FECA-01 ETHERCAT ADAPTER APPLICATION NOTE FIRMWARE VERSION FFECS109

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1 GENERAL

1.1 Introduction

This document describes shortly the functions and features of the FECA-01 EtherCAT adapter module firmware version FFECS109.

1.2 Abbreviations in this document

FBA   Fieldbus adapter

NVS   Non-volatile storage

SW   Status word

1.3 Safety information

> ⚠ **WARNING**
> **LOSS OF CONTROL**
> - The designer of the control scheme must consider the potential failure modes of the control paths and provide means to achieve a safe state during and after a control path failure.
> - Consideration must be given to the implication of unanticipated transmission delays or failures of the communication link.
> - Separate and redundant control paths must be provided for critical functions.
> - The system does not react to interruption of the communication link unless connection monitoring has been configured and activated in the fieldbus adapter module and the drive.
> - Each implementation must be individually and thoroughly tested for proper operation before being placed into service.

> ⚠ **WARNING**
> **UNINTENDED OPERATION**
> - Do not write values to objects or parameters unless you fully understand the function.
> - Run initial tests without coupled loads.
> - Do not establish fieldbus communication unless you have fully understood the communication principles.
> - Only start the system if there are no persons or obstructions in the hazardous area.
> - Signal interference can cause unexpected behavior of the system.

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1.4 Features

The features supported by the adapter module are listed below.

Drives
- ACSM1 motion variant
- ACSM1 speed variant
- ACS850
- ACS355

Protocols
- CoE

Profiles
- CiA 402
- ABB Drives
- Transparent 32

CiA 402 operation modes
- Velocity mode (vl)
- Profile torque mode (tq)
- Profile velocity mode (pv)
- Profile position mode (pp)
- Homing mode (hm)
- Cyclic synchronous torque mode (cst)
- Cyclic synchronous velocity mode (csv)
- Cyclic synchronous position mode (csp)

Different drive types support the CiA 402 operation modes as depicted in the table below.

mode	ACSM1 motion	ACSM1 speed	ACS850	ACS355
vl	●	●	●	●
tq	●	●	●	●
pv	●			
pp	●			
hm	●			
cst	●	●	●	●
csv	●	●	●	
csp	●			

Note: Drive synchronization is available only with ACSM1 drives.

Synchronization types
- Free run
- SM sync (ACSM1 only)
- DC sync (ACSM1 only)

1.5 First time boot

When the adapter module is powered up for the first time, it scans through all the drive parameter groups and builds a database of the drive parameters in order to allow the master to access the drive parameters via CoE objects. This scanning procedure can take up to about one minute, depending on the drive type, and the module will not respond to the EtherCAT bus during this time. The procedure is not performed on the next power up anymore (it is performed again if the module is connected to a different drive type, or if the drive firmware has been upgraded).

2   DRIVE CONFIGURATION

2.1   Drive parameters "FBA configuration parameters - group A"

In ACSM1, ACS850 and ACS355 the "parameter group A" is drive parameter group 51 (FBA SETTINGS / EXT COMM MODULE).

Settings for the FBA are read from the drive during FBA initialization and when the "Fieldbus parameter refresh" notice is received from the drive. The FBA TYPE parameter is processed only during initialization after module boot.

Par	Name	Description	Default
01	FBA TYPE	**135** = EtherCAT If value is not 135, then default values are written to the drive.	135
02	PROFILE	**0** = CiA 402 **1** = ABB Drives profile **3** = Transparent 32	0
03	STATION ALIAS	Configured Station Alias	0
...	...	...	...
21	ERASE FBA CONFIG	**1** = Delete FBA configuration files **others** = No operation	0
22	DRIVE POS CTL MODE	**0** = Position control **1** = Synchron control	0
...	...	...	...
27	FBA PAR REFRESH	Command for the FBA to read settings from drive parameters (including, but not limited to, group 51 parameters.	-

Note that the above names for group 51 parameters are not displayed on the control panel or the PC tool.

01 FBA TYPE

The fieldbus adapter writes its type code into this parameter. The user should not adjust this parameter.

02 PROFILE

Selects the communication profile. It is not recommended to switch the communication profile during operation.

- **0** = CiA 402
- **1** = ABB Drives
- **3** = Transparent 32

03 STATION ALIAS

The Configured Station Alias address which can be used for node addressing. The use of this alias is activated by the master.

21 ERASE FBA CONFIG

To erase all saved CoE objects from the adapter module, write value 1 to this parameter and refresh the parameters by par. 51.27. The parameter value is then set back to 0 by the module automatically.

22 DRIVE POS CTL MODE

Selects which ACSM1 control mode to use when in the *cyclic synchronous position* (csp) operation mode. For more information on the ACSM1 position control and synchron control modes, refer to the ACSM1 drive firmware manual.

- **0** = Position control
- **1** = Synchron control

2.2   Drive parameters "FBA configuration parameters - groups B and C"

In ACSM1 and ACS850 the "parameter group B" is drive parameter group 53 FBA DATA OUT and "group C" is parameter group 52 FBA DATA IN.

