Quonset Microwave
www.quonsetmicrowave.com

QM2010-4400
USB RF Synthesizer Module
35 MHz – 4.4 GHz output

Typical Applications

- Low cost signal generators
- Test equipment
- Communication systems
- Frequency conversion
- OEM integration into RF systems

Features

- Wideband RF output, 35 MHz to 4.4 GHz
- Integer and Fractional operating modes
- Pout: -20 dBm to +10 dBm typical
- USB interface
- USBTMC VISA Compliant
- User selectable internal reference or externally applied reference

General Description

QM2010-4400 Top View
Part Number and Serial Number

QM2010-4400 Top/Side View
USB, Lock Status, and External Reference LEDs
External Reference MMCX input, Reference Out MMCX output

Larger images in the Device Housing section

The QM2010 USB RF synthesizer series from Quonset Microwave offers a low cost solution for today's demanding RF signal generation needs.

The QM2010-4400 RF Synthesizer Module is a low-cost, wideband 35 MHz to 4.4 GHz frequency synthesizer ideally suited for bench top test and measurement as well as low-cost small form-factor communications systems. Its wide output frequency range, superb spurious rejection, and excellent phase noise performance provide a high-quality, low-cost alternative to conventional bench top RF signal generators. The RF synthesizer module is capable of phase locking to its internal 50 MHz reference or a user provided external reference.

The RF synthesizer module is powered and controlled directly by a host PC through USB. The QM2010-4400 is VISA compliant, enabling seamless cross-platform use. Users can control QM2010 series synthesizers through a lightweight control GUI, supported on Windows®, Macintosh®, or Linux® platforms, with SCPI compliant VISA commands, described in the QM2010 User Manual, or with third party development environments such as LabVIEW®.

The RF Synthesizer you can carry in your pocket!

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Revised June 21, 2023

Electrical Specifications

Parameter		Min.	Typ.	Max.	Units
RF Operating Frequency		35	-	4400	MHz
Reference Input Frequency		10	50	100	MHz
Reference Input Power		0		15	dBm
SSB RF Phase Noise: (100 kHz Offset, with Internal Ref)	200 MHz 2000 MHz 4000 MHz		-117 -108 -103		dBc/Hz dBc/Hz dBc/Hz
Locking Time				1	ms
Frequency Resolution:*	Integer Mode Freq < 2200 Freq > 2200 Fractional Mode		 25 50 2.441		 MHz MHz kHz
Power Resolution			0.5	1	dB
Internal reference frequency			50		MHz
Internal oscillator frequency stability			±0.5		ppm

** Under default conditions – a 50 MHz reference input with a reference divider of 1. See "Integer and Fractional Modes of Operation" for more information*

Programming Interface

The QM2010 series of RF synthesizers can be controlled using any computer with a USB port running Windows®, Macintosh®, or Linux® operating systems. Other configurations may be possible since the synthesizer uses the USB Test and Measurement Device (USBTMC) class standard to emulate a GPIB bus. This allows for easy integration into existing test setups. A Windows® compatible USBTMC driver is supplied with the module. Most distributions of Linux® already have USBTMC drivers included in the kernel, and Macintosh® users will need to obtain drivers from a third party. Installation of drivers is not necessary if you already have a compliant VISA runtime installation, such as one provided by National Instruments or Agilent. A lightweight GUI using the VISA runtime is provided with the module.

The synthesizer is controlled by delivering SCPI 1999.0 compliant text-based commands through the USB interface. For command structure information and a full command list, see the USB Programming manual (QM2010-99-2).

