Modicon
A120 Series I/O Modules
User Guide
Volume 1

890 USE 109 00   Version 4.0

Schneider Electric

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Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death, serious injury, or equipment damage.

WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About the Book

At a Glance

Document Scope

This manual describes the functionality of the Modicon A120 Series I/O Modules.

Validity Note

The data and illustrations found in this book are not binding. We reserve the right to modify our products in line with our policy of continuous product development. The information in this document is subject to change without notice and should not be construed as a commitment by Schneider Electric.

Related Documents

Title of Documentation
IEEE Std 518--1977, Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources
IEEE Std 142--1982, Recommended Practice for Grounding of Industrial and Commercial Power Systems
Noise Reduction Techniques in Electronic Systems, by Henry W. Ott; published by Wiley--Interscience of New York in 1976

Product Related Warnings

Schneider Electric assumes no responsibility for any errors that may appear in this document. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

User Comments

We welcome your comments about this document. You can reach us by e-mail at TECHCOMM@modicon.com

Panel Software Options with A120 I/O Modules

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Panel Software Option with A120 I/O Modules

Overview

This section describes Panel Software options for the A120 series I/O Modules, and related information.

Panel Software Support

The Compact Controllers may be configured, I/O Mapped, and programmed using either Concept panel software, full-feature Modsoft panel software or Modsoft Lite depending upon the model.

Either software package may be installed on the Modicon P230, an IBM-AT, or compatible computer.

Programming and configuration editors used for a Compact are similar to those used for other 984s, special I/O Map screens have been designed for A120 I/O modules.

Concept (E984-258/265/275/285 Only)

Concept may be used with the E984-258/265/275/285 models. Concept contains Function Block Diagram (FBD) and Sequential Function Chart (SFC) programming languages as well as a subset of data types of the international IEC 1131-3 norm. Concept features the following:

- FBD depicts process data flow typically suited for discrete and continuous control applications.
- SFC provides a graphical representation of the process.
- Instruction List is a text-based Boolean language used to build more complex applications.
- EFB is a "C" tool kit that permits you to create custom function blocks.
- Structured Text is ideal to implement complex equations.
- Ladder Diagram (ladder logic) complies with the IEC 1131-3 ladder diagram specification.
- LL984 inside Concept provides the same tools as Modsoft 984 ladder logic.

Concept operates with either: Windows 98, Windows NT, or Windows 2000. The E984-258/265/275/285 models are supported by three different Concept software packages: Concept M (372 SPU 472 01vxx), Concept XL (372 SPU 474 01vxx), and Concept 984 XL (372 SPU 479 0x).

Note: You must use Concept 2.1 or higher to operate the E984-258/265/275/285 models. Modsoft does not support these models.

For a detailed description of Concept and its operations, see the Concept User Manual (840 USE 49300).
Refer to *I/O Configuration with Concept, p. 671*, for a list of A120 I/O modules that are compatible with Concept.

CAUTION

Mode Malfunction Hazard

The output module Time Out States are only valid in a normal PLC stop state. Therefore, when the PLC powers down or goes into kernel mode, the outputs default to the modules fail safe state. The Time Out States are defined in the I/O Map modules parameter screens.

Failure to follow this precaution can result in injury or equipment damage.

Modsoft Lite (A984-1xx, E984-24x/251/255 Only)

Modsoft Lite (371SPU921000) is provided on 3.5 inch diskettes. Standard panel software packages contain the following editors:

Editor	Description
Configuration	Defines controller and communication parameters, allocates memory, accesses controller operations and specials (e.g., battery coil register, timer register, and time-of-day clock)
I/O Map	Links discrete and register reference numbers to modules in the I/O subsystems. Defines I/O data types
Programmer	Generates, edits, monitors ladder logic, and accesses controller
Transfer	Loads programs from disk to controller, records 984 memory to disk, compares programs on disk and in memory
Print	Generates hard copy of user logic program and prints user comments
Environment	Defines default configurations for the panel software (e.g. printer setup, file locations)

For a detailed description of Modsoft lite and its operations, see the Modsoft Lite Programmer User Manual (GM-MSLT-001).

Modsoft-Full-Feature (A984-1xx, E984-24x/ 251/255 Only)

Modsoft full-feature (SW-MSxD-9SA) is an integrated software tool for programming, testing, and documenting application logic for 984 controllers. The full-feature Modsoft package includes all the editor functions available with Modsoft Lite along with enhanced features, including sequential function chart (SFC) and macros.

Sequential Function Charting: SFC allows you to generate programs arranged in steps rather than a linear ladder logic sequence, this is especially suitable for sequential processes. A sequential function chart can solve multiple networks in a parallel link or one in a choice of several networks in a selective link. Logic is solved within a block until a specified transition event informs the CPU to move to the next step. SFC allows application software to be created in a format that more closely emulates an actual machining procedure or process flow; it can help improve system throughput by solving only those networks specified by transition events rather than moving linearly through each network in the program on every scan.

Modsoft macros simplify the task of generating and updating large numbers of repetitive network structures. They allow you to create the repeating structure once, then specify the node values using macro parameters rather than standard 984 reference numbers. Each macro can contain up to 66 macro parameters-by using (*) wild card characters in your naming scheme, you can create thousands of parameters per macro.

> **Note:** If you are using full-feature Modsoft to develop application logic for a Compact system that will be using full Modsoft as its permanent programming software, you must be careful when dealing with SFC and macro ladder logic. You may develop your programs using the /p switch; this switch prevents you from creating SFC logic and does not reserve any registers or coils for SFC use-do not use macros in this case. Alternatively, you may develop programs with SFC and macros, then use the convert-to-file menu in Modsoft to produce an equivalent program in standard ladder logic that will run with other panel software.

For a detailed description of full-feature Modsoft and its operations, see the Modsoft Programmer User Manual (890 USE 115 00).

For a list of A120 I/O modules that are compatible with Modsoft refer to *I/O Configuration of A120 Series I/O Modules with Modsoft, p. 745*

Overview of the ADU 204/254 Analog Input Module

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At a Glance

Purpose

This chapter begins with an overview of the ADU 204/254 Analog Input Module. The chapter continues with discussions on field wiring, the noise suppression DIP switch, and calibration. Finally, the specifications are given, for the ADU 204/254 Analog Input Module.

What's in this Chapter?

This chapter contains the following topics:

What is the ADU 204/254 Analog Input Module?

Brief Product Description

Note: Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The ADU 204/254 is a four-channel analog input module without opto-isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values in the recommended range. It may be used in conjunction with either two-wire +/-500 mV sensor field devices or PT100 four-wire resistance temperature detector (RTD) field devices. The ADU 254 functions just like the ADU 204, except that the ADU 254 operates at extended temperature.

Note: The ADU 254 model is available with conformal coating. The conformal coating model is ADU 254C, which meets Railway standard EN 50 155.

ADU 204/254 Analog Input Module Conversion Ranges

Introduction

The ADU 204/254 is a four-channel analog input module without opto-isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values in the recommended range. It may be used in conjunction with either two-wire +/-500 mV sensor field devices or PT100 four-wire resistance temperature detector (RTD) field devices. The ADU 254 functions just like the ADU 204, except that the ADU 254 operates at extended temperature.

Note: The ADU 254 model is available with conformal coating. The conformal coating model is ADU 254C, which meets Railway standard EN 50 155.

Conversion Ranges

The PLC model determines the ranges. A table is provided below for each of the available ranges:
When the module goes out of range--either over or under range--and then returns to a valid operating range, the module will resume proper operations, unless your out-of-range condition reaches or exceeds the safety range of +/-24 V.

Conversion table for A984-1xx and E984-24x/251/255

The following table gives the ranges for A984-1xx, E984-24x/251/255 PLC models:

Input/Voltage	Data Count (Decimal)	Operating Results
less than or equal to +1 V	0	Under range
-0.99... -0.501 V	1... 2048	
-500 mV ... 0 mV ...	2049 ... 4096 ...	up arrow ... Recommended operating range ...
+500 mV	6143	0
+0.501... +0.99 V	6144... 8191	
greater than or equal to +1 V	8192	Over range

Conversion table for Pt 100 -200 degrees C to 850 degrees C for E984-258/265/ 275/285

The ranges for Pt 100 -200 degrees C to 850 degrees C for E984-258/265/275/285 PLC models are:

Temp (degrees C)	**1.0 degrees C**	**0.1 degrees C**	**1.0 degrees F**	**0.1 degrees F**	**13-bit**	**15-bit + sign**	**Measuring step/value range**
less than -205	-32768	-32768	-32768	-32768	0	-32768	Under range
-200	-200	-2000	-328	-3280	3132	-7529	Nominal range
0	0	0	+32	+320	4096	0	
+850	+850	+8500	+1562	+15620	8191	32000	
greater than +870	+32767	+32767	+32767	+32767	8191	+32767	Over range

Conversion table for Pt 200 -200 degrees C to 250 degrees C for E984-258/265/ 275/285

The ranges for Pt 200 -200 degrees C to 250 degrees C for E984-258/265/275/285 PLC models are:

Temp (degrees C)	**1.0 degrees C**	**0.1 degrees C**	**1.0 degrees F**	**0.1 degrees F**	**13-bit**	**15-bit + sign**	**Measuring step/value range**
less than -205	-32768	-32768	-32768	-32768	0	-32768	Under range
-200	-200	-2000	-328	-3280	819	-25600	Nominal range
0	0	0	+32	+320	4096	0	
+250	+250	+2500	+482	+4820	8191	32000	
greater than +256	+32767	+32767	+32767	+32767	8191	+32767	Over range

Conversion table for Ni 100 -60 degrees C to 250 degrees C for E984-258/265/275/285

The ranges for Ni 100 -60 degrees C to 250 degrees C for E984-258/265/275/285 PLC models are:

Temp (degrees C)	1.0 degrees C	0.1 degrees C	1.0 degrees F	0.1 degrees F	13-bit	15-bit + sign	Measuring step/value range
less than -61	-32768	-32768	-32768	-32768	0	-32768	Under range
-60	-60	-600	-328	-3280	819	-25600	Nominal range
0	0	0	+32	+320	4096	0	
+250	+250	+2500	+482	+4820	8191	32000	
greater than +256	+32767	+32767	+32767	+32767	8191	+32767	Over range

Conversion table for Ni 200 -60 degrees C to 150 degrees C for E984-258/265/275/285

The ranges for Ni 200 -60 degrees C to 150 degrees C for E984-258/265/275/285 PLC models are:

Temp (degrees C)	1.0 degrees C	0.1 degrees C	1.0 degrees F	0.1 degrees F	13-bit	15-bit + sign	Measuring step/value range
less than -61	-32768	-32768	-32768	-32768	0	-32768	Under range
-60	-60	-600	-76	-760	2458	-12800	Nominal range
0	0	0	+32	+320	4096	0	
+150	+150	+1500	+302	+3020	8191	32000	
greater than +151	+32767	+32767	+32767	+32767	8191	+32767	Over range

Conversion table for APt100 -200 degrees C to 600 degrees C for E984-258/265/275/285

The ranges for APt100 -200 degrees C to 600 degrees C for E984-258/265/275/285 PLC models are:

Temp (degrees C)	1.0 degrees C	0.1 degrees C	1.0 degrees F	0.1 degrees F	13-bit	15-bit + sign	Measuring step/value range
less than -205	-32768	-32768	-32768	-32768	0	-32768	Under range
-200	-200	-2000	-328	-3280	2731	-10667	Nominal range
0	0	0	+32	+320	4096	0	
+600	+600	+6000	+1112	11120	8191	32000	
greater than +614	+32767	+32767	+32767	+32767	8191	+32767	Over range

Conversion table for APt200 -200 degrees C to 250 degrees C for E984-258/265/275/285

The ranges for APt200 -200 degrees C to 250 degrees C for E984-258/265/275/285 PLC models are:

Temp (degrees C)	1.0 degrees C	0.1 degrees C	1.0 degrees F	0.1 degrees F	13-bit	15-bit + sign	Measuring step/value range
less than -205	-32768	-32768	-32768	-32768	0	-32768	Under range
-200	-200	-2000	-328	-3280	819	-25600	Nominal range
0	0	0	+32	+320	4096	0	
+250	+250	+2500	+482	+4820	8191	32000	
greater than +256	+32767	+32767	+32767	+32767	8191	+32767	Over range

Conversion table for R, 0 to 400 ohms for E984-258/265/275/285

The ranges for R, 0 to 400 ohms for E984-258/265/275/285 PLC models are:

Resistance in ohms	13-bit	15-bit + sign	Value range
0	0	0	Recommended nominal range
100	2048	+8000	
200	4096	+16000	
399.902	8191	+32000	
Greater than or equal to 400	8191	+32767	Over range

Note: In RTD applications, the internal precision source forces a 2.5 mA current through the resistance. For a PT 100 RTD, a range of 18.49... 390.25 ohms would correspond to -200... +850 degrees C; the values 80.31 ohms (-50 degrees C) to 194 ohms (+250 degrees C) are in the recommended range. Consult your RTD data book for the appropriate linearization equations for your field device.

WARNING

Unit Damage Hazard

Operation at an extreme out-of-range voltage--at or beyond +/-24 V--will cause permanent damage to the module.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

The ADU 204/254 operates off the 5 V supply voltage provided internally over the I/O bus.

ADU 204/254 Analog Input Module Field Wiring and LED Displays

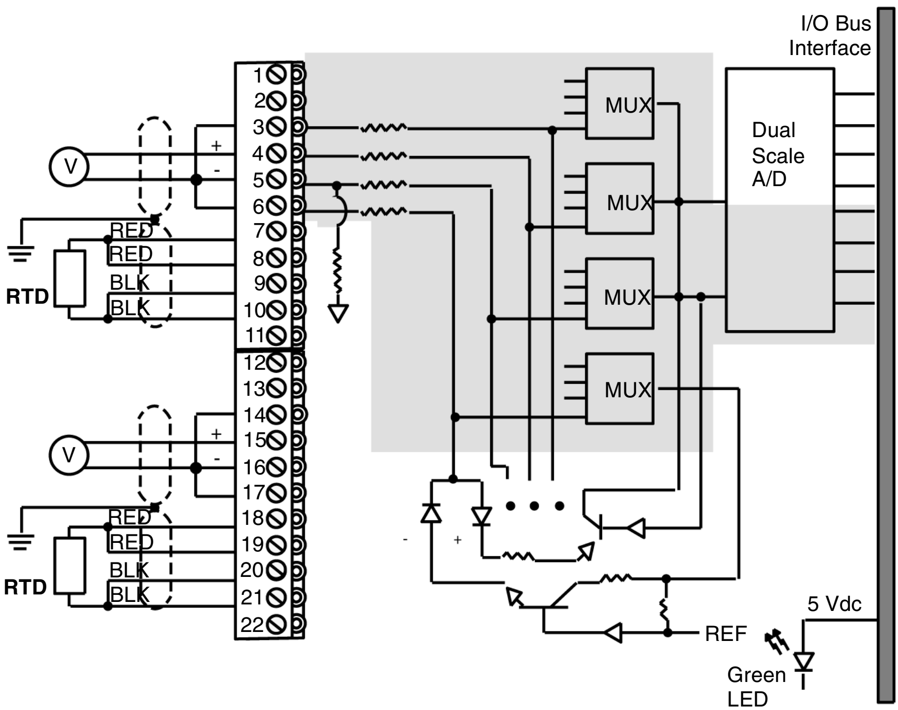
Introduction

The ADU 204/254 module may be field wired for any combination of RTD or 500 mV inputs at its four analog channels.

> **Note:** Unused inputs should always be jumpered. Therefore, jumper pins 3 ... 6 for channel 1, pins 7 ... 10 for channel 2, pins 14 ... 17 for channel 3, pins 18 ... 21 for channel 4.

Wiring Diagram

The following illustration is a wiring diagram and simplified schematic for the ADU 204/254 analog input module.



ADU 204/254 Analog Input Module LED

The ADU 204/254 has one green LED opposite terminal screw 1, used to indicate the presence of the 5 V power supply from the backplane.

