



# DATASHEET RFS20 Specification V1.47

10 MHz to 20 GHz Wideband Synthesizer



## DEFINITIONS

The specifications in the following pages describe the warranted performance of the instrument for  $23 \pm 5$  °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

### Ultra-compact, fast and low power consumption Frequency Synthesizer with USB & LAN interface

The RFS20 is a wideband low phase-noise synthesizer operating from 10 MHz to 20 GHz. The nominal output power is +23 dBm.

The module has a milli-Hz frequency resolution and uses a high-stability internal reference. The internal reference can be phase-locked to a user-settable external reference. For highest phase coherence, multiple RFS20s can be cascaded with just one master reference clock.

The RFS20 offers dedicated sweeping capabilities with switching speeds of only 25  $\mu$ s and wideband frequency modulation as well as narrow pulse modulation.

The module has USB and LAN interfaces and can be controlled using the SCPI 1999 command set. Operated with an external 6V DC supply, it consumes less than 10 watts.

# FACTS & FIGURES & SPECIFICATIONS

## Signal Specifications

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Frequency Range</b>	10 MHz		20 GHz	
Resolution		0.001 Hz		
<b>Phase Resolution</b>		0.1 deg		
<b>Switching Speed</b>		1.5 ms		after SCPI command received
CW Mode		180 μs		
Sweep / List Mode		25 μs		Option FS
<b>SSB Phase noise at 1 GHz</b>				(see also plot)
at 1 kHz from carrier		-118 dBc/Hz		
at 100 kHz from carrier		-128 dBc/Hz		
Wideband noise		-150 dBc/Hz		
<b>SSB Phase noise at 10 GHz</b>				
at 1 kHz from carrier		-100 dBc/Hz		
at 100 kHz from carrier		-108 dBc/Hz		
Wideband noise		-150 dBc/Hz		
<b>Output power</b>	18 dBm	23 dBm	26 dBm	(see plot)
<b>Reverse Power Protection</b>				
DC Voltage		7 V		
RF Power			23 dBm	
<b>Output impedance</b>		50 Ohms		
VSWR		1.8		
<b>Spectral purity</b>				
Output harmonics		-15 dBc		
Sub-harmonics		-75 dBc	-60 dBc	
<b>Non-harmonic spurious</b>		-75 dBc	-60 dBc	



## Modulation Capabilities

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Pulse Modulation</b>				
Modulation source		Internal/ External		
External input amplitude	TTL			
Pulse rise/fall time		7 ns		
On/off ratio	30 dB	45 dB		Pout > +10 dBm
Pulse overshoot			10%	
Pulse delay		20 ns		
Pulse polarity	1V	2V TTL		AC coupled DC coupled
<b>Internal pulse generator</b>				
Repetition frequency (PRF)	0.1 Hz		10 MHz	= 1/T
Duty cycle	1 % to 99 % in 1% steps			within specified minimum pulse width
Pulse Width settling range	30 ns		1 s	
Pulse Pattern Modulation & Staggered PRF				Using internal pattern generator
Programmable pattern length	2		4192	
Pulse width resolution		15 ns		
Pulse jitter		2 ns	10 ns	
Polarity		Normal, inverse		selectable
<b>Frequency Modulation</b>				
Modulation source		Internal		
Maximum Frequency deviation (peak)	N · 500 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		800 kHz	3dB
Modulation waveforms	Sine			
<b>Phase Modulation</b>				
Modulation source		Internal		
Phase deviation (peak)	0		100 · N · rad	
Deviation accuracy		0.50%	2%	
Modulation rate	0.1 Hz		800 kHz	
Modulation waveforms	Sine			
Distortion (THD)		< 1%		1 kHz rate & N x rad deviation
<b>Frequency Chirps</b>				
Modulation source		Linear, ramp, up/down		
Bandwidth			10%	
Dwell time	1 ns		10 ms	
Slope	0.1 Hz		100 MHz / μs	

