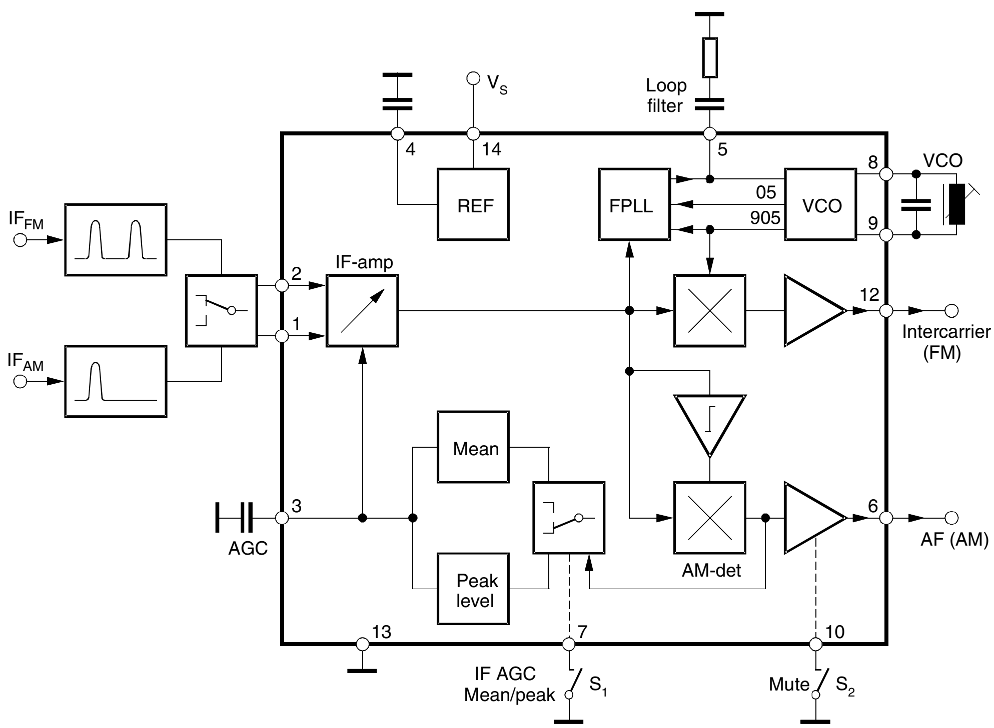
## Features

- **5-V Supply Voltage**
- **Gain-controlled 3-stage Wide-band 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**

## Description

The U4468B is an integrated bipolar circuit for full multistandard 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 design of a universal sound IF module for various applications.

**Figure 1.** Block Diagram




# Quasi-split Sound Circuit and AM Demodulator IC

# U4468B

Rev. 4777A–TVVCR–01/04

# Circuit Description

## IF Amplifier and AGC

The symmetrical IF input signal from the external SAW filter is fed to the pins 1 and 2. In case of FM/NICAM applications, a SAW filter with double band-pass characteristic is required for the vision and sound carrier. In case of the L-standard, a band-pass filter with the center frequency at the L-sound carrier is used.

The amplifier consists of three AC-coupled wide-band 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 wide-band amplifier to provide a constant SIF signal to the AM demodulator or to the QSS (quasi-split sound) mixer.

## 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 acts as a peak value detector.

## Internal Voltage Stabilizer

The internal band gap 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, the 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 wide-band 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 to 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

The AM sound output (pin 6) can be muted by switching the pulling mute switch (pin 10) to “low”.

