DVB-Cable IF Converter and Full Multi-Standard Video-/Sound IF Processing

Description

The U4479B is a bipolar circuit for the processing of cable DVB IF (**D**igital **V**ideo **B**roadcasting) and multi-standard analog TV IF signals. The combi circuit processes QAM modulated IF signals, all TV video IF with negative/ positive modulation and the FM/ NICAM, AM sound IF signals. With 5 V supply voltage the IC is suitable for cable DVB receiver (set top boxes).

Features

- 5 V supply voltage; low power consumption
- DVB signal processing with a converter for the 2nd IF; VCO is controlled by an external PLL
- Active carrier generation by FPLL principle (frequency-phase-locked-loop) for true synchronous demodulation in the “analog mode”
- Switchable VCO frequency (33.4/38.9/43.0 MHz)
- Very linear video demodulation, good pulse response and excellent intermodulation figures
- Bandwidth of the output signal 10 MHz (–1 dB) in DVB mode
- Alignment-free AFC
- AGC for negative modulation signals (peak sync detection) and for positive modulation (peak white/ black level detector)
- AGC with average detection for the QAM modulated DVB signal, reference level is adjustable
- Tuner AGC with adjustable take over point
- Alignment-free quasi parallel sound (QPS) mixer for FM/NICAM sound IF signals
- 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)
- Two IF inputs for DVB-/Analog Video IF
- One sound IF input

