

FURUNO Multi-GNSS Disciplined Oscillator

GF-870x Series Evaluation Kit

Models **VF-01, VF-02, VF-03,
VF-04, VF-05**

User's Guide

(Document No. SE17-900-003-02)



FURUNO ELECTRIC CO., LTD.

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- GLONASS (Russia)
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- SBAS(USA: WAAS, Europe: EGNOS, Japan: MSAS)

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Revision History

| Version | Changed contents | Date |
|---------|--------------------------------|------------|
| 0 | Initial release | 2017.02.09 |
| 1 | Error correction in Table 6.3. | 2017.11.02 |
| 2 | Error correction in Table 5.2 | 2019.05.24 |

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1 Outline

This documents describe the operation guides one of which is for the GF-8701/02/03 receivers and the other for the GF-8704/05 receivers.

- VF-01/02/03: GF-8701/02/03 evaluation platform
- VF-04/05: GF-8704/05 evaluation platform

2 Component List

- a. Evaluation platform
- b. AU-18: GNSS Antenna
- c. Conversion cable
- d. USB cable
- e. CD-ROM
 - GNSS Conductor GF monitoring software
 - GNSS Conductor GF User's Guide
 - GF-870x series Hardware Specifications
 - GF-870x series Protocol Specifications
 - This document

3 Overview of Evaluation Platform

Figure 3.1 shows an overview of VF-01/02/03.

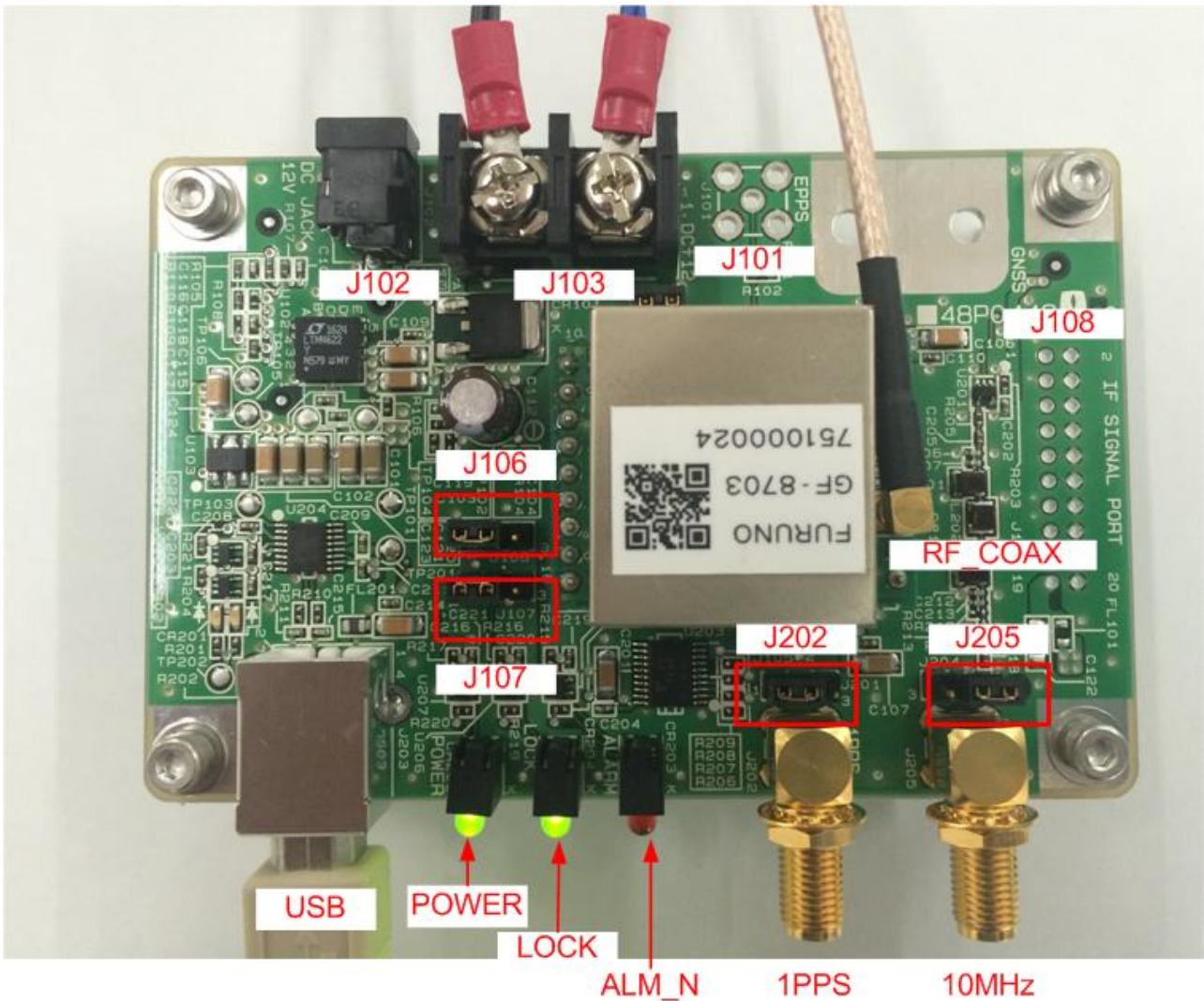


Figure 3.1 Overview of VF-01/02/03

Figure 3.2 and Figure 3.3 show overviews of VF-04/05.

