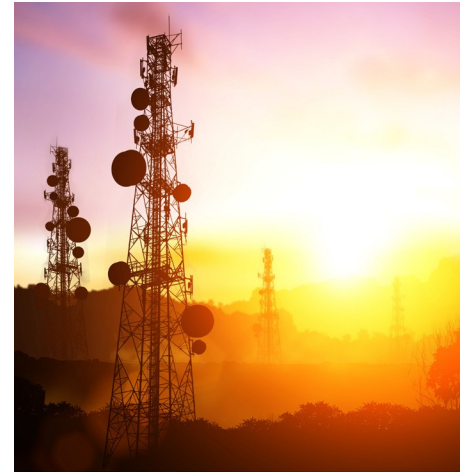


Model 865B-M-40-X Multi-Channel Wideband Synthesizer



Features

- Highly Phase Synchronous
- Fast Switching Down to 20 μ s
- Angular and Pulse modulation
- Internal OCXO, External Variable Reference

Applications

- ATE
- LO for Frequency Converters
- Telecom / SatCom
- System Integration



Model 865B-M-40-X Datasheet

8 kHz to 40 GHz Multi-Channel Wideband Synthesizer

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DEFINITIONS

- The specifications in the following pages describe the warranted performance of the instrument for 23 ± 5 °C after a 30-minute warm-up period

Typical: Expected mean values, not warranted performance

Min and max: Parameter range that is guaranteed by product design, and/or production tested. Warranted performance specifications include guard-bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

INTRODUCTION

• Multi-Output ultra-low Phase Noise Wideband Frequency Synthesizer with USB & LAN Interface

The Model 865B-M-X is a multi-channel wideband low phase-noise synthesizer settable from 100 kHz (8 kHz with option 8K) to 40 GHz.

The product is available with 1, 2, 3 or 4 fully independently configurable outputs. For each output channel, frequency, output power, phase and modulation can be set.

The settable output power range is from -5 to +25 dBm.

The Model 865B-M-X has a milli-Hz frequency resolution and uses a high-stability OCXO internal reference. The reference can be phase-locked to a 10 or 10 MHz external reference. With option VREF, a user-settable range from 1 to 250 MHz is available.

For highest phase coherence, multiple 865B-M-Xs can be cascaded with just one master reference clock.

When ordered with option FILT, the 865B-M-X provides excellent harmonic rejection even a full output power.

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

The module has USB and LAN interfaces (optionally also GPIB) and can be controlled using the SCPI 1999 command set.

FACTS & FIGURES & SPECIFICATIONS

Signal Specifications

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency Range	100 kHz 8 kHz		40 GHz	Settable to 43.5 GHz Option 8K
Resolution		0.001 Hz		
Phase Resolution		0.01 deg		
Switching Speed		1.5 ms		after SCPI command received
CW Mode		500 μs		
Sweep / List Mode		20 μs		Option FS

Frequency Reference

PARAMETER	MIN	TYPICAL	MAX	NOTE
Internal reference frequency		100 MHz 10 MHz		Option LN
Internal Reference Output Frequency				
Temperature stability			±100 ppb ±20 ppb	0 to 50 degC Option LN / LN+
Aging 1st year			1 ppm 0.03 ppm 0.02 ppm	Option LN Option LN+
Aging per day			5 ppb 0.5 ppb < 0.5 ppb	after 30 days operations Option LN Option LN+
Warm-up time		5 min		
Output of internal reference		100 MHz		
		10 / 100 MHz		Option LN / LN+
Output power	0 dBm	5 dBm		
Output impedance		50 Ohms		
Bypass Internal reference Input		100 MHz		High phase synchronous mode
Phase Lock to External Reference	1 MHz	integer MHz	250 MHz	Option VREF
Reference Bypass Mode		100 MHz		
Reference input level				
10 MHz or 1-250 MHz	-5 dBm	0 dBm	+13 dBm	
Bypass 100 MHz	5 dBm		+15 dBm	
Reference input impedance		50 Ohm		
Lock Range				
10 MHz or 1-250 MHz			±1.5 ppm	
Bypass 100 MHz			>100 ppm	

Level Performance

PARAMETER	MIN	TYPICAL	MAX	NOTE
Output power range				(see also plots) option 8K
8 kHz to 10 MHz	-10 dBm		+20 dBm	
10 MHz to 5 GHz	-10 dBm		+20 dBm	
5 to 20 GHz	-5 dBm		+20 dBm	
20 to 28 GHz	10 dBm		+19 dBm	
28 to 40 GHz	0 dBm		+16 dBm	
10 MHz to 5 GHz	-10 dBm		+15 dBm	Option FILT
5 to 20 GHz	-10 dBm		+12 dBm	Option FILT
20 to 28 GHz	5 dBm		+12 dBm	Option FILT
28 to 40 GHz	-10 dBm		+10 dBm +8 dBm	Option FILT Option FILT + 8K

