VT-AGV-3588J AGV Controller

User Manual

Version: 1.4

Revision History:

No.	Version	Description	Date
1	V1.0	First release	Mar. 26, 2025
2	V1.1	Updated the instructions for project creation in CODESYS.	May 19, 2025
3	V1.2	1. Updated 4.4.5 Adding the I/O Module to clarify the operations for keeping the device and PC in the same subnet. 2. Updated 4.4.6 I/O settings to add the input and output ranges.	Jul. 11, 2025
4	V1.3	Added 4.5 instructions for demo test of ROS 2 Humble.	Aug. 6, 2025
5	V1.4	1. Updated the memory and storage parameters in 1.6; 2. Modified the pinout of pins 7, 8, 15, 16, 22, 34 on connector A. 3. Corrected the timeout for WDT; 4. Clarified the description of the button and LEDs.	Aug. 7, 2025

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Foreword

Thank you for purchasing VT-AGV-3588J AGV controller ("the Device" or "the Product"). This manual intends to provide guidance and assistance necessary on setting up, operating or maintaining the Product. Please read this manual and make sure you understand the structure and functionality of the Product before putting it into use.

Intended Users

This manual is intended for:

- Operator of the Product
- Technical support engineers
- Other users

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Disclaimer

While all information contained herein has been carefully checked to assure its accuracy in technical details and typography, Vantron does not assume any responsibility resulting from any error or features of this manual, nor from improper uses of this manual or the software.

It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without notice.

Technical Support and Assistance

Should you have any question about the Product that is not covered in this manual, contact your sales representative for solution. Please contain the following information in your question:

- Product name and PO number;
- Complete description of the problem;
- Error message you received, if any.

Vantron Technology, Inc.

Address: 48434 Milmont Drive, Fremont, CA 94538

Tel: (650) 422-3128

Email: sales@vantrontech.com

Regulatory Information

The Product is designed to comply with:

- FCC

Please refer to the Appendix for Regulatory Compliance Statement.

Symbology

This manual uses the following signs to prompt users to pay special attention to relevant information.

⚠	Caution for latent damage to system or harm to personnel
▷i	Attention to important information or regulations

General Safety Instructions

The Product is supposed be installed by knowledgeable, skilled persons familiar with local and/or international electrical codes and regulations. For your safety and prevention of damage to the Product and other equipment connected to it, please read and observe carefully the following safety instructions prior to installation and operation. Keep this manual well for future reference.

- Do not disassemble or otherwise modify the Product. Such action may cause heat generation, ignition, electronic shock, or other damages including human injury, and may void your warranty.
- Keep the Product away from heat source, such as heater, heat dissipater, or engine casing.
- Do not insert foreign materials into any opening of the Product as it may cause the Product to malfunction or burn out.
- To ensure proper functioning and prevent overheating of the Product, do not cover or block the ventilation holes of the Product.
- Follow the installation instructions with the installation tools provided or recommended.
- The use or placement of the operation tools shall comply with the code of practice of such tools to avoid short circuit of the Product.
- Cut off the power before inspection of the Product to avoid human injury or product damage.

Precautions for Power Cables and Accessories

⚠ Use proper power source only. Make sure the supply voltage falls within the specified range. The Product is designed to use 9-36V DC. Always check whether the Product is DC powered before applying power.

⚠ Place the cables properly at places without extrusion hazards.

⚠ Use only approved antenna(s). Non-approved antenna(s) may produce spurious or excessive RF transmitting power which may violate FCC limits.

⚠ Cleaning instructions:

- Power off before cleaning the Product
- Do not use spray detergent
- Clean with a damp cloth
- Do not try to clean exposed electronic components unless with a dust collector

⚠ Power off and contact Vantron technical support engineer in case of the following faults:

- The Product is damaged
- The temperature is excessively high
- Fault is still not solved after troubleshooting according to this manual

⚠ Do not use in combustible and explosive environment:

- Keep away from combustible and explosive environment
- Keep away from all energized circuits
- Unauthorized removal of the enclosure from the device is not allowed
- Do not replace components unless the power cable is unplugged
- In some cases, the device may still have residual voltage even if the power cable is unplugged. Therefore, it is a must to remove and fully discharge the device before replacement of the components.

CHAPTER 1 PRODUCT INTRODUCTION

1.1 Terminologies and Acronyms

Below is a summary of the key terminologies and acronyms that will be covered in this manual.

Glossary	Description
AGV	Automated guided vehicle
I/O	Input / output
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output
CAN	Controller Area Network
TX	Data transmission
RX	Data reception
DAC	Digital-analog converter
M12 connector	A metric circular connector with a 12mm locking thread interface
CODESYS	Controlled Development System (Codesys) is a comprehensive environment that includes both the development environment (IDE – Integrated Development Environment) and the runtime environment. It supports a wide array of programming languages, allowing developers to use preferred tools with greater flexibility.
ROS	Robot Operating System (ROS) is a set of software libraries and tools for building robot applications. It provides the services you would expect from an operating system, including drivers to state-of-the-art algorithms, and with powerful developer tools.

1.2 Overview

VT-AGV-3588J AGV controller is dedicated for the Automated Guided Vehicle (AGV) and Autonomous Mobile Robot (AMR) industries, boasting outstanding performance and powerful functions for the automation of vehicles, such as standard lift trucks and mobile robots. It comes with a 16GB memory and 128GB storage, with option for larger capacity configurations, easily handling complex computations and large-scale data storage requirements. Equipped with an STM32 series MCU, it provides a reliable control foundation for the entire system, enabling rapid and accurate data processing and instruction execution.

VT-AGV-3588J features three Gigabit Ethernet ports (M12 aviation plugs), dual-band (2.4GHz&5GHz) Wi-Fi, and Bluetooth 5.4, ensuring stable network communication to meet the rapid data transfer needs. The full-function USB Type-C interface supports OTG and DP output for convenient operation and monitoring. In addition, the controller offers rich interfaces for connection of various peripherals, including USB Type-A, CAN 2.0, DI, DO, AI, AO, isolated RS232, RS485, and SSI, ensuring efficient and stable operation of AGVs.

VT-AGV-3588J runs on the ubuntu 22.04 operating system, with flexible integration of Codesys Runtime and ROS 2 Humble, which enables customers to develop AGV/AMR control solutions for different application scenarios according to their specific needs, achieving more function expansions.

1.3 Product Features

- Arm-based Octa-core processor
- 6 TOPS NPU for AI acceleration
- AI/AO/DI/DO for industrial data automation
- Wi-Fi/BT/ETH for network connectivity
- USB, RS32/RS485/SSI, and CAN bus support for flexible system integration options
- CANOpen, EtherCAT supported
- Low-latency, low-jitter motion control
- 9V-36V wide input voltage range
- IP65-rated for demanding environments
- Ubuntu 22.04 + CODESYS Runtime & ROS 2 Humble

1.4 Unpacking

The Product has been carefully packed with special attention to quality. However, should you find any component damaged or missing, please contact your sales representative in due time.

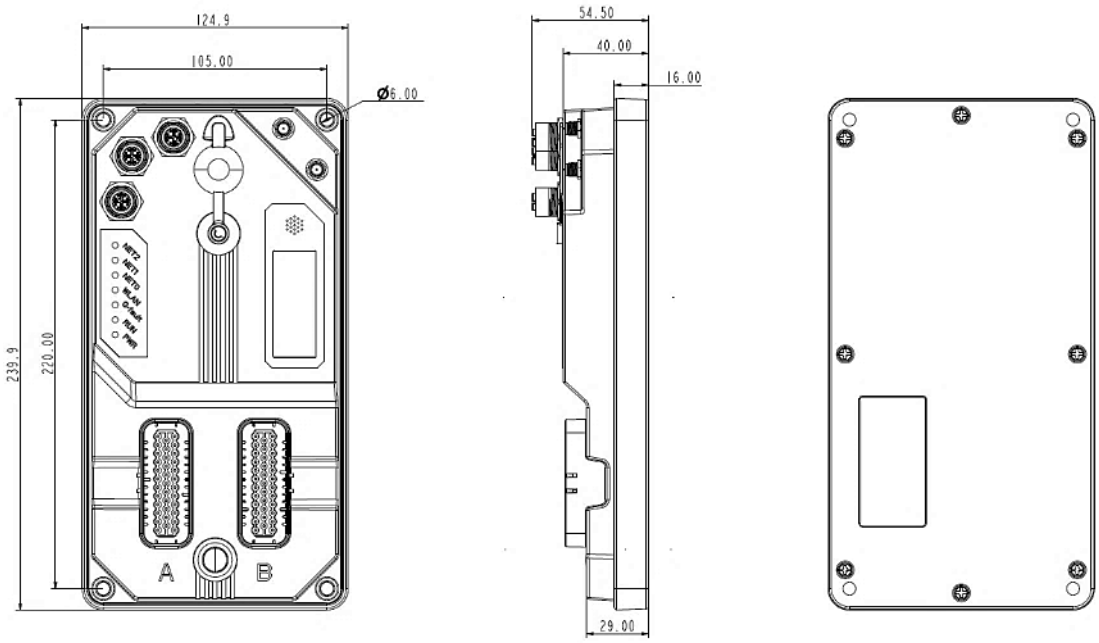
Standard accessories:

- 1 x VT- AGV-3588J AGV Controller
- 2 x Wi-Fi and Bluetooth antenna

Actual accessories might vary slightly from the list above as the customer order might be different from the standard configuration options.

1.5 Mechanical Dimensions

- 239.9mm x 124.9mm x 54.5mm



1.6 Specifications

VT-AGV-3588J			
System	CPU	Quad-core ARM Cortex-A76 MPCore processor (Max. 2.0GHz) + Quad-core ARM Cortex-A55 MPCore processor (Max. 1.7GHz)	
	GPU	ARM Mali-G610 MC4, OpenGL ES 1.1/2.0/3.2, OpenCL 2.2, and Vulkan1.2 supported	
	NPU	6 TOPS, INT4/INT8/INT16/FP16 supported	
	Memory	8GB LPDDR4 (Optional: 16GB)	
	Storage	64GB eMMC V5.1 (Optional: 128GB)	
Communication	Ethernet	3 x M12, 1000Mbps	
	Wi-Fi & Bluetooth	Wi-Fi IEEE 802.11 a/b/g/n/ac + BT 5.4	
Media	Video processing	8K@60fps H.265 / 8K@30fps H.264 decoder, 8K@30fps H.265/H.264 encoder	
	Display	1 x DisplayPort 1.4a combo with USB 3.0 Type-C	
I/O	USB	2 x USB 2.0 Host	1 x USB 3.0 Type-C (OTG, DP)
	Serial port	2 x RS232, isolated (Max. 235kbps)	2 x RS485, isolated (Max.500kbps)
		2 x SSI, isolated (Max. 10mbps)	
	CAN	2 x CAN 2.0	
	Analog input	4 x AI, isolated (2 x 0-20mA, 2 x 0-24V)	
	Analog output	2 x AO, isolated (0-20mA)	
	Digital input	12 x DI, isolated (0-24V at 50mA)	
	Digital output	12 x DO, isolated (0-24V at 0.5A)	
	Relay	2 x All_Ok relay output	
	Antenna	2 x SMA male antenna connector for Wi-Fi and Bluetooth (distance: 3cm)	
Miscellaneous	RTC	Supported	
	Watchdog timer	Supported	
System Control	Button	1 x User button (user definable)	
	LED indicator	1 x Power indicator	3 x ETH connectivity indicator
		1 x Error indicator for Codesys	1 x Wi-Fi connectivity indicator
		1 x Codesys running status indicator (Green: Normal operation; Red: Stopped)	
Power	Input	9V-36V DC (over-voltage / power failure protection, reverse polarity protection)	
	Consumption	~6W (Power on without applications running)	
Software	OS	Ubuntu 22.04 + Codesys Runtime & ROS 2 Humble	
	Protocol	CANOpen, EtherCAT	
Mechanical	Dimensions	239.9mm x 124.9mm x 54.5mm	
	Weight	960g	
	Installation	4 x M5-16mm screw recommended	
	IP rating	IP65	
Environmental condition	Temperature	Operating: -20°C~70°C	Storage: -40°C ~ +80°C
	Humidity	5%~95% RH (non-condensing)	

1.7 Product Layout

No.	Description
1	3 x M12 Ethernet port, 1000Mbps (refer to the pinout in section **3.1**)
2	7 x LED indicator (refer to the LED definitions in section **3.5**)
3	Connector A (refer to the pinout in section **3.2**)
4	Connector B (refer to the pinout in section **3.3**)
5	User button (user definable)
6	Full-featured USB 3.0 Type-C, supporting OTG, DisplayPort, programming
7	2 x Wi-Fi and Bluetooth antenna

1.8 Operating System

The device supports Ubuntu 22.04 operating system, with flexible integration of CODESYS Runtime and ROS 2 Humble for customized development.

