

# SCG2000 Series Synchronous Clock Generators



PLL

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## Application

The Connor-Winfield SCG2000 Series provides high precision phase lock loop frequency translation for the telecommunication applications.

SCG2000 Series is well suited for use in line cards, service termination cards and similar functions to provide reliable reference, phase locked, synchronization and low phase gain for TDM, PDH, SONET and SDH network equipment. The SCG2000 Series provides a jitter filtered, wander following output signal synchronized to a superior Stratum or peer input reference signal.

## Features

- **3.3V High Precision PLL**
- **Tri-State Capability**
- **Active Alarms**
- **Guaranteed Free Run  $\pm 20$ ppm**
- **1 Sec. Acquisition Time**

|           |                  |
|-----------|------------------|
| Bulletin  | <b>SG035</b>     |
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| Revision  | <b>00</b>        |
| Date      | <b>23 AUG 04</b> |
| Issued By | <b>MBATTS</b>    |

# General Description

The SCG2000 Series provides high precision phase lock loop frequency translation for the telecommunication applications. The SCG2000 products generate a CMOS output from an intrinsically low jitter, voltage controlled crystal oscillator. Most models provide a jitter attenuated, internal reference that is connected to a Reference Output pin.

SCG2000 Series is well suited for use in line cards, service termination cards and similar functions to provide reliable reference, phase locked, synchronization for TDM, PDH, SONET and SDH network equipment . The SCG2000 Series provides a low phase gain (<0.2dB), jitter filtered, wander following output signal synchronized to a superior Stratum or peer input reference signal.

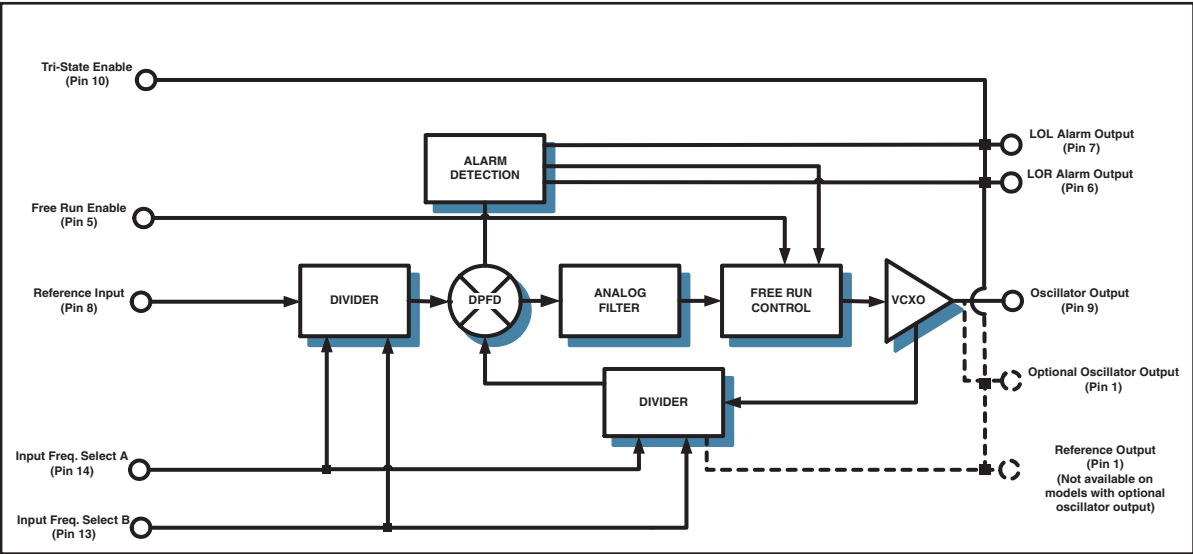
The SCG2000 Series include the following features: Free Run, Tri-state and alarm outputs for Loss-of-Reference, (LOR), Loss-of-Lock, (LOL). During the LOR alarm, the SCG2000 will

also enter a Free Run state which will guarantee a 20 ppm accurate output. Additionally the Free Run mode may be entered manually by asserting a high signal to the Free Run Enable pin. The outputs, except the oscillator output, may be put into the tri-state high impedance condition for external testing purposes by asserting a high signal to the Tri-State Enable pin.

The SCG2000 Series are 3.3 Volt components that typically draw less than 100 mA. All models have an acquisition time of approximately 1.0 second and can be used in applications that require temperature rating of 0° - 70° C. All models have a 33Ω resistor in series with the oscillator output. The SCG2000 maximum package dimensions are .78" x .83" x .35" on a six layer FR4 board with surface mount pins. Parts are assembled using high temperature solder to withstand surface mount reflow process.

## Functional Block Diagram

Figure 1



## Model Comparison Table

Table 1

| Model   | Input Ref Freq   | Max Duty Cycle | Reference Output (Pin #1)   | Oscillator Output (Pin #9)  | Notes                   |
|---------|------------------|----------------|-----------------------------|-----------------------------|-------------------------|
| SCG2000 | 8-64 kHz         | 40/60          | = Input Ref Freq.           | 1.544 MHz to 125.0 MHz      | Basic Model             |
| SCG2010 | <b>19.44 MHz</b> | 40/60          | <b>8 kHz</b>                | <b>19.44 MHz</b>            |                         |
| SCG2020 | <b>19.44 MHz</b> | 40/60          | <b>19.44 MHz</b>            | <b>77.76 MHz</b>            |                         |
| SCG2030 | 8-64 kHz         | <b>45/55</b>   | = Input Ref Freq.           | 1.544 MHz to 125.0 MHz      | Tight Duty Cycle        |
| SCG2050 | 8-64 kHz         | 40/60          | <b>19.44 MHz</b>            | <b>77.76 MHz</b>            |                         |
| SCG2070 | <b>19.44 MHz</b> | 40/60          | <b>51.84 MHz, 77.76 MHz</b> | <b>51.84 MHz, 77.76 MHz</b> | Ref Output = Osc Output |

\*Features which differentiate a model from the base model (SCG2000) are highlighted in boldface color and in the notes column.

