Allen-Bradley

4 or 8 Way Encoder Buffer Unit

(Cat. Nos. 4100-EF04, 4100-EF08)

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:

WARNING

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 — Using This Manual

Chapter 1 — Overview

Chapter 2 — Installation

Chapter 3 Operation

Appendix A Accessories

Index

Read This Manual

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

- Who should use this manual
- The purpose of this manual
- Terminology
- 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 or set up of the Encoder Buffer Unit in either its 8 or 4 way configuration.

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

Purpose of this Manual

This manual is an installation and set up guide for the Encoder Buffer Unit in both its 8 and 4 Way configurations. It describes the procedures necessary to properly install and configure it into your motion control system. Apart form the number of outputs both units are identical and the information in this manual applies equally to both. Where it is necessary to differentiate between them, this is clearly indicated in the text.

Safety Precautions

The following general precautions apply to the Encoder Buffer Unit:

WARNING

Electric shock can kill. Make sure the Encoder Buffer Unit 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.

WARNING

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 Encoder Buffer Unit 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 Encoder Buffer Unit, its features and mechanical specifications.
2	Installation	Provides the steps needed to successfully mount and wire the Encoder Buffer Unit.
3	Operation	Provides information on using the Encoder Buffer Unit.
Appendix A	Accessories	Contains a list of principle accessories available for use with the Encoder Buffer Unit

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
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
Instructions for using the Ultra Plus	1398 Ultra plus User Manual	1398-5.1
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:

Encoder Buffer Unit - Refers to the product in general terms where the information applies to both the 8 Way and 4 Way configurations.

ESRS - Refers to the Encoder Signal Reference Simulator.

Way - Refers to the number of channels on the Encoder Buffer Unit.

8 Way- Refers to the Encoder Buffer Unit when configured for 8 follower outputs.

4 Way- Refers to the Encoder Buffer Unit when configured for 4 follower outputs.

System Control Encoder - Is used interchangeably with Master Encoder.

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.
- When we refer you to another location, the section name appears in italics.
- An **Important Table** as shown below provides information that is necessary to successful use and understanding of the product.

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

- The exclamation point inside of a triangle indicates circumstances that can lead to personal injury, death, property damage or economic loss. See example below.

WARNING 	Failure to observe these warnings may cause damage to the unit, unexpected and/or uncontrolled movement of peripheral equipment, and your health and safety.

Product Receiving & 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 numbers are:

For Europe: (+44) 1270 580142

For North America: 1-603-443-5419

On the Web

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

http://www.ab.com/

Overview

Encoder Buffer Unit Description

The Encoder Buffer Unit is a DIN rail mounting module designed to duplicate the master incremental quadrature pulse train with index. The device accepts the master incremental signals at connector P2, buffers them, and makes a duplicate of them available on all follower outputs.

Provided the format of the signal at the master input is TTL level RS422, the Encoder Buffer Unit is not concerned about its source. Therefore, an encoder (the master encoder) can be connected to this input or other hardware items such as an ESRS (Encoder Signal Reference Simulator) can be used.

Encoder Buffer Unit Principal Features

- Selectable “As Master” or “Reversed” of quadrature A & B phases to provide an electrical reverse at the buffer outputs.
- Selectable 5V or 12V Master encoder supply.
- Individually selectable 5V power to follower outputs.
- Individual 5V and 12V power supply OK indicators.
- Product housed in a rugged DIN rail mounting PCB tray with integral mounting feet.
- Powered from a single +24V DC supply.

Encoder Buffer Unit Principal Specifications

Mechanical Specifications

Table 1.A Mechanical Specifications

Enclosure Type	Plastic DIN rail mounting tray with integral feet.	
Enclosure Size, 8 Way	English (inch) 16.90 x 3.00 x 2.50	Metric (mm) 430 x 76 x 64
Enclosure Size, 4 Way	English (inch) 11.6 x 3.00 x 2.50	Metric (mm) 294 x 76 x 64

Environmental Specifications

Table 1.B Environmental Specifications

	Operating	**Storage**
Temperature	0 to 60°C	-40 to 70°C
Humidity	95% non condensing @ 60°C	

Power Supply

Power Input Specifications

Table 1.C Power Specifications Input

Input Voltage Range	+18 to +36V DC.
Reverse Polarity Protection	Yes
Maximum Input Current, 8 Way	Approx. 1.1A at 18V Supply Approx. 0.80A at 24V Supply Approx. 0.70A at 36V Supply
Maximum Input Current, 4Way	Approx. 0.70A at 18V Supply Approx. 0.60A at 24V Supply Approx. 0.50A at 36V Supply
Inrush	Approx. 5 times maximum input current

Note: The above input currents are drawn when full rated current is drawn from the master and all outputs.

