



# DATASHEET RFS20 Specification V1.47

10 MHz to 20 GHz Wideband Synthesizer



**Document size:**

1 (one) title page  
8 (eight) content pages

## 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/<br>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<br>TTL                |                 | AC coupled<br>DC coupled  |
| <b>Internal pulse generator</b>             |                            |                          |                 |   |
| Repetition frequency (PRF)                  | 0.1 Hz                     |                          | 10 MHz          | = 1/T   |
| Duty cycle                                  | 1 % to 99 %<br>in 1% steps |                          |                 | within specified minimum pulse<br>width   |
| Pulse Width settling range                  | 30 ns                      |                          | 1 s             |   |
| Pulse Pattern Modulation & Staggered<br>PRF |                            |                          |                 | Using internal pattern generator  |
| Programmable pattern length                 | 2                          |                          | 4192            |   |
| Pulse width resolution                      |                            | 15 ns                    |                 |   |
| Pulse jitter                                |                            | 2 ns                     | 10 ns           |   |
| Polarity                                    |                            | Normal,<br>inverse       |                 | selectable  |
| <b>Frequency Modulation</b>                 |                            |                          |                 |   |
| Modulation source                           |                            | Internal                 |                 |   |
| Maximum Frequency deviation (peak)          | N · 500 MHz                |                          |                 | < 1.25 GHz (N=1)<br>1.25 GHz to 2.5 GHz (N=0.125)<br>2.5 GHz to 5 GHz (N=0.25)<br>5 GHz to 10 GHz (N=0.5)<br>10 GHz to 20 GHz (N=1)<br>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,<br>up/down |                 |   |
| Bandwidth                                   |                            |                          | 10%             |   |
| Dwell time                                  | 1 ns                       |                          | 10 ms           |   |
| Slope                                       | 0.1 Hz                     |                          | 100 MHz /<br>µs |   |

