

## Video IF Amplifier with FPLL Demodulation

### Description

The U4460BG is an integrated bipolar circuit for video IF (VIF) signal processing in TV/VCR and multimedia applications.

The circuit processes all TV video IF signals with negative modulation (e.g., B/G standard).

### Features

- 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 operates on picture carrier frequency
  - Alignment-free AFC, no external reference circuit
  - VIF-AGC with peak sync. detection
  - Tuner AGC with adjustable take over point
  - 5 V supply voltage; low power consumption
  - Relevant pinning is compatible with the TDA4474 /71 video-/ sound IF combination
- Package:** SDIP28

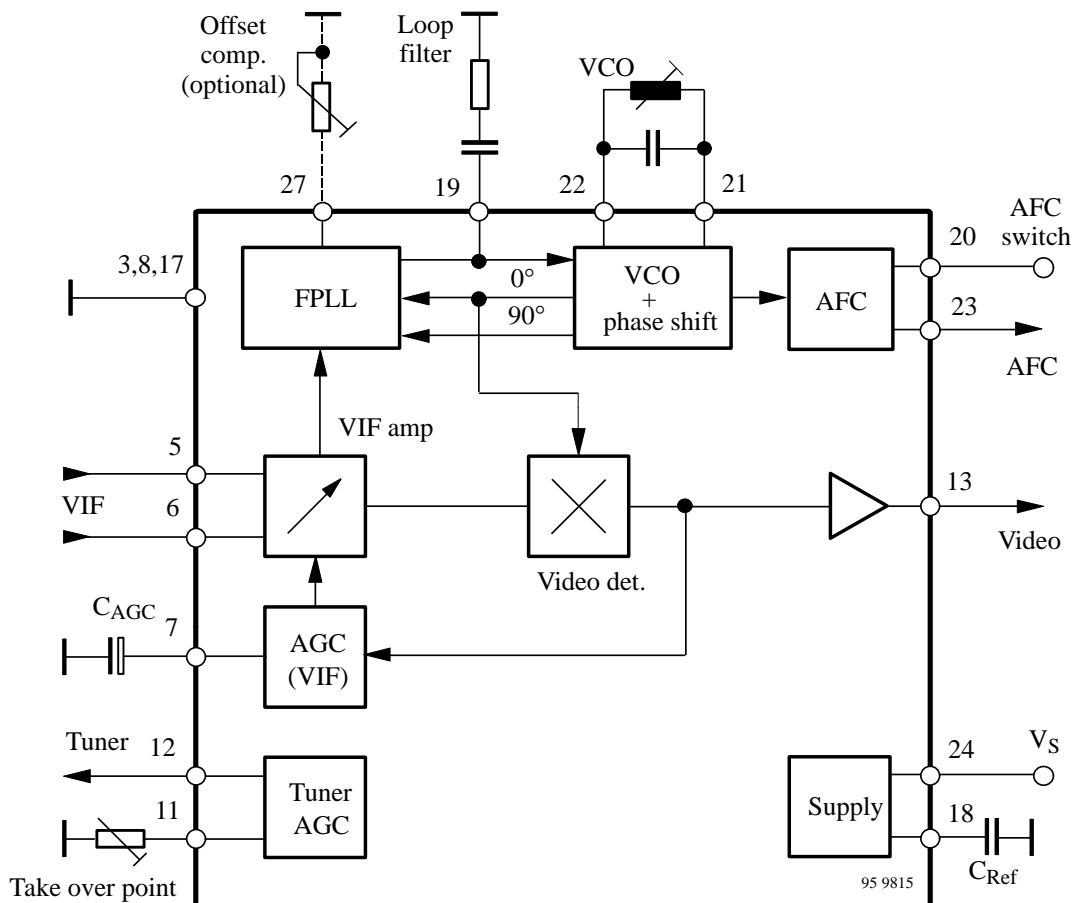


Figure 1. Block diagram

## Pin Description

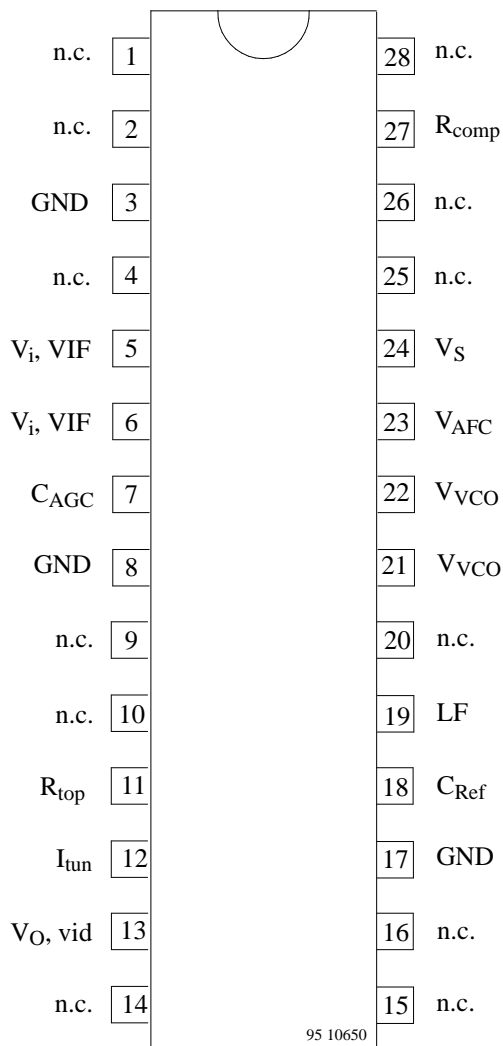


Figure 2. Pinning

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

## Circuit Description

### Vision IF Amplifier

The video IF signal (VIF) is fed through a SAW filter to the VIF input (Pin 5–6). The VIF amplifier consists of three AC-coupled amplifier stages. Each differential amplifier is gain controlled by the automatic gain control (VIF-AGC). Output signal of the VIF amplifier is applied to the FPLL carrier generation and the video demodulator.

### VIF-AGC and Adjustable Tuner AGC

At Pin 7, the VIF-AGC charges/ discharges the AGC capacitor to generate a control voltage for setting the gain of VIF amplifier and tuner in order to keep the video output signal at a constant level. Therefore, 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 7) is transferred