



RAIBOX-ORNX

USER MANUAL

UM-RBXORNX-01

Revision 1.01

01/10/2024



Forecr
<https://www.forecr.io>
support@forecr.io

Table of Contents

- Preface 4**
 - Disclaimer..... 4
 - Customer Support 4
 - Contact Information 4
 - Copyright Notice..... 4
 - Trademark Acknowledgment..... 4
 - Limited Product Warranty 5
 - Revision History 5
- 1. Introduction 6**
- 2. Product Specification 6**
 - 2.1 Technical Specification 6
 - 2.2 Block Diagram 7
 - 2.3 RAIBOX Visuals 7
- 3. Hardware Information 8**
 - 3.1 Connector Location 8
 - 3.1.1 Front Connectors Layout 8
 - 3.1.2 Rear Connectors Layout 8
 - 3.2 List of Connector 9
 - 3.3 The Definition of Each Connector 9
 - 3.3.1 Power Connector (X6) 9
 - 3.3.2 Serial Communication Connector (X5) 10
 - 3.3.3 CANBus Connector (X4) 10
 - 3.3.4 Industrial Input Output Connector (X3) 11
 - 3.3.5 10/100/1000 Ethernet Connectors (X1-X2)..... 11
 - 3.3.6 GMSL (FAKRA Connectors)..... 12
 - 3.3.7 HDMI Connector 12
 - 3.3.8 USB 3.1 Type -A Connector 12
 - 3.3.9 Recovery Mode USB Type-C Connector 12
 - 3.3.10 Antenna Connector 12
- 4. Software Information 13**
 - 4.1 Installation 13
- 5. Connectivity..... 13**
 - 5.1 Industrial Input Output Interface 13
 - 5.1.1 Setting and Reading Input Pin 13
 - 5.1.2 Setting Digital Output as High and Low 14

5.2 Serial Communication Interface	14
5.2.1 Installing GTKTerm	15
5.2.2 Testing Serial Communication Interfaces	15
5.2.3 Serial Communication Termination Resistors	15
5.3 CANBus Interface.....	16
5.4 General Purpose Input/Output (GPIO)	16
6. 3D Model & Mechanical Information	18
7. Power Consumption	19
8. MTBF Prediction.....	19
9. Ordering Information	19

Preface

Disclaimer

Forecr emphasizes that the information contained in this user manual is continuously updated in line with the technical modifications and enhancements made by Forecr to its RAIBOX-ORNX. Therefore, this manual only represents the technical status of Forecr RAIBOX-ORNX at the time of publishing.

Forecr shall not be held responsible for any damages that may occur directly or indirectly as a result of any technical or typographical errors or omissions found in this document or for any discrepancies between the product and the user's manual.

Customer Support

In case you encounter any challenges after reading the user manual and/or using the RAIBOX-ORNX, please reach out to the Forecr reseller from which you purchased the RAIBOX-ORNX.

See the contact information section below for more information on how to contact us directly.

Contact Information

E-mail Address	For information requests: info@forecr.io For support requests: support@forecr.io For wholesale inquiries: sales@forecr.io
Address	Forecr OÜ Akadeemia tee 21/1 (II floor), Room 219, 12618, Tallinn, Estonia
Telephone Number	Estonia +372 5332 2632
Website	https://www.forecr.io

Copyright Notice

The information provided in this manual is subject to change without notice. Forecr shall not be held responsible for any errors contained herein or for any incidental or consequential damages that may arise from the provision, implementation, or utilization of this material. This manual is protected by copyright. All rights are reserved by Forecr. No part of this manual may be reproduced, copied, translated or transmitted in any form without the prior written consent of Forecr.

Copyright © 2023 - Forecr.io

Trademark Acknowledgment

Forecr recognizes and acknowledges that all trademarks, registered trademarks, and/or copyrights mentioned in this user manual belong to their respective owners. All possible trademarks or copyright acknowledgments that are not listed herein do not mean a lack of acknowledgment to the rightful owners of mentioned trademarks and copyrights. Forecr acknowledge the rights of the trademark owners and respect their intellectual property.

Limited Product Warranty

Forecr provides a 1-year Warranty for the RAIBOX-ORNX. This warranty period is valid from the original purchase date of the RAIBOX-ORNX. In order to maintain warranty, the RAIBOX-ORNX must not be altered or modified in any way. Changes or modifications to the RAIBOX-ORNX, that are not explicitly approved by Forecr and described in this user manual or received from Forecr Support as a special handling instruction, will void your warranty.

To receive warranty service, the RAIBOX-ORNX must be delivered to Forecr within the warranty period together with the original invoice or proof of purchase.

Revision History

Revision No	Revision Date	Revision Description
rev 1.0	16.07.2024	Preliminary Release

1. Introduction

Introducing the RAIBOX-ORNX, a ruggedized railway grade computer that meets the EN50155 standard, ensuring reliability and safety for your critical railway applications. Powered by the high-performance Orin NX or Nano processors, this computer features 2x Gigabit Ethernet and GMSL Camera support, enabling seamless data transmission and processing.

