SAFETY, TECHNOLOGY & INNOVATION

OMRON

OS32C-DM Safety Laser Scanner with EtherNet/IP

This addendum is to be used in conjunction with the

OS32C User's Manual (P/N 99863-0010 or Manual No. Z296-E1)

EtherNet/IP™
conformance tested

OSTI P/N 99863-0060 Rev.D
Cat. No. Z336-E1-04

Safety Precautions

The Alert symbols and their meanings ensure safe use of the products

In order to use the OS32C safely, the precautions listed in this manual are indicated by alert symbols. The descriptions must be followed. Failure to follow all precautions and alerts may result in an unsafe installation or operation.

The following indications and symbols are used.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally, there may be significant property damage.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or there may be property damage.

Meanings of Alert Symbols

	Indicates prohibited actions.
	Indicates mandatory actions.

Alert Statements in this Manual

⚠ WARNING

System and zone status parameters monitored over EtherNet/IP are to be used for diagnostic purposes only, and must not be used in safety-critical functions.

Measurement data monitored over EtherNet/IP are to be used for diagnostic purposes only, and must not be used in safety-critical functions.

⚠ CAUTION

Ensure the measurement report configuration matches the expected measurement data format.

Contents

1. Introduction

The OS32C-xxx-DM Safety Laser Scanner with EtherNet/IP and Measurement Data allows the laser scanner to be monitored by products that adhere to the ODVA guidelines for EtherNet/IP communications. The OS32C with EtherNet/IP functions as an EtherNet/IP target (slave) device to the products that function as EtherNet/IP originator (master) devices. Multiple EtherNet/IP master devices can be set up to monitor a single OS32C and a single EtherNet/IP master can be set up to monitor multiple OS32Cs.

The OS32C with EtherNet/IP uses standard EtherNet/IP communications and does not use CIP safety protocols. EtherNet/IP communications with this laser scanner are for monitoring purposes only. EtherNet/IP originator products are able to monitor the OS32C's detection zone state, input & output status, configuration checksum values, and more. Full details of the OS32C's produced data assembly can be found in this document, along with detailed instructions for establishing communications between commonly used PLCs and the OS32C. General information for setting up communication connections between the OS32C and a computer based device is also provided in this document.

A data measurement demo tool for the PC is available on the Omron STI website at www.sti.com This demo tool is a C++ application that allows a user to view information such as system status, zone status, range measurement, and more from the OS32C without the need for a PLC. Also available on the website are data application function blocks for PLC programs. Users can use or modify these function blocks for their own PLC programs. One such function block is a "configuration" function block which allows users to choose the amount of data they would like to receive from the OS32C by specifying parameters such as the number of beams and number of scans. "Object detection" function blocks are also available to help users process the data they receive from the scanner.

2. Range Data Accuracy

Range (mm)	Recommended Minimum Reflector Width (mm)*1	Estimated 1δ random error in mm (A) for given target reflectivity *2							
		1.8%	5%	10%	25%	50%	75%	100%	Retro (330/sr)
250	70	20	10	10	10	10	10	10	10
500	70	20	10	10	10	10	10	10	10
1000	70	20	10	10	10	10	10	10	10
2000	70	20	20	10	10	10	10	10	10
3000	70	20	20	10	10	10	10	10	10
4000	70	20	20	20	20	20	20	20	20
5000	80	30	20	20	20	20	20	20	20
7500	120		40	20	20	20	20	20	20
10000	150			40	20	20	20	20	20
20000	300				40	20	20	20	20
30000	450					30	30	30	30
40000	600	Outside recommended range*3					30	30	30
50000	750							40	40

*1. Reflector Height should be between 300mm to 1000mm depending on application and range.

*2. To apply A toward a maximum expected error, use the formula n*A+B, where n corresponds to the desired multiplier for s (1, 2, 3 etc.), and B is the maximum systematic error of 30mm. If there are reflectors in the background of the target, refer to Table 7-2 in the OS32C user manual. Other error factors could arise depending on other measurement conditions such as objects in close proximity to the beam path.

*3. Maximum range can vary depending on desired measurement accuracy, and can also be affected by environmental conditions (e.g. smoke), window and/or target cleanliness.

For non-safety applications a value of 1 sigma can be used to determine the range accuracy of the OS32C-DM, so the following calculation can be used in this case.

Range accuracy = (n * A) + B; where n = 1σ (sigma), A = random error and B = systematic error.

For example, at a range of 1000 mm with a reflectivity of 50%, the following range accuracy can be expected:

Using these attribute values and the value from the table, A = 10 mm and B is 30 mm, the range accuracy at 1000 mm with 50% reflectivity = (10 mm) + 30 mm = +- 40 mm.

3. Laser Scanner Setup

Aside from changing the IP address settings of the OS32C, no configuration changes are required to establish communications between the OS32C and an EtherNet/IP master device.

To change the OS32C configuration, including the IP address settings, refer to Chapter 3 of the OS32C Safety Laser Scanner manual.

For OS32C wiring diagrams, refer to Chapter 5 of the OS32C Safety Laser Scanner manual.

4. EtherNet/IP Input Assembly Data

The OS32C has twelve standard input assembly objects and four vendor specific objects as described below:

- Input Assembly Object 100 (32 bytes) and Vendor Specific Object 112 provide system status data.
- Input Assembly Object 101 (296 bytes) provides both system status and zone status data.
- Input Assembly Object 102 (up to 1410 bytes) and Vendor Specific Object 114 provide both system status and range measurement data.
- Input Assembly Object 103 (up to 1410 bytes) and Vendor Specific Object 116 provide both system status and reflectivity measurement data.
- Input Assembly Object 104 (up to 960 bytes) provides both system status and range measurement data.
- Input Assembly Object 105 (up to 960 bytes) provides both system status and reflectivity measurement data.
- Input Assembly Object 106 (up to 554 bytes) provides range measurement data.
- Input Assembly Object 107 (up to 554 bytes) provides reflectivity measurement data.
- Input Assembly Object 108 (up to 454 bytes) provides range measurement data.
- Input Assembly Object 109 (up to 454 bytes) provides reflectivity measurement data.
- Input Assembly Object 110 (up to 358 bytes) provides range measurement data.
- Input Assembly Object 111 (up to 358 bytes) provides reflectivity measurement data.
- Vendor Specific Object 117 (up to 2764 bytes) provides system status, range and reflectivity measurement data.

Note: The term "Input Assembly" is from the originating devices perspective. PLCs and PC client software applications are considered the originating devices from the OS32C's perspective.

The input assembly object data provided by the OS32C can be obtained by using either explicit TCP/IP request/reply messages or by using implicit UDP I/O connections in order to receive the assembly data at a specific repetitive interval. Vendor specific object data provided by the OS32C can be obtained by using explicit TCP/IP request/reply messages at a rate defined by the software application. Data provided in vendor specific objects 114, 116 and 117 are synchronous with the scan period of the OS32C (40ms) and can be used in applications requiring greater time precision.

To read individual data attributes from the scanner, service code 14 (0x0E, Get Single Attribute) in a TCP request/response explicit message can be used to obtain the data.

For example, sending the following parameters to the scanner will provide an unsigned 16-bit machine state value:

Service code 14 (0x0E) // Get Single Attribute
Object class 112 (0x70) // Vendor Specific Object Number, System Status
Instance 1 (0x01) // Vendor Specific Instance
Attribute 4 (0x04), see additional attributes listed in the tables specified below.

To read the entire input assembly object data, service code 14 (0x0E, Get Single Attribute) can be used in a TCP request/reply explicit message using the following parameters.

Service code 14 (0x0E) // Get Single Attribute
Object class 4 (0x04) // Assembly Object Class

Instance 100 (0x64) // Input Assembly Object Number, System Status
Attribute 03 (0x03) // Input Assembly Object Data

To read the entire vendor specific object data, service code 14 (0x0E, Get Single Attribute) can be used in a TCP request/reply explicit message using the following parameters.

Service code 14 (0x0E) // Get Single Attribute
Object class 114 (0x72) // Vendor Specific Object Number (Range Data)
Instance 1 (0x01) // Vendor Specific Instance
Attribute 03 (0x03) // Vendor Specific Object Data

4.1 Table 1: EtherNet/IP Data Types

Keyword	Description	Minimum	Maximum
SINT, INT8	Short Integer	-128	127
USINT, UINT8	Unsigned Short Integer	0	255
INT, INT16	Integer	-32768	32767
UINT, UINT16	Unsigned Integer	0	65535
DINT, INT32	Double Integer	-2147483647 (-2^{31})	2147483646 ($2^{31} - 1$)
UDINT, UINT32	Unsigned Double Integer	0	4294967295 (2^{32})
BYTE	Bit string 8-bits	0	0xFF
WORD	Bit string 16-bits	0	0xFFFF
DWORD	Bit string 32-bits	0	0xFFFFFFFF

Input Assembly 100 listed in Table 2 below provides run-time system status information that can be used to monitor the behavior and the current configuration of the scanner. Using an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.2 Table 2: Input Assembly 100 and Vendor Object 112 (32bytes), System Status

WORD # (16-bit)	**Description**	**Vendor Specific Object 0x70, Instance 0x01 Attribute Number**	**Enumeration / Possible Values**

0	Machine State
	
	Data Type: UINT 16-bit
		4	POST = 0 // Power-on-self-test
			STOP = 1 // Machine Stop, Protection Zone Violation
			INTERLOCK = 2 // Start Interlock
			RUN = 3 // Machine Run
			STANDBY = 4 // System Standby.
			DEEPSTANDBY = 5 // System Standby with reduced power.
			CONFIGURE = 6 // Configuration process in session.
			FAULT = 7 // System Faulted, OSSD's are OFF.

WORD # (16-bit)	Description	Vendor Specific Object 0x70, Instance 0x01 Attribute Number	Enumeration / Possible Values

1	Machine Stop Reasons
	
	Data Type: UINT 16-bit
		5	DIRTY_WINDOW = 0 // Dirty window cause system to stop.
			ZONE_SELECT_NUM_ACTIVE = 1 // Invalid zone inputs, with wrong number of active inputs.
			ZONE_SELECT_INVALID = 2 // Invalid zone inputs, with correct number of active inputs.
			QUALIFIED_ZONE_VIOLATION = 3 // Qualified protection zone violation.
			STAND_BY_REQUEST = 4 // Stand-by or deep stand-by requested.
			RX_ERROR = 5 // Receiver error
			NOT IN MACHINE STOP = 7 // System currently not in stop mode
			SYSTEM FAULTED = 8 // The system faulted, check display code

2	Active Zone Set Data Type: UINT 16-bit	6	AZS_01 = 0 (0x00) … AZS_70 = 69 (0x45) INVALID AZS = 32,768 (0x8000)
3	Zone Inputs Data Type: WORD 16-bit	7	Zinput 1 = bit 0 Zinput 2 = bit 1 Zinput 3 = bit 2 Zinput 4 = bit 3 Zinput 5 = bit 4 Zinput 6 = bit 5 Zinput 7 = bit 6 Zinput 8 = bit 7
4	Detection Zone Status Data Type: WORD 16-bit	8	Protection Zone = bit 0 Warning Zone #1 = bit 1 Warning Zone #2 = bit 2 Window Contamination = bit 3
5	Output Status Data Type: WORD 16-bit	9	OSSD Output = bit 0 Auxiliary Output = bit 1 Warning Output = bit 2
6	Input Status Data Type: WORD 16-bit	10 (0x0A)	Standby Input = bit 0 Start Input = bit 1 EDM Input = bit 2
7	Seven Segment Display Data Type: UINT 16-bit	11 (0x0B)	Digit Low followed by Digit High Each Digit Displays 1 to 9 (0x01 to 0x09) for normal operation. 0x1B and 0x1B for dashes "--" during machine stop operation.
8	Non-Safety Configuration Checksum Value Data Type: UINT 16-bit	12 (0x0C)	16-bit Non-Safety Configuration CRC Value
9	Safety Configuration Checksum Value Data Type: UINT 16-bit	13 (0x0D)	16-bit Safety Configuration CRC Value

NOTE: Words 10-15 are unused.

Input Assembly 101 listed in Table 3 below provides run-time system status plus, protection zone, warning zone 1 and warning zone 2, detection status information. This information can be used to monitor the behavior of the scanner as well as the detection zones of the scanner. Using an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.3 Table 3: Input Assembly 101 (296 bytes), System & Detection Status

WORD # (16-bit)	Attribute Description	Data Field (16-bit)

0	Machine State	POST = 0 // Power-on-self-test
		STOP = 1 // Machine Stop, Protection Zone Violation
		INTERLOCK = 2 // Start Interlock
		RUN = 3 // Machine Run
		STANDBY = 4 // System Standby.
		DEEPSTANDBY = 5 // System Standby with reduced power.
		CONFIGURE = 6 // Configuration process in session.
		FAULT = 7 // System Faulted, OSSD's are OFF.

1	Machine Stop Reasons	DIRTY_WINDOW = 0 // Dirty window cause system to stop.
		ZONE_SELECT_NUM_ACTIVE = 1 // Invalid zone inputs, with wrong number of active inputs.
		ZONE_SELECT_INVALID = 2 // Invalid zone inputs, with correct number of active inputs.
		QUALIFIED_ZONE_VIOLATION = 3 // Qualified protection zone violation.
		STAND_BY_REQUEST = 4 // Stand-by or deep stand-by requested.
		RX_ERROR = 5 // Receiver error
		NOT IN MACHINE STOP = 7 // System currently not in stop mode
		SYSTEM FAULTED = 8 // The system faulted, check display code

2	Active Zone Set	AZS_01 = 0 (0x00) ... AZS_70 = 69 (0x45) INVALID AZS = 32,768 (0x8000)
3	Zone Inputs	Zinput 1 = bit 0 Zinput 2 = bit 1 Zinput 3 = bit 2 Zinput 4 = bit 3 Zinput 5 = bit 4 Zinput 6 = bit 5 Zinput 7 = bit 6 Zinput 8 = bit 7
4	Detection Zone Status	Protection Zone = bit 0 Warning Zone #1 = bit 1 Warning Zone #2 = bit 2 Window Contamination = bit 3
5	Output Status	OSSD Output = bit 0 Auxiliary Output = bit 1 Warning Output = bit 2
6	Input Status	Standby Input = bit 0 Start Input = bit 1 EDM Input = bit 2
7	Seven Segment Display	Digit Low followed by Digit High Each Digit Displays 1 to 9 (0x01 to 0x09) for normal operation. 0x1B and 0x1B for dashes "--" during machine stop operation.
8	Non-Safety Configuration Checksum Value	16-bit Non-Safety Configuration CRC Value
9	Safety Configuration Checksum Value	16-bit Safety Configuration CRC Value
10	Unused	For future use.
11	Unused	For future use.

WORD # (16-bit)	Attribute Description	Data Field (16-bit)
12	Unused	For future use.
13	Unused	For future use.
14	Unused	For future use.
15	Unused	For future use.
16	Protection Zone Status Beams #1 (Beams 1-16)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
17	Protection Zone Status Beams #2 (Beams 17-32)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
18 through 57	Protection Zone Status Beams #3 (Beam 33-48) Through Protection Zone Status Beams #42 (Beams 653-672)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
58	Protection Zone Status Beams #43 (Beams 673-688)	Beam status bit0 to bi16 (0 = Clear , 1 = Blocked) Beam 678-688 unused. Unused beams set to zero. Note: Data used to maintain 16-bit word alignment.
59	Unused Zone Status Beams #44 (Beams 689-704)	Unused beams set to zero. Note: Data used to maintain 32-bit alignment..
60	Warning Zone #1 Status Beams #1 (Beams 1-16)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
61	Warning Zone #1 Status Beams #2 (Beams17-32)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
62-101	Warning Zone #1 Status Beams #3 (Beam 33-48) Through Warning Zone #1 Status Beams #42 (Beams 653-672)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
102	Warning Zone #1 Status Beams #43 (Beams 672-688)	Beam status bit0 to bi16 (0 = Clear , 1 = Blocked) Beam 678-688 unused. Unused beams set to zero. Note: Data used to maintain 16-bit word alignment.
103	Warning Zone #1 Status Beams #44 (Beams 689-704)	Unused beams set to zero. Note: Data used to maintain 32-bit alignment.
104	Warning Zone #2 Status Beams #1 (Beams 1-16)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
105	Warning Zone #2 Status Beams #2 (Beams17-32)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
106-145	Warning Zone #2 Status Beams #3 (Beam 33-48) Through Warning Zone #2 Status Beams #42 (Beams 653-672)	Beam status bit0 to bit16 (0 = Clear , 1 = Blocked)
146	Warning Zone #2 Status Beams #43 (Beams 672-688)	Beam status bit0 to bi16 (0 = Clear , 1 = Blocked) Beam 678-688 unused. Unused beams set to zero. Note: Data used to maintain 16-bit word alignment.
147	Warning Zone #2 Status Beams #44 (Beams 689-704)	Unused beams set to zero. Note: Data used to maintain 32-bit alignment.

Output Assembly Object 113 and Vendor Specific Object 115 listed in Table 4 below are used to configure the run-time measurement data that the scanner provides in input assembly objects 102 and 103 as well as vendor specific objects 114, 116 and 117. In output assembly 113 and vendor specific 115 objects the measurement report range and reflectivity formats as well as the individual beams to be monitored can be selected using a beam report selection mask array.

4.4 Table 4: Output Assembly 113 and Vendor Object 115 (104 bytes), Measurement Report Configuration for Input Assembly 102 & 103

Data # (16-bit)	Description	Vendor Specific Object x, Instance y, Attribute Number z	Enumeration / Possible Values

0	Range Report Format
	Data Type: UINT 16-bit
		0x73, 1, 4	NO_TOF_MEASUREMENTS = 0,
			// No time-of-flight measurements required.
			
			RANGE_MEASURE_50M = 1, // default setting.
			// Bit 0 to 15 (16-bit) distance measurement value (0 to 50,000 millimeters).
			// Value of 0x0001 = Noisy Beam, Value of 0xFFFF = No Reflection.
			
			RANGE_MEASURE_32M_PZ = 2,
			// Bit 0 to 14 (15-bit) distance measurement value (0 to 32,766 millimeters).
			// Value of 0x0001 = Noisy Beam, Value of 0x7FFF = No Reflection.
			// Bit 15: object detected (beam blocked) within protection zone.
			
			RANGE_MEASURE_16M_WZ1PZ = 3,
			// Bit 0 to 13 (14-bit) distance measurement value (0 to 16,382 millimeters).
			// Value of 0x0001 = Noisy Beam, Value of 0x3FFF = No Reflection.
			// Bit 14: object detected (beam blocked) within the warning zone 1.
			// Bit 15: object detected (beam blocked) within protection zone.
			
			RANGE_MEASURE_8M_WZ2WZ1PZ = 4,
			// Bit 0 to 12 (13-bit) distance measurement value (0 to 8,190 millimeters).
			// Value of 0x0001 = Noisy Beam, Value of 0x1FFF = No Reflection.
			// Bit 13: object detected (beam blocked) within the warning zone 2.
			// Bit 14: object detected (beam blocked) within the warning zone 1.
			// Bit 15: object detected (beam blocked) within protection zone.
			
			RANGE_MEASURE_TOF_4PS = 5
			// Bit 0 to 15 (16-bit) TOF measurement value (0 to 65,534 x 4ps).
			// Value of 0x0001 = Noisy Beam, Value of 0xFFFF = No Reflection.
			
			RANGE_MEASURE_50M_W3BIT_ENCODED_TOT = 6,
			// Bit 0 to 12 (13-bit) distance measurement value
			// (0 to 50,000 millimeters, 50 meters with 8mm resolution).
			// Bit 13 to 15 (3 bits) encoded reflectivity value (1/128 of measured value).
			
			RANGE_MEASURE_32M_WZ2 = 7,
			// Bit 0 to 14 (15-bit) distance measurement value (0 to 32,766 millimeters).
			// Bit 15: measure value detected (beam blocked) within the warning zone 2.
			
			RANGE_MEASURE_16M_WZ1WZ2 = 8,
			// Bit 0 to 13 (14-bit) distance measurement value (0 to 16,382 millimeters).
			// Bit 14: measure value detected (beam blocked) within the warning zone 1.
			// Bit 15: measure value detected (beam blocked) within the warning zone 2.
			
