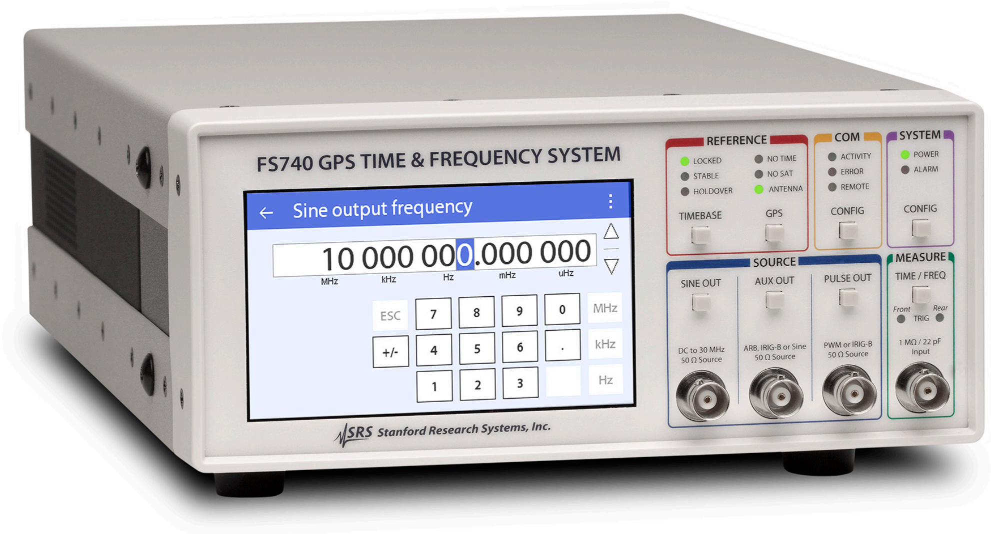
Frequency Standards

FS740 — GPS Time and Frequency System



FS740 GPS Time and Frequency System

- ***GPS disciplined 10 MHz reference***
- ***1×10^{-13} long-term stability***
- ***Time tag events to UTC or GPS***
- ***Sine, square, triangle, IRIG-B output***
- ***Frequency counter with 12 digits/s***
- ***Built-in distribution amplifiers***
- ***Ethernet & RS-232 interfaces***

- ***FS740 ... $2495** (U.S. list)*

The FS740 provides a 10 MHz frequency reference which is disciplined by GPS with a long-term stability of better than 1×10^{-13}. The instrument can also time tag external events with respect to UTC or GPS and measure the frequency of user inputs. The instrument has DDS synthesized frequency outputs, adjustable rate (and width) pulse outputs, and an AUX output for arbitrary waveforms including an IRIGB timecode output.

Standard, OCXO, or Rubidium Timebase

The standard timebase provides 1×10^{-9} short-term frequency stability and phase noise of less than –100 dBc/Hz (10 Hz offset). An optional OCXO (ovenized crystal oscillator) timebase provides 1×10^{-11} short-term frequency stability and phase noise of less than –130 dBc/Hz (10 Hz offset). An optional rubidium timebase provides 1×10^{-12} short-term frequency stability, phase noise of less than –130 dBc/Hz (10 Hz offset), and a long-term holdover (lost GPS signal) of better than 1 µs/day.

Both optional timebases (OCXO or rubidium) provide a dramatic improvement in the holdover characteristics, a 30 dB reduction in the phase noise and a tenfold reduction in the TDEV (rms timing deviation). There are some users who would not need this performance improvement. For example, users who only need time tags with 1µs accuracy or frequency measurements with 1×10^{-8} accuracy could use the standard timebase.

GPS Receiver

The FS740 provides bias for a remote active GPS antenna. The unit's GPS receiver tracks up to 12 satellites, will automatically survey and fix its position, then use all received signals to optimize its timing solution. The FS740 time-tags the 1 pps output from the receiver, corrects the result for the receiver's sawtooth error, then phase locks the timebase to the GPS 1 pps with an adjustable time constant between 1 minute and 10 hours. The TDEV between two instruments is a few nanoseconds.

If the GPS signal is lost, the timebase is left at the last locked frequency value. The timebase will age or drift in frequency by up to ±2 ppm (for the standard timebase), ±0.05 ppm per year and ±0.002 ppm (0 to 45°C) for the OCXO, and ±0.001 ppm per year and ±0.0001 ppm (0 to 45°C) for the rubidium timebase.

