Multistandard Video-IF + Quasi Parallel Sound Processing IC

TDA4474

Features

- **5 V Supply Voltage**
- **Active Carrier Generation by FPLL (Frequency-Phase-Locked Loop) Principle for True Synchronous Demodulation**
- **VCO Circuit is Operating on Picture Carrier Frequency, the VCO Frequency is Switchable for the L' Mode**
- **Alignment-free AFC without External Reference Circuit, Polarity of the AFC Curve is Switchable**
- **VIF-AGC for Negatively Modulated Signals (Peak Synchronous Detection) and for Positive Modulation (Peak White/Black Level Detector)**
- **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)**
- **Complete Alignment-free AM Demodulator with Gain Controlled AF Output**
- **Separate SIF-AGC with Average Detection**
- **Parallel Operation of the AM Demodulator and QPS Mixer (for NICAM-L Stereo Sound)**
- **Four IF Inputs ($2 \times VIF_{IN}$ and $2 \times SIF_{IN}$)**
- **Package and Relevant Pinning is Compatible with the TDA4471; Simplifies the Design of a Universal IF Module**

Benefits

- **Linear Video Demodulation**
- **Good Pulse Response**
- **Excellent Intermodulation Figures**

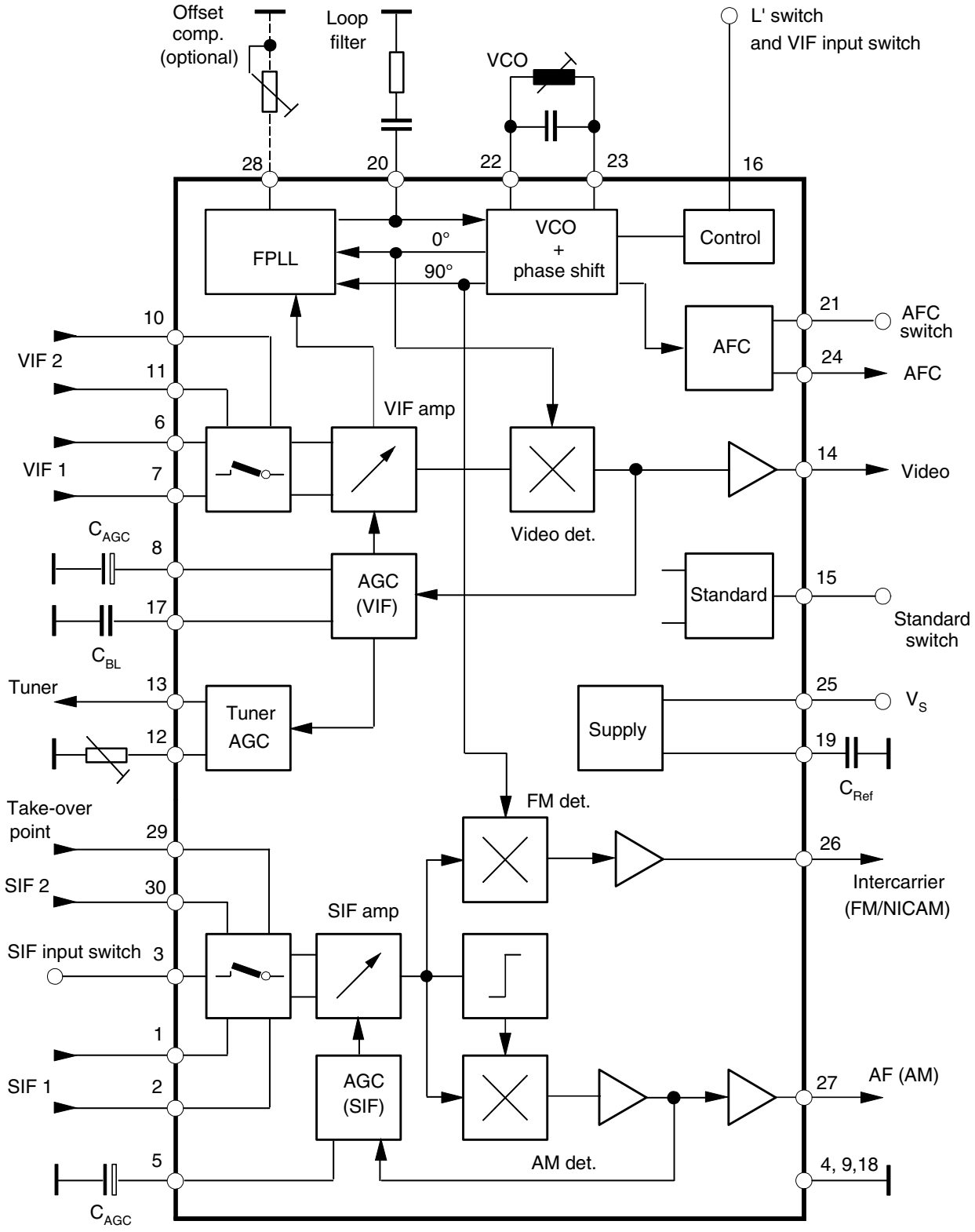
Description

The TDA4474 is an integrated bipolar circuit for full multistandard 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), positive modulation (e.g., L standard) and the AM, FM/NICAM sound IF signals.

Four IF inputs ($2 \times$ VIF plus $2 \times$ SIF) and the common pinning with the TDA4471 provides flexibility to design a universal IF module for various applications.

