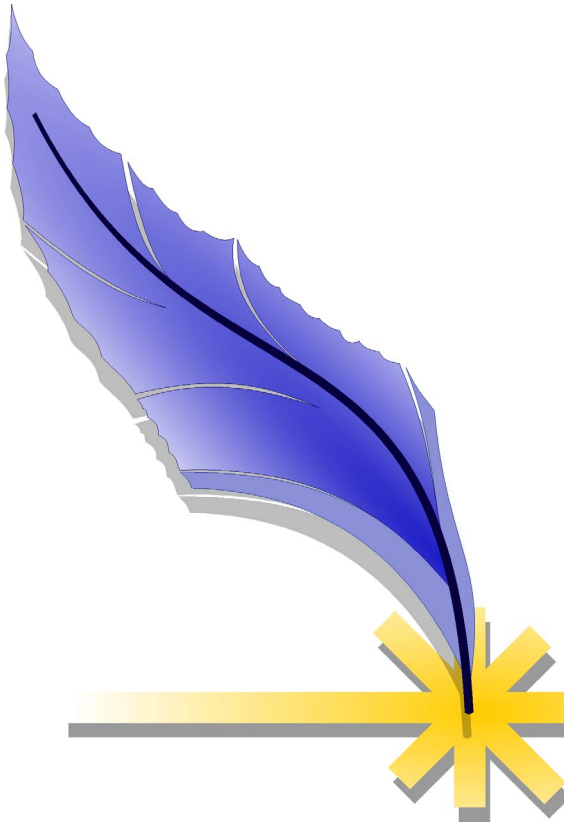
ProfiNet I/O

USER MANUAL



Communication Protocol 2.0

DATALOGIC

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Ed: 05/2020

This manual refers to Lighter™ Suite software version 7.3.1 and later

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PREFACE

ABOUT THIS MANUAL

This User Manual (UM) provides users with information on how to use the communication protocol. Other publications associated with this product can be downloaded free of charge from the website listed on the back cover of this manual.

NOTE

Datalogic recommends to read this User Manual carefully before performing any kind of operation both on the PLC and the Laser Marker. In case of any doubts, please contact your local Datalogic Technical Support or fill in the Support Web form on the Datalogic website.

This User Manual has been developed for PLC programmers who intend to connect a Datalogic Laser Marker to a PLC via ProfiNet I/O, in order to handle the Laser Marker and its operations following the flow of the Production Chain.

All the screenshots and tests made as a reference for the creation of this User Manual were made using the following versions of HW and SW:

ELEMENT USED	VERSIONING
PLC	Siemens™ S7-1200 CPU 1214C DC/DC/DC Article no. 6ES7 214-1AG31-0XB0 Firmware rev. 3.0
PLC programming SW tool	TIA Portal v.13 SP1
Datalogic Laser Marker	Arex™ 430 PRO
Lighter™ Suite version	Lighter™ Suite 7.2.0

Manual Conventions

The symbols listed below are used in this manual to notify the reader of key issues or procedures that must be observed when using the laser marker:

NOTE

Notes contain information necessary for properly diagnosing, repairing and operating the laser marker.

CAUTION

The CAUTION symbol advises you of actions that could damage equipment or property.

WARNING

The WARNING symbol advises you of actions that could result in harm or injury to the person performing the task.

TECHNICAL SUPPORT

Support Through the Website

Datalogic provides several services as well as technical support through its website. Log on to (www.datalogic.com).

For quick access, from the home page click on the search icon, and type in the name of the product you're looking for. This allows you access to download Data Sheets, Manuals, Software & Utilities, and Drawings.

Hover over the Support & Service menu for access to Services and Technical Support.

CHAPTER 1
SETUP OVER PROFINET I/O NETWORK

NOTE

Embedded PrefiNet I/O connection is available only after activating a dedicated Lighter™ SW License. Please contact your DATALOGIC Sales Representative or distributor to purchase one.

NOTE

Embedded ProfiNet I/O is available starting Lighter™ Suite 7.2.0.

In order to have ProfiNet I/O connection between the PLC and the Datalogic Laser Marker, it is necessary to set up both elements: this chapter wants to show the necessary steps and the choices which the PLC programmer can make according to his needs, in order to have communication between the two ProfiNet I/O devices.

CONFIGURING THE LASER MARKER FOR USE OVER PNIO

Some operations must be performed on the Laser Marker to make it work on a Profinet I/O network: the PLC programmers will have to assign a Device Name to each Laser Marker and if necessary, make some changes to the firewall rules; moreover, according to its application, the user will have to choose the size of the input and output memory areas. These settings are described in the following paragraphs.

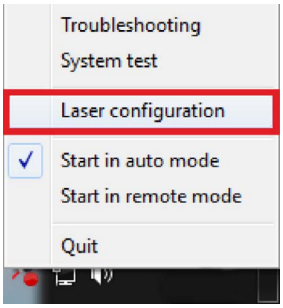
Basic network settings of Laser Engine

The Datalogic Laser Marker can be discovered on a ProfiNet I/O network only if a number of parameters on the Laser Marker and on the PLC match. The parameters which should match are the following:

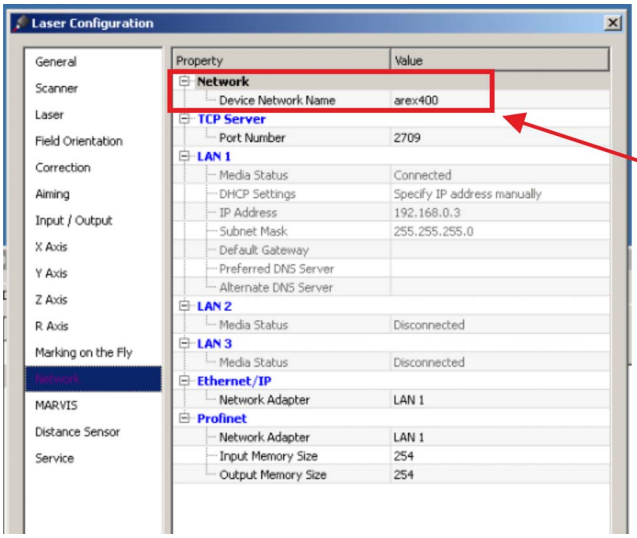
- Device Name
- Size of Input and Output memory maps

The **Device Name** of the Laser Marker can be changed following these steps:

1. Open '**Laser configuration**' by right-clicking the Laser Engine icon in the Windows tray bar.



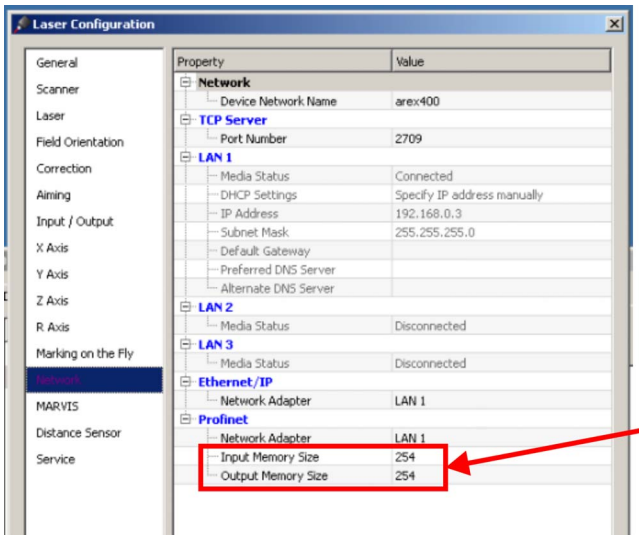
2. Once the Laser Configurator is open, select the 'Network' voice of the menu from the left side of the interface and the Device Name can be found under the voice 'Device Network Name'.



Please follow these rules when selecting the Device Name:

1. Use only Alphanumerical characters ('a'...'z' and '0'...'9'), excluding capital letters, '-' and '.'
2. The Device name must begin with a letter ('a'...'z')

3. The '**Input Memory size**' and '**Output Memory size**' have to be set also inside the '**Profinet**' section, choosing from the 3 possible sizes expressed in Bytes (64, 128 or 254).



Datalogic recommends to use the same size for Input and Output Memory Maps.
Moreover, depending on the size of each Memory map chosen, the Response/Request Data Field will be able to contain a limited amount of data requested by the command which is needed in this application (e.g. by choosing a 64 byte Output Memory Area, the PLC will only have 8 bytes, equal to 8 characters, to point the name of the marking layout when executing a 'Open Document from Device' command)

4. Once these parameters have been set, press '**Apply**' followed by '**OK**'.

NOTE

The network adapters in Control Panel > Network Connections must not be renamed.

Advanced network setting of the Laser Marker

All Datalogic Laser Markers are controlled by the Windows Firewall; in order to establish a ProfiNet I/O connection between the PLC and the Laser Marker, the user should **allow all Inbound and Outbound traffic regarding** "`LaserEngine.exe`".

Check that the firewall settings are correct and that the Inbound and Outbound rules regarding "`LaserEngine.exe`" are present, otherwise follow the procedure below:

NOTE

A major Lighter™ Suite upgrade requires modification of the firewall Inbound and Outbound rules regarding "`LaserEngine.exe`" due to the change of the "`LaserEngine.exe`" folder.

- System running Windows 7:

  - Skip to step 1

- System running Windows 10:

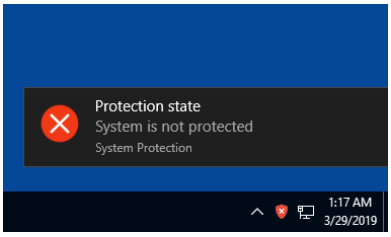
  - **Disable system protection** (see laser marker User's Manual -> Disable the system protection...)

NOTE

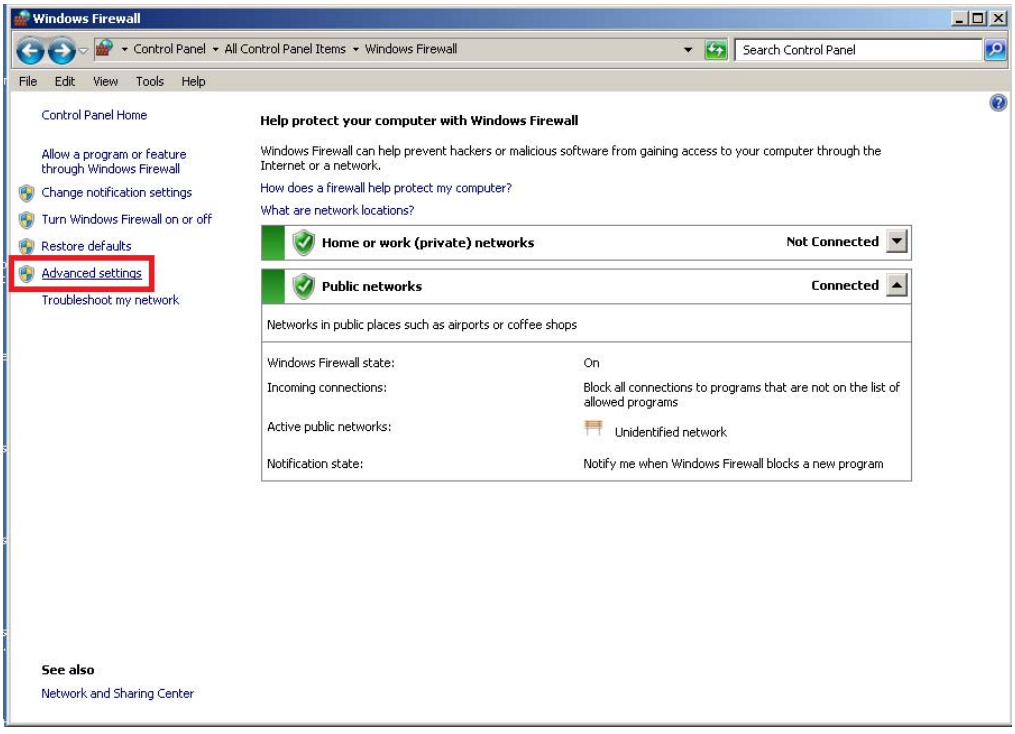
When the System Protection is disabled the system is not protected against disk corruption or malware attacks. Disable the protection only for the time necessary to make disk changes.