Ordering Information

Extended Type Number	Package	Remarks
U4479B-MFLG3	SO28	Taped and reeled

Block Diagram

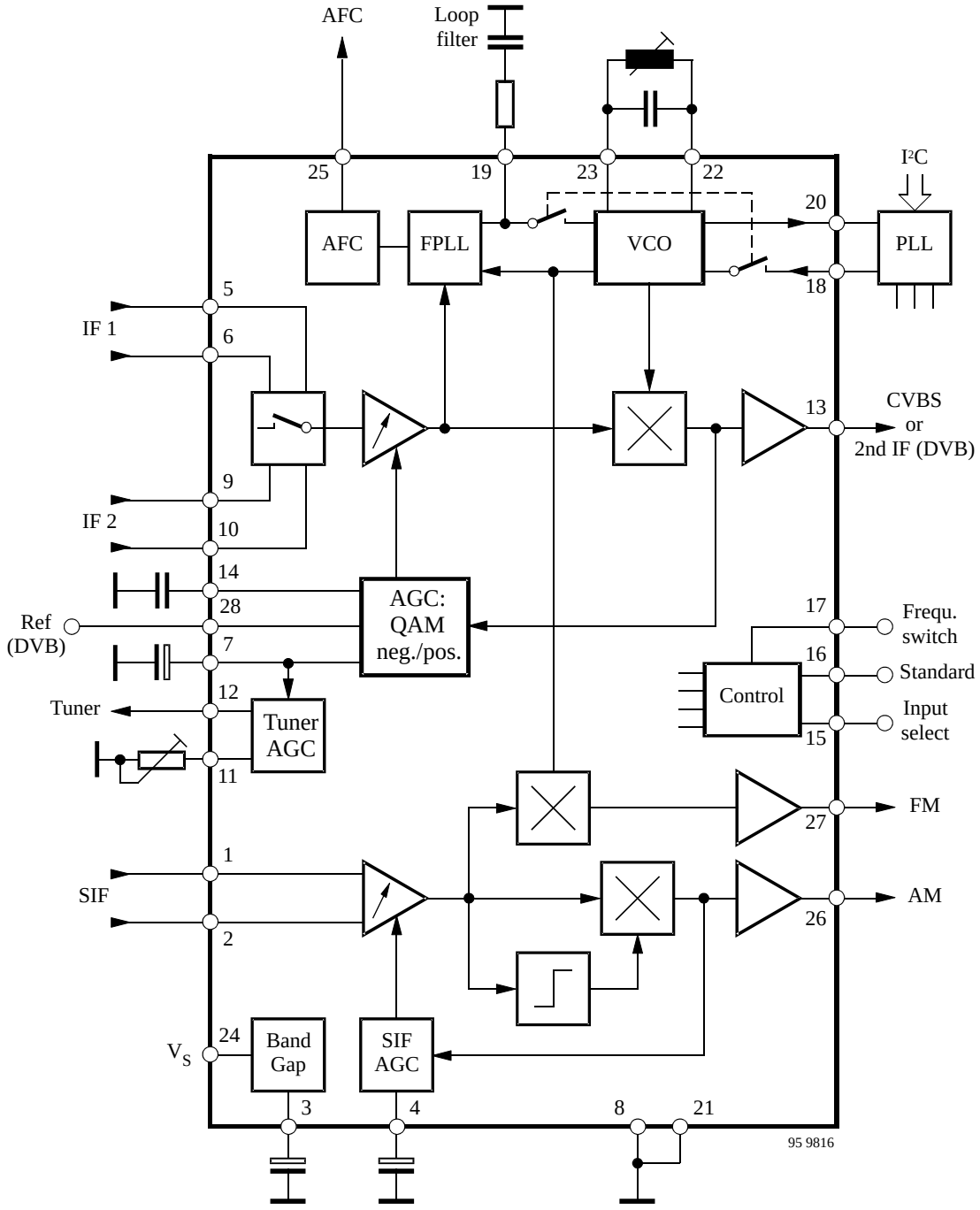


Figure 1. Block diagram

Pin Description

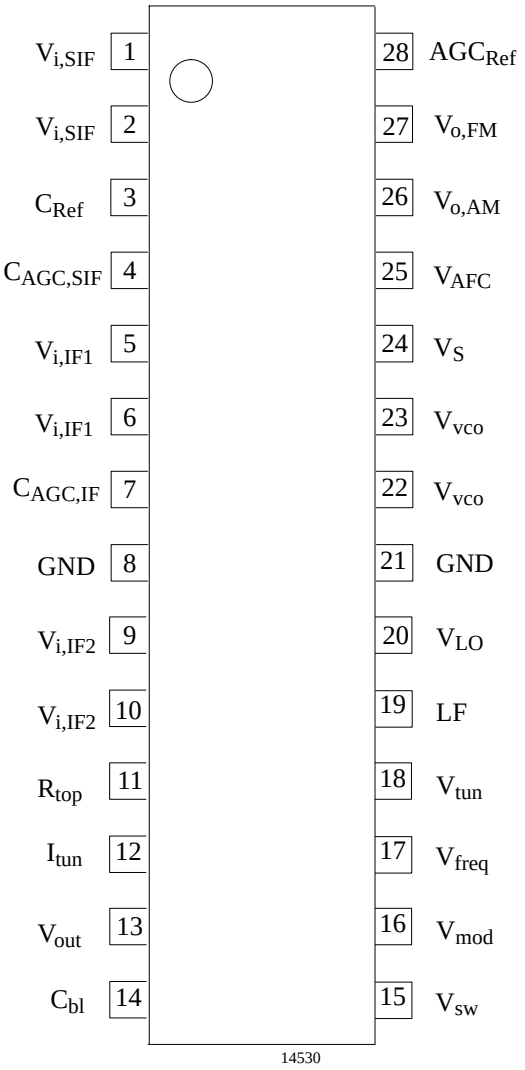


Figure 2. Pinning

Pin	Symbol	Function
1, 2	$V_{i,SIF}$	SIF input (symmetrical)
3	C_{Ref}	Internal reference voltage (BG)
4	$C_{AGC,SIF}$	SIF-AGC (time constant)
5, 6	$V_{i,IF1}$	IF1 input (symmetrical)
7	$C_{AGC,IF}$	IF-AGC (time constant)
8	GND	Ground
9, 10	$V_{i,IF2}$	IF2 input (symmetrical)
11	R_{top}	Take over point, tuner AGC
12	I_{tun}	Tuner AGC output current
13	V_{out}	CVBS or 2nd IF output
14	C_{bl}	Capacitor – black level detector
15	V_{sw}	IF input selector switch
16	V_{mod}	Modulation switch
17	V_{freq}	VCO frequency switch
18	V_{tun}	External VCO tuning voltage
19	LF	Loop filter
20	V_{LO}	Local oscillator output voltage
21	GND	Ground
22, 23	V_{vco}	VCO circuit (symmetrical)
24	V_s	Supply voltage
25	V_{AFC}	AFC output
26	$V_{o,AM}$	AF output – AM sound
27	$V_{o,FM}$	Intercarrier output
28	AGC_{Ref}	AGC reference for DVB operation

Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Supply voltage	V_S	5.5	V
Supply current	I_S	100	mA
Power dissipation, V_S = 5.5 V	P_{tot}	550	mW
Output currents	I_{out}	5	mA
Junction temperature	T_j	125	°C
Storage temperature	T_{stg}	–25 to +125	°C
Electrostatic handling *)	V_{ESD}	tbd	V

*) Equivalent to discharging a 200-pF capacitor through a 0-Ω resistor

Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range	V_S	4.5 to 5.5	V
Ambient temperature	T_{amb}	0 to +85	°C

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient (when soldered to PCB)	R_{thJA}	75	K/W

Electrical Characteristics

V_S = 5 V, T_{amb} = +25°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
DC supply						
Supply voltage		V_S	4.5	5.0	5.5	V
Supply current		I_S		80	100	mA
Video IF- and DVB IF inputs						
Input sensitivity, RMS value		v_{in}		80	120	µV
Input impedance	See note 1	R_{in}		1.2		kΩ
Input capacitance	See note 1	C_{in}		2		pF
