

## Quasi-Split Sound Circuit and AM Demodulator

### Description

The U4488B is an integrated bipolar circuit for full multi-standard sound IF signal processing in TV/VTR and Multimedia applications. It supplies AM signals as well as FM/NICAM sound IF signals and thus allows the de-

sign of a universal sound IF module for various applications. The U4488B has the same performance like the U4468B, with the additional feature of a second symmetrical IF input.

### Features

- 5-V supply voltage; low power consumption
- Gain-controlled 3-stage wideband IF amplifier
- Active carrier generation by FPLL principle (frequency-phase-locked-loop) for true quadrature demodulation
- Complete alignment-free AM demodulator
- Switchable amplitude detector for gain control, which operates as a peak detector for FM sound and as a mean level detector for AM sound
- Two symmetrical IF inputs

### Block Diagram

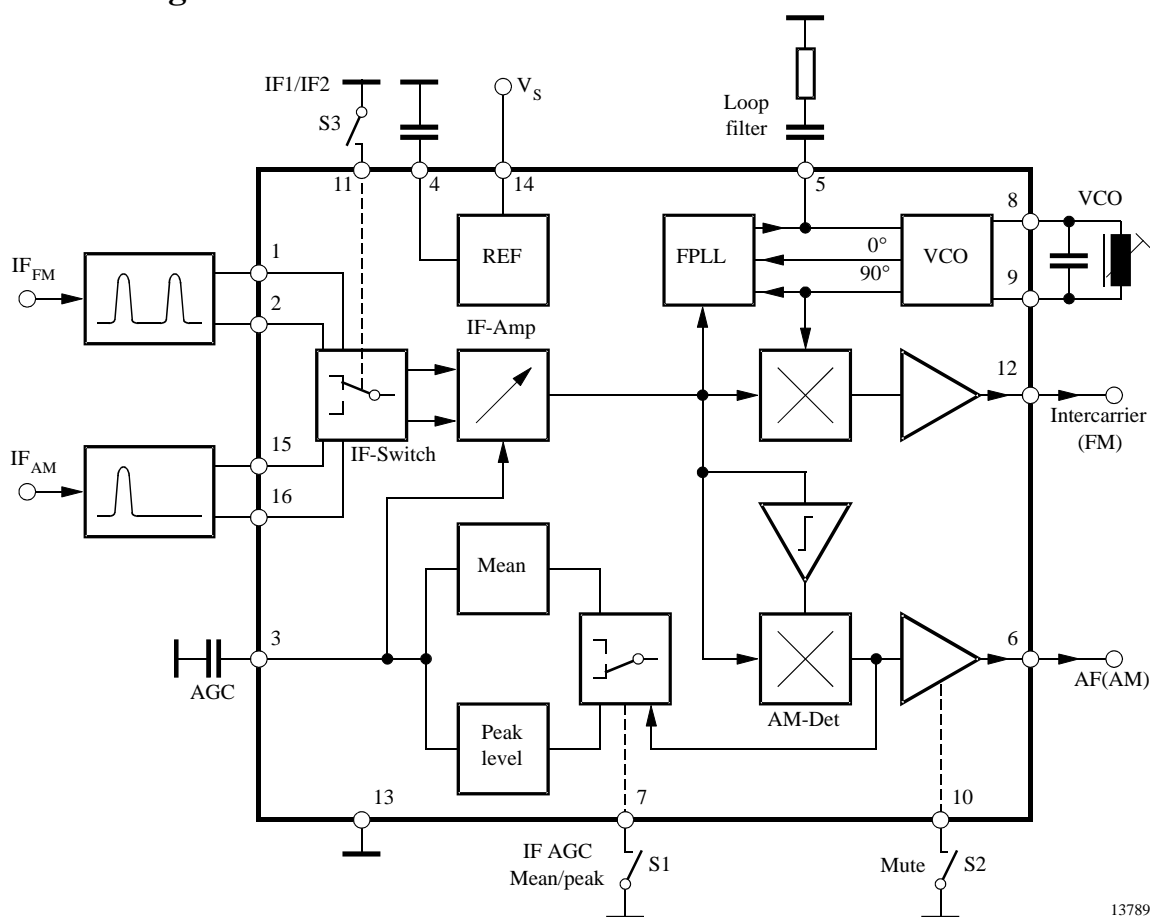


Figure 1. Block diagram

### Ordering Information

Extended Type Number	Package	Remarks
U4488B	DIP16	

## Circuit Description

### IF Amplifier and AGC

The symmetrical IF input signal from the external SAW filter is fed to the Pins 1 and 2 resp. Pins 15 and 16. For FM/NICAM application, a SAW filter with double bandpass characteristic is required for the vision and sound carrier. In case of L-standard, a bandpass filter with the center frequency at the L-sound carrier is used.

