HSM SERIES

RF Synthesizer Modules

ULTRA LOW PHASE NOISE

PRODUCT SUMMARY

The Holzworth HSM Series RF Synthesizer Modules are stand alone, CW sources. These sources are designed as building blocks for systems integration where performance at the foundation is critical. Holzworth synthesizers provide incredible signal stability. When integrated as multiple units connected to the same reference signal, a phase coherent relationship is created which provides optimal unit-to-unit stability.

The core architecture of the HSM Series modules is derived from Holzworth's proprietary NON-PLL design to provide the ultimate in phase / frequency stability. This direct-digital/direct-analog hybrid design was originally developed as a key building block for our phase noise analysis products. The hybrid architecture provides frequency agility & resolution, phase continuous switching and predictable performance without compromising on spurious or phase noise performance.

HSM EXTENDED FREQUENCY OPTIONS:

Model No.	Frequency Range	Phase Noise Performance
HSM1001B	10MHz to 1GHz	-133dBc/Hz at 1GHz (10kHz offset)
HSM2001B	10MHz to 2GHz	-127dBc/Hz at 2GHz (10kHz offset)
HSM3001B	10MHz to 3GHz	-123dBc/Hz at 3GHz (10kHz offset)
HSM4001B	10MHz to 4GHz	-121dBc/Hz at 4GHz (10kHz offset)
HSM6001B	10MHz to 6.7GHz	-117dBc/Hz at 6GHz (10kHz offset)

Note: 100% of all RF synthesizers manufactured by Holzworth Instrumentation are subjected to full phase noise performance testing prior to shipment.

The versatile HSM Synthesizer Modules can be controlled directly via the SPI bus, the Holzworth GUI, a preloaded lookup table, LabVIEW™, MATLAB™, C++, C#, *etc.* Some systems integrators have preferred the supported Linux platform over a Windows based PC. An advanced application example uses a preloaded lookup table in a multi-channel configuration further leveraging the unique NON-PLL characteristics to achieve switching speeds of <100ns with phase memory.

The attractive performance-to-price ratios available with the Holzworth HSM Series offer optimal solutions for electronics design, manufacturing test applications, and OEM systems integration.

Finally, with MTBFs greater than 200,000 hours, the HSM Series synthesizer modules have been designed to exceed the most stringent reliability requirements.

HSM DESIGN HIGHLIGHTS

- **Amplitude Accuracy ±0.25dB to as low as -70dBm**
- **Frequency Switching Speed: 6µS, 100% settled**
- **Pulse Modulation Burst Mode (internal pulse)**
- **Onboard Precision 100MHz OCXO**
- **100MHz Reference Out: -153dBc/Hz (10kHz OS)**
- **Reference Input: 10MHz or 100MHz**
- **SPI or USB Communications Interface**
- **Internal Temperature Monitor Output**

ELECTRICAL SPECIFICATIONS - FREQUENCY

The specified parameters for the HSM Series RF Synthesizer Modules are fully verified at final performance test and 100% guaranteed for the warranty life of the product. Performance specifications listed on this page are specific to Frequency.

FREQUENCY PERFORMANCE[1]

PARAMETER	MIN	TYPICAL	MAX	COMMENTS
Frequency Range				
Model **HSM1001B**	10 MHz		1.024 GHz	Settable from 5MHz to 1.024GHz
Model **HSM2001B**	10 MHz		2.048 GHz	Settable from 5MHz to 2.048GHz
Model **HSM3001B**	10 MHz		3.072 GHz	Settable from 5MHz to 3.072GHz
Model **HSM4001B**	10 MHz		4.096 GHz	Settable from 5MHz to 4.096GHz
Model **HSM6001B**	10 MHz		6.400 GHz	Settable from 5MHz to 6.720GHz
Frequency Step Size		0.001 Hz		
Phase Offset Resolution				**Offset Accuracy:**
10 MHz – 512 MHz		0.1 deg		±0.05 deg
512 MHz – 1.024 GHz		0.2 deg		±0.10 deg
1.024 GHz – 2.048 GHz		0.4 deg		±0.20 deg
2.048 GHz – 4.096 GHz		0.8 deg		±0.40 deg
4.096 GHz – 6.400 GHz		1.6 deg		±0.80 deg
Switching Speed (Frequency)				
SPI Mode (ASCII)			300us	
SPI Mode (Binary)				
< 3.072 GHz		75us	100us	
≥ 3.072 GHz		100us		
List/Step Sweep Mode (WB)		100us		Wideband Steps (full bandwidth)
List/Step Sweep Mode (NB)		6us		Narrowband Steps (<5% bandwidth)
Internal Time Base Reference (Oscillator Aging Rate)		± 1 ppm/yr		1st year. ±0.5 ppm/yr each subsequent year
Temperature Effects		± 1 ppm		0 to 55 °C
Line Voltage Effects (12V)		± 0.1 ppm		±5%
Reference Output				
Frequency		100 MHz		
Amplitude	+2 dBm		+6 dBm	Nominal
Impedance		50 Ω		Nominal
External Reference Input				
Input Frequency		10 / 100		Software Select 10MHz, 100MHz or No Ext. Ref.
10MHz Lock Range		± 4 ppm	± 1 ppm	20Hz Locking BW, Internal OCXO remains on
10MHz External Amplitude	0 dBm		+10 dBm	20Hz Locking BW, Internal OCXO remains on
100MHz External Amplitude	+2 dBm		+6 dBm	Internal OXCO shuts off
Impedance		50 Ω		50 Ω (nom)
Waveform				Sine
Digital Sweep Modes				
Operating Modes				Step sweep (linear, internal) List Sweep (arbitrary list of freq steps) Simultaneous Amplitude sweep (list)
Sweep Range	10 MHz		6.700 GHz	
Dwell Time	100 µs		100 s	1 µs increments
Number of Points (STEP)	2		65535	
Number of Points (LIST)	2		3201	
Triggering				Free Run, External Trigger

[1] Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc
[2] ASCII mode only

ELECTRICAL SPECIFICATIONS - AMPLITUDE

The specified parameters for the HSM Series RF Synthesizer Modules are fully verified at final performance test and 100% guaranteed for the warranted life of the product. Performance specifications listed on this page are specific to Amplitude.

AMPLITUDE PERFORMANCE[1]

PARAMETER	MIN[2]	TYPICAL[3]	MAX[2]	COMMENTS
Output Power (Calibrated)	-50 dBm		+18 dBm	Settable from -90dBm to +25dBm Refer to typical data: Page 4
Resolution		0.01 dB		
Connector		50 Ω		SMA
SWR (S_{22}) f < 32MHz 32MHz < f < 1.024GHz 1.024GHz < f < 6.4GHz		 1.4 (-15.6 dB) 1.15 (-23.0 dB) 1.3 (-17.7 dB)	 1.7 (-11.7 dB) 1.4 (-15.6 dB) 1.5 (-14 dB)	
Maximum Reverse Power Max DC Voltage > 10 MHz	25 VDC maximum by design. 10 mW (+16dBm) max by design.			*** Some applications may require reverse power protection.
Switching Speed (Amplitude) SPI Mode List / Step Sweep Mode			 300 µs 100 µs	Settling to within 0.1 dB.
Absolute Level Accuracy 10MHz < f < 6.4GHz +18 to -10dBm 10MHz < f < 6.4GHz -10 to -50dBm		 ± 0.25 dB ± 0.50 dB	 ± 0.5 dB ± 1.5 dB	25C to 35C (case temperature)
SSB Phase Noise 100 MHz, 10kHz offset 500 MHz, 10kHz offset 1.0 GHz, 10kHz offset 2.0 GHz, 10kHz offset 3.0 GHz, 10kHz offset 4.0 GHz, 10kHz offset 6.0 GHz, 10kHz offset		 ≤ -153 dBc/Hz ≤ -139 dBc/Hz ≤ -133 dBc/Hz ≤ -127 dBc/Hz ≤ -123 dBc/Hz ≤ -121 dBc/Hz ≤ -117 dBc/Hz	 ≤ -145 dBc/Hz ≤ -134 dBc/Hz ≤ -128 dBc/Hz ≤ -122 dBc/Hz ≤ -117 dBc/Hz ≤ -115 dBc/Hz ≤ -111 dBc/Hz	Refer to typical data: Pages 5 ≤ -152 dBc/Hz @ 20kHz offset ≤ -140 dBc/Hz @ 20kHz offset ≤ -134 dBc/Hz @ 20kHz offset ≤ -128 dBc/Hz @ 20kHz offset ≤ -124 dBc/Hz @ 20kHz offset ≤ -122 dBc/Hz @ 20kHz offset ≤ -118 dBc/Hz @ 20kHz offset
Harmonics (CW mode) 100 MHz to 6.4GHz		**(2^{ND} / 3^{RD})** -40 / -60 dBc	**(All)** -30 dBc	Refer to typical data: Page 6 @ +10dBm
Sub-Harmonics (CW mode) 10 MHz to 1.024 GHz 1.024 GHz to 4.2 GHz 4.2 GHz to 6.4 GHz		**($^{1}I_2$ / $^{3}I_2$)** -85 / -75 dBc -70 / -55 dBc -65 / -70 dBc	**(All)** -60 dBc -40 dBc -50 dBc	Refer to typical data: Page 6 @ +10 dBm @ +10 dBm @ +10 dBm
Non-Harmonics / Spurious Broadband (CW mode) 10 MHz to 1.5 GHz 1.5 GHz to 6.4 GHz		 -80 dBc -70 dBc	 -70 dBc -60 dBc	Refer to typical data: Page 7 @ +10 dBm @ +10 dBm
Jitter 155 MHz 622 MHz 2.488 GHz		 60 fs 61 fs 55 fs	 NS NS NS	 100Hz < BW < 1.5MHz 1kHz < BW < 5MHz 5kHz < BW < 20MHz

[1] Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc.
[2] All MIN/ MAX (Minimum/ Maximum) performance parameters are guaranteed and 100% verified during final performance test.
[3] Typical performance is "by design" and consistent with field performance data.