In ACS355 the "parameter group B" is drive parameter group 55 FBA DATA OUT and "group C" is parameter group 54 FBA DATA IN.

⚠ All parameters in these groups are handled by the module automatically. Do not tamper with these parameters.

2.3 Other drive parameters on ACSM1

Apart from the parameters described in chapter 2.1, the following drive parameters must be checked and set when using the ACSM1 drive.

General settings

Parameter	Setting
10.01 EXT1 START FUNC	FBA
24.01 SPEED REF1 SEL	FBA REF1
32.01 TORQ REF1 SEL	FBA REF1
50.01 FBA ENABLE	Enable
50.04 FBA REF1 MODESEL	Raw data Torque Speed Position
50.05 FBA REF2 MODESEL	Raw data Torque Speed Position
60.05 POS UNIT	Revolution
60.10 POS SPEED UNIT	u/s
65.01 POS REFSOURCE	Ref table
65.02 PROF SET SEL	C.False
65.03 POS START 1	P.2.12 FBA MAIN CW.25
65.04 POS REF 1 SEL	FBA REF1
65.22 PROF VEL REF SEL	FBA REF1
67.01 SYNC REF SEL	FBA REF1
70.03 POS REF ENA	C.False

Settings for the homing function

Parameter	Setting
62.02 HOMING START FUNC	Normal
62.03 HOMING START	P.2.12 FBA MAIN CW.26

For drive synchronization to work, the following parameter must be set

Parameter	Setting
57.09 KERNEL SYNC MODE	FBSync

Interpolator settings (applicable in the Synchron control mode only)

Parameter	Setting
67.03 INTERPOLAT MODE	INTERPOLATE
67.04 INTERPOLAT CYCLE	set equal to the bus cycle time (ms)

Select default drive control mode

Parameter	Setting
34.01 EXT1/EXT2 SEL	C.False
34.02 EXT1 MODE 1/2SEL	C.False
34.03 EXT1 CTRL MODE1	Speed Torque Position Synchron

Note: Drive control mode is changed by the FBA according to operation mode requested by the master. However, it is recommended to set par. 34.03 according to the primary operation mode.
Note: Par. 34.03 value does not change when the FBA switches the drive control mode.

Select feedbacks from the drive to the adapter module
The data sources for the DCU ACT1 and ACT2 values are selected by the FBA REF1/2 MODESEL parameters. Torque, speed or position feedbacks may be selected. Note that only two out of the three can be selected at one time.

Parameter	Setting
50.04 FBA REF1 MODESEL	Torque Speed Position
50.05 FBA REF2 MODESEL	Torque Speed Position

If the FBA REF1/2 MODESEL parameters are set to "Raw data", then the data sources are selected by the FBA ACT1/2 TR SRC parameters.

Parameter	Setting
50.06 FBA ACT1 TR SRC	P.1.06 TORQUE P.1.01 SPEED ACT P.1.12 POS ACT
50.07 FBA ACT2 TR SRC	P.1.06 TORQUE P.1.01 SPEED ACT P.1.12 POS ACT

Note: After changing par. 50.06 or 50.07, the settings must be read into the FBA by using the parameter 51.27 FBA PAR REFRESH (applies when par. 50.04 or 50.05 is set to "Raw data").

Position data configuration

Parameter	Setting
60.02 POS AXIS MODE	Linear Rollover
60.09 POS RESOLUTION	10...24

Note: In the rollover mode, the position data ranges always within one revolution (0...1 rev). When the linear mode is selected, the range of total revolutions depends on par. 60.09 setting. Position data size is always 32 bits total, and par. 60.09 determines the number of bits used for the fractional part. E.g. with value 24, there are 8 bits for integral revolutions (-128...127) and 24 bits for fractional part within the revolution.

2.4 Other drive parameters on ACS850

Apart from the parameters described in chapter 2.1, the following drive parameters must be checked and set when using the ACS850 drive.

General settings

Parameter	Setting
10.01 Ext1 start func	FBA
16.15 Menu set sel	Load long
21.01 Speed ref1 sel	FBA ref1
22.01 Acc/Dec sel	C.False
24.01 Torq ref1 sel	FBA ref1
50.01 Fba enable	Enable
50.04 Fba ref1 modesel	Raw data Torque Speed
50.05 Fba ref2 modesel	Raw data Torque Speed

Note: Re-read all groups after changing parameter 16.15.

Select default drive control mode

Parameter	Setting
12.01 Ext1/Ext2 sel	C.False
12.03 Ext1 ctrl mode	Speed Torque

Note: Drive control mode is changed by the FBA according to operation mode requested by the master. However, it is recommended to set par. 12.03 according to the primary operation mode.
Note: Par. 12.03 value does not change when the FBA switches the drive control mode.

Select feedbacks from the drive to the adapter module
The data sources for the DCU ACT1 and ACT2 values are selected by the "Fba ref1/2 modesel" parameters. Torque and speed feedbacks may be selected.