Integer and Fractional Modes of Operation

The QM2010 RF Synthesizer Module is capable of operating in integer or fractional mode. In integer mode, the frequency resolution of the QM2010-4400 is dependent on the reference frequency and reference divider as defined by this relationship $fres = \frac{reference}{ref\ divider}$. On first power-up, the QM2010-4400 is set to integer mode and uses the internal 50 MHz reference with a reference divider value of 1. The frequency is set to 2200 MHz. This provides a default frequency step size of 50 MHz. Synthesizer frequencies above 2200 MHz will have a frequency resolution of 50 MHz, while synthesizer frequencies below 2200 MHz will have a frequency resolution of 25 MHz. Operation in fractional mode allows for a frequency step size of 2.441 kHz. When operating in fractional mode, it is recommended to set the reference divider value to 1.

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Table 1 – Integer vs. Fractional Mode Comparison

Parameter	Integer Mode	Fractional Mode
Phase Noise	• Comparable to fractional mode phase noise at offset frequencies ≤ 100 kHz, *if* the reference divider value is ≤ 2 • Degrades as reference divider increases	• Comparable to integer mode at offset frequencies ≤ 100 kHz, *if* the reference divider value = 1 (should always be 1 for best performance).
Spurious Content	• Better spurious performance	• Additional spurs present at frequency offsets ≤ 5 MHz
Recommendation	• Use whenever possible for best performance	• Use when fine frequency resolution is required

Figures 1 and 2 illustrate the phase noise performance difference between integer and fractional mode when tuning to 200 MHz, 500MHz, 1GHz, 2GHz, and 4GHz with a 50 MHz reference. All integer phase noise measurements were taken with a reference divider of 1.

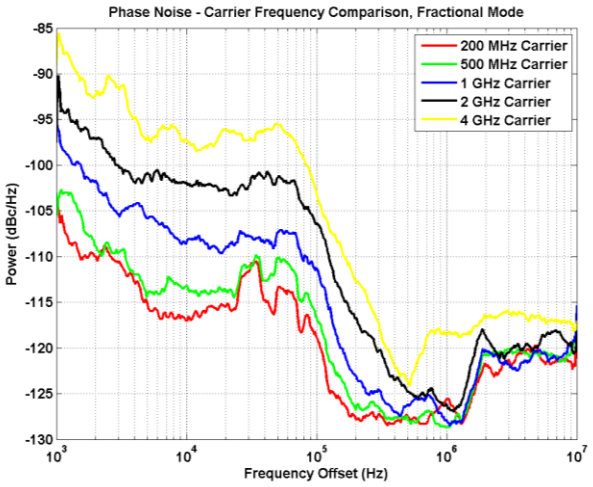

Figure 1 – Phase Noise Carrier Frequency Comparison, Fractional mode

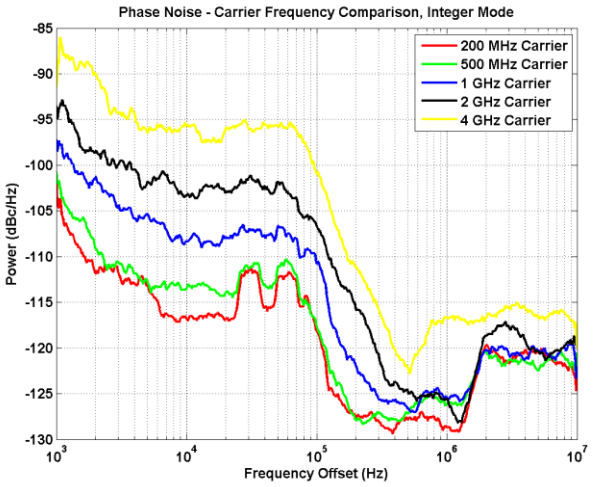

Figure 2 – Phase Noise – Carrier Frequency Comparison, Integer Mode

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Frequency Reference Consideration

Aside from reference divider considerations, the phase noise performance and stability of the reference oscillator is closely related to that of the RF Synthesizer Module. It is important to choose an accurate and stable reference in order to ensure the best possible performance of the QM2010. The QM2010-4400 comes with an internal reference for operation without the need of an external reference. However, phase noise can be improved with a more stable external oscillator. Figure 3 shows phase noise plots with varying reference dividers and the internal reference vs. a external reference.