Figure 1: Maximum Output Power (without option FILT)

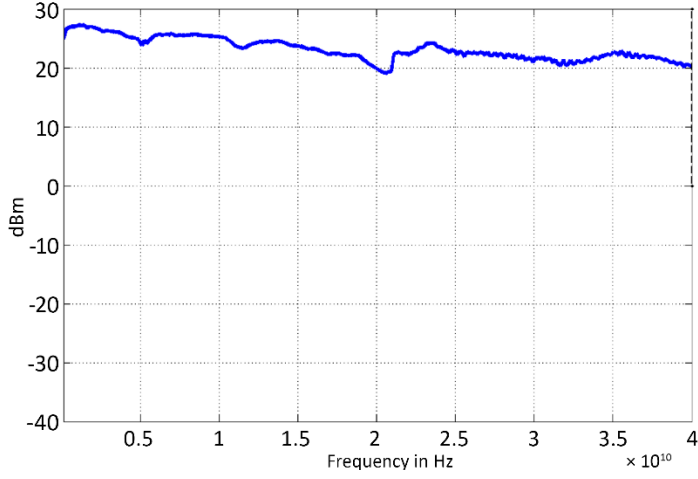


Figure 2: Maximum Output Power with FILT

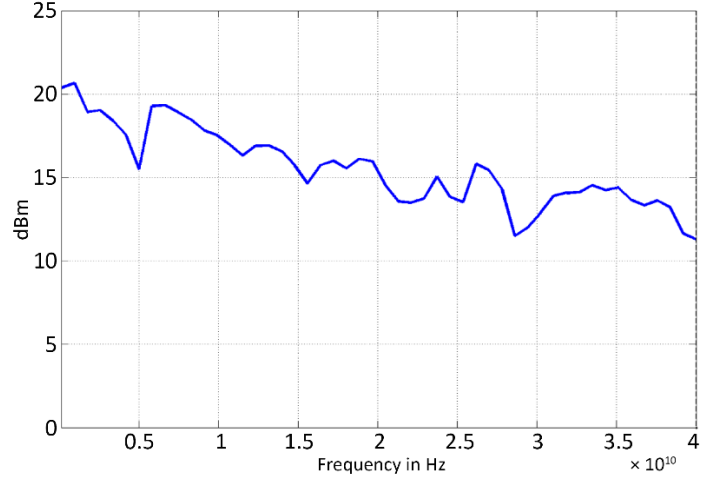
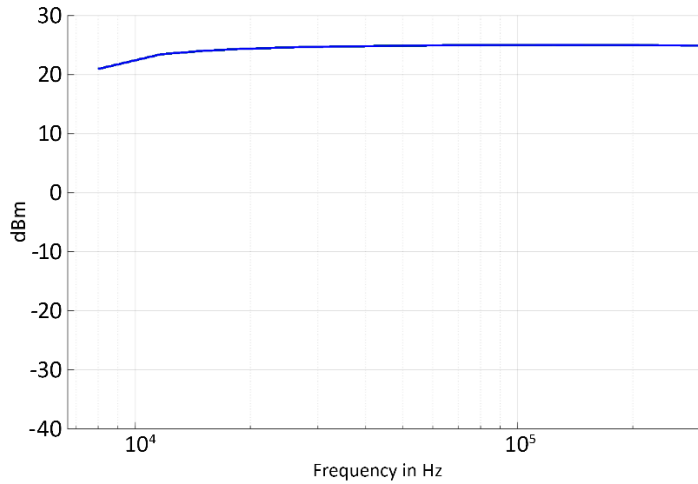


Figure 3: Maximum Output Power at 8 to 250 kHz (option 9K)



Level Accuracy

PARAMETER	MIN	TYPICAL	MAX	NOTE
Power Resolution		0.5 dB		
Power Accuracy		±1.0 dB	± 2.5 dB	

Figure 4: Power level accuracy (with option FILT)

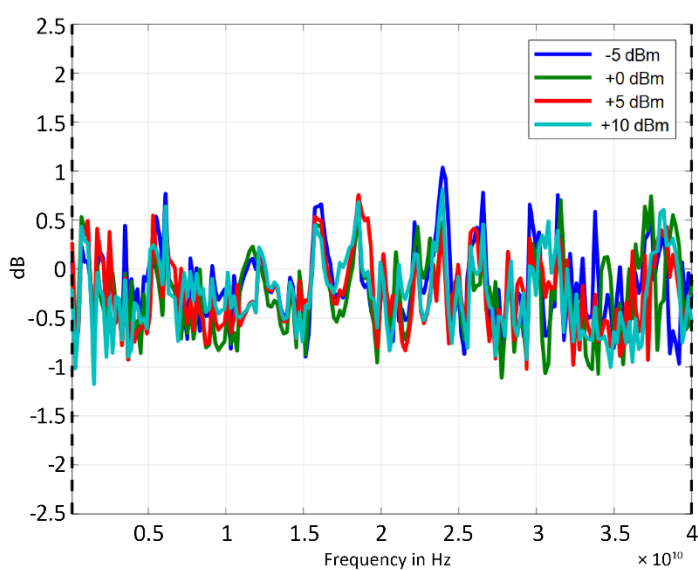


Figure 5: Power level linearity (with option FILT)

