

# EtherNet/IP

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## Introduction

This section explains how to use the CM1-T Cool Muscle motor with EtherNet/IP. It is assumed there is a basic knowledge of EtherNet/IP and PLC programming. The implementation makes use of the different [Direct Control](#) in the motor. It does not use CML logic and bank programming. However, setup (K) and controller gain (H) parameters are used for things like motor resolution, s-curve, software limits, etc. These are all accessible to be setup with Control Room or over explicit messages.

## Device Profile

The CM1-T uses a generic device profile. This is to allow it to be flexible and operate in a number of operation modes.

## Direct Control Operation

This mode enables the PLC to directly control the motor. See [Direct Control](#) on how to use the I/O messages to control the motor. Add on instructions are supplied in the downloads section.

## CML Operation

This mode lets to motor control itself through CML programming. The PLC reads and writes to registers to monitor and make changes how the motor operates.

## I/O Messages

There are two distinct I/O Assemblies based on the operation mode required.

### Direct Control Operation

I/O	Assembly Instance	Size
Input	100	36
Output	112	28
Configuration	1	0

#### T2O (Input) Message

- Instance = 100
- Size = 36 bytes

Byte	Name	Data Type
0-3	us50Counter	DINT
4-7	ActualPosition	DINT
8-11	MotionTarget	DINT
12-15	ActualSpeed	DINT
16-17	MotorStatus	INT
18-19	PercentActualCurrent	INT
20-21	PercentOverloadTorque	INT
22-23	AnalogIN	INT
24-25	DCVoltage	INT
26	DigitalIO	SINT
27	Temperature	SINT
28	ModeOfOperationDisplay	SINT
29	ErrorCode <sup>(1)</sup>	SINT
30-31	ReadAddress1	INT
32-35	ReadValue1	DINT

(1) - ErrorCode is currently reserved and returns 0. Use MotorStatus to get motor error information

#### O2T (Output) Message

- Instance = 112
- Size = 28

Byte	Name	Data Type
0-3	TargetPosition	DINT
4-7	TargetSpeed	DINT
8-9	TargetTorque	INT

10-11	TargetAcceleration	INT
12-13	TargetDeceleration	INT
14-15	Controlword	INT
16	ModeOfOperation	SINT
17	DigitalOUT	SINT
18-19	WriteAddress1	INT
20-23	WriteValue1	DINT
24-25	ReadAddress1	INT
26-27	PAD	INT

## CML Operation

I/O	Assembly Instance	Size
Input	101	60
Output	113	44
Configuration	1	0

## T2O (Input) Message

- Instance = 101
- Size = 60 bytes

Byte	Name	Data Type
0-3	us50Counter	DINT
4-7	ActualPosition	DINT
8-11	MotionTarget	DINT
12-15	ActualSpeed	DINT
16-17	MotorStatus	INT
18-19	PercentActualCurrent	INT
20-21	PercentOverloadTorque	INT
22-23	AnalogIN	INT
24-25	DCVoltage	INT
26	DigitalIO	SINT
27	Temperature	SINT
28	ModeOfOperationDisplay	SINT
29	ErrorCode <sup>(1)</sup>	SINT
30-31	ReadAddress1	INT
32-35	ReadValue1	DINT
36-37	ReadAddress2	INT
38-39	ReadAddress3	INT
40-41	ReadAddress4	INT
42-43	ReadAddress5	INT
44-47	ReadValue2	DINT

48-51	RadValue3	DINT
52-55	ReadValue4	DINT
56-59	ReadValue5	DINT

(1) - ErrorCode is currently reserved and returns 0. Use MotorStatus to get motor error information

## O2T (Output) Message

- Instance = 113
- Size = 44

Byte	Name	Data Type
0-3	WriteValue1	DINT
4-7	WriteValue2	DINT
8-11	WriteValue3	DINT
12-15	WriteValue4	DINT
16-19	WriteValue5	DINT
20-21	WriteAddress1	INT
22-23	WriteAddress2	INT
24-25	WriteAddress3	INT
26-27	WriteAddress4	INT
28-29	WriteAddress5	INT
30-31	ReadAddress1	INT
32-33	ReadAddress2	INT
34-35	ReadAddress3	INT
36-37	ReadAddress4	INT
38-39	ReadAddress5	INT
40	DigitalOUT	SINT
41	PAD	SINT
42-43	PAD	INT

## Read/Write Motor Registers

In the I/O messages there is the ability to read and write to internal motor registers. These registers could be configured as flags, input counters, or other custom operations.

1. Direct Operation has
  - 1 x read register
  - 1 x write register
2. CML Operation has
  - 5 x read registers
  - 5 x write registers

The register addresses can be changed after a cycle to read/write to more than 1 register.

## Register Address

The register address is coded into a 2 byte (UINT16) format as follows

B1	B0
Register Type (P, S, A, V, etc)	Register Number (0 to max)

Register Address = Register Type Register Number

The following list maps the register type and the applicable number range

B1 Value (hex)	Register	Register No. Range	Example		
			Register	Address	
				Hex	Decimal
16#00	N/A	N/A	-	-	-
16#01	reserved	reserved	-	-	-
16#02	reserved	reserved	-	-	-
16#03	P	0-25	P0	16#0300	768
16#04	S	0-15	S1	16#0x0401	1025
16#05	A	0-8	A5	16#0x0505	1285
16#06	T	0-8	T2	16#0x0602	1538
16#07	M	0-8	M0	16#0x0700	1792
16#08	R	0-25	R16	16#0x0810	2064
16#09	N	0-25	N15	16#0x090F	2319
16#0A	V	0-15	V10	16#0x0A0A	2570

For a complete list go to [Complete Register Address Map](#)

## Explicit Messages

### K Parameters - Setup Parameters

- Get Attribute Single - Service Code 0x0E
- Set Attribute Single - Service Code 0x10

<b>Class</b>	0x64
<b>Instance</b>	1
<b>Attribute</b>	The attribute represents the K number. example: K37 37 <sub>d</sub> 0x25

### H Parameters - Gain Parameters

- Get Attribute Single - Service Code 0x0E
- Set Attribute Single - Service Code 0x10

<b>Class</b>	0x65
<b>Instance</b>	1
<b>Attribute</b>	H0 0x01 H1 0x02 H2 0x03 H3 0x04 H4 0x05 H5 0x06 H6 0x07 H7 0x08

## Direct Control Operation

### Control Modes

This section focuses on controlling the motor with the provided Add on Instructions (AOIs). These will satisfy most applications, however, if required, the motor can be controlled by setting the CM1-T objects directly (see I/O Messages). Understanding the [Direct Control](#) will be important in this case.

There are currently 3 main control modes available while running the motor over EtherNet/IP.

1. Position - this mode sets the motor to run to a target position. The position could be absolute or relative
2. Speed - this mode allows the motors speed to be controlled for continuous motion
3. Torque - this mode allows the motors torque to be controlled.

The control modes are mapped to the ModeOfOperation value from the CM1T\_ControlMode AOI:

Control Mode	CM1T_ControlMode AOI value	O2T ModeOfOperation Value
Position	0	3
Speed	1	3
Torque	2	11

In addition:

- Homing is an additional mode that can be executed at any point. Homing should start from a known safe state to avoid unexpected changes in motion
- All modes can be switched to during motion. It is recommended the state is switched during a known safe state.
- Torque can be limited in all modes. Running in torque mode will disable errors such as position error which can still occur in other modes if the set torque is too low. The torque is set in 0.1% of rated torque. The range is [0,1100]. By default the torque is set to 1100 when using the AOIs supplied.