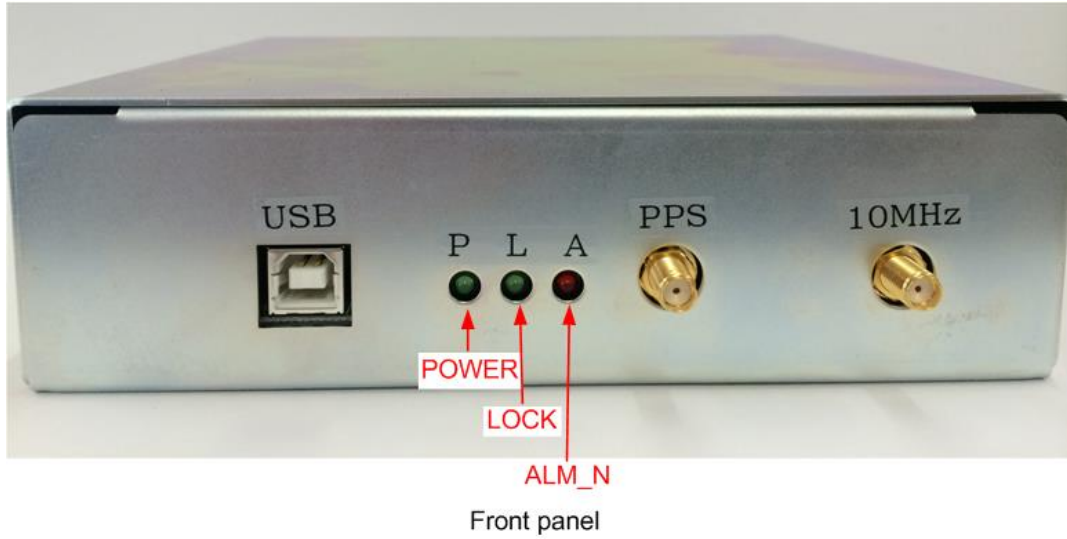


Figure 3.2 Outside Overview of VF-04/05

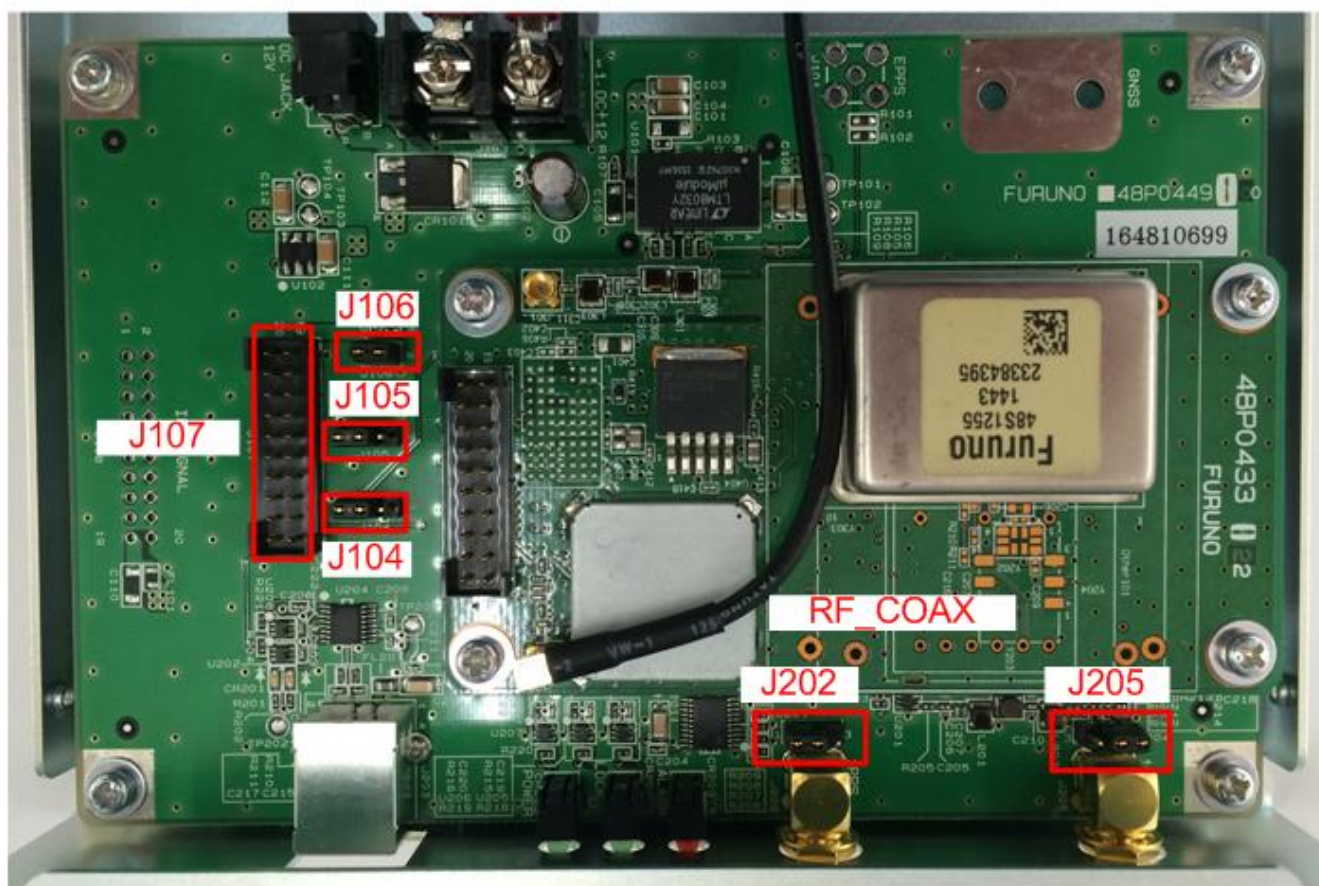


Figure 3.3 Inside Overview of VF-04/05

4 General Connection Diagram

Figure 4.1 shows a general connection diagram of VF-01/02/03.

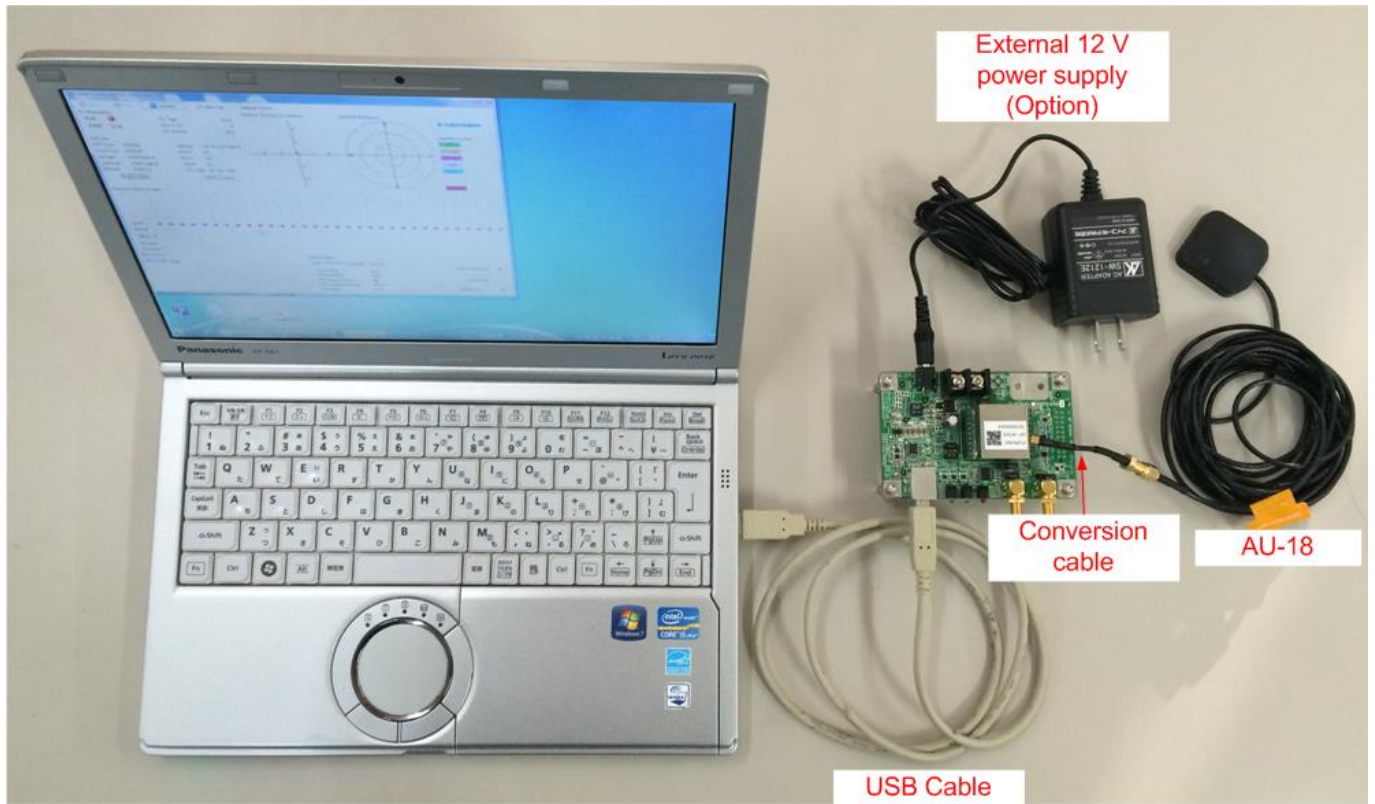


Figure 4.1 Overview of General Connection Diagram of GF-870x Series Evaluation Platform