Table 2 - Reference Characteristics – Internal Reference vs. External

Parameter	50 MHz TCXO Internal Reference	20 MHz OCXO Ext Ref
SSB Phase Noise at 10 Hz Offset	-70 dBc/Hz	-110 dBc/Hz
SSB Phase Noise at 100 Hz Offset	-100 dBc/Hz	-135 dBc/Hz
SSB Phase Noise at 1 kHz Offset	-120 dBc/Hz	-150 dBc/Hz
Frequency Stability at 25 ºC	± 0.5 ppm	± 0.2 ppm
Frequency Stability vs. Temp	± 0.25 ppm	± .02 ppm

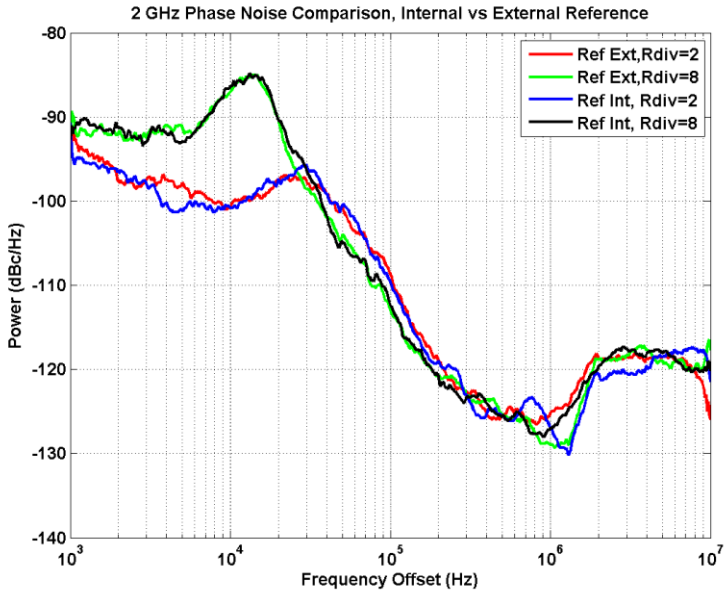

Figure 3 - Phase Noise Reference and Reference Divider Comparison

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QM2010-4400 Performance Plots

Unless explicitly defined, all data was taken with the internal 50 MHz reference operating in integer mode with a reference divider value of 1.

Figure 4 shows the maximum and minimum power output vs. tuning frequency.

Figures 5-9 show the representative spectral plots at several frequencies. Every frequency includes 3 plots at different frequency spans.

Power Calibration

The QM2010 series of USB Stick Synthesizers feature output power control tunable to within ± 1 dB of a desired power level.