## Pin Configuration

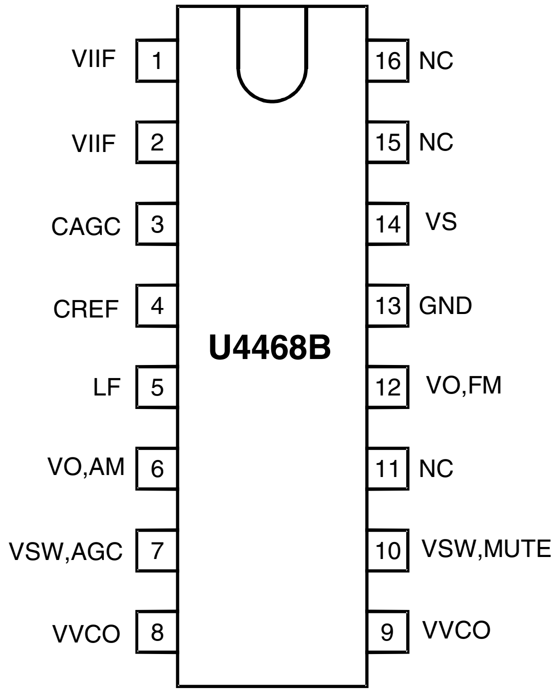



**Figure 2.** Pinning DIP16

## Pin Description

| Pin | Symbol | Function |
|---|---|---|
| 1, 2 | VI,IF | IF input (symmetrical) |
| 3 | CAGC | Capacitor for the AGC time constant |
| 4 | CREF | Capacitor for the internal reference voltage |
| 5 | LF | Loop filter |
| 6 | VO,FM | AF output (AM sound) |
| 7 | VSW,AGC | Standard switch |
| 8, 9 | VVCO | VCO circuit |
| 10 | VSW,MUTE | Mute switch |
| 12 | VO,FM | Intercarrier output (FM sound) |
| 13 | GND | Ground |
| 14 | VS | Supply voltage (5 V) |
| 11, 15, 16 | NC | Not connected |

## Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Reference point pin 13, unless otherwise specified.

| Parameters | Pin | Symbol | Value | Unit |
|---|---|---|---|---|
| Supply voltage range | 14 | $V_s$ | 4.5 to 9.0 | V |
| Supply current | 14 | $I_s$ | 55 | mA |
| Power dissipation ($V_S$ = 9 V) | | P | 500 | mW |
| Output currents | 6, 12 | $I_{out}$ | 5 | mA |
| External voltages | 1 - 4, 6, 12 | $V_{ext}$ | +4.5 | V |
| | 5, 8, 9 | | +3.5 | V |
| | 7, 10 | | $V_s$ | 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[(1)] | All | $V_{ESD}$ | ±300 | V |

Note: 1. 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 V, $T_{amb}$ = +25°C; reference point pin 13, unless otherwise specified.

| Parameters | Test Conditions | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DC Supply (Pin 14)** | | | | | | |
| Supply voltage | | $V_S$ | 4.5 | 5.0 | 9.0 | V |
| Supply current | $V_{in}$ =10 mV or $V_3$ = 2 V | $I_S$ | | 40 | | mA |
| **IF Input (Pins 1, 2)** | | | | | | |
| Minimum IF input signal | Output signal: -3 dB | $v_{in}$ | | 50 | | $\mu V_{rms}$ |
| Maximum IF input signal | Output signal: +1 dB | $v_{in}$ | 70 | 100 | | $mV_{rms}$ |
| Input impedance | (1) | $R_{in}$ | | 1.2 | | kΩ |
| Input capacitance | (1) | $C_{in}$ | | 2 | | pF |
| **SIF-AGC (Pin 3)** | | | | | | |
| IF gain control range | | $G_v$ | 60 | 65 | | dB |
| AGC capacitor | | $C_{AGC}$ | | 4.7 | | µF |
| **FPLL and VCO (Pins 5, 8, and 9)** | | | | | | |
| Maximum oscillator frequency | For carrier generation | $f_{VCO}$ | 70 | | | MHz |
| Vision carrier capture range | $f_{VCO}$ = 38.9 MHz<br>$C_{VCO}$ = 6.2 pF | $\Delta f_{cap}$ | ±1.5 | ±2 | | MHz |
| Oscillator drift (free running) as function of temperature | $\Delta T_{amb}$ = 55°C,<br>$f_{VCO}$ = 38.9 MHz<br>$C_{VCO}$ = 6.2 pF(2) | $\Delta f/\Delta T$ | | | -0.3 | % |
| **Standard Switch (Pin 7)** | | | | | | |
| Switching voltage for mode 1: FM/NICAM sound | Peak value control(3) | $V_{sw1}$ | 2.0 | | $V_S$ | V |
| Switching voltage for mode 2: AM sound | Average level control | $V_{sw2}$ | 0 | | 1.5 | V |
| Switching current | | $I_{sw}$ | | ±100 | | µA |
| **AM Mute Switch (Pin 10)** | | | | | | |
| Switching voltage | AM output active | $V_{mute1}$ | | open | | |
| Switching voltage | AM output switched off | $V_{mute2}$ | 0 | | 1.5 | V |
| Switching current | | $I_{mute}$ | | -100 | | µA |
| **Intercarrier Output (Pin 12)(4)** | | | | | | |
| DC output voltage | | $V_{DC}$ | | 2 | | V |
| Output resistance | (1) | $R_{out}$ | | | 200 | Ω |
| Intercarrier output signal | $v_{in}$ = 10 mV<br>5.5 MHz output signal | $V_{out}$ | 100 | 150 | | $mV_{rms}$ |
| Intercarrier bandwidth | -1 dB<br>-3 dB | B | | TBD<br>TBD | | MHz<br>MHz |

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 an 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 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.