5 I/O Signal Description

Table 5.1 and Table 5.2 show the I/O signal description of GF-870x series evaluation platform.

Table 5.1 I/O Signal Description of VF-01/02/03

| Signal name | Connector # | Pin# | Connector | Jumper configuration | Default | I/O | Description |
|-------------|-------------------------|----------|---------------------------------------|----------------------|---------|--|---|
| VCC12 | J102 | P | EIAJ RC5320A TYPE4 | - | - | I | DC 12V |
| | J103 | 1 | BP101-2PN10 | | | I | |
| EPPS | J101 | 1 | Not implemented | J107 2-1 | ● | I | External PPS input with 50Ω termination |
| | | 17 | Pin Number: 1-20 Pin Pitch: 2.54mm | J107 2-3 | - | I | External PPS input with CMOS 3.3V level |
| GF_RST_N | 1 | - | | - | I | External reset signal | |
| GF_VCLK | 3 | - | | - | O | Rectangular waveform 10MHz | |
| GF_RXD | 5 | J106 2-1 | | ● | I | USB | |
| | | J106 2-3 | | | I | | |
| GF_TXD | 7 | - | | - | O | UART TX | |
| GF_ALM_N | 9 | - | | - | O | Alarm status H: Normal L: Failed | |
| GF_LOCK | 11 | - | | - | O | Lock status H: Lock L: Unlock | |
| GF_GLK | 13 | - | | - | O | Programmable clock output signal Frequency range is from 4kHz to 40MHz. | |
| GF_PPS | 15 | - | | - | O | PPS output signal | |
| GND | 2,4,8,10,12,14,16,18-20 | - | - | - | - | Signal ground | |
| 10MHz | J205 | 1 | SMA | J204 2-1 | ● | O | 50Ω sine wave |
| | | | | J204 2-3 | - | O | CMOS 3.3V rectangular wave |
| PPS | J202 | 1 | SMA | J201 2-1 | ● | O | 3.3V PPS at 50Ω termination |
| | | | | J201 2-3 | - | O | CMOS 3.3V PPS |

Table 5.2 I/O Signal Description of VF-04/05

| Signal name | Connector # | Pin# | Connector | Jumper configuration | Default | I/O | Description |
|----------------|--------------------|----------|---|----------------------|---------|--|---|
| VCC12 | J103 | 1 | BP101-2PN10 | - | - | I | DC 12V |
| EPPS | J101 | 1 | Not implemented | J104 2-1 | ● | I | External PPS input with 50Ω termination |
| | J107 ¹⁾ | 2 | Pin Number: 1-20 Pin Pitch: 2.54mm | J104 2-3 | - | I | External PPS input with CMOS 3.3V level |
| 1 | | - | | - | I | External reset signal | |
| 16 | | - | | - | O | Rectangular waveform 10MHz | |
| 14 | | J105 2-1 | | ● | I | USB | |
| 12 | | J105 2-3 | | - | I | CMOS 3.3V RX | |
| 10 | | - | | - | O | Alarm status H: Normal L: Failed | |
| 8 | | - | | - | O | Lock status H: Lock L: Unlock | |
| 6 | | - | | - | O | Programmable clock output signal Frequency range is from 4kHz to 40MHz. | |
| 4 | | - | | - | O | PPS output signal | |
| 5,7,9,13,18,20 | | - | | - | - | - | Signal ground |
| 10MHz | J205 | 1 | SMA | J204 2-1 | ● | O | 50Ω sine wave |
| | | | | J204 2-3 | - | O | CMOS 3.3V rectangular wave |
| PPS | J202 | 1 | SMA | J201 2-1 | ● | O | 3.3V PPS at 50Ω termination |
| | | | | J201 2-3 | - | O | CMOS 3.3V PPS |

Notes:

1) J107 is connected to J108 in GF-8704 or 8705.

6 Electrical Specifications

6.1 Absolute Maximum Rating

Table 6.1 shows the absolute maximum rating of GF-870x series evaluation platform.

Table 6.1 Absolute Maximum Rating

| Items | Symbol | Min. | Max. | Unit | Notes |
|-----------------------------|-------------------|------|------|------|-------------------------------|
| 12V Supply voltage | V_{CC_ABS} | -0.3 | 22 | V | |
| Digital input (DI) voltage | V_{DI_ABS} | -0.5 | 6.5 | V | |
| Digital output (DO) voltage | V_{DO_ABS1} | -0.5 | 6.5 | V | Condition: VCC=0 |
| | V_{DO_ABS2} | -0.5 | 3.8 | V | Condition: VCC=normal voltage |
| Digital output (DO) current | I_{DO_ABS} | - | ±50 | mA | |
| VCC_RF output current | $I_{CC_RF_ABS}$ | - | 75 | mA | |
| RF_IN input power | P_{RFIN_ABS} | - | -5 | dBm | at 1575.42MHz & 1602MHz |
| | | - | 0 | dBm | at 900MHz |
| | | - | -1 | dBm | at 1800MHz |

6.2 Power Supply

Table 6.2 shows the power supply range of VCC as main voltage at GF-870x series evaluation platform.

Table 6.2 Power Supply Range of VCC

$T_A=25^\circ\text{C}$, unless otherwise stated

| Items | Condition | Symbol | Min. | Typ. | Max. | Unit | Notes |
|------------------------------|-----------------------------------|--------------|------|------|------|------|-------------|
| Supply voltage to VCC | - | V_{CC} | 10.5 | 12 | 13.5 | V | |
| VCC current consumption | GF-8701 | I_{CCAL01} | - | - | 100 | mA | VF-01/02/03 |
| | GF-8702 | I_{CCAL02} | - | - | 500 | mA | |
| | GF-8703 | I_{CCAL03} | - | - | 800 | mA | |
| | GF-8704 | I_{CCAL04} | - | - | 850 | mA | VF-04/05 |
| | GF-8705 | I_{CCAL05} | - | - | 850 | mA | |
| Antenna power supply voltage | $I_{ANT}=75\text{mA}(\text{Max})$ | V_{ANT} | 4.5 | 5 | - | V | |

6.3 DC Characteristics

Table 6.3 shows the DC characteristics of digital I/O port at GF-870x series evaluation platform.

