Zebra RFID Modbus TCP

User Guide

MN-004136-01EN Rev. A

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Revision History

Change	Date	Description
MN-004136-01EN Rev. A	March 2021	Initial release.

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About This Guide

Introduction

This guide describes how to install Modbus TCP application on FX Series RFID reader and how to configure it using Siemens TIA Portal to perform RFID operations.

IMPORTANT: If you have a problem with your equipment, contact Zebra Global Customer Support for your region. Contact information is available at: www.zebra.com/support.

Chapter Descriptions

Topics covered in this guide are as follows:

- FX9600 Reader Configuration provides instruction on installing and running the Modbus TCP application.
- RFID Inventory Parameters explains parameter structure definition to perform RFID inventory operations.
- RFID Access Parameter explains parameter structure definitions to perform RFID access operations.
- RFID Configuration Parameters explains parameter structure definitions to set various RFID configurations such as antenna, filters, GPIO.
- RFID Inventory Operation provides instruction on how to perform RFID inventory operations using Siemens PLC and TIA portal V15.1.
- RFID Access Operation provides instruction on how to perform RFID access operations using Siemens PLC and TIA portal V15.1.
- Event Mask and Error Codes provides details on various events and error codes specific to RFID operation.
- Appendix provides some common RFID use case scenarios.

Related Documents and Software

The following documents provide more information.

- FX Series RFID Fixed Reader Integration Guide
- FX Series RFID Fixed Reader FX Connect Licensing Management User Guide
- RFID Reader Software Interface Control Guide
- Zebra RFID PROFINET User Guide

- Zebra RFID EtherNet/IP Sample Application User Guide.

For the latest version of this guide and all guides, go to www.zebra.com/support.

Notational Conventions

The following conventions are used in this document:

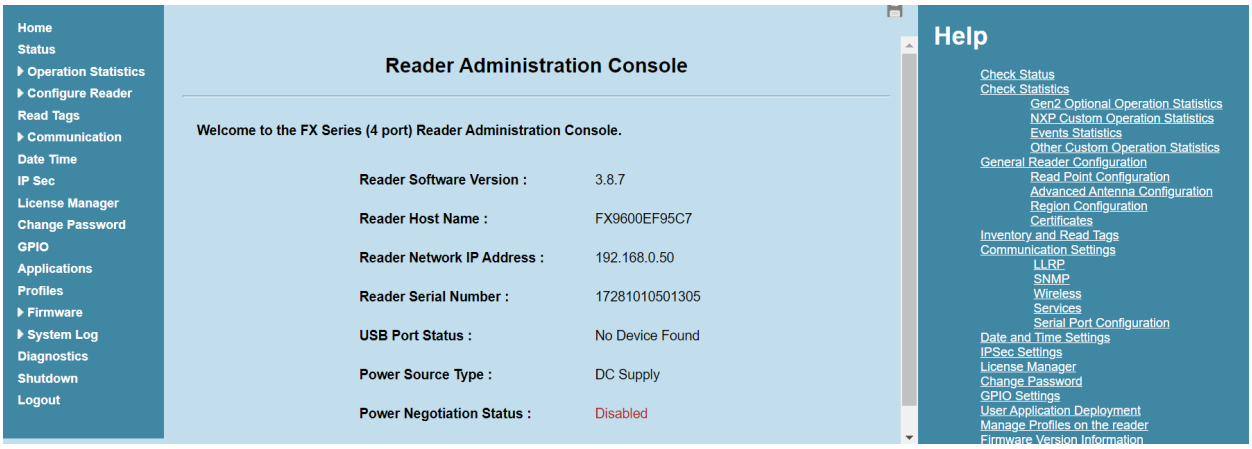
- **Bold** text is used to highlight the following:
  - Dialog box, window and screen names
  - Drop-down list and list box names
  - Check box and radio button names
  - Icons on a screen
  - Key names on a keypad
  - Button names on a screen.
- Bullets (•) indicate:
  - Action items
  - Lists of alternatives
  - Lists of required steps that are not necessarily sequential.
- Sequential lists (such as those that describe step-by-step procedures) appear as numbered lists.

FX9600 Reader Configuration

Update Reader Software

Update the reader software to use the Modbus functionality. The FX9600 Reader must run firmware version 3.8.7, or later. Verify the current running version from the FX9600 Reader web-console shown in Figure 1.

Figure 1 Reader Web-Console



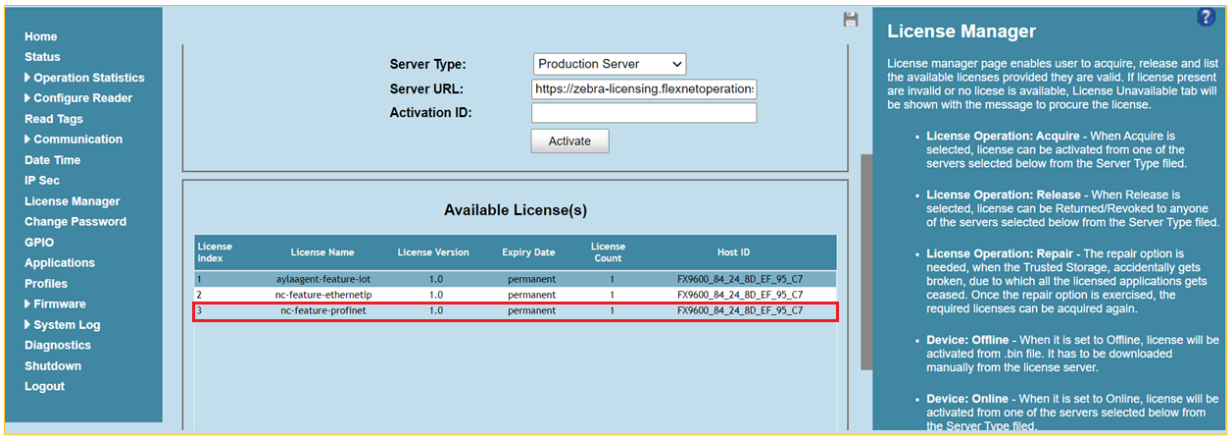
If the reader is running an older software version, upgrade the reader with the new version. Download the FX Series RFID Fixed Reader Integration Guide and follow the instructions in the section Firmware Upgrade.

Install License

The Modbus application requires either an Ethernet/IP or PROFINET license to be available on the FX9600 Reader.

Install the Ethernet/IP or PROFINET license from the FX9600 Reader web-console. Follow the instructions in the FX Series RFID Fixed Reader FX Connect Licensing Management User Guide to request, obtain and install the license for Zebra FX Series readers. When the license is installed, the licensing information can be viewed from the web-console shown in Figure 2.

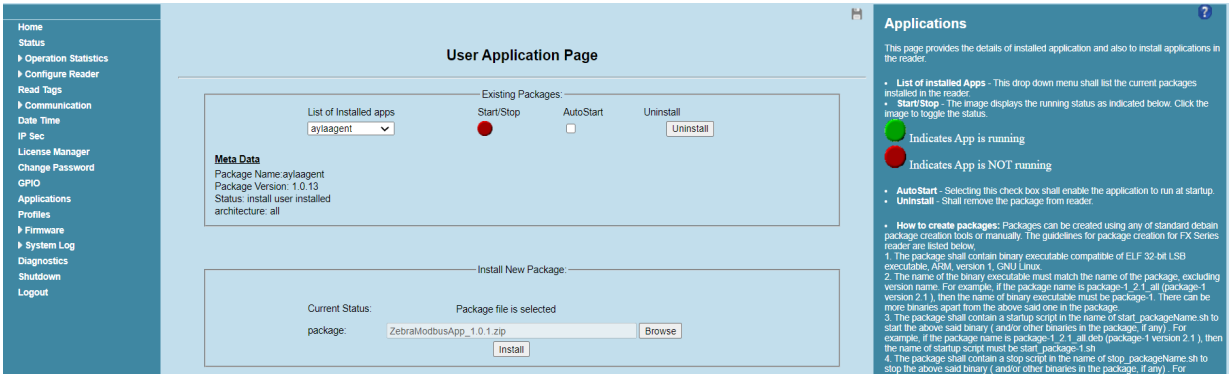
Figure 2 Web-Console



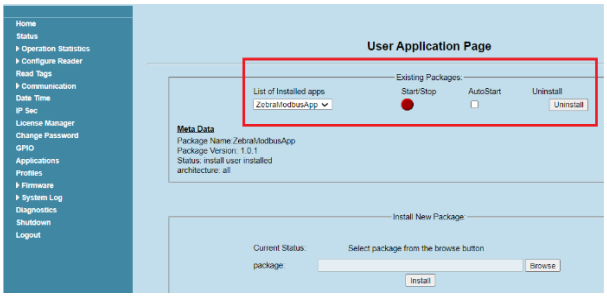
Install and Run the Modbus Application

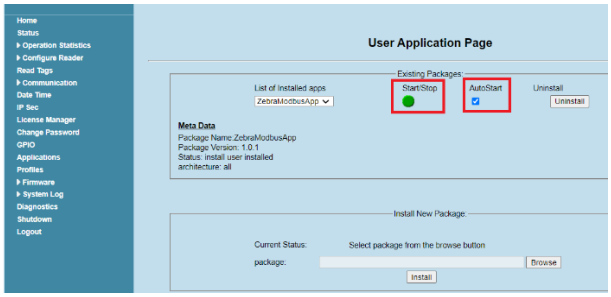
To install the Modbus application:

1. Download the Modbus zip package from the Zebra web site at: https://www.zebra.com/us/en/support-downloads/software/developer-tools/network-connect-modbus.html and unzip it.
2. Navigate to the User Application Page and browse to the ZebraModbusApp_X.X.X.zip file.
3. Click **Install**. When the application is installed, it is available under **Existing Packages** in the List of Installed apps drop-down list.



4. Select the **AutoStart** option to enable the Modbus application to start up automatically on the reader during the power cycle.
5. To run the application, click the red **Start/Stop** button. The button turns green when the application runs.





Modbus Settings

- The FX9600 Reader supports Modbus TCP on port 502.
- The FX9600 Reader supports Big-Endian Data format for all Modbus operations.
- The IP address of the FX9600 Reader can be obtained or modified by accessing the Communications page on the web-console.
- The FX9600 Reader supports communication with only Single Modbus Master.

RFID Inventory Parameters

Inventory Command

Operation - Write only

Holding Register - 40100

Length - 8 Bytes (4 Words)

Table 1 Inventory Command

Inventory Command	Data Type	Offset	Comments
Command	Byte	0	This field is used to specify the Inventory Commands. It can be either 1 (Start) or 2 (Stop).
Handshake	Byte	1	For each new command, Handshake value must be modified to instruct the FX9600 Reader to process the command. Handshake parameter can take any value between 0-127. one way to use is to increment each time a new command is to be processed and roll it over when it reaches 127 to 0.
EnablePreFilter	Byte	2	Used to specify whether the user wants to use pre-filter with this Inventory Command. Non-zero value is treated as TRUE and pre-filter takes effect.
EnablePostFilter	Byte	3	Used to specify whether post-filter is used. Criteria is the same as pre-filter.
AntennaMask	DInt	4	Use this mask to specify the antenna IDs on which this inventory operation should perform. Each bit in the antenna mask, from 0 bit, represents one antenna. 0 bit for antenna ID 1, and so on. If the AntennaMask is 0, then inventory is performed with all available antennas.

