## Features

- Two Alignment-free PLL FM Demodulators, Automatic Lock-in on the Received Sound Carrier Frequency
- Mono and Dual Channel Application
- Sound IF Inputs Provided for Ceramic Filters
- Automatic Mute for Second Sound Channel (Squelch)
- Mute Function for Both Sound Channels
- 5-V Supply Voltage, Low-power Consumption
- Few External Components

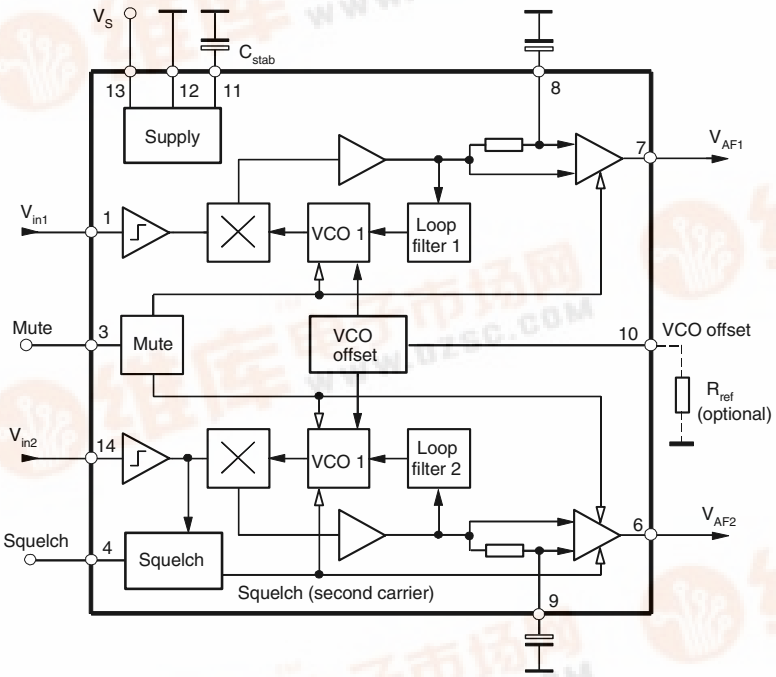
# Dual-Channel FM Sound Demodulator for TV Systems

# U2860B-M

## Description

The U2860B-M is a dual-channel FM sound demodulator realized with Atmel 's advanced bipolar process. All TV FM standards, from 4.5 MHz up to 6.5 MHz (standard M, B/G, I, D/K) can be processed with high performance. The circuit is alignment-free and has a minimum number of external components. With 5 V supply voltage, the U2860B-M is suitable for TV, VCR and multimedia applications.

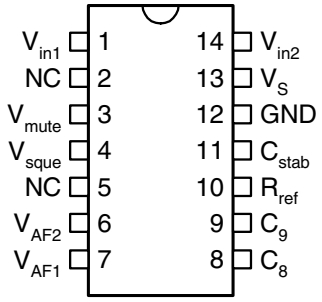
**Figure 1.** Block Diagram




Rev. 4794A–TVVCR–02/04

## Pin Configuration

**Figure 2.** Pinning




## Pin Description

| Pin | Symbol | Function |
|---|---|---|
| 1 | $V_{in1}$ | Intercarrier input of sound channel 1 (5.5 MHz) |
| 2 | NC | Not connected |
| 3 | $V_{mute}$ | Mute for sound channel 1+2 “on/off” |
| 4 | $V_{sque}$ | Automatic mute for 2nd sound channel (squelch) “on/off” |
| 5 | NC | Not connected |
| 6 | $V_{AF2}$ | Audio output AF2 of sound channel 2 |
| 7 | $V_{AF1}$ | Audio output AF1 of sound channel 1 |
| 8 | $C_8$ | Decoupling capacitor for sound channel 1 |
| 9 | $C_9$ | Decoupling capacitor for sound channel 2 |
| 10 | $R_{ref}$ | VCO offset of the free-running frequency |
| 11 | $C_{stab}$ | Internal supply voltage stabilization |
| 12 | GND | Ground |
| 13 | $V_S$ | Supply voltage |
| 14 | $V_{in2}$ | Intercarrier input of sound channel 2 (5.74 MHz) |

## Circuit Description

The U2860B-M includes two identical sound IF channels. Each consists of a limiter amplifier, PLL FM demodulator and AF amplifier. Additionally, this circuit contains a squelch function, mute switch and internal voltage regulation.

