AS2100 EtherNet/IP™ Technical Manual

Version: 1.0.0

For use with AS2100 Ethernet Accurate Distance Sensor

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Contents

1 Introduction

The AS2100 with EtherNet/IP™ allows the sensor to connect and send data to EtherNet/IP™ compatible hardware. A specialized back cover contains all the hardware to communicate with this protocol. If the cover is removed the AS2100 still works as normal and information can be obtained through the serial connection or analog output.

This manual details the specifics of the additional hardware and its communication protocol.

2 Information

2.1 Specifications

Specification	
Ethernet Ports Number of ports Data rate	 2 100 Mbit/s (Full duplex)
Power supply Voltage range Current consumption (@ 24 VDC) Current consumption (@ 12 VDC)	 12 - 30 VDC 0.25 - 0.6 A 0.8 - 1.0 A
Temperature range during operation	-40 - +50°C
Temperature range during storage	-40 - +70°C
Relative humidity (operation / storage)	85% (RH), non-condensing
Environmental Protection	IP65 (only with ports connected)
Electromagnetic compatibility (EMC)	IEC/EN 61000-6-4 / 61000-6-3 IEC/EN 61000-6-2 / 61000-6-1

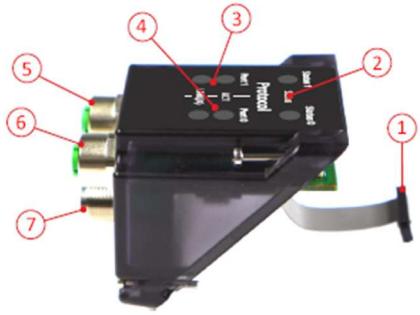
2.2 Components

The components of the EtherNet/IP™ interface cover are marked below.

1. Screws, Philips Slotted Combo (Philips size 1, slot size 2)
2. EtherNet/IP™ status LED's
3. Ribbon cable to connect the EtherNet/IP™ interface cover to the AS2100
4. Ethernet port 1 status LED's (Link, activity)
5. Ethernet port 0 status LED's (Link, activity)
6. Ethernet port 1
7. Valve diaphragm
8. Ethernet port 0
9. Power supply

3 Electrical interfaces

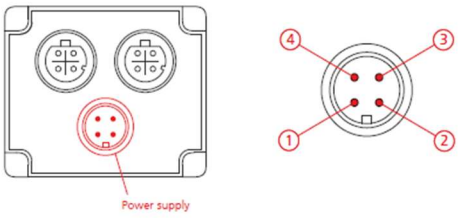
The main electrical components of the EtherNet/IP™ interface cover are described in the following chapter. The overview of the relevant components is labeled in below.



1. Ribbon cable (20 pin) to connect the EtherNet/IP™ interface cover to the AS2100
2. EtherNet/IP™ status LED's
3. Ethernet port 1 status LED's: LINK, ACT or L/A
4. Ethernet port 0 status LED's: LINK, ACT or L/A
5. Ethernet port 1 (M12 socket female, 4 pin, D coded)
6. Ethernet port 0 (M12 socket female, 4 pin, D coded)
7. Power supply (M12 socket male, 4 pin, A coded).

3.1 Power supply

The connector for the power supply (M12 socket, A coded) is shown below.



The EtherNet/IP™ interface cover is overvoltage and reverse voltage protected, but for proper operation consider the power supply requirements and the corresponding specifications.

The metal case of the M12 connector is not connected to any shield or housing.

Connection diagram of power supply connector (M12 socket male, 4 pin, A coded):

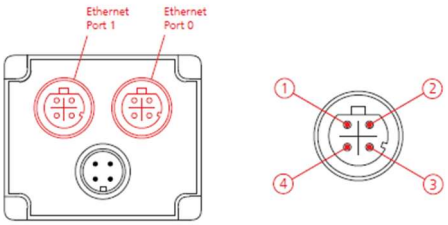
1. Supply voltage V+ (12 - 30 VDC)
2. Supply voltage GND (0 V)
3. Not connected (NC)
4. Not connected (NC)

Power cables can be purchased from Acuity. They have 5 conductors and flying leads. The below table describes the relationship between wire color and function.

