FURUNO

Multi-GNSS Disciplined Oscillator

Model GF-8801, GF-8802, GF-8803

Hardware Specifications

(Document No. SE19-410-006-00)

FURUNO ELECTRIC CO., LTD.

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- Galileo (Europe)
- QZSS (Japan)
- SBAS (USA: WAAS, Europe: EGNOS, Japan: MSAS, India: GAGAN)

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Revision History

Version	Change contents	Date
0	Initial release	2019.4.18

Table of Contents

1 Outline

This document describes the hardware specifications of GF-8801, GF-8802 and GF-8803 which is the GNSS Disciplined Oscillator (GNSSDO). This document uses GNSS as general term of GPS, GLONASS, Galileo and QZSS.

2 Function Overview

This product is a GNSSDO that can provide PVT (Position, Velocity and Time) information. Figure 2-1 shows the block level diagram. Main features are as follows:

- Supports GPS, GLONASS, Galileo, QZSS (L1C/A, L1S) and SBAS.
- Provides 1PPS with high accuracy and stability synchronized with GPS time or UTC time.
- Provides clock signal (VCLK 10MHz) synchronized with 1PPS.
- Software upgrade capability by Flash ROM.
- Active Anti-Jamming capability to suppress effects of CW jammers.
- Effects Multi-path mitigation.
- GNSS high sensitivity.
- An expensive external power supply component is unnecessary since an LDO is built in.
- Coaxial connector (RF_COAX) or IF connector (RF_PIN) for GNSS signal input are selectable.
- GF-8701, GF-8702, GF-8703, GF-8801, GF-8802 and GF-8803 are pin compatible.[1)]

Notes:
1) The specifications of power consumption, PPS and 10 MHz are different.

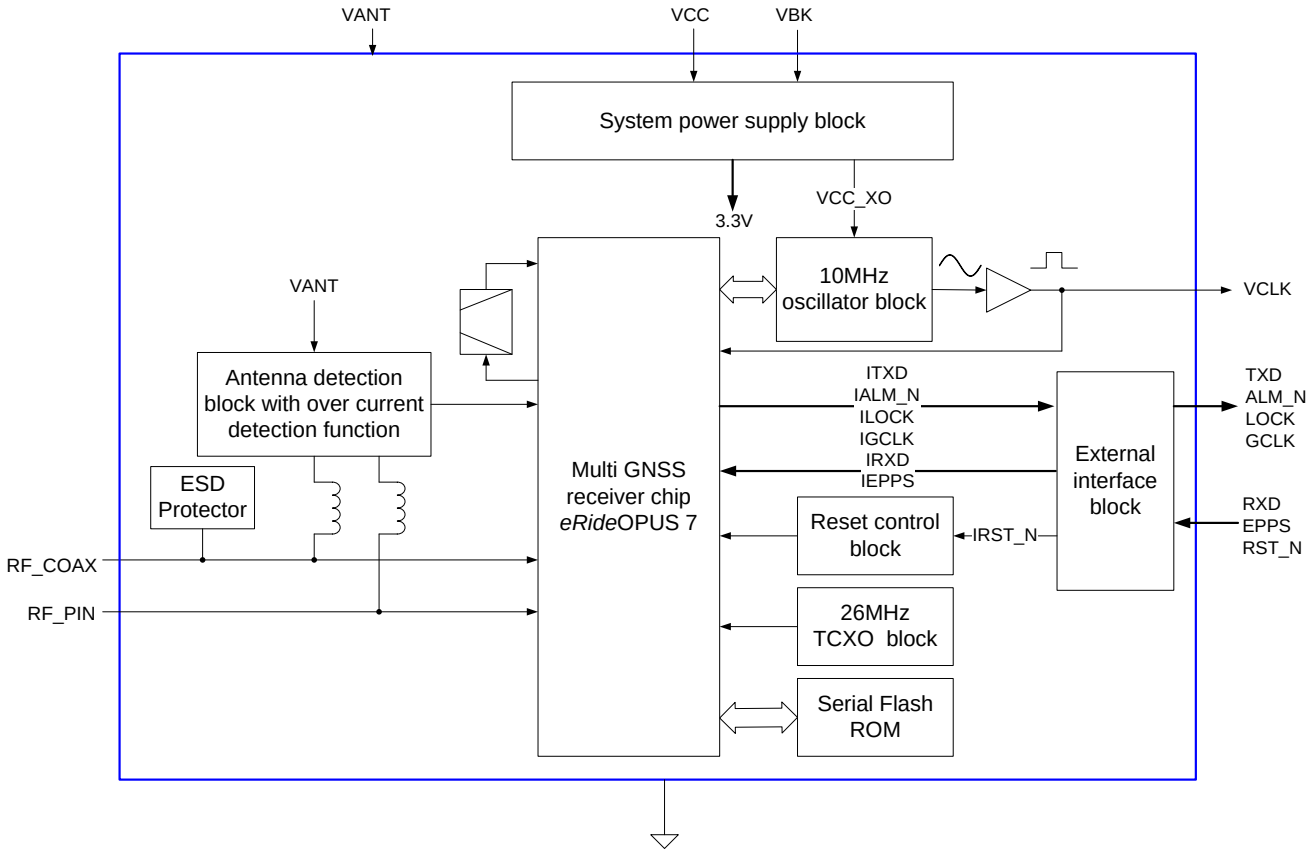


Figure 2-1. GF-8801/02/03 block diagram

3 GNSS General Performance

These performances are measured and evaluated under the environment shown in Figure 3-1. The measurement conditions are default setting and 25°C constant (no wind). When the signal level mask is set, the performance is limited by the mask.

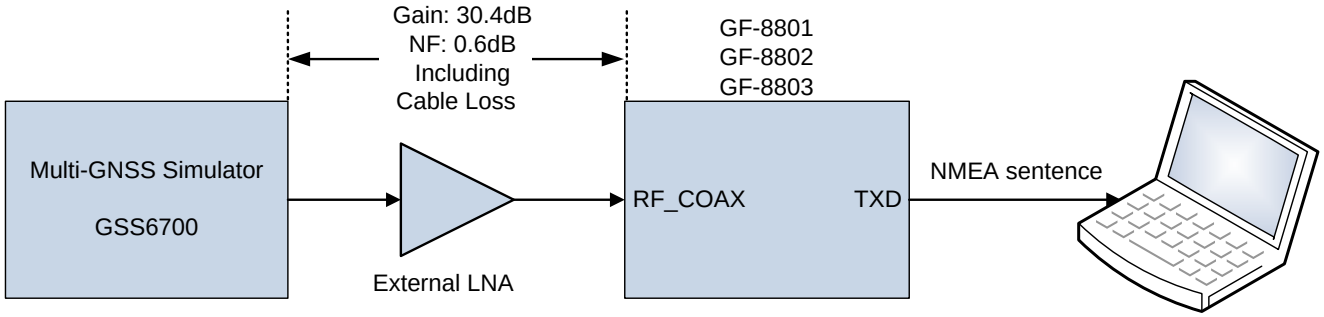


Figure 3-1. Measurement platform

Table 3-1. Time To First Fix (TTFF)

Item	Specification	Note
TTFF (HOT)	< 5 sec	[*1] [*2]
TTFF (COLD)	< 35 sec	[*1] [*3]

Table 3-2. GPS performance

Item	Specification	Note
Signal type	GPS L1C/A	
Channel	MAX 12	[*4]
HOT acquisition sensitivity	> -162 dBm	[*5]
COLD acquisition sensitivity	> -148 dBm	[*6]
Tracking sensitivity	> -162 dBm	
Re-acquisition sensitivity	> -162 dBm	[*7]

Table 3-3. GLONASS performance

Item	Specification	Note
Signal type	GLONASS L1OF	
Channel	MAX 10	[*4]
HOT acquisition sensitivity	> -158 dBm	[*5]
COLD acquisition sensitivity	> -144 dBm	[*6]
Tracking sensitivity	> -158 dBm	
Re-acquisition sensitivity	> -158 dBm	[*7]

Table 3-4. Galileo performance

Item	Specification	Note
Signal type	Galileo E1B/E1C	[*8]
Channel	MAX 8	[*4]
HOT acquisition sensitivity	> -136 dBm	[*5]
COLD acquisition sensitivity	> -136 dBm	[*6]
Tracking sensitivity	> -146 dBm	
Re-acquisition sensitivity	> -136 dBm	[*7]

Table 3-5. QZSS L1C/A performance

Item	Specification	Note
Signal type	QZSS L1C/A	
Channel	MAX 4	[*4] [*11]
HOT acquisition sensitivity	> -136 dBm	[*5]
COLD acquisition sensitivity	> -131 dBm	[*6]
Tracking sensitivity	> -147 dBm	
Re-acquisition sensitivity	> -136 dBm	[*7]
GEO satellite	Available	SVID=199 is supported.

