

# **Multi-GNSS Disciplined Oscillator**

**Model GF-8804, GF-8805**

## **Hardware Specifications**

(Document No. SE19-410-007-00)



**FURUNO ELECTRIC CO., LTD.**

[www.furuno.com](http://www.furuno.com)

## IMPORTANT NOTICE

No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the express written permission of the publisher, FURUNO ELECTRIC CO., LTD.  
FURUNO ELECTRIC CO., LTD. All rights reserved.

Any information of this documentation shall not be disclosed to any third party without permission of the publisher, FURUNO ELECTRIC CO., LTD.

The following satellite systems are operated and controlled by the authorities of each government.

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

Thus FURUNO is not liable for the degradation of the above systems so therefore FURUNO cannot guarantee specification based on their conditions. By solar flare or coronal mass ejection due to solar surface activity, depending on the scale, there is a possibility that a decrease in reception sensitivity or deterioration in precision may be temporarily observed. User is expected to be familiar with the System and make full use of it with their own responsibility.

Although this product is paying attention to compatibility with the past products, due to the correspondence to various additions of specifications, some actions may differ unavoidably. Regarding the specifications, the contents described in this document are set as true, and for items not described in this document, the actual operations of this product are set as true. For this product, if you need items compatible with past products, please consult us before mass-producing this product.

We pay through attention about the software of this product. But, if perchance you found a bug or a trouble, please feel free to contact us directly. We will check it, and if it is a bug, we may send you a new version with a bug fix. If perchance we found a bug or a trouble, we may send you a new version after we contact you.

When we send you the new version software, we may ask you to update software. Therefore, we strongly recommended being able to access to serial port of this product from outside of your product to make software update easy. In addition, we also strongly recommend connecting between serial port of this product and network to remote access and update software.

In this product, FURUNO can ensure safe performance only the commands and the sentences which are written in this document or are written in the document for this product. Please do not use the commands of the others products, otherwise this product may have troubles and FURUNO may not support about the troubles.

FURUNO may inform some internal commands for verification etc. In this case, please use the commands only for operation test and please do not use them for technical operation.

FURUNO ELECTRIC CO., LTD. reserves the right to make changes to its products and specifications without notice.

---

## Revision History

Version	Change contents	Date
0	Initial release	2019.04.18

## Table of Contents

<b>1</b>	<b>Outline</b> .....	<b>1</b>
<b>2</b>	<b>Function Overview</b> .....	<b>1</b>
<b>3</b>	<b>GNSS General Performance</b> .....	<b>2</b>
<b>4</b>	<b>1PPS and Clock (VCLK, GCLK) Signal Specifications</b> .....	<b>5</b>
4.1	<b>1PPS</b> .....	<b>6</b>
4.2	<b>Clock (VCLK)</b> .....	<b>8</b>
4.3	<b>Clock (GCLK)</b> .....	<b>9</b>
<b>5</b>	<b>Time to FINE LOCK</b> .....	<b>9</b>
<b>6</b>	<b>Phase Relation between PPS and VCLK</b> .....	<b>10</b>
<b>7</b>	<b>Environment Robustness Performance</b> .....	<b>11</b>
<b>8</b>	<b>Operation Restriction</b> .....	<b>11</b>
<b>9</b>	<b>I/O Signal Description</b> .....	<b>12</b>
9.1	<b>I/O Signal Description</b> .....	<b>12</b>
9.2	<b>Pin Arrangement</b> .....	<b>13</b>
9.3	<b>Alarm Signal (ALM_N)</b> .....	<b>13</b>
9.4	<b>Lock Signal (LOCK)</b> .....	<b>14</b>
9.5	<b>PPS Input Signal for External Synchronization (EPPS)</b> .....	<b>14</b>
9.6	<b>Backup Power Supply (VBK)</b> .....	<b>14</b>
<b>10</b>	<b>Electrical Characteristics</b> .....	<b>15</b>
10.1	<b>Absolute Maximum Rating</b> .....	<b>15</b>
10.2	<b>Power Supply</b> .....	<b>16</b>
10.3	<b>Reset</b> .....	<b>17</b>
10.4	<b>Interface Signal</b> .....	<b>17</b>
10.5	<b>Baud Rate and Error</b> .....	<b>18</b>
10.6	<b>UART Wake-up Timing</b> .....	<b>19</b>
10.7	<b>Recommended GNSS Antenna</b> .....	<b>20</b>
10.8	<b>Antenna Amplifier Power</b> .....	<b>20</b>
<b>11</b>	<b>RoHS</b> .....	<b>21</b>
<b>12</b>	<b>Flame Retardancy Rank</b> .....	<b>21</b>
<b>13</b>	<b>FIT</b> .....	<b>21</b>
<b>14</b>	<b>Reliability Test</b> .....	<b>21</b>
<b>15</b>	<b>Equivalent Circuit</b> .....	<b>22</b>
<b>16</b>	<b>Mechanical Specifications</b> .....	<b>22</b>
<b>17</b>	<b>Packaging</b> .....	<b>24</b>
<b>18</b>	<b>Warranty</b> .....	<b>26</b>
<b>19</b>	<b>Special Attention</b> .....	<b>27</b>
19.1	<b>Precautions for Use</b> .....	<b>27</b>
19.2	<b>Electronic Component</b> .....	<b>27</b>
19.3	<b>Precautions at Mounting</b> .....	<b>27</b>
19.4	<b>Precautions on Industrial Property Rights</b> .....	<b>28</b>
19.5	<b>Export Control for Security</b> .....	<b>28</b>

---

## 1 Outline

This document describes the hardware specifications of GF-8804 and GF-8805 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.
- GF-8704, GF-8705, GF-8804 and GF-8805 are pin compatible.<sup>1)</sup>

