

## 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

## Description

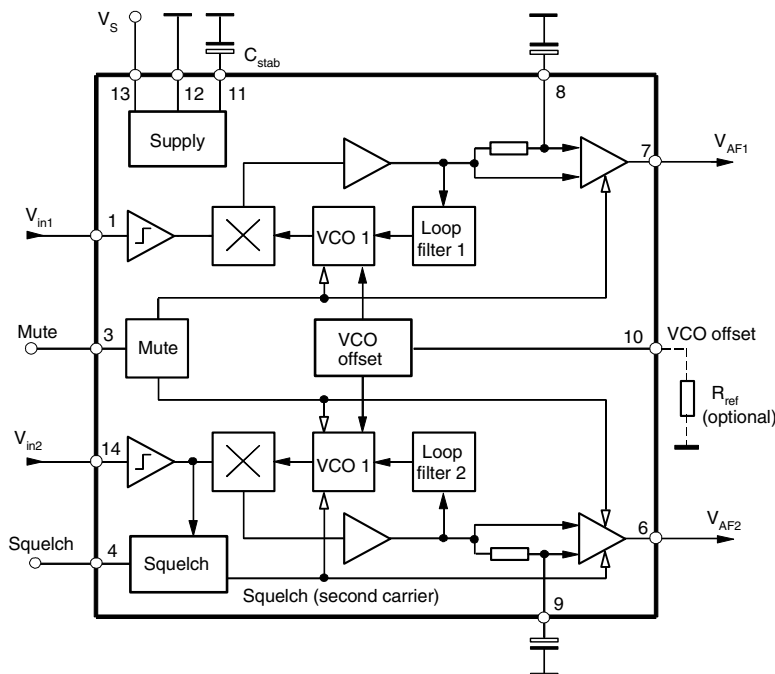
The U2860B-M is a dual-channel FM sound demodulator realized with Atmel's advanced bipolar process. All TV FM standards, from 4.5 MHz up to 6.5 MHz (standard M, B/G, I, D/K) can be processed with high performance. The circuit is alignment-free and has a minimum number of external components. With 5 V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



## Dual-Channel FM Sound Demodulator for TV Systems

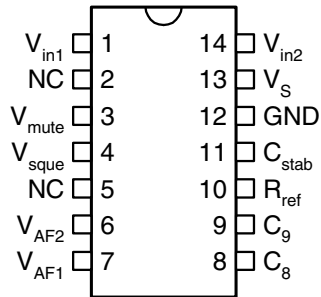
### U2860B-M

Figure 1. Block Diagram



## Pin Configuration

Figure 2. Pinning



## Pin Description

Pin	Symbol	Function
1	$V_{in1}$	Inter-carrier 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	$V_{in2}$	Inter-carrier 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  $\pm 1$  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	$I_{out}$	$\pm 1.5$	mA
External voltages	1, 14	$V_{ext}$	2.0	V
	3, 4	$V_{ext}$	$V_S$	V
	6, 7, 8, 9, 10, 11	$V_{ext}$	4.5 V	V
Junction temperature		$T_j$	+125	°C
Storage temperature		$T_{stg}$	-25 to +125	°C
Electrostatic handling <sup>(1)</sup> all pins		$V_{ESD}$	$\pm 200$	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

