

# 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**

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Revision	<b>A04</b>
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Data Sheet #: **SG029** Page 1 of 20 Rev: **A04** Date: **01 / 29 / 02**

## 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.

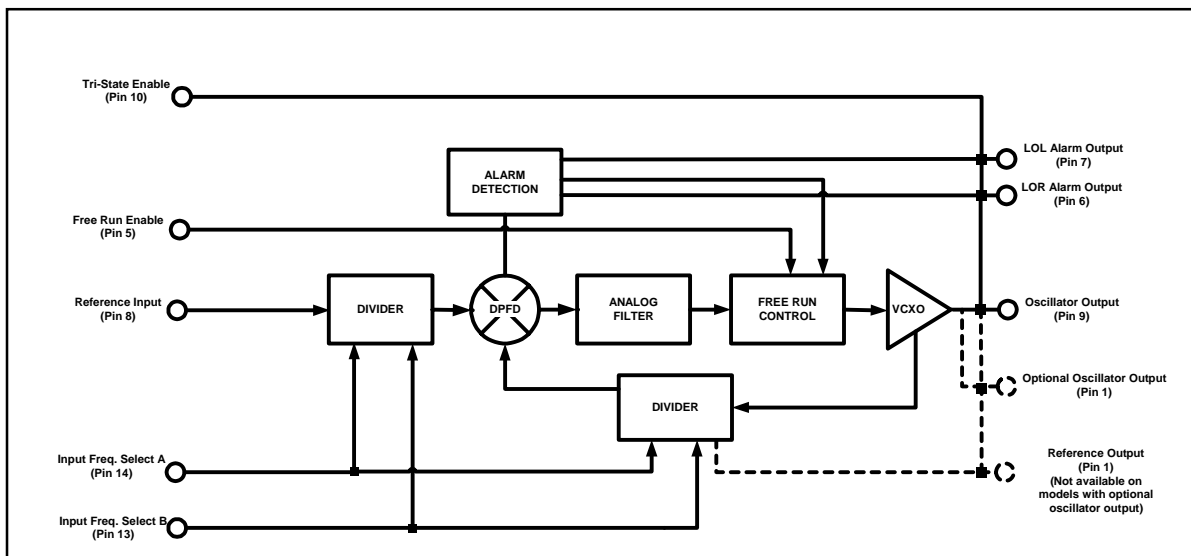
The SCG2000 Series include the following features: Free Run, Tri-state and alarm outputs for Loss-of-Reference, (LOR),

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 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 package dimensions are .775" x .825" 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

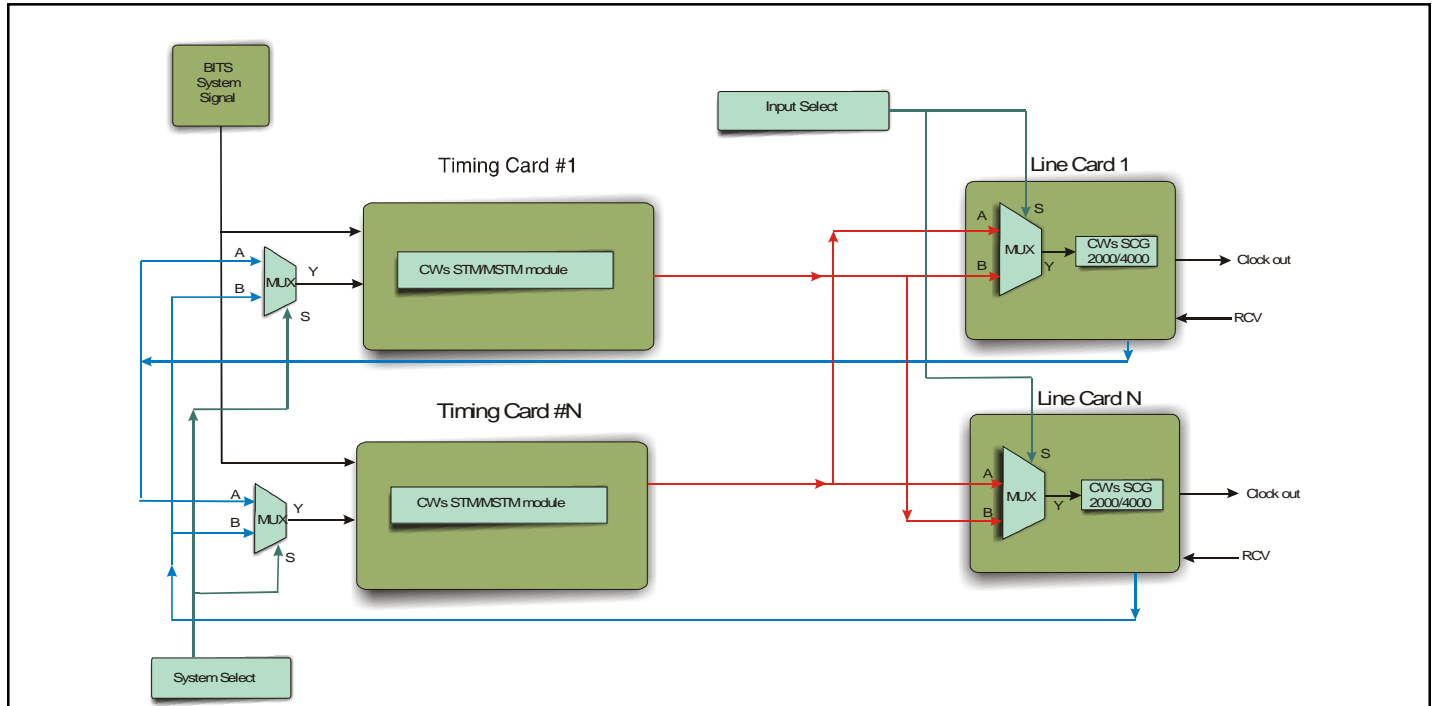
All SCG2000 Models

Table 2

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 GND	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. 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>1</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 ±5%	1.0
Current	100 mA	
Temperature Range	0 to 70°C	
Input Jitter Tolerance	6.25 us, 10 Hz (.05 UI @ 8000 Hz)	
Jitter Bandwidth	<10 Hz	
Acquisition Time	Approx 1.0 second	2.0
Capture/Pull-in Range	±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 seperate outputs	
Free Run Accuracy	±20 ppm	
Package	Fr4 SM 0.775" x .825" x 0.350"	
TDEV	≤0.4 ns Typical	
MTIE	2 ns Typical	

