

***THIS DOCUMENT IS FOR MAINTENANCE  
PURPOSES ONLY AND IS NOT  
RECOMMENDED FOR NEW DESIGNS***



# SL6444

## 1GHz AMPLIFIER / MIXER

The SL6444 Amplifier and Mixer is designed for use in Cordless Telephones, Cellular Radios, Pagers and Low Power receivers operating at frequencies up to 1GHz. It contains a low noise amplifier and mixer. Operating from a single supply it draws a current of 9.5mA and has a power down facility.

### FEATURES

- 1GHz Operation
- Low Power Consumption
- Low Noise Figure
- Suitable for Superheterodyne Architectures
- Power Down Facility for Battery Economy
- Balun for Balanced Mixer Drive

### ORDERING INFORMATION

SL6444 KG MPAS Miniature Plastic Dil Package

NOTE. This device has static sensitive terminations, sensitivity typically measured as 200V using MIL-STD-883 method 3015. ESD handling precautions are essential to avoid degradation of performance or permanent damage to this device.

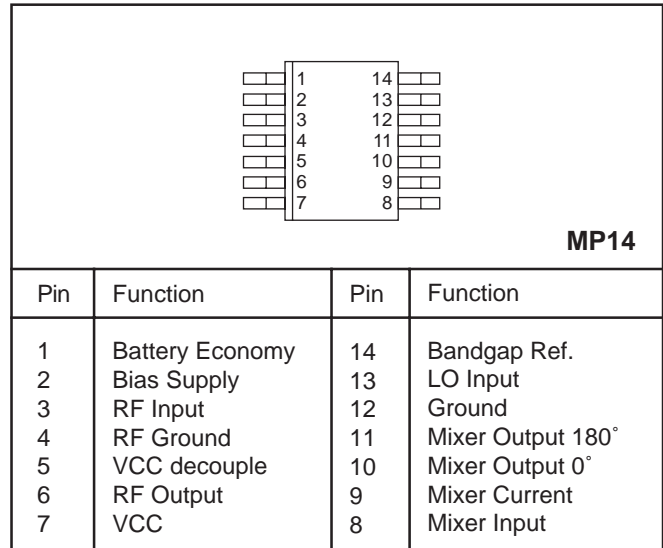


Fig. 1 Pin connections - top view

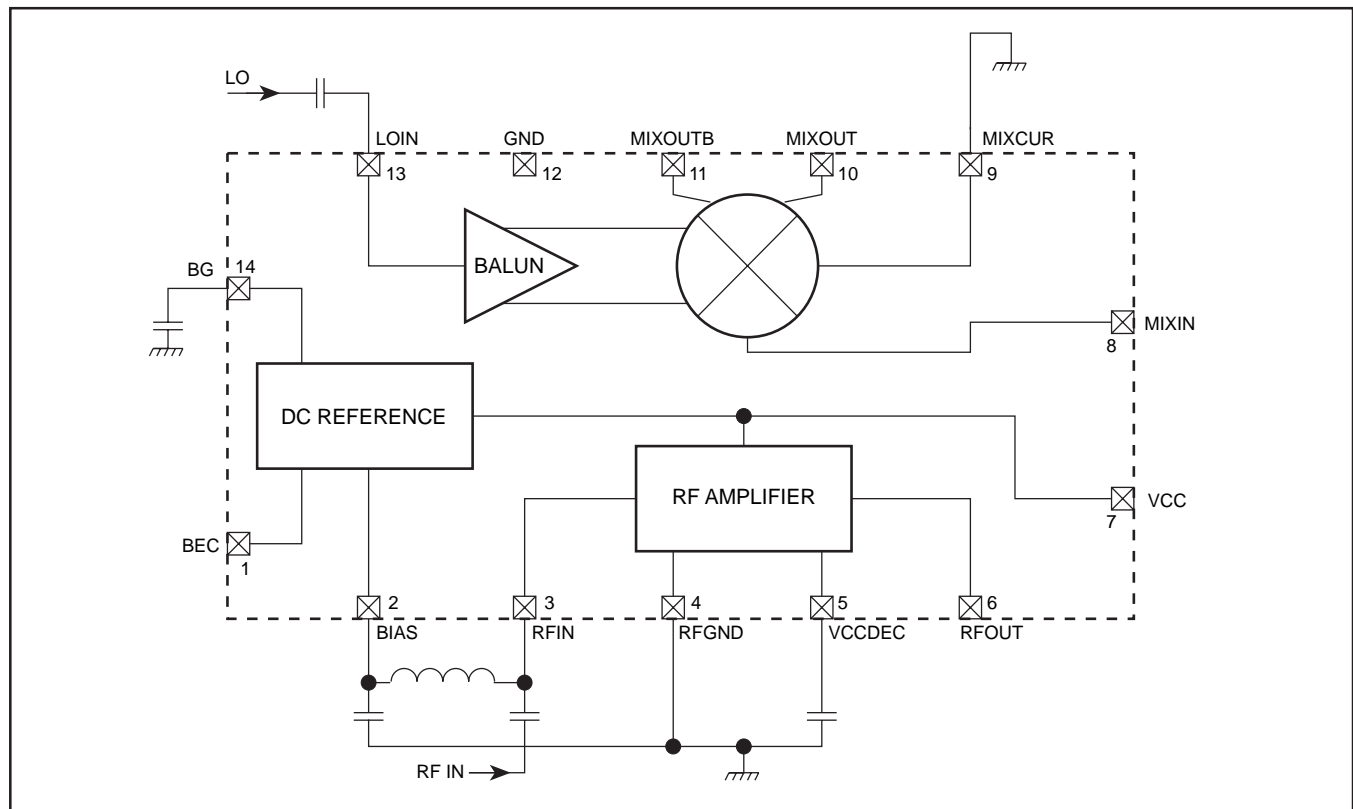


Fig. 2 Block diagram

**ELECTRICAL CHARACTERISTICS**

These characteristics are guaranteed over the following conditions unless otherwise stated.

$T_{amb} = 25^{\circ}\text{C}$ ,  $V_{CC} = 2.7\text{V}$  and at  $V_{CC} = 6.0\text{V}$

| Characteristic                      | Pin      | Value        |      |          | Units         | Conditions                         |
|-------------------------------------|----------|--------------|------|----------|---------------|------------------------------------|
|                                     |          | Min          | Typ  | Max      |               |                                    |
| <b>DC CHARACTERISTICS</b>           |          |              |      |          |               |                                    |
| Supply voltage                      | $V_{CC}$ | 2.7          | 5.0  | 6.0      | V             |                                    |
| Supply current, $I_{CC}$ Note 1     |          | 7.0          | 7.8  | 8.5      | mA            | Battery economy low $V_{CC} = 2.7$ |
|                                     |          | 8.7          | 9.7  | 10.7     | mA            | Battery economy low $V_{CC} = 6.0$ |
|                                     |          |              | 0.5  | 1.0      | $\mu\text{A}$ | Battery economy high               |
| Bandgap reference                   | VBG      | 1.15         | 1.17 | 1.20     | V             | No external load $V_{CC} = 2.7$    |
|                                     | VBG      | 1.19         | 1.22 | 1.25     | V             | No external load $V_{CC} = 6.0$    |
| Battery economy high                | BEC      | $V_{CC}-0.5$ |      | $V_{CC}$ | V             |                                    |
| Battery economy low                 | BEC      | 0            |      | 0.5      | V             |                                    |
| Battery economy sink current        | BEC      |              | 0.1  | 2.0      | $\mu\text{A}$ | Battery economy high               |
| Battery economy source current      | BEC      |              | 1.0  | 2.0      | $\mu\text{A}$ | Battery economy low                |
| <b>RFAMPLIFIER (COMMON EMITTER)</b> |          |              |      |          |               |                                    |
| Supply current                      | RFOUT    | 2.1          | 2.5  | 2.8      | mA            | $V_{CC} = 6.0\text{V}$             |
| <b>MIXER</b>                        |          |              |      |          |               |                                    |
| Optimum frequency range             | MIXIN    | 0.1          |      |          | GHz           |                                    |
| Supply current Note 2.              |          | 3.5          | 3.9  | 4.3      | mA            | $V_{CC} = 2.7$                     |
|                                     |          | 4.2          | 4.6  | 5.0      | mA            | $V_{CC} = 6.0\text{V}$             |
| Mixer conversion                    | MIXOUT   | 10.3         | 11.0 | 11.7     | dB            | $V_{CC} = 6.0\text{V}$ Note 3      |
| Voltage gain                        | MIXOUTB  | 10.0         | 10.6 | 11.2     | dB            | $V_{CC} = 2.7\text{V}$ Note 3      |
| Mixer output gain match             |          |              |      | -/+ 0.5  | dB            |                                    |

NOTES: (1) Total device supply current

(2) Half mixer current in each of MIXOUT and MIXOUTB

(3) conditions:- LOIN = 100MHz, -15dBm  
MIXIN = 100.01MHz, -30dBm  
MIXOUT and MIXOUTB 470 $\Omega$  load  
IF = 10kHz

**TYPICAL ELECTRICAL CHARACTERISTICS**

These characteristics are guaranteed by design.