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

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
<b>DC Supply (Pin 13)</b>							
Supply voltage range			$V_S$	4.5	5.0	9.0	V
Supply current			$I_S$		27	33	mA
<b>Intercarrier Input 1 (Pin 1)</b>							
DC input voltage			$V_{DC}$		1.75		V
Input resistance <sup>(1)</sup>			$R_{in}$		680	750	$\Omega$
Input limiting voltage	Input signal $v_{in}$ : $f = 5.5\text{ MHz}$ output signal AF1: $V_{AF1} = -3\text{ dB}$		$V_{lim}$			150	$\mu\text{V}$
<b>Intercarrier Input 2, Pin 14</b>							
DC input voltage			$V_{DC}$		1.75		V
Input resistance <sup>(1)</sup>			$R_{in}$		680	750	$\Omega$
Input limiting voltage	Input signal $v_{in}$ : $f = 5.74\text{ MHz}$ output signal AF2: $V_{AF2} = -3\text{ dB}$		$V_{lim}$			150	$\mu\text{V}$
Input signal for automatic second sound carrier mute off (squelch)	Audio output AF2 active		$v_{in}$	> 0.7	1.0	< 1.5	mV
<b>FM Demodulators, Internal VCO's (Pin 10)</b>							
Free-running frequency			$f_{VCO}$		5.5		MHz
Oscillator drift (free-running) as function of temperature	$\Delta T = 55^\circ\text{C}$		$\Delta f_{VCO}$		500		kHz
Oscillator shift (free-running) as function of supply voltage	$4.5\text{ V} < V_S < 5.5\text{ V}$		$\Delta f_{VCO}$		200		kHz
Adjustment range of free-running frequencies	By external resistor $R_{ref}$ at pin 10		$\Delta f_{adj}$	$\pm 1$			MHz
Adjustment resistance for free-running frequencies			$R_{ref}$	15	22	30	k $\Omega$
<b>FM Demodulators, Internal VCO's (Pin 10)</b>							
Steepness of free-running frequency adjustment	Resistor $R_{ref}$ at pin 10		S		200		kHz/k $\Omega$
Capture range of PLL's			$\Delta f_{cap}$	$\pm 1.4$	$\pm 1.9$		MHz
Holding range of PLL's			$\Delta f_{hold}$	$\pm 2.0$	$\pm 3.0$		MHz
<b>Audio Outputs, AF1 (Pin 7) and AF2 (Pin 6)</b>							
DC output voltage			$V_{DC}$		2.2		V
DC output current			$I_{DC}$		1.0	-1.3	mA
Output resistance <sup>(1)</sup>			$R_{out}$		150		$\Omega$
AC output peak current			$i_{AC}$			$\pm 1.0$	mA

