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INTEGRATED CIRCUITS

DATA SHEET

TDA9801
Single standard VIF-PLL demodulator and FM-PLL detector

Product specification
Supersedes data of 1998 May 06
File under Integrated Circuits, IC02

1999 Aug 26

Philips Semiconductors

PHILIPS

FEATURES

- Suitable for negative vision modulation
- Applicable for IF frequencies of 38.9, 45.75 and 58.75 MHz
- Gain controlled wide-band Vision Intermediate Frequency (VIF) amplifier (AC-coupled)
- True synchronous demodulation with active carrier regeneration (ultra-linear demodulation, good intermodulation figures, reduced harmonics and excellent pulse response)
- Peak sync pulse AGC
- Video amplifier to match sound trap and sound filter
- AGC output voltage for tuner with fixed resistor for takeover point setting
- AFC detector without extra reference circuit
- Alignment-free FM-PLL detector with high linearity
- Stabilizer circuit for ripple rejection and to achieve constant output signals
- 5 to 9 V positive supply voltage range
- Low power consumption of 300 mW at 5 V supply voltage.

GENERAL DESCRIPTION

The TDA9801(T) is a monolithic integrated circuit for vision and sound IF signal processing in TV and VTR sets and multimedia front-ends.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA9801	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
TDA9801T	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage	note 1	4.5	5.0	9.9	V
I_P	supply current	V_P = 9 V	52	61	70	mA
$V_{i(sens)(VIF)(rms)}$	sensitivity of VIF input signal (RMS value)	–1 dB video at output; f_{PC} = 38.9 or 45.75 MHz	–	50	90	μV
$V_{i(max)(rms)}$	maximum input voltage (RMS value)	+1 dB video at output; f_{PC} = 38.9 or 45.75 MHz	70	150	–	mV
G_{IF}	IF gain control	f_{PC} = 38.9 or 45.75 MHz	64	70		dB
$V_{o(CVBS)(p-p)}$	CVBS output voltage (peak-to-peak value)	V_P = 5 V	1.7	2.0	2.3	V
$B_{v(-3dB)}$	–3 dB video bandwidth	C_L < 20 pF; R_L > 1 kΩ	6	8	–	MHz
S/N_W	weighted signal-to-noise ratio	V_P = 5 V; note 2	56	60	–	dB
$\alpha_{IM(0.92/1.1)}$	intermodulation attenuation at f = 0.92 or 1.1 MHz	for BLUE	56	62	–	dB
$\alpha_{IM(2.76/3.3)}$	intermodulation attenuation at f = 2.76 or 3.3 MHz	for BLUE	56	62	–	dB
$\alpha_{H(sup)}$	harmonics suppression in video signal	note 3	35	40	–	dB
$V_{o(AF)(max)(rms)}$	maximum output AF signal handling voltage (RMS value)	THD < 1.5%	0.8	–	–	V
T_{amb}	ambient temperature		–20	–	+70	°C

Notes

1. Values of video and sound parameters can be decreased at V_P = 4.5 V.
2. S/N is the ratio of the black-to-white amplitude to the black level noise voltage (RMS value) at pin CVBS. B = 5 MHz weighted in accordance with *"CCIR 567"* at a source impedance of 50 Ω.
3. Measurements taken with SAW filter G1962; VSB modulation; f_{video} > 0.5 MHz; loop bandwidth BL = 60 kHz.

BLOCK DIAGRAM

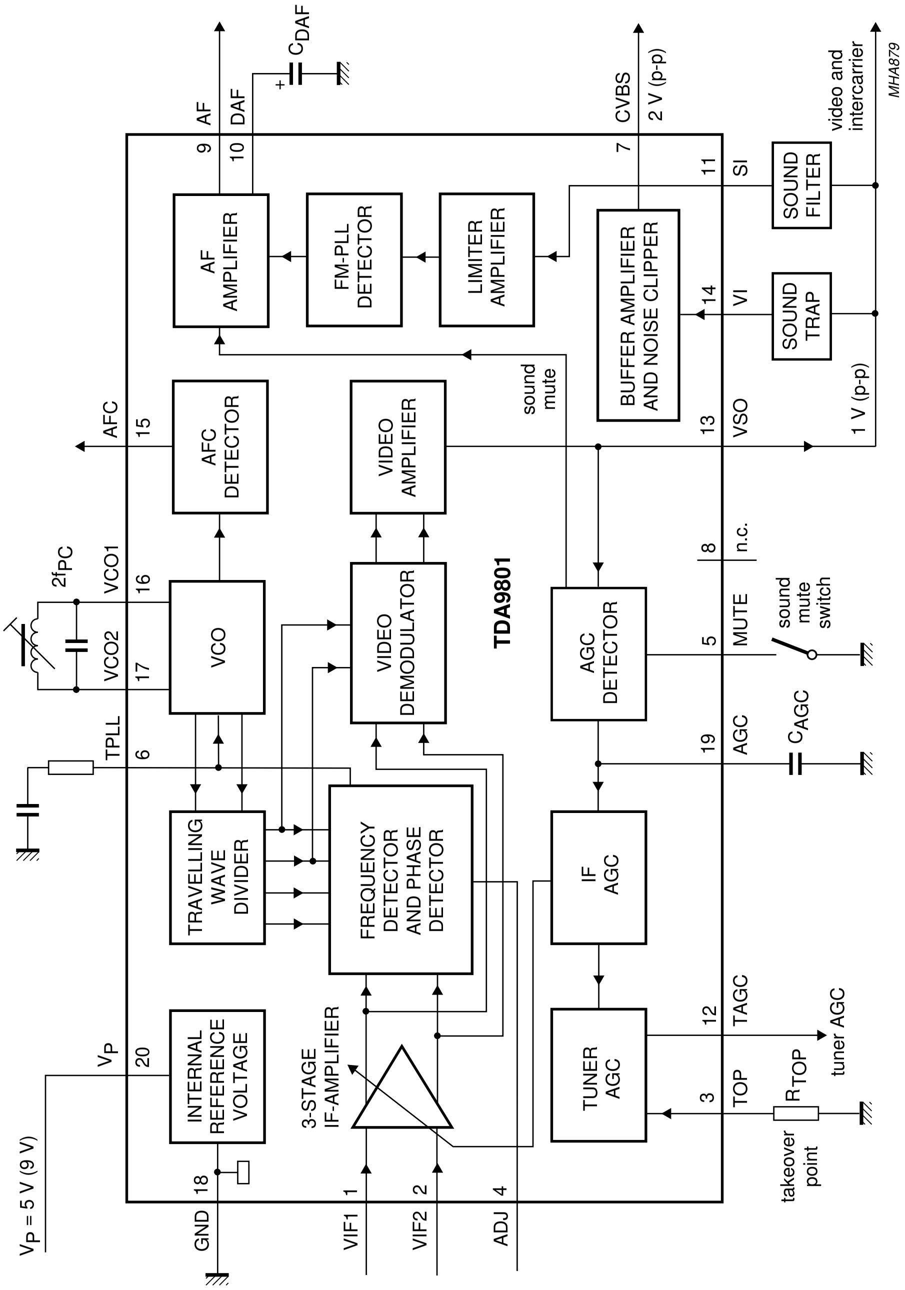


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
VIF1	1	VIF differential input 1
VIF2	2	VIF differential input 2
TOP	3	tuner AGC TakeOver Point (TOP) connection
ADJ	4	phase adjust connection
MUTE	5	sound mute switch connection
TPLL	6	PLL time constant connection
CVBS	7	CVBS (positive) video output
n.c.	8	not connected
AF	9	AF output
DAF	10	AF amplifier decoupling capacitor connection
SI	11	sound intercarrier input
TAGC	12	tuner AGC output
VSO	13	video and sound intercarrier output
VI	14	buffer amplifier video input
AFC	15	AFC output
VCO1	16	VCO1 reference circuit for $2f_{PC}$
VCO2	17	VCO2 reference circuit for $2f_{PC}$
GND	18	ground supply (0 V)
AGC	19	AGC detector capacitor connection
V_P	20	supply voltage (+5 V)

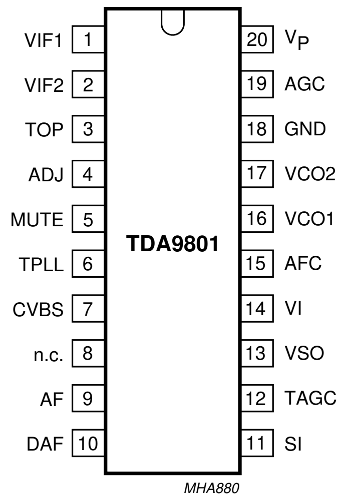


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

3-stage IF amplifier

The VIF amplifier consists of three AC-coupled differential amplifier stages (see Fig.1). Each differential stage comprises a feedback network controlled by emitter degeneration.

