

|                         |   |          |             |                 |      |
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| <b>ABB Oy</b><br>Drives | <b>FECA-01 APPLICATION NOTE</b><br><b>FIRMWARE VERSION FFECS109</b> |          |             | 3AXD10000040043 |      |
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# 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

|  |  |
|--|--|
|   | <b>WARNING</b><br><b>LOSS OF CONTROL</b> |
| <ul style="list-style-type: none"> <li>• 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.</li> <li>• Consideration must be given to the implication of unanticipated transmission delays or failures of the communication link.</li> <li>• Separate and redundant control paths must be provided for critical functions.</li> <li>• 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.</li> <li>• Each implementation must be individually and thoroughly tested for proper operation before being placed into service.</li> </ul> |  |

|  |   |
|--|---|
|   | <b>WARNING</b><br><b>UNINTENDED OPERATION</b> |
| <ul style="list-style-type: none"> <li>• Do not write values to objects or parameters unless you fully understand the function.</li> <li>• Run initial tests without coupled loads.</li> <li>• Do not establish fieldbus communication unless you have fully understood the communication principles.</li> <li>• Only start the system if there are no persons or obstructions in the hazardous area.</li> <li>• Signal interference can cause unexpected behavior of the system.</li> </ul> |   |

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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)

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## 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).

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## 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           | <b>135</b> = EtherCAT<br>If value is not 135, then default values are written to the drive.                     | 135     |
| 02  | PROFILE            | <b>0</b> = CiA 402<br><b>1</b> = ABB Drives profile<br><b>3</b> = Transparent 32                                | 0       |
| 03  | STATION ALIAS      | Configured Station Alias  | 0       |
| ... | ...                | ...   | ...     |
| 21  | ERASE FBA CONFIG   | <b>1</b> = Delete FBA configuration files<br><b>others</b> = No operation                                       | 0       |
| 22  | DRIVE POS CTL MODE | <b>0</b> = Position control<br><b>1</b> = 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

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### 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.

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### 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<br>Torque<br>Speed<br>Position |
| 50.05 FBA REF2 MODESEL | Raw data<br>Torque<br>Speed<br>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) |

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### 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<br>Torque<br>Position<br>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<br>Speed<br>Position |
| 50.05 FBA REF2 MODESEL | Torque<br>Speed<br>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<br>P.1.01 SPEED ACT<br>P.1.12 POS ACT |
| 50.07 FBA ACT2 TR SRC | P.1.06 TORQUE<br>P.1.01 SPEED ACT<br>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<br>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.



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## 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<br>Torque<br>Speed |
| 50.05 Fba ref2 modesel | Raw data<br>Torque<br>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<br>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<br>Speed<br>Raw data |
| 50.05 Fba ref2 modesel | Torque<br>Speed<br>Raw data |

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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<br>P.1.06 Motor torque<br>P.1.12 Pos act<br>P.1.09 Encoder1 pos<br>P.1.11 Encoder2 pos |
| 50.07 Fba act2 tr act | P.1.01 Motor speed rpm<br>P.1.06 Motor torque<br>P.1.12 Pos act<br>P.1.09 Encoder1 pos<br>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").

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## 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)<br>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.

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## 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   |
| Rx PDO 2  | 1601           | 6040 Controlword<br>607A Target position                                  |
| Tx PDO 2  | 1A01           | 6041 Statusword<br>6064 Position actual value                             |
| Rx PDO 3  | 1602           | 6040 Controlword<br>60FF Target velocity                                  |
| Tx PDO 3  | 1A02           | 6041 Statusword<br>6064 Position actual value                             |
| Rx PDO 4  | 1603           | 6040 Controlword<br>6071 Target torque                                    |
| Tx PDO 4  | 1A03           | 6041 Statusword<br>6064 Position actual value<br>6077 Torque actual value |
| Rx PDO 6  | 1605           | 6040 Controlword<br>6042 vl target velocity                               |
| Tx PDO 6  | 1A05           | 6041 Statusword<br>6044 vl velocity actual value                          |
| Rx PDO 21 | 1614           | 2001 DCU CW<br>2002 DCU REF1<br>2003 DCU REF2                             |
| Tx PDO 21 | 1A14           | 2004 DCU SW<br>2005 DCU ACT1<br>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 (UMF11510) 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 |

|                         |            |   |             |          |                 |
|-------------------------|------------|---|-------------|----------|-----------------|
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### 5.3 Cyclic low priority communication