The amplifier consists of three AC-coupled wideband IF stages. Each differential amplifier stage is gain controlled by the AGC (Automatic Gain Control) voltage, available at Pin 3. The output signal of the IF amplifier is then applied to the FPLL carrier generation, to the mixer for FM/NICAM signals and to the AM demodulator.

The IF-AGC is derived from the average level of the AM carrier (L standard) or from the peak value of the FM carrier (e.g., B/G standard). It controls the three-stage wideband amplifier to provide a constant SIF signal to the AM demodulator or to the QSS (quasi-split sound) mixer.

### IF Input Switch

If Pin 11 is open, the IF input 1 is switched on (Pins 1 and 2). If Pin 11 is connected to ground, the IF input 2 is switched on (Pins 15 and 16).

### Standard Switch

If the standard switch (Pin 7) is in position 'low' (for AM sound), the AGC is operating as an average level detector. In position 'open' or 'high' (for FM/NICAM sound), the AGC is a peak value detector.

### Internal Voltage Stabilizer

The internal bandgap reference voltage (4.25 V at Pin 4) ensures constant performance, independent of supply voltage and temperature.

### FPLL, VCO

The FPLL (frequency-phase-locked loop) circuit consists of a frequency detector and a phase detector to generate a control voltage for the VCO tuning. In locked mode the VCO is controlled by the phase detector while in unlocked mode, the frequency detector is superimposed. The VCO operates with an external resonance circuit (L and C parallel) and is controlled by integrated varicaps.

A practicable VCO alignment of the external coil is the adjustment of the loop filter voltage (Pin 5) to 2.3 V. At this value, capture and hold range are centered.

### AM Demodulator

The alignment-free AM demodulator is realized by a synchronous detector. The modulated IF signal from the wideband IF amplifier output is multiplied in phase with the limited SIF signal to remove the AM. Then, the resulting AF signal of the demodulator output is fed to the output amplifier and to the AGC stage.

### Quasi-Split-Sound (QSS) Mixer

The QSS mixer is realized by a multiplier circuit. The IF signal (FM/NICAM) is converted in the intercarrier frequency by means of a quadrature signal from the generated picture carrier provided by the PLL. The intercarrier signal is fed via an output amplifier to Pin 12.

### Mute Switch

AM sound output (Pin 6) can be muted in pulling mute switch (Pin 10) to 'low'.

## Pin Description

Pin	Symbol	Function
1, 2	$V_{i1,IF}$	IF input 1 (symmetrical)
3	$C_{AGC}$	Capacitor for AGC time constant
4	$C_{REF}$	Capacitor for internal reference voltage
5	LF	Loop filter
6	$V_{o,AM}$	AF output (AM sound)
7	$V_{sw,AGC}$	Standard switch
8, 9	$V_{VCO}$	VCO circuit
10	$V_{sw,mute}$	Mute switch
11	$V_{sw,IF}$	IF input switch IF1 / IF2
12	$V_{o,FM}$	Intercarrier output (FM sound)
13	GND	Ground
14	$V_S$	Supply voltage (5 V)
15, 16	$V_{i2,IF}$	IF input 2 (symmetrical)

