CLEARPATH-EC ETHERCAT SOFTWARE REFERENCE

MODELS ECSK AND ECHP

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INTRODUCTION

DOCUMENT OVERVIEW

Thank you for purchasing ClearPath-EC Industrial Servo Motor. This document is designed to act as a quick software reference for ClearPath-EC (CPM-ECxx-xxxxx-xxxx). For hardware, wiring, and ClearView 3.0 documentation, please see the ClearPath-EC User Manual. The ClearPath-EC User Manual can be found on the downloads page of Teknic's website or at the following link.

ClearPath-EC User Manual Link:
https://teknic.com/files/downloads/ClearPath-EC_User_Manual.pdf

INTRODUCTION TO CLEARPATH-EC

ClearPath-EC is used within an EtherCAT network, and implements the CiA402 Device Profile for drives and motion control. Supported operational modes include Cyclic Synchronous Position (CSP), Cyclic Synchronous Velocity (CSV), Cyclic Synchronous Torque (CST), Profile Position (PP), Profile Velocity (PV), Profile Torque (TQ), and Homing (HM) with various homing methods. Teknic recommends using the ClearView 3.0 motor setup software for initial product configuration. ClearView 3.0 has helpful interfaces for setting up many ClearPath-EC features, including:

- Auto-Tuning *(required one-time after mounting to new mechanics)*
- Homing
- Torque Limiting
- Limit Switch Setup
- Software Limits
- Disable and Stop Options
- Move Status Feedback *(i.e. In Range and Move Done)*
- Torque Foldback
- Regenerated Energy Handling
- Power and Temperature Settings

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SAFETY INFORMATION

PRECAUTIONARY STATEMENT

Always follow appropriate safety precautions when installing and using automated motion control equipment. Motion control systems should be designed and utilized to prevent personnel from coming into contact with moving parts and electrical contacts that could cause injury or death. Read all cautions, warnings, and notes before attempting to install or operate this device. Follow all applicable codes and standards when using this equipment. Failure to use this equipment as described may impair or neutralize protections built into the product.

GENERAL DISCLAIMER

The User is responsible for determining the suitability of this product for his/her application. The User must ensure that Teknic's products are installed and utilized in accordance with all local, state, federal, and private governing bodies and meet all applicable health and safety standards.

Teknic has made all reasonable efforts to accurately present the information in the published documentation and shall not be responsible for any incorrect information which may result from unintentional oversights.

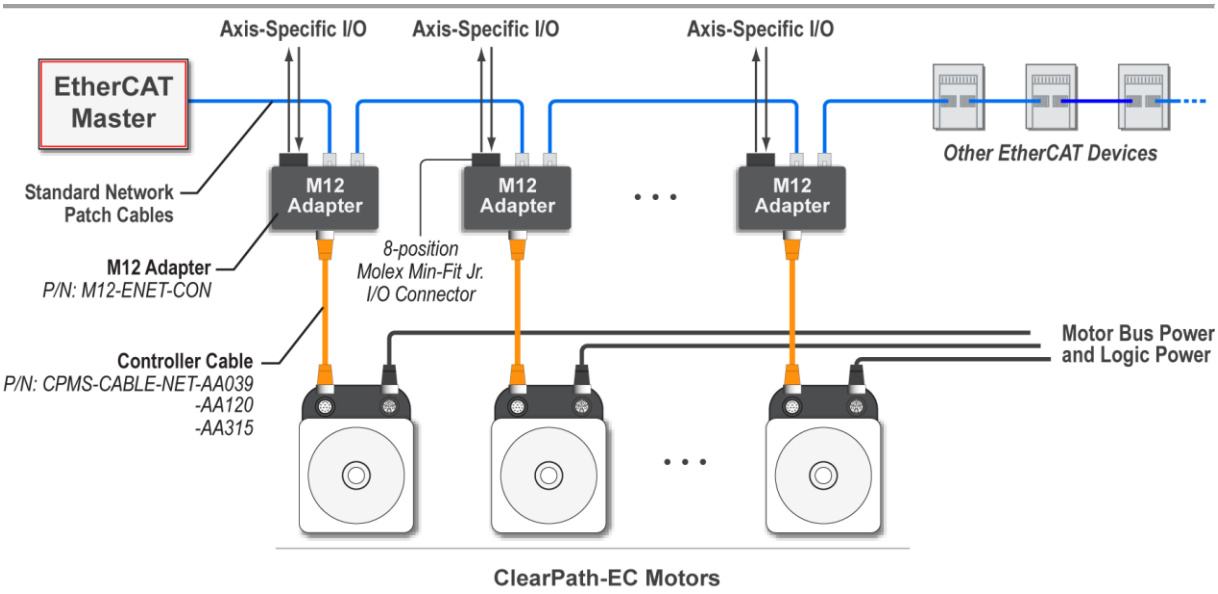
Due to continuous product improvements, the product specifications as stated in the documentation are subject to change at any time and without notice. The User is responsible for consulting a representative of Teknic for detailed information and to determine any changes of information in the published documentation.

Should Teknic's products be used in an application that is safety critical, the User must provide appropriate safety testing of the products, adequate safety devices, guarding, warning notices, and machine-specific training to protect the operator and/or bystanders from injury.

CONNECTING CLEARPATH-EC TO A MASTER

CONNECTING CLEARPATH-EC TO A NETWORK

ClearPath-EC components easily connect to any EtherCAT network.



ClearPath-EC EtherCAT System Overview

More information about integrating your ClearPath-EC motor into an EtherCAT network can be found in the ClearPath-EC User Manual.

MASTER SOFTWARE CONFIGURATION (ESI FILE)

Many EtherCAT Masters use EtherCAT Slave Information (ESI) files to load information about specific devices on their network. The process of loading an ESI file is different for every master, but is typically one of the first steps when setting up a new device. You can download the ClearPath-EC ESI file from the download page of Teknic's website HERE.

CLEARPATH-EC ENCODER RESOLUTION

ClearPath-EC motors have two resolution options for their high-precision optical encoder:

- **12,800 counts/revolution** for part numbers ending in **-Rxxx**
- **51,200 counts/revolution** for part numbers ending in **-Exxx**

Ensure the EtherCAT master is configured appropriately using the resolution of your ClearPath-EC before commanding motion.

CLEARPATH-EC NETWORK TIMING CONFIGURATION

IMPORTANT: For optimal performance and reliable operation of ClearPath-EC, Teknic strongly recommends following the configuration guidelines in this section. Deviations from these settings may result in degraded performance or communication issues.

CYCLE TIME

Set the EtherCAT master's cycle time to an integer multiple of **250 µs** (e.g., 250 µs, 500 µs, 1000 µs, etc.).

The minimum recommended cycle time is **250 µs**.

INTERPOLATION TIME PERIOD (0X60C2)

Set the interpolation time period to match the EtherCAT master's cycle time.

A few common cycle times and their corresponding Interpolation Time settings can be found in the table below.

Cycle Time / Frequency	Interpolation Time Period Value (0x60C2[1])	Interpolation Time Index (0x60C2[2])
2 ms / 500 Hz (default)	2 (default)	-3 (default)
1 ms / 1 kHz	1	-3
500 µs* / 2 kHz	50*	-5*
250 µs* / 4 kHz	25*	-5*

Interpolation Time Period (in seconds) =

$$Interpolation\ Time\ Period\ Value * 10^{Interpolation\ TIme\ Index}$$

**Note: cycle times less than 1 ms may require changes to the DC sync pulse settings within the master for the CSP/CSV/CST operating modes. Ensure sync pulses are always timed such that they are received after the datagram is received by ClearPath, not during.*

SYNCHRONIZATION MODES & DISTRIBUTED CLOCKS

We recommend setting your EtherCAT master to use Distributed Clock Sync (DC-Sync) for the highest timing precision.

Distributed Clock Sync (DC-Sync) requires proper configuration of the DC objects through your EtherCAT master, and is highly recommended for ClearPath-EC when cycle times are below 1 ms or when deterministic timing is critical.

SyncManager Sync (SM-Sync) is a good compromise for applications needing moderate synchronization without the extra configuration of distributed clocks.

Note: Free Run is not supported by ClearPath-EC.

COMMUNICATING WITH CLEARPATH-EC

The data that can be transmitted between an EtherCAT master and ClearPath-EC is organized into parameters. Each parameter has a unique Index and various Sub-indices.

Cyclic data is exchanged via Process Data Objects (PDOs). The PDOs contain frequently updated or requested data such as motion targets, motor feedback, and digital I/O data. Service Data Objects (SDOs) are used for parameters that should not be exchanged cyclically or only need to be written or read occasionally. Motion control is executed as part of the cyclic PDO update and is not triggered by SDO communication.

SETTING A PDO

PDOs are used to communicate cyclically between the EtherCAT master and a ClearPath-EC motor. PDOs are split into receive PDOs and transmit PDOs. The receive PDOs (RxPDOs) contain the parameters sent from the master to a device. The transmit PDOs (TxPDOs) contain feedback parameters from the device to the master.

All ClearPath-EC PDOs can contain up to 8 parameters. The parameters contained in each PDO are defined in the PDO mapping objects. Parameters 0x1600 to 0x1605 are the mapping objects for the RxPDOs. Parameters 0x1A00 to 0x1A05 are the mapping objects for the TxPDOs. Sub-Index [0] of each mapping object defines the number of parameters that will be mapped. Parameters are added to a PDO using the following format:

PDO Mapping Value Breakdown:

Bit	31-16	15-8	7-0
Value	Index	Sub-Index	Length

For example, these are the parameters included in the combined operating mode PDOs, along with their corresponding PDO mapping values:

Default Combined Receive PDO (0x1600):

Index[Sub-IDX]	Name	Length [Hex (Bit)]	PDO Mapping Value
0x6040[00]	Controlword	0x10 (16)	0x60400010
0x6060[00]	Modes of Operation	0x08 (8)	0x60600008
0x6071[00]	Target Torque	0x10 (16)	0x60710010
0x607A[00]	Target Position	0x20 (32)	0x607A0020
0x60FE[01]	Digital Outputs	0x20 (32)	0x60FE0120
0x60FF[00]	Target Velocity	0x20 (32)	0x60FF0020

Default Combined Transmit PDO (0x1A00):

Index[Sub-IDX]	Name	Length [Hex (Bit)]	PDO Mapping Value
0x603F	Error Code	0x10 (16)	0x603F0010
0x6041	Statusword	0x10 (16)	0x60410010
0x6061	Modes of Operation Display	0x08 (8)	0x60610008
0x6064	Position Actual Value	0x20 (32)	0x60640020
0x606C	Velocity Actual Value	0x20 (32)	0x606C0020
0x6077	Torque Actual Value	0x10 (16)	0x60770010
0x60F4	Following Error Actual Value	0x20 (32)	0x60F40020
0x60FD	Digital Inputs	0x20 (32)	0x60FD0020

Note: the master must set the servo's EtherCAT state to "PREOP" to change PDO mapping and assignments.

SETTING THE PDO ASSIGNMENT

A PDO must be part of the PDO Assignment for its data to actually be exchanged between the master and device. The RxPDO Assignment (0x1C12[0-6]) and TxPDO Assignment (0x1C13[0-6]) parameters define which PDOs will be exchanged.
To assign a PDO, set the value of a PDO Assignment sub-index to the desired PDO index. Set any remaining PDO Assignment sub-indices to 0.