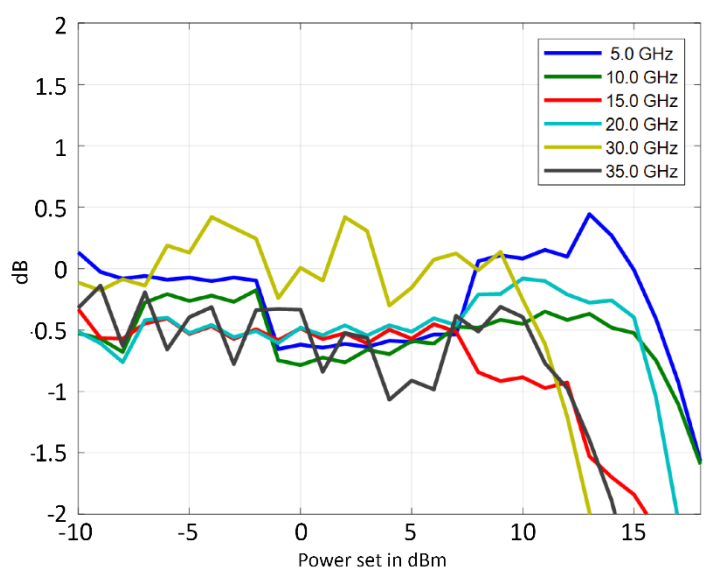
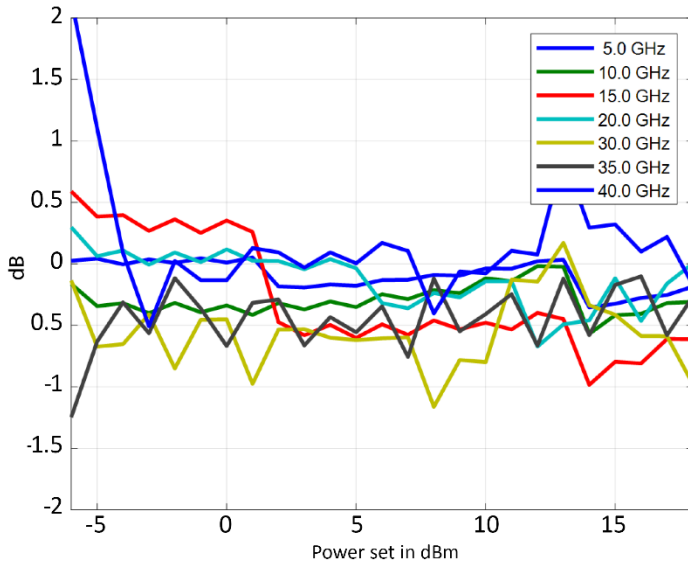


Figure 6: Power level linearity



Reverse Power Protection and VSWR

PARAMETER	MIN	TYPICAL	MAX	NOTE
Reverse Power Protection				
DC Voltage		7 V		
RF Power			20 dBm	
Output impedance		50 Ohms		
VSWR		1.8		

Phase Noise

PARAMETER	MIN	TYPICAL	MAX	NOTE
SSB Phase noise at 1 GHz				(see also plot)
at 10 Hz from carrier		-93 dBc/Hz		Option LN / LN+
at 1 kHz from carrier		-130 dBc/Hz		
at 100 kHz from carrier		-145 dBc/Hz		
Wideband noise		-160 dBc/Hz		
SSB Phase noise at 10 GHz				
at 10 Hz from carrier		-73 dBc/Hz		Option LN / LN+
at 1 kHz from carrier		-110 dBc/Hz		
at 100 kHz from carrier		-125 dBc/Hz		
Wideband noise		-160 dBc/Hz		