Video IF AGC (negative/ positive modulation)						
IF gain control range		G_v	60	65		dB
AGC capacitor		C_{AGC}		2.2		µF
Black level capacitor		C_{BL}		100		nF
DVB AGC (QAM modulation)						
IF gain control range	IF2 output voltage Pin 13 = 1.8 Vpp	G_v	60	65		dB
Tuner AGC						
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%	G_{IF}		8	10	dB
IF input signal for minimum take over point		v_{in}			4	mV
IF input signal for maximum take over point		v_{in}	40			mV
Variation of the take over point by temperature	ΔT_{amb} = 55°C IF AGC: G_v = 46 dB	Δv_{in}		2	3	dB

Electrical Characteristics (continued)

V_S = 5 V, T_{amb} = +25°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
FPLL and VCO						
Max. oscillator frequency	For carrier generation	f_{vco}	70			MHz
Capture range	f_{vco} = 38.9 MHz C_{vco} = 8.2 pF	Δf_{cap}	±1.4			MHz
Oscillator drift (free runing) as function of temperature	See note 2, ΔT_{amb} = 55°C, C_{vco} = 8.2 pF, f_{vco} = 38.9 MHz	$\Delta f/_{\Delta T}$			–0.3	%
Local oscillator output signal	Internal control loop switched off	LO_{out}		100		mV
Local oscillator control signal	Internal control loop switched off	v_{tun}	0.5		4.5	V
CVBS and 2nd IF output						
Output current –source –sink		$\pm I_{out}$	 2		5 4	mA mA
Output resistance	See note 1	R_{out}			100	Ω
Output amplitude DVB signal CVBS signal	Peak to peak value	$v_{o,vid}$	 1.6 1.8	 1.8 2.0	 2.0 2.2	 V V
Difference of the CVBS signals	Between B/G and L	$\Delta v_{o,vid}$			10	%
DC output voltage	DVB mode			2.2		V
Sync level	B/G mode	V_{sync}		1.2		V
Zero carrier level for negative modulation (Ultra white level)	B/G mode	V_{DC}		3.4		V
Zero carrier level for positive modulation (Ultra black level)	L mode	V_{DC}		1.14		V
Supply voltage influence on the ultra black- and ultra white level		$\Delta V/_V$		1		%/V
Bandwidth (–1 dB) of 2nd IF, in DVB mode	$R_L \geq 1$ kΩ, $C_L \leq 50$ pF	B	10			MHz
Frequency response over 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 3	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}		5	15	mV