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

## Electrical Characteristics (Continued)

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

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

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

Figure 3. Total Harmonic Distortion

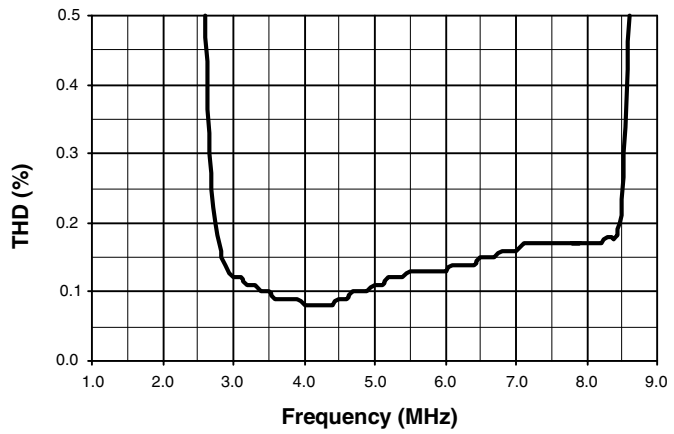


Figure 4. AM Suppression

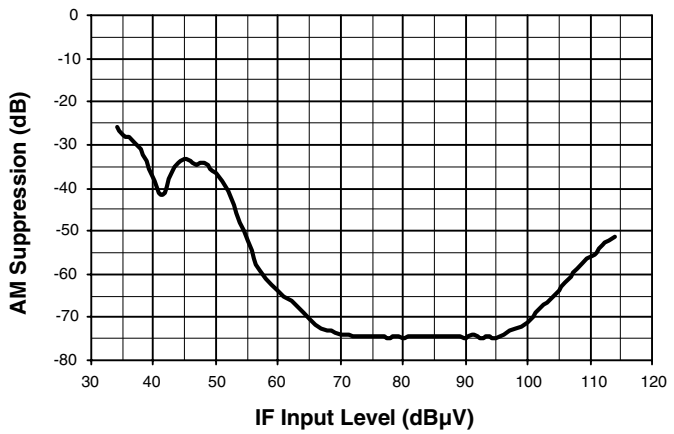
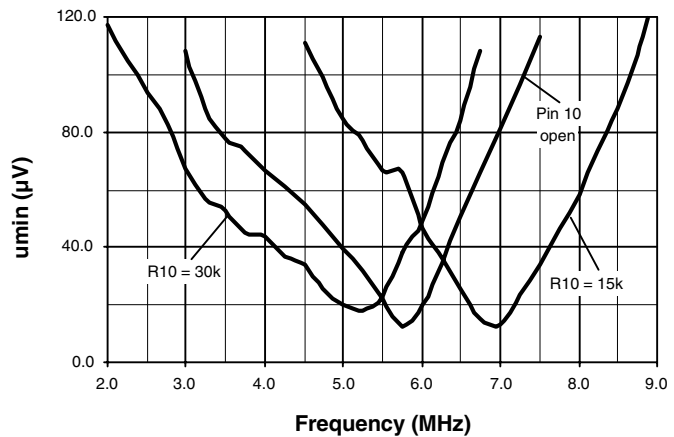
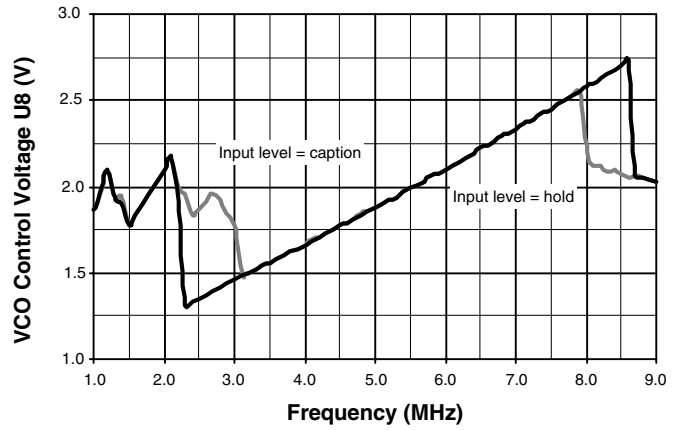


