Profinet IO Fieldbus

Lexium MDrive Profinet Products

V1.00, 10.2014

PROFINET®

Schneider Electric

Profinet IO Fieldbus Manual For Lexium MDrive		
Date	**Revision**	**Changes**
04/29/2014	V1.00, 04.2014	Initial release
08/15/2014	V1.00, 08.2014	Changed Max Velocity (VM) from 5000000 to 2560000 steps/sec
10/21/2014	V1.00, 10.2014	Changed toggle register update from bit state change to the toggle occurring on the positive transition from 0 to 1.

Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

Hand this manual and all other pertinent product documentation over to all users of the product.

Carefully read and observe all safety instructions and the chapter “Before you begin - safety information”.

Some products are not available in all countries.

For information on the availability of products, please consult the catalog.

Subject to technical modifications without notice.

All details provided are technical data which do not constitute warranted qualities.

Most of the product designations are registered trademarks of their respective owners, even if this is not explicitly indicated.

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Table of Contents

List of Figures

List of Tables

About this manual

The information provided in this manual supplements the product hardware manual.

Source manuals

The latest versions of the manuals can be downloaded from the Internet at:

http://motion.schneider-electric.com

Applicable manuals for Lexium MDrive Profinet products are:

- MCode Programming and Software Reference manual
- Lexium MDrive Ethernet TCP/IP Hardware manual
- Profinet IO Fieldbus manual

Graphic User Interface software

For commissioning, a Graphic User Interface (GUI) is available for use with Lexium MDrive products as part of the Lexium MDrive Software Suite. This software is available for download from the Internet at:

http://motion.schneider-electric.com

Further reading

Recommended literature for further reading.

Reference documents

- PROFINET Technology and Application - System Description
- PROFINET IO Specification

User Association

- PROFIBUS and PROFINET International (PI)
  http://www.profibus.com/

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1 Introduction

1

Profinet IO is used for data exchange between I/O controllers (PLC, etc.) and I/O devices (field devices) such as the Lexium MDrive Profinet. Profinet IO uses the proven communication model and application view of Profibus DP and extends it by Ethernet as the communication medium. Among other benefits, this provides a greater bandwidth and allows more stations on the network. The Profinet IO specifications define a protocol and an application interface for exchanging I/O data, alarms and diagnostics and for transmitting data records and logbook information. To exchange I/O data and alarms, Profinet IO is based directly on the Ethernet protocol.

1.1 Fieldbus devices on the Profinet IO network

Profinet IO classifies devices into three types:

1) **IO Controllers,** such as PLC's, map IO data from Profinet IO devices, such as the Lexium MDrive.
2) **IO Devices,** in this case the Lexium MDrive Profinet.
3) **IO Supervisors,** such as a PC is used for commissioning and system diagnostics.

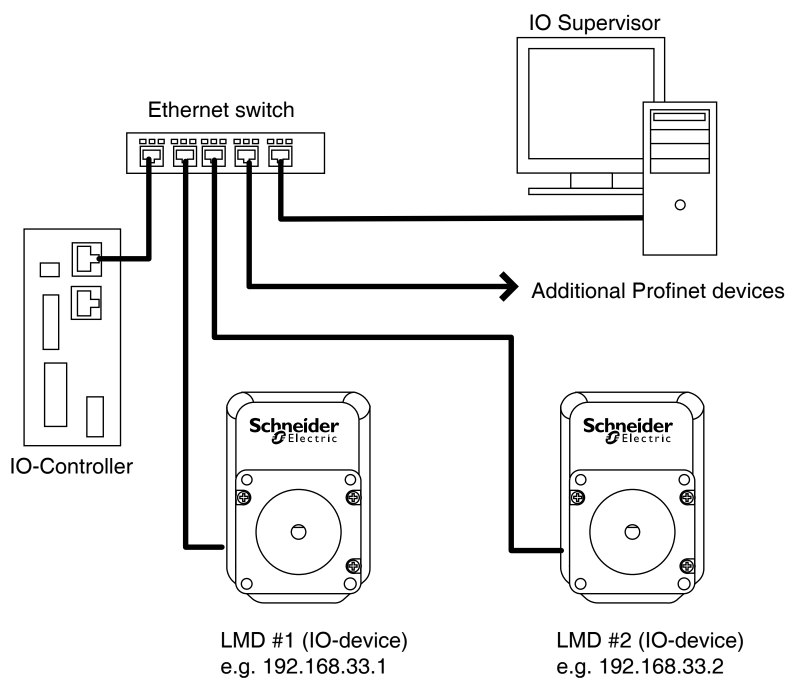

Figure 1.1: Example Profinet IO network using Lexium MDrive products.

V1.00, 10.2014

1.2 Lexium MDrive Profinet configuration

The Lexium MDrive is classed as an IO-device and must be manually configured using the TCP/IP Configuration tool: Setting the IP address, the sub net mask and setting the desired mapping for the registers.

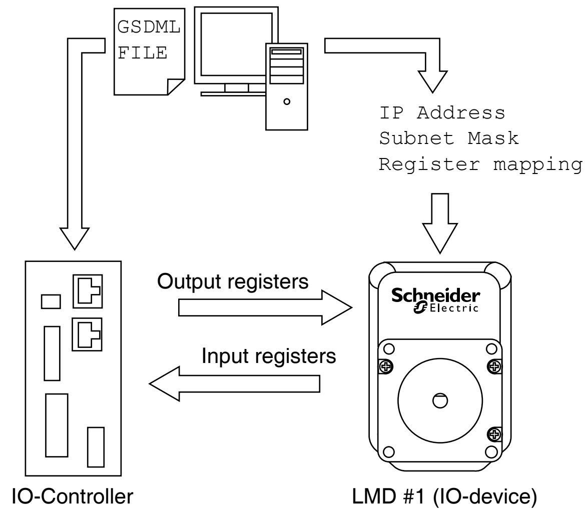

Figure 1.2: Configuration and operational flow of Lexium MDrive Profinet.

1.2.1 Output registers

The Lexium MDrive Profinet has 38 output registers that can be mapped to specific data types representative of the two character mnemonics of the MCode control language common to all Schneider Electric Motion Lexium MDrive Motion products.

These registers represent the output from the system IO-Controller to the device and can contain: Variable and Flag data, Motion commands, hardware I/O commands and requests for data.

The default mapping of the output registers is detailed in Section 7 of this document.

1.2.2 Input registers

The device has 34 input registers mappable to specific data types representative of the two character mnemonics of the MCode control language common to all Schneider Electric Motion Lexium MDrive Motion products.

These registers represent the input to the IO-controller from the device containing status data.

The default mapping of the input registers is detailed in Section 7 of this document.

2 Before you begin - safety information

2

The information provided in this manual supplements the product manual. Carefully read the product manual before using the product.

2.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

2.2 Intended use

The functions described in this manual are only intended for use with the basic product; you must read and understand the appropriate product manual.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design).

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

Any use other than the use explicitly permitted is prohibited and can result in hazards.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

The product must NEVER be operated in explosive atmospheres (hazardous locations, Ex areas).

2.3 Hazard categories

Safety instructions to the user are highlighted by safety alert symbols in the manual. In addition, labels with symbols and/or instructions are attached to the product that alert you to potential hazards.

Depending on the seriousness of the hazard, the safety instructions are divided into 4 hazard categories.

⚠ DANGER
DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ WARNING
WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION
CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

CAUTION
CAUTION used without the safety alert symbol, is used to address practices not related to personal injury (e.g. **can result** in equipment damage).

V1.00, 10.2014

2.4 Basic information

⚠ DANGER

UNINTENDED CONSEQUENCES OF EQUIPMENT OPERATION

When the system is started, the drives are usually out of the operator's view and cannot be visually monitored.

- Only start the system if there are no persons in the hazardous area.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines. 1)
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death or serious injury.

1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems".

V1.00, 10.2014

2.5 Standards and terminology

Technical terms, terminology and the corresponding descriptions in this manual are intended to use the terms or definitions of the pertinent standards.

In the area of drive systems, this includes, but is not limited to, terms such as “safety function”, “safe state”, “fault”, “fault reset”, “failure”, “error”, “error message”, “warning”, “warning message”, etc.

Among others, these standards include:

- IEC 61800 series: “Adjustable speed electrical power drive systems”
- IEC 61158 series: “Industrial communication networks - Fieldbus specifications”
- IEC 61784 series: “Industrial communication networks - Profiles”
- IEC 61508 series: “Functional safety of electrical/electronic/programmable electronic safety-related systems”

3 Basics

3

3.1 Profinet IO technology

Profinet IO is one of two open Ethernet automation standards from Profibus International. Profinet IO is a high level networking protocol for industrial automation applications. Using the framework of standard Ethernet hardware and software to exchange data, alarms and diagnostic data.