			RANGE_MEASURE_8M_PZWZ1WZ2 = 9,
			// Bit 0 to 12 (13-bit) distance measurement value (0 to 8,190 millimeters).
			// Bit 13: measure value detected (beam blocked) within protection zone.
			// Bit 14: measure value detected (beam blocked) within the warning zone 1.
			// Bit 15: measure value detected (beam blocked) within the warning zone 2.

Data # (16-bit)	Description	Vendor Specific Object x, Instance y, Attribute Number z	Enumeration / Possible Values

1	Reflectivity Report Format
	Data Type: UINT 16-bit
		0x73, 1, 5	NO_TOT_MEASUREMENTS = 0,
			// No time-over-threshold measurements required.
			
			REFLECTIVITY_MEASURE_TOT_ENCODED = 1, // default setting.
			// Bit 0 to 9 (10-bit) TOT scaled value (0 to 1,000)
			// Bit 10: unused.
			// Bit 11: object detected (beam blocked) within the warning zone 2.
			// Bit 12: object detected (beam blocked) within the warning zone 1.
			// Bit 13: object detected (beam blocked) within protection zone.
			// Bit 14: noisy beam detected.
			// Bit 15: no reflection detected.
			
			REFLECTIVITY_MEASURE_TOT_4PS = 2
			// Bit 0 to 15 (16-bit) TOT measurement value (0 to 65,535 x 4ps).

2	Unused.		For future use.
3	Unused.		For future use.
4	Unused.		For future use.
5	Unused.		For future use.
6	Unused.		For future use.
7	Unused.		For future use.

8 - 51	Beam Report Selection Mask
	Data Type: UINT 16-bit ARRAY[44]
		0x73, 1, 12 (0x0C)	Beam Report Selection Mask is used to define the reported beam measurements in Assembly Input Objects 102, 103 & Vendor Specific Objects 114, 116 and 117.
			Bit = 0, excluded from measurement report. // default setting.
			Bit = 1, included in measurement reports.

4.5 Table 5: Output Assembly 114 (108 bytes), Measurement Report Configuration for Input Assembly 104 & 105

Data # (16-bit)	Description	Enumeration / Possible Values

0	Range Report Format
	Data Type: UINT
	16-bit
		NO_TOF_MEASUREMENTS = 0,
		// No time-of-flight measurements required.
		
		RANGE_MEASURE_50M = 1, // default setting.
		// Bit 0 to 15 (16-bit) distance measurement value (0 to 50,000 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0xFFFF = No Reflection.
		
		RANGE_MEASURE_32M_PZ = 2,
		// Bit 0 to 14 (15-bit) distance measurement value (0 to 32,766 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0x7FFF = No Reflection.
		// Bit 15: object detected (beam blocked) within protection zone.
		
		RANGE_MEASURE_16M_WZ1PZ = 3,
		// Bit 0 to 13 (14-bit) distance measurement value (0 to 16,382 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0x3FFF = No Reflection.
		// Bit 14: object detected (beam blocked) within the warning zone 1.
		// Bit 15: object detected (beam blocked) within protection zone.
		
		RANGE_MEASURE_8M_WZ2WZ1PZ = 4,
		// Bit 0 to 12 (13-bit) distance measurement value (0 to 8,190 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0x1FFF = No Reflection.
		// Bit 13: object detected (beam blocked) within the warning zone 2.
		// Bit 14: object detected (beam blocked) within the warning zone 1.
		// Bit 15: object detected (beam blocked) within protection zone.
		
		RANGE_MEASURE_TOF_4PS = 5
		// Bit 0 to 15 (16-bit) TOF measurement value (0 to 65,534 x 4ps).
		// Value of 0x0001 = Noisy Beam, Value of 0xFFFF = No Reflection.
		
		RANGE_MEASURE_50M_W3BIT_ENCODED_TOT = 6,
		// Bit 0 to 12 (13-bit) distance measurement value
		// (0 to 50,000 millimeters, 50 meters with 8mm resolution).
		// Bit 13 to 15 (3 bits) encoded reflectivity value (1/128 of measured value).
		
		RANGE_MEASURE_32M_WZ2 = 7,
		// Bit 0 to 14 (15-bit) distance measurement value (0 to 32,766 millimeters).
		// Bit 15: measure value detected (beam blocked) within the warning zone 2.
		
		RANGE_MEASURE_16M_WZ1WZ2 = 8,
		// Bit 0 to 13 (14-bit) distance measurement value (0 to 16,382 millimeters).
		// Bit 14: measure value detected (beam blocked) within the warning zone 1.
		// Bit 15: measure value detected (beam blocked) within the warning zone 2.
		
		RANGE_MEASURE_8M_PZWZ1WZ2 = 9,
		// Bit 0 to 12 (13-bit) distance measurement value (0 to 8,190 millimeters).
		// Bit 13: measure value detected (beam blocked) within protection zone.
		// Bit 14: measure value detected (beam blocked) within the warning zone 1.
		// Bit 15: measure value detected (beam blocked) within the warning zone 2.

Data # (16-bit)	Description	Enumeration / Possible Values

1	Reflectivity Report Format
	Data Type: UINT 16-bit
		NO_TOT_MEASUREMENTS = 0,
		// No time-over-threshold measurements required.
		
		REFLECTIVITY_MEASURE_TOT_ENCODED = 1, // default setting.
		// Bit 0 to 9 (10-bit) TOT scaled value (0 to 1,000)
		// Bit 10: unused.
		// Bit 11: object detected (beam blocked) within the warning zone 2.
		// Bit 12: object detected (beam blocked) within the warning zone 1.
		// Bit 13: object detected (beam blocked) within protection zone.
		// Bit 14: noisy beam detected.
		// Bit 15: no reflection detected.
		
		REFLECTIVITY_MEASURE_TOT_4PS = 2
		// Bit 0 to 15 (16-bit) TOT measurement value (0 to 65,535 x 4ps).

2	Range Report Mode
	Data Type: UINT 16-bit
		REPORT_RANGE_ONLY = 0,
		// Report Range Only.
		
		REPORT_RANGE_AND_REFLECTIVITY = 1,
		// Report Range & Reflectivity.

3	Assembly 104 & 105 Enable User Tags Data Type: UINT 16-bit	Enable User Provided Tag Values for First & Last Positions of Input Assembly Data. // Disable = 0 (default), Enable = 1
4	Assembly 104 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
5	Assembly 104 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
6	Assembly 105 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
7	Assembly 105 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
8	Unused.	For future use.
9	Unused.	For future use.
10- 53	Beam Report Selection Mask Data Type: UINT 16-bit ARRAY[44]	Beam Report Selection Mask is used to define the reported beam measurements in Assembly Input Objects 104, 105. Bit = 0, excluded from measurement report. Bit = 1, included in measurement reports. // default setting.

4.6 Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

Data # (16-bit)	Description	Enumeration / Possible Values

0	Range Report Format
	Data Type: UINT
	16-bit
		NO_TOF_MEASUREMENTS = 0,
		// No time-of-flight measurements required.
		
		RANGE_MEASURE_50M = 1, // default setting.
		// Bit 0 to 15 (16-bit) distance measurement value (0 to 50,000 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0xFFFF = No Reflection.
		
		RANGE_MEASURE_32M_PZ = 2,
		// Bit 0 to 14 (15-bit) distance measurement value (0 to 32,766 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0x7FFF = No Reflection.
		// Bit 15: object detected (beam blocked) within protection zone.
		
		RANGE_MEASURE_16M_WZ1PZ = 3,
		// Bit 0 to 13 (14-bit) distance measurement value (0 to 16,382 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0x3FFF = No Reflection.
		// Bit 14: object detected (beam blocked) within the warning zone 1.
		// Bit 15: object detected (beam blocked) within protection zone.
		
		RANGE_MEASURE_8M_WZ2WZ1PZ = 4,
		// Bit 0 to 12 (13-bit) distance measurement value (0 to 8,190 millimeters).
		// Value of 0x0001 = Noisy Beam, Value of 0x1FFF = No Reflection.
		// Bit 13: object detected (beam blocked) within the warning zone 2.
		// Bit 14: object detected (beam blocked) within the warning zone 1.
		// Bit 15: object detected (beam blocked) within protection zone.
		
		RANGE_MEASURE_TOF_4PS = 5
		// Bit 0 to 15 (16-bit) TOF measurement value (0 to 65,534 x 4ps).
		// Value of 0x0001 = Noisy Beam, Value of 0xFFFF = No Reflection.
		
		RANGE_MEASURE_50M_W3BIT_ENCODED_TOT = 6,
		// Bit 0 to 12 (13-bit) distance measurement value
		// (0 to 50,000 millimeters, 50 meters with 8mm resolution).
		// Bit 13 to 15 (3 bits) encoded reflectivity value (1/128 of measured value).
		
		RANGE_MEASURE_32M_WZ2 = 7,
		// Bit 0 to 14 (15-bit) distance measurement value (0 to 32,766 millimeters).
		// Bit 15: measure value detected (beam blocked) within the warning zone 2.
		
		RANGE_MEASURE_16M_WZ1WZ2 = 8,
		// Bit 0 to 13 (14-bit) distance measurement value (0 to 16,382 millimeters).
		// Bit 14: measure value detected (beam blocked) within the warning zone 1.
		// Bit 15: measure value detected (beam blocked) within the warning zone 2.
		
		RANGE_MEASURE_8M_PZWZ1WZ2 = 9,
		// Bit 0 to 12 (13-bit) distance measurement value (0 to 8,190 millimeters).
		// Bit 13: measure value detected (beam blocked) within protection zone.
		// Bit 14: measure value detected (beam blocked) within the warning zone 1.
		// Bit 15: measure value detected (beam blocked) within the warning zone 2.

Data # (16-bit)	Description	Enumeration / Possible Values

1	Reflectivity Report Format
	Data Type: UINT
	16-bit
		NO_TOT_MEASUREMENTS = 0,
		// No time-over-threshold measurements required.
		
		REFLECTIVITY_MEASURE_TOT_ENCODED = 1, // default setting.
		// Bit 0 to 9 (10-bit) TOT scaled value (0 to 1,000)
		// Bit 10: unused.
		// Bit 11: object detected (beam blocked) within the warning zone 2.
		// Bit 12: object detected (beam blocked) within the warning zone 1.
		// Bit 13: object detected (beam blocked) within protection zone.
		// Bit 14: noisy beam detected.
		// Bit 15: no reflection detected.
		
		REFLECTIVITY_MEASURE_TOT_4PS = 2
		// Bit 0 to 15 (16-bit) TOT measurement value (0 to 65,535 x 4ps).

2	Assembly 106 Range Report Mode
	Data Type: UINT
	16-bit
		REPORT_RANGE_ONLY = 0,
		// Report Range Only.
		
		REPORT_RANGE_AND_REFLECTIVITY = 1,
		// Report Range & Reflectivity.

3	Assembly 106 & 107 Enable User Tags Data Type: UINT 16-bit	Enable User Provided Tag Values for First & Last Positions of Input Assembly Data. // Disable = 0 (default), Enable = 1
4	Assembly 106 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
5	Assembly 106 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
6	Assembly 107 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
7	Assembly 107 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
8	Unused.	For future use.
9	Unused.	For future use.
10- 53	Beam Report Selection Mask Data Type: UINT 16-bit ARRAY[44]	Beam Report Selection Mask is used to define the reported beam measurements in Assembly Input Objects 106, 107. Bit = 0, excluded from measurement report. Bit = 1, included in measurement reports. // default setting.

54	Assembly 108 Range Report Mode
	Data Type: UINT
	16-bit
		REPORT_RANGE_ONLY = 0,
		// Report Range Only.
		
		REPORT_RANGE_AND_REFLECTIVITY = 1,
		// Report Range & Reflectivity.

55	Assembly 108 & 109 Enable User Tags Data Type: UINT 16-bit	Enable User Provided Tag Values for First & Last Positions of Input Assembly Data. // Disable = 0 (default), Enable = 1
56	Assembly 108 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.

Data # (16-bit)	Description	Enumeration / Possible Values
57	Assembly 108 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
58	Assembly 109 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
59	Assembly 109 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
60	Unused	For future use.
61	Unused	For future use.
62-105	Beam Report Selection Mask Data Type: UINT 16-bit ARRAY[44]	Beam Report Selection Mask is used to define the reported beam measurements in Assembly Input Objects 108, 109. Bit = 0, excluded from measurement report. Bit = 1, included in measurement reports. // default setting.

106	Assembly 110 Range Report Mode
	Data Type: UINT
	16-bit
		REPORT_RANGE_ONLY = 0,
		// Report Range Only.
		
		REPORT_RANGE_AND_REFLECTIVITY = 1,
		// Report Range & Reflectivity.

107	Assembly 110 & 111 Enable User Tags Data Type: UINT 16-bit	Enable User Provided Tag Values for First & Last Positions of Input Assembly Data. // Disable = 0 (default), Enable = 1
108	Assembly 110 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
109	Assembly 110 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
110	Assembly 111 User First Position Tag Data Type: UINT 16-bit	User Provided Tag Value for First Position of Input Assembly Data.
111	Assembly 111 User Last Position Tag Data Type: UINT 16-bit	User Provided Tag Value for Last Position of Input Assembly Data.
112	Unused	For future use.
113	Unused	For future use.
114-157	Beam Report Selection Mask Data Type: UINT 16-bit ARRAY[44]	Beam Report Selection Mask is used to define the reported beam measurements in Assembly Input Objects 110, 111. Bit = 0, excluded from measurement report. Bit = 1, included in measurement reports. // default setting.

The range report formats available in the configuration output assembly 113, 114 and 115 provide options to receive range measurements in millimeters units, encoded detection zone bits and millimeter units, or time-of-flight measurements in picoseconds. The encoded detection zone bits that are provided by the scanner serve two purposes, 1) to provide fast detection of the location where zone violations occur, and 2) so that the client application (PLC or PC) is not required to maintain the

same detection zone parameters that are already stored in the scanner. When encoded range measurements are provided the measurement values can be separated from the detection zone bits by using a binary mask for the selected format. When a measurement beam is noisy and does not contain valid information the value returned is 1 (0x0001) and when there is no measurement of the value the maximum value for the range report format is returned (i.e. for the RANGE_MEASURE_50M format the returned value is 65535 (0xFFFF)). The range measurements are provided in input assembly object 102, 104, 106, 108 and 110 as well as vendor specific object 114 and 117 which also contains reflectivity measurements.

The reflectivity report formats available in the configuration output assembly 113, 114 and 115 provides another option to receive reflectivity measurements in a scaled unit with encoded detection zone bits, or time-over-threshold measurements in picoseconds. The encoded detection bits that are embedded in the reflectivity measurements serve the same purpose as described above but provide an alternate method for zone detection when long range measurements are required. The reflectivity measurements are provided in input assembly object 103, 105, 107,109, and 111 as well as vendor specific objects 116 and 117 which also contains range measurements.

Output Assembly 112 is a single word assembly which is used to keep a PLC I/O connection alive for streaming any of the standard Input assemblies (100 through 111). The output data of this assembly has no effect on the measurement report configuration and can be used to trigger an alternate I/O connection. When the measurement report configuration, Output Assembly 113, is used to collect range measurement data for example, Output Assembly 112 can be used to create an alternate streaming connection in order to collect reflectivity data.

4.7 Table 7 : Output Assembly 112, I/O Connection Trigger

Data # (16-bit)	Description	Enumeration / Possible Values
0	Data Type: UINT 16-bit	Not used.

The OS32C uses a beam report selection mask to select the areas of interest. When defining the required resolution and selected zones of interest, the beam report selection mask provides the greatest flexibility for changing monitored zones during run-time. Figure 4-1 below shows the coverage area when all beams are selected and each bit in the beam report selection mask is set to 1. Two additional beams before and after the sensing field are provided to ensure the full safety region is protected at all times. Therefore the true monitoring region coverage is from -0.4° to 270.4°.

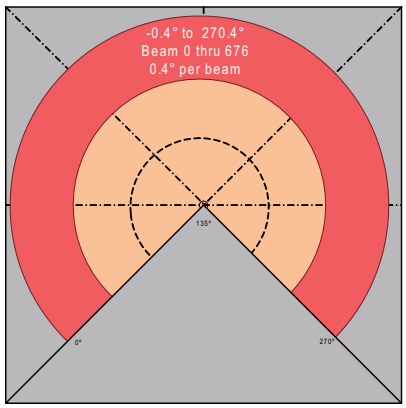


Fig. 4-1 Beam Report Selection Mask, All Beams

Using the OS32C beam report selection mask smaller areas of interest can also be defined. For example setting the selection bits 225 thru 450 in the beam report selection mask provides an area of coverage from 90 to 180 degrees in the scan plane.

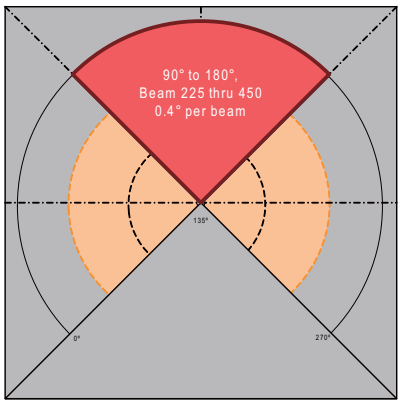


Fig. 4-2 Beam Report Selection Mask, Beam 225 through 450

As shown in Figure 4-3 below, the beam report selection mask can also be used to reduce the amount of data provided in the area of interest. For example setting every 5th beam in the selection bits 225 through 450 in the selection mask provides an area of coverage with a resolution of 2 degrees.

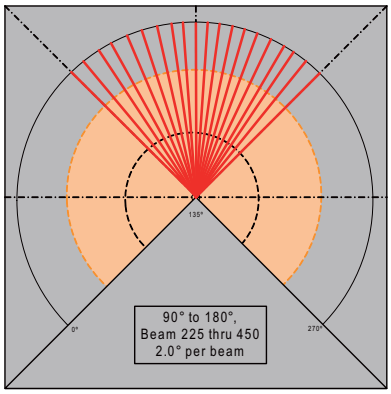


Fig. 4-3 Beam Report Selection Mask, Beam 225 through 450 with Low Resolution

Input assembly objects 102 through 105 as well as vendor specific objects 114, 116 and 117 provide a common measurement report header format in addition to the specific measurement data provided in these assembly structures. Table 8 below shows the common measurement report header format. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection for assembly objects 102 through 105 the scanner can be monitored at a repetition rate defined for the application.

4.8 Table 8: Common Measurement Report Header Format (56 bytes)

Data # (16-bit)	Description	Vendor Specific Object x, Instance y, Attribute Number z	Enumeration / Possible Values
0 & 1	Scan Count Data Type: UDINT 32-bit	0x72, 1, 13 (0x0D)	0 to 4294967295 (2^{32})
2 & 3	Scan Rate Data Type: UDINT 32-bit	0x72, 1, 14 (0x0E)	39,000 us ± 500 us
4 & 5	Scan Time Stamp Data Type: UDINT 32-bit	0x72, 1, 15 (0x0F)	0 to 4294967295 (2^{32}) us
6 & 7	Scan Beam Period Data Type: UDINT 32-bit	0x72, 1, 16 (0x10)	42,777 to 43,888 ns

8	Machine State
	Data Type: UINT 16-bit
		0x70, 1, 4	POST = 0 // Power-on-self-test
			STOP = 1 // Machine Stop, Protection Zone Violation
			INTERLOCK = 2 // Start Interlock
			RUN = 3 // Machine Run
			STANDBY = 4 // System Standby.
			DEEPSTANDBY = 5 // System Standby with reduced power.
			CONFIGURE = 6 // Configuration process in session.
			FAULT = 7 // System Faulted, OSSD's are OFF.