Encoder Power Supply (master socket)

Table 1.D Encoder Power Supply (master socket)

Output Voltages	+5V or +12V DC. Both ± 7.5%.
Maximum Output Current	0.75A DC 5V DC Selected 0.25A DC 12V DC Selected
Overcurrent Protection	Both supplies are short circuit and over temperature protected.

Follower Outputs

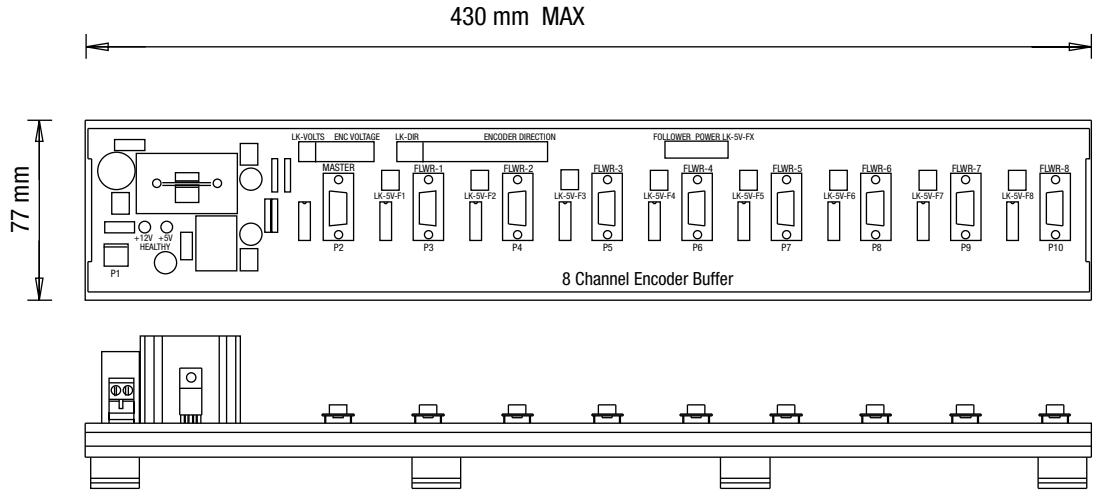
Table 1.E Follower Outputs

Number of follower outputs.	8 or 4
Output data type.	RS422 TTL Levels
Output phase definitions.	"As Master" is defined as the A & B phases from the master input remaining unchanged at the follower outputs. "Reversed" is defined as the A & B phases from the master input being reversed at the follower outputs.
Power Output	5V DC ± 7.5% at 0.2A maximum per follower output

8 Way Encoder Buffer Unit Mechanical Drawing

(Part Number 4100-EF08 series B)

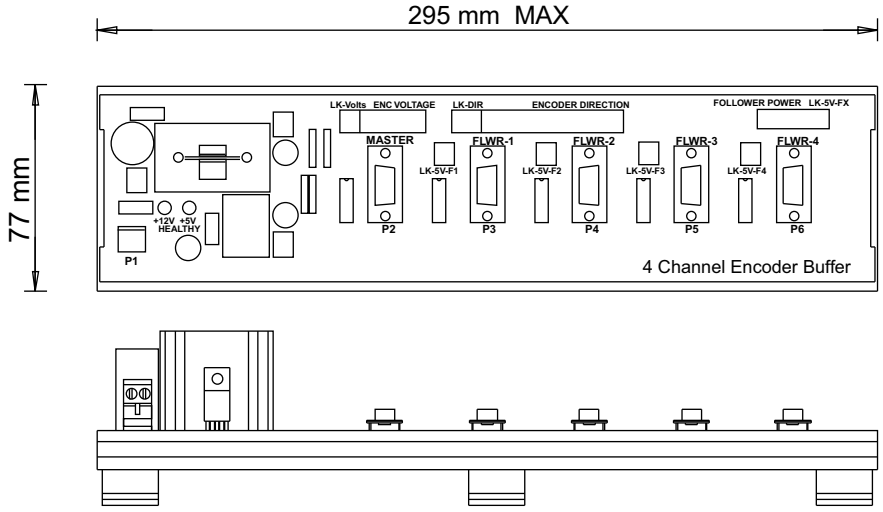
Figure 1.1 8 Way Encoder Buffer Unit



4 Way Encoder Buffer Unit Mechanical Drawing

(Part Number 4100-EF04 series B)

Figure 1.2 4 Way Encoder Buffer Unit



Installation

The Encoder Buffer Unit is designed to be mounted in an electrical cabinet via its integral mounting feet. For all applications, this installation method should be observed. Before powering up your Encoder Buffer Unit, make sure it has been configured correctly and that all peripheral equipment has been correctly connected to it.