Figure 7: Phase Noise Performance with option LN

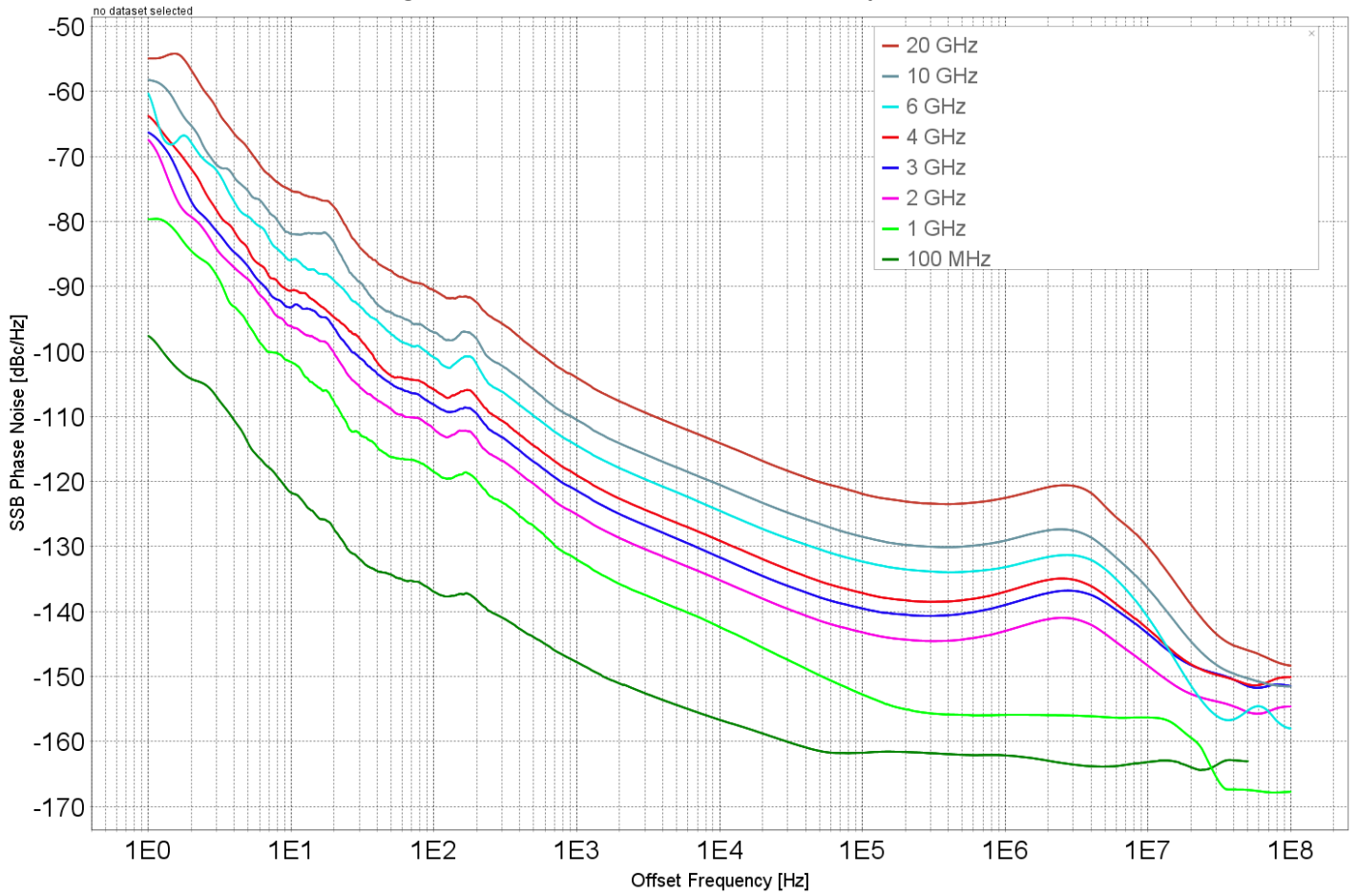


Figure 8: Phase Noise