OUTPUT POWER DATA

The data contained in this section demonstrates the typical output power performance of the HSM Series designs.

OUTPUT POWER MAXIMUM

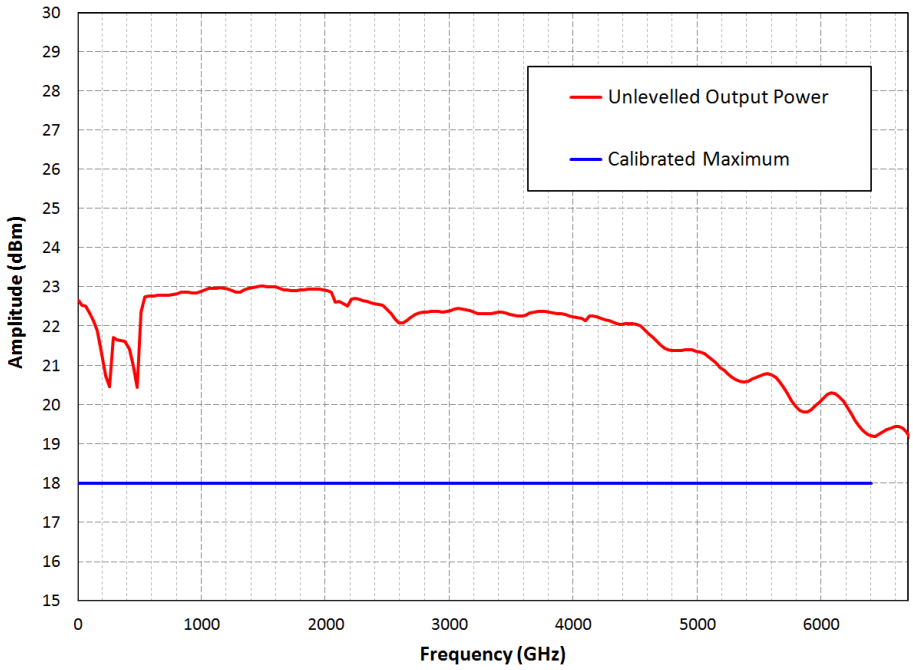
FIGURE 1:

Maximum Output Power (unleveled)

Typical Performance

10MHz - 6.7GHz

P_{OUT} Setting: +25dBm



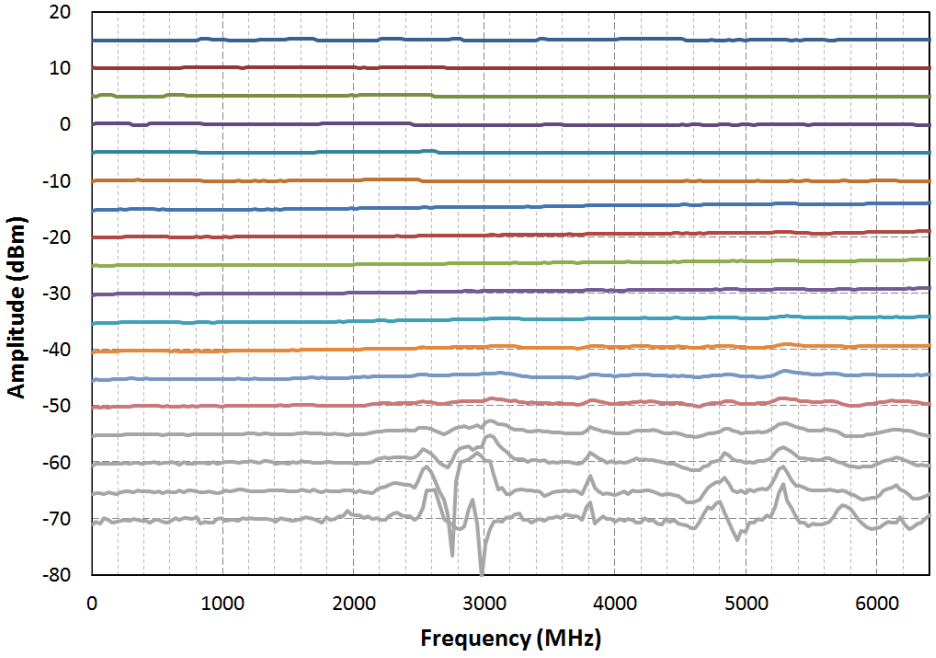
CALIBRATED OUTPUT POWER

FIGURE 2:

Calibrated Output Power

+15dBm to -50dBm

10MHz - 6.7GHz



PHASE NOISE DATA

The raw data contained in this section demonstrates the typical phase noise performance of the HSM Series designs, dependant on installation of the standard OCXO or optional ULN OCXO.

STANDARD OCXO

FIGURE 3:

Phase Noise Performance

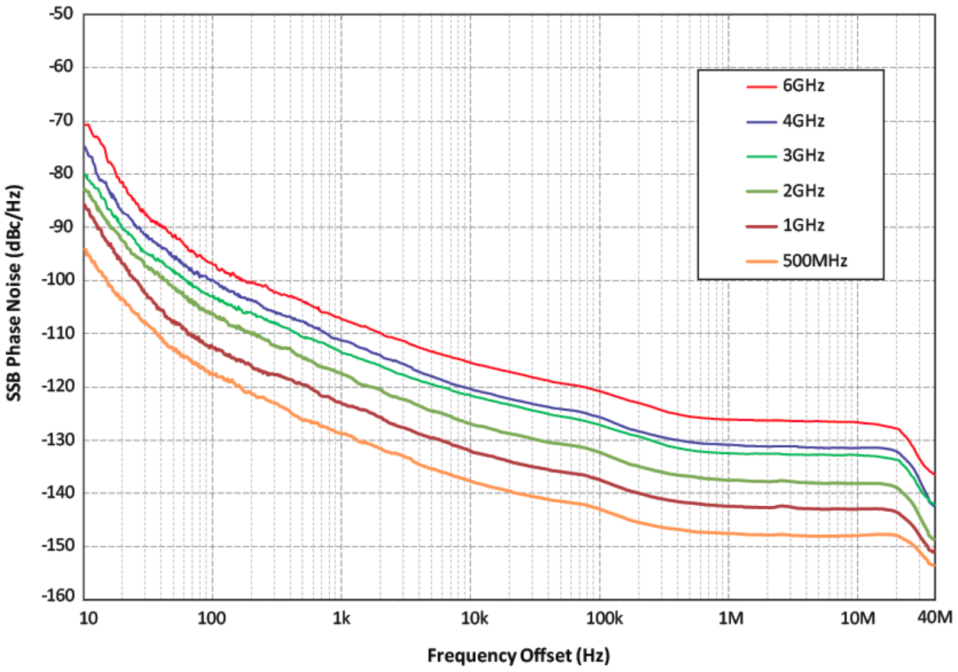
Standard OCXO

Typical Performance

500MHz - 6GHz

P_{OUT} Setting: +10dBm

Offset: 10Hz - 40MHz



ULN OCXO OPTION: OPT-OCXO

FIGURE 4:

