MOTION CONTROL SYSTEMS

SOFTWARE INSTRUCTION MANUAL

STEPPING MOTOR DRIVES

ET SERIES

(PLUS ET, X-PLUS ET, HI-MOD ET, HI-MOD ETS, R-MOD ET and CSD ET)

Release - 03

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WARNING: it is user RESPONSIBILITY to check that this manual refers to product model and version that will be used

1. NOTICES AND MANUAL STRUCTURE

This manual has been realized in order to give all the necessary information to program and manage PLUS ET, X-PLUS ET, HI-MOD ET, R-MOD ET and CSD ET series drives. The manual is valid for REL.3 version of the following models:

- **PLUS ET A3, PLUS ET B3**
- **X-PLUS ET B4, X-PLUS ET S4**
- **CSD ET**
- **HI-MOD ET E3F2HA / E3F2HA.C**
- **HI-MOD ETS E4F2HC**
- **R-MOD ET E3H2MA**

Note: The ESI files (.xml file) corresponding to the models listed above are available together with technical manuals. It is mandatory to use the ESI file received with the drive. The drive release version (REL.3) can be recognized by the corresponding label on the drive itself.

2. DRIVE DESCRIPTION

The main characteristics of PLUS ET, X-PLUS ET, HI-MOD ET, HI-MOD ETS, R-MOD ET and CSD ET series drives are the following:

- EtherCAT communication protocol (CoE).
- Identification of stall and position error through encoder. Runs with or without encoder. Auto-recovery function in case of synloss, with encoder (Auto-Syncronization function).
- Digital I/O and proximity hardware input for zero search procedure.
- Setting of coordinates system: relative coordinates mode, absolute coordinates mode(see Chap. 2.2).

Proximity input allows execution of zero procedure (HOMING); this procedure is described in Chapter 2.1.2.

2.1. MODE OF OPERATION

According to object value 6060 (Mode of Operation) can be set 4 modes of operation:

- 1: **Profile position** mode of operation
- 3: **Profile velocity** mode of operation
- 6: **Homing** mode of operation
- 8: **Cyclic Sync Position (CSP)** mode of operation
- 9: **Cyclic Sync Velocity (CSV)** mode of operation

2.1.1. PROFILE POSITION MODE OF OPERATION

With **Profile position** mode of operation, coordinates system is set by bit 6 of CONTROL WORD (see Chap. 3.4.1).

- bit 6 = 0 absolute coordinates system
- bit 6 = 1 relative coordinates system

RELATIVE COORDINATES SYSTEM

Using this operation mode, the number of steps of the movement does not depend on the starting position of the motor. For example, executing the run corresponding to the storage shown in Table 1, motor covers 24000 steps in the positive direction; the starting position of the motor has no influence on the number of covered steps. The operation range is between [-2^{31}; $2^{31}-1$]. The maximum number of steps that can be executed with one instruction is equal to 2^{31}.

Index (hex)	Sub Ind.	Object type	Access type		Default value	Entry description	Set Value
607A	0	I32	RW		0	Target position	**24000**
6081	0	U32	RW		0x5DC0 (24000)	Profile Velocity	**30000 [Hz]**
6083	0	U32	RW		0x9C400 (640000)	Profile Acceleration	**80000 [Hz/sec]**

Table 1

ABSOLUTE COORDINATES SYSTEM

Using this operation mode, the number of motor steps depends on the position of the motor shaft before the movement start (shown in object 0x6064 subindex 0 “Position Actual Value”). Supposing to execute the same run described in the example of Table 1, the motor shift is in positive direction if the motor is in a position lower then +24000 steps, or in negative direction if the position before the start of the movement is higher than +24000. The borderline case is when the starting position is +24000, in this case then motor doesn’t move.
Working with absolute coordinates operation mode requires the definition of an origin corresponding to coordinate 0. Usually coordinate 0 can be defined through the execution of an HOMING procedure.
The operation range is between $[-2^{31}; 2^{31}-1]$. The maximum number of steps that can be executed with one instruction is equal to 2^{31}.
In Profile Position, Mode Of Operation can be switched from the following sub-states: Switched On, Ready to Switch ON, Switch On Disabled, Operation Enabled.

MOTION PROFILES

The “0” to “1“ transition of the 4th bit of the Control Word determines the start of a movement (see Chapter 3.4.1).
The motion profile depends on the setting values of Profile Velocity (PV), Profile Acceleration (PA) and from the distance (number of steps) between start position and target position (ΔS). In relative coordinates system, this difference is equal to the absolute value of the Target Position, whereas in absolute coordinates system, this difference is equal to the absolute value of the difference from Target Position and the Actual Position of the shaft before moving starts.

Motion profiles can be of three type:

- START-STOP, if PV is minor or equal to 16000 Hz (12800 step/rev). Motion profile not available in MULTI SET POINT mode (in this case one of the following is used)
- TRAPEZOIDAL, if the relation $PV^2 < PA * \Delta S$ is valid
- TRIANGULAR, in all the other cases

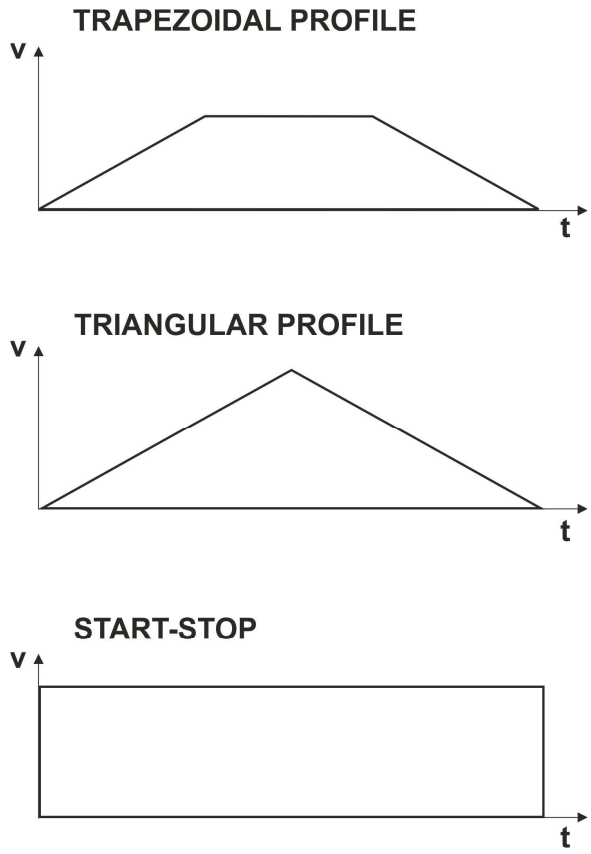


Figure 1: Motor frequency related to motor position during a generic motion execution. Acceleration profiles are only an example.

MULTI-SET-POINT MODE

To enable this function, the bit 5 (Change Set Point Immediately) of Control Word (oggetto 0x6040) must be set.

- bit 5 = "**0**", function Disable:

motion parameters cannot be modified when motor is running until the target position is reached or before sending a HALT (bit 8 of Control Word) or QUICK STOP (bit 2 of Control Word) command.

- bit 5 = "**1**": function Enable:

Target Position and/or Profile Velocity parameter can be modified when motor is running. In any case, the Profile Acceleration cannot be modified; a new value is loaded only when the movement gets the final target position.

Multi Set Point function limits:

- bit 6 of the Control Word (enable absolute/relative coordinates) should not be changed: if it is changed, the new value is ignored. A relative movement has the overall starting point as a reference.

- The Profile Velocity value is changed immediately after a new value is received, even during a motion execution, independently of the New Set Point bit status.

- It is not possible to set Profile Velocity = 0 when motor is running (in this case the previous value of Profile Velocity remains be valid). To stop a movement the commands HALT or QUICK STOP can be used.

- The drive acquires a new value of Target Position and changes the final position of the movement only if the new target position is followed by a New Set Point command (i.e. a low->high transition of bit 4 of the Control Word).

- To execute a movement without intermediate stops, the movement must be monotonous, i.e. the new Target Position must be greater or equal to the previous one for positive direction, or lower (or equal) to the previous one for negative direction.
A not monotonous new Set Point is executed with the stop of the movement with a deceleration ramp, the calculation of the new motion profile (during motor stop) and then the restart of the motion to the new Target Position.

- The motion cannot be changed when a HALT or QUICK STOP command is sent or in case of a stop and restart operation.

- The Set Point can be changed in any position of the run, even during acceleration or deceleration ramps.

- When motor is running, the Set Point value can be changed many times.

2.1.2. HOMING MODE OF OPERATION

With **Homing** mode of operation, the encoder position (Position Actual Value, object 0x6064) can be reset depending on a proximity sensor connected to the hardware **I0** input (proximity input if it is set in object 0x320C). Available Homing Method (see the description of object 0x6098 or the standard CiA DSP 402 V.2.0): 3, 4, 5, 6, 19, 20, 21, 22, 35, 37 (available Homing Method for Hi-Mod ET and R-MOD ET: 19, 20, 21, 22, 35 and 37).
An example of valid parameters storage can be:

Index (hex)	Sub Ind.	Object type	Access type		Entry description	Set Value
607C	0	I32	RW		Home Offset	**0**
6098	0	I8	RW		Homing Method	**19**
6099		Rec			**Homing Speeds**	
"	0	U8	RO		Number of entries	**2**
"	1	U32	RW		Speed during Search for Switch	**40000** [Hz]
"	2	U32	RW		Speed during Search for Zero	**3200** [Hz]
609A	0	U32	RW		Homing Acceleration	**600000** [Hz/sec]

Table 2

As example, the setting showed in Table 2 corresponds to a zero search procedure with 12800 step/rev, maximum frequency of 40 KHz, acceleration of 600 KHz/sec, slow approaching frequency at 3200 Hz and with homing method 19 (DSP 402 V.2.0).
Figure 1 shows motor frequency VS time during a zero search procedure execution.

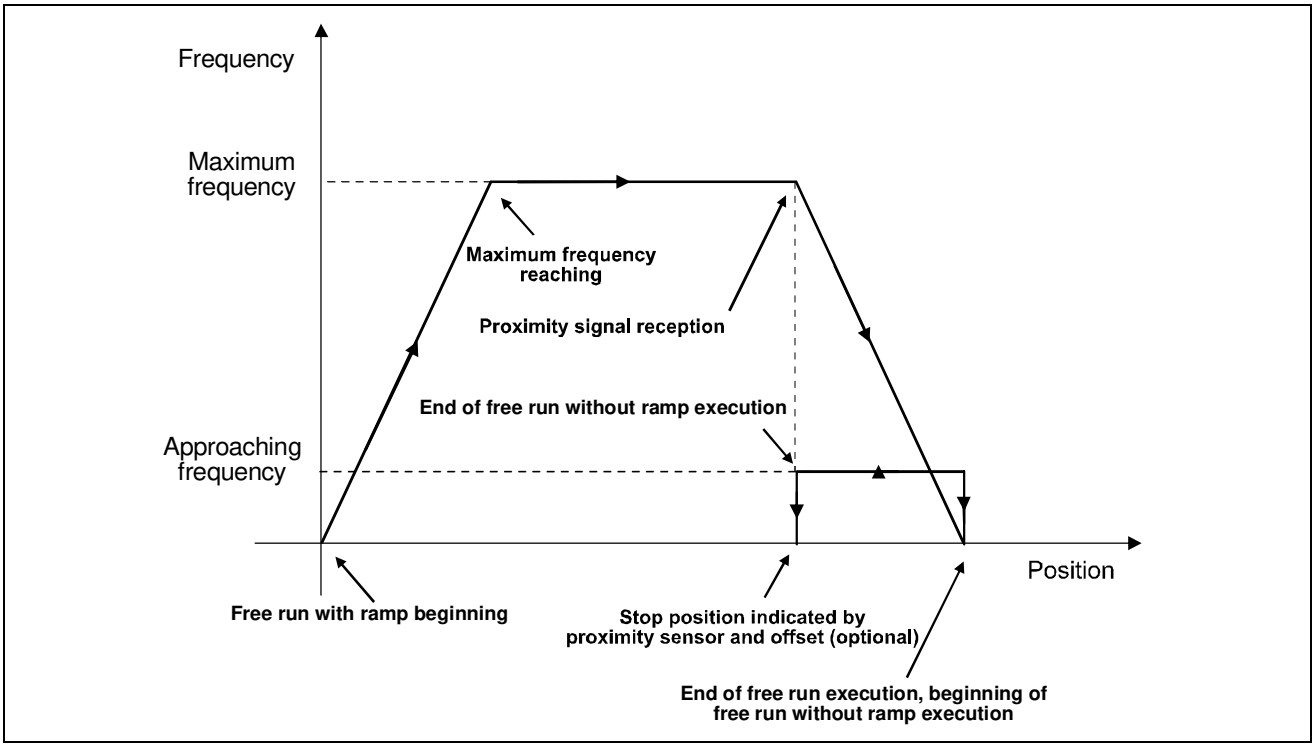


Figure 2: Motor frequency VS time during a zero search procedure execution.

If, for example, the *Home offset* is ±1000, after having reached the proximity sensor, this is the position indicated as ±1000.

Without encoder (object 0x3206 set to 17), the homing methods 19, 20, 21, 22, 35 and 37 can be used and works as mentioned above except for the Position actual Value object that not shows the encoder actual position, but the electric field position.

With encoder and with the Auto-Sync function enabled (object 0x3222 subindex 1 set to a value greater than 0) it is possible to reset the encoder on mechanical impact position by means of homing methods (RTA drive specific) -1 (or 255) and -2 (or 254).

Note: In HOMING parameters setting and with reference to Figure 2, it is suggested to set maximum speed higher than frequency value corresponding to 75 rpm (Index 0x6099 subindex1) and it is mandatory to set an approaching speed lower or equal than frequency value corresponding to 75 rpm (Index 0x6099 subindex2).

In Profile Homing, Mode Of Operation can be changed from the following sub-states: Switched On, Ready to Switch ON, Switch On Disabled, Operation Enabled.

2.1.3. CSP MODE OF OPERATION

In **CSP** mode of operation, Target Position (object 0x607A) is refreshed from the master every Cycle Time. In this mode of operation, the Target Position is always considered as an absolute reference.

Cycle Time allowed: 1ms, 2ms, 4ms.
In CSP, Mode Of Operation can be changed from the following sub-states: Switched On, Ready to Switch ON, Switch On Disabled, Operation Enabled.

2.1.4. CSV MODE OF OPERATION

In **CSV** mode of operation, Target Velocity (object 0x60FF) is refreshed from the master every Cycle Time.
Cycle Time allowed: 1ms, 2ms, 4ms.
Speed tolerance = ±0.24% ±0.10RPM.
Drive internal scale factor FS = 1.024; to have 600 RPM motor speed equal to 128000 step/s with resolution of 12800 step/rev, Index 0x60FF must be set to 131072. The autoscale function can be enable by set to 1 the object 0x3320 subindex3: in this case, to move the axis with velocity of 128000 step/s, the value of 128000 must be write in object 0x60FF.

2.1.5. PROFILE VELOCITY MODE OF OPERATION

In Profile Velocity, the drive receive from the master the requested Target Velocity (object 0x60FF) following the Master timing.
The drive process the Target values received from the Master with interpolation timer set to 1 kHz (cycle time 1 ms).

Velocity tolerance = ±0.24% ±1.5RPM.

Note: Switching between different mode of operations in Operation Enabled state must be done when the motor is standstill. Pay attention to Target Position and Target Velocity values.

2.2. DRIVE SUB-STATES

In accordance with standard CiA DSP 402, the drive can be described as a state machine.

When the drive is in Operational Mode, the behavior of the drive complies with diagram of Figure 2 in accordance with CiA DSP402 V.2.0 standard. Change of sub-states are manage through the CONTROL WORD.

Note: When the drive is power supplied, it automatically goes into the SWITCH ON DISABLED status.

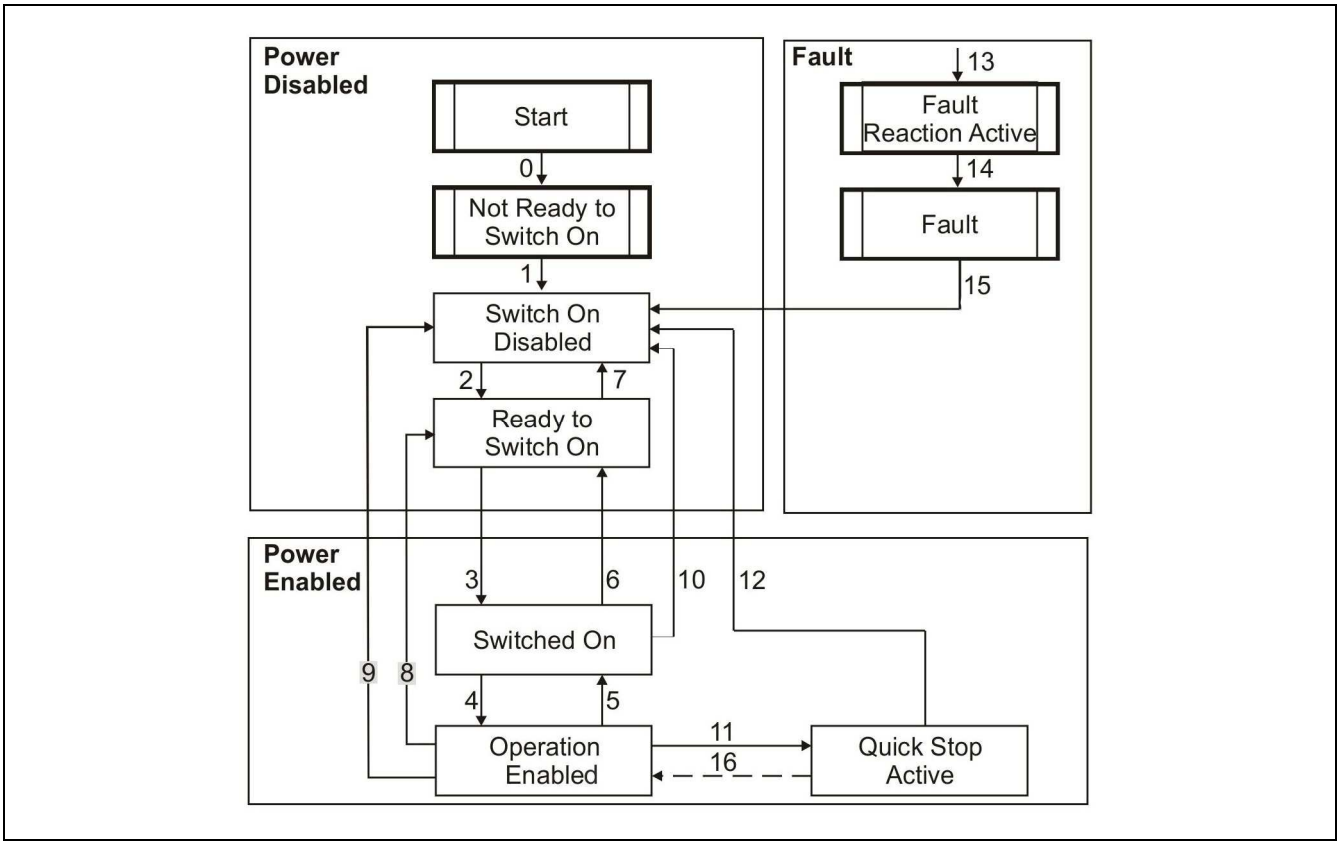


Figure 3

In detail:

Transition 3: READY TO SWITCH ON => SWITCHED ON
'Switch On' command received from master.
This transition is possible when drive power section is supplied (between HVDC+ and HVDC-) at least 500ms before the transition itself; otherwise drive remains in "READY TO SWITCH ON" state.

