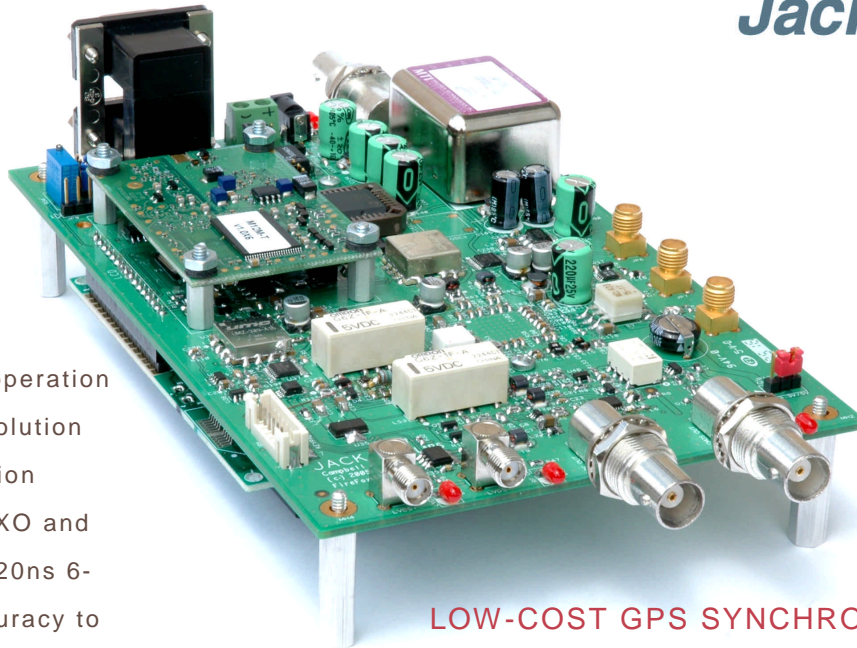


# FireFox Broadband Synthesizer

Jackson  
Labs



## KEY FEATURES

- 10 $\mu$ Hz to 1640MHz operation
- 10 $\mu$ Hz (15-digit) resolution
- $\pm$ 10 $\mu$ Hz basic precision
- GPS Disciplined OCXO and 1PPS output with <20ns 6-Sigma average Accuracy to UTC
- 2MHz to 1.64GHz, >+10dBm typ. RF output with 50db adjustment range
- <10MHz to 1.64GHz LVDS outputs
- DC to 398MHz 3.3V/5V CMOS output
- Ultra low phase-noise Crystal Oscillator reference with 10MHz CMOS output
- Built in general purpose 2GHz mixer with >350MHz IF BW
- Internal 1Gs/s DDS 10bit DAC
- Better than 10E-12 long term accuracy
- +12V <0.8A low power operation
- Small 110x170mm form factor
- Built-in LCD and keypad
- RS232 operation/control

## LOW-COST GPS SYNCHRONIZED FREQUENCY SYNTHESIZER MODULE



Highly accurate: the FireFox Synthesizer uses the Motorola M12+ timing receiver and an OCXO to exceed 10E-12 Stratum-1 long term UTC-locked performance.

“ *Setting new standards in frequency generation for engineering, test & measurement, broadcast, defense, and research.* ”

The FireFox Synthesizer presents unprecedented frequency accuracy and resolution by combining industry-proven GPS timing performance (USNO lab test report available) with the very latest in DDS synthesizer technology in one cost-effective module. An ultra-stable GPS disciplined frequency reference is combined with a broadband synthesizer on one board. Virtually any Frequency from 10 $\mu$ Hz to 1640MHz can be set quickly with 10 $\mu$ Hz resolution (15-Digits) by using the built-in LCD and keypad, or via RS-232 control. Settings and calibrations are automatically stored in non-volatile memory. RF, LVDS, and CMOS outputs are standard. The RF output provides >50dB adjustable range and more than +10dBm typical output power (2MHz to 1640MHz). Outputs can be continuous wave or swept.

Unmatched price/performance



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# FireFox Broadband Synthesizer



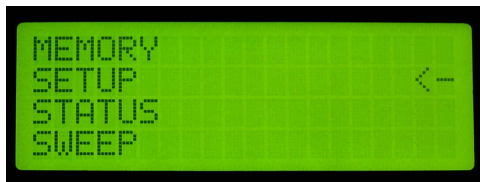
## Operation

The FireFox Synthesizer can be controlled via the built-in keypad, an optional external keypad, or serial port SCPI commands (Q1/06). Frequencies are entered with up to 15 Digits of resolution. The RF output amplitude can be varied in relative mode from 0 to 100% (equals ca. -44dBm to +18dBm at the extremes) or in absolute mode from -40dBm to +8dBm. A comprehensive LCD display shows frequency, amplitude, and GPS status information:



All settings and auto-calibration data are stored in non-volatile memory and are automatically loaded upon power-up.