AGC detector, IF AGC and tuner AGC

The automatic control voltage to maintain the video output signal at a constant level is generated in accordance with the transmission standard. Since the TDA9801(T) is suitable for negative modulation only the peak sync pulse level is detected.

The AGC detector charges and discharges capacitor C_{AGC} to set the IF amplifier and tuner gain. The voltage on capacitor C_{AGC} is transferred to an internal IF control signal, and is fed to the tuner AGC to generate the tuner AGC output current on pin TAGC (open-collector output). The tuner AGC takeover point level is set at pin TOP. This allows the tuner to be matched to the SAW filter in order to achieve the optimum IF input level.

Frequency detector and phase detector

The VIF amplifier output signal is fed into a frequency detector and into a phase detector. During acquisition the frequency detector produces a DC current proportional to the frequency difference between the input and the VCO signal. After frequency lock-in the phase detector produces a DC current proportional to the phase difference between the VCO and the input signal. The DC current of either frequency detector or phase detector is converted into a DC voltage via the loop filter which controls the VCO frequency.

Video demodulator

The true synchronous video demodulator is realized by a linear multiplier which is designed for low distortion and wide bandwidth. The vision IF input signal is multiplied with the ‘in phase’ component of the VCO output.
The demodulator output signal is fed via an integrated low-pass filter (f_g = 12 MHz) for suppression of the carrier harmonics to the video amplifier.

VCO, AFC detector and travelling wave divider

The VCO operates with a symmetrically connected reference LC circuit, operating at the double vision carrier frequency. Frequency control is performed by an internal variable capacitor diode.

The voltage to set the VCO frequency to the actual double vision carrier frequency is also amplified and converted for the AFC output current.

The VCO signal is divided-by-2 with a Travelling Wave Divider (TWD) which generates two differential output signals with a 90 degree phase difference independent of the frequency.

Video amplifier

The composite video amplifier is a wide bandwidth operational amplifier with internal feedback. A nominal positive video signal of 1 V (p-p) is present at pin VSO.

Buffer amplifier and noise clipper

The input impedance of the 7 dB wideband CVBS buffer amplifier (with internal feedback) is suitable for ceramic sound trap filters. Pin CVBS provides a positive video signal of 2 V (p-p). Noise clipping is provided internally.

Sound demodulation

LIMITER AMPLIFIER

The FM sound intercarrier signal is fed to pin SI and through a limiter amplifier before it is demodulated.
The result is high sensitivity and AM suppression.
The limiter amplifier consists of 7 stages which are internally AC-coupled in order to minimizing the DC offset.

FM-PLL DETECTOR

The FM-PLL demodulator consists of an RC oscillator, loop filter and phase detector. The oscillator frequency is locked on the FM intercarrier signal from the limiter amplifier. As a result of this locking, the RC oscillator is frequency modulated. The modulating voltage (AF signal) is used to control the oscillator frequency. By this, the FM-PLL operates as an FM demodulator.

AF AMPLIFIER

The audio frequency amplifier with internal feedback is designed for high gain and high common-mode rejection. The low-level AF signal output from the FM-PLL demodulator is amplified and buffered in a low-ohmic audio output stage. An external decoupling capacitor C_{DAF} removes the DC voltage from the audio amplifier input.

By using the sound mute switch (pin MUTE) the AF amplifier is set in the mute state.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_P	supply voltage	I_P = 70 mA; T_{amb} = 70 °C; maximum chip temperature			
		125 °C for TDA9801	0	9.9	V
		128 °C for TDA9801T	0	9.9	V
V_n	voltage on				
	pins VIF1, VIF2, AFC and AGC		0	V_P	V
	pin TAGC		–	13.2	V
$t_{sc(max)}$	maximum short-circuit time	to ground or V_P	–	10	s
T_{stg}	storage temperature		–25	+150	°C
T_{amb}	ambient temperature		–20	+70	°C
V_{es}	electrostatic handling voltage	note 1	–300	+300	V

Notes

1. Machine model class B (L = 2.5 μH).

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		
	TDA9801		73	K/W
	TDA9801T		85	K/W