## Pin Description

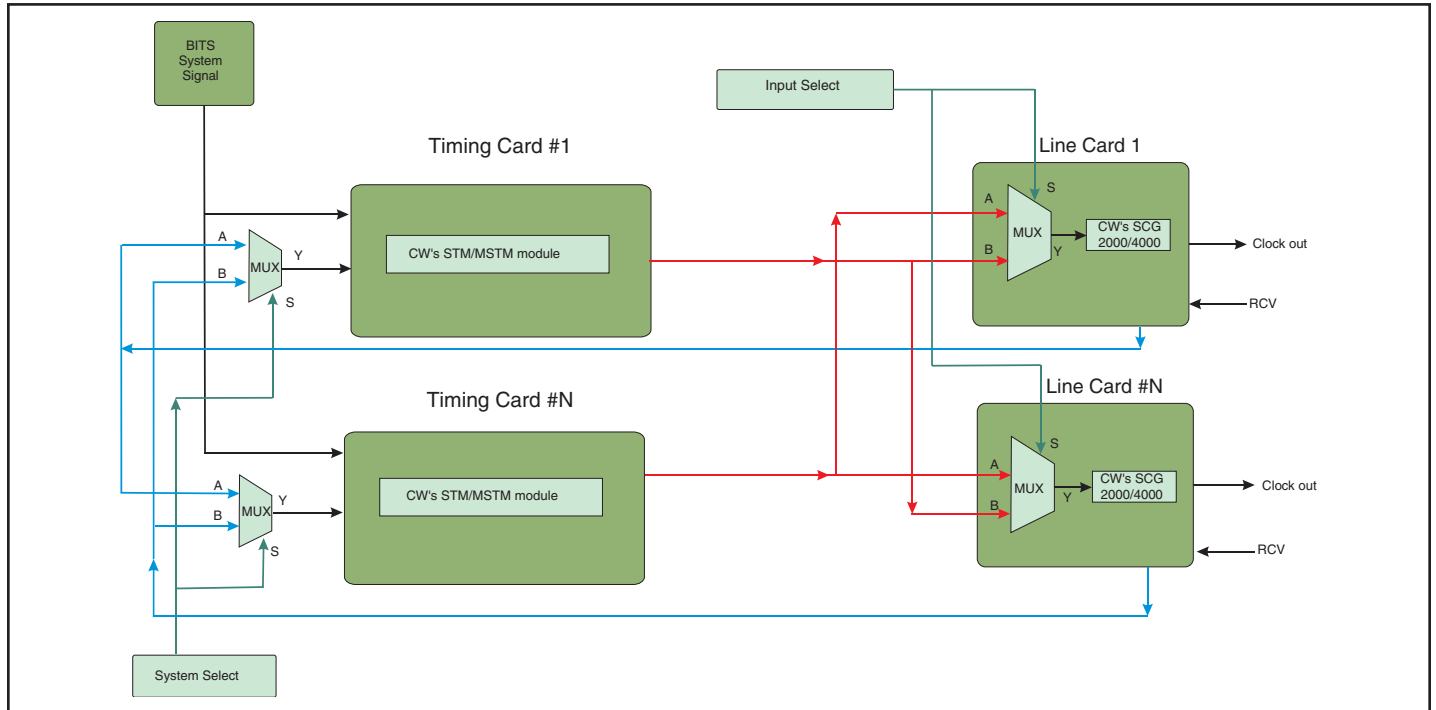
Table 2

All SCG2000 Models

| Pin # | Connection              | Description                                                                                               |
|-------|-------------------------|-----------------------------------------------------------------------------------------------------------|
| 1     | Reference Output        | Output frequency is dependent on SCG model                                                                |
| 2     | TCK                     | JTAG pin that is used only by Connor-Winfield for programming. Do not connect                             |
| 3     | TMS                     | JTAG pin that is used only by Connor-Winfield for programming. Do not connect                             |
| 4     | Ground                  | Ground                                                                                                    |
| 5     | Free Run Enable/TDI     | Free Run enable pin. 1 = Free Run at nominal frequency $\pm 20$ ppm. Input is pulled to GND               |
| 6     | Loss of Reference (LOR) | Alarm indicator. 1 = The reference has been lost.                                                         |
| 7     | Loss of Lock (LOL)      | Alarm indicator. 1 = Phase lock has been lost                                                             |
| 8     | Reference Input         | Input reference frequency                                                                                 |
| 9     | Oscillator Output       | Output frequency is dependent on SCG model                                                                |
| 10    | Tri-State enable        | Tri State control for all outputs except Oscillator Output. 1 = Hi-Z, 0 = normal. Input is pulled to GND. |
| 11    | Vcc                     | 3.3V Supply Voltage.                                                                                      |
| 12    | TDO                     | JTAG pin that is used only by Connor-Winfield for programming. Do not connect                             |
| 13    | Input Freq. Select B    | Control pin B used to select input frequency. Input is pulled to GND.                                     |
| 14    | Input Freq. Select A    | Control pin A used to select input frequency. Input is pulled to GND.                                     |

## Typical Application

Figure 2



## Absolute Maximum Rating

Table 3

All SCG2000 Models

| Symbol          | Parameter            | Minimum | Nominal | Maximum | Units  | Notes |
|-----------------|----------------------|---------|---------|---------|--------|-------|
| V <sub>cc</sub> | Power Supply Voltage | -0.5    |         | 4       | Volts  |       |
| V <sub>I</sub>  | Input Voltage        | -0.5    |         | 5.5     | Volts  |       |
| T <sub>s</sub>  | Storage Temperature  | -65     |         | 150     | deg. C |       |

## Specifications

Table 4

All SCG2000 Models

| Parameter                                                         | Specifications                                                                                           | Notes    |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|----------|
| Voltage                                                           | 3.3V $\pm$ 5%                                                                                            | 1.0      |
| Current                                                           | 100 mA Typical                                                                                           |          |
| Temperature Range                                                 | 0 to 70°C                                                                                                |          |
| Input Jitter Tolerance<br>(Input Jitter Frequencies $\geq$ 10 Hz) | $\geq$ 31.25us Typical (SCG2000, SCG2030, SCG2050)<br>>1 us Typical (SCG2010, SCG2015, SCG2020, SCG2070) |          |
| Jitter Bandwidth                                                  | <15 Hz                                                                                                   |          |
| Acquisition Time                                                  | Approx 1.0 second                                                                                        | 2.0      |
| Capture/Pull-in Range                                             | $\pm$ 25 ppm Minimum                                                                                     |          |
| Output Duty Cycle                                                 | 40/60 % Min/Max @ 50% Level                                                                              |          |
| Output Rise and Fall Time                                         | 3 ns @ 20% to 80% output level                                                                           |          |
| Output Load                                                       | 30 pF                                                                                                    |          |
| Alarms                                                            | LOR, LOL Status on separate outputs                                                                      |          |
| Free Run Accuracy                                                 | $\pm$ 20 ppm                                                                                             |          |
| Package                                                           | Fr4 SM 0.78" x .83" x 0.35" (maximum)                                                                    |          |
| TDEV                                                              | 60 ps Typical                                                                                            |          |
| MTIE                                                              | 750 ps Typical                                                                                           |          |
| Reference Output/Oscillator Output Offset                         | $\leq$ 8 ns                                                                                              |          |
| Static Offset                                                     | $\pm$ 26 ns Maximum                                                                                      | 3.0, 5.0 |
| Dynamic Offset                                                    | $\pm$ 20 ns Maximum                                                                                      | 4.0, 5.0 |

## Input And Output Characteristics

Table 5

All SCG2000 Models

| Symbol          | Parameter                                        | Minimum | Nominal | Maximum | Units | Notes                |
|-----------------|--------------------------------------------------|---------|---------|---------|-------|----------------------|
| V <sub>IH</sub> | High Level Input Voltage                         | 2       |         | 5.5     | V     |                      |
| V <sub>IL</sub> | Low Level Input Voltage                          | 0       |         | 0.8     | V     |                      |
| T <sub>IO</sub> | I/O to Output Valid                              |         |         | 10      | nS    |                      |
| C <sub>O</sub>  | Output Capacitance                               |         |         | 10      | pF    |                      |
| V <sub>HO</sub> | High Level Output Voltage I <sub>oH</sub> = -4mA | 2.4     |         |         |       | V <sub>cc</sub> Min. |
| V <sub>IO</sub> | Low Level Output Voltage I <sub>oL</sub> = 8mA   |         |         | 0.4     |       | V <sub>cc</sub> Max. |
| T <sub>IR</sub> | Input Reference Signal Pulse Width               | 30      |         |         | nS    |                      |

NOTES: 1.0: Requires external regulation  
2.0: From a 20 ppm offset in reference frequency  
3.0: Offset between Reference Input and Reference Output @ room temp.  
4.0: Offset change between Reference Input and Reference Output over temperature range from room temperature.  
5.0: The SCG2015 will maintain an offset/skew, between the reference input and the oscillator output, of X  $\pm$  1ns. X is TBD.

## Output Jitter Specifications

Table 6

All SCG2000 Models

| Jitter BW 10 Hz - 20 MHz |          |            | SONET Jitter BW 12 KHz - 20 MHz |            |
|--------------------------|----------|------------|---------------------------------|------------|
| Frequency (MHz)          | pS (RMS) | m UI       | pS (RMS)                        | m UI       |
| 1.544                    | 30 Typ.  | 0.046 Typ. | 4 Typ.                          | 0.006      |
| 2.048                    | 30 Typ.  | 0.061 Typ. | 4 Typ.                          | 0.008      |
| 8.448                    | 10 Typ.  | 0.084 Typ. | 1 Max., 0.5 Typ.                | 0.008 Max. |
| 16.384                   | 10 Typ.  | 0.164 Typ. | 1 Max., 0.5 Typ.                | 0.016 Max. |
| 19.44                    | 10 Typ.  | 0.194 Typ. | 1 Max., 0.5 Typ.                | 0.019 Max. |
| 20.48                    | 10 Typ.  | 0.205 Typ. | 1 Max., 0.5 Typ.                | 0.020 Max. |
| 37.056                   | 10 Typ.  | 0.371 Typ. | 1 Max., 0.5 Typ.                | 0.037 Max. |
| 44.736                   | 10 Typ.  | 0.457 Typ. | 1 Max., 0.5 Typ.                | 0.045 Max. |
| 49.152                   | 10 Typ.  | 0.492 Typ. | 1 Max., 0.5 Typ.                | 0.049 Max. |
| 51.84                    | 10 Typ.  | 0.518 Typ. | 1 Max., 0.5 Typ.                | 0.052 Max. |
| 77.76                    | 10 Typ.  | 0.778 Typ. | 1 Max., 0.5 Typ.                | 0.078 Max. |
| 125.0                    | 10 Typ.  | 1.25 Typ.  | 1 Max., 0.5 Typ.                | 0.125 Max. |

\* Note: These jitter specs only apply to version 2 models

## Output Programming

Table 7

All SCG2000 Models

| Tristate | Free Run | Output                                 |
|----------|----------|----------------------------------------|
| 0        | 0        | Locked to reference selected (default) |
| 1        | X        | Hi-Z Tristate condition                |
| 0        | 1        | Free run at nominal frequency          |