Phase Noise Performance

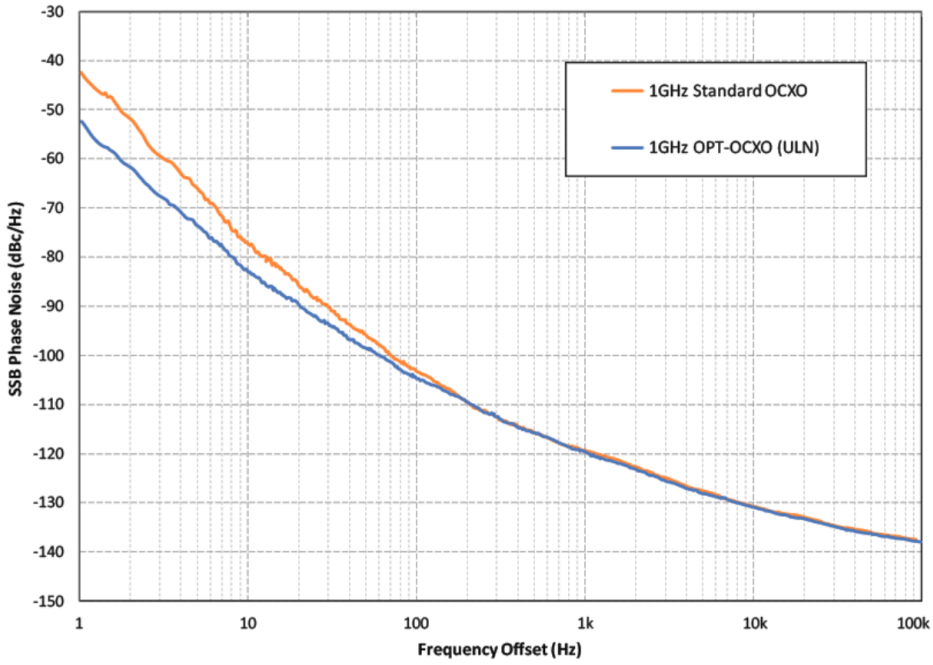
ULN OCXO (optional)

Typical Performance

1GHz Comparison

P_{OUT} Setting: +10dBm

Offset: 1Hz - 100kHz



SPECTRAL PURITY DATA

The data contained in this section demonstrates the typical spectral purity performance of the HSM Series designs.

HARMONICS

FIGURE 5:

Harmonics Performance

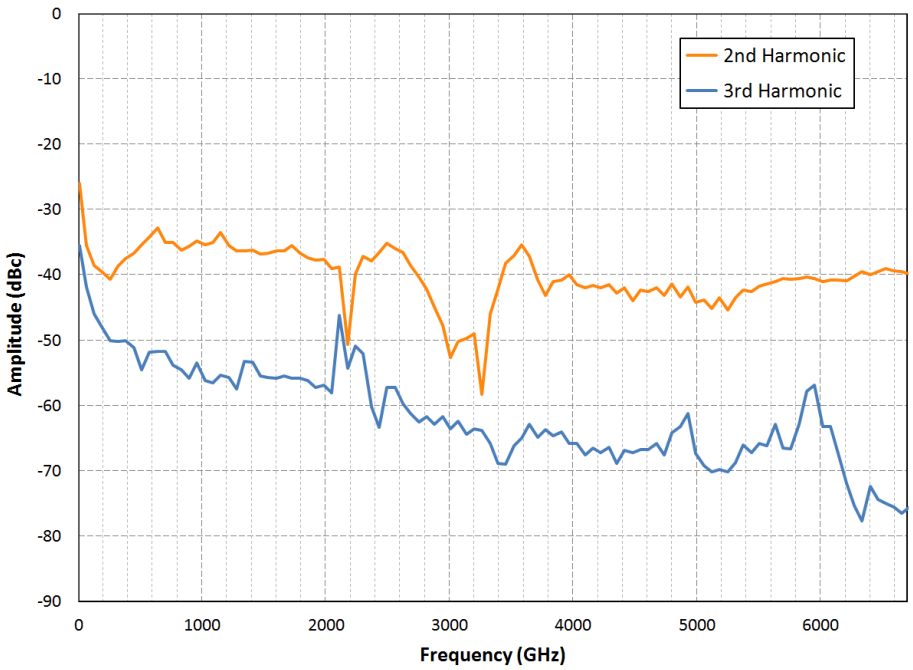
Typical Performance

10MHz - 6.7GHz

P_{OUT} Setting: +10dBm

RBW: 3kHz

VBW: 3kHz



SUB-HARMONICS

FIGURE 6:

Sub-Harmonics Performance

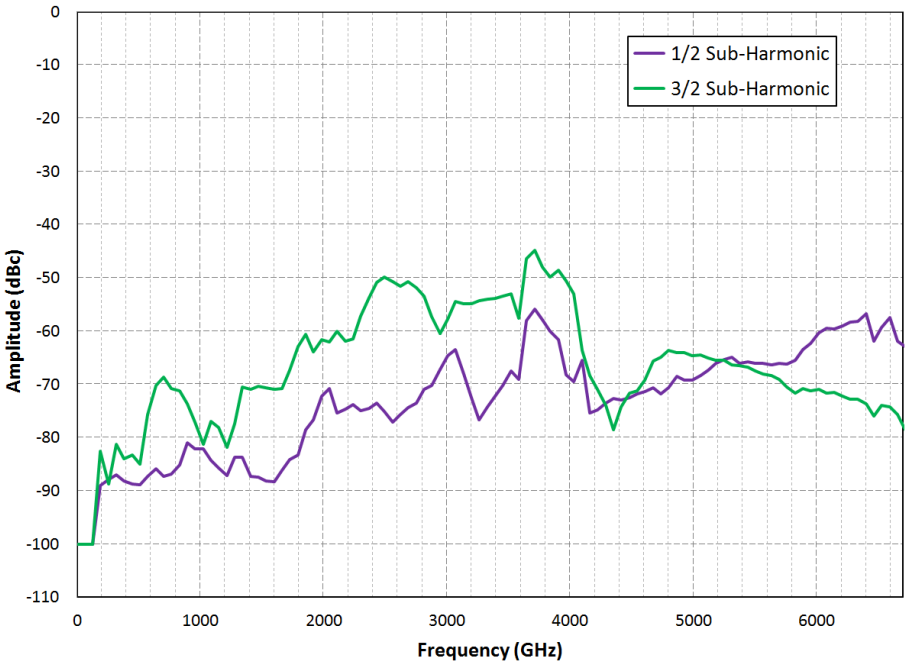
Typical Performance

10MHz - 6.7GHz

P_{OUT} Setting: +10dBm

RBW: 3kHz

VBW: 3kHz



SPECTRAL PURITY DATA (continued)

The data contained in this section demonstrates the typical spurious performance of the HSM Series designs. Test bands: 10MHz-30MHz, 30MHz-85MHz, 85MHz-2.4GHz, 2.4GHz-6.4GHz.

BROADBAND NON-HARMONICS / SPURIOUS

FIGURE 7:

Broadband Maximum Spurious Performance

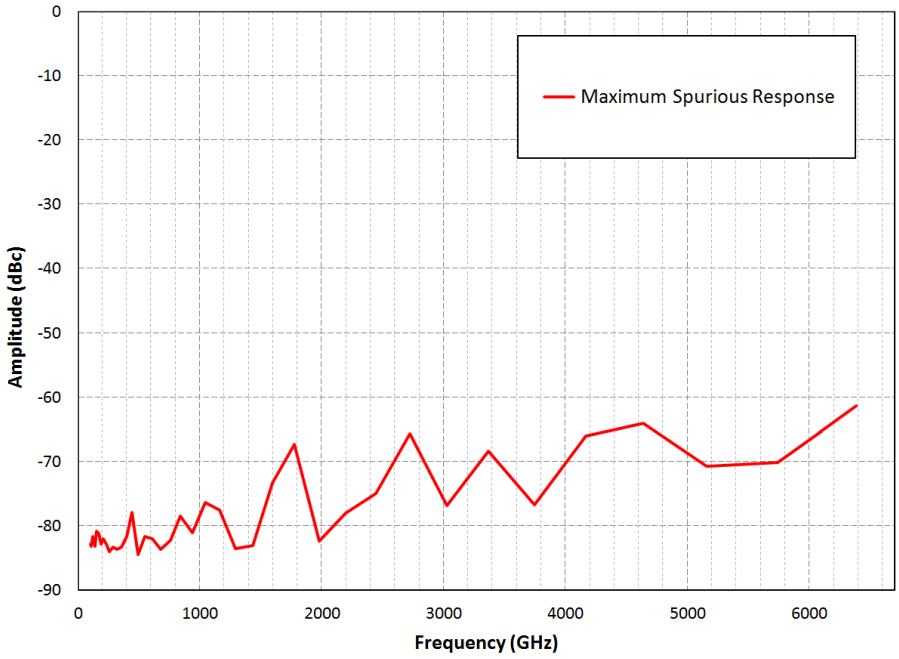
Typical Performance

10MHz - 6.4GHz

P_{OUT} Setting: +10dBm

RBW: 2kHz

VBW: 2kHz



NARROWBAND NON-HARMONICS / SPURIOUS

FIGURE 8:

