Allen-Bradley

AEC

Absolute Encoder Converter

(Cat. No. 4100-5.2)

Installation and Setup Manual

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Throughout this manual we use notes to make you aware of safety considerations:

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

European Communities (EC) Directive Compliance

If this product has the CE mark 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 the Council Directive 89/336/EC Electromagnetic Compatibility (EMC) by applying the following standards, in whole or in part, documented in a technical construction file:

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

This product is intended for use in an industrial environment.

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 Tests. For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the Allen-Bradley publication Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1.

This equipment is classified as open equipment and must be mounted in an enclosure during operation to provide safety protection.

Preface — Read This Manual

Read This Manual 1
Who Should Use this Manual. 1
Purpose of this Manual 1
Safety Precautions 2
    Contents of this Manual 3
    Related Documentation 3
Terminology 4
Common Techniques Used in this Manual 4
AEC Product Receiving and Storage Responsibility 5
Allen-Bradley Support 5
    Local Product Support 5
    Technical Product Assistance 6
On the Web 6

Chapter 1 — Overview

AEC Description 7
AEC Features 8
AEC Mechanical Specifications. 8

Chapter 2 — Installation & Hook-Up

Chapter Objectives 11
Installing the AEC 11
Complying with European Union Directives. 11
    EMC Directive 12
Mounting the AEC. 12
Connecting the AEC 15
    Connecting the AEC to the 1394 16
    Connecting the AEC to the Compact. 17
    Connecting the AEC to the 1756-MO2AE. 19
Wiring the AEC. 21
    Wiring Cable Flying Leads to the Plugs 21
    The SSI Connector 22

The Control Connector. 24
Fault Relay 24
Analog Servo Command Pass Through (For Compact Only) 26
Power Supply Connector 27

Chapter 3 Setup

Chapter Objectives 29
Setting the Rotary Switches 29
Configuration Switch Tables 30
Configuration Switch A 30
Configuration Switch B 31
Powering the AEC. 32
AEC With GML Commander 32
Adding AEC to your Commander Diagram 32
Setting the Transducer Resolution. 33
Selecting Homing Procedure 33
Aligning Absolute Encoder 34

Chapter 4 Operation

Chapter Objectives 35
Absolute Position Update 35
Incremental Position Output 35
Position at Start-up 36

Chapter 5 Fault Indication & Control Status

Chapter Objectives 37
Transducer Faults. 38
Encoder Faults. 38
Internal Faults 39
No Faults. 39

Appendix A Specifications

Equivalent Circuit Diagrams. 44

Appendix B Strobe Position For Applications Not Using the 1394 or Compact

Absolute Strobe Cycle 47
Absolute Strobe Timing 48
Incremental Strobe Period 49

Index

Read This Manual

Read and understand this instruction manual. It provides the necessary information to let you install, connect, and set up the AEC for safe, reliable operation. This preface covers the following topics:

- Who should use this manual
- The purpose of this manual
- Terms
- Common techniques used in this manual
- Allen-Bradley support

Who Should Use this Manual

You should read this manual if you are responsible for the installation, set up or operation of the AEC (Absolute Encoder Converter).

If you do not have a basic understanding of the products listed below, contact your local Allen-Bradley representative for information on available training courses before using this product.

- S Class Compact motion controller
- 1394 GMC System module
- GML (Graphic Motion Language) Commander software

Purpose of this Manual

This manual is an installation and set up guide for the AEC and describes the procedures necessary to properly install and configure it into your motion control system.

Safety Precautions

The following general precautions apply to the AEC:

ATTENTION

Electric shock can kill. Make sure the AEC is safely installed in accordance with the Installation and Set-up chapters of this manual. Avoid contact with electrical wires and cabling while power is on. Only trained service personnel should open the electrical cabinet.

This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on the capacitors has been discharged before attempting to service, repair, or remove this unit. You should only attempt the procedures in this manual if you are qualified to do so and familiar with solid-state control equipment and the safety procedures in publication NFPA 70E and BS-EN60204.

The system integrator is responsible for local safety and electrical codes.

ATTENTION

An incorrectly applied or installed product can result in component damage or a reduction in product life. Wiring or application errors, such as undersizing or inadequate DC supply, or excessive ambient temperatures can result in a malfunction.

The AEC contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing, or repairing this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, Guarding Against Electrostatic Damage or any other applicable ESD Protection Handbook.

Contents of this Manual

Chapter	Title	Contents
	Preface	Describes the purpose, background, and scope of this manual. Also specifies the audience for whom this manual is intended.
1	Overview	Provides a general description of the AEC, its features and mechanical specifications.
2	Installation	Provides the steps needed to successfully mount and wire the AEC to an SSI device and the S Class Compact Motion Controller or the 1394 GMC system.
3	Set-Up	Provides the guidelines for setting up and configuring the AEC.
4	Operation	Provides information on Absolute and Incremental Position.
5	Fault Indication & Control Status	Provides information on fault and status indicators and types of faults.
Appendix A	Specifications	Provides physical, electrical, environmental, and functional specifications for the AEC.
Appendix B	Strobe Position	Contains additional information about setting the strobe for those users connecting their AEC to a controller other than the S Class Compact Motion Controller or the 1394 GMC system.

Related Documentation

The following documents contain additional information concerning related Allen-Bradley products. To obtain a copy, contact your local Allen-Bradley office or distributor.

For	Read This Document	Document Number
Programming Allen-Bradley motion controller with GML	GML Commander Reference Manual	GMLC-5.2
Instructions for installation and set-up for the 1394 GMC system	1394 Digital, AC, Multi-Axis Motion Control System User Manual	1394-5.0
Instructions for installation and set-up for the S Class Compact motion controller	IMC S Class Compact Motion Controller Installation and Set-up Manual	999-122
An article on wire sizes and types for grounding electrical equipment (North American standards)	National Electrical Code	Published by the National Fire Protection Association of Boston, MA.
An article on wire sizes and types for grounding electrical equipment (European standards).	BS-EN 60204 Electrical Equipment of Machines	Published by British Standards Institute
A complete listing of current Allen-Bradley documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations	Allen-Bradley Industrial Automation Glossary	AG-7.1

Terminology

In order to avoid confusion, we have used the following general terms in a specific manner within this manual. We define them as follows:

Transducer - the SSI device is considered a transducer for the purposes of this manual.

Encoder - Refers to the AEC connector that goes to the 1394 GMC System or the S Class Compact motion controller. The cable from the controller attaches to the AEC at the Encoder connector.

For specific definitions of other terms used in industrial automation, see the *Allen-Bradley Industrial Automation Glossary* (publication number AG-7.1).

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Words that you type or select appear in bold.
- When we refer you to another location, the section name appears in italics.

ATTENTION

The exclamation point inside of a triangle, followed by the word “ATTENTION” indicate circumstances that can lead to personal injury, death, property damage or economic loss.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

AEC Product Receiving and Storage Responsibility

You, the customer, are responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the item(s) you receive against your purchase order. If any items are obviously damaged, it is your responsibility to refuse delivery until the freight agent has noted the damage on the freight bill. Should you discover any concealed damage during unpacking, you are responsible for notifying the freight agent. Leave the shipping container intact and request that the freight agent make a visual inspection of the equipment.

Leave the product in its shipping container prior to installation. If you are not going to use the equipment for a period of time, store it:

- in a clean, dry location
- within an ambient temperature range of 0 to 85° C (32 to 185° F)
- within a relative humidity range of 5% to 95%, non-condensing
- in an area where it cannot be exposed to a corrosive atmosphere
- in a non-construction area

Allen-Bradley Support

Allen-Bradley offers support services worldwide, with over 75 Sales/ Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Allen-Bradley representatives in every major country in the world.

Local Product Support

Contact your local Allen-Bradley representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact Allen-Bradley for technical assistance, please review the information in this manual first. Then call your local Allen-Bradley representative. For the quickest possible response, we recommend that you have the catalog numbers of your products available when you call. See the *Related Documentation* section of this chapter for the publication numbers of other manuals that can help with this product.

The Rockwell Automation Technical Support number is:

1-603-443-5419

On the Web

For information about Allen-Bradley, visit the following World Wide Web site:

http://www.ab.com/

Overview

AEC Description

The AEC is an absolute encoder converter. It receives the absolute position sent by the SSI transducer and changes it to an incremental quadrature signal that the 1394 GMC System module and the S Class Compact motion controller can use.

The AEC is designed to accept outputs from absolute encoders, linear displacement transducers, or any other measuring device, which transmits its measured values over an SSI. Several devices are supported with various combinations of counts per turn and number of turns. These are defined in the *Setup* chapter of this manual. Parallel output devices are not supported.

The AEC provides two independent channels from absolute to incremental quadrature conversion. The resolution of each channel is set via rotary switches and each one can operate with a transducer using a different supply voltage. (Although the supply voltages may be different, they are not isolated. The grounds must be of equal potential.) Each channel can be individually strobed to obtain new absolute or incremental position information.

AEC Features

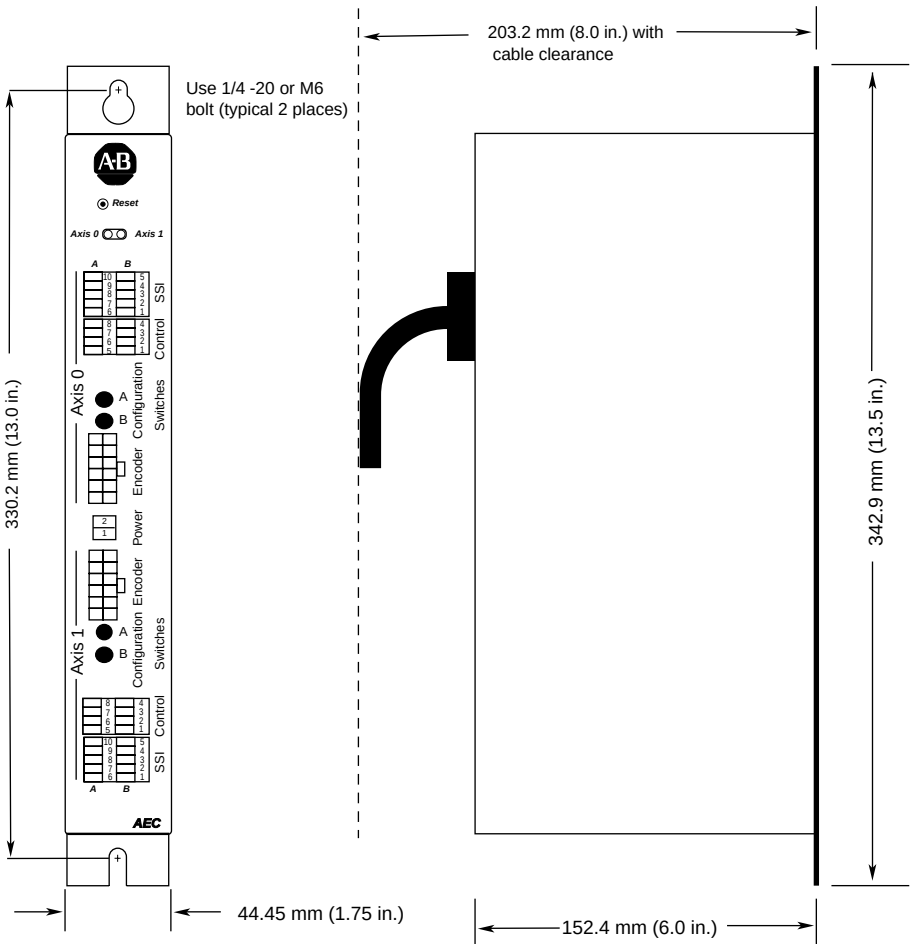
The AEC has the following features:

