Frequency Standards

FS725 — Benchtop 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 Rubidium Frequency Standard

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 $5 \times 10^{-9}$, 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 ... $2995$ (U.S. list)
FS725 Specifications

Output
Output frequencies 10 MHz sine, 5 MHz sine, 10 µs wide 1 pps pulse
Amplitude 0.5 V rms, ±10%
1 pps pulse amplitude 2.5 V into 50Ω, 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)

Spurious <-100 dBc (100 kHz BW)
Harmonics <-60 dBc
Accuracy at shipment ±5 × 10⁻¹¹
Aging (after 30 days) ±5 × 10⁻¹¹ (monthly), ±5 × 10⁻¹⁰ (yearly)
5 × 10⁻⁹ (20 years, typ.)
Short-term stability <2 × 10⁻¹¹ (1 s)
(Allan variance) <1 × 10⁻¹¹ (10 s), <2 × 10⁻¹² (100 s)
Holdover 72 hour Stratum 1 level (1 × 10⁻¹¹)
Frequency retrace ±5 × 10⁻¹¹ (72 hrs. off, then 72 hrs. on)
Settability ±5 × 10⁻¹²
Trim range ±2 × 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 50Ω isolated sine outputs
5 MHz output One 50Ω sine output
1 pps output One 50Ω 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 Δf/f < ±1 × 10⁻¹⁰ (+10°C to +40°C)
Storage temperature −55°C to +85°C
Magnetic field Δf/f < 2 × 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 $2995
Option 01 Distribution amplifier (6 outputs) $495
Option 02 Distribution amplifier (12 outputs) $995
Option 03 Distribution amplifier (18 outputs) $1495
O725RMD Double rack mount kit $100
O725RMS Single rack mount kit $100

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FS725 rear panel (with Opt. 03)