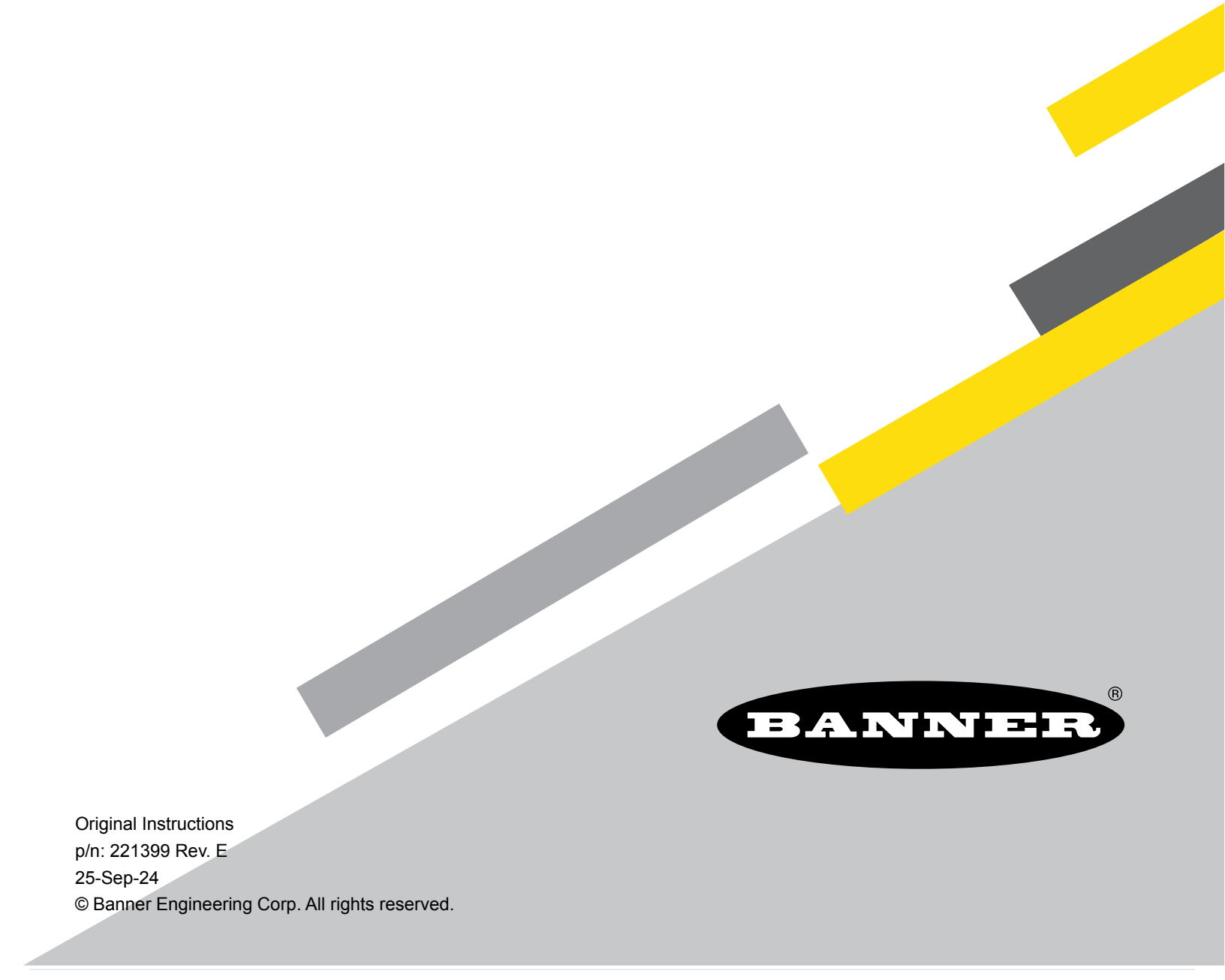
IO-Link Master for Modbus Converter Device Register Map



Original Instructions
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ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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Chapter 1 Important Information

The device register map supports the Compact 2-port IO-Link Master for Modbus (R45C-2K-MQ) and the Compact 4-port IO-Link Master for Modbus (R90C-4K-MQ).

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
23 (0x17)	Read and Write Registers	246 bytes

Modbus Configuration

Modbus configuration is used for changing communications settings on converter.