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

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Frequency Sweep</b>				
Step time ( $t_{step}$ )	180 $\mu$ s 25 $\mu$ s			Option FS
Dwell time ( $t_{dwell}$ )	15 $\mu$ s			

## Frequency Reference

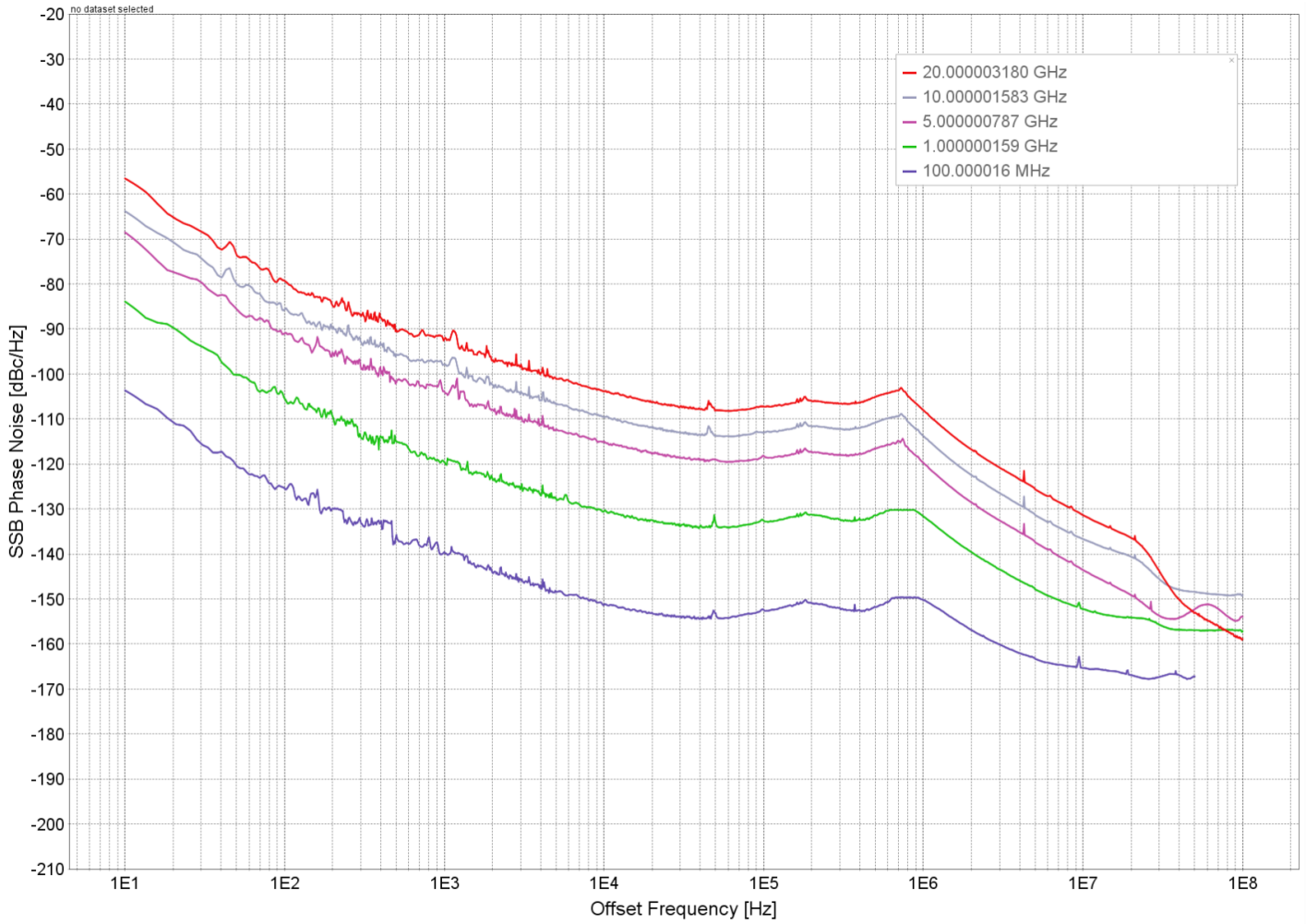
PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Internal reference frequency</b>		100 MHz		
<b>Internal Reference Output Frequency</b>				
Output Power	0 dBm	5 dBm		
		50 Ohms		
Temperature stability			$\pm$ 100 ppb	0 to 50 degC
Aging 1st year		0.5 ppm	1 ppm	
Aging per day			5 ppb	after 30 days operations
Warm-up time		5 min		
Output of internal reference		100 MHz		
Output power	0 dBm	5 dBm		
Output impedance		50 Ohms		
<b>Bypass Internal reference Input</b>		100 MHz		High phase synchronous mode
<b>Phase Lock to External Reference</b>	1 MHz	integer MHz	250 MHz	
<b>Reference input level</b>	-5 dBm	0 dBm	+13 dBm	
Reference Bypass Mode	5 dBm		+15 dBm	
<b>External Reference Lock Range</b>				
1-250 MHz			$\pm$ 1.0 ppm	
Bypass 100 MHz			>100 ppm	
<b>Reference input impedance</b>		50 Ohms		

