FURUNO

Time Synchronization

Product Catalog -vol.3-

- GNSS Disciplined Oscillators (GNSSDO)
- GNSS Timing Modules
- GNSS Antennas
- GNSS Accessories

www.furuno.com

—GNSS Disciplined Oscillators (GNSSDO)—

Generate UTC-synchronized 1PPS and continuously disciplined 10 MHz

Small size ⟷ High performance

[GT-88 + TCXO]
Model GF-8801

[GT-88 + OCXO]
Model GF-8802

[GT-88 + OCXO]
Model GF-8803

[GT-88 + OCXO]
Model GF-8804

[GT-88 + OCXO]
Model GF-8805

- One-module combining a GNSS receiver, a 10 MHz crystal oscillator (TCXO or OCXO) and peripheral circuits that dramatically reduces the design cycle (time-to-market) of wireless systems
- 5G timing performance using a single-band GNSS receiver. Conform to G.8272 PRTC-A and PRTC-B
- Suitable for various RF-Broadcasting applications
- A line up of "Small" (GF-8801/02/03) and "Compact" (GF-8804/05) form factors

GNSS Timing Modules

Generate UTC-synchronized 1PPS

Model GT-88

- Concurrent reception of GPS/GLONASS/ Galileo/QZSS/SBAS
- 1PPS stability : < 4.5 nsec (1 σ)
- 1PPS accuracy ≤ 40 ns
- TRAIM, Single Satellite Tracking, Multipath Mitigation, Anti-Jamming and Anti-Spoofing
- Configurable frequency output (10 Hz to 40 MHz)

GNSS Antennas (for Timing)

IP67 Heavy-duty design

Model AU-217

- GPS/GLONASS/Galileo/QZSS/ SBAS reception
- Built-in noise filter
- Required supply voltage : 2.5 to 16 V(Superimposed on RF-coax cable)

* Other GNSS antennas also available

GNSS Accessories

Coaxial lighting arrestors

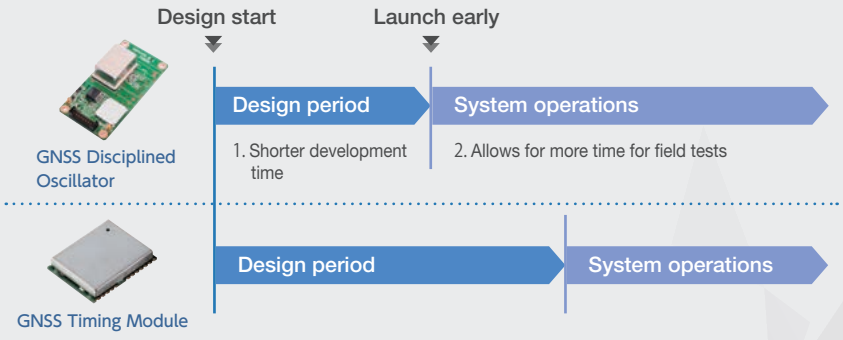
Model TVA-03V, TVA-03C

- Protect GPS/GNSS receivers from lightning surges
- Covers GPS/QZSS/SBAS (L1), GLONASS (L1), and Galileo(E1)
- TVA-03C protects against direct lightning surges. TVA-03V protects against induced lightning surges

Advantage of GNSS Disciplined Oscillator and GNSS Timing Module

【GNSS Disciplined Oscillator (GF Series)】
Tightly integrated GNSSDO in a single module, offering all necessary functions for time and frequency synchronization to UTC, including holdover. It allows a shorter time-to-market for developers.

【GNSS Timing Module (GT Series)】
Cost competitive solution, when designing GNSSDO with independent GNSS receiver and 10MHz oscillator is desired.



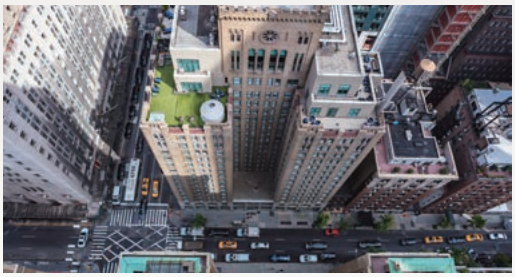
FURUNO Technology

The number of radio stations equipped with GNSS time synchronization, such as various types of professional mobile radios (PMR), local 5G base stations, and V2X, has been increasing year-by-year. The professionals installing such equipment in urban canyons often face problems with the reception of attenuated and reflected (multipath) GNSS signals.
GT-88 and GF-88 series have unique embedded solutions against these problems. In addition, Furuno provides the same carrier-grade quality that have been qualified by major mobile base station venders.