Note: the master must set the servo's EtherCAT state to "PREOP" to change PDO mapping and assignments.

SENDING AN SDO

SDO communication is intended for configuration and diagnostics and does not replace cyclic, PDO-based control. The process of sending an SDO varies by EtherCAT master implementation.

If you experience difficulty performing SDO reads/writes, Teknic recommends contacting your EtherCAT master vendor/manufacturer for technical support.

OPERATING MODES

ClearPath-EC Industrial Servo Motors support seven operating modes:

- Cyclic Synchronous Position Mode (CSP)
- Cyclic Synchronous Velocity Mode (CSV)
- Cyclic Synchronous Torque Mode (CST)
- Profile Position Mode (PP)
- Profile Velocity Mode (PV)
- Profile Torque Mode (TQ)
- Homing (HM)

Each control mode is implemented according to the CiA402 drive profile specification.

CYCLIC SYNCHRONOUS POSITION MODE (CSP)

Cyclic Synchronous Position (CSP) mode is the default control mode for ClearPath-EC. It provides the most flexibility in contoured/interpolated motion control, as well as the highest degree of multi-axis coordination and synchronization.

In CSP mode, the master sends an updated Target Position to ClearPath cyclically (at the PDO update cycle rate). ClearPath follows these provided target positions in real time. The master must "profile" the target positions to command the desired velocity and rate of acceleration (i.e. the rate of change of Target Position should ramp up and down to avoid undesired abrupt changes in position).

Note: Homing mode can be used in addition to CSP mode when the application must find or set a zero position. Change to Homing mode when using any of ClearPath's automatic homing methods, then switch back to CSP mode to command typical position moves.

CONTROLWORD (CSP)

The master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4-6	Unused
7	Fault Reset
8-10	Unused
11	External Positive Limit
12	External Negative Limit
13-15	Unused

Note: To enable a ClearPath-EC motor, the master must turn on bits 1 and 2 of the Controlword (Ready to Switch On) then turn on bits 0-3 of the Controlword (Operation Enabled).

STATUSWORD (CSP)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Reserved
11	Internal Limit Active
12	Drive Follows Command
13	Following Error
14	Move Done
15	In Range

CSP DEFAULT PDOS

Default CSP Receive PDO (0x1601):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6040	Controlword	0x60400010
0x607A	Target Position	0x607A0020
0x60FE[01]	Digital Outputs	0x60FE0120

Default CSP Transmit PDO (0x1A01):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6041	Statusword	0x60410010
0x6064	Position Actual Value	0x60640020
0x60F4	Following Error Actual Value	0x60F40020
0x60FD	Digital Inputs	0x60FD0020
0x603F	Error Code	0x603F0010

CYCLIC SYNCHRONOUS VELOCITY MODE (CSV)

Cyclic Synchronous Velocity (CSV) mode provides direct control of motor velocity. In CSV mode, the master sends an updated Target Velocity to ClearPath cyclically (at the PDO update cycle rate). ClearPath follows these provided target velocities in real time. The master must "profile" the target velocities to command the desired acceleration (i.e. the Target Velocity should ramp up and down to avoid undesired abrupt changes in speed).

CONTROLWORD (CSV)

The master uses the Controlword to manipulate the state of the ClearPath, allowing for the control of key functions (such as enabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4-6	Unused
7	Fault Reset
8-10	Unused
11	External Positive Limit
12	External Negative Limit
13-15	Unused

Note: To enable a ClearPath-EC motor, the master must turn on bits 1 and 2 of the Controlword (Ready to Switch On) then turn on bits 0-3 of the Controlword (Operation Enabled).

STATUSWORD (CSV)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Reserved
11	Internal Limit Active
12	Drive Follows Command
13	Unused
14	Move Done
15	In Range

CSV DEFAULT PDOS

Default CSV Receive PDO (0x1602):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6040	Controlword	0x60400010
0x60FF	Target Velocity	0x60FF0020
0x60FE[01]	Digital Outputs	0x60FE0120

Default CSV Transmit PDO (0x1A02):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6041	Statusword	0x60410010
0x6064	Position Actual Value	0x60640020
0x606C	Velocity Actual Value	0x606C0020
0x60FD	Digital Inputs	0x60FD0020
0x603F	Error Code	0x603F0010

CYCLIC SYNCHRONOUS TORQUE MODE (CST)

Cyclic Synchronous Torque (CST) mode provides direct control of motor torque. In CST mode, the master sends a Target Torque to the ClearPath motor cyclically (at the PDO update cycle rate). This torque is applied immediately.

CONTROLWORD (CST)

The master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4-6	Unused
7	Fault Reset
8-10	Unused
11	External Positive Limit*
12	External Negative Limit*
13-15	Unused

**Limits do not apply in CST mode.*

Note: To enable a ClearPath-EC motor, the master must turn on bits 1 and 2 of the Controlword (Ready to Switch On) then turn on bits 0-3 of the Controlword (Operation Enabled).

STATUSWORD (CST)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Reserved
11	Unused
12	Drive Follows Command
13	Unused
14	Over-Speed
15	Unused

CST DEFAULT PDOS

Default CST Receive PDO (0x1603):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6040	Controlword	0x60400010
0x6071	Target Torque	0x60710010
0x60FE[01]	Digital Outputs	0x60FE0120

Default CST Transmit PDO (0x1A03):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6041	Statusword	0x60410010
0x6064	Position Actual Value	0x60640020
0x6077	Torque Actual Value	0x60770010
0x60FD	Digital Inputs	0x60FD0020
0x603F	Error Code	0x603F0010

PROFILE POSITION MODE (PP)

Profile Position (PP) mode is another operating mode used to command position, but with less external control than Cyclic Synchronous Position (CSP) mode. CSP tends to be more commonly used than Profiled Position because many EtherCAT masters provide an interface to easily manage the move profile generation required for CSP mode, especially those that support "motion" as a feature[1]. Profile Position mode tends to be a better fit for positioning applications where: 1) the EtherCAT master does not support CSP mode, 2) the EtherCAT master only supports slower communication cycle times, or 3) the EtherCAT network has extremely limited bandwidth or a very large number of nodes.

In Profile Position mode, the motor automatically moves to the user-defined Target Position while adhering to the pre-set Profile Velocity, Profile Acceleration, and Profile Deceleration. To issue a move command, set the Target Position, Profile Velocity, Profile Acceleration, and Profile Deceleration parameters to the desired values. Then raise the New Set-Point bit in the Controlword to begin the move. The Set-Point Acknowledge bit of the Statusword will turn on when the move command is received.

Target Positions can be either Absolute (measured from a pre-defined zero/home position), Relative to the motor's actual position, or Relative to the preceding (internal absolute) target position.

"Single Setpoint" moves are supported to allow new moves to interrupt a previous move and smoothly transition to a new Target Position.

"Set of Setpoints" moves are supported to block new moves from interrupting a previous move. Setpoints cannot be buffered up within the servo, even when using the Set of Setpoints method.

Note: Homing mode can be used in addition to PP mode when the application must find or set a zero position. Change to Homing mode when using any of ClearPath's automatic homing methods, then switch back to PP mode to command typical position moves.

[1]Note: always check the documentation for your EtherCAT master to verify support of motion features.

CONTROLWORD (PP)

The master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4	New Set-Point
5	Change Set Immediately 0 = Set of Setpoints 1 = Single set Point
6	Position Move Type 0 = Absolute 1 = Relative
7	Fault Reset
8	Halt
9-10	Unused
11	External Pos Limit
12	External Neg Limit
13	Relative Move Option 0 = relative moves occur relative to the preceding (internal absolute) target position 1 = relative moves occur relative to actual current motor position
14-15	Unused

Note: To enable a ClearPath-EC motor, the master must turn on bits 1 and 2 of the Controlword (Ready to Switch On) then turn on bits 0-3 of the Controlword (Operation Enabled).

STATUSWORD (PP)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Target Reached/Move Done
11	Internal Limit Active
12	Set-Point Acknowledge
13	Following Error
14	At Velocity
15	In Range

PP DEFAULT PDOS

Default PP Receive PDO (01604):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6040	Controlword	0x60400010
0x607A	Target Position	0x607A0020
0x6081	Profile Velocity	0x60810020
0x6083	Profile Acceleration	0x60830020
0x6084	Profile Deceleration	0x60840020
0x60FE[01]	Digital Outputs	0x60FE0120

Default PP Transmit PDO (01A04):

Index[Sub-IDX]	Name	PDO Mapping Value
0x603F	Error Code	0x603F0010
0x6041	Statusword	0x60410010
0x6064	Position Actual Value	0x60640020
0x2316	Current Profile Position	0x23160020
0x2317	Current Profile Velocity	0x23170020
0x2318	Current Profile Acceleration	0x23180020
0x2319	Current Profile Deceleration	0x23190020
0x60FD	Digital Inputs	0x60FD0020

PROFILE VELOCITY MODE (PV)

Profile Velocity (PV) mode is used to command motor velocity, but with less external control than Cyclic Synchronous Velocity (CSV) mode. In Profile Velocity mode, the motor automatically ramps to a Target Velocity while adhering to the Profile Acceleration and Profile Deceleration rates set by the master.

CONTROLWORD (PV)

The master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4-6	Unused
7	Fault Reset
8	Halt
9-10	Unused
11	External Pos Limit
12	External Neg Limit
13-15	Unused

Note: To enable a ClearPath-EC motor, the master must turn on bits 1 and 2 of the Controlword (Ready to Switch On) then turn on bits 0-3 of the Controlword (Operation Enabled).

STATUSWORD (PV)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Target Reached/At Velocity
11	Internal Limit Active
12	Stationary
13-15	Unused

PV DEFAULT PDOS

Default PV Receive PDO (0x1605):

Index[Sub-IDX]	Name	PDO Mapping Value
0x6040	Controlword	0x60400010
0x60FF	Target Velocity	0x60FF0020
0x6083	Profile Acceleration	0x60830020
0x6084	Profile Deceleration	0x60840020
0x60FE	Digital Outputs	0x60FE0120

Default PV Transmit PDO (0x1A05):

Index[Sub-IDX]	Name	PDO Mapping Value
0x603F	Error Code	0x603F0010
0x6041	Statusword	0x60410010
0x6064	Position Actual Value	0x60640020
0x606C	Velocity Actual Value	0x606C0020
0x2317	Current Profile Velocity	0x23170020
0x2318	Current Profile Acceleration	0x23180020
0x2319	Current Profile Deceleration	0x23190020
0x60FD	Digital Inputs	0x60FD0020

PROFILE TORQUE MODE (TQ)

Profile Torque Mode (TQ) is used to command motor torque, but with less external control than Cyclic Synchronous Torque (CST) mode. ClearPath automatically ramps its torque output up/down to meet the Target Torque. The ramp rate is defined by the Torque Slope parameter, which is set by the master to adjust how quickly torque is changed.

CONTROLWORD (TQ)

The master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4-6	Unused
7	Fault Reset
8	Halt
9-10	Unused
11	External Pos Limit*
12	External Neg Limit*
13-15	Unused

**Limits do not apply in TQ mode.*

Note: To enable a ClearPath-EC motor, the master must turn on bits 1 and 2 of the Controlword (Ready to Switch On) then turn on bits 0-3 of the Controlword (Operation Enabled).

STATUSWORD (TQ)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Target Reached
11	Unused
12	Reserved
13	Unused
14	Over-Speed
15	Unused

TQ DEFAULT PDOS

Default TQ Receive PDO (0x1603):

TQ mode uses the same default Receive PDO as CST mode.