3.1.1 Data security

The larger the network into which the product is integrated, the greater the risk of unauthorized external access. The operator of the local network must take appropriate measures to prevent unauthorized access. Contact your network administrator prior to commissioning the product.

3.1.2 Basics

PROFINET is defined by PROFIBUS and PROFINET International (PI) and backed by the INTERBUS Club and, since 2003, is part of the IEC 61158 and IEC 61784 standards.

http://www.profibus.com/

Number of nodes

The number of nodes in an Profinet network is theoretically unlimited; it depends on the subnet size. For example, 254 nodes are possible in a class C subnet.

Cable length

The maximum cable length is 100 m between Profinet terminal points and 90 m between infrastructure components. However, interference in industrial environments may require you to use shorter cables.

Device classification

Profinet IO classifies devices into three types:

- **IO-Supervisors:** IO-Supervisors are devices such as HMI's or PC's which are used on a network for commissioning and collection of diagnostic data associated with the Profinet IO stack or by the application program of a device.
- **IO-Controllers:** IO Controllers, devices such as PLC's which map IO data from a device into the processor of a controller. IO-controllers support cyclic data exchange of data between the controller and an IO-Device, acyclic data such as configuration and diagnostic data, and alarm data, as well as managing the connection.
- **IO-Devices:** IO-Devices are distributed devices connected to an IO-Controller over Ethernet. The Lexium MDrive Profinet is classified as an IO-device.

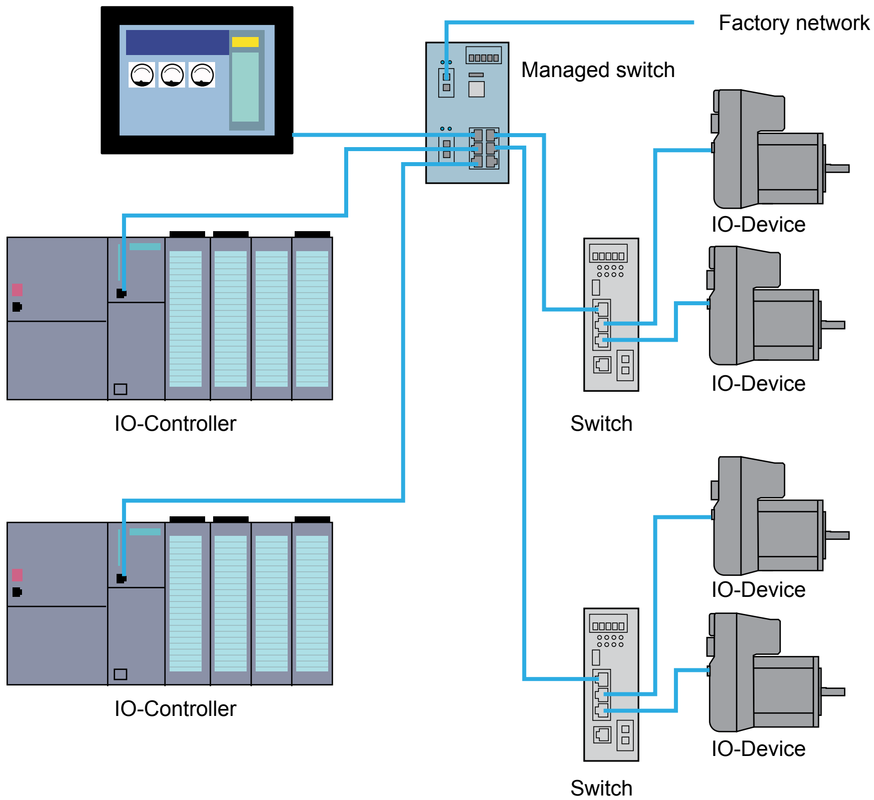

Figure 3.1: Profinet IO network with Lexium MDrive

Lexium MDrive IO structure

The Lexium MDrive network representation is consists of three slots, 0...2.

Slot 0 does not contain IO data, but contains the device identification information. Slots 1 and 2 represent the input and output data, each in a 128 byte string containing IO data divided into registers to represent Lexium MDrive control and status data.

The registers may be variably mapped to desired MDrive functions using the TCP/IP configuration Utility. The default parameter mapping is shown in Section 7 of this document.

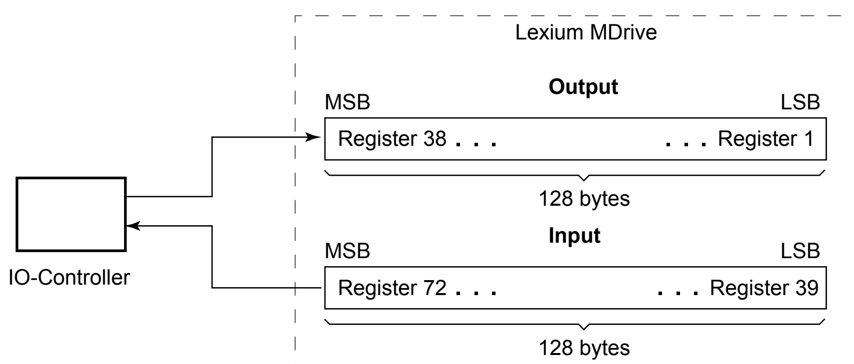

Figure 3.2: Lexium MDrive IO structure

V1.00, 10.2014

3.2 Lexium MDrive Profinet configuration

3.2.1 TCP/IP configuration tool

IP Address and subnet masl

A Profinet IO device requires three things to operate within a Profinet network:

1) A MAC address: This is preassigned to each Lexium MDrive Ethernet TCP/IP product at time of manufacture.
2) IP Address: This is assigned during configuration using the TCP/IP configuration utility, part of the LMD Software Suite. The defailt IP is 192.168.33.1
3) A logical name: This is a unique name by which the device is identifiable to the IO Controller. It is assigned by the user during configuration using the TCP/IP configuration Utility. The default name is “mdrive”

The basic TCP/IP configuration such as the IP address and subnet mask MUST be first configured using the TCP/IP configuration tool before installing into a network.

Note that the Lexium MDrive Profinet DOES not support Profinet RDO services, bootp or DHCP. The use of the TCP/IP tool is required for initial TCP/IP setup>

Detailed instructions for initial configuration is contained in the Lexium MDrive Software Suite manual, available online at:

http://motion.schneider-electric.com

IO register mapping

The input and output channels of the Lexium MDrive are configured by default to map to the most commonly used parameters, commands and status data.

These may be remapped based upon the needs of the application using the TCP/IP Configuration Utility.

See the Lexium MDrive Software Suite manual, instructions.

http://motion.schneider-electric.com

The default mapping of the IO registers is contained in Section 7 of this document.

3.2.2 GSDML (Generic Station Description Markup Language) file

Definition

The GSDML file is an XML (eXtensible Markup Language) file that describes the implementation of the Lexium MDrive Profinet device. This file will be loaded into the SIMATIC S7 controller software for your Siemens PLC.

The file contains all of the identification and configuration information for the Lexium MDrive Profinet device, with the exception of the TCP/IP information.

The following information is contained in the GSDML file.

Item	Description	Lexium MDrive
Vendor ID	Unique value identifying an authorized PROFINET IO Vendor. This value is assigned by Profibus Internationa	0x0261
Device ID	Unique value identifying a PROFINET IO device. This value is assigned by the device manufacturer	0x0001
Module ID	Unique value identifying a specific module type. This value is assigned by the device manufacturer. When the PROFINET IO device plugs in a module, the module id must agree with the module id specified in the GSDML file.	ID_Mod_11 (Input) ID_Mod_12 (output)
Product Family	A manufacturer specific text string describing the product family.	Lexium MDrive

The GSDML file for the Lexium MDrive Profinet device may be located either in the installation folder (C:\Program Files (x86)\Schneider Electric Motion USA\Lexium Mdrive\LMDxE\) for the TCP/IP Configuration Utility on your computer's hard drive or on the web at:

http://motion.schneider-electric.com

4 Installation

4

⚠ WARNING
SIGNAL AND DEVICE INTERFERENCE Signal interference can cause unexpected responses of device. • Install the wiring in accordance with the EMC requirements. • Verify compliance with the EMC requirements. Failure to follow these instructions can result in death, serious injury or equipment damage.

For information on installation of the device and connecting the device to the fieldbus see the product hardware manual.