- Wait for the operating system to restart

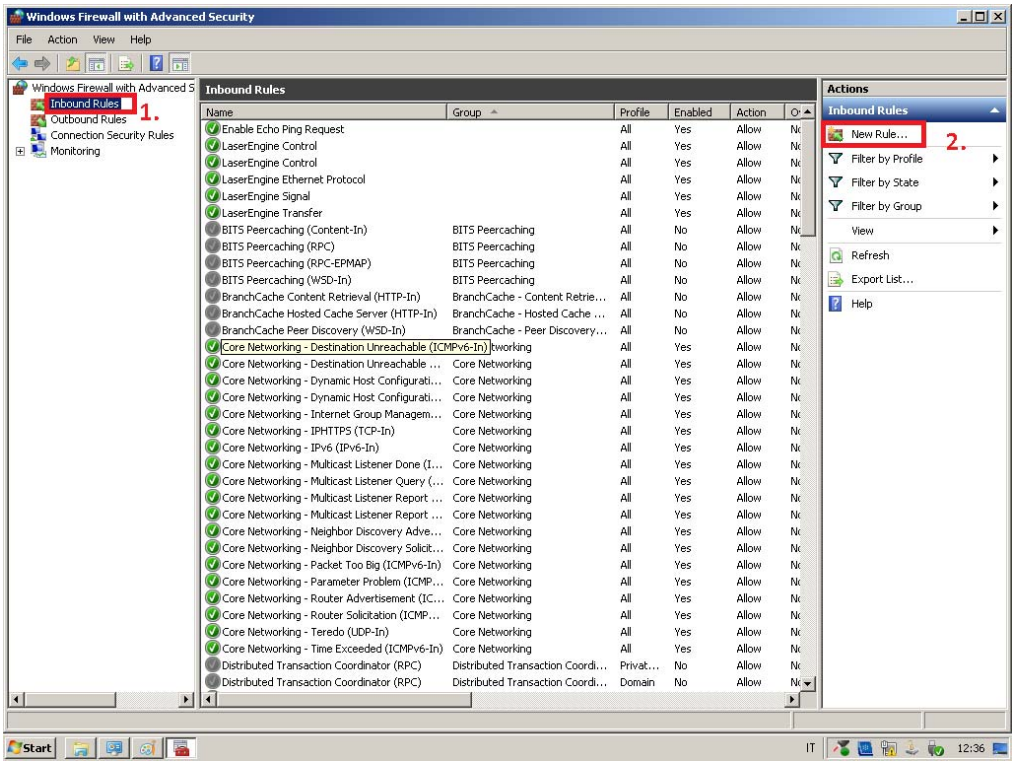
- Check that the System protection is disabled (red icon):



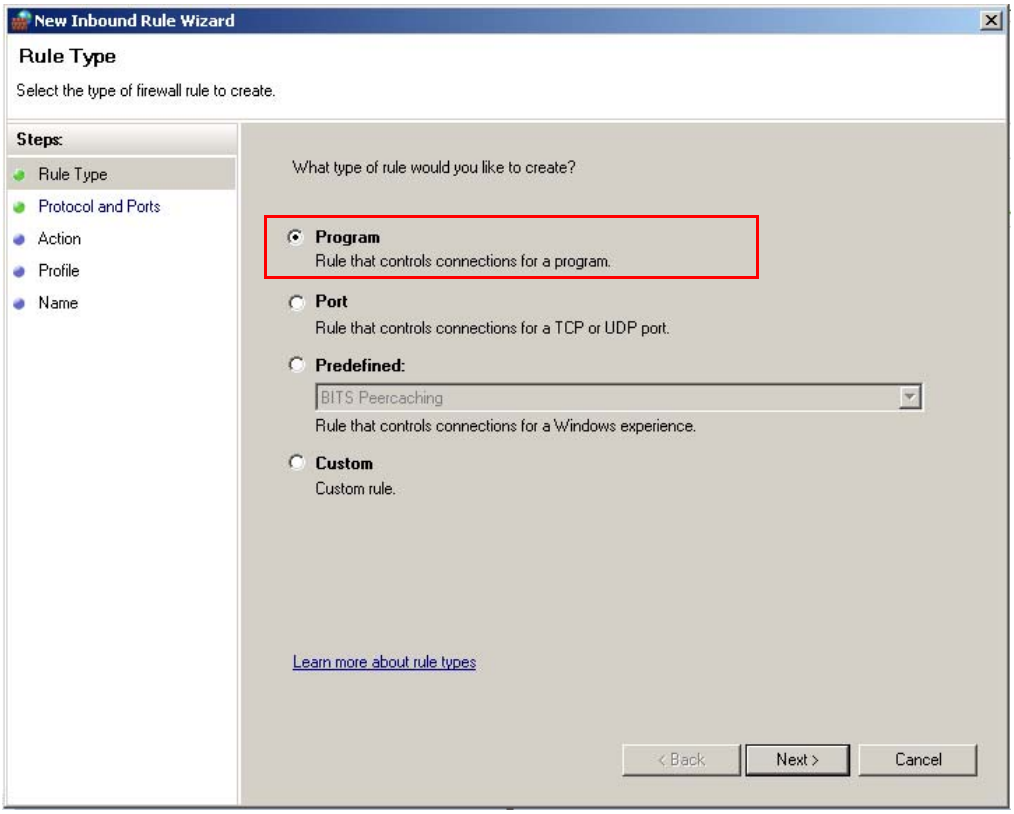
1. Go to **Control Panel -> Windows Firewall** and then select '**Advanced settings**'.



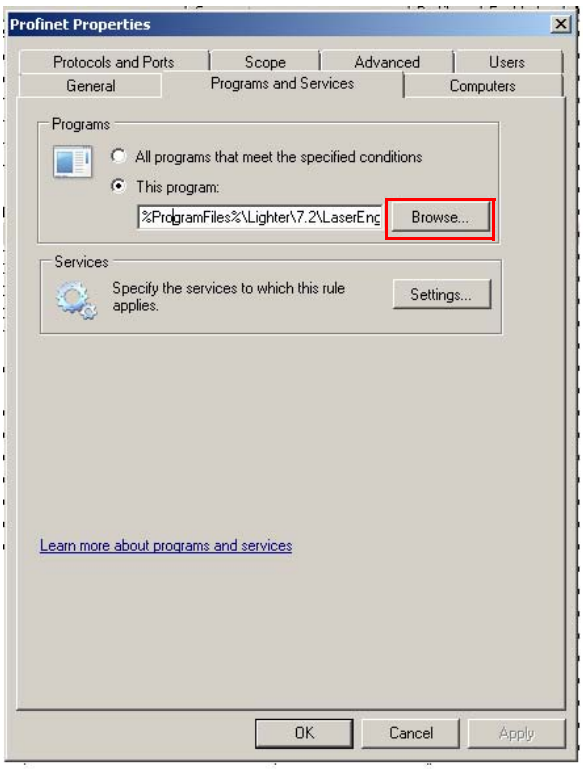
2. New Inbound and Outbound rules need to be set for the '`LaserEngine.exe`' program: click on '**Inbound Rules**' and then select '**New Rule...**'.

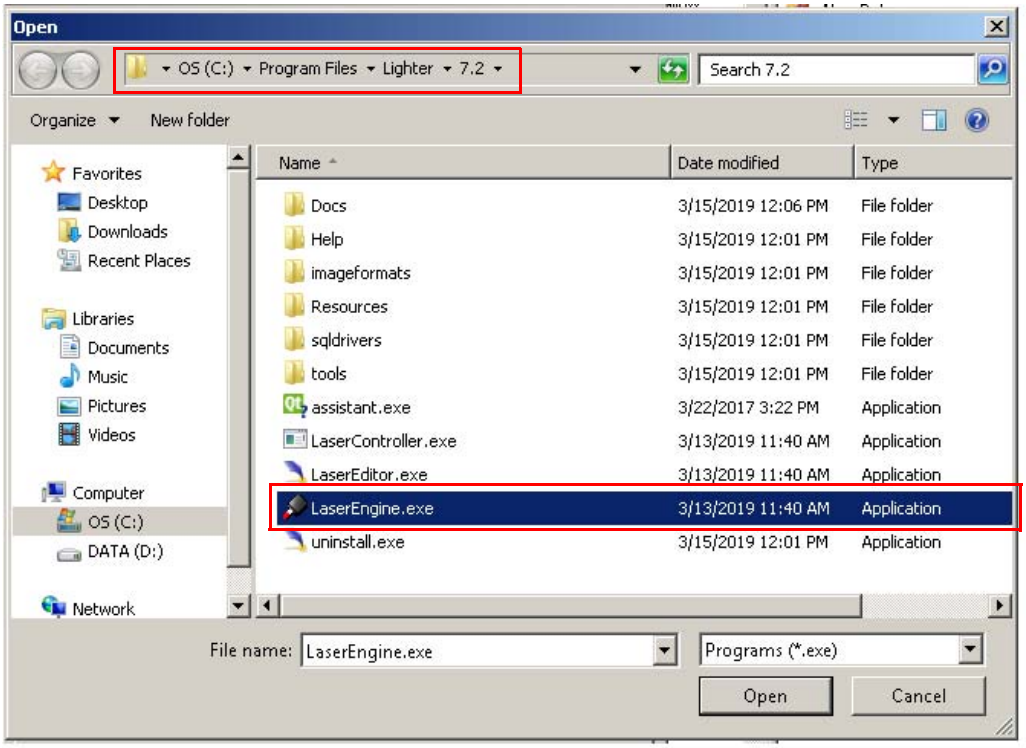


3. A Wizard GUI will guide you through the procedure: select '**Program**'.

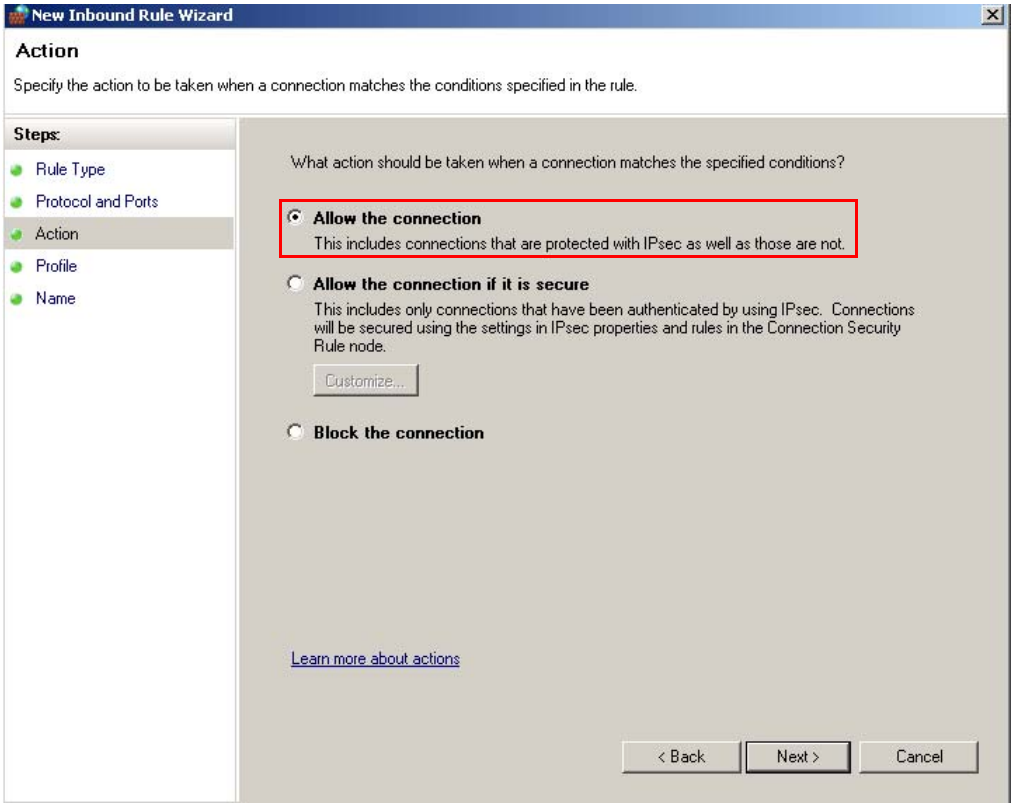


4. In the **Program And Services** tab, browse towards the 'LaserEngine.exe' application (*C:\Program Files\Lighter\X.x* for systems running Windows7 and *C:\Program Files (x86)\Lighter\X.x* for systems running Windows 10)

