EtherNet/IP Fieldbus

Lexium MDrive Ethernet TCP/IP Products

V1.00, 08.2014

EtherNet/IP™ EtherNet/IP™ conformance tested

CE RoHS REACH

Schneider Electric

EtherNet/IP Fieldbus Manual For Lexium MDrive		
Date	**Revision**	**Changes**
02/21/2013	V1.00, 03.2013	Initial release
08/15/2014	V1.00, 08.2014	Changed Max Velocity (VM) from 5000000 to 2560000 steps/sec

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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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 Lexium MDrive Ethernet products are:

- MCode Programming and Software Reference manual
- MODBUS/TCP Fieldbus manual
- EtherNet/IP Fieldbus manual

Graphic User Interface software

For easier prototyping and development, a Graphic User Interface (GUI) is available for use with Lexium Lexium MDrive products. This software is available for download from the Internet at:

http://motion.schneider-electric.com

Further reading

Recommended literature for further reading.

Reference documents

- The CIP Networks Library Volume 1 Common Industrial Protocol
- The CIP Networks Library Volume 3 DeviceNet Adaptation of CIP
- The CIP Networks Library Volume 2 DeviceNet Adaptation of CIP
- DeviceNet terms of Usage Agreement http://www.odva.org

User Association

- Open DeviceNet Vendor Association (ODVA)
  http://www.odva.org

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1 Introduction

EtherNet/IP is a fieldbus based on TCP and UDP. EtherNet/IP extends Ethernet by an advanced industrial protocol (CIP, Common Industrial Protocol) as an application layer for automation applications - this way, Ethernet is excellently suited for industrial control . Products from different manufacturers can be networked without the need for special interface adaptation. The majority of the required network components correspond to the Ethernet components used in the PC world.

1.1 Fieldbus devices on the EtherNet/IP network

Different products with an EtherNet/IP interface can be operated in the same fieldbus. EtherNet/IP provides a common basis for interchanging commands and data between the network devices.

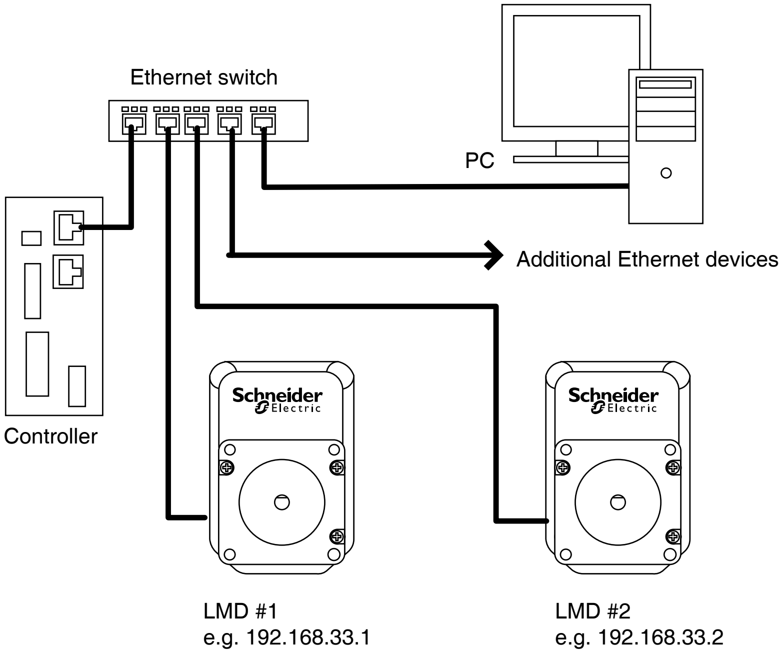

Figure 1.1: Example TCP/IP network with Lexium MDrive products.

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2 Before you begin - safety information

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).

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”.

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

3.1 EtherNet/IP technology

EtherNet/IP devices are based on the same technology as devices on Ethernet networks in the computer world. For many applications, components from the existing company network can be used. However, it is recommended to use industrial switches for time-critical applications.

This manual is not intended to convey basic knowledge, for example in terms of network topology, data security or address assignment.

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

The ODVA (is in charge of the specifications for the EtherNet/IP network and EtherNet/IP data terminal equipment. For more information on the ODVA see:

http://www.odva.org

Number of nodes The number of nodes in an EtherNet/IP network is theoretically unlimited; it depends on the subnet size and on whether or not a CIP router is used. For example, 254 nodes are possible in a class C subnet.

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

Drive profiles The product supports the following drive profiles:

- “Drive Profile Lexium MDrive”

Communication means

The product supports the following communication means:

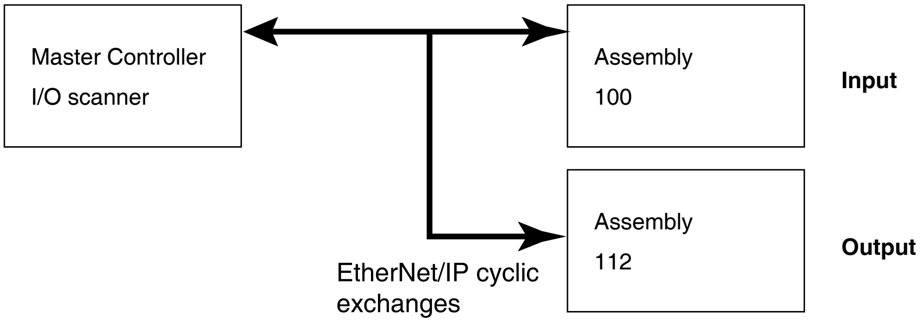

Figure 3.1: Overview of communication means

The product identifies itself as CIP “Generic Device” (Device Type = 0h).

Data link layer

The EtherNet/IP data link layer uses the transmission mechanisms as per IEEE 802.3 Standard Ethernet specification (edition 2002). This makes it possible to use a wide selection of available Ethernet components.

Physical layer

Industrial EtherNet/IP specifies minimum requirements in terms of ambient conditions, cabling and connectors, based on IEC, ANSI, TIA and EIA standards.

The connectors required for Industrial EtherNet/IP include RJ-45 connectors. Use shielded or unshielded CAT5 or CAT6 cables for Industrial EtherNet/IP.

Copper media may be used only for distances up to 100 m.

Terms: Object class, instance, attribute, service

The EtherNet/IP approach is object-oriented. CIP defines object classes; one or more instances (objects) can be derived from such object classes. The attributes of an object class or the instance derived from it contain the various parameters. Services are actions that are possible with these attributes.

Example

Class	Instance	Attribute ID	Description	MCode
0x64	0x01	0x01	Reset enable	CE

CIP object model

See section 7.

Communication model

EtherNet/IP uses the producer-consumer communication model. All nodes check the bus as to whether a data packet with the Identifier they support is available. Data packets that are sent by producers can only be received by the consumers of these packets.

Groups of connections

EtherNet/IP is a connection-oriented network. Connections must be established and managed between two nodes. There are 4 connection groups with different priorities:

Group 1	Top-priority process data (highest priority)
Group 2	For simple master-slave connections
Group 3	For Explicit Messages
Group 4	Reserved group (lowest priority)

Table 3.1: Connection groups

Electronic Data Sheet

An EDS file is a file in ASCII format. This file contains device-specific and vendor-specific descriptions of all parameters for a device. The EDS file also contains the fieldbus-specific communication parameters. The EDS file is required for commissioning.

3.1.3 Encapsulation

EtherNet/IP is based entirely on existing TCP/IP and UDP/IP technologies that are used without any modification. TCP/IP is used for the transmission of Explicit Messages while UDP/IP is used for I/O Messaging.

3.1.4 Messaging and message types

EtherNet/IP uses two types of messaging: Explicity Messaging and Implicit (I/O data) Messaging. EtherNet/IP defines several message types for communication. The product described here uses the “Explicit Message” and “I/O Message” message types.

Explicit messages

Explicit Messaging connections are point-to-point connections between two network nodes that are used for transactions of the type request - response. These connections are used to address parts of a device which are accessible via the network. The data field of Explicit Messages contains both protocol data and application-specific commands.

I/O messages

I/O Messages, also referred to as Implicit Messages, are transmitted via UDP/IP. I/O Message connections are often established as One-to- Many relationships in the producer-consumer Multicast model of Ether-Net/IP. The data fields of I/O Messages contain no protocol information, but only time-critical I/O data. I/O Messages are a lot smaller than Explicit Messages, thus allowing for much faster processing. These messages are used to to transport application-specific I/O data over the network at regular intervals. The meaning of the data is pre-defined at the time the connection is established. I/O Messages can contain socalled Assemblies of several parameters that can be transmitted with a single message. The parameters for configuring EtherNet/IP communication are described in chapter 5 “Commissioning”.