Color	Function
Brown	Supply voltage V+ (12 - 30 VDC)
White	Supply voltage GND (0 V)
Black	Not used
Gray	Not used
Blue	Not used

3.2 Ethernet ports

The connector for the Ethernet ports (M12 socket, D coded) are shown below.



Connection diagram of Ethernet port 0 and 1 (M12 socket female, 4 pin, D coded):

1. Transmit data positive (Tx+)
2. Receive data positive (Rx+)
3. Transmit data negative (Tx-)
4. Receive data negative (Rx-)

The Ethernet signals and connector are standard used in conjunction with EtherNet/IP™ compatible devices.

3.3 Ribbon cable

A ribbon cable between the EtherNet/IP™ interface cover and the body of the AS2100 factory is factory installed. This ribbon cable must be connected the interface to function. If it is removed for any reason, it must be reconnected before the interface can be used.

Ribbon cable specifications:

- 20 conductors with codded connectors
- Grid 0.635 mm
- Length 60 mm with connectors

3.4 Shielding

The metal case of the power supply connector (M12 socket male, A coded) is not connected to the aluminum housing (shield) of the AS2100.

- The metal cases of the Ethernet port 0 & 1 connectors (M12 sockets female, D coded) are connected individually over an R-C element to the aluminum housing (shield) of the AS2100.

3.5 Status LED

The LED's on the exchangeable cover show the status of the EtherNet/IP™ connection. See 5.2 for more information.

4 General Operation

4.1 General functionality

4.1.1 Cyclic / Acyclic data communication

The AS2100 with EtherNet/IP™ interface uses cyclic (Process data) and acyclic communication for configuration, operation, and identification. The cyclic and acyclic communication functionality is described below..

- Cyclic communication (Process data)
  - Used for measurement data and to control the AS2100. The cyclic process data consists of output and input data with fixed mapping and size. For the output data (Device input data) a data range check is done automatically. The sensor state parameter Sensor Output Data Limit Exceeded shows the state of this range check.
  - For more details about the available cyclic process data (I/O data), see the marked rows in the table of chapter 4.2 Parameter description (Cyclic process data marked in the column Access – Cyclic).
- Acyclic communication
  - Used to read sensor information (Serial number, part number, firmware versions, etc.) and to write some sensor configurations (Measurement speed, measurement characteristic and distance unit) acyclic to the cyclic communication. The acyclic data

(/parameter) can be read and / or write independently according the defined acyclic access type.

- For more details about the available acyclic data access, see the marked rows in the table of chapter 4.2 Parameter description (Acyclic data access marked in the column Access – Acyclic).

The cyclic and acyclic data access details (e.g. number, index, class, ...) are specified in separate tables in section 5.3.

4.1.2 Control and configuration

The AS2100 with EtherNet/IP™ interface can be controlled and configured in its entirety over the EtherNet/IP™ interface with cyclic (Process data) and acyclic data communication. The control and configuration parameter are described in chapter 4.2 Parameter description, see the parameter group "Measurement configuration".

A standard configuration and control sequence for a AS2100 with EtherNet/IP™ interface is listed below.

Step	Description	Access	Actions	Remark
1	Connection		Turn on the power supply and check the green power LED on the AS2100.	
2	Control	Cyclic	Set Measurement Control to 0 to stop distance measurement of AS2100.	For more details about measurement control, see chapter 6.2 Parameter description.
3	Configuration	Acyclic	Set the Measurement Mode E.g. "Normal"	The "Normal" measurement mode is fine for most applications. For more details about the available measurement modes, see chapter 4.2 Parameter description.
4		Acyclic	Set the Measurement Speed E.g. "0" for measurements as fast as possible	The measurement speed allows the configuration of an automatic distance measurement trigger in a defined speed range. For more details about the measurement speed, see chapter 4.2 Parameter description.
5		Acyclic	Set the Distance Unit E.g. "mm"	For more details about the available distance units, see chapter 4.2 Parameter description.
6	Control	Cyclic	Set Measurement Control for start / stop of distance measurement of the AS2100	For more details about the measurement control, see chapter 4.2 Parameter description.
…	Operation	Cyclic	Use cyclic process data with input and output data for measurement data (Distance, temperature, ...) and control	Cyclic process data will be updated with measurement data (only if Measurement Control was set to 1 / started before).
		Acyclic	Use acyclic read / write of data / parameter for additional information and configuration	Acyclic communication can be performed with low priority beside the cyclic process data communication. **Note:** Some configurations will not take effect before the measurement is stopped and restarted. For more details, see the corresponding configuration data in chapter 4.2 Parameter description.

