

# DS-3020

Spectrum Series™ Synthesizers  
Ultra-Low Phase Noise, 0.1 - 20 GHz

## Ultra-low phase noise synthesizer

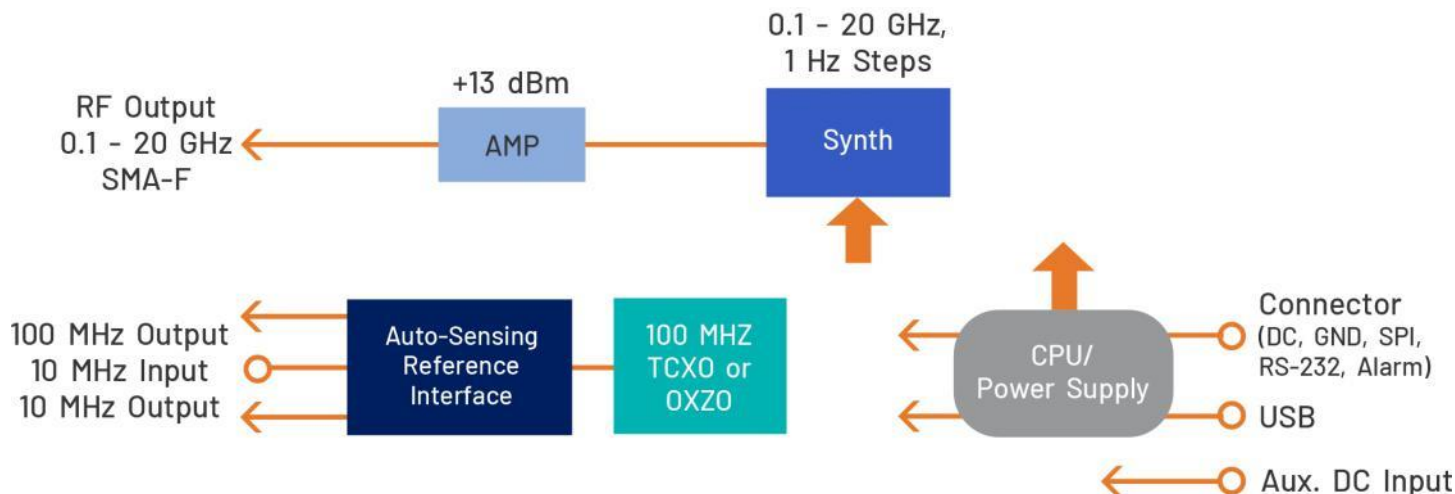
- 100 MHz to 20 GHz in 1 Hz steps
- State-of-the-art phase noise
- 10W power consumption
- Auto-sensing reference clock
- -30° to +70° C temperature range
- SPI, SCPI, and USB control – command-set and GUI control



**Mercury's DS-3020 series is a state-of-the-art, DDS-based synthesizer family tuning continuously from 100 MHz to 20 GHz, in 1 Hz steps.** Industry leading low phase noise and spurious performance meet and exceed requirements of the most demanding test equipment, receivers, and carrier transmitters.

Tuning is accomplished via 4-wire SPI, RS-232 SCPI commands or USB tuning. The synthesizer includes an internal reference which will auto-lock to an external 10 MHz reference when present.

### DS-3020 BLOCK DIAGRAM



**SPECIFICATIONS**

**RF Output**

Parameter	Value
Frequency Tuning Range	100 MHz to 20 GHz
Frequency Tuning Resolution	1 Hz
Switching Speed	50 microsec, max, list mode; 200 microsec nominal mode
RF Power Output	+13 dBm typ
RF Power Flatness, over freq range	+/- 2 dB max
Harmonics	-12 dBc max
Non-Harmonic spurious	-60 dBc max
VSWR (in band)	2.5:1 max (50 ohm)
Connector	SMA-female

**General**

Parameter	Value
DC Power	+9 to +15 VDC
Power Consumption	12W typ after warm-up
Stand-By Power & Wake-Up	<2 Watt in stand-by (std reference). Wake-up time approx. 100 mS
DC Power & Control Connector	14 Pin Male. Harwin M80-5401442. Datamate High Reliability series. Mates with M80-4611442 (female).
Aux DC Power	2.00 mm center pin. CUI MODEL: PJ-063AH. Mates with Jack insertion Diameter/Depth: 5.5.
USB Connection	Mini-USB
Operating Temperature	-30° to +70° C baseplate
Warm Up Time	2 minutes, max
Humidity	95% non-condensing
Alarm Type	TTL, Hi = OK
Size, Inches	6.5 x 4 x 0.7
Weight	14.5 oz.

