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SL6659

LOW POWER IF/AF CIRCUIT (WITH RSSI) FOR FM RADIO

The SL6659 is a complete single chip mixer, IF amplifier and detector for FM cellular radio, cordless telephones and low power radio applications. It features an exceptionally stable RSSI (Received Signal Strength Indicator) output using a unique system of detection. Supply current is less than 2mA from a supply voltage in the range 2·5V to 7·5V.

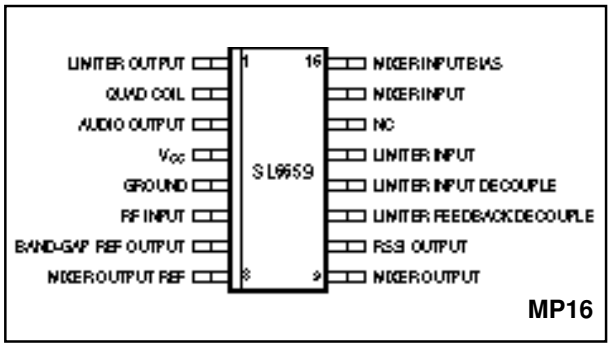

Fig. 1 Pin connections – top view

FEATURES

- Low Power Consumption (1·5mA)
- Single Chip Solution
- Guaranteed 200MHz Operation
- Exceptionally Stable RSSI

APPLICATIONS

- Cellular Radio Telephones
- Cordless Telephones

ORDERING INFORMATION

SL6659 NA MP – Miniature plastic DIL package
SL6659 NA MPTD - As above, supplied on tape and reel