## Alarm Status

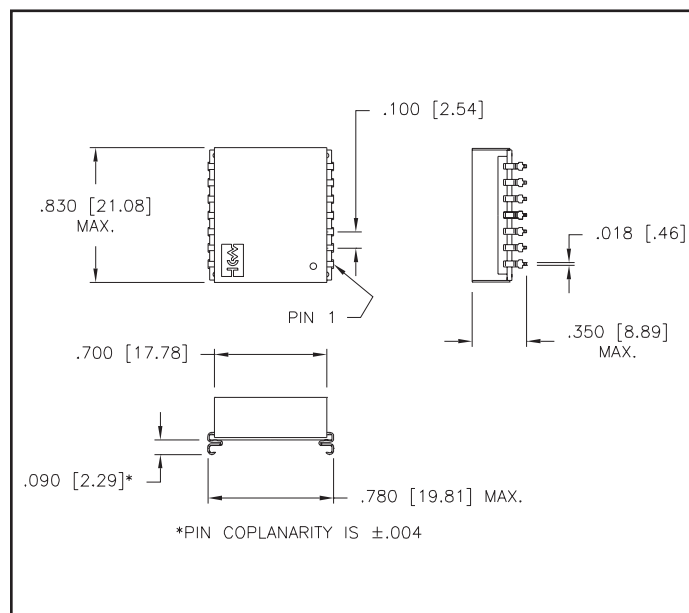
Table 8

All SCG2000 Models

| LOL Output | LOR Output | Alarm Output      |
|------------|------------|-------------------|
| 0          | 0          | No alarm          |
| 1          | 0          | Loss-of-Lock      |
| X          | 1          | Loss-of-Reference |