Table 3-6. QZSS L1S performance

Item	Specification	Note
Signal type	QZSS L1S	[*9] [*12]
Channel	MAX 2	[*4]
COLD acquisition sensitivity	> -130 dBm	[*6]
Tracking sensitivity	> -134 dBm	
Re-acquisition sensitivity	> -130 dBm	[*7]
SLAS	Available	[*10]

Table 3-7. SBAS performance

Item	Specification	Note
Signal type	SBAS L1C/A	SVID=120 to 138 are supported. [*9]
Channel	MAX 2	[*4] [*13]
Acquisition sensitivity	> -130 dBm	[*6]
Tracking sensitivity	> -139 dBm	
Reacquisition sensitivity	> -130 dBm	[*7]

[*1] These are specified in the measurement environment shown in Figure 3-1. Simulator output level is set to -130 dBm.
[*2] The time from sending HOT restart command to re-acquisition
[*3] The time from sending COLD restart command to re-acquisition
[*4] Up to 32 channels are available for whole GNSS.
[*5] After sending HOT restart command during satellite receiving
[*6] After sending COLD restart command during satellite receiving
[*7] Within 250 seconds after the last signal receiving
[*8] Due to the composition of the message broadcast by Galileo, TTFF of Galileo may take about 100 seconds.
[*9] Only one of QZSS L1S and SBAS L1C/A can be used. They cannot be received at the same time.
[*10] SLAS correction is performed to GPS and QZSS.
[*11] Up to 4 satellites can be received simultaneously among 193, 194, 195, 196 and 199.
[*12] Up to 2 satellites can be received simultaneously among 183, 184, 185, 186 and 189.
[*13] WAAS, MSAS, EGNOS and GAGAN are supported.

4 1PPS and Clock (VCLK, GCLK) Signal Specifications

The follow is the specifications of 1PPS and clock (GCLK, VCLK). Please refer to the eSIP Protocol Specification for switching setting etc. The performance described in this chapter is measured and evaluated under the environment shown in Figure 4-1 and 4-2 below. In the absence of any notes, measurement conditions are default setting, open sky, constant at 25 degree (no wind).

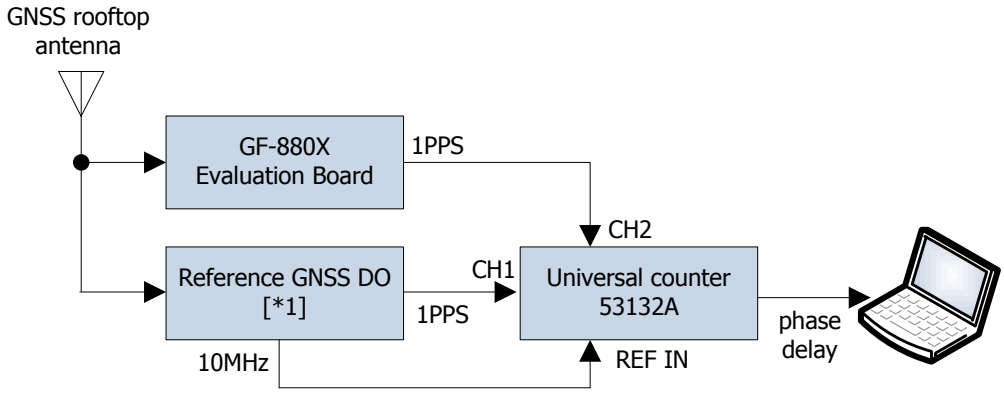


Figure 4-1. 1PPS measurement environment

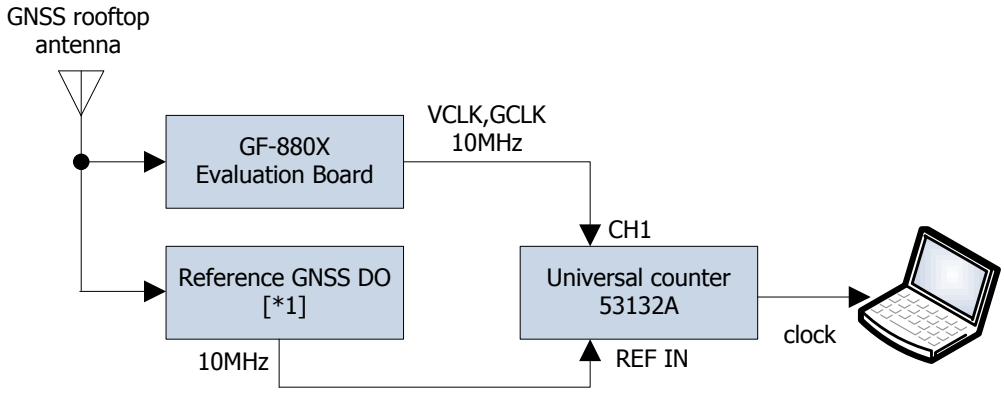
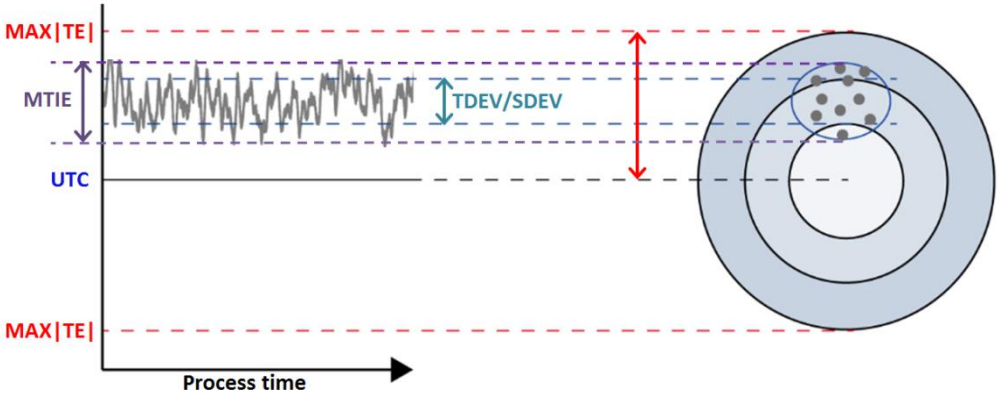


Figure 4-2. Clock measurement environment

[*1] GNSSDO equipped with rubidium oscillator calibrated by USNO (United States Naval Observatory).

The definition of the terms is as follows.

MAX|TE|: It is a maximum time error (absolute value) of 1PPS for UTC time.
MTIE: Maximum time interval error. It is a relative MIN-MAX value of 1PPS.
SDEV, TDEV: Standard deviation and Time deviation. They show 1PPS fluctuation.



