# SL6619

## DIRECT CONVERSION FSK DATA RECEIVER

*(Supersedes the July 1995 Edition D.S. 3853 – 2.3)*

The SL6619 is an advanced Direct Conversion FSK Data Receiver for operation up to 450MHz. The device integrates all functions to convert a binary FSK modulated RF signal into a demodulated data stream.

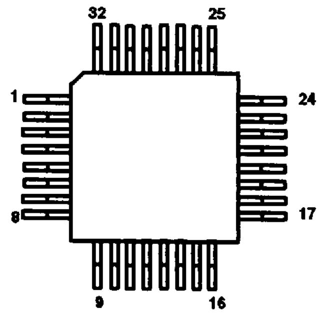
Adjacent Channel Rejection is provided using tuneable gyrator filters. RF and Audio AGC functions assist operation when large interfering signals are present and an Automatic Frequency Control (AFC) function is provided to extend Centre Frequency Acceptance.

### FEATURES

- Very low power operation from single cell
- Superior sensitivity
- Operation at 512, 1200 and 2400 baud
- On–chip 1Volt regulator
- 1mm height miniature package offering
- Automatic frequency control function
- Programmable post detection filter
- AGC detection circuitry
- Powerdown function
- Battery strength indicator

### APPLICATIONS

- Pagers: including Credit card, PCMCIA and Watch pagers.
- Low data rate receivers e.g. Security Systems




| PIN | NAME | PIN | NAME |
|---|---|---|---|
| 1 | IRF | 17 | TPQ |
| 2 | GND | 18 | VREF |
| 3 | MIXIP A | 19 | AFC OP |
| 4 | MIX DEC | 20 | BEC |
| 5 | MIXIP B | 21 | DATA OP |
| 6 | REG CNT | 22 | VCC2 |
| 7 | VREG | 23 | BATT FLAG |
| 8 | TPI | 24 | AFC1 |
| 9 | I1 | 25 | AFC2 |
| 10 | I2 | 26 | BRF CNT |
| 11 | VCC1 | 27 | BRF1 |
| 12 | LOIP I | 28 | VBATT |
| 13 | GYRI | 29 | TP LIM I |
| 14 | LOIP Q | 30 | IAGC OP |
| 15 | Q1 | 31 | TC ADJ |
| 16 | Q2 | 32 | GTH ADJ |

*Fig. 1 Pin connections*

### ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Storage temperature | –55°C to +150°C |
| Operating temperature | –10°C to +55°C |

The absolute maximum voltage on any pin with respect to any other pin is +4V, subject to the following restrictions.Most negative voltage on any pin –0.5V with respect to ground.

| | |
|---|---|
| Pin 3, MIXIP | magnitude of current<5mA |
| Pin 5, MIXIPB | magnitude of current<5mA |
| Pin 12, LOIPI | magnitude of current<5mA |
| Pin 14, LOIPB | magnitude of current<5mA |

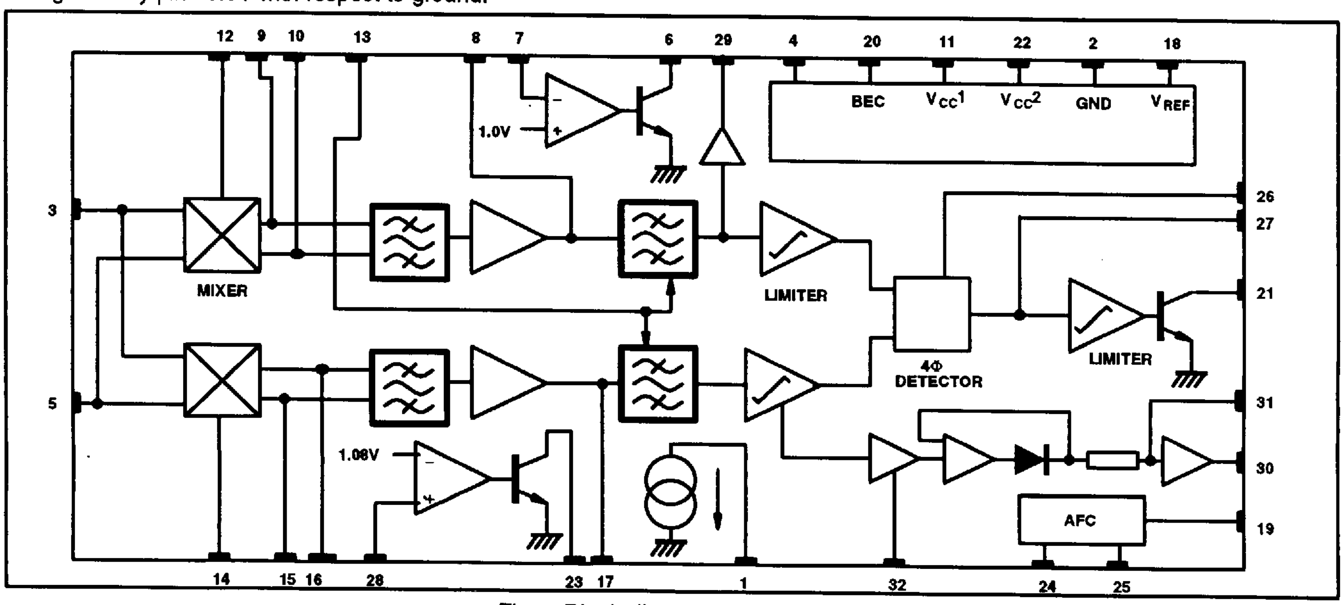



*Fig. 2 Block diagram of SL6619*

## ELECTRICAL CHARACTERISTICS

These characteristics are guaranteed over the following conditions unless otherwise stated. $T_{amb}$ = 25°C Vcc1=1.3V, Vcc2=2.7V

| Characteristics | Pin | Value | | | Units | Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Vcc1 – Supply voltage | 11 | 0.95 | 1.3 | 2.7 | V | Vcc1 $\leq$ Vcc2 – 0.8volts |
| Vcc2 – Supply voltage | 22 | 1.9 | 2.7 | 3.5 | V | |
| Icc1 – Supply current | 11 | 1.20 | 1.60 | 2.2 | mA | Including IRF |
| Icc2 – Supply current | 22 | 260 | 350 | 460 | µA | |
| 1 volt regulator | 7 | 0.95 | 1.0 | 1.05 | V | I load =3mA. Ext PNP. $\beta$> = 100, $V_{CE}$ = 0.1 V |
| 1 volt regulator load current | 7 | 0.25 | | 3 | mA | External PNP $\beta$> = 100, $V_{CE}$=0.1 V |
| LNA current source, IRF | 1 | 375 | 500 | 700 | µA | PTAT, voltage on Pin 1 = 0.3V and 1.3V |
| Voltage reference | 18 | 1.15 | 1.25 | 1.31 | V | Typ. temp co. +0.1mV/°C |
| Voltage reference source current | 18 | | | 20 | µA | |
| Voltage reference sink current | 18 | | | 1.0 | µA | |
| **Data amplifier** | | | | | | |
| Data O/P sink current | 21 | 25 | | | µA | Output logic low Pin 21 voltage = 0.3V |
| Data O/P leakage current | 21 | | | 1.0 | µA | Output logic high Pin 21 voltage = Vcc2. |
| Output mark space ratio | 21 | 7: 9 | | 9: 7 | | Preamble at 1200 baud Δf = 4kHz Pin 26 = 0V BRF capacitor = 560pF Data Op pull up resistor = 200kΩ |
| **Battery Economy** | | | | | | |
| Power down Icc1 | 11 | | 0.5 | 10 | µA | Pin 20=Logic low |
| Power down Icc2 | 22 | | 2.0 | 10 | µA | Pin 20=Logic low |
| Input logic high | 20 | Vcc2–0.3 | | Vcc2 | V | Powered up |
| Input logic low | 20 | 0 | | 0.3 | V | Powered down |
| Input current | 20 | –1.0 | | 1.0 | µA | Powered up |
| Input current | 20 | –1.0 | | 1.0 | µA | Powered down |
| **Battery Flag** | | | | | | |
| Battery flag trigger point | 28, 23 | 1.04 | 1.08 | 1.12 | | Current sunk by Pin 23 = 1µA |
| Battflag sink current | 28, 23 | | | 1.0 | µA | Pin 28 voltage = 1.04V |
| Battflag sink current | 28, 23 | 1.0 | | | µA | Pin 28 voltage = 1.12V |
| Battflag sink current | 28, 23 | 25 | | | µA | Pin 28 voltage = 1.14V |
| VBatt input voltage | 28 | | | 2.0 | V | |
| VBatt input current | 28 | –1.0 | | 1.0 | µA | VBatt = 1.14V |
| VBatt input current | 28 | –1.0 | | 1.0 | µA | VBatt = 1.04V |