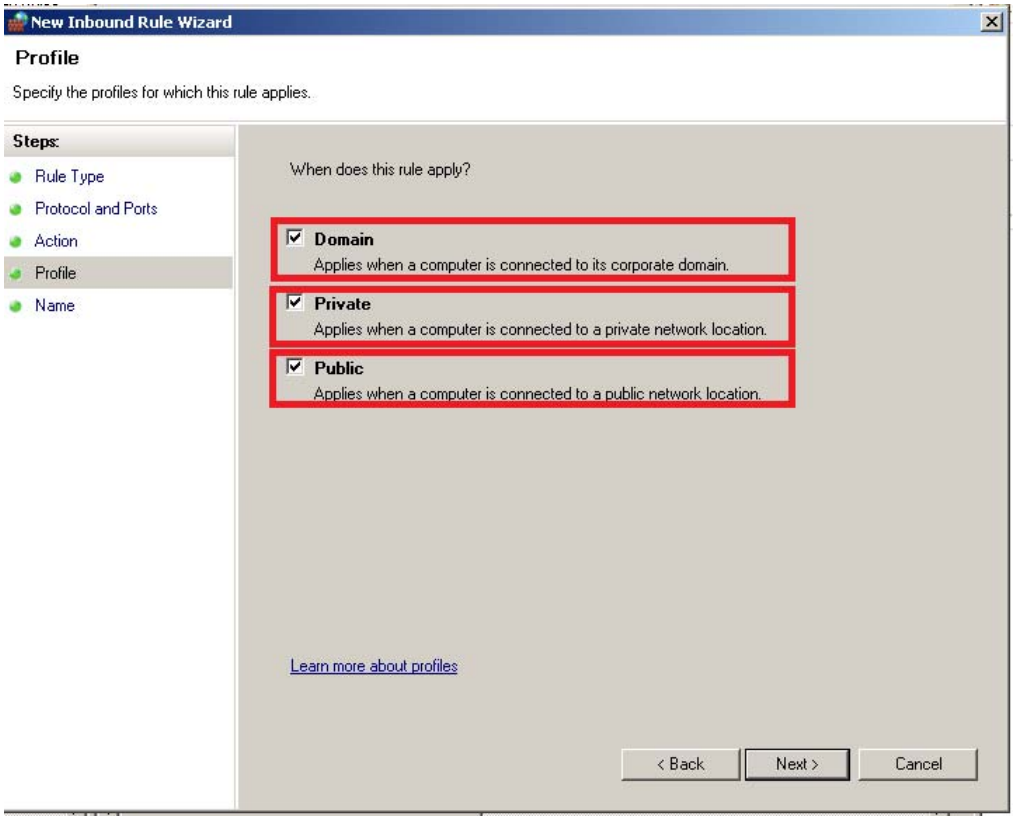




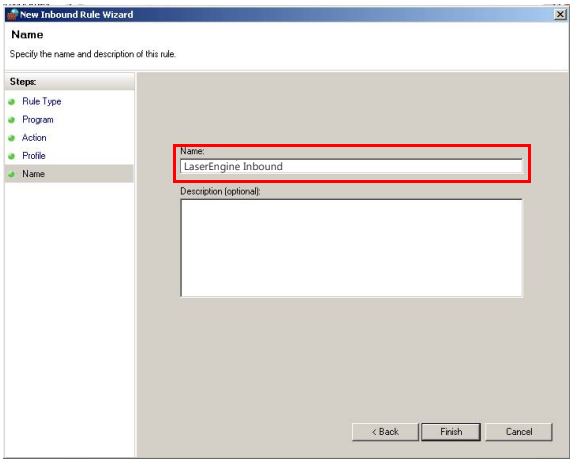
5. Select '**Allow the connection**', then press '**Next**'.



6. Select '**Domain**', '**Private**' and '**Public**', then press '**Next**'.



7. Give this rule a recognizable name.



8. Now the Outbound rule must be set, making sure that all connection would be allowed also in an Output direction. Basically, the procedure must be repeated from point 2 to point 7, selecting '**Outbound Rules**' at point 2 of the procedure. Once this is done, the created input and output rules will be seen along with all the other firewall rules.

To make all these settings permanent on the Laser Marker, please follow this procedure:

- System running Windows 7:

  - Close all the open windows

  - Double click on the '`Save-Data.bat`' icon, present in the Desktop

  - Restart Windows.

- System running Windows 10:

  - Close all the open windows

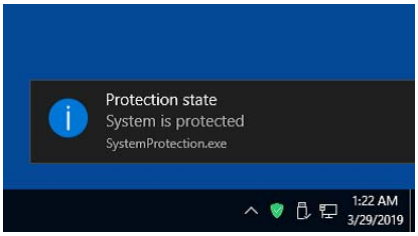
  - **Enable system protection** (see laser marker User's Manual -> Enable the system protection...)

NOTE

When the System Protection is disabled the system is not protected against disk corruption or malware attacks.

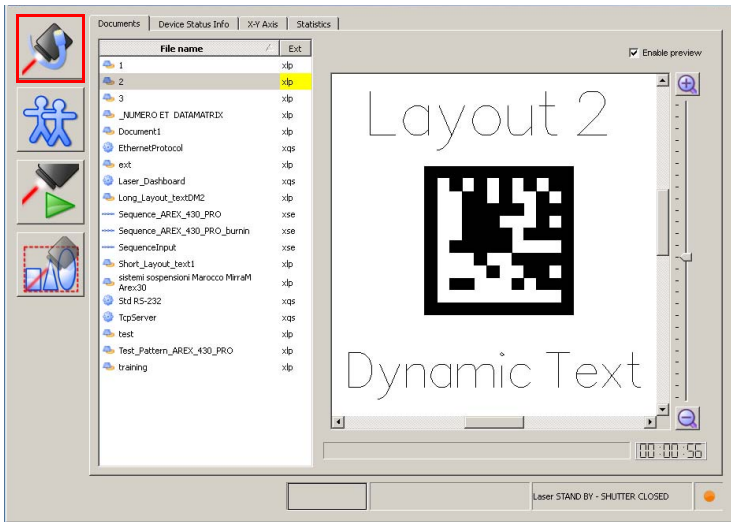
  - Wait for the operating system to restart

  - Check that the System protection is enabled (green icon):

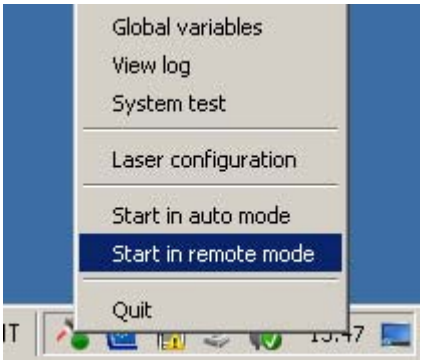


Set Laser Engine in remote mode

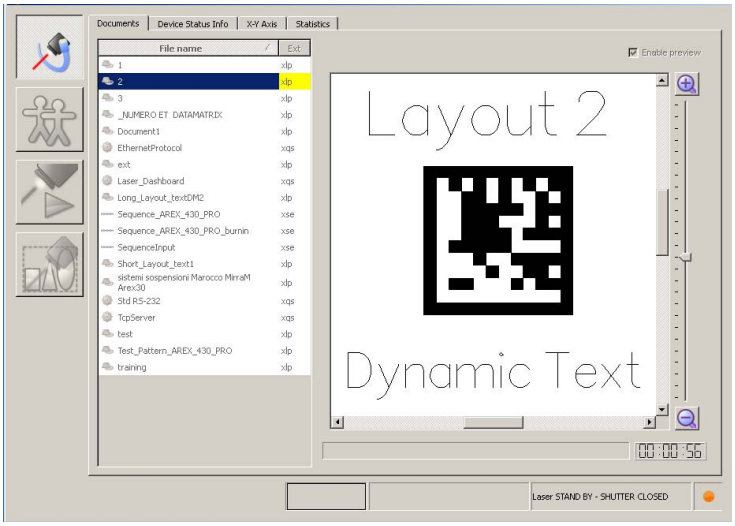
To activate ProfiNet I/O communication on the Datalogic Laser Marker side, it is sufficient to set Laser Engine in Remote Mode, by clicking on the indicated Push Button from the Laser Engine GUI:



In order to have the Laser Engine starting in Remote Mode also after the Laser Marker has rebooted, enable '**Start in remote mode**' from the Laser Engine icon in the Windows tray bar.



When in Remote Mode, the Laser Engine GUI will look like this (having all the Push Buttons disabled except for the one which brings Laser Engine back to Local Mode).



Disabling the WinSAT task

WinSAT is a Windows Scheduled Task, which is executed weekly every Sunday at 1 AM (by default, on our Embedded PCs): more information about this task can be found at the following link https://en.wikipedia.org/wiki/Windows_System_Assessment_Tool

The execution of this Task can create issues to the Laser Marker during communication with PLC, as it interferes with the communication stacks which are included inside Lighter: because of this, if the Laser Marker is going to be connected to the PLC via Profi-Net I/O, Ethernet IP, TcpServer, the user must manually disable this scheduled task, so to be sure that the PC on board the Laser Marker doesn't execute such task.

Check that the Laser Marker has the WinSAT task disabled. If not, follow these steps:

- System running Windows 7:

  - Skip to step 1

- System running Windows 10:

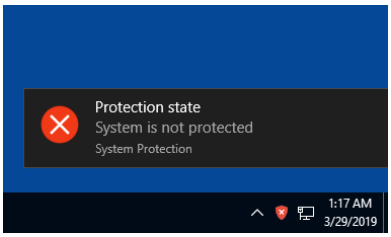
  - **Disable system protection** (see laser marker User's Manual -> Disable the system protection...)

NOTE

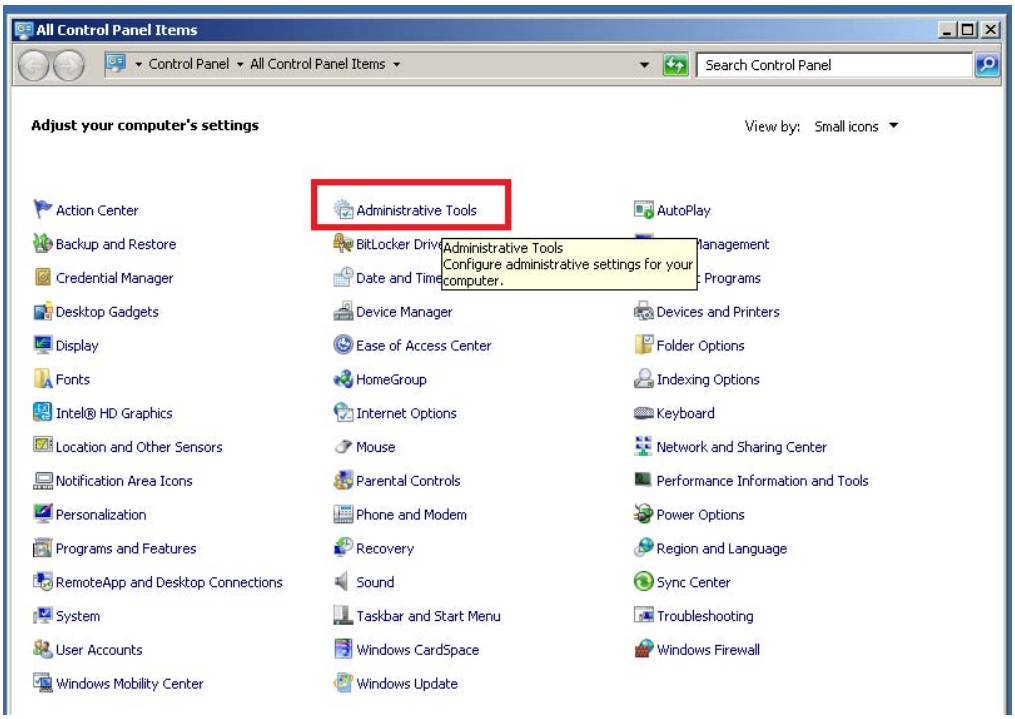
When the System Protection is disabled the system is not protected against disk corruption or malware attacks. Disable the protection only for the time necessary to make disk changes.

