TEKNIC

ClearLink EtherNet/IP Setup and Object Data Reference

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Introduction

Welcome

Thank you for purchasing a ClearLink EtherNet/IP Motion and I/O Controller. This document is an EtherNet/IP object reference manual for the following products:

- ClearLink Controller (Teknic Part # **CLNK-4-13**)
- I/O Expansion Board, optional (Teknic Part # **CCIO-8**)
- Encoder Input Board, optional (Teknic Part # **CL-ENCDR-DFIN**)

For the hardware reference and hook-up information, please see the ClearLink (Hardware) User Manual at https://teknic.com/files/downloads/clearlink_user_manual.pdf

What's in this Document

- Network Configuration Setup
- ClearPath Motor Compatibility and Motor Setup Information
- Implicit Messaging Data Assemblies
- EtherNet/IP Objects and Attributes
- ClearLink Blink/Status Codes
- Troubleshooting Motion Issues

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.

ClearLink Network Configuration

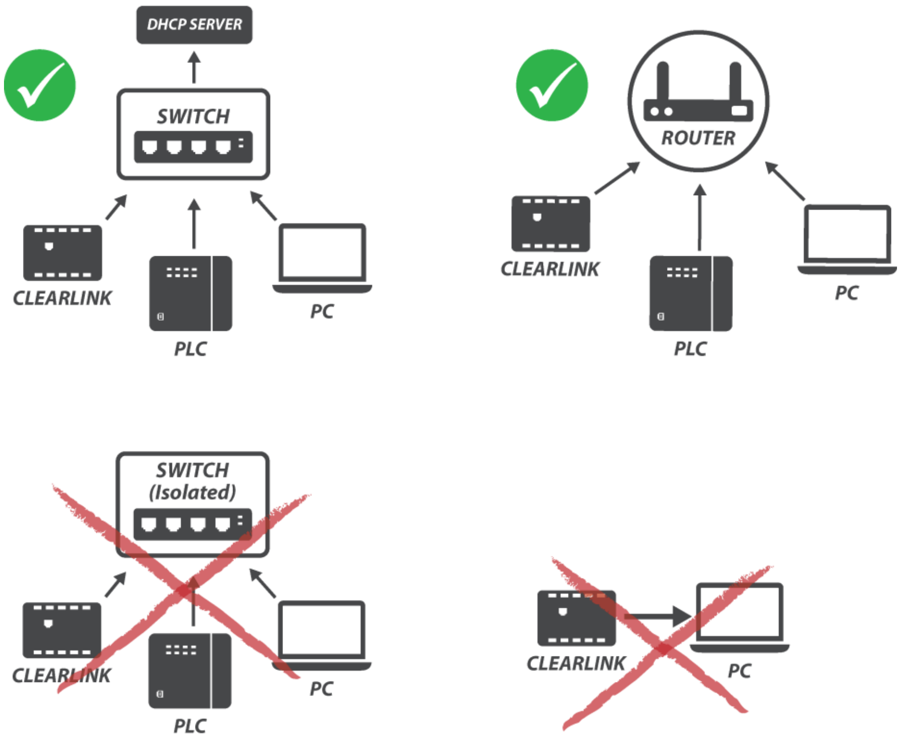
Please Read This Before You Begin

ClearLink comes preconfigured with DHCP (Dynamic Host Configuration Protocol) enabled by default. ***ClearLink does not ship with a pre-assigned (static) IP address***. ClearLink network configuration settings can only be changed via Ethernet connection, so to get started, your ClearLink must first be connected to a DHCP server, which will automatically assign an IP address to your ClearLink. ***Note:*** *Routers and office networks almost always have built in DHCP servers.*

After an IP address has been assigned to your ClearLink, you should be able to locate it on your network at which point you can assign it a static IP address if you prefer. Instructions for this can be found later in this section.

Note: *ClearLink cannot be assigned an IP address via direct connection to a PC or to a switch that is not connected to an upstream DHCP server.*

ClearLink Initial IP Address Assignment (DHCP)



Find the IP Address for Your ClearLink

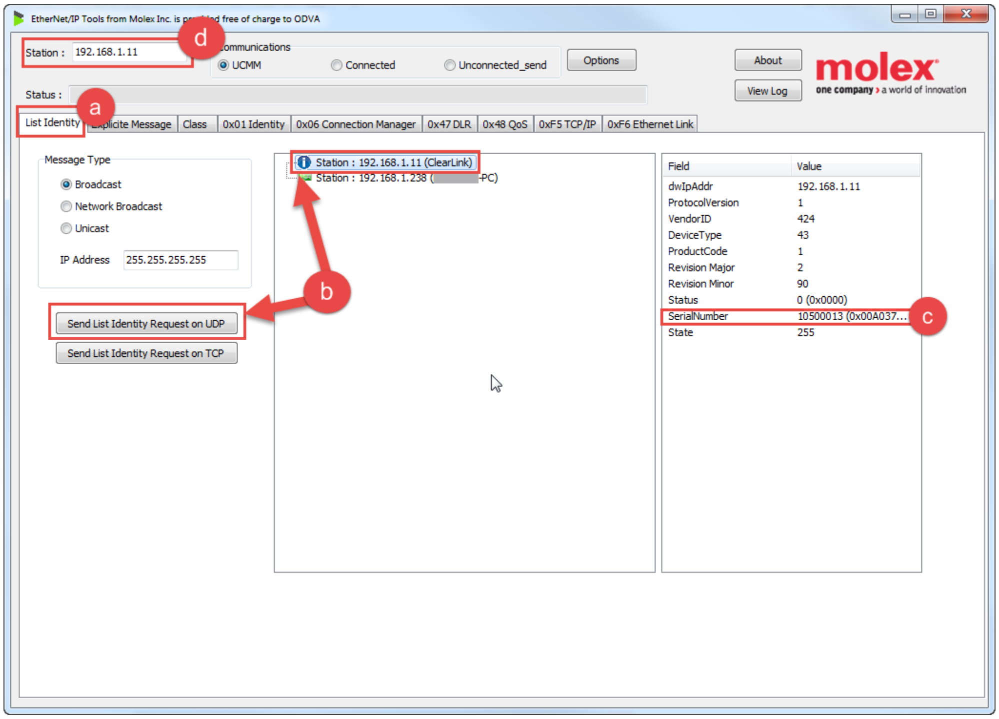
All steps require the ClearLink to be powered with 20-28 VDC power (24VDC typical). See the ClearLink Hardware User Manual for information on how to power your ClearLink.

1. Connect ClearLink to your network or router via its EtherNet/IP port. An IP address will be assigned to it automatically. *(Note: this step is invisible to the user).*

   Important: *This step will not work if ClearLink is actively communicating with another EtherNet/IP device (like a PLC).*

2. Download and install the Molex EIP software. Link

3. Find your ClearLink using the Molex EIP software tool:
   a. From the "List Identity" tab, set Message type to Broadcast and click "Send List Identity Request on UDP"
   b. Select the ClearLink that you want to configure from the center panel
   c. Verify that you are talking to the desired ClearLink by checking the Serial Number in the right panel
   d. The Station field in the top left corner should be set the selected IP address



Station : 192.168.1.11

● UCMM ○ Connected ○ Unconnected_send

● Broadcast
○ Network Broadcast
○ Unicast

IP Address 255.255.255.255

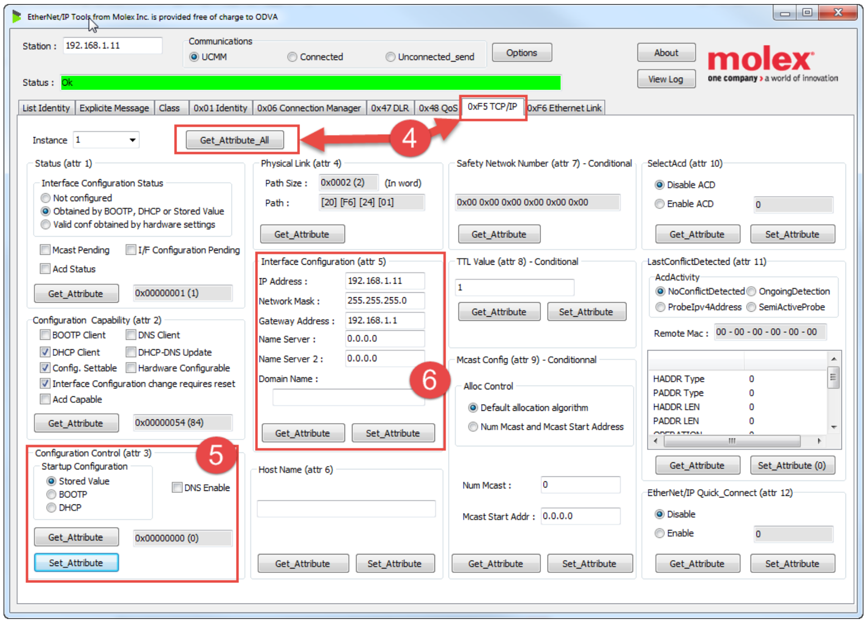
Station : 192.168.1.11 (ClearLink)
Station : 192.168.1.238 ([redacted]-PC)

Field	Value
dwIpAddr	192.168.1.11
ProtocolVersion	1
VendorID	424
DeviceType	43
ProductCode	1
Revision Major	2
Revision Minor	90
Status	0 (0x0000)
SerialNumber	10500013 (0x00A037...
State	255

Note: If you do not see the ClearLink after clicking the "Send List Identity Request on UDP" ensure your network configuration includes a DHCP server (See ClearLink Network Configuration for valid network configurations). Some routers can be configured to block the UDP messaging so if you still experience issues you can look up the ClearLink's assigned IP address directly from the router/DHCP server and manually type in the IP address in the Station field.

Setting a Static IP Address

4. In the “0xF5 TCP/IP” tab, click Get_Attribute_All to read the current settings.
5. Change Configuration Control (attr 3) Startup Configuration to “Stored Value” and click Set_Attribute in that frame.
6. Enter the desired values in Interface Configuration (attr 5) and click Set_Attribute in that frame.



Station : 192.168.1.11

Communications ● UCMM ○ Connected ○ Unconnected_send

Status : Ok

Instance 1

Status (attr 1)
Interface Configuration Status
○ Not configured
● Obtained by BOOTP, DHCP or Stored Value
○ Valid conf obtained by hardware settings
□ Mcast Pending □ I/F Configuration Pending
□ Acd Status
0x00000001 (1)

Configuration Capability (attr 2)
□ BOOTP Client □ DNS Client
☑ DHCP Client □ DHCP-DNS Update
☑ Config. Settable □ Hardware Configurable
☑ Interface Configuration change requires reset
□ Acd Capable
0x00000054 (84)

Configuration Control (attr 3)
Startup Configuration
● Stored Value
○ BOOTP
○ DHCP
□ DNS Enable
0x00000000 (0)

Physical Link (attr 4)
Path Size : 0x0002 (2) (In word)
Path : [20] [F6] [24] [01]

Interface Configuration (attr 5)
IP Address : 192.168.1.11
Network Mask : 255.255.255.0
Gateway Address : 192.168.1.1
Name Server : 0.0.0.0
Name Server 2 : 0.0.0.0
Domain Name :

Host Name (attr 6)

Safety Netwok Number (attr 7) - Conditional
0x00 0x00 0x00 0x00 0x00 0x00

TTL Value (attr 8) - Conditional
1

Mcast Config (attr 9) - Conditionnal
Alloc Control
● Default allocation algorithm
○ Num Mcast and Mcast Start Address
Num Mcast : 0
Mcast Start Addr : 0.0.0.0

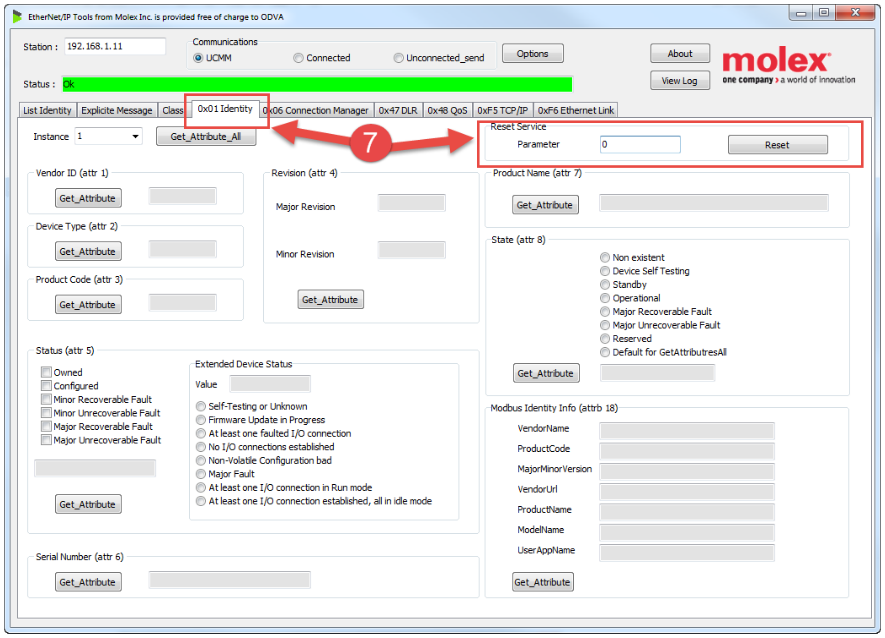
SelectAcd (attr 10)
● Disable ACD
○ Enable ACD 0

LastConflictDetected (attr 11)
AcdActivity
● NoConflictDetected ○ OngoingDetection
○ ProbeIpv4Address ○ SemiActiveProbe
Remote Mac : 00 - 00 - 00 - 00 - 00 - 00

HADDR Type	0
PADDR Type	0
HADDR LEN	0
PADDR LEN	0

EtherNet/IP Quick_Connect (attr 12)
● Disable
○ Enable 0

7. Restart the ClearLink
   a. On the “0x01 Identity” tab, set the Reset Service parameter to 0 and click Reset.



Station : 192.168.1.11

Communications ● UCMM ○ Connected ○ Unconnected_send

Status : Ok

Instance 1

Reset Service
Parameter 0

Vendor ID (attr 1)