1.9 Power Supply and Consumption

VT-AGV-3588J works with 9V~36V DC power input supplied by the power pins included in connector A.

The device consumes approximately 6W in an idle state (powered on but without active applications). Note that power consumption may vary significantly based on storage capacity, connected peripherals, operating system configuration, and other hardware/software settings.

1.10 Environmental & Mechanical Specifications

VT-AGV-3588J operates within a temperature ranging from -20℃ to +70℃ and at a relative humidity between 5% and 95% for non-condensing purpose. It is designed to be stored at a temperature range of -40℃ to +80℃.

Parameter	Description
Ingress Protection	IP65
Weight	960g
Antenna Connector	SMA male

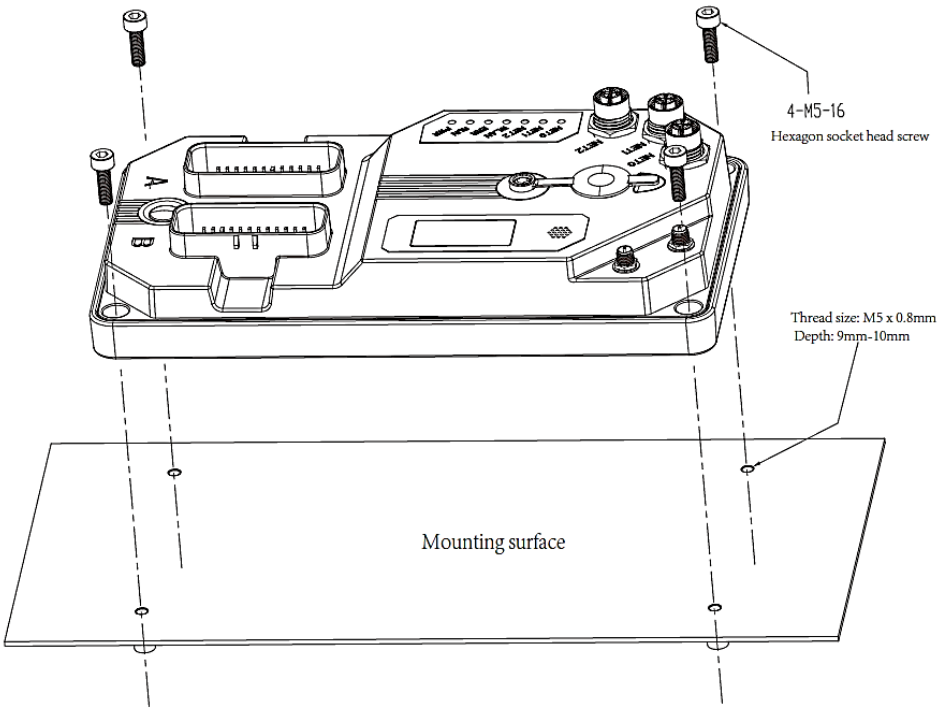
CHAPTER 2 GETTING STARTED

2.1 Device Installation

Follow the steps below to finish hardware connection.

1. Prepare four M5-16mm hexagon socket head screws.

2. Parameters for the screw holes are as follows:
   - Device-side through hole:
     - Diameter: 6mm
     - Depth: 8mm
   - Mounting surface threaded hole:
     - Recommended thread size: M5 × 0.8mm (coarse thread)
     - Recommended depth: 9mm-10mm
3. Use a 5.0mm drill bit for the M5 threads and make sure the hole depth is about 9mm-10mm.
4. Insert the screws through the device-side holes, then tighten the screws to make sure the device is securely fastened on the mounting surface.



2.2 Wiring the Device

Once the device has been installed, adhere to the instructions provided below to wire the device **as needed** for subsequent use.

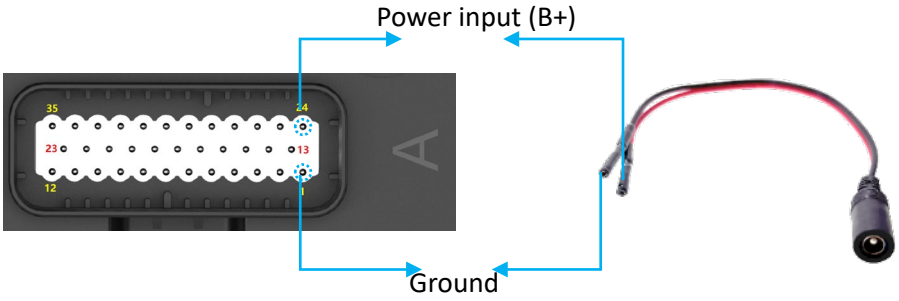
1. Install the two provided Wi-Fi and Bluetooth antennas to the antenna connectors, and hand tighten the antennas clockwise until they snug.

2. Connect one of the device's M12 Ethernet ports to a switch using an M12 X-coded (8-pin) male-to-RJ45 cable (**NET 0 is configured with a static IP address (192.168.17.253/24) by default. To avoid conflicts, do not use this port for switch connections**).

3. Remove the USB Type-C cover, and use a USB Type-C to Type-C cable with display support to connect the device to a monitor for optimal performance.

4. Prepare a DC power connector with wires crimped into insulated female butt splices.

5. Insert the red wire (+) of the DC power connector into the power input pin, and the black wire (-) into the ground pin on the connector A of the device.



6. Connect the DC power connector with a power adapter that supports 9V-36V power input, then plug the power adapter into an outlet to power up the device.

CHAPTER 3 HARWARE DESCRIPTION

This section briefs on the hardware definition and connector/jumper pinout.

3.1 Ethernet

VT-AGV-3588J offers three X-Coded M12 female Ethernet connectors, supporting up to 1000Mbps transfer rate. NET 0 is configured with a static IP address (192.168.17.253/24) by default.

Pinout description:

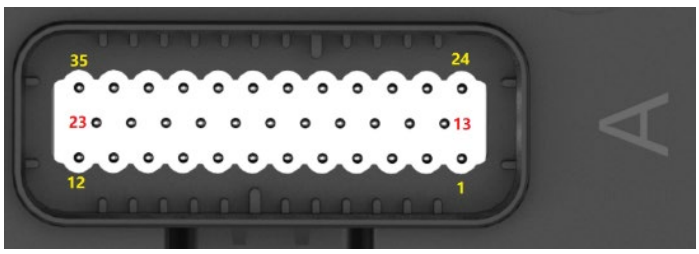
Pin	Wire Color	Signal
1	White + Orange	D1 +
2	Orange	D1 -
3	White + Green	D2 +
4	Green	D2 -
5	White + Brown	D4 +
6	Brown	D4 -
7	White + Blue	D3 +
8	Blue	D3 -

3.2 Connector A

VT-AGV-3588J offers two 35-pin connectors, connector A and connector B.

Connector A offers signals including RS232/485, AI, AO, CAN, USB 2.0, all OK (relay output), and power supply.

Connector A Profile



Pinout description:

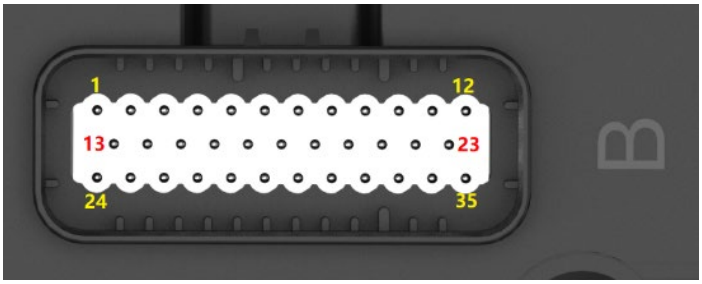
Pin	Signal	Description
1	P_GND	Power ground
2	RS232_RX0	RS232 receive (Channel 0)
3	RS232_RX1	RS232 receive (Channel 1)
4	RS232_TX1	RS232 transmit (Channel 1)
5	RS485_A0	RS485 A (Channel 0)
6	RS485_B0	RS485 B (Channel 0)
7	RS485_B1	RS485_1 B
8	RS485_A1	RS485_1 A
9	DAC_GND	DAC analog output ground
10	AO_OUT2	DAC analog output (Channel 2, 4–20mA)
11	AO_OUT1	DAC analog output (Channel 1, 4–20mA)
12	ALL OK_CO	Self-test OK output (short connect CO & NO)
13	GND_ISO_232	RS232 ground signal
14	RS232_TX0	RS232 transmit (Channel 0)
15	CAN0_L	CAN0 L
16	CAN0_H	CAN0 H
17	GND_ISO_485	RS485 signal ground
18	USB20_CONN_2_DP	USB2.0-2 DP host only
19	USB20_CONN_2_DM	USB2.0-2 DM host only
20	GND	Digital ground
21	AI_V1	ADC analog input (0-24V, Channel 1)
22	AI_A0	ADC analog input (0-20mA, Channel 0)
23	AGND	ADC analog ground
24	B+	Power input (+) (9V-36V, Typ. 24V)
25	CAN1_H	CAN1 H
26	CAN1_L	CAN1 L
27	CAN_GND	CAN ground
28	GND	Digital ground

Pin	Signal	Description
29	USB20_CONN_1_DP	USB2.0-1 DP host only
30	USB20_CONN_1_DM	USB2.0-1 DM host only
31	VBUS5V0_USB20	USB2.0 5V VBUS
32	VBUS5V0_USB20	USB2.0 5V VBUS
33	AI_V0	ADC analog input (0–24V, Channel 0)
34	AI_A1	ADC analog input (0-20mA, Channel 1)
35	ALL OK_NO	Self-test OK output (short connect CO & NO)

3.3 Connector B

Connector B offers signals including SSI, DI, and DO.