Narrowband Spurious Performance

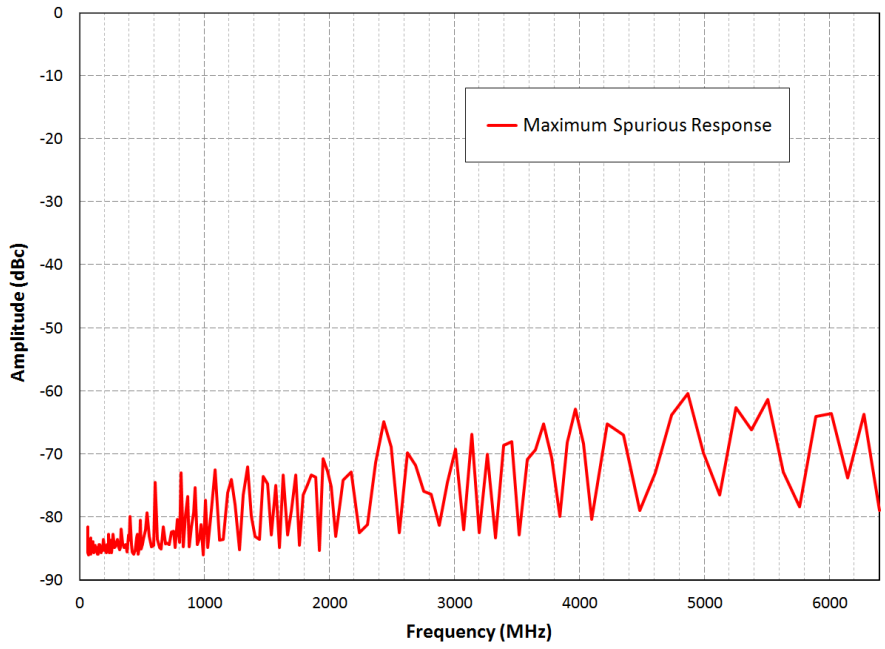
Typical Performance

10MHz - 6.4GHz

P_{OUT} Setting: +10dBm

RBW: 3kHz

VBW: 3kHz



ELECTRICAL SPECIFICATIONS - MODULATION (External Stimulus)

The modulation parameters listed here are based on modulation functions as related to the use of an external modulation stimulus. Internal "self pulse" functions are available with the current revision of the HSM series RF synthesizers (to be specified).

PARAMETER	PERFORMANCE	COMMENTS
FREQUENCY MODULATION[1] (Analog)		
Max Deviation	100 kHz	
Resolution	0.01% or 1mHz, whichever is greater	
Modulation Freq. Response	DC to 20 kHz (-3dB)	DC Coupled
Sensitivity when using Ext. Input	± 1V peak into 50Ω	+ 1V: Maximum Positive Deviation 0V: Zero Deviation from Carrier - 1V: Maximum Negative Deviation
PHASE MODULATION[1] (Analog)		
Modulation Deviation	±1.6 deg to ±180 deg	
Frequency Response	DC to 20 kHz (-3dB)	DC Coupled
Resolution	Frequency Dependent	See Phase Offset Specification
Sensitivity when using Ext. Input	± 1V peak into 50Ω	+ 1V: Maximum Positive Deviation 0V: Zero Deviation from Carrier - 1V: Maximum Negative Deviation
AMPLITUDE MODULATION[1] (Analog)		
AM Depth Type	Linear	
Depth Maximum Resolution Depth Accuracy	 5% to 75% <3% of Maximum Depth 5% of Maximum Depth	0.45 dB to 12 dB
Modulation Rate	DC to 10 kHz (-3dB)	DC Coupled
Sensitivity when using Ext. Input	± 1V peak for indicated Depth (into 50Ω)	+ 1V: Maximum Amplitude 0V: 50% of Maximum Depth - 1V: Maximum Depth
PULSE MODULATION[1] (Analog)		
Risetime (T_r)	<50 ns	
Falltime (T_f)	<50 ns	
On/Off Ratio	> 70dB	
Minimum Pulse Width	<100 ns	
ALC Loop Deviation (ALC disabled)	1dB difference from ALC enabled	

[1] Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc

PARAMETER	PERFORMANCE	COMMENTS
External Trigger Threshold	+1.2V	±5% into 50Ω

ELECTRICAL SPECIFICATIONS - PULSE MODULATION (External Stimulus cont.)

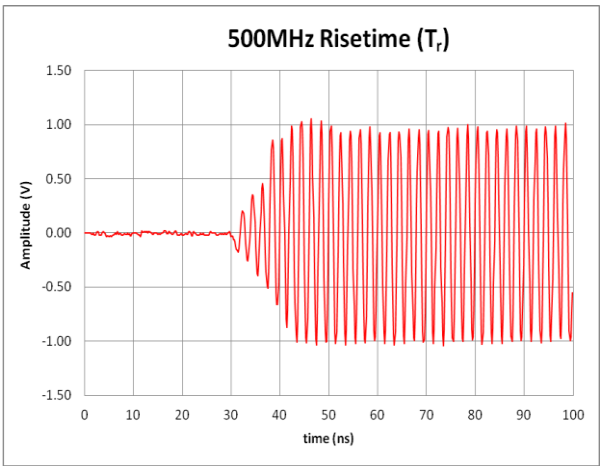


Figure 1a: Pulse Mod Rise Time, f_c = 500MHz

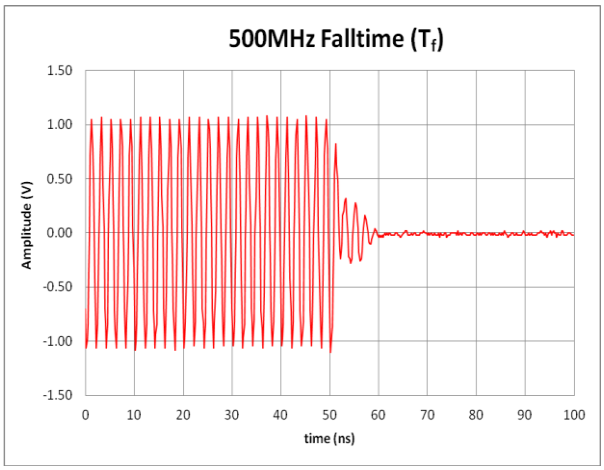


Figure 1b: Pulse Mod Fall Time, f_c = 500MHz

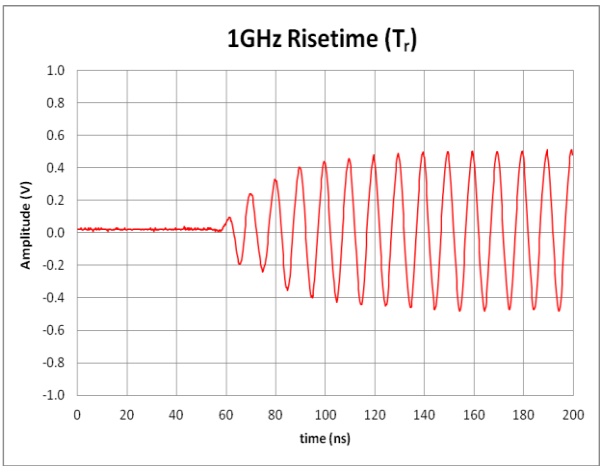


Figure 2a: Pulse Mod Rise Time, f_c = 1GHz

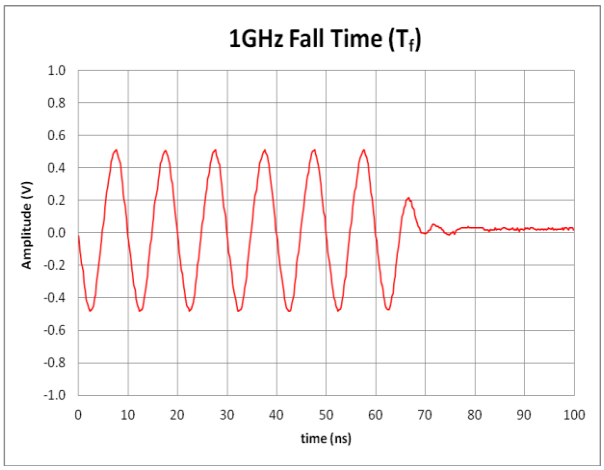


Figure 2b: Pulse Mod Fall Time, f_c = 1GHz

ELECTRICAL SPECIFICATIONS - PULSE MODULATION (External Stimulus cont.)