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5 Configuration

5

Configuring the Lexium MDrive Profinet devices is accomplished using the TCP/IP Configuration utility. This required utility is part of the Lexium MDrive Software Suite and may be found on the Internet at:

http://motion.schneider-electric.com/lmd/lexium-mdrive-software.php

This utility will be used to configure the networking information such as the IP address and Subnet mask, and the device name required by Profinet IO devices.

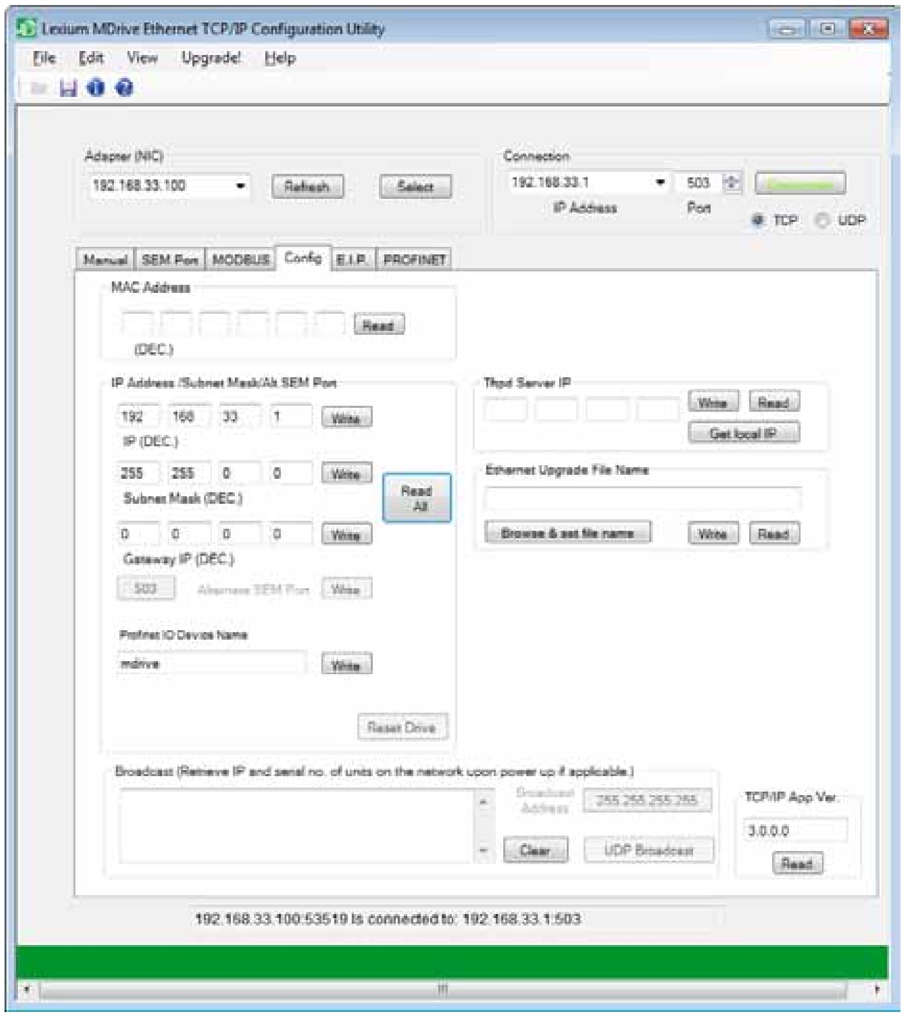

Figure 5.1: TCP/IP Configuration utility

V1.00, 10.2014

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6 Diagnostics and troubleshooting

6

6.1 Fieldbus communication error diagnostics

A properly operating fieldbus is essential for evaluating operating and error messages.

Connections for fieldbus mode

If the product cannot be addressed via the fieldbus, first check the connections. The product manual contains the technical data of the device and information on network and device installation. Check the following:

- Power connections to the device
- Fieldbus cable and fieldbus wiring
- Network connection to the device

You can also use the TCP/IP Configuration Utility for troubleshooting.

Fieldbus function test

If the connections are correct, check the settings for the fieldbus addresses. After correct configuration of the transmission data, test fieldbus mode.

1) In addition to the master that knows the product via the GSDML file and addressing, activate a bus monitor that, as a passive device, displays messages.
2) Switch the supply voltage off and on.
3) Observe the network messages that are generated briefly after the supply voltage is switched on. A bus monitor can be used to record the elapsed time between

Addressing, parameterization

If it is impossible to connect to a device, check the following:

1) Addressing: Each network device must have a unique IP address. and the correct subnet mask.
2) Parameterization: “Vendor ID” and “Product Code” must match the values stored in the GSML file.

V1.00, 10.2014

6.2 Status LEDs

The Lexium MDrive Profinet has two dual-color (red/green) LEDs visible from the back of the drive to give status and error indication of the Profinet IO connection.

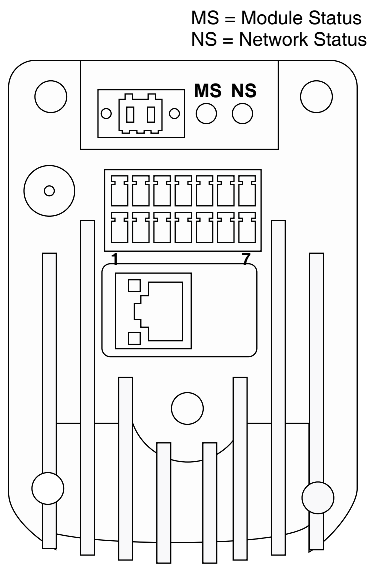

Figure 6.1: Status indicator LEDs

Color	State	Description
LED 1 – Network Status (NS)		
None	Off	No power
Green	Solid	Valid Profinet connection exists
	Flashing	Device never connected
Red	Solid	Profinet stack failure
	Flashing	Profinet connection lost/disconnected
LED 2 – Module Status (MS)		
None	Off	No power
Red	Solid	Unrecoverable fault - drive not responding
	Flashing	Minor, recoverable fault
Green	Solid	Device operational
	Flashing	Drive fault/failure, in firmware upgrade mode

NOTE: The term IO, in this context refers to Profinet IO communications protocol and is unrelated to the hardware input - output points.

Table 6.1: Status indicator LEDs

7 Register mapping

7

The Lexium MDrive Profinet IO uses 72 registers to transfer IO data between the IO-CONTROLLER (PLC) and the IO-DEVICE (Lexium MDrive Profinet.)

Output registers .... 1 - 38

Input registers .... 39 - 72

All of the registers ar by default mapped to an MCode command. For example Register 1 is mapped to A (Acceleration).

These (with the exception of the toggle and string registers, may be remapped to an MCode command corresponding to the register's data type, or set to NULL.

It is recommended that unused commands be remapped to a NULL setting to speed cycle time

7.1 Register mapping to address

Registers hold a place on a 128 byte input or 128 byte output string. Each register is mapped to an address in an IO Controller using a standard mnemonic followed by a numeric address.

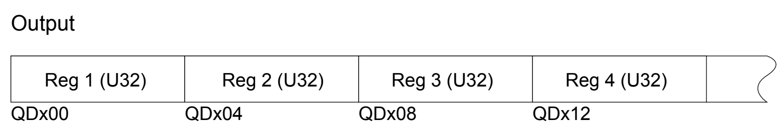

Figure 7.1: Register mapping

The mapping of the addresses are determined by the PLC, the TCP/IP configuration Utility may be used as an address reference by entering a starting address and viewing the tool tips on the Profinet tab of the utility.

7.2 Data types used

Data Type	Description
I32	Signed 32-bit integer
U8	Unsigned 8-bit integer
U16	Unsigned 16-bit integer
U32	Unsigned 32-bit integer
STRING	Character string (1 byte per character)
TOGGLE	Toggle registers allow for output registers to be manually resent, toggles will update on positive going transition from 0 to 1.

Table 7.1: Data types identification

7.3 Output register mapping

7.3.1 Variably mapped registers

The following table contains the output register, data type. mapping and default value.

These registers may be mapped to applicable MCode mnemonic commands matching the maximum size of the data type. i.e an Unsigne16 datatype may be mapped to an Unsigned 32 register, but not the opposite.

The TCP/IP Configuration utility only allows applicable mapping of registers.