Table 6.3 DC Characteristics of Digital I/O Port

| Items | Condition | Symbol | Min. | Typ. | Max. | Unit | Notes |
|--------------------------------|-----------------------------------|----------|------|------|------|------|----------|
| Low level input voltage | - | V_{IL} | - | - | 0.8 | V | |
| High level input voltage | - | V_{IH} | 2.0 | 3.3 | 5.5 | V | |
| 1PPS Low level output voltage | $I_{OL}=16\text{mA}(\text{Max})$ | V_{OL} | - | - | 0.4 | V | J201 2-3 |
| VCLK Low level output voltage | $I_{OL}=16\text{mA}(\text{Max})$ | V_{OL} | - | - | 0.4 | V | J204 2-3 |
| 1PPS High level output voltage | $I_{OH}=-18\text{mA}(\text{Max})$ | V_{OH} | 2.4 | 3.3 | 3.6 | V | J201 2-3 |
| VCLK High level output voltage | $I_{OH}=-18\text{mA}(\text{Max})$ | V_{OH} | 2.4 | 3.3 | 3.6 | V | J204 2-3 |
| Input pull-down resistance | - | R_{PD} | - | 10 | - | kΩ | |
| Input pull-up resistance | - | R_{PU} | - | 10 | - | kΩ | |
| Input pull-up voltage | - | V_{PU} | - | 3.3 | - | V | |

7 Environmental Specifications

Table 7.1 shows the environmental specifications of GF-870x series evaluation platform.

Table 7.1 Environmental Specifications

| Items | Specifications | unit | Notes |
|-----------------------|-----------------------|-------------|---|
| Operating Temperature | 0 to +45 | °C | |
| Storage temperature | -40 to +85 | °C | |
| Operation humidity | 85 (MAX) | %R.H | T _A = 60 °C, No condensation |

8 RF Specifications (RF_COAX)

8.1 Recommended Antenna Specifications

Please refer to “6.6.1 Recommended Antenna” at Hardware Specifications of GF-8701/02/03 and GF-8704/05.

8.2 Antenna Amplifier Power

Please refer to “6.6.2 Antenna Amplifier Power” at Hardware Specifications of GF-8701/02/03 and GF-8704/05.

9 Receiver Status Signal Specifications

9.1 Alarm Signal (ALM_N)

Table 9.1 shows the relation between the alarm status and the configuration of LED. The user can check the alarm field in CRZ(TPS4)²⁾ sentence with this table.

Table 9.1 Relation between Alarm Status and Configuration of LED

| Status of alarm field at CRZ(TPS4) | ALM_N | Red LED | Description |
|------------------------------------|---------|-----------|-------------|
| 00 | Logic H | Light-out | Normal |
| Except 00 | Logic L | Lighting | Abnormal |

Notes:

2) Please refer to “7.3.4 CRZ (TPS4) - Output Time Transfer Info per Second (Frequency)” at Protocol Specifications of GF-8701/02/03 and GF-8704/05.

9.2 Lock Signal (LOCK)

Table 9.2 shows the relation between the lock status and the configuration of LED. The user can check the frequency mode field in CRZ(TPS4)³⁾ sentence with this table. The user can set the output condition of LOCK signal with the Lock port set field in MODESET command.

Table 9.2 Relation between Lock Status and Configuration of LED

| MODESET lock port set | Status of frequency mode field at CRZ(TPS4) | LOCK | LED |
|-----------------------|---|---------|-----------|
| 0 | 2,3,4 | Logic H | Lighting |
| | Except the above mode | Logic L | Light-out |
| 1 (default) | 2,3 | Logic H | Lighting |
| | Except the above mode | Logic L | Light-out |
| 2 | 3 | Logic H | Lighting |
| | Except the above mode | Logic L | Light-out |
| 3 | 3,4 | Logic H | Lighting |
| | Except the above mode | Logic L | Light-out |

Notes:

3) Please refer to “7.3.4 CRZ (TPS4) - Output Time Transfer Info per Second (Frequency)” at Protocol Specifications of GF-8701/02/03 and GF-8704/05.

10 Restriction of Power ON/OFF Sequence between VCC12 and USB

Please keep the following power on/off sequence specifications between VCC12 and USB power.

In case the user does not follow the below specification, the PC may not be able to read correct identification from USB interface device in evaluation kit. This is due to the fact that the identification data in memory of the USB interface device is erased which is caused by unstable power supply voltage.

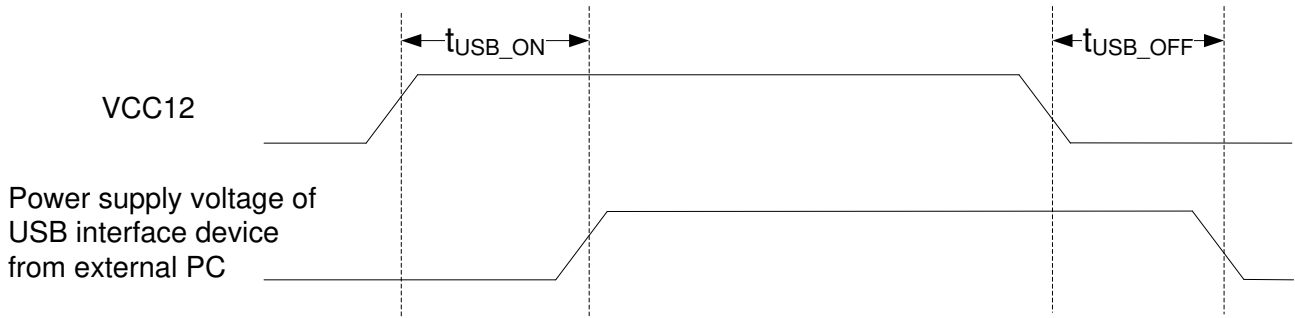


Figure 10.1 Power On/Off Sequence Specifications between VCC12 and USB Power

Table 10.1 Specifications of t_{USB_OFF} and t_{USB_ON}

| Items | Symbol | Min. | Max. | Unit |
|---|----------------|------|------|------|
| Necessary low level time of USB power after VCC12 is high level | t_{USB_OFF} | 0 | - | sec |
| Necessary high level time of USB power after VCC12 is low level | t_{USB_ON} | 2 | - | sec |