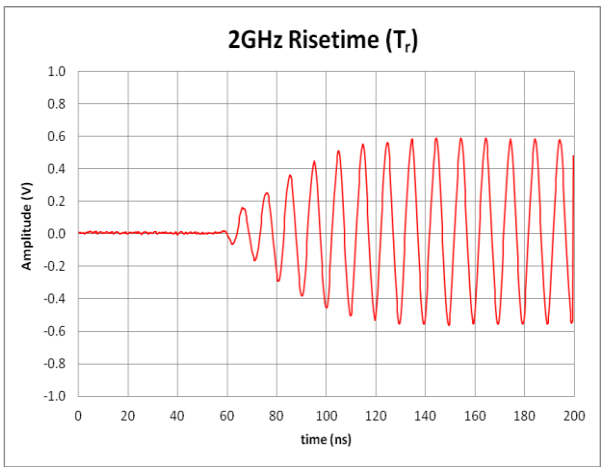


Figure 3a: Pulse Mod Rise Time, f_c = 2GHz

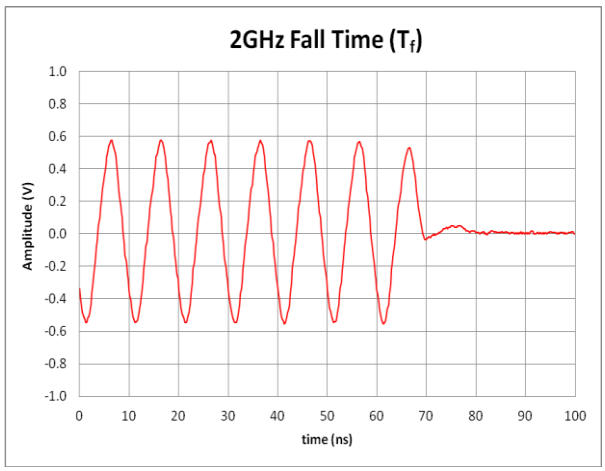


Figure 3b: Pulse Mod Fall Time, f_c = 2GHz

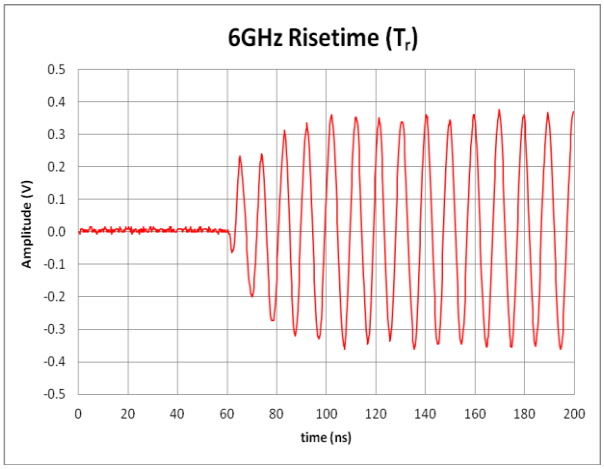


Figure 4a: Pulse Mod Rise Time, f_c = 6GHz

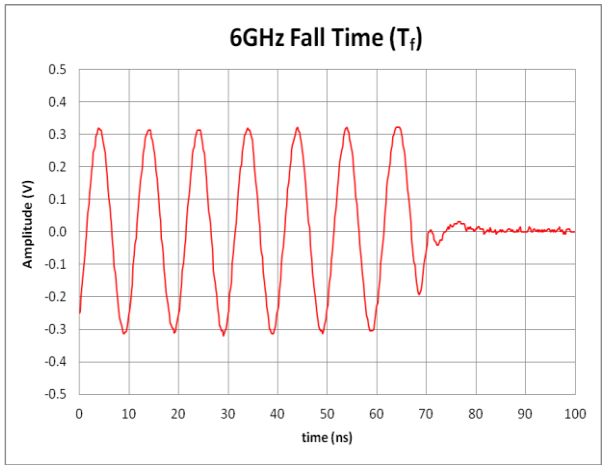
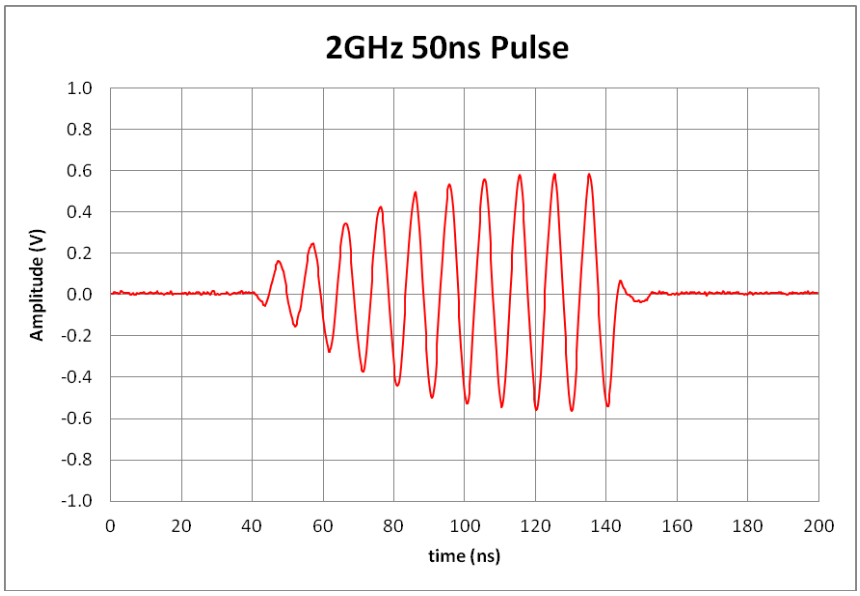


Figure 4b: Pulse Mod Fall Time, f_c = 6GHz

ELECTRICAL SPECIFICATIONS - PULSE MODULATION (External Stimulus cont.)



(Figure 5: Self Pulse Mod f_c = 2GHz, 50ns Pulse[2])

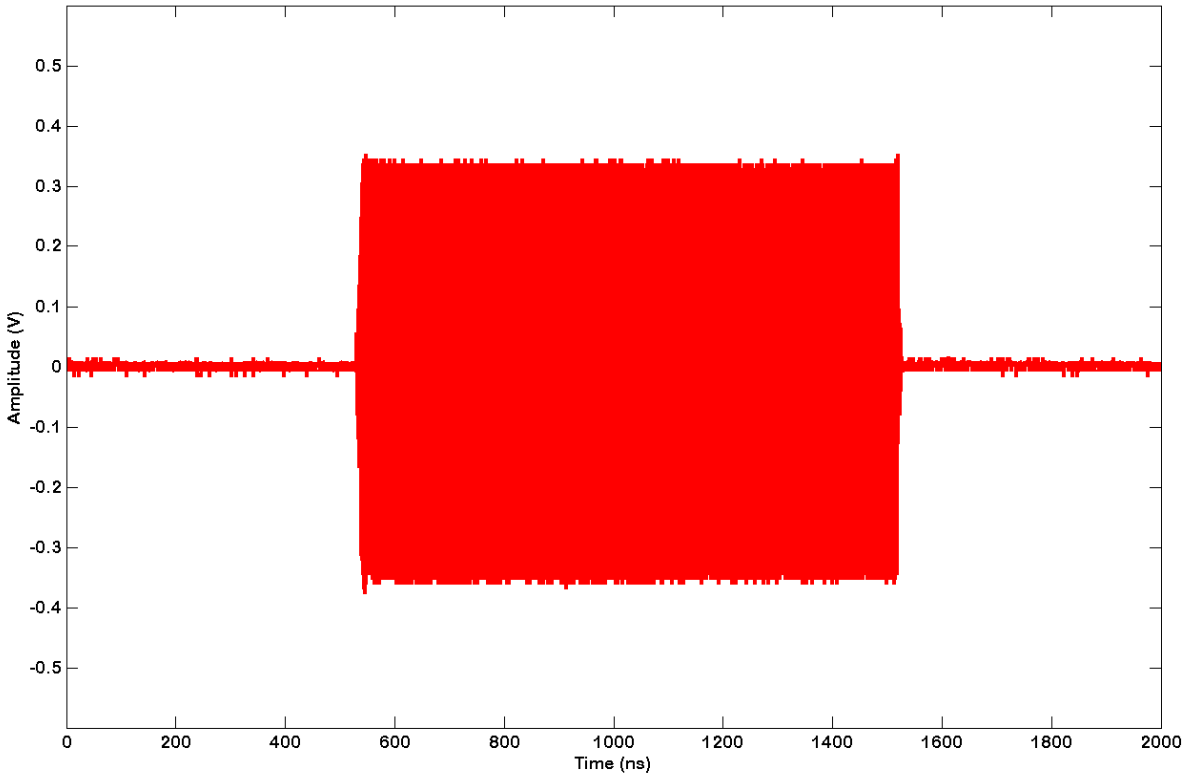
(Figure 6: Self Pulse Mod f_c = 2GHz, 100ns Pulse[2])

ELECTRICAL SPECIFICATIONS - SELF PULSE MODULATION

HSM series synthesizers that have the firmware version 3.31 or higher, are capable of operating in self pulse modulation mode, which does not require an external stimulus signal.

PARAMETER	PERFORMANCE	COMMENTS
PULSE MODULATION[1] (Analog)		
Risetime (T_r) **fc < 512MHz** **fc > 512 MHz**	 10ns (typical) 35ns (typical)	
Falltime (T_f) **fc < 512MHz** **fc > 512 MHz**	 8ns (typical) 10ns (typical)	
On/Off Ratio	> 70dB	
Minimum Pulse Width	50ns	
ALC Loop Deviation (ALC disabled)	1dB difference from ALC enabled	

[1] Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc



(Figure 1: Self Pulse Mod f_c = 500MHz, 1us Pulse[2])

[2] Internal pulse modulation for frequencies greater than 512MHz will exhibit increased settling time. Contact Holzworth customer support for additional data.

