

DASP Gen5 Software / Hardware Overview

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DASP Gen5 IQAN, Panel PC and Vision PC Overview

The Gen5 DASP uses vision-based control automation to automatically detect and adjust two anchors on one rail or four anchors on two rails to a pre-determined width.

The Gen5 Dual Anchor Adjuster / Spreader has:

- **IQAN Modules** that control and run machine operations.
- **Panel PC** that controls machine to machine communications.
- **Vision PC** that controls machine automation (autonomous anchor squeezing).

Gen5 IQAN Modules

All basic machine functions such as workhead auto-cycle, machine movements, and the operator interface are controlled by the Parker IQAN control system.

Modules communicate with each other via network of CAN busses.



Master Module (MD4-10)

The master module is the central processing and control hub of the IQAN system.

It executes the control logic, manages communication with I/O expansions, handles operator interfaces, monitors system health, and ensures safe, coordinated machine.

Example

MD4-10 [**M**aster **D**isplay 4-10]

MC44 [**M**aster **C**ontroller 44] *Non display*



Expansion Module(XC-21 / XC-44)

An expansion module in an IQAN system is a remote input/output (I/O) unit that extends the capabilities of the master controller.



It doesn't make decisions or run logic itself.

Instead, it provides extra inputs and outputs for sensors, switches, and actuators, all managed by the master over the CAN bus.

Example

XC-21 [Expansion Controller 31]

XC-44 [Expansion Controller 44]

CAN BUS and Module Address Tags

- Each module on the CAN bus network needs a unique ID so the master module knows where to send and receive information.
- IQAN modules use physical address tags that serve as a home address.
- Depending on module and available harness space, address tags can be placed right at the module or on the terminal blocks inside the junction boxes.
 - Address tags are pre-defined resistors with specific ohms value.

CAN Error

CAN error indicates the module is having issues joining the network. This can be caused by:

- CAN bus cable is unplugged.
- Loose CAN High wire.
- Loose CAN Low wire.
- Loose CAN H / CAN L terminal pin.

CAN Critical

CAN critical error indicate CAN network shut down. All modules stop transmitting/receiving information. This can be caused by:

- CAN cable is shorted.
- External power is present on either CAN H or CAN L wire (someone accidentally plugged in the CAN wires to power).

XC-21 / XC-44 Error Codes

I/O

Blink codes starting with **one red** indicate an error is detected on an output, usually a wiring error.



R1:1 Output error, for example open load.



R1:2 Input error, for example low error on a Voltage input. Input disconnected.



(XC-21 Only) R1:3 Voltage reference, for example short to ground on sensor supply.

Power or Temperature

Blink codes starting with **two reds** indicate an error is detected on the power supply or temperature.



R2:1 Module supply voltage too low. Under voltage condition may cause additional output/input faults.



R2:2 Module internal temperature too high.

CAN Communication and Address

Blink codes starting with **three reds** indicate an error is detected with CAN communication.



R3:1 Loss of CAN bus communication. Loose wire or connection issue.



R3:2 ID tag error. Check ADDR pins. Wrong or faulty address tag.

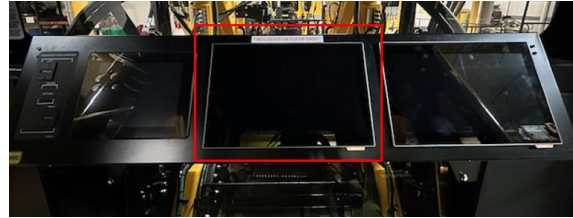


R3:4 Critical CAN bus error. Module stopped CAN activity due to fault severity on the CAN network.

Gen5 Panel PC and Monitor

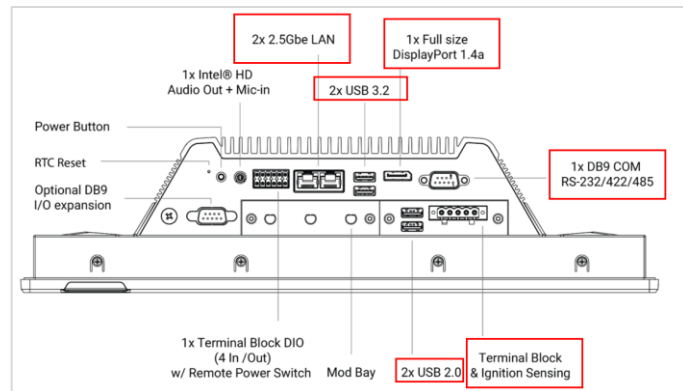
The Panel PC controls machine to machine communications.

- The Panel PC displays live workhead camera feeds for pilot or drone machine.
- Provides interface for pairing and managing pilot and drone configurations.
- Provides vision monitoring during auto cycle such as:
 - Searching for targets
 - Squeezing
 - Workhead stall detection
 - Indexing



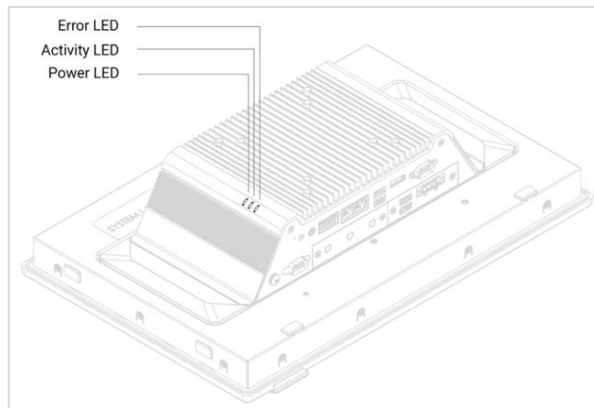
Only the following port interfaces are used on the Panel PC.