Update cycle time is 50 ms (20 Hz) with ACSM1 (UMFI1510) and ACS850 (UFI201B).  
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<br>6043 vl velocity demand<br>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.

|                         |            |   |             |          |                 |
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## 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 ...  $2^{32} - 1$ )
  - I32 = 32 bit signed integer ( $-2^{31} ... 2^{31} - 1$ )
  - 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.<br>When a bit is set, the error is active.<br>Bits:<br>7: Manufacturer specific (see object 2202).<br>4: Communication.<br>3: Temperature.<br>2: Voltage.<br>1: Current.<br>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.<br>E.g. value 0x20A = ACSM1 speed, 0x20B = ACSM1 motion, 0x21C = ACS850, 0x1F7 = ACS355.   |     |
|       | 3   | Revision                   | U32    | R   |   | FBA firmware version number (hex)<br>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)<br>Write access in PREOP state only   | FBA |
|       | 1   | -                          | U32    | RW  |   | Rx PDO mapping entry 1.<br>E.g. value 0x60400010 = object 6040:00 <i>Controlword</i> , length 16 bits.   | FBA |
|       | ... | ...                        | U32    | RW  |   | ...  | FBA |
|       | 8   | -                          | U32    | RW  |   | Rx PDO mapping entry 8.<br>E.g. value 0 = none   | FBA |
| 1601  | ... | RxPDO 2 map                | ...    | ... | <i>Similar to object 1600 (see above)</i> | FBA  |     |
| 1602  | ... | RxPDO 3 map                | ...    | ... | <i>Similar to object 1600 (see above)</i> | FBA  |     |

