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# JULY 1995 ADVANCE INFORMATION

# GEC PLESSEY

DS4015 - 2.5

# SL6609A

# DIRECT CONVERSION FSK DATA RECEIVER

This device is an advanced direct conversion receiver for operation up to 470MHz. The design is based on the SL6609 receiver and is a pin for pin product upgrade. The device integrates all functions to translate a binary FSK modulated RF signal into a demodulated data stream. Adjacent channel rejection is provided using tuneable gyrator filters. To assist operation in the presence of large interfering signals both RF and audio AGC functions are provided.

The device also includes a 1 volt regulator capable of sourcing up to 5mA, a battery flag and the facility of incorporating a more complex post detection filter off-chip. Both battery flag and data outputs have open collector outputs to ease their interface with other devices.

#### FEATURES

- Very low power operation typ 3.0mW
- Single cell operation for most of the device. Limited functional blocks operating via an inverter
- Superior sensitivity of -130dBm
- Operation at wide range of paging data rates 512, 1200, 2400 baud
- On chip 1 volt regulator
- Small package offering SSOP

# APPLICATIONS

- Credit card pagers
- Watch pagers
- Small form factor pagers i.e. PCMCIA
- Low data rate data receivers i.e. Security/remote control

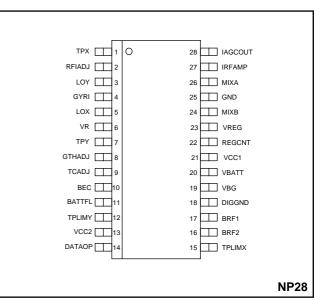


Fig.1 Pin connections

#### **ABSOLUTE MAXIMUM RATINGS**

Supply voltage	6V
Storage temperature	-55°C to +150°C
Operating temperature	-20°C to +70°C

#### **ORDERING INFORMATION**

SL6609A / KG / NPDS - SSOP devices in anti-static sticks SL6609A / KG / NPDE - SSOP devices in tape and reel

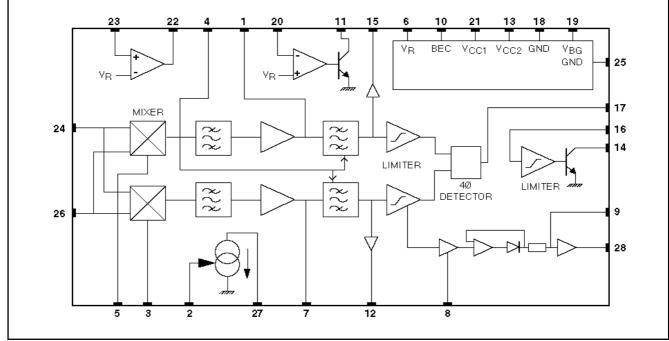


Fig.2 Block diagram of SL6609A

## **ELECTRICAL CHARACTERISTICS**

These characteristics are guaranteed over the following conditions unless otherwise stated: Tamb =  $25^{\circ}$ C, VCC1 = 1.3V, VCC2 = 2.7V

Characteristics	Dia		Value		Unite	Comments
Characteristics	Pin -	Min	Тур	Max	Units	
VCC1 - Supply voltage	21	0.95	1.3	2.8	V	VCC1 $\leq$ VCC2 - 0.7 volts
VCC2 - Supply voltage	13	1.8	2.7	3.5	V	
ICC1 - Supply current	21,27,28		1.5	1.8	mA	Includes IRF. Does not include regulator supply. Audio AGC inactive
ICC2 - Supply current	11,13,14		550	700	μA	Batt flag & Data O/P high Pin 27 voltage: 0.3 - 1.3V
Power down ICC1 Power down ICC2	21,27,28 11,13,14			1 8	μΑ μΑ	
1 volt regulator	23	0.95	1.0	1.05	V	I Load = 3mA. Ext PNP. $\beta \ge 100$ , $V_{CE} = 0.1$ volt
Band gap voltage reference Band gap current source Voltage reference Voltage reference sink/source 1 volt regulator load current	19 19 6 6	1.15 0.93 0.25	1.21 1.0 3	1.27 20 1.07 10 5	V µA V µA mA	VCC1 > 1.1V
Turn on Time			5		ms	Stable data o/p when 3dB above sensitivity. $C_{BG}$ and $C_{VR} = 2.2 \mu F$
Turn off Time			1		ms	Fall to 10% of steady state current $C_{_{BG}}$ and $C_{_{VR}}$ = 2.2 $\mu F$
Detector output current	17		+/-4		μA	
RF current source						
Current Source (IRF)	27	400	500	600	μA	Pin 27 voltage: 0.3 - 1.3V
Decoder						
Sensitivity		40			µVrms	Signal injected at TPX and TPY B.E.R. $\leq$ 1 in 30 5KHz deviation @ 1200 bits/sec BRF capacitor = 1nF
Output mark space ratio Data O/P Sink Current Data O/P Leakage Current	14 14 14	7:9 100		9:7 500 1.0	μΑ μΑ	Output logic low Output logic high

#### **ELECTRICAL CHARACTERISTICS**

These characteristics are guaranteed over the following conditions unless otherwise stated: Tamb =  $25^{\circ}$ C, VCC1 = 1.3V, VCC2 = 2.7V

