

## PRODUCT SUMMARY

The Holzworth HS3002A RF Synthesizer is a stand alone, ultra low phase noise, two channel CW source. Capable of tuning frequencies from 8MHz to 3GHz in 0.001Hz step resolution, this versatile multi-channel synthesizer can be controlled directly by the proprietary application software, LabVIEW™, MATLAB™ or any control program/language capable of calling header commands within a .DLL file.

Key product features include:

- **PHASE COHERENCY: channel-to-channel and unit-to-unit**
- **Industry leading phase noise performance (-151 dBc/Hz)**
- **Phase Offset tuning resolution of 0.1 degree**
- **Frequency tuning resolution of 0.001 Hz**
- **Amplitude tuning resolution of 0.1 dBm**
- **1U high, 19in rack mount design**
- **CE and RoHS certified design**

The attractive performance-to-price ratio makes Holzworth RF Synthesizers optimal solutions for precision measurement/phased array test systems where maintaining absolute phase coherency across multiple channels is imperative. Holzworth multi-channel synthesizers are available in a compact, reinforced, rack mountable form factor. The design has been optimized to maintain best in class channel-to-channel phase drift over both temperature and time.

## PROVEN PERFORMANCE

Holzworth Instrumentation has been providing versatile ultra low phase noise products since 2004.

Holzworth RF synthesizer products are designed to meet the phase noise, spurious and harmonic performance levels that are demanded of laboratory grade references. To push the envelope even further, Holzworth design engineers have also created a highly reliable electronics architecture inside a compact form factor for the highest level of portability from a multi-channel synthesizer contained in a unit height of only 1.75 inches.

Holzworth multi-channel RF Synthesizer designs are built off of Holzworth's field proven single channel platforms, which demonstrated the highest levels of reliability and performance in endless applications worldwide. Furthermore, the Holzworth engineering team has developed a proprietary synchronization architecture which enables unmatched phase coherency performance.

All Holzworth synthesizer products undergo full burn-in and 100% final performance testing to verify stability and phase noise performance. The end user receives product that performs as specified.

**SPECIFICATION**

The specified<sup>2</sup> parameters for the HS3002A 3GHz RF Synthesizer are fully verified at final performance test and 100% guaranteed for the warranted life of the product.

PARAMETER	MIN	TYP	MAX	UNITS	COMMENTS	
RF Output Frequency Range	8 M		3 G	Hz	50 ohms output impedance	
RF Output Frequency Resolution		0.001		Hz		
Output Power Range 8 MHz to 1 GHz 1 GHz to 3 GHz	- 110 - 110		+ 15 + 12	dBm dBm	} -110dBm is a typical minimum	
Output Power Resolution		0.1		dB		
Output Power Accuracy 0dBm to max -20dBm to 0dBm -50dBm to -20dBm -80dBm to -50dBm -110dBm to -80dBm		±0.3 ±0.5 ±1.0 ±3.0 ±5.0	±1.00 ±2.00 ±4.00 ±6.00 ±10.0	dB dB dB dB dB	} Verified only at max freq, +10dBm. See data in Figure 4.	
Output Phase Offset Range	0		360	deg		
Phase Drift (channel-to-channel)		±0.5	±1.0	deg		Post warm up. 1hr at 20C ±2C. See Fig 1&2
Output Phase Offset Resolution Below 1GHz 1GHz to 2GHz 2GHz to 4GHz 4GHz to 3GHz		0.1 0.2 0.4 0.8		deg deg deg deg		
Switching Speed USB Interface Wideband Lookup Narrowband Lookup (<5% BW)		1.0 50 5		ms µs µs		Limited by USB HID Protocol Any frequency over full instrument BW Any frequency within 5% BW
Settling Time Wideband Narrowband (<5% BW)		< 40us < 1us		µs µs		
ALC Bandwidth		40		kHz	ALC fine tunes P <sub>OUT</sub> leveling ±2.5dB. Major leveling managed by fixed attenuation.	
Phase Noise <sup>1</sup> 100MHz, 10kHz offset 1GHz, 10kHz offset 2GHz, 10kHz offset 3GHz, 10kHz offset		-151 -131 -125 -121		dBc/Hz dBc/Hz dBc/Hz dBc/Hz	Refer to data in Figure 3 Refer to data in Figure 3 Refer to data in Figure 3 Refer to data in Figure 3	
Output Spurious Signals		-70 -100	-60 -90	dBc dBm	Whichever is higher. See data in Fig 5-8 Reference Spurs Related by Nx 100MHz	
Output Harmonics		-40	- 30	dBc	+8dBm, >50MHz. See data in Figures 5 - 10	
Output Sub-Harmonics		-70	-60	dBc	Refer to data in Figures 5 - 8	
Operating Temperature Range	0		35	C		
Initial Reference Accuracy			100	ppb	Within 1 <sup>st</sup> month of operation	
Reference Aging		50		ppb/mo	1ppm/yr max	
Reference Temp Stability			500	ppb	0C to 35C	
Reference Frequency Input/Output		10/100		MHz	Auto-detection. Output matches input	
Reference Input Level	+3	4	+5	dBm		
Reference Output Level	+3	4	+5	dBm		
Reference Input/Output Impedance		50		ohms		
Reverse Power Protection			+15	dBm		
Power Consumption		12	15	W	6 V <sub>DC</sub> at 2.5A (± 5%) maximum	

