



## *Installation Instructions*

# Analog Encoder (AE) Servo Module

(Catalog Number 1756-M02AE)

The Analog Encoder (AE) Servo Module mounts in a ControlLogix™ chassis and uses a removable terminal block (RTB) to connect all field-side wiring.

Before you install your module you should have:

- installed and grounded a 1756 chassis and power supply.
- ordered and received an RTB and its components for your application.

	<b>page:</b>
Preventing Electrostatic Discharge	2
Removing and Inserting Under Power (RIUP)	3
Understanding Compliance to the European Union Directive	3
Determining the Power Requirements	4
Identifying Module Components	4
Installing the Module	6
Keying the Removable Terminal Block	8
Wiring a Removable Terminal Block	10
Wiring Examples	13
Assembling the Removable Terminal Block and Housing	22
Installing the Removable Terminal Block onto the Module	23
Checking the LED Indicators	24
Removing the Removable Terminal Block from the Module	29
Removing the Module from the Chassis	31
Module Specifications	32
Installation Environment	34

### Preventing Electrostatic Discharge

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**WARNING**

Electrostatic discharge can damage the servo board if you touch the circuitry or connector pins without taking precautions. Follow these guidelines when you handle the servo board:

- Touch a grounded object to discharge potential static.
  - Wear an approved grounding wrist strap.
  - Do not touch the connector or connector pins on the servo board.
  - Do not touch circuit components inside the servo board.
  - If available, use a static-safe work station.
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## Removing and Inserting Under Power (RIUP)

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**WARNING**

This module is designed so you can remove and insert it under backplane power and field-side power. When you remove or insert a module while field-side power is applied, you can cause an electrical arc. An electrical arc can cause personal injury or property damage because it can:

- Send an erroneous signal to your system field devices causing unintended machine motion or loss of process control.
- Cause an explosion in a hazardous environment.

Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts can create electrical resistance. For additional information on RIUP, please contact your local Allen-Bradley sales representative.

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## Understanding Compliance to the European Union Directive

If this product bears the CE marking, it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

### *EMC Directive*

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

## 4 Analog Encoder (AE) Servo Module

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### *Low Voltage Directive*

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Test.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines publication 1770-4.1
- Automation Systems Catalog, publication B111

This equipment is classified as open equipment and must be installed (mounted) in an enclosure during operation as a means of providing safety protection.

### **Determining the Power Requirements**

This module receives power from the 1756 chassis power supply and requires two sources of power: 700mA at 5V and 2.5 mA at 24V from the backplane. Add this current to the requirements of all other modules in this chassis to prevent overloading the backplane power supply.

### **Identifying Module Components**

You received two components with your order:

- 1756-M02AE module
- RTB door label



## 6 Analog Encoder (AE) Servo Module

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- 1756-TBCH 36-position cage clamp RTB
- 1756-TBS6H 36-position spring clamp RTB

You received the following components with your RTB:

- 1756-TBH standard-depth RTB housing
- wedge-shaped keying tabs and U-shaped keying bands
- RTB door label

### Installing the Module

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#### WARNING

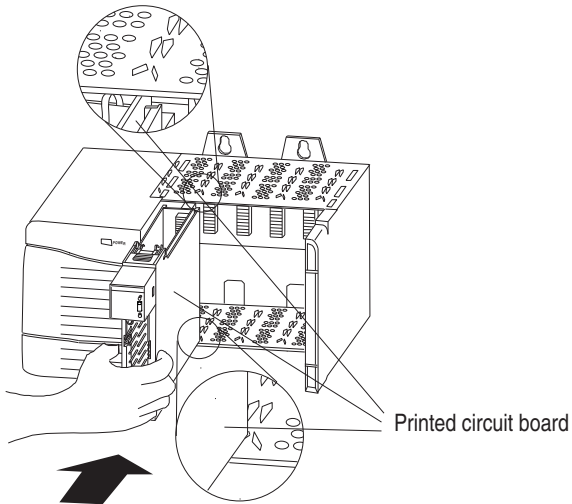


When you remove or insert an RTB with field-side power applied, unintended machine motion or loss of process control can occur. Exercise extreme caution when power is applied. Failure to observe this caution can cause personal injury.

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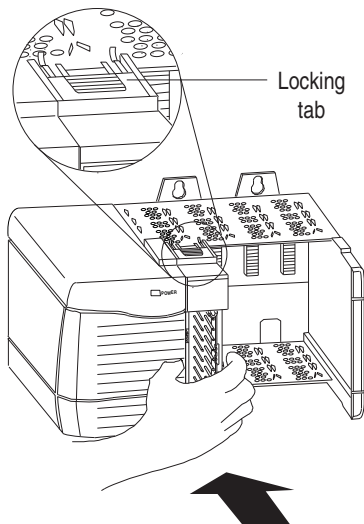
To install the AE module:

1. Align the module circuit board with the top and bottom chassis guides.

**Figure 2 Circuit Board Alignment**

2. Push evenly and firmly to seat the module in the chassis. It is seated when the top and bottom locking tabs have snapped into place.