- Two fully independent axes capable of absolute to incremental quadrature conversion.
- Each channel can support independent absolute transducer input.
- User selectable resolution.
- Fixed transducer acquisition speed of 400 kHz.
- Each axis provides one differential quadrature output.
- Fixed quadrature output frequency of 800 kHz.
- Independent +5 V DC, + 15 V DC, and +24 V DC transducer voltages.
- Selectable for incremental strobes or internal 1ms timebase.
- Interfaces directly to Allen-Bradley 1394 GMC System and S Class Compact motion controllers.
- Normally open and normally closed status outputs for each axis.
- Bicolor LED status indication for each axis.
- An on-board reset switch that resets both axes.
- Absolute Home request remotely clears corrected faults and resets system on a per axis basis.
- Single 18-36 V DC input voltage power requirement.
- A rugged steel case for greater protection. The case has pre-drilled mounting tabs.

AEC Mechanical Specifications

The following figure shows the placement and labeling of major items on the AEC front panel.

Figure 1 AEC front panel



Package Specifications	
Package size mm and (in.)	342.9 x 152.4 x 44.45 (13.5 x 6.0 x 1.75)
Product weight kg and (lbs.)	2.27 (5.0)
Material	Painted Steel

Installation & Hook-Up

Chapter Objectives

Read this entire chapter before beginning to mount, connect, or wire any of the components to the AEC. It is the responsibility of the installer to see that the installation conforms to the directions in this manual and local codes and procedures. This chapter covers the following topics.

- European Union Compliance
- Mounting the AEC
- Connecting the AEC to the 1394 GMC system
- Connecting the AEC to the Compact motion controller
- Connecting the AEC to the 1746-MO2AE
- Wiring the SSI transducer to the AEC
- Wiring the Control connector
- An example of a Fault relay
- Wiring the Power connector

Installing the AEC

The AEC is designed to mount in an electrical cabinet using the flanges on its back panel. This installation method should be observed for all applications. Before powering the AEC, make sure it has been configured correctly and that the transducer(s) and control devices (controller) are connected to it correctly.

Complying with European Union Directives

The information contained in this document pertains to the Absolute Encoder Converter (AEC), an Allen-Bradley product. If the AEC is installed within the European Union or EEA regions and has the CE mark, the following regulations apply.

EMC Directive

The AEC is tested to meet Council Directive 89/336 Electromagnetic Compatibility (EMC) in accordance with Article 10 (1). The following directives apply:

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

The AEC, as described in this document, is intended for use in an industrial environment and is not intended for use in a residential, commercial, or light industrial environment.

To meet CE requirements, the following are required:

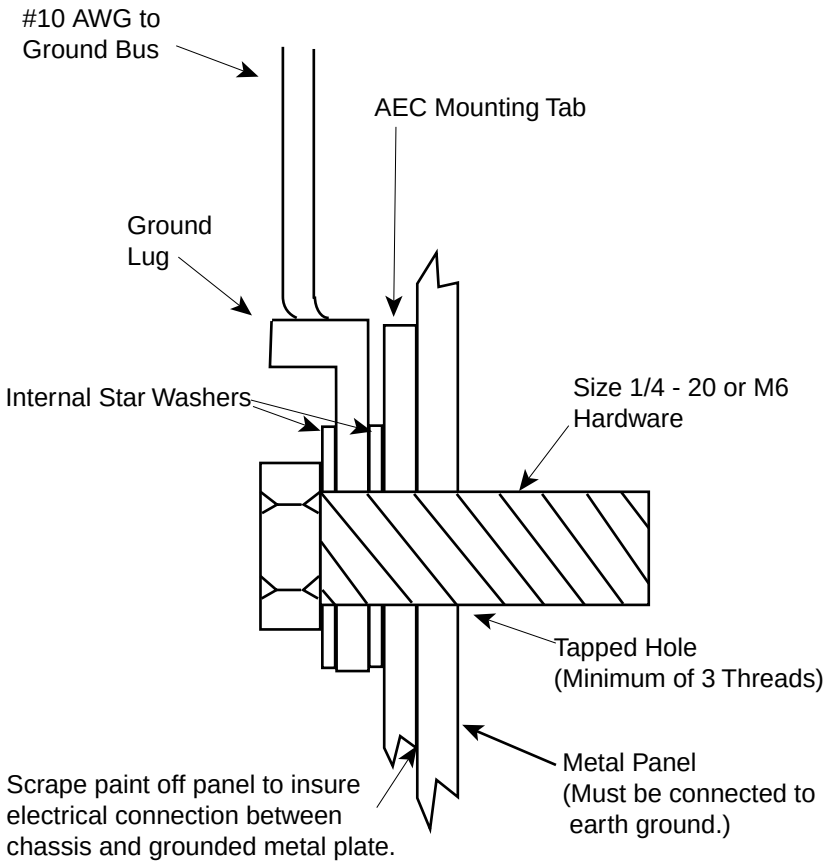
- The AEC must be mounted in an IP 54 rated metal enclosure on a metal panel.
- All equipment must be bonded.
- You must use the specified Allen-Bradley cables.
- The AEC is designed to function without maintenance when operated in the environment specified in this manual.
- Under normal conditions, the AEC should not require any periodic maintenance. However, if conditions are less than ideal and any superficial dust has accumulated on the controller over time, remove the dust carefully. Also, it is recommended to periodically inspect all cables for abrasion and all connectors for proper seating.

Mounting the AEC

Before mounting the AEC, verify that the 1394 GMC System or the S Class Compact motion controller is installed correctly. Refer to the *1394 Digital AC Multi-Axis Motion Control System User Manual* (publication 1395-5.0) or the *IMC 23/x Installation and Set-up Manual* (publication 999-122) for installation instructions.

The AEC must be properly grounded to the metal enclosure panel. The following diagram shows how to ground the AEC to the panel.

Figure 2 Mounting and Grounding Diagram



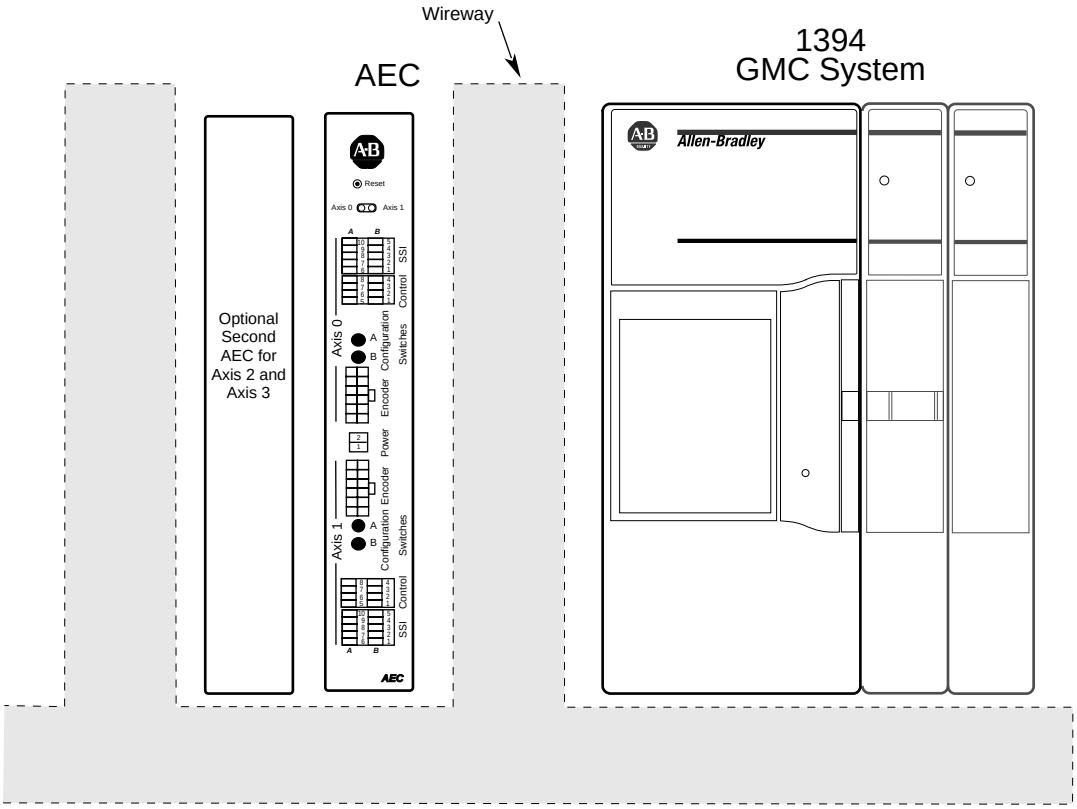
Mount the AEC next to a 1394 GMC system or an S Class Compact motion controller on a metal enclosure panel using two 1/4 -20 or M6 bolts. Refer to the Mechanical Specifications in the *Overview* chapter of this manual for mounting dimensions. Figures 3 and 4 in this chapter show where to mount the AEC.

ATTENTION

To avoid a shock hazard, remove all power to the system panel before mounting the AEC.