Extremely high stability of < 4.5 ns (1sigma) using a single-band GNSS timing receiver

UTC time-synchronized signal performance to meet 5G requirments is obtained without any changes to existing single-band GNSS antennas.

GNSS antennas can be mounted on walls and windows of tall buildings



The Dynamic Satellite Selection™ minimizes deterioration of time synchronization performance by choosing only the high quality satellite signals.

* a new satellite signal selection algorithm developed by NTT

Functions designed for actual threats

Solutions against jamming and spoofing.

Industry-leading holdover performance (GF series)

Provides highly accurate timing signals even if satellite reception is lost due to antenna failure.

User Case

Furuno is the only manufacturer of dedicated time synchronization GNSS receivers in Japan. Furuno's GNSS timing receivers and GNSSDO have been used for more than 20 years in critical infrastructure such as mobile base stations and terrestrial digital broadcasting stations.

GT Series

Japan Communication Equipment Co., Ltd.

FM synchronous broadcasting system

GT series has been used in FM synchronous broadcasting system to provide reference signal in order to adjust the broadcast timing from each transmitter station and maintain audio quality in equal field areas at a single frequency.

GF Series

Seiko Solutions Inc.

Grandmaster Clock

GF-88 series has been selected as a core part of Seiko's Grandmaster Clock (GMC), that transmit signals to synchronize devices in network.

Dainichi Denshi Co., Ltd.

Railway Radio Communication System

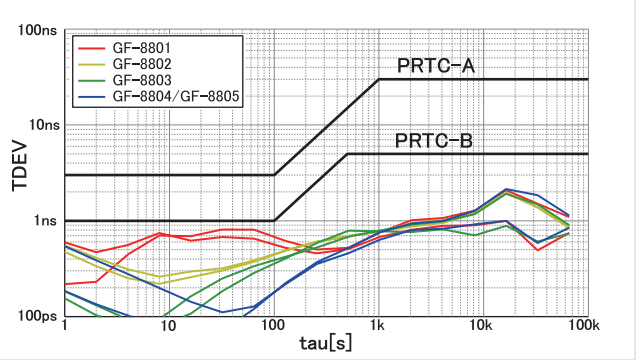
GF-88 series has been adopted in this radio system to achieve high quality communication through stable transmission frequencies.

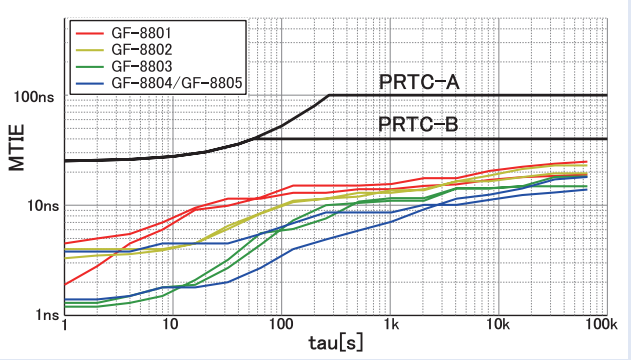
FURUNO time synchronization products : GF/GT-88 series

Meet 5G required performance using a single-band receiver

FURUNO technology made it possible to achieve 5G-required performance. A time stability of < 4.5ns (1 sigma) is obtained using a single-band GNSS receiver. These receivers are in comformitity with G.8272 PRTC-B. This is achieved by using an improved and advanced position estimation algorithm. It optimizes position calculations using several different GNSS satellite constellations constellations and selecting their best signals. It allows users to achieve 5G-required performance without changing existing single-band GNSS antennas.