Parameter	Setting
50.04 Fba ref1 modesel	Torque Speed Raw data
50.05 Fba ref2 modesel	Torque Speed Raw data

If the "Fba ref1/2 modesel" parameters are set to "Raw data", then the data sources are selected by the "Fba act1/2 tr src" parameters. In this way the position feedback can be used also.

Parameter	Setting
50.06 Fba act1 tr src	P.1.01 Motor speed rpm P.1.06 Motor torque P.1.12 Pos act P.1.09 Encoder1 pos P.1.11 Encoder2 pos
50.07 Fba act2 tr act	P.1.01 Motor speed rpm P.1.06 Motor torque P.1.12 Pos act P.1.09 Encoder1 pos P.1.11 Encoder2 pos

Note: After changing par. 50.06 or 50.07, the settings must be read into the FBA by using the parameter 51.27 FBA par refresh (applies when par. 50.04 or 50.05 is set to "Raw data").

2.5 Other drive parameters on ACS355

Apart from the parameters described in chapter 2.1, the following drive parameters must be checked and set when using the ACS355 drive.

General settings

Parameter	Setting
9904 MOTOR CTRL MODE	VECTOR:TORQ (vl, tq, cst) VECTOR:SPEED (vl)
1001 EXT1 COMMANDS	COMM
1002 EXT2 COMMANDS	COMM
1102 EXT1/EXT2 SEL	COMM
1103 REF1 SELECT	COMM
1106 REF2 SELECT	COMM
1601 RUN ENABLE	COMM
1604 FAULT RESET SEL	COMM
1608 START ENABLE 1	COMM
1609 START ENABLE 2	COMM
2201 ACC/DEC 1/2 SEL	COMM
2209 RAMP INPUT 0	COMM
9802 COMM PROT SEL	EXT FBA

Note: The CiA 402 operation modes available depend on parameter 9904 MOTOR CTRL MODE setting.

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3 DRIVE SYNCHRONIZATION

There are three synchronization types:
- Free run = no synchronization
- SM sync = synchronization to SM2 event or SM3 event (in case only cyclic inputs used)
- DC sync = synchronization to DC Sync0 event

ACSM1 is the only drive which supports drive synchronization (SM sync and DC sync types). The ACSM1 parameter 57.09 KERNEL SYNC MODE must be set to value "FBSync" in order for the drive to be synchronized.

With the **SM sync**, the minimum cycle time is 1 ms and the cycle time must be an integral multiple of 1 ms. I.e. allowed cycle time values are **1 ms, 2 ms, 3 ms, ... etc.**

With the **DC sync**, the minimum cycle time is 500 us and the cycle time must be an integral multiple of 500 us. I.e. allowed cycle time values are **0.5 ms, 1 ms, 1.5 ms, ... etc**.

Synchronization type is set by objects 0x1C32 *Output sync manager parameter* and 0x1C33 *Input sync manager parameter*. Settings for the different synchronization types are listed below. These settings should be made in the PREOP state.

Free run

Index / Sub-index	Value
0x1C32:01	0
0x1C33:01	0

SM sync - Synchronous with SM2 event

Index / Sub-index	Value
0x1C32:01	1
0x1C33:01	0x22 (34'd)

SM sync - Synchronous with SM3 event
Used when there are no cyclic outputs, but only cyclic inputs (TxPDO).

Index / Sub-index	Value
0x1C33:01	1

DC sync - Synchronous with DC Sync0 event

Index / Sub-index	Value
0x1C32:01	2
0x1C33:01	2

When using DC sync, the Distributed Clocks must also be configured to enable DC and enable SYNC 0. The default configuration is one Sync0 pulse per bus cycle. This configuration is automatically set by selecting the "DC for synchronization" option on the DC settings at the master (e.g. TwinCAT). The settings come from the xml file, therefore make sure the correct xml file is available for the master. When using other sync types (Free run or SM sync), select the "DC unused" option.

4 PRE-DEFINED PDO MAPS

The PDO maps have been pre-defined with the following objects as default. All PDOs can be reconfigured by the user and also saved to the adapter module.

PDO	Mapping object	Content
Rx PDO 1	1600	6040 Controlword
Tx PDO 1	1A00	6041 Statusword

PDO	Mapping object	Content
Rx PDO 2	1601	6040 Controlword 607A Target position
Tx PDO 2	1A01	6041 Statusword 6064 Position actual value

PDO	Mapping object	Content
Rx PDO 3	1602	6040 Controlword 60FF Target velocity
Tx PDO 3	1A02	6041 Statusword 6064 Position actual value

PDO	Mapping object	Content
Rx PDO 4	1603	6040 Controlword 6071 Target torque
Tx PDO 4	1A03	6041 Statusword 6064 Position actual value 6077 Torque actual value

PDO	Mapping object	Content
Rx PDO 6	1605	6040 Controlword 6042 vl target velocity
Tx PDO 6	1A05	6041 Statusword 6044 vl velocity actual value

PDO	Mapping object	Content
Rx PDO 21	1614	2001 DCU CW 2002 DCU REF1 2003 DCU REF2
Tx PDO 21	1A14	2004 DCU SW 2005 DCU ACT1 2006 DCU ACT2

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5 COMMUNICATION BETWEEN THE MODULE AND THE DRIVE

5.1 General

There are two mechanisms of cyclic process data transmission between the drive and the adapter module: the faster, so-called *cyclic high priority* communication service, which is suitable for control and the slower, *cyclic low priority* communication service, which is suitable mainly for secondary e.g. monitoring purposes.

