

Quick Start Guide

for

OBU-352 Family

Product Variants

Model	Description
OBU-352	V2X On-Board Unit, 0A1
OBU-352ED	DSRC-V2X On-Board Unit, V2Xcast® - Europe ETSI ITS-G5 stack, 0A1
OBU-352UC	C-V2X On-Board Unit, V2Xcast® - US C-V2X stack, 0A1
OBU-352UD	DSRC-V2X On-Board Unit, V2Xcast® - US DSRC/WAVE stack, 0A1
EVK-352	V2X Starter Kit, 0A1
EVK-352ED	DSRC-V2X Starter Kit, V2Xcast® - Europe ETSI ITS-G5 stack, 0A1
EVK-352UC	C-V2X Starter Kit, V2Xcast® - US C-V2X stack, 0A1
EVK-352UD	DSRC-V2X Starter Kit, V2Xcast® - US DSRC/WAVE stack, 0A1

Reviewers

Department	Name	Acceptance Date	Note
PD	Nidor Huang	2023/07/10	
RD	P.C Kang	2023/07/10	

Modification History

Revision	Date	Originator	Comment
0.1	2021/08/23	Nidor Huang	Creating document
0.2	2021/10/13	Nidor Huang	Adding product variants Adding product characteristics Adding dimensions and weight Adding EVK package content
0.3	2022/04/15	Nidor Huang	Adding GNSS antenna detection mechanism
0.4	2022/07/13	Nidor Huang	Adding tamper backup power description
0.5	2022/12/30	Nidor Huang	Updating product variants to 352 series Updating functional block diagram

Revision	Date	Originator	Comment
			Updating product photos
0.6	2023/03/03	Nidor Huang	Updating Unex BSP interface settings Updating product photos Adding V2X antenna detection function Updating maximum supply voltage
0.7	2023/03/08	Nidor Huang	Updating Unex logo Adding GNSS reset in Unex BSP interface settings
0.8	2023/05/10	Nidor Huang	Changing Ethernet over USB protocol to RNDIS
0.9	2023/07/10	Nidor Huang	Updating functional block diagram Updating SAR_ADC file path Removing EC series from product variants

Unex Confidential

TABLE OF CONTENTS

1. Objective.....	6
2. Reference	6
3. Limited Warranty Policy	6
4. Safety Guidelines.....	7
5. Product Appearance	7
6. Functional Block Diagram	9
7. Electrical Characteristics	10
7.1. Absolute Maximum Ratings	10
7.2. Recommended Operating Conditions.....	10
7.3. Power Consumption.....	12
8. I/O Interfaces	12
8.1. OBU-352	12
8.1.1. External Interfaces.....	12
8.1.2. Internal Interfaces	18
8.2. I/O Conversion Board (EVK-352 Series Only).....	24
8.2.1. Console.....	24
8.2.2. Ext GNSS.....	25
8.2.3. CAN0	25
8.2.4. CAN1	26
8.2.5. USB1.....	27
8.2.6. GPIO	27
8.2.7. DC Power Jack	28
8.2.8. Reset Button	28
9. Dimensions and Weight.....	29
10. Software Settings.....	30

LIST OF FIGURES

Figure 1: OBU-352 series package content	8
Figure 2: EVK-352 series package content.....	8
Figure 3: OBU-352 series complete assembly appearance.....	9
Figure 4: Functional block diagram	9
Figure 5: LED.....	12
Figure 6: USB0 (CN2)	13
Figure 7: Ethernet port.....	14
Figure 8: I/O port (J8)	14
Figure 9: I/O port cable connector	15

Figure 10: V2X antenna ports.....	16
Figure 11: GNSS antenna port	16
Figure 12: Mini PCIe Port (J6)	18
Figure 13: SIM slot (J7)	20
Figure 14: Tamper input (J5)	21
Figure 15: SAR ADC input (J4).....	22
Figure 16: DIP switches. SW3 (Left), SW2 (Right).....	23
Figure 17: EX-46 (Left), EX-47 (Right)	24
Figure 18: Console port (CN4)	24
Figure 19: Ext GNSS port (CN6)	25
Figure 20: CAN0 port (CN5).....	25
Figure 21: CAN0 terminator jumpers (JP1/JP2).....	26
Figure 22: CAN1 port (CN7).....	26
Figure 23: CAN1 terminator jumpers (JP3/JP4).....	27
Figure 24: USB1 port (CN2)	27
Figure 25: GPIO headers (J1)	27
Figure 26: DC power jack	28
Figure 27: Reset button	28
Figure 28: Mechanical dimensions - TOP	29
Figure 29: Mechanical dimensions - FRONT	29

LIST OF TABLES

Table 1. Absolute maximum ratings.....	10
Table 2. Recommended operating conditions	10
Table 3: Power consumption	12
Table 4: LED function	13
Table 5: USB0 (CN2) pinout	13
Table 6: Ethernet LED function.....	14
Table 7: I/O port pin map (J8).....	15
Table 8: I/O port pinout (J8).....	15
Table 9: V2X antenna status.....	16
Table 10: GNSS antenna status	17
Table 11: Mini PCIe pinout (J6, Row 0)	18
Table 12: Mini PCIe pinout (J6, Row 1)	19
Table 13: Tamper functions (J5)	21
Table 14: SAR ADC functions.....	22
Table 15: SAR ADC performance	23
Table 16: SW2 and SW3 functions	23

Table 17: Console pinout (CN4)	24
Table 18: Ext GNSS pinout (CN6)	25
Table 19: CAN0 pinout (CN5)	25
Table 20: CAN1 pinout (CN7)	26
Table 21: USB1 pinout (CN2)	27
Table 22: GPIO pinout (J1)	27
Table 23: Dimensions and weight.....	29
Table 24: Unex BSP interface settings	30

Unex Confidential

1. Objective

The purpose of this document is to provide necessary information to help setup and installation of OBU-352 series product. To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to OBU-352. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

2. Reference

- Unex OBU-352 datasheet
- Unex EVK-352 datasheet

3. Limited Warranty Policy

Unex Technology Corporation selling the product warrants that commencing from the date of shipment to customer and continuing for a period of twelve (12) months. This limited warranty extends only to the original customer of the product. Customer's sole and exclusive remedy and the entire liability of Unex under this limited warranty will be, at Unex's option, return for repair to Unex's repair center with freight and insurance prepaid or shipment of a replacement within the warranty period or a refund of the purchase price if the hardware is returned to Unex. Unex's obligations hereunder are conditioned upon the return of affected hardware in accordance with Unex's service center's then-current Return Material Authorization (RMA) procedures.

This warranty does not cover:

- Products found to be defective after the warranty period has expired.
- Products subjected to misuse or abuse, whether by accident or other causes. Such product conditions will be determined by Unex at its sole and unfettered discretion.
- Products damaged due to a natural disaster, including but not limited to lightning, flooding, earthquake, or fire.
- Software products.
- Products dismantled or opened by unauthorized persons. Please contact a representative of Unex if you need advanced technical support.
- Products with an altered and/or damaged serial number.

-
- Loss of data or software.
 - Products that have been updated, reworked, or improperly tested by the Customer, or by a third party at the request of the Customer.
 - Customized and original design manufacturer (ODM) products. The warranty terms for customized and ODM products should be defined in the contract that governs the project.

4. Safety Guidelines

- Keep working area clean and dry while assembling/installing.
- When operating under extreme temperature conditions, environmental control measures (e.g., heating, cooling) should be considered.
- It is suggested to connect the metal enclosure to a well-grounded metal structure (i.e., vehicular chassis).
- Make sure every accessory has been fastened, including the V2X antennas, GNSS antenna, Ethernet cable, and I/O cable.

5. Product Appearance

An OBU-352 series package contains the following items:

- OBU-352 x1
- V2X antenna x2
- GNSS antenna x1
- Mini-USB Y-cable x1
- USB charger x1

The photos shown in this document may seem different from actual product. However, the differences do not affect actual functionalities.