Characteristics Pir		Value		Units	Comments	
	FIII	Min	Тур	Мах	Units	Comments
Battery Economy						
Input logic high	10	(V <sub>CC2</sub> -0.3)			V	Powered Up
Input logic low	10			0.3	V	Powered Down
Input current	10		0.05	1	μA	Powered Up
Input current	10		6	8	μA	Powered down transient initial
Battery Flag Input						
Input current	20			1		μΑ
Battery Flag Output						
Battfl Sink Current	11	50		500	μA	(VBATT-VR) > 20mV
Battfl leakage current	11			1	μA	(VBATT-VR) < -20mV
Mixers						
Gain to "IF Test"		34		41	dB	LO inputs driven in parallel with
RF input impedance	24, 26					50mVRMS @ 50MHz.IF = 2kHz See Figs.8a, 8b
LO input impedance	3, 5					See Fig.9
LO DC bias voltage	3, 5				V	Equal to Pin 21 (VCC1)
Audio AGC						
Max Audio AGC Sink Current	28	45	65	85	μΑ	

### **RECEIVER CHARACTERISTICS (GPS Demonstration board)**

Measurement conditions unless stated Vcc1 = 1.3V, Vcc2 = 2.7V, LNA = 18dB Power Gain, 2dB Noise figure, Carrier frequency 153MHz, BER 1 in 30, Tamb = 25°C

(TPx/TPy typically:-  $160mV_{pp} \pm 10\%$  for - 73dBm RF input to the LNA)

Characteristics	Characteristics Pin Value U		Units	Comments		
Gharacteristics	FIII	Min	Тур	Max	Onits	Comments
Sensitivity		-130	-128	-125	dBm	1200 bps f = 4kHz LO = -18dBm
Intermodulation		52	56		dB	1200 bps f = 4kHz LO = -18dBm
Adjacent channel		68	73		dB	1200 bps f = 4kHz LO = -18dBm Channel spacing 25kHz
Centre frequency acceptance			+/-2.3		kHz	1200 bps f = 4kHz LO = -18dBm
Deviation acceptance			+/-2.2		kHz	1200 bps f = 4kHz LO = -18dBm

### **RECEIVER CHARACTERISTICS (GPS Demonstration board)**

Measurement conditions unless stated Vcc1 = 1.3V, Vcc2 = 2.7V, LNA = 20dB Power Gain, 2dB Noise figure, Carrier frequency 282MHz, BER 1 in 30, Tamb =  $25^{\circ}$ C (TPx/TPy typically:-  $160mV_{pp} \pm 10\%$  for - 73dBm RF input to the LNA)

Characteristics	Pin		Value		Units	Comments
Gharacteristics	F 111	Min	Тур	Max	Onits	Commonito
Sensitivity		-130	-128 -125.5	-125 -122	dBm dBm	1200 bps f = 4kHz 2400 bps f = 4.5kHz LO = -15dBm
Intermodulation (IP3)		52 49	56 53.5		dB	1200 bps f = 4kHz 2400 bps f = 4.5kHz LO = -15dBm
Intermodulation (IP2)		47	52		dB	1200 bps f = 4kHz LO = -15dBm
Adjacent channel		67 64	72.5 69.5		dB	1200 bps f = 4kHz 2400 bps f = 4.5kHz LO = -15dBm Channel spacing 25kHz
Centre frequency acceptance		+/-1.9	+/-2.3 +/-2		kHz	1200 bps f = 4kHz 2400 bps f = 4.5kHz LO = -15dBm
Deviation acceptance			+/-2.2 +/-2		kHz	1200 bps f = 4kHz 2400 bps f = 4.5kHz LO = -15dBm

### **RECEIVER CHARACTERISTICS**

Measurement conditions unless stated Vcc1 = 1.3V, Vcc2 = 2.7V, LNA = 22dB Power Gain, 2dB Noise figure, Carrier frequency 470MHz, BER 1 in 30, Tamb = 25°C ٩)

Characteristics	Pin	Value			Units	Comments
Characteristics	F III -	Min	Тур	Max	Onits	Comments
Sensitivity		-128	-126	-123	dBm	1200 bps f = 4kHz LO = -15dBm
Intermodulation		50	55.5		dB	1200 bps f = 4kHz LO = -15dBm
Adjacent channel		67	72.5		dB	1200 bps f = 4kHz LO = -15dBm Channel spacing 25kHz
Centre frequency acceptance			+/- 2.3		kHz	1200 bps
Deviation acceptance			+/- 2.2		kHz	1200 bps f = 4kHz LO = -15dBm

#### **OPERATION OF SL6609A**

The SL6609A is a Direct Converson Receiver designed for use up to 470MHz. It is available in a 28 pin SSOP package and it integrates all the facilities required for the conversion of an RF FSK signal to a base-band data signal.

#### Low Noise Amplifier

To achieve optimum performance it is necessary to incorporate a Low Noise RF Amplifier at the front end of the receiver. This is easily biased using the on chip voltage and current sources provided.