11 Monitoring Software

11.1 Installation

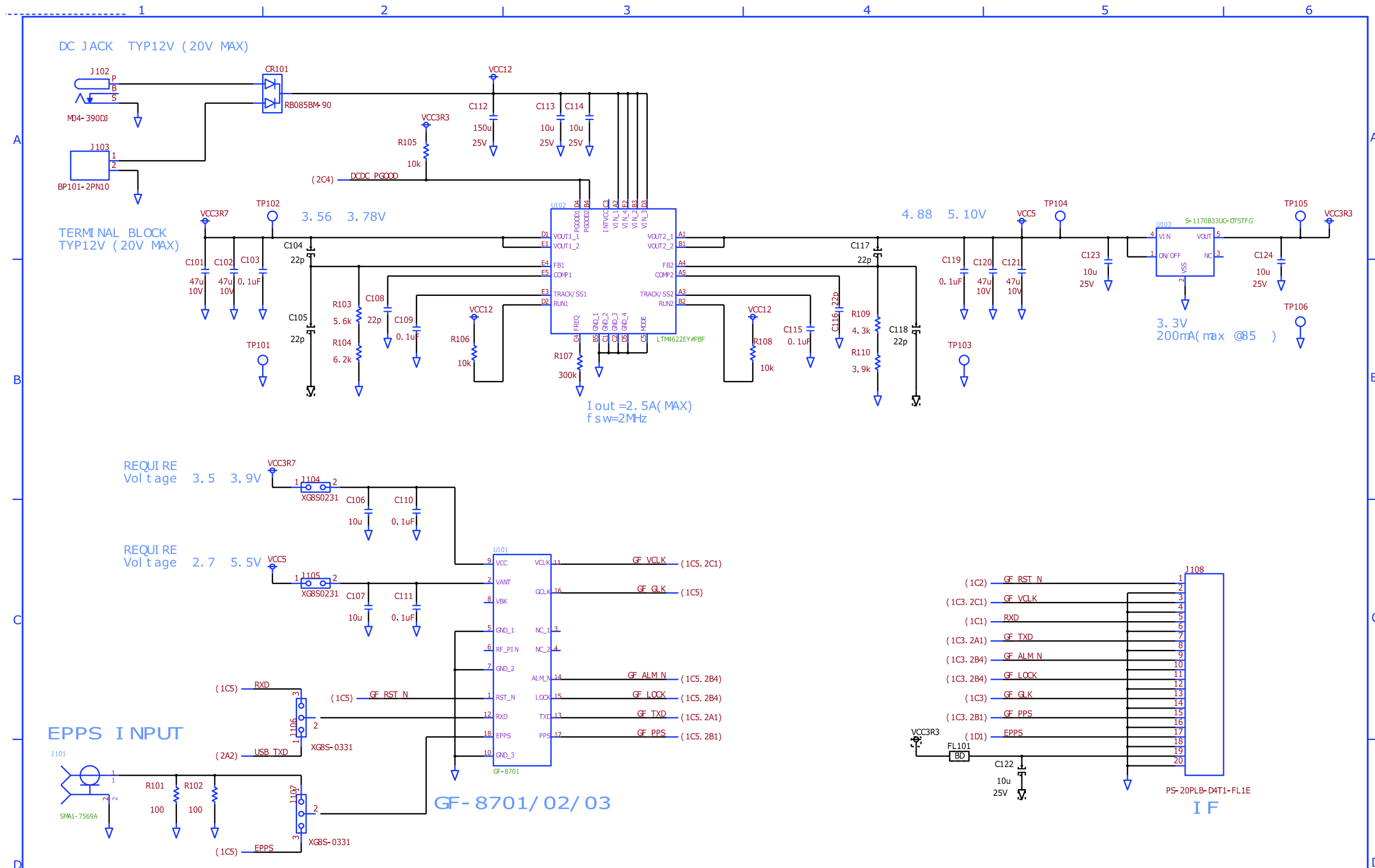
Please refer to “GNSS Conductor GF User’s Guide (SE16-900-008)”.

11.2 Operation

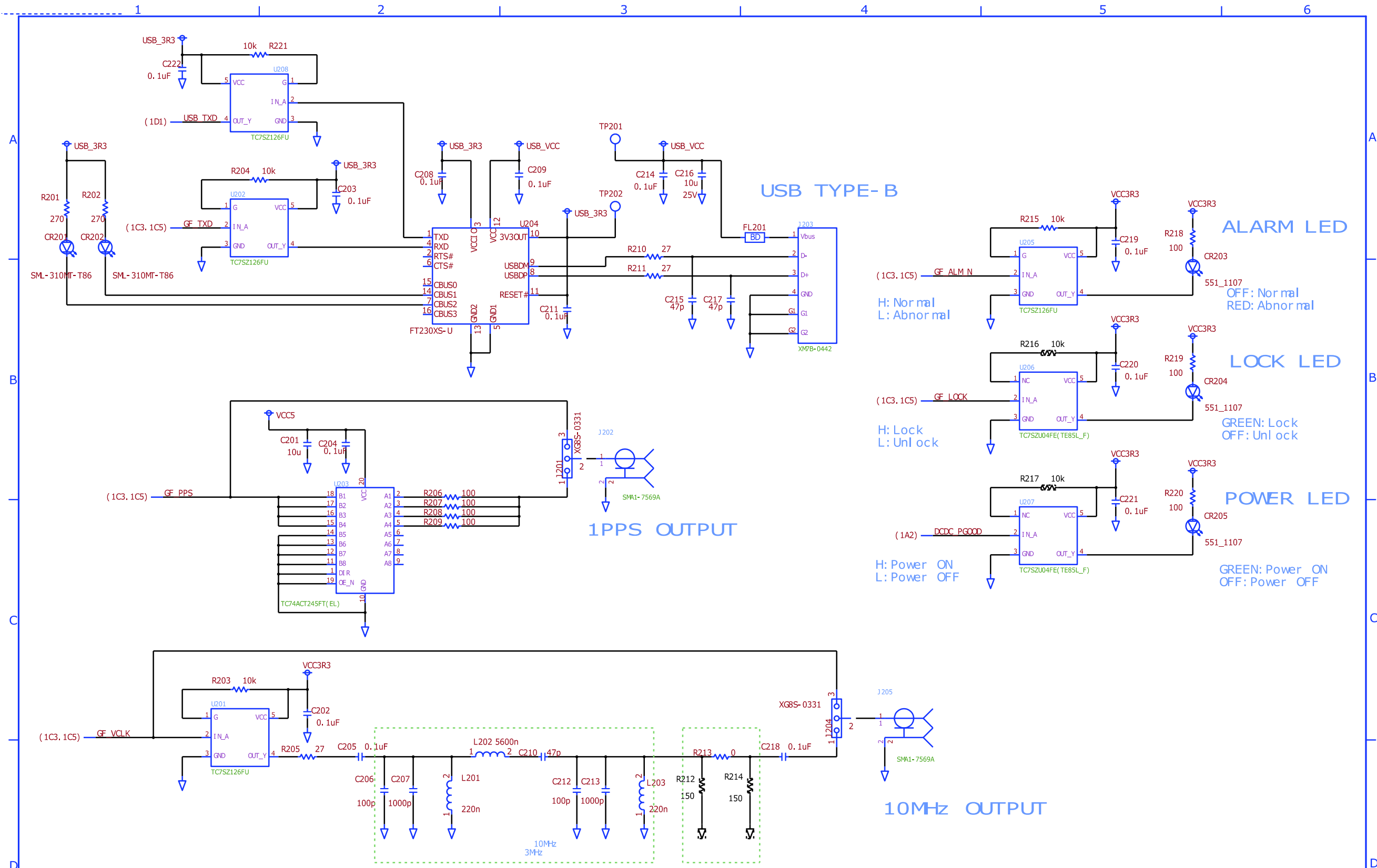
Please refer to “GNSS Conductor GF User’s Guide (SE16-900-008)”.