WARNING

A feedback loop must not be closed via the Encoder Buffer Unit. Use of this Buffer in the feedback path of a position controller disables any "encoder loss" detection function which can cause a runaway condition.

Failure to observe these warnings will cause unexpected and/or uncontrolled movement of peripheral equipment. This may cause damage to the equipment and to your health and safety.

WARNING

Do not apply power to your Encoder Buffer Unit when it is part of a control system without first establishing that this will not have any adverse effects.

Do not make or break any electrical connections to your Encoder Buffer Unit while power is applied.

Do not change any selection link settings on your Encoder Buffer Unit while power is applied.

Failure to observe the above warnings may cause damage to the follower unit, unexpected and/or uncontrolled movement of peripheral equipment and your health and safety.

The following safety points must be observed when installing the unit:

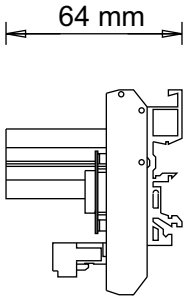
- The 24V DC supplies must be electrically isolated from all other supplies with higher potentials.
- The 0V (common) side of the 24V DC supply must be connected to a safety ground.
- The unit is intended for installation and use within an electrical control cabinet in a normal industrial environment.

IMPORTANT System designers should take care to avoid long encoder cable runs when using a 5V encoder. If cable volt drop is a problem, the use of a 12V encoder is recommended.

Mounting the Encoder Buffer Unit

The Encoder Buffer Unit is mounted onto a DIN rail using the mounting feet on the back of the board.

Figure 2.1 Encoder Buffer Unit DIN Rail Mounting Foot

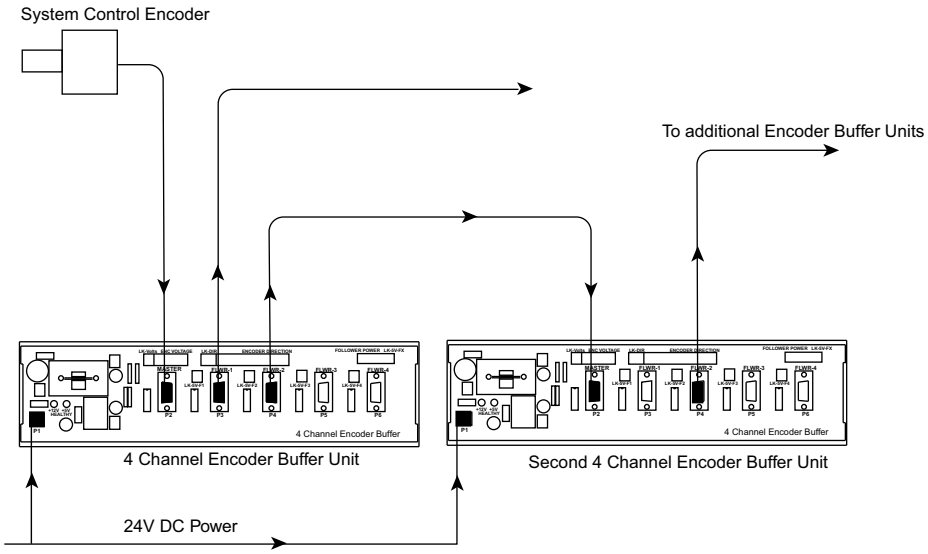


Typical Applications

This section illustrates some typical applications for the Encoder Buffer Unit. Although the 4 channel unit is shown in the diagrams, all applications apply equally to the 8 channel unit. A range of cables and other accessories are available for use with this product – see the table in Appendix B - Accessories.

