

Features

- Single Chip Broadband Solution
- Wide Dynamic Range RF Input
- Low Phase Noise Balanced Internal Local Oscillator
- High Frequency Range: 1 to 1.3 GHz
- ESD Protection 2kV min., MIL-STD-883B Method 3015 Cat.1 (Normal ESD handling procedures should be observed)

Applications

- Double Conversion Tuners
- Digital Terrestrial Tuners
- Data Transmit Systems
- Data Communications Systems

The SL2035 is a bipolar, broadband wide dynamic range mixer oscillator, optimised for applications as the downconverter in double conversion tuner systems. It also has application in any system where a wide dynamic range broadband frequency converter is required.

The SL2035 is a single chip containing all necessary active circuitry and simply requires an external tuneable resonant network for the local oscillator. The block diagram is shown in Figure 1 and pin connections are shown in Figure 2.

In normal application the signal from the high IF output is connected to the RFIN and RFIN inputs. The RF input preamplifier of the device is designed for low noise figure within the operating region and for high intermodulation distortion intercept so offering good signal to noise plus composite distortion spurious performance.

The preamplifier also provides gain to the mixer section and back isolation from the local oscillator section. The approximate model of the RF input is shown in Figure 3.

Ordering Information

SL2035/IG/MP1S (Tubes)
SL2035/IG/MP1T (Tape and Reel)

The output of the preamplifier is fed to the mixer section which is optimised for low radiation application. In this stage the RF signal is mixed with the local oscillator frequency, which is generated by an on-chip oscillator. The oscillator block uses an external tuneable network and is optimised for low phase noise. A typical application is shown in Figure 5. This block also contains a buffer-amplifier to interface with an external PLL to allow for frequency synthesis of the local oscillator.

The IF output can be loaded either differentially or single-ended. It is recommended that the differential load as in Figure 5 is applied as this gives best noise performance. If the output is loaded single-ended the noise figure will be degraded. The approximate model of the IF output is shown in Figure 4.

In application care should be taken to achieve symmetric balance to the IF outputs to maximise intermodulation performance.

Absolute Maximum Ratings

| | |
|--------------------------------|------------------------|
| Supply voltage, V_{CC} | -0.3V to +7V |
| RF differential input voltage | 2.5V |
| All I/O port DC offset | -0.3 to V_{CC} +0.3V |
| Storage temperature | -55°C to +150°C |
| Junction temperature | +150°C |
| Package thermal resistance | |
| Chip to ambient, θ_{JA} | 20°C/W |
| Chip to case, θ_{JC} | 80°C/W |