## ELECTRICAL CHARACTERISTICS (cont)

These characteristics are guaranteed over the following conditions unless otherwise stated. $T_{amb}$ = 25°C Vcc1=1.3V, Vcc2=2.7V

| Characteristics | Pin | Value | | | Units | Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| **Mixers** | | | | | | |
| LO DC bias voltage | 12, 14 | | Vcc1 | | V | |
| Gain to TPI | 3,5,8, 12 | 38 | 42 | 46 | dB | LO inputs (12, 14) driven in quadrature 45mVrms @ 450MHz, cw. Mixer inputs (3, 5) driven differentially 0.45mVrms @ 450.004MHz, cw. |
| Gain to TPQ | 3,5, 14,17 | 38 | 42 | 46 | dB | As Gain to TPI |
| Match of Gain to TPI and TPQ | 3,5,8, 12,14, 17 | −1 | 0 | +1 | dB | As Gain to TPI |
| **Audio AGC** | | | | | | |
| Max Audio AGC sink current | 30 | | 40 | | µA | TPI, TPQ signals limiting |
| Audio AGC leakage current | 30 | | | 1 | µA | No signal applied |
| **AFC** | | | | | | |
| AFC DC current, 4.5kHz IF, $I_{afc4k5}$ | 19 | | 0.0 | | µA | $F_C = F_{LO}$ +4.5kHz, cw |
| AFC DC current, 2.5kHz IF | 19 | $I_{afc4k5}$ +0.2 | $I_{afc4k5}$ +0.7 | | µA | $F_C = F_{LO}$ +2.5kHz,cw |
| AFC DC current, 6.5KHz IF | 19 | | $I_{afc4k5}$ −0.9 | $I_{afc4k5}$ −0.2 | µA | $F_C = F_{LO}$ +6.5kHz, cw |
| **Bit Rate Filter Control** | | | | | | |
| Input logic high | 26 | Vcc2−0.3 | | Vcc2 | V | 2400 baud |
| Input logic low | 26 | 0 | | 0.1 | V | 1200 baud |
| Tristate input current window | 26 | −0.4 | | +0.4 | µA | 512 baud |
| Output current BRF1 | 27 | | 3.5 | | µA | Pin 26 logic High |
| Output current BRF1 | 27 | | 1.7 | | µA | Pin 26 logic Low |
| Output current BRF1 | 27 | | 0.74 | | µA | Pin 26 logic tristate |
| Input high current | 26 | −7.5 | | +7.5 | µA | |
| Input low current | 26 | −7.5 | | +7.5 | µA | |

## ELECTRICAL CHARACTERISTICS

Characteristics apply over the range $V_{cc}1$=1.04V to 2.0V, $V_{cc}2$=2.3V to 3.2V. $V_{cc}1<V_{cc}2$. –0.8V, temperature=–10C to +55C, unless otherwise stated. Characteristics are tested at room temperature only and are guaranteed by characterisation test or design.

| Characteristics | Pin | Value | | | Units | Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Vcc1 – Supply voltage | 11 | 0.95 | 1.3 | 2.7 | V | Vcc1 ≤ Vcc2 – 0.8volts ≥25°C only |
| Vcc2 – Supply voltage | 22 | 1.9 | 2.7 | 3.5 | V | |
| Icc1 – Supply current | 11 | | 1.60 | 2.4 | mA | Including IRF |
| Icc2 – Supply current | 22 | | 350 | 510 | µA | |
| 1 volt regulator | 7 | 0.93 | 1.0 | 1.05 | V | I load =3mA. Ext PNP. $\beta>=100$, $V_{CE}=0.1$ V |
| 1 volt regulator load current | 7 | 0.25 | | 3 | mA | External PNP $\beta>=100$, $V_{CE}$=0.1 V |
| LNA current source, IRF | 1 | 375 | 500 | 800 | µA | PTAT, voltage on Pin 1 = 0.3V and 1.3V |
| Voltage reference | 18 | 1.13 | 1.25 | 1.33 | V | Typ. temp co. +0.1mV/°C |
| Voltage reference source current | 18 | | | 18 | µA | |
| Voltage reference sink current | 18 | | | 0.8 | µA | |
| Turn on time | | | 5 | | ms | Stable data O/P when 3dB above sensitivity. $C_{VREF}$ = 2.2µF |
| Turn off Time | | | 1 | | ms | Fall to 10% of steady state $I_{CC1}$ current, $C_{VREF}$ = 2.2µF |
| **Data amplifier** | | | | | | |
| Data O/P sink current | 21 | 22 | | | µA | Output logic low Pin 21 voltage = 0.3V |
| Data O/P leakage current | 21 | | | 1.5 | µA | Output logic high Pin 21 voltage = Vcc2. |
| Output mark space ratio | 21 | 7: 9 | | 9: 7 | | Preamble at 1200 baud Δf = 4kHz Pin 26 = 0V BRF capacitor = 560pF Data Op pull up resistor = 200kΩ |
| **Battery Economy** | | | | | | |
| Power down Icc1 | 11 | | 0.5 | 12 | µA | Pin 20=Logic low |
| Power down Icc2 | 22 | | 2 | 12 | µA | Pin 20=Logic low |
| Input logic high | 20 | Vcc2–0.3 | | Vcc2 | V | Powered up |
| Input logic low | 20 | 0 | | 0.3 | V | Powered down |
| Input current | 20 | –1.5 | | 1.5 | µA | Powered up |
| Input current | 20 | –1.5 | | 1.5 | µA | Powered down |
| **Battery Flag** | | | | | | |
| Battery flag trigger point | 28, 23 | 1.04 | 1.08 | 1.12 | | Current sunk by Pin 23 = 1µA |
| Battflag sink current | 28, 23 | | | 2 | µA | Pin 28 voltage = 1.04V |
| Battflag sink current | 28, 23 | 2 | | | µA | Pin 28 voltage = 1.12V |
| Battflag sink current | 28, 23 | 20 | | | µA | Pin 28 voltage = 1.14V |
| VBatt input voltage | 28 | | | 2.0 | V | |
| VBatt input current | 28 | –1.5 | | 1.5 | µA | VBatt = 1.14V |
| VBatt input current | 28 | –1.5 | | 1.5 | µA | VBatt = 1.04V |

## ELECTRICAL CHARACTERISTICS (cont)

Characteristics apply over the range $V_{cc}1$=1.04V to 2.0V, $V_{cc}2$=2.3V to 3.2V. $V_{cc}1$<$V_{cc}2$. –0.8V, temperature=–10C to +55C, unless otherwise stated. Characteristics are tested at room temperature only and are guaranteed by characterisation test or design.

| Characteristics | Pin | Value | | | Units | Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| **Mixers** | | | | | | |
| LO DC bias voltage | 12, 14 | | Vcc1 | | V | |
| Gain to TPI | 3,5,8,12 | 35 | 42 | 46 | dB | LO inputs (12, 14) driven in quadrature 45mVrms @ 450MHz, cw. Mixer inputs (3, 5) driven differentially 0.45mVrms @ 450.004MHz, cw. |
| Gain to TPQ | 3,5, 14,17 | 35 | 42 | 46 | dB | As Gain to TPI |
| Match of Gain to TPI and TPQ | 3,5,8,12,14,17 | –1.5 | 0 | +1.5 | dB | As Gain to TPI |
| **Audio AGC** | | | | | | |
| Max Audio AGC sink current | 30 | 15 | 40 | 80 | µA | TPI, TPQ signals limiting |
| Audio AGC leakage current | 30 | | | 2 | µA | No signal applied |
| **AFC** | | | | | | |
| AFC DC current, 4.5kHz IF, $I_{afc4k5}$ | 19 | | 0.0 | | µA | $F_C = F_{LO}$ +4.5kHz, cw |
| AFC DC current, 2.5kHz IF | 19 | $I_{afc4k5}$ +0.1 | $I_{afc4k5}$ +0.7 | | µA | $F_C = F_{LO}$ +2.5kHz,cw |
| AFC DC current, 6.5KHz IF | 19 | | $I_{afc4k5}$ –0.9 | $I_{afc4k5}$ –0.1 | µA | $F_C = F_{LO}$ +6.5kHz, cw |
| **Bit Rate Filter Control** | | | | | | |
| Input logic high | 26 | Vcc2–0.3 | | Vcc2 | V | 2400 baud |
| Input logic low | 26 | 0 | | 0.1 | V | 1200 baud |
| Tristate input current window | 26 | –0.4 | | +0.4 | µA | 512 baud |
| Output current BRF1 | 27 | | 3.5 | | µA | Pin 26 logic High |
| Output current BRF1 | 27 | | 1.7 | | µA | Pin 26 logic Low |
| Output current BRF1 | 27 | | 0.74 | | µA | Pin 26 logic tristate |
| Input high current | 26 | –10 | | +10 | µA | |
| Input low current | 26 | –10 | | +10 | µA | |

## RECEIVER CHARACTERISTICS (450MHz)

Characteristics apply over the range Vcc1=1.04V to 2.0V, Vcc2=2.3V to 3.2V. Vcc1<Vcc2.–0.8V, temperature=–10C to +55C, unless otherwise stated. Characteristics are not tested but are guaranteed by characterisation test or design. Carrier frequency 450MHz, BER 1 in 30, AFC open loop. All measurements using GPS characterisation circuit.
The LNA gain is set such that an RF signal of –73dBm at the LNA input, offset from the LO by 4kHz, gives a typical IF signal level of 300mV p–p at TPI and TPQ. LNA noise figure < 2dB. See Application Note AN137 for details of Test method.