4.1 1PPS

Table 4.1-1. 1PPS general specifications

Item	Specification	Note
Nominal frequency	1 Hz	
Duty cycle	50 %	[*1]
Synchronization target	GPS, UTC	[*2]

[*1] The pulse width can be changed by PPS command. Please refer to the eSIP protocol specifications for details.
[*2] 1PPS is output in synchronization with GPS time or UTC time. Please refer to the eSIP protocol specifications for details.

Table 4.1-2. 1PPS output specifications [FINE LOCK]

Item	Specification	Note
1PPS accuracy (MAX|TE|)	< 40 nsec	MIN-MAX value from UTC time / [*1][*2]
1PPS stability (Standard deviation)	< 4.5 nsec	@ 1sigma / [*2][*3]
1PPS stability (Time deviation)	G.8272 PRTC-B compliant	@ 1sigma / [*2][*4][*6]
1PPS stability (MTIE)	G.8272 PRTC-B compliant	Relative MIN-MAX value / [*2][*5][*6]

[*1] It is necessary to adjust cable offset beforehand. In addition, it may be necessary to adjust the hardware offset of the entire device incorporating this product.
[*2] After SS mode or CSS mode for more than 24 hours, or after TO mode via it
[*3] GF-8701 uses a TCXO as an internal oscillator. Please pay attention to the installation environment since it is particularly susceptible to wind and temperature.
[*4] TDEV of G.8272 PRTC-B compliant means that it meets the following specifications.

Time deviation limit [nsec]	Observation interval τ [sec]
1	1<τ<100
0.01τ	100<τ<500
5	500<τ<100000

[*5] MTIE of G.8272 PRTC-B compliant means that it meets the following specifications.

MTIE limit [nsec]	Observation interval τ [sec]
0.275τ + 25	1<τ<55
40	55<τ

[*6] G.8272 PRTC-B compliant is GF-8802 and GF-8803 only. TDEV and MTIE of GF-8801 is G.8272 PRTC-A compliant.

Table 4.1-3. 1PPS output specifications [HOLDOVER]

Item		Specification	Note
1PPS accuracy (MAX|TE|)	GF-8801	-	
	GF-8802	< ± 50 usec	@ < 24 hours / [*1][*3]
		< ± 3 usec (TYP)	@ < 1 hour / [*2][*3]
	GF-8803	< ± 10 usec	@ < 24 hours / [*1][*3]
		< ± 3 usec (TYP)	@ < 1 hour / [*2][*3]
1PPS stability		-	Standard deviation / Time deviation / MTIE

[*1] This specification is satisfied when all of the following conditions are satisfied.
- The time of power on is more than 7 days before Holdover.
- FINE LOCK period (open sky) is more than 72 hours before Holdover.
- Temperature variation range is less than ±20°C in the 72 hours just before Holdover and the Holdover period.
- Temperature gradient is less than ±5°C/Hour in the 72 hours just before Holdover and the Holdover period.
- Temperature integrated value is less than 240 Hour * °C in the 72 hours just before Holdover and the Holdover period. The temperature integrated value means a time integrated value of temperature variation. It is an integrated value every 24 hours with reference to the temperature at the start of holdover.

Figure 4.1-1 shows the Holdover measurement environment.

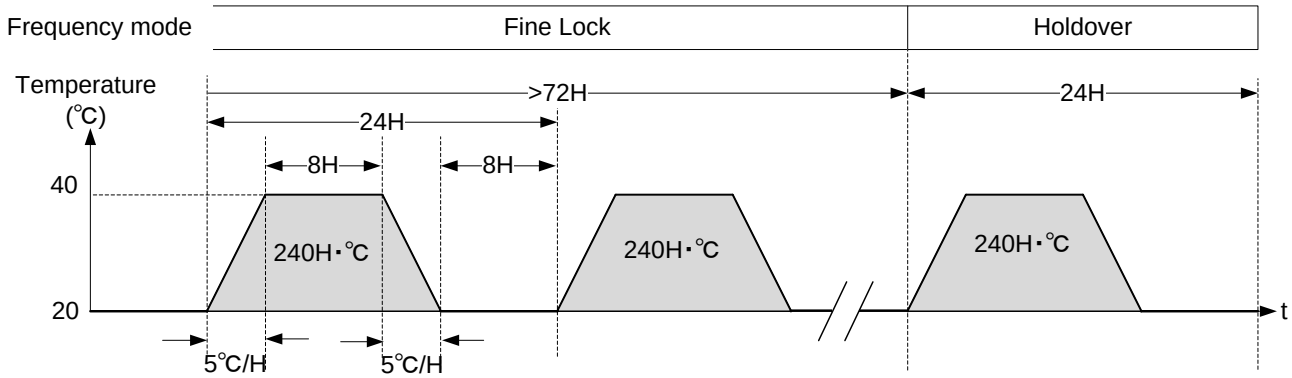


Figure 4.1-1. Holdover measurement environment

[*2] This specification is satisfied when all of the following conditions are satisfied.
- The time of power on is more than 1 day before Holdover.
- FINE LOCK period (open sky) is more than 10 minutes before Holdover.
- Temperature constant (25°C).
- Wind does not directly blow.

[*3]
This product learns the frequency variation of the oscillator in FINE LOCK state and reflects the learning result in HOLDOVER state. Therefore, when the temperature environment is significantly different, the above specifications may not be satisfied. For example, it is the case when there is no temperature change in FINE LOCK state and there is a temperature change in HOLDOVER state.

The frequency of the oscillator changes due to fluctuation of gravitational acceleration. Therefore, it is recommended to operate this product at a fixed point. For moving applications during operation, fluctuations of frequency can be suppressed by not changing the tilt of the product as much as possible in FINE LOCK state and HOLDOVER state (When the product is operating horizontally, move it as horizontally as possible). In addition, it is recommended to shorten the travel time as much as possible. By doing so, it is possible to suppress frequency fluctuations.

4.2 Clock (VCLK)

Table 4.2-1. VCLK general specifications

Item		Specification	Note
Nominal frequency		10 MHz	
Short term stability (Root Allan variance τ=1sec)	GF-8801	< ± 5E-10	
	GF-8802	< ± 5E-11	
	GF-8803	< ± 2E-11	

Table 4.2-2. VCLK output specifications [FINE LOCK]

Item		Specification	Note
Long term stability (24 hours average)	GF-8801	< ± 1E-11	
	GF-8802	< ± 1E-12	
	GF-8803	< ± 1E-12	

Table 4.2-3. VCLK output specifications [HOLDOVER]

Item		Specification	Note
Long term stability (24 hours average)	GF-8801	-	
	GF-8802	< ± 1E-9	@ < 24 hours / [*1]
	GF-8803	< ± 2E-10	@ < 24 hours / [*1]

[*1] This specification is satisfied when all of the following conditions are satisfied.
- The time of power on is more than 7 days before Holdover.
- FINE LOCK period (open sky) is more than 72 hours before Holdover.
- Temperature variation range is less than ±20°C in the 72 hours just before Holdover and the Holdover period.
- Temperature gradient is less than ±5°C/Hour in the 72 hours just before Holdover and the Holdover period.
- Temperature integrated value is less than 240 Hour * °C in the 72 hours just before Holdover and the Holdover period. The temperature integrated value means a time integrated value of temperature variation. It is an integrated value every 24 hours with reference to the temperature at the start of holdover.

The Holdover measurement environment is shown in Figure 4.1-1.