With USB3.2, HDMI, 2x CAN, Wireless, and 5G connectivity, the RAIBOX-ORNX offers unparalleled flexibility and connectivity options. The M.2 SSD support further enhances its storage capabilities, making it ideal for storing and processing large amounts of data.

Designed to withstand extreme temperatures, shock, vibration, and electromagnetic interference, the RAIBOX-ORNX is the perfect solution for railway applications that require reliable and ruggedized computing power.

Whether you're looking for a powerful and dependable onboard computer for your train control and monitoring systems, or a robust and secure gateway for your railway infrastructure, the RAIBOX-ORNX is the perfect choice for your critical railway applications.

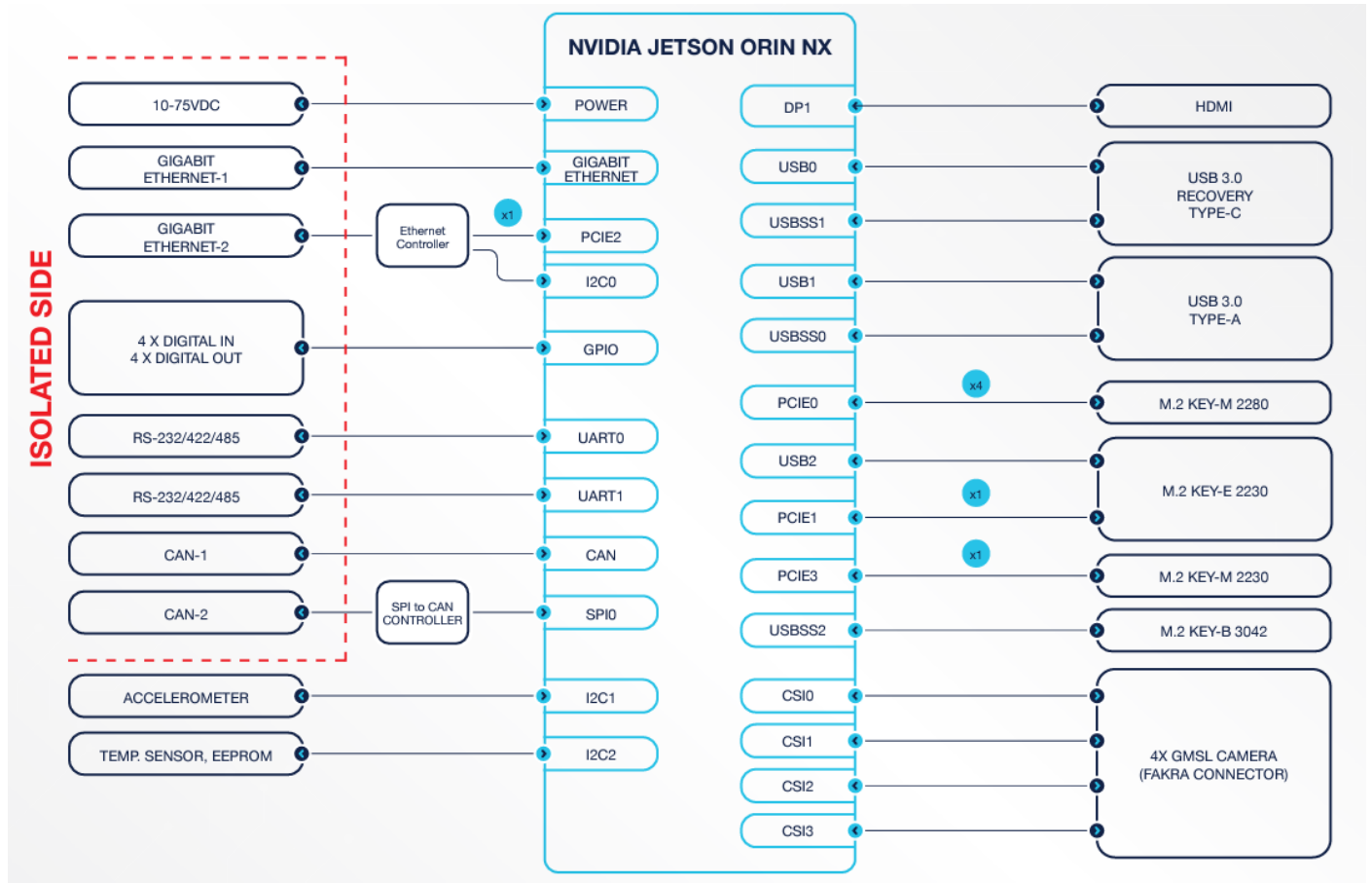
Latest revision of this user manual, datasheet, and 3D model can be downloaded from [Forecr Web Page](#).