All modes use common objects such as position, speed, torque, acceleration and controlword. Switching parameters in another mode will change the value in the existing mode.



Setting the Start bit to 0 will NOT halt motion. The HALT bit must be used to interrupt motion.

## Position Mode

Absolute position and relative position both use the position mode. The key difference in operation between the two is the usage of the start bit in the CM1T\_Controlword. An absolute move will accept a new position immediately if the start bit is 1.

### Start Bit Usage

BIT	Name	Value	Description
B0	Start/New Set Point	0	<ul style="list-style-type: none"><li>• Do not execute any changes in profile registers</li><li>• Do not start a new profile</li><li>• Any profile currently in motion will be completed</li></ul>
		0 1	<ul style="list-style-type: none"><li>• Start a profile move defined by the profile registers</li><li>• 0 1 transition is required to start a profile after<ul style="list-style-type: none"><li>◦ an error has been cleared</li><li>◦ a home has been completed</li><li>◦ a stop command has been given from CML or an input.</li></ul></li><li>• In relative mode transition is required to start the next incremental move.<ul style="list-style-type: none"><li>◦ The move is incremented from the current 1ms target position not the actual position.<ul style="list-style-type: none"><li>▪ This will be the same if there is no position error</li><li>▪ This is to account for possible drift in a repetitive motion.</li></ul></li></ul></li></ul>
		1	Execute any changes in any of the profile registers immediately.

## Motion Parameters

Position moves will accept the following motion parameters. These will be processed immediately if the start bit is high.

Name	Unit	Data Type	Access
------	------	-----------	--------

PositionTarget	counts	DINT	AOI <sup>(2)</sup> or Axis tag
SpeedTarget	counts/s	DINT	AOI or Axis tag
AccelerationTarget	1000 counts/s <sup>2</sup>	INT	AOI or Axis tag
DecelerationTarget <sup>(1)</sup>	1000 counts/s <sup>2</sup>	INT	AOI or Axis tag
TorqueTarget	0.1% rated torque	INT	Axis Tag

(1) If the deceleration is set to 0 the acceleration value will be used

(2) MoveAbsolute or MoveRelative AOI

## Speed Mode

A speed move has no target position and will continue to run at the target speed. Setting a -ve speed value will reverse direction.

### Start Bit Usage

BIT	Name	Value	Description
B0	Start/New Set Point	0	<ul style="list-style-type: none"> <li>Do not execute any changes in profile registers</li> <li>Do not start a new profile</li> <li>Any profile currently in motion will be completed</li> </ul>
		0 1	<ul style="list-style-type: none"> <li>Start a profile move defined by the profile registers</li> <li>0 1 transition is required to start a profile after <ul style="list-style-type: none"> <li>an error has been cleared</li> <li>a home has been completed</li> <li>a stop command has been given from CML or an input.</li> </ul> </li> </ul>
		1	Execute any changes in any of the profile registers immediately.

### Motion Parameters

Speed moves will accept the following motion parameters. These will be processed immediately if the start bit is high.

Name	Unit	Data Type	Access
SpeedTarget	counts/s	DINT	AOI <sup>(2)</sup> or Axis tag
AccelerationTarget	1000 counts/s <sup>2</sup>	INT	AOI or Axis tag
DecelerationTarget <sup>(1)</sup>	1000 counts/s <sup>2</sup>	INT	AOI or Axis tag
TorqueTarget	0.1% rated torque <sup>(1)</sup>	INT	Axis Tag

(1) If the deceleration is set to 0 the acceleration value will be used

(2) MoveSpeed AOI

## Torque Mode

A torque move only uses a target torque and maximum speed. Acceleration of the motor should be limited by adjusting the target torque or speed.

Setting a -ve torque value will reverse direction.

### Start Bit Usage

BIT	Name	Value	Description
B0	Start/New Set Point	0	<ul style="list-style-type: none"> <li>Do not execute any changes in profile registers</li> <li>Do not start a new profile</li> <li>Any profile currently in motion will be completed</li> </ul>
		0 1	<ul style="list-style-type: none"> <li>Start a profile move defined by the profile registers</li> <li>0 1 transition is required to start a profile after <ul style="list-style-type: none"> <li>an error has been cleared</li> <li>a home has been completed</li> <li>a stop command has been given from CML or an input.</li> </ul> </li> </ul>
		1	Execute any changes in any of the profile registers immediately.

		1	Execute any changes in any of the profile registers immediately.
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## Motion Parameters

Torque moves will accept the following motion parameters. These will be processed immediately if the start bit is high.

Name	Unit	Data Type	Access
SpeedTarget	counts/s	DINT	AOI <sup>(1)</sup> or Axis tag
TorqueTarget	0.1% rated torque  Range: $\pm 1100$  Where: <ul style="list-style-type: none"> <li>• 1100 = peak torque</li> <li>• 1000 = rated torque</li> </ul>	INT	AOI or Axis Tag

(1) MoveTorque AOI

## General Resources

### EDS File

The CM1-T EtherNet/IP eds file can be found on the [Datasheets and Downloads](#) page.

### CM1-T Library

The CM1-T Library for use with Codesys, Schneider, Beckhoff, Wago and other IEC 61131-3 PLCs can be found on the [Datasheets and Downloads](#) page.

## RSLogix Resources

See [Datasheets and Downloads](#) to download the UDTs, AOIs and sample program.

## User Data Types

### Direct Control Operation

#### CM1T\_Axis

The CM1-T\_Axis data type defines how the bytes are assigned withing the IO message.

Name	Data Type	Description
Input	SINT[36]	Data coming from the CM1-T
Output	SINT[28]	Data going to the CM1-T
us50Counter	DINT	Motor 50us counter
ModeOfOperation	SINT	Select control mode
ModeOfOperationDisplay	SINT	Current control mode
Controlword	CM1T_Controlword	Control operation
DriveStatus	CM1T_DriveStatus	Drive status
PositionTarget	DINT	Target position for position move
SpeedTarget	DINT	Max speed for target move
TorqueTarget	INT	Max torque for target move
AccelerationTarget	INT	Acceleration for target move
DecelerationTarget	INT	Deceleration for target move



PositionActual	DINT	Actual position of the motor
TargetActual	DINT	1ms target position of the motor
PositionError	DINT	Error between actual and target
SpeedActual	DINT	Actual speed of the motor
CurrentActual	INT	Actual current percentage of the motor (0.1% rated)
OverloadActual	INT	0.1% of overload torque
DCVoltage	INT	24V DC input value at 0.1V
AnalogIN	INT	10bit analog input (0-1023)
DigitalIN	SINT	Read digital inputs
DigitalOUT	SINT	Set digital outputs
Temperature	SINT	Drive temperature in °C
ErrorCode	SINT	ErrorCode is currently reserved and returns 0. Use MotorStatus to get motor error information
ReadAddress1	INT	Address of register to read
ReadValue1	DINT	Value of read register
ReadValueAddress1	INT	Address of the current read register
WriteValue1	DINT	Register write value
WriteRegister1	INT	Write register address

### CM1T\_Controlword

Name	Data Type	Description
Start	BOOL	Start/New set point
Halt	BOOL	Halt current motion
Relative_Move	BOOL	Execute position move as relative
Speed_Control	BOOL	Execute move as a speed only move
Disable	BOOL	Disable the drive
Reset_Error	BOOL	Reset error with rising edge
Set_to_Zero	BOOL	Set the current position to zero with rising edge
Home	BOOL	Home the motor with rising edge

### CM1T\_DriveStatus

Name	Data Type	Description
StatusValue	SINT	Motor status and error type
StatusValue1	SINT	Additional motor status
In_Position	BOOL	Motor is in position and ready to move
Moving	BOOL	Motor is currently moving
Disabled	BOOL	Drive is disabled
Error	BOOL	Drive is in error state
MoveComplete	BOOL	Move is completed
NewStartRequired	BOOL	Rising edge required to restart motion
HomeAchieved	BOOL	Homing has been achieved

## CML Operation

### CM1T\_CMLAxis

The CM1-T\_CMLAxis data type defines how the bytes are assigned withing the IO message.