|                         |   |          |             |                 |       |
|-------------------------|---|----------|-------------|-----------------|-------|
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| Index | SI  | Name                               | Type | RW  | PM | Description   | NVS |
|-------|-----|------------------------------------|------|-----|----|---|-----|
| 1603  | ... | RxPDO 4 map                        | ...  | ... |    | <i>Similar to object 1600 (see above)</i>   | FBA |
| 1605  | ... | RxPDO 6 map                        | ...  | ... |    | <i>Similar to object 1600 (see above)</i>   | FBA |
| 1614  | ... | RxPDO 21 map                       | ...  | ... |    | <i>Similar to object 1600 (see above)</i>   | FBA |
| 1A00  | 0   | TxPDO 1 map                        | U8   | RW  |    | Number of mapped objects (0...8)<br>Write access in PREOP state only  | FBA |
|       | 1   | -                                  | U32  | RW  |    | Tx PDO mapping entry 1.<br>E.g. value 0x60410010 = object<br>6041:00 Statusword, length 16 bits.                | FBA |
|       | ... | ...                                | U32  | RW  |    | ...   | FBA |
|       | 8   | -                                  | U32  | RW  |    | Tx PDO mapping entry 8.<br>E.g. value 0 = none.   | FBA |
| 1A01  | ... | TxPDO 2 map                        | ...  | ... |    | <i>Similar to object 1A00 (see above)</i>   | FBA |
| 1A02  | ... | TxPDO 3 map                        | ...  | ... |    | <i>Similar to object 1A00 (see above)</i>   | FBA |
| 1A03  | ... | TxPDO 4 map                        | ...  | ... |    | <i>Similar to object 1A00 (see above)</i>   | FBA |
| 1A05  | ... | TxPDO 6 map                        | ...  | ... |    | <i>Similar to object 1A00 (see above)</i>   | FBA |
| 1A14  | ... | TxPDO 21 map                       | ...  | ... |    | <i>Similar to object 1A00 (see above)</i>   | FBA |
| 1C00  | 0   | Sync manager<br>communication type | U8   | R   |    | SM0 ... SM3 communication types<br>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)<br>PDO assign  | U8   | RW  |    | Number of assigned PDOs (0...3)   | FBA |
|       | 1   | -                                  | U16  | RW  |    | Sync manager 2 PDO assignment 1.<br>E.g. value 0x1600 = Rx PDO 1  | FBA |
|       | 2   | -                                  | U16  | RW  |    | Sync manager 2 PDO assignment 2.<br>E.g. value 0 = none   | FBA |
|       | 3   | -                                  | U16  | RW  |    | Sync manager 2 PDO assignment 3   | FBA |
| 1C13  | 0   | Sync manager 3 (Tx)<br>PDO assign  | U8   | RW  |    | Number of assigned PDOs (0...3)   | FBA |
|       | 1   | -                                  | U16  | RW  |    | Sync manager 3 PDO assignment 1.<br>E.g. value 0x1A00 = Tx PDO 1  | FBA |
|       | 2   | -                                  | U16  | RW  |    | Sync manager 3 PDO assignment 2.<br>E.g. value 0 = none   | FBA |
|       | 3   | -                                  | U16  | RW  |    | Sync manager 3 PDO assignment 3   | FBA |
| 1C32  | 0   | Output sync manager<br>parameter   | U8   | R   |    | Sync manager 2 synchronization<br>settings  | -   |
|       | 1   | Synchronization type               | U16  | RW  |    | 0x00 = Free run ( <i>default</i> )<br>0x01 = SM sync, SM2 event<br>0x02 = DC Sync0                              | FBA |
|       | 4   | Synchronization types<br>supported | U16  | R   |    | Drive dependent. Bits:<br>4..2: 000 = No DC, 001 = DC Sync0.<br>1: SM sync supported.<br>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<br>SM2 event and DC sync event (ns)   | -   |
|       | 9   | Delay time                         | U32  | R   |    | Delay between DC sync event and<br>the time when the data is available in<br>the process (ns)                   | -   |
|       | C   | Cycle time too small               | U16  | R   |    | Error counter which is incremented if<br>input process data has not been<br>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 ( <i>default</i> )<br>0x01 = SM sync, SM3 event<br>0x22 = SM sync, SM2 event<br>0x02 = DC Sync0   | FBA |
|       | 4  | Synchronization types supported | U16  | R  |    | Drive dependent. Bits:<br>4..2: 000 = No DC, 001 = DC Sync0.<br>1: SM sync supported.<br>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.<br><b>Note:</b> 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.<br><b>Note:</b> 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.<br><b>Note:</b> 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.<br>Values:<br>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.)<br>3 = Cyclic low priority communication failed.<br>5 = FBA configuration files corrupted.<br>8 = Error in drive parameters or other information received from the drive or acyclic communication failed.<br>64 = Cyclic high priority communication failed. |     |