CHARACTERISTICS

V_P = 5 V; T_{amb} = 25 °C; see Table 1 for input frequencies and picture-to-sound carrier ratios; $V_{i(VIF)(rms)}$ = 10 mV (sync pulse level); IF input from 50 Ω via broadband transformer 1 : 1; DSB video modulation; 10% residual carrier; video signal in accordance with *"CCIR, line 17"* or *"NTC-7 Composite"*; measurements taken in test circuit of Fig.12; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply: pin V_P						
V_P	supply voltage	note 1	4.5	5.0	9.9	V
I_P	supply current	V_P = 5 V	51	60	70	mA
		V_P = 9 V	52	61	70	mA
Vision IF input: pins VIF1 and VIF2						
$V_{i(sens)(VIF)(rms)}$	sensitivity of VIF input voltage (RMS value)	–1 dB video at output				
		f_{PC} = 38.9 or 45.75 MHz	–	50	90	μV
		f_{PC} = 58.75 MHz	–	60	100	μV
$V_{i(max)(rms)}$	maximum VIF input voltage (RMS value)	1 dB video at output				
		f_{PC} = 38.9 or 45.75 MHz	70	150	–	mV
		f_{PC} = 58.75 MHz	80	160	–	mV
V_I	DC input voltage		3.0	3.4	3.8	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
ΔV_{int}	internal IF amplitude difference between picture and sound carrier	within AGC range	–	0.7	1	dB
G_{IF}	IF gain control	see Fig.6				
		f_{PC} = 38.9 or 45.75 MHz	64	70	–	dB
		f_{PC} = 58.75 MHz	62	68	–	dB
$B_{IF(-3dB)}$	–3 dB IF bandwidth	upper limit cut-off frequency	70	100	–	MHz
$R_{i(dif)}$	differential input resistance	note 2	1.7	2.2	2.7	kΩ
$C_{i(dif)}$	differential input capacitance	note 2	1.2	1.7	2.5	pF
VCO and video demodulator; note 3						
$f_{VCO(max)}$	maximum VCO frequency	for carrier regeneration; $f = 2f_{PC}$	125	130	–	MHz
$\Delta f_{VCO}/\Delta T$	VCO frequency variation with temperature	free running; I_{AFC} = 0; note 4	–	–	$\pm 20 \times 10^{-6}$	K^{-1}
$V_{VCO(rms)}$	VCO voltage swing (RMS value)	measured between pins VCO1 and VCO2				
		f_{PC} = 38.9 MHz	–	120	–	mV
		f_{PC} = 45.75 MHz	–	100	–	mV
		f_{PC} = 58.75 MHz	–	80	–	mV
$f_{cr(PC)}$	picture carrier capture frequency range	negative	1.4	1.8	–	MHz
		positive	1.4	1.8	–	MHz
t_{acq}	acquisition time	BL = 60 kHz; note 5	–	–	30	ms
$V_{i(sens)(VIF)(rms)}$	sensitivity of VIF input (RMS value)	PLL still locked; maximum IF gain; note 6	–	50	90	μV
		C/N = 10 dB; note 7	–	100	140	μV
$I_{offset(TPLL)}$	offset current at pin TPLL	note 8	–	–	±2.0	μA
Video amplifier output (sound carrier off): pin VSO						
$V_{o(VSO)(p-p)}$	VSO output voltage (peak-to-peak value)	see Fig.5				
		V_P = 5 V	0.90	1.0	1.25	V
		V_P = 9 V	0.95	1.1	1.25	V
V_{sync}	sync pulse voltage level		1.35	1.5	1.6	V
$V_{v(clu)}$	upper video clipping voltage level		$V_P - 1.1$	$V_P - 1$	–	V
$V_{v(cll)}$	lower video clipping voltage level		–	0.7	0.9	V
$V_{o(intc)(rms)}$	intercarrier output voltage (RMS value)	sound carrier on; note 9	–	32	–	mV
R_o	output resistance	note 2	–	–	10	Ω
I_{bias}	DC bias current	for internal emitter-follower at pin VSO	1.8	2.5	–	mA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{o(sink)(max)}$	maximum AC and DC output sink current		1.4	–	–	mA
$I_{o(source)(max)}$	maximum AC and DC output source current		2.0	–	–	mA
$B_{v(-3dB)}$	–3 dB video bandwidth	C_L < 50 pF; R_L > 1 kΩ	7	10	–	MHz
$\alpha_{H(sup)}$	harmonics suppression in video signal	C_L < 50 pF; R_L > 1 kΩ; note 10	35	40	–	dB
$PSRR_{VSO}$	power supply ripple rejection at pin VSO	see Fig.7	32	35	–	dB
Buffer amplifier and noise clipper input: pin VI						
R_i	input resistance		2.6	3.3	4.0	kΩ
C_i	input capacitance		1.4	2	3.0	pF
V_I	DC input voltage	pin VI not connected	1.5	1.8	2.1	V
Buffer amplifier output: pin CVBS						
G_v	voltage gain	note 11	6	7	7.5	dB
$B_{v(-3dB)}$	–3 dB video bandwidth	C_L < 20 pF; R_L > 1 kΩ	8	11	–	MHz
$V_{o(v)(p-p)}$	video output voltage (peak-to-peak value)	sound carrier off; see Fig.12	1.7	2.0	2.3	V
$V_{v(clu)}$	upper video clipping voltage level		3.9	4.0	–	V
$V_{v(cll)}$	lower video clipping voltage level		–	1.0	1.1	V
V_{sync}	sync pulse voltage level		–	1.35	–	V
R_o	output resistance		–	–	10	Ω
I_{bias}	DC bias current	internal emitter-follower at pin CVBS	1.8	2.5	–	mA
$I_{o(sink)(max)}$	maximum AC and DC output sink current		1.4	–	–	mA
$I_{o(source)(max)}$	maximum AC and DC output source current		2.4	–	–	mA
Measurements from VIF inputs to CVBS output (330 Ω connected between pins VSO and VI, sound carrier off)						
$V_{o(CVBS)(p-p)}$	CVBS output voltage (peak-to-peak value)	V_P = 5 V	1.7	2.0	2.3	V
		V_P = 9 V	1.8	2.2	2.6	V
$\Delta V_{o(CVBS)}$	deviation of CVBS output voltage	at B/G standard				
		50 dB gain control	–	–	0.5	dB
		30 dB gain control	–	–	0.1	dB
$\Delta V_{o(bl)}$	black level tilt	gain variation; note 12	–	–	1	%
G_{dif}	differential gain	*“CCIR, line 330”* or *“NTC-7 Composite”*	–	2	5	%
φ_{dif}	differential phase	*“CCIR, line 330”* or *“NTC-7 Composite”*	–	2	4	deg
$B_{v(-3dB)}$	–3 dB video bandwidth	C_L < 20 pF; R_L > 1 kΩ	6	8	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
S/N_W	weighted signal-to-noise ratio	see Fig.3; note 13				
		V_P = 5 V	56	60	–	dB
		V_P = 9 V	55	59	–	dB
$\alpha_{IM(0.92/1.1)}$	intermodulation attenuation at f = 0.92 or 1.1 MHz	see Fig.4; note 14				
		for BLUE	56	62	–	dB
		for YELLOW	58	64	–	dB
$\alpha_{IM(2.76/3.3)}$	intermodulation attenuation at f = 2.76 or 3.3 MHz	see Fig.4; note 14				
		for BLUE	56	62	–	dB
		for YELLOW	57	63	–	dB
$\Delta V_{r(PC)(rms)}$	residual picture carrier (RMS value)	fundamental wave	–	1	10	mV
		harmonics	–	1	10	mV
$\alpha_{H(sup)}$	harmonics suppression in video signal	note 10	35	40	–	dB
$PSRR_{CVBS}$	power supply ripple rejection at pin CVBS	see Fig.7	25	28	–	dB
AGC detector output: pin AGC						
t_{res}	response time	at 50 dB amplitude step of input signal				
		for increasing step	–	1	10	ms
		for decreasing step	–	50	100	ms
I_{ch}	charging current	note 12	0.82	1.1	1.38	mA
I_{dch}	discharging current		16	22	28	μA
V_o	gain control output voltage	see Fig.6				
		maximum gain	0	–	–	V
		minimum gain	–	–	V_P – 0.7	V
Tuner AGC						
$V_{i(VIF)(rms)}$	VIF input voltage (RMS value)	for onset tuner takeover point				
		minimum level with R_{TOP} = 22 kΩ	–	–	5	mV
		maximum level with R_{TOP} = 0 Ω	50	–	–	mV
$QV_{i(VIF)(rms)}$	accuracy level of tuner takeover point (RMS value)	R_{TOP} = 13 kΩ; I_{TAGC} = 0.4 mA	7	–	14	mV
$\Delta V_{i(VIF)}/\Delta T$	variation of tuner takeover point with temperature	I_{TAGC} = 0.4 mA	–	0.02	0.06	dB/K
ΔG_{IF}	IF slip by automatic gain control	tuner gain current from 20 to 80%	–	6	8	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
TUNER AGC OUTPUT: PIN TAGC						
V_{max}	maximum voltage	from external source; note 2	–	–	13.2	V
V_{sat}	saturation voltage	I_{TAGC} = 1.7 mA	–	–	0.2	V
I_{sink}	sink current	see Fig.6				
		no tuner gain reduction	–	0.1	0.3	μA
		maximum tuner gain reduction	1.7	2.0	2.6	mA
AFC detector: pin AFC; note 15						
CR_{stps}	control steepness	equal to $\Delta I_{AFC}/\Delta f_{VIF}$ see Table 2				
		f_{PC} = 38.9 MHz	–0.5	–0.75	–1.0	μA/kHz
		f_{PC} = 45.75 MHz	–0.4	–0.65	–0.9	μA/kHz
		f_{PC} = 58.75 MHz	–0.3	–0.55	–0.8	μA/kHz
$\Delta f/\Delta T$	frequency variation with temperature	I_{AFC} = 0; note 4	–	–	$\pm 20 \times 10^6$	K^{-1}
V_o	output voltage	without external components; see Fig.8				
		upper limit	V_P – 0.5	V_P – 0.3	–	V
		lower limit	–	0.3	0.5	V
I_o	output current	see Fig.8				
		source current	150	200	250	μA
		sink current	150	200	250	μA
$\Delta I_{r(v)(p-p)}$	residual video modulation current (peak-to-peak value)		–	20	30	μA
Sound mute switch: pin MUTE; note 16						
V_{IL}	LOW-level input voltage	mute on	0	–	0.8	V
V_{IH}	HIGH-level input voltage	mute off	1.5	–	V_P	V
I_{IL}	LOW-level input current	V_{MUTE} = 0 V	–	–300	–360	μA
α_{mute}	mute attenuation	V_{MUTE} = 0 V	70	80	–	dB
$\Delta V_{offset(MUTE)}$	DC offset voltage at pin MUTE	at switching to mute on state (plop)	–	100	500	mV
FM sound limiter amplifier input: pin SI; note 17						
$V_{i(FM)(rms)}$	FM input voltage (RMS value)	*"CCIR468-4"*				
		S/N = 40 dB; see Fig.10	–	200	300	μV
		α_{AM} = 40 dB; f = 1 kHz; m = 0.3	–	1	–	mV
$V_{i(FM)(max)(rms)}$	maximum FM input handling voltage (RMS value)		200	–	–	mV
V_I	DC input voltage		2.3	2.6	2.9	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
R_i	input resistance	note 2	480	600	720	Ω
α_{AM}	AM suppression	AM signal: f = 1 kHz; m = 0.3; see Fig.9	46	50	–	dB
$f_{res(-3dB)}$	frequency response	–3 dB points of lower and upper limits of IF sound cut-off frequency	3.5	–	10	MHz
FM-PLL sound detector and AF amplifier; note 17						
$f_{cr(PLL)}$	catching range of PLL	upper limit	7	–	–	MHz
		lower limit	–	–	4	MHz
$f_{hr(PLL)}$	holding range of PLL	upper limit	8	–	–	MHz
		lower limit	–	–	3.5	MHz
t_{acq}	acquisition time		–	–	4	μs
Δf_{AF}	audio frequency deviation	THD < 1.5%; note 18	–	–	±50	kHz
$B_{AF(-3dB)}$	–3 dB audio frequency bandwidth		95	120	–	kHz
THD	total harmonic distortion	27 kHz FM deviation; R3 = 0 Ω; note 18	–	0.25	0.5	%
S/N_W	weighted signal-to-noise ratio	*"CCIR 468-4"*; see Fig.10	50	55	–	dB
$\Delta V_{r(SC)(rms)}$	residual sound carrier (RMS value)	fundamental wave and harmonics	–	–	75	mV
AUDIO OUTPUT: PIN AF						
$V_{o(AF)(rms)}$	AF output voltage (RMS value)	Δf_{AF} = ±27 kHz; B/G standard; see Fig.10	400	500	600	mV
		Δf_{AF} = ±25 kHz; M standard; see Fig.10	370	460	550	mV
$V_{o(AF)(max)(rms)}$	maximum AF output handling voltage (RMS value)	THD < 1.5%	0.8	–	–	V
$\Delta V_{o(AF)}/\Delta T$	AF output voltage variation with temperature		–	3×10^{-3}	7×10^{-3}	dB/K
R_o	output resistance	note 2	–	200	–	Ω
R_L	load resistance	AC-coupled at pin AF	2.2	–	–	kΩ
$I_{o(sink/source)(max)}$	maximum sink or source output current	AC and DC	–	–	1.5	mA
V_O	DC output voltage		2.1	2.5	2.9	V
$PSRR_{AF}$	power supply ripple rejection at pin AF	R3 = 0 Ω; see Fig.7; note 18	24	30	–	dB
DECOUPLING CAPACITOR: PIN DAF						
V_{DAF}	DC voltage at decoupling capacitor	voltage depends on VCO frequency; note 19	1.5	–	3.3	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Measurements from VIF input to AF output; notes 20 and 21; see Fig.13						
S/N_W	weighted signal-to-noise ratio	*"CCIR 468-4"*				
		black picture (sync only)	46	52	–	dB
		white picture	42	48	–	dB
		colour bar	40	46	–	dB