Command processing: Transmit data and receive data

The master sends a command to the drive system (slave) to execute a motion command, activate functions or request information from the slave. The slave executes the command and acknowledges it with a response message that may contain an error message if an error occurred.

The master device can send new commands as soon as it has received acknowledgement concerning the current command. Acknowledgement information and error messages are included in the transmitted data in bit-coded form.

The master must then continuously monitor for completion of the processing command by evaluating the acknowledgment from the slave. I/O messages are a special case. I/O messages are not acknowledged from the slave.

3.1.5 Communication via Explicit Message

An Explicit Message (EtherNet/IP-specific or vendor-specific) is used to read or write an individual parameter. See the product manual for an overview of all parameters.

The parameter is accessed by means of Class.Instance.Attribute as per CIP.

3.1.6 Communication via I/O Messages

An I/O Message is used for realtime exchange of process data. I/O messages lend themselves for motion commands. Transmission is very fast because the data is sent without administration data and a transmission acknowledgement from the recipient is not required.

The master can control the operating states of the slave by means of I/O Message, for example, enable and disable the power stage, trigger a “Quick Stop”, reset errors and activate operating modes.

Changing operating states and activating operating modes must be done separately. An operating mode can usually only be activated if the operating state is already “Operation Enabled”.

A new operating mode can only be activated when the motor is at a standstill.

Output, Input

Output and Input refer to the direction of data transmission from the perspective of the master.

- Output: Commands from the master to the slave, or originator to target.
- Input: Status messages from the slave to the master, or target to originator.

Assembly

I/O Messages contain a collection (Assembly) of different parameters that are transmitted with a single message.

The following Assemblies are defined for EtherNet/IP:

- Output Assembly, instance 112
- Input Assembly, instance 100

Polled I/O Connection

The Assemblies are used in a Polled I/O Connection . A Polled I/O Connection is initiated by the master with a Poll Command. The Slave responds with a Poll Response.

4 Installation

⚠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

Configuring the Lexium MDrive Ethernet devices is accmplished using the TCP/IP Configuration utility.

Please refer to the Lexium MDrive Software Suite manual.

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6 Diagnostics and troubleshooting

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 EDS 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 EDS file.

6.2 Status LEDs

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

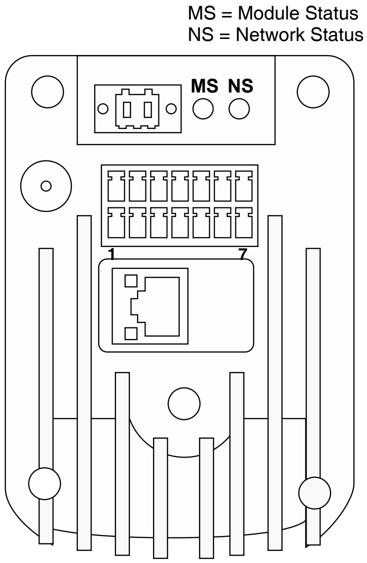

Figure 6.1: Status indicator LEDs

Color	State	Description
LED 1 – Network Status (NS)		
None	Off	No power
	Flashing	Recoverable fault or I/O connection timed out
Green	Solid	Normal runtime operation (I/O connection allocated)
	Flashing	Device is idle or not allocated to a client (PLC)
Red/green	Alternating	Power-up self test in progress
LED 2 – Module Status (MS)		
None	Off	No power
Red	Solid	Unrecoverable fault
	Flashing	Minor, recoverable fault
Green	Solid	Device operational
	Flashing	Standby, device has not been configured
Red/green	Alternating	Power-up self test in progress

NOTE: The term I/O, in this context refers to EtherNet/IP communications protocol and is unrelated to the hardware Input - output points.

Table 6.1: Status indicator LEDs

7 Object model

7.1 Data types used in this object model

Data Type	Description
SINT	Signed 8-bit integer
INT	Signed 16-bit integer
DINT	Signed 32-bit integer
USINT	Unsigned 8-bit integer
UINT	Unsigned 16-bit integer
UDINT	Unsigned 32-bit integer
STRING	Character string (1 byte per character)
SHORTSTRING*nn*	Character string (1 byte in length; up to *nn* characters)
BOOL	1 bit
BYTE	Bit string (8-bits)
WORD	Bit string (16-bits)
DWORD	Bit string (32-bits)
REAL	IEEE 32-bit single precision floating point

Table 7.1: Data types identification

7.2 Identity object (01_h – 1 instance)

The following tables contain the attribute, status, and common services information for the identity object.

Instance	Attribute ID	Name	Data type	Data value	Access rule
0x00	0x01	Revision	UINT	1	Get
0x01	0x01	Vendor number	UINT	243	Get
	0x02	Device type	UINT	43	Get
	0x03	Product code number	UINT	15362	Get
	0x04	Product major revision Product minor revision	USINT USINT	02 22	Get
	0x05	Status	WORD	See Table 7.4	Get
	0x06	Serial number	UDINT	Unique 32 bit value	Get
	0x07	Product name	SHORTSTRING32	Lexium MDrive	Get

Table 7.2: Identity object (01h – 1 instance)

Service code	Implemented for		Service name
	Class level	Instance levels	
0x05	No	Yes	Reset
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute Single

Table 7.3: Identity object's common services

7.2.1 Identity object attribute 0x05 (Status)

This attribute represents the current status of the entire device. Its value changes as the state of the device changes. The status attribute is a WORD, with the following bit definitions:

15 ... 12	11	10	9	8	7 ... 4	3	2	1	0
Rsrvd	Maj UF	Maj RF	Min.UF	Min. RF	Ext Stat	Rsrvd	Config	Rsrvd	Owned

Bit(s)	Name	Meaning
0		1 indicates the device (or an object within the device) has an owner. Within the Master/Slave paradigm the setting of this bit means that the Predefined Master/Slave Connection Set has been allocated to a master.
1		Reserved, always 0
2	Configured	1 indicates the application of the device has been configured to do something different than the "out–of–box" default. This shall not include configuration of the communications.
3		Reserved, always 0
4 – 7	Extended Device Status	Vendor–specific or as defined by table below. The EDS shall indicate if the device follows the public definition for these bits using the DeviceStatusAssembly keyword in the [Device] section of the EDS. If these bits are vendor specific then they shall be enumerated in the EDS using the Assembly and Parameter sections.
8	Minor Recoverable Fault	1 indicates the device detected a problem with itself, which is thought to be recoverable. The problem does not cause the device to go into one of the faulted states.
9	Minor Unrecoverable Fault	1 indicates the device detected a problem with itself, which is thought to be unrecoverable. The problem does not cause the device to go into one of the faulted states.
10	Major Recoverable Fault	TRUE indicates the device detected a problem with itself, which caused the device to go into the "Major Recoverable Fault" state.
11	Major Unrecoverable Fault	TRUE indicates the device detected a problem with itself, which caused the device to go into the "Major Unrecoverable Fault" state.
12 – 15		Reserved, always 0

Table 7.4: Bit definitions for status instance attribute of identity object

7.3 Assembly object (04_h – 4 instances)

Note that instance attributes show the default mapping of parameters to an attribute. This mapping may be changed to any MCode mnemonic of the same datatype using the TCP/IP Configuration Utility. See Section 5: Commissioning.