- USB
- Power terminal & ignition
- Ethernet LAN
- Display Port
- CAN COM



Panel PC LEDs

Panel PC is equipped with basic status LED indicators: Error, Activity, and Power.

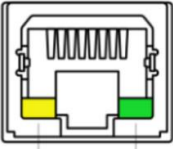


LED	Color	Indicator
Error	Orange	- Solid ON = No DIMMs installed - Slow blinking = Boot issue - Fast blinking = Voltage fault 2 fast blinking followed by 1 slow blinking = Panel installation issue (Enable LED indicator in the BIOS setup)
Activity	White	Blink = There is a read/write activity
Power	Blue	- ON = System in S0 - Blink = System in standby mode (S3) - OFF = S5 or Power OFF

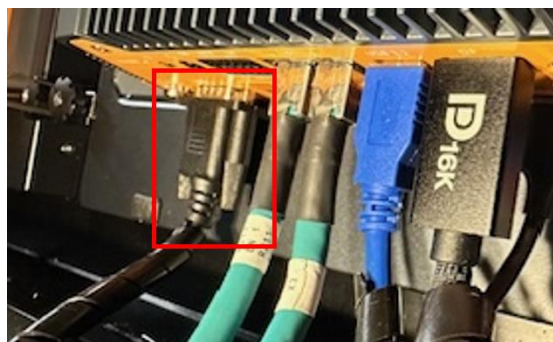
Two ethernet ports enable communication between the Panel PC, the Vision PC, and the remote drone connection.

Each port is equipped with status LED indicators.



	LED	Color	State	Function
	Link	-	Off	LAN link is not established
		Yellow	On	LAN link is established
		Blinking		LAN activity occurring
	Speed	-	Off	10 Mb/s 100Mb/s data rate
		Orange	On	1 Gb/s data rate
		Green	On	2.5 Gb/s data rate

The Panel PC must communicate with local IQAN controller. This is done via D-SUB J1939 CAN bus interface.



Pin	Signal
1	CAN_2_L
2	CAN_1_L
3	GND
4	NC
5	NC
6	GND
7	CAN_1_H
8	CAN_2_H
9	NC

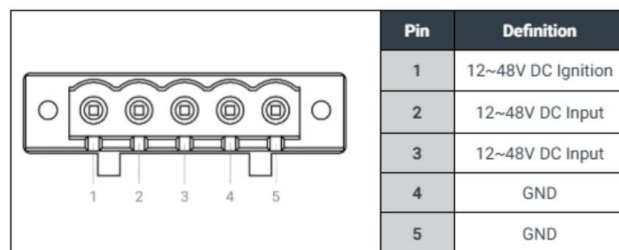
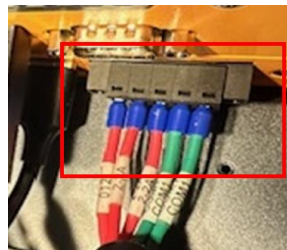
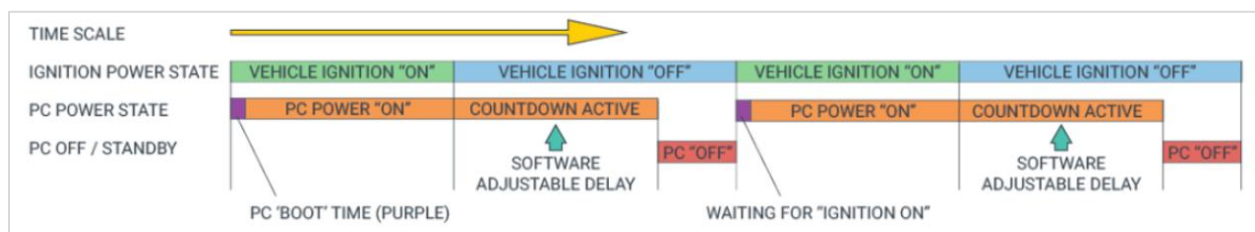
Panel PC Power and Ignition Signals

The Panel PC uses power and ignition signals.

- **Ignition signals** control how the computer powers on and off based on the machine's ignition key.

It makes sure that power is stable (after engine crank) and allows the computer to ***gracefully shut down*** once the IGN signal is off. This ensures that the computer can properly shut down the operating system.

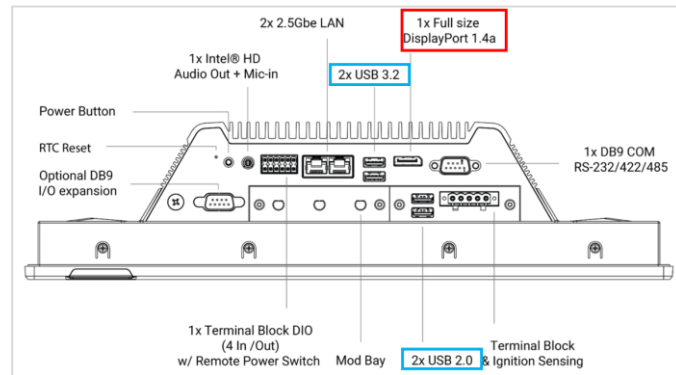
- **Dual power** provides two independent power sources in case one becomes faulty. On Gen5, both power signals are connected to the same power source.