Reg	Map	Name	Type	Mnemonic + address*	Data range	Default
1	A	Acceleration	U32	QD*5000*	91 to 1525878997 (steps/sec^2) 91 to 61035160 (encoder counts/ sec^2)	1000000 40000
2	D	Deceleration	U32	QD*5004*	91 to 1525878997 (steps/sec^2) 91 to 61035160 (encoder counts/sec^2)	1000000 40000
3	TS	Torque Speed	U32	QD*5008*	38,910 to 5,000,000 (steps/sec)	0
4	VI	Initial Velocity	U32	QD*5012*	1 to (VM [Reg 5] –1)	1000 (steps) 40 (encoder counts)
5	VM	Max Velocity	U32	QD*5016*	(VI [Reg 4] + 1) to 5000000 (steps) (VI + 1) to 200000 (encoder counts)	768000 (steps) 30720 (encoder counts)
6	C1	Position counter	I32	QD*5020*	-2147483648 to +2147483647 (steps)	0
7	C2	Encoder counter	I32	QD*5024*	-2147483648 to +2147483647 (encoder counts)	0
8	HT	Hold Current Delay	I32	QD*5028*	0 (no current reduction) or 1 - 65535 (mSec)	500 (mSec)
9	MA	Move Absolute	I32	QD*5032*	—	—
10	MR	Move Relative	I32	QD*5036*	—	—
11	SL	Slew	I32	QD*5040*	±5000000 (steps) ±200000 (encoder counts)	—
12	P	Position	I32	QD*5044*	-2147483648 to +2147483647	0
13	MT	Motor Settling Delay	I32	QD*5048*	0 to 65000 (mSec)	0
14	MS	Microstep Resolution	U16	QW*5052*	See MCode manual for valid settings	256
15	ER	Error	U16	QW*5054*	See MCode manual for error codes	0
16	AO	Attention Output	U16	QW*5056*	See MCode manual for valid settings	—
17	AS	hMTechnology Mode	U8	QB*5058*	0 — 3, See MCode manual for more info	0 (hMT off)
18	HC	Hold Current	U8	QB*5059*	0 to 100 (%)	5 (%)
19	OT	Write All Outputs	U8	QB*5060*	0 — 7, See MCode manual for more info	—
20	RC	Run Current	U8	QB*5061*	1 to 100 (%)	25 (%)
21	TQ	Torque	U8	QB*5062*	1 to 100 (%)	25 (%)
22	HM	Homing	U8	QB*5063*	0 — 4, See MCode manual for more info	—
23	HI	Home to Index	U8	QB*5064*	0 — 4, See MCode manual for more info	—
24	DE	Drive Enable	U8	Q*5065*	0 (disabled) / 1 (enabled)	1 (enabled)
25	EE	Encoder Enable	U8	Q*5066*	0 (disabled) / 1 (enabled)	0 (disabled)
26	TD	Torque Direction	U8	Q*5067*	0 (CCW facing shaft) / 1 (CW facing shaft)	1(CW)
27	0x1B	<esc>	U8	Q*5068*	Sends an "escape" to the device	—
28	CF	Clear Locked Rotor	U8	Q*5069*	0 — 2, See MCode manual for more info	1

**This* table uses an example starting address of 5000. The tooltip in the TCP configuration utility,will display the register address you have set in the "Starting address tooltip."

XX	*Available on closed loop models only (LMDCNxxx), will be NULL on open loop models (LMDONxxx).*

Table 7.2: Output register mapping

7.3.2 Fixed mapping registers

The registers notated by the data types STRING (Str) and TOGGLE (Tggl) are special function registers which cannot be remapped to other functions.

- **STRING Registers:** String register output MCode string data that doesn't comply to any other data type. Due to the unique structure of each string, these registers are fixed and cannot be remapped.
- **TOGGLE Registers:** The TOGGLE registers allow for register data to be resent to the Lexium MDrive. The register data is resent to the Lexium MDrive on the positive going transition from 0 to 1.

Register	Map	Name	Type	Mnemonic+ address*	Description
29	R9	Toggle Register 9	Tggl	Q*5070*	Default toggle for Register 9, Move Absolute (MA)

Toggle Register 9	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	*x*	*x*	*x*	*x*	*x*	*x*	*x*	Reg 9

Register	Map	Name	Type	Mnemonic+ address*	Description
30	R10	Toggle Register 10	Tggl	Q*5071*	Default toggle for Register 10, Move Relative (MR)

Toggle Register 10	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	*x*	*x*	*x*	*x*	*x*	*x*	*x*	Reg 10

Register	Map	Name	Type	Mnemonic+ address*	Description
31	R11	Toggle Register 11	Tggl	Q*5072*	Default toggle for Register 11, Slew (SL)

Toggle Register 11	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	*x*	*x*	*x*	*x*	*x*	*x*	*x*	Reg 11

Register	Map	Name	Type	Mnemonic+ address*	Description
32	OS	Output setup	Str	String 16 byte staring at address *5073*	Setup output points
33	MU	Position make-up	Str	String 16 byte staring at address *5089*	Setup make up for hMTechnology
34	R1 - R8	Toggle Register 1 - 8	Tggl	QB*5105*	Selectively toggle registers 1 through 8

Toggle Registers 1 — 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	Reg 8	Reg 7	Reg 6	Reg 5	Reg 4	Reg 3	Reg 2	Reg 1

Register	Map	Name	Type	Mnemonic+ address*	Description
35	R9 - R16	Toggle Register 9 - 16	Tggl	QB*5106*	Selectively toggle registers 9 through 16

Toggle Registers 9 — 16	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	Reg 16	Reg 15	Reg 14	Reg 13	Reg 12	Reg 11	Reg 10	Reg 9

Register	Map	Name	Type	Mnemonic+ address*	Description
36	R17 - R24	Toggle Register 17 - 24	Tggl	QB*5107*	Selectively toggle registers 17 through 24

Toggle Registers 17 — 24	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	Reg 24	Reg 23	Reg 22	Reg 21	Reg 20	Reg 19	Reg 18	Reg 17

Register	Map	Name	Type	Mnemonic+ address*	Description
37	R25-28, R32, R33, R38	Toggle Register 25-28, 32, 33. 38	Tggl	QB*5108*	Selectively toggle registers 25 - 28, 32, 33 and 38

Toggle Registers	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x = doesn't care	x	Reg 38	Reg 33	Reg 32	Reg 28	Reg 27	Reg 26	Reg 25

Register	Map	Name	Type	Mnemonic+ address*	Description
38	IS	Input setup	Str	String 19 byte staring at address *5109*	Setup input points

**This* table uses an example starting address of 5000. The tooltip in the TCP configuration utility,will display the register address you have set in the "Starting address tooltip."

XX	*Available on closed loop models only (LMDCNxxx), will be NULL on open loop models (LMDONxxx).*

7.4 Input register mapping

7.4.1 Variably mapped registers

The following table contains the input register default mapping, data type. mapping and default value.

These registers may be mapped to read applicable MCode mnemonic commands matching the maximum size of the data type. i.e an Unsigned16 datatype may be mapped to an Unsigned 32 register, but not the opposite.

The TCP/IP Configuration utility only allows applicable mapping of registers.

Reg	Map	Name	Type	Mnemonic + address*	Data range	Default
39	A	Acceleration	U32	ID*5130*	91 to 1525878997 (steps/sec^2) 91 to 61035160 (encoder counts/ sec^2)	1000000 / 40000
40	D	Deceleration	U32	ID*5134*	91 to 1525878997 (steps/sec^2) 91 to 61035160 (encoder counts/sec^2)	1000000 / 40000
41	TS	Torque Speed	U32	ID*5138*	38,910 to 2,560,000 (steps/sec)	0
42	VI	Initial Velocity	U32	ID*5142*	1 to (VM [Reg 5] –1)	1000 (steps) 40 (encoder counts)
43	VM	Max Velocity	U32	ID*5146*	(VI [Reg 4] + 1) to 2560000 (steps) (VI + 1) to 200000 (encoder counts)	768000 (steps) 30720 (encoder counts)
44	C1	Position counter	I32	ID*5150*	-2147483648 to +2147483647 (steps)	0
45	C2	Encoder counter	I32	ID*5154*	-2147483648 to +2147483647 (encoder counts)	0
46	LL	Position lead/lag	I32	ID*5158*	-2147483647 to +2147483647 (steps)	—
47	V	Current axis velocity	I32	ID*5162*	—	—
48	PC	Position capture at trip	I32	ID*5166*	—	—
49	MS	Microstep Resolution	U32	ID*5170*	See MCode manual for valid settings	256
50	P	Position	I32	ID*5174*	-2147483648 to +2147483647	0
51	AO	Attention Output	U32	IW*5178*	See MCode manual for valid settings	—
52	AF	hMT status flag	U16	IW*5182*	See MCode manual for valid settings	0
53	ER	Error	U16	IW*5184*	See MCode manual for error codes	0
54	I5	Read Analog input	U16	IW*5186*	0 to 4095	—
55	AS	hMTechnology Mode	U8	IB*5188*	0 — 3, See MCode manual for more info	0 (hMT off)
56	HC	Hold Current	U8	IB*5189*	0 to 100 (%)	5 (%)
57	IN	Read all inputs	U8	IB*5190*	0 — 15, See MCode manual for more info	—
58	RC	Run Current	U8	IB*5191*	1 to 100 (%)	25 (%)
59	TQ	Torque	U8	IB*5192*	1 to 100 (%)	25 (%)
60	OF	Output fault	U8	IB*5193*	0 (no fault) / 1 (fault)	—
61	TE	Trip enable	U8	IB*5194*	0 (disabled) / 1 (enabled)	—
62	DE	Drive Enable	U8	IB*5195*	0 (disabled) / 1 (enabled)	1 (enabled)
63	EE	Encoder Enable	U8	IB*5196*	0 (disabled) / 1 (enabled)	0 (disabled)
64	TD	Torque Direction	U8	IB*5197*	0 (CCW facing shaft) / 1 (CW facing shaft)	1(CW)
65	MV	Moving flag	U8	IB*5198*	0 (stopped) / 1 (moving)	—
66	MP	Moving to position flag	U8	IB*5199*	0 (stopped) / 1 (moving to position)	1