Connector B profile



Pinout description:

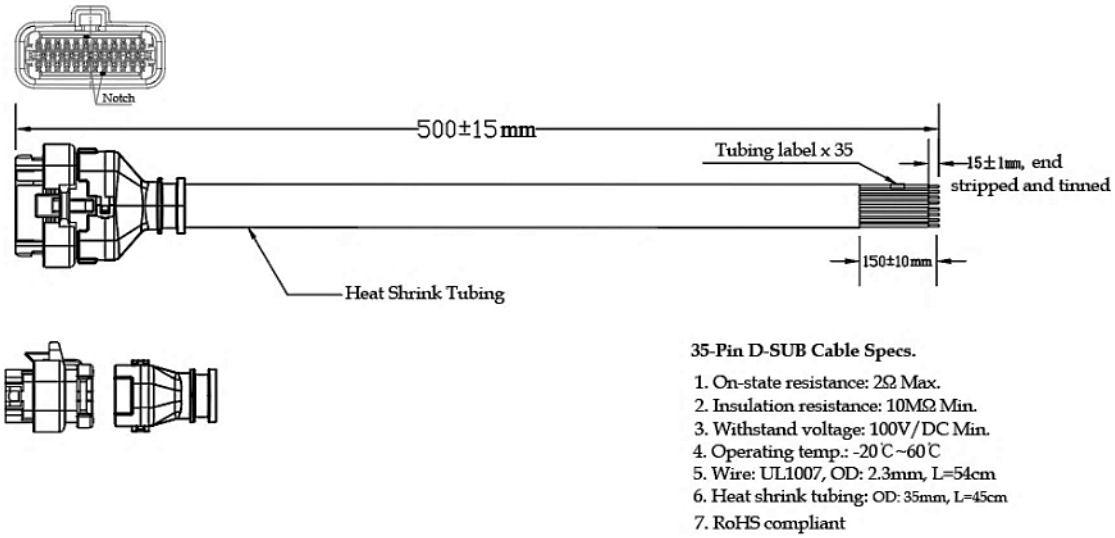
Pin	Signal	Description
1	D_IN10	Digital input (Channel 10)
2	D_IN11	Digital input (Channel 11)
3	D_IN8	Digital input (Channel 8)
4	D_IN7	Digital input (Channel 7)
5	D_IN12	Digital input (Channel 12)
6	DGND	Digital input ground
7	D_OUT1	Digital output (Channel 1)
8	D_OUT2	Digital output (Channel 2)
9	D_OUT3	Digital output (Channel 3)
10	D_OUT4	Digital output (Channel 4)

Pin	Signal	Description
11	D_OUT5	Digital output (Channel 5)
12	D_OUT6	Digital output (Channel 6)
13	D_IN9	Digital input (Channel 9)
14	D_IN6	Digital input (Channel 6)
15	D_IN5	Digital input (Channel 5)
16	ISO_GND	SSI ground
17	CLK1+	SSI_1 differential clock +
18	CLK1-	SSI_1 differential clock -
19	D_OUT7	Digital output (Channel 7)
20	D_OUT9	Digital output (Channel 9)
21	EX_GND	Digital output ground
22	D_OUT8	Digital output (Channel 8)
23	D_OUT10	Digital output (Channel 10)
24	D_IN1	Digital input (Channel 1)
25	D_IN2	Digital input (Channel 2)
26	D_IN3	Digital input (Channel 3)
27	D_IN4	Digital input (Channel 4)
28	DATA0+	SSSI_0 differential data+
29	DATA0-	SSI_0 differential data-
30	CLK0-	SSI_0 differential clock -
31	CLK0+	SSI_0 differential clock +
32	DATA1-	SSI_1 differential data -
33	DATA1+	SSI_1 differential data +
34	D_OUT11	Digital output (Channel 11)
35	D_OUT12	Digital output (Channel 12)

3.4 Recommended Connector Cable

You can use a 35-pin female D-SUB connector cable to interface with connector A or connector B. For custom wiring configurations, you can use standalone adapter wires with one end terminated in insulated female butt splices.

The following reference diagram illustrates the specifications of a recommended 35-pin D-SUB connector cable for the connection.



35-Pin D-SUB Cable Specs.

1. On-state resistance: 2Ω Max.
2. Insulation resistance: 10MΩ Min.
3. Withstand voltage: 100V/DC Min.
4. Operating temp.: -20℃~60℃
5. Wire: UL1007, OD: 2.3mm, L=54cm
6. Heat shrink tubing: OD: 35mm, L=45cm
7. RoHS compliant

3.5 LED Indicators

The definition of the LED indicators is set out as follows.

LED	Description
NET 0 / NET 1 / NET 2	Blinks when there is active network communication via the corresponding Ethernet port. (NET 0 / NET 1 / NET 2)
WLAN	Blinks when a Wi-Fi connection is established.
ERR	Turns red upon system fault detection in CODESYS Runtime. (user configurable in ROS)
RUN	Device status indication in CODESYS Runtime: red for stop and green for normal operation. (user configurable in ROS)
PWR	Illuminates when the device is powered up.

3.6 Electrical Parameters

This section details the critical electrical specifications and interface requirements for safe and optimal device operation, ensuring compatibility with industrial power systems and peripheral devices.

3.6.1 Absolute Maximum Ratings

Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device.

Parameter	Min.	Typ.	Max.	Unit
B+ Signal (Power input)	9	24	36	V
Output Voltage	GND		B+	V
Input Voltage	GND		B+	V
Operational Temperature	-20		70	℃
Storage Temperature	-40		80	℃

3.6.2 CAN

Parameter	Min.	Typ.	Max.	Unit
CAN H/L voltage	-2		7	V
CAN H/L baud rate	80	500	5000	kbps
CAN H/L positive going input threshold			900	mV
CAN H/L negative going input threshold	500			mV
CAN H/L input resistance	9	15	28	kΩ
Power consumption			400	mW

3.6.3 RS485

Parameter	Min.	Typ.	Max.	Unit
Signaling rate			500	Kbps
Differential load resistance	54			Ω
Output current, driver	-60		60	mA
Output current, receiver	-8		8	mA
High-level input voltage (Driver, driver enable, and receiver enable inputs)	2		5.5	V
Low-level input voltage (Driver, driver enable, and receiver enable inputs)	0		0.8	V

3.6.4 RS232

Parameter	Min.	Typ.	Max.	Unit
RS232 TX high level output voltage	2.7	3.2		V
RS232 TX low level output voltage			0.4	V
RS232 RX positive going input threshold	0.6	1.2		V
RS232 RX negative going input threshold		1.5	2.4	V
RS232 RX input resistance	3	5	7	kΩ
RS232 baud rate		115200	235000	bps

3.6.5 Digital Output

Condition	Typical
24V power input	0~24V, 500mA

CHAPTER 4 SOFTWARE GUIDE

VT-AGV-3588J operates on Ubuntu 22.04 operating system with flexible integration of CODESYS Runtime and ROS 2 Humble for custom development.

This chapter is mainly about the interface debugging and functionality testing. For interactive operation, you can:

- Connect a monitor via the USB Type-C (DisplayPort Alt Mode) port.
- Connect a keyboard and mouse to the USB 2.0 pins on connector A (refer to section 3.2 for the pinout)

4.1 System Settings

4.1.1 User Login

The system will automatically log in to **linaro** as the default user after boot.

- User: linaro
- Password: linaro

These credentials are also valid for SSH login.

4.1.2 SSH Login

Follow these steps for SSH login via Ethernet to debug the device:

1. Connect VT-AGV-3588J's **NET 0** Ethernet port to a host computer using an M12 X-coded (8-pin) male-to-RJ45 cable.
2. Manually assign an IP address to the host computer's Ethernet interface, ensuring it is in the same subnet as VT-AGV-3588J.
   - **Device (NET 0) IP**: 192.168.17.253/24 (Default static IP)
   - **Example Host IP**: 192.168.17.100/24
3. Open an SSH client utility on the host computer and log in to the device using credentials below.

   IP address: 192.168.17.253

   Username: linaro

   Password: linaro

4.1.3 EEPROM

1. Create EEPROM Symlink.

```
# ln -s /sys/bus/i2c/devices/6-0050/eeprom /dev/eeprom
```

2. Read device serial number.

```
# vtvdm -r sn
```

3. Read device MAC address.

```
# vtvdm -r mac
```

4.1.4 Time Zone Setup

1. Access the interactive time zone menu.

```
# tzselect
```

2. Follow the on-screen prompts to select the continent, country/region, and city (for instance: Detroit in the US).
3. Copy the time zone file to the local time directory (/etc/localtime) to apply the time zone settings.

```
# cp /usr/share/zoneinfo/America/Detroit /etc/localtime
```

4. Display the active time zone and current time information.

```
# date -R
```

4.1.5 RTC

Real-Time Clock (RTC) is an onboard hardware component that maintains time and date independently of the operating system. Correct RTC synchronization ensures consistent timekeeping across system reboots and power cycles.

1. Update the software system clock (replace with desired date/time).

```
# date -s "2025-08-01 22:01:00"    // Format: YYYY-MM-DD HH:MM:SS
```

2. Write the current system time to the hardware RTC.

```
# hwclock -w
```

3. Power off the device for about 2 minutes.
4. Power on the device and proceed to the next step.
5. Read the RTC time information.

```
# hwclock -r                        // The time should be later than that set in step 1
```

4.1.6 Watchdog Timer

The watchdog timer (WDT) is a hardware-based fail-safe mechanism that reboots the system if software fails to periodically "feed" it (indicating system hangs or critical failures). The WDT is disabled by default. Once enabled, the timeout is **7.8** seconds, meaning that the device must receive "feed" signals within this interval. If not, the system will reboot upon timeout, indicating a system or application failure.

1. Enable the watchdog.

```
# echo 1 > /sys/class/leds/wdt_set/brightness
```

2. Feed the watchdog within the feeding intervals.

```
# echo 1 > /dev/watchdog
```

The command in step 2 must repeat at least once in every <7.8 seconds. Failure to feed will trigger hardware reboot or kernel warnings in system logs.

4.1.7 Static Ethernet IP Setup

After connecting the device to an active Ethernet network (via NET1 or NET2), you may configure a static IP address for the corresponding interface when required.

By default, the NET0 interface has already been configured with a static IP address: 192.168.17.253/24.

Physical Ethernet ports NET 0, NET 1, and NET 2 correspond to net0, net1, and net2, respectively in the software system.

Steps for setting up a static IP address for NET1:

1. Open the Netplan configuration file.

```
# vim /etc/netplan/01-network-manager-all.yaml
```

2. Configure static IP for the desired interface using NetworkManager.

```
network:
  version: 2
  renderer: NetworkManager
  ethernets:
   net1:
    addresses:
    - 192.168.17.259/24
```

4.2 Communication

This section validates the core communication capabilities of the device through comprehensive testing of its network interfaces.

4.2.1 Ethernet

Physical Ethernet ports NET0, NET1, and NET2 correspond to net0, net1, and net2 in the software system.

1. When needed, connect the device to an active Ethernet network via NET1 or NET2.
2. Check the network interface information.

```
# ifconfig
docker0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        inet 172.17.0.1  netmask 255.255.0.0  broadcast 172.17.255.255
        ether 02:42:b7:37:06:d6  txqueuelen 0  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 160  bytes 13996 (13.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 160  bytes 13996 (13.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

net0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.17.253  netmask 255.255.255.0  broadcast 192.168.17.255
        inet6 fe80::78a5:98ff:fe3e:d183  prefixlen 64  scopeid 0x20<link>
        ether 7a:a5:98:3e:d1:83  txqueuelen 1000  (Ethernet)
```

```
        RX packets 5  bytes 405 (405.0 B)
        RX errors 0  dropped 1  overruns 0  frame 0
        TX packets 10  bytes 970 (970.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

net1: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 18:9b:15:a5:12:12  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

net2: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 18:9b:15:a5:12:11  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 82

wlan0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 58:02:05:b6:53:09  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

wlan1: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 5a:02:05:16:53:09  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
```

```
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Software network interfaces net0~2 correspond to physical Ethernet ports NET 0~2.

net0 has been configured with a default static IP address: 192.168.17.253/24.

wlan0 is the Wi-Fi client interface, and wlan1 is the Wi-Fi AP interface.

4.2.2 Wi-Fi

You can configure Wi-Fi either by using the Network icon on the taskbar of the device GUI or by using NetworkManager's command-line tool (nmcli).

Wi-Fi Client Mode

Using NetworkManager's command-line tool:

1. Turn off the Wi-Fi feature.

