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

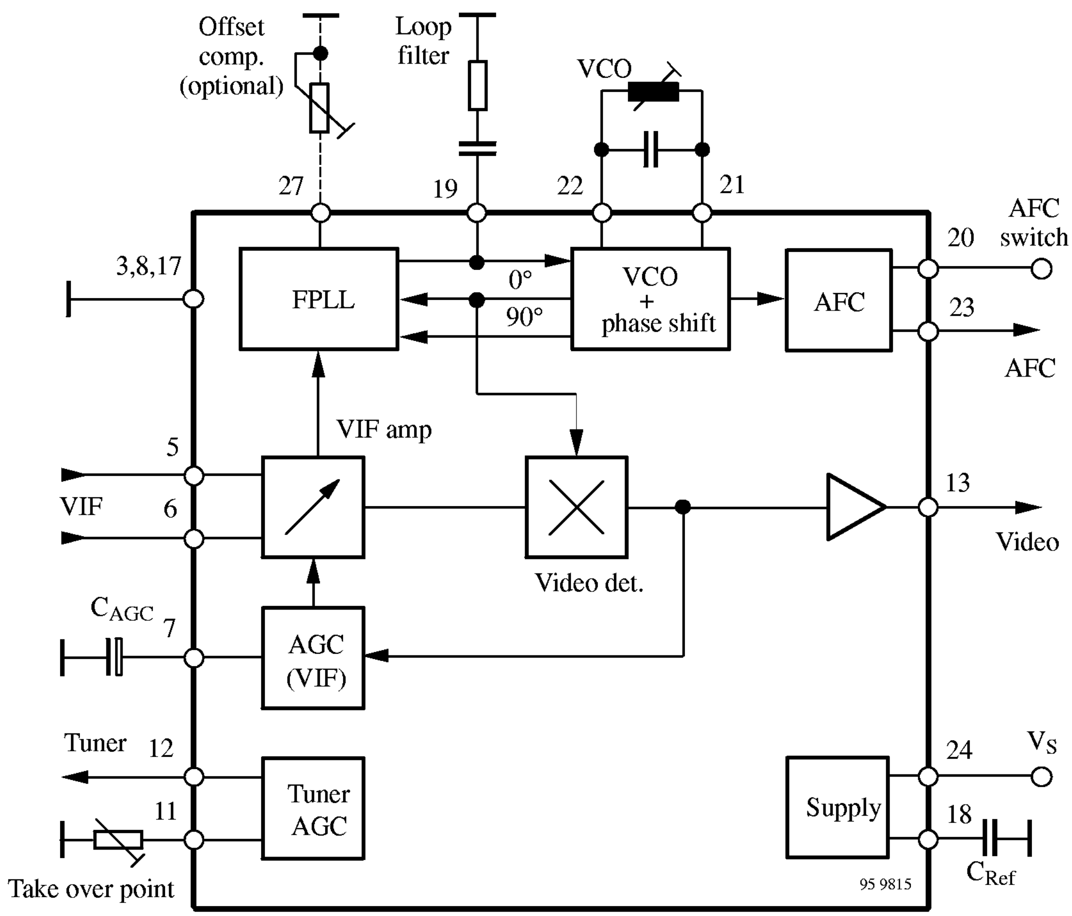


Figure 1. Block diagram

Pin Description

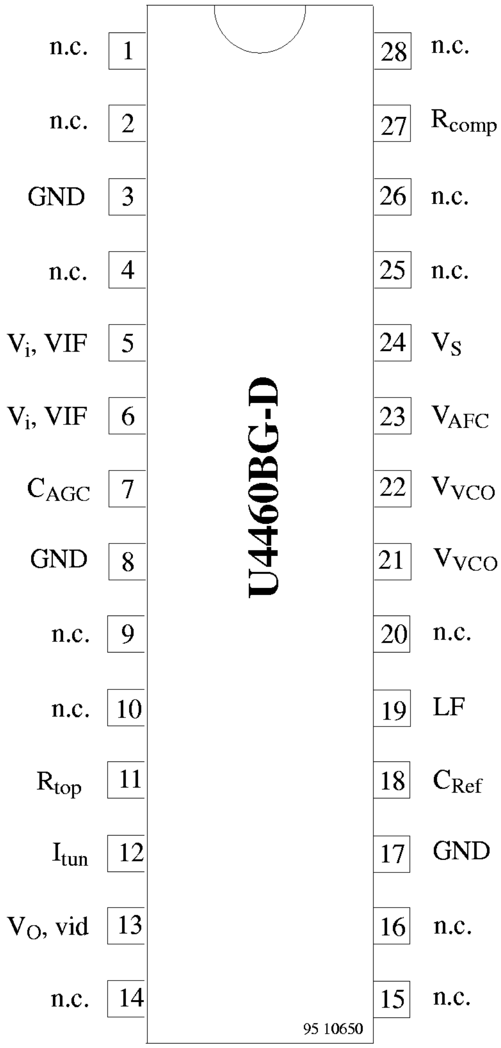


Figure 2. Pinning

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 V, T_{amb} = +25°C; reference point Pin 3 (8, 17), unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
DC-supply	Pin 24					
Supply voltage		V_s	4.5	5.0	9.0	V
Supply current:		I_s		85	93	mA
VIF-input	Pins 5–6					
Input sensitivity, RMS value	For FPLL locked	v_{in}		80	120	μV_{RMS}
Input impedance	See note 1	R_{in}		1.2		kΩ
Input capacitance	See note 1	C_{in}		2		pF
VIF-AGC	Pin 7					
IF gain control range		G_v	60	65		dB
AGC capacitor		C_{AGC}		2.2		µF
Switching voltage: VCR mode	See note 2	V_{sw}		4.0		V
Switching current: VCR mode	See note 2	I_{sw}		50		µA
Tuner-AGC	Pins 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%	ΔG_{IF}		8	10	dB
IF input signal for minimum take over point	R_{top} = 10 k (V_{top}= 4.5 V)	v_{in}			4	mV
IF input signal for maximum take over point	R_{top} = 0 (V_{top} = 0.8 V)	v_{in}	40			mV
Variation of the take over point by temperature	T_{amb} = 55°C VIF–AGC: G_v = 46 dB	Δv_{in}		2	3	dB
FPLL and VCO	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 MHz C_{vco} = 8.2 pF	Δf_{cap}	± 1.5	± 2		MHz