**This* table uses an example starting address of 5130. The tooltip in the TCP configuration utility,will display the register address you have set in the "Starting address tooltip."

XX *Available on closed loop models only (LMDCNxxx), will be NULL on open loop models (LMDONxxx).*

Table 7.3: Input register mapping

Register	Map	Name	Type	Mnemonic + address*	Data range	Default
67	VC	Velocity changing	U8	IB*5200*	0 (constant) / 1 (changing)	—
68	ST	Stall flag	U8	IB*5201*	0 (not stalled) / 1 (axis stalled)	—
69	LR	Locked rotor flag	U8	IB*5202*	0 (not locked) / 1 (rotor is locked)	—
70	IT	Internal temperature	Str	16 bytes starting *@5203*	—	—
71	MU	Make up mode	Str	16 bytes starting *@5219*	—	—
72	SN	Serial number	Str	23 bytes starting *@5235*	—	—

**This* table uses an example starting address of 5130. The tooltip in the TCP configuration utility,will display the register address you have set in the “Starting address tooltip.”

XX *Available on closed loop models only (LMDCNxxx), will be NULL on open loop models (LMDONxxx).*

7.5 Register mapping best practices

The default IO register mapping configuration mapps the most commonly used, variables, flags and commands to the available registers.

It is recommended that only the registers needed to meet the application requirements be used with the remaining registers mapped to a NULL state to conserve network bandwidth,

Note that registers with the datatype toggle or string are fixed to a vendor specific function because of string formatting and cannot be remapped.

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9 Glossary

9

9.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd]
5 m / 0.9144 = 5.468 yd

9.1.1 Length

	in	ft	yd	m	cm	mm
in	—	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	—	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	—	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	—	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	—	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	—

9.1.2 Mass

	lb	oz	slug	kg	g
lb	—	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	—	* $1.942559*10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	* $1.942559*10^{-3}$	—	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	—	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	—

9.1.3 Force

	lb	oz	p	dyne	N
lb	—	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	—	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	—	* 980.7	* $9.807*10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	—	/ $100*10^{3}$
N	/ 4.448222	/ 0.27801	/ $9.807*10^{-3}$	* $100*10^{3}$	—

9.1.4 Power

	HP	W
HP	—	* 745.72218
W	/ 745.72218	—

9.1.5 Rotation

	min^{-1} (RPM)	rad/s	deg./s
min^{-1} (RPM)	—	* π / 30	* 6
rad/s	* 30 / π	—	* 57.295
deg./s	/ 6	/ 57.295	—

9.1.6 Torque

	lb·in	lb·ft	oz·in	Nm	kp·m	kp·cm	dyne·cm
lb·in	—	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* $1.129*10^6$
lb·ft	* 12	—	* 192	* 1.355822	* 0.138255	* 13.8255	* $13.558*10^6$
oz·in	/ 16	/ 192	—	* $7.0616*10^{-3}$	* $720.07*10^{-6}$	* $72.007*10^{-3}$	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ $7.0616*10^{-3}$	—	* 0.101972	* 10.1972	* $10*10^6$
kp·m	/ 0.011521	/ 0.138255	/ $720.07*10^{-6}$	/ 0.101972	—	* 100	* $98.066*10^6$
kp·cm	/ 1.1521	/ 13.8255	/ $72.007*10^{-3}$	/ 10.1972	/ 100	—	* $0.9806*10^6$
dyne·cm	/ $1.129*10^6$	/ $13.558*10^6$	/ 70615.5	/ $10*10^6$	/ $98.066*10^6$	/ $0.9806*10^6$	—

9.1.7 Moment of inertia

	$lb·in^2$	$lb·ft^2$	$kg·m^2$	$kg·cm^2$	$kp·cm·s^2$	$oz·in^2$
$lb·in^2$	—	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
$lb·ft^2$	* 144	—	* 0.04214	* 421.4	* 0.429711	* 2304
$kg·m^2$	* 3417.16	/ 0.04214	—	* $10*10^3$	* 10.1972	* 54674
$kg·cm^2$	* 0.341716	/ 421.4	/ $10*10^3$	—	/ 980.665	* 5.46
$kp·cm·s^2$	* 335.109	/ 0.429711	/ 10.1972	* 980.665	—	* 5361.74
$oz·in^2$	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	—

9.1.8 Temperature

	°F	°C	K
°F	—	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	—	°C + 273,15
K	(K - 273.15) * 9/5 + 32	K - 273.15	—

9.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

9.2 Terms and Abbreviations

AC Alternating current

Acceleration The time rate of change of velocity with respect to a fixed reference frame. The commanded step rate is started at a base velocity and accelerated at a slew velocity at a defined and controlled rate or rate of changes.

ASCII American Standard Code for Information Interchange. Standard for coding of characters.

Back Electro-Motive Force (Back EMF) Also known as regeneration current, the reversed bias generated by rotation of the magnetic field across a stator’s windings. Sometimes referred to as counter EMF.

CAN (Controller Area Network), standardized open fieldbus as per ISO 11898, allows drives and other devices from different manufacturers to communicate.

CANopen CANopen is a CAN-based higher layer protocol. It was developed as a standardized embedded network with highly flexible configuration capabilities. CANopen was designed motion oriented machine control networks, such as handling systems. It is used in many various fields, such as medical equipment, off-road vehicles, maritime electronics, public transportation, building automation, etc

Closed Loop System In motion control, this term describes a system wherein a velocity or position (or both) sensor is used to generate signals for comparison to desired parameters. For cases where loads are not predictable, the closed loop feedback from an external encoder to the controller may be used for stall detection, position maintenance or position verification.

Daisy Chain This term is used to describe the linking of several devices in sequence, such that a single signal stream flows through one device and on to another

DC Direct current

Deadband A range of input signals for which there is no system response.

Default value Factory setting.

Detent Torque The periodic torque ripple resulting from the tendency of the magnetic rotor and stator poles to align themselves to positions of minimal reluctance. The measurement is taken with all phases de-energized.

Direction of rotation Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.

DOM The Date of manufacturing on the nameplate of the device is shown in the format DD.MM.YY,
e.g. 31.12.06 (December 31, 2006).

Duty Cycle For a repetitive cycle, the ratio of on time to total cycle time.

EMC Electromagnetic compatibility

Encoder Sensor for detection of the angular position of a rotating component. The motor encoder shows the angular position of the rotor.

Error class Classification of errors into groups. The different error classes allow for specific responses to faults, e.g. by severity.

Fatal error In the case of fatal error, the drive is not longer able to control the motor, so that an immediate switch-off of the drive is necessary.

Fault Operating state of the drive caused as a result of a discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.

Fault reset A function used to restore the drive to an operational state after a detected fault is cleared by removing the cause of the fault so that the fault is no longer active (transition from state “Fault” to state “Operation Enable”).

Forcing Forcing switching states of inputs/outputs. Forcing switching states of inputs/outputs.

Full Duplex The transmission of data in two directions simultaneously. For example, a telephone is a full-duplex device because both parties can talk at the same time.

Ground Loop A ground loop is any part of the DC return path (ground) that has more than one possible path between any two points.

Half Duplex The transmission of data in just one direction at a time. For example, a walkie-talkie is a half-duplex device because only one party can talk at a time.

Half Step This term means that the motor shaft will move a distance of 0.9 degree (400 steps per shaft revolution) instead of moving 1.8 degree per digital pulse.

