

VTS-1000 USER

Xilinx Zynq® UltraScale+™ MPSoC, In-vehicle Time Sync Box
Sync In/Out, Frame Out, RTCM, UART, GNSS GPS, 9-axis IMU

Manual

Record of Revision

Version	Date	Page	Description	Remark
1.00	2025/03/11	All	Official Release	

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Order Information

Model Name	Description
VTS-1100	VTS-1000,Xilinx Ultrascale+ ZU5EG, 2 10/100/1000 Base-T GigE LAN, 1 GNSS in, 5 Sync out
VTS-1200	VTS-1000,Xilinx Ultrascale+ ZU5EG, 2 10/100/1000 Base-T GigE LAN, 1 GNSS in, 8 Sync out, 1 UART Sync
VTS-1200GU	VTS-1000,Xilinx Ultrascale+ ZU5EG, 2 10/100/1000 Base-T GigE LAN, 1 GNSS in, 8 Sync out, RTCM, 1 UART Sync, GPS, IMU, 1 Serial, 1CAN

Software Tool

Model Name	Description
Daisy Chain	Synchronization tool between controllers, auto calibration of latency
Sync Tool	Python sync tool for customizable sync signal to support various sensor requirements
Sensor Fusion	Sensor fusion tool for Dual GNSS and IMU yaw, integrated EKF algorithm

Optional Accessories

Part Number	Description
PWA-120W1	120W, 24V, 90V AC to 264V AC Power Adapter with 3-pin Terminal Block
PWA-160W-WT	PWA-160W-WT 160W, 24V, 85V AC to 264V AC Power Adapter with 3-pin Terminal Block, Wide Temperature -30°C to +70°C
DC-IN Cable	DC-IN Cable, 200cm
Vchain Cable	M12 Vchain Cable, 200cm
RTCM Cable Kit	RTK RTCM input Cable, 200cm
Sync in Cable Kit	External GNSS input Cable, 200cm
Sync out Cable Kit	Sync out Cable, 200cm
Sync out 2 Cable Kit	Sync out Cable, 200cm
Frame Out Cable Kit	Frame out Cable Kit, 200cm
LAN Switch	10/100/1000Base-T(X) Gigabit Ethernet switch with PTP/gPTP support

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1

GENERAL INTRODUCTION

1.1 Overview

The Vecow VTS-1000 Series is a rugged in-vehicle time synchronization box designed to meet the growing demands for multi-sensor synchronization. It supports a wide range of edge applications, from autonomous systems and manufacturing to AIoT and Industry 4.0.

Powered by the Xilinx Zynq® UltraScale+™ MPSoC, the Vecow VTS-1000 is equipped with three innovative key technologies—Time Winding, Time Stamping, and Time Keeping. These technologies enhance multi-sensor synchronization, perception, precision, and positioning capabilities. Time Winding ensures synchronization of internal clocks across sensors and outputs signals in the required time format to Time Stamping. Time Keeping provides continuous time information, unaffected by GNSS reception conditions or interference, thereby mitigating issues with time format outputs.

Additionally, the VTS-1000 Series includes Time Sync Software tools such as daisy chain, sensor fusion, and Python-based tools. These features enhance robotic perception, precision, and positioning, making the VTS-1000 Series well-suited for navigating the complexities of dynamic outdoor environments.

1.2 Features

- Powered by Xilinx Zynq® UltraScale+™ MPSoC, rugged & compact design
- Multi-channel PPS Time Sync and Frame Out for cameras, Lidars, Radars, and IMU
- 2 X-coded M12 GigE LAN with 1 Network Sync LAN support PTP/gPTP Protocol
- Integrated with Septentrio high precision Dual-Antenna GPS
- Supports RTK RTCM centimeter level position accuracy
- Integrated with Xsens MTi-670 high precision 9-axis IMU
- Supports External GNSS input and Daisy Chain sync out
- DC 5V to 60V wide range power input, Fanless -20°C to 75°C operation

1.3 Product Specification

1.3.1 Specifications of VTS-1100

System	
Processor	Xilinx Zynq® UltraScale+™ ZU5EG MPSoC
Memory	DDR4 Memory, up to 8GB
eMMC	64GB eMMC
OS	<ul style="list-style-type: none"> • Embedded : Linux System • Framework : ROS 2 Humble
I/O Interface	
Button	Restore to Factory Default Button
LED	Power, Ready, 1 Programmable LED, PTP, Sync In, GNSS, IMU, VCHAIN
Daisy Chain	Provides PPS and UART for sync channel extensions 8-pin A-coded M12 Connector
Sync In	Provides 1 PPS and 1 ToD for External GNSS input 8-pin A-coded M12 Connector
Sync Out	Provides 5 PPS and 5 ToD for hardware sync and time stamp output. 17-pin A-coded M12 Connector
Frame Out	Provides 8 Trigger for GMSL cameras frame sync 17-pin A-coded M12 Connector
Storage	
SD	1 External Micro SD Socket
Ethernet	
LAN 1	10/100/1000 Base-T GigE LAN for hardware PTP/gPTP master, IEEE802.3AS compliant X-coded M12 Connector
LAN 2	10/100/1000 Base-T GigE LAN X-coded M12 Connector
Power	
Power Input	DC 5V to 60V
Power Interface	5-pin L-coded M12 Connector : V+, V
Mechanical	
Dimension (W x L x H)	150 mm x 150 mm x 55 mm (5.9" x 5.9" x 2.16")
Weight	1.6KG (3.52 lb)
Mounting	<ul style="list-style-type: none"> • DIN-Rail • Wall-mount

Environment	
Operating Temp.	-20°C to 75°C (-4°F to 167°F), Fanless
Storage Temp.	-40°C to 85°C (-40°F to 185°F)
Humidity	5% to 95% Humidity, non-condensing
Rel. Humidity	95% @75°C
Shock	Operating, MIL-STD-810H, Method516.8, Procedure I
Vibration	Operating, MIL-STD-810H, Method 514.8 ,Procedure I, Category 4
EMC	CE, FCC

1.3.2 Specifications of VTS-1200

System	
Processor	Xilinx Zynq® UltraScale+™ ZU5EG MPSoC
Memory	DDR4 Memory, up to 8GB
eMMC	64GB eMMC
OS	<ul style="list-style-type: none"> • Embedded : Linux System • Framework : ROS 2 Humble
I/O Interface	
Button	Restore to Factory Default Button
LED	Power, Ready, 1 Programmable LED, PTP, Sync In, GNSS, IMU, VCHAIN
Daisy Chain	Provides PPS and UART for sync channel extensions 8-pin A-coded M12 Connector
Sync In	Provides 1 PPS and 1 ToD for External GNSS input 8-pin A-coded M12 Connector
Sync Out	Provides 5 PPS and 5 ToD for hardware sync and time stamp output. 17-pin A-coded M12 Connector
Frame Out	Provides 8 Trigger for GMSL cameras frame sync 17-pin A-coded M12 Connector
RTCM & UART	Provides 1 RTK RTCM and 1 UART : <ul style="list-style-type: none"> • RTK RTCM input, NMEA 0183 protocol followed • UART for communication to PC • 8-pin A-coded M12 Connector
Storage	
SD	1 External Micro SD Socket
Ethernet	
LAN 1	10/100/1000 Base-T GigE LAN for hardware PTP/gPTP master, IEEE802.3AS compliant X-coded M12 Connector
LAN 2	10/100/1000 Base-T GigE LAN X-coded M12 Connector
Power	
Power Input	DC 5V to 60V
Power Interface	5-pin L-coded M12 Connector : V+, V
Mechanical	
Dimension (W x L x H)	150 mm x 150 mm x 70 mm (5.9" x 5.9" x 2.75")
Weight	1.7KG (3.74 lb)
Mounting	<ul style="list-style-type: none"> • DIN-Rail • Wall-mount

Environment	
Operating Temp.	-20°C to 75°C (-4°F to 167°F), Fanless
Storage Temp.	-40°C to 85°C (-40°F to 185°F)
Humidity	5% to 95% Humidity, non-condensing
Rel. Humidity	95% @75°C
Shock	Operating, MIL-STD-810H, Method516.8, Procedure I
Vibration	Operating, MIL-STD-810H, Method 514.8 ,Procedure I, Category 4
EMC	CE, FCC

1.3.3 Specifications of VTS-1200GU

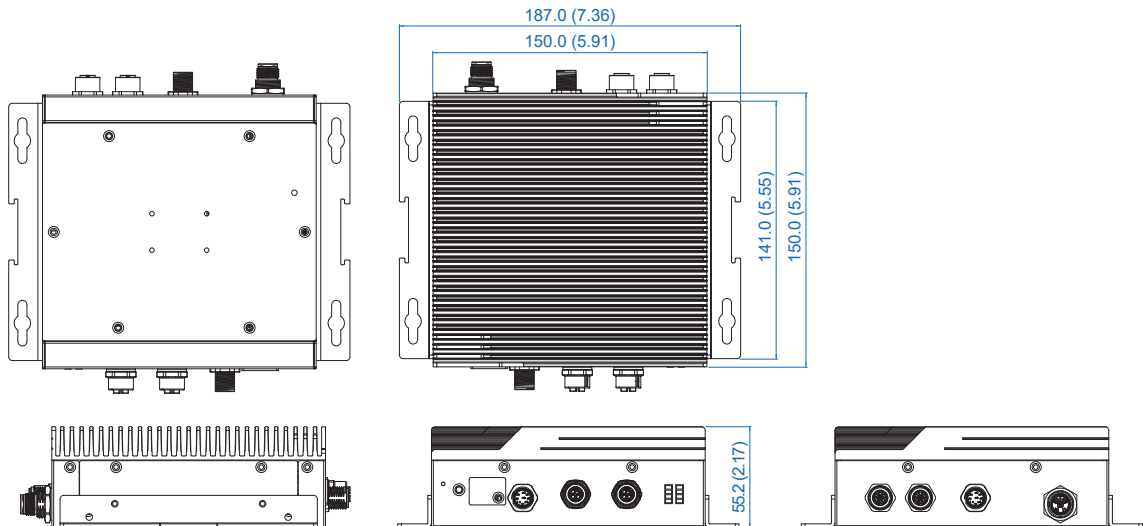
System	
Processor	Xilinx Zynq® UltraScale+™ ZU5EG MPSoC
Memory	DDR4 Memory, up to 8GB
eMMC	64GB eMMC
OS	<ul style="list-style-type: none"> • Embedded : Linux System • Framework : ROS 2 Humble
I/O Interface	
Button	Restore to Factory Default Button
LED	Power, Ready, 1 Programmable LED, PTP, Sync In, GNSS, IMU, VCHAIN
Daisy Chain	Provides PPS and UART for sync channel extensions 8-pin A-coded M12 Connector
IMU Out	Provides 1 RS-232 and 1 CAN Bus for 9-axis IMU raw data output 17-pin A-coded M12 Connector
Sync In	Provides 1 PPS and 1 ToD for External GNSS input 8-pin A-coded M12 Connector
Sync Out	Provides 8 PPS and 8 ToD for hardware sync and time stamp output. 17-pin A-coded M12 Connector
Frame Out	Provides 8 Trigger for GMSL cameras frame sync 17-pin A-coded M12 Connector
RTCM & UART	Provides 1 RTK RTCM and 1 UART : <ul style="list-style-type: none"> • RTK RTCM input, NMEA 0183 protocol followed • UART for communication to PC • 8-pin A-coded M12 Connector
Antenna	2 SMA GNSS Antenna Connector
Storage	
SD	1 External Micro SD Socket
Ethernet	
LAN 1	10/100/1000 Base-T GigE LAN for hardware PTP/gPTP master, IEEE802.3AS compliant X-coded M12 Connector
LAN 2	10/100/1000 Base-T GigE LAN X-coded M12 Connector
Power	
Power Input	DC 5V to 60V
Power Interface	5-pin L-coded M12 Connector : V+, V