$T_{amb} = 25^{\circ}\text{C}$ ,  $V_{CC} = 5$  Volts.

| Characteristics                               | Pin | Value |     |     | Units | Conditions           |
|---|-----|-------|-----|-----|-------|----------------------|
|   |     | Min   | Typ | Max |       |                      |
| <b>RF AMPLIFIER (COMMON EMITTER)</b>          |     |       |     |     |       |                      |
| Input Impedance                               |     |       |     |     |       | 50Ω system see fig 3 |
| Output Impedance                              |     |       |     |     |       | 50Ω system see fig 3 |
| Gain ( $RF_{IN}$ to $RF_{OUT}$ )              |     |       |     |     |       | 50Ω system see fig 3 |
| Reverse isolation ( $RF_{IN}$ to $RF_{OUT}$ ) |     |       |     |     |       | 50Ω system see fig 3 |
| <b>MIXER</b>                                  |     |       |     |     |       |                      |
| Input Impedance                               |     |       |     |     |       | 50Ω system see fig 4 |
| Output Impedance                              |     |       |     |     |       | 50Ω system see fig 4 |

**PERFORMANCE CHARACTERISTICS (GPS Demonstration boards)**

Test conditions (unless otherwise stated):  $V_{CC} = 2.7\text{V}$ ;  $T_{amb} = 25^{\circ}\text{C}$

Input frequency 915MHz; Local oscillator frequency 765MHz;

Intermediate frequency 150MHz; Local oscillator amplitude 80mV r.m.s.

| Characteristics                             | Pin | Value |      |     | Units | Conditions                 |
|---|-----|-------|------|-----|-------|----------------------------|
|   |     | Min   | Typ  | Max |       |                            |
| <b>RF AMPLIFIER COMMON EMITTER (NOTE 1)</b> |     |       |      |     |       | Application circuit Fig. 5 |
| Power gain                                  |     |       | 16   |     | dB    |                            |
| Third order intercept point                 |     |       | -12  |     | dBm   | At input                   |
| Noise figure                                |     |       | 2.7  |     | dB    |                            |
| Output power at 1dB gain compression        |     |       | -6   |     | dBm   |                            |
| <b>SINGLE BALANCED MIXER (Note 1)</b>       |     |       |      |     |       | Application circuit Fig. 6 |
| Power conversion gain                       |     |       | 4.5  |     | dB    |                            |
| Third order intercept point                 |     |       | -5.5 |     | dBm   | At input                   |
| Double sideband noise figure                |     |       | 10   |     | dB    |                            |
| LO to RF isolation                          |     |       | 28   |     | dB    |                            |
| LO to IF isolation                          |     |       | 39   |     | dB    |                            |

**PERFORMANCE CHARACTERISTICS (GPS Demonstration boards) continued**

Test conditions (unless otherwise stated): VCC = 2.7V; T<sub>amb</sub> = 25°C

Input frequency 915MHz; Local oscillator frequency 765MHz;

Intermediate frequency 150MHz; Local oscillator amplitude 80mV r.m.s.

| Characteristics                           | Pin | Value |     |     | Units | Conditions                 |
|---|-----|-------|-----|-----|-------|----------------------------|
|   |     | Min   | Typ | Max |       |                            |
| RF to IF isolation                        |     |       | 18  |     | dB    | Application circuit Fig. 7 |
| <b>DOUBLE BALANCED MIXER<br/>(Note 1)</b> |     |       |     |     |       |                            |
| Power conversion gain                     |     |       | 10  |     | dBm   | At input                   |
| Third order intercept point               |     |       | -8  |     |       |                            |
| Double sideband noise figure              |     |       | 10  |     | dB    |                            |
| LO to RF isolation                        |     |       | 26  |     | dB    |                            |
| LO to IF isolation                        |     |       | 42  |     | dB    |                            |
| RF to IF isolation                        |     |       | 32  |     | dB    |                            |

## NOTE.

1. Application circuits have been optimised for minimum noise figure and maximum gain. Typical performance across temp at 2.7V and 6.0V are shown in graphs 1 to 6.

**ABSOLUTE MAXIMUM RATINGS**

|                       |                  |
|-----------------------|------------------|
| Supply voltage        | 8V               |
| Storage temperature   | -55°C to + 150°C |
| Operating temperature | -10°C to + 85°C  |

| PIN NO | NAME    | TITLE             | DESCRIPTION   |
|--------|---------|-------------------|---|
| 1      | BEC     | Battery Economy   | Turns device OFF when "HIGH", on when "LOW".  |
| 2      | BIAS    | Bias Supply       | Controls the bias current in the RF amplifier. Must be decoupled externally to ground through 1nF capacitor.  |
| 3      | RFIN    | RFInput           | This is the common emitter input to the base of the RF transistor. It is DC biased externally through a suitable inductor to the bias pin, pin 2.                   |
| 4      | RFGND   | R.F. Ground       | Must be connected to the system ground with minimum inductance.   |
| 5      | VCCDEC  | VCC Decouple      | This pin allows the VCC supply at the RF Amplifier to be effectively decoupled.   |
| 6      | RFOUT   | RF Output         | The collector of the RF amplifier output transistor. Must be returned to VCC through a load in which the DC bias current can flow.                                  |
| 7      | VCC     | Power Supply      | Positive supply.  |
| 8      | MIXIN   | Mixer Input       | Input port of mixer, should be AC coupled externally.   |
| 9      | MIXCUR  | Mixer Current     | A resistor may be placed between this pin and ground to reduce mixer current. Otherwise connect to GND.   |
| 10     | MIXOUT  | Mixer Output 0°   | Output port of the mixer. An open collector output which must be returned to VCC through a suitable load. Half of the total Mixer current will flow from this port. |
| 11     | MIXOUTB | Mixer Output 180° | Output port of the mixer. An open collector output which must be returned to VCC through a suitable load. Half the total mixer current will flow from this port.    |
| 12     | GND     | Ground            | Must be connected to the system ground with minimum inductance.   |
| 13     | LOIN    | LO Input          | Local Oscillator input to mixer, should be AC coupled externally.   |
| 14     | VBG     | Bandgap           | Temperature compensated voltage reference. Must be decoupled externally to ground through a 1nF capacitor.  |

VCC = 5V Amplifer current 2.2mA

| FREQ-MHz | MAG[S11] | ANG[S21] | MAG [S21] | ANG [S21] | MAG [S12] | ANG [12] | MAG [S22] | ANG [S22] |
|----------|----------|----------|-----------|-----------|-----------|----------|-----------|-----------|
| 100.000  | 0.91     | -10      | 5.89      | 167       | 0.016     | 158      | 0.99      | -5        |
| 200.000  | 0.89     | -21      | 5.86      | 151       | 0.010     | -75      | 0.99      | -11       |
| 300.000  | 0.86     | -30      | 5.60      | 136       | 0.004     | 55       | 0.99      | -16       |
| 400.000  | 0.81     | -39      | 5.19      | 121       | 0.003     | 118      | 0.98      | -21       |
| 500.000  | 0.77     | -47      | 4.86      | 108       | 0.004     | -102     | 0.97      | -25       |
| 600.000  | 0.72     | -55      | 4.48      | 95        | 0.005     | 154      | 0.98      | -32       |
| 700.000  | 0.67     | -63      | 4.11      | 84        | 0.004     | 134      | 0.97      | -38       |
| 800.000  | 0.62     | -70      | 3.73      | 73        | 0.008     | 165      | 0.97      | -44       |
| 900.000  | 0.58     | -77      | 3.35      | 61        | 0.008     | 150      | 0.94      | -52       |
| 1000.000 | 0.55     | -83      | 2.97      | 52        | 0.010     | 117      | 0.91      | -59       |
| 1100.000 | 0.52     | -87      | 2.64      | 43        | 0.014     | 97       | 0.87      | -66       |
| 1200.000 | 0.49     | -92      | 2.32      | 34        | 0.013     | 82       | 0.82      | -73       |
| 1300.000 | 0.47     | -95      | 2.06      | 28        | 0.010     | 78       | 0.76      | -79       |
| 1400.000 | 0.45     | -98      | 1.85      | 22        | 0.009     | 59       | 0.71      | -85       |
| 1500.000 | 0.45     | -101     | 1.71      | 16        | 0.004     | 80       | 0.67      | -89       |