## Limiter Amplifiers

The intercarrier signals are fed through external ceramic bandpass filters to a 7-stage limiter amplifier. This guarantees high input sensitivity and excellent AM suppression.

## PLL FM Demodulators

The alignment-free Phase Locked Loop (PLL) demodulator covers a wide frequency range of 4.5 MHz up to 6.5 MHz with low-noise performance. The linear voltage to frequency characteristic results in low harmonic distortion. The free-running frequency of the internal VCO circuit is about 5.5 MHz. For this frequency, the input sensitivity and VCO locking is optimal. An additional external resistor at pin 10 allows a frequency shift of ±1 MHz via an internal offset current. With this option, it is possible to shift the optimum conditions to the upper frequency (6.5 MHz) or to the lower frequency (4.5 MHz). The offset current acts simultaneously on both VCO circuits. If no resistor is connected, the offset current is disabled.

## Audio Amplifiers

The demodulated signals are amplified to 500 mVrms with low output impedance at the audio outputs (pin 6 and pin 7). AC decoupling at pin 8 and pin 9 of the audio amplifiers leads to high common mode rejection.

## Squelch Function

For channel 2 the audio output amplifier and VCO2 is muted automatically (squelch) when the second sound carrier is not present. This avoids a wrong identification for stereo and dual sound in the stereo decoder. Therefore, with mono sound, there is no output signal at pin 6. The automatic squelch function can be disabled by switching pin 4 to ground.

## Mute Switch

Simultaneous muting of both circuits is possible by switching pin 3 to ground.

## Internal Voltage Stabilizer

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

## 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 12, unless otherwise specified.

| Parameters | Pin | Symbol | Value | Unit |
|---|---|---|---|---|
| Supply voltage | 13 | $V_S$ | 9.0 | V |
| Supply current | 13 | $I_S$ | 33 | mA |
| Power dissipation $V_S$ = +9 V | | P | 300 | mW |
| Output currents | 6, 7 | $I_{out}$ | ±1.5 | mA |
| External voltages | 1, 14<br>3, 4<br>6, 7, 8, 9, 10, 11 | $V_{ext}$<br>$V_{ext}$<br>$V_{ext}$ | 2.0<br>$V_S$<br>4.5 V | V<br>V<br>V |
| Junction temperature | | $T_j$ | +125 | °C |
| Storage temperature | | $T_{stg}$ | -25 to +125 | °C |
| Electrostatic handling[1] all pins | | $V_{ESD}$ | ±200 | V |

Notes: 1. Machine model in accordance with ESD S5.2 standard.

## Thermal Resistance

| Parameters | Symbol | Value | Unit |
|---|---|---|---|
| Junction ambient when soldering to PCB | $R_{thJA}$ | 90 | K/W |

## Operating Range

| Parameters | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage range, pin 13 | $V_S$ | 4.5 to 9.0 | V |
| Ambient temperature | $T_{amb}$ | 0 to 85 | °C |