Notes

1. Values of video and sound parameters can be decreased at V_P = 4.5 V.
2. This parameter is not tested during production and is only given as application information for designing the television receiver.
3. Conditions for video demodulator:
   a) Loop bandwidth: BL = 60 kHz, natural frequency f_n = 15 kHz, damping factor d = 2, calculated with grey level and FPLL input level
   b) Resonance circuit of VCO: Q_o > 50, see Table 2 for the value of the external capacitor C; C_{VCO} = 8.5 pF, loop voltage is approximately 2.6 V at V_P = 5 V and approximately 2.7 V at V_P = 9 V.
4. Temperature coefficient of the external LC circuit is equal to zero.
5. $V_{i(VIF)(rms)}$ = 10 mV; Δf = 1 MHz (VCO frequency offset related to f_{PC}); white picture video modulation.
6. $V_{i(VIF)}$ signal for nominal video signal.
7. Broadband transformer at the VIF input (see Fig.12). The C/N ratio at the VIF input for 'lock-in' is defined as the VIF input signal (RMS value of sync pulse level) related to a superimposed 5 MHz band-limited white noise signal (RMS value). The video modulation is for white picture.
8. The offset current is measured between pin TPLL and half of the supply voltage (V_P = 2.5 V) under the conditions:
   a) no input signal at VIF inputs
   b) IF amplifier gain at minimum ($V_{AGC} = V_P$) and pin ADJ is left open-circuit.
9. The intercarrier output signal is superimposed to the video signal at pin VSO and can be calculated by the following formula:

$$V_{o(intc)(rms)} = 1.0\ \text{V (p-p)} \times \frac{1}{2\sqrt{2}} \times 10^{\frac{\frac{V_{i(SC)}}{V_{i(PC)}}(\text{dB}) + 6\ \text{dB} \pm 2\ \text{dB}}{20}}$$

   where

   a) 1.0 V (p-p) = video output signal as reference
   b) $\frac{1}{2\sqrt{2}}$ = correction term for RMS value
   c) $\frac{V_{i(SC)}}{V_{i(PC)}}$ (dB) = sound-to-picture carrier ratio at VIF inputs in dB
   d) 6 dB = correction term of internal circuitry
   e) ±2 dB = tolerance of video output and intercarrier output amplitude $V_{o(intc)(rms)}$.
   f) Example for SAW filter G1962:
   sound shelf value = 20 dB,

   $\frac{V_{i(SC)}}{V_{i(PC)}}$ = –27 dB ⇒ $V_{o(intc)(rms)}$ = 32 mV (typical value)

10. Measurements taken with SAW filter G1962; VSB modulation; f_{video} > 0.5 MHz; loop bandwidth BL = 60 kHz.
11. The 7 dB buffer amplifier gain accounts for 1 dB loss in the sound trap. The buffer output signal is typical 2 V (p-p). If no sound trap is applied a resistor of 330 Ω must be connected between pins VSO and VI.
12. The leakage current of C_{AGC} should not exceed 1 μA. Larger currents will increase the tilt.
13. S/N is the ratio of the black-to-white amplitude to the black level noise voltage (RMS value) at pin CVBS. B = 5 MHz weighted in accordance with *"CCIR 567"* at a source impedance of 50 Ω.
14. The intermodulation figures are defined:

    a) $$\alpha_{IM(0.92/1.1)} = 20\ \log\left(\frac{V_o\ \text{at 4.4 (3.58) MHz}}{V_o\ \text{at 0.92 (1.1) MHz}}\right) + 3.6\ \text{dB}$$

    $\alpha_{IM(0.92/1.1)}$ value at 0.92 (or 1.1) MHz referenced to black or white signal

    b) $$\alpha_{IM(2.76/3.3)} = 20\ \log\left(\frac{V_o\ \text{at 4.4 (3.58) MHz}}{V_o\ \text{at 2.76 (3.3) MHz}}\right)$$