Device Type (attr 2)

Product Code (attr 3)

Revision (attr 4)
Major Revision
Minor Revision

Product Name (attr 7)

State (attr 8)
○ Non existent
○ Device Self Testing
○ Standby
○ Operational
○ Major Recoverable Fault
○ Major Unrecoverable Fault
○ Reserved
○ Default for GetAttributresAll

Status (attr 5)
□ Owned
□ Configured
□ Minor Recoverable Fault
□ Minor Unrecoverable Fault
□ Major Recoverable Fault
□ Major Unrecoverable Fault

Extended Device Status
Value
○ Self-Testing or Unknown
○ Firmware Update in Progress
○ At least one faulted I/O connection
○ No I/O connections established
○ Non-Volatile Configuration bad
○ Major Fault
○ At least one I/O connection in Run mode
○ At least one I/O connection established, all in idle mode

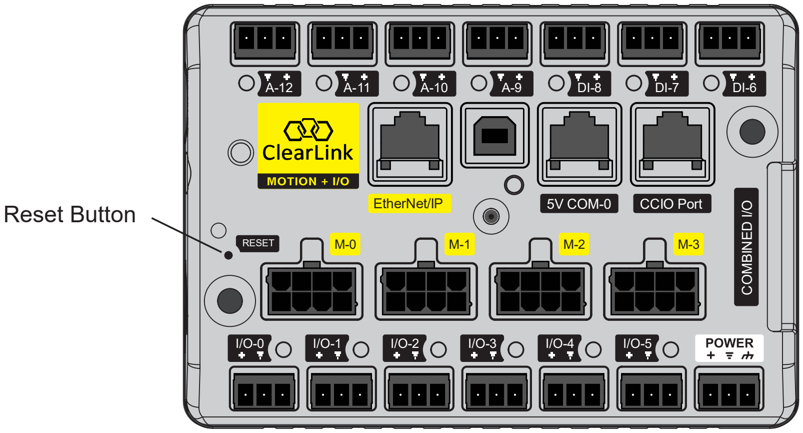
Modbus Identity Info (attrb 18)
VendorName
ProductCode
MajorMinorVersion
VendorUrl
ProductName
ModelName
UserAppName

Serial Number (attr 6)

8. Verify TCP/IP changes
   a. Find your ClearLink again using the “List Identity” tab.
   b. Switch to the “0xF5 TCP/IP” tab.
   c. Click Get_Attribute_All.
   d. Verify that the settings are correct.

Re-enabling DHCP

If you are connected to the ClearLink with your PC, you can follow the same steps using the Molex EIP tool to change network settings back to DHCP. If you are unable to communicate because you forgot the static IP address and network settings, you can reset the ClearLink to DHCP by double pressing the reset button with a paperclip or similar.



Using your EtherNet/IP PLC with ClearLink

ClearLink is an EtherNet/IP slave device (aka server or adapter), and as such must be controlled from an EtherNet/IP master device (aka client or scanner). This is typically a PLC. Exactly *how* you set up communication between your PLC and ClearLink depends on your answers to the following questions:

- **"Can you add ClearLink's EDS file (Electronic Data Sheet) to your PLC project?"**
- **"Can your PLC send Explicit Messages targeting specific Classes, Instances, and Attributes?"**

If your PLC supports EDS files, the easiest way to get started is to set up an Implicit Connection using ClearLink's EDS file.

If your PLC does not support EDS files or Implicit communication, then your PLC must be able to send repeated Explicit Messages to communicate with ClearLink.

Note: If your PLC does not support EDS files or Explicit Messaging, it is not compatible with ClearLink.

EDS File and Implicit Communication

Implicit EtherNet/IP communication involves the back and forth streaming of data between two or more EtherNet/IP devices. It requires the establishment of a formal "Connection" between these devices (i.e. means of communication) as well as a predefined definition of the data being exchanged. These (often large) collections of data are referred to as "Assemblies".

Implicit Connections are typically defined in a device's EDS (Electronic Data Sheet) file. The EDS file specifies the types of Connections supported as well as the sizes and types of data used for the device.

Data Assembly Types

Data for Implicit communication is sorted into three assembly types:

- **Input Assembly** - The Input Assembly data can be thought of as the feedback information from ClearLink to the PLC. This data is sent from ClearLink (Target) to the PLC (Originator) at a regular interval.
- **Output Assembly** - This data is how commands are sent from the PLC to ClearLink. The Output Assembly data is sent from the PLC (Originator) to ClearLink (Target) at a regular interval.
- **Configuration Assembly** - The Configuration Assembly contains ClearLink setup data that does not typically need to be modified during PLC program runtime (e.g. configuring a connector to be an analog input as opposed to the default digital I/O). This data is automatically sent by the PLC to ClearLink only once during runtime, specifically when communication between the PLC and ClearLink is first established (or *re*-established if the connection was broken or interrupted for some reason).

  Note: *Any changes you make to the Configuration tags during system operation will not take effect until the connection between ClearLink and PLC is terminated and re-established.*

  Note: *An Explicit Message can be used to change a Configuration value within ClearLink immediately, i.e. without terminating and re-establishing the connection.*

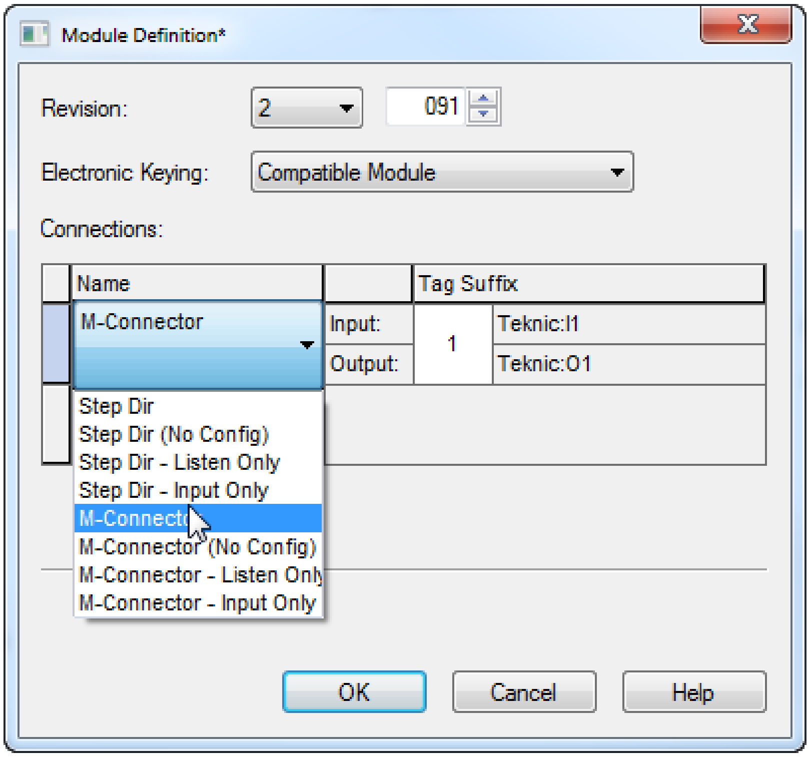
Implicit Connection Setup (general instructions):

Note: *Due to differences in EtherNet/IP PLC models, the following instructions should be considered general guidelines on how to set up Implicit Connections. For comprehensive instructions on this topic, refer to your PLC's documentation.*

1. Load the appropriate ClearLink EDS file into your PLC software and create a module using the ClearLink's IP address and network settings. See ClearLink Network Configuration section for more information on how to set the ClearLink's IP address and network settings.
   a. If your PLC software cannot load an EDS file, double check that it indeed supports Implicit EtherNet/IP communication. In some rare cases the PLC software may not be capable of loading EDS files but has alternative methods for setting up Implicit Connections and defining Assemblies.

2. Set the appropriate Connection type (see figure below). For ClearPath-SD servos and other Step and Direction drives, select the ***"Step Dir"*** Connection type. For ClearPath-MC servos, use the ***"M-Connector"*** type.

   Note: *Any application that uses a combination of SD and MC series ClearPath motors will require two separate ClearLink units, each configured with the appropriate Connection type.*



Revision: 2 091

Electronic Keying: Compatible Module

Connections:

Name			Tag Suffix
M-Connector	Input:	1	Teknic:I1
	Output:		Teknic:O1

   a. The "No Config", "Listen Only", and "Input Only" Connection types are not appropriate for most PLCs. However, for PLCs that don't support Configuration Assemblies, the "No Config" Connection type may be the right choice. In such a case, changing any of the default configuration data would require a (manually programmed) Explicit Message from the PLC.

3. The next steps will depend on your PLC and how much information was utilized from the EDS file. Ideally, you will have defined a Configuration Assembly, an Input Assembly, and an Output Assembly, broken out into named tags. Use these tags to interact with ClearLink.

   a. If the PLC software can load EDS files, but the Configuration, Input, and Output Assemblies are not automatically broken into separate tags for each parameter, you may have to manually extract the parameters from each Assembly. Consult the Assembly Object section for this information.

Sending Explicit Messages

Explicit EtherNet/IP Messaging involves programming the PLC to send messages to the device, and requires a response for each message sent. Unlike with Implicit communication, data is not automatically updated without a message (originating from the PLC) requesting that data.

You can use Explicit Messages to get/set individual Attributes, or to send and receive entire data assemblies.

When a response to an Explicit Message is received, it is up to the PLC program to properly unpack the data to appropriate tags in the program.

> ***Note:*** *Teknic has written an example for the Allen Bradley Micro800 series PLC that does this, i.e. it packs and unpacks a set of data into named tags.*

Using Explicit Messages (general instructions):

Note: *Due to differences in EtherNet/IP PLC models, the following instructions should be considered general guidelines on how to use Explicit Messages. For comprehensive instructions on this topic, refer to your PLC's documentation.*

1. Most PLCs that support Explicit Messages will have some type of ladder or function block to trigger the message. To define the message, you will need to specify some or all of the following:
    a. The IP address/network settings of the ClearLink device. See ClearLink Network Configuration section for more information on how to set the ClearLink's IP address and network settings.
    b. CIP Service Code (usually 0x0E for 'getting' and 0x10 for 'setting').
    c. Class number, Attribute number, Instance number for the parameter/assembly you intend to read/write. The Class, Attribute, and Instance numbers for ClearLink can be found in the tables for each type of Class in this document.
    d. The size/type of the data you are requesting to read/write. Data is typically presented as an array of bytes.
2. Once the Explicit Message is defined, it is likely that the data will need to be packed/unpacked into individual named tags in order to be referenced by the rest of the PLC program.
3. During operation, the PLC program must manage when and how often to send the message.
    a. Some applications might use Explicit Messaging instead of an Implicit connection to get/set assembly data. These messages should be configured to continuously repeat at a high frequency.
    b. Other applications might only change a single parameter at a time, so Explicit Messages would only be sent as needed.

If you are using a ClearPath-MC motor with Explicit Messages only**, **you must change the default Motor Mode in the ClearLink Board Object from 0 to 1. (This is only done automatically when using an Implicit Connection.)

Using ClearPath Servo Motors with ClearLink

In addition to configurable analog and digital I/O, a ClearLink controller can be configured to communicate with up to four independent stepper/servo motors such as Teknic's ClearPath, All-In-One servo motors.

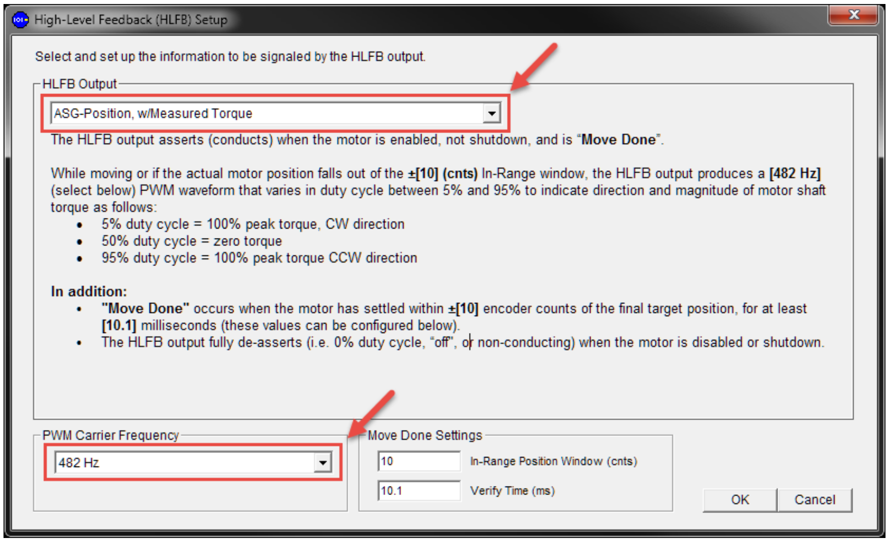
ClearPath servo motors have three distinct digital control series; Step and Direction (SD), Motion Control (MC), and Software Control (SC). The ClearLink controller can control up to four Step and Direction (SD) servos ***or*** up to four ClearPath-MC servos. **ClearLink cannot communicate with the SC (Software Control) series of ClearPath motors.**

Configuring a ClearPath-SD Servo

The ClearPath motor settings must be set using the MSP software to enable all features of ClearLink's Step and Direction control.

Note: this section is not intended to be a comprehensive setup guide for ClearPath. It will only cover the specific settings recommended for ClearLink to correctly interface with a ClearPath-SD servo. Refer to the user manual of your ClearPath series for additional configuration and setup information.

1. Configure ClearPath to use the correct High-Level Feedback (HLFB) mode
    a. In MSP, click the "Advanced" tab, then "High-Level Feedback"
    b. Select the HLFB mode "ASG-Position, w/Measured Torque"
    c. Select the 482 Hz PWM Carrier Frequency



High-Level Feedback (HLFB) Setup

Select and set up the information to be signaled by the HLFB output.