| Characteristics | Value | | | Units | Conditions |
|---|---|---|---|---|---|
| | Min | Typ | Max | | |
| **Sensitivity** | | –128 | | dBm | 512 bps Δf=4.5kHz |
| | | –126 | –122 | dBm | 1200 bps Δf=4.0kHz |
| | | –123 | –119 | dBm | 2400bps Δf=4.5kHz |
| | | | | | LO=–15dBm |
| **Intermodulation, IP3** | | 57 | | dB | 512 bps Δf=4.5kHz |
| | 50 | 55 | | dB | 1200 bps Δf=4.0kHz |
| | 48 | 53 | | dB | 2400bps Δf=4.5kHz |
| | | | | | LO=–15dBm |
| | | | | | Channel spacing 25kHz |
| **Adjacent channel** | | 74 | | dB | 512 bps Δf=4.5kHz |
| | 62.5 | 72 | | dB | 1200 bps Δf=4.0kHz |
| | 60 | 69 | | dB | 2400bps Δf=4.5kHz |
| | | | | | LO=–15dBm |
| | | | | | Channel spacing 25kHz |
| **Deviation acceptance** | | +1.9 | | kHz | 512 bps Δf=4.5kHz No AFC |
| (AFC not connected) | | –2.5 | | kHz | 512 bps Δf=4.5kHz No AFC |
| | +1.8 | +3.0 | +4.6 | kHz | 1200 bps Δf=4.0kHz No AFC |
| | –2.7 | –2.3 | –1.7 | kHz | 1200 bps Δf=4.0kHz No AFC |
| | +1.7 | +2.5 | +4.6 | kHz | 2400bps Δf=4.5kHz No AFC |
| | –3 | –2.3 | –1.7 | kHz | 2400bps Δf=4.5kHz No AFC |
| **Centre frequency acceptance** | | ±2.8 | | kHz | 512 bps Δf=4.5kHz No AFC |
| **(AFC not connected)** | ±2.0 | ±2.5 | ±2.9 | kHz | 1200 bps Δf=4.0kHz No AFC |
| | ±2.0 | ±2.5 | ±3.2 | kHz | 2400bps Δf=4.5kHz No AFC |
| **AFC Capture Range** | | ±4 | | kHz | 512 bps Δf=4.5kHz All at sensitivity +3db or above |
| (AFC closed loop) | | ±3.5 | | kHz | 1200 bps Δf=4.0kHz All at sensitivity +3db or above |
| | | ±4 | | kHz | 2400bps Δf=4.5kHz All at sensitivity +3db or above |

## ELECTRICAL CHARACTERISTICS (280MHz)

Characteristics apply over the range Vcc1=1.04V to 2.0V, Vcc2=2.3V to 3.2V. Vcc1<Vcc2.–0.8V, temperature=–10C to +55C, unless otherwise stated. Characteristics are not tested but are guaranteed by characterisation test or design. Carrier frequency 280MHz, BER 1 in 30, AFC open loop. All measurements using GPS characterisation circuit.
The LNA gain is set such that an RF signal of –73dBm at the LNA input, offset from the LO by 4kHz, gives a typical IF signal level of 300mV p–p at TPI and TPQ. LNA noise figure < 2dB. See Application Note AN137 for details of Test method.

| | | | | | |
|---|---|---|---|---|---|
| **Sensitivity** | | –129 | | dBm | 512 bps Δf=4.5kHz |
| | –128 | –127 | –124 | dBm | 1200 bps Δf=4.0kHz |
| | –127 | –124 | –121 | dBm | 2400bps Δf=4.5kHz |
| | | | | | LO=–15dBm |
| **Intermodulation, IP3** | | 57 | | dB | 512 bps Δf=4.5kHz |
| | 52 | 56 | 60 | dB | 1200 bps Δf=4.0kHz |
| | 49 | 53.5 | 57 | dB | 2400bps Δf=4.5kHz |
| | | | | | LO=–15dBm |
| **Adjacent channel** | | 74 | | dB | 512 bps Δf=4.5kHz |
| | 62.5 | 73 | 80 | dB | 1200 bps Δf=4.0kHz |
| | 60 | 70 | 77 | dB | 2400bps Δf=4.5kHz |
| | | | | | LO=–15dBm |
| | | | | | Channel spacing 25kHz |
| **Deviation acceptance** | | +1.9 | | kHz | 512 bps Δf=4.5kHz No AFC |
| (AFC not connected) | | –2.5 | | kHz | 512 bps Δf=4.5kHz No AFC |
| | +1.8 | +3.0 | +4.6 | kHz | 1200 bps Δf=4.0kHz No AFC |
| | –2.7 | –2.3 | –1.7 | kHz | 1200 bps Δf=4.0kHz No AFC |
| | +1.7 | +2.5 | +4.6 | kHz | 2400bps Δf=4.5kHz No AFC |
| | –3.0 | –2.3 | –1.7 | kHz | 2400bps Δf=4.5kHz No AFC |
| **Centre frequency acceptance** | | ±2.8 | | kHz | 512 bps Δf=4.5kHz No AFC |
| (AFC not connected) | ±2.0 | ±2.5 | ±2.9 | kHz | 1200 bps Δf=4.0kHz No AFC |
| | ±2.0 | ±2.5 | ±3.2 | kHz | 2400bps Δf=4.5kHz No AFC |
| **AFC capture range** | | ±4 | | kHz | 512 bps Δf=4.5kHz All at sensitivity +3dB or above |
| (AFC Closed Loop) | | ±3.5 | | kHz | 1200 bps Δf=4.0kHz All at sensitivity +3dB or above |
| | | ±4 | | kHz | 2400bps Δf=4.5kHz All at sensitivity +3dB or above |
| **1MHz Blocking** | | 75 | | dB | 512bps Δf=4.5kHz |
| | 67 | 75 | 78 | dB | 1200bps Δf=4.0kHz |
| | 65 | 73 | 76 | dB | 2400bps Δf=4.5kHz LO=–15dBm |

## OPERATION OF SL6619

### 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 voltages and current source provided.

All voltages and current sources used for bias of the RF amplifier, receiver and mixers should be RF decoupled using 1nF capacitors.

The receiver also requires a stable Local Oscillator at the required channel frequency.

### 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 their –3dB/45° transfer characteristic. The RC characteristics for I and Q channels are combined to give 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. This is achieved by forming the two RC networks into a power divider.

### Gyrator Filters

The on–chip filters include an adjustable gyrator filter. This may be adjusted by changing the value of the resistor connected between Pin 13 and GND. This allows adjustment of the filters' cut off frequency and allows for compensation for possible process variations.

### Audio AGC (See Fig. 4)

The Audio AGC consists of a current sink which is controlled by the audio (baseband) 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.

The Attack time is simply determined by the value of the external capacitor connected to "(TCADJ)". The external capacitor is in series with an internal 100kOhm resistor and the time constant of this circuit dictates the attack time of the AGC.

$$\text{i.e. } T_{attack} = 100k*C_{18}$$

The decay time is determined by the external resistor connected in parallel to the capacitor $C_{tc}$. The Decay time is simply $T_{decay} = R_{17} \times C_{18}$

When a large audio (baseband) signal is incident on the input to the AGC circuit, the variable current source is turned on. This causes a voltage drop across $R_{13}$. The voltage potential between $V_{REF}$ and the voltage on Pin 31 causes a current to flow in Pin 30. This charges up $C_{18}$ through the 100K internal resistor. As the voltage across the capacitor increases, a current source is turned on and this sinks current from Pin 32.

The current sink on Pin 32 can be used to drive the external AGC circuit by causing a PIN diode to conduct, reducing the signal to the RF amplifier.

### RF AGC

The RF AGC is an automatic gain control loop that protects the mixer's RF inputs, Pins 3 and 5, from large out of band RF signals.

The loop consists of an RF received signal strength indicator which detect on the signal at the inputs of the mixers.

This RSSI signal is then used to control the LNA current source (Pin 1)

### Regulator

The on–chip regulator should 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:–

$$H_{FE} > 100 \text{ for } V_{CE} >= 0.1V.$$

If no external pnp transistor is used, the maximum current sourcing capability of the regulator is limited to 30μA.

### Automatic Frequency Control (See Fig. 5)

The Automatic Frequency Control consists of a detection circuit which gives a current output at AFC OP whose magnitude and sign is a function of the difference between the local oscillator ($F_{LO}$) and carrier frequencies ($F_C$). This output current is then filtered by an off chip integrating capacitor. The integrator's output voltage is used to control a voltage control crystal oscillator. This closes the AFC feedback loop giving the Automatic frequency control function.

For an FSK modulated incoming RF carrier, the AFC OP current's polarity is positive, i.e.current is sourced, for $F_{LO} < F_C < F_{LO}$ +4K and negative, i.e. current is sunk, for $F_{LO} > F_C > F_{LO}$ –4K. The magnitude of the AFC OP current is a function of frequency offset and the transmitted data's bit stream. If the carrier frequency, ($F_C$), equals the local oscillator frequency, ($F_{LO}$), then the magnitude of the current is zero.

### BIT RATE FILTER CONTROL

The logic level on Pin 26 controls the cut off frequency of the 1st order bit rate for a given bit rate filter capacitor at Pin 27. This allows the cut off frequency to be changed between $F_C$, $2xF_C$ and $0.43xF_C$ through the logic level on Pin 26.

