54 MHz – 13.6 GHz Dual Channel RF Signal Generator

Features

- Open source Labveiw GUI software control via USB
- Run hardware functions with or without a PC
- 72MHz 32 bit ARM processor on board
- Two channel frequency, phase and amplitude control
- Quadrature (or other phase) LO signal generation
- 0.1Hz or less frequency resolution
- 2.5ppm generator frequency accuracy
- 24 bit phase control on each channel
- 2mS RF lock time
- +18dBm output power
- 16 bit 0.1dB or less amplitude resolution
- Over 50dB of power control
- Absolute power display on Software GUI
- Calibration option
- 10MHz – 100MHz external reference input
- 27MHz internal reference output
- FM, AM and PM Modulations
- External Sweep Trigger
- Daughter card expandability (custom applications)
- Channel enable / disable saves energy
- 7 Ultra Low Noise linear regulators on board
- 2.75 X 2.15 inches not including mounting flanges

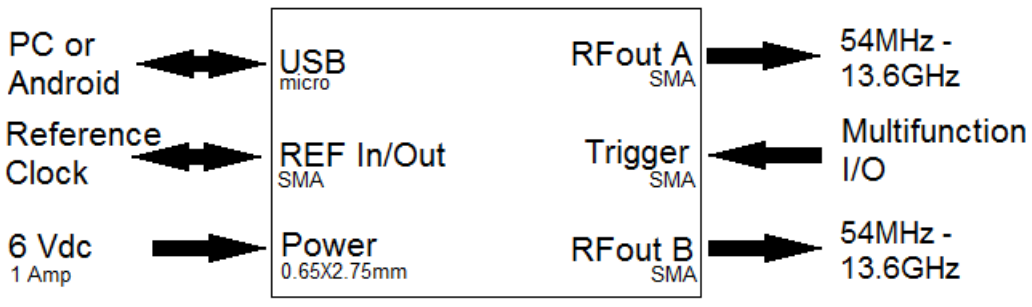
Overview Description

The Windfreak Technologies SynthHD is a 54 MHz to 13.6 GHz dual channel software tunable RF signal generator and frequency sweeper controlled and powered by a device running Windows or Android via its USB port. The SynthHD's dual independent channels can be configured to run as two different frequencies, or the same frequency with different phases. This allows its use in antenna beam steering applications or quadrature signal generation commonly used in image reject frequency conversion. The SynthHD also has nonvolatile on board memory so it can be programmed to fire up by itself on any frequency, power, sweep and modulation setting to run stand alone in the field. This makes for a highly mobile, low power and light weight solution for your RF signal generation needs.

Applications

- Wireless communications systems
- Antenna beam steering
- Quadrature LO for image reject mixers
- RF and Microwave radios
- Software Defined Radio (SDR)
- Radar
- Automated Test Equipment (ATE)
- EMC - radiated immunity pre-compliance testing
- Electronic Warfare (EW) and Law Enforcement
- Quantum device research
- Plasma physics
- Education

SynthHD Functional Diagram



Windfreak Technologies, LLC.

Contents

1 Characteristics

1.1 Electrical Characteristics

Characteristic	Notes	Min.	Typ.	Max.	Unit
Supply Voltage		5.5	6	6.5	V
Supply Current	370mA per Channel		800		mA
Standby Supply Current	Both RF Channels OFF		70		mA
RF Output Frequency Range		54	-	13600	MHz
RF Output Power Maximum	See Graph	6	18	22	dBm
RF Output Power Minimum	See Graph	-80	-50	-30	dBm
RF OFF Output Power	100% Shutdown of RF Section			-90	dBm
RF Output Power Resolution	16 bit Drive	0.1			dB
RF Output Impedance			50		Ω
Internal Reference Frequency			27		MHz
Internal Reference Tolerance			2.5		ppm
External Reference Frequency		10	-	50	MHz
External Reference Level		2	2.5	3.3	Vpp
Trigger		-0.3		3.3	V

1.2 Thermal Operating Characteristics

Description	Notes	Min	Max	Unit
Operating Temperature	Without Airflow	-40	40	°C
Operating Temperature	Query internal temperature sensor with software and keep below 75C with airflow, heat sinking or limited duty cycle.	-40	75 Internal	°C

2 Typical Performance

2.1 RF Output Power

The typical output power (per channel) of the SynthHD is shown below. This graph is of raw unleveled operation at both the maximum and minimum gain settings of the output variable gain section. Gain is set via a 16 bit D/A allowing output power levels anywhere in the range between the minimum and maximum levels shown below. Each RF channel power and frequency is independent of each other. Under operation with the Windfreak Technologies supplied software GUI, power levels are settable in dBm with 0.1dB increments via a generic text based lookup calibration table. This table can be updated by the end user for more accurate power setting levels.