## 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



# Output Jitter Specifications

Table 6

All SCG2000 Models

Frequency (MHz)	Jitter BW 10 Hz - 1 MHz		Sonnet Jitter BW 12 KHz - 20 MHz	
	pS (RMS)	m UI	pS (RMS)	m UI
1.544	TBD	TBD	TBD	TBD
2.048	60	0.122	4	0.008
16.384	35	0.573	2.25	0.037
19.44	50	0.972	2.4	0.047
20.48	TBD	TBD	TBD	TBD
37.056	30	1.11	1.25	0.046
44.736	30	1.34	1.15	0.051
49.152	30	1.47	1.25	0.061
51.84	TBD	TBD	TBD	TBD
77.76	30	2.33	2.25	0.175
125.0	30	3.75	1.5	0.186

## 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

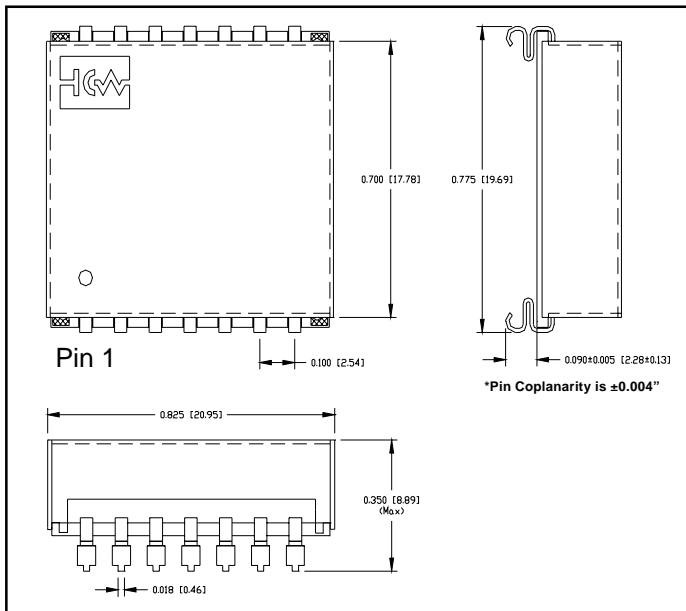
Table 8

All SCG2000 Models

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

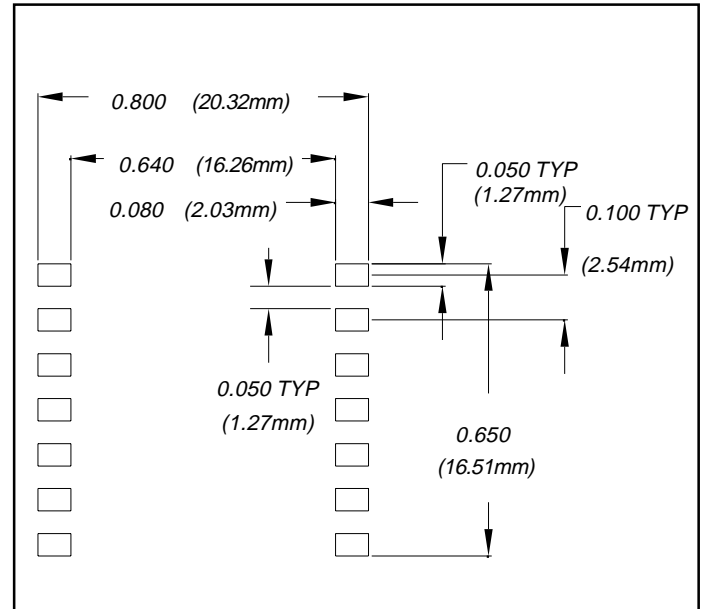
## Package Dimensions

Figure 3



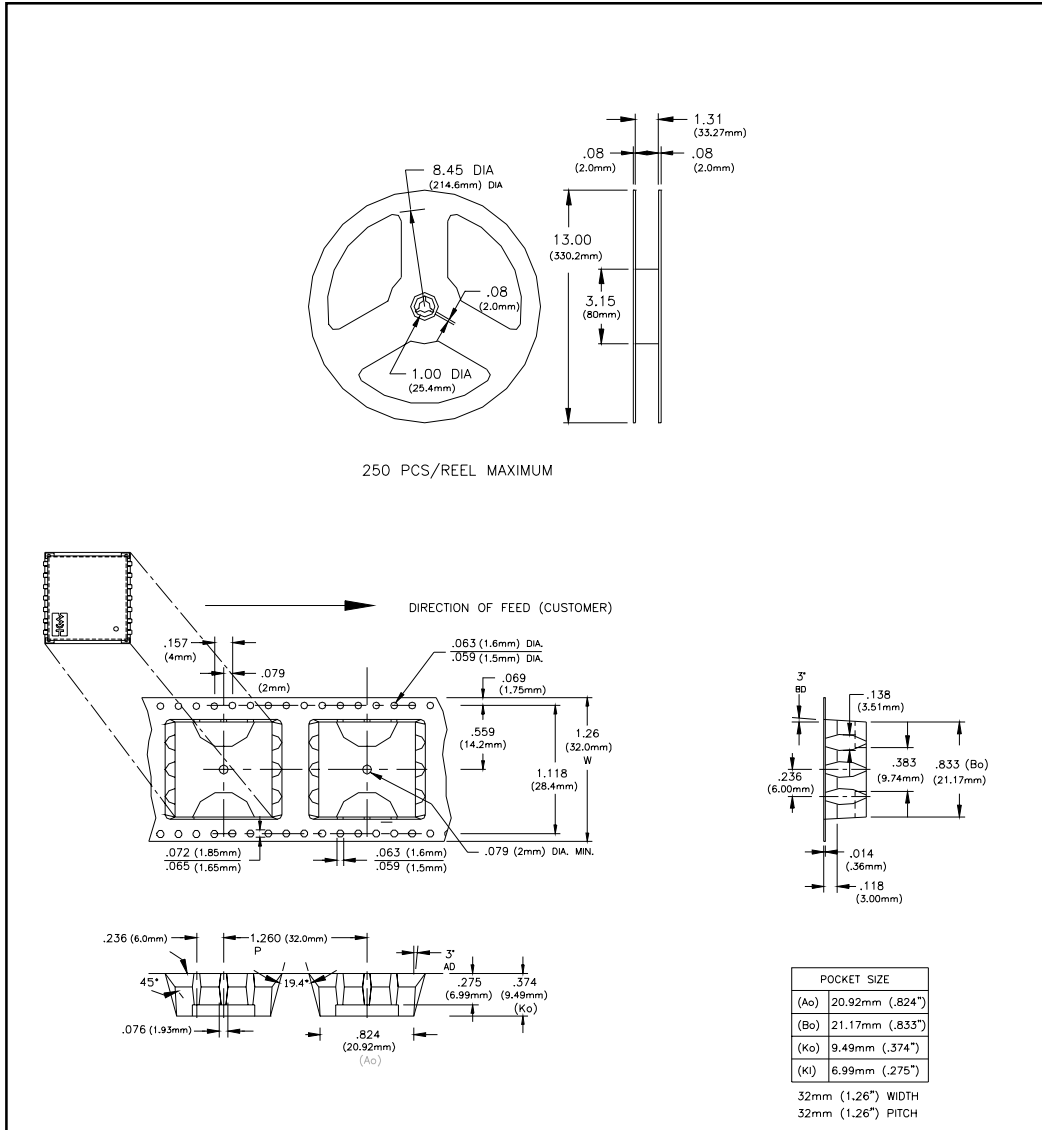