<table>
<tr><th>Instance</th><th>Attribute ID</th><th>Name</th><th>Data type</th><th>Data value</th><th>Access rule</th></tr>
<tr><td>Class
(Instance 0)</td><td>1</td><td>Revision</td><td>UINT</td><td>2</td><td>Get</td></tr>
<tr><td></td><td>2</td><td>Max instance</td><td>UINT</td><td>0xFF</td><td>Get</td></tr>
<tr><td>Input (T→O)
Instance 100</td><td>3</td><td colspan="3"><table>
<tr><th>Bytes</th><th>MCode mnemonic</th><th colspan="2">Description</th></tr>
<tr><td>BOOL</td><td>EF</td><td>Error flag</td><td rowspan="2">Same byte</td></tr>
<tr><td>BOOL</td><td>MV</td><td>Moving flag</td></tr>
<tr><td>USINT</td><td>IN</td><td colspan="2">Read inputs as a group</td></tr>
<tr><td>USINT</td><td>Pad</td><td colspan="2"></td></tr>
<tr><td>USINT</td><td>Pad</td><td colspan="2"></td></tr>
<tr><td>DINT</td><td>C1</td><td colspan="2">Position counter</td></tr>
<tr><td>DINT</td><td>C2</td><td colspan="2">Encoder counter</td></tr>
<tr><td>DINT</td><td>LL</td><td colspan="2">Lead/Lag</td></tr>
</table></td><td>Get</td></tr>
<tr><td>Output
(O→T)
Instance 112</td><td>3</td><td colspan="3"><table>
<tr><th>Bytes</th><th>MCode mnemonic</th><th>Description</th></tr>
<tr><td>UDINT</td><td>A</td><td>Acceleration</td></tr>
<tr><td>UDINT</td><td>D</td><td>Deceleration</td></tr>
<tr><td>DINT</td><td>MA</td><td>Move to absolute position</td></tr>
<tr><td>DINT</td><td>MR</td><td>Move to relative position</td></tr>
<tr><td>USINT</td><td>RC</td><td>Run current percent</td></tr>
<tr><td>USINT</td><td>HC</td><td>Hold current percent</td></tr>
<tr><td>BYTE</td><td>OT</td><td>Write digital outputs</td></tr>
<tr><td>USINT</td><td>Pad</td><td></td></tr>
<tr><td>DINT</td><td>SL</td><td>Slew</td></tr>
<tr><td>UDINT</td><td>VI</td><td>Initial (starting) velocity</td></tr>
<tr><td>UDINT</td><td>VM</td><td>Maximum (final) velocity</td></tr>
<tr><td>USINT</td><td>TQ</td><td>Torque percent</td></tr>
<tr><td>USINT</td><td>EF</td><td>Error Flag</td></tr>
</table></td><td>Get/set</td></tr>
<tr><td>128 (0x80)</td><td></td><td>Input only heartbeat[1]</td><td>Heartbeat</td><td>0</td><td>n/a</td></tr>
<tr><td>129 (0x81)</td><td></td><td>Listen only heartbeat[2]</td><td>Heartbeat</td><td>0</td><td>n/a</td></tr>
<tr><td>Unused (n)</td><td></td><td>Configuration[3]</td><td></td><td></td><td></td></tr>
</table>

[1] This instance allows clients to monitor input data without providing output data.

[2] This instance allows clients (PLCs) to monitor input data without providing output data. To use this connection type, an owning connection must exist from a second client and the configuration of the connection must match exactly.

[3] Configuration data is not required, but it must match if supplied. Contents of the configuration instance are yet to be determined.

Table 7.5: Assembly object (04h – 4 instances)

Service code	Implemented for		Service name
	Class level	Instance levels	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute Single

Table 7.6: Assembly object’s common services

7.4 TCP object (F5$_h$ – 1 instance)

The following tables contain the attribute and common services information for the TCP Object.

Instance	Attribute ID	Name	Data type	Data value	Access rule
Class (Instance 0)	1	Revision	UINT	1	Get
Instance 1	1	Status*	DWORD	See Table 5-3.2*	Get
	2	Configuration capability*	DWORD	See Table 5-3.4*	Get
	3	Configuration control*	DWORD	0x0	Get/set
	4	Physical Link Object * Structure of		Below are defaults	Get
		Path Size	UINT	0x2	
		Path	Array of Word	0x20 0xF6 0x24 0x01	
	5	Interface configuration* Structure of		Below are defaults	Get
		IP Address	UDINT	192.168.33.1	
		Network Mask	UDINT	255.255.0.0	
		Gateway Address	UDINT	192.168.1.200	
		Name Server	UDINT	0x0	
		Name Server 2	UDINT	0x0	
		Domain Name Size	UINT	0x0	
		Domain Name	STRING	0x0	
	6	Host name* Structure of		Below are defaults	Get
		Host Name Size	UINT	0x0	
		Host Name	STRING	0x0	

*For more details on these attributes, see ***Volume 2: EtherNet/IP Adaptation of CIP,*** Section 5-3.2 from ODVA. Tables reference in the data value column are located in that document.

Table 7.7: TCP object (05h – 1 instance)

Service code	Implemented for		Service name
	Class level	Instance levels	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute Single

Table 7.8: Assembly object’s common services

7.5 Ethernet Link object (F6$_h$ – 1 instance)

The following tables contain the attribute and common services information for the Ethernet Link Object.

Instance	Attribute ID	Name	Data type	Data value	Access rule
Class (Instance 0)	1	Revision	UINT	1	Get
Instance 1	1	Interface speed*	DWORD	0	Get
	2	Interface flag*	DWORD	See Table 5-4.44*	Get
	3	Physical address	ARRAY	MAC Address	Get

*For more details on these attributes, see ***Volume 2: EtherNet/IP Adaptation of CIP,*** Section 5-3.2 from ODVA. Tables reference in the data value column are located in that document.

Table 7.9: Ethernet object (0xF6 – 1 instance)

Service code	Implemented for		Service name
	Class level	Instance levels	
0x0E	Yes	Yes	Get_Attribute_Single

Table 7.10: Assembly object's common services

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8 Manufacturer specific objects

8.1 Preliminary

This section contains the objects specific to the Lexium Lexium MDrive Motion Control devices.

It is divided into Object classes by functional grouping, these are:

Object	Description
0x64	Setup instructions
0x65	Miscellaneous instructions and flags
0x66	Motion instructions and flags
0x67	I/O instruction variables and flags
0x68	Position related instructions and flags
0x69	Encoder related instructions and flags
0x6A	Hybrid specific instructions and flags

Table 8.1: Object class groupings

Access	Description
RO	Readable only
WO	Writable only
WONE	Writable only , no equal sign
RW	Readable and writable, unconditional
RW_IO	Readable always, Writable only if I/O connection present

Table 8.2: Access types identification

NOTE: References in the section to “I/O” refer to the control of the hardware input/output points on the device.

8.1.1 MCode compatibility

Each attribute on the object class grouping references a 1 or 2 character MCode mnemonic.

Please reference the ***Lexium MCode Programming and Reference Manual,*** which is located on the web site at http://www.motion.schneider-electric.com for detailed usage instructions, value ranges and restrictions.

8.2 Setup object (64_h – 1 instance)

The Setup object contains attributes configuring basic setup parameters.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
Instance 1	0x01	Software reset enable	USINT	CE	RW
	0x02	Output clock width	USINT	CW	RW
	0x03	Drive enable	BOOL	DE	RW
	0x04	Trip on relative position	USINT	TR	RW
	0x05	Warning temperature	USINT	WT	RW

Table 8.3: Setup object (64h – 1 instance)

8.3 Miscellaneous object (65_h – 1 instance)

The Miscellaneous object contains attributes for reading and/or setting miscellaneous variables and flags.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
	0x01	Output clock width	USINT	CW	RW
	0x02	Error flag	BOOL	EF	RO
	0x03	Read/clear error condition	UNIT16	ER	RW
	0x04	Read internal temperature	INT	IT	RO
	0x05	Part Number	STRING	PN	RO
	0x06	Read/set user register 1 value	DINT	R1	RW
	0x07	Read/set user register 2 value	DINT	R2	RW
	0x08	Read/set user register 3 value	DINT	R3	RW
	0x09	Read/set user register 4 value	DINT	R4	RW
	0x0A	Read device serial number	STRING	SN	RO
	0x0B	Read hardware/firmware version number	STRING	VR	RO
	0x0C	Read device voltage	STRING	VT	RO

Table 8.4: Miscellaneous object (65_h – 1 instance)

8.4 Motion object (66_h – 1 instance)

The Motion object contains attributes for issuing motion commands and reading and/or writing motion related variables or flags.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
Instance 1	0x01	Read/set acceleration	UDINT	A	RW_IO
	0x02	Read/set deceleration	UDINT	D	RW_IO
	0x03	Read/set motor holding current percent	USINT	HC	RW_IO
	0x04	Read/set holding current time delay	UINT	HT	RW
	0x05	Read/set jog mode enable/disable	BOOL	JE	RW
	0x06	Read/set limit switch response mode	USINT	LM	RW
	0x07	Command absolute move	DINT	MA	RW_IO
	0x08	Moving to position flag	BOOL	MT	RO
	0x09	Command relative move	DINT	MR	RW_IO
	0x0A	Read/set microstep resolution	UINT	MS	RW
	0x0B	Read/set motor settling delay time	UINT	MT	RW
	0x0C	Read axis in motion flag	BOOL	MV	RO
	0x0D	Read/set motor run current percent	USINT	RC	RW_IO
	0x0E	Command slew at constant velocity	DINT	SL	RW_IO
	0x0E	Read current velocity	DINT	V	RO
	0x10	Read velocity changing flag	BOOL	VC	RO
	0x11	Read/set initial (starting) velocity	UDINT	VI	RW_IO
	0x12	Read/set maximum (terminal) velocity	UDINT	VM	RW_IO

Table 8.5: Motion object (65_h – 1 instance)

8.5 I/O object (67_h – 1 instance)

The I/O object contains attributes for issuing I/O commands and reading and/or writing I/O related variables or flags.