HLFB Output: ASG-Position, w/Measured Torque

The HLFB output asserts (conducts) when the motor is enabled, not shutdown, and is "**Move Done**".

While moving or if the actual motor position falls out of the **±[10] (cnts)** In-Range window, the HLFB output produces a **[482 Hz]** (select below) PWM waveform that varies in duty cycle between 5% and 95% to indicate direction and magnitude of motor shaft torque as follows:

- 5% duty cycle = 100% peak torque, CW direction
- 50% duty cycle = zero torque
- 95% duty cycle = 100% peak torque CCW direction

In addition:

- **"Move Done"** occurs when the motor has settled within **±[10]** encoder counts of the final target position, for at least **[10.1]** milliseconds (these values can be configured below).
- The HLFB output fully de-asserts (i.e. 0% duty cycle, "off", or non-conducting) when the motor is disabled or shutdown.

PWM Carrier Frequency: 482 Hz

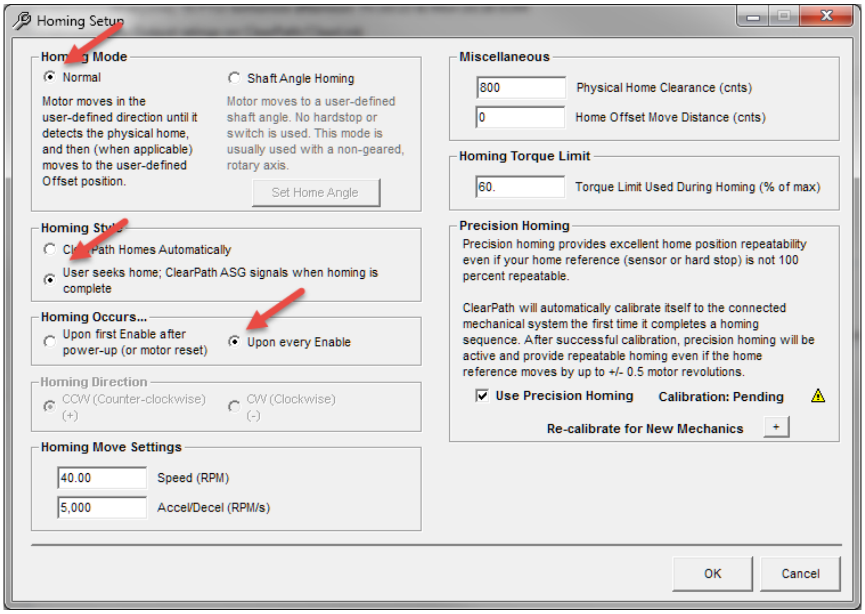
Move Done Settings

10 In-Range Position Window (cnts)

10.1 Verify Time (ms)

2. Configure ClearPath with the correct homing settings (this is only necessary when using hardstop homing)
    a. In the Homing section of MSP, enable homing and click "Setup..."

i. Select "Normal" homing mode
ii. Select "User seeks home"
iii. Select homing "Upon every Enable"



Homing Setup

Homing Mode

● Normal
Motor moves in the user-defined direction until it detects the physical home, and then (when applicable) moves to the user-defined Offset position.

○ Shaft Angle Homing
Motor moves to a user-defined shaft angle. No hardstop or switch is used. This mode is usually used with a non-geared, rotary axis.

Homing Style

○ ClearPath Homes Automatically
● User seeks home; ClearPath ASG signals when homing is complete

Homing Occurs...

○ Upon first Enable after power-up (or motor reset)
● Upon every Enable

Homing Direction

● CCW (Counter-clockwise) (+)
○ CW (Clockwise) (-)

Homing Move Settings

40.00 Speed (RPM)
5,000 Accel/Decel (RPM/s)

Miscellaneous

800 Physical Home Clearance (cnts)
0 Home Offset Move Distance (cnts)

Homing Torque Limit

60. Torque Limit Used During Homing (% of max)

Precision Homing

Precision homing provides excellent home position repeatability even if your home reference (sensor or hard stop) is not 100 percent repeatable.

ClearPath will automatically calibrate itself to the connected mechanical system the first time it completes a homing sequence. After successful calibration, precision homing will be active and provide repeatable homing even if the home reference moves by up to +/- 0.5 motor revolutions.

☑ Use Precision Homing Calibration: Pending ⚠

Re-calibrate for New Mechanics

Configuring a ClearPath-MC Servo

ClearPath-MC servos are only recommended with ClearLink for applications that require variable torque control and have no precise positioning requirements. If the application requires positioning and/or velocity control, consider using the ClearPath-SD servo motors instead.

There are no specific motor settings required to make ClearPath-MC servos compatible with ClearLink. Consideration should be given in selecting the operating mode and HLFB settings appropriate for the application. The two options for torque operational modes are **Follow Digital Torque** and **Follow Digital Velocity w/ Variable Torque**. Configure the ClearPath-MC servo in the correct torque control mode for your application.

Note: *The ClearLink motor connectors can output PWM signals, but not variable digital frequency signals. When using one of the torque operational modes mentioned above, be sure to select one of the PWM-controlled versions of the mode.*

Configuring Third Party Step and Direction Drives

ClearLink is also compatible with most stepper or servo drives capable of receiving step and direction or pulse and direction signals. When using 3rd party drives and motors, please consult the ClearLink Hardware Reference manual for information on wiring the step and direction control signals. Depending on the drives, it may be required to set the Enable and/or HLFB signal inversions in the step and direction motor configuration registers.

Note: *ClearLink's step and direction output uses a fixed 1us pulse width with a maximum step rate of 500k steps/sec, so your step and direction drive must be configured to accept these pulse times.*

EtherNet/IP Object Model

Identity Object (01$_{HEX}$ - 1 Instance)

The following tables contain the attribute, status, and common services information for the Identity Object.

Table 1 Identity Object (01$_{HEX}$ - 1 Instance)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	1.1	Get
Instance 1	1	Vendor number	UINT	424	Get
	2	Device type	UINT	43	Get
	3	Product code number	UINT	1	Get
	4	Product major revision Product minor revision	USINT USINT	2.91	Get
	5	Status	WORD	0	Get
	6	Serial number	UDINT	Unique 32 bit value	Get
	7	Product name	SHORT STRING32	“ClearLink”	Get

Table 2 Identity Object’s common services

Service code	Implemented for		Service name
	Class level	Instance level	
05$_{Hex}$	No	Yes	Reset
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Assembly Object (04HEX - 4 Instances)

The following tables contain the attribute, instance, data mapping, and common services information for the Assembly Object.

Table 3 Assembly Object (04_{HEX} - 2 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	2	Get
	2	Max instance	UINT	238	Get
100 (0x64)	3	T2O (Input) Assembly1 (Step and Direction Motors)	SINT[332]	Varies	Get
101 (0x65)	3	T2O (Input) Assembly2 (M-Connectors)	SINT[228]	Varies	Get
112 (0x70)	3	O2T (Output) Assembly1 (Step and Direction Motors)	SINT[280]	Varies	Set
113 (0x71)	3	O2T (Output) Assembly2 (M-Connectors	SINT[200]	Varies	Set
150 (0x96)	3	Configuration Assembly1 (Step and Direction Motors)	SINT[232]	Varies	Get/Set
151 (0x97)	3	Configuration Assembly2 (M-Connector)	SINT[120]	Varies	Get/Set

Table 4 Assembly Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	Yes	Yes	Set_Attribute_Single

Step and Direction T2O Assembly

	Step and Direction Input Assembly (Instance 100)						
	Byte #	EDS Param #	Name	Data Type	Class ID	Instance ID	Attribute ID
IO Input Data	0-1	10	DIP Value	BOOL[13]	0x08	1-13	3
	2-3	11	DIP Status	BOOL[13]	0x08	1-13	4
	4-11	12	AIP Value	INT[4]	0x0A	1-4	3
	12-13	13	AIOP Status ***	BOOL[5]	0x0A-0B		
	14-15	14	DOP Status	BOOL[6]	0x09	1-6	4
	16-23	15	CCIO Input Value	ULINT	0x68	1	2
	24-31	16	CCIO Status	ULINT	0x68	1	3
	32	17	CCIO Board Count	USINT	0x68	1	4
	33-35	***	Reserved Padding				
Encoder Input Data	36-39	35	Encoder Position	DINT	0x23	1	10
	40-43	36	Encoder Velocity	DINT	0x23	1	24
	44-47	37	Encoder Index Position	DINT	0x23	1	101
	48	38	Encoder Status	BOOL[2]	0x23	1	46,104
	49-51	***	Reserved Padding				
Motor 0 Input Data	52-55	180	Commanded Position	DINT	0x65	1	1
	56-59	181	Commanded Velocity	DINT	0x65	1	2
	60-63	182	Target Position	DINT	0x65	1	3
	64-67	183	Target Velocity	DINT	0x65	1	4
	68-71	184	Captured Position	DINT	0x65	1	5
	72-75	185	Measured Torque	REAL	0x65	1	6
	76-79	186	Status Register	DWORD	0x65	1	7
	80-83	187	Shutdown Register	DWORD	0x65	1	8
Motor 1 Input Data	84-87	190	Commanded Position	DINT	0x65	2	1
	88-91	191	Commanded Velocity	DINT	0x65	2	2
	92-95	192	Target Position	DINT	0x65	2	3
	96-99	193	Target Velocity	DINT	0x65	2	4
	100-103	194	Captured Position	DINT	0x65	2	5
	104-107	195	Measured Torque	REAL	0x65	2	6
	108-111	196	Status Register	DWORD	0x65	2	7
	112-115	197	Shutdown Register	DWORD	0x65	2	8
Motor 2 Input Data	116-119	200	Commanded Position	DINT	0x65	3	1
	120-123	201	Commanded Velocity	DINT	0x65	3	2
	124-127	202	Target Position	DINT	0x65	3	3
	128-131	203	Target Velocity	DINT	0x65	3	4
	132-135	204	Captured Position	DINT	0x65	3	5
	136-139	205	Measured Torque	REAL	0x65	3	6
	140-143	206	Status Register	DWORD	0x65	3	7
	144-147	207	Shutdown Register	DWORD	0x65	3	8
Motor 3 Input Data	148-151	210	Commanded Position	DINT	0x65	4	1
	152-155	211	Commanded Velocity	DINT	0x65	4	2
	156-159	212	Target Position	DINT	0x65	4	3
	160-163	213	Target Velocity	DINT	0x65	4	4
	164-167	214	Captured Position	DINT	0x65	4	5
	168-171	215	Measured Torque	REAL	0x65	4	6
	172-175	216	Status Register	DWORD	0x65	4	7
	176-179	217	Shutdown Register	DWORD	0x65	4	8
Serial ASCII Input Data	180-183	510	Serial Status	DWORD	0x70	1	3
	184-187	511	Output Char Count	UDINT	0x70	1	10
	188-191	512	Input Char Count	UDINT	0x70	1	11
	192-195	513	Output Sequence Ack	UDINT	0x70	1	
	196-199	514	Input Size	UDINT	0x70	1	
	200-203	515	Input Sequence	UDINT	0x70	1	
	204-331	516	Input Data	USINT[128]	0x70	1	

***** AIOP Statuses are grouped in the following order: A-9 Status, A-10 Status, A-11 Status, A-12 Status, IO-0 Status (Analog Output)**

Step and Direction O2T Assembly

	Step and Direction Output Assembly (Instance 112)						
	Byte #	EDS Param #	Name	Data Type	Class ID	Instance ID	Attribute ID
IO Output Data	0-1	20	AOP Value	INT	0x0B	1	3
	2-3	21	DOP Value	BOOL[6]	0x09	1-6	3
	4-9	22	DOP PWM	USINT[6]	0x09	1-6	100
	10-11	***	Reserved				
	12-19	23	CCIO Output Value	ULINT	0x68	1	1
	20-23	40	Encoder AddToPosition	DINT	0x23	1	103
Motor 0 Output Data	24-27	220	Move Distance	DINT	0x66	1	1
	28-31	221	Velocity Limit	UDINT	0x66	1	3
	32-35	222	Acceleration Limit	UDINT	0x66	1	4
	36-39	223	Deceleration Limit	UDINT	0x66	1	5
	40-43	224	Jog Velocity	DINT	0x66	1	2
	44-47	225	Add To Position	DINT	0x66	1	7
	48-51	226	Output Register	DWORD	0x66	1	6
Motor 1 Output Data	52-55	230	Move Distance	DINT	0x66	2	1
	56-59	231	Velocity Limit	UDINT	0x66	2	3
	60-63	232	Acceleration Limit	UDINT	0x66	2	4
	64-67	233	Deceleration Limit	UDINT	0x66	2	5
	68-71	234	Jog Velocity	DINT	0x66	2	2
	72-75	235	Add To Position	DINT	0x66	2	7
	76-79	236	Output Register	DWORD	0x66	2	6
Motor 2 Output Data	80-83	240	Move Distance	DINT	0x66	3	1
	84-87	241	Velocity Limit	UDINT	0x66	3	3
	88-91	242	Acceleration Limit	UDINT	0x66	3	4
	92-95	243	Deceleration Limit	UDINT	0x66	3	5
	96-99	244	Jog Velocity	DINT	0x66	3	2
	100-103	245	Add To Position	DINT	0x66	3	7
	104-107	246	Output Register	DWORD	0x66	3	6
Motor 3 Output Data	108-111	250	Move Distance	DINT	0x66	4	1
	112-115	251	Velocity Limit	UDINT	0x66	4	3
	116-119	252	Acceleration Limit	UDINT	0x66	4	4
	120-123	253	Deceleration Limit	UDINT	0x66	4	5
	124-127	254	Jog Velocity	DINT	0x66	4	2
	128-131	255	Add To Position	DINT	0x66	4	7
	132-135	256	Output Register	DWORD	0x66	4	6
Serial ASCII Output Data	136-139	520	Serial Config	DWORD	0x70	1	2
	140-143	521	Input Sequence Ack	UDINT	0x70	1	
	144-147	522	Output Size	UDINT	0x70	1	
	148-151	523	Output Sequence	UDINT	0x70	1	
	152-279	524	Output Data	USINT[128]	0x70	1	

