DXMR90-4K Device Register and IO-Link Data Reference Guide

Original Instructions
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Contents

Chapter 1 Device Register Map 3
Supported Function Codes 3
Identification Information 3
Multi-Port Support 4
Port Status 4

Chapter 2 Process Data 6
Process Data Input 6
Process Data Output 6

Chapter 3 ISDU (Index/Subindex) Data 7
ISDU Request Register Block (Port Specific) 7
ISDU Response Register Block (Port-Specific) 7
Universal ISDU Request Register Block 8
Universal ISDU Response Register Block 8
ISDU Read/Write in Single Register Write 9
ISDU Read/Write in Multiple Register Writes 10

Chapter 4 Port Configuration 11
IO-Link Port/Operating Modes 12

Chapter 5 Replacing an IO-Link Device During Operation (Backup/Restore Mode) 13

Chapter 6 IO-Link Events 14
IO-Link Event Processing 15

Chapter 7 Data Storage 16
Data Storage Content 16
Reading from Data Storage Content 17
Writing from Data Storage Content 17

Chapter 8 Traditional DXM Local Registers 18

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Chapter Contents

Supported Function Codes 3
Identification Information 3
Multi-Port Support 4
Port Status 4

Chapter 1 Device Register Map

The device register map supports the DXMR90-4K IO-Link Master.

Supported Function Codes

Function Code	Name	Max Message Size
3 (0x03)	Read Holding Register	250 bytes
6 (0x06)	Write Single Register	2 bytes
16 (0x10)	Write Multiple Registers	246 bytes

Identification Information

Register	Parameter	Access
40001	Vendor ID	r/o
40002-40003	Master ID	r/o
40004	Master Type (see IO-Link Specification V1.1.3 table 29 for enumeration)	r/o
40005	**Features_1:** Bit 0: DeviceParBatch (SMI_ParamWriteBatch) Bit 1: DeviceParBatch (SMI_ParamReadBatch) Bit 2: PortPowerOffOn (SMI_PortPowerOffOn)	r/o
40006	Number of Supported Channels	r/o
40007-40014	Port Type [n] (see Table E.2 - MasterIDent from IO-Link Interface Specification V1.1.3 for enumerations)	r/o
40015	Total Max Power Supply (in units of 0.1 A)	r/o
40016-40023	Max Power Supply (in units of 0.1 A)	r/o
40024	Revision	r/o
40025-40040	Vendor Name	r/o
40041-40056	Product Name	r/o
40057-40088	Vendor URL	r/o
40089-40120	Manual URL	r/o
40121-40122	Firmware P/N	r/o
40123	Firmware Version	r/o
40124	Firmware Build Number	r/o
40125-40140	Application Specific Tag *	r/w
40141-40156	Function Tag *	r/w
40157-40172	Location Tag *	r/w

* User modifications of these identifiers are saved in non-volatile memory five seconds after write.

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Multi-Port Support

All register maps shown below are specific to port 1. For multi-port adapters, each port is given its own register range within the holding register space.

Registers	Port
41001-41999	Port 1
42001-42999	Port 2
43001-43999	Port 3
44001-44999	Port 4
45001-45999	Port 5
46001-46999	Port 6
47001-47999	Port 7
48001-48999	Port 8

For a given register, the starting address of the port can be applied to determine the register address for the new port. For example, the calculation below demonstrates how to find the address of the process data output for port 8.

Equivalent Port 1 Register	Port	Port Starting Register	Offset	New Register
41051	1	41001	50	41051
41051	8	48001	50	48051

Port Status

Information regarding the connected device is provided by the following holding registers. When a new device is connected, all data attempts to be read from the device. Unsupported commands read as an empty string.

Register endian swapping is not performed on the string values. The byte order of the data payload matches the byte-order from the device.

Writing to these registers results in an error.