QUICK REFERENCE DATA

- Supply Voltage: 2·5V to 7·5V
- Sensitivity: 3µV
- Co-channel Rejection: 7dB

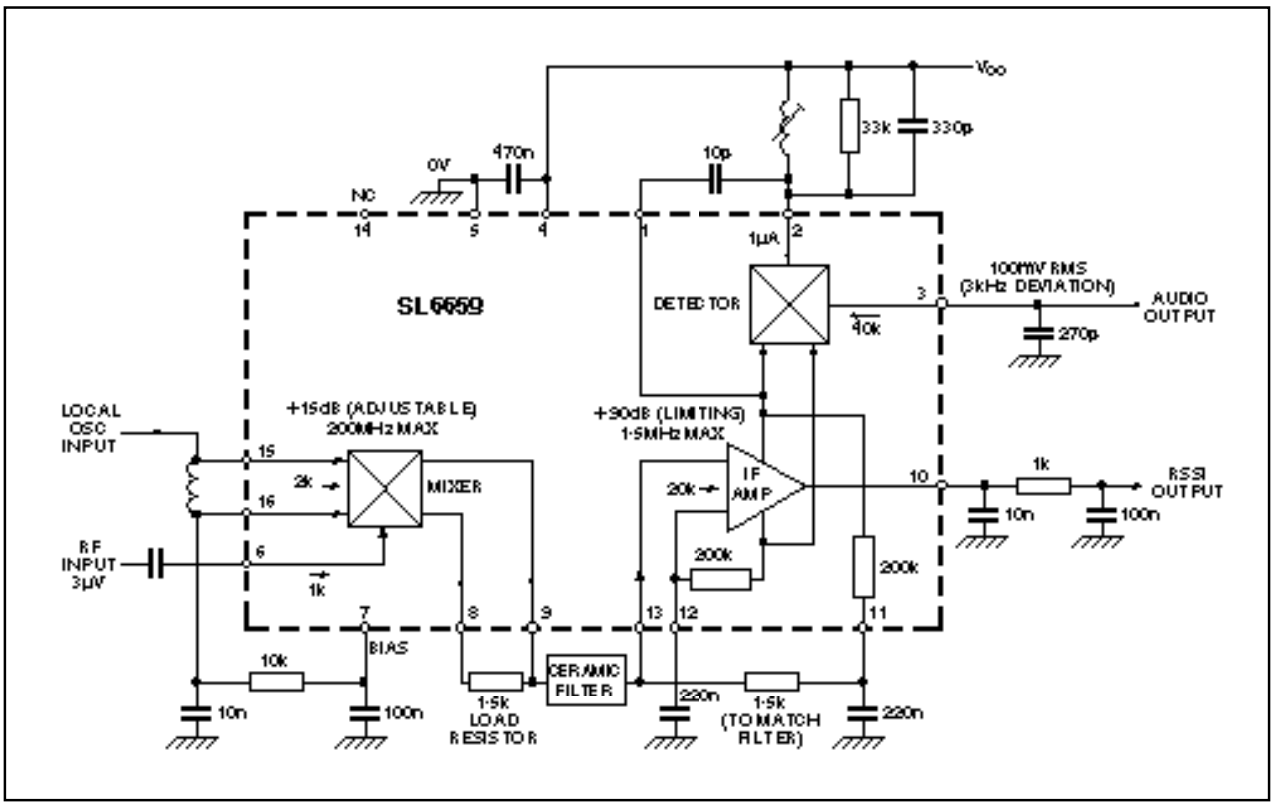

Fig. 2 Block diagram

ABSOLUTE MAXIMUM RATINGS

Supply voltage	8V
Storage temperature	55°C to 150°C
Mixer input	1Vrms

NOTE: This device has static sensitive inputs, sensitivity typically measured as 500V using MIL-STD-883 method 3015. Therefore, ESD handling precautions are essential to avoid degradation of performance or permanent damage of this device.

ELECTRICAL CHARACTERISTICS

The characteristics are guaranteed over the following condltions, unless otherwise stated:

V_{CC} = 2·5V to 7·5V, T_{AMB} = 30°C to 85°C, IF = 455kHz, RF = 50MHz, Quad Coil working Q = 30

Characteristic	Value Min.	Value Typ.	Value Max.	Units	Conditions
Overall					
Supply current		1·5	2·0	mA	20dB SINAD
Sensitivity		5		µV	12dB SINAD
		3		µV	RF input <500µV
AM rejection		40		dB	T_{AMB} = 25°C
V_{BIAS}	1·0	1·2	1·4	V	See Note 2
Co-channel rejection		7		dB	
Mixer					
RF input impedance		1		kΩ	
LO input impedance		2		kΩ	
LO input bias		5		µA	At V_{BIAS}
Mixer gain		15		dB	R_{LOAD} = 1.5kΩ
3rd order input intercept		10		dBm	
LO input level	180		300	mV	
LO frequency	200			MHz	
IF Amplifier					
Gain		90		dB	
Frequency	455	1500		kHz	
Differential input impedance		20		kΩ	
Detector					
Audio output level	75		125	mV	5mV into pin 13
Ultimate S/N ratio		60		dB	5mV into pin 13
THD		0·5	5	%	5mV into pin 13
Output impedance		40		kΩ	
RSSI Output (T_{AMB} = 25°C)					
Output current			25	µA	No input pin13
	50		80	µA	Pin 13 = 2·5mV
Current change	0·9	1·22	1·5	µA/dB	See Note 1
Linear dynamic range	70			dB	See Note 1

NOTES

1. The RSSI output is 100% dynamically tested at 5V and 20°C over a 70dB range. First the input to pin 13 is set to 2·5mV and the RSSI current recorded. Then for each step of 10dB from 40 to 30db, the current is measured. The current change in each step must meet the specified figure for current change. The RSSI output is guaranteed monotonic and free from discontinuities over this range.
2. Co-channel rejection is measured by applying a 3kHz deviation, 1kHz modulated signal at an input level to give a 20dB SINAD ratio. Then a 3kHz deviation 400Hz modulated slgnal on the same frequency is also applied and its level increased to degrade the SINAD to 14dB.