Registers	Parameter	Access	Default
40601	**Baud Rate:** 9600 = 0 19200 = 1 38400 = 2	r/w	19200
40602	**Parity:** None = 0 Odd = 1 Even = 2	r/w	None
40603	Address	r/w	1
40604	Reserved (cannot be read or written)	None	—
40605	**Restore Factory Configuration:** No Operation = 0 Restore Factory Configuration = 1	w/o	—

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

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Register	Parameter	Access
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](1) (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(1)	r/o
40123	Firmware Version(1)	r/o
40124	Firmware Build Number(1)	r/o
40125-40140	Application Specific Tag	r/w
40141-40156	Function Tag	r/w
40157-40172	Location Tag	r/w

Device Information

R45C-2K-MQ Device Information

Modbus Register Address	Description	I/O Range	Comments	Default	Access	Notes
40606-40615	Banner Name	0..65535		Banner Engineering	RO	(9 words/18 Characters)
40616-40631	Product Name	0..65535		R45C-2K-MQ	RO	(16 words/32 Characters)
40632	Item H	0..65535	810974 split into two 16-bit registers	12	RO	Banner Item Number
40633	Item L	0..65535		24542	RO	
40634	Serial Number H	0..65535			RO	Serial Number is
40635	Serial Number	0..65535			RO	split into (4) 16-bit registers
40636	Serial Number	0..65535			RO	
40637	Serial Number L	0..65535			RO	
40644-40659	User Define Tag	0..65535	User writable space	More Sensors. More Solutions.	RW	(16 words/32 Characters)

R90C-4K-MQ Device Information

Modbus Register Address	Description	I/O Range	Comments	Default	Access	Notes
40606-40615	Banner Name	0..65535		Banner Engineering	RO	(9 words/18 Characters)

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(1) Normally available as an input register. Added to holding registers so it can be accessed if input registers are not supported.

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Modbus Register Address	Description	I/O Range	Comments	Default	Access	Notes
40616-40631	Product Name	0..65535		R90C-4K-MQ	RO	(16 words/32 Characters)
40632	Item H	0..65535	811445 split into two 16-bit registers	12	RO	Banner Item Number
40633	Item L	0..65535		25013	RO	
40634	Serial Number H	0..65535			RO	Serial Number is
40635	Serial Number	0..65535			RO	split into (4) 16-bit registers
40636	Serial Number	0..65535			RO	
40637	Serial Number L	0..65535			RO	
40644-40659	User Define Tag	0..65535	User writable space	More Sensors. More Solutions.	RW	(16 words/32 Characters)

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Chapter 2 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

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Chapter 3 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
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

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[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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Registers	Parameter	Access
41792-41823	Profile Characteristic	r/o

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Chapter 4 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.

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Chapter 5 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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ISDU Response Register Block 11
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Chapter 6 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.

Any write to any of the request registers 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

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

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

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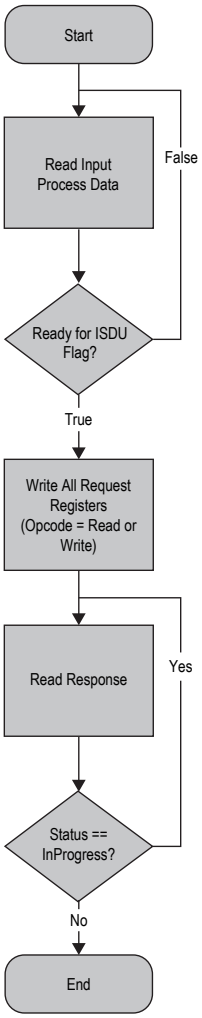
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Registers	Parameter	Access
41102	**Status:** NOP = 0 In Progress = 1 Success = 2 Failure = 3	r/o
41103	Index	r/o
41104	Subindex (max = 255)	r/o
41105	Data Length (max = 238)	r/o
41106-41224	Data	r/o

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.