Name	Data Type	Description
Input	SINT[60]	Data coming from the CM1-T
Output	SINT[44]	Data going to the CM1-T
us50Counter	DINT	Motor 50us counter
DriveStatus	CM1T_DriveStatus	Drive status
PositionActual	DINT	Actual position of the motor
TargetActual	DINT	1ms target position of the motor
PositionError	DINT	Error between actual and target
SpeedActual	DINT	Actual speed of the motor
CurrentActual	INT	Actual current percentage of the motor (0.1% rated)
OverloadActual	INT	0.1% of overload torque
DCVoltage	INT	24V DC input value at 0.1V
AnalogIN	INT	10bit analog input (0-1023)
DigitalIN	SINT	Read digital inputs
DigitalOUT	SINT	Set digital outputs
Temperature	SINT	Drive temperature in °C
ErrorCode	SINT	(1) - ErrorCode is currently unused and returns 0. Use MotorStatus to get motor error information
WriteValue	DINT[5]	Register write value (array) Address of register to read
ReadValue	DINT[5]	Value of read register (array)
WriteAddress	INT[5]	Write register address (array)
ReadAddress	INT[5]	Read address register (array)
ReadValueAddress	INT[5]	Address of the current returned read register (array)

### CM1T\_CMLDriveStatus

Name	Data Type	Description
StatusValue	SINT	Motor status and error type
StatusValue1	SINT	Additional motor status
In_Position	BOOL	Motor is in position and ready to move
Moving	BOOL	Motor is currently moving
Disabled	BOOL	Drive is disabled
Error	BOOL	Drive is in error state
HomeAchieved	BOOL	Homing has been achieved

## Add-On Instructions

### Direct Control Operation

The following tables outlines the available add-on instructions

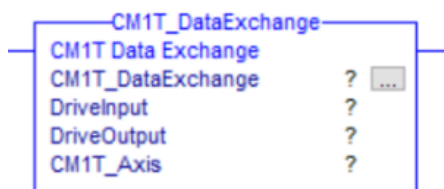
Name	Description	Required
CM1T_DataExchange	Exchanges data between the drive and the drive variable	Yes
CM1T_Enable	Enables the motor	No
CM1T_Disable	Disables the motor	No
CM1T_ClearFault	Clears any faults on the drive	No
CM1_TControlMode	Set the type of control mode required	No
CM1T_MoveAbsolute	Executes an absolute position move	No
CM1T_MoveRelative	Executes a relative position move	No
CM1T_MoveSpeed	Executes a speed move	No
CM1T_MoveTorque	Executes a torque move	No
CM1T_MoveHome	Executes a home routine	No
CM1T_ReadRegister	Read a motor register value	No
CM1T_WriteRegister	Write a value to a motor register	No

## CM1T\_DataExchange

This AOI is required if any other AOIs are used. One instance is required for each CM1-T axis being controlled.

It has a number of functions

1. It exchanges data between the motor connections and the motor/drive tag.
2. It places the Controlword bits into the Controlword data type
3. It retrieves the drive status and places it into the DriveStatus variable.



## Parameters

Operand	Type	Format	Description
CM1T_DataExchange	CM1T_DataExchange	Tag	Instance tag for the AOI
DriveInput	AB:ETHERNET_MODULE_SINT_32Bytes:I:0	Tag	Module defined connection input for the CM1-T
DriveOutput	AB:ETHERNET_MODULE_SINT_20Bytes:O:0	Tag	Module defined connection output for the CM1-T
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis

## Execution

Condition	Action
Prescan	<ul style="list-style-type: none"> <li>• Initialize tag and local variables</li> <li>• rung-condition-out is set to false</li> </ul>
Rung Condition - TRUE	<ul style="list-style-type: none"> <li>• Process DataExchange</li> <li>• rung-condition-out is set to true</li> </ul>
Rung Condition - FALSE	N/A - rung-condition-out is set to false

CM1T\_Enable

This AOI enables the motor and drive. Torque will be present.



Parameters

Operand	Type	Format	Description
CM1T_Enable	CM1T_Enable	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis

Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<div>1. Drive disable bit is set to false (drive is enabled)</div> <div>2. rung-condition-out is set<div>a. true - when drive status bit shows drive enabled</div><div>b. false - when drive status bit show drive disabled</div></div>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_Disable

This AOI disables the motor and drive. Torque will not be present



Parameters

Operand	Type	Format	Description
CM1T_Disable	CM1T_Disable	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis

Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<div>1. Drive disable bit is set to true (drive is disabled)</div> <div>2. rung-condition-out is set<div>a. true - when drive status bit shows drive disabled</div><div>b. false - when drive status bit show drive enabled</div></div>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_ClearFault

This AOI clears any drive fault/error condition. This will also enable the motor. The rung-out-condition indicates the drive error state (true or false).

Parameters

Operand	Type	Format	Description
CM1T_ClearFault	CM1T_ClearFault	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis

Execution

Condition	Action
Prescan	N/A
rung-condition-in is true	<ul style="list-style-type: none"><li>Assert clear error bit</li><li>rung-condition-out is set<ul style="list-style-type: none"><li>true - when drive status bit shows drive error</li><li>false - when drive status bit shows no drive error</li></ul></li></ul>
rung-condition-in is false	<ul style="list-style-type: none"><li>Deassert clear error bit</li><li>rung-condition-out is set<ul style="list-style-type: none"><li>true - when drive status bit shows drive error</li><li>false - when drive status bit shows no drive error</li></ul></li></ul>

CM1T\_ControlMode

This AOI set the motion control mode.



Parameters

Operand	Type	Format	Description
CM1T_Disable	CM1T_ControlMode	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
ControlMode_Value	DINT	Immediate/Tag	A value that sets the type of control mode required  0 - POSITION 1 - SPEED 2 - TORQUE

Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"><li>Sets ModeOfOperation value and Controlword bits to set the control mode required</li><li>rung-condition-out is true</li></ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_MoveAbsolute

This AOI will execute an absolute position move.



Parameters

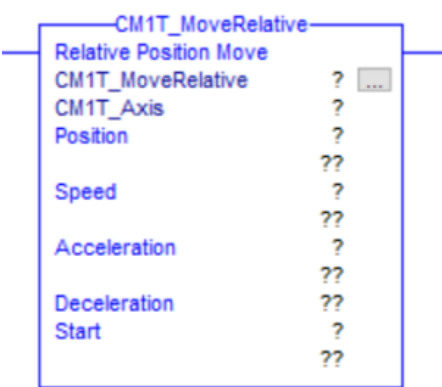
Operand	Type	Format	Description
CM1T_MoveAbsolute	CM1T_MoveAbsolute	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Position	DINT	Immediate/Tag	Target absolute position
Speed	DINT	Immediate/Tag	Target speed
Acceleration	INT	Immediate/Tag	Target acceleration
Deceleration (optional)	INT	Immediate/Tag	Target deceleration (uses acceleration if set to 0)

Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"><li>Processes values and sets start bit</li><li>rung-condition-out is true</li></ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_MoveRelative

This AOI will execute a relative position move.