5.2 Cyclic high priority communication

Minimum update cycle time is 500 us (2000 Hz) with ACSM1 (UMFI1510) and ACS850 (UIFI201B). With ACS355 (SWDA503C) the minimum update cycle time is approx. 4 ms (250 Hz).

Axis command and feedback data, i.e. torque, velocity and position command and feedback values, use the high priority service. There is room for the drive control word and reference values (command values) and the drive status word and two actual values (feedback values).

The values of the following objects are transferred, or the data where the following objects' values' are derived, is transferred between the drive and the module via the cyclic high priority service. Note that since there is room for only two feedback values, the CiA 402 feedback data objects will not be operational unless the corresponding feedback data has been selected to be transmitted from the drive. See chapters 2.3 and 2.4 on how to select source data for feedback values on the ACSM1 and ACS850 drives.

2001 DCU CW	2004 DCU SW
2002 DCU REF1	2005 DCU ACT1
2003 DCU REF2	2006 DCU ACT2
2101 ABB Drives control word	2104 ABB Drives status word
2102 ABB Drives REF1	2105 ABB Drives ACT1
2103 ABB Drives REF2	2106 ABB Drives ACT2
6040 Controlword	6041 Statusword
6042 vl target velocity	6044 vl velocity actual value
6071 Target torque	6064 Position actual value
607A Target position	606C Velocity actual value
60FF Target velocity	6077 Torque actual value
	60F4 Following error actual value

5.3 Cyclic low priority communication

Update cycle time is 50 ms (20 Hz) with ACSM1 (UMFI1510) and ACS850 (UIFI201B).
Update cycle time is approx. 20 ms (50 Hz) with ACS355 (SWDA503C).

The velocity demand value and all drive parameters, when mapped into a PDO, are transferred between the drive and the module via the cyclic low priority communication service.

> 4001 ... 4063 Drive parameters
> 6043 vl velocity demand
> 606B Velocity demand value

The cyclic low priority communication service allows transmission of up to 12 x 16 bit words on ACSM1 and ACS850, and 10 x 16 bit words on ACS355, in each direction. If a 32 bit drive parameter is mapped to a PDO, it reserves two word spaces on the cyclic low priority exchange. In ACS355 all parameters are 16 bits long.

Example: It would be possible to map four 16 bit drive parameters and four 32 bit drive parameters in Rx/Tx PDOs with ACSM or ACS850.

6 COE OBJECT DICTIONARY

6.1 Introduction

All supported CoE objects are listed in the following tables. Explanations for the columns of the tables are given below.

- Index : object index (hex)
- SI : sub-index (hex)
- Type : data type
    - U32 = 32 bit unsigned integer $(0 \ldots 2^{32} - 1)$
    - I32 = 32 bit signed integer $(-2^{31} \ldots 2^{31} - 1)$
    - U16 = 16 bit unsigned integer (0 ... 65535)
    - I16 = 16 bit signed integer (-32768 ... 32767)
    - U8 = 8 bit unsigned integer (0 ... 255)
    - I8 = 8 bit signed integer (-128 ... 127)
- RW : SDO read/write access
    - R = object can only be read by SDO service
    - RW = object can be both read and written by SDO service
- PM : PDO mapping
    - Rx = object can be mapped into an Rx PDO
    - Tx = object can be mapped into a Tx PDO
- NVS : possibility of non-volatile storage
    - FBA = object value will be saved into the adapter module
    - drv = object value will be saved in drive parameters

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6.2 Communication profile area (0x1000...0x1FFF)