GNSS Antennas

You may choose to purchase a GPS antenna from SRS, or a third party, or use an existing GPS antenna at your facility. SRS timing receivers require a net gain (after cable losses) of +20 dBi to +32 dBi, which is a very common level from a variety of available active antennas and typical cable lengths. The antenna input to SRS timing receivers have a female BNC connector, provide +5 V bias, and have a 50 Ω input impedance.

SRS offers two antenna solutions, both of which have LNAs. All systems components have a 50 Ω characteristic impedance. For antenna details click here.

Graphical User Interface

A graphical user interface allows the user to configure the instrument and see the results of time and frequency measurements. The instrument can be configured in one of three modes: There are two user inputs (one on the front, one on the rear-panel) for frequency and time tag events. The inputs have adjustable thresholds and slopes. Frequencies are measured with a precision of 1×10^{-11} in 1 s, 1×10^{-12} in 10 s, and 1×10^{-13} in 100 s. Time tags are reported with 1 ps resolution which is comparable to the short-term stability of the OCXO and rubidium timebases. Time tags will have an error of about 10 ns rms with respect to UTC or GPS time.

FS740 rear panel

Front and Rear Panel

The FS740 has a rear-panel low phase noise (–130 dBc/Hz at 10 Hz offset) 10 MHz sine output with an amplitude of 1 Vrms. Up to 15 additional copies of the 10MHz output are available via optional rear-panel outputs.

The FS740 has front-panel and rear-panel SINE outputs which provide sine outputs from 1 μHz to 30.1 MHz with 1 μHz resolution, or a fixed 100 MHz, with adjustable amplitude from 100 mV to 1.2 V rms. Up to 15 additional copies of the SINE outputs are available via optional rear-panel outputs.

The FS740 has front-panel and rear-panel PULSE outputs which can provide low jitter (<50 ps,rms) pulses from 1 μHz to 30.1 MHz. The PULSE outputs have adjustable phase with respect to UTC and the pulse width can be set as narrow as 5 ns, or as wide as the entire pulse period minus 5 ns, with 10 ps resolution. Up to 15 additional copies of the PULSE outputs are available via optional rear-panel outputs.

The FS740 has front-panel and rear-panel AUX output which can generate standard or arbitrary waveforms (sine, ramp, triangle, etc.) The AUX output can also provide an IRIG-B timecode output. Both width coded pulses and amplitude modulated sine waves (with carrier frequencies from 100 Hz to 1 MHz) are available for the IRIG-B outputs. Up to 15 additional copies of the AUX output are available via optional rear-panel outputs.

A rear-panel alarm relay is set if power is lost or under user defined conditions including: timebase fault, loss of GPS reception, or any failure to maintain phase lock between the timebase and GPS. The relay has both normally open and closed outputs.

Distribution Amplifiers

Optional distribution amplifiers, each providing six additional rear-panel outputs for the 10 MHz, SINE, PULSE, AUX or IRIG-B outputs, can be installed. Up to three distribution amplifiers can be installed and configured from the front panel. Each output has its own driver which

FS740 Specifications

Standard TCXO Timebase

Oscillator type	Oven controlled, 3rd OT, AT-cut crystal
Temp. Stability	$<2\times10^{-6}$ (20 to 30 °C)
Aging	<5 ppm/year (undisciplined to GPS)
Phase noise (SSB)	<–105 dBc/Hz (typical)
Stability	See graphs next page

OCXO Timebase

Oscillator type	Oven controlled, 3rd OT, SC-cut crystal
Temp. Stability	$<2\times10^{-9}$ (20 to 30 °C)
Aging	<0.2 ppm/year (undisciplined to GPS)
Phase noise (SSB)	<–130 dBc/Hz (typical)
Stability	See graphs next page

Rubidium Timebase

Oscillator type	Oven controlled, 3rd OT, AT-cut crystal
Physics package	Rb vapor frequency discriminator
Temp. Stability	$<2\times10^{-10}$ (20 to 30 °C)
Aging	<0.0005 ppm/year (undisciplined to GPS)
Phase noise (SSB)	<–130 dBc/Hz (typical)
Stability	See graphs next page

GPS Receiver

Satelite acq. time	Less than 1 minute (typ.)
Almanac acq. time	Approximately 15 minutes when continuously tracking satellites
Optimized for static applications	Over determined clock mode enables receiver to use all satellites for timing Gates
Accuracy of UTC	<100 ns
Time wander	<15 ns rms (in over determined clock mode)
Antenna delay correction range	±0.1 s

