

# X-gateway Interface Addendum **EtherCAT Slave**

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# Important User Information

This document is intended to provide a good understanding of the functionality offered by the Interface described here.

The reader is expected to be familiar with high level software design, and communication systems in general. The use of advanced interface-specific functionality may require in-depth knowledge of networking internals and/or information from the network specifications. In such cases, the persons responsible for the implementation of this product should either obtain the necessary specifications to gain sufficient knowledge, or alternatively limit the implementation in such a way that this is not necessary.

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## Trademark Acknowledgements

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EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

EtherCAT® 

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**WARNING:** This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

**ESD Note:** This product contains ESD (Electrostatic Discharge) sensitive parts that may be damaged if ESD control procedures are not followed. Static control precautions are required when handling the product. Failure to observe this may cause damage to the product.

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## P. About This Document

### P.1 How To Use This Document

This document describes network specific features and procedures needed when operating the EtherCAT Slave Interface for the Anybus X-gateway. For general information and operating instructions for the Anybus X-gateway, consult the Anybus X-gateway User Manual.

The reader of this document is expected to be familiar with EtherCAT networking technology, and communication systems in general.

For further information, documentation etc., please visit [www.anybus.com](http://www.anybus.com).

### P.2 Related Documents

Document	Author
Anybus X-gateway User Manual	HMS
Anybus-S EtherCAT Fieldbus Appendix	HMS
EtherCAT Slave Interface, Installation Sheet	HMS

### P.3 Document History

#### Revision List

Revision	Date	Author	Chapter	Description
1.00	2007-09-20	PeP	All	First release
1.01	2007-12-30	PeP	-	Minor update
1.02	2008-05-21	PeP	-	Minor update
1.03	2012-11-20	KeL	P,1	Minor corrections
2.00	May 2014	SDa	Multiple	New hardware and Anybus Configuration Manager

### P.4 Conventions & Terminology

The following conventions are used throughout this document:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The term 'X-gateway' refers to the Anybus X-gateway
- The term 'Slave Interface' refers to the EtherCAT Slave interface for the Anybus X-gateway.
- The term 'user manual' refers to the Anybus X-gateway User Manual.
- Hexadecimal values are written in the format NNNNh, where NNNN is the hexadecimal value.
- 16/32 bit values are generally stored in Motorola (big endian) format unless otherwise stated.

## **P.5 Sales and Support**

For general contact information and support, please refer to the contact and support pages at [www.anybus.com](http://www.anybus.com).

# 1. About the EtherCAT Slave Interface

## 1.1 General Description

The EtherCAT Slave Interface for the Anybus X-gateway implements CANopen over EtherCAT, and exchanges up to 512 bytes of data in each direction. The interface acts as a slave node, which means it can be accessed by an EtherCAT master, but it will not initiate communication by itself.

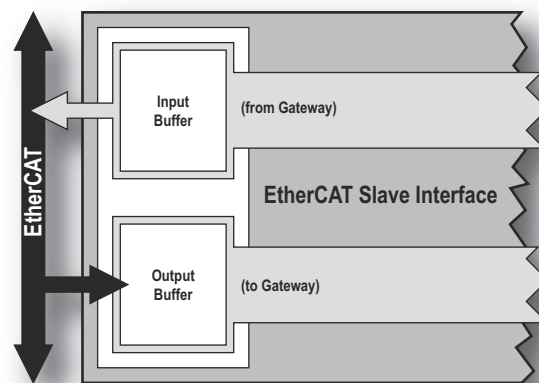
The interface exchanges data through two buffers as follows:

- **Input Buffer**

This buffer holds data forwarded *from* the other network, i.e. data which can be read by the EtherCAT master.

- **Output Buffer**

This buffer is forwarded *to* the other network, i.e. data which can be written by the EtherCAT master.



