Video-IF and Quasi Parallel Sound Processing

Description

The TDA4472 is an integrated bipolar circuit for video/ sound IF (VIF/SIF) signal processing in TV/VCR and multimedia applications. The circuit processes all TV video IF signals with negative modulation (e.g., B/G standard), and the FM/NICAM sound IF signals.

Features

- 5 V supply voltage; low power consumption

- Active carrier generation by FPLL principle (frequency-phase-locked-loop) for true synchronous demodulation

- Very linear video demodulation, good pulse response and excellent intermodulation figures

- VCO circuit operates at picture carrier frequency

- Alignment-free AFC without external reference circuit, polarity of the AFC curve is switchable

- VIF-AGC with peak sync. detection

- Tuner AGC with adjustable take over point

- Alignment-free quasi parallel sound (QPS) mixer for FM/NICAM sound IF signals

- Intercarrier output signal is gain controlled (necessary for digital sound processing)

- Separate SIF-AGC with average detection

- Two independent SIF inputs

- Package and relevant pinning is compatible with the multistandard version TDA4470, which simplifies the design of an universal IF module

Package: SDIP28, SO28

Ordering Information

Extended Type Number	Package	Remarks
TDA4472-MSD	SDIP28	
TDA4472-MFLG3	SO28	Delivery in taped form

Preliminary Information

Block Diagram

Figure 1. Block diagram

Preliminary Information
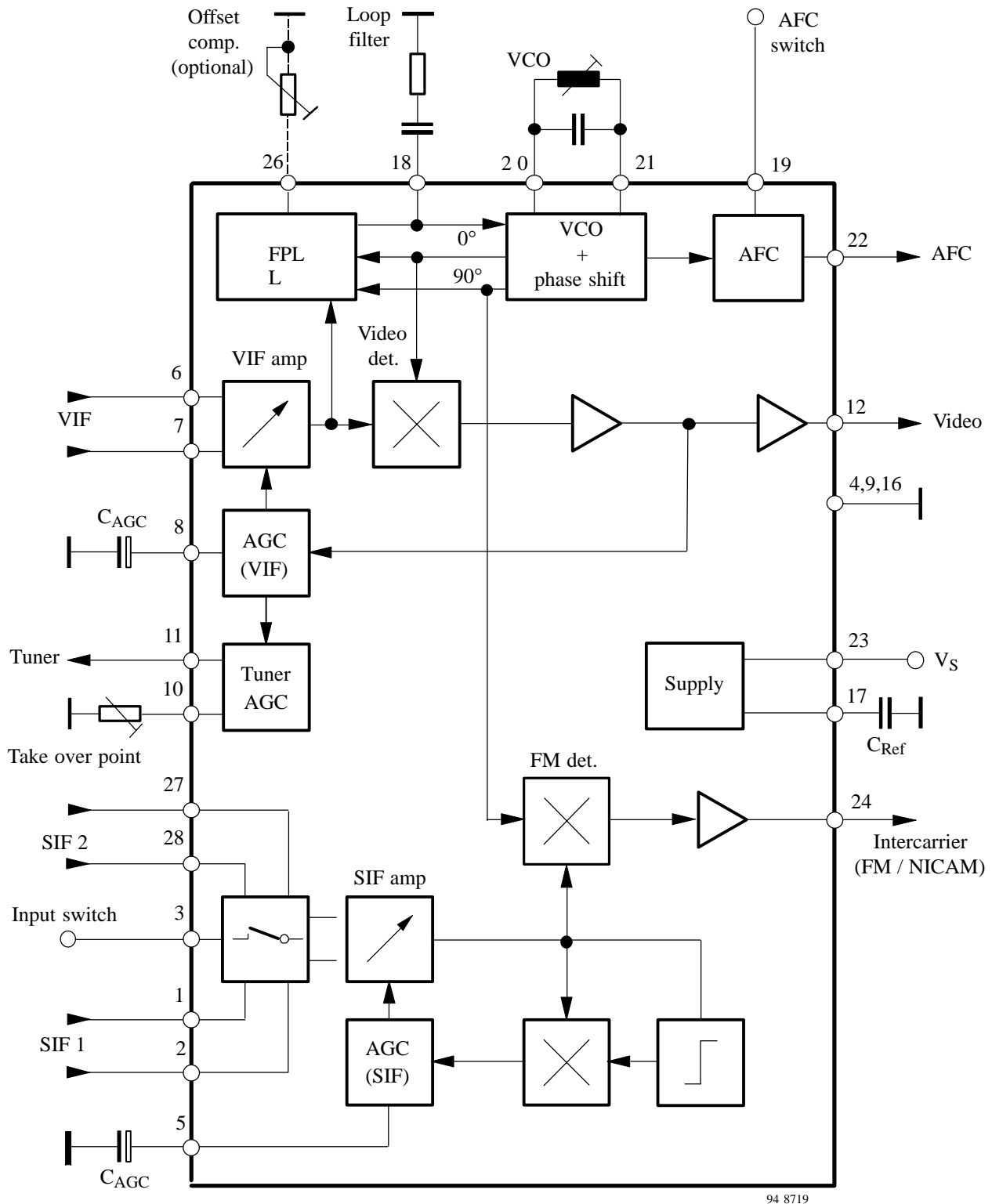
Circuit Description

Vision IF Amplifier

The video IF signal (VIF) is fed through a SAW filter to the differential input (Pin 6-7) of the VIF amplifier. This amplifier consists of three AC-coupled amplifier stages. Each differential amplifier is gain controlled by the automatic gain control (VIF-AGC). The output signal of the VIF amplifier is applied to the FPLL carrier generation and the video demodulator.