```
# nmcli r wifi off
```

2. Turn on the Wi-Fi feature.

```
# nmcli r wifi on
```

3. Scan for available Wi-Fi SSIDs.

```
# nmcli dev wifi list
```

4. Connect to an existing SSID.

```
# nmcli dev wifi connect <ssid> password <password> ifname wlan0
```

5. Check the Wi-Fi connection status.

```
# nmcli dev status
```

6. Disconnect the current hotspot.

```
# nmcli dev disconnect wlan0     // wlan0 is the Wi-Fi client interface
```

7. Reconnect to the previously connected SSID.

```
# nmcli dev conn wlan0
```

8. Delete the connection.

```
# nmcli connection delete <ssid>
```

Wi-Fi AP Mode

To switch the device to Wi-Fi Access Point (AP) mode using the configuration file /etc/hostapd/wlan1.conf, follow these steps:

- Start the Wi-Fi AP manually:

```
# systemctl start hostapd@wlan1          // Wi-Fi AP interface
```

- Enable automatic startup on boot:

```
# systemctl enable hostapd@wlan1
```

- Default Wi-Fi AP parameters in /etc/hostapd/wlan1.conf:

  SSID: agv-ap

  Password: 12345678

4.2.3 Bluetooth

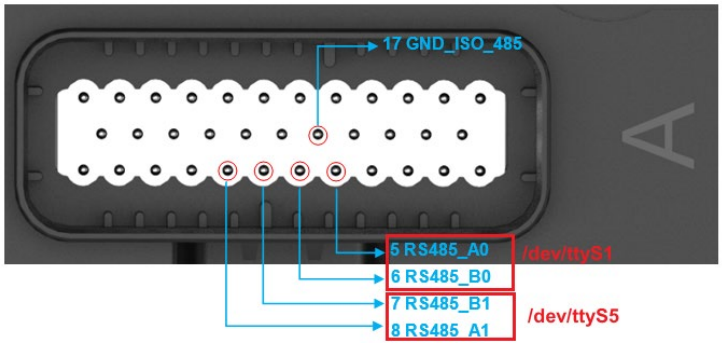
Use the Bluetooth Manager to pair a Bluetooth device.

4.3 Peripheral Interfaces

This section briefs on the functionality testing of the peripheral interfaces. You can refer to section 3.4 for the cable recommended for interfacing with the connector pins.

4.3.1 RS485

VT-AGV-3588J offers two RS485 ports mapped as /dev/ttyS1 and /dev/ttyS5, respectively.



1. Use twisted-pair cables to wire the two RS485 ports (A0-A1, B0-B1).
2. Open two separate terminals and set the baud rate for both ports.

```
Terminal 1: # stty -F /dev/ttyS1 speed 115200
Terminal 2: # stty -F /dev/ttyS5 speed 115200
```

3. Transmit data in Terminal 1.

```
# echo test > /dev/ttyS1
```

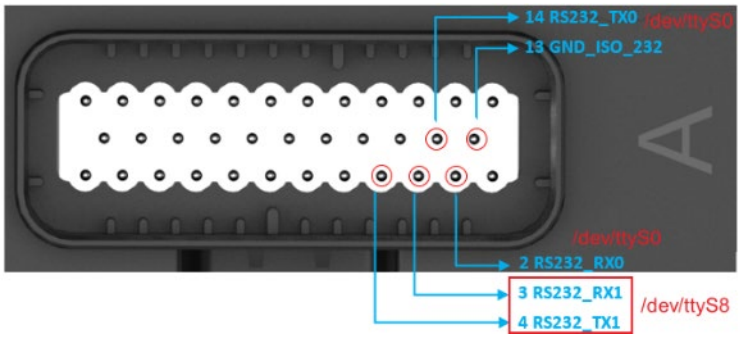
4. Receive data in terminal 2.

```
# cat  /dev/ttyS5
```

5. The data received in Terminal 2 should be the same as those sent in Terminal 1.

4.3.2 RS232

VT-AGV-3588J offers two RS232 ports mapped as /dev/ttyS0 and /dev/ttyS8, respectively.



1. Use a straight-through cable to wire the TX and RX pins of an RS232 port (/dev/ttyS0 for instance).
2. Open a terminal and set the baud rate for the port.

```
# stty -F /dev/ttyS0 speed 115200
```

3. Transmit data.

```
# echo test > /dev/ttyS0
```

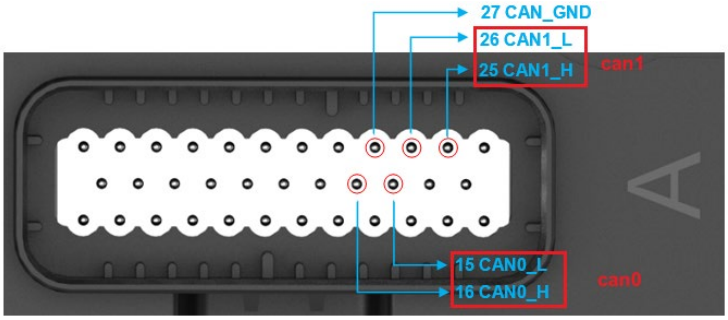
4. Receive data.

```
# cat  /dev/ttyS0
```

5. The data received should be the same as those sent in the prior step.

4.3.3 CAN

VT-AGV-3588J offers two CAN buses, mapped as can0 and can1, respectively.



1. Connect the two CAN buses (H-H, L-L, GND-GND).
2. Open a terminal (Terminal 1) and bring up can0 with a bitrate of 500,000 bps:

```
# ip link set can0 down
# ip link set can0 up type can bitrate 500000
# ip link set can0 up
```

3. Open another terminal (Terminal 2) and bring up can1 with a bitrate of 500,000 bps:

```
# ip link set can1 down
# ip link set can1 up type can bitrate 500000
# ip link set can1 up
```

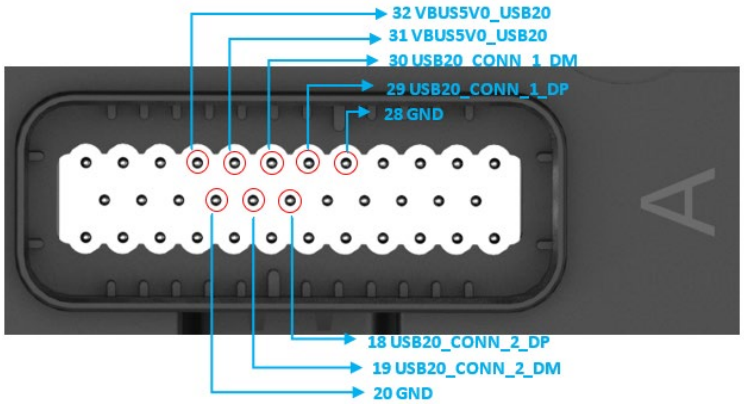
4. Use can0 to transmit data and can1to receive data.

```
# cansend can0 123#1122334455667788      (Terminal 1)
# candump can1                           (Terminal 2)
```

5. The data received in Terminal 2 should be the same as those sent in Terminal 1.

4.3.4 USB 2.0 Host

VT-AGV-3588J offers two USB 2.0 Host ports. You can connect a USB peripheral to either port to test the functionality of the port.



1. List all connected USB devices.

```
# lsusb
```

2. After connecting a USB flash drive to the device, mount it to a specified directory (e.g., /mnt) using the device name identified in the prior step.

```
# mount /dev/xxx /mnt
```

3. Display the disk space usage of file systems.

```
# df -h
```

4. Check the mounted content.

```
# ls /mnt
```

5. Unmount the USB flash drive:

```
# umount /dev/xxx
```

4.3.5 USB 3.0 Type-C

VT-AGV-3588J offers a USB Type-C port, supporting USB OTG and DP alt mode for display output. To output images from the device, please use a USB Type-C to Type-C cable to connect the device and the monitor.

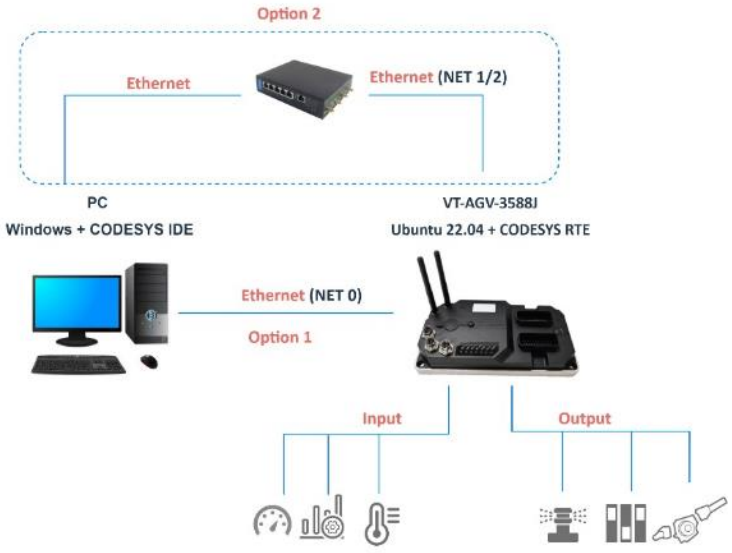
4.3.6 User Button

The button is user definable, and you can execute the following command to print the button log upon a press.