4.3 Clock (GCLK)

Table 4.3-1. Clock (GCLK) output specifications

Item	Specification	Note
GCLK setting range	10 Hz to 40 MHz	[*1]
GCLK stability	< ± 1 ppb	@ 1sigma / [*2]
GCLK output resolution	< ± 8 nsec	clock total jitter / [*3]
Relation between 1PPS and GCLK	Non coherent	
Holdover	No specification	

[*1] Please refer to the eSIP Protocol Specifications for GCLK frequency setting.
[*2] It is when the GCLK frequency is 100 Hz or more. When less than 100 Hz, output is possible, but there is no stability specification.
[*3] It is a mechanism to generate arbitrary frequency by using the system clock of this product and built-in adder. By receiving the GNSS satellite, it is possible to output arbitrary frequency accurately. Since the frequency is generated using the adder, it is recommended to check in advance whether jitter and spurious included in the GCLK frequency are within the allowable range of the application to be used.

5 Time to FINE LOCK

This product transitions to FINE LOCK for GPS time within 5 minutes from power on. However, the conditions are constant temperature and open sky. Otherwise, the time to FINE LOCK may be extended.

6 Phase Relation between PPS and VCLK

Figure 6-1 shows the phase relation between PPS and VCLK. This relation is coherent.

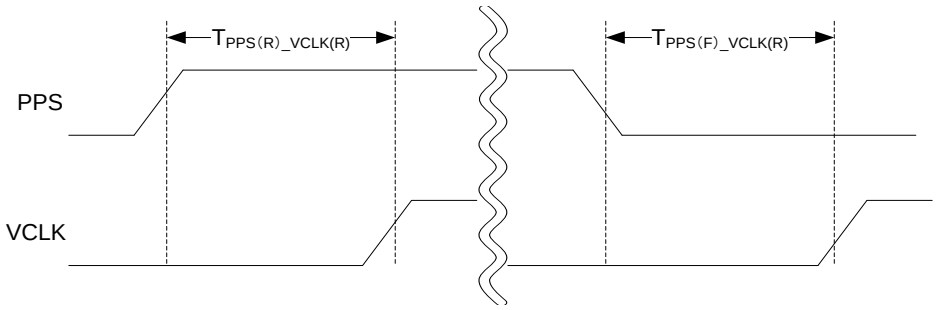


Figure 6-1. Phase relation between PPS and VCLK

Table 6-1. Phase relation between PPS and VCLK

Symbol	Description	Min	Max	Note
$T_{PPS(R)\_VCLK(R)}$	VCLK rising delay time from PPS rising	35 nsec	55 nsec	[*1]
$T_{PPS(F)\_VCLK(R)}$	VCLK rising delay time from PPS falling	35 nsec	55 nsec	[*1]

[*1] The frequency mode is PULL-IN, COARSE LOCK or FINE LOCK.

7 Environment Robustness Performance

Table 7-1. Environment robustness performance

Item	Specification	Note
Active anti-jamming	8 CW	[*1]
Multipath mitigation	Available	
T-RAIM function	Available	[*2]
Antenna current detection	Available	
Spoofing signal mitigation	Available	Anti-spoofing / [*3]
Operating temperature	-40 to +85 °C	[*4]
Storage temperature	-40 to +85 °C	
Operation humidity	< 85 %R.H	[*5]

[*1] It has eight anti-jamming functions for CW waves.
[*2] Time Receiver Autonomous Integrity Monitoring (T-RAIM) is a mechanism to identify and eliminate satellites that may have a bad influence on the positioning calculation by combining and principle of majority when the number of satellites in use is larger than the minimum number of satellites required for positioning.
[*3] This product has a function to notify an alarm by detecting a spoofing signal, and to eliminate the decoding of spoofing signal. Please refer to the eSIP Protocol Specifications for details.
[*4] A sudden temperature change may disturb the frequency of the TCXO installed inside, possibly causing instantaneous satellite reception failure. Especially when installing a fan, it is recommended to take care not to blow the wind directly to this product.
[*5] Ta=60°C, No condensation

8 Operation Restriction

Operation of this product is limited to the following conditions based on the Wassenaar Arrangement (The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies).

Table 8-1. Operation restriction

Item	Specification	Note
Altitude	< 18300 meters	
Velocity	< 515 m/s	

9 I/O Signal Description

9.1 I/O Signal Description

Table 9.1-1. I/O signal description

#	Pin name	Type	PU/PD [*1]	Note
1	RST_N	Digital input	PU	External reset input pin [*2]
2	VANT	Power input	-	Power supply input pin for antenna
3	-	-	-	-
4	-	-	-	-
5	GND	-	-	Ground
6	RF_PIN	-	-	GNSS signal input pin [*3]
7	GND	-	-	Ground
8	VBK	Power input	-	Backup power supply input pin [*4]
9	VCC	Power input	-	Main power supply input pin
10	GND	-	-	Ground
11	VCLK	Digital output	-	VCLK output pin (10MHz, Square wave)
12	RXD	Digital input	PU	Serial communication input pin
13	TXD	Digital output	-	Serial communication output pin
14	ALM_N	Digital output	-	Alarm signal output pin [*5]
15	LOCK	Digital output	-	Lock signal output pin [*6]
16	GCLK	Digital output	-	GCLK output pin (10Hz to 40MHz)
17	PPS	Digital output	-	PPS output pin
18	EPPS	Digital input	PD	External PPS input pin
RF	RF_COAX	Analog input	-	GNSS signal input connector [*7]

[*1] PU: Pull-Up, PD: Pull-Down.
[*2] Logic L: Reset, Logic H or open: Normal operation
[*3] VANT voltage is superimposed and output. In case of not using, do not connect anything.
[*4] See Chapter Section 9.6 for the specifications of backup power supply. In case of not using, do not connect anything.
[*5] Logic L: Abnormal, Logic H: Normal. See Section 9.3 for the alarm output condition.
[*6] Logic L: Unlock, Logic H: Lock. See Section 9.4 for the lock signal output condition.
[*7] VANT voltage is superimposed and output. MMCX connector / Receptacle / 50Ω.

9.2 Pin Arrangement

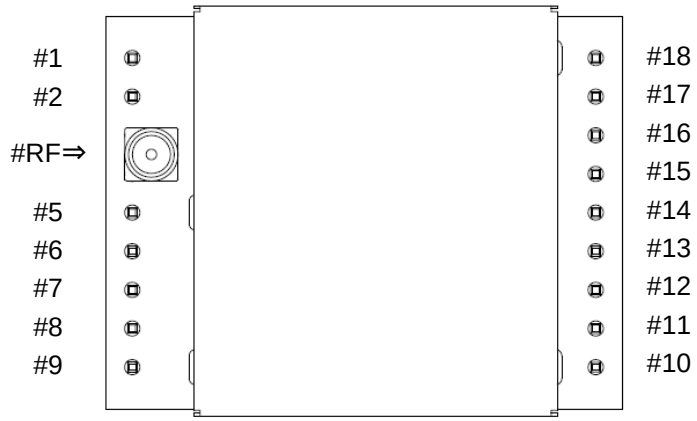


Figure 9.2-1. Top of view

9.3 Alarm Signal (ALM_N)

It shows the status of “alarm” field in CRZ (TPS4) sentence. The alarm signal specification is shown in Table 9.3-1.

Table 9.3-1. Alarm signal specifications

CRZ(TPS4) “alarm field”	ALM_N pin	Description
00	Logic H	Normal
Other than 00	Logic L	Abnormal

9.4 Lock Signal (LOCK)

It shows the status of “frequency mode” field in CRZ (TPS4) sentence. The output condition can be set by “Lock port set” field in MODESET command. The lock signal specification is shown in Table 9.4-1.