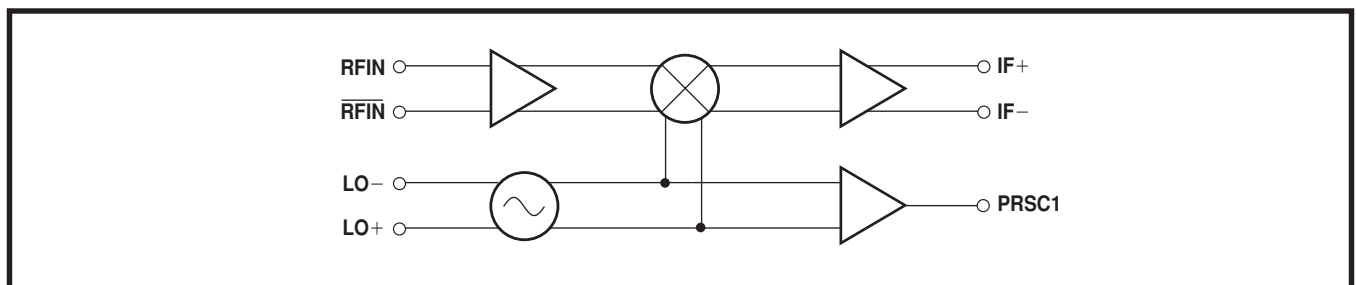


Figure 1 SL2035 block diagram

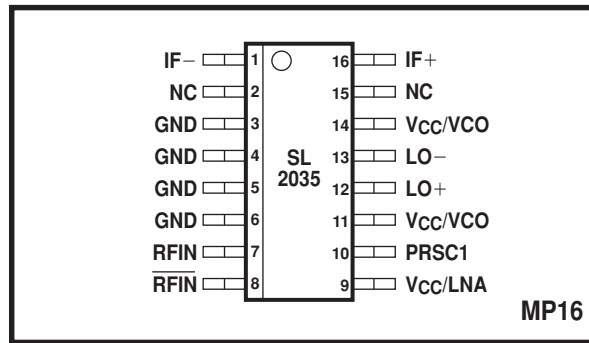


Figure 2 Pin connections - top view

Quick Reference Data

All data applies with circuit component values given in Table 1

| Characteristic | Value | Units |
|---|-----------|------------|
| RF input operating frequency range | 1000-1300 | MHz |
| Input noise Figure, SSB | 12 | dB |
| Conversion gain | 11 | dB |
| IIP3 input referred | 118 | dB μ V |
| P1dB input referred | 106 | dBc |
| LO phase noise at 10 kHz offset, f_{RF} 1 to 1.3GHz, application as in Figure 5 | < -90 | dBc/Hz |

Electrical Characteristics

$T_{amb} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 5\text{V} \pm 5\%$, $V_{EE} = 0\text{V}$. These characteristics are guaranteed by either production test or design. They apply within the specified ambient temperature and supply voltage ranges unless otherwise stated.

| Characteristic | Pin | Value | | | Units | Conditions |
|-------------------------------|---------|-------|------|------|------------|--|
| | | Min. | Typ. | Max. | | |
| Supply current | 9,11,14 | | | 99 | mA | IF output pins 1 and 16 will be nominally connected to V_{CC} through the differential balun load as in Figure 5 |
| Input frequency range | 7,8 | 1000 | | 1300 | MHz | |
| Composite peak input signal | 7,8 | | 97 | | dB μ V | Operating condition only |
| Input impedance | 7,8 | | | | | See Figure 3 |
| Input return loss | 7,8 | -7 | | -21 | dB | See Note 1 |
| Input noise figure | | 9 | 10 | 13 | dB | $T_{AMB} = 27^{\circ}\text{C}$, with input matching network as in Figure 5. |
| Conversion gain | | 8 | 11 | 14 | dB | With differential load Differential voltage gain to 50Ω load on output of impedance transformer as in Figure 5 |
| Gain variation within channel | | | | 0.5 | dB | Channel bandwidth 8MHz within operating frequency range |
| Through gain | | | | -20 | dB | 995-1305MHz |
| IIP3 | | 116 | 118 | 125 | dB μ V | See Note 1 |
| LO operating range | 12,13 | 0.9 | | 1.4 | GHz | Application as Figure 5. See Note 2 |
| LO phase noise, 10kHz offset | | -95 | -90 | -88 | dBc/Hz | Application as Figure 5 |
| LO phase noise floor | | | | TBA | dBc/Hz | Application as Figure 5 |
| IF output frequency range | 1,16 | 30 | | 60 | MHz | Compatible with all standard IF frequencies, determined by application |

NOTES

- Any two tones within RF operating range at 92dB μ V with output load as in Figure 5.
- Use low side LO injection.

cont...

Electrical Characteristics (continued)

| Characteristic | Pin | Value | | | Units | Conditions |
|-------------------------------------|------|-------|------|------|------------|-----------------------|
| | | Min. | Typ. | Max. | | |
| LO and harmonic leakage to RF input | | | | | | |
| Fundamental | 7,8 | | | 72 | dB μ V | To device input |
| 2nd harmonic | 7,8 | | | 92 | dB μ V | To device input |
| LO Prescaler output swing | 10 | 95 | | | dB μ V | Into 50 Ω load |
| LO Prescaler output impedance | 10 | 25 | | 75 | Ω | |
| IF output impedance | 1,16 | | | | Ω | See Figure 4 |

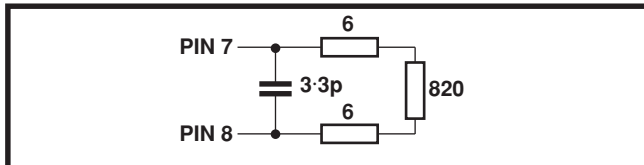


Figure 3 Approximate model of RF input

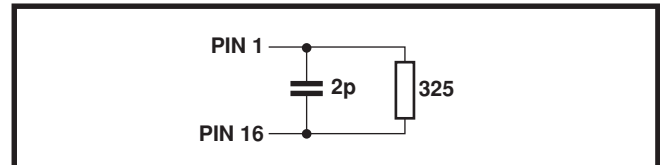


Figure 4 Approximate model of IF output

Application Notes

Figure 5 shows the SL2035 in a typical downconverter application.