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

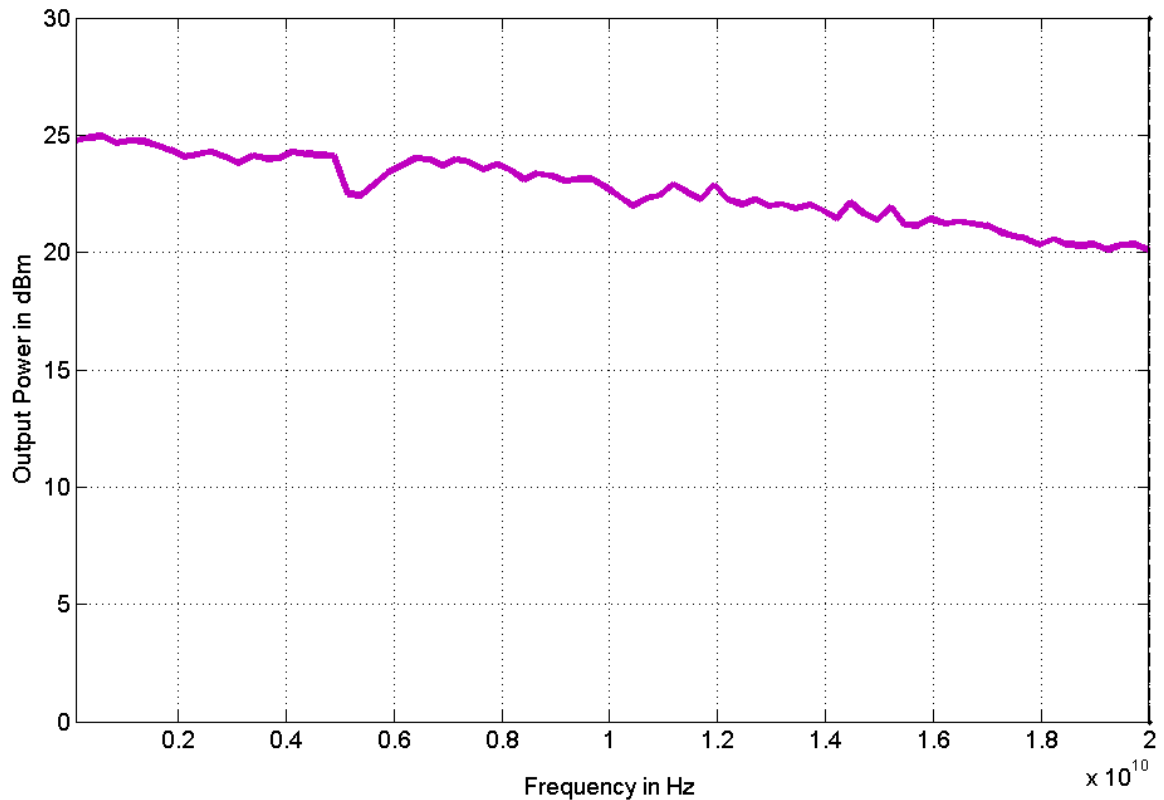
PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Trigger Types</b>				Continuous, single (point), gated, gated direction
<b>Trigger Source</b>				external, bus (LAN, USB)
<b>Trigger Modes</b>				Continuous free run, trigger and run, reset and run
Trigger uncertainty		5 $\mu$ s		
External Trigger delay	50 $\mu$ s		40 s	
External Delay Resolution		15 ns		
<b>Trigger Modulo</b>	1		255	Execute only on Nth trigger event
<b>Trigger Polarity</b>		Rising, falling		

