

## 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

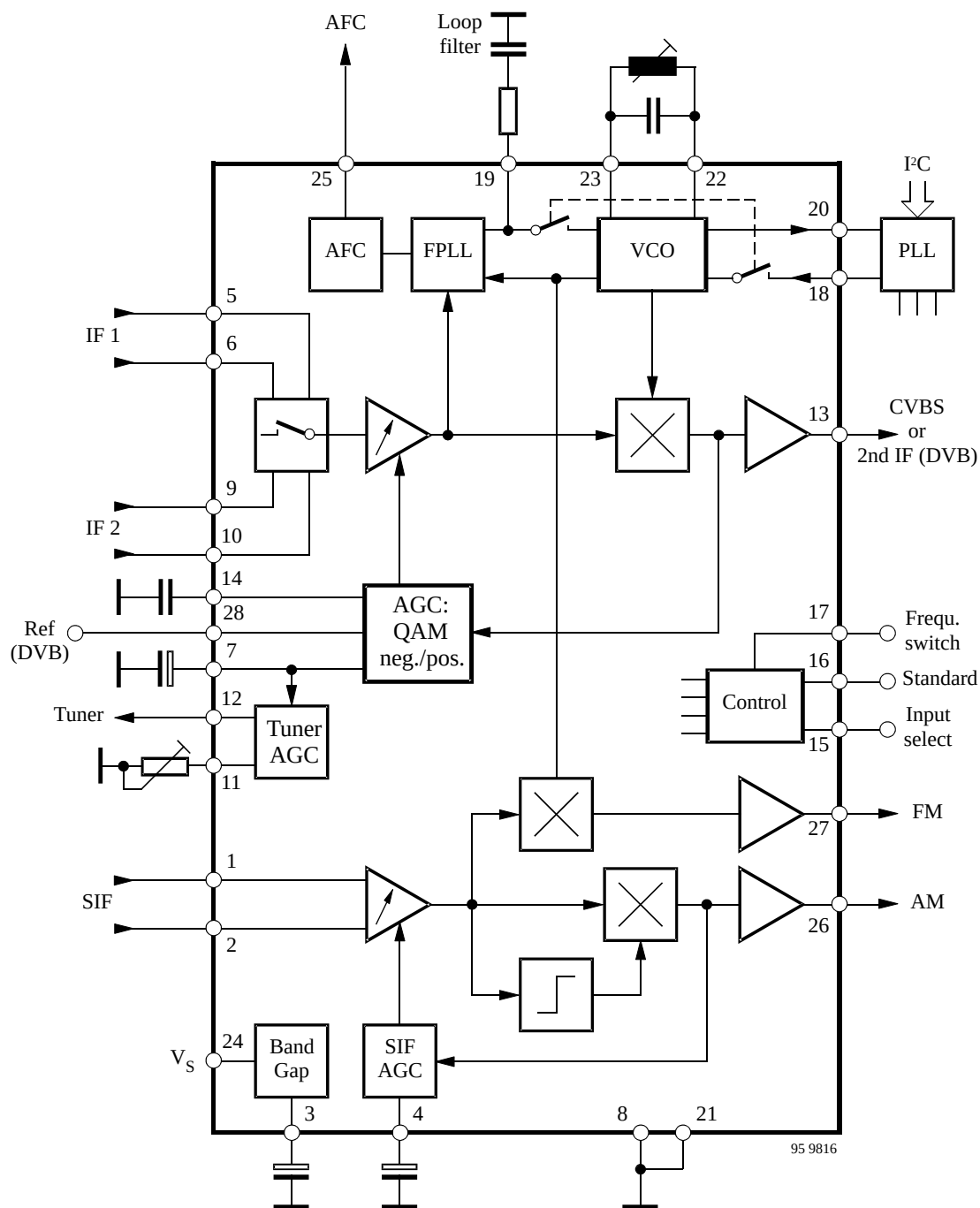
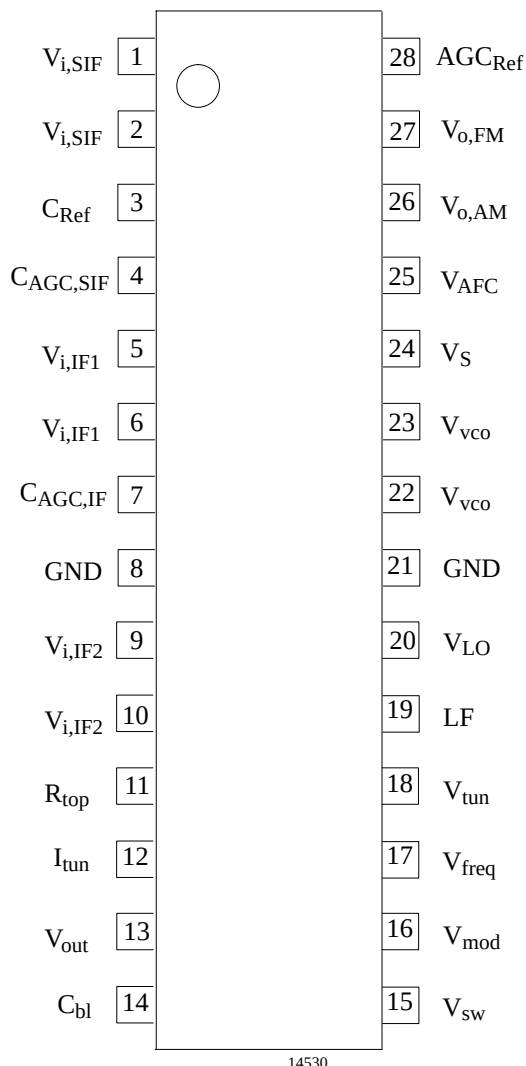


