Fusion.IO EtherCAT Programmer's Guide

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Digital Dynamics, Inc | 5 Victor Square, Scotts Valley, CA 95066
Tel: 831-438-4444 | https://www.digitaldynamics.com

Contents

1 OVERVIEW

This document provides the following documentation:

- A listing of the Fusion.IO EtherCAT manufacturer-specific objects. See Fusion.IO EtherCAT Manufacturer-Specific Objects for details.
- A description of the Fusion.IO Exception Tree. See Exception Tree for details.
- A description of how to use the Fusion.IO manufacturer-specific objects and Exception Tree to detect Fusion.IO specific system events. See Fusion.IO System Behavior for details.
- An Object Dictionary listing for the Fusion.IO system, which contains descriptions of all CANopen over EtherCAT (CoE) objects. See Appendix A for details. The CoE Object Dictionary is defined by ETG1000.5 and further details of the attributes can be found in that specification.

The numbering of some object indices includes placeholders such as:

- "nn" (e.g. 0x3nn1) to represent the module number assigned to a slot card which is installed in a Fusion or RIM device. **nn = module number – 1**
- "rr" (e.g. 0x2rr1) to represent the RIM number in a Fusion.IO system

2 FUSION.IO ETHERCAT MANUFACTURER-SPECIFIC OBJECTS

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2.1 DEVICE INFORMATION (0X2000)

The device information object 0x2000 describes the Fusion.IO Control Module (CM) configuration and status. There is one instance of Index 0x2000 per Fusion.IO CM.

Table 26 - Descriptions of Object Listing Columns provides a description of the attributes provided in the object listing, by column. The CoE Object Dictionary is defined by ETG1000.5 and further details of the attributes can be found in that specification.

Table 1- Device Information 0x2000

Subindex	Name	Definition	Type
0x01	Part Number	The part number of this Control Module configuration. The part number has the format "CC-CCCCCC-CC".	String(64)
0x02	Firmware Version	Lists the firmware version of the Control Module.	String(4)
0x03	Serial Number	Describes the Serial Number used to uniquely identify this Control Module. The serial number is in the format: <Part number>-NNNN, where: NNNN: Unit identifier which ranges from 0 to 9999. The part-number is a subset of the serial number.	String(24)
0x04	IPv4 Address	Lists the configured IP address of the Control Module Ethernet LAN port. 192.168.9.50 is the default value. This subindex is writable in PREOP and is saved to the NVRAM using the Store Parameters Command at index 0xFBF2.	String(24)
0x05	MAC Address	Lists the configured MAC address of the Control Module Ethernet LAN port.	String(24)
0x06	Control Module Configuration MD5	Lists the MD5 checksum of the file used to configure this Fusion.IO CM.	String(24)
0x07	Control Module Configuration Date	Displays the creation date of the Fusion.IO CM configuration listed in subindex 0x06. The format is "YYYY-MM-DD" e.g. "2021-02-27".	String(16)
0x08	Clock	Sets the date string that appears in the system logs. Because the Fusion.IO does not have a battery backup for the Real-Time Clock, this value is not retained over Fusion.IO reboot cycles. This subindex is writable in PREOP mode. The format is "YYYY-MM-DD HH:MM:SS" e.g. "2021-02-27 02:09:45".	String(32)

Subindex	Name	Definition	Type
0x09	Event Mask	The mask for the Control Module event status.	UDINT
0x0A	Event Status	The event status bits for the Control Module. See Device Information Event Status (0x2000.0A) for details.	UDINT
0x0B	Detect Modules Override	The detect modules override status for the Control Module. See Detect Modules Override (0x2000.0B)for additional details. This subindex is writable in PREOP mode and is committed to the NVRAM using the Store Parameters Command at index 0xFBF2.	BIT1
0x0C	Padding	Padding.	PAD15
0x0D	Fan Status (CPU Zone)	The fan deviation from nominal for the Control Module CPU-zone fan.	REAL32
0x0E	Fan RPM (CPU Zone)	The absolute fan RPM for the Control Module CPU-zone fan.	REAL32
0x0F	Temperature (CPU Zone)	The temperature reading for the CPU zone in degrees Celsius. The temperature sensor used for this reading has a resolution of 0.5 Degrees Celsius. This value updates every 30 seconds.	REAL32

2.2 RIM INFORMATION (0X2RR1)

The RIM information object 0x2nn1 describes the RIM configuration and status. Each RIM device in a Fusion.IO system has its own 0x2rr1 entry, where "rr" represents the RIM number.

Table 2- RIM Information 0x2rr1

Subindex	Name	Definition	Type
0x01	Part Number	The part number of this RIM configuration.	String(64)
0x02	Firmware Version	This field lists the firmware version of the RIM.	String(4)
0x03	Serial Number	Lists the Serial Number of this Control Module.	String(24)
0x04	Type	Lists the RIM type. Example values are: • "24-slot (integrated)" • "24-slot" • "12-slot" • "6-slot"	String(24)
0x05	Unit Information	Lists unit-specific information. Example values are: • "FUSION RIM 6" • "FUSION RIM 12" • "FUSION HIGH SIDE" • "FUSION LOW SIDE"	String(24)
0x06	IO cards	Lists the configured IO card types for this RIM. See Table 3 - DDI I/O Card Types Used in 0x2rr1.06 for a description of the possible I/O cards.	Array(0...23) of UINT
0x07	Event Mask	The mask for the Control Module event status bits.	UDINT
0x08	Event Status	The event status bits for the Control Module. See RIM Information Event Status (0x2RR1.08) for details.	UDINT
0x09	Padding	Padding	PAD16
0x0A	Fan Status (Power Supply Zone)	The fan deviation from nominal for the Power Supply Zone fan. If there is no Power Supply Zone fan installed this value will read -100.	REAL32

Subindex	Name	Definition	Type
0x0B	Fan Status (Slot Card Zone)	The fan deviation from nominal for the Slot Card Zone fan. If there is no Slot Card Zone fan installed this value will read -100.	REAL32
0x0C	Fan RPM (Power Supply Zone)	The absolute fan RPM for the Power Supply Zone fan. If there is no Power Supply Zone fan installed this value will read 0.	REAL32
0x0D	Fan RPM (Slot Card Zone)	The absolute fan RPM for the Slot Card Zone fan. If there is no Slot Card Zone fan installed this value will read 0.	REAL32

Table 3 - DDI I/O Card Types Used in 0x2rr1.06

I/O Card ID	Slot-card Type
0x3000	4-Channel Force Guided Relay
0x4000	E84 Communication (8 Digital Input & 8 Digital Output)
0x5000	16-Channel Sinking Digital Output
0x7000	8-Channel SPST Relay
0x9000	16-Channel Inverted Digital Input
0xA000	16-Channel Opto-Isolated Digital Output
0xB000	8-Channel Opto-Isolated Digital Output
0xC000	16-Channel 5 V Digital Input
0xD000	16-Channel 24 V Digital Input
0xE000	16-Channel Sourcing Digital Output
0xF011	8-Channel Analog Output -10 V to 10 V
0xF015	16-Channel Analog Output -10 V to 10 V
0xF081	8-Channel Analog Input -10 V to 10 V
0xF085	16-Channel Analog Input -10 V to 10 V
0xF012	8-Channel K-type Thermocouple
0xF013	8-Channel J-type Thermocouple
0xF014	8-Channel R-type Thermocouple
0xF022	4-Channel RTD
0xF210	4-Channel UART

2.3 MODULE IDENT MAP (0X3000)

The module indent map object 0x3000 provides the module IDs for every enumerated EtherCAT module and is used by the Fusion ESI file.

Table 4 – Module Identity Map 0x3000

Subindex	EtherCAT name
1...255	Module Identifier. See Table 5 for possible values.

Table 5 – Description of Module Identities used in Index 0x3000

DDI Module Identity	Slot-card type
0x0064C004	4-Channel UART
0x0064C104	4-Channel RTD
0x0064C108	8-Channel Thermocouple
0x0064D004	4-Channel Digital Output
0x0064D008	8-Channel Digital Output
0x0064D016	16-Channel Digital Output
0x0064D108	8-Channel Digital Input
0x0064D808	8-Channel Digital Input 8x Oversampled
0x0064D116	16-Channel Digital Input
0x0064D816	16-Channel Digital Input 8x Oversampled
0x0064DD08	8-Channel Digital Input, 8 Channel Digital Output
0x0064A008	8-Channel Analog Output
0x0064A016	16-Channel Analog Output
0x0064A108	8-Channel Analog Input
0x0064A808	8-Channel Analog Input 8x Oversampled
0x0064A116	16-Channel Analog Input
0x0064A816	16-Channel Analog Input 8x Oversampled

2.4 MODULE INFORMATION (0X3NN1)

Details about a specific EtherCAT module are available from object 0x3nn1:

Table 6 – Module Information 0x3nn1

Subindex	Name	Definition	Type
1	IO Card Type	The IO Card Type. Possible values are: • "CAI-11" • "CAI-15" • "CAO-15" • "CAO-17" • "CDI-10" • "CDI-11" • "CDI-12" • "CDO-10" • "CDO-11" • "CIO-10" • "COO-10" • "COO-11" • "CPM-10" • "CRS-10" • "CRS-14" • "CTC-10" • "CTP-11" • "CTP-12" • "CTP-13" • "CTP-14" • "CUR-12" The description of each card type is found in 0x3nn1.2, respectively.	String(8)

Subindex	Name	Definition	Type
2	IO Card Type Description	A description of the IO card Type. Possible values are: • "16xDin 24V" • "16xDin 5V" • "16xInverted Din" • "16xDout Source" • "16xDout Sink" • "16xDout Opto" • "8xDout Relay" • "4xDout FG Relay" • "8xAin 16-bit Open reads 0" • "16xAin 16 bit Open read 0" • "8xAout 16 bit -10 to 10" • "16xAout 16 bit -10 to 10" • "8xThermocouple J-type" • "8xThermocouple K-type" • "8xThermocouple R-type" • "4xRTD -10 to 10" • "4xUART RS232/RS485"	String(32)
3	Number of Channels	Number of channels in the slot-card	INT
4	RIM Number	The RIM which this module belongs to. Valid values range from 1 to 5.	SINT
5	Slot Number	The slot number of the RIM which this module belongs to. Valid values range from 1 to 24.	SINT
6	IO Channel Low	The low channel value for this IO card. Each card type has its own range that starts from 0: • Digital Output • Digital Input • Analog Output • Analog Input For example, if this is an 8-channel analog output card, then a value of 7 would refer to the 8th analog channel. This number is zero-indexed.	INT
7	IO Channel High	The high channel value for this IO card. Each card type has its own range that starts from 0: • Digital Output • Digital Input • Analog Output • Analog Input For example, if this is an 8-channel analog output card, then a value of 15 refers to the 16th analog channel. This number is zero-indexed.	INT
8	Min Voltage	The minimum voltage output or input supported by this slot-card represented by this EtherCAT module.	REAL

Subindex	Name	Definition	Type
9	Max Voltage	The minimum voltage output or input supported by this slot-card represented by this EtherCAT module.	REAL

2.5 SAFE STATE SETTINGS (0X4NN0, 0X4NN1, 0X4NN2 AND 0X4NN3)

Per-pin safe state control is provided with objects 0x4nn0, 0x4nn1, 0x4nn2 and 0x4nn3. This allows the output values to be set to an operator-defined value when the Fusion.IO system transitions from OP mode to any other state.
Object 0x4nn0 provides safe-state control for a 16-channel digital output EtherCAT module:

Table 7 – 16-channel Digital Output Safe-State Control 0x4nn0

Subindex	Name	Definition	Type
0x01	Enable	For each bit[n]; 0 = disable; 1 = enable action at 0x4nn0.02	UINT
0x02	Action	For each bit[n]; 0 = hold current value; 1 = set Value at 0x4nn0.03.	UINT
0x03	Value	Bit[n] of Value is set when the Fusion.IO system transitions from OP to any other state if bit[n] of 0x4nn0.01 and 0x4nn0.02 are both set to 1.	UINT

Object 0x4nn1 provides safe-state control for an 8-channel digital output EtherCAT module:

Table 8 – 8-channel Digital Output Safe-State Control 0x4nn1

Subindex	Name	Definition	Type
0x01	Enable	For each bit[n]; 0 = disable; 1 = enable action at 0x4nn1.02	USINT
0x02	Action	For each bit[n]; 0 = hold current value; 1 = set Value at 0x4nn1.03.	USINT
0x03	Value	Bit[n] of Value is set when the Fusion.IO system transitions from OP to any other state if bit[n] of 0x4nn1.01 and 0x4nn1.02 are both set to 1.	USINT

Object 0x4nn2 provides safe-state control for an 8-channel analog output EtherCAT module:

Table 9 – 8-channel Analog Output Safe-State Control 0x4nn2

Subindex	Name	Definition	Type
0x01	Enable	For each bit[n]; 0 = disable; 1 = enable action in subindex 2 for analog channel[n].	USINT
0x02	Action	For each bit[n]; 0 = hold current value; 1 = set Value[n]	USINT
0x03..0x0A	Value	The value that is asserted on analog output channel[n] when the Fusion.IO system transitions from OP to any other state if bit[n] of 0x4nn2.01 and 0x4nn2.02 are both set to 1.	UINT

Object 0x4nn3 provides safe-state control for a 16-channel analog output EtherCAT module:

Table 10 – 16-channel Analog Output Safe-State Control 0x4nn3

Subindex	Name	Definition	Type
0x01	Enable	For each bit[n]; 0 = disable; 1 = enable action in subindex 2 for analog channel[n].	UINT
0x02	Action	For each bit[n]; 0 = hold current value; 1 = set Value[n] in analog channel[n].	UINT
0x03..0x12	Value	The value that is asserted on analog output channel[n] when the Fusion.IO system transitions from OP to any other state if bit[n] of 0x4nn3.01 and 0x4nn3.02 are both set to 1.	UINT

2.6 THERMOCOUPLE OHMS READINGS (0X5NN4)

Thermocouple resistance readings are provided as a user-Process Data Objects (PDO) mappable subindex. The thermocouple resistance measurements are not in the default PDO mapping and are mapped in by the EtherCAT operator on an as-needed basis.
Use thermocouple resistance readings to measure the resistance of the thermocouple over time. The readings monitor and detect early failure in the thermocouple wire.