NOTE: Attributes in this object relate solely to the configuration and control of the hardware Input–Output points and have no bearing on EtherNet/IP communications protocol I/O messaging.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
Instance 1	0x01	Read/set attention output mask	USINT	AO	RW
	0x02	Read/set digital filtering for input 1	USINT	D1	
	0x03	Read/set digital filtering for input 2	USINT	D2	RW
	0x04	Read/set digital filtering for input 3	USINT	D3	RW
	0x05	Read/set digital filtering for input 4	USINT	D4	RW
	0x06	Read/set digital filtering for analog input	USINT	D5	RW
	0x07	Read/set filtering for the capture input	USINT	FC	RW
	0x08	Read/set filtering for the motion inputs	USINT	FM	RW
	0x09	Read the state of input 1	BOOL	I1	RO
	0x0A	Read the state of input 2	BOOL	I2	RO
	0x0B	Read the state of input 3	BOOL	I3	RO
	0x0C	Read the state of input 4	BOOL	I4	RO
	0x0D	Read the value of the analog input	UINT	I5	RO
	0x0E	Read inputs as a group	BOOL	IN	RO
	0x0F	Setup input funtion	UINT	IS	RW
	0x10	Set the state of output 1	BOOL	O1	WONE
	0x11	Set the state of output 2	BOOL	O2	WONE
	0x12	Set the state of output 3	BOOL	O3	WONE
	0x13	Read the output fault flag	BOOL	OF	RO
	0x14	Setup output function	UINT	OS	RW
	0x15	Write the binary state of the outputs as a group (NEMA 23 and 34 only)	UINT	OT	WONE

Table 8.6: I/O object (67_h – 1 instance)

8.6 Position object (68_h – 1 instance)

The position object contains attributes for reading and/or writing position related variables or flags.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
Instance 1	0x01	Read/set counter 1 (position)	DINT	C1	RW
	0x02	Read/set homing mode	USINT	HM	
	0x03	Read/set position	DINT	P	RW
	0x04	Read position capture at trip	DINT	PC	RO
	0x05	Read/set trip enable	USINT	TE	RW

Table 8.7: Position object (68_h – 1 instance)

8.7 Encoder object (69_h – 1 instance)

The encoder object contains attributes for reading and/or writing encoder related variables or flags.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
Instance 1	0x01	Read/set counter 2 (encoder)	DINT	C1	RW
	0x02	Read/set encoder deadband	UINT	DB	RW
	0x03	Enable/disable encoder functions	BOOL	EE	RW
	0x04	Read/set home to index mode	USINT	HI	RW
	0x05	Read encoder index mark	BOOL	I6	RO
	0x06	Enable/disable position maintenance (non-hybrid only)	BOOL	PM	RW
	0x07	Read/set stall factor (non-hybrid only)	UINT	SF	RW
	0x08	Read/set stall detect mode (non-hybrid only)	BOOL	SM	RW
	0x09	Read stall flag (non-hybrid only)	BOOL	ST	RO

Table 8.8: Encoder object (69_h – 1 instance)

8.8 Hybrid specific object ($6A_h$ – 1 instance)

The hybrid specific object contains attributes for issuing hybrid commands and reading and/or writing hybrid related variables or flags.

Instance	Attribute ID	Description	Data type	MCode	Access
Class (Instance 0)	0x01	Revision	UINT	—	RO
Instance 1	0x01	Read hybrid status	USINT	AF	RO
	0x02	Read/set hybrid operating mode	USINT	AS	RW
	0x03	Read/set control bounds	USINT	CB	RW
	0x04	Clear locked rotor flag	BOOL	CF	CMD
	0x05	Read/set remote encoder line count	UINT	EL	RW
	0x06	Read/set lead limit	UDINT	LD	RW
	0x07	Read lead/lag position error	DINT	LL	RO
	0x08	Read/set lag limit	UDINT	LG	RW
	0x09	Read state of rotor locked/unlocked	BOOL	LR	RO
	0x0A	Read set locked rotor timeout time	UINT	LT	RW
	0x0B	Read set make-up speed	UDINT	MF	RW
	0x0C	Read/set make-up mode	STRING	MU	RW
	0x0D	Command calibration start	USINT	SC	WONE
	0x0E	Read/set torque direction	BOOL	TD	RW
	0x0F	Read/set torque current percent	USINT	TQ	RW
	0x10	Read/set torque speed	USINT	TS	RW

Table 8.9: Hybrid specific object ($6A_h$ – 1 instance)

9 Glossary

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
mm^2	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
mm^2	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.

A Setting up an Lexium MDrive using RS Logix 5000

A

A.1 Adding the Lexium MDrive

This appendix shows an example of adding an Lexium MDrive EtherNet/IP unit to an RS Logix 5000 project. The PLC used in this example was an Rockwell Automation Compact Logix L23E.

Step 1

1) Open a new project

2) Click the [+] next to I/O Configuration, Under your [PLC Name] right-click “Ethernet”

3) Select “New Module”

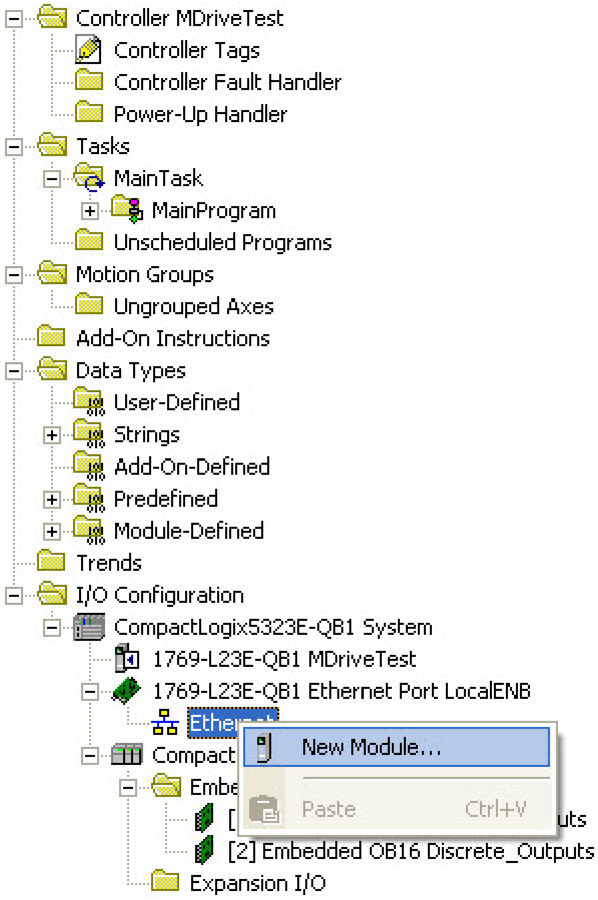
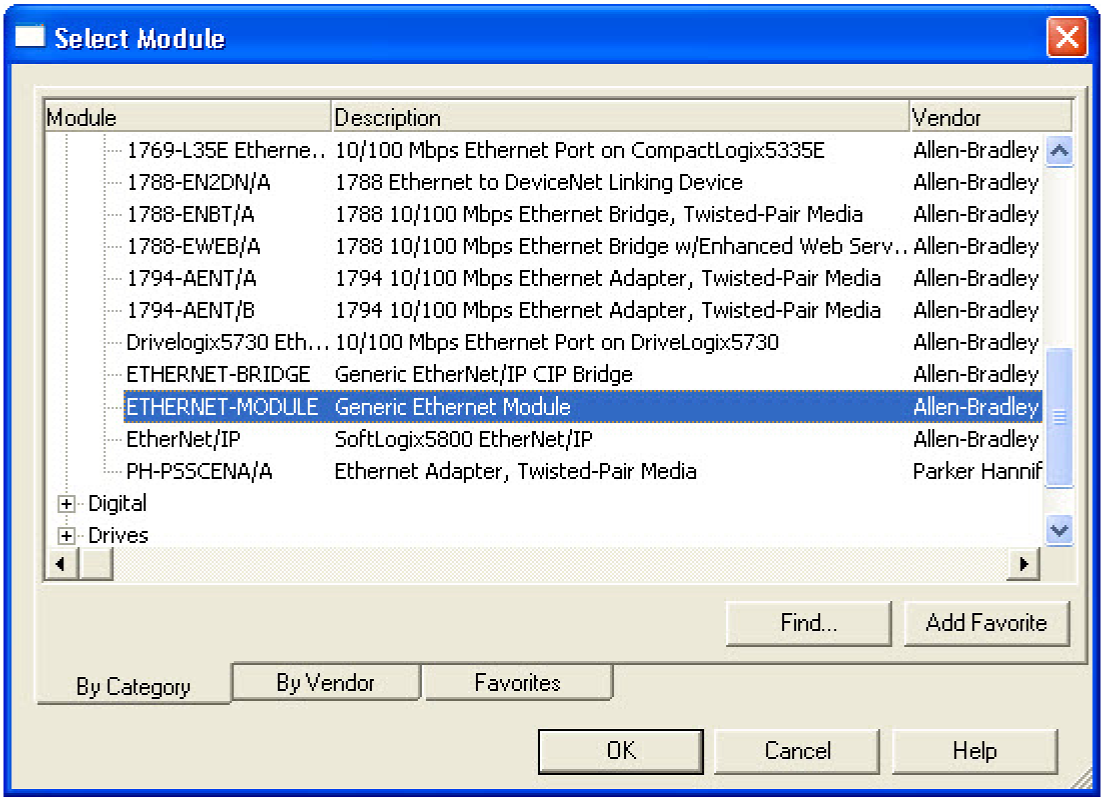