## Electrical Characteristics

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

| Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **DC Supply (Pin 13)** | | | | | | | |
| Supply voltage range | | | $V_S$ | 4.5 | 5.0 | 9.0 | V |
| Supply current | | | $I_S$ | | 27 | 33 | mA |
| **Intercarrier Input 1 (Pin 1)** | | | | | | | |
| DC input voltage | | | $V_{DC}$ | | 1.75 | | V |
| Input resistance(1) | | | $R_{in}$ | | 680 | 750 | Ω |
| Input limiting voltage | Input signal $v_{in}$: f = 5.5 MHz output signal AF1: $v_{AF1}$ = -3 dB | | $v_{lim}$ | | | 150 | µV |
| **Intercarrier Input 2, Pin 14** | | | | | | | |
| DC input voltage | | | $V_{DC}$ | | 1.75 | | V |
| Input resistance(1) | | | $R_{in}$ | | 680 | 750 | Ω |
| Input limiting voltage | Input signal $v_{in}$: f = 5.74 MHz output signal AF2: $v_{AF2}$ = -3 dB | | $v_{lim}$ | | | 150 | µV |
| Input signal for automatic second sound carrier mute off (squelch) | Audio output AF2 active | | $v_{in}$ | > 0.7 | 1.0 | < 1.5 | mV |
| **FM Demodulators, Internal VCO's (Pin 10)** | | | | | | | |
| Free-running frequency | | | $f_{VCO}$ | | 5.5 | | MHz |
| Oscillator drift (free-running) as function of temperature | ΔT = 55° C | | $\Delta f_{VCO}$ | | 500 | | kHz |
| Oscillator shift (free-running) as function of supply voltage | 4.5 V < $V_S$ < 5.5 V | | $\Delta f_{VCO}$ | | 200 | | kHz |
| Adjustment range of free-running frequencies | By external resistor $R_{ref}$ at pin 10 | | $\Delta f_{adj}$ | ±1 | | | MHz |
| Adjustment resistance for free-running frequencies | | | $R_{ref}$ | 15 | 22 | 30 | kΩ |
| **FM Demodulators, Internal VCO's (Pin 10)** | | | | | | | |
| Steepness of free-running frequency adjustment | Resistor $R_{ref}$ at pin 10 | | S | | 200 | | kHz/kΩ |
| Capture range of PLL's | | | $\Delta f_{cap}$ | ±1.4 | ±1.9 | | MHz |
| Holding range of PLL's | | | $\Delta f_{hold}$ | ±2.0 | ±3.0 | | MHz |
| **Audio Outputs, AF1 (Pin 7) and AF2 (Pin 6)** | | | | | | | |
| DC output voltage | | | $V_{DC}$ | | 2.2 | | V |
| DC output current | | | $I_{DC}$ | | 1.0 | -1.3 | mA |
| Output resistance(1) | | | $R_{out}$ | | 150 | | Ω |
| AC output peak current | | | $i_{AC}$ | | | ±1.0 | mA |

Note: 1. This parameter is given as an application information and not measured during final testing.

## Electrical Characteristics (Continued)

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

| Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| AF output voltage, RMS value | $v_{in}$ = 10 mV<br>f = 5.5 MHz<br>FM-dev. = 27 kHz<br>$f_{mod}$ = 1 kHz | | $v_{AF}$ | | 500 | | mV |
| Difference between the output signals | | | $\Delta v_{AF}$ | | | ±1 | dB |
| Total harmonic distortion | $v_{in}$ = 10 mV<br>f = 5.5 MHz<br>FM-dev. = 27 kHz<br>$f_{mod}$ = 1 kHz | | THD | | 0.1 | 0.5 | % |
| AM suppression | $v_{in}$ = 10 mV<br>f = 5.5 MHz<br>$f_{mod}$ = 1 kHz<br>reference signal:<br>FM-dev. = 50 kHz<br>test signal: m = 30% | | $\alpha_{AM}$ | 46 | 66 | | dB |
| Crosstalk attenuation between the AF outputs | f = 50 Hz to 12.5 kHz | | $\alpha_{att}$ | | 70 | | dB |
| Supply voltage ripple rejection | $V_{RR}$ < 200 mV, f = 70 Hz | | RR | | 24 | | dB |
| **Mute Switch (Pin 3)** | | | | | | | |
| Control voltage<br>- mute off<br>- mute on | <br>AF outputs active<br>AF outputs not active | | $V_{mute}$ | <br>2.0<br>0 | | <br>$V_S$<br>0.8 | <br>V<br>V |
| Control current | | | $I_{mute}$ | | 150 | | µA |
| **Squelch Function, (Pin 4)** | | | | | | | |
| Control voltage for automatic mute 2nd carrier<br>- off<br>- on | | | $V_{sque}$ | <br>0<br>2.0 | | <br>0.8<br>$V_S$ | <br>V<br>V |
| Control current | | | $I_{sque}$ | | 150 | | µA |

