

# Model 865-M Wideband Synthesizer



## Features

- Wideband Low phase noise
- Fast switching down to 20  $\mu$ s
- FM, Chirps, Pulse
- Internal OCXO, external variable reference
- Single DC supply

## Applications

- ATE
- LO for frequency converters
- Telecom / SatCom



## Model 865-M v.1.04

100 kHz to 40 GHz Wideband Synthesizer

## Model 865-M RF / Microwave Synthesizer

### Introduction

The Model 865-M is a wideband low phase-noise synthesizer operating from 100 kHz to 40 GHz. The settable output power range is from -5 to +20 dBm. The module has a milli-Hz frequency resolution that uses a high-stability internal reference. The internal reference can be phase-locked to a user-settable external reference. For highest phase coherence, multiple 865-M's can be cascaded with just one master reference clock.

The 865-M offers dedicated sweeping capabilities with switching speeds of only 500  $\mu$ s (20  $\mu$ s with option FS) and internal phase and narrow pulse modulation.

The module has a USB and LAN interface and can be controlled using SCPI 1999 command set. Operated with an external 24V DC supply, it consumes less than 25 watts.

### Options

- **FS:** Ultra fast switching speed
- **LN:** Enhanced close in phase noise & stability
- **865-M-40-2:** 2 outputs (Rackmount Chassis)
- **865-M-40-4:** 4 outputs (Rackmount Chassis)



## Signal Specifications

The specifications in the following pages describe the performance of the signal generator for  $23 \pm 5 \text{ }^\circ\text{C}$  after a 30 minute warm-up period. Typical specifications describe expected, but not warranted performance. Min and Max specifications are warranted.

Parameter	Min.	Typ.	Max.	Note
<b>Frequency Range</b>	100 kHz		40 GHz	Settable from 9 kHz to 43.5 GHz
Resolution		0.001 Hz		
<b>Phase resolution</b>		0.01 deg		
<b>Switching Speed</b>		1.5 ms		After SCPI command received
CW Mode		500 $\mu\text{s}$		
Sweep / List Mode		500 $\mu\text{s}$		
		20 $\mu\text{s}$		<b>Option FS</b>
<b>SSB Phase Noise at 1 GHz</b>				(Also see plot)
at 1 kHz from carrier		-140 dBc/Hz		
at 100 kHz from carrier		-150 dBc/Hz		
Wideband noise		-160 dBc/Hz		
<b>SSB Phase Noise at 10 GHz</b>				
at 1 kHz from carrier		-120 dBc/Hz		
at 100 kHz from carrier		-130 dBc/Hz		
Wideband Noise		-160 dBc/Hz		
<b>Output power Level</b>				(Also see plot)
10 Mhz to 1.2 Ghz	0 dBm		+20 dBm	
1.2 Ghz to 20 Ghz	-5 dBm		+20 dBm	
20 to 30 Ghz	10 dBm		+18 dBm	
30 to 40 Ghz	0 dBm		+15 dBm	
<b>Resolution</b>		0.5 dB		
<b>Reverse Power Protection</b>				
DC Voltage		7 V		
RF power			20 dBm	
<b>Output impedance</b>		50 $\Omega$		
VSWR		1.8		
<b>Spectral purity</b>				
Output harmonics		-15 dBc		
Sub-harmonics		-75 dBc	-45 dBc	< 20 GHz
		-50 dBc	-30 dBc	> 20 GHz
Non-harmonic spurious		-75 dBc	-60 dBc	