Registers	Parameter	Access
41501	Port Mode[1]	r/o
41502	**PortQualityInfo:** Bit0: Process Data In Valid Bit1: Process Data Out Valid	r/o
41503	IO-Link Revision	r/o
41504	**Com Mode:** COM1 = 0 COM2 = 1 COM3 = 2	r/o

Continued on page 5

[1] Enumerations (from IO-Link Interface Spec V1.1.3, Table E.4):

- 0: `NO_DEVICE`
- 1: `DEACTIVATED`
- 2: `PORT_DIAG`
- 3: `PREOPERATE`
- 4: `OPERATE`
- 5: `DI_C/Q`
- 6: `DO_C/Q`

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Continued from page 4

Registers	Parameter	Access
41505	Master Cycle Time	r/o
41506	Process Data Input Size (bytes)	r/o
41507	Process Data Output Size (bytes)	r/o
41508	Vendor ID (for pre 1.1 devices)	r/o
41509-41510	Device ID (for pre 1.1 devices)	r/o
41511	Min Cycle Time	r/o
41512-41543	Vendor Name	r/o
41544-41575	Vendor Text	r/o
41576-41607	Product Name	r/o
41608-41639	Product ID	r/o
41640-41671	Product Text	r/o
41672-41679	Serial Number	r/o
41680-41711	Hardware Revision	r/o
41712-41743	Firmware Revision	r/o
41744-41759	Application Specific Tag	r/o
41760-41775	Function Tag	r/o
41776-41791	Location Tag	r/o
41792-41823	Profile Characteristic	r/o

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Chapter Contents

Process Data Input 6
Process Data Output 6

Chapter 2 Process Data

Process Data Input

If no device is connected, all registers read as 0. Unused process data bytes also read as 0.

Data bytes are not register endian swapped. The byte order of the data payload matches the byte-order from the device.

Writing to these registers results in an error.

Registers	Parameter	Access
41001	**Port Status:** **Bit0** = Connected?**Bit1** = Process Data Valid?**Bit2** = Event Pending?**Bit3** = Ready for ISDU? **Bit4** = Pin4 SIO State**Bit5** = Pin2 SIO State **Bit6-7 = Pin4 Mode:** SDCI Mode = 0 SIO Input Mode = 1 SIO Output Mode = 2 **Bit8-10 = Pin2 Mode:** Disabled = 0 Input Normal = 1 Output = 2 Diagnostic Input = 3 Inverted Input = 4	r/o
41002-41017	Data	r/o

Discrete modes can be added as input process data so that a reset of the master can be detected when discrete output mode is being used. After reset, the master returns to `SDCI Mode` on Pin4 and `Disabled` on Pin2.

Process Data Output

Data bytes are not register-endian swapped. The byte order of the data payload matches the byte order written to the device.

A read of this parameter returns the most recent process data output written to the adapter.

The process data out behavior if a sensor is disconnected and reconnected is undefined.

Registers	Parameter	Access
41051	Bit0 = IsValid Bit1 = Pin4 Output State Bit2 = Pin2 Output State If Pin4 and Pin2 are not configured in SIO output mode, writes are ignored and reads are returned as `0`.	r/w
41052-41067	Data	r/w

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Chapter Contents

ISDU Request Register Block (Port Specific)..... 7
ISDU Response Register Block (Port-Specific)..... 7
Universal ISDU Request Register Block 8
Universal ISDU Response Register Block 8
ISDU Read/Write in Single Register Write 9
ISDU Read/Write in Multiple Register Writes 10

Chapter 3 ISDU (Index/Subindex) Data

ISDU data operations are based on a request/response model. First the request is written to the adapter, and then the response is read. The request is non-blocking, so the status register of the response must be polled to determine when the request has been completed.

A write to the operation register with a read or write command triggers the request. If the write is to be broken up into multiple write operations, a NOP opcode should first be written to prevent the request from being handled until all data has been written to the adaptor.

The result register contains an indication of whether the requested operation succeeded or failed. In the case of a failure, the error code returned by the device is not available.

Data bytes are not register endian swapped. The byte order of the data payload matches the byte-order read from/written to the device.

ISDU Request Register Block (Port Specific)

For a write, the data length must match the required data length being written to the device. For a read, the length is a don't care; that is, the returned length of the read is not checked by the adapter.

For a write, the data contains the data to be written to the sensor. For a read, the data is a don't care.