2. Product Specification

2.1 Technical Specification

Supported Modules	NVIDIA Jetson Orin Nano 4GB / 8GB NVIDIA Jetson Orin NX 8GB / 16GB
Memory	4 GB 64-bit LPDDR5 / 8 GB 128 bit LPDDR5 8 GB 256-bit LPDDR5 / 16 GB 128 bit LPDDR5
Graphics Interfaces	1x HDMI 2.0(max resolution 3840x2160)
Interfaces	2x Gigabit Ethernet 1x USB 3.1 Type-A 1x USB 3.1 Type-C 2x CAN Bus (Isolated) 2x RS232/RS422/RS485 (Isolated) 4x Digital In 4x Digital Out (Isolated) 4x GMSL (FAKRA Connector)
Wireless Communication	WiFi/Bluetooth/LTE Connectivity by extension sockets
Power Supply	10-75VDC
Extension Sockets	1x M.2 Key-E, 1x M.2 Key-B, 1x SIM
Mass Storage	2x M.2 Key-M SSD Slot
Ambient Conditions	-25°C ... +85°C
Form Factor / Dimensions	275 mm x 200 mm x 75 mm 2750gr
Operating Systems	Ubuntu Linux 20.04
Standards	EN50155, EN45545-2 HL3, EN61373, EN60068, IP67
JetPack Support	JetPack 5.x JetPack 6.x