Figure 1. Block diagram

## Pin Description



14530

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

$V_S = 5\text{ V}$ ,  $T_{amb} = +25^\circ\text{C}$

| Parameters                                          | Test Conditions / Pins                                              | Symbol          | Min. | Typ. | Max. | Unit          |
|-----------------------------------------------------|---------------------------------------------------------------------|-----------------|------|------|------|---------------|
| <b>DC supply</b>                                    |                                                                     |                 |      |      |      |               |
| Supply voltage                                      |                                                                     | $V_S$           | 4.5  | 5.0  | 5.5  | V             |
| Supply current                                      |                                                                     | $I_S$           |      | 80   | 100  | mA            |
| <b>Video IF- and DVB IF inputs</b>                  |                                                                     |                 |      |      |      |               |
| Input sensitivity, RMS value                        |                                                                     | $v_{in}$        |      | 80   | 120  | $\mu\text{V}$ |
| Input impedance                                     | See note 1                                                          | $R_{in}$        |      | 1.2  |      | $k\Omega$     |
| Input capacitance                                   | See note 1                                                          | $C_{in}$        |      | 2    |      | pF            |
| <b>Video IF AGC (negative/ positive modulation)</b> |                                                                     |                 |      |      |      |               |
| IF gain control range                               |                                                                     | $G_v$           | 60   | 65   |      | dB            |
| AGC capacitor                                       |                                                                     | $C_{AGC}$       |      | 2.2  |      | $\mu\text{F}$ |
| Black level capacitor                               |                                                                     | $C_{BL}$        |      | 100  |      | nF            |
| <b>DVB AGC (QAM modulation)</b>                     |                                                                     |                 |      |      |      |               |
| IF gain control range                               | IF2 output voltage<br>Pin 13 = 1.8 Vpp                              | $G_v$           | 60   | 65   |      | dB            |
| <b>Tuner AGC</b>                                    |                                                                     |                 |      |      |      |               |
| 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     | $\Delta T_{amb} = 55^\circ\text{C}$<br>IF AGC: $G_v = 46\text{ dB}$ | $\Delta v_{in}$ |      | 2    | 3    | dB            |