Registers	Parameter	Access
41301	**Operation:** NOP = 0 Read = 1 Write = 2	r/w
41302	Index	r/w
41303	Subindex (max = 255)	r/w
41304	Data Length (max = 238)	r/w
41305-41423	Data	r/w

ISDU Response Register Block (Port-Specific)

The Operation, Index, and Subindex match the value from the most recent request.

For a write, the length matches the length of data written. For a read, the length contains the number of bytes returned from the device.

For a write, the data contains the data written to the device. For a read, the data contains the data read from the device.

If a failure has occurred (Status == `Failure`), then the `Data Length` is set to 2. `Data[0]` contains the `Error Code` while `Data[1]` contains the `Additional Code`. An `Error Code` of 0 represents an internal error within the master module, while other `Error Codes` are defined in `Annex C` of the `IO-Link Interface Specification`.

Registers	Parameter	Access
41101	Operation (see Request for opcodes)	r/o

Continued on page 8

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Continued from page 7

Registers	Parameter	Access
41102	**Status:** NOP = 0 In Progress = 1 Success = 2 Failure = 3	r/o
41103	Index	r/o
41104	Subindex (max = 255)	r/o
41105	Data Length (max = 238)	r/o
41106-41224	Data	r/o

Universal ISDU Request Register Block

An additional register set capable of addressing all ports is available for ISDU requests. This register set is intended for use with Ethernet/IP and Profinet communications.

For both reads and writes, the Port register must be written before writing any other request register.

Registers	Parameter	Access
40201	**Operation:** NOP = 0 Read = 1 Write = 2	r/w
40202	Port	r/w
40203	Index	r/w
40204	Subindex (max = 255)	r/w
40205	Data Length (max = 238)	r/w
40206-40324	Data	r/w

Universal ISDU Response Register Block

An additional register set capable of addressing all ports is available for ISDU responses. This register set is intended for use with Ethernet/IP and Profinet communications.

Registers	Parameter	Access
40351	Operation (see Request for opcodes)	r/o
40352	**Status:** NOP = 0 In Progress = 1 Success = 2 Failure = 3	r/o
40353	Port	r/o
40354	Index	r/o
40355	Subindex (max = 255)	r/o
40356	Data Length (max = 238)	r/o
40357-40475	Data	r/o

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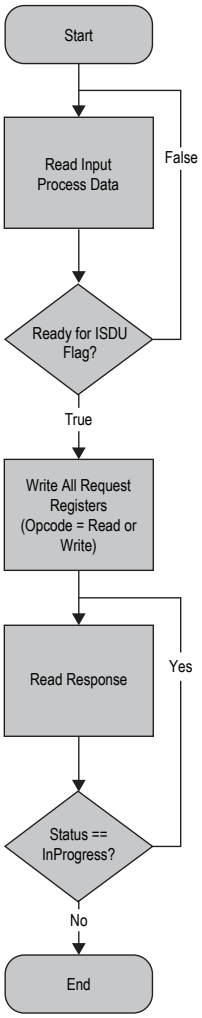
ISDU Read/Write in Single Register Write

The flowchart documents how to perform an ISDU read/write operation using a single *Write Multiple Registers* Modbus command of the *ISDU Request* register block.



The request is dispatched to the connected device after the request is written. For a read operation, at the end of the sequence, the response data contains the data returned from the device.

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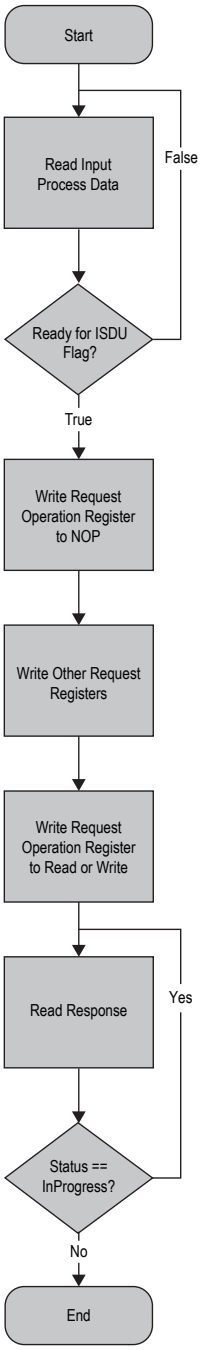
ISDU Read/Write in Multiple Register Writes

The flowchart documents how to perform an ISDU read/write operation using multiple *Write Multiple Registers* or *Write Single Register* Modbus commands of the *ISDU Request* register block.