This function is achieved by changing the value of the current in the 4 Φ detector's output stage. A logic zero (0V to 0.1V) on Pin 26 gives a cutoff frequency of $F_C$, a logic one (Vcc2 –0.3 to Vcc2) gives a cut off frequency of $2xF_C$ and an open circuit connection to Pin 26 gives a cutoff frequency of $0.43xF_C$.

| Pin Number | Pin Name | Pin Description |
|---|---|---|
| 1 | IRF | LNA current source |
| 2 | GND | Ground |
| 3 | MIXIP A | Mixer input A |
| 4 | MIX DEC | Mixer biasing decouple |
| 5 | MIXIP B | Mixer input B |
| 6 | REG CNT | 1V regulator control external PNP drive |
| 7 | VREG | 1V regulator output voltage |
| 8 | TPI | I channel pre–gyrator filter test–point. |
| 9 | I1 | Mixer output, I channel |
| 10 | I2 | Mixer output I channel |
| 11 | VCC1 | Supply connection |
| 12 | LOIP I | LO input channel I |
| 13 | GYRI | Gyrator current adjust pin |
| 14 | LOIP Q | LO input channel Q |
| 15 | Q1 | Mixer output, Q channel |
| 16 | Q2 | Mixer output, Q channel |
| 17 | TPQ | Q channel pre–gyrator filter test point |
| 18 | VREF | Reference voltage |
| 19 | AFC OP | AFC output |
| 20 | BEC | Battery economy control |
| 21 | DATA OP | Data output pin |
| 22 | VCC2 | Supply Connection |
| 23 | BATT FLAG | Battery flag output |
| 24 | AFC1 | AFC characteristic defining pin |
| 25 | AFC2 | AFC characteristic defining pin |
| 26 | BRF CNT | Bit rate filter control |
| 27 | BRF1 | Bit rate filter 1, output from detector |
| 28 | VBATT | Battery flag input voltage |
| 29 | TP LIM I | I channel limiter (post gyrator filter) test point, output only |
| 30 | IAGC OP | Audio AGC output current |
| 31 | TC ADJ | Audio AGC time constant adjust |
| 32 | GTH ADJ | Audio AGC gain and threshold adjust. RSSI signal indicator |

*Fig.3 Pin description of SL6619*

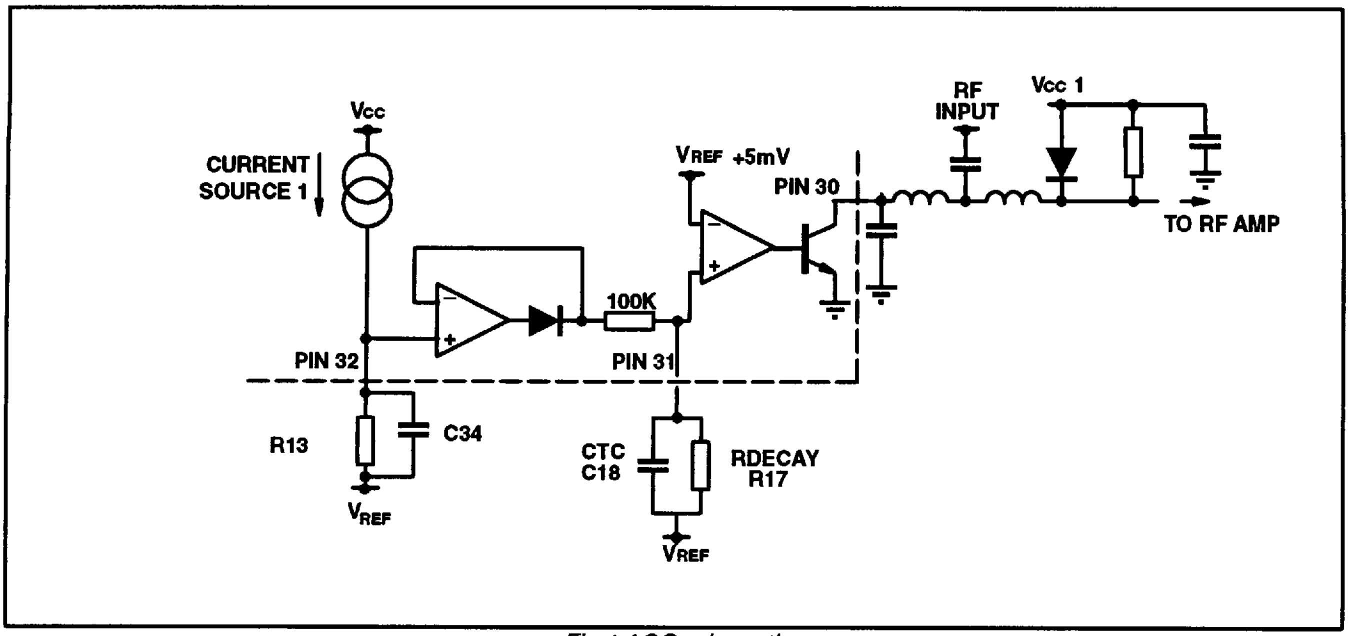



*Fig.4 AGC schematic*

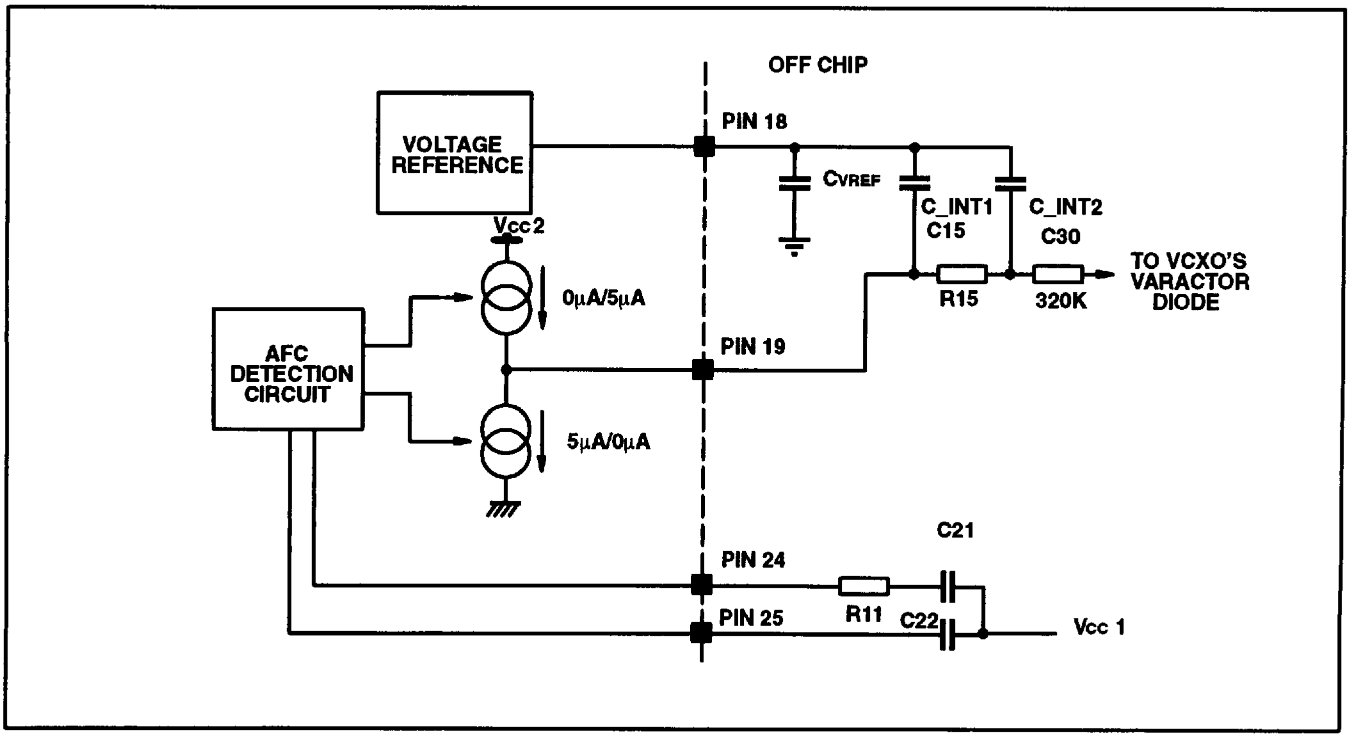



*Fig.5 AFC schematic*

## AFC Characteristic Defining Components

| Peak Deviation | Baud Rate (bps) | C22 | C21 | R11 |
|---|---|---|---|---|
| 3.5kHz | 512, 1200, 2400 | 750p | 2.0n | 15k |
| 4kHz | 512, 1200, 2400 | 560p | 1.5n | 15k |
| 4.5kHz | 512, 1200, 2400 | 510p | 1.3n | 15k |
| 5kHz | 512, 1200, 2400 | 470p | 1.2n | 15k |
| 5.5kHz | 512, 1200, 2400 | 430p | 1.1n | 15k |

(Components: C22, C21, R11)