Transition 4: SWITCHED ON => OPERATION ENABLED
'Enable Operation' command received from master.
After this transition current in stepping motor windings is enabled.
With reference to the drive power supply 24Vdc, the first time that this transition is executed, there is a simultaneous reset of Position Actual Value object (obj 0x6064, subindex 0).

⚠ WARNING!

To interface the drive with all kind of Master that NOT expect the Position Actual Value reset at the end of this transition (TRIO, Beckhoff, etc.), the object 0x3321 subindex2 must be set to 0 (reset at the first current ON transition disabled). The customer must verify the setting (reset or not) on the specific Master.

In CSP, these cases are possible:
- If the object 0x3321 subindex2 is set to 1 (reset at first current ON transition enabled), after the first transition Switched On -> Operation Enabled, master must set Target Position = 0, regardless the encoder position before Enable Operation command.

- If the object 0x3321 subindex2 is set to 0 (reset at first current ON transition disabled), after the first transition Switched On -> Operation Enabled, the master must set Target Position = Position actual Value (the last position indicated by encoder before the Enable Operation command)
The Target Position can be changed only after 200 ms from the end of transition to Operation Enabled in order to ensure a suitable/fitting mechanical settling time of the system.
- With the next transitions Switched On -> Operation Enabled, master must set Target Position = encoder position (Position actual Value) before Enable Operation command.
The Master can change the Target Position only after 200 ms from the end of transition to Operation Enabled in order to ensure a suitable/fitting mechanical settling time of the system.

In CSV or Profile Velocity, these cases are possible:
- After the transition Switched On -> Operation Enabled, master must set Target Velocity = 0, regardless the encoder position before Enable Operation command.
Target Velocity can be changed only after 200 ms from the end of transition to Operation Enabled in order to ensure a suitable/fitting mechanical settling time of the system.

Transition 5: OPERATION ENABLED => SWITCHED ON
'Disable Operation' command received from master.
After this transition current in stepping motor windings is disabled (CURRENT OFF).

Transition 6: SWITCHED ON => READY TO SWITCH ON
'Shutdown' command received from master.
After this transition drive power supply can be disconnected.

Transition 8: OPERATION ENABLED => READY TO SWITCH ON
'Shutdown' command received from master.
After this transition current in stepping motor windings is disabled (CURRENT OFF); after this transition drive power supply can be disconnected.

Transition 9: OPERATION ENABLED => SWITCH ON DISABLED
'Disable Voltage' command received from master.
After this transition current in stepping motor windings is disabled (CURRENT OFF); after this transition drive power supply can be disconnected.

Transition 10: SWITCHED ON => SWITCH ON DISABLED
'Disable Voltage' or 'Quick Stop' command received from master.
After this transition drive power supply can be disconnected.

Transition 11: OPERATION ENABLED => QUICK STOP ACTIVE
'Quick Stop' command received from master.
- **Profile Position and Homing Profile (Quick Stop Option Code = 5)**
  Drive automatically goes into the quick stop status and, if the motor is running, bit 10 (target reached) of Status Word is 0 until the motor is stopped (in this case bit 10 = high and **that means that the motor stopped, it does NOT mean that the motor reached the target position**). Current is not disabled in stepping motor windings (motor torque is maintained).
- **CSP, CSV and Profile Velocity (Quick Stop Option Code = 0)**
  Drive automatically goes into the quick stop status, current is disabled in stepping motor windings and Transition 12 is automatically executed.

Transition 12: QUICK STOP ACTIVE => SWITCH ON DISABLED
- **Profile Position and Homing Profile (Quick Stop Option Code = 5)** - *'Disable Voltage' command received from master.*
  The drive does not execute this transition automatically, this transition is possible by means of 'Disable Voltage' command only. In this case current is disabled in stepping motor windings (CURRENT OFF).
- **CSP, CSV and Profile Velocity (Quick Stop Option Code = 0)**

- AUTOMATIC TRANSITION AT STANDSTILL MOTOR
  In quick stop active status, if the motor is running during Quick Stop reception, bit 10 (TARGET REACHED) of Status Word is set to 0 until the motor is stopped. After that bit 10 is set to 1 and **that means that the motor stopped, it does NOT mean that the motor reached the target position**. The automatic transition to Switch On Disabled causes the setting of bit 10 of SW to 0.

Transition 13-14: => FAULT
This transition is caused by drive internal faults only (thermal protection, no power supply, etc.); before this transition there is an EMERGENCY message (see chap. 3.6 about error codes); at the same time current in stepping motor windings is disabled (CURRENT OFF). In Fault state drive power supply can be disconnected.

Transition 15: FAULT => SWITCH ON DISABLED
'Fault Reset' command received from master.
This transition is allowed when the fault of the drive is solved. It is shown with EMERGENCY message 0x0000.

Transition 16: QUICK STOP ACTIVE => OPERATION ENABLED
'Enable Operation' command received from master.

- **Profile Position and Homing Profile (Quick Stop Option Code = 5)**
  This transition is allowed because Quick-Stop-Option-Code = 5. Current is kept into the motor windings (motor torque is kept).
- **CSP, CSV and Profile Velocity (Quick Stop Option Code = 0)**
  This transition is not possible because Quick-Stop-Option-Code = 0.

Note: because of electro-mechanical interactions in stepping motors, when current in motor windings is enabled or disabled (for example Transition 4), it is required to wait for a settling time of the motor of ~ 50-200ms before the motor is stabilized from the mechanical point of view. Therefore, Status Word indicating the transition to Operation Enabled means only the acknowledge of the transition, it does not mean that the drive is already stabilized. Any New Set Point commands sent before the stabilization of the drive can cause a loss of synchronism of the run in execution sent into execution.

The above-mentioned commands are achieved setting the CONTROL WORD as in Table 3, in compliance with the Table in Chapter 10.3.1 of "CiA DSP 402 V.2.0", reported as follows.

Command	Bit of the CONTROL WORD					Transitions
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	X	1	1	1	3
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset	Trans. L/H	X	X	X	X	15

Table 3

Drive status can be read by means bit of STATUS WORD as in Table 4, in compliance with the Table 5 in Chapter 10.3.2 of "CiA DSP 402 V.2.0", reported as follows.

Status	Bit of the STATUS WORD					
	Switch On Disabled Bit 6	Quick Stop Bit 5	Fault Bit 3	Operation Enabled Bit 2	Switched On Bit 1	Ready to Switch ON Bit 0
Switch on disabled	1	1	0	0	0	0
Ready to switch on	0	1	0	0	0	1
Switched on	0	1	0	0	1	1
Operation enabled	0	1	0	1	1	1
Quick stop active	0	0	0	1	1	1
Fault	0	x	1	0	0	0

Table 4

Basically: from Switch On Disabled state, in order to enable motor Current-ON and then start the motion (relating to the previously set parameters), the **requested Control Word (CW) command sequence** is the following:

CW = **0x0006** -> (Drive goes in Ready to Switch-ON state, Status Word = 0x0221 or 0x1221 if High Voltage is not available, StatusWord = 0x0231 or 0x1231 if High Voltage is available)
CW = **0x0007** -> (Drive goes in Switched-ON state, Status Word = 0x0233 or 0x1233 only if High Voltage is available, in other cases, the transition cannot be completed)
CW = **0x000F** -> (Drive goes in Operation Enabled state, Status Word = 0x0637 or 0x1637 or 0x1237, regarded to the value of Mode of Operation)
CW = **0x001F** or CW = **0x005F** (Motor starts to move following absolute or relative coordinate system, respectively. Relative coordinate are available only if the set value of Mode of Operation enables them)

The direct sequence from CW = 0x0006 to CW = 0x000F can be done. Pay attention to the High Voltage restrictions

3. OBJECT DICTIONARY

Object dictionary structure is described in the following chapter. In the appendix a summarizing table with all the object dictionary is shown.

3.1 BASIC PARAMETERS AND IDENTIFICATION (0x1000-0x1018)

In accordance with standard CANopen DS301 following objects are implemented:

Index (hex)	Sub Ind.	Object type	Acces s type		Default value	Entry description	Valid values
1000	0	U32	RO		0x0004 0192	Device type	0x0004 0192
1001	0	U8	RO		0	Error Register	0 / 1
1008	0		RO		--	Device name	PLUS ET X-PLUS ET HI-MOD ET HI-MOD ETS R-MOD ET CSD ET depending on the cases
1009	0		RO		-	Hardware version	
100A	0		RO			Software version	
1010		Rec				**Store parameters**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RW		0x00000001 (1)	Save all parameters	0x65766173 ("save")
1011		Rec				**Restore Default Parameters**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RW		0x00000001 (1)	Restore all Default Parameters	0x64616F6C ("load")
1018		Rec				**Identity**	
"	0	U8	RO		4	Number of entries	
"	1	U32	RO		0x0000017F (383)	Vendor ID	0x0000 017F
"	2	U32	RO		0x00000000 (0)	Product code	0x0000 0000…0x FFFF FFFF
"	3	U32	RO		0x00000000 (0)	Revision	0x0000 0000…0x FFFF FFFF
"	4	U32	RO		0x00000000 (0)	Serial number	0x0000 0000…0x FFFF FFFF

Table 5

In accordance with Table 5:

Index 0x1001: Error register
Valid values are:

- 0: normal operating condition; no errors
- 1: there is an error; EMERGENCY telegram is sent and the error type is shown in the Index 0x603F (Error Code) and in index 0x303F (Last Error Code).

Index 0x1010: Store Parameters
The object is used to save parameters.
In order to avoid storage of parameters by misstate, storage is only executed when a specific signature is written to the Sub Index 1. The signature is "save":

MSB			LSB
e	**v**	**a**	**s**
0x65	0x76	0x61	0x73

Note1: Keep the control power ON more than 5 seconds, after the "save" command.
Note2: "Confirmed message" via SDO means "Command Accepted", it does not mean "Parameter Saving Completed" for this object.
Note3: Alternative code for the save operation is 0xEEEEEEEE.

Index 0x1011: Restore Default Parameters
The object is used to restore the default parameters.
In order to avoid the restoring of default parameters by misstate, restoring is only executed when a specific signature is written to the Sub Index 1. The signature is “load”:

MSB			LSB
d	**a**	**o**	**l**
0x64	0x61	0x6F	0x6C

Note 1: Keep the control power ON more than 5 seconds, after the “load” command.
Note 2: “Confirmed message” via SDO means “Command Accepted”, it does not mean “Parameter Loading Completed” for this object.
Note3: Alternative code for the restore operation is 0xDDDDDDDD.

3.2 COMMUNICATION OBJECTS (0x1600-0x1B00)

Index (hex)	Sub Ind.	Object type	Acces s type		Default value	Entry description	Valid values
1600		Rec				**RPDO1**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RO		0x6040 0010	Control Word	0x6040 0010
1601		Rec				**RPDO2**	
"	0	U8	RO		2	Number of entries	
"	1	U32	RO		0x6040 0010	Control Word	0x6040 0010
"	2	U32	RO		0x607A 0020	Target Position	0x607A 0020
1700		Rec				**RPDO100**	
"	0	U8	RW		5	Number of entries	
"	1	U32	RW		0x6040 0010	1st mapping data	See the following NOTE
"	2	U32	RW		0x6060 0008	2nd mapping data	
"	3	U32	RW		0x0000 0008	3rd mapping data	
"	4	U32	RW		0x607A 0020	4th mapping data	
"	5	U32	RW		0x0000 0000	5th mapping data	
"	6	U32	RW		0x0000 0000	6th mapping data	
"	7	U32	RW		0x0000 0000	7th mapping data	
"	8	U32	RW		0x0000 0000	8th mapping data	
1A00		Rec				**TPDO1**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RO		0x6041 0010	Status Word	0x6041 0010
1A01		Rec				**TPDO2**	
"	0	U8	RO		2	Number of entries	
"	1	U32	RO		0x6041 0010	Status Word	0x6041 0010
"	2	U32	RO		0x6064 0020	Position Actual Value	0x6064 0020
1B00		Rec				**TPDO100**	
"	0	U8	RW		7	Number of entries	
"	1	U32	RW		0x6041 0010	1st mapping data	See the following NOTE
"	2	U32	RW		0x6061 0008	2nd mapping data	
"	3	U32	RW		0x0000 0008	3rd mapping data	
"	4	U32	RW		0x6064 0020	4th mapping data	
"	5	U32	RW		0x0000 0000	5th mapping data	
"	6	U32	RW		0x0000 0000	6th mapping data	
"	7	U32	RW		0x0000 0000	7th mapping data	
"	8	U32	RW		0x0000 0000	8th mapping data	

Table 6

EMERGENCY OBJECT

The error codes mapped in the EMERGENCY message are listed in the description of 0x603F (see Chap. 3.6).

PROCESS DATA OBJECT (PDO)

Every PDO can be enabled.

The available PDO are the following (the example about TPDO100 and RPDO100 corresponds to default configuration):

RPDO 1:

Byte0	Byte1
Control Word	

RPDO 2:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5
Control Word		Target Position			

RPDO 100:

Byte0	Byte1	Byte2	ByteEmpty	Byte4	Byte5	Byte6	Byte7
Control Word		Mode of Operation		Target Position			

TPDO 1:

Byte0	Byte1
Status Word	

TPDO 2:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5
Status Word		Actual Position			

TPDO 100:

Byte0	Byte1	Byte2	ByteEmpty	Byte4	Byte5	Byte6	Byte7
Status Word		Mode of Op.disp		Actual Position			

Note: RPDO100 / TPDO100
It is available the mapping of the following objects:

- RPDO100:
CURRENT RATIO (obj 0x3201),
CONTROL WORD (obj 0x6040),
MODE OF OPERATION (obj 0x6060),
TARGET POSITION (obj 0x607A),
TOUCH PROBE FUNCTION (obj 0x60B8),
TARGET VELOCITY (obj 0x60FF),
SET OUTPUT (obj 0x320A)
PROFILE VELOCITY (obj 0x6081)

- TPDO100:
STATUS WORD (obj 0x6041),
MODE OF OPERATION DISPLAY (obj 0x6061),
ACTUAL POSITION (obj 0x6064),
VELOCITY ACTUAL VALUE (obj 0x606C),
TOUCH PROBE POSITION POSITIVE VALUE (obj 0x60BA),
TOUCH PROBE POSITION NEGATIVE VALUE (obj 0x60BB),
TOUCH PROBE STATUS (obj 0x60B9),
DIGITAL INPUTS (obj 0x60FD)
ERROR CODE (obj 0x603F)

Mapping an 8 bit object (for example MODE OF OPERATION) requires an empty byte, placed immediately after the same object. For more details, see the previous examples.
If required, it is possible to map empty object of 16 or 32 bit dimension.

POSITION POSITIVE VALUE and TOUCH PROBE POSITION NEGATIVE VALUE objects can be mapped at the same time, but it is not possible to use Touch Probe Function to sample at the same time the positive edge trigger position and the negative edge trigger position.

The maximum range of mapping objects in TPDO100 and RPDO100 is 16 bytes (dummy objects with 1 byte included); the maximum number of mapping objects in TPDO100 and RPDO100 is 8 (dummy objects included).
In the case of use at the same time RPDO1 (or RPDO2) and RPDO100, it is strictly forbidden to map objects Control Word and Target Position also as a copy in RPDO100.

When SET OUTPUT is mapped in RPDO100:
- The minimum time between two switching requests of any output cannot be less than 10ms
- The minimum time between the switching request of any output and writing of SDO cannot be less than 5ms

If it is necessary to map SET OUTPUT object and TOUCH PROBE FUNCTION object at the same time and Mode of Operation is set to Profile Position or Homing, please contact RTA in order to evaluate the specific application limits.

3.3 COMMUNICATION TIMING (0x1C32-0x1C33)

In EtherCAT, synchronization mode is displayed in 0x1C32 and 0x1C33 Sub Index in Object Dictionary.
About setting of synchronization mode, refer to Chap. 4.1.
The synchronous mode supported to RTA series drives are the following:

3.3.1 SYNCHRONOUS WITH SM2 EVENT

Since slave process is started to SM2 event cycle, always synchronizes with SM2 event (TxPDO received).
Operated in local cycle time receiving SM2 event.
In OP and Safe OP, process data frame on SM2 event must be always enabled.