The network connected to RF input pin 7 and pin 8 is to improve the matching between the device input and the source. The source would normally be from the 1.1MHz IF output of the upconverter (SL2030) via passive BPF and gain stage all designed for 50 Ω characteristic impedance.

The network connected to the IF output pin 1 and pin 16 is a narrow band tuned balun centred typically on 40MHz.

This matches the device output impedance of nominally 400 Ω (balanced) to 50 Ω (unbalanced).

The network connected to the LO pin 12 and pin 13 is a varactor diode loaded resonant microstrip line resonator. Fine adjustment of the tuning range can be achieved by physically moving C19 (see Figure 5) closer to the LO pins. This extends the bottom end of the tuning range.

It is important to provide good decoupling on the 5V supplies and to use a layout which provides some isolation between the RF, IF and LO ports.

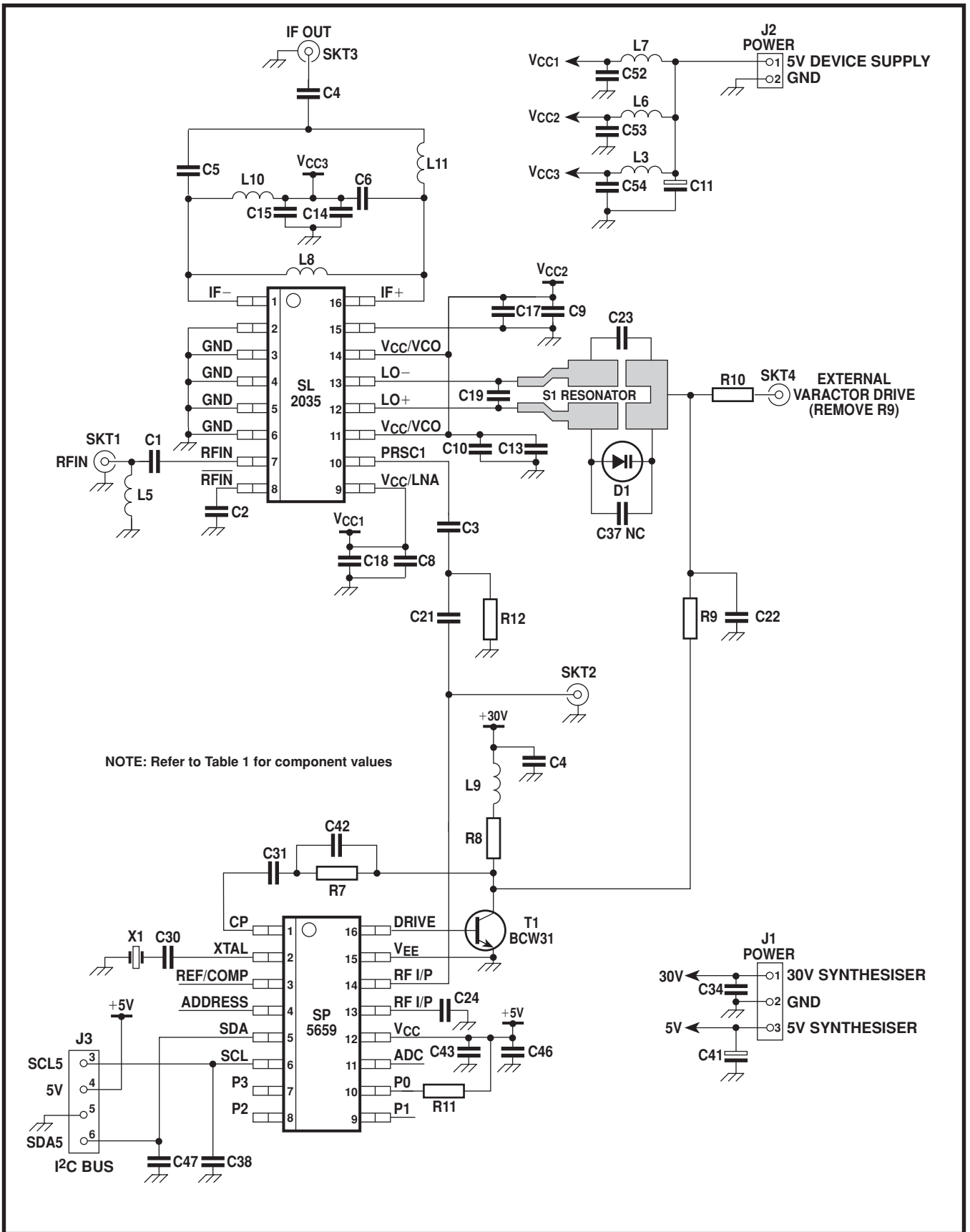


Figure 5 SL2035 upconverter application