Sensor Fusion													
GPS	Septentrio AsteRx-m3 Pro Dual GNSS Module Position accuracy (Open sky conditions and RMS level) <table border="1" data-bbox="730 383 1345 577"> <thead> <tr> <th></th> <th>Horizontal</th> <th>Vertical</th> </tr> </thead> <tbody> <tr> <td>Standalone</td> <td>1.2 m</td> <td>1.9 m</td> </tr> <tr> <td>SBAS</td> <td>0.6 m</td> <td>0.8 m</td> </tr> <tr> <td>DGNSS</td> <td>0.4 m</td> <td>0.7 m</td> </tr> </tbody> </table>		Horizontal	Vertical	Standalone	1.2 m	1.9 m	SBAS	0.6 m	0.8 m	DGNSS	0.4 m	0.7 m
	Horizontal	Vertical											
Standalone	1.2 m	1.9 m											
SBAS	0.6 m	0.8 m											
DGNSS	0.4 m	0.7 m											
IMU	Movella MTi-670 9-axis IMU Sensor Performance : <ul style="list-style-type: none"> • Roll, Pitch : 0.2 deg RMS • Yaw/Heading : 0.8 deg RMS • Velocity : 0.05 m/s RMS 												
Mechanical													
Dimension (W x L x H)	150 mm x 150 mm x 70 mm (5.9" x 5.9" x 2.75")												
Weight	1.8KG (3.96 lb)												
Mounting	<ul style="list-style-type: none"> • DIN-Rail • Wall-mount 												
Environment													
Operating Temp.	-20°C to 75°C (-4°F to 167°F), Fanless												
Storage Temp.	-40°C to 85°C (-40°F to 185°F)												
Humidity	5% to 95% Humidity, non-condensing												
Rel. Humidity	95% @75°C												
Shock	Operating, MIL-STD-810H, Method516.8, Procedure I												
Vibration	Operating, MIL-STD-810H, Method 514.8 ,Procedure I, Category 4												
EMC	CE, FCC												

1.4 Mechanical Dimension

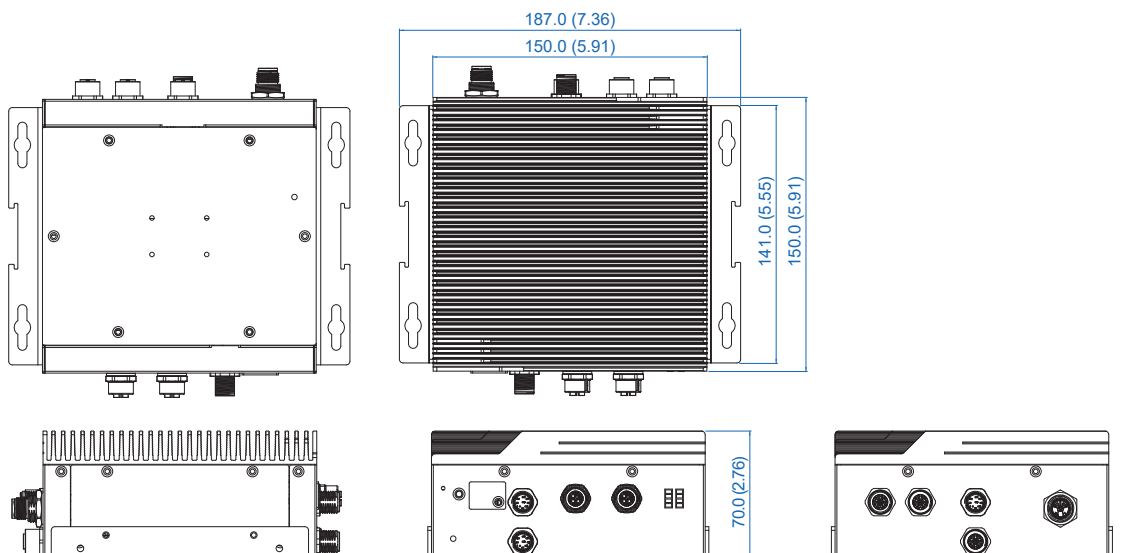
1.4.1 Dimensions of VTS-1100

Unit : mm (inch)



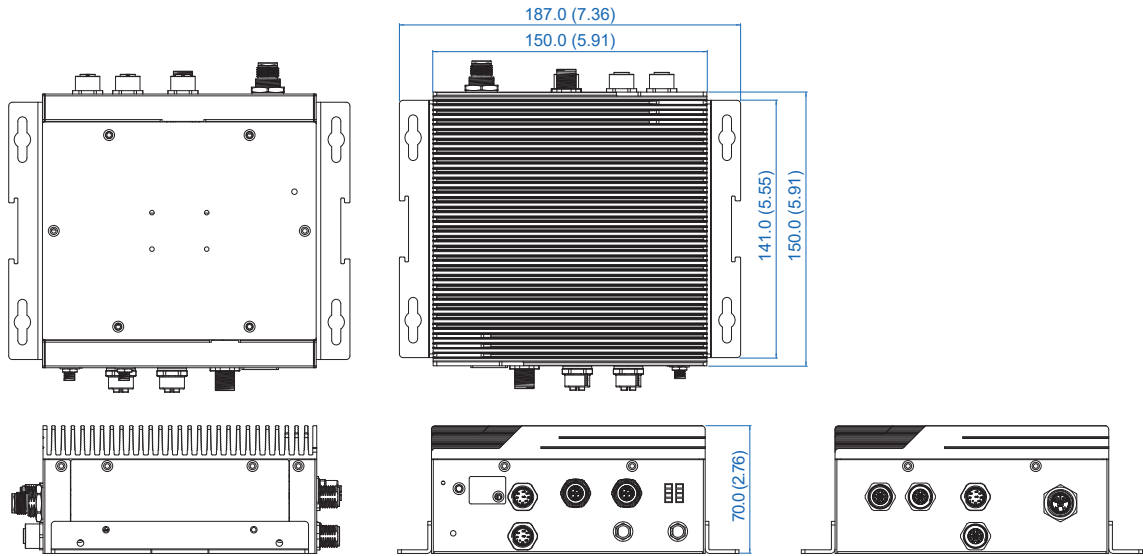
1.4.2 Dimensions of VTS-1200

Unit : mm (inch)



1.4.3 Dimensions of VTS-1200GU

Unit : mm (inch)





2

GETTING TO KNOW YOUR VTS-1100/1200/1200GU

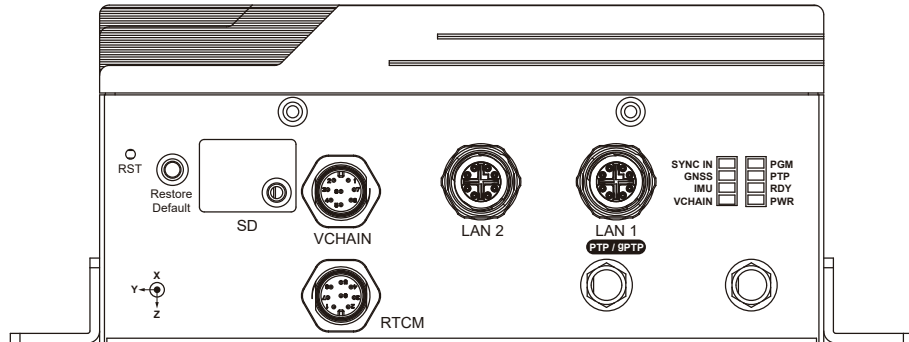
2.1 Packing List

Item	Description	Qty
1	VTS-1000 Time Sync Solution (According to the configuration of you order, the VTS-1000 series may contain GPS module and IMU. Please verify these items if necessary.)	1

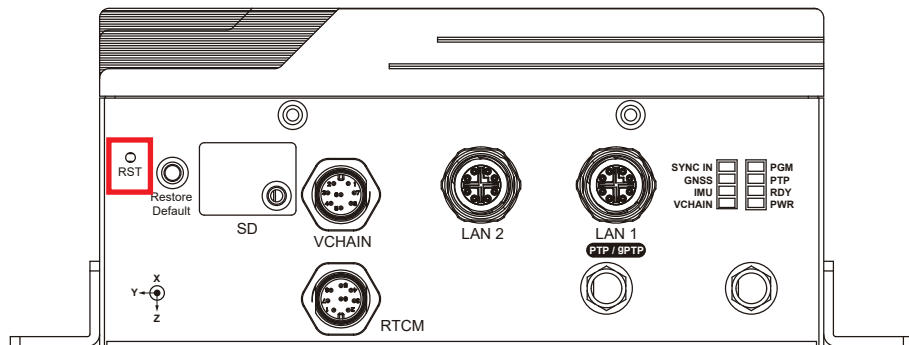
Item	Description	Outlook	Usage	P/N	Qty
1	I-head M3x5L		Fasten bracket to VTS series	53-M014800-000	4
2	Wall Mount Bracket		Mount	62-A520011-012	2

2.2 Front Panel I/O Functions

In Vecow VTS-1000 series family, Some of the I/O connectors are located on the front panels. Such as SD card , VCHAIN ,LAN and RTCM .