Panel PC Display Port

The Display Port on the Panel PC provides extended display capabilities to the right monitor and displays the front and rear travel cameras.

Note: The monitor receives power via separate power port.



USB Ports

USB ports on the Panel PC enable:

- Touch functionality for the right monitor.
- Access for RRP service department.

Right Monitor

- The main purpose of the right monitor is to display forward and reverse travel camera feeds for better situational awareness especially during drone operation.
- Panel PC transfers the camera feeds via display port cable.
- Monitors are not programmed like panel PCs. Their purpose is to extend monitor real-estate capabilities of the panel PC.

Vision PC

The Vision PC (VPC) is the dedicated brain for AI detections and machine-to-machine communication. This specialized PC runs sophisticated computer vision models to interpret camera feeds in real time.

The VPC processes visual data for autonomous decision-making and enables communication with the pilot and drone machines. The Vision PC:



Captures live image streams from the machine-mounted vision cameras.



Runs real-time object detection and vision processing algorithms.



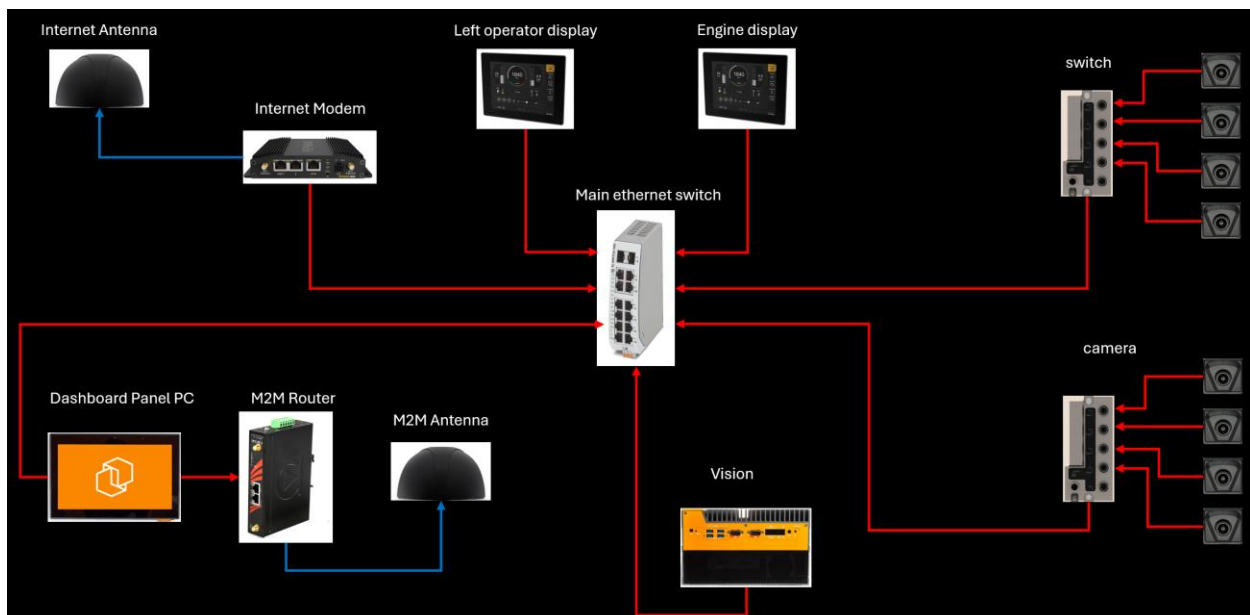
Identifies objects, positions, and conditions relevant to machine operation.



Converts detection results into structured data from machine control.



Sends processed information to the IQAN system via J1939 communication.



Vision PC Power and Ignition Signal

The Vision PC also uses power and ignition signals.

- **Ignition signals** control how the computer powers on and off based on the machine's ignition key.

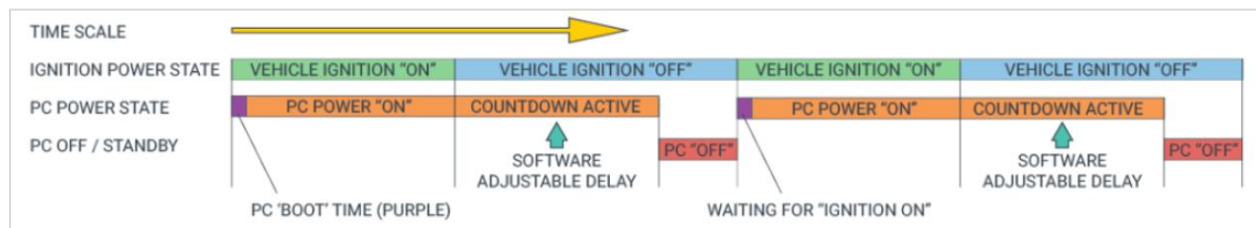
It makes sure that power is stable (after engine crank) and allows the computer to ***gracefully shut down*** once the IGN signal is off. This ensures that the computer can properly shut down the operating system.

CAUTION Vision Hard Drive Failure.

If the machine is not properly shut down, the Vision PC hard drive may fail or become corrupt and all the stored vision data will be lost.

Vision PC hard drives are specific to the machine and will need to be programmed by RRP Service before replacing.

- **Dual power** provides two independent power sources in case one becomes faulty. On GEN5, both power signals are connected to the same power source.



The Vision PC uses M12 type ethernet ports:

- To communicate with machine vision cameras. Vision PC runs real-time object detection and vision processing algorithms.
- To communicate with remote access modem (Peplink) to allow wireless updates.