### Notes:

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

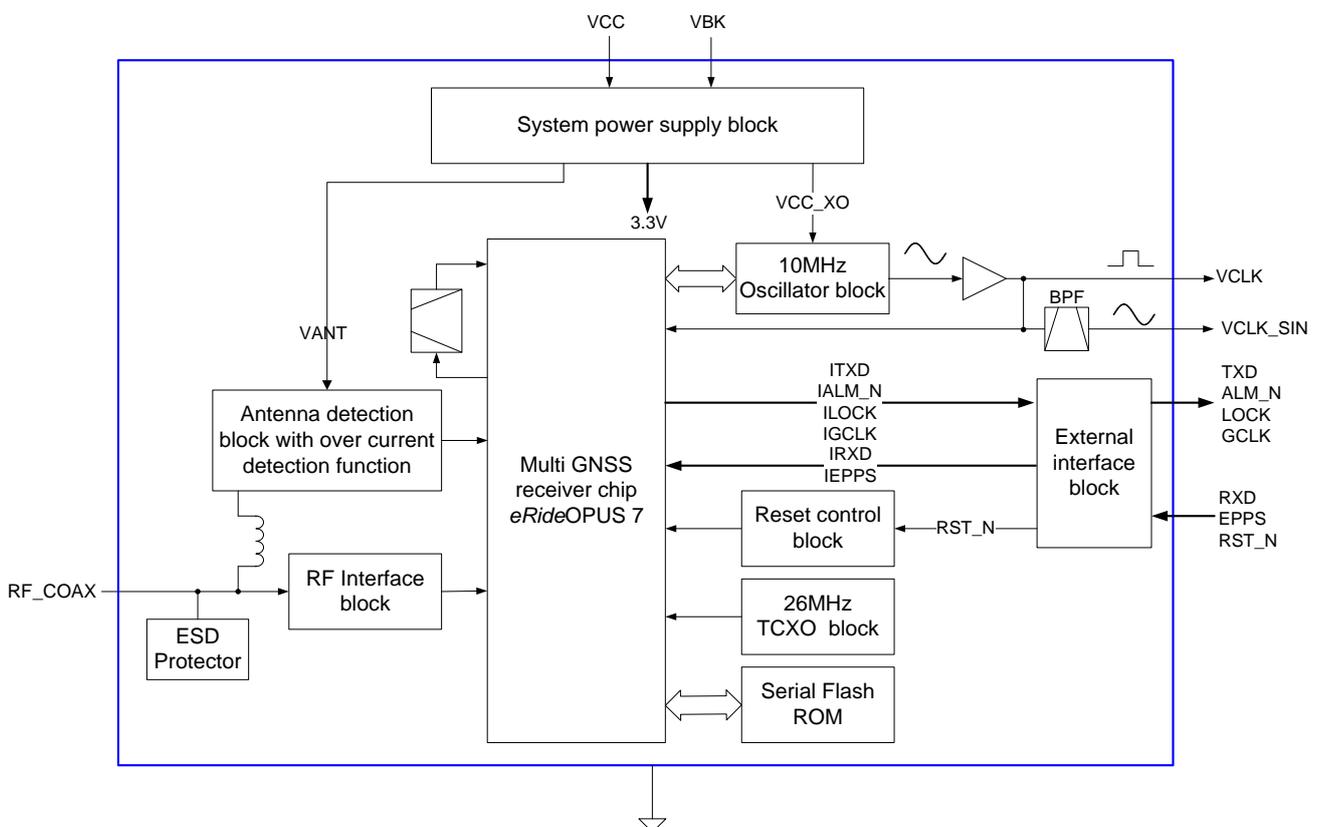
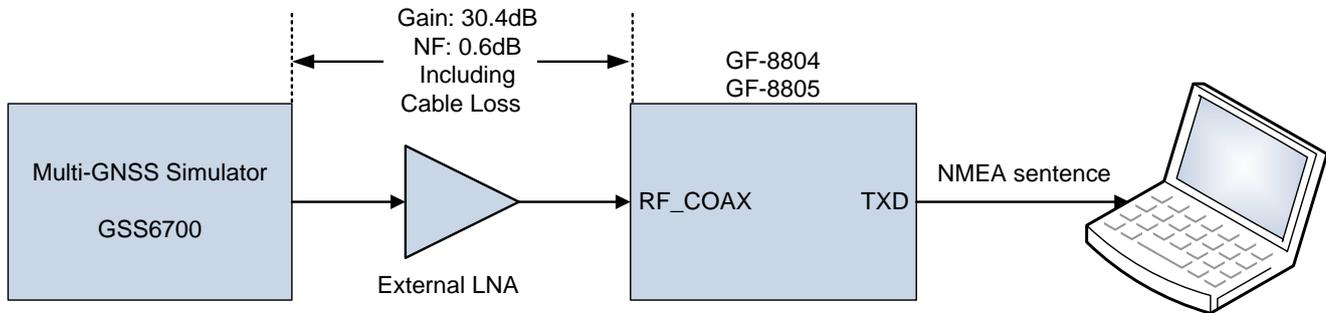


Figure 2-1. GF-8804/8805 block diagram

### 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. TTFF (Time To First Fix)**

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.