    $\alpha_{IM(2.76/3.3)}$ value at 2.76 (or 3.3) MHz referenced to colour carrier.
15. To match the AFC output signal to different tuning systems a current source output is provided (see Fig.8).
16. The no mute state is also valid when pin MUTE is not connected.
17. The input signal is provided by an external generator with 50 Ω source impedance, AC-coupled with a 10 nF capacitor, f_{mod} = 1 kHz and 27 kHz (54% FM deviation) of audio reference. A VIF input signal is not permitted. Pin AGC has to be connected to the supply voltage. Measurements are taken at 50 μs de-emphasis (75 μs at the M standard).
18. To allow a higher frequency deviation, the value of resistor R3 on pin DAF (see Fig.13) has to be increased. However, the AF output signal must not exceed 0.5 V (nominal value) for THD = 0.2%. R3 = 4.7 kΩ provides –6 dB amplification.
19. The leakage current of the 2.2 μF decoupling capacitor should not exceed 100 nA.
20. For all S/N measurements the used vision IF modulator has to meet the following specifications:
    a) Incidental phase modulation for black-to-white jump less than 0.5 degrees
    b) AF performance, measured with the television demodulator AMF2 (audio output, weighted S/N ratio), better than 60 dB (deviation 27 kHz) for white picture video modulation.
21. Input signal according to B/G standard of Table 1:
    a) Input: $V_{i(VIF)(rms)}$ = 10 mV, VSB modulation and 10% residual carrier
    b) Reference: FM deviation = 27 kHz and measurements are taken at 50 μs de-emphasis.

Table 1 Input frequencies and carrier ratios

SYMBOL	DESCRIPTION	STANDARD			UNIT
		B/G	M/N	M	
f_{PC}	picture carrier frequency	38.9	45.75	58.75	MHz
f_{SC}	sound carrier frequency	33.4	41.25	54.25	MHz
PC/SC	picture-to-sound carrier ratio	13	7	7	dB

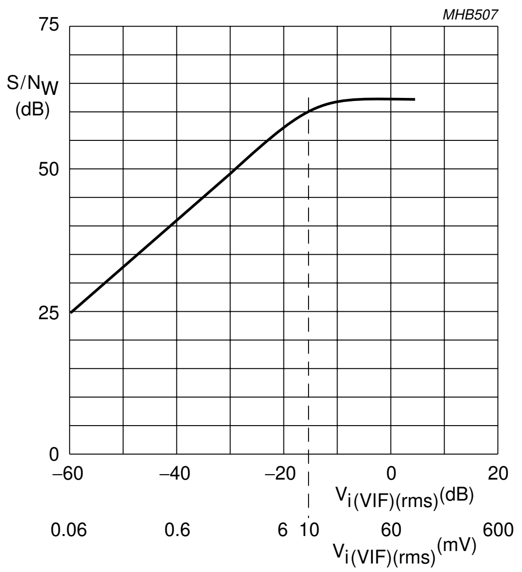
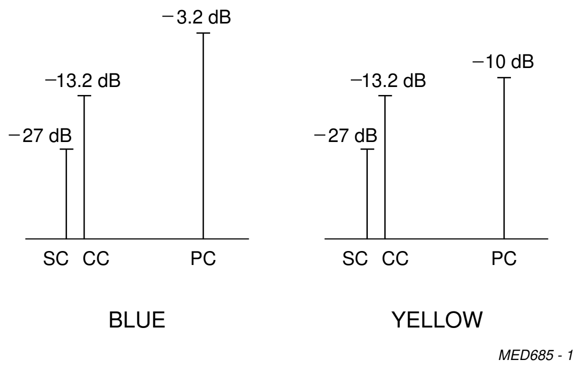


Fig.3 Video output weighted signal-to-noise ratio as a function of the VIF input voltage.



SC = sound carrier level, with respect to sync pulse level.
CC = chrominance carrier level, with respect to sync pulse level.
PC = picture carrier level, with respect to sync pulse level.
Sound shelf attenuation: 20 dB.

Fig.4 Input signal conditions for intermodulation measurements.

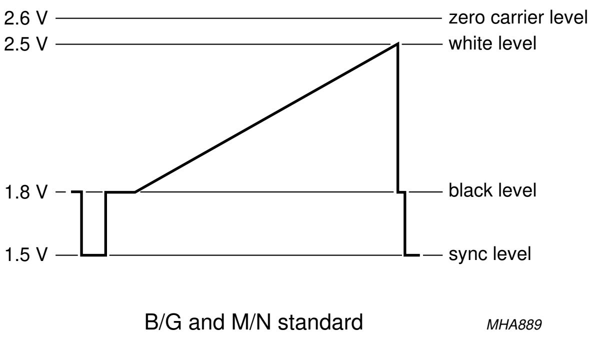
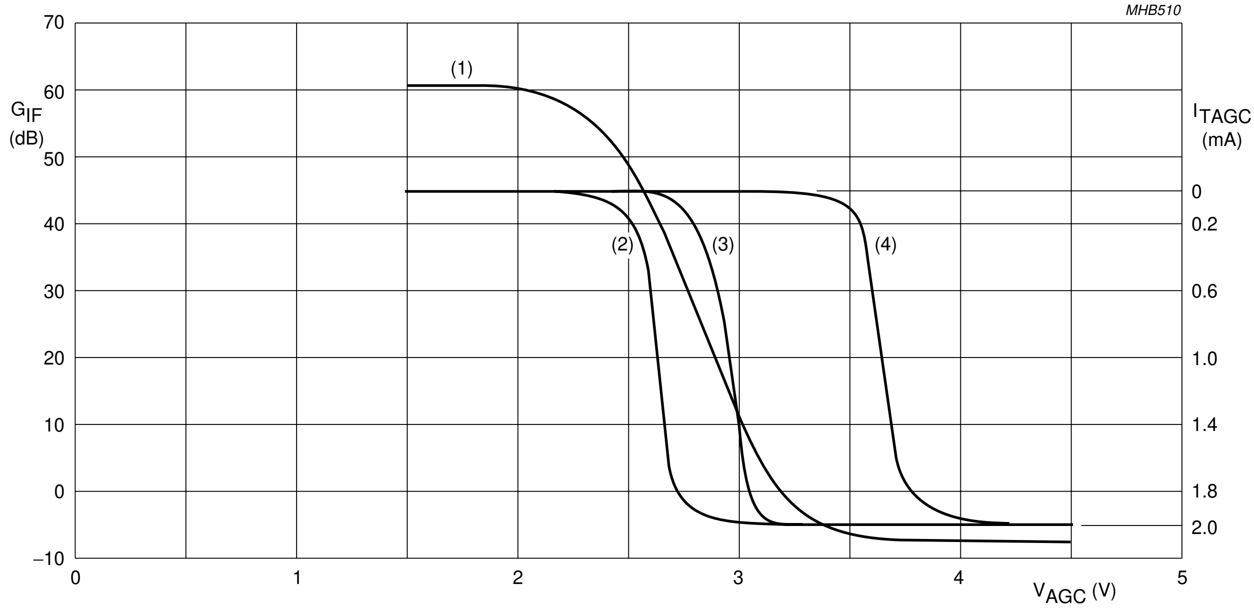


Fig.5 Video signal levels on output pin VSO (sound carrier off).



(1) G_{IF} (IF gain control).
(2) R_{TOP} = 22 kΩ.
(3) R_{TOP} = 13 kΩ.
(4) R_{TOP} = 0 Ω.

Fig.6 IF AGC gain control and tuner AGC output current as a function of the tuner AGC detector voltage.