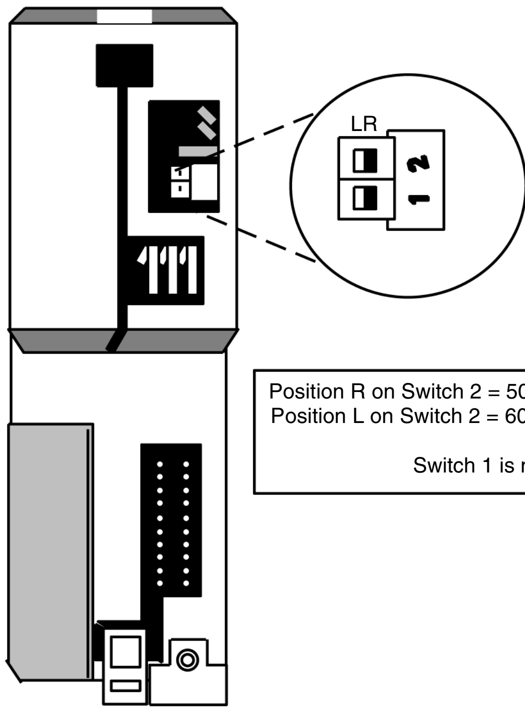
ADU 204/254 Analog Input Module Noise Suppression DIP Switch

Introduction

A two-position DIP switch on the back of the ADU 204/254 can be set to protect the module from external noise interference.

Changing the Switch Setting

The factory setting is for 50 Hz voltage interferences. By alternating the switch position, you can set the device for 60 Hz noise suppression.
The following illustration shows the noise suppression switch on the rear of the ADU 204/254.



Position R on Switch 2 = 50 Hz Noise Suppression
Position L on Switch 2 = 60 Hz Noise Suppression

Switch 1 is not used

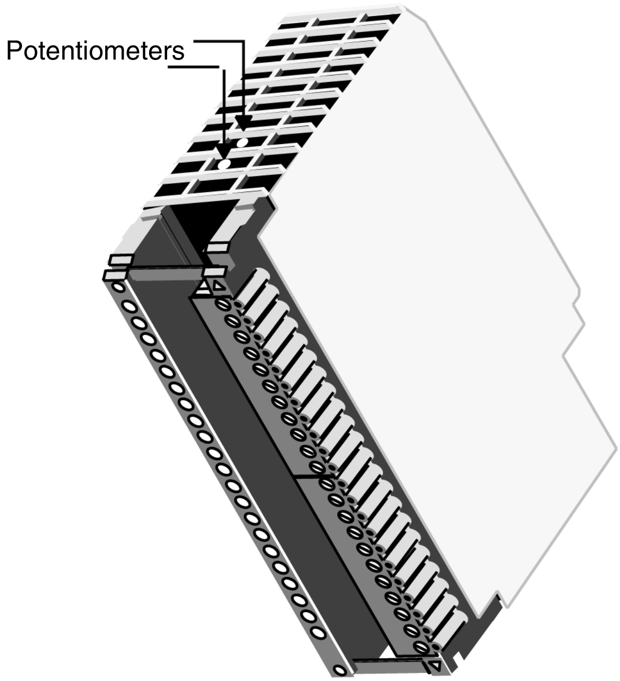
ADU 204/254 Analog Input Module Calibration

Introduction

By adjusting the two potentiometers on the top of the ADU 204/254, you can calibrate the four analog input channels to an accuracy of +/-3 counts over the recommended linear count range of the module (2049... 6143).

Calibrating the Analog Input Channels

The following illustration shows the location of the potentiometers on the ADU 204.

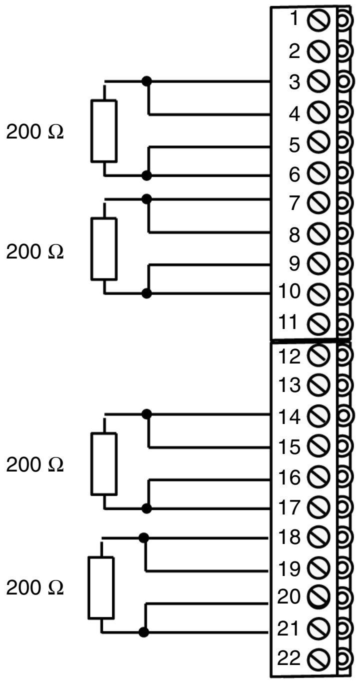


To adjust the potentiometers:

Adjusting the Potentiometers

The following are the steps to adjust the potentiometers on the 204/254 Input Module:

Step	Action
1	Stop your A984-1xx controller.
2	Using the DIP switch on the back of the module, set it for the desired noise suppression.
3	To calibrate all analog channels, install a precision 200 ohm (+/-1%) resistor across each input, as instructed below. **Note:** Make sure all jumper wires are the same length and resistor/wire connections are of high quality.
4	Identify the active input point by taking a precision multimeter and connecting it across each of the 200 ohm resistors. Only one point will display approximately 500 mV; the other three points will equal 0 mV. The identified point is the last point polled by the A/D converter, and is the only point presently outputting the 2.5 mA constant current source.
5	Having identified the active input point, use the precision Multimeter to adjust potentiometer "A" for a reading of 500 mV (+/-100 mV). This adjustment calibrates the internal 2.5 mA constant current source.
6	START the 984-1xx controller and enter the Online Reference screen to view the input values associated with the ADU 204: 3XXX16143 3XXX26143 3XXX46143 3XXX36143 You need one input data register per channel.
7	Adjust Potentiometer "B" for an input of 6143 (+/-3 counts). This adjustment sets up the overall A/D converter accuracy for all four inputs.
8	When you are satisfied with the readings on all channels, drop a bead of sealing varnish on each potentiometer to secure its setting.

Step	Action
9	The following illustration shows a 200 ohm resistor across each Input on the ADU 204. 

ADU 204/254 Analog Input Module Specifications

Table of Specifications

The following table contains a list of ADU 204/254 specifications.

Module Topology	Number of Channels	4	
	Isolation	Non-isolated, channel-to-bus or channel-to-channel	
	Signal types supported	Two-pole voltage inputs	
		Four-pole RTD inputs	
Required Loadable	SW-IODR-001		
Power Supply	Internally provided source	5 V, less than 50 mA from I/O bus	
DIN Rail Grounding	Less than 0.1 ohms		
Voltage Input Capabilities	Linear Measuring Range	+/-0.5 V nominal	
	Channel over range delay	250 ms at +/-1 V, corresponding to the maximum negative or positive decimal value	
	Input Impedance	greater than 10M ohms	
	Input Voltage	24 V maximum	
	Wire Size	One wire	14 AWG
		Two wires	20 AWG
RTD Input Capabilities	PT100 RTD Impedance Range	18.49 ... 390.26 ohms	
	Temperature Measuring Range	-200 ... +850 degrees C	
	Resolution	0.25 degrees C	
A/D Conversion	Conversion Time	@4096 in	80 ms/input (max) @ 50 Hz suppression
		@2048 in	66.6 ms/input (max) @ 60 Hz suppression
			60 ms/input (max) @ 50 Hz suppression
			50 ms/input (max) @ 60 Hz suppression
	Resolution	12 bits recommended range (+1)	
	In-range Error Limit	0.4% of input value @ 0 ... 60 degrees C	
	Nonlinearity	+/-2 counts @ 0 ... 60 degrees C	

<table>
<tr><td>Environmental Characteristic</td><td>Operating Temperature</td><td>0 ... 60 degrees C for ADU 204
-40 ... +70 degrees C for ADU 254</td></tr>
<tr><td>I/O Map</td><td>Register 3x/4x</td><td>4 in/0 out</td></tr>
<tr><td colspan="2" rowspan="2">Dimensions (WxHxD)</td><td>40.3 x 145 x 117.5 mm</td></tr>
<tr><td>1.6 x 5.6 x 4.5 in</td></tr>
<tr><td colspan="2" rowspan="2">Weight</td><td>220 g</td></tr>
<tr><td>.5 lb</td></tr>
<tr><td rowspan="2">Agency Approvals</td><td colspan="2">ADU204: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards.</td></tr>
<tr><td colspan="2">ADU254C: Railway standard EN 50 155; and European Directive EMC 89/336/EEC Standards. UL 508; CSA 22.2 No. 142; FM Class I, Div 2 pending.</td></tr>
</table>

Overview of the ADU 205 Analog Input Module

3

At a Glance

Purpose

The purpose of this chapter is to describe the ADU 205 analog input module.

What's in this Chapter?

This chapter contains the following topics:

What is the ADU 205 Analog Input Module?

Brief Product Description

The ADU 205 is a four-channel analog input module without opto-isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values plus sign. It can handle either voltage inputs in the range of +/- 20 V or current inputs in the range of +/-40 mA. The linear input data range is from 2049 ... 6143.

ADU 205 Analog Input Module Conversion Ranges

Introduction

The ADU 205 is a four-channel analog input module without isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values plus sign. It can handle either voltage inputs in the range of +/- 20 V or current inputs in the range of +/-40 mA. The linear input data range is from 2049 ... 6143. The PLC model determines the available ranges. Refer to the tables below.

A984-1xx, E984-24x/251/255 PLC Models

A984-1xx, E984-24x/251/255 PLC Models

Input Signals			
Voltage	**Current**	**Data Count (Decimal)**	**Operating Results**
<= -20 V	<= -40 mA	0	Under Range
-19.99 ... -10.001 V	-39.99 ... -20.1 mA	1 ... 2048	
-10 V ... 0 V ... +10 V	-20 mA ... 0 mA ... +20 mA	2049 ... 4096 ... 6143	↑ ... Recommended operating range ... ↓
10.001 ... 19.99 V	20.1 ... 39.99 mA	6144 ... 8191	
>= +20 V	>= 40 mA	8192	Over range

+/-20 mA, +/-40 mA for E984-258/265/275/285 PLC Models

+/-20 mA, +/-40 mA for E984-258/265/275/285 PLC Models

Input current (mA)	**12-bits**	**13-bits**	**16-bits**	**12-bits + sign**	**15-bits + sign**	**Range**
<-20/-40	0	0	0	-4095	-32768	Under-range
-20/-40	0	0	0	-4095	-32000	Nominal range
0	2048	4096	32768	0	0	
+20/+40	4095	8191	65520	+4095	+32000	
>+20/+40	4095	8191	65520	+4095	+32767	Overrange

+/- 10 VDC, +/- 20 VDC for E984-258/265/275/285 PLC Models

+/- 10 VDC, +/- 20 VDC for E984-258/265/275/285 PLC Models

Input current VDC	12-bits	13-bits	16-bits	12-bits + sign	15-bits + sign	Range
<-20/-40	0	0	0	-4095	-32768	Under-range
-10/-20	0	0	0	-4095	-32000	Nominal range
0	2048	4096	32768	0	0	
+10/+20	4095	8191	65520	+4095	+32000	
>+10/+20	4095	8191	65520	+4095	+32767	Overrange

0 ... 10 VDC, 0 ... 20 VDC for E984-258/265/275/285 PLC Models

0 ... 10 VDC, 0 ... 20 VDC for E984-258/265/275/285 PLC Models

Input current VDC	12-bits	13-bits	16-bits	12-bits + sign	15-bits + sign	Range
< 0	0	0	0	-4095	-32768	Under-range
0	0	0	0	0	0	Nominal range
10/20	4095	8191	65520	+4095	+32000	
>10/20	4095	8191	65520	+4095	+32767	Overrange

0 ... 20 mA for E984-258/265/275/285 PLC Models

0 ... 20 mA for E984-258/265/275/285 PLC Models

Input current mA	12-bits	13-bits	16-bits	12-bits + sign	15-bits + sign	Range
< 0	0	0	0	-4095	-32768	Under-range
0	0	0	0	0	0	Nominal range
20	4095	8191	65520	+4095	+32000	
>20	4095	8191	65520	+4095	+32767	Overrange

4 ... 20 mA for E984-258/265/275/285 PLC Models

4 ... 20 mA for E984-258/265/275/285 PLC Models

Input current mA	12-bits	13-bits	16-bits	12-bits + sign	15-bits + sign	Range
< 0 ... 2	0	0	0	0	0	Wire breakage
2.1 ... 3.61	0	0	0	0	-32768	Under-range
3.62 ... 3.99	0	0	0	0		Tolerable
4	0	0	0	0	0	Nominal range
20	4095	8191	65520	+4095	+32000	
> 20	4095	8191	65520	+4095	+32767	Overrange

ADU 205 Operation

The ADU 205 operates off the 5 V supply voltage provided internally over the I/O bus.
When the module goes out of range—either over or under range—and then returns to a valid operating range, the module will resume proper operations unless your out-of-range condition reaches or exceeds the safety range of +/-30 Vdc.

CAUTION

Do not operate at extreme ranges.

Operating at an extreme out-of-range voltage—at or beyond +/-30 Vdc—will cause permanent damage to the module.

Failure to follow this precaution can result in injury or equipment damage.

LED

The ADU 205 has one green LED opposite terminal screw 1. This LED is used to indicate the presence of the 5 V power supply from the backplane.

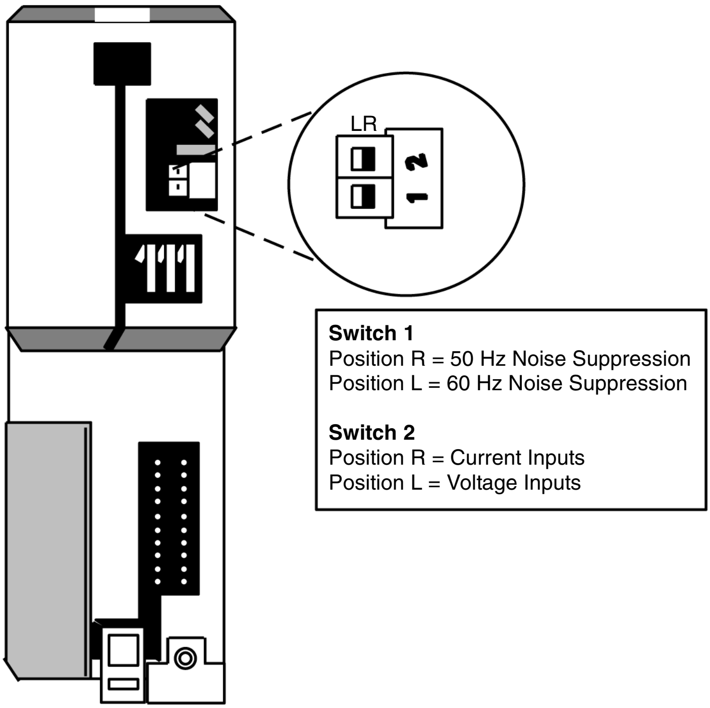
ADU 205 Analog Input Module Switch Settings

Introduction

Two two-position DIP switches are located on the back of the ADU 205.

Changing the Switch Settings

Switch 2 is used to specify whether the inputs are voltage or current inputs; switch 1 is used to set external noise interference protection for the module.
The following illustration shows the switches on the rear of the ADU 205.