Index	SI	Name	Type	RW	PM	Description	NVS
1000		Device type	U32	R		Value 0x00020192 = servo drive, generic PDO mapping, profile 402	
1001		Error register	U8	R		CiA 301 Error register object. When a bit is set, the error is active. Bits: 7: Manufacturer specific (see object 2202). 4: Communication. 3: Temperature. 2: Voltage. 1: Current. 0: Generic error (any drive fault).	
1008		Device name	string	R		"FECA-01 and <drive type>"	
1009		Hardware version	string	R		Board revision, e.g. "A"	
100A		Software version	string	R		Firmware name and version	
1010	0	Store parameters	U8	R		Write value 0x65766173 into relevant subindex to save NVS object values.	
	1	Save all parameters	U32	RW		Save communication and device profile areas	
	2	Save comm parameters	U32	RW		Save objects 1000 - 1FFF (Communication profile area)	
	3	Save appl parameters	U32	RW		Save objects 6000 - 9FFF (Std. device profile area)	
1011	0	Restore default parameters	U8	R		Write value 0x64616F6C into relevant subindex to restore default values to NVS objects.	
	1	Restore all defaults	U32	RW		Restore default values to communication and device profile areas	
	2	Restore comm defaults	U32	RW		Restore objects 1000 - 1FFF (Communication profile area)	
	3	Restore appl defaults	U32	RW		Restore objects 6000 - 9FFF (Std. device profile area) which are saved into the FBA	
1018	0	Identity	U8	R		Number of entries (4)	
	1	Vendor ID	U32	R		Value 0xB7 = ABB Drives	
	2	Product code	U32	R		Product code read from the drive. E.g. value 0x20A = ACSM1 speed, 0x20B = ACSM1 motion, 0x21C = ACS850, 0x1F7 = ACS355.	
	3	Revision	U32	R		FBA firmware version number (hex) E.g. value 0x109 = FFECS109	
	4	Serial number	U32	R		Adapter module serial number	
1600	0	RxPDO 1 map	U8	RW		Number of mapped objects (0...8) Write access in PREOP state only	FBA
	1	-	U32	RW		Rx PDO mapping entry 1. E.g. value 0x60400010 = object 6040:00 *Controlword*, length 16 bits.	FBA
	...	...	U32	RW		...	FBA
	8	-	U32	RW		Rx PDO mapping entry 8. E.g. value 0 = none	FBA
1601	...	RxPDO 2 map	...	...		*Similar to object 1600 (see above)*	FBA
1602	...	RxPDO 3 map	...	...		*Similar to object 1600 (see above)*	FBA

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Index	SI	Name	Type	RW	PM	Description	NVS
1603	...	RxPDO 4 map	...	...		*Similar to object 1600 (see above)*	FBA
1605	...	RxPDO 6 map	...	...		*Similar to object 1600 (see above)*	FBA
1614	...	RxPDO 21 map	...	...		*Similar to object 1600 (see above)*	FBA
1A00	0	TxPDO 1 map	U8	RW		Number of mapped objects (0...8) Write access in PREOP state only	FBA
	1	-	U32	RW		Tx PDO mapping entry 1. E.g. value 0x60410010 = object 6041:00 *Statusword*, length 16 bits.	FBA
	...	...	U32	RW		...	FBA
	8	-	U32	RW		Tx PDO mapping entry 8. E.g. value 0 = none.	FBA
1A01	...	TxPDO 2 map	...	...		*Similar to object 1A00 (see above)*	FBA
1A02	...	TxPDO 3 map	...	...		*Similar to object 1A00 (see above)*	FBA
1A03	...	TxPDO 4 map	...	...		*Similar to object 1A00 (see above)*	FBA
1A05	...	TxPDO 6 map	...	...		*Similar to object 1A00 (see above)*	FBA
1A14	...	TxPDO 21 map	...	...		*Similar to object 1A00 (see above)*	FBA
1C00	0	Sync manager communication type	U8	R		SM0 ... SM3 communication types Number of entries (4)	
	1	-	U8	R		Value 1 = mailbox receive (output)	
	2	-	U8	R		Value 2 = mailbox send (input)	
	3	-	U8	R		Value 3 = process data output	
	4	-	U8	R		Value 4 = process data input	
1C12	0	Sync manager 2 (Rx) PDO assign	U8	RW		Number of assigned PDOs (0...3)	FBA
	1	-	U16	RW		Sync manager 2 PDO assignment 1. E.g. value 0x1600 = Rx PDO 1	FBA
	2	-	U16	RW		Sync manager 2 PDO assignment 2. E.g. value 0 = none	FBA
	3	-	U16	RW		Sync manager 2 PDO assignment 3	FBA
1C13	0	Sync manager 3 (Tx) PDO assign	U8	RW		Number of assigned PDOs (0...3)	FBA
	1	-	U16	RW		Sync manager 3 PDO assignment 1. E.g. value 0x1A00 = Tx PDO 1	FBA
	2	-	U16	RW		Sync manager 3 PDO assignment 2. E.g. value 0 = none	FBA
	3	-	U16	RW		Sync manager 3 PDO assignment 3	FBA
1C32	0	Output sync manager parameter	U8	R		Sync manager 2 synchronization settings	-
	1	Synchronization type	U16	RW		0x00 = Free run (*default*) 0x01 = SM sync, SM2 event 0x02 = DC Sync0	FBA
	4	Synchronization types supported	U16	R		Drive dependent. Bits: 4..2: 000 = No DC, 001 = DC Sync0. 1: SM sync supported. 0: Free run supported.	-
	5	Minimum cycle time	U32	R		Minimum supported cycle time (ns)	-
	6	Calc and copy time	U32	R		Minimum required time between SM2 event and DC sync event (ns)	-
	9	Delay time	U32	R		Delay between DC sync event and the time when the data is available in the process (ns)	-
	C	Cycle time too small	U16	R		Error counter which is incremented if input process data has not been refreshed before next SM2 event	-