Parameters

Operand	Type	Format	Description
CM1T_MoveRelative	CM1T_MoveRelative	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Position	DINT	Immediate/ Tag	Target absolute position
Speed	DINT	Immediate/ Tag	Target speed
Acceleration	INT	Immediate/ Tag	Target acceleration
Deceleration (optional)	INT	Immediate/ Tag	Target deceleration (uses acceleration if set to 0)
Start	BOOL	Immediate/ Tag	0 1 transition will execute a new relative move.  If a motion is currently in process it will increment relative to the current position

Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"><li>Processes values and sets start bit as per Start input variable</li><li>rung-condition-out is true</li></ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_MoveSpeed

This AOI will execute a speed move.



Parameters

Operand	Type	Format	Description
CM1T_MoveSpeed	CM1T_MoveSpeed	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Speed	DINT	Immediate/ Tag	Target speed
Acceleration	INT	Immediate/ Tag	Target acceleration
Deceleration (optional)	INT	Immediate/ Tag	Target deceleration (uses acceleration if set to 0)

Execution

Condition	Action
-----------	--------

prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"><li>Processes values and start the speed move</li><li>rung-condition-out is true</li></ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_MoveTorque

This AOI will execute a torque move.



Parameters

Operand	Type	Format	Description
CM1T_MoveSpeed	CM1T_MoveSpeed	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Torque	INT	Immediate/Tag	Target torque
MaxSpeed	DINT	Immediate/Tag	Target speed

Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"><li>Processes values and start the torque move</li><li>rung-condition-out is true</li></ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

CM1T\_ReadRegister

This AOI loads a register address to read. It returns the register value. The value is returned when the ReadRegister (output) address and the ReadValueAddress (input) address are equal.



Parameters

Operand	Type	Format	Description
---------	------	--------	-------------



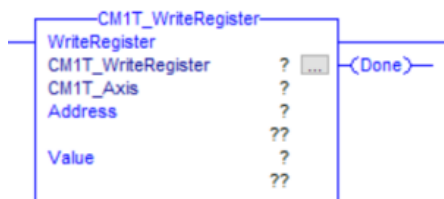
CM1T_ReadRegister	CM1T_ReadRegister	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Address	INT	Immediate/ Tag	Address of register to read
Value	DINT	Tag	Tag to load the returned value
Done	BOOL	Tag	Optional output indicating the value has been returned.

#### Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"> <li>Processes values and start the torque move</li> <li>rung-condition-out is true</li> </ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

### CM1T\_WriteRegister

This AOI loads a register address and value to write. Once the write cycle is complete the done output is set.



#### Parameters

Operand	Type	Format	Description
CM1TWriteRegister	CM1T_WriteRegister	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Address	INT	Immediate/ Tag	Address of register to write
Value	DINT	Immediate/ Tag	Tag/value to load into the write value
Done	BOOL	Tag	Optional output indicating the value has been written.

#### Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"> <li>Processes values and start the torque move</li> <li>rung-condition-out is true</li> </ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

### CML Operation

The following tables outlines the available add-on instructions

Name	Description	Required
CM1T_CMLDataExchange	Exchanges data between the drive and the drive variable	Yes

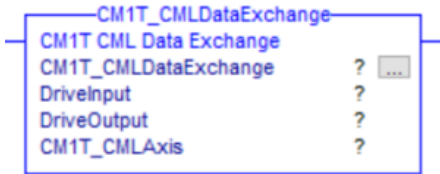
CM1T_CMLReadRegister	Reads a motor register	No
CM1T_CMLWriteRegister	Writes to a motor register	No

## CM1T\_CMLDataExchange

This AOI is required if any other CML AOIs are used. One instance is required for each CM1-T axis being controlled.

It has a number of functions

1. It exchanges data between the motor connections and the motor/drive tag.
2. It retrieves the drive status and places it into the DriveStatus variable.



### Parameters

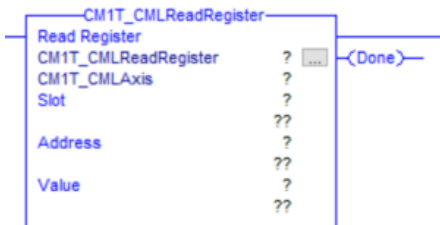
Operand	Type	Format	Description
CM1T_DataExchange	CM1T_DataExchange	Tag	Instance tag for the AOI
DriveInput	AB:ETHERNET_MODULE_SINT_32Bytes:I:0	Tag	Module defined connection input for the CM1-T
DriveOutput	AB:ETHERNET_MODULE_SINT_20Bytes:O:0	Tag	Module defined connection output for the CM1-T
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis

### Execution

Condition	Action
Prescan	N/A - rung-condition-out is set to false
Rung Condition - TRUE	<ul style="list-style-type: none"> <li>• Process DataExchange</li> <li>• rung-condition-out is set to true</li> </ul>
Rung Condition - FALSE	N/A - rung-condition-out is set to false

## CM1T\_CMLReadRegister

This AOI loads a register address to read. It returns the register value. The value is returned when the ReadRegister (output) address and the ReadValueAddress (input) address are equal.



### Parameters

Operand	Type	Format	Description
CM1T_ReadRegister	CM1T_ReadRegister	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Slot	SINT	Immediate/Tag	There are 5 slots available. Enter 1-5.

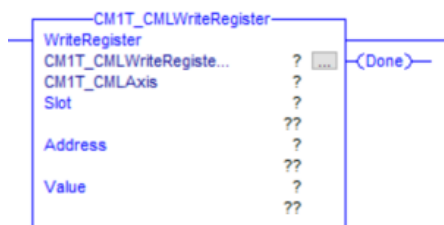
Address	INT	Immediate/ Tag	Address of register to read
Value	DINT	Tag	Tag to load the returned value
Done	BOOL	Tag	Optional output indicating the value has been returned.

#### Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"> <li>Processes values and start the torque move</li> <li>rung-condition-out is true</li> </ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

### CM1T\_CMLWriteRegister

This AOI loads a register address and value to write. Once the write cycle is complete the done output is set.



#### Parameters

Operand	Type	Format	Description
CM1TWriteRegister	CM1T_WriteRegister	Tag	Instance tag for the AOI
CM1T_Axis	CM1T_Axis	Tag	Working tag for the CM1-T axis
Slot	SINT	Immediate/ Tag	There are 5 slots available. Enter 1-5.
Address	INT	Immediate/ Tag	Address of register to write
Value	DINT	Immediate/ Tag	Tag/value to load into the write value
Done	BOOL	Tag	Optional output indicating the value has been written.

#### Execution

Condition	Action
prescan	N/A - rung-condition-out is set to false
rung-condition-in is true	<ul style="list-style-type: none"> <li>Processes values and start the torque move</li> <li>rung-condition-out is true</li> </ul>
rung-condition-in is false	N/A - rung-condition-out is set to false

## Adding CM1-T and AOIs to Project

Download and extract the [CM1-T\\_AOIs.zip](#) support file.