Default TQ Transmit PDO (0x1A03):

TQ mode uses the same default Transmit PDO as CST mode.

HOMING MODE (HM)

In many servo positioning applications, the moving element of the stage (i.e., the load) must be precisely positioned at a known location along the stroke of the axis before accurate positioning can begin. When a ClearPath motor is powered up, the motor does not know exactly where its load is positioned along the stroke. Thus, if an application requires the load to be in a specific location before operations begin, the motor must be homed. Homing ensures that an application will always begin in the same physical location regardless of the motor's position upon power-up.

ClearPath-EC has implemented several automatic homing methods to simplify the homing operation and allow for flexibility in the home target.

HOMING METHODS

Teknic recommends using ClearView 3.0 to configure your homing preferences and choose the optimal homing method. ClearView's homing interface will automatically configure the homing method based on your selected homing preferences. The table below can be used as a quick reference for the various homing methods.

ClearPath-EC Homing Methods:

Homing Method Value (0x6098)	Input Type	Direction
-2	Hard Stop	CW(-)
-1	Hard Stop	CCW(+)
17	Limit Switch	CW(-)
18	Limit Switch	CCW(+)
19	Home Sensor (*Turns On*)	CCW(+)
20	Home Sensor (*Turns Off*)	CW(-)
21	Home Sensor (*Turns On*)	CW(-)
22	Home Sensor (*Turns Off*)	CCW(+)
33	Shaft Angle	CW(-)
34	Shaft Angle	CCW(+)
37	Current Position	N/A

CONTROLWORD (HM)

The master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode.

Controlword Bitwise Breakdown:

Bit	Name
0	Switch On
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4	Start Homing
5-6	Unused
7	Fault Reset
8	Halt
9-10	Unused
11	External Positive Limit
12	External Negative Limit
13-15	Unused

HOMING MODE PROCEDURE

The following are instructions for homing a ClearPath-EC motor using the built-in homing mode. This homing mode can be configured using the ClearView 3.0 software.

1. To begin homing, change from your current operating mode to homing mode by setting the Modes of Operation parameter (0x6060) to 0x06.
2. The servo must be Enabled before it can follow any command. Enable the servo by turning on bits 1 and 2 of the Controlword (Ready to Switch On) then turning on bits 0-3 of the Controlword (Operation Enabled).
3. Begin homing by setting the Controlword Start Homing bit (4) high. The motor will begin to move towards its home target (except when using Method 37 “Current Position”).
4. The motor will signal that the selected homing operation is complete by raising the Homing Attained bit (12) of the Statusword.
5. Change from homing mode back to your desired operating mode by setting the Modes of Operation parameter (0x6060) to the appropriate value (e.g. 0x08 for CSP mode).

STATUSWORD (HM)

The master uses the Statusword to obtain feedback about ClearPath's status. The bits of the Statusword are unique for each operating mode.

Statusword Bitwise Breakdown:

Bit	Name
0	Ready to Switch On
1	Switched On
2	Operation Enabled
3	Fault
4	Voltage Enabled
5	Quick Stop
6	Switch on Disabled
7	Warning
8	Has Homed
9	Remote
10	Target Reached
11	Internal Limit Active
12	Homing Attained
13	Homing Error
14-15	Unused

PARAMETER DESCRIPTIONS

This section contains detailed descriptions of commonly used parameters organized by functional group.

- Device Information
- PDO Configuration
- Motor Configuration
- Motion Command
- Motor Feedback
- Homing
- Quick Stop, Halt, and Disable Actions
- Power and Temperature
- Torque Limiting and Software Limits
- I/O
- Motor Tuning

Each functional group contains parameters used for a specific function. For a full list of all available parameters, see Appendix A.

DEVICE INFORMATION PARAMETER DETAILS

The Device Information functional group contains parameters with details about your ClearPath-EC Servo.

Device Type (0x1000):
This parameter specifies the type of device. The lower 16 bits contain the device profile number (0x0192, or decimal "402" for CiA 402).

Manufacturer Device Name(0x1008):
This parameter contains the motor part number (e.g. CPM-ECHP-3411H-ELSB)

Hardware Revision (0x1009):
This parameter contains Teknic's device hardware revision number.

Software Revision (0x100A):
This parameter contains Teknic's device firmware revision number.

Identity Object (0x1018 [0-4]):
This object contains general information about the device.

- **Number of entries (x1018 [0]):** The number of entries in the identity object.
- **Vendor ID (x1018 [1]):** The Teknic vendor ID.
- **Product code (x1018 [2]):** The EtherCAT product code.
- **Revision number (x1018 [3]):** The EtherCAT product revision number.
- **Serial number (x1018 [4]):** The product's serial number.

On Time (0x201D):
Total powered on time of the motor in tenths of a second.

Position Encoder Resolution (0x608F [0-2]):
This object contains the data required to calculate the position encoder resolution.

- **Highest Subindex Supported (0x608F [0]):** The number of sub-indices supported by the Position encoder resolution parameter (x608F).
- **Encoder Increments (0x608F [1]):** The motor's configured encoder increments Note: *This value is 12800 for part numbers ending in Rxxx or 51200 for part numbers ending in Exxx.*
- **Motor Revolutions (0x608F [2]):** The number of motor revolutions Note: *This value is 1 for all ClearPath-EC motors.*

Position encoder resolution = encoder increments/motor revolutions.

Supported Drive Modes (0x6502):
This object provides information about supported drive modes.
Note: R = Reserved

Bit	31-10	9	8	7	6	5	4	3	2	1	0
Value	R	CST	CSV	CSP	R	Homing	R	TQ	PV	R	PP

Version Number (0x67FE):
This object provides the version number of the CiA-402 profile implemented on this device.

Device Profile Number (0x67FF):
This object defines the specific drive type within a multi-device module
Note: ClearPath-EC only supports a single device profile, so this value is identical to the Device Type in 0x1000.

PDO CONFIGURATION PARAMETER DETAILS

The PDO Configuration functional group contains the parameters used to map objects to PDOs and add the desired PDOs to the Sync Manager.

Receive PDO Mapping Parameter 1 (0x1600 [0-8]):
This object contains the mapped data objects for Receive PDO 1. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Receive PDO Mapping Parameter 2 (0x1601 [0-8]):
This object contains the mapped data objects for Receive PDO 2. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Receive PDO Mapping Parameter 3 (0x1602 [0-8]):
This object contains the mapped data objects for Receive PDO 3. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Receive PDO Mapping Parameter 4 (0x1603 [0-8]):
This object contains the mapped data objects for Receive PDO 4. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Receive PDO Mapping Parameter 5 (0x1604 [0-8]):
This object contains the mapped data objects for Receive PDO 5. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Receive PDO Mapping Parameter 6 (0x1605 [0-8]):
This object contains the mapped data objects for Receive PDO 6. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Transmit PDO Mapping Parameter 1 (0x1A00 [0-8]):
This object contains the mapped data objects for Transmit PDO 1. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Transmit PDO Mapping Parameter 2 (0x1A01 [0-8]):
This object contains the mapped data objects for Transmit PDO 2. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Transmit PDO Mapping Parameter 3 (0x1A02 [0-8]):
This object contains the mapped data objects for Transmit PDO 3. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Transmit PDO Mapping Parameter 4 (0x1A03 [0-8]):
This object contains the mapped data objects for Transmit PDO 4. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Transmit PDO Mapping Parameter 5 (0x1A04 [0-8]):
This object contains the mapped data objects for Transmit PDO 5. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

Transmit PDO Mapping Parameter 6 (0x1A05 [0-8]):
This object contains the mapped data objects for Transmit PDO 6. For more information about mapping objects to a PDO see the Communicating with ClearPath-EC section.

- **Number of entries:** This is the number of entries.
- **Mapping Entry 1-8:** Each sub-index contains a mapped object.

Bit	31-16	15-8	7-0
Value	Object Index	Object Sub-Index	Object Length

RxPDO Assignment (0x1C12 [0-6]):
This object is used to assign PDOs to the Sync Manager.

- **Number of assigned PDOs:** This sub-index contains the number of assigned PDOs.
- **RxPDO(1-6) Mapping Object:** These sub-indices contain the index of the assigned PDO.

TxPDO Assignment (0x1C13 [0-6]):
This object is used to assign PDOs to the Sync Manager.

- **Number of assigned PDOs:** This sub-index contains the number of assigned PDOs.
- **TxPDO(1-6) Mapping Object:** These sub-indices contain the index of the assigned PDO.

RxPDO/TxPDO Synchronization (0x1C32 & 0x1C33):
Synchronization parameters are generally configured by your EtherCAT master. Choosing the right mode keeps the motor's internal control cycles synchronized with the EtherCAT master's communication cycle, ensuring accurate and coordinated motion control. Refer to the Network Timing section for recommended settings.

Distributed Clock-Synchronous (DC-Sync)
The slave uses the EtherCAT Distributed Clock mechanism to trigger its cycle at fixed, phase-aligned instants across all nodes. DC-Sync delivers the highest timing precision, essential for multi-axis coordinated motion and high-performance control.

SyncManager-Synchronous (SM-Sync)
The slave synchronizes its cycle to the SyncManager event which is triggered each time an EtherCAT frame passes. This alignment ensures that tasks start immediately after the data exchange, reducing variability compared to Free Run.

Note: Free Run is not supported by ClearPath-EC.

MOTOR CONFIGURATION PARAMETER DETAILS

The Motor Configuration functional group contains parameters used to configure various features of the servo.

Store Parameters (0x1010 [0-1]):
This object triggers saving of all EEPROM-backed parameters (listed in Appendix A) into non-volatile memory. Although direct use of this command is supported, most users should configure and store parameters through ClearView 3.0 for greater convenience and reduced risk of errors.

- **Highest sub-index supported (0x1010 [0]):** Always reads "1", since only "Save all parameters" is supported.
- **Save all parameters (0x1010 [1]):** Writing the signature value 0x65766173 ("save") to this sub-index stores every EEPROM-backed parameter into non-volatile memory.

Application Config Register (0x2018):
The Application Config Register is used to enable features like Move Done Torque Foldback and change the behavior of Software Limits.

Bit	Value
0-22	Reserved
23	0 = Disable Move Done Torque Foldback 1 = Enable Move Done Torque Foldback
24	0 = Base Software Limit positions relative to the 0 position 1 = Base Software Limit positions relative to the 0 position plus the Home Offset (0x607C)
25-31	Reserved

Overspeed Timeout (0x231A):
The value of this parameter represents the amount of time (in milliseconds) that a motor can exceed the configured Max Motor Speed before an overspeed shutdown occurs.
Note: Although the Max Motor Speed applies to all ClearPath-EC operational modes, overspeed shutdowns can only occur in the Cyclic Synchronous Position (CSP), Cyclic Synchronous Torque (CST), and Profile Torque (TQ) modes.

Following Error Window (0x6065):
This parameter defines the allowed amount of Following Error before a Following Error Shutdown can occur. *Note: Entering a value of 0xFFFFFFFF will allow any amount of Following Error.*

Following Error Time Out (0x6066):
This object indicates the amount of time (in milliseconds) the Following Error is allowed outside the Following Error Window before a Following Error Shutdown occurs.