| Component | Value/type | Component | Value/type |
|-----------|------------|-----------|----------------------|
| C1 | 1nF | C41 | 4.7 μ F |
| C2 | 1nF | C42 | 3.3nF |
| C3 | 1 nF | C43 | 100nF |
| C4 | 10nF | C46 | 100pF |
| C5 | 56pF | C47 | 100pF |
| C8 | 100pF | D1 | IT397 |
| C9 | 100pF | L3 | 220nH |
| C10 | 100pF | L5 | 1.8nH |
| C11 | 10 μ F | L6 | 220nH |
| C13 | 100nF | L7 | 220nH |
| C14 | 100nF | L8 | 1 μ H |
| C15 | 100pF | L9 | 220nH |
| C17 | 100nF | L10 | 680nH |
| C18 | 100nF | L11 | 680nH |
| C19 | 2pF | R7 | 15k Ω |
| C21 | 1nF | R8 | 22k Ω |
| C22 | 33nF | R9 | 15k Ω |
| C23 | 47pF | R10 | 1k Ω |
| C24 | 1nF | R11 | 4.7k Ω |
| C30 | 18pF | R12 | 50 Ω |
| C31 | 330nF | S1 | Resonator (Figure 6) |
| C34 | 100nF | T1 | BCW31 |
| C36 | 56pF | X1 | 4MHz crystal |
| C37 | NC | | |
| C38 | 100nF | | |

Table 1 Component values for Figure 5

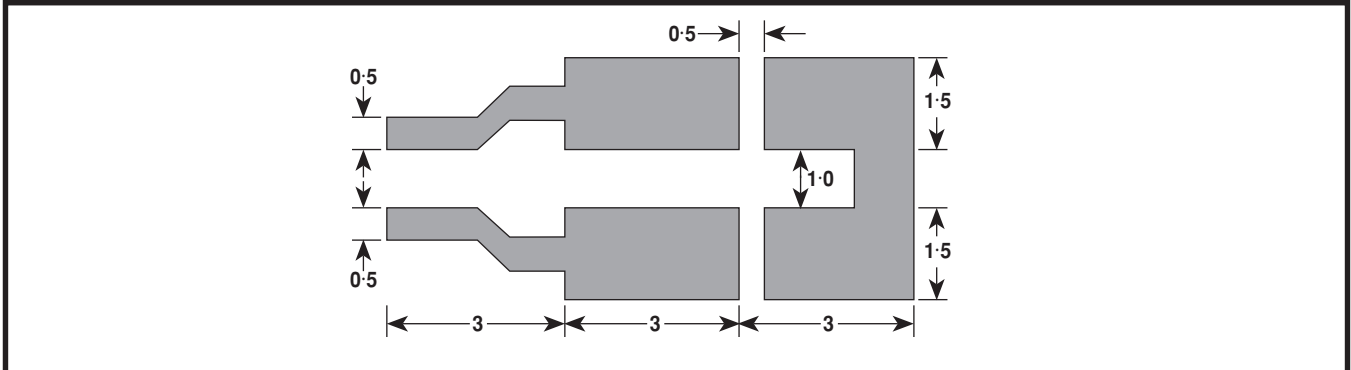


Figure 6 Microstrip resonator (dimensions are in mm)



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