Table 11 – Thermocouple Ohms Readings (0x5nn4)

Subindex	Name	Definition	Type
0x01..0x08	Ohms[n]	For each subindex[n]; the resistance readings from TC channel n are populated at this subindex. The value reported is in Ohms, no further conversions are required.	UINT

2.7 UART CONFIGURATION (0X5NN5)

The UART Configuration object is used to set communication properties for each of the 4 channels on a UART card.

Table 12 – UART Configuration 0x5nn1

Subindex	Name	Definition	Type
0x01	Channel 0 Interface	Provides selection of the physical interface of the UART channel. Writable in PREOP mode. Allowed values are: • 0: "RS-232" (default) • 1: "RS-485" • 2: "RS-485 with Termination Resistors"	ENUM
0x02	Channel 0 Baud Rate	Provides selection of the baud rate of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1200" • 1: "2400" • 2: "4800" • 3: "9600" (default) • 4: "19200" • 5: "31200" • 6: "38400" • 7: "57600" • 8: "115200"	ENUM
0x03	Channel 0 Parity Mode	Provides selection of the parity bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "even" • 2: "odd"	ENUM
0x04	Channel 0 Data Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "5" • 1: "6" • 2: "7" • 3: "8" (default)	ENUM
0x05	Channel 0 Stop Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1" (default) • 1: "2"	ENUM
0x06	Channel 0 Flow Control	Provides selection of the flow control of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "Xon/Xoff" • 2: "RTS/CTS"	ENUM
0x07	not used	n/a	n/a

Subindex	Name	Definition	Type
0x08	Channel 1 Interface	Provides selection of the physical interface of the UART channel. Writable in PREOP mode. Allowed values are: • 0: "RS-232" (default) • 1: "RS-485" • 2: "RS-485 with Termination Resistors"	ENUM
0x09	Channel 1 Baud Rate	Provides selection of the baud rate of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1200" • 1: "2400" • 2: "4800" • 3: "9600" (default) • 4: "19200" • 5: "31200" • 6: "38400" • 7: "57600" • 8: "115200"	ENUM
0x0A	Channel 1 Parity Mode	Provides selection of the parity bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "even" • 2: "odd"	ENUM
0x0B	Channel 1 Data Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "5" • 1: "6" • 2: "7" 3: "8" (default)	ENUM
0x0C	Channel 1 Stop Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1" (default) • 1: "2"	ENUM
0x0D	Channel 1 Flow Control	Provides selection of the flow control of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "Xon/Xoff" • 2: "RTS/CTS"	ENUM
0x0E	not used	• n/a	n/a

Subindex	Name	Definition	Type
0x0F	Channel 2 Interface	Provides selection of the physical interface of the UART channel. Writable in PREOP mode. Allowed values are: • 0: "RS-232" (default) • 1: "RS-485" • 2: "RS-485 with Termination Resistors"	ENUM
0x10	Channel 2 Baud Rate	Provides selection of the baud rate of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1200" • 1: "2400" • 2: "4800" • 3: "9600" (default) • 4: "19200" • 5: "31200" • 6: "38400" • 7: "57600" • 8: "115200"	ENUM
0x11	Channel 2 Parity Mode	Provides selection of the parity bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "even" • 2: "odd"	ENUM
0x12	Channel 2 Data Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "5" • 1: "6" • 2: "7" 3: "8" (default)	ENUM
0x13	Channel 2 Stop Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1" (default) • 1: "2"	ENUM
0x14	Channel 2 Flow Control	Provides selection of the flow control of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "Xon/Xoff" • 2: "RTS/CTS"	ENUM
0x15	not used	• n/a	n/a
0x16	Channel 3 Interface	Provides selection of the physical interface of the UART channel. Writable in PREOP mode. Allowed values are: • 0: "RS-232" (default) • 1: "RS-485" • 2: "RS-485 with Termination Resistors"	ENUM

Subindex	Name	Definition	Type
0x17	Channel 3 Baud Rate	Provides selection of the baud rate of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1200" • 1: "2400" • 2: "4800" • 3: "9600" (default) • 4: "19200" • 5: "31200" • 6: "38400" • 7: "57600" • 8: "115200"	ENUM
0x18	Channel 3 Parity Mode	Provides selection of the parity bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "even" • 2: "odd"	ENUM
0x19	Channel 3 Data Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "5" • 1: "6" • 2: "7" 3: "8" (default)	ENUM
0x1A	Channel 3 Stop Bits	Provides selection of the data bits of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "1" (default) • 1: "2"	ENUM
0x1B	Channel 3 Flow Control	Provides selection of the flow control of the selected UART channel. Writable in PREOP mode. Allowed values are: • 0: "none" (default) • 1: "Xon/Xoff" • 2: "RTS/CTS"	ENUM

2.8 UART INFORMATION (0X5NN6)

The UART Information object provides status and error for each UART channel as well as control of transmission and flushing channel FIFO buffers.

Table 13 – UART Configuration 0x5nn6

Subindex	Name	Definition	Type
0x01	UART Control Channel 0	Provides selection to control the UART channel 0. Writable in PREOP mode. Allowed values are: • 0: 0 = "Transmit Enable", 1 = "Transmit Hold" • 1: 0 = "No Operation", 1 = "Flush"	USINT
0x02	UART Control Channel 1	Provides selection to control the UART channel 0. Writable in PREOP mode. Allowed values are: • 0: 0 = "Transmit Enable", 1 = "Transmit Hold" • 1: 0 = "No Operation", 1 = "Flush"	USINT
0x03	UART Control Channel 2	Provides selection to control the UART channel 0. Writable in PREOP mode. Allowed values are: • 0: 0 = "Transmit Enable", 1 = "Transmit Hold" • 1: 0 = "No Operation", 1 = "Flush"	USINT
0x04	UART Control Channel 3	Provides selection to control the UART channel 0. Writable in PREOP mode. Allowed values are: • 0: 0 = "Transmit Enable", 1 = "Transmit Hold" • 1: 0 = "No Operation", 1 = "Flush"	USINT
0x05	Status Channel 0	Provides status of UART channel 0. Writable in PREOP mode. Channel status is defined as follows: • 0-11: "Number of bytes available in the FIFO (0-4095)" • 12: ": Error Occurred, See error details subindex." • 13: "Tx Buffer Almost Full" • 14: "Rx Buffer Almost Full" (default) • 15: "CTS from slot-card"	USINT
0x06	Status Channel 0	Provides status of UART channel 1. Writable in PREOP mode. Channel status is defined as follows: • 0-11: "Number of bytes available in the FIFO (0-4095)" • 12: ": Error Occurred, See error details subindex." • 13: "Tx Buffer Almost Full" • 14: "Rx Buffer Almost Full" (default) • 15: "CTS from slot-card"	USINT
0x07	Status Channel 2	Provides status of UART channel 2. Writable in PREOP mode. Channel status is defined as follows: • 0-11: "Number of bytes available in the FIFO (0-4095)" • 12: ": Error Occurred, See error details subindex." • 13: "Tx Buffer Almost Full" • 14: "Rx Buffer Almost Full" (default) • 15: "CTS from slot-card"	USINT

Subindex	Name	Definition	Type
0x08	Status Channel 3	Provides status of UART channel 3. Writable in PREOP mode. Channel status is defined as follows: • 0-11: "Number of bytes available in the FIFO (0-4095)" • 12: ": Error Occurred, See error details subindex." • 13: "Tx Buffer Almost Full" • 14: "Rx Buffer Almost Full" (default) • 15: "CTS from slot-card"	USINT
0x09	Error Details Channel 0	Provides error details of UART channel 0. Writable in PREOP mode. Allowed values are: • 0: "Rx Overflow Occurred" • 1: "Rx Farming Error Occurred" • 2: "Rx Parity Error Occurred" • 7: "Tx Overflow Occurred"	USINT
0x0A	Error Details Channel 1	Provides error details of UART channel 1. Writable in PREOP mode. Allowed values are: • 0: "Rx Overflow Occurred" • 1: "Rx Farming Error Occurred" • 2: "Rx Parity Error Occurred" • 7: "Tx Overflow Occurred"	USINT
0x0B	Error Details Channel 2	Provides error details of UART channel 2. Writable in PREOP mode. Allowed values are: • 0: "Rx Overflow Occurred" • 1: "Rx Farming Error Occurred" • 2: "Rx Parity Error Occurred" • 7: "Tx Overflow Occurred"	USINT
0x0C	Error Details Channel 3	Provides error details of UART channel 3. Writable in PREOP mode. Allowed values are: • 0: "Rx Overflow Occurred" • 1: "Rx Farming Error Occurred" • 2: "Rx Parity Error Occurred" • 7: "Tx Overflow Occurred"	USINT

3 EXCEPTION TREE

The exceptions are organized as a hierarchical set of CoE objects which report active and latched exception states and also allow masks to be set for exception reporting. At the top level is the Exception Status 0xF3x0 which contains flags that indicate an error or warning condition is asserted in a sub-category of the exception tree. The placeholder "x" in the object index (e.g. 0xF3x0") can have the following values:

- **8: Active Exceptions** – The active exception state of the Fusion.IO system
- **9: Latched Exceptions** – Exceptions which have occurred since the Fusion.IO system was powered up or since the last issued exception status reset command (0xFBF1). Any bit which is TRUE will remain TRUE until an exception reset command (0xFBF1) has been issued.
- **A: Exception Mask** – Allows specific exceptions to be mapped or unmapped to the exception status. By default, all exceptions are reported.

3.1 EXCEPTION STATUS (0XF3X0)

A condensed summary byte describing the collection of active device exceptions after corresponding masks (0xF3Ax) were applied.

Table 14 – EXCEPTION_STATUS: (active:F380, latched:F390, mask:F3A0)

31 4	3	2	1	0	Bit
Reserved	Mfg Error	Device Error	Mfg Warning	Device Warning	

BIT	Definition
31 – 4	Reserved
3	Manufacturer Error
2	Device Error
1	Manufacturer Warning
0	Device Warning

3.2 DEVICE INFORMATION EVENT STATUS (0X2000.0A)

Table 15 – DEVICE_INFORMATION_EVENT_STATUS: (0x2000.0A)

31 11	10	9	8	7 0	Bit
Reserved	CPU Fan Failure	CPU Fan Error	CPU Fan Warning	Reserved	

Bit	Definition
31 – 11	Reserved
10	CPU Fan FAILURE (RPM dropped below 50% of nominal)
9	CPU Fan ERROR (RPM dropped below 30% of nominal)
8	CPU Fan WARNING (RPM dropped below 15% of nominal)
0	Reserved

3.3 RIM INFORMATION EVENT STATUS (0X2RR1.08)

There are up to five RIM Information objects which can be read online from a Fusion.IO system. The Event Status at sub-index 0x08 contains a 32-bit variable which describes the errors and warnings on each RIM.