## Electrical Characteristics (continued)

$V_S = 5\text{ V}$ ,  $T_{\text{amb}} = +25^\circ\text{C}$

| Parameters                                                                              | Test Conditions / Pins                                                                                                                  | Symbol                    | Min.       | Typ.       | Max.       | Unit     |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------|------------|------------|----------|
| <b>FPLL and VCO</b>                                                                     |                                                                                                                                         |                           |            |            |            |          |
| Max. oscillator frequency                                                               | For carrier generation                                                                                                                  | $f_{\text{VCO}}$          | 70         |            |            | MHz      |
| Capture range                                                                           | $f_{\text{VCO}} = 38.9\text{ MHz}$<br>$C_{\text{VCO}} = 8.2\text{ pF}$                                                                  | $\Delta f_{\text{cap}}$   | $\pm 1.4$  |            |            | MHz      |
| Oscillator drift<br>(free running) as function of<br>temperature                        | See note 2,<br>$\Delta T_{\text{amb}} = 55^\circ\text{C}$ ,<br>$C_{\text{VCO}} = 8.2\text{ pF}$ ,<br>$f_{\text{VCO}} = 38.9\text{ MHz}$ | $\Delta f / \Delta T$     |            |            | -0.3       | %        |
| Local oscillator output<br>signal                                                       | Internal control loop<br>switched off                                                                                                   | $\text{LO}_{\text{out}}$  |            | 100        |            | mV       |
| Local oscillator control<br>signal                                                      | Internal control loop<br>switched off                                                                                                   | $v_{\text{tun}}$          | 0.5        |            | 4.5        | V        |
| <b>CVBS and 2nd IF output</b>                                                           |                                                                                                                                         |                           |            |            |            |          |
| Output current    -source<br>-sink                                                      |                                                                                                                                         | $\pm I_{\text{out}}$      | 2          |            | 5<br>4     | mA<br>mA |
| Output resistance                                                                       | See note 1                                                                                                                              | $R_{\text{out}}$          |            |            | 100        | $\Omega$ |
| Output amplitude<br>DVB signal<br>CVBS signal                                           | Peak to peak value                                                                                                                      | $v_{\text{o,vid}}$        | 1.6<br>1.8 | 1.8<br>2.0 | 2.0<br>2.2 | V<br>V   |
| Difference of the CVBS sig-<br>nals                                                     | Between B/G and L                                                                                                                       | $\Delta v_{\text{o,vid}}$ |            |            | 10         | %        |
| DC output voltage                                                                       | DVB mode                                                                                                                                |                           |            | 2.2        |            | V        |
| Sync level                                                                              | B/G mode                                                                                                                                | $V_{\text{sync}}$         |            | 1.2        |            | V        |
| Zero carrier level for<br>negative modulation<br>(Ultra white level)                    | B/G mode                                                                                                                                | $V_{\text{DC}}$           |            | 3.4        |            | V        |
| Zero carrier level for<br>positive modulation<br>(Ultra black level)                    | L mode                                                                                                                                  | $V_{\text{DC}}$           |            | 1.14       |            | V        |
| Supply voltage influence on<br>the ultra black- and ultra<br>white level                |                                                                                                                                         | $\Delta V / V$            |            | 1          |            | %/V      |
| Bandwidth (-1 dB) of<br>2nd IF, in DVB mode                                             | $R_L \geq 1\text{ k}\Omega$ , $C_L \leq 50\text{ pF}$                                                                                   | B                         | 10         |            |            | MHz      |
| Frequency response over<br>AGC range                                                    |                                                                                                                                         | $\Delta B$                |            |            | 2.0        | dB       |
| Differential gain error                                                                 |                                                                                                                                         | DG                        |            | 2          | 5          | %        |
| Differential phase error                                                                |                                                                                                                                         | DP                        |            | 2          | 5          | deg      |
| Intermodulation 1.07 MHz                                                                | See note 3                                                                                                                              | $\alpha_{\text{IM}}$      | 52         | 60         |            | dB       |
| Video signal-to-noise ratio                                                             | Weighted, CCIR-567                                                                                                                      | S/N                       | 56         | 60         |            | dB       |
| Residual vision carrier<br>fundamental wave<br>38.9 MHz and second<br>harmonic 77.8 MHz |                                                                                                                                         | $v_{\text{res1}}$         |            | 5          | 15         | mV       |