- Wait for the operating system to restart

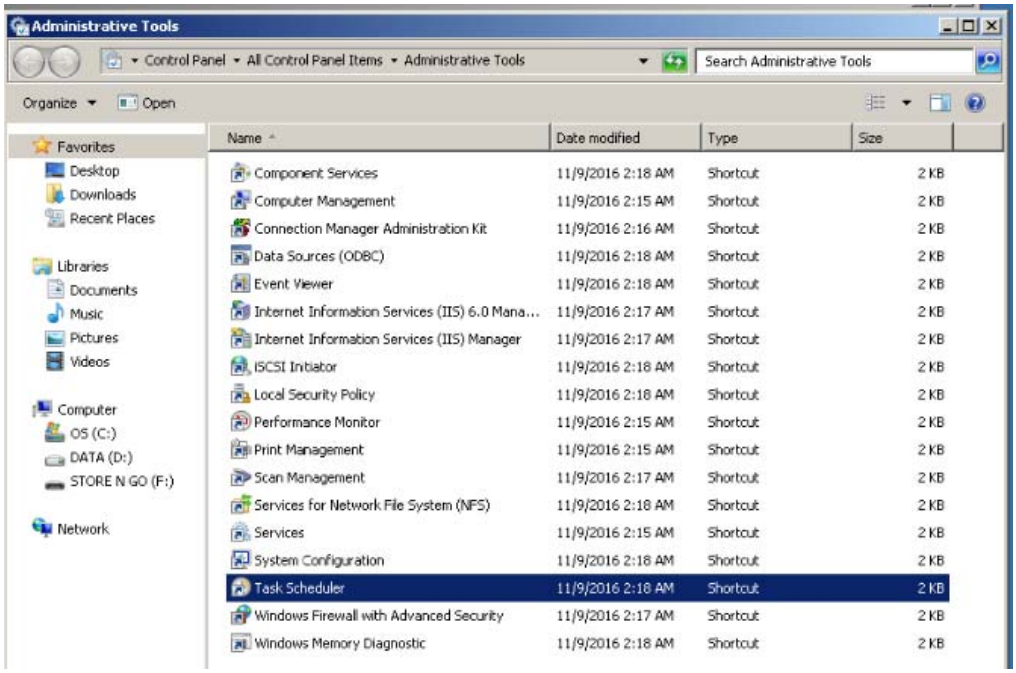
- Check that the System protection is disabled (red icon):



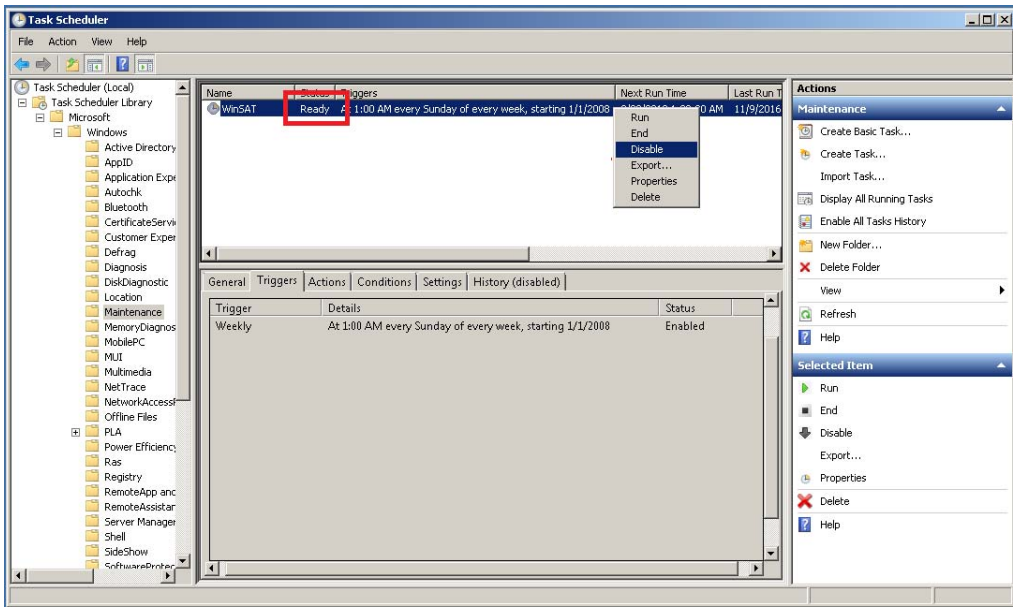
1. Open the '**Administrative Tools**' from the Control Panel:



2. Select the '**Task Scheduler**':



3. Follow the filepath Task Scheduler (*Local)\Task Scheduler Library\Microsoft\Windows\Maintenance* and check WinSAT. If the Status is '**Ready**', then right-click on the WinSAT task and select '**Disable**'.



To make all these settings permanent on the Laser Marker, please follow this procedure:

- System running Windows 7:

  - Close all the open windows

  - Double click on the '`Save-Data.bat`' icon, present in the Desktop

  - Restart Windows.

- System running Windows 10:

  - Close all the open windows

  - **Enable system protection** (see laser marker User's Manual -> Enable the system protection...)

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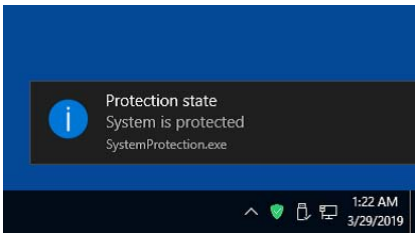
When the System Protection is disabled the system is not protected against disk corruption or malware attacks.

  - Wait for the operating system to restart

  - Check that the System protection is enabled (green icon):



CONFIGURING A SIEMENS™ S7-1200 CONTROLLER FOR USE OVER PNIO

In order to create a Datalogic Laser Marker new ProfiNet I/O node in an already existing TIA Portal project, it is necessary to install the GSDML file.

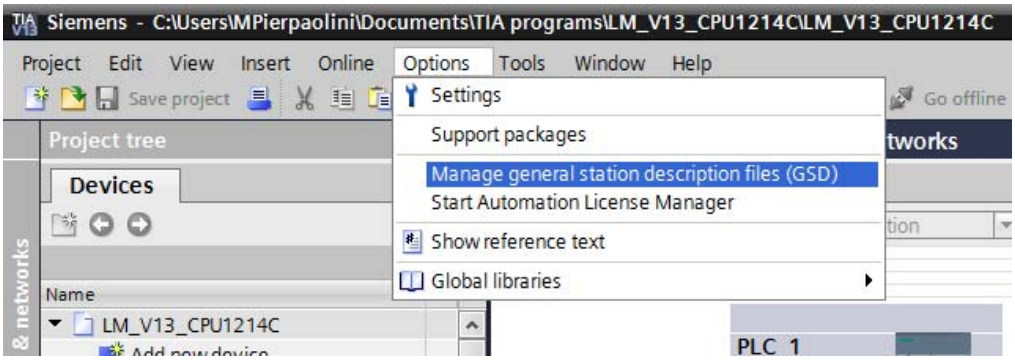
To get the GSDML file suitable for Lighter™ Suite, visit www.datalogic.com > Products > Laser Marking Systems, or consult DATALOGIC Technical Support.

Once the new ProfiNet I/O node has been imported inside the project, there are some parameters which need to be set before starting to work on the data exchange between the PLC and the Laser Marker.

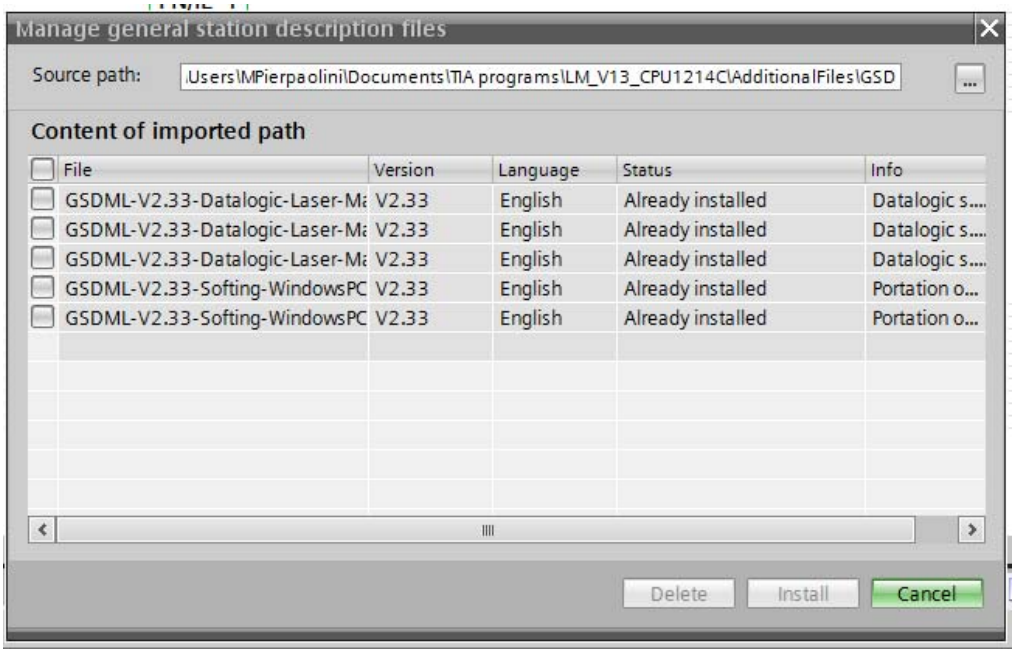
Datalogic provides also a sample TIA Library for integration of the basic Laser Marker PNIO functionalities: if needed, do not hesitate to contact your local Datalogic Technical Support, who will share the available material with you.

Creating a PNIO node using the GSDML file

Select the '**Manage general station description files (GSD)**' from the Options Menu.



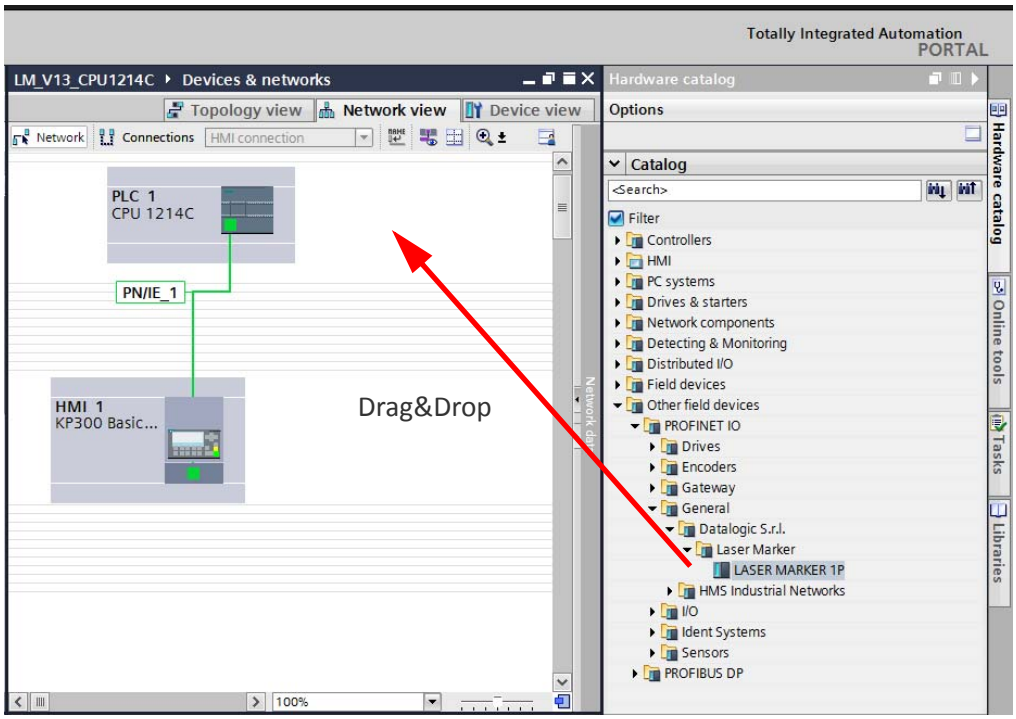
Now follow the steps in order to install the GSDML file, indicating the filepath of the GSDML file on the PC where TIA is running.



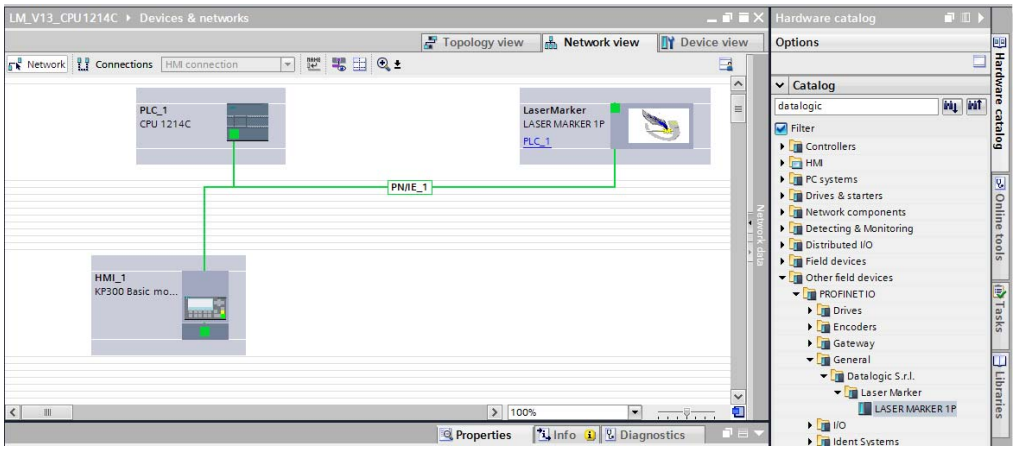
NOTE

The default Request Time Interval for a Laser Marker device is 128 ms. This value is saved inside the GSDML file, and must not be modified from TIA Portal.

Once the GSDML installation is complete, you will be able to import a 'Laser Marker' device from the HW catalog under this file path: **Other field devices -> PROFINET IO -> General -> Datalogic S.r.l. -> Laser Marker -> LASER MARKER 1P**. To do so, drag & drop the device from the Hardware Catalog into the HW configuration of the device.