9	Machine Stop Reasons
	Data Type: UINT 16-bit
		0x70, 1, 5	DIRTY_WINDOW = 0 // Dirty window cause system to stop.
			ZONE_SELECT_NUM_ACTIVE = 1 // Invalid zone inputs, with wrong number of active inputs.
			ZONE_SELECT_INVALID = 2 // Invalid zone inputs, with correct number of active inputs.
			QUALIFIED_ZONE_VIOLATION = 3 // Qualified protection zone violation.
			STAND_BY_REQUEST = 4 // Stand-by or deep stand-by requested.
			RX_ERROR = 5 // Receiver error
			NOT IN MACHINE STOP = 7 // System currently not in stop mode
			SYSTEM FAULTED = 8 // The system faulted, check display code

10	Active Zone Set Data Type: UINT 16-bit	0x70, 1, 6	AZS_01 = 0 (0x00) ... AZS_70 = 69 (0x45) INVALID AZS = 32,768 (0x8000)
11	Zone Inputs Data Type: WORD 16-bit	0x70, 1, 7	Zinput 1 = bit 0 Zinput 2 = bit 1 Zinput 3 = bit 2 Zinput 4 = bit 3 Zinput 5 = bit 4 Zinput 6 = bit 5 Zinput 7 = bit 6 Zinput 8 = bit 7

Data # (16-bit)	Description	Vendor Specific Object x, Instance y, Attribute Number z	Enumeration / Possible Values
12	Detection Zone Status Data Type: WORD 16-bit	0x70, 1, 8	Protection Zone = bit 0 Warning Zone #1 = bit 1 Warning Zone #2 = bit 2 Window Contamination = bit 3
13	Output Status Data Type: WORD 16-bit	0x70, 1, 9	OSSD Output = bit 0 Auxiliary Output = bit 1 Warning Output = bit 2
14	Input Status Data Type: WORD 16-bit	0x70, 1, 10 (0x0A)	StandBy Input = bit 0 Start Input = bit 1 EDM Input = bit 2
15	Seven Segment Display Data Type: UINT 16-bit	0x70, 1, 11 (0x0B)	Digit Low followed by Digit High Each Digit Displays 1 to 9 (0x01 to 0x09) for normal operation. 0x1B and 0x1B for dashes "--" during machine stop operation.
16	Non-Safety Configuration Checksum Value Data Type: UINT 16-bit	0x70, 1, 12 (0x0C)	16-bit Non-Safety Configuration CRC Value
17	Safety Configuration Checksum Value Data Type: UINT 16-bit	0x70, 1, 13 (0x0D)	16-bit Safety Configuration CRC Value
18	Unused		For future use.
19	Unused		For future use.
20	Unused		For future use.
21	Unused		For future use.
22	Unused		For future use.
23	Unused		For future use.
24	Range Report Format Data Type: UINT 16-bit	0x72, 1, 4	Report format of range data
25	Reflectivity Report Format Data Type: UINT 16-bit	0x72, 1, 5	Report format of reflectivity data
26	Unused		For future use.
27	Number of Beams	0x72, 1, 17 (0x11)	Number of measurement beams in report.

In addition to the common measurement report header defined in Table 8, Input Assembly 102 and Vendor Specific Object 114 includes range measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.9 Table 9: Input Assembly 102 and Vendor Specific Object 114 (max. 1410 bytes)

28 - 704	Range (TOF) data[] UINT 16-bit		Range measurement data, variable size. Size selected using the beam report mask configuration. (1) Array Size = Number of Beams included in measurement report header, maximum size = 677.

In addition to the common measurement report header defined in Table 8, Input Assembly 103 includes reflectivity measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.10 Table 10: Input Assembly 103 and Vendor Specific Object 116 (max. 1410 bytes)

28 - 704	Reflectivity (TOT) data[] UINT 16-bit		Reflectivity measurement data, variable size. Size selected using the beam report mask configuration. (1) Array Size = Number of Beams included in measurement report header, maximum size = 677.

In addition to the common measurement report header defined in Table 8, Vendor Specific Object 117 includes both range and reflectivity measurement data for the selected area of interest. Since UDP I/O messages are limited to less than 1500 bytes this assembly can only be provided using explicit TCP/IP request/reply messages. The scanner will respond to each request immediately after the next scan period.

4.11 Table 11: Vendor Specific Object 117 (max. 2764 bytes)

28 - 704	Range (TOF) data[] UINT 16-bit		Range measurement data, variable size. Size selected using the beam report mask configuration. *1. *2. Array Size = Number of Beams included in measurement report header, maximum size = 677.
705-1381	Reflectivity (TOT) data[] UINT 16-bit		Reflectivity measurement data, variable size. Size selected using the beam report mask configuration. *1. *2. Array Size = Number of Beams included in measurement report header, maximum size = 677.

Note *1. See section Table 4: Output Assembly 113 and Vendor Object 115 (104 bytes), Measurement Report Configuration for Input Assembly 102 & 103 for beam selection mask usage.

*2. Vendor Specific Assembly reports are synchronous with the scan period of the scanner.

In addition to the common measurement report header defined in Table 8, Input Assembly 104 includes range measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.12 Table 12: Input Assembly 104 (max. 960 bytes)

28 - 479	Range (TOF) data[] UINT 16-bit		Range measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size = 452 without tags.

* See Table 5: Output Assembly 114 (108 bytes), Measurement Report Configuration for Input Assembly 104 & 105 for beam selection mask usage.

In addition to the common measurement report header defined in Table 8, Input Assembly 105 includes reflectivity measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.13 Table 13: Input Assembly 105 (max. 960 bytes)

28 - 479	Reflectivity (TOT) data[] UINT 16-bit		Reflectivity measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size =452 without tags.

* See Table 5: Output Assembly 114 (108 bytes), Measurement Report Configuration for Input Assembly 104 & 105 for beam selection mask usage.

Input Assembly 106 includes range measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.14 Table 14: Input Assembly 106 (max. 554 bytes)

0 - 276	Range (TOF) data[] UINT 16-bit		Range measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size = 277 without tags.

* See Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

Input Assembly 107 includes reflectivity measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.15 Table 15: Input Assembly 107 (max. 554 bytes)

0 - 276	Reflectivity (TOT) data[] UINT 16-bit		Reflectivity measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size =277 without tags.

* See Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

Input Assembly 108 includes range measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.16 Table 16: Input Assembly 108 (max. 454 bytes)

0 - 226	Range (TOF) data[] UINT 16-bit		Range measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size = 227 without tags.

* See Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

Input Assembly 109 includes reflectivity measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.17 Table 17: Input Assembly 109 (max. 454 bytes)

0 - 226	Reflectivity (TOT) data[] UINT 16-bit		Reflectivity measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size =227 without tags.

* See Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

Input Assembly 110 includes range measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.18 Table 18: Input Assembly 110 (max. 358 bytes)

0 -178	Range (TOF) data[] UINT 16-bit		Range measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size = 179 without tags.

* See Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

Input Assembly 111 includes reflectivity measurement data for the selected area of interest. Using explicit TCP/IP request/reply messages or an implicit UDP I/O connection the scanner can be monitored at a repetition rate defined for the application.

4.19 Table 19: Input Assembly 111 (max. 358 bytes)

0 - 178	Reflectivity (TOT) data[] UINT 16-bit		Reflectivity measurement data, variable size. Size selected using the beam report mask configuration. * Array Size = Number of Beams included in measurement report header, maximum size =179 without tags.

* See Table 6 : Output Assembly 115 (316 bytes), Measurement Report Configuration for Input Assembly 106 through 111

4.20 Data Refresh Rate (Expected Packet Rate)

The data refresh rate for the scanner is approximately 40 (38.5 to 39.5) milliseconds. When configuring the scanner on an EtherNet/IP PLC network it is recommended to set the expected packet rate for the input assembly data to a value of 50 milliseconds or more.

5. Installing the OS32C EDS file

The EDS file for the OS32C can be found on the OS32C Configuration Tool CD that is shipped with the scanner.

To install the EDS file in Omron's Network Configurator software:

From the **EDS File** menu, select **Install**.

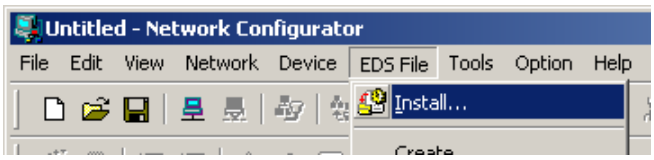


Fig. 5-1 Install EDS File

When prompted, locate the EDS file then click **OK**. The OS32C will now appear in the hardware list on the left side of the Network Configurator window.

6. Establishing a connection with Omron CJ2

This section provides step by step instructions for setting up communication from the OS32C to Omron's CJ2 (or CJ1) PLC via EtherNet/IP.

6.1 Setting up the EtherNet/IP Network

Start up Network Configurator and create a new EtherNet/IP network.

Drag and drop the OS32C and the CJ2B-EIP21 from the hardware list onto the EtherNet/IP network in Network Configurator.

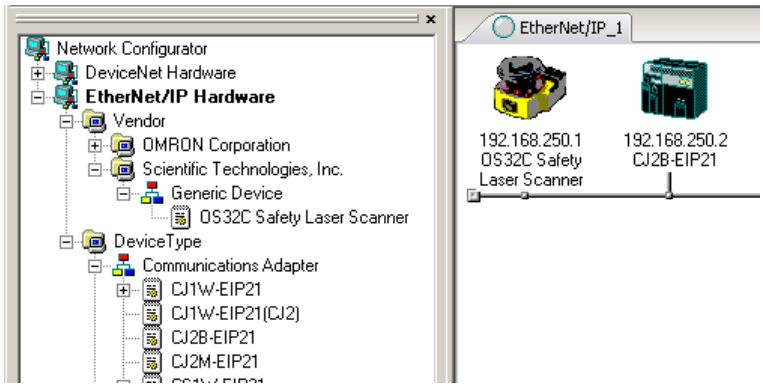


Fig. 6-1 Select Devices from Hardware List

Make sure the IP addresses match the IP address of the respective devices. To change the IP address of the device, right click on the device icon and select **Change Node Address**.

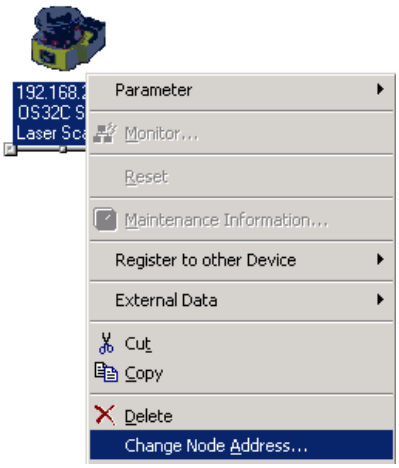


Fig. 6-2 Change Node Address

In this example, the OS32C has an IP address of 192.168.250.1 and the CJ2 has an IP address of 192.168.250.2

6.2 Setting up EtherNet/IP Tags for the CJ2

Double-click the CJ2B-EIP21 icon and select the **Tag Sets** tab, select the **In-Consume** tab, then click the **Edit Tags** button.

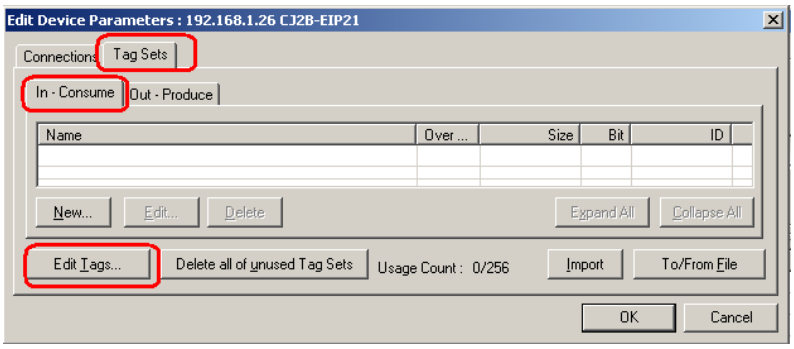


Fig. 6-3 Edit Tags

Select the **In-Consume** tab then click **New** to create a new tag:

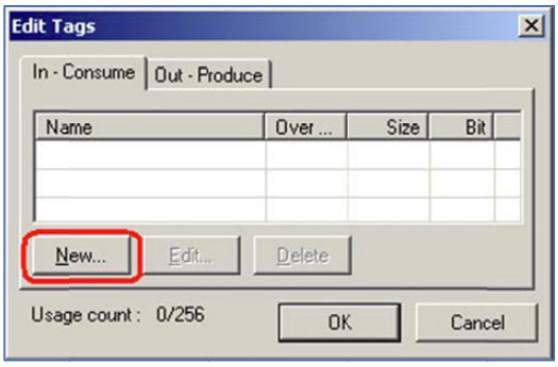


Fig. 6-4 Create New Tag

For the Name field, enter the memory location in the PLC where the OS32C data will be written to. For this example, enter **D0** for the name to specify the DM memory area 0 of the CJ2.

NOTE: upper case letters must be used when specifying these memory area. In this case, enter “D0” exactly as shown. A lower case “d” will not work.

Enter **32** bytes for the size field. When done, click the **Regist** button, then the **Close** button.

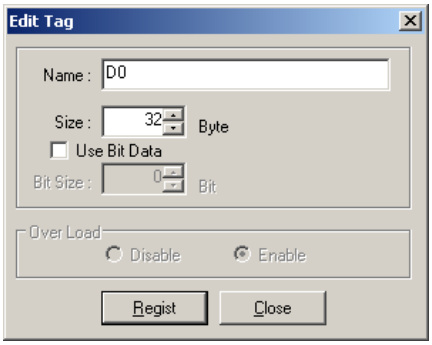


Fig. 6-5 Register Tag

Select the **Out-Produce** tab then click **New** to create a new tag:

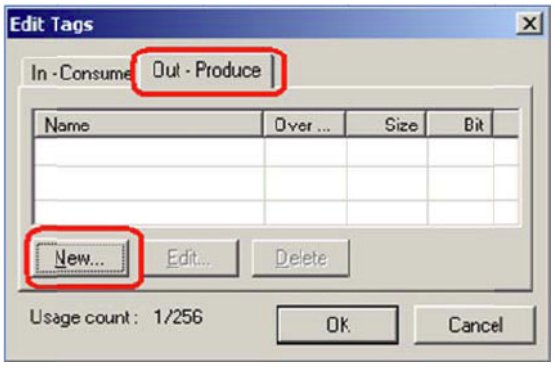


Fig. 6-6 Create New Tag

Enter **D100** for the name to specify DM memory area 100 of the CJ2. Reminder: the D in **D100** must be upper case. Enter 2 bytes for the size. When done, click the **Regist** button, then the **Close** button.

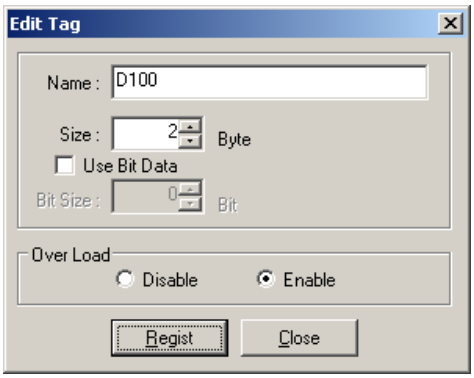


Fig. 6-7 Register Tag

Click **OK** to complete the creation of the tags.

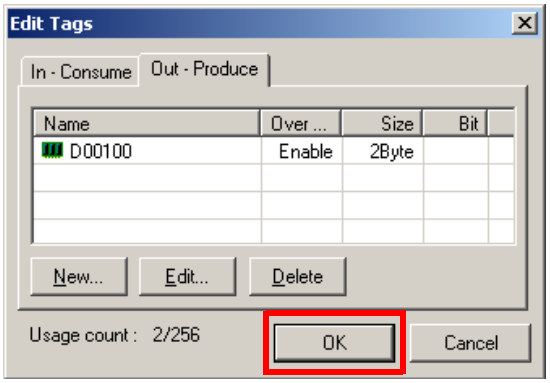


Fig. 6-8 Click OK

When prompted, click **Yes** to register the new Tags as Tag Sets:

Fig. 6-9 Register Tag Sets

Select the **Connections** tab, highlight the OS32C, then click the down arrow to register the OS32C as a slave device to the CJ2:

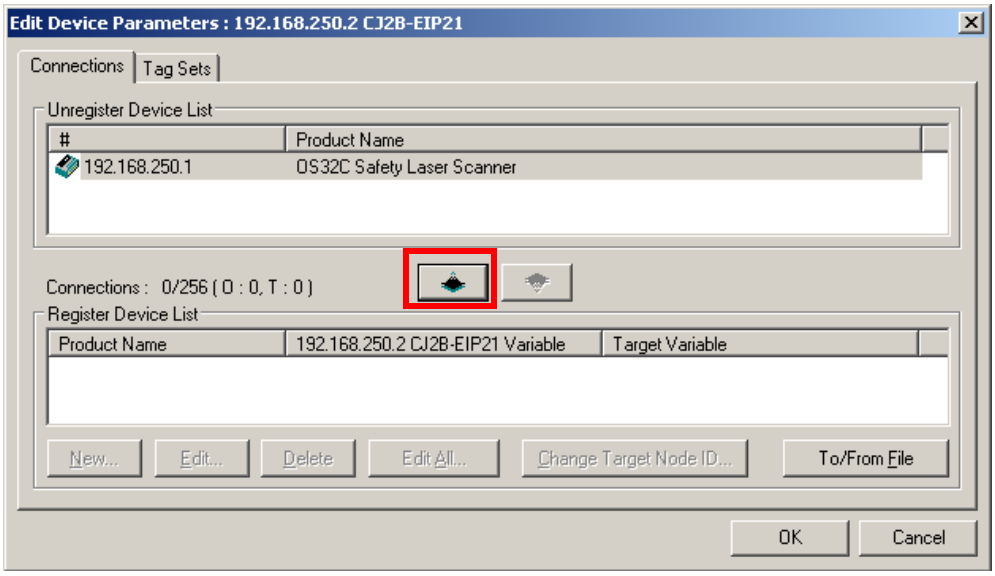


Fig. 6-10 Register OS32C to CJ2

Once the OS32C is listed under the Register Device List, double-click on the OS32C to edit the connection. Under the Originator Device, select the input and output tag sets that were just created, so that it matches the screenshot below.

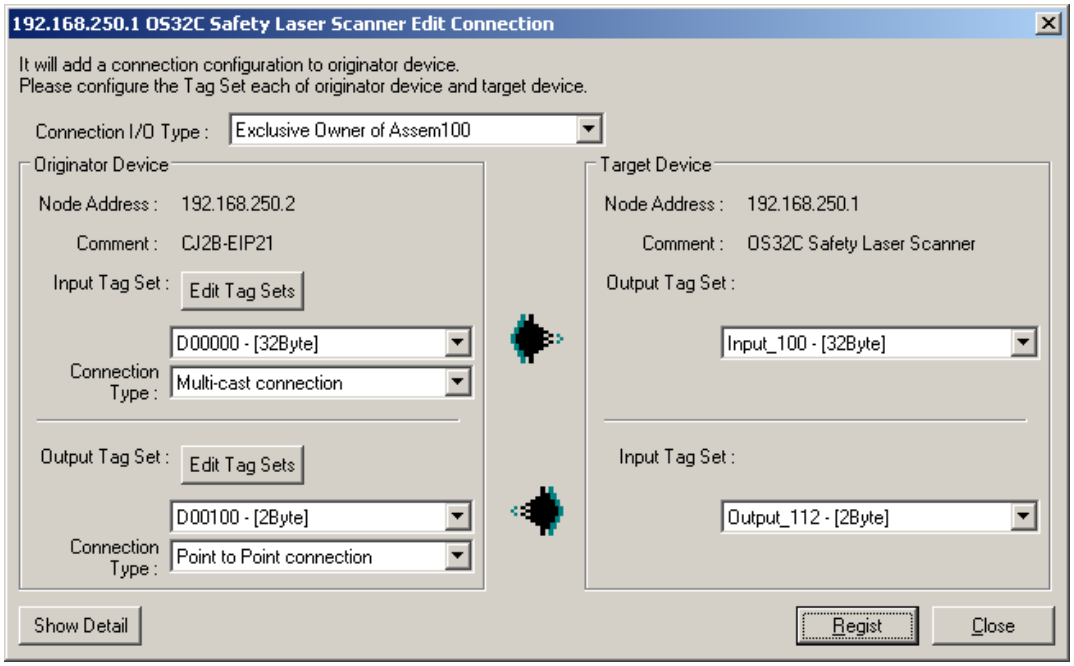


Fig. 6-11 Edit Connection Window

Click the **Show Detail** button in the lower left hand corner of this window. Set the RPI to **200** ms. Click the **Regist** button when finished then click **Close**.