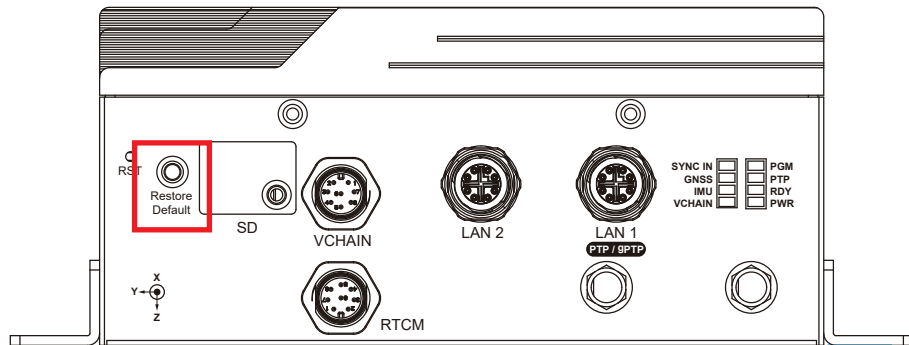


2.2.1 RST bottom



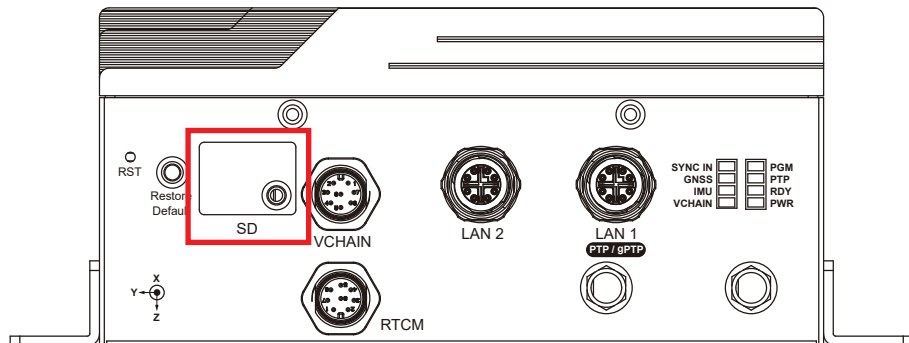
Used to force a full system reset.

2.2.2 Restore Default bottom



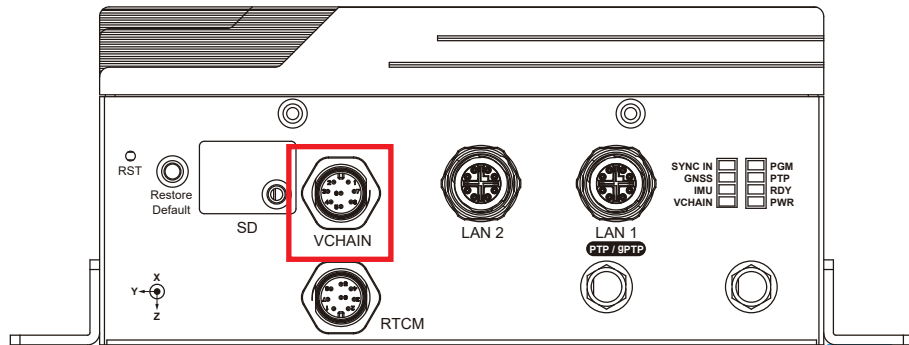
Used to enter Force Recovery Mode. Button is held down while either system is first powered on, or by pressing & releasing reset button while Recovery button is pressed.

2.2.3 Micro SD



The external Micro SD card provides additional storage expansion. It is located behind the cover-plate on the front panel

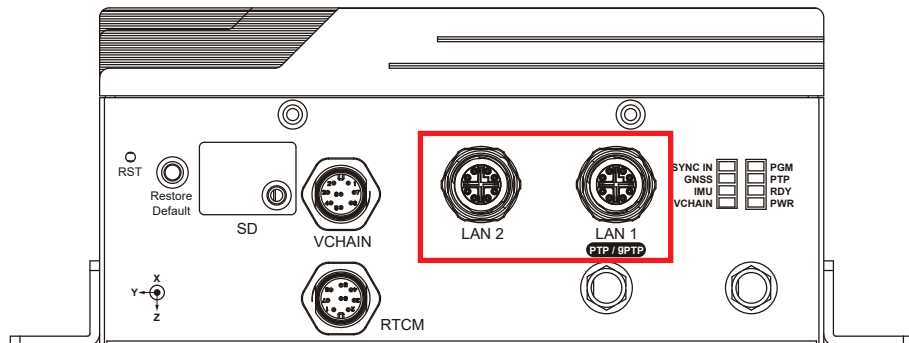
2.2.4 VCHAIN



VCHAIN is used to connect other VTS-1000 series system to form an Daisy chain topology. The pin-outs of VCHAIN is listed as follows:

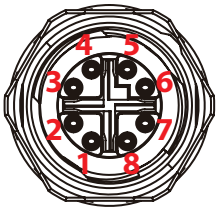
Pin No.	Definition	Pin No.	Definition
1	CHAIN_COM_RX	2	CHAIN_COM_TX
3	CHAIN_PPS1_TX	4	CHAIN_PPS1_RX
5	GND	6	CHAIN_PPS2_RX
7	CHAIN_PPS2_TX	8	GND

2.2.5 Ethernet port

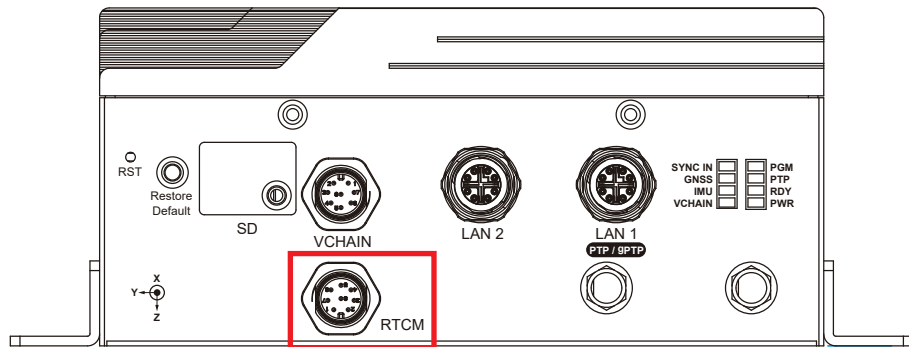


There are 2 M12 connectors supporting 10/100/1000 Mbps Ethernet connections on the front side of VTS-1000 series. It supports 1000BASE-T and IEEE 1588v2 (LAN1 only).

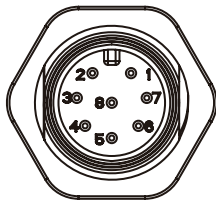
Using suitable M12 cable, you can connect the system to a computer, or to any other devices with Ethernet connection, for example, a hub or a switch. The pin-outs of LAN1 and LAN2 are listed as follows:

	Pin No.	10/100 Mbps	1000Mbps
	1	E_TX+	MDI0_P
	2	E_TX-	MDI0_N
	3	E_RX+	MDI1_P
	4	E_RX-	MDI1_N
	5		MDI2_P
	6		MDI2_N
	7		MDI3_P
8		MDI3_N	

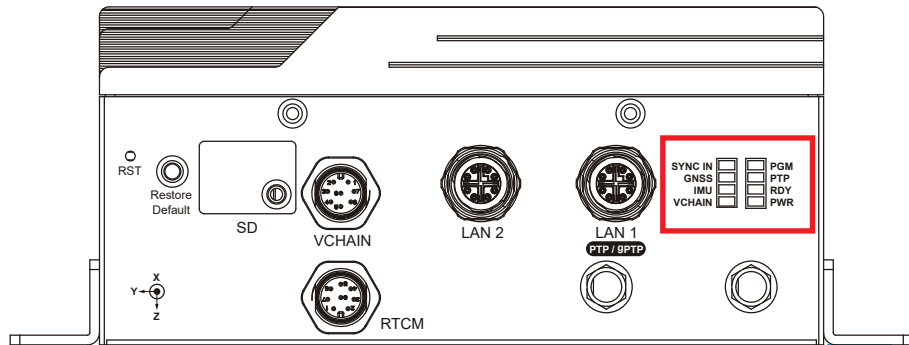
2.2.6 RTCM Connector



There is a M12 connector support RTK RTCM centimeter level position accuracy. The pin-outs of RTCM is listed as follows :

	Pin No.	Definition	Pin No.	Definition
	1	P3V3	2	P3V3
	3	GNSS_TX_COM	4	GNSS_RX_COM
	5	GND	6	ToD
	7	TCC	8	GND

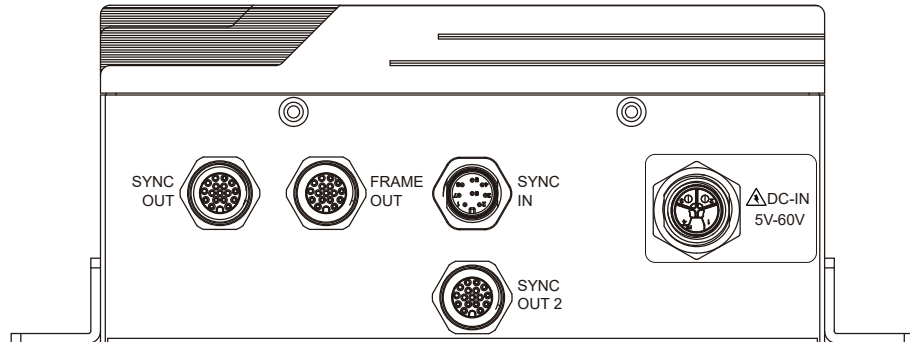
2.2.7 Status LED Indicators



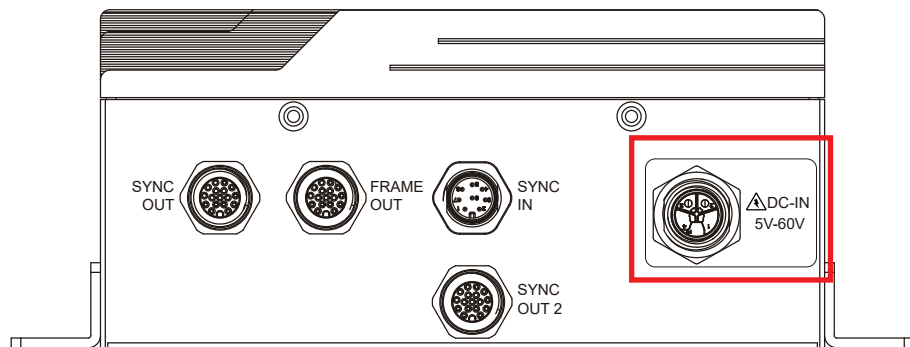
Name	LED Color	System status
SYNC IN	Solid Green	On/Off : GNSS SYNC status, function or not.
GNSS	Solid Green	On/Off : GNSS status, function or not.
IMU	Solid Green	On/Off : IMU status, function or not.
VCHAIN	Solid Green	On/Off : VCHAIN status, function or not.
PGM	Solid Green	Programable LED .
PTP	Solid Green	On/Off : PTP status, function or not.
RDY	Solid Green	System ready status (on/off)
PWR	Solid Green	System power status (on/off)

2.3 Rear Panel I/O & Functions


In Vecow VTS-1000 series family, Some of the I/O connectors are located on the rear panels. such as Power input, SYNC and FRAME out .