1C32		Rec		**SM output parameter**	
“	1	U16	RW	Sync mode	Synchronized with 0x01: SM2
“	2	U32	RO	Cycle time	Communication Cycle time
“	4	U16	RO	Sync modes supported	Bit1=1: Synchronization Supported
“	5	U32	RO	Minimum cycle time	
“	8	U16	RW	Get cycle time	
“	B	U32	RO	Cycle exceeded counter	
“	C	U32	RO	SM event missed counter	
“	20	U32	RO	Sync error	
1C33		Rec		**SM input parameter**	
“	1	U16	RW	Sync mode	Synchronized with 0x22: SM2
“	2	U32	RO	Cycle time	Same set to 0x1C32.2
“	4	U16	RO	Sync modes supported	Same set to 0x1C32.4
“	5	U32	RO	Minimum cycle time	Same set to 0x1C32.5
“	8	U16	RW	Get cycle time	Same set to 0x1C32.8
“	B	U32	RO	Cycle exceeded counter	Same set to 0x1C32.B
“	C	U32	RO	SM event missed counter	Same set to 0x1C32.C
“	20	U32	RO	Sync error	Same set to 0x1C32.20

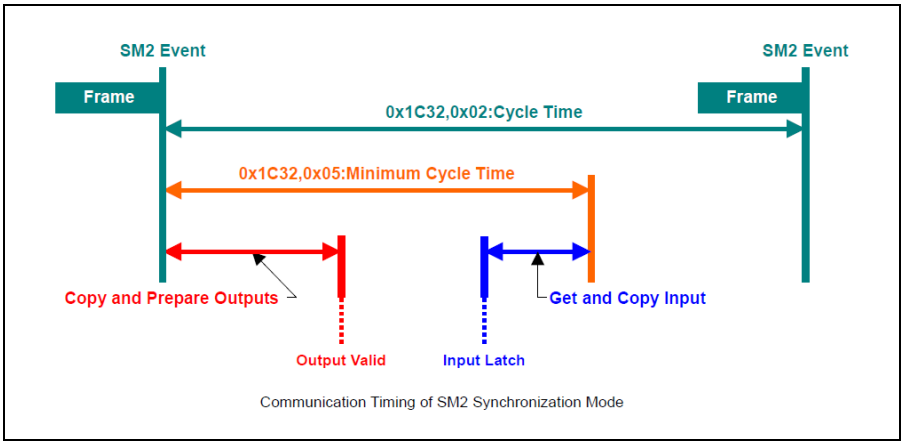


Figure 4

3.3.2 DC MODE 1 (SYNC0 Event Synchronization)

Local cycle of slave is started to SYNC0 event reception.
Process data frame (PDO sent on SM2) must be received by the slave before the next SYNC0 interrupt generation. If the reception is not completed before the generation of SYNC0 interrupt, the value of PDO registers is not changed until the reception of the next SYNC0 event.

1C32		Rec		**SM output parameter**	
“	1	U16	RW	Sync mode	Synchronized with 0x02: DC SYNC0
“	2	U32	RW	Cycle time	Cycle time SYNC0
“	4	U16	RO	Sync modes supported	Bit4:2=001: Synchronization Supported
“	5	U32	RO	Minimum cycle time	
“	8	U16	RW	Get cycle time	
“	B	U32	RO	Cycle exceeded counter	
“	C	U32	RO	SM event missed counter	
“	20	U32	RO	Sync error	
1C33		Rec		**SM input parameter**	
“	1	U16	RW	Sync mode	Synchronized with 0x02: DC SYNC0
“	2	U32	RW	Cycle time	Same set to 0x1C32.2
“	4	U16	RO	Sync modes supported	Same set to 0x1C32.4
“	5	U32	RO	Minimum cycle time	Same set to 0x1C32.5
“	8	U16	RW	Get cycle time	Same set to 0x1C32.8
“	B	U32	RO	Cycle exceeded counter	Same set to 0x1C32.B
“	C	U32	RO	SM event missed counter	Same set to 0x1C32.C
“	20	U32	RO	Sync error	Same set to 0x1C32.20

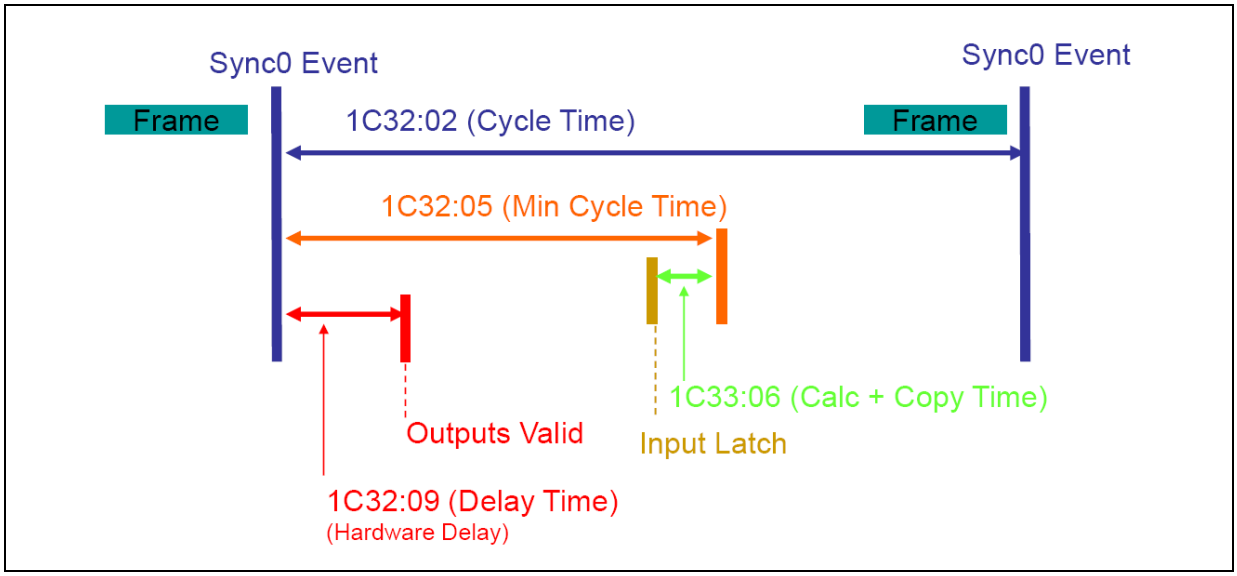


Figure 5

Note: DC MODE on ETHERCAT MASTER

With DC MODE and Mode of Operation set to CSP, some Ethercat masters may show a communication jitter so large that the frames including Target Position do not get the slave into the correct timeout limits. As a consequence, movements can be noisy. To overcome this challenge, the DC MODE master parameter named “Shift Time” must be set to a value in the range of +150 µs and +300 µs.

3.3.3 TRIO MASTER CONFIGURATION

In order to adjust the communication jitter, the DC shift time must be set to the proper value. It is thus mandatory to insert in any project the following instruction lines:

In MC_CONFIG:

```
AUTO_ETHERCAT = $21                          ' start the master up to PRE-OPERATIONAL
```

In STARTUP:

```
ETHERCAT($91, -1, 1000 * SERVO_PERIOD + 300)      ' DC shift time = + 300 µs
ETHERCAT(0,0)                                     ' start the EtherCAT net
UNIT_CLEAR                                        ' clear system errors register, once in OPERATIONAL
```

3.3.4 FREE RUN

The drive working cycle does not depends on the Master PDO cycle. The frame sending cycle on SM2 must be always set to a value lower than 100 ms. If it is greater than 100ms, the drive will change its own state to Ethercat Pre-OP (Watchdog Timeout).

1C32		Rec		**SM output parameter**	
“	1	U16	RW	Sync mode	0x00: Free Run
“	2	U32	RO	Cycle time	
“	4	U16	RO	Sync modes supported	
“	5	U32	RO	Minimum cycle time	
“	8	U16	RW	Get cycle time	
“	B	U32	RO	Cycle exceeded counter	
“	C	U32	RO	SM event missed counter	
“	20	U32	RO	Sync error	
1C33		Rec		**SM input parameter**	
“	1	U16	RW	Sync mode	0x00: Free Run
“	2	U32	RO	Cycle time	Come 0x1C32.2
“	4	U16	RO	Sync modes supported	Come 0x1C32.4
“	5	U32	RO	Minimum cycle time	Come 0x1C32.5
“	8	U16	RW	Get cycle time	Come 0x1C32.8
“	B	U32	RO	Cycle exceeded counter	Come 0x1C32.B
“	C	U32	RO	SM event missed counter	Come 0x1C32.C
“	20	U32	RO	Sync error	Come 0x1C32.20

3.4 CONTROL WORD, STATUS WORD (0x6040-0x6041)

Index (hex)	Sub Ind.	Object type	Access type.		Default value	Entry description	Valid values
6040		U16	RW		--	Control Word	0x0000…0xFFFF
6041		U16	RO		--	Status Word	0x0000…0xFFFF

Table 7

3.4.1 CONTROL WORD STRUCTURE

In accordance with standard CAN (DSP 402 V.2.0, Chap 10.3.1) CONTROL WORD (object 0x6040 of Object Dictionary) corresponds to a string of 16 bit. Through the control word the user can control the condition of the device.
In the following table the meaning of control word bits is shown.

Profile Position mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
User specification					reserved		Halt	Fault reset	abs/rel	Change set immed	New set point	Enable operat	quick stop	Enable voltage	switch ON
0	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Homing mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
User specification					reserved		Halt	Fault reset	reserved	reserved	New set point	Enable operat	quick stop	Enable voltage	switch ON
0	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**S**	**0**	**0**	**S**	**S**	**S**	**S**	**S**

CSP mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
User specification					reserved		--	Fault reset	--	--	--	Enable Operat	Quick Stop	Enable voltage	switch ON
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**S**	**S**	**S**	**S**

CSV mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
User specification					reserved		--	Fault reset	--	--	--	Enable Operat	Quick Stop	Enable voltage	switch ON
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**S**	**S**	**S**	**S**

Profile Velocity mode of operation															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
User specification					reserved		**Halt**	Fault Reset	--	--	--	Enable Operat	Quick Stop	Enable Voltage	Switch ON
0	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**S**	**S**	**0**	**S**	**S**	**S**	**S**	**S**

Key:
S: managed. 0: Not managed; set always bit = 0
To have a right transition between OPERATIONAL MODE status, refer to Chap. 2.3, Table 4.

Bit 2: Quick Stop
1 = no Quick Stop execution
0 = Quick Stop execution.

Bit 3: Enable Operation
1 = normal working drive (CURRENT ON)
0 = CURRENT OFF

Bit 4: New Set Point
If set to 1 by master it modifies bit 12 of the STATUS WORD (Set Point Acknowledge) and executes a run depending on Target Position sent to the drive.

Bit 5: Change Set Point Immediately
0 = Target Position and/or Profile Velocity can be modified only after the target was reached or after an Halt command;
1 = Target Position and/or Profile Velocity can be modified as indicated in Chap.2.1.1

Bit 6: Rel/Abs
0 = absolute coordinates system
1 = relative coordinates system
(See Chap. 2.1.1).
In CSP operation mode, bit 6 is always = 0; master can emulate a relative coordinate system, but it must always send information in absolute coordinate to the drive.

Bit 7: Fault Reset
If set to 1, Fault condition is reset, if the problem is finished (that means an EMERGENCY 0x0000 is sent, the value of the object 0x603F is 0x0000). After this bit 7 has to be set to 0.

Bit 8: Halt
0 = normal working condition
1 = Halt execution and request stop to the motor. At motor standstill, after Halt execution, Target Reached = 1 (bit 10 of STATUS WORD). If Halt is then set to 0, Target Reached is automatically set to 0 and the interrupted movement is not completed.

3.4.2 STATUS WORD STRUCTURE

In accordance with standard CAN (DSP 402 V.2.0, Chap 10.3.2) the STATUS WORD (object 0x6041 of object dictionary) corresponds to a string of 16 bit used to communicate the device condition.

Profile Position mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
Profile Ramp	Closed Loop Active	Position Error	Set point acknowl edge	Int. Limit active	Target Reached	Remote	Manufa ct Spec	Warning	Switch ON Disable d	Quick Stop	Voltage Enabled	Fault	Oper. Enabled	Switche d On	Ready to switch ON
S	**S**	**S**	**S**	**0**	**S**	**S**	**0**	**0**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Homing Mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
Profile Ramp	Closed Loop Active	Position Error	Homing Attained	Int. limit active	Target Reached	Remote	Manufa ct Spec	Warning	Switch ON Disable d	Quick Stop	Voltage Enabled	Fault	Oper. Enabled	Switche d On	Ready to switch ON
S	**S**	**S**	**S**	**0**	**S**	**S**	**0**	**0**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

CSP Mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
Manufac Spec	Closed Loop Active	Following Error	Target Position Ignored	Int. Limit Active	CSP Toggle	Remote	Manufact Spec	Warning	Switch ON Disable d	Quick Stop	Voltage Enabled	Fault	Oper. Enable	Switched On	Ready To Switch ON
0	**S**	**S**	**S**	**0**	**S**	**S**	**0**	**0**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

CSV Mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
Manufac Spec	Closed Loop Active	Max slippage error	Target Value Ignored	Int. Limit Active	Reserved	Remote	Manufact Spec	Warning	Switch ON Disable d	Quick Stop	Voltage Enabled	Fault	Oper. Enable	Switched On	Ready To Switch ON
0	**S**	**S**	**S**	**0**	**S**	**S**	**0**	**0**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Profile Velocity Mode of operation															
Bit **15**	Bit **14**	Bit **13**	Bit **12**	Bit **11**	Bit **10**	Bit **9**	Bit **8**	Bit **7**	Bit **6**	Bit **5**	Bit **4**	Bit **3**	Bit **2**	Bit **1**	Bit **0**
Manufac Spec	Closed Loop Active	Max slippage error	**Zero speed**	Int. Limit Active	Target Reached	Remote	Manufact Spec	Warning	Switch ON Disable d	Quick Stop	Voltage Enabled	Fault	Oper. Enabled	Switched On	Ready To Switch ON
0	**S**	**S**	**S**	**0**	**S**	**S**	**0**	**0**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Key: S: managed. 0: always = 0. 1: always = 1.
For the right meaning of the current status in OPERATIONAL MODE, refer to Chap. 2.3 Table 5.
Managed bits of the STATUS WORD have the following meaning:

Bit 2: Operation Enable
1 = Drive is in CURRENT ON status and the current flows in each motor winding.

Bit 3: Fault
Usually is 0, when it is 1 the drive is in Fault condition.

Bit 4: Voltage Enabled
0 = The power supply is higher than maximum allowed voltage or lower than minimum allowed voltage.

Bit 5: Quick stop
Usually 1, when it is 0 drive is in QUICK STOP status.

Bit 9: Remote
Drive can receive and execute command through communication bus when it is 1. Communication through PDO is not allowed when it is 0.

Bit 10: Target reached
Usually it is 0, it is 1 when a run or an homing procedure or a quick stop or halt command is successfully executed.

In Profile Velocity Mode, bit 10 becomes equal to 1 when the motor speed is equal to Target Velocity (or 0 after an Halt command) with a tolerance range defined by the object index 0x606D and for a time interval defined in the object index 0x606E.
In CSP mode of operation, the bit 10 is a toggle and indicates Target Position drive interpolation is active following the communication period set on Master.

Bit 11: Internal limit active
It is 1 when the motor position exceeded the limit switch (if limit switch function is active).
Note: see the object 0x320C.

Bit 12: Zero speed status
In Profile Velocity mode, the bit 12 is equal to 1 when motor speed is 0 with a tolerance range defined in object index 0x606F, for a time interval defined in object 0x6070.

Bit 13: Following Error / Max Slippage Error
It indicates the Position Error for motor stall, read by the drive through encoder.
0: No Position Error
1: Position Error

Bit 14: Closed Loop Active
Become active by means of object Status Word Manufacturer Bits (index 0x3322, subindex2).
1: show that the drive auto-syncronization function (see object index 0x3222 Auto-Synchronization Parameters) is working in order to modify the motion;
0: show that the drive is in standstill state or the execution movements are Open Loop type.

Bit 15: Profile Ramp
Become active by means of object Status Word Manufacturer Bits (index 0x3322, subindex1).
1: show that the actual movement is an acceleration or deceleration ramp;
0: show that the motor is standstill or the velocity is constant.
This bit is active only in Profile Position or Homing mode of operation.

Note: Control Word/Status Word timing on a Master state Machine
When designing a state machine on an Ethercat Master, and starting from the Control Word sending moment, we suggest to wait at least 12ms before verify (read) the effects on the Status word. This time delay not depends on the communication Cycle tyme.