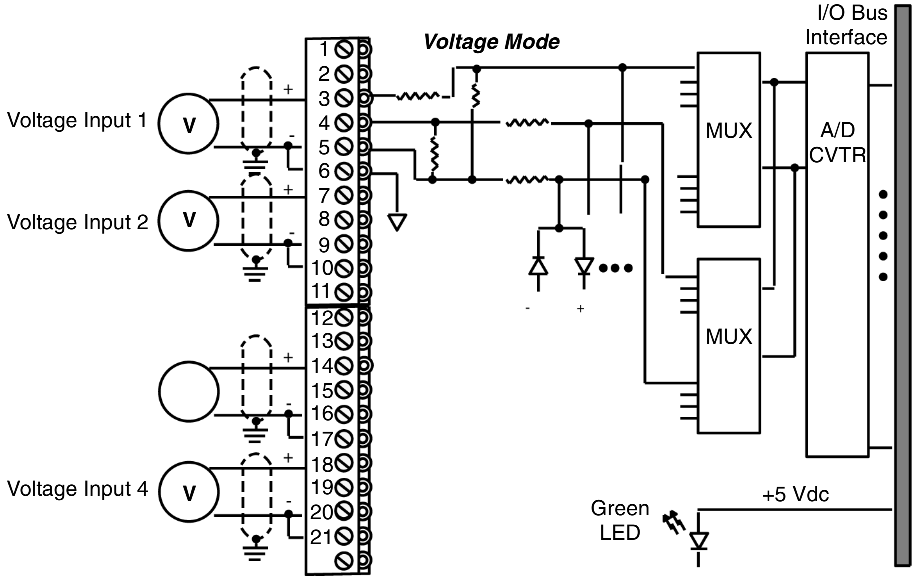
ADU 205 Analog Input Module Field Wiring

Introduction

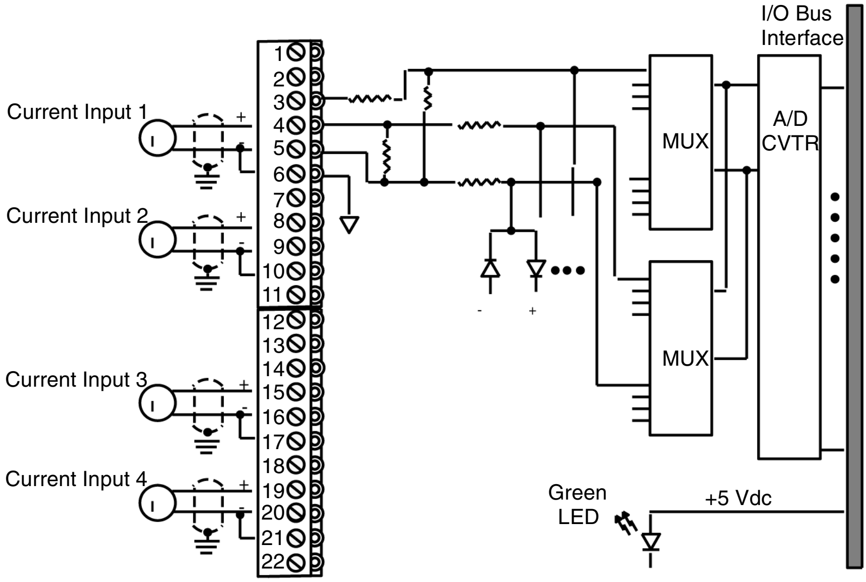
The module will be field wired differently, depending on whether the field device provides voltage or current inputs.

Wiring Diagram

The following illustration is a wiring diagram and simplified schematic for the ADU 205 analog input module (voltage mode).



The following illustration is a wiring diagram and simplified schematic for the ADU 205 analog input module (current mode).



Note: The jumpers at terminals 5-6, 9-10, 16-17, and 20-21 are factory set to reference the input source(s) to ground. If the source(s) that you use are already grounded, remove the associated jumper(s) to omit ground looping problems and possible module failure.

⚠	**CAUTION**
	Operation Failure Hazard When the installed jumpers reference a ground on the negative input and using a grounded power supply, the full loop supply voltage causes the module to fail. We recommend that you wire the loop supply to the negative input side of your module. **Failure to follow this precaution can result in injury or equipment damage.**

ADU 205 Analog Input Module LED

The ADU 205 has one green LED opposite terminal screw 1, used to indicate the presence of the 5 V power supply from the backplane.

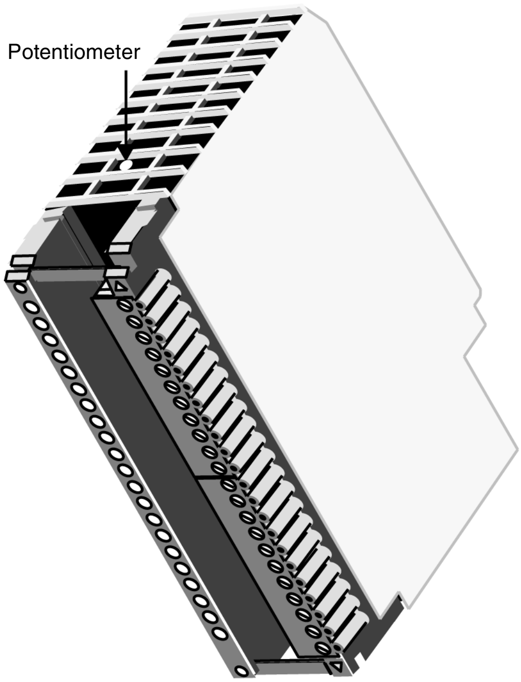
ADU 205 Analog Input Module Calibration

Introduction

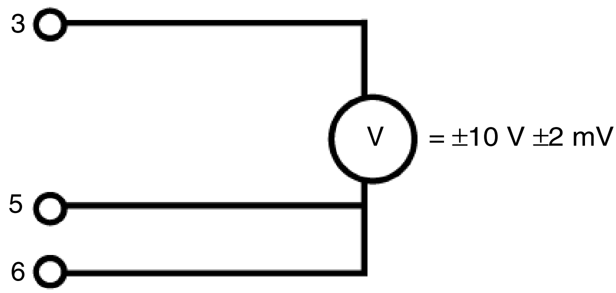
By adjusting a single potentiometer on the top of the ADU 205, you can calibrate the four analog input channels to an accuracy of +/-3 counts over the recommended linear count range of the module (2049 ... 6143).

Calibrating the Analog Input Channels

The following illustration shows the location of the potentiometer on the ADU 205.



The following procedure is for voltage inputs. The process is nearly identical for current inputs, except that the input signals applied to each channel must be -20 mA, 0 mA, and +20 mA. To adjust the potentiometers:

Step	Action
1	Using the DIP switch on the back of the module, set it for the desired noise suppression.
2	Calibrate analog channel 1 by wiring terminal 3 to the positive side, and terminals 5 and 6 to the negative side, of a voltage standard - as shown in the following figure. 
3	Connect terminals 7, 9, 10, 14, 16, 17, 18, 20, and 21 to each other.
4	Set the voltage standard to +10 V and adjust the potentiometer until you get a reading of 6143 counts.
5	Set the voltage standard to -10 V, and adjust the potentiometer until you get a reading of 2049 +/-1 count.
6	Check the accuracy of your midrange setting by setting the voltage standard to 0 V; the reading should be at or within a count of 4096 counts. Then recheck your high range count by setting the voltage standard to +10 V; the reading should be within 3 counts of 6143.
7	Verify the calibration adjustment on the other three analog channels: for channel 2, wire terminals 7, 9, and 10 to the voltage standard; for channel 3, use terminals 14, 16, and 17; and for channel 4, use terminals 18, 20, and 21. If you make any fine tuning adjustments on any of these channels, verify their effects on channel 1.
8	When you are satisfied with the readings on all four channels, drop a bead of sealing varnish on the potentiometer to secure its setting.

ADU 205 Analog Input Module Specifications

Table of Specifications

The following table contains a list of system-specific specifications for the ADU 205 Analog Input Module.

Module Topology	Number of Channels	4	
	Isolation	Non-isolated, channel-to-bus or channel-to-channel	
	Signal types supported	Two-pole voltage inputs	
Power Supply	Internally provided source	5 V, less than 50 mA from I/O bus	
Voltage Input Capabilities	Linear Measuring Range	Nominal	+/-10 V
		Maximum	+/-19.99 V
	Input Impedance	50 ohms	
	Absolute Maximum Input Voltage	+/-30 V	
	Wire Size	One wire	14 AWG
		Two wires	20 AWG
A/D Conversion	Conversion Time	Each input @ 4096 in	80 ms (max) @ 50 Hz
			66.6 ms (max) @60 Hz
		Each input @ 2048 in	60 ms (max) @ 50 Hz
			50 ms (max) @ 60 Hz
	Resolution	12 bits recommended range (+1)	
	In-range Error Limit	0.5% of input value @ 0... 60 degrees C	
	Nonlinearity	+/-2 counts @ 0... 60 degrees C	
Noise Suppression	Normal Mode Rejection	40 dB minimum	
	Common Mode Rejection	86 dB minimum	
I/O Map	Register 3x/4x	4 in/0 out	

The following table gives general specifications for the ADU 205 Analog Input Module.

Dimensions (WxHxD)	40.3 x 145 x 117.5 mm
	1.6 x 5.6 x 4.5 in
Weight	220 g
	.5 lb.
Agency Approvals	ADU204: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards.
	VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards.

Overview of the ADU 206/256 Analog Input Module

4

At a Glance

Purpose

The purpose of this chapter is to describe the ADU 206/256 analog input module.

What's in this Chapter?

This chapter contains the following topics:

What is the ADU 206/256 Analog Input Module?

Brief Product Description

The ADU 206/256 is a four-channel analog input module with opto-isolation. It performs dual-slope integrating A/D conversions, converting analog input signals into digital values based on the principle of successive approximation. The ADU 256 functions just like the ADU 206, except that the ADU 256 operates at extended temperature.

Note: The ADU 256 model is available with conformal coating. The conformal coating model is ADU 256C, which meets Railway standard EN 50 155.

WARNING

The ADU 206/256 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

ADU 206/256 Analog Input Module Conversion Ranges

Introduction

The ADU 206/256 is a four-channel analog input module with opto-isolation. It performs dual-slope integrating A/D conversions, converting analog input signals into digital values based on the principle of successive approximation. The ADU 256 functions just like the ADU 206, except that the ADU 256 operates at extended temperature.

Note: The ADU 256 model is available with conformal coating. The conformal coating model is ADU 256C, which meets Railway standard EN 50 155.

WARNING

Faulty operation.

The ADU 206/256 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

Conversion Ranges

The ADU 206/256 module has the following characteristics:

- Voltage/current input selection is made using jumpers; range values are set in the software.
- Operates off the 5 V supply voltage provided internally over the I/O bus, along with a user-supplied 24 VDC external power source.
- Resolution is 11 Bit + sign or 12 Bit, depending on the input range selected.
- Out-of-range status indication is software selectable.

The PLC model determines the ranges. A table is provided below for each of the following:

- 0... 10 VDC/2... 10 VDC, 0... 20 mA/4... 20 mA for E984-258/265/275/285
- +/-10 VDC/ +/-20 mA for E984-258/265/275/285

> **Note:** See the Specifications section for the ranges for the A984-1xx, E984-24x/251/255 PLC models

The following table lists the input ranges for voltage/current input selection.

Voltage	Current
+/-1 V	+/-20 mA
+/-10 V	4... 20 mA
0... 1 V	0... 20 mA
0... 10 V	
0.2... 1 V	
2... 10 V	

The ranges for 0... 10 VDC/2... 10 VDC, 0... 20 mA/4... 20 mA for E984-258/265/275/285 PLC models are:

Input voltage (VDC)	Current (mA)	12-bits	16-bits	11-bits + sign	15-bits + sign	Measuring step/value range
		0	0	0	0	Under range
		0	0	0	0	Neg. tolerance range
0/2	0/4	0	0	0	0	Nominal range
10	20	4000	64000	+2000	+32000	
10.01...	20.02...	4001	64016	+2001	+32016	Pos. tolerance range
greater than/ equal to 10.24/10.19	greater than/ equal to 20.48/20.39	4095	65520	+2047	+32760	Over range

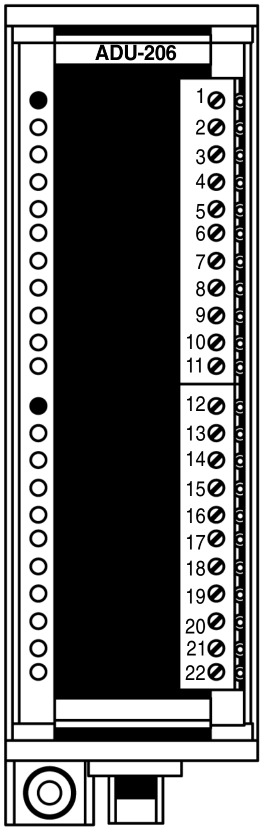
The ranges for +/-10 VDC/ +/-20 mA for E984-258/265/275/285 PLC models are:

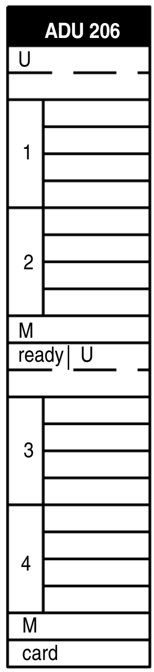
Input voltage (VDC)	**Current (mA)**	**12-bits**	**16-bits**	**11-bits + sign**	**15-bits + sign**	**Measuring step/value range**
less than or equal to -10.24	less than or equal to -20.48	0	0	-2048	-32768	Under range
-10.01	-20.02	47		-2001	-32016	Neg. tolerance range
-10.00 0 +10.00	-20 0 +20	48 2048 4048	768 32768 64768	-2000 0 +2000	-32000 0 +32000	Nominal range
+10.01	+20.02...					
10.01...	20.02...	4049		+2001	+32016	Pos. tolerance range
greater than or equal to 10.24	greater than or equal to 20.48	4095	65520	+2047	+32752	Over range

ADU 206/256 Analog Input Module Physical Characteristics

Illustration

The ADU 206/256 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.
A front view with ADU 206 label is provided below.





LEDs

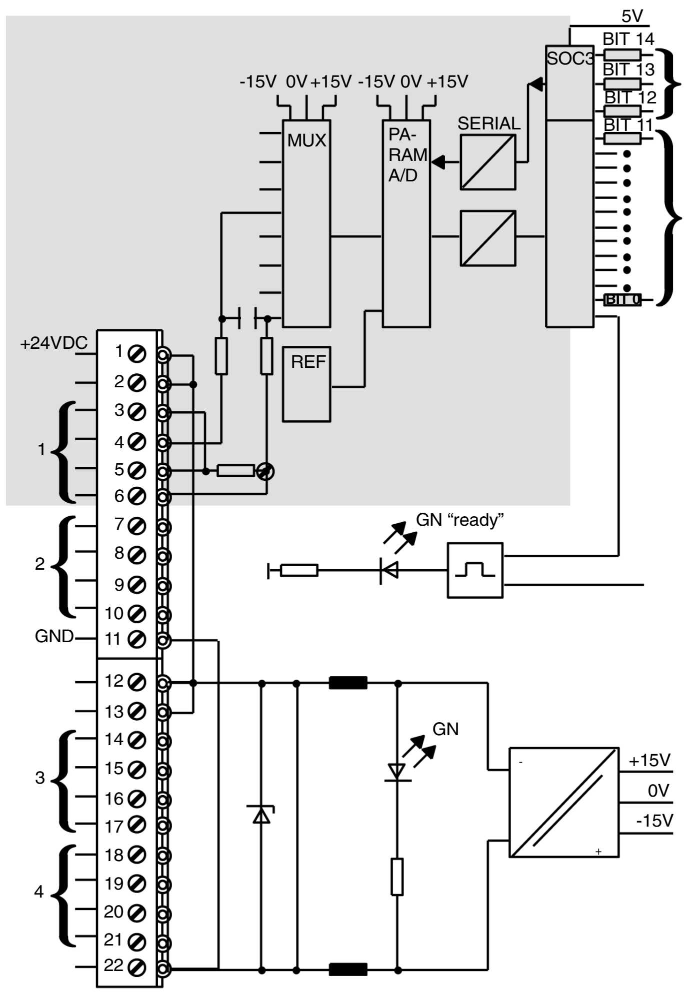
The ADU 206/256 has two green LEDs:

- The LED opposite field wiring terminal #1 indicates the presence of 24 Vdc power from the external source (ON = power supplied; OFF = power off.
- The LED opposite field wiring terminal #12 indicates the condition of the processor/module (ON = fault-free operation; OFF = fault condition).

Note: The controller must be running for the READY LED to illuminate.

Simplified Schematic

A simplified schematic for the ADU 206/256 is provided below.



ADU 206/256 Analog Input Module Configuration

Introduction

The following items must be addressed when configuring the ADU 206/256:
- The module must be I/O mapped as five 3x input registers and one 4x output register. Binary must be set for data type.
- Make connections and assignments of input addresses.
- Identify overall mode of operation, type of input, and error indication.
- Cabling guidelines.

Cabling

- Shielded, twisted pair cable (2 or 4 x 0.5mm per channel) should be used. All channels can be connected with a common shielded cable.
- Connect shield to ground (GND) on one side with a short cable (less than 8 in).
- Observe a minimum distance of 20 in. between the module and power lines or other sources of electrical disturbance.

Connection and Assignment of Input Addresses

> **Note:** Detailed Compact 984 cabling and installation instructions are found in the User Guide.