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Index	SI	Name	Type	RW	PM	Description	NVS
1C33	0	Input sync manager parameter	U8	R		Sync manager 3 synchronization settings	-
	1	Synchronization type	U16	RW		0x00 = Free run (*default*) 0x01 = SM sync, SM3 event 0x22 = SM sync, SM2 event 0x02 = DC Sync0	FBA
	4	Synchronization types supported	U16	R		Drive dependent. Bits: 4..2: 000 = No DC, 001 = DC Sync0. 1: SM sync supported. 0: Free run supported.	-
	5	Minimum cycle time	U32	R		Same value as in 1C32:05	-
	6	Calc and copy time	U32	R		Delay between the time of input process data sampling and the time when the data is available for the master (ns)	-
	C	Cycle time too small	U16	R		Same value as in 1C32:0C	-

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6.3 Manufacturer specific profile area (0x2000...0x5FFF)

Index	SI	Name	Type	RW	PM	Description	NVS
2001		DCU CW	U32	R	Rx	Drive native control word. **Note:** May be mapped into an active PDO only when Transparent 32 profile is used.	
2002		DCU REF1	U32	R	Rx	Drive raw reference value 1. **Note:** May be mapped into an active PDO only when Transparent 32 profile is used.	
2003		DCU REF2	U32	R	Rx	Drive raw reference value 2. **Note:** May be mapped into an active PDO only when Transparent 32 profile is used.	
2004		DCU SW	U32	R	Tx	Drive native status word	
2005		DCU ACT1	U32	R	Tx	Drive raw actual value 1	
2006		DCU ACT2	U32	R	Tx	Drive raw actual value 2	
2101		ABB Drives control word	U16	R	Rx	ABB Drives profile control word	
2102		ABB Drives REF1	I16	R	Rx	ABB Drives profile REF1 value	
2103		ABB Drives REF2	I16	R	Rx	ABB Drives profile REF2 value	
2104		ABB Drives status word	U16	R	Tx	ABB Drives profile status word	
2105		ABB Drives ACT1	I16	R	Tx	ABB Drives profile ACT1 value	
2106		ABB Drives ACT2	I16	R	Tx	ABB Drives profile ACT2 value	
2200		Diagnostic message	string	R		Plain text status or error message from the adapter module	
2201		Last drive fault code	U16	R	Tx	Latest "fieldbus" fault code read from the drive	
2202		Diagnostic number	I16	RW		Status/error code from the adapter module. Indications 1,5,8 are reset by the fault reset mechanism of the currently selected communication profile. All indications are reset by writing the current error number into this object. This does not resolve the cause of the error. Values: 1 = Default group 51 parameter values written to the drive. (This is normal for the first power-up when the module has been installed to the drive.) 3 = Cyclic low priority communication failed. 5 = FBA configuration files corrupted. 8 = Error in drive parameters or other information received from the drive or acyclic communication failed. 64 = Cyclic high priority communication failed.	

Index	SI	Name	Type	RW	PM	Description	NVS
4001	0	Group 1	U8	R		Drive parameter group 1	
	1	Parameter 1.01	?	?	?	Drive parameter 1.01	drv
	2	Parameter 1.02	?	?	?	Drive parameter 1.02	drv
	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
4063	0	Group 99	U8	R		Drive parameter group 99	
	1	Parameter 99.01	?	?	?	Drive parameter 99.01	drv
	...	...	...	...	...	...	...

Notes:

- The DCU and ABB Drives command values cannot be changed by an SDO write.
- Do not use the DCU command values (objects 0x2001...0x2003) in an active Rx PDO unless the Transparent 32 profile has been selected.

Drive parameter access via CoE objects

Drive parameters can be accessed via objects 0x4001 ... 0x4063. The 8 least significant bits of the object index correspond to the drive parameter group and the sub-index is the drive parameter index.

	Index		Sub-index	
Bit	15 8	7 0	8 0	
Value	0x40	Drive par. group (hex)	Drive par. index (hex)	

Examples:
object 0x400A:02 = drive par. 10.02
object 0x4033:0F = drive par. 51.15

Drive parameters are not restored to default values by object 0x1011.
Drive parameters, when mapped into a PDO, are transmitted via the cyclic low priority communication service (see chapter 5.3).

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6.4 Standardized device profile area (0x6000...0x9FFF)