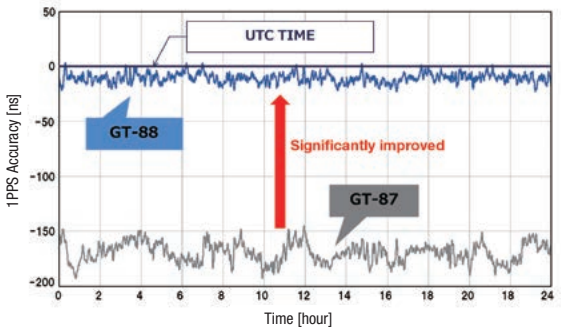
In comformity with G.8272 PRTC-B





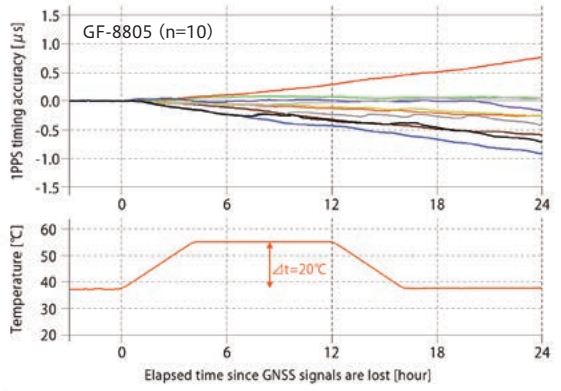
GF-8801 : PRTC-A complied only

GNSS antennas can be mounted on walls and windows of tall buildings



Normally typical time synchronization performance deteriorates in urban canyon environments due to the effects of multipath. The Dynamic Satellite Selection™ makes it possible for GT/GF-88 to keep providing highly accurate 1PPS by selecting high quality satellite signals only. Consequently GT/GF-88 permits GNSS antennas to be mounted more freely than ever before including wall mounting and window mounting installations.

Industry-leading holdover performance (GF series)



Holdover function of GF-88 makes it possible to keep providing highly accurate timing signals even after satellite reception is lost, for example due to antenna failure or jamming issues. Furuno offers a wide range of GF-88 series products. The GF-8801 provides cost effective solutions and the GF-8805 provides industry-leading holdover time duration. The GF-88 series can also replace Rubidium oscillator as a clock source.

GNSS Disciplined Oscillators (GNSSDO)

Model	GF-8801	GF-8802	GF-8803	GF-8804	GF-8805
Equipped Oscillator	TCXO	OCXO			
GNSS Reception Capability	GPS L1C/A, GLONASS L1OF, Galileo E1B/E1C, QZSS L1C/A, QZSS L1S, SBAS L1C/A				
GNSS Concurrent Reception	32 channels				
Sensitivity *1	GPS/ Tracking: > -162 dBm, Acquisition: > -148 dBm Galileo/ Tracking: > -146 dBm, Acquisition: > -136 dBm			GLONASS/ Tracking: > -158 dBm, Acquisition: > -144 dBm QZSS/ Tracking: > -147 dBm, Acquisition: > -131 dBm	
ITU-T Recommendation	in comformity with G.8272 PRTC-A	in comformity with G.8272 PRTC-A, PRTC-B			
1PPS Stability *2	< 4.5 ns (1σ)				
1PPS Accuracy *2	< ±40 ns (vs UTC)				
1PPS Accuracy (Long term holdover)	—	< ±50 us/24h	< ±10 us/24h	< ±5 us/24h	< ±1.5 us/24h
1PPS Accuracy (Short term holdover)	—	< ±3 us/1h (Typ)		< ±400 ns/1h (Typ)	
10 MHz Output	Square pulse			Square pulse, Sine wave	
10 MHz Short Term Stability (Root Allan variance (=1s))	$< 5 \times 10^{-10}$	$< 5 \times 10^{-11}$	$< 2 \times 10^{-11}$	$< 1 \times 10^{-11}$	
10 MHz Long Term Stability (24h average)	$< \pm 1 \times 10^{-11}$	$< \pm 1 \times 10^{-12}$			
10 MHz Long Term Stability (24h average, Holdover)	—	$< \pm 1 \times 10^{-9}$	$< \pm 2 \times 10^{-10}$	$< \pm 1 \times 10^{-10}$	$< \pm 3 \times 10^{-11}$
Initial Stabilization Time	< 5 minutes (untill lock state)				
Supply Voltage	3.7 VDC			5.5 VDC	
Power Consumption *3	< 150 mA	450 mA (Typ)	600 mA (Typ)	400 mA (Typ)	
Antenna Detection	Short and Open Detection				
Operating Temperature	-40°C to +85°C				
Outer Size	34 mm × 27 mm × 11 mm	34 mm × 27 mm × 15.5 mm	34 mm × 27 mm × 20 mm	100 mm × 52 mm × 20 mm	
Protocol	eSIP (NMEA 0183 Standard Ver 4.10)				
Function	Anti-Jamming (8CW), Multipath Mitigation (Dynamic Satellite Selection™), Anti-Spoofing, T-RAIM, Synchronization with external pulse				