A multi-level menu structure allows access to system status-information and setup options, and is easily navigated:



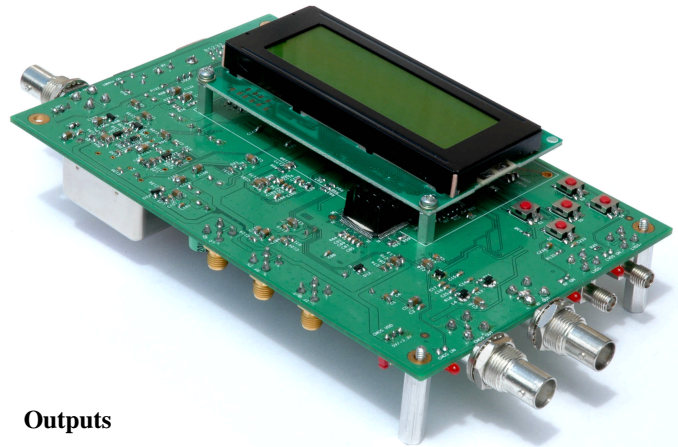
## Resolution and Accuracy

The revolutionary proprietary 47bits effective DDS clock generator of the FireFox Synthesizer allows any frequency between 10 $\mu$ Hz and 1640MHz to be generated with 10 $\mu$ Hz resolution and better than  $\pm$ 10 $\mu$ Hz precision relative to the internal 10MHz crystal oscillator.

The long term accuracy of the 10MHz reference output is better than 10E-12 and is phase locked to the UTC atomic clock via a Motorola M12+ timing GPS receiver. Short term performance is typically better than 5x10E-11 over a 30 minute time period. The reference output accuracy is only limited by the quality of the reference signal provided by the GPS satellites.

## UTC Frequency Reference Standard

The unit provides a 10MHz UTC-locked frequency standard available on a dedicated BNC connector. The output is locked to UTC via the GPS timing receiver and a phase-locked low-noise Crystal Oscillator Oven. Traditionally available only as an expensive separate unit from other vendors, this function provides the basis for the ultra-high frequency accuracy of the FireFox Synthesizer.



## Outputs

The following seven output signals are available in the standard product configuration:

- RF output: BNC, 2MHz-to-1.64GHz, power -40dBm to >+10dBm typ. adjustable via keypad
- CMOS output: BNC, DC-to-398MHz 3.3V/5V
- LVDS output: on two SMA's, <10MHz-to-1.64GHz
- 10MHz OCXO GPS reference output: BNC, 3.3V CMOS
- General purpose 2GHz mixer output: SMA 4.5MHz-to-350MHz, can be disabled for power savings
- 1PPS output: locked to UTC to within <20ns, 3.3V CMOS

The RF, LVDS and CMOS outputs are driven by the DDS synthesizer in parallel, and thus provide the same frequency (displayed on the LCD) within their respective operating ranges. LED's provide status information about individual connector output ranges, and light up when an output is active and valid. Frequencies can be automatically swept (Q1/06).

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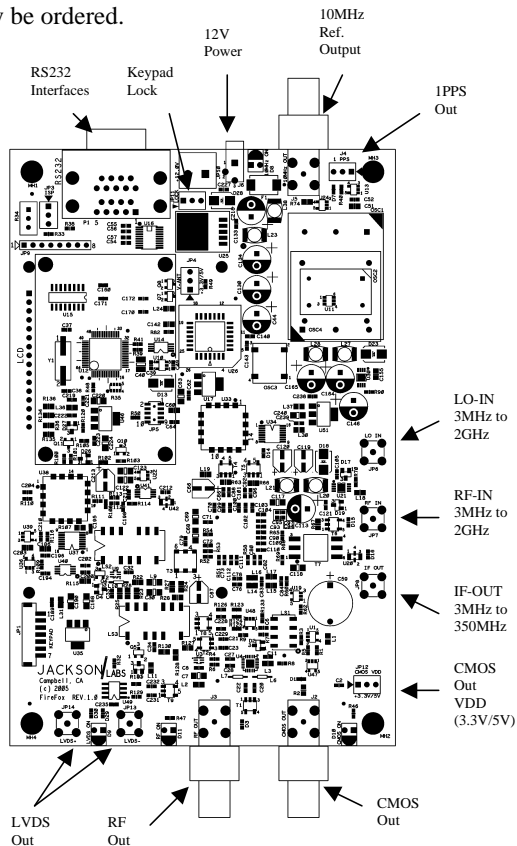


# FireFox Broadband Synthesizer



## Hardware Features

The FireFox board is fully self-contained and needs only an external +12.0V/1A power supply and a GPS antenna to operate (A Wall Wart supply and GPS antenna are included in the FireFox package). Customers may use the board as an OEM product inside their enclosure, or an optional metal enclosure may be ordered.