QM2010-4400 Performance Plots

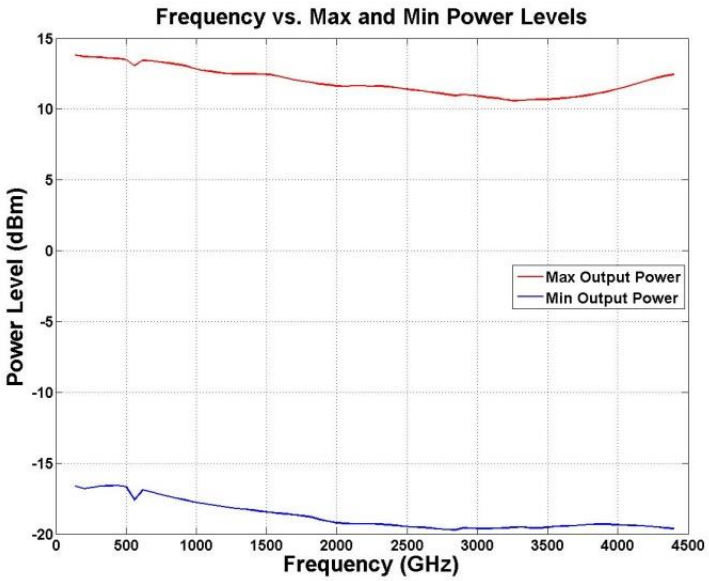

Figure 4 – Frequency vs. Output Power from 100 MHz to 4400 MHz in 60 MHz steps

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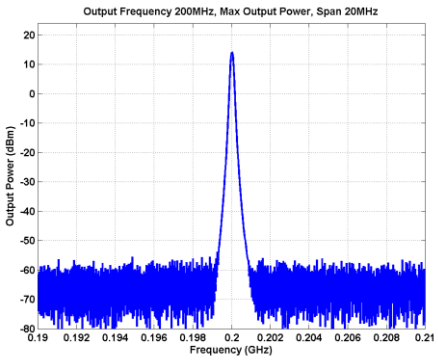
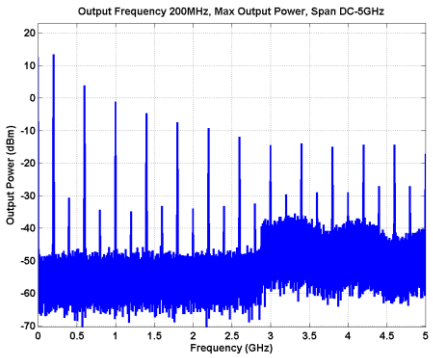




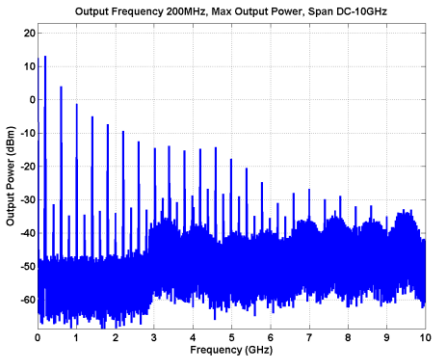
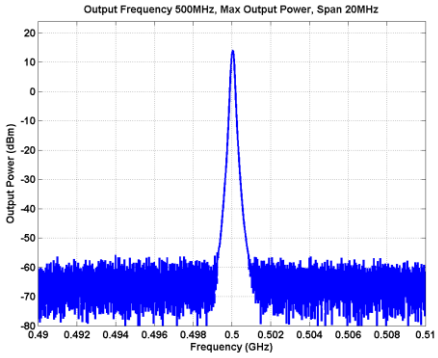
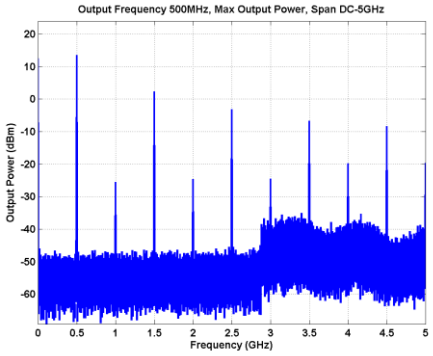


Figure 5 a),b),c) –
Output Frequency 200 MHz,
Span of 20 MHz, 5 GHz, 10 GHz





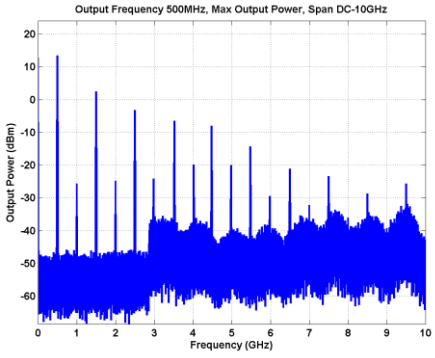
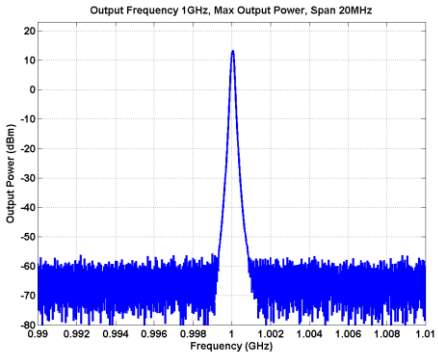
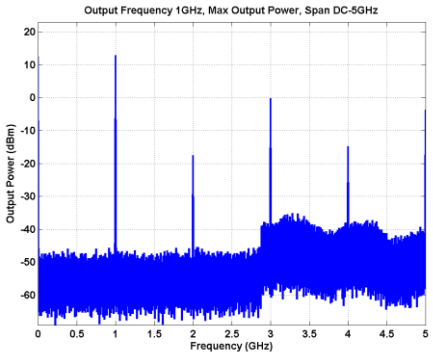