Rev. 4802A–TVVCR–03/04

Figure 1. Block Diagram



4802A–TVVCR–03/04

Circuit Description

Vision IF Amplifier

The video IF signal (VIF) is fed through an external SAW filter to one of the two VIF inputs (pins 6-7 or 10-11). The selection of VIF inputs is controlled by pin 16 in combination with the standard switch. With a minimal external expense it is possible to switch between two different SAW filters. Both VIF inputs features excellent cross-talk attenuation and an input impedance which is independent from the switching condition. The VIF 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 the synchronous level of the demodulated video signal is the criterion for a fast charge/discharge of the AGC capacitor. For positive modulation (e.g., L standard) the peak white level of the video signal controls the charge current. In order to reduce the reaction time for positive modulation, where a very large time constant is needed, an additional black level detector (pin 17) controls the discharge current in the event of decreasing VIF input signal. The AGC voltage is transferred to an internal control signal and fed to the AGC tuner to generate the AGC tuner current at pin 13 (open collector output).

Take-over point of the AGC tuner can be adjusted at pin 12 by a potentiometer or an external DC voltage (from an interface circuit or microprocessor).

FPLL, VCO and AFC

The FPLL (Frequency-Phase-Locked Loop) circuit consists of a frequency and phase detector to generate control voltage for the VCO tuning. In locked mode the VCO is controlled by the phase detector, in unlocked mode the frequency detector is superimposed. The VCO operates with an external resonance circuit (L and C in 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 24. With the AFC switch (pin 21) three operating conditions of the AFC are possible: the AFC curve “rising” or “falling” and AFC “off”.

A practicable VCO alignment of the external coil is the adjustment to zero AFC output current at pin 24. At the center frequency, the AFC output current is equal to zero. Furthermore, at pin 16, the VCO center frequency can be switched to set it to the required L’ value This function is active when the “L mode” is selected by the standard switch.

The optional potentiometer at pin 28 allows an offset compensation of the VCO phase for improved sound quality (fine adjustment). Without a potentiometer (open circuit at pin 28) 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 in-phase 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). A standard dependent DC level shift in this stage delivers the same synchronous level for positive and negative modulation. Additional noise clipping is provided. The video signal is fed to the VIF-AGC and to the video output buffer. This amplifier, with a gain of 6 dB, offers easy adoption of the sound trap. For nominal video IF modulation, the video output signal at pin 14 is 2 V (peak-to-peak value).

Sound IF Amplifier and SIF-AGC

The SIF amplifier is nearly identical with the 3-stage VIF amplifier, except that the first amplifier stage exists twice and is switchable by a control voltage at pin 3. Therefore, it is possible to switch between two different SAW filters with minimal external expense. Both SIF inputs features excellent cross-talk attenuation and an input impedance which is independent from the switching condition. Each differential amplifier is controlled by the automatic gain control for the sound IF path (SIF-AGC). The output signal of the SIF amplifier is applied to the mixer for FM/NICAM signals and the demodulator for AM sound signals.

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

AM Demodulator

The alignment-free AM demodulator is realized by a synchronous detector. The modulated SIF signal from the SIF amplifier output is multiplied in phase with the limited SIF signal (AM is removed). The AF signal of the demodulator output is fed to the output amplifier and to the SIF-AGC. For all TV standards with negative video modulation (e.g., B/G standard) the AF output signal (pin 27) is switched off by the standard switch.

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 26.

Standard Switch

To have equal polarity of the video output signal the polarity can be switched in the demodulation stage in accordance with the TV standard. Additionally a standard dependent DC level shift in the video amplifier delivers the same synchronous level. Parallelly the correct VIF-AGC is selected for positively or negatively modulated VIF signals. In case of negative modulation (e.g., B/G standard) the AM output signal is switched off. If the standard for positive modulation (L standard) is selected the AM demodulator and QPS mixer is active. This condition allows a parallel operation of the AM sound signal and the NICAM-L stereo sound.

L' Switch and VIF Input Selection

For positively modulated signals (L/L' standard) pin 16 works as an L' switch. With a control voltage the VCO frequency can be switched to set it to the required L' value (L' standard). Also, a fine adjustment of the L'-VCO center frequency is possible with a potentiometer. The L' switch is only active for positively modulated video IF signals (standard switch in L mode). In this mode the video IF input 2 (VIF2) is forced by the standard switch. The possibility to select VIF1 input is given by connecting VIF2 input (pin 10 or 11) via a 10 kΩ resistor to ground.

If negative modulation (B/G mode) is selected pin 16 operates as an input selection switch for the two VIF inputs.

