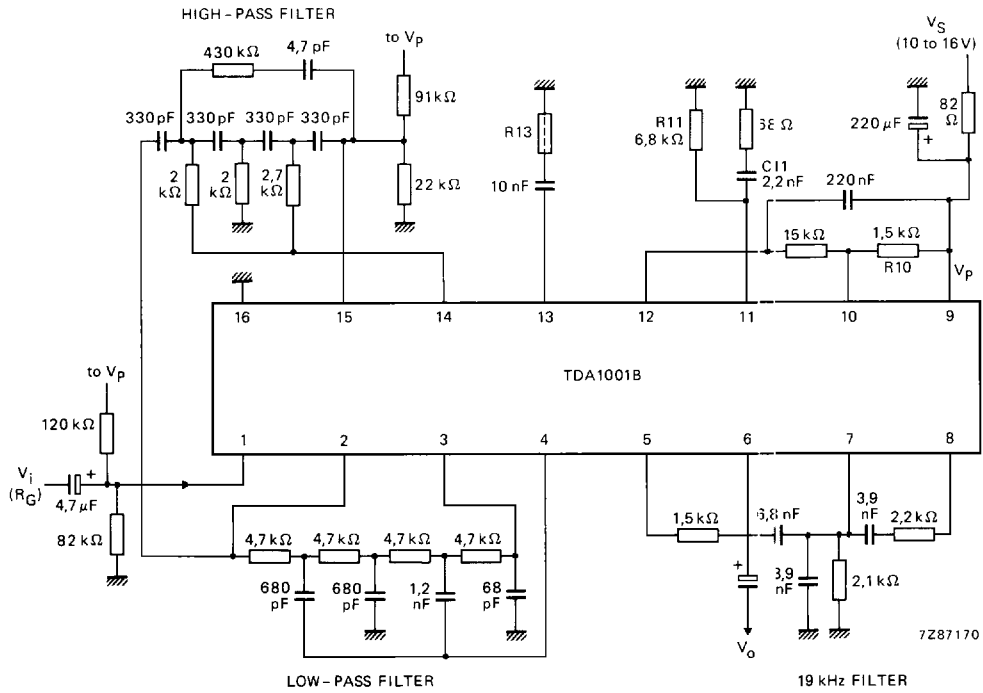


Fig. 4 Application circuit diagram.