<sup>1</sup> Final performance phase noise verification at 100MHz & 3GHz, P<sub>OUT</sub>=+12dBm

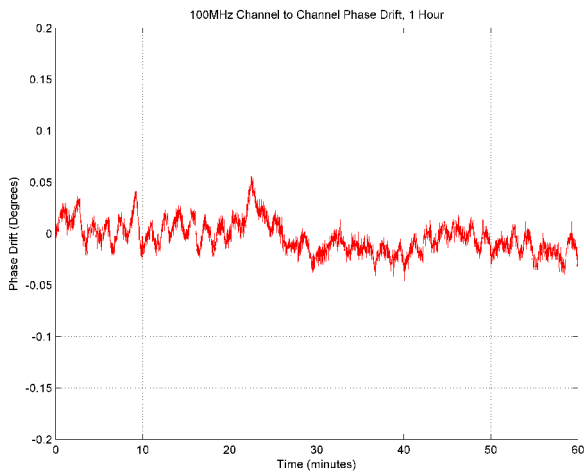
<sup>2</sup> Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc

**MODULATION PERFORMANCE for OPTIONS:** See options: OPT-EXTMOD and OPT-EXTMOD1

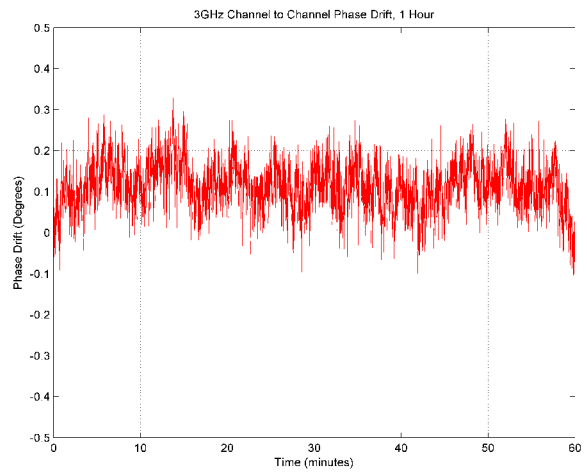
PARAMETER	MIN	TYP	MAX	UNITS	COMMENTS
Modulation (DC Coupled)					
Rate	DC		40k	Hz	10kohm input impedance
Frequency Deviation	1		40k	Hz	±1V Input (10kohm)
Amplitude Modulation Depth	5		95	%	Linear, 0 to 1V Input (10kohm)
Phase Deviation	1		180	degrees	±1V Input (10kohm)
Pulse Modulation					
Threshold Voltage		1.65		V	3.3V/5V CMOS / TTL Compatible
On/Off Ratio		-90	-70	dBc	For POUT> -20dBm
Repetition Frequency	DC		1 M	Hz	
Pulse Width	200			ns	
T <sub>r</sub> /T <sub>f</sub>		100		ns	

### PHASE DRIFT PERFORMANCE

Holzworth non-PLL based multi-channel RF synthesizers provide superior channel-to-channel phase coherency. The unique architecture also leverages a channel-to-channel phase drift advantage over other synthesis solutions. Figures 1 and 2 demonstrate channel-to-channel phase drift over a 1 hour period under ambient laboratory conditions (20C ±2C).