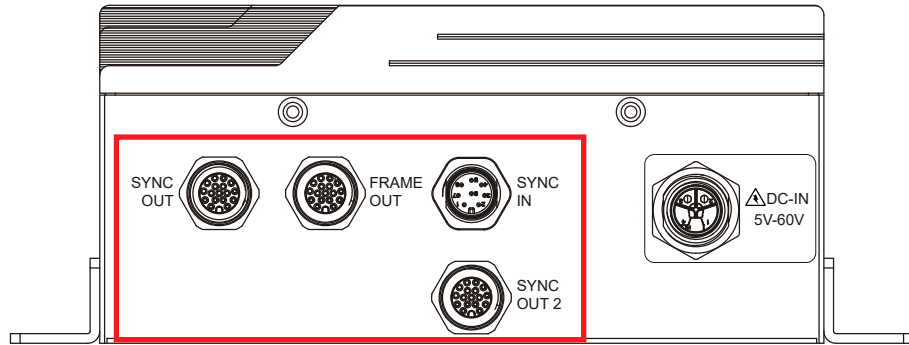
2.3.1 Power input



Used to force a full system reset.

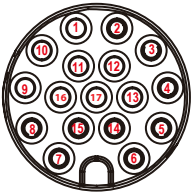
	Pin No.	Definition	Pin No.	Definition
	1	NC	2	+VDC_IN
3	GND	4	NC	

2.3.2 SYNC IN/OUT and FRAME OUT

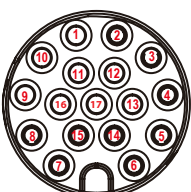


There are many M12 connector which can connect to other device to achieve Multi-channel PPS Time Sync and Frame Out for cameras, Lidars, Radars, and IMU, The pin-outs are listed as follows :

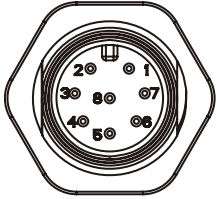
SYNC OUT

				
	Pin No.	Definition	Pin No.	Definition
	1	COM1_TX	2	PPS5_TX
	3	COM5_TX	4	PPS4_TX
	5	COM4_TX	6	PPS3_TX
	7	COM3_TX	8	PPS2_TX
	9	COM2_TX	10	PPS1_TX
	11	GND	12	P3V3
	13	GND	14	GND
	15	GND	16	GND
	17	P3V3		

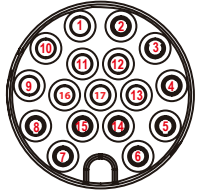
SYNC OUT2

				
	Pin No.	Definition	Pin No.	Definition
	1	IMU_RS-232_TX	2	PPS8_TX
	3	COM8_TX	4	PPS7_TX
	5	COM7_TX	6	PPS6_TX
	7	COM6_TX	8	CAN_L
	9	CAN_H	10	IMU_RS-232_RX
	11	GND	12	IMU_RS-232_CTS
	13	GND	14	GND
	15	GND	16	GND
	17	IMU_RS-232_RTS		

SYNC IN

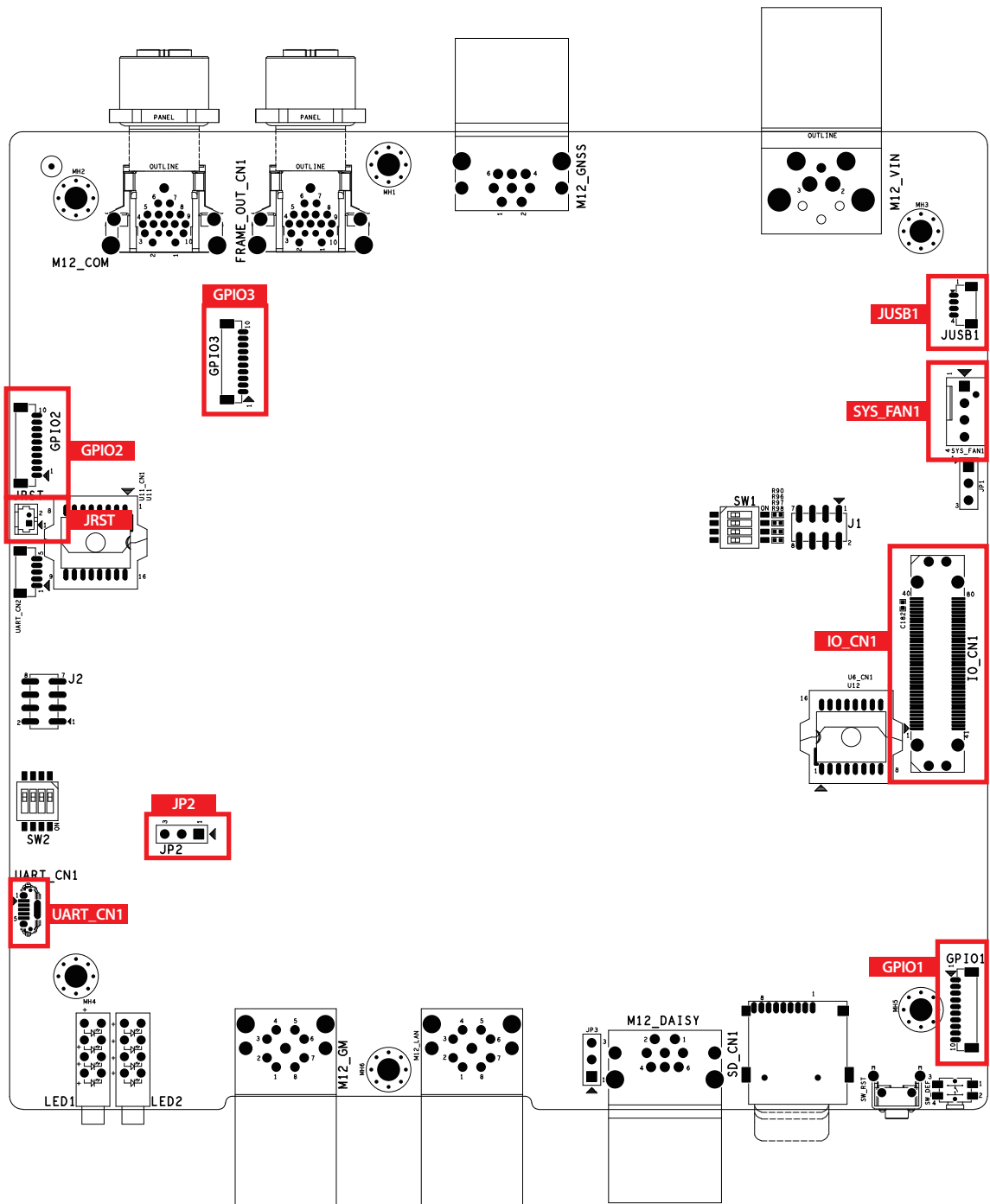
	Pin No.	Definition	Pin No.	Definition
		1	P3V3	2
	3	GNSS_TX_COM	4	GNSS_RX_COM
	5	GND	6	ToD
	7	TCC	8	GND

FRAME OUT

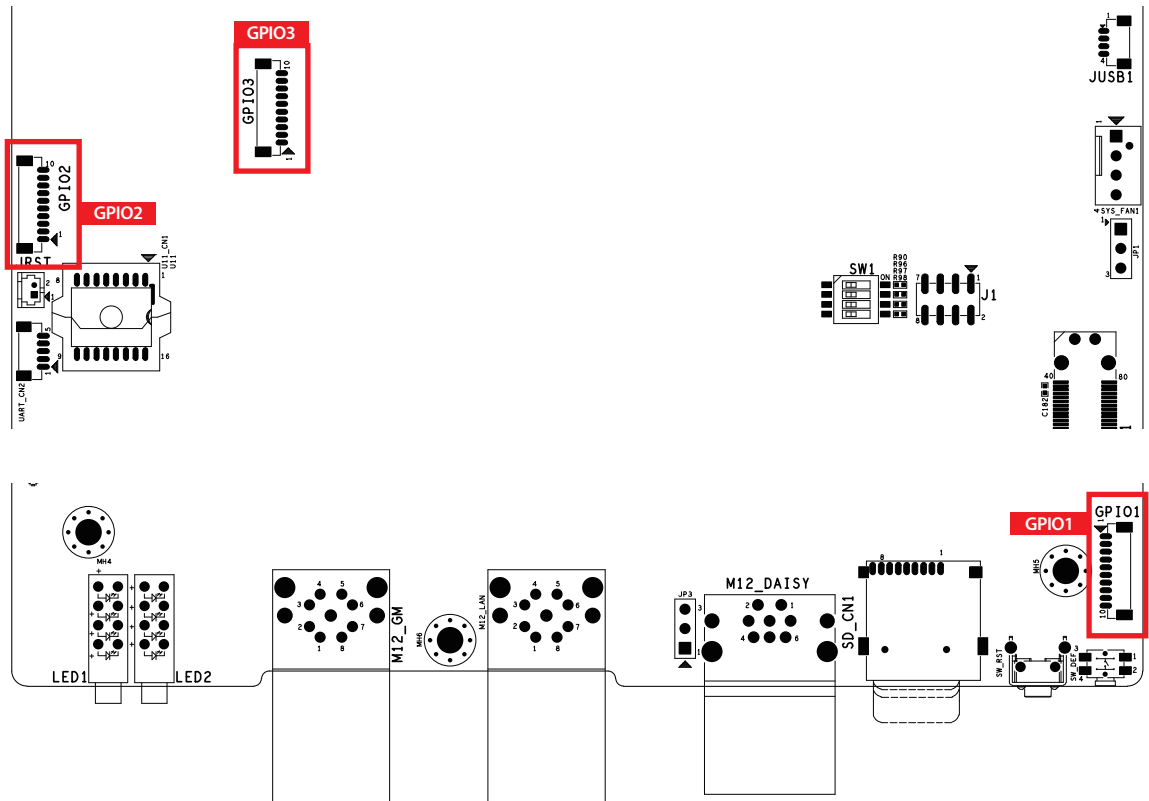
	Pin No.	Definition	Pin No.	Definition
		1	TRIGGER2_P3V3	2
	3	TRIGGER4_P3V3	4	GND
	5	TRIGGER5_P1V8	6	TRIGGER6_P1V8
	7	TRIGGER7_P1V8	8	TRIGGER8_P1V8
	9	GND	10	TRIGGER1_P3V3
	11	GND	12	GND
	13	GND	14	GND
	15	GND	16	GND
	17	GND		