Note: 1. This parameter is given as an application information and not measured during final testing.

**Figure 3.** Total Harmonic Distortion

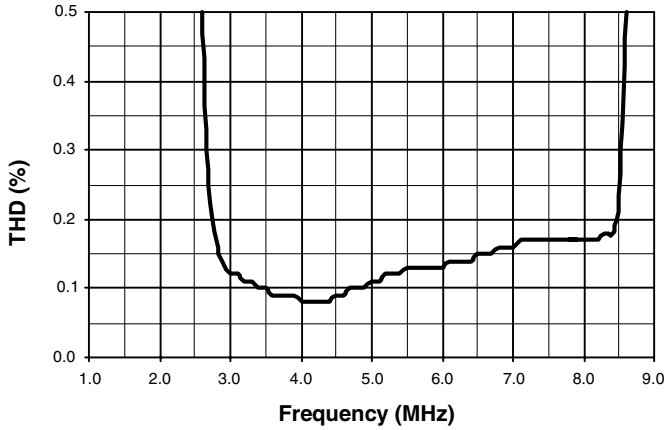



**Figure 4.** AM Suppression

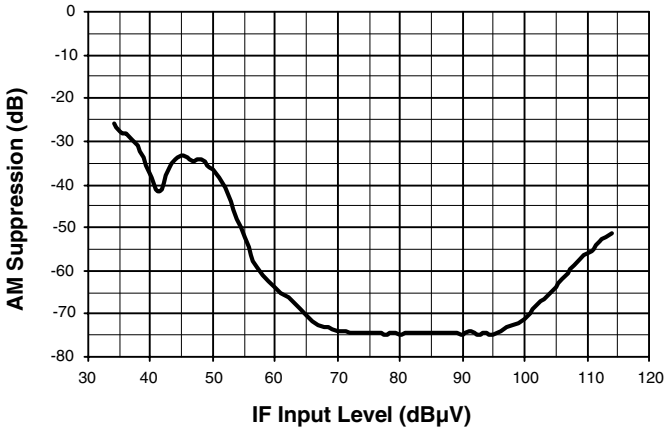



**Figure 5.** VCO Free-running Frequency

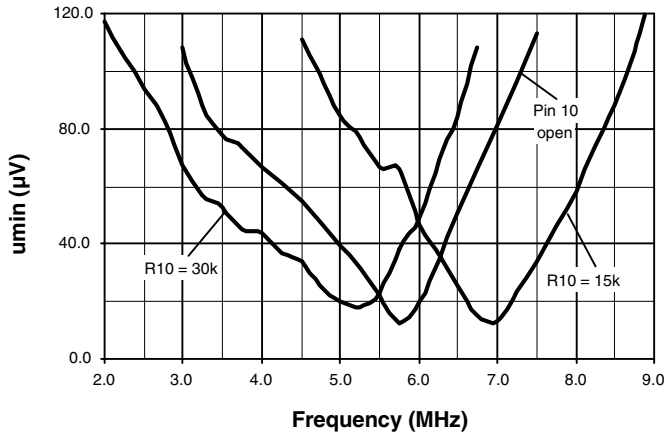