All voltages and current sources used for bias of the RF amplifier, receiver and mixers should be RF decoupled using suitable capacitors (see Fig.4 for a suitable Low-Noise-Amplifier).

#### Local Oscillator

The Local Oscillator signal is applied to the device in phase quadrature. This can be achieved with the use of two RC networks operating at the -3dB/45° transfer characteristic, giving a full 90° phase differential between the LO ports of the device. Each LO port of the device also requires an equal level of drive from the Oscillator. (see Fig.5).

#### **Gyrator Filters**

The on chip filters include an adjustable gyrator filter. This may be adjusted with the use of an additional resistor between Pin 4 and GND. This allows flexibility of filter characterstics and also allows for compensation for possible process variations.

#### Audio AGC

The Audio AGC fundamentally consists of a current sink which is controlled by the audio (baseband data) signal. It has three parameters that may be controlled by the user. These are the Attack (turn on) time, Decay (duration) time and Threshold level (see Figs.6 and 7). See Application note for details.

#### Regulator

The on chip regulator must be used in conjunction with a suitable PNP transistor to achieve regulation. As the transistor forms part of the regulator feedback loop the transistor should exhibit the following characteristics:-

$$H_{_{FE}}$$
 > = 100 for  $V_{_{CE}}$  > = 0.1V

Pin Number	Pin Name	Pin Description
1	ТРХ	X channel pre-gyrator filter test-point. This can be used for input and output
2	RFIADJ	RF current source adjustment pin
3	LOY	LO input channel Y
4	GYRI	Gyrator current adjust pin
5	LOX	LO input channel X
6	VR	VREF 1.0 V internal signal ground
7	TPY	Y channel pre-gyrator filter test point, input or output
8	GTHADJ	Audio AGC gain and threshold adjust. RSSI signal indicator
9	TCADJ	Audio AGC time constant adjust
10	BEC	Battery economy control
11	BATTFL	Battery flag output
12	TPLIMY	Y channel limiter (post gyrator filter) test point, output only
13	VCC2	Supply connection
14	DATAOP	Data output pin
15	TPLIMX	X channel limiter (post gyrator filter) test point, output only
16	BRF2	Bit rate filter 2, input to data output stage
17	BRF1	Bit rate filter 1, output from detector
18	DIG GND	Digital ground
19	VBG	Bandgap voltage output
20	VBATT	Battery flag input voltage
21	VCC1	Supply connection
22	REGCNT	1V regulator control external PNP drive
23	VREG	1V regulator output voltage
24	MIXB	Mixer input B
25	GND	Ground
26	MIXA	Mixer input A
27	IRFAMP	Current source for external LNA. Value of current output will decrease at high mixer
		input signal levels due to RF AGC
28	IAGCOUT	Audio AGC output current

#### COMPONENTS LIST FOR APPLICATION BOARD At 282MHz, 25kHz Channel Spacing.

(LO Circuit ir <b>Resistors</b>	n Fig.3)	C18 C19	1n not used
	anon aircuit	C19 C20	
R1	open circuit		1n 1n
R2	open circuit	C21	1n
R3	100	C22	not used
R4	100k	C23	1n
R5	1k	C24	1n
R6	1k	C25	1n
R7	100	C26	6p8
R8	open circuit	C27	1n
R9	220k	C28	1n
R10	1M	C29	100p
R11	100k <sup>(6)</sup>	C30	2u2
R12	not used	C31	2u2
R13	1k5 <sup>(1)</sup>	C32	4p7
R14	4k7	C33	4p7
R15	4k7	C34	3p3
R16	33k	C35	not used
R17	not used	VC1	1-10p
R18	0R <sup>(3)</sup>	VC2	1-10p
R19	10k	VC3	1-10p
R20	620		
R21	1k	Inductors	
R21 R22	1k open circuit	L1	68n <sup>(4)</sup>
			68n <sup>(4)</sup> not used <sup>(3)</sup>
		L1	
R22		L1 L2	not used (3)
R22 Capacitors	open circuit	L1 L2 L3	not used <sup>(3)</sup> 470n
R22 Capacitors C1	open circuit 1n 2p7	L1 L2 L3 L4	not used <sup>(3)</sup> 470n 39n
R22 Capacitors C1 C2	open circuit 1n	L1 L2 L3 L4	not used <sup>(3)</sup> 470n 39n
R22 Capacitors C1 C2 C3	open circuit 1n 2p7 4p7 1n	L1 L2 L3 L4 L5	not used <sup>(3)</sup> 470n 39n 680n
R22 Capacitors C1 C2 C3 C4 C5	open circuit 1n 2p7 4p7	L1 L2 L3 L4	not used <sup>(3)</sup> 470n 39n 680n
R22 Capacitors C1 C2 C3 C4 C5 C6	open circuit 1n 2p7 4p7 1n 2p7	L1 L2 L3 L4 L5 <b>Active Com</b> Q1	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589
R22 Capacitors C1 C2 C3 C4 C5 C6 C7	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba)
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips)
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup>	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C6 C7 C8 C9 C10	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n ( <sup>2)</sup> 2u2	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba)
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5 D1	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba)
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n 1n	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5 D1 <b>Misc</b>	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba) Panasonic MA862 <sup>(5)</sup>
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n 1n 1n 1n 1n 1n 1n 1n 1n 1	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5 D1	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba) Panasonic MA862 <sup>(5)</sup> 30nH 1:1
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n 1n 1n 1n 1n 1n 1n 1n 1n 1	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5 D1 <b>Misc</b> T1	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba) Panasonic MA862 <sup>(5)</sup> 30nH 1:1 Coilcraft M1686-A
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n 1n 1n 1n 1n 1n 1n 1n 1n 1	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5 D1 <b>Misc</b>	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba) Panasonic MA862 <sup>(5)</sup> 30nH 1:1 Coilcraft M1686-A 5th Overtone
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15	open circuit 1n 2p7 4p7 1n 2p7 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n 1n 1n 1n 1n 1n 1n 1n 1n 1	L1 L2 L3 L4 L5 <b>Active Com</b> Q1 Q2 Q3 Q4 Q5 D1 <b>Misc</b> T1	not used <sup>(3)</sup> 470n 39n 680n <b>ponents</b> FMMT589 2SC5065 (Toshiba) BFT25A (Philips) not used 2SC5065 (Toshiba) Panasonic MA862 <sup>(5)</sup> 30nH 1:1 Coilcraft M1686-A