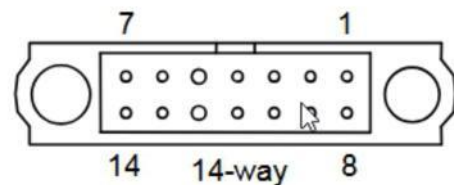
**Reference**

Parameter	Value
Internal Oscillator Type	OCXO
Internal Reference Frequency	100 MHz
Internal Reference, Aging, per year	<1 ppm
Internal Reference Stability over temp*	+/- .01 ppm
*Stability Temperature Range	-20° to +70° C
Reference Output, 10 MHz	10 MHz @ 6 dBm, +/- 2 dB, locked to the reference in use
Reference Output, 100 MHz	100 MHz @ 6 dBm, +/- 2 dB, locked to the reference in use
External Reference Input (customer supplied)	10 MHz @ 0 dBm, +/- 6 dBm
External Reference Input Max (no damage)	+17 dBm
Locking Range of External Reference	+/- 0.5 ppm
Reference Select	Auto-Sense; locked to external if present, otherwise internal
Input/Output Connectors	SMA-female

The DS-3020 has an internal 100 MHz reference. Two versions are available with differing stabilities and phase noise. A sample of the 100 MHz is provided. An external 10 MHz can be used to phase lock the internal 100 MHz and a sample of the external 10 MHz reference is provided for daisy-chaining purposes.

**MONITOR AND CONTROL**

Monitor and Control of the DS-3020 is accomplished by a single connector which provides DC, Ground, 4-Wire SPI, RS-232 (for SCPI commands), Alarms, and Muting. The interface connector locks to the female mating connector, providing a rugged and stable coupling for lab or field use. A secondary connection port is provided utilizing mini-USB. A user GUI is provided via the USB and packet level control is accomplished via SPI.



PROGRAMMING

Part	Description
DC Power & Control Connector	Multi-pin interface, male (all connections on one connector)
Programming Interfaces	RS-232 for SCPI commands, and 4 -Wire SPI (Clock/MOSI/MISO/SS)
Alternate Programming Port	USB, mini-USB form factor with GUI on Windows

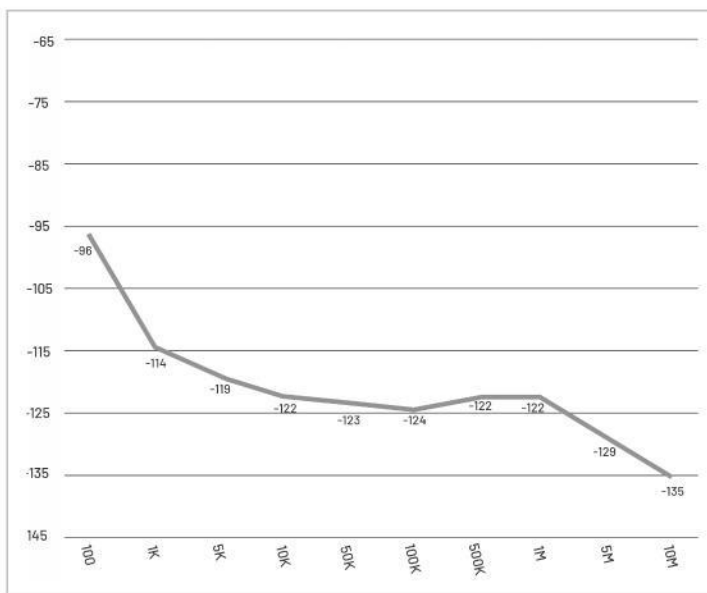
14-Pin Connector	Designation
Pin 1	RS-232 TX
Pin 2	ARM_NRST
Pin 3	LD OUT (5V)
Pin 4	SWDIO
Pin 5	SPI: MOSI
Pin 6	SPI: SS
Pin 7	+VIN
Pin 8	RS-232 RX
Pin 9	SW_CLK
Pin 10	TRIGGER
Pin 11	SPI: MISO
Pin 12	SPI: SCLK
Pin 13	GND
Pin 14	+VIN