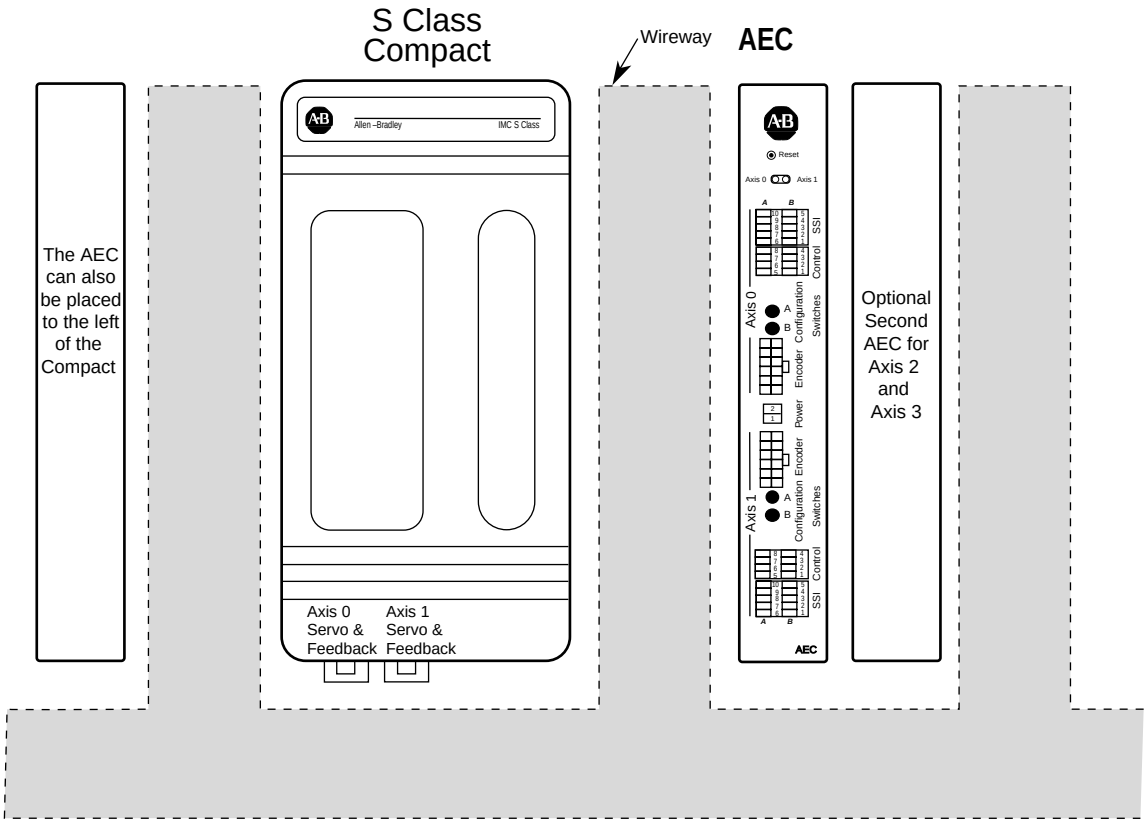
The 1394 contains stored energy devices. To avoid the hazard of electrical shock, verify that all voltages are zero (0.00) before proceeding.

Figure 3 Mounting the AEC next to a 1394 GMC on a system panel



IMPORTANT The AEC can only be mounted on the left side (when looking directly at the mounted 1394) of the 1394 GMC System. This is due to cable specifications and module expansion of the 1394.

Figure 4 Mounting the AEC next to an S Class Compact motion controller.



IMPORTANT The AEC can be mounted on either side of the S Class Compact motion controller on the system panel.

Connecting the AEC

The following section details how to connect the AEC encoder connectors to the 1394 GMC System and the S Class Compact motion controller.

ATTENTION Do not attempt to make any electrical connections to the AEC while power is applied. Doing so risks damage to the AEC, peripheral equipment, and your health and safety.

ATTENTION

The AEC does not support the removal or the insertion of any connectors when under power. The power disturbance can result in unintended machine motion, loss of process control, or an electrical arc that can cause an explosion in a hazardous environment.

Connecting the AEC to the 1394

Connect the AEC to a 1394 GMC System using the encoder cable (catalog number 1394-GR04) for each axis. This is a four foot cable that connects Axis 0 Encoder or Axis 1 Encoder connector on the AEC to the J3, J4, J5, or J10 encoder feedback connector on the 1394.

IMPORTANT This cable is polarity sensitive.

IMPORTANT The AEC does not require power from the 1394 to operate nor does it provide power to the 1394. However, the 1394 requires a separate 5V power supply to run its interface circuitry.

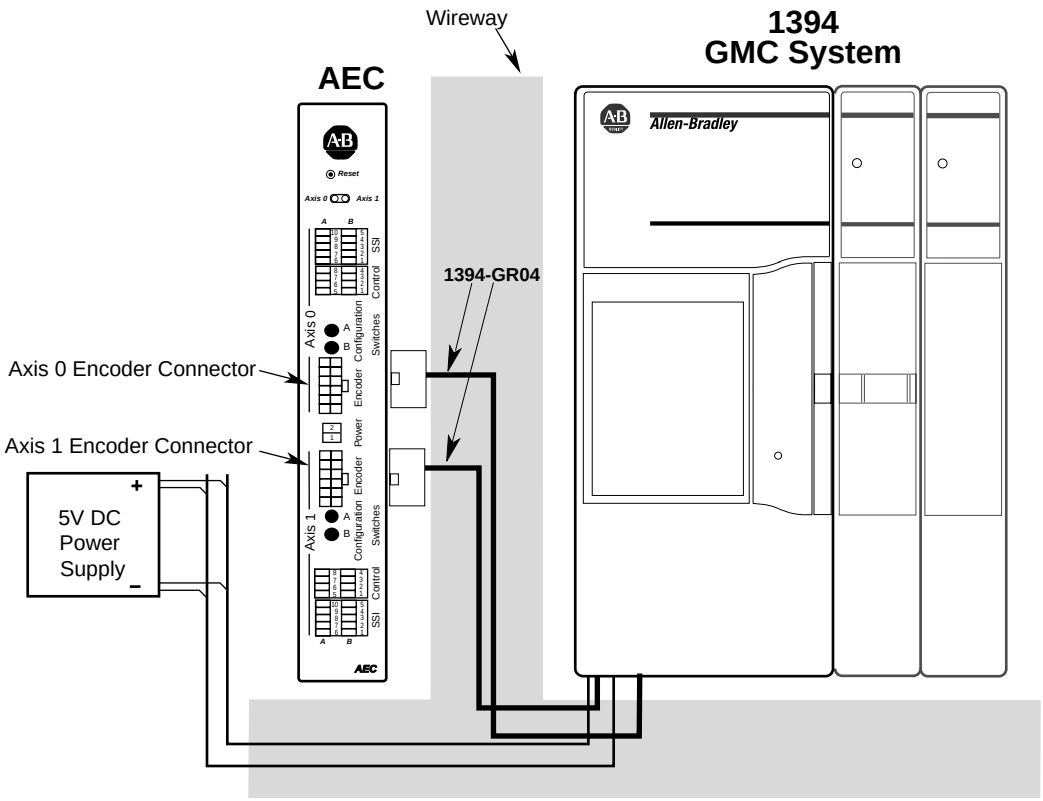
The 1394 interface circuitry requires 0.325A to operate. Any additional devices connected to the 1394, such as incremental encoders, can require an additional 0.2A per device (check your device for the precise requirements).

To connect the encoder cables:

1. Insert the 12-pin plug labeled “REC/AEC” in the Axis 0 Encoder or Axis 1 Encoder connector on the AEC.
2. Insert the 12-pin plug labeled “1394” in the J3, J4, J5, or J10 encoder feedback connector on the 1394.
3. Wire the remaining auxiliary power labeled “ENC. PWR” to the 5V DC power supply. The red wire is +5V and the black is a +5 common.

IMPORTANT When using multiple Encoder devices, we recommend you wire all of the auxiliary power cables to the same 5V DC power supply.

Figure 5 Connecting the Encoder Cables and the 5V Power Supply to the 1394



IMPORTANT Anchor the cable so that no more than 2 feet of cable is left unsupported. The excessive weight of an unanchored cable could pull the plug out of the connector

Connecting the AEC to the Compact

To connect the AEC to the S Class Compact motion controller, use the encoder cable (catalog number 4100-RCS3T) for each axis. This three foot cable connects the Axis 0 Encoder or the Axis 1 Encoder connector on the AEC to the Axis 0, 1, 2, or 3 servo and feedback connector on the Compact. The Compact sends the drive servo output

signal through the 4100-RCS3T cable. The following figure shows where to connect the encoder cable to the AEC and the Compact.

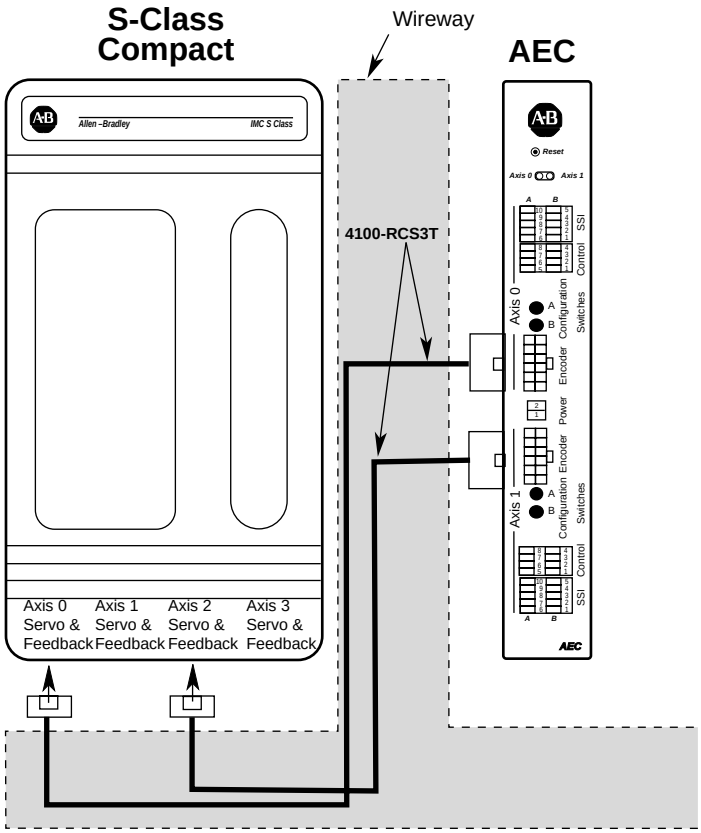
IMPORTANT This cable is NOT polarity sensitive.