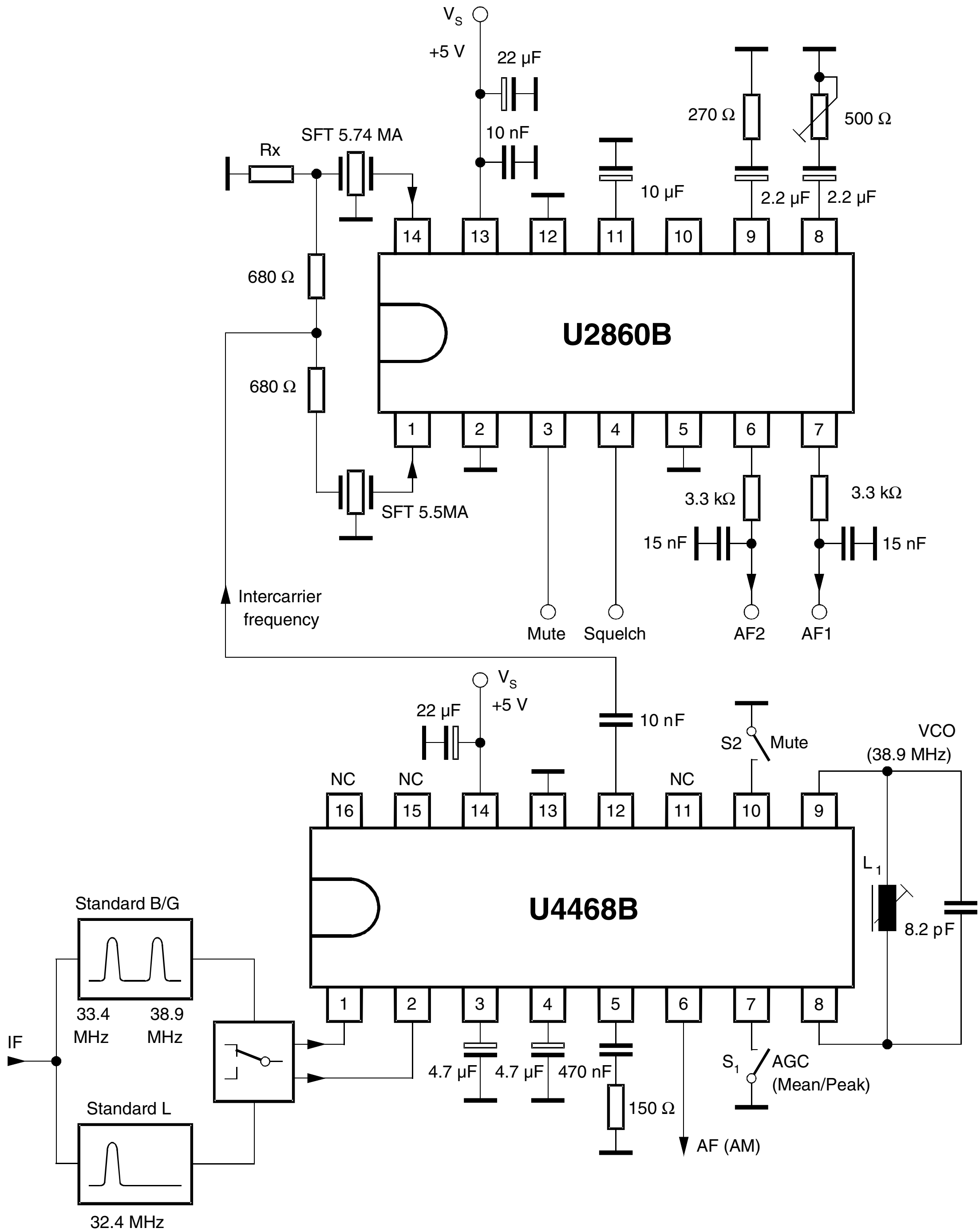
# Electrical Characteristics (Continued)