Step and Direction Configuration Assembly

	Step and Dir Config Assembly (Instance 150)							
	Byte #	EDS Param #	Name	Data Type	Default	Class ID	Instance ID	Attribute ID
IO Mode Config Data	0	1	AI0 Range	USINT	100	0x0A	1	7
	1	2	AI1 Range	USINT	100	0x0A	2	7
	2	3	AI2 Range	USINT	100	0x0A	3	7
	3	4	AI3 Range	USINT	100	0x0A	4	7
	4	5	AO0 Range	USINT	100	0x0B	1	7
	5-6	6	Bit0 DOP PWM Frequency	BOOL	0	0x09	0	100
			Bit 1 CCIO Enable	BOOL	0	0x68	1	6
	7	***	Reserved Padding					
IO Filters	8-11	7	AIP Filters	USINT	10	0x0A	1-4	100
	12-63	8	DIP Filters***	UINT[26]	10000	0x08	1-13	5,6
	64-71	9	CCIO Filters	USINT[8]	10	0x68	1	5
Encoder Config Data	72-75	30	Encoder Velocity Resolution	UDINT	100	0x23	1	26
	76	31	Reserved	USINT	5	0x23	1	100
	77	32	Encoder Configuration		0	0x23	1	12, 102
	78-79	***	Reserved Padding					
Motor 0 Configuration Data	80-83	100	Config Register	DWORD	0x0008	0x64	1	1
	84-87	101	Follow Divisor	DINT	1	0x64	1	12
	88-91	102	Follow Multiplier	DINT	1	0x64	1	13
	92-95	103	Max Deceleration	DINT	10000000	0x64	1	9
	96-99	104	Soft Limit 1	DINT	0	0x64	1	2
	100-103	105	Soft Limit 2	DINT	0	0x64	1	3
	104	107	Positive Limit	SINT	-1	0x64	1	4
	105	108	Negative Limit	SINT	-1	0x64	1	5
	106	109	Home Sensor	SINT	-1	0x64	1	6
	107	110	Brake	SINT	-1	0x64	1	7
	108	111	Stop Sensor	SINT	-1	0x64	1	10
	109	112	Position Capture Sensor	SINT	-1	0x64	1	8
	110	106	Follow Axis	SINT	-1	0x64	1	11
	111	***	Reserved Padding					
Motor 1 Configuration Data	112-115	120	Config Register	DWORD	0x0008	0x64	2	1
	116-119	121	Follow Divisor	DINT	1	0x64	2	12
	120-123	122	Follow Multiplier	DINT	1	0x64	2	13
	124-127	123	Max Deceleration	DINT	10000000	0x64	2	9
	128-131	124	Soft Limit 1	DINT	0	0x64	2	2
	132-135	125	Soft Limit 2	DINT	0	0x64	2	3
	136	127	Positive Limit	SINT	-1	0x64	2	4
	137	128	Negative Limit	SINT	-1	0x64	2	5
	138	129	Home Sensor	SINT	-1	0x64	2	6
	139	130	Brake	SINT	-1	0x64	2	7
	140	131	Stop Sensor	SINT	-1	0x64	2	10
	141	132	Position Capture Sensor	SINT	-1	0x64	2	8
	142	126	Follow Axis	SINT	-1	0x64	2	11
	143	***	Reserved Padding					
Motor 2 Configuration Data	144-147	140	Config Register	DWORD	0x0008	0x64	3	1
	148-151	141	Follow Divisor	DINT	1	0x64	3	12
	152-155	142	Follow Multiplier	DINT	1	0x64	3	13
	156-159	143	Max Deceleration	DINT	10000000	0x64	3	9
	160-163	144	Soft Limit 1	DINT	0	0x64	3	2
	164-167	145	Soft Limit 2	DINT	0	0x64	3	3
	168	147	Positive Limit	SINT	-1	0x64	3	4
	169	148	Negative Limit	SINT	-1	0x64	3	5
	170	149	Home Sensor	SINT	-1	0x64	3	6
	171	150	Brake	SINT	-1	0x64	3	7

	172	151	Stop Sensor	SINT	-1	0x64	3	10
	173	152	Position Capture Sensor	SINT	-1	0x64	3	8
	174	146	Follow Axis	SINT	-1	0x64	3	11
	175	***	Reserved Padding					
Motor 3 Configuration Data	176-179	160	Config Register	DWORD	0x0008	0x64	4	1
	180-183	161	Follow Divisor	DINT	1	0x64	4	12
	184-187	162	Follow Multiplier	DINT	1	0x64	4	13
	188-191	163	Max Deceleration	DINT	10000000	0x64	4	9
	192-195	164	Soft Limit 1	DINT	0	0x64	4	2
	196-199	165	Soft Limit 2	DINT	0	0x64	4	3
	200	167	Positive Limit	SINT	-1	0x64	4	4
	201	168	Negative Limit	SINT	-1	0x64	4	5
	202	169	Home Sensor	SINT	-1	0x64	4	6
	203	170	Brake	SINT	-1	0x64	4	7
	204	171	Stop Sensor	SINT	-1	0x64	4	10
	205	172	Position Capture Sensor	SINT	-1	0x64	4	8
	206	166	Follow Axis	SINT	-1	0x64	4	11
	207	***	Reserved Padding					
Serial Config	208-211	500	Serial Baud Rate	UDINT	115200	0x70	1	1
	212-215	501	Input Start Delimiter	DWORD	0	0x70	1	6
	216-219	501	Input End Delimiter	DWORD	0	0x70	1	7
	220-223	501	Output Start Delimiter	DWORD	0	0x70	1	8
	224-227	501	Output End Delimiter	DWORD	0	0x70	1	9
	228-231	502	Input Timeout	UDINT	10	0x70	1	12

***** DIP filters are grouped in the following order: DIP0 Off_On, DIP0 On_Off, DIP1 Off_On, DIP1, On_Off etc.**

Motor Connector T2O Assembly

	Motor Connector Input Assembly (Instance 101)						
	Byte #	EDS Param #	Name	Data Type	Class ID	Instance ID	Attribute ID
IO Input Data	0-1	10	DIP Value	BOOL[13]	0x08	1-13	3
	2-3	11	DIP Status	BOOL[13]	0x08	1-13	4
	4-11	12	AIP Value	INT[4]	0x0A	1-4	3
	12-13	13	AIOP Status ***	BOOL[5]	0x0A-0B		
	14-15	14	DOP Status	BOOL[6]	0x09	1-6	4
	16-23	15	CCIO Input Value	ULINT	0x68	1	2
	24-31	16	CCIO Status	ULINT	0x68	1	3
	32	17	CCIO Board Count	USINT	0x68	1	4
	33-35	***	Reserved Padding				
Encoder Input Data	36-39	35	Encoder Position	DINT	0x23	1	10
	40-43	36	Encoder Velocity	DINT	0x23	1	24
	44-47	37	Encoder Index Position	DINT	0x23	1	101
	48	38	Encoder Status	BOOL[2]	0x23	1	46,104
	49-51	***	Reserved Padding				
Motor Input Data	52-55	321	Motor 0 HLFB Duty	REAL	0x67	1	6
	56-59	326	Motor 1 HLFB Duty	REAL	0x67	2	6
	60-63	331	Motor 2 HLFB Duty	REAL	0x67	3	6
	64-67	336	Motor 3 HLFB Duty	REAL	0x67	4	6
	68-69	320	Motor 0 Status Reg	WORD	0x67	1	2
	70-71	325	Motor 1 Status Reg	WORD	0x67	2	2
	72-73	330	Motor 2 Status Reg	WORD	0x67	3	2
	74-75	335	Motor 3 Status Reg	WORD	0x67	4	2
Serial ASCII Input Data	76-79	510	Serial Status	DWORD	0x70	1	3
	80-83	511	Output Char Count	UDINT	0x70	1	10
	84-87	512	Input Char Count	UDINT	0x70	1	11
	88-91	513	Output Sequence Ack	UDINT	0x70	1	
	92-95	514	Input Size	UDINT	0x70	1	
	96-99	515	Input Sequence	UDINT	0x70	1	
	100-227	516	Input Data	USINT[128]	0x70	1	

***** AIOP Statuses are grouped in the following order: A-9 Status, A-10 Status, A-11 Status, A-12 Status, IO-0 Status (Analog Output)**

Motor Connector O2T Assembly

	Motor Connector Output Assembly (Instance 113)						
	Byte #	EDS Param #	Name	Data Type	Class ID	Instance ID	Attribute ID
IO Output Data	0-1	20	AOP Value	INT	0x0B	1	3
	2-3	21	DOP Value	BOOL[6]	0x09	1-6	3
	4-9	22	DOP PWM	USINT[6]	0x09	1-6	100
	10-11	***	Reserved				
	12-19	23	CCIO Output Value	ULINT	0x68	1	1
Encoder	20-23	40	Encoder AddToPosition	DINT	0x23	1	103
Motor 0 Output Data	24-25	341	Trig Pulses	UINT	0x67	1	7
	26-27	342	A PWM	UINT	0x67	1	8
	28-29	343	B PWM	UINT	0x67	1	9
	30-31	340	Output Register	USINT	0x67	1	1
Motor 1 Output Data	32-33	346	Trig Pulses	UINT	0x67	2	7
	34-35	347	A PWM	UINT	0x67	2	8
	36-37	348	B PWM	UINT	0x67	2	9
	38-39	345	Output Register	USINT	0x67	2	1
Motor 2 Output Data	40-41	351	Trig Pulses	UINT	0x67	3	7
	42-43	352	A PWM	UINT	0x67	3	8
	44-45	353	B PWM	UINT	0x67	3	9
	46-47	350	Output Register	USINT	0x67	3	1
Motor 3 Output Data	48-49	356	Trig Pulses	UINT	0x67	4	7
	50-51	357	A PWM	UINT	0x67	4	8
	52-53	358	B PWM	UINT	0x67	4	9
	54-55	355	Output Register	USINT	0x67	4	1
Serial ASCII Output Data	56-59	520	Serial Config	DWORD	0x70	1	2
	60-63	521	Input Sequence Ack	UDINT	0x70	1	
	64-67	522	Output Size	UDINT	0x70	1	
	68-71	523	Output Sequence	UDINT	0x70	1	
	72-199	524	Output Data	USINT[128]	0x70	1	

Motor Connector Configuration Assembly

	Motor Connector Config Assembly (Instance 151)							
	Byte #	EDS Param #	Name	Data Type	Default	Class ID	Instance ID	Attribute ID
IO Mode Config Data	0	1	AI0 Range	USINT	100	0x0A	1	7
	1	2	AI1 Range	USINT	100	0x0A	2	7
	2	3	AI2 Range	USINT	100	0x0A	3	7
	3	4	AI3 Range	USINT	100	0x0A	4	7
	4	5	AO0 Range	USINT	100	0x0B	1	7
	5-6	6	bit 0 DOP PWM Frequency	BOOL	0	0x09	0	100
			bit 1 CCIO Enable	BOOL	0	0x68	1	6
	7	***	Reserved Padding					
IO Filters	8-11	7	AIP Filters	USINT[4]	10	0x0A	1-4	100
	12-63	8	DIP Filters***	UINT[26]	10000	0x08	1-13	5,6
	64-71	9	CCIO Filters	USINT[8]	10	0x68	1	5
Encoder Config Data	72-75	30	Encoder Velocity Resolution	UDINT	100	0x23	1	26
	76	31	Reserved	USINT	5	0x23	1	100
	77	32	Encoder Configuration		0	0x23	1	12, 102
	78-79	***	Reserved Padding					
Motor 0 Config	80	300	Enable Input Connector	SINT	-1	0x67	1	3
	81	301	A Input Connector	SINT	-1	0x67	1	4
	82	302	B Input Connector	SINT	-1	0x67	1	5
	83	303	Trigger Pulse Time	USINT	30	0x67	1	10
Motor 1 Config	84	300	Enable Input Connector	SINT	-1	0x67	2	3
	85	301	A Input Connector	SINT	-1	0x67	2	4
	86	302	B Input Connector	SINT	-1	0x67	2	5
	87	303	Trigger Pulse Time	USINT	30	0x67	2	10
Motor 2 Config	88	300	Enable Input Connector	SINT	-1	0x67	3	3
	89	301	A Input Connector	SINT	-1	0x67	3	4
	90	302	B Input Connector	SINT	-1	0x67	3	5
	91	303	Trigger Pulse Time	USINT	30	0x67	3	10
Motor 3 Config	92	300	Enable Input Connector	SINT	-1	0x67	4	3
	93	301	A Input Connector	SINT	-1	0x67	4	4
	94	302	B Input Connector	SINT	-1	0x67	4	5
	95	303	Trigger Pulse Time	USINT	30	0x67	4	10
Serial Config	96-99	500	Serial Baud Rate	UDINT	115200	0x70	1	1
	100-103	501	Input Start Delimiter	DWORD	0	0x70	1	6
	104-107	501	Input End Delimiter	DWORD	0	0x70	1	7
	108-111	501	Output Start Delimiter	DWORD	0	0x70	1	8
	112-115	501	Output End Delimiter	DWORD	0	0x70	1	9
	116-119	502	Input Timeout	UDINT	10	0x70	1	12

***** DIP filters are grouped in the following order: DIP0 Off_On, DIP0 On_Off, DIP1 Off_On, DIP1, On_Off etc.**

TCP Object (F5$_{HEX}$ - 1 Instance)

The following tables contain the attribute and common services information for the TCP Object.

Table 5 TCP Object (F5$_{HEX}$ - 1 Instance)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	4	Get
Instance 1	1	Status*	DWORD	Varies	Get
	2	Configuration capability*	DWORD	Varies	Get
	3	Configuration control*	DWORD	Varies	Get
	4	Physical Link Object * Structure of Path Size Path	 UINT Array of Word	 Varies	Get
	5	Interface configuration* Structure of IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name Size Domain Name	 UDINT UDINT UDINT UDINT UDINT UINT STRING	 Varies Varies Varies Varies Varies Varies Varies	Get
	6	Host name* Structure of Host Name Size Host Name	 UINT STRING	 Varies Varies	Get
	13	Encapsulation Inactivity Timeout	UINT	Varies	Get / Set (NVRAM)

* For more details on these attributes, see *Volume 2: EtherNet/IP Adaptation of CIP*, Section 5-4.3.2 from ODVA.