Position Window (0x6067):
This object indicates the position window (in encoder counts) the motor must maintain to be considered "In Range" of its command (bit 15 of the Statusword). Only applies in Position modes.

Position Window Time (0x6068):
This object indicates the amount of time (in milliseconds) the motor must be within the Position Window before it is considered "In Range" of its command (bit 15 of the Statusword). Only applies in Position modes.

Velocity Window (0x606D):
This object indicates the velocity window (in encoder counts/sec) the motor must maintain to be considered "In Range" of its command (bit 15 of the Statusword). Only applies in Velocity modes.

Velocity Window Time (0x606E):
This object indicates the amount of time (in milliseconds) the motor must be within the Velocity Window before it is considered "In Range" of its command (bit 15 of the Statusword). Only applies in Velocity modes.

Polarity (0x607E):
This object is used to set the polarity of the position, velocity, or torque demand value (CCW =0, CW =1). The polarity of the torque demand value is inverted by raising bit 6 or 7.

When polarity is inverted (by raising either bit 6 or 7), only the position/velocity **demand** is multiplied by -1. The measured position does not invert.

Bit	7	6	5-0
Value	Position (or Torque) Polarity	Velocity (or Torque) Polarity	Reserved

Max Motor Speed (0x6080):
The servo's internal commanded velocity is capped at this value (in RPM).

Interpolation Time Period (0x60C2 [0-2]):
This parameter defines the interval at which a servo drive generates intermediate setpoints between the target values received from the EtherCAT master. This parameter is crucial in CSP/CSV/CST, where the drive's internal control loops operate at higher frequencies than the master's communication cycle time.

By configuring the interpolation time period, you're informing the servo drive of the expected interval between setpoints. This enables the drive to calculate and follow a smooth path between the points provided by the master, aligning its internal control loop with the master's communication cycle. Refer to the Network Timing section for recommended settings.

- **Highest Sub-Index Supported (0x60C2 [0]):** Highest sub-index value supported

- **Interpolation Time Period Value (0x60C2 [1]):** The parameter is the time period value (no units are associated with this value).
- **Interpolation Time Index (0x60C2 [2]):** This parameter is the index for the time period.

The Time Period (in seconds) =

$$Interpolation\ Time\ Period\ Value * 10^{Interpolation\ TIme\ Index}$$

MOTION COMMAND PARAMETER DETAILS

The Motion Command functional group contains the parameters used to enable the motor and command motion.

Controlword (0x6040):

The EtherCAT master uses the Controlword to manipulate the state of ClearPath, allowing for the control of key functions (such as enabling or disabling the motor). The bits of the Controlword are unique for each operating mode. Check the Operating Modes section for a more detailed controlword breakdown.

Modes of Operation (0x6060):

This object is used to select the desired operational mode.

Note: this sets the requested operating mode, but does not necessarily show the current operating mode. Modes of Operation Display (0x6061) provides the current operating mode.

Enter the following values to change operating modes:

- **Profile Position Mode:** 0x01
- **Profile Velocity Mode:** 0x03
- **Profile Torque Mode:** 0x04
- **Homing Mode:** 0x06
- **Cyclic Synchronous Position Mode:** 0x08
- **Cyclic Synchronous Velocity Mode:** 0x09
- **Cyclic Synchronous Torque Mode:** 0x0A

Target Torque (0x6071):

This object is used to command a specific torque output in the Cyclic Synchronous Torque (CST) and Profile Torque (TQ) modes. In TQ mode, the Torque Slope defines the rate at which the torque output changes to meet the Target Torque.

Target Position (0x607A):

This object is used to command position moves in Cyclic Synchronous Position (CSP) and Profile Position (PP) Mode. See the CSP mode or PP mode descriptions for details on how this parameter is used.

Profile Velocity (0x6081):

This object is used in Profile Position (PP) mode to set the velocity limit used in position moves.

Profile Acceleration (0x6083):

This object is used to set the acceleration rate in Profile Position (PP) and Profile Velocity (PV) mode.

Profile Deceleration (0x6084):

This object is used to set the deceleration rate in Profile Position (PP) and Profile Velocity (PV) mode.

Target Velocity (0x60FF):
This object is used to command a specific velocity in the Cyclic Synchronous Velocity (CSV) and Profile Velocity (PV) modes. The Profile Acceleration and Profile Deceleration are used in PV mode to ramp to the new velocity target.

MOTOR FEEDBACK PARAMETER DETAILS

The Motor Feedback functional group contains parameters that provide information about the motor's state. This includes motion feedback, error codes, and sensor feedback.

Error Register (0x1001):
The error register is a field of 8 bits, each for a certain error type. The appropriate bit is set when an error occurs to provide a high-level categorization of the error.

Bit	Value
0	Generic Error
1	Current
2	Voltage
3	Temperature
4	Communication Error (Overrun, Error State)
5	Device Profile Specific
6	Reserved
7	Manufacturer Specific

Alert Register (0x2009):
This parameter contains the motor's real-time alert register. Teknic recommends using ClearView 3.0 to identify the shutdown and troubleshoot the issue if an alert occurs.

Bus Voltage Measured (0x2118):
The parameter represents the motor's main bus voltage.

Drive Temperature (0x2123):
The parameter contains the current drive temperature in degrees Celsius.

Mechanical Position (0x216F):
This parameter contains a single-turn absolute representation of the motor's encoder position, ranging from 0 to the encoder density (x2136). A value of -1 (0xFFFFFFFF) means the mechanical position has not yet been identified based on encoder index pulses.

RMS Level (0x230F):
The RMS Level is a representation of how much of the servo's continuous torque capability is being used, 0-100%. It is the end result of a set of calculations based on servo drive current measured over time. The servo will protectively shut itself down if this value reaches 100%.

Current Profile Position (0x2316):
This parameter contains the position target for the currently executing move.
Note: This object is only used in Profile Position (PP) mode.

Current Profile Velocity (0x2317):
This parameter contains the velocity command/limit for the currently executing move.
Note: This object is only used in the Profile Position (PP) and Profile Velocity (PV) modes.

Current Profile Acceleration (0x2318):
This parameter contains the acceleration rate used for the currently executing move.
Note: This object is only used in the Profile Position (PP) and Profile Velocity (PV) modes.

Current Profile Deceleration (0x2319):
This parameter contains the deceleration rate used for the currently executing move.
Note: This object is only used in the Profile Position (PP) and Profile Velocity (PV) modes.

Error Code (0x603F):
This parameter provides the error code for the last error that occurred. Teknic recommends using ClearView 3.0 to identify the shutdown and troubleshoot the issue if an error occurs.
Refer to Appendix B for a list of error codes.

Statusword (0x6041):
This object provides information about the motor's current state (e.g. enabled/disabled, fault) and status (e.g. in range, move done). Check the Operating Modes section for a more detailed Statusword breakdown.

Modes of Operation Display (0x6061):
This object displays the current operating mode.

- 0x00 = Internal Motion Generator (used by ClearView only)
- 0x01 = Profile Position Mode
- 0x03 = Profile Velocity Mode
- 0x04 = Profile Torque Mode
- 0x06 = Homing Mode
- 0x08 = Cyclic Synchronous Position Mode
- 0x09 = Cyclic Synchronous Velocity Mode
- 0x0A = Cyclic Synchronous Torque Mode

Position Demand Value (0x6062):
This object provides the position output by the trajectory generator. It is used as the servo's internal commanded position.

Position Actual Value (0x6064):
This parameter contains the motor's current position based on encoder feedback.

Velocity Demand Value (0x606B):
This object provides the velocity output by the trajectory generator. It is used as the servo's internal commanded velocity.

Velocity Actual Value (0x606C):
This object contains the motor's instantaneous velocity based on encoder feedback.

Torque Demand Value (0x6074):
This object provides the servos' internal commanded torque.

Torque Actual Value (0x6077):
This object provides the measured instantaneous torque of the motor.

DC Link Circuit Voltage (0x6079):
This object provides the instantaneous DC link voltage at the drive device. This is identical to the Bus Voltage.

Following Error Actual Value (0x60F4):
This object contains the motor's real-time following error. Following error is the difference between the Position Actual Value (0x6064) and the Position Demand Value (0x6062).

HOMING PARAMETER DETAILS

The Homing functional group contains parameters used when the motor is in homing mode. Many of these parameters can be easily set in the "Homing & Software Limits Setup" window in ClearView 3.0. See the ClearPath-EC User Manual for details.

Hardstop Torque Maximum (0x216B):
The max allowed torque used when the motor is homing to a hardstop. Set in units of 0.1% of the servo's peak torque.

Physical Home Clearance (0x2201):
This object defines a clearance distance between a hardstop and where the servo will conclude homing. After detecting the hardstop, the motor will move this distance in the opposite direction. Teknic recommends setting this parameter to at least 1/2 of a rev when homing to a hardstop

Shaft Homing Target (0x2300):
This parameter contains the shaft angle used as a homing target for homing methods 33 and 34

Home Offset (0x607C):
The servo reports a position equal to the Home Offset at the conclusion of homing. This value does not affect the physical position of the motor.

Homing Method (0x6098):
This object is used to set the active homing method. The homing configuration options within ClearView 3.0 will automatically set the Homing Method based on your selections.

Available Homing Methods	Input Type	Direction
-2	Hard Stop	CW(-)
-1	Hard Stop	CCW(+)
17	Limit Switch	CW(-)
18	Limit Switch	CCW(+)
19	Home Sensor (*Turns On*)	CW(-)
20	Home Sensor (*Turns Off*)	CCW(+)
21	Home Sensor (*Turns On*)	CW(-)
22	Home Sensor (*Turns Off*)	CCW(+)
33	Shaft Angle	CW(-)
34	Shaft Angle	CCW(+)
37	Current Position	N/A

Homing Speeds (0x6099 [0-2]):
This object indicates the commanded speeds used during homing.

- **Highest Subindex supported (0x6099 [0]):** Stores the number of supported sub-indices
- **Fast Homing Speed (0x6099 [1]):** The fast homing speed is used for the initial move towards a sensor or limit switch in sensor-based homing modes.
- **Slow Homing Speed (0x6099 [2]):** The slow homing speed is used for hardstop homing, shaft angle homing, and capturing a more accurate sensor position.

Homing Acceleration (0x609A):
This object defines the acceleration and deceleration used during homing.

Supported Homing Methods (0x60E3 [0-11]):
This object indicates the servo's supported homing methods.

- **Highest Subindex Supported (0x60E3 [0]):** The number of supported sub-indices.

  Note: This value also equals the number of supported homing methods.
- **1st Supported Homing Method (0x60E3 [1]):** 17 = Limit Switch CW(-)
- **2nd Supported Homing Method (0x60E3 [2]):** 18 = Limit Switch CCW(+)
- **3rd Supported Homing Method (0x60E3 [3]):** 19 = Home Sensor (Turns On) CW(-)

- **4th Supported Homing Method (0x60E3 [4]):** 20 = Home Sensor (Turns Off) CCW(+)
- **5th Supported Homing Method (0x60E3 [5]):** 21 = Home Sensor (Turns On) CW(-)
- **6th Supported Homing Method (0x60E3 [6]):** 22 = Home Sensor (Turns Off) CCW(+)
- **7th Supported Homing Method (0x60E3 [7]):** 37 = Current Position
- **8th Supported Homing Method (0x60E3 [8]):** -1 = Hard Stop CCW(+)
- **9th Supported Homing Method (0x60E3 [9]):** -2 = Hard Stop CW(-)
- **10th Supported Homing Method (0x60E3 [10]):** 33 = Shaft Angle CW(-)
- **11th Supported Homing Method (0x60E3 [11]):** 34 = Shaft Angle CCW(+)

QUICK STOP, HALT, AND DISABLE ACTIONS PARAMETER DETAILS

The Quick Stop, Halt, and Disable Actions functional group contains parameters used to configure these features.