Standard Inventory Response

Operation - Write only

Holding Register - 40200

Length - 44 Bytes (22 Words)

Table 2 Standard Inventory Response

Extended Standard Inventory Response	Data Type	Offset	Comments
Status	Struct	0	
ErrorStatus	Word	0	RFID errors are reported in this field
EventMask	Word	2	RFID events are reported in this field
AntennaStatusMask	Byte	4	Currently connected antennas. Bit n = Antenna ID n.
GPIOStatusMask	Byte	5	Current GPIO pin status
TagCount	Byte	6	Number of tag report
SeqNo	Byte	7	SeqNo is incremented with each new report. Note: The same tag may be read several times and are reported each time and SeqNo is also incremented to indicate that tag was newly read.
TagReport	Struct	8	Tag info data
SeenCount	Word	8	No of times the tag was read
TagPC	Word	10	PC of the tag read
TagCRC	Word	12	CRC of the tag read
ChannelIndex	Word	14	Channel On which tag was read
PhaseInfo	Word	16	Phase angle of the tag read
AccessStatus	Word	18	Results of access operation
TagEpc	Byte[12]	20	EPC ID of the tag
TagTimeStamp	Struct	32	Date and time of the tag read
Year	Byte	32	Year 2020 is reported as 20 (after subtracting 2000).
Month	Byte	33	Month
Day	Byte	34	Day
Hour	Byte	35	Hour
Minute	Byte	36	Minute
Second	Byte	37	Second
MillisecondMSB	Byte	38	MSB value of millisecond
MillisecondLSB	Byte	39	LSB value of millisecond
TagLength	Byte	40	Length of EPC ID of the tag
AntennaId	Byte	41	Antenna ID on which tag was read
RSSI	Byte	42	RSSI value of the tag read
TagEvent	Byte	43	Tag event info

Long Inventory Response

Operation - Write only

Holding Register - 40300

Length - 96 Bytes (48 Words)

Table 3 Long Inventory Response

Extended Long Inventory Response	Data Type	Offset	Comments
Status	Struct	0	
ErrorStatus	Word	0	RFID errors are reported in this field
EventMask	Word	2	RFID events are reported in this field
AntennaStatusMask	Byte	4	Currently connected antennas. Bit n = Antenna ID n
GPIOStatusMask	Byte	5	Current GPIO pin status
TagCount	Byte	6	Number of tag report
SeqNo	Byte	7	SeqNo is incremented with each new report. Note: The same tag may be read several times and is reported each time and SeqNo is also incremented to indicate that tag was newly read.
TagReport	Struct	8	Tag info data
SeenCount	Word	8	No of times the tag was read
TagPC	Word	10	PC of the tag read
TagCRC	Word	12	CRC of the tag read
ChannelIndex	Word	14	Channel On which tag was read
PhaseInfo	Word	16	Phase angle of the tag read
AccessStatus	Word	18	Results of access operation
TagEpc	Byte[64]	20	EPC ID of the tag
TagTimeStamp	Struct	84	Date and time of the tag read
Year	Byte	84	Year 2020 is reported as 20 (after subtracting 2000)
Month	Byte	85	Month
Day	Byte	86	Day
Hour	Byte	87	Hour
Minute	Byte	88	Minute
Second	Byte	89	Second
MillisecondMSB	Byte	90	MSB value of millisecond
MillisecondLSB	Byte	91	LSB value of millisecond
TagLength	Byte	92	Length of EPC ID of the tag
AntennaId	Byte	93	Antenna ID on which tag was read
RSSI	Byte	94	RSSI value of the tag read
TagEvent	Byte	95	Tag event Info

Multiple Standard Inventory Responses

Operation - Write only

Holding Register - 40400

Length - 224 Bytes (112 Words)

Table 4 Multiple Standard Inventory Responses

Multiple Standard Inventory Response	Data Type	Offset	Comments
Status	Struct	0	
ErrorStatus	Word	0	RFID errors are reported in this field
EventMask	Word	2	RFID events are reported in this field
AntennaStatusMask	Byte	4	Currently connected antennas. Bit n = Antenna ID n
GPIOStatusMask	Byte	5	Current GPIO pin status
TagCount	Byte	6	Number of tag report
SeqNo	Byte	7	SeqNo is incremented with each new report. Note: The same tag may be read several times and is reported each time and SeqNo is also incremented to indicate that tag was newly read.
TagReport1	StdTagReport	8 - 43	12 Byte tag EPC with tag Info
TagReport2	StdTagReport	44 - 79	12 Byte tag EPC with tag Info
TagReport3	StdTagReport	80 - 115	12 Byte tag EPC with tag Info
TagReport4	StdTagReport	116 - 151	12 Byte tag EPC with tag Info
TagReport5	StdTagReport	152 - 187	12 Byte tag EPC with tag Info
TagReport6	StdTagReport	188 - 223	12 Byte tag EPC with tag Info

StdTagReport	Struct	Tag info data
SeenCount	Word	No of times the tag was read
TagPC	Word	PC of the tag read
TagCRC	Word	CRC of the tag read
ChannelIndex	Word	Channel On which tag was read
PhaseInfo	Word	Phase angle of the tag read
AccessStatus	Word	Results of access operation
TagEpc	Byte[12]	EPC ID of the tag
TagTimeStamp	Struct	Date and time of the tag read
Year	Byte	Year 2020 is reported as 20 (after subtracting 2000)
Month	Byte	Month
Day	Byte	Day
Hour	Byte	Hour

Minute	Byte	Minute
Second	Byte	Second
MillisecondMSB	Byte	MSB value of millisecond
MillisecondLSB	Byte	LSB value of millisecond
TagLength	Byte	Length of EPC ID of the tag
AntennaId	Byte	Antenna ID on which tag was read
RSSI	Byte	RSSI value of the tag read
TagEvent	Byte	Tag event Info

Multiple Long Inventory Responses

Operation - Write only

Holding Register - 40700

Length - 184 Bytes (92 Words)

Table 5 Multiple Long Inventory Responses

Multi Long Inventory Response	Data Type	Offset	Comments
Status	Struct	0	
ErrorStatus	Word	0	RFID errors are reported in this field
EventMask	Word	2	RFID events are reported in this field
AntennaStatusMask	Byte	4	Currently connected antennas. Bit n = Antenna ID n.
GPIOStatusMask	Byte	5	Current GPIO pin status
TagCount	Byte	6	Number of tag report
SeqNo	Byte	7	Report Note: The same tag may be read several times and is reported each time and SeqNo is also incremented to indicate that tag was newly read.
TagReport1	LongTagReport	8 - 95	64 Byte tag EPC with tag Info
TagReport2	LongTagReport	96 - 183	64 Byte tag EPC with tag Info

LongTagReport	Struct	Tag info data
SeenCount	Word	No of times the tag was read
TagPC	Word	PC of the tag read
TagCRC	Word	CRC of the tag read
ChannelIndex	Word	Channel On which tag was read
PhaseInfo	Word	Phase angle of the tag read
AccessStatus	Word	Results of Access operation
TagEpc	Byte[64]	EPC ID of the tag

TagTimeStamp	Struct	Date and time of the tag read
Year	Byte	Year 2020 is reported as 20 (after subtracting 2000)
Month	Byte	Month
Day	Byte	Day
Hour	Byte	Hour
Minute	Byte	Minute
Second	Byte	Second
MillisecondMSB	Byte	MSB value of millisecond
MillisecondLSB	Byte	LSB value of millisecond
TagLength	Byte	Length of EPC ID of the tag
AntennaId	Byte	Antenna ID on which tag was read
RSSI	Byte	RSSI value of the tag read
TagEvent	Byte	Tag event Info

RFID Access Parameter

Access Command

Operation - Write only

Holding Register - 40900

Length - 152 Bytes (76 Words)

Table 6 Access Command

Access Command	Data Type	Offset	Comments
AntennaMask	DWord	0	Use this mask to specify the antenna IDs on which this inventory operation should perform. Each bit in the antenna mask, from 0 bit, represents one antenna. 0 bit for antenna ID 1, and so on. If the AntennaMask is 0, then inventory is performed with all available antennas.
Password	DWord	4	Password if the memory bank to be accessed needs a password to access
ByteOffset	Word	8	Byte offset from where the memory needs to access
ByteCount	Word	10	How many Bytes to be read. 0 indicate all the Bytes available.
TagEpc	Byte[64]	12	EPC of the tag on which access operation to be performed. This field can be used to provide EPC pattern as well. For example, all tags starting with 2F 22.
AccessData	Struct	76	Access data info
PageIndex	DWord	76	0
PageDataLen	Word	80	Length of Access Data Bytes to be written when using Access Write
PageData	Byte[64]	82	Access Data Bytes to be written when using Access Write
TagLen	Byte	146	Length if EPC tag/pattern provided
Command	Byte	147	1 = Access Read 2 = Access Write

Table 6 Access Command (Continued)

Access Command	Data Type	Offset	Comments
Handshake	Byte	148	For each new command, Handshake value must be modified to instruct the FX9600 Reader to process the command. Handshake parameter can take any value between 0-127. one way to use is to increment each time a new command is to be processed and roll it over when it reaches 127 to 0.
MemoryBank	Byte	149	Access command memory banks values can be given in separate lines as follows: 0 = Reserved 1 = EPC 2 = TID 3 = User Memory
EnableAccessFilter	Byte	150	Non-zero value is treated as TRUE and Access Filter takes effect
Pad	Byte	151	Ignore

Access Response

Operation - Write only

Holding Register - 41100

Length - 156 Bytes (78 Words)

Table 7 Access Response

Access Response	Data Type	Offset	Comments
Status	Struct	0.0	
ErrorStatus	Word	0.0	RFID errors are reported in this field
EventMask	Word	2.0	RFID events are reported in this field
AntennaStatusMask	Byte	4.0	Currently connected antennas. Bit n = Antenna ID n.
GPIOStatusMask	Byte	5.0	Current GPIO pin status
SeqNo	Byte	6.0	SeqNo is incremented with each new report. Note: The same tag may be read several times and is reported each time and SeqNo is also incremented to indicate that tag was newly read.
ResponseHeader	Byte	7.0	0 = Success 1 = Tag Found but access operation failed 2 = Tag not found, and access operation failed
TagReport	Struct	8.0	Tag report info
SeenCount	Word	8.0	No of times tag was read
TagEpc	Byte[64]	10.0	EPC ID of the tag

Table 7 Access Response (Continued)

Access Response	Data Type	Offset	Comments
TagTimeStamp	Struct	74.0	Date and time of the tag read
Year	Byte	74.0	Year 2020 is reported as 20 (after subtracting 2000)
Month	Byte	75.0	Month
Day	Byte	76.0	Day
Hour	Byte	77.0	Hour
Minute	Byte	78.0	Minute
Second	Byte	79.0	Second
MillisecondMSB	Byte	80.0	MSB value of millisecond
MillisecondLSB	Byte	81.0	LSB value of millisecond
AccessData	Struct	82.0	Contents of the memory bank accessed
PageIndex	DWord	82.0	Page index of the memory
PageDataLen	Word	86.0	Length memory data accessed
PageData	Byte[64]	88.0	contents of the memory bank
TagLength	Byte	152.0	Length of EPC ID of the tag
AntennaId	Byte	153.0	Antenna ID on which tag was read
RSSI	Byte	154.0	RSSI value of the tag read
Pad	Byte	155.0	Ignore

RFID Configuration Parameters

Reader Capability

NOTE: For more information on RFID parameters, refer to the EPC UHF Gen2 Air Interface Protocol https://www.gs1.org/sites/default/files/docs/epc/uhfc1g2_1_2_0-standard-20080511.pdf.