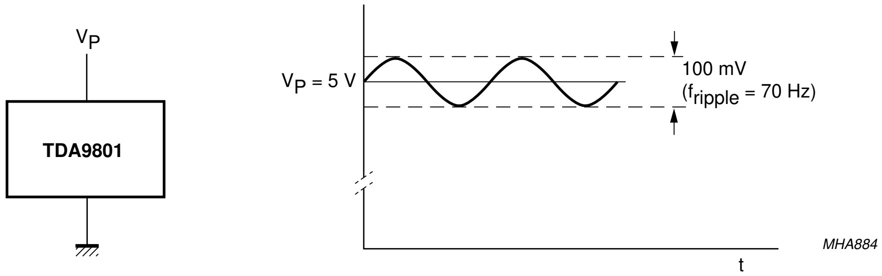
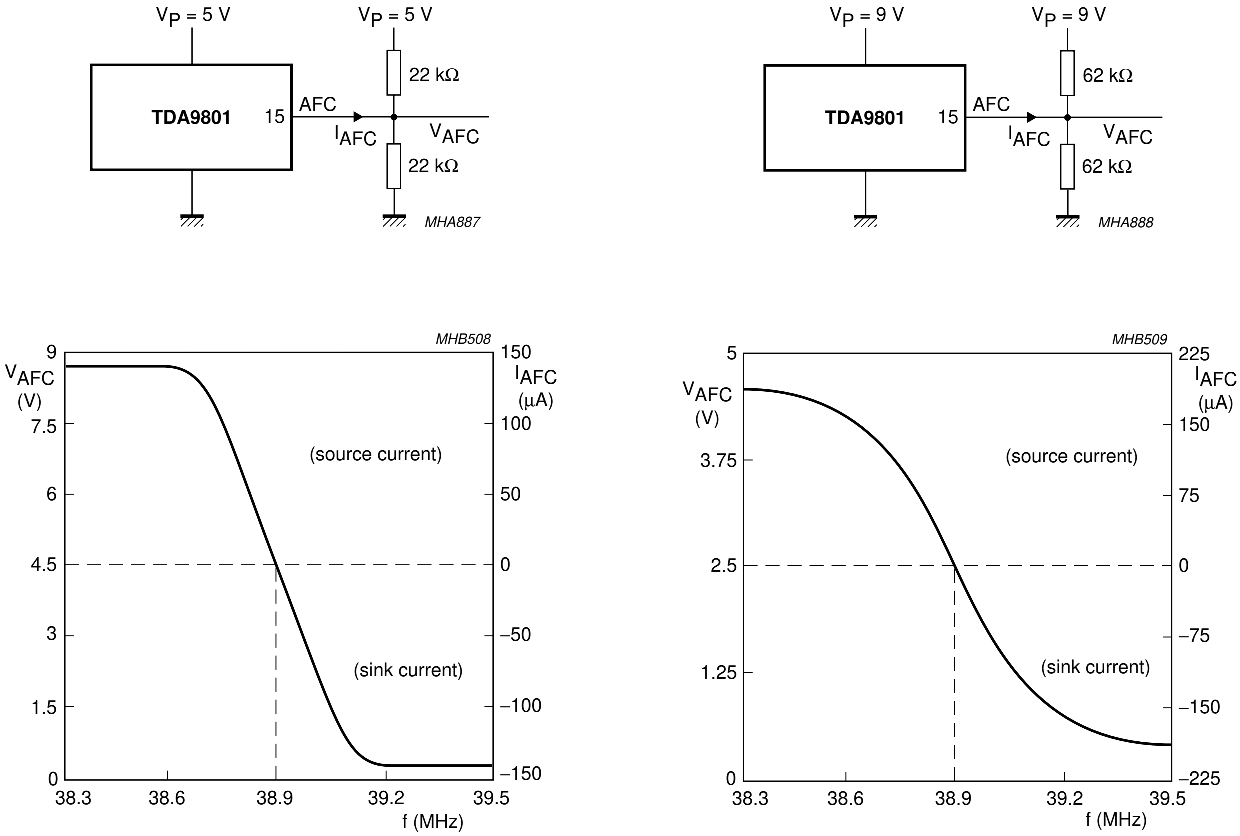


Fig.7 Power supply ripple rejection condition.



a. V_P = 5 V.

b. V_P = 9 V.

Fig.8 AFC measurement conditions and typical characteristics.

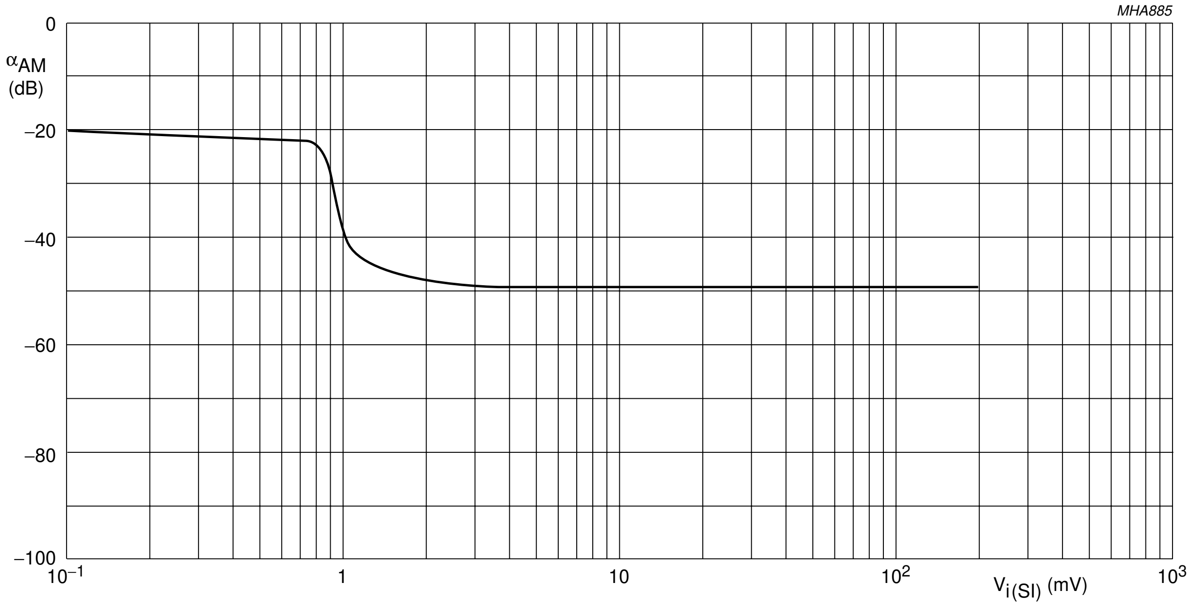
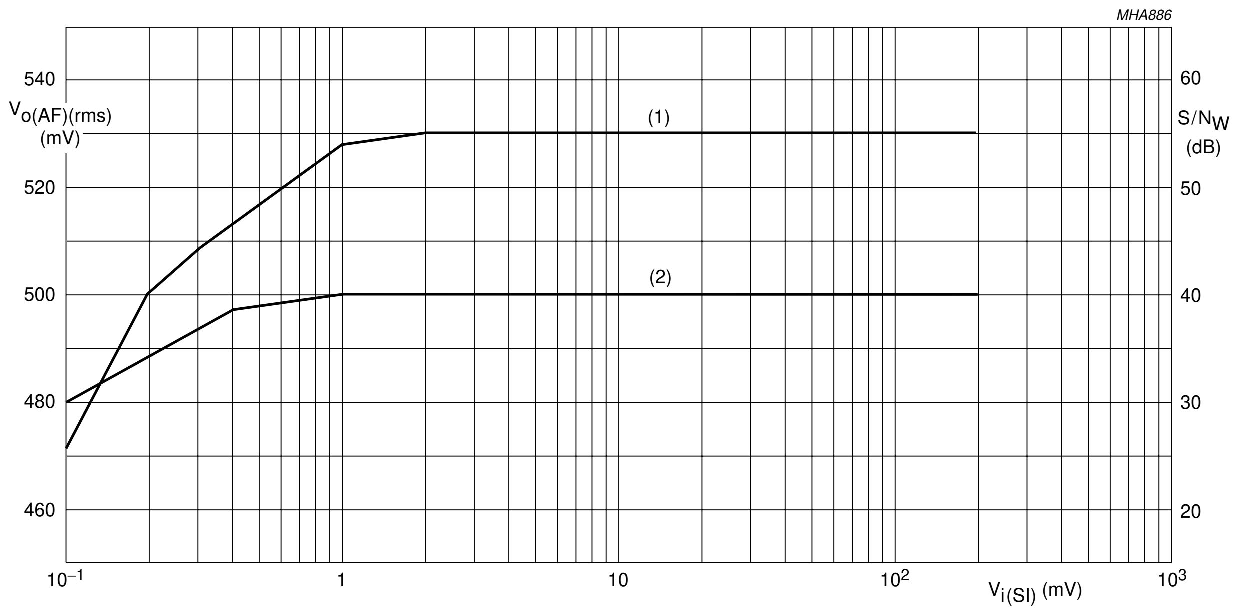