ELECTRICAL SPECIFICATIONS - SELF PULSE MODULATION (continued)

Pulse modulation will exhibit longer rise/fall times for frequencies greater than 512 MHz. Figures 2 and 3 below demonstrate this difference between set frequencies.

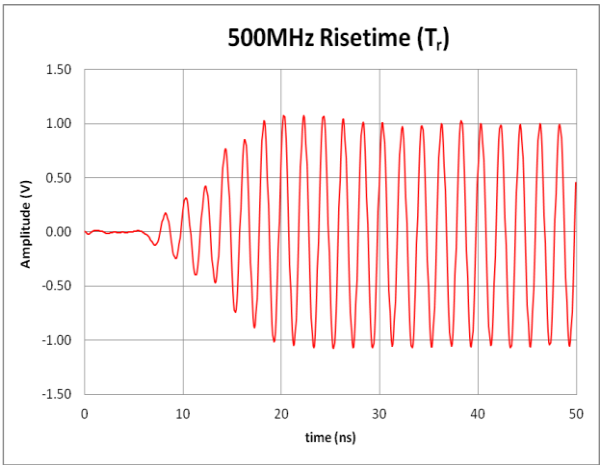


Figure 2a: Pulse Mod Rise Time, f_c = 500MHz

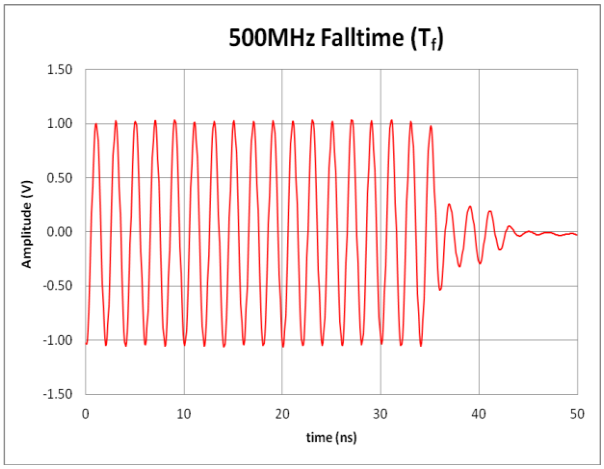


Figure 2b: Pulse Mod Fall Time, f_c = 500MHz

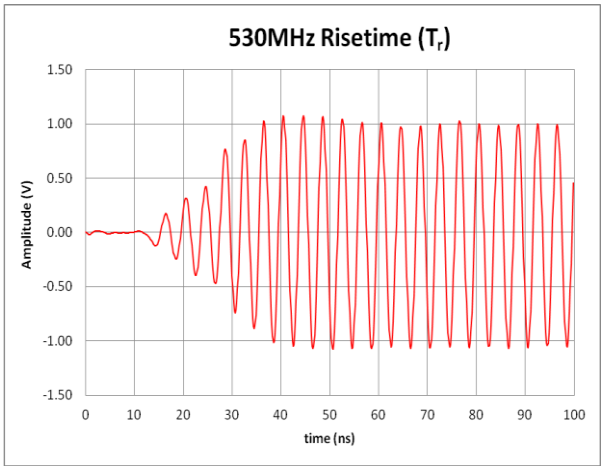


Figure 3a: Pulse Mod Rise Time, f_c = 530MHz

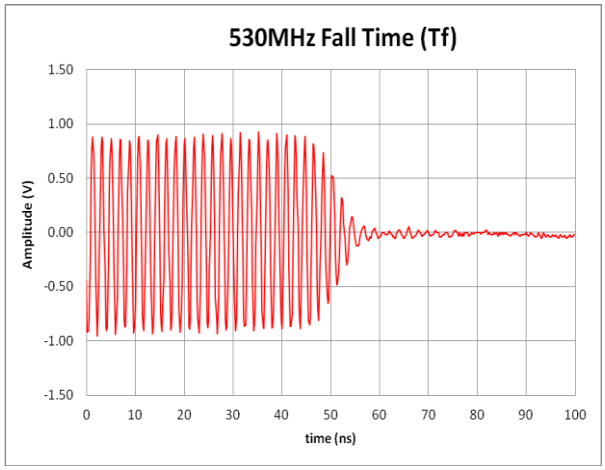


Figure 3b: Pulse Mod Fall Time, f_c = 530MHz

ENVIRONMENTAL SPECIFICATIONS [1]

Environmental specifications are based on component margins, thermal verification testing and current draw tests. Thermal characterization data is supplied with all OPT-SYS options.

PARAMETER	MIN	TYPICAL	MAX	COMMENTS
Operating Temperature				
Standard Models	0 C		+55 C	Performance tests at: +20C ±5C
Option: OPT-SYS1 [2]	-40 C		+75 C	Performance tests at: -40, +20, +75C ±2C
Option: OPT-SYS2	0 C		+55 C	Performance tests at: +20C ±5C
Option: OPT-SYS3 [2]	-40C		+75C	Performance tests at: -40, +20, +75C ±2C
Temperature Monitor Range	-40 C		+85 C	Absolute
Power Consumption[3]				
Standard Models		9 W	12 W	12W during warm-up (OCXO)
Option: OPT-SYS1		7 W		No OCXO
Option: OPT-SYS2		7 W		No OCXO
Option: OPT-SYS3		9W	12W	12W during warm-up (OCXO)
Warm-Up Time		5 min	10 min	20 C (ambient temp. dependent)

[1] Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc
[2] Extended temperature testing conducted using an external 100MHz reference.
[3] See PINOUT CONFIGURATION table on page 10 for volt/amp ratings per pin.

WARRANTY

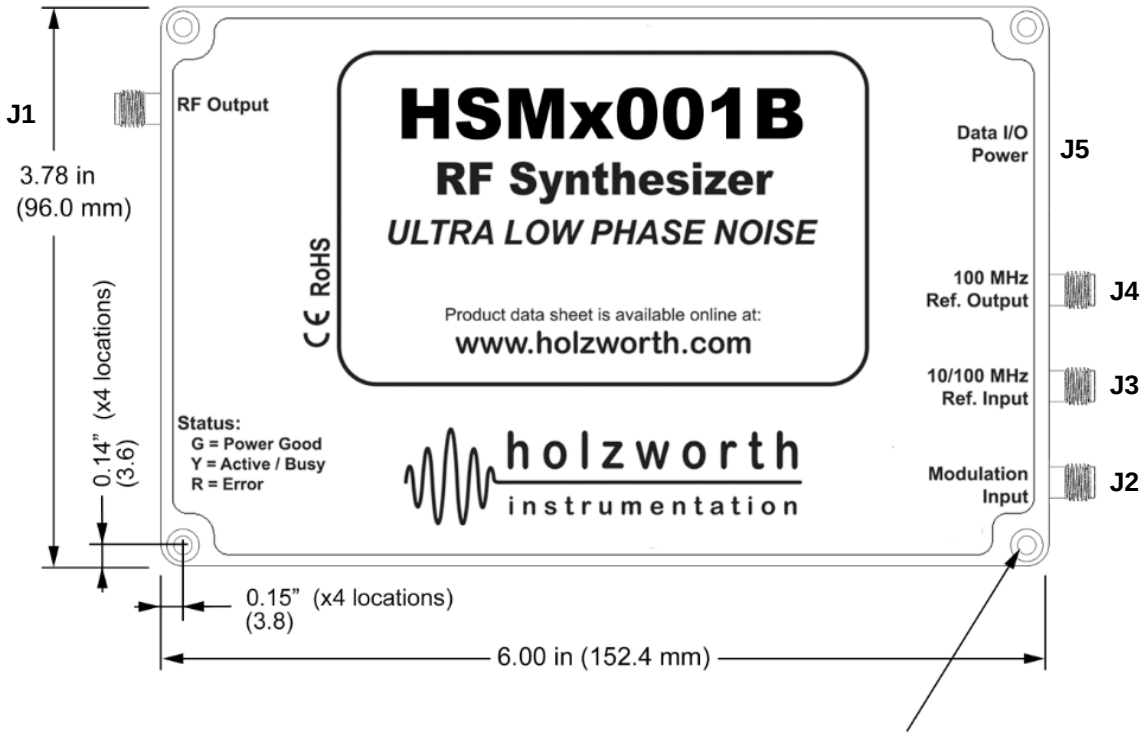
All Holzworth synthesizer products come with a standard 3 year 100% product warranty covering manufacturing defects. All product repairs and maintenance must be performed by Holzworth Instrumentation. Holzworth reserves the right to invalidate the warranty for any products that have been tampered with or used improperly. Refer to Holzworth Terms & Conditions of Sales for more details.