## Recommended Footprint Dimensions

Figure 4



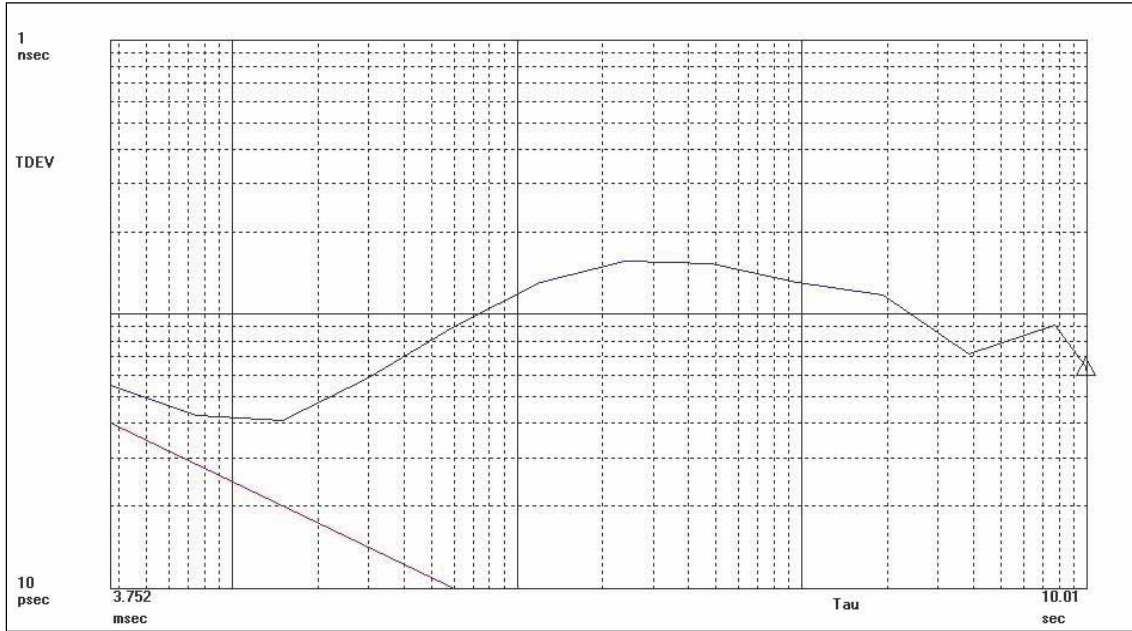
# Tape and Reel Dimensions

Figure 5



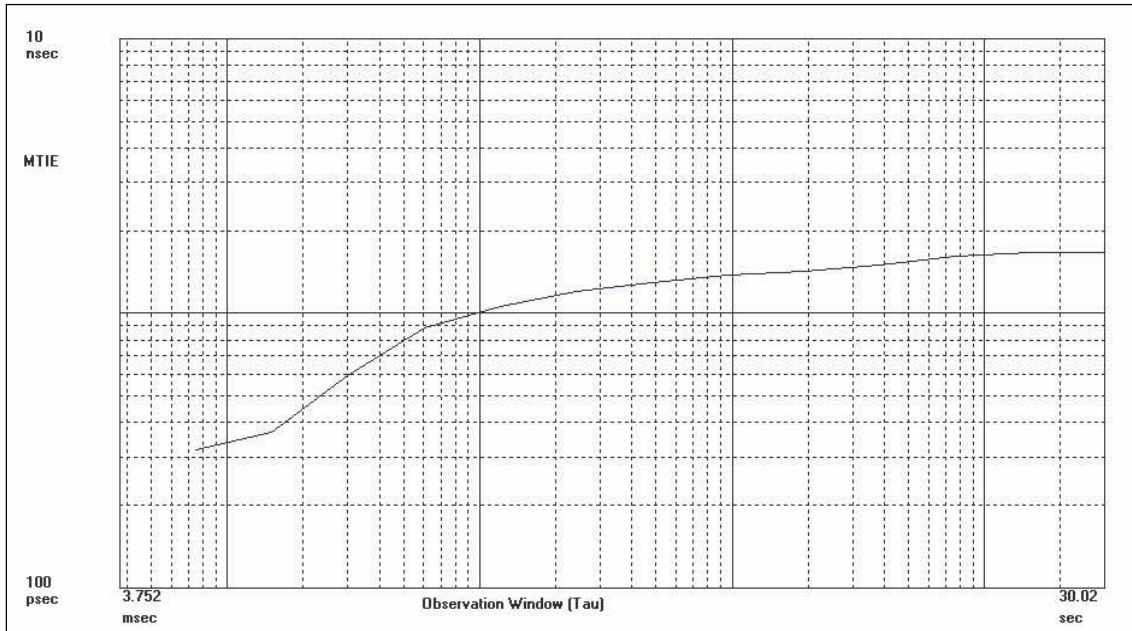
# SCG2000 Typical TDEV

Figure 6



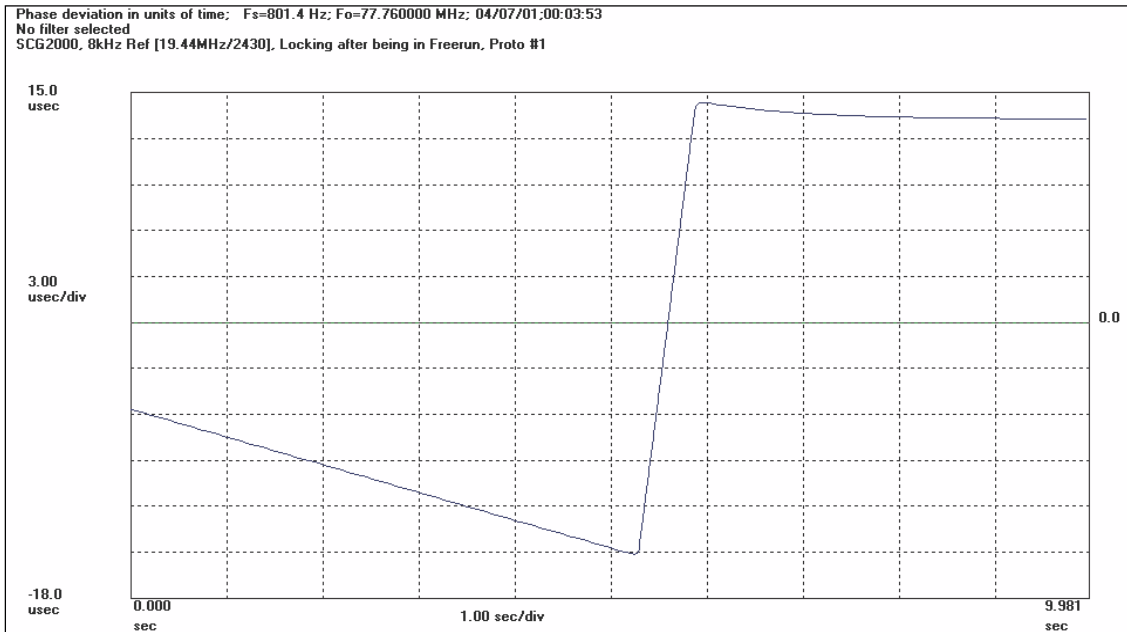
# SCG2000 Typical MTIE

Figure 7



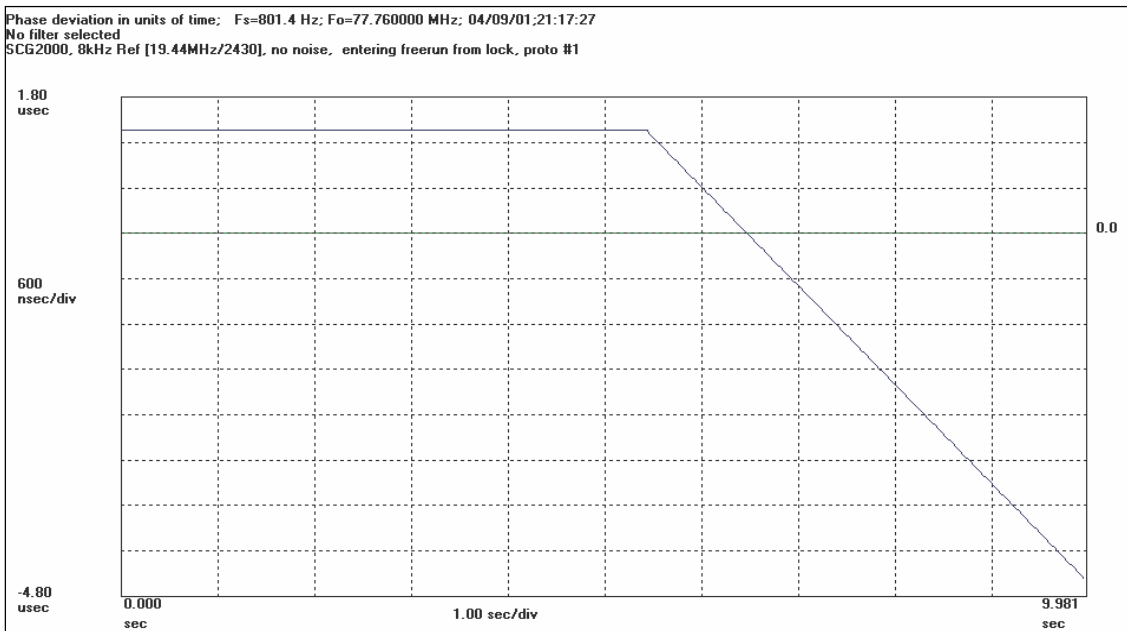
# SCG2000 Switch from Free Run to a new Reference