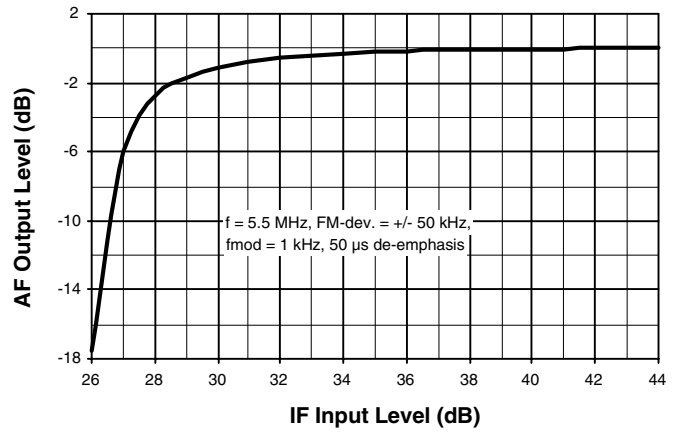
Figure 5. VCO Free-running Frequency



**Figure 6. Capture and Hold Range**



**Figure 7. Limiter Characteristics**



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

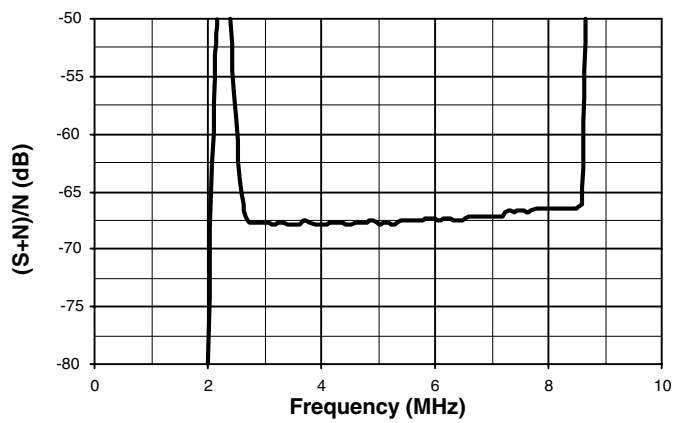




Figure 9. SIF Inputs

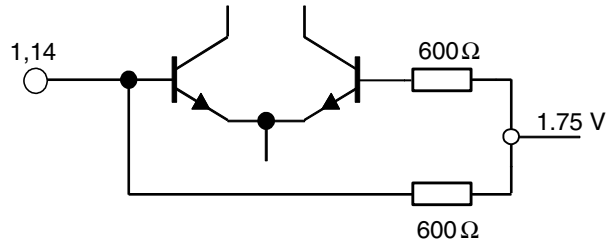


Figure 10. Mute Switch/Squelch Switch

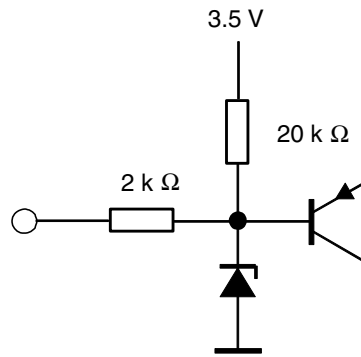
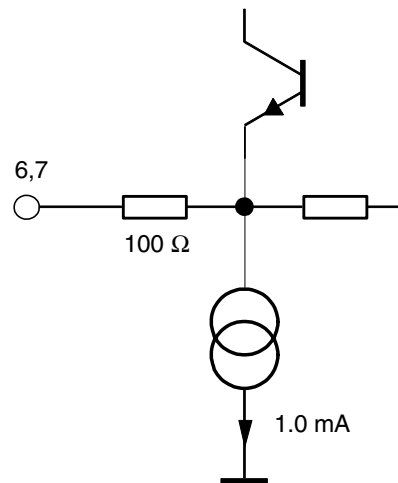
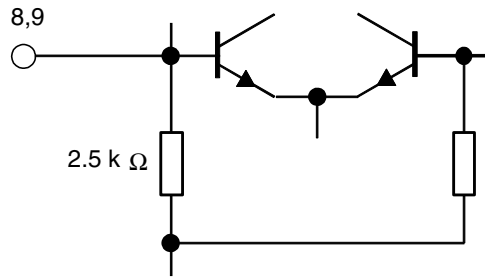