**Figure 3 Module Locking Tabs**



**Note:** The 1756 chassis provides grounding for your module.

### Keying the Removable Terminal Block

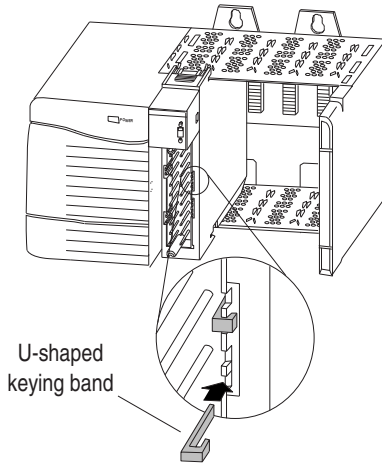
To identify the RTB that belongs with each module, you can use a module keying pattern. First, you can create a unique keying pattern for your module using the U-shaped keying bands that you received with your RTB. Then you can use the keying tabs to key the RTB with the same pattern as the module.

To prevent confusion, use a unique keying pattern to each module.

To key the module:

1. Insert the U-shaped keying band with the longer side near the terminals.



**Figure 4 Keying Band**

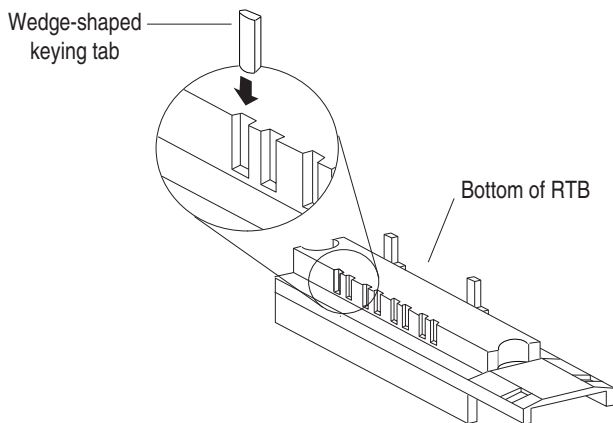
2. Push the keying band onto the module until it snaps into place.

To key your removable terminal block:

1. With the rounded edge first, insert the wedge-shaped keying tab on the RTB.

**Note:** Insert the wedge-shaped keying tabs in positions that correspond to unkeyed positions on the module

**Figure 5 Keying Tab.**



2. Push the keying tab onto the RTB until it stops.

**Note:** To use the RTB in future module applications, you can reposition the keying tabs on the RTB.

## Wiring a Removable Terminal Block

There are two types of RTBs:

- spring clamp
- cage clamp

This section describes how to wire each type of RTB and shows wiring examples for the AE module.

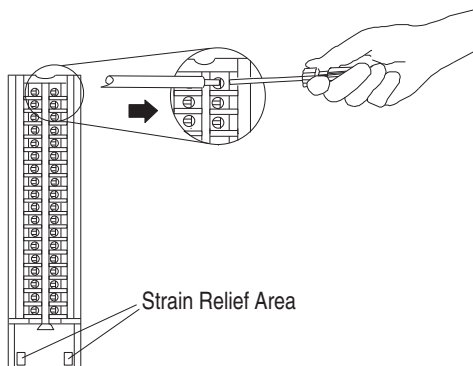
Wire the RTB before installing it onto the module. Use a 1/8 inch (3.2mm) maximum flat-bladed screwdriver.

### Wiring a Spring Clamp RTB

To wire a spring clamp RTB:

1. Strip a maximum of 7/16 inch (11mm) of insulation from the end of your wire.
2. Insert the screwdriver into the outer hole of the RTB.
3. Insert the wire into the open terminal and remove the screwdriver.

**Figure 6 Strain Relief Area**



4. After you complete field-side wiring, secure the wires in the strain relief area with a cable-tie.

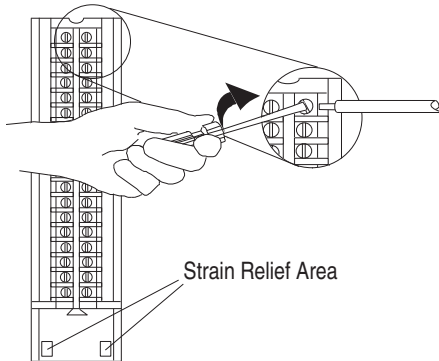
### Wiring a Cage Clamp RTB

To wire a cage clamp RTB:

1. Strip 5/16 - 3/8 inch (8 - 9.5mm) of insulation from the end of your wire.
2. Insert the screwdriver into the open terminal.