Figure 1: OBU-352 series package content



Figure 2: EVK-352 series package content



Figure 3: OBU-352 series complete assembly appearance

6. Functional Block Diagram

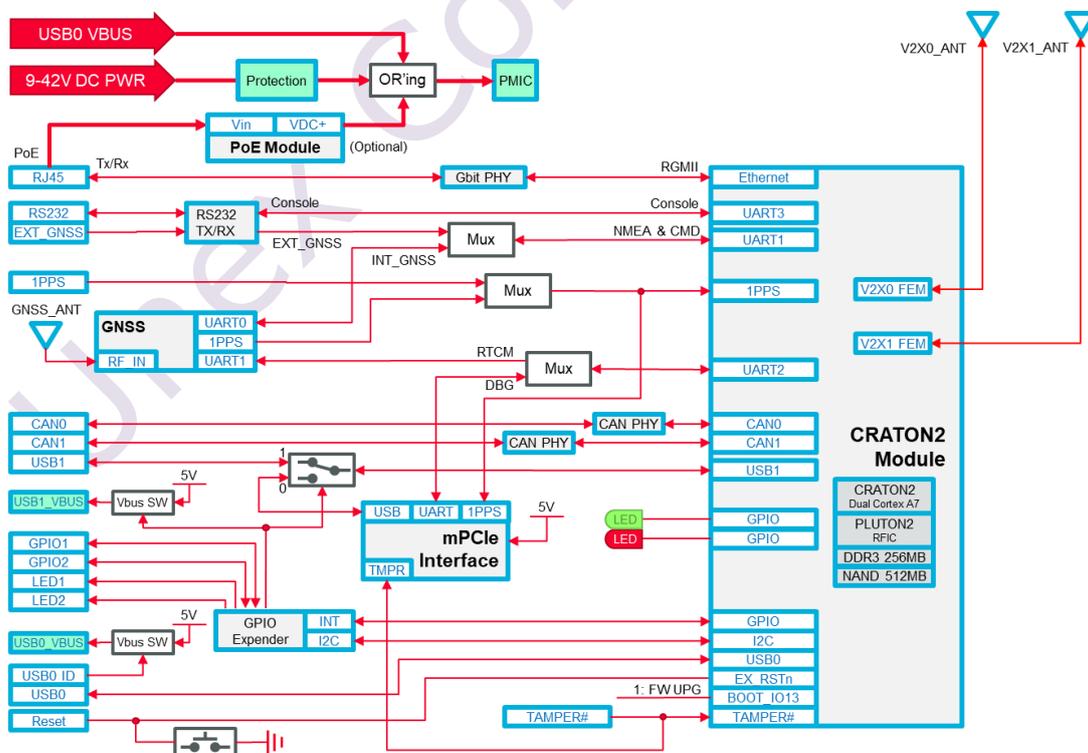


Figure 4: Functional block diagram

7. Electrical Characteristics

7.1. Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted).

Table 1. Absolute maximum ratings

Parameters	Conditions	Min.	Max.	Unit
Storage Temperature	-	-40	105	°C
Supply Voltage	USB0 Vbus	-0.3	6.0	V
	POWER (J8.1)	-180	180	V
I/O Interface Voltage	RS232 Receiver *1	-13	60	V
	RS232 Driver *2	-6	60	V
	CAN0/CAN1 *3	-40	40	V
	USB1_Vbus	-2	25/20 *4	V
	GPIO1/GPIO2	-0.5	16.5	V
	EXT_1PPS RESET USB_DN/USB_DP	-0.3	16.5	V
V2X maximum input level	-	-	10	dBm
GNSS maximum input level	-	-	-10	dBm
Note: *1: RS232 Receiver: TX (J8.4), EXT_GNSS_RX (J8.13) *2: RS232 Driver: RX (J8.3), EXT_GNSS_TX (J8.14) *3: CAN0/CAN1: CAN0_H (J8.6), CAN0_L (J8.16), CAN1_H (J8.7), CAN1_L (J8.17) *4: If USB1_Vbus = ON, 25V; if USB1_Vbus = OFF, 20V Note: (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime. (2) All voltages are with respect to network GND.				

7.2. Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted).

Table 2. Recommended operating conditions

Parameters	Conditions	Min.	Typ.	Max.	Unit
Ta (Ambient operating temperature)	Free-air temp.	-40	25	85	°C
Supply voltage	USB0 Vbus	4.8	5.0	5.2	V
	POWER	9	12	42	V
USB1_Vbus output	Vbus voltage	4.8	5.0	5.2	V

Parameters	Conditions	Min.	Typ.	Max.	Unit
	Output current	-	500	900	mA
VIL (Input low level voltage)	EXT_1PPS RESET TAMPER GPIO1/GPIO2	-0.3	-	0.8	V
	RS232 *1	0.8	1.5	-	V
VIH (Input high level voltage)	EXT_1PPS RESET TAMPER GPIO1/GPIO2	2.0	-	3.6	V
	RS232 *1	-	1.8	2.4	V
RPU (Equivalent pull-up)	EXT_1PPS	32	50	60	kΩ
	RESET	1.8	2.1	2.3	kΩ
	TAMPER *2	0.9	1.0	1.1	kΩ
RPD (Equivalent pull-down)	TAMPER *3	32	50	60	kΩ
VOL (Output low level voltage)	GPIO1/GPIO2 *4	-	-	0.7	V
	RS232 *5	-5	-5.4	-	V
VOH (Output high level voltage)	GPIO1/GPIO2 *4	2.5	-	-	V
	RS232 *5	5	5.4	-	V
IOL (low level output current)	GPIO1/GPIO2	-	10	18	mA
IOH (high level output current)	GPIO1/GPIO2	-	-	-10	mA
EXT_1PPS (J8.12) tolerance	Accuracy/Bias	-100	-	100	ns
	Precision/Jitter	-30	-	30	ns
	Pulse width	15	-	-	ns
V2X antenna gain	5850-5925MHz	-	-	5	dBi
V2X sensitivity	PER ≤ 10%	-92	-	-	dBm
	PER ≤ 10%, -40 - +85 °C	-82	-	-	dBm
V2X maximum Input Level	PER ≤ 10%	-	-	-30	dBm
V2X adjacent channel rejection	-	13	-	-	dB
V2X non-adjacent channel rejection	-	29	-	-	dB
V2X output power	Spectrum mask Class C	-	-	20	dBm
GNSS antenna gain	Antenna Gain	-	-	-2	dBic
	LNA Gain *4	24	27	30	dB
GNSS sensitivity (C/N ₀)	Acquisition	22	30	45	dB-Hz
GNSS antenna bias	I _{ANT} ≤ 20mA	3.0	-	3.3	V
GNSS antenna detection current	I _{ANT} *6	12	-	58	mA
Note: *1: TX (J8.4) / EXT_GNSS_RX (J8.13) *2: TRIGGER_SW (SW3.2) = ON *3: TRIGGER_SW (SW3.2) = OFF *4: IOL = 10 mA, IOH = -10mA *5: RX (J8.3) / EXT_GNSS_TX (J8.14) *6: I _{ANT} under Min. = OPEN; I _{ANT} over Max. = SHORT; I _{ANT} between Min/Max. = NORMAL.					

7.3. Power Consumption

OBU-352 can be powered from a DC power source (e.g., automotive ACC) or from a mini-USB Vbus power source. OBU-352 will automatically switch to the power source with the highest input voltage. Changing power source can be done any time before and during operation, however a reset may be triggered during switch.

Table 3: Power consumption

Condition			Power Consumption		
Temp.	Power Source	Voltage (V)	Low *1	Typical *2	High *3
25°C	USB0 Vbus	5	0.52A (2.60W)	0.53A (2.65W)	0.94A (4.70W)
	POWER (J8.1)	12	0.24A (2.88W)	0.25A (3.00W)	0.45A (5.40W)
85°C	USB0 Vbus	5	0.65A (3.25W)	0.66A (3.30W)	1.03A (5.15W)
	POWER (J8.1)	12	0.30A (3.60W)	0.30A (3.60W)	0.50A (6.00W)

Note:
 *1: RX only
 *2: TX @ 1% duty cycle (CH172, 20dBm, 6Mbps, 750B, 10Hz)
 *3: TX @ 100% duty cycle (CH172, 20dBm)

8. I/O Interfaces

8.1. OBU-352

8.1.1. External Interfaces

8.1.1.1. LED



Figure 5: LED

Table 4: LED function

Position	Symbol	Color	Description
1	STATUS *Note	Green Amber Red	Start-up: Blinking Green Operational: Solid Green FW upgrade: Amber Fault: Red
2	POWER	Green	System power indicator
3	1PPS	Green	ON: 1PPS signal HI OFF: 1PPS signal LOW Blinking: receiving 1PPS signal
4	EXT_GNSS	Green	ON: 1PPS and NMEA from external GNSS module OFF: 1PPS and NMEA from internal GNSS module
5	WWAN	Green	ON: LTE module connected to WWAN
6	LED1	Green	User defined LED
7	LED0	Green	User defined LED

Note: Please see [TABLE 24: UNEX BSP INTERFACE SETTINGS](#) for Status LED BSP settings. The definition of each status and its related behavior should be implemented by the user.