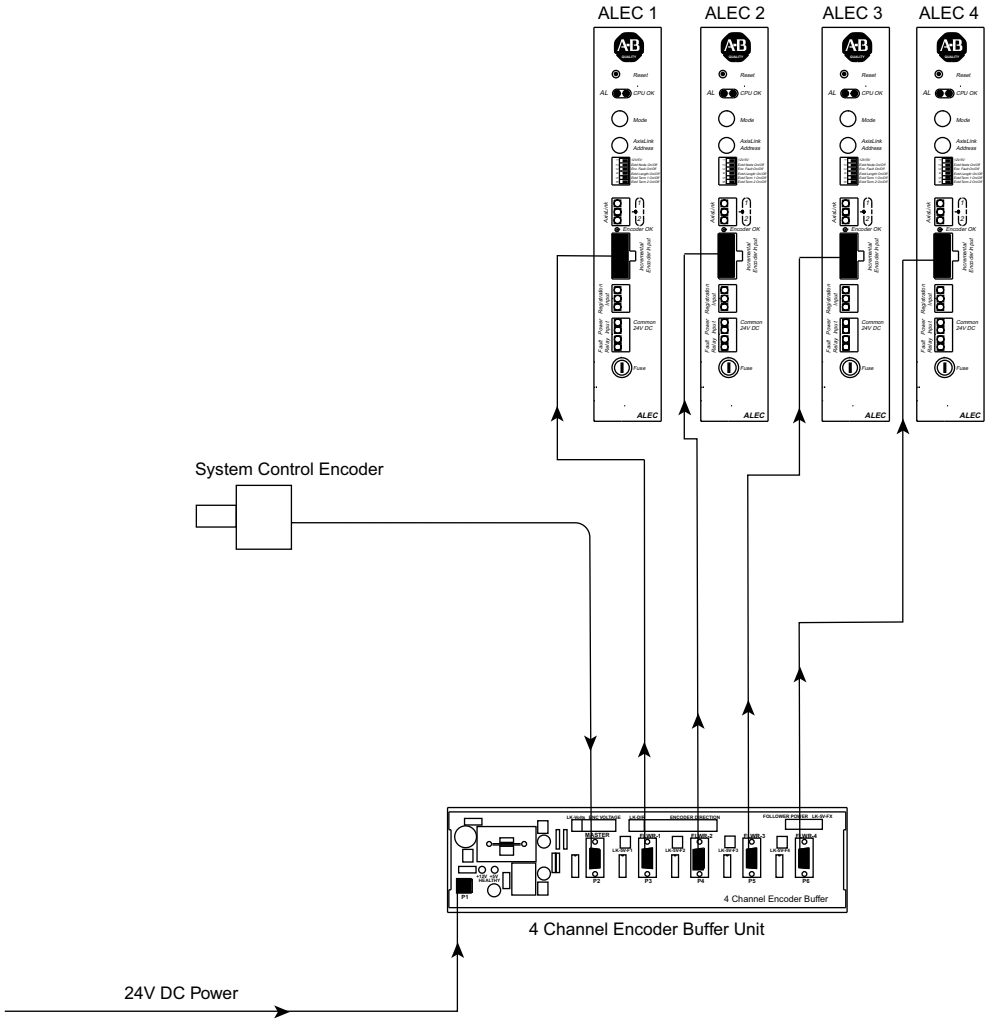
The following diagram shows two units connected in cascade. The cable, which connects P4 (first unit) to P2 (second unit), must join only the following pins: 1, 2, 3, 4, 5, 6, 10 &15.

Figure 2.2 EBU Units Connected in Cascade



This diagram shows a system control encoder, in the stand-alone mode, connected to the master input of the 4 Channel Encoder Buffer and an ALEC module being driven off each follower output.