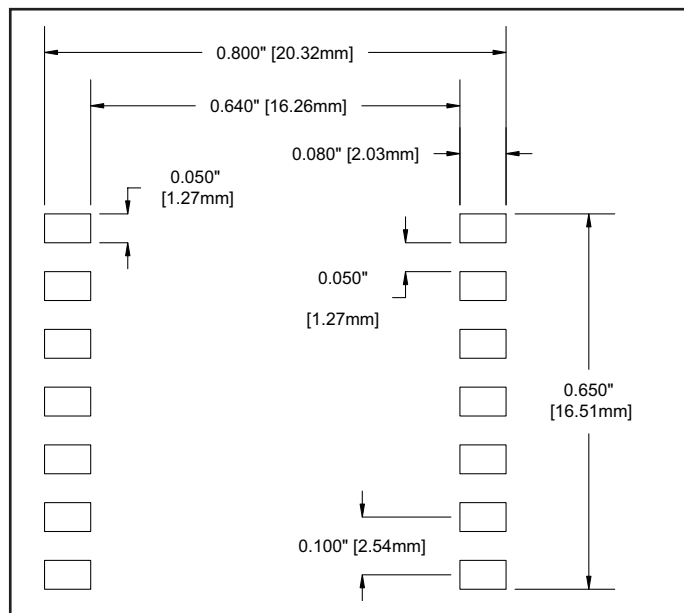
## Maximum Package Dimensions

Figure 3



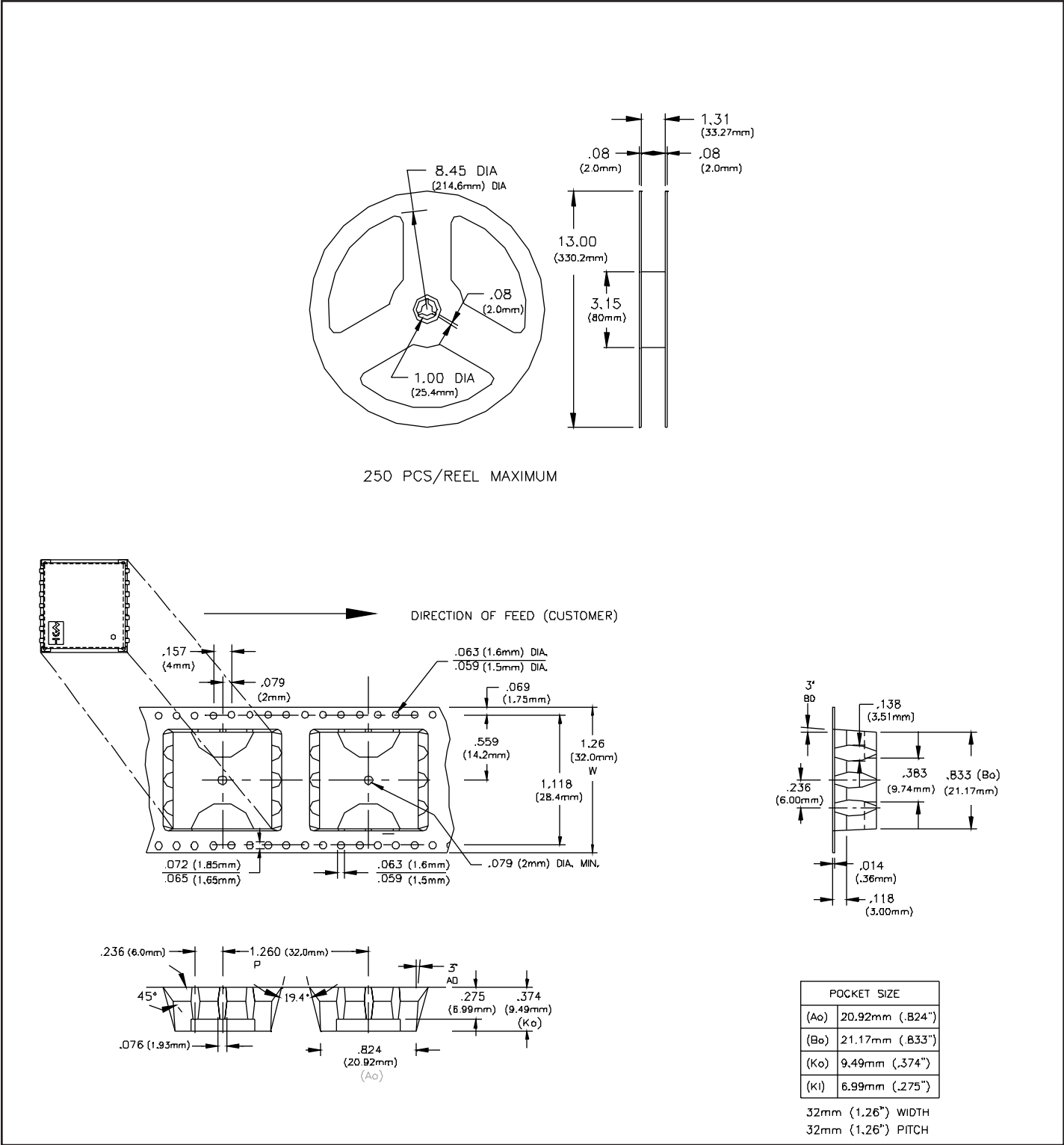
## Recommended Footprint Dimensions

Figure 4



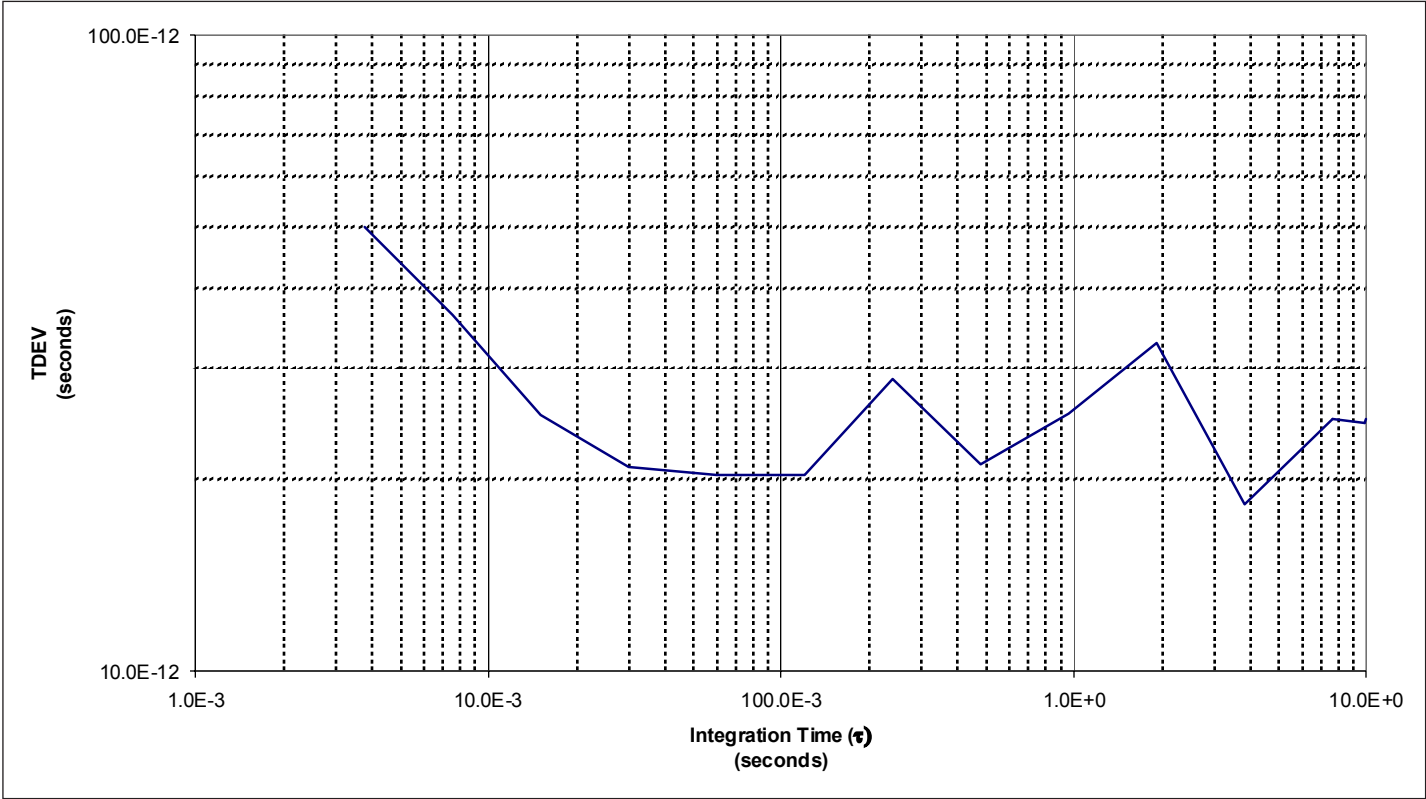
Tape and Reel Dimensions

Figure 5



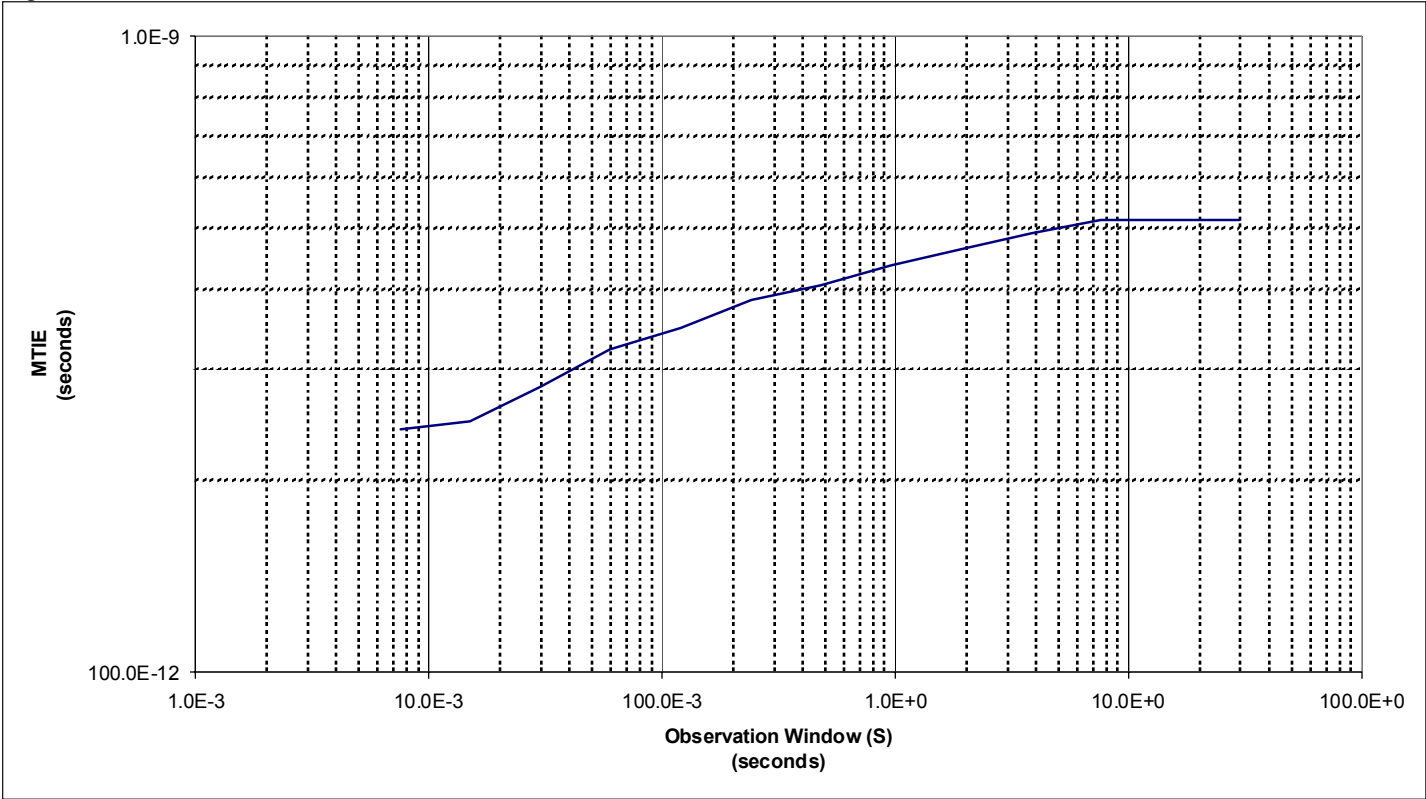