The request is not dispatched to the connected device until the opcode is written to read/write. For a read operation, at the end of the sequence, the response data contains the data returned from the device.

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Chapter Contents

IO-Link Port/Operating Modes..... 12

Chapter 4 Port Configuration

Registers	Parameter	Access
41851	Port Mode[2]	r/w
41852	Validation&Backup[3]	r/w
41853	I/Q behavior[4]	r/w
41854	PortCycleTime (reserved): 0 = As Fast As Possible.	r/w
41855	Vendor ID	r/w
41856-41857	Device ID	r/w
41858	**Pin4 Extra Configuration** **Bit0-1: Output Type:** Push-Pull = 0 PNP = 1 NPN = 2	r/w
	Bit2: If configured as a diagnostic input, then the LED turns red when the input is in the inactive state. This can be used to indicate a failure of the connected device. Normal Input = 0 Diagnostic Input = 1	
	Bit3: (Don't care if not in SIO Input mode.) Non-inverted Input = 0 Inverted Input = 1	
	Bit4:[5] Input Type 1 = 0 Input Type 2 = 1	

Continued on page 12

[2] Enumerations (from IO-Link Interface Spec V1.1.3, Table E.3):
- 0: `DEACTIVATED` (SM: INACTIVE - Port is deactivated; input and output Process Data are 0; Master shall not perform activities at this port)
- 1: `IOL_MANUAL` (SM: CFGCOM - Target Mode based on user defined configuration including validation of RID, VID, DID)
- 2: `IOL_AUTOSTART` (SM: AUTOCOM - Target Mode w/o configuration and w/o validation of VID/DID; RID gets highest revision the Master is supporting; Validations: NO_CHECK)
- 3: `DI_C/Q` (Pin 4 at M12) (SM: DI - Port in input mode SIO)
- 4: `DO_C/Q` (Pin 4 at M12) (SM: DO - Port in output mode SIO)

[3] Enumerations (from IO-Link Interface Spec V1.1.3, Table E.3):
- 0: No Device check
- 1: Type compatible Device V1.0
- 2: Type compatible Device V1.1
- 3: Type compatible Device V1.1, Backup + Restore
- 4: Type compatible Device V1.1, Restore

[4] Enumerations (from IO-Link Interface Spec V1.1.3, Table E.3):
- 0: Not supported
- 1: Digital Input
- 2: Digital Output

[5] Type 1 supports IEC 61131-2 Type 1 input voltage levels. Type 2 supports IEC 61131-2 Type 2 and Type 3 input voltage levels.

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Continued from page 11

Registers	Parameter	Access
41859	**Pin2 Extra Configuration:** Normal = 0 Diagnostic Input = 1 Inverted Input = 2 If configured as a diagnostic input, then the LED turns red when the input is in the inactive state. This can be used to indicate a failure of the connected device.	r/w

If *Port Mode* is set to *IOL_AUTOSTART* (default), the master ignores the Vendor ID and Device ID of the connected device.

If *Port Mode* is set to *IOL_MANUAL*, the master will attempt to write the *Device ID* into the device at connection. If the *Vendor ID* and *Device ID* are not supported by the device, the master will not connect.

For non-volatile Port Configuration that persists across adapter power cycles, use the DXM Configuration Software to modify the device's XML file.

IO-Link Port/Operating Modes

The operating mode can be configured for any port on the IO-Link master. The following modes can be used:

Deactivated
Use deactivated mode for any unused IO-link master ports if a device is not connected.

IO-Link Manual
The IO-Link master only connects IO-Link devices that have a certain vendor ID and device ID (1: IOL_MANUAL).

This mode is also required to for the Backup and Restore or Restore function.

IO-Link Autostart
The IO-Link master connects to every connected IO-Link device (2: IOL_AUTOSTART).

Digital Input
The IO-Link port functions as a standard digital input (3: DI_C/Q).