The file includes the following

1. Direct Control Operation

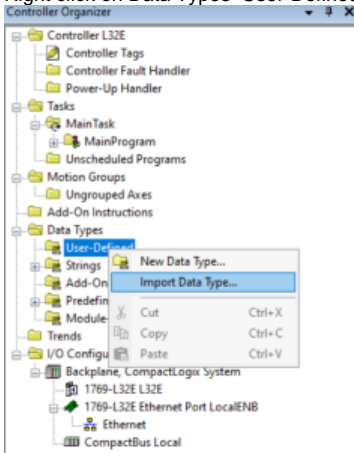
- a. CM1T\_SampleApplication.ACD - This a sample application built RSLogix. It shows how to
    - i. Run the motors in each of the modes
    - ii. Reset from faults
    - iii. Enable/Disable the motor
  - b. User Data Types (UDT)
  - c. Add-On Instructions (AOI)
2. CML Operation
- a. CM1T\_CMLSampleApplication.ACD - RSLogix application to read/write motor registers
  - b. CM1T\_CMLSampleApplication.crp - Control Room project with CML sample program.
    - i. Executes incremental move if variable is set (Run, distance, speed and acceleration set from PLC)
    - ii. Increments counter variable (Variable read in PLC)
  - c. User Data Types (UDT)
  - d. Add-On Instructions (AOI)

## Direct Control Operation

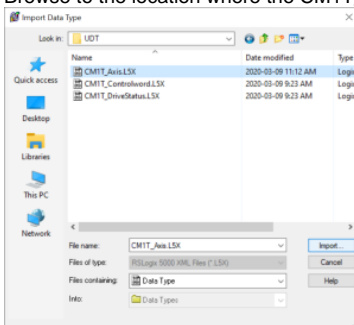
### Import User Data Types (UDTs)

The following steps show how to import the UDTs used by the CM1-T module.

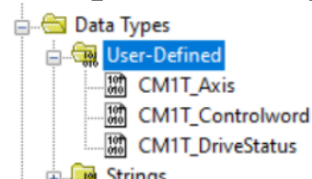
1. Right click on Data Types User-Defined and select "Import Data Type..."



2. Browse to the location where the CM1T\_AOI support file was extracted. Select the CM1T\_Axis and click import.



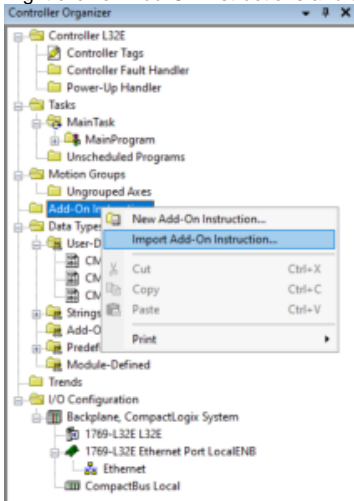
3. On the Import Configuration window click OK
4. The CM1T\_Axis, CM1T\_Controlword and CM1T\_DriveStatus should all have been import as shown below. If they were not repeat steps 1-3 with the CM1T\_Controlword and CM1T\_DriveStatus.



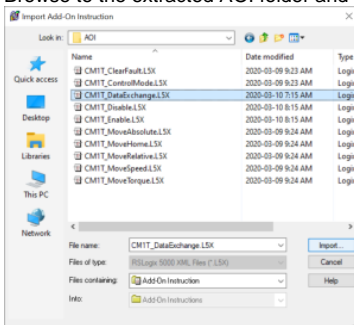
### Import Add-On Instructions (AOIs)

The following steps show how to import the CM1-T modules AOIs. The only required AOI is CM1T\_DataExchange. All the other AOIs depend on this one to populate the data type.

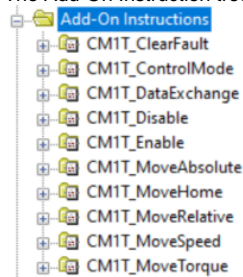
1. Right click on Add-On Instructions and select "Import Add-On Instruction..."



2. Browse to the extracted AOI folder and select CM1T\_DataExchange. Click Import



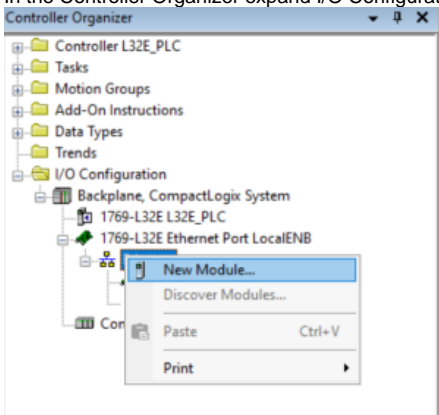
3. On the Configuration Import window click OK.
4. Repeat steps 1-3 until all required AOIs are imported
5. The Add-On Instruction tree will look as follows once all AOIs are imported



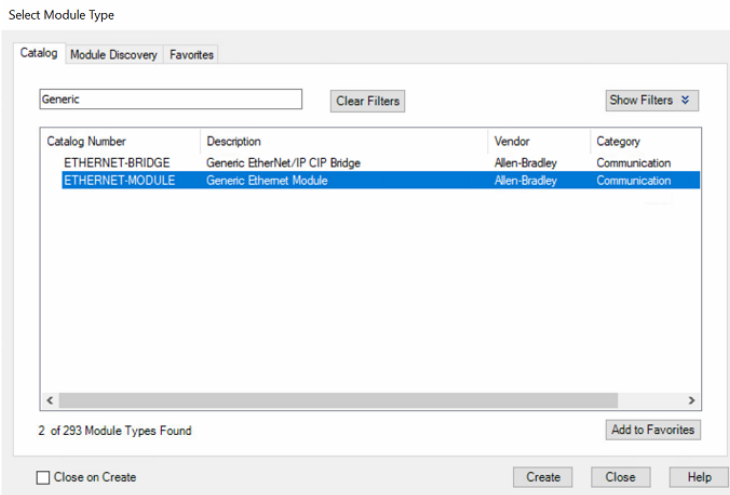
## Add CM1-T Module

The following steps show how to add an CM1-T module in RSLogix. At present the Ethernet/IP is in testing and the CM1-T is added as a generic module.

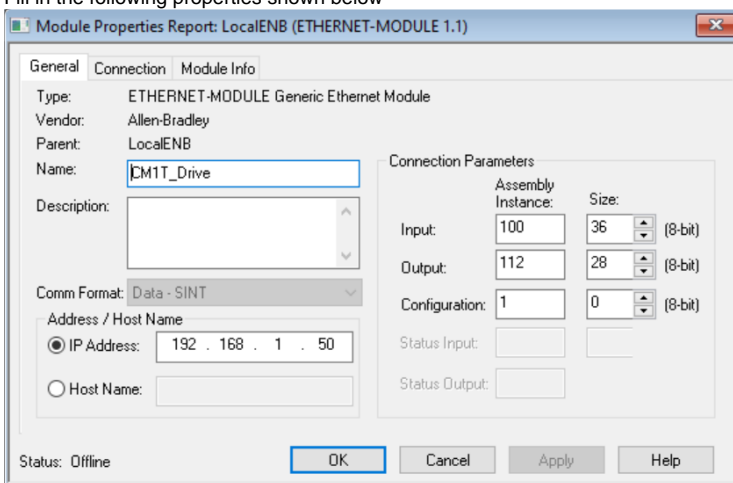
1. Open an existing project or start a new one
2. In the Controller Organizer expand I/O Configuration and right click on "Ethernet". Select "New Module"