Connection and Assignment for Current Inputs

For current inputs:
- Jumper 3-4 for input 1
- Jumper 7-8 for input 2
- Jumper 14-15 for input 3
- Jumper 18-19 for input 4

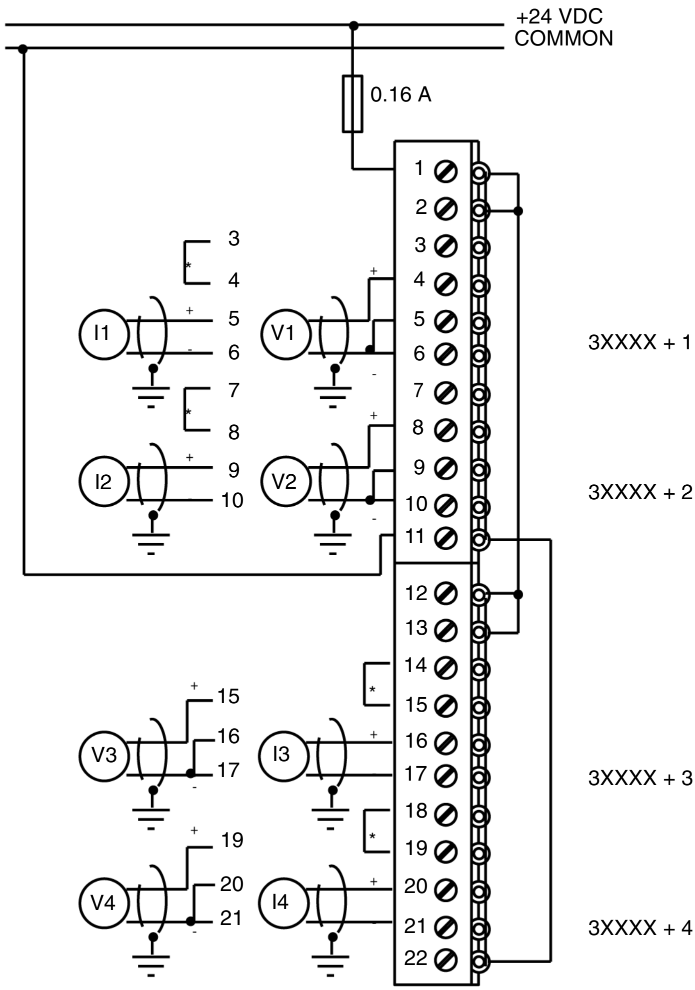
Connection and Assignment for Voltage Inputs

For voltage inputs:
- Jumper 5-6 for input 1
- Jumper 9-10 for input 2
- Jumper 16-17 for input 3
- Jumper 20-21 for input 4

Corresponding input signal names or addresses can be entered on the blank label (supplied).

Wiring Diagram

An ADU 206/256 wiring diagram and associated registers for inputs are provided below.



ADU 206/256 Analog Input Module Programming Modes

Introduction

The ADU 206/256 is a four-channel analog input module. Its field connector is wired depending on the type of input to be measured, either voltage or current. Any of the four inputs can be either voltage or current, and any combination of the four may be used if levels are within the programmed range for the channel.

The module can operate in one of several modes, and the input channel ranges are individually selectable. The mode and ranges are set by an I/O mapped 4x register. Five sequential 3x registers must also be I/O mapped. The first register is used to read module operating status, and the remainder contain data representing voltage or current levels at the four channel inputs. Channel input data is updated every 10 ms.

4x Control Register

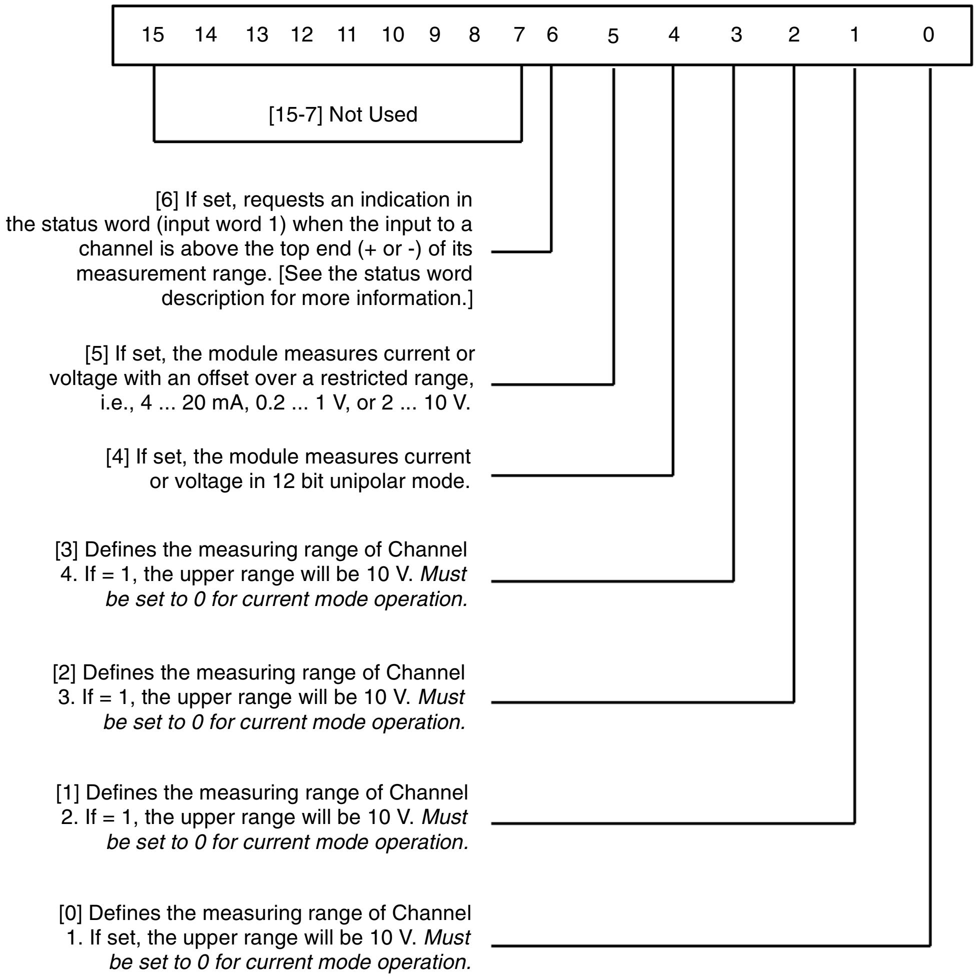
The operating mode of the module and individual channel ranges are set using the lower 7 bits of the 4x register.

Options are:

Bit	Operating Mode Setting
000X	Bipolar mode without overrange indication
001X	Unipolar mode without overrange indication
002X	Bipolar with offset and extended resolution without overrange indication
003X	Unipolar with offset and extended resolution without overrange indication
004X	Bipolar mode with overrange indication
005X	Unipolar mode with overrange indication
006X	Bipolar with offset and extended resolution with overrange indication
007X	Unipolar with offset and extended resolution with overrange indication

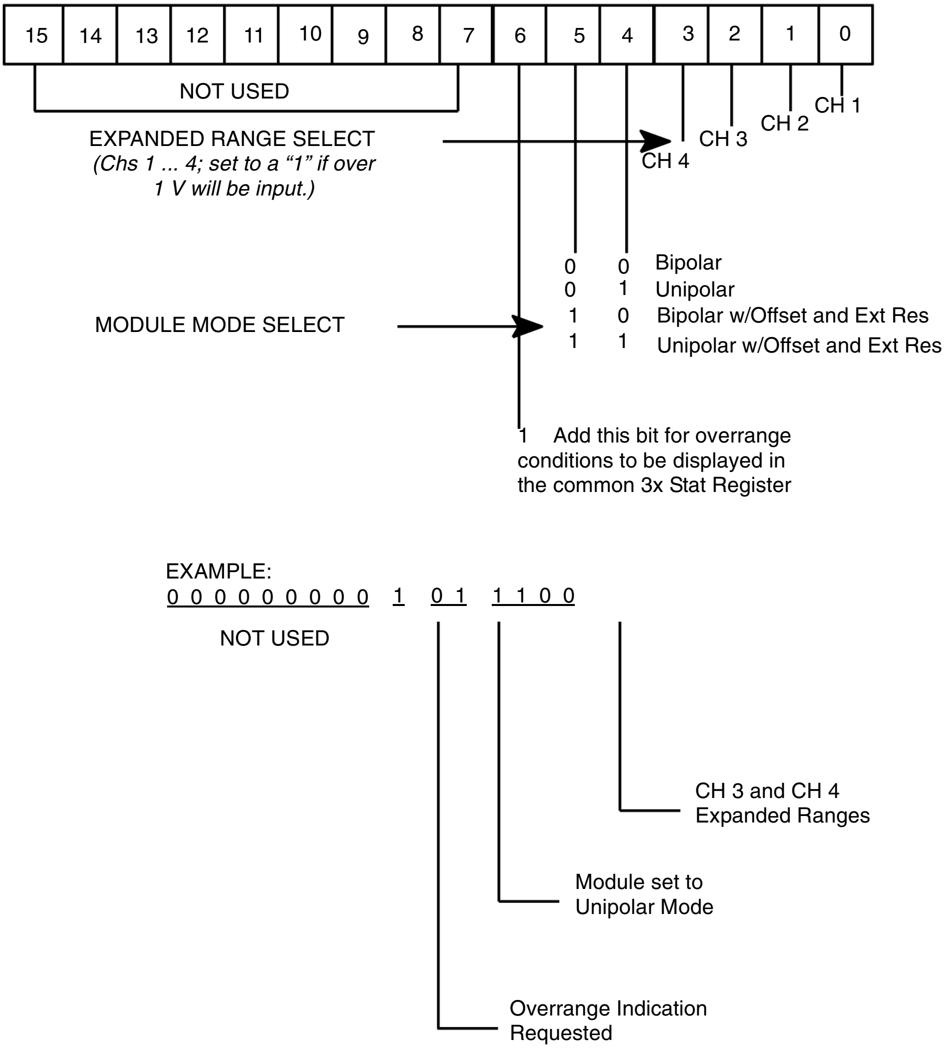
Note: These values are in Hexadecimal.
where the X value determines the individual channel range:
1 = expanded voltage range (10 V)
0 = normal voltage range (1 V)

The following diagram illustrates bits in the ADU 206/256 control word and their meanings.



4x Control Register Quick Reference

A quick reference diagram of the ADU 206/256 4x Control Register is provided below.

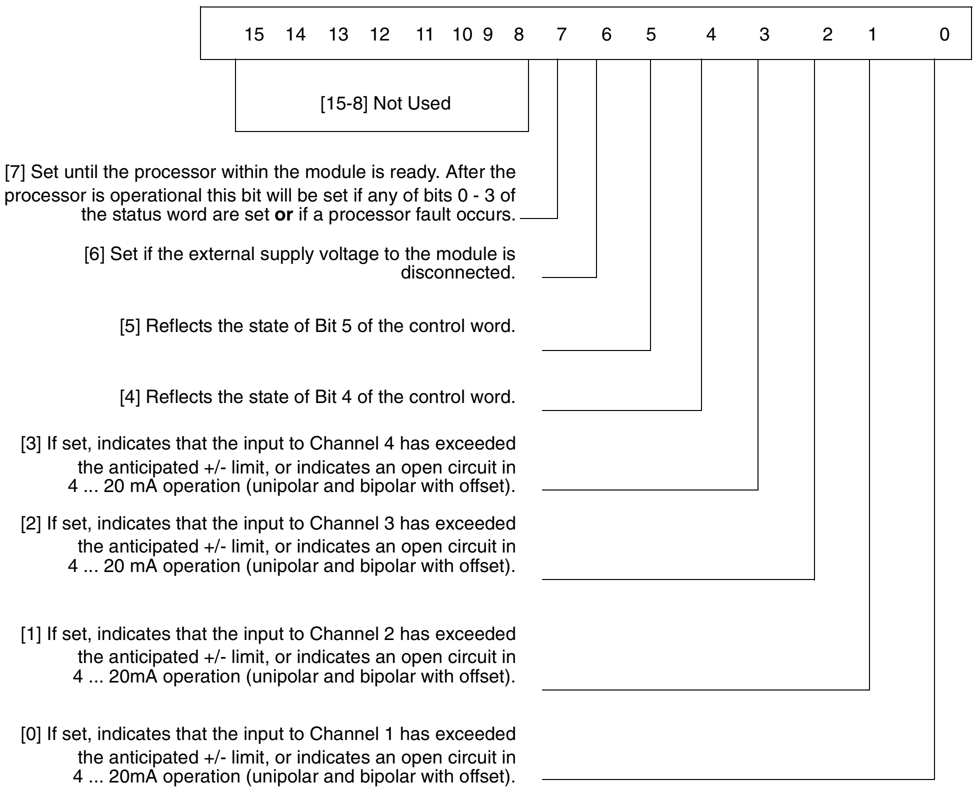


3X Status and Data Registers

The bit significance of the first 3x input register, which displays the module status, is displayed in the following illustration. The next four registers contain data representative of the individual channel input values. Refer to the rest of the information in this map for more detail about the values that may be expected.
Data values are the result of the type of input selected, the field connector wiring, the module operating mode selected, and the range selected for the channel (normal or expanded).

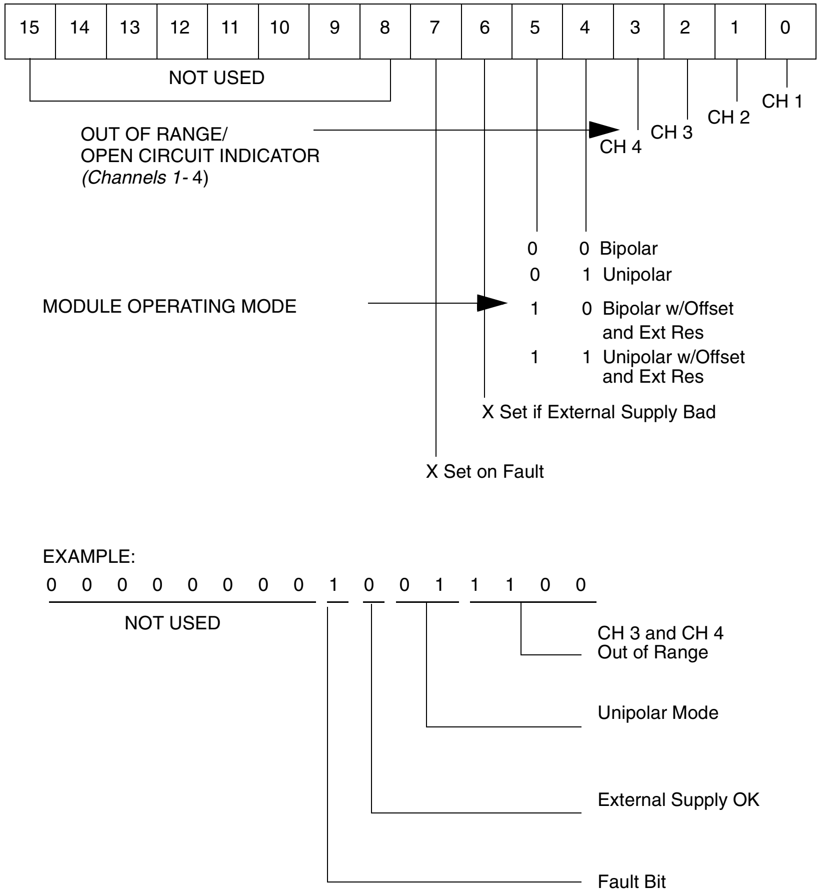
I/O Map Registers	Data
3x	Module status information
3x + 1	Input #1 data
3x + 2	Input #2 data
3x + 3	Input #3 data
3x + 4	Input #4 data

The following diagram illustrates bits in the ADU 206/256 status word and their meanings.



30xxx Status Register Quick Reference

A quick reference diagram of the ADU 206/256 30xxx Status Register is provided below.



Types of Modes and Their Functions

When power is first applied to the module, it will be in a state equivalent to all of the control bits being 0. As long as power to the unit is maintained, the operating mode of the module will be unchanged through a stop/start cycle.
When the module goes out of range-either over or under range-and then returns to a valid operating range, the module will resume proper operations unless your out-of-range condition reaches or exceeds the safety range of +/-30 VDC.