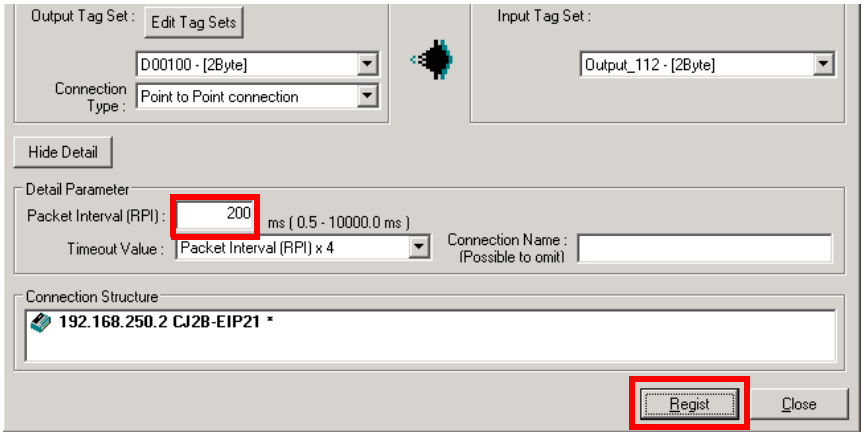


Fig. 6-12 Packet Interval Setting

Click **OK** in the **Edit Device Parameters** window:

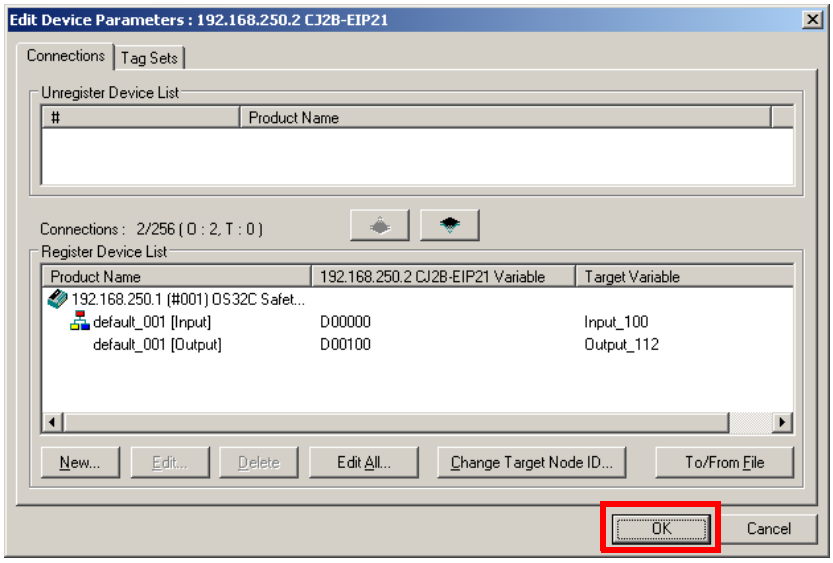


Fig. 6-13 OS32C Is Registered

6.3 Downloading EtherNet/IP Configuration to the CJ2

Now that the Tags have been set up, the EtherNet/IP configuration needs to be downloaded to the CJ2. Connect the computer to the CJ2 via USB cable.

In the Network Configurator, go to the **Option** menu, choose **Select Interface**, then select **CJ2 USB/ Serial Port**.

Fig. 6-14 Select Interface

From the **Network** menu, select **Connect**.

Select **TCP:2**, then click **OK** to connect.

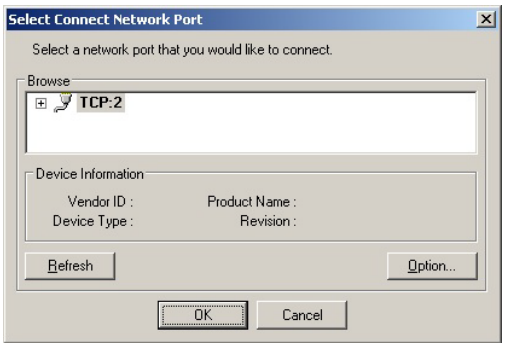


Fig. 6-15 Select Network Port

Right click on the CJ2B icon, select **Parameter**, then select **Download**.

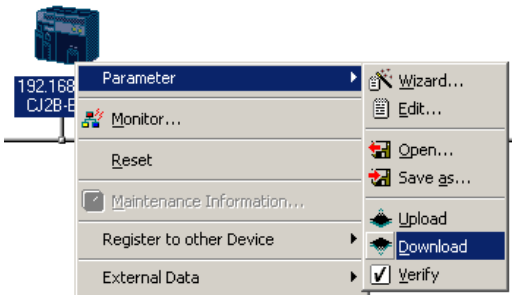


Fig. 6-16 Download to Device

To download to the CJ2 module without changing the PLC to Program mode, click **Download with Current Mode** when prompted:

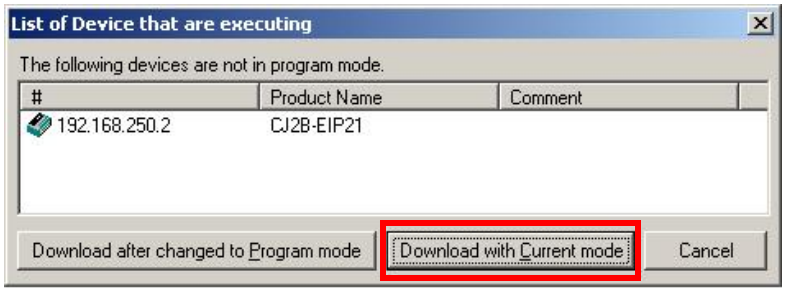


Fig. 6-17 Download with Current Mode

7. Establishing a connection with Omron NJ

This section provides step by step instructions for setting up communication from the OS32C to Omron's NJ5 PLC using EtherNet/IP communications.

7.1 NJ5 MAC EtherNet/IP Adapter Setup

Open the Sysmac Studio programming software and either open the project associated with the machine or create a new one. Double click on the **Built-in EtherNet/IP Port Setting** option under **Configurations and Setup** as shown below:

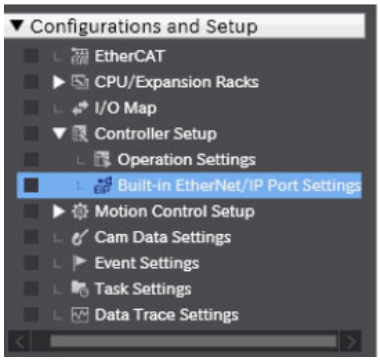


Fig. 7-1 Built-in EtherNet/IP Port Setting

In the window that appears, make the appropriate IP address setting to the NJ. In this example the NJ will be set to 192.168.250.2 and the OS32C will be set to 192.168.250.7

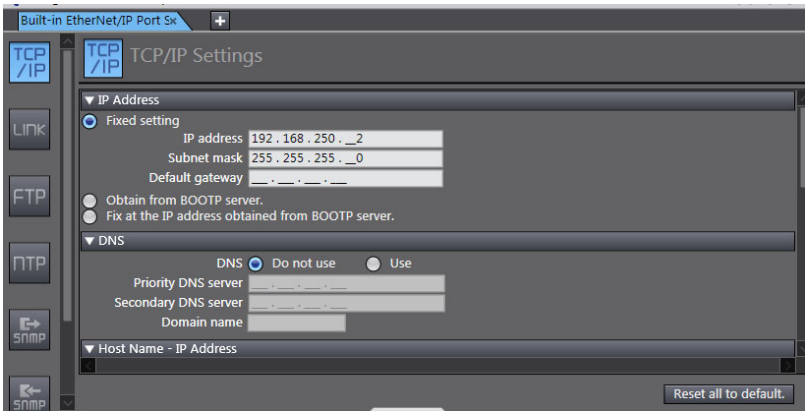


Fig. 7-2 IP Address Setting

7.2 Setting up tags in the NJ Controller

The NJ supports tag based I/O structures and these tags need to be generated in order for the OS32C to communicate correctly with the NJ controller via EtherNet/IP.

Under the **Programming** tab in the menu tab select **Data** and then **Data Types**.

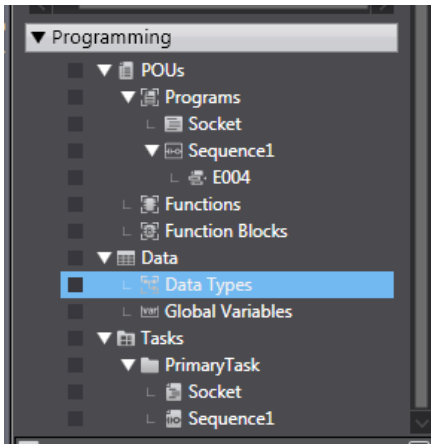


Fig. 7-3 Data Types

In the window that appears, right click on "Name" and select **Create New Data Type**.

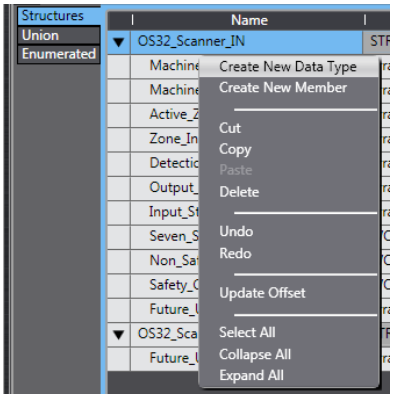


Fig. 7-4 Create New Data Type

Two new data types will need to be created, "**OS32C_Scanner_IN**" and "**OS32C_Scanner_OUT**", along with the Base Type "**STRUCT**". The tags will look like the following screenshot:

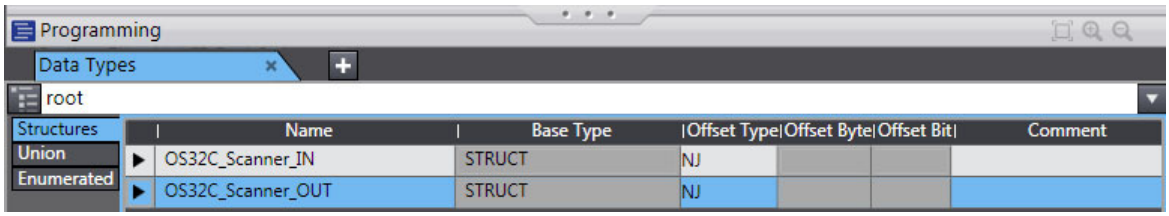
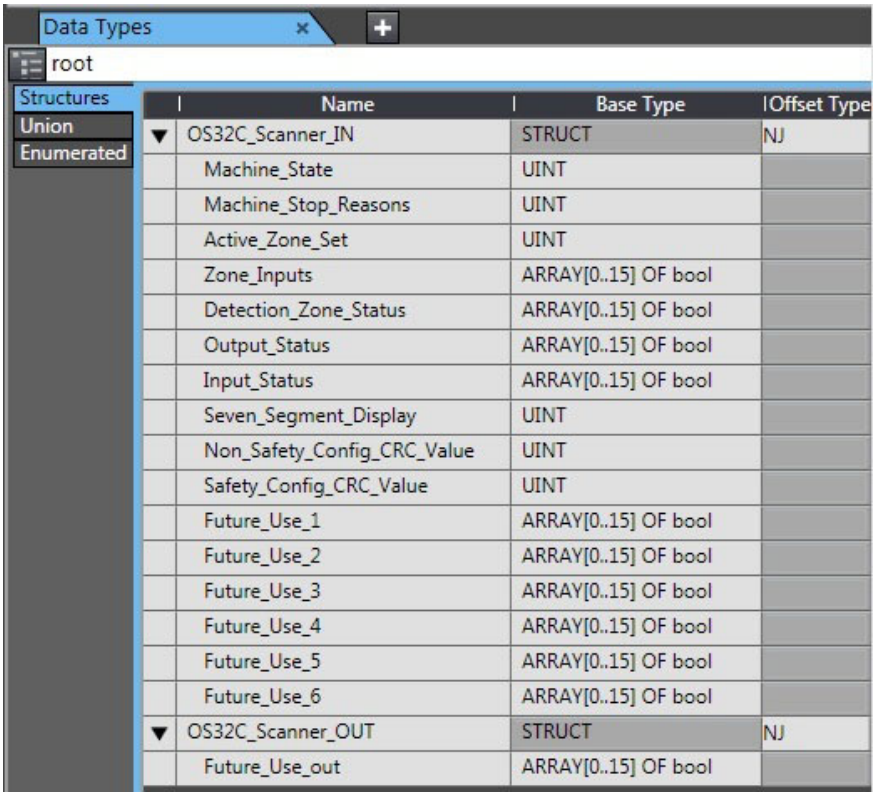


Fig. 7-5 OS32C IN and OUT Structure Data Types

Once the base tag has been created, assembly I/O data needs to be added to each tag. Right click on the tag name and select **Create New Member**. Repeat this until all I/O data is created as shown in the figure below:



Name	Base Type	Offset Type
OS32C_Scanner_IN	STRUCT	NJ
Machine_State	UINT	
Machine_Stop_Reasons	UINT	
Active_Zone_Set	UINT	
Zone_Inputs	ARRAY[0..15] OF bool	
Detection_Zone_Status	ARRAY[0..15] OF bool	
Output_Status	ARRAY[0..15] OF bool	
Input_Status	ARRAY[0..15] OF bool	
Seven_Segment_Display	UINT	
Non_Safety_Config_CRC_Value	UINT	
Safety_Config_CRC_Value	UINT	
Future_Use_1	ARRAY[0..15] OF bool	
Future_Use_2	ARRAY[0..15] OF bool	
Future_Use_3	ARRAY[0..15] OF bool	
Future_Use_4	ARRAY[0..15] OF bool	
Future_Use_5	ARRAY[0..15] OF bool	
Future_Use_6	ARRAY[0..15] OF bool	
OS32C_Scanner_OUT	STRUCT	NJ
Future_Use_out	ARRAY[0..15] OF bool	

Fig. 7-6 OS32C IN and OUT Structure Members

7.3 Setting Tags into Global Variable Section

Once the OS32C EtherNet/IP tags and I/O data have been created in the NJ, a global variable will have to be generated for every laser scanner that the NJ will establish EtherNet/IP communications with.

Click on the **Global Variables** option in the project work space. Right click in the global variable window and select **Create New** and a new variable will be created.

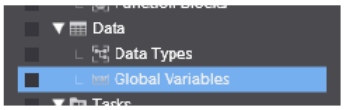


Fig. 7-7 Global Variables

Fig. 7-8 Create New Global Variable

Give the variable a name and choose the structure name from the variable type. It is also necessary to define the tag as an input or output on the network. This will need to be done once for the produced variable and once for the consumed variable.

The OS32C produced and consumed tags are shown below:

Name	Data Type	Initial Value	AT	Retain	Constant	Network Publish
OS32C_Out_Node7	OS32C_Scanner_OUT			☐	☐	Output
OS32C_In_Node7	OS32C_Scanner_IN			☐	☐	Input

Fig. 7-9 OS32C Produced and Consumed Tags

Notice that the OS32C produced information is named as an input for the tag creation. This is because when the OS32C produces data, it is consumed by the NJ5. Therefore, it acts like as an input to the NJ5. The OS32C consumed information is produced (or output) by the NJ5, so the network publish type is set to output.

7.4 Exporting Tags to Network Configurator

The tags that have been created in the NJ can now be exported to be used by the Network Configurator software. Doing this will ensure the tag I/O structure will match.

Under the **Tools** menu in the main window select **Export Global Variables** then select **Network Configurator**:

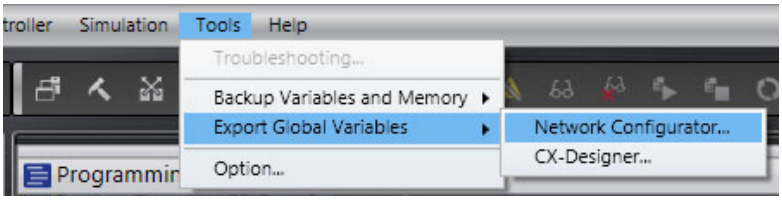


Fig. 7-10 Export Global Variables

This will save the data in an Excel spreadsheet as a .csv file to be imported by the Network Configurator software.

7.5 Configuring the EtherNet/IP Network

To configure the Ethernet /IP connection to the NJ, start up the Network Configurator software and create a new EtherNet/IP program.

Drag and drop the NJ5 and the OS32C from the hardware list onto the EtherNet/IP network in the Network Configurator. Ensure the IP addresses match the hardware IP settings.

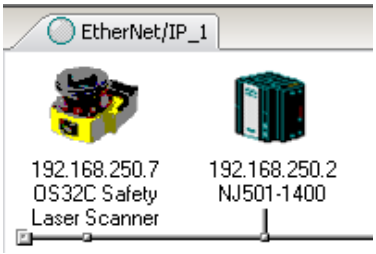


Fig. 7-11 Add NJ5 and OS32C to the EtherNet/IP Network

Double click on the NJ5 and select the **Tag Sets** tab. Click the **To/From** button and select **Import From File**.

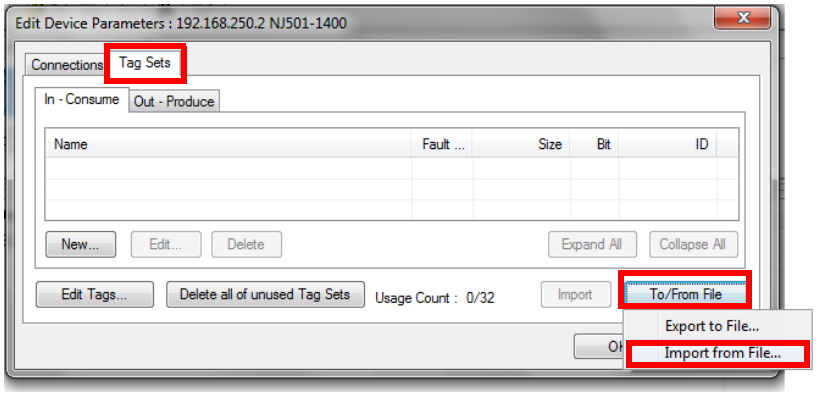


Fig. 7-12 Import Tag Sets from File

Browse to the .csv file that contains the network tags that were exported from Sysmac Studio, select it and press **OK**. When prompted, click **Yes** to import the symbols. The tags will now appear on the In-Consume and Out-Produce tabs. When complete, the **In - Consume** and **Out - Produce** tabs will appear as follows:

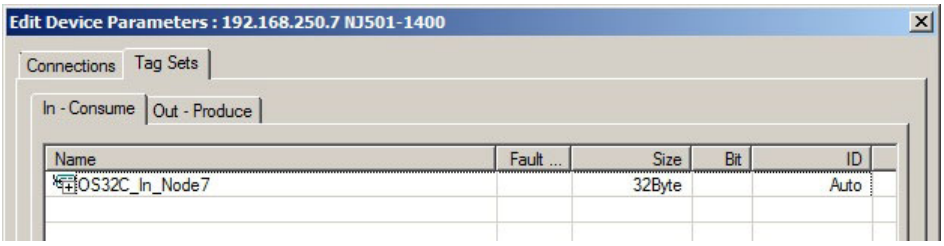


Fig. 7-13 In - Consume Tab

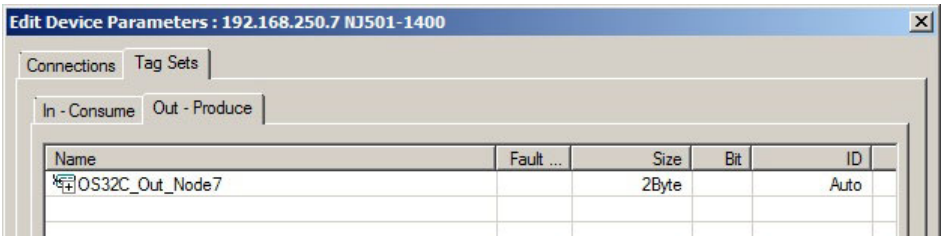


Fig. 7-14 Out - Produce Tab

Select the **Connections** tab. The OS32C module will appear under the list of unregistered devices. Select **OS32C module** and press the **down arrow** to move the OS32C from the unregistered device list to the registered device list.