12 Schematics

12.1 VF-01/02/03



| REV. NO. | MARK | DATE | REMARKS | REV. BY | APPRV | M/D/L | GF-870x IF Board | 48P0448-00 | CODE NO. | ITEM NO. | SHEET NO. | 1/2 |
|----------|------|---------|---------|---------|---------------|-------|------------------|------------|----------|----------|-----------|-----|
| △ x | | | | | | | | | | | | |
| △ x | | | | | | | | | | | | |
| △ x | | | | | | | | | | | | |
| △ x | | | | | | | | | | | | |
| △ x | | | | | | | | | | | | |
| APPRV | CHKD | DSI GND | DRAWN | TITLE | PAGE1 | | | | | | | |
| | | @DSI GN | @DRAWN | DWG NO. | 48-201-0050-0 | | | | | | | |



| △ x | | | | | |
|----------|------|------|---------|--------|-------|
| △ x | | | | | |
| △ x | | | | | |
| △ x | | | | | |
| △ x | | | | | |
| REV. NO. | MARK | DATE | REMARKS | REV-BY | APPRV |

| | | | | | | | |
|-------|------|------------------|--------|----------|---------------|-------|-----|
| M D L | | GF-870x IF Board | | CODE NO. | | SHEET | 2/2 |
| | | 48P0448-00 | | ITEM NO. | | NO. | |
| APPRV | CHKD | DSI GND | DRAWN | TITLE | PAGE2 | | |
| | | @DSI GN | @DRAWN | DWG NO. | 48-201-0051-0 | | |

| Component # | Products # | Vender |
|---|------------------------|-----------|
| C101,C102,C120,C121 | GRM31CR61A476ME15L | Murata |
| C103,C109,C110,C111,C115,C119,C202,C203,C204,C205,C208,C209,C211,C214,C214,C218,C219,C220,C221,C222 | GRM155R11C104KA88D | Murata |
| C104,C105,C108,C116,C117,C118 | GRM1552C1H220JA01D | Murata |
| C106,C107,C113,C114,C122,C123,C124,C201,C216 | GRM31CR71E106KA12L | Murata |
| C112 | EKZN250ETD151MF11D | Nichikemi |
| C206,C212 | GRM1552C1H101JA01D | Murata |
| C207,C213 | GRM1552C1H102JA01D | Murata |
| C210,C215,C217 | GRM1552C1H470JA01D | Murata |
| CR101 | RB085BM-90 | Rohm |
| CR201,CR202 | SML-310MT-T86 | Rohm |
| CR203,CR204,CR205 | 551_1107 | dialight |
| FL101,FL201 | MPZ2012S601AT000 | TDK |
| J101 | SMA1-7569A | Connect |
| J102 | M04-390DJ | Marushin |
| J103 | BP101-2PN10 | IDEC |
| J104,J105 | XG8S0231 | Omron |
| J106,J107,J201,J204 | XG8S-0331 | Omron |
| J108 | PS-20PLB-D4T1-FL1E | JAE |
| J202 | SMA1-7569A | Connect |
| J203 | XM7B-0442 | Omron |
| J205 | SMA1-7569A | Connect |
| L201 | KQ1008TTER22G | KOA |
| L202 | KQ1008TTE5R6G | KOA |
| L203 | KQ1008TTER22G | KOA |
| R101,R102 | MCR03EZPJ101 | Rohm |
| R103 | MCR01MZPD5601 | Rohm |
| R104 | MCR01MZPD6201 | Rohm |
| R105,R106,R108,R203,R204,R215,R216,R217,R221 | MCR01MZPJ103 | Rohm |
| R107 | MCR01MZPJ304 | Rohm |
| R109 | MCR01MZPD4301 | Rohm |
| R110 | MCR01MZPD3901 | Rohm |
| R201,R202 | MCR01MZPJ271 | Rohm |
| R205,R210,R211 | MCR01MZPJ270 | Rohm |
| R206,R207,R208,R209,R218,R219,R220 | MCR01MZPJ101 | Rohm |
| R212,R214 | MCR01MZPJ151 | Rohm |
| R213 | MCR01MZPJ000 | Rohm |
| U101 | GF-8701/GF-8702/GF8703 | FURUNO |
| U102 | LTM4622EY#PBF | LT |
| U103 | S-1170B33UC-OTSTFG | SII |
| U201,U202,U205,U208 | TC7SZ126FU | Toshiba |
| U203 | TC74ACT245FT(EL) | Toshiba |
| U204 | FT230XS-U | FTDI |
| U206,U207 | TC7SZ04FU(TE85L_JF) | Toshiba |

<Power supply electric characteristics>

$T_A=25^{\circ}\text{C}$, unless otherwise stated

| Symbol | Description | Unit | Min | Typ | Max |
|-----------|---------------------|------|------|-----|------|
| V_{IN} | Input voltage | V | 3.6 | - | 20 |
| V_{OUT} | Output voltage | V | 3.56 | - | 3.78 |
| I_{OUT} | Output current | A | - | - | 2.5 |
| f_{SW} | Switching frequency | MHz | - | 2 | - |

<Band pass filter characteristics>

-Filter Type: 3rd Butterworth filter

-Cutoff Frequency : 3MHz

-Input/Output Impedance : 50Ω

Figure 12.1 shows a filter characteristics simulation result of 3rd Butterworth filter in the schematics.