Hybrid Motion Technology™ (HMT) A motor control technology representing a new paradigm in brushless motor control. By bridging the gap between stepper and servo performance, HMT offers system integrators a third choice in motion system design.

Hybrid Motors Hybrid stepper motors feature the best characteristics of PM and VR motors. Hybrid steppers are best suited for industrial applications because of high static and run torque, a standard low step angle of 1.8°, and the ability to Microstep. Hybrid stepper motors offer the ability to precisely position a load without using a closed-loop feedback device such as an encoder.

Holding Torque The maximum torque or force that can be externally applied to a stopped, energized motor without causing the rotor to rotate continuously. This is also called “static torque”.

I/O Inputs/outputs

Inc Increments

Index pulse Signal of an encoder to reference the rotor position in the motor. The encoder returns one index pulse per revolution.

Inertia A measure of an object’s resistance to a change in velocity. The larger an object’s inertia, the greater the torque required to accelerate or decelerate it. Inertia is a function of an object’s mass and shape. For the most efficient operation, the system-coupling ratio should be selected so that the reflected inertia of the load is equal to or no greater than 10 times the rotor inertia of the stepper motor.

Inertia (Reflected) Inertia as seen by the stepper motor when driving through a speed change, reducer or gear train.

Lag The amount (in full motor steps) that the rotor lags the stator. Lag conditions are caused by loading on the motor shaft, as during transient loading or rapid acceleration.

Lead The amount (in full motor steps) that the rotor leads the stator. Lead conditions are caused by an overhauling load, as during periods of rapid deceleration.

Limit switch Switch that signals overtravel of the permissible range of travel.

Load Any external resistance (static or dynamic) to motion that is applied to the motor.

Locked rotor When the lag/lead limit is reached, a timer starts a countdown that is determined by the user. The locked rotor will assert itself by triggering a flag and, depending on the selected mode, by disabling the output bridge.

Loss of synchronization In traditional stepper systems, when the lead/lag relationship of the rotor and stator reaches two full motor steps, the alignment of the magnetic fields is broken and the motor will stall in a freewheeling state. Hybrid Motion Technology eliminates this.

Microstepping A control electronic technique that proportions the current in a stepper motor's windings to provide additional intermediate positions between poles. Produces smooth rotation over a wide range and high positional resolution. Typically, step resolutions range from 400 to 51,200 steps per shaft revolution.

Motor phase current The available torque of a stepper motor is determined by the motor phase current. The higher the motor phase current the higher the torque.

Multidrop A communications configuration in which several devices share the same transmission line, although generally only one may transmit at a time. This configuration usually uses some kind of polling mechanism to address each connected device with a unique address code.

NEMA The acronym for the National Electrical Manufacturer's Association, an organization that sets standards for motors and other industrial electrical equipment.

Node guarding Monitoring of the connection with the slave at an interface for cyclic data traffic.

Open Loop System An open loop motion control system is where no external sensors are used to provide position or velocity feedback signals, such as encoder feedback of position.

Opto-Isolated A method of sending a signal from one piece of equipment to another without the usual requirement of common ground potentials. The signal is transmitted optically with a light source (usually a Light Emitting Diode) and a light sensor (usually a photo-sensitive transistor). These optical components provide electrical isolation.

Parameter Device data and values that can be set by the user.

Persistent Indicates whether the value of the parameter remains in the memory after the device is switched off.

PLC Programmable logic controller

Position lead/lag The HMT circuitry continually tracks the position lead or lag error, and may use it to correct position.

Position make-up When active, the position make-up can correct for position errors occurring due to transient loads. The lost steps may be interleaved with incoming steps, or reinserted into the profile at the end of a move.

Power stage The power stage controls the motor. The power stage generates currents for controlling the motor on the basis of the positioning signals from the controller.

Pull-In Torque This is the maximum torque the stepper motor can develop when instantaneously started at that speed.

Pull-Out Torque This is the maximum torque that the stepper can develop once an acceleration profile has been used to “ramp” it to the target speed.

Quick Stop Function used to enable fast deceleration of the motor via a command or in the event of a malfunction.

Resolution The smallest positioning increment that can be achieved.

Resonance The frequency that a stepper motor system may begin to oscillate. Primary resonance frequency occurs at about one revolution per second. This oscillation will cause a loss of effective torque and may result in loss of synchronism. The designer should consider reducing or shifting the resonance frequency by utilizing half step or micro-step techniques or work outside the primary resonance frequency.

Rotor The moving part of the motor, consisting of the shaft and the magnets. These magnets are similar to the field winding of a brush type DC motor

Rotor Inertia The rotational inertia of the rotor and shaft.

RS485 Fieldbus interface as per EIA-485 which enables serial data transmission with multiple devices.

Sinking Current Refers to the current flowing into the output of the chip. This means that a device connected between the positive supply and the chip output will be switched on when the output is low.

Slew The position of a move profile where the motor is operating at a constant velocity

Sourcing Current Refers to the current flowing out of the output of the chip. This means that a device connected between the chip output and the negative supply will be switched on when the output is high.

Stall detection Stall detection monitors whether the index pulse is always correctly triggered at the same angle position of the motor shaft.

Stator The stationary part of the motor. Specifically, it is the iron core with the wire winding in it that is pressed into the shell of the frame. The winding pattern determines the voltage constant of the motor.

Torque ramp Deceleration of the motor with the maximum possible deceleration, which is only limited by the maximum permissible current. The higher the permissible braking current, the stronger the deceleration. Because energy is recovered up depending on the coupled load, the voltage may increase to excessively high values. In this case the maximum permissible current must be reduced.

Variable current control When active, variable current control will control the motor current as such to maintain the torque and speed on the load to what is required by the profile. This leads to reduced motor heating and greater system efficiency.

Warning If not used within the context of safety instructions, a warning alerts to a potential problem detected by a monitoring function. A warning is not a fault and does not cause a transition of the operating state. Warnings belong to error class 0.

Watchdog Unit that monitors cyclic basic functions in the product. Power stage and outputs are switched off in the event of faults.

Zero crossing The point in a stepper motor where one phase is at 100% current and the other is at 0% current.

8 Setting up LMD using Siemens Totally Integrated Automation

8

8.1 Adding the Lexium MDrive from start

1) Create a new project.

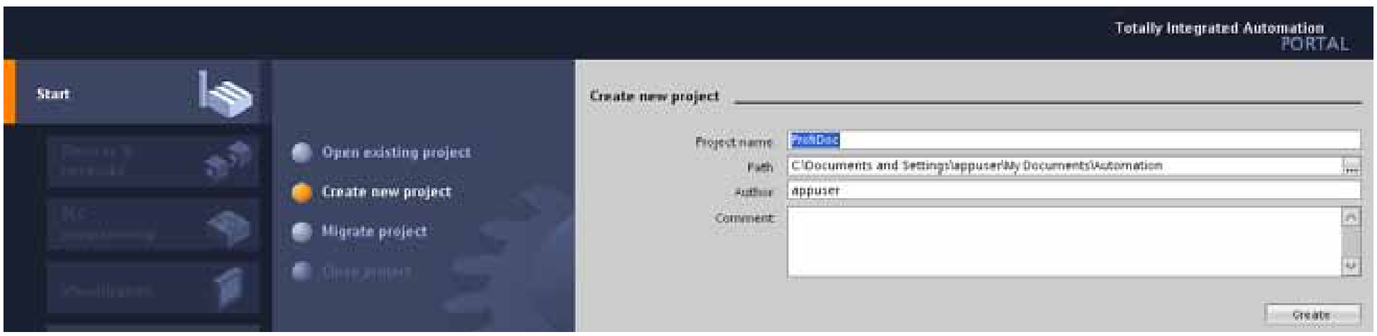

Figure 8.1: New project creation

2) Add your PLC by selecting the appropriate controller model and clicking “Add”.