- All bits from 31 to 2 are latched and remain set until an Exception Reset Command 0xFBF1 is executed.
- Bits 1 to 0 are the active RIM state and are not latched.

The Event Status contains error flags and warning flags.

- Any error flags which are set will also set a flag in the Global Manufacturer Error Details bit field for the RIM with the error.
- Any warning flags which are set also set a flag in the Global Manufacturer Warning Details bit field for the RIM with the warning.

Table 16 – RIM_INFO_EVENT_STATUS (per-RIM: 0x2rr1.08) where rr = (RIM # 1..5)

Bit	Definition
31-20	Reserved
19	SOUT Compare MCM1 error
18	SLOT Machine MCM1 error
17	SOUT Compare MCM0 error
16	SLOT Machine MCM0 error
15	Reserved
14	Aux Power Supply Fan FAILURE (RPM dropped below 50% of nominal)
13	Aux Power Supply Fan ERROR (RPM dropped below 30% of nominal)
12	Aux Power Supply Fan WARNING (RPM dropped below 15% of nominal)
11	Reserved
10	Slot Card Fan FAILURE (RPM dropped below 50% of nominal)
9	Slot Card Fan ERROR (RPM dropped below 30% of nominal)
8	Slot Card Fan WARNING (RPM dropped below 15% of nominal)
7-5	Reserved
4	RIM Communication error
3	RIM State Error: ONLINE to OFFLINE (RIM device was connected and then went offline) This could be caused by a RIM device being unplugged from the Remote Module Interface Port.
2	RIM State Warning OFFLINE to OHMS (RIM device connected but not online) This could be caused by connecting a RIM device which is not configured for the Fusion.IO system or connected to the wrong Remote Module Interface Port.
1-0	Active RIM state: 0:OFFLINE, 1:CONNECTED;NOT ONINE, 2:ONLINE, 3:ERROR

3.4 OBJECTS NOT IMPLEMENTED

The following objects are not currently implemented.

- Device Warning Details (0xF3x1) DEVICE_WARNING_DETAILS: (active:F381, latched:F391, mask:F3A1)
- Device Error Details (0xF3x3) DEVICE_ERROR_DETAILS: (active:F383, latched:F393, mask:F3A3)
- Global Device Warning Details (0xF3x5) DEVICE_ERROR_DETAILS: (active:F385, latched:F395, mask:F3A5)
- Global Device Error Details (0xF3x7) GLOBAL_DEVICE_ERROR_DETAILS: (active:F387, latched:F397, mask:F3A7)

3.5 MANUFACTURER WARNING DETAILS (0XF3X2)

These are IO card specific warnings.

Table 17 – MANUFACTURER_WARNING_DETAILS: (active:F382, latched:F392, mask:F3A2)

31 16	15 0	Bit
Reserved	I/O Warning	

Bit	Definition
31 – 16	Reserved
15 – 0	IO Warning: IO card specific warning (each bit is for a channel) For SOUT cards each bit indicates a Safe-Wiring Fault on DOUT channel[n] (1<<n) A Safe-Wiring Fault is when the output is driven high, and sense input is low. For AIN/AOUT/DIN/TC cards = 0 (undefined)

3.6 MANUFACTURER ERROR DETAILS (0XF3X4)

These are IO card specific error details.

Table 18 – MANUFACTURER_ERROR_DETAILS: (active:F384, latched:F394, mask:F3A4)

31 16	15 0	Bit
Reserved	I/O Error	

Bit	Definition
31 – 16	Reserved
15 – 0	IO Error: IO card specific error (each bit is for a channel) For SOUT cards each bit indicates an unsafe-wiring Fault on DOUT channel[n] (1<<n) An unsafe-wiring Fault occurs when the output is driven low and sense input is high. For AIN/AOUT/DIN/TC cards = 0 (undefined)

3.7 GLOBAL MANUFACTURER WARNING DETAILS (0XF3X6)

The Global Manufacturing Warning Details object 0xF3x6 provides a top-level indication of warnings present in a Fusion.IO system, by Fusion & RIM device. Details of the specific warnings can be obtained from objects 0x2000.A and 0x2rr1.08.

Table 19 – GLOBAL_MANUFACTURER_WARNING_DETAILS: (active:F385, latched:F395, mask:F3A5)

31 17	16 1	0	Bit
Reserved	RIM Warnings	Device Warning	

Bit	Definition
31 – 17	Reserved
16 – 1	RIM Warnings: bit (1<<(rr-1)) is set when any 0x2rr1.08 event status warning flags are active where rr = (RIM # 1..5)
0	Device Warning: 1 = indicates a warning condition in 0x2000.0A is set

3.8 GLOBAL MANUFACTURER ERROR DETAILS (0XF3X8)

The Global Manufacturing Error Details object 0xF3x6 provides a top-level indication of errors present in a Fusion.IO system, by Fusion & RIM device. Details of the specific warnings can be obtained from objects 0x2000.A and 0x2rr1.08.

Table 20 – GLOBAL_MANUFACTURER_ERROR_DETAILS: (active:F388, latched:F398, mask:F3A8)

31 17	15 1	0	Bit
Reserved	RIM Errors	Device Error	

Bit	Definition
31 – 17	Reserved
16 – 1	RIM Errors: bit (1<<(nn-1)) when any 0x2rr1.08 event status error flags are active where rr = (RIM # 1..5)
0	Device Error: 1 = indicates an error condition in 0x2000.0A is set

4 FUSION.IO SYSTEM BEHAVIOR

4.1 UART PROCESS DATA MAPPING

Each UART card has the following process data mapping:

Table 21 – UART TxPDO Mapping

Index	Subindex	Data Type	Definition
0x6nnA	1	UINT	Status[0]
	2	UINT	Status[1]
	3	UINT	Status[2]
	4	UINT	Status[3]

Table 22 – UART Status (0x5nn6.5 – 0x5nn6.9) Definition for UART Channels 0-3

Bit	Description
15	CTS from slot-card
14	Rx Buffer Almost Full
13	Tx Buffer Almost Full
12	Error occurred. Error details for channels 0-3 available from 0x5nn6.9 – 0x5nn6.C
11-0	Number of bytes available to be read (0-4095).

4.2 DETECT MODULES OVERRIDE (0X2000.0B)

Table 23 – Impacts of the Detect Modules Override Bit on System Behavior

Detect Modules Override (0x2000.0B)	EtherCAT Module Enumeration Behavior	Fusion.IO Behavior When a RIM Disconnects	Fusion.IO Behavior When an Unsafe I/O Error Occurs
0	Enumerates only the I/O slot-cards detected at system initialization or when the Detect Modules command (0xF0002.01) is issued.	When you remove a RIM device that has process data mapped it results in the Fusion.IO system transitioning into SAFEOP mode if the Fusion.IO system is in OP mode. The outputs are set to the safe-state levels at 0x4nn0 through 0x4nn3. The disconnected RIM device will drive its outputs to a TÜV-safe level.	When a RIM device that has process data mapped to it goes offline due to an unsafe I/O error it results in the Fusion.IO system going into SAFEOP mode, if the Fusion.IO system is in OP mode. The outputs will be set to the safe-state levels at 0x4nn0 through 0x4nn3. The disconnected RIM device will drive its outputs to the TÜV-safe level.
1 (Default)	Enumerates any configured I/O slot-cards as the default PDO regardless of the state of any integrated or external RIM devices.	The Fusion.IO system retains its current slave state. The disconnected RIM device will drive its outputs to a TÜV-safe level. Bits [1:0] in 0x2rr1.08 will reflect the new RIM state.	The Fusion.IO system retains its current slave state. The disconnected RIM device will drive its outputs to a TÜV-safe level. Bits [1:0] in 0x2rr1.08 will reflect the new RIM state.

4.3 COMMUNICATION STATES

Each Fusion or RIM device is in in one of three communication states: Online, Connected, or Offline. These states are defined as follows:

- **Online:** The authentication of a device has completed successfully and no diagnostic or safety issues are present.
  - For a RIM device, this means that the RIM device is connected to the expected port on the Fusion device and there are no safety, diagnostic, or communication issues present. The following LED states are present when a RIM is Online:
    - RIM device's RIM PORT: Green
    - RIM Power: Green
    - Fusion device's RIM Port RJ45: Green
  - For a Fusion device, this means that there are no safety, diagnostic, or configuration issues present. In this state the Fusion device's Online LED is green.
- **Connected**: This state applies to RIM devices and indicates the following possible cases:
  - RIM device did not authenticate when plugged into the Fusion device or has shut itself down itself due to a diagnostic, communication, or unsafe wiring error.
  - RIM device is powered but not physically connected to a Fusion device
  - In this state, the following LED states are present:
    - RIM device's RIM PORT: Amber
    - RIM Power LED: Off
    - Fusion device's RIM Port: Amber LED, when the RIM is physically connected
- **Offline:** The RIM device cable has been unplugged or power has been removed from the RIM device.

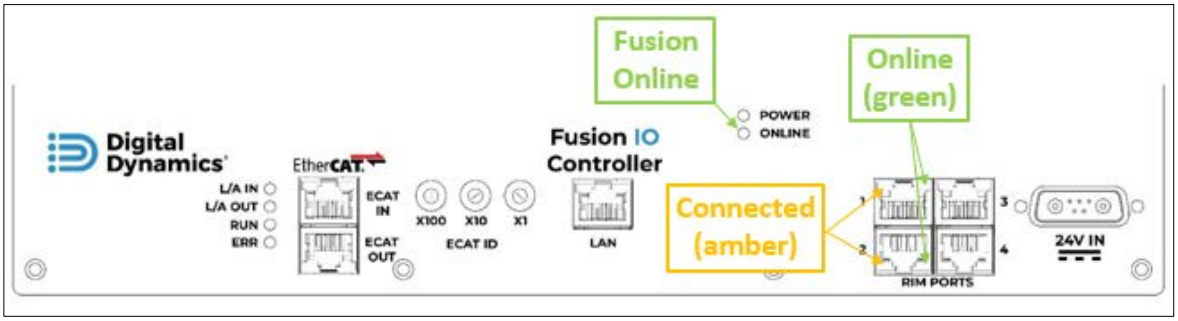

Figure 2 - Fusion Device Communication LEDs

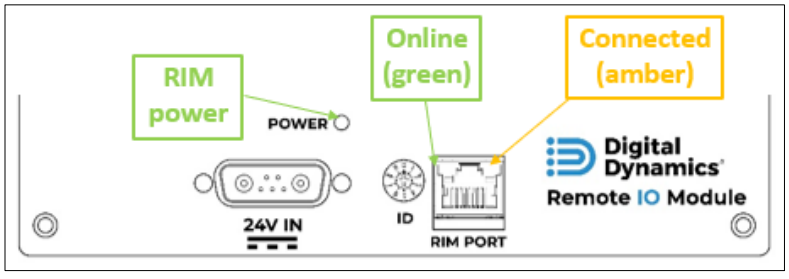

Figure 1 - RIM Device Communication LEDs

4.4 QUERYING THE STATE OF A RIM

Starting in Fusion.IO firmware version 1.09.5, by default the RIM devices that have process data mapped to them are not required to be online for the Fusion.IO system to transition to OP mode. This setting is controlled in 0x2000.0B.

Bits [1:0] ("Active RIM state") of 0x2nn1.08 are used to monitor the state of a particular RIM device. In addition, bit 3 ("RIM state error") of 0x2rr1.08 is set if the RIM device goes from "online" to "offline". Bit 2 ("RIM state warning") of 0x2rr1.08 is set if the RIM device goes from "online" to "connected".

4.5 RIM COMMUNICATION ERROR NOTIFICATION

If the RIM device goes offline due to an error in the communication between the RIM device and CM, bit 4 ("RIM Communication error") of 0x2rr1.08 is set.