Figure A.1: Adding a new module

4) Under “communications” of the Select Module” dialog Select ‘ETHERNET-MODULE Generic Ethernet Module’

5) Click OK



Module	Description	Vendor
1769-L35E Etherne..	10/100 Mbps Ethernet Port on CompactLogix5335E	Allen-Bradley
1788-EN2DN/A	1788 Ethernet to DeviceNet Linking Device	Allen-Bradley
1788-ENBT/A	1788 10/100 Mbps Ethernet Bridge, Twisted-Pair Media	Allen-Bradley
1788-EWEB/A	1788 10/100 Mbps Ethernet Bridge w/Enhanced Web Serv..	Allen-Bradley
1794-AENT/A	1794 10/100 Mbps Ethernet Adapter, Twisted-Pair Media	Allen-Bradley
1794-AENT/B	1794 10/100 Mbps Ethernet Adapter, Twisted-Pair Media	Allen-Bradley
Drivelogix5730 Eth...	10/100 Mbps Ethernet Port on DriveLogix5730	Allen-Bradley
ETHERNET-BRIDGE	Generic EtherNet/IP CIP Bridge	Allen-Bradley
ETHERNET-MODULE	Generic Ethernet Module	Allen-Bradley
EtherNet/IP	SoftLogix5800 EtherNet/IP	Allen-Bradley
PH-PSSCENA/A	Ethernet Adapter, Twisted-Pair Media	Parker Hannif
⊞ Digital		
⊞ Drives		

Figure A.2: Generic Ethernet Module

Step 2 A “New Module” dialog will appear. Fill in the following information as follows:

Name: Lexium MDrive (IMPORTANT!)

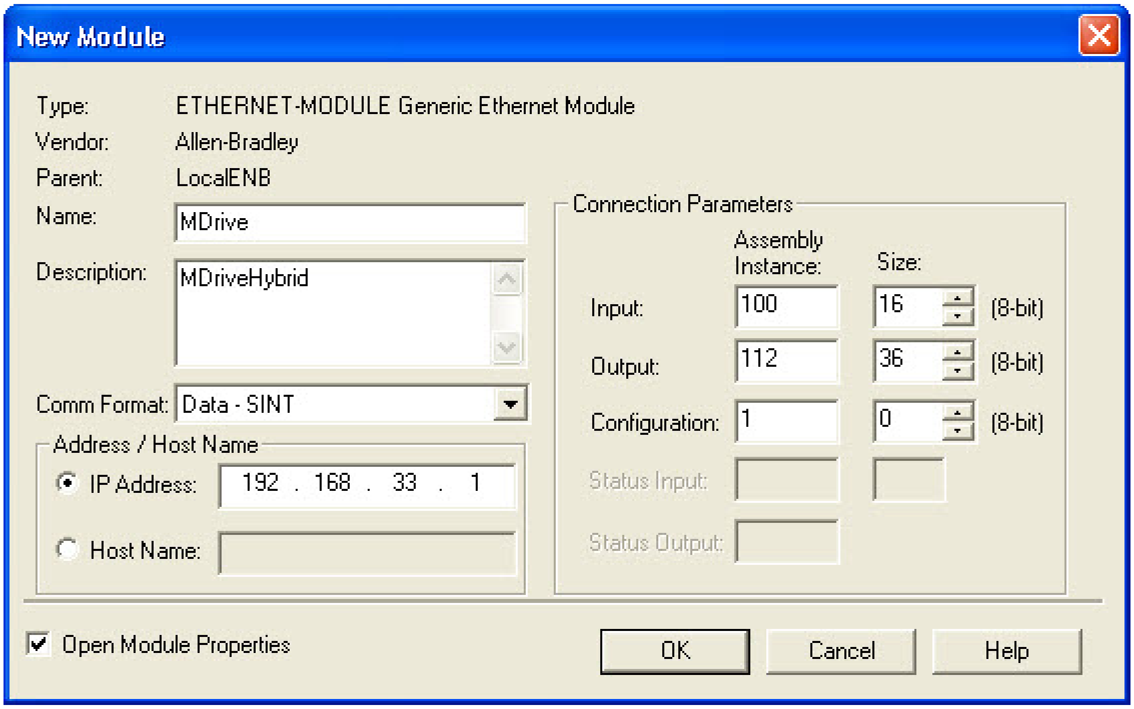
Description: Lexium MDrive (Desc. is at user discretion)

Comm Format: Data - SINT

IP Address: 192.168.33.1

Connection Parameters:

	Assembly Instance	Size
Input	100	16
Output	112	36
Configuration	1	0



New Module

Type: ETHERNET-MODULE Generic Ethernet Module
Vendor: Allen-Bradley
Parent: LocalENB
Name: MDrive
Description: MDriveHybrid
Comm Format: Data - SINT

Address / Host Name
● IP Address: 192 . 168 . 33 . 1
○ Host Name:

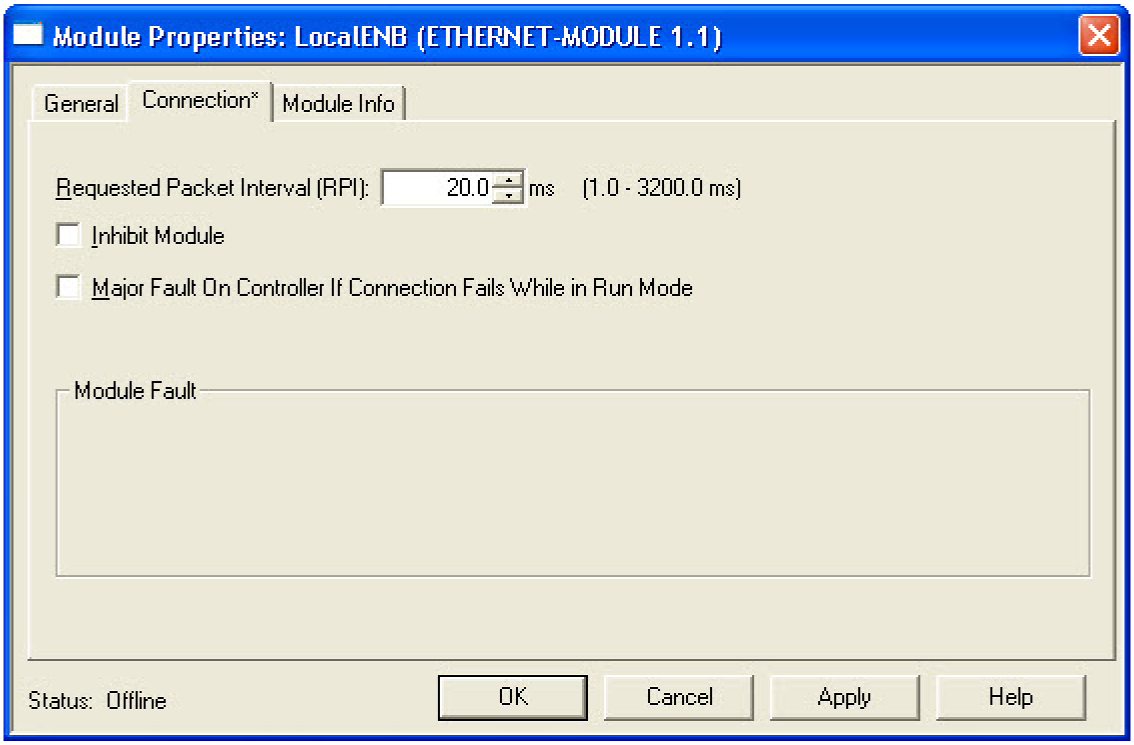
Connection Parameters

	Assembly Instance:	Size:	
Input:	100	16	(8-bit)
Output:	112	36	(8-bit)
Configuration:	1	0	(8-bit)
Status Input:			
Status Output:			

☑ Open Module Properties

Figure A.3: New module setup

Step 3 Set “Request Packet Interval (RPI)” under the connection tab to 20ms.