2.4 Main Board Expansion Connectors

2.4.1 Top View of VTS-1000 series Main Board



2.4.1.1 GPIO1,GPIO2,GPIO3



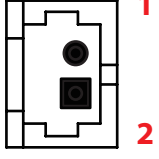
There are 3 8-bit GPIO connector in the Top side. Each GPIO channel can be configuration GPI or GPO. The pin-outs are listed as follows :

	Pin No.	GPIO1 Definition	GPIO2 Definition	GPIO3 Definition
	1	5EG_GPIO1_3V3	P3V3	5EG_GPIO9_3V3
	3	5EG_GPIO2_3V3	1CG_GPIO1_3V3	5EG_GPIO10_3V3
	5	5EG_GPIO3_3V3	1CG_GPIO2_3V3	5EG_GPIO11_3V3
	7	5EG_GPIO4_3V3	1CG_GPIO3_3V3	5EG_GPIO12_3V3
	9	GND	1CG_GPIO4_3V3	GND
	1	5EG_GPIO5_1V8	1CG_GPIO5_3V3	5EG_GPIO13_3V3
	3	5EG_GPIO6_1V8	1CG_GPIO6_3V3	5EG_GPIO14_3V3
	5	5EG_GPIO7_1V8	1CG_GPIO7_3V3	5EG_GPIO15_3V3
	7	5EG_GPIO8_1V8	1CG_GPIO8_3V3	5EG_GPIO16_3V3
		9	GND	GND

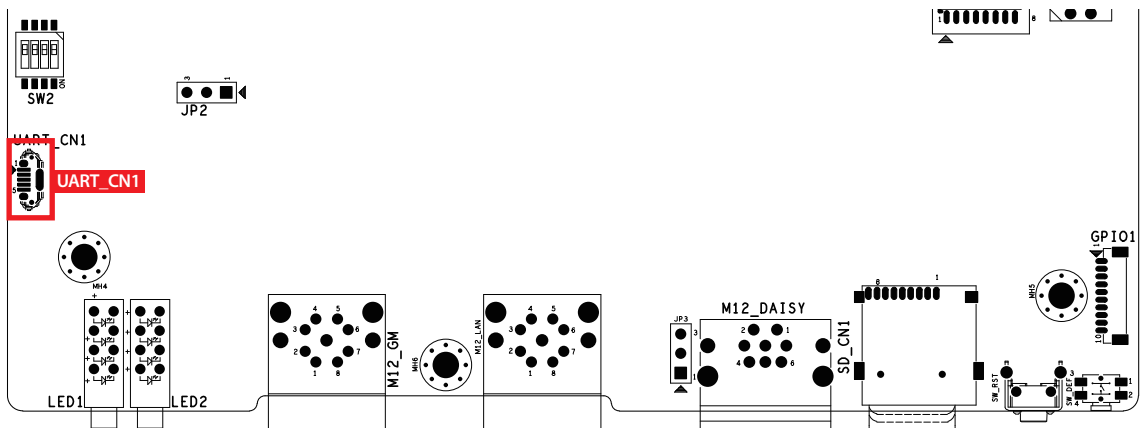
2.4.1.2 JRST : Miscellaneous Pin Header



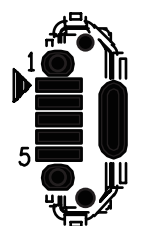
The pinouts of Miscellaneous port are listed in following table :

	Pin No.	Definition
	1	1
2	2	GND

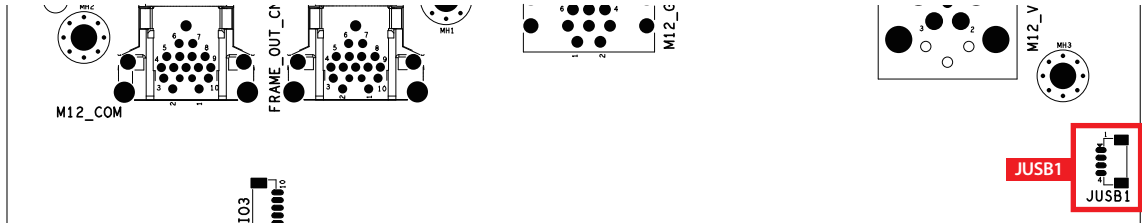
2.4.1.3 UART_CN1 : external firmware update connector



The pinouts of Miscellaneous port are listed in following table :

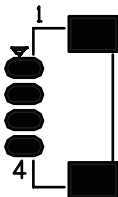
	Pin No.	Definition
	1	VBUS
	2	USB_DN
	3	USB_DP
	4	NC
5	GND	

2.4.1.4 JUSB1



There is a USB 2.0 connections available supporting up to 480MB per second data rate in VTS-1000.

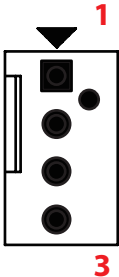
The pindefine are listed in following table :

	Pin No.	Definition
	1	VBUS
	2	USB_DN
	3	USB_DP
	4	GND

2.4.1.5 SYS_FAN1



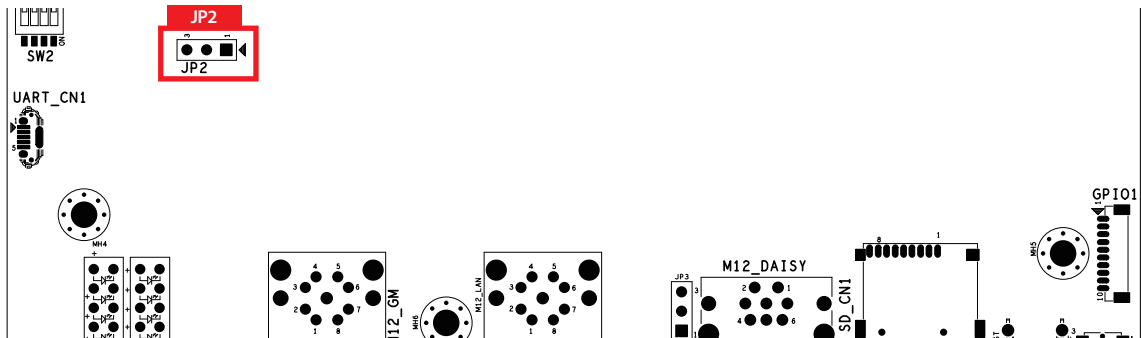
Fan power connector supports higher thermal requirements .The pindefine are listed in following table :

	Pin No.	Definition
	1	VBUS
	2	USB_DN
	3	USB_DP
	4	GND


2.4.1.6 IO_CN1 : IO board connector



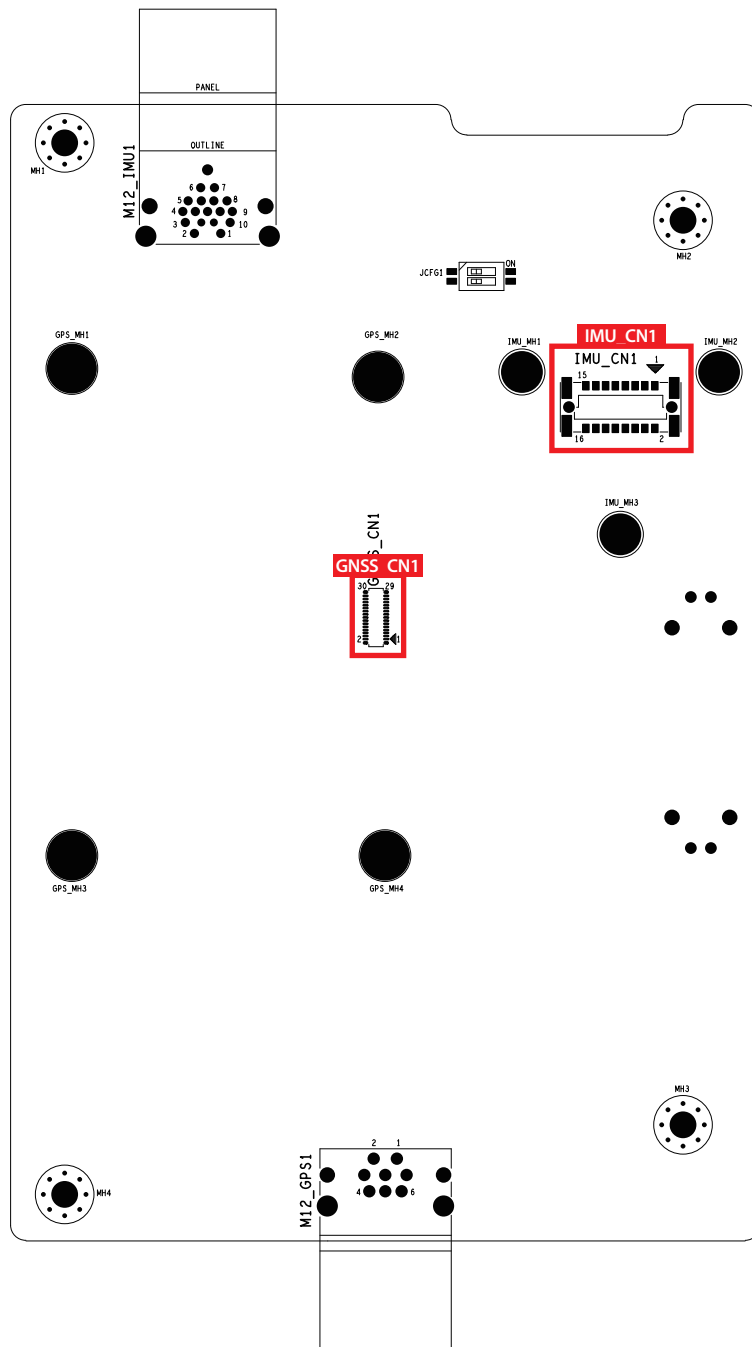
2.4.1.7 JP2 : LAN1 Led header



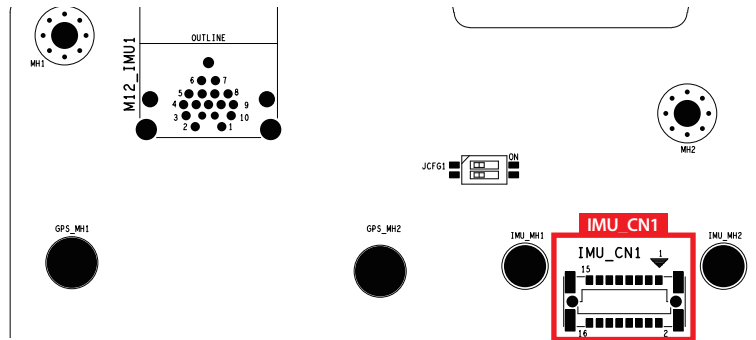
The pindefine are listed in following table :