Parameter	Min.	Typ.	Max.	Note
<b>Pulse Modulation</b>				
Modulation source		Internal/ External		
Pulse rise/fall time		10 ns		
On/off ratio		40 dB		Pout > +10 dBm, see plot
Pulse overshoot			10 %	
Pulse delay		20 ns		
Pulse polarity		Normal, inverse		Selectable
External input amplitude	1V	2V TTL		AC coupled DC coupled
<b>Internal Pulse Generator</b>				
Repetition frequency (PRF)	0.1 Hz		100 MHz	= 1/T
Duty cycle	1 % to 99 % in 1 % steps			Within specified minimum pulse width
Pulse width settling range	30 ns		5 s	
Pulse Pattern Modulation & Staggered PRF				Using internal pattern generator
Programmable pattern length	2		65536	
Duty cycle	0.05 %		99.95 %	
Pulse period (T) accuracy		0.00005xT+3ns		
Pulse width accuracy		0.00005xT+ 5ns		
Pulse width resolution		5 ns		
Pulse jitter		2 ns	5 ns	
Polarity		selectable		
<b>Frequency Modulation</b>				
Modulation source		Internal		
Maximum Frequency deviation (peak)		N · 400 MHz		< 1.25 GHz (N=1) 1.25 GHz to 2.5 GHz (N=0.125) 2.5 GHz to 5 GHz (N=0.25) 5 GHz to 10 GHz (N=0.5) 10 GHz to 20 GHz (N=1) 20 GHz to 40 GHz (N=2)
Deviation accuracy		0.50 %	2 %	
Distortion (THD)		< 1 %		1 kHz rate, 10 kHz deviation
Modulation rate	0.1 Hz		80 kHz	
Modulation waveforms	Sine			
<b>Phase Modulation</b>				
Modulation source		Internal		
Phase deviation (peak)	0		300 · N· rad	
Deviation accuracy		0.50 %	2 %	
Modulation rate	0.1 Hz		80 kHz	

Parameter	Min.	Typ.	Max.	Note
Modulation waveforms		Sine		
Distortion (THD)		<1%		1 kHz rate & N x rad deviation

## Sweeping Capability

Parameter	Min.	Typ.	Max.	Note
<b>Frequency Sweep</b>				
Sweep type: linear, logarithmic, random				
Step time ( $t_{step}$ )	500 $\mu$ s 20 $\mu$ s			Option FS
Dwell time ( $t_{dwell}$ )	15 $\mu$ s			

## Frequency Reference

Parameter	Min.	Typ.	Max.	Note
<b>Internal Reference Frequency</b>		100 MHz 10 MHz		Option LN
<b>Internal reference output frequency</b>				
Temperature stability			$\pm$ 100 ppb	0 to 50 °C
Aging 1st year			1 ppm 0.3 ppm	Option LN
Aging per day			5 ppb 0.5 ppb	After 30 days of operation Option LN
Warm-up time		5 min		
Output internal reference		10 MHz 10/100 MHz		Option LN
Output power	0 dBm	5 dBm		
Output impedance		50 $\Omega$		
<b>Bypass internal reference input</b>		100 MHz		High phase synchronous mode
<b>Phase lock to external reference</b>	1 MHz	10 MHz integer MHz	250 MHz	Option VREF
Reference Bypass mode		100 MHz		
<b>Reference input level</b>				
10 MHz or 1-250 MHz	-5 dBm	0 dBm	+13 dBm	
Bypass 100 MHz	5 dBm		+15 dBm	
<b>Reference input impedance</b>		50 $\Omega$		
<b>Lock Range</b>				
10 MHz or 1-250 MHz			$\pm$ 1.5 ppm	
Bypass 100 MHz			> 100 ppm	