Vision PC Ports

The Vision PC uses a D-SUB type J1939 port which enables the Vision PC to communicate with IQAN control system.



The Vision PC uses a HDMI (High-Definition Multimedia Interface) port to display desktop environment.

The overhead display is mainly used for troubleshooting purposes.



Vision PC uses two hard drive bays. The hard drive stores all software related to object detection and communication.

If hard drive fails and has to be replaced, it must be **pre-programmed**.



Contact RRP Service for a pre-programmed hard drive.

Vison PC to IQAN Loop

The Gen5 IQAN system's control loop relies on continuous, real-time feedback from the Vision PC, which processes data from both the pre-detection camera (forward-looking) and the workhead camera (close-up monitoring).

Under normal conditions, the AI maintains consistent detections across frames. The Vision PC identifies the target and sends steady signals to the Parker IQAN controller. This smoothly modulates the Danfoss CMA valves, providing continuous control of the travel motors for precise positioning.

The system operates in both "searching" and "found" modes. Once an anchor spread above the user-set threshold is detected, the machine slows, switches to a lower travel speed, and uses closed-loop control to position itself accurately.

VPC Detection

In some frames, however, the AI may lose track: bounding boxes disappear or confidence scores drop below thresholds, causing the Vision PC to output "no detection."

This can lead the machine to skip ties where anchors are spread beyond the operator-set threshold and revert to "searching" mode.

To mitigate this, the Vison PC employs techniques like temporal tracking to "remember" positions across frames, bridging brief dropouts. Note, issues can still occur in extreme lighting conditions or with dirty cameras.

Cameras

Note: *Cameras must be programmed for each location. See page 14 for pre-programmed camera part numbers.*

Pre-Detection Camera (Locates Anchors)

Mounted in the front of the machine, this camera scans the upcoming track in advance.

It employs AI to identify potential anchors spread beyond the setpoint.

By pre-detecting these anchors, the machine can proactively adjust its speed, allowing for faster indexing while traveling over areas with squeezed anchors.



Pre-Detection Camera Calibration: align the horizontal green line parallel with the rail.

Workhead Camera (Identifies Anchors)

Positioned directly across the squeezer's workhead, this camera provides real-time, close-up monitoring of the anchor position and spread width.

AI detects when an anchor is spread beyond the threshold and signals the exact stopping point to the IQAN modules.

Workhead Camera Calibration: align the horizontal green line parallel with the rail and the vertical green line in the middle of the workhead.



Gauge Adjust Camera

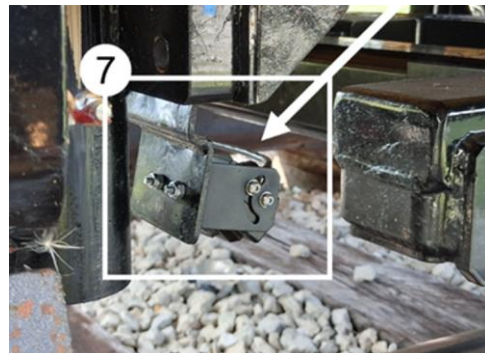
In addition to the pre-detection and workhead cameras, the dedicated gauge-detection camera confirms the workhead is perfectly centered over the rail during anchor-squeezing operations.

The Vision PC processes feeds from these cameras in real time. If the workhead is not centered, the system automatically adjusts lateral positioning by commanding the Danfoss CMA valves that control the side-shift hydraulics on the workhead.

This closed-loop feedback ensures sub-inch accuracy, aligning the squeezer workhead directly over the rail.