AFC Switch

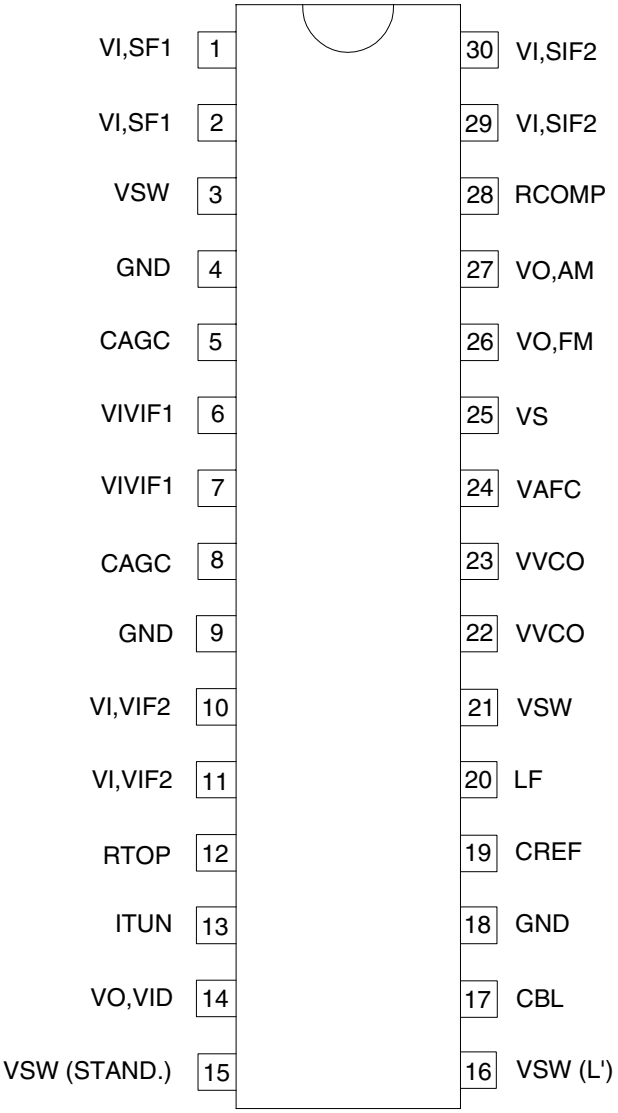
The AFC output signal at pin 24 can be controlled by a switching voltage at pin 21. It is possible to select an AFC output signal with a rising- or falling AFC curve and to switch off the AFC.

Internal Voltage Stabilizer

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

Pin Configuration

Figure 2. Pinning SDIP30



Pin Description

Pin	Symbol	Function
1, 2	VI,SF1	SIF1 input (symmetrical)
3	VSW	SIF input selector switch
4	GND	Ground
5	CAGC	SIF-AGC (time constant)
6, 7	VI,VIF1	VIF input (symmetrical)
8	CAGC	VIF-AGC (time constant)
9	GND	Ground
10, 11	VI,VIF2	VIF2 input (symmetrical)
12	RTOP	Take-over point, tuner AGC
13	ITUN	Tuner AGC output current
14	VO,VID	Video output
15	VSW	Standard switch
16	VSW	L'-/VIF input selector switch
17	CBL	Capacitor - black level detector
18	GND	Ground
19	CREF	Internal reference voltage
20	LF	Loop filter
21	VSW	AFC switch
22, 23	VVCO	VCO circuit
24	VAFC	AFC output
25	VS	Supply voltage
26	VO,FM	Intercarrier output
27	VO,AM	AF output - AM sound
28	RCOMP	Offset compensation
29, 30	VI,SIF2	SIF2 input (symmetrical)

Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Reference point pin 4 (9, 18), unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage, pin 25	V_S	9.0	V
Supply current, pin 25	I_S	93	mA
Power dissipation, V_S = +9 V	P	840	mW
Output currents, pins 14, 26, 27	I_{OUT}	5	mA
External voltages Pins 1, 2, 5 to 8, 10 to 12, 14, 16, 19, 20, 26-30 Pins 17, 22, 23 Pin 13 Pins 3, 15, 21, 24	V_{ext}	 +4.5 +3.5 +13.5 V_S	 V V V V
Junction temperature	T_j	+125	°C
Storage temperature	T_{stg}	-25 to +125	°C
Electrostatic handling[1], all pins	V_{ESD}	±300	V

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

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient, when soldered to PCB	R_{thJA}	55	K/W

Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range, pin 25	V_S	4.5 to 9.0	V
Ambient temperature	T_{amb}	-10 to +85	°C

Electrical Characteristics

V_S = +5 V, T_{amb} = +25°C; reference point pin 4 (9, 18), measurements taken in test circuit according to Figure 3 on page 12 unless otherwise specified.

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
DC-supply		**25**					
Supply voltage			V_S	4.5	5.0	9.0	V
Supply current			I_S		85	93	mA
VIF-input		**6-7, 10-11**					
Input sensitivity (RMS value)	For FPLL locked		V_{IN}		80	120	μV_{RMS}
Input impedance	(1)		R_{IN}		1.2		kΩ
Input capacitance	(1)		C_{IN}		2		pF
VIF-AGC		**8 and 17**					
IF gain control range	Video output: 2 V_{PP}		G_V	60	65		dB
AGC capacitor		8	C_{AGC}		2.2		µF
Black level capacitor		17	C_{BL}		100		nF
Tuner-AGC		**12 and 13(2)**					
Available tuner-AGC current			I_{tun}	1	2	4	mA
Allowable output voltage			V_{OUT}	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} = 2.5 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		**20, 22, 23 and 28(3)**					
Maximum 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	(4) ΔT_{amb} = 55°C, C_{vco} = 8.2 pF, f_{vco} = 38.9 MHz		$\Delta f/_{\Delta t}$			-0.3	%
Video Output		**14**					
Output current - source - sink			$\pm I_{OUT}$	2		5 3	mA mA
Output resistance	(1)		R_{OUT}			100	Ω
Video output signal	Peak-to-peak value		$V_{O,VID}$	1.8	2.0	2.2	V_{pp}
Difference of the video signals	Between B/G and L		$\Delta V_{O,VID}$			10	%
Synchronous level			V_{SYNC}		1.2		V
Zero carrier level for negative modulation, ultra white level	V_8 = 3 V		V_{DC}		3.4		V

Electrical Characteristics (Continued)

V_S = +5 V, T_{amb} = +25°C; reference point pin 4 (9, 18), measurements taken in test circuit according to Figure 3 on page 12 unless otherwise specified.