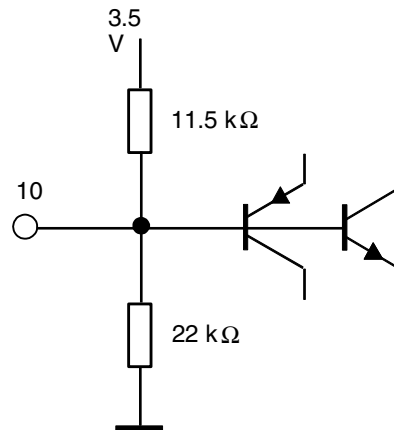
Figure 11. Audio Outputs



**Figure 12.** Decoupling Capacitor



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



**Figure 14.** Internal Supply Voltage Stabilization

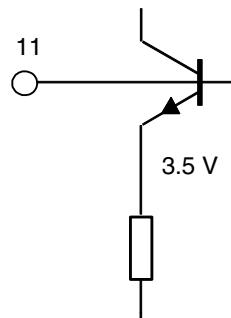


Figure 15. Test Circuit

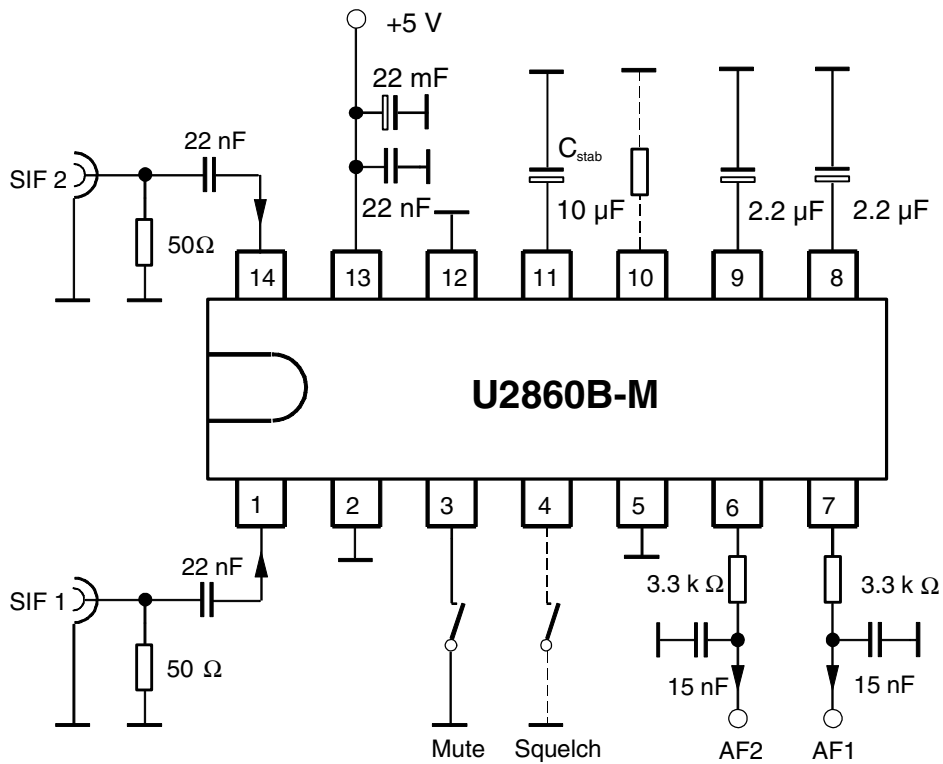


Figure 16. Application Circuit

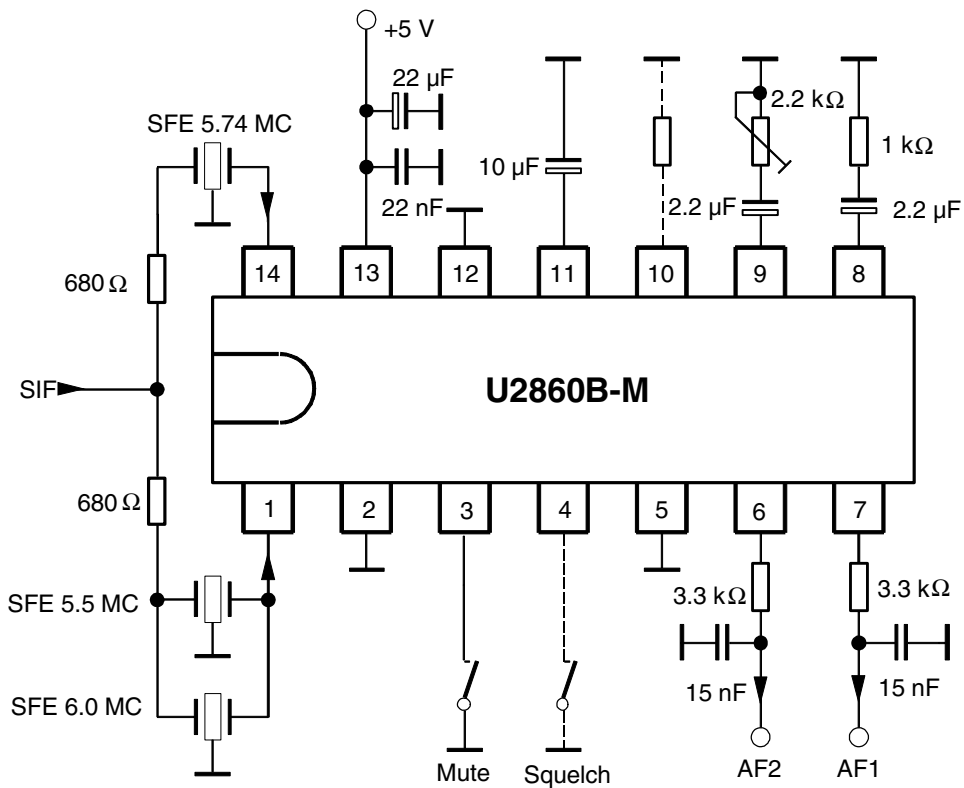


Figure 17. PCB Layout (Test/Application Circuit)