3.5 DRIVE SETTINGS (0x303F-0x3333)

Index (hex)	Sub Ind.	Object type	Access type.	Note	Default value	Entry description	Valid values
303F	0	U16	RO	1	0x0000	Last Error Code	0x0000…0x8611
3201	0	U8	RW	1,2	0x46 (70)	Current Ratio	0…120
3202	0	U16	RW	1,2	0x3200 (12800)	Step Revolution	12800
3203	0	U8	RW	1,2	0x00 (0)	Current Equalization	0 / 1, 0 only for CSD ET and R-MOD ET
3204	0	U8	RW	1,2	0x01 (1)	Current Reduction	0 / 1 for PLUS ET, X-PLUS ET, HI-MOD ET e HI-MOD ETS 1 for CSD ET and R-MOD ET
3205	0	U8	RO	1,2	0x03 (3)	Encoder Window	0 / 1 / 2 / 3 / 4 / 5
3206	0	U8	RW	1,2	0x00 (0)	Following Error Reaction Code	0x00 / 0x01 / 0x02 / 0x11
3207	0	U8	RW	1	0x00 (0)	Following Error Reset	0 / 1 / 2
3208	0	U8	RW	1,2	0x32 (50)	Current Reduction Ratio	0…100
320A	0	U8	RW	1	0x00 (0)	Set Output	0…15 for PLUS ET and X-PLUS ET 0…3 for HI-MOD ETS 0…31 for CSD ET 04 / 94 0 for CSD ET 24
320C	0	U8	RW	1,2	0x0F (15) 0x1F (31) for CSD ET	Input Config	0…15 for PLUS ET and X-PLUS ET 14…15 for Hi-Mod ET 0x0E, 0x0F, 0x8E, 0x8F for HI-MOD ETS 0…31 for CSD ET and R-MOD ET 0…143 for X-PLUS ET S4
320D	0	U8	RW	1,2	0x03 (3) 0x01 (1) for Hi-Mod ET and X-Plus ETS 0x1B (27) and CSD ET	Output Config	0…7 for PLUS ET and X-PLUS ET 0…39 for CSD ET 04 / 94 0 for CSD ET 24
3210	0	U32	RW RO	1,2	-0x00045E2C (286252) --for PLUS ET 0x00045E2B (286251) -- for X-PLUS ET 0x000ADFA9 (712617) - for CSD ET	Motor Code	[see object description]
3211	0	U32	RW	2	0x0000 0000 (0)	Final Velocity	[reserved]
3212	0	U8	RW	1,2	0x00 (0)	Revolution Direction (CW / CCW setting)	0 / 1
3214	0	I32	RW		0x0000 0000 (0)	Minimum Speed Monitor	[reserved]
3220		Rec		1		**Drive Parameters**	
	0	U8	RO		0x04 (4)	Number of entries	
	1	U16	RO		- 0x06 (6) for PLUS ET e Hi-Mod ET - 0x04 (4) for other models	Current Limit (A)	- 2, 3, 4, 5, 6 for PLUS ET, Hi-Mod ET and Hi-Mod ETS - 1, 2, 3, 4 for the others models
	2	U16	RO		0x190 (400)	Proportional Gain (%)	100, 200, 300, 400
	3	U16	RO		0x1F4 (500)	Dynamic Balancing Gain (%)	0, 500
	4	U16	RO		0x01 (1)	Current Recycling Enable	0, 1
	5	U16	RO		0x00	Proportional Feed Forward	0
3222		Rec		1,2		**Auto-Sync Parameters**	
	0	U8	RO		0x03 (3)		
	1	U16	RW		0x00 (0)	Enable Mode	0 / 1 / 2 / 3
	2	U16	RW		0x64 (100)	Reactivity (Kv Gain)	0, 50, 100, 150, 200, 250, 300
	3	U16	RW		0x7D00 (32000)	Error Window (steps)	1…64000
3305	0	U8	RW	2	0x00 (0)	Emcy Enable	0 / 1
3306	0	U8	RW	2	0x00 (0)	Interp_Enable Bit	0 / 1
3307	0	U8	RW	2	0x00 (0)	INIT Reaction	0 / 3
3308	0	U16	RW	2	0x0190 (400)	CPR (Encoder Counts Per Revolution)	400 / 500 / 512 / 1000 / 1024 / 4000/ 4096
330A	0	U16		1,2	0x0064 (100)	Brake Delay Lock	0…1000

330B		Rec		1,2		**Brake Unlock Delay**	
	0	U8	RO		0x03 (3)	Number of entries	--
	2	U16	RW		0x0000 (0)	Brake Delay Current ON	0…1000
	3	U16	RW		0x00E6 (230)	Brake Delay Azio Ready	0…1000
3320		Rec		1,2		**Advanced Interpolation Parameters**	
	0	U8	RO		0x03 (3)	Number of entries	
"	1	U16	RW		1	CSP Hole Correction Enable	0 / 1
"	2	U16	RW		0	CSP-CSV Extended Interpolation Time (ms)	0 / 8 / 16
	3	U16	RW		0	CSV Automatic 1.024 Correction Factor Enable	0 / 1
3321		Rec		1,2		**Advanced Position-Velocity Parameters**	
	0	U8	RO		0x04 (4)	Number of entries	
	1	U16	RW		100	Velocity Actual Value Total Samples	1 / 2 / 4 / 5 / 8 / 10 / 20 / 25 / 40 / 50 / 100 / 200
	2	U16	RW		1	Reset Encoder On First Power Up	0 / 1
	3	U16	RW		64	Hard Stop Homing Disengaging Steps	0…255
3330		Rec				**Request Parameters**	
"	0	U8	RO		2	Number of entries	
"	1	I16	RW		0	View data	
"	2	I32	RO		0	N holes corrected	
3333		Rec		1,2		**Drive Alarm Register**	
"	0	U8	RO		20	Number of entries	
"	1	I32	RO		0	1st Latest Alarm Time	
"	2	I32	RO		0	1st Latest Alarm	
"	...	I32	RO		0	nth Latest Alarm Time	
"	...	I32	RO		0	nth Latest Alarm	
"	19	I32	RO		0	10th Latest Alarm Time	
"	20	I32	RO		0	10th Latest Alarm	

Table 8

In the column "**Note**":
1: This value shows that there is a comment for this object in the preceding chapters.
2: This value shows that the data written in the object can be stored in permanent storage (see Index 0x1010).

OGGETTO 0x303F: Last Error Code
Shows the same Error Code saved in object index 0x603F and mapped in EMERGENCY message.
Last Error Code, in case of Fault Transition, does not switch automatically to 0x0000 when the alarm cause vanish.
Implemented error code:
0x8611: "Motor following error"
0x8400: "Axis speed too high" (see object 0x3321 subindex 4)
0x5100: "Error power supply out of range"
0x4310: "Error drive excessive temperature"
0x2130: "Error short circuit" (or overcurrent on motor phase)
0x0000: "Emergency end"

After sending the message 0x2130, 0x4310, 0x5100, 0x8400, 0x8611, the drive state switch to Fault (and the current in motor winding become zero).

Index 0x3201: Current Ratio
Valid values are in the range **0** - **120**% and corresponds to nominal current percentage set as regards to full-scale current of the drive (object 0x3220 subindex 1) and depends also from the motor used. The drive current can be calculated by the following expression (in square brackets, the objects are indicated as [index.subindex]):

$$I_N = [0x3220.1] * [0x3201.0/100]$$

The current can be automatically reduced in case of motor standstill (see objects 0x3204, 0x3208, 0x3222 subindex1)
Default value is 70.
Motor code can be selected through the object 0x3210. It is suggested to avoid the continuous use of current values higher than 100% to avoid overheating of the motor and drive.

It is suggested to set a new setting only if motor is stopped.

Index 0x3202: Steps per Revolution
Valid values are:

- 12800: 12800 step/rev

Note: Lower step/revolution (400, 800, 1600, 3200, 6400 step/rev) are also available. In any case it is recommended to use the default value. Lower step revolution can be used only in particular cases.
The writing of this object produces the reset of Position Actual Value if the drive is not in Operation Enabled or in Quick Stop Active state. In these cases, the position will reset when the drive switch to a current OFF state.

Index 0x3203: Equalization
Valid values are:

- 0: equalization EXCLUDED
- 1: equalization ACTIVE

The new value must be set only if motor is stopped and it become active immediately.
Note1: with equalization active the motor has more torque at intermediate speed.
In any case it is recommended to exclude the equalization if the drive has to make short runs with short stopping time between them.
Note2: for CSD ET and R-MOD ET, the available value is 0 only.
Note3: equalization is always disabled if the Auto Sync function is enabled (object 0x3222).

Index 0x3204: Current Reduction
Valid values are:

- 0: automatic reduction excluded (this value is not available for CSD ET and R-MOD ET)
- 1: automatic reduction active

It is suggested to set a new setting only if motor is stopped.

If automatic reduction is active the current is reduced with respect to the nominal current following the ratio set in the object 0x3208 (Current Reduction Ratio) about 80ms after the end of the run, when motor is in standstill condition. The drive current is equal to the following expression (in square brackets, the objects are indicated as [index.subindex]):

$$I_{SS} = [0x3220.1] * [0x3201.0/100] * [0x3208.0/100]$$

Note1: With the exception of particular applications, we recommend to maintain the automatic current reduction enabled to avoid overheating.
Nota2: when Auto Sync function is enabled, the Current Reduction setting is è ignored: the current reduction is set by the object 0x3222 subindex1.

Index 0x3205: Encoder Window
Valid values are:

- 0: position error of 0.9° (1/2 full step) compared with the command position
- 1: position error of 1.8° (1 full step) compared with the command position
- 2: position error of 3.6° (2 full step) compared with the command position
- 3: position error of 5.4° (3 full step) compared with the command position
- 4: position error of 7.2° (4 full step) compared with the command position
- 5: position error of 9.0° (5 full step) compared with the command position

The value of the encoder window corresponds to the limit of the angular error that causes the raising of the synchronism motor loss error (the drive synloss reaction can be set by object 0x3206 Following Error Reaction Code). Suggested value: 3. Lower values can be used in particular mechanical conditions only. (With values lower than 2 you can have alarm intervention also for auto-recovering position error).

The object can be written also when motor is running.
Note1: if the encoder reading is disabled (object 0x3206 set to 17), the synloss cannot be sensed and the Encoder Window setting is ignored).
Note2: if the Auto Sync function is enabled, the Encoder Window setting is ignored: the error window become equal to the value set by the value in the object 0x3222 subindex3.

Index 0x3206: Following Error Reaction Code
Following Error Reaction Code allows to set different possible drive reactions when maximum error is exceeded, set by means of index 0x3205 if Auto Sync function is disabled or by means of object 0x3222 subindex3 if the Auto Sync function is enabled. In every Operation Modes, the Alarm of Following Error causes the setting of bit 13 (Following Error) of Status Word at 1.
In case of use of a motor without encoder this index must be set to 17 (0x11), see also details about object 0x3210.

- "0x0**0**": **Profile Position and Homing operation mode:** when a Following Error is raised during the execution of run with ramp, the drive executes the deceleration ramp and stops. When a Following Error is raised during the execution of run without ramp, the drive immediately stops. *Bit 10 (Target Reached) of Status Word is set to 1 when the motor stops, not when the target position is reached.*

  Bit 13 of Status Word remains high until a following run execution.

  CSP, CSV and Profile Velocity operation mode: the drive works in the same way as in "2" mode of operation as described below.

- "0x0**1**": **Profile Position and Homing operation mode:** when a Following Error is raised, running motor is not stopped*; bit 10 (Target Reached) of Status Word is set to 1 when all steps required by the execution of the run are completed; not when the set position is reached.*
  Bit 13 of Status Word remains high also during the following runs, as long as Index 3207.0 is set = 1 or 2 (or the drive executes transition that causes the disabling of the current in motor windings, for example: Ready to Switch On).
  Bit 13 of Status Word must be reset to run in Absolute Coordinate System.
  CSP, CSV and Profile Velocity operation mode: the drive continues to follow the Target received from master. Bit 13 of Status Word means an emergency condition, which is the loss of synchronism in relation to the specific run required from master.

⚠ WARNING!

When the Auto Sync function is enabled, (value of object 0x3222 subindex1 greater than 0), the setting Following Error Reaction Code = 0x01 (which is only a software monitor and does not produce an automatic transition to the Fault state in case of following error) can result in a potentially dangerous situation if it's not correctly managed, because the drive will not automatically go into a Fault status in case of loss of synchronism.
It is recommended not to use the above settings; if the setting is used, the customer is the only responsible to ensure the required safe operation of the system.
Safe operation can be obtained by using an Ethercat Master (such as for example Master TRIO Motion) which provides built-in drives following error control systems (i.e. monitor for the difference from command Target Position and Position Actual Value).

Note: When Auto Sync function is enabled with optional setting Following Error Reaction Code = 0x01, the *bit 13 of Status Word* becomes equal to 0 when the synchronization between motor command position and actual position is recovered.

- "0x0**2**":**Profile Position and Homing operation mode:** when a Following Error is raised, the drive goes in Fault state and current in the motor windings is disabled (current off).
  CSP, CSV and Profile Velocity operation mode: when the Following Error exceeds the value set in Encoder Window object (0x3205) and the Auto Sync function is disabled or by object 0x3222 subindex3 with Auto Sync function enabled, the drive automatically is inhibited and current in the motor windings is disabled. In this condition, the drive works in this way:
  A - CoE-Emergency (Hex: 8611, 00, '00 00 00 00 00 ') is sent.
  B - The drive goes in Current Off state with a motor deceleration (the drive doesn't keep torque in the motor during deceleration).
    1) – Status Word indicates the transition from "Operation Enabled" (0x1237 and 0x1637) to "Fault Reaction Active" (0xXXXF).
    2) – Setting of bit 12 and 13 of Status Word are the following: bit 13 = 1, bit 12 = 0.
    3) – Status Word is 0x201F (bit Remote and Quick Stop are set = 0).
    4) – The drive ignores the new target sent from the master.
    Typically, when the master receives a CoE - Emergency message (and Fault Reaction Active), it sends a Control Word = 0x0006 (Shutdown).
  C - When the motor stops:
    1) – The drive goes in "Fault" state (0x1218).
    2) – Bit 12 and 13 of Status Word values are the following: bit 13 = 0, bit 12 = 1.
    3) – Bit Remote = 1 (bit 9 of SW) means that the drive can receive new commands (by means Control Word).
  D - To reset error and set the drive in Operation Enabled state:
    1) – Master must send a Control Word of "Fault Reset" (0x0086)
    2) – Master must set the target with the same value read by encoder
    3) – Master must reset the drive in "Operation Enabled" by means CoE commands.

Note: in Twincat, procedure described in "D" is executed automatically by means function "FUNCTION_BLOCK MC_Reset" ("F8" of panel "on line").

- "**0x11"**: It is the value to set if motor is without encoder. This is a preliminary basic setting of the drive, the value must be written in a state lower than Operation Enabled. In this case, the drive cannot read the encoder position and so cannot activate any kind of Following Error alarm. The Position Actual Value sent to the Master corresponds to the command position sent from the drive to the motor. The bit 13 of the Status Word is always equal to "0".

Index 0x3207: Following Error Reset
Write 1 to reset bit 13 (Following Error) of Status Word.
In case of Auto Sync function disabled (object 0x3222 subindex1 = 0), writing 1 in this object also produces the reset of the offset between encoder position and command position.
This object can also be used to fix starting offset between Position Actual Value and Target Position, for example due to an excessive load inertia on the motor shaft.
In case of Following Error Reaction Code = 0x1, this is the only method allowing the Status Word bit 13 reset (when Auto Sync function disabled).
In case of Following Error Reaction Code = 0 or 2, the Status Word bit 13 reset automatically when drive state switch to a current OFF state or when a new Profile Position or Homing movement start.

It is not possible to use the reset command when the drive state is different from Operation Enabled.
By writing Following Error Reset = 2, the reset of following error is obtained by loading the drive internal value of the logic step counter into encoder position register (Position Actual Value). The command Following Error Reset = 2 is available only if index 0x3308 CPR (Encoder Counts per Revolution) is set to 400.
We suggest to use this command only when the standard procedure cannot be used. For further information please contact RTA.

Note1: the command is executed when receiving the SDO. It is not mandatory to switch back to 0 the value of Following Error reset if it must be used again.
Note2: Following Error Reset commands are ignored when encoder is not active (Following Error Reaction Code = 0x11) or when motor is not in current ON state (DSP402 state equal to Operation Enabled).

Index 0x3208: Current Reduction Ratio
Allows to set the ratio (as a percentage) of the standstill current with respect to the nominal current when the current reduction function is enabled (by means of object 0x3204 or object 0x3222 subindex1).
Setting values are in the range: **0** ÷ **100** (%).
Default value is 50.
The standstill current value can be calculated as follows (by using parameters in objects indexes 0x3220 subindex1, 0x3201 and 0x3208):

$$I_{SS} = [0x3220.1] * [0x3201.0/100] * [0x3208.0/100]$$

Index 0x320A: Set Output
Set Output object value allows to set O0, O1, O2, O3 and O4 programmable outputs (O3 and O4 are available for CSD ET 04 / 94 only, no output available for CSD ET 24), depending on the binary code shown in the following tables:

For PLUS ET and X-PLUS ET:

	0x320A	O0	O1	O2
▶	0	0	0	0
	1	1	0	0
	2	0	1	0
	3	1	1	0
	4	0	0	1
	5	1	0	1
	6	0	1	1
	7	1	1	1

Table 9

For HI-MOD ETS:

0x320A	O0	O1
0	0	0
1	1	0
2	0	1
3	1	1

Table 10

For CSD ET 04 / 94:

	0x320A	O0	O1	O2	O3	O4
►	0	0	0	0	0	0
	1	1	0	0	0	0
	2	0	1	0	0	0
	3	1	1	0	0	0
	4	0	0	1	0	0
	5	1	0	1	0	0
	6	0	1	1	0	0
	7	1	1	1	0	0
	8	0	0	0	1	0
	9	1	0	0	1	0
	10	0	1	0	1	0
	11	1	1	0	1	0
	12	0	0	1	1	0
	13	1	0	1	1	0
	14	0	1	1	1	0
	15	1	1	1	1	0
	16	0	0	0	0	1
	17	1	0	0	0	1
	18	0	1	0	0	1
	19	1	1	0	0	1
	20	0	0	1	0	1
	21	1	0	1	0	1
	22	0	1	1	0	1
	23	1	1	1	0	1
	24	0	0	0	1	1
	25	1	0	0	1	1
	26	0	1	0	1	1
	27	1	1	0	1	1
	28	0	0	1	1	1
	29	1	0	1	1	1
	30	0	1	1	1	1
	31	1	1	1	1	1

Table 11

► = ***Default setting***

In the tables, 0 corresponds to OFF output and 1 corresponds to ON output.
The outputs are considered ON when they are closed as regards to common of outputs (see hardware instruction manual).

Note1: In the tables, the outputs are set as “general-purpose” by means Index 0x320D (for PLUS ET and X-PLUS ET Output Config = 7, for CSD ET Output Config = 15).
Note2: For R-MOD ET, the object 0x320A can be set as for CSD ET, but in this case no hardware outputs are available. This settings have to be considered as virtual outputs only.