SCG2000 Typical TDEV

Figure 6



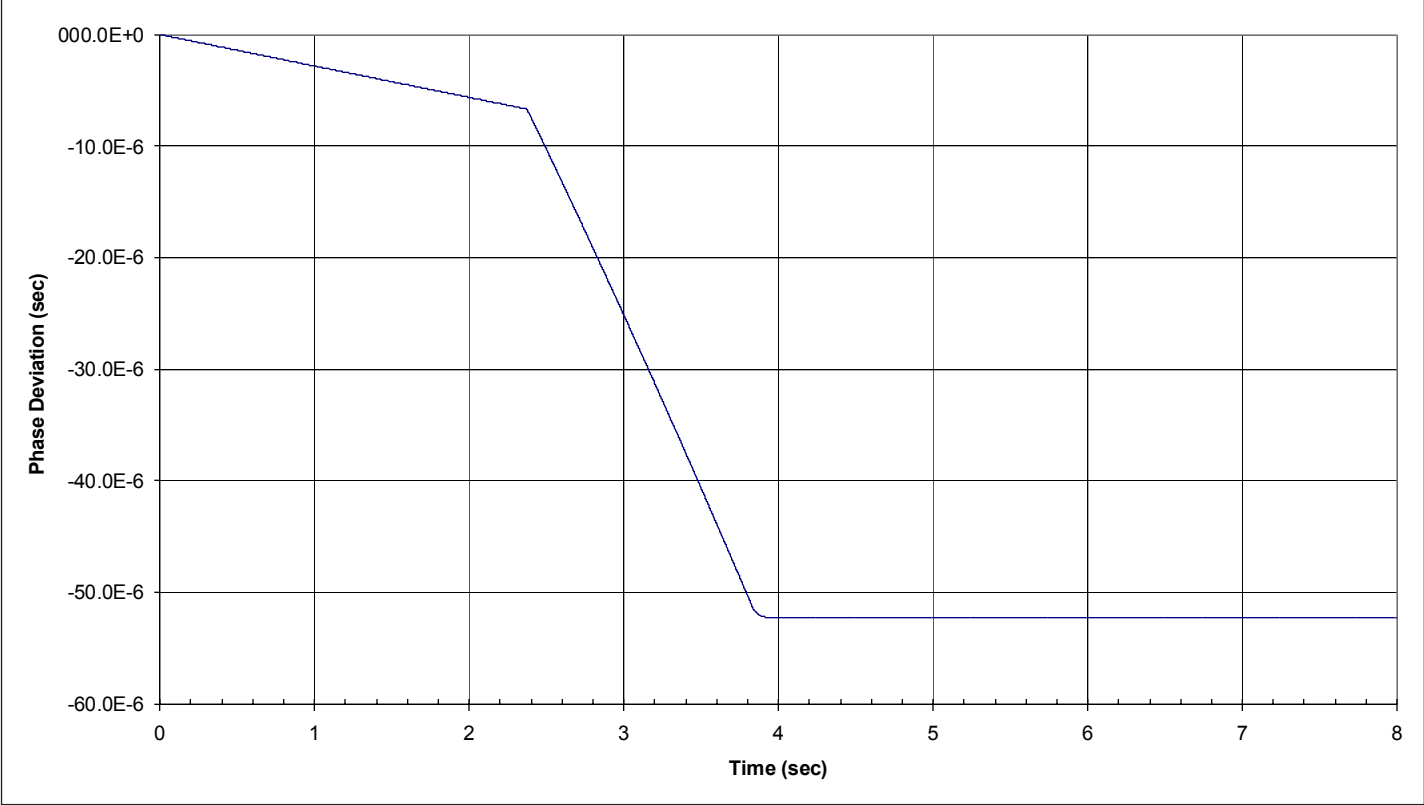
SCG2000 Typical MTIE

Figure 7



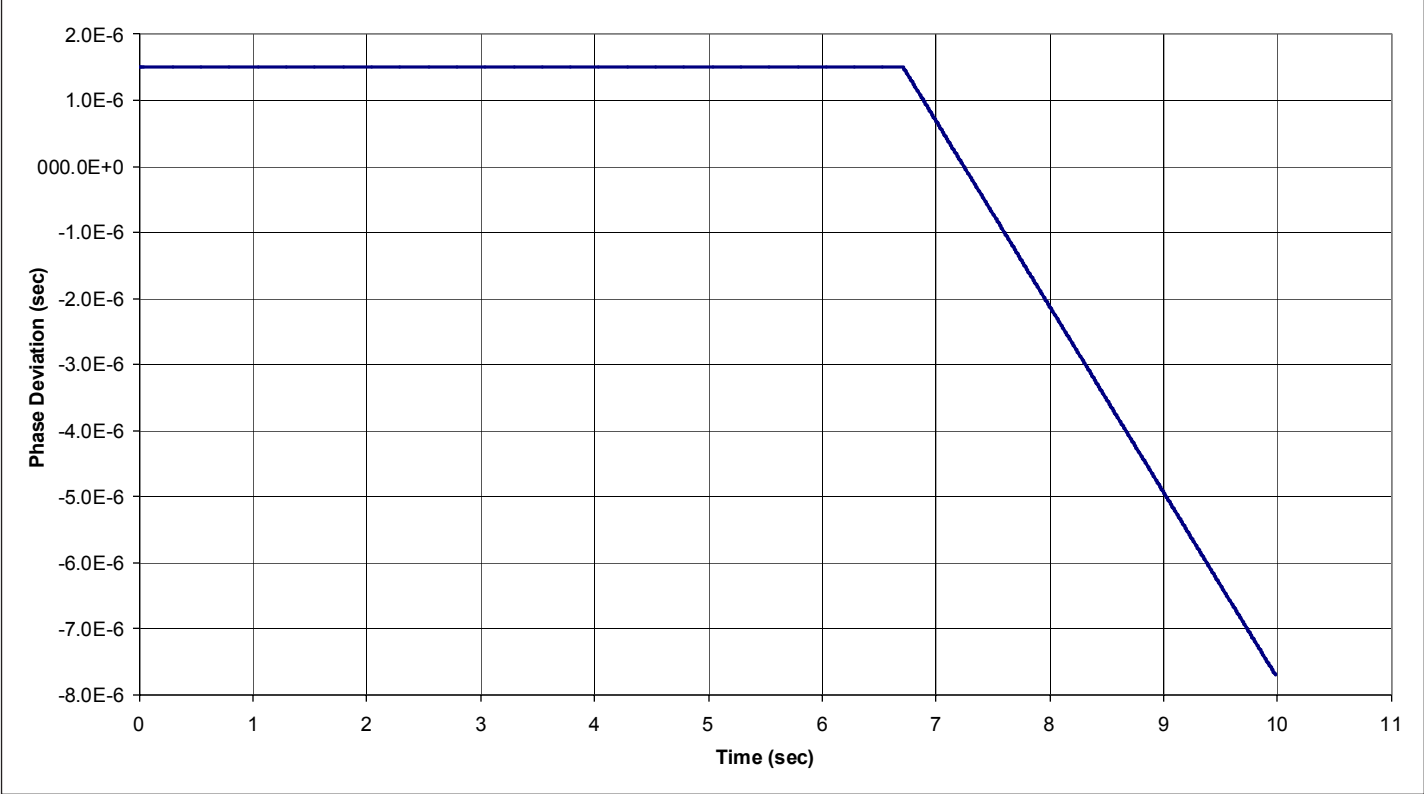
# SCG2000 Switch from Free Run to a new Reference

Figure 8



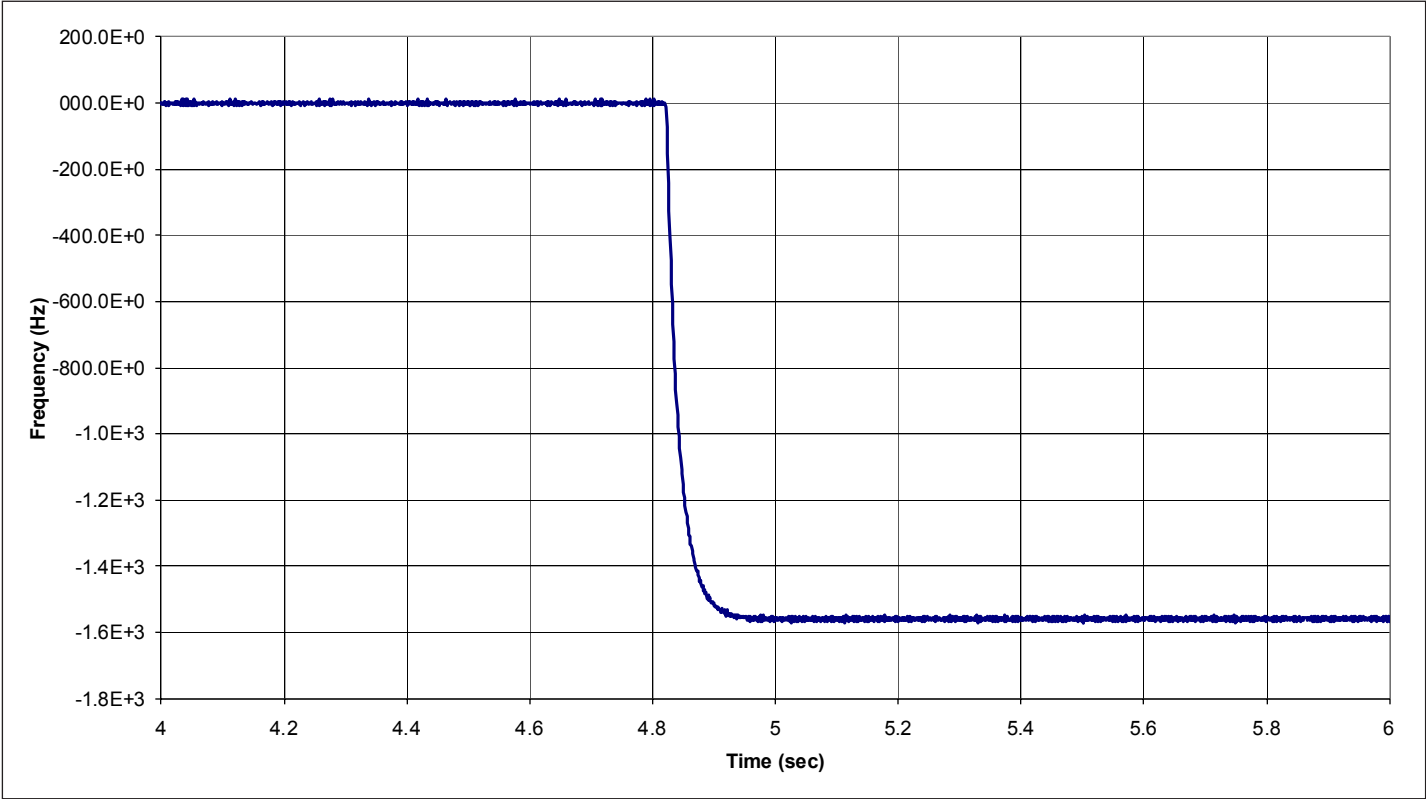
# SCG2000 Switch from a Reference to Free Run