Table 6 TCP Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Ethernet Link Object (EtherNet/IP only) (F6$_{HEX}$ - 1 Instance)

The following tables contain the attribute and common services information for the Ethernet Link Object.

Table 7 Ethernet Link Object (F6$_{HEX}$ - 1 Instance)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	4	Get
Instance 1	1	Interface Speed*	UDINT	Varies	Get
	2	Interface Flags*	DWORD	Varies	Get
	3	Physical Address	USINT Array (6)	Varies	Get
	11	Interface Capabilities	STRUCT	Varies	Get

* For more details on these attributes, see *Volume 2: EtherNet/IP Adaptation of CIP*, Section 5-5.3.2 from ODVA.

Table 8 Ethernet Link Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single

Discrete Input Point Object (8$_{HEX}$ - 13 Instances)

The Discrete Input Point (DIP) Object models discrete (digital) inputs in a product. Each of ClearLink's 13 I/O points can be used as a digital input. ***Note:*** *The term "input" is defined from the network's point of view. An input will produce data on the network.*

Table 9 Discrete Input Point Object (8$_{HEX}$ - n Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Group
Class (Instance 0)	1	Revision	UINT	2	Get	
	2	Max Instance	UINT	13	Get	
	3	Number of Instances	UINT	13	Get	
Instance 1-13	3	Value	BOOL	Varies	Get	I/O Input
	4	Status	BOOL	Varies	Get	I/O Input
	5	Off_On Delay	UINT	Varies	Get / Set	I/O Filters Config
	6	On_Off_Delay	UINT	Varies	Get / Set	I/O Filters Config

* For more details on these attributes, see *Volume 1: Common Industrial Protocol Specification*, Section 5A-9.3 from ODVA.

Table 10 Discrete Input Point Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance -** 13 This includes all I/O points on the ClearLink board.
- **Number of instances -** 13

Instance #	ClearLink Connector
1	I/O-0
2	I/O-1
3	I/O-2
4	I/O-3
5	I/O-4
6	I/O-5

7	DI-6
8	DI-7
9	DI-8
10	A-9
11	A-10
12	A-11
13	A-12

- **Value**
  - Returns the state of the ClearLink input connector pin.
  - By default, all connectors capable of being outputs will default to being internally configured as outputs (I/O-0 through I/O-5), and all other connectors will be configured as inputs (DI-6 through A-12). It is not necessary to configure a pin to be a discrete (digital) input, even if it defaults internally as an output, because these pins will have a default output value of 0 or "off". Simply wire the digital input device to the I/O point and it will toggle the input appropriately.
    - ***Warning:*** *Be sure not to accidentally set the pin output value when you intend to use the pin as an input. This could potentially damage the input device wired to that pin.*
  - Returns 0 if the associated connector is in analog input/output mode, or outputting a PWM signal with a non-zero duty cycle.
- **Status** - This will return true (error case) if the associated input has been configured as an Analog I/O, if the associated output is turned on (since the signal could override any potential input) or if the associated output is outputting a non-zero PWM duty cycle. This value cannot return true for DI-6,7,8.
- **Off_On_Delay** - The time (in microseconds) an input must be held on before the Value changes from 0 to 1. This value is rounded to the nearest 200us, with a minimum value of 200 us. The units are derived from the EtherNet/IP spec.
- **On_Off_Delay** - The time (in microseconds) an input must be held off before the Value changes from 1 to 0. This value is rounded to the nearest 200us, with a minimum value of 200 us.

Configuring IO-0 through IO-5 as digital inputs

1. For IO-0, ensure the Analog Output Range is set to 100 (default)
2. For each input ensure the associated Discrete output point (DOP) value is set to 0 (Default)

Configuring DI-6 through DI-8 as digital inputs

1. No configuration needed

Configuring A-9 through A-12 as digital inputs

1. For each input ensure the Analog Input Range is set to 100 (default)

Discrete Output Point Object (9$_{HEX}$ - 6 Instances)

A Discrete Output Point (DOP) models discrete (digital) outputs in a product. ClearLink's ***I/O-0 through I/O-5*** can be used as digital outputs. Note that the term “output” is defined from the network’s point of view. An output will consume data from the network.

Table 11 Discrete Output Point Object (9$_{HEX}$ - n Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Data
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT	6	Get	
	3	Number of Instances	UINT	6	Get	
	100	PWM Frequency	BOOL	Varies	Get/Set	I/O Modes Config
Instance 1-6	3	Value	BOOL	Varies	Set	I/O Output
	4	Status	BOOL	Varies	Get	I/O Input
	100	PWM	USINT	Varies	Set	I/O Output

* For more details on these attributes, see *Volume 1: Common Industrial Protocol Specification*, Section 5A-9.3 from ODVA.

Table 12 Discrete Output Point Object’s common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance -** 6
- **Number of instances -** 6

Instance #	ClearLink Connector
1	I/O-0
2	I/O-1
3	I/O-2
4	I/O-3
5	I/O-4
6	I/O-5

- **Value**
  - Sets the NPN type output (0 = off, 1 = on)

    - This attribute is ignored if the PWM attribute is non-zero or if the corresponding Analog output range is not set to 100 (disabled).
- **Status** - This will return true (error case) if the digital output is overloaded, or if the corresponding Analog output range is not set to 100 (disabled).
- **PWM**
    - Configured as a digital output (default) - If the PWM is set to 0 (default) the output behavior will match what is determined by the value attribute. If the PWM != 0 then the Value attribute is ignored and the output is set to a PWM duty cycle at the selected frequency determined by the PWM Frequency attribute.
    - Configured as an analog output (Based on the input range attribute of the associated instance of the Analog output point) - PWM is ignored
- **PWM Frequency** - This selects between two PWM carrier frequencies for all outputs (0 = 500 Hz, 1 = 8 kHz)

Configuring IO-0 through IO-5 as a digital outputs

2. For IO-0 ensure the Analog Output Range is set to 100 (default)
   For IO-1 through 5 no configuration is needed.

Analog Input Point Object (A$_{HEX}$ - 4 Instances)

The Analog Input Point (AIP) Object models analog inputs in a product. ClearLink's ***A-9 through A-12*** pins can be configured as analog inputs. ***Note:*** *that the term "input" is defined from the network's point of view (i.e. an input will produce data on the network).*

Table 13 Analog Input Point Object (A$_{HEX}$ - n Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Data
Class (Instance 0)	1	Revision	UINT	2	Get	
	2	Max Instance	UINT	4	Get	
	3	Number of Instances	UINT	4	Get	
Instance 1-4	3	Value	INT	Varies	Get	I/O Input
	4	Status	BOOL	Varies	Get	I/O Input
	7	Input Range	USINT	2,100	Get / Set	I/O Modes Config
	100	Analog Filter	USINT	Varies	Get / Set	I/O Filters Config

* For more details on these attributes, see *Volume 1: Common Industrial Protocol Specification*, Section 5A-11.3 from ODVA.

Table 14 Analog Input Point Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 4
- **Number of instances** - 4

Instance #	ClearLink Connector
1	A-9
2	A-10
3	A-11
4	A-12

- **Value**
  - If the Input range attribute is set to 100 (disabled), the Value will always return 0.
  - If the Input range attribute is set to 2 (0-10VDC), the Value is determined by the measured analog voltage on the ClearLink Connector.

- **Status** - This will return true (error case) if the Input Range is not specified as "2 = 0-10VDC". When reading the status through an input assembly, the analog input statuses will be the first 4 bits of the AIOP statuses.
- **Input Range** - This refers to a list of Input ranges specified in Ethernet/IP. ClearLink only supports "2=0V-10V". (Attribute defaults to "100 =Disabled").
- **Analog Filter** - IIR filter length in ms. Defaults to 10.

Configuring A-9 through A-12 as a 0-10V analog input

1. Change the desired Analog Input Range from 100 to 2. This is part of the Configuration assembly.
    a. AI0_Range corresponds to pin A-9, AI1_Range corresponds to pin A-10, etc.

2. (Optional) Set your desired analog filter using the AIP_Filter corresponding to the analog pin. This is part of the Configuration assembly.

3. Use the AIP_Value corresponding to the analog pin to read the analog signal. This is part of the Input assembly.
    a. The analog input has 12 bits of resolution, filtered and scaled between a minimum value of 0 (=0V) and a maximum value of 32,767 (=10V).

Analog Output Point Object (B_{HEX} - 1 Instances)

The Analog Output Point (AOP) models the point level attributes and services of the analog outputs in a product. ClearLink's ***I/O-0*** can be configured as an analog output. ***Note:*** *The term "output" is defined from the network's point of view. An output will consume data from the network.*

Table 15 Analog Output Point Object (B_{HEX} - n Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Data
Class (Instance 0)	1	Revision	UINT	2	Get	
	2	Max Instance	UINT	1	Get	
	3	Number of Instances	UINT	1	Get	
Instance 1	3	Value	INT	Varies	Set	I/O Output
	4	Status	BOOL	Varies	Get	I/O Input
	7	Output Range	USINT	0,2,100	Get / Set	I/O Modes Config

* For more details on these attributes, see *Volume 1: Common Industrial Protocol Specification*, Section 5A-12.2 from ODVA.

Table 16 Analog Output Point Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{Hex}$	Yes	Yes	Get_Attribute_Single
10_{Hex}	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 1
- **Number of instances** - 1

Instance #	ClearLink Connector
1	I/O-0

- **Value**
  - If the Output Range attribute is set to 100 (disabled) the Value is ignored.
  - If the Output Range attribute is set to 0 or 2 (4-20 mA or 0-20 mA respectively) the analog output current is set based on the value scaled to the specified output range.
- **Status** - This will return true (error case) if the Output Range is set to 100 (disabled). When reading the status through an input assembly, the analog output status will be the fifth bit of the AIOP statuses.
- **Output Range** - Sets the Analog Output Range as follows: 0 = [4mA to 20mA] and 2 = [0mA to 20mA]. Attribute defaults to 100 (Disabled).

Configuring IO-0 as a 4-20mA or 0-20mA analog output

3. For a 4-20 mA signal, change the Analog Output Range from 100 to 0.
   For a 0-20 mA signal, change the Analog Output Range from 100 to 2.
   AO0_Range is part of the Configuration assembly.

4. Use AOP_Value to set the analog output signal. This is part of the Output Assembly.
   a. This value has a minimum input of 0 (= 0 mA or 4 mA) and a maximum input of 32,767 (= 20 mA). **The analog output has 11 bits of resolution between 0 and 20 mA**.

Position Sensor Object (23$_{HEX}$ - 1 Instance)

The Position Sensor Object models an incremental encoder. For ClearLink, this would be used with the ClearLink Encoder Board accessory (PN: CL-ENCDR-DFIN) and an external differential encoder.

Table 17 Position Sensor Object (23$_{HEX}$ - 1 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Data
Class (Instance 0)	1	Revision	UINT	2	Get	
	2	Max Instance	UINT	1	Get	
	3	Number of Instances	UINT	1	Get	
Instance 1	10	Position Value Signed	DINT	Varies	Get	Encoder Input
	12	Direction Counting Toggle	BOOL	Varies	Get / Set	Encoder Config
	24	Velocity Value	DINT	Varies	Get	Encoder Input
	25	Velocity Format	ENGUNIT	0	Get/Set	
	26	Velocity Resolution	UDINT	Fixed	Get/Set	Encoder Config
	44	Alarms	WORD	0,1	Get	
	45	Supported Alarms	WORD	1	Get	
	46	Alarm Flag	BOOL	Varies	Get	Encoder Input
	100	Reserved	USINT	Varies	Set	Encoder Config
	101	Index Location	DINT	Varies	Get	Encoder Input
	102	Index Active Level	BOOL	Varies	Get / Set	Encoder Config
	103	Add to Position	DINT	Varies	Set	Encoder Output
	104	Add to Position Ack	BOOL	Varies	Get	Encoder Input

* For more details on these attributes, see *Volume 1: Common Industrial Protocol Specification*, Section 5A-23.3 from ODVA.

Table 18 Position Sensor Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single

Service code	Implemented for		Service name
	Class level	Instance level	
10_{Hex}	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 1
- **Number of instances** - 1

Instance #	ClearLink Connector
1	DI-6, DI-7, and DI-8 (though the combined I/O header with CL-ENCDR-DFIN)

- **Position Value Signed** - Returns the current signed position.
- **Direction Counting Toggle** - Defines the direction of increasing position value.
- **Velocity Value** - This reads the current measured velocity (as subject to the Velocity filter setting).
- **Velocity Format** - ClearLink supports only count/sec (0x1f04).
- **Velocity Resolution** - Used to minimize velocity dither. User settable, defaults to 100.
- **Alarms** - This shows active alarm flags.
- **Supported Alarms** - Lists supported Alarms (ClearLink only supports Position Error).
- **Alarm Flag** - This is the flag to indicate one of the Alarm fields is asserted (ClearLink only supports one alarm) 0 = OK, 1 = Alarm Error. Possible causes: encoder frequency above max spec or encoder electrical noise.
- **Index Location** - The stored position value since the Index trigger.
- **Index Active level** - Sets the Index input active level which determines when the index triggers.
- **Add to Position** - When this value is non-zero and the Add to Position Ack Attribute is de-asserted, then the position will be adjusted by the specified amount and the Add to Position Ack will be set true.
- **Add to Position Ack** - This is used for handshaking with the Add to Position attribute. This value is set to true whenever the Add To position is set to be non-zero, and when true, prevents the number space from changing. This value is reset to zero when the AddToPosition value is set to 0.

Step and Direction Motor Configuration Object (64$_{HEX}$ - 4 Instances)

The Motor Configuration Object configures a Step and Direction motor.