PHASE NOISE

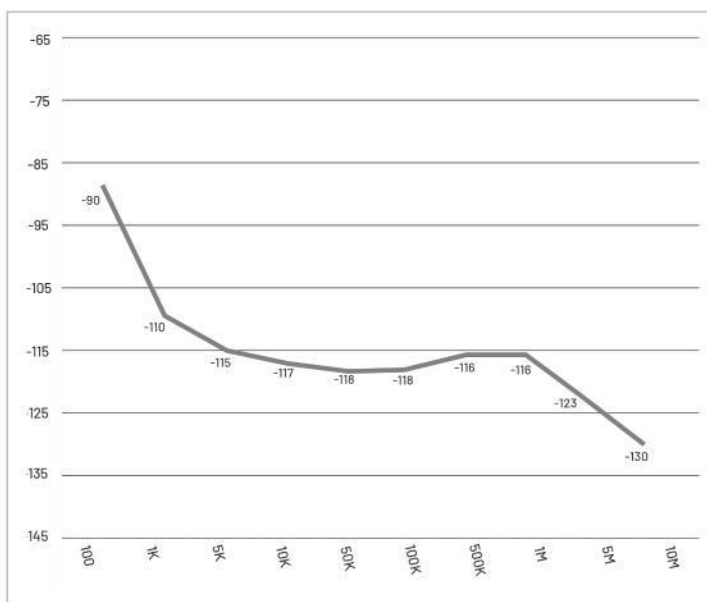
Model DS-3020 was created to give state-of-the-art noise performance. It is OCXO-based.

Phase Noise: typ, in dBc/Hz	2.5 GHz	5 GHz	10 GHz	20 GHz
100 Hz	-108	-102	-96	-90
1 kHz	-126	-120	-114	-110
10 kHz	-134	-128	-122	-117
100 kHz	-138	-132	-124	-118
1 MHz	-134	-128	-122	-116

Phase Noise: typ, in dBc/Hz	2.5 GHz	5 GHz	10 GHz	20 GHz
10 MHz	-147	-141	-135	-130
Deg RMS	0.02	0.05	0.10	0.20



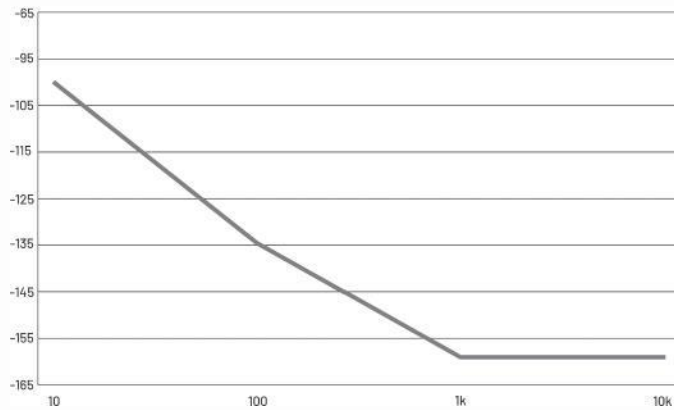
Phase Noise of DS-3020 at 10 GHz Output



Phase Noise of DS-3020 at 20 GHz

100 MHz Reference Oscillator Output Phase Noise

Phase Noise: typ, in dBc/Hz	DS-3020 (OCXO)
10 Hz	-100
100 Hz	-135
1 kHz	-160
10 kHz	-160



Phase Noise 100 MHz Reference Output

GUI-DRIVEN INTERFACE AND CONTROL

Examples of the GUI are shown below. Complete control is also available using SPI.

Home | List Mode | List Management | Sweep Mode | Setup/Status

Frequency: **20,000.00** MHz

RF Output:  On  Off

Start Frequency: **100.00** MHz

Stop Frequency: **20,000.00** MHz

Step Frequency: **10.00** MHz

Dwell Time: **100** mS

Man Step:

List # **1**

Unlock Alarm  Over Temp Alarm

Home | List Mode | List Management | Sweep Mode | Setup/Status

Display Resolution:

1Hz  10 Hz  100 Hz  1 kHz  10 kHz  100 kHz

Status Byte:

Temperature Alarm  Synthesizer Unlocked  Reference Unlocked  Reference External  RF is Off  Unit is in Standby

Internal Ref Adjust: **2075** (0-4095)

Internal Temp(C): **20.00**

On  Off  Last State

List and Sweep Modes are available.

Home List Mode List Management Sweep Mode Setup/Status

### Synthesizer List Mode Setup

List #	RF On	Frequency in MHz	Dwell in milli-Sec
1	<input checked="" type="checkbox"/>	16,400.00	0.0
2	<input checked="" type="checkbox"/>	16,200.00	0.0
3	<input checked="" type="checkbox"/>	16,000.00	0.0
4	<input checked="" type="checkbox"/>	15,800.00	0.0
5	<input checked="" type="checkbox"/>	15,600.00	0.0
6	<input checked="" type="checkbox"/>	15,400.00	0.0
7	<input checked="" type="checkbox"/>	15,200.00	0.0
8	<input checked="" type="checkbox"/>	15,000.00	0.0
9	<input checked="" type="checkbox"/>	14,800.00	0.0
10	<input checked="" type="checkbox"/>	14,600.00	0.0
11	<input checked="" type="checkbox"/>	14,400.00	0.0
12	<input checked="" type="checkbox"/>	14,200.00	0.0
	<input type="checkbox"/>		