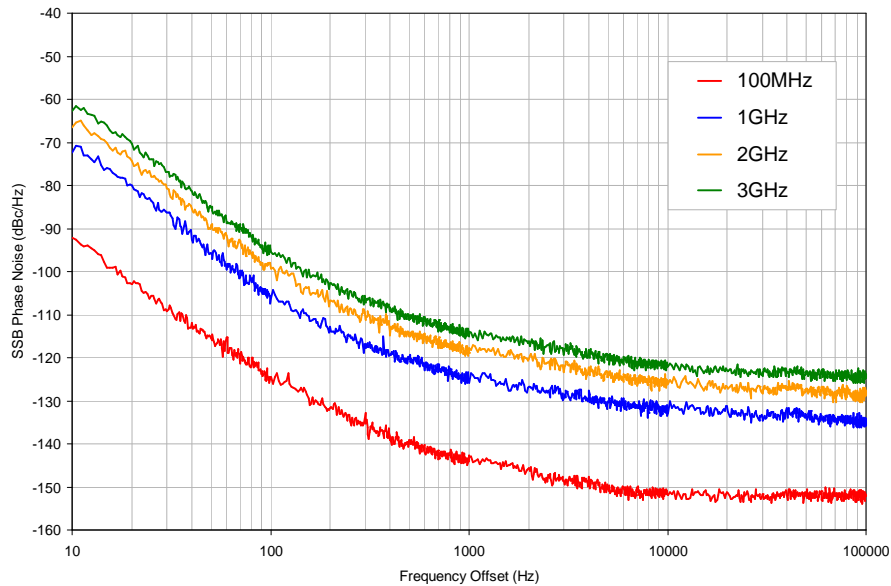
**Figure 1: 100MHz Phase Drift (1hr, 20C)**



**Figure 2: 3GHz Phase Drift (1hr, 20C)**

**PHASE NOISE**

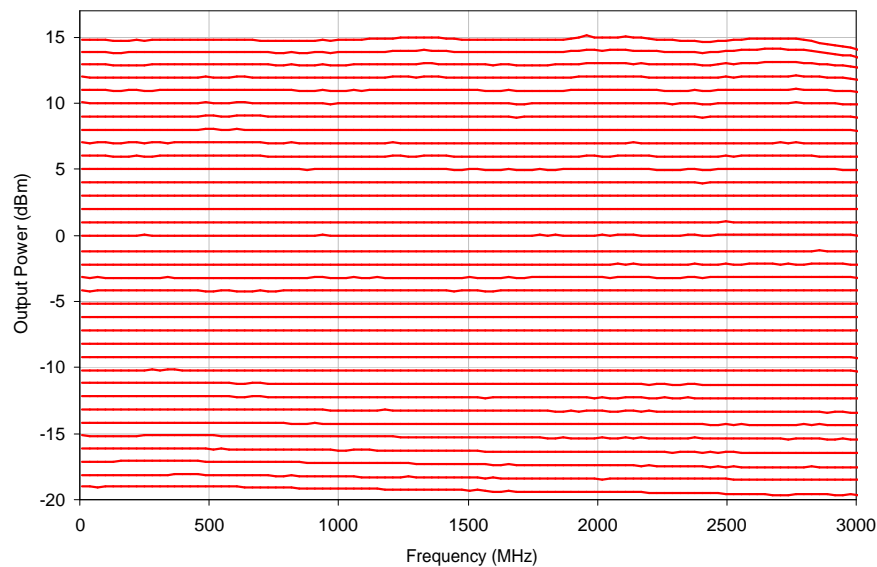
The raw data displayed in Figure 3 is of SSB Phase Noise vs. Frequency Offset as measured for the HS3002A RF Synthesizer. All data was collected at an output power setting of +12dBm.



**Figure 3: SSB Phase Noise at 100MHz, 1GHz, 3GHz & 3GHz ( $P_{OUT}=+12dBm$ )**

**OUTPUT POWER FLATNESS**

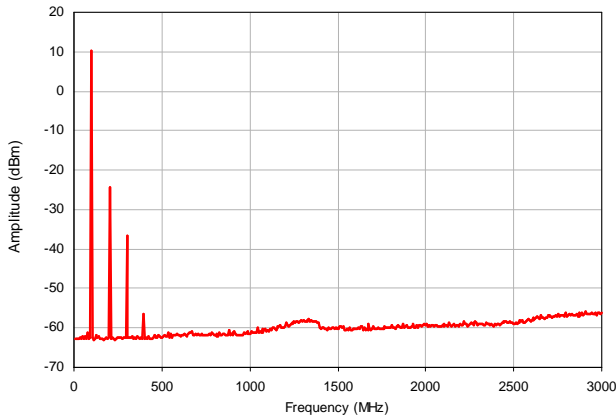
The data contained in Figure 4 demonstrates the output power flatness performance from -19dBm to +15dBm (1dB increments), over a frequency range of 8MHz to 3GHz.