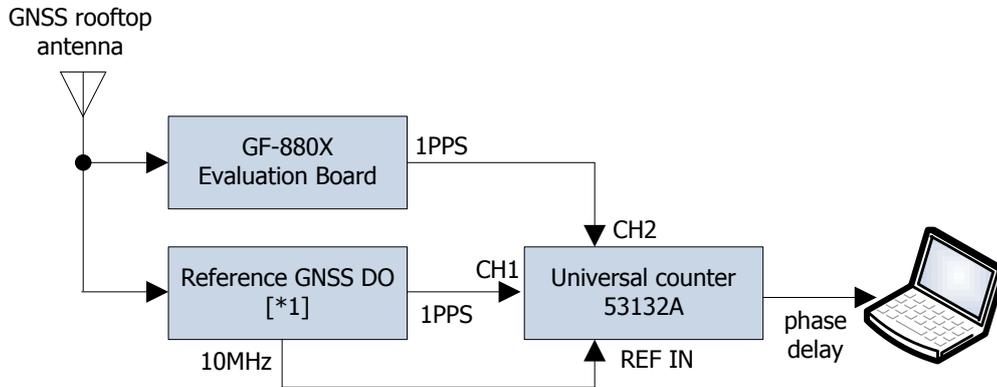
[\*11] Up to 4 satellites can be received simultaneously among 193, 194, 195, 196 and 199.

[\*12] Up to 2 satellites can be received simultaneously among 183, 184, 185, 186 and 189.

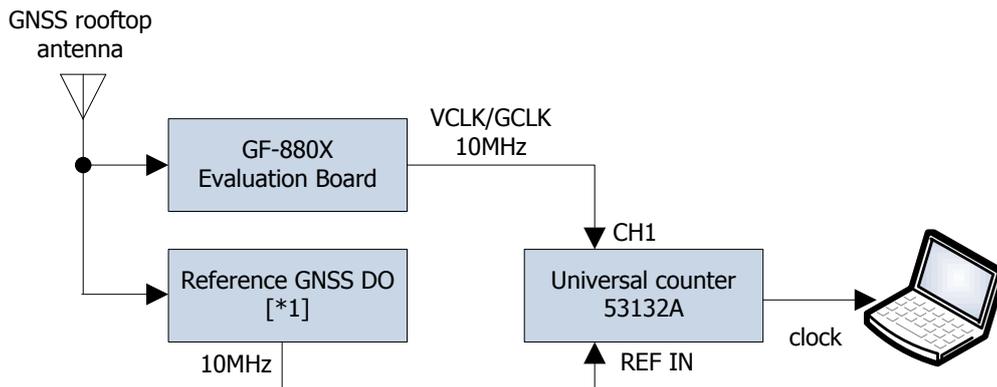
[\*13] WAAS, MSAS, EGNOS and GAGAN are supported.

## 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]
1PPS stability (Time deviation)	G.8272 PRTC-B compliant	@ 1sigma / [*2][*3]
1PPS stability (MTIE)	G.8272 PRTC-B compliant	Relative MIN-MAX value / [*2][*4]

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

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

[\*4] MTIE of G.8272 PRTC-B compliant means that it meets the following specifications.

MTIE limit [nsec]	Observation interval $\tau$ [sec]
$0.275\tau + 25$	$1 < \tau < 55$
40	$55 < \tau$

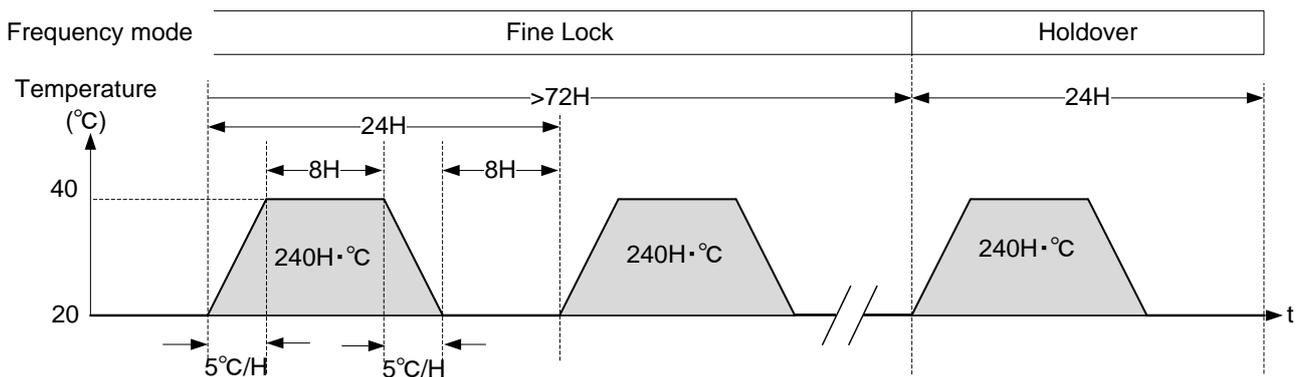
**Table 4.1-3. 1PPS output specifications [HOLDOVER]**

Item		Specification	Note
1PPS accuracy (MAX TEI)	GF-8804	< ± 5.0 usec	@ < 24 hours / [*1][*3]
		< ± 400 nsec (TYP)	@ < 1 hour / [*2][*3]
	GF-8805	< ± 1.5 usec	@ < 24 hours / [*1][*3]
		< ± 400 nsec (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 $\tau=1\text{sec}$ )	GF-8804	$< 1\text{E-}11$	
	GF-8805	$< 1\text{E-}11$	
VCLK_SIN Phase noise	1Hz	$< -90 \text{ dBc/Hz}$	
	10Hz	$< -120 \text{ dBc/Hz}$	
	100Hz	$< -135 \text{ dBc/Hz}$	
	1KHz	$< -145 \text{ dBc/Hz}$	
	>10KHz	$< -145 \text{ dBc/Hz}$	
	10 to 10KHz	$< -95 \text{ dBc}$	Accumulated phase noise

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

Item		Specification	Note
Long term stability (24 hours average)	GF-8804	$< \pm 1\text{E-}12$	
	GF-8805	$< \pm 1\text{E-}12$	

**Table 4.2-3. VCLK output specifications [HOLDOVER]**

Item		Specification	Note
Long term stability (24 hours average)	GF-8804	$< \pm 1\text{E-}10$	@ < 24 hours / [*1]
	GF-8805	$< \pm 3\text{E-}11$	@ < 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  $\pm 20^\circ\text{C}$  in the 72 hours just before Holdover and the Holdover period.
- Temperature gradient is less than  $\pm 5^\circ\text{C}/\text{Hour}$  in the 72 hours just before Holdover and the Holdover period.
- Temperature integrated value is less than  $240 \text{ Hour} * ^\circ\text{C}$  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.