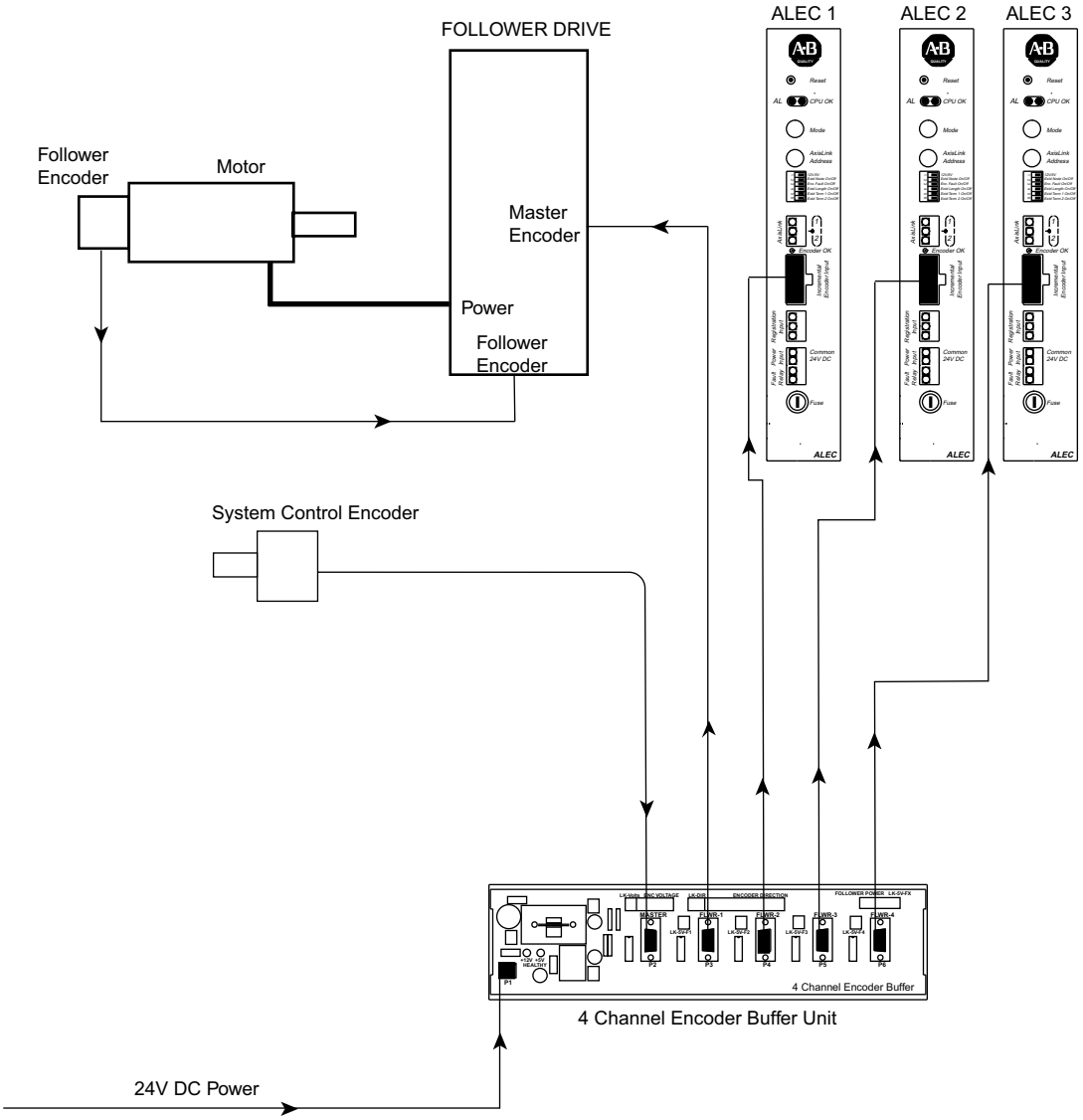
Figure 2.3 4 Way EBU and ALEC



This diagram shows a system control encoder used in the stand-alone mode and connected to the master input of the 4 Channel Encoder Buffer Unit. One follower output is connected to the “Master Encoder” input on a follower drive (this drive must be in the encoder follower mode). With this arrangement, the follower encoder follows the system control encoder, taking into account any gearing, etc. configured in the drive.

ALEC units are also shown connected to other follower outputs demonstrating that a combination of ALEC modules and follower drives is permissible.

Figure 2.4 4 Way EBU with Follower Drive



IMPORTANT P3 is the only output to which the motor thermal information and analog position reference are brought out. Only this output should be used to complete the encoder feedback loop.

Operation

General

Your Encoder Buffer Unit is fitted with a range of indicators, I/O ports and links to allow easy configuration and use. This section explains the function and operation of these and provides additional technical data where appropriate.

Indicators

Two green LED indicators are provided on the Encoder Buffer Unit front panel to give you at-a-glance information regarding the status of the Encoder Buffer Unit. When they are both lit the encoder power supply are healthy.

Inputs and Outputs

The following digital I/Os are provided with the Encoder Buffer unit. The only difference between the 4 Way and the 8 Way is the number of Follower Outputs available.