WARNING

Extreme out-of-range voltage.

Operation at an extreme out-of-range voltage-at or beyond +/-30 VDC-will cause permanent damage to the module.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

Bipolar (000X, 004X)
Bipolar mode is selected by setting the control word to the value 000X, where X defines the range of any channels used for voltage measurement. In this mode, if out of range indication is requested (control word = 004x), it will turn on at voltages/currents exceeding the +/- maximum value. Refer to status word description.
The following table describes the current/voltage values in bipolar mode.

Current	Normal Voltage	Expanded Voltage	Value
-20 mA	-1 V	-10 V	48
0 mA	0 V	0 V	2048
+20 mA	+1 V	+10 V	4048

Unipolar (001X, 005X)
This mode is selected by setting the control word to the value 001X, where X defines the range of any channels used for voltage measurements. In this mode, if overrange indication is requested (i.e., control word = 005X), it will turn on if an input exceeds the maximum range value. Refer to status word description.
The following table describes the current/voltage values in unipolar mode.

Current	Normal Voltage	Expanded Voltage	Value
0 mA	0 V	0 V	0
20 mA	+1 V	+10 V	4000

Bipolar with Offset and Extended Resolution (002X, 006X)

This mode is selected by setting the control word to the value 002X, where X defines the range of any channels used for voltage measurements. In this mode, the out of range indication is set whenever the inputs are less than 10% of the range maximum value (i.e., 2 mA, 0.1 V or 1 V). This serves as a broken wire detector in addition to being a low input indicator. The out of range indication request bit does not have to be set, and the indication will reset once the input returns to the active range. In this mode, if overrange indication is requested (control word = 006X), it will turn on if an input exceeds the maximum range value. Refer to status word description.
The following table describes the current/voltage values in bipolar mode with offset and extended resolution.

Current	Normal Voltage	Expanded Voltage	Value
4 mA	0.2 V	2 V	2048
20 mA	1 V	10 V	4048

Unipolar with Offset and Extended Resolution (003X, 007X)
This mode is selected by setting the control word to the value 003X, where X defines the range of any channels used for voltage measurements. In this mode, the out of range indication is set whenever the inputs are less than 10% of the range maximum value (i.e., 2 mA, 0.1 V or 1 V). This serves as a broken wire detector in addition to being a low input indicator. The out of range indication request bit does not have to be set, and the indication will reset once the input returns to the active range. In this mode, if overrange indication is requested (control word = 007X), it will turn on if an input exceeds the maximum range value. Refer to status word description.
The following table describes the current/voltage values in unipolar mode with offset and extended resolution are.

Current	Normal Voltage	Expanded Voltage	Value
4 mA	0.2 V	2 V	0
20 mA	1 V	10 V	4000

ADU 206/256 Analog Input Module Calibration

Introduction

By adjusting the two potentiometers located on the top of the ADU 206/256, you can independently calibrate both the normal and expanded ranges for the four input channels.

CAUTION

Return units requiring calibration.

Modicon recommends that units requiring recalibration be returned to the factory, since inaccuracies could be due to faulty components. However, users who wish to perform their own calibration should use the following procedure.

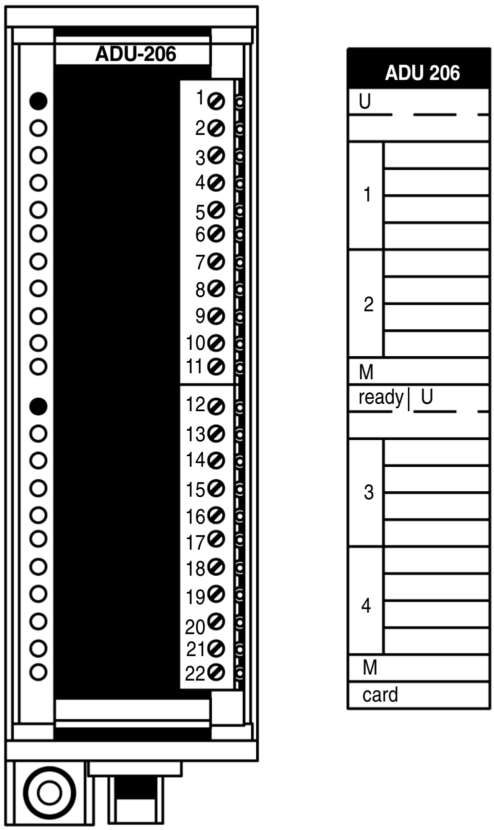
Failure to follow this precaution can result in injury or equipment damage.

Calibrating the Analog Input Channels

In the procedure that follows, R65 is used to calibrate the normal ranges, and R64 is used to calibrate the expanded ranges. Items required for calibration are:

- A 1 VDC Power Supply (+/-0.1 mV)
- A 10 VDC Power Supply (+/-1.0 mV)
- A voltmeter with appropriate scales and accuracy of 0.2... 0.5 parts/million

The following illustration shows the location of the potentiometers on the ADU 206/256.



Adjusting the Potentiometers Procedure

Use the following procedure to adjust the potentiometers.

Step	Action
1	Connect a 1 VDC source (+/-0.1 mV), verified with the voltmeter, to the four voltage inputs. Set the module for Unipolar mode and all channels for Normal range. Adjust R65 for a reading of 4000 counts on Channel 1. Channels 2... 4 should read 4000, +/-2 counts.
2	Set the module to Bipolar mode and check all channels for a reading of 4048 +/ -2 counts.
3	Reverse the 1 VDC supply polarity and check all channels in Bipolar mode. All channels should read 48 +/-2 counts.
4	Set the module for Unipolar mode and all channels for Expanded range. Connect a 10 VDC source (+/-1.0 mV), verified with the voltmeter, to the four voltage inputs. Adjust R64 for a reading of 4000 counts on Channel 1. Channels 2 to 4 should read 4000, +/-2 counts.
5	Set the module to Bipolar mode and check all channels for a reading of 4048 +/ -2 counts.
6	Reverse the 10 Vdc supply polarity and check all channels in Bipolar mode. All channels should read 48 +/-2 counts.
7	When satisfied with the readings on all four channels, drop a bead of sealing varnish on both potentiometers’ adjusting screws to secure their settings.

ADU 206/256 Analog Input Module Specifications

Table of Specifications

The following table contains a list of ADU 206/256 specifications.

Module Topology		Number of Channels		4			
		Data Format		Two-pole as voltage or current inputs			
		Isolation		Channel-to-bus			500 V
				Channel-to-external supply			500 V
				Nonisolated channel-to-channel			
Power Supply		External		24 Vdc	Typical		70 mA
					Maximum		100 mA
		Internal Source (from I/O bus)		5 Vdc	Typical		60 mA
				Maximum			
		Power Dissipation			Typical		2 Ω
					Maximum		3 Ω
Voltage Input		Linear Measuring Range					
A984-1xx, E984-24x/251/255 PLC Models							
Analog Value Voltage Inputs (V)		Current Inputs (mA)			Decimal Value	Ext. Resolution	Comments
+/-1 V	+/-10 V	2...10 V	+/-20 mA	4...20 mA			
-1.024 ...	-10.24		-20.48 ...		0		Under range in dication in status word
-1.015	-10.15		20.30				
-1.001	-10.01 ...		-20.02		47		
-1.00	-10.00		-20.00		48		
-0.50	-5.00		-10.00		1048		
-0.10	-1.00		-2.00		1848		
-0.050	-0.50		-1.00		1948		
-0.01	-0.10		-0.20		2028		
-0.001	-0.01		-0.02		2046		Linear Range
-0.0005	-0.005		-0.01		2047		
0.00	0.00	+2.00	0.00	+4.00	2048	0	
+0.0005	+0.005	+2.004	+0.01	+4.008	2049		
+0.001	+0.01	+2.008	+0.02	+4.016	2050		
+0.01	+0.10	+2.08	+0.20	+4.16	2068		
+0.050	+0.50	+2.40	+1.00	+4.80	2148		

+0.10	+1.00	+2.80	+2.00	+5.60	2248		
+0.50	+5.00	+6.00	+10.00	+12.00	3048		
+1.00	+10.00	+10.00	+20.00	+20.00	4048	4000	
+1.015 ...	+10.15 ...	+10.155 ...	+20.30 ...	+20.30 ...			Over range Indication in Status Word
+1.024	+10.24	+10.19	+20.47	+20.38	4095		

	Absolute Max. Input Voltage		+/-30 V
	Input Impedance		greater than 1 M ohms
	Wire Size	One wire	14 AWG
		Two wires	20 AWG
Current Input Capabilities	Linear Measuring Range		See the table above
	Absolute Maximum Input Current (continuous)		40 mA/input
	Input Impedance		50 ohms
	Wire Size	One wire	14 AWG
		Two wires	20 AWG
A/D Conversion	Conversion Time (maximum)		10 ms for all 4 inputs
	Resolution		11 bits plus sign
	In-range Error Limit	Voltage Maxi mum	0.4% of input value @ 0 ... 60 degrees C
		Current Maxi mum	0.56% of input value @ 0 ... 60 degrees C
Environmental Characteristics	Operating Temperature	0 ... 60 degrees C for ADU 206 -40 ... +70 degrees C for ADU 256	
I/O Map	Register 3x/4x	5 in/1 out	
Noise Suppression	Common Mode Rejection (minimum)		60 dB @ 1 kHz
Dimensions (W x H x D)			40.3 x 145 x 117.5 mm
			1.6 x 5.6 x 4.5 in
Weight			330 g
			0.725 lb
Agency Approvals	ADU206: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards.		
	ADU256C: Railway standard EN 50 155; European Directive EMC 89/336/EEC Standards. UL 508; CSA 22.2 No.142; and FM Class I, Div 2 pending.		

Overview of the ADU 210 Isolated Analog Input Module

5

At a Glance

Purpose

The purpose of this chapter is to describe the ADU 210 isolated analog input module.

What's in this Chapter?

This chapter contains the following topics:

What is the ADU 210 Isolated Analog Input Module?

Brief Product Description

The ADU 210 is a four-channel analog input module with opto-isolation. It performs analog-to-digital conversions using a delta-sigma conversion method, converting analog input signals into digital values. The ADU 210 module has the following characteristics:

- Voltage/Current input selection is made by appropriate wiring; the range values are set via the panel software.
- Operates off the 5 V supply voltage provided internally over the I/O bus, along with a user-supplied 24 VDC external power source.
- Provides 300 volts maximum channel-to-channel isolation.
- Provides a 15-bit + sign resolution.
- Errors are noted via the Concept I/O Map Status Word.
- Input selection and range can be set independently.

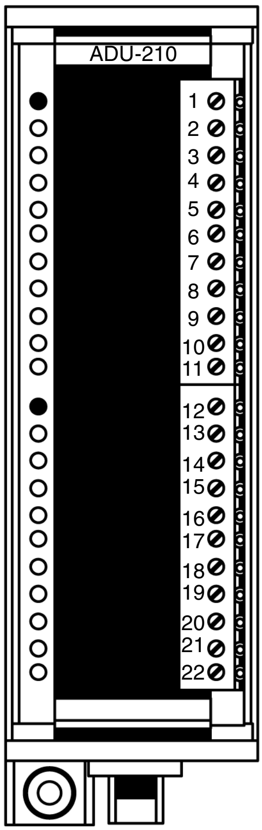
Input ranges are:

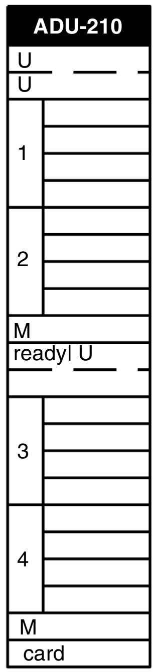
Voltage	Current
+/-10 V	
0 ... 10 V	
1 ... 5 V	4 ... 20 mA
0 ... 5 V	0 ... 20 mA
2 ... 10 V	
+/-5 V	+/-20 mA

ADU 210 Isolated Analog Input Module Physical Characteristics

Illustration

The ADU 210 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.
A front view with ADU 210 label is provided below.





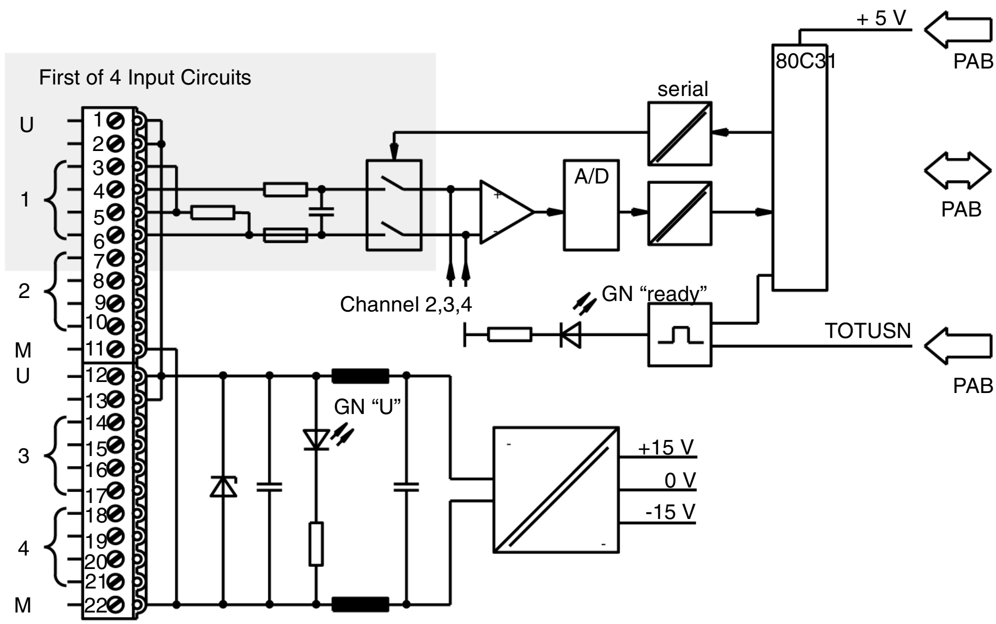
LEDs

The ADU 210 has two green LEDs.

LED#	LED Name	Function
1	Power (U)	Pertains to the 24 VDC: ON = Power supply is available OFF = Power supply is NOT available.
12	Ready	Pertains to the processor operation: ON = Processor operating between the ADU 210 and the PLC without fault OFF = Fault in processor operation

Simplified Schematic

A simplified schematic for the ADU 210 is provided below.



Installing the ADU 210 Isolated Analog Input Module

Introduction

The following procedures are necessary when installing the ADU 210:
- Make connections and assign input addresses.
- Map the I/O module as 4-3x input registers.
- Identify the overall mode of operation and type of input.

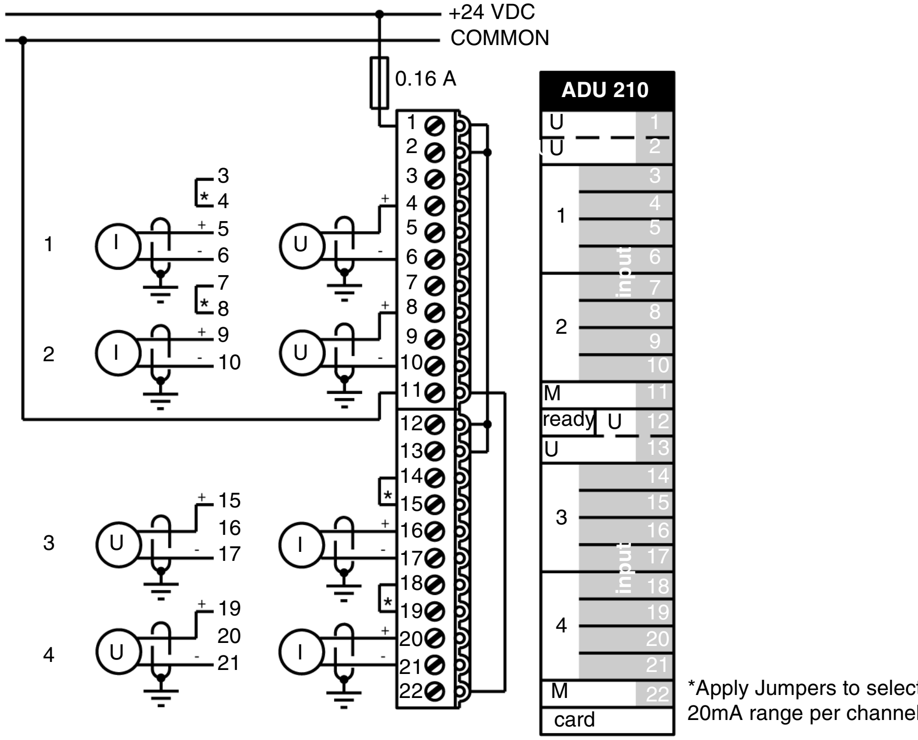
Make Connections and Assign Input Addresses

The selection of current (I) or voltage (U) input is determined primarily on the connections and the panel software. However, for the 20mA current range you MUST use the jumpers as noted. Mixed ranges are allowed among the four channels.
The following table outlines jumper placement for a 20 mA current range.