## 1.2 Features

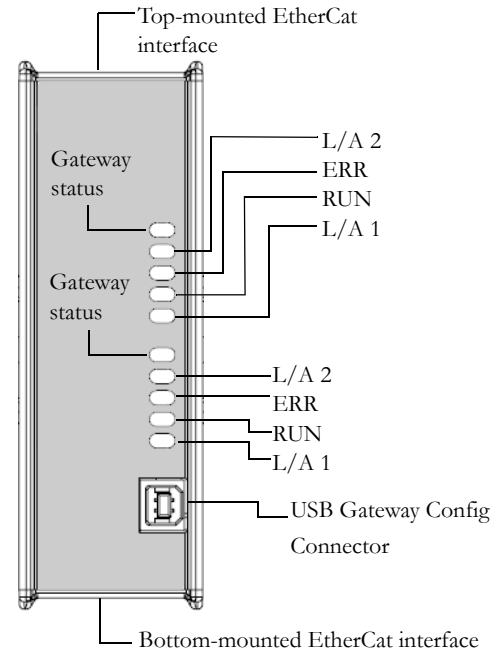
- CANopen over EtherCAT
- DS301 v4.02 compliant
- Galvanically isolated network electronics
- Up to 512 bytes of cyclic data in each direction (PDO)
- Up to 512 bytes of acyclic data in each direction (SDO)

## 1.3 External View

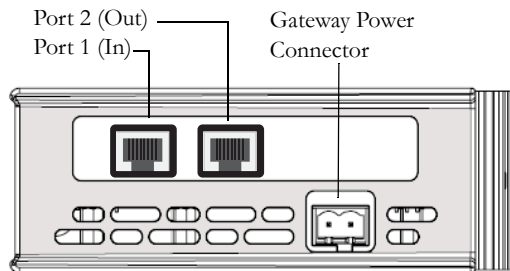
### EtherCAT Interface Status LEDs

LED	Colour	Indication
Gateway Status		(Consult the user manual for further details)
L/A 2	Off	No link sensed on port 2 (no power)
	Green	Link sensed on port 2
	Green, flickering	Exchanging packets on port 2
ERR	Off	Normal operation (no power)
	Red, blinking	General EtherCAT configuration error
	Red, single flash	EtherCAT state changed autonomously
	Red, double flash	Sync manager watchdog timeout
	Red	Application watchdog timeout
RUN	Off	Device in INIT state (no power)
	Green, blinking	Device in PRE-OPERATIONAL state
	Green, single flash	Device in SAFE-OPERATIONAL state
	Green	Device in OPERATIONAL state
L/A 1	Off	No link sensed on port 1 (no power)
	Green	Link sensed on port 1
	Green, flickering	Exchanging packets on port 1

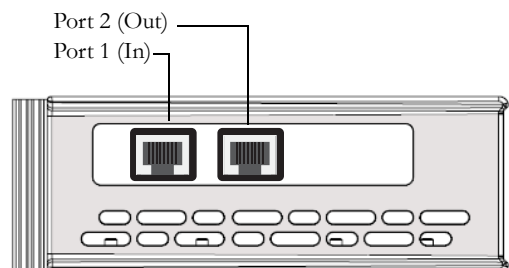
### Front View



### Top-mounted interface



### Bottom-mounted interface



### Connectors and Switches

#### EtherCAT Port 1

See A-15 “EtherCAT Connector Pinout”.

#### EtherCAT Port 2

See A-15 “EtherCAT Connector Pinout”.

#### Gateway power connector

See the Gateway manual for further details.

#### USB Gateway config connector

Consult the user manual for further details.

## 2. Installation and Configuration

### 2.1 Gateway Config Interface

The X-Gateway and the EtherCAT interface may be configured by using the software tool **Anybus Configuration Manager** (ACM), which is available from [www.anybus.com/support](http://www.anybus.com/support)

When ACM is connected to the gateway via the USB configuration connector, the following settings are available:

Network Type	
Name	EtherCAT slave
General	
Input PDO Size (bytes)	20
Output PDO Size (bytes)	20
Input SDO Size (bytes)	0
Output SDO Size (bytes)	0
Offline option	Clear ▼
Control word/Status word	Disable ▼

See also...