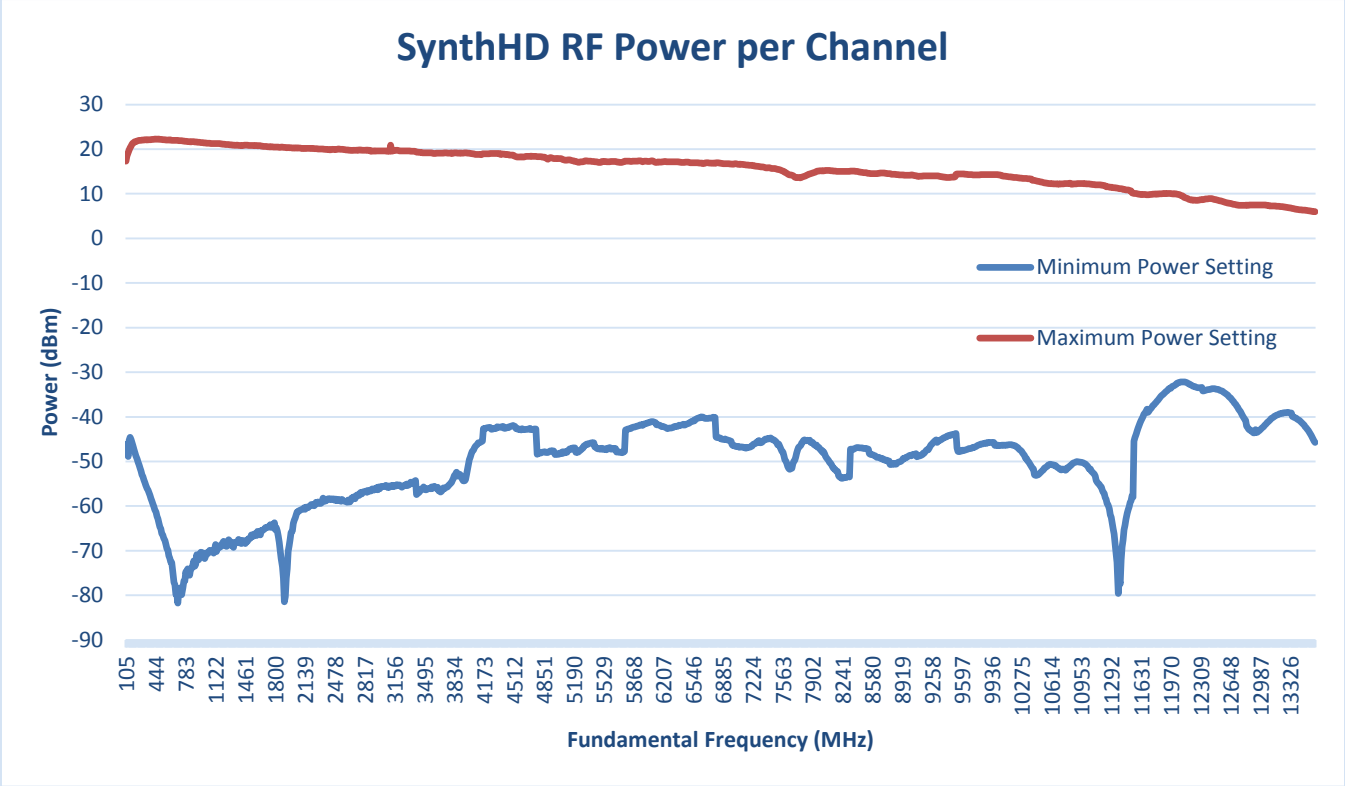


Figure 1. Output Power over Frequency at Room Temperature

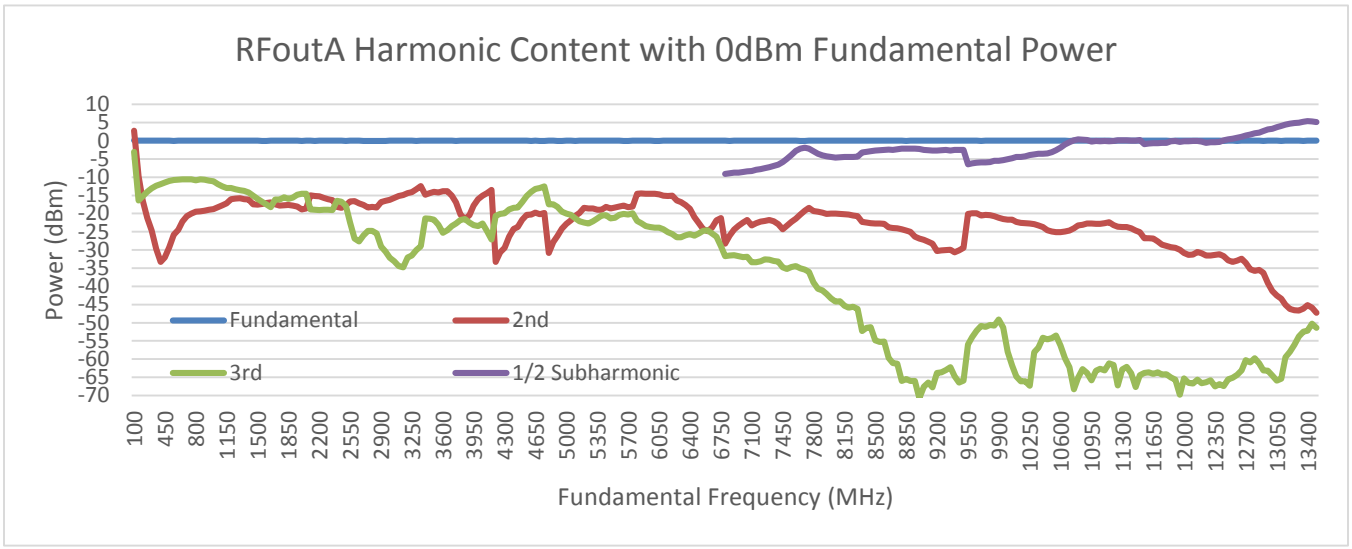
2.2 RF Output Harmonic Content

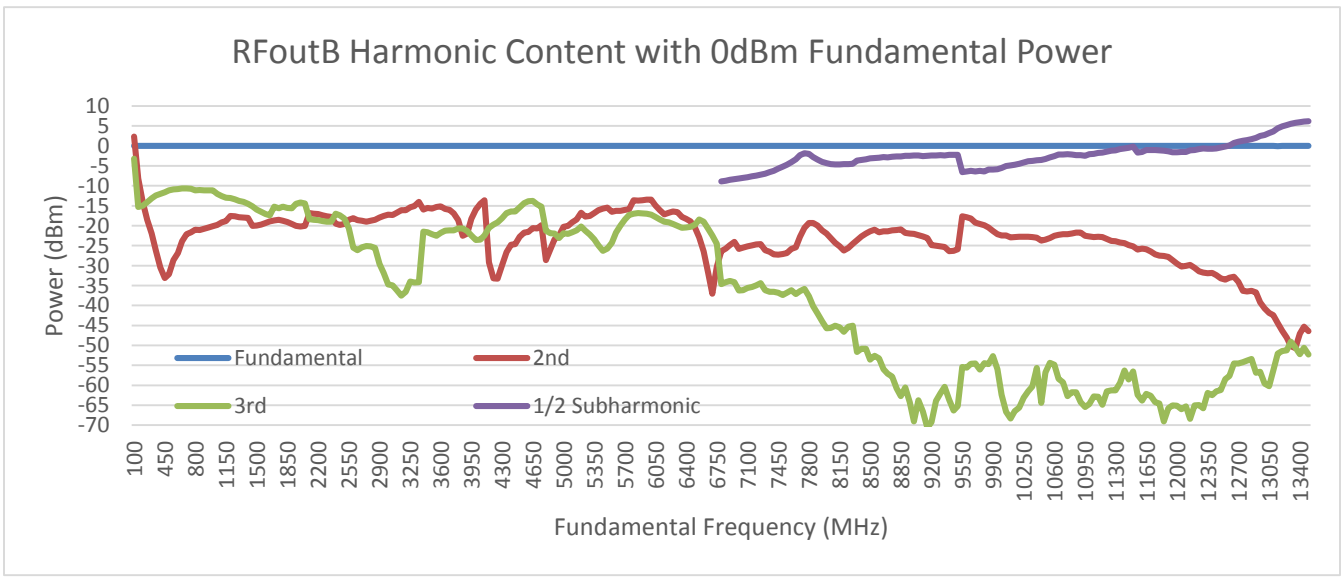
The typical SynthHD harmonic distortion is shown below for the second and third harmonics. Also shown is a subharmonic created when generating fundamental frequencies above 6800MHz. All frequencies above 6800MHz are generated with an RF doubler. This data is taken at a leveled fundamental power of 0dBm.