#### Notes

- 1. The values of R13 is determined by the set-up procedure. See Application Note.
- The value of C9 is determined by the output data rate. Use 2nF for 512bps, 1nF for 1200bps and 470pF for 2400bps.
- L2 is used in the Audio AGC circuit (see Fig. 6). For the characteristics of the Audio AGC current source see Fig.7. If the audio AGC is not required then the current source (Pin 28) may be disabled by connecting Pin 9 (TCADJ) to VR (Pin 6) and by connecting Pin 28 (IAGCOUT) to Vcc1, (R18). The voltage at Pin 8 may still be used as an RSSI. R9, C8, C14, C19, R17 and D1 may then be omitted. See Fig.6 for AGC component values.
- 4. L1and C26 form the low noise matching network for the RF amplifier. The values given are for the RF amplifier specified in the Applications Circuit with no Audio AGC connected. i.e. R17 and D1 omitted.
- Suggested diode for use with the Audio AGC circuit (see Fig.6) (D1 is not included on the general demonstration circuit).
- The value of R11 is dependent on the data output load. R11 should allow sufficient current to drive the data output load.

# **COMPONENTS LIST FOR APPLICATION BOARD** At 470MHz, 25kHz Channel Spacing. (LO circuit is 50 network as in Fig.5 - crystal oscillator not specified)

Resistors

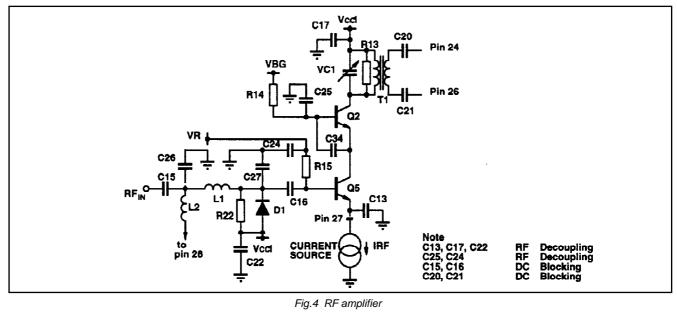
Resistors			
		C14	1n
R1	open circuit	C15	1n
R2	open circuit	C16	1n
R3	100	C17	1n
R4	100k	C18	1n
R5	100	C19	not used
R6	100	C20	1n
R7	100	C21	1n
R8	open circuit	C22	not used
R9	220k	C23	not used
R10	1M	C24	1n
R11	100k <sup>(2)</sup>	C25	1n
R12	300 <sup>(3)</sup>	C26	open circuit
R12	3k9 <sup>(1)</sup>	C27	not used
R13 R14	4k7	C28	not used
R14 R15	4k7 4k7	C29	100p
R15 R16	33k	C30	2u2
R10 R17	open circuit <sup>(4)</sup>	C31	2u2
		C34	1p5
R18	•••		
R18 R22	open circuit	VC1	1-3pF
R22	•••	VC1	
-	•••		
R22 Capacitors	open circuit	VC1 Inductors	1-3pF
R22 Capacitors C1	open circuit 1n	VC1 Inductors L1	1-3pF 47nH <sup>(5)</sup>
R22 Capacitors C1 C2	open circuit 1n 3.3pF	VC1 Inductors L1 L2	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup>
R22 Capacitors C1 C2 C3	open circuit 1n 3.3pF 1n	VC1 Inductors L1	1-3pF 47nH <sup>(5)</sup>
R22 Capacitors C1 C2 C3 C4	open circuit 1n 3.3pF 1n 1n	VC1 Inductors L1 L2 T1	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A
R22 Capacitors C1 C2 C3 C4 C5	open circuit 1n 3.3pF 1n 1n 3.9pF	VC1 Inductors L1 L2	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A
R22 Capacitors C1 C2 C3 C4 C5 C6	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2	VC1 Inductors L1 L2 T1 Active Com	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A ponents
R22 Capacitors C1 C2 C3 C4 C5 C6 C7	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n	VC1 Inductors L1 L2 T1 Active Com	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n 100n	VC1 Inductors L1 L2 T1 Active Com Q1 Q2	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589 Philips BFT25A
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n 100n 1n <sup>(2)</sup>	VC1 Inductors L1 L2 T1 Active Com Q1 Q2 Q3	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589 Philips BFT25A Not Used
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n 100n 1n <sup>(2)</sup> 2u2	VC1 Inductors L1 L2 T1 Active Com Q1 Q2 Q3 Q4	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589 Philips BFT25A Not Used Philips BFT25A <sup>(3)</sup>
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n	VC1 Inductors L1 L2 T1 Active Com Q1 Q2 Q3 Q4 Q5	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589 Philips BFT25A Not Used Philips BFT25A <sup>(3)</sup> Philips BFT25A
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n 1n	VC1 Inductors L1 L2 T1 Active Com Q1 Q2 Q3 Q4	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589 Philips BFT25A Not Used Philips BFT25A <sup>(3)</sup>
R22 Capacitors C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11	open circuit 1n 3.3pF 1n 1n 3.9pF 2u2 1n 100n 1n <sup>(2)</sup> 2u2 100n	VC1 Inductors L1 L2 T1 Active Com Q1 Q2 Q3 Q4 Q5	1-3pF 47nH <sup>(5)</sup> not used <sup>(3)</sup> 16nH 2 Turn 1:1 (Coilcraft) Q4123-A <b>ponents</b> Zetex FMMT589 Philips BFT25A Not Used Philips BFT25A <sup>(3)</sup> Philips BFT25A