Index 0x320C: Input Config
Input Config allows to set the operation mode of hardware inputs (see hardware manual and object Digital Input 0x60FD description) as shown in the following tables:

For PLUS ET and X-PLUS ET:

INPUT	BIT OF INPUT CONFIG	VALUE	OPERATION MODE
I0	**IC0**	0	PROXIMITY INPUT
		1	GENERAL-PURPOSE INPUT
I1	**IC1**	0	NEGATIVE LIMIT SWITCH INPUT
		1	GENERAL-PURPOSE INPUT
I2	**IC2**	0	POSITIVE LIMIT SWITCH INPUT
		1	GENERAL-PURPOSE INPUT
I3	**IC3**	0	TOUCH PROBE INPUT
		1	GENERAL-PURPOSE INPUT

Table 12

For CSD ET:

INPUT	BIT OF INPUT CONFIG	VALUE	OPERATION MODE
I0	**IC0**	0	PROXIMITY INPUT
		1	GENERAL-PURPOSE INPUT
I1	**IC1**	0	NEGATIVE LIMIT SWITCH INPUT
		1	GENERAL-PURPOSE INPUT
I2	**IC2**	0	POSITIVE LIMIT SWITCH INPUT
		1	GENERAL-PURPOSE INPUT
I3	**IC3**	0	TOUCH PROBE INPUT
		1	GENERAL-PURPOSE INPUT
I4	**IC4**	0	GENERAL-PURPOSE INPUT
		1	GENERAL-PURPOSE INPUT

Table 13

For R-MOD ET:

INPUT	BIT OF INPUT CONFIG	VALUE	OPERATION MODE
I0	**IC0**	0	PROXIMITY INPUT
		1	GENERAL-PURPOSE INPUT

Table 14

For HI-MOD ET:

INPUT CONFIG	OPERATION MODE
0x0E	**I0**: PROXIMITY INPUT
0x0F	**I0**: GENERAL-PURPOSE INPUT

Table 15

Per HI-MOD ETS:

INPUT CONFIG	OPERATION MODE
0x0E (14)	**I0**: PROXIMITY INPUT **I1**: GENERAL-PURPOSE INPUT
0x0F (15)	**I0**: GENERAL-PURPOSE INPUT **I1**: GENERAL-PURPOSE INPUT
0x8E (142)	**I0**: PROXIMITY INPUT **I1**: GENERAL-PURPOSE INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE
0x8F (143)	**I0**: GENERAL-PURPOSE INPUT **I1**: GENERAL-PURPOSE INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE

Table 16

For X-PLUS ET S4:

INPUT CONFIG	OPERATION MODE
0x00	**I0**: PROXIMITY INPUT **I1**: NEGATIVE LIMIT SWITCH INPUT **I2**: POSITIVE LIMIT SWITCH INPUT **I3**: TOUCH PROBE INPUT
0x07	**I0, I1, I2**: GENERAL-PURPOSE INPUT **I3**: TOUCH PROBE INPUT
0x09	**I0, I3**: GENERAL-PURPOSE INPUT **I1**: NEGATIVE LIMIT SWITCH INPUT **I2**: POSITIVE LIMIT SWITCH INPUT
0x0E	**I0**: PROXIMITY INPUT **I1, I2, I3**: GENERAL-PURPOSE INPUT
0x0F	**I0**, **I1, I2, I3**: GENERAL-PURPOSE INPUT
0x80	**I0**: PROXIMITY INPUT **I1**: NEGATIVE LIMIT SWITCH INPUT **I2**: POSITIVE LIMIT SWITCH INPUT **I3**: TOUCH PROBE INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE
0x87	**I0, I1, I2**: GENERAL-PURPOSE INPUT **I3**: TOUCH PROBE INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE
0x89	**I0, I3**: GENERAL-PURPOSE INPUT **I1**: NEGATIVE LIMIT SWITCH INPUT **I2**: POSITIVE LIMIT SWITCH INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE
0x8E	**I0**: PROXIMITY INPUT **I1, I2, I3**: GENERAL-PURPOSE INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE
0x8F	**I0**, **I1, I2, I3**: GENERAL-PURPOSE INPUT BIT 24 OF OBJ DIGITAL INPUT (0X60FD) SHOWS STO INPUTS STATE

Table 17

Index 0x320D: Output Config
Output Config allows to set the operation mode of hardware outputs (see hardware manual) as shown in the following table:

For PLUS ET and X-PLUS ET:

OUTPUT CONFIG	OPERATION MODE
0x03	**O0**, **O1**: GENERAL-PURPOSE OUTPUT **O2**: DRIVE FAULT OUTPUT
0x07	**O0**, **O1, O2**: GENERAL-PURPOSE OUTPUT
0x23	**O0**: GENERAL-PURPOSE OUTPUT **O1**: BRAKE OUTPUT **O2**: DRIVE FAULT OUTPUT
0x27	**O0**, **O2**: GENERAL-PURPOSE OUTPUT **O1**: BRAKE OUTPUT

Table 18

For CSD ET 04 / 94:

OUTPUT CONFIG	OPERATION MODE
0x1B	**O0**, **O1, O3, O4**: GENERAL-PURPOSE OUTPUT **O2**: DRIVE FAULT OUTPUT
0x1F	**O0**, **O1, O2, O3, O4**: GENERAL-PURPOSE OUTPUT
0x23	**O0**, **O3, O4**: GENERAL-PURPOSE OUTPUT **O1**: BRAKE OUTPUT **O2**: DRIVE FAULT OUTPUT
0x27	**O0**, **O2, O3, O4**: GENERAL-PURPOSE OUTPUT **O1**: BRAKE OUTPUT

Table 19

For CSD ET 24:
No output available. Any value in OUTPUT CONFIG object has no effect.

For X-PLUS ET S4:

OUTPUT CONFIG	OPERATION MODE
0x01	**O0**: GENERAL-PURPOSE OUTPUT **O1**: EDM OUTPUT (MONITOR OUTPUT) **O2**: DRIVE FAULT OUTPUT
0x05	**O0**: GENERAL-PURPOSE OUTPUT **O1**: EDM OUTPUT (MONITOR OUTPUT) **O2**: GENERAL-PURPOSE OUTPUT
0x21	**O0**: GENERAL-PURPOSE OUTPUT **O1**: EDM OUTPUT (MONITOR OUTPUT) **O2**: BRAKE OUTPUT

Table 20

For HI-MOD ET and R-MOD ET:
No output available. Any value in OUTPUT CONFIG object has no effect.

For HI-MOD ETS:

OUTPUT CONFIG	OPERATION MODE
0x01	**O0**: GENERAL-PURPOSE OUTPUT **O1**: DRIVE FAULT OUTPUT
0x03	**O0**: GENERAL-PURPOSE OUTPUT **O1**: EDM OUTPUT (MONITOR OUTPUT).

Table 21

In case of output O1 is set as “Brake Output”, this output is exclusively controlled by the drive to command the holding brake only (see related parts of this manual). In this case the output cannot be set by the user, but it is controlled by the drive only.
The output is ON only when the drive is in Operation Enabled state.

Note 1: The setting of Output Config object must be done as a basic preliminary parameter, before the transition to OPERATION ENABLED and it cannot be changed.
In detail, when the drive is in OPERATION ENABLED or during the execution of movements, it is not allowed to modify the Output config object (0x320D) to enable or disable the "Brake Output".
In this case an EMERGENCY message is raised.
Note 2: The value set in object Output Config vanish when the 24 V_{DC} logic supply voltage is switched OFF. As a consequence, the value of Output Config must be write again after the next logic supply switch ON. Alternatively, and in particular when the output is used as “Brake Output”, we advise to store in the non volatile memory the desired value of Output Config by means of Save Parameter command (see chap. **Errore. L'origine riferimento non è stata trovata.**).

⚠ WARNING!

Use for safety related functions is forbidden (EN 60204-1). Moreover, when the application arrangement is in such way that a motor fault or failure could generate a risk for property or human life, external independent safety protection system must be provided in the machine.

Index 0x3210: Motor Code

- Setting of a Motor
It is possible to set a 6 digit exadecimal motor code, for example 0x**M**0**IJKL**, to configure some internal drive parameters to maximize drive performance in case of use of a specific motor.
In detail:

- **M** is a reserved parameter (default value: **0**. Do not change)

- **I** set the current recirculation (**0**: recirculation disable; **1**: recirculation enabled)
- **J** set the dynamic compensation value (setting values are from **0** to **7**, where 0 = 0%; 5 = 500%)
- **K** set the current proportional gain (setting values are from **1** to **F**, where 1 = 100%, F = 1500%)
- **L** set the value of nominal current in Ampere (setting values are **1**,**2**,**3**,**4**; for Plus and Hi-Mod **2**,**3**,**4**,**5**,**6**).

⚠ WARNING!

- It is mandatory to carefully check the set drive current: it must not be greater than 1,5 times the nominal motor current. In any case, the drive current does not be set over the maximum motor current limit indicated on the motor datasheet. When it is not possible (for example when using very small motors), the customer must set a value of current in the object Current Ratio (index 0x3201) in such a way that the drive current does not exceed the absolute maximum rating of the motor.
- The settings of “Motor Code” parameters and in particular the current gain value requires attention.
Wrong settings can cause erratic behavior and in some cases fatal failure.
We advise to contact RTA for specific applications.

Note 1: In case of use of a motor without encoder, please consider that:

Object 0x3206 (Following Error Reaction Code) should be set to 17 (0x11). In this case, a possible loss of synchronism cannot be detected.
The bit 13 of Status Word is always = 0 and object 0x6064 (Position Actual Value) will show the command position sent from the drive to the motor.

Note 2: When motor SH2285-5271 is connected (setting 5441 in Index 0x3210 for CSD ET), keep in mind the following points:
1) The motor SH2285-5271 is without encoder: see Note 1.
2) The motor SH2285-5271 needs windings series connection (see motor's data sheet).

MOTOR CODE	
Motor Current (Ampere)	**Value of 0x3210**
1	5441 (0x001541)
2	5442 (0x001542)
3	5443 (0x001543)
4	5444 (0x001544)
5	5445 (0x001545)
6	5446 (0x001546)

Table 22

- Setting of RTA motor
In case of using an RTA motor (with or without encoder), we suggest to set the corresponding Motor Code value as shown in the following tables:

R.T.A. MOTOR CODE			
With Encoder	**Without Encoder**	**0x3210 value**	
MOTORS FOR PLUS ET			
EM 3F1H- xxxx	SM 2861-5255	*5446* (0x001546)	
EM 3F2H- xxxx	SM 2862-5255	*5446* (0x001546)	*
EM 3F3H- xxxx	SM 2863-5255	*5446* (0x001546)	
EM 6H2M- xxxx	103-H7823-1740	*5444* (0x001544)	
EM 2H1M- xxxx	103-H7123-17xx	*5444* (0x001544)	
EM 2H2M- xxxx	103-H7126-1740 / RM 2R2M	*5444* (0x001544)	
EM 6H3H- xxxx	103-H7826-1642	*5426* (0x001526)	
MOTORS FOR X-PLUS ET			
----	SP 2566-5000	*5441* (0x001541)	
----	SP 2566-5100	*5426* (0x001532)	
----	SP 2566-5200	*5411* (0x001523)	
EM 3F1L- xxxx	SM 2861-5055	*5442* (0x001542)	
RM 3T1M-xxxx	RM 3R1M	*5396* (0x001514)	
----	SM2862-5055	*5442* (0x001542)	
EM 3F2M- xxxx / RM 3T2M-xxxx	SM 2862-515x / RM 3R2M	*5444* (0x001544)	*
EM 3F3M- xxxx / RM 3T3M-xxxx	SM 2863-5155 / RM 3R3M	*5444* (0x001544)	
MOTORS FOR CSD ET			
----	SH2285-5271	*5441* (0x001541)	
RH 1S0M – xxxx	RH 1S0M	*5473* (0x001561)	
RH 1S1M – xxxx	RH 1S1M	*5505* (0x001581)	
RH 1S2M – xxxx	RH 1S2M	*5521* (0x001591)	
RH 1S3M – xxxx	RH 1S3M	*5537* (0x0015A1)	
EM 1H2H- xxxx	103-H5210-4541	*5442* (0x001542)	
EM 2H1M- xxxx	103-H7123-17xx	*5444* (0x001544)	
EM 2H2M- xxxx	103-H7126-1740 / RM 2R2M	*5444* (0x001544)	*
EM 6H2M- xxxx	103-H7823-1740	*5444* (0x001544)	

Table 23

In the table above, xxxx can assume the following values:
- “04D0” = motor with 400 CPR encoder (cfr. index x3308), no zero index;
- “04E0” = motor with 400 CPR encoder (cfr. index x3308), and zero index;
- “0HE0” = motor with 4000 CPR encoder (cfr. index x3308), and zero index.

*** Default value**:
- For Plus ET, the default value is 286252 (0x00045E2C) which is equal to the setting value 5446 (0x001546).
- For X-Plus ET, the default value is 286251 (0x00045E2B) which is equal to the setting value 5444 (0x001544).
- For CSD ET, the default value is 712617 (0x000ADFA9) which is equal to the setting value 5444 (0x001544).

Index 0x3212: Revolution Direction (CW / CCW setting)

Revolution Direction allows to reverse motor direction.

This parameter becomes active after Current Off –> Current On transition of the drive (for example Ready to switch On -> Operation Enabled) and the object 0x6064 (Position Actual Value) is set = 0.

Writing this object when state machine is different from Operation Enabled or Quick Stop Active, produce the reset of encoder position (Position Actual Value).

Writing this object when state machine is Operation Enabled or Quick Stop Active, produce the reset of encoder position only after the following transition Current ON -> Current OFF.

Index 0x3220: Drive Parameters

This object allow to view the parameters related to the motor drive that can be configured by object 0x3210 (Motor Code).

- Current Limit (Sub1): show the maximum current value (peak value) that drive can supply to the motor in the actual configuration (A).

- Proportional Gain (Sub2): show the proportional gain value of the current regulation circuit. It is expressed as a percentage ratio (%)

- Dynamic Balancing Gain (Sub3): show the dynamic compensation parameter. It is expressed as a percentage fraction (%).

- Current Recycling Enable (Sub4): show the status of the current recirculation (enable or disable).

- **Proportional Feed Forward (%) (Sub5):** reserved parameter. Default value = 0.

Index 0x3222: Auto-Synchronization Parameters

This object allows to enable the Auto Synchronization function.

Auto Synchronization allows the drive to recover – within specific range limits – possible gaps between rotor position and drive command that can be result in a loss of syncronism.

If rotor is stopped, the range limits are equal to 1 full step (±1.8°).

If rotor is moving, the range limits corresponds to 2 full steps (3.6°).

In practice, the Auto-Sync function enable a sort of hybrid control system similar to a Closed Loop system: when the gap between rotor position and drive command is lower than 1 full step, the drive works in Open Loop mode (micro-stepping); when the gap between rotor position and drive command is greater than 1 full step, the drive works in Closed Loop mode up to the complete recovery of motor synchronism, then the drive turn to work in Open Loop mode. When operating in Closed Loop mode, the drive operates to provides the maximum torque at the motor depending on nominal current and speed.

The Auto-Sync function cannot be enabled when object Following Error Reaction Code (0x3206) is set to 17 (0x11), i.e. when drive is working without encoder. In this case drive is always working in open loop mode.

Auto Synchronization function can also be used to:

- Mechanical impact position search: the bit 23 of Digital Inputs (0x60FD) switch to 1 when the gap between rotor position and drive command overcome the internal limit (window). This condition can also be indicated by bit 14 of Status Word (see description of object index 0x6041)
- Movements with speed, acceleration/deceleration greater than the maximum allowable in Open Loop mode.

The Auto Sync function can be enabled and disabled at any time, also when motor is in Current ON.
The function can be configured by setting the following parameters:

- Enable Mode (Sub1):
0 = function disabled (default value)
1 = function enabled, current reduction disabled
2 = function enabled, current reduction enabled when motor standstill and the Auto Sync function is not working to recover an excessive position gap (shown by bit 23 of the object 0x60FD, Digital Inputs)
3 = function enabled, current reduction enabled when motor is standstill

Note1: it is recommended to enable Auto Sync after having carefully verified the encoder connections, ground connection of both drive and motor and after basic test of movements in Open Loop mode.

Note2: it is advised to enable Auto Sync function in mode 2. Use mode 1 only when the Auto Sync function become active frequently. Use 3 only for cases when is not possible to reach a safe thermal working conditions by simply set the suitable drive nominal current (object Current Ratio 0x3201).

- Reactivity [Kv Gain] (Sub2): set the reactivity of the Auto Sync function.
Available setting values are: 0, 50, 100 (default), 150, 200, 250, 300.
Greater is the setting value and greater is the precision of the movements in Closed Loop when recover synchronism and greater is the maximum motor velocity limit.
Values greater than the default value can be set only in case of low load inertia, low acceleration/deceleration ramp. In other cases, back-EMF can generate overvoltages which can produce unwanted turn ON of the overvoltage protection system of the drive (Error Code 0x5100).

High values of Reactivity (250 and 300) could be generate in particular conditions, a loss of smoothness of motion profiles.

- Error Window (Sub3): this parameter defines the threshold of the angular position error which is the limit of the activation of synloss alarm. When this limit is overcome, drive rais the alarm.
Whit Auto-Sync function enabled, this object substitutes the Encoder Window (object 0x3205). The drive read the correct index (0x3205 or 0x3222 subindex3) with respect to the function mode (Open Loop or Closed Loop.
The available setting values are in the range: 1 ÷ 64000 (number of step). The default value is 32000.
If the object Following Error Reaction Code is set to 0x01, the following error alarm is automatically reset when the cause vanish. In standard mode of operation, the alert is not automatically reset (see 0x3206 object description).

All the above parameters can be set in any drive state.