To connect the Encoder cable:

1. Insert one 12-pin plug in the Axis 0 Encoder or Axis 1 Encoder connector on the AEC.

2. Insert the remaining 12-pin plug in the Axis 0, 1, 2, or 3 servo and feedback connector on the Compact.

Figure 6 Connecting the Encoder Cables to the Compact



IMPORTANT Anchor the cable so that no more than 2 feet of cable is left unsupported. The excessive weight of an unanchored cable could pull the plug out of the connector.

Connecting the AEC to the 1756-MO2AE

TIP See Application Note, publication number 4100-2.7 for more detailed information regarding using the AEC with the 1756-MO2AE.

To connect the AEC to the 1756-MO2AE, use the pre-made encoder cable (4100-CCS15F) for each axis. This 15 foot cable connects the Axis 0 Encoder or Axis 1 Encoder connector on the AEC to the 1756-MO2AE. The 4100-CCS15F is a 15 foot cable with a 12-pin plug on one end and the flying leads on the other end.

IMPORTANT This cable is NOT polarity sensitive.

To connect the 4100-CCS15F Encoder cable:

1. Insert the end with the 12-pin plug to either the Axis 0 Encoder or Axis 1 Encoder connector on the AEC.

2. Connect the flying leads to the appropriate pin locations on the 1756-MO2AE using the pin locations as shown in the following diagram.

1756-MO2AE Pins for Connecting AEC

Pin Number	Pin Value	Wire Color
1	V REF+	Red
3	V REF-	Black
11	Chassis	Black
25	A+	White
27	A-	Black
29	B+	Green
31	B-	Black
33	Z+	Blue
35	Z-	Black

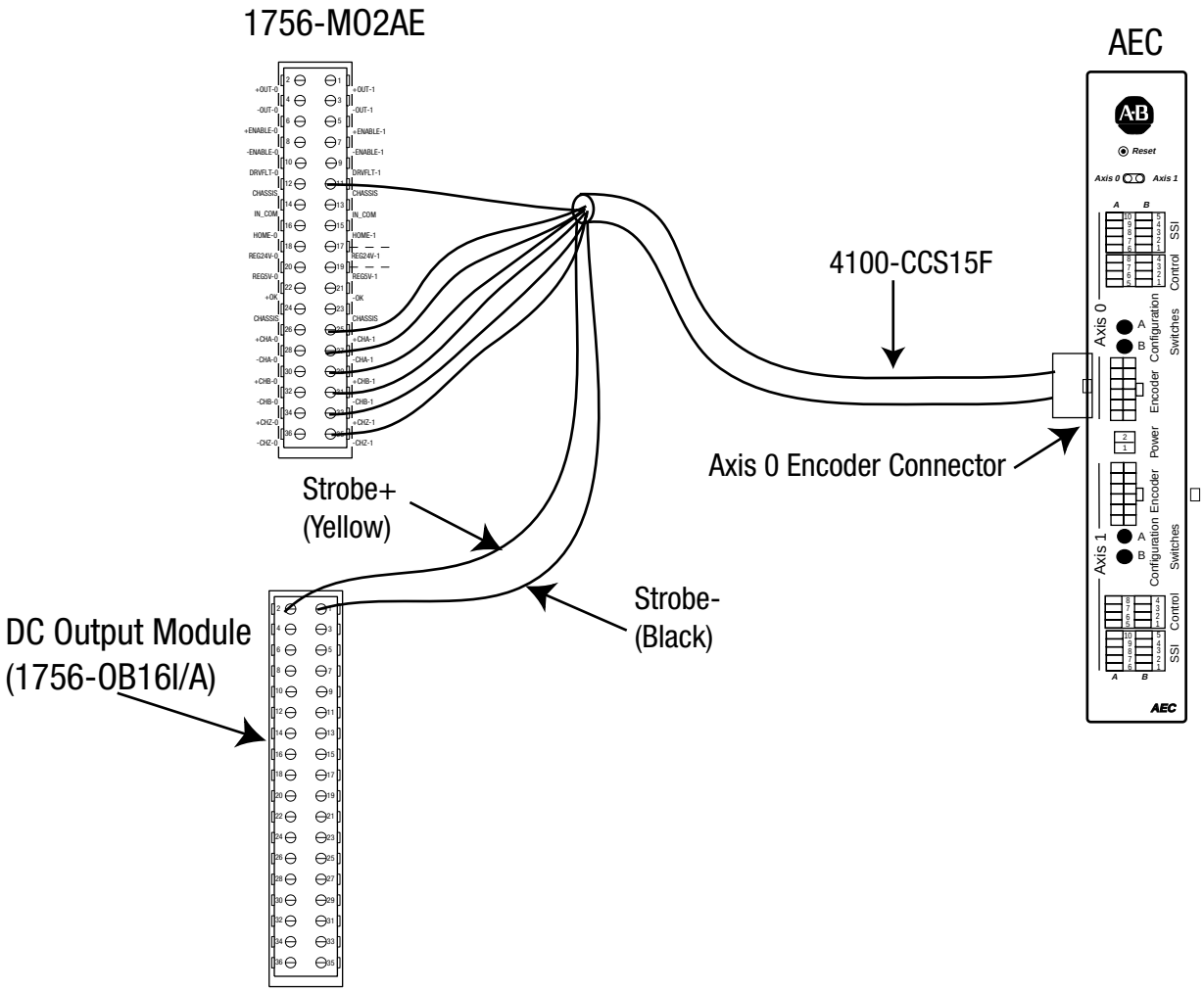
The wires for Strobe+ and Strobe- must be run through the DC Output card. The pin locations are designated in the following table.

DC Output 1756-OB16I/A Pins for Connecting the AEC Strobe

Pin Number	Pin Value	Wire Color
2	Strobe +	Yellow
1	Strobe -	Black

The following diagram shows the 4100-CCS15F cable connecting the AEC to the 1756-MO2AE.

Figure 7 Connecting the Encoder Cable to the 1756-MO2AE and DC Output



Wiring the AEC

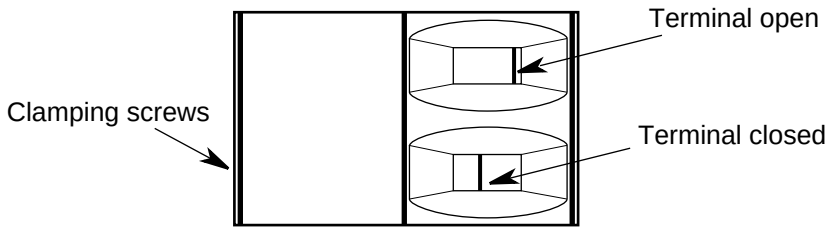
There are several connectors on the front of the AEC. All are duplicated for each axis except the power input connector. Each axis has two five-pin plugs for connecting the SSI transducer and two four-pin plugs for connecting a control. In the center is a 2-pin plug for the power cable. The flying leads wire directly to the screw terminals on the plugs.

Wiring Cable Flying Leads to the Plugs

To wire the cable leads to the plug:

1. Look at the plug to make sure the terminal is open. The following figure shows both an open and a closed terminal.

Figure 8Terminal diagram



2.

Terminal Steps

If the terminals are:	Do this:
Not open	Go to step 3
Open	Go to step 4

3. Using a small, flat-head screwdriver, turn the clamping screw counter-clockwise several times.

4. Using a proper stripping tool, strip the wire insulation back on the cable lead.

IMPORTANT All terminals accommodate a maximum of 14 gauge wire.

5. Trim the cable lead so that 0.275 inches of metal wire is exposed.

6. Insert the cable lead in the appropriate terminal. Refer to the proper figures for their locations.

7. Use the screwdriver to tighten the clamping screw to the proper torque (0.25 N-m/2.2 in-lb.).

8. Verify that the cable lead does not pull out of the terminal.

9.

Cable Leads

If the cable lead:	Do this:
Pulls out of the terminal	Repeat steps 3 through 9 again
Does not pull out of the terminal	Repeat steps 3 through 9 for the next terminal

The function of these connectors, their pinouts, and names are defined in the following sections.

The SSI Connector

The SSI connectors are used to connect the absolute transducer to the AEC. The pin layout and functionality for this connector are as follows.

SSI Connector Pin Functions

SSI Input	
Pin Number	**Pin Function**
1	Transducer Power +24V DC
2	Transducer Power +15V DC
3	Transducer Power +5V DC
4	Data -
5	Clock -
6	Shield
7	Transducer Power Return
8	Shield
9	Data +
10	Clock +

The following is the connector pin numbering scheme for the SSI connector as viewed with the AEC mounted in its normal position.

SSI Connector Pin Numbering

A	B
10	5
9	4
8	3
7	2
6	1

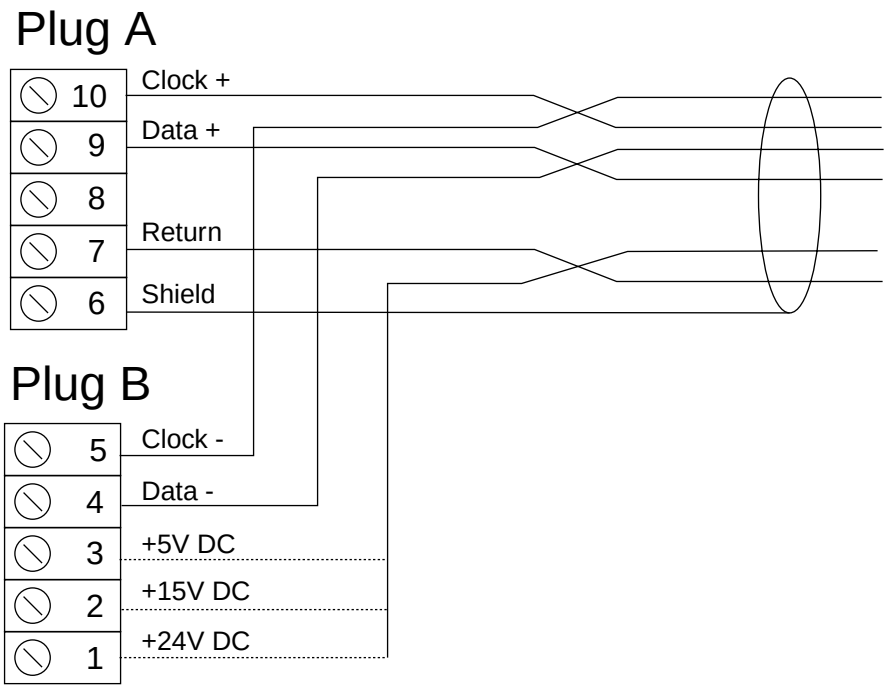
ATTENTION

Wiring the connector for the wrong transducer power can result in improper operation or damage to the position transducer.