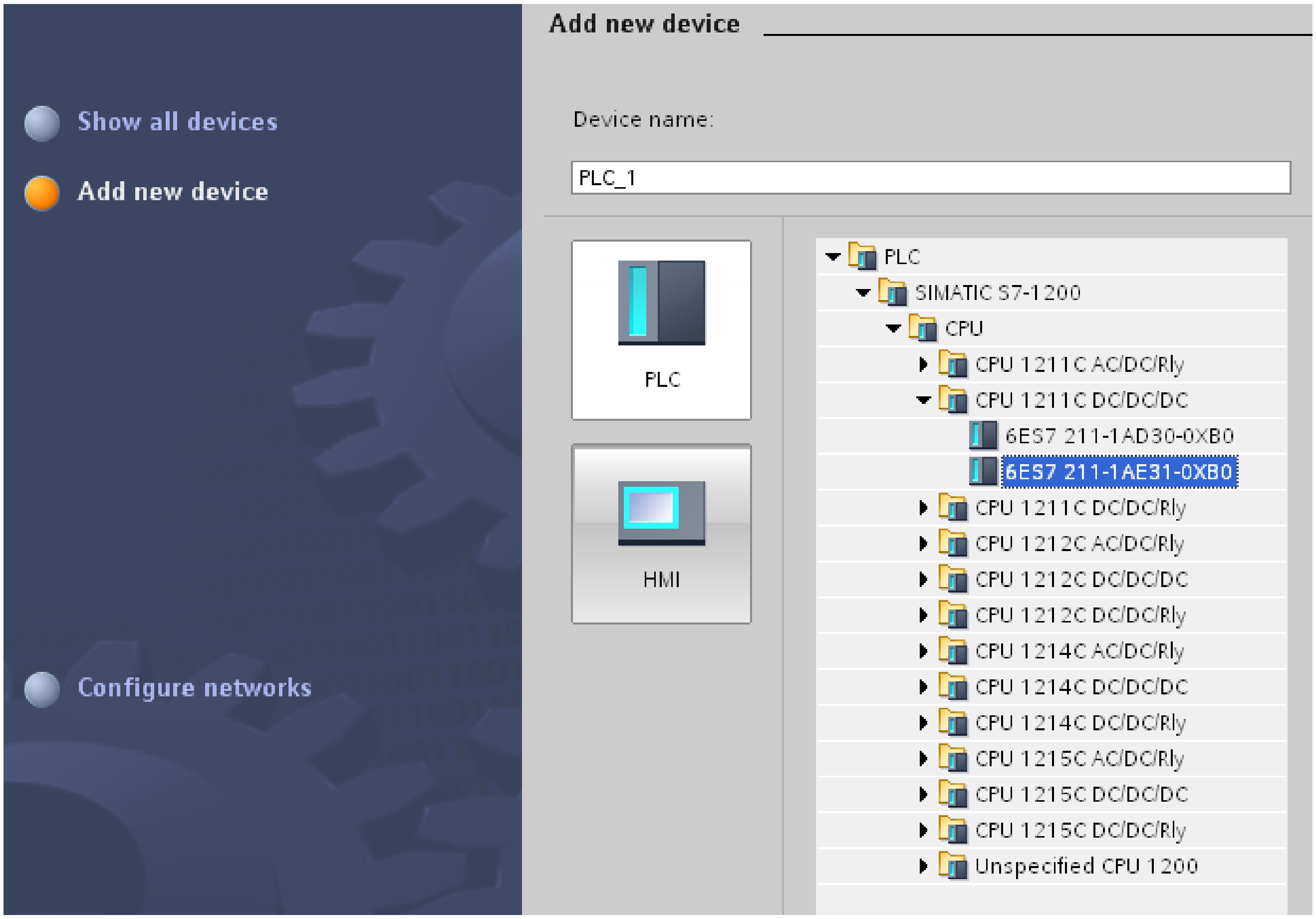

Figure 8.2: Add PLC to project

3) Install the General Station Description (GSD) file. This will make the Lexium MDrive available in the system Hardware Catalog. This is done through the options menu.

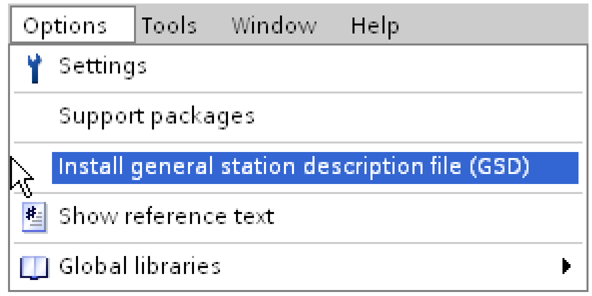

Figure 8.3: Install GSD file

a) Browse to the GSDML file (located in the TCP/IP Configuration Utility installation folder or on the web at http://motion.schneider-electric.com. Click install.

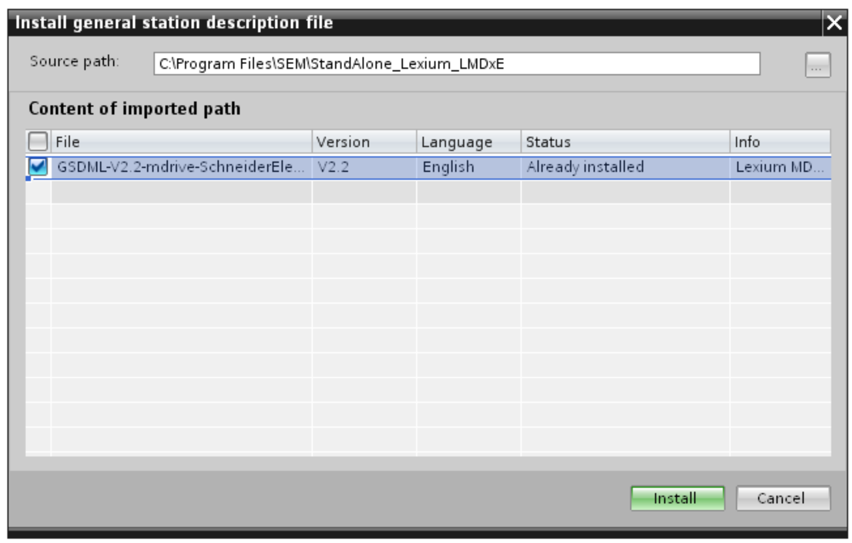

Figure 8.4: Install GSD file

b) The Lexium MDrive should now be available in the Hardware Catalog under Other field devices/PROFINET IO/IO/Schneider Electric Motion/Lexium MDrive or MDrive

4) Assign an IP address to the PLC.

Figure 8.5 Assign IP address to PLC

5) From the Topology Screen, select a Lexium MDrive from the Catalog. It will be located in the "Other Field Devices/PROFINET IO/I/O/Schneider Electric/Lexium MDrive/Head Module/Lexium Mdrive/Standalone, no Pdev

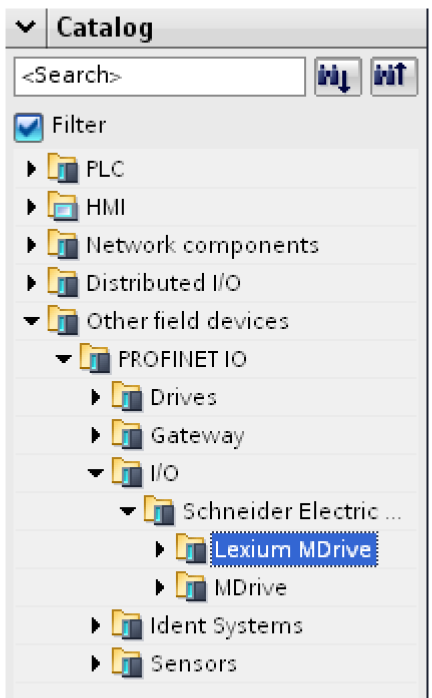

Figure 8.6: Select Lexium MDrive

V1.00, 10.2014

6) In device view, set the IP Address of the LMD. This must match what is set using the TCP Configuration Utility.

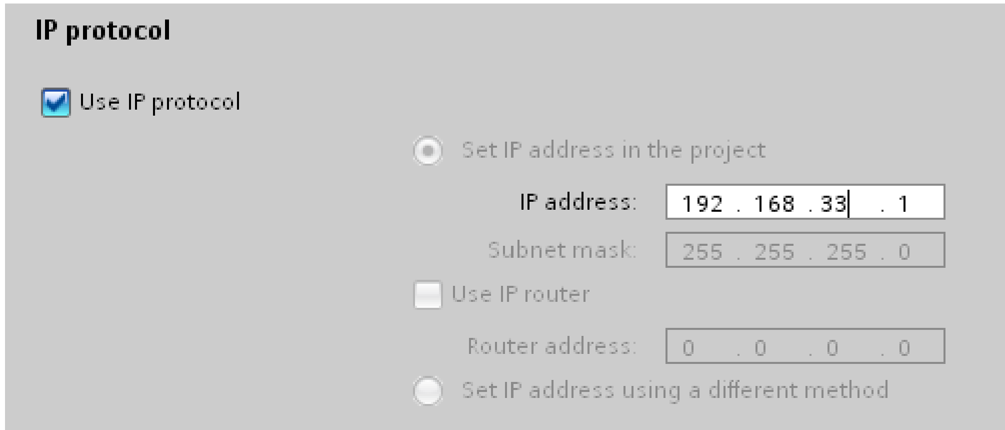

Figure 8.7: Assign Lexium MDrive IP to project

7) In device view, set the name of the LMD.