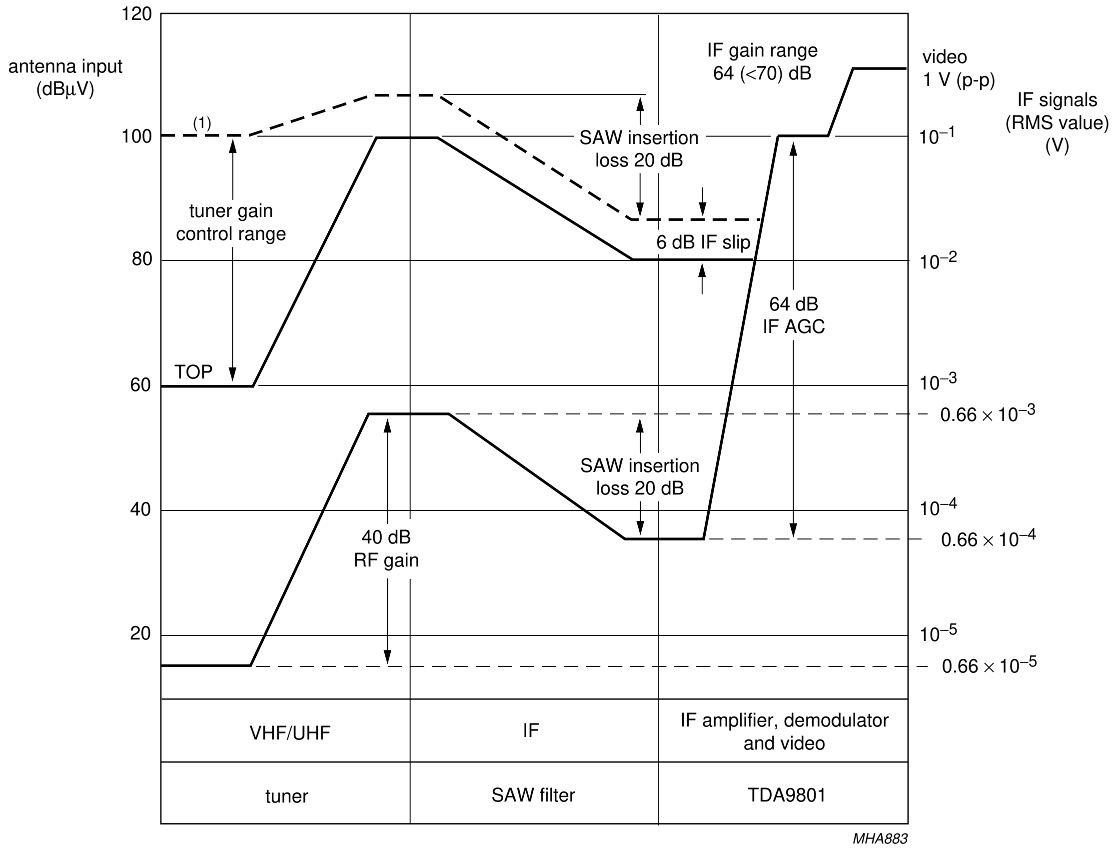
Fig.9 AM suppression (typical value) of the FM limiter amplifier as a function of the input voltage.



(1) Signal-to-noise ratio (weighted).

(2) AF output signal (typical value).

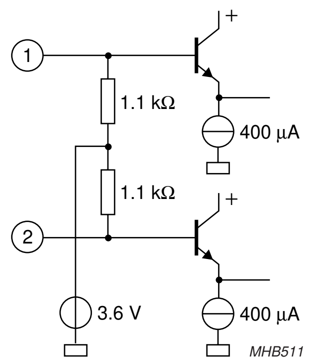
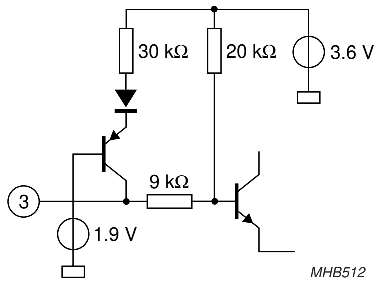
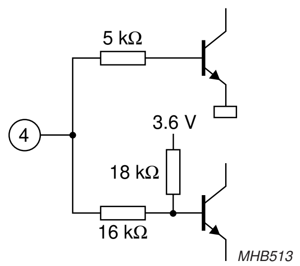
Fig.10 AF output signal and signal-to-noise ratio as a function of the input voltage.

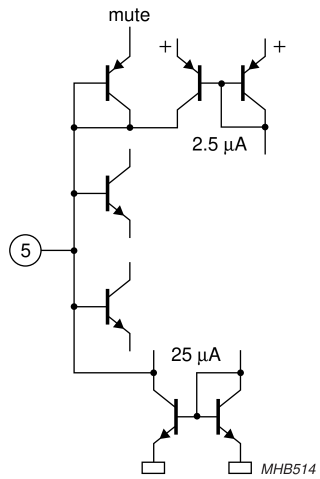


(1) Depends on TOP.

Fig.11 Front-end level diagram.

INTERNAL CIRCUITRY

PIN	SYMBOL	DC VOLTAGE (V)	EQUIVALENT CIRCUIT (WITHOUT ESD PROTECTION CIRCUIT)
1	VIF1	3.4	
2	VIF2	3.4	
3	TOP	0 to 1.9	
4	ADJ	0 to 0.4	