IMPORTANT

Pins 1 through 3 are reserved for transducer power output. Only one of these can be in use at a time. It is your responsibility to determine the power requirement of the transducer you are connecting to the AEC and to use the pin that corresponds to that requirement.

Figure 9 Wiring Diagram for SSI Connector



IMPORTANT Maximum cable length between SSI Device and the AEC is 100 feet.

IMPORTANT Anchor the cable so that no more than 2 feet of cable is left unsupported. The excessive weight of an unanchored cable can pull the plug out of the connector.

The Control Connector

The control connectors let you connect the AEC to an application fault string to indicate an AEC related fault condition to the controlling hardware. The connector also has an analog command pass through signal pair for connecting a servo amplifier.

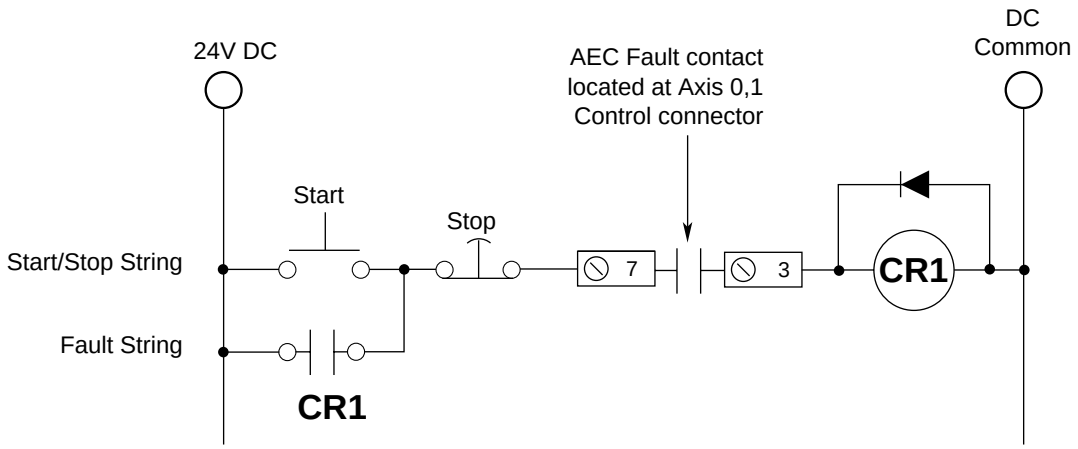
Fault Relay

To provide safe operation (opening the fault string if a fault occurs or power to the AEC is lost) the control status relay outputs must be

connected appropriately. The control status relay N/O contact is held energized when the AEC has not detected a fault.

There is one control status relay per axis. Each relay provides one normally open and one normally closed pair that is voltage free and isolated from each other and the ground.

Figure 10 An example of a Normally Open Fault status contact



ATTENTION

The Fault Contacts are NOT intended to be used for an emergency stop string. They are intended for fault indication only.

The diagram shows an example of connecting the AEC fault contact into a system fault string. Since the status relay is energized when the AEC is indicating no faults, the contact is closed.

A typical fault detection scheme may require additional circuitry when used in applications where the AEC fault contacts do not have sufficient capacity to drive a fault detection circuit directly.

The pin layout and functionality for the Control connector is as follows:

Control Connector Pin Functions

	Control
Pin Number	Pin Function
1	Shield
2	Fault N/C Relay Contact
3	Fault N/O Relay Contact
4	Reference -
5	Shield
6	N/C Relay Common Contact
7	N/O Relay Common Contact
8	Reference +

The following table displays the connector pin numbering scheme, as seen with the AEC mounted in its normal position.

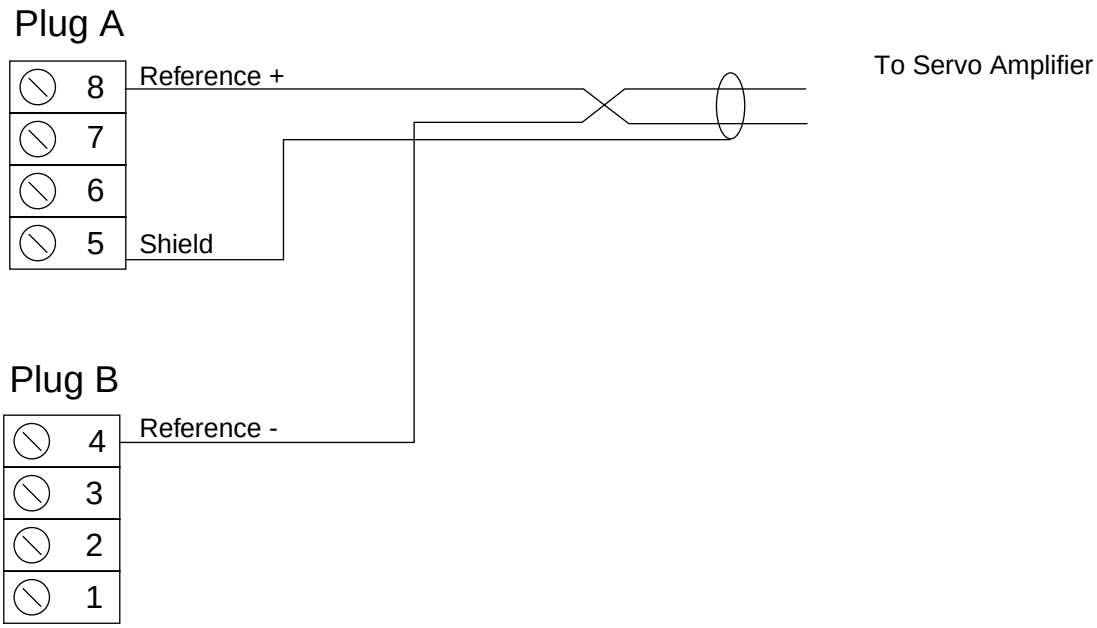
Control Connector Pin Numbering

A	B
8	**4**
7	**3**
6	**2**
5	**1**

Analog Servo Command Pass Through (For Compact Only)

There is one analog command pass through signal pair (Reference + and Reference -) per axis. The 4100-RCS3T encoder cable between the AEC and the Compact (see *Connecting the AEC to a Compact* section of this chapter) passes the analog command signal from the Compact, through the AEC, and out to the servo amplifier, if connected.

Figure 11 Wiring diagram for connecting a Servo Amplifier to the Control Connector



IMPORTANT Anchor the cable so that no more than 2 feet of cable is left unsupported. The excessive weight of an unanchored cable could pull the plug out of the connector.

Power Supply Connector

The power supply connector is used to connect power to the AEC. There is one power input connector for the AEC. The input power is used to operate the AEC and attached transducers.

The AEC operates within the voltage range of 18-36V DC. The power source must be able to supply 21W of power continuously.

The pin layout and functionality for this connector are shown in the following table.

Power Supply Pin Functions

Power Supply	
Pin Number	Pin Function
1	Supply Common
2	Supply +

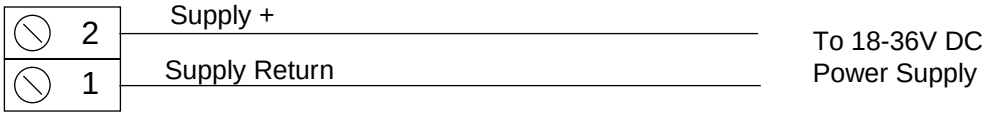
The following table shows the power supply connector pin numbering, as seen with the AEC mounted in its normal position.

Power Supply Pin Numbering

Power
2
1

The following diagram illustrates the power connections for the AEC.

Figure 12 Wiring diagram for connecting the power cable to the connector



IMPORTANT Anchor the cable so that no more than 2 feet of cable is left unsupported. The excessive weight of an unanchored cable could pull the plug out of the connector.

Setup

Chapter Objectives

The AEC is used in conjunction with the 1394 GMC System or the S Class Compact motion controller and SSI transducers. It is not a stand-alone product and must be configured to work with the hardware connected to it. This involves specific steps that are determined by the make and model of the hardware connected to the AEC. This manual assumes that the GML Commander v4.01 or higher software is used.

This chapter covers :

- Explanation of the Rotary switch settings
- Powering the AEC
- Configuring the AEC with the GML Commander software
- Homing Procedure
- Aligning Absolute Device

Setting the Rotary Switches

Setting the rotary switches located on the front panel, configures the AEC.

Before you apply power to the AEC you must configure each axis to suit the transducer connected to it. A total of four parameters per axis must be configured. For each axis, determine the following:

1. Transducer resolution in counts/turn (this is in counts/stroke for linear displacement transducers). Parameter 1 is set by configuration switch “A”. The table “Configuration Switch A” lists all the options supported by the AEC. Use this table to select the switch setting that matches the value for your transducer.

IMPORTANT Configuration switch “B” is used for setting the next three parameters. You must find the setting that meets the combination of values for all three parameters.

2. Whether the transducer is a single or multi turn device.
3. Whether Grey or Binary is used for transducer data.
4. The operation mode. Locked or free running.

ATTENTION

The Compact and 1394 motion controllers must use the **LOCKED** mode of operation.

Configuration Switch Tables

Configuration Switch A

Transducer Resolutions

Transducer Resolution		
Switch Setting	**Counts/Turn**	**Bits/Turn**
0	128	2^7
1	256	2^8
2	512	2^9
3	1024	2^{10}
4	2048	2^{11}
5	4096	2^{12}
6	8192	2^{13}
7	16384	2^{14}
8	32768	2^{15}
9	65536	2^{16}
A	131072	2^{17}
B	262144	2^{18}
C	2097152	2^{21}
D	4194304	2^{22}
E	16777216	2^{24}
F	33554432	2^{25}

IMPORTANT All Allen-Bradley 842A Encoders must have Configuration Switch A set to E.

Configuration Switch B

Transducer Turns, Data Format, & Operation Mode

Transducer Turns, Data Format, & Operation Mode			
Switch Setting	Turns	Data Code	Operation Mode
0	Single	Grey	Locked
1	Reserved for future use		
2	Single	Grey	Free Run
3	Reserved for future use		
4	Single	Binary	Locked
5	Reserved for future use		
6	Single	Binary	Free Run
7	Reserved for future use		
8	Multi	Grey	Locked
9	Reserved for future use		
A	Multi	Grey	Free Run
B	Reserved for future use		
C	Multi	Binary	Locked
D	Reserved for future use		
E	Multi	Binary	Free Run
F	Reserved for future use		

IMPORTANT All Allen-Bradley 842A Encoders set for **grey** output must have Configuration Switch B set to 0. All Allen-Bradley 842A Encoders set for **binary** output must have Configuration Switch B set to 4.