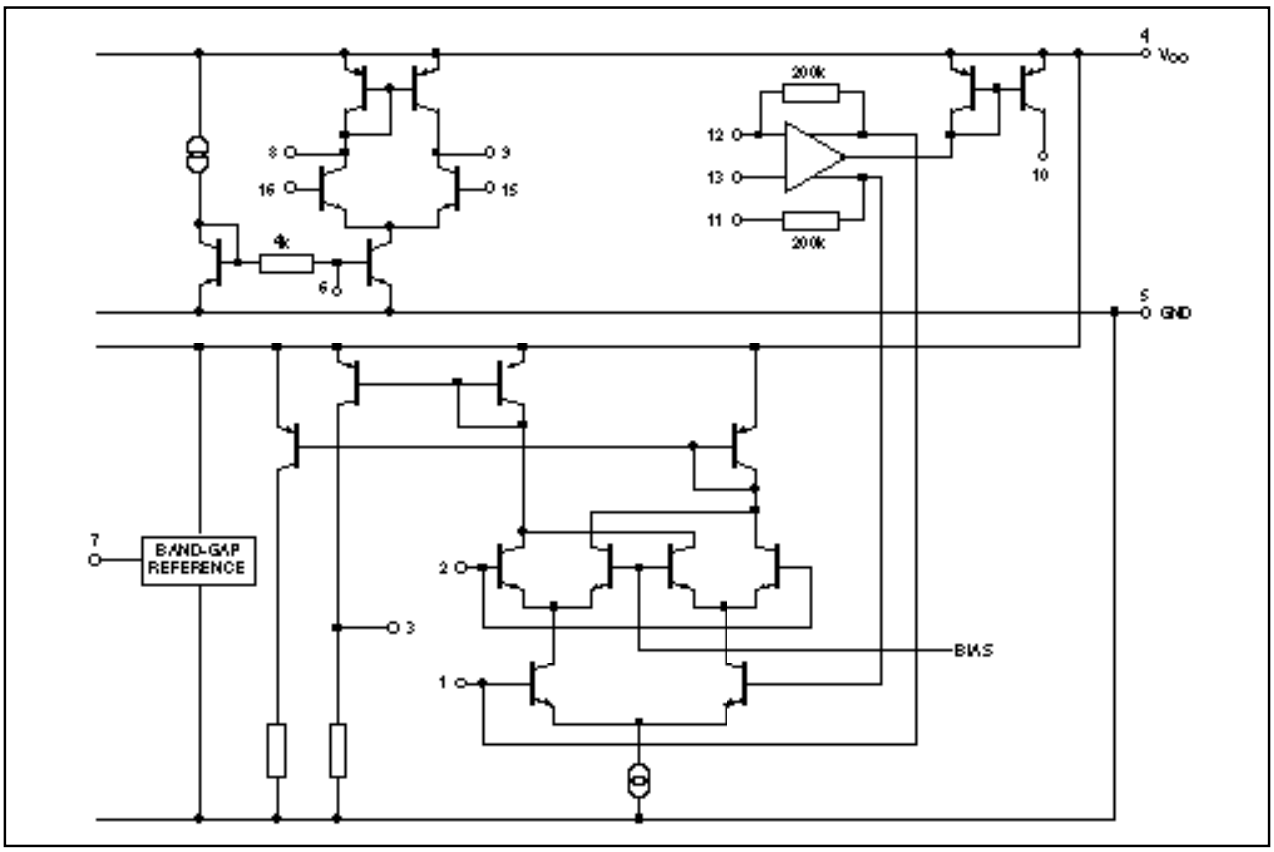

Fig. 3 Internal schematic

GENERAL DESCRIPTION

The SL6659 is a very low power, high performance integrated circuit intended for IF amplification and demodulation in FM radio receivers. It comprises:

- A mixer stage for use up to 200MHz
- A limiting amplifier operating up to 1·5MHz
- A quadrature detector with AF output
- An RSSI (Received Signal Strength Indicator) output

Mixer

The Mixer is single balanced with an active load. Gain is set externally by the load resistor, although the value is normally determined by that required for matching into the ceramic filter. It is possible to use a tuned circuit but an increase in mixer gain will result in a corresponding reduction of the mixer input intercept point.

The RF input is a diode-biased transistor with a bias current of typically 300µA. The LO input is differential but would normally be driven single-ended. Special care should be taken to avoid accidental overload of the local oscillator input.

IF Amplifier

The limiting amplifier is capable of operation to at least 1MHz and the input impedance is set by an external resistor to match the ceramic filter. Because of the high gain, pins 11 and 12 must be adequately bypassed.

Detector

A conventional quadrature detector providing audio output is fed internally from the IF amplifier; the quadrature input is fed externally using an appropriate capacitor and phase shift network.

RSSI Output

The RSSI output is a current source with value proportional to the logarithm of the IF signal amplitude. There is a small residual current due to noise within the amplifier (and mixer) but beyond this point there is a measured and guaranteed 70dB dynamic range. The typical range extends to 92dB, independent of frequency, and with exceptionally good temperature and supply voltage stability.

Supply Voltage

The SL6659 will operate reliably trom 2·5V to 7·5V. The supply line must be decoupled with 470nF using short leads.

Internal Bias Voltage

The internal band-gap reference must be externally decoupled. It can be used as an external reference but must not be loaded heavily; the output impedance is typically 14Ω.