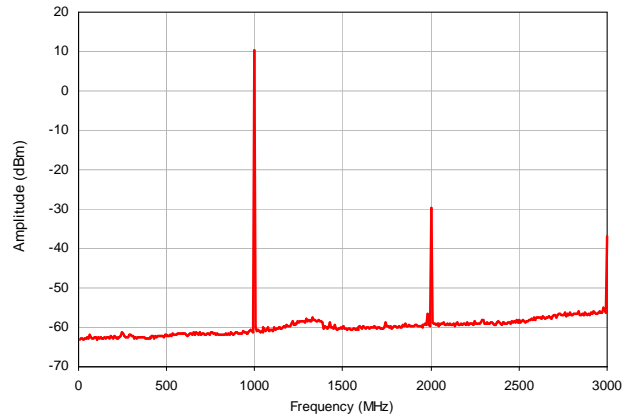
**Figure 4: Output Power Flatness vs. Frequency**

**SPECTRAL PERFORMANCE**

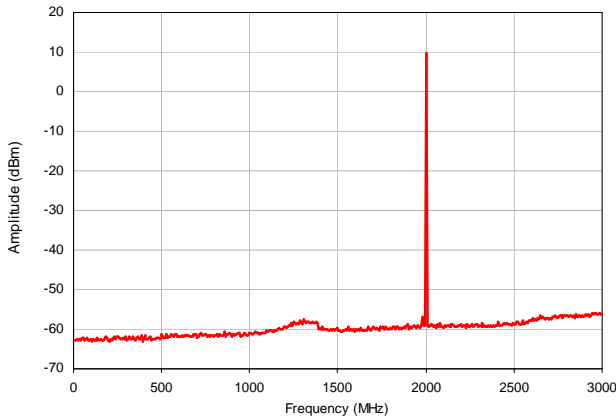
The data contained in Figures 5 through 8 demonstrate the spectral purity performance of the RF synthesizer at 100MHz, 1GHz, 2GHz and 2.9GHz carriers ( $P_{OUT} = +10\text{dBm}$ ).



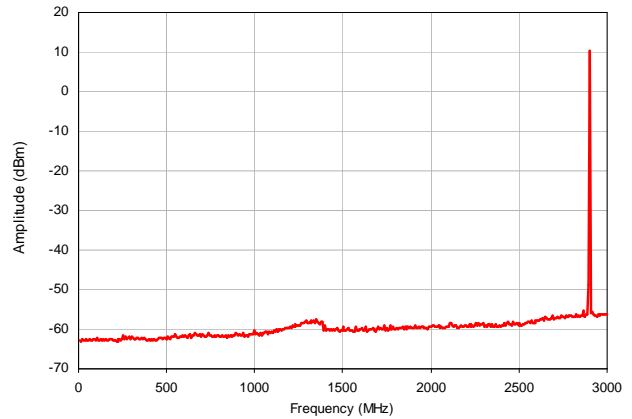
**Figure 5: Spectral Data at 100MHz ( $P_{OUT} = +10\text{dBm}$ )**