GNSS Timing Modules

Model	GT-87	GT-88
GNSS Reception Capability	GPS L1C/A, GLONASS L1OF, QZSS L1C/A, SBAS L1C/A	GPS L1C/A, GLONASS L1OF, Galileo E1B/E1C, QZSS L1C/A, QZSS L1S, SBAS L1C/A
GNSS Concurrent Reception	26 channels	32 channels
Sensitivity *1	GPS/ Tracking: > -162 dBm, Acquisition: > -148 dBm GLONASS/ Tracking: > -158 dBm, Acquisition: > -144 dBm Galileo *4/ Tracking: > -146 dBm, Acquisition: > -136 dBm QZSS/ Tracking: > -147 dBm, Acquisition: > -131 dBm	
ITU-T Recommendation	—	in comformity with G.8272 PRTC-A *5
1PPS Stability *2	< 15 ns (1σ)	< 4.5 ns (1σ)
1PPS Accuracy *2	—	< ±40 ns (vs UTC)
1PPS resolution	±1.75 ns	
TTFF *1	Hot Start: <5 sec, Cold Start: <35 sec	
Clock Configurable Range	4 kHz to 40 MHz	10 Hz to 40 MHz
Operating Temperature	-40°C to +85°C	
Supply Voltage	3.3 VDC	
Power Consumption *6	< 62 mA	< 68 mA
Package	24Pin LCC (Leadless Chip Carrier), 12.2 mm × 16.0 mm × 2.8 mm	
Interfaces	UART, Time Pulse (1PPS), Clock	
Protocol	eSIP (NMEA 0183 Standard Ver 4.10)	
Function	Anti-Jamming (8CW), Multipath Mitigation *7, Anti-Spoofing *4, T-RAIM	

*1 Measurement platform with recommended active antenna *2 Open sky *3 When supply voltage is stabilized
*4 GT-88 only *5 In conformity with TDEV/MTIE *6 85°C when tracking
*7 GT-88 has the Dynamic Satellite Selection™ while the GT-87 has a high performance conventional multipath mitigation algorithm.

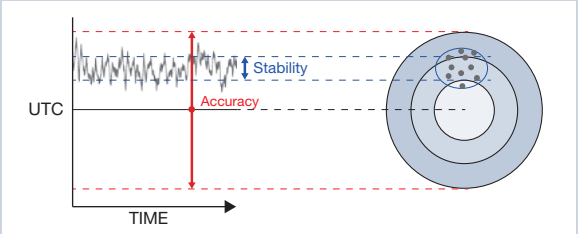
GNSS Antennas

Model	AU-217
Input Frequency	1575 MHz to 1606 MHz
Polarization	R. H. C. P. (Right Hand Circular Polarization)
Antenna Gain	>= 4.25 dBi (at 90° elev. angle) >= -3 dBi (at 10° elev. angle)
Output Impedance	50 Ω
Pre. Amp Gain	40 ±2 dB
Pre. Amp Noise Figure	2.5 dB Typ
VSWR	<1.5:1 (@LNA output)
Supply Voltage	2.5 to 16 VDC nominal
Power Consumption	20 mA max (85°C)
Operating Temperature	-40°C to +85°C
Operating Relative Humidity	< 97%RH
Water Resistant	IP67
Connector Type	TNC(F)

Defining accuracy and stability

Accuracy refers to the maximum error deviation from UTC true value.
Stability refers to the degree of variation from accuracy over a period of time.

* FURUNO defines accuracy on the basis of UTC (vs UTC).



Evaluation Kit

(GNSS antenna and monitoring software included)

Model : VF/VN series

Related information available on the FURUNO website.

This site contains information related to technical support and important notes on the handling of Furuno GNSS products for time synchronization applications.

White paper

With GNSS receivers, it becomes easy to get accurate time. However, GNSS receivers also have inherent vulnerabilities. To counter these vulnerabilities, Furuno has developed and integrated advanced mitigation solutions into its GNSS receivers, and issued technical white papers to explain these problems, in particular multipath, jamming, spoofing, and interruption of GNSS signal reception.

GNSS Glossary

This is a glossary specific to the use of GNSS for time and frequency synchronization.
It covers technical terms related to satellites and satellite signals, timing, positioning, PPS/frequency, communication and memory etc.

In addition to the above, various documents such as hardware specifications, protocol specifications, 3D data, and monitor software for GNSS receivers are also available on this site.

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