Master Input

The Master input (P2) receives the signal from the master encoder or other peripheral equipment. It has a 15 way male high density D socket that connects the Master Encoder cable to the Encoder Buffer Unit.

The following table shows the pin outs for the connector.

Table 3.A Master Connector Pin Layout

Pin Number	Signal Name
1	A+
2	A-
3	B+
4	B-
5	I+ (Z+)
6	Encoder Return
7	Encoder Return
8	Encoder Supply
9	Encoder Supply
10	I- (Z-)
11*	Motor Thermal

Table 3.A Master Connector Pin Layout

12*	Motor Thermal
13*	Absolute Position
14	No Connection
15	Shield
* This pin configuration is for IQ and Ultra Plus drives only.	

Follower-1 Output

The Follower-1 Output (P3) allows the user to connect a follower drive or other peripheral equipment to the Encoder buffer Unit. The connector is a 15 way male high density D plug.

Note: The Motor Thermal and analog position reference are brought out through this follower connector.

Table 3.B Follower-1 Output Connector Pin Layout

Pin Number	Signal Name
1	A+
2	A-
3	B+
4	B-
5	I+ (Z+)
6	Encoder Return
7	Encoder Return
8	No Connection
9	5V DC (optional)
10	I- (Z-)
11*	Motor Thermal
12*	Motor Thermal
13*	Absolute Position
14	No Connection
15	Shield
* This pin configuration is for IQ and Ultra Plus drives only.	

Follower-2 to 4 or 8 Outputs

The Follower-2 through Follower-4 (4 Way unit) or Follower-2 through Follower-8 (8 Way unit) outputs let you connect to follower drives or other devices. The connector is a 15 way male high density D plug.

Note: The Motor Thermal and analog position reference are **NOT** brought out to these follower connectors.

The pin layout for these connectors is illustrated in the following table.

Table 3.C Follower-2 through 4 (or 8) Pin Layout

Pin Number	Signal Name
1	A+
2	A-
3	B+
4	B-
5	I+ (Z+)
6	Encoder Return
7	Encoder Return
8	No Connection
9	5V DC (optional)
10	I- (Z-)
11	No Connection
12	No Connection
13	No Connection
14	No Connection
15	Shield

Configuration Links

Configuration links have been provided on the Encoder Buffer Unit to let you set the Encoder Supply Voltage, Encoder Direction, and Follower Power. The Configuration Links are a series of pins and two-way jumpers. The required configuration is set by connecting the pins with the two-way jumpers as specified in the following directions.

Encoder Supply Voltage

The Encoder Buffer Unit lets you set the Encoder Supply voltage to either +5V DC or +12V DC. This is done through the three-way link marked LK-VOLTS . Where you place the two-way jumper determines the supply voltage.

The Encoder Supply Voltage is set by placing the two-way jumper so that is connects the link pins in the following sequence:

For a 12V Encoder Supply, Link 1- 2.

For a 5V Encoder Supply, Link 2 – 3

The following diagram shows the layout of the links that select encoder supply voltage.

LK-VOLTS	ENC VOLTAGE
n 1 n 2 n 3	 Link 1 – 2 = 12V Link 2 – 3 = 5V

The default setting is for +5V DC.

Encoder Direction

The Encoder Direction is set with the Configuration Link marked LK-DIR. This is four links arranged in a square with 2 two-way jumpers. The direction can be set to either As Master or Reversed.

When the configuration link is set in the As Master position, the quadrature pulse train at the follower outputs are in phase with those produced by the encoder.

When the configuration link is set in the Reversed position, it changes the A&B phases produced by the Master encoder such that, when viewed at a follower output, the encoder appears to be rotating in the opposite direction (i.e. Reversed produces an electrical direction reverse.) The Index pulse gating is not affected. All follower outputs are reversed simultaneously.

To set the Encoder Direction to As Master, move the 2 two-way jumpers to link 1- 2 & 3 - 4.

To set the Encoder Direction to Reversed, move the 2 two-way jumpers to link 1 - 3 & 2 - 4

The following diagram shows the layout of the links that select encoder direction as laid out on the Encoder Buffer Unit.

LK-DIR	ENCODER DIRECTION
1 n n 2	Link 1 – 2 & 3 – 4 = As Master
3 n n 4	Link 1 – 3 & 2 – 4 = Reversed

The default setting is As Master.

WARNING

A feedback loop must not be closed via the Encoder Buffer Unit. Use of this Buffer in the feedback path of a position controller disables any "encoder loss" detection function which can cause a runaway condition.