Figure 9



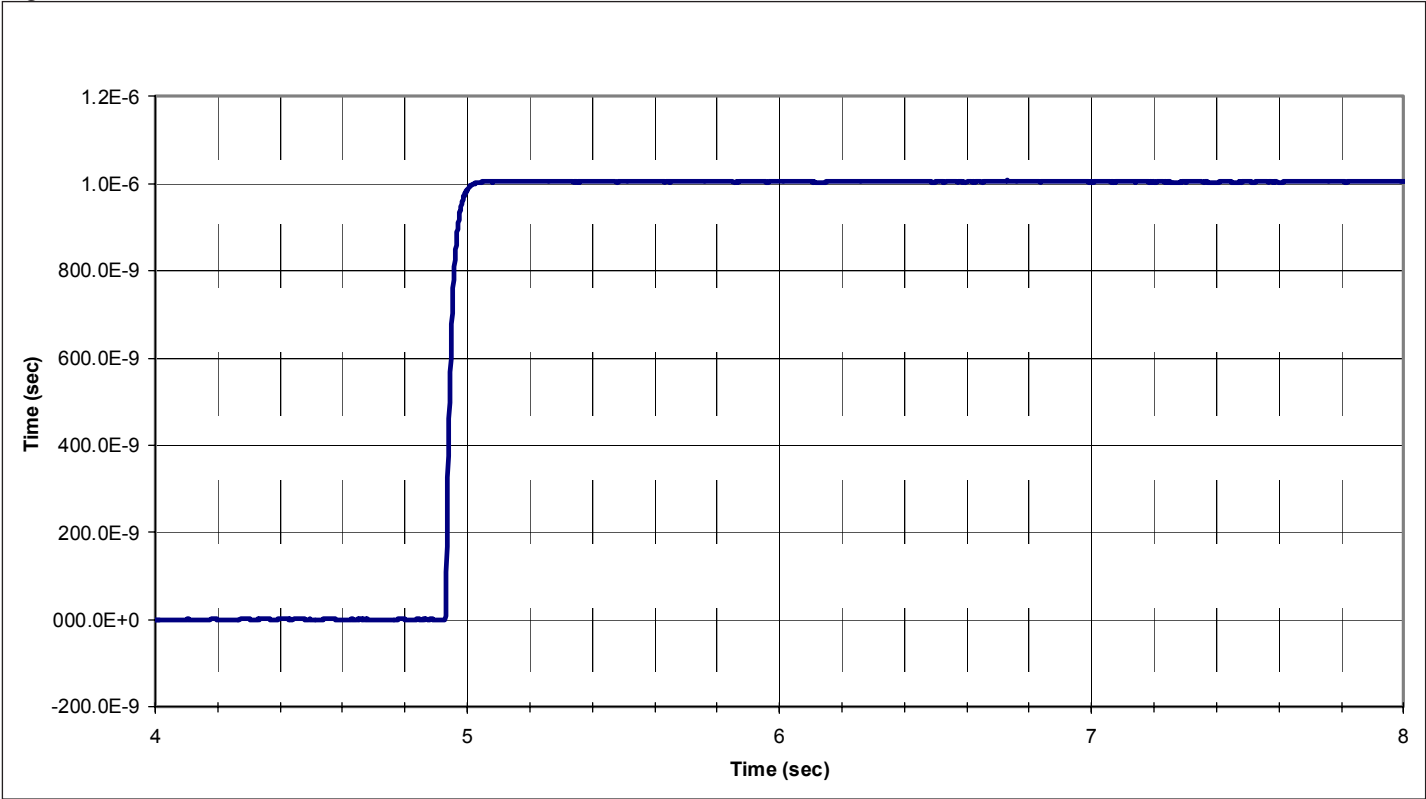
SCG2000 Step Response due to a -20ppm Freq. Step