3. Turn the screw clockwise to close the terminal on the wire. Use 5 lb-in. (0.5 Nm) maximum torque

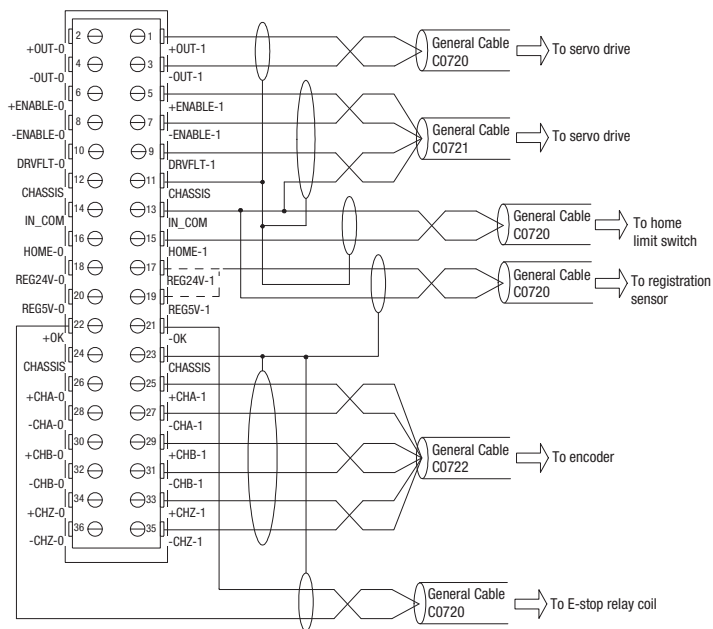
**Figure 7 Closing Wire Terminal.**



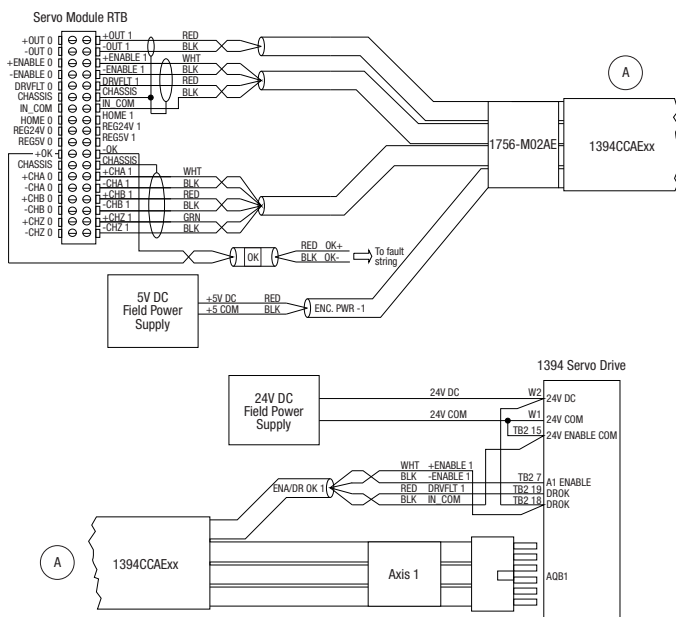
4. After you complete field-side wiring, secure the wires in the strain relief area with a cable-tie.

## Wiring Examples

Figure 8 Wiring to a servo module RTB



**Note:** This is a general wiring example illustrating Axis 1 wiring only. Other configurations are possible with Axis 0 wiring identical to Axis 1.

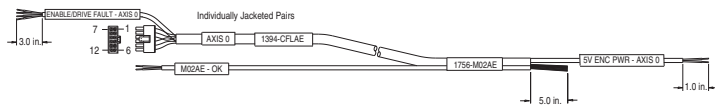
**Figure 9 Wiring to a 1394 Servo Drive (in Torque Mode only)**

**Note:** The wiring diagram illustrates Axis 1 wiring only. Other configurations are possible.

**Note:** The 1394CCAExx cable is wired to connect to torque command reference input pins.

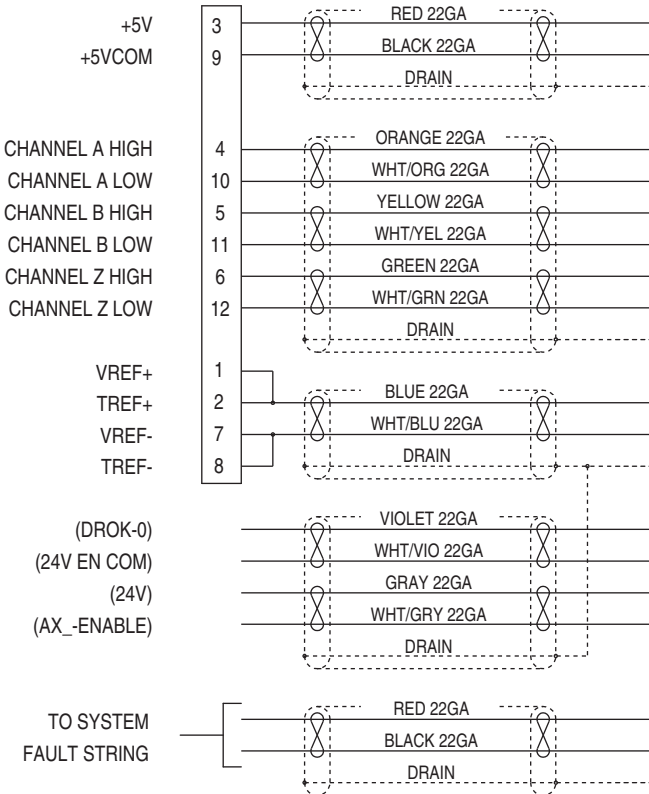
**Note:** An external +5V power supply is required to power the encoder driver circuit of the 1394 servo drive. Because this connection is shared by all four axis encoder driver circuits, only one connection is needed to the +5V field supply.