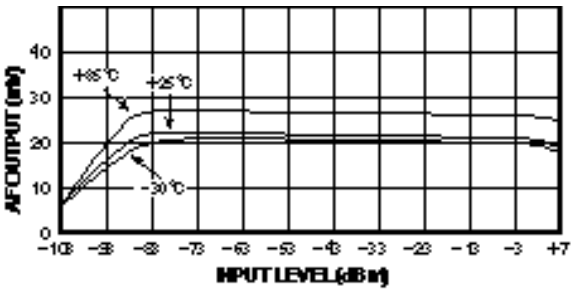

Fig. 4 Audio output v. input and temperature at 2·5V

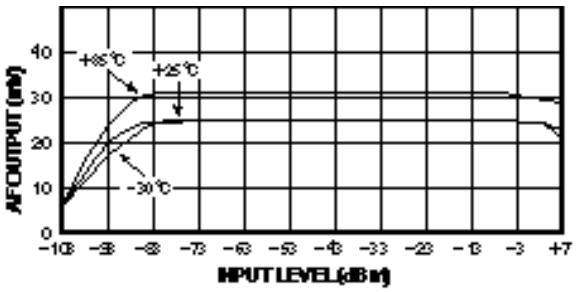

Fig. 5 Audio output v. input and temperature at 5·0V

Fig. 6

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Fig. 6 Audio output v. input and temperature at 7·5V

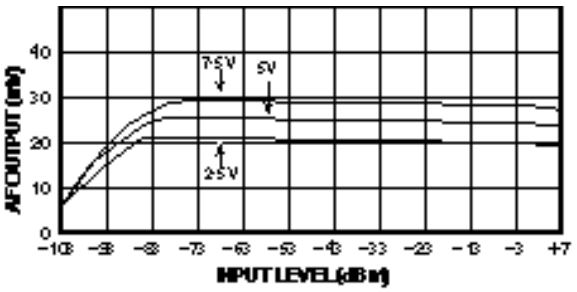

Fig. 7 Audio output v. input and supply voltage at 25°C

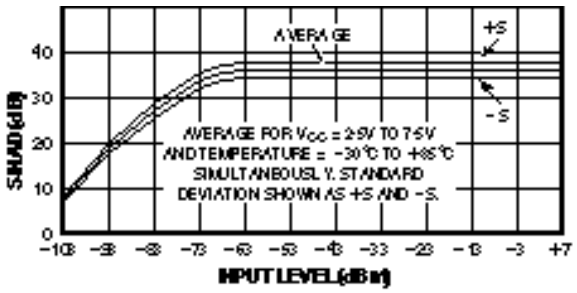

Fig. 8 SINAD v. input level

Fig. 9

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Fig. 9 AM rejection and input level

Fig. 10 RSSI output v. input and supply voltage (T_{AMB} = 20°C)

Fig. 11 RSSI output v. input and temperature (V_{CC} = 2·5V)

Fig. 12 RSSI output v. input level and temperature (V_{CC} = 5V)

Fig. 13 RSSI output v. input level and temperature (V_{CC} = 7·5V)