ATTENTION The Compact and 1394 motion controllers must use the **LOCKED** mode of operation.

Powering the AEC

The AEC has reverse polarity protection. However, always take care to observe correct polarity when you connect the power to your unit. If power is connected with the wrong polarity, no damage is done. The AEC simply does not function until the polarity is corrected. There is no warning or indication of an incorrect polarity connection.

The AEC also has over current protection provided by a fuse on the printed circuit board. The fuse is a 2 amp/250V, 5mm radial. A spare fuse is located on the lower left portion of the printed circuit board and is clearly marked “Spare Fuse”. If the fuse blows, always determine and correct the reason it blew before installing the new fuse.

ATTENTION

Never replace the fuse with the unit under power. When replacing the fuse, make sure it is of the proper rating.

IMPORTANT

Before powering the AEC, make sure that it has been properly installed and configured according to the instructions contained in this manual.

AEC With GML Commander

The AEC can only be used with GML Commander version 4.01 or higher. There are several steps that must be taken in GML Commander before the AEC can be used within a GML Commander diagram. This section outlines the necessary steps. For more detail about individual steps, see the *GML Commander Reference Manual* (publication number GMLC-5.2), the “Configuring Axis Use” chapter, “Defining Feedback” section.

Adding AEC to your Commander Diagram

To add the AEC to your GML Commander diagrams go to GML Commander and do the following:

1. Select the Configure menu option from the opening GML Commander screen.

2. Select Axis Use from the Configure pull-down menu.

3. Select the axis to configure for the AEC from the Axis Use pull-down. The Configure Axis Use screen displays.

4. At the General screen, select the Axis Type.

5. Go to the Position Mode field select either rotary or linear.

6. Select the Feedback Tab from the Configure Axis Use screen.

7. Select AEC for the Transducer Type field.

8. Check the Transducer Loss Detection box.

Setting the Transducer Resolution

1. Enter the Transducer Resolution Conversion Constant.

2. Enter a value for the External Conversion Constant. (1394 series only.)

3. Enter the value for the Unwind Constant (rotary axis only).

4. Enter the Unwind Reference (rotary axis only). This defines the point where the Unwind returns at each cycle.

For more information about the above fields, see the *GML Commander Reference Manual* (publication number GMLC-5.2).

Selecting Homing Procedure

The AEC only uses the Absolute Serial procedure for Homing the axis.

1. Select the Homing tab from the Configure Axis Use screen.

2. Select Absolute Serial from the pull down list of the Procedure option box.

For more information on Homing procedures, refer to the *GML Commander Reference Manual* (publication number GMLC-5.2), the "Configuring Axis Use" chapter, "Defining Homing" section.

ATTENTION

When executing the Homing or Alignment procedure on a servo axis, feedback is momentarily disabled and then re-enabled (if the error checking features do not detect an error) in the motion controller. If the axis has stored energy or the ability to move during the time feedback is disabled, you have to apply a breaking mechanism to the axis before you execute the procedure.

Aligning Absolute Encoder

Once the hardware is wired and the configuration steps have been taken, it is important to align the Absolute Encoder. The alignment process aligns the absolute device to the zero position of the axis, and updates both the working and power-up home position values. It also changes the Position setting in the Homing page of the Configure Axis Use dialog box. This is done from the Hookups section of the Configure Axis Use screen in GML Commander.

To align the devices:

1. Make sure all external components are connected.
2. Make sure All Configured Axis Use information is entered. (Refer to previous steps in this chapter.)
3. Download the Configured Axis information.
4. Select the Hookups tab from the Configure Axis Use screen.
5. Click on the A**lign Absolute Device** button.
6. In response to the Commander message box, move the axis to its minimum travel position and click on **OK**.
7. The alignment procedure runs.

For more information about alignment, see the *GML Commander Reference Manual* (publication number GMLC-5.2), the “Configuring Axis Use” chapter, “Verifying Hookups” section.

Operation

Chapter Objectives

This chapter provides an overview of how the AEC determines position. This chapter covers the following topics:

- Absolute Position Update
- Incremental Position Output
- Position at Start-up

Absolute Position Update

Absolute position information can be requested from the transducer via the AEC at any time. When the AEC interprets the strobe pulse train to be an absolute update request from the controlling hardware, it interrogates the transducer's absolute position and incrementally streams the position to the awaiting controller.

IMPORTANT During an absolute position update, the quadrature encoder output stream is always positive: A leads B. See the *Incremental Position Output* section of this manual for more details.

Incremental Position Output

The AEC checks for the transducer position periodically. In the Locked mode of operation, this process is triggered and synchronized by the strobe input. In the Free-running mode of operation, the position is sampled, calculated, and transmitted every $1/1000^{th}$ of a second, based on the internal time of the AEC. The AEC compares the newly sampled absolute position against the last. It calculates the difference between the new and the old positions and transmits the difference through the encoder port in an incremental fashion.

The position and direction information is encoded and sent using the industry standard (A and B) channels in quadrature (90 degree phasing). Each channel is driven differentially for improved noise immunity. When moving in the positive direction, the phase of the quadrature pulse train is A leading B. When moving in the negative direction, the phase of the quadrature pulse train is B leading A. The output frequency of both channels is fixed at 800kHz. One transducer position count is represented by one edge transition (either positive or negative) of the quadrature pulse train. This encoding scheme is defined as 4X. Your position controller must support the 4X decode of the AEC encoder output.

Position at Start-up

In locked mode, the AEC sends incremental position after receiving incremental strobe pulses. The AEC, when configured for free-running mode for controlling hardware other than the Compact or 1394, sends the incremental position at start-up. In this mode, the AEC behaves like an incremental encoder. Neither mode requires an absolute update to begin transmitting positional information.

Fault Indication & Control Status

Chapter Objectives

This chapter covers the AEC operation status. Fault states are separated into four basic categories:

- Transducer
- Encoder
- Internal
- No Fault

Faults can be attributed to:

- Improper installation
- Improper AEC switch configuration
- Faulty hardware (i.e. broken cable)
- Improper application

It is the responsibility of the user to make sure that the application is safe. Understanding the capabilities of the AEC can help you achieve this goal.

The AEC provides bicolor LED fault indication for each axis. The color and pattern of these LEDs provide “at-a-glance” indication of the status of each axis.

Although the AEC is equipped with a Reset button, it is not a recommended form of fault resolution. If the non-offending axis is running fine, pressing the reset button could result in a hazardous situation.

ATTENTION

Pressing the Reset Button or Powering Off the AEC results in both axes being reset. This can cause problems if one axis is running in a no-fault condition and either of these procedures is followed to correct a fault on the other axis.

Transducer Faults

Transducer faults detected by the AEC are indicated by a flashing RED LED for the offending axis. In a fault condition, the quadrature output is inhibited and the fault relay is de-energized. The following table displays a list of probable causes to investigate.

Transducer Faults

Transducer Faults and Causes	
Fault	**Possible Cause**
Configuration error	Configuration switches are set to an illegal combination.
SSI Line Break	AEC detected loss of data signal. This is the normal state for an unused SSI.
SSI Time-out	Transducer position not received after 100ms.

Encoder Faults

Encoder faults are strobe cycle errors. The strobe is an input to the AEC through the Encoder connector. When detected by the AEC, the offending axis's LED alternately flashes RED-GREEN. This causes the quadrature output to default to free-running mode and the fault relay is de-energized. The following table lists faults and possible causes when Encoder faults are indicated.

Encoder Faults

Encoder Faults & Causes	
Fault	**Possible Cause**
Incremental Strobe Loss	The AEC is in locked mode & stopped receiving incremental strobe pulses.
Absolute Strobe Loss	AEC did not receive the second absolute strobe pulse in time.
Strobe Timing Violations	Incremental or Absolute strobe update timing has been violated.

In the case of an incremental strobe loss or move error, sending an Absolute Home command may reset the fault.

Internal Faults

Internal faults are internal hardware errors detected by the AEC. For both axes, indication is solid RED, quadrature output is inhibited, and the fault relay is de-energized. In the case of a Global Hardware fault, where both LEDs are solid red, Call Allen-Bradley Technical Support.

No Faults

In this state, the AEC has detected no errors. The indication per axis is either flashing or solid GREEN. FLASHING GREEN indicates that the AEC has not yet detected a strobe. When configured for locked mode, the AEC is waiting for either an absolute strobe cycle or incremental strobe. When configured for free-running mode, the AEC is waiting for an absolute strobe cycle. Regardless of the selected mode, the AEC is operating in free-running mode. When the LEDs are SOLID GREEN, the AEC has received a strobe and is operating in its program mode. There is no fault action and the relay is energized.

Specifications

Figure 13 AEC Front Panel

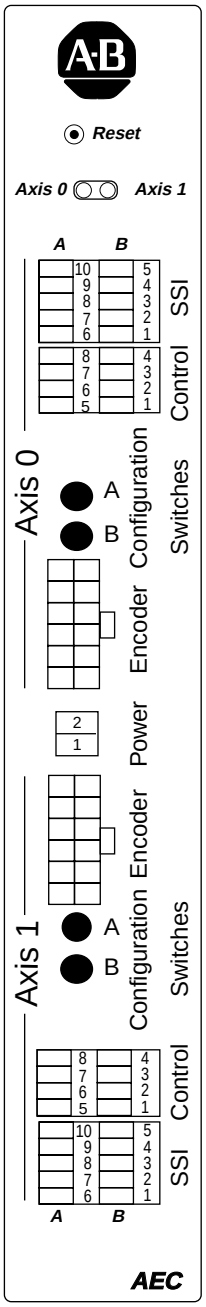


Figure A.1 shows the connector locations for the AEC. The following tables provide the pin numbers and their respective descriptions.