20mA Channel Selection	Jumper Placement
Input 1	3 and 4
Input 2	7 and 8
Input 3	14 and 15
Input 4	18 and 19

Note: The ADU 210 ships with the four jumpers installed.

Wiring Diagram The following illustration is an ADU 210 wiring diagram.



ADU 210 Isolated Analog Input Module Operation

Introduction

The ADU 210 is a four-channel analog input module. Its field connector is wired depending on the type of input to be measured, either voltage or current. Any of the four inputs can be either voltage or current, and any combination of the four may be used if levels are within the programmed range for the channel.
The module can operate in one of several modes, and the input channel ranges are individually selectable. The mode and ranges are set via the panel software. Channel input data is updated every 270mS. When power is first applied to the module, its inputs are inactive.

I/O Map

The ADU 210 requires 4-3x input registers. These four registers contain data representative of the individual channel input values.

I/O Map Registers	Data
3x	Input #1 data
3x + 1	Input #2 data
3x + 2	Input #3 data
3x + 3	Input #4 data

Note: Inputs that are NOT used MUST be set to inactive. This avoids error messages and reduces the conversion time.

Error Detections and Limits

After system start-up a measured value remains 0, until the ADU 210 is addressed. Next, the ADU 210 displays a parameter error (-32 768) until the value is changed by selecting a valid range. Then the valid range is displayed. Changing the measuring range displays a parameter error (-32 768) in the following cycle, until the valid range is shown after subsequent cycles. It may take up to 300mS maximum.
Input voltages (currents) of up to -1.6% of the rated value in unipolar mode and limiting value 0 result in a digital value (0) without causing an error. When input voltage (currents) fall below this limit an error results and a measured value (-32 767) is displayed.
Negative input voltage (current) in unipolar mode and limiting value -1.6% produce an appropriate digital value (up to -512) without causing an error - up to a input voltage of -1.6% of the rated value. When the measured value falls below this limit an error results and a measured value (-32 767) is displayed.
When measuring ranges with a 20% offset (live-zero) the error limit for value measure underflow is about 10% of the rated value.
When errors occur simultaneously in several inputs the error with the lowest input number is displayed until debugged. Next, the error with the next highest input number is displayed and so on.
When an input error occurs the transferred measured value of that input is set to the defined constants of:
Transferred Measured Values after an Error Detection are listed in the following table.

Measured Values	Descriptions
-32 768	Inactive input (invalid measuring range)
+32 767	Measuring range overflow
-32 767	Measuring range underflow

Conversions

The following tables detail the various voltage and current conversions for the ADU 210 module.

> **Note:** Brackets denote range with limiting value -1.6%. No brackets denotes range with limiting value 0.

The conversion values of voltage inputs are listed in the following table.

Analog value 0 ... 5 V	**Analog value 0 ... 10V**	**Analog value 1 ... 5 V**	**Analog value 2 ... 10 V**	**Analog value +/-5 V**	**Analog value +/-10 V**	**Decimal value**	**Notes**
<-0.080	<-0.16	<+0.52	<+1.04	<-5.12	<-10.24	-32 767	underflow error
				-5.119 ... -5.00	-10.239... -10.00	-32 766... -32 001	overload range
-0.08 ... -0.00	-0.16 ... -0.00	+0.52 ... +0.936 ... +0.99	+1.04 .. +1.87 ... +1.99			0 (-3 840) 0 (-512) 0 (-1)	overload range
				-5.00	-10.00	-32 000	linear
				-2.50	-5.00	-16 000	linear
				-0.50	-1.00	-3 200	linear
				-0.25	-0.50	-1 600	linear
				-0.05	-0.10	-320	linear
				-0.005	-0.01	-32	linear
				-0.0025	-0.005	-16	linear
0	0	1	2	0	0	0	linear
0.0025	0.005	1.002	2.004	+0.0025	+0.005	+16	linear
0.005	0.01	1.004	2.008	+0.005	+0.01	+32	linear
0.05	0.10	1.04	2.08	+0.05	+0.10	+320	linear
0.25	0.50	1.20	2.40	+0.25	+0.50	+1 600	linear
0.50	1.00	1.40	2.80	+0.50	+1.00	+3 200	linear
2.50	5.00	3.00	6.00	+2.50	+5.00	+16 000	linear
5.00	10.00	5.00	10.00	+5.00	+10.00	+32 000	rated value
5.000... 5.119	10.000... 10.239	5.00... 5.09	10.00... 10.19	+5.000.. +5.119	+10.00... +10.239	+32 001... +32 766	overload range
>5.12	>10.24	>5.09	>10.19	>+5.20	>+10.24	>+32 767	overflow error

The conversion values of current inputs are listed in the following table.

Analog value 0 ... 20 mA	**Analog value 4 ... 20 mA**	**Analog value +/-20 mA**	**Decimal value**	**Notes**
<-0.32	<+2.08	<-20.479	-32 767	underflow error
		-20.478 ... -20.000	-32 766 ... -32 001	overload range
-0.32 ... -0.00	+2.08 ... +3.74 ... +3.99		0 (-3 840) 0 (-512) 0 (-1)	overload range
		-20.00	-32 000	linear
		-10.00	-16 000	linear
		-2.00	-3 200	linear
		-1.00	-1 600	linear
		-0.20	-320	linear
		-0.02	-32	linear
		-0.01	-16	linear
0	+4	0	0	linear
+0.01	+4.008	+0.01	+16	linear
+0.02	+4.016	+0.02	+32	linear
+0.20	+4.16	+0.20	+320	linear
+1.00	+4.80	+1.00	+1 600	linear
+2.00	+5.60	+2.00	+3 200	linear
+10.00	+12.00	+10.00	+16 000	linear
+20.00	+20.00	+20.00	+32 000	rated value
+20.000 ... +20.478	+20.00 ... +20.38	+20.000 ... +20.478	+32 001 ... +32 766	overload range
>+20.479	>+20.38	>+20.479	>+32 767	overflow error

ADU 210 Isolated Analog Input Module Specifications

Table of Specifications

The following table contains a list of specifications for the ADU 210 module.

Module Topology	Number of channels	4
	Data Format	Unipolar and Bipolar as voltage or current inputs
	Isolation channel to channel	300 Vdc maximum
	Isolation channel to bus	500 Vac maximum
Power Supply	Internal Source (from I/O bus)	5 VIO; 90mA maximum, 40mA typical
	External	24 Vdc; 120 mA maximum, 60 mA typical
	Power Dissipation	3Ω maximum, 2Ω typical
I/O Map	Register 3x/4x	4 in/0 out
Voltage Inputs	Linear Measuring Range	Unipolar: 1 ... 5V, 0 ... 5V, 2 ... 10V, 0 ... 10V Bipolar: +/-5V, +/-10V,
	Input Impedance	≥ 1 M ohms
	Resolution	*Brief Product Description, p. 54*
	Absolute accuracy error @ 25 degrees C	Maximum 0.1% of full scale
	Absolute accuracy error @ 60 degrees C	Maximum 0.25% of full scale
	Typical accuracy error	≤0.5 of above maximum error
	Maximum overvoltage	+/-30 V static (1 input for each module) +/-50 V dynamic for max. 100 ms
	Conversion values	*ADU 210 Isolated Analog Input Module Operation, p. 59*
Current Inputs	Linear Measuring Range	+/-20 mA (+/- 5 V), 0 ... 20mA (0 ... 5 V), 4 ... 20 mA (1 ... 5 V)
	Input Impedance	250 ohms
	Resolution	*Brief Product Description, p. 54*
	Absolute accuracy error @ 25 degrees C	Maximum 0.1% of full scale
	Absolute accuracy error @ 60 degrees C	Maximum 0.25% of full scale
	Typical accuracy error	0.5 of above maximum error
	Critical values	48 mA, maximum overvoltage from 12 V

	Conversion values	*ADU 210 Isolated Analog Input Module Operation, p. 59*
Dynamic Characteristics of Inputs	Conversion time for all inputs	270 mS maximum
	Time constant for HF suppression	0.4 mS typical
	Interference voltage suppression (main suppression) for f=nx50 or 60Hz	n=1,2 ...
	Common-mode rejection	≥105 dB
Processor/ Memory	Processor Type	Intel 80C31 (8-bit)
	Memory	32 kByte EPROM for firmware
Physical Characteristics	Format	1 slot
	Dimensions (W x H x D)	40.3 x 145 x 117.5 mm 1.6 x 5.6 x 4.5 in
	Weight	320 g, 0.710 lb.
	Wire Size	1-14 AWG, 2-20 AWG
Environmental Characteristics	Operating Temperature	0 ... 60 degrees C
	Agency Approvals	VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards

Overview of the ADU 211/212 Universal Analog Input Module

6

At a Glance

Purpose

The purpose of this chapter is to describe the ADU 211/212 universal analog input module.

What's in this Chapter?

This chapter contains the following topics:

What is the ADU 211/212 Universal Analog Input Module?

Brief Product Description

> **Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft. Refer to *Installing the Loadables for A120 Series I/O Modules, p. 791*

The ADU 211/212 Universal Analog Input Module is a highly versatile module that digitizes up to eight analog inputs into a Modicon Compact 984 or Micro PLC (programmable logic controller). The module accepts thermocouple, RTD (resistance temperature device), voltage, and current loop inputs, and (through automatic channel sequencing or ladder logic) provides these inputs to the PLC using only three 30XXX registers. Commands to the module are processed through three 40XXX registers.

CAUTION

Note difference between ADU 211 and ADU 212.

The difference between the ADU 211 and the ADU 212 is how they are powered. The ADU 211 requires a external 24 Vdc power supply and draws less than1 mA from the internal +5 Vdc. In contrast, the ADU 212 only draws power from the internal +5 Vdc (450 mA typical, 600 mA maximum) and does not require an external power supply.

Failure to follow this precaution can result in injury or equipment damage.

> **Note:** For application specific concerns refer to *ADU 211/212 Universal Analog Input Module Application Notes, p. 84*

ADU 211/212 Universal Analog Input Module "J" Thermocouple Quick Start

Introduction

This section is provided as a reference **only** for users who are familiar with the ADU 211/212 module. Until you have become completely familiar with the ADU 211/212 module, do **not** try to follow these steps.

Note: For application specific concerns, refer to *ADU 211/212 Universal Analog Input Module Application Notes, p. 84*

Procedure for "J" Thermocouple Quick Start

The following table describes the procedure for "J" Thermocouple Quick Start

Step	Action
1	Ensure that DIP switch poles 1, 3, and 9 (both top and bottom DIP switches) are turned ON (closed), while the others are turned OFF (open). This step configures the module for thermocouple inputs.
2	Attach a "J"-type thermocouple to the field wiring terminal block: connect the thermocouple white wire (+) to Terminal 2 and the red wire (-) to Terminal 3.
3	Install the ADU 211/212 in the rack. +24 VDC power and common need to be connected on the ADU 211.
4	I/O map the module slot as 30001-30003 and 40001-40003 BIN.
5	With the controller in RUN mode, in the panel software reference screen, configure the Control Words as follows: • 40001 = 1660 HEX (degrees F display of "J" Thermocouple) • 40002 = 0F6A HEX (internal cold junction compensation, 100 ms integration time and Floating Point data format)
6	Display 30001 in Floating Point format and 30003 hex. The Registers should appear as: • 30001 = Room temperature in degrees F • 30003 = 8000 HEX, indicating valid data on Channel 1

ADU 211/212 Universal Analog Input Module Inputs

Introduction

Built into the module's firmware are automatic calibration, linearization of thermocouple and RTD inputs, and internal diagnostic tests.

Channels

The module provides two groups of four isolated input channels. Each group can be configured independently for:

- 100 ohms Platinum RTDs, 385 or 392 alpha
- Type J, K, T, E, R, S, or B thermocouples (ungrounded type)
- +/-0.050, 0.5, 2, 5, or 10 VDC inputs
- 4-20 or +/-20 mA current loops

Formats

The module can provide data to the PLC in these formats:

- 12-bit (0 to 4095)
- signed 15-bit (-32768 to +32767)
- unsigned 16-bit (0 to 65535)
- IEEE 754 floating point

ADU 211/212 Universal Analog Input Module Installation

Before You Install the Module

Before installing the ADU 211/212 module, you should:
- Set the DIP switches to correspond to your application.
- Field wire the module's terminal block for your application.

Note: For application-specific concerns refer to *ADU 211/212 Universal Analog Input Module Application Notes, p. 84*

ADU 211/212 Universal Analog Input Module Switch Settings

Introduction

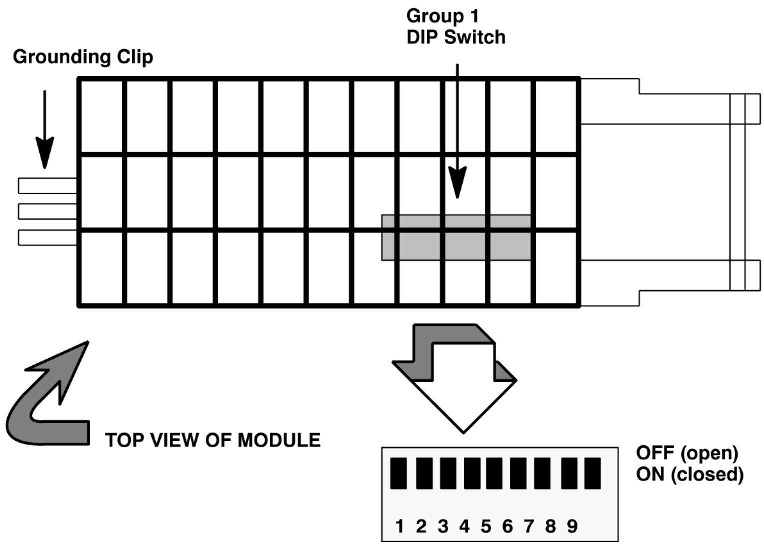
Before installing the ADU 211/212 module, you should:

- Set the DIP switches to correspond to your application.
- Field wire the module's terminal block for your application.

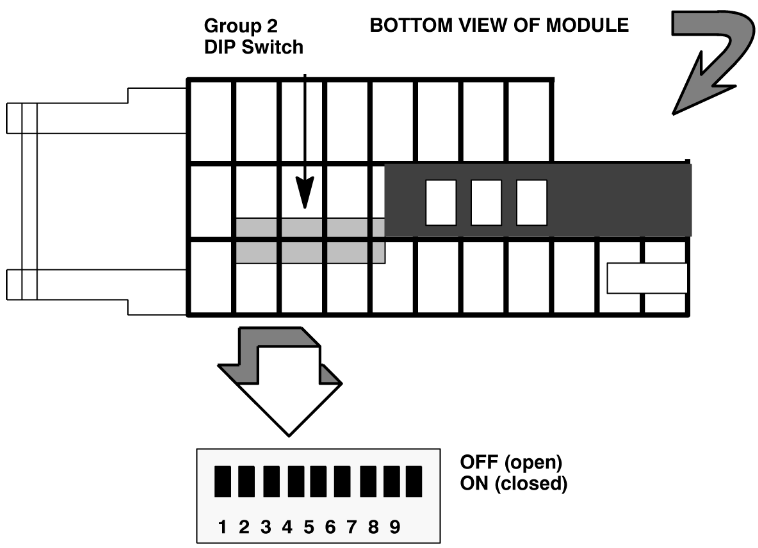
Setting the DIP Switches

Prepare the ADU 211/212 for operation by setting the DIP switches on the top and bottom of the module. In general, the switches on the top of the module configure Group 1, and the switches on the bottom of the module configure Group 2. See the following illustrations and tables for DIP switch locations and settings.