Electrical Characteristics (continued)

V_S = 5 V, T_{amb} = +25°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
AFC output						
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
SIF input						
Input sensitivity, RMS value	Output signal: –3 dB	v_{in}		80	120	V
Input impedance	See note 1	R_{in}		1.2		kΩ
Input capacitance	See note 1	C_{in}		2		pF
SIF – AGC						
IF gain control range		G_v	60	65		dB
AGC capacitor		C_{AGC}		4.7		µF
Intercarrier output FM (see note 4)						
DC output voltage		V_{DC}		2		V
Output resistance	See note 1	R_{out}		150		Ω
Sound IF output voltage, RMS value	5.5 MHz output voltage v_{in} = 10 mV	v_{out}		200		mV
Weighted signal-to-noise ratio: (CCIR 468) Black screen: Channel 1/2 Grid pattern: Channel 1/2 Grey screen 50%: Channel 1/2	Reference signal: v_{in} =10 mV; f_{mod} = 1 kHz; FM dev. = ±27 kHz tested with the double FM demodulator U2860B; B/G modulated IF signal	 S/N S/N S/N		 60/58 54/52 60/57		 dB dB dB
AF output AM (see note 5)						
DC output voltage		V_{DC}		2.2		V
Output resistance	See note 1	R_{out}		150		Ω
AF output voltage, RMS value	m = 54 %	v_{oAF}		500		mV
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
IF input switch (Pin 15)						
Control voltage for HIGH: IF1 input active LOW: IF2 input active	See note 6	Vsw	2.5		 3.5 1.5	 V V
Switching current	Pin 15 to ground	Isw		30		µA

Electrical Characteristics (continued)

V_S = 5 V, T_{amb} = +25°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Modulation switch (pin 16):						
Control voltage for HIGH: neg. modulation LOW: pos. modulation	See note 6	V_{mod}	2.5		3.5 1.5	V V
Switching current	Pin 16 to ground	I_{mod}		30		µA
Frequency switch (Pin 17)						
Control voltage for HIGH: f_{VCO} = 38.9 MHz LOW: f_{VCO} = 33.4/43 MHz (depends on Pin 16)	see also note 6	V_{freq}	3.35		3.5 3.2	V V
Switching current	Pin 17 to ground	I_{freq}			700	µA

Table of Switch Settings

Active IF input	IF 1 (Pins 5, 6)	IF 2 (Pins 9, 10)
IF input switch (Pin 15)	Pin 15 ‘high’	Pin 15 ‘low’

Standard	DVB	BG	L	L’
VCO frequency	43 MHz	38.9 MHz	38.9 MHz	33.4 MHz (see note 7)
Modulation switch (Pin 16)	‘high’	‘high’	‘low’	‘low’
Frequency switch (Pin 17)	‘low’	‘high’	‘high’	‘low’

Notes

1. This parameter is given as an application information and it is not tested during production.
2. The oscillator drift is related to the picture carrier frequency, at external temperature-compensated LC circuit
3. 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
   color carrier –6 dB
   sound carrier –24 dB
4. 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)
5. Sound carrier SC = 32.4 MHz, modulated with f_{mod} = 1 kHz, m = 54%; v_{in} = 10 mV
6. Without control voltage ‘High Level’ mode is automatically selected
7. For L’: AFC is adjustable with external potentiometer