8.1.1.2. USB0



Figure 6: USB0 (CN2)

Table 5: USB0 (CN2) pinout

Pin	Symbol	I/O	Level (V)	Description
CN2.1	VBUS	I/O	5.0	USB device mode = USB 5V power input USB host mode = 5V/900mA power output (e.g., when connecting an OTG cable)
CN2.2	D-	I/O	0.4	Data -
CN2.3	D+	I/O	0.4	Data +
CN2.4	ID	I	-	USB device mode = NC USB host mode = Tied to GND (e.g., connecting an OTG cable)
CN2.5	GND	G	-	Ground

USB0 (CN2) on OBU-352 is a USB 2.0 dual role device which can act as either a USB device or a USB host. The connector of USB0 is mini-B.

When connecting to a computer or a USB charger with a regular mini-USB cable, OBU-352 acts as a USB device and is powered by the external Vbus. However, when connecting to another USB device (e.g., USB flash drive) with a mini-USB OTG cable, OBU-352 acts as a USB host and starts providing 5V Vbus power to the USB device up to 900mA.

The power input/output is determined by the hardware design of the OTG cable. However, setting of the USB mode and detection of external device should be implemented by the user.

8.1.1.3. Ethernet



Figure 7: Ethernet port

Table 6: Ethernet LED function

LED	Symbol	Color	Description
1	LINK	Green	ON = link up, OFF = link down
2	ACTIVE	Yellow	Flashing = activity detected, OFF = no activity

OBU-352 has one Gigabit Ethernet port which supports 10/100/1000 Mbps connection. It is suggested to use an Ethernet cable compatible with Cat5e or above standard for best connection speed. The connector type should be RJ45 (TIA/EIA 568B).

The Ethernet port also acts as a 12W PoE (802.3af) PD (powered device) with an add-on PoE module, POE-301. It supports both mode A and mode B PSE (power sourcing equipment). POE-301 is not included in product package and should be ordered separately if needed. Passive PoE is not supported.

8.1.1.4. I/O Port



Figure 8: I/O port (J8)

The I/O port (J8) is the main interface of OBU-352 for console, in-vehicle networks and peripherals. The I/O port connector is JST SM20B-CPTK-1A-TB, and the mating cable connector is JST 20CPT-B-2A (see [FIGURE 9: I/O PORT CABLE CONNECTOR](#)). A cable assembly with 24AWG wire should be used to connect to vehicular wire harnesses.

Table 7: I/O port pin map (J8)

Pin No.	10	9	8	7	6	5	4	3	2	1
Symbol	GPIO1	USB1_VBUS	USB1_DP	CAN1_H	CAN0_H	GND	TX	RX	RESET	POWER
Pin No.	20	19	18	17	16	15	14	13	12	11
Symbol	GPIO2	GND	USB1_DN	CAN1_L	CAN0_L	GND	EXT_GNSS_TX	EXT_GNSS_RX	EXT_1PPS	GND

Table 8: I/O port pinout (J8)

Pin	Symbol	I/O	Level (V)	Description
J8.1	POWER	I	-	6-48V DC input, 12W
J8.2	RESET	I	3.3	Reset CRATON2 Linux system. (Active LOW) Low=reset, high or float=running
J8.3	RX	O	5.0	RS232 serial data to DTE (console)
J8.4	TX	I	5.0	RS232 serial data from DTE (console)
J8.5	GND	G	-	Ground
J8.6	CAN0_H	I/O	5.0	CAN0 High. 1KΩ split termination resistors inside CAN0 port.
J8.7	CAN1_H	I/O	5.0	CAN1 High. 1KΩ split termination resistors inside CAN1 port.
J8.8	USB1_DP	I/O	0.4	USB 2.0 data +
J8.9	USB1_VBUS	O	5.0	USB Vbus power output 5V/900mA GPIO508=0, USB1_VBUS OFF; GPIO508=1, USB1_VBUS ON (default)
J8.10	GPIO1	I/O	3.3	GPIO1
J8.11	GND	G	-	Ground
J8.12	EXT_1PPS	I	3.3	External 1PPS input
J8.13	EXT_GNSS_RX	I	5.0	RS232 serial data from DCE (e.g., an external GNSS device)
J8.14	EXT_GNSS_TX	O	5.0	RS232 serial data to DCE (e.g., an external GNSS device)
J8.15	GND	G	-	Ground
J8.16	CAN0_L	I/O	5.0	CAN0 Low. 1KΩ split termination resistors inside CAN0 port.
J8.17	CAN1_L	I/O	5.0	CAN1 Low. 1KΩ split termination resistors inside CAN1 port.
J8.18	USB1_DN	I/O	0.4	USB 2.0 data -
J8.19	GND	G	-	Ground
J8.20	GPIO2	I/O	3.3	GPIO2

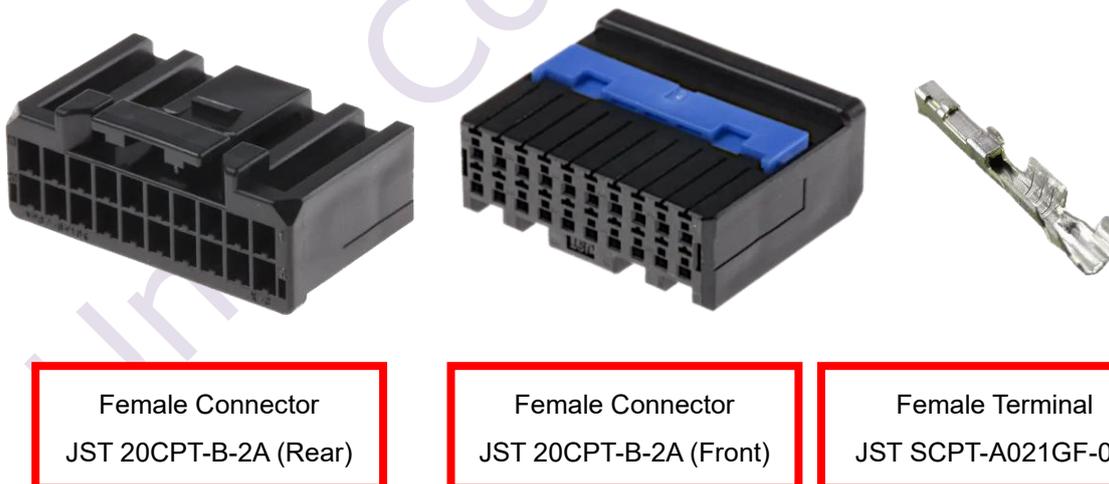


Figure 9: I/O port cable connector

8.1.1.5. 5.9GHz V2X



Figure 10: V2X antenna ports

OBU-352 provides two 5.9GHz V2X antenna connectors. Receptacle (jack) connectors are **FAKRA-Z**. User should connect a pair of V2X antenna to this port directly or with a pair of FAKRA-Z plug extension cables. A pair of FAKRA-Z V2X antennas (EX-55) are provided in product package.

The V2X antenna ports has a built-in antenna detection function. This detection mechanism only works with the stock EX-55 antennas provided.

Table 9: V2X antenna status

Antenna Status	Value	Command
OPEN	616-1023	V2X0: cat /sys/bus/iio/devices/iio\:device0/in_voltage4_raw V2X1: cat /sys/bus/iio/devices/iio\:device0/in_voltage5_raw
NORMAL	410-615	
SHORT	0-409	

8.1.1.6. GNSS



Figure 11: GNSS antenna port

OBU-352 provides one GNSS antenna connector. This GNSS antenna port is compatible with both passive and active GNSS antennas. The receptacle (jack) connector is **FAKRA-C**. User should connect a GNSS antenna to this port with a FAKRA-C plug cable. A FAKRA-C active GNSS antenna is provided in OBU-352 package.

For stable fix acquisition, at least 4 satellites with enough signal strength (C/N₀ value above 30 dB-Hz) are required. If the signal strength goes below 30 dB-Hz, the fix will become unstable.