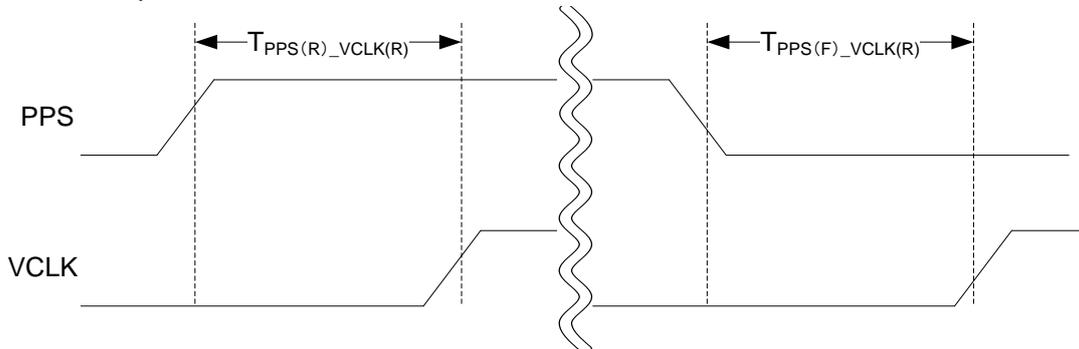
[\*3] It is a mechanism to generate arbitrary frequency by using the system clock of this product and built-in adder. By receiving the GNSS satellite, it is possible to output arbitrary frequency accurately. Since the frequency is generated using the adder, it is recommended to check in advance whether 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.



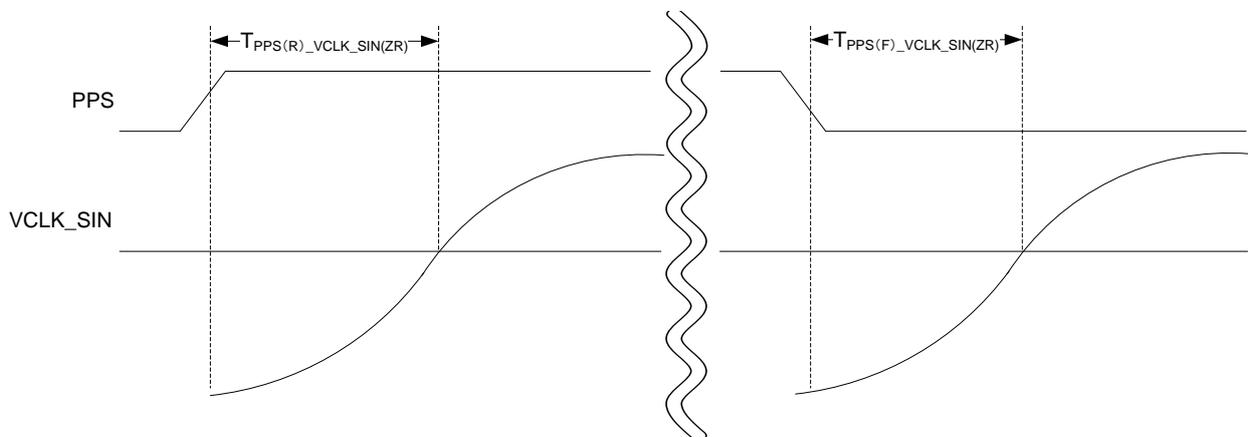
**Figure 6-1. Phase relation between PPS and VCLK**

**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 ns	55 ns	[*1]
$T_{PPS(F)\_VCLK(R)}$	VCLK rising delay time from PPS falling	35 ns	55 ns	[*1]

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

Figure 6-2 shows the phase relation between PPS and VCLK\_SIN. This relation is coherent.



**Figure 6-2. Phase relation between PPS and VCLK\_SIN**

**Table 6-2. Phase relation between PPS and VCLK\_SIN**

Symbol	Description	Min	Max	Note
$T_{PPS(R)\_VCLK\_SIN(ZR)}$	VCLK_SIN zero cross rising delay time after PPS rising	15 ns	35 ns	[*1]
$T_{PPS(F)\_VCLK\_SIN(ZR)}$	VCLK_SIN zero cross rising delay time after PPS falling	15 ns	35 ns	[*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	EPPS	Digital input	PD	External PPS input pin
3	RESERVE	-	-	Do not connect
4	PPS	Digital output	-	PPS output pin
5	GND	-	-	Ground
6	GCLK	Digital output	-	GCLK output pin (10Hz to 40MHz)
7	GND	-	-	Ground
8	LOCK	Digital output	-	Lock signal output pin [*3]
9	GND	-	-	Ground
10	ALM_N	Digital output	-	Alarm signal output pin [*4]
11	RESERVE	-	-	Do not connect
12	TXD	Digital output	-	Serial communication output pin
13	GND	-	-	Ground
14	RXD	Digital input	PU	Serial communication input pin
15	VBK	Power input	-	Backup power supply input pin [*5]
16	VCLK	Digital output	-	VCLK output pin (10MHz, Square wave)
17	VCC	Power input	-	Main power supply input pin
18	GND	-	-	Ground
19	VCC	Power input	-	Main power supply input pin
20	GND	-	-	Ground
-	RF	Analog input	-	GNSS signal input pin [*6]
-	VCLK_SIN	Analog output	-	VCLK output pin (10MHz, Sine wave) [*7]

[\*1] PU: Pull-Up, PD: Pull-Down.