Figure 8



# SCG2000 Switch from a Reference to Free Run

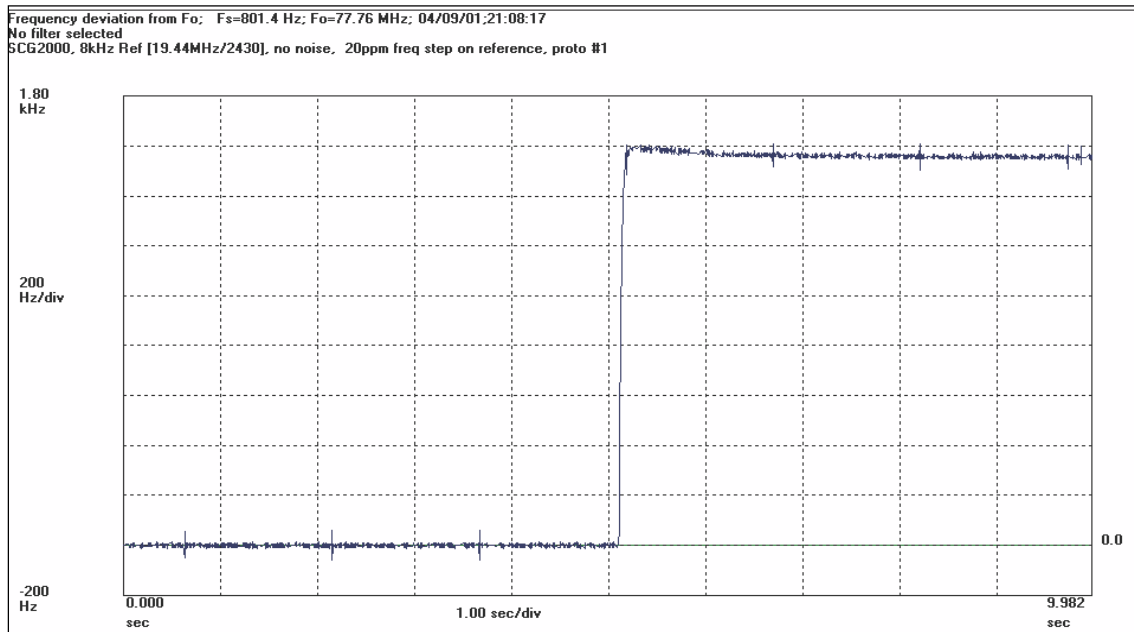
Figure 9





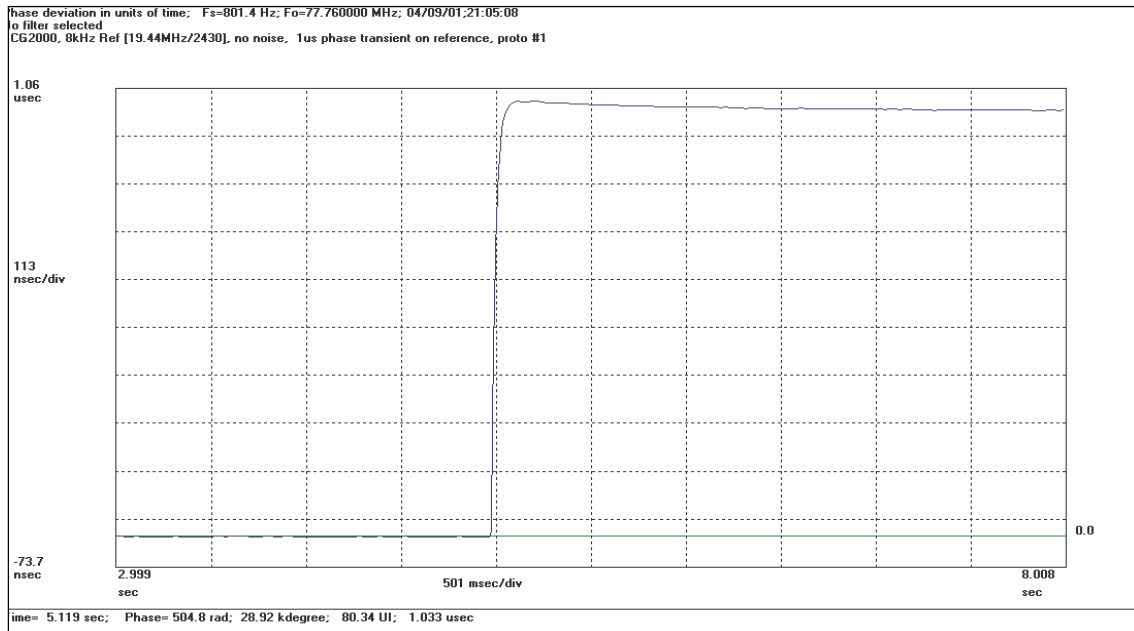
# SCG2000 Step Response due to a Freq. Step