Performance without option LN

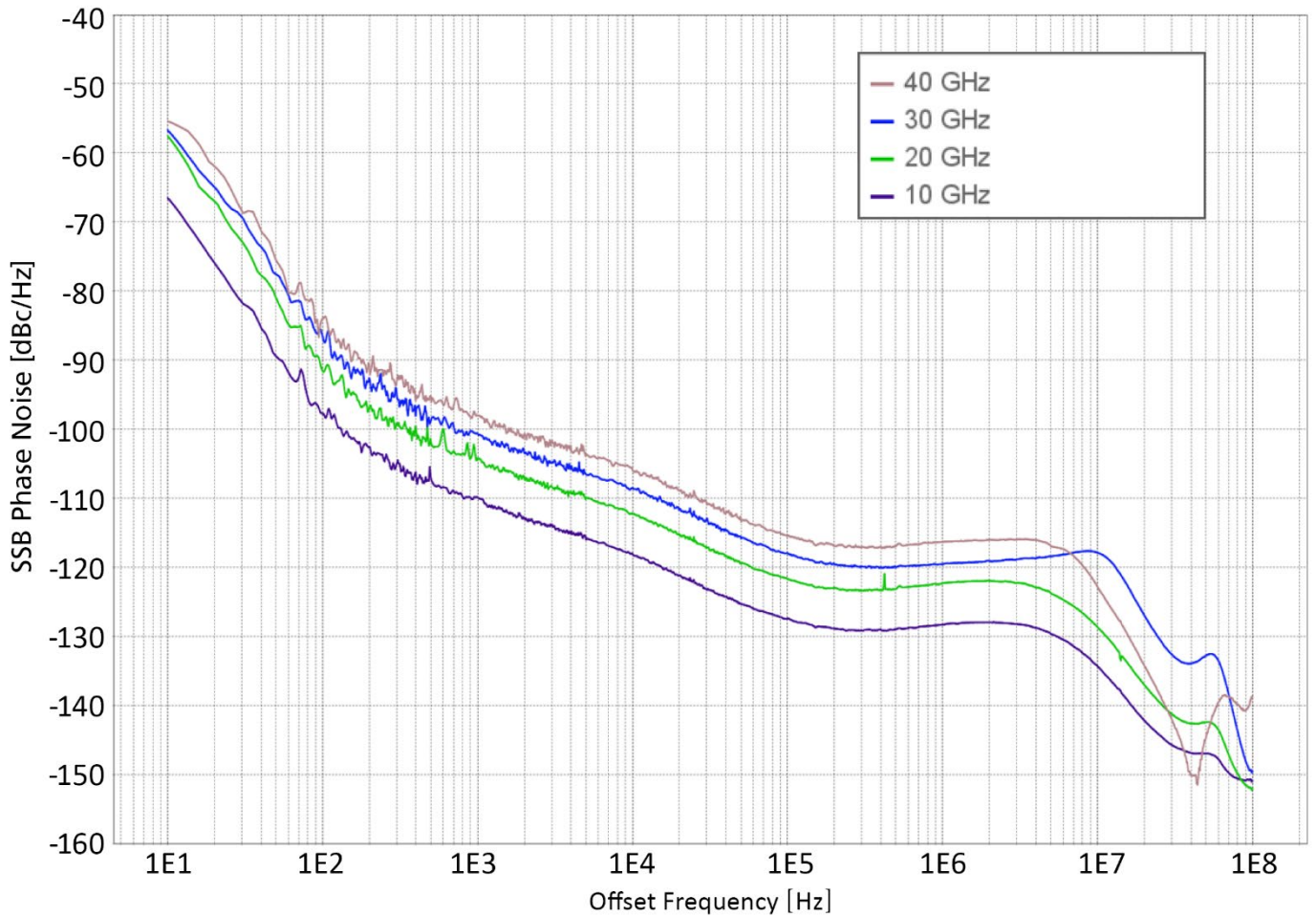
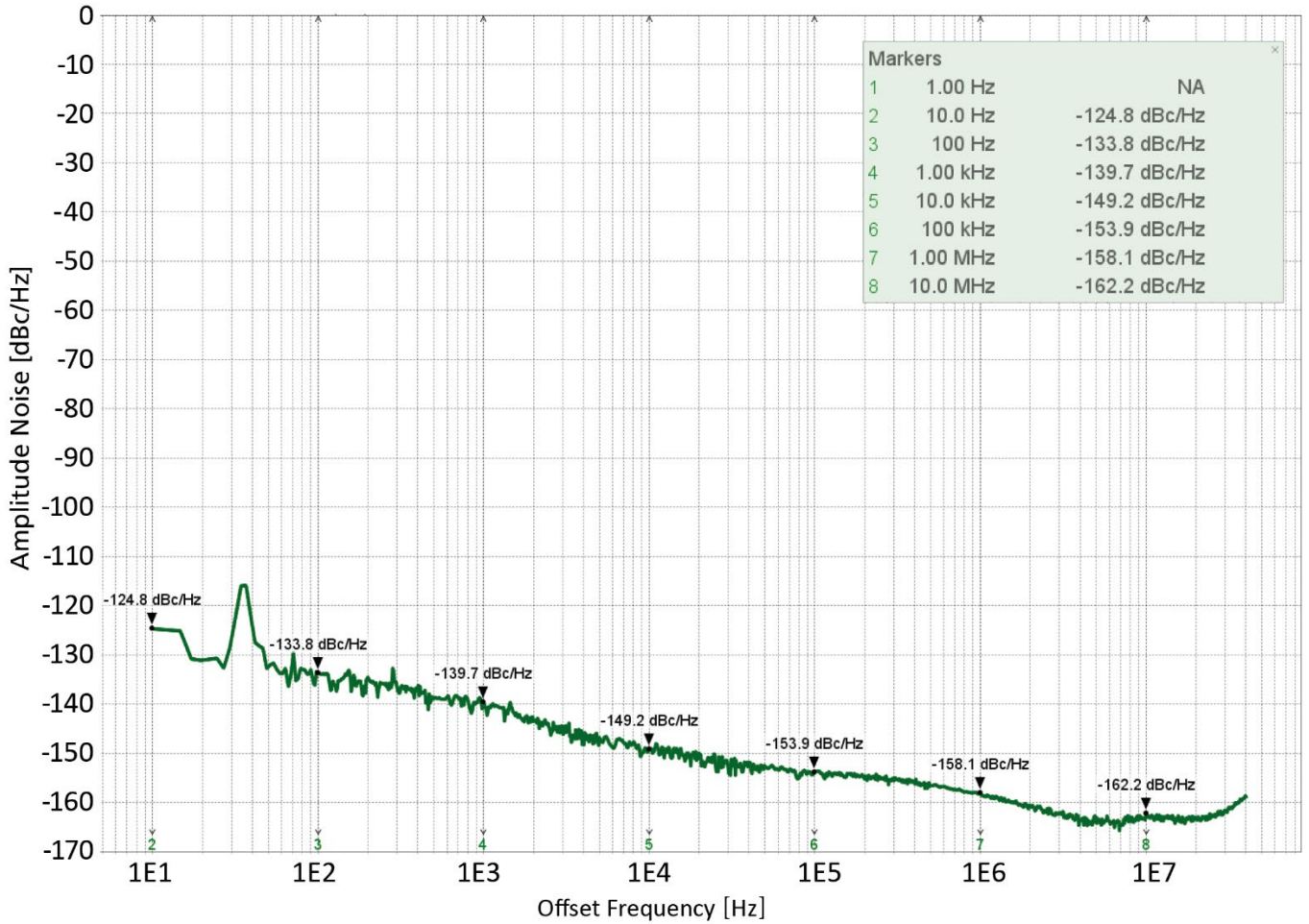