Delay Disable Time (0x2170):

The delay between a disable command and the drive disabling. Only applies when using the "Position Hold" or "Decelerate to Stop" options below.

Note: This object is commonly used to ensure a power off brake has time to engage before the motor disables.

Abort Connection Option Code (0x6007):

This object indicates what action will be performed when connection is lost to the to the controller (i.e. an EtherCAT Master or ClearView), or when the device is reset.

Note: The motor will always abrupt stop in CSP mode.

Value	Stop Action
0	No Action: When this option is selected, the motor will continue to execute the last command sent by the controller.
1	Fault Reaction: The motor will follow the Fault Reaction Option Code when connection is lost or the motor is reset.
2	Disable Voltage Command: The motor will follow the Disable Operation Option Code when connection is lost or the motor is reset.
3	Quick Stop Command (*default*): The motor will follow the Quick Stop Option Code when connection is lost or the motor is reset.

Quick Stop Option Code (0x605A):
This object indicates what action is performed when the Quick Stop function is executed. To execute a Quick Stop, lower bit 2 of the Controlword (0x6040).

Value	Stop Action
0	Coast to Stop: The servo will disable and the motor will spin freely.
-1	Dynamic Brake (*default*): The servo will disable and engage its dynamic brake feature.
-2	Position Hold: The motor will use power to abruptly stop. The servo will disable after the Delay Disable Time (0x2170).
2	Decelerate to Stop: The motor will use power to decelerate to a stop using the Quick Stop Deceleration (0x6085). The servo will disable after the Delay Disable Time (0x2170).

Disable Operation Option Code (0x605C):
This object indicates what action is performed when the drive is disabled (transitions from OPERATION ENABLED to the SWITCHED ON Finite State Automation (FSA) state).

Value	Stop Action
0	Coast to Stop: The servo will disable and the motor will spin freely.
-1	Dynamic Brake (*default*): The servo will disable and engage its dynamic brake feature.
-2	Position Hold: The motor will use power to abruptly stop. The servo will disable after the Delay Disable Time (0x2170).
1	Decelerate to Stop: The motor will use power to decelerate to a stop using the Quick Stop Deceleration (0x6085). The servo will disable after the Delay Disable Time (0x2170).

Halt Option Code (0x605D):
This object indicates what action is performed when the halt function is executed. To execute a halt, raise Bit 8 of the Controlword (0x6040).
Note: Halt functionality is only supported in PP, PV, TQ, and HM modes. Bit 8 of the Controlword should not be used in CSP, CSV, and CST modes.

Value	Stop Action
-1	Position Hold: The motor will use power to abruptly stop and actively hold its current position.
2	Decelerate to Stop: The motor will use power to decelerate to a stop using the Quick Stop Deceleration (0x6085). The motor will actively hold its position after the ramp is complete.

Fault Reaction Option Code (0x605E):
This object indicates what action is performed when a motor fault occurs.

Value	Stop Action
-1	Dynamic Brake (*default*): The servo will disable and engage its dynamic brake feature.
0	Coast to Stop: The servo will disable and the motor will spin freely.

Quick Stop Deceleration (0x6085):
This object indicates the deceleration rate used to stop the motor when a "Decelerate to Stop" option is used (see the Option Code parameters above).

Torque Slope (0x6087):
This object is used in TQ mode to ramp the motor's torque up and down when the Target Torque is changed.

POWER AND TEMPERATURE PARAMETER DETAILS

The Power and Temperature functional group contains parameters used to configure the power and temperature limits.

Minimum Operating Volts (0x2242):
Minimum allowable operating voltage. A motor shutdown is triggered if the bus voltage drops below this value.

Max User Temp (0x2243):
A protective shutdown is triggered when this temperature is reached.
Note: the statusword Warning bit is set when drive temperature approaches this value.

Bus Current Trip (0x2244):
A protective shutdown is triggered if this Bus Current is reached.

TORQUE LIMITING AND SOFTWARE LIMITS PARAMETER DETAILS

The Torque Limiting and Software Limits functional group contains parameters used to limit the motor's torque output and configure software position limits.

Max Torque (0x6072):
This parameter is used to limit the amount of torque the motor can output in either direction. A value of 1000 = 100% of the motor's peak torque.
Note: The motor's maximum torque in each direction is limited to the smaller of the Max Torque and that direction's torque limit (Positive Torque Limit Value (0x60E0) or Negative Torque Limit Value (0x60E1)).

Software Position Limit (0x607D [0-2]):
This object represents the absolute software position limits based on the machine's zero position. *Note: Homing must be complete for software limits to take effect.*

- **Highest sub-index supported (x607D [0]):** The number of sub-indices supported by the Software position limit object.
- **Min software position limit (x607D [1]):** Position limit lower bound.
- **Max software position limit (x607D [2]):** Position limit upper bound.

Positive Torque Limit Value (0x60E0):
This parameter is used to limit the amount of torque the motor can output in the positive direction. This value equals the maximum amount of torque the motor can use, 1000 = 100% of the motor's peak torque. *Note: The motor's maximum torque in the positive direction is limited to the smaller of the Max Torque (0x6072) and the Positive Torque Limit Value.*

Negative Torque Limit Value (0x60E1):
This parameter is used to limit the amount of torque the motor can output in the negative direction. This value equals the maximum amount of torque the motor can use, 1000 = 100% of the motor's peak torque. *Note: The motor's maximum torque in the negative direction is limited to the smaller of the Max Torque (0x6072) and the Negative Torque Limit Value.*

I/O PARAMETER DETAILS

The I/O Parameter functional group contains objects used to control ClearPath-EC's inputs and outputs. ClearPath-EC's I/O can be easily accessed through the 8-pin Molex connector on the M12 adapter (PN: M12-ENET-CON). For wiring information, please reference the ClearPath-EC User Manual.

Input A Filter Time (0x2063):
The amount of time Input A must remain toggled before a state change is reported. Use this to prevent switch bounce from triggering the input multiple times. The units are milliseconds.

Input B Filter Time (0x2066):
The amount of time Input B must remain toggled before a state change is reported. Use this to prevent switch bounce from triggering the input multiple times. The units are milliseconds.

Digital Input Map (0x230E):
The Digital Input Map is used to define the mapping of automatic features to inputs on the M12 Adapter.

Bit	Value
0-1	0 = Negative Limit Switch is unused 1 = Negative Limit Switch is mapped to input A 2 = Negative Limit Switch is mapped to input B 3 = Negative Limit Switch is mapped to External Neg Limit (Controlword bit 12)
2	0 = Negative limit switch source is taken as-is 1 = Negative limit switch source is inverted
3-4	0 = Positive Limit Switch is unused 1 = Positive Limit Switch is mapped to input A 2 = Positive Limit Switch is mapped to input B 3 = Positive Limit Switch is mapped to External Pos Limit (Controlword bit 11)
5	0 = Positive limit switch source is taken as-is 1 = Positive limit switch source is inverted
6-7	0 = Home Switch is unused 1 = Home Switch is mapped to input A 2 = Home Switch is mapped to input B
8	Reserved
9-10	0 = Interlock is unused 1 = Interlock is mapped to input A 2 = Interlock is mapped to input B
11	0 = Interlock source is taken as-is 1 = Interlock source is inverted
12-14	Reserved
15	0 = Autobrake is off (no brake is hooked up to output B) 1 = Autobrake is on (a brake is hooked up to output B)

Touch Probe Function (0x60B8):
This object is used to configure ClearPath-EC's touch probe feature.

Bit	Value
0	0 = Switch off touch probe 1 1 = Enable touch probe 1
1	0 = Only trigger Touch Probe 1 on the first edge transition 1 = Trigger Touch Probe 1 on every edge transition
2	0 = Trigger Touch Probe 1 using input A 1 = Trigger with zero-pulse signal
3	Reserved
4	0 = Disable sampling at positive edge of Touch Probe 1 1 = Enable sampling at positive edge of Touch Probe 1
5	0 = Disable sampling at negative edge of Touch Probe 1 1 = Enable sampling at negative edge of Touch Probe 1
6-7	Reserved

8	0 = Switch off Touch Probe 2 1 = Enable Touch Probe 2
9	0 = Only trigger Touch Probe 2 on first edge transition 1 = Trigger Touch Probe 2 on every edge transition
10-	0 = Trigger Touch Probe 2 using input B 1 = Trigger with zero-pulse signal
11	Reserved
12	0 = Disable sampling at positive edge of Touch Probe 2 1 = Enable sampling at positive edge of Touch Probe 2
13	0 = Disable sampling on negative edge of Touch Probe 2 1 = Enable sampling at negative edge of Touch Probe 2
14-15	Reserved

Note: When enabled, Touch Probe 1 acts as a high-speed input and ignores the Input A Filter Time (0x2063).

Touch Probe Status (0x60B9):
This object contains touch probe status information. It is used to verify the Touch Probe's configuration and identify when positions have been captured.

Bit	Value
0	0 = Touch Probe 1 is switched off 1 = Touch Probe 1 is enabled
1	0 = Touch Probe 1 no positive edge value stored 1 = Touch Probe 1 positive edge position stored
2	0 = Touch Probe 1 no negative edge value stored 1 = Touch Probe 1 negative edge position stored
3-7	Reserved
8	0 = Touch Probe 2 is switched off 1 = Touch Probe 2 is enabled
9	0 = Touch Probe 2 no positive edge value stored 1 = Touch Probe 2 positive edge position stored
10	0 = Touch Probe 2 no negative edge value stored 1 = Touch Probe 2 negative edge position stored
11-15	Reserved

Touch Probe Position 1 Positive Value (0x60BA):
This object contains the position value Touch Probe 1 captured at the last positive edge transition.

Touch Probe Position 1 Negative Value (0x60BB):
This object contains the position value Touch Probe 1 captured at the last negative edge transition.

Touch Probe Position 2 Positive Value (0x60BC):
This object provides the position value Touch Probe 2 captured at the last positive edge transition.

Touch Probe Position 2 Negative Value (0x60BD):
This object provides the position value Touch Probe 2 captured at the last negative edge transition.

Touch Probe 1 Positive Edge Counter (0x60D5):
This object provides a continuous counter that is incremented with each positive edge transition of Touch Probe 1. The counter is only valid if the touch probe input is enabled. For single event measuring, only the value of bit 0 shall be evaluated. For continuous measuring, the value is an unsigned 16-bit number with overflow.

Touch Probe 1 Negative Edge Counter (0x60D6):
This object provides a continuous counter that is incremented with each negative edge transition of Touch Probe 1. The counter is only valid if the touch probe input is enabled. For single event measuring, only the value of bit 0 shall be evaluated. For continuous measuring, the values is an unsigned 16-bit number with overflow.

Touch Probe 2 Positive Edge Counter (0x60D7):
This object provides a continuous counter that is incremented with each positive edge transition of Touch Probe 2. The counter is only valid if the touch probe input is enabled. For single event measuring, only the value of bit 0 shall be evaluated. For continuous measuring, the value is an unsigned 16-bit number with overflow.