Once you have imported the device into the HW configuration of your project, you will need to link it to the PLC which will communicate with the Datalogic Laser Marker.



Configuring the Laser Marker PNIO node TIA Portal

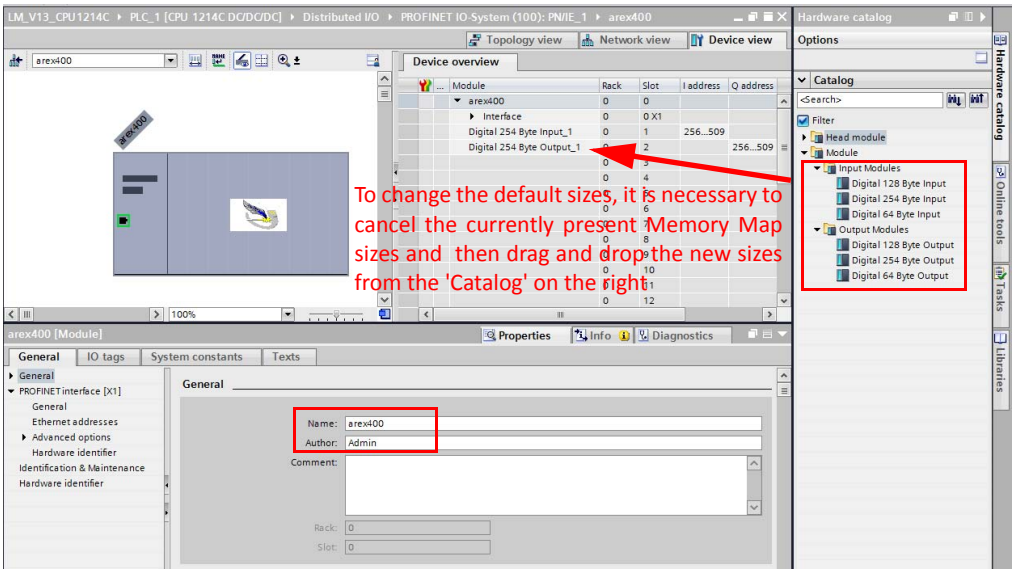
Once the Laser Marker node has been imported, the user has to check or change the settings of this node.

By double-clicking on the Laser Marker from the 'Network View' of the HW configuration, the interface will switch to Device View. From here the user is able to:

- assign a new **Device Name** to the Laser Marker PNIO node
- choose the size (64, 128 and 254 Bytes) **of the Input and/or Output Memory Maps**

A new Device Name can be entered in the Module properties in the section 'General'->'Name'.

Regarding Input and Output Memory sizes, users will be able to check the default size of both areas (254 bytes) from the 'Device View': if the user wants to change such memory sizes, he can cancel the default settings from the 'Device overview' and then drag and drop into the Device Overview one of the possible sizes for the Input and Output Modules.



NOTE

Both the Device Name and the sizes of the Input and Output memory Maps must be the same as the ones set inside the Laser Configurator (see page 2).

CHAPTER 2

CYCLIC COMMUNICATION BETWEEN THE PLC AND THE DATALOGIC LASER MARKER

A ProfiNet I/O network allows the PLC to monitor and command each device to which it is connected: in order to do so, there needs to be a continuous flow of information between the PLC and each device on the network. After every Update Time, whole memory areas are exchanged from the Laser Marker in one way (Laser Marker -> PLC) and in the other (PLC -> Laser Marker) so to accomplish this behavior. In order to properly command the Laser Marker and to give the PLC an appropriate feedback, all the information must be entered in precise portions of these memory maps, which are exchanged periodically between the devices.

The memory area which is generated by the Laser Marker towards the PLC will be called **Input Assembly Memory Map**, while the memory area generated by the PLC towards the Laser Marker will be called **Output Assembly Memory Map**.

Once connection is established between the PLC and the Datalogic Laser Marker, most certainly the PLC programmer will want to program the PLC so to command the Laser Marker by giving it an automatic flow of commands: this process will include the handling of a simple protocol handshake, regarding the use of different bits, both on the Input and Output Assembly Memory Map:

- **Command Bit**: single bit of the Output Memory Map, which through its position represents the command which the PLC is requesting the Laser Marker to execute.
- **Mirroring Bit**: single bit - of a group of bits - on the Input Memory Map, which through its position and value notifies the PLC that the execution of the requested command has started (when HIGH) and completed (when LOW), if the Handshake is followed.

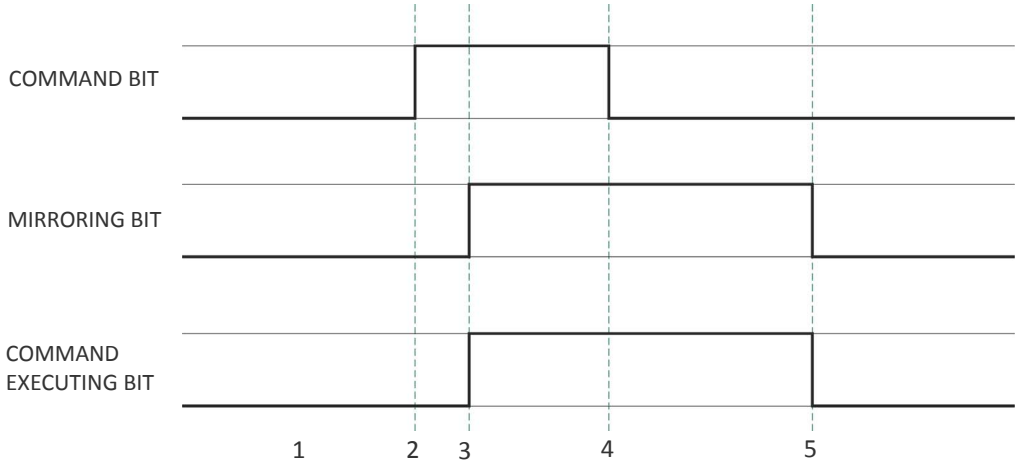
NOTE

Every Command Bit has a matching Mirroring Bit: this means that whatever command the PLC requests the Laser Marker to execute by setting a Command Bit 0->1, there will always be a dedicated Mirroring bit which informs the PLC about executing stage of the specific command.

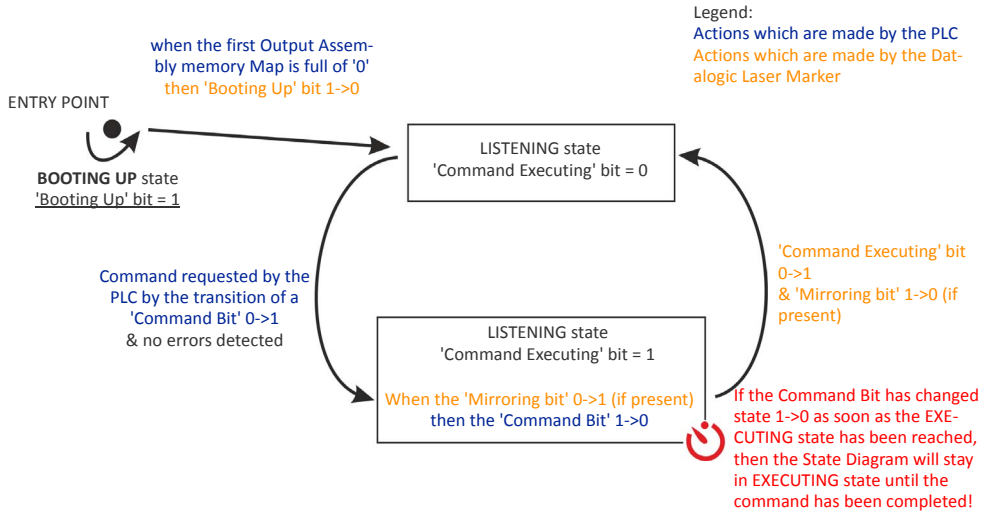
In order to make sure that the command is fully executed by the laser, a simple Handshake must be respected by the PLC programmer. Here are the 5 steps:

1. Check the State of the Laser System (address 0 and 1 of the Input Memory Map) and that the protocol is still running correctly (address 2 and 3 must be '0' in DEC format): see the list of “Possible errors” on page 25.
2. Set the Command Bit 0->1 (e.g. if the requested command is to Start Marking, then the Command Bit is bit 0 at Address 0, which volue must now pass 0->1), and if necessary also enter the necessary data in the Request Data field along with the Request Data size.
3. The requested command can be considered in execution when the Mirroring Bit and/or the Command Executing bit pass 0->1;

4. The PLC must reset the Command Bit 1->0 as soon as it detects the Mirroring Bit and/or the Command Executing bit are changing state 0->1 (e.g. the Mirroring Bit for the 'Start Marking Command' is at Address 10 Bit 0).
5. When the Mirroring bit and the Command Executing bit pass 1->0, it means that the requested command has been completed: the Laser Marker is ready to start again from step 1 with another command.



This behavior is summed up by this State Diagram:



As soon as the connection is established, the State diagram is positioned at its Entry Point: the protocol will not accept any command from the PLC before receiving an Output Assembly Memory Map fully made of '0'. Until this condition is fulfilled, the Laser State Diagram will remain in BOOTING UP state and the 'Booting Up' bit=1 (the 'Booting Up' bit is bit 7 address 3 of the Input Assembly Memory Map).

When this condition is achieved, the 'Booting Up' bit passes 1->0, meaning that the LISTENING state has been reached. Now the PLC can request the execution of a command to the Laser Marker.

The execution of the command is underway when the Command Executing bit and the Mirroring Bit change state 0->1; moreover, as soon as the Command Executing bit and the Mirroring Bit change state 0-1, the PLC must reset the Command Bit 1->0.

If, by any chance, the Command Bit is not pulled down when the Mirroring Bit and Command Executing bit turns 0->1, then the Command Executing bit and the Mirroring Bit will not turn to 0 when the command is ended. The Protocol State will pass in LISTENING as soon as the Command Executing bit passes 1->0.

OUTPUT ASSEMBLY MEMORY MAP

The Output Assembly Memory Map has been developed in order to structure all the data coming from the PLC towards the Laser Marker. The PLC will need to set a single bit and a number of bytes in the following memory map.

ADDRESS	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
							Stop System	Start Marking
1	Protocol Error Clear						Get Laser Engine Version	Get PNIO Protocol Version
2	Set Global String Value	Get Global String Value	Set Global Counter Value	Get Global Counter Value	Set Data Field Value	Get Data Field Value	Save Document	Open Document from Device
3							Disable Data Filed	Enable Data Field
4							Move Data Field	Move and Rotate Document
5 to 7	Reserved							
8			Set Focus Distance Sensor Reference	Stop Autofocus	Start Autofocus	Stop Axis	Reset Axis	Move Axis
9	Reserved							
10					R Axis	Z Axis	Y Axis	X Axis
11 to 21	Reserved							
22							Reset Output	Set Output
23	Reserved							
24	I/O Port Digital Output (0..7)							
25	I/O Port Digital Output (8..15)							
26 to 31	Reserved							
32				Get ID Marvis Result	Set ID Marvis Configuration	Get ID Marvis configuration	Get ID Match Result	
33 to 53	Reserved							
54	Request Data Size							
55	Reserved							
56 to 63/127/253	Request Data							