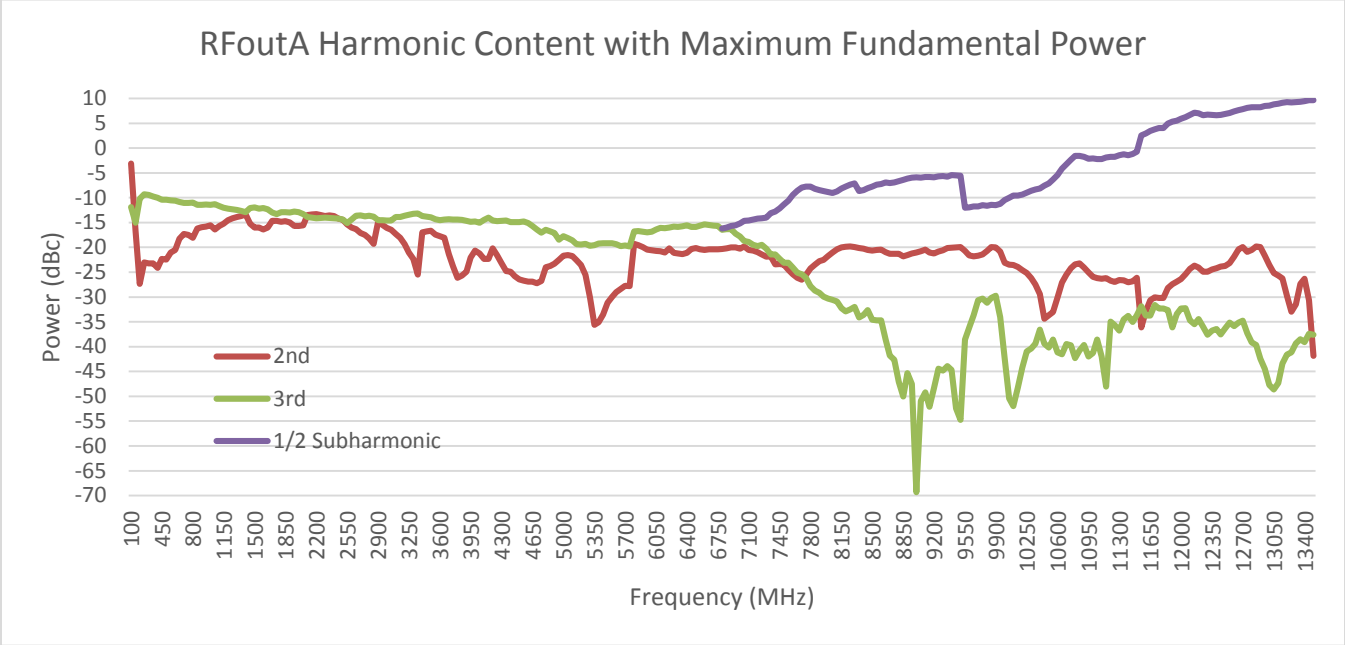
If lower harmonic and subharmonic levels are needed, Windfreak Technologies suggest the use of low cost SMA filters from Crystek and Minicircuits.