Failure to observe these warnings will cause unexpected and/or uncontrolled movement of peripheral equipment. This may cause damage to the equipment and to your health and safety.

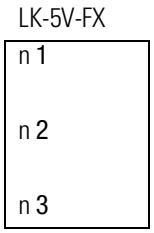
Follower Power

The Follower Power configuration link sets the follower output to either unpowered or powered. There is one Configuration Link for each follower channel, marked LK-5V-F1 etc. These are three-way links with two-way jumpers. In the powered state, the follower supplies +5V output power.

To set the Follower output to unpowered, link 1- 2 with the two-way jumper.

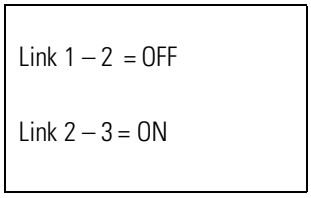
To set the Follower output to powered, Link 2 - 3 with the two-way jumper.

The following diagram shows the layout of the links that select encoder supply voltage. These are located to the left of the Follower Output that they effect and are numbered accordingly.



The following diagram shows the text indicating the selection options for the Follower Outputs. It is located in one location near the top of the board.

FOLLOWER POWER
LK-5V-FX



The default setting is unpowered (OFF).

Accessories

Principle Accessories

This section lists the principle accessories available for use with this product. It includes cables for connecting the Encoder Buffer Unit to Master Encoders and other devices.

Table 0.A Principle Accessories

Crimped flying leads to 15 way high density D socket. Supplied with loose 12 way AMP connector shell which can be used for 1394 or ALEC. User connection drawing for 1394 & ALEC included. Red and Black wires for the 1394 5V encoder supply included.	Crewe Part number	44-0268-XXX
	Crewe Description	8 or 4 Channel Buffer to 1394 or ALEC
	Passport No.	4100-EFCCXXX
	Passport Description	Encoder Fanout Board to 1394 cable
Un-crimped flying leads to 15 way high density D plug compatible with EF08/04 Master socket. Allows customers to connect non-standard encoder to EFO08/4. Data sheet defining pin-out and color included. Has encoder power connected to pin 9.	Crewe Part number	44-0269-XXX
	Crewe Description	Flying lead to 8/4 Channel Buffer I/P
	Passport No	4100-EFCEXXX
	Passport Description	Encoder Fanout Board to Encoder Flying leads.
MIL spec 10way (18-1) socket to 15 way high density D plug compatible with EF08/04 Master socket. Connects 845 encoder (or equivalent) to EF08/04. Has encoder power connected to pin 9.	Crewe Part number	44-0192-XXX
	Crewe Description	5V & 12V encoder to 8/4 Channel Buffer I/P
	Passport No.	N/A
	Passport Description	N/A
Fitted 12 way AMP connector to 15 way high density D socket. Dedicated for 1394 only and supplied with user sheet for external 5V connection.	Crewe Part number	44-0254-XXX
	Crewe Description	8/4 Channel Follower to 1394 only
	Passport No.	N/A
	Passport Description	N/A

Table 0.A Principle Accessories

Fitted 12 way AMP connector to15 way high density D socket. Dedicated for ALEC only. No other data supplied as it is not required	Crewe Part number	44-0249-XXX
	Crewe Description	8/4 Channel Buffer to ALEC only
	Passport No.	N/A
	Passport Description	N/A
15 way high density D socket to 15 way high density D plug compatible with EF08/04 Master socket. Cable connects EF08/04 to ESRS or to IQ2000 or UltraPlus.	Crewe Part number	44-0280-XXX
	Crewe Description	IQ2000 to ESRS
	Passport No.	4100-EFCS
	Passport Description	Encoder Fanout Board to ESRS
This unit generates a variable frequency bi-directional quadrature pulse train with index at selectable counts. The unit excepts an external speed command, produces a commanded velocity output and provides a square wave strobe locked to the index pulse. Same size as the AEC and REC.	Crewe Part number	9103-0170
	Crewe Description	ESRS
	Passport No.	4100-ESRS
	Passport Description	Encoder Simulator

NOTE: In the Crewe part numbers for cables, XXX defines the cable length in feet.

www.rockwellautomation.com

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Publication 4100-IN054B-EN-P - January 2001 PN 4100-IN054B
Supersedes Publication 4100-IN054A - November 2000