SL6444 Typical RF Amplifer scattering parameters

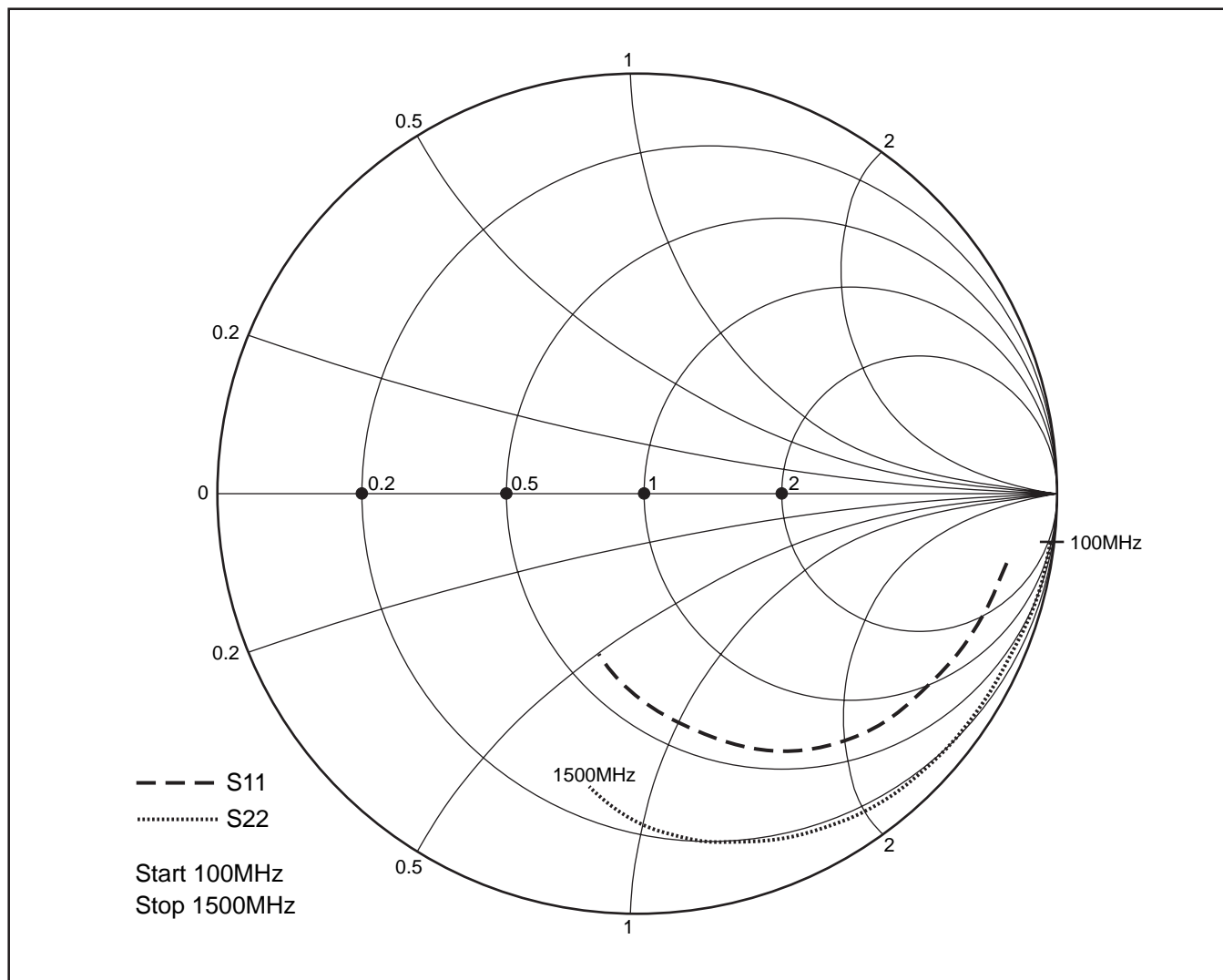


Fig. 3 Typical Input and Output Impedance of SL6444 RF Amplifier (Normalised to 50Ω)

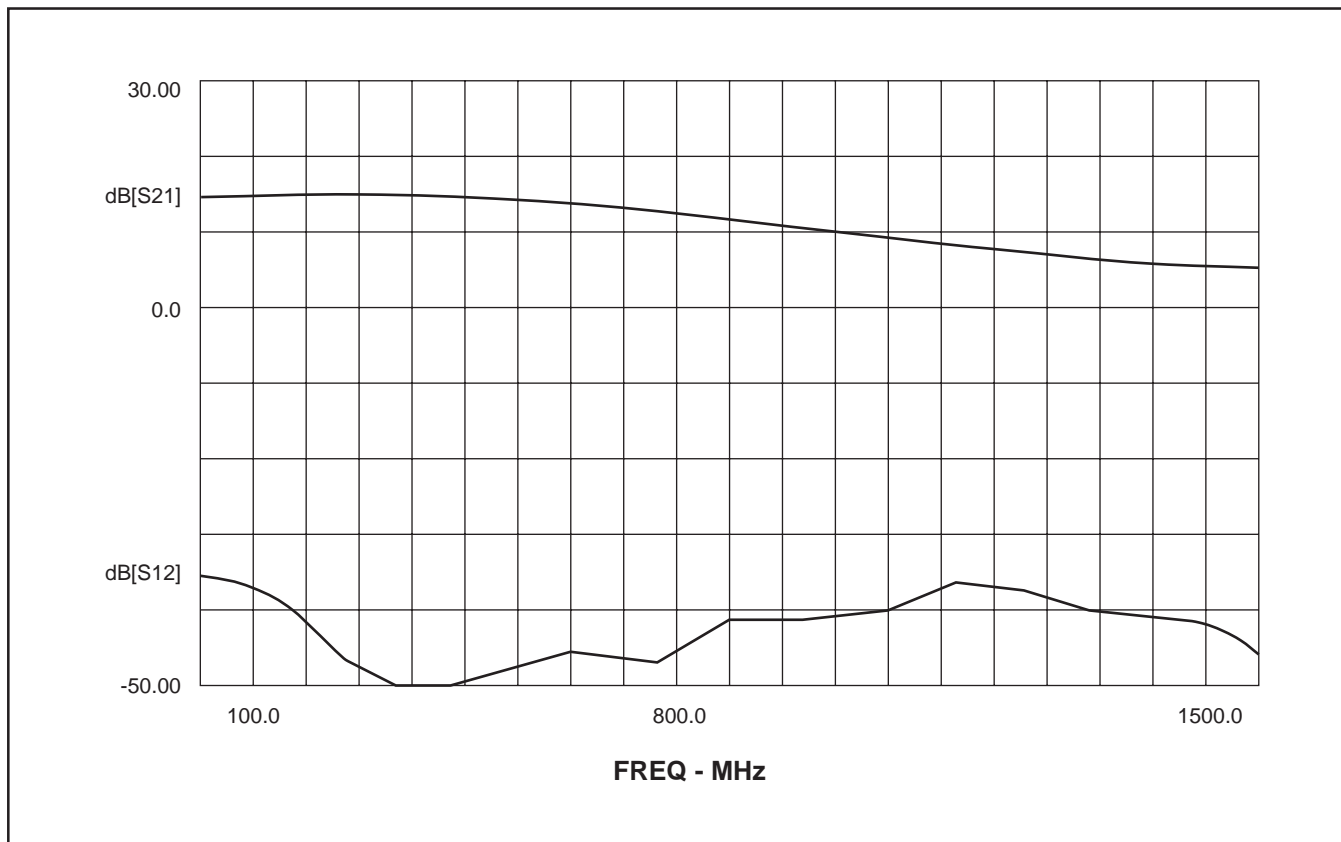


Fig. 3b Typical gain and reverse isolation of SL6444 RF Amplifier in a 50 Ohm test system

VCC = 5V Mixer current 4.4mA. S22 is measured at either MIXOUT or MIXOUTB. S11 is measured at MIXIN.

| FREQ-MHz | MAG[S11] | ANG[S11] | MAG [S22] | ANG [S21] |
|----------|----------|----------|-----------|-----------|
| 100.000  | 0.79     | -6       | 1.00      | -6        |
| 200.000  | 0.78     | -13      | 0.99      | -12       |
| 300.000  | 0.77     | -20      | 0.99      | -16       |
| 400.000  | 0.76     | -28      | 0.97      | -22       |
| 500.000  | 0.77     | -34      | 0.96      | -28       |
| 600.000  | 0.78     | -41      | 0.97      | -35       |
| 700.000  | 0.70     | -50      | 0.94      | -40       |
| 800.000  | 0.70     | -58      | 0.91      | -47       |
| 900.000  | 0.68     | -67      | 0.88      | -54       |
| 1000.000 | 0.64     | -76      | 0.86      | -60       |
| 1100.000 | 0.61     | -86      | 0.83      | -67       |
| 1200.000 | 0.58     | -95      | 0.79      | -74       |
| 1300.000 | 0.55     | -105     | 0.75      | -82       |
| 1400.000 | 0.51     | -117     | 0.71      | -89       |
| 1500.000 | 0.49     | -129     | 0.68      | -96       |