A top view of the module -- the Group 1 DIP switch location -- is provided below.



A bottom view of the module -- the Group 2 DIP switch location -- is provided below.



DIP Switch Settings

DIP switch settings for Groups 1 and 2 are listed in the following table.

For this type of application...		Turn these DIP switch poles ON (ON = closed)
Thermocouple	with internal CJC	1, 3, and 9 only
	with external CJC*	1, 9 and see table below
Voltage	+/-0.05, 0.5, 2.0, or 5.0 VDC	1, 3, and 9 only
	+/-10.0 VDC	1 and 3 only
Current		1, 3, and 5 through 9**
RTD		2, 4, and 9 only

* You need external CJC (cold junction compensation) only if the ADU 211 will be operating under extreme temperatures.
** If you want to use your own current shunts (instead of the internal shunts provided), see the table provided for that purpose later in this section.

DIP switch settings for external CJC* are listed in the following table.

For external CJC on this Group...	Turn this DIP switch pole ON... ON = closed	And turn these DIP switch poles OFF OFF = open
Group 1	4 on bottom	3 and 4 on top, and 3 on bottom
Group 2	4 on top	3 on top, and 3 and 4 on bottom

* If external CJC is needed, these settings for DIP switch poles 3 and 4 (only) take precedence. This is the only time when DIP switch settings for one group affect the other

Note: Only one Group may be configured with external Cold Junction Compensation (CJC). If external CJC is needed with both groups (e.g., when thermocouples are used with both groups), configure Group 1 for external CJC. The module will use the external CJC value from Group1 for both groups of thermocouples. See the Field Wiring examples for more information.

Set the DIP switches as follows to disable the internal 250 ohm shunts.

	To disable the shunt on this channel...	Turn this DIP switch pole OFF. OFF = open
Group 1 DIP switch:	1	8
	2	7
	3	6
	4	5
Group 2 DIP switch:	5	8
	6	7
	7	6
	8	5

Note: For current applications, you should enable the internal 250 ohm current shunts, unless you want to connect your own.

ADU 211/212 Universal Analog Input Module Field Wiring

Introduction

Before installing the ADU 211/212 module, you should:
- Set the DIP switches to correspond to your application.
- Field wire the module's terminal block for your application.

Field Wiring

	WARNING
⚠	**Possible Injury Hazard** When in hazardous location, turn off power before replacing or wiring modules. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

Power, input, and output (I/O) wiring must be in accordance with Class 1, Division 2, wiring methods [Article 501-4 (b) of the National Electrical Code, NFPA 70] and accordance with the authority having jurisdiction.
For field wiring, use shielded, twisted-pair cable (such as Belden 9418 for voltage and current applications), and ground each cable's shield wire at one end only. At the opposite end of each cable, tape the exposed shield wire to insulate it from electrical contact. A good shield wire ground is a rack assembly mounting bolt or stud.
When wiring the terminal block, keep the length of the unshielded hookup wires as short as possible. Use 60/75 copper (Cu) for the power connections and 4.5 in-lb of torque for the set screws. See the table below for the terminal block assignments.

Note: The ADU 211 requires power from an external 24 Vdc source to operate. The ADU 212 draws power from the A120 rack's +5 Vdc internal supply. Ensure that 450 mA of rack power is available for the ADU 212.

Note: The ADU 212 draws power from the A120 rack's +5 Vdc internal supply. Ensure that 450 mA of rack power is available for the ADU 212.

Note: For application specific concerns refer to the *ADU 211/212 Universal Analog Input Module Application Notes, p. 84*

For an unused channel, you should short the unused channel's terminals (that is, run a wire from the channel's + terminal to the channel's - terminal).

	CAUTION
	Connection Hazard If during installation you hear a high pitched audible sound, ensure that power and ground are properly wired. **Failure to follow this precaution can result in injury or equipment damage.**

When configured for RTD operation, only one two-wire, three-wire, or four-wire RTD is allowed per group. Connect the sense lines to Channel 1 (for Group 1) or Channel 5 (for Group 2) only. Leave the other channels unconnected.

For a four-wire RTD (the most accurate), the excitation line resistance should never exceed 40 ohms. For a three-wire RTD (the next most accurate), the excitation line resistance should never exceed 20 ohms. For a two-wire RTD (the least accurate), the excitation line resistance should be kept as low as possible.

Note: For thermocouple wiring, the U.S. convention is to use red wire for negative, so when connecting thermocouples, always check the manufacturer's color-coding tables.

After wiring the module, route all signal wires as far as possible from potential sources of electrical noise, such as motors, transformers, contactors, etc., (especially ac devices). As a general rule, allow 15.2 cm (6 in) of separation for every 120 V of power. Signal wires must never share the same conduit with ac wiring. Also, when you must route signal wires past ac wiring, do so at right angles.

The following table lists the ADU 211/212 terminal block assignments.

Group	Terminal	Channel	Function
One*	1		+24 Vdc External Power (required for the ADU 211): No connection (for the ADU 212)
	2	1	TC, Voltage, Cur rent, or RTD Sense +
	3		Channel 1 Common or RTD Sense -
	4	2	TC, Voltage, or Current +
	5		Channel 2 Common
	6	4	TC, Voltage, or Current +
	7		Channel 3 Common
	8	4	TC, Voltage, or Current +
	9		Channel 4 Common
	10		Open TC circuit detection or RTD 200 micro A Ex citation +
	11		External CJC Thermistor or RTD Excitation -
Two*	12		24 VDC Common required for the ADU 211; no connection for the ADU 212
	13	5	TC, Voltage, Cur rent, or RTD Sense +
	14		Channel 5 Common or RTD Sense -
	15	6	TC, Voltage, or Current +
	16		Channel 6 Common
	17	7	TC, Voltage, or Current +
	18		Channel 7 Common
	19	8	TC, Voltage, or Current +
	20		Channel 8 Common
	21		Open TC circuit detection or RTD 200 micro A Ex citation +
	22		External CJC Thermistor or RTD Excitation -
* Signal types may not be mixed within a group.			

ADU 211/212 Universal Analog Input Module LEDs

The ADU 211/212 module has two front-panel LEDs (light-emitting diodes). When ON, the **Amber** LED signifies that the module is powered-up and has passed power-up diagnostics, and the **Green** LED signifies that the module has established communication with the PLC and is ready to run. More information on the LEDs is provided in *ADU 211/212 Universal Analog Input Module Troubleshooting, p. 103*

ADU 211/212 Universal Analog Input Module Field Wiring Examples

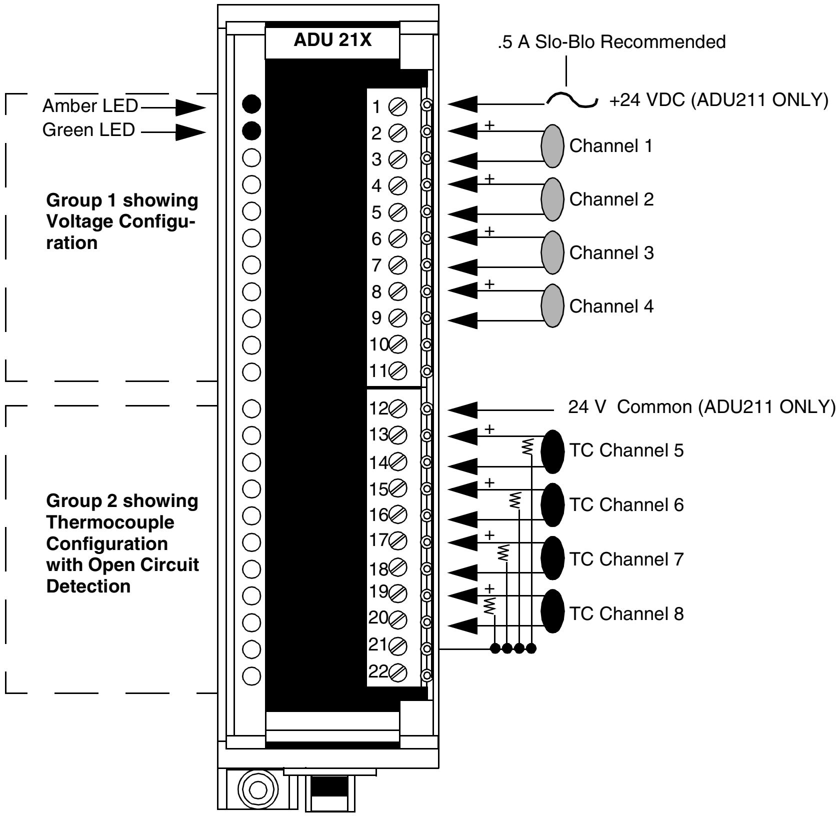
Cautions and Warnings

	CAUTION
	Unit Failure Hazard Do not run PLC without power applied to the ADU 211. **Failure to follow this precaution can result in injury or equipment damage.**

	WARNING
	Unit Wear Hazard It is not recommended to leave unpowered modules in the rack. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

Voltage and Thermocouple Combination

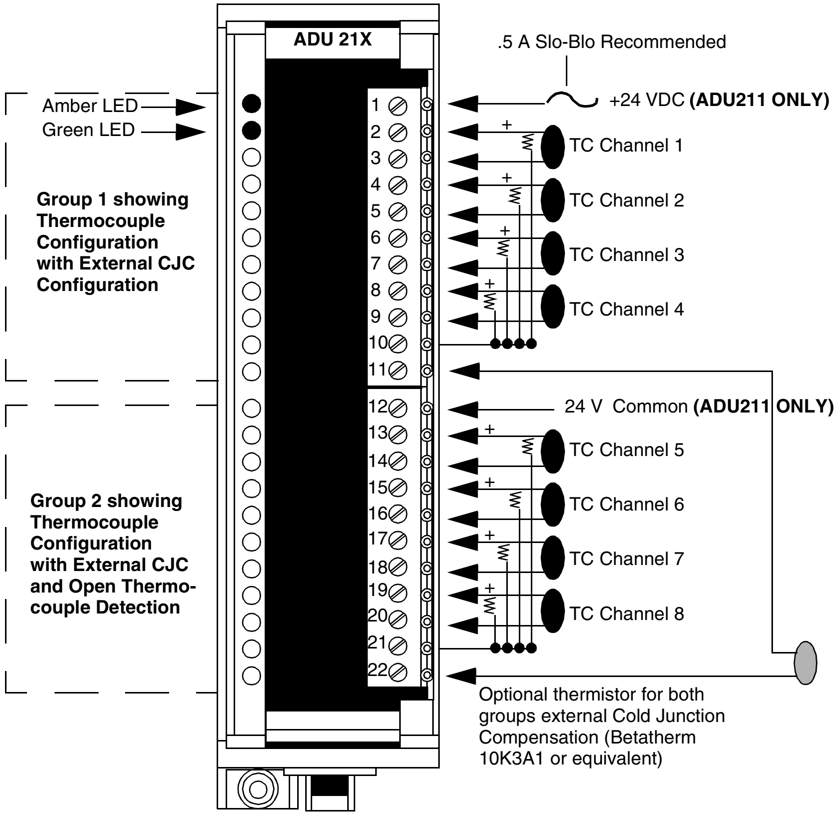
The following figure shows Group 1 configured for voltage and Group 2 configured for thermocouple inputs.



NOTE: To detect an open thermocouple (TC) circuit, connect Terminal 10 (if Group 1) or Terminal 21 (if Group 2) to any TC+ channel. To detect individual open circuits, add 22-47 M·   to each + side.

Two Groups of Thermocouples with External CJC

The following illustration shows the module wired for thermocouples on both groups and external Cold Junction Compensation (CJC).



NOTE: To detect an individual open thermocouple (TC) circuit, connect Terminal 10 (if Group 1) or Terminal 21 (if Group 2) to any TC + channel. To detect individual open circuits, add 22-47 M· to each + side.

All thermocouples require CJC to work correctly. (RTDs do not require CJC.) In the ADU 211/212, CJC can be performed by the module internally. However, if the ADU 211/212 will be operating under extreme temperatures, or if remote sensing is needed, an external thermistor (a Betatherm 10K3A or equivalent) can be connected as shown to improve CJC accuracy. This external thermistor provides CJC for both Groups 1 and 2.

When using external CJC with two groups of thermocouples, you should set bits 11 and 12 of Control Word 40XXX+1 to 1 (see ADU 211/212 Universal Analog Input Module Switch Settings for more information on proper CJC configuration).

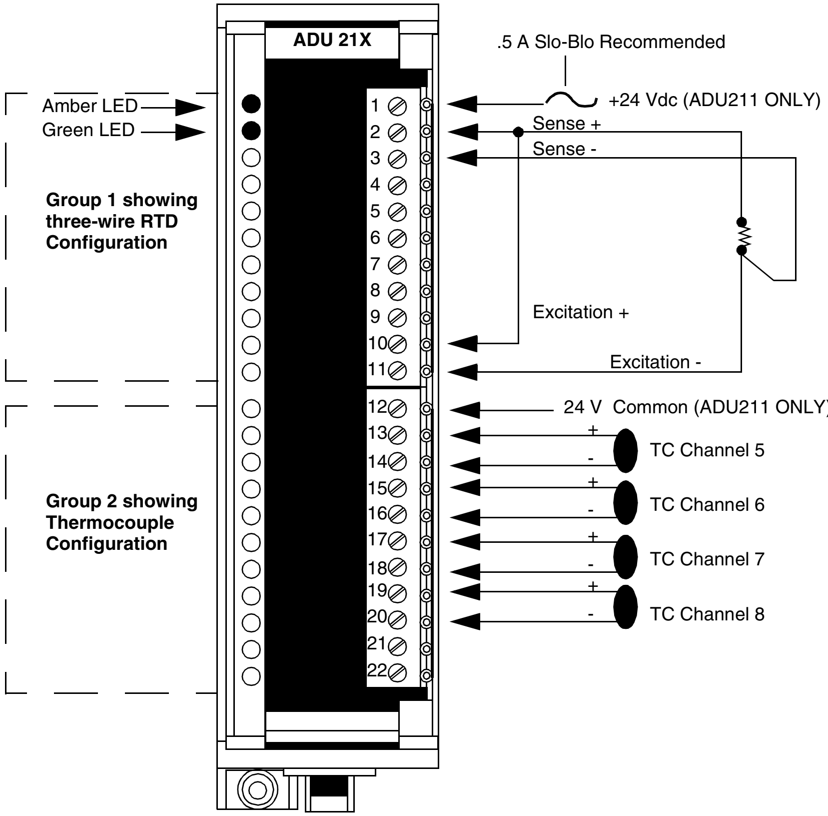
Note: The ADU 211/212 is a differential analog input module and, for most applications, this is the best operation mode for reasons of signal accuracy and noise reduction, but in some cases it maybe desirable to have single ended (common ground) operation for either one or both groups of channels to share a common ground.

To set up the module to a single-ended mode for a group, voltage or current:
- Leave all of the signal connections for the group open (TB 1 ... 3, 5, 7 and 9 for Group 1 or TB 1 ... 14, 16, 18 and 20 for Group 2).
- Open DIP switch 1 for the group (this floats the channel analog grounds).
- Close DIP switch 4 for the group (this places an analog module ground at TB 1 ... 11 or TB 1 ... 22).
- Connect the group signal common ground to TB 1 ... 11 for group 1 or TB 1 ... 22 for Group 2.

It is recommended that the entire module be utilized in either differential or single ended mode (common ground mode).