Once the OS32C is shown in the registered device list, double click on the OS32C which will bring up an Edit Connection window. Match the tag names on the left hand side up with the input and the output assemblies on the right hand side. In this example, only one tag will be in the list for each of the connections. Use **200** for the RPI value. When done, the settings will look like the screenshot below.

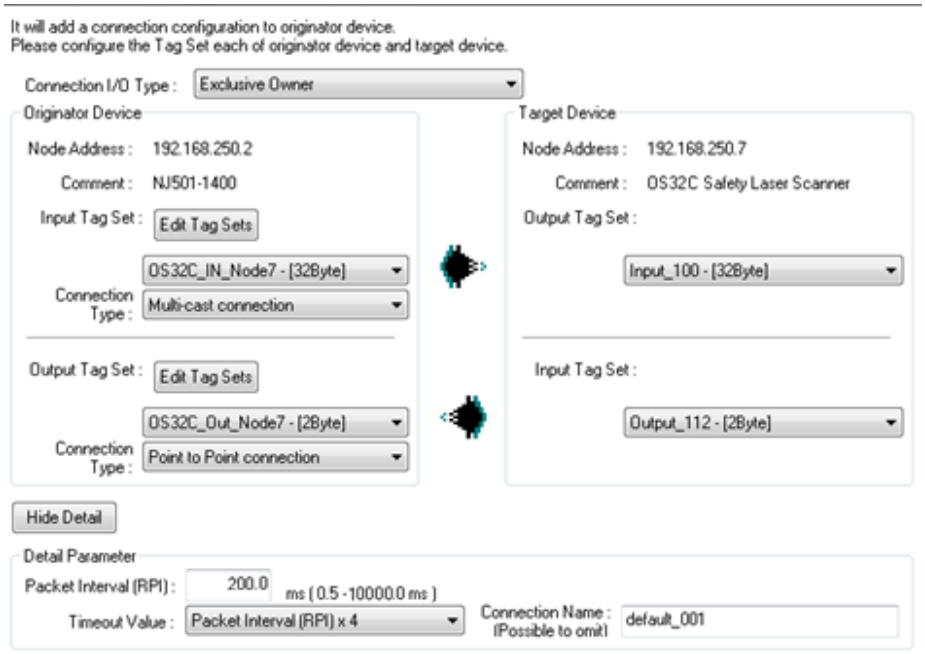


Fig. 7-15 Edit Connection Window

Press the **Regist** button at the bottom of the window then press the **Close** button. Lastly, click **OK** on the **Edit Device Parameters** page.

The network will now look like the screenshot shown below. The arrow (highlighted in the red box) shows that the node is now registered to the NJ5.

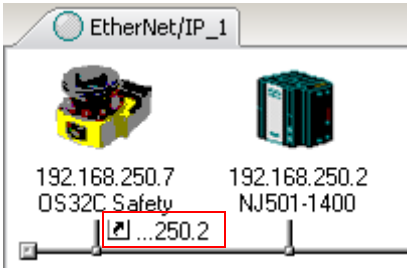


Fig. 7-16 OS32C Is Registered to NJ5

7.6 Downloading EtherNet/IP Configuration to the NJ

Connect the NJ5 to the computer using the USB cable.

In the Network Configurator software, choose the **Option** pull-down menu then choose **Select Interface**, then choose **NJ Series USB Port**.

From the **Network** menu, select **Connect**.

Click on **TCP:2** and then press **OK**.

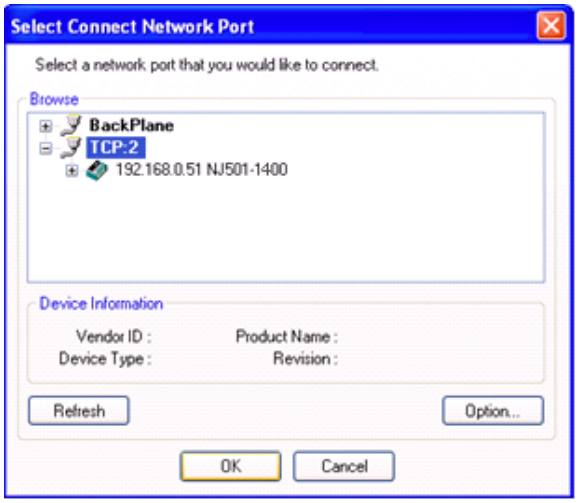


Fig. 7-17 Select Network Port

Select **Use the existing network**, and click **OK**.

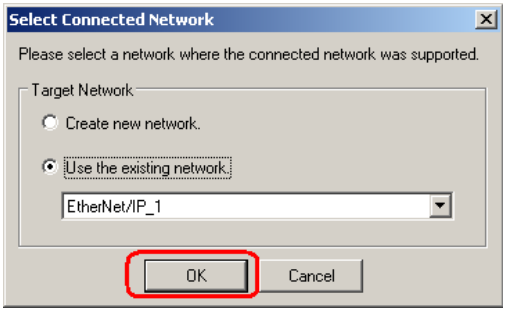


Fig. 7-18 Use Existing Network

Right-click the NJ5 icon, select **Parameter**, then choose **Download**.

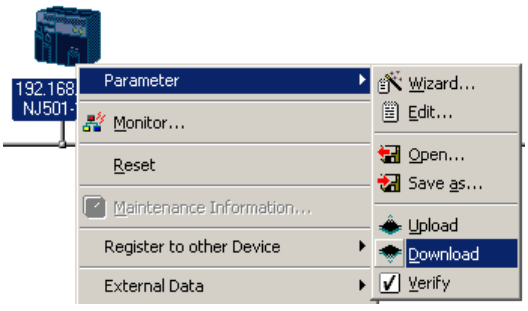


Fig. 7-19 Download to NJ5

To download to the NJ5 without changing the PLC to Program mode, click **Download with Current Mode**.

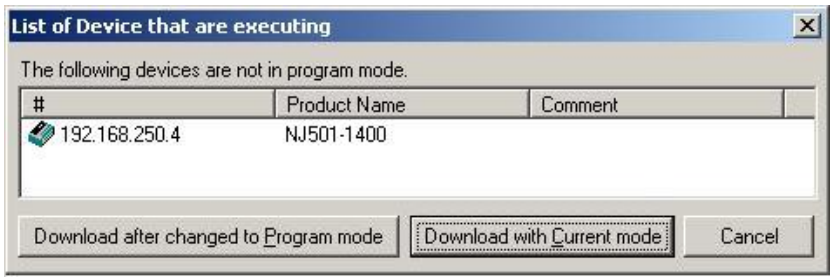


Fig. 7-20 Download with Current Mode

When the download is complete, click **OK**. Setup is now complete.

8. Setup for multiple OS32Cs or multiple PLCs

The OS32C with EtherNet/IP can be polled in a few different ways. The laser scanner can have multiple EtherNet/IP master devices polling it for information or one EtherNet/IP master can be set up to poll multiple scanners.

8.1 One PLC Polling Multiple OS32Cs

One master device can poll multiple laser scanners on the network.

Open Network Configurator and add the number of needed scanners to the EtherNet/IP network. For this example there are three OS32Cs and a CJ2 PLC.

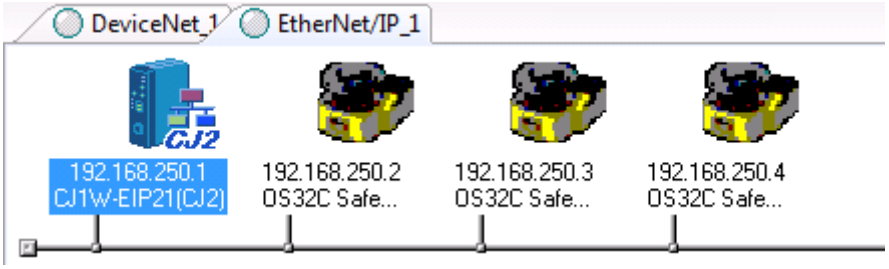


Fig. 8-1 One PLC with Multiple OS32Cs

Double-click the CJ1W-EIP21 icon and select the Tag Sets tab, select the In-Consume tab, then click the **Edit Tags** button.

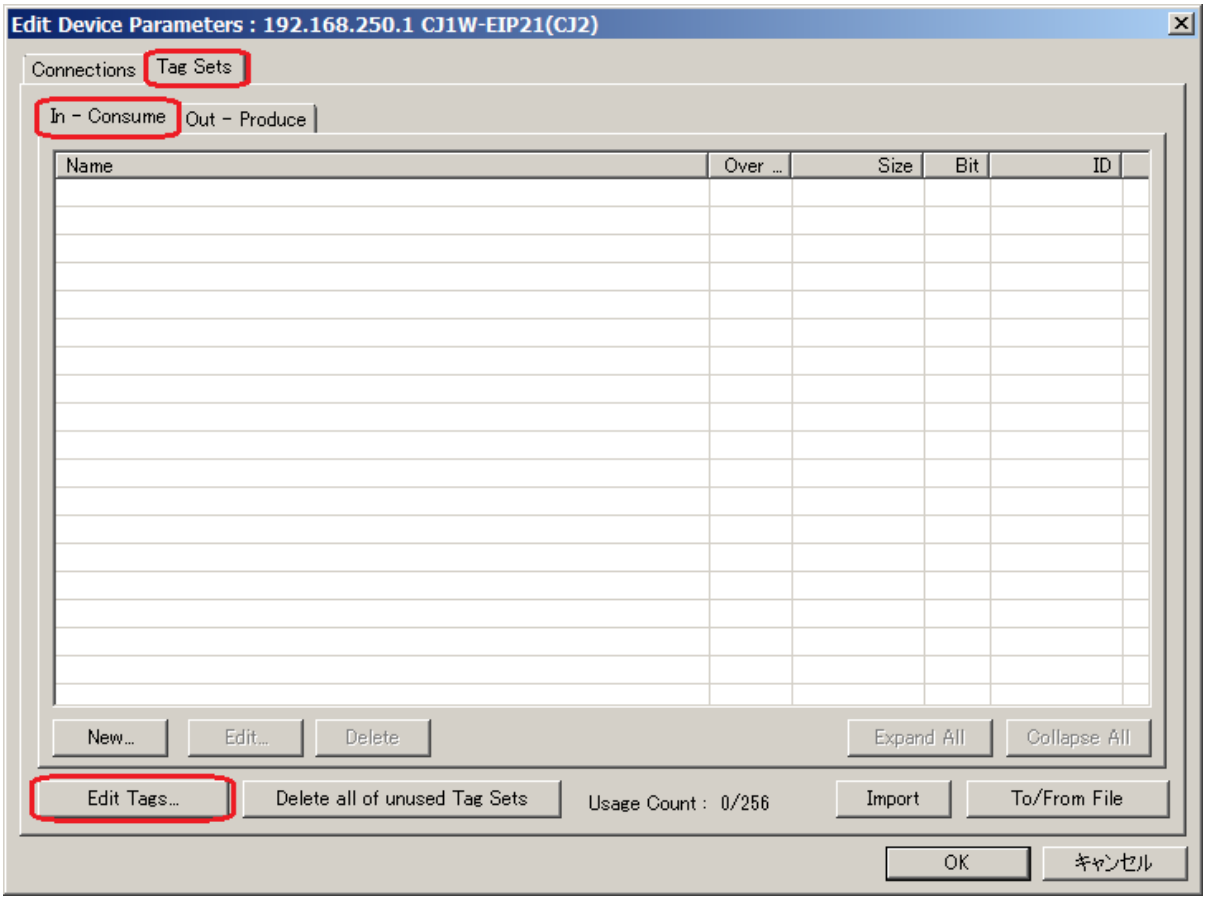


Fig. 8-2 Edit Tags

Enter **D0** for name, this field will determine the memory location written to in the PLC. In the size field enter **32** bytes, this number needs to match the number of **Target Input** bytes on the OS32C. This step will need to be repeated for the number of scanners to be registered to this master. Make sure the memory locations do not overlap.

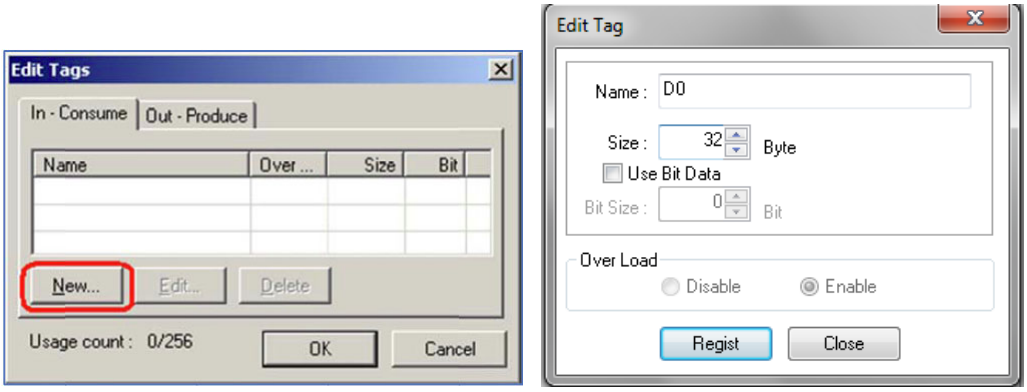


Fig. 8-3 Create Input Tags

Click **Regist** to create the tag. Repeat this for every laser scanner.

Select the **Out-Produce tab** then Click **New** to create a new tag.

Enter **D100** for name, this field will determine the memory location written to in the PLC. D100 would be location DM100 in the PLC. The size field needs to be **2** bytes as this number has to match the number of **Target Output** bytes on the OS32C.

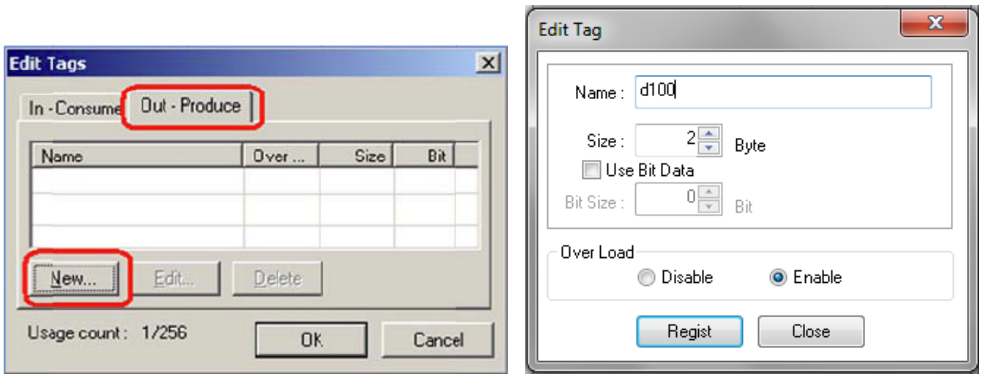


Fig. 8-4 Create Output Tags

Click **Regist** to create the tag.

When all tags have been created the tag window should look like this:

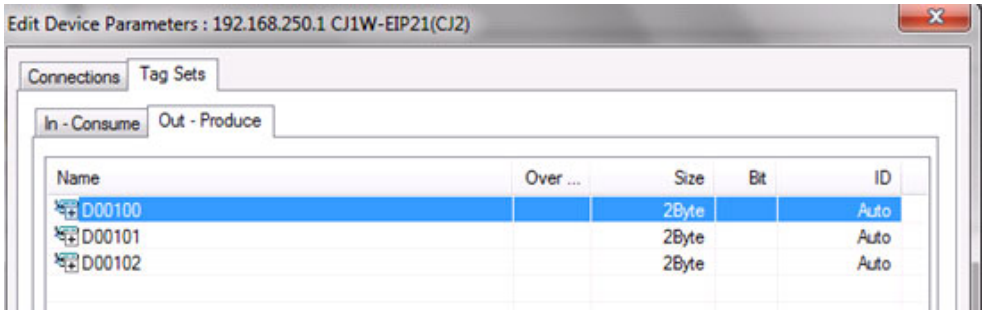


Fig. 8-5 Completed Output Tags

Select the **Connections** tab, highlight the OS32C and click the **Down Arrow** as shown below to move the device from the unregistered device list to the registered device list. Repeat for all scanners that will be slaves to this master.

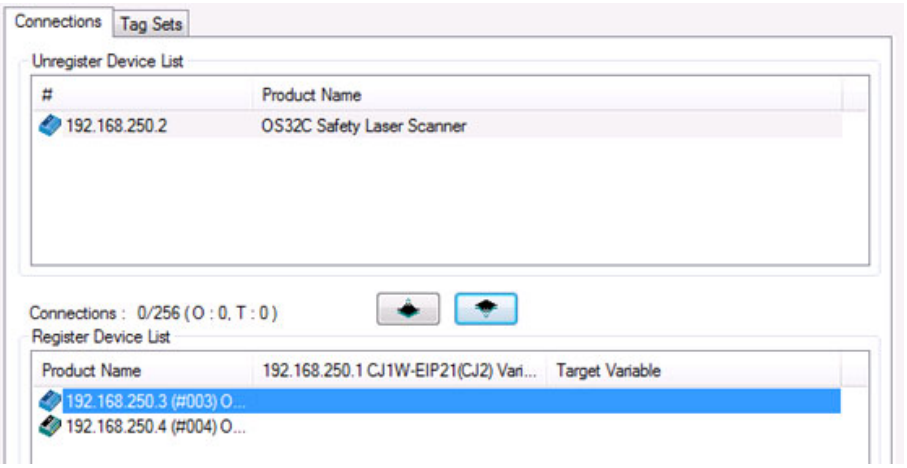


Fig. 8-6 Register Each OS32C to PLC

Double click on the scanner in the registered device window to configure each scanner's I/O location in the PLC. Notice that there will be three different Input and Output Tags to choose from. Select the DM location in the PLC where the data from the scanner will be written to. This step is needed for every scanner.

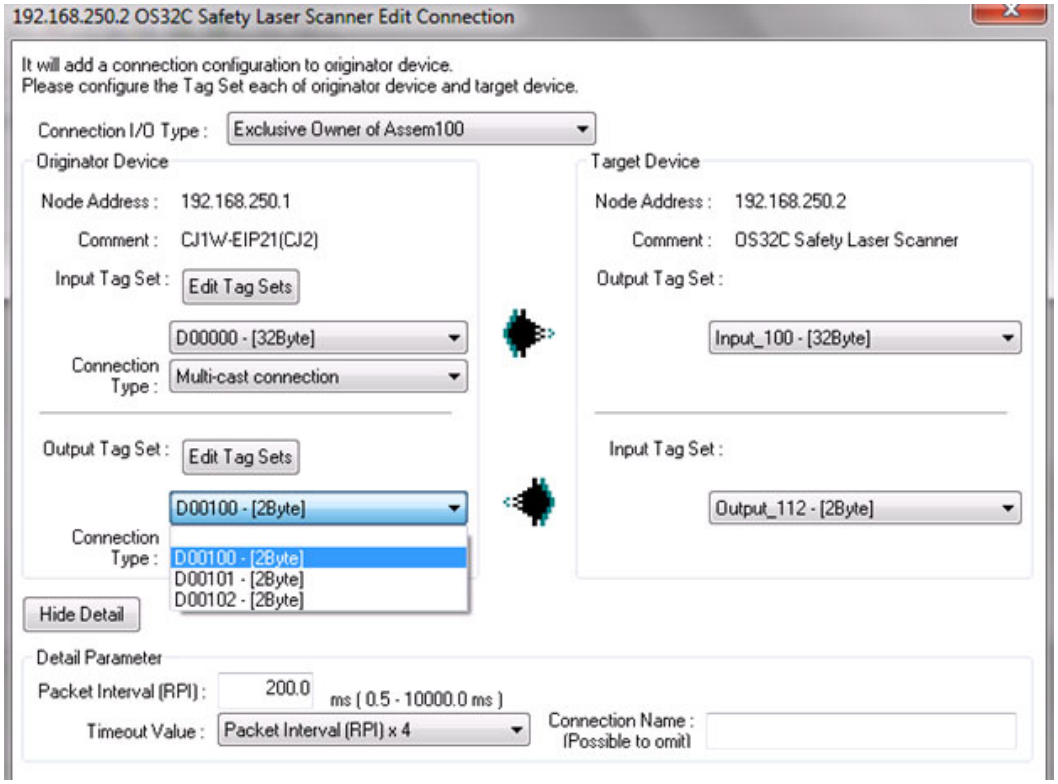


Fig. 8-7 Edit Connection Window

When all scanners have been configured the screen should look like the following figure:

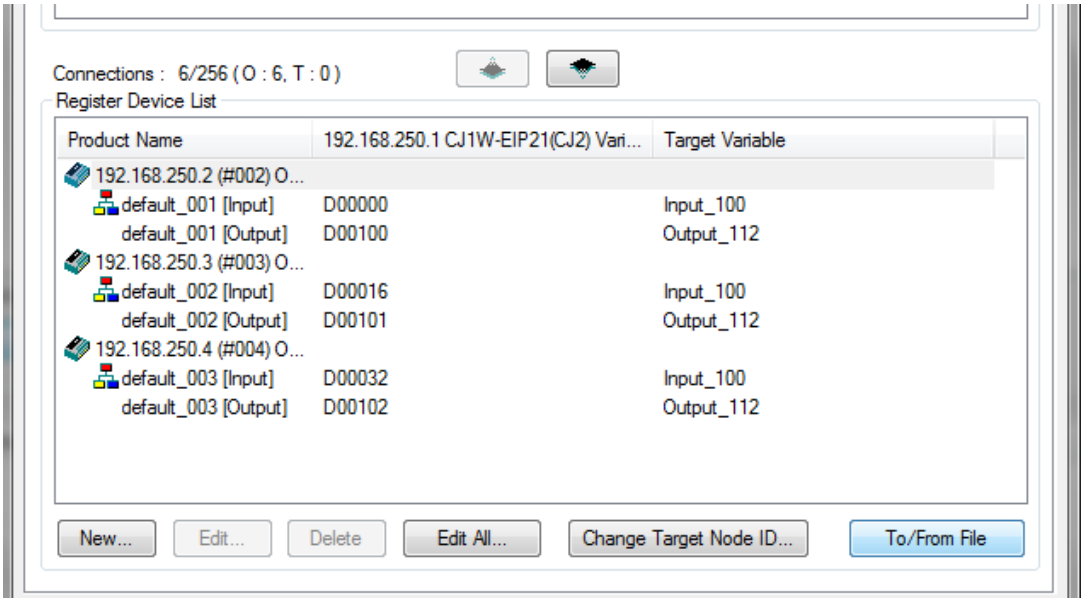


Fig. 8-8 All Scanners Configured

All three laser scanners are now registered to the CJ2:

Fig. 8-9 Registration Complete

8.2 Multiple PLCs Polling One OS32C

The setup for multiple devices polling a single OS32C is very similar to the setup for one device polling multiple scanners. The key point with this type of configuration is only one device can be the **Exclusive Owner** of the scanner while all other master devices need to be configured as **Listen only** or **Input Only**.