8.1.1.7. GNSS Antenna Detection

The antenna detection mechanism is a 2-step process: First check the signal strength. If the signal strength drops to zero, then check the antenna status flag.

When all the C/N₀ values becomes null, it means that the GNSS antenna or its cable may either become detached or damaged. The GNSS antenna port has a built-in antenna detection function. The detection mechanism is based on the current consumption of an active antenna (I_{ANT}). If the active antenna consumes less current than 12 mA, then it is considered as the OPEN status; if the antenna consumes more than 58 mA, then it is considered as the SHORT status. Anything between 12-58 mA is considered as the NORMAL status.

The GNSS 3.3V antenna bias will be continuously supplied in OPEN/NORMAL status. Once the SHORT status is triggered, the SHORT flag will persist, and the 3.3V bias will be turned off until the reset of the GNSS module. After the reset of the GNSS module, the detection process will start all over again.

It is possible for a good active antenna to be reported OPEN because it consumes less current than 12 mA, or a good passive antenna to be considered SHORT because it is DC shorted (e.g., a slot antenna). However, as long as there are more than 4 satellites with enough signal strength (C/N₀ value above 30 dB-Hz), the GNSS is in good state.

The antenna status flag is reported in a proprietary NMEA message:

```
$PSTMANTENNASTATUS,<status>*<checksum><cr><lf>
```

where <status> can be:

- 0 - The antenna current is in the normal range (NORMAL)
- 1 - The antenna current is below the normal range (OPEN)
- 2 - The antenna current is above the normal range (SHORT)

Table 10: GNSS antenna status

Antenna Status	Current Consumption (mA)	3.3V bias	NMEA Sentence
OPEN	< 12	ON	\$PSTMANTENNASTATUS,1*4C
NORMAL	between 12- 58	ON	\$PSTMANTENNASTATUS,0*4D
SHORT	> 58	Turned OFF once triggered	\$PSTMANTENNASTATUS,2*4F

8.1.2. Internal Interfaces

8.1.2.1. Mini PCIe Port (Optional)

A USB 2.0 device with mini PCIe form factor can be connected to the mini PCIe port (J6). However please note that although the form factor is mini PCIe, the PCI Express interface is not available.

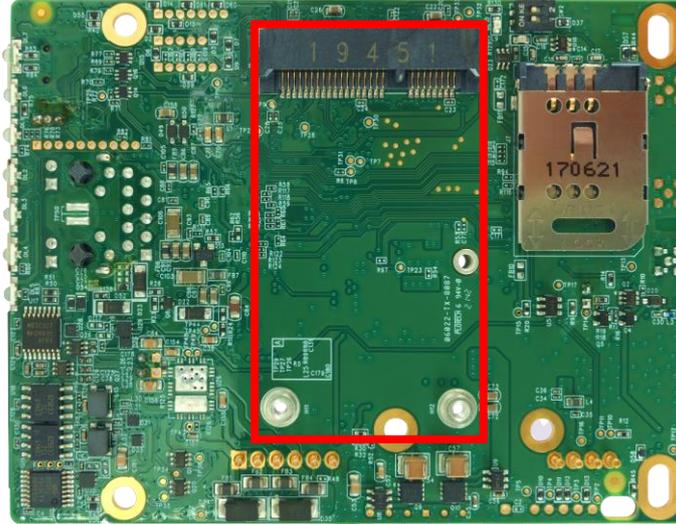


Figure 12: Mini PCIe Port (J6)

Table 11: Mini PCIe pinout (J6, Row 0)

Pin	Symbol	I/O	Level (V)	Description
J6.1	WAKE#	I	OC	Sierra MC series: Wake host. (OC output. Active LOW)
J6.3	5V	O	5.0	5V power output for SOM-300 family
J6.5	5V	O	5.0	5V power output for SOM-300 family
J6.7	NC	-	-	Not connected
J6.9	GND	G	-	Ground
J6.11	NC	-	-	Not connected
J6.13	NC	-	-	Not connected
J6.15	GND	G	-	Ground
-	KEY	-	-	Mechanical Key
J6.17	UART2_TX	O	3.3	UART transmit data output for SOM-300 family
J6.19	UART2_RX	I	3.3	UART transmit data input for SOM-300 family
J6.21	GND	G	-	Ground
J6.23	NC	-	-	Not connected
J6.25	NC	-	-	Not connected
J6.27	GND	G	-	Ground
J6.29	GND	G	-	Ground
J6.31	NC	-	-	Not connected
J6.33	NC	-	-	Not connected
J6.35	GND	G	-	Ground
J6.37	GND	G	-	Ground
J6.39	3.3 Vaux	O	3.3	Max 1100mA
J6.41	3.3 Vaux	O	3.3	Max 1100mA
J6.43	GND	G	-	Ground
J6.45	5V	O	5	5V power output for SOM-300 family
J6.47	5V	O	5	5V power output for SOM-300 family
J6.49	1PPS	O	3.3	GNSS 1 pulse per second input
J6.51	TAMPER#	O	3.3	0=Tamper tripped, 1=Normal operation. SW3.2 ON: J6.51 close to OBU-352 tamper SW3.2 OFF: J6.51 open from OBU-352 tamper

Table 12: Mini PCIe pinout (J6, Row 1)

Pin	Symbol	I/O	Level (V)	Description
J6.2	3.3 Vaux	O	3.3	Max 1100mA
J6.4	GND	G	-	Ground
J6.6	NC	-	-	Not connected
J6.8	UIM_PWR	O	3.0/1.8	SIM card power
J6.10	UIM_DATA	I/O	3.0/1.8	SIM card data
J6.12	UIM_CLK	O	3.0/1.8	SIM card clock
J6.14	UIM_RESET	O	3.0/1.8	SIM card reset
J6.16	NC	-	-	Not connected
-	KEY	-	-	Mechanical Key
J6.18	GND	G	-	Ground
J6.20	W_DISABLE#	O	OC	1 = Modem on; 0 = Modem off (Sierra MC series)
J6.22	PERST#	O	OC	Signal rising edge (0 -> 1) will reset mPCIe module
J6.24	3.3Vaux	O	3.3	Max 1100mA
J6.26	GND	G	-	Ground
J6.28	NC	-	-	Not connected
J6.30	NC	-	-	Not connected
J6.32	NC	-	-	Not connected
J6.34	GND	G	-	Ground
J6.36	USB_D-	I/O	0.4	USB 2.0 differential data (-)
J6.38	USB_D+	I/O	0.4	USB 2.0 differential data (+)
J6.40	GND	G	-	Ground
J6.42	LED_WWAN#	I	OC	WWAN LED signal. OC input. Active LOW.
J6.44	NC	-	-	Not connected
J6.46	DPR	O	OC	Dynamic Power Control (Sierra MC series) High: No SAR backoff; Low: Backoff 1
J6.48	NC	-	-	Not connected
J6.50	GND	G	-	Ground
J6.52	3.3 Vaux	O	3.3	Max 1100mA

8.1.2.2. SIM Slot (Optional)

If a WWAN (LTE) module is connected to the mini PCIe port, the sim card should be installed. The SIM slot has a metal flip lid. It is necessary to slide the lid into “Unlock” position before open it.