Oscillator drift (free runing) as function of temperature	See note 5 ΔT_{amb} = 55°C, C_{vco} = 8.2 pF, f_{vco} = 38.9 MHz	$\Delta f/_{\Delta T}$			–0.3	%

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Video output	Pin 13					
Output current –source –sink		$\pm I_{out}$	2		5 3	mA
Output resistance	See note 1	R_{out}			100	Ω
Video output signal	Peak-to-peak value	$v_{o,vid}$	1.8	2.0	2.2	V_{pp}
Sync. level		V_{sync}		1.2		V
Zero carrier level (neg. modolation) (= ultra white level)	$V_7 = 3$ V	ΔV_{DC}		3.4		V
Supply voltage influence on the ultra white level		$\Delta V/_V$		1		%/V
Video bandwidth (–3 dB)	$R_L \geq 1$ kΩ, $C_L \leq 50$ pF	B	6	8		MHz
Video frequency response over the AGC range		ΔB			2.0	dB
Differential gain error		DG		2	5	%
Differential phase error		DP		2	5	deg
Intermodulation 1.07 MHz	See note 6	α_{IM}	52	60		dB
Video signal to noise ratio	Weighted , CCIR–567	$S/_N$	56	60		dB
Residual vision carrier fundamental wave 38.9 MHz and second harmonic 77.8 MHz		v_{res1}		2	10	mV
Lower limiting level	Below sync. level	ΔV_{lim1}		400		mV
Upper limiting level	Above ultra white level	ΔV_{lim2}		600		mV
Ripple rejection	Pin 24/ Pin 13; see note 1	RR	35			dB
AFC output	Pin 23					
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

