Frequency Standards

FS725 — Benchtop rubidium frequency standard

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FS725 Rubidium Frequency Standard

- **10 MHz and 5 MHz outputs**
- **1 pps input and output for GPS synchronization**
- **20 year aging less than 0.005 ppm**
- **Ultra-low phase noise (<−130 dBc/Hz at 10 Hz)**
- **Built-in distribution amplifiers (up to 22 outputs)**
- **RS-232 computer interface**
- **Two status alarm relays**

- **FS725 ... $2695** *(U.S. list)*

The FS725 integrates a rubidium oscillator (SRS model PRS10), a low-noise AC power supply, and distribution amplifiers in a compact, half-width 2U chassis. It provides stable and reliable performance with an estimated 20 year aging of less than 5×10^{-9}, and a demonstrated rubidium oscillator MTBF of over 200,000 hours. The FS725 is an ideal instrument for calibration and R&D laboratories, or any application requiring a precision frequency standard.

There are two 10 MHz and one 5 MHz outputs with exceptionally low phase noise (–130 dBc/Hz at 10 Hz offset) and one second Allan variance ($<2 \times 10^{-11}$). The FS725 can be phase-locked to an external 1 pps reference (like GPS) providing Stratum 1 performance. A 1 pps output is also provided that has less than 1 ns of jitter, and may be set with 1 ns resolution.

Up to three internal distribution modules can be added to the FS725. Each module has four 10 MHz outputs, one 5 MHz output, and one 1 pps output, all with the same low phase noise, harmonic distortion and jitter.

An RS-232 interface allows direct communication with the rubidium oscillator. Using the provided Windows software, you can easily monitor and control 1 pps timing, and determine the instrument's operational status.

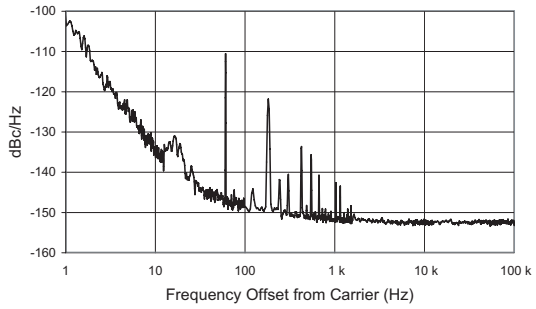
There are two alarm relays that indicate the status of the rubidium oscillator lock state and synchronization to an external 1 pps input. The relays are SPDT, providing both normally-open and normally-closed contacts.

FS725 Specifications

Output

Output frequencies	10 MHz sine, 5 MHz sine, 10 µs wide 1 pps pulse
Amplitude	0.5 Vrms, ±10 %
1 pps pulse amplitude	2.5 V into 50 Ω, 5 V into High-Z loads
Phase noise (SSB)	<–130 dBc/Hz (10 Hz) <–140 dBc/Hz (100 Hz) <–150 dBc/Hz (1 kHz) <–155 dBc/Hz (10 kHz)

FS725 Single Sideband Phase Noise



Spurious	<–100 dBc (100 kHz BW)
Harmonics	<–60 dBc
Accuracy at shipment	$\pm 5 \times 10^{-11}$
Aging (after 30 days)	
Monthly	$<5 \times 10^{-11}$ ($<2.5 \times 10^{-11}$ with opt. C)
Yearly	$<5 \times 10^{-10}$
20 years (typ.)	5×10^{-9}
Short-term stability	$<2 \times 10^{-11}$ (1 s)
(Allan variance)	$<1 \times 10^{-11}$ (10 s)
	$<2 \times 10^{-12}$ (100 s)
Holdover	72 hour Stratum 1 level (1×10^{-11})
Frequency retrace	$\pm 5 \times 10^{-11}$ (72 hrs. off, then 72 hrs. on)
Settability	$<5 \times 10^{-12}$
Trim range	$\pm 2 \times 10^{-9}$ (0 to 5 VDC)
	±0.5 ppm (via RS-232)
Warm-up time	<6 minutes (time to lock)
	<7 minutes (time to 1×10^{-9})

Front-Panel Indicators (Green LEDs)

Power	"On" when AC power is applied
Locked	"On" when frequency is locked to Rb
1 pps input	Blinks with each 1 pps reference input applied to rear panel
1 pps sync	"On" when 1 pps output is synchronized within ±1 µs of 1 pps input
Receive	Blinks when RS-232 characters are received by FS725
Send	Blinks when RS-232 characters are sent by FS725

Rear-Panel Connections

Frequency adjust	0 to 5 VDC adjusts frequency by ±0.002 ppm (normally unconnected)
1 pps input	One 100 kΩ input. Requires CMOS level pulses (0 to 5 VDC). If an external 1 pps input is applied, lock is maintained between the 1 pps input and 1 pps output, with computer adjustable time constant from 8 minutes to 18 hours.
10 MHz outputs	Two 50 Ω isolated sine outputs
5 MHz output	One 50 Ω sine output
1 pps output	One 50 Ω pulse output
Optional outputs	Each option board provides four 10 MHz, one 5 MHz, and one 1 pps outputs. Up to 3 boards can be installed.
Alarm relays	Max. current, 3 A. SPDT, normally open or normally closed. May be wired in parallel with other relays to "wire-or" a single alarm.
Rb lock	Relay status matches the front-panel "Locked" LED.
1 pps	Relay status matches the front-panel "1 pps sync" LED.
RS-232	9-pin connector configured as DCE, 9600 baud. Windows RbMon software is provided.

Environmental

Operating temperature	+10 °C to +40 °C
Temperature stability	$\Delta f/f < \pm 1 \times 10^{-10}$ (+10 °C to +40 °C)
Storage temperature	–55 °C to +85 °C
Magnetic field	$\Delta f/f < 2 \times 10^{-10}$ (1 Gauss field reversal)
Relative humidity	95 % (non-condensing)

General

AC power	90 to 132 VAC or 175 to 264 VAC, 47 to 63 Hz, 50 W
Dimensions, weight	8.5" × 3.5" × 13" (WHL), 9 lbs.
Warranty	One year parts and labor on defects

Ordering Information

FS725	Benchtop Rb frequency standard	$2695
Option 01	Distribution amplifier (6 outputs)	$495
Option 02	Distribution amplifier (12 outputs)	$995
Option 03	Distribution amplifier (18 outputs)	$1495
Option C	Low monthly aging ($<2.5 \times 10^{-11}$)	$495
O725RMD	Double rack mount kit	$100
O725RMS	Single rack mount kit	$100

FS725 rear panel (with Opt. 03)