|                         |   |          |             |          |                 |
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| 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                         |
| Value | 0x40  |   | Drive par.<br>group (hex) | Drive par.<br>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:<br>0 = No action ( <i>default</i> )<br>1 = Fault signal (off-line status)<br>2 = Disable voltage command<br>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.<br><b>Note:</b> 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).<br><b>Note:</b> 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).<br><b>Note:</b> 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).<br><b>Note:</b> 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  | vI dimension factor           | U8   | R  |    | Velocity data scaling factor for vI operation mode. Basic unit in vI operation mode is <i>rpm</i> .  | -   |
|       | 1  | numerator                     | I32  | RW |    | Default: 1   | FBA |
|       | 2  | denominator                   | I32  | RW |    | Default: 1   | FBA |
| 605B  |    | Shutdown option code          | I16  | RW |    | 0 = coast stop ( <i>default</i> )<br>1 = ramp stop   | FBA |
| 605C  |    | Disable operation option code | I16  | RW |    | 0 = coast stop ( <i>default</i> )<br>1 = ramp stop   | FBA |
| 605D  |    | Halt option code              | I16  | RW |    | vI mode:<br>1 = force ramp generator input to zero ( <i>default</i> )<br>2...4 = force ramp generator output to zero<br><b>Note:</b> 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.<br>0 = No mode change ( <i>default</i> )<br>1 = Profile position mode (pp)<br>2 = Velocity mode (vI)<br>3 = Profile velocity mode (pv)<br>4 = Profile torque mode (tq)<br>6 = Homing mode (hm)<br>8 = Cyclic sync position mode (csp)<br>9 = Cyclic sync velocity mode (csv)<br>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 <i>following error</i> bit.<br>Default: 0xFFFFFFFF (= disabled)   | FBA |
| 6066  |    | Following error time out      | U16  | RW |    | Timeout (ms) after which the status word <i>following error</i> bit is asserted when the following error window is exceeded.<br>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.<br><b>Note:</b> 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: <i>position increments / s<sup>2</sup></i>   | drv |
| 6084  |    | Profile deceleration           | U32  | RW |    | The deceleration during a profiled move. Unit: <i>position increments / s<sup>2</sup></i>   | drv |
| 6085  |    | Quick stop deceleration        | U32  | RW |    | The deceleration used to stop the motor when quick stop command is given. Unit: <i>position increments / s<sup>2</sup></i>  | drv |
| 6087  |    | Torque slope                   | U32  | RW |    | Effective in tq operation mode. Unit: <i>0.1% / s</i> . 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: <i>position increments / s</i>  | -   |
|       | 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.<br>0 = No method<br>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:<br>9: cst<br>8: csv<br>7: csp<br>6<br>5: hm<br>4:<br>3: tq<br>2: pv<br>1: vl<br>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<br>ABS                  | 21.09 SpeedRef min<br>abs                  | 2001 MINIMUM<br>SPEED                       |
|       | 2  | max abs velocity                  | 20.01 MAXIMUM SPEED<br>20.02 MINIMUM SPEED | 20.01 Maximum speed<br>20.02 Minimum speed | 2002 MAXIMUM<br>SPEED                       |
| 6048  | 1  | Delta speed                       | 25.02 SPEED SCALING                        | 19.01 Speed scaling                        | 2002 MAXIMUM<br>SPEED<br><i>(read only)</i> |
|       | 2  | Delta time                        | 25.03 ACC TIME                             | 22.02 Acc time1                            | 2202 ACCELER<br>TIME 1                      |
| 6049  | 1  | Delta speed                       | 25.02 SPEED SCALING                        | 19.01 Speed scaling                        | 2002 MAXIMUM<br>SPEED<br><i>(read only)</i> |
|       | 2  | Delta time                        | 25.04 DEC TIME                             | 22.03 Dec time1                            | 2203 DECELER<br>TIME 1                      |
| 604A  | 1  | Delta speed                       | 25.02 SPEED SCALING                        | 19.01 Speed scaling                        | 2002 MAXIMUM<br>SPEED<br><i>(read only)</i> |
|       | 2  | Delta time                        | 25.11 EM STOP TIME                         | 22.12 Em stop time                         | 2208 EMERG<br>DEC TIME                      |
| 6081  |    | Profile velocity                  | 65.05 POS SPEED 1                          | -  | -   |
| 6083  |    | Profile<br>acceleration           | 65.06 PROF ACC 1                           | -  | -   |
| 6084  |    | Profile<br>deceleration           | 65.07 PROF DEC 1                           | -  | -   |
| 6085  |    | Quick stop<br>deceleration        | 25.02 SPEED SCALING<br><i>(read only)</i>  | 19.01 Speed scaling<br><i>(read only)</i>  | 2002 MAXIMUM<br>SPEED<br><i>(read only)</i> |
|       |    |                                   | 25.11 EM STOP TIME                         | 22.12 Em stop time                         | 2208 EMERG<br>DEC TIME                      |
| 6098  |    | Homing method                     | 62.01 HOMING METHOD                        | -  | -   |
| 6099  | 1  | Speed during<br>search for switch | 62.07 HOMING<br>SPEEDREF 1                 | -  | -   |
|       | 2  | Speed during<br>search for zero   | 62.08 HOMING<br>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.

|                         |   |          |             |                 |       |
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## 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<br>(IN / X1)  | green flickering<br>green<br>off   | Activity on Port 0<br>Link on Port 0<br>No link on Port 0  |
| LINK/ACT<br>(OUT / X2) | green flickering<br>green<br>off   | Activity on Port 1<br>Link on Port 1<br>No link on Port 1  |
| STATUS                 | off<br>green blinking<br>green single flash<br>green<br>red blinking<br>red single flash<br>red double flash | INIT<br>PREOP<br>SAFEOP<br>OP<br>State change requested by master is impossible due to local error<br>Slave changed state autonomously due to local error<br>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.