Digital Output
The IO-Link port functions as a standard digital output (4: DO_C/Q).

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Chapter Contents

Chapter 5 Replacing an IO-Link Device During Operation (Backup/Restore Mode)

Replacing an IO-Link device during operation is common, and inadvertent changes to device settings can cause operational problems and down-times. Operating personnel without special knowledge or tools can replace IO-Link devices quickly and without errors.

When the backup function of the IO-Link master is used, the IO-Link master automatically provides the saved parameters to the new device after replacement. This makes IO-Link device replacement seamless in IO-Link applications. Another common industry term for this function is *data storage mode*.

. Backup+Restore Mode

If a port on the IO-Link master is set to Backup+Restore, then the new device added to the IO-Link port takes in the same device configuration as the device that was just replaced, as the IO-Link master had stored the last configuration change by a backup (3: Type compatible Device V1.1, Backup + Restore).

. Restore

If the port on the IO-Link master port is set to Restore, then the new device takes in the configuration according the settings saved in the master at the time of the last backup. Because possible configuration changes were not saved in the master, a different behavior from the previous one before the replacement may occur (4: Type compatible Device V1.1, Restore).

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Chapter Contents

IO-Link Event Processing 15

Chapter 6 IO-Link Events

If an event is pending, the *Event Pending* flag is set in the process data input register block. If a user is not concerned with IO-Link events, they can ignore the state of this flag.

Events are read via the Event status register block:

Registers	Parameter	Access
41901	Count (max = 10)	r/o
41902	**Mode[0]:** None = 0 SingleShot = 1 Disappears = 2 Appears = 3	r/o
41903	**Type[0]:** None = 0 Notification = 1 Warning = 2 Error = 3	r/o
41904	Code[0]	r/o
41905	Mode[1] (Repeats for 10 total supported events)	r/o
41906	Type[1] (Repeats for 10 total supported events)	r/o
41907	Code[1] (Repeats for 10 total supported events)	r/o

Events are stored in a FIFO buffer, where Mode[0] is the oldest event in the queue. If a new event is received when the queue is full, the oldest event in the queue is shifted out.

After an event has been read, it can be cleared by writing its event code to the *Clear Event Register:*

Registers	Parameter	Access
41951	Event Code	w/o

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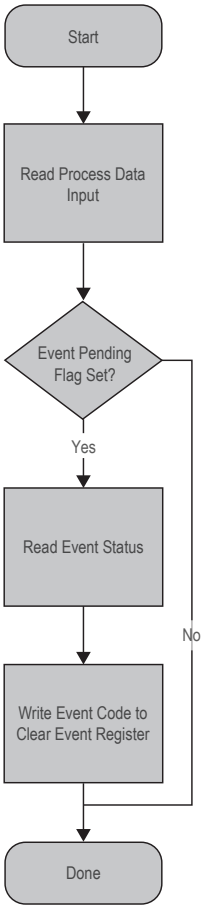
IO-Link Event Processing



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Chapter Contents

Data Storage Content 16

Chapter 7 Data Storage

The data storage configuration is set as part of the *Port Configuration* object. The operations can also be triggered manually using the *Data Storage Command* register:

Registers	Parameter	Access
41981	**Data Storage Command:** NOP = 0 Upload = 1 Download = 2 Clear = 3	w/o

The command is executed immediately upon writing the command.

The status of the requested data storage command can be accessed via the *Data Storage Command Status* register:

Registers	Parameter	Access
41991	**Data Storage Command Status:** NOP = 0 In Progress = 1 Success = 2 Failure = 3	r/o

Data Storage Content

The following registers are outside the normal 40000-49999 range of holding registers. They are only available through direct addressing, and not through Modicon.

Registers	Parameter	Register Description
50000	Port Selection	—
50001	Operation	0 = NOP 1 = Read 2 = Write
50002	Status[6]	0 = NOP 1 = In Progress 2 = Success 3 = Failure

Reading/writing the data storage contents does not trigger an upload/download to/from the connected device. To do so, write the desired operation to the appropriate port's `Data Storage Command` register.