**Figure 6.** Capture and Hold Range

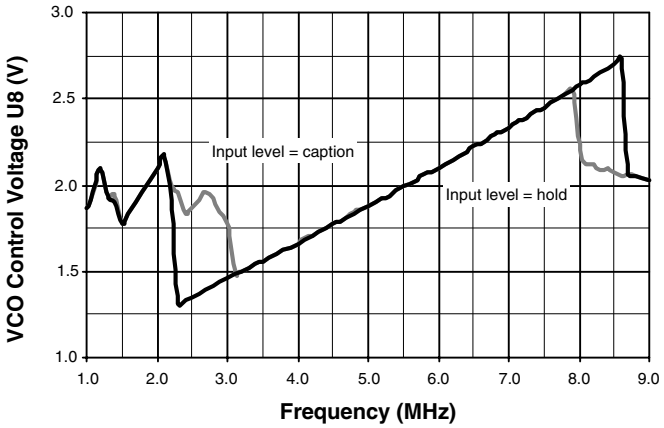



**Figure 7.** Limiter Characteristics

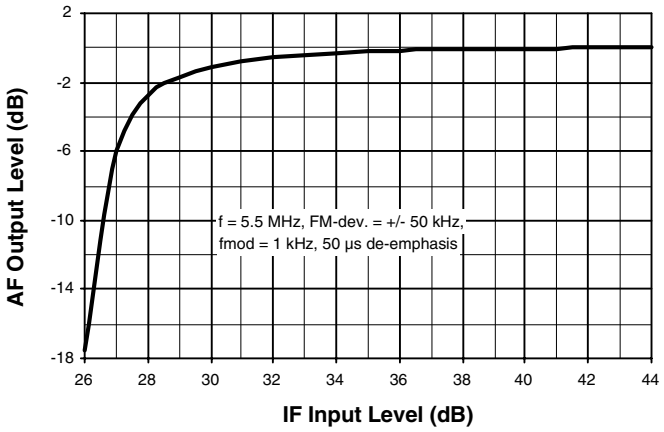



**Figure 8.** Signal-to-noise Ratior

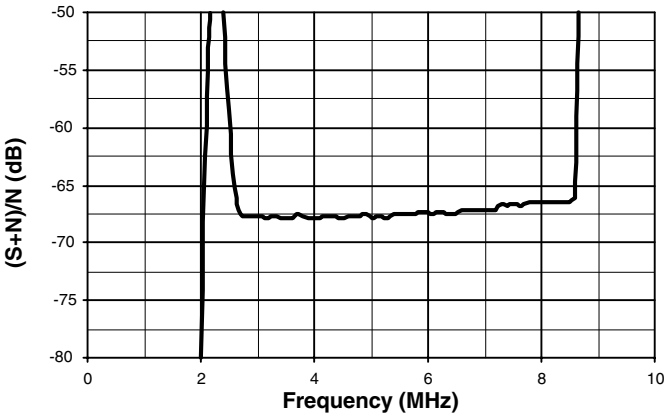


**Figure 9.** SIF Inputs

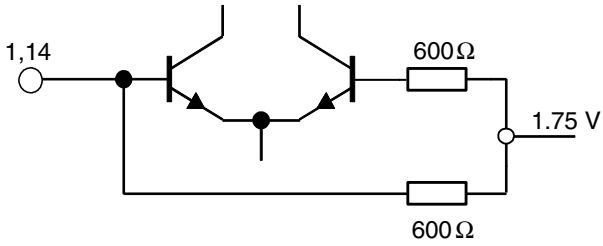



**Figure 10.** Mute Switch/Squelch Switch

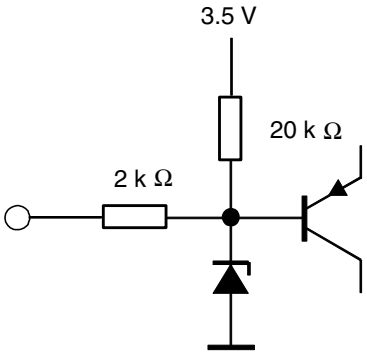