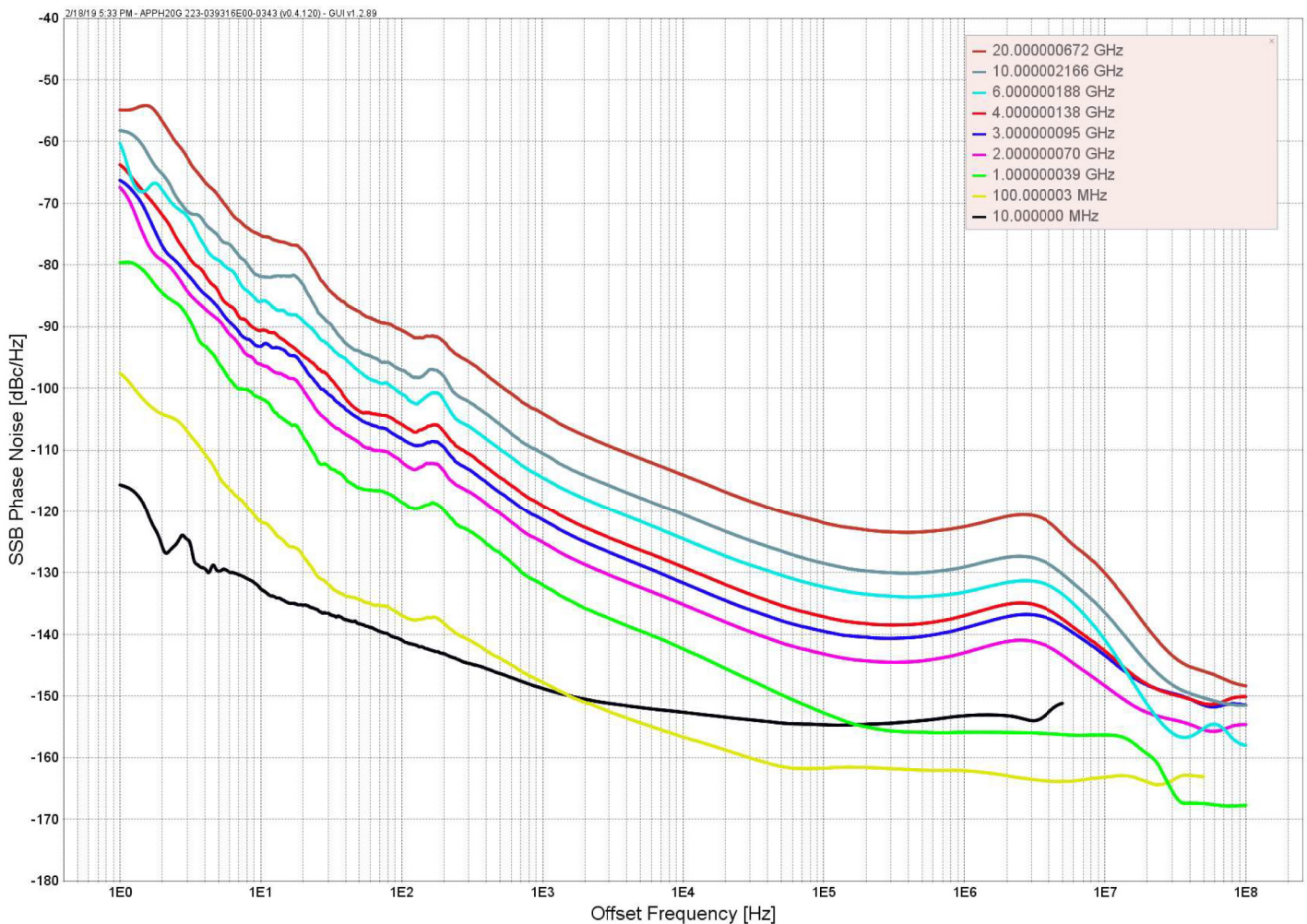
# Trigger (TRIG IN)

Input is TRIG IN at front panel

Parameter	Min.	Typ.	Max.	Note
Trigger Types	continuous, single (point), gated, gated direction			
Trigger Source	external, bus (LAN, USB)			
Trigger Modes	continuous free run, trigger and run, reset and run			
Trigger latency		5 ns		
Trigger uncertainty		10 ns		
External Trigger delay	50 ns		40 s	
External Delay Resolution		5 ns		
Trigger Modulo	1		255	Execute only on Nth trigger event
Trigger Polarity	Rising, falling			