SL6444 Typical Mixer port impedance



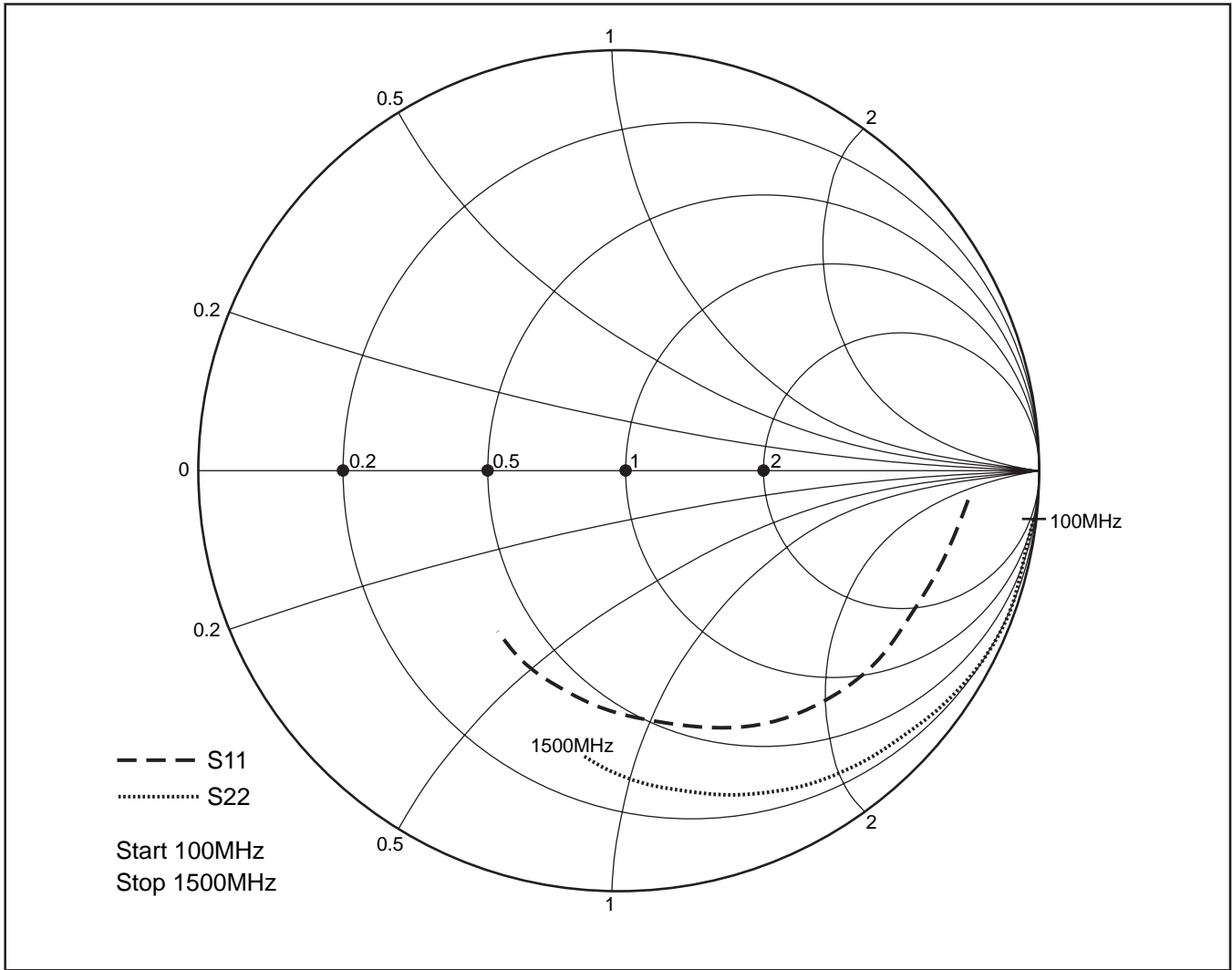


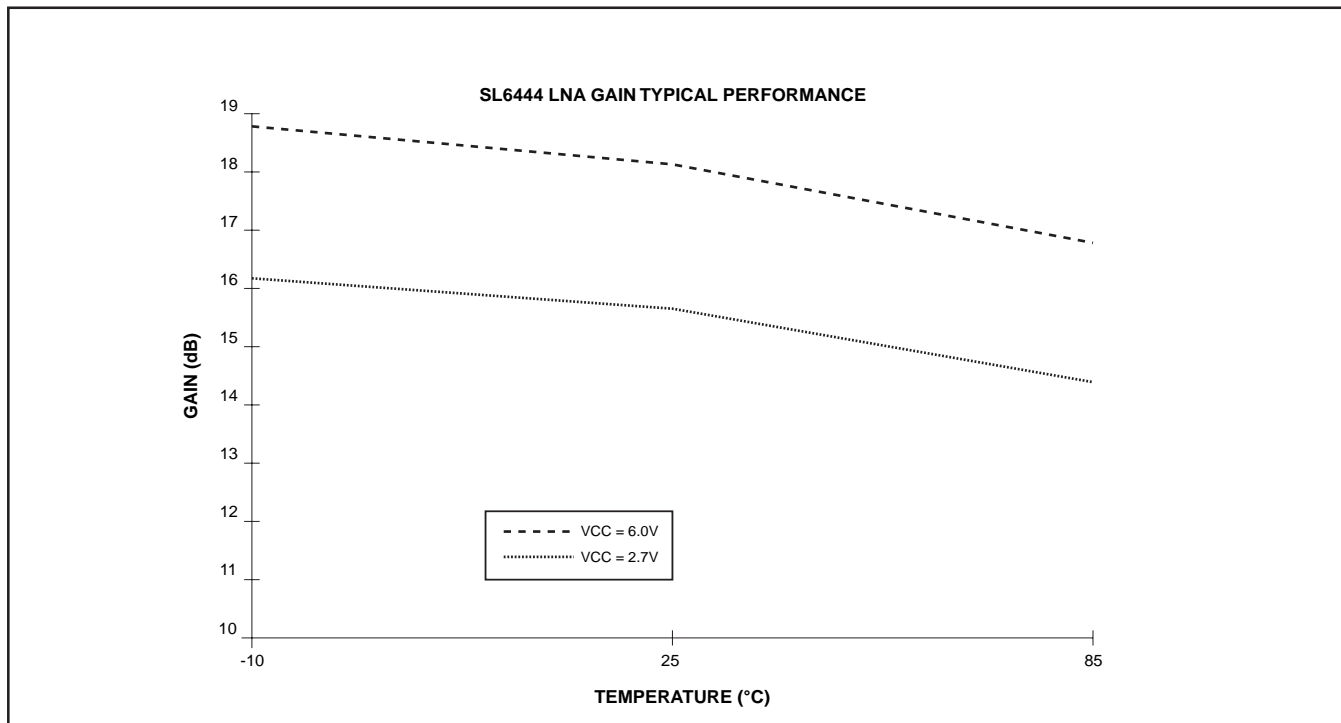
Fig. 4 Typical Input and Output Impedance of SL6444 Mixer (Normalised to 50Ω)