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

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

## Frequency Reference

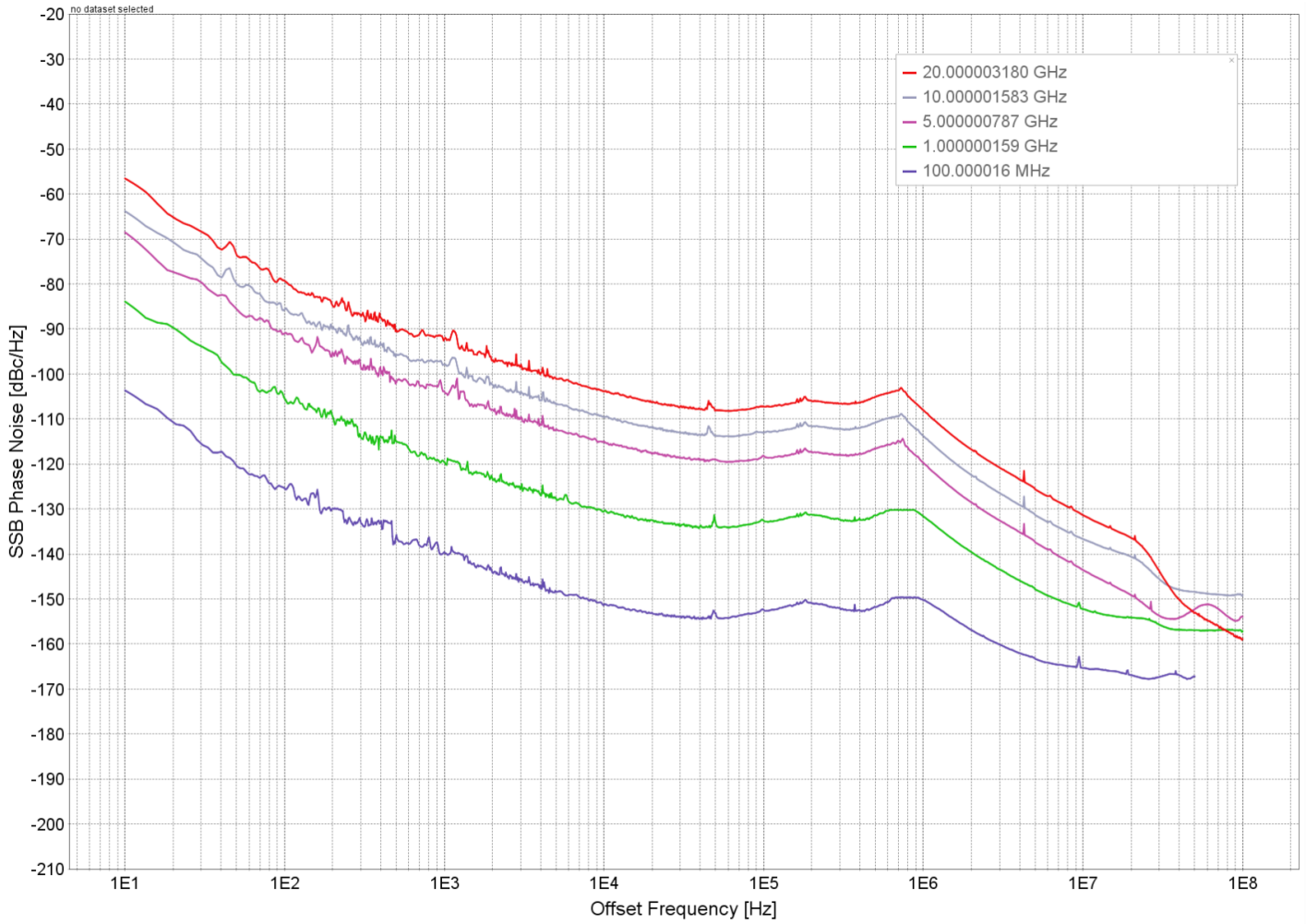
| PARAMETER                                  | MIN    | TYPICAL     | MAX           | NOTE                        |
|--|--------|-------------|---------------|-----------------------------|
| <b>Internal reference frequency</b>        |        | 100 MHz     |               |                             |
| <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

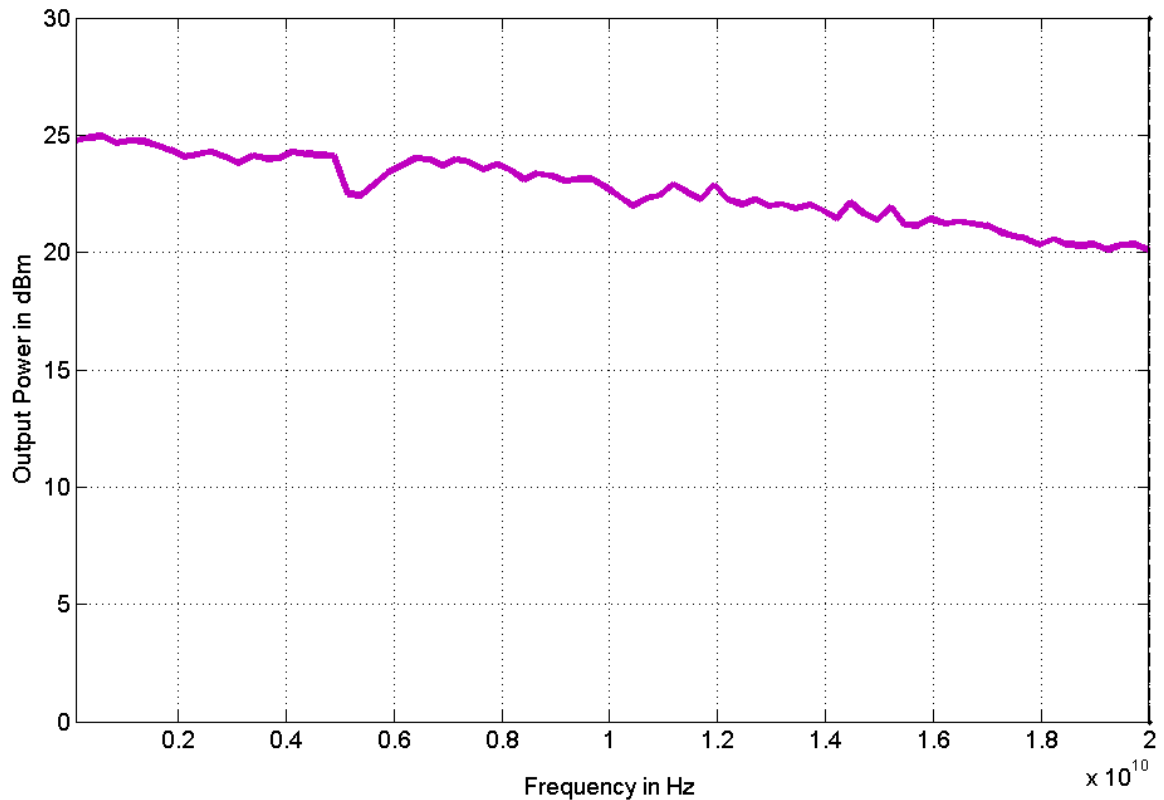
| PARAMETER                 | MIN        | TYPICAL         | MAX  | NOTE  |
|---------------------------|------------|-----------------|------|---|
| <b>Trigger Types</b>      |            |                 |      | Continuous, single (point), gated, gated direction  |
| <b>Trigger Source</b>     |            |                 |      | 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