Notes:

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

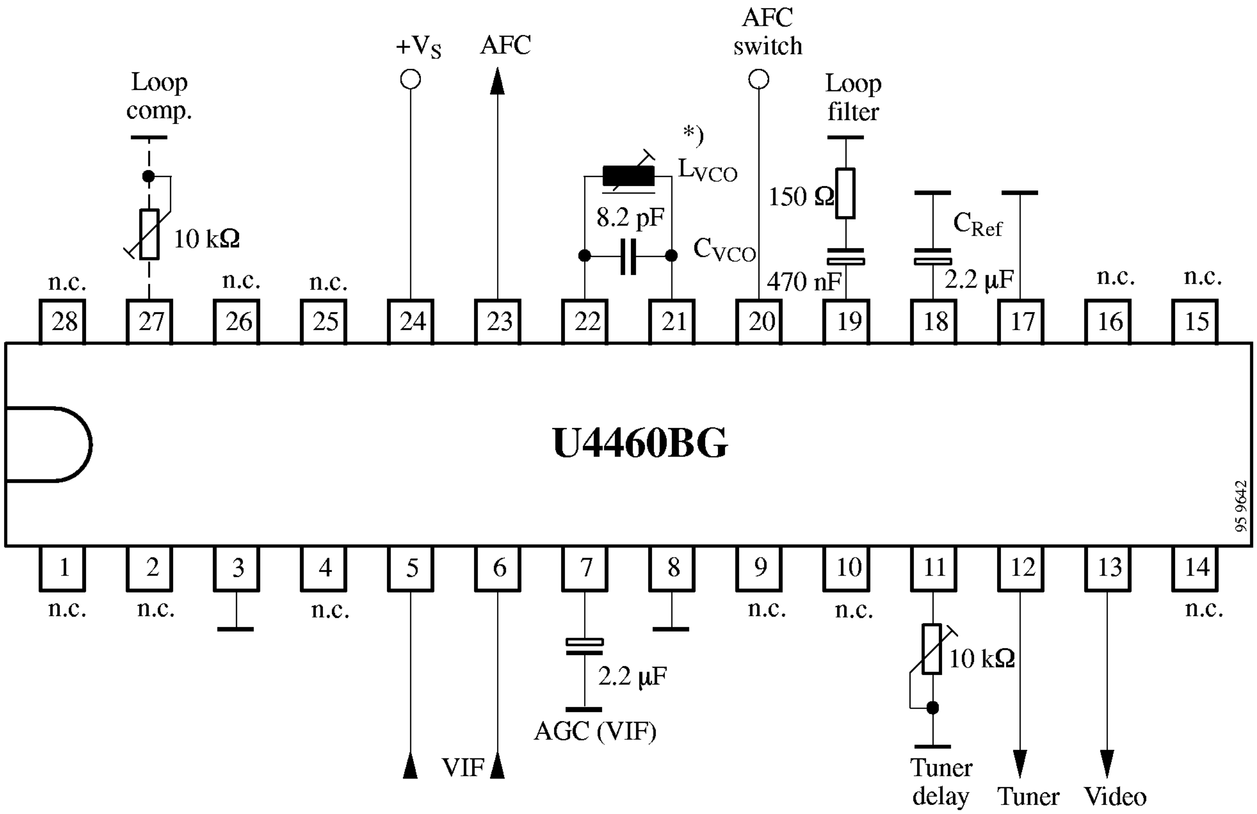
2.) In “VCR mode” the VIF path is switched off.