**Note:** The xx in the cable number is the length of the cable. Options are 5, 10, 25, and 50 feet.

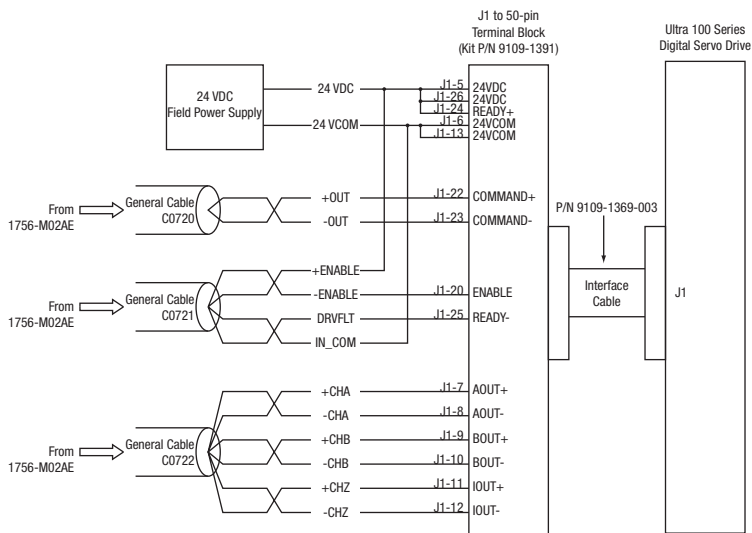
**Figure 10 The 1394-CFLAExx Cable Wiring Diagram**

**Note:** The 1394-CFLAE cable is available in 1, 3, 8, and 15 meter lengths.

**Figure 11 Pinouts for the 1394-CFLAE**

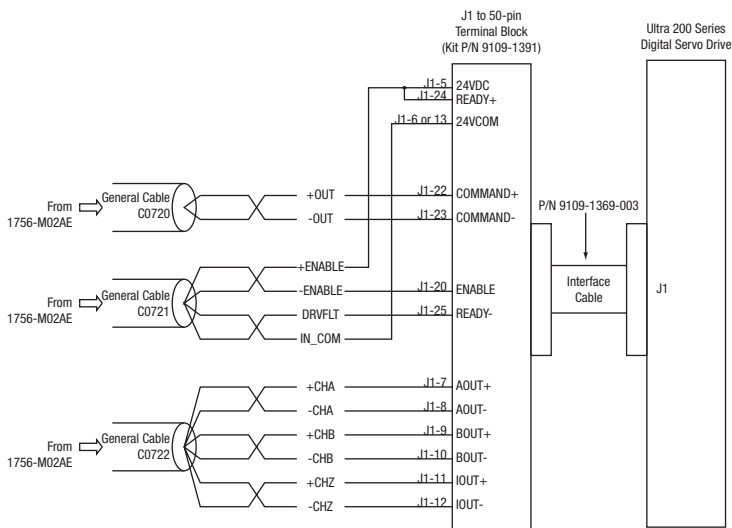




**Figure 12 Wiring to an Ultra 100 Series Drive**

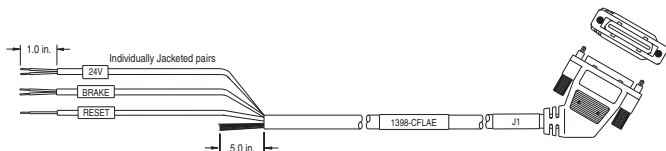
**Note:** This is a general wiring example only. Other configurations are possible. For more information, refer to the *Ultra 100 Series Installation Manual*, publication number 1398-5.2.