- The Anybus X-gateway User Manual, for full details on using ACM.
- The online help in ACM, for further help on the available settings.
- 3-8 “Data Exchange”
- 4-11 “CANopen Object Dictionary Implementation”
- 4-12 “Manufacturer Specific Objects”



## 3. Data Exchange

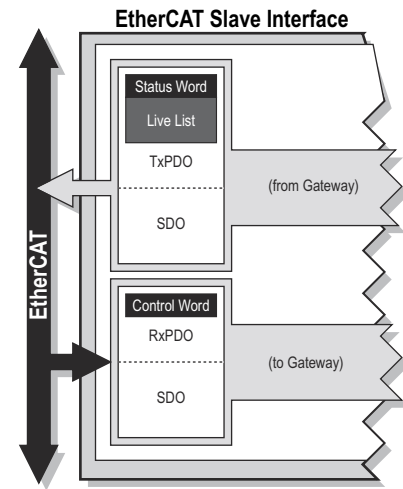
### 3.1 General Information

As mentioned previously, the EtherCAT Slave Interface implements CANopen over EtherCAT. This means that the Input- and Output Data is mapped to dedicated object entries in the manufacturer-specific range.

The amount of data exchanged by means of PDOs (Process Data Objects) can be specified via the Gateway Config Interface.

See also...

- 3-9 “Input Data (Gateway to EtherCAT)”
- 3-9 “Output Data (EtherCAT to Gateway)”
- 4-12 “Manufacturer Specific Objects” (4-12 “Input Buffer” & 4-13 “Output Buffer”)



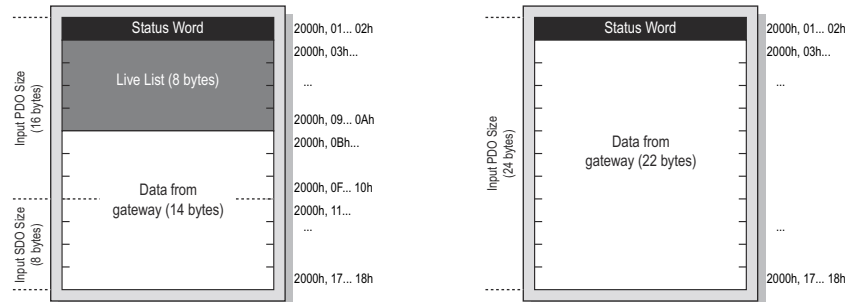
The EtherCAT Slave Interface uses a fixed PDO mapping as follows:

PDO	Corresponding Object	Gateway Memory
TxPDO 1A00h	Index 2000h, sub-index 1...128	Input Data, bytes 0... 127
TxPDO 1A01h	Index 2001h, sub-index 1...128	Input Data, bytes 128... 255
TxPDO 1A02h	Index 2002h, sub-index 1...128	Input Data, bytes 256... 383
TxPDO 1A03h	Index 2003h, sub-index 1...128	Input Data, bytes 384... 511
RxPDO 1600h	Index 2100h, sub-index 1...128	Output Data, bytes 0... 127
RxPDO 1601h	Index 2101h, sub-index 1...128	Output Data, bytes 128... 255
RxPDO 1602h	Index 2102h, sub-index 1...128	Output Data, bytes 256... 383
RxPDO 1603h	Index 2103h, sub-index 1...128	Output Data, bytes 384... 511

**Note:** The Slave Interface will only map as many PDOs as required to hold the specified configuration.

## Input Data (Gateway to EtherCAT)

Depending on the actual gateway configuration and how it has been set up to operate, parts of the data produced by the EtherCAT Slave Interface may be used to represent status information (i.e. Status Word, Live List etc.).