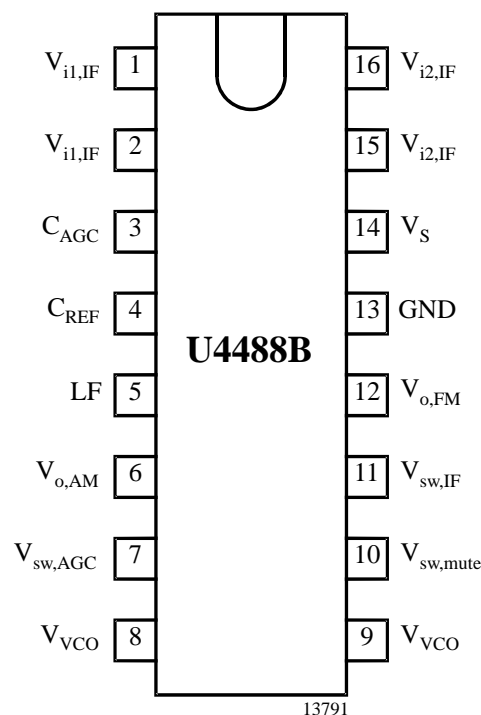


Figure 2. Pinning

## Absolute Maximum Ratings

Reference point Pin 13, unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage range Pin 14	$V_S$	4.5 to 9.0	V
Supply current Pin 14	$I_S$	55	mA
Power dissipation ( $V_S = 9\text{ V}$ )	$P$	500	mW
Output currents Pins 6 and 12	$I_{out}$	5	mA
External voltages Pins 1, 2, 3, 4, 6, 12, 15 and 16 Pins 5, 8 and 9 Pins 7, 10 and 11	$V_{ext}$	+ 4.5	V
		+ 3.5	V
		$V_S$	V
Junction temperature	$T_j$	+125	°C
Operating temperature range	$T_{amb}$	0 to +85	°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

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient when soldered to PCB	$R_{thJA}$	60	K/W

## Electrical Characteristics

$V_S = +5\text{ V}$ ,  $T_{\text{amb}} = +25^\circ\text{C}$ ; reference point Pin 13, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>DC-supply (Pin 14)</b>						
Supply voltage		$V_S$	4.5	5.0	9.0	V
Supply current	$v_{\text{in}}=10\text{ mV}$ or $V_3 = 2\text{ V}$	$I_S$		40		mA
<b>IF-input (Pins 1 and 2 resp. 15 and 16)</b>						
Minimum IF input signal	Output signal: -3 dB	$v_{\text{in}}$		50		$\mu\text{V}_{\text{rms}}$
Maximum IF input signal	Output signal: +1 dB	$v_{\text{in}}$	70	100		$\text{mV}_{\text{rms}}$
Input impedance	(See note 1)	$R_{\text{in}}$		1.2		$\text{k}\Omega$
Input capacitance	(See note 1)	$C_{\text{in}}$		2		pF
<b>IF input switch (Pin 11)</b>						
Switching voltage: IF input 1	Inputs: Pins 1 and 2	$V_{\text{swIF1}}$		open		
Switching voltage: IF input 2	Inputs: Pins 15 and 16	$V_{\text{swIF2}}$	0		1.5	V
Switching current		$I_{\text{sw}}$		-50		$\mu\text{A}$
<b>SIF-AGC (Pin 3)</b>						
IF gain control range		$G_V$	60	65		dB
AGC capacitor		$C_{\text{AGC}}$		4.7		$\mu\text{F}$
<b>FPLL and VCO (Pins 5, 8 and 9)</b>						
Max. oscillator frequency	For carrier generation	$f_{\text{VCO}}$	70			MHz
Vision carrier capture range	$f_{\text{VCO}} = 38.9\text{ MHz}$ $C_{\text{VCO}} = 6.2\text{ pF}$	$\Delta f_{\text{cap}}$	$\pm 1.5$	$\pm 2$		MHz
Oscillator drift (free running) as function of temperature	$\Delta T_{\text{amb}} = 55^\circ\text{C}$ , $f_{\text{VCO}} = 38.9\text{ MHz}$ $C_{\text{VCO}} = 6.2\text{ pF}$ , (see note 2)	$\Delta f/\Delta T$			-0.3	%
<b>Standard switch (Pin 7)</b>						
Switching voltage for mode 1: FM/NICAM sound	Peak value control (see note 3)	$V_{\text{sw1}}$	2.0		$V_S$	V
Switching voltage for mode 2: AM sound	Average level control	$V_{\text{sw2}}$	0		1.5	V
Switching current		$I_{\text{sw}}$		$\pm 100$		$\mu\text{A}$
<b>AM mute switch (Pin 10)</b>						
Switching voltage	AM output active	$V_{\text{mute1}}$		open		
Switching voltage	AM output switched off	$V_{\text{mute2}}$	0		1.5	V
Switching current		$I_{\text{mute}}$		-100		$\mu\text{A}$

### Notes

1. This parameter is given as an application information and not tested during production
2. The oscillator drift is related to the picture carrier frequency, with external temperature compensated LC circuit
3. Without external control voltage (Pin 7 open), the IC automatically operates in mode 1