Figure 9: Amplitude Noise at 10 GHz



Spectral Purity

PARAMETER	MIN	TYPICAL	MAX	NOTE
Output harmonics @ 5 dBm				(see also plots)
< 1.2 GHz		-25 dBc	-20 dBc	
1.2 to 2.5 GHz		-15 dBc	-9 dBc	
2.5 to 5 GHz		-30 dBc	-23 dBc	
5 to 12 GHz		-15 dBc	-9 dBc	
12 to 20 GHz		-25 dBc	-20 dBc	
>20 GHz		-20 dBc	-12 dBc	
Output harmonics @ 0 dBm				Option FILT
<1 GHz		-35 dBc	-25 dBc	
>1 GHz		-55 dBc	-45 dBc	
Sub-harmonics @ 5 dBm				< 20 GHz >20 GHz
		-75 dBc	-50 dBc	
		-55 dBc	-25 dBc	
Non-harmonic spurious @ 5 dBm				
CW, offset from 10 kHz until 500 MHz				
<1.2 GHz		-90 dBc	-60 dBc	
1.2 - 2.5 GHz		-85 dBc	-55 dBc	
2.5 - 5 GHz		-80 dBc	-55 dBc	
5 - 10 GHz		-75 dBc	-55 dBc	
10 - 20 GHz		-70 dBc	-55 dBc	
>20 GHz		-65 dBc	-50 dBc	

Figure 10: Harmonics @ 0 dBm (with option FILT)

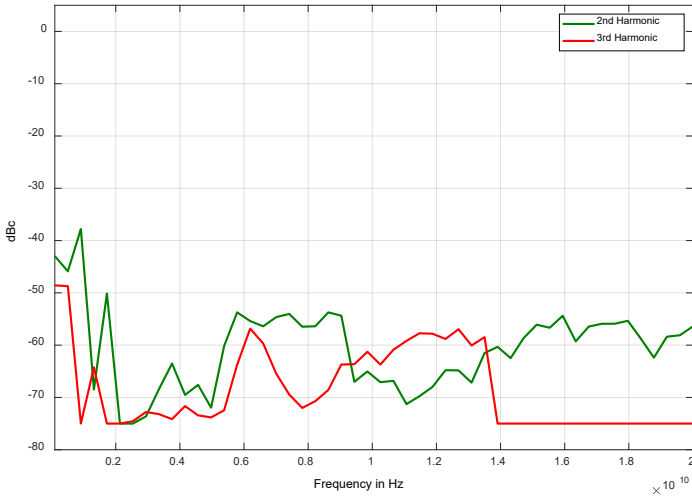


Figure 11: Harmonics +15 dBm(with option FILT)