**Electrical Characteristics (continued)**
 $V_S = 5\text{ V}$ ,  $T_{\text{amb}} = +25^\circ\text{C}$ 

| Parameters                                                             | Test Conditions / Pins                                                                                                                                                                                  | Symbol              | Min.        | Typ.      | Max.       | Unit              |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------|-----------|------------|-------------------|
| <b>AFC output</b>                                                      |                                                                                                                                                                                                         |                     |             |           |            |                   |
| Control slope                                                          |                                                                                                                                                                                                         | $\Delta I/\Delta f$ |             | 0.7       |            | $\mu\text{A/kHz}$ |
| Frequency drift by temperature                                         | Related to the picture carrier frequency                                                                                                                                                                |                     |             | 0.25      | 0.6        | %                 |
| Output voltage<br>upper limit<br>lower limit                           |                                                                                                                                                                                                         | $V_{\text{AFC}}$    | $V_S - 0.4$ |           | 0.4        | V<br>V            |
| Output current                                                         |                                                                                                                                                                                                         | $I_{\text{AFC}}$    |             | $\pm 0.2$ |            | mA                |
| <b>SIF input</b>                                                       |                                                                                                                                                                                                         |                     |             |           |            |                   |
| Input sensitivity,<br>RMS value                                        | Output signal: -3 dB                                                                                                                                                                                    | $v_{\text{in}}$     |             | 80        | 120        | V                 |
| Input impedance                                                        | See note 1                                                                                                                                                                                              | $R_{\text{in}}$     |             | 1.2       |            | k $\Omega$        |
| Input capacitance                                                      | See note 1                                                                                                                                                                                              | $C_{\text{in}}$     |             | 2         |            | pF                |
| <b>SIF – AGC</b>                                                       |                                                                                                                                                                                                         |                     |             |           |            |                   |
| IF gain control range                                                  |                                                                                                                                                                                                         | $G_v$               | 60          | 65        |            | dB                |
| AGC capacitor                                                          |                                                                                                                                                                                                         | $C_{\text{AGC}}$    |             | 4.7       |            | $\mu\text{F}$     |
| <b>Intercarrier output FM (see note 4)</b>                             |                                                                                                                                                                                                         |                     |             |           |            |                   |
| DC output voltage                                                      |                                                                                                                                                                                                         | $V_{\text{DC}}$     |             | 2         |            | V                 |
| Output resistance                                                      | See note 1                                                                                                                                                                                              | $R_{\text{out}}$    |             | 150       |            | $\Omega$          |
| Sound IF output voltage,<br>RMS value                                  | 5.5 MHz output voltage<br>$v_{\text{in}} = 10\text{ mV}$                                                                                                                                                | $v_{\text{out}}$    |             | 200       |            | mV                |
| Weighted signal-to-noise<br>ratio: (CCIR 468)                          | Reference signal:<br>$v_{\text{in}} = 10\text{ mV}$ ; $f_{\text{mod}} = 1\text{ kHz}$ ;<br>FM dev. = $\pm 27\text{ kHz}$<br>tested with the double FM<br>demodulator U2860B;<br>B/G modulated IF signal |                     |             |           |            |                   |
| Black screen: Channel 1/2                                              |                                                                                                                                                                                                         | S/N                 |             | 60/58     |            | dB                |
| Grid pattern: Channel 1/2                                              |                                                                                                                                                                                                         | S/N                 |             | 54/52     |            | dB                |
| Grey screen 50%:<br>Channel 1/2                                        |                                                                                                                                                                                                         | S/N                 |             | 60/57     |            | dB                |
| <b>AF output AM (see note 5)</b>                                       |                                                                                                                                                                                                         |                     |             |           |            |                   |
| DC output voltage                                                      |                                                                                                                                                                                                         | $V_{\text{DC}}$     |             | 2.2       |            | V                 |
| Output resistance                                                      | See note 1                                                                                                                                                                                              | $R_{\text{out}}$    |             | 150       |            | $\Omega$          |
| AF output voltage,<br>RMS value                                        | $m = 54\%$                                                                                                                                                                                              | $v_{\text{oAF}}$    |             | 500       |            | mV                |
| Total harmonic distortion                                              | $m = 54\%$<br>$f_{\text{mod}} = 1\text{ kHz}, 12.5\text{ kHz}$                                                                                                                                          | THD                 |             | 1         | 2          | %                 |
| Signal-to-noise ratio                                                  | Reference:<br>$m = 54\%$ , $f_{\text{mod}} = 1\text{ kHz}$ ,<br>22 kHz low-pass filter                                                                                                                  | S/N                 |             | 65        |            | dB                |
| <b>IF input switch (Pin 15)</b>                                        |                                                                                                                                                                                                         |                     |             |           |            |                   |
| Control voltage for<br>HIGH: IF1 input active<br>LOW: IF2 input active | See note 6                                                                                                                                                                                              | $V_{\text{sw}}$     | 2.5         |           | 3.5<br>1.5 | V<br>V            |
| Switching current                                                      | Pin 15 to ground                                                                                                                                                                                        | $I_{\text{sw}}$     |             | 30        |            | $\mu\text{A}$     |