```
# hexdump /dev/input/by-path/platform-gpio-keys-event-joystick
00000c0 9d93 6835 0000 0000 ddd3 0001 0000 0000
00000d0 0001 02c0 0001 0000 9d93 6835 0000 0000
00000e0 ddd3 0001 0000 0000 0000 0000 0000 0000
00000f0 9d93 6835 0000 0000 b288 0003 0000 0000
0000100 0001 02c0 0000 0000 9d93 6835 0000 0000
0000110 b288 0003 0000 0000 0000 0000 0000 0000
```

4.4 Programming in CODESYS

For VT-AGV-3588J running Ubuntu 22.04 with CODESYS Runtime, users can download and install the IDE (integrated development environment) package on the PC for device programming and control.



Prerequisites:

- VT-AGV-3588J running Ubuntu 22.04 with CODESYS Runtime integrated
- A Windows-based PC
- VT-AGV-3588J and the PC are in the same subnet
- Device description file and I/O description file

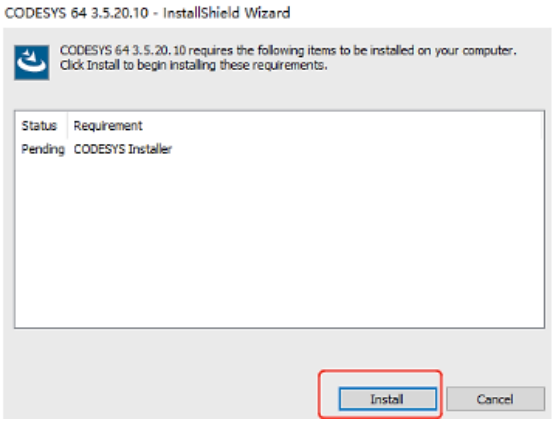
4.4.1 IDE Download and Installation

The following sections outlines the steps to use a Windows PC to connect VT-AGV-3588J for the purpose of programming and control.

1. Download CODESYS Development System V3 (3.5.19 or later) from the official website of CODESYS: https://store.codesys.com/en/codesys.html.

   A user account is required for the first-time login.

2. Follow the installation wizard to complete the installation of CODESYS IDE on the PC.



4.4.2 Device and I/O Description Installation

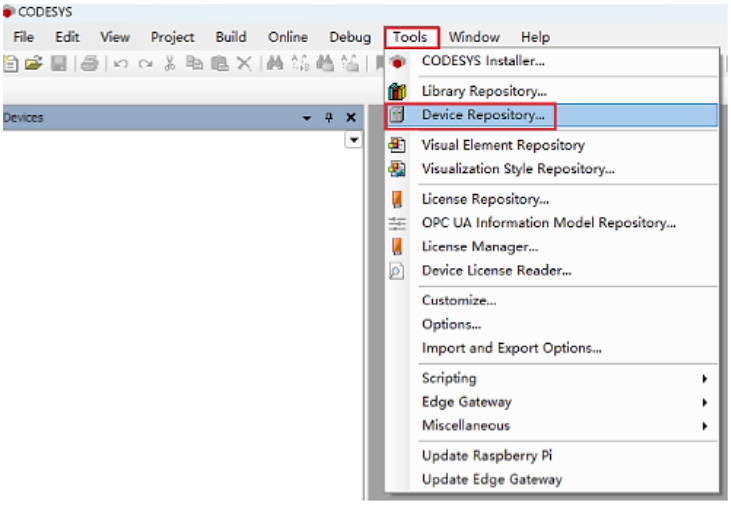
Before you start, make sure you have received the following files as part of the software release package:

Device description file: /path/to/SW/codesys/Vantron-ARM_64-Linux-SoftMotion.devdesc.xml)

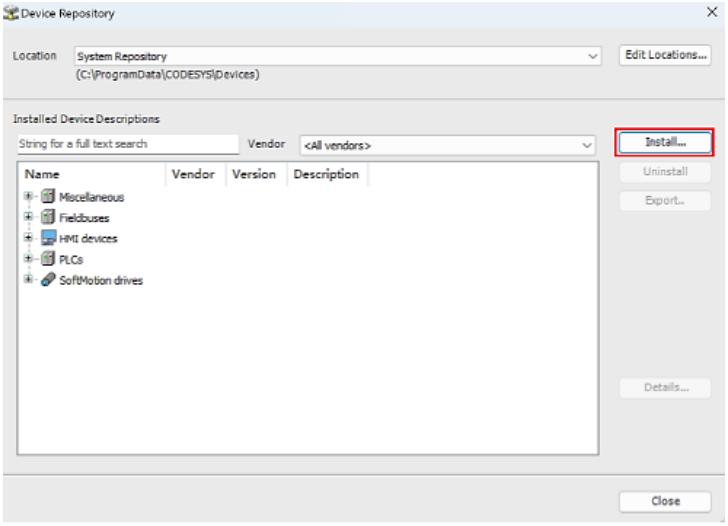
I/O description file: /path/to/SW/codesys/devdescIoDrvVantron.devdesc.xml

1. Install the device description:

   - Click **Tools > Device Repository** from the menu bar of CODESYS program.



   - Select the install location. **System Repository** is set by default.
   - Click the **Install** button to open the **Install Device Description** dialog.



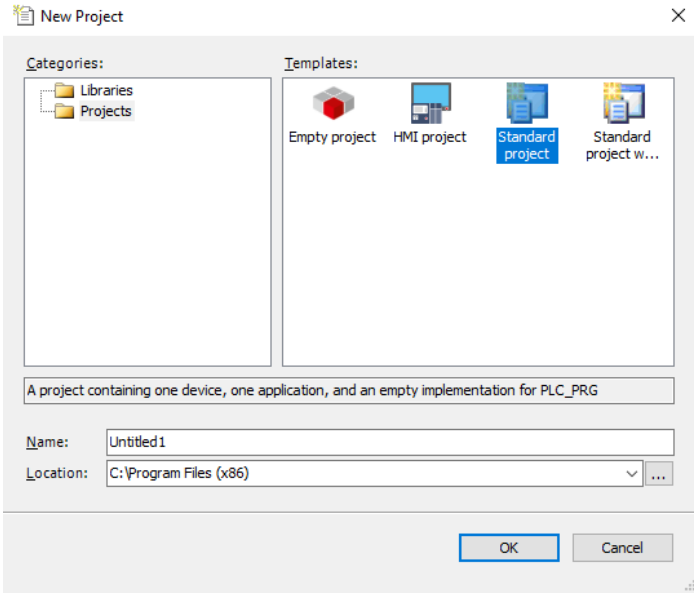
   - Select the file path of the device description.
   - Select the file type filter of the required device description.
   - Select the device description file (**Vantron-ARM_64-Linux-SoftMotion.devdesc.xml**) and click **Open**.
   - When the installation completes with success, the device will appear in the list of device descriptions in the middle of the window.

2. Install the I/O description:

   - Repeat the operations in the prior step and select the I/O description file (**devdescIoDrvVantron.devdesc.xml**) for installation.

4.4.3 Project Creation and Device Connection

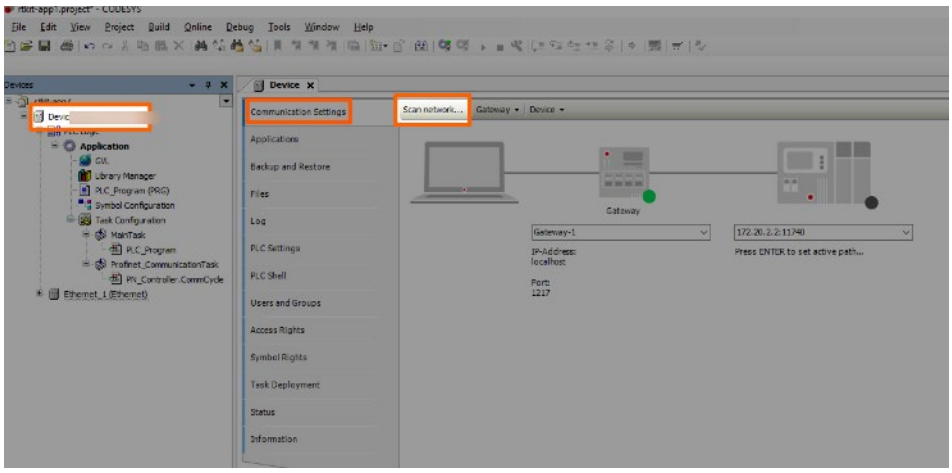