	Pin No.	Definition
	1	LAN1_ACT_N
	2	LAN1_LINK_N
	3	GND

2.4.2 Top View of VTS-1000 series IO Board

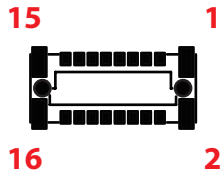


2.4.2.1 IMU_CN1 : IMU module connector

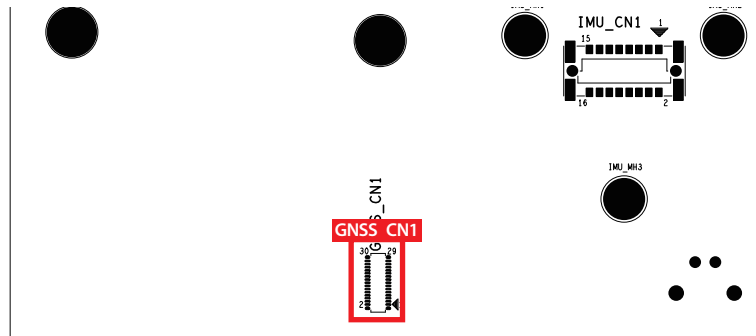


The pindefine are listed in following table :

	Pin No.	Definition	Pin No.	Definition
	1	P5V	2	GND
	3	CAN_H	4	CAN_L
	5	IMU_RS232_TX	6	IMU_RS232_RTS
	7	IMU_RS232_RX	8	IMU_RS232_CTS
	9	NC	10	IMU_BOARD_SYNC_IN
	11	NC	12	IMU_MAX3221_TX
	13	NC	14	GND
	15	UART_1_RX_IMU	16	UART_1_TX_IMU



2.4.2.2 GNSS_CN1 : GPS module connector

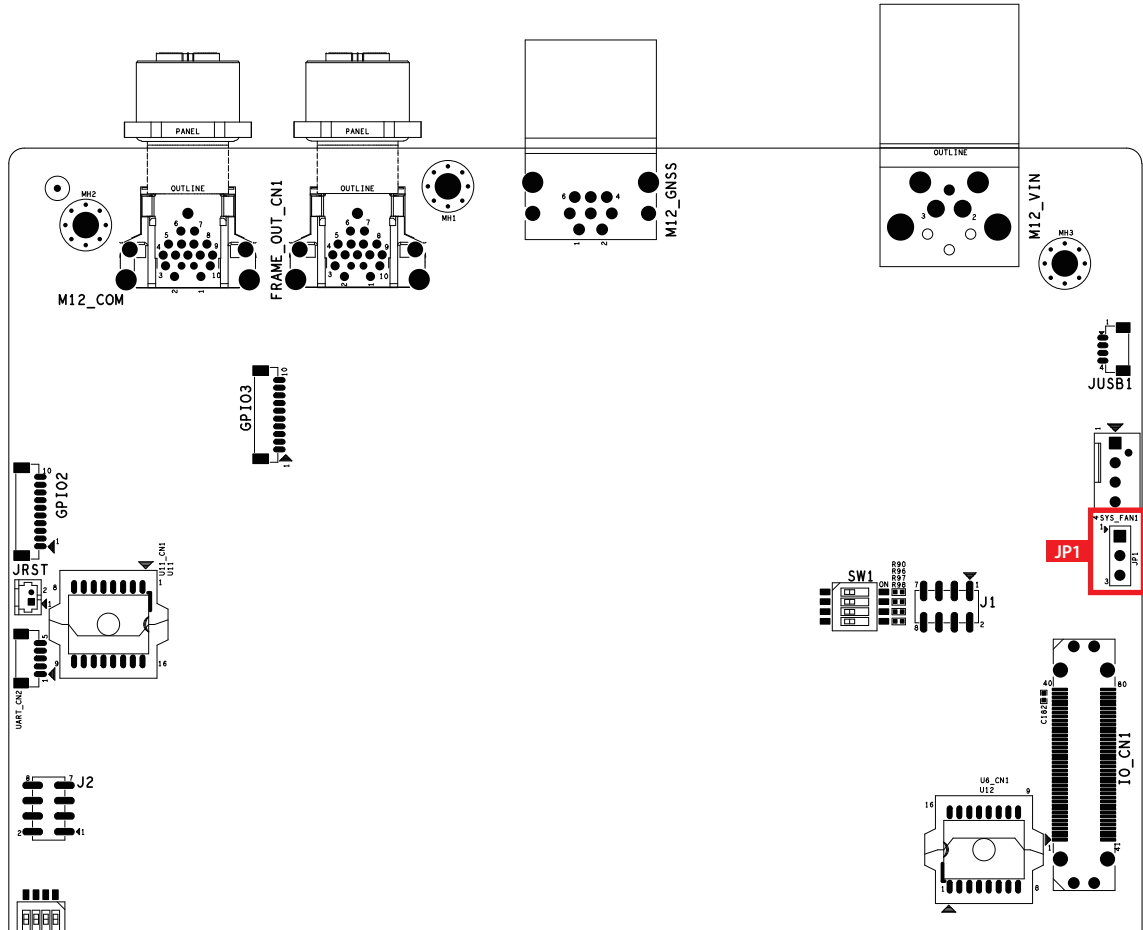


The pindefine are listed in following table :

	Pin No.		Definition	
	1	2	1	2
	1	2	P3V3	P3V3
	3	4	GND	GND
	5	6	NC	NC
	7	8	NC	GPS_nRST
	9	10	GNSS_TX_COM_0	GNSS_RX_COM_0
	11	12	GND	GNSS_PPS_IN
	13	14	GNSS_TX_COM_1	GNSS_RX_COM_1
	15	16	GNSS_TX_COM_2	GNSS_RX_COM_2
	17	18	GND	VANT
	19	20	NC	nPDN
	21	22	NC	GPLED
	23	24	GND	NC
	25	26	NC	GNSS_SD_CLK
	27	28	LOGLED	GNSS_SD_CMD
	29	30	GND	GNSS_SD_DAT

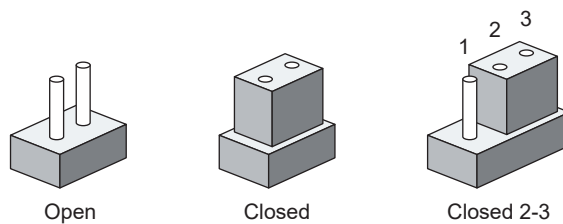
2.5 Main Board Jumper/Switch Settings

2.5.1 Board top view of the system main board with jumper

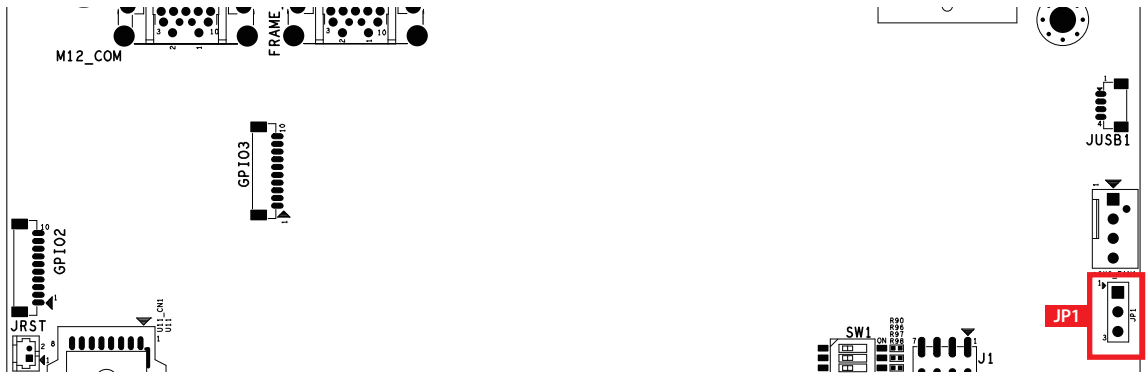




The figure below is the top view of the system main board which is the main board. It shows the location of the jumpers and the switches.

You may configure your card to match the needs of your application by setting jumpers. A jumper is a metal bridge used to close an electric circuit. It consists of two metal pins and a small metal clip (often protected by a plastic cover) that slides over the pins to connect them. To “close” a jumper, you connect the pins with the clip. To “open” a jumper, you remove the clip. Sometimes a jumper will have three pins, labeled 1, 2 and 3. In this case you would connect either pins 1 and 2, or 2 and 3.