## Electrical Characteristics (continued)

$V_S = 5\text{ V}$ ,  $T_{\text{amb}} = +25^\circ\text{C}$

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

## 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<br>(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.  $\alpha(1.07) = 20 \log (4.43\text{ MHz component} / 1.07\text{ MHz component})$ ;  
 $\alpha(1.07)$  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  $SC_1 = 33.4\text{ MHz}$ ,  $SC_2 = 33.16\text{ MHz}$ ;  
PC/ $SC_1 = 13\text{ dB}$ ; PC/ $SC_2 = 20\text{ dB}$ ; PC unmodulated (equivalent to sync peak level)
5. Sound carrier SC = 32.4 MHz, modulated with  $f_{\text{mod}} = 1\text{ kHz}$ ,  $m = 54\%$ ;  $v_{\text{in}} = 10\text{ mV}$
6. Without control voltage 'High Level' mode is automatically selected
7. For L': AFC is adjustable with external potentiometer

## Basic Application Circuit

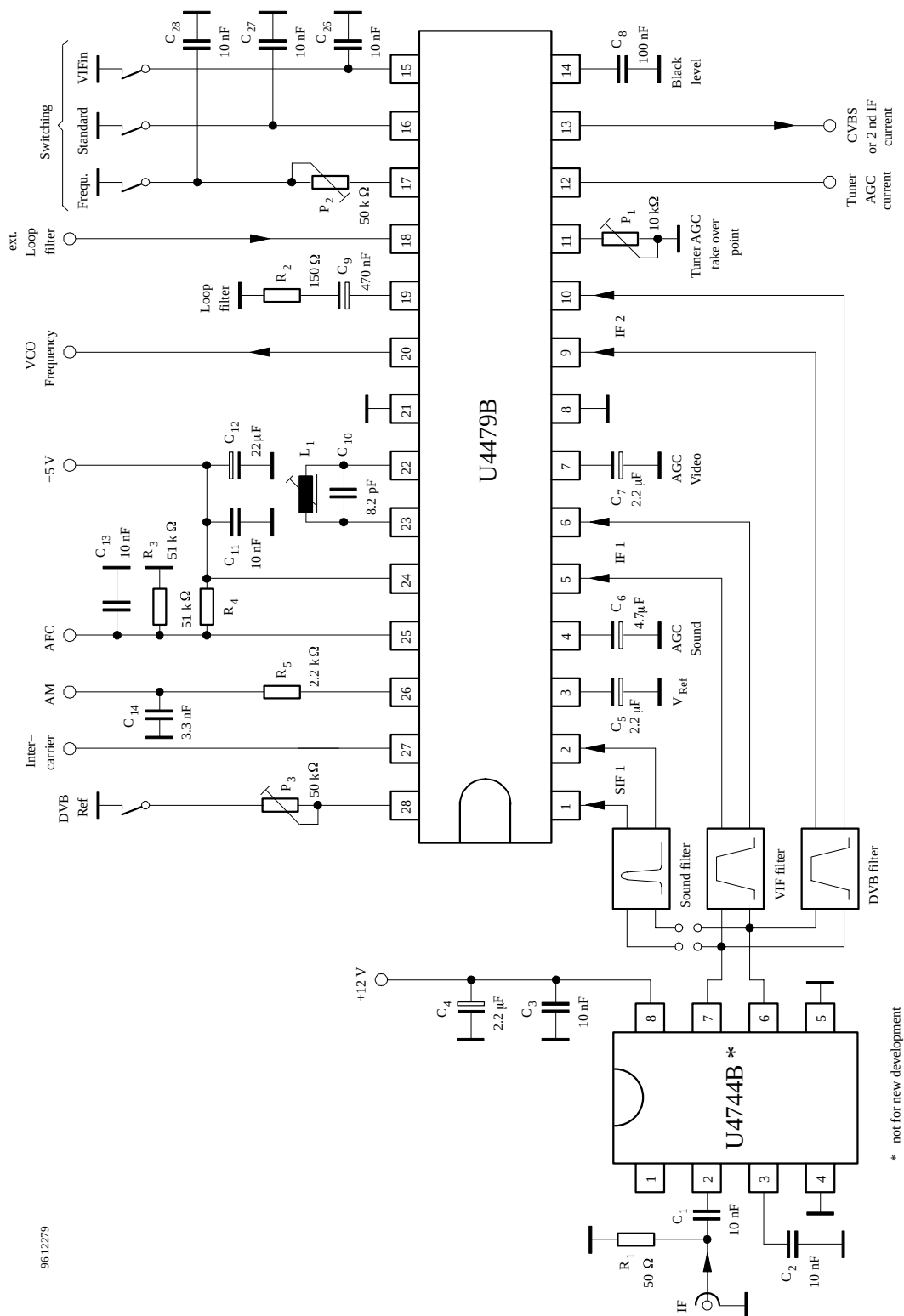


Figure 3. Basic application circuit

\* not for new development



## 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:

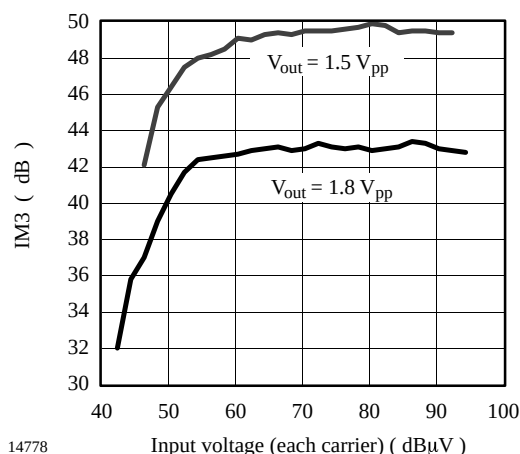


Figure 4. IM3 vs. IF input voltage and IF2out voltage  
Test conditions: input:  $f_1 = 38$  MHz,  
 $f_2 = 39$  MHz, LO = 43 MHz

### 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  $\pm 20 \mu A$ . Therefore, the minimum current capacity of the external voltage source should be  $\pm 30 \mu A$  or more.

The circuitry shown in figure 5 takes some more current.

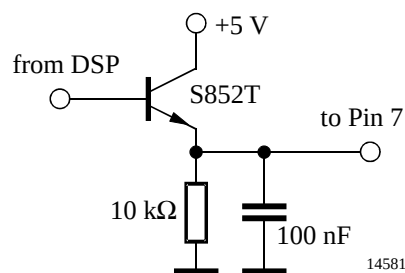


Figure 5.