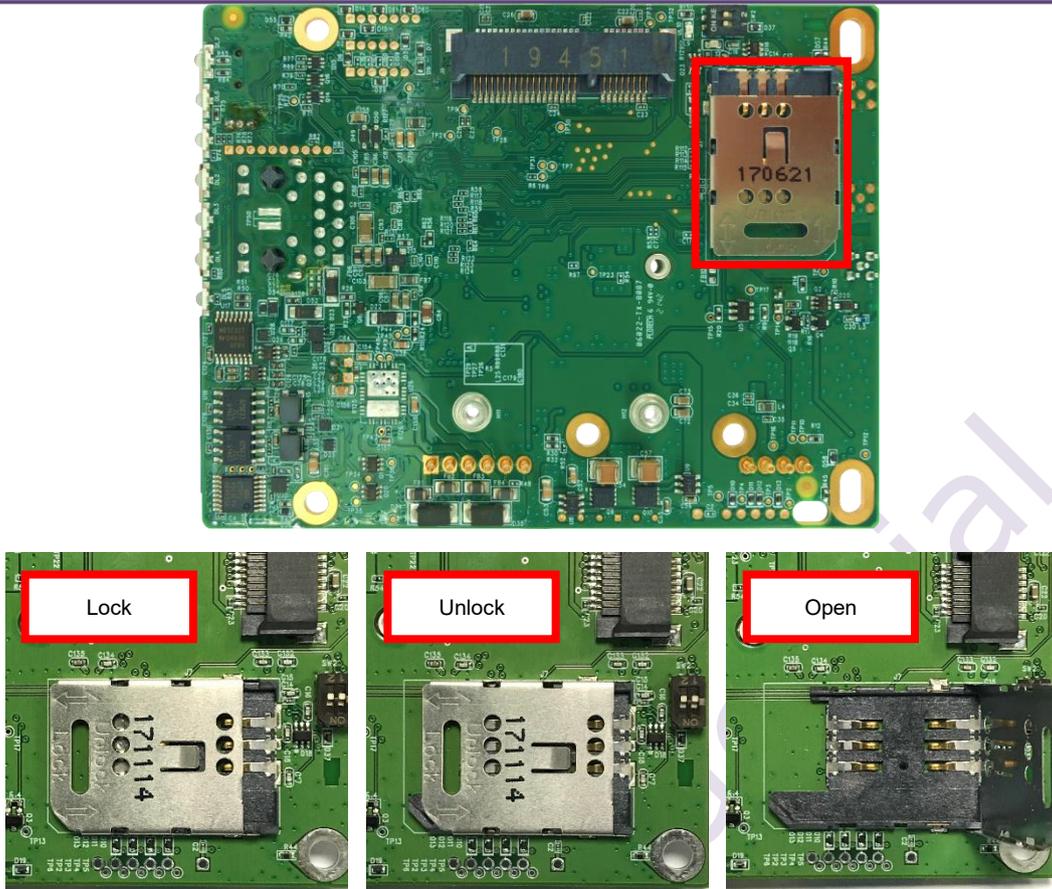


Figure 13: SIM slot (J7)

Unex Confidential

8.1.2.3. Tamper Detection (Optional)

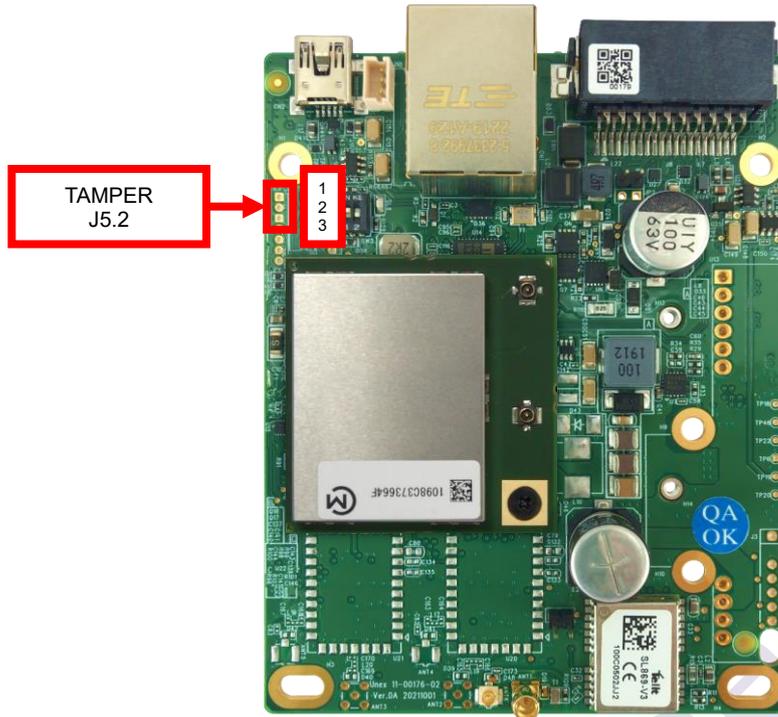


Figure 14: Tamper input (J5)

Table 13: Tamper functions (J5)

Pin	Symbol	I/O	Level (V)	Description
J5.1	VDD_3V3	O	3.3	3.3V power to tamper switch
J5.2	TAMPER	I	-	Tamper signal. Active LOW.
J5.3	GND	G	-	Ground
J5.4	Reserved	-	-	Reserved. Leave open if not used.
J5.5	Reserved	-	-	Reserved. Leave open if not used.
J5.6	Reserved	-	-	Reserved. Leave open if not used.
J5.7	Reserved	-	-	Reserved. Leave open if not used.

The tamper detection function will be supported by project base. It is disabled by default.

The OBU-352 has to be powered up for the tamper detection function to work. The design and implementation of a backup power source is not in the product scope and should be considered by the user.

J5 consists of 1.5mm pitch PTHs (Plated Through Holes) reserved for tamper detection function. For connecting the tamper signal, tamper signal wires can be soldered directly into PTHs. (Wires with JST 7P-SZN 1.5mm pitch board-in connector can be handled more easily when soldering.)

Pulling the tamper detection pin to ground will trigger a tamper event, indicating that the enclosure of the system has been opened without proper authorization.

The tamper detection mechanism is part of the FIPS 140-2 Level 3 security

requirements. The tamper detection itself is carried out entirely in HW. On SW level, there is only an API that allows enabling the tamper detection mechanism. Calling this API will move tamper HW state from the testing mode to the production mode. Once called, it cannot move back to the testing mode.

The trigger mode of tamper detection signal can be selected with the DIP switch SW3.2. If a SOM-300 family module is added to the mPCIe port, it is possible to tie the tamper signal of SOM-300 family module and OBU-352 together. In this case, it can be selected with the DIP switch SW2.2. For more information, please see [8.1.2.5 DIP SWITCH SETTINGS](#) for details.

8.1.2.4. SAR ADC

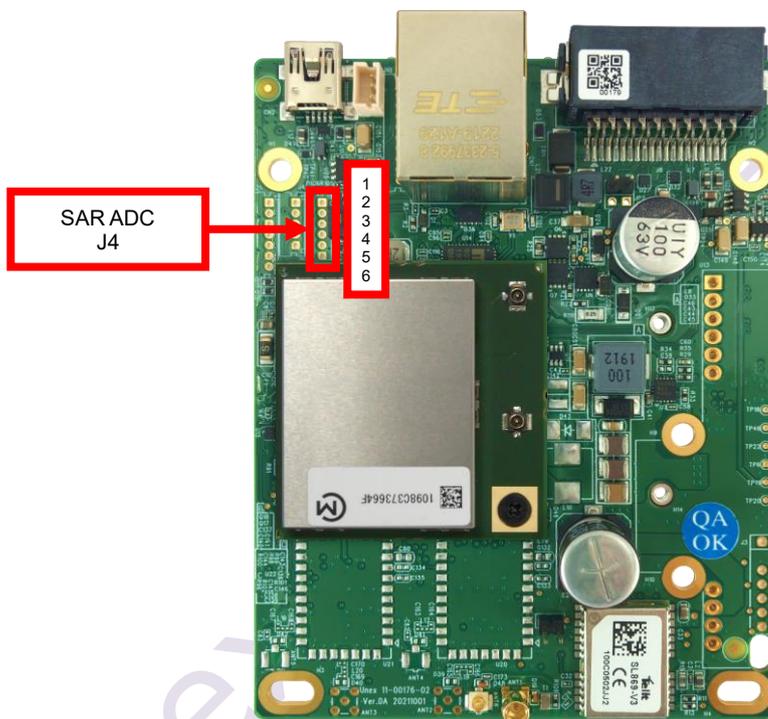


Figure 15: SAR ADC input (J4)

Table 14: SAR ADC functions

Pin	Symbol	I/O	Level (V)	Description
J4.1	SAR_ADC_CH0	I	3.3	SAR ADC input. /sys/bus/iio/devices/iio:device0/in_voltage0_raw
J4.2	SAR_ADC_CH1	I	3.3	SAR ADC input. /sys/bus/iio/devices/iio:device0/in_voltage1_raw
J4.3	Reserved	-	-	Reserved. Leave open if not used.
J4.4	Reserved	-	-	Reserved. Leave open if not used.
J4.5	Reserved	-	-	Reserved. Leave open if not used.
J4.6	GND	G	-	Ground

Table 15: SAR ADC performance

Resolution	ENOB (Effective number of bits)	Sampling Frequency
10 bits (0-1023, 3.22mV/step)	9 bits	2.5 MHz

J4 consists of 1.5mm pitch PTHs (Plated Through Holes) reserved for SAR ADC (Successive-Approximation-Register Analog-to-Digital Converter) function. For connecting the ADC signal, ADC signal wires can be soldered directly into PTHs. (Wires with JST 6P-SZN 1.5mm pitch board-in connector can be handled more easily when soldering.)