Note: The sensor only considers changes in measurement speed and characteristics at measurement start. Setting Measurement Control to 0 stops the running measurement. When restarting the measurements the new configurations will be enabled.

4.2 Parameter description

The following table shows all available parameters (cyclic and acyclic data) of the AS2100. Each parameter is listed with its functionality, the data type with size, the lower / upper limits, and the default value.

Group	Number	Designation	Description	Data Type [1]	Default Value	Limit		Access [2]	
						Lower	Upper	Cyclic	Acyclic
Measurement configuration	8193	Measurement Control	Measurement control to start and stop continuous distance measurement. 0 –› Stop / No measurement, 1 –› Start measurement (with configured speed and measurement mode) **Note:** Configured measurement speed and measurement mode are only applied at measurement start. To set a different measurement speed and mode, continuous measurements must be stopped and restarted.	UINT16	0	0	1	O	R
	8194	Measurement Speed	Measurement time for a single distance measurement (Measurement speed of continuous measurement is calculated with 1 / Time). 0 –› Measurement as fast as possible, >0 –› Time in [ms] Configured measurement speed is only applied at measurement start. **Note:** Measurement speed depends on measurement conditions and may vary.	UINT32	0	0	86400000	-	R/W
	8195	Measurement Mode	Measurement mode configuration used for distance measurement. 0 –› Normal, 1 –› Fast, 2 –› Precise, 3 –› Timed, 4 –› Moving target Measurement modes enable the user to customize measurement behaviors for a specific measurement application. Configured measurement mode is only applied at measurement start. For more details about the available measurement modes see the standard AS2100 manual.	UINT8	0	0	4	-	R/W
	8196	Distance Unit	Distance unit for distance output (configurable / selectable). 0 –› um, 1 –› mm, 2 –› cm, 3 –› m, 4 –› mil, 5 –› inch, 6 –› ft The distance unit configuration takes effect immediately on the distance parameters (Integer and float) of the AS2100.	UINT8	0	0	6	I	R/W
	8197	Additional Measurement Filter 1	Additional plausibility check of the distance measurement by the max. allowed distance change / jump configuration. 0 –› Filter disabled, >0 –› Max. allowed distance change in [0.1 mm]	UINT32	0	0	5000000	-	R/W
	8198	Additional Measurement Filter 2	Additional smoothing filter for distance measurements in Moving Target mode (see parameter measurement mode) configuration. This filter smooths distance readings needed in some applications. 0 –› Filter disabled, 1...400 –› Calming filter length High filter lengths results in more distance calming / smoothing. Note that the response time of the sensor decreases accordingly when using long filter lengths. It's recommended to start with low filter lengths.	UINT32	0	0	400	-	R/W
	8199	Additional Measurement Filter 3	Additional plausibility check of the signal measurement data. The max. allowed signal change / jump can be configured in %. 0 –› Filter disabled, >0 –› Max. allowed signal change in [%]	UINT32	0	0	500	-	R/W