**Example A:**  
 Input PDO Size: 16  
 Input SDO Size: 8  
 Live List: Enabled  
 Control & Status Word: Enabled

**Example B:**  
 Input PDO Size: 24  
 Input SDO Size: 0  
 Live List: Disabled  
 Control & Status Word: Enabled

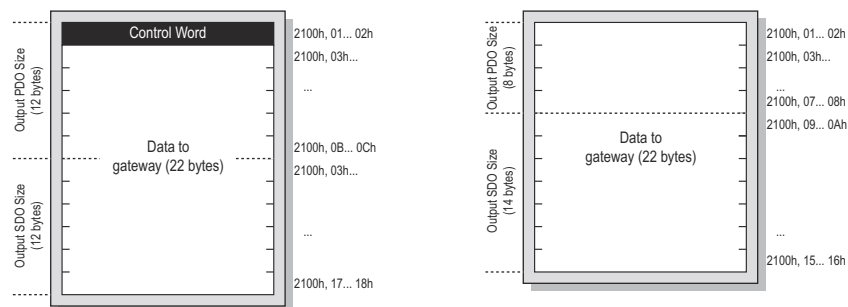
**Note:** The Live List is only available on master-slave gateway configurations.

See also...

- 4-12 “Input Buffer”

## Output Data (EtherCAT to Gateway)

Depending on the actual gateway configuration and how it has been set up to operate, the first two bytes consumed by the EtherCAT Slave Interface may be interpreted as control information (i.e. the Control Word).



**Example A:**  
 Output PDO Size: 12  
 Output SDO Size: 12  
 Control & Status Word: Enabled

**Example B:**  
 Output PDO Size: 8  
 Output SDO Size: 14  
 Control & Status Word: Disabled

**Note:** The exact interpretation of the Control Word depends on the actual gateway configuration. Consult the main User Manual and X-gateway Interface Appendix for the other network interface for further information.

See also...

- 4-13 “Output Buffer”

## 4. CANopen Object Dictionary Implementation

### 4.1 Standard Objects

#### General Information

The standard object dictionary is implemented in accordance with the DS301 specification (v4.02).

#### Object Entries

Index	Object Name	Sub-Index	Description	Type	Access	Notes
1000h	Device Type	00h	Device Type	U32	RO	0000 0000h (No profile)
1008h	Manufacturer device name	00h	Manufacturer device name	Visible string	RO	-
1018h	Identity object	00h	Number of entries	U8	RO	04h
		01h	Vendor ID	U32	RO	-
		02h	Product Code	U32	RO	
		03h	Revision Number	U32	RO	
		04h	Serial Number	U32	RO	
1600h ... 1603h	Receive PDO mapping	00h	Number of entries	U8	R	See 3-8 “Data Exchange”
		01h... n	Mapped object #n	U32	R	
1A00h ... 1A03h	Transmit PDO mapping	00h	Number of entries	U8	R	See 3-8 “Data Exchange”
		01h... Nn	Mapped object #n	U32	R	
1C00h	Sync Manager Communication Type	00h	Number of entries	U8	R	04h
		01h	Mailbox wr	U8	R	01h
		02h	Mailbox rd	U8	R	02h
		03h	Process Data out	U8	R	03h
		04h	Process Data in	U8	R	04h
1C12h	Sync Manager Rx PDO Assign	00h	Number of entries <sup>a</sup>	U8	R	No. of assigned RxPDOs (0... 4)
		01h	Assigned RxPDO	U8	R	Assigned to RxPDO 1600h
		02h	Assigned RxPDO	U8	R	Assigned to RxPDO 1601h
		03h	Assigned RxPDO	U8	R	Assigned to RxPDO 1602h
		04h	Assigned RxPDO	U8	R	Assigned to RxPDO 1603h
1C13h	Sync Manager Tx PDO Assign	00h	Number of entries <sup>a</sup>	U8	R	No. of assigned TxPDOs (0... 4)
		01h	Assigned TxPDO	U8	R	Assigned to TxPDO 1A00h
		02h	Assigned TxPDO	U8	R	Assigned to TxPDO 1A01h
		03h	Assigned TxPDO	U8	R	Assigned to TxPDO 1A02h
		04h	Assigned TxPDO	U8	R	Assigned to TxPDO 1A03h

a. The number of entries equals the number of mapped PDOs, see 3-8 “Data Exchange”.