**Figure 11.** Audio Outputs

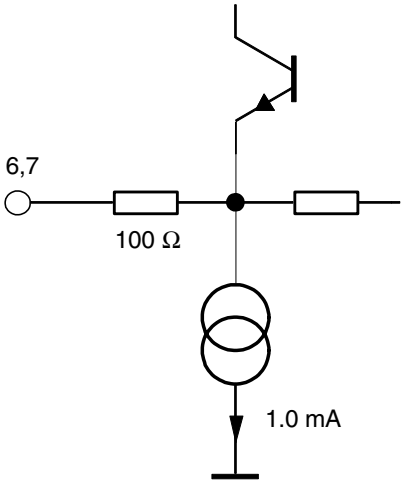


**Figure 12.** Decoupling Capacitor

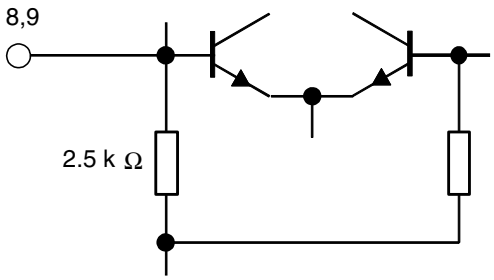



**Figure 13.** VCO Offset (Reference Resistor)

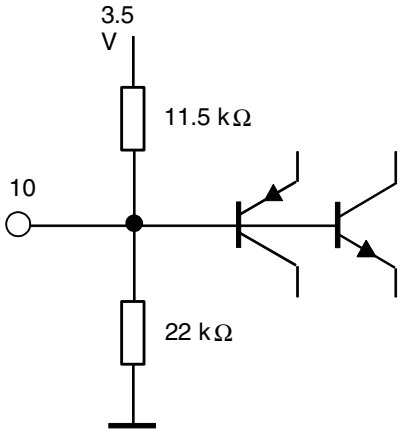



**Figure 14.** Internal Supply Voltage Stabilization

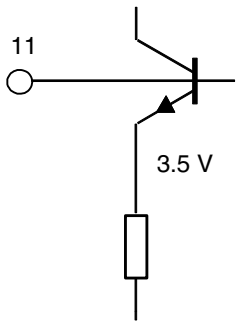