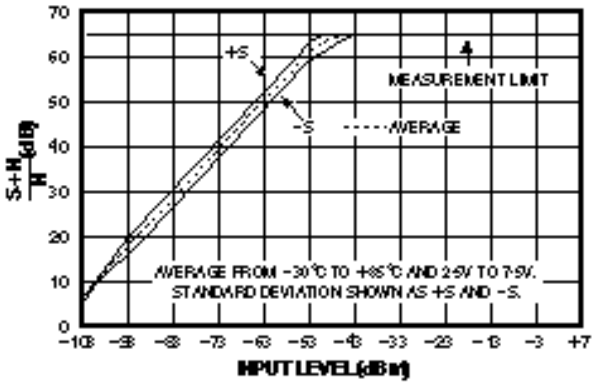


Fig. 14 (Signal noise) to noise ratio v. input level

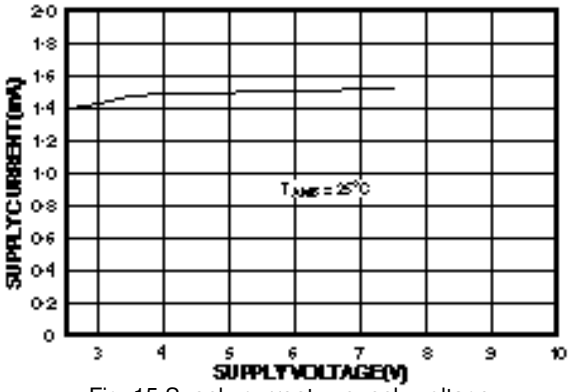


Fig. 15 Supply current v. supply voltage

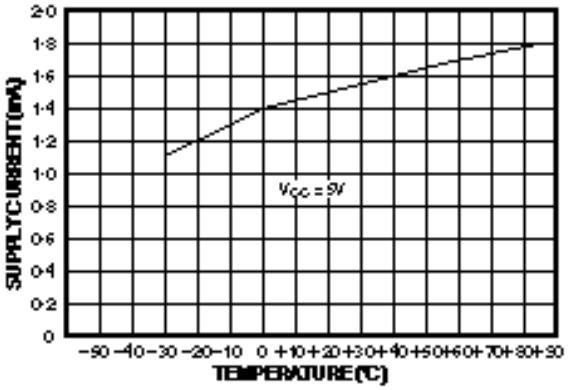


Fig. 16 Supply current v. temperature