Figure 6 a),b),c) –
Output Frequency 500 MHz,
Span of 20 MHz, 5 GHz, 10 GHz





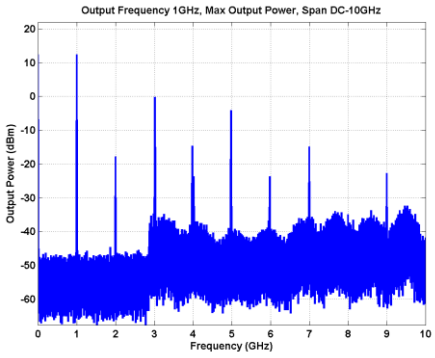


Figure 7 a),b),c) –
Output Frequency 1 GHz,
Span of 20 MHz, 5 GHz, 10 GHz

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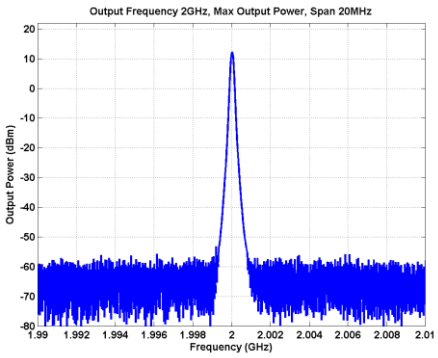
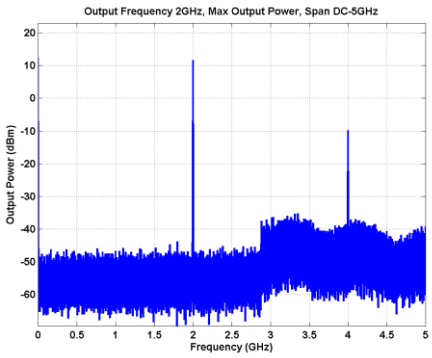




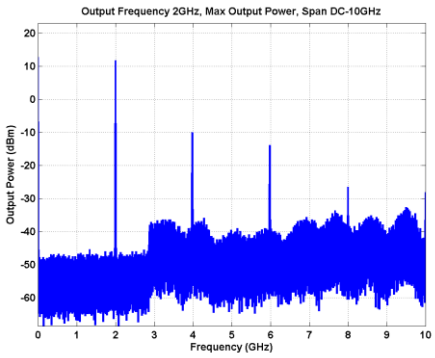
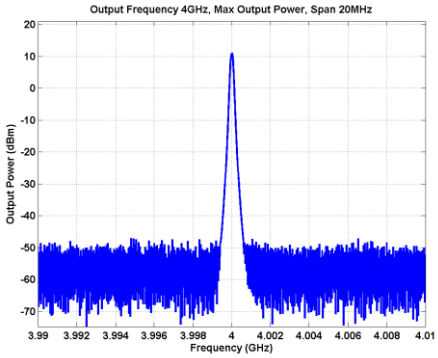
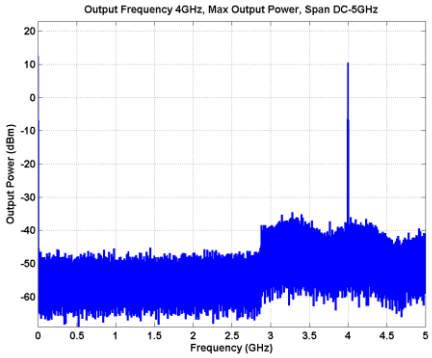