Figure 10



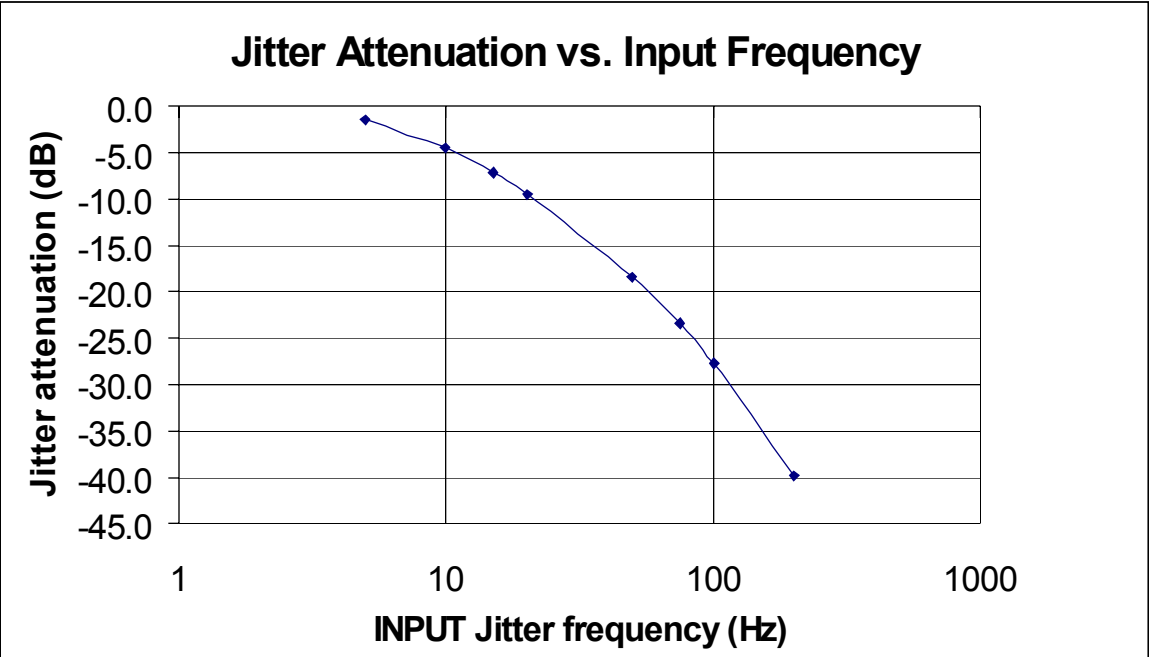
SCG2000 1μs Phase Transient Response

Figure 11



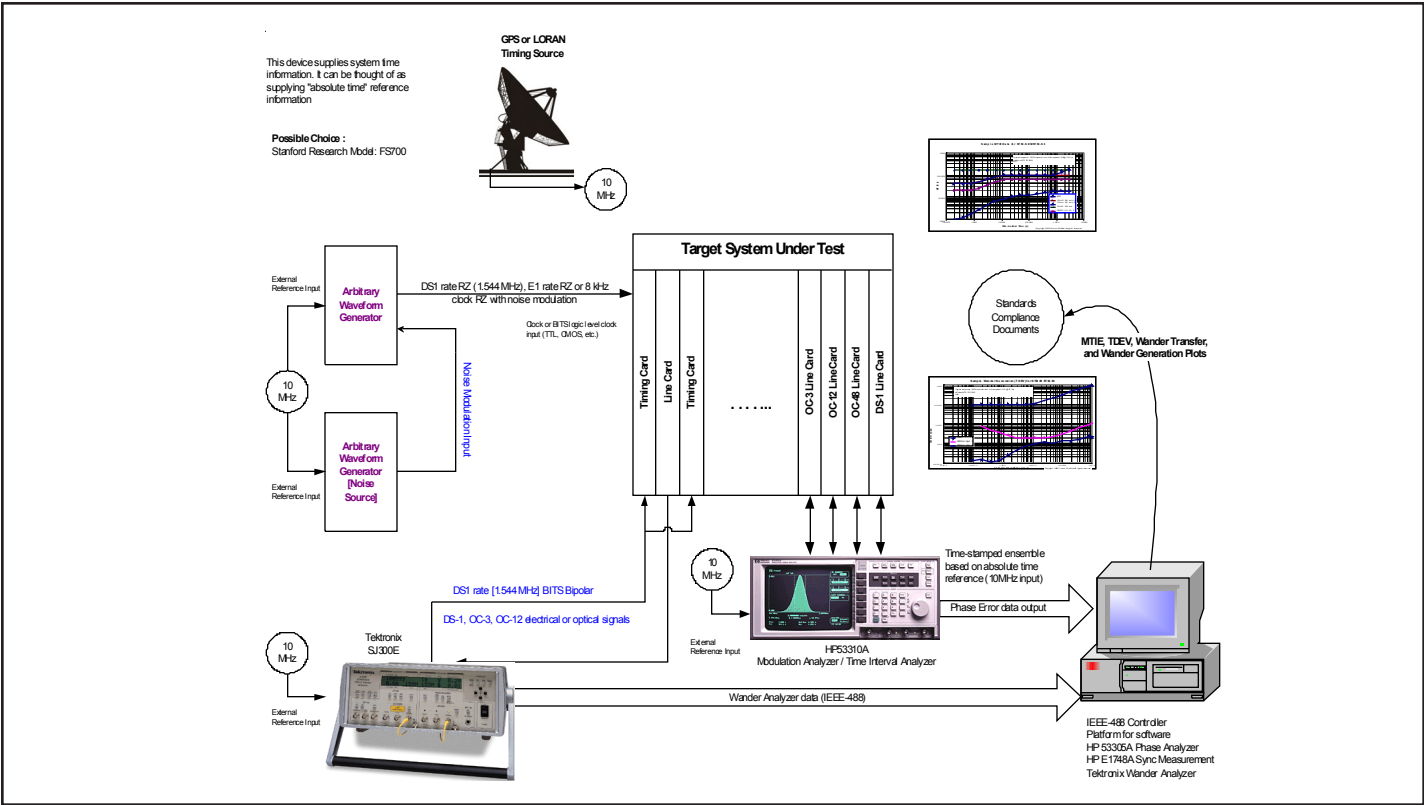
SCG2000 Jitter Attenuation

Figure 12



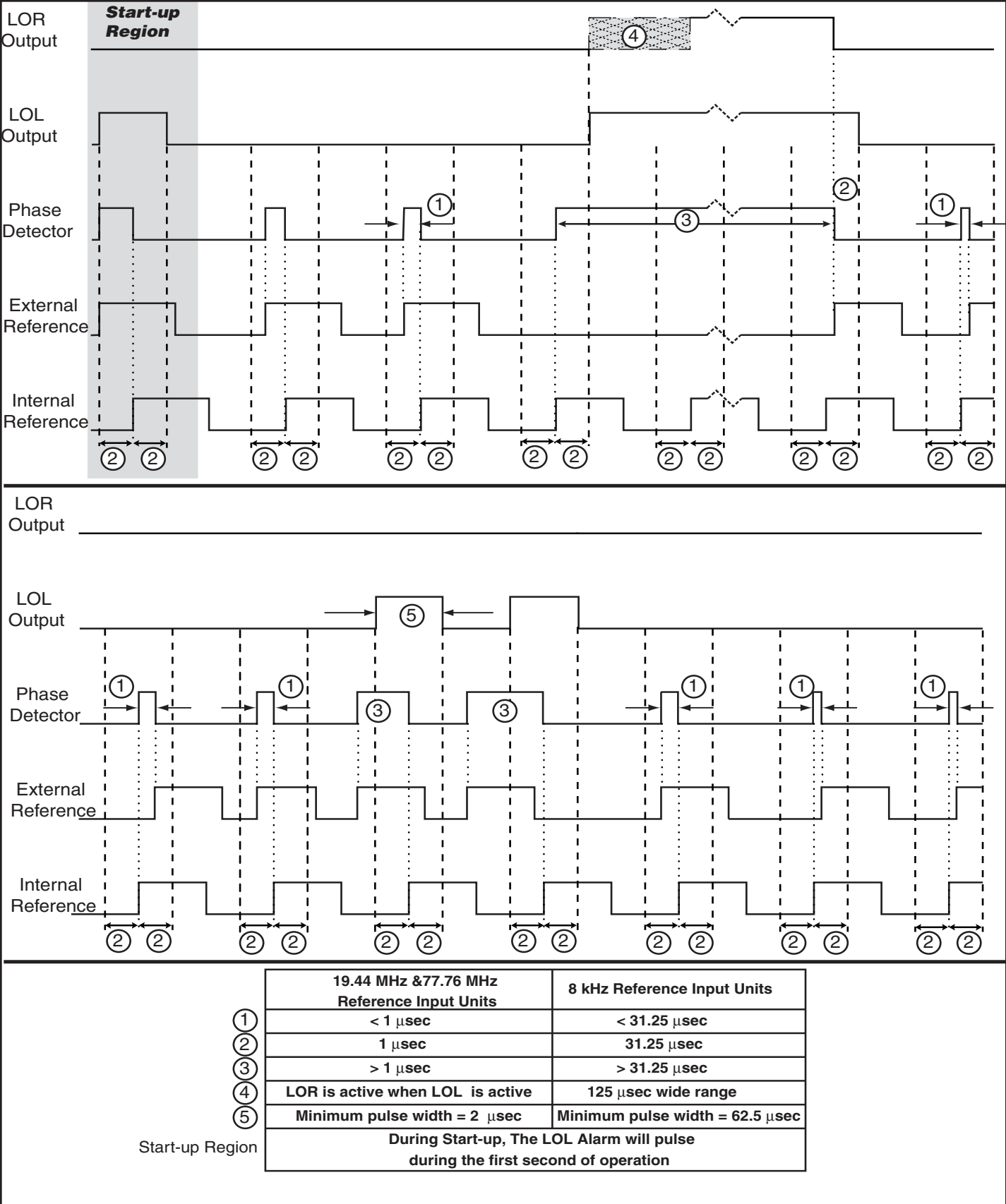
Typical System Test Setup

Figure 13



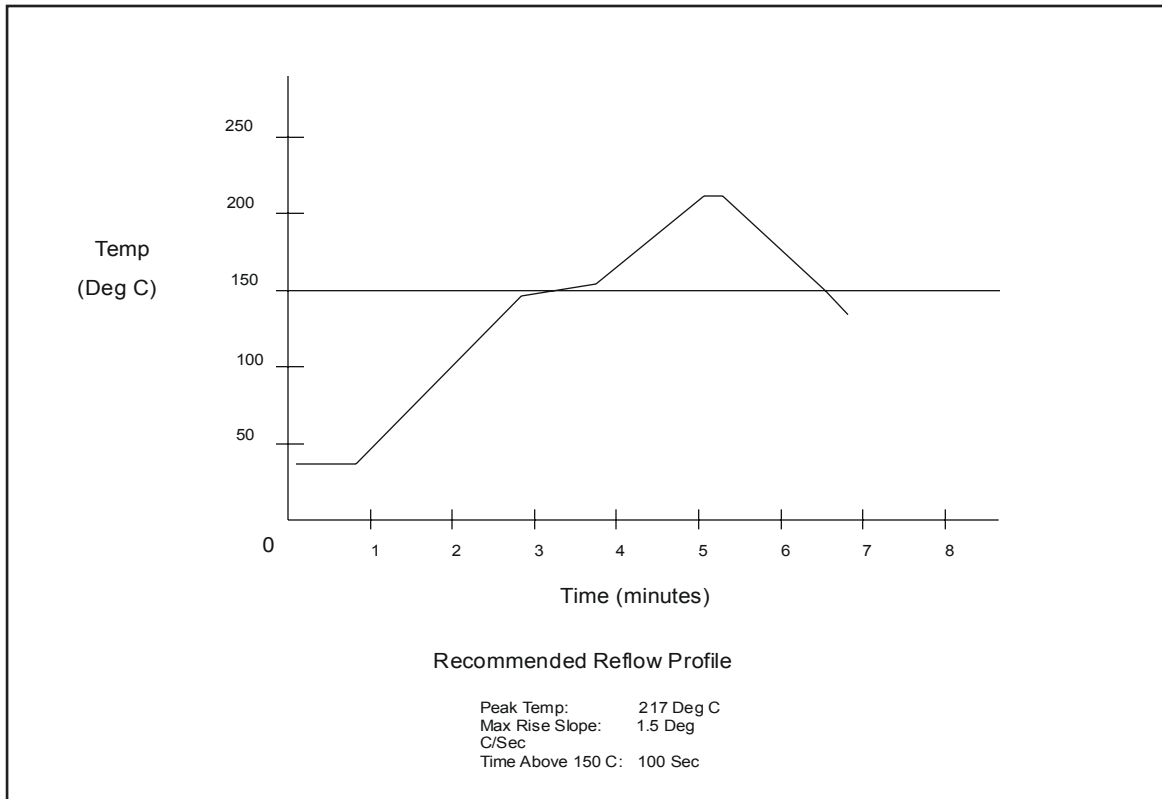
# Alarm Timing Diagram

Figure 14



## Solder Profile

Figure 15



## Ordering Information

SCG{XXXX}-{FFF.FFF}{M}

XXXX equals a specific model (2000, 2010, 2020, 2030, 2050, 2070)

FFF.FFF equals the Oscillator Output frequency (001.544, 002.048, 008.448, 016.384, 019.44, 020.48, 037.056, 044.736, 049.152, 051.84, 077.76, 125.0)

M equals MHZ and is added to all part numbers

Example: To order an SCG2000 with an Oscillator Output of 77.76 MHz,  
Order part number SCG2000-077.76M

Please contact Connor-Winfield for other frequencies that may be available.

## SCG2000

### SCG2000 Individual Features:

- Four selectable References:  
8, 16, 32, and 64 kHz.
- Oscillator Output Available:  
1.544 MHz to 125.0 MHz.