3. Search "Generic", Select "ETHERNET-MODULE" and click Create

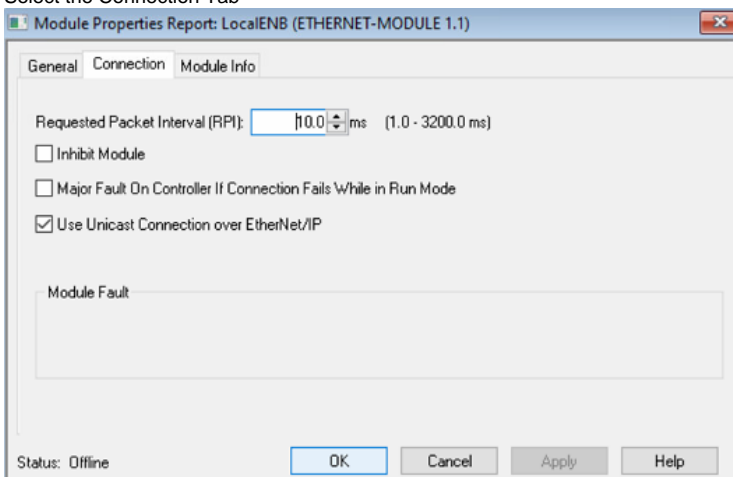


4. Fill in the following properties shown below



- Name: Give the drive a name. E.g. CM1T\_Drive, Axis1, LabelXAxis, etc
- Comm Format: Data - SINT
- IP Address: Enter the IP Address of the CM1-T you are adding.
- Connection Parameters
  - Input: Assembly Instance = 100, Size = 36
  - Output: Assembly Instance = 112, Size = 28
  - Configuration: Assembly Instance = 1, Size = 0
- Click OK

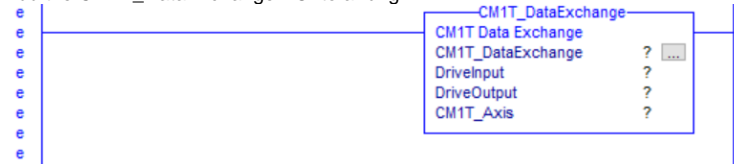
5. The Module Properties window should open. If it does not double click on the newly created module inside the Ethernet heading. Select the Connection Tab



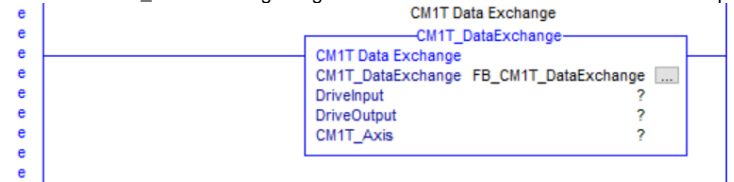
- Set the packet interval as required. Typically this would be 10ms.
- Check the boxes as shown in the picture above

The final set of steps below shows how to add the CM1T\_DataExchange AOI and configure it to exchange data between the tag created for the CM1-T and the CM1-T module. A single instance of the CM1T\_DataExchange should be created per module. There should never be more than one per module.

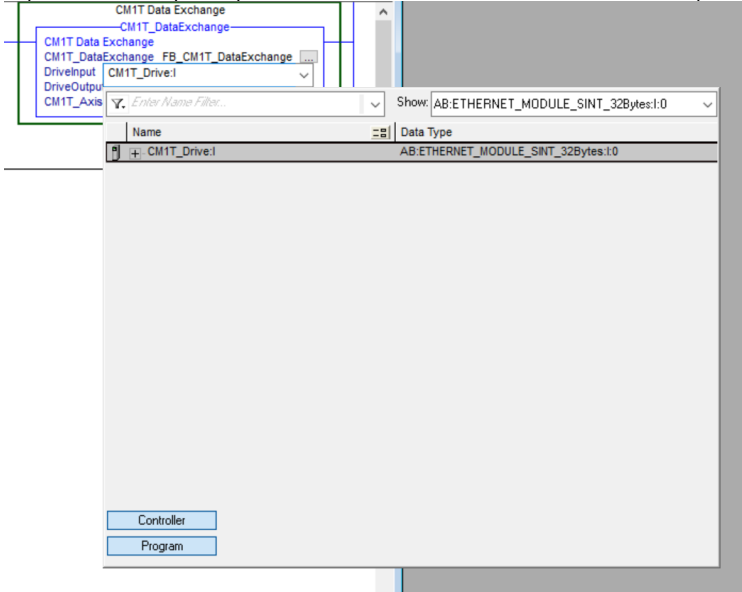
1. Add the CM1T\_DataExchange AOI to a rung



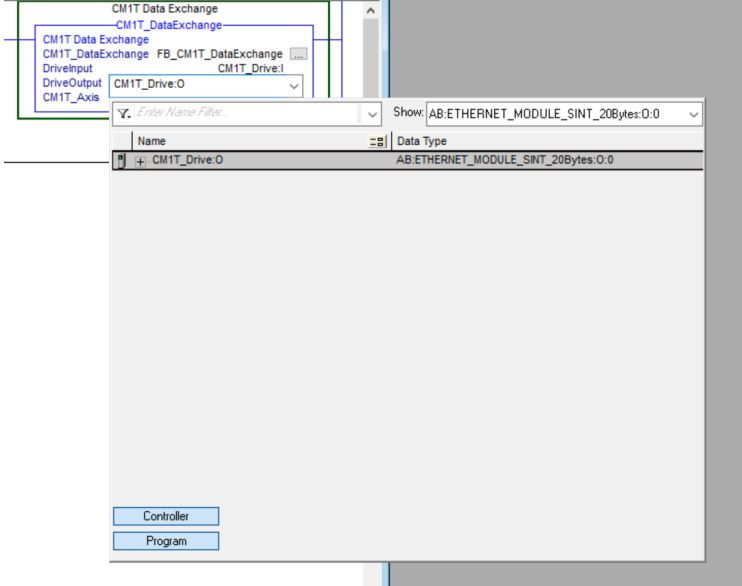
2. Create a CM1T\_DataExchange Tag and attached it to this instance. In this example it is called FB\_CM1T\_DataExchange



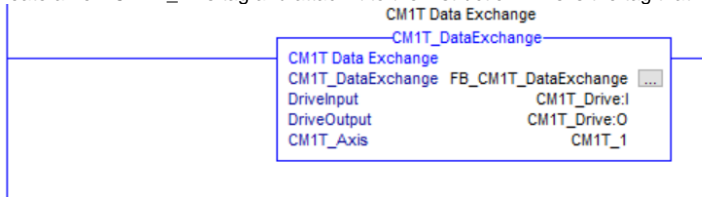
3. Expand the DriveInput drop down menu and select the CM1T\_Drive module input create earlier