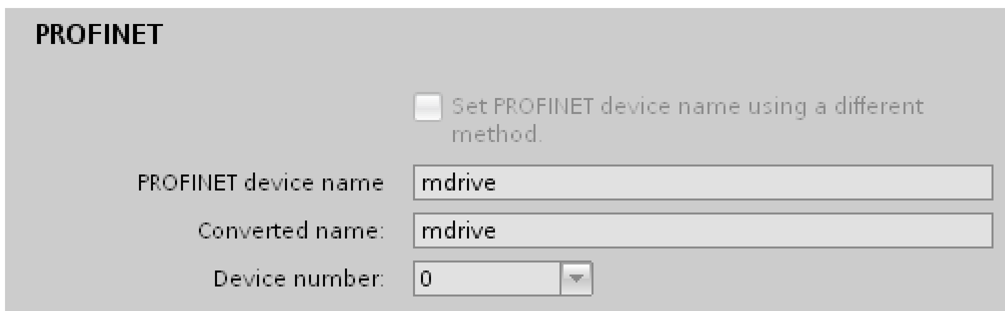

Figure 8.8: Assign Lexium MDrive IP to project

8) Define I/O by double clicking on the 128 bytes I and 128 bytes 0 subtext in the catalog menu.

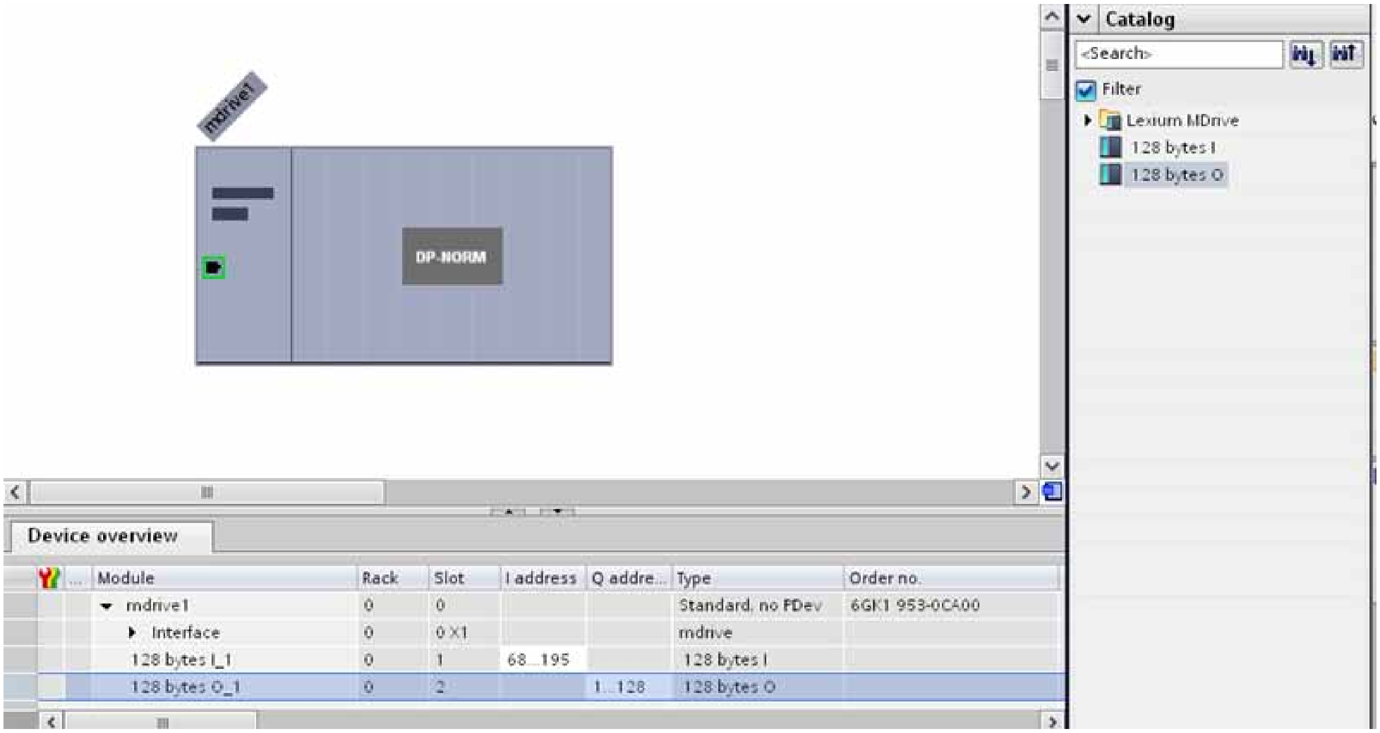

Figure 8.9: Define IO

9) In Topology view, connect the PLC port and the LMD port by dragging from one to the other..

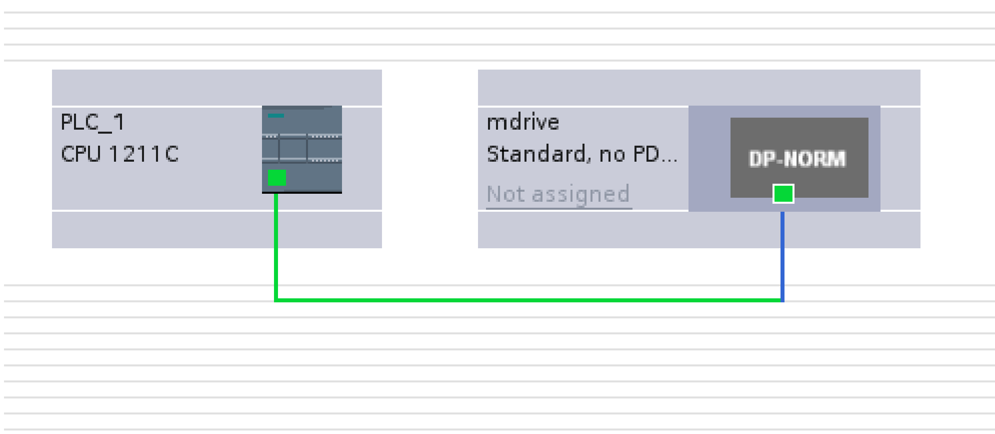

Figure 8.10: Define IO

10) In network view, ensure that the Lexium MDrive is assigned to the PLC that is controlling it.

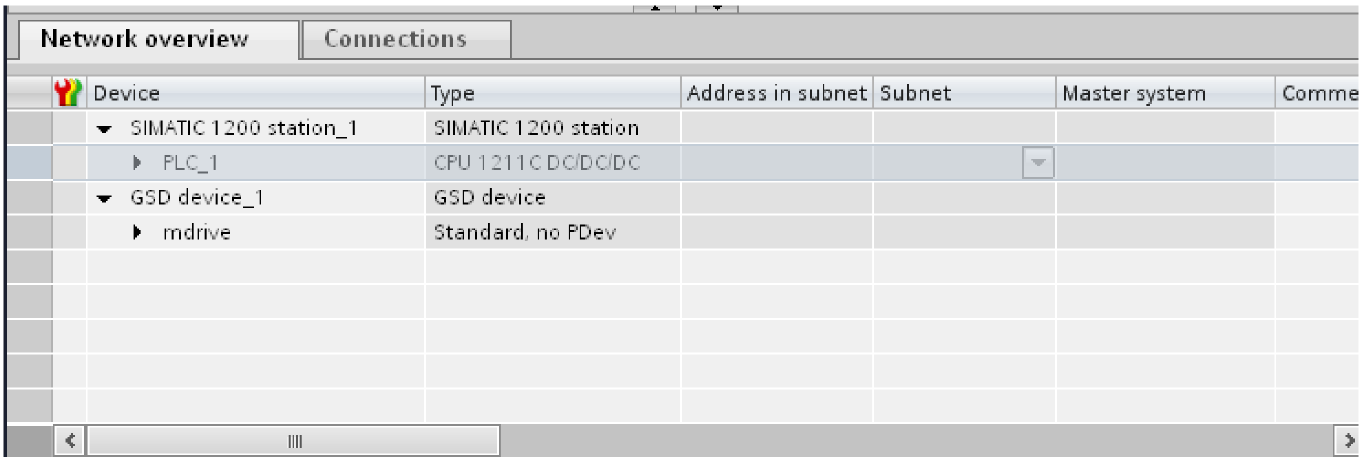

Figure 8.11: Network assignment

WARRANTY

Reference the web site at www.motion.schneider-electric.com for the latest warranty and product information.

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East Region
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