#### Notes

- 1. The values of R13 is determined by the set-up procedure. See Application Note.
- 2. The value of "C9" is determined by the output data rate. Use 2nF for 512bps, 1nF for 1200bps and 470pF for 2400bps.
- R12 & Q4 form a dummy load for the regulator. Permitted load currents for the regulator are 250µA to 5mA. The 1V regulator (output Pin 23) can be switched off by connecting Pin 23 directly to VCC2. Q1, Q4, R12 and C12 must then be omitted
- 4. L2 is used in the Audio AGC circuit (see Fig.6). For the characteristics of the Audio AGC current source see figure 7. If the Audio AGC is not required then the current source (Pin 28) may be disabled by connecting

Pin 9 (TCADJ) to VR (Pin 6) and by connecting Pin 28 (IAGCOUT) to Vcc1, (R18). The voltage at Pin 8 may still be used as an RSSI. R9, C8, C14, C19, R17 and D1 may then be omitted.

- 5. L1and C26 form the low noise matching network for the RF amplifier. The values given are for the RF amplifier specified in the Applications Circuit with no Audio AGC connected. i.e. R17 and D1 omitted.
- Suggested diode for use with the Audio AGC circuit (D1 is not included on the general demonstration circuit).
- The value of R11 is dependent on the data output load. R11 should allow sufficient current to drive the data output load.



#### **RF** Amplifier Components Values

Resistors	•	Capacitors		
R14, R15	4k7	C13, C15	1nF	Active components
R13	see note 1	C16, C17	1nF	D1 MA862 (Panasonic)
R22	47k	C20, C21	1nF see note 2	. ,
		C24, C25	1nF	
		L2	820nH	

#### Notes:

- (1) The value of R13 is determined by the set up procedure (See "Set up for optimum performance").
- (2) C20 and C21 are purely for deomonstration purposes. Pin 24 and Pin 26 may be DC coupled provided that no DC voltage is applied to the mixer inputs.

### Frequency Dependent Components

	153MHz	280MHz	450MHz
C26	not used	6.8p	not used
C27	not used	not used	not used
L1	150nH	68nH	39nH
C34	3p3	2p2	1p5
T1	100nH	30nH	16nH
	Coilcraft N2261-A	Coilcraft M1686-A	Coilcraft Q4123-A
VC1	1-10pF	1-10pF	1-3pF
Q4, Q5	Toshiba 2SC5065	Toshiba 2SC5065	Philips BFT25A
(See also Lo dr	ive Network)		

C18 Vcc1 **R5** R3 TO Pin 3 TO Pin 5 C3 C5 **R7** Note C4 C3 R5 R6 RF Decoupling DC Block Mixer Bias C18 Vcc C4 R6

Fig.5 Local oscillator drive network

#### LO Drive Network Component Values

500nm input impedance (External LO injection)					
	153MHz	280MHz	450MHz		
C2	10p	5p6	3p3		
C5	10p	5p6	3p9		
C3, C4, C18 = 1n					
R3, R5, R6, R7 = 1000hms					

#### Higher Input Impedance (crystal oscillator input)

	ISSIMITZ		450IWITZ
C3	Set by load allo	owable on crys	stal oscillator (typical 4p7)
C2	10p	5p6	3р3
C5	10p	5p6	3p9
R3	100	100	100
R7	100	100	100
R5, R6 =	1k		
C4, C18 =	= 1n		