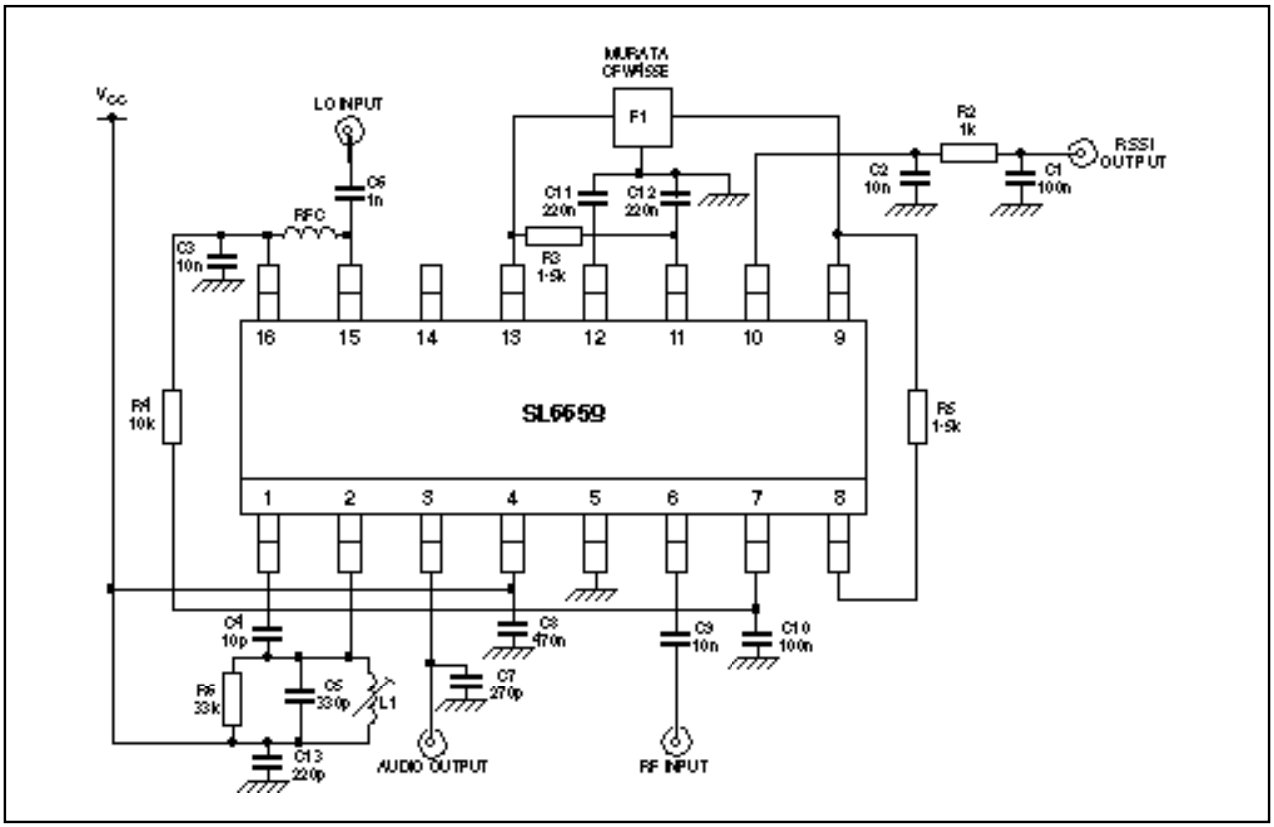


Fig. 17 Circuit diagram of SL6659 demonstration board

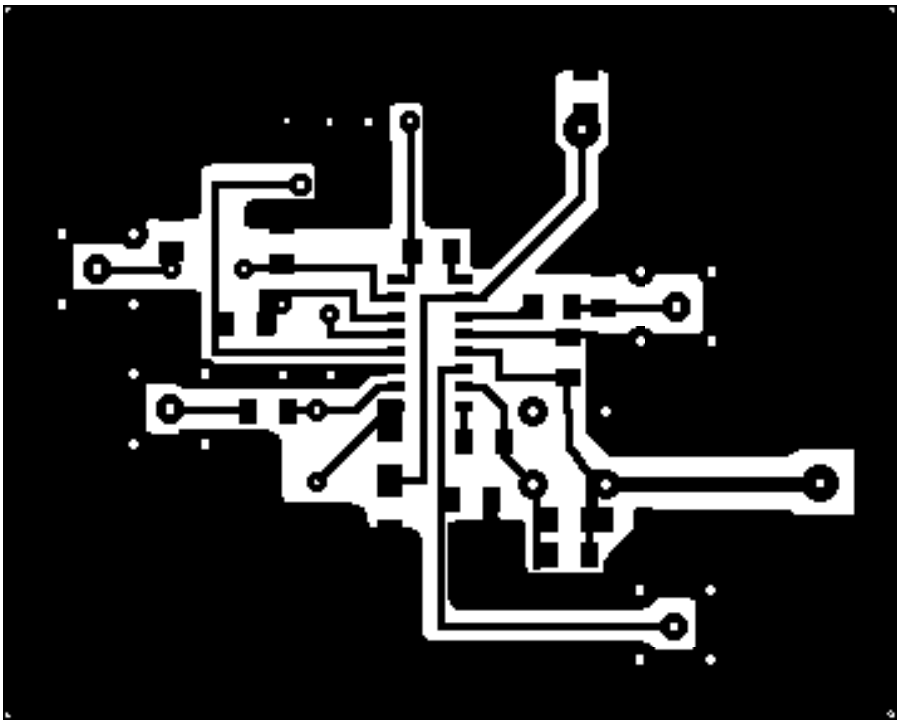


Fig. 18 Track side of demonstration board. Scale = 2:1.

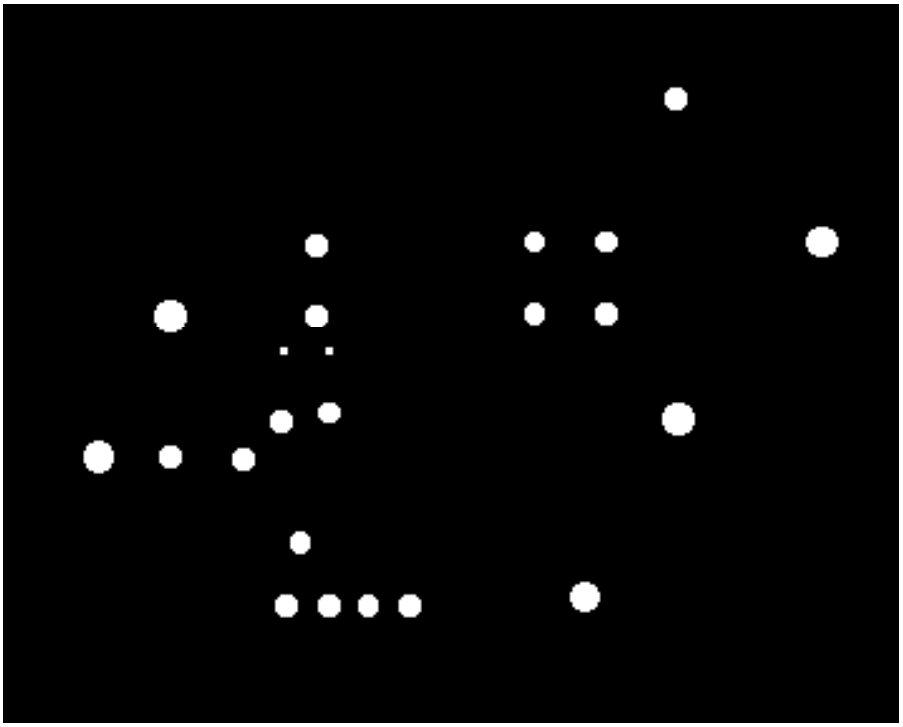


Fig. 19 Ground plane side of demonstration board. Scale = 2:1.