Description of the Output Assembly Memory Map

ADDRESS	BIT	NAME	VALUE	DESCRIPTION AND EXAMPLES
0	0	Start Marking	0 -> 1 Start Marking ; 1 -> 0 as soon as the mirroring bit is HIGH	This action starts the Marking process (in order to have Laser emission, the Laser Marker must be in Laser Ready State before this bit goes HIGH)
	1	Stop System	0 -> 1 Stops the System; 1 -> 0 as soon as the mirroring bit is HIGH	This action stops the Marking and/or the axis movement process in course
1	0	Get PNIO Protocol Version	0 -> 1 Requesting the Profinet I/O Protocol version; 1 -> 0 as soon as the mirroring bit is HIGH	Gets the Profinet protocol version currently running inside the Laser Engine
	1	Get Laser Engine Version	0 -> 1 Requesting the Laser Engine version; 1 -> 0 as soon as the mirroring bit is HIGH	Gets the Laser Engine Version running on the PC communicating with the PLC
	7	Protocol Error Clear	0 -> 1 Sets the Laser Engine back into 'Listening' state after a 'Protocol Error' ; 1 -> 0 after a minimum of 1 RTI since 0->1 of this same bit	Sets the Laser Marker back to 'Listening' state after that a Protocol Error is notified to the PLC
2	0	Open Document From Device	0 -> 1 Asking to load an XLP ; 1 -> 0 as soon as the mirroring bit is HIGH	Loads the document specified in the Request Data Field ("`.xlp`" extension must be included); the document must be in the Laser Engine default filepath (*D:\Data\Docs\Layouts*) Request Data Field: <DocumentName>
	1	Save Document	0 -> 1 Save current document; 1 -> 0 as soon as the mirroring bit is HIGH	Overwrites the currently loaded document
	2	Get Data Field value	0 -> 1 Gets the content of the Data Field specified inside the Requested Data Field; 1 -> 0 as soon as the mirroring bit is HIGH	Requests the content of the object which ID is specified in the Request Data Field. Request Data Field: <objectID>
	3	Set Data Field Value	0 -> 1 Sets the content of the specified Data Field ; 1 -> 0 as soon as the mirroring bit is HIGH	Sets the content of the object which ID is specified in the Request Data Field. Request Data Field: <objectID><LF><NewValue>
	4	Get Global Counter Value	0 -> 1 Asking to return the value of the Global Counter specified in the Request Data Field ; 1 -> 0 as soon as the mirroring bit is HIGH	Requests the value of the Global Counter specified in the Request Data Field. Request Data Field: <globalCounterName>
	5	Set Global Counter Value	0 -> 1 Setting the value of the Global Counter; 1 -> 0 as soon as the mirroring bit is HIGH	Sets the value of the Global Counter specified in the Request Data Field. Request Data Field: <globalCounterName><LF><newGlobalCounterValue>
	6	Get Global String Value	0 -> 1 Asking to return the value of the Global String specified in the Request Data Field ; 1 -> 0 as soon as the mirroring bit is HIGH	Requests the value of the Global String specified in the Request Data Field. Request Data Field: <globalStringName>
	7	Set Global String Value	0 -> 1 Setting the value of the Global String; 1 -> 0 as soon as the mirroring bit is HIGH	Sets the value of the Global String specified in the Request Data Field. Request Data Field: <globalStringName><LF><newGlobalStringValue>
3	0	Enable Data Field	0 -> 1 Enables an object inside the loaded layout; 1 -> 0 as soon as the mirroring bit is HIGH	Enables the object which ID is specified in the Request Data Field. Request Data Field: <objectID>
	1	Disable Data Field	0 -> 1 Disables an object inside the loaded layout; 1 -> 0 as soon as the mirroring bit is HIGH	Disables the object which ID is specified in the Request Data Field. Request Data Field: <objectID>
4	0	Move and Rotate Document	0 -> 1 Moves and/or rotates the document; 1 -> 0 as soon as the mirroring bit is HIGH	Moves the document's origin and its content of the given offsets and then rotates it of the given angle. The rotation is done considering the new origin of the document. Request Data Field: <X>,<Y>,<Angle>
	1	Move Data Field	0 -> 1 Moves the specified Data Field to the position specified inside Request Data Field; 1 -> 0 as soon as the mirroring bit is HIGH	Moves the object which ID is specified in the Request Data to the given position. The X,Y coordinates refer to the center of the marking area. The object's positioning is done considering the object's origin. Request Data Field: <FieldID><LF><NewXPos>,<NewYPos>
5 to 7	Reserved			
8	0	Move Axis	0 -> 1 Moves the Axis specified in address 10 to the position reported in Request Data Field; 1 -> 0 as soon as the mirroring bit is HIGH	Moves the axis reported at address 10 into the position specified inside the Requested Data field. Request Data Field: <NewAxisPosition>
	1	Reset Axis	0 -> 1 Moves the Axis specified at address 10 in Home position; 1 -> 0 as soon as the mirroring bit is HIGH	Moves the axis reported at address 10 into Home Position
	2	Stop Axis	0 -> 1 Stops the movement of the Axis specified at address 10; 1 -> 0 as soon as the mirroring bit is HIGH	Stops the movement of the axis specified at address 10 Note: It is recomended to perform a "Reset Axis" command after the "Stop Axis" command.
	3	Start Autofocus	0 -> 1 Starts the Autofocus; 0 -> 1 when the Mirroring bit is HIGH	Available only for Arex™ 400. Starts the Autofocus process: the Autofocus functionality is available only on the Z axis
	4	Stop Autofocus	0 -> 1 Stops the Autofocus; 1 -> 0 when the Mirroring bit is HIGH	Available only for Arex™ 400. Stops the Autofocus process
	5	Set Focus Distance Sensor Reference	0 -> 1 Sets the current position as a reference for the following Autofocus commands; 1 -> 0 when the Mirroring bit is HIGH	Available only for Arex™ 400. Sets the axis current position as distance reference value for all the following Autofocus executions
9	Reserved			

ADDRESS	BIT	NAME	VALUE	DESCRIPTION AND EXAMPLES
10	0	X Axis	0 -> 1 indicates that the operation requested at address 8 must be made on the selected Axis; 1 -> 0 as soon as the selected Axis Movement bit is HIGH	Indicated the axis on which the command requested at address 8 must be executed
	1	Y Axis		
	2	Z Axis		
	3	R Axis		
11 to 21	Reserved			
22	0	Set Output	0 -> 1 Sets the Outputs selected by the mask at the address 24 and 25; 1 -> 0 as soon as the 'I/O port Laser Output Status' mask turns to the desired mask	Requesting the set the digital outputs indicated at address 24 and 25
	1	Reset Output	0 -> 1 Resets the Outputs selected by the mask at the address 24 and 25; 1 -> 0 as soon as the 'I/O port Laser Output Status' mask turns to the desired mask	Requesting to reset the digital outputs indicated at address 24 and 25
23	Reserved			
24	0 to 7	I/O port Laser Output (0..7)	(Regarding each bit) 0 -> 1: asking for the matching I/O to be set or reset, depending on the command bit selected on address 22; 1 -> 0: as soon as the mirroring of the command bit selected at address 22 is HIGH	Indicating a single or a multiple I/O in relation to the command reported at address 22
25	0 to 7	I/O port Laser Output (8..15)		
26 to 31	Reserved			
32	1	Get ID Match Result	0 -> 1 Requests the Match Result and content of the latest MARVIS verification; 1 -> 0 as soon as the mirroring bit turns to 1	Gets the last Match result and the content for the object, which ID is specified in the Request Data Field. Request Data Field: <objectID>
	2	Get ID Marvis configuration	0 -> 1 Requests the MARVIS Configuration of an object; 1-> 0 as soon as the mirroring bit turns to 1	Requests the configuration of the specified object. Returns the MARVIS verification status, the Overall Grade threshold value and, if the code object is a DPM code with Overall Grade='Custom', also the thresholds for each metric. Request Data Field: <objectID>
	3	Set ID Marvis Configuration	0 -> 1 Requests to set the MARVIS Configuration of an object; 1 -> 0 as soon as the mirroring bit turns to 1	Requests to set the MARVIS configuration of the specified object. Sets the following MARVIS parameters for the specified object: • <Verification> MARVIS verification on the specified object (0: Verification disabled, 1: Verification enabled) • <Overall> grade threshold value can be used only if the object is a DPM code (0=Grade A, 1=Grade B, 2=Grade C, 3=Grade D, 4=Grade F, 5=Grade Custom) • <Metrics> to be set only if <Overall>=5, it describes the threshold value for each metric (0=Grade A, 1=Grade B, 2=Grade C, 3=Grade D, 4=Grade F) Request Data Field (if non DPM code): <objectID><LF><Verification> Request Data Field (if DPM code with <Overall>!=Custom): <objectID><LF><Verification><Overall> Request Data Field (if DPM code with <Overall>=Custom): <objectID><LF><Verification><Overall><CellContrast><CellModulation><AxialNonUniformity><UnusedErrorCorrection><PrintGrowth><MinimumReflectance><FixedPatternDamage><GridNonUniformity>
	4	Get ID Marvis Result	0 -> 1 Requests the latest MARVIS results of the specified object; 1 -> 0 as soon as the mirroring bit turns to 1	Requests the Grade, Symbol result, Match result and the Value of the last MARVIS acquisition for the specified object. Request Data Field: <objectID>
33 to 53	Reserved			
54	0 to 7	Request Data Size	'Request Data Field' usable length	Matches the length of the usable data entered in the Request Data Field. When the Laser Marker is requested to execute a command which needs additional information to the Command Bit , the PLC must: • Enter the Information inside the Request Data Field • Enter the number of bytes of such information in the Request Data Size • E.g.: Request Data Size=12 in DEC format (in BIN format, from bit 7 to bit 0 the address 54 value is '0001100') means that the command requests to take into account only the first 12 bytes starting from address 56 onwards
55	Reserved			
56 to 63/127/253	0 to 7 (for each address Byte)	Request Data Field	Each byte represents an ASCII character that the PLC is reporting towards the Laser Marker	According to the command which has been requested to execute, the PLC must place from Address 56 onwards the additional data (if requested) following the syntax which can be found in the description of the command

INPUT ASSEMBLY MEMORY MAP

The input Assembly Memory Map has been developed in order to structure all the data coming from the Datalogic Laser Marker towards the PLC. Depending on the information that the Laser is returning at every Update Time, the PLC could need to check a single bit or multiple bytes from the following memory map.

ADDRESS	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
	Laser Emission		Laser Ready	Laser Standby Shutter Closed	Laser Standby	Laser Wait for Start	Laser Warm Up	Laser Off
1						Laser Error	Laser Warning	Laser Busy Shutter Closed
2						Protocol Error	Command Error	Command Executing
3	Protocol Boot Up							
4	Command Error Code							
5	Protocol Error Code							
6 to 9	Reserved							
10							Stop System	Start Marking
11							Get Laser Engine Version	Get PNIO Protocol Version
12	Set Global String Value	Get Global String Value	Set Global Counter Value	Get Global Counter Value	Set Data Field Value	Get Data Field Value	Save Document	Open Document From Device
13							Disable Data Field	Enable Data Field
14							Move Data Field	Move and Rotate Document
15 to 17	Reserved							
18			Set Focus Distance Reference	Stop Autofocus	Start Autofocus	Stop Axis	Reset Axis	Move Axis
19	Reserved							
20	R Axis is Home	Z Axis is Home	Y Axis is Home	X Axis is Home	R Axis Enabled	Z Axis Enabled	Y Axis Enabled	X Axis Enabled
21			Focus Distance Sensor is available	Z Axis is on Focus	R Axis Movement	Z Axis Movement	Y Axis Movement	X Axis Movement
22 to 23	Reserved							
24							Reset Output	Set Output
25	Reserved							
26	I/O Port Digital Output Status (0..7)							
27	I/O Port Digital Output Status (8..15)							
28	I/O Port Digital Input Status (0..7)							
29	I/O Port Digital Input Status (8..15)							
30 to 33	Reserved							
34				Get ID Marvis Result	Set ID Marvis Configuration	Get ID Marvis Configuration	Get ID Match Result	
35	Reserved							
36	Symbol Match Result Fail	Symbol Match Result OK	Symbol Grade Result Fail	Symbol Grade Result OK	Symbol Read Fall	Symbol Read OK	Marvis Result Fail	Marvis Result OK
37	Reserved							
38				Marvis Status Error	Marvis Status Warning	Marvis Status Busy	Marvis Status Available	
39 to 53	Reserved							
54	Response Data Size							
55	Reserved							
56 to 63/127/253	Response Data							

Description of the Input Assembly Memory Map

According to the logic state of the following bits, the PLC is constantly informed about the Datalogic Laser System state, in addition to the state of a requested command.