2.2 Block Diagram



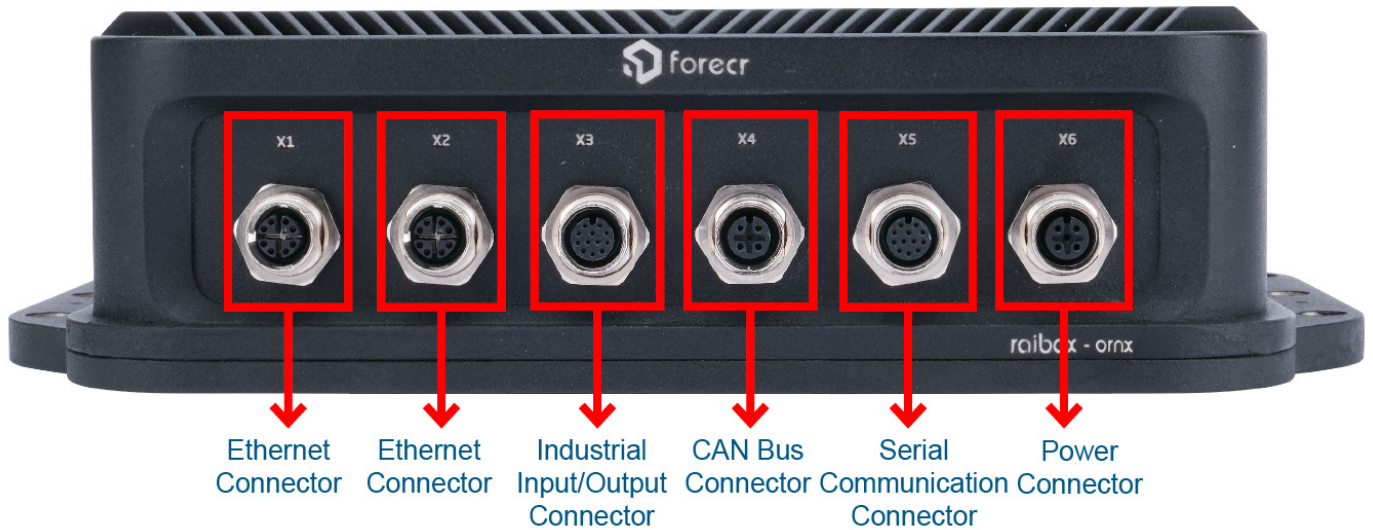
2.3 RAIBOX Visuals



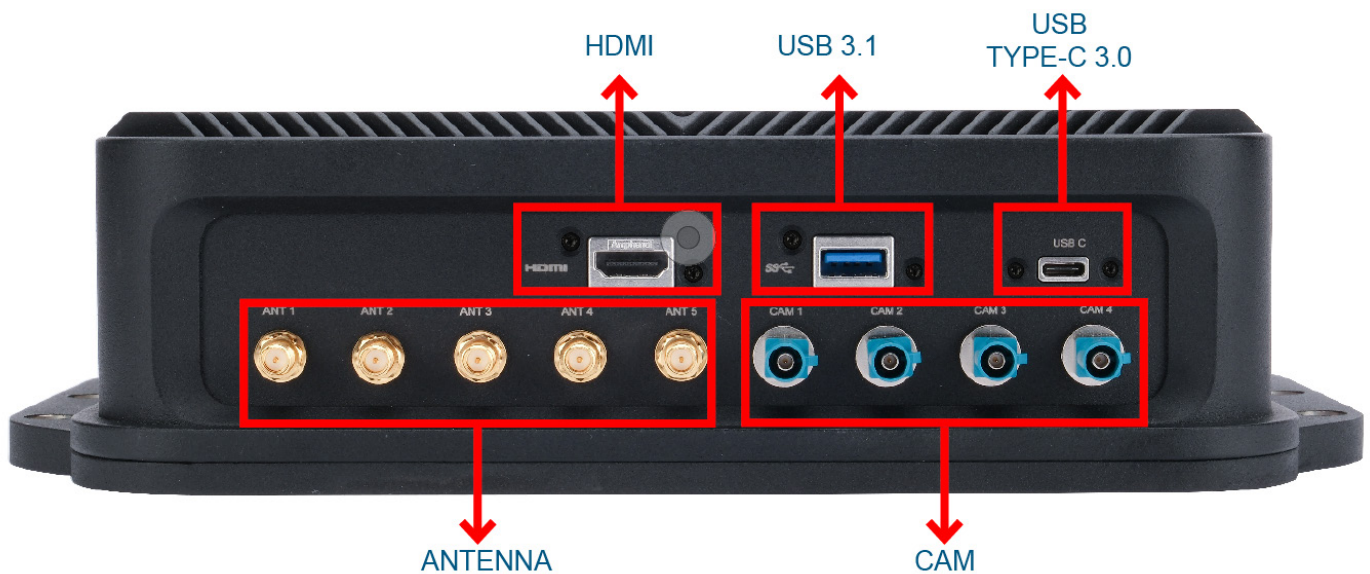
3. Hardware Information

3.1 Connector Location

3.1.1 Front Connectors Layout



3.1.2 Rear Connectors Layout




3.2 List of Connector

Connectors
RAIBOX-ORNX Power Connector
RAIBOX-ORNX Serial Communication Connector
RAIBOX-ORNX CAN Bus Connector
RAIBOX-ORNX Industrial Input Output Connector
RAIBOX-ORNX 10/100/1000 Ethernet Connectors
RAIBOX-ORNX GMSL (FAKRA Connectors)
RAIBOX-ORNX HDMI Connector
RAIBOX-ORNX USB 3.1 Type-A Connector
RAIBOX-ORNX Recovery Mode USB Type-C Connector
RAIBOX-ORNX Antenna Connector

3.3 The Definition of Each Connector

3.3.1 Power Connector (X6)


Front View (X6)	Function	Description		
	Connector Type	1411584 from Phoenix Contact M12, 4-pos, A-coded		
	Minimum Input Voltage	+10V		
	Maximum Input Voltage	+75V		
	X6-Pinout	Pin	Description	
		1	VDD	
		2	VDD	
3		GND		
4	GND			

3.3.2 Serial Communication Connector (X5)


The RAIBOX-ORNX implements 12 pin serial communication connector which has 8 serial and 2 ground pins. Both serial communications can be configurable for RS232, RS422 or RS485 protocols independently.

Front View (X5)	Function	Description		
	Connector Type	1411589 from Phoenix Contact. M12, 12-pos, A-coded		
	X5-Pinout	Pin	Description	
		1	SERIAL_CH0.TX_N	
		2	SERIAL_CH1.TX_N	
		3	SERIAL_CH1.TX_P	
		4	SERIAL_CH1.RX_N	
		5	SERIAL_CH1.RX_P	
		6	RESET_ISO	
		7	SERIAL_CH0.RX_P	
		8	SERIAL_CH0.RX_N	
		9	SERIAL_CH0.TX_P	
		10	RECOVERY_ISO_N	
		11	GND_ISO_SERIAL	
	12	GND_ISO_SERIAL		


3.3.3 CANBus Connector (X4)

Front View (X4)	Function	Description		
	Connector Type	1411586 from Phoenix Contact. M12, 5-pos, A-coded		
	X4-Pinout	Pin	Description	
		1	CAN0_HI	
		2	CAN1_HI	
		3	CAN1_LO	
		4	CAN0_LO	
5	GND			


3.3.4 Industrial Input Output Connector (X3)

Front View (X3)	Function		Description		
	Connector Type		1411589 from Phoenix Contact. M12, 12-pos, A-coded		
	X3-Pinout	Pin		Description	
		1	DIGITAL_OUT3		
		2	DIGITAL_IN0		
		3	DIGITAL_IN1		
		4	DIGITAL_IN2		
		5	DIGITAL_IN3		
		6	GND_ISO		
		7	DIGITAL_OUT0		
		8	DIGITAL_OUT1		
		9	DIGITAL_OUT2		
		10	GND_ISO		
		11	GND_ISO		
	12	GND_ISO			


3.3.5 10/100/1000 Ethernet Connectors (X1-X2)