## Electrical Characteristics (continued)

$V_S = +5\text{ V}$ ,  $T_{amb} = +25^\circ\text{C}$ ; reference point Pin 13, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Intercarrier output (Pin 12) (see note 4)</b>						
DC output voltage		$V_{DC}$		2		V
Output resistance	(See note 1)	$R_{out}$			200	$\Omega$
Intercarrier output signal	$v_{in} = 10\text{ mV}$ 5.5 MHz output signal	$V_{out}$	100	150		$\text{mV}_{rms}$
Intercarrier bandwidth	-1 dB -3 dB	B		tbd tbd		MHz MHz
Weighted signal-to-noise ratio (CCIR 468)	B/G mod. VIF signal: $v_{in} = 10\text{ mV}$ ; FM dev. = $\pm 27\text{ kHz}$ ; $f_{mod} = 1\text{ kHz}$ ; tested with U2860B; Black screen: Channel 1/2 Color bar: Channel 1/2			60/58 58/56		dB dB
Ripple rejection	Tested from Pin 14 to 12 (see note 1)	RR	35			dB
Allowable AC output peak current		$I_{AC}$			$\pm 0.7$	mA
Allowable DC output current		$I_{DC}$			-2	mA
<b>AF output – AM (Pin 6) (see note 5)</b>						
DC output voltage		$V_{DC}$		2.2		V
Output resistance	(See note 1)	$R_{out}$			150	$\Omega$
AF output signal	$m = 54\%$	$v_{oAF}$		500		$\text{mV}_{rms}$
AF bandwidth	-3 dB	B		tbd		kHz
Total harmonic distortion	$m = 54\%$ $f_{mod} = 1\text{ kHz}, 12.5\text{ kHz}$	THD		1	2	%
Weighted signal-to-noise ratio (CCIR 468)	Reference: $m = 54\%$ ; $f_{mod} = 1\text{ kHz}$	S/N		56		dB
Ripple rejection	Tested from Pin 14 to 6 (see note 1)	RR	28			dB
Allowable AC output peak current		$I_{AC}$			$\pm 0.3$	mA
Allowable DC output current		$I_{DC}$			-1	mA

### Notes

1. This parameter is given as an application information and is not tested during production
2. The oscillator drift is related to the picture carrier frequency, with external temperature compensated LC circuit
3. Without external control voltage (Pin 7 open), the IC automatically operates in mode 1
4. Picture carrier  $PC = 38.9\text{ MHz}$ ; 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  $SC = 32.4\text{ MHz}$ , modulated with  $f_{mod} = 1\text{ kHz}$ ,  $m = 54\%$ ;  $v_{in} = 10\text{ mV}$