Touch Probe 2 Negative Edge Counter (0x60D8):
This object provides a continuous counter that is incremented with each negative edge transition of Touch Probe 2. The counter is only valid if the touch probe input is enabled. For single event measuring, only the value of bit 0 shall be evaluated. For continuous measuring, the value is an unsigned 16-bit number with overflow.

Note : Touch Probe edge counters will reset when:

- *the corresponding touch probe is Enabled using Bit 0 or Bit 8 of Touch Probe Function (0x60B8)*
- *the corresponding touch probe edge transition is Enabled using Bit 5, 6, 12 or 13 of Touch Probe Function (0x60B8)*

Digital Inputs (0x60FD):
This object contains the current state of ClearPath-EC's digital inputs.

Bit	Value
0	0 = Negative Limit Switch not reached 1 = Negative Limit Switch reached
1	0 = Positive Limit Switch not reached 1 = Positive Limit Switch reached
2	0 = Home Sensor not reached 1 = Home Sensor reached
3	0 = Interlock not active (Motion disabled) 1 = Interlock Active (Motion allowed)
4-15	Reserved

16	0 = Input A line is off 1 = Input A line is on
17	0 = Input B line is off 1 = Input B line is on
18	0 = External brake should be engaged/ Output B Autobrake is engaged 1 = External brake should be disengaged/Output B Autobrake is disengaged
19	0 = Communication with an EtherCAT network has not been established 1 = Communication with an EtherCAT network has been established

Note: Bit 18 differs from the Enabled/Disabled state of the servo when a Delay Disable Time has taken effect. This is why it is the preferred feedback for controlling an external axis brake (e.g. if the brake cannot be wired to ClearPath-EC Output B).

Digital Outputs (x60FE [0-2]):
This object is used to control ClearPath-EC's digital outputs.

- **Highest Subindex Supported (x60FE [0]):** The number of sub-indices supported by the Digital Outputs parameter (x60FE)
- **Digital Outputs (x60FE [1]):** Direct control of output state

Bit	Value
0	Unsupported[1]
1-15	Reserved
16	0 = Output A off 1 = Output A on
17	0 = Output B off 1 = Output B on
18-31	Reserved

[1]*Note: For power-off axis brake control, Teknic recommends using automatic brake control via Output B.*

- **Output Mask (x60FE [2]):** This value should not typically change from its default 0xFFFFFFFF.

MOTOR TUNING PARAMETER DETAILS

Teknic recommends using the auto-tuner provided in the ClearView 3.0 software to tune your ClearPath-EC motor. You can download ClearView 3.0 from the downloads page on Teknic's website HERE. Additional information about ClearView 3.0 and the auto-tuning process can be found in the ClearPath-EC User Manual.

APPENDIX A: CLEARPATH-EC PARAMETER TABLE

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1000	0	Device Type	0x20192		U32						Device Info
x1001	0	Error Register			U8						Motor Feedback
x1008	0	Manufacturer Device Name			STR[21]						Device Info
x1009	0	Manufacturer Hardware Version			STR[3]						Device Info
x100A	0	Manufacturer Software Version			STR[10]						Device Info
x1010	Store Parameters										
x1010	0	Highest Subindex Supported			U8						Motor Config
x1010	1	Save All Parameters	-		U32	PREOP Only					Motor Config
x1018	Identity Object										
x1018	0	Number Of Entries	4		U8						Device Info
x1018	1	Vendor ID	3222		U32						Device Info
x1018	2	Product Code	0x1		U32						Device Info
x1018	3	Revision Number	2		U32						Device Info
x1018	4	Serial Number			U32						Device Info
x1023	Command Object										
x1023	0	Number Of Entries	3		U8						Motor Feedback
x1023	1	Command	-		BYTE[32]	Yes					Motor Config
x1023	2	Status			U8						Motor Feedback
x1023	3	Reply			BYTE[32]						Motor Feedback
x10F3	Diagnosis History										
x10F3	0	Highest Subindex Supported	55		U8						Motor Feedback
x10F3	1	Maximum Messages	50		U8						Motor Feedback
x10F3	2	Newest Message	0		U8						Motor Feedback
x10F3	3	Newest Acknowledged Message	-		U8	Yes		0	55		Motor Feedback
x10F3	4	New Messages Available			BOOL						Motor Feedback
x10F3	5	Flags	-		U16	Yes					Motor Feedback
x10F3	6-55	Diagnosis Message 001-050			BYTE[26]						Motor Feedback
x10F9	0	Time Distribution Object	-	ns	U64	Yes					Motor Config
x1600	Receive PDO Mapping Parameter 1										

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1600	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1600	1	Mapping Entry 1	0x60400010		U32	PREOP Only					PDO Config
x1600	2	Mapping Entry 2	0x60600008		U32	PREOP Only					PDO Config
x1600	3	Mapping Entry 3	0x607A0020		U32	PREOP Only					PDO Config
x1600	4	Mapping Entry 4	0x60FF0020		U32	PREOP Only					PDO Config
x1600	5	Mapping Entry 5	0x60710010		U32	PREOP Only					PDO Config
x1600	6	Mapping Entry 6	0x60FE0120		U32	PREOP Only					PDO Config
x1600	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1600	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1601	Receive PDO Mapping Parameter 2										
x1601	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1601	1	Mapping Entry 1	0x60400010		U32	PREOP Only					PDO Config
x1601	2	Mapping Entry 2	0x607A0020		U32	PREOP Only					PDO Config
x1601	3	Mapping Entry 3	0x60FE0120		U32	PREOP Only					PDO Config
x1601	4	Mapping Entry 4	-		U32	PREOP Only					PDO Config
x1601	5	Mapping Entry 5	-		U32	PREOP Only					PDO Config
x1601	6	Mapping Entry 6	-		U32	PREOP Only					PDO Config
x1601	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1601	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1602	Receive PDO Mapping Parameter 3										
x1602	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1602	1	Mapping Entry 1	0x60400010		U32	PREOP Only					PDO Config
x1602	2	Mapping Entry 2	0x60FF0020		U32	PREOP Only					PDO Config
x1602	3	Mapping Entry 3	0x60FE0120		U32	PREOP Only					PDO Config
x1602	4	Mapping Entry 4	-		U32	PREOP Only					PDO Config
x1602	5	Mapping Entry 5	-		U32	PREOP Only					PDO Config
x1602	6	Mapping Entry 6	-		U32	PREOP Only					PDO Config
x1602	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1602	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1603	Receive PDO Mapping Parameter 4										
x1603	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1603	1	Mapping Entry 1	0x60400010		U32	PREOP Only					PDO Config
x1603	2	Mapping Entry 2	0x60710010		U32	PREOP Only					PDO Config
x1603	3	Mapping Entry 3	0x60FE0120		U32	PREOP Only					PDO Config
x1603	4	Mapping Entry 4	-		U32	PREOP Only					PDO Config
x1603	5	Mapping Entry 5	-		U32	PREOP Only					PDO Config
x1603	6	Mapping Entry 6	-		U32	PREOP Only					PDO Config
x1603	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1603	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1604	Receive PDO Mapping Parameter 5										
x1604	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1604	1	Mapping Entry 1	0x60400010		U32	PREOP Only					PDO Config
x1604	2	Mapping Entry 2	0x607A0020		U32	PREOP Only					PDO Config
x1604	3	Mapping Entry 3	0x60810020		U32	PREOP Only					PDO Config
x1604	4	Mapping Entry 4	0x60830020		U32	PREOP Only					PDO Config
x1604	5	Mapping Entry 5	0x60840020		U32	PREOP Only					PDO Config
x1604	6	Mapping Entry 6	0x60FE0120		U32	PREOP Only					PDO Config
x1604	7	Mapping Entry 7	0x0		U32	PREOP Only					PDO Config
x1604	8	Mapping Entry 8	0x0		U32	PREOP Only					PDO Config
x1605	Receive PDO Mapping Parameter 6										
x1605	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1605	1	Mapping Entry 1	0x60400010		U32	PREOP Only					PDO Config
x1605	2	Mapping Entry 2	0x60FF0020		U32	PREOP Only					PDO Config
x1605	3	Mapping Entry 3	0x60830020		U32	PREOP Only					PDO Config
x1605	4	Mapping Entry 4	0x60840020		U32	PREOP Only					PDO Config
x1605	5	Mapping Entry 5	0x60FE0120		U32	PREOP Only					PDO Config
x1605	6	Mapping Entry 6	0x0		U32	PREOP Only					PDO Config
x1605	7	Mapping Entry 7	0x0		U32	PREOP Only					PDO Config
x1605	8	Mapping Entry 8	0x0		U32	PREOP Only					PDO Config
x1A00	Transmit PDO Mapping Parameter 1										
x1A00	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1A00	1	Mapping Entry 1	0x60410010		U32	PREOP Only					PDO Config

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1A00	2	Mapping Entry 2	0x60610008		U32	PREOP Only					PDO Config
x1A00	3	Mapping Entry 3	0x60640020		U32	PREOP Only					PDO Config
x1A00	4	Mapping Entry 4	0x606C0020		U32	PREOP Only					PDO Config
x1A00	5	Mapping Entry 5	0x60770010		U32	PREOP Only					PDO Config
x1A00	6	Mapping Entry 6	0x60FD0020		U32	PREOP Only					PDO Config
x1A00	7	Mapping Entry 7	0x60F40020		U32	PREOP Only					PDO Config
x1A00	8	Mapping Entry 8	0x603F0010		U32	PREOP Only					PDO Config
x1A01	Transmit PDO Mapping Parameter 2										
x1A01	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1A01	1	Mapping Entry 1	0x60410010		U32	PREOP Only					PDO Config
x1A01	2	Mapping Entry 2	0x60640020		U32	PREOP Only					PDO Config
x1A01	3	Mapping Entry 3	0x60F40020		U32	PREOP Only					PDO Config
x1A01	4	Mapping Entry 4	0x60FD0020		U32	PREOP Only					PDO Config
x1A01	5	Mapping Entry 5	0x603F0010		U32	PREOP Only					PDO Config
x1A01	6	Mapping Entry 6	-		U32	PREOP Only					PDO Config
x1A01	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1A01	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1A02	Transmit PDO Mapping Parameter 3										
x1A02	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1A02	1	Mapping Entry 1	0x60410010		U32	PREOP Only					PDO Config
x1A02	2	Mapping Entry 2	0x60640020		U32	PREOP Only					PDO Config
x1A02	3	Mapping Entry 3	0x606C0020		U32	PREOP Only					PDO Config
x1A02	4	Mapping Entry 4	0x60FD0020		U32	PREOP Only					PDO Config
x1A02	5	Mapping Entry 5	0x603F0010		U32	PREOP Only					PDO Config
x1A02	6	Mapping Entry 6	-		U32	PREOP Only					PDO Config
x1A02	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1A02	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1A03	Transmit PDO Mapping Parameter 4										
x1A03	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1A03	1	Mapping Entry 1	0x60410010		U32	PREOP Only					PDO Config
x1A03	2	Mapping Entry 2	0x60640020		U32	PREOP Only					PDO Config