4. Expand the DriveOutput drop down menu and select the CM1T\_Drive module output create earlier



5. Create a new CM1T\_Axis tag and attach it to the instruction. This is the tag that will be used in all other AOIs

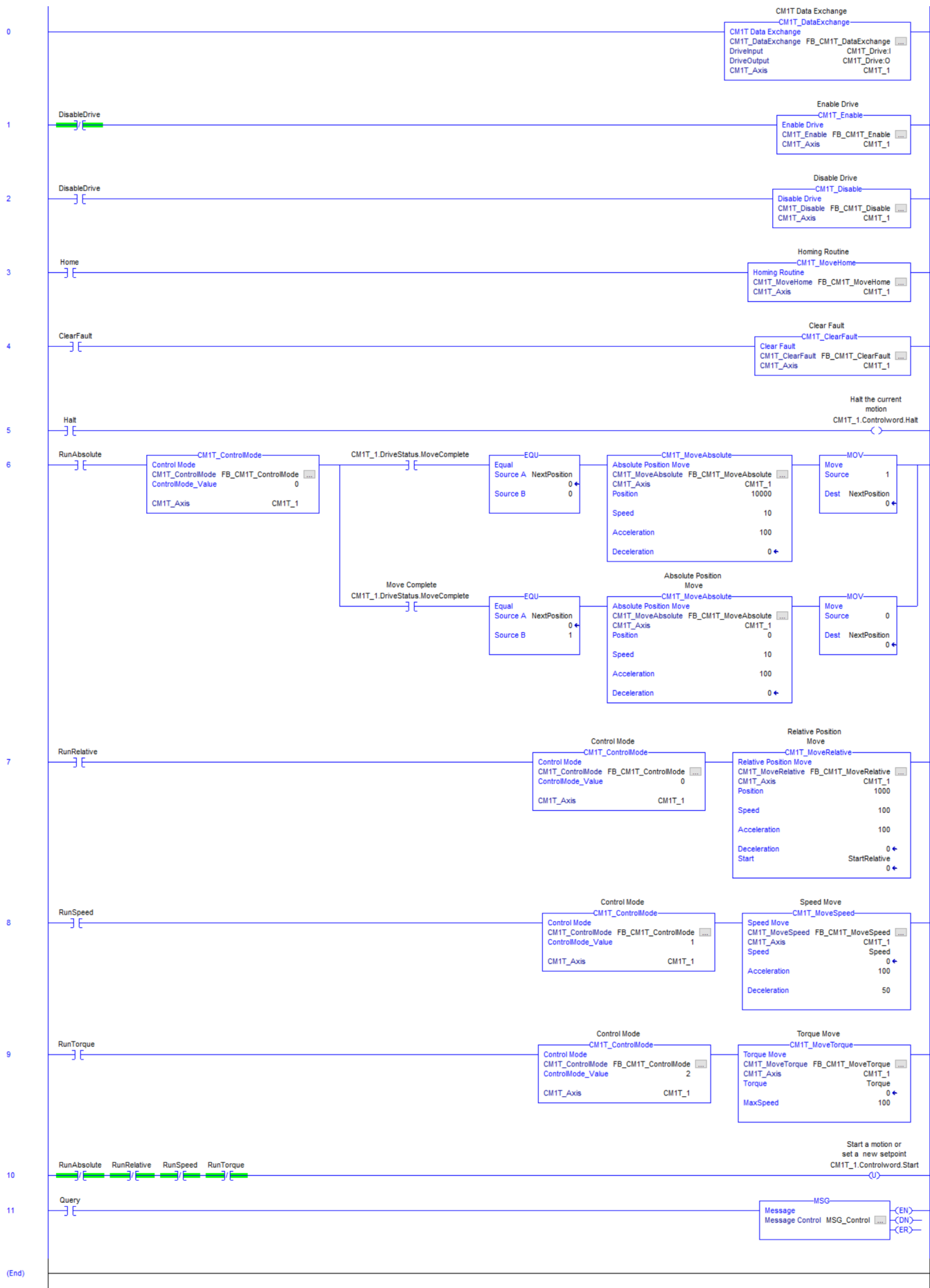


All CM1-T AOIs are now ready to be used. See the example application for more details on running the motor.

### Example Logic - Direct Control Operation Sample

The following logic is from the Direct operation sample application. The example shows how to run the motor in each of the modes, enable, disable, halt, and recover from an error.





## CML Operation

### Import User Data Types (UDTs)

Following the instructions for Direct Control Operation except import

- CM1T\_CMLAxis
- CM1T\_CMLDriveStatus

### Import Add-On Instructions (AOIs)

Follow the instructions for Direct Control Operation except import

- CM1T\_CMLDataExchange
- CM1T\_CMLReadRegister
- CM1T\_CMLWriteRegister

### Add CM1-T Module

Follow the instructions for Direct Control Operation except on step 4 enter the following configuration data

Module Properties Report: LocalENB (ETHERNET-MODULE 1.1)

General Connection Module Info

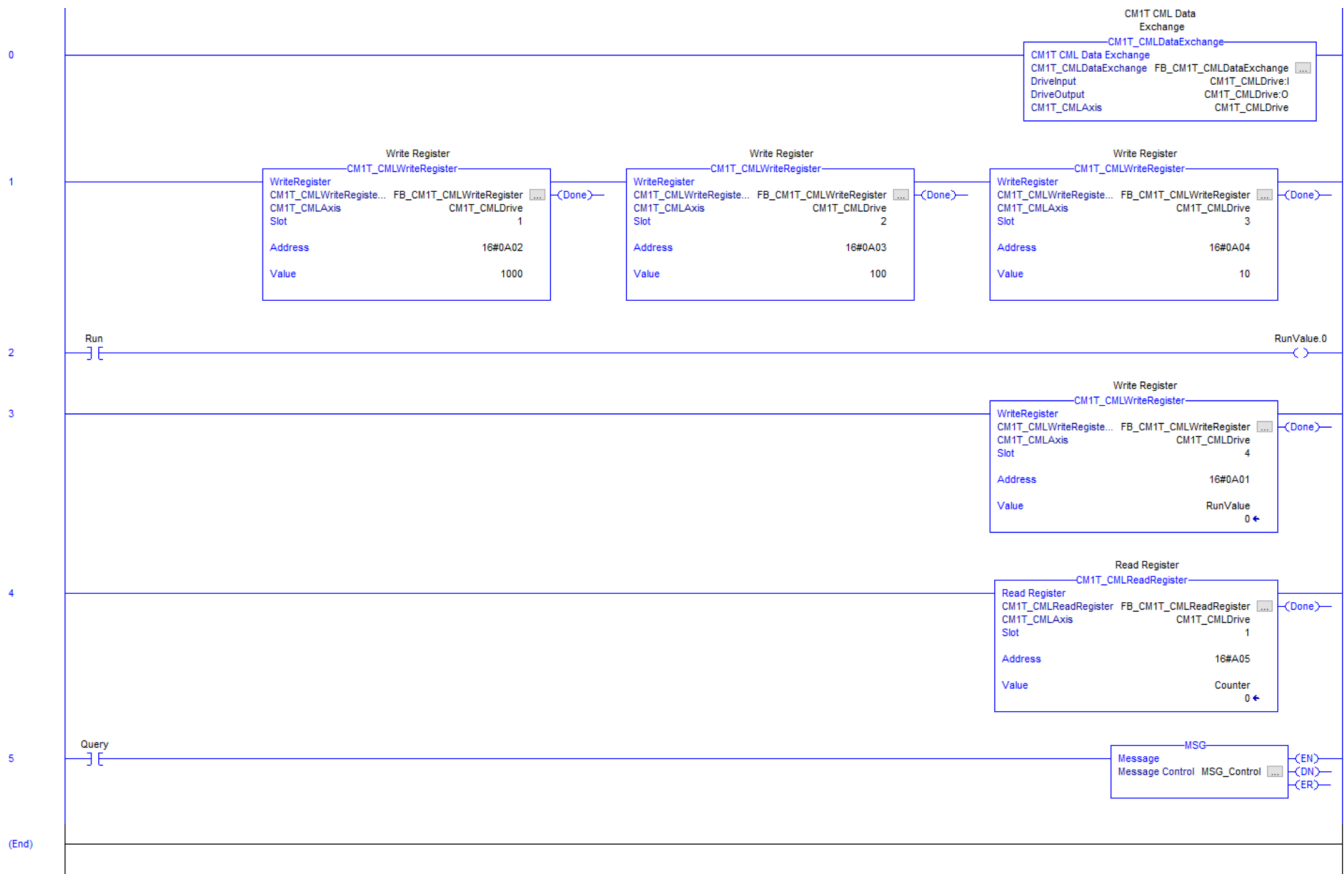
Type: ETHERNET-MODULE Generic Ethernet Module  
Vendor: Allen-Bradley  
Parent: LocalENB  
Name: CM1T\_CMLDrive  
Description:  
Comm Format: Data - SINT  
Address / Host Name  
☒ IP Address: 192 . 168 . 1 . 50  
☐ Host Name:  
Connection Parameters  
Input: Assembly Instance: 101 Size: 60 (8-bit)  
Output: Assembly Instance: 113 Size: 44 (8-bit)  
Configuration: 1 0 (8-bit)  
Status Input:  
Status Output:  
Status: Offline  
OK Cancel Apply Help