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 MHz
Capacitor C_{VCO} = 8.2 – 10 pF, coil L_{VCO} with unloaded
Q-factor Qo ≥ 60 for an oscillator voltage ≥ 100 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.) 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



*) External L/C circuit (VCO: 38.9 MHz) with
TOKO coil 7KM, 292 XNS-4051Z

Figure 3. Test circuit

Internal Pin Configuration

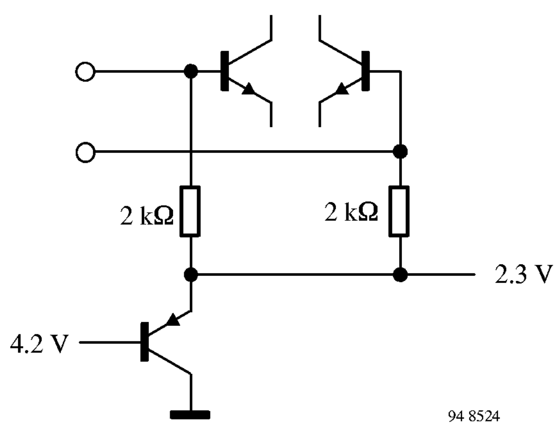


Figure 4. Video IF input (Pin 5–6)

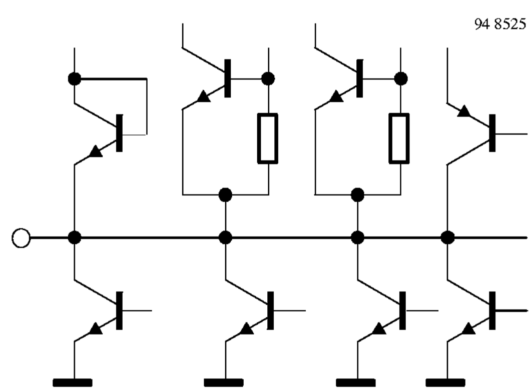


Figure 5. VIF-AGC time constant (Pin 7)

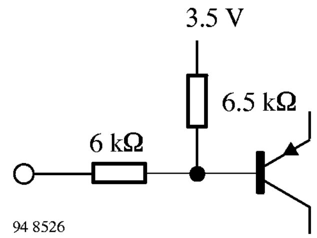


Figure 6. Tuner AGC – take-over point (Pin 11)

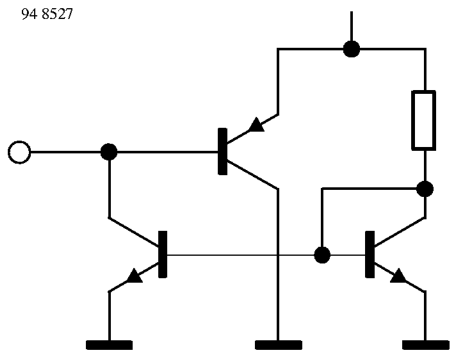


Figure 7. Tuner AGC – output (Pin 12)

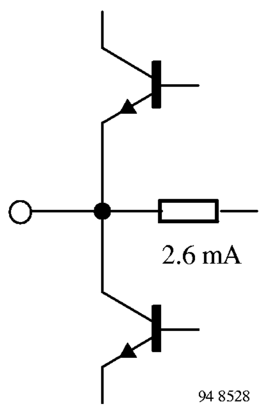


Figure 8. Video output (Pin 13)

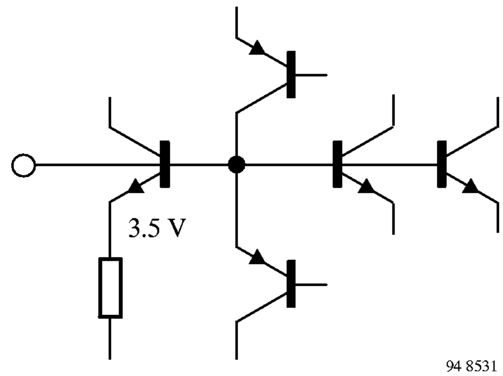


Figure 9. Internal reference voltage (Pin 18)