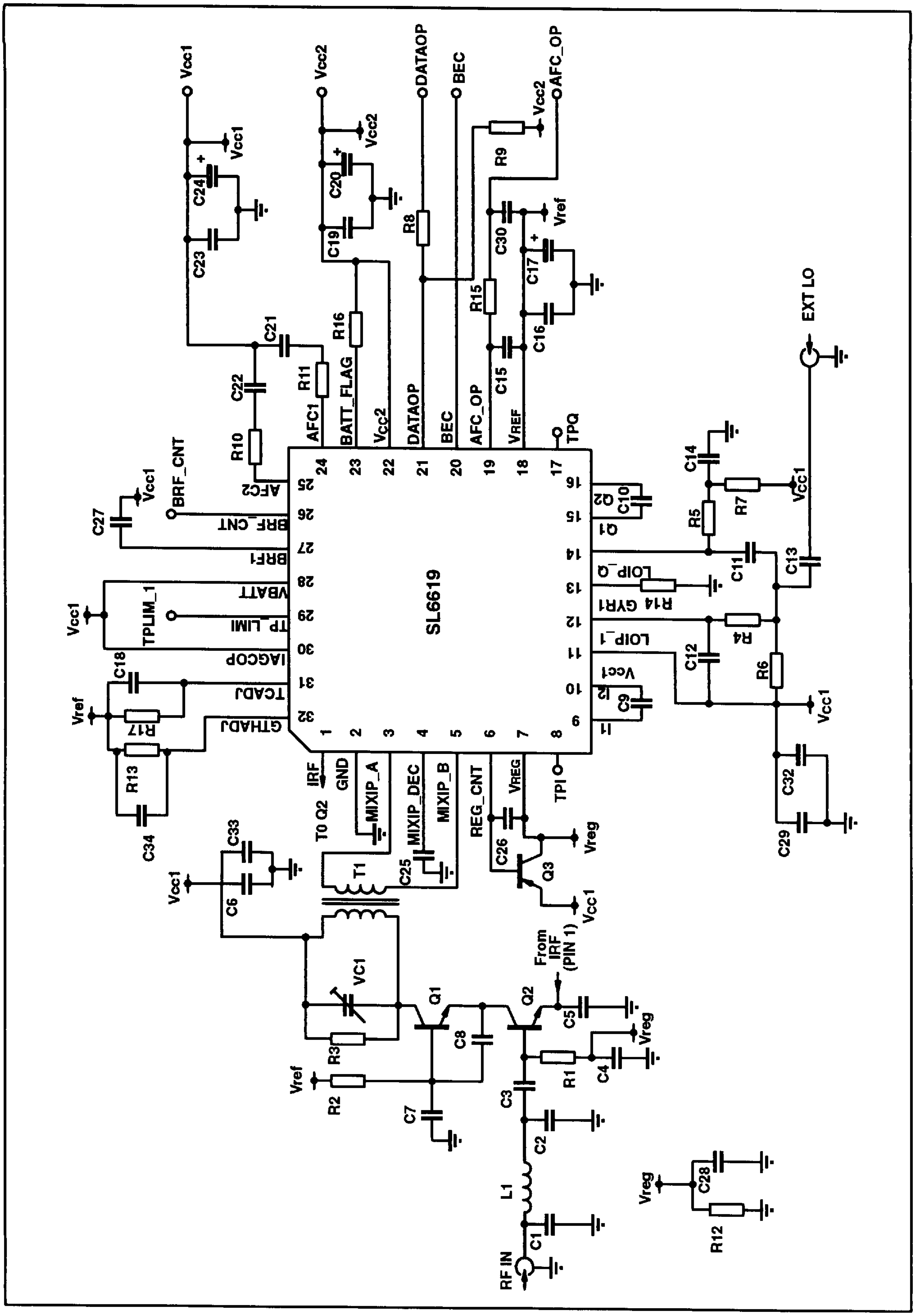



*Fig. 6 Characterisation circuit*

## COMPONENT LIST for 280MHz CHARACTERISATION BOARD

**Resistors**

| | |
|---|---|
| R1 | 4k7 |
| R2 | 4k7 |
| R3 | 2k |
| R4 | 100 |
| R5 | 100 |
| R6 | 100 |
| R7 | 100 |
| R8 | 430k |
| R9 | 220k |
| R10 | short circuit |
| R11 | 15k |
| R12 | 2k |
| R13 | 33k |
| R14 | 180k |
| R15 | 430k |
| R16 | 220k |
| R17 | 220k |

**Capacitors**

| | |
|---|---|
| C1 | 12p |
| C2 | open circuit |
| C3 | 220n |
| C4 | 1n |
| C5 | 1n |
| C6 | 1n |
| C7 | 1n |
| C8 | 3p3 |
| C9 | 4n7 |
| C10 | 4n7 |
| C11 | 4p7 |
| C12 | 5p6 |
| C13 | 1n |
| C14 | 1n |
| C15 | 1n |
| C16 | 1n |
| C17 | 2µ2 |
| C18 | 100n |
| C19 | 1n |
| C20 | 2µ2 |
| C21 | 1n5 |
| C22 | 560pf |
| C23 | 1n |
| C24 | 2µ2 |
| C25 | 100n |
| C26 | 100n |
| C27 | 560p |
| C28 | 1n |
| C29 | 1n |
| C30 | 1n |
| C32 | 100n |
| C33 | 100n |
| C34 | 100n |
| VC1 | 3–10p |

**Inductors**

| | |
|---|---|
| L1 | 56n |

**Active Components**

| | |
|---|---|
| Q1 | Toshiba 2SC5065 |
| Q2 | Toshiba 2SC5065 |
| Q3 | FMMT589 (Zetex ZTX550) |

**Misc**

| | |
|---|---|
| T1 | 30nH 1:1<br>coilcraft M1686–A |

## COMPONENT LIST for 450MHz CHARACTERISATION BOARD

**Resistors**

| | |
|---|---|
| R1 | 4k7 |
| R2 | 4k7 |
| R3 | 1k8 |
| R4 | 100 |
| R5 | 100 |
| R6 | 100 |
| R7 | 100 |
| R8 | 430k |
| R9 | 220k |
| R10 | short circuit |
| R11 | 15k |
| R12 | 2k |
| R13 | 33k |
| R14 | 180k |
| R15 | 430k |
| R16 | 220k |
| R17 | 220k |

**Capacitors**

| | |
|---|---|
| C1 | open circuit |
| C2 | open circuit |
| C3 | 1n |
| C4 | 1n |
| C5 | 1n |
| C6 | 1n |
| C7 | 1n |
| C8 | 3p3 |
| C9 | 4n7 |
| C10 | 4n7 |
| C11 | 3p9 |
| C12 | 3p3 |
| C13 | 1n |
| C14 | 1n |
| C15 | 1n |
| C16 | 1n |
| C17 | 2μ2 |
| C18 | 100n |
| C19 | 1n |
| C20 | 2μ2 |
| C21 | 1n5 |
| C22 | 560p |
| C23 | 1n |
| C24 | 2μ2 |
| C25 | 100n |
| C26 | 100n |
| C27 | 560p |
| C28 | 1n |
| C29 | 1n |
| C30 | 1n |
| C32 | 100n |
| C33 | 100n |
| C34 | 100n |
| VC1 | 3–10p |

**Inductors**

| | |
|---|---|
| L1 | 47n |

**Active Components**

| | |
|---|---|
| Q1 | Philips BFT25A |
| Q2 | Philips BFT25A |
| Q3 | FMMT589 (Zetex ZTX550) |

**Misc**

| | |
|---|---|
| T1 | 16nH 1:1<br>coilcraft Q4123–A |

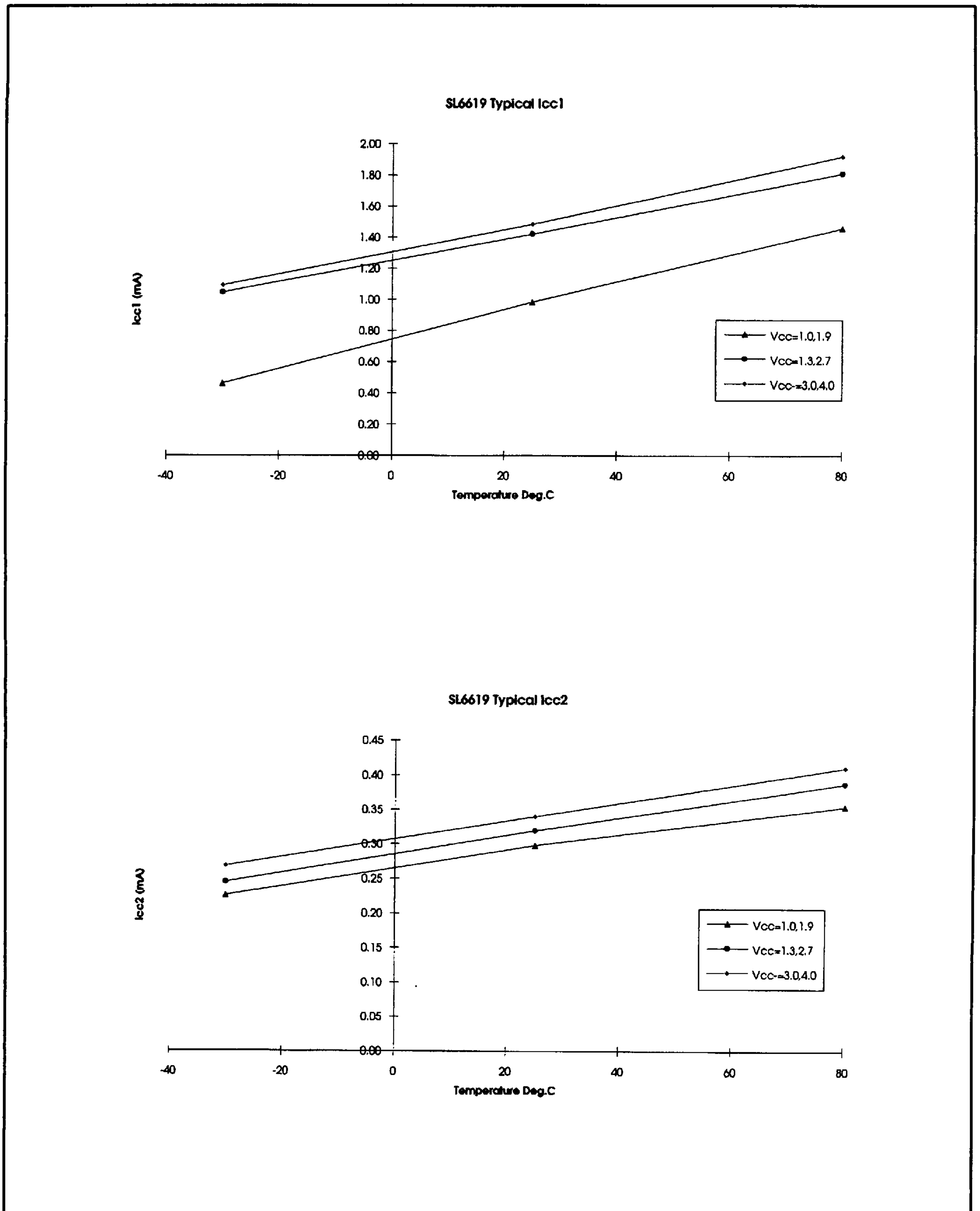
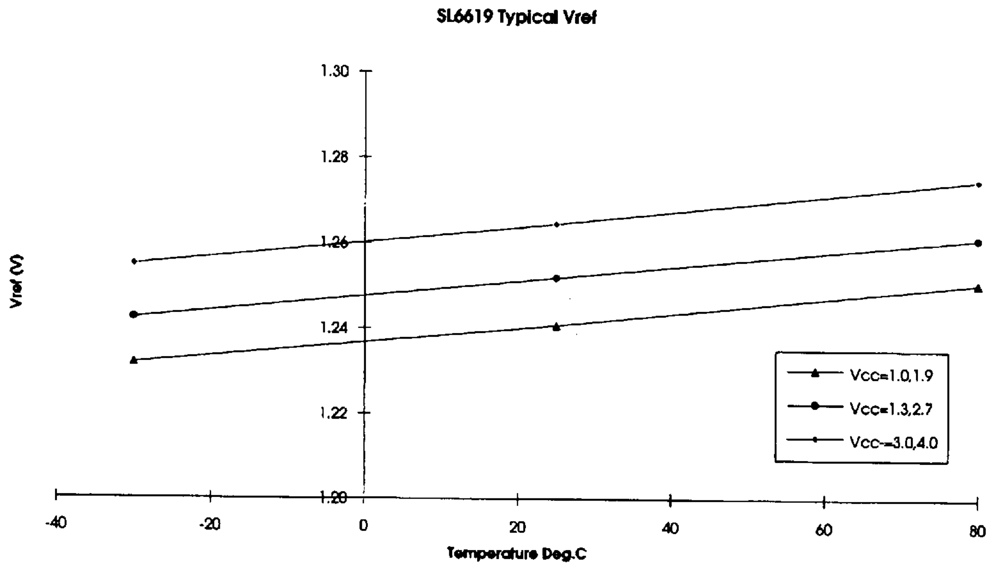