1. In CODESYS, click **File > New Project**, and then the **Projects** category **> Standard Project template**.
2. Specify a project name and its location in the file system, then click **OK** to save the settings.



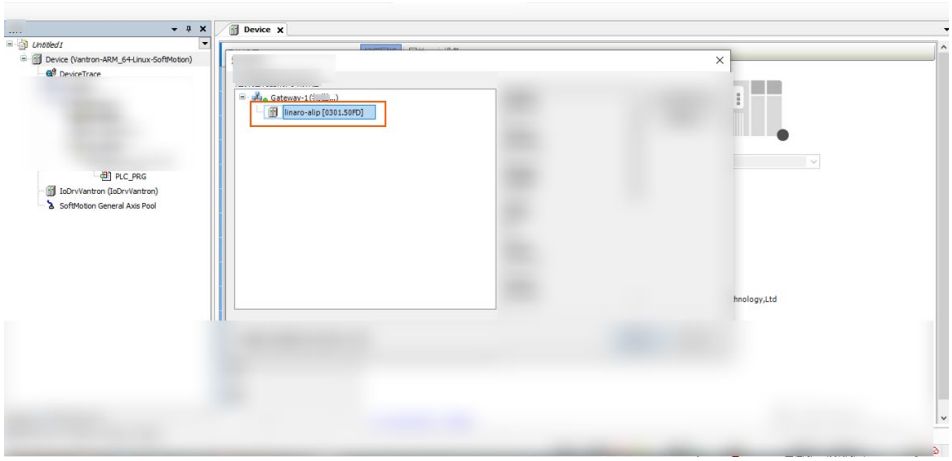
3. Select **Vantron-ARM_64-Linux-SoftMotion** as the device, then click **OK**. The project is now created.
4. Power on VT-AGV-3588J.
5. Connect VT-AGV-3588J's **NET 1/NET 2** Ethernet port to a switch using an M12 X-coded (8-pin) male-to-RJ45 cable.
6. Connect the PC to the same switch to make sure both devices are in the same subnet.

   Alternatively, to replace steps 5 and 6 you can:

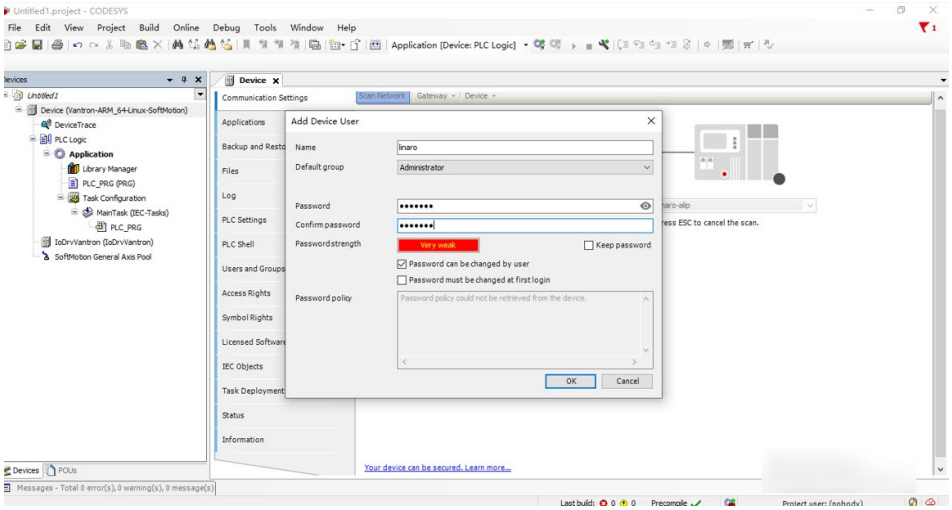
   - *Connect VT-AGV-3588J's **NET 0** directly to your PC's Ethernet port.*
   - *Configure a static IP address (e.g., 192.168.17.100/24) on the PC's Ethernet interface, ensuring it's in the same subnet as the device's NET 0 (192.168.17.253/24).*
7. In CODESYS, double click **Device** (**Vantron-ARM_64-Linux-SoftMotion**) under the new project.
8. Go to **Communication Settings > Scan network.**



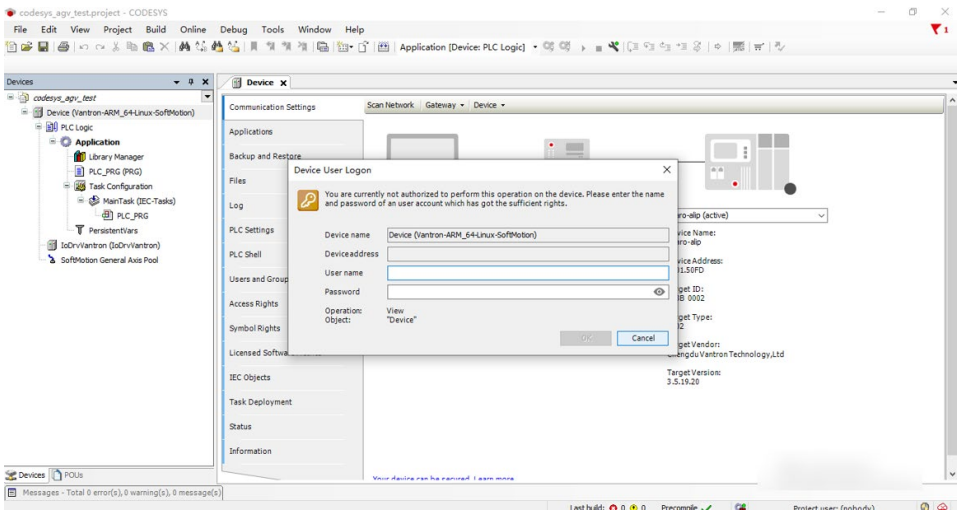
9. Select the device (linaro-alip xxx) from the list, and click **OK**.



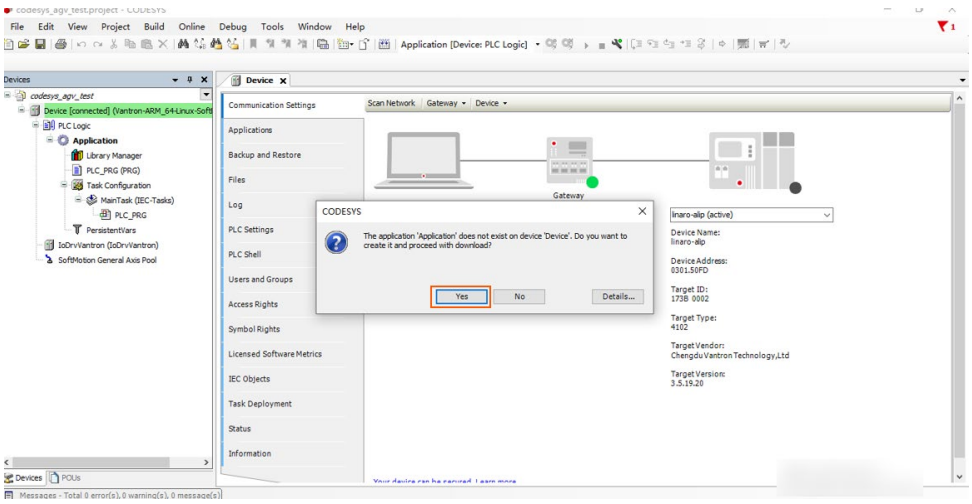
10. Create a device user if this is the first time you have added the device to the project.



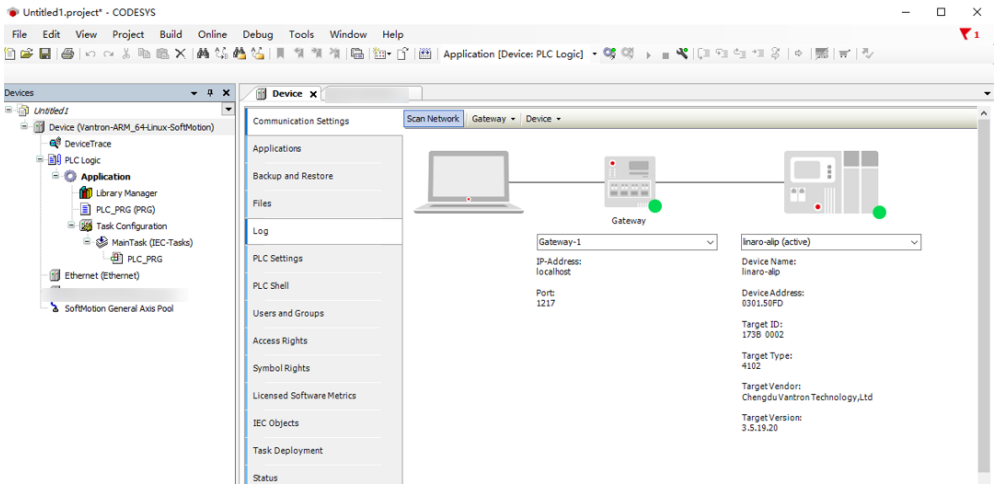
11. Enter the username and password you created in the prior step for authentication.



12. Allow the application to be created and downloaded.

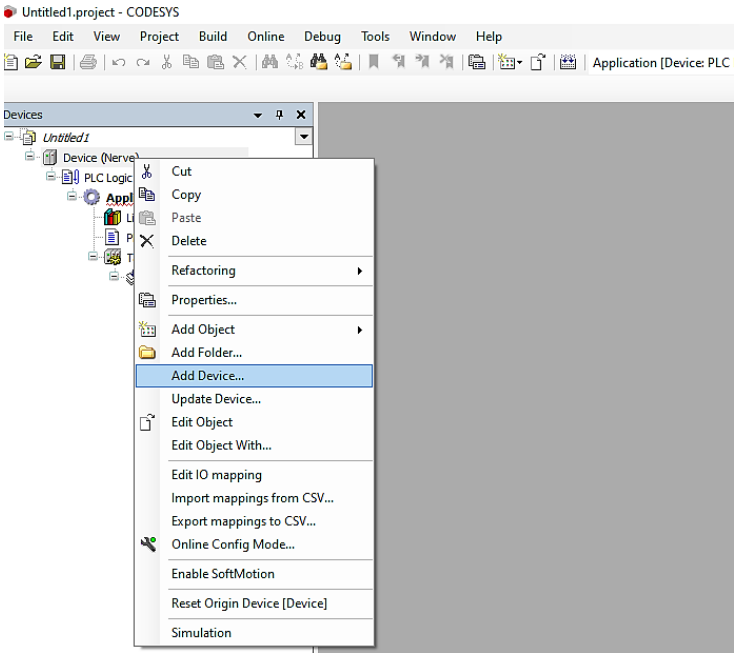


13. When VT-AGV-3588J connects to the PC, both gateway and controller icons in CODESYS will be highlighted with a green dot, with details of the controller displayed.

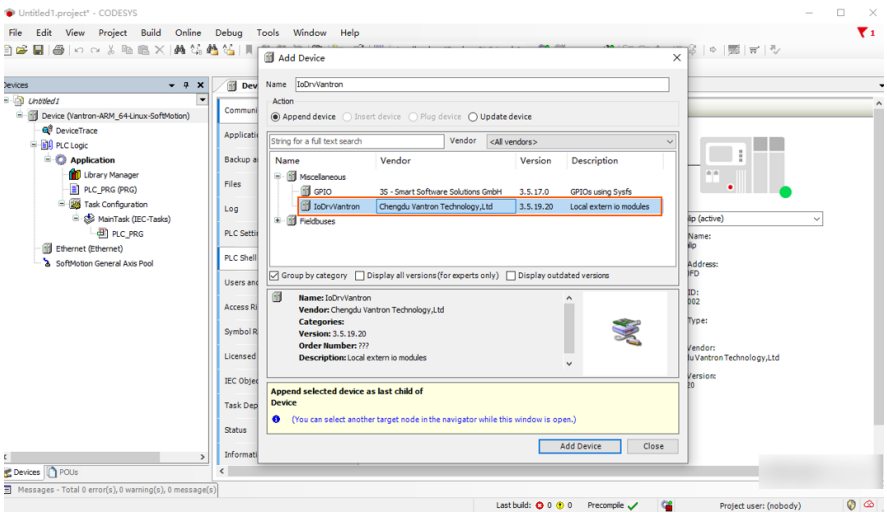


4.4.4 Adding the I/O Module

1. In CODESYS, right click **Device** (**Vantron-ARM_64-Linux-SoftMotion**) under the new project.



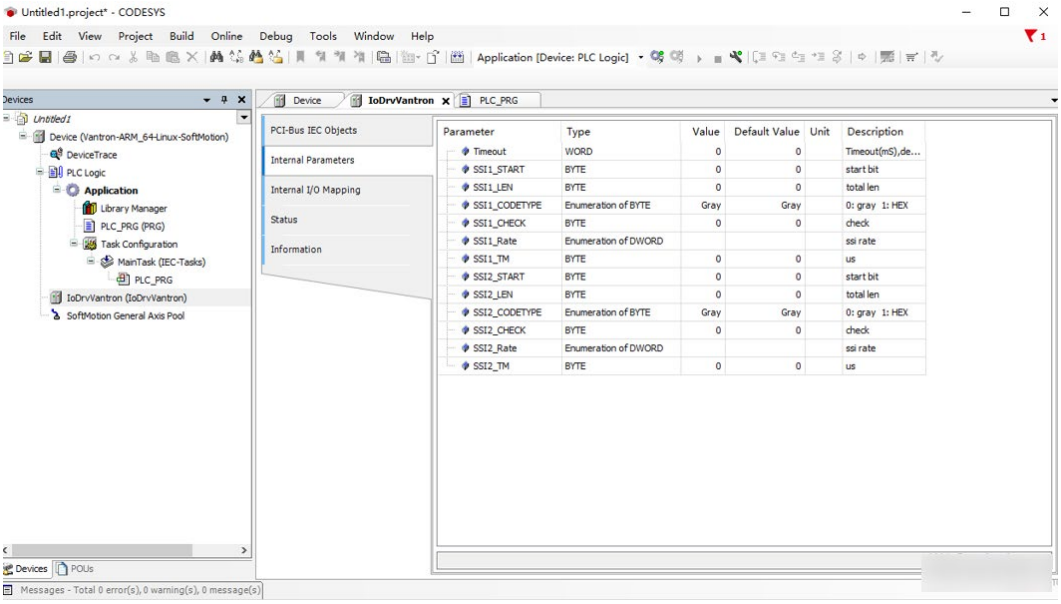
2. Expand the **Miscellaneous** menu and select **IoDrvVantron**.



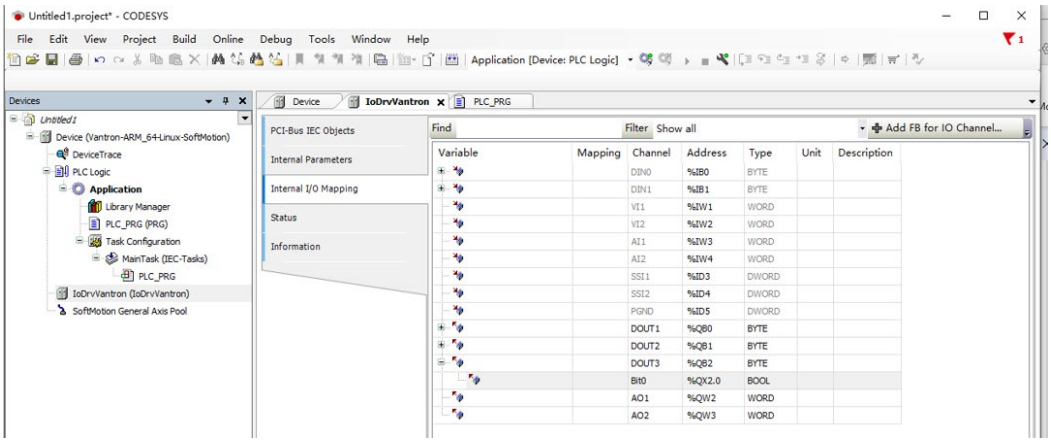
3. Click **Add Device**, and it will display under the current project. Click **Close** to exit.

4.4.5 I/O Settings

After enabling the I/O module upon a double click, you can configure the parameters for SSI under **Internal Parameters** menu.



Under the **Internal I/O Mapping** menu, the AI, DI, AO, DO interfaces are displayed, where AI values are raw ADC readings, and AO values are raw DAC reading.



System interfaces and the hardware ports are mapped as follows.

CODESYS Channel		Signal	Hardware Pin	