**Figure 13 Wiring to an Ultra 200 Series Drive**

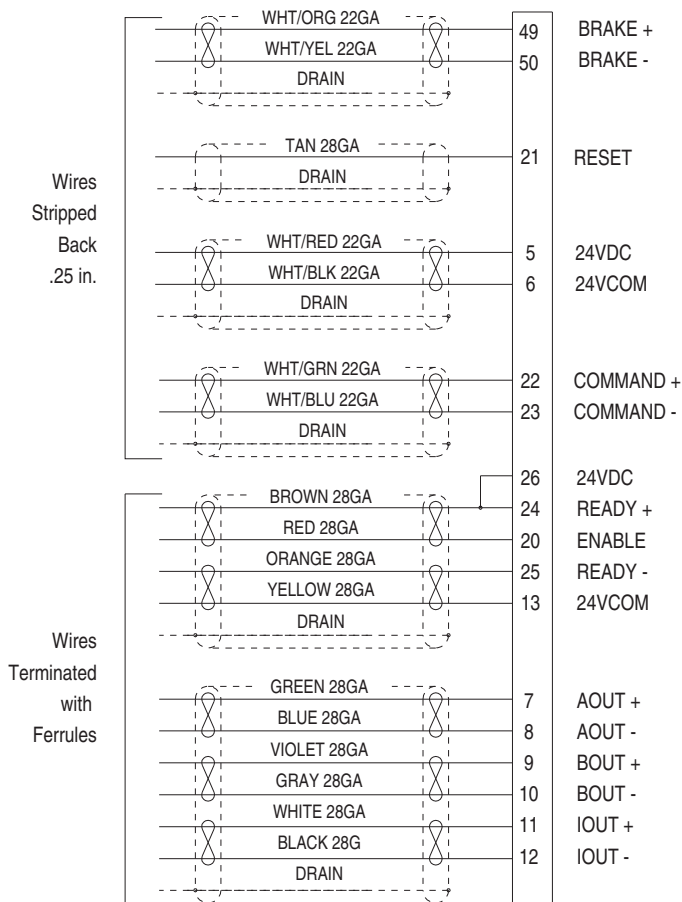


**Note:** This is a general wiring example only. Other configurations are possible. For more information, refer to the *Ultra 200 Series Installation Manual*, publication number 1398-5.0.

**Figure 14 1398-CFLAExx Cable Diagram**



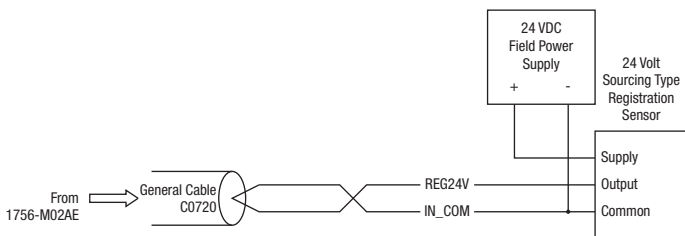
**Note:** The 1398-CFLAE Cable is available in 10, 25, and 50 foot lengths.

**Figure 15 Pinouts for 1398-CFLAExx Cable**

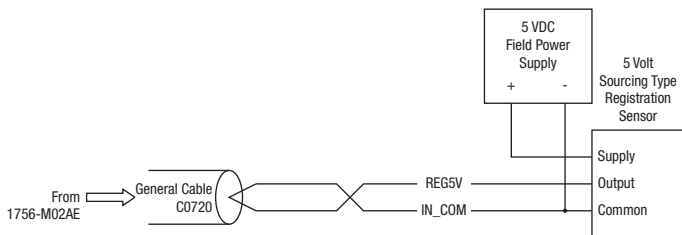
### Wiring Registration Sensors

The registration inputs to the servo module can support 24V or 5V registration sensors. These inputs must be wired to receive source current from the sensor. Only use sourcing type registration sensors. Current sinking sensor configurations are not allowed because the registration input common (IN\_COM) is shared with the other 24V servo module inputs.

**Figure 16 24V Registration Sensor**



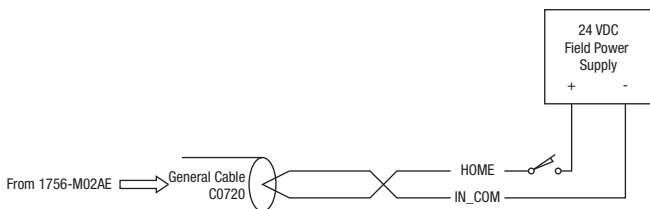
**Figure 17 5V Registration Sensor**



### *Wiring the Home Limit Switch Input*

The home limit switch inputs to the servo module are designed for 24V nominal operation. These inputs should be wired for current sourcing operation.

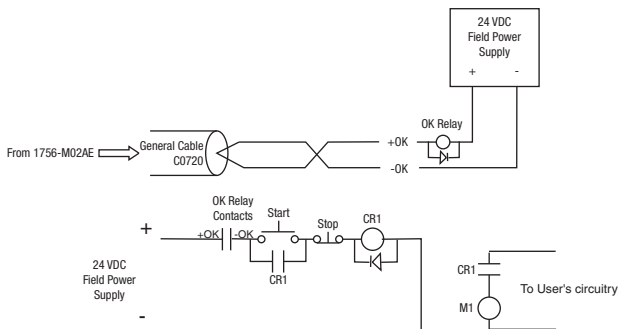
**Figure 18 Home Limit Switch**



### *Wiring the OK Contacts*

A set of isolated solid-state OK relay contacts is provided for optional interface to an E-stop string, which controls power to the associated drives. The OK contacts are rated for pilot duty and can drive an external 24V relay (for example, Allen-Bradley 700-HA32Z24) whose contacts can be incorporated into the E-Stop string as shown below.

**Figure 19 OK Relay Pilot Duty Application Wiring**



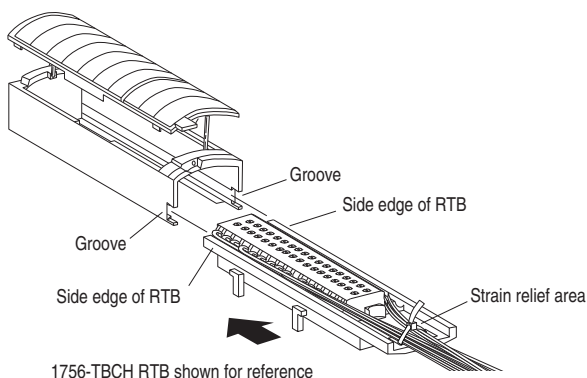
**IMPORTANT**

When the OK Relay is loaded with an inductive load, use a counter-EMF suppression diode across the load. The maximum rating of the OK relay contacts must not exceed 60V DC.

