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
- FS700 ... $2950 (U.S. list)

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 99400 µs	Fallon, Nevada, USA George, Washington, USA Middletown, California, USA Searchlight, Nevada, USA
Canadian West Coast 59900 µs	Williams Lake, BC, Canada Shoal Cove, Alaska, USA George, Washington, USA Port Hardy, BC, Canada
North Central USA 82900 µs	Havre, Montana, USA Baudette, Minnesota, USA Gillette, Wyoming, USA Williams Lake, BC, Canada
South Central USA 96100 µs	Boise City, Oklahoma, USA Gillette, Wyoming, USA Searchlight, Nevada, USA Las Cruces, New Mexico, USA Raymondville, Texas, USA Grangeville, Louisiana, US
Great Lakes 89700 µs	Dana, Indiana, USA Malone, Florida, USA Seneca, New York, USA Baudette, Minnesota, USA Boise City, Oklahoma, USA
Southeast USA 79800 µs	Malone, Florida, USA Grangeville, Louisiana, USA Raymondsville, Texas, USA Jupiter, Florida, USA Carolina Beach, NC, USA
Northeast USA 99600 µs	Seneca, New York, USA Caribou, Maine, USA Nantucket, Massachusetts, USA Carolina Beach, NC, USA Dana, Indiana, USA
Canadian East Coast 59300 µs	Caribou, Maine, USA Nantucket, Mass., USA Cape Race, Newfoundland, Fox Harbor, Labrador, Canada
Newfoundland Coast 72700 µs	Comfort Cove, Canada Cape Race, Canada Fox Harbor, Canada
Bo 70010 µs	Bo Norway Jan Mayen, Norway Berlevag, Norway
Eidi 90070 µs	Eidi, Faeroe Island, Denmark Jan Mayen, Norway Bo, Norway Vaerlandet, Norway Loop Head, Ireland
Leassay 67310 µs	Leassay, France Soustons, France Loop Head, Ireland Sylt, Germany
Sylt 74990 µs	Sylt, Germany Lessay, France Vaerlandet, Norway
Mediterranean Sea 79900 µs	Sellia Marina, Italy Lampedusa, Italy Estartit, Spain Kargabaruu, Turkey
Saudi Arabia North 88300 µs	Afif, SA Salwa, SA Al Hamasin, SA Ash Shaykh Humayd, SA Al Muwassam, SA
Saudi Arabia South 70300µs	Al Khamasin, SA Salwa, SA Afif, SA Ash Shaykh Humayd, SA Al Muwassam, SA
Western Russia 80000 µs	Bryansk, Russia Petrozavodsk, Russia Solnim, Russia Simferopol, Ukraine Syzran, Russia
Eastern Russia 79500 µs	Aleksandrovsk, Russia Petrozavodsk, Russia Ussuriysk, Russia Tokachibuto, Japan Ohotosk, Russia
East Asian 99300 µs	Pohang, Korea Kwang-Ju, Korea Gesashi, Okinawa Niijima, Japan Ussuriisk, Russia
China North Sea 74300 µs	Rongcheng, PRC Xuancheng, PRC Helong, PRC
China East Sea 83900 µs	Xuancheng, PRC Raoping, PRC Rongcheng, PRC
China South Sea 67800 µs	Hexian, PRC Raoping, PRC Chongzuo, PRC
Northwest Pacific 89300 µs	Niijima, Japan Gesashi, Okinawa Miamitorishima, Japan Tokatibutto, Hokkaido, Japan Pohang, Korea
Russia-American 59800 µs	Petropavlo, Russia Attu, Alaska Aleksandrovsk, Russia
North Pacific 99900 µs	St. Paul, Pribilof Is, Alaska, USA Attu, Alaska, USA Point Clarence, Alaska, USA Narrow Cape, Kodiak Is, USA
Gulf of Alaska 79600 µs	Tok, Alaska, USA Narrow Cape, Kodiak Is, USA Shoal Cove, Alaska, USA Port Clarence, Alaska, USA
Bombay 60420 µs	Dhrangadhr, India Veraval, India Billamora, India
Calcutta 55430 µs	Balasore, India 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)	$2950
Option 01	Low phase noise oscillator	$450
Option 02	RS-232 interface	$350
O700ANT	Replacement antenna	$250
O700LNG	Lightning protection module	$100
FS710	10 MHz distribution amplifier	$1000

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