Tuner-and VIF-AGC

At Pin 8, the VIF-AGC charges/discharges the AGC capacitor to generate a control voltage for setting the gain of the VIF amplifier and tuner in order to keep the video output signal at a constant level. Therefore, in the case of all negative modulated signals (e.g., B/G standard) the sync. level of the demodulated video signal is the criterion for a fast charge/discharge of the AGC capacitor. The control voltage (AGC voltage at Pin 8) is transferred to an internal control signal, and is fed to the tuner AGC to generate the tuner AGC current at Pin 11 (open collector output). The take over point of the tuner AGC can be adjusted at Pin 10 by a potentiometer or an external dc voltage (from interface circuit or microprocessor).

FPLL, VCO and AFC

The FPLL circuit (frequency phase locked loop) consists of a frequency and phase detector to generate the control voltage for the VCO tuning. In the locked mode, the VCO is controlled by the phase detector and in unlocked mode, the frequency detector is superimposed. The VCO operates with an external resonance circuit (L and C parallel) and is controlled by internal varicaps. The VCO control voltage is also converted to a current and represents the AFC output signal at Pin 22.

A practicable VCO alignment of the external coil is the adjustment to zero AFC output current at Pin 22. At center frequency the AFC output current is equal to zero.

The optional potentiometer at Pin 26 allows an offset compensation of the VCO phase for improved sound quality (fine adjustment). Without a potentiometer (open circuit at Pin 26), this offset compensation is not active.

The oscillator signal passes a phase shifter and supplies the in-phase signal (0°) and the quadrature signal (90°)of the generated picture carrier.

Video Demodulation and Amplifier

The video IF signal, which is applied from the gain controlled IF amplifier, is multiplied with the inphase component of the VCO signal. The video demodulator is designed for low distortion and large bandwidth. The demodulator output signal passes an integrated low pass filter for attenuation of the residual vision carrier and is fed to the video amplifier. The video amplifier is realized by an operational amplifier with internal feedback and 8 MHz bandwidth (–3 dB). An additional noise clipping is provided. The video signal is fed to VIF-AGC and to the video output buffer. This amplifier with a 6 dB gain offers easy adaption of the sound trap. For nominal video IF modulation the video output signal at Pin 12 is 2 V_{pp}.

Sound IF Amplifier and SIF-AGC

The SIF amplifier is nearly identical with the 3-stage VIF amplifier. Only the first amplifier stage exists twice and is switchable by a control voltage at Pin 3. Therefore with a minimal external expense it is possible to switch between two different SAW filters. Both SIF inputs features excellent cross-talk attenuation and an input impedance which is independent from the switching condition.

The SIF-AGC is related to the average level of FM-carrier and controls the SIF amplifier to provide a constant SIF signal to the QPS mixer.

Quasi-Parallel-Sound (QPS) Mixer

The QPS mixer is realized by a multiplier. The SIF signal (FM or NICAM carrier) is converted to the intercarrier frequency by the regenerated picture carrier (quadrature signal) which is provided from the VCO. The intercarrier signal is fed via an output amplifier to Pin 24.

AFC Switch

The AFC output signal at Pin 22 can be controlled by a switching voltage at Pin 19. It is possible to switch off the AFC.

VCR Mode

For the VCR mode in a TV set (external video source selected), it is recommendable to switch off the IF circuit. With an external switching voltage at Pin 6 or 7, the IF amplifiers are switched off and all signal output levels at Pins 12 and 24 are according to the internal dc voltage.

Internal Voltage Stabilizer

The internal bandgap reference ensures constant performance independent of supply voltage and temperature.
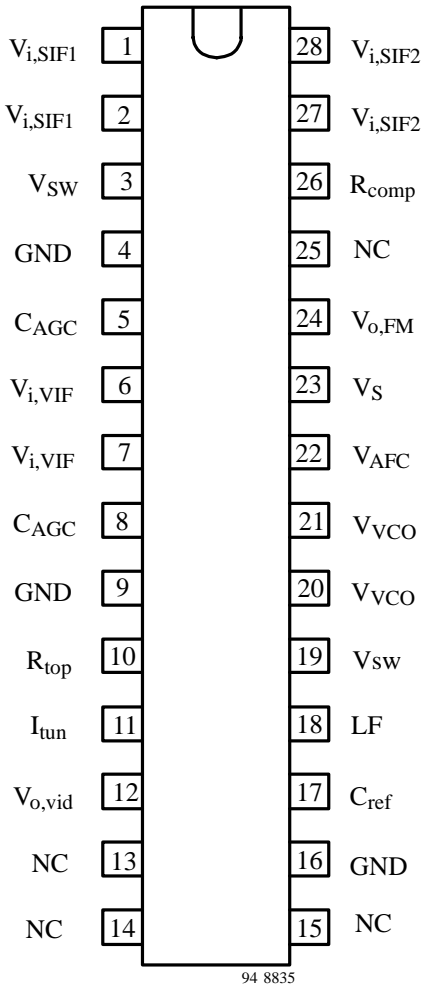
Preliminary Information