ADDRESS	BIT	NAME	VALUE	DESCRIPTION AND EXAMPLES
0	0	Laser Off	(Regarding each bit) 0: Laser Engine is not currently in this state; 1: Laser Engine is currently in this state	Available only for ULYXE. USB connection not established
	1	Laser Warm Up		Laser Engine is in Warm Up State (KEY=1, ENABLE=0)
	2	Laser Wait For Start		Laser Engine is in Wait For Start State (KEY=0, ENABLE=0)
	3	Laser Standby		Available only for EOX. When one of the two Enables has been closed
	4	Laser Standby Shutter Closed		Laser Engine is in Standby Shutter Closed State (KEY=1, ENABLE=0, after the Warm Up stage)
	5	Laser Ready		Laser Engine is in Laser Ready State (KEY=1, ENABLE=1)
	7	Laser Emission		Laser Engine is in Laser Emission State (KEY=1, ENABLE=1 and the Laser has received a Start Marking command)
1	0	Laser Busy Shutter Closed		Laser Engine is in Laser Busy Shutter Closed State (KEY=1, ENABLE=0 and the Laser has received a Start Marking command)
	1	Laser Warning		Laser Engine is in Laser Warning State
	2	Laser Error		Laser Engine is in Laser Error State
2	0	Command Executing	(Regarding each bit) 0: Protocol is not currently in this phase; 1: Protocol is currently in this phase	Lighter™ is executing a command
	1	Command Error		Notifies a Command Error (see “Command Error” on page 25)
	2	Protocol Error		Notifies a Protocol Error (see “Protocol Error” on page 26)
3	7	Protocol Boot Up	0: Protocol is not currently in this phase; 1: Protocol is currently in this phase	Lighter PNIO is in booting-up stage: this stage will end as soon as a completely empty memory map is sent to the Laser
4	0 to 7	Command Error Code	The value of this byte represents the code of the Command Error	Gives information about the Command error which has been notified (see “Command Error” on page 25)
5	0 to 7	Protocol Error Code	The value of this byte represents the code of the Protocol Error	Gives information about the Protocol error which has been notified (see “Protocol Error” on page 26)
6 to 9	Reserved			
10	0	Start Marking	(Regarding each bit) 0 -> 1: Laser is executing the command; 1 -> 0 Laser has executed the command	Informs about the execution of the Start Marking command
	1	Stop System		Informs about the execution of the Stop System command
11	0	Get PNIO Protocol Version		Informs about the execution of the Get PNIO Protocol Version command. When the command is completed, the requested data is available in the Response Data Field. Response Data Field: <PNIOProtocolVersion>
	1	Get Laser Engine Version		Informs about the execution of the Get Laser Engine Version command. When the command is completed, the requested data is available in the Response Data Field. Response Data Field: <LaserEngineVersion>
12	0	Open Document From Device		Informs about the execution of the Open Document From Device command
	1	Save Document		Informs about the execution of the Save Document command
	2	Get Data Field Value		Informs about the execution of the Get Data Field Value command. When the command is completed, the requested data is available in the Response Data Field. Response Data Field: <objectValue>
	3	Set Data Field Value		Informs about the execution of the Set Data Field Value command
	4	Get Global Counter Value		Informs about the execution of the Get Global Counter Value command. When the command is completed, the requested data is available in the Response Data Field. Response Data Field: <GlobalCounterValue>
	5	Set Global Counter Value		Informs about the execution of the Set Global Counter Value command
	6	Get Global String Value		Informs about the execution of the Get Global String Value command. When the command is completed, the requested data is available in the Response Data Field. Response Data Field: <GlobalStringValue>
	7	Set Global String Value		Informs about the execution of the Set Global String Value command
13	0	Enable Data Field		Informs about the execution of the Enable Data Field command
	1	Disable Data Field		Informs about the execution of the Disable Data Field command
14	0	Move and rotate document		Informs about the execution of the Move and Rotate Document command
	1	Move Data Field		Informs about the execution of the Move Data Field command
15 to 17	Reserved			
18	0	Move Axis	(Regarding each bit) 0 -> 1: Laser is executing the command; 1 -> 0 Laser has executed the command	Informs about the execution of the Move Axis command, along with the bit of the Axis Movement at address 21
	1	Reset Axis		Informs about the execution of the Reset Axis command, along with the bit of the Axis Home at address 20
	2	Stop Axis		Informs about the execution of the Stop Axis command
	3	Start Autofocus		Available only for Arex™400. Informs about the Start Autofocus Command
	4	Stop Autofocus		Available only for Arex™400. Informs about the Stop Autofocus Command
	5	Set Focus Distance Reference		Available only for Arex™400. Setting the current distance as Reference for the next Start Autofocus executions
19	Reserved			

ADDRESS	BIT	NAME	VALUE	DESCRIPTION AND EXAMPLES
20	0	X Axis Enabled	0: Axis not enabled; 1: Axis enabled	Notifies if the X Axis is enabled or not
	1	Y Axis Enabled		Notifies if the Y Axis is enabled or not
	2	Z Axis Enabled		Notifies if the Z Axis is enabled or not
	3	R Axis Enabled		Notifies if the R Axis is enabled or not
	4	X Axis Home	0: Axis not in Home position; 1: Axis in Home position	Notifies if the X Axis is in its Home position or not
	5	Y Axis Home		Notifies if the Y Axis is in its Home position or not
	6	Z Axis Home		Notifies if the Z Axis is in its Home position or not
	7	R Axis Home		Notifies if the R Axis is in its Home position or not
21	0	X Axis Movement	0: Axis not moving; 1: Axis moving	Notifies if the X Axis is moving or not
	1	Y Axis Movement		Notifies if the Y Axis is moving or not
	2	Z Axis Movement		Notifies if the Z Axis is moving or not
	3	R Axis Movement		Notifies if the R Axis is moving or not
	4	Z Axis is on Focus	0: Z Axis is not on Focus; 1: Z Axis is on Focus	Available only for Arex™ 400. Notifies if the Z Axis is on Focus or not (available only if the Focus Distance Sensor is enabled)
	5	Focus Distance Sensor is available	0: Focus Distance Sensor is not available; 1: Focus Distance Sensor is available	Available only for Arex™ 400. Notifies if the Focus Distance Sensor is available or not
22 to 23	Reserved			
24	0	Set Output	(Regarding each bit) 0 -> 1: Laser is executing the command; 1 -> 0 Laser has executed the command	Setting the status of the Digital Output signal of the DB25 Axis Connector indicated at Address 24 and 25 of Output Memory Map
	1	Reset Output		Resetting the status of the Digital Output signal of the DB25 Axis Connector indicated at Address 24 and 25 of Output Memory Map
25	Reserved			
26	0 to 7	I/O port Laser Output Status (0..7)	(Regarding each bit) 0: the matching Output is not being pulled up; 1: the matching Output is being pulled up	Pulling up Output N where N is the position of the HIGH bit inside these addresses (example: if address 26 has value 4 (equal to 00000100 in binary format), it means output2 is HIGH, while if address 27 has value 4, it means output10 is HIGH)
27	0 to 7	I/O port Laser Output Status (8..15)		
28	0 to 7	I/O port Laser Input Status (0..7)	(Regarding each bit) 0: the matching Input is not being pulled up; 1: the matching Input is being pulled up	Pulling up Input N where N is the position of the HIGH bit inside these addresses
29	0 to 7	I/O port Laser Input Status (8..15)		
30 to 33	Reserved			
34	1	Get ID Match Result	(Regarding each bit) 0 -> 1: Laser is executing the command; 1 -> 0 Laser has executed the command	For the object specified in the Request Data Field, it returns the Symbol Read and Code Match results, along with the Received and Configured Text. Response Data Field: <SymbolReadPassFail><CodeMatchPassFail><LF><ReceivedText><LF><ConfiguredText>
	2	Get ID Marvis Configuration		For the object specified in the Request Data Field, it returns the Verification flag, its Overall Grade and the value of each metric. Response Data Field: <Verification><Overall><CellContrast><CellModulation><AxialNonUniformity><UnusedErrorCorrection><PrintGrowth><MinimumReflectance><FixedPatternDamage><GridNonUniformity>
	3	Set ID Marvis Configuration		Notifies if the command has been completed or not.
	4	Get ID Marvis Result		For the object specified in the Request Data Field, it returns all the detailed information about the configured vs. received metrics, and the Received vs. Configured Text. Response Data Field: <SymbolReadPassFail><CodeMatchPassFail><GradePassFail><RecOverall><ConfigOverall><RecMetrics><ConfigMetrics><MetricsPassFail><LF><ReceivedText><LF><ConfiguredCode><LF>
35	Reserved			
36	0	Marvis Result OK	(Regarding each bit) 0 -> 1: The latest MARVIS™ acquisition has produced this Result; 1 -> 0: when a new 'Start Marking' command is executed	Notifies if the last MARVIS™ verification has been OK or not: it will only be OK if Symbol Read, Symbol Grade Result and the Symbol Match Result are OK
	1	Marvis Result Fail		
	2	Symbols Read OK	(Regarding each bit) 0 -> 1: The latest MARVIS™ acquisition has produced this Symbol Read; 1 -> 0: when a new 'Start Marking' command is executed	Notifies if the last MARVIS™ verification has produced a Symbol Read or not of all the objects marked with Verification enabled. After marking a document which contains a Datamatrix with enabled MARVIS™ Verification, the Symbol Read will be OK if during the verification a general Datamatrix is found
	3	Symbols Read Fail		
	4	Symbol Grade Result OK	(Regarding each bit) 0 -> 1: The latest MARVIS™ acquisition has produced this Symbol Grade Result; 1 -> 0: when a new 'Start Marking' command is executed	Notifies if the last MARVIS™ verification of all the objects marked with Verification enabled have passed the Grade threshold or not
	5	Symbol Grade Result Fail		
	6	Symbol Match Result OK	(Regarding each bit) 0 -> 1: The latest MARVIS™ acquisition has produced this Symbol Match Result; 1 -> 0: when a new 'Start Marking' command is executed	Notifies if in the last MARVIS™ verification the content of all the objects marked with Verification enabled match the content of the objects found by MARVIS™
	7	Symbol Match Result Fail		
37	Reserved			

ADDRESS	BIT	NAME	VALUE	DESCRIPTION AND EXAMPLES
38	1	Reader Status Available	(Regarding each bit) 0: MARVIS is not currently in this state; 1: MARVIS is currently in this state	Laser Engine is not connected to the Reader, as connection happens after every marking session of an XLP which has to undergo a MARVIS™ verification
	2	Reader Status Busy		Laser Engine is connected to the Reader and the MARVIS™ verification is undergoing
	3	Reader Status Warning		Reader has returned 1 MARVIS™ Result Fail (it will stay in this state until Laser Engine will reconnect to the Reader)
	4	Reader Status Error		Reader is in Error State
39 to 53	Reserved			
54	0 to 7	Response Data Size	"Response Data" field usable length	Notifies about how many usable bytes starting from Address 56 are available for the PLC to read.
55	Reserved			
56 to 63/ 127/253	0 to 7 (for each address Byte)	Response Data Field	Each byte represents an ASCII character that the laser is reporting towards the PLC	Starting from Address 56, the PLC will find here the Response to the command he has requested (if the executed command returns such data). The number of bytes which the PLC will need to read is specified at Address 54

POSSIBLE ERRORS

There are 2 kinds of error which can turn up during the normal use of a Datalogic Laser Marker via ProfiNet I/O:

- “Command Error” on page 25
- “Protocol Error” on page 26

The PLC is informed by 2 bits in the Input Assembly Memory Map if any kind of error happens: these 2 bits are bits 1 and 2 in Address 2 (respectively 'Command Error' and 'Protocol Error').

Command Error

A Command Error is notified to the PLC when the requested command cannot be executed.

In addition to the single 'Command Error' notification bit, a whole byte (address 4) of the Input Assembly Memory Map describes the reason of such an error. The values which address 4 can have when a Command Error is notified, are summed up in the following table.

Both kinds of error should be monitored constantly and we advise the PLC programmer to think about a routine which will manage these errors.

VALUE	DESCRIPTION
0001	Command not recognized
0002	Invalid date value
0003	File does not exist
0004	File opening error
0005	Invalid I/O port
0006	Global variable does not exist
0007	Global variable is not a counter
0008	Global variable is not a string
0009	Bad command
0010	Invalid field
0011	No document loaded
0012	No document saved
0013	Laser already stopped
0014	Command not allowed by device status
0015	Invalid Field Symbol Object ID
0016	Invalid reader result
0017	Result not found
0018	Symbol not found
0019	Bad Grade required validation
0020	MARVIS™ is not enabled
0021	MARVIS™ License is not enabled
0022	Focal Distance Sensor Unavailable
0024	Focal Distance Sensor Focus Error
0025	Focal Distance Sensor Reference Invalid
0026	Focal Distance Sensor Out Of Range
0027	Focal Distance Sensor Connection Error
0028	Focal Distance Sensor Communication Error
0029	Focal Distance Sensor Invalid Focus Search
0030	Command exceeds memory area

Protocol Error

A Protocol Error is notified to the PLC when the Laser Marker is not able to correctly determinate a single command to execute.