Basic Application Circuit

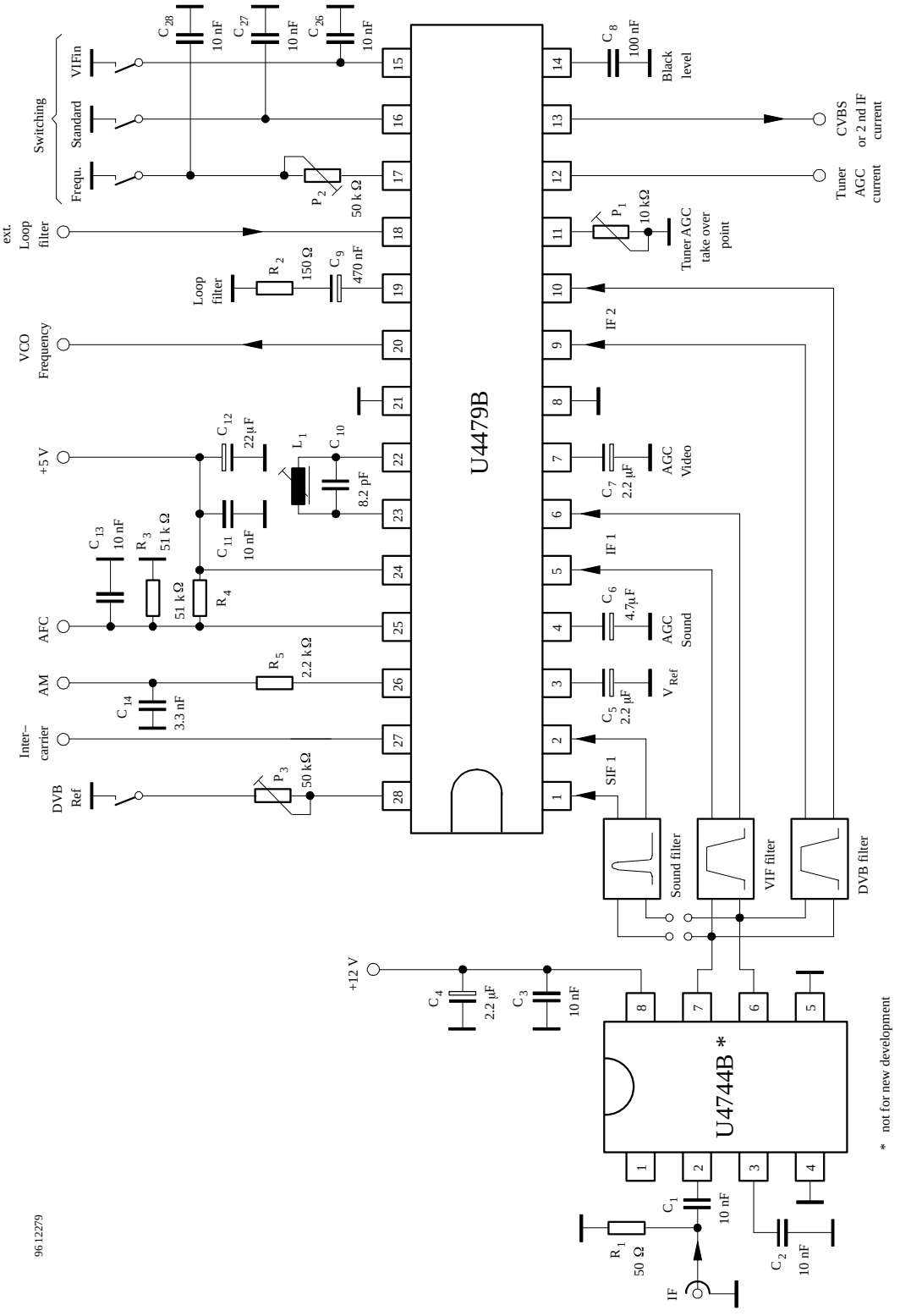


Figure 3. Basic application circuit

IM3 Measurements and Application Recommendations for DVB Operation

IM3 Measurement

For correct measurement of IM3 with the 2-carrier method, it is necessary to control the internal IF amplifier via an external voltage at Pin 7. The criteria for a correct value of the external control voltage is the output amplitude of 1.8 V_{pp} (or lower). Please note that each change of the input level requests a correction of the external gain control voltage at Pin 7 in order to achieve the 1.8-V_{pp} output level again. In this case, IM3 is nearly 43 dB, independent from the input level. With an output voltage of 1.5 V_{pp} only, the IM3 is about –50 dB. Anyway, if the output amplitude is more than 1.8 V_{pp} (specified), the IM3 will decrease rapidly. In the graphic below, IM3 is shown for two different conditions:

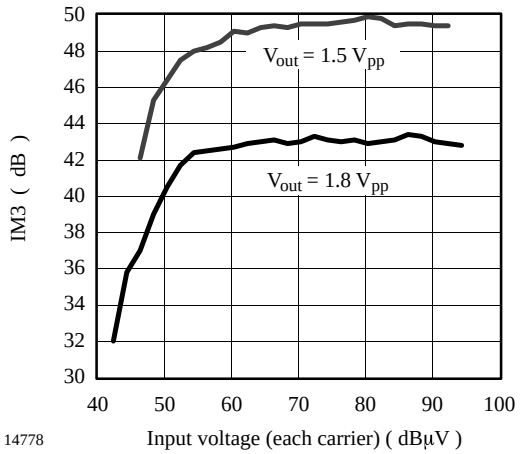


Figure 4. IM3 vs. IF input voltage and IF2out voltage
Test conditions: input: f_1 = 38 MHz,