**PERFORMANCE CHARACTERISTICS (GPS Demonstration boards)**

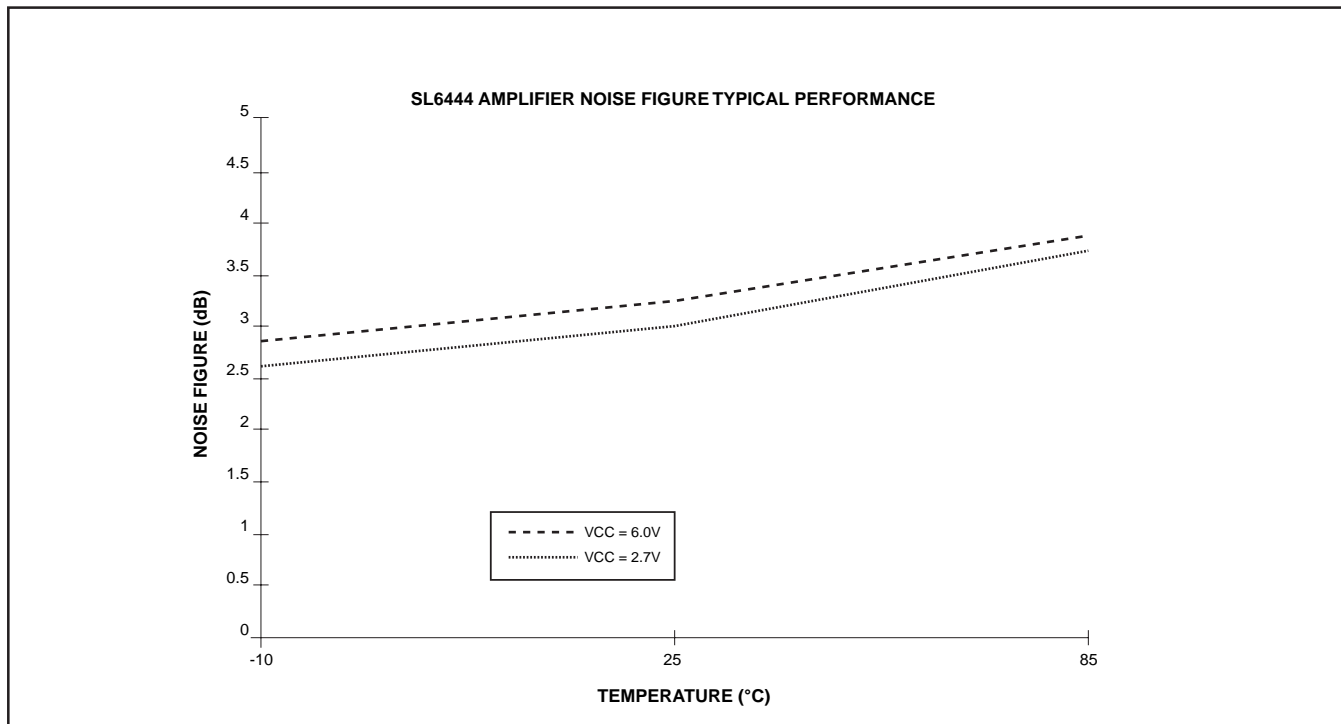
Test conditions (unless otherwise stated)

Input frequency 915MHz; Local oscillator frequency 765MHz;

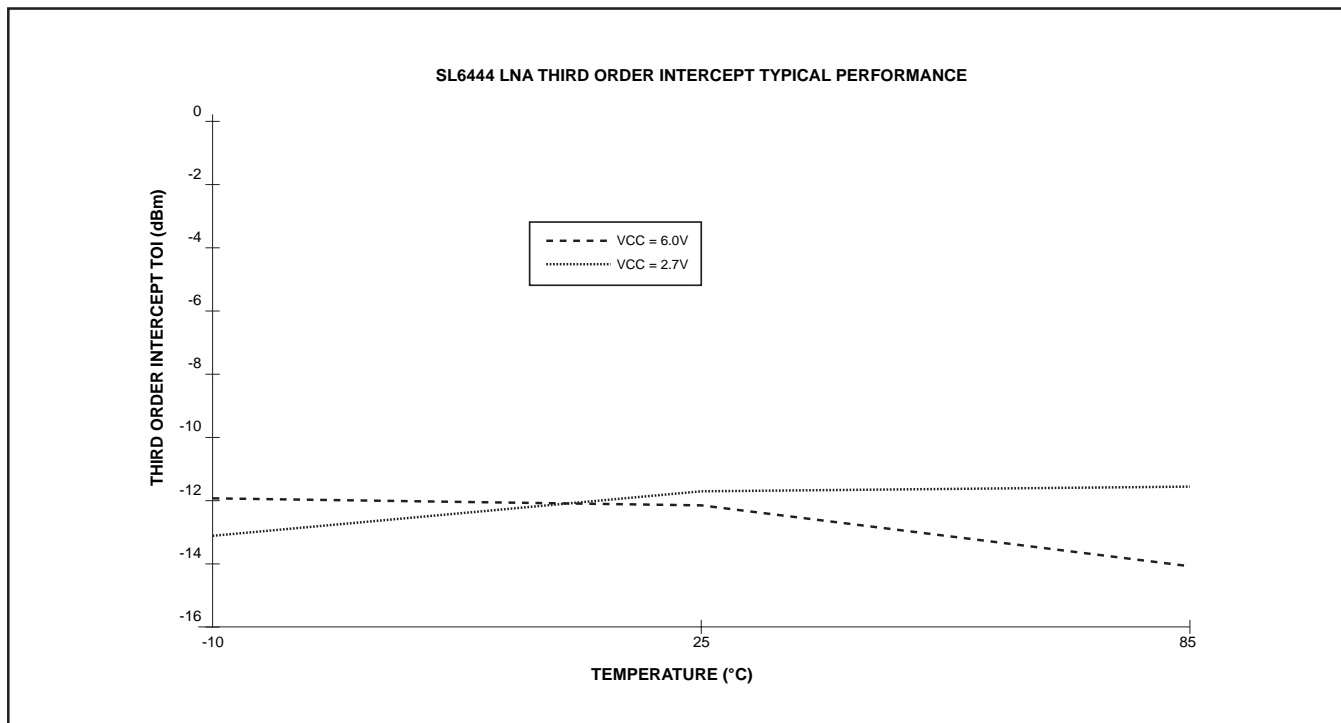
Intermediate frequency 150MHz; Local oscillator amplitude 80mV r.m.s.