<table>
<tr><th>PIN</th><th>SYMBOL</th><th>DC VOLTAGE (V)</th><th>EQUIVALENT CIRCUIT (WITHOUT ESD PROTECTION CIRCUIT)</th></tr>
<tr><td>5</td><td>MUTE</td><td>0 to V_P</td><td>
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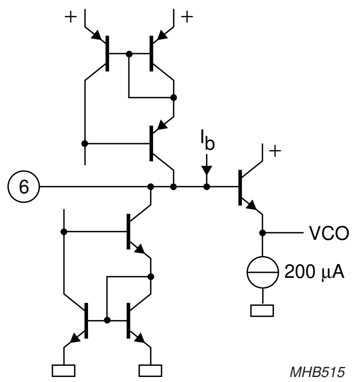
<tr><td>6</td><td>TPLL</td><td>1.5 to 4.0</td><td>
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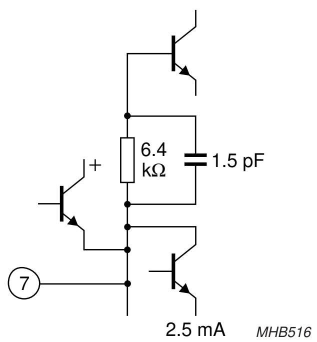
<tr><td>7</td><td>CVBS</td><td>sync pulse level:
1.35</td><td>
</td></tr>
<tr><td>8</td><td>n.c.</td><td>–</td><td></td></tr>
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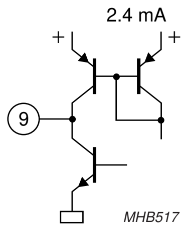
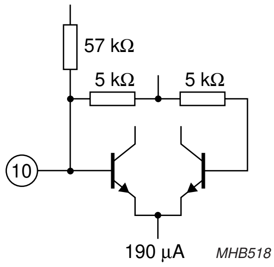
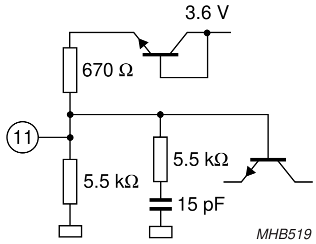
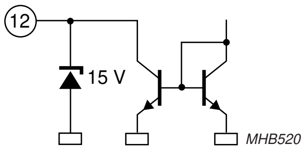
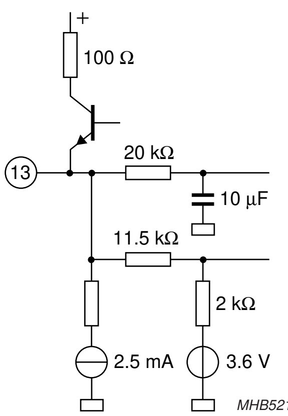
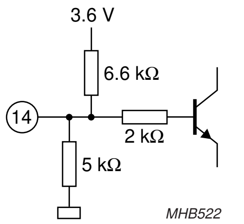
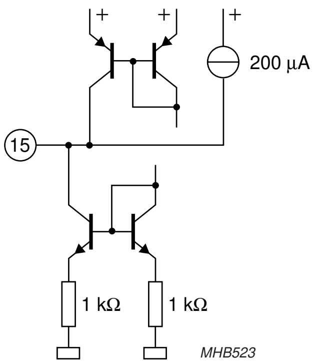
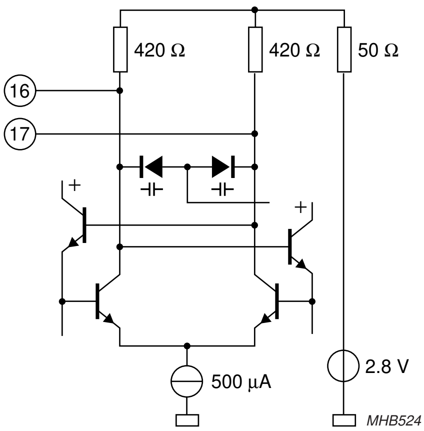
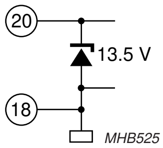
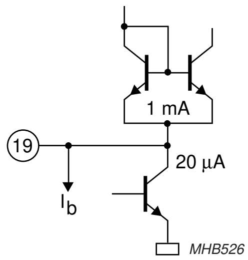
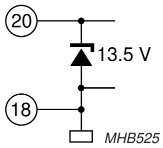
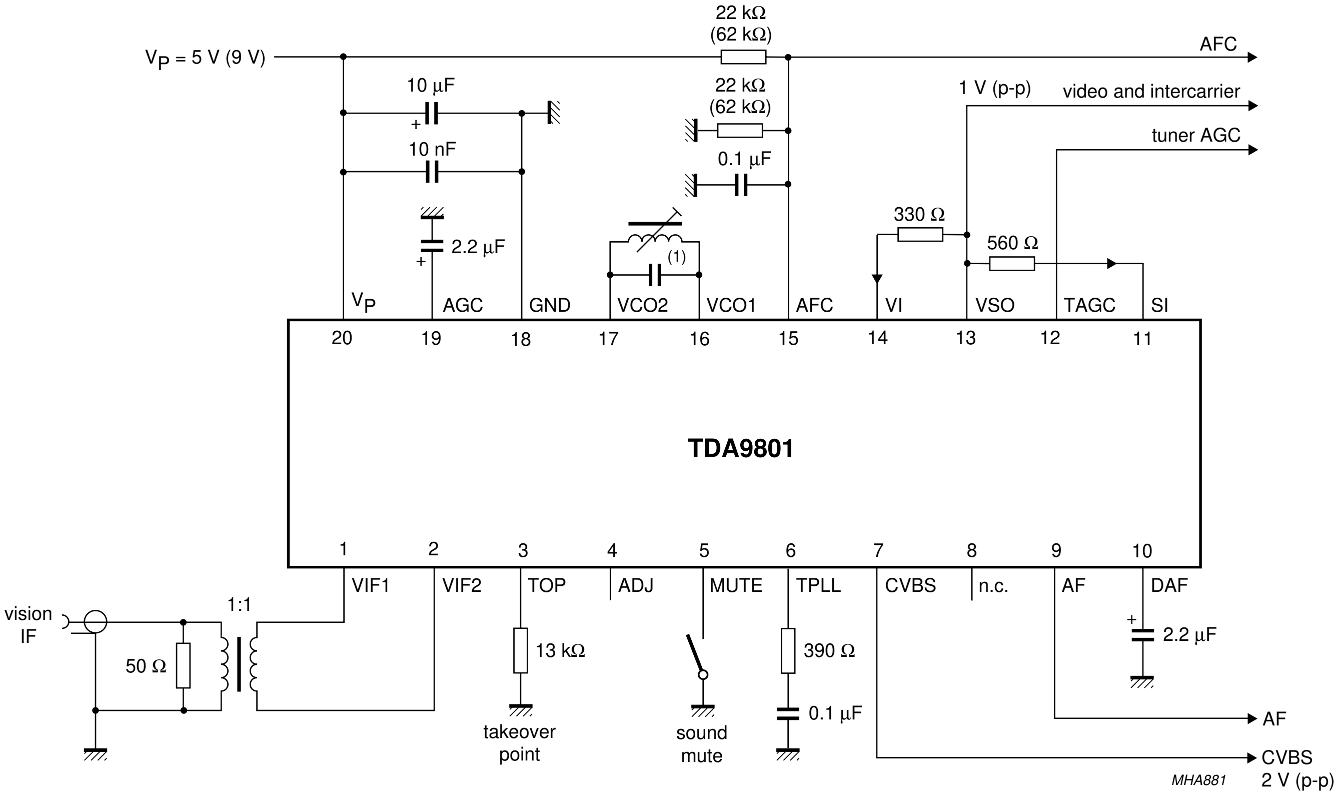
PIN	SYMBOL	DC VOLTAGE (V)	EQUIVALENT CIRCUIT (WITHOUT ESD PROTECTION CIRCUIT)
9	AF	2.5	
10	DAF	1.5 to 3.3	
11	SI	2.6	
12	TAGC	0 to 13.2	
13	VSO	sync pulse level: 1.5	

PIN	SYMBOL	DC VOLTAGE (V)	EQUIVALENT CIRCUIT (WITHOUT ESD PROTECTION CIRCUIT)
14	VI	1.8	
15	AFC	0.3 to V_P – 0.3	
16	VCO1	2.7	
17	VCO2	2.7	

PIN	SYMBOL	DC VOLTAGE (V)	EQUIVALENT CIRCUIT (WITHOUT ESD PROTECTION CIRCUIT)
18	GND	0	
19	AGC	1.5 to 4.0	
20	V_P	V_P	

TEST AND APPLICATION INFORMATION



(1) See Table 2.

Fig.12 Test circuit.