Subharmonic: Minicircuits Highpass Filter, VHF-6010+, $25, stopband DC – 5200MHz

Harmonic: Crystek Lowpass Filter – many cutoff frequencies, 1GHz example: CLPFL-1000, $25

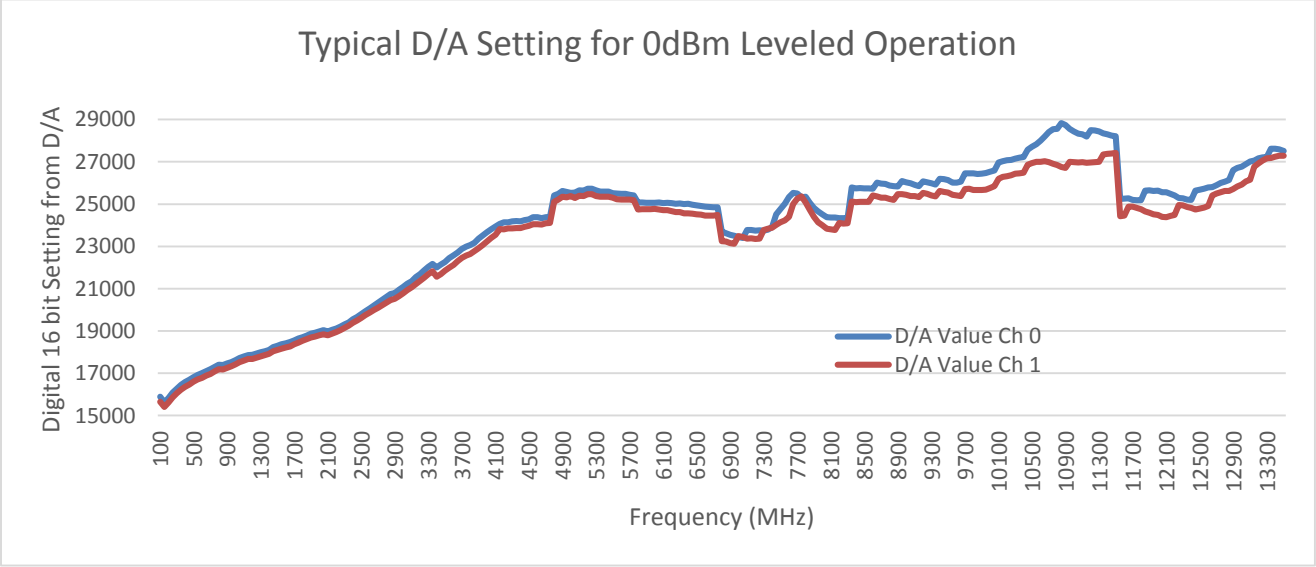






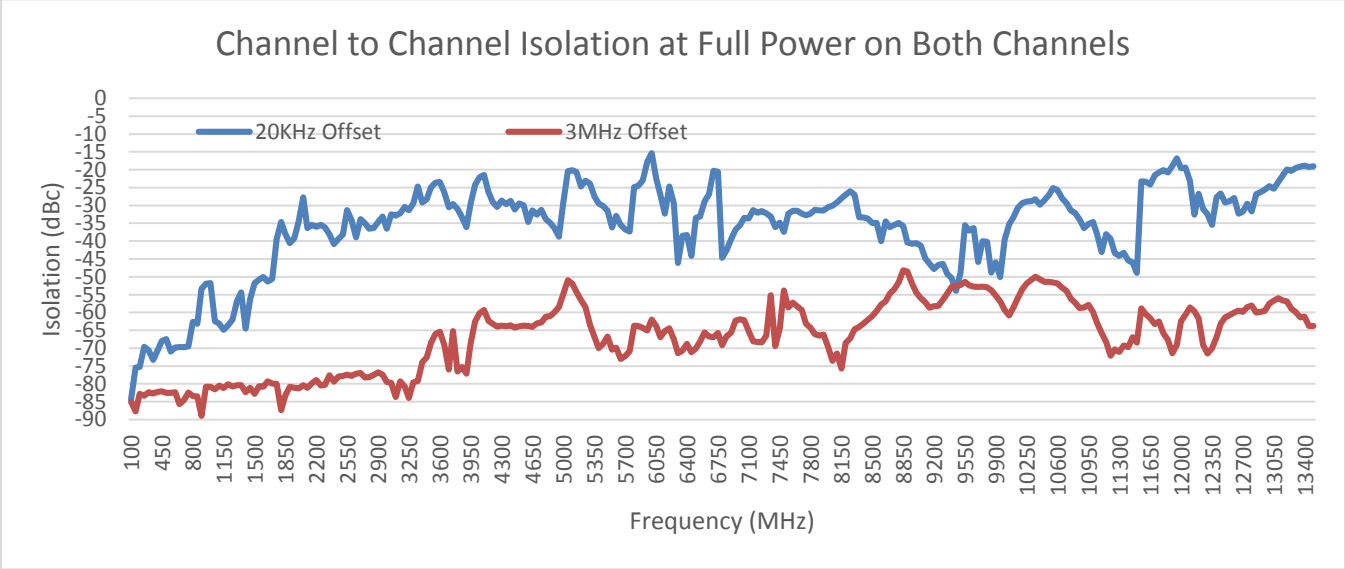
2.3 VGA Drive Values for Leveled Operation at 0dBm

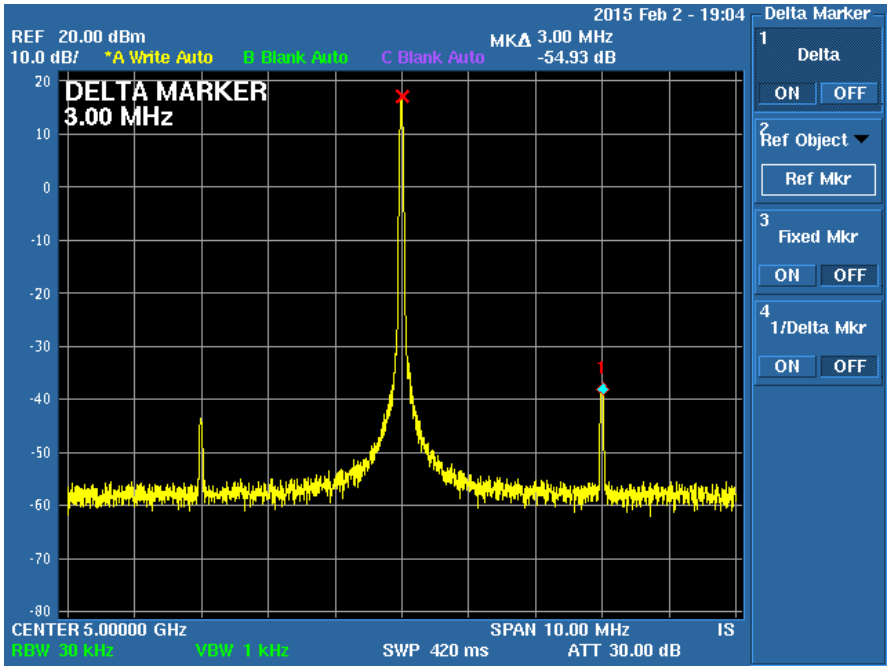
Output power is controlled by a 16 bit D/A driving the gain in the output amplifiers. It is non-monotonic and can be compensated for in software. Below is an example of what is required to sweep across frequency at a leveled power of 0dBm. The Windfreak SynthHD GUI does this automatically and transparently. The GUI Labview source code is provided (with purchase of hardware) as an example for those that write their own software or those that need to enhance what is provided.



2.4 Channel to Channel Isolation

Channel to channel isolation is shown below with both channels dialed to full output power. One trace is taken with a 3MHz offset between channels. The other trace is taken with a 20KHz offset between channels. The 20KHz offset places each signal within each other's loop bandwidth and the leakage modulates each other's VCO control voltages where loop gain is high. This is why levels with offsets inside the loop bandwidth are higher.