to an internal control signal and fed to the tuner AGC to generate the tuner AGC current at Pin 12 (open collector output). The take over point of the tuner AGC can be adjusted at Pin 11 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 for generating the control voltage for the VCO tuning. In the locked mode, the VCO is controlled by the phase detector, whereas 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 23.

A practicable VCO alignment of the external coil is the adjustment to zero AFC output current at Pin 23. At center frequency, the AFC output current is equal to zero. The optional potentiometer at Pin 27 allows an offset compensation of the VCO phase for improved sound quality (fine adjustment). Without a potentiometer (open circuit at Pin 27), 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). 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 13 is 2 V (peak-to-peak value).

## Internal Voltage Stabilizer

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

## Absolute Maximum Ratings

Reference point Pin 3 (8, 17), unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage Pin 24	$V_s$	9.0	V
Supply current Pin 24	$I_s$	93	mA
Power dissipation, $V_s = +9$ V	P	840	mW
Output currents Pin 13	$I_{out}$	5	mA
External voltages Pin 5, 6, 7, 11, 13, 18, 19, 27		+ 4.5	V
Pin 21, 22	$V_{ext}$	+ 3.5	V
Pin 12		+ 13.5	V
Pin 20,23		$V_s$	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 through a 0 Ω resistor

## Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range Pin 24	$V_s$	4.5 to 9.0	V
Ambient temperature	$T_{amb}$	-10 to +85	°C