1. Name: Give the drive a name. E.g. CM1T\_Drive, Axis1, LabelXAxis, etc
2. Comm Format: Data - SINT
3. IP Address: Enter the IP Address of the CM1-T you are adding.
4. Connection Parameters
  - a. Input: Assembly Instance = 101, Size = 60
  - b. Output: Assembly Instance = 113, Size = 44
  - c. Configuration: Assembly Instance = 1, Size = 0
5. Click OK

### Example Logic - CML Operation Sample

The following sample logic is supplied with the AOIs. It requires the motor to be programmed with a CML program. The program does the following

1. Motor indexes continuously by the distance amount defined by PLC
2. Motor indexes with speed and acceleration defined by PLC
3. Indexing is started and stopped by PLC
4. A counter showing number of indexes is read by the PLC



# Appendix

## A - Support Files

See [Datasheets and Downloads](#).

## B - Complete Register Address Map

### K Registers

Register	Address	
	Hex	Decimal
K21	16#0115	277
K22	16#0116	278
K23	16#0117	279
K24	16#0118	280
K25	16#0119	281
K26	16#011A	282
K27	16#011B	283
K28	16#011C	284
K29	16#011D	285
K30	16#011E	286
K31	16#011F	287
K32	16#0120	288

K33	16#0121	289
K34	16#0122	290
K35	16#0123	291
K36	16#0124	292
K37	16#0125	293
K38	16#0126	294
K39	16#0127	295
K40	16#0128	296
K41	16#0129	297
K42	16#012A	298
K43	16#012B	299
K44	16#012C	300
K45	16#012D	301
K46	16#012E	302
Register	Address	
	Hex	Decimal
K47	16#012F	303
K48	16#0130	304
K49	16#0131	305
K50	16#0132	306
K51	16#0133	307
K52	16#0134	308
K53	16#0135	309
K54	16#0136	310
K55	16#0137	311
K56	16#0138	312
K57	16#0139	313
K58	16#013A	314
K59	16#013B	315
K60	16#013C	316
K61	16#013D	317
K62	16#013E	318
K63	16#013F	319
K64	16#0140	320
K65	16#0141	321
K66	16#0142	322
K67	16#0143	323
K68	16#0144	324
K69	16#0145	325
K70	16#0146	326

K71	16#0147	327
K72	16#0148	328

Register	Address	
	Hex	Decimal
K73	16#0149	329
K74	16#014A	330
K75	16#014B	331
K76	16#014C	332
K77	16#014D	333
K78	16#014E	334
K79	16#014F	335
K80	16#0150	336
K81	16#0151	337
K82	16#0152	338
K83	16#0153	339
K84	16#0154	340
K85	16#0155	341
K86	16#0156	342
K87	16#0157	343
K88	16#0158	344
K89	16#0159	345
K90	16#015A	346

## H Registers

Register	Address	
	Hex	Decimal
H0	16#0200	512
H1	16#0201	513
H2	16#0202	514
H3	16#0203	515
H4	16#0204	516
H5	16#0205	517
H6	16#0206	518
H7	16#0207	519

## P Registers

Register	Address	
	Hex	Decimal
P0	16#0300	768
P1	16#0301	769

P2	16#0302	770
P3	16#0303	771
P4	16#0304	772
P5	16#0305	773
P6	16#0306	774
P7	16#0307	775
P8	16#0308	776
P9	16#0309	777
P10	16#030A	778
P11	16#030B	779
P12	16#030C	780
P13	16#030D	781
P14	16#030E	782
P15	16#030F	783
P16	16#0310	784
P17	16#0311	785
P18	16#0312	786
P19	16#0313	787
P20	16#0314	788
P21	16#0315	789
P22	16#0316	790
P23	16#0317	791
P24	16#0318	792
P25	16#0319	793

## S Registers

Register	Address	
	Hex	Decimal
S0	16#0400	1024
S1	16#0401	1025
S2	16#0402	1026
S3	16#0403	1027
S4	16#0404	1028
S5	16#0405	1029
S6	16#0406	1030
S7	16#0407	1031
S8	16#0408	1032
S9	16#0409	1033
S10	16#040A	1034
S11	16#040B	1035
S12	16#040C	1036

S13	16#040D	1037
S14	16#040E	1038
S15	16#040F	1039

## A Registers

Register	Address	
	Hex	Decimal
A0	16#0500	1280
A1	16#0501	1281
A2	16#0502	1282
A3	16#0503	1283
A4	16#0504	1284
A5	16#0505	1285
A6	16#0506	1286
A7	16#0507	1287
A8	16#0508	1288

## T Registers

Register	Address	
	Hex	Decimal
T1	16#0601	1537
T2	16#0602	1538
T3	16#0603	1539
T4	16#0604	1540
T5	16#0605	1541
T6	16#0606	1542
T7	16#0607	1543
T8	16#0608	1544

## M Registers

Register	Address	
	Hex	Decimal
M0	16#0700	1792
M1	16#0701	1793
M2	16#0702	1794
M3	16#0703	1795
M4	16#0704	1796
M5	16#0705	1797
M6	16#0706	1798
M7	16#0707	1799

## R Registers

Register	Address	
	Hex	Decimal
R0	16#0800	2048
R1	16#0801	2049
R2	16#0802	2050
R3	16#0803	2051
R4	16#0804	2052
R5	16#0805	2053
R6	16#0806	2054
R7	16#0807	2055
R8	16#0808	2056
R9	16#0809	2057
R10	16#080A	2058
R11	16#080B	2059
R12	16#080C	2060
R13	16#080D	2061
R14	16#080E	2062
R15	16#080F	2063
R16	16#0810	2064
R17	16#0811	2065
R18	16#0812	2066
R19	16#0813	2067
R20	16#0814	2068
R21	16#0815	2069
R22	16#0816	2070
R23	16#0817	2071
R24	16#0818	2072
R25	16#0819	2073

## N Registers

Register	Address	
	Hex	Decimal
N0	16#0900	2304
N1	16#0901	2305
N2	16#0902	2306
N3	16#0903	2307
N4	16#0904	2308
N5	16#0905	2309
N6	16#0906	2310
N7	16#0907	2311
N8	16#0908	2312



N9	16#0909	2313
N10	16#090A	2314
N11	16#090B	2315
N12	16#090C	2316
N13	16#090D	2317
N14	16#090E	2318
N15	16#090F	2319
N16	16#0910	2320
N17	16#0911	2321
N18	16#0912	2322
N19	16#0913	2323
N20	16#0914	2324
N21	16#0915	2325
N22	16#0916	2326
N23	16#0917	2327
N24	16#0918	2328
N25	16#0919	2329

## V Registers

Register	Address	
	Hex	Decimal
V0	16#0A00	2560
V1	16#0A01	2561
V2	16#0A02	2562
V3	16#0A03	2563
V4	16#0A04	2564
V5	16#0A05	2565
V6	16#0A06	2566
V7	16#0A07	2567
V8	16#0A08	2568
V9	16#0A09	2569
V10	16#0A0A	2570
V11	16#0A0B	2571
V12	16#0A0C	2572
V13	16#0A0D	2573
V14	16#0A0E	2574
V15	16#0A0F	2575