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Pin Description

		Pin	Symbol	Function
		1, 2	$V_{i, SIF1}$	SIF1 input (symmetrical)
		3	V_{sw}	Input selector switch
		4, 9, 16	GND	Ground
		5	C_{AGC}	SIF-AGC (time constant)
		6, 7	$V_{i, VIF}$	VIF input (symmetrical)
		8	C_{AGC}	VIF-AGC (time constant)
		10	R_{top}	Take over point, tuner AGC
		11	I_{tun}	Tuner AGC output current
		12	$V_{o,vid}$	Video output
		13	NC	Not connected
		14	NC	Not connected
		15	NC	Not connected
		17	C_{ref}	Internal reference voltage
		18	LF	Loop filter
		19	V_{sw}	AFC switch
		20, 21	V_{VCO}	VCO circuit
		22	V_{AFC}	AFC output
		23	V_S	Supply voltage
		24	$V_{O, FM}$	Intercarrier output
		25	NC	Not connected
		26	R_{comp}	Offset compensation
		27, 28	$V_{i, SIF2}$	SIF 2 input (symmetrical)

Pin diagram (Figure 2):

Left side:
1 — $V_{i,SIF1}$
2 — $V_{i,SIF1}$
3 — V_{SW}
4 — GND
5 — C_{AGC}
6 — $V_{i,VIF}$
7 — $V_{i,VIF}$
8 — C_{AGC}
9 — GND
10 — R_{top}
11 — I_{tun}
12 — $V_{o,vid}$
13 — NC
14 — NC

Right side:
28 — $V_{i,SIF2}$
27 — $V_{i,SIF2}$
26 — R_{comp}
25 — NC
24 — $V_{o,FM}$
23 — V_S
22 — V_{AFC}
21 — V_{VCO}
20 — V_{VCO}
19 — V_{sw}
18 — LF
17 — C_{ref}
16 — GND
15 — NC

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Figure 2. Pinning

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Absolute Maximum Ratings

Reference point Pin 4 (9, 16), unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage Pin 23			
SDIP28 package	V_S	9.0	V
SO28 package	V_S	6.0	V
Supply current Pin 23	I_s	93	mA
Power dissipation SDIP28 package	P	840	mW
SO28 package	P	560	mW
Output currents Pins 12 and 24	I_{out}	5	mA
External voltages			
Pins 1, 2, 5 to 8, 10, 12, 17, 18 and 24, 26 to 28		+4.5	V
Pins 20 and 21	V_{ext}	+3.5	V
Pin 11		+13.5	V
Pins 3, 19 and 22		V_S	V
Junction temperature	T_j	+125	°C
Storage temperature	T_{stg}	–25 to +125	°C
Electrostatic handling [*] all pins	V_{ESD}	± 300	V

[*]   Equivalent to discharging a 200 pF capacitor trough a 0 Ω resistor.

Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range Pin 23			
SDIP28 package	V_S	4.5 to 9.0	V
SO28 package	V_S	4.5 to 6.0	V
Ambient temperature	T_{amb}	–10 to +85	°C

Thermal Resistance

Parameters	Symbol	Maximum	Unit
Junction ambient, when soldered to PCB			
SDIP28 package	R_{thJA}	55	K/W
SO28 package	R_{thJA}	75	K/W

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Electrical Characteristics

V_S = +5 V, T_{amb} = +25°C; reference point Pin 4 (9, 16), unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
DC-supply	Pin 23					
Supply voltage – SDIP28		V_S	4.5	5.0	9.0	V
– SO28		V_S	4.5	5.0	5.5	V
Supply current		I_S		85	93	mA
VIF-input	Pin 6-7					
Input sensitivity, (RMS value)	For FPLL locked	v_{in}		80	120	μV_{RMS}
Input impedance	See note 1	R_{in}		1.2		kΩ
Input capacitance	See note 1	C_{in}		2		pF
VIF-AGC	Pins 8 and 15					
IF gain control range		G_v	60	65		dB
AGC capacitor	Pin 8	C_{AGC}		2.2		μF
Black level capacitor	Pin 15	C_{BL}		100		nF
Switching voltage: VCR mode	See note 2	V_{sw}		4.0		V
Switching current: VCR mode	See note 2	I_{sw}		50		μA
Tuner-AGC	Pins 10 and 11 see note 3					
Available tuner-AGC current		I_{tun}	1	2	4	mA
Allowable output voltage		V_{11}	0.3		13.5	V
IF slip – tuner AGC	Current I_{tun}: 10 to 90%	ΔG_{IF}		8	10	dB
IF input signal for minimum take over point	R_{top} = 10 kΩ (V_{top} = 4.5 V)	v_{in}			4	mV
IF input signal for maximum take over point	R_{top} = 0, (V_{top} = 0.8 V)	v_{in}	40			mV
Variation of the take over point by temperature	ΔT_{amb} = 55°C VIF-AGC: G_v = 46 dB	Δv_{in}		2	3	dB
FPLL and VCO	Pins 18, 20, 21 and 26 see note 4					
Max. oscillator frequency	For carrier generation	f_{vco}	70			MHz
Vision carrier capture range	f_{vco} = 38.9 MHz, C_{vco} = 8.2 pF	Δf_{cap}	±1.5	±2		MHz
Oscillator drift (free running) as function of temperature	See note 5, ΔT_{amb} = 55°C, C_{vco} = 8.2 pF, f_{vco} = 38.9 MHz	$\Delta f/_{\Delta T}$			–0.3	%
Video output	Pin 12					
Output current – source		$\pm I_{12}$			5	mA
– sink			2		3	mA
Output resistance	See note 1	R_{out}			100	Ω
Video output signal	Peak-to-peak value	$v_{o,vid}$	1.8	2.0	2.2	Vpp
Difference of the video signals	Between B/G and L	$\Delta v_{o,vid}$			10	%
Sync. level		V_{sync}		1.2		V
Zero carrier level for neg. modulation, ultra white level	V_{13} = V_S V_8 = 3 V	V_{DC}		3.4		V
Zero carrier level for pos. modulation, ultra black level	V_{13} = 0 V_8 = 3 V	V_{DC}		1.15		V
Supply voltage influence on the ultra white and ultra black level		$\Delta V/_V$		1		%/V
Video bandwidth (–3 dB)	$R_L \geq$ 1 kΩ, $C_L \leq$ 50 pF	B	6	8		MHz