	8200	User mode	User mode for additional measurement functions. 0 (0x0000) –› Default (no additional functions) 32 (0x0020 –› Linear signal output enabled (e.g. used for signal monitoring function)	UINT16	0	0	0x003F	-	R/W
Options Output	8225	Optional Output Data 0	Optional output data. Currently not used.	UINT16	0	0	0x7FFFFFFF	O	R
	8226	Optional Output Data 1	Optional output data. Currently not used.	UINT32	0	0	0x7FFFFFFF	O	R
	8227	Optional Output Data 2	Optional output data. Currently not used.	UINT32	0	0	0x7FFFFFFF	O	R
	8228	Optional Output Data 3	Optional output data. Currently not used.	UINT32	0	0	0x7FFFFFFF	O	R
Measurement	12289	Distance Integer	Measured distance as integer value in the configured / selected distance unit. Note that any values with a decimal will be truncated (happens often when converting units).	UINT32	0	0	0x7FFFFFFF	I	R
	12290	Distance Float	Measured distance as floating point value in the configured / selected distance unit.	FLOAT32	0.0	0.0	MAXFLOAT	I	R
	12291	Signal Strength	Signal strength of the active distance measurement. [1]	UINT32	0	0	0x7FFFFFFF	I	R
	12292	Temperature	Sensor temperature at the active distance measurement. [1/10 °C]	SINT16	0	-32768	32767	I	R
	12293	Measurement State	Shows the state of the active distance measurement. 0 –› No new measurement, 1 –› New measurement, 2 –› Overwritten measurement	UINT8	0	0	2	I	R
	12294	Measurement Reserved	Reserved measurement data output. Currently not used.	UINT16	0	0	0x7FFF	I	R
Sensor State	12321	Sensor State	Sensor state for operation monitoring. 0 –› OK, 1 –› Info, 2 –› Warning, 3 –› Error	UINT8	0	0	0x7F	I	R
	12322	Sensor Output Data Limit Exceeded	Bit coded output data limit exceeded (lower or upper limit) warning. Limit exceeded indicator only used for process output data. Bit0 –› Measurement Control Bit1 –› Optional Output Data 0 Bit2 –› Optional Output Data 1 Bit3 –› Optional Output Data 2 Bit4 –› Optional Output Data 3 Bit5..7 –› Not used	UINT8	0	0	0x7F	I	R
	12323	Sensor Error Code	Sensor error code for troubleshooting (for error codes details see the standard AS2100 manual).	UINT16	0	0	0x7FFF	I	R
Options Input	12353	Optional Input Data 0	Optional input data. Currently not used.	UINT16	0	0	0x7FFF	I	R
	12354	Optional Input Data 1 / Speed Integer	Speed data as integer value (with speed offset for data transmission) [mm/s] Real sensor / target speed = Speed Integer – 1,000,000 Note: Speed Integer values of 215,748,364 (0x0CDC0F0C) indicates invalid speed data(only in Moving Target with distance jumps).	UINT32	0	0	0x7FFFFFFF	I	R
	12355	Optional Input Data 2	Optional input data. Currently not used.	UINT32	0	0	0x7FFFFFFF	I	R
	12356	Optional Input Data 3	Optional input data. Currently not used.	UINT32	0	0	0x7FFFFFFF	I	R
Hardware Information	16385	Serial Number	Serial number of the AS2100	UINT32				-	R
	16386	Part Number	Part number of the AS2100	UINT32				-	R
	16387	Part Description	Part description of the AS2100	STRING[20]				-	R

	16388	HW Version IF Board	Hardware version of device interface board on the AS2100	UINT16				-	R
	16389	HW Version M Module	Hardware version of device measurement module on the AS2100	UINT16				-	R
	16390	Serial Number RTE	Internal Identification Code	UINT32				-	R
	16391	Part Number RTE	Internal Identification Code	UINT32				-	R
	16392	Part Description RTE	Internal Identification Code	STRING[20]				-	R
	16393	HW Version RTE	Internal Identification Code	UINT16				-	R
Firmware Information	16417	FW Version IF Board	Firmware version of device interface board on the AS2100.	UINT16				-	R
	16418	FW Version M Module	Firmware version of device measurement module on the AS2100.	UINT16				-	R
	16419	FW Version RTE SSBL	Not used.	UINT32				-	R
	16420	FW Version RTE Stack	Internal Identification Code	UINT32				-	R

[1] Data types: UINTx / SINTx used for unsigned / signed integer values, x for size / number of bits (e.g. UINT16 –› 16 Bit / 2 Byte). FLOATx used for floating point values, x for size / number of bits (e.g. FLOAT32 –› 32 Bit / 4 Byte). STRING[x] used for character string, x for size / number of bytes (e.g. STRING[20] –› 20 Byte).

[2] Cyclic and acyclic data / parameter access: Column with cyclic access (process data), O –› Output data, I –› Input data. Column with acyclic access, R –› Read-only, R/W –› Read & Write.

4.3 Startup / Shutdown procedure

While starting up or shutting down the following points should be considered:

- Power supply – Voltage range and current consumption (see the specifications in chapter 2.1).
- Do not switch on the power supply before the sensor finished the power down cycle properly.
- Do not switch off the power supply before the sensor finished the power up and configuration process properly.
- Stop measurement before switching off the sensor's power supply.
- Configure the sensor (for more details see chapter 4.1.2) before starting the measurements.

