Frequency Standards

FS725 — Benchtop rubidium frequency standard

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**

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.

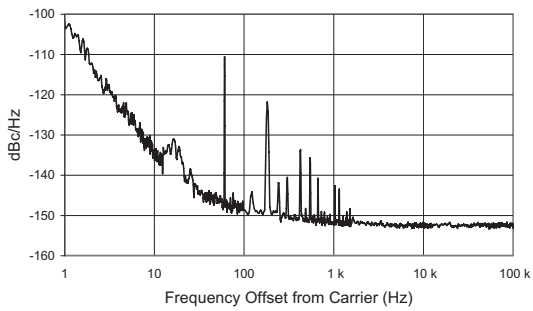
There are two alarm relays that indicate the status of the rubidium oscillator lock state and synchronization to an external 1 pps input. The relays are SPDT, providing both normally-open and normally-closed contacts.

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)	$<5 \times 10^{-11}$ (monthly) $<5 \times 10^{-10}$ (yearly) 5×10^{-9} (20 years, typ.)
Short-term stability (Allan variance)	$<2 \times 10^{-11}$ (1 s) $<1 \times 10^{-11}$ (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 in materials and workmanship

Ordering Information

FS725	Benchtop Rb frequency standard
Option 01	Distribution amplifier (6 outputs)
Option 02	Distribution amplifier (12 outputs)
Option 03	Distribution amplifier (18 outputs)
O725RMD	Double rack mount kit
O725RMS	Single rack mount kit

FS725 rear panel (with Opt. 03)