Front View (X1-X2)	Function		Description				
	Connector Type		1424135 from Phoenix Contact. M12, 8-pos, X-coded				
	Pinout			X1-Pinout		X2-Pinout	
				Pin	Description	Pin	Description
				1	GBE2.X0_P	1	GBE.X0_P
				2	GBE2.X0_N	2	GBE.X0_N
				3	GBE2.X1_P	3	GBE.X1_P
				4	GBE2.X1_N	4	GBE.X1_N
				5	GBE2.X3_P	5	GBE.X3_P
				6	GBE2.X3_N	6	GBE.X3_N
			7	GBE2.X2_P	7	GBE.X2_P	
		8	GBE2.X2_N	8	GBE.X2_N		


3.3.6 GMSL (FAKRA Connectors)

	<table border="1"> <thead> <tr> <th data-bbox="799 262 1505 302">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="799 302 1505 470"> <p>The RAIBOX-ORNX implements 4 GMSL camera connectors.</p> </td> </tr> </tbody> </table>	Description	<p>The RAIBOX-ORNX implements 4 GMSL camera connectors.</p>
Description			
<p>The RAIBOX-ORNX implements 4 GMSL camera connectors.</p>			


3.3.7 HDMI Connector

	<table border="1"> <thead> <tr> <th data-bbox="799 575 1505 616">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="799 616 1505 804"> <p>The NVIDIA® Jetson Orin modules will output video via the RAIBOX-ORNX's HDMI connector that is HDMI 2.0 capable.</p> </td> </tr> </tbody> </table>	Description	<p>The NVIDIA® Jetson Orin modules will output video via the RAIBOX-ORNX's HDMI connector that is HDMI 2.0 capable.</p>
Description			
<p>The NVIDIA® Jetson Orin modules will output video via the RAIBOX-ORNX's HDMI connector that is HDMI 2.0 capable.</p>			

3.3.8 USB 3.1 Type -A Connector

	<table border="1"> <thead> <tr> <th data-bbox="799 909 1505 949">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="799 949 1505 1099"> <p>The RAIBOX-ORNX incorporates 1 USB 3.1 Type-A connector with a 1.5A current limit per connector.</p> </td> </tr> </tbody> </table>	Description	<p>The RAIBOX-ORNX incorporates 1 USB 3.1 Type-A connector with a 1.5A current limit per connector.</p>
Description			
<p>The RAIBOX-ORNX incorporates 1 USB 3.1 Type-A connector with a 1.5A current limit per connector.</p>			

3.3.9 Recovery Mode USB Type-C Connector

	<table border="1"> <thead> <tr> <th data-bbox="799 1207 1505 1247">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="799 1247 1505 1393"> <p>The RAIBOX-ORNX implements a USB Type-C connector to allow to install or upgrade the operating system.</p> </td> </tr> </tbody> </table>	Description	<p>The RAIBOX-ORNX implements a USB Type-C connector to allow to install or upgrade the operating system.</p>
Description			
<p>The RAIBOX-ORNX implements a USB Type-C connector to allow to install or upgrade the operating system.</p>			

3.3.10 Antenna Connector

	<table border="1"> <thead> <tr> <th data-bbox="799 1494 1505 1534">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="799 1534 1505 1662"> <p>RAIBOX-ORNX implements SMA type antenna connectors to use with WiFi, BT, LTE, 5G, GNSS add-ons.</p> </td> </tr> </tbody> </table>	Description	<p>RAIBOX-ORNX implements SMA type antenna connectors to use with WiFi, BT, LTE, 5G, GNSS add-ons.</p>
Description			
<p>RAIBOX-ORNX implements SMA type antenna connectors to use with WiFi, BT, LTE, 5G, GNSS add-ons.</p>			

4. Software Information

4.1 Installation

JetPack-5.x Installation can be found here: <https://www.forecr.io/blogs/installation/jetpack-5-x-installation-for-raibox-ornx>

JetPack-6.x Installation can be found here: <https://www.forecr.io/blogs/installation/jetpack-6-x-installation-for-raibox-ornx>

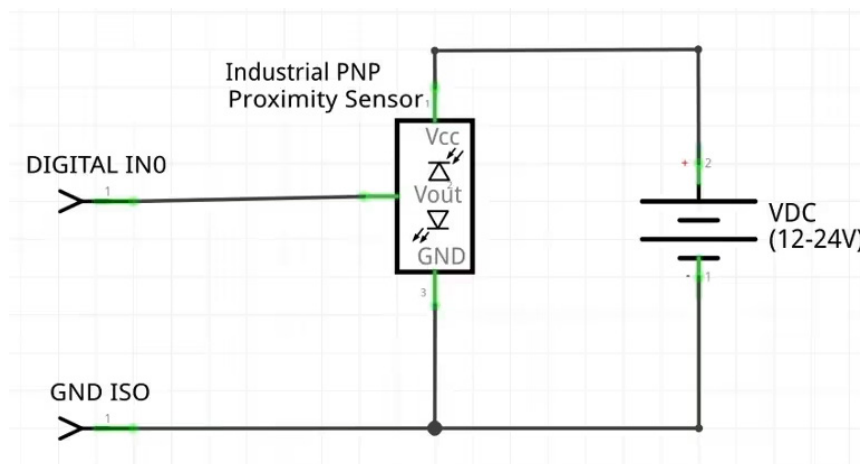
5. Connectivity

5.1 Industrial Input Output Interface

On the industrial input output connector, there are 4 ground, 4 digital input and 4 digital output pins. The pinout detail of the connector is given in section 3.3.4.