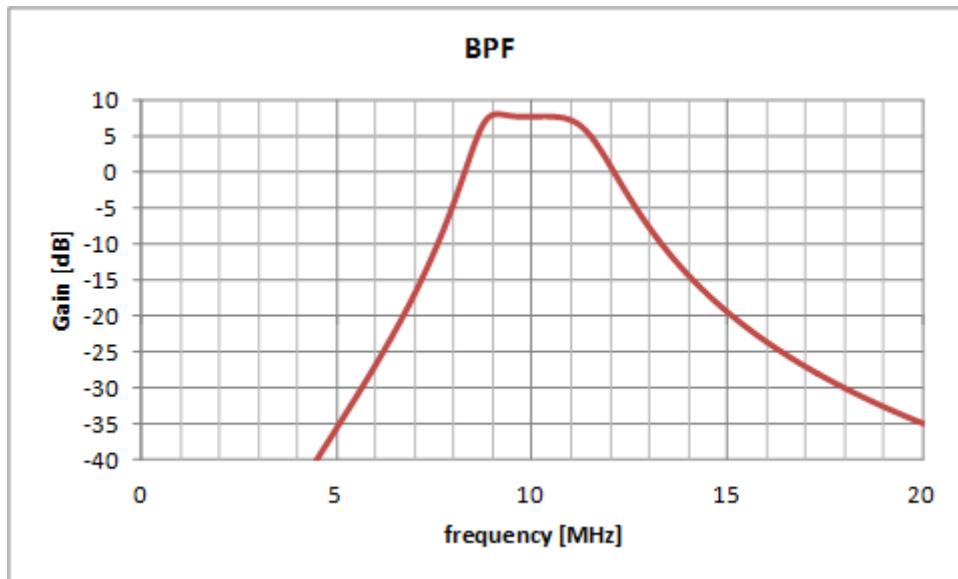
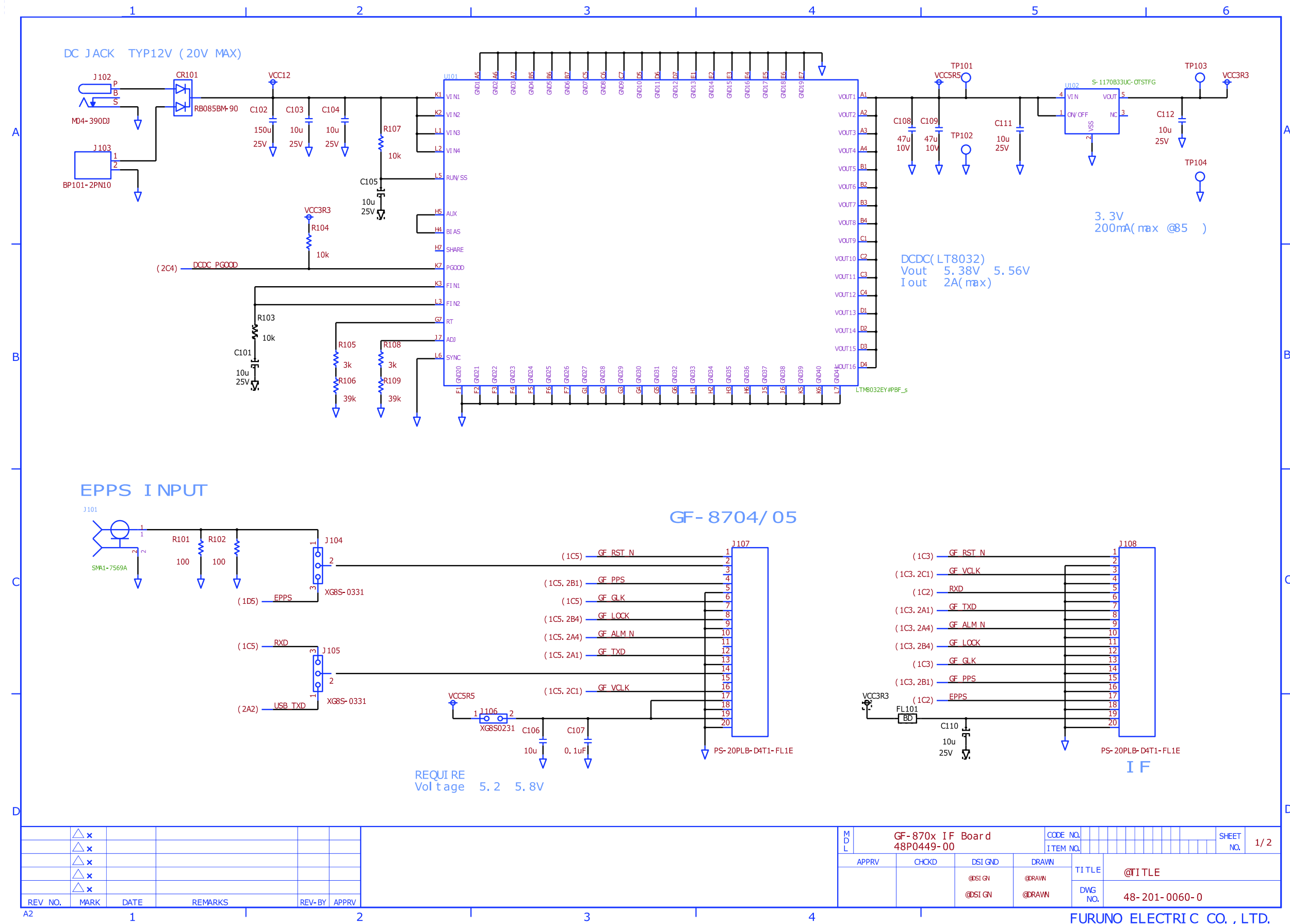