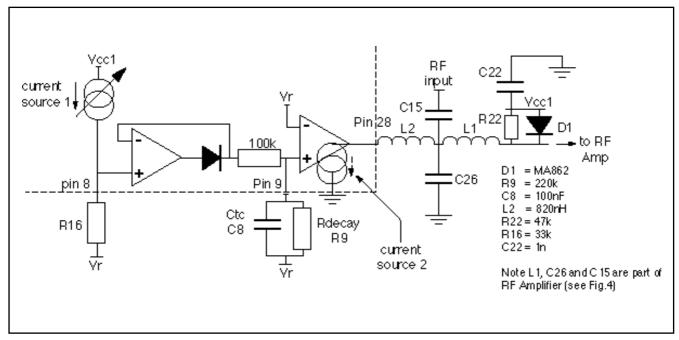


Fig.6 AGC Schematic

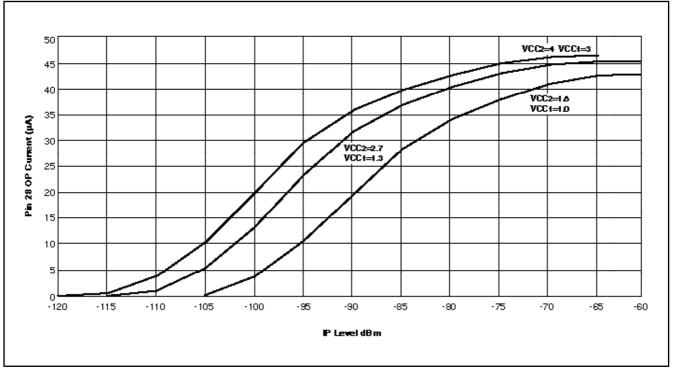


Fig.7 Audio AGC current vs. IP power at 25°C

S11	FREQ	MAG	ANG	1
	50.000	0.969	-7.20	
	100.000	0.958	-14.45	5
	150.000	0.942	-20.59	
	200.000	0.917	-26.40	
	250.000	0.893	-33.26	
	300.000	0.858	-39.84	
	350.000	0.832	-44.78	
	400.000	0.806	-49.01	
	450.000	0.000	-54.00	
	450.000 500.000	0.755	-59.53	50MHz
			-64-35	SUMHZ
	550.000	0.743		
	600.000	0.725	-68.43	
	650.000	0.703	-73.01	
	700.000	0.680	-78.74	
	750.000	0.666	-83.76	
	800.000	0.653	-87.48	1GHz
	850.000	0.636	-91.32	$\times$
	900.000	0.615	-97.17	
	950.000	0.604	-102.84	
	1000.00	0.600	-105.23	

Fig.8a SL6609A Mixer A input S-Parameters

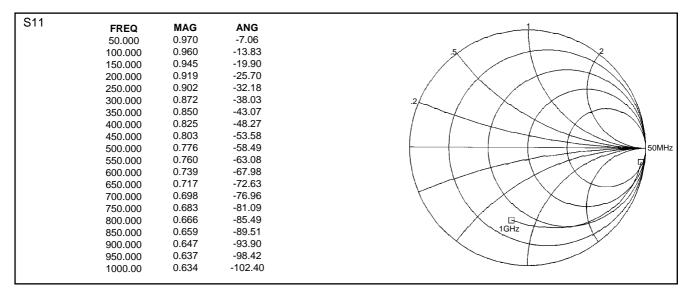


Fig.8b SL6609A Mixer B input S-Parameters

S11	FREQ	MAG	ANG	1
	50.000	0.993	-4.17	
	100.000	0.995	-8.43	.5 2
	150.000	0.997	-12.88	
	200.000	0.997	-17.57	
	250.000	0.996	-22.63	
	300.000	0.986	-28.16	2/
	350.000	0.965	-33.87	
	400.000	0.936	-39.17	
	450.000	0.902	-43.88	
	500.000	0.872	-48.54	50MHz
	550.000	0.838	-52.81	
	600.000	0.804	-56.60	
	650.000	0.798	-59.47	
	700.000	0.810	-65.19	$\mathcal{F} \setminus X \times \mathcal{I}$
	750.000	0.784	-71.49	
	800.000	0.779	-75.97	
	850.000	0.790	-82.54	
	900.000	0.788	-91.16	1GHz
	950.000	0.768	-100.20	
	1000.00	0.743	-108.52	