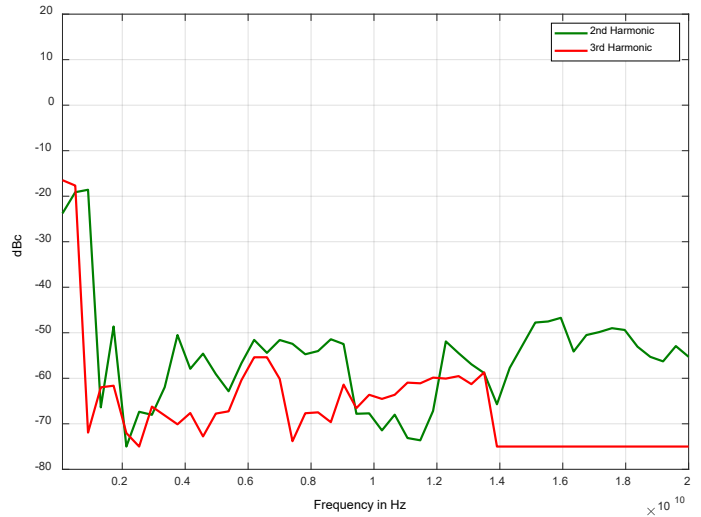
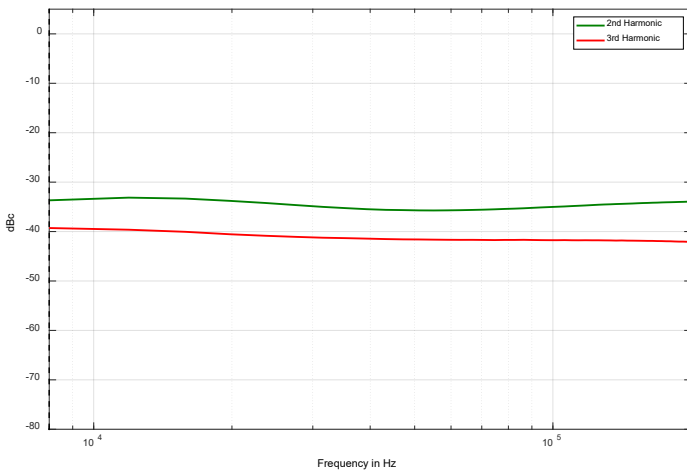


Figure 12: Harmonics at lower frequencies and 0 dBm (with option 9K)

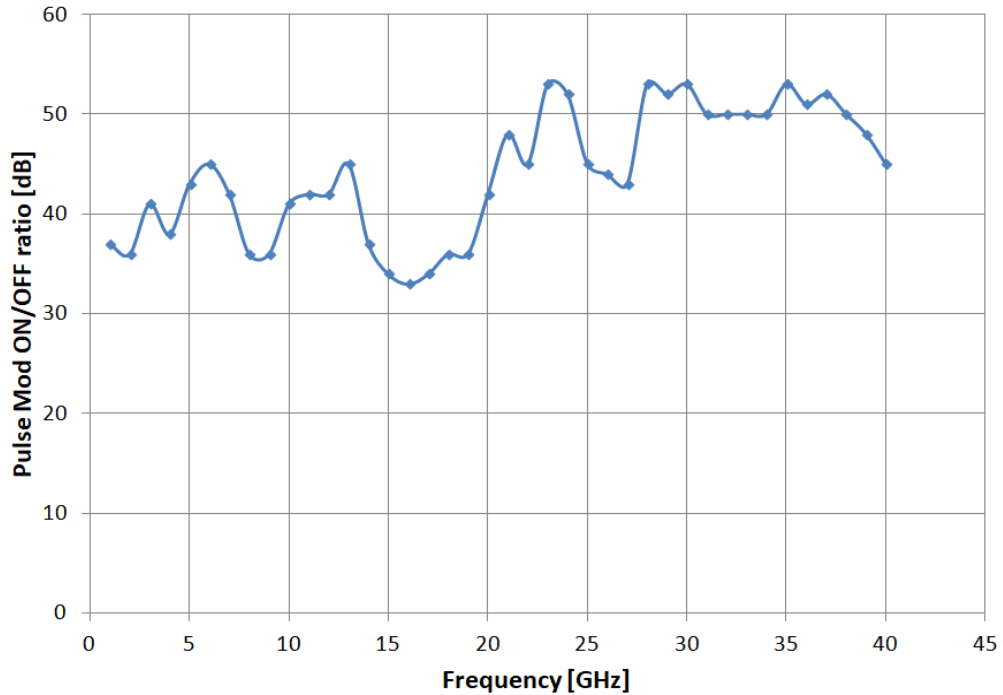


Modulation Capabilities

Pulse Modulation

PARAMETER	MIN	TYPICAL	MAX	NOTE
Modulation source		Internal/ External		
Pulse rise/fall time		10 ns		
On/off ratio		40 dB	25 dB	Pout > +10 dBm, see plot
Pulse overshoot			10%	
Pulse delay		20 ns		
Pulse polarity		Normal, inverse		selectable
External input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External input voltage range	-0.5 V		+5.5 V	TTL compatible
External input hysteresis		60 mV		