Operation - Read only

Holding Register - 41300

Length - 116 Bytes (58 Words)

Table 8 Reader Capability

Reader Capability	Data Type	Offset	Comments
ReaderID	Byte[32]	0	Reader ID in (ASCII String)
FirmwareVersion	Byte[32]	32	Firmware version (ASCII String)
ModelName	Byte[32]	64	Model name (ASCII String)
CountryCode	Word	96	Country of the code
CommunicationStandard	Word	98	Communication standard
NoOfRFModes	Word	100	No of supported modes
MinPower	Word	102	Minimum power supported
MaxPower	Word	104	Maximum power supported
StepPower	Word	106	Step size of power
NoOfAntennas	Byte	108	No of antenna supported
NoOfGPI	Byte	109	No of GPI
NoOfGPO	Byte	110	No of GPO
MaxNoOfPreFilters	Byte	111	No of pre-filters supported by the Reader
ReaderIDLen	Byte	112	Reader ID string length
FirmwareVersionLen	Byte	113	Firmware version string length
ModelNameLen	Byte	114	Model name string length
Pad	Byte	115	Ignore

Antenna Config

Operation - Read/Write

Holding Registers - 41500, 41520, 41540, 41560,41580, 41600, 41620, 41640 (antenna 1-8)

Length - 12 Bytes (6 Words)

Table 9 Antenna Config

Antenna Config	Data Type	Offset	Comments	Default
PowerLevel	Word	0	1000 - 3000 (dBm)	3000
TagPopulation	Word	2	0 - 32767	100
TariValue	Word	4	Depends on RF Mode	0
RFModeIndex	Byte	6	0 - 39	0
Target	Byte	7	State A = 0 State B = 1 AB FLIP = 2	0
Session	Byte	8	S0 = 0 S1 = 1 S2 = 2 S3 = 3	1
Sel	Byte	9	Asserted = 0 De-asserted = 1 SL ALL=2	2
AntennaId	Byte	10	0-8, 0=All Antenna	0
Pad	Byte	11	Ignore	

NOTE: The AntennaID parameter can be set to 0 to apply settings to all antennae on the FX9600 Reader.

Power Level Range, RF Mode Index supported depends on the region selected at time of initial Reader configuration.

Pre-Filter Config

Operation - Read/Write

Holding Registers - 41700, 41750, 41800, 41850, 41900, 41950, 42000, 42050, 42100, 42150, 42200, 42250, 42300, 42350, 42400, 42450, 42500, 42550, 42600, 42650, 42700, 42750, 42800, 42850, 42900, 42950, 43000, 43050, 43100, 43150, 43200, 43250 (Pre-Filters 1-32)

Length - 46 Bytes (23 Words)

Table 10 Pre-Filter Config

Pre-Filter	Data Type	Offset	Comments
TagPatternBitCount	Word	0	Length tag pattern in number of bits
BitOffset	Word	2	Bit offset from where tag pattern begins
Tagpattern	Byte[36]	4	Tag pattern
Action	Byte	40	0 – 7 Refer to the Select Command Section under C1G2 Specification in: https://www.gs1.org/sites/default/files/docs/epc/uhfc1g2_1_2_0-standard-20080511.pdf.
Target	Byte	41	SL = 0 S0 = 1 S1 = 2 S2 = 3 S3 = 4
MemoryBank	Byte	42	EPC = 1 TID = 2 USER = 3
AntennaID	Byte	43	0-8, 0 = All Antenna
Pre-FilterID	Byte	44	1 to 32
Pad	Byte	45	ignore

Delete Pre-Filter

Operation - Write only

Holding Register - 43300

Length - 2 Bytes (1 Words)

Table 11 Delete Pre-Filter

Delete Pre-Filter	Data Type	Offset	Comments
PreFilterID	Word	0	Delete pre-filter (1 -32)

Trigger Config

Operation - Read/Write

Holding Register - 43400

Length - 28 Bytes (14 Words)

Table 12 Trigger Config

Trigger Config	Data Type	Offset	Comments	Default Values
PeriodicTime	DWord	0	Used when start trigger is "periodic" (millisecond)	0
StartDelay	DWord	4	Used when start trigger is "periodic" (millisecond)	0
Timer	DWord	8	When stop trigger type is "Duration" or as "Timeout" (millisecond)	0
PeriodicReportDuration	DWord	12	-1 = Disable periodic reporting 0 = Report at the end of inventory n = report once every n second	-1
TagEventTimeOut	Word	16	Tag Event Timeout (millisecond)	0
Count	Word	18	Used when stop trigger is "tag observations" or "n attempts"	1
StartTriggerType	Byte	20	0 = Immediate 1 = Periodic 2 = GPI	0
StartGPIPortNumber	Byte	21	GPI pin number	1
StartEventType	Byte	22	0 = High to low 1 = Low to high (GPI pin state transition)	0
StopTriggerType	Byte	23	0 = Immediate 1 = Duration 2 = GPI with timeout 3 = Tag observation 4 = n attempts	0
StopGPIPortNumber	Byte	24	GPI pin number	1
StopEventType	Byte	25	0 = High to low 1 = low to high (GPI pin state transition)	0
EnableTagEvent	Byte	26	Enables tag Events like (Reports TagEvents in the Extended standard and Long Inventory Response modules)	0
Pad	Byte	27	Ignore	

Post-Filter Config

Operation - Read/Write

Holding Register - 43500

Length - 164 Bytes (82 Words)

Table 13 Post-Filter Config

Post-Filter	Data Type	Offset	Comments
TagPatternA	Struct	0	Pattern A Params
Bitoffset	Word	0	Bit offset from where tag pattern begins
TagPatternBitCount	Word	2	Length tag pattern in number of bits
TagMaskBitCount	Word	4	Length tag mask in number of bits
TagPattern	Byte[36]	6	Tag pattern
TagMask	Byte[36]	42	Tag mask
MemoryBank	Byte	78	Reserved = 0 EPC = 1 TID = 2 USER = 3
pad	Byte	79	
TagPatternB	Struct	80	Pattern B Params
Bitoffset	Word	80	Bit offset from where tag pattern begins
TagPatternBitCount	Word	82	Length tag pattern in number of bits
TagMaskBitCount	Word	84	Length tag mask in number of bits
TagPattern	Byte[36]	86	Tag pattern
TagMask	Byte[36]	122	Tag mask
MemoryBank	Byte	158	Reserved = 0 EPC = 1 TID = 2 USER = 3
pad	Byte	159	
MatchPattern	Byte	160	A_AND_B = 0 NOTA_AND_B = 1 NOTA_AND_NOTB = 2 A_AND_NOTB = 3
PeakRSSILowerLimit	Byte	161	RSSI Filter Lower Limit
PeakRSSIUpperLimit	Byte	162	RSSI Filter Higher Limit
PeakRSSIMatchRange	Byte	163	WITHIN_RANGE = 0 OUTSIDE_RANGE = 1 GREATER_THAN_LOWER_LIMIT = 2 LOWER_THAN_UPPER_LIMIT = 3

GPIO Config

Operation - Read/Write

Holding Register - 43700

Length - 24 Bytes (12 Words)

Table 14 GPIO Config

GPIO Config	Data Type	Offset	Comments
ConfigGPI1	Struct	0	
Enable	Byte	0	R: Shows status W: Enable GPIO events
State	Byte	1	R: Shows status W: Ignore
Set	Byte	2	W: 0 ignore this update W: 1 set this update
Pad	Byte	3	W: Ignore
ConfigGPI2	Struct	4	
Enable	Byte	4	R: Shows status W: Enable GPIO events
State	Byte	5	R: Shows state W: Ignore
Set	Byte	6	W: 0 ignore this update W: 1 set this update
Pad	Byte	7	W: Ignore
ConfigGPI3	Struct	8	
Enable	Byte	8	R: Shows status W: Enable GPIO events
State	Byte	9	R: Shows status W: Ignore
Set	Byte	10	W: 0 ignore this update W: 1 set this update
Pad	Byte	11	W: Ignore
ConfigGPI4	Struct	12	
Enable	Byte	12	R: Shows status W: Enable GPIO events
State	Byte	13	R: Shows status W: Ignore
Set	Byte	14	W: 0 ignore this update W: 1 set this update
Pad	Byte	15	W: Ignore
ConfigGPO1	Struct	16	
State	Byte	16	R: Shows current state W: New State
Set	Byte	17	W: 0 ignore this update W: 1 set the new state
ConfigGPO2	Struct	18	
R = While reading **W = While writing**			

Table 14 GPIO Config (Continued)

GPIO Config	Data Type	Offset	Comments
State	Byte	18	R: Shows current state W: New State
Set	Byte	19	W: 0 ignore this update W: 1 set the new state
ConfigGPO3	Struct	20	
State	Byte	20	R: Shows current state W: New State
Set	Byte	21	W: 0 ignore this update W: 1 set the new state
ConfigGPO4	Struct	22	
State	Byte	22	R: Shows current state W: New State
Set	Byte	23	W: 0 ignore this update W: 1 set the new state
R = While reading W = While writing			

Get Active Profile Name

Operation - Read only

Holding Register - 43800

Length - 66 Bytes (33 Words)

Table 15 Get Active Profile Name

Profile Name	Data Type	Offset	Comments
ProfileNameLen	Word	0	Length of profile name string
ProfileName	Byte[64]	2	Profile name string

Set Active Profile

Operation - Write only

Holding Register - 43900

Length - 2 Bytes (1 Words)

Table 16 Set Active Profile

Set Active Profile	Data Type	Offset	Comments
Profile Index	Word	0	Profile index (can be obtained from the FX9600 web pages).

Get Profile Name

Operation - Read only

Holding Register - 44000, 44100, 44200, 44300, 44400, 44500, 44600, 44700, 44800, 44900, 45000, 45100, 45200, 45300, 45400, 45500, 45600, 45700, 45800, 45900, 46000, 46100, 46200 46300, 46400, 46500, 46600, 46700, 46800, 46900, 47000, 47100 (Profile Names at index 1- 32)

Length - 66 Bytes (33 Words)

Table 17 Get Profile Name

Profile Name	Data Type	Offset	Comments
ProfileNameLen	Word	0	Length of profile name string
ProfileName	Byte[64]	2	Profile name string

Event Report

Operation - Read/Write

Holding Register - 47200

Length - 8 Bytes (4 Words)

Table 18 Event Report

Event Report	Data Type	Offset	Comments
EventType	Byte	0	R = Select appropriate event
GpiPortNumber	Byte	1	R = Event reported on GPI PIN number
GpiValue	Byte	2	R = GPI state
AntennaID	Byte	3	R = Event reported on Antenna ID
AntennaStatus	Byte	4	R = Antenna status
TemperatureSource	Byte	5	R = Source of temperature event
TemperatureAlarm	Byte	6	R = Temperature alarm level
TemperatureValue	Byte	7	Temperature value

Using Event Report

EventMask is reported in RFID Inventory Operation and Access Command Response (RFID Access Parameter) in every cycle.