Figure 10



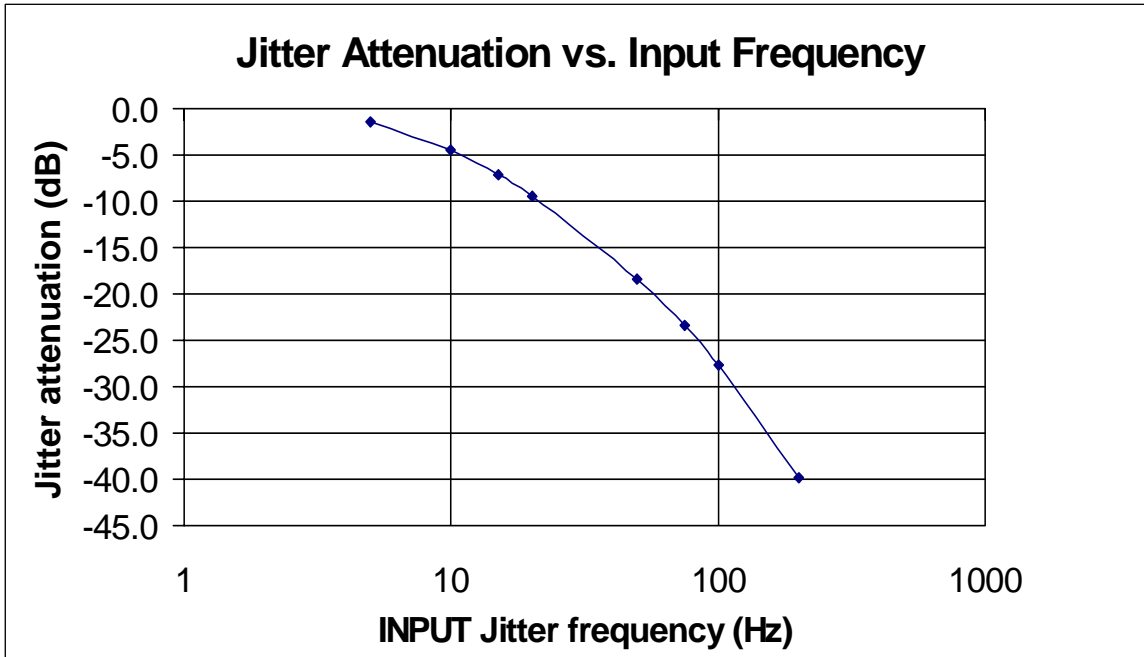
# SCG2000 1μs Phase Transient

Figure 11



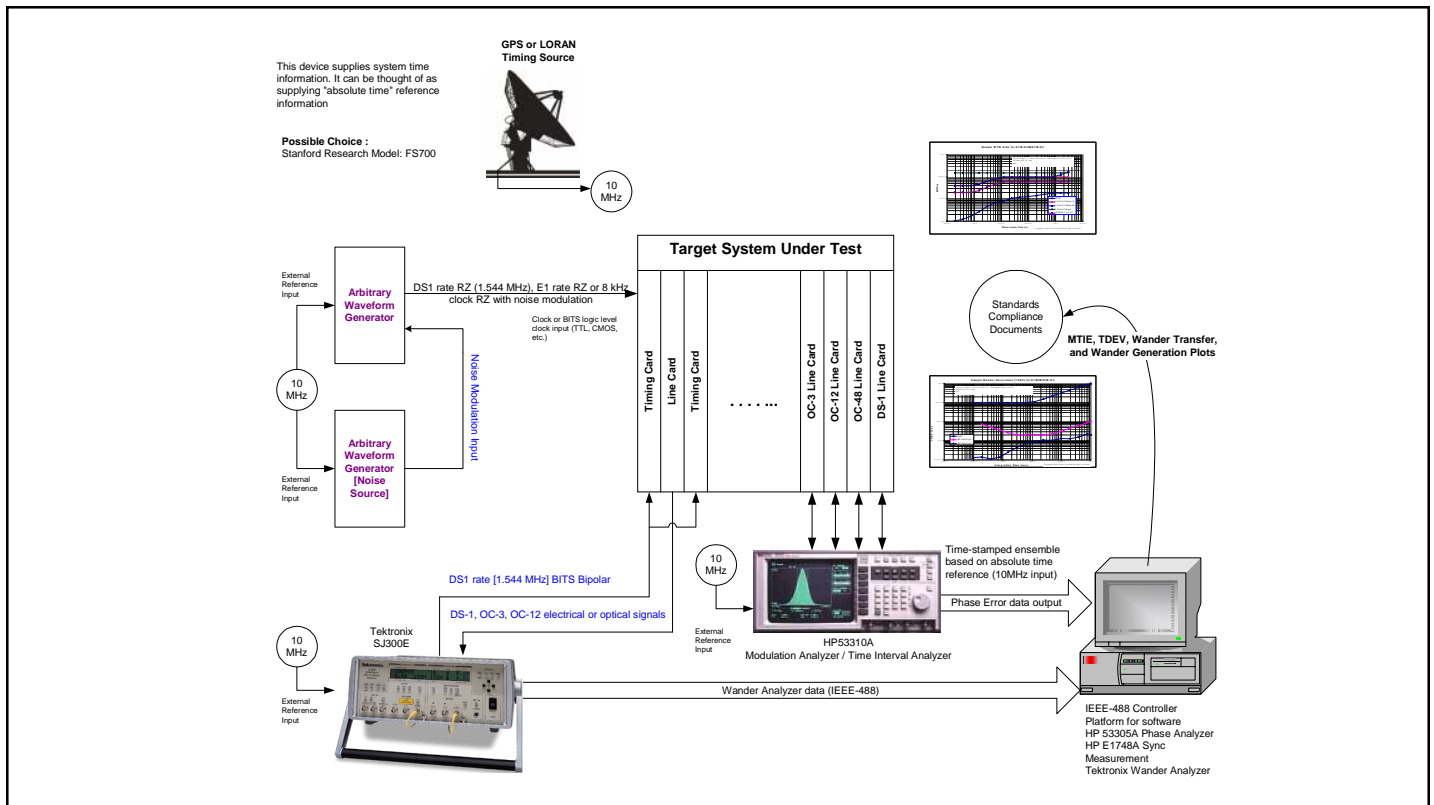
# SCG2000 Jitter Attenuation

Figure 12



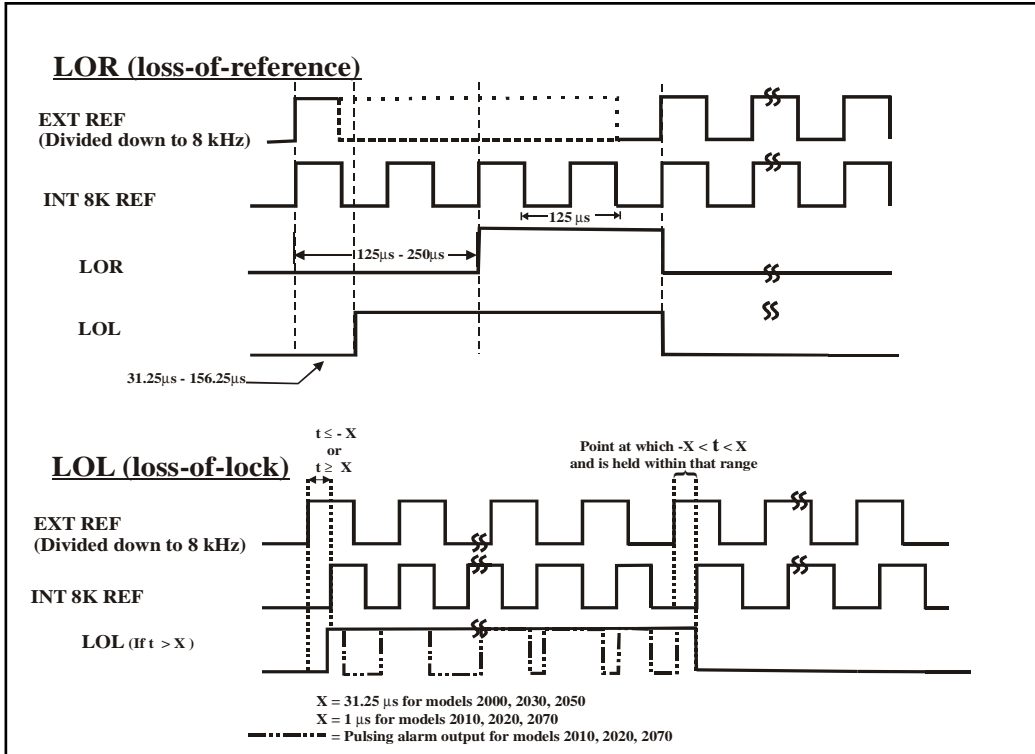
# Typical System Test Setup

Figure 13



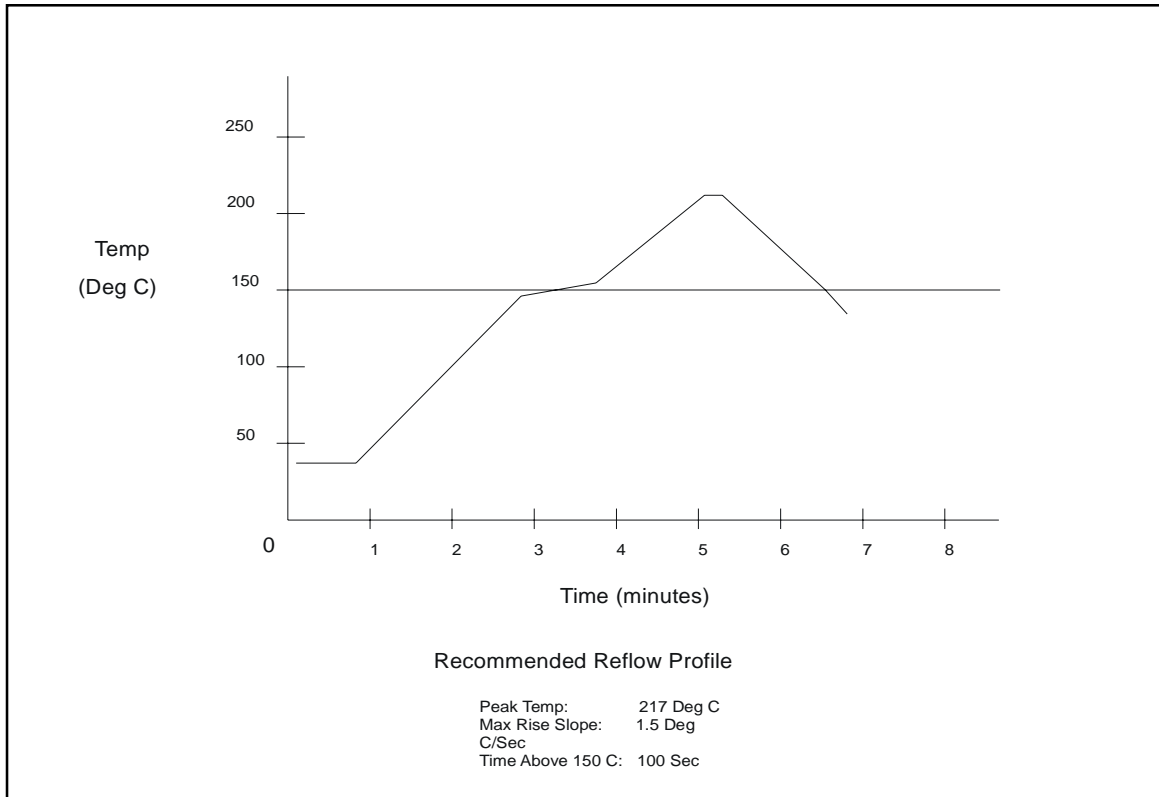
# Alarm Timing Diagram

Figure 14



# Solder Profile

Figure 15



# SCG2000

## SCG2000 Individual Features:

- Four selectable References: 8, 16, 32, and 64 kHz.
- Oscillator Output Available: 1.544 MHz to 77.76 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 (Pin #14)	Input Sel B (Pin #13)	Reference Frequency (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 (Pin #8)	Oscillator Output (Pin #9)	Reference Output (Pin #1)
8 kHz 16 kHz	19.44 MHz	8 kHz 16 kHz
8 kHz 16 kHz 32 kHz 64 kHz	1.544, 2.048, 16.384 20.48, 37.056, 44.736, 49.152, 51.84 and 77.76 MHz	8 kHz 16 kHz 32 kHz 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 1us p-p of jitter on the reference. Jitter greater than 1us p-p will result in LOL alarm pulses.

## Input Reference Selection

Table 11 SCG2010

Input Sel A (Pin #14)	Input Sel B (Pin #13)	Reference Frequency (Pin #8)
X	X	19.44 MHz (Default)

X= Don't Care

## Reference and Output Availability

Table 12 SCG2010

Input Reference (Pin #8)	Oscillator Output (Pin #9)	Reference Output (Pin #1)
19.44 MHz	19.44 MHz	8 kHz

## LOL Alarm Note

Units that use 19.44 MHz reference has a pulsing LOL Alarm output during an alarm condition. The pulsing output is at an 8 kHz rate and the pulse width can be between 1μs and 124 μs wide.