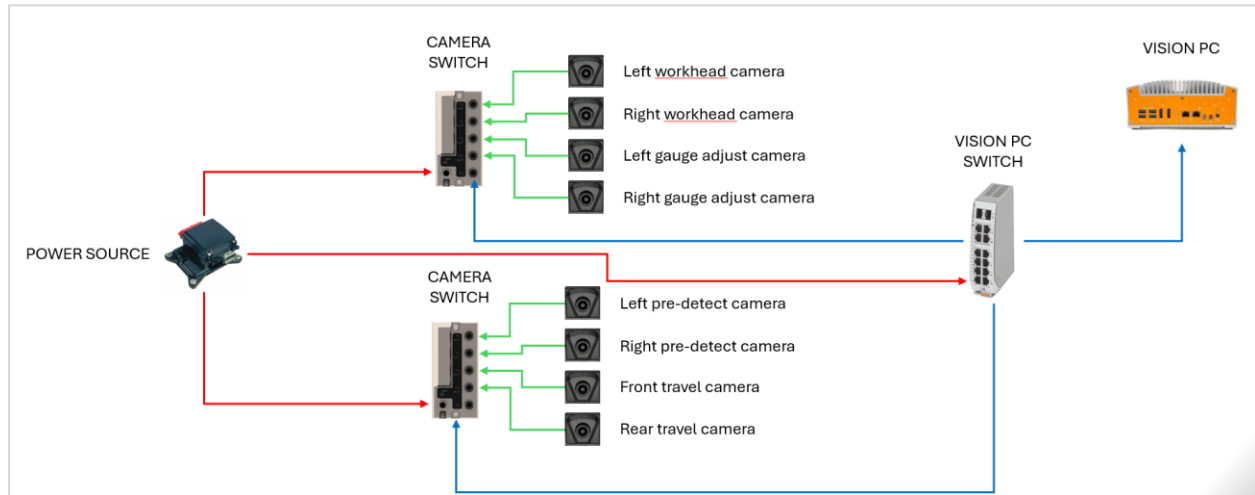


Camera View over Rail



Gauge Adjust Camera

Vision System Vision Camera

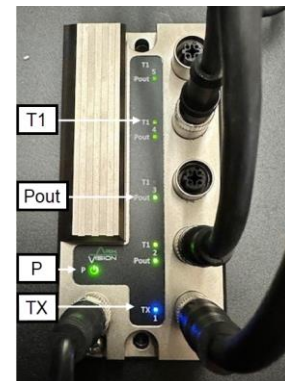


Vision Switch And Cameras Layout

- Each camera has a specific role in the detection process, capturing unique elements on the railroad environment.
- ***Each camera is assigned with unique IP address to prevent network conflicts and to ensure no two same cameras can exist on the network.***
- ***Each camera is assigned with unique parameters for detection purposes.***

Gen5 Cameras & Vison Switch

- Collects multiple cameras and feed the data to the vision PC via single ethernet cable.
- Provide power to each camera.
- LED status indication for troubleshooting purposes.
- **[T1] Camera Data Status:** This LED indicates if the camera is transmitting ethernet data.
- **[Pout] Camera Power Indicator LED:** This LED indicates if the camera is receiving 24 Vdc source power
- **[P] Switch Power Indicator LED:** This LED indicates if the camera switch is receiving 24 Vdc source power. This power is to run the switch and provide power to each camera.
- **[TX] Switch Data Uplink LED:** This LED indicates if the switch is communicating with the vision PC.



Camera Maintenance

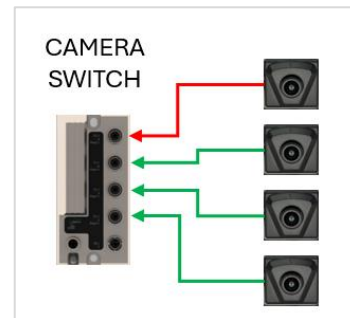


Keeping the camera lens clean is essential for accurate object detection.

Any dirt, dust, or smudges can significantly reduce detection performance.

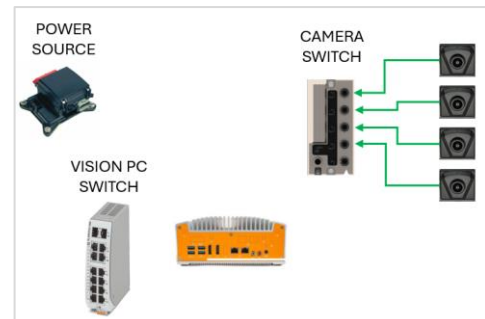
If a Single Cameras Report A Fault

- Check camera ethernet switch LEDs to determine which signals are missing [Camera Power, Camera Data].
- Check camera cable for damages.
- Try replacement camera [pre-programmed].



If Multiple Cameras Report a Fault

- Check camera ethernet switch LEDs to determine which signals are missing [Main Power, Data Uplink, Camera Power, Camera Data].
- Check vision PC switch LEDs for power and data status.
- Check vision PC power.
- Check main ethernet cable feeds between switches and vision PC.



Pre-Programmed Camera, Sensor and Module Part Numbers

DESCRIPTION	PART NO.
CAMERA, FRONT TRAVEL	325990
CAMERA, REAR TRAVEL	325993
CAMERA, RH, SEES LEFT WORKHEAD	325994
CAMERA, LEFT GAUGE ADJUST	325995
CAMERA, LH, SEES RIGHT WORKHEAD	326003
CAMERA, RIGHT GAUGE ADJUST	326004
COMPUTER, PANEL: PROGRAMMED	326008
CAMERA, RH, PRE DETECT, SEES LEFT RAIL	326144
CAMERA, LH, PRE DETECT, SEES RIGHT RAIL	326145
SENSOR, INFRARED: PROGRAMMED	326607
SENSOR, INFRARED: PROGRAMMED	326608
MODULE, MD4-10: PROGRAMMED	326609
MODULE, MD4-10: PROGRAMMED	326610
COMPUTER, VISION: PROGRAMMED	326612
MODULE, ROUTER: PROGRAMMED	326615
MODEM, TELEMATICS: 5G: PROGRAMMED	326616
MODULE, GPS RECEIVER: PROGRAMMED	326617
ALARM, AUDIBLE LIGHT: PROGRAMMED	326618
VALVE, CONTROL: PROGRAMMED	326619
VALVE, CONTROL: PROGRAMMED	326620

Collision Avoidance (Time of Flight)

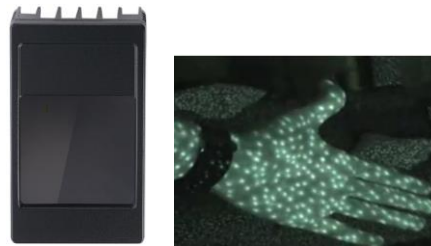
Time-of-Flight [ToF] Sensor

The main purpose is to provide operator awareness on large vehicles by detecting people, obstacles, walls, or piles of material around the machine.

Components

Emitter

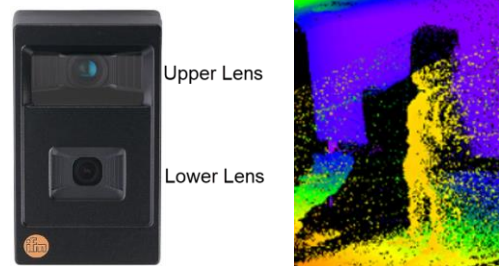
Light emitter emits constellation of light dots in space.