4.6 FAN MONITORING

There are three types of fans in the Fusion.IO system:

- **CPU Zone fan:** This fan is present in every Fusion.IO CM. The external RIM devices do not have a CPU fan.
  - The CPU Zone fan RPM deviation from nominal RPM can be monitored at 0x2000.0D.
  - The CPU Zone fan RPM can be monitored in at 0x2000.0E.
  - 0x2000.0A lists the CPU Zone fan deviations that result in a EtherCAT exception.
- **Auxiliary Power Supply Zone Fan:** This fan may be present in each CM and external RIM device.
  - The Auxiliary Power Supply Zone fan RPM deviation from nominal RPM can be monitored at 0x2rr1.0A.
  - The Auxiliary Power Supply Zone fan RPM can be monitored in at 0x2rr1.0C.
  - 0x2rr1.08 lists the Auxiliary Power Supply Zone deviations that result in a EtherCAT exception.
- **Slot-card Zone Fan**: This fan is present in each CM and external RIMs that contain slot-cards.
  - The Slot-card Zone fan RPM deviation from nominal RPM can be monitored at 0x2rr1.0B.
  - The Slot-card Zone fan RPM can be monitored in at 0x2rr1.0D.
  - 0x2rr1.08 lists the Slot-card Zone fan deviations that will result in a EtherCAT exception.

All three types of fans have warning and error notifications that are propagated up through the Exception Tree. See Section 5 for details.

4.7 WIRING FAULT DETECTION

The sourcing digital output cards are the only slot-cards capable of detecting a safe or unsafe wiring fault.

There are two types of wiring faults in Digital Output connections detected by the Fusion.IO system:

- **Safe wiring fault**: This condition occurs when the Fusion.IO system drives a logic high but the safety mechanism reads back a logic 0 on the wire. This condition is detected in index 0xF3x2.
- **Unsafe wiring fault**: This condition occurs when the Fusion.IO device drives a logic low but the safety mechanism reads back a logic 1 on the wire. This condition is detected in index 0xF3x4.

4.8 FUSION.IO CM CPU TEMPERATURE MONITORING

Each Fusion.IO CM CPU temperature is monitored with a temperature sensor which has its readings available from object 0x2000.0F.

Subindex 0x2000.0F provides a floating point reading with a resolution of 0.5 Degrees C. This reading updates every 30 seconds.

Starting in firmware version 1.09.6, 0x2000.0F is user-PDO mappable.

5 GLOSSARY

These are a combination of Digital Dynamics specific terms and industry standard terms.

Term	Description
Analog Input (AIN)	An analog input style channel which can include -10…+10V, thermocouple, and RTD signals. Analog inputs are not available to be used in Interlocks.
Analog Output (AOUT)	An analog output style channel, for example -10..10V outputs. Analog outputs are not available to be used in interlocks.
CANOpen	Controller Area Network, the Open Communication Solution Dissemination Project (CANOpen) is a communication protocol and device profile specification for embedded systems used in automation.
CoE	CANopen over EtherCAT (CoE) protocol allows devices equipped with CANopen to be used on EtherCAT-based Industrial Ethernet networks.
Complete Access	A mode in which all sub-indices of an object can be accessed (read/write) via SDOs.
Control Module (CM)	The Control Module, or CM, is the section of a Fusion device which interfaces with both the EtherCAT network and any Remote Interface Modules (RIMs).
DC	Distributed Clocks (DC) supports a 64-bit DC System Time value
Digital Input (DIN)	A digital input channel which can be used as an input term to an interlock
ESC	EtherCAT Slave Controller (ESC) provides the communication interface between the EtherCAT network and the host controller (device application controller) or the digital I/O (if no host controller is used).
ESI (EtherCAT Slave Information) ESI file	EtherCAT Slave Information (ESI) file is an XML file which describes an EtherCAT slave device's implementation is often used by EtherCAT masters to configure the slaves and generate network configurations.
EtherCAT	EtherCAT is an industrial ethernet protocol which is suitable for both hard and soft real-time computing requirements in automation technology. EtherCAT is commonly used in machine control, measurement equipment, medical devices, automobiles and mobile machines, as well as in innumerable embedded systems. The EtherCAT Technology Group (ETG) is the standardization organization for EtherCAT and is an official partner of the IEC. Both EtherCAT and Safety over EtherCAT are IEC-Standards (IEC 61158 and IEC 61784).
EtherCAT Master	EtherCAT master is the host device in an EtherCAT network which is responsible for managing network activity such as configuration, frame transmission, time synchronization, etc. It is typically a combination of an EtherCAT master stack and computing hardware which includes an Ethernet port.
EtherCAT Module	An EtherCAT Module refers generically to functional devices/components which make up an EtherCAT slave device as part of that device's implementation of the Modular Device Profile (MDP), ETG 5001.1- 5001.4. The Fusion.IO system implements the Modular Device Profile such that the slot cards used with Fusion and RIM devices are individual EtherCAT Modules.
EtherCAT Technology Group (ETG)	The EtherCAT Technology Group is the standardization organization for EtherCAT technology.
Fusion	A Fusion device is the main device used in a Fusion IO system. It connects to the EtherCAT network and is where Remote Interface Modules (RIMs) are connected. The Fusion device also provides field connections to I/O channels through its on-board slot cards and field connect interface.
Index	16-bit address of an object in the object dictionary
Object	An object represents a component of a device for use via CoE and which can include one or more of the following: data, configuration parameters, methods or functions.
Object Dictionary	A data structure which contains description of various objects implemented by a device, for example data types, communication objects, and application objects.
OP/PREOP/SAFEOP/INIT	Communication states defined as part of the EtherCAT State Machine (ESM), defined in ETG.1000.6. • OP: Operational state. Process data inputs and outputs are valid and processed by the EtherCAT master. • PREOP: Pre-Operational state. Only mailbox communication, including use of SDOs, is allowed. No process data communication is available. • SAFE-OP: Safe-Operational state. Mailbox communication, including SDOs, is available and process data inputs are also available; process data outputs are not

Term	Description
	available. • INIT: Init state. No mailbox or process data communication is available. ESC registers can be accessed by the EtherCAT master in INIT state.
PDO	Process Data Object (PDO) is used to transmit the application data. The application data is transmitted without any protocol overhead in broadcast. TX and RX are abbreviations for Transmit and Receive.
PL	Performance Level (PL) is a rating used to define the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions and are correlated with the probability of dangerous failures per hour. The EN/ISO 13849-1 machine safety standard defines Performance Levels a, b, c, d, and e where PL e correlates with the lowest probability of dangerous failures per hour and PL a with the highest.
RIMs	A RIM, or Remote Interface Module, is an I/O expansion module which can be located remotely from the Fusion device and connects to the Fusion device via a redundantly monitored, safety certified serial bus. I/O channels on a RIM are updated in real-time along with a Fusion device's I/O channels and can be combined with Fusion I/O channels in safety interlocks.
RX (and TX) PDO	Receive (Rx) PDOs and transmit (Tx) PDOs are distinguished, the name being chosen from the point of view of a device: an Fusion.IO system sends its input data with TxPDOs and receives its output data in the RxPDOs
Safety	Safety is defined as the freedom from unacceptable risk of physical injury or of damage to the health of people, either directly, or indirectly as a result of damage to property or to the environment.
Safety Digital Output (SOUT)	A safety digital output (SOUT) is a digital output channel can be controlled as the output of a programmed interlock as well as by an EtherCAT master.
SIL	Safety Integrity Level, or SIL, is a measure of a system's safety performance in terms of probability of failure. IEC 61508 defines four SIL levels: SIL 1, SIL 2, SIL 3, and SIL 4. A higher number means better safety performance, such as lower probability of failure.
SDO	Service Data Object (SDO) is used to gain access to all device parameters. SDO is used for direct device-to-device communication.
Specific Device Profile (SDP)	The aspects of specification which are common to a particular class or family of devices (e.g. motion drives).
Slot	Location in a Fusion or RIM device where a slot card can be installed. Each model of Fusion and RIM device has a specific number of slots available (e.g. 6, 12, 24, etc.)
Slot Card	A slot card is a device which implements various types of I/O channels (e.g. digital I/Os, analog I/Os, serial data, temperature measurements, etc.) and is installed in Fusion and RIM devices.
Sub-index	8-bit address of an element within a complex object, for example members of an array or structure
SyncManager	SyncManager (synchronization manager) ensure a consistent and secure data exchange between the EtherCAT master and the local application of a slave device
TÜV	TÜV is a testing and certification organization which ensures that a product, service, or process has been tested for safety and that it complies with the requirements of national, regional, and international regulations.
UART	Universal Asynchronous Receiver-Transmitter (UART) is a hardware communication protocol that uses asynchronous serial communication with configurable speed and data format.

6 APPENDIX A - FUSION_IO COE OBJECT LIST

These tables contain a listing of the objects available in the Fusion IO system CoE Object Dictionary, presented in order of each object's index. Table 26 - Descriptions of Object Listing Columns provides a description of the attributes provided in the object listing, by column. The CoE Object Dictionary is defined by ETG1000.5 and further details of the attributes can be found in that specification.

Table 24 - Descriptions of Object Listing Columns

Column	Description
Index	16-bit address of an object in the object dictionary
Sub-Index	8-bit address of an element within a complex object, for example members of an array or structure
Name	The name of the object
Description	Details of the object, provided by index and sub-index
Data Type	The data type used by an object, including a particular sub-index. Standard data types are defined by ETG1000.5
Default	The default value of an object
Access	Specifies an object's access rights (e.g. read/write, read-only, write-only, etc.)
RX/TX	Indicates if an object may be mapped to an RX or TX PDO. (Receive or Transmit)