8.1.2.5. DIP Switch Settings

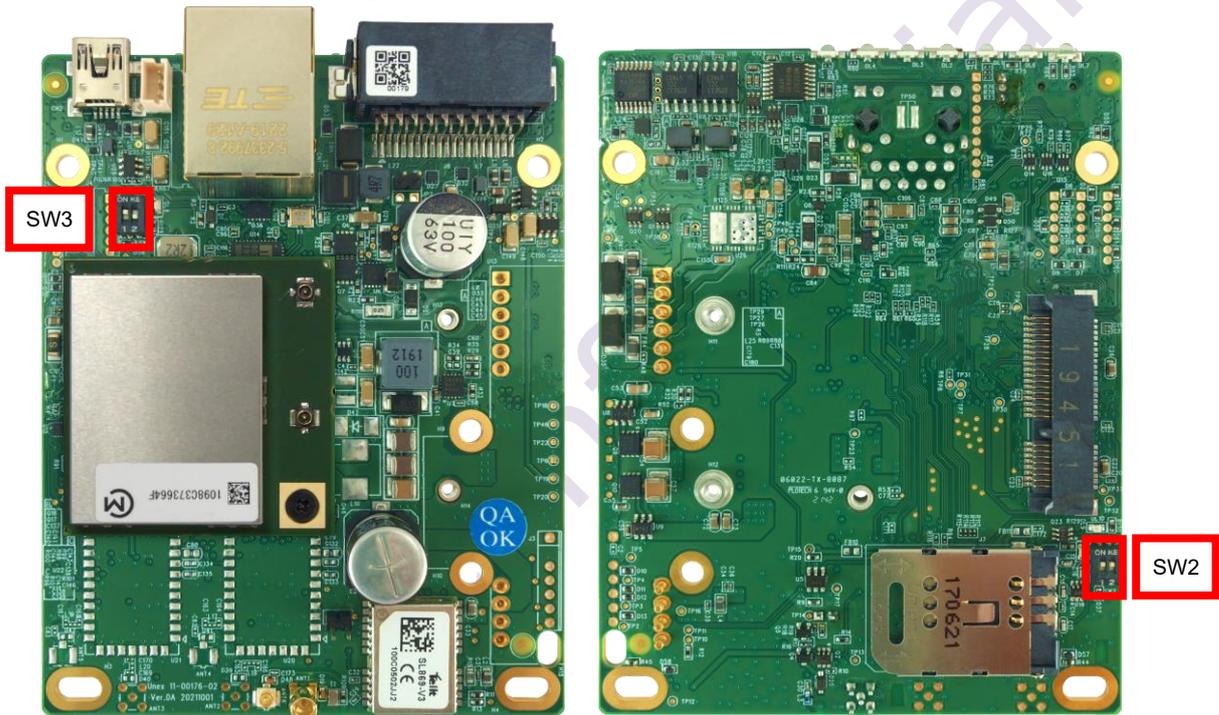


Figure 16: DIP switches. SW3 (Left), SW2 (Right)

Table 16: SW2 and SW3 functions

Position	Name	Function	Description
SW2.1	5V_SW	mPCIe 5V	ON: mPCIe 5V ON, UART2 to mPCIe OFF: mPCIe 5V OFF, UART2 to GNSS module
SW2.2	TAMPER#_SW	mPCIe TAMPER#	ON: mPCIe P51 close to OBU-352 tamper OFF: mPCIe P51 open from OBU-352 tamper
SW3.1	BOOT_SW	Boot strapping	ON: boot from NAND (Normal boot) OFF: boot from USB0 (FW upgrade)
SW3.2	TRIGGER_SW	Trigger mode	ON: Trigger when tamper SW close to GND (1K PU) OFF: Trigger when tamper SW open from 3V3 (30K PD)

8.2. I/O Conversion Board (EVK-352 Series Only)

An I/O conversion board (EX-47) and an adapter cable (EX-46) is included in EVK-352 series package. The I/O conversion board (EX-47) is an accessory which converts the JST 20 pin headers into industrial standard connectors which are more familiar to users. The adapter cable (EX-46) should be connected between EVK-352 and EX-47.

The EX-46 and EX-47 are not included in OBU-352 package and should be ordered separately if needed.

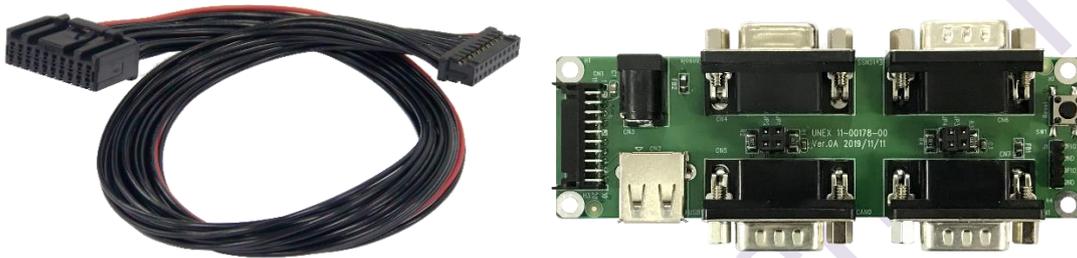


Figure 17: EX-46 (Left), EX-47 (Right)

8.2.1. Console

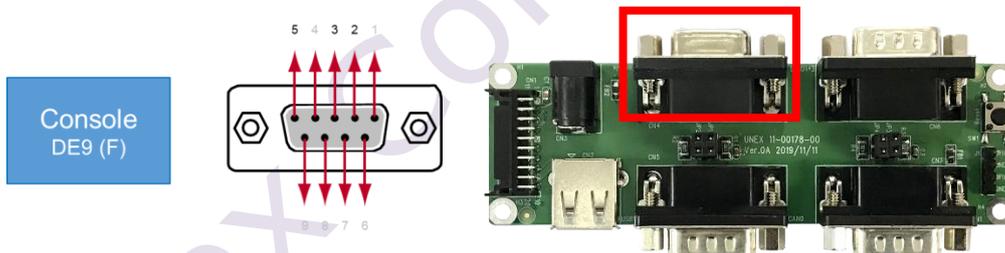


Figure 18: Console port (CN4)

Table 17: Console pinout (CN4)

Pin	Symbol	I/O	Level (V)	Description
CN4.1	NC	-	-	Not Connected
CN4.2	RX	O	5.0	RS232 serial data to DTE
CN4.3	TX	I	5.0	RS232 serial data from DTE
CN4.4	NC	-	-	Not Connected
CN4.5	GND	G	-	Ground
CN4.6	NC	-	-	Not Connected
CN4.7	NC	-	-	Not Connected
CN4.8	NC	-	-	Not Connected
CN4.9	NC	-	-	Not Connected

Console is a RS232 DCE (Data Communication Equipment).

8.2.2. Ext GNSS

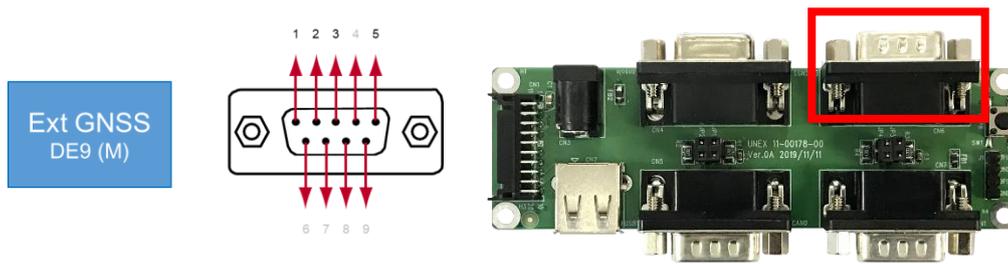


Figure 19: Ext GNSS port (CN6)

Table 18: Ext GNSS pinout (CN6)

Pin	Symbol	I/O	Level (V)	Description
CN6.1	EXT_1PPS	I	3.3	External 1PPS signal
CN6.2	RX	I	5.0	RS232 serial data from DCE
CN6.3	TX	O	5.0	RS232 serial data to DCE
CN6.4	NC	-	-	Not Connected
CN6.5	GND	G	-	Ground
CN6.6	NC	-	-	Not Connected
CN6.7	NC	-	-	Not Connected
CN6.8	NC	-	-	Not Connected
CN6.9	NC	-	-	Not Connected

Ext GNSS is a RS232 DTE (Data Terminal Equipment). If an external GNSS source can output NMEA sentences over RS232, this is the port to connect. Please note that software integration of GNSS protocol will be needed for proper functionality. Contact Unex representative for more detail.