Index 0x3308: CPR (Encoder Counts per Revolution)
Set the corresponding CPR (counts per revolution) of the motor encoder.
For RTA motors, the default value is suitable for motor series EM xxxx-04D0 or EM xxxx-04E0 and it must not be changed.
For RTA motors series xxxx-0HE0, the object value must be set to “4000” (see index 0x3210).
For other motor models with encoder, it would be necessary set a value different from the default one.
Verify the encoder motor features before changing the default value. In any case, it is always possible to contact RTA.
Writing this object when state machine is different from Operation Enabled or Quick Stop Active, produce the reset of the encoder position (Position Actual Value).
Writing this object when state machine is Operation Enabled or Quick Stop Active, produce the reset of the encoder position only after the following transition Current ON -> Current OFF.

Note1: the output signals of the encoder are 90 degrees out of phase each other, as a consequence, the real encoder resolution is 4 times the value indicate in CPR index.
Note2: the unit of measure for the encoder position shown in object Position Actual Value (index 0x6064) is “number of steps”, in accordance with the step/revolution value indicated in object 0x3202.
Note3: This index must not be changed in Hi Mod ET series drive.

Index 0x330A: Brake Delay Lock

For Output Config values which include the setting of output O1 as Brake Output, the object 0x330A allows to set the delay between disable of the brake output (BRAKE LOCKED) and next transition Current-ON -> Current-OFF (5.8 and 9 in Fig. 2).

This parameter can be set in a range of values between 0 and 1000 ms.

The default value is 100 ms.

Note:

Current ON equals Operation Enable

Current OFF equals:

- Switched ON
- Ready to Switch ON

Index 0x330B: Brake Delay Unlock

For Output Config values which include the setting of output O1 as Brake Output, the object 0x330B allows to set the delay to enable brake output (BRAKE UNLOCKED) in the transitions Current-OFF -> Current-ON.

This object allows to set the delay values since the transition of Current-ON command:

- Current ON delay (default value 0 ms);
- Brake output enable delay (default value 100 ms);
- Status Word transition delay and drive ready (default value 230 ms).

These parameters can be set in a range of values between 0 and 1000 ms.

In Figure 5 are shown timing diagram setting by means the objects 0x330A e 0x330B.

Note:

Current ON equals Operation Enable

Current OFF equals:

- Switched ON
- Ready to Switch ON

For further information about different settings, please contact R.T.A.

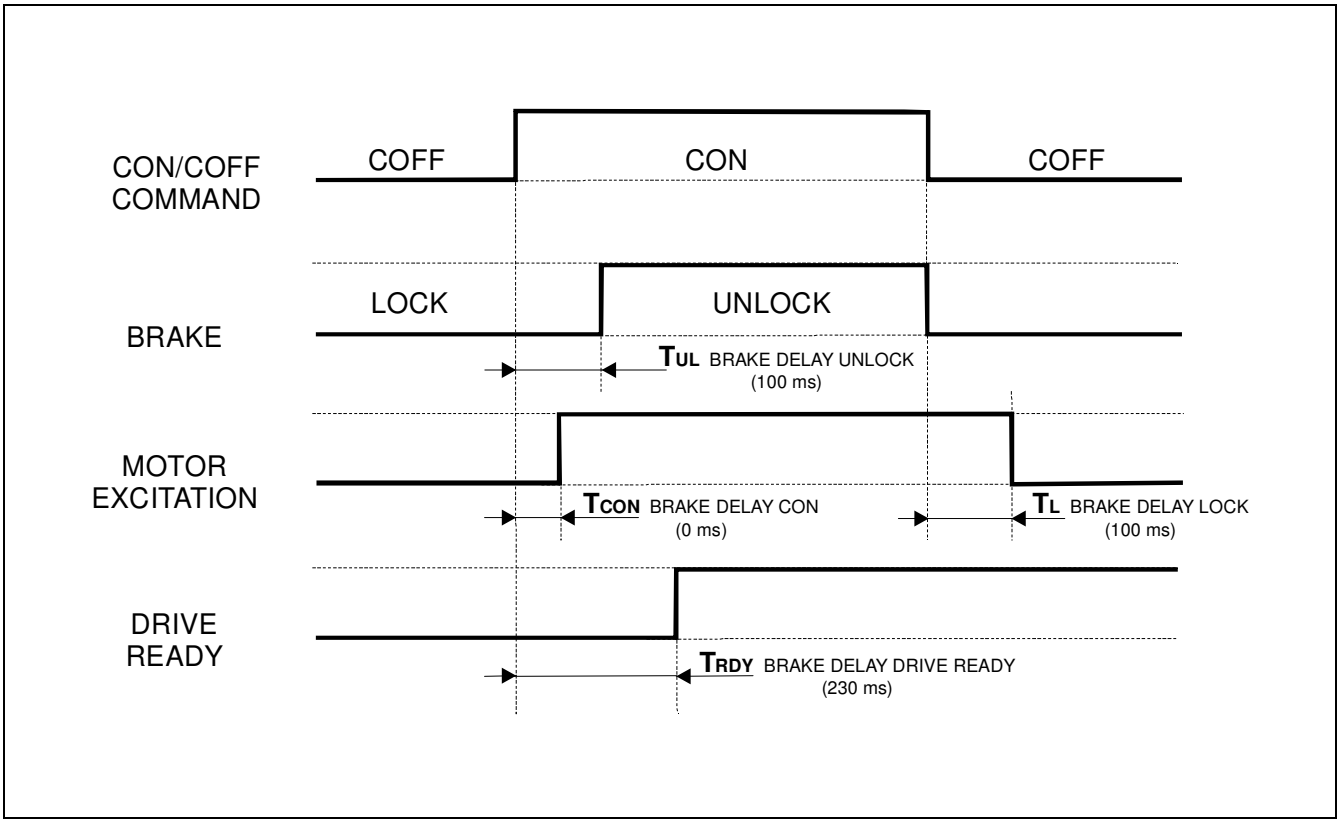


Figure 5

Index 0x3320: Advanced Interpolation Parameters
Allow to set some configuration parameters for interpolation in CSP e/o CSV modes of operation.

- CSP Hole Correction Enable (Sub1): allow to recover possible non consequential position communication errors (corrupted frame, frame out of the correct time window in DC Mode) in CSP/CSV.
Setting values are:

1 = correction enable (default)
0 = correction disabled

- CSP - CSV Extended Interpolation Time (Sub2): allow to set the value of time period for data interpolation in CSP and CSV mode of operation.
Setting values are:

0 = standard interpolation (default)
8 = 8 ms interpolation
16 = 16 ms interpolation

Note: set values different from 0 in particolar cases only. Please contact RTA technical customer service before change the default value.

- **CSV Automatic 1.024 Correction Factor Enable (Sub3):** enable the automatic correction factor 1.024 applied to the targets in CSV mode of operation (see description paragraph 2.1.4).
Setting values are:

1 = automatic correction enable
0 = automatic correction disabled (default)

Index 0x3321: Advanced Position - Velocity Parameters
Though this object it is possible to set some configuration parameters regarding rotor position and velocity sensing.

- Velocity Actual Value Total Samples (Sub1): allow to set the number of samples of Position Actual Value (object 0x6064) used to calculate the actual velocity, Velocity Actual Value (object 0x606C). The calculation time (in ms), is equal to the number of setting samples.
Setting values are: 1,2,4,5,8,10,20,25,40,50,100,200.
Default value is 100.

- Reset Encoder On First Power Up (Sub2): allow to set the automatic encoder position reset function when the drive switch to current ON the first time from the $24V_{DC}$ power ON (see paragraph 2.2, transition 4**:** SWITCHED ON => OPERATION ENABLED) or when writing the following objects: CPR (index 0x3308) or Step Resolution (index 0x3202) or Revolution Direction (index 0x3212).
Setting values are:

0 = no reset
1 = reset encoder enabled (default)

- **Hard Stop Homing Disengaging Steps (Sub3):** allow to set the number of steps executed in the opposite direction respect to the main movement at the end of the homing sequence in mechanical impact position search (Homing Method -1 e -2).
Setting values are in the range from 0 to 255.
The default value is 64.

- **Power Up Speed Limit (Sub4):** by writing a value > 0, the motor state monitor function is enabled.
In particular, if the motor is running before the transition Current OFF->Current ON with a speed greater than the value set in this subindex (indicated in steps/s), the current in motor windings is limited to zero. The drive do not swich to Current ON state, but goes to the Fault state and the Emergency message with Error Code 0x8400 is sent.
This feature is useful to prevent potential dangerous conditions in case of vertical load axis.
The setting values are in the range 0÷32000.
The default value is 0 (function disabled)

Index 0x3322: Status Word Manufacturer Bits
Allow to set some optional function regarding bit 14 and 15 of Status Word (object 0x6041), as follows:

- Status Word bit 15 as Profile Ramp (Sub1): by setting 1, the bit 15of Status Word indicate that the drive command an acceleration or deceleration ramp in Profile Position or Homing mode of operation.
The default value is 0.

- Status Word bit 14 as Closed Loop Active (Sub2): by setting 1, the bit 14 of Status Word indicate in real time the state of the function Auto Sync (see object 0x3222).
Auto Sync is operating (if bit 14 = 1) or Auto Sync is no operating (if bit 14 = 0).
The logic behavior of this bit is the same of the bit 23 of Digital Inputs (object 0x60FD).

Index 0x3333: Drive Alarm Register
10 events Alarm Register.
For each event the following values are logged:
- Event delay since the last power on of the drive (ms)
- Alarm code as the following example:

Event Number			**Drive State**			**Emergency Code**			
0	7		1	0		5	1	0	0

The available values in “Emergency Code” are the following:

0x8611: “Motor following error”
0x8400: “Axis speed too high”
0x5100: “Error power supply out of range”
0x4310: “Error drive excessive temperature”
0x2130: “Error short circuit” (or overcurrent on motor phase)
0x0000: “Emergency end”

The available values in “Drive State” are the following:
0x01: Not ready to switch on
0x02: Switch on disable
0x04: Ready to switch on
0x08: Switched on
0x10: Operation Enable

The available values in “Event Number” are 00-99.

Note: Set “1” in sub index 0 of object 0x3333 to reset Drive Alarm Register.

3.6 MOTION CONTROL PARAMETERS SETTINGS (0x603F-0x6502)

Index (hex)	Sub Ind.	Object type	Access type.	Note	Default value	Entry description	Valid values
603F		U16	RO	1	0x0000 (0)	Error Code	0x0000…0x8611
6040		U16	RW		0x0000 (0)	Control Word	0x 0000…0x FFFF
6041		U16	RO		0x0000 (0)	Status Word	0x 0000…0x FFFF
605A		I16	RW		5	Quick Stop Option Code	5, 0
605B		I16	RW		0	Shutdown Option Code	0
605C		I16	RW		0	Disable Operation Option Code	0
605D		I16	RW		1	Halt Option Code	1
605E		I16	RW		0	Fault Reaction Code	0
6060		I8	RW		0	Modes of Operation	1 / 3 / 6 / 8 / 9
6061		I8	RO		0	Mode of Operation Display	1 / 3 / 6 / 8 / 9
6064		I32	RO	1	0	Position Actual Value	-2147483648…+2147483647
606C		I32	RW	1	0	Velocity Actual Value	[depending on axis]
606D		U16	RW	1	6400 [30RPM]	Velocity Window	0…65 536
606E		U16	RW	1	100 [ms]	Velocity Window Time	0… 5 000
606F		U16	RW	1	6400 [30RPM]	Velocity Threshold	0… 65 536
6070		U16	RW	1	100 [ms]	Velocity Threshold time	0…5 000
607A		I32	RW	1	0	Target Position	-2147483648…+2147483647
607B		Rec				**Position Range Limit**	
"	0	U8	RO		2	Number of entries	
"	1	I32	RW		0	Minimum position range limit	
"	2	I32	RW		0	Maximum position range limit	
607C		I32	RW	1	0	Home Offset	-2147483648…+2147483647
6080		U32	RW	1	300 000	Max Motor Speed	0…800 000
6081		U32	RW	1	0x5DC0 (24000)	Profile Velocity	0…800 000
6083		U32	RW	1	0x9C400 (640000)	Profile Acceleration	2000…10 000 000
6084		U32	RW	1	0x9C400 (640000)	Profile Deceleration	2000…10 000 000
6098		I8	RW	1	37	Homing Method	3 / 4 / 5 / 6 / 19 / 20 / 21 / 22 / 33 / 34 / 35 / 37 / -1(255) / -2 (254)
6099		Rec				**Homing Speeds**	
"	0	U8	RO		2	Number of entries	
"	1	U32	RW	1	0x5DC0 (24000)	Speed during Search for Switch	16001…400 000
"	2	U16 or U32	RW	1	0x0C80 (3200)	Speed during Search for Zero	0…16000
609A		U32	RW	1	0x9C400 (640000)	Homing Acceleration	2000…10 000 000
60B8		U16	RW	1	0x0000 (0)	Touch Probe Function	0 / 0x11 / 0x15 / 0x21 / 0x25
60B9		U16	RW	1	0x0000 (0)	Touch Probe Status	0x 0…0x 0087
60BA		I32	RO		--	Touch Probe Pos Pos Value	-2147483648…+2147483647
60BB		I32	RO		--	Touch Probe Pos Neg Value	-2147483648…+2147483647
60E3		Rec				**Supported Homing Methods**	
	0	U8	RO			Number of entries	14
	1	I8	RO		0x03 (3)	1st supported homing method	3 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	2	I8	RO		0x04 (4)	2nd supported homing method	4 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	3	I8	RO		0x05 (5)	3rd supported homing method	5 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	4	I8	RO		0x06 (6)	4th supported homing method	6 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	5	I8	RO		0x13 (19)	5th supported homing method	19
	6	I8	RO		0x14 (20)	6th supported homing method	20
	7	I8	RO		0x15 (21)	7th supported homing method	21
	8	I8	RO		0x16 (22)	8th supported homing method	22
	9	I8	RO		0x21 (33)	9th supported homing method	33 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	A	I8	RO		0x22 (34)	10th supported homing method	34 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC

							and R-MOD ET)
	B	I8	RO		0x23 (35)	11th supported homing method	35
	C	I8	RO		0x25 (37)	12th supported homing method	37 (alias of 35)
	D	I8	RO		0xFF (-1)	13th supported homing method	-1 (or 255)
	E	I8	RO		0xFE (-2)	14th supported homing method	-2 (or 254)
60FD	0	U32	RO	1	0x00000000 (0)	Digital Inputs	0x0…0x7FFFFFFF
60FE		Rec		1		**Digital Outputs**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RO		0x00000000 (0)	Physical Outputs	0x0…0x01F00001
60FF		U32	RW	1	0x00000000 (0)	Target Velocity	-2147483648…+2147483647
6502		I8	RO		0x000001A1 (417)	Supported Drive Modes	0x000001A1 (417)

Table 21

Index 0x603F: Error Code
Error codes mapped in the EMERGENCY message; the following are added:

0x8611: "Motor following error" (see Chap.3.5)
0x8400: "Axis speed too high" (see object 0x3321 subindex 4)
0x5100: "Error power supply out of range"
0x4310: "Error drive excessive temperature"
0x2130: "Error short circuit" (or overcurrent on motor phase)
0x0000: "Emergency end"

After 0x2130, 0x4310, 0x5100, 0x8400, 0x8611 messages, the drive goes in Fault state and current in the motor windings is disabled (current off).

Note: The Error Code value switch back automatically to 0x0000 after 200 ms minimum from the emergency end. As a consequence, once detected the fault state through the bit 3 of Status Word, the master has to read the Error Code as quickly as possible. In any case, it is always possible to read the Fault event register (object 0x3333 or object Last error Code 0x303F).

Index 0x6064: Position actual value
Number of steps corresponding to the position of the motor shaft read through encoder.
For motors without encoder (object 0x3206 Following Error Reaction Code = 17), the Position Actual Value represents the electrical step counter of the drive.

Index 0x606C: Velocity Actual Value
Represents the velocity value calculated by means of the sample position in object Position Actual Value (0x6064).
The unit of measure is step/s, in accordante to the resolution set in object 0x3202
The default value for the speed sample period is 100 ms; this value can be modified by the object 0x3321 subindex1.

Index 0x606D: Velocity Window (*)
Allows the setting of a threshold speed value (in step/s).
When Actual Velocity become greater than the set value, after the delay written in register "Velocity Window Time" (object 0x606E), the bit 10 of Status Word "Target Velocity Reached" switch to the value "1".

Index 0x606E: Velocity Window Time (*)
Allow to set a time threshold.
When Actual Velocity become greater than the velocity threshold set in register "Velocity Window" (0x606D), the bit 10 of Status Word "Target Velocity Reached" switch to "**1**" after a time delay equal to the value set in this register (in ms).

Index 0x606F: Velocity Threshold (*)
Allow to set a velocity threshold (in steps/s).
When Actual Velocity become lower than the velocity threshold, after a time delay equal to the value set in register "Velocity Threshold Time" (0x6070), the bit 10 of Status Word "Target Velocity Reached" switch to "**0**".

Index 0x6070: Velocity Threshold Time (*)
Allow to set a time threshold.
When Actual Velocity become lower than the velocity threshold set in register "Velocity Threshold" (0x606F), the bit 10 of Status Word "Target Velocity Reached" switch to "**0**" after a time delay equal to the value set in this register (in ms).

Note (*): *These objects are active in "Profile Velocity" mode of Operation only.*

Index 0x607A: Target Position
This object is active only in Profile Position or CSP mode of operation
If bit 6 of CONTROL WORD =1, and the Mode Of Operation is Profile Position, the Target Position corresponds to number of steps in relative coordinates to be executed after receiving a "New Set Point".
If bit 6 of CONTROL WORD =0, and the Mode Of Operation is CSP, the Target Position corresponds to the position in absolute coordinates to be reached after receiving a "New Set Point".

Index 0x607C: Home Offset
This object represents the load value in Position Actual Value (0x6064) at the end of Homing procedure.
The default value is 0.

Index 0x6080: Max Motor Speed
In CSV or Profile Velocity operation mode, when Target Velocity has a large increase, MAX MOTOR SPEED is the maximum velocity limit (absolute value). The value of the requested speed must be multiplied by the scale factor FS = 1.024. (see paragraph 2.1.4)

Index 0x6081: Profile Velocity
Object active in Profile Position mode of operation only.
Maximum speed of the movement in Profile Position. Hz corresponds to steps/sec.