Table 9.4-1. Lock signal specifications

MODESET “Lock port set” field	CRZ(TPS4) “frequency mode”	LOCK pin
0	2, 3, 4	Logic H
	Other than above values	Logic L
1 (default)	2, 3	Logic H
	Other than above values	Logic L
2	3	Logic H
	Other than above value	Logic L
3	3, 4	Logic H
	Other than above values	Logic L

9.5 PPS Input Signal for External Synchronization (EPPS)

When 1PPS is input to the EPPS pin and the command is set up, the VCLK and the PPS will be synchronized with the pulse. The synchronous target is the rising edge of the pulse to be input to the EPPS. Please refer to the “EXTSYNC” in the protocol specifications to set the external synchronization function.

9.6 Backup Power Supply (VBK)

When using the backup power supply, the information obtained from the navigation message of each satellite, the positioning result and the input value of the command set by the user are saved into the backup RAM (BBRAM) in this product at the main power-off. With this backup function, when this product returns from the main power-off, the TTFF will be shortened. However, the almanac and the ephemeris data should be received before the main power shut down. Please refer to the eSIP protocol specifications for the data to be saved into the BBRAM.

9.7 RF_COAX and RF_PIN

RF_COAX and RF_PIN are GNSS signal input pins. By using the RF_COAX, user can reduce the time for design and evaluation because of omitting the high frequency circuit design. On the other hand, when using RF_PIN, user can expect cost reduction since the cable for connecting to RF_COAX is unnecessary.

Only one of RF_COAX and RF_PIN can be used. Use the RF_COAX when the antenna coaxial cable will be connected directly to the MMCX connector of this product. Use the RF_PIN when GNSS signals are input via the microstrip line from the user board. Please refer to the Design Guide (SE13-900-000) for the microstrip line.

RF_COAX and RF_PIN cannot be used at the same time, and it is necessary to switch by the command. The default is set to the RF_COAX. When the RF_COAX is set, it is not used even if GNSS signals are input to the RF_PIN.

10 Electrical Characteristics

10.1 Absolute Maximum Rating

Table 10.1-1 shows the values when used in the operating temperature range shown in Chapter 7. Stresses beyond those listed under those range may cause permanent damage to the product.

Table 10.1-1. Absolute Maximum Rating

Item	Symbol	MIN	MAX	Unit	Note
VCC supply voltage	V_{CC_ABS}	-0.3	6.0	V	
Backup supply voltage	V_{BK_ABS}	-0.3	4.0	V	
VANT voltage	V_{ANT_ABS}	-0.3	6.0	V	
Other pins DC voltage	V_{IN_ABS}	-0.5	6.5	V	
	V_{OUT_ABS}	-0.5	3.8	V	
Other pins DC current	-	-	± 50	mA	
RF_COAX input power	$P_{RF\_COAX\_ABS}$	-	8	dBm	[*1]
		-	6		[*2]
		-	8		[*3]
RF_IN input power	$P_{RF\_IN\_ABS}$	-	-5	dBm	[*1]
		-	0		[*2]
		-	-1		[*3]

[*1] at 1575.42MHz & 1602MHz
[*2] at 900MHz
[*3] at 1800MHz

10.2 Power supply

Below are power supply specifications. The conditions satisfying this specification are Ta = 25 °C.

Table 10.2-1. Power supply Characteristics

Item		Symbol	MIN	TYP	MAX	Unit	Note
VCC supply voltage		V_{CC}	3.5	3.7	3.9	V	
VANT supply voltage		V_{ANT}	2.7	-	5.5	V	
VBK supply voltage		V_{BK}	1.4	-	3.6	V	Using VBK
VCC rising slew rate		V_{CC_SR}	-	-	$3.9x10^4$	V/s	[*1]
VBK rising slew rate		V_{BK_SR}	3.6	-	$3.6x10^4$	V/s	[*1]
VCC current consumption (at start-up)	GF-8801	I_{CC_WU01}	-	-	150	mA	[*2]
	GF-8802	I_{CC_WU02}	-	-	800		[*2]
	GF-8803	I_{CC_WU03}	-	-	1400		[*2]
VCC current consumption (at stable state)	GF-8801	I_{CC_ST01}	-	-	150	mA	[*3]
	GF-8802	I_{CC_ST02}	-	450	-		[*3]
	GF-8803	I_{CC_ST03}	-	600	-		[*3]
VBK current consumption (at back up)		I_{BKN}	-	9	20	μA	[*4]
VBK current consumption (at normal operation)		I_{BKB}	-	0.4	2	μA	[*5]

[*1] See Figure 10.2-1 for the rising slew rate.
[*2] Within 5 minutes from power-on.
[*3] After 5 minutes from power-on.
[*4] Vcc = 0 V
[*5] Vcc = 3.7 V

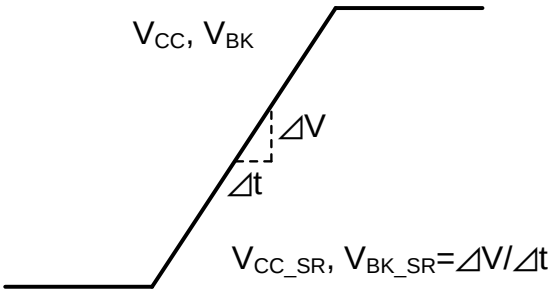


Figure 10.2-1. Rising slew rate

10.3 Reset

This product has an internal power-on reset circuit which detects the VCC voltage and creates POR_N (power-on reset) signal form initializing the module. Table 10.3-1 shows the threshold voltages to detect and create POR_N signal.

Table 10.3-1. Power-on reset voltage

Item	Symbol	MIN	TYP	MAX	Unit	Note
Power on reset threshold voltage (rising)	V_{RTH_POR}	-	-	3.3	V	
Power on reset threshold voltage (falling)	V_{FTH_POR}	2.7	-	-	V	

This product can also be controlled by external reset signal (RST_N) with the following sequence.

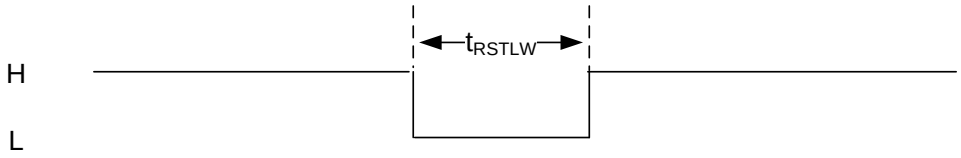


Figure 10.3-1. Reset sequence

Table 10.3-2. Reset sequence

Item	Symbol	Min.	Max.	Unit	Note
Reset pulse width	T_{RSTLW}	300	-	ms	

10.4 Interface Signal

Table 10.4-1 shows the interface signal specifications. These are specifications when the terminal temperature of this product is 25 °C.

Table 10.4-1. Interface signal

Item	Symbol	MIN	TYP	MAX	Unit	Note
Low-Level input voltage	V_{IL}	-	-	0.8	V	
High-Level input voltage	V_{IH}	2.0	3.3	5.5	V	
Low-Level output voltage	V_{OL}	-	-	0.4	V	I_{OL} = 16mA
High-Level output voltage	V_{OH}	2.4	3.3	3.6	V	I_{OH} = -18mA
Digital input pull-up resistor	R_{PU}	9.5	10	10.5	kΩ	
Digital input pull-down resistor	R_{PD}	9.5	10	10.5	kΩ	
Digital input pull-up voltage	V_{PU}	-	3.3	-	V	

10.5 Baud Rate and Error

Table 10.5-1 shows the relation between the baud rate and the deviation error for TXD.

Table 10.5-1. Baud rate and deviation error (TXD)

Baud rate [bps]	Deviation error [%]
4800	+0.00
9600	+0.11
19200	-0.11
38400	+0.32
57600	-0.54
115200	-0.54
230400	+2.08
460800	-3.02

Table 10.5-2 shows the relation between the baud rate and the lower and upper limit of tolerance error.