8.2.3. CAN0

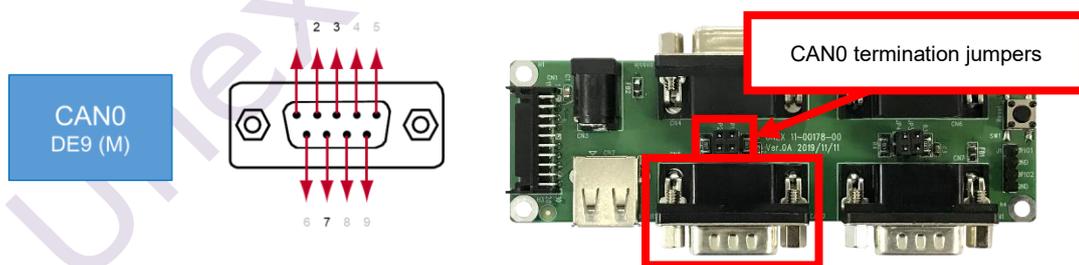


Figure 20: CAN0 port (CN5)

Table 19: CAN0 pinout (CN5)

Pin	Symbol	I/O	Level (V)	Description
CN5.1	NC	-	-	Not Connected
CN5.2	CAN_L	I/O	5.0	CAN Low. 5V output, maximum input range +/- 40V.
CN5.3	GND	G	-	Ground
CN5.4	NC	-	-	Not Connected
CN5.5	NC	-	-	Not Connected
CN5.6	NC	-	-	Not Connected

Pin	Symbol	I/O	Level (V)	Description
CN5.7	CAN_H	I/O	5.0	CAN High. 5V output, maximum input range +/- 40V.
CN5.8	NC	-	-	Not Connected
CN5.9	NC	-	-	Not Connected

If CAN0 termination jumper caps (JP1/JP2) are closed, a pair of 60 Ω termination resistors (total 120 Ω) are added to CAN0 port. If jumper caps are removed, the termination resistors are disconnected.

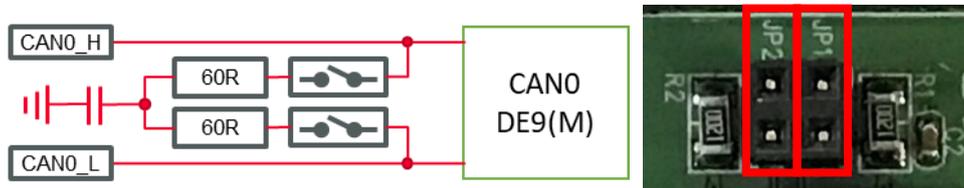


Figure 21: CAN0 terminator jumpers (JP1/JP2)

8.2.4. CAN1

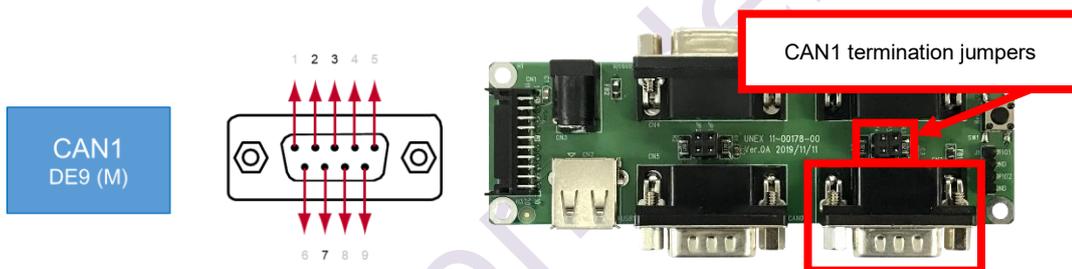


Figure 22: CAN1 port (CN7)

Table 20: CAN1 pinout (CN7)

Pin	Symbol	I/O	Level (V)	Description
CN7.1	NC	-	-	Not Connected
CN7.2	CAN_L	I/O	5.0	CAN Low. 5V output, maximum input range +/- 40V.
CN7.3	GND	G	-	Ground
CN7.4	NC	-	-	Not Connected
CN7.5	NC	-	-	Not Connected
CN7.6	NC	-	-	Not Connected
CN7.7	CAN_H	I/O	5.0	CAN High. 5V output, maximum input range +/- 40V.
CN7.8	NC	-	-	Not Connected
CN7.9	NC	-	-	Not Connected

If CAN1 termination jumper caps (JP3/JP4) are closed, a pair of 60 Ω termination resistors (total 120 Ω) are added to CAN1 port. If jumper caps are removed, the termination resistors are disconnected.

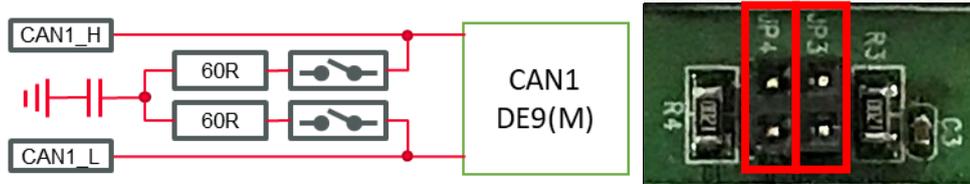


Figure 23: CAN1 terminator jumpers (JP3/JP4)

8.2.5. USB1

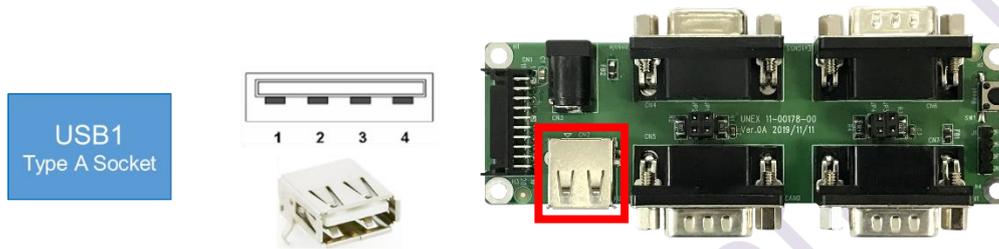


Figure 24: USB1 port (CN2)

Table 21: USB1 pinout (CN2)

Pin	Symbol	I/O	Level (V)	Description
CN2.1	VBUS	O	5.0	5V/900mA
CN2.2	D-	I/O	0.4	USB 2.0 data -
CN2.3	D+	I/O	0.4	USB 2.0 data +
CN2.4	GND	G	-	Ground

8.2.6. GPIO

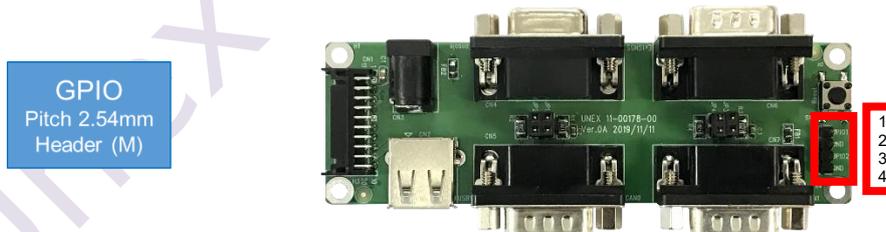


Figure 25: GPIO headers (J1)

Table 22: GPIO pinout (J1)

Pin	Symbol	I/O	Level (V)	Description
J1.1	GPIO1	I/O	3.3	GPIO1
J1.2	GND	G	-	Ground
J1.3	GPIO2	I/O	3.3	GPIO2
J1.4	GND	G	-	Ground

8.2.7. DC Power Jack

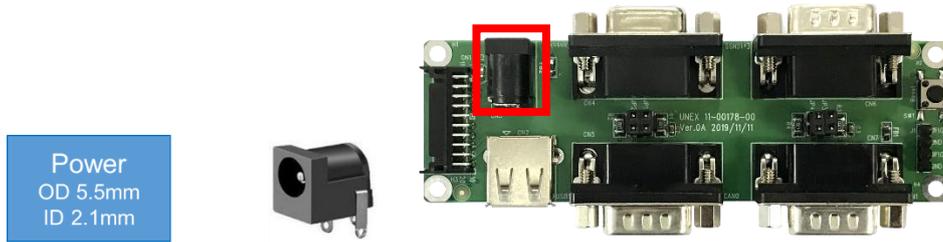


Figure 26: DC power jack

Input power range is DC 6-48V. Suggested power is 12W or higher.