Fig.9 SL6609A LO X, Y inputs S-Parameters

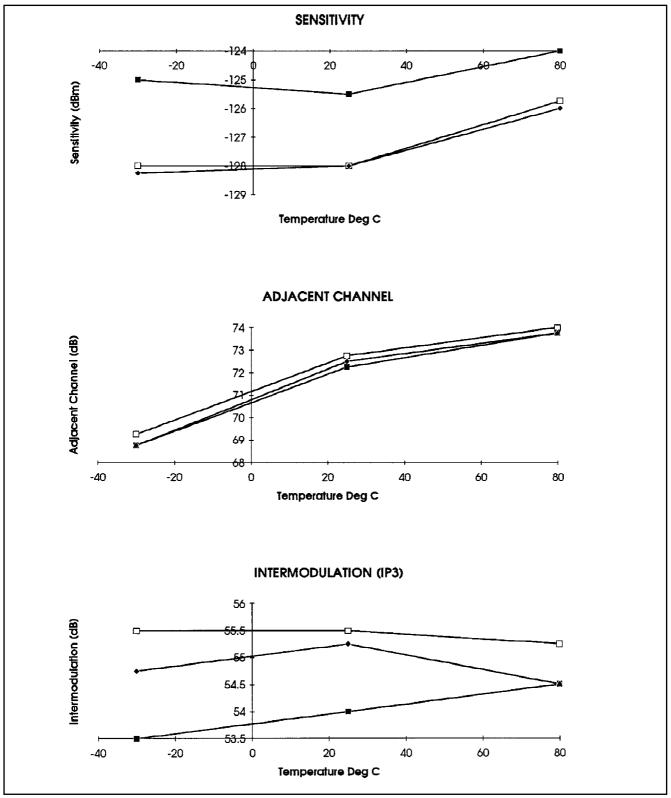


Fig.10a AC parameters vs. supply and temperature

Conditions:- 282MHz GPS demonstration board i.e. 20dB LNA, 2dB noise figure, carrier frequency 282MHz, 1200bps baud rate, 4kHz deviation frequency, BER 1 in 30.

Vcc1 = 1.0V, Vcc2 = 1.8V	
Vcc1 = 1.3V, Vcc2 = 2.7V	
Vcc1 = 3.0V, Vcc2 = 4.0V	
	Vcc1 = 1.0V, Vcc2 = 1.8V Vcc1 = 1.3V, Vcc2 = 2.7V Vcc1 = 3.0V, Vcc2 = 4.0V

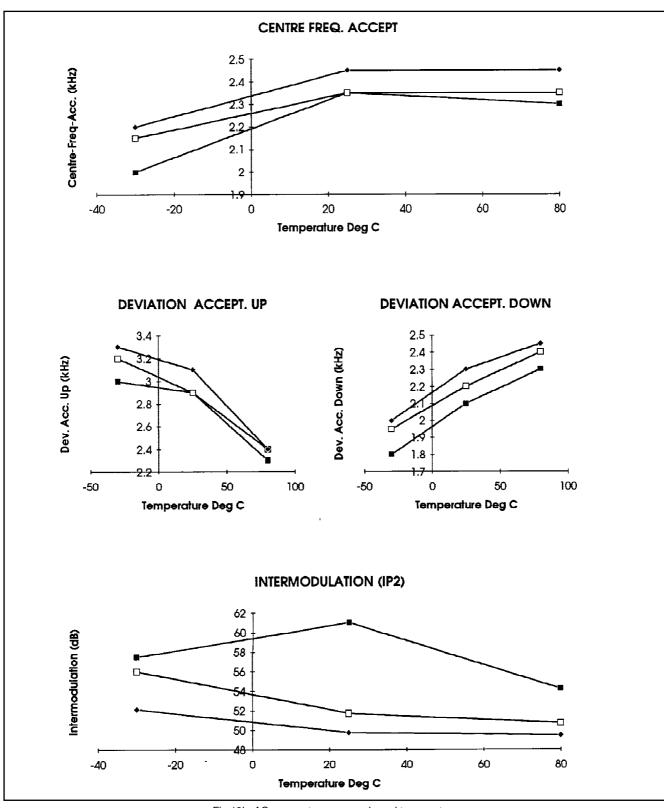
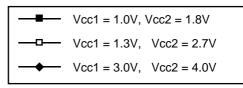


Fig. 10b AC parameters vs. supply and temperature

Conditions:- 282MHz GPS demonstration board i.e. 20dB LNA, 2dB noise figure, carrier frequency 282MHz, 1200bps baud rate, 4kHz deviation frequency, BER 1 in 30.



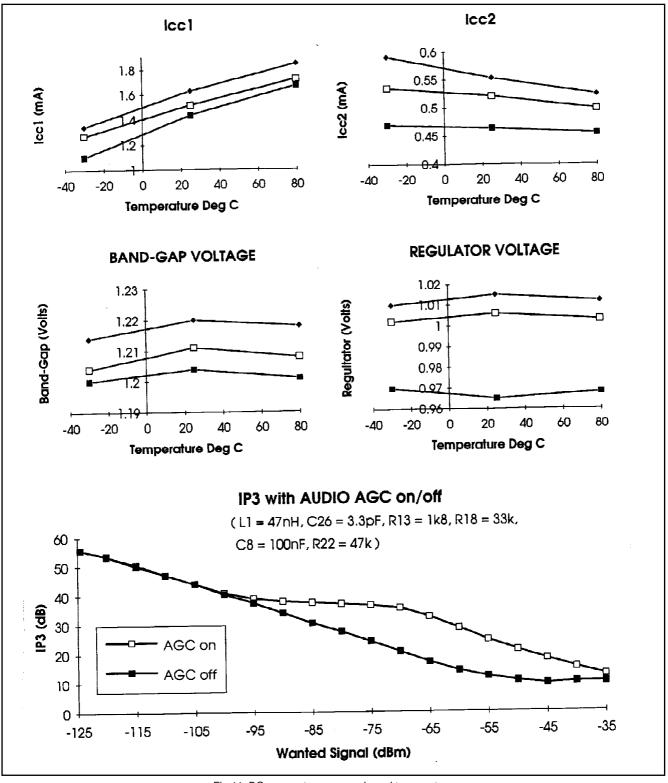
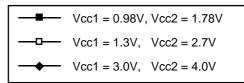


Fig.11 DC parameters vs. supply and temperature (IP3 vs audio AGC both on and off)

Conditions:- ICC1 includes 500 $\mu$ A LNA current but does not include the regulator supply (audio AGC inactive). ICC2 measured with BATT FLAG and DATA O/P HIGH, Fc = 282MHz.