Figure 12.1 Simulation Results of 3rd Butterworth Filter

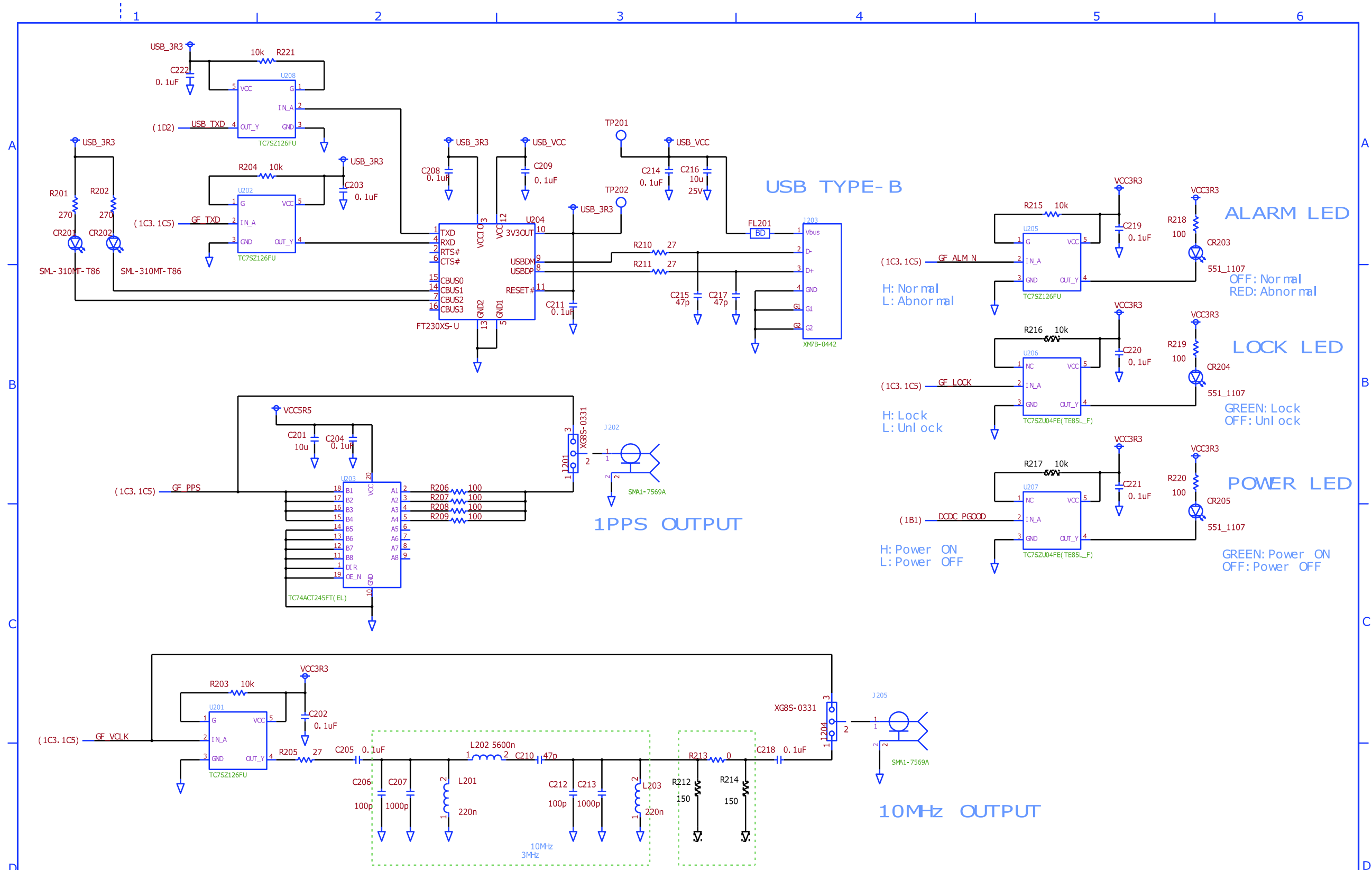
12.2 VF-04/05



| △x | | | | | |
|----------|------|------|---------|--------|-------|
| △x | | | | | |
| △x | | | | | |
| △x | | | | | |
| △x | | | | | |
| REV. NO. | MARK | DATE | REMARKS | REV-BY | APPRV |

| | | | | | |
|-------|------------------|----------|--------|---------|---------------|
| M | GF-870x IF Board | CODE NO. | | SHEET | 1/2 |
| D | 48P0449-00 | ITEM NO. | | NO. | |
| APPRV | CHKD | DSI GND | DRAWN | TITLE | @TITLE |
| | | @DSI GN | @DRAWN | DWG NO. | 48-201-0060-0 |
| | | @DSI GN | @DRAWN | | |

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| REV. NO. | MARK | DATE | REMARKS | REV-BY | APPRV |
|----------|------|------|---------|--------|-------|
| △x | | | | | |
| △x | | | | | |
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| | | | | | | | |
|-------|--------------------------------|---------|--------|----------|---------------|-------|-----|
| M/D/L | GF-870x IF Board 48P0449-00 | | | CODE NO. | | SHEET | 2/2 |
| APPRV | CHCKD | DSI GN | DRAWN | TITLE | @TITLE | | |
| | | @DSI GN | @DRAWN | DWG NO. | 48-201-0061-0 | | |

| Component # | Products # | Vender |
|---|---------------------|-----------|
| C101,C103,C104,C105,C106,C110,C111,C112,C201,C216 | GRM31CR71E106KA12L | Murata |
| C102 | EKZN250ETD151MF11D | Nichikemi |
| C107,C202,C203,C204,C205,C208,C209,C211,C214,C218,C219,C220,C221,C222 | GRM155R11C104KA88D | Murata |
| C108,C109 | GRM31CR61A476ME15L | Murata |
| C206,C212 | GRM1552C1H101JA01D | Murata |
| C207,C213 | GRM1552C1H102JA01D | Murata |
| C210,C215,C217 | GRM1552C1H470JA01D | Murata |
| CR101 | RB085BM-90 | Rohm |
| CR201,CR202 | SML-310MT-T86 | Rohm |
| CR203 | 551_1107 | dialight |
| CR204 | 551_1107 | dialight |
| CR205 | 551_1107 | dialight |
| FL101,FL201 | MPZ2012S601AT000 | TDK |
| J101,J202,J205 | SMA1-7569A | Connect |
| J102 | M04-390DJ | Marushin |
| J103 | BP101-2PN10 | IDEC |
| J104,J105,J201,J204 | XG8S-0331 | Omron |
| J106 | XG8S0231 | Omron |
| J107,J108 | PS-20PLB-D4T1-FL1E | JAE |
| J203 | XM7B-0442 | Omron |
| L201,L203 | KQ1008TTER22G | KOA |
| L202 | KQ1008TTE5R6G | KOA |
| R101,R102 | MCR03EZPJ101 | Rohm |
| R103,R104,R107,R203,R204,R215,R216,R217,R221 | MCR01MZPJ103 | Rohm |
| R105,R108 | MCR01MZPD3001 | Rohm |
| R106,R109 | MCR01MZPD3902 | Rohm |
| R201,R202 | MCR01MZPJ271 | Rohm |
| R205,R210,R211 | MCR01MZPJ270 | Rohm |
| R206,R207,R208,R209,R218,R219,R220 | MCR01MZPJ101 | Rohm |
| R212,R214 | MCR01MZPJ151 | Rohm |
| R213 | MCR01MZPJ000 | Rohm |
| U101 | LTM8032EY#PBF_s | LT |
| U102 | S-1170B33UC-OTSTFG | SII |
| U201,U202,U205,U208 | TC7SZ126FU | Toshiba |
| U203 | TC74ACT245FT(EL) | Toshiba |
| U204 | FT230XS-U | FTDI |
| U206,U207 | TC7SZ04FU(TE85L_JF) | Toshiba |

<Power supply electric characteristics>

T_A=25°C, unless otherwise stated

| Symbol | Description | Unit | Min | Typ | Max |
|------------------|---------------------|------|------|-----|------|
| V _{IN} | Input voltage | V | - | 12 | |
| V _{OUT} | Output voltage | V | 5.38 | - | 5.56 |
| I _{OUT} | Output current | A | - | - | 2 |
| f _{SW} | Switching frequency | MHz | - | 2 | - |

<Notification>

Please note that those schematics in this documents are only samples on which FURUNO has designed this product and are provided to users as a reference for further development at each user-end.

FURUNO shall NOT indemnify and hold the users harmless from any loss, damage, or liability for direct/indirect infringement of any third party's patent or copyright arising from the usage of any of the schematics in this document.

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Thus FURUNO is not liable for the degradation by their operating so that FURUNO cannot guarantee specification based on this condition. User is expected to be familiar with the System and make full use of it with their responsibility.

13 Special Attention

13.1 Precaution for Users

- (1) A GNSS receiver receives very weak signals sent by the GNSS satellites. Using an antenna with band limitations or insufficient preamplifier 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 preamplifier front stage to ensure stable GNSS reception.
- (2) It is recommended to install the antenna vertically outdoors in a location where there are no obstacles within its elevation angle of 5°. GNSS signals may reflect from buildings, trees or ground surfaces and reach a GNSS antenna via the reflected (delayed) route. Therefore install a GNSS antenna in environment where there are no reflected waves. Therefore avoid mounting near buildings or other obstructions.
- (3) 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.
- (4) RF noise may interfere via the GNSS antenna and adversely affect the GNSS signal reception. Avoid using GNSS devices near equipment emitting RF noise.
- (5) 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.
- (6) Ensure a stable power supply connection.
- (7) Install in a stable temperature, wind free environment for the GNSS unit to eliminate errors caused by temperature deviations.
- (8) Improper heat dissipation may increase the device temperature beyond the upper limit specifications resulting in performance degradation or failure. Install the device allowing sufficient space around the device for heat dissipation considerations.
- (9) 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.

14 Contact Information

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