Input Only Example

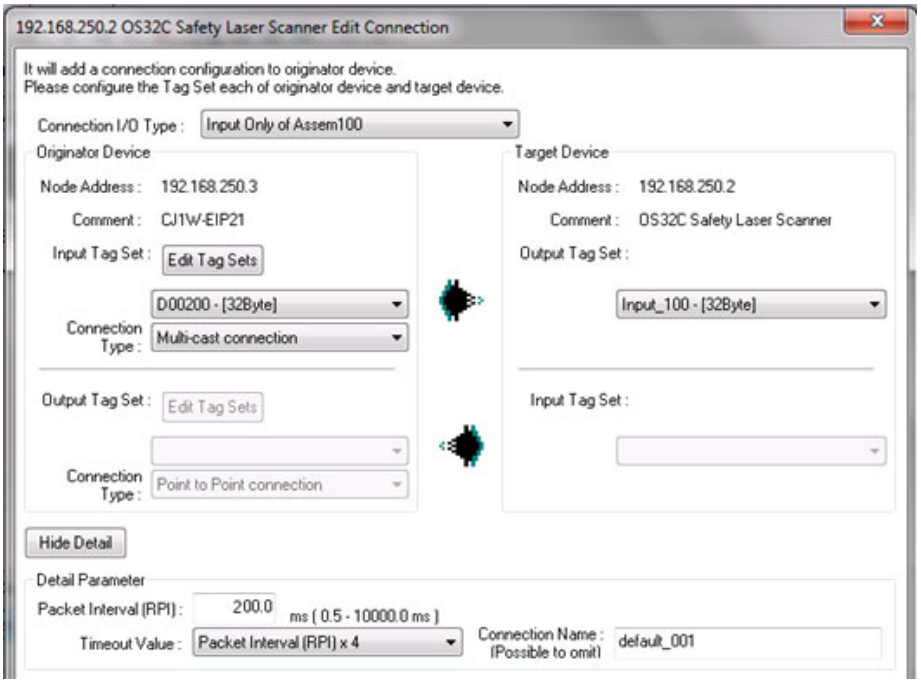


Fig. 8-10 Input Only Example

Listen Only Example

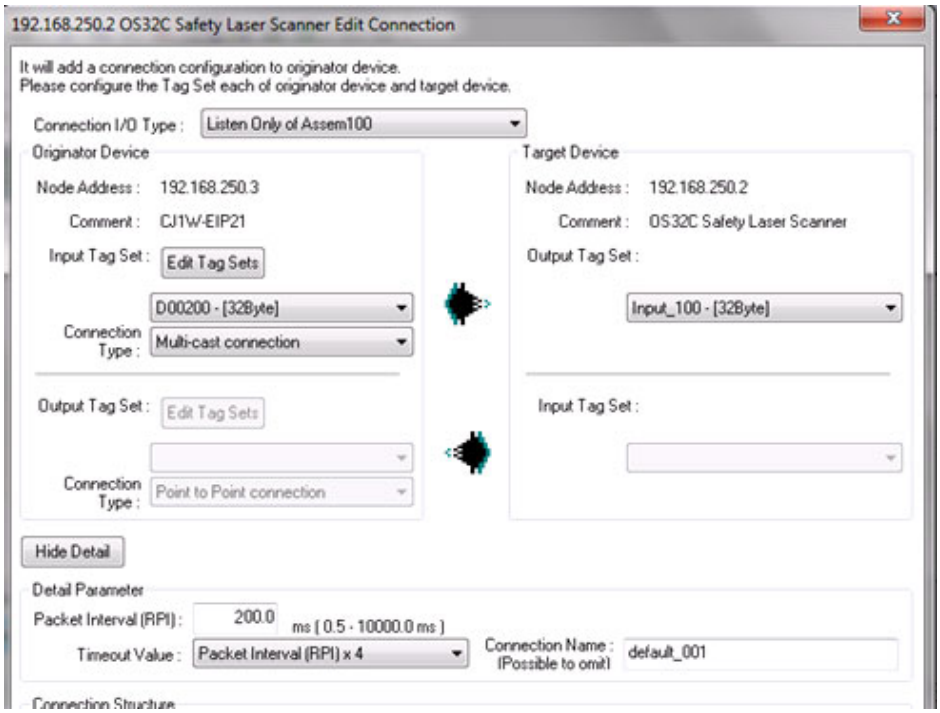


Fig. 8-11 Listen Only Example

Both of these methods work for this type of configuration but note the differences between these two options that should be taken in account:

1. Input Only: This type of configuration will generate a message to poll the scanner as the RPI set rate, this may be an issue if too many devices are requesting data from the scanner.

2. Listen Only: This type of configuration will only listen to messages generated by a master on the network; it will not generate its own. This is good to limit generated messages on the network but if the master device stops polling the sensor all other devices will stop as well.

9. Establishing communications with a computer based device

This section provides general information for setting up communication connections between the OS32C and a computer based device. This section provides information from the EtherNet/IP specification necessary to communicate with the OS32C within a single EtherNet/IP subnet/network. When used in a standard Ethernet network, communications across subnet/networks is also possible using the communication formats provided in this manual.

9.1 EtherNet/IP Command Protocol

All electronic datagram command payloads contain a fixed-length header of 24-bytes followed by an optional data portion. The total datagram payload length is limited to 65535 bytes for TCP/IP messages and 1500 bytes for UDP/IP messages. Table 10 below outlines the basic structure for EtherNet/IP commands.

9.1.1 Table 10: EtherNet/IP Datagram Header - Command Format

Structure	Field Name	Data Type	Data Size	Field Value
Encapsulation Header	Command	UINT	2 bytes	Encapsulation command number.
	Length	UINT	2 bytes	Length, in bytes, of the command specific data portion of the message following the encapsulation header.
	Session Handle ID	UDINT	4 bytes	Session identification used for configuration and run-time monitoring.
	Status	UDINT	4 bytes	Status code used in reply messages.
	Sender Context Data	ARRAY of 8 octets	8 bytes	Information pertinent only to the sender of an encapsulation command.
	Command options	UDINT	4 bytes	Optional command flags.
Command specific data	Command data	ARRAY of 0 to 65511 octets	0 to 65511 bytes	The encapsulation data portion of the message is required only for certain commands.

9.2 EtherNet/IP Command List

EtherNet/IP provides fundamental commands for accessing all scanner data as outlined in Table 11 below.

9.2.1 Table 11: EtherNet/IP Command List

Command Name	Command Code	Description
NOP	0x0000	A non-operational command used during TCP communications to verify TCP connections (may be sent only using TCP).
List Services	0x0004	List the scanners EtherNet/IP services available (may be sent using either UDP or TCP).
List Identity	0x0063	List the scanners EtherNet/IP identity, vendor ID, device ID, serial number and other information (may be sent using either UDP or TCP).
List Interfaces	0x0064	List the scanners EtherNet/IP assembly and input/output object interfaces available (may be sent using either UDP or TCP).
Register Session	0x0065	Open and register a communication session with the scanner (may be sent only using TCP).

Command Name	Command Code	Description
Un-Register Session	0x0066	Close the registered communication session with the scanner (may be sent only using TCP).
SendRRData	0x006F	Send a request/reply command to the scanner along with a sub-command and optional data (may be sent only using TCP).

If the command requests are successfully registered with the scanner, the Status field shall be zero (0). If the command requests are not successfully registered, the Status field shall contain the one of the following error codes.

9.2.2 Table 12: EtherNet/IP Status Error Code List

Error Codes	Description
0x0000	No error in command request.
0x0001	Invalid command used in request.
0x0002	Insufficient memory in target device.
0x0003	Incorrect data used in request.
0x0064	Invalid session handle used in request.
0x0065	Invalid command length used in request.
0x0069	Unsupported Protocol Version used in request.

9.3 EtherNet/IP Command Specific Data

Command specific data provided by the scanner must follow the CIP Common Packet Format as shown in Table 13 below.

9.3.1 Table 13: EtherNet/IP Common Packet Format (CPF)

Field Name	**Data Type**				**Description**
Item count	UINT				Number of items to follow
Item #1	Item Structure	**Field Name**	**Data Type**	**Description**	1st Common Packet Format (CPF) item
		Type ID	UINT	Type of item encapsulated	
		Length	UINT	Length in bytes of the Data Field	
		Data	Variable	The data (if length >0)	
Item #2	Item Structure (see above)				2nd CPF item
------	------				------
Item #n	Item Structure (see above)				nth CPF item

9.4 EtherNet/IP Commands

9.4.1 List Identity Command

A connection originator may use the List Identity command to locate and identify the scanner. This command shall be sent as a unicast message using TCP or UDP, or as a broadcast message using UDP and does not require that a session be established. The reply shall always be sent as a unicast message.

When received as a broadcast message, the receiving device shall delay for a pseudo-random period of time prior to sending the reply as specified in section 2-4.2.3 of the EtherNet/IP standard. Delaying before sending the reply helps to spread out any resulting ARP requests and List Identity replies from target devices on the network.

9.4.2 Table 14: List Identity Command Request

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x0063	UINT	2 bytes	List Identity Command
	Length	0	UINT	2 bytes	Length of command specific data.
	Session Handle ID	Any value	UDINT	4 bytes	Any value (ignored by target).
	Status	0	UDINT	4 bytes	0
	Sender Context Data		UINT	2 bytes	Maximum Response Delay in milliseconds.
		0	ARRAY[6]	6 bytes	Reserved shall be ignored by receiver, values shall be 0.
	Command options	0	UDINT	4 bytes	0

9.4.3 Table 15: List Identity Command Reply

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x0063	UINT	2 bytes	List Identity Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Any value (ignored by receiver).
	Status	0	UDINT	4 bytes	Error status equals 0x0000 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from the original request. Length of 8. Maximum Response Delay in milliseconds.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Item Count	1	UINT	2 bytes	
	Item ID	0x0C	UINT	2 bytes	CIP Identity Object.
	Item Length	2	UINT	2 bytes	Number of bytes in item.
	ARRAY of octet				See Table 16: EtherNet/IP Identity Object Parameters

9.4.4 Table 16: EtherNet/IP Identity Object Parameters

Parameter Name	Data Type	Description
Encapsulation Protocol Version	UINT	Encapsulation Protocol Version supported (also returned with Register Session reply).
Socket Address	Structure of	
	INT	sin_family (big-endian)
	UINT	sin_port (big-endian)
	UDINT	sin_addr (big-endian)
	ARRAY[8]	UINT8 [8] sin_zero (length of 8) (big-endian)
Vendor ID	UINT	Device manufacturers Vendor ID
Device Type	UINT	Device Type of product
Product Code	UINT	Product Code assigned with respect to device type
Revision	ARRAY[2]	Device revision
Status	WORD	Current status of device
Serial Number	UDINT	Serial number of device
Product Name	ARRAY[32]	Human readable description of device
State	UINT8	Current state of device

9.4.5 Register Scanner Session Command

The register session procedure is a single step process which only involves obtaining a TCP session handle from the scanner using the TCP port. Once the session handle is obtained it can be used for all subsequent TCP and UDP I/O communications. Standard UDP communications using the List Identity or List Interface commands do not require a session handle.

9.4.5.1 Required Sequence:

- Request a session handle from the scanner using the Register Session command.

9.4.6 Table 17: Register Session Command Request

Datagram part	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x0065	UINT	2 bytes	Request a session handle
	Length	4	UINT	2 bytes	Length of command specific data.
	Session Handle ID	0	UDINT	4 bytes	Any value (ignored by scanner)
	Status	0	UDINT	4 bytes	
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Any value. Length of 8.
	Command options	0	UDINT	4 bytes	0
Command Specific Data	Protocol Version	1	UINT	2 bytes	
	Option flags	0	UINT	2 bytes	

9.4.7 Table 18: Register Session Command Reply

Telegram-Datagram part	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x0065	UINT	2 bytes	Request a session handle
	Length	4	UINT	2 bytes	Length of command specific data.

Telegram-Datagram part	Field Name	Field Value	Data Type	Data Size	Comments
	Session Handle ID		UDINT	4 bytes	Session Handle ID returned by the scanner.
	Status	0	UDINT	4 bytes	Error status equals 0x0000 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	0
Command Specific Data	Protocol Version		UINT	2 bytes	Version from Register Session request if supported. If the request version is not supported, contains the highest version supported.
	Option flags		UINT	2 bytes	Option flags from Register Session request if supported. If the request Option flags are not supported, contains the supported Option flags.

The Session Handle field of the header shall contain a scanner generated identifier that the client application shall save and insert in the Session Handle field of the header for all subsequent command requests. This field shall be valid only if the Status field is zero (0). If the client application was successfully registered with the scanner, the Status field shall be zero (0). If the client application was not successfully registered, the Status field shall contain the appropriate error code, as follows:

•Error code 0x0001 shall be returned if the client application attempts to register more than 1 active session on the same TCP connection.
•Error code 0x0002 shall be returned if the scanner does not have sufficient resources to register the client application.
•Error code 0x0069 shall be returned for Protocol Version or Options mismatches, as described below:

The Protocol Version field shall equal the requested version if the client application was successfully registered. If the scanner does not support the requested version of the protocol,

•the session shall not be created;
•the Status field shall be set to 'unsupported encapsulation protocol' (0x0069);
•the scanner shall return the highest supported version in the Protocol Version field;

9.4.8 Un-Register Scanner Session Command

Either the client application or the scanner may send this command to terminate the session using the TCP port. The receiver shall initiate a close of the underlying TCP/IP connection when it receives this command. The session shall also be terminated when the connection between the client application and scanner is terminated. The receiver shall perform any other associated cleanup required on its end. There shall be no reply to this command.

9.4.8.1 Required Sequence:

- After a request of a session handle from the scanner using the Register Session command (see section 9.4.5).
- Logoff the scanner using the current session handle.

9.4.9 Table 19: Un-Register Session Command Request

Telegram-Datagram part	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x0066	UINT	2 bytes	Terminate the Session.
	Length	0	UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Value of current Session Handle ID.
	Status	0	UDINT	4 bytes	
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Any value. Length of 8 (ignored by scanner).
	Command options	0	UDINT	4 bytes	0

The receiver shall not reject the Un-Register Session due to unexpected values in the encapsulation header (invalid Session Handle, non-zero Status, non-zero Options, or additional command data). In all cases the TCP connection shall be closed.

9.4.10 SendRRData Command

The SendRRData command is used to send an encapsulated request/reply packet between the originator and target scanner using the TCP port, where the originator initiates the command. The actual request/reply packets shall be encapsulated in the data portion of the message and are the responsibility of the target scanner and originator.

9.4.11 Table 20: SendRRData Command Request

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle ID received in the Register Session reply message.
	Status	0	UDINT	4 bytes	0
	Sender Context Data	0	ARRAY[8]	8 bytes	Reserved shall be ignored by receiver, values shall be 0.
	Command options	0	UDINT	4 bytes	0
Command Specific Data	Interface Handle ID	0	UDINT	4 bytes	Interface Handle selected by originator (PLC or PC).
	Timeout	0	UINT	2 bytes	0 to 65535 in seconds.
	Encapsulation packet				See Common Packet Format specification in section 9.3 and section 9.4.12 Table 21: Get Single Attribute Service Code Request CPF Data.

9.4.12 Table 21: Get Single Attribute Service Code Request CPF Data

Field Name	Sub-Field Name	Field Value	Data Type	Data Size	Comments
Encapsulation packet	Item count	2	UINT	2 bytes	Number of items to follow
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	8	UINT	2 bytes	Data Item Length

Field Name	Sub-Field Name	Field Value	Data Type	Data Size	Comments
	Data Item 1	Service Code #	UINT8	1 byte	Get or Set Single Attribute Request
	Data Item 2	0x03	UINT8	1 byte	Request Path Size in Words
	Data Item 3	0x20	UINT8	1 byte	Logical Class Type
	Data Item 4	Class #	UINT8	1 byte	Logical Class Number
	Data Item 5	0x24	UINT8	1 byte	Logical Instance Type
	Data Item 6	Instance #	UINT8	1 byte	Logical Instance Number
	Data Item 7	0x30	UINT8	1 byte	Logical Attribute Type
	Data Item 8	Attribute #	UINT8	1 byte	Logical Attribute Number

9.4.13 Table 22: SendRRData Command Reply to a Get Single Attribute Request

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle received in the Register Session reply message.
	Status	0	UDINT	4 bytes	Error status equals 0x0000 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Interface Handle ID	0	UDINT	4 bytes	Interface Handle selected by originator (PLC or PC).
	Timeout	0	UINT	2 bytes	0 to 65535 in seconds.
Encapsulation Packet	Item count	2	UINT	2 bytes	Number of items to follow
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	8 + data length	UINT	2 bytes	Data Item Length
	Data Item 1	Response	UINT8	1 byte	Get or Set Single Attribute Response Code
	Reserved field	0	UINT8	1 byte	Reserve field not used.
	Data Item 2	Status	UINT8	1 byte	Get or Set Single Attribute error status code.
	Data Item 3	Additional Status Size	UINT8	1 byte	Number of additional error status information in 16-bit words .
Attribute Data	Data Array		ARRAY[]	Length of data	Attribute Data if any.