Figure 13: Pulse Modulation on-off ratio



Internal pulse generator

PARAMETER	MIN	TYPICAL	MAX	NOTE
Repetition frequency (PRF)	0.1 Hz		100 MHz	= 1/T
Duty cycle	1 % to 99 % in 1% steps			within specified minimum pulse width
Minimum pulse settling range	30 ns		20 s	
Pulse Pattern Modulation & Staggered PRF				Using internal pattern generator
Pulse width	30 ns		5 s	
Programmable pattern length	2		65536	
Duty cycle	0.05%		99.95%	
Pulse width resolution		5 ns		
Pulse period (T) accuracy		0.00005xT+ 3ns		
Pulse width accuracy		0.00005xT+ 5ns		
Pulse width resolution		5 ns		
Pulse jitter		<100 ps	1 ns	
Polarity		selectable		

Frequency Modulation

PARAMETER	MIN	TYPICAL	MAX	NOTE
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			

Phase Modulation

PARAMETER	MIN	TYPICAL	MAX	NOTE
Modulation source		Internal		
Phase deviation (peak)	0		300 · N · rad	
Deviation accuracy		0.50%	2%	
Modulation rate	0.1 Hz		80 kHz	
Modulation waveforms	Sine			
Distortion (THD)	< 1%			1 kHz rate & N x rad deviation

⬢ Sweeping Capability, Sweep type: linear, logarithmic, random

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency Sweep				
Step time (t_{step})	500 μ s 20 μ s			Option FS
Dwell time (t_{dwell})	15 μ s			

⬢ Trigger (TRIG IN): Input is TRIG IN at front panel

PARAMETER	MIN	TYPICAL	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			
External trigger input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External trigger input voltage range	-0.5 V		+5.5 V	TTL compatible
External trigger input hysteresis		60 mV		

Front



1. DC power switch
2. External pulse modulation inputs: BNC female (1 to 4)
3. RF outputs: K (2.92 mm) female (1 to 4)

Rear



1. Unit-to-unit synchronization signal input (SYNC IN): SMA female
2. Unit-to-unit synchronization signal output (SYNC OUT): SMA female
3. High Stability Reference input (CLK IN, 3 GHz): SMA female
4. High Stability Reference output (CLK OUT, 3 GHz): SMA female
5. Trigger output (TRIG OUT): BNC female
6. Trigger input (TRIG IN): BNC female
7. Reference output (REF OUT): BNC female
8. Reference input (REF IN): BNC female
9. GPIB: IEEE-488.2, 1987 with listen and talk (optional)
10. LAN connection: RJ-45
11. USB 2.0 device
12. FUSE (3.15 A)
13. 100-240V AC power plug

CASINGS

Standard 19" 1U



High Isolation Casing 19" 1U (Option HI, rack mount kit included)



ORDERING INFORMATION



HOST MODEL	PRODUCT	DESCRIPTION
865B-M-X	865B-M-1	Single output, 19" 1U rack-mount module
865B-M-X	865B-M-2	Dual-Output, 19" 1U rack-mount module
865B-M-X	865B-M-3	Triple-Output, 19" 1U rack-mount module
865B-M-X	865B-M-4	Quad-Output, 19" 1U rack-mount module
865B-M-X	Option LN	Enhanced close in phase noise & frequency stability
865B-M	Option LN+	Enhanced close in phase noise & further enhanced long term frequency stability
865B-M-X	Option FS	Ultra-fast switching speed
865B-M-X	Option VREF	Variable external reference
865B-M-X	Option GPIB	GPIB interface
865B-M-X	Option HI	High isolation 19" 1U casing
865B-M-X	Option FILT	Enhanced harmonic rejection
865B-M-X	Option 8K	Frequency range extension to 8 kHz

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 24V ± 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)

Operating temperature range 0 to 45 °C

Storage temperature range -40 to 70 °C

Operating and storage altitude up to 15,000 feet (4600 m)



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

Weight ≤ 10.0 kg (22 lbs) net

Dimensions: 19" 1U enclosure: 43 mm H x 426 mm W x 460 mm L [1.7 in H x 16.8 in W x 18.1 in L]



Document History

Version/Status	Date	Author	Notes
V10	2019-02-20	jk	first release
V110	2020-01-26	jk	Added option FILT & option 8K
V120	2020-04-30	jk	Added plots for 8K and FILT
V121	2021-02-25	db	Pulse and trigger input electrical specifications
V122	2022-10-20	jk	Pmax Specs revised
V123	2023-06-15	mh	Removed serial number info. This version covers all HW.
V124	2023-10-04	ee	New layout structure
V125	2023-11-15	ap/mh	Nonharmonics revised

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