The SCG2000 is Connor-Winfield's base model for the SCG2000 Series product line. The SCG2000 can lock to one of four input reference frequencies from 8 to 64 kHz which is selectable using two input control pins.

### Input Reference Selection

Table 9 SCG2000

| Input Sel A<br>(Pin #14) | Input Sel B<br>(Pin #13) | Reference Frequency<br>(Pin #8) |
|--------------------------|--------------------------|---------------------------------|
| 0                        | 0                        | 8 kHz (default)                 |
| 1                        | 0                        | 16 kHz                          |
| 0                        | 1                        | 32 kHz (see note 4.0)           |
| 1                        | 1                        | 64 kHz (see note 4.0)           |

### Reference and Output Availability

Table 10 SCG2000

| Input Reference<br>(Pin #8)         | Oscillator Output<br>(Pin #9)                                              | Reference Output<br>(Pin #1)        |
|-------------------------------------|----------------------------------------------------------------------------|-------------------------------------|
| 8 kHz<br>16 kHz                     | 19.44 MHz                                                                  | 8 kHz<br>16 kHz                     |
| 8 kHz<br>16 kHz<br>32 kHz           | 38.88 MHz                                                                  | 8 kHz<br>16 kHz<br>32 kHz           |
| 8 kHz<br>16 kHz<br>32 kHz<br>64 kHz | 1.544, 2.048, 16.384 20.48, 37.056,<br>44.736, 49.152, 51.84 and 77.76 MHz | 8 kHz<br>16 kHz<br>32 kHz<br>64 kHz |
| 8 kHz                               | 125.0 MHz                                                                  | 8 kHz                               |

#### Notes:

**Note 4.0:** Not available with 19.44 MHz output.

## SCG2010

### SCG2010 Individual Features:

- Input References (Pin #8) at 19.44 MHz.
- Oscillator Output (Pin #9) at 19.44 MHz.
- Reference Output (Pin #1) at 8 kHz.

The SCG2010 is designed as a clean-up PLL with the input reference frequency (Pin #8) equal to the oscillator output (Pin #9). The reference output frequency (Pin #1) is 8 kHz. The LOL alarm is designed to tolerate 1 $\mu$ s p-p of jitter on the reference. Jitter greater than 1 $\mu$ s p-p will result in LOL alarm pulses.

### Input Reference Selection

Table 11 SCG2010

| Input Sel A<br>(Pin #14) | Input Sel B<br>(Pin #13) | Reference Frequency<br>(Pin #8) |
|--------------------------|--------------------------|---------------------------------|
| X                        | X                        | 19.44 MHz (Default)             |

X= Don't Care

### Reference and Output Availability

Table 12 SCG2010

| Input Reference<br>(Pin #8) | Oscillator Output<br>(Pin #9) | Reference Output<br>(Pin #1) |
|-----------------------------|-------------------------------|------------------------------|
| 19.44 MHz                   | 19.44 MHz                     | 8 kHz                        |

## SCG2020

### SCG2020 Individual Features:

- Input References (Pin #8) at 19.44 MHz.
- Oscillator Output (Pin #9) at 77.76 MHz.
- Reference Output (Pin #1) at 19.44 MHz.

The SCG2020 accepts a 19.44 MHz Input Reference (Pin #8) and provides a 19.44 MHz Output Reference (Pin #1) and a 77.76 MHz signal output on Output #2. The LOL alarm is designed to tolerate 1 $\mu$ s p-p of jitter on the reference. Jitter greater than 1 $\mu$ s p-p will result in LOL alarm pulses.

### Input Reference Selection

Table 15

SCG2020

| Input Sel A<br>(Pin #14) | Input Sel B<br>(Pin #13) | Reference Frequency<br>(Pin #8) |
|--------------------------|--------------------------|---------------------------------|
| X                        | X                        | 19.44 MHz (Default)             |
| X= Don't Care            |                          |                                 |

### Reference and Output Availability

Table 16

SCG2020

| Input Reference<br>(Pin #8) | Oscillator Output<br>(Pin #9) | Reference Output<br>(Pin #1) |
|-----------------------------|-------------------------------|------------------------------|
| 19.44 MHz                   | 77.76 MHz                     | 19.44 MHz                    |

## SCG2030

### SCG2030 Individual Features:

- Four selectable References:  
8, 16, 32, and 64 kHz.
- Oscillator Output Available:  
1.544 MHz to 125.0 MHz.
- Tight Duty cycle

The SCG2030 is similar to the SCG2000 but with a tighter duty cycle of 45/55.

### Input Reference Selection

Table 17

SCG2030

| Input Sel A<br>(Pin #14) | Input Sel B<br>(Pin #13) | Reference Frequency<br>(Pin #8) |
|--------------------------|--------------------------|---------------------------------|
| 0                        | 0                        | 8 kHz (default)                 |
| 1                        | 0                        | 16 kHz                          |
| 0                        | 1                        | 32 kHz (see note 4.0)           |
| 1                        | 1                        | 64 kHz (see note 4.0)           |

### Reference and Output Availability

Table 18

SCG2030

| Input Reference<br>(Pin #8)         | Oscillator Output<br>(Pin #9)                                                                                                                        | Reference Output<br>(Pin #1)        |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| 8 kHz<br>16 kHz                     | 19.44 MHz                                                                                                                                            | 8 kHz<br>16 kHz                     |
| 8 kHz<br>16 kHz<br>32 kHz<br>64 kHz | 1.544, 2.048, 8.448, 16.384, 17.408 MHz<br>1.544, 2.048, 8.448, 20.48, 37.056 MHz<br>8.448, 16.384, 44.736, 49.152 MHz<br>8.448, 51.84 and 77.76 MHz | 8 kHz<br>16 kHz<br>32 kHz<br>64 kHz |
| 8 kHz                               | 125.0 MHz                                                                                                                                            | 8 kHz                               |

#### Notes:

**Note 4.0:** Not available with 19.44 MHz output.

## SCG2050

### SCG2050 Individual Features:

- Four selectable References:  
8, 16, 32, and 64 kHz.
- Oscillator Output Available:  
77.76 MHz only

The SCG2050 can use any 1 of 4 selectable Input Reference frequencies with an Oscillator output of 77.76 MHz and a Reference Output of 19.44 MHz

### Input Reference Selection

Table 19

SCG2050

| Input Sel A<br>(Pin #14) | Input Sel B<br>(Pin #13) | Reference Frequency<br>(Pin #8) |
|--------------------------|--------------------------|---------------------------------|
| 0                        | 0                        | 8 kHz (default)                 |
| 1                        | 0                        | 16 kHz                          |
| 0                        | 1                        | 32 kHz                          |
| 1                        | 1                        | 64 kHz                          |

### Reference and Output Availability

Table 20

SCG2050

| Input Reference<br>(Pin #8) | Oscillator Output<br>(Pin #9) | Reference Output<br>(Pin #1) |
|-----------------------------|-------------------------------|------------------------------|
| 8 kHz                       | 77.76 MHz                     | 19.44 MHz                    |
| 16 kHz                      | 77.76 MHz                     | 19.44 MHz                    |
| 32 kHz                      | 77.76 MHz                     | 19.44 MHz                    |
| 64 kHz                      | 77.76 MHz                     | 19.44 MHz                    |

## SCG2070

### SCG2070 Individual Features:

- Input References (Pin #8) at 19.44 MHz.
- Oscillator Output (Pin #9) equals Reference Output (Pin #1)

The SCG2070 is designed to provide two output frequencies that are equal. The Reference Output is actually a second Oscillator Output. SCG2070 is available with either 77.76 MHz outputs or with 51.84 MHz outputs. The LOL alarm is designed to tolerate 1 $\mu$ s p-p of jitter on the reference. Jitter greater than 1 $\mu$ s p-p will result in LOL alarm pulses.

### Input Reference Selection

Table 21 SCG2070

| Input Sel A<br>(Pin #14) | Input Sel B<br>(Pin #13) | Reference Frequency<br>(Pin #8) |
|--------------------------|--------------------------|---------------------------------|
| X                        | X                        | 19.44 MHz (Default)             |

X= Don't Care

### Reference and Output Availability

Table 22 SCG2070

| Input Reference<br>(Pin #8) | Oscillator Output<br>(Pin #9) | Reference Output<br>(Pin #1) |
|-----------------------------|-------------------------------|------------------------------|
| 19.44 MHz                   | 77.76 MHz                     | 77.76 MHz                    |
| 19.44 MHz                   | 51.84 MHz                     | 51.84 MHz                    |





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| Revision | Revision Date | Note          |
|----------|---------------|---------------|
| 00       | 8/23/04       | Final Release |