## Thermal Resistance

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

## Electrical Characteristics

$V_s = +5\text{ V}$ ,  $T_{amb} = +25^\circ\text{C}$ ; reference point Pin 3 (8, 17), unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>DC-supply</b> Pin 24						
Supply voltage		$V_s$	4.5	5.0	9.0	V
Supply current:		$I_s$		85	93	mA
<b>VIF-input</b> Pins 5–6						
Input sensitivity, RMS value	For FPLL locked	$v_{in}$		80	120	$\mu\text{V}_{RMS}$
Input impedance	See note 1	$R_{in}$		1.2		$\text{k}\Omega$
Input capacitance	See note 1	$C_{in}$		2		pF
<b>VIF-AGC</b> Pin 7						
IF gain control range		$G_v$	60	65		dB
AGC capacitor		$C_{AGC}$		2.2		$\mu\text{F}$
Switching voltage: VCR mode	See note 2	$V_{sw}$		4.0		V
Switching current: VCR mode	See note 2	$I_{sw}$		50		$\mu\text{A}$
<b>Tuner-AGC</b> Pins 11, 12, see note 3						
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%	$\Delta G_{IF}$		8	10	dB
IF input signal for minimum take over point	$R_{top} = 10\text{ k}$ ( $V_{top} = 4.5\text{ V}$ )	$v_{in}$			4	mV
IF input signal for maximum take over point	$R_{top} = 0$ ( $V_{top} = 0.8\text{ V}$ )	$v_{in}$	40			mV
Variation of the take over point by temperature	$T_{amb} = 55^\circ\text{C}$ VIF-AGC: $G_v = 46\text{ dB}$	$\Delta v_{in}$		2	3	dB
<b>FPLL and VCO</b> Pins 19, 21, 22, 27, see note 4						
Max. oscillator frequency	For carrier generation	$f_{vco}$	70			MHz
Vision carrier capture range	$f_{vco} = 38.9\text{ MHz}$ $C_{vco} = 8.2\text{ pF}$	$\Delta f_{cap}$	$\pm 1.5$	$\pm 2$		MHz
Oscillator drift (free running) as function of temperature	See note 5 $\Delta T_{amb} = 55^\circ\text{C}$ , $C_{vco} = 8.2\text{ pF}$ , $f_{vco} = 38.9\text{ MHz}$	$\Delta f/\Delta T$			-0.3	%

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Video output</b>		Pin 13				
Output current –source –sink		$\pm I_{out}$	2		5 3	mA
Output resistance	See note 1	$R_{out}$			100	$\Omega$
Video output signal	Peak-to-peak value	$v_{o,vid}$	1.8	2.0	2.2	$V_{pp}$
Sync. level		$V_{sync}$		1.2		V
Zero carrier level (neg. modulation) (= ultra white level)	$V_7 = 3\text{ V}$	$\Delta V_{DC}$		3.4		V
Supply voltage influence on the ultra white level		$\Delta V/V$		1		%/V
Video bandwidth (–3 dB)	$R_L \geq 1\text{ k}\Omega, C_L \leq 50\text{ pF}$	B	6	8		MHz
Video frequency response over the 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 6	$\alpha_{IM}$	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	$\Delta V_{lim1}$		400		mV
Upper limiting level	Above ultra white level	$\Delta V_{lim2}$		600		mV
Ripple rejection	Pin 24/ Pin 13; see note 1	RR	35			dB
<b>AFC output</b>		Pin 23				
Control slope		$\Delta I/\Delta f$		0.7		$\mu\text{A}/\text{kHz}$
Frequency drift by temperature	Related to the picture car- rier frequency			0.25	0.6	%
Output voltage upper limit lower limit		$V_{AFC}$	$V_S - 0.4$		0.4	V V
Output current		$I_{AFC}$		$\pm 0.2$		mA