Sine Output (50 Ω load)

Frequency range	1 mHz to 30.1 MHz
Frequency resolution	1 µHz
Frequency error	<10 pHz + timebase error × FC
Phase settability	1 mDeg
Phase accuracy	<1 ns (to internal reference)
Amplitude	10 mVpp to 1.414 Vpp
Amplitude resolution	<1 %
Amplitude accuracy	±5 %
Harmonics	<–40 dBc
Spurious	<–70 dBc
Output coupling	DC, 50 Ω ±2 %
User load	50 Ω
Reverse protection	±5 VDC

Aux Output (50 Ω load)

Output options	Sine, Triangle, Square, 100 MHz, AM IRIG-B
Frequency range	1 mHz to 10 MHz (sine) 1 mHz to 1 MHz (triangle or square) 100 MHz (100 MHz sine) 1 kHz (AM IRIG-B)
Frequency resolution	1 µHz
Frequency error	<10 pHz + timebase error × FC
Phase settability	1 mDeg (cannot adjust phase of 100 MHz sine output)
Amplitude	10 mVpp to 1.414 Vpp (sine, triangle, square) 2.75 dBm ±0.5 dBm (100 MHz)
Amplitude resolution	<1 %
Amplitude accuracy	±5 %
Harmonics	<–40 dBc
Spurious	<–70 dBc
Output coupling	DC, 50 Ω ±2 %
User load	50 Ω
Reverse protection	±5 VDC

Pulse Output

Output options	Period/width, Freq/duty, Pulse IRIG-B
Period	40 ns to 1000 s
Width	5 ns to (Period – 5 ns)
Period/width resolution	1 ps
Frequency range	1 mHz to 25 MHz
Frequency resolution	1 µHz
Frequency error	<10 pHz + timebase error × FC
Jitter	<50 ps rms
Level	+5 V CMOS logic
Transition time	<2 ns
Source impedance	50 Ω

10 MHz Output (50 Ω load)

Amplitude	13 dBm
Amplitude accuracy	±1.5 dBm
Harmonics	<–50 dBc
Spurious	<–90 dBc (100 kHz BW)
Output coupling	DC, 50 Ω ±2 %
User load	50 Ω
Reverse protection	±5 VDC

Time and Frequency Input

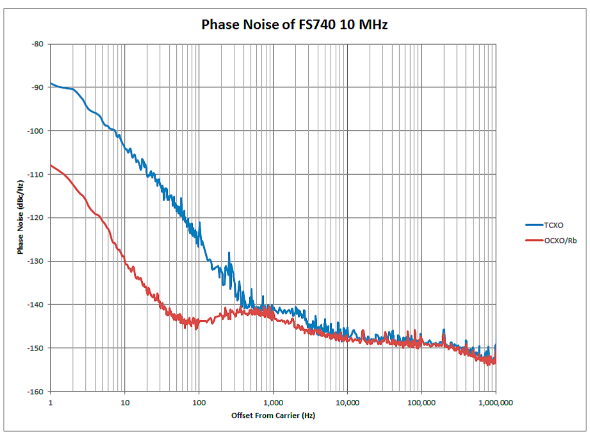
Time tag resolution	1 ps
Time tag jitter (rms)	<50 ps
Frequency resolution	1 μHz
Measurement stability	$<5 \times 10^{-12}$ (1 s gate), synchronous with fast averaging enabled $<5 \times 10^{-11}$ otherwise

Computer Interfaces

Ethernet (LAN)	10/100 Base-T. TCP/IP & DHCP
RS-232	4.8k-115.2k baud, RTS/CTS flow

General

AC power	90 to 264 VAC, 90 W 47 to 63 Hz with PFC
EMI Compliance	FCC Part 15 (Class B), CISPR-22 (Class B)
Dimensions	8.5” × 3.5” × 13” (WHL)
Weight	10 lbs.
Warranty	One year parts and labor on defects in materials and workmanship



10 MHz Phase Noise

Ordering Information

FS740	GPS Time and Frequency System	$2495
Option 01	OCXO timebase	$650
Option 02	Rubidium timebase	$1500
Option A	Five 10 MHz outputs	$495
Option B	Five Sine/Aux outputs	$495
Option C	Five Pulse outputs	$495