**Assembling the Removable Terminal Block and Housing**

To assemble the removable terminal block and housing:

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.
2. Slide the RTB into the housing until it snaps into place

**Figure 20 RTB and Housing.****Installing the Removable Terminal Block onto the Module****WARNING**

A shock hazard exists. If the RTB is installed onto the module while the field-side power is applied, the RTB is electrically live. Do not touch the RTB terminals. Failure to observe this caution can cause personal injury.

**WARNING**

When you connect or disconnect the RTB with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that all sources of power are removed or the area is nonhazardous before proceeding.

Before installing the RTB, make certain:

## 24 Analog Encoder (AE) Servo Module

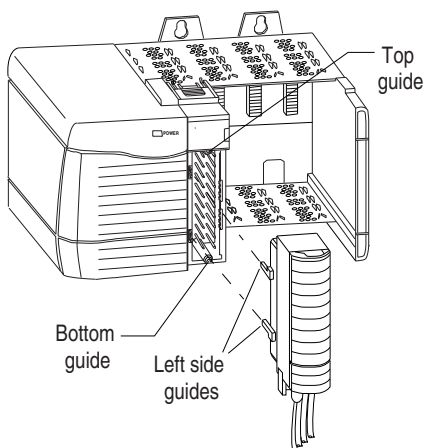
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- field-side wiring of the RTB has been completed.
- the RTB housing is snapped into place on the RTB.
- the RTB housing door is closed.
- the locking tab at the top of the module is unlocked.

To install the removable terminal block onto the module:

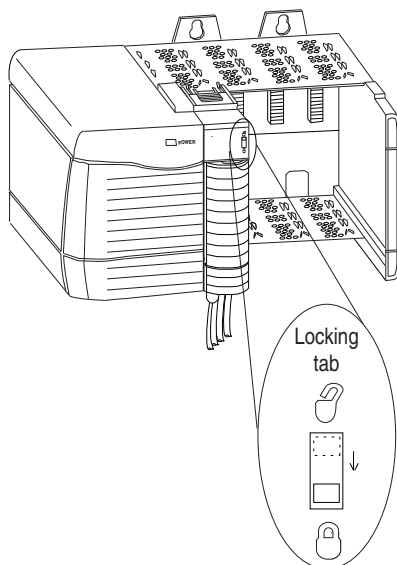
1. Align the top, bottom, and left side guides of the RTB with the guides on the module.

**Figure 21 Aligning RTB**



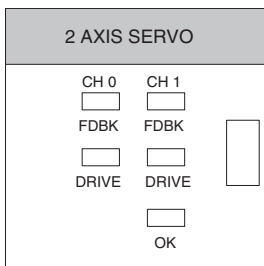
2. Press quickly and evenly to seat the RTB on the module until the latches snap into place.
3. Slide the locking tab down to lock the RTB onto the module.



**Figure 22 Locking Tabs**

### Checking the LED Indicators

The module provides bi-colored LED indicators to show individual drive and feedback status for both axes and a single bi-colored LED for module OK.

**Figure 23 1756-M02AE Module LEDs**

During power up, the module completes an indicator test. The OK indicator turns red for 1 second and then turns to flashing green if the module passes all its self tests.

This completes the installation of the module.

### *Understanding Module Status Using the OK Indicator*

<b>If the OK LED displays:</b>	<b>Then the module status is:</b>	<b>Take this action:</b>
Off	The module is not operating.	<ul style="list-style-type: none"> <li>• Apply chassis power.</li> <li>• Verify the module is completely inserted into the chassis and backplane.</li> </ul>
Flashing green light	The module has passed internal diagnostics, but it is not communicating axis data over the backplane.	<ul style="list-style-type: none"> <li>• None, if you have not configured the module.</li> <li>• If you have configured the module, check the slot number in the 1756-M02AE Properties dialog box.</li> </ul>

<b>If the OK LED displays:</b>	<b>Then the module status is:</b>	<b>Take this action:</b>
Steady green light	<ul style="list-style-type: none"> <li>• Axis data is being exchanged with the module.</li> <li>• The module is in the normal operating state.</li> </ul>	None. The module is ready for action.
Flashing red light	<ul style="list-style-type: none"> <li>• A major recoverable failure has occurred.</li> <li>• A communication fault, timer fault, or NVS update is in progress.</li> <li>• The OK contact has opened.</li> </ul>	<p>If an NVS update is in progress, complete the NVS update.</p> <p>If an NVS update is not in progress:</p> <ul style="list-style-type: none"> <li>• Check the Servo Fault word for the source of the error.</li> <li>• Clear the servo fault condition using the Motion Axis Fault Reset instruction.</li> <li>• Resume normal operation.</li> <li>• If the flashing persists, reconfigure the module.</li> </ul>
Solid red light	<ul style="list-style-type: none"> <li>• A potential nonrecoverable fault has occurred.</li> <li>• The OK contact has opened.</li> </ul>	<ul style="list-style-type: none"> <li>• Reboot the module.</li> <li>• If the solid red persists, replace the module.</li> </ul>

### *Understanding Module Status Using the FDBK Indicator*

<b>If the FDBK LED displays:</b>	<b>Then the module status is:</b>	<b>Take this action:</b>
Off	The axis is not used.	<ul style="list-style-type: none"> <li>• None, if you are not using this axis.</li> <li>• If you are using this axis, make sure the module is configured and an axis tag has been associated with the module.</li> </ul>
Flashing green light	The axis is in the normal servo loop inactive state.	None. The servo axis state can be changed by executing motion instructions.