Each bit in EventMask is used to identify the corresponding EventType (Event Mask).

To use Event Report:

1. Set the Event Report parameter to the FX9600 Reader with the required EventType parameter (bit number) for which the detailed report needs to be read. For example, EventMask value 4 corresponds to bit number 3 being set. By Referring to Event Mask Table, bit number 3 corresponds to Antenna Event and its EventType value is 3.
2. Get the Event Report parameter from the FX9600 Reader and the values corresponding to the EventType set in step 1.

Last Error Report

Operation - Read only

Holding Register - 47300

Length - 6 Bytes (3 Words)

Table 19 Last Error Report

Last Error Report	Data Type	Offset	Comments
Address	Word	0	Register address where operation was done.
Operation	Word	2	1 = Read 2 = Write
Error	Word	4	0 = Success RFID API error.

The FX9600 Reader stores up to previous 5 Error results in the buffer. Its recommended to check the last error report after each Set/Get parameter operation.

NOTE: If address, operation and error values are all 0 in the read response, it indicates no error reports are currently on the device and all previous operations were successful.

RFID Inventory Operation

Siemens S7-1200 PLC and TIA Portal V15.1 is used to demonstrate the RFID Inventory start/stop operation.

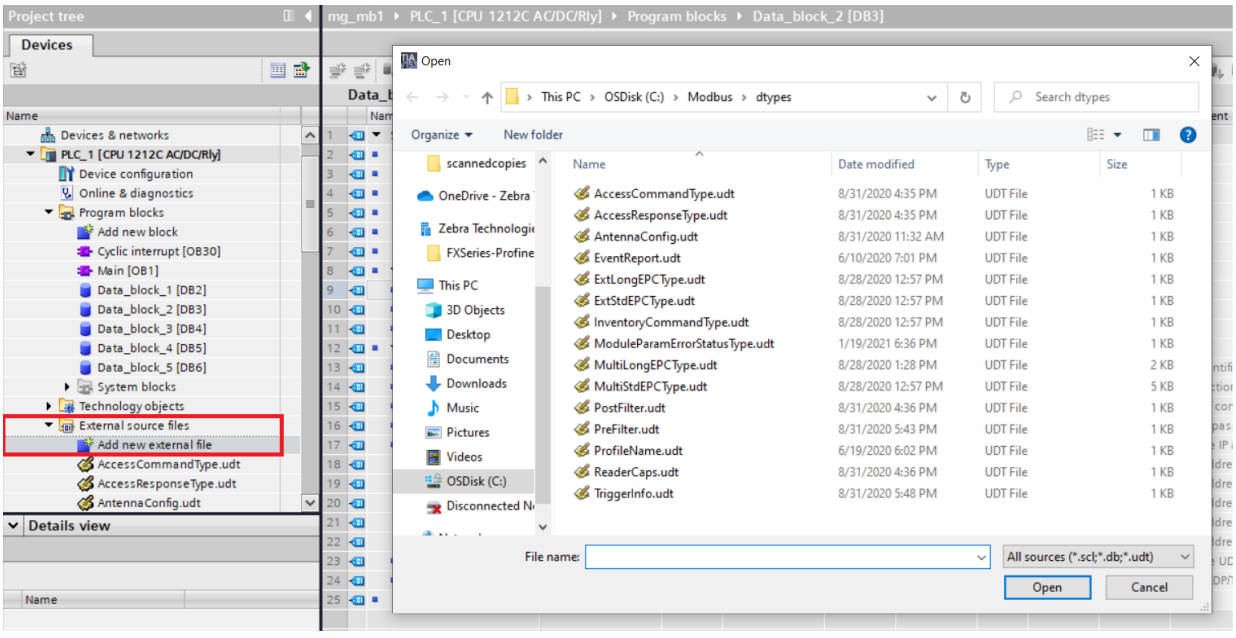
The RFID Inventory operation is done continuously when the Inventory Command is received to start the operation and only stops when the Inventory Command is received to stop the operation or the Inventory Stop condition is met, as set by Trigger Config.

It is recommended to read the Inventory Response periodically (10 msec or higher) during the Inventory operation.

Create User Defined Data Types (UDT)

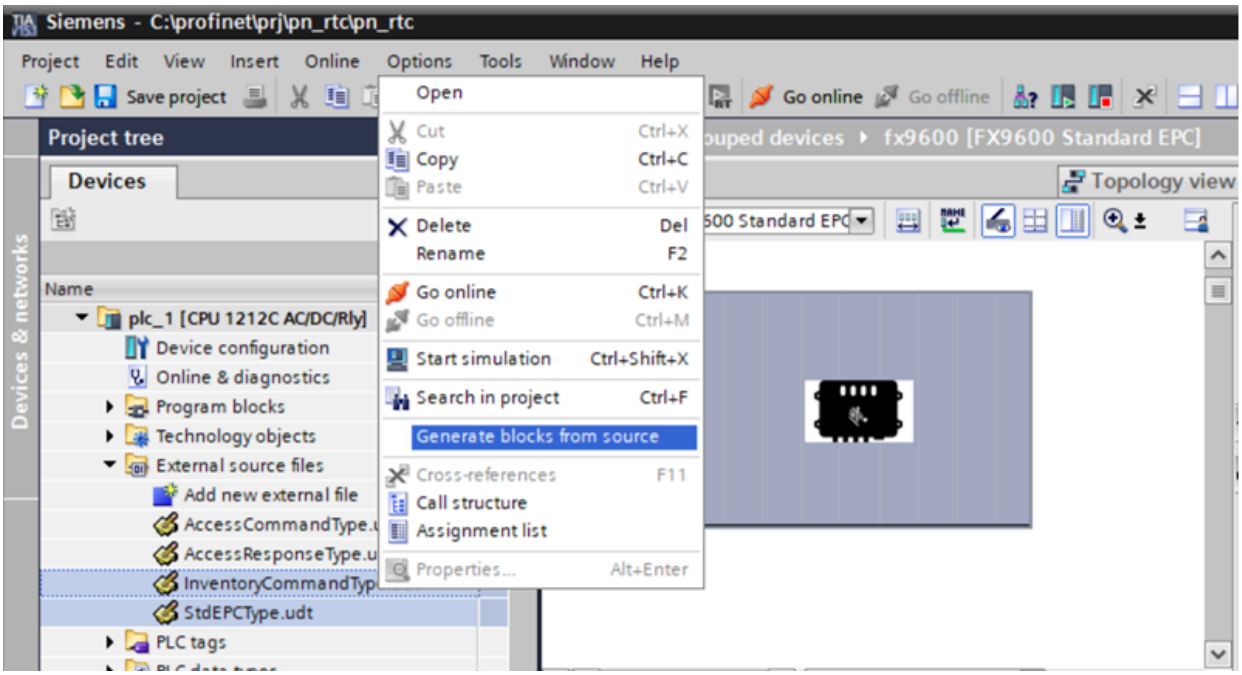
Add the necessary UDT supplied by Zebra for the FX9600 Reader by selecting **Add new external file** shown in the Figure 3.

Figure 3 User Defined Data Type



After adding the necessary UDT files, create UDTs by right clicking and selecting **Generate blocks from source** option as shown in Figure 4.

Figure 4 Generate Blocks From Source

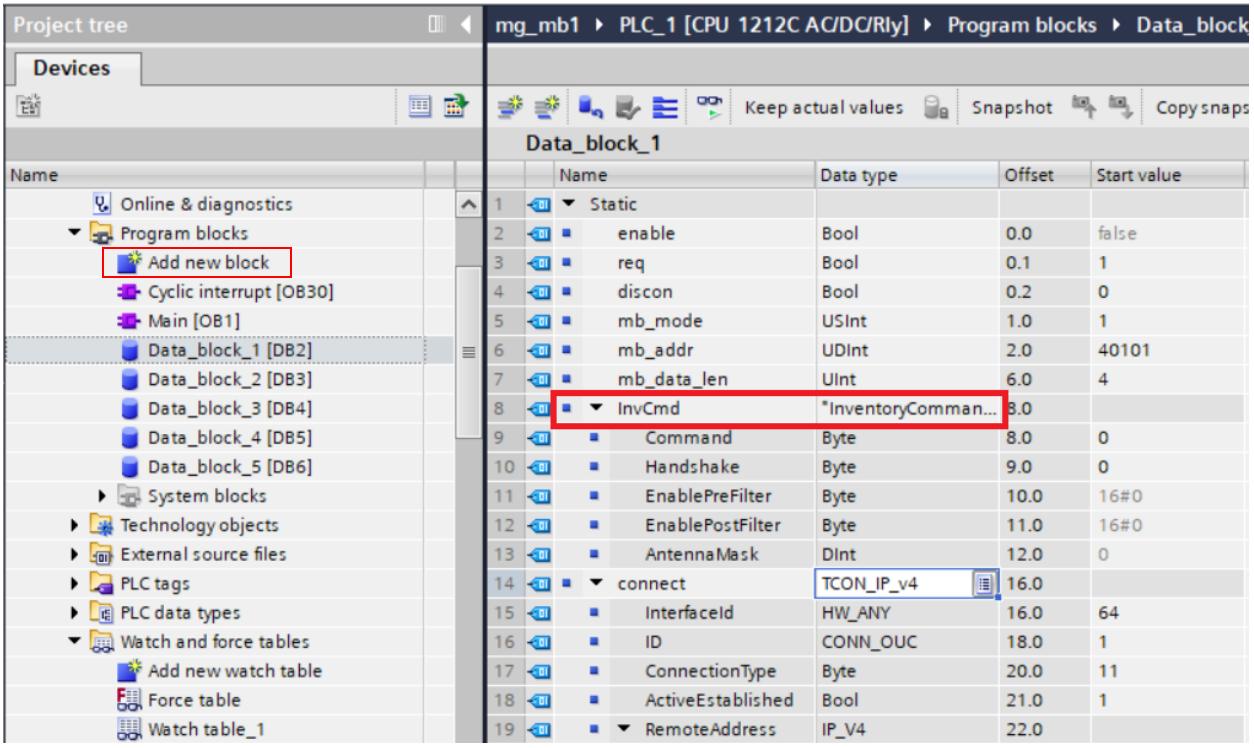


Create Data Blocks and Variables to Use With Inventory Operation

Create Data Blocks Data_block_1 by selecting **Add new block**.

Create variables to hold the Inventory Command and other Modbus connection parameters as shown in Figure 5.