Note: Switching off the power supply before the configuration process at power up is finished properly may result in an unrecoverable fatal error.

- Avoid switching off the power supply just after switching it on.

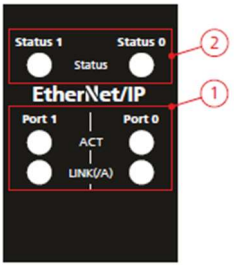
5 EtherNet/IP™

5.1 Specifications

Specification	Properties/Options
IO Connection Types (implicit)	Exclusive Owner Listen Only Input only
IO Connection Trigger Types	Cyclic (min. 1 ms) Application triggered (min. 1 ms) Change of state (min. 1 ms)
Baud rate	10 / 100 Mbit/s
Duplex modes	Half duplex Full duplex Auto-Negotiation
MDI modes	MDI, MDI-X, Auto-MDIX
Data transport layer	Ethernet II, IEEE 802.3
Cyclic process data	Distance data, measurement control, sensor state (For details see chapter 5.3.1)
Acyclic communication	Set and Get Attribute (For details see chapter 5.3.2)
Predefined standard objects	Identity Object (0x01) Message Route Object (0x02) Assembly Object (0x04) Connection Manager (0x06) Ethernet Link Object (0xF6) TCP/IP Object (0xF5) DLR Object (0x47) QoS Object (0x48)
Features supported	DLR (Device Level Ring), beacon based "Ring Node" ACD (Address Conflict Detection) DHCP, BOOTP Integrated switch
Supported topology	Tree, Line or Ring

5.2 Status LED

The status LED's of the EtherNet/IP™ protocol are marked in the figure below. The possible EtherNet/IP™ status conditions are displayed with two green and two red status LED's with three LED states – OFF, ON or FLASHING.



Status LED's:

- Network Status (NS) – Green / Red LED
- Module Status (MS) – Green / Red LED

The EtherNet/IP™ status conditions and some notes about troubleshooting are described in the table below.

LED	Color	State	Meaning	Troubleshooting
MS	Green	On	Device operational: The device is operating correctly.	
	Green	Flashing (1Hz)	Standby: The device has not been configured.	
	Red and Green	Flashing (1Hz)	Self-test: The device is performing its power up testing.	
	Red	Flashing (1Hz)	Minor fault: The device has detected a recoverable minor fault. (an incorrect or inconsistent configuration can be considered as a minor fault)	Configure device or check configuration
	Red	On	Major fault: The device has detected a nonrecoverable major fault.	
	None	Off	No power: The power supply to the device is missing.	Check wiring and connection
NS	Green	On	Connected: The device has at least one established connection (even to the Message Router).	
	Green	Flashing (1Hz)	No connections: The device has no established connections but has obtained an IP address.	
	Red and Green	Flashing (1Hz)	Self-test: The device is performing its power up testing.	
	Red	Flashing (1Hz)	Connection timeout: The device connections has timed out. This status will be cleared only if connection is reestablished or if the device is reset.	
	Red	On	Duplicate IP: The device has detected that its IP address is already in use.	Configure device or check configuration
	None	Off	Not powered, no IP address: The device does not have an IP address (or is powered off).	Check wiring and connection
LINK	Green	On	The device is linked to the Ethernet.	
	None	Off	The device has no link to the Ethernet	Check wiring and connection
ACT	Yellow	Flashing	The device sends/receives Ethernet packets	
	None	Off	The device does not send/receive Ethernet packets	

5.3 Parameter list

5.3.1 Cyclic process data

The cyclic process data (grouped in input / output data with fixed mapping and size) of the AS2100 with EtherNet/IP™ are shown in the table below. Every single cyclic process data can be read with acyclic communication too.