Receiver

Detects light reflections, calculates distance and size of the objects.

- The Upper lens is the actual sensor which reads lights reflections. For the sensor to operate properly, this area must be clean and clear of any obstructions such as dust or snow.
- The lower lens provides video feedback which can be played back on the operator display.



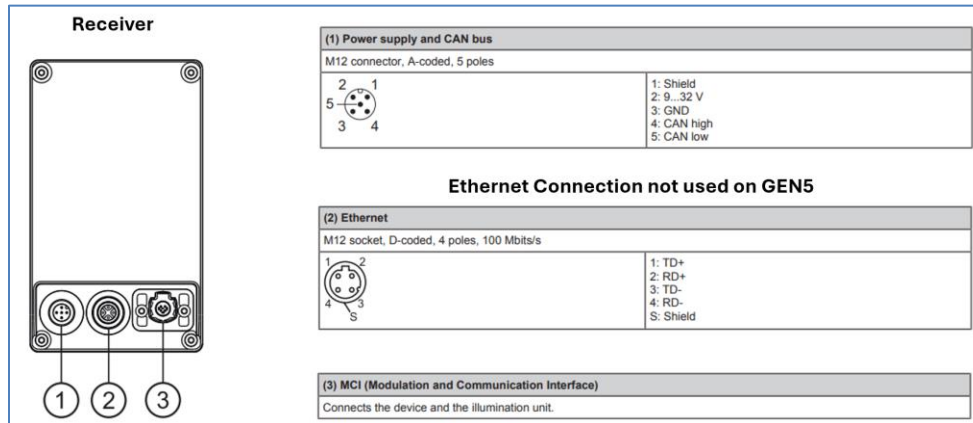
Calibration

- Since sensors might be installed in different locations on the machine, **they are pre-loaded with unique and pre-defined calibration parameters.**
- ***When replacing the sensor, the end user must verify that the replacement unit is properly programmed, configured, and installed according to the manufacturer's specifications.***

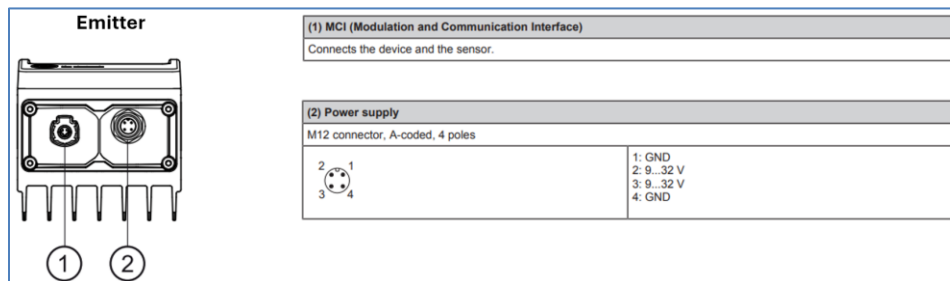
Incorrect installation may result in improper detection or complete loss of detection functionality.

Wiring

Receiver

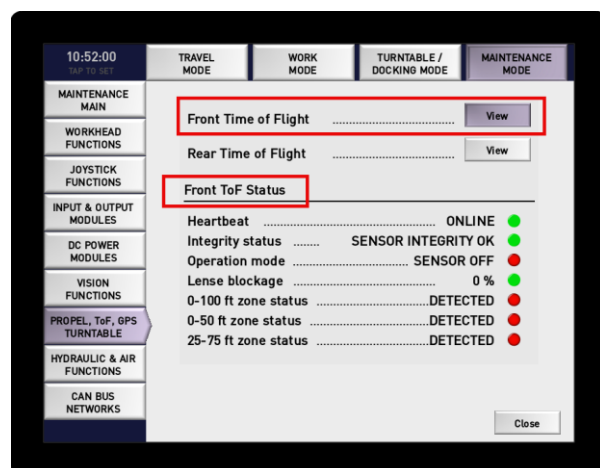
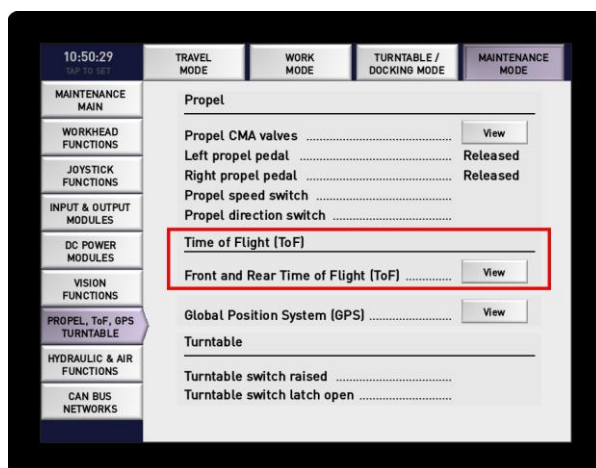


Emitter



Diagnostic Information

ToF sensor diagnostic information is available on the operator display in the Maintenance Mode / Propel, ToF, GPS, Turntable tab.