Figure 5 Inventory Command

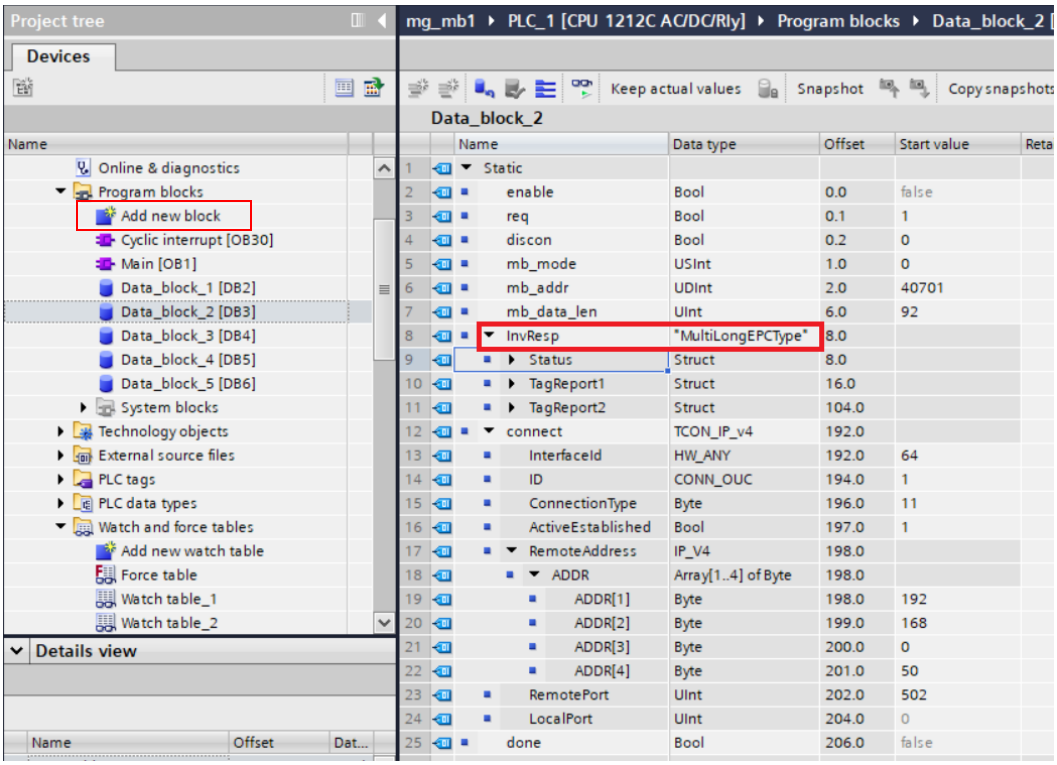


InvCmd variable is defined of type InventoryCommandType and it holds the data related to Inventory Command that is sent from PLC to the device using the Modbus TCP Write request.

Create Data Blocks Data_block_2 by selecting **Add new block**.

Create variables to hold Inventory Response Command and other Modbus connection parameters as shown in Figure 6.

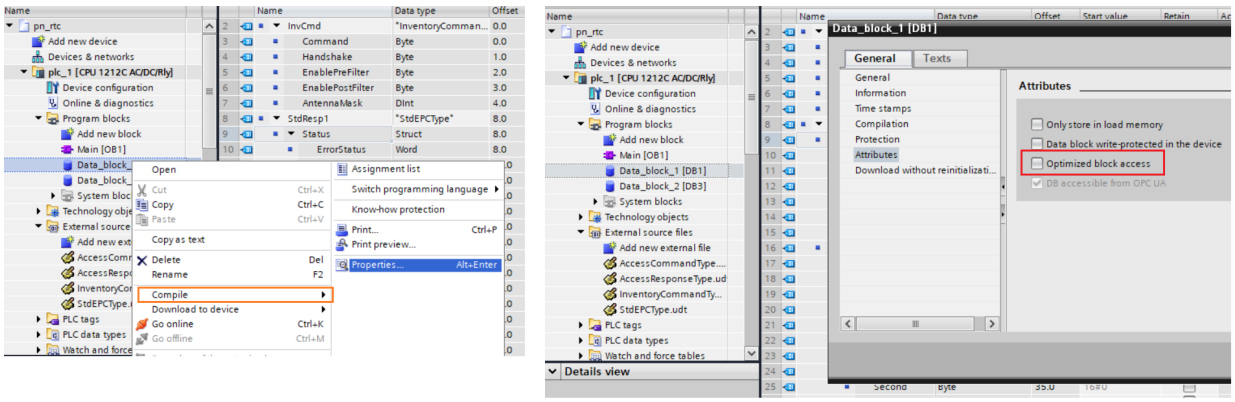
Figure 6 Inventory Response Command



InvResp variable is defined of type MultiLongEPCType and it holds the data related to Inventory Response that is read from the device using the Modbus TCP Read request.

These variables are used in the ladder diagrams to exchange data between PLC and the device.

Figure 7 Data Block Configuration



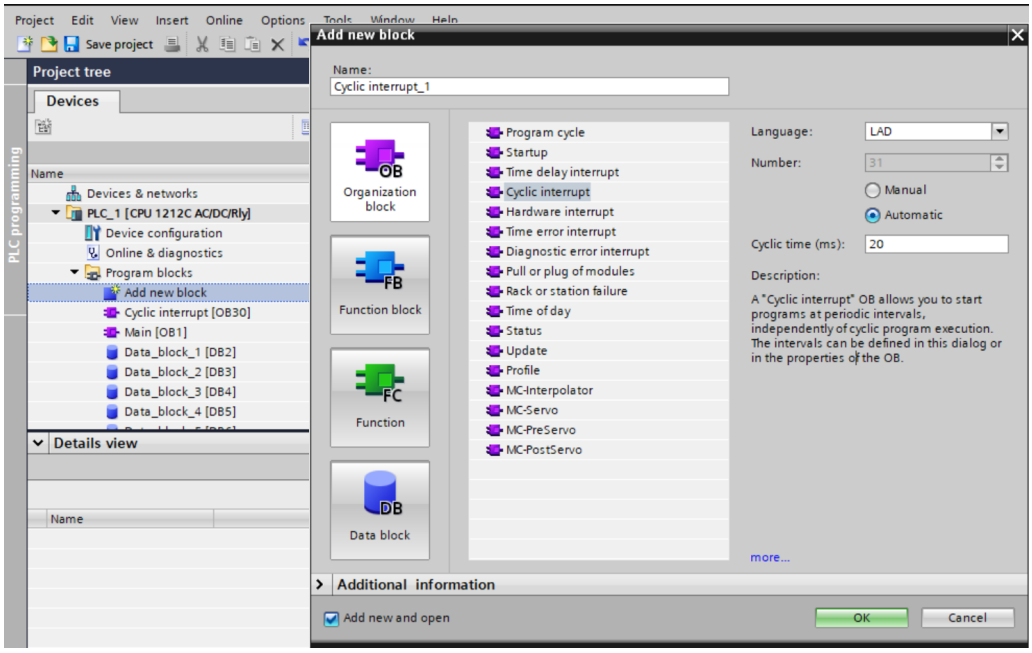
Uncheck the **Optimized block access** attribute by going to the Properties page of the Data blocks created in the previously.

Compile the data block before it is used in the ladder diagrams.

Ladder Diagram

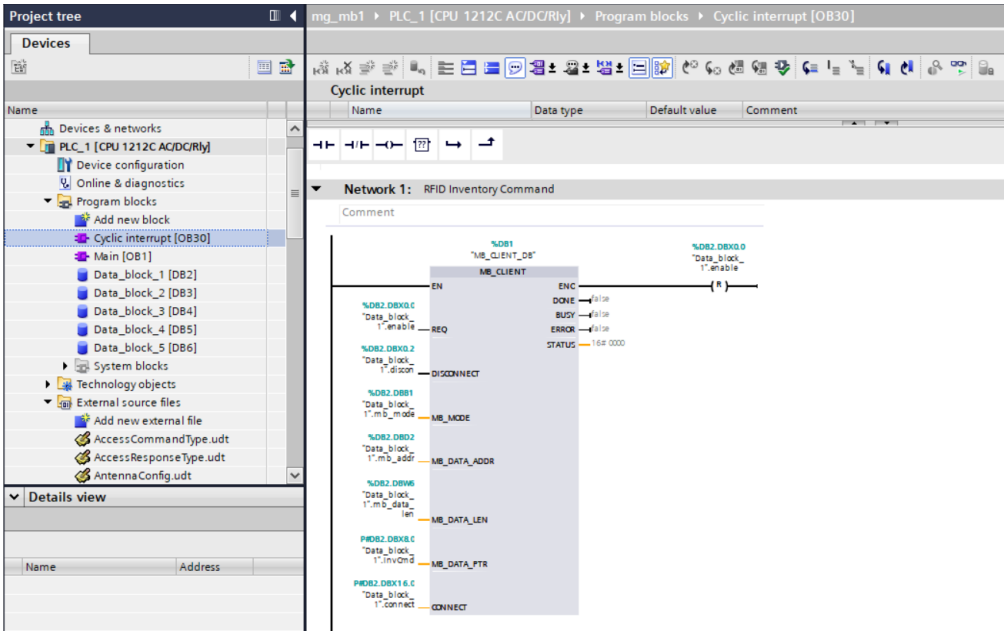
Create a Cyclic Interrupt to run the ladder logic at a defined periodicity as shown in Figure 8.

Figure 8 Cyclic Interrupt



Add the ladder diagram, shown in Figure 9, to send the Inventory Command.

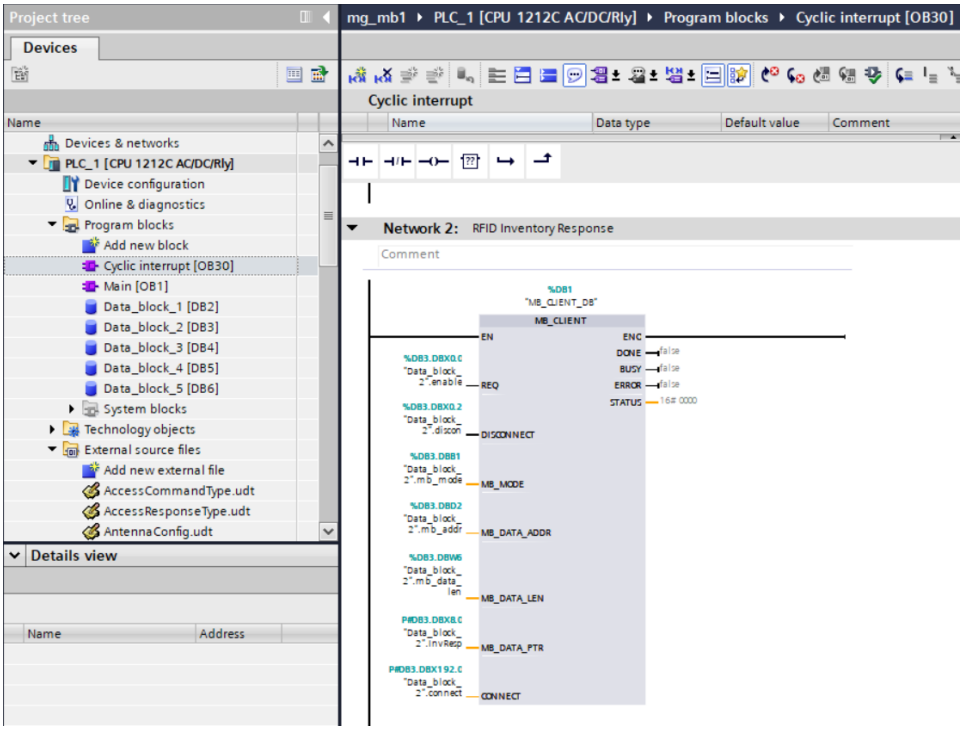
Figure 9 Ladder Diagram - Inventory Command



Each Time Data_block_1.enable is set high, Inventory Command is sent and once the MB_CLIENT Function block finishes the command, Data_block_1.enable is reset to low so that command is not sent each cycle.