**Figure 6: Spectral Data at 1GHz ( $P_{OUT} = +10\text{dBm}$ )**

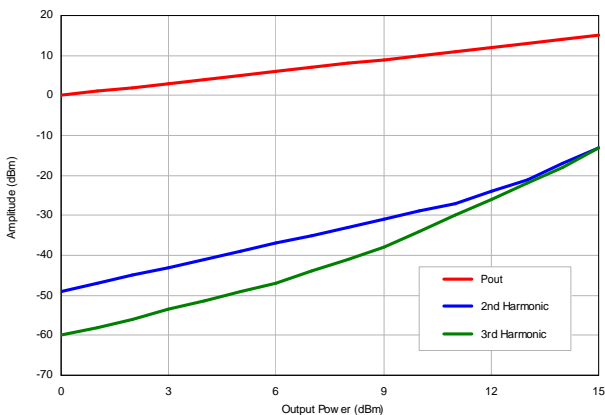


**Figure 7: Spectral Data at 2GHz ( $P_{OUT} = +10\text{dBm}$ )**

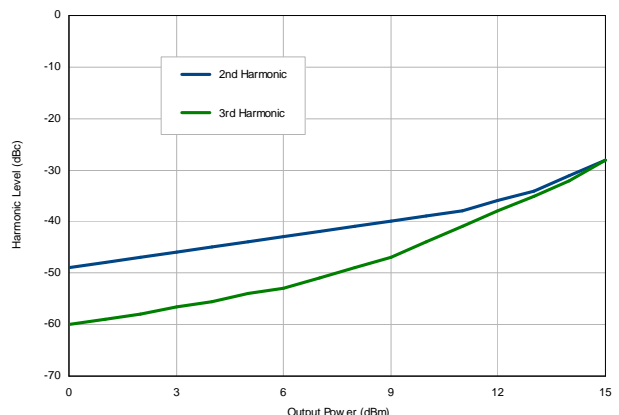


**Figure 8: Spectral Data at 2.9GHz ( $P_{OUT} = +10\text{dBm}$ )**

Figure 9 demonstrates the absolute performance of the 2<sup>ND</sup> and 3<sup>RD</sup> harmonics as they vary with the output power setting of the synthesizer. Figure 10 shows the 2<sup>ND</sup> and 3<sup>RD</sup> harmonic levels relative to the fundamental.



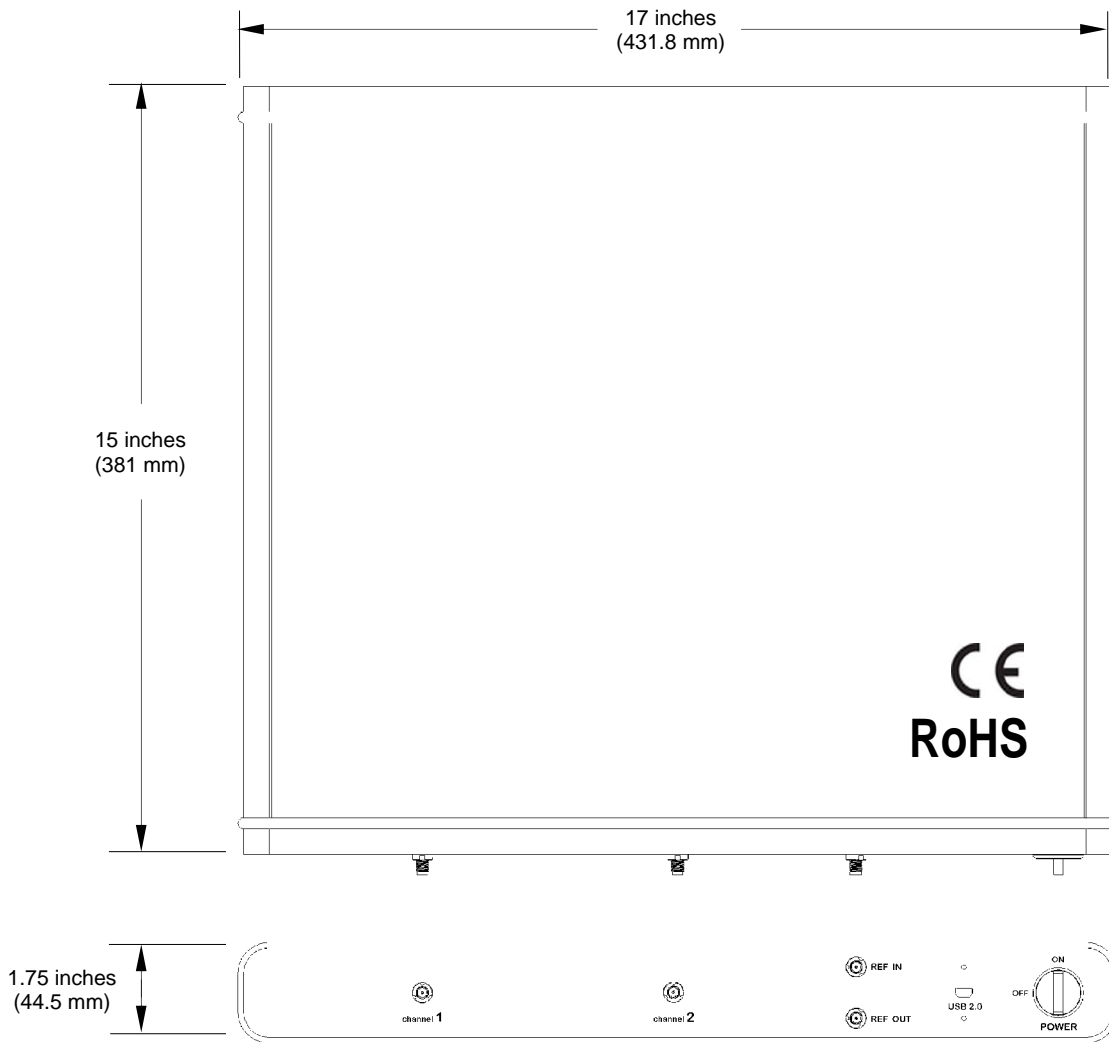
**Figure 9: Absolute Harmonic Data ( $F_0 = 1\text{GHz}$ )**