f_2 = 39 MHz, LO = 43 MHz

Circuitry for External Gain Control

If the gain control of the IC is carried out by an external DSP, the internal charge pumps of the AGC (Pin 7) have to be overlapped by an external voltage source. The internal AGC currents are ± 20 µA. Therefore, the minimum current capacity of the external voltage source should be ± 30 µA or more.

The circuitry shown in figure 5 takes some more current.

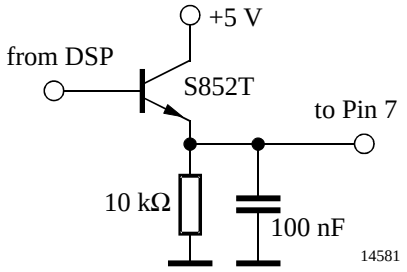


Figure 5.

External LO Application

If the internal VCO is not used, the LO can be fed unbalanced or balanced to the VCO Pins 22 and 23. The application shown below is generating an unbalanced LO signal by using a 36-MHz third-overtone quartz reference. The application circuit is taken from IQD Limited Crystal Product Data Book. The LO signal is fed unbalanced with 1 nF coupling capacity to Pin 22. Pin 23 has to be blocked to ground with an 1-nF capacitor. The typical LO amplitude is 100 dBµV. The variation of the LO input amplitude should not exceed ± 5 dB (better: ±3 dB).