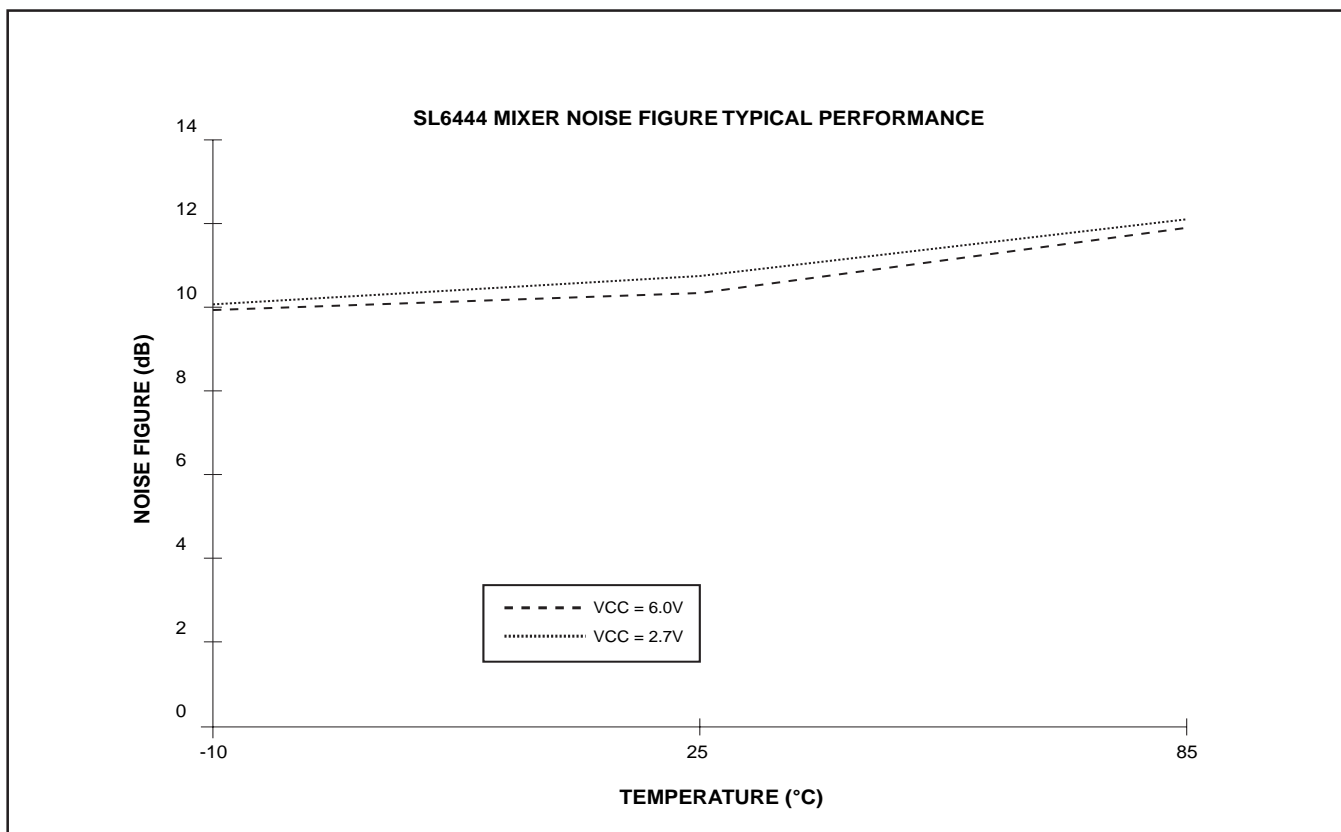
Graph 1



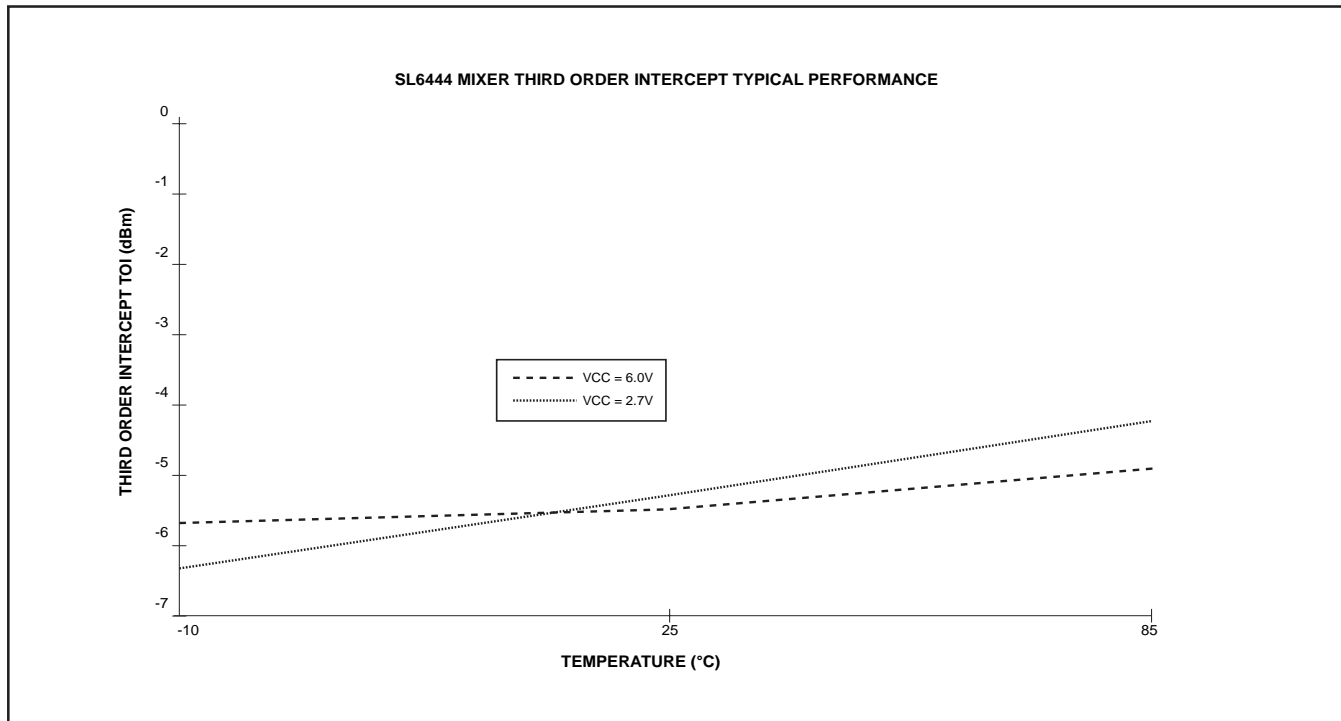
Graph 2



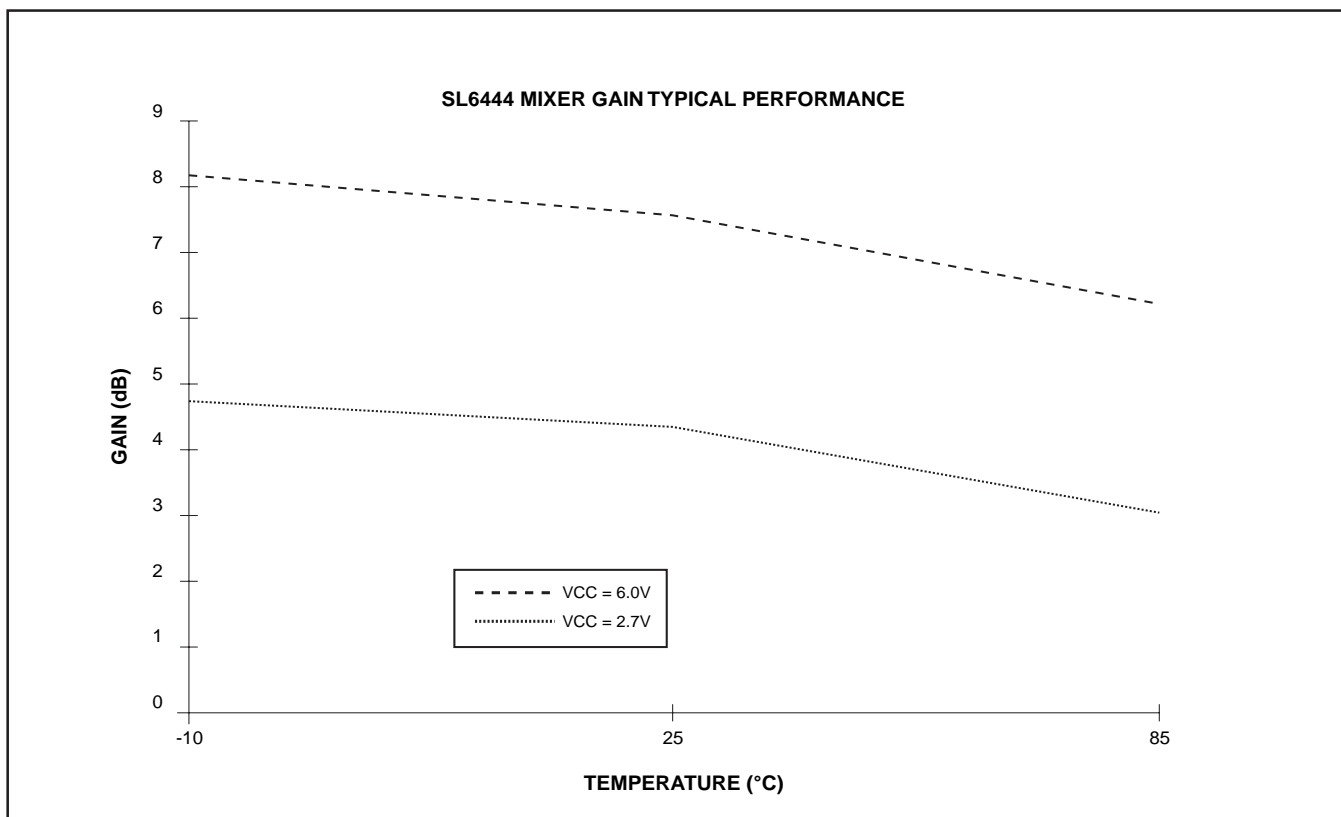
Graph 3



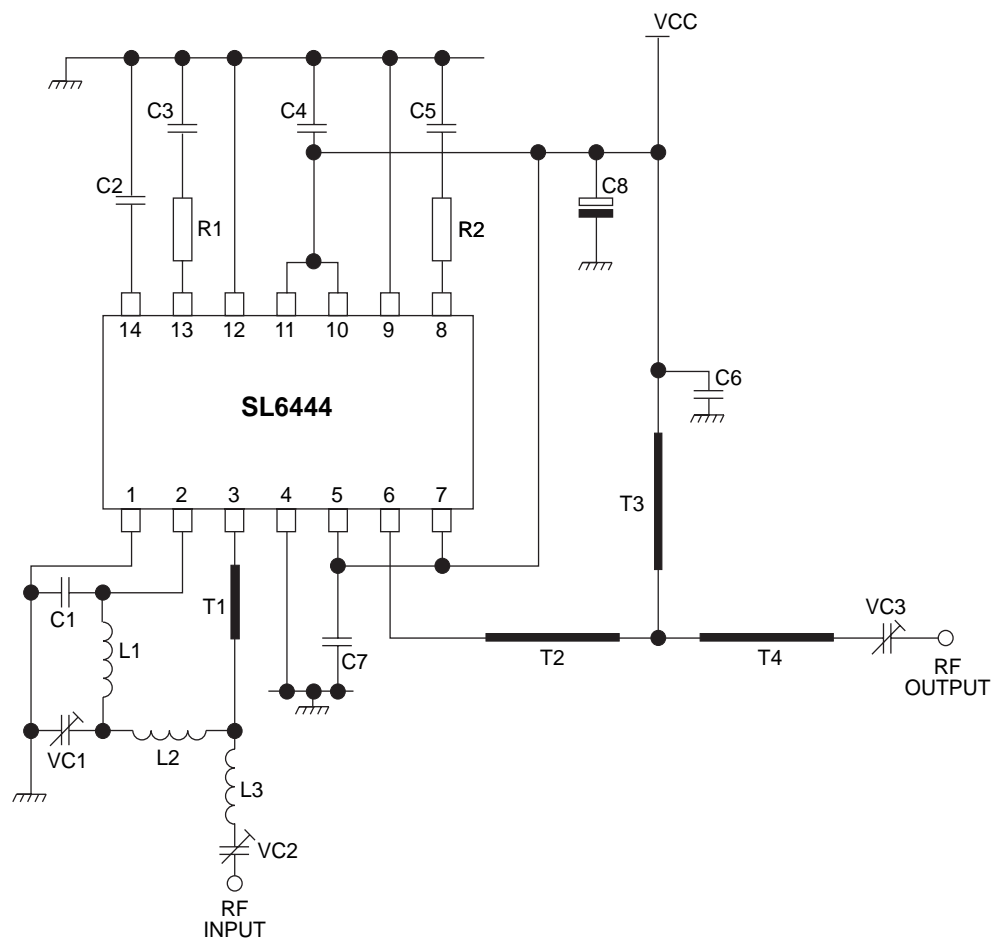
Graph 4



Graph 5



Graph 6



## NOTES

1. Double sided board should be used
2. Low inductive resistors should be used
3. Good quality capacitors with high self resonant frequency should be used
4. Components should be placed in close proximity to device

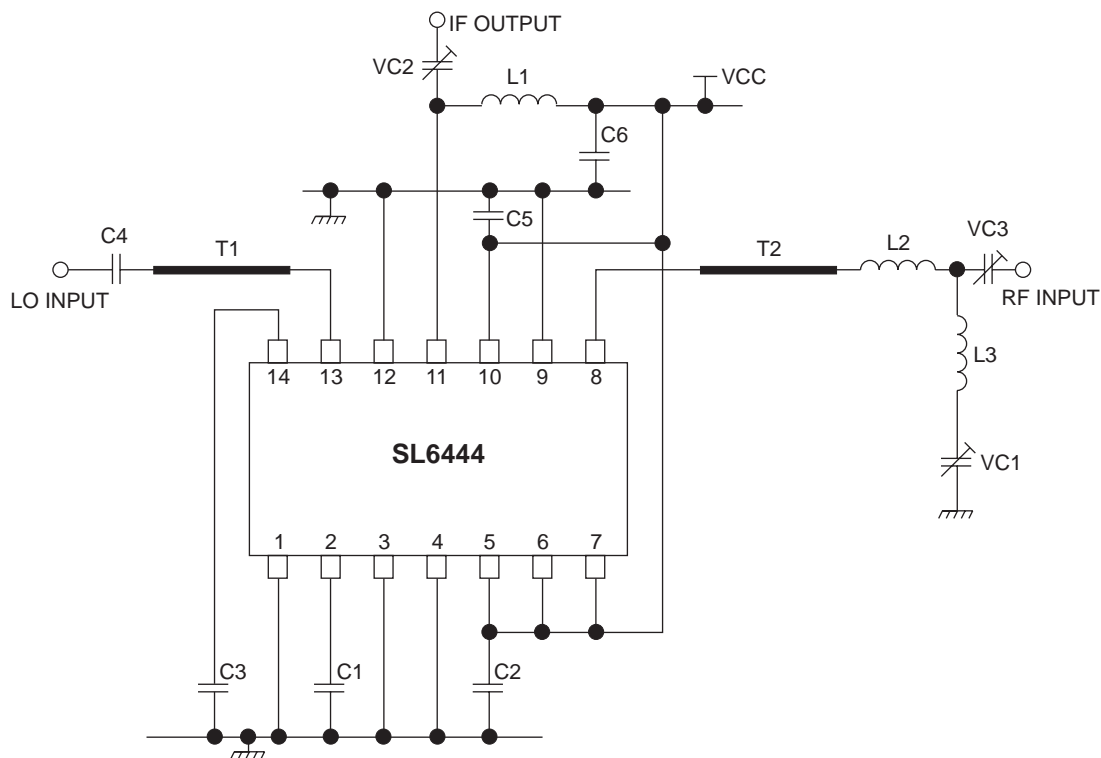
## COMPONENT LIST

|                        |                                  |
|------------------------|----------------------------------|
| R1, R2                 | 47 Ohm                           |
| C1, C2, C3, C4, C5, C7 | 1nF                              |
| C6                     | 270pF                            |
| C8                     | 1 $\mu$ F                        |
| VC1, VC2, VC3          | 20pF Trimmer                     |
| L1                     | 56nH                             |