[\*2] Logic L: Reset, Logic H or open: Normal operation

[\*3] Logic L: Unlock, Logic H: Lock. See Section 9.4 for the lock signal output condition.

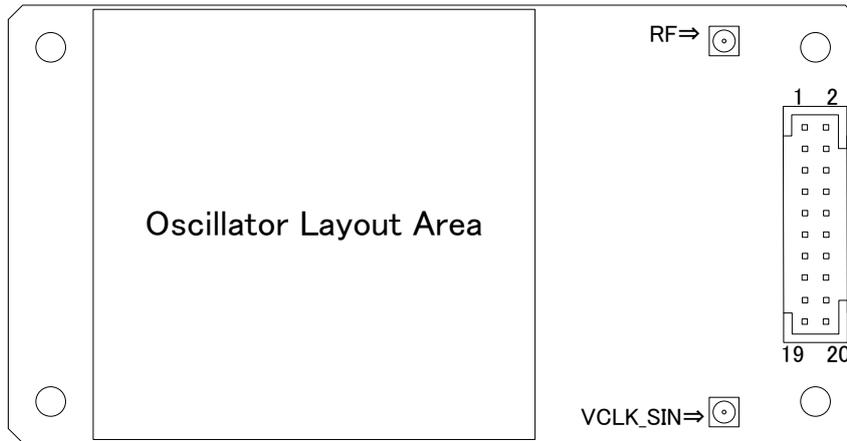
[\*4] Logic L: Abnormal, Logic H: Normal. See Section 9.3 for the alarm output condition.

[\*5] See Chapter 10 for the specifications of backup power supply. In case of not using, do not connect anything.

[\*6] VANT voltage is superimposed and output. MMCX connector / Receptacle / 50Ω.

[\*7] 9dBm (Typ) / 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 pn	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 (BDRAM) 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 BDRAM.

## 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	7.0	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 input power	$P_{RF\_COAX\_ABS}$	-	8	dBm	[*1]
		-	6		[*2]
		-	8		[*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  $T_a = 25\text{ }^\circ\text{C}$ .

**Table 10.2-1. Power supply Characteristics**

Item	Symbol	MIN	TYP	MAX	Unit	Note	
VCC supply voltage	$V_{CC}$	5.2	5.5	5.8	V		
VBK supply voltage	$V_{BK}$	1.4	-	3.6	V	Using VBK	
VCC rising slew rate	$V_{CC\_SR}$	-	-	$5.8 \times 10^4$	V/s	[*1]	
VBK rising slew rate	$V_{BK\_SR}$	3.6	-	$3.6 \times 10^4$	V/s	[*1]	
VCC current consumption (at inrush)	GF-8804	$I_{CC\_RC04}$	-	-	1200	mA	[*2]
	GF-8805	$I_{CC\_RC05}$	-	-	1200		[*2]
VCC current consumption (at start-up)	GF-8804	$I_{CC\_WU04}$	-	-	1000	mA	[*3]
	GF-8805	$I_{CC\_WU05}$	-	-	1000		[*3]
VCC current consumption (at stable state)	GF-8804	$I_{CC\_ST04}$	-	400	-	mA	[*4]
	GF-8805	$I_{CC\_ST05}$	-	400	-		[*4]
VBK current consumption (at back up)	$I_{BKN}$	-	9	20	$\mu\text{A}$	[*5]	
VBK current consumption (at normal operation)	$I_{BKB}$	-	0.4	2	$\mu\text{A}$	[*6]	

[\*1] See Figure 10.2-1 for the rising slew rate.

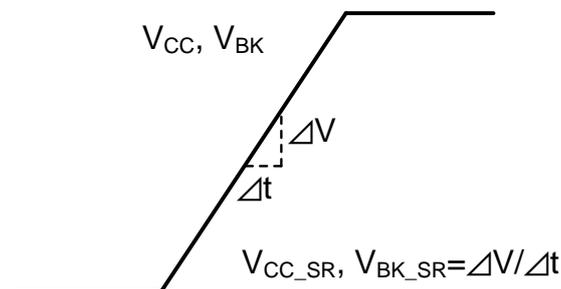
[\*2] Within 10 seconds from power-on.

[\*3] Within 5 minutes after 10 seconds from power-on. Antenna pre-amplifier output current ( $I_{APO}$ ) excluded.

[\*4] After 5 minutes from power-on. Antenna pre-amplifier output current ( $I_{APO}$ ) excluded.

[\*5]  $V_{CC} = 0\text{ V}$

[\*6]  $V_{CC} = 5.5\text{ V}$



**Figure 10.2-1. Rising slew rate**

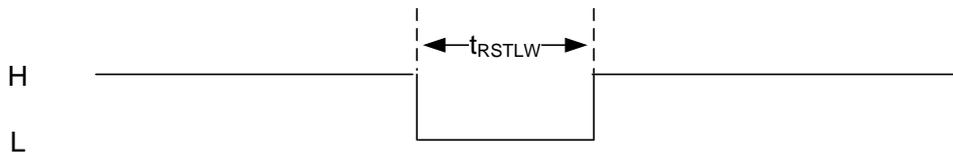
### 10.3 Reset

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 <sub>RTH_POR</sub>	-	-	3.3	V	
Power on reset threshold voltage (falling)	V <sub>FTH_POR</sub>	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 <sub>RSTLW</sub>	300	-	msec	

### 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 <sub>IL</sub>	-	-	0.8	V	
High-Level input voltage	V <sub>IH</sub>	2.0	3.3	5.5	V	
Low-Level output voltage	V <sub>OL</sub>	-	-	0.4	V	I <sub>OL</sub> = 16mA
High-Level output voltage	V <sub>OH</sub>	2.4	3.3	3.6	V	I <sub>OH</sub> = -18mA
Digital input pull-up resistor	R <sub>PU</sub>	9.5	10	10.5	kΩ	
Digital input pull-down resistor	R <sub>PD</sub>	9.5	10	10.5	kΩ	
Digital input pull-up voltage	V <sub>PU</sub>	-	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.