Figure 8 a),b),c) –
Output Frequency 2 GHz,
Span of 20 MHz, 5 GHz, 10 GHz





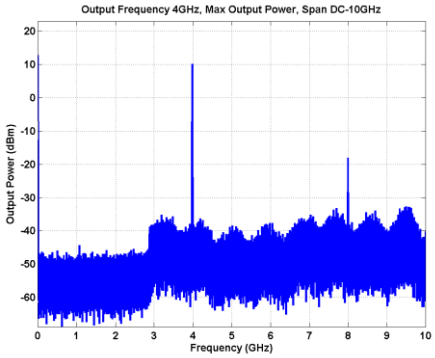


Figure 9 a),b),c) –
Output Frequency 2 GHz,
Span of 20 MHz, 5 GHz, 10 GHz

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Device Housing

The QM2010-4400 is housed within a compact plastic housing as shown in Figures 10 and 11. The unit is designed to operate in a non condensing 0° – 50° C environment. The housing has several cutouts for I/O and communications ports as well as status LEDs. Care should be taken to avoid allowing containments and moisture from entering these cutouts during operation. If the unit is used outside of a lab environment proper protection should be used to avoid overheating and moisture from damaging the internal electronics.

Table 3 - QM2010 USB RF Synthesizer Module Physical Parameters

Dimensions	3.3” x 0.9” x 0.6” [L x W x H]
Weight	15 grams

Figure 10 – QM2010-4400 Top View, Part Number and Device Name

Figure 11 – QM2010-4400 Side View, Status LEDs and External Reference Input

Figure 11 shows the status LED locations on the QM2010 series of USB stick synthesizers. The blue LED to the left of the “USB” text will illuminate when the device is enumerated by a host PC. The “LOCK” LED will be green when the device is phase locked or red if the device is unlocked or has RF power disabled.

Interface Connections

I/O Connector	Connector Type	Description
EXT REF	MMCX-F	External Reference input (10 MHz to 100 MHz)
REF DIV OUT	MMCX-F	Reference divider out – not used in normal operation
RF out	SMA-F	RF output: 35 – 4400 MHz
USB	USB Type A – Male	USB signal and power

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Accessories

A USB A Extension Cable, 3 feet is included. It is recommended that any non-supplied USB A Extension Cable have power strands less than or equal to 24 AWG and be as short as possible. The additional voltage drop inherent in long or high gauge USB cabling will negatively affect QM2010 performance.

Associated Manuals

Description	Link
QM2010 USB Synthesizer Stick Quick Start Manual	http://www.quonsetmicrowave.com/v/vspfiles/Manuals/QM2010_Quick_Start.pdf
QM2010 USB Stick Synthesizer User Manual	http://www.quonsetmicrowave.com/v/vspfiles/Manuals/QM2010_User_Manual.pdf

Associated Products

Product Number	Description
QM2010-6000	25 MHz to 6 GHz USB Synthesizer
QM2010-5-10	5 GHz to 10 GHz USB Synthesizer
QM2010-10-20	10 GHz to 20 GHz USB Synthesizer
QM2010-21-24	21 GHz to 24 GHz USB Synthesizer
QM2010-24-27	24 GHz to 27 GHz USB Synthesizer
QM1002 Series	1U 19” Rack-mountable Single or Dual Channel RF Upconverters
QM1003 Series	1U 19” Rack-mountable Single or Dual Channel RF Downconverters
QM1004 Series	1U 19” Rack-mountable RF Up-Downconverter Module
QM1007 Series	1U 19” Rack-mountable RF Up-Downconverter Module

Absolute Maximums

Ref input power	+20 dBm
Vcc	+5.5 Vdc
Operating Temperature	0 to +55 ºC
Storage Temperature	-50 to +100 ºC

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Ordering Information

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