Index	SI	Name	Type	RW	PM	Description	NVS
6007		Abort connection option code	I16	RW		Action to take when the slave leaves OP state. Values: 0 = No action (*default*) 1 = Fault signal (off-line status) 2 = Disable voltage command 3 = Quick stop command	FBA
603F		Error code	U16	R	Tx	CiA 402 error code of the last error which occurred in the drive. Values according to IEC 61800-7-201. Manufacturer-specific error codes 0xFF00...0xFFFF: In general, all drive fault codes from 0xFF00 and above pass straight through into this object. Two error codes are generated by the adapter module: 0xFFE1: Failed to read fault code from the drive. 0xFFFF: Unhandled drive fault code - corresponding CiA 402 error code does not exist. See object 2201 and the drive manual.	
6040		Controlword	U16	RW	Rx	CiA 402 control word	
6041		Statusword	U16	R	Tx	CiA 402 status word	
6042		vl target velocity	I16	RW	Rx	Effective in the vl operation mode	
6043		vl velocity demand	I16	R	Tx	Operational if the ramp function generator output is available from the drive. Cyclic low priority communication. **Note:** Not available with ACS355.	
6044		vl velocity actual value	I16	R	Tx	Operational when velocity feedback is available from the drive	
6046	0	vl velocity min max amount	U8	R		Minimum and maximum velocity absolute value settings for vl operation mode	-
	1	min abs velocity	U32	RW		Velocity absolute value minimum	drv
	2	max abs velocity	U32	RW		Velocity absolute value maximum	drv
6048	0	vl velocity acceleration	U8	R		Acceleration ramp settings for vl operation mode	-
	1	Delta speed	U32	RW		Ramp delta speed (vl scaling units). **Note:** Read only on ACS355.	drv
	2	Delta time	U16	RW		Ramp delta time (s)	drv
6049	0	vl velocity deceleration	U8	R		Deceleration ramp settings for vl operation mode	-
	1	Delta speed	U32	RW		Ramp delta speed (vl scaling units). **Note:** Read only on ACS355.	drv
	2	Delta time	U16	RW		Ramp delta time (s)	drv
604A	0	vl velocity quick stop	U8	R		Quick stop ramp settings for vl operation mode	-
	1	Delta speed	U32	RW		Ramp delta speed (vl scaling units). **Note:** Read only on ACS355.	drv
	2	Delta time	U16	RW		Ramp delta time (s)	drv

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Index	SI	Name	Type	RW	PM	Description	NVS
604C	0	vl dimension factor	U8	R		Velocity data scaling factor for vl operation mode. Basic unit in vl operation mode is *rpm*.	-
	1	numerator	I32	RW		Default: 1	FBA
	2	denominator	I32	RW		Default: 1	FBA
605B		Shutdown option code	I16	RW		0 = coast stop (*default*) 1 = ramp stop	FBA
605C		Disable operation option code	I16	RW		0 = coast stop (*default*) 1 = ramp stop	FBA
605D		Halt option code	I16	RW		vl mode: 1 = force ramp generator input to zero (*default*) 2...4 = force ramp generator output to zero **Note:** Halt does not cause the drive to stop, merely to run at "zero speed".	FBA
6060		Modes of operation	I8	RW	Rx	CiA 402 operation mode request. 0 = No mode change (*default*) 1 = Profile position mode (pp) 2 = Velocity mode (vl) 3 = Profile velocity mode (pv) 4 = Profile torque mode (tq) 6 = Homing mode (hm) 8 = Cyclic sync position mode (csp) 9 = Cyclic sync velocity mode (csv) 10 = Cyclic sync torque mode (cst)	FBA
6061		Modes of operation display	I8	R	Tx	Current operation mode	
6064		Position actual value	I32	R	Tx	Operational when position feedback is available from the drive	
6065		Following error window	U32	RW		Maximum allowed position error for the status word *following error* bit. Default: 0xFFFFFFFF (= disabled)	FBA
6066		Following error time out	U16	RW		Timeout (ms) after which the status word *following error* bit is asserted when the following error window is exceeded. Default: 0 (= immediate)	FBA
606B		Velocity demand value	I32	R	Tx	Operational if the ramp function generator output is available from the drive. Cyclic low priority communication. **Note:** Not available with ACS355.	
606C		Velocity actual value	I32	R	Tx	Operational when velocity feedback is available from the drive	
6071		Target torque	I16	RW	Rx	Effective in cst, tq operation modes	
6077		Torque actual value	I16	R	Tx	Operational when torque feedback is available from the drive	
607A		Target position	I32	RW	Rx	Effective in csp, pp operation modes	