5GHz Channel to Channel Isolation Spectrum with +3MHz Offset

2.5 Integer Boundary Spurs

A mechanism for inband fractional spur creation is the interactions between the RF VCO frequency and the 27MHz internal (or arbitrary external) reference frequency. When these frequencies are not integer related, spur sidebands appear on the VCO output spectrum at an offset frequency that corresponds to the difference in frequency between an integer multiple of the reference and the VCO frequency. These spurs are attenuated when outside the loop filter which is 20KHz wide. In general integer boundary spurs affect less than 1% of all possible frequencies that can be generated by the SynthHD.

Example: The internal reference on the SynthHD is 27MHz. For the fundamental VCO range of 3400MHz to 6800MHz the first integer boundary happens at 27MHz X 126 = 3402MHz, the next at 27MHz X 127 = 3429MHz and every 27MHz thereafter up to 6777MHz. Above and below the fundamental VCO band the spacing will be affected by the RF dividers or RF doubler.

Integer boundary spur levels on the SynthHD are still being studied and optimized. Full optimization and characterization are expected for the final production release.

2.6 Phase Noise

Phase noise on the SynthHD is still being studied and optimized. Current levels at 1GHz with a 10KHz offset are around 95 dBc/Hz.

3 Device Information

3.1 Mechanical Dimensions (inches)

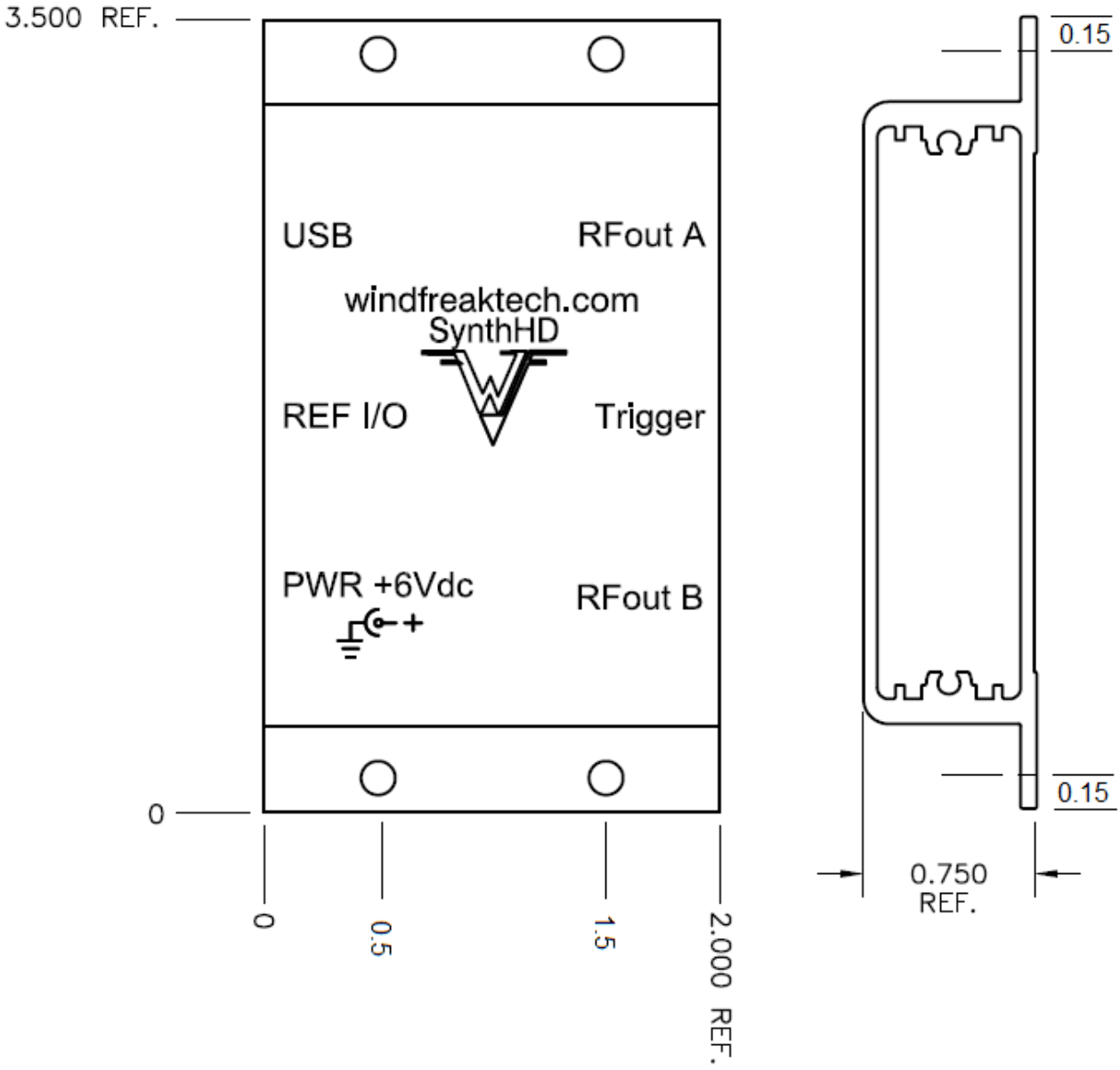
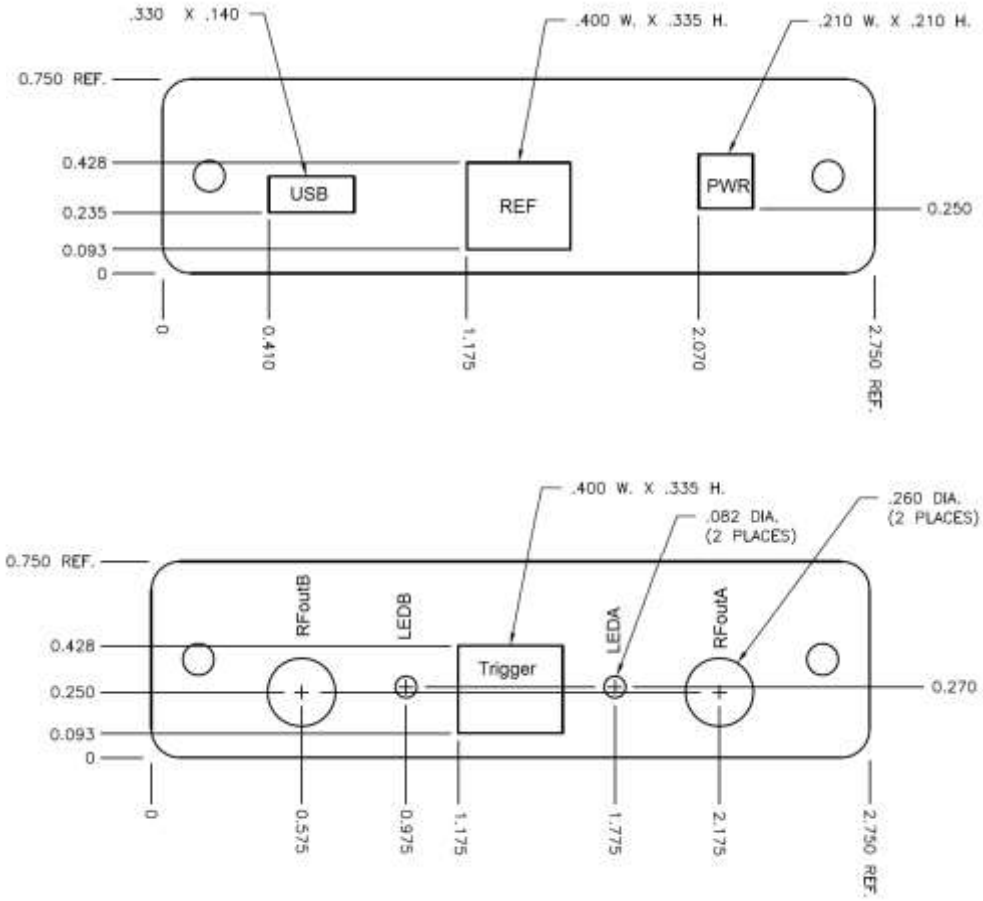


Figure 2. Outer Dimensions



Plates mount external to the extrusion and are 0.0615 inches thick.

Figure 3. End Panels

Figure 4. Picture