Frequency Standards

FS700 — LORAN-C frequency standard

FS700 LORAN-C Frequency Standard

- ***10^{-12} long-term stability***
- ***10^{-10} short-term stability (10^{-11} opt.)***
- ***NIST traceable***
- ***Reception throughout most of the northern hemisphere***
- ***Four 10 MHz outputs***
- ***Phase detector with analog output***
- ***0.01 Hz to 10 MHz TTL output***

Many complex electronic systems require a stable, highly accurate timebase. Communication, automatic test and measurement, and precision time-measurement systems all require accurate frequency standards. Traditionally, users have looked to atomic clocks (cesium) for high stability and accuracy. With the FS700 LORAN-C Frequency Standard, cesium-clock stability is now available at a fraction of the cost of atomic standards. The FS700 serves as a NIST traceable frequency reference in the US, Europe and Asia.

Cesium Stability

More than 50 LORAN-C transmitters are maintained throughout the Northern Hemisphere by the US Coast Guard. The timing of their transmissions is controlled by cesium clocks located at each transmitter site. The FS700 extracts the timing information from the transmitted signal and uses it to frequency-lock its own highly stable oscillator. The result is a 10 MHz output signal with the same stability as the cesium clock used to generate the LORAN-C transmissions.

Frequency Outputs and Phase Detector

Four 10 MHz sine outputs are available at the rear panel of the instrument, and an additional front-panel, adjustable frequency TTL source is also provided. A built-in phase detector measures the phase shift between an external timebase and the internal frequency source allowing you to easily calibrate precision oscillators between 100 kHz and 10 MHz. The FS710 can help you distribute the 10 MHz reference signal throughout your facility.

West Coast USA	Fallon, Nevada, USA
99400 µs	George, Washington, USA
	Middletown, California, USA
	Searchlight, Nevada, USA
Canadian West Coast	Williams Lake, BC, Canada
59900 µs	Shoal Cove, Alaska, USA
	George, Washington, USA
	Port Hardy, BC, Canada
North Central USA	Havre, Montana, USA
82900 µs	Baudette, Minnesota, USA
	Gillette, Wyoming, USA
	Williams Lake, BC, Canada
South Central USA	Boise City, Oklahoma, USA
96100 µs	Gillette, Wyoming, USA
	Searchlight, Nevada, USA
	Las Cruces, New Mexico, USA
	Raymondville, Texas, USA
	Grangeville, Louisiana, US
Great Lakes	Dana, Indiana, USA
89700 µs	Malone, Florida, USA
	Seneca, New York, USA
	Baudette, Minnesota, USA
	Boise City, Oklahoma, USA
Southeast USA	Malone, Florida, USA
79800 µs	Grangeville, Louisiana, USA
	Raymondsville, Texas, USA
	Jupiter, Florida, USA
	Carolina Beach, NC, USA
Northeast USA	Seneca, New York, USA
99600 µs	Caribou, Maine, USA
	Nantucket, Massachusetts, USA
	Carolina Beach, NC, USA
	Dana, Indiana, USA
Canadian East Coast	Caribou, Maine, USA
59300 µs	Nantucket, Mass., USA
	Cape Race, Newfoundland,
	Fox Harbor, Labrador, Canada
Newfoundland Coast	Comfort Cove, Canada
72700 µs	Cape Race, Canada
	Fox Harbor, Canada
Bo	Bo Norway
70010 µs	Jan Mayen, Norway
	Berlevag, Norway
Eidi	Eidi, Faeroe Island, Denmark
90070 µs	Jan Mayen, Norway
	Bo, Norway
	Vaerlandet, Norway
	Loop Head, Ireland
Leassay	Leassay, France
67310 µs	Soustons, France
	Loop Head, Ireland
	Sylt, Germany
Sylt	Sylt, Germany
74990 µs	Lessay, France
	Vaerlandet, Norway
Mediterranean Sea	Sellia Marina, Italy
79900 µs	Lampedusa, Italy
	Estartit, Spain
	Kargabaruu, Turkey