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
0x0800		DT0800EN04	UART Baud Rate				
	1	1200 Baud			0		
	2	2400 Baud			1		
	3	4800 Baud			2		
	4	9600 Baud			3		
	5	19200 Baud			4		
	6	31250 Baud			5		
	7	38400 Baud			6		
	8	57600 Baud			7		
	9	115200 Baud			8		
0x0801		DT0801EN02	UART Parity				
	1	No Parity			0		
	2	Odd Parity			1		
	3	Even Parity			2		
0x0802		DT0802EN01	UART Stop Bits				
	1	1 Stop Bit			0		
	2	2 Stop Bits			1		
0x0803		DT0803EN02	UART Data Bits				
	1	5 Bits			0		
	2	6 Bits			1		
	3	7 Bits			2		
	4	8 Bits			3		
0x0804		DT0804EN02	UART Interface Selection				
	1	RS-232			0		
	2	RS-485			1		
	3	RS-485 with Termination Resis-tor			2		
0x0805		DT0805EN02	UART Flow Control				
	1	None			0		
	2	Xon-Xoff			1		
	3	RTS/CTS			2		
0x100B		Manufacturer FW Bootloader Version	Manufacturer FW Bootloader Version (1.09.0)	STRING(6)	0x302e39302e31	ro	
0x1600		**RxPDO Mapping (DOUTx16)**	**16-bit DOUT**			**ro**	
	0x01	DOUT[15..0]		UINT32	0x70000110	ro	
0x1601		**RxPDO Mapping (DOUTx8)**	**8-bit DOUT**			**ro**	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	0x01	DOUT[7..0]		UINT32	0x70010108	ro	
0x1602		**RxPDO Mapping (AOUTx8)**	**8-ch AOUT**			**ro**	
	0x01	AOUT[0]		UINT32	0x70020110	ro	
	0x02	AOUT[1]		UINT32	0x70020210	ro	
	0x03	AOUT[2]		UINT32	0x70020310	ro	
	0x04	AOUT[3]		UINT32	0x70020410	ro	
	0x05	AOUT[4]		UINT32	0x70020510	ro	
	0x06	AOUT[5]		UINT32	0x70020610	ro	
	0x07	AOUT[6]		UINT32	0x70020710	ro	
	0x08	AOUT[7]		UINT32	0x70020810	ro	
0x1603		**RxPDO Mapping (AOUTx16)**				**ro**	
	0x01	AOUT[0]		UINT32	0x70030110	ro	
	0x02	AOUT[1]		UINT32	0x70030210	ro	
	0x03	AOUT[2]		UINT32	0x70030310	ro	
	0x04	AOUT[3]		UINT32	0x70030410	ro	
	0x05	AOUT[4]		UINT32	0x70030510	ro	
	0x06	AOUT[5]		UINT32	0x70030610	ro	
	0x07	AOUT[6]		UINT32	0x70030710	ro	
	0x08	AOUT[7]		UINT32	0x70030810	ro	
	0x09	AOUT[8]		UINT32	0x70030910	ro	
	0x0A	AOUT[9]		UINT32	0x70030A10	ro	
	0x0B	AOUT[10]		UINT32	0x70030B10	ro	
	0x0C	AOUT[11]		UINT32	0x70030C10	ro	
	0x0D	AOUT[12]		UINT32	0x70030D10	ro	
	0x0E	AOUT[13]		UINT32	0x70030E10	ro	
	0x0F	AOUT[14]		UINT32	0x70030F10	ro	
	0x10	AOUT[15]		UINT32	0x70031010	ro	
0x160B		**RxPDO Mapping (DOUTx4)**	**4-bit DOUT**			**ro**	
	0x01	DOUT[3..0]		UINT32	0x700B0104	ro	
	0x02			UINT32	0x700B0204	ro	
0x160C		**RxPDO Mapping (DIOx8)**	**8-bit DIO**			**ro**	
	0x01	DOUT[7..0]		UINT32	0x70010108	ro	
0x1A00		**TxPDO Mapping (DINx16)**	**16-bit DIN**			**ro**	
	0x01	DIN[15..0]		UINT32	0x60000110	ro	
0x1A01		**TxPDO Mapping (DINx8)**	**8-bit DIN**			**ro**	
	0x01	DIN[7..0]		UINT32	0x60010108	ro	
0x1A02		**TxPDO Mapping (AINx8)**	**8-ch AIN**			**ro**	
	0x01	AIN[0]		UINT32	0x60020110	ro	
	0x02	AIN[1]		UINT32	0x60020210	ro	
	0x03	AIN[2]		UINT32	0x60020310	ro	
	0x04	AIN[3]		UINT32	0x60020410	ro	
	0x05	AIN[4]		UINT32	0x60020510	ro	
	0x06	AIN[5]		UINT32	0x60020610	ro	
	0x07	AIN[6]		UINT32	0x60020710	ro	
	0x08	AIN[7]		UINT32	0x60020810	ro	
0x1A03		**TxPDO Mapping (AINx16)**				**ro**	
	0x01	AIN[0]		UINT32	0x60030110	ro	
	0x02	AIN[1]		UINT32	0x60030210	ro	
	0x03	AIN[2]		UINT32	0x60030310	ro	
	0x04	AIN[3]		UINT32	0x60030410	ro	
	0x05	AIN[4]		UINT32	0x60030510	ro	
	0x06	AIN[5]		UINT32	0x60030610	ro	
	0x07	AIN[6]		UINT32	0x60030710	ro	
	0x08	AIN[7]		UINT32	0x60030810	ro	
	0x09	AIN[8]		UINT32	0x60030910	ro	
	0x0A	AIN[9]		UINT32	0x60030A10	ro	
	0x0B	AIN[10]		UINT32	0x60030B10	ro	
	0x0C	AIN[11]		UINT32	0x60030C10	ro	
	0x0D	AIN[12]		UINT32	0x60030D10	ro	
	0x0E	AIN[13]		UINT32	0x60030E10	ro	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	0x0F	AIN[14]		UINT32	0x60030F10	ro	
	0x10	AIN[15]		UINT32	0x60031010	ro	
0x1A04		**TxPDO Mapping (TCx8)**	**8-ch thermocouple PDO + 8-ch ohms SDO (all 16-bit analog ins)**			**ro**	
	0x01	TC[1]		UINT32	0x60040110	ro	
	0x02	TC[2]		UINT32	0x60040210	ro	
	0x03	TC[3]		UINT32	0x60040310	ro	
	0x04	TC[4]		UINT32	0x60040410	ro	
	0x05	TC[5]		UINT32	0x60040510	ro	
	0x06	TC[6]		UINT32	0x60040610	ro	
	0x07	TC[7]		UINT32	0x60040710	ro	
	0x08	TC[8]		UINT32	0x60040810	ro	
0x1a05		**TxPDO Mapping (DINx16x8)**	**DINx16 Card with 8 samples per channel**				
	0x01			UINT32	0x60050180	ro	
0x1a06		**TxPDO Mapping (DINx8x8)**	**DINx8 Card with 8 samples per channel**				
	0x01			UINT32	0x60060140	ro	
0x1A07		**TxPDO Mapping (AINx16x8)**	**AINx16 Card with 8 samples per channel**			**ro**	
	0x01	AIN[0]		UINT32	0x60070180	ro	
	0x02	AIN[1]		UINT32	0x60070280	ro	
	0x03	AIN[2]		UINT32	0x60070380	ro	
	0x04	AIN[3]		UINT32	0x60070480	ro	
	0x05	AIN[4]		UINT32	0x60070580	ro	
	0x06	AIN[5]		UINT32	0x60070680	ro	
	0x07	AIN[6]		UINT32	0x60070780	ro	
	0x08	AIN[7]		UINT32	0x60070880	ro	
	0x09	AIN[8]		UINT32	0x60070980	ro	
	0x0A	AIN[9]		UINT32	0x60070A80	ro	
	0x0B	AIN[10]		UINT32	0x60070B80	ro	
	0x0C	AIN[11]		UINT32	0x60070C80	ro	
	0x0D	AIN[12]		UINT32	0x60070D80	ro	
	0x0E	AIN[13]		UINT32	0x60070E80	ro	
	0x0F	AIN[14]		UINT32	0x60070F80	ro	
	0x10	AIN[15]		UINT32	0x60071080	ro	
0x1A08		**TxPDO Mapping (AINx8x8)**	**AINx8 Card with 8 samples per channel**			**ro**	
	0x01	AIN[0]		UINT32	0x60080180	ro	
	0x02	AIN[1]		UINT32	0x60080280	ro	
	0x03	AIN[2]		UINT32	0x60080380	ro	
	0x04	AIN[3]		UINT32	0x60080480	ro	
	0x05	AIN[4]		UINT32	0x60080580	ro	
	0x06	AIN[5]		UINT32	0x60080680	ro	
	0x07	AIN[6]		UINT32	0x60080780	ro	
	0x08	AIN[7]		UINT32	0x60080880	ro	
0x1A09		**TxPDO Mapping (AINx4)**	**4-ch RTD (all 16-bit analog ins)**			**ro**	
	0x01	AIN[1]		UINT32	0x60090110	ro	
	0x02	AIN[2]		UINT32	0x60090210	ro	
	0x03	AIN[3]		UINT32	0x60090310	ro	
	0x04	AIN[4]		UINT32	0x60090410	ro	
0x1A0A		**TxPDO Mapping (UARTx4)**	**4-ch UART**			**ro**	
	0x01	Status[0]		UINT32	0x600A0110	ro	
	0x02	Status[1]		UINT32	0x600A0210	ro	
	0x03	Status[2]		UINT32	0x600A0310	ro	
	0x04	Status[3]		UINT32	0x600A0410	ro	
0x1A0B		**TxPDO Mapping (DINx4)**	**4-bit DIN**			**ro**	
	0x01	DIN[3..0]		UINT32	0x600B0104	ro	
	0x02			UINT32	0x600B0204	ro	
0x1A0C		**TxPDO Mapping (DIOx8)**	**8-bit DIO**			**ro**	
	0x01	DIN [7..0]		UINT32	0x600C0108	ro	
	0x02	DIN RB[7..0]		UINT32	0x600C0208	ro	
0x1C12		**RxPDO assign**				ro,wr_preop	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	1…255		Output assignments (1 to 255)	UINT16	0x1603	ro,wr_preop	
0x1C13		**TxPDO assign**				ro,wr_preop	
	1…255		Input assignments (1 to 255)	UINT16	0x1A03	ro,wr_preop	
0x2000		**Device Information**				**RO**	
	0x01	Part Number	Part number assigned by DDI	string(64)		RO	
	0x02	FW Version	e.g. "6b"	string(4)		RO	
	0x03	Serial Number	e.g. "nnnnnn-nnnn"	string(24)		RO	
	0x04	IPv4 Address	IPv4 Address aaa.bbb.ccc.ddd	string(16)		ro, wr_preop	
	0x05	MAC Address	MAC Address aa:bb:cc:dd:ee:ff	string(24)		RO	
	0x06	Config MD5	ODS file MD5	string(24)		RO	
	0x07	Config Date	e.g. "2020-04-13"	string(16)		RO	
	0x08	Clock	Current Date: e.g. "2020-04-13 24:59:59"	string(32)		ro, wr_preop	
	0x09	Event Mask		UDINT		RW	
	0x0a	Event Status	See Exception Tree Documentation	UDINT		RO	TX
	0x0b	Detect Modules Override		BIT1		ro, wr_preop	
	0x0c			pad_15			
	0x0d	Fan Status (CPU Zone)	Percent Deviation from Nominal RPM	REAL		RO	TX
	0x0e	Fan RPM (CPU Zone)	RPM	REAL		RO	TX
	0x0f	Temperature (Slot Zone)	°C	REAL		RO	TX
0x2rr1		**RIM Information**	**rr = rim number: 1..MAX_NUMBER_OF_RIMS**			**RO**	
	0x01	Part Number	Part number assigned by DDI	string(64)		RO	
	0x02	FW Version	**e.g. "0e"**	string(4)		RO	
	0x03	Serial Number	e.g. "nnnnnn-nnnn"	string(24)		RO	
	0x04	Type	**"24-slot (integrated)"** **"24-slot"** **"12-slot"** **"6-slot"**	string(24)		RO	
	0x05	Unit Information	ASCII String from RIM config PROM / Discovery ROM	string(32)		RO	
	0x06	IO Slot Cards	Array of IO card hex codes from the config PROM	ARRAY [0..23] of UINT		RO	
	0x07	Event Mask		UDINT		RW	
	0x08	Event Status	See Exception Tree Documentation	UDINT		RO	TX
	0x09			pad_16			
	0x0a	Fan Status (Power Supply Zone)	Percent deviation from nominal RPM	REAL		RO	TX
	0x0b	Fan Status (Slot Card Zone)	Percent deviation from nominal RPM	REAL		RO	TX
	0x0c	Fan RPM (Power Supply Zone)	RPM	REAL		RO	TX
	0x0d	Fan RPM (Slot Card Zone)	RPM	REAL		RO	TX
0x3000		**Module Ident Map**				**RO**	
	1…255		Array of idents for all modules found in the config PROM	UDINT		RO	
0x3nn1		**Module Information**	**nn = module number - 1**			**RO**	
	0x01	IO Card Type	e.g. "CDO-10"	string(8)		RO	
	0x02	Description	e.g. "8xAout 16 bit 0 to 10"	string(32)		RO	
	0x03	Number Of Channels	e.g. 8, 16	INT		RO	
	0x04	RIM Number	1..5	SINT		RO	
	0x05	IO card slot	1..24	SINT		RO	
	0x06	IO Channel Low	Low Ch# 0..960: AIN[low..high]	INT		RO	
	0x07	IO Channel High	High Ch# 0..960: AIN[low..high]	INT		RO	
	0x08	Max Voltage	e.g. 24.0	REAL		RO	
	0x09	Min Voltage	e.g. -10.0	REAL		RO	
0x4nn0		**Safe State Settings**	**nn = module number – 1**			**RO**	
	0x01	Enable	for each bit[n]; 0 = disable; 1 = enable action	UINT		ro, wr_op	
	0x02	Action	for each bit[n]; 0 = hold; 1 = set Value[n]	UINT		ro, wr_op	
	0x03	Value[1]		UINT		ro, wr_op	
0x4nn1		**Safe State Settings**	**nn = module number – 1**			**RO**	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	0x01	Enable	for each bit[n]; 0 = disable; 1 = enable action	USINT		ro, wr_op	
	0x02	Action	for each bit[n]; 0 = hold; 1 = set Value[n]	USINT		ro, wr_op	
	0x03	Value[1]		USINT		ro, wr_op	
0x4nn2		**Safe State Settings**	**nn = module number – 1**			**RO**	
	0x01	Enable	for each bit[n]; 0 = disable; 1 = enable action	USINT		ro, wr_op	
	0x02	Action	for each bit[n]; 0 = hold; 1 = set Value[n]	USINT		ro, wr_op	
	0x03	Value[1]		UINT		ro, wr_op	
	0x04	Value[2]		UINT		ro, wr_op	
	0x05	Value[3]		UINT		ro, wr_op	
	0x06	Value[4]		UINT		ro, wr_op	
	0x07	Value[5]		UINT		ro, wr_op	
	0x08	Value[6]		UINT		ro, wr_op	
	0x09	Value[7]		UINT		ro, wr_op	
	0x0a	Value[8]		UINT		ro, wr_op	
0x4nn3		**Safe State Settings**	**nn = module number – 1**			**RO**	
	0x01	Enable	for each bit[n]; 0 = disable; 1 = enable action	UINT		ro, wr_op	
	0x02	Action	for each bit[n]; 0 = hold; 1 = set Value[n]	UINT		ro, wr_op	
	0x03	Value[1]		UINT		ro, wr_op	
	0x04	Value[2]		UINT		ro, wr_op	
	0x05	Value[3]		UINT		ro, wr_op	
	0x06	Value[4]		UINT		ro, wr_op	
	0x07	Value[5]		UINT		ro, wr_op	
	0x08	Value[6]		UINT		ro, wr_op	
	0x09	Value[7]		UINT		ro, wr_op	
	0x0a	Value[8]		UINT		ro, wr_op	
	0x0b	Value[9]		UINT		ro, wr_op	
	0x0c	Value[10]		UINT		ro, wr_op	
	0x0d	Value[11]		UINT		ro, wr_op	
	0x0e	Value[12]		UINT		ro, wr_op	
	0x0f	Value[13]		UINT		ro, wr_op	
	0x10	Value[14]		UINT		ro, wr_op	
	0x11	Value[15]		UINT		ro, wr_op	
	0x12	Value[16]		UINT		ro, wr_op	
0x5nn4		**Thermocouple Info**				**ro**	
	0x01	Ohms[1]		UINT		ro	tx
	0x02	Ohms[2]		UINT		ro	tx
	0x03	Ohms[3]		UINT		ro	tx
	0x04	Ohms[4]		UINT		ro	tx
	0x05	Ohms[5]		UINT		ro	tx
	0x06	Ohms[6]		UINT		ro	tx
	0x07	Ohms[7]		UINT		ro	tx
	0x08	Ohms[8]		UINT		ro	tx
0x5nn5		**UART Config**	Grouping of 4 UART channels. **nn = module number – 1**			**ro**	
	0x01	Channel 0 Interface	"RS-232", "RS-485", "RS-485 with Termination Resistor"	DT0804EN02	0	ro, wr_preop	
	0x02	Channel 0 Baud Rate	"1200", "2400", "4800", "9600", "19200", "31200","38400", "57600","112500"	DT0800EN04	3	ro, wr_preop	
	0x03	Channel 0 Parity Mode	"none", "1", "2"	DT0801EN02	0	ro, wr_preop	
	0x04	Channel 0 Data Bits	"5", "6", "7", "8"	DT0803EN02	3	ro, wr_preop	
	0x05	Channel 0 Stop Bits	"1", "2"	DT0802EN01	0	ro, wr_preop	
	0x06	Channel 0 Flow Control	"none", "RTS/CTS", "Xon-Xoff"	DT0805EN02	0	ro, wr_preop	
	0x07			pad_3			
	0x08	Channel 1 Interface	"RS-232", "RS-485", "RS-485 with Termination Resistor"	DT0804EN02	0	ro, wr_preop	
	0x09	Channel 1 Baud Rate	"1200", "2400", "4800", "9600", "19200", "31200","38400", "57600","112500"	DT0800EN04	3	ro, wr_preop	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	0x0A	Channel 1 Parity Mode	"none", "1", "2"	DT0801EN02	0	ro, wr_preop	
	0x0B	Channel 1 Data Bits	"5", "6", "7", "8"	DT0803EN02	3	ro, wr_preop	
	0x0C	Channel 1 Stop Bits	"1", "2"	DT0802EN01	0	ro, wr_preop	
	0x0D	Channel 1 Flow Control	"none", "RTS/CTS", "Xon-Xoff"	DT0805EN02	0	ro, wr_preop	
	0x0E			pad_3			
	0x0F	Channel 2 Interface	"RS-232", "RS-485", "RS-485 with Termination Resistor"	DT0804EN02	0	ro, wr_preop	
	0x10	Channel 2 Baud Rate	"1200", "2400", "4800", "9600", "19200", "31200","38400", "57600","112500"	DT0800EN04	3	ro, wr_preop	
	0x11	Channel 2 Parity Mode	"none", "1", "2"	DT0801EN02	0	ro, wr_preop	
	0x12	Channel 2 Data Bits	"5", "6", "7", "8"	DT0803EN02	3	ro, wr_preop	
	0x13	Channel 2 Stop Bits	"1", "2"	DT0802EN01	0	ro, wr_preop	
	0x14	Channel 2 Flow Control	"none", "RTS/CTS", "Xon-Xoff"	DT0805EN02	0	ro, wr_preop	
	0x15			pad_3			
	0x16	Channel 3 Interface	"RS-232", "RS-485", "RS-485 with Termination Resistor"	DT0804EN02	0	ro, wr_preop	
	0x17	Channel 3 Baud Rate	"1200", "2400", "4800", "9600", "19200", "31200","38400", "57600","112500"	DT0800EN04	3	ro, wr_preop	
	0x18	Channel 3 Parity Mode	"none", "1", "2"	DT0801EN02	0	ro, wr_preop	
	0x19	Channel 3 Data Bits	"5", "6", "7", "8"	DT0803EN02	3	ro, wr_preop	
	0x1A	Channel 3 Stop Bits	"1", "2"	DT0802EN01	0	ro, wr_preop	
	0x1B	Channel 3 Flow Control	"none", "RTS/CTS", "Xon-Xoff"	DT0805EN02	0	ro, wr_preop	
0x5nn6		**UART Information**	**nn = module number - 1**			ro	
	0x01	UART Control Channel 0	Bit 0: 0 = Transmit Enable. 1 = Transmit Hold Bit 1: 0 = No Operation. 1 = Flush	USINT		rw	
	0x02	UART Control Channel 1		USINT		rw	
	0x03	UART Control Channel 2		USINT		rw	
	0x04	UART Control Channel 3		USINT		rw	
	0x05	UART Status Channel 0	Bit 0-11: Number of bytes available in the FIFO (0-4095) Bit 12: Error Occurred, See error details subindex 0x09 Bit 13: Tx Buffer Almost Full Bit 14: Rx Buffer Almost Full Bit 15: CTS from slot-card	UINT		ro	tx
	0x06	UART Status Channel 1		UINT		ro	tx
	0x07	UART Status Channel 2		UINT		ro	tx
	0x08	UART Status Channel 3		UINT		ro	tx
	0x09	UART Error Details Channel 0	Bit 0: Rx Overflow Occurred Bit 1: Rx Farming Error Occurred Bit 2: Rx Parity Error Occurred Bit 7: Tx Overflow Occurred	USINT		ro	tx
	0x0A	UART Error Details Channel 1		USINT		ro	tx
	0x0B	UART Error Details Channel 2		USINT		ro	tx
	0x0C	UART Error Details Channel 3		USINT		ro	tx
0x5nn7		**UART Tx Data Channel 0**	**nn = module number – 1**			rw	
	1…255		UART Tx Data	USINT		rw	
0x5nn8		**UART Tx Data Channel 1**	**nn = module number – 1**			rw	
	1…255		UART Tx Data	USINT		rw	
0x5nn9		**UART Tx Data Channel 2**	**nn = module number – 1**			rw	
	1…255		UART Tx Data	USINT		rw	
0x5nnA		**UART Tx Data Channel 3**	**nn = module number – 1**			rw	
	1…255		UART Tx Data	USINT		rw	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
0x5nnB		**UART Rx Data Channel 0**	**nn = module number – 1**			ro	
	1…255		UART Rx Data	USINT		rw	
0x5nnC		**UART Rx Data Channel 1**	**nn = module number – 1**			ro	
	1…255		UART Rx Data	USINT		rw	
0x5nnD		**UART Rx Data Channel 2**	**nn = module number – 1**			ro	
	1…255		UART Rx Data	USINT		rw	
0x5nnE		**UART Rx Data Channel 3**	**nn = module number - 1**			ro	
	1…255		UART Rx Data	USINT		rw	
0x6nn0		**DINx16 (inputs)**	**16x DIN**				
	0x01	DIN[15..0]		UINT		ro	tx
0x6nn1		**DINx8 (inputs)**	**8x DIN**				
	0x01	DIN[7..0]		BYTE		ro	tx
0x6nn2		**AINx8 (inputs)**	**8-ch AIN**				
	0x01	AIN[0]		UINT		ro	tx
	0x02	AIN[1]		UINT		ro	tx
	0x03	AIN[2]		UINT		ro	tx
	0x04	AIN[3]		UINT		ro	tx
	0x05	AIN[4]		UINT		ro	tx
	0x06	AIN[5]		UINT		ro	tx
	0x07	AIN[6]		UINT		ro	tx
	0x08	AIN[7]		UINT		ro	tx
0x6nn3		**AINx16 (inputs)**					
	0x01	AIN[0]		UINT		ro	tx
	0x02	AIN[1]		UINT		ro	tx
	0x03	AIN[2]		UINT		ro	tx
	0x04	AIN[3]		UINT		ro	tx
	0x05	AIN[4]		UINT		ro	tx
	0x06	AIN[5]		UINT		ro	tx
	0x07	AIN[6]		UINT		ro	tx
	0x08	AIN[7]		UINT		ro	tx
	0x09	AIN[8]		UINT		ro	tx
	0x0A	AIN[9]		UINT		ro	tx
	0x0B	AIN[10]		UINT		ro	tx
	0x0C	AIN[11]		UINT		ro	tx
	0x0D	AIN[12]		UINT		ro	tx
	0x0E	AIN[13]		UINT		ro	tx
	0x0F	AIN[14]		UINT		ro	tx
	0x10	AIN[15]		UINT		ro	tx
0x6nn4		**Thermocouplex8 (inputs)**	**8-ch thermocouple PDO + 8-ch ohms SDO (all 16-bit analog ins). nn = module number – 1**				
	0x01	TC[1]		UINT		ro	tx
	0x02	TC[2]		UINT		ro	tx
	0x03	TC[3]		UINT		ro	tx
	0x04	TC[4]		UINT		ro	tx
	0x05	TC[5]		UINT		ro	tx
	0x06	TC[6]		UINT		ro	tx
	0x07	TC[7]		UINT		ro	tx
	0x08	TC[8]		UINT		ro	tx
0x6nn5		**DINx16 (x8samples)**	**16-ch DIN card with each channel sampled 8x between PD updates. nn = module number – 1**				
	0x01	DIN[15..0]		ARRAY [0..7] OF UINT		ro	tx
0x6nn6		**DINx8 (x8samples)**	**8-ch DIN card with each channel sampled 8x between PD updates. nn = module number – 1**				
	0x01	DIN[7..0]		ARRAY [0..7] OF BYTE		ro	tx
0x6nn7		**AINx16 (x8samples)**	**16-ch AIN card with each channel sampled 8x between PD updates. nn = module number – 1**				
	0x01	AIN[0]		ARRAY [0..7] OF UINT		ro	tx
	0x02	AIN[1]		ARRAY [0..7] OF UINT		ro	tx