**Figure 15.** Test Circuit

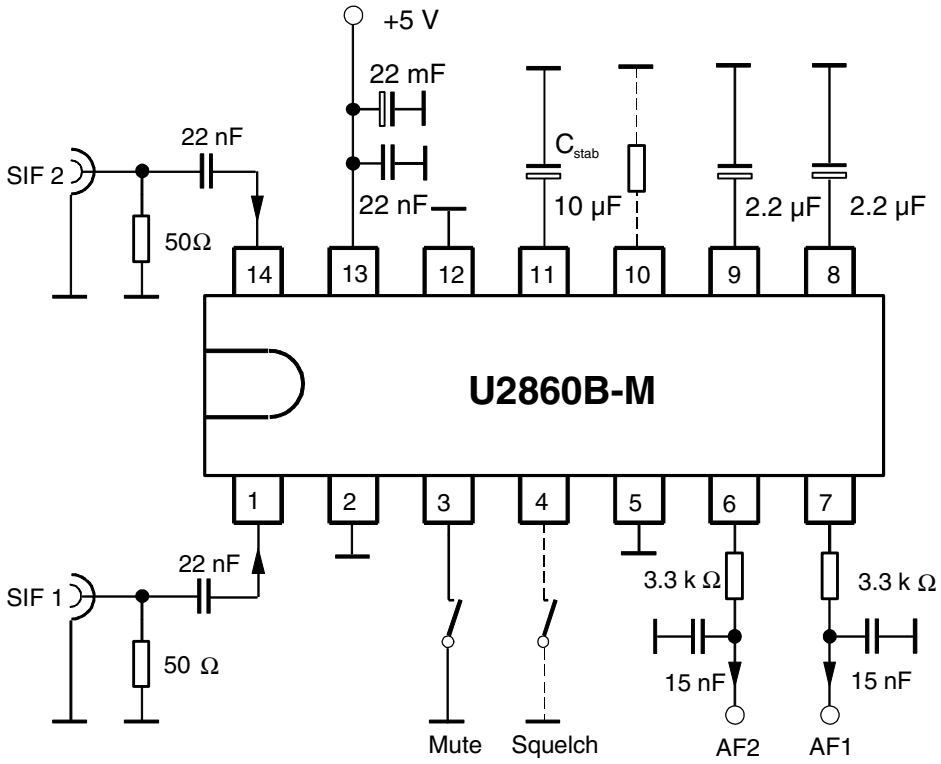



**Figure 16.** Application Circuit

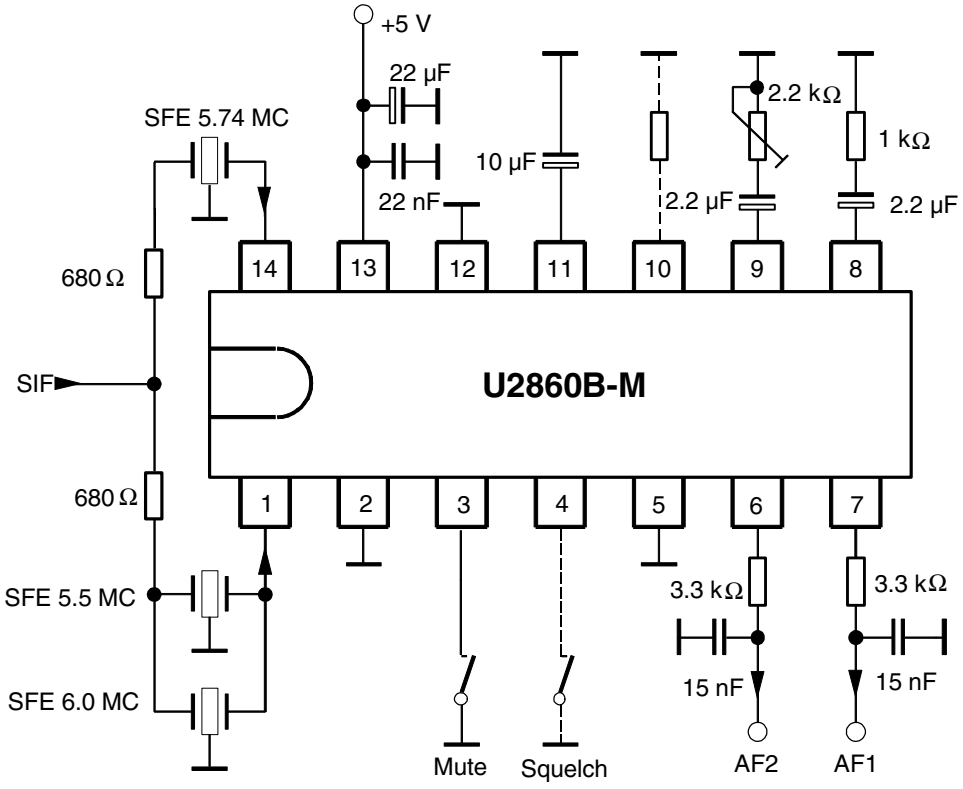


**Figure 17.** PCB Layout (Test/Application Circuit)

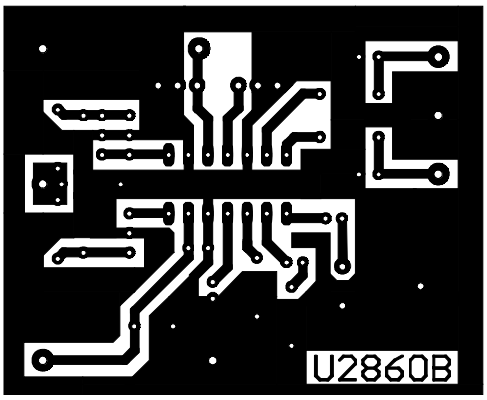



**Figure 18.** Component Layout (Test Circuit)

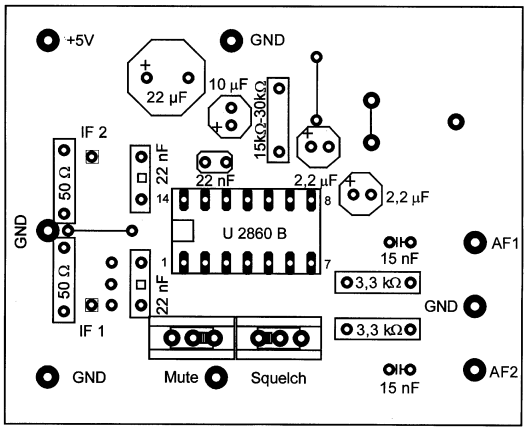
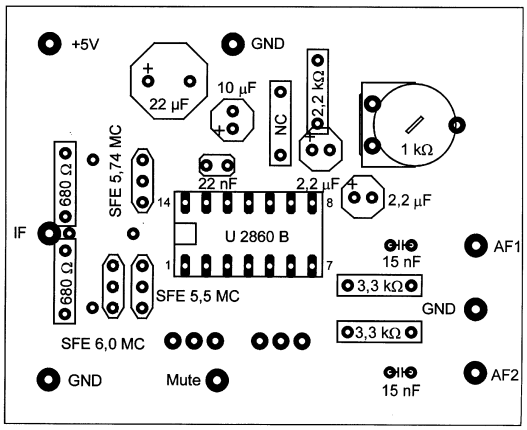