Add the ladder diagram in Figure 10 to read the Inventory Response periodically.

Figure 10 Ladder Diagram - Read Inventory Response



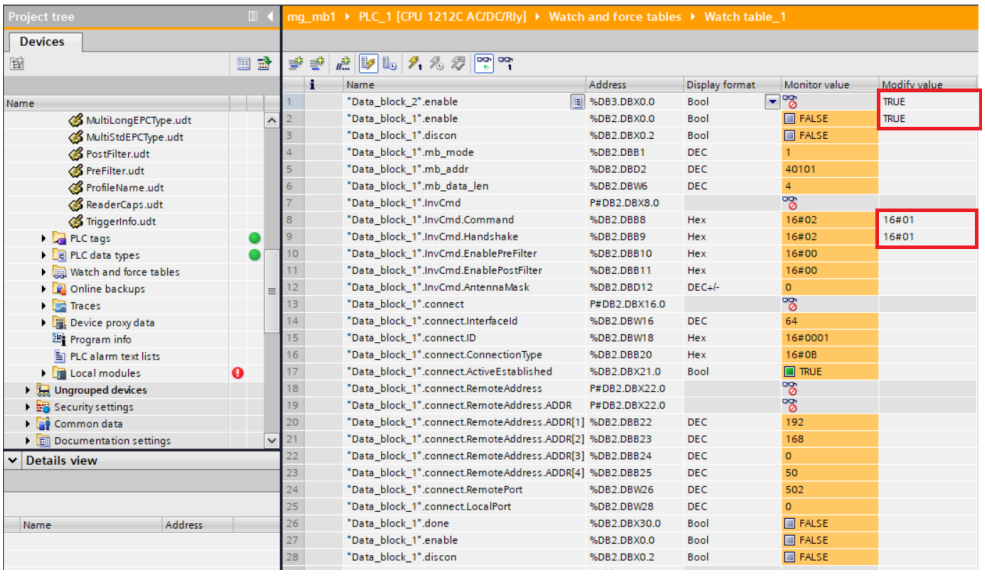
Once Data_block_2.enable is set to high, the MB_CLIENT function block reads the Inventory Response each cycle.

NOTE: Data_block_2.InvResp.Status.SeqNo is incremented only when new tag data is available from the device.

Start/Stop RFID Inventory

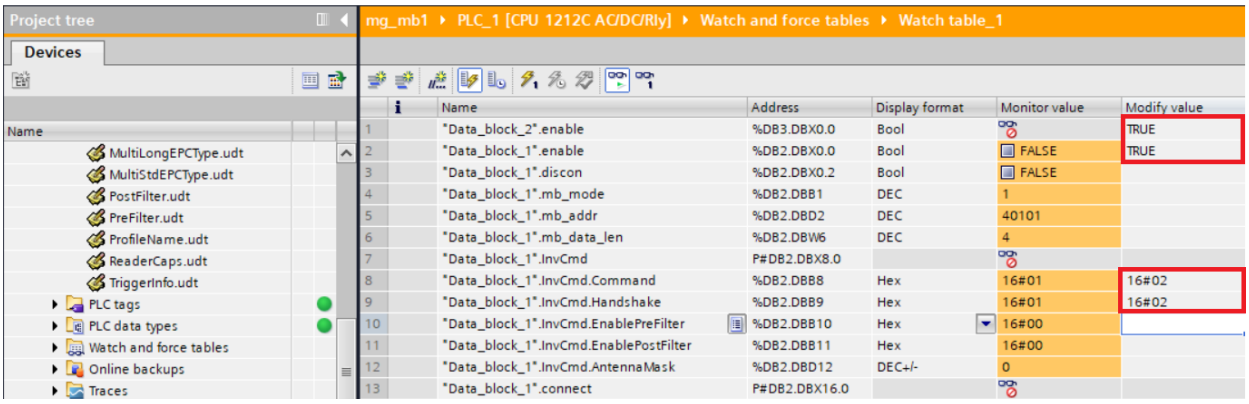
By setting Data_block_1.InvCmd.Command and Data_block_1.InvCmd.Handshake to value 1, RFID Inventory can be started using Watch Table, shown in Figure 11.

Figure 11 Watch Table - Start Inventory



By setting Data_block_1.InvCmd.Command and Data_block_1.InvCmd.Handshake to value 2, RFID Inventory can be stopped using Watch Table, shown in Figure 12.

Figure 12 Watch Table - Stop Inventory



RFID Access Operation

Siemens S7-1200 PLC and TIA Portal V15.1 is used to demonstrate the RFID Inventory Start/Stop operation.

Access operation is performed only once each time a new Access Command is received with a Handshake parameter value incremented to any value between (0 -1 27).

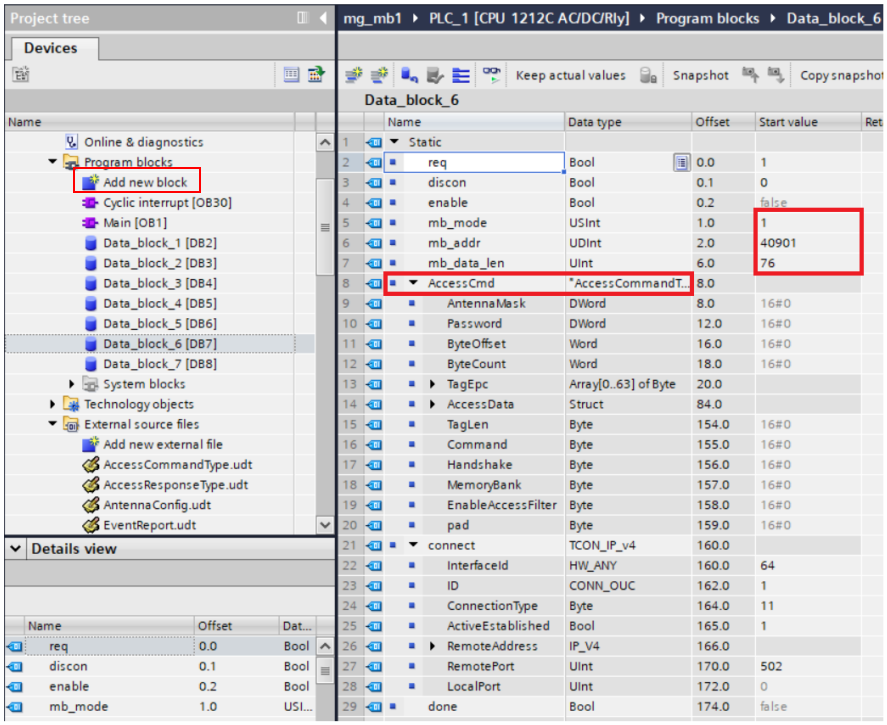
This operation is unlike the Inventory operation where the tag Inventory operation is performed continuously until the Inventory Stop Command is received or Inventory Stop condition is met as set by the Trigger Config.

Create Data Blocks and Variables to Use With Access Operation

Create Data Blocks Data_block_6 by selecting **Add new block**.

Create variables to hold Access Command and other Modbus Connection parameters as shown in Figure 13.

Figure 13 Access Command

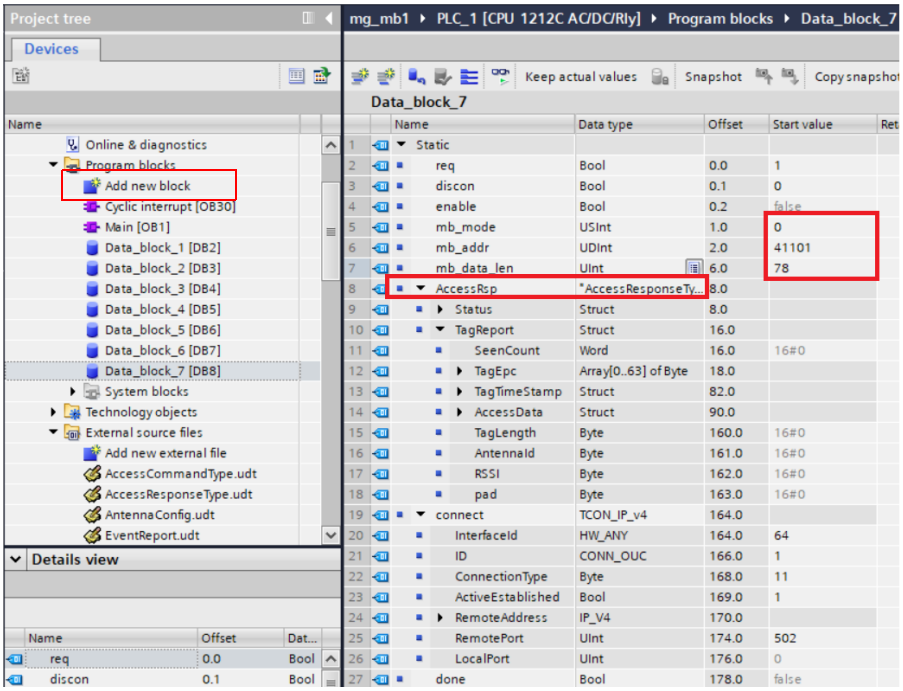


AccessCmd variable is defined of type AccessCommandType and it holds the data related to Access Command that is sent from PLC to Device using Modbus TCP Write request.

Create Data Blocks Data_block_7 by selecting **Add new block.**

Create variables to hold Access Response Command and other Modbus Connection parameters as shown in Figure 14.

Figure 14 Create Variables



AccessResp variable is defined of type AccessResponseType and it holds the data related to Access Response that is read from the device using Modbus TCP Read request.

Uncheck the **Optimized Block Access** attribute by going to the Properties page of the Data blocks created previously.

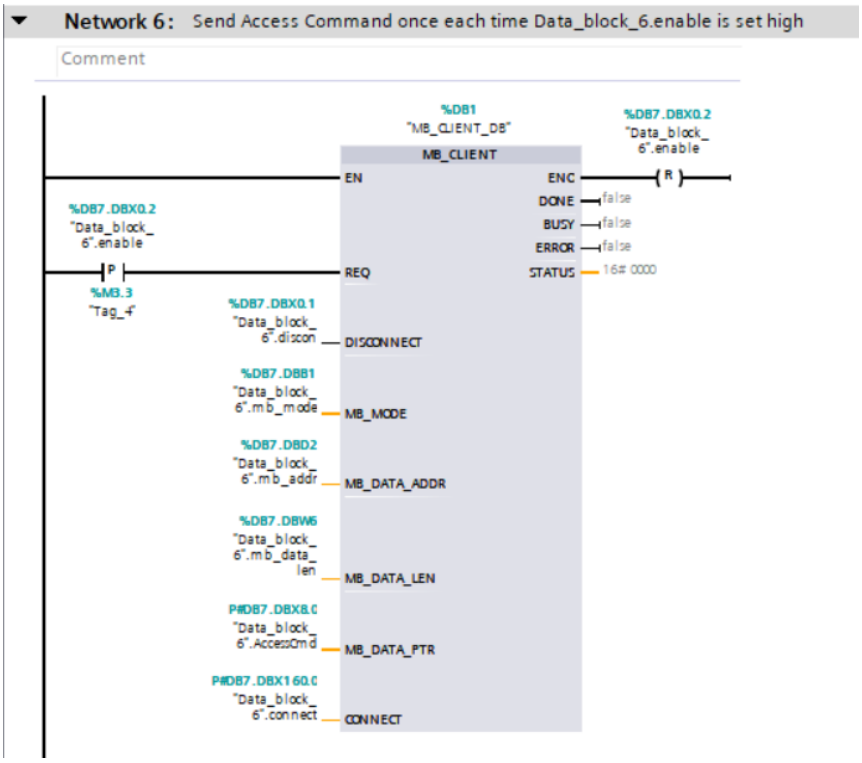
Compile the Data block before it is used in the ladder diagrams.