Table 10.5-2. Baud rate and tolerance error

Baud rate [bps]	Tolerance error [%] Lower limit	Tolerance error [%] Upper limit
4800	-4.64	5.26
9600	-4.53	5.38
19200	-4.74	5.15
38400	-4.33	5.60
57600	-5.15	4.70
115200	-5.15	4.70
230400	-2.65	7.45
460800	-7.52	2.08

10.6 UART Wake-up Timing

The start timing specifications of UART input / output are described below.

Figure 10.6-1 shows the UART wake-up timing by the internal reset control (without external reset).

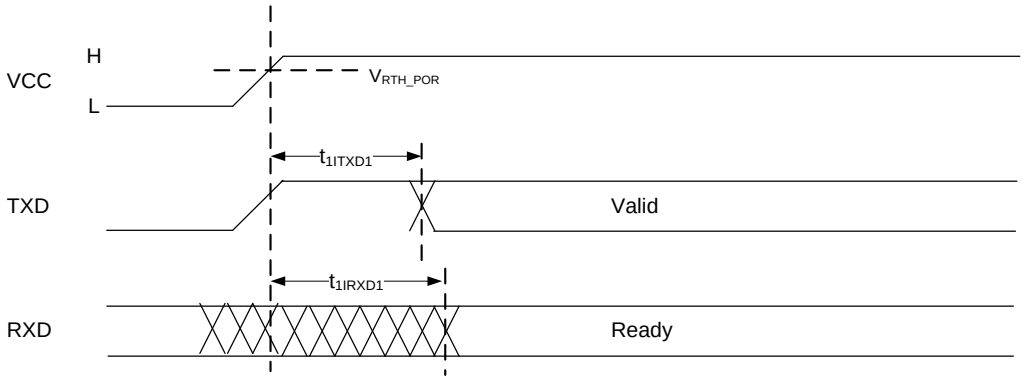


Figure 10.6-1. UART wake-up timing after V_{RTH_POR}

Table 10.6-1. UART wake-up timing after V_{RTH_POR}

Item	Symbol	TYP	MAX	Unit	Note
Time delay until periodic data output	t_{1ITXD1}	3.3	6	sec	[*1]
Time delay until the command input is available	t_{1IRXD1}	3.3	6	sec	[*1]

[*1] after VCC reaches V_{RTH_POR}

Figure 10.6-2 shows the UART wake-up timing when external reset is used.

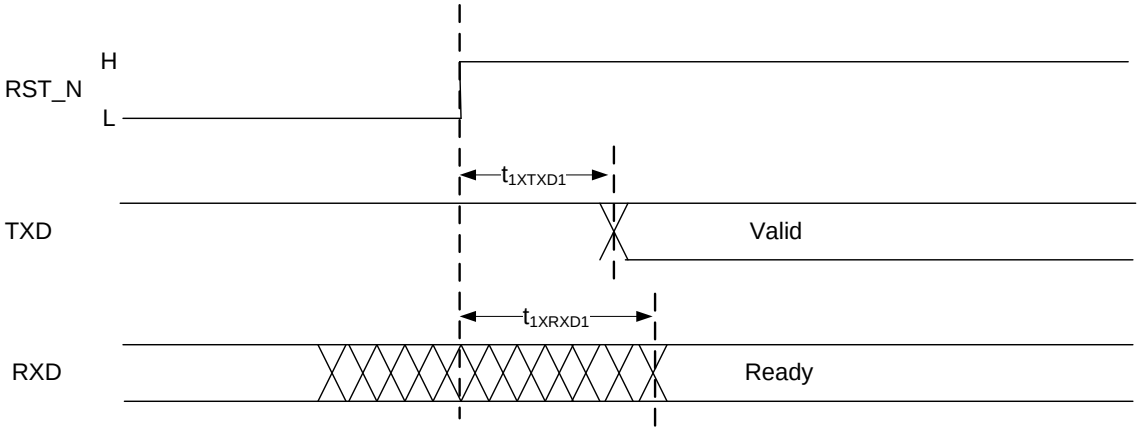


Figure 10.6-2. UART wake-up timing after RST_N

Table 10.6-2. UART wake-up timing after RST_N

Item	Symbol	TYP	MAX	Unit	Note
Time delay until periodic data output	t_{1XTXD1}	3.1	6	sec	[*1]
Time delay until the command input is available	t_{1XRXD1}	3.1	6	sec	[*1]

[*1] after VCC reaches V_{RTH_POR}

10.7 Recommended GNSS Antenna

Table 10.7-1. Recommended GNSS antenna

Item	MIN	TYP	MAX	Unit	Note
GPS/QZSS center frequency	-	1575.42	-	MHz	2.046 MHz bandwidth
GLONASS center frequency	-	1602	-	MHz	9 MHz bandwidth
Galileo center frequency		1575.42			4.092 MHz bandwidth
Antenna element gain	0	-	-	dBi	
Pre-amplifier gain	15	-	35	dB	Including cable loss
Pre-amplifier NF	-	-	3.5	dB	
Impedance	-	50	-	Ω	
VSWR	-	-	2	-	

10.8 Antenna Amplifier Power

The power input from the pin #2 (VANT) is superimposed with the antenna connector (RF_COAX) or the interface connector (RF_PIN) and output. The power supply is ON by default and it is able to be stopped the power supply with the command.

This product incorporates an antenna current error sensing function. In case of detecting an antenna current error, the alarm (ALM_N) is output. If the error is an antenna short (an over current), the antenna pre-amplifier power supply is stopped.

Table 10.8-1. Antenna pre-amplifier power supply

Item	Symbol	MIN	TYP	MAX	Unit	Note
Antenna pre-amplifier output voltage	V_{APO}	V_{ANT}-0.5	-	-	V	@ I_{APO}=75mA
Antenna pre-amplifier output current	I_{APO}	-	-	75	mA	
Threshold current of antenna open	I_{AOD}	-	5	10	mA	
Threshold current of antenna short	I_{ASD}	80	85	-	mA	
Antenna current upper limitation	I_{AOL}	-	-	200	mA	Antenna shortage

Multiple GNSSDO can be connected to one antenna since the antenna pre-amplifier power output incorporates a preventive function of current backflow. It is not necessary for user to use a DC cut for redundancy.

11 RoHS

This product is RoHS compliant.

12 Flame Retardancy Rank

UL94V-1 compliance.

13 FIT

GF-8801 ---2000FIT
GF-8802 ---2500FIT
GF-8803 ---3100FIT

Calculation requirements
- Telcordia 332 issue3
- Parts count method
- Environmental factor: GF
- Operating temperature: 50°C
- Quality level: Level 0
- Using the failure rate from manufacturer: Yes

14 Reliability Test

#	Test Item	Conditions
1	High temperature high humidity bias life	1000 hours, T_A=85°C, RH=85%
2	High temperature high humidity storage life	1000 hours, T_A=85°C, RH=85%
3	Low temperature operating life	500 hours, T_A=-40°C
4	Low temperature storage life	500 hours, T_A=-40°C
5	Drop test	With packing, 50 cm natural drop
6	Vibration test	Each three direction (x,y,z), 10 to 55 Hz, 4.7G (46m/s^2), 30 minutes (Not operating)
7	ESD test	JIS C 61000-4-2 Contact

15 Soldering Condition

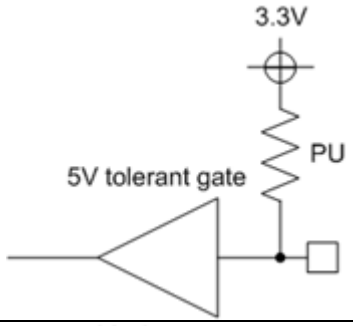
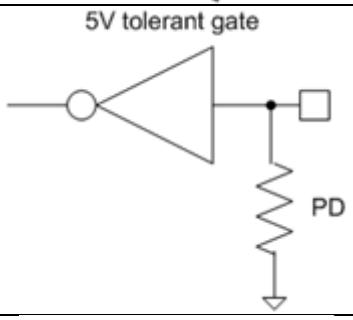
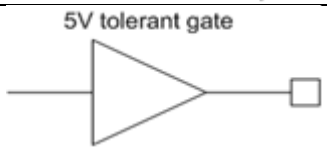
Recommended flow soldering conditions are as follows. However, please adjust the conditions depending on the board and the equipment.
- Pre-heat: 120 to 150 °C for 2 minutes
- Peak temperature: 250 °C for 10 seconds max

Recommended hand soldering condition is as follows.
- 350 °C for 3 seconds or less

16 Equivalent Circuit

Table 16.1 shows the equivalent circuits of digital signal port.