Assembly Name	Assembly	Class	Instance	Attribute	Designation	Data Type	Access
Output Basic	0x64	0x64	1	1	Measurement Control	UINT16	Output (Sensor input) 16 Byte
		0x69	1	1	Optional Output Data 0	UINT16	
				2	Optional Output Data 1	UINT32	
				3	Optional Output Data 2	UINT32	
				4	Optional Output Data 3	UINT32	
Input Basic	0x96	0x82	1	1	Distance Integer	UINT32	Input (Sensor output) 36 Byte
				2	Distance Float	FLOAT32	
				3	Signal Strength	UINT32	
				4	Temperature	SINT16	
		0x64	1	4	Distance Unit	UINT8	
		0x82	1	5	Measurement State	UINT8	
				6	Measurement Reserved	UINT16	
		0x87	1	1	Sensor State	UINT8	
				2	Sensor Output Data Limit Exceeded	UINT8	
				3	Sensor Error Code	SINT16	
		0x8C	1	1	Optional Input Data 0	SINT16	
				2	Optional Input Data 1 / Speed Integer	UINT32	
				3	Optional Input Data 2	UINT32	
				4	Optional Input Data 3	UINT32	

5.3.2 Acyclic communication

The acyclic communication used for data read / write access of the AS2100 with EtherNet/IP™ is shown in the table below. The available access type of every data / parameter must be considered. To access the data / parameter see the details about class, instance, and attribute.

Class	Instance	Attribute	Parameter group	Designation	Data type	Access type
0x64	1	1	Measurement Configuration	Measurement Control	UINT16	R
		2		Measurement Speed	UINT32	R/W
		3		Measurement Mode	UINT8	R/W
		4		Distance Unit	UINT8	R/W
		5		Additional Measurement Filter 1	UINT32	R/W
		6		Additional Measurement Filter 2	UINT32	R/W
		7		Additional Measurement Filter 3	UINT32	R/W
		8		User mode	UINT16	R/W
0x69	1	1	Options Output	Optional Output Data 0	UINT16	R
		2		Optional Output Data 1	UINT32	R
		3		Optional Output Data 2	UINT32	R
		4		Optional Output Data 3	UINT32	R
0x82	1	1	Measurement	Distance Integer	UINT32	R
		2		Distance Float	FLOAT32	R
		3		Signal Strength	UINT32	R
		4		Temperature	SINT16	R
		5		Measurement State	UINT8	R
		6		Measurement Reserved	UINT16	R
0x87	1	1	Sensor State	Sensor State	UINT8	R
		2		Sensor Output Data Limit Exceeded	UINT8	R
		3		Sensor Error Code	UINT16	R
0x8C	1	1	Options Input	Optional Input Data 0	UINT16	R
		2		Optional Input Data 1	UINT32	R
		3		Optional Input Data 2	UINT32	R
		4		Optional Input Data 3	UINT32	R
0xA0	1	1	Hardware Information	Serial Number	UINT32	R
		2		Part Number	UINT32	R
		3		Part Description	STRING[20]	R
		4		HW Version IF Board	UINT16	R
		5		HW Version M Module	UINT16	R
		6		Serial Number RTE	UINT32	R
		7		Part Number RTE	UINT32	R
		8		Part Description RTE	STRING[20]	R
		9		HW Version RTE	UINT16	R
0xA5	1	1	Firmware Information	FW Version IF Board	UINT16	R
		2		FW Version M Module	UINT16	R
		3		FW Version SSBL RTE	UINT32	R
		4		FW Version Stack RTE	UINT32	R

5.4 Configuration

5.4.1 Overview

Configuration control	Static / BOOTP / DHCP (Factory default: Static)
IP address	e.g. 192.168.0.20 (Factory default: 192.168.0.20)
RUN / IDLE notification	RUN –› Cyclic process data exchange running
	IDLE –› Save values, no cyclic process data exchange

5.4.2 Electronic Data Sheet (EDS)

The EDS (Electronic Data Sheet) file is an ASCII text file that describes the features of EtherNet/IP™ device and is used by software tools for device and network configuration.

The required EDS file for the EtherNet/IP™ protocol for the AS2100 can be found on the Acuity website (https://www.acuitylaser.com/product/laser-sensors/long-range-sensors/as2100-accurate-distance-sensor/)

5.4.3 Software / Tools

No additional software in needed. The configurations of the laser distance sensor can be done over the EtherNet/IP™ interface.

The “Ethernet Device Configuration” software (free of charge) from Hilscher can be used to find an EtherNet/IP™ device (e.g. MAC, IP,...). The software “BOOTP/DHCP Server” from Rockwell Automation can be used too to search and configure device settings [e.g. IP or configuration control (Static, DHCP, BOOTP)]