These data blocks are used in ladder diagrams to exchange data between PLC and device.

Ladder Diagram

Add the ladder diagram in Figure 15 to send the Modbus Write request to send Access Command data From PLC to the device once each time Data_block_6.enable is set to high.

Figure 15 Ladder Diagram - Modbus Write

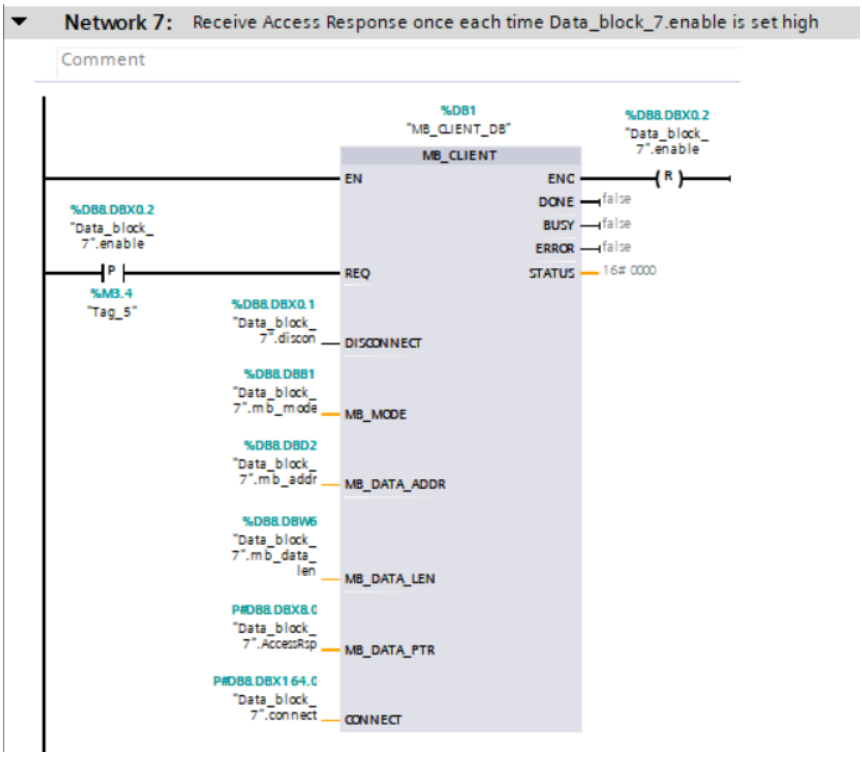


NOTE: Data_block_6.AccessCmd.Handshake value must be incremented to a value between 0-127 for the device to process each time a new Access operation is requested.

Add the ladder diagram in Figure 16 to send the Modbus Read request to receive Access Response Data from PLC to the device once each time Data_block_6.enable is set to high.

Access Response must be requested after sending the Access Command operation is complete.

Figure 16 Ladder Diagram - Modbus Read



Data_block_7.AccessResp.Status.SeqNo is incremented each time a new Response is received and Data_block_7.AccessResp.Status.ResponseHeader reflects the result of the Access operation (0 – success, 1 – Tag Found but Access operation failed, 2 – Tag was not found).

RFID Config Operation

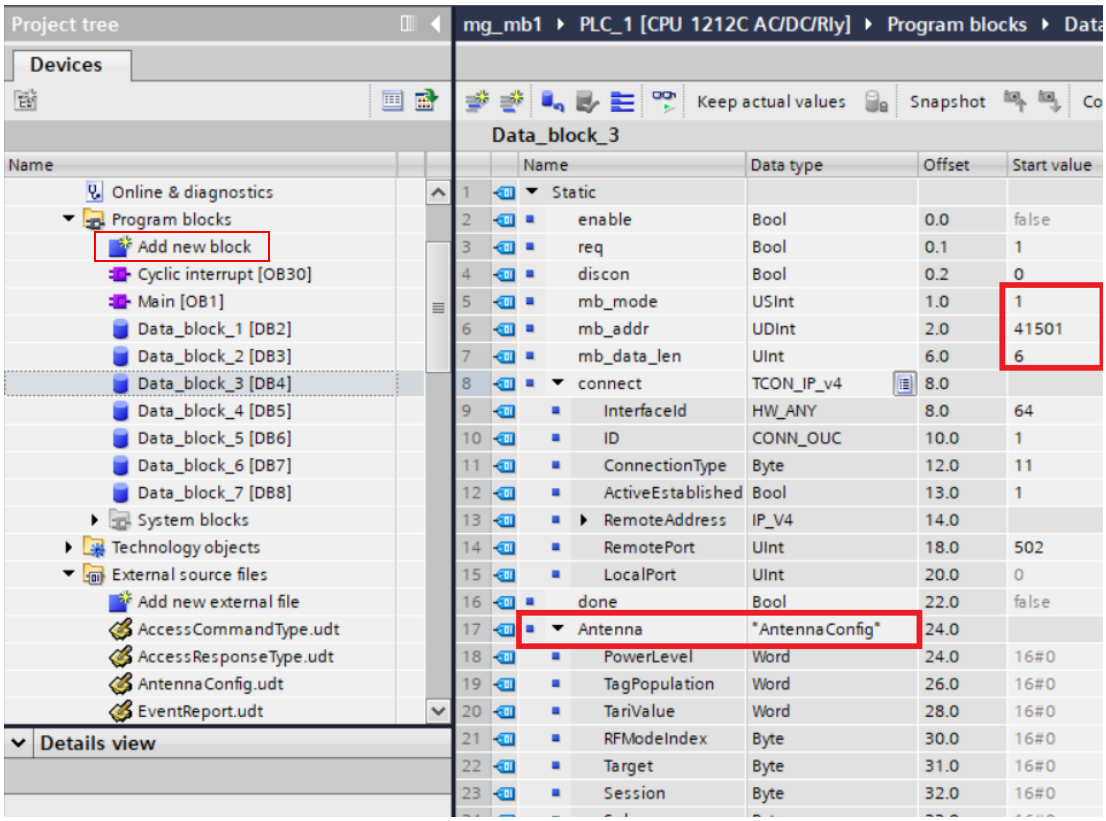
Modbus TCP Read/Write Holding Registers can be used to Set/Get RFID configurations from the FX9600 Reader.

In the example shown in Figure 17, Antenna Config is written to the FX9600 Reader using S7-1200 PLC and TIA Portal 15.1.

Create Data Blocks Data_block_3 by selecting **Add new block**.

Create variables to hold Antenna Config and other Modbus connection parameters as shown in Figure 17.

Figure 17 Antenna Config Write

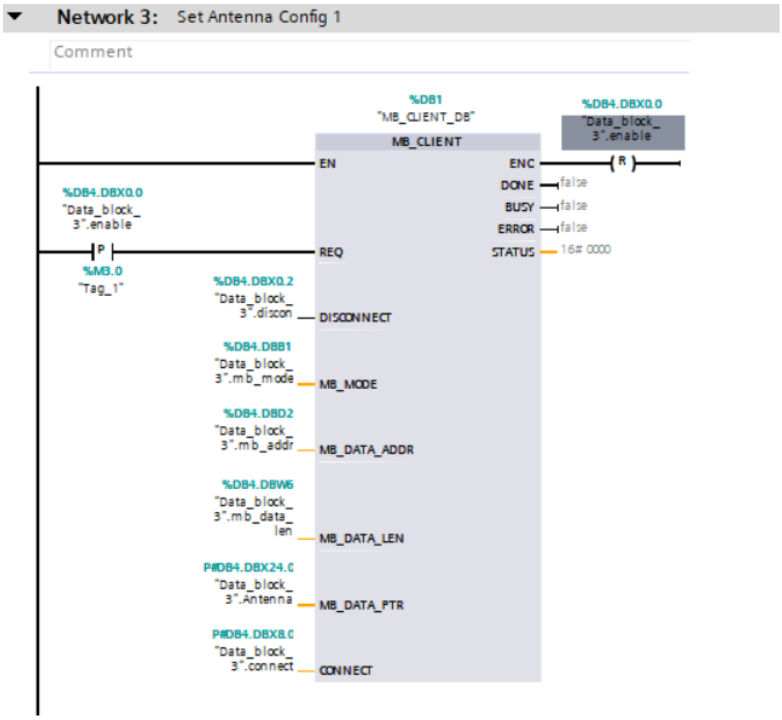


Uncheck the **Optimized block access** attribute by going to the Properties page of the Data blocks created previously.

Compile the Data block before it is used in the ladder diagrams.

Add the ladder diagram in Figure 18 to send the Modbus Write request to send Antenna Config data from PLC to the device once each time Data_block_3.enable is set to high.

Figure 18 Ladder Diagram - Send Modbus Write Request



Event Mask and Error Codes

Event Mask

Event Mask Is reported as part of Inventory Response and Access Command Response data.

Each bit in the Event Mask corresponds to an Event. EventType value could be used to fetch additional details from the the FX9600 Reader by using the Event Report RFID parameter.