DIN0 (digital input 0)	Bit0	D_IN1	Pin 24	Connector B **(Input range: 0-24V at 50mA)**
	Bit1	D_IN2	Pin 25	
	Bit2	D_IN3	Pin 26	
	Bit3	D_IN4	Pin 27	
	Bit4	D_IN5	Pin 15	
	Bit5	D_IN6	Pin 14	
	Bit6	D_IN7	Pin 4	
	Bit7	D_IN8	Pin 3	
DIN1 (digital input 1)	Bit0	D_IN9	Pin 13	
	Bit1	D_IN10	Pin 1	
	Bit2	D_IN11	Pin 2	
	Bit3	D_IN12	Pin 5	

CODESYS Channel	Signal	Hardware Pin	
VI1	AI_V0	Pin 33	Connector A **(Input range: 0-24V)**
VI2	AI_V1	Pin 21	
AI1	AI_A0	Pin 22	Connector A **(Input range: 0-20mA)**
AI2	AI_A1	Pin 34	
AO1	AO_OUT1	Pin 11	Connector A **(Output range: 0-20mA)**
AO2	AO_OUT2	Pin 10	
SSI1	DATA0-	Pin 29	Connector B
	DATA0+	Pin 28	
	CLK0-	Pin 30	
	CLK0+	Pin 31	
SSI2	DATA1-	Pin 32	
	DATA1+	Pin 33	
	CLK1-	Pin 18	
	CLK1+	Pin 17	
PGND	P_GND	Pin 1	Connector A

CODESYS Channel		Signal	Hardware Pin	
DOUT1 (digital output 1)	Bit0	D_OUT1	Pin 24	Connector B **(Output range: 0-24V at 0.5A)**
	Bit1	D_OUT2	Pin 25	
	Bit2	D_OUT3	Pin 26	
	Bit3	D_OUT4	Pin 27	
	Bit4	D_OUT5	Pin 15	
	Bit5	D_OUT6	Pin 14	
	Bit6	D_OUT7	Pin 4	
	Bit7	D_OUT8	Pin 3	
DOUT2 (digital output 2)	Bit0	D_OUT9	Pin 13	
	Bit1	D_OUT10	Pin 1	
	Bit2	D_OUT11	Pin 2	
	Bit3	D_OUT12	Pin 5	

CODESYS Channel		Signal	Hardware Pin	
DOUT3 (digital output 3)	Bit0	ALL OK_CO	Pin 12	Connector A
		ALL OK_NO	Pin 35	

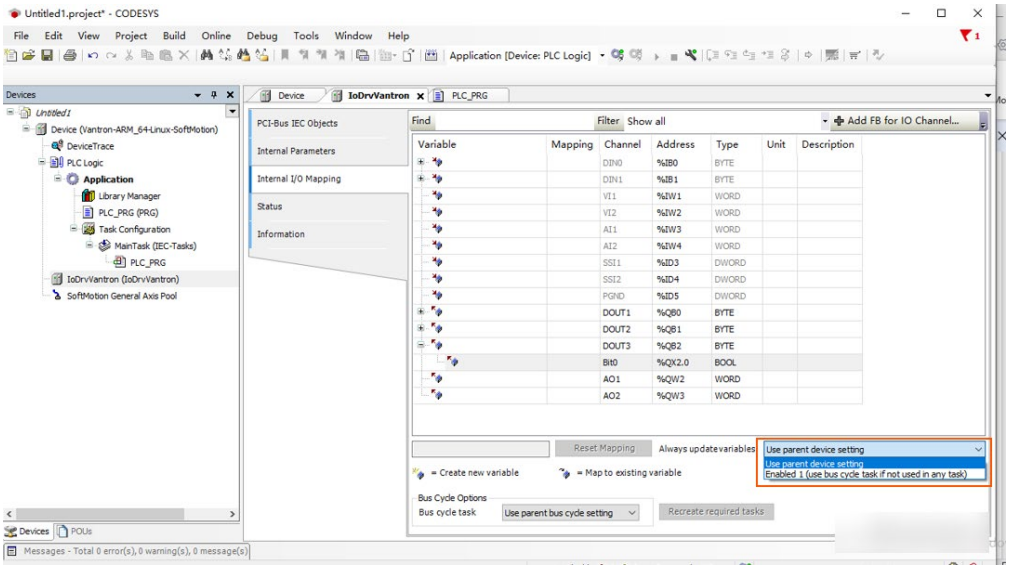
Bit0 = True, ALL OK_CO and ALL OK_NO are shorted.

Bit0 = False, ALL OK_CO and ALL OK_NO are not shorted.

4.4.6 Device Login

After setting up the parameters:

1. Click the login symbol ( ) to connect the application to the VT-AGV-3588J and starts the online mode.
2. click the start icon ( ) to start the application.
3. Select a mode for updating I/O variables on the lower right corner of the window.



- **Use parent device setting**: Update according to the setting of the superordinate device.
- **Enabled 1** (use bus cycle task if not used in any task): CODESYS updates the I/O variables in the bus cycle task if they are not used in any other task.
- E**nabled 2** (always in bus cycle task): CODESYS updates all variables in each cycle of the bus cycle task, regardless of whether they are used and whether they are mapped to an input or output channel.

4.5 ROS 2 Humble Demo Test

VT-AGV-3588J is pre-installed with required deb packages for ROS 2 Humble, including ros-humble-desktop, python3-colcon-common-extensions, python3-colcon-core, ros-humble-v4l2-camera, ros-humble-usb-cam, and ros-humble-image-pipeline.

To run a demo test, follow these steps:

1. Power on VT-AGV-3588J and open two terminals, terminal 1 (T1) for the publisher and terminal (T2) for the subscriber.
2. Source the setup files in both terminals.