## Test Circuit

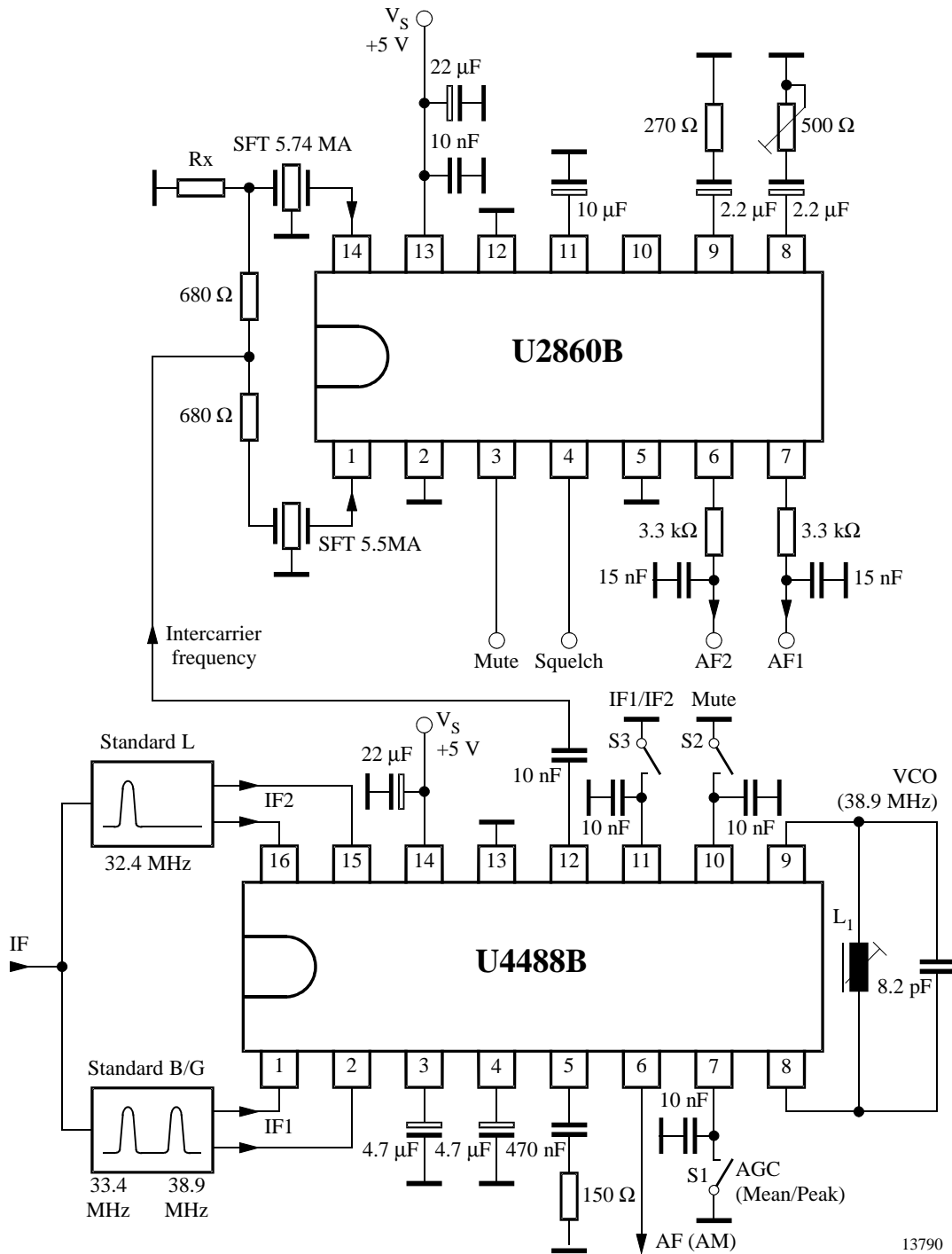


Figure 3.

**Internal Pin Configuration**

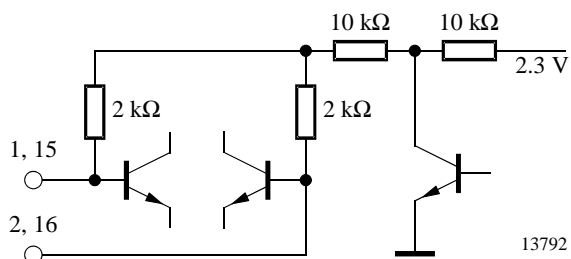


Figure 4. Sound IF inputs (Pins 1, 2 resp. 15,16)

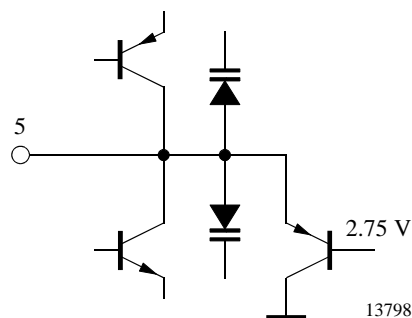


Figure 7. Loop filter (Pin 5)

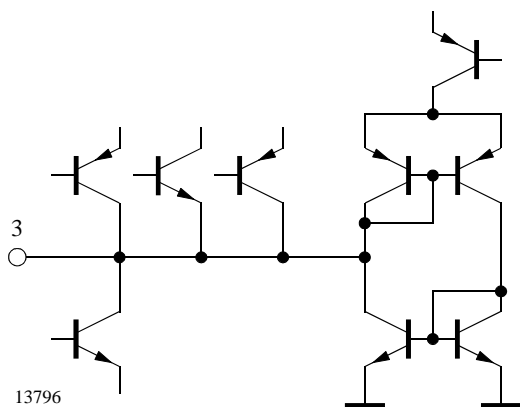


Figure 5. AGC time constant (Pin 3)

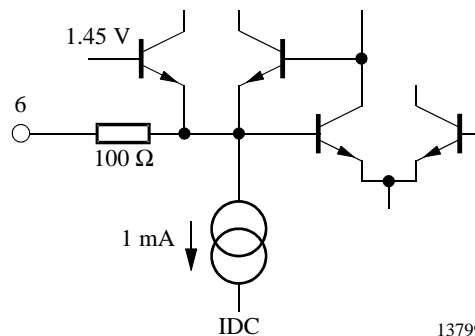


Figure 8. AM output (Pin 6)