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Index	SI	Name	Type	RW	PM	Description	NVS
607B	0	Position range limit	U8	R		Modulo values for position command value. When the limits are exceeded, the command value wraps around to the other end of the range. Modulo calculation is disabled when both limit values are zero.	-
	1	Min position range limit	I32	RW		Minimum input position data value. Default: 0	FBA
	2	Max position range limit	I32	RW		Maximum input position data value. Default: 0	FBA
607C		Home offset	I32	RW		Offset from zero point to home position. Default: 0. Note new values are activated in homing mode only.	FBA
607D	0	Software position limit	U8	R		Saturation limit values for the position command value	-
	1	Min position limit	I32	RW		Default: -2^{31}	FBA
	2	Max position limit	I32	RW		Default: $2^{31} - 1$	FBA
6081		Profile velocity	U32	RW		The velocity normally attained at the end of the acceleration ramp during a profiled move	drv
6083		Profile acceleration	U32	RW		The acceleration during a profiled move. Unit: *position increments / s^2*	drv
6084		Profile deceleration	U32	RW		The deceleration during a profiled move. Unit: *position increments / s^2*	drv
6085		Quick stop deceleration	U32	RW		The deceleration used to stop the motor when quick stop command is given. Unit: *position increments / s^2*	drv
6087		Torque slope	U32	RW		Effective in tq operation mode. Unit: *0.1% / s*. Default: 1000.	FBA
608F	0	Position encoder resolution	U8	R		Position scale definition. Position increments per specified number of axis revolutions.	-
	1	Increments	U32	RW		Default: 65536	FBA
	2	Revolutions	U32	RW		Default: 1	FBA
6093	0	Position factor	U8	R		Position data scaling factor	-
	1	Numerator	U32	RW		Default: 1	FBA
	2	Divisor	U32	RW		Default: 1	FBA
6094	0	Velocity encoder factor	U8	R		Velocity data scaling factor. Basic velocity unit is: *position increments / s*	-
	1	Numerator	U32	RW		Default: 1	FBA
	2	Divisor	U32	RW		Default: 1	FBA
6098		Homing method	I8	RW		See ACSM1 firmware manual for description of the homing methods. 0 = No method 1...35 = CiA 402 method 1...35	drv
6099	0	Homing speeds	U8	R		Speeds during the homing procedure	-
	1	Speed during search for switch	U32	RW		ACSM1 homing speed 1	drv
	2	Speed during search for zero	U32	RW		ACSM1 homing speed 2	drv
60F4		Following error actual value	I32	R	Tx	Position error. Operational when position feedback is available from the drive.	
60FF		Target velocity	I32	RW	Rx	Effective in csv, pv operation modes	

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Index	SI	Name	Type	RW	PM	Description	NVS
6502		Supported drive modes	U32	R		Drive dependent. Bits: 9: cst 8: csv 7: csp 6 5: hm 4: 3: tq 2: pv 1: vl 0: pp	
6504		Drive manufacturer	string	R		"ABB Drives"	
6505		http drive catalog address	string	R		"www.abb.com"	

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6.5   CoE objects which affect drive parameters

The CoE objects which directly affect drive parameters, and vice versa, are listed in the table below (excluding, of course, the drive parameter objects 0x4001...0x4063).

Index	SI	Name	ACSM1 parameter	ACS850 parameter	ACS355 parameter
6046	1	min abs velocity	24.12 SPEED REFMIN ABS	21.09 SpeedRef min abs	2001 MINIMUM SPEED
	2	max abs velocity	20.01 MAXIMUM SPEED 20.02 MINIMUM SPEED	20.01 Maximum speed 20.02 Minimum speed	2002 MAXIMUM SPEED
6048	1	Delta speed	25.02 SPEED SCALING	19.01 Speed scaling	2002 MAXIMUM SPEED (*read only*)
	2	Delta time	25.03 ACC TIME	22.02 Acc time1	2202 ACCELER TIME 1
6049	1	Delta speed	25.02 SPEED SCALING	19.01 Speed scaling	2002 MAXIMUM SPEED (*read only*)
	2	Delta time	25.04 DEC TIME	22.03 Dec time1	2203 DECELER TIME 1
604A	1	Delta speed	25.02 SPEED SCALING	19.01 Speed scaling	2002 MAXIMUM SPEED (*read only*)
	2	Delta time	25.11 EM STOP TIME	22.12 Em stop time	2208 EMERG DEC TIME
6081		Profile velocity	65.05 POS SPEED 1	-	-
6083		Profile acceleration	65.06 PROF ACC 1	-	-
6084		Profile deceleration	65.07 PROF DEC 1	-	-
6085		Quick stop deceleration	25.02 SPEED SCALING (*read only*) 25.11 EM STOP TIME	19.01 Speed scaling (*read only*) 22.12 Em stop time	2002 MAXIMUM SPEED (*read only*) 2208 EMERG DEC TIME
6098		Homing method	62.01 HOMING METHOD	-	-
6099	1	Speed during search for switch	62.07 HOMING SPEEDREF 1	-	-
	2	Speed during search for zero	62.08 HOMING SPEEDREF 2	-	-

Note: Some objects affect the same drive parameter as another object - i.e. writing one object may cause the value of the other object to change.

7 DIAGNOSTICS

7.1 Vendor specific AL Status codes

Vendor specific AL Status codes are listed in the table below.

AL Status code	Description
0x8001	Cyclic low priority mapping failed

7.2 FBA LEDs

There are three LEDs on the FBA. LED indications are described on the table below.

LED	Indication	Description
LINK/ACT (IN / X1)	green flickering	Activity on Port 0
	green	Link on Port 0
	off	No link on Port 0
LINK/ACT (OUT / X2)	green flickering	Activity on Port 1
	green	Link on Port 1
	off	No link on Port 1
STATUS	off	INIT
	green blinking	PREOP
	green single flash	SAFEOP
	green	OP
	red blinking	State change requested by master is impossible due to local error
	red single flash	Slave changed state autonomously due to local error
	red double flash	Process data watchdog timeout

Note that in the STATUS LED, the green indications (EtherCAT "RUN" indicator) and the red error indications (EtherCAT "ERROR" indicator) are superimposed on the same LED.