Table 19 Motor Configuration Object (64$_{HEX}$ - 1 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	1	Get
	2	Max Instance	UINT	4	Get
	3	Number of Instances	UINT	4	Get
Instance 1-4	1	Config Register	DWORD	Varies	Get / Set
	2	Soft Limit Position 1	DINT	Varies	Get/Set
	3	Soft Limit Position 2	DINT	Varies	Get/Set
	4	Positive Limit connector	SINT	Varies	Get / Set
	5	Negative Limit Connector	SINT	Varies	Get / Set
	6	Home Sensor Connector	SINT	Varies	Get / Set
	7	Brake Output	SINT	Varies	Get / Set
	8	Position Capture Sensor Connector	SINT	Varies	Get / Set
	9	Max Deceleration Rate	DINT	Varies	Get / Set
	10	Stop Sensor	SINT	Varies	Get / Set
	11	Follow Encoder/Axis	SINT	-1 to 4	Get / Set
	12	Follow Divisor	DINT	Varies	Get / Set
	13	Follow Multiplier	DINT	Varies	Get / Set

Table 20 Motor Configuration Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max Instance** - 4
- **Number of Instances** - 4 This instance correlates to Motor connectors 0-3
- **Positive Limit Connector Number** - This number corresponds to the positive hard limit switch connector, if used.
    - For values between 0-12 the corresponding input on ClearLink will be used as a limit switch.
    - For values between 64-127 the corresponding CCIO input (0-63) will be used as the limit switch.
    - If the supplied connector number is -1 then Positive limit is ignored.
    - Defaults to -1

  - This limit is considered Active-Low. If the value of Discrete Input Point Object returns False, further motion in the positive direction will be prevented and the “In Positive Limit” status bit will be set.
  - If there is currently executing positive motion when the limit is asserted a SW E-Stop will be triggered to stop current motion and the shutdown register bit “Motion Canceled (positive limit)” will be asserted. The deceleration rate with be the higher of the last loaded deceleration rate or the Max deceleration rate.
- **Negative Limit Connector Number** – Same as previous definition *except that negative motion is prevented.*
- **Soft Limit Position 1**
  - The soft limit positions will limit commanded motion inclusive between these values (the higher value is taken as a positive limit and the lower value is taken as a negative limit). Default to 0
  - Soft limits will only function when both positions are set to different numbers, AND the Soft Limit Enable bit is asserted, AND when the “Has Homed” Status has asserted
  - If a positional move is commanded which will result in a target position that is FURTHER outside of the defined soft limits (as compared to the current commanded position), the move is ignored and the “Motion Canceled (Soft Limits Exceeded)” bit of the motor shutdown register will be set. Positional moves that begin outside the limit, but end closer to the range will be accepted and executed.
  - Velocity moves when commanded while the motor is in the range will execute normally however when the edge of the range is reached, the motion should terminate at the more aggressive of Max deceleration rate or the loaded move Deceleration rate such that the final position is at the soft limit. Velocity moves commanded while the motor is outside of the range will only be executed if the direction would move the motor towards the range.
  - If the motor has homed, and has soft limits enabled, but the current commanded position is at the boundary or outside of the defined soft limit range, then the motor status “Outside Soft Limits” will be asserted.
- **Soft Limit Position 2** - See previous definition
- **Home Sensor Input** - This value determines whether the homing statuses will be set by a sensor or an end of travel
  - For values between 0-12 the corresponding local ClearLink input will be used as a home switch. The homing target will be determined by looking at the Discrete input object’s Value attribute.
  - For values between 64-127 the corresponding CCIO input (0-63) will be used to supply the home sensor signal. The homing target will be determined by looking at the CCIO’s object’s Input Value attribute.
  - For all other Values the Homing target will be assumed to be provided by an end of travel hard stop detected when the M-Connector HLFB input fully asserts while the Steps active flag is true.
- **Brake Output** - This value determines which output should be used as a power off brake for this motor.
  - For values between 0-5 the corresponding local ClearLink Output will be configured to automatically control a power-off brake. Having this set will cause the corresponding

output value attributes to no longer function. User Note: if value = 0 and the Analog output range attribute !=100, then the brake will not function on I/O-0.

  - For values between 64-127 the corresponding CCIO output (0-63) will be configured to automatically control a power-off brake. The corresponding CCIO output value bit will be ignored.
  - Brake outputs will be energized whenever the motor status bit “Enabled” is asserted (when the M-Connector Enable signal is asserted AND the HLFB signal is NOT de-asserted).
- **Position Capture Sensor Connector** - This number corresponds to the input used for Position Capture.
  - For values between 0-12 the corresponding input on ClearLink will be used to capture position. The input delay in capturing position will be less than 200us.
  - For values between 64-127 the corresponding CCIO input (0-63) will be used to capture position. The input delay in capturing position will be more than 200us.
- **Max Deceleration Rate** - This value specifies a separate deceleration rate that can be used for canceling motion. The deceleration used to cancel motion (e.g. using the Stop sensor) will be the higher value of this and the acceleration/deceleration value for position and velocity moves.
- **Stop Sensor** - When the associated discrete input/CCIO value attribute = 0 the E-Stop sensor will cancel motion. (State based, not edge based)
  - For values between 0-12 the corresponding local ClearLink input will be used as an E-Stop Sensor.
  - For values between 64-127 the corresponding CCIO input (0-63) will be used to supply the E-Stop signal.
  - All other values are ignored
  - Defaults to -1
- **Follow Encoder/Axis** - This value determines which axis/encoder this motor should follow.
  - For values between 0-3 the corresponding M-Connector command will be used as the axis to follow. If the value is the same as this motor’s M-Connector number, then the value is ignored (a motor can't follow itself). A value of 4 corresponds to the position sensor object. A value of -1 will disable the feature. All other numbers are invalid.
  - If the motor you have specified to follow is configured to follow another motor/encoder, then the value is ignored. This will prevent the possibility of setting motor 1 to follow motor 2 which is then set to follow motor 3.
  - Note: calling addToPosition or otherwise changing the number-space of either the leading Encoder/Motor or the Following motor will not cause a change to the number-space of the other or result in motion.
  - Soft Limits are ignored for a motor configured to follow another axis/encoder.
  - For the encoder following feature, any stop command (E-Stop, Limits, SW-E-Stop) will either cause an Abrupt stop or a ramped stop at Max decel rate pending a real-time calculation of the command velocity).
  - For Following another axis, any stop command (E-Stop, Limits, SW-E-Stop, or a motor in fault) will be transferred to the axis being followed in order to stop it as well. Step commands will still be sent to the follower until the master finishes stopping.

- **Follow Divisor** - The divisor used for calculating steps to send when configured to follow another axis. 0 is ignored.
- **Follow Multiplier** - The multiplier used for calculating steps to send when configured to follow another axis. 0 is ignored.
- **Config Register**

Table 21 Step and Direction Motor Config Register

Bit #	Value	Description
0	Homing Enable	This value is used to determine whether the Homing Status, and homing move flag will function
1	Home Sensor Active Level	This value determines if the homing target occurs when the associated sensor value is true or false. NOTE: Filter will equal whatever the associated input filter is
2	Enable Inversion	This inverts the electronic sense of the enable M-Connector output. Defaults to ClearPath compatible, False for active low (electrically)
3	HLFB Inversion	This inverts the electronic sense of the HLFB input on the M-Connector. Defaults to ClearPath compatible, True for active high (electrically)
4	Position Capture Active Level	This inverts the sense of the position capture sensor and determines when the position capture occurs (0 = Rising edge. 1 = falling edge)
5	Soft Limit Enable	This value determines whether soft limits are enabled (Note: homing moves ignore soft limits)
6-31	Reserved	

Step and Direction Motor Input Object (65$_{HEX}$ - 4 Instance)

The Motor Input Object monitors the Step and Direction motor.

Table 22 Motor Input Object (65$_{HEX}$ - 1 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	1	Get
	2	Max Instance	UINT	4	Get
	3	Number of Instances	UINT	4	Get
Instances 1-4	1	Commanded Position	DINT	Varies	Get
	2	Commanded Velocity	DINT	Varies	Get
	3	Target Position	DINT	Varies	Get
	4	Target Velocity	DINT	Varies	Get
	5	Captured Position	DINT	Varies	Get
	6	Measured Torque (ClearPath Motors)	REAL	Varies	Get
	7	Motor Status	DWORD	Varies	Get
	8	Motor Shutdowns	DWORD	Varies	Get

Table 23 Motor Input Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 4
- **Number of instances** - 4 This instance correlates to Motor connectors 0-4
- **Commanded Position** - This value represents the real-time commanded position (number of steps) sent to the motor. This position would be updated if the Add To Position causes a change in the motor's number space. This parameter is commonly used to determine motor position.
- **Commanded Velocity** - This value represents the current velocity in steps/sec that is being sent to the motor.
- **Target Position/Velocity** - This value represents the target position/velocity that the motor is being commanded to. In the case where the motor is not actively executing a new command, this value will show the last commanded position/velocity. Any event which results in a canceled/E-Stop command this value will change to the final position where the stop will be achieved. Any invalid command (such as a command past a soft limit) will not result in a change to this value.
    - If the value is a position, it will be an absolute position even if the last command was a relative positional move.

- **Captured Position** - This value represents the step-position captured upon triggering the Position Capture Sensor Connector to the set Position Capture Active Level.
- **Measured Torque (ClearPath Motors)** - This value represents the measured duty cycle of the HLFB signal expressed as a percentage of torque between -100% and 100%.
  USER NOTE: This calculation is only valid during motion, and if the ClearPath's HLFB output is configured using ASG with Measured Torque.
  USER NOTE: Measured Torque returns -9999 whenever there is no torque measurement (move done, disabled, motor fault).
- **Motor Status** - This register is a real time register.

Table 24 Step and Direction Motor Status Register

Bit #	Value	Description
0	At Target Position	True if the “Commanded position” attribute equals the “Target Position” attribute and HLFB is Asserted
1	Steps Active	True if the “Commanded Velocity” Attribute != 0
2	At Velocity	True if the Commanded Velocity attribute equals the Jog Velocity attribute (for velocity moves) or the Velocity Limit (for position moves).
3	Move Direction	True if the last motion was in the positive direction
4	In Positive Limit	Reflects the state of the Value attribute of the Discrete Input/CCIO specified in the Positive Limit connector number attribute
5	In Negative Limit	Reflects the state of the Value attribute of the Discrete Input/CCIO specified in the Negative Limit connector number attribute
6	In E-Stop Sensor	Reflects the state of the Value attribute of the Discrete Input/CCIO specified in the E-Stop Sensor Connector number attribute
7	In Home Sensor	Reflects the state of the Value attribute of the Discrete Input/CCIO specified in the Home Sensor Connector number attribute
8	Homing	True if the last processed move command loaded had the Homing Flag asserted AND the Has Homed status is False
9	Motor in Fault	True if the HLFB signal on the M-Connector is De-asserted AND the M-Connector Enable output is Asserted (This status will cancel any currently executing motion)
10	Enabled	True if the M-Connector Enable output is Asserted AND the M-Connector HLFB signal is NOT de-asserted
11	At/Outside Soft Limits	True if the “Commanded Position” is at the boundary, or outside the range specified by the Soft limit positions AND the Soft Limit Enable attribute is set to true
12	Positional Move	True if the last commanded move was a positional move

13	Has Homed	This Value is asserted whenever the position number space is changed. This value will DE-assert when any of the following occur: The M-Connector HLFB input DE-asserts. A new command is loaded with the Homing flag set.
14	HLFB_On	Return true if the high level feedback signal from the Motor/drive is asserted.
15	Has Torque Measurement	Return true if a PWM is detected from the high level feedback signal from the motor/drive.
16	Ready to Home	Indicates if the axis is ready to home. If false check: • Homing is enabled in the configuration • The motor is enabled via the Output Register • There are no shutdowns present • The selected homing sensor input is valid • If using hard-stop homing, clear motor faults or cycle enable.
17	Shutdowns Present	Indicates if any ClearLink shutdowns have occurred which will prevent further motion until they are cleared.
18	Add To Position Ack	This is used for handshaking with the Add to Position attribute. This value is set to true whenever the Add To position is set to be non-zero, and when true, prevents the number space from changing. This value is reset to zero when the Add to Position value is set to 0.
19	Load Position Move Ack	This value is used for handshaking and loading motion commands. This value is set whenever the Load Position Move is set, and is cleared whenever the Load Position Move bit is de-asserted. When set, this value will prevent subsequent move commands from being loaded.
20	Load Velocity Move Ack	This value is used for handshaking and loading motion commands. This value is set whenever the Load Velocity Move is set, and is cleared whenever the Load Velocity Move bit is de-asserted. When set, this value will prevent subsequent move commands from being loaded.
21	Clear Motor Fault Ack	This value is used for handshaking and clearing motor faults by cycling the enable output. This value asserts after a “clear motor fault” command has been processed and the axes has been disabled and re-enabled (10 ms disable pulse + wait for up to 25 ms for HLFB) If set, this value will prevent further Clear Motor fault commands from being received.
22-31	Reserved	

- **Motor Shutdowns** - This register is a Or-Accumulating register which is manually cleared by the Clear Alerts flag in the Step and Direction motors Output data.