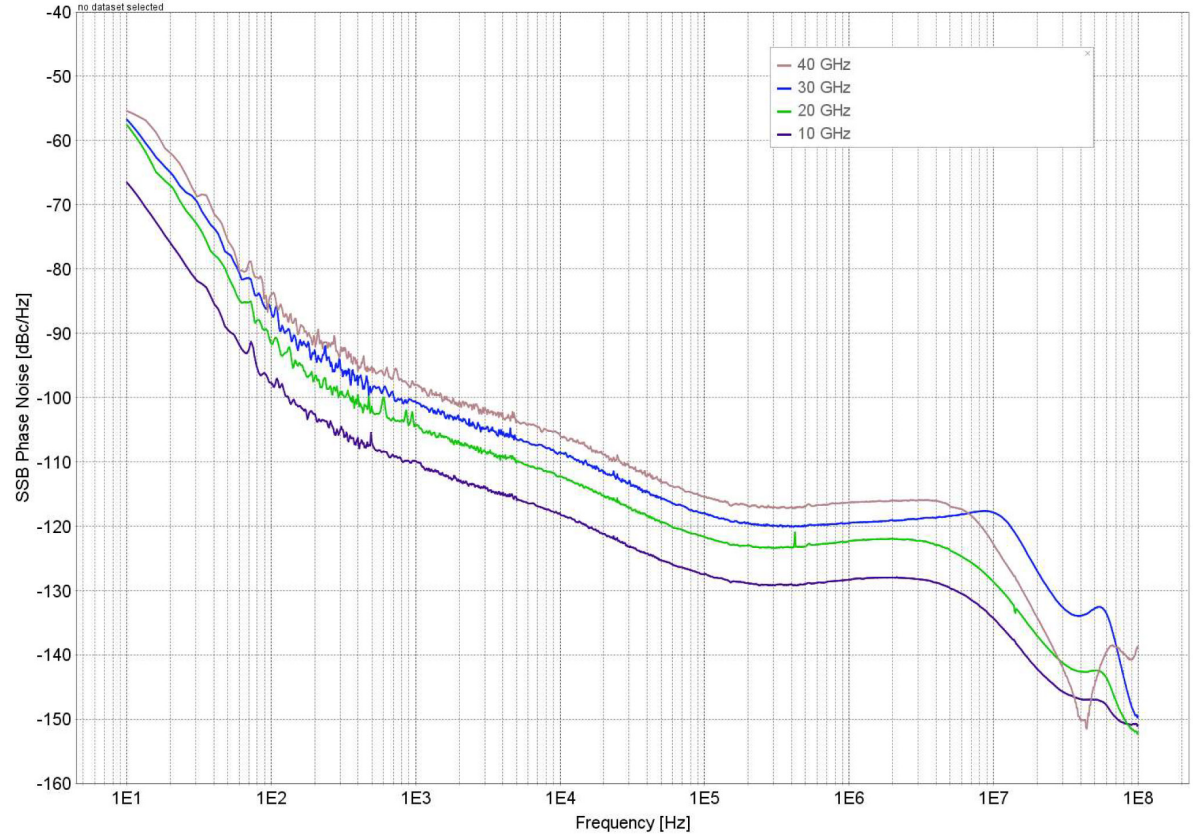
## Typical Performance Curves

### Phase Noise Performance with option LN



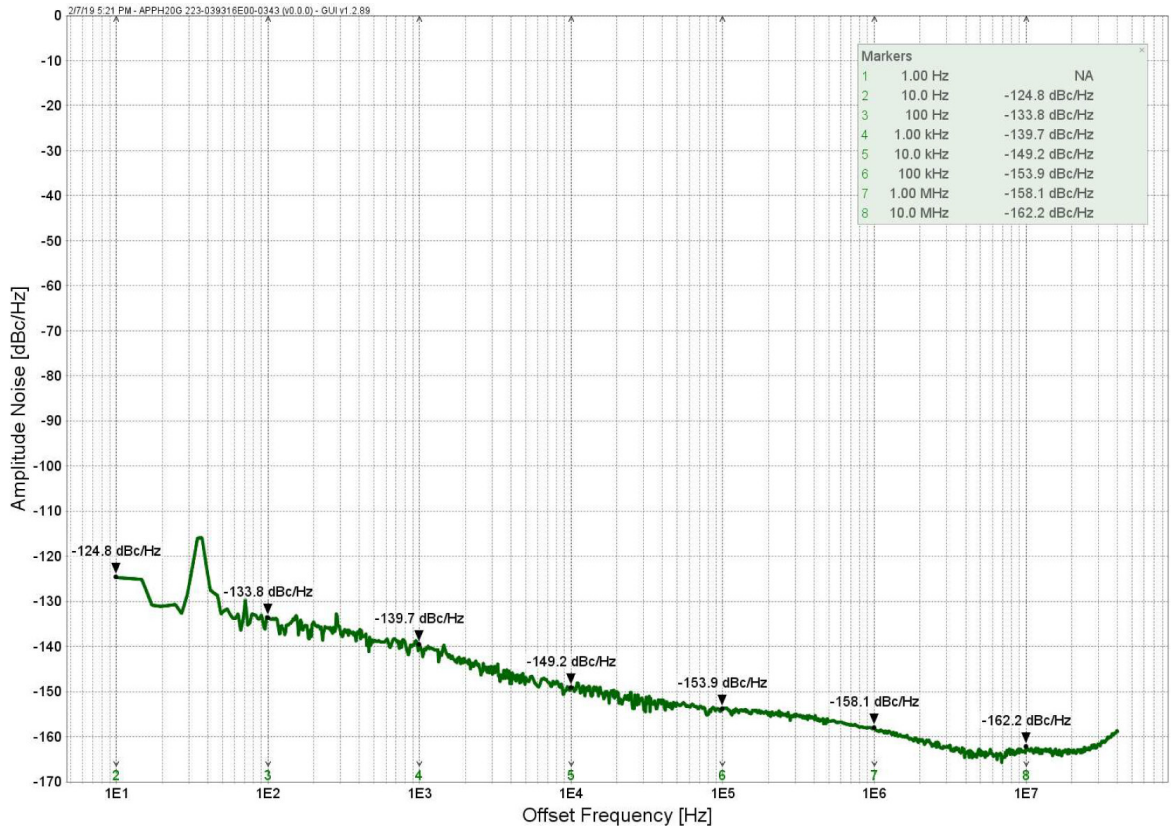
# Model 865-M RF / Microwave