Note 1- IP3 is level above wanted needed to reduce receiver to 1 in 30 B.E.R.

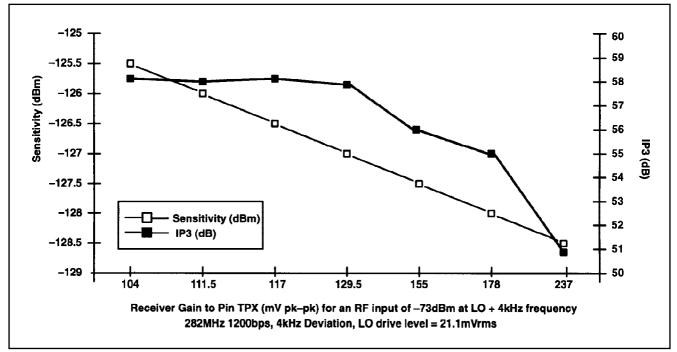


Fig. 12 Sensitivity, IP3 vs Receiver Gain

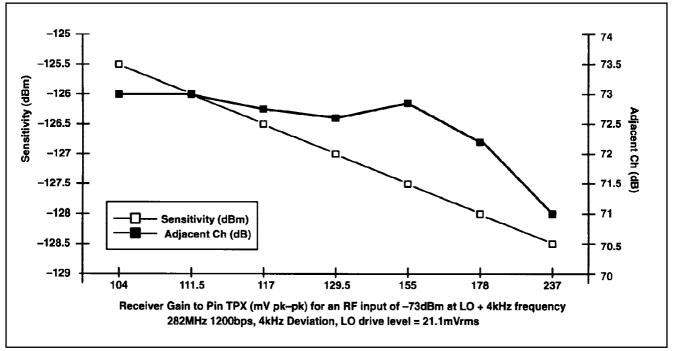


Fig.13 Sensitivity, adjacent Channel vs Receiver Gain

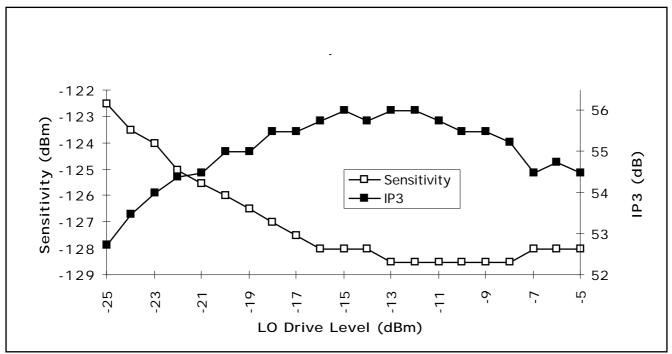


Fig.14 Sensitivity, IP3 vs LO level

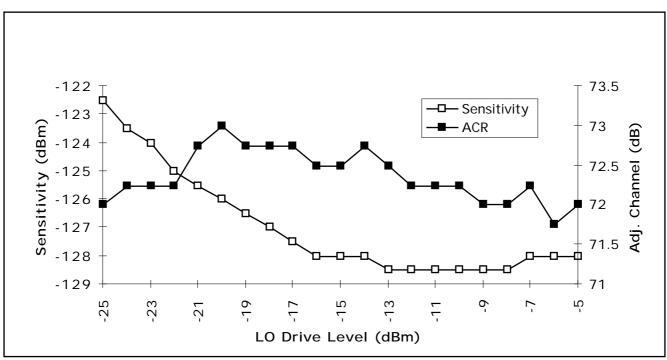
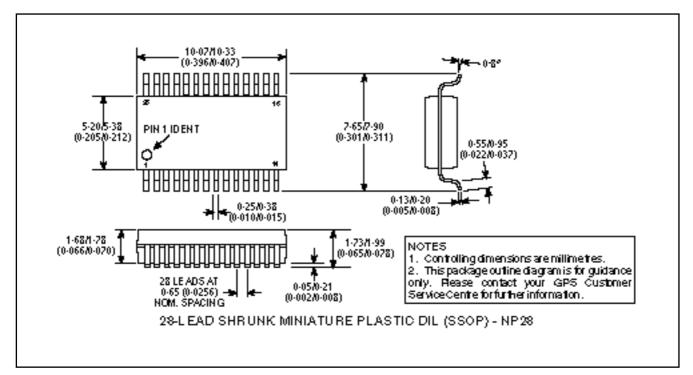


Fig.15 Sensitivity, Adjacent Channel vs LO level

#### PACKAGE DETAILS

Dimensions are shown thus: mm (in)





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