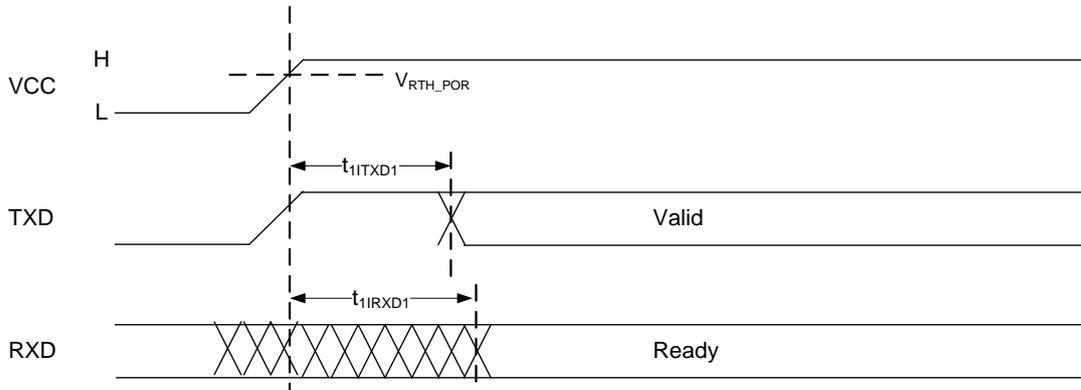
**Table 10.5-2. Baud rate and tolerance error**

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).



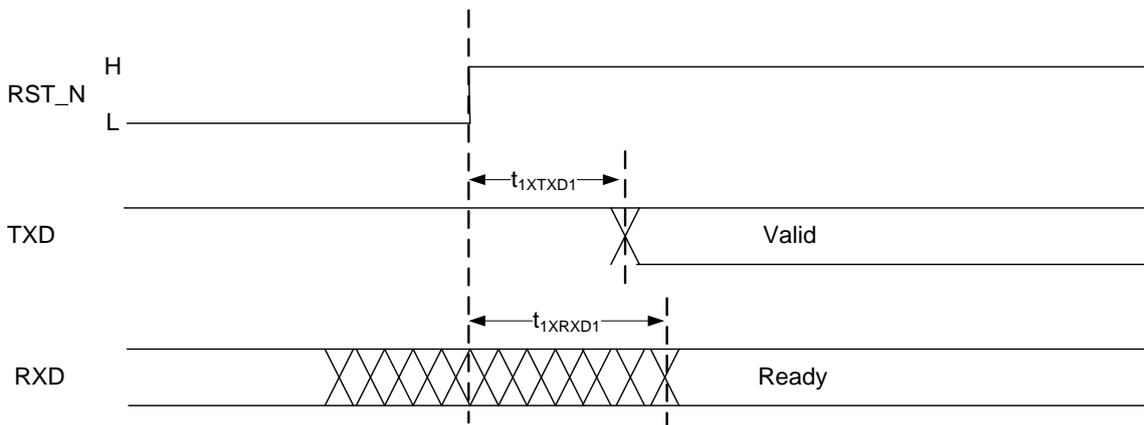
**Figure 10.6-1. UART wake-up timing after  $V_{RTH\_POR}$**

**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	-	$\Omega$	
VSWR	-	-	2	-	

## 10.8 Antenna Amplifier Power

The power for antenna pre-amplifier is superimposed (biased) from the RF connector. The power supply is ON by default and it is able to be stopped the power supply with the command.

GNSSDO 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	$V_{APO}$	4.5	-	5.35	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 for 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-8804 --- 3210FIT

GF-8805 --- 3210FIT

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, $T_A=85^{\circ}\text{C}$ , RH=85%
2	High temperature high humidity storage life	1000 hours, $T_A=85^{\circ}\text{C}$ , RH=85%
3	Low temperature operating life	500 hours, $T_A=-40^{\circ}\text{C}$
4	Low temperature storage life	500 hours, $T_A=-40^{\circ}\text{C}$
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 <sup>2</sup> ), 30 minutes (Not operating)
7	ESD test	JIS C 61000-4-2 Contact

## 15 Equivalent Circuit

Table 15.1 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	

## 16 Mechanical Specifications

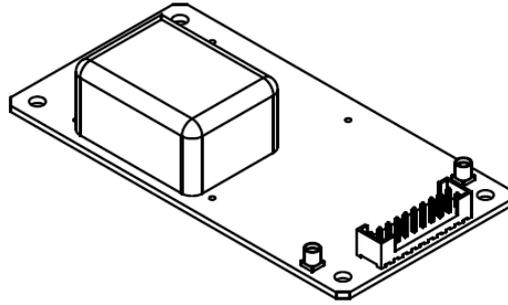
The mechanical specifications are shown on the next page. The notes are as follows.