## 4.2 Manufacturer Specific Objects

### Input Buffer

Index	Object Name	Sub-Index	Description	Type	Access	Notes
2000h	Inputs	00h	No. of entries	U8	RO	-
		01h	Input byte 0000	U8	RO	-
		02h	Input byte 0001			
		...	...			
		80h	Input byte 0127			
2001h	Inputs	00h	No. of entries	U8	RO	-
		01h	Input byte 0128	U8	RO	-
		02h	Input byte 0129			
		...	...			
		80h	Input byte 0255			
2002h	Inputs	00h	No. of entries	U8	RO	-
		01h	Input byte 0256	U8	RO	-
		02h	Input byte 0257			
		...	...			
		80h	Input byte 0383			
2003h	Inputs	00h	No. of entries	U8	RO	-
		01h	Input byte 0384	U8	RO	-
		02h	Input byte 0385			
		...	...			
		80h	Input byte 0511			

**Note:** The EtherCAT Slave Interface will only create the number of objects and sub-indexes needed to hold the specified data size (e.g. for a configuration which uses 130 byte of input data (PDO+SDO), the Slave Interface creates Object Index 2000h, Sub-Index 00h... 80h, and Object Index 2001, Sub-Index 00h... 02h).

See also...

- 4-12 “Input Buffer”

## Output Buffer

Index	Object Name	Sub-Index	Description	Type	Access	Notes
2100h	Outputs	00h	No. of entries	U8	RO	-
		01h	Output byte 0000	U8	R(W)	-
		02h	Output byte 0001			
		...	...			
		80h	Output byte 0127			
2101h	Outputs	00h	No. of entries	U8	RO	-
		01h	Output byte 0128	U8	R(W)	-
		02h	Output byte 0129			
		...	...			
		80h	Output byte 0255			
2102h	Outputs	00h	No. of entries	U8	RO	-
		01h	Output byte 0256	U8	R(W)	-
		02h	Output byte 0257			
		...	...			
		80h	Output byte 0383			
2103h	Outputs	00h	No. of entries	U8	RO	-
		01h	Output byte 0384	U8	R(W)	-
		02h	Output byte 0385			
		...	...			
		80h	Output byte 0511			

**Note 1:** For consistency reasons, PDO data will be read-only when accessed acyclically.

**Note:** The EtherCAT Slave Interface will only create the number of objects and sub-indexes needed to hold the specified data size (e.g. for a configuration which uses 130 byte of output data (PDO+SDO), the Slave Interface creates Object Index 2100h, Sub-Index 00h... 80h, and Object Index 2101, Sub-Index 00h... 02h).

See also...

- 4-13 “Output Buffer”

# A. Technical Specification

## A.1 Network Interface Details

### General Information

The EtherCAT Slave Interface acts as a full EtherCAT slave device with the following properties:

#### General Properties

- Full EtherCAT slave device
- 4 FMMU channels (can be used freely by the EtherCAT master for any purpose.)
- 4 SM channels
- Bit-oriented FMMU operation
- Position addressing, node addressing and logical addressing
- PDI Watchdog
- Output I/O Sync Manager Watchdog

#### Supported Features

- CANopen over EtherCAT
- DS301 v4.02 compliant
- Supports segmented SDO access
- Up to 512 bytes of cyclic data in each direction

### Sync Managers

The EtherCAT Slave Interface features four Sync Managers:

- **Sync Manager 0**  
Used for mailbox write transfers (Master to Slave).  
The Slave Interface supports mailbox sizes of 50... 256 bytes (default = 192).
- **Sync Manager 1**  
Used for mailbox read transfers (Slave to Master).  
The Slave Interface supports mailbox sizes of 50... 256 bytes (default = 192).
- **Sync Manager 2**  
Contains the RxPDOs specified by the PDO assignment.  
In practice, Sync Manager 2 holds the unmodified Output I/O data.
- **Sync Manager 3**  
Contains the TxPDOs specified by the PDO assignment.  
In practice, Sync Manager 3 holds the unmodified Input I/O data.

## A.2 EtherCAT Connector Pinout

Pin	Signal	Notes
1	TD+	-
2	TD-	-
3	RD+	-
4	-	Normally left unused to ensure signal integrity, these pins are internally tied together and terminated to PE via a filter circuit.
5	-	
6	RD-	-
7	-	Normally left unused; to ensure signal integrity, these pins are internally tied together and terminated to PE via a filter circuit.
8	-	