Module Properties: LocalENB (ETHERNET-MODULE 1.1)

Requested Packet Interval (RPI): 20.0 ms (1.0 - 3200.0 ms)

□ Inhibit Module

□ Major Fault On Controller If Connection Fails While in Run Mode

Module Fault

Status: Offline

Figure A.4: Request Packet Interval setting

Step 4 Under “Data Types”, right-click on “User-Defined and select “Import Data Type”.

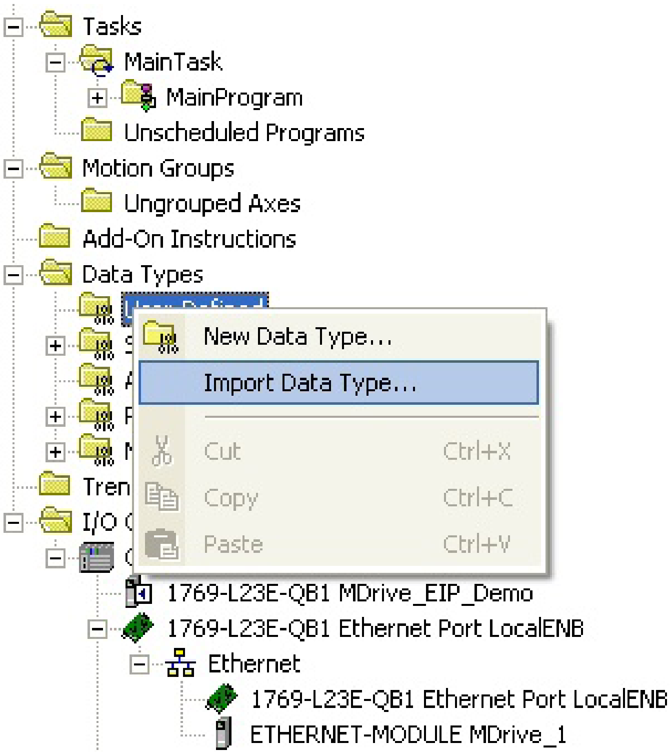
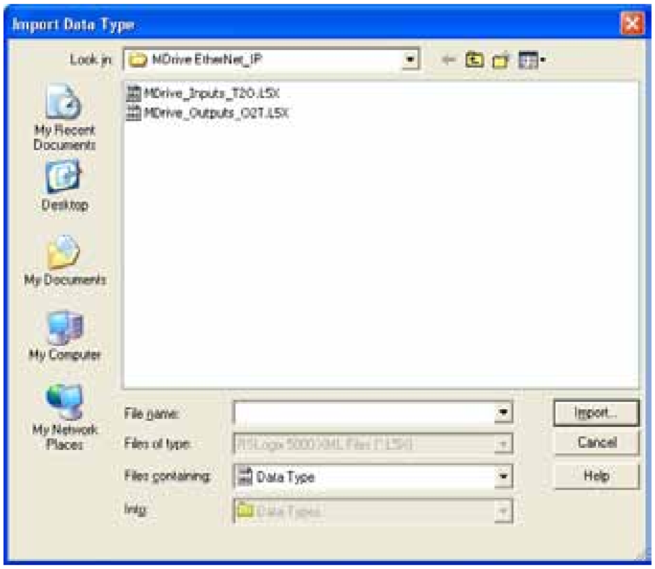


Figure A.5: Import routine

Select and import both Lexium MDrive_Inputs_T2O.L5X and Lexium MDrive_Outputs_O2T.L5X . These files are created using the TCP/IP Configuration Utility and exported as shown in Section 5.1.2 of this document.


Import Data Type

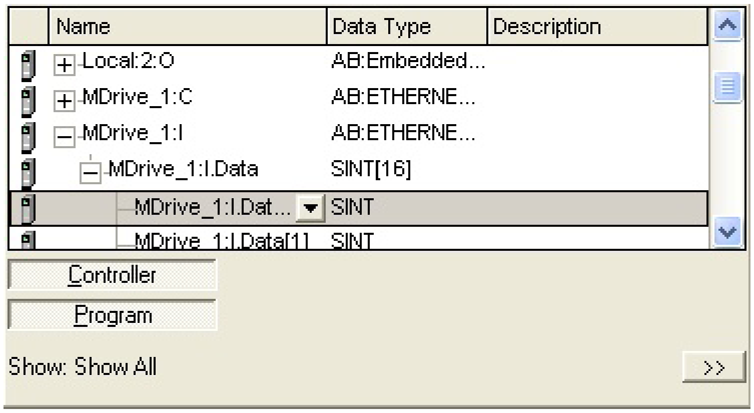
Look in: MDrive EtherNet_IP

MDrive_Inputs_T2O.L5X
MDrive_Outputs_O2T.L5X

File name:
Files of type: RSLogix 5000 XML Files (*.L5X)
Files containing: Data Type
Into: Data Types

Figure A.6: I/O Data type files

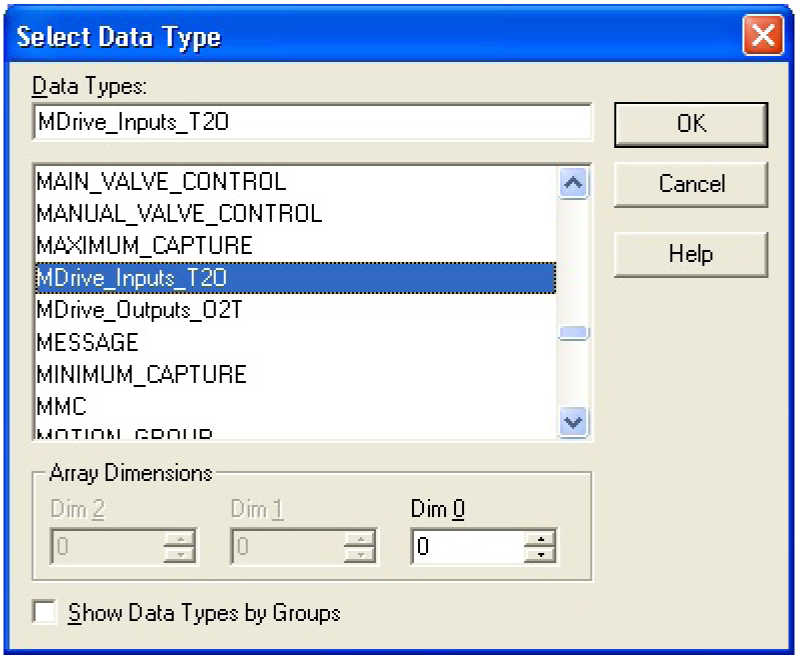
In the Program Window, select the Synchronous Copy File Function (CPS). For the Source, The Lexium MDrive Input Data [0] tag.



Name	Data Type	Description
+ Local:2:O	AB:Embedded...	
+ MDrive_1:C	AB:ETHERNE...	
− MDrive_1:I	AB:ETHERNE...	
− MDrive_1:I.Data	SINT[16]	
MDrive_1:I.Dat...	SINT	
MDrive_1:I.Data[1]	SINT	

Figure A.7: Synchronous Copy File Function

For the Destination, create a Tag using the User Defined data type Lexium MDrive_Inputs_T2O as the Data Type.