Synthesizer

Noise Performance without option LN (10, 20, 30, 40 GHz)

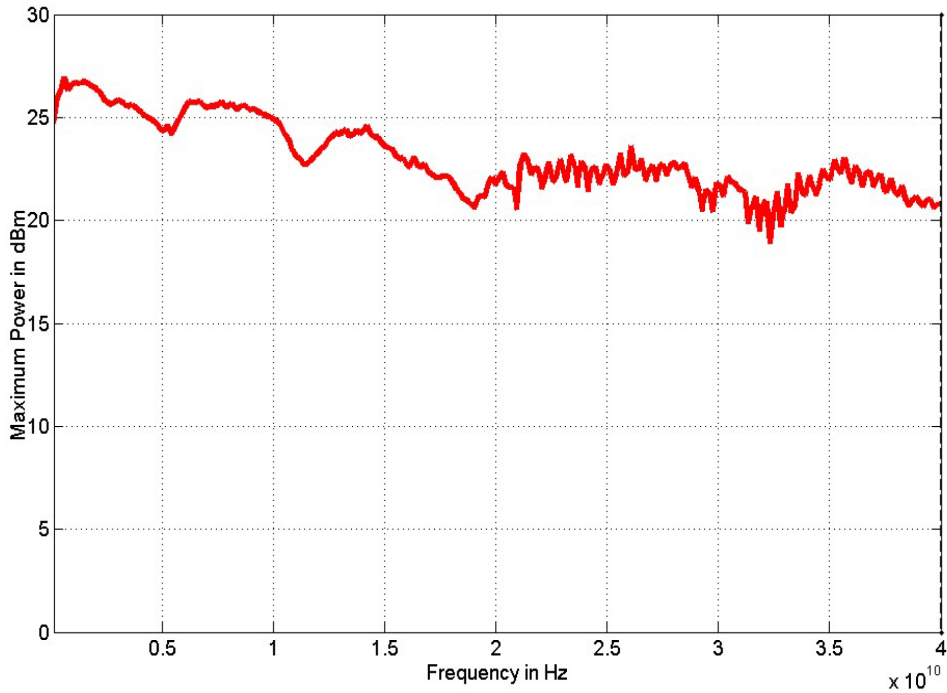


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## Amplitude Noise at 10 GHz