<b>If the FDBK LED displays:</b>	<b>Then the module status is:</b>	<b>Take this action:</b>
Steady green light	The axis is in the normal servo loop active state.	None. The servo can may be changed by executing motion instructions.
Flashing red light	The axis servo loop error tolerance has been exceeded.	<ul style="list-style-type: none"> <li>• Correct the source of the problem.</li> <li>• Clear the servo fault condition using the Motion Axis Fault Reset instruction.</li> <li>• Resume normal operation.</li> </ul>
Solid red light	An axis encoder feedback fault has occurred.	<ul style="list-style-type: none"> <li>• Correct the source of the problem by checking the encoder and power connections.</li> <li>• Clear the servo fault condition using the Motion Axis Fault Reset instruction.</li> <li>• Resume normal operation.</li> </ul>

*Understanding Module Status Using the DRIVE Indicator*

<b>If the DRIVE LED displays:</b>	<b>Then the module status is:</b>	<b>Take this action:</b>
Off	<ul style="list-style-type: none"> <li>• The axis is not used.</li> <li>• The axis is a position-only axis type.</li> </ul>	<ul style="list-style-type: none"> <li>• None, if the axis is not used or is a position-only type.</li> <li>• Otherwise, make sure the module is configured, an axis tag has been associated with the module, and the axis type is servo.</li> </ul>
Flashing green light	The axis drive is in the normal disabled state.	None. The servo axis state can be changed by executing motion instructions.

If the DRIVE LED displays:	Then the module status is:	Take this action:
Steady green light	The axis drive is in the normal enabled state.	None. The servo axis state can be changed by executing motion instructions.
Flashing red light	The axis drive output is in the shutdown state.	<ul style="list-style-type: none"> <li>• Check for faults that may have generated this state.</li> <li>• Execute the Shutdown Reset motion instruction.</li> <li>• Resume normal operation.</li> </ul>
Solid red light	The axis drive is faulted.	<ul style="list-style-type: none"> <li>• Check the drive status.</li> <li>• Clear the Drive Fault condition at the drive.</li> <li>• Clear the servo fault condition using the Motion Axis Fault Reset instruction.</li> <li>• Resume normal operation.</li> <li>• Check the configuration for the Drive Fault.</li> </ul> <p>- If configured to be normally open and there is no voltage, this is the normal condition.</p> <p>- If configured to be normally closed and 24V is applied, this is the normal condition.</p>

## Removing the Removable Terminal Block from the Module

### WARNING



A shock hazard exists. If the RTB is removed from the module while the field-side power is applied, the module is electrically live. Do not touch the RTBs terminals. Failure to observe this caution can cause personal injury.

### WARNING



When you connect or disconnect the RTB with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that all sources of power are removed or the area is nonhazardous before proceeding.

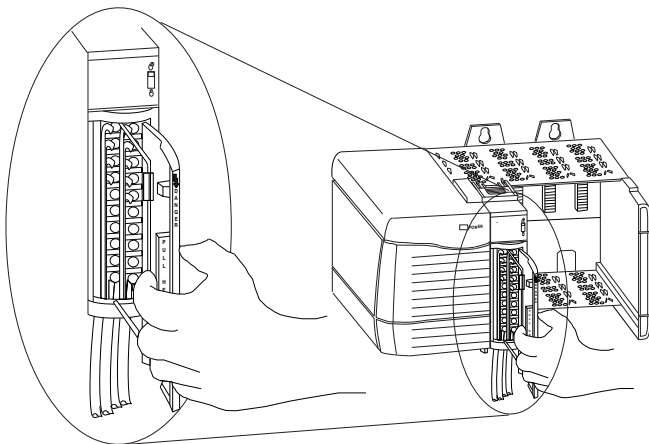
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You must remove the RTB before you can remove the module.

To remove the RTB from the module:

1. Unlock the locking tab at the top of the module.
2. Open the RTB door using the bottom tab.
3. Hold the spot marked PULL HERE and pull the RTB toward you and off the module.