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	0x03	AIN[2]		ARRAY [0..7] OF UINT		ro	tx
	0x04	AIN[3]		ARRAY [0..7] OF UINT		ro	tx
	0x05	AIN[4]		ARRAY [0..7] OF UINT		ro	tx
	0x06	AIN[5]		ARRAY [0..7] OF UINT		ro	tx
	0x07	AIN[6]		ARRAY [0..7] OF UINT		ro	tx
	0x08	AIN[7]		ARRAY [0..7] OF UINT		ro	tx
	0x09	AIN[8]		ARRAY [0..7] OF UINT		ro	tx
	0x0A	AIN[9]		ARRAY [0..7] OF UINT		ro	tx
	0x0B	AIN[10]		ARRAY [0..7] OF UINT		ro	tx
	0x0C	AIN[11]		ARRAY [0..7] OF UINT		ro	tx
	0x0D	AIN[12]		ARRAY [0..7] OF UINT		ro	tx
	0x0E	AIN[13]		ARRAY [0..7] OF UINT		ro	tx
	0x0F	AIN[14]		ARRAY [0..7] OF UINT		ro	tx
	0x10	AIN[15]		ARRAY [0..7] OF UINT		ro	tx
0x6nn8		**AINx8 (x8samples)**	**8-ch AIN card with each channel sampled 8x between PD updates. nn = module number – 1**				
	0x01	AIN[0]		ARRAY [0..7] OF UINT		ro	tx
	0x02	AIN[1]		ARRAY [0..7] OF UINT		ro	tx
	0x03	AIN[2]		ARRAY [0..7] OF UINT		ro	tx
	0x04	AIN[3]		ARRAY [0..7] OF UINT		ro	tx
	0x05	AIN[4]		ARRAY [0..7] OF UINT		ro	tx
	0x06	AIN[5]		ARRAY [0..7] OF UINT		ro	tx
	0x07	AIN[6]		ARRAY [0..7] OF UINT		ro	tx
	0x08	AIN[7]		ARRAY [0..7] OF UINT		ro	tx
0x6nn9		**RTDx4 (inputs)**	**4-ch RTD (all 16-bit analog ins). nn = module number – 1**				
	0x01	AIN[1]		UINT		ro	tx
	0x02	AIN[2]		UINT		ro	tx
	0x03	AIN[3]		UINT		ro	tx
	0x04	AIN[4]		UINT		ro	tx
0x6nnA		**UARTx4 (inputs)**	**4-ch UART. nn = module number – 1**				
	0x01	Status[0]		UINT		ro	tx
	0x02	Status[1]		UINT		ro	tx
	0x03	Status[2]		UINT		ro	tx
	0x04	Status[3]		UINT		ro	tx
0x6nnB		**DINx4 (inputs)**	**4-ch DIN or SIN. nn = module number – 1**				
	0x01	DIN[3..0]		BIT4		ro	tx
	0x02			Pad_4			
0x6nnC		**DIOx8 (inputs)**	**8x DOUT/DIN. nn = module number – 1**				
	0x01	DIN[7..0]		BYTE		ro	tx
	0x02	DIN RB[7..0]		BYTE		ro	tx
0x7nn0		**DOUTx16 (outputs)**	**16x DOUT. nn = module number – 1**				
	0x01	DOUT[15..0]		UINT		rw	rx