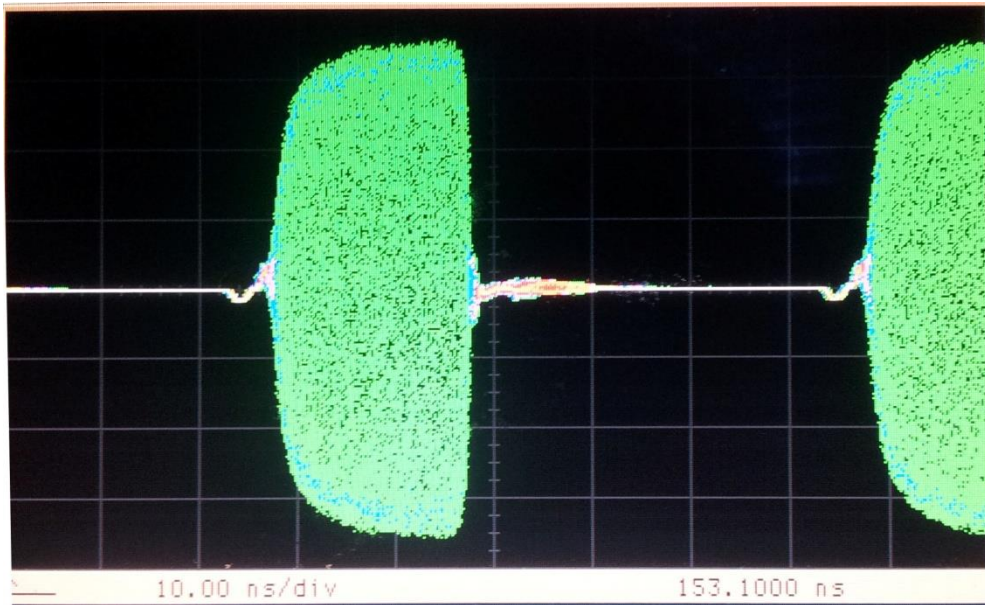
## Phase Noise Performance




## 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  | <b>Option 1URM</b> | 19 inch 1HU rackmount enclosure         |
| RFS20  | <b>Option FS</b>   | Ultra fast switching speed              |
| RFS20  | <b>Option GPIB</b> | 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 |
|                |            |        |            |
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