Registers	Parameter
50100-51123	Data Storage Content

The data storage content is unpopulated (read as `0`) prior to performing a data storage read operation.

While the master supports storing separate data storage contents per port, a single buffer is shared for all ports for communications purposes. To support data storage content over multiple ports, the port must be specified in the `Data Storage Request` registers prior to reading/writing the contents.

[6] Writes to this register are ignored.

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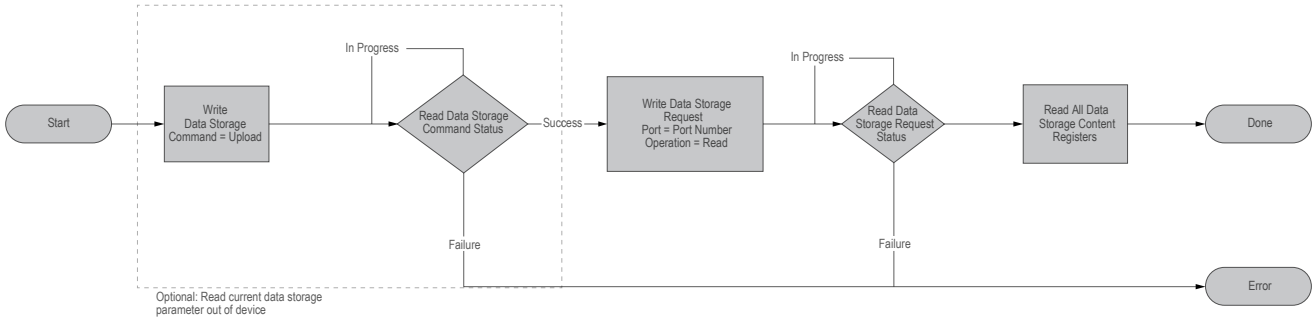
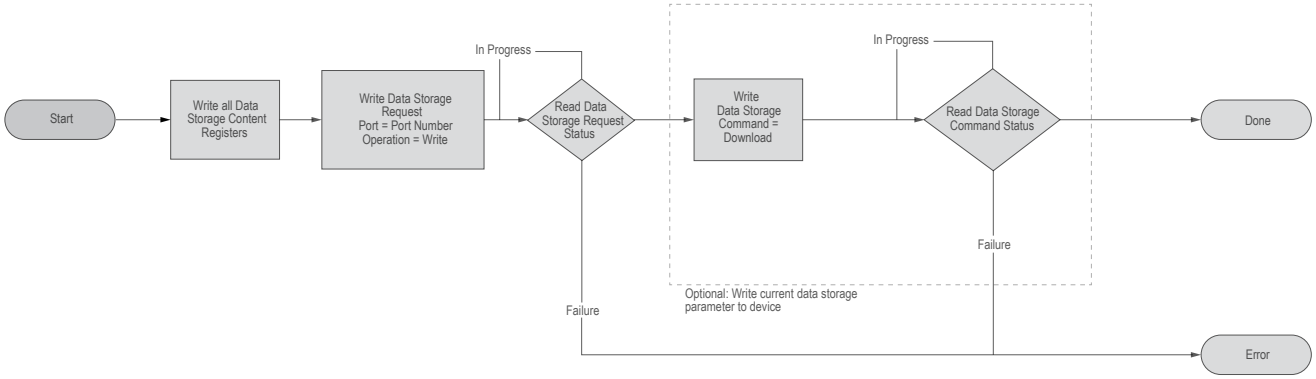
Reading from Data Storage Content



Writing from Data Storage Content



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Chapter Contents

Chapter 8 Traditional DXM Local Registers

The following registers are outside the normal 40000-49999 range of holding registers. They are only available through direct addressing and not through Modicon.

Registers	Description
12001-12845, 17001-19000	32-bit unsigned integer-based registers
12846-12850	Special function registers (can be reset registers)
12851-12900, 19001-20000	Non-volatile register with limited capability for permanent data storage
13001-17000	32-bit IEEE 754 floating point registers. Floating point values require two Local Registers to store a value. Floating point Local Registers are referenced on the odd-numbered register addresses: 13001, 13003, and 13005. When using Action Rules/Read Rules, always reference the odd-numbered register addresses.

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