$V_S$ = +5 V, $T_{amb}$ = +25°C; reference point pin 13, unless otherwise specified.

| Parameters | Test Conditions | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Weighted signal-to-noise ratio (CCIR 468) | B/G mod. VIF signal:<br>$v_{in}$ =10 mV<br>FM deviation = ±27 kHz<br>$f_{mod}$ = 1 kHz<br>Tested with U2860B<br>Black screen: channel 1/2<br>Color bar: channel 1/2 | | | <br><br><br><br><br>60/58<br>58/56 | | <br><br><br><br><br>dB<br>dB |
| Ripple rejection | Tested from pin 14 to 12(1) | RR | 35 | | | dB |
| Allowable AC output peak current | | $I_{AC}$ | | | ±0.7 | mA |
| Allowable DC output current | | $I_{DC}$ | | | -2 | mA |
| **AF Output - AM (Pin 6)** | | | | | | |
| DC output voltage | | $V_{DC}$ | | 2.2 | | V |
| Output resistance | (1) | $R_{out}$ | | | 150 | Ω |
| AF output signal | m = 54%(5) | $v_{oAF}$ | | 500 | | $mV_{rms}$ |
| AF bandwidth | -3 dB(5) | B | | TBD | | kHz |
| Total harmonic distortion | m = 54%<br>$f_{mod}$ = 1 kHz, 12.5 kHz | THD | | 1 | 2 | % |
| Weighted signal-to-noise ratio (CCIR 468) | Reference: m = 54%(5)<br>$f_{mod}$ = 1 kHz | S/N | | 56 | | dB |
| Ripple rejection | Tested from pin 14 to 6(1) | RR | 28 | | | dB |
| Allowable AC output peak current | | $I_{AC}$ | | | ±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 an 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 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.