Data Types: MDrive_Inputs_T2O

Dim 2: 0

Dim 1: 0

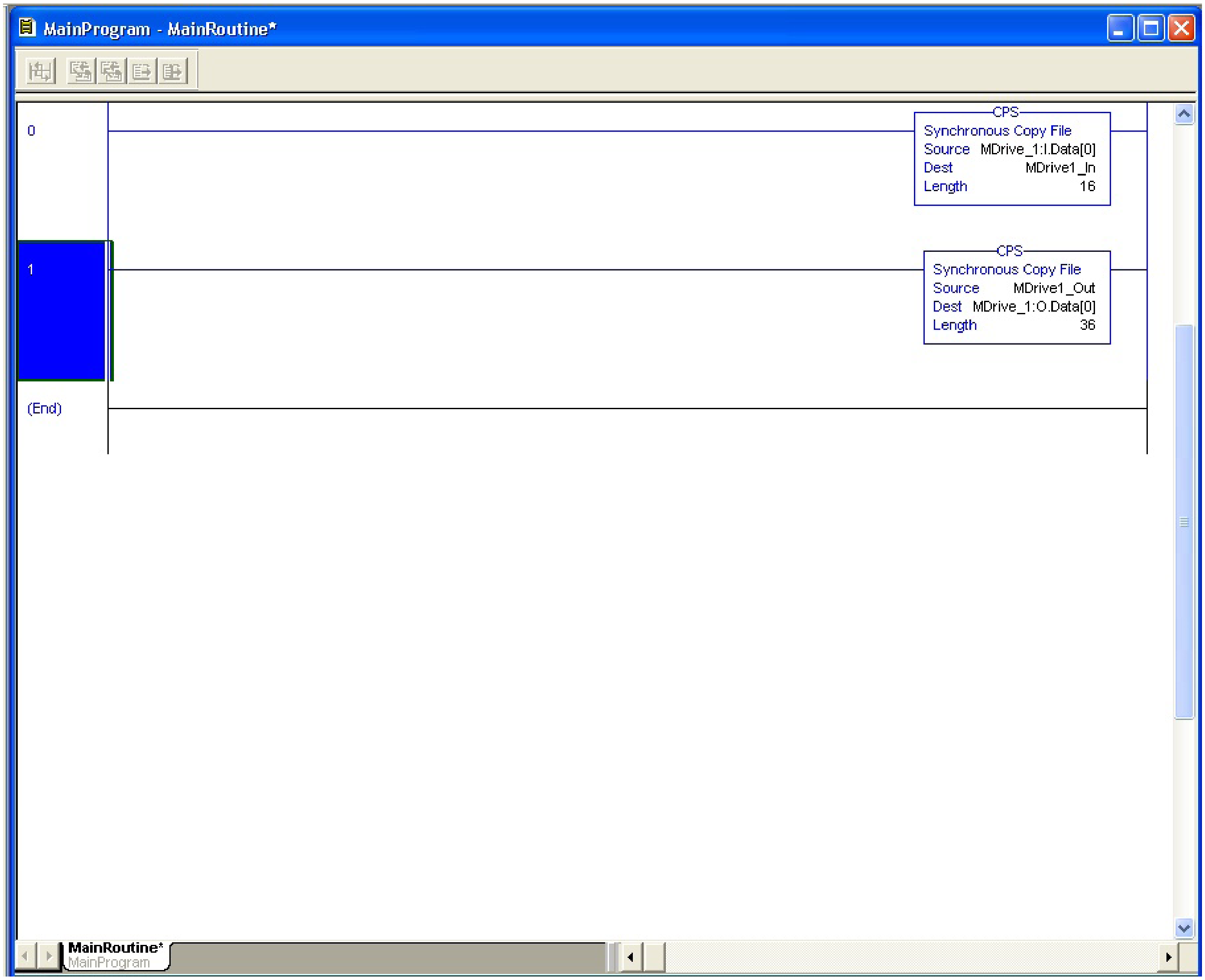
Dim 0: 0

☐ Show Data Types by Groups

Figure A.8: Select data type

Set the Length to 16.

On the following rung, repeat the above process using a created Tag using the Lexium MDrive_Outputs_T2O data type as the source, The Lexium MDrive Output Data [0] as the destination and 36 as the length



CPS
Synchronous Copy File
Source MDrive_1:I.Data[0]
Dest MDrive1_In
Length 16

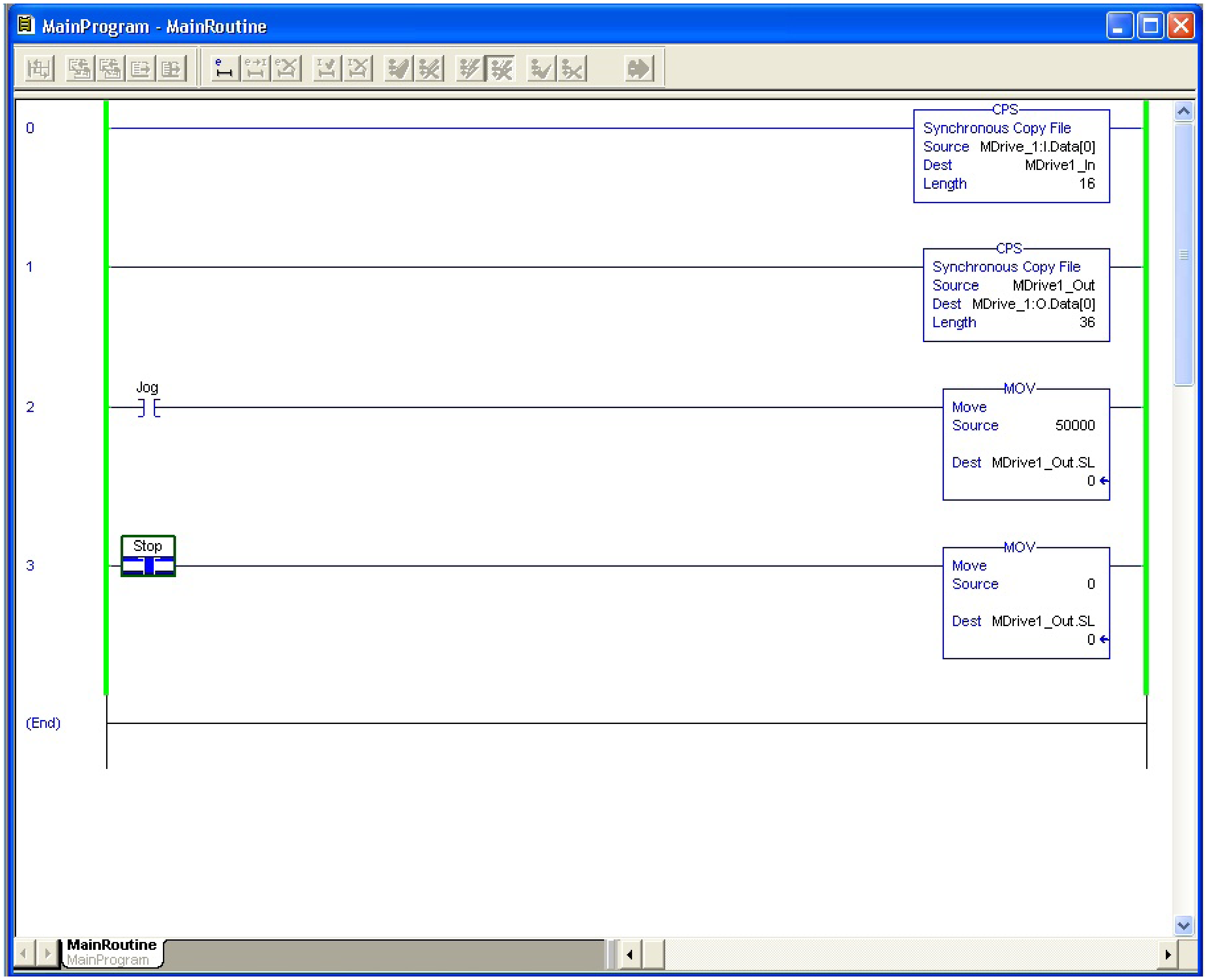
CPS
Synchronous Copy File
Source MDrive1_Out
Dest MDrive_1:O.Data[0]
Length 36

Figure A.9: Main program window

This associates the Tags created with the import of the user defined data types with the data in the implicit data object in the Lexium MDrive.

Step 5 Add another rung to the routine created above. This rung should include a N/O contact as well and a Move (MOV) command. For the Contact, create a Tag called “Jog”. In the Move, select the Source to be a Jog speed in micosteps/sec. Set the Destination to be the “SL” parameter within the Lexium MDrive Out Tag created in Step 4. Copy this rung, changing the contact Tag to “Step”, and set the source to be 0.

Download the application and go online with the project. Toggling the “Jog” contact will cause the connected Lexium MDrive to Slew at the requested speed. Toggling the “Stop” contact will make it stop.