Index 0x6083: Profile Acceleration
In Profile Position or Profile Velocity mode of Operation, is the acceleration value used to reach maximum speed of the movement in Profile Position.
In CSV mode of operation is the acceleration limit following the relation:

$$-15 * \text{Profile Acceleration} \leq \text{ACCELERATION} \leq 15 * \text{Profile Acceleration}$$

Hz / sec corresponds to number of steps/s^2.
The minimum setting value is equal to 2000 step/s^2.
If a movement is running, a new value write in this object become active when the actual movement is completed.

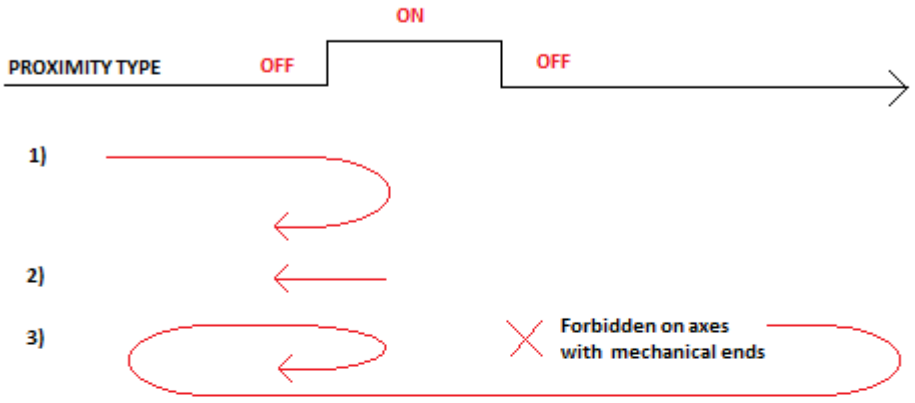
Index 0x6084: Profile Deceleration
In Profile Position.or Profile Velocity mode of operation, is the deceleration value used to reach the zero speedat the end of a positioning movement.
Hz / sec corresponds to number of steps/s^2.
The minimum setting value is equal to 2000 step/s^2 and must be set equal to the value of Profile Acceleration (object 0x6083). Any different value will be overwrite by the value in the object 0x6083.
Note: the object Profile Deceleration is, equivalent to the Profile Acceleration object and was implemented in the software of the drive only for compatibility reason with some Ethercat Master.

Index 0x6098: Homing Method
- 3 (0x3) homing on positive home switch and index pulse (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC andR-MOD ET); proximity sensor and zero index required
- 4 (0x4) homing on positive home switch and index pulse (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC andR-MOD ET) ; proximity sensor and zero index required
- 5 (0x5) homing on negative home switch and index pulse (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC andR-MOD ET) ; proximity sensor and zero index required
- 6 (0x6) homing on negative home switch and index pulse (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC andR-MOD ET) ; proximity sensor and zero index required
- 19 (0x13) homing on positive home switch; proximity sensor required
- 20 (0x14) homing on positive home switch; proximity sensor required
- 21 (0x15) homing on negative home switch; proximity sensor required
- 22 (0x16) homing on negative home switch; proximity sensor required
- 33 (0x21) homing on index pulse, negative direction (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC andR-MOD ET); proximity sensor required
- 34 (0x22) homing on index pulse, positive direction (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC andR-MOD ET); proximity sensor required
- 35 (0x23) homing on current position
- 37 (0x25) homing on current position (alias of 35)

- -1 o 255 (0xFF) homing mechanical impact position search, negative direction
  encoder required (object 0x3206 different to 17) and Auto Sync function enabled (object 0x3222 subindex 1 greater than zero)
- -2 o 254 (0xFE) homing mechanical impact position search, positive direction
  encoder required (object 0x3206 different from 17) and Auto Sync function enabled (object 0x3222 subindex 1 greater than zero)

TYPICAL PARAMETERS CONFIGURATION FOR HOMING 19, 20, 21 AND 22

C PS	CoE	0x320C:00	0x06 (6)	Input Config
C PS	CoE	0x6060:00	0x06 (6)	Modes of Operation
C PS	CoE	0x6098:00	0x13 (19)	Homing Method
C PS	CoE	0x6099:01	0x00003E81 (16001)	Speed during search for switch
C PS	CoE	0x6099:02	0x07D0 (2000)	Speed during search for zero
C PS	CoE	0x609A:00	0x00007D00 (32000)	Homing Acceleration



C PS	CoE	0x320C:00	0x06 (6)	Input Config
C PS	CoE	0x6060:00	0x06 (6)	Modes of Operation
C PS	CoE	0x6098:00	0x13 (22)	Homing Method
C PS	CoE	0x6099:01	0x00003E81 (16001)	Speed during search for switch
C PS	CoE	0x6099:02	0x07D0 (2000)	Speed during search for zero
C PS	CoE	0x609A:00	0x00007D00 (32000)	Homing Acceleration

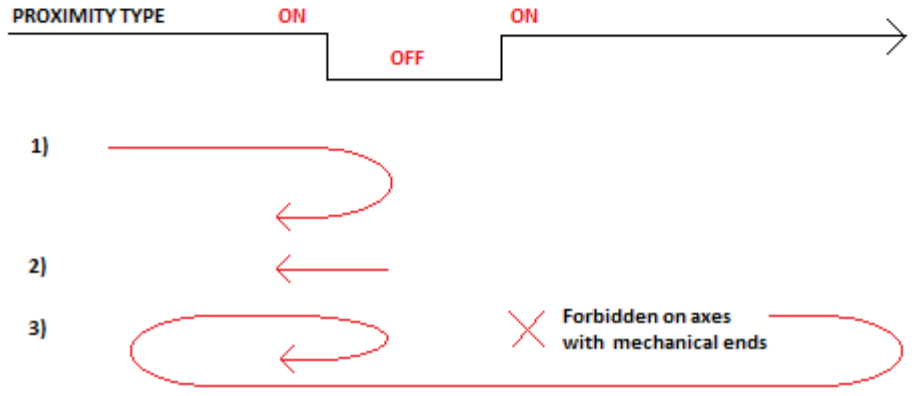
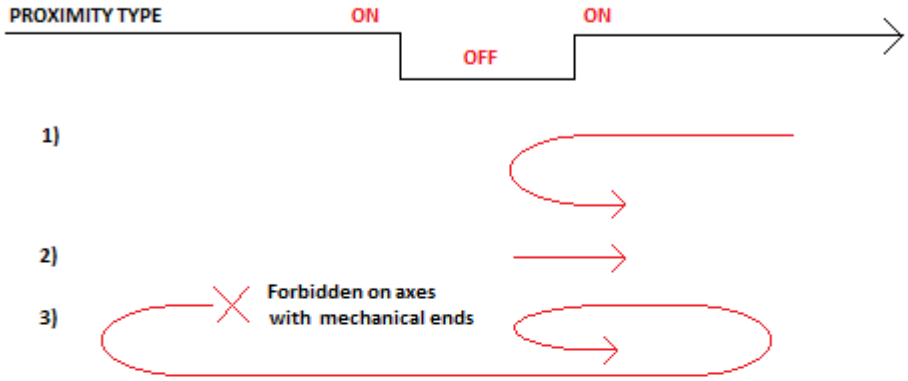


Figure 6

C PS	CoE	0x320C:00	0x06 (6)	Input Config
C PS	CoE	0x6060:00	0x06 (6)	Modes of Operation
C PS	CoE	0x6098:00	0x13 (20)	Homing Method
C PS	CoE	0x6099:01	0x00003E81 (16001)	Speed during search for switch
C PS	CoE	0x6099:02	0x07D0 (2000)	Speed during search for zero
C PS	CoE	0x609A:00	0x00007D00 (32000)	Homing Acceleration



C PS	CoE	0x320C:00	0x06 (6)	Input Config
C PS	CoE	0x6060:00	0x06 (6)	Modes of Operation
C PS	CoE	0x6098:00	0x13 (21)	Homing Method
C PS	CoE	0x6099:01	0x00003E81 (16001)	Speed during search for switch
C PS	CoE	0x6099:02	0x07D0 (2000)	Speed during search for zero
C PS	CoE	0x609A:00	0x00007D00 (32000)	Homing Acceleration

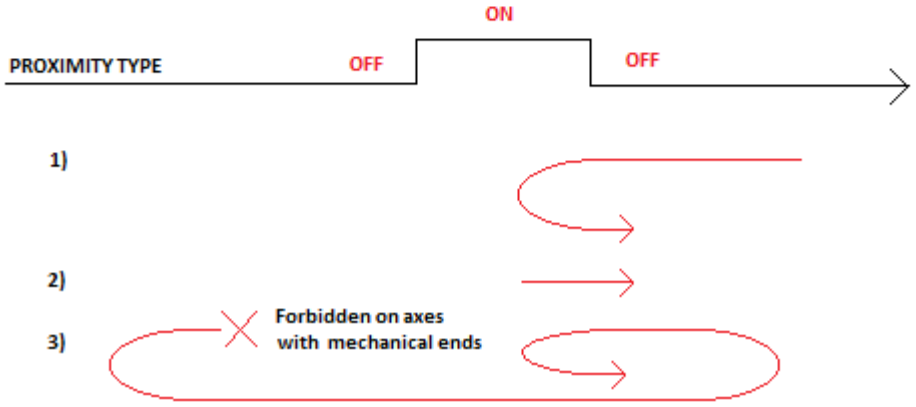


Figure 7

Note: Homing Method 3, 4, 5 and 6 are equivalent to Homing Method 19, 20, 21 and 22, respectively. The difference is only one: the homing procedure do not stops at the last transitions of proximity sensor, but stops at the next zero index transition.

Note: Homing method -1 and -2 are mechanical impact position homing. After the zero search, the procedure provide an extra movement in the opposite direction. The number of steps of the extra movement can be set in object 0x3321 subindex3

Index 0x6099, Sub index 1: Homing Speed During Search for Switch
Maximum speed during homing procedure (see Chap. 2.1.2). Hz corresponds to steps/sec.

Note: for the execution of a correct homing procedure, the Homing Speed and Homing must be chosen in such a way that, during the deceleration ramp after reaching the proximity, the motor exceeds the position range of the sensor. Therefore, the setting values for this object must be greater than 75 RPM (16001 step/s with resolution factor of 12800 step/rev)

Index 0x6099, Sub index 2: Homing Speed During Search for Zero
Speed during zero final approach in homing procedure (see Chap. 2.1.2). Hz corresponds to steps/sec.
Note1: for the execution of a correct homing procedure, it is mandatory speed setting < or equal to 75 rpm.
Note2: the value of this speed is used also in homing method -1 and -2.
Note3: when index 0x3308 CPR (Encoder Counts per Revolution) is set to 4000 or 4096, the velocity search limit of index pulse is 40 rpm. If the index "Homing During Search for Zero" is previously set to a greater value, the drive will reduce the velocity to 40 rpm (for Homing Methods 3, 4, 5, 6, 33 and 34)

Index 0x609A: Homing Acceleration
Acceleration/deceleration to reach the maximum speed during homing procedure. Hz / sec corresponds to number of steps / s^2.
The minimum setting value is equal to 2000 step / s^2.

Index 0x60B8: Touch Probe Function
Bit 0 enables Touch Probe Function. Disable and enable Touch Probe Function to reset stored position.
Bit 2 enables position sampling on encoder index pulse (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET).
Bit 4 enables position sampling on positive edge of the signal on:
- I3 input, when Bit2 = 0
- encoder index pulse, when Bit2 = 1

Bit 5 enables position sampling on negative edge of the signal on:
- I3 input, when Bit2 = 0
- encoder index pulse, when Bit2 = 1

Note 1: The sampling of the position can be affected by a maximum delay of 300us, compared to the switching of the TOUCH PROBE INPUT. In some particular cases the delay can be greater (for example when SET OUTPUT and TOUCH PROBE FUNCTION are both PDO mapped at the same time and Mode of Operation is set to Profile Position or Homing).
Note 2: The sampling of the Touch Probe Function cannot be enabled simultaneously on positive and negative edge trigger. The desired sampling edge (positive or negative) must be chosen when function is enabled.
Note 3: The sampling on index pulse is correct and reliable up to a motor shaft velocity value (in rpm) related to the value set in the index 0x3308 CPR (Encoder Counts per Revolution), following the expression:

$$V_{LIM} = 160000 / [0x3308.0]$$

For example, for CPR = 4000 the velocity limit is 40 rpm.

Index 0x60B9: Touch Probe Status
Bit 0 indicates Touch Probe Function is active.
Bit 1 indicates that a position has been sampled on positive edge of sampling signal.
Bit 2 indicates that a position has been sampled on negative edge of sampling signal.
Bit 6 indicates the set sampling operation mode: 0=Touch Probe input; 1=index pulse.
Bit 7 indicates current logic state of sampling signal.

Index 0x60FD: Digital Inputs
This object shall monitor the status of general-purpose input and the status of special function inputs as shown in the following table:

Bit 22,21	Bit 20#	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15…3	Bit 2	Bit 1	Bit 0
Reserved	I4	I3	I2	I1	I0	Reserved	PX (Home Switch)	Positive Limit	Negative Limit

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24(*)	Bit23
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	STO	Closed Loop Active

Note: Available/Setting inputs are described in 0x320C Index.

When bit 1 and bit 2 of Input Config (Index 0x320C) are equal to 0 (IC1 = 0 and IC2 = 0), I1 and I2 inputs are used as limit switch.
When limit switch inputs are ON, the motor is free to move. When a limit switch input is OFF, the following behaviors depending on different operation modes are possible:

Mode of Operation CSP

- Bit 11 of Status Word goes to 1 (Internal Limit Active)
- In this mode of operation, any movement will not be blocked by the drive (software monitor only).

Mode of Operation PROFILE POSITION, HOMING PROFILE, PROFILE VELOCITY and CSV

- Bit 11 of Status Word goes to 1 (Internal Limit Active)
- The motor begins to stop like it has received Halt command by means of Control Word.
- After a motor stop depending on Internal Limit Active, the motor can run only in the opposite direction. Movements in previous direction are inhibited until limit switch is ON.

(#) Only for **CSD ET**
(*) Only for **X-PLUS ET S4**:
When bit 7 of Input Config (Index 0x320C) is set = 1, bit 24 = 1 when the drive is in Safe Torque Off status.

Index0x60FE (subindex 1): Physical Outputs
This object shall monitor the status of general-purpose output and the status of special function output (O1 Brake Out) as shown in the following table:

Bit 31…19	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15…3	Bit 0
Reserved	O4	O3	O2	O1	O0	Reserved	Brake Out

Note1: Available/Setting outputs are described in 0x320D Index.
Note2: this object is read only and it is not PDO mapping. It is a monitor for the outputs status. It is possible to map the object 0x320A (Set Output).

Index 0x60FF: Target Velocity
Is the Set Point speed in CSV operation mode. The motor speed value can be carried out multiplying the Target Velocity value for the scale factor FS = 1.024 (see paragraph 2.1.4) if automatic correction factor is not enabled (see object 0x3320 subindex3).

4. DATA LINK LAYER (configuration registers)

ASIC address space in ESC (from 0x0000 to 0x1000) is dedicated for configuration registers common to all EtherCAT products.

	START ADDRESS	FINAL ADDRESS
ESC INFORMATION	0x0000	0x0009
STATION ADDRESS	0x0010	0x0013
WRITE PROTECTION	0x0020	0x0031
DATA LINK LAYER	0x0040	0x0111
APPLICATION LAYER	0x0120	0x0135
PDI	0x0140	0x0153
INTERRUPTS	0x0200	0x0223
ERROR COUNTERS	0x0300	0x0313
WATCHDOGS	0x0400	0x0443
ESI EEPROM Interface (ESI)	0x0500	0x050F
MII MANAGEMENT Interface (ESI)	0x0510	0x0515
FMMU (Fieldbus Memory Management Unit)	0x0600	0x06FF
SYNC MANAGER (SM)	0x0800	0x087F
DISTRIBUTED CLOCKS (DC)	0x0900	0x090F
DC-TIME LOOP CONTROL UNIT	0x0910	0x0935
DC-CYCLIC UNIT CONTROL	0x0980	0x0980
DC-SYNC OUT UNIT	0x0981	0x09A7
DC-LATCH IN UNIT	0x09A8	0x09CF
DC-SYNCMANAGER EVENT TIMES	0x09F0	0x09FF
ESC SPECIFIC	0x0E00	0x0EFF
DIGITAL INPUT/OUTPUT	0x0F00	0x0F19
USER RAM	0x0F80	0x0FFF
PROCESS DATA RAM	0x1000	0x2FFF

4.1 SYNCHRONIZATION MODE

In EtherCAT, master-slave synchronization mode can be set by writing on configuration registers 0x0980 e 0x09A0÷0x09A3

RTA synchronization mode are: SM2 Event (SM Mode), SYNC0 Event (DC Mode1) and Free Run.

The setting of desired synchronization mode needs configuration registers must be written as follows. Settings must be written before PRE-OPERATIONAL → SAFE OPERATIONAL state transition.

REGISTER ADDRESS	REGISTER NAME	DC MODE VALUE	SM2 MODE VALUE OR FREE RUN
0x0980	CYCLIC UNIT CONTROL	0x03	0x00
0x09A0÷0x09A3	SYNC0 CYCLE TIME	Cycle time (ns)	Not used

Note: in PRE-OPERATIONAL state, to configure the Free Run mode, the objects 0x1C32 subindex1 e 0x1C33 subindex1 must be set to 0. (that objects must not be write by the Master in SM Mode or DC Mode).