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1A03	3	Mapping Entry 3	0x60770010		U32	PREOP Only					PDO Config
x1A03	4	Mapping Entry 4	0x60FD0020		U32	PREOP Only					PDO Config
x1A03	5	Mapping Entry 5	0x603F0010		U32	PREOP Only					PDO Config
x1A03	6	Mapping Entry 6	-		U32	PREOP Only					PDO Config
x1A03	7	Mapping Entry 7	-		U32	PREOP Only					PDO Config
x1A03	8	Mapping Entry 8	-		U32	PREOP Only					PDO Config
x1A04	Transmit PDO Mapping Parameter 5										
x1A04	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1A04	1	Mapping Entry 1	0x603F0010		U32	PREOP Only					PDO Config
x1A04	2	Mapping Entry 2	0x60410010		U32	PREOP Only					PDO Config
x1A04	3	Mapping Entry 3	0x60640020		U32	PREOP Only					PDO Config
x1A04	4	Mapping Entry 4	0x23160020		U32	PREOP Only					PDO Config
x1A04	5	Mapping Entry 5	0x23170020		U32	PREOP Only					PDO Config
x1A04	6	Mapping Entry 6	0x23180020		U32	PREOP Only					PDO Config
x1A04	7	Mapping Entry 7	0x23190020		U32	PREOP Only					PDO Config
x1A04	8	Mapping Entry 8	0x60FD0020		U32	PREOP Only					PDO Config
x1A05	Transmit PDO Mapping Parameter 6										
x1A05	0	Number Of Entries	8		U8	PREOP Only		0	8		PDO Config
x1A05	1	Mapping Entry 1	0x603F0010		U32	PREOP Only					PDO Config
x1A05	2	Mapping Entry 2	0x60410010		U32	PREOP Only					PDO Config
x1A05	3	Mapping Entry 3	0x60640020		U32	PREOP Only					PDO Config
x1A05	4	Mapping Entry 4	0x606C0020		U32	PREOP Only					PDO Config
x1A05	5	Mapping Entry 5	0x23170020		U32	PREOP Only					PDO Config
x1A05	6	Mapping Entry 6	0x23180020		U32	PREOP Only					PDO Config
x1A05	7	Mapping Entry 7	0x23190020		U32	PREOP Only					PDO Config
x1A05	8	Mapping Entry 8	0x60FD0020		U32	PREOP Only					PDO Config
x1C00	Sync Manager Communication Type										
x1C00	0	Highest Subindex Supported	4		U8						Device Info
x1C00	1	Sync Manager 0 Communication Type	1		U8						Device Info
x1C00	2	Sync Manager 1 Communication Type	2		U8						Device Info
x1C00	3	Sync Manager 2 Communication Type	3		U8						Device Info

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1C00	4	Sync Manager 3 Communication Type	4		U8						Device Info
x1C12	RxPDO Assignment										
x1C12	0	Number Of Assigned PDOs	1		U8	PREOP Only		0	6		PDO Config
x1C12	1	RxPDO1 Mapping Object	0x1601		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C12	2	RxPDO2 Mapping Object	0x0		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C12	3	RxPDO3 Mapping Object	0x0		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C12	4	RxPDO4 Mapping Object	0x0		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C12	5	RxPDO5 Mapping Object	0x0		U16	PREOP Only		0x1600	0x1BFF		PDO Config
x1C12	6	RxPDO6 Mapping Object	0x0		U16	PREOP Only		0x1600	0x1BFF		PDO Config
x1C13	TxPDO Assignment										
x1C13	0	Number Of Assigned PDOs	1		U8	PREOP Only		0	6		PDO Config
x1C13	1	TxPDO1 Mapping Object	0x1A01		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C13	2	TxPDO2 Mapping Object	0x0		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C13	3	RxPDO3 Mapping Object	0x0		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C13	4	RxPDO4 Mapping Object	0x0		U16	PREOP Only		0x0	0x1BFF		PDO Config
x1C13	5	TxPDO5 Mapping Object	0x0		U16	PREOP Only		0x1600	0x1BFF		PDO Config
x1C13	6	TxPDO6 Mapping Object	0x0		U16	PREOP Only		0x1600	0x1BFF		PDO Config
x1C32	RxPDO Synchronization										
x1C32	0	Number Of Synchronization Parameters	32		U8						Device Info
x1C32	1	Synchronization Type	0		U16						Device Info
x1C32	2	Cycle Time	0	ns	U32						Device Info
x1C32	3	Output Shift Time	440	ns	U32						Device Info
x1C32	4	Synchronization Types Supported	2054		U16						Device Info
x1C32	5	Minimum Cycle Time	62500	ns	U32						Device Info
x1C32	6	Calc And Copy Time	15000	ns	U32						Device Info
x1C32	9	DC Output Delay Time	440	ns	U32						Device Info
x1C32	12	Cycle Time Too Small			U16						Device Info
x1C32	32	Sync Error			BOOL						Device Info
x1C33	TxPDO Synchronization										
x1C33	0	Number Of Synchronization Parameters	32		U8						Device Info
x1C33	1	Synchronization Type	0		U16						Device Info

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x1C33	2	Cycle Time	0	ns	U32						Device Info
x1C33	3	Input Shift Time	5200	ns	U32						Device Info
x1C33	4	Synchronization Types Supported	6		U16						Device Info
x1C33	5	Minimum Cycle Time	62500	ns	U32						Device Info
x1C33	6	Calc And Copy Time	10000	ns	U32						Device Info
x1C33	9	DC Input Delay Time	5200	ns	U32						Device Info
x1C33	12	Cycle Time Too Small			U16						Device Info
x1C33	32	Sync Error			BOOL						Device Info
x2006	0	Internal Parameter 6	-		U16	PREOP Only				Yes	Motor Config
x2007	0	Internal Parameter 7			U16						Motor Config
x2009	0	Alert Register			BYTE[12]		Tx				Motor Feedback
x2014	0	Internal Parameter 20	-		U16	PREOP Only				Yes	Motor Config
x2015	0	Internal Parameter 21			U16						Motor Config
x2017	0	Hardware Config Register	-		U32	Yes				Yes	Motor Config
x2018	0	Application Config Register	-		U32	Yes				Yes	Motor Config
x201D	0	On Time		0.1s	U32						Device Info
x2039	0	RAS Delay		ms	U16						Motor Tuning
x2048	0	Internal Parameter 72	1000		U16	Yes		0	8191	Yes	Motor Config
x204A	0	Internal Parameter 74	-		I32	Yes		0	219999	Yes	Motor Config
x205C	0	Internal Parameter 92	10		I16	Yes		0	8191	Yes	Motor Config
x2063	0	Input A Filter Time	5	ms	U16	Yes		0	4850	Yes	I/O
x2066	0	Input B Filter Time	5	ms	U16	Yes		0	4850	Yes	I/O
x2068	0	Internal Parameter 104			I32						Motor Config
x2069	0	Internal Parameter 105	2000		U16	Yes		0	10000	Yes	Motor Config
x206A	0	Internal Parameter 106	1000		U16	Yes		0	10000	Yes	Motor Config
x206B	0	Internal Parameter 107	500		U16	Yes		0	10000	Yes	Motor Config
x206F	0	Internal Parameter 111	300		U16	Yes		0	8191	Yes	Motor Config
x2071	0	Internal Parameter 113	-		U16	Yes				Yes	Motor Config
x2072	0	Internal Parameter 114	-		U16	Yes				Yes	Motor Config
x2073	0	Internal Parameter 115	100		U16	Yes		0	8191	Yes	Motor Config
x210B	0	Internal Parameter 267	-		I32	Yes		0	29999	Yes	Motor Config

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x210E	0	Internal Parameter 270	-		I32	Yes		0	10005	Yes	Motor Config
x210F	0	Internal Parameter 271	-		U16	Yes		0	123	Yes	Motor Config
x2113	0	Internal Parameter 275	-		I32	Yes		0	10005	Yes	Motor Config
x2118	0	Bus Voltage Measured		V	U16						Power & Temp
x2123	0	Drive Temperature	0	°C	I16						Power & Temp
x2135	0	Internal Parameter 309	-		U16	Yes				Yes	Motor Tuning
x213E	0	Kip	-		U16	Yes				Yes	Motor Tuning
x213F	0	Kii	-		U16	Yes				Yes	Motor Tuning
x2143	0	Kr	512	Q9	I16	Yes		0	2048	Yes	Motor Tuning
x2144	0	Internal Parameter 324	-		U16	Yes				Yes	Motor Tuning
x2145	0	Tuning Config Register	-		U32	Yes				Yes	Motor Config
x2146	0	Kv	-		U32	Yes				Yes	Motor Tuning
x2147	0	Kp	-		U32	Yes				Yes	Motor Tuning
x2148	0	Ki	-		U32	Yes				Yes	Motor Tuning
x2149	0	Kfv	-		U32	Yes				Yes	Motor Tuning
x214A	0	Kfa	-		U32	Yes				Yes	Motor Tuning
x214B	0	Kfj	-		U32	Yes				Yes	Motor Tuning
x214D	0	Knv	-		U32	Yes				Yes	Motor Tuning
x214E	0	Internal Parameter 334	50		I16	Yes		0	9430	Yes	Motor Config
x214F	0	Torque Bias	0	0.003% trq	I16	Yes		-32767	32767	Yes	Motor Tuning
x2150	0	Internal Parameter 336	-		U16	Yes				Yes	Motor Config
x2151	0	Internal Parameter 337	-		U16	Yes				Yes	Motor Config
x2152	0	Internal Parameter 338	50		U16	Yes		0	8191	Yes	Motor Config
x2153	0	Internal Parameter 339	-		U32	Yes				Yes	Motor Config
x2154	0	Internal Parameter 340	-		U32	Yes				Yes	Motor Config
x2155	0	Internal Parameter 341	-		U16	Yes				Yes	Motor Config
x2156	0	Internal Parameter 342	-		U16	Yes				Yes	Motor Config
x215A	0	Internal Parameter 346	-		I32	Yes		1	2147483647	Yes	Motor Config
x215B	0	Internal Parameter 347	-		I32	Yes		1	2147483647	Yes	Motor Config
x215C	0	Internal Parameter 348	-		I32	Yes		1	2147483647	Yes	Motor Config
x215D	0	Fine Tuning Slider	19		U16	Yes		0	31	Yes	Motor Tuning