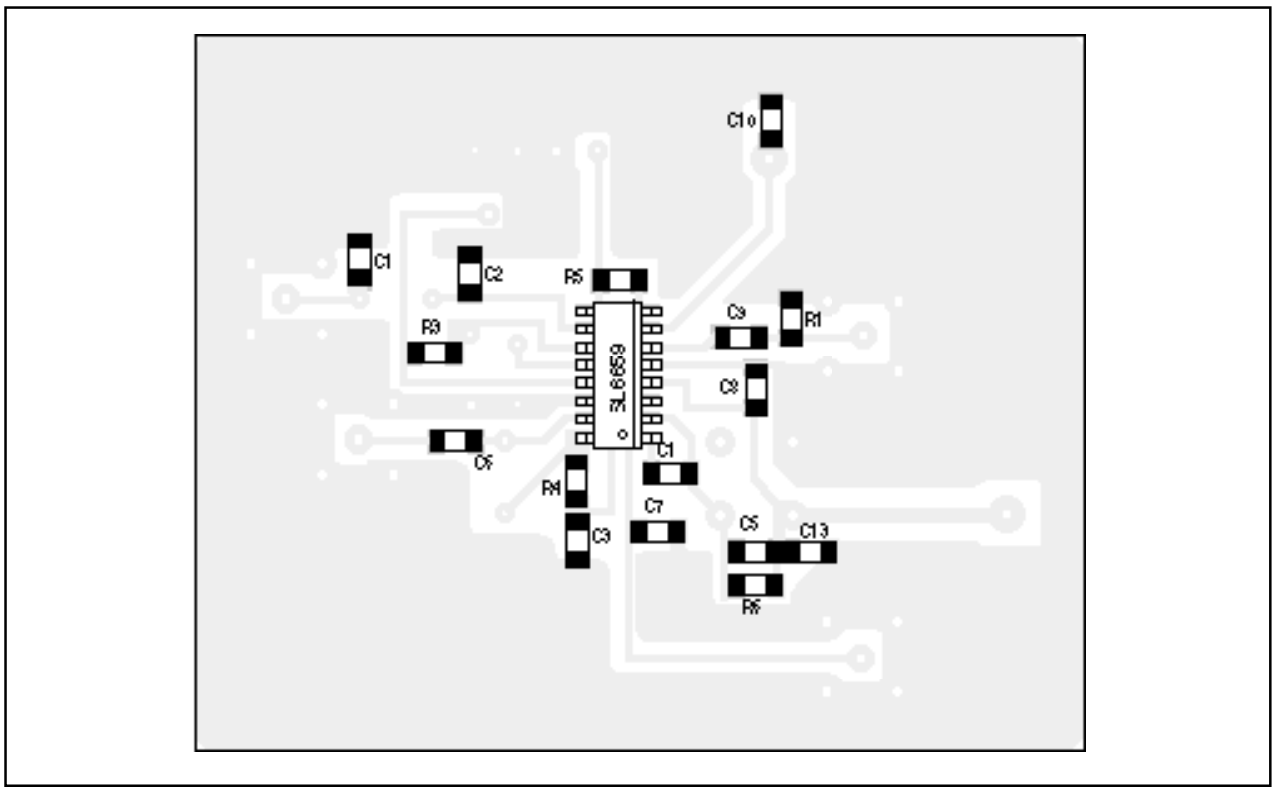


Fig. 20 Demonstration board surface mount component overlay (track side). Scale = 2:1.