5.1.1 Setting and Reading Input Pin

Digital input side accepts signals between 12-24V (rated for 2.25mA). In our application, we used [Heschen M12 Inductive Proximity Sensor \(PNP & Normally Open\(NO\)\)](#) with 24V voltage source.



Find sysfs equivalent of the connected output pin from the table below. For this setup, it is DIGITAL_IN0. After proper hardware connection with industrial LED, we can continue with the software side.

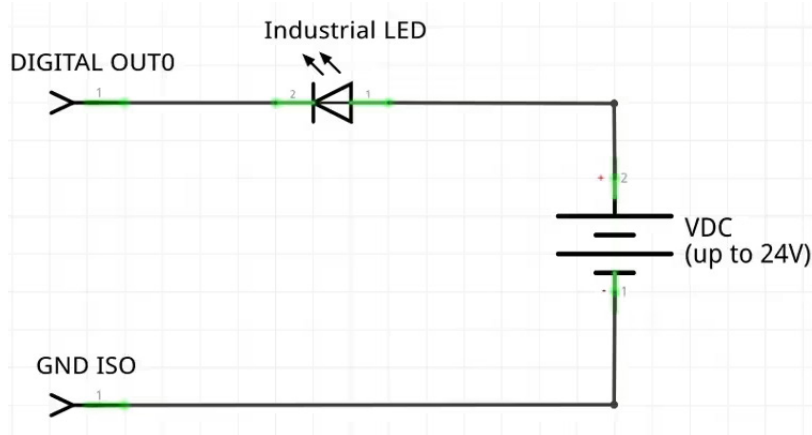
Pin Name	Sysfs Name
DIGITAL_IN0	gpio-399 (PI.00)
DIGITAL_IN1	gpio-400 (PI.01)
DIGITAL_IN2	gpio-401 (PI.02)
DIGITAL_IN3	gpio-398 (PH.07)
GROUND	GND

Set DIGITAL_IN0 as input and read sensor value. To do this, you should use the commands below.

```
sudo sh -c "echo 399 > /sys/class/gpio/export"
sudo sh -c "echo in > /sys/class/gpio/PI.00/direction"
sudo sh -c "cat /sys/class/gpio/PI.00/value"
```

5.1.2 Setting Digital Output as High and Low

Digital output side can drive loads up to 24V and has a current limit of 1A. They work as low side switches, open-close between them and GND. So, you should have a circuitry as in the schematic below. In our application, we used [GASH-ER 24V Indicator Light](#) with 24V voltage source.



Find sysfs equivalent of the connected output pin from the table below. For this setup, it is DIGITAL_OUT0. After proper hardware connection with industrial LED, we can continue with the software side.

Pin Name	Sysfs Name
DIGITAL_OUT0	gpio-352 (PA.04)
DIGITAL_OUT1	gpio-353 (PA.05)
DIGITAL_OUT2	gpio-354 (PA.06)
DIGITAL_OUT3	gpio-355 (PA.07)
GROUND	GND

Then, set DIGITAL_OUT0 as output and control light state. To do this, you should use the commands below.

```
sudo sh -c "echo 352 > /sys/class/gpio/export"
sudo sh -c "echo out > /sys/class/gpio/PA.04/direction"
```

To short output:

```
sudo sh -c "echo 1 > /sys/class/gpio/PA.04/value"
```

To open output:

```
sudo sh -c "echo 0 > /sys/class/gpio/PA.04/value"
```

5.2 Serial Communication Interface

On the serial communication connector, there are 8 serial communication, 2 ground pins. The pinout detail of the connector is given in section 3.3.2.

5.2.1 Installing GTKTerm

To test all serial communication interfaces, open a new terminal and install the GtkTerm program for ease of use (make sure Ethernet cable is connected). You can install GtkTerm with this terminal command:

```
sudo apt install gtkterm
```