Holzworth products are proudly designed and manufactured in the USA.

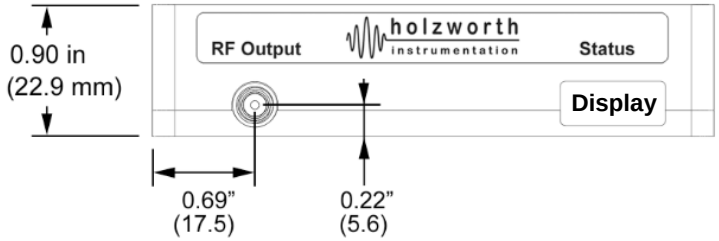
MECHANICAL CONFIGURATION (Standard and OPT-SYS3)

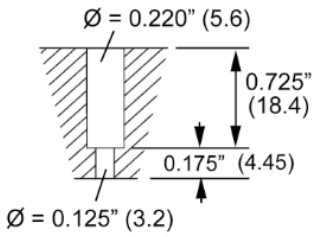
Mechanical details are in both inches and millimeters (listed inside parenthesis). All dimensions hold tolerances to within ±0.010 inches.

TOP VIEW

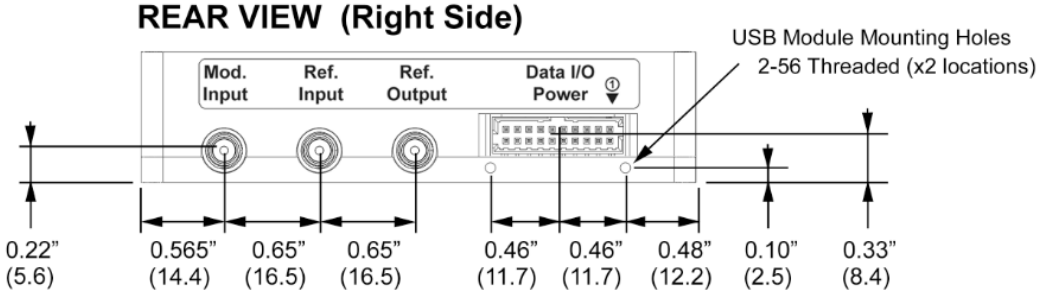


FRONT VIEW (Left Side)



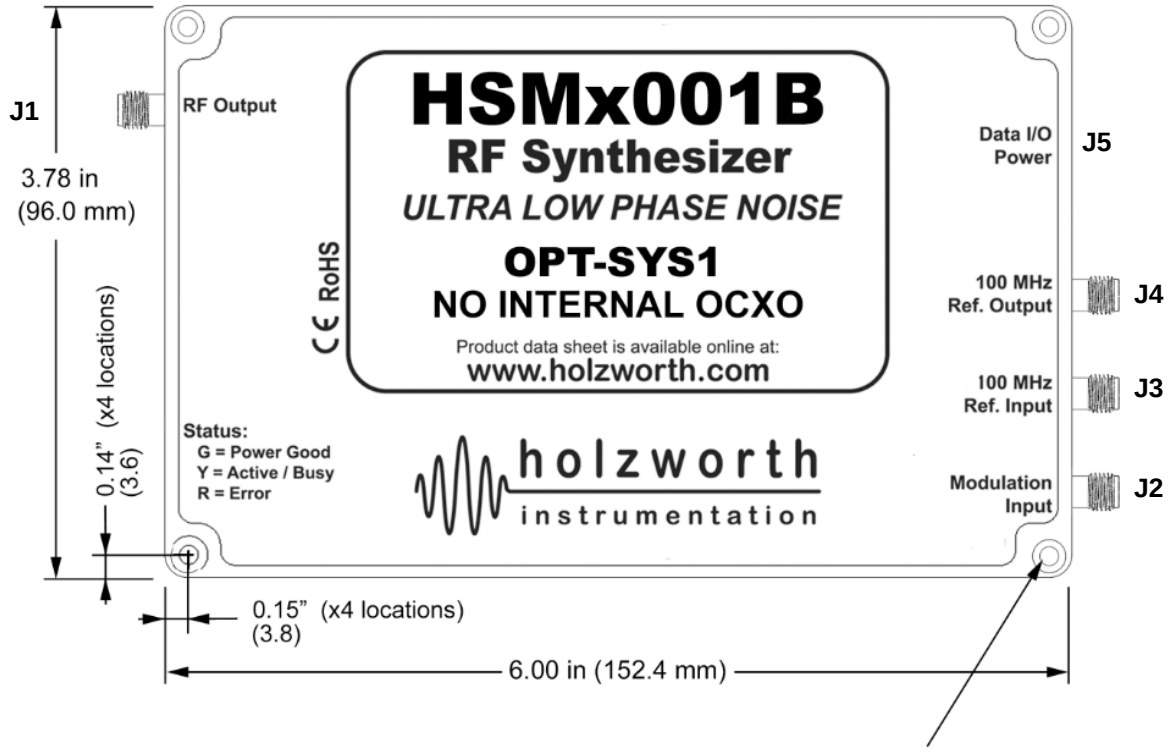


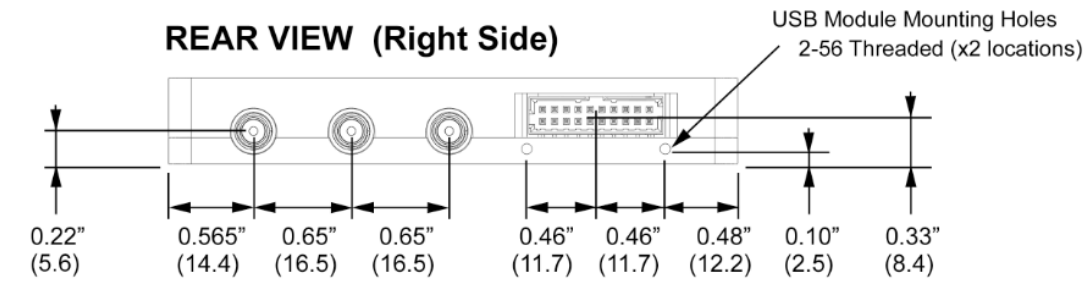
REAR VIEW (Right Side)



MECHANICAL CONFIGURATION - OPTIONS: OPT-SYS1 / OPT-SYS2

Option “OPT-SYS1” & “OPT-SYS2” do not contain an OCXO, allowing for an extended operating temperature range and smaller form factor. An external 100MHz reference is required. OPT-SYS1 units are performance tested over full specified temperature range. Mechanical details are in both inches and millimeters (listed inside parenthesis). All dimensional tolerances are within ±0.010in.





INTERFACE DEFINITIONS

The interfaces defined within this section are cross referenced to the mechanical configuration included in this document. Ports are labeled on the synthesizer modules, but numbers are not physically printed on the module.

J-PORT DEFINITIONS

PORT	LABEL	DESCRIPTION
J1	**RF Output**	SMA Jack, Multiplexed, 50ohm Input • Max Reverse Power: 10dBm (10mW)
J2	**Modulation Input**	SMA Jack, Multiplexed, 50ohm Input • Frequency Modulation: ± 1 V Analog Input • Amplitude Modulation: 0 to 1 V Analog Input • Phase Modulation: ± 1 V Analog Input • Trigger/Pulse mod: 1.2 V Threshold • Max Voltage: $5V_{DC}$
J3	**10/100 MHz Ref. Input**	SMA Jack: 10MHz/100MHz Reference Input (software selectable) • 10MHz: 0dBm to +10dBm Input (PLL Lock Range: ±1ppm) • 100MHz: +4 dBm out, ± 2 dB Input (Internal OCXO is shut off) • Maximum Input: 15dBm (32mW)
J4	**100MHz Ref. Output**	SMA Jack: 100MHz Reference Output • 100MHz: +4 dBm out, ± 2 dB (nom) • Max Reverse Power: 15dBm (32mW)
J5	**Data I/O - Power**	2mm, 20pin (2x10) Milli-grid Shrouded Pin Header (detent type) Contains Power, Ground, SPI and Status Indicators
Display	**Status**	Tri-color LED Indicator Panel: GREEN = Power Good YELLOW = Communication Active / Busy / Not Ready RED = ERROR (i.e. no 10MHz PLL lock, Unleveled, *etc.*)

PINOUT CONFIGURATION

PIN No.	Label	PIN No.	Label
1	GND	2	GND
3	+ 5V, 1A (max)	4	+5V tied to pin 3
5	+12V , 400mA (nom), 600mA (warm-up)[1]	6	N.C. (reserved)
7	NC	8	N.C. (reserved)
9	INPUT: /RESET (10k PU to 3.3V)	10	N.C. (reserved)
11	INPUT: /CS (Synthesizer Select)	12	N.C. (reserved)
13	OUTPUT: SDO (Synthesizer Data Output)	14	OUTPUT: Power Good (OC – 47k PU to 3.3V)
15	INPUT: SDI (Synthesizer Data Input)	16	OUTPUT: /ERROR (OC – 47k PU to 3.3V)
17	INPUT: SCLK (Synthesizer Clock Input)	18	OUTPUT: /BUSY (OC – 47k PU to 3.3V)
19	GND	20	GND