*Fig. 7. Typical DC parameters vs supply and temperature.*

Conditions:– Standard GPS characterisation board.
Icc1 includes IRF LNA current (typ. 500μA) but does not include the regulator load current.
The Audio AGC and RF AGC are both inactive.
Icc2 is measured with BATTFLAG and DATA OP high, Fc = 282MHz.
VBATT connected to Vcc1.



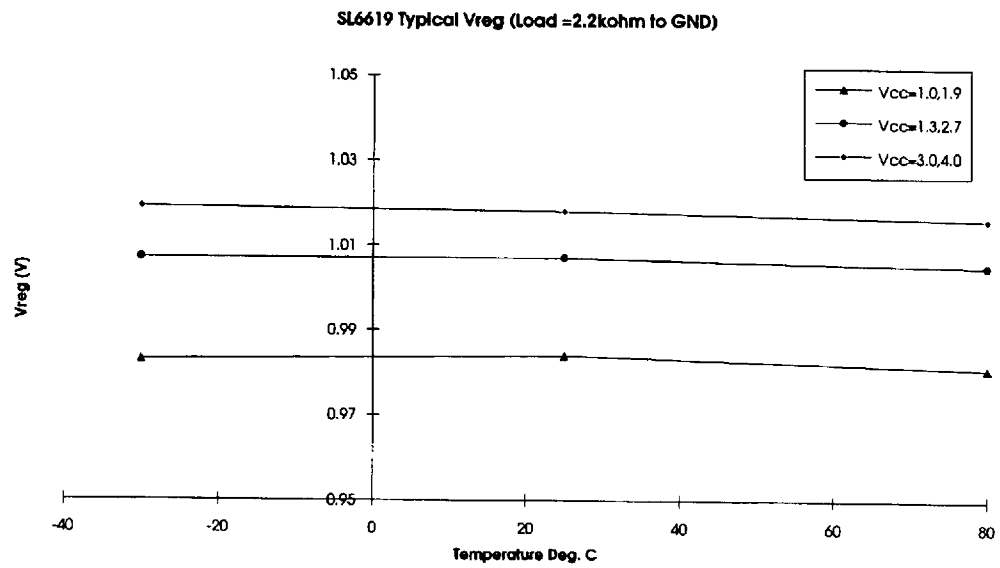
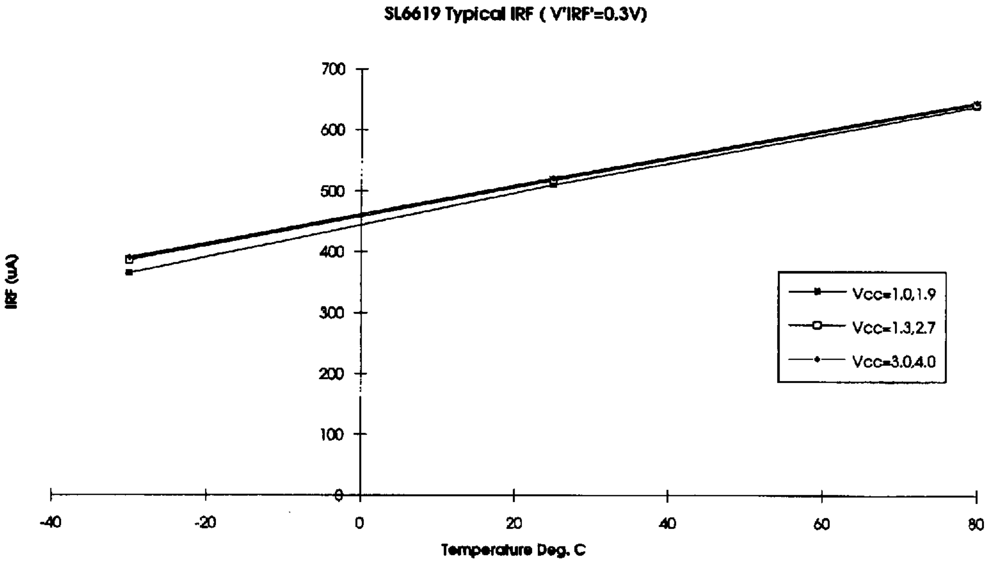




*Fig. 8. Typical DC parameters vs supply and temperature.*

Conditions:– Standard GPS characterisation board.
Icc1 includes IRF LNA current (typ. 500µA) but does not include the regulator load current.
The audio AGC and RF AGC are both inactive.
Icc2 is measured with BATTFLAG and DATA OP high, Fc = 282MHz.
VBATT connected to Vcc1.



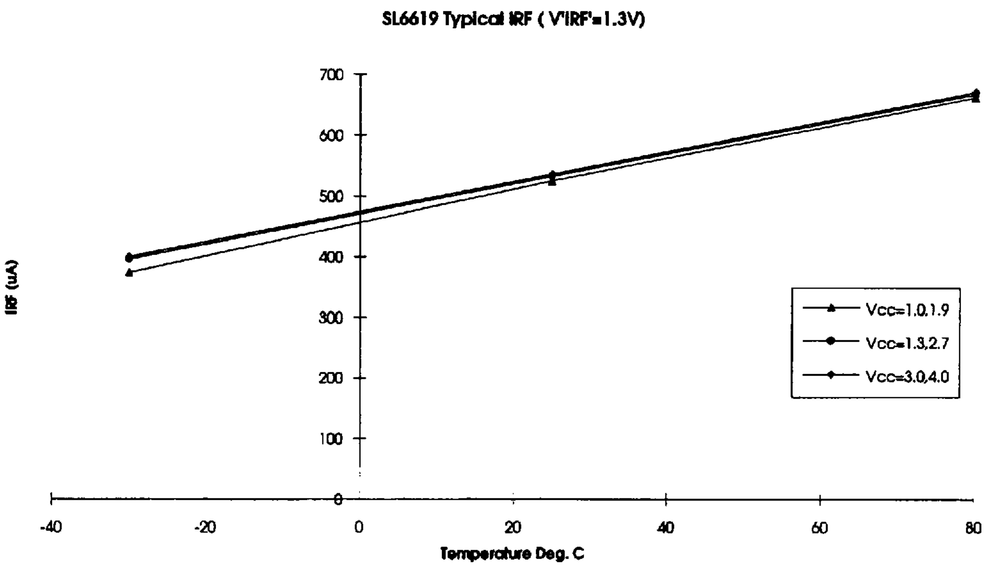




*Fig. 9 Typical DC parameters vs supply and temperature.*

Conditions:– Standard GPS characterisation board.
Icc1 includes IRF LNA current (typ. 500µA) but does not include the regulator load current.
The audio AGC and RF AGC are both inactive.
Icc2 is measured with BATTFLAG and DATA OP high, Fc = 282MHz.
VBATT connected to Vcc1.