**Figure 24 Removing RTB**

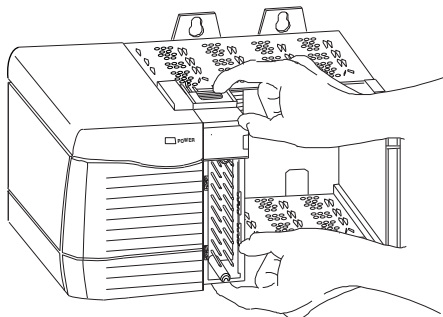


## Removing the Module from the Chassis

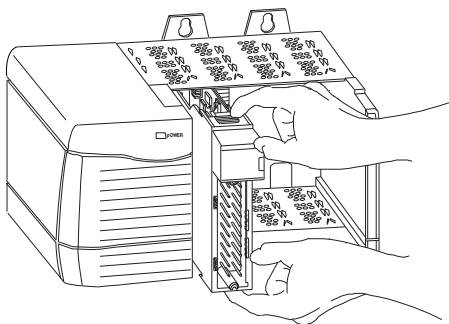
To remove the module from the chassis:

1. If the RTB is on the module, unlock the RTB and remove it. For more information, refer to *Removing the Removable Terminal Block from the Module*.
2. Push in and hold the top and bottom locking tabs on the module.

### Figure 25 Hold Locking Tabs



3. Pull the module out of the chassis.





**Figure 26 Pulling Module Out**

## Module Specifications

Number of axes	2 axes maximum
Servo loop Type Gain resolution Absolute position range Rate	Nested PI digital position and velocity servo 32-bit floating point ±1,000,000,000 encoder counts 5 kHz
Module location	1756 ControllLogix chassis
Module keying	Electronic
Power dissipation	5.5W maximum
Backplane current	5.1V dc @ 700 mA and 24V dc @ 2.5 mA
Encoder input Type Mode Rate Electrical interface Voltage range On state Off state Input impedance	Incremental AB quadrature with marker 4X quadrature 4 MHz counts per second maximum Optically isolated 5V differential 3.4V to 5.0V 0V to 1.8V 531 Ohms differential



Registration inputs	
Type	Optically isolated, current sinking input
24V input voltage	+24V dc nominal
Maximum	26.4V
Minimum on	18.5V
Maximum off	3.5V
5V input voltage	+5V dc nominal
Maximum	5.5V
Minimum on	3.7V
Maximum off	1.5V
Input impedance	
24V input	9.5 kOhms
5V input	1.2 kOhms
Response time (position latched)	1 $\mu$ s
All other inputs	
Type	Optically isolated, current sinking input
Input voltage	+24V dc nominal
Maximum	26.4V
Minimum on	17.0V
Maximum off	8.5V
Input impedance	7.5 kOhms
Servo output	
Type	Analog voltage
Isolation	200 kOhms
Voltage range	$\pm$ 10V
Voltage resolution	16 bits
Load	5.6 kOhms resistive minimum
Maximum offset	25 mV
Gain error	$\pm$ 4%
All other outputs	
Type	Solid-state isolated relay contacts
Operating voltage	+24V dc nominal (Class 2 source)
Maximum	26.4V
Operating current	75 mA
RTB keying	User-defined
Field wiring arm	36-position RTB (1756-TBCH or -TBS6H) <sup>1</sup>
RTB screw torque (cage clamp)	5 lb-in. (0.5 Nm) maximum
Conductors	
Wire size	22 AWG to 14 AWG copper <sup>1</sup>
Category	3/64 inch (1.2 mm) insulation maximum $\uparrow$ 2,3
Screwdriver blade width for RTB	1/8 inch (3.2 mm) maximum

Environmental conditions Operating temperature Storage temperature Relative humidity	0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Agency Certifications When product is marked	 Listed Industrial Control Equipment   Certified Process Control Equipment Certified Class I, Division 2, Group A, B, C, D   Marked for applicable directives   Marked for all applicable acts N223

- 1) Maximum wire size will require the extended depth RTB housing (1756-TBE).
- 2) Use this conductor category information for planning conductor routing as described in the system level installation manual.
- 3) Refer to *Industrial Automation Wiring and Grounding Guidelines*, publication number 1770-4.1.

### Installation Environment

This product must be mounted within a suitable system enclosure to prevent personal injury resulting from accessibility to live parts. The interior of this enclosure must be accessible only by the use of a tool.

This industrial control equipment is intended to operate in a Pollution Degree 2 environment, in overvoltage category II applications, (as defined in IEC publication 664A) at altitudes up to 2000 meters without derating.

### The following information applies when operating this equipment in hazardous locations:

Products marked “CL I, DIV 2, GP A, B, C, D” are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest “T” number) may be used to help determine the overall temperature

code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.

**WARNING****EXPLOSION HAZARD –**

- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Substitution of components may impair suitability for Class I, Division 2.
- If this product contains batteries, they must only be changed in an area known to be nonhazardous.

## Informations sur l'utilisation de cet équipement en environnements dangereux:

Les produits marqués «CL I, DIV 2, GP A, B, C, D» ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.

## Informations sur l'utilisation de cet équipement en environnements dangereux:

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**AVERTISSEMENT**



### **RISQUE D'EXPLOSION –**

- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.
  - Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.
  - La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe 1, Division 2.
  - S'assurer que l'environnement est classé non dangereux avant de changer les piles.
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**NOTES:**

**NOTES:**

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ControlLogix is a trademark of Allen-Bradley Company, Inc., a Rockwell International company.

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