5.2.2 Testing Serial Communication Interfaces

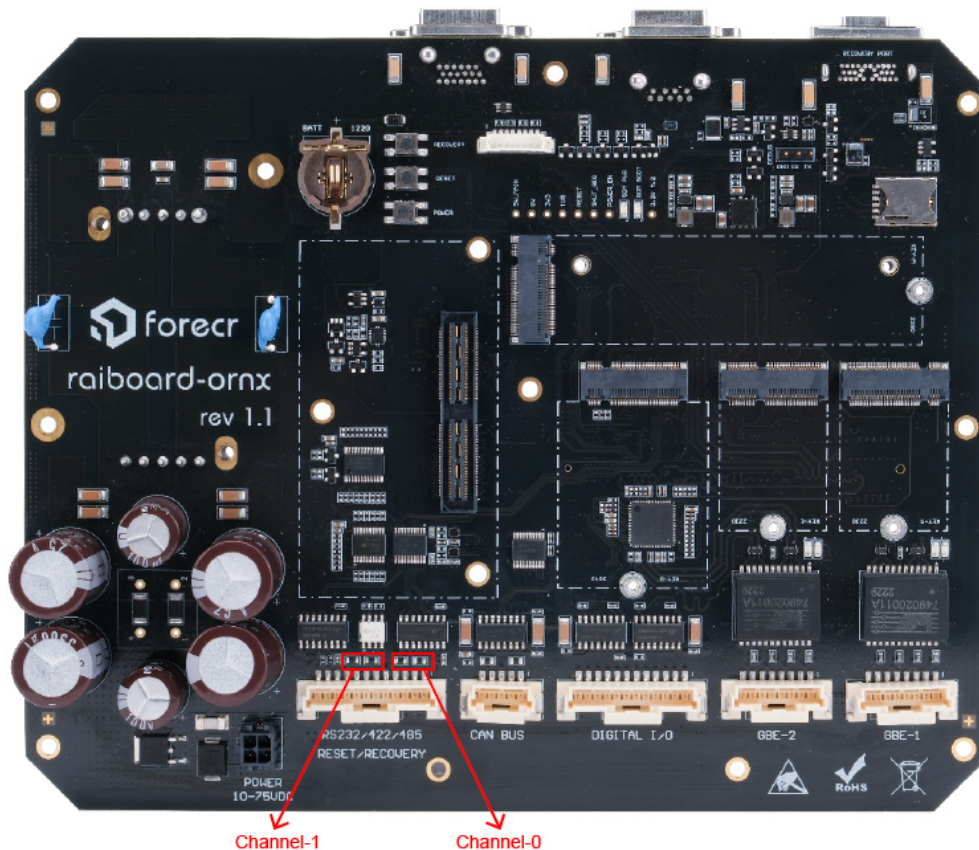
Run the GtkTerm program with arguments. On the host side, you can use TeraTerm or Putty for Windows; GtkTerm for Ubuntu OS.

Job (1/0)	Sysfs Name	
	Channel-0	Channel-1
Half/Full#	gpio-470 (PY.00)	gpio-473 (PY.03)
RS485/RS232#	gpio-471 (PY.01)	gpio-474 (PY.04)
Driver Enable	gpio-485 (PZ.07)	gpio-472 (PY.02)
Receivr Enable#	gpio-468 (PX.06)	gpio-469 (PX.07)

5.2.3 Serial Communication Termination Resistors

There are serial communication termination resistors on the RAIBOX-ORNX. There are 0805 size 120R termination resistors between RS422 TX+/TX- and RX+/RX- pairs on the board, which are not populated by default. Standard resistors with above specs can be fitted if termination resistors are needed on the RAIBOX-ORNX side.

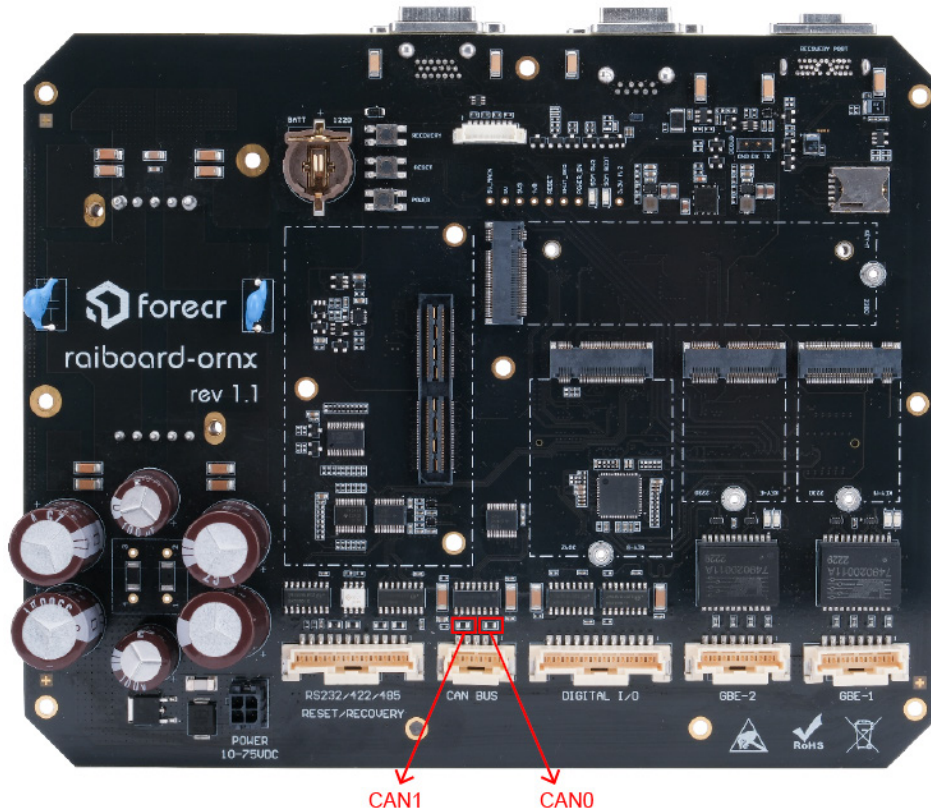
Serial Communication Termination Resistors