**Figure 19.** Component Layout (Application Circuit)

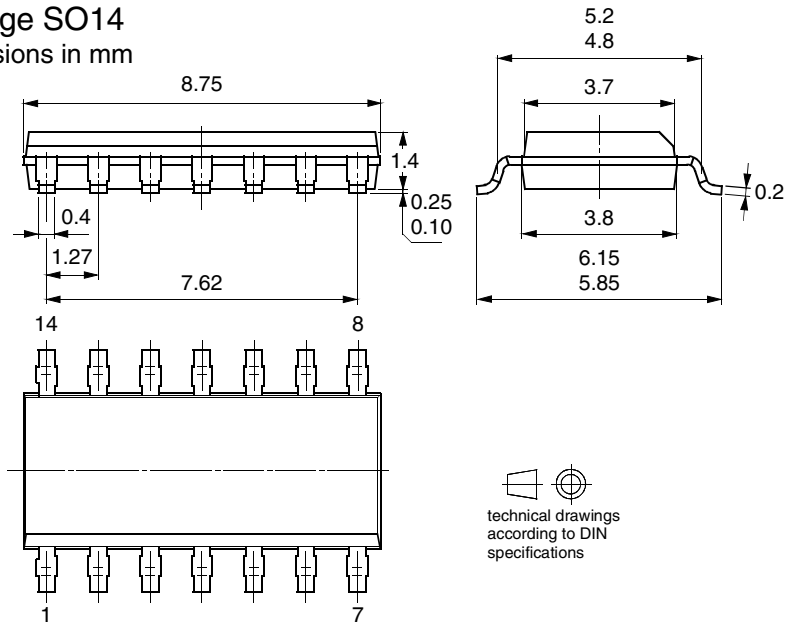


## Ordering Information

| Extended Type Number | Package | Remarks |
|---|---|---|
| U2860B-MFP | SO14 | Tube |
| U2860B-MFPG3 | SO14 | Taped and reeled |

## Package Information

Package SO14
Dimensions in mm

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