**Notes:**

- 1.) This parameter is given as an application information and not tested during production.
- 2.) In “VCR mode” the VIF 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 the VCO:  $f = 38.9\text{ MHz}$   
Capacitor  $C_{VCO} = 8.2 - 10\text{ pF}$ , coil  $L_{VCO}$  with unloaded  
Q-factor  $Q_0 \geq 60$  for an oscillator voltage  $\geq 100\text{ mV}_{RMS}$  (Pin 21-22),  
e.g. TOKO coil 7KM, 292XNS-4051Z)
- 5.) The oscillator drift is related to the picture carrier frequency, at external temperature-compensated LC circuit
- 6.)  $\alpha(1.07) = 20 \log (4.43\text{ MHz component}/1.07\text{ MHz component})$ ;  
 $\alpha(1.07)$  value related to black–white signal  
input signal conditions:

picture carrier	0 dB
colour carrier	–6 dB
sound carrier	–24 dB

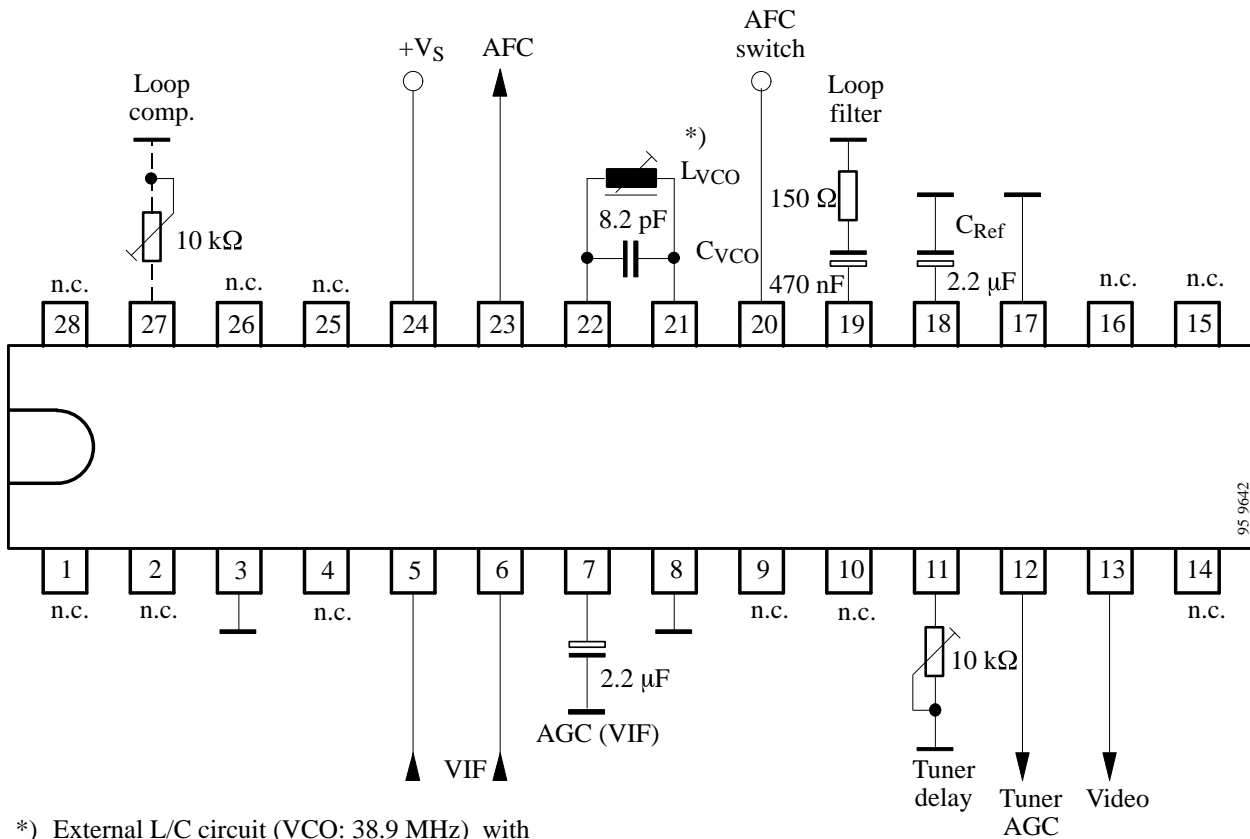


Figure 3. Test circuit

## Internal Pin Configuration

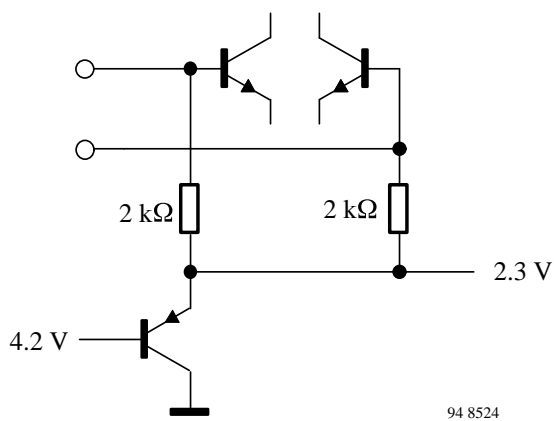


Figure 4. Video IF input (Pin 5-6)

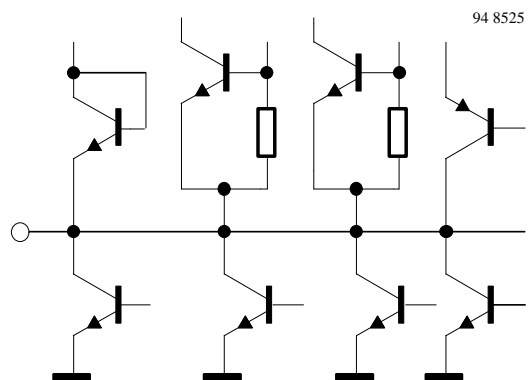


Figure 5. VIF-AGC time constant (Pin 7)

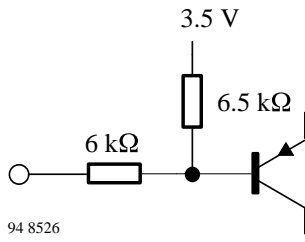


Figure 6. Tuner AGC – take-over point (Pin 11)

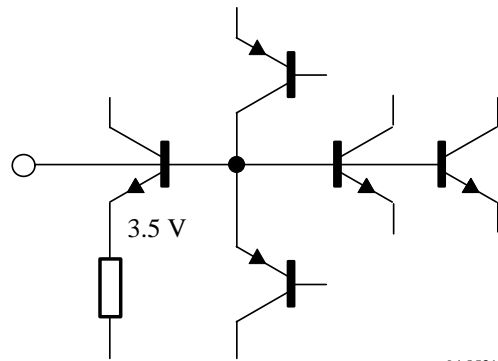


Figure 9. Internal reference voltage (Pin 18)

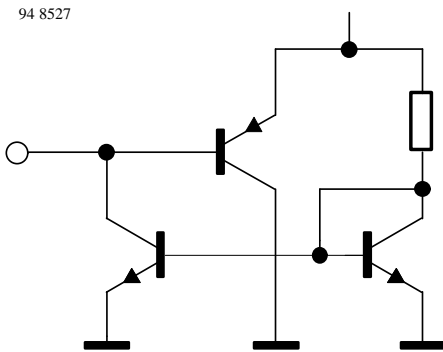


Figure 7. Tuner AGC – output (Pin 12)