MainProgram - MainRoutine

0 CPS Synchronous Copy File
Source MDrive_1:I.Data[0]
Dest MDrive1_In
Length 16

1 CPS Synchronous Copy File
Source MDrive1_Out
Dest MDrive_1:O.Data[0]
Length 36

2 Jog] [MOV Move
Source 50000
Dest MDrive1_Out.SL
0

3 Stop] [MOV Move
Source 0
Dest MDrive1_Out.SL
0

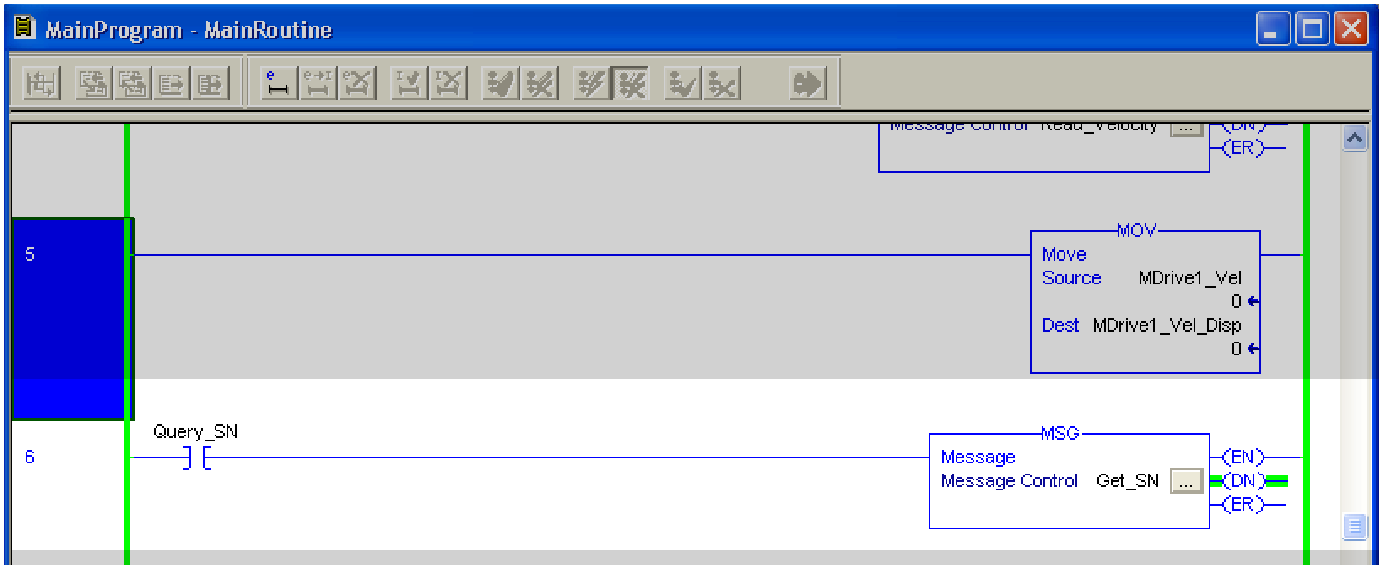
(End)

MainRoutine
MainProgram

Figure A.10: Main program

A.2 Explicit messaging

Explicit messaging is used to transfer data that does not require continual updates. All Lexium MDrive parameters may be accessed via explicit messaging



Message Control Read_Velocity ... DN ER

5
MOV
Move
Source MDrive1_Vel
0
Dest MDrive1_Vel_Disp
0

6
Query_SN
MSG
Message
Message Control Get_SN ... EN DN ER

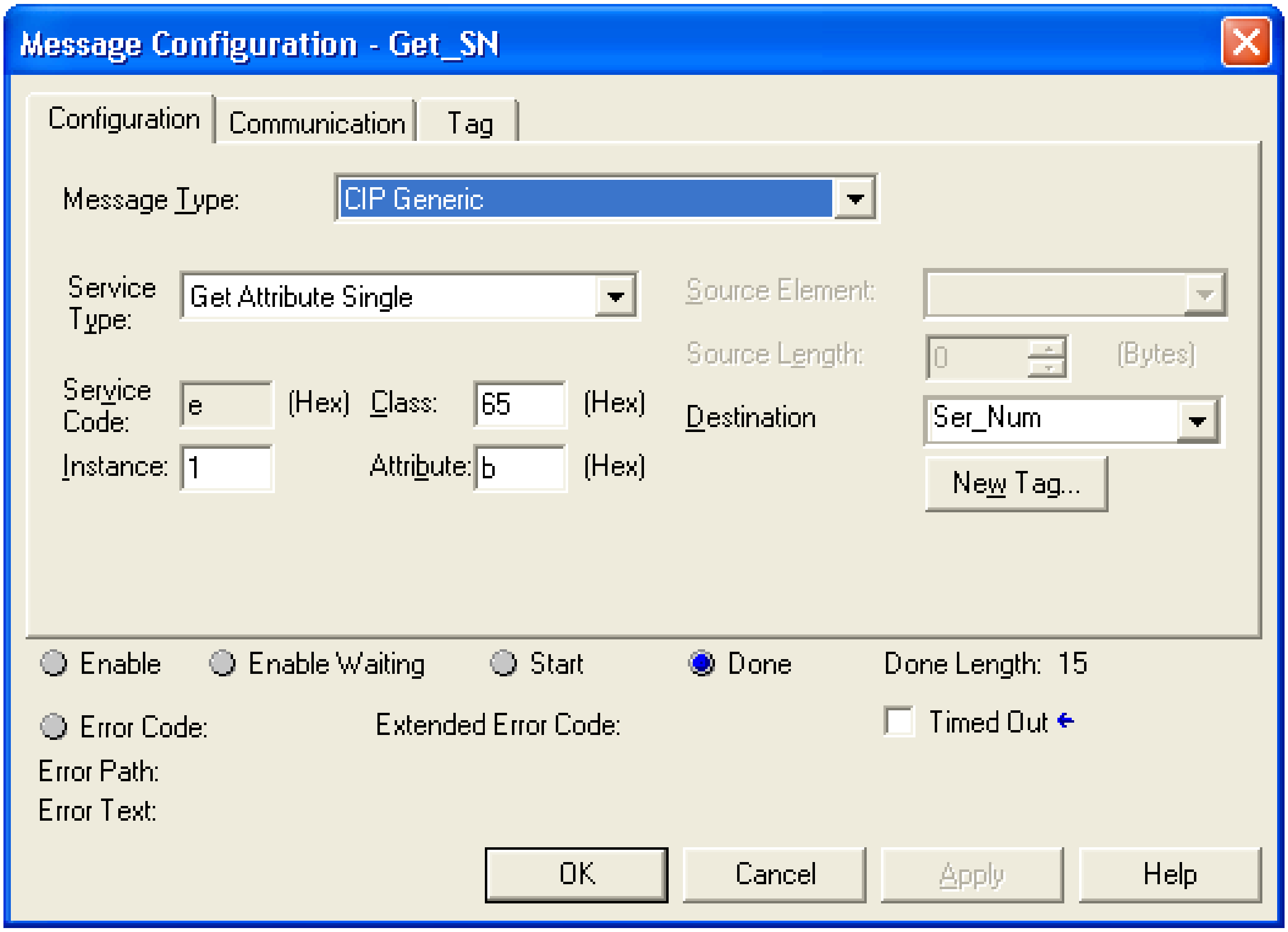
Figure A.11: Explicit message Query_SN

The message instruction must be configured to read or write to a specific Attribute (parameter) in the Lexium MDrive.

In this case, the Message is set to read the Serial Number from the Lexium MDrive and move it into a Tag labeled “Ser_Num”. This is done by chosing the “Get Attribute Single” from the Service Type pull-down and selecting the appropriate Class, Instance and Attribute. This information can be found in Section 8 of the Ethernet/IP Fieldbus Manual.

A.2.1 Formatting the message

1) Add a message instruction (MSG), create a new tag for the message Get_SN (properties, base tag type, message data typt, controller scope) and click the configure button.



Message Configuration - Get_SN

Message Type: CIP Generic

Service Type: Get Attribute Single

Service Code: e (Hex) Class: 65 (Hex)

Instance: 1 Attribute: b (Hex)

Source Element:

Source Length: 0 (Bytes)

Destination: Ser_Num

○ Enable ○ Enable Waiting ○ Start ● Done Done Length: 15

○ Error Code: Extended Error Code: □ Timed Out

Error Path:

Error Text:

Figure A.12: Message configuration dialog

2) Set the message parameters as shown in the screen capture above in accordance with Table A.1,

Field	Description
Message Type	The message type for Lexium MDrive parameters will be `CIP Generic`
Service Type	The service type for Lexium MDrive, in this case will be `Get Attribute Single`. If setting a parameter the service type would be `Set Attribute Single`. Available services depend on the class and instance being read or written.
Service code	This field will be read only when `Set Attribute Single` or `Get Attribute Single` is the service type.
Class	This is the EtherNet/IP class. For this exercise it is 64_h Miscellaneous. Refer to Section 8: Manufacturer specific objects, for a listing of supported classes, instances and attributes.
Instance	This is the EtherNet/IP instance or object. Refer to Section 8: Manufacturer specific objects, for a listing of supported classes, instances and attributes.
Attribute	The attribute represents, in this exercise, the hex number (0x0B), of the instance assigned to the `Read_Serial_Number` command. Refer to Section 8: Manufacturer specific objects, for a listing of supported classes, instances and attributes.

Table A.1: Message configuration

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