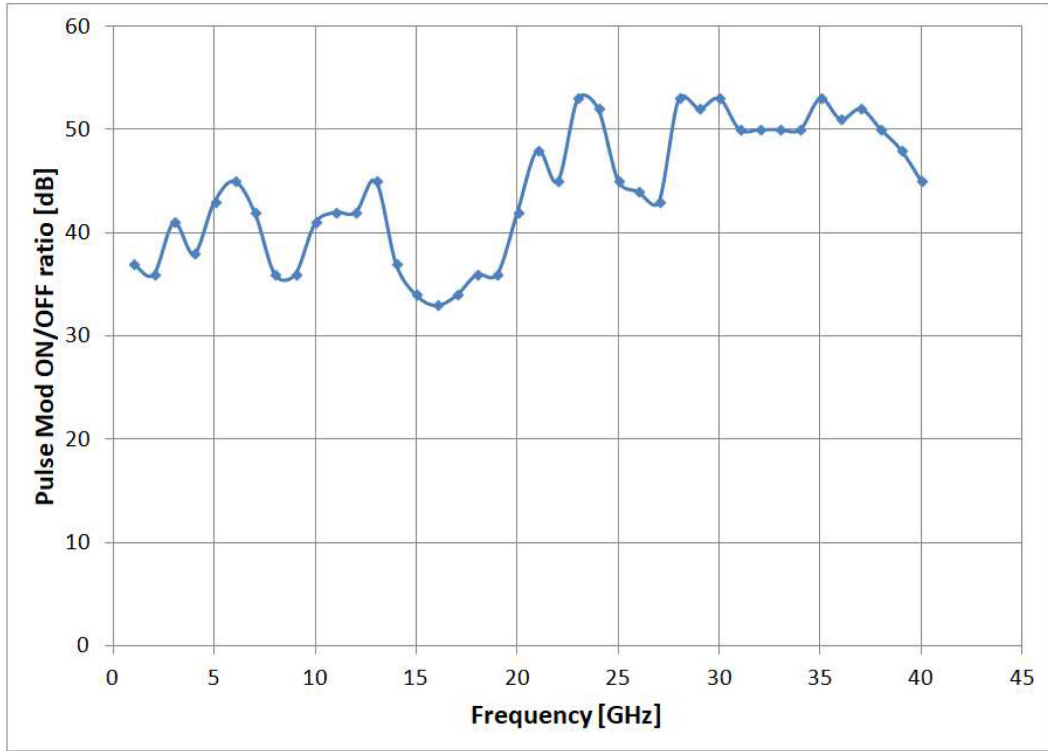
## Maximum Output Power





# Model 865-M RF / Microwave Synthesizer

## Pulse modulation on-off ratio



## Front Panel



## Back Panel



## General Characteristics

### Remote programming interfaces:

Ethernet 100BaseT LAN interface, USB 2.0 host & device, GPIB (IEEE-488.2,1987) with listen and talk (optional), Control language SCPI Version 1999.0

**Power requirements:** 24 V  $\pm$  3.0 VDC; 25 W maximum

**Mains adapter supplied:** 100-240 VAC in/ 24 V 4.0 A DC out

**Environmental** (Levels similar to MIL-PRF-28800F Class 3/4)

Environmental stress samples of this product have been type tested to be robust against the environmental stresses of storage, transportation, and end-use; those stresses to temperature, humidity, shock, vibration, altitude, and power line conditions.

**Operating temperature range:** 0 to 45 °C

**Storage temperature range:** -40 to 70 °C

**Operating and storage altitude:** up to 15,000 feet



notice

Safety/EMC complies with applicable Safety and EMC regulations and directives.

**Weight:**  $\leq$  1.0 kg (2.2 lbs) net

**Dimensions:** 27 x 10.5 x 6 cm [10.63 x 4.13 x 2.366 in]

## Options

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\*Specifications subject to change