## General Purpose RF Mixer Building Block

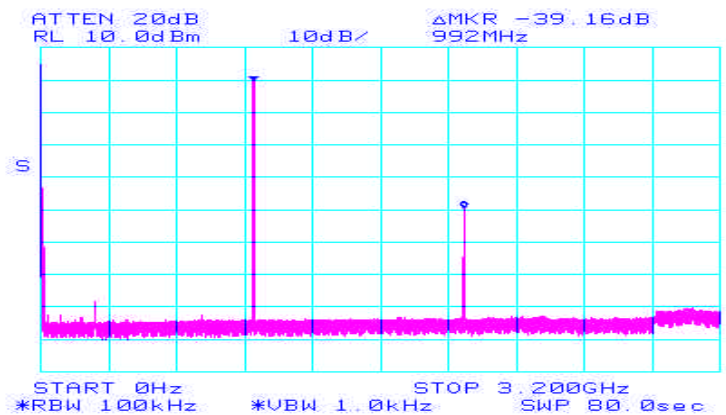
A general purpose 2GHz mixer building block is accessible on SMA connectors. The FireFox RF output can be used as a local-oscillator mixer-source for RF receiver/down-converter applications.

## Signal Quality

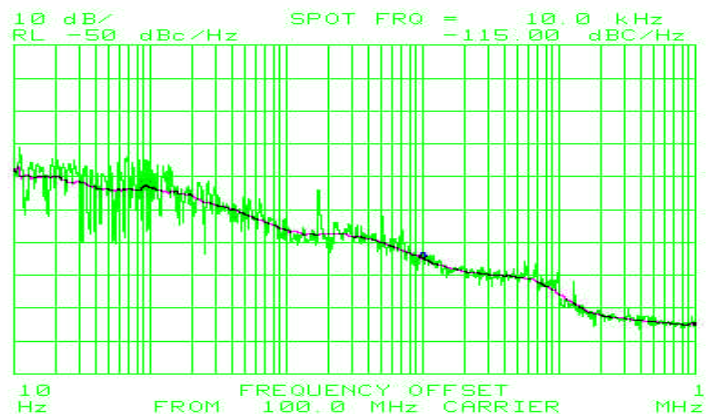
The performance of the FireFox synthesizer is exceptional and unparalleled in this price range and size, and is attributable to its innovative design:

A low-noise 1GHz PLL is phase locked to a 10MHz oven-enclosed crystal oscillator reference. This 1GHz signal drives a novel true 1Gs/s DDS system with 47 bits of effective resolution which is then frequency-multiplied to provide outputs ranging from DC to 1.64GHz, effectively increasing the DDS resolution to close to 48 bits (up to 15 digits of frequency can be entered).

The FireFox synthesizer output signals are generated in three bands from DC up to 400MHz, 400MHz to 800MHz, and 800MHz to 1.64GHz. Bands are switched via high-quality non-reflective RF relays. Extensive low-pass filtering of all signals provides high harmonic suppression and reduces aliased spurs. The following Figures showcase the signal quality of the FireFox Synthesizer RF output:



1000MHz output: low spurs and harmonic distortion



100MHz Phase Noise: very low spurs and noise floor

## Calibration

The FireFox synthesizer does not require frequency calibration. An Agilent E4418B power meter can be connected to the units' output and RS-232 port to calibrate the RF output level. The FireFox will automatically calibrate its RF output to better than 0.5dBm by communicating with the power meter via RS-232.

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High quality analog RF, and digital outputs