## LOR Alarm Note

Units that use 19.44 MHz reference will have a pulse that appears on the LOR alarm output when the reference is  $\leq 9.1$  MHz.

# 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 13 SCG2020

Input Sel A (Pin #14)	Input Sel B (Pin #13)	Reference Frequency (Pin #8)
X	X	19.44 MHz (Default)

X= Don't Care

## Reference and Output Availability

Table 14 SCG2020

Input Reference (Pin #8)	Oscillator Output (Pin #9)	Reference Output (Pin #1)
19.44 MHz	77.76 MHz	19.44 MHz

## LOL Alarm Note

Units that use 19.44 MHz reference has a pulsing LOL Alarm output during an alarm condition. The pulsing output is at an 8 kHz rate and the pulse width can be between 1 $\mu$ s and 124 $\mu$ s wide.

## LOR Alarm Note

Units that use 19.44 MHz reference will have a pulse that appears on the LOR alarm output when the reference is  $\leq$  9.1 MHz.

# SCG2030

## SCG2030 Individual Features:

- Four selectable References: 8, 16, 32, and 64 kHz.
- Oscillator Output Available: 1.544 MHz to 77.76 MHz.
- Tight Duty cycle

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

## Input Reference Selection

Table 15 SCG2030

Input Sel A (Pin #14)	Input Sel B (Pin #13)	Reference Frequency (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 16 SCG2030

Input Reference (Pin #8)	Oscillator Output (Pin #9)	Reference Output (Pin #1)
8 kHz 16 kHz	19.44 MHz	8 kHz 16 kHz