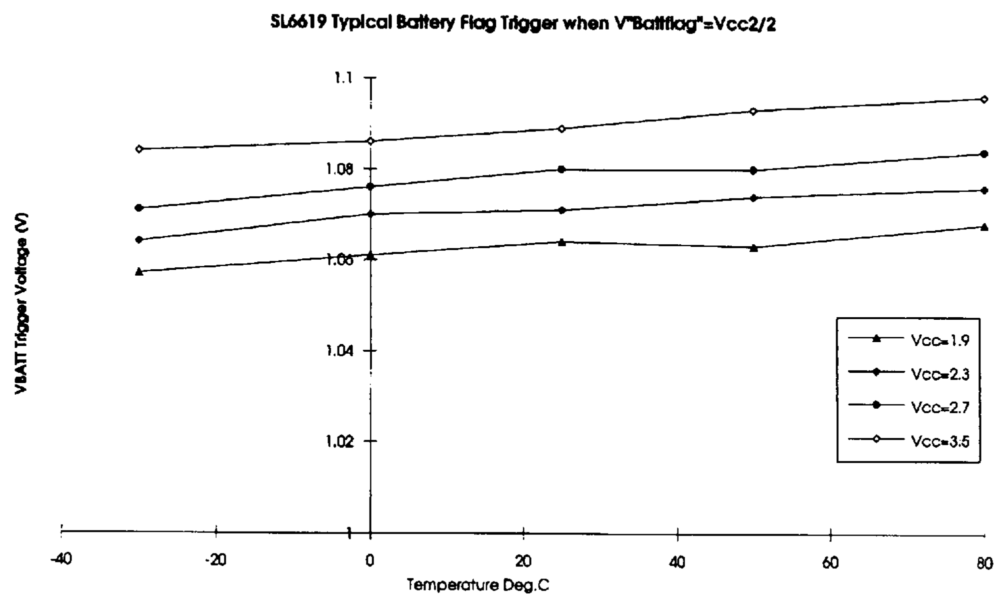



*Fig. 10. Typical DC parameters vs supply and temperature.*

Conditions:– Standard GPS characterisation board.
Icc1 includes IRF LNA current (typ. 500μA) but does not include the regulator load current.
The audio AGC and RF AGC are both inactive.
Icc2 is measured with BATTFLAG and DATA OP high, Fc = 282MHz.
VBATT connected to Vcc1.

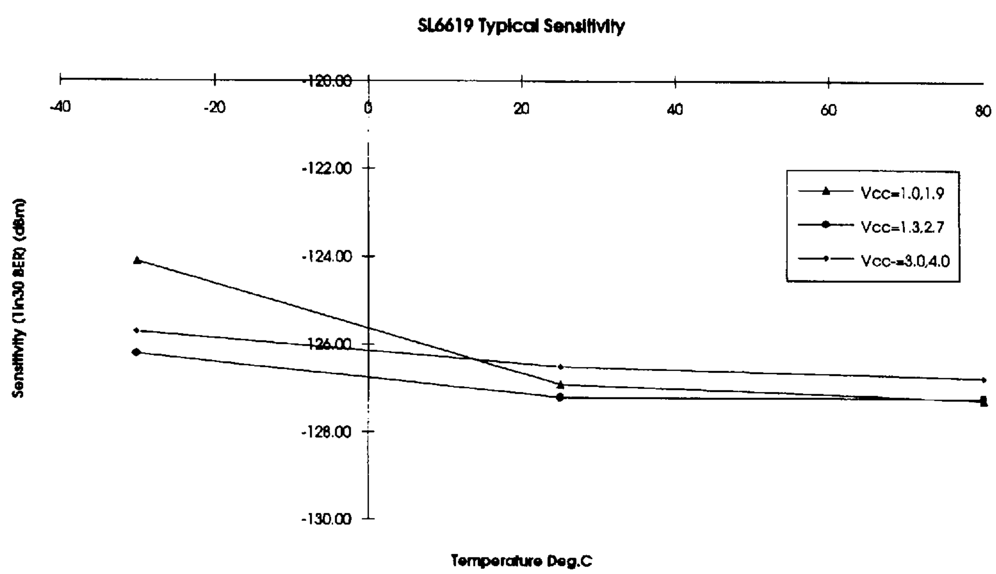



*Fig. 11 Typical AC parameters vs supply and temperature.*

Conditions:– 282MHz GPS characterisation board
i.e. Carrier frequency 282MHz,
1200bps baud rate, 4kHz peak deviation frequency, BER 1in 30.
The LNA gain is set such that an RF signal of –73dBm at the LNA input, offset from the LO by 4kHz, gives a typical IF signal level of 300mV p–p at TPI and TPQ.

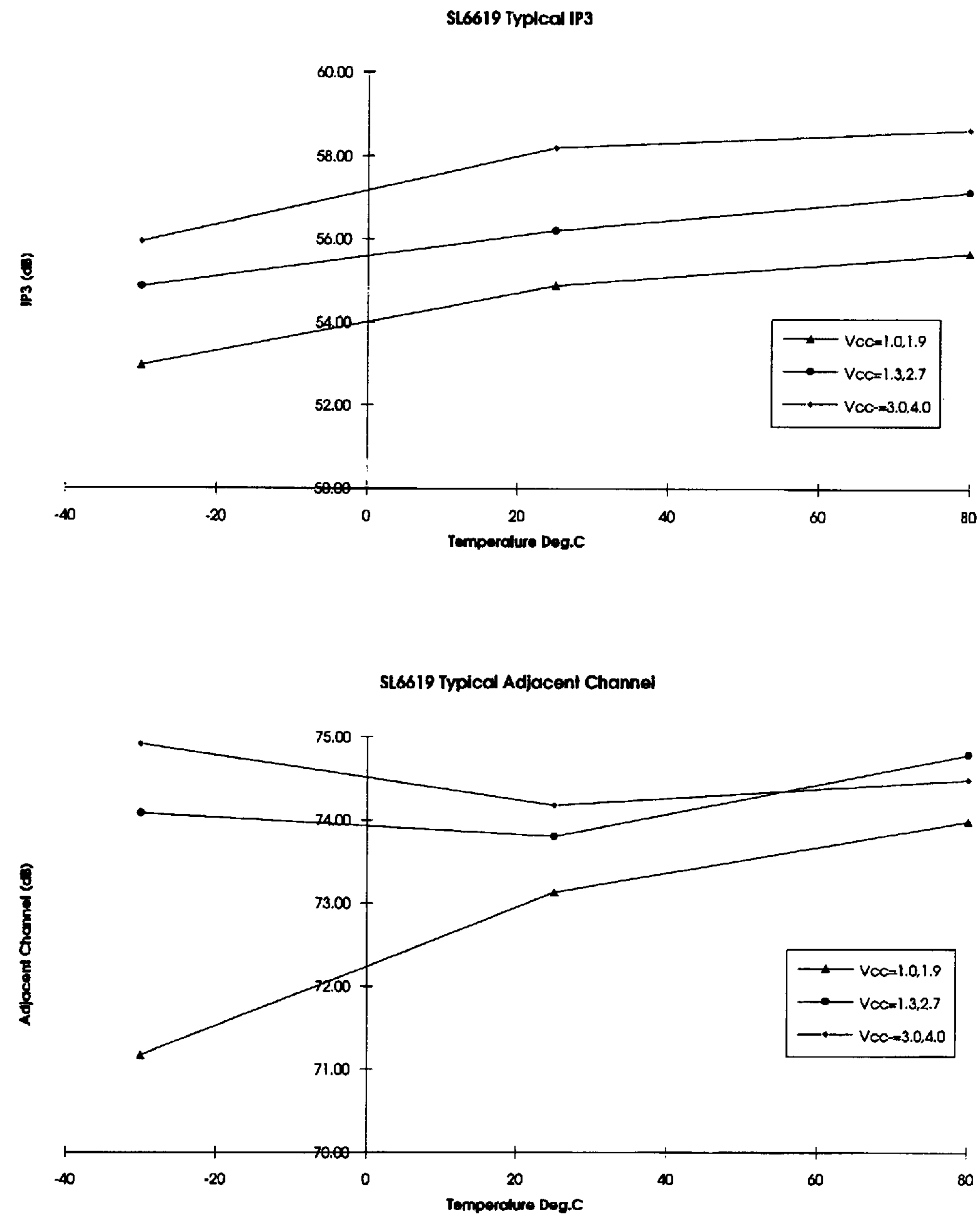
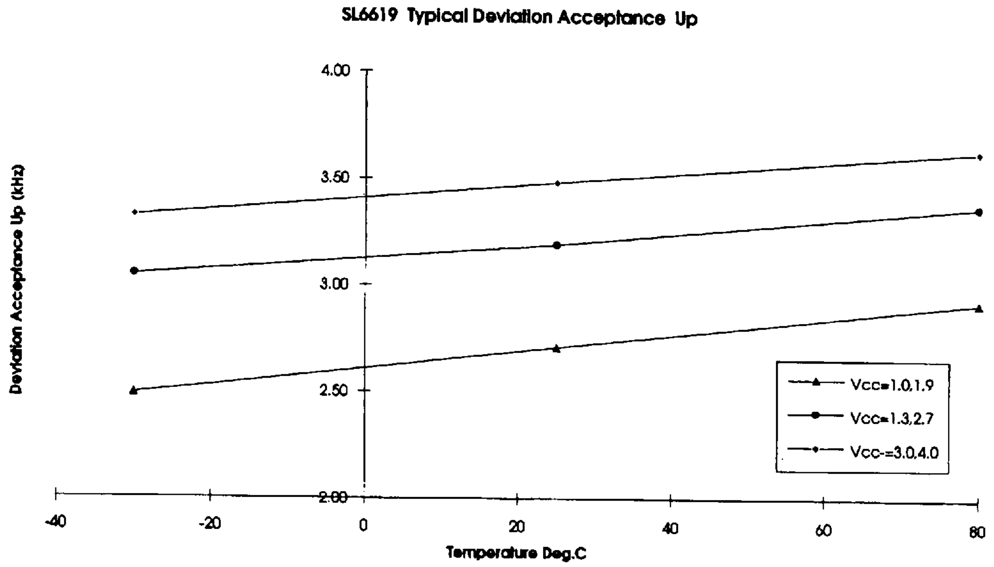



*Fig. 12 Typical AC parameters vs. Supply and temperature*

Conditions:– 282MHz GPS characterisation board
i.e. Carrier frequency 282MHz,
1200bps baud rate, 4kHz peak deviation frequency, BER 1 in 30.
The LNA gain is set such that an RF signal of –73dBm at the LNA input, offset from the LO by 4kHz, gives a typical IF signal level of 300mV p–p at TPI and TPQ.