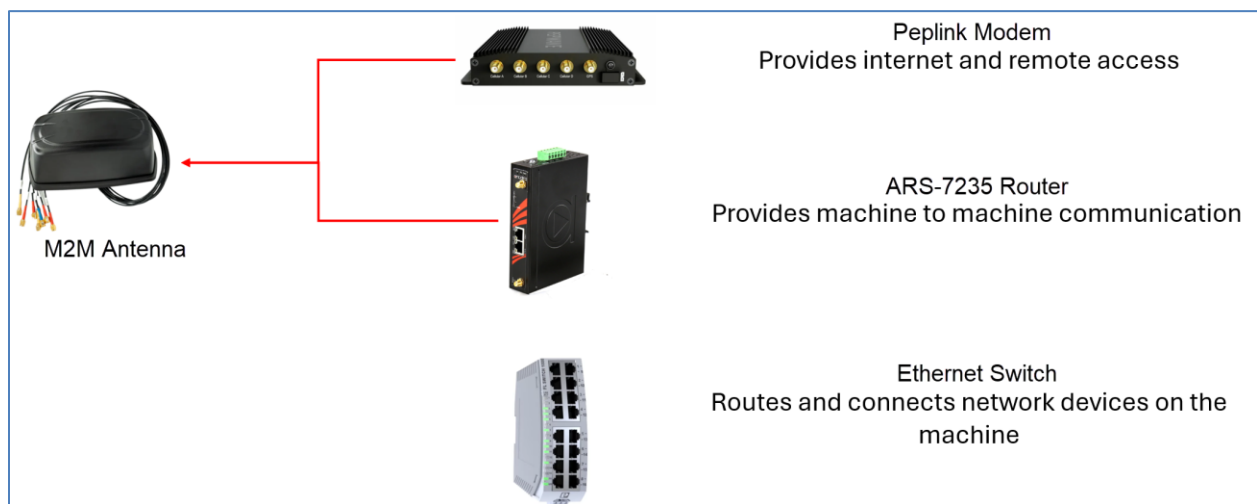


Wireless Communication

Common Wireless Connectivity Problems

- **Power issues** – the device or wireless module may not be receiving stable or sufficient power.
- **Unseated or loose RJ45 ethernet cables** – partially plugged or disconnected network cables can interrupt communication.
- **Loose or improperly connected antenna cables** – poor antenna connection can significantly weaken or eliminate wireless signal strength.

Wireless Communication Components



Machine to Machine (M2M) Communications



M2M Antenna and ARS-7325 Router Connections

Cable	Connector Type	Function	Connect To
LTE #1 (Main)	SMA - Male	5G/4G antenna 1	Peplink Cellular A
LTE #2 (Aux/MIMO)	SMA - Male	5G/4G antenna 2	Peplink Cellular B
LTE #3 (MIMO)	SMA - Male	5G/4G antenna 3	Peplink Cellular C
LTE #4 (MIMO)	SMA - Male	5G/4G antenna 4	Peplink Cellular D
Wi-Fi #1 (Main)	RP - SMA - Male	Wi-Fi 2.4/5/6E Main	WiFi 1 on ARS-7235 Router
Wi-Fi #2 (Aux/MIMO)	RP - SMA - Male	Wi-Fi MIMO	WiFi 2 on ARS-7235 Router
GNSS	SMA - Male	GPS	Peplink GPS




ARS-7235 Router

ARS-7325 Router Connections

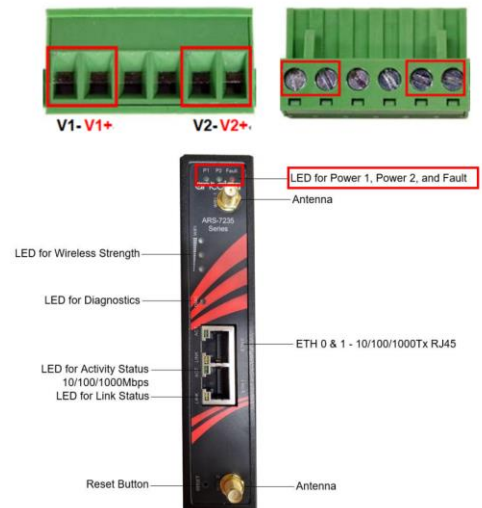
ARS-7325 uses two power sources; primary and backup.

P1 – main machine power 24Vdc

P2 – backup power (UPS, or secondary 24Vdc) in case P1 loses power.

On GEN5 P1 and P2 receive power from the same source.

LED	Color	Description	
P1	Green	On	Power input 1 is active
		Off	Power input 1 is inactive
P2	Green	On	Power input 2 is active
		Off	Power input 2 is inactive
Fault	RED	On	Power input 1 or 2 is inactive
		Off	Preconfigured alarms are detecting failure

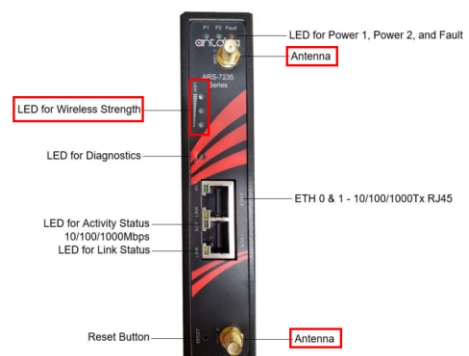


Single MIMO antenna (Multiple-Input Multiple-Output) uses two antennas (single unit)to:

- Increase throughput (higher data speed)
- Improve signal quality
- Reduce dead zones and interference
- Improve stability inside metal/industrial environments.

Wi-Fi signal degradation usually is caused by loose antenna connection.