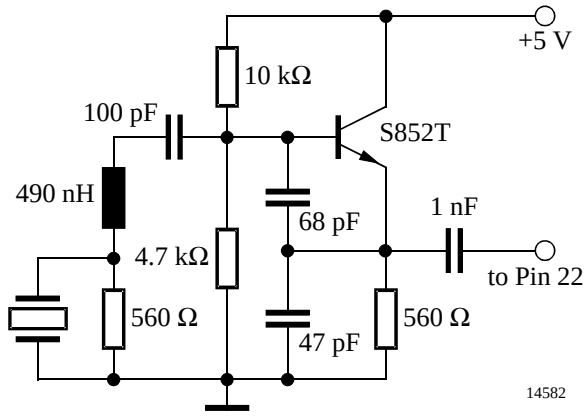
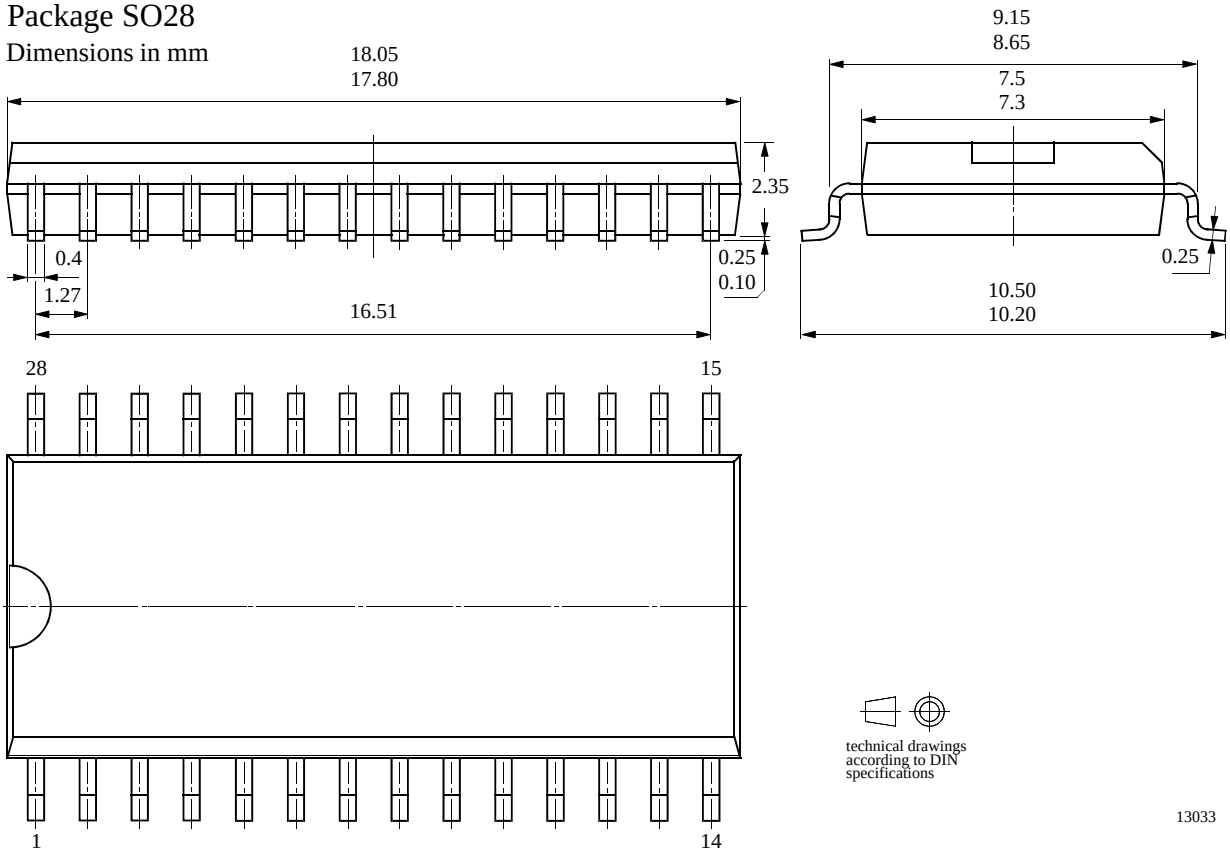


Figure 6.

Note:
With external LO operation, Pin 18 (VCO tuning voltage) should be connected to the supply voltage, and Pin 20 (LO output) should not be connected to the PCB.

Package Information

Package SO28
Dimensions in mm



Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic 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.

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division 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.

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

TEMIC TELEFUNKEN microelectronic GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany
Telephone: 49 (0)7131 67 2831, Fax number: 49 (0)7131 67 2423