9.4.14 Table 23: Set Single Attribute Service Code Request CPF Data

Field Name	Sub-Field Name	Field Value	Data Type	Data Size	Comments
Encapsulation packet	Item count	2	UINT	2 bytes	Number of items to follow
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	8 + data length	UINT	2 bytes	Data Item Length

Field Name	Sub-Field Name	Field Value	Data Type	Data Size	Comments
	Data Item 1	Service Code #	UINT8	1 byte	Get or Set Single Attribute Request
	Data Item 2	0x03	UINT8	1 byte	Request Path Size in Words
	Data Item 3	0x20	UINT8	1 byte	Logical Class Type
	Data Item 4	Class #	UINT8	1 byte	Logical Class Number
	Data Item 5	0x24	UINT8	1 byte	Logical Instance Type
	Data Item 6	Instance #	UINT8	1 byte	Logical Instance Number
	Data Item 7	0x30	UINT8	1 byte	Logical Attribute Type
	Data Item 8	Attribute #	UINT8	1 byte	Logical Attribute Number
	Data Array		ARRAY[]	Length of attribute data	Attribute Data

9.4.15 Table 24: SendRRData Command Reply to a Set Single Attribute Request

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle received in the Register Session reply message.
	Status	0	UDINT	4 bytes	Error status equals 0x0000 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Interface Handle ID		UDINT	4 bytes	Interface Handle selected by originator (PLC or PC).
	Timeout	0	UINT	2 bytes	0 to 65535 in seconds.
Encapsulation Packet	Item count	2	UINT	2 bytes	Number of items to follow
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	8 + data length	UINT	2 bytes	Data Item Length
	Data Item 1	Response	UINT8	1 byte	Get or Set Single Attribute Response Code
	Reserved field	0	UINT8	1 byte	Reserve field not used.
	Data Item 2	Status	UINT8	1 byte	Get or Set Single Attribute error status code.
	Data Item 3	Additional Status Size	UINT8	1 byte	Number of additional error status information in 16-bit words .

The SendRRData command is also used to establish a UDP I/O connection between the originating (PC or PLC) and the target (OS32C) devices. Section 9.4.16 Table 25: Large Forward Open Request Encapsulation Packet describes the common packet format used along with the SendRRData command in order to initiate a streaming UDP I/O connection from the OS32C scanner.

9.4.16 Table 25: Large Forward Open Request Encapsulation Packet

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle received in the Register Session reply message.
	Status	0	UDINT	4 bytes	Error status equals 0x0000 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Interface Handle ID		UDINT	4 bytes	Interface Handle selected by originator (PLC or PC).
	Timeout	0	UINT	2 bytes	0 to 65535 in seconds.
Encapsulation packet	Item count	2	UINT	2 bytes	Number of items to follow
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	(ex. 54)	UINT	2 bytes	Data Item Length, length of data to follow below.
	Data Item 1	0x5B	UINT8	1 byte	Large Forward Open Request
	Data Item 2	0x02	UINT8	1 byte	Request Path Size in Words
	Data Item 3	0x20	UINT8	1 byte	Logical Class Type
	Data Item 4	0x06	UINT8	1 byte	Logical Class Request
	Data Item 5	0x24	UINT8	1 byte	Logical Instance Type
	Data Item 6	0x01	UINT8	1 byte	Logical Instance Request
	Data Item 7	0x06	UINT8	1 byte	Priority Time Tick
	Data Item 8	(ex. 880)	UINT8	1 byte	Timeout Ticks (ms)
	Data Item 9	0	UDINT	4 bytes	O->T identification number
	Data Item 10	Any	UDINT	4 bytes	T->O identification number, use a random number here.
	Data Item 11	Any	UINT	2 bytes	Connection serial number.
	Data Item 12	405	UINT	2 bytes	Vendor identification number, use of the OSTI vendor ID is acceptable here.
	Data Item 13	Any	UDINT	4 bytes	Originator serial number
	Data Item 14	0	UINT8	1 byte	Connection Timeout Multiplier (default = 0)
	Data Item 15	0	UINT8	1 byte	Reserved
	Data Item 16	0	UINT8	1 byte	Reserved
	Data Item 17	0	UINT8	1 byte	Reserved
	Data Item 18	Any (ex.880000)	UDINT	4 bytes	O->T repetitive packet interval (RPI) in microseconds (us).
	Data Item 19	(ex.0x48000008)	UDINT	4 bytes	O->T connection parameters. See EDS file.
	Data Item 20	Any (ex.80000)	UDINT	4 bytes	T->O repetitive packet interval (RPI) in microseconds (us).
	Data Item 21	(ex.0x48000588)	UDINT	4 bytes	T->O connection parameters. See EDS file.
	Data Item 22	0x01	UINT8	1 byte	Transport Class Trigger, Client.
	Data Item 23	0x04	UINT8	1 byte	Number of words in connection path.
	Data Item 24	0x20	UINT8	1 byte	Connection path class, instance.
	Data Item 25	0x04	UINT8	1 byte	Assembly Object connection path logical class.

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
	Data Item 26	0x24	UINT8	1 byte	Connection path logical instance segment.
	Data Item 27	0x01	UINT8	1 byte	Connection path logical instance.
	Data Item 28	0x2c	UINT8	1 byte	Connection point, O->T
	Data Item 29	any (ex. 112)	UINT8	1 byte	Output assembly number See EDS file.
	Data Item 30	0x2c	UINT8	1 byte	Connection point, T->0
	Data Item 31	any (ex. 102)	UINT8	1 byte	Input assembly number See EDS file.

9.4.17 Table 26: SendRRData Command Reply to a Large Forward Open Request

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle received in the Register Session reply message.
	Status	0	UDINT	4 bytes	0 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Connection Interface Handle		UDINT	4 bytes	Connection interface handle to be used in data stream.
	Timeout Period		UINT	2 bytes	Connection timeout period to be used in timer.
Encapsulation Data	Item count	4	UINT	2 bytes	Number of items to follow.
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	Data length	UINT	2 bytes	Data Item Length, length of data to follow below.
	Data Item 1	Response (ex. 0xDB)	UINT8	1 byte	Response Code
	Reserved field	0	UINT8	1 byte	Reserve field not used.
	Data Item 2	Status	UINT8	1 byte	Status Code
	Data Item 3	Additional Status Size	UINT8	1 byte	Additional status size data. If not zero, check following error status word.
	Data Item 4		UDINT	4 bytes	O->T identification number (ID).
	Data Item 5		UDINT	4 bytes	T->O identification number (ID).
	Data Item 6		UINT	2 bytes	Connection serial number.
	Data Item 7		UINT	2 bytes	Originator Vendor ID number.
	Data Item 8		UDINT	4 bytes	Originator serial number.
	Data Item 9		UDINT	4 bytes	O->T accepted packet interval (API).
	Data Item 10		UDINT	4 bytes	T->O accepted packet interval (API).
	Data Item 11	Data Size	UINT8	1 byte	Application data size.
	Data Array		ARRAY[]	Length of data size	Data if any.

Once the UDP I/O connection has been established the target device will stream assembly data to the originating device at the accepted packet interval. Section 9.4.18 Table 27: UDP I/O connection packet below describes the format of the data stream sent by the OS32C scanner (target device).

9.4.18 Table 27: UDP I/O connection packet

Field Name	Sub-Field Name	Field Value	Data Type	Data Size	Comments
Encapsulation packet	Item count		UINT	2 bytes	Number of items to follow
	Item #1 / Type ID		UINT	2 bytes	Address Item Type ID
	Item #1 / Length		UINT	2 bytes	Address Item Length
	Item #1 / Connection ID		UDINT	4 bytes	Connection ID number
	Item #1 / Sequence ID		UDINT	4 bytes	Sequence ID number
	Item #2 / Type ID		UINT	2 bytes	Data Item Type ID
	Item #2 / Length		UINT	2 bytes	Data Item Length, length of data to follow below.
	Sequence Number		UINT	2 bytes	Packet Sequence number
	Data Array		ARRAY[]	Length of data length - 2 bytes	Assembly Object Data

To terminate the UDP I/O connection the originating device must send the SendRRData command along with the Forward Close Request. Section 9.4.19 Table 28: Forward Close Request Encapsulation Packet below describes the format of the encapsulated message sent to the OS32C scanner (target device).

9.4.19 Table 28: Forward Close Request Encapsulation Packet

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle received in the Register Session reply message.
	Status	0	UDINT	4 bytes	
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Connection Interface Handle		UDINT	4 bytes	Connection interface handle to be used in data stream.
	Timeout Period		UINT	2 bytes	Connection timeout period to be used in timer.
Encapsulation packet	Item count	2	UINT	2 bytes	Number of items to follow
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	(ex. 0x16)	UINT	2 bytes	Data Item Length, length of data to follow below.
	Data Item 1	0x4E	UINT8	1 byte	Forward Close Request
	Data Item 2	0x02	UINT8	1 byte	Number of 16-bit words in path.
	Data Item 3	0x20	UINT8	1 byte	Logical class segment
	Data Item 4	0x06	UINT8	1 byte	Logical class request - Message Router
	Data Item 5	0x24	UINT8	1 byte	Logical instance segment
	Data Item 6	0x01	UINT8	1 byte	Logical instance request.
	Data Item 7	0x06	UINT8	1 byte	Priority Time Tick
	Data Item 8	(ex. 880)	UINT8	1 byte	Timeout Ticks (ms)
	Data Item 9		UDINT	4 bytes	Originator serial number
	Data Item 10	2	UINT8	1 byte	Number of 16-bit words in path.
	Data Item 11	0	UINT8	1 byte	Reserved
	Data Item 12	0x20	UINT8	1 byte	Logical class segment
	Data Item 13	0x02	UINT8	1 byte	Logical class request - Connection Manager
	Data Item 14	0x24	UINT8	1 byte	Logical instance segment
	Data Item 15	0x01	UINT8	1 byte	Logical instance request.

9.4.20 Table 29: SendRRData Command Reply to a Forward Close Request

Datagram	Field Name	Field Value	Data Type	Data Size	Comments
EtherNet/IP Header	Command	0x006F	UINT	2 bytes	SendRRData Command
	Length		UINT	2 bytes	Length of command specific data.
	Session Handle ID		UDINT	4 bytes	Session Handle received in the Register Session reply message.
	Status	0	UDINT	4 bytes	0 if successful.
	Sender Context Data	Array[8]	ARRAY of octet	8 bytes	Value from request. Length of 8.
	Command options	0	UDINT	4 bytes	
Command Specific Data	Connection Interface Handle		UDINT	4 bytes	Connection interface handle to be used in data stream.
	Timeout Period		UINT	2 bytes	Connection timeout period to be used in timer.
Encapsulation Data	Item count	2	UINT	2 bytes	Number of items to follow.
	Item #1 / Type ID	0	UINT	2 bytes	Address Item Type ID
	Item #1 / Length	0	UINT	2 bytes	Address Item Length
	Item #2 / Type ID	0xB2	UINT	2 bytes	Data Item Type ID
	Item #2 / Length	Data length	UINT	2 bytes	Data Item Length, length of data to follow below.
	Data Item 1	Response (ex. 0xCE)	UINT8	1 byte	Response Code
	Reserved field	0	UINT8	1 byte	Reserve field not used.
	Data Item 2	Status	UINT8	1 byte	Status Code
	Data Item 4		UINT	2 bytes	Connection serial number.
	Data Item 5		UINT	2 bytes	Originator Vendor ID number.
	Data Item 6		UDINT	4 bytes	Originator serial number.
	Data Item 7	Data Size	UINT8	1 byte	Application data size. Number of 16-bit words in application data array.
	Reserved field	0	UINT8	1 byte	Reserve field not used.
	Data Array		ARRAY[]	Length of data size	Application data if any.

10.Application Examples

10.1 Runtime Monitoring using Explicit TCP/IP Request/Reply Messages

10.1.1 Network Configuration

Configure the scanners IP Address, Subnet Mask and Default Gateway using the OS32C Configuration Tool from Omron Scientific Technologies, Inc. (See OS32C User Manual).

10.1.2 Computer/PLC Configuration & Process Control Example

Using the explicit message command information provided in the scanners electronic data sheet, configure the Computer or PLC device to access the scanners EtherNet/IP Explicit Messages for monitoring measurement report data. In this example, configure the scanner's run-time monitoring attributes to monitor two sector locations within the -0.4° to 270.4° scanning field. The following information outlines the configuration and TCP/IP request/reply commands for this example.

10.1.2.1 Configure the scanner's protection and warning zones

1. Using the scanners configuration tool, configure the scanner for a limited protection zone range of 500 mm.
2. Using the configuration tool, configure the scanners Warning Zone #1 for detection zone range of 1000 mm in sector #1 (0 to 45°).
3. Using configuration tool, configure the scanners Warning Zone #2 for detection zone range of 1500 mm for sector #2 (225 to 270°).

10.1.2.2 Configure the software driver communication ports

•Initialize a UDP/IP port 44818 for performing the discovery process on all connected scanners. The List identity command can be used to determine which devices are OS32C scanners.

•Initialize a TCP/IP port 44818 for receiving and transmitting all explicit messages used to establish connections with the OS32C scanners.

•If a UDP I/O connection is required for the application, initialize the UDP/IP port 2222 for receiving and transmitting all I/O connected messages.

10.1.2.3 Establishing a TCP connection with a scanner using a known IP address

Using the appropriate socket programming language establish a TCP/IP connection to the scanner using the local computer IP address and the target scanner IP address.

10.1.2.4 Discover the identity of the scanner

Using the List Identity Command described in section 9.4.1determine the serial number and product name of the target scanner.

PC → SCANNER	
Datagram Structure	See section 9.4.2 Table 14: List Identity Command Request
Size	24 bytes
Parameters to update	EIP_UINT16 Timeout: 0x01F4 = 500 milliseconds.
Hexadecimal	**63** 00 00 00 00 00 00 00 00 00 00 00 00 F4 01 00 00 00 00 00 00 00 00 00 00

SCANNER → PC	
Datagram Structure	See section 9.4.3 Table 15: List Identity Command Reply
Size	90 bytes
List Identity Response Example	
Additional Parameters returned	EIP_UINT16 item_count = 0x0001 EIP_UINT16 item_id = 0x000C EIP_UINT16 item_length = 0x003C EIP_UINT16 encap_version = 0x0001 EIP_UINT8 sock_family[2] = 0x0002 (Big Endian) EIP_UINT8 sock_port[2] = 0x12AF (Big Endian) EIP_UINT8 sock_addr[4] = 0x0101A8C0 (Big Endian) EIP_UINT8 sock_zero[8] = 00 00 00 00 00 00 00 00 (Big Endian) EIP_UINT16 vendor_id = 0x0195 (405) EIP_UINT16 device_type = 0x002B (Generic) EIP_UINT16 product_code = 0x000C (12, OS32C) EIP_UINT8 revision[2] = 0x030B (v3.11) EIP_UINT16 current_status = 0x0000 EIP_UINT16 serial_number_low = 0x0649 (AS01609) EIP_UINT16 serial_number_high = 0x0000 EIP_UINT8 name_length = 0x1A (26) EIP_UINT8 product_name[name_length] = 4F 53 33 32 43 20 53 61 66 65 74 79 20 4C 61 73 65 72 20 53 63 61 6E 6E 65 72 (OS32C Safety Laser Scanner) EIP_UINT8 product_state = 0x03 (Operational)
Hexadecimal	**63** 00 42 00 00 00 00 00 00 00 00 00 **F4 01** 00 00 00 00 00 00 00 00 00 00 01 00 0C 00 3C 00 01 00 00 02 AF 12 C0 A8 01 01 00 00 00 00 00 00 00 00 00 95 01 2B 00 0C 00 03 0B 00 00 49 06 00 00 1A 4F 53 33 32 43 20 53 61 66 65 74 79 20 4C 61 73 65 72 20 53 63 61 6E 6E 65 72 03

10.1.2.5 Register a communication session with the scanner

Using the Register Scanner Session command described in section 9.4.5, register a session with the target device in order to obtain the session handle from the target scanner. This session handle will be used for all further communications with the scanner including terminating the communication session.

PC → SCANNER	
Datagram Structure	See section 9.4.6 Table 17: Register Session Command Request:
Size	28 bytes
Parameters to update	EIP_UINT16 length = 0x0004 (Length of command specific data) EIP_UINT16 protocol_version = 0x0001 EIP_UINT16 option_flags = 0x0000
Hexadecimal	**65** 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 00 00 00

SCANNER → PC	
Datagram Structure	See section 9.4.7 Table 18: Register Session Command Reply (Successful):
Size	28 bytes
Register Session Response Example	
Updated Parameter(s) returned	EIP_UINT32 session_handle_id = 0x00000005
Hexadecimal	**65** 00 04 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 00 00 00

10.1.2.6 Configure the scanner's measurement range format

Using the EtherNet/IP SendRRData command send an explicit TCP/IP messages to configure the range measurement format of the scanner using the following parameters.

- o Service code 16 (0x10) // Set Single Attribute
- o Object class 115 (0x73) // Vendor Specific Object Class
- o Instance 1 (0x01) // Vendor Specific Instance
- o Attribute 4 (0x04) // Range Measurement Reporting Format
- o UINT16 Data // Data = 1 , RANGE_MEASURE_50M (default value)

PC → SCANNER	
Datagram Structure	See section 9.4.11 Table 20: SendRRData Command Request: See section 9.4.14 Table 23: Set Single Attribute Service Code Request CPF Data
Size	50 bytes
Parameters to update	EIP_UINT16 length = 0x001A (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT8 service_code = 0x10 (Set_Single_Attribute) EIP_UINT8 class_code = 0x73 (Vendor Object, Measurement Configuration) EIP_UINT8 instance_id = 0x01 (Vendor Object Instance) EIP_UINT8 attribute_id = 0x04 (Range Format Attribute Number) EIP_UINT16 attribute data = 0x0001 (Range Format Setting)
Hexadecimal	**6F** 00 1A 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 0A 00 10 03 20 73 24 01 30 04 01 00

SCANNER → PC	
Datagram Structure	See section 9.4.15 Table 24: SendRRData Command Reply to a Set Single Attribute Request
Size	44 bytes
SendRRData Response Example	
Updated Parameter(s) returned	EIP_UINT16 length = 0x0014 (Length of command specific data) EIP_UINT16 data_length = 0x0004 (4 bytes of service response data) EIP_UINT8 service_response = 0x90 (Set_Single_Attribute | 0x80) EIP_UINT8 service_status = 0x00 (Success)
Hexadecimal	**6F** 00 14 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 04 00 90 00 00 00

10.1.2.7 Configure the scanner's measurement reflectivity format

Using the EtherNet/IP SendRRData command send an explicit TCP/IP messages to configure the reflectivity measurement format of the scanner using the following parameters.

- o Service code 16 (0x10) // Set Single Attribute
- o Object class 115 (0x73) // Vendor Specific Object Class
- o Instance 1 (0x01) // Vendor Specific Instance
- o Attribute 5 (0x05) // Reflectivity Measurement Reporting Format
- o UINT16 Data // Data = 1 , REFLECTIVITY_MEASURE_TOT_ENCODED (default value)

PC → SCANNER	
Datagram Structure	See section 9.4.11 Table 20: SendRRData Command Request See section 9.4.14 Table 23: Set Single Attribute Service Code Request CPF Data
Size	50 bytes
Parameters to update	EIP_UINT16 length = 0x001A (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT8 service_code = 0x10 (Set_Single_Attribute) EIP_UINT8 class_code = 0x73 (Vendor Object, Measurement Configuration) EIP_UINT8 instance_id = 0x01 (Vendor Object Instance) EIP_UINT8 attribute_id = 0x05 (Reflectivity Format Attribute Number) EIP_UINT16 attribute data = 0x0001 (Reflectivity Format Setting)
Hexadecimal	**6F** 00 1A 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 0A 00 10 03 20 73 24 01 30 05 01 00

SCANNER → PC	
Datagram Structure	See section 9.4.15 Table 24: SendRRData Command Reply to a Set Single Attribute Request
Size	44 bytes
SendRRData Response Example	
Updated Parameter(s) returned	EIP_UINT16 length = 0x0014 (Length of command specific data) EIP_UINT16 data_length = 0x0004 (4 bytes of service response data) EIP_UINT8 service_response = 0x90 (Set_Single_Attribute | 0x80) EIP_UINT8 service_status = 0x00 (Success)
Hexadecimal	**6F** 00 14 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 04 00 90 00 00 00

10.1.2.8 Configure the scanner's measurement beam selection mask

Using the EtherNet/IP SendRRData command send an explicit TCP/IP messages to configure the beam selection mask of the scanner using the following parameters.