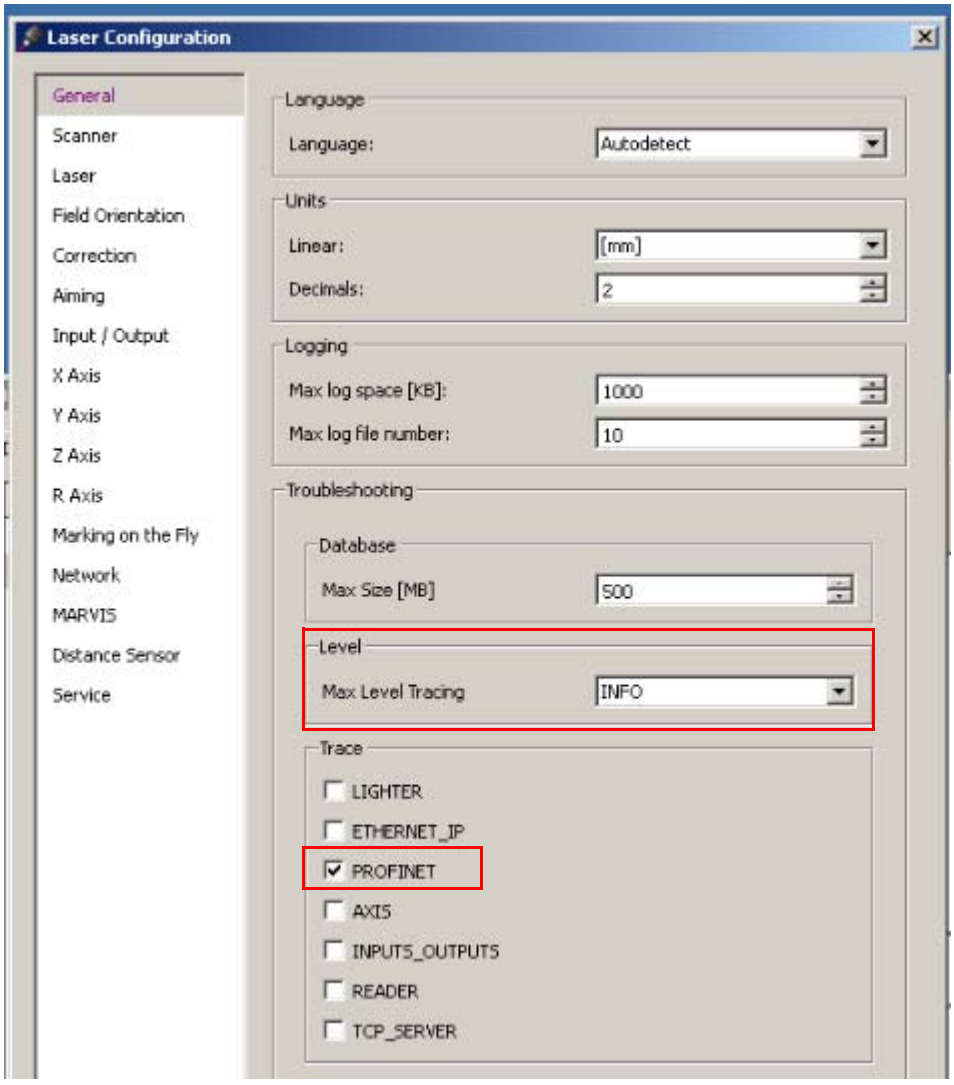
In addition to the single 'Protocol Error' notification bit, a whole byte (address 5) of the Input Assembly Memory Map describes the reason of the error:

VALUE	DESCRIPTION
0001	Command conflict: more than 1 command bit is set to 1
0002	Unknown command: bit(s) in a reserved area is/are set to 1
0003	Busy: Protocol in Executing state when Command bit is set to 1 (except for STOP command bit)
255	Critical: Protocol state machine is faulted

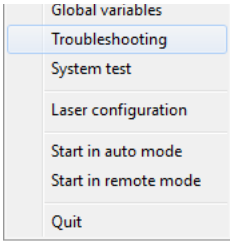
When a Protocol Error is notified, in case 1, 2 and 3 it is necessary for the PLC to set the 'Protocol Error Clear' bit (Address 1 bit 7), which sets the Protocol back into LISTENING state. This operation will not work if the value returned by the Protocol Error is 255: in this case, the ProfiNet I/O connection must be closed and then re-established between the Laser System and the PLC.

CHAPTER 3
TROUBLESHOOTING

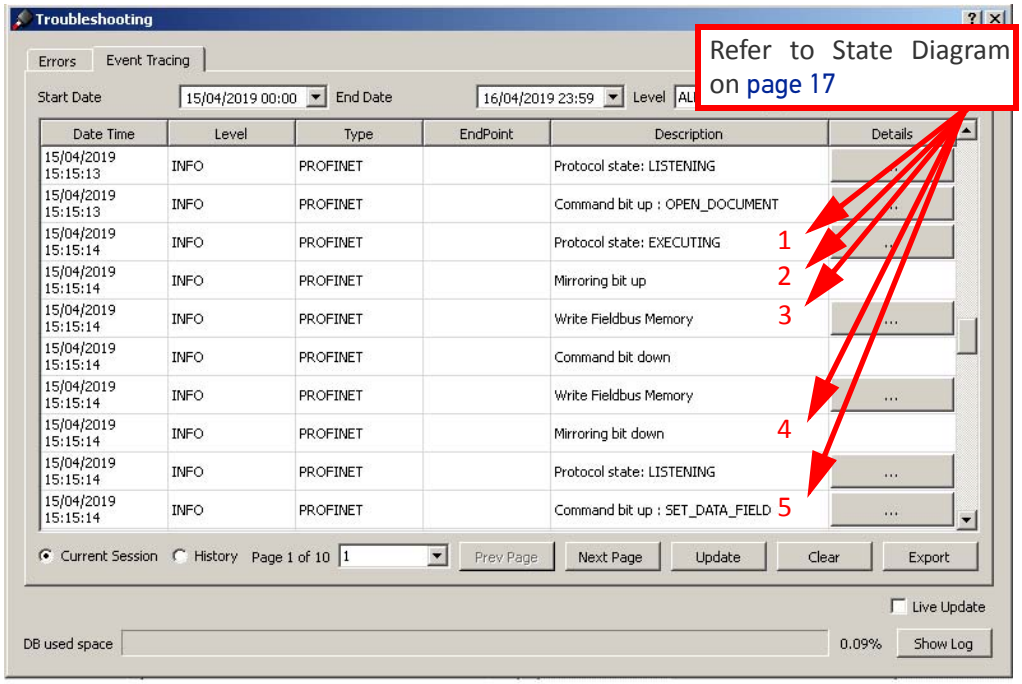
To enable Profinet I/O troubleshooting, go to Laser Configuration -> General and set the '**Max Level Tracing**' to **INFO** and check the voice '**PROFINET**'.



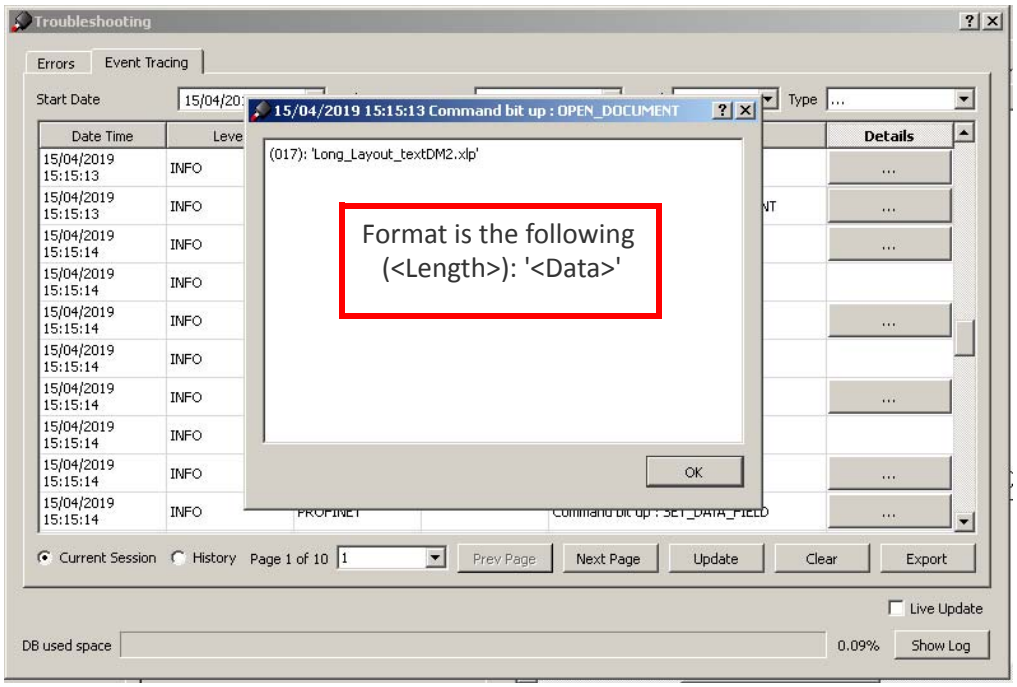
Each command that the PLC sends to the laser marker is recorded in detail in the Troubleshooting database, which can be opened as shown:



The user will find the Errors and the Event Tracing, depending on the selected tab. When the Event Tracing is selected, the user can check the details of each command which the Laser Marker has executed via ProfiNet I/O.



By clicking on the '...' button in the Details column, the user can find the Data and the reported length which was either necessary to execute the command (present on the Request Data area) or the data which has been returned to the PLC along with its length.



CHAPTER 4
MARVIS™ COMMANDS APPENDIX

ADDRESS IMM	INFO	DESCRIPTION	FIELD LENGTH
56	Symbol Read/ No Read	Positive = 31 Hex, Negative=30 Hex	1 byte
57	Code Match/No Match	Positive = 31 Hex, Negative=30 Hex	1 byte
58	<LF>		1 byte
59			N byte
59+N	<LF>		1 byte
59+N+1	Configured Text		M bytes
59+N+M+1	<LF>		1 byte
...			
67/127/253			

Table 1: Get ID Match Result Response

ADDRESS IMM	INFO	DESCRIPTION	FIELD LENGTH
56	ID Verification	Positive = 31 Hex, Negative=30 Hex	1 byte
57	Overall Grade	A=30,..,F=34,CUSTOM=35 Hex Only if it is a DPM code	1 byte
58	Cell Contrast	Metrics Threshold A=30,..,F=34 Only if is a DPM code	8 bytes
59	Cell Modulation		
60	Axial NON-Uniformity		
61	Unused Error Correction		
62	Print Growth		
63	Minimum Reflectance		
64	Fixed Pattern Damage		
65	Grid Nonuniformity		
66			
...			
127/253			

Table 2: Get ID Marvis Configuration Response

ADDRESS IMM	INFO	DESCRIPTION	FIELD LENGTH
56	Symbol Read/ No Read	Positive = 31 Hex, Negative=30 Hex	1 byte
57	Code Match/No Match	Positive = 31 Hex, Negative=30 Hex	1 byte
58	Grade Threshold Pass/ Fail	Positive = 31 Hex, Negative=30 Hex	1 byte
59	Overall Grade Received	A=30,..,F=34,CUSTOM=35,N=36 Hex NA if the Symbol is non DPM or is not found	1 byte
60	Overall Grade Configured	A=30,..,F=34,CUSTOM=35,N=36 Hex NA if the Symbol is non DPM or is not found	8 bytes
61	Cell Contrast	Metrics received. Value: A=30,..,F=34,N=36 Hex. Received is shown only if Overall Grade Configured is CUSTOM, otherwise NA. NA will be returned for each metric if Overall Grade Configured is not CUSTOM or the relative symbol is not found	
62	Cell Modulation		
63	Axial NON-Uniformity		
64	Unused Error Correction		
65	Print Growth		
66	Minimum Reflectance		
67	Fixed Pattern Damage		
68	Grid Nonuniformity		
69	Cell Contrast	Metrics configured. Value: A=30,..,F=34,N=36 Hex. Configured is shown only if Overall Grade Configured is CUSTOM, otherwise NA. NA will be returned for each metric if Overall Grade Configured is not CUSTOM or the relative symbol is not found	8 bytes
70	Cell Modulation		
71	Axial NON-Uniformity		
72	Unused Error Correction		
73	Print Growth		
74	Minimum Reflectance		
75	Fixed Pattern Damage		
76	Grid Nonuniformity		
77	Cell Contrast	Metrics Pass/Fail. Pass = 31 Hex, Fail =30 Hex. NA=36 Hex will be returned for each metric if the symbol is not found or is not a DPM Code	8 bytes
78	Cell Modulation		
79	Axial NON-Uniformity		
80	Unused Error Correction		
81	Print Growth		
82	Minimum Reflectance		
83	Fixed Pattern Damage		
84	Grid Nonuniformity		
85	<LF>		1 byte
	Received Code		N bytes
86+N	<LF>		
86+N+1	Configured Code		M bytes
86+N+1+M	<LF>		1 byte
...			
127/253			

Table 3: Get ID Marvis Result Response

ADDRESS 0MM	INFO	DESCRIPTION	FIELD LENGTH
56	Object ID		N bytes
57+N	<LF>		1 byte
56+N+1	ID Verification	Positive = 31 Hex, Negative=30 Hex	1 byte
56+N+2	Overall Grade	A=30,..,F=34,CUSTOM=35 Hex	1byte
56+N+3	Cell Contrast	Metrics Threshold A=30,..,F=34 Hex	8 bytes
	Cell Modulation		
	Axial NON-Uniformity		
	Unused Error Correction		
	Print Growth		
	Minimum Reflectance		
	Fixed Pattern Damage		
	Grid Nonuniformity		
56+N+3+8			
...			
127/253			

Table 4: Set ID Marvis Configuration Request

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