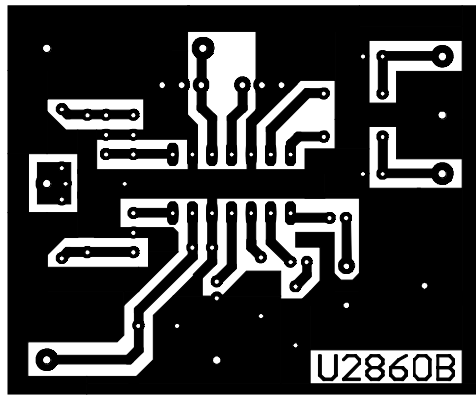


Figure 18. Component Layout (Test Circuit)

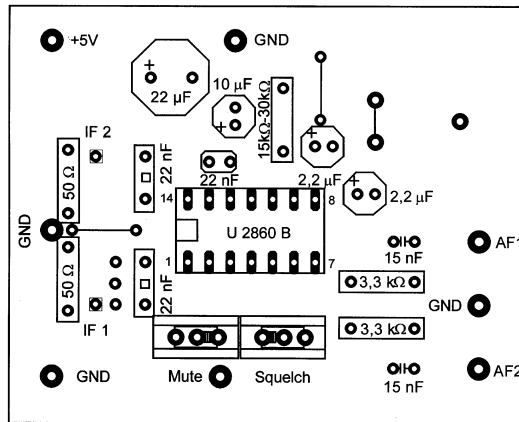
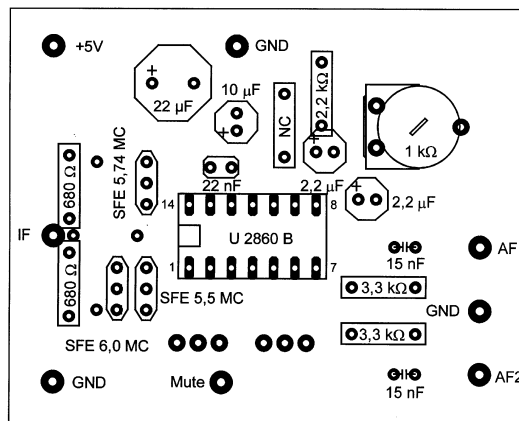


Figure 19. Component Layout (Application Circuit)

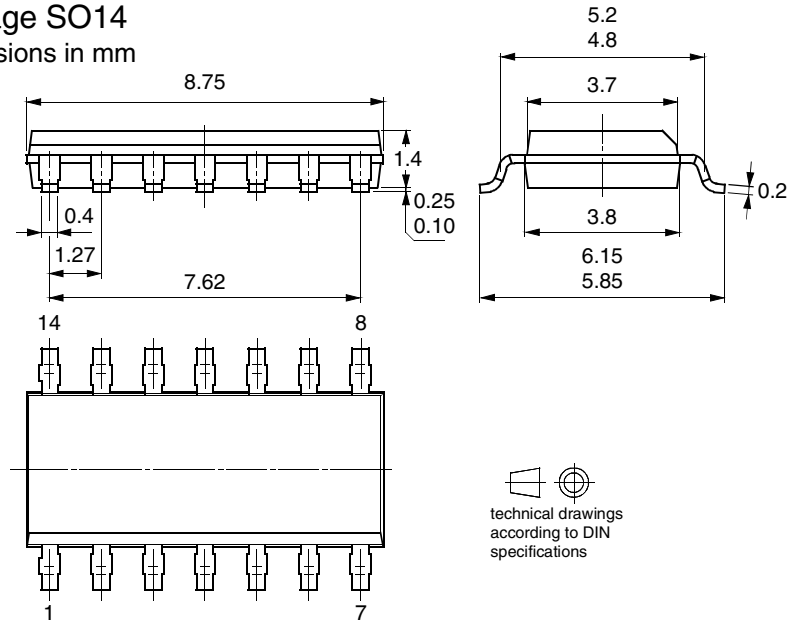


### Ordering Information

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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