Table 16.1. Equivalent circuit

Pin name	Equivalent circuit
1. RST_N 12. RXD	
18. EPPS	
11. VCLK 14. ALM_N 15. LOCK 16. GCLK 17. PPS	

17 Mechanical Specifications

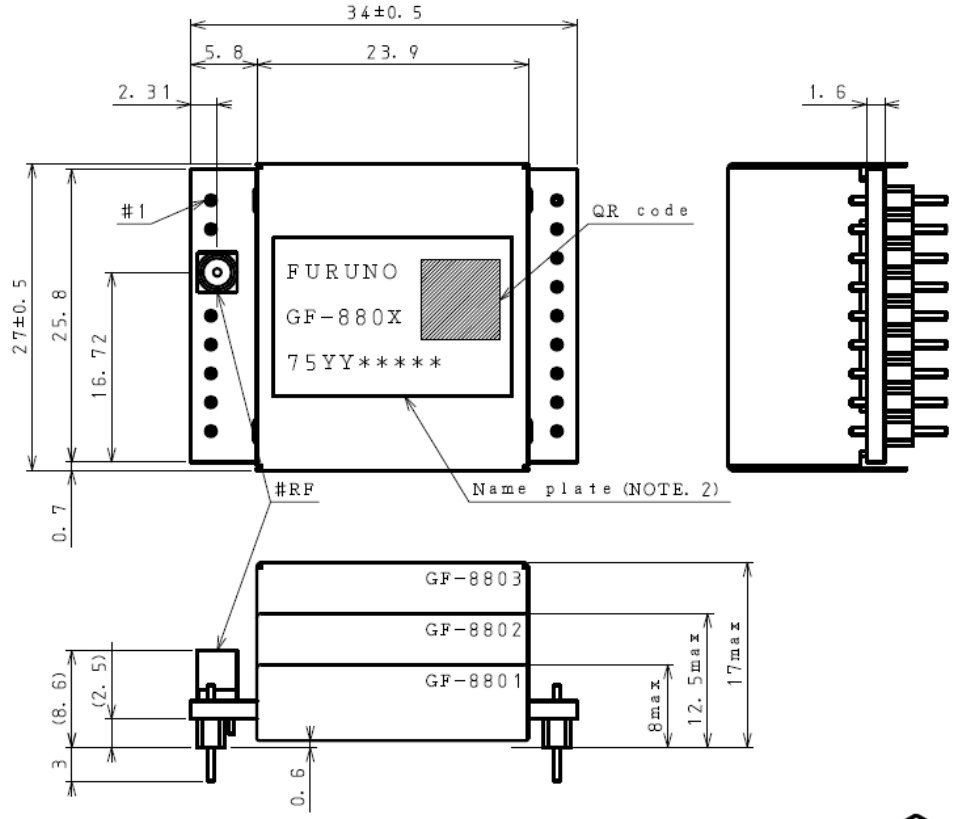
The mechanical specifications are shown on the next page. The notes are as follows.

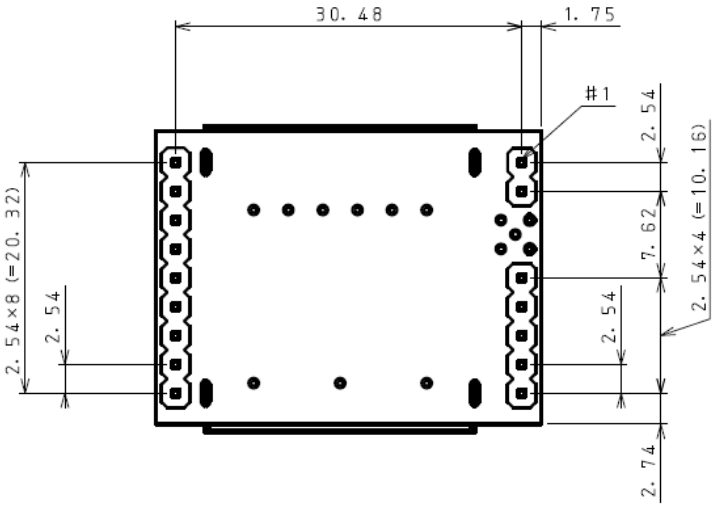
Notes:

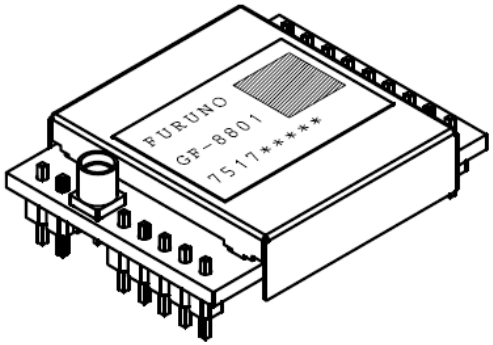
1. Dimensional tolerance is ±0.2mm unless otherwise stated.
2. Products label specifications.

Product	GF-8801	GF-8802	GF-8803
Products number code (X)	1	2	3
Products unique code (YY)	17	18	19

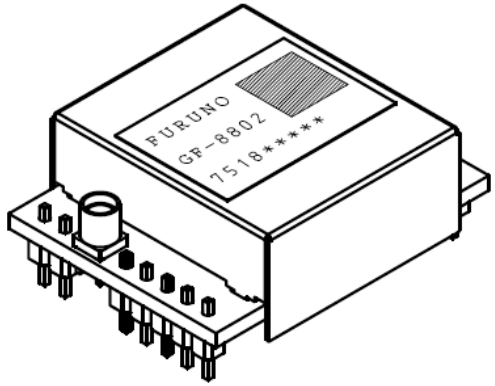
3. "*****" represents serial number.
4. It is recommended that the layout of under this product is ground plane.
5. RF connector product number: MMCX1-4024 (CONNEKT)