### 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  $\pm 5$  dB (better:  $\pm 3$  dB).

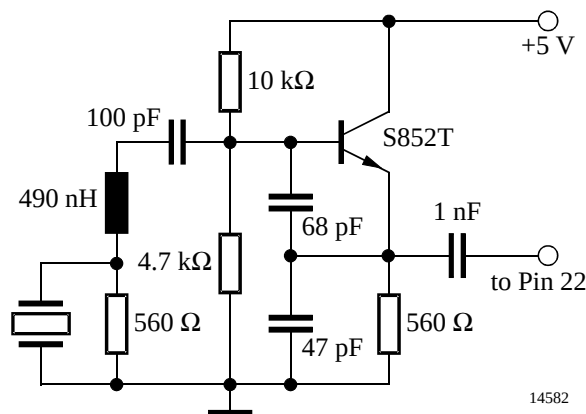


Figure 6.

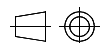
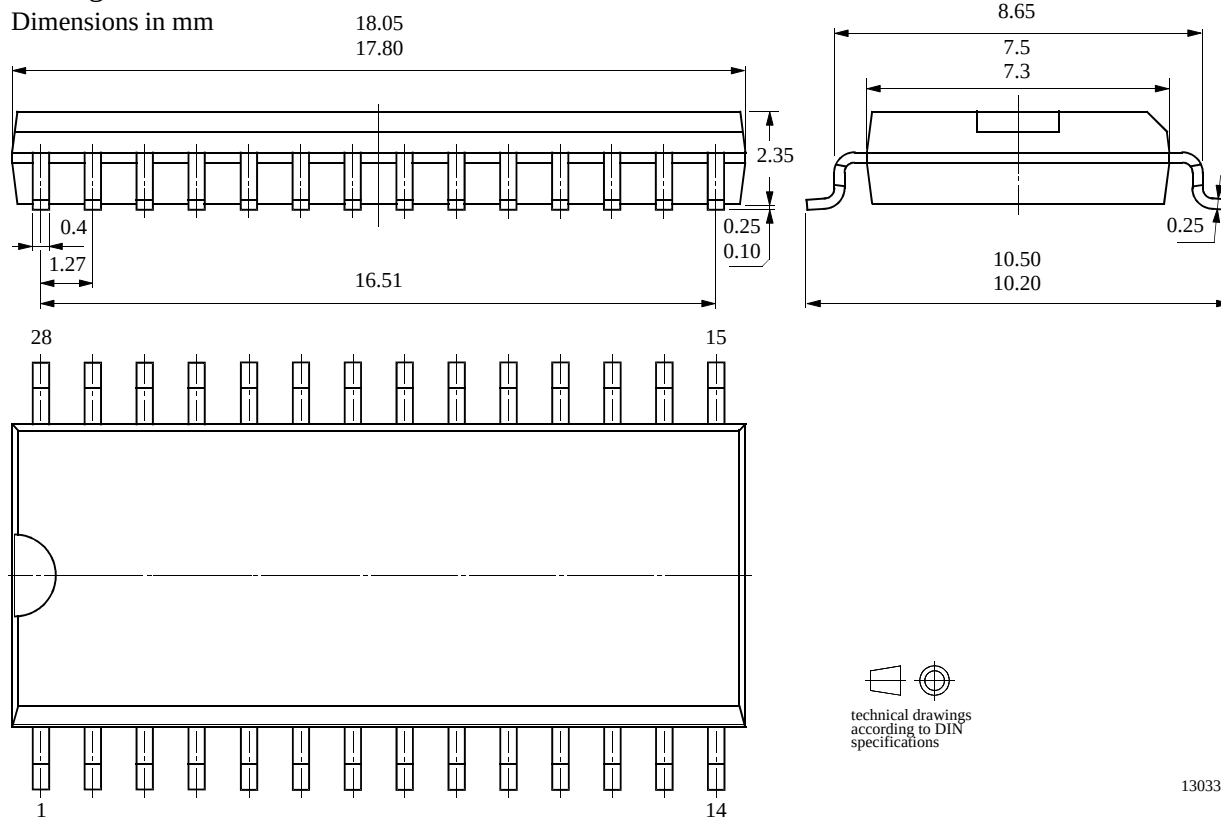
#### Note:

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



technical drawings  
according to DIN  
specifications

13033

## Ozone Depleting Substances Policy Statement

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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.

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