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
Zero carrier level for positive modulation, ultra black level	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
Video frequency response over the AGC range			ΔB			2.0	dB
Differential gain error			ΔG		2	5	%
Differential phase error			ΔP		2	5	deg
Intermodulation 1.07 MHz	(5)		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 synchronous level		ΔV_{lim1}		400		mV
Upper limiting level	Above ultra white level		ΔV_{lim2}		600		mV
Ripple rejection	Pin 25/pin 14(1)		RR	35			dB
Standard Switch		**15**					
Control voltage for mode 1: negatively modulated VIF and FM/NICAM sound	(6)		V_{sw1}	2.0		V_s	V
Control voltage for mode 2: positively modulated VIF and AM/L-NICAM sound			V_{sw2}	0		0.8	V
Switching current			I_{sw}		±100		µA
AFC Output		**24**					
Control slope			$\Delta I/_{\Delta f}$		0.7		µA/kHz
Frequency drift by temperature	Related to the picture carrier frequency		Δf_{IF}		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		**21(7)**					
Control voltage: AFC "off" AFC curve rising AFC curve falling			V_{sw}	 0 1.5 3.5		 0.8 2.5 V_S	 V V V
Switching current			I_{sw}		±100		µA

Electrical Characteristics (Continued)

V_S = +5 V, T_{amb} = +25°C; reference point pin 4 (9, 18), measurements taken in test circuit according to Figure 3 on page 12 unless otherwise specified.

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
L' and VIF Input Selector Switch		**16(8)**					
Control voltage: VIF input 2 active VIF input 1 active	Standard switch in mode 1 (negative modulation)		V_{sw1}	0 3.4		3.0 4.5	V V
Control voltage: L'-VCO frequency L-VCO frequency	Standard switch in mode 2 (positive modulation)		V_{sw2}	0 3.4		3.0 4.5	V V
Switching current	V_{sw} = 0		I_{sw}			700	µA
SIF Inputs		**1-2, 29-30**					
Input sensitivity (RMS value)	Output signal: -3 dB		V_{IN}		80	120	μV_{RMS}
Input impedance	(1)		R_{IN}		1.2		kΩ
Input capacitance	(1)		C_{IN}		2		pF
SIF-AGC		**5**					
IF gain control range			G_V	60	65		dB
AGC capacitor			C_{AGC}		10		µF
Intercarrier Output		**26(9)**					
DC output voltage			V_{DC}		2		V
Output resistance	(1)		R_{OUT}		150		Ω
Intercarrier output voltage, RMS value	V_{IN} = 10 mV 5.5 MHz output voltage		V_{OUT}	180	250	350	mV_{RMS}
Weighted signal-to-noise ratio: (CCIR 468)	Reference signal: V_{IN} = 10 mV FM deviation = ±27 kHz f_{mod} = 1 kHz tested with the double FM demodulated 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	(1)	25, 26	RR	35			dB
AF Output - AM		**27(10)**					
DC output voltage			V_{DC}		2.2		V
Output resistance	(1)		R_{OUT}		150		Ω
AF output voltage, RMS value	m = 54%		v_{oAF}	400	500	630	mV_{RMS}
Total harmonic distortion	m = 54% f_{mod} = 1kHz, 12.5kHz		THD		1	2	%
Signal-to-noise ratio	Reference: m = 54%, f_{mod} = 1 kHz, 22 kHz low pass filter		S/N		65		dB
Ripple rejection	Pins 25, 27(1)		RR	28			dB

Electrical Characteristics (Continued)

V_S = +5 V, T_{amb} = +25°C; reference point pin 4 (9, 18), measurements taken in test circuit according to Figure 3 on page 12 unless otherwise specified.

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
SIF Input Selector Switch		**3**					
Control voltage: - input 1 active - input 2 active	(11)		V_{SW}	2.0 0		V_S 0.8	V V
Switching current			I_{SW}		±100		µA

Notes:
1. This parameter is given as an application information and has not been tested during production.
2. The adjustment of the turn-over point (delayed tuner AGC) with external resistor R_{TOP} or external voltage V_{TOP}
3. Resonance circuit of the VCO, f = 38.9 MHz: Capacitor $C_{VCO} \approx$ 8.2 - 10 pF, coil L_{VCO} with unloaded Q-factor $Q_0 \geq 60$ for an oscillator voltage ≥ 100 mV_{RMS} (pin 22-23); e.g., TOKO coil 7KM, 292 XNS - 4051Z.
4. The oscillator drift is related to the picture carrier frequency, given that external circuit is temperature-compensated.
5. 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
6. Without an external control voltage at pin 15 (open circuit) the IC automatically operates in mode 1: negatively modulated video IF and FM/NICAM sound signals

	Mode 2	Mode 1
Voltage at pin 15 (Standard Switch)	0 - 0.8 V	2 V - V_S (or pin 15 open)
Selected Standard (Mode)	(L standard) VIF: positive modulation SIF: AM + NICAM	(B/G standard) VIF: negative modulation SIF: FM/ NICAM