**Notes:**

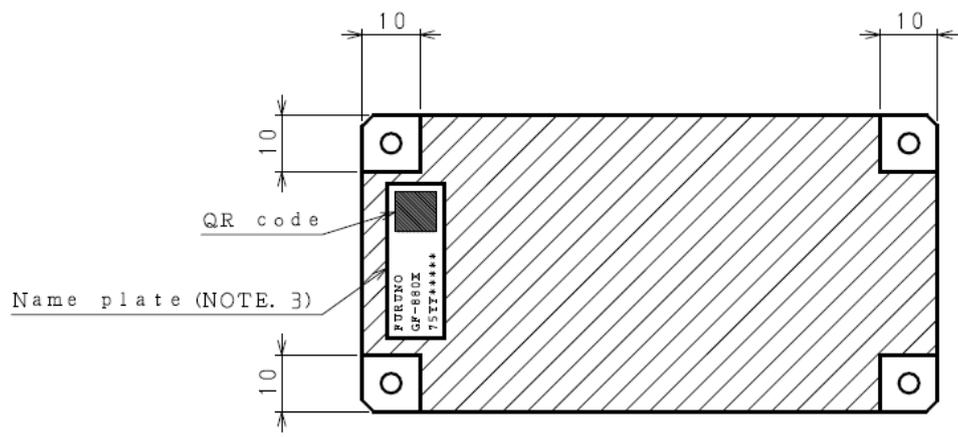
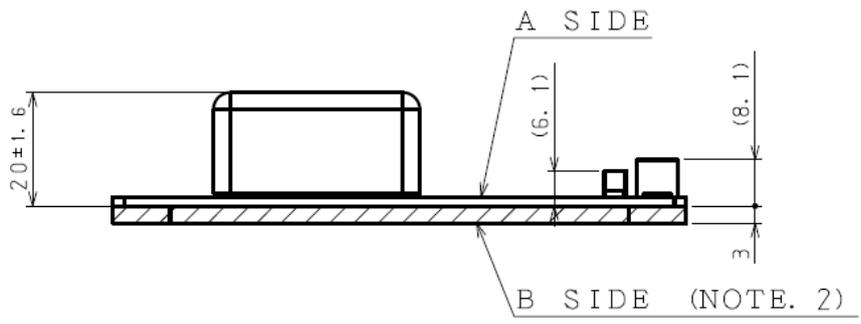
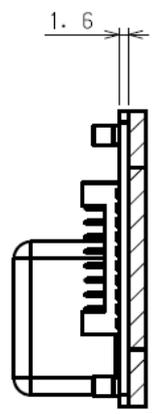
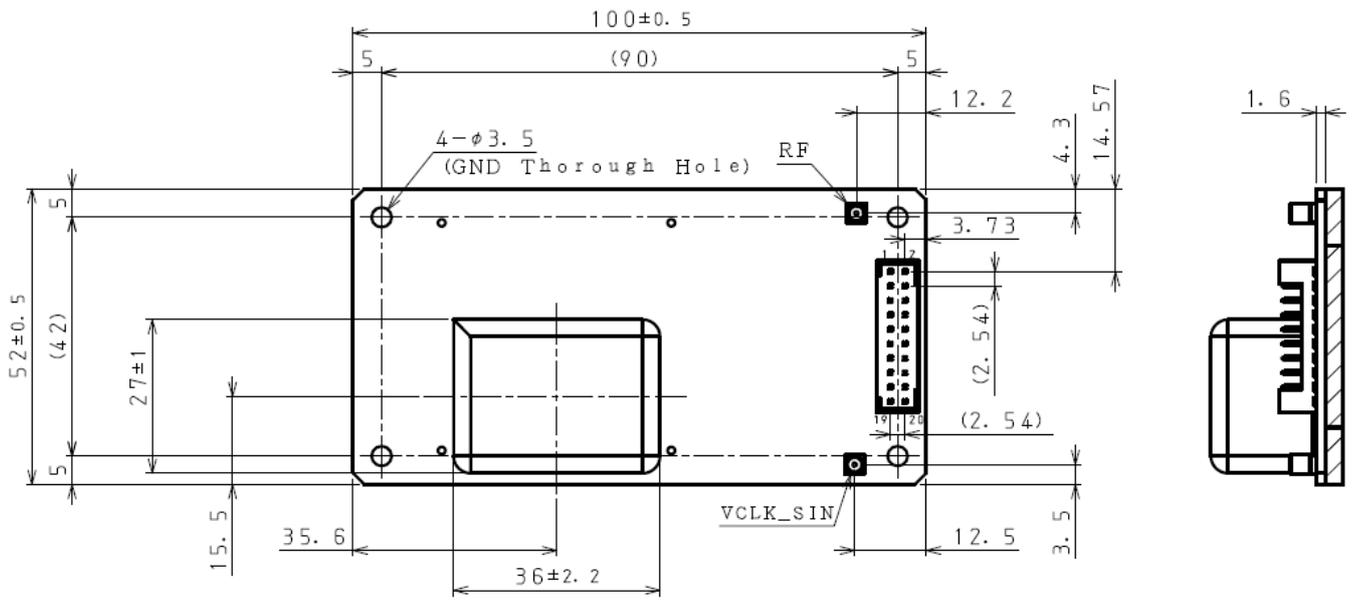
1. Dimensional tolerance is  $\pm 0.2\text{mm}$  unless otherwise stated.
2. Some parts are mounted on the hatching area of the B side.
3. Products label specifications.

Product	GF-8804	GF-8805
Products number code (X)	4	5
Products unique code (YY)	20	21

4. "\*\*\*\*\*" represents serial number.
5. Interface connector product number: PS-20PLB-D4T1-FL1E (JAE)
6. RF and VCLK\_SIN connector product number: MMCX1-4024 (CONNEKT)