8 kHz 16 kHz 32 kHz 64 kHz	1.544, 2.048, 16.384, 20.48, 37.056, 44.736, 49.152, 51.84 and 77.76 MHz	8 kHz 16 kHz 32 kHz 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 References 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 (Pin #14)	Input Sel B (Pin #13)	Reference Frequency (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 (Pin #8)	Oscillator Output (Pin #9)	Reference Output (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

Input Sel A (Pin #14)	Input Sel B (Pin #13)	Reference Frequency (Pin #8)
X	X	19.44 MHz (Default)

X= Don't Care

### Reference and Output Availability

Input Reference (Pin #8)	Oscillator Output (Pin #9)	Reference Output (Pin #1)
19.44 MHz	77.76 MHz	77.76 MHz
19.44 MHz	51.84 MHz	51.84 MHz

### LOL Alarm Note

Units that use 19.44 MHz reference has a pulsing LOL Alarm output during an alarm condition. The pulsing output is at an 8 kHz rate and the pulse width can be between 1 $\mu$ s and 124  $\mu$ s wide.

### LOR Alarm Note

Units that use 19.44 MHz reference will have a pulse that appears on the LOR alarm output when the reference is  $\leq 9.1$  MHz.

## 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, 017.408, 019.44, 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

<b>Revision</b>	<b>Revision Date</b>	<b>Note</b>
A00	4/27/01	Advance Informational Release
A01	5/22/01	Added new frequencies
A02	7/10/01	Changed LOL alarm information
A03	7/30/01	Filled in some jitter specs
A04	1/29/02	Added ordering information

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