Synthesizer List: DL All, 1, Upload All, DL Range, Start, Erase All, DL Changed, End, 12, Upload Rng

Computer: Save To Disk, Clear Grid, Load From Disk

Home List Mode List Management Sweep Mode Setup/Status

### Synthesizer Sweep Mode Control

Start Frequency: 100.00 MHz

Stop Frequency: 20,000.00 MHz

Increment Frequency: 10.00 MHz

Dwell Time: 1 mS

Run Count: 1

Sweep Direction:  Sweep Up,  Sweep Down,  Sweep Up/Down

Increment Control:  Hardware Trig,  Software Delay

Start Sweep

Run Continuous

Home List Mode List Management Sweep Mode Setup/Status

### Synthesizer List Mode Control

Frequency: 20,000.00 MHz

Dwell Time: 1.1 Global, 2.2 Current Entry mS

List #: 1

Run Count: 1

Run Continuous:

Run List

RF Output:  On,  Off

Step Control:  SW Delay,  HW Trigger

Step Direction:  Step Up,  Step Down,  Step Up/Down

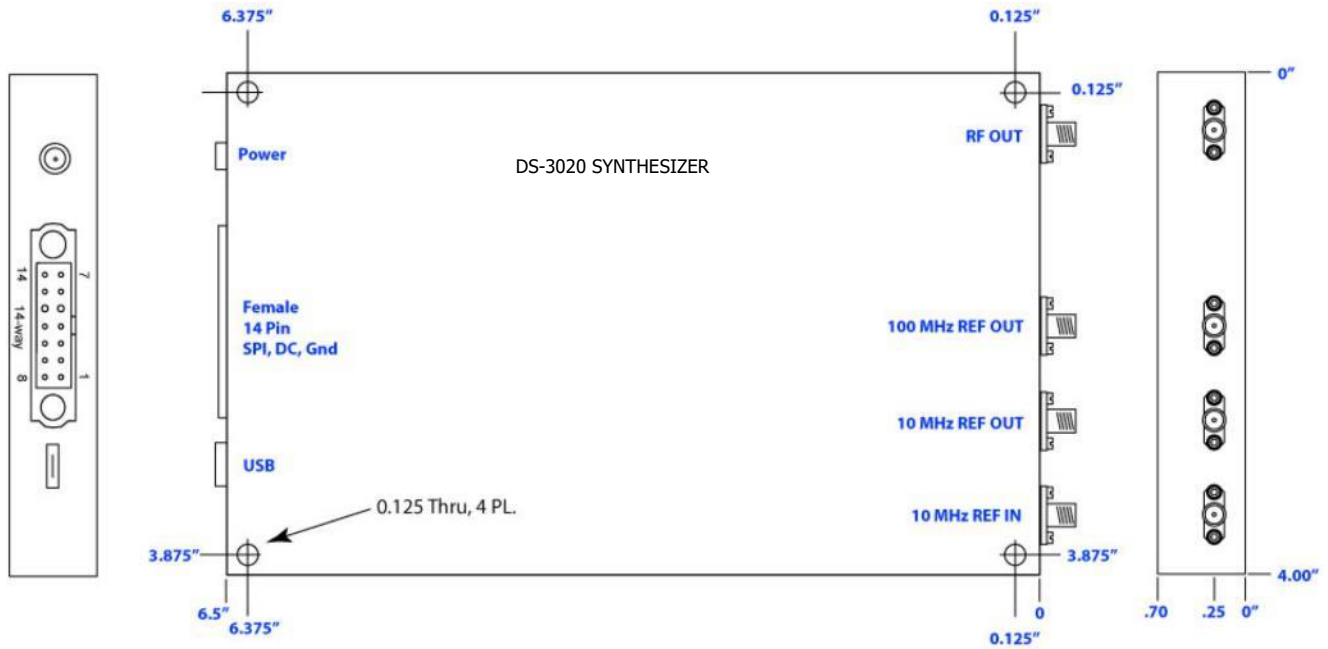
SW Delay Source:  Global Delay,  Indv. Delay

Save, Recall, Previous, Next

ORDERING INFORMATION

Model	Description
DS-3020	DS-3020 with "Ultimate" Phase Noise profile and stability
Option - SK	Optional Shock Mount Kit
Option - HS	Heatsink and Mount Kit
Option - CAB	Custom Cable Kit

DS-3020 OUTLINE DRAWING



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