2.5.2 JP1 :SYS_FAN1 Operation Voltage Select



	Pin No.	Definition
	1	FAN Operation Voltage 5V
	2	FAN Operation Voltage 12V (default)

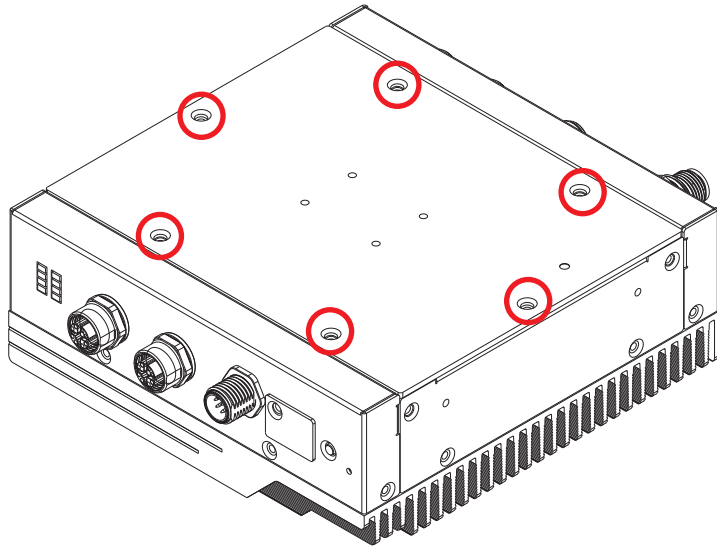
3

SYSTEM SETUP

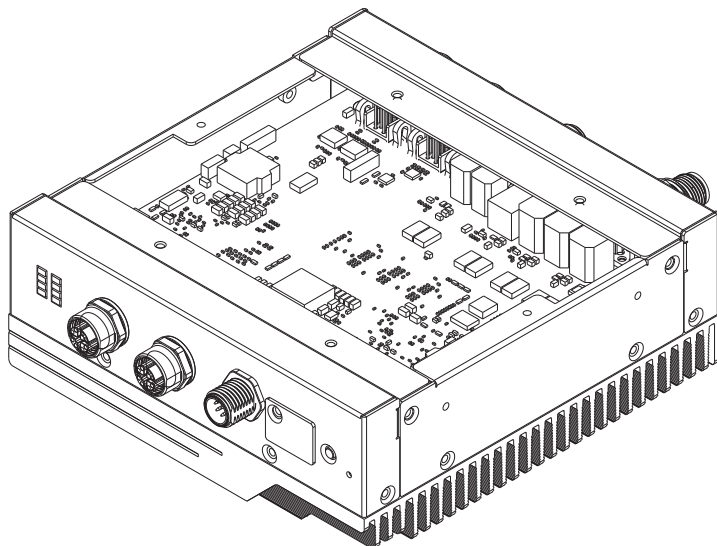
3.1 How to Open Your VTS-1100/1200/1200GU

3.1.1 VTS-1100

Step 1 Remove six Flat-M3x5L screws on Bottom Cover.

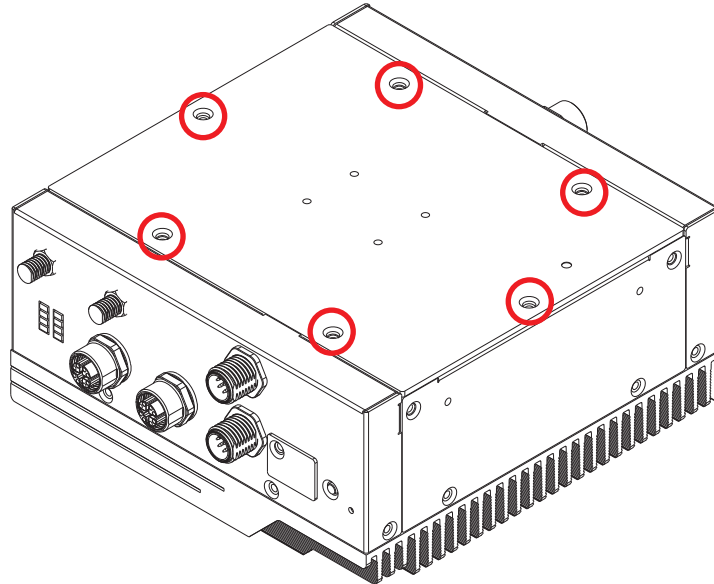


Step 2 Finish.

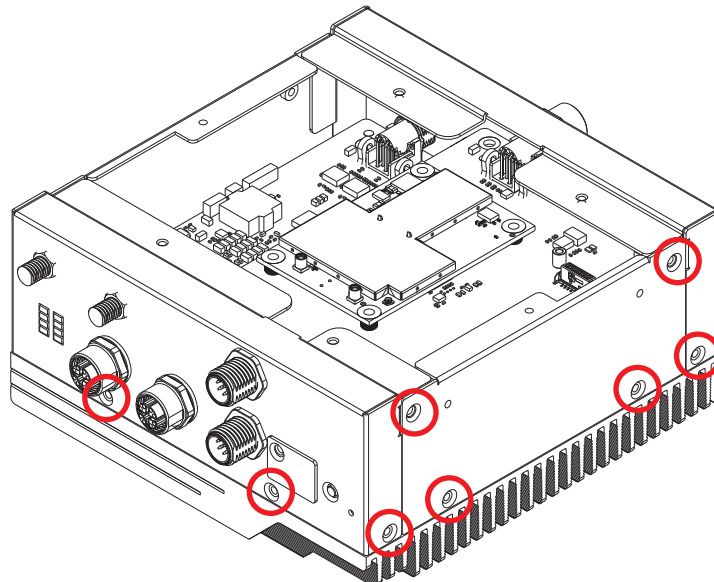


3.1.2 VTS-1200/1200GU

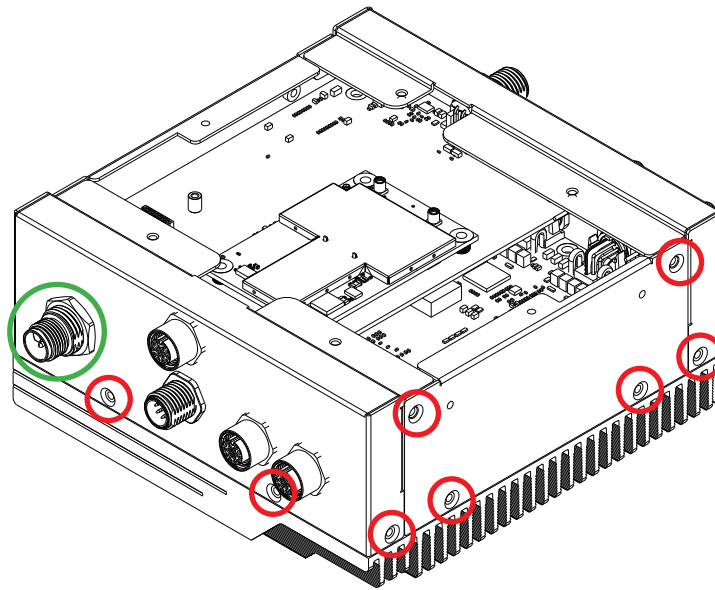
Step 1 Remove six Flat-M3x5L screws on Bottom Cover.



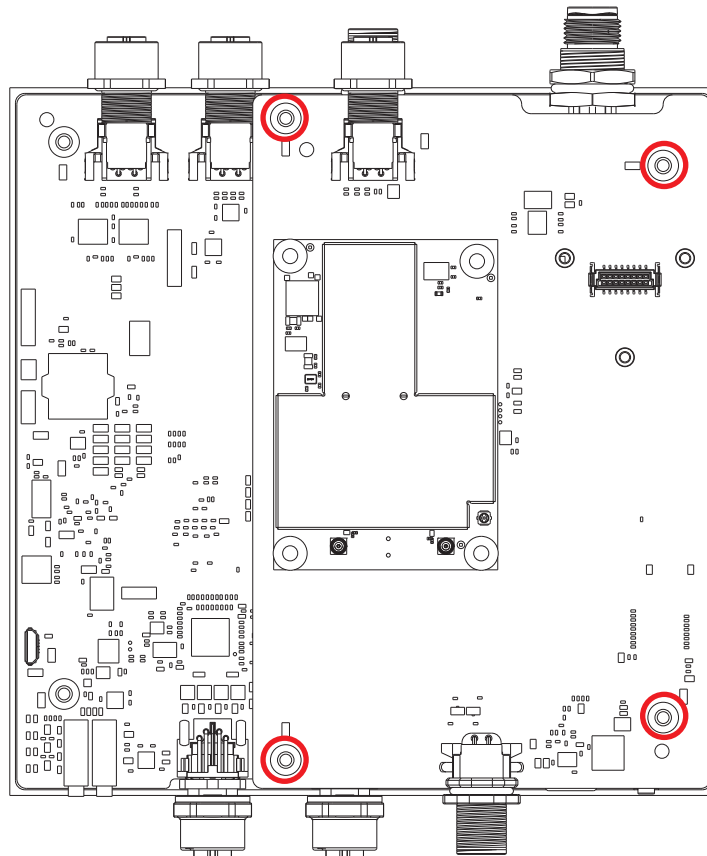
Step 2 Remove eight Flat-M3x5L screws at front and side panel.



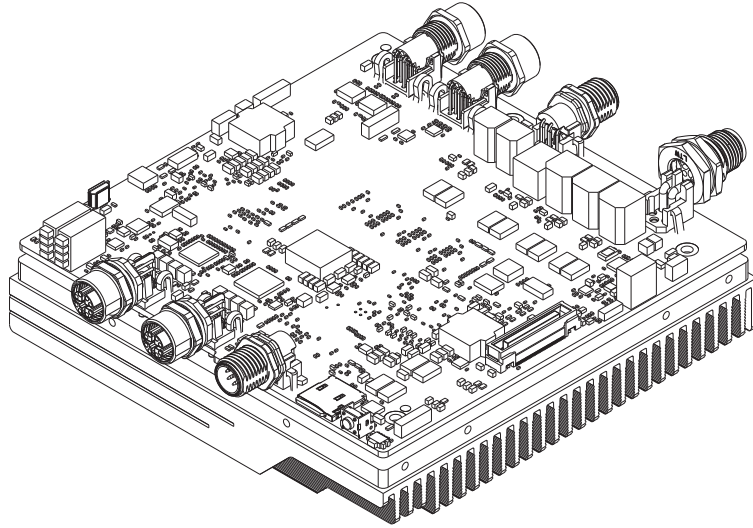
Step 3 Remove eight Flat-M3x5L screws at rear and side panel.
Remove one NUT on DC connector at rear panel.



Step 4 Remove four PH-M3x4L screws at I/O board.

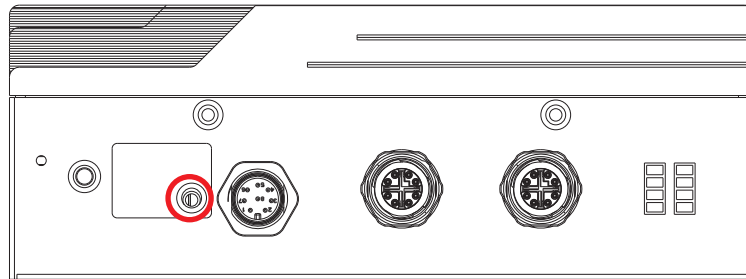


Step 5 Finish.