Three-wire RTD and Thermocouple Combination

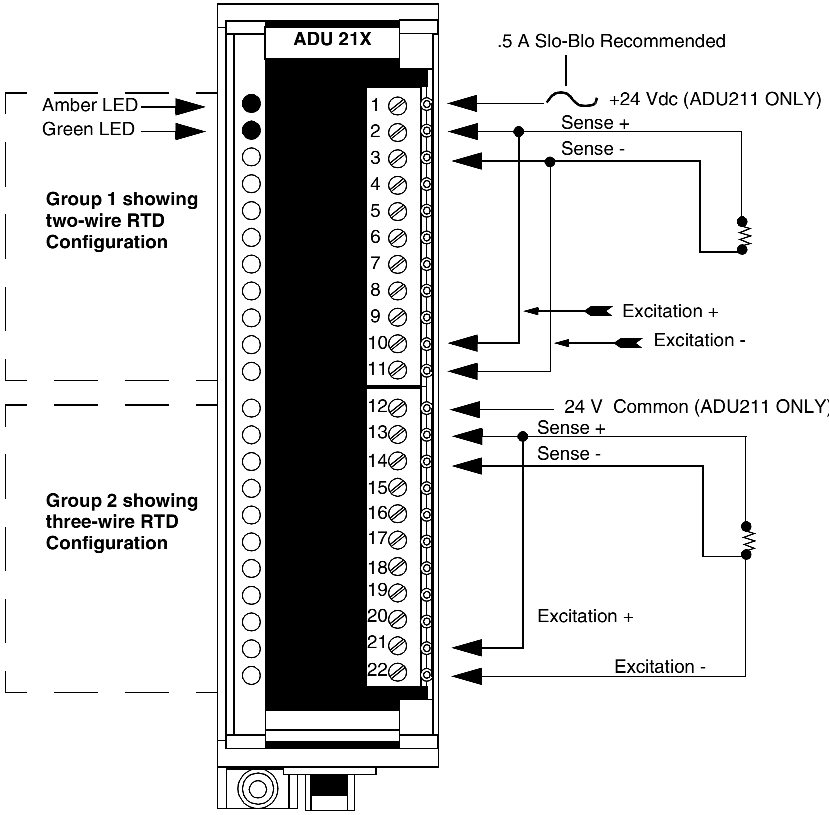
The following illustration shows a three-wire RTD configuration for Group 1 and a thermocouple configuration for Group 2.



In this illustration, the RTD excitation current is sourced from Terminal 11 (Terminal 22 is used if Group 2 is configured for RTDs). For thermocouple configurations, the module can detect open thermocouple circuits with the addition of external pull-up resistors.

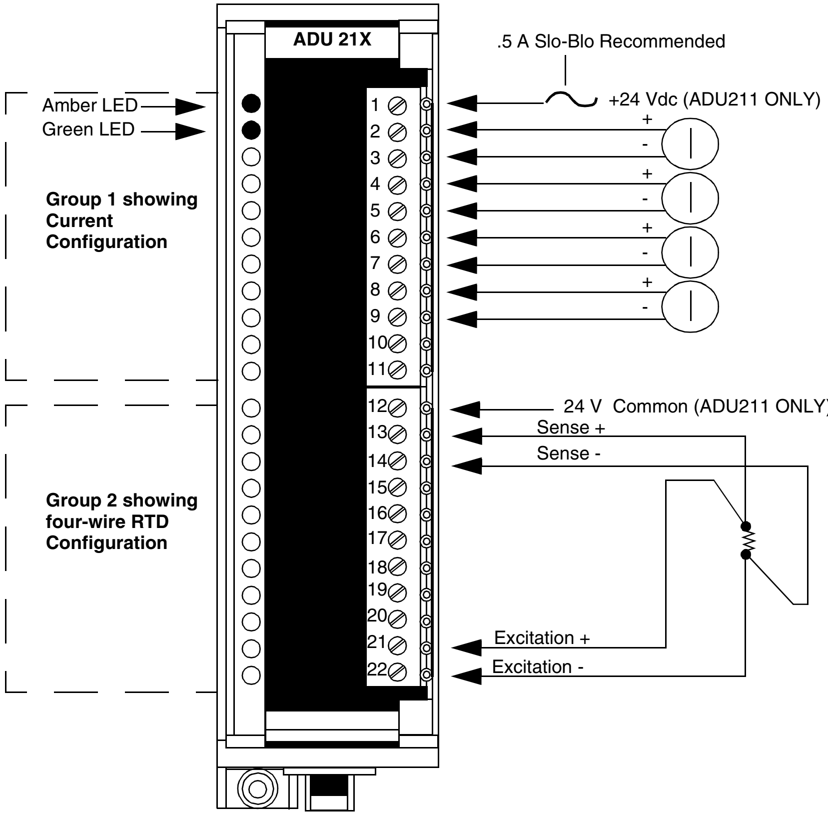
Two- and Three-wire Combination

The following illustration shows the ADU 211/212 wired for two-wire RTD operation in Group 1 and three-wire RTD operation in Group 2.



Current and Four-wire RTD Combination

The following illustration shows the ADU 211/212 wired for current in Group 1 and four-wire RTD operation in Group 2.



ADU 211/212 Universal Analog Input Module Application Notes

Introduction

This section contains application notes and usage recommendations in the following categories:
- General
- Current and Voltage Ranges
- RTD Ranges
- Thermocouple Ranges

General

- Power the ADU 211/212 module from the same 24 Vdc power supply as the PLC, the unit has an approximate 2 times nominal (4 VA maximum) inrush current for approximately 10 ms during power up.
- Do not leave the module unpowered in the PLC rack.
- Ensure the SVI.DAT DX loadable is installed and is the latest revision.
- Do not install or remove the module when the rack or module is powered.
- Use the on line help file for reference in the configuration screen by using <ALT H>.
- Ensure correct units of measure are selected for temperature, e.g. degrees C or degrees F. This configures all eight channels.
- Use the highest integration setting possible for your application, this ensures the most stable and accurate readings.

The following table lists integration time settings.

For operation at:	**50 Hz**	**60 Hz**
Set integration time to:	40 ms	33.3 ms
	60 ms	50 ms
	100 ms	100 ms
	200 ms	200 ms
NOTE: Integration rates of less than 33.3 ms are not recommended.		

- An asterisk in the rack ID indicates that the module is not correctly identified to the PLC; check DX loadable and module power.
- A flashing green RUN LED means the module has not established communications with the PLC.
- The signal inputs are optical/magnetic isolated from rack 500 V 25 micro A maximum at 60 Hz.
- Channel to channel isolation is +/- 30 V at 68 dB typical.
- For unused voltage, current or thermocouple channels, short the positive to negative terminals. For unused RTD channels, short the sense negative to sense positive terminals.
- Field wiring blocks are not interchangeable due to power and ground, employ keys.

- Observe good field wiring shield termination, typically only at the module end.
- In the temperature mode only, allow a warmup time of up to 10 minutes. During warmup temperature readings from 0 to 10 degrees above actual thermocouple readings may be seen.

Current and Voltage Ranges

- The ADU 211/212 module normally operates in a pseudo-differential mode. However, for some voltage sensing applications it may be preferred to configure for common ground. To set this mode of operation:
  - open DIP SW1 for the group (this floats differential ground)
  - close DIP SW4 for the group (this supplies a ground to TB1-11 for group 1 or TB1-22 for group 2)
  - connect all signal commons (grounds) to TB1-11 for group 1 or to TB1-22 for group 2
- As protection to the ADU 21X the module uses an active signal clamp that engages when signal levels are 3-12.5 Vdc or . +12.5 Vdc. Resistance between input terminals will decrease as voltage levels increase in magnitude.
- To reduce the effects of noise on field wiring, external capacitance may be added to the terminal block. A good capacitor for starters would be a 0.1 micro F 50 ... 100 V disc capacitor.
- Use high quality 100 percent shielded twisted-pair field wiring, Belden 8760 or equal.

Resistance Temperature Detector (RTD) Range

- Ensure that the format type is correctly selected, e.g. 2/4 or 3 wire mode.
- Ensure the total excitation lead resistance is under 10 ohms, in 3 and 4 wire modes.
- Use high quality 100 percent shielded field wiring.
- The 250 ohms internal current shut resistors maybe used to test or simulate a 400 degrees C 392 alpha.
- RTD excitation current is -200 micro A typical, be aware of RTD self heating.
- The RTD and field wiring should be isolated and floating from system grounds, etc.

Thermocouple Range

- Ensure the thermocouple type is correctly selected and that CJC is enabled.
- Verify thermocouple color coding and terminal block connections, because some thermocouples use red for the negative lead.
- The 250 ohms internal current shut resistors maybe used to simulate a short thermocouple thus yielding CJC/ambient rack temperature.
- Use isolated and shielded thermocouples whenever possible. The shield maybe connected to the thermocouples negative lead.
- Only use thermocouple extension grade wire because other choices may introduce additional thermocouple junctions.
- When possible, use a suitable thermocouple bead forming machine to weld the thermocouple wire.
- Total system accuracy = Thermocouple A/D conversion accuracy + Cold Junction Compensation (CJC) accuracy + thermocouple accuracy (available from the thermocouple manufacturer). The thermocouple A/D conversion accuracy and CJC accuracy specifications are in the last section of this chapter.

  Example - For a Type J thermocouple with +/- 0.5 C accuracy, the total system accuracy with internal CJC is:

A/D conversion accuracy (Type J)	+/-1.5 degrees C (+/-2.7 degrees F)
+ CJC accuracy	+/-1.7 degrees C (+/-3.0 degrees F)
+ Thermocouple accuracy	+/-0.5 degrees C (+/-0.9 degrees F)
Total system accuracy	+/-3.7 degrees C (+/-6.6 degrees F)

- For more than one thermocouple open detection circuit, external 22 M ohms ... 47 M ohms resistors must be used.
- Open thermocouple wiring without open circuit detection resistors will read large over-range or under-range values due to the high input impedance of the ADU 21X. Open thermocouple wiring with open circuit detection resistors will yield a high positive reading.
- The ADU 211/212 requires a warm-up period of about 10 minutes for readings to stabilize. Extreme variations in ambient temperature over short time causes module readings to drift as much as 10 degrees C.
- Ensure correct units are selected for modes of temperature, e.g. degrees C or degrees F.
- Do not select different temperature units for each channel or group, all channels must be either degrees C or degrees F.

ADU 211/212 Universal Analog Input Module Configuration

Introduction

The ADU 211/212 uses three 4x output registers and three 3x input registers, I/O mapped as binary (BIN) data.
You can call up the built-in help screens at any time by highlighting "ADU 211" and then pressing <ALT><H> for more information about the module. Both the ADU 211 and ADU 212 are I/O mapped as an "ADU 211" module.

Note: For application-specific concerns refer to the *ADU 211/212 Universal Analog Input Module Application Notes, p. 84*

ADU 211/212 Universal Analog Input Module Output Registers

Introduction

The output registers control how the ADU 211/212 operates.
The output registers for the ADU 211/212 are:

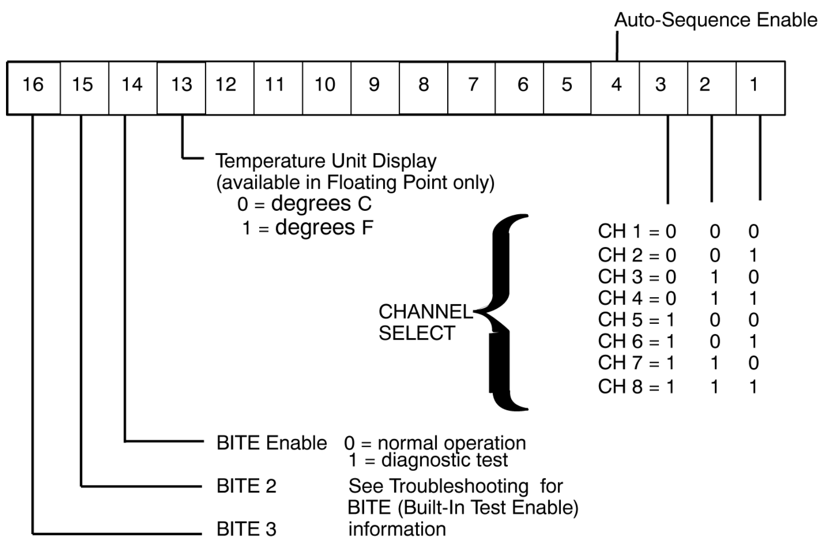
Register	Function
4x	Control Word
4x + 1	Control Word
4x + 2	Reserved for Future Use (do not use in user logic)

Control Word

Register 4x is the control word. It is used to:

- Select the type of field device to be used in each of the terminal block groups.
- Manually set the input channel to be displayed or enable auto-sequencing through all channels at a fixed interval.
- Select either Fahrenheit or Centigrade display.
- Enable the built-in test functions.

Control Word 4x is defined in the illustrations that follow.
The following figure illustrates Control Word 4x: Bits 1 ... 4 and 13 ... 16.



Channel Select (Bits 1 ... 3)

These bits manually select the channel to be displayed in input registers 3x and 3x + 1. If auto-sequence is enabled (bit 4 = 1), it overrides these bit settings. When the auto-sequence bit is released (bit 4 = 0), the module returns to manual operation.

> **Note:** For RTD applications, use only the data provided by Channel 1 (for Group 1) or Channel 5 (for Group 2); the module will use the other channels for its own calculations.

Auto-Sequence Enable (Bit 4)

This bit instructs the ADU 211/212 to automatically scan the input channels and present the data to the PLC at fixed intervals. When enabled (1), the module controls the active channel bits (bits 1 ... 3) of input register 3x + 2.

Temperature Unit Display (Bit 13)

If this bit is turned OFF (= 0), TC and RTD inputs will be displayed in degrees Centigrade. If this bit is turned ON (= 1), temperature data will be displayed in degrees Fahrenheit. Temperature data can be displayed in any data format, but it can only be displayed in degrees C or degrees F when in IEEE 754 floating point mode.

The following illustration shows the control word 4x: bits 5 ... 8.

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

GROUP 1
Input Type
and Range

*4 - 20mA/+/- 20mA =	0	0	0	0
+/-0.05V =	0	0	0	1
+/-0.50V =	0	0	1	0
+/-2.0V =	0	0	1	1
+/-5.0V =	0	1	0	0
+/-10.0V =	0	1	0	1
Type J =	0	1	1	0
Type K =	0	1	1	1
Type T =	1	0	0	0
Type E =	1	0	0	1
Type R =	1	0	1	0
Type S =	1	0	1	1
Type B =	1	1	0	0
Alpha 385 RTD =	1	1	0	1
Alpha 392 RTD =	1	1	1	0

*For 12-bit operation, the range is 4-20 mA. For 16-bit and IEEE 754 Floating Point, the range is +/- 20 mA.

The following illustration shows the control word 40XXX: bits 9 ... 12.

GROUP 2 Input Type and Range	12	11	10	9
*4 - 20mA/+/- 20mA =	0	0	0	0
+/-0.05V =	0	0	0	1
+/-0.50V =	0	0	1	0
+/-2.0V =	0	0	1	1
+/-5.0V =	0	1	0	0
+/-10.0V =	0	1	0	1
Type J =	0	1	1	0
Type K =	0	1	1	1
Type T =	1	0	0	0
Type E =	1	0	0	1
Type R =	1	0	1	0
Type S =	1	0	1	1
Type B =	1	1	0	0
Alpha 385 RTD =	1	1	0	1
Alpha 392 RTD =	1	1	1	0

*For 12-bit operation, the range is 4-20 mA. For 16-bit and IEEE 754 Floating Point, the range is +/- 20 mA.

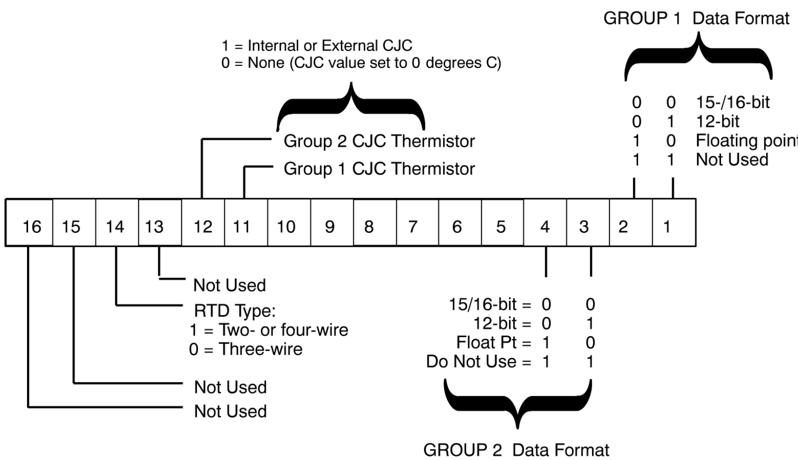
GROUP 2
Input Type
and Range