Table 20 Event Mask Descriptions

Event Mask Bit Number	Event Name	EventType
0	GPI_EVENT	0
1	TAG_DATA_EVENT	1
2	BUFFER_FULL_WARNING_EVENT	2
3	ANTENNA_EVENT	3
4	INVENTORY_START_EVENT	4
5	INVENTORY_STOP_EVENT	5
6	ACCESS_START_EVENT	6
7	ACCESS_STOP_EVENT	7
8	DISCONNECTION_EVENT	8
9	BUFFER_FULL_EVENT	9
10	NXP_EAS_ALARM_EVENT	10
11	READER_EXCEPTION_EVENT	11
13	DEBUG_INFO_EVENT	13
14	TEMPERATURE_ALARM_EVENT	14

RFID Error Codes

Table 21 RFID Error Codes

Error Code	Error Type
0	RFID_API_SUCCESS
1	RFID_API_COMMAND_TIMEOUT
2	RFID_API_PARAM_ERROR
3	RFID_API_PARAM_OUT_OF_RANGE
4	RFID_API_CANNOT_ALLOC_MEM
5	RFID_API_UNKNOWN_ERROR
6	RFID_API_INVALID_HANDLE
7	RFID_API_BUFFER_TOO_SMALL
8	RFID_READER_FUNCTION_UNSUPPORTED
9	RFID_RECONNECT_FAILED
10	RFID_API_DATA_NOT_INITIALISED
11	RFID_API_ZONE_ID_ALREADY_EXITS
12	RFID_API_ZONE_ID_NOT_FOUND
100	RFID_COMM_OPEN_ERROR
101	RFID_COMM_CONNECTION_ALREADY_EXISTS
102	RFID_COMM_RESOLVE_ERROR
103	RFID_COMM_SEND_ERROR
104	RFID_COMM_RECV_ERROR
105	RFID_COMM_NO_CONNECTION
106	RFID_INVALID_SOCKET
107	RFID_READER_REGION_NOT_CONFIGURED
108	RFID_READER_REINITIALIZING
109	RFID_SECURE_CONNECTION_ERROR
110	RFID_ROOT_SECURITY_CERTIFICATE_ERROR
111	RFID_HOST_SECURITY_CERTIFICATE_ERROR
112	RFID_HOST_SECURITY_KEY_ERROR
200	RFID_CONFIG_GET_FAILED
201	RFID_CONFIG_SET_FAILED
202	RFID_CONFIG_NOT_SUPPORTED
300	RFID_CAP_NOT_SUPPORTED
301	RFID_CAP_GET_FAILED
400	RFID_FILTER_NO_FILTER
401	RFID_FILTER_INVALID_INDEX
402	RFID_FILTER_MAX_FILTERS_EXCEEDED

Table 21 RFID Error Codes (Continued)

Error Code	Error Type
403	RFID_NO_READ_TAGS
404	RFID_NO_REPORTED_EVENTS
405	RFID_INVENTORY_MAX_TAGS_EXCEEDED
406	RFID_INVENTORY_IN_PROGRESS
407	RFID_NO_INVENTORY_IN_PROGRESS
420	RFID_TAG_LOCATING_IN_PROGRESS
421	RFID_NO_TAG_LOCATING_IN_PROGRESS
422	RFID_NXP_EAS_SCAN_IN_PROGRESS
423	RFID_NO_NXP_EAS_SCAN_IN_PROGRESS
500	RFID_ACCESS_IN_PROGRESS
501	RFID_NO_ACCESS_IN_PROGRESS
502	RFID_ACCESS_TAG_READ_FAILED
503	RFID_ACCESS_TAG_WRITE_FAILED
504	RFID_ACCESS_TAG_LOCK_FAILED
505	RFID_ACCESS_TAG_KILL_FAILED
506	RFID_ACCESS_TAG_BLOCK_ERASE_FAILED
507	RFID_ACCESS_TAG_BLOCK_WRITE_FAILED
508	RFID_ACCESS_TAG_NOT_FOUND
510	RFID_ACCESS_SEQUENCE_NOT_INITIALIZED
511	RFID_ACCESS_SEQUENCE_EMPTY
512	RFID_ACCESS_SEQUENCE_IN_USE
513	RFID_ACCESS_SEQUENCE_MAX_OP_EXCEEDED
514	RFID_ACCESS_TAG_RECOMMISSION_FAILED
515	RFID_ACCESS_TAG_BLOCK_PERMALOCK_FAILED
516	RFID_ACCESS_NXP_TAG_SET_EAS_FAILED
517	RFID_ACCESS_NXP_TAG_READ_PROTECT_FAILED
518	RFID_ACCESS_FUJITSU_CHANGE_WORDLOCK_FAILED
519	RFID_ACCESS_FUJITSU_CHANGE_BLOCKLOCK_FAILED
520	RFID_ACCESS_FUJITSU_READ_BLOCKLOCK_FAILED
521	RFID_ACCESS_FUJITSU_BURST_WRITE_FAILED
522	RFID_ACCESS_FUJITSU_BURST_ERASE_FAILED
523	RFID_ACCESS_FUJITSU_CHANGE_BLOCK_OR_AREA_GROUPPASSWORD_FAILED
524	RFID_ACCESS_FUJITSU_AREA_READLOCK_FAILED
525	RFID_ACCESS_FUJITSU_AREA_WRITELOCK_FAILED
526	RFID_ACCESS_FUJITSU_AREA_WRITELOCK_WOPASSWORD_FAILED

Table 21 RFID Error Codes (Continued)

Error Code	Error Type
527	RFID_ACCESS_NXP_CHANGE_CONFIG_FAILED
528	RFID_ACCESS_IMPINJ_QT_READ_FAILED
529	RFID_ACCESS_IMPINJ_QT_WRITE_FAILED
530	RFID_ACCESS_G2V2_AUTHENTICATE_FAILED
531	RFID_ACCESS_G2V2_READBUFFER_FAILED
532	RFID_ACCESS_G2V2_UNTRACEABLE_FAILED
533	RFID_ACCESS_G2V2_CRYPTO_FAILED
601	RFID_RM_INVALID_USERNAME_PASSWORD
602	RFID_RM_NO_UPDATION_IN_PROGRESS
603	RFID_RM_UPDATION_IN_PROGRESS
604	RFID_RM_COMMAND_FAILED
605	RFID_NXP_BRANDID_CHECK_IN_PROGRESS
606	RFID_NO_RF_SURVEY_OPERATION_IN_PROGRESS
607	RFID_RFSURVEY_IN_PROGRESS
700	RFID_INVALID_ERROR_CODE

Appendix

Pre-Filter Settings Example

The FX9600 Reader supports up to 32 pre-filters.

Report Tags That Match Pattern

In Table 22 and Table 23, the Antenna Config parameter values and Pre-Filter Config parameter values are shown to apply a filter to **repor**t only tag EPCs that begin with 2F 22.

Table 22 Antenna Config - Report Tag EPCs Beginning With 2F 22

Antenna Config	Data Type	Value	Comments
PowerLevel	Word	1000 - 3000	Choose required power
tagPopulation	Word	100	Assuming 100 tags in field
TariValue	Word	0	Default
RFModeIndex	Byte	0	Default
Target	**Byte**	**0 (State A)**	**State A**
Session	**Byte**	**S1**	**Session S1**
Sel	**Byte**	**2**	**Select SL_ALL**
AntennaId	Byte	0 (All Antenna)	All antenna
Pad	Byte	0	Ignore

Table 23 Pre-Filter Config - Report Tag EPCs Beginning With 2F 22

Pre-Filter	Data Type	Value	Comments
TagPatternBitCount	Word	16	2F 22 is 2 bytes of 16 bits
BitOffset	Word	32	TAG EPC has PC (2 bytes) and CRC (2 bytes) at the beginning and the Pattern 2F 22 will only start after these 4 Bytes. Therefore, offset is 32.
Tagpattern	Byte[36]	2F, 22, 00, 00, . .	Tag EPC begins with pattern 2F, 22

Table 23 Pre-Filter Config - Report Tag EPCs Beginning With 2F 22 (Continued)

Pre-Filter	Data Type	Value	Comments
Action	**Byte**	**0**	**0 (INV_A_NOT_INV_B to report tags with this pattern, refer to 0 – 7 the Select Command Section under C1G2 Specification in:** https://www.gs1.org/sites/default/files/docs/epc/uhfc1g2_1_2_0-standard-20080511.pdf.
Target	**Byte**	**2**	**as Session S1 is selected in Antenna Config**
MemoryBank	Byte	1	EPC memory bank
AntennaID	Byte	0	Apply this filter on all antenna
PreFilterID	Byte	2	using pre-filter ID 2
Pad	Byte	0	Ignore

Ignore Tags That Match Pattern

In Table 24 and Table 25, the Antenna Config parameter values and Pre-Filter Config parameter values are shown to apply a filter to **not repor**t tag EPCs that begin with 8D F0.

Table 24 Antenna Config - Do Not Report Tag EPCs Beginning With 8D F0

Antenna Config	Data Type	Value	Comments
PowerLevel	Word	1000 - 3000	Choose required power
TagPopulation	Word	100	Assuming 100 tags in field
TariValue	Word	0	Default
RFModeIndex	Byte	0	Default
Target	**Byte**	**0**	**State A**
Session	**Byte**	**S1**	**Session S1**
Sel	**Byte**	**2**	**Select SL_ALL**
AntennaId	Byte	0 (All Antenna)	All antenna
Pad	Byte	0	Ignore

NOTE: The examples in Table 25 can be customized by keeping the parameter values (shown in bold text) and changing the remaining parameter values. For example, choose a Memory Bank other than EPC, select a specific antenna or change the Power or RF Mode Index.

The pre-filter applied takes effect when the Inventory operation is performed with the EnablePreFilter Inventory Command parameter on page 13 set to a non-zero value.

Table 25 Pre-Filter Config - Do Not Report Tag EPCs Beginning With 8D F0

Pre-Filter	Data Type	Value	Comments
TagPatternBitCount	Word	16	8D F0 is 2 bytes of 16 bits
BitOffset	Word	32	TAG EPC has PC (2 bytes) and CRC (2 bytes) at the beginning and the Pattern 2F 22 will only start after these 4 Bytes. This is why offset is 32
Tagpattern	Byte[36]	8D F0 00 00 . .	Tag EPC begins with pattern 8D, F0
Action	**Byte**	**4**	**4 (INV_A_NOT_INV_B to report tags with this pattern, refer to 0 – 7 the Select Command Section under C1G2 Specification in:** https://www.gs1.org/sites/default/files/docs/epc/uhfc1g2_1_2_0-standard-20080511.pdf
Target	**Byte**	**2**	**As Session S1 is selected in Antenna Config**
MemoryBank	Byte	1	EPC memory bank
AntennaID	Byte	0	Apply this filter on all antenna
PreFilterID	Byte	2	Using pre-filter ID 2
Pad	Byte	0	Ignore

Reading Only Unique EPC Tags

With the default trigger setting, the FX9600 Reader reports each time a tag EPC is read. The tag closer to the antenna is likely read a greater number of times. However, there are situations where it is necessary to read all the tags in visibility of the antenna only once.

The FX9600 Reader can be configured to report once every few seconds/minutes/hours using the Trigger Config. Using this feature, it is possible to read only the unique tags.

Consider a scenario where RFID tagged items are moving on a conveyor belt and in the field of Antenna Visibility for about 30 seconds. In this scenario it is possible to set the trigger settings to report all tags only once every 30 seconds. Since tagged items are moving out of Antenna Visibility within 30 seconds, each tag is reported only once.

Table 26 Trigger Config to Read Unique EPC Tags

Trigger Config	Data Type	Default Values	Default Values and Comments
PeriodicTime	DWord	0	Used when start trigger is "periodic" (millisecond)
StartDelay	DWord	0	Used when start trigger is "periodic" (millisecond)
Timer	DWord	0	When stop trigger type is "Duration" or as "Timeout" (millisecond)
PeriodicReportDuration	**DWord**	**30**	**30 = report once every 30 second**
TagEventTimeOut	Word	0	Tag Event Timeout (millisecond)
Count	Word	0	Used when stop trigger is "tag Observations" or "n attempts"
StartTriggerType	Byte	0	0 = Immediate

Table 26 Trigger Config to Read Unique EPC Tags (Continued)

Trigger Config	Data Type	Default Values	Default Values and Comments
StartGPIPortNumber	Byte	0	GPI pin number
StartEventType	Byte	0	0 = High to low
StopTriggerType	Byte	0	0 = Immediate
StopGPIPortNumber	Byte	0	GPI pin number
StopEventType	Byte	0	0 = High to low
EnableTagEvent	Byte	0	Enables tag Events like (Reports TagEvents in the Extended standard and Long Inventory Response modules)
Pad	Byte	0	Ignore