SSI Connector

Plug A	Plug B
10 = Clock +	5 = Clock -
9 = Data +	4 = Data -
8 = Shield	3 = Transducer Power +5V DC
7 = Transducer Power Return	2 = Transducer Power +15V DC
6 = Shield	1 = Transducer Power +24V DC

Control Connector

Plug A	Plug B
8 = Reference +	4 = Reference -
7 = N/O Fault Relay Contact	3 = N/O Fault Relay Contact
6 = N/C Fault Relay Contact	2 = N/C Fault Relay Contact
5 = Shield	1 = Shield

Encoder Connector

Plug A	Plug B
12 = Z -	6 = Z + (Blue)
11 = B -	5 = B + (Green)
10 = A -	4 = A + (White)
9 = Strobe -	3 = No Connection
8 = Reference Shield Input	2 = Strobe +
7 = Reference - Input	1 = Reference + Input

Power Connector

2 = Supply +
1 = Supply -

Mechanical Specifications

Specification	Description
Enclosure Type	Steel case with integral mounting tabs
Enclosure Size	295 x 343 x 43 mm (11.6 x 13.5 x 1.7 in)

Environmental Specification

Specification	Description
Operating Temperature	0 to 60 °C
Storage Temperature	-40 to 85 °C
Humidity	95% non condensing @ 60 °C

Supported Devices

Manufacturer	Model
Allen-Bradley	All series 842A Encoders
Stegmann:	AG661, AG626
Heidenhain:	ROC424 & 417
BEI:	MT40 Multi-Turn, BEI RAS25 Single Turn
Temposonics III:	Model PA and Model RH
IVO:	GM 400, GM 401

Module Specifications

Specification	Description
Number of Axes	2
Transducer Resolution Counts/Turn Number of Turns	 2^7 - 2^{18} and 2^{21} - 2^{25} 1 - 2^{25} except 2^{19}, 2^{20}, 2^{23}
Transducer Interface Protocol Acquisition Frequency Data Format Line Driver (Clock) Line Receiver (Data) Minimum Data Voltage Maximum Rate of Position Change (Delta Count)	 SSI 400 kHz Binary or Gray Code RS-422 (IC 26LS31) RS-422 (IC 26LS33) +/- 3.0V measured from Data+ to Data- Must be lesser of: 1/2 (Counts/Turn) per 1/1000th second or 2048 counts per 1/1000th second
Input Isolation Voltage Range Power Fuse	 Chassis Common 18 to 36 V 21 Watts maximum 2 A/250V, 5mm Radial Wickmann # 19372-057-K, ABLeb.# 515-038
Transducer Output Power Isolation Voltage Current	 Chassis Common 5, or 15, or 24V DC 300mA maximum
Fault Contact Outputs Type Isolation Coil-Contact Open Contact Rating AC DC	 NO/NC contact set per axis 1000V AC 750 V AC AC/DC 125V AC @ 10mA - 0.6A 110V DC @ 10mA - 0.6A 30V DC @ 10mA - 2.0A
Encoder Ouputs Channel Frequency Driver Type	4X quadrature encoding 800kHz fixed (3.2 Meg cnts/sec) RS-422 (IC26LS31)
Strobe Inputs: Type Source Impedance Maximum active Voltage Minimum Inactive Voltage	 Current Sourcing Active Low 10k Ohm 0.6V DC 2.2V DC

Equivalent Circuit Diagrams

The following diagrams detail the equivalent circuits for the Strobe Input, Transducer Data Input, the SSI Clock Output, and the Encoder Output.

Figure 14 Strobe Input Equivalent Circuit

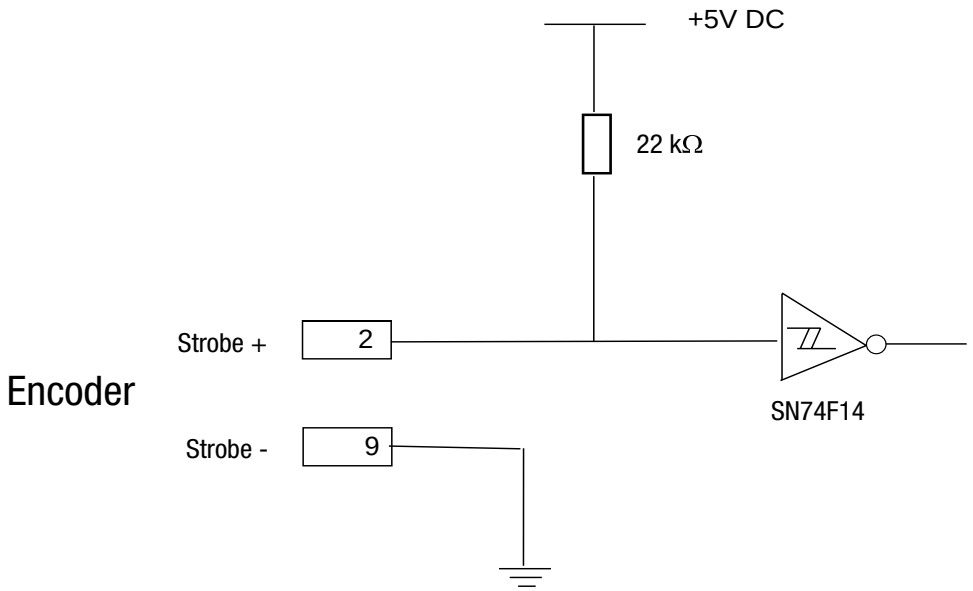
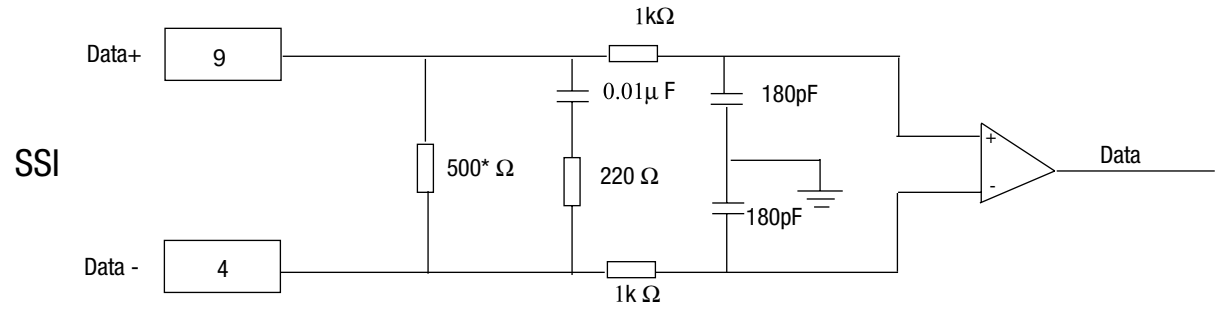


Figure 15 Transducer Data Input Equivalent Circuit



*Impedance includes loss detection circuit

Figure 16 SSI Clock Output Equivalent Circuit

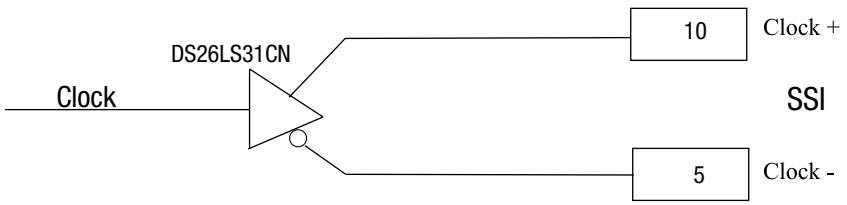
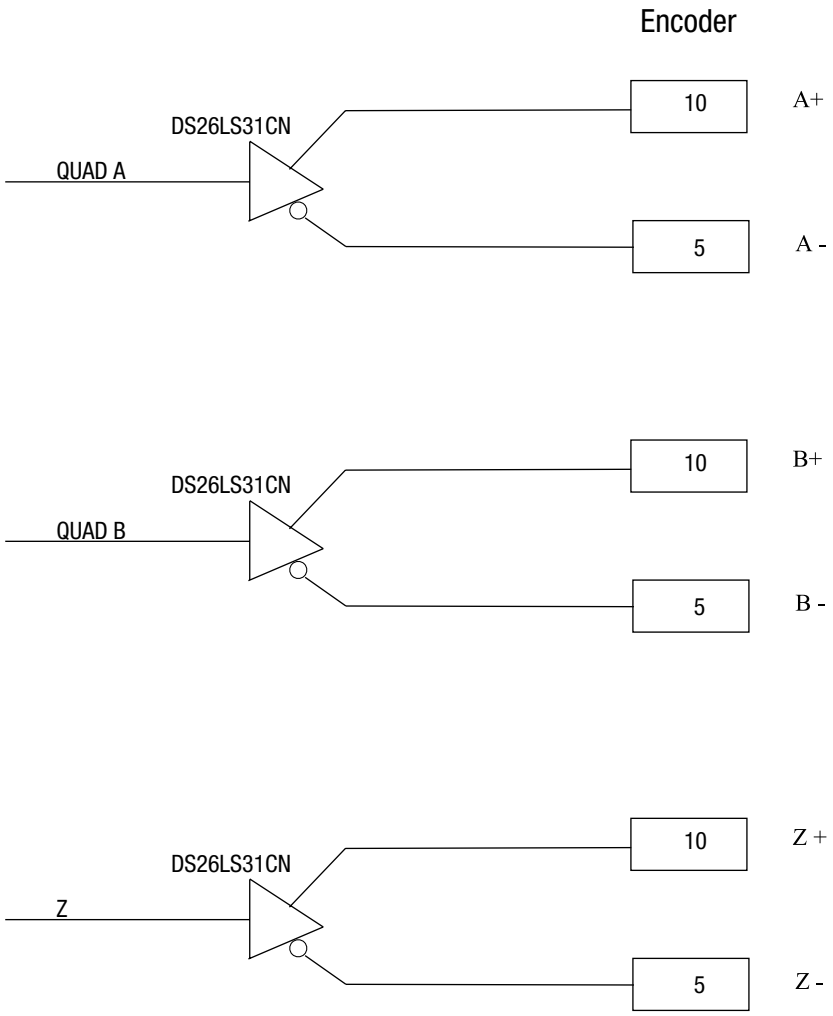


Figure 17 Encoder Output Equivalent Circuit



IMPORTANT Do not wire to the Z signals. The Z channel is not supported at this time. Allen-Bradley reserves the right to use this signal for future purposes.

Strobe Position For Applications Not Using the 1394 or Compact

Absolute Strobe Cycle

When the AEC is connected to controlling hardware other than the 1394 or Compact, the setup must be capable of generating Absolute Strobe pulses as outlined in this appendix. An Absolute Strobe cycle is required to obtain the absolute position from the transducer.

The absolute position is transmitted to the controller as a stream of incremental quadrature pulses on the rising edge of an Absolute Strobe pulse. The absolute position is transmitted in a two strobe pulse train sequence. This lets the controller determine the position of the controlled hardware.