```
source /opt/ros/humble/setup.bash
```

3. In T1, start the publisher.

```
$ ros2 run demo_nodes_cpp talker
# Expected output:
[INFO] [1749065505.376454068] [talker]: Publishing: 'Hello World: 1'
[INFO] [1749065506.376398235] [talker]: Publishing: 'Hello World: 2'
[INFO] [1749065507.376399277] [talker]: Publishing: 'Hello World: 3'
[INFO] [1749065508.376398569] [talker]: Publishing: 'Hello World: 4'
```

4. In T2, start the subscriber.

```
$ ros2 run demo_nodes_cpp listener
# Expected output:
[INFO] [1749065560.509145927] [listener]: I heard: [Hello World: 1]
[INFO] [1749065561.509041094] [listener]: I heard: [Hello World: 2]
[INFO] [1749065562.509033095] [listener]: I heard: [Hello World: 3]
[INFO] [1749065563.509184345] [listener]: I heard: [Hello World: 4]
```

For further guidance and advanced operations, refer to the official ROS 2 Humble documentation at https://docs.ros.org/en/humble/index.html.

CHAPTER 5 IMAGE FLASHING

5.1 Firmware Upgrade in Windows Environment

Prerequisites:

- A Windows host computer
- VT-AGV-RK3588J AGV controller
- A USB Type-A to Type-C cable
- Software release package

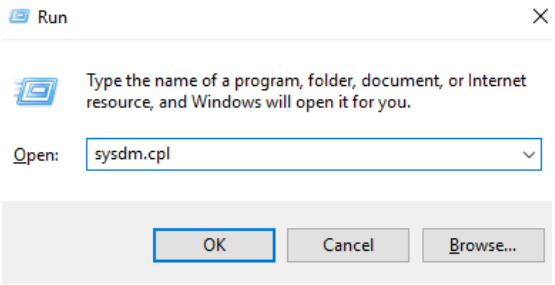
5.1.1 ADB setup on the Windows host

Android Debug Bridge (ADB) is a tool that is designed to connect your development workstation directly to your Android device for debugging, device upgrading, app installation, etc.

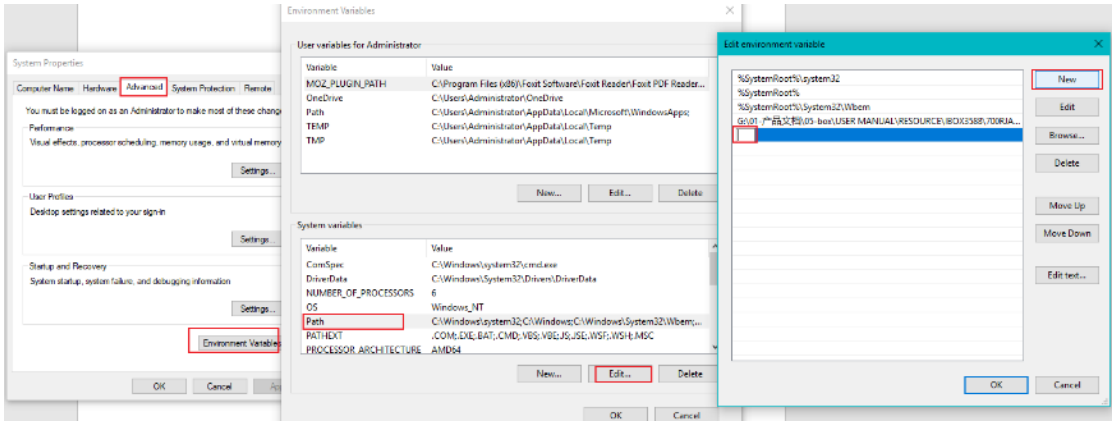
Adding the ADB executable file to the system's environment variable allows you to run the ADB tool regardless of your current working directory.

Follow the steps below to set up the ADB on the Windows host.

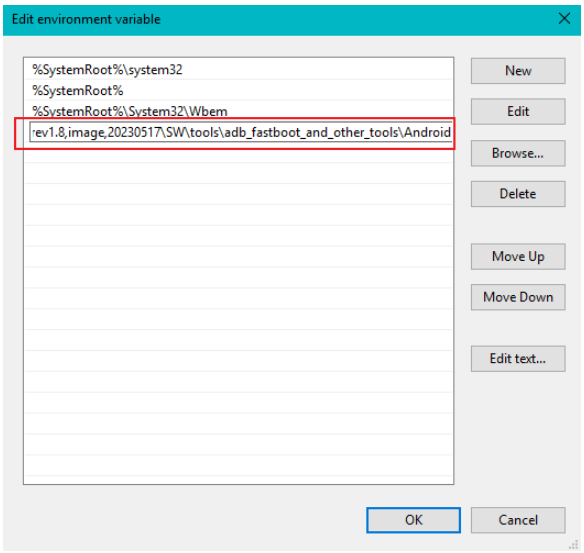
1. Unzip the software release package and navigate to the following directory: \SW\downloadetools\windows.
2. Extract the **adbtoolswindows** zip file.
3. Navigate to the **platform-tools** folder that contains the ADB tool kit, and copy the folder path.
4. Press "Win + R" and input sysdm.cpl in the dialogue box to open the settings interface.



5. Click in sequence **Advanced > Environment Variables > System Variables > Path > Edit**, and click **New** in the pop-up.

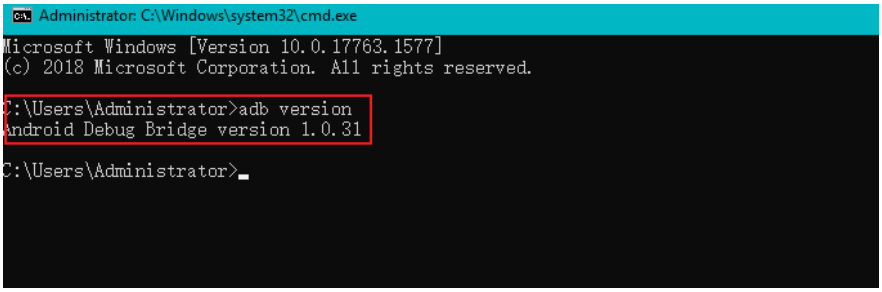


6. Paste the path of the **platform-tools** folder, and click **OK** one by one to confirm and exit.



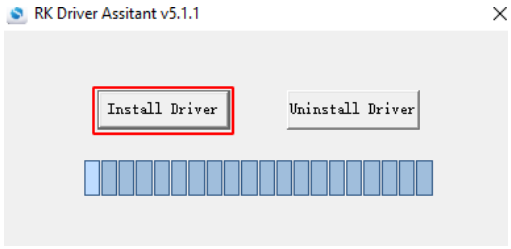
7. Press “Win + R” and input cmd in the dialogue box.

8. Input adb version in the command prompt to check if the ADB tool is installed.

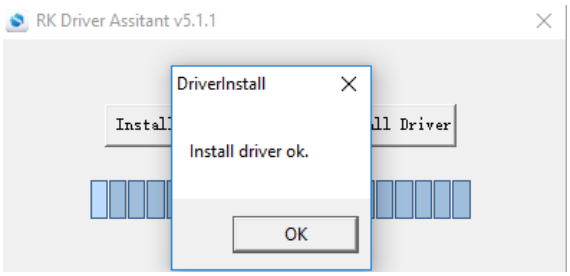


5.1.2 Firmware upgrade

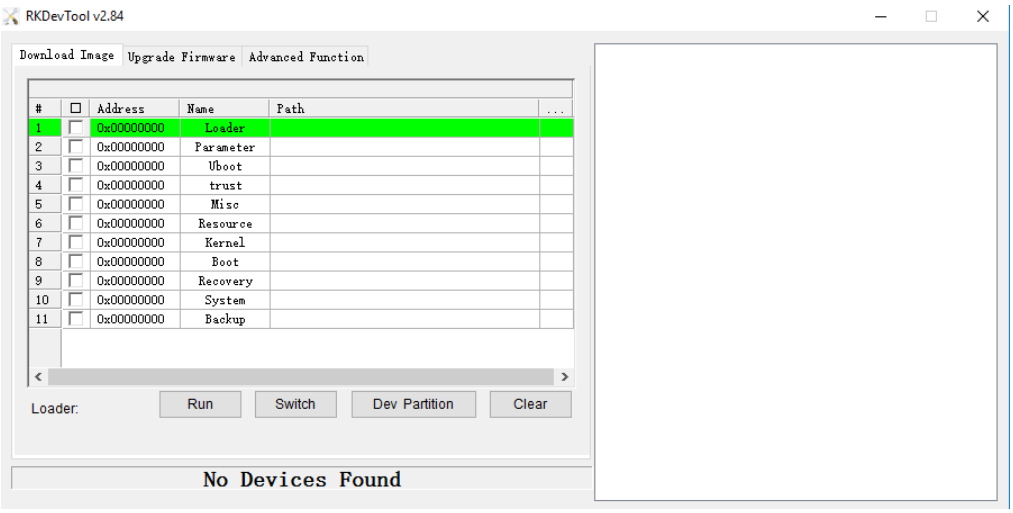
1. Unzip the release package and open the directory of the upgrade driver (\SW \downloadetools\windows\DriverAssitant_vxxx);
2. Right click the mouse and run the driver program **DriverInstall.exe** as administrator;
3. Click **Install Driver** and wait for the installation to proceed;



4. A pop-up will appear in a second suggesting the driver is installed;

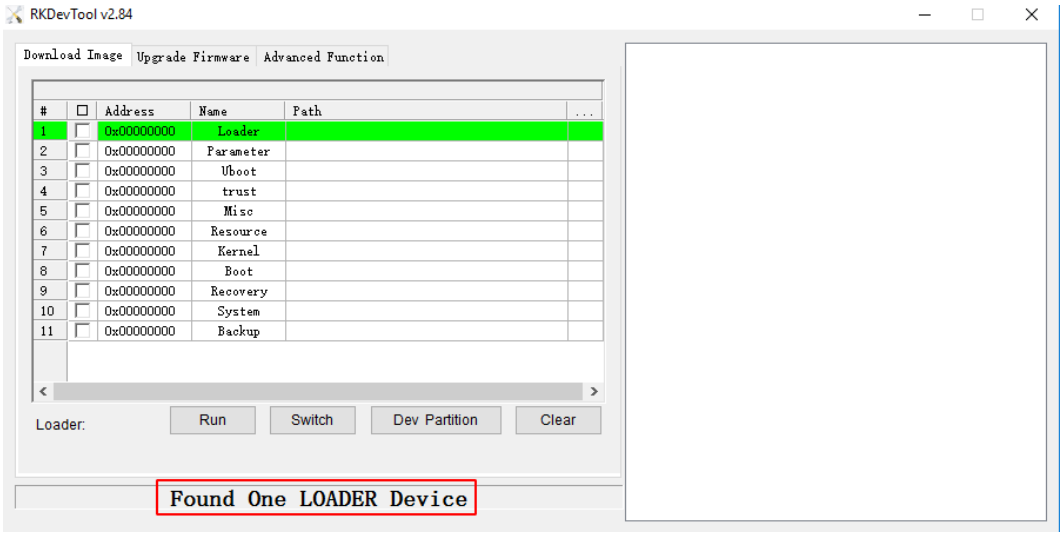


5. Open the directory of the upgrade tool (\SW\downloadetools\windows\ RKDevTool_Release_vxxx);
6. Double click the driver for the upgrade tool **RKDevTool.exe** to open the upgrade window;

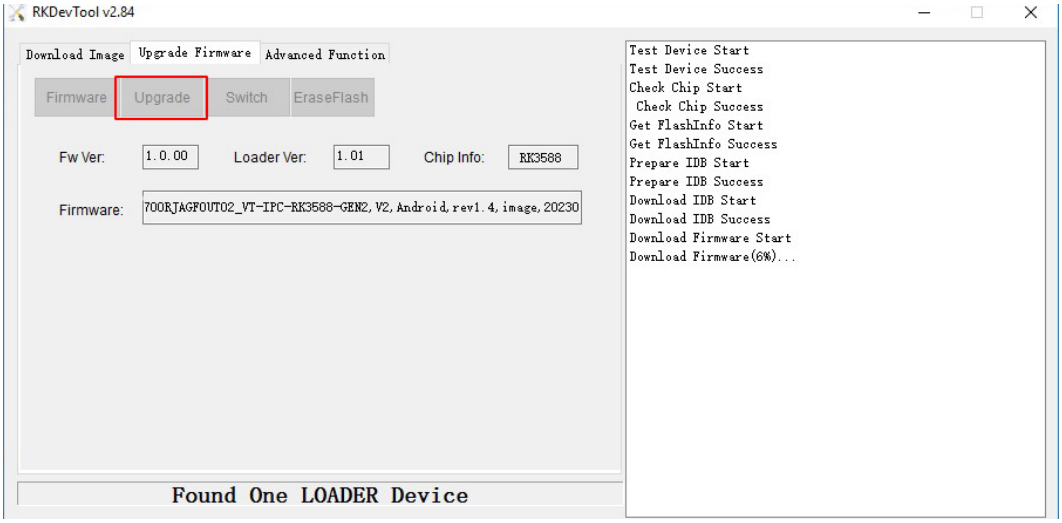


7. Connect VT-AGC-3588J to the Windows host using a USB Type-A to Type-C cable;

8. Press “Win + R” and input cmd in the dialog box to open the command prompt;
9. Input adb devices in the command prompt to check if the device is connected to the Windows host;
10. Once the device is identified by the Windows host, input adb reboot loader to reboot the device into the bootloader mode;
11. Then the upgrade window will prompt for the existence of a Loader device, indicating that the upgrade process is ready;



12. Click **Upgrade Firmware** > **Firmware** in the upgrade window;
13. Select the upgrade file (**update.img)** from the directory (\SW\Image) and click **Open**, and the firmware details will be automatically populated in the boxes;
14. Click the **Upgrade** button and the device will start to download the image and upgrade the firmware automatically;



15. When the upgrade finishes, the device will reboot automatically.

5.2 Firmware Upgrade in Ubuntu Environment

Prerequisites:

- A Ubuntu host computer
- VT-AGV-RK3588J AGV controller
- A USB Type-A to Type-C cable
- Software release package

1. Connect VT-AGC-3588J to an Ubuntu host computer using a USB Type-A to Type-C cable.
2. Open a terminal on the Ubuntu host computer and input the following command to install the ADB tool if necessary.

   ```
   $ sudo apt-get install adb -y
   ```

3. Check if the device is connected to the Ubuntu host computer via the ADB tool.

   ```
   $ adb devices -l
   ```

4. Execute `adb shell` to access the device's shell.
5. Run `reboot loader` to reboot the device to the bootloader mode.
6. Copy the release package to the Ubuntu host computer or save the release package to a USB flash drive and mount the USB drive to the Ubuntu system.
7. On the Ubuntu host computer, open the directory where the upgrade tool (named as "upgrade_tool") is located: \SW\downloadetools\linux\Linux_Upgrade_Tool_vxxx.
8. Unzip the folder.
9. Right click the mouse in an empty space of the folder and click **Open in Terminal**.
10. Input the following command to start the upgrade process.

    ```
    $ sudo ./upgrade_tool uf xxx/update.img
    ```

    "xxx" is the path of the image file (update.img), usually found in /SW/Image.

11. The system will start upgrading after the download finishes, and it will reboot automatically when the upgrade finishes.

CHAPTER 6 DISPOSAL AND WARRANTY

6.1 Disposal

When the device comes to end of life, you are suggested to properly dispose of the device for the sake of the environment and safety.

Before you dispose of the device, please back up your data and erase it from the device.

It is recommended that the device is disassembled prior to disposal in conformity with local regulations. Please ensure that the abandoned batteries are disposed of according to local regulations on waste disposal. Do not throw batteries into fire or put in common waste canister as they are explosive. Products or product packages labeled with the sign of “explosive” should not be disposed of like household waste but delivered to specialized electrical & electronic waste recycling/disposal center.

Proper disposal of this sort of waste helps avoid harm and adverse effect upon surroundings and people’s health. Please contact local organizations or recycling/disposal center for more recycling/disposal methods of related products.

6.2 Warranty

Product warranty

VANTRON warrants to its CUSTOMER that the Product manufactured by VANTRON, or its subcontractors will conform strictly to the mutually agreed specifications and be free from defects in workmanship and materials (except that which is furnished by the CUSTOMER) upon shipment from VANTRON. VANTRON's obligation under this warranty is limited to replacing or repairing at its option of the Product which shall, within **24 months** after shipment, effective from invoice date, be returned to VANTRON's factory with transportation fee paid by the CUSTOMER and which shall, after examination, be disclosed to VANTRON's reasonable satisfaction to be thus defective. VANTRON shall bear the transportation fee for the shipment of the Product to the CUSTOMER.

Out-of-Warranty Repair

VANTRON will furnish the repair services for the Product which are out-of-warranty at VANTRON's then-prevailing rates for such services. At customer's request, VANTRON will provide components to the CUSTOMER for non-warranty repair. VANTRON will provide this service as long as the components are available in the market; and the CUSTOMER is requested to place a purchase order up front. Parts repaired will have an extended warranty of 3 months.

Returned Products

Any Product found to be defective and covered under warranty pursuant to Clause above, shall be returned to VANTRON only upon the CUSTOMER's receipt of and with reference to a VANTRON supplied Returned Materials Authorization (RMA) number. VANTRON shall supply a RMA, when required within three (3) working days of request by the CUSTOMER. VANTRON shall submit a new invoice to the CUSTOMER upon shipping of the returned products to the CUSTOMER. Prior to the return of any products by the CUSTOMER due to rejection or warranty defect, the CUSTOMER shall afford VANTRON the opportunity to inspect such products at the CUSTOMER's location and no Product so inspected shall be returned to VANTRON unless the cause for the rejection or defect is determined to be the responsibility of VANTRON. VANTRON shall in turn provide the CUSTOMER turnaround shipment on defective Product within **fourteen (14) working days** upon its receipt at VANTRON. If such turnaround cannot be provided by VANTRON due to causes beyond the control of VANTRON, VANTRON shall document such instances and notify the CUSTOMER immediately.

Appendix Regulatory Compliance Statement

FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Note: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate this equipment.

RF Radiation Exposure Statement:

1. This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body.
2. The device has been evaluated to meet general RF exposure requirement.