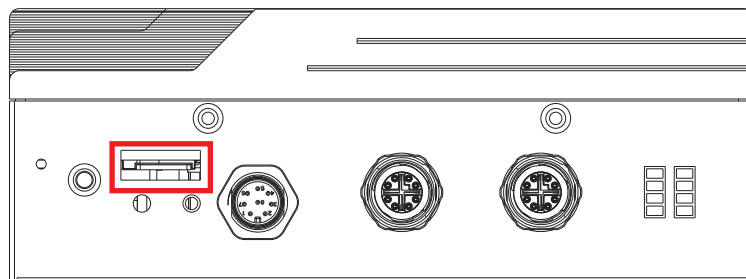


3.2 Installing Micro SD Card

Step 1 Remove one Flat-M3x5L screw on SD cover at front panel.

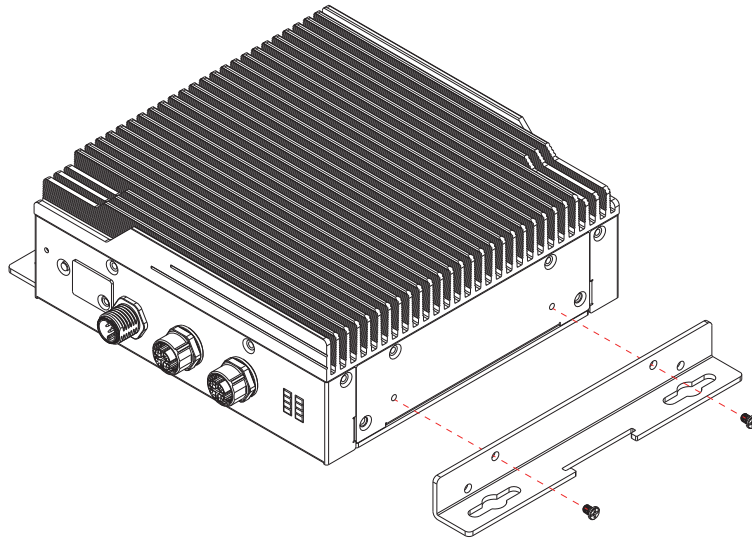


Step 2 Inserting Micro SD card.

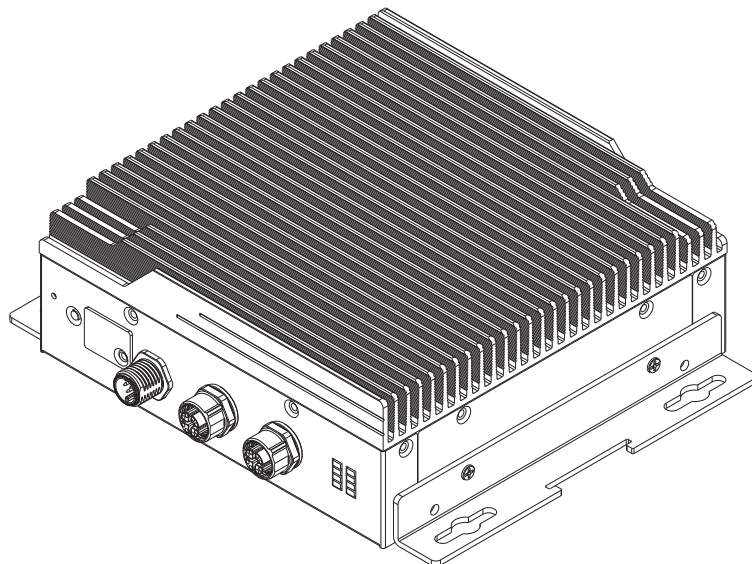


3.3 VTS-1100/1200/1200GU

Step 1 Ensure the screw holes on the right and left side match the ones on VTS-1000 series. Fasten four Hexagon M3x5L screws.



Step 2 Finish.



4

SOFTWARE SETUP

4.1 Getting Started with Your VTS-1100/1200/1200GU

This platform requires a personal computer to communicate with it. It is recommended to use Ubuntu as the operating system for your computer. To establish the connection, use a network cable to connect the LAN 2 port of the platform to the LAN port of your computer.

We provide ROS interface nodes and services for seamless integration. Therefore, it is recommended to install ROS 2 (Humble) on your computer.

Once the platform is powered on and connected to your computer via LAN 2, you can use a DHCP service to assign IP addresses to the platform. To verify the network connection, ping the platform to confirm successful communication. After confirming the network is operational, you can execute the following commands to interact with the ROS 2 interface:

```
ros2 topic list
```

```
ros2 service list
```

4.2 Time Synchronization

The Vecow VTS-1000 features three innovative technologies to ensure precise timing: Time Winding, Time Stamping, and Time Keeping. These features are supported by specialized hardware (FPGA) and intuitive software interfaces. In this section, we'll focus on how the VTS-1000 syncs time across networks and hardware.

4.2.1 Network Sync

The VTS-1000 uses LAN1 for Precision Time Protocol (PTP) and generalized PTP (gPTP) synchronization. This port allows external devices (such as switches or sensors) to sync with the device's clock. LAN 2 is reserved for user access to the VTS settings, allowing you to observe or modify operational parameters.

For more details and usage instructions with an connection to LAN 2, please refer to Section 4.3.3 to adjust the time synchronization settings.

To synchronize external devices (e.g., LiDAR or cameras), connect them to a PTP-enabled switch like the Netgear M4250. We validated the functionality using LinuxPTP version 3.1. If time synchronization fails, it is recommended to increase the “neighborPropDelayThresh” value.

4.2.2 Hardware Sync

As illustrated in Chapter 2, Hardware Sync supports three ports: SYNC IN, SYNC OUT, and FRAME OUT. We provide a SYNC IN cable to connect to an external GNSS input. Through this connection, the PPS and ToD signals from the GNSS are synchronized and output via the cable. Additionally, a frame trigger is provided for cameras that support the trigger pin.

To control these interfaces, three ROS services are available, offering enhanced functionality. For more details and usage instructions, please refer to Section 4.3.3: ROS Services.

4.3 ROS Node and Service List

The VTS series provides an interface for users to modify operational parameters and offers ROS topics and services for advanced developers requiring precise timestamps and synchronized sensor data. By default, the VTS publishes GNSS and IMU topics and provides services for developers to utilize ports such as SYNC IN, SYNC OUT, and FRAME OUT.

4.3.1 Prerequisites

Before entering the ROS environment, ensure it is correctly configured:

```
source /usr/bin/ros_setup.bash
```

Additionally, specify your ROS Middleware (RMW) implementation:

```
export RMW_IMPLEMENTATION=rmw_cyclonedds_cpp
```

```
export RMW_IMPLEMENTATION=rmw_fastrtps_cpp
```

4.3.2 ROS Nodes

The Vecow VTS-1200GU is equipped with the following default devices:

(a) Septentrio AsteRx-m3 Pro Dual GNSS Module

(b) Xsens MTi-670 9-axis IMU

If these devices are correctly installed, their corresponding ROS nodes will start automatically. You can manually launch them as follows:

```
export RMW_IMPLEMENTATION=rmw_cyclonedds_cpp
```

```
ros2 launch bluespace_ai_xsens_mti_driver xsens_mti_node.launch.py
```

```
ros2 launch septentrio_gnss_driver rover_node.launch.py
```

4.3.3 ROS Services

4.3.3.1 Time Zone

This service aligns your time zone to your current location.

```
export RMW_IMPLEMENTATION=rmw_cyclonedds_cpp
```

```
ros2 service call /set_time_zone vts_interfaces/srv/SetTimeZone
```

4.3.3.2 PTP Profile

This service switches the PTP profile to one of the PTP profiles: PTP, ptpv2, or gPTP.

```
export RMW_IMPLEMENTATION=rmw_cyclonedds_cpp
```

```
export RMW_IMPLEMENTATION=rmw_cyclonedds_cpp
```

```
ros2 service call /set_ptp_profile vts_interfaces/srv/SetPtpProfile '{"ptp_profile': 'gptp'}"
```

And you can use the "--help" flag to see the specific ptp_profile name.

4.3.3.3 Time Source

This service switches time synchronization to an external time source (SYNC IN).

```
export RMW_IMPLEMENTATION=rmw_fastrtps_cpp
```

```
ros2 run vts_client vts_ts_client
```

And you can use the parameter "time_source" to specify the external time source.

4.3.3.4 Time Serial Port

This service modifies the ToD NMEA data (SYNC OUT).

```
export RMW_IMPLEMENTATION=rmw_fastrtps_cpp
```

```
ros2 run vts_client vts_tsyn_client --com 1 --baud 2
```

And the following parameters are provided to customize the service.

- com: Specifies the communication port.
- baud: Sets the baud rate.
- ctime: Configures the cycle time.
- dtime: Defines the defer time.
- pulsew: Sets the pulse width.
- sat: Specifies the satellite source.
- sched: Configures the scheduling.

4.3.3.5 Frame Triggering

This service triggers camera captures (FRAME OUT).

```
export RMW_IMPLEMENTATION=rmw_fastrtps_cpp
```

```
ros2 run vts_client vts_fsyn_client --com 1 --frate 30
```

And the following parameters are provided to customize the service.

- com: Specifies the communication port.
- frate: Sets the frame rate.
- dtime: Defines the defer time.
- pulsew: Configures the pulse width.

4.3.4 Additional Notes

- Ensure the specified RMW implementation is compatible with your ROS2 setup.
- Use “ros2 node list” to verify that the nodes are running.
- Check “ros2 topic echo <topic_name>” to confirm data is being published.
- If a service does not respond, verify the service is available using “ros2 service list”.

A

APPENDIX A : Power Consumption

Testing Board :	VTS-1000
RAM	8GB * 1
Lan1	Lan connect to Router
Lan2	Lan connect to Router
Power plan	Balance
Power Source	Chroma 62006P-100-25
Test Program	SE-Durability-Test

Power on and boot to Yocto

CPU	Power Input	Power on and boot to Yocto	
		Run 100% CPU	
		Max Current	Max Consumption
Xilinx Zynq® UltraScale+™ ZU5EG MPSoC	5V	3.257A	16.290W
	12V	1.267A	15.204W
	24V	0.646A	15.504W
	48V	0.448A	21.504W
	60V	0.475A	28.505W

** If more help is needed, please contact Vecow Technical Support.



For further support information, please visit www.vecow.com

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