APPENDIX 1. OBJECTS DICTIONARY COMPLETE TABLE

Index (hex)	Sub Ind.	Object type	Access type	Note	Default value	Entry description	Valid values
1000	0	U32	RO		0x0004 0192	Device type	0x0004 0192
1001	0	U8	RO	1	0	Error Register	0 / 1
1008	0		RO		--	Device name	depending on the cases
1009	0		RO			Hardware version	
100A	0		RO			Software version	
1010		Rec		1		**Store parameters**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RW		0x00000001 (1)	Save all parameters	0x65766173 ("save")
1011		Rec		1		**Restore Default Parameters**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RW		0x00000001 (1)	Restore all Default Parameters	0x64616F6C ("load")
1018		Rec				**Identity**	
"	0	U8	RO		4	Number of entries	
"	1	U32	RO		0x0000017F (383)	Vendor ID	0x0000 017F
"	2	U32	RO		0x00000000 (0)	Product code	0x0000 0000…0xFFFF FFFF
"	3	U32	RO		0x00000000 (0)	Revision	0x0000 0000…0x FFFF FFFF
"	4	U32	RO		0x00000000 (0)	Serial number	0x0000 0000…0x FFFF FFFF
1600		Rec				**RPDO1**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RO		0x6040 0010	Control Word	0x6040 0010
1601		Rec				**RPDO2**	
"	0	U8	RO		2	Number of entries	
"	1	U32	RO		0x6040 0010	Control Word	0x6040 0010
"	2	U32	RO		0x607A 0020	Target Position	0x607A 0020
1700		Rec				**RPDO100**	
"	0	U8	RW		5	Number of entries	
"	1	U32	RW	1	0x6040 0010	1st mapping data	
"	2	U32	RW		0x6060 0008	2nd mapping data	
"	3	U32	RW		0x0000 0008	3rd mapping data	
"	4	U32	RW		0x607A 0020	4th mapping data	
"	5	U32	RW		0x0000 0000	5th mapping data	
"	6	U32	RW		0x0000 0000	6th mapping data	
"	7	U32	RW		0x0000 0000	7th mapping data	
"	8	U32	RW		0x0000 0000	8th mapping data	
1A00		Rec				**TPDO1**	
"	0	U8	RO		1	Number of entries	
"	1	U32	RO		0x6041 0010	Status Word	0x6041 0010
1A01		Rec				**TPDO2**	
"	0	U8	RO		2	Number of entries	
"	1	U32	RO		0x6041 0010	Status Word	0x6041 0010
"	2	U32	RO		0x6064 0020	Position Actual Value	0x6064 0020
1B00		Rec				**TPDO100**	
"	0	U8	RW	1	7	Number of entries	
"	1	U32	RW		0x6041 0010	1st mapping data	
"	2	U32	RW		0x6061 0008	2nd mapping data	
"	3	U32	RW		0x0000 0008	3rd mapping data	
"	4	U32	RW		0x6064 0020	4th mapping data	
"	5	U32	RW		0x0000 0000	5th mapping data	
"	6	U32	RW		0x0000 0000	6th mapping data	
"	7	U32	RW		0x0000 0000	7th mapping data	
"	8	U32	RW		0x0000 0000	8th mapping data	
1C00		Rec				**Sync manager type**	
"	0	U8	RO		4	Number of entries	
"	1	U8	RO		0x01 (1)	SubIndex 001	0x01 (1)
"	2	U8	RO		0x02 (2)	SubIndex 002	0x02 (2)
"	3	U8	RO		0x03 (3)	SubIndex 003	0x03 (3)
"	4	U8	RO		0x04 (4)	SubIndex 004	0x04 (4)

Index (hex)	Sub Ind.	Object type	Access type	Note	Default value	Entry description	Valid values
1C12		Rec				**RPDO assign**	
“	0	U8	RW		1	Number of entries	
“	1	U16	RW		0x1700 (5888)	SubIndex 001	0x1600…0x1700
“	2	U16	RW		--	SubIndex 002	0x1600…0x1700
“	3	U16	RW		--	SubIndex 003	0x1600…0x1700
“	4	U16	RW		--	SubIndex 004	0x1600…0x1700
1C13		Rec				**TPDO assign**	
“	0	U8	RW		1	Number of entries	
“	1	U16	RW		0x1B00 (6912)	SubIndex 001	0x1A00… 0x1B00
“	2	U16	RW		--	SubIndex 002	0x 1A00…0x1B00
“	3	U16	RW		--	SubIndex 003	0x 1A00…0x1B00
“	4	U16	RW		--	SubIndex 004	0x 1A00…0x1B00
1C32		Rec				**SM output parameter**	
“	0	U8	RO		32	Number of entries	
“	1	U16	RW		0x0000 (0)	Sync mode	0 (Free Run) / 1 (SM) / 2 (DC)
“	2	U32	RO		0x00000000 (0)	Cycle time	1000000 / 2000000 / 4000000
“	3	U32	RO		0x00000000 (0)	Shift time	0x00000000 (0)
“	4	U16	RO		0x0000 (0)	Sync modes supported	0x4007 (16391)
“	5	U32	RO		0x00000000 (0)	Minimum cycle time	0x0007A120 (500000)
“	6	U32	RO		0x00000000 (0)	Calc and copy time	0x00000000 (0)
“	8	U16	RW		0x0000 (0)	Get cycle time	0x0000 (0)
“	9	U32	RO		0x00000000 (0)	Delay time	0x00000000 (0)
“	A	U32	RW		0x00000000 (0)	Sync0 time	0 … 4000000
“	B	U32	RO		0x00000000 (0)	Cycle exceeded counter	0x00000000 (0)
“	C	U32	RO		0x00000000 (0)	SM event missed counter	0x00000000 (0)
“	D	U32	RO		0x00000000 (0)	Shift too short counter	0x00000000 (0)
“	20	U32	RO		FALSE	Sync error	FALSE
1C33		Rec				**SM input parameter**	
“	0	U8	RO		32	Number of entries	
“	1	U16	RW		0x0000 (0)	Sync mode	0 (Free Run) / 2 (DC) / 22 (SM)
“	2	U32	RO		0x00000000 (0)	Cycle time	1000000 / 2000000 / 4000000
“	3	U32	RO		0x00000000 (0)	Shift time	0x00000000 (0)
“	4	U16	RO		0x0000 (0)	Sync modes supported	0x4007 (16391)
“	5	U32	RO		0x00000000 (0)	Minimum cycle time	0x0007A120 (500000)
“	6	U32	RO		0x00000000 (0)	Calc and copy time	0x00000000 (0)
“	8	U16	RW		0x0000 (0)	Get cycle time	0x0000 (0)
“	9	U32	RO		0x00000000 (0)	Delay time	0x00000000 (0)
“	A	U32	RW		0x00000000 (0)	Sync0 time	0 … 4000000
“	B	U32	RO		0x00000000 (0)	Cycle exceeded counter	0x00000000 (0)
“	C	U32	RO		0x00000000 (0)	SM event missed counter	0x00000000 (0)
“	D	U32	RO		0x00000000 (0)	Shift too short counter	0x00000000 (0)
“	20	U32	RO		FALSE	Sync error	FALSE
303F	0	U16	RO	1	0x0000	Last Error Code	0x0000…0x8611
3201	0	U8	RW	1,2	0x46 (70)	Current Ratio	0…120
3202	0	U16	RW	1,2	0x3200 (12800)	Step Revolution	12800
3203	0	U8	RW	1,2	0x00 (0)	Current Equalization	0 / 1, 0 for CSD ET and R-MOD ET
3204	0	U8	RW	1,2	0x01 (1)	Current Reduction	0 / 1 for PLUS ET, X-PLUS ET, HI-MOD ET and HI-MOD ETS 1 for CSD ET and R-MOD ET
3205	0	U8	RO	1,2	0x03 (3)	Encoder Window	0 / 1 / 2 / 3 / 4 / 5
3206	0	U8	RW	1,2	0x00 (0)	Following Error Reaction Code	0x00 / 0x01 / 0x02 / 0x11
3207	0	U8	RW	1	0x00 (0)	Following Error Reset	0 / 1 / 2
3208	0	U8	RW	1,2	0x32 (50)	Current Reduction Ratio	0…100
320A	0	U8	RW	1	0x00 (0)	Set Output	0…15 for PLUS ET, X-PLUS ET 0…3 for HI-MOD ETS 0…31 for CSD ET 04/94
320C	0	U8	RW	1	0x0F (15) 0x1F (31) for CSD ET	Input Config	0…15 for PLUS ET, X-PLUS ET 14…15 for HI-MOD ET 0x0E 0x0F 0x8E 0x8F Hi-Mod ETS 0…31 for CSD ET and R-MOD ET 0…143 for X-PLUS ET S4
ì320D	0	U8	RW	1	0x03 (3) 0x01 (1) for Hi-Mod ET and X-Plus ETS 0x1B (27) for CSD ET	Output Config	0…7 for PLUS ET and X-PLUS ET 0…39 for CSD ET 04 / 94 0 for CSD ET 24 1…3 for Hi-Mod ETS

Index (hex)	Sub Ind.	Object type	Access type	Note	Default value	Entry description	Valid values
3210	0	U32	RW	1,2	0x00045E2C (286252) -- for PLUS ET 0x00045E2B (286251) -- for X-PLUS ET 0x000ADFA9 (712617) - for CSD ET	Motor Code	[see object description]
3211	0	U32	RW	2	0x00000000 (0)	Final Velocity	[reserved]
3212	0	U8	RW	1,2	0x00 (0)	Revolution Direction (CW / CCW setting)	0 / 1
3220		Rec		1		**Drive Parameters**	
	0	U8	RO		0x04 (4)	Number of entries	
	1	U16	RO		- 0x06 (6) per PLUS ET e Hi-Mod ET - 0x04 (4) per gli altri	Current Limit (A)	- 2, 3, 4, 5, 6 for PLUS ET, Hi-Mod ET and Hi-Mod ETS - 1, 2, 3, 4 for other models
	2	U16	RO		0x190 (400)	Proportional Gain (%)	100, 200, 300, 400
	3	U16	RO		0x1F4 (500)	Dynamic Balancing Gain (%)	0, 500
	4	U16	RO		0x01 (1)	Current Recycling Enable	0, 1
	5	U16	RO		0x00	Proportional Feed Forward	0
3222		Rec		1,2		**Auto-Sync Parameters**	
	0	U8	RO		0x03 (3)		
	1	U16	RW		0x00 (0)	Enable Mode	0 / 1 / 2 / 3
	2	U16	RW		0x64 (100)	Reactivity (Kv Gain)	0, 50, 100, 150, 200, 250, 300
	3	U16	RW		0x7D00 (32000)	Error Window (steps)	1…64000
3305	0	U8	RW	2	0x00 (0)	Emcy Enable	0 / 1
3306	0	U8	RW	2	0x00 (0)	Interp_Enable Bit	0 / 1
3307	0	U8	RW	2	0x00 (0)	INIT Reaction	0 / 3
3308	0	U16	RW	2	0x0190 (400)	CPR (Encoder Counts Per Revolution)	400 / 500 / 512 / 1000 / 1024 / 4000/ 4096
330A	0	U16		1,2	0x0064 (100)	Brake Delay Lock	0…1000
330B		Rec		1,2		**Brake Unlock Delay**	
	0	U8	RO		0x03 (3)	Number of entries	--
	2	U16	RW		0x0000 (0)	Brake Delay Current ON	0…1000
	3	U16	RW		0x00E6 (230)	Brake Delay Azio Ready	0…1000
3320		Rec		1,2		**Advanced Interpolation Parameters**	
	0	U8	RO		0x03 (3)	Number of entries	
“	1	U16	RW		1	CSP Hole Correction Enable	0 / 1
“	2	U16	RW		0	CSP-CSV Extended Interpolation Time (ms)	0 / 8 / 16
	3	U16	RW		0	CSV Automatic 1.024 Correction Factor Enable	0 / 1
3321		Rec		1,2		**Advanced Position-Velocity Parameters**	
	0	U8	RO		0x04 (4)	Number of entries	
	1	U16	RW		100	Velocity Actual Value Total Samples	1 / 2 / 4 / 5 / 8 / 10 / 20 / 25 / 40 / 50 / 100 / 200
	2	U16	RW		1	Reset Encoder On First Power Up	0 / 1
	3	U16	RW		64	Hard Stop Homing Disengaging Steps	0…255
	4	U16	RW		0	Power Up Speed Limit (steps/s)	0…32000
3322		Rec		1,2		**Status Word Manufacturer Bits**	
	0	U8	RO		0x02 (2)	Number of entries	
	1	U16	RW		0	Status Word Bit 15 As Profile Ramp	0 / 1
	2	U16	RW		0	Status Word Bit 14 As Closed Loop Active	0 / 1
3330		Rec				**Request Parameters**	
“	0	U8	RO		2	Number of entries	
“	1	I16	RW		0	View data	
“	2	I32	RO		0	N holes corrected	

Index (hex)	Sub Ind.	Object type	Access type	Note	Default value	Entry description	Valid values
3333		Rec		1,2		**Drive Alarm Register**	
"	0	U8	RO		20	Number of entries	
"	1	I32	RO		0	1st Latest Alarm Time	
"	2	I32	RO		0	1st Latest Alarm	
"	...	I32	RO		0	nth Latest Alarm Time	
"	...	I32	RO		0	nth Latest Alarm	
"	19	I32	RO		0	10th Latest Alarm Time	
"	20	I32	RO		0	10th Latest Alarm	
603F	0	U16	RO	1	0x0000 (0)	Error Code	0x0000…0x8611
6040	0	U16	RW		0x0000 (0)	Control Word	0x 0000 …0x FFFF
6041	0	U16	RO		0x0000 (0)	Status Word	0x 0000 …0x FFFF
605A	0	I16	RW		5	Quickstop Option Code	5
605B	0	I16	RW		0	Shutdown Option Code	0
605C	0	I16	RW		0	Disable Operation Option Code	0
605D	0	I16	RW		1	Halt Option Code	1
605E	0	I16	RW		0	Fault Reaction Code	0
6060	0	I8	RW		0	Mode of Operation	1 / 3 / 6 / 8 / 9
6061	0	I8	RO		0	Mode of Operation Display	1 / 3 / 6 / 8 / 9
6064	0	I32	RO	1	0	Position Actual Value	-2147483648 … +2147483647
606C		I32	RW	1	0	Velocity Actual Value	[depending on axis]
606D		U16	RW	1	6400 [30RPM]	Velocity Window	0…65 536
606E		U16	RW	1	100 [ms]	Velocity Window Time	0…5000
606F		U16	RW	1	6400 [30RPM]	Velocity Threshold	0…65 536
6070		U16	RW	1	100 [ms]	Velocity Threshold time	0…5 000
607A	0	I32	RW	1	0	Target Position	-2147483648 … +2147483647
607B		Rec				**Position Range Limit**	
"	0	U8	RO		2	Number of entries	
"	1	I32	RW		0	Minimum position range limit	
"	2	I32	RW		0	Maximum position range limit	
607C	0	I32	RW	1	0	Home Offset	-2147483648 … +2147483647
6080	0	U32	RW	1	300 000	Max Motor Speed	0…800 000
6081	0	U32	RW	1	0x5DC0 (24000)	Profile Velocity	0…800 000
6083	0	U32	RW	1	0x9C400 (640000)	Profile Acceleration	2000…10 000 000
6084		U32	RW	1	0x9C400 (640000)	Profile Deceleration	2000…10 000 000
6098	0	I8	RW	1	37	Homing Method	3 / 4 / 5 / 6 / 19 / 20 / 21 / 22 / 33 / 34 / 35 / 37 / -1 (255) / -2 (254)
6099		Rec				**Homing Speeds**	
"	0	U8	RO		2	Number of entries	
"	1	U32	RW	1	0x5DC0 (24000)	Speed during Search for Switch	1…400 000
"	2	U16 or U32	RW	1	0x0C80 (3200)	Speed during Search for Zero	0…16000
609A	0	U32	RW	1	0x9C400 (640000)	Homing Acceleration	2000…10 000 000
60B8	0	U16	RW	1	0x0000 (0)	Touch Probe Function	0x00 / 0x11 / 0x15 / 0x21 / 0x25
60B9	0	U16	RW	1	0x0000 (0)	Touch Probe Status	0x 0…0x 0087
60BA	0	I32	RO		--	Touch Probe Pos Pos Value	-2147483648 … +2147483647
60BB	0	I32	RO		--	Touch Probe Pos Neg Value	-2147483648 … +2147483647
60E3	0	Rec				**Supported Homing Methods**	
	0	U8	RO			Number of entries	14
	1	I8	RO		0x03 (3)	1st supported homing method	3 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	2	I8	RO		0x04 (4)	2nd supported homing method	4 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	3	I8	RO		0x05 (5)	3rd supported homing method	5 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	4	I8	RO		0x06 (6)	4th supported homing method	6 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	5	I8	RO		0x13 (19)	5th supported homing method	19
	6	I8	RO		0x14 (20)	6th supported homing method	20
	7	I8	RO		0x15 (21)	7th supported homing method	21

	8	I8	RO		0x16 (22)	8th supported homing method	22
	9	I8	RO		0x21 (33)	9th supported homing method	33 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	A	I8	RO		0x22 (34)	10th supported homing method	34 (not available for Hi-Mod ET E3F2HA, Hi-Mod ETS E4F2HC and R-MOD ET)
	B	I8	RO		0x23 (35)	11th supported homing method	35
	C	I8	RO		0x25 (37)	12th supported homing method	37(alias of 35)
	D	I8	RO		0xFF (-1)	13th supported homing method	-1 (o 255)
	E	I8	RO		0xFE (-2)	14th supported homing method	-2 (o 254)
60FD	0	U32	RO	1	0x00000000 (0)	Digital Inputs	0x0…0xFFFFFFFF
60FE		Rec		1		**Digital Outputs**	
“	0	U8	RO		1	Number of entries	
“	1	U32	RO		0x00000000 (0)	Physical Outputs	0x0…0x01F00001
60FF	0	U32	RW	1	0x00000000 (0)	Target Velocity	-2147483648…+2147483647
6502	0	U32	RO		0x000001A1 (417)	Supported Drive Modes	0x000001A1 (417)

In the column “**Note**”:
1: This value shows that there is a comment for this object in the preceding chapters.
2: This value shows that the data written in the object can be stored in permanent storage (see Index 0x1010-0x1011).