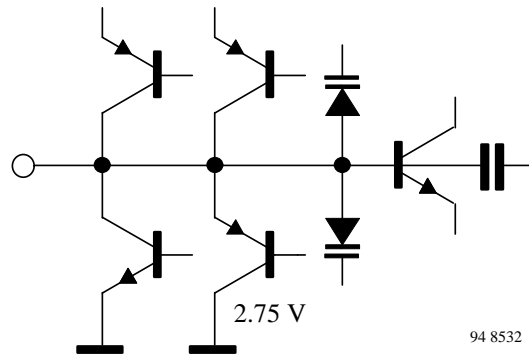


Figure 10. Loop filter (Pin 19)

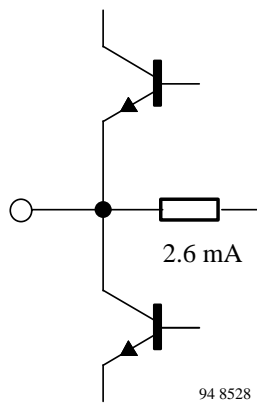


Figure 8. Video output (Pin 13)

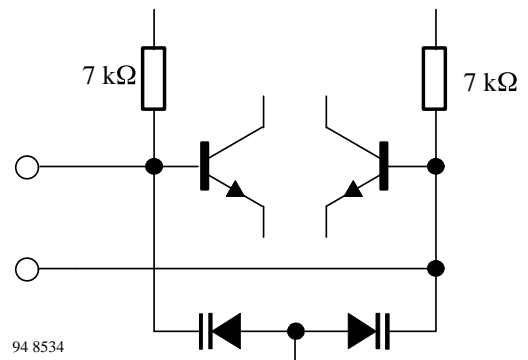


Figure 11. VCO (Pin 21-22)

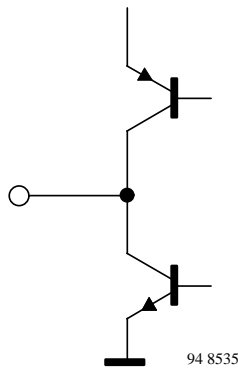


Figure 12. AFC output (Pin 23)

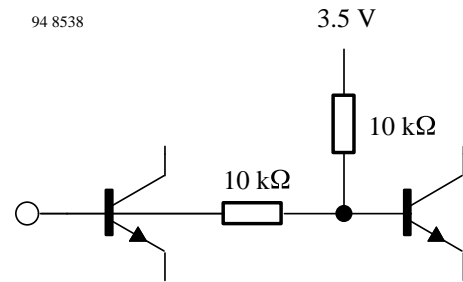


Figure 13. VCO offset compensation (Pin 27)

## Dimensions in mm

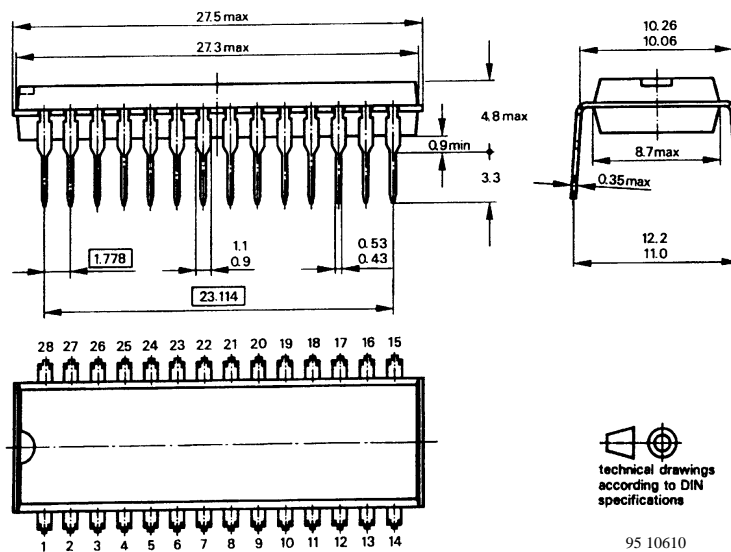


Figure 14. 28 pin shrink-dual-inline-plastic (SDIP28)



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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.

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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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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.

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