Table 25 Step and Direction Motor Shutdowns

Bit #	Value	Description
0	Motion Canceled (Command While Shutdown)	This shutdown will occur when a motion command is blocked due to a previously uncleared shutdown
1	Motion Canceled (Positive Limit)	This bit will be set when executing motion is canceled due to a positive limit switch being asserted. This would also assert if a command is sent and rejected while currently in the limit, or at a soft limit (only moves in the opposite direction are then allowed)
2	Motion Canceled (Negative Limit)	This bit will be set when executing motion is canceled due to a negative limit switch being asserted. This would also assert if a command is sent and rejected while currently in the limit, or at a soft limit (only moves in the opposite direction are then allowed)
3	Motion Canceled (Sensor E-Stop)	This bit will be set when executing motion is canceled due to an E-Stop triggered by the specified E-Stop sensor. This would also assert if a command is sent and rejected while the E-Stop is asserted
4	Motion Canceled (SW E-Stop)	This bit will be set when executing motion is canceled due to an E-Stop commanded by the SW E-Stop flag in the motor output data This would also assert if a command is sent and rejected while the SW E-Stop output is asserted
5	Motion Canceled (Motor Disabled)	This bit will be set when current motion is canceled if the enable output attribute de-asserts This would also assert if a command is sent and rejected while enable output attribute is de-asserted
6	Motion Canceled (Soft Limits Exceeded)	This bit will be set when current motion is canceled or when a new loaded move is canceled due to the commanded position or the position target exceeding the range defined by the soft limit range
7	Motion Canceled (Follower Axis Fault)	This bit will be asserted if another motor which has been configured to follow this motor has had its motioned canceled for any reason.
8	Motion Canceled (Command while following)	This bit will be asserted if a move is commanded to a motor while the Follow Encoder/Axis Enable parameter is true,

9	Motion Canceled Homing Not Ready	This bit will be asserted if a homing move is rejected due to the axis not being ready to home. Check: • Homing is enabled in the configuration. • The selected homing sensor input is valid. If using sensor-less homing (hard-stop), clear motor faults or cycle enable.
10	Motor Faulted	This bit will be set whenever the Motor in Fault status state is set.
11	Following Overspeed	This bit will be set when the required axis following speed exceeds the maximum step rate of the ClearLink (500k steps/sec). Consider lowering the steps/rev setting of the master and following motor and/or lowering your following ratio. If following an encoder consider using a lower density encoder.
12-31	Reserved	

Step and Direction Motor Output Object (66$_{HEX}$ - 4 Instance)

The Motor Output Object controls the motor.

Table 26 Motor Output Object (66$_{HEX}$ - 1 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	2	Get
	2	Max Instance	UINT	4	Get
	3	Number of Instances	UINT	4	Get
Instance 1-4	1	Move Distance	DINT	Varies	Set
	2	Jog Velocity	DINT	Varies	Set
	3	Velocity Limit for Positional Move	UDINT	Varies	Set
	4	Acceleration Limit for Velocity/Positional Move	UDINT	Varies	Set
	5	Deceleration Limit	UDINT	Varies	Set
	6	Output Register	DWORD	Varies	Set
	7	Add to Position	DINT	Varies	Set

Table 27 Motor Output Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 4
- **Number of instances** - 4 This instance correlates to Motor connectors 0-3.
- **Move Distance** - This represents the target position of the next commanded positional move. This can be an absolute position or incremental distance, depending on the state of the Absolute Flag bit. Units are in steps.
- **Jog Velocity** - This represents the target velocity of the next commanded velocity move. Units are in steps/sec. **Max value: 500,000 steps/sec.**
- **Velocity Limit for Positional Move** - This represents the velocity limit used for the commanded positional move. Units are in steps/sec**. Max value: 500,000 steps/sec.**
- **Acceleration Limit for Velocity/Positional Move** - This represents the acceleration limit used for the commanded position/velocity moves. Units are in steps/sec^2. **Minimum Resolution: 1527 steps/sec^2.**
- **Deceleration Limit** - This represents the Deceleration limit used for the commanded position/velocity move. If this value is set to 0, the Acceleration limit will be used for deceleration. Units are in steps/sec^2.
- **Add to Position** - ***User Warning:*** *This value should only be set when the Steps Active Status is false).* When this value is non-zero and the Add to Position Ack Status attribute is de-asserted, then the position will be adjusted by the specified amount and the Add to Position

Ack will be set true. Setting this value to zero will de-assert the Add to Position Ack Status to false.

- The Following attributes WILL be changed: Commanded Position, target position (if specified as a position).
- Soft Limit positions will NOT be adjusted.
- The Was Homed status will be set.

- **Output Register**

Table 28 Step and Direction Motor Output Register

Bit #	Value	Description
0	Enable	This value directly controls the Enable output signal of the M-Connector.
1	Absolute Flag	This flag indicates whether the commanded position move will be an incremental move vs. an absolute move. True = absolute move
2	Homing Move Flag	This flag indicates if the position/velocity move is a homing move. True = Homing move
3	Load Position Move	When this value is true and both the Load Position Move ACK status and Load Velocity Move ACK status are false, all move parameters/flags are loaded and a position move is commanded. After the move is loaded, the Load Position Move ACK Status is set to true to prevent subsequent moves from being loaded. When this value is false the Load Position Move ACK status is set to false.
4	Load Velocity Move	When this value is true and both the Load Position Move ACK status and Load Velocity Move ACK status are false, all move parameters/flags are loaded and a velocity move is commanded. After the move is loaded, the Load Velocity Move ACK Status is set to true to prevent subsequent moves from being loaded. When this value is false the Load Velocity Move ACK status is set to false.
5	SW E-Stop	If this value is true, any currently executing move is canceled, and subsequent move commands will be canceled until this bit is set to false. Defaults to false
6	Clear Alerts	When this value is set to True the ClearLink will clear all bits in the Shutdown register, then ClearLink will set this value equal to False.
7	Clear Motor Fault	When this value is set to true, the axis is momentary disabled (10ms) and re-enabled in order to clear any motor faults. This bit will be acknowledged up to 35ms after the initial disable.
8-31	Reserved	

- **Homing Move Flag** - This flag indicates whether the commanded move will be a homing move. This value is ignored if the Home Enable attribute is set to false.

- Before a Homing move begins, if no valid Home Sensor Input is selected (indicating ClearPath SD hard-stop homing), the enable output of the M-Connector will momentarily de-assert and then re-assert. This makes ClearPath's User Seeks Home feature active (when configured to home on every enable).

- A Homing move will be executed in the same way a non-homing position/velocity move would, except when the homing target is reached, the current motion is canceled and when the Steps Active flag = 0, ClearLink sets the addToPosition value to the negative of the Commanded position, resulting in the current position being 0.

- If the homing target is not reached, then ClearLink does not set the addToPosition.

- If no valid Home Sensor Input is selected (indicating ClearPath-SD hard-stop homing), the homing target is considered to be reached when the M-Connector’s HLFB input transitions from a PWM signal to become fully asserted (after the hard-stop is reached) while the Steps Active status is true.

- If a Valid Home Sensor Input is selected, then the homing target is considered to be achieved when the corresponding input value attribute of the digital input or CCIO pin transitions according to the Home Sensor Active level selection.

- Use the Ready To Home bit of the Motor Status Register to determine if ClearLink and the ClearPath-SD are both in a state to make a homing move.

M-Connector Object (67HEX - 4 Instances)

The M-Connector Object contains the data used to interact with ClearPath MC motors in their various operating modes. See the ClearPath manual for additional information about the individual operating modes.

Note: *If you are communicating with the ClearLink through Explicit Messages (i.e. not using an EDS file), you will need to set the ClearLink board's motor mode to true. This is* **Class: 69hex Attribute: 2 Instance: 1**

Table 29 Motor Configuration Object (64HEX - 1 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Data
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT	4	Get	
	3	Number of Instances	UINT	4	Get	
Instance 1-4	1	Output Register	USINT	Varies	Set	M-Connector Output
	2	Status Register	WORD	Varies	Get	M-Connector Input
	3	Enable Connector Number	SINT	Varies	Get / Set	M-Connector Config
	4	A Connector Number	SINT	Varies	Get / Set	M-Connector Config
	5	B Connector Number	SINT	Varies	Get / Set	M-Connector Config
	6	HLFB Input Duty	REAL	Varies	Get	M-Connector Input
	7	Enable Trigger Pulses	UINT	Varies	Set	M-Connector Output
	8	A Output PWM Value	UINT	Varies	Get / Set	M-Connector Output
	9	B Output PWM Value	UINT	Varies	Get / Set	M-Connector Output
	10	Enable Pulse Time	UINT	Varies	Get/Set	M-Connector Config

Table 30 Motor Configuration Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0EHex	Yes	Yes	Get_Attribute_Single
10Hex	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max Instance** - 4

- **Number of instances** - 4 This instance correlates to Motor connectors 0-3.
- **Enable Connector Number** - This number corresponds to the ClearLink input used to control the M-Connector Enable signal.
  - For values between 0-12 the corresponding ClearLink input will control the M-Connector Enable signal such that if the value attribute of Discrete Input Point Object returns true, the M-Connector Enable signal will be asserted. The Enable bit of the Output Register and Enable Trigger pulse attribute of the M-Connector output object will be ignored.
  - For values between 64-127 the corresponding CCIO input (0-63) will control the M-Connector Enable signal such that if the Input value of the corresponding CCIO Input Value Bit returns true, the M-Connector Enable signal will be asserted. The Enable bit of the Output Register and Enable Trigger pulse attribute of the M-Connector output object will be ignored.
  - For all other values, the M-Connector Enable signal will be determined by the Enable bit of the Output Register and Enable Trigger pulse attribute of the M-Connector output object.
- **Input A Connector Number** - See previous definition. If a valid number is specified, the A Output bit of the Output Register, and A Output Duty cycle attributes will be ignored.
- **Input B Connector Number** - See previous definition. If a valid number is specified, the B Output bit of the Output Register, and B Output Duty cycle attributes will be ignored.
- **HLFB Duty** - This reads the duty cycle of a detected PWM signal on the HLFB input of the M-Connector. If no PWM is detected this value will return -9999.
- **Enable Trigger Pulses** - When this value changes from 0 to a new value, the ClearLink will start sending a number of pulses on the M-Connector's enable output equal to the new value. Pulses will be sent at a 50% duty cycle with a pulse width equal to the Enable Pulse Time. If the Enable Pulses ack bit is asserted then this value is ignored. Setting this value to zero will reset the Enable Pulses Ack bit. After the pulses are sent, the enable output will return to the state specified by the Enable bit of the output register or the specified enable connector number. If the Enable bit is de-asserted while pulses are being sent, then the pulses will stop sending.
- **A Output PWM Value** - This value adjusts the duty cycle of a fixed frequency PWM signal. 0 = 0% duty cycle, 5000 = 100% duty cycle. **Note: values 0-15 and 4990-5000 will not be readable by ClearPath motors due to electrical limitations.**
- **B Output PWM Value** - See definition for A Output PWM value, for the B Output.
- **Enable Pulse Time** - Sets the pulse time used when outputting enable trigger pulses, in ms. The pulses will be sent with a 50% duty cycle, so the period will equal 2x the specified pulse time. **Minimum 2 ms**.

- **Status Register**

Table 31 M-Connecter Status Register

Bit #	Value	Description
0	HLFB On	Return true when the high level feedback signal is asserted. HLFB is de-asserted when HLFB On and HLFB has PWM are both false.
1	HLFB has PWM	Return true if a PWM is detected from the high level feedback signal from the motor/drive
2	Enable Trigger Pulses Active	Return true if currently sending enable pulses
3	Enable Trigger Pulses Ack	Used as handshaking to accept an enable pulses command. When this value is true, the enable trigger pulses value is ignored. This value is set to true when the enable trigger pulses is changed from zero to a nonzero value. This value is set to false when the enable trigger pulses is set to zero.
4	Disable Pulse Ack	This value is used for handshaking and clearing motor faults by cycling the enable output. This value asserts after a “Disable Pulse” command has been processed and the axes has been disabled and re-enabled . If set, this value will prevent further Disable Pulse commands from being received.
5-32	Reserved	

- **Output Register**

Table 32 M-Connector Output Register

Bit #	Value	Description
0	Enable	This output determines whether the Enable output is asserted or de-asserted. This value is ignored when the M-Connector is configured with an Enable Connector Number
1	Output A	This output determines whether the A output is asserted or de-asserted. This value is ignored when configured with an A Connector Number >-1. This value is also ignored if the value of A Output Duty Cycle != 0.
2	Output B	This output determines whether the B output is asserted or de-asserted. This value is ignored when configured with an B Connector Number >-1. This value is also ignored if the value of A Output Duty Cycle != 0.
3	Disable Pulse	Sends a disable pulse 3X longer than the Enable Pulse Time in order to clear ClearPath motor faults. Minimum 15 ms.
4-7	Reserved	

CCIO Object (68$_{HEX}$ - 1 Instances)

The CCIO Object models the attributes and services of the CCIO-8 I/O extension module

Table 33 Analog Output Point Object (B$_{HEX}$ - n Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly Data
Class (Instance 0)	1	Revision	UINT	2	Get	
	2	Max Instance	UINT	1	Get	
	3	Number of Instances	UINT	1	Get	
Instance 1	1	Output Value	ULINT	Varies	Set	I/O Output
	2	Input Value	ULINT	Varies	Get	I/O Input
	3	Output Overload Status	ULINT	Varies	Get	I/O Input
	4	Number of Boards	USINT	0...8	Get	I/O Input
	5	CCIO Board Filter	USINT[8]	Varies	Get/Set	I/O Filters
	6	CCIO Enable	USINT	0-1	Get/Set	I/O Modes

* For more details on these attributes, see *Volume 1: Common Industrial Protocol Specification*, Section 5A-12.2 from ODVA.

Table 34 Analog Output Point Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 1
- **Number of instances** - 1 (Corresponds to CCIO Port.)
- **Output Value**
  - Set - This will turn on the corresponding output of the bit number (up to 64). If set to 1, the output will turn on, if set to 0 the output will turn off and can be read as an input. Defaults to 0.
- **Input Value**
  - Get - This will read the corresponding input of the bit number.
- **Output Overload Status** - This will return the status of the corresponding output pin. This will be set only when the output is asserted but cannot be electrically turned on.
- **Number of Boards** - This is the count of how many CCIO boards are detected.
- **CCIO Board Filter** - This array corresponds to the input filter setting in ms of each CCIO board. Defaults to 10 ms.
- **CCIO Enable** - This determines whether CCIO boards can be used. Set to 1 if using any CCIO expansion boards. Defaults to 0.