# FireFox Broadband Synthesizer



## Technical Specifications

<b>General Characteristics</b>	Synthesizer Architecture	Low-cost Broadband Synthesizer with 48 bit (eff.) DDS fractional-N control and GPS-disciplined OCXO reference. Three main outputs (CMOS, LVDS, RF). Over 160 Trillion individual frequencies, resolution to within $\pm 10E-6$ Hz. Built-in 10MHz reference standard.
	Form Factor	Small 110x170mm OEM form-factor with single +12V 1A power. Available in optional 19-Inch rack-mount or custom enclosure
	Built In Frequency Standard	Ultra-accurate Motorola 12 Channel GPS Timing receiver driving OCXO 10MHz Frequency Standard.
	Applications	Any frequency such as 1622.123.456,78901Hz can be generated with 10E-12 accuracy. Ultra-high precision CW fixed-frequency reference for * communications equipment * calibration labs * manufacturing * test&measurement * engineering * R&D * military applications (COTS). Sweep features allow applications traditionally served by expensive test equipment. Generate any frequency with the touch of a few buttons.
<b>Reference Standard Characteristics</b>		Uses 12 Channel Motorola GPS Timing receiver 1PPS signal output. Output locked to within <20ns (Six Sigma) to UTC. GPS Pulse sampled at 100MHz then phase-locked to 10MHz low phase-noise OCXO. Phase noise of OCXO module is -115 dbc/Hz at 10Hz offset, -160dbc/Hz at 10KHz offset. Short-term OCXO stability is $2 \times 10E-11$ for one second. CMOS 3.3V output driver. Better than 10E-12 long-term accuracy.
<b>DDS Synthesizer Characteristics</b>	CW output and Sweep functions	48 effective bits DDS with fractional-N technology. DC to 1640MHz output. $\pm 10\mu$ Hz resolution over entire bandwidth (DC to 1640MHz). DC to 400MHz range output generated by 10-bit DAC. 400MHz to 1640MHz range output generated by low-noise PLL, phase-locked to DDS. CW output or Sweep functions (Q1/06) set via user interface. Sweep controlled via software.
<b>Output Signals</b>	RF output CMOS output LVDS output 10MHz reference output	50Ohm BNC output 2MHz to 1640MHz, adjustable from -40dBm to +8dBm (+15dBm typ. in relative mode). Harmonics less than -30dB DC to 398MHz CMOS output on BNC connector. 3.3Vpp or 5Vpp. Series terminated, or 50 Ohm parallel terminated (2.4Vpp) Matched differential LVDS outputs on two SMA connectors. <10MHz to 1640MHz with >300mVpp single ended output amplitude. DC offset. CMOS 10MHz Frequency standard output from GPS-disciplined OCXO. Low phase noise, 3.3V series terminated. Lock indicator LED.
<b>User Interface</b>	Keypad or SCPI RS232 (Q4/05)	Detachable, backlit 20 character x 4 lines LCD display. 5-Button keypad. Menu system with over 19 sub-menus. Frequency and amplitude set via keypad. Settings stored in non-volatile memory. Frequency, amplitude, GPS timing, and status information displayed on LCD.
<b>Mixer</b>	General Purpose building block	General-purpose, non-dedicated mixer available via gold-plated SMA connectors. RF and LO inputs from 4.5MHz to 2GHz. Filtered IF output bandwidth is 4.5MHz to >350MHz. -20dBm RF input and -10 to +5dBm LO input sensitivity. 0-3.5dBm conversion gain. 14dBm damage level.
<b>Non Volatile Memory</b>	GPS timing reference System Controller Settings GPS receiver	Timing offsets, and auto-calibration data stored in EEPROM for fast cold boot. All system settings including Frequency and Amplitude stored in EEPROM. Amplitude correction data (AMPCOR) stored in Flash. GPS receiver Almanac, position, hold-mode, time and offsets stored in maintenance-free battery-backed-up memory.
<b>Miscellaneous</b>	Optional Features	Cost reduced TCXO option. Cost-reduced option with 0-400MHz output range. Cost reduced option without GPS reference receiver.
<b>Serial Communication</b>	Ports	2x RS232 ports, one for GPS receiver communication (to optional freeware Motorola WinOnCore12™ control and configuration), second port for system control. RS-232 to USB converter included in FireFox package. Connects to Agilent E4418B type power meters for auto-calibration.
<b>Electrical Characteristics</b>	Power Requirements Power Consumption Battery Backup	+11.7V to +12.3V with 50mVp-p ripple (max) at 0.8A (operating) to 1.1A (warmup for 5 minutes). <13W during warm up, 10W typ. during operation. Maintenance-free Super Capacitor for GPS receiver almanac memory with >>2 Hour data retention.
<b>Physical Characteristics</b>	Dimensions	170 x 110 x 55mm (ca. 6.7 x 4.4 x 2.2 in.) excluding connector protrusions outside of typical enclosure.
<b>Environmental Characteristics</b>	Operating Temperature Storage Temperature Operating shock and vibration	0-50°C, with less than 1°C change per 24 hours recommended for full performance. 0-85°C Unit should be shielded from any shock, vibration, rotation, magnetic flux, airflow, and movement for full performance.
<b>NOTE</b>	All specifications typical and quoted at 25.0°C after 1 day operation with GPS reception in still air with < 1°C change with +12.0V power supply unless otherwise specified.	

Lowest power consumption in class



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