The phase of the encoder output pulses for an absolute strobe is always positive as defined by A leading B. The absolute position is transmitted with a sequence of two encoder pulse streams. With the first absolute strobe (Strobe 1), the lower 16 bits of the transducer position is transmitted. On the second absolute strobe (Strobe 2), the 9 most significant bits of the transducer position is transmitted (9 bits of actual data transmitted since only 25 bits are supported). After completing an absolute update cycle, the position can be calculated by summing the least significant count with the most significant count multiplied by 65536 (2^{16}). The total maximum number of transducer counts which can be transmitted is 33554431 (2^{25} - 1).

IMPORTANT Regardless of the number of transducer bits, two absolute strobe pulses must be sent to the AEC to complete an absolute position update.

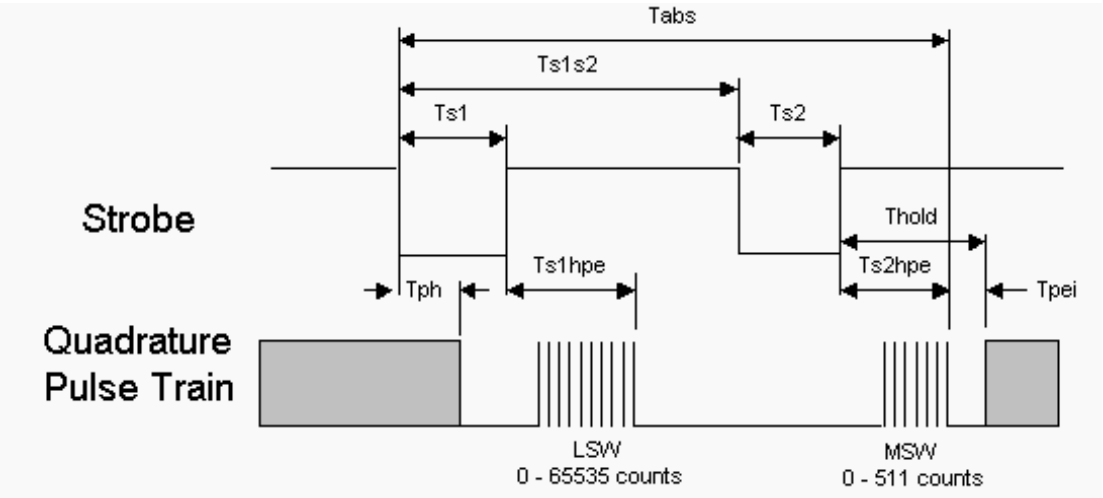
ATTENTION

Issuing an Absolute Strobe causes the AEC to stream position information from the transducer. During this time, if servo action is enabled by the controlling hardware, motion can occur. Place your system in a safe state and disable servo action before performing an Absolute position update.

Absolute Strobe Timing

This section defines the timing requirements for the two-strobe pulse train required for absolute position updates. The AEC must receive two strobe pulses to initiate and complete an absolute position update transfer. These are referred to as Ts1 and Ts2 in the data transfer protocol diagram. The following diagram and table outline the parametric requirements for an absolute position update cycle.

Figure 18 Absolute Position Transfer Protocol



Absolute Position Transfer Timing

Parameter	Locked Mode		Free-Running Mode	
	Min	Max	Min	Max
Tabs (absolute update cycle) = (Ts1s2 + Ts2 + Ts2hpe)		3001ms		
Ts1 (Strobe1 active pulse width)	100ms	1000ms	100ms	1000ms
Ts2 (Strobe2 active pulse width)	5ms	1000ms	5ms	1000ms
Ts1s2 (time from Strobe1 inactive to strobe2 active)	Ts1+Ts1hpe+2	2000ms	Ts1+Ts1hpe+2	2000ms
Tph (time from Strobe1 inactive edge to encoder state hold)		30ms		30ms
Ts1hpe (time from Strobe1 inactive to end of encoder stream)	0	25ms	0	25ms
Ts2hpe (time from Strobe2 inactive to end of encoder stream)	0	1ms	0	1ms
Tpei (*time from MSW pulse train end to incremental updating)	0	indefinite	N/A	N/A
Thold	N/A	N/A	500ms	500ms

*Operation mode dependent: Locked or Free-Running

An absolute position request is an asynchronous event initiated by the controlling hardware. The first strobe starts the absolute position update cycle. The first strobe (Ts1) must be active for a minimum of 100ms, but for less than 1000ms to be valid. A strobe is sourcing

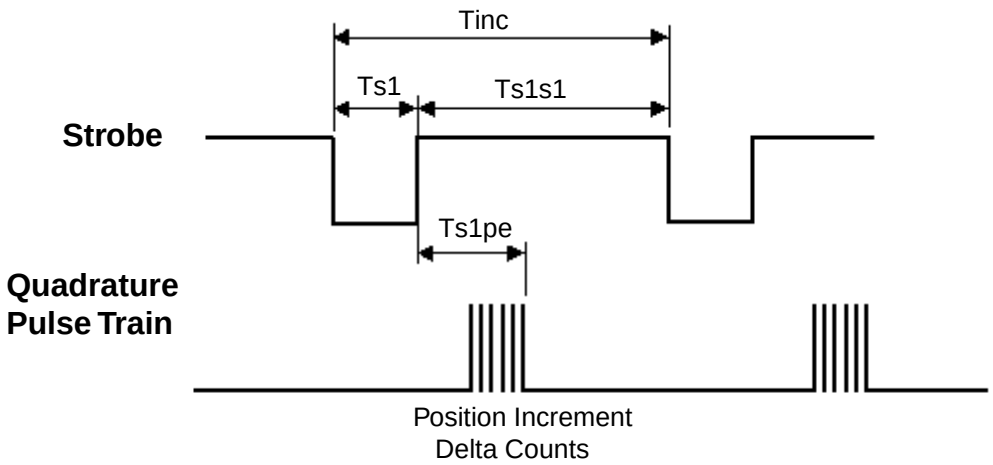
input on the AEC. Internally the AEC, holds it high when inactive and to activate, it must be connected and pulled low. Within 30ms (tph) of the strobe going active, the encoder output A and B signals are held at their current state (any incremental updating is prohibited). On Ts1 going inactive, the lower 16 bits of the absolute position is transmitted. Anywhere from 0 to 65535 counts can be transmitted. It can take up to 25ms (Ts1hpe) to transmit the least significant word (LSW) of the transducer position. After the LSW has been transmitted, the second strobe (Ts1s2) is brought active.

When the second strobe goes inactive (ts2), it triggers the transmission of the most significant word (MSW). Anywhere from 0 to 511 counts can be transmitted. This completes an absolute position update cycle. Once the MSW has been sent(Tpei), the AEC begins sending incremental changes (Free-Running) or the Encoder output remains inactive as the AEC waits for an incremental strobe pulse (Locked).

Incremental Strobe Period

When using controlling hardware other than the 1394 or Compact, it is recommended that you set the Configuration Switch B for Free Run operation (see Chapter 3, *Setup*). In this mode position, changes from the transducer are sent every 1/1000th second by the AEC via the encoder port (see Chapter 4, *Operation at Startup*). If synchronization of incremental position updates is required by your application, the controller hardware must be capable of generating periodic strobe pulses as described in this section. The following diagram and table outline the parametric requirements for an incremental strobe period.

Figure 19 Incremental Strobe Period Protocol



Incremental Strobe Timing Period

Parameter	Min	Max
Tinc (Incremental strobe period = Ts1 + Ts1s1)	1ms	60ms
Ts1 (Strobe1 active pulse width)	0.005ms	10ms
Ts1s1 (Time from Strobe inactive to next active strobe)	Ts1pe	30000 - Ts1
Ts1pe (Time from Strobe inactive edge to end of position increments)		*Maximum Delta Count

* Position increment must not exceed the maximum Delta Count rate during Ts1s1. The count rate is equal to the encoder channel frequency times four (4X encode).

The Strobe (Ts1) must be active for a minimum of 5µs, but less than 5ms to be a valid incremental strobe. When the strobe goes inactive, the AEC interrogates the transducer position and sends any incremental change from the previous sample. The time (Ts1pe) to transmit the incremental position is dependent on the size of the position increment. The position increment must not exceed the maximum delta count allowed between consecutive incremental strobe pulses (Tinc). The period (Tinc) of the strobe must be greater than 1ms, but less than 10ms. This period is constrained by the incremental strobe active time (Ts1) and the time to send the position (Ts1pe).

A

Absolute Position Update, 35
Absolute Strobe Cycle, 47
Absolute Strobe Timing, 48
AEC Product Receiving and Storage Responsibility 5
Allen-Bradley Support 5

C

CE requirements, 12
Common Techniques Used in this Manual 4
Configuration
  GML Commander
    Adding to a Commander Diagram, 32
    Aligning Absolute Encoder, 34
    Selecting Homing Procedure, 33
    Setting the Transducer Resolution, 33
Configuration Switch Tables 30
Connecting the AEC
  to the 1394, 16
  to the 1756-M02AE, 19
  to the Compact, 17
Contents of this Manua 3

D

Definitions
  encoder, 4
  transducer, 4
Description, 7

E

European Union Directives
  EMC Directive, 12

F

Fault Indication
  Encoder Faults, 38
  Internal Faults, 39
  No Faults, 39
  Transducer Faults, 38
Features, 8
Fuse, 32

I

Incremental Position Output, 35
Incremental Strobe Period, 49

M

Mounting the AEC
  next to a 1394, 14
  next to a Compact, 15

P

Pin Functions
  Control Connector, 26
  Power Supply, 28
  SSI Connector, 22
Pin Numbering
  Control Connector, 26
  Power Supply, 28
  SSI Connector, 23
Position at Start-up, 36
Powering the AEC, 34
Purpose of this Manual 1

R

Read This Manual 1
Related Documentation 3
Rotary Switches
  Setting, 29
  Switch A, 30
  Switch B, 31

S

Safety Precautions 2
Specifications
  Connector Locations
    Control, 41
    Encoder, 41
    Power, 42
    SSI, 41
  Environmental, 42
  Mechanical, 42
  Mechanical,
  Module, 43
  Package, 9
  Pin Numbers, 41
Strobe Position
  Absolute Position Transfer Protocol, 48
  Incremental Strobe Period Protocol, 49
  Incremental Strobe Timing Period, 50
Support
  Allen-Bradley, 5

local product, 5
technical product assistance, 6
support
On the Web 6

T

Terminology 4

W

Who Should Use this Manual 1
Wiring
Cable Flying Leads, 21
Control Connector
Analog Servo, 26
Fault Relay 24
Power Supply, 27
SSI Connector, 22
World Wide Web site 6

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