ASCII Object (70$_{HEX}$ - 1 Instance)

The ASCII Serial Object

Class Attributes

Table 35 Serial Object (70$_{HEX}$ - 1 Instances)

Instance	Attribute ID	Name	CIP Data Type	Data Value	Access Rule	Assembly
Class (Instance 0)	1	Revision	UINT	2	Get	
	2	Max Instance	UINT	1	Get	
	3	Number of Instances	UINT	0-2	Get	
Instance 1	1	Baud Rate	UDINT	Varies	Get / Set	ASCII Config
	2	Config Register	DWORD	Varies	Get / Set	ASCII Output
	3	Status Register	DWORD	Varies	Get	ASCII Input
	4	Output Buffer Length	UINT	128	Get	
	5	Input Buffer Length	UINT	128	Get	
	6	Input Start Delimiter	DWORD	Varies	Get / Set	ASCII Config
	7	Input End Delimiter	DWORD	Varies	Get / Set	ASCII Config
	8	Output Start Delimiter	DWORD	Varies	Get / Set	ASCII Config
	9	Output End Delimiter	DWORD	Varies	Get / Set	ASCII Config
	10	Output Character Count	UDINT	Varies	Get	ASCII Input
	11	Input Character Count	UDINT	Varies	Get	ASCII Input
	12	Input Timeout (ms)	UDINT	Varies	Get / Set	ASCII Config
	N/A	Output Sequence	UDINT	Varies	Set	ASCII Output
	N/A	Input Sequence	UDINT	Varies	Get	ASCII Input
	N/A	Output Sequence Ack	UDINT	Varies	Get	ASCII Input
	N/A	Input Sequence Ack	UDINT	Varies	Set	ASCII Output
	N/A	Input Size	UDINT	Varies	Get	ASCII Input
	N/A	Output Size	UDINT	Varies	Set	ASCII Output
	N/A	Input Data	USINT[128]	Varies	Get	ASCII Input
	N/A	Output Data	USINT[128]	Varies	Set	ASCII Output

Table 36 Serial Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 1
- **Number of instances** - 1 (Corresponds to 5v COM-0)
- **Baud Rate** - This specifies the baud rate used for serial communication (default 115200)
- **Config Register**

Table 37 ASCII Config Register

Bit #	Value	Description
0	open	This bit determines whether the serial port is opened or not
1	rs232	Set this bit if connected to an RS-232 device
2	outBreak	This bit sends a serial break command
3	flowControl	This bit enables flow control signals
4-5	rtsMode	Line off Line on Hardware control Reserved
6-7	parity	8 bit no parity 1 stop bit (8N1) 7 bit even parity 1 stop bit (7E1) 7 bit odd parity 1 stop bit (7O1) Reserved
8-9	outStartDelimCnt	Specifies how many output Start delimiter bytes are used (0-3)
10-11	outEndDelimiCnt	Specifies how many output End delimiter bytes are used (0-3)
12-13	inStartDelimCnt	Specifies how many input Start delimiter bytes are used (0-3)
14-15	inEndDelimCnt	Specifies how many input Start delimiter bytes are used (0-3)
16	keepInDelims	Specify whether to keep delimiters in input data
17	Clear Errors	Used to Clear recorded errors from the status register.
18	Flush Input Data	Flush any pending input data.
19-32	Reserved	

- **Status Register**

Table 38 ASCII Status Register

Bit #	Value	Description
0	Port Opened	Returns whether the port is currently opened
1	ctsState	Return the state of the CTS flow control signal
2	strays	Set to true if any stray packets have been received
3	fragments	Set to true if any fragmented packets have been received
4	Framing Error	Set to true if any packets with framing errors have been received
5	Parity Error	Set to true if any packets with parity errors have been received
6	Overflow Error	Set to true if data has been lost due to a buffer overflow. (This usually is caused by not acknowledging input messages quickly enough)
7	Sending data status(reserved)	True if output data is currently being sent (to support half duplex operation)
8-32	Reserved	

- **Output Buffer Length** - Maximum output buffer length 128 bytes.
- **Input Buffer Length** - Maximum input buffer length 128 bytes.
- **Input Start Delimiter** - The three lower bytes represent the input start delimiter.
- **Input End Delimiter** - The three lower bytes represent the input end delimiter.
- **Output Start Delimiter** - The three lower bytes represent the output start delimiter.
- **Output End Delimiter** - The three lower bytes represent the output end delimiter.
- **Output Character Count** - The output character count specifies how much of the output buffer will be used in the next sent message. The maximum count is 128 bytes.
- **Input Character Count** - The input character count specifies how much of the input buffer the last received message has filled. The maximum count is 128 bytes.
- **Input Timeout (ms)** - This timeout specifies the amount of time between the last received character and when a message is considered received. This timeout is used to differentiate messages when no Input end delimiters are used. Input messages not acknowledged within this time frame can cause a buffer overrun or can cause separate messages to be combined.
- **Output Sequence** - This specifies the output sequence number of the last commanded message. Changing this number results in an output message of the specified size being sent on the port. An output sequence number = 0 is considered an Idle command where no message is sent.
- **Input Sequence** - This number specifies the input sequence number of the last received input message. The first message received will start at 1, and increment by one for each successive message skipping over 0 after a rollover. Sequence number = 0 indicates no data in the input data. Acknowledging the input sequence number will zero the input sequence until the next message is received. Failing to acknowledge input messages in a timely manner can result in combined messages or buffer overflows and lost data.

- **Output Sequence Ack** - The Output Sequence Ack returns the last commanded message sequence number loaded into the serial buffer. Once the Output sequence Ack equals the output Sequence number no additional messages will be sent until the output sequence number is changed.
- **Input Sequence Ack** - The input Sequence ack is used to acknowledge the receipt and processing of the last received input message. To acknowledge the message, the Input Sequence Ack must be set to the Input Sequence number which will subsequently clear the message from the Input Data array.
- **Input Size** - Specifies the size of the currently stored input message. Max of 128.
- **Output Size** - Specified the size of the next commanded output message. Max of 128.
- **Input Data** - This array stores pending input messages. Only one input message at a time is stored. Once the input message is acknowledged, this array is cleared.
- **Output Data** - This array stores the message data for outgoing messages.

ClearLink Board Object (69$_{HEX}$ - 1 Instance)

The ClearLink Board Object models the board-level attributes and services of the ClearLink module.

Class Attributes

Table 39 Serial Object (71$_{HEX}$ - 1 Instances)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	2	Get
	2	Max Instance	UINT	1	Get
	3	Number of Instances	UINT	0-2	Get
Instance 1	1	Blink Codes	BYTE[5]	Varies	Get / Set
	2	Motor Mode	BOOL	Varies	Get/Set
	3	Reset Blink code	BOOL	Varies	Set
	4	Aux Voltage level	REAL	Varies	Get
	5	Supply Voltage	REAL	Varies	Get

Table 40 ClearLink Board Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E$_{Hex}$	Yes	Yes	Get_Attribute_Single
10$_{Hex}$	No	Yes	Set_Attribute_Single

Attribute Semantics

- **Revision**
- **Max instance** - 1
- **Number of instances** - 1
- **Blink Codes** - See below for byte definitions
- **Motor Mode** - 0 = Step & Direction, 1 = M-Connector. This will be set automatically based on the connection type and configuration data sent to ClearLink.
- **Reset Blink Code** - resets all latching blink codes.
- **Aux Voltage** - the measured voltage of ClearLink's 5V auxiliary supply.
- **Supply Voltage** - the measured voltage of ClearLink's main power input.

Blink Code Bytes

Byte 0: Output Connector Overload Group

```
IO_OVERLOAD_NONE = 0x00,
IO0_OVERLOAD_BOARD = 0x01,
IO1_OVERLOAD_BOARD = 0x02,
IO2_OVERLOAD_BOARD = 0x04,
IO3_OVERLOAD_BOARD = 0x08,
IO4_OVERLOAD_BOARD = 0x10,
IO5_OVERLOAD_BOARD = 0x20,
```

Byte 1: Power Supply Error Group

```
SUPPLY_ERROR_NONE = 0x00,
SUPPLY_ERROR_VSUPPLY_LOW = 0x01,
SUPPLY_ERROR_VSUPPLY_HIGH = 0x02,
SUPPLY_ERROR_5VOB_OVERLOAD = 0x04,
```

Byte 2: Device Error Group

```
DEVICE_ERROR_NONE = 0x00,
Reserved = 0x01,
Reserved = 0x02,
DEVICE_ERROR_ETHERNET = 0x04,
DEVICE_ERROR_CCIO = 0x08,
Reserved = 0x10,
DEVICE_ERROR_NVM = 0x20,
```

Byte 3: CCIO Overload Group

```
CCIO_OVERLOAD_NONE = 0x00,
CCIO_OVERLOAD_BOARD0 = 0x01,
CCIO_OVERLOAD_BOARD1 = 0x02,
CCIO_OVERLOAD_BOARD2 = 0x04,
CCIO_OVERLOAD_BOARD3 = 0x08,
CCIO_OVERLOAD_BOARD4 = 0x10,
CCIO_OVERLOAD_BOARD5 = 0x20,
CCIO_OVERLOAD_BOARD6 = 0x40,
CCIO_OVERLOAD_BOARD7 = 0x80,
```

Byte 4: Reserved

Appendix A: ClearLink Status Blink Codes

ClearLink’s operational status is conveyed by its blue “underglow” LEDs.

Normal Operation: ClearLink’s blue status LEDs display a repeating “breathing” pattern.

Error Condition: ClearLink’s blue status LEDs display a repeating strobing and blinking pattern (not the normal breathing pattern). See information and timing diagram below for how to decode ClearLink status codes.

Status Code Regions *(Refer to timing diagram below for details.)*

- **Start of Code (long strobe)** The blue status LED will strobe (flicker rapidly) for 2.3 seconds. This indicates that a status code is about to display.
- **Code Group (short strobes):** The blue status LEDs will then indicate the **Code Group** with a series of strobe pulses. One strobe pulse is ½ second strobing, followed by ½ second off. The Code Group number is the number of short strobe pulses.
- **Code Value (blinks):** After the Code Group displays, the status LEDs display the **Code Value.** This is a series of short blinks, ½ second on followed by ½ second off. The Code Value is the number of blink pulses counted.

  Multiple Status Codes: If *ClearLink has more than one status code to show you, the first status code [Code Group + Code Value] will be displayed, followed by a short pause, followed by the second status code [Code Group + Code Value], and so forth.*

Code Group 1: An output connector was overloaded

- Value N: Connector (N-1) was overloaded.

Code Group 2: Power Supply Error

- Value 1: Vsupply voltage was low.
- Value 2: Vsupply voltage was high.
- Value 3: Offboard 5V supply was overloaded.

Code Group 3: Device Error

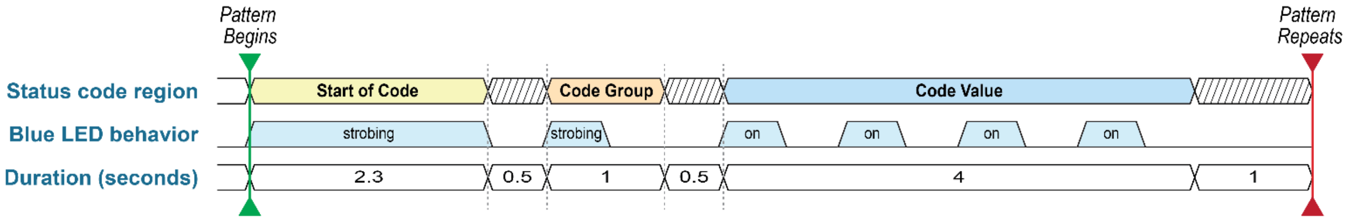
- Value 1: Reserved
- Value 2: Reserved
- Value 3: Ethernet error
- Value 4: CCIO-8 error
- Value 5: Reserved

Code Group 4: CCIO-8 output was overloaded

- Value N: Connector(s) on the Nth CCIO-8 board in the chain were overloaded

Example Status Code Timing Diagram

The timing diagram below shows ***Code Group 1, Value 4. (Connector I/O-3 overloaded)***



Example Status Code: **Code Group 1, Value 4** *(Translation: I/O-3 was overloaded)*

Appendix B: Troubleshooting Motion

Motor Behavior

- The motor attached to ClearLink does not move when given an appropriate move command.
- The motor attached to ClearLink stops unexpectedly and will not respond to further move commands.

Most Likely Cause

This is probably the result of either a **motor shutdown** or a **ClearLink shutdown**. When ClearLink enters a shutdown state, it immediately cancels motion and simultaneously prevents new moves from executing.

Potential Solutions

For ClearPath Servos:

1. Check that you are using the correct connection type for your servos. ClearPath-MC servos require a different connection type than the default option (which is Step and Direction).
2. Check to see if the Motor Shutdowns register has any bits set. Motion is inhibited if this register contains anything but zeros. Use “Clear Alerts” to clear this register. If the register does not clear, this means that the shutdown condition is still present and the same register bit(s) are immediately being set again.
    a. If the ClearLink shutdown is a Motor Fault, use ClearPath MSP software to determine what type of motor shutdown is occurring. These ClearPath shutdowns are cleared using “Clear Motor Faults”.
        i. If ClearLink thinks there is a Motor Fault but the motor is not in a shutdown state, this means ClearLink is having an issue reading the motor’s HLFB signal properly. Double check: 1. correct HLFB settings in MSP, 2. HLFB Inversion is properly turned on, 3. cable issues.

For third-party (non-Teknic) step and direction drives:

1. Verify that the drive is set to accept step frequencies of at least 500kHz (minimum step pulse width no greater than 1 uS).
2. Verify that the drive enables when the ClearLink enable signal is given. If not, you may need to use the Enable Inversion.
3. Check the Motor Shutdowns register. Motion is canceled if this register contains anything except zeros. Use “Clear Alerts” to clear this register. If the register does not clear, this means the shutdown condition is still present and the same register bit(s) are immediately being set again.
    b. If the ClearLink shutdown is a Motor Fault, check for drive errors. This register is cleared using “Clear Motor Faults”.
        i. If ClearLink thinks there is a Motor Fault but the drive is not in a shutdown state, double check: 1. HLFB Inversion may need to be turned off, 2. fault signal cable issues.