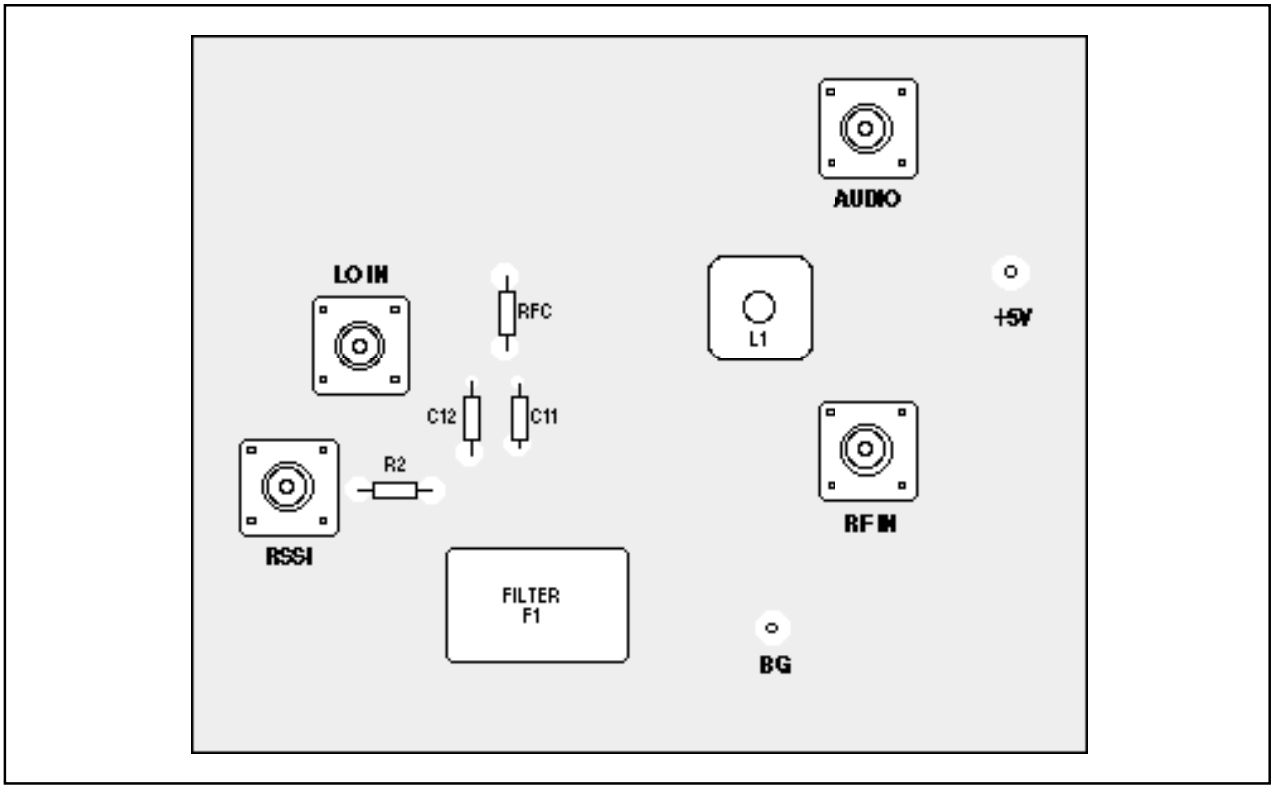


Fig. 21 Demonstration board connectors and through-board component overlay (ground plane side). Scale = 2:1.

COMPONENT LIST

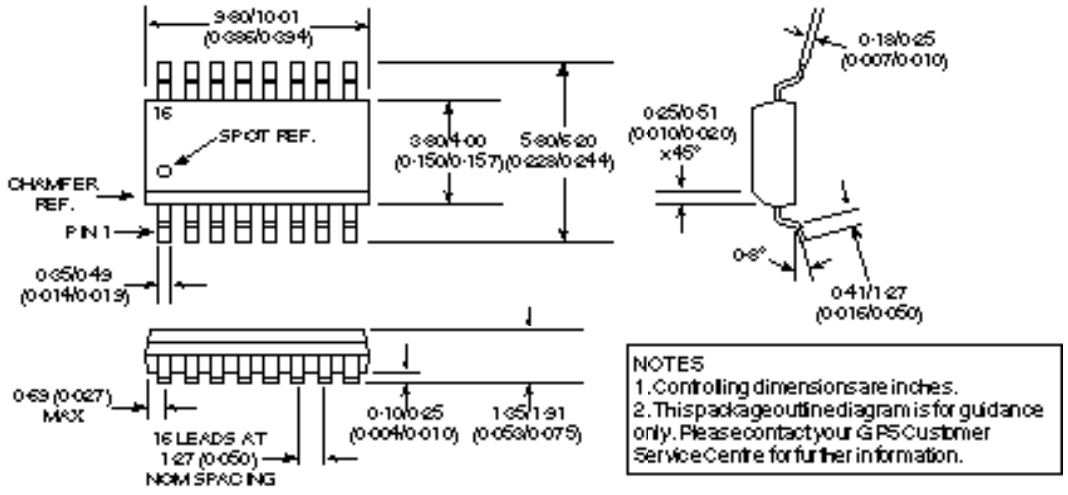
Resistors		Capacitors				Inductors		Filter	
R1	51Ω	C1	100nF	C8	470nF	L1*	330µH (adjustable), CAMBION Type 553-7107-43	F1*	MURATA Type CFW 445 E
R2*	1kΩ	C2	10nF	C9	10nF				
R3	1·5kΩ	C3	10nF	C10	100nF	RFC*	4·7µH		
R4	10kΩ	C4	10pF	C11	220nF*				
R5	1·5kΩ	C5	330pF	C12	220nF*				
R6	33kΩ	C6	1nF	C13	220nF				
		C7	270pF						

Components marked thus: * are through-board mounted from the ground plane side; all other components are surface mounted on the track side. See Figs. 20 and 21.

NOTES

PACKAGE DETAILS

Dimensions are shown thus: mm (in).



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