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Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Video frequency response over the AGC range		ΔB			2.0	dB
Differential gain error		DG		2	5	%
Differential phase error		DP		2	5	deg
Intermodulation 1.07 MHz	See note 6	α_{IM}	52	60		dB
Video signal to noise ratio	Weighted, CCIR-567	$S/_N$	56	60		dB
Residual vision carrier fundamental wave 38.9 MHz and second harmonic 77.8 MHz		v_{res1}		2	10	mV
Lower limiting level	Below sync level	ΔV_{lim1}		400		mV
Upper limiting level	Above ultra white level	ΔV_{lim2}		600		mV
Ripple rejection	See note 1, Pin 23/Pin 12	RR	35			dB
AFC output	Pin 22					
Control slope		$\Delta I/_{\Delta f}$		0.7		µA/kHz
Frequency drift by temperature	Related to the picture carrier frequency			0.25	0.6	%
Output voltage – upper limit – lower limit		V_{AFC}	V_S–0.4		0.4	V V
Output current		I_{AFC}		±0.2		mA
AFC switch	Pin 19					
Control voltage: AFC "off" AFC "on"	See note 7	V_{SW}	0 3.5		0.8 V_S	V V
Switching current		I_{SW}		±100		µA
SIF inputs	Pin 1-2, 27-28					
Input sensitivity (RMS value)	Output signal at Pin 24/25: –3 dB	v_{in}		80	120	µV$_{RMS}$
Input impedance	See note 1	R_{in}		1.2		kΩ
Input capacitance	See note 1	C_{in}		2		pF
SIF-AGC	Pin 5					
IF gain control range		G_v	60	65		dB
AGC capacitor		C_{AGC}		10		µF
Intercarrier output-FM	Pin 24 see note 8					
DC output voltage		V_{DC}		2		V
Output resistance	See note 1	R_{out}		150		Ω
Sound IF output voltage (5.5 MHz output voltage)	v_{in} = 10 mV	v_{out}	180	250	350	mV$_{RMS}$
Weighted signal to noise ratio: (CCIR 468)	Ref. signal: v_{in} = 10 mV; FM dev. = ±27 kHz f_{mod} = 1 kHz; tested with the double FM demod. U2860B; B/G modulated VIF signal Black screen: Channel 1/2 Grid pattern: Channel 1/2 Grey screen 50%: Channel 1/2	S/N S/N S/N		60/58 54/52 60/57		dB dB dB
Ripple rejection	See note 1, Pin 23/Pin 24	RR	35			dB
SIF input selector switch	Pin 3					

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Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Control voltage: – input 1 active	See note 9	V_{SW}	2.0		V_S	V
– input 2 active			0		0.8	V
Switching current		I_{SW}		±100		µA

Notes

1.) This parameter is given as an application information and not tested during production.

2.) In VCR mode the VIF- and SIF path is switched off.

3.) Adjustment of turn over point (delayed tuner AGC) with external resistor R_{top} or external voltage V_{top} possible.

4.) Resonance circuit of VCO (f_o = 38.9 MHz): C_{VCO} = 8.2 – 10 pF,
Coil L_{VCO} with unloaded Q-factor $Q_o \geq 60$ for an oscillator voltage ≥ 100 mV$_{RMS}$ at Pin 20 – 21
(e.g. TOKO coil 7 KM, 292 XNS - 4051Z)

5.) The oscillator drift is related to the picture carrier frequency, at external temperature-compensated LC circuit.

6.) α (1.07) = 20 log (4.43 MHz component/1.07 MHz component); α (1.07) value related to black-white signal
input signal conditions: picture carrier = 0 dB, colour carrier = –6 dB, sound carrier = –24 dB

7.) Without control voltage at Pin 19 "AFC on" is automatically selected.

8.) Picture carrier PC = 38.9 MHz; sound carrier SC_1 = 33.4 MHz, SC_2 = 33.16 MHz;
PC/SC_1 = 13 dB; PC/SC_2 = 20 dB; PC unmodulated (equivalent to sync. peak level).

9.) Without control voltage at Pin 3 the SIF input 1 is automatically selected.

Figure 3. Test circuit

Preliminary Information

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*) External L/C circuit (VCO: 38.9 MHz)
with TOKO coil 7KM, 292 XNS – 4051Z
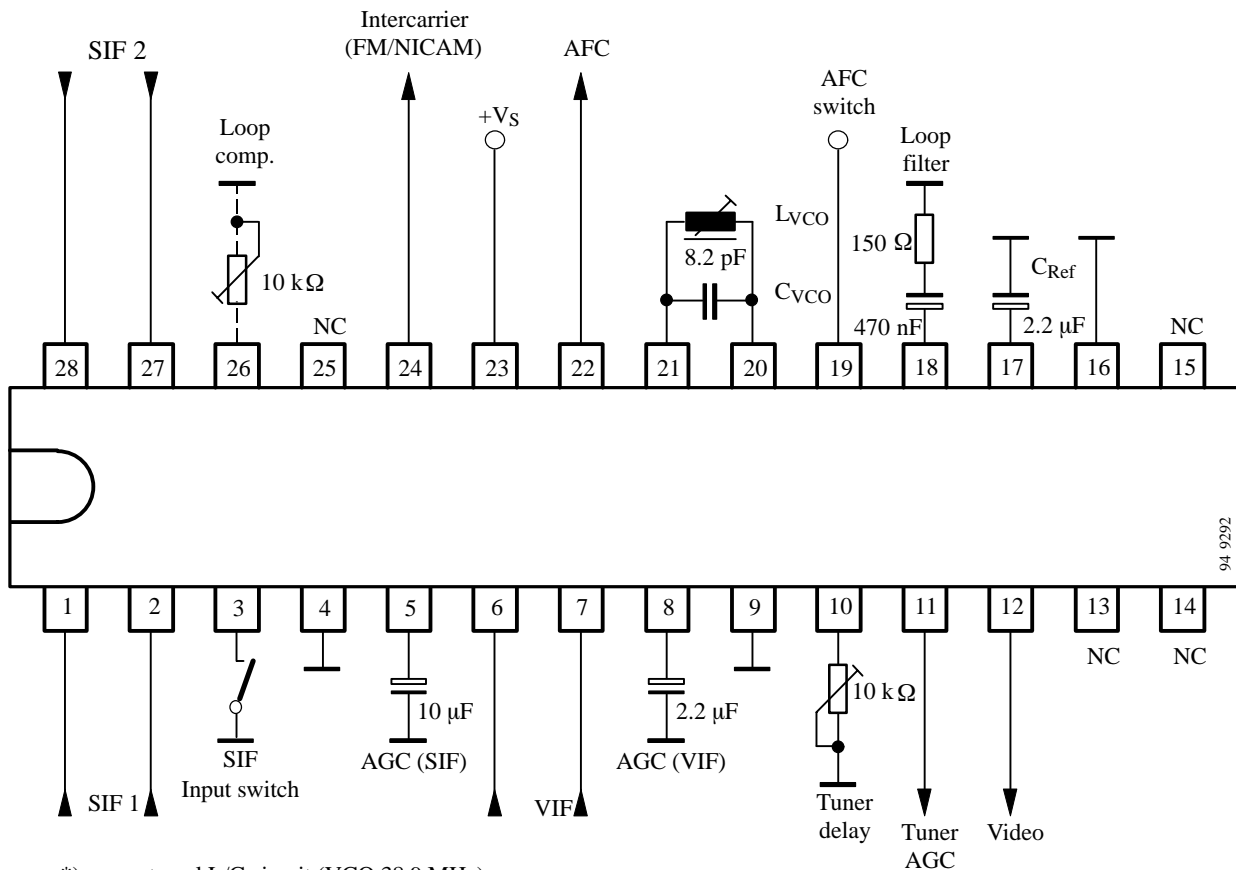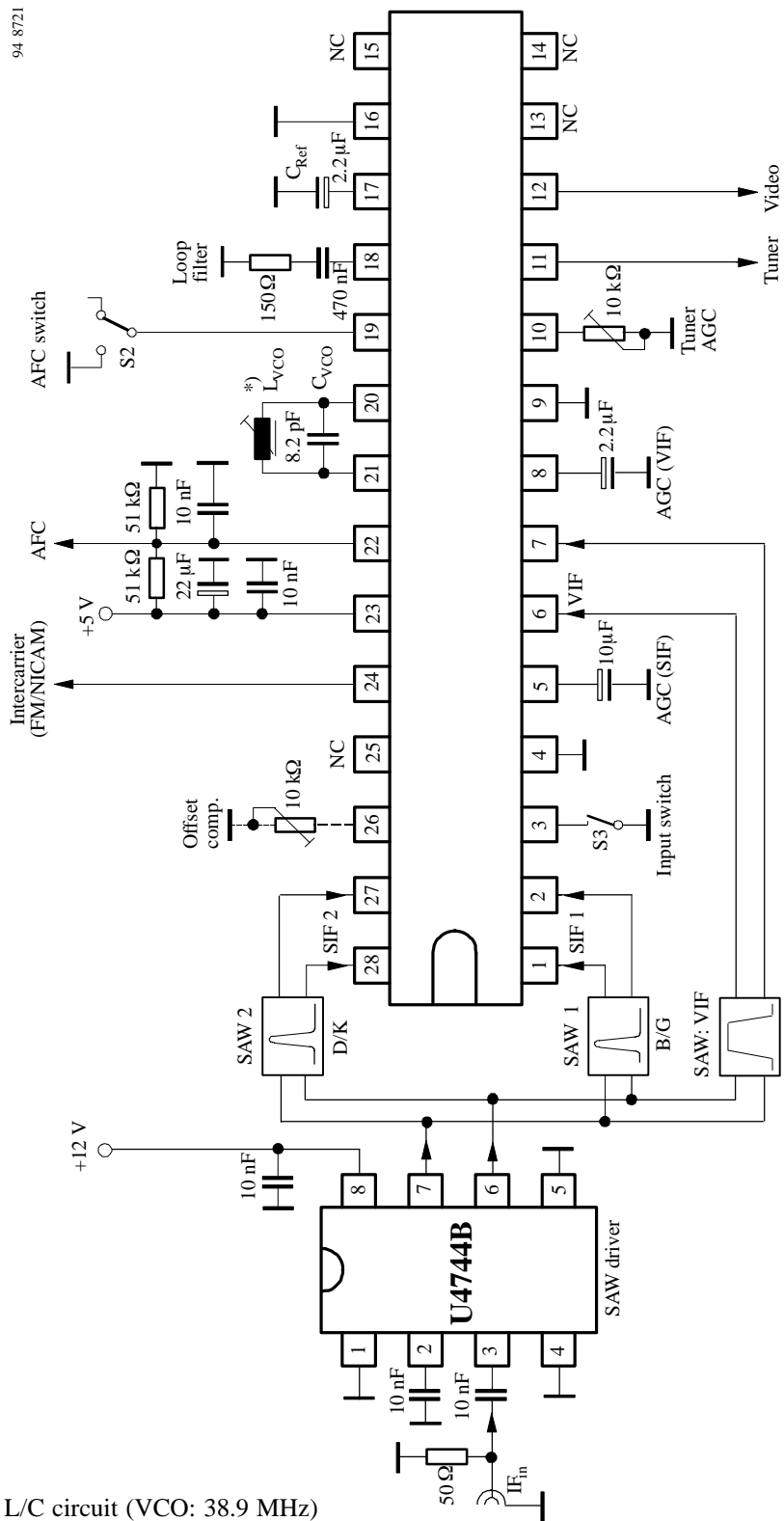
Figure 4. Basic application circuit

Preliminary Information

TDA4472

Internal Pin Configuration

1, 27

2, 28

2 k Ω 2 k Ω

3 V

20 k Ω

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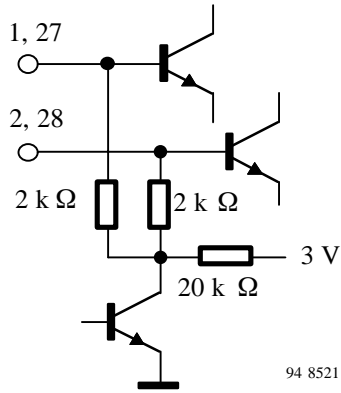
Figure 5. Sound IF inputs (Pin 1-2, 27-28)

2 kΩ 2 kΩ

2.3 V

4.2 V

94 8524
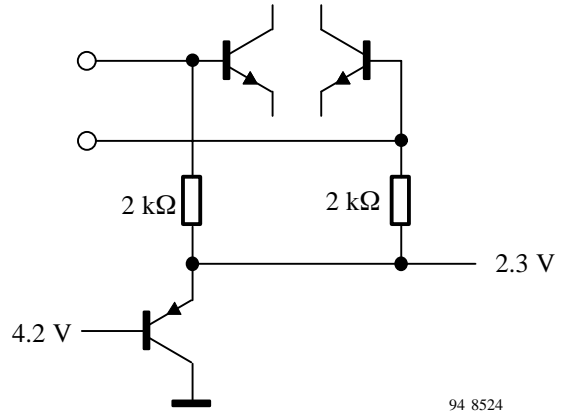
Figure 8. Video IF input (Pin 6-7)

3.5 V

60 kΩ

3 10 kΩ

94 8522
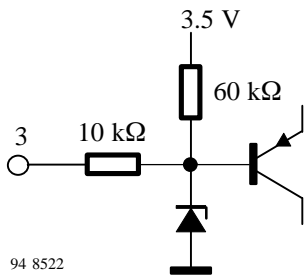
Figure 6. Input selector switch (Pin 3)

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8
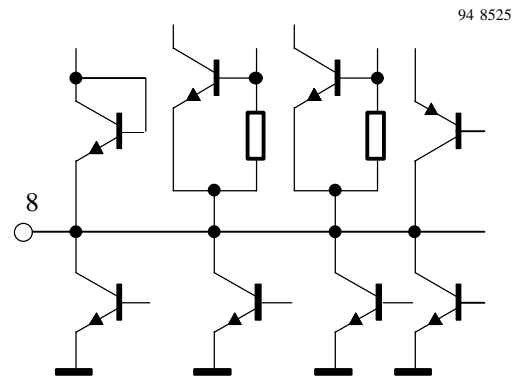
Figure 9. VIF-AGC time constant (Pin 8)

5

94 8523
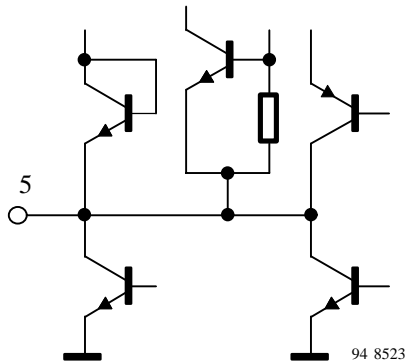
Figure 7. SIF-AGC time constant (Pin 5)

3.5 V

6.5 kΩ

6 kΩ

94 8526
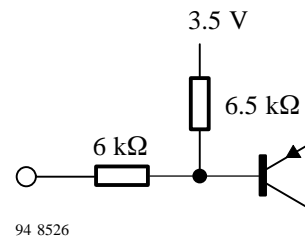
Figure 10. Tuner AGC – take over point (Pin 10)

Preliminary Information

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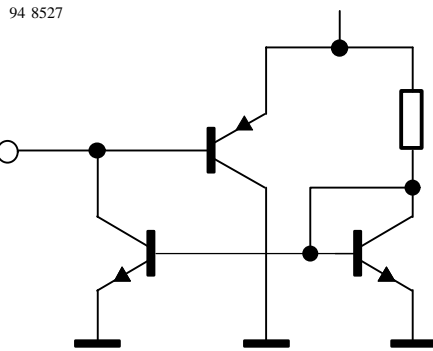
Figure 11. Tuner AGC – output (Pin 11)

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2.75 V
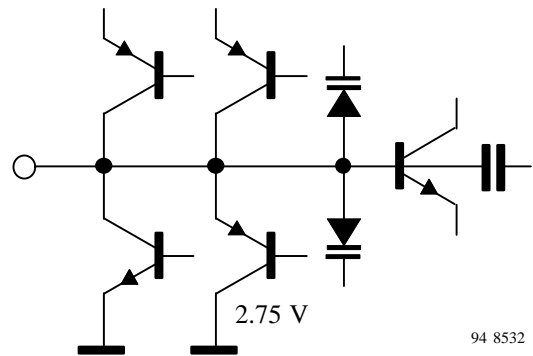
Figure 14. Loop filter (Pin 18)

2.6 mA

94 8528
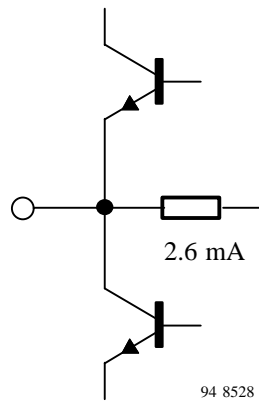
Figure 12. Video output (Pin 12)

3.5 V

30 k Ω

19

10.5 k Ω

94 8533
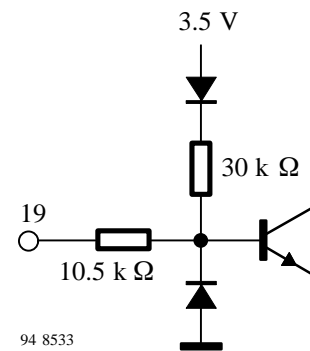
Figure 15. AFC switch (Pin 19)

3.5 V

94 8531
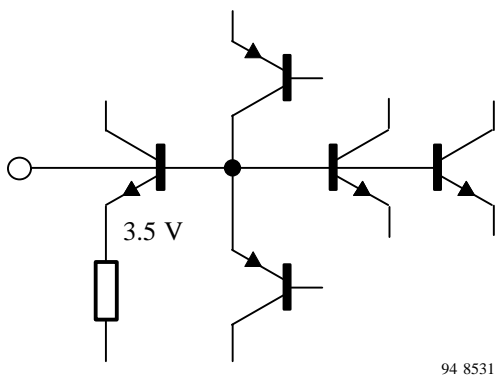
Figure 13. Internal reference voltage (Pin 17)

7 kΩ

7 kΩ

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Figure 16. VCO (Pin 20-21)

Preliminary Information

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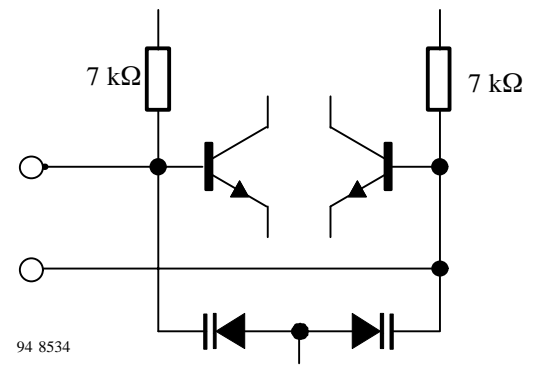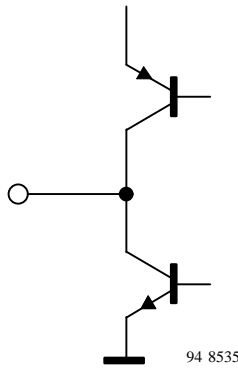
Figure 17. AFC output (Pin 22)

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3.5 V

10 kΩ

10 kΩ
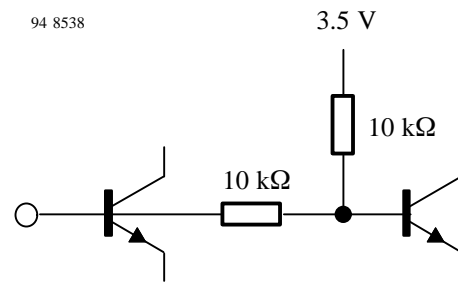
Figure 19. VCO offset compensation (Pin 26)

100 Ω

24

1 mA

94 8536
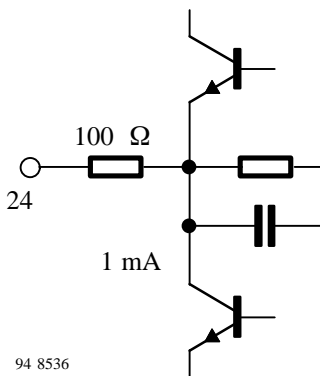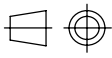
Figure 18. Intercarrier output (Pin 24)

Preliminary Information

## Dimensions in mm

Package SDIP28

Dimensions in mm
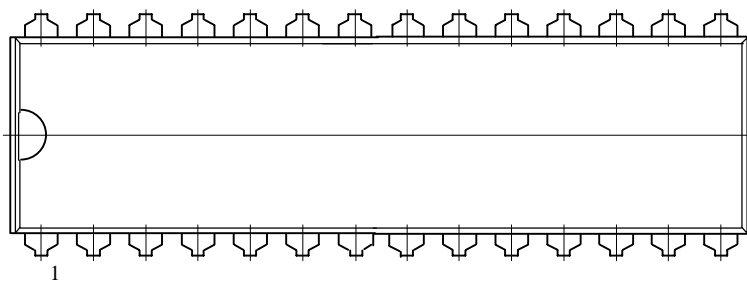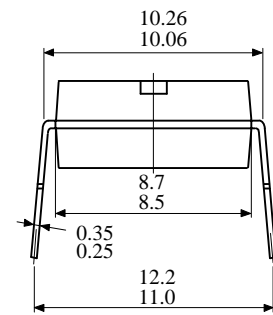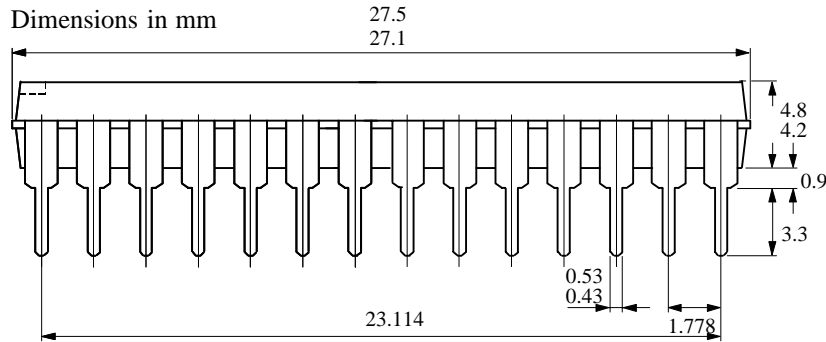
technical drawings
according to DIN
specifications

13044

Package SO28

Dimensions in mm

technical drawings
according to DIN
specifications

13033

Preliminary Information

WIRELESS & µC ®
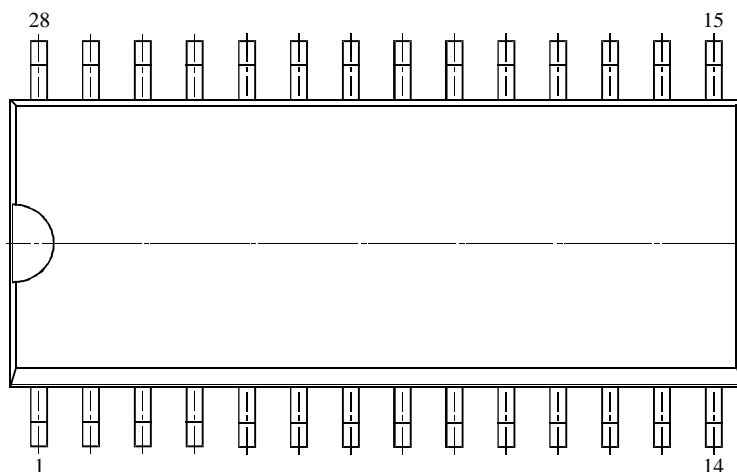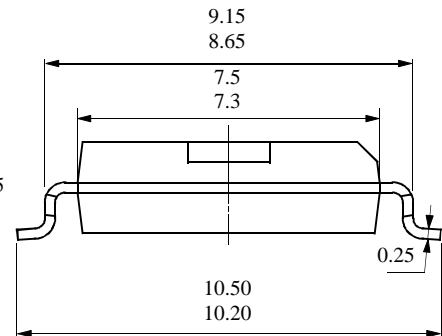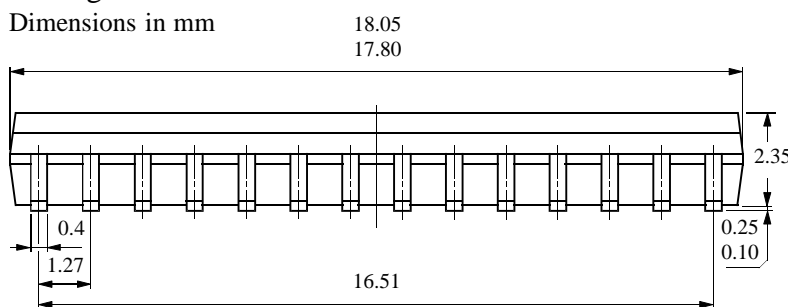
Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Atmel Germany GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Atmel Germany GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Preliminary Information