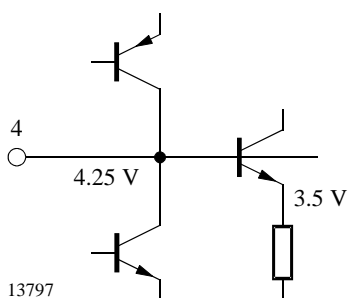


Figure 6. Internal reference voltage (Pin 4)

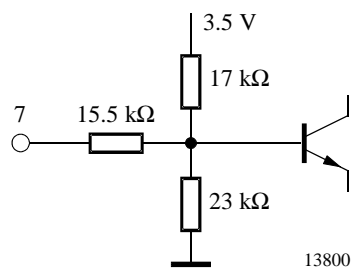


Figure 9. AGC switch (Pin 7)

## Internal Pin Configuration

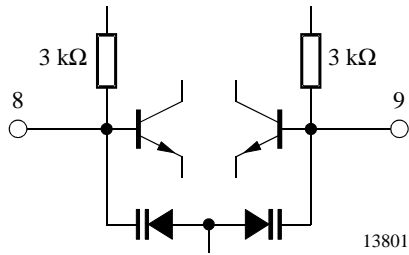


Figure 10. VCO (Pins 8 and 9)

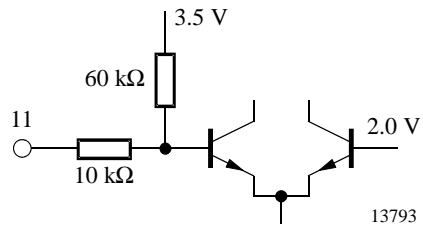


Figure 12. IF input switch (Pin 11)

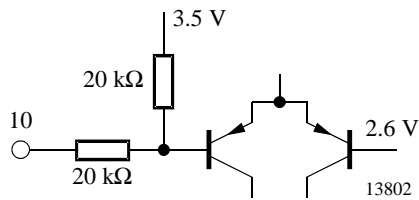


Figure 11. Mute switch (Pin 10)

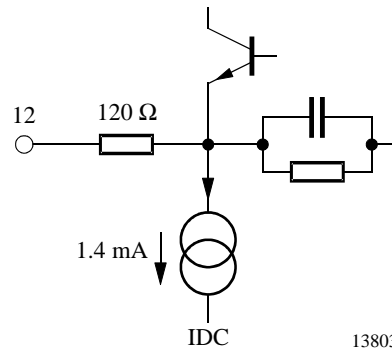
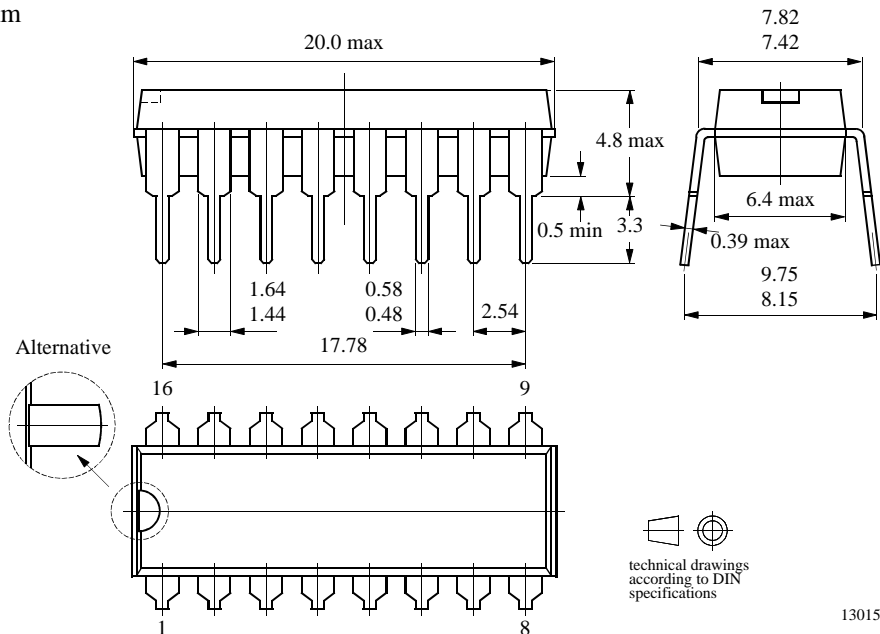


Figure 13. Inter-carrier output (Pin 12)

## Package Information

Package DIP16

Dimensions in mm





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## Ozone Depleting Substances Policy Statement

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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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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.

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