Saudi Arabia North	Afif, SA
88300 µs	Salwa, SA
	Al Hamasin, SA
	Ash Shaykh Humayd, SA
	Al Muwassam, SA
Saudi Arabia South	Al Khamasin, SA
70300µs	Salwa, SA
	Afif, SA
	Ash Shaykh Humayd, SA
	Al Muwassam, SA
Western Russia	Bryansk, Russia
80000 µs	Petrozavodsk, Russia
	Solnim, Russia
	Simferopol, Ukraine
	Syzran, Russia
Eastern Russia	Aleksandrovsk, Russia
79500 µs	Petrozavodsk, Russia
	Ussuriysk, Russia
	Tokachibuto, Japan
	Ohotosk, Russia
East Asian	Pohang, Korea
99300 µs	Kwang-Ju, Korea
	Gesashi, Okinawa
	Niijima, Japan
	Ussuriisk, Russia
China North Sea	Rongcheng, PRC
74300 µs	Xuancheng, PRC
	Helong, PRC
China East Sea	Xuancheng, PRC
83900 µs	Raoping, PRC
	Rongcheng, PRC
China South Sea	Hexian, PRC
67800 µs	Raoping, PRC
	Chongzuo, PRC
Northwest Pacific	Niijima, Japan
89300 µs	Gesashi, Okinawa
	Miamitorishima, Japan
	Tokatibutto, Hokkaido, Japan
	Pohang, Korea
Russia-American	Petropavlo, Russia
59800 µs	Attu, Alaska
	Aleksandrovsk, Russia
North Pacific	St. Paul, Pribilof Is, Alaska, USA
99900 µs	Attu, Alaska, USA
	Point Clarence, Alaska, USA
	Narrow Cape, Kodiak Is, USA
Gulf of Alaska	Tok, Alaska, USA
79600 µs	Narrow Cape, Kodiak Is, USA
	Shoal Cove, Alaska, USA
	Port Clarence, Alaska, USA
Bombay	Dhrangadhr, India
60420 µs	Veraval, India
	Billamora, India
Calcutta	Balasore, India
55430 µs	Diamond Harbour, India
	Patpur, India

Receiver

Sensitivity	Will lock with signal-to-atmospheric noise level of –10 dB or better
LORAN output	Filtered and gain controlled antenna signal, typically 6 Vpp
Station search	All available stations programmed, Auto-Seek finds and tracks strongest station
Notch filters	Six adjustable –30 dB notch filters (three at 40 to 90 kHz, three at 110 to 220 kHz)

Frequency

Frequency stability	
Long-term	10^{-12}, the same as LORAN-C transmitter cesium clock
Short-term	10^{-10} (standard oscillator) 10^{-11} (low phase noise option)
Outputs	Four 10 MHz outputs, 1 Vpp sine into 50 Ω
LOCK output	Rear-panel TTL indicates receiver lock
Front-panel output	TTL level output from 0.01 Hz to 10 MHz in a 1–2.5–5 sequence

Internal Oscillator

	Standard	*Option 01*
Frequency	10.000 MHz	10.000 MHz
Type (ovenized)	AT-cut	SC-cut
Aging	5×10^{-10}/day	5×10^{-10}/day
Allan variance (1s)	5×10^{-11}	5×10^{-12}
Stability (0 to 50 °C)	0.005 ppm	$<2 \times 10^{-9}$
Phase noise		
10 Hz		–125 dBc/Hz
100 Hz	–130 dBc/Hz	–155 dBc/Hz
1 kHz		–165 dBc/Hz

Phase Meter

Frequency output	0.01 Hz to 10 MHz in 1–2.5–5 sequence, TTL level. Can be 50 Ω terminated.
Oscillator input	1 kΩ, 0.5 V min., 5.0 V max.
Phase output	0.01 V/degree, 0 to ±360°. Output proportional to phase difference between OSC IN and FREQUENCY OUTPUT for frequencies between 100 kHz and 10 MHz.

Computer Interface

GPIB (standard)	IEEE-488 compatible interface. All instrument functions may be controlled.
RS-232 (optional)	300 to 19,200 baud DCE serial interface. All instrument functions may be controlled.

Antenna

Type	100 kHz active antenna with 40 kHz bandwidth band pass filter in base.
Height	102"
Material	Fiberglass whip
Base	2" dia. × 7.5", PVC
Mounting	3/4" FIPT
Output	50 Ω nominal, female BNC
Environmental	–40 °C to 60 °C, 0 % to 100 % RH
Lightning protection module (opt.)	
Surge	18,000 A IEEE 8/20 waveform (based on ANSI C62.1)
Frequency range	DC to 30 MHz
Throughput energy	<16 µJ (based on 1 kV/nS waveform)
Insertion loss	<0.25 dB

General

Operating	0 °C to 50 °C
Power	100/120/220/240 VAC, 50/60 Hz, 50 W
Dimensions	17" × 3.5" × 17" (WHD)
Weight	14 lbs.
Warranty	One year parts and labor on defects in materials and workmanship

FS700 rear panel

Ordering Information

FS700	LORAN-C receiver (w/ GPIB, rack mount kit and antenna)
Option 01	Low phase noise oscillator
Option 02	RS-232 interface
O700ANT	Replacement antenna
O700LNG	Lightning protection module
FS710	10 MHz distribution amplifier