LED	Color	Description	
Wi-Fi Signal Strength	Green/Red	Red	Less than 25% signal strength
		Green	LED 2 less than 50% signal strength
		Green	LED 3 less than 75% signal strength
		Green	LED 4 less than 100% signal strength



Port 1 – WAN (internet source; modem, another router, upstream network.
 Port 2 – LAN (local devices: cameras, PLCs, switches, Vision PC

LED	Color	Description	
ETH Port 0~1 (Upper LED)		On	Connected to network 10/100/1000Mbps
		Flashing	Network is active
		Off	Not connected to network
ETH Port 0~1 (Lower LED)		On	Link established
		Off	No link detected

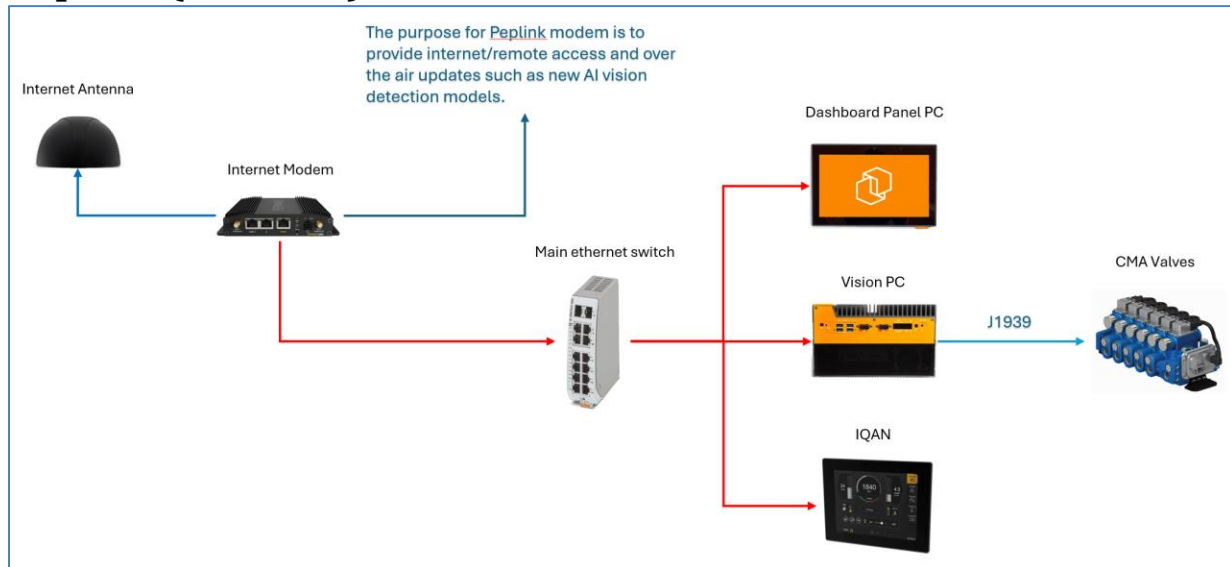


ARS-7235 uses diagnostic LED to indicate if the device is ready for operation.

LED	Color	Description	
Diagnostics	Red	Flashing	Unit not ready / Boot sequence
		Off	Unit ready



Peplink (Internet) Modem



Peplink Modem Status Lights

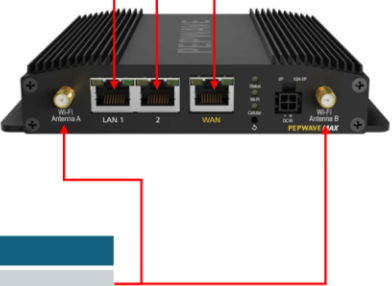
LED	Color	Description
Status	Off	System initializing
	Red	Booting up or busy
	Blinking red	Boot up error
	Green	Ready

LED	Color	Description
Wi-Fi / Wi-Fi AP	Off	Disabled intermittent
	On	Connected to wireless network(s)

LED	Color	Description
Cellular	Off	Disabled or no SIM card inserted
	Blinking Slowly	Connecting to network(s)
	Green	Connected to network(s)



LED	Color	Description
	On	1000 Mbps
	Off	Port not connected or 10Mbps / 100 Mbps
	Blinking	Data is transferring
	Off	No data is being transferred or port not connected



Cable	Connector Type	Function	Connect To
Wi-Fi Antenna A	RP-SMA-Male	Wi-Fi Main	Not used. Not connected
Wi-Fi Antenna B	RP-SMA-Male	Wi-Fi MIMO	Not used. Not connected

Peplink and ARS-7325 Router Connections

Cable	Connector Type	Function	Connect To
LTE #1 (Main)	SMA - Male	5G/4G antenna 1	Peplink Cellular A
LTE #2 (Aux/MIMO)	SMA - Male	5G/4G antenna 2	Peplink Cellular B
LTE #3 (MIMO)	SMA - Male	5G/4G antenna 3	Peplink Cellular C
LTE #4 (MIMO)	SMA - Male	5G/4G antenna 4	Peplink Cellular D
Wi-Fi #1 (Main)	RP - SMA - Male	Wi-Fi 2.4/5/6E Main	WiFi 1 on ARS-7235 Router
Wi-Fi #2 (Aux/MIMO)	RP - SMA - Male	Wi-Fi MIMO	WiFi 2 on ARS-7235 Router
GNSS	SMA - Male	GPS	Peplink GPS










Ethernet Switch Status Lights

LED	Color	Description
1~16 Port number	Off	Network not communicating
	On	Link established and network available
	Blinking	Data transmission active

LED	Color	Description
US	Off	Power is not present
	On	Power is present