**Figure 10: Relative Harmonic Data ( $F_0 = 1\text{GHz}$ )**

## MECHANICAL CONFIGURATION

Holzworth multi-channel RF Synthesizer modules are encased in a 1U high, reinforced housing. All RF outputs, modulation and reference connectors are contained on the front panel; along with a USB input and the rotary power switch. The rear panel contains an AC power cord input.



## CONNECTORS and PHYSICAL SPECIFICATIONS

Front Panel Connectors (standard)	SMA-F (4): Ch 1 - 2 RF Output, Reference In, Reference Out; USB 2.0: Data
Front Panel Connectors (optional)	OPT-EXTMOD1: SMA-F (1): Global Modulation Input OPT-EXTMOD: SMA-F (2): Channel Dedicated Modulation Inputs OPT-FIX10: SMA-F (1): Fixed 10MHz Output OPT-FIX100: SMA-F (1): Fixed 100MHz Output
Rear Panel Connectors	AC Input (1)
Physical Dimensions (L x W x H)	1U high, 19" rack mount: 15in x 17in x 1.75in ( 381mm x 431.8mm x 44.5mm )
Weight	15 lb ( 9.1 kilograms )

## VIRTUAL INSTRUMENT

Holzworth USB controlled Virtual Instruments have been designed to be as versatile as possible for integration into existing systems. Holzworth RF synthesizers can be controlled by the proprietary GUI application, LabVIEW™, MATLAB™, or any application capable of sending/receiving commands through a .DLL file.

Holzworth Synthesizers utilize the USB HID (Human Interface Device) transfer protocol. The HID protocol requires no installation of hardware drivers while providing the highest level of stability.

The provided GUI application is Java™ based as Java™ is an extremely robust platform and accepted as an industry standard. Operating on a minimal amount of memory (<2.0MB), users can run the application directly from a USB memory stick, if need be.

DLL access is also provided for “VISA”, LabVIEW™, MATLAB™, *etc.* control over the instrument.

## OPTIONS

Holzworth multi-channel synthesizers can be ordered with various options to add application specific functionality. Most options require an internal architecture pre-configuration and must be specified at the time of the initial purchase order. Retrofitting options to completed product is possible as an upgrade. Please contact Holzworth or your local sales Representative/Distributor for further details.

<b>OPT-RACK</b>	19" Rack Mount Bracket Kit
<b>OPT-EXTMOD</b>	Channel Dedicated External Modulation Inputs
<b>OPT-EXTMOD1</b>	Global External Modulation Input / Output
<b>OPT-FIX10</b>	Fixed 10MHz Output (dedicated connector in addition to Reference out)
<b>OPT-FIX100</b>	Fixed 100MHz Output (dedicated connector in addition to Reference out)
<b>OPT-OCXO1</b>	High performance OCXO for 5dB improved close in phase noise
<b>OPT-OCXO2</b>	High performance OCXO for 10dB improved close in phase noise
<b>OPT-TEMP</b>	Channel Dedicated temperature sensors with output data log

## WARRANTY

All Holzworth synthesizers come with a 2 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.