| L2                     | 39nH                             |
| L3                     | 6nH 1 Turn 24SWG<br>8mm diameter |

Microstrip lines 0.5mm wide on 1.6mm thick glass fibre PCB and the following lengths.

|    |      |
|----|------|
| T1 | 5mm  |
| T2 | 16mm |
| T3 | 8mm  |
| T4 | 15mm |

Fig. 5 SL6444 RF amplifier demonstration circuit

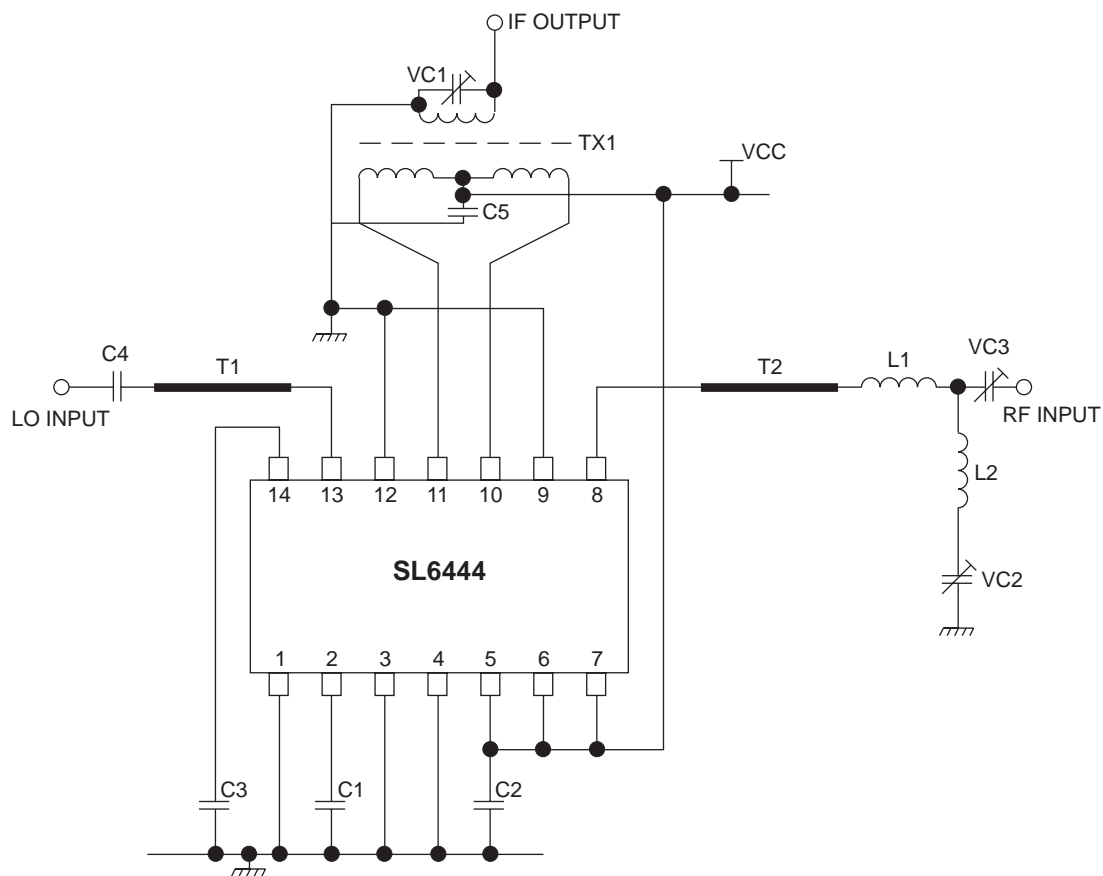


## COMPONENT LIST

|                        |                                  |
|------------------------|----------------------------------|
| C1, C2, C3, C4, C5, C6 | 1nF                              |
| VC1, VC2, VC3          | 20pF Trimmer                     |
| L1                     | 220nH                            |
| L2                     | 6nH 1 Turn 24SWG<br>8mm diameter |
| L3                     | 39nH                             |
| T1                     | 50 Ohm line                      |

Microstrip line T2 is 0.5mm wide on 1.6mm thick glass fibre PCB and of 5mm length.