5.3 CANBus Interface

There are two CANBus interfaces on the RAIBOX-ORNX. There are 0805 size 120R termination resistors between CAN_H and CAN_L pins on the board, which are not populated by default. Standard resistors with above specs can be fitted if termination resistors are needed on the RAIBOX-ORNX side.

CANBus Termination Resistors



5.4 General Purpose Input/Output (GPIO)

MODULE PIN NUMBER	I/O NAME	MODULE PIN NAME	TYPE	DESCRIPTION
193	GPIO3_PI.00	I2S0_DOUT	INPUT	DIGITAL I/O
195	GPIO3_PI.01	I2S0_DIN	INPUT	DIGITAL I/O
197	GPIO3_PI.02	I2S0_FS	INPUT	DIGITAL I/O
199	GPIO3_PH.07	I2S0_SCLK	INPUT	DIGITAL I/O
220	GPIO3_PA.05	I2S1_DOUT	OUTPUT	DIGITAL I/O
222	GPIO3_PA.06	I2S1_DIN	OUTPUT	DIGITAL I/O
224	GPIO3_PA.07	I2S1_FS	OUTPUT	DIGITAL I/O
226	GPIO3_PA.04	I2S1_SCLK	OUTPUT	DIGITAL I/O
126	M2B_W_DISABLE1#	GPIO03	OUTPUT	LTE/5G module airplane mode control. Drive low to enable airplane mode. Drive high for normal operation.
124	M2B_W_DISABLE2#	GPIO02	OUTPUT	LTE/5G module GNSS enablement control. Drive low to disable GNSS. Drive high for normal operation.

130	M2B_PWR_ON#	GPIO06	OUTPUT	LTE/5G module 3.8V power supply LDO enable control. Drive high to disable LDO. Drive low for normal operation.
216	M2B_RESET	GPIO11	OUTPUT	LTE/5G module reset control input. Drive low to trigger reset. Drive high for normal operation.
218	M2B_FULLCARD_PWROFF#	GPIO12	OUTPUT	LTE/5G module power on/off control. Drive low to power off the module. Drive high for normal operation.
228	M2E_WDISABLE1	GPIO13	OUTPUT	WiFi/BT module full powerdown control for the WiFi/BT radio. Drive low to disable WiFi/BT. Drive high for normal operation.
207	M2E_WDISABLE2	UART1_RTS	OUTPUT	WiFi/BT module full power down control for the WiFi/BT radio. Drive low to disable WiFi/BT. Drive high for normal operation. Interrupt output pin for CAN controller.
212	CAN_INT_N	GPIO10	INPUT	Interrupt output pin for CAN controller
211	USB_MUX	GPIO09	OUTPUT	USB2.0 mux control pin. Drive low to rout USB2.0 connection to Key-B connector. Drive high to rout USB2.0 connection to Key-E connector.
97	SERIAL_CH0.DE	SPI0_CS1	OUTPUT	Driver enable for serial communication control.
103	SERIAL_CH0.RE#	UART0_RTS	OUTPUT	Receiver enable for serial communication control.
108	SERIAL_CH0.MODE	SPI1_MISO	OUTPUT	RS-485/RS-232 mode select pin. Drive high for RS-485 communication. Drive low for RS-232 communication.
106	SERIAL_CH0.HALF/FULL#	SPI1_SCK	OUTPUT	Half duplex or full duplex control for RS-485 communication protocol. Drive low for full duplex communication. Drive high for half duplex communication.
104	SERIAL_CH1.DE	SPI1_MOSI	OUTPUT	Driver enable for serial communication control.
105	SERIAL_CH1.RE#	UART0_CTS	OUTPUT	Receiver enable for serial communication control.
112	SERIAL_CH1.MODE	SPI1_CS1	OUTPUT	RS-485/RS-232 mode select pin. Drive high for RS-485 communication. Drive low for RS-232 communication.
110	SERIAL_CH1.HALF/FULL#	SPI1_CS0	OUTPUT	Half duplex or full duplex control for RS-485 communication protocol. Drive low for full duplex communication. Drive high for half duplex communication.

7. Power Consumption

This section will be completed soon. It will be published on our website once completed. Please check our [Forecr](#) Web Page regularly.

8. MTBF Prediction

This section will be completed soon. It will be published on our website once completed. Please check our [Forecr](#) Web Page regularly.

9. Ordering Information