# TYPICAL PERFORMANCE CURVES

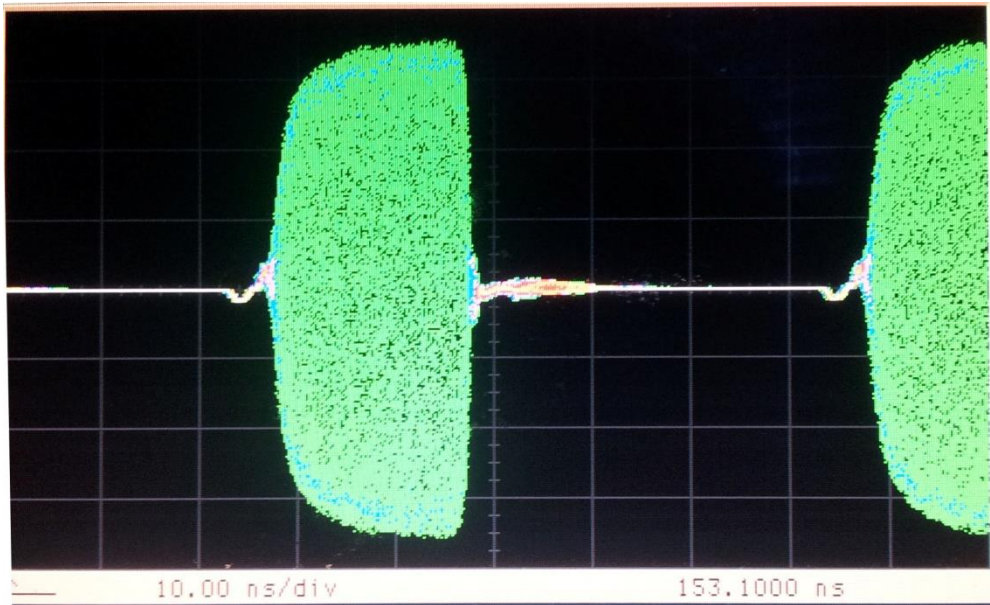
## Phase Noise Performance




## Output Power 0.01 to 20 GHz



## Pulse Modulation (20 ns width, 100 ns period)



## ORDERING INFORMATION

 HOST MODEL	PRODUCT	DESCRIPTION
RFS20	RFS20	20 GHz Synthesizer, flange-mount module
RFS20	Option 1URM	19 inch 1HU rackmount enclosure
RFS20	Option FS	Ultra fast switching speed
RFS20	Option GPIB	GPIB interface (only with option 1URM)

## GENERAL CHARACTERISTICS

### Remote programming interfaces

Ethernet 100BaseT LAN interface, USB 2.0 host & device, Control language SCPI Version 1999.0

### Power requirements 6V VDC; 20 W maximum

**Mains adapter supplied:** 100-240 VAC in/ 6 V 6.0 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 (4600 m)



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

Weight ≤ 1.0 kg (2.2 lbs) net

Dimensions 24 x 10.5 x 6 cm

Dimensions 21 x 10.5 x 6 cm

24 x 10.5 x 6 cm (with option FS)



Front view



Rear view

## Document History

Version/Status	Date	Author	Notes
V147	2019-03-01	jk	New layout