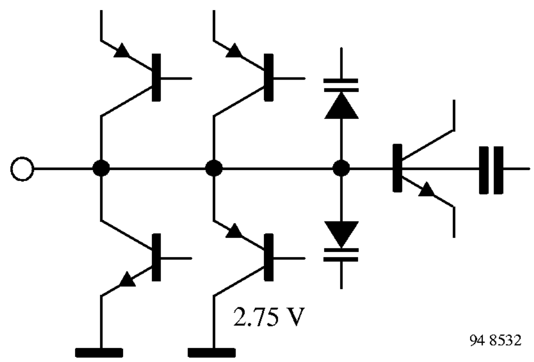


Figure 10. Loop filter (Pin 19)

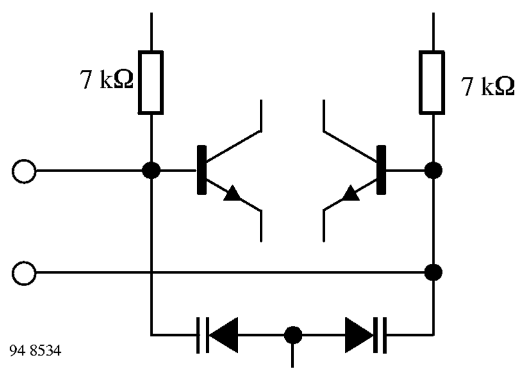


Figure 11. VCO (Pin 21–22)

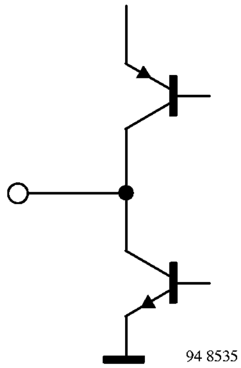


Figure 12. AFC output (Pin 23)

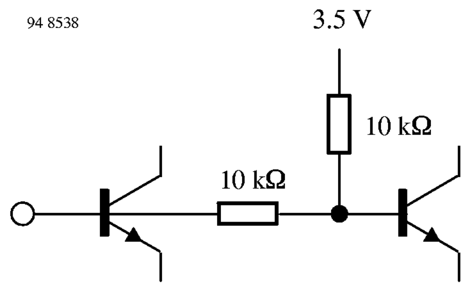


Figure 13. VCO offset compensation (Pin 27)

Dimensions in mm

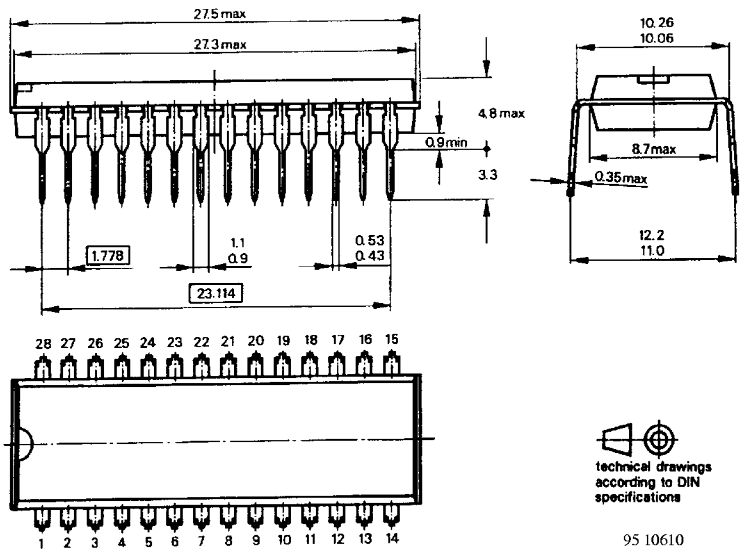


Figure 14. 28 pin shrink-dual-inline-plastic (SDIP28)

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.

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