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x2163	0	Move Done Torque Foldback	0	0.1% trq	I16	Yes		0	1000	Yes	Limits
x2164	0	Move Done Torque Foldback Tc	200	ms	I16	Yes		0	10000	Yes	Limits
x2167	0	Internal Parameter 359	-		I32	Yes		0	299999	Yes	Motor Config
x2168	0	Internal Parameter 360	-		I16	Yes		0	1000	Yes	Motor Config
x2169	0	Internal Parameter 361	50		I16	Yes		0	8191	Yes	Motor Config
x216A	0	Internal Parameter 362	-		I16	Yes		0	1024	Yes	Motor Config
x216B	0	Hardstop Torque Maximum	-	0.1% trq	I16	Yes		0	1000	Yes	Homing
x216C	0	Internal Parameter 364	-		U16	Yes		0	32767	Yes	Motor Config
x216F	0	Mechanical Position		cnts	I32						Motor Feedback
x2170	0	Delay Disable Time	-	ms	I16	Yes		0	16383	Yes	Stop Actions
x2172	0	Internal Parameter 370	10		I16	Yes		0	275	Yes	Motor Config
x2173	0	Internal Parameter 371	-		I16	Yes		0	1024	Yes	Motor Config
x2201	0	Physical Home Clearance	0		U32	Yes				Yes	Homing
x2209	0	Internal Parameter 521	500		I16	Yes		1	8191	Yes	Motor Config
x2242	0	Minimum Operating Volts	0	V	I16	Yes		0	92	Yes	Power & Temp
x2243	0	Max User Temp	83	°C	I16	Yes		0	93	Yes	Power & Temp
x2244	0	Bus Current Trip	-	A	I16	Yes		0	9	Yes	Power & Temp
x2300	0	Shaft Homing Target	4294967295	cnts	U32	Yes				Yes	Homing
x230E	0	Digital Input Map	0x0		U16	Yes				Yes	I/O
x230F	0	RMS Level		0.1%	U16		Tx				Motor Feedback
x2316	0	Current Profile Position		cnts	I32		Tx				Motor Feedback
x2317	0	Current Profile Velocity		cnts/s	I32		Tx				Motor Feedback
x2318	0	Current Profile Acceleration		cnts/s²	U32		Tx				Motor Feedback
x2319	0	Current Profile Deceleration		cnts/s²	U32		Tx				Motor Feedback
x231A	0	Overspeed Timeout	10	ms	U16	Yes				Yes	Motor Config
x6007	0	Abort Connection Option Code	3		I16	Yes		0	3	Yes	Stop Actions
x603F	0	Error Code			U16		Tx				Motor Feedback
x6040	0	Controlword	-		U16	Yes	Rx				Motion Command
x6041	0	Statusword			U16		Tx				Motor Feedback
x605A	0	Quick Stop Option Code	-1		I16	Yes		-2	6	Yes	Stop Actions
x605C	0	Disable Operation Option Code	-1		I16	Yes		-2	1	Yes	Stop Actions

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x605D	0	Halt Option Code	-1		I16	Yes		-1	2	Yes	Stop Actions
x605E	0	Fault Reaction Option Code	-1		I16	Yes		-1	0	Yes	Stop Actions
x6060	0	Modes Of Operation	8		I8	Yes	Rx	0	10	Yes	Motion Command
x6061	0	Modes Of Operation Display			I8		Tx				Motor Feedback
x6062	0	Position Demand Value		cnts	I32		Tx				Motor Feedback
x6063	0	Position Actual Internal Value		cnts	I32		Tx				Motor Feedback
x6064	0	Position Actual Value		cnts	I32		Tx				Motor Feedback
x6065	0	Following Error Window	-	cnts	U32	Yes	Rx			Yes	Motor Config
x6066	0	Following Error Time Out	0	ms	U16	Yes	Rx			Yes	Motor Config
x6067	0	Position Window	-	cnts	U32	Yes	Rx			Yes	Motor Config
x6068	0	Position Window Time	0	ms	U16	Yes	Rx			Yes	Motor Config
x606B	0	Velocity Demand Value		cnts/s	I32		Tx				Motor Feedback
x606C	0	Velocity Actual Value		cnts/s	I32		Tx				Motor Feedback
x606D	0	Velocity Window	-	cnts/s	U16	Yes	Rx			Yes	Motor Config
x606E	0	Velocity Window Time	0	ms	U16	Yes	Rx			Yes	Motor Config
x6071	0	Target Torque	-	0.1% trq	I16	Yes	Rx	-1000	1000		Motion Command
x6072	0	Max Torque	1000	0.1% trq	U16	Yes	Rx	0	1000	Yes	Limits
x6074	0	Torque Demand Value		0.1% trq	I16		Tx				Motor Feedback
x6077	0	Torque Actual Value		0.1% trq	I16		Tx				Motor Feedback
x6079	0	DC Link Circuit Voltage		mV	U32		Tx				Power & Temp
x607A	0	Target Position	-	cnts	I32	Yes	Rx				Motion Command
x607C	0	Home Offset	0	cnts	I32	Yes	Rx			Yes	Homing
x607D	Software Position Limit										
x607D	0	Highest Subindex Supported	2		U8						Limits
x607D	1	Min Software Position Limit	0	cnts	I32	Yes	Rx			Yes	Limits
x607D	2	Max Software Position Limit	0	cnts	I32	Yes	Rx			Yes	Limits
x607E	0	Polarity	0x0		U8	Yes	Rx			Yes	Motor Config
x6080	0	Max Motor Speed	-	rpm	U32	Yes	Rx			Yes	Motor Config
x6081	0	Profile Velocity	-	cnts/s	U32	Yes	Rx	0	2147483647		Motion Command
x6083	0	Profile Acceleration	-	cnts/s²	U32	Yes	Rx	0	2147483647		Motion Command
x6084	0	Profile Deceleration	-	cnts/s²	U32	Yes	Rx	0	2147483647		Motion Command

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x6085	0	Quick Stop Deceleration	-	cnts/s²	U32	Yes	Rx			Yes	Stop Actions
x6087	0	Torque Slope	4294967295	0.1% trq/s	U32	Yes	Rx	1	4294967295	Yes	Motor Config
x608F	Position Encoder Resolution										
x608F	0	Highest Subindex Supported	2		U8						Device Info
x608F	1	Encoder Increments		cnts	U32						Device Info
x608F	2	Motor Revolutions		rev	U32						Device Info
x6098	0	Homing Method	37		I8	Yes	Rx	-2	37	Yes	Homing
x6099	Homing Speeds										
x6099	0	Highest Subindex Supported	2		U8						Homing
x6099	1	Fast Homing Speed	-	cnts/s	U32	Yes	Rx	213	536870911	Yes	Homing
x6099	2	Slow Homing Speed	-	cnts/s	U32	Yes	Rx	213	536870911	Yes	Homing
x609A	0	Homing Acceleration	-	cnts/s²	U32	Yes	Rx			Yes	Homing
x60B0	0	Position Offset	0	cnts	I32	Yes	Rx			Yes	Motor Config
x60B1	0	Velocity Offset	0	cnts/s	I32	Yes	Rx			Yes	Motor Config
x60B2	0	Torque Offset	0	0.1% trq	I16	Yes	Rx	-1000	1000	Yes	Motor Config
x60B8	0	Touch Probe Function	0x1713		U16	Yes	Rx			Yes	I/O
x60B9	0	Touch Probe Status			U16		Tx				I/O
x60BA	0	Touch Probe Position 1 Positive Value		cnts	I32		Tx				I/O
x60BB	0	Touch Probe Position 1 Negative Value		cnts	I32		Tx				I/O
x60BC	0	Touch Probe Position 2 Positive Value		cnts	I32		Tx				I/O
x60BD	0	Touch Probe Position 2 Negative Value		cnts	I32		Tx				I/O
x60C2	Interpolation Time Period										
x60C2	0	Highest Subindex Supported	2		U8						Motor Config
x60C2	1	Interpolation Time Period Value	2	(10^i) s	U8	PREOP Only		1	250	Yes	Motor Config
x60C2	2	Interpolation Time Index	-3		I8	PREOP Only		-128	63	Yes	Motor Config
x60D5	0	Touch Probe 1 Positive Edge Counter			U16		Tx				I/O
x60D6	0	Touch Probe 1 Negative Edge Counter			U16		Tx				I/O
x60D7	0	Touch Probe 2 Positive Edge Counter			U16		Tx				I/O
x60D8	0	Touch Probe 2 Negative Edge Counter			U16		Tx				I/O
x60E0	0	Positive Torque Limit Value	1000	0.1% trq	U16	Yes	Rx	0	1000	Yes	Limits
x60E1	0	Negative Torque Limit Value	1000	0.1% trq	U16	Yes	Rx	0	1000	Yes	Limits

Index	Subindex	Name	Default Value	Unit	Type	Writeable	PDO	Lower Limit	Upper Limit	EEPROM	Group
x60E3	Supported Homing Methods										
x60E3	0	Highest Subindex Supported	11		U8						Homing
x60E3	1	1st Supported Homing Method	17		I8						Homing
x60E3	2	2nd Supported Homing Method	18		I8						Homing
x60E3	3	3rd Supported Homing Method	19		I8						Homing
x60E3	4	4th Supported Homing Method	20		I8						Homing
x60E3	5	5th Supported Homing Method	21		I8						Homing
x60E3	6	6th Supported Homing Method	22		I8						Homing
x60E3	7	7th Supported Homing Method	37		I8						Homing
x60E3	8	8th Supported Homing Method	-1		I8						Homing
x60E3	9	9th Supported Homing Method	-2		I8						Homing
x60E3	10	10th Supported Homing Method	33		I8						Homing
x60E3	11	11th Supported Homing Method	34		I8						Homing
x60F4	0	Following Error Actual Value		cnts	I32		Tx				Motor Feedback
x60FC	0	Position Demand Internal Value		cnts	I32		Tx				Motor Feedback
x60FD	0	Digital Inputs			U32		Tx				I/O
x60FE	Digital Outputs										
x60FE	0	Highest Subindex Supported	2		U8						I/O
x60FE	1	Digital Outputs	0x0		U32	Yes	Rx			Yes	I/O
x60FE	2	Output Mask	0xFFFFFFFF		U32	Yes	Rx			Yes	I/O
x60FF	0	Target Velocity	-	cnts/s	I32	Yes	Rx				Motion Command
x6502	0	Supported Drive Modes	0x3AD		U32		Tx				Device Info
x67FE	0	Version Number	0x40100		U32						Device Info
x67FF	0	Single Device Type	0x192		U32						Device Info

APPENDIX B: ERROR CODES

IMPORTANT: For the most efficient troubleshooting, use ClearView 3.0 to identify shutdowns and errors. If you're parsing error codes directly from your EtherCAT master, see the table below for codes reported via the Error Code (0x603F) parameter.

Error Code	Description
0x21D2	**Excessive Bus Current** - Probable cause: Bad tuning or low bus voltage
0x3220	**Bus voltage was lost or was too low** - Probable causes: interlock open, brown out, power supply too small
0x3274	**Max bus voltage exceeded** - Probable cause: Large regenerated voltage upon deceleration or high AC line voltage. Enable the Vector Regen Shunt (VRS) under the Details menu as a possible remedy
0x32D8	**Bus under Operating Voltage** - Possible causes: Brown out, power supply too small, Low Voltage Exception Threshold set too high (can be changed in Clearview's Power and Temperature menu under "Additional Features")
0x4310	**Excessive motor temp** - Possible causes: ambient temperature too high, low airflow, high load at high ambient temperature
0x619D	**Old config file version** - Probable cause: Firmware updated after config file was saved. Create or load a new config file
0x62A3	**Move canceled (Range)** - Move target out of range
0x62A9	**Move canceled (Limit Switch)** - Limit switch activated
0x62AA	**Move canceled (Soft Limit)** - Target position violates software limit settings
0x80BD	**Overspeed Timeout** - The motor has exceeded the Max Motor Speed for the Overspeed Timeout Limit
0x80C5	**Tracking error limit** - Possible causes: excessive friction, mechanical misalignment, vel/accel too high, low DC bus voltage
0x8321	**RMS torque limit** - Possible causes: excessive friction, mechanical misalignment, duty cycle too high, undersized motor
0xFFCC, 0xFFCD, 0xFFCE	**Sensorless startup error** - Error during sensorless startup. Probable causes: external force or bus voltage too low during sensorless startup, motor against an end stop, incorrect motor settings
0xFFDA	**Interlock Triggered** - The input used as an Interlock has been triggered. The motor will stay disabled until the interlock input returns to its normal state

Note: *The error codes listed in this section represent the most common issues. If you encounter an error code not shown here or need further assistance, please contact Teknic.*

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