Fig. 6 Single balanced mixer demonstration circuit



## COMPONENT LIST

C1, C2, C3, C4, C5

1nF

VC1, VC2, VC3

20pF Trimmer

L1

6nH 1 Turn 24SWG 8mm diameter

L2

39nH

T1

50 Ohm line

TX1

4 + 4:1

Transformer wound on a 2.5mm long double aperture ferrite bead. The material having an initial permeability of approximately 15.

Microstrip line T2 is 0.5mm wide on 1.6mm thick glass fiber PCB and of length 5mm.

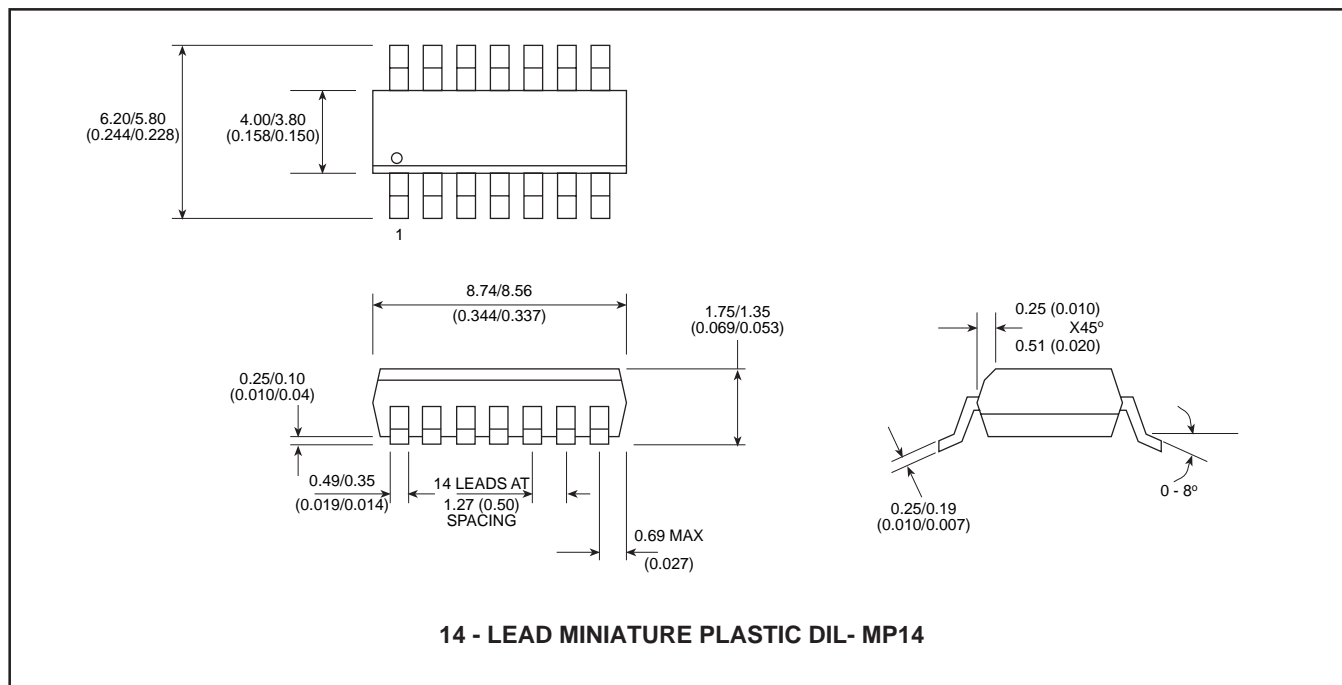
Fig. 7 Double balanced mixer demonstration circuit





## PACKAGE DETAILS

Dimensions are shown thus: mm (in). For further package information please contact your local Customer Service Centre.



## HEADQUARTERS OPERATIONS

**GEC PLESSEY SEMICONDUCTORS**

Cheney Manor, Swindon,  
Wiltshire SN2 2QW, United Kingdom.  
Tel: (0793) 518000  
Fax: (0793) 518411

**GEC PLESSEY SEMICONDUCTORS**

P.O. Box 660017  
1500 Green Hills Road,  
Scotts Valley, California 95067-0017,  
United States of America.  
Tel: (408) 438 2900  
Fax: (408) 438 5576

## CUSTOMER SERVICE CENTRES

- **FRANCE & BENELUX** Les Ulis Cedex Tel: (1) 64 46 23 45 Fax : (1) 64 46 06 07
- **GERMANY** Munich Tel: (089) 3609 06-0 Fax : (089) 3609 06-55
- **ITALY** Milan Tel: (02) 66040867 Fax: (02) 66040993
- **JAPAN** Tokyo Tel: (03) 5276-5501 Fax: (03) 5276-5510
- **NORTH AMERICA Integrated Circuits and Microwave Products** Scotts Valley, USA  
Tel (408) 438 2900 Fax: (408) 438 7023.  
**Hybrid Products**, Farmingdale, USA Tel (516) 293 8686 Fax: (516) 293 0061.
- **SOUTH EAST ASIA** Singapore Tel: (65) 3827708 Fax: (65) 3828872
- **SWEDEN** Stockholm, Tel: 46 8 702 97 70 Fax: 46 8 640 47 36
- **UK, EIRE, DENMARK, FINLAND & NORWAY**  
Swindon Tel: (0793) 518510 Fax : (0793) 518582

These are supported by Agents and Distributors in major countries world-wide.

© GEC Plessey Semiconductors 1993 Publication No. DS3224 Issue No. 2.3 November 1993

This publication is issued to provide information only which (unless agreed by the Company in writing) may not be used, applied or reproduced for any purpose nor form part of any order or contract nor to be regarded as a representation relating to the products or services concerned. No warranty or guarantee express or implied is made regarding the capability, performance or suitability of any product or service. The Company reserves the right to alter without prior knowledge the specification, design or price of any product or service. Information concerning possible methods of use is provided as a guide only and does not constitute any guarantee that such methods of use will be satisfactory in a specific piece of equipment. It is the user's responsibility to fully determine the performance and suitability of any equipment using such information and to ensure that any publication or data used is up to date and has not been superseded. These products are not suitable for use in any medical products whose failure to perform may result in significant injury or death to the user. All products and materials are sold and services provided subject to the Company's conditions of sale, which are available on request.



**For more information about all Zarlink products  
 visit our Web Site at  
[www.zarlink.com](http://www.zarlink.com)**

Information relating to products and services furnished herein by Zarlink Semiconductor Inc. trading as Zarlink Semiconductor or its subsidiaries (collectively "Zarlink") is believed to be reliable. However, Zarlink assumes no liability for errors that may appear in this publication, or for liability otherwise arising from the application or use of any such information, product or service or for any infringement of patents or other intellectual property rights owned by third parties which may result from such application or use. Neither the supply of such information or purchase of product or service conveys any license, either express or implied, under patents or other intellectual property rights owned by Zarlink or licensed from third parties by Zarlink, whatsoever. Purchasers of products are also hereby notified that the use of product in certain ways or in combination with Zarlink, or non-Zarlink furnished goods or services may infringe patents or other intellectual property rights owned by Zarlink.

This publication is issued to provide information only and (unless agreed by Zarlink in writing) may not be used, applied or reproduced for any purpose nor form part of any order or contract nor to be regarded as a representation relating to the products or services concerned. The products, their specifications, services and other information appearing in this publication are subject to change by Zarlink without notice. No warranty or guarantee express or implied is made regarding the capability, performance or suitability of any product or service. Information concerning possible methods of use is provided as a guide only and does not constitute any guarantee that such methods of use will be satisfactory in a specific piece of equipment. It is the user's responsibility to fully determine the performance and suitability of any equipment using such information and to ensure that any publication or data used is up to date and has not been superseded. Manufacturing does not necessarily include testing of all functions or parameters. These products are not suitable for use in any medical products whose failure to perform may result in significant injury or death to the user. All products and materials are sold and services provided subject to Zarlink's conditions of sale which are available on request.

Purchase of Zarlink's I<sup>2</sup>C components conveys a licence under the Philips I<sup>2</sup>C Patent rights to use these components in an I<sup>2</sup>C System, provided that the system conforms to the I<sup>2</sup>C Standard Specification as defined by Philips.

Zarlink and the Zarlink Semiconductor logo are trademarks of Zarlink Semiconductor Inc.

Copyright 2001, Zarlink Semiconductor Inc. All Rights Reserved.

TECHNICAL DOCUMENTATION - NOT FOR RESALE