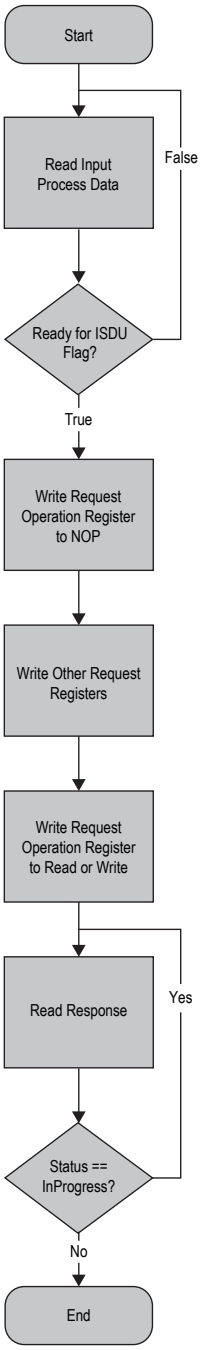


The request is dispatched to the connected device after the request is written. For a read operation, at the end of the sequence, the response data contains the data returned from the device.

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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 7 Port Configuration

Registers	Parameter	Access
41851	Port Mode(1)	r/w
41852	Validation&Backup(2)	r/w
41853	I/Q behavior(3)	r/w
41854	PortCycleTime (reserved): 0 = As Fast As Possible. See PortCycleTime Value Calculation"PortCycleTime Value Calculation" on page 15 below.	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:(4) Input Type 1 = 0 Input Type 2 = 1	

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(1) 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)

(2) 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

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

(4) 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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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.

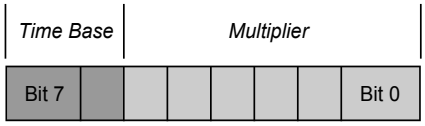
If *Port Mode* is set to *IOL_MANUAL*, the master will attempt to write the *Device ID* into the device at connection. If the *Vendor ID* and *Device ID* are not supported by the device, the master will not connect.

This value is non-volatile and is stored to EEPROM and persisted across adapter power cycles. After a write to any register in this block, the port is reset to apply the new configuration settings.

PortCycleTime Value Calculation

Bits 6 to 7: Time Base. These bits specify the time base for PortCycleTime calculation.

Bits 0 to 5: Multiplier. These bits contain the 6-bit multiplier for PortCycleTime calculation.



Time Base	Time Base Value	Calculation	PortCycleTime
00	0.1 ms	*Multiplier × Time Base*	0.4 ms to 6.3 ms
01	0.4 ms	6.4 ms + (*Multiplier × Time Base*)	6.4 ms to 31.6 ms
10	1.6 ms	32 ms + (*Multiplier × Time Base*)	32 ms to 132.8 ms
11	Reserved	Reserved	Reserved

NOTE: 0.4 ms is the minimum possible PortCycleTime.

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Chapter 8 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 9 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 10 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

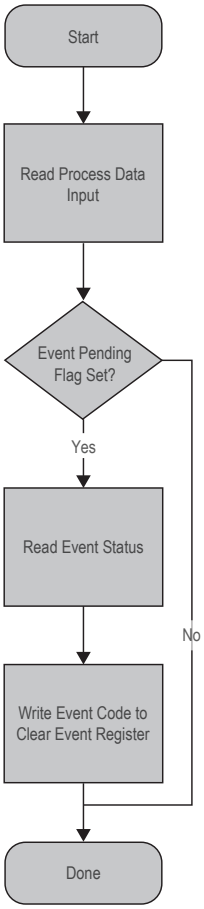
Events are stored in a FIFO buffer, where Mode[0] is the oldest event in the queue. If a new event is received when the queue is full, the oldest event in the queue is shifted out.

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 11 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[1]	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

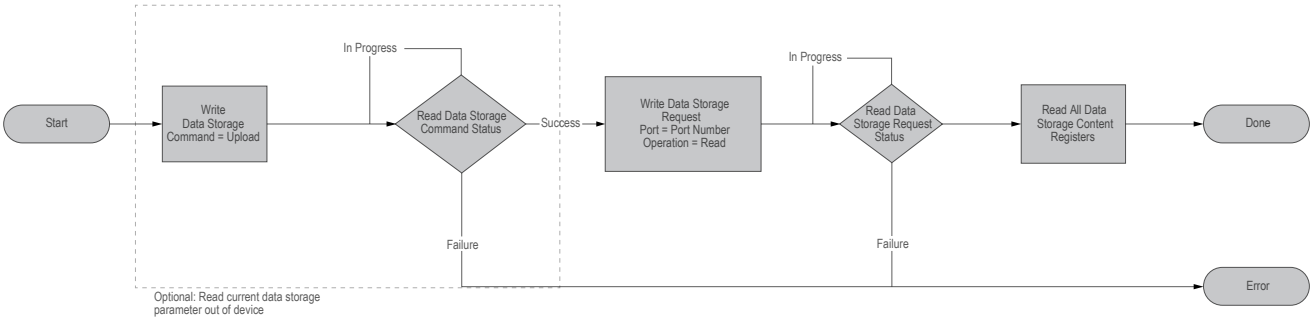
The data storage content is unpopulated (read as `0`) prior to performing a data storage read operation.