**Figure 3.** Test Circuit



## Internal Pin Configuration

**Figure 4.** Sound IF Inputs (Pins 1 and 2)

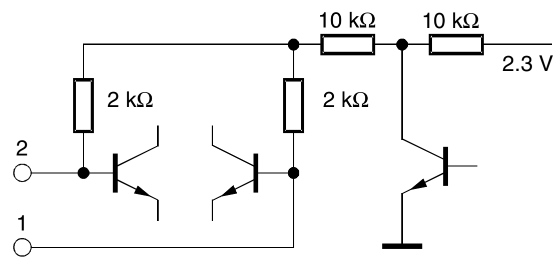



**Figure 5.** AGC Time Constant (Pin 3)

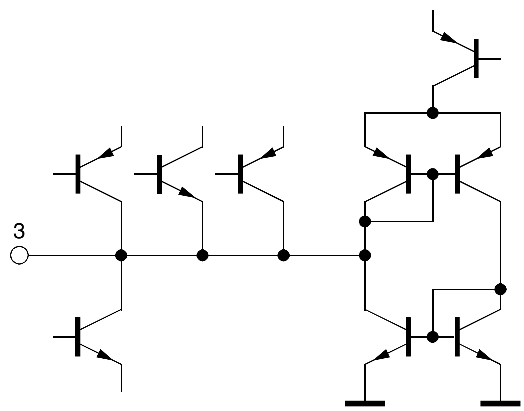



**Figure 6.** Internal Reference Voltage (Pin 4)

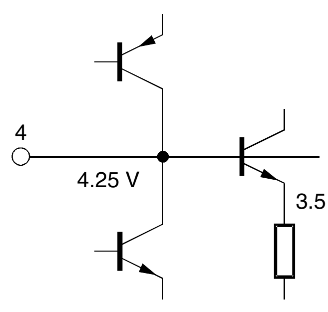



**Figure 7.** Loop Filter (Pin 5)

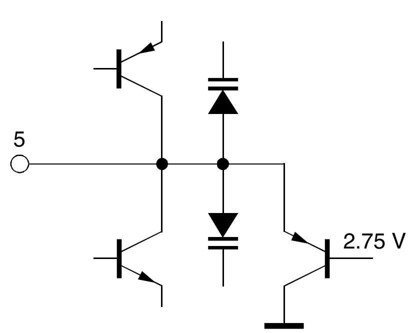


**Figure 8.** AM Output (Pin 6)

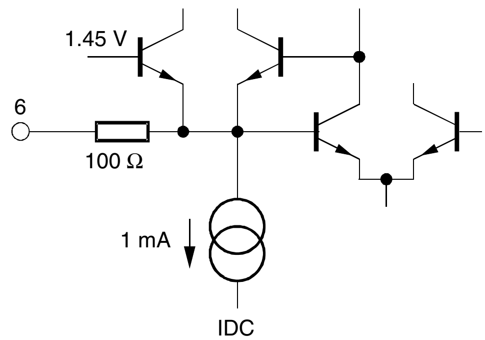



**Figure 9.** AGC Switch (Pin 7)

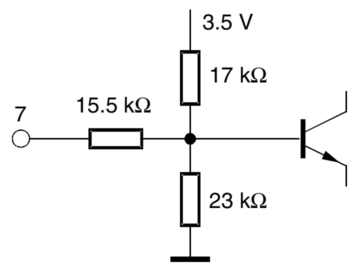



**Figure 10.** VCO (Pins 8 and 9)

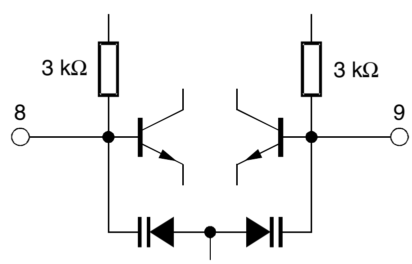



**Figure 11.** Mute Switch (Pin 10)

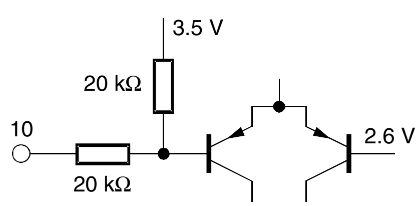
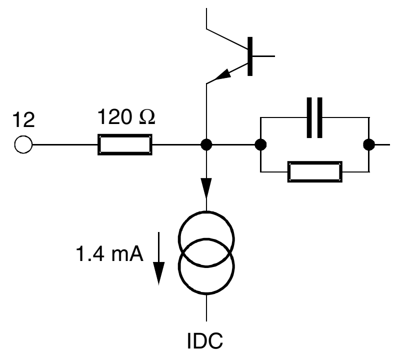


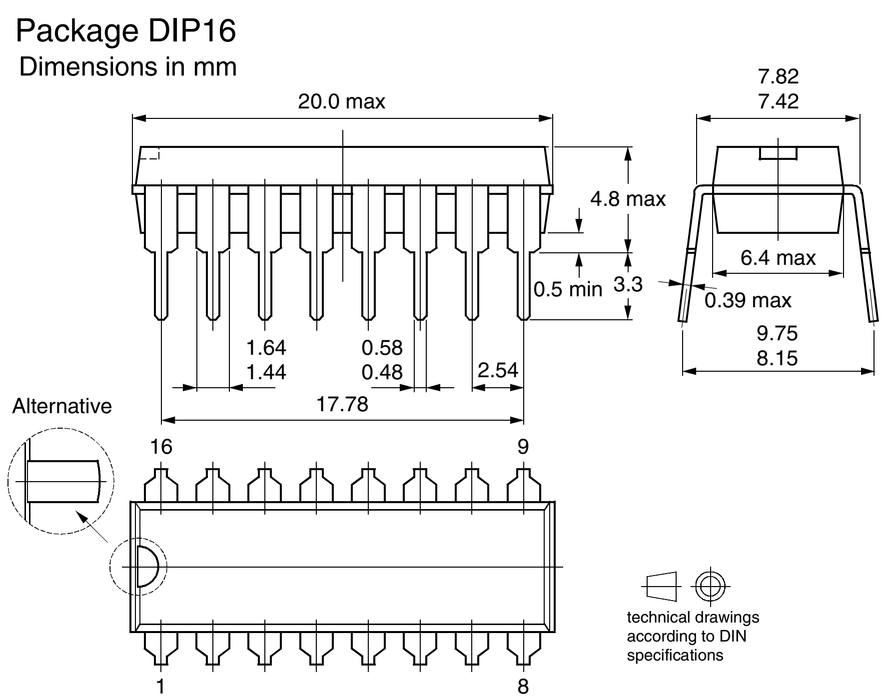
**Figure 12.** Intercarrier Output (Pin 12)




## Ordering Information

| Extended Type Number | Package | Remarks |
|---|---|---|
| U4468B | DIP16 | – |

## Package Information



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