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
0x7nn1		**DOUTx8 (outputs)**	**8x DOUT. nn = module number – 1**				
	0x01	DOUT[7..0]		BYTE		rw	rx
0x7nn2		**AOUTx8 (outputs)**	**8-ch AOUT. nn = module number – 1**				
	0x01	AOUT[0]		UINT		rw	rx
	0x02	AOUT[1]		UINT		rw	rx
	0x03	AOUT[2]		UINT		rw	rx
	0x04	AOUT[3]		UINT		rw	rx
	0x05	AOUT[4]		UINT		rw	rx
	0x06	AOUT[5]		UINT		rw	rx
	0x07	AOUT[6]		UINT		rw	rx
	0x08	AOUT[7]		UINT		rw	rx
0x7nn3		**AOUTx16 (outputs)**	**16-ch AOUT. nn = module number – 1**				
	0x01	AOUT[0]		UINT		rw	rx
	0x02	AOUT[1]		UINT		rw	rx
	0x03	AOUT[2]		UINT		rw	rx
	0x04	AOUT[3]		UINT		rw	rx
	0x05	AOUT[4]		UINT		rw	rx
	0x06	AOUT[5]		UINT		rw	rx
	0x07	AOUT[6]		UINT		rw	rx
	0x08	AOUT[7]		UINT		rw	rx
	0x09	AOUT[8]		UINT		rw	rx
	0x0A	AOUT[9]		UINT		rw	rx
	0x0B	AOUT[10]		UINT		rw	rx
	0x0C	AOUT[11]		UINT		rw	rx
	0x0D	AOUT[12]		UINT		rw	rx
	0x0E	AOUT[13]		UINT		rw	rx
	0x0F	AOUT[14]		UINT		rw	rx
	0x10	AOUT[15]		UINT		rw	rx
0x7nnB		**DOUTx4 (outputs)**	**4-ch DOUT. nn = module number – 1**				
	0x01	DOUT[3..0]		BIT4		rw	rx
	0x02			Pad_4			
0xF000		**Modular Device Profile**					
	0x01	Index distance	Index distance between two modules (maximum number of objects per module and area)	UNSIGNED16	0x10	ro	tx
	0x02	Maximum number of modules	Maximum Number of Modules	UNSIGNED16	0xFF	ro	tx
0xF002		**Detect Modules Command**				**RO**	
	0x01	Command		ARRAY [0..3] OF BYTE		ro,wr_preop	
	0x02	Status	Supported values: 0: Default value if the command has not been initiated. Not a supported value otherwise. 1: Reserved 2: Last command completed, error, no response 3: Reserved 3-99: Reserved, 100-200: Indicates how much of the command has been executed (in %, 100 = 0%, 200 = 100%) 201-254: Reserved, 255: Command is executing (if the percentage display is not supported)	USINT		RO	
0xF010		**Module Profile List**	**Mandatory if modules have different profiles** **Bit 0..15: Module profile information of the module on position [n]** **Bit 16...31: Module profile specific**				
	0x01	DOUTx16		UINT32	0x0064D016	ro	
	0x02	DOUTx8		UINT32	0x0064D008	ro	
	0x03	AOUTx16		UINT32	0x0064A016	ro	
	0x04	AOUTx8		UINT32	0x0064A008	ro	
	0x05	DINx16		UINT32	0x0064D116	ro	
	0x06	DINx8		UINT32	0x0064D108	ro	
	0x07	AINx16		UINT32	0x0064A116	ro	
	0x08	AINx8		UINT32	0x0064A108	ro	
	0x09	DINx16(x8samples)		UINT32	0x0064D816	ro	
	0x0A	DINx8(x8samples)		UINT32	0x0064D808	ro	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	0x0B	AINx16(x8samples)		UINT32	0x0064A816	ro	
	0x0C	AINx8(x8samples)		UINT32	0x0064A808	ro	
	0x0D	AIOx16		UINT32	0x0064AA16	ro	
	0x0E	TCx8		UINT32	0x0064C108	ro	
	0x0F	RTDx4		UINT32	0x0064C104	ro	
	0x10	UARTx4		UINT32	0x0064C004	ro	
	0x11	DOUTx4		UINT32	0x0064D004	ro	
	0x12	DIOx8		UINT32	0x0064DD08	ro	
0xF030		**Configured Module Ident List**				ro, wr_preop	
	1…255		Configured module ident of the module	UINT32		ro, wr_preop	
0xF050		**Detected Module Ident List**				ro	
	1…255		Configured module ident of the module	UINT32		ro	
0xF380		**Active Exception Status**	A condensed summary byte describing the collection of active device exceptions after corresponding masks (0xF3Ax) were applied. See ETG5003.1 Common Device Profile for additional information. Bit 0: Device Warning Bit 1: Manufacturer Warning Bit 2: Device Error Bit 3: Manufacturer Error Bit 4...7: Reserved	**USINT**		**RO**	**tx**
0xF381		**Active Device Warning Details**					
	1…255			UDINT		RO	tx
0xF382		**Active manufacturer Warning Details**	**Expanded details of the manufacturer warning exceptions specified by the manufacturer. See ETG5003.1 Common Device Profile for additional information.**			**RO**	
	1…255		See Exception Tree	UDINT		RO	TX
0xF383		**Active Device Error Details**					
	1…255			UDINT		RO	tx
0xF384		**Active Manufacturer Error Details**	**Expanded details of the manufacturer error exceptions specified by the manufacturer. See ETG5003.1 Common Device Profile for additional information.**			**RO**	
	1…255		See Exception Tree	UDINT		RO	TX
0xF386		**Active Global Manufacturer Warning Details**				**RO**	
	0x01		Expanded details of the SDP specific device error exceptions, applicable to the overall device (one instance only).	UDINT		RO	TX
0xF388		**Active Global Manufacturer Error Details**				**RO**	
	0x01		Expanded details of the manufacturer error exceptions specified by the manufacturer, applicable to the overall device (one instance only). See Exception Tree Documentation	UDINT		RO	TX
0xF390		**Latched Exception Status**	A condensed summary byte describing the collection of device exceptions after corresponding masks (0xF3Ax) were applied. See CDP for additional information. Bit 0 : Device Warning Bit 1: Manufacturer Warning Bit 2: Device Error Bit 3: Manufacturer Error Bit 4...7: Reserved	**USINT**		**RO**	**TX**
0xF391		**Latched Device Warning Details**					
	1…255		Expanded details of the SDP specific device warning exceptions. See ETG5003.1 Common Device Profile exception topic for additional information.	UDINT		RO	tx
0xF392		**Latched Manufacturer Warning Details**	**[Mandatory if 0xF382 is supported]**			**RO**	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
	1…255		Expanded details of the manufacturer warning exceptions specified by the manufacturer [Mandatory if 0xF382 is supported]	UDINT		RO	TX
0xF393		**Latched Device Error Details**					
	1…255			UDINT		RO	tx
0xF394		**Latched Manufacturer Error Details**	**[Mandatory if 0xF384 is supported]**			**RO**	
	1…255		Expanded details of the manufacturer error exceptions specified by the manufacturer [Mandatory if 0xF384 is supported]	UDINT		RO	TX
0xF396		**Latched Global Manufacturer Warning Details**	**[Mandatory if 0xF386 is supported]**			**RO**	
	0x01	Latched Global Manufacturer Warning Details	Expanded details of the manufacturer warning exceptions specified by the manufacturer, applicable to the overall device (one instance only). [Mandatory if 0xF386 is supported]	UDINT		RO	TX
0xF398		**Latched Global Manufacturer Error Details**	**[Mandatory if 0xF388 is supported]**			**RO**	
	0x01	Latched Global Manufacturer Error Details	Expanded details of the manufacturer error exceptions specified by the manufacturer, applicable to the overall device (one instance only). [Mandatory if 0xF388 is supported]	UDINT		RO	TX
0xF3A1		**Device Exception Warning Mask**					
	1…255		Bitmask to include the corresponding device warning exception bits (as defined in the device warning details) in the active and latched exception status objects (0xF380 bit 0 and 0xF390 bit 0), if the corresponding bit is TRUE. Default of all bits TRUE (no masking).	UDINT		RW	
0xF3A2		**Manufacturer Warning Mask**	**[Mandatory if 0xF382 is supported]**				
	1…255		Bitmask to include the corresponding manufacturer warning exception bits (as defined in the manufacturer warning details) in the active and latched exception status objects (0xF380 bit 1 and 0xF390 bit 1), if the corresponding bit is TRUE. Default of all bits TRUE (no masking). [Mandatory if 0xF382 is supported]	UDINT		RW	
0xF3A3		**Device Error Mask**					
	1…255		Bitmask to include the corresponding device error exception bits (as defined in the device error details) in the active and latched exception status objects (0xF380 bit 2 and 0xF390 bit 2), if the corresponding bit is TRUE. Default of all bits TRUE (no masking).	UDINT		RW	
0xF3A4		**Manufacturer Error Mask**	**[Mandatory if 0xF384 is supported]**				
	1…255		Bitmask to include the corresponding manufacturer error exception bits (as defined in the manufacturer error details) in the active and latched exception status objects (0xF380 bit 3 and 0xF390 bit 3), if the corresponding bit is TRUE. Default of all bits TRUE (no masking). [Mandatory if 0xF384 is supported]	UDINT		RW	
0xF3A6		**Global Manufacturer Warning Mask**	**[Mandatory if 0xF386 is supported]**				
	0x01	Global Manufacturer Warning Mask	Bitmask to include the corresponding manufacturer warning exception bits (as defined in the global manufacturer warning details) in the active and latched exception status objects (0xF380 bit 1 and 0xF390 bit 1), if the corresponding bit is TRUE. Default of all bits TRUE (no masking). [Mandatory if 0xF386 is supported]	UDINT		RW	
0xF3A8		**Global Manufacturer Error Mask**	**[Mandatory if 0xF388 is supported]**				
	0x01	Global Manufacturer Error Mask	Bitmask to include the corresponding manufacturer error exception bits (as defined in the global manufacturer error details) in the active and latched exception status objects (0xF380 bit 3 and	UDINT		RW	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
			0xF390 bit 3), if the corresponding bit is TRUE. Default of all bits TRUE (no masking). [Mandatory if 0xF388 is supported]				
0xF6F0		**Input Latch Local Timestamp**				**RO**	
	1...255		Local controller time corresponding to the input latch time in microseconds. It starts at zero on device power-up. If device has physical inputs: time of latching those inputs If device has no physical inputs: time immediately prior to writing to input SyncManager	UDINT		RO	TX
0xF6F2		**Input Latch ESC Timestamp (64-bit)**	**Mandatory if DC supported and ESC supports a 64-bit DC System Time value.**			**RO**	
	1...255		ESC DC time in nanoseconds corresponding to the input latch time. Mandatory if DC supported and ESC supports a 64-bit DC System Time value.	ULINT		RO	TX
0xF9F0		Manufacturer Serial Number	A string representing the manufacturer's serial number for the device. NOTE: This may have the same value as 0x1018:04.	STRING(16)		RO	
0xF9F1		CDP Functional Generation Number				RO	
	0x01		Common Device Profile Functional Generation Number	UDINT	0x02	RO	
0xF9F2		SDP Functional Generation Number				RO	
	1…255		Standard Device Profile (SDP) functional generation number off nn-th module It shall be specified by each SDP.	UDINT		RO	
0xF9F3		Vendor Name	This string identifies the supplier of the device.	STRING(16)	0x7363696d616e7944206c616974676944	RO	
0xF9F4		Semiconductor SDP Device Name				RO	
	1…255		String identifying the device type of nn-th module as defined by the Standard Device Profile.	UDINT	0x412f4e	RO	
0xF9F5		Output Identifier				RO	
	1…255		Output identifier of nn-th module This value can be mapped to both the RxPDO and TxPDO. The required function of the slave device is to store the value in memory as written by the host. The master can then read this value back through the TxPDO to ensure the RxPDO was received.	USINT		RW	RX,TX
0xF9F6		Time since power on	This is the time the device has been currently powered on, in seconds, regardless of communication presence.	UDINT		RO	
0xF9F8		Firmware Update Functional Generation Number	Firmware Update Functional Generation Number supported by the device. Value shall be specified by the Firmware Update Profile (ETG.5003-2) 0x00000000: FW Update according to ETG.5003-2 not supported. **A device cannot return this value and still be compliant with ETG.5003.1, as ETG.5003-2 compliance is mandatory.**	UDINT	0x01	RO	
0xFBF0		**Device Reset Command**	Execution of this command causes the device to emulate a complete power cycle. This includes an ESC reset. Some devices may require this reset to maintain a specific state not matching power cycle behavior for proper operation, per the SDP. NOTE: As a consequence of an ESC reset all of the subsequent devices are disconnected from the network. There are two versions of this command: Device Reset: Backup parameters will not change as a result of this reset. All setting parameters will			**RO**	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
			revert to power-on defaults as a result of the reset. Factory Reset: All backup parameters will be changed to their as-shipped defaults. All setting parameters will revert to power-on defaults as a result of the reset.				
	0x01	Command	A device reset is initiated when the following byte sequence is sent: Byte 0: 0x74 Byte 1: 0x65 Byte 2: 0x73 Byte 3: 0x65 Byte 4: 0x72 Byte 5: Device Standard Reset = 0x00, Factory Reset = 0x66	ARRAY [0..5] OF BYTE		RW	
	0x02	Status	Supported values: 0: Default value if the command has not been initiated. Not a supported value otherwise. 1: Reserved 2: Last command completed, error, no response 3: Reserved 3-99: Reserved, 100-200: Indicates how much of the command has been executed (in %, 100 = 0%, 200 = 100%) 201-254: Reserved, 255: Command is executing (if the percentage display is not supported)	USINT		RO	
	0x03	Response	Byte 0: see Subindex 2 Byte 1: Unused - Shall be zero	ARRAY [0..1] OF BYTE		RO	
0xFBF1		**Exception Reset Command**	Execution of this command clears the latched exceptions. Execution of this command may also optionally acknowledge device or SDP-specific exceptions (if specified) that would otherwise require a separate acknowledgement action to resume normal operation. If this is required, it shall be noted in the SDP or device documentation.			**RO**	
	0x01	Command	A Latched Exception Reset is initiated when the following byte sequence is sent: Byte 0: 0x74 Byte 1: 0x65 Byte 2: 0x73 Byte 3: 0x65 Byte 4: 0x72	ARRAY [0..4] OF BYTE		RW	
	0x02	Status	Supported values: 0: last command completed, no error, no response 1: Reserved 2: Last command completed, error, no response 3: Reserved 3-99: Reserved, 100-200: Indicates how much of the command has been executed (in %, 100 = 0%, 200 = 100%) 201-254: Reserved, 255: Command is executing (if the percentage display is not supported)	USINT		RO	
	0x03	Response	Byte 0: see Subindex 2 Byte 1: Unused- Shall be zero	ARRAY [0..1] OF BYTE		RO	
0xFBF2		**Store Parameters Command**	Execution of this command will store all parameters to non-volatile memory. If a device automatically saves all non-volatile parameters at the time they are written, this command will not take any action. If this command may interfere with the safe or expected functional operation of a device, it may be optionally restricted to functioning only in certain functional conditions while in OPERATIONAL state. If the command cannot be performed due to this operating condition, the Abort			**RO**	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
			Code "0x08 00 00 21" shall be returned. All devices shall be able to execute this command in PREOP without restriction.				
	0x01	Command	Read: Bit 0 = 1: slave saves the non-volatile parameters when writing 0xFBF2:01 with 0x65766173 Bit 1 = 1: slave saves the non-volatile parameters automatically when they are written Bit 2-31: reserved, shall be 0 Write: All writable, non-volatile values will be stored in non-volatile memory when the following is sent: Byte 0: 0x73 Byte 1: 0x61 Byte 2: 0x76 Byte 3: 0x65 If other values are written the Abort Code "0x06040043 General parameter incompatibility reason" shall be returned.	ARRAY [0..3] OF BYTE	0x01000000	RW	
	0x02	Status	Supported values: 0: last command completed, no error, no response 1: Reserved 2: Last command completed, error, no response 3-99: Reserved, 100-200: Indicates how much of the command has been executed (in %, 100 = 0%, 200 = 100%) 201-254: Reserved, 255: Command is executing (if the percentage display is not supported)	USINT		RO	
	0x03	Response	Byte 0: see Subindex 2 Byte 1: Unused - Shall be zero	ARRAY [0..1] OF BYTE		RO	
0xFBF3		**Calculate Checksum Command**	Execution of this command will calculate a checksum for all writable, non-volatile parameters as currently stored in non-volatile memory. If this calculation may interfere with the safe or expected functional operation of a device, it may be optionally restricted to functioning only in certain functional conditions while in OPERATIONAL state. If the Checksum cannot be calculated the Abort Code "0x08 00 00 21" shall be returned. All devices shall be able to calculate the checksum in PREOP without restriction. Even if the manufacturer chooses to store the checksum itself in non-volatile or volatile memory, the device shall perform the calculation at the time of executing this command and return this calculated value. This command shall therefore not return a value calculated prior to executing this command.			**RO**	
	0x01	Command	Read: Returns information about the supported checksum type Bit 0 = 0: no non-volatile parameters supported Bit 0 = 1: non-volatile parameters supported, at least 1 of the defined bits 1-7 shall be set Bit 1 = 1: CRC-32 Bit 2 = 1: MD5 Bit 3 = 1: SHA-1 Bit 4-6: Reserved, shall be 0 Bit 7 = 1: other algorithm Bit 8...31: Reserved, shall be 0 Write: Checksum Type Selection and Start Calculation A write access to this subindex shall only set one bit true in Bit[0...7]. If other values are written the	ARRAY [0..3] OF BYTE	0x05000000	RW	