7. Without a control voltage at pin 21 (open circuit) the falling AFC curve is automatically selected

Voltage at pin 21 (AFC Switch)	0 - 0.8 V	1.5 - 2.5 V	3.5 V - V_S (or pin 21 open)
AFC Function	AFC switched OFF	AFC curve rising	AFC curve falling

8. Without a control voltage at pin 16 (open circuit) the L' switch is not active.

Standard Switch, pin 15	Mode 1: negative modulation (B/G) 2.0 V - VS				Mode 2: positive modulation (L) 0 - 0.8 V			
L'/VIF Input Switch, pin 16	3.4 V - 4.5 V (or pin 16 open)		0 - 3.1 V		3.4 V - 4.5 V (or pin 16 open)		0 - 3.1 V	
External Voltage at VIF Input 2 pin 10 or 11	open	1 V	open	1 V	open	1 V	open	1 V
Modulation	negative	negative	negative	not useful	positive	positive	positive	positive
Standard	B/G,...	B/G,...	B/G,...	not useful	L	L	L'	L'
Active VIF Input	VIF1	VIF1	VIF2	not useful	VIF2	VIF1	VIF2	VIF1

9. Picture carrier PC = 38.9 MHz; sound carrier SC_1 = 33.4 MHz, SC_2 = 33.1578 MHz; PC/SC_1 =13 dB; PC/SC_2 = 20 dB; PC unmodulated (equivalent to synchronous peak level).
10. Sound carrier SC = 32.4 MHz, modulated with fmod = 1 kHz, m = 54%; V_{IN} = 10 mV.
11. Without a control voltage at pin 3 (open circuit) the SIF input 1 is automatically selected.

Figure 3. Test Circuit

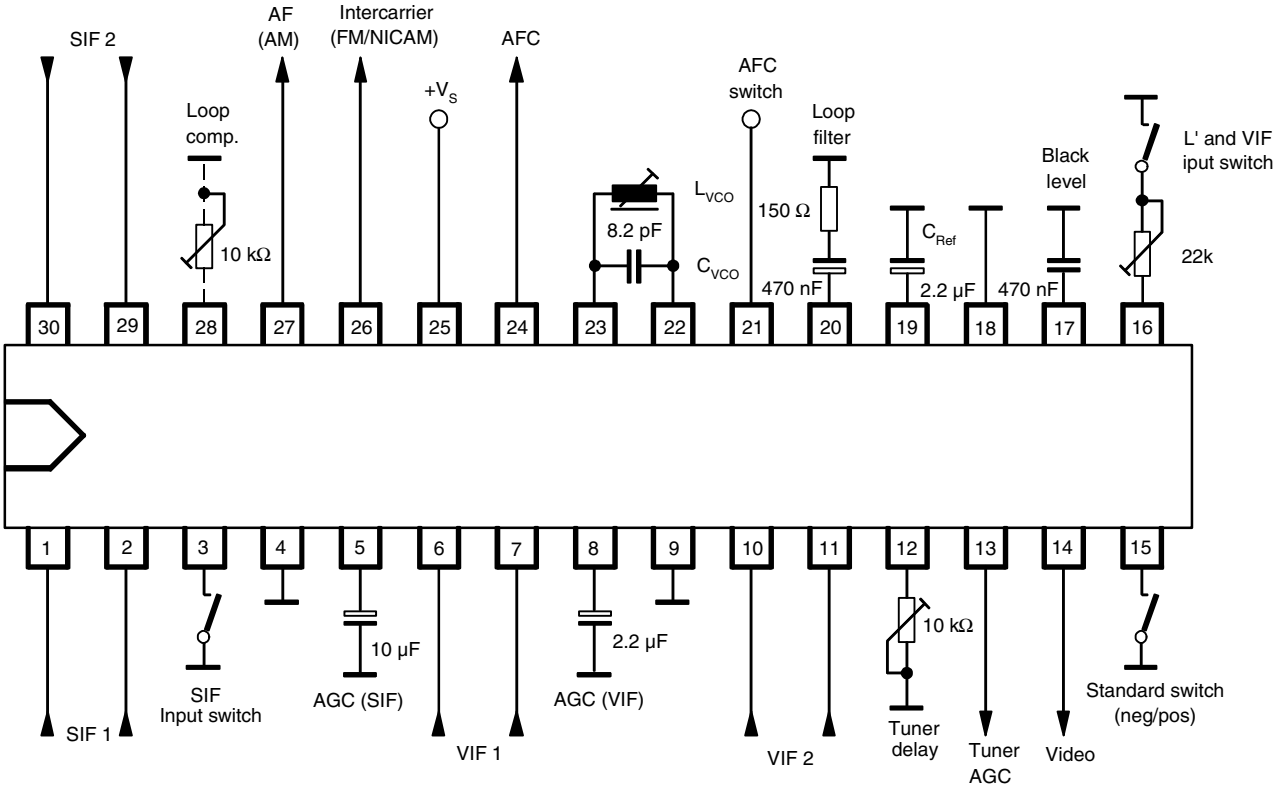
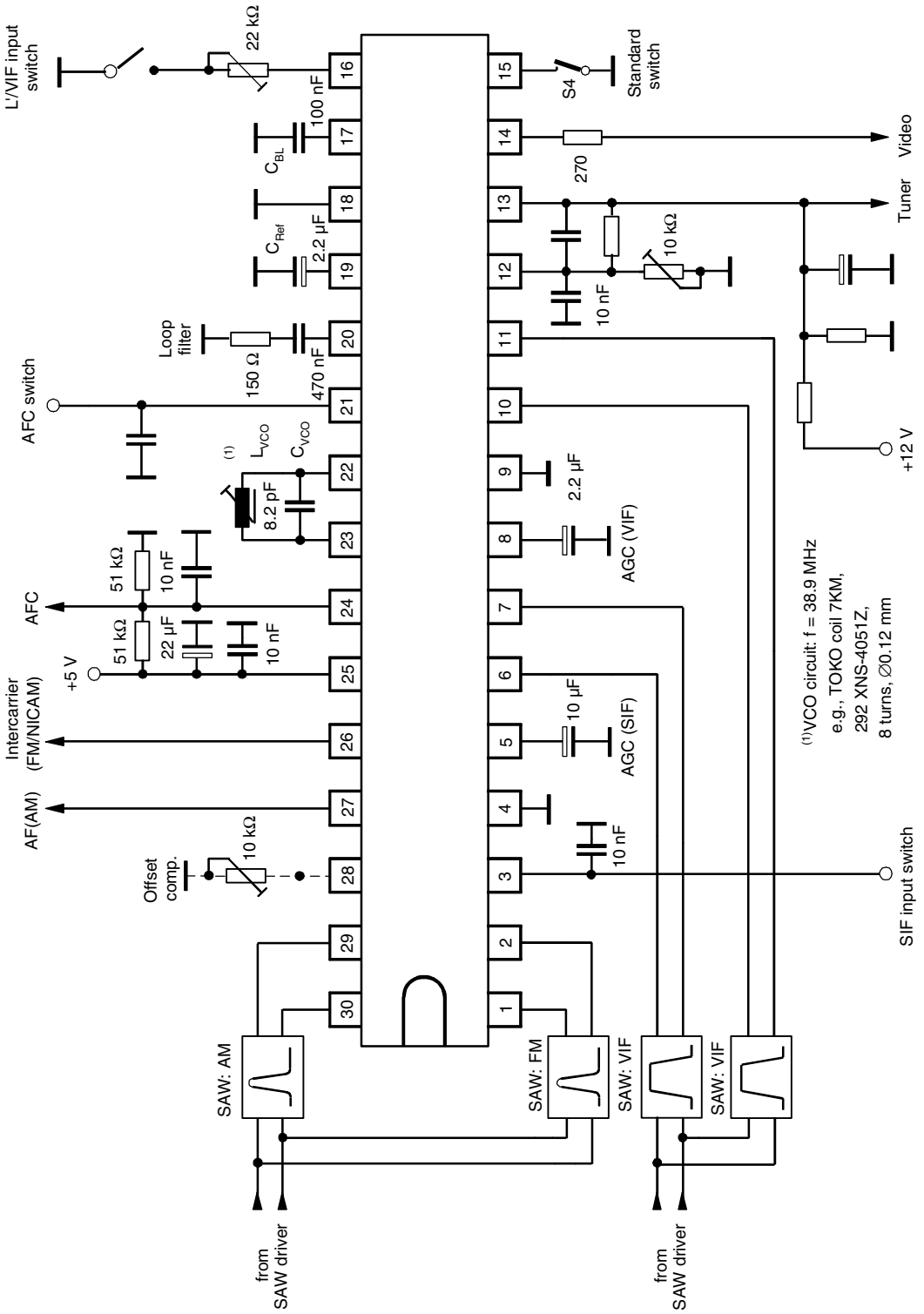