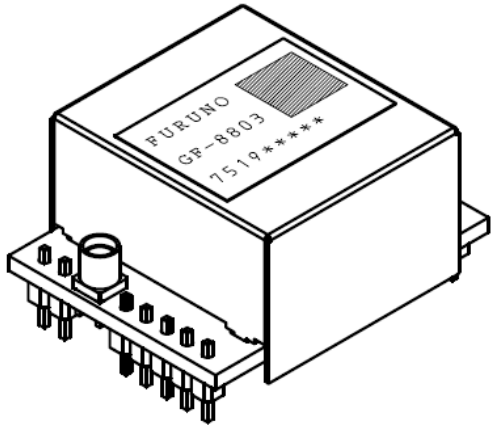




GF-8801 External view



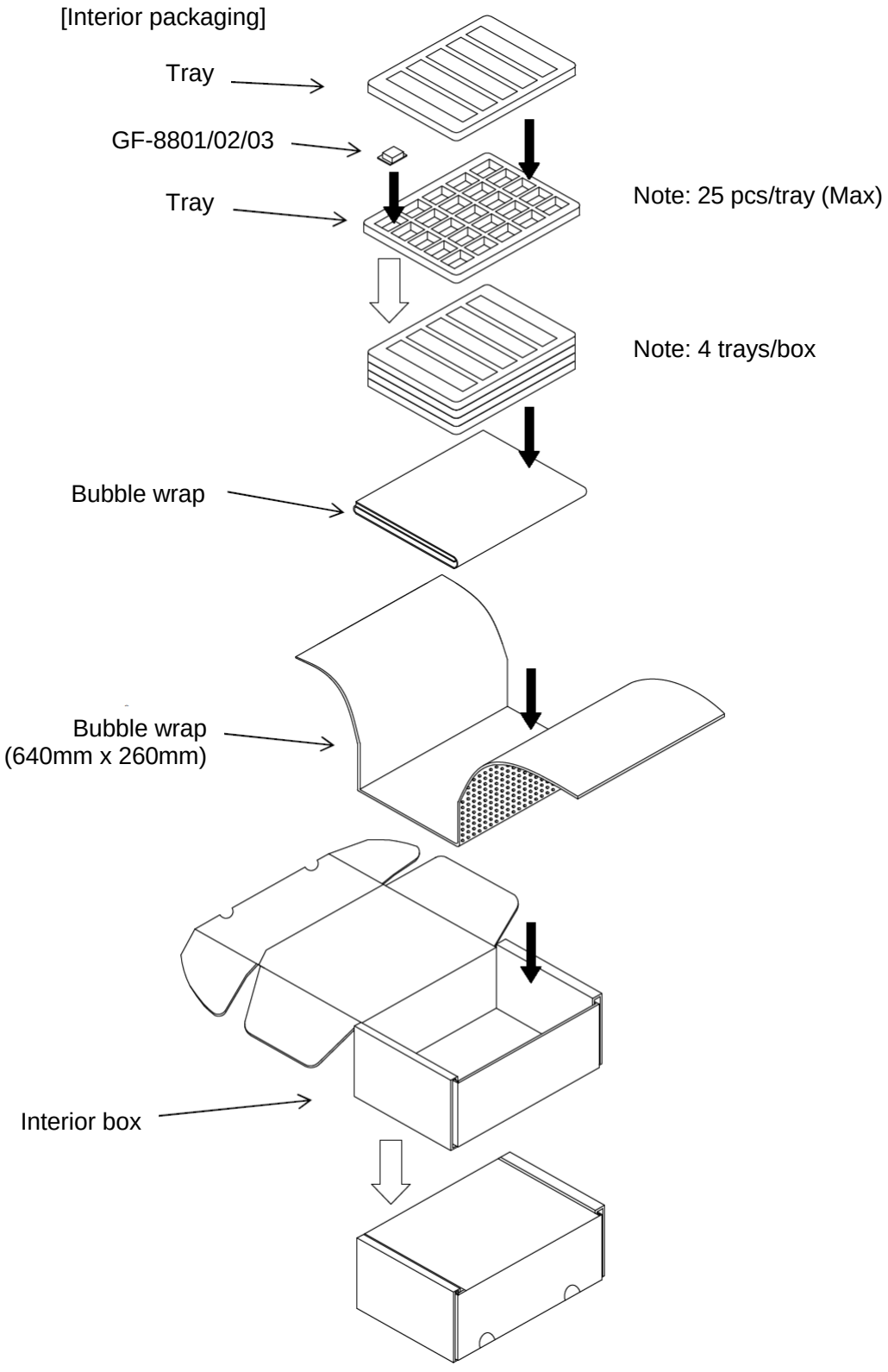
GF-8802 External view



GF-8803 External view

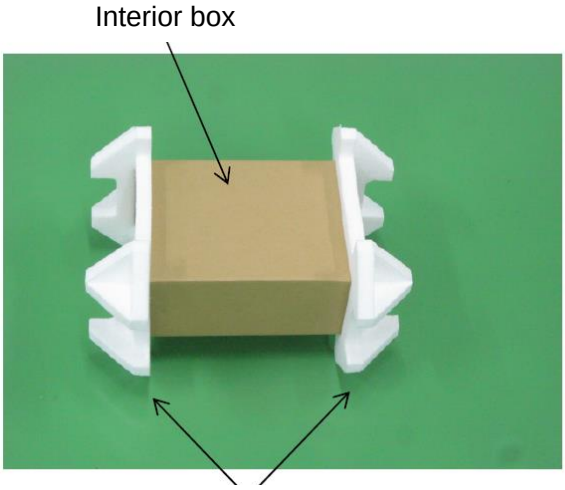
18 Packaging

Below is a description of the packaging. This packaging is applied only when shipping the regular lot number (100 pieces). Regarding the shipment when the number of order is less than the regular lot number, we will contact you separately.



[Exterior packaging]

Attach the cushioning materials to the interior box.



Put the interior box in the exterior box.

Close the cover with sealing tape, and attach the product label.

19 Warranty

The warranty term of this product is one year after the delivery.

20 Special Attention

20.1 Precautions for Use

(1) A GNSS receiver receives very weak signals broadcasted by the GNSS satellites. Using an antenna with band limitations or insufficient pre-amplifier could be disrupted by transmitted power from TV broadcast, mobile phone, MCA or similar transmitting devices causing unstable reception status. Therefore use an antenna equipped with a SAW filter on the pre-amplifier front stage to ensure stable GNSS reception.

(2) Radio waves transmitted by handheld transmitters or transmitting antennas may adversely affect GNSS signal reception by superimposing interfering signal onto the GNSS antenna. When locating the GNSS antenna ensure is not located in the direction of offending transmitting antenna beam.

(3) RF noise may interfere via the GNSS antenna and adversely affect the GNSS signal reception. Avoid using GNSS devices near equipment emitting RF noise.

(4) Considering the information above check tracking status of the GNSS satellites and positioning information. Possibly for an extended period of time (8 to 24 hours) to ensure no multipath signal or other reception issues exist. Also check the overall environment where the GNSS antenna will be located.

(5) Ensure a stable power supply connection.

(6) Install in a stable temperature, wind free environment for the GNSS unit to eliminate errors caused by temperature deviations.

(7) GF-8802 and GF-8803 use an oven-controlled crystal oscillator (OCXO) which controls to maintain the temperature constant. Therefore, since the temperature near the product may exceed 85°C, pay attention to the heat resistance of parts when using.

(8) Lightning may strike the GNSS antenna. This product does not have a lightning protector so we recommend inserting an appropriate arrester between the GNSS antenna and this product.

20.2 Electronic Component

Components in this product are planned to be purchased from multiple manufacturers / vendors according to FURUNO's procurement policy. Therefore, multiple components from multiple manufacturers / vendors may be used even in the same production lot.

20.3 Precautions at Mounting

(1) This product contains semiconductor inside. While handling this, be careful about the static electrical charge (less than 100V). To avoid it, use conductive mat, ground wristband, anti-static shoes, ionizer, etc. as may be necessary.

(2) Avoid mechanical shock and vibration. Do not drop this product.

20.4 Precautions on Industrial Property Rights

(1) Since this document includes our copyrights and know-how, do not use it for any purpose other than the intended use of this product. Do not make any copies of this document and disclose it to any third parties without our prior consent.

(2) Except the use of this product itself, the sale and its disposal, the sale of this product to you does not grant explicitly or implicitly the right of use or implement any Intellectual Property rights or any other rights contained in this product to your company.

20.5 Export Control for Security

(1) Based on the catch-all controls, if an end-user or application is related or suspected to be related to development, manufacturer or usage of mass-destruction weapons, export is prohibited.

(2) If you intend to export this product, contact us beforehand.