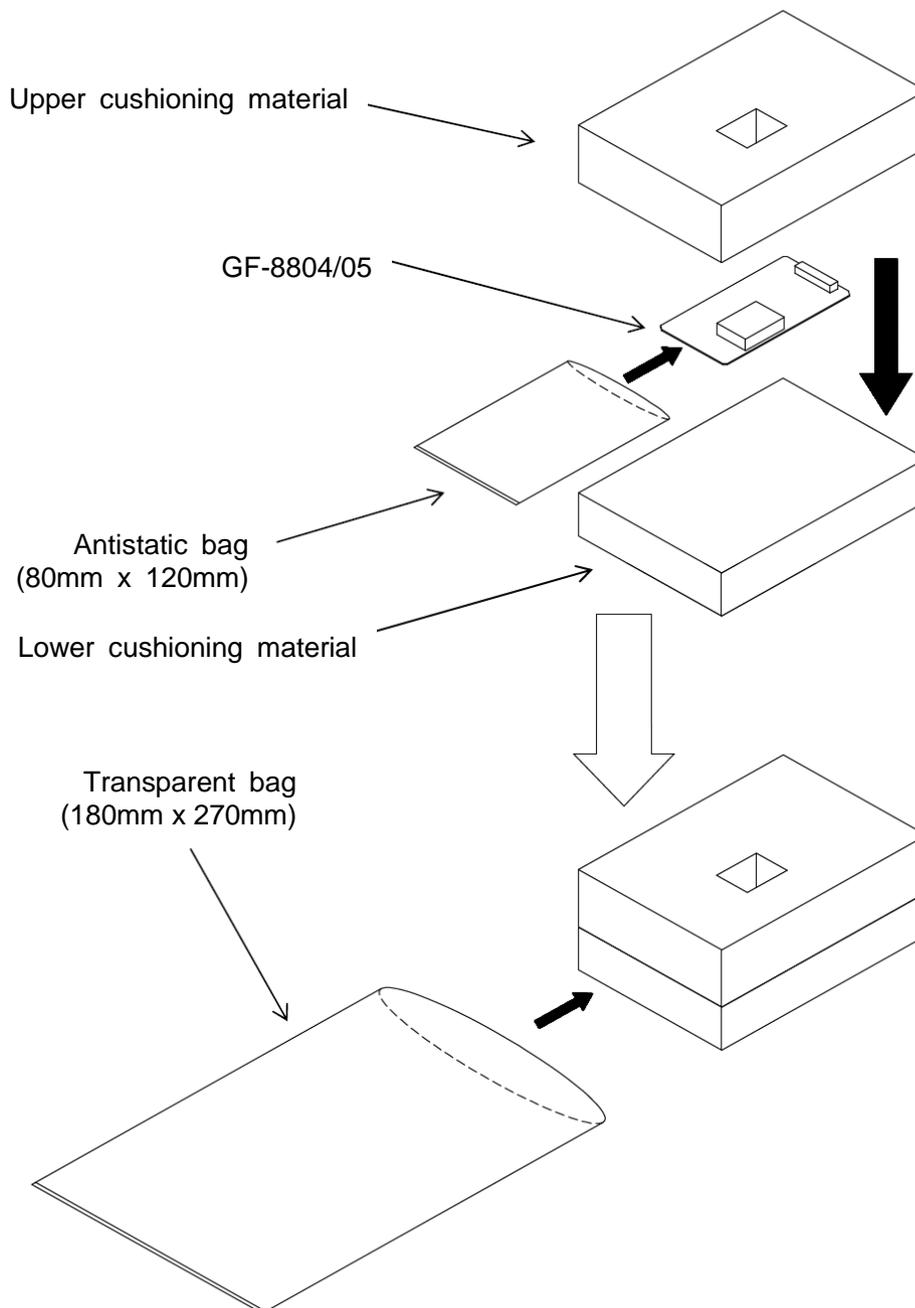
GF-8804/8805 External view



## 17 Packaging

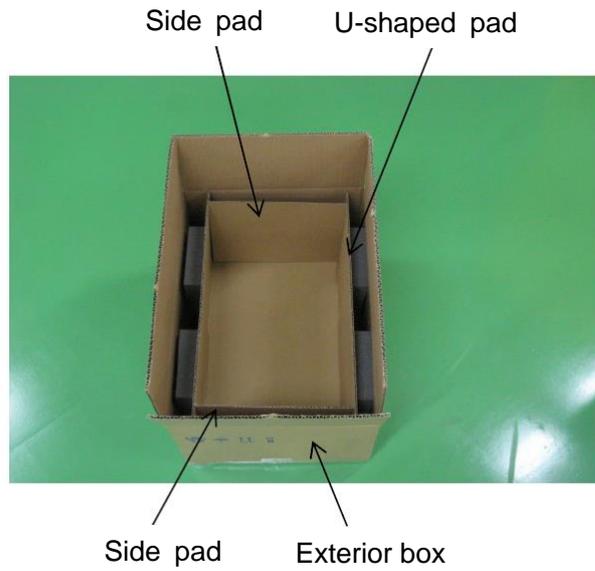
Below is a description of the packaging. This packaging is applied only when shipping the regular lot number (10 pieces). Regarding the shipment when the number of order is less than the regular lot number, we will contact you separately.

[Interior packaging]



[Exterior packaging]

Prepare the exterior box.



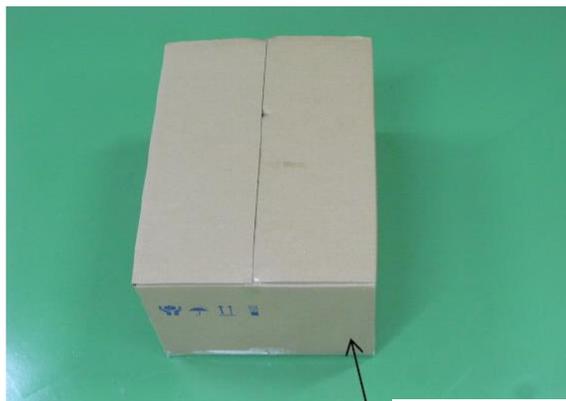
Put the products in the exterior box.



Put the upper pad on the products.



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



Product label

品名	周波数発生器
型式	GF-88
数量	<input type="text"/>
兵庫県西宮市西宮浜2丁目20番	
古野電気株式会社	
MADE IN JAPAN	

## 18 Warranty

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

## 19 Special Attention

### 19.1 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.

### 19.2 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.

### 19.3 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.

**19.4 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.

**19.5 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.