- o Service code 16 (0x10) // Set Single Attribute
- o Object class 115 (0x73) // Vendor Specific Object Class
- o Instance 1 (0x01) // Vendor Specific Instance
- o Attribute 12 (0x0C) // Beam Selection Mask
- o UINT16 Data [44] // Data required can be selected using the following algorithms.

```
// define beam selection mask.
memset((uint8 *)&BeamReportMask, ZERO, sizeof(BeamReportMask));
SetupBeamSelectionMask(0, 45, BeamReportMask);
SetupBeamSelectionMask(225, 270, BeamReportMask);
/*****************************************************************************
** Function/Task: SetupBeamSelectionMask
**  Purpose:    Select the beams used within the measurement data reports.
**  Arguments:  float  startAngle (-0.4 to 270.4 degrees)
**         float  endAngle  (-0.4 to 270.4 degrees)
**                uint16 *BeamSelectionData (pointer to Beam Selection Array)
**  Return:       bool TRUE/FALSE  (PASS/FAIL )
*****************************************************************************/
bool SetupBeamSelectionMask(float startAngle, float endAngle, uint16 *BeamSelectionData)
{
    int16 i;
    int16 startBeam = ((startAngle * 10) / 4);   // startAngle/0.4 degress per beam.
    int16 endBeam   = ((  endAngle * 10) / 4);   // endAngle/0.4 degress per beam.

    uint32 beamSelectionMask = 0x0001;
    uint32 beamSelctionCtr   = 0;

    if ((startBeam < -1) || (startBeam > 677) || (  endBeam < -1) || (endBeam   > 677) || (startBeam > endBeam)) {
        return(FALSE);
    }
   // setup initial mask variables.
   for (i = -1; i < startBeam; i++){
        if (beamSelectionMask == 0x8000) {
          beamSelctionCtr++;
          beamSelectionMask = 0x0001;
         } else {
beamSelectionMask = beamSelectionMask << 1;
         } // end if else
     } // end for
     // setup required measurement beams.
     for (i = startBeam; i < endBeam; i++) {
         BeamSelectionData[beamSelctionCtr] |= beamSelectionMask;
         if (beamSelectionMask == 0x8000) {
beamSelctionCtr++;
beamSelectionMask = 0x0001;
         } else {
beamSelectionMask = beamSelectionMask << 1;
         } // end if else
      } // end for
      return (TRUE);
} // end SetupBeamSelectionMask()
```

PC → SCANNER	
Datagram Structure	See section 9.4.11 Table 20: SendRRData Command Request See section 9.4.14 Table 23: Set Single Attribute Service Code Request CPF Data
Size	136 bytes
Parameters to update	EIP_UINT16 length = 0x0070 (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT8 service_code = 0x10 (Set_Single_Attribute) EIP_UINT8 class_code = 0x73 (Vendor Object, Measurement Configuration) EIP_UINT8 instance_id = 0x01 (Vendor Object Instance) EIP_UINT8 attribute_id = 0x0C (Beam Selection Mask Attribute Number) EIP_UINT16 attribute data[44] = 88 bytes (Beam Selection Mask Setting)
Hexadecimal	6F 00 70 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 60 00 10 03 20 73 24 01 30 0C FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 F8 FF FF FF FF FF FF FF FF FF FF FF FF FF 07 00 00 00

SCANNER → PC	
Datagram Structure	See section 9.4.15 Table 24: SendRRData Command Reply to a Set Single Attribute Request
Size	44 bytes
SendRRData Response Example	
Updated Parameter(s) returned	EIP_UINT16 length = 0x0014 (Length of command specific data) EIP_UINT16 data_length = 0x0004 (4 bytes of service response data) EIP_UINT8 service_response = 0x90 (Set_Single_Attribute | 0x80) EIP_UINT8 service_status = 0x00 (Success)
Hexadecimal	6F 00 14 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 04 00 90 00 00 00

10.1.2.9 Read the scanners measurement data using explicit TCP/IP messages

1. In order to read the scanner's measurement data, use the SendRRData command to send an explicit TCP/IP message to read the entire assembly object of interest. When requesting data from input assemblies 102 and 103 the scanner will reply with data that is not synchronous with the scan period. To read scanner data that is synchronous with the scan period the vendor specific assemblies 114, 116 and 117 must be used. For vendor specific object data requests the scanner will reply with the required data after the end of the current scan cycle and before the next scan cycle. Service code 14 (0x0E, Get Single Attribute) should be used in a TCP request/reply explicit message using the following parameters.

For standard input assemblies 102 & 103 use:

Service code 14 (0x0E)	// Get Single Attribute
Object class 0x04 (0x04)	// Assembly Object Class
Instance number	// Assembly Number, for example 102 (0x66).
Attribute 03 (0x03)	// Assembly Data

For vendor specific objects 114, 116 & 117 use:

Service code 14 (0x0E)	// Get Single Attribute
Object class number	// Vendor Specific Object, for example 114 (0x72).
Instance 1 (0x01)	// Instance Number
Attribute 03 (0x03)	// Assembly Data

PC → SCANNER	
Datagram Structure	See section 9.4.11 Table 20: SendRRData Command Request See section 9.4.12 Table 21: Get Single Attribute Service Code Request CPF Data
Size	48 bytes
Parameters to update	EIP_UINT16 length = 0x0018 (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT8 service_code = 0x0E (Get_Single_Attribute) EIP_UINT8 class_code = 0x72 (Vendor Object 114, Range Measurement Data) EIP_UINT8 instance_id = 0x01 (Vendor Object Instance) EIP_UINT8 attribute_id = 0x03 (Assembly Object Data)
Hexadecimal	**6F** 00 18 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 08 00 0E 03 20 72 24 01 30 03

SCANNER → PC	
Datagram Structure	See section 9.4.13 Table 22: SendRRData Command Reply to a Get Single Attribute Request
Size	140 bytes (For this example there are 20 beams in measurement report)
SendRRData Response Example	
Updated Parameter(s) returned	EIP_UINT16 length = 0x0074 (Length of command specific data) EIP_UINT16 data_length = 0x0064 (100 bytes = 4 bytes of service response + 56 bytes of the measurement report header + 40 bytes of the beam data) EIP_UINT8 service_response = 0x8E (Get_Single_Attribute| 0x80) EIP_UINT8 service_status = 0x00 (Success) EIP_UINT8 Data_Array[data_length - 4]; See section 4.8 Table 8: Common Measurement Report Header Format (56 bytes) Note: Number of beams = 0x0014 (20) See section 4.9 Table 9: Input Assembly 102 and Vendor Specific Object 114 (max. 1410 bytes)
Hexadecimal	**6F** 00 74 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 64 00 **8E** 00 00 00 D3 D7 02 00 38 98 00 00 28 7E C4 B0 21 A9 00 00 03 00 07 00 00 00 00 00 00 00 01 00 00 00 02 01 88 33 AE 31 00 00 00 00 00 00 00 00 00 00 00 00 01 00 01 00 00 00 14 00 4D 08 3E 08 4E 08 3D 08 4E 08 53 08 4E 08 3D 08 5B 08 53 08 5B 08 53 08 5B 08 61 08 65 08 61 08 65 08 63 08 65 08 6D 08

2. To maintain a constant connection with the scanner, the application code should resend the TCP/IP request with a minimum delay of 2 milliseconds after receiving data from the scanner. The scanner will reply with new data at the end of the next scan cycle.
3. To terminate the connection with the scanner, the application code should first send the UnRegister Scanner Session command as described in section 9.4.8 and then close the appropriate TCP/IP socket.

PC → SCANNER	
Datagram Structure	See section 9.4.9 Table 19: Un-Register Session Command Request
Size	24 bytes
Parameters to update	EIP_UINT32 session_handle_id = 0x00000005
Hexadecimal	**66** 00 00 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

SCANNER → PC	
Note	There will be no reply to this command. The scanner will close the TCP/IP socket connection when it receives this command.
Size	0 bytes
Un-Register Session Response Example	
Hexadecimal	None

10.2 Runtime Monitoring using an Implicit UDP I/O Connection

10.2.1 Network Configuration

Configure the scanners IP Address, Subnet Mask and Default Gateway using the OS32C Configuration Tool from Omron Scientific Technologies, Inc. (See OS32C User Manual).

10.2.2 Computer/PLC Configuration & Process Control Example

Using the I/O message command information provided in the scanners electronic data sheet, configure the Computer or PLC device to access the scanners I/O messages in order to monitor the measurement data. In this example, configure the scanner's run-time monitoring attributes to monitor two sector locations within the 0 to 270° scanning field. The following information outlines the configuration and request/reply commands needed in this example.

10.2.2.1 Configure the scanner's protection and warning zones

1. Using the scanners configuration tool, configure the scanner for a limited protection zone range of 500 mm.
2. Using the configuration tool, configure the scanners Warning Zone #1 for detection zone range of 1000 mm in sector #1 (0 to 45°).
3. Using configuration tool, configure the scanners Warning Zone #2 for detection zone range of 1500 mm for sector #2 (225 to 270°).

10.2.2.2 Configure the software driver communication ports

- Initialize a UDP/IP port 44818 for performing the discovery process on all connected scanners. The List identity command can be used to determine which devices are OS32C scanners.
- Initialize a TCP/IP port 44818 for receiving and transmitting all explicit messages used to establish connections with the OS32C scanners.
- Initialize a UDP I/O connection for the required application. Initialize the UDP/IP port 2222 for receiving and transmitting all I/O connected messages.

10.2.2.3 Establishing a TCP connection with a scanner using a known IP address

Using the appropriate socket programming language establish a TCP/IP connection to the scanner using the local computer IP address and the target scanner IP address.

10.2.2.4 Register a communication session with the scanner

See section 10.1.2.5 Register a communication session with the scanner described in TCP/IP example.

10.2.2.5 Configure the scanner's measurement range format

See section 10.1.2.6 Configure the scanner's measurement range format described in TCP/IP example.

10.2.2.6 Configure the scanner's measurement reflectivity format

See section 10.1.2.7 Configure the scanner's measurement reflectivity format described in TCP/IP example.

10.2.2.7 Configure the scanner's measurement beam selection

See section 10.1.2.8 Configure the scanner's measurement beam selection mask described in TCP/IP example.

10.2.2.8 Create a Large Forward Open I/O Connection between the originator (PC) and the scanner

Using the SendRRData command described in section 9.4.10 and the Large Forward Open Request described in section 9.4.16 create an I/O connection with the scanner to stream Assembly Object 102 at an interval of 80 milliseconds with a timeout period of 800 milliseconds.

PC → SCANNER	
Datagram Structure	See section 9.4.11 Table 20: SendRRData Command Request See section 9.4.16 Table 25: Large Forward Open Request Encapsulation Packet
Size	94 bytes
Parameters to update	EIP_UINT16 length = 0x0046 (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT32 interface_handle_id = 0x00000000 EIP_UINT16 timeout = 0x0050 (80 milliseconds) EIP_UINT16 data_item_length = 0x0036 (54 bytes) EIP_UINT8 service request = 0x5B (Large Forward Open) EIP_UINT16 timeout_ticks = 0x0050 (80 milliseconds) EIP_UINT32 o_to_t_connection_id = 0x00020003 (User selectable) EIP_UINT32 t_to_o_connection_id = 0x00020004 (User selectable) EIP_UINT16 connection_serial_number = 0x6789 (User selectable) EIP_UINT16 originator_vendor_id = 0x0195 (405, OSTI) EIP_UINT32 originator_serial_number = 0x00004321 (User selectable) EIP_UINT32 o_to_t_rpi = 0x00177FA0 (originator to target repeat packet interval) EIP_UINT32 o_to_t_connection_parameters = 0x48000000 + 6E (output assembly size + 6) EIP_UINT32 t_to_o_rpi = 0x00013070 (target to originator repeat packet interval) EIP_UINT32 t_to_o_connection_parameters = 0x4A000000 + 0x0584 (input assembly size + 2) EIP_UINT8 output_assembly_number = 0x71 (Output Assembly 113 used as trigger) EIP_UINT8 input_assembly_number = 0x66 (Input Assembly 102)
Hexadecimal	**6F** 00 46 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 50 00 02 00 00 00 00 00 B2 00 36 00 5B 02 20 06 24 01 06 50 03 00 02 00 04 00 02 00 89 67 95 01 21 43 00 00 00 00 00 00 A0 7F 17 00 6E 00 00 48 70 30 01 00 84 05 00 4A 01 04 20 04 24 01 2C 71 2C 66

SCANNER → PC	
Datagram Structure	See section 9.4.17 Table 26: SendRRData Command Reply to a Large Forward Open Request
Size	110 bytes
SendRRData Response to Large Forward Open Example	
Updated Parameter(s) returned	EIP_UINT16 length = 0x0056 (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT16 data_item_length = 0x001E (30 bytes) EIP_UINT8 service_response = 0xDB (Large Forward Open | 0x80) EIP_UINT32 o_to_t_connection_id = 0x780C0002 (id selected by scanner) EIP_UINT32 t_to_o_connection_id = 0x00020004 (id accepted by scanner) EIP_UINT16 connection_serial_number = 0x6789 EIP_UINT16 originator_vendor_id = 0x0195 (405, OSTI) EIP_UINT32 originator_serial_number = 0x00004321 EIP_UINT32 o_to_t_rpi = 0x001781D0 (originator to target actual packet interval) EIP_UINT32 t_to_o_rpi = 0x00025CD8 (target to originator actual packet interval) EIP_UINT8 application_reply_size = 0x00 (Number of 16-bit words) EIP_UINT8 reserved = 0x00 Note: remaining data not used.
Hexadecimal	**6F** 00 56 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 04 00 00 00 00 00 B2 00 1E 00 DB 00 00 00 02 00 0C 78 04 00 02 00 89 67 95 01 21 43 00 00 D0 81 17 00 D8 5C 02 00 00 00 00 80 10 00 00 02 08 AE C0 A8 01 01 00 00 00 00 00 00 00 00 01 80 10 00 00 02 08 AE C0 A8 01 07 00 00 00 00 00 00 00 00

10.2.2.9 Keep the I/O Connection Alive between the originator (PC) and the scanner

Using the UDP I/O Output Assembly send a trigger to keep the I/O connection alive and updated with new data if needed. The keep-alive command should be sent on the UDP I/O port at an interval less than the previously defined timeout period, 800 milliseconds in this example.

PC → SCANNER	
Datagram Structure	UDP I/O Connection Alive
Size	128 bytes
Parameters to update	EIP_UINT16 item_count = 0x0002 EIP_UINT16 address_item_type = 0x8002 EIP_UINT16 address_item_length = 0x0008 EIP_UINT32 o_to_t_connection_id = 0x780C0002 (selected by scanner) EIP_UINT32 o_to_t_sequence_id = 0x00000001 (selected by originator) EIP_UINT16 data_item_type = 0x00B1 EIP_UINT16 data_item_length = 0x006E (output assembly size + 6) EIP_UINT16 o_to_t_16bit_sequence_# = 0x0001 (selected by originator) EIP_UINT32 header_trigger = 0x00000003 EIP_UINT8 DataArray [104] = Output Assembly 113 data. Note: 1) o_to_t_sequence_# must be incremented by originating application. 2) Only 20 measurement beams were selected in this example.
Hexadecimal	02 00 02 80 08 00 02 00 0C 78 01 00 00 00 B1 00 6E 00 01 00 03 00 00 00 01 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 FF FF 0F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

SCANNER → PC	
Datagram Structure	UDP I/O Connection Alive
Size	0 bytes
UDP I/O Connection Alive Response Example	
Hexadecimal	None, there is no response to this command but I/O data will continue to be streamed on this connection.

10.2.2.10 I/O Connection Assembly Data sent from the target (OS32C) and the originator (PC)

Using the UDP I/O Output Assembly send a trigger to keep the I/O connection alive and updated with new data if needed. The keep-alive command should be sent on the UDP I/O port at an interval less than the previously defined timeout period, 800 milliseconds in this example.

SCANNER → PC	
Datagram Structure	UDP I/O Connection Stream
Size	116 bytes
Parameters to update	EIP_UINT16 item_count = 0x0002 EIP_UINT16 address_item_type = 0x8002 EIP_UINT16 address_item_length = 0x0008 EIP_UINT32 t_to_o_connection_id = 0x00020004 (selected by scanner) EIP_UINT32 t_to_o_sequence_id = 0x00000015 (selected by scanner) EIP_UINT16 data_item_type = 0x00B1 EIP_UINT16 data_item_length = 0x0062 (input assembly size + 2) EIP_UINT16 t_to_o_16bit_sequence_# = 0x00A1 (selected by scanner) EIP_UINT8 DataArray [data_item_length - 2] = Input Assembly Data (56 bytes of measurement report header + 40 bytes of beam data) Note: 1) t_to_o_sequence_id will be incremented by the scanner. 2) Only 20 (0x0014) measurement beams were selected in this example.
Hexadecimal	02 00 02 80 08 00 04 00 02 00 15 00 00 00 B1 00 62 00 A1 00 76 53 04 00 64 96 00 00 18 BE 97 8A 19 A7 00 00 03 00 07 00 00 00 00 00 00 00 01 00 00 00 08 07 88 33 AE 31 00 00 00 00 00 00 00 00 00 00 00 00 01 00 02 00 00 00 14 00 52 08 42 08 52 08 40 08 52 08 40 08 53 08 58 08 52 08 40 08 58 08 58 08 58 08 5E 08 67 08 5D 08 67 08 5E 08 5E 08 6F 08

10.2.2.11 Terminate a Forward Open I/O Connection between the originator (PC) and the scanner

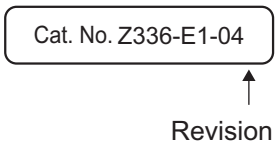
Using the SendRRData command described in section 9.4.10 and the Forward Close Request described in section 9.4.19 terminate the I/O connection with the scanner. The command is sent before un-registering a scanner session and closing the TCP socket connection.

PC → SCANNER	
Datagram Structure	See section 9.4.11 Table 20: SendRRData Command Request See section 9.4.19 Table 28: Forward Close Request Encapsulation Packet
Size	62 bytes
Parameters to update	EIP_UINT16 length = 0x0026 (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT32 interface_handle_id = 0x00000000 EIP_UINT16 timeout = 0x0028 (40 milliseconds) EIP_UINT16 data_item_length = 0x0016 (22 bytes) EIP_UINT8 service request = 0x4E (Forward Close) EIP_UINT8 timeout_ticks = 0x28 (40 milliseconds) EIP_UINT16 connection_serial_number = 0x6789 (User selected) EIP_UINT16 originator_vendor_id = 0x0195 (405, OSTI) EIP_UINT32 originator_serial_number = 0x00004321 (User selected)
Hexadecimal	**6F** 00 26 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 28 00 02 00 00 00 00 00 B2 00 16 00 4E 02 20 06 24 01 06 28 65 87 95 01 21 43 00 00 02 00 20 02 24 01

SCANNER → PC	
Datagram Structure	See section 9.4.20 Table 29: SendRRData Command Reply to a Forward Close Request
Size	54 bytes
SendRRData Response to Forward Close Example	
Updated Parameter(s) returned	EIP_UINT16 length = 0x001E (Length of command specific data) EIP_UINT32 session_handle_id = 0x00000005 EIP_UINT16 data_item_length = 0x000E (14 bytes) EIP_UINT8 service_response = 0xCE (Forward Close | 0x80) EIP_UINT16 connection_serial_number = 0x6789 EIP_UINT16 originator_vendor_id = 0x0195 (405, OSTI) EIP_UINT32 originator_serial_number = 0x00004321 EIP_UINT8 application_reply_size = 0x00 (Number of 16-bit words) EIP_UINT8 reserved = 0x00
Hexadecimal	**6F** 00 1E 00 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00 00 B2 00 0E 00 CE 00 00 00 65 87 95 01 21 43 00 00 00 00

11.Revision History

A revision code appears as a suffix to the catalog number at the bottom of the front and back covers of this document.



Revision code	Date	Revised contents
01	January 2013	First edition
02	February 2013	Minor corrections
03	April 2013	- minor corrections and updates - added figure numbers
04	November 2013	- Added Input Assemblies 104 to 111 with reduced assembly data sizes as well as Output Assemblies 114 to 120 to support the interfacing with CJ2, NJ and other PLC's." - Added Range Reporting Formats to support compressed Range & Reflectivity data and alternative encoded protection and warning zone bits. - Added User Tag option for Input Assemblies 104 to 111 to allow users to insert predefined data in the first and last positions of the assembly data. - Minor corrections and updates

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