Index	Sub-Index	Name	Description	Data Type	Default	Access	RX/TX
			Abort Code "0x06040043 Parameter is incompatible" shall be returned. Bit 0 = 1: Use default checksum algorithm of the slave Bit 1 = 1: CRC-32 Bit 2 = 1: MD5 Bit 3 = 1: SHA-1 Bit 4-6: Reserved, shall be 0 Bit 7 = 1: other algorithm Bit 8...31: Reserved, shall be 0				
	0x02	Status	Supported values: 0: Default value if the command has not been initiated. Not a supported value otherwise. 1: Last command completed, no error, reply there 2: Last command completed, error, no response 3: Reserved 3-99: Reserved, 100-200: Indicates how much of the command has been executed (in %, 100 = 0%, 200 = 100%) 201-254: Reserved, 255: Command is executing (if the percentage display is not supported)	USINT		RO	
	0x03	Response	Byte 0: see Subindex 2 Byte 1: Unused - Shall be zero Byte 2-n: Checksum return value. Size varies depending on checksum type used. The maximum length shall be 64 bytes.	ARRAY [0..17] OF BYTE		RO	
0xFBF4		**Load Parameters Command**	Execution of this command will load all parameters from non-volatile memory. If a device automatically saves all non-volatile parameters at the time they are written, this command will not take any action. If this command may interfere with the safe or expected functional operation of a device, it may be optionally restricted to functioning only in certain functional conditions while in OPERATIONAL state. If the command cannot be performed due to this operating condition, the Abort Code "0x08 00 00 21" shall be returned. All devices shall be able to execute this command in PREOP without restriction.			**RO**	

7 APPENDIX B REFERENCES

ETG 1000.5 Application Layer Service Definition
ETG 1000.6 Application Layer Protocol Specification
ETG 2200 Slave Implementation Guide
ETG 5001.1 General MDP Device Model
ETG 5001.2 MDP Module Device Specification
ETG 5003.1 Common Device Profile (CDP)

8 APPENDIX C: SDO ABORT CODES

XXX Ryan, it would be good to have a brief introduction to this table that explains some of the min and max allowable values or parameters or we can have them within the table. Also, if we can provide some general troubleshooting information that would be helpful too. For example, how should they go about trying to resolve a General Error?

The SDO protocol is used to set and read values from the object dictionary of a remote device. The device whose object dictionary is accessed is the SDO server and the device accessing the remote device is the SDO client.

Table 25 -- SDO Abort Codes

	Name	Description
0x00000000	ABORT_NOERROR	No SDO error
0x05030000	ABORT_TOGGLE_BIT_NOT_CHANGED	Toggle bit not changed
0x05040000	ABORT_SDO_PROTOCOL_TIMEOUT	SDO protocol timeout
0x05040001	ABORT_COMMAND_SPECIFIER_UNKNOWN	Client/Server command specifier not valid or unknown
0x05040005	ABORT_OUT_OF_MEMORY	Out of memory.
0x06010000	ABORT_UNSUPPORTED_ACCESS	Unsupported access to an object
0x06010001	ABORT_WRITE_ONLY_ENTRY	Attempt to read from a write only object
0x06010002	ABORT_READ_ONLY_ENTRY	Attempt to write to a read only object
0x06010003	ABORT_ENTRY_CANT_BE_WRITTEN_SI0_NOT	Entry cannot be written because Subindex0 is not 0.
0x06010004	ABORT_COMPLETE_ACCESS_NOT_SUPPORTED	The object cannot be accessed via complete access.
0x06020000	ABORT_OBJECT_NOT_EXISTING	The object does not exist in the object dictionary
0x06040041	ABORT_OBJECT_CANT_BE_PDOMAPPED	The object cannot be mapped to PDO
0x06040042	ABORT_MAPPED_OBJECTS_EXCEED_PDO	The number and length of the objects to be mapped would exceed the PDO length
0x06040043	ABORT_PARAM_IS_INCOMPATIBLE	General parameter incompatibility reason
0x06060000	ABORT_HARDWARE_ERROR	Access failed due to a hardware error
0x06070010	ABORT_PARAM_LENGTH_ERROR	Data type does not match; length of service parameter does not match. Verify the data type of the object being accessed ~~Parameter length error.~~
0x06070012	ABORT_PARAM_LENGTH_TOO_LONG	Data type does not match; length of service parameter too high. Verify the data type of the object being accessed
0x06070013	ABORT_PARAM_LENGTH_TOO_SHORT	Data type does not match; length of service parameter too low. Verify the data type of the object being accessed
0x06090011	ABORT_SUBINDEX_NOT_EXISTING	Subindex does not exist
0x06090030	ABORT_VALUE_EXCEEDED	Value range of parameter exceeded (only for write access). Verify range allowed by object being accessed. ~~the Value exceeds.~~
0x06090031	ABORT_VALUE_TOO_GREAT	Value of parameter written too high. Verify range allowed by object being accessed. ~~Value is too great.~~
0x06090032	ABORT_VALUE_TOO_SMALL	Value of parameter written too low. Verify range allowed by object being accessed. ~~Value is too small.~~
0x06090033	ABORT_MODULE_ID_LIST_NOT_MATCH	Detected Module Ident List (0xF030) and Configured Module Ident list (0xF050) do not match.
0x06090036	ABORT_MAX_VALUE_IS_LESS_THAN_MIN_VALUE	Maximum value is less than minimum value
0x08000000	ABORT_GENERAL_ERROR	General error
0x08000020	ABORT_DATA_CANNOT_BE_READ_OR_STORED	Data cannot be read or written
0x08000021	ABORT_DATA_CANNOT_BE_READ_OR_STORED_BECAUSE_OF_LOCAL_CONTROL	Data cannot be accessed because of local control
0x08000022	ABORT_DATA_CANNOT_BE_READ_OR_STORED_IN_T	Data cannot be read or written in the device's current state. Verify allowed access in object dictionary

	Name	Description
	HIS_STATE	
0x08000023	ABORT_NO_OBJECT_DICTION-ARY_IS_PRESENT	Object dictionary dynamic generation fails or no object dictionary is present ~~is not in the object dictionary.~~