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.

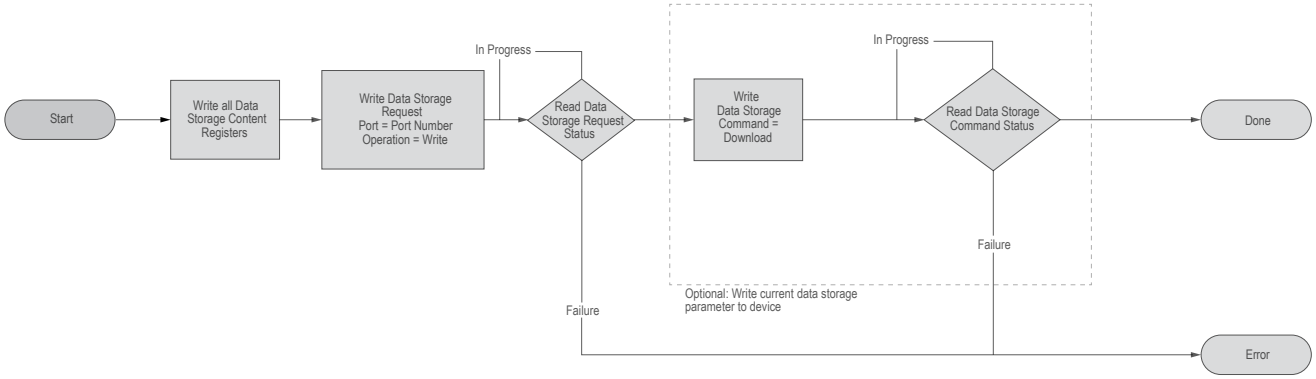
[1] Writes to this register are ignored.

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Reading from Data Storage Content



Writing from Data Storage Content



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Read-Write Alias Registers 23

Chapter 12 Alias Registers

There are two register sets that are part of the holding registers.

Read-Only Alias Registers

This set is the user-configurable alias configuration registers:

Registers	Parameter	Access
40701-40768	Read/Only Alias Register Address	r/w

Each register in this section contains the 16-bit register address for the corresponding alias holding register, which is readable in the alias register space:

Registers	Parameter	Access
40501-40568	Read/Only Alias Register	r/o

When reading an alias register, the data in the register is filled with the contents of the address that are present in the corresponding alias configuration register. The address can be stored in either direct or modicon addressing. Note that all aliased registers are read-only, and it is not possible to write to an alias register.

Any alias registers that are configured to an unsupported register address, or where the read operation fails for some other reason, returns as a zero when read.

Example

Consider reading the process data state registers for all four ports in a single read operation. In this example, the holding registers are configured with the data below:

Register	Value	Register Description
40701	41001	Port 1 input process data state
40702	42001	Port 2 input process data state
40703	43001	Port 3 input process data state
40704	44001	Port 4 input process data state

If the alias registers are read, then they will contain the following register contents:

Register	Value	Register Description
40501	41001	Port 1 input process data state
40502	42001	Port 2 input process data state
40503	43001	Port 3 input process data state
40504	44001	Port 4 input process data state

By default, the alias register is set-up to alias process data for all available ports into a consecutive register map. The alias configuration can always be restored to its factory default value by writing to the Restore Factory Configuration holding register (40605). The alias register space is sized to allow reading all input process data from a 4-port device.

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Read-Write Alias Registers

This set is a series of alias registers with read-write access allowed:

Registers	Parameter	Access
40901-40968	Read/Write Alias Register Address	r/w

Each register in this section contains the 16-bit register address for the corresponding alias holding register, which is readable in the alias register space:

Registers	Parameter	Access
40801-40868	Read/Write Alias Register	r/w

By default, the read-write alias registers are configured to point to the output process data for each port. The register space is sized to allow for aliasing all output process data for a 4-port device.

If writing to an alias register fails (for example, if the aliased register is not writeable), then the write operation of the alias registers will NACK.

A register value that is set to 65535 is always read as 0, and no write operation will be attempted.

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