J5 PIN LABEL DEFINITIONS

PIN Label	DEFINITION
+5V	Nominally pulls 1A from the +5V Rail. Initially at power on the draw will be 100mA then increase as subsystems power-on. Tolerance +10% to -2%. 4.9V to 5.5V.
+12V [or +15V]	Nominally 400mA draw at steady state. 600mA draw at startup for at least 5 mins for OCXO power\ on. +15V O.K.. but increases power dissipation. Units without OCXO will draw constant 175mA (OPTT-SYS1 & OPT-SYS2).
NC	No Connect. Voltage supply pin. Not currently used.
/RESET	Active low on this pin put the module in reset, releasing it returns to reset operation. Module is ready 1-2 seconds after /RESET is released. 10K pullup to 3.3V in parallel to 0.01uF cap to ground.
/CS	Communications chip select, active low. 47K pullup on this line. /CS must be low for any communication to occur. Allows for multiple synthesizer modules on 1 spi bus. 3.3V logic levels, 5V tolerant.
SDO	Synthesizer (module/slave) Data Output. Connects to Master Serial Data Input (Active when chip select is low. High-Z when /CS is high. 47K pulldown. 3.3V logic levels, 5V tolerant.
SDI	Synthesizer (module/slave) Data Input. Connects to Master Serial Data Output (High-Z input on module. 3.3V logic levels, 5V tolerant. 47K pulldown.
SCLK	SPI Clock (slave clock input). Idle Low, Active High. Data is transitioned into the module on a rising low to high transition. Data is transitioned out on the same edge and is valid on the falling edge of SCLK. 3.3V logic levels, 5V tolerant. 47K pulldown.
Power Good	Open collector output, 47k pullup to 3.3V. When high, power is healthy. When low, either voltages or currents are problematic. Module may not operate correctly. There is a 0.5 second delay from when power is applied to a valid PowerGood. Actual PowerGood may take up to 2 seconds to go high due to some very stable internal references that are settling. This may be multiplexed with other HSM6001 synthesizers.
/ERROR	Open collector output, 47k pullup to 3.3V. Nominally high. If an error condition occurs, such as a PLL unlock or un-leveled condition, this will go active low. This can be multiplexed with other HSM6001 synthesizers.
READY or /BUSY	Open collector output, 47k pullup to 3.3V. Nominally high. After an SPI communication, if a command has been issued, then the /BUSY will go active low until that command is finished. During this time no communication may occur and SPI bus will be asleep.
N.C.	These are reserved lines for use in our communications module. They should be left floating.

J5 (SPI) MATING CONNECTOR PART NUMBERS

APPLICATION	MOLEX PART NUMER	DESCRIPTION
IDC Ribbon	Molex 87568-2093	2mm Milli-Grid, 20pin (2x10) Female, Polarization and Ramp Locking
Vertical PCB Thru Hole	Molex 79107-7009	2mm Milli-Grid, 20pin (2x10) Female, NO Polarization or Ramp Locking
Vertical PCB SMT	Molex 79109-1009	2mm Milli-Grid, 20pin (2x10) Female, NO Polarization or Ramp Locking

SPI COMMUNICATIONS

BUS OVERVIEW

The SPI bus is a byte oriented bus, sending 8bits at a time. Any number of bytes may be sent, from 1 byte to 64 bytes while chip select is low. Bytes sent beyond 64 bytes will be ignored. The data is held in a buffer until chip select goes high, initiating the parsing of the data and execution of the commands. The maximum speed of the bus is 10Mbits/s. Data may be written to the module and data may be received from the module. After a command is sent requesting data, the next transfer sends this data out on SDO. During the read, a new command may be send and will be parsed when chip select goes high. A read is always followed by a write with a read request.

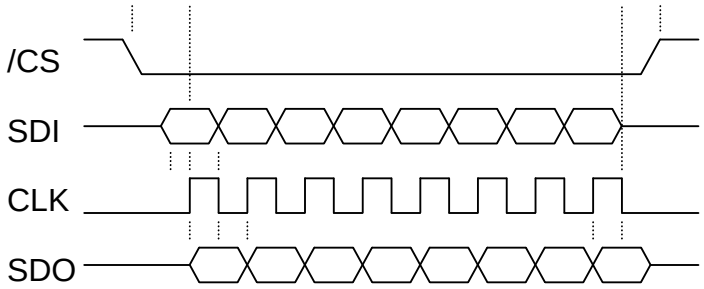
BUS HARDWARE PROTOCOL

Data is clocked into the module on the rising edge of sclk. Data is clocked out of the module on this same edge. Data output is valid on the falling edge of sclk. Data is only transferred when chip select is low. When chip select goes high, this initiates the parsing and execution of data.

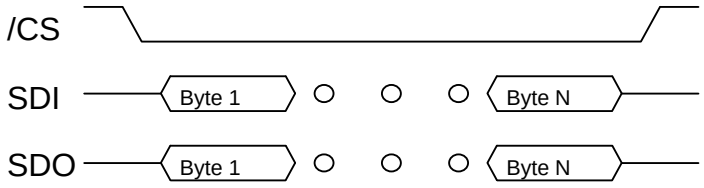
CONTROLLING MULTIPLE SYNTHESIZERS

The SPI bus may be daisy chained. The Status flags can be daisy chained as well, they are open-collector. Each synthesizer requires its own chip select in a multiple channel scenario.

SPI TIMING



The figure above demonstrates bit level timing where data is sampled into and out of the module on the rising edge of SCLK (Slave Clock). Data out is valid on the falling edge of SCLK.



The above figure displays how byte level communications occurs. Any number of bytes may be sent. After /CS goes high, the data is parsed and executed. If no data is sent, the SPI communications module simply resets itself and no parsing or execution of data occurs. If /CS goes high in the middle of a byte transfer (1-7 bits are sent instead of 8) this byte is ignored.

OPTIONS

Holzworth HSM series RF synthesizers have options to assist with better meeting specific systems requirements.

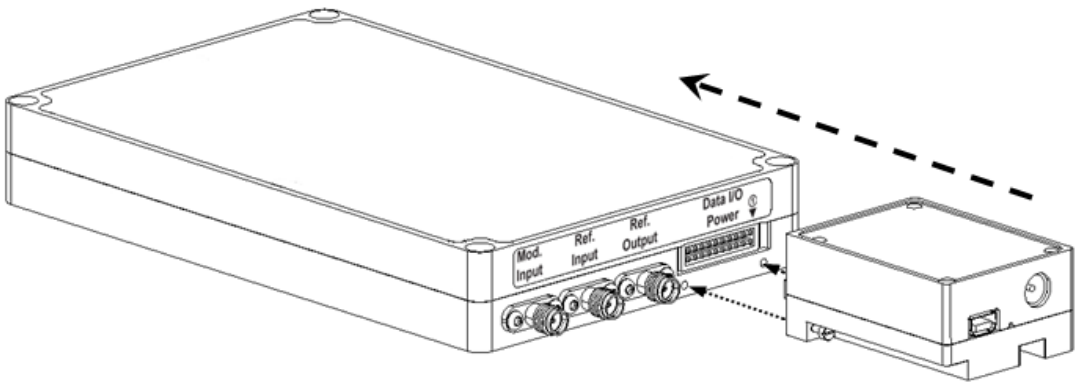
OPT-OCXO	10dB Improved Close to the Carrier Phase Noise (1Hz offset)
OPT-SYS1	14mm Profile (no OCXO), Tested over extended Temp. Range
OPT-SYS2	14mm Profile (no OCXO), Tested over standard Temp. Range
OPT-SYS3	Includes internal OCXO. Tested over extended Temp. Range with external 100MHz reference.

Communications modules are also made available for ease of integration or simply to match legacy laboratory communications requirements. USB, Ethernet, *etc.* modules can be purchased directly from Holzworth.

HCM1	USB Communications Module with power supply
HCM3	Ethernet Communications Module with power supply

HCM Communications Module Installation

The HCM Communication Module is an SPI to USB (or Ethernet) adapter that also includes a power supply adapter allowing the user to connect the RF synthesizer to standard AC power. The selected HCM Module creates a USB (or Ethernet) connection to a PC so that the Holzworth GUI, LabVIEW™, MATLAB™, *etc.* can be utilized to control the source. No drivers are required to run the Holzworth GUI.



Each variation of the HCM Communications Module securely fastens to the synthesizer and comes complete with an AC power supply and the appropriate cable. HCM modules are a recommended accessory as the first step in integrating the HSM series synthesizers via the SPI bus. More information is available upon request.

CONTACT INFORMATION

Contact Holzworth directly for a product quotation, a product demonstration, or for technical inquiries.

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