8.2.8. Reset Button

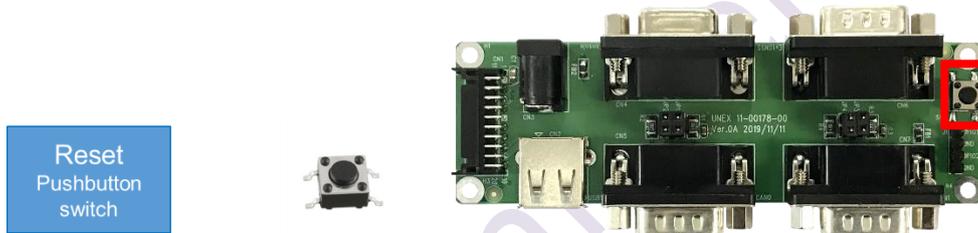


Figure 27: Reset button

Pushing the reset button can reboot Linux system.

Unex Confidential

9. Dimensions and Weight

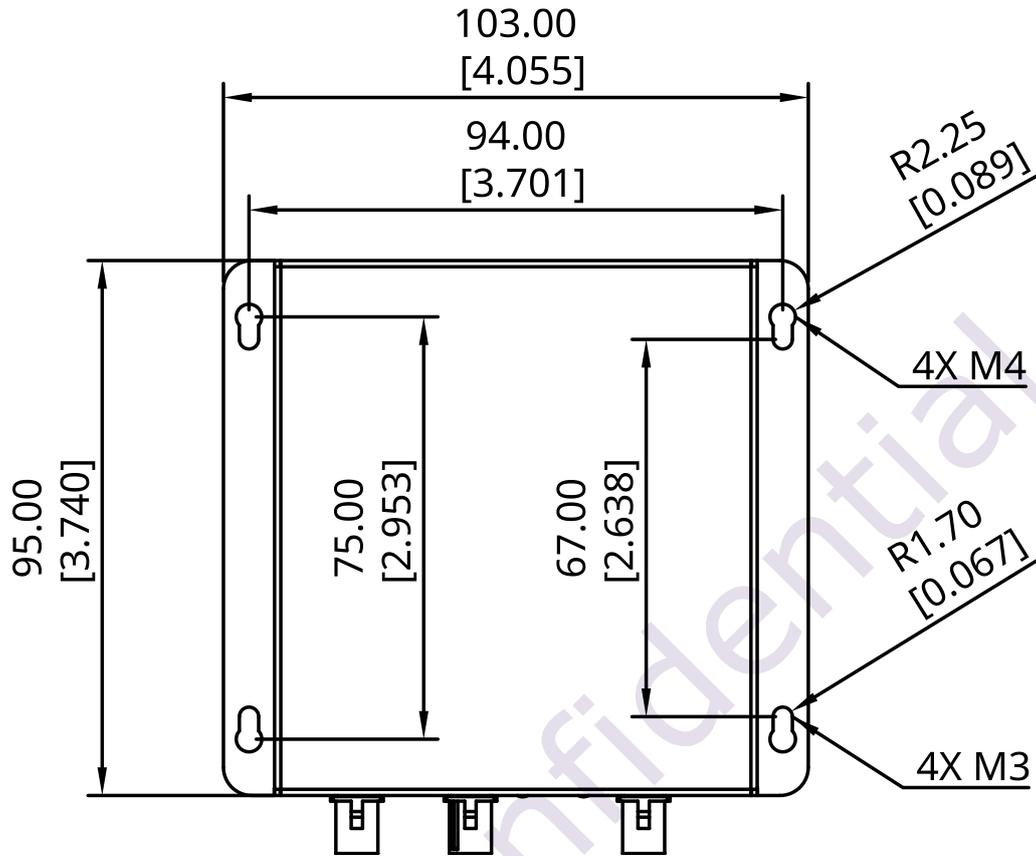


Figure 28: Mechanical dimensions - TOP

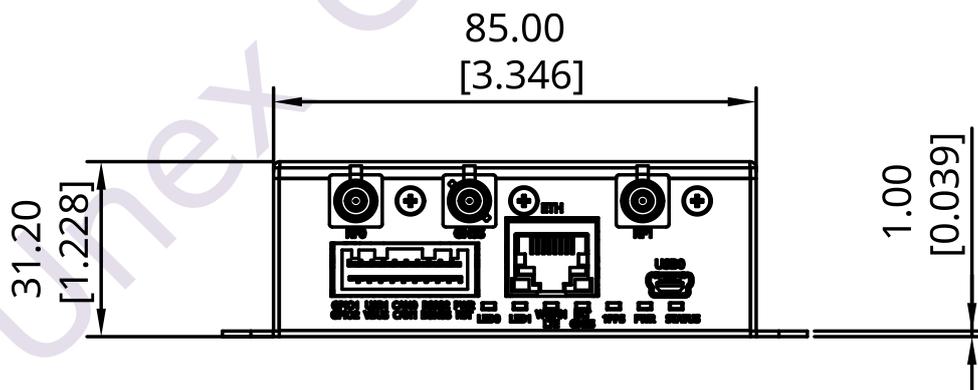


Figure 29: Mechanical dimensions - FRONT

Table 23: Dimensions and weight

Model	Length (mm)	Width (mm)	Height (mm)	Weight (g)
OBU-352	95.0	103.0	31.2	152.6

10. Software Settings

The following BSP settings are applicable for Unex software package only.

Table 24: Unex BSP interface settings

Function	Description
Console	RS232, 115200bps, 8N1, ttyAMA2
EXT GNSS	RS232, 230400bps, 8N1, ttyAMA1 (GPIO100=0)
GNSS NMEA	UART1, 230400bps, 8N1, ttyAMA1 (GPIO100=1)
GNSS Debug (Opt.)	UART2, 230400bps, 8N1, ttyAMA0
GNSS Reset	GPIO111, 0->1 = GNSS module reset (cold start, clear SRAM and RTC)
Ext GNSS SW	GPIO100. 0=Ext_GNSS, 1=Int_GNSS (default=1)
USB0	Default USB 2.0 device mode. RNDIS device IP = 192.168.1.3, RNDIS host IP = 192.168.1.1
Ethernet	Eth0 default IP = 192.168.100.3
USB1	Default USB 2.0 host mode
CAN0	500kbps
CAN0 stand-by mode	GPIO 115 (xloader), GPIO 139 (user space). 0=normal mode (10mA), 1=stand-by mode (10uA)
CAN1	500kbps
CAN1 stand-by mode	GPIO 122 (xloader), GPIO 146 (user space) 0=normal mode (10mA), 1=stand-by mode (10uA)
STATUS LED Green	/sys/class/leds/status-green/brightness, 0=OFF, 1-255=ON
STATUS LED Red	/sys/class/leds/status-red/brightness, 0=OFF, 1-255=ON
LED0	GPIO 504. 0=ON, 1=OFF (default=1)
LED1	GPIO 505. 0=ON, 1=OFF (default=1)
GPIO1	GPIO 506. 0=LOW, 1=HI (default=1)
GPIO2	GPIO 507. 0=LOW, 1=HI (default=1)
USB SW	GPIO 508. 0=USB1 to mPCIe, 1=USB1 to I/O port (default=1)
mPCIe Reset	GPIO 511, 0->1 = mPCIe module reset
SAR_ADC_CH0	/sys/bus/iio/devices/iio\:device0/in_voltage0_raw
SAR_ADC_CH1	/sys/bus/iio/devices/iio\:device0/in_voltage1_raw
V2X0 antenna detection	/sys/bus/iio/devices/iio\:device0/in_voltage4_raw
V2X1 antenna detection	/sys/bus/iio/devices/iio\:device0/in_voltage5_raw
MAC address	grep V2X_0 /etc/unex/device/device_info.txt
BSP/protocol version	/etc/unex/update.log