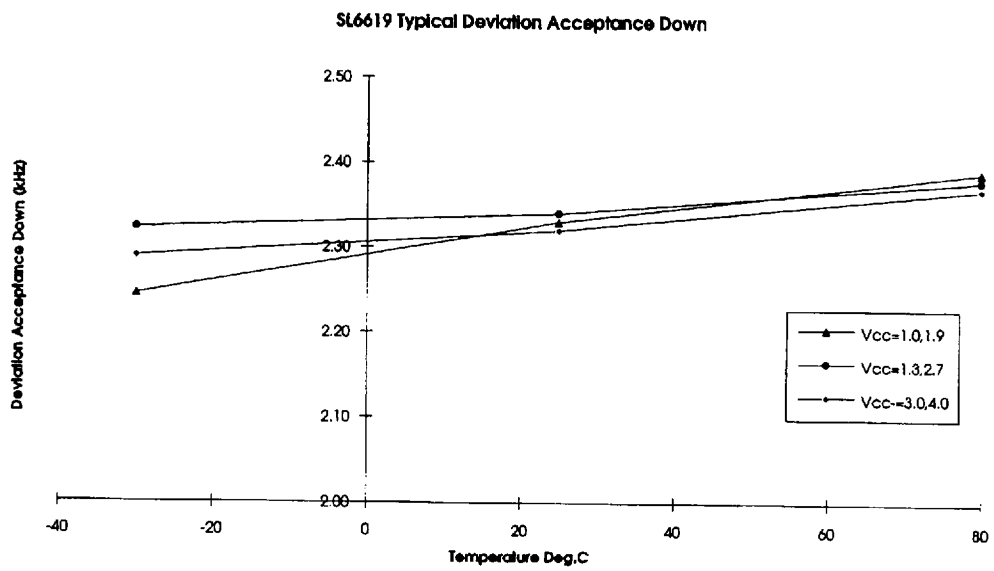




*Fig. 13 Typical AC parameters vs. Supply and temperature*

Conditions:– 282MHz GPS characterisation board
i.e. Carrier frequency 282MHz,
1200bps baud rate, 4kHz peak deviation frequency, BER 1in 30.
The LNA gain is set such that an RF signal of –73dBm at the LNA input, offset from the LO by 4kHz, gives a typical IF signal level of 300mV p–p at TPI and TPQ.

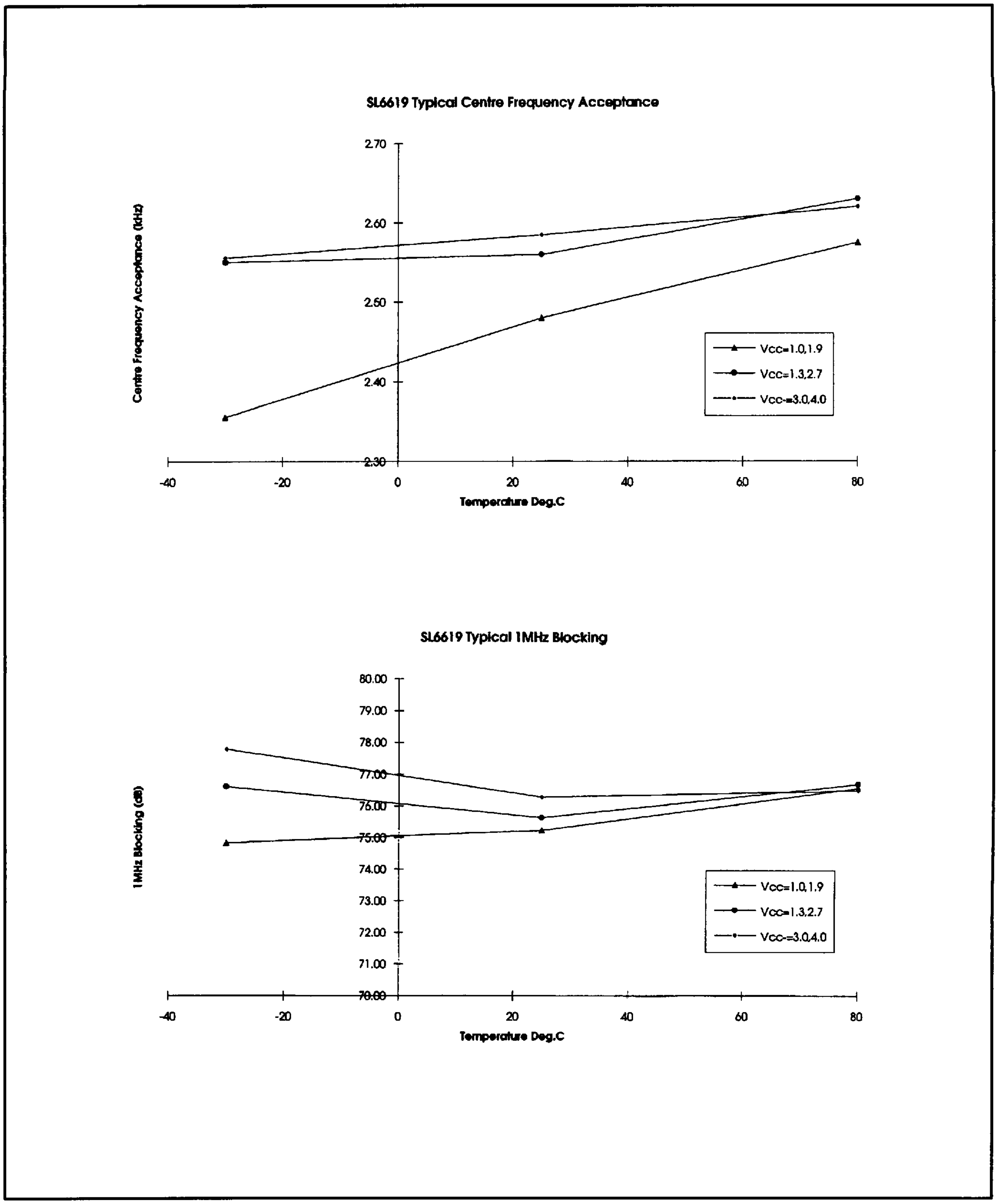
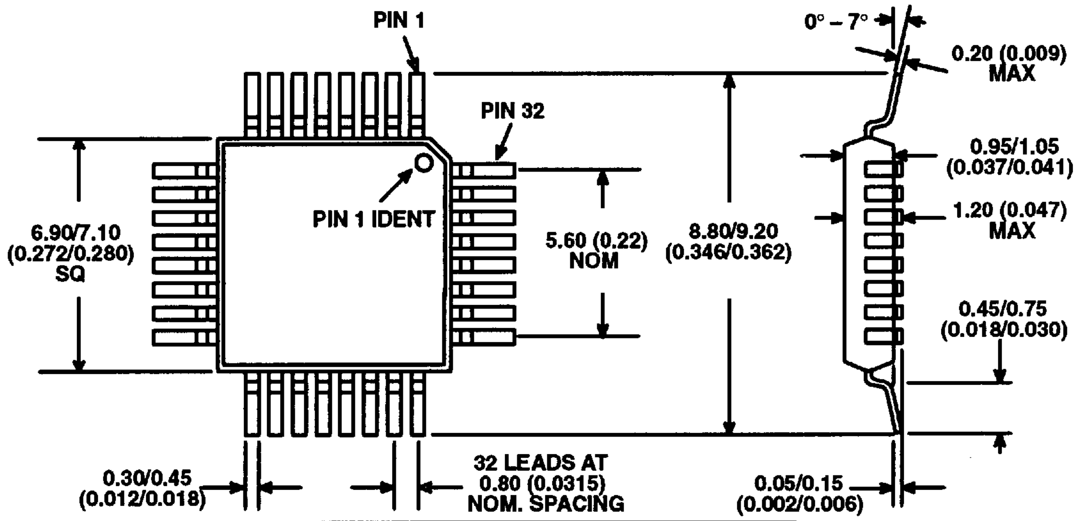



*Fig. 14 Typical AC parameters vs. Supply and temperature*

Conditions:– 282MHz GPS characterisation board
i.e. Carrier frequency 282MHz,
1200bps baud rate, 4kHz peak deviation frequency, BER 1in 30.
The LNA gain is set such that an RF signal of –73dBm at the LNA input, offset from the LO by 4kHz, gives a typical IF signal level of 300mV p–p at TPI and TPQ.

## PACKAGE DETAILS

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




**NOTES**
1. Controlling dimensions are millimetres.
2. This package outline diagram is for guidance only. Please contact your GPS Customer Service Centre for further information

**32–LEAD THIN PLASTIC QUAD FLATPACK – TP32**

## ORDERING INFORMATION

SL6619/KG/TP1N – 1mm TQFP device dry packed supplied in trays.
SL6619/KG/TP1Q – 1mm TQFP devices dry packed supplied in tape and reel.

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