Figure 4. Basic Application Circuit



Internal Pin Configuration

Figure 5. Sound IF Inputs (Pins 1-2, 29-30)

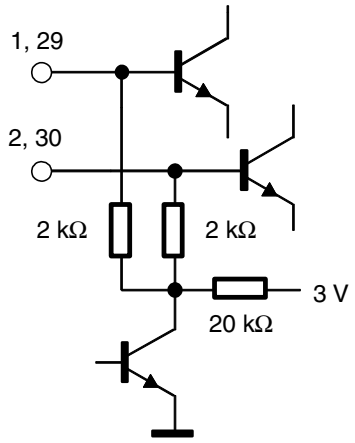


Figure 6. Input Selector Switch (Pin 3)

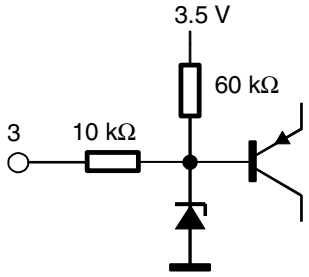


Figure 7. SIF-AGC Time Constant (Pin 5)

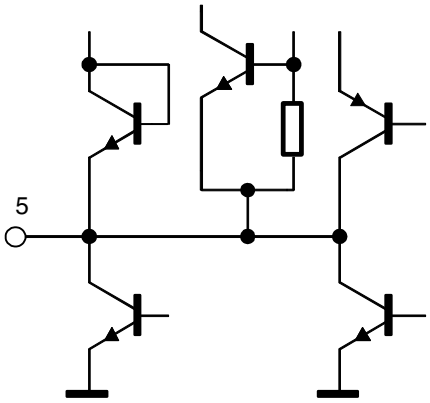


Figure 8. Video IF Input 1 (Pins 6-7)

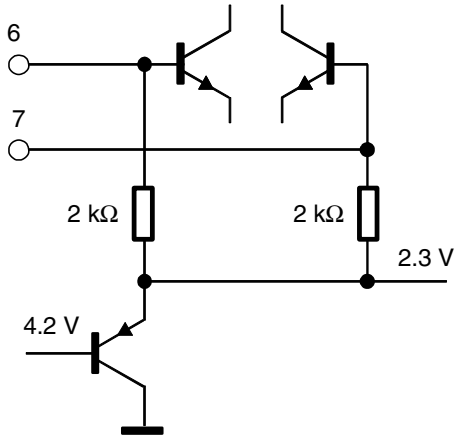


Figure 9. VIF-AGC Time Constant (Pin 8)

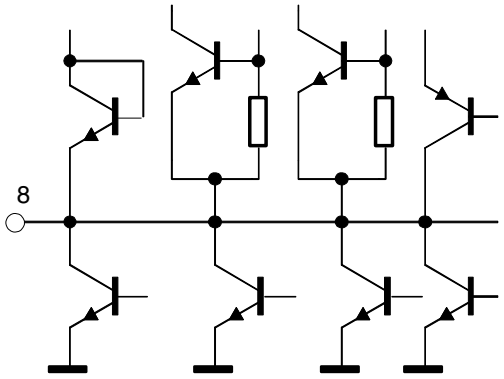


Figure 10. Video IF Input 2 (Pins 10-11)

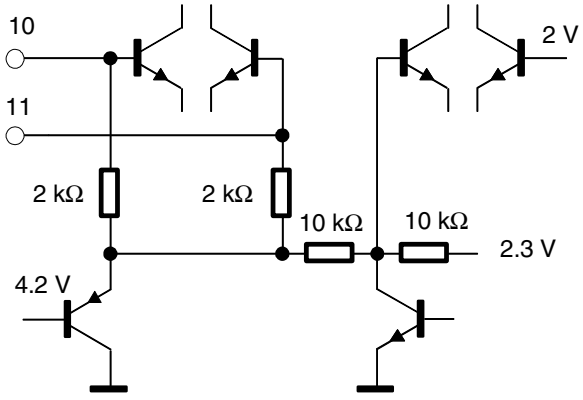


Figure 11. Tuner AGC - Take-over Point (Pin 12)

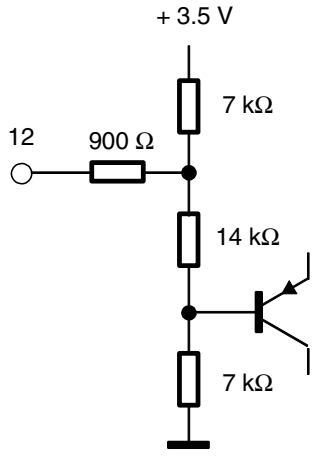


Figure 12. Tuner AGC - Output (Pin 13)

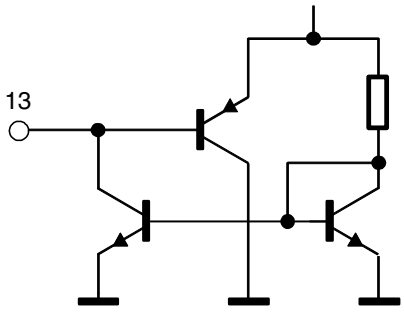


Figure 13. Video Output (Pin 14)

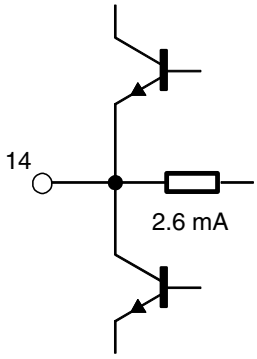


Figure 14. Standard Switch (Pin 15)

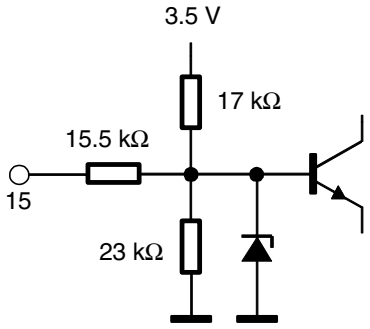


Figure 15. L'/VIF Input Switch (Pin 16)

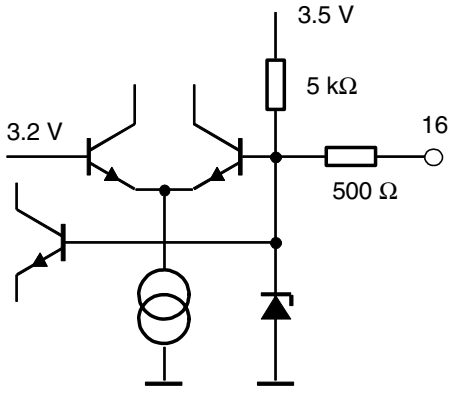


Figure 16. Black Level Capacitor (Pin 17)

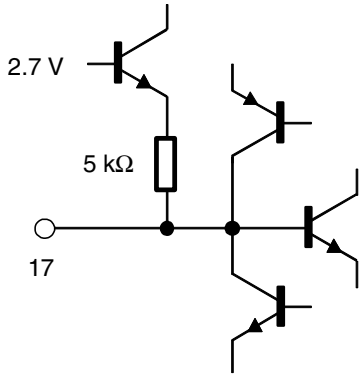


Figure 17. Internal Reference Voltage (Pin 19)

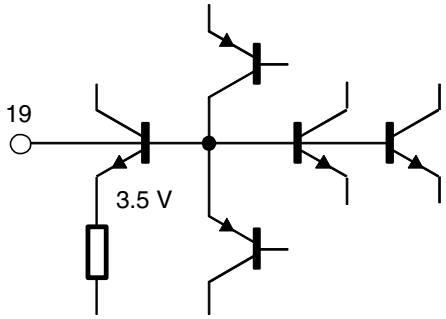


Figure 18. Loop Filter (Pin 20)

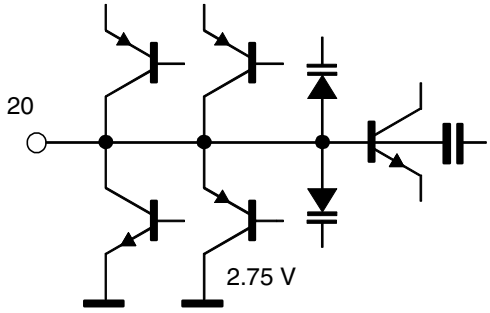


Figure 19. AFC Switch (Pin 21)

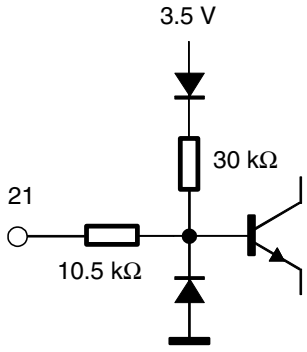


Figure 20. VCO (Pins 22-23)

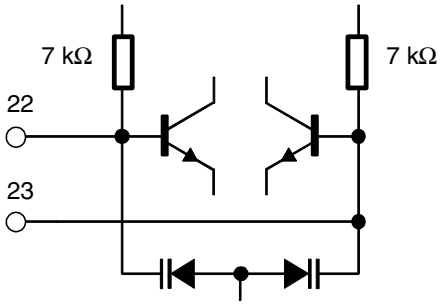


Figure 21. AFC Output (Pin 24)

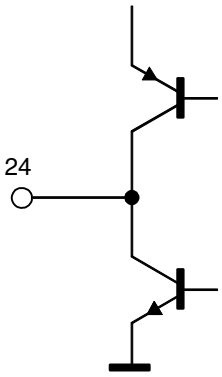


Figure 22. Intercarrier Output (Pin 26)

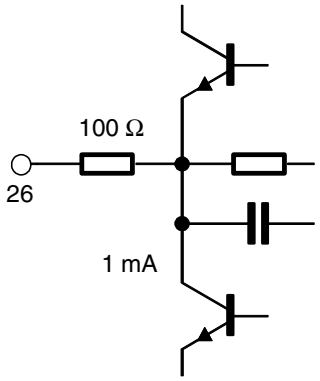


Figure 23. AF-AM Output (Pin 27)

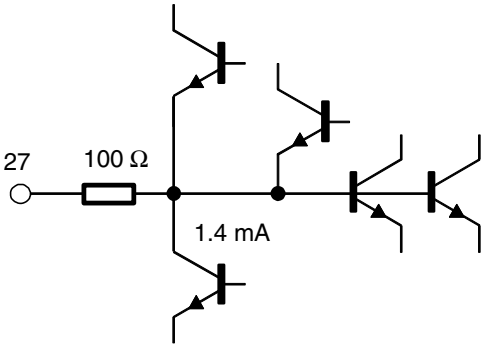
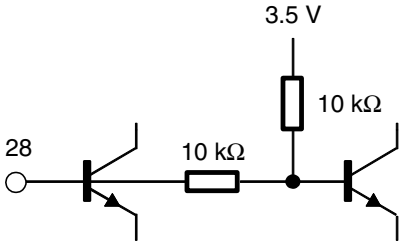


Figure 24. VCO Offset Compensation (Pin 28)



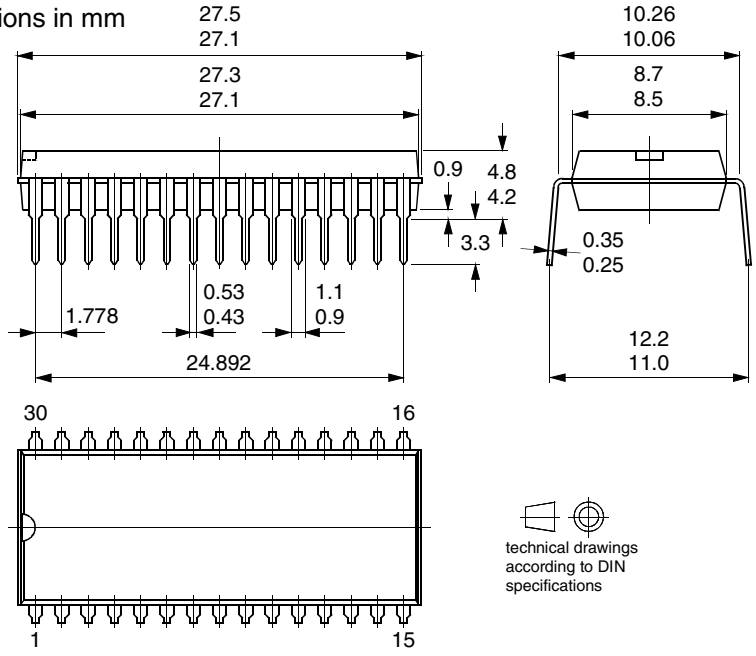
Ordering Information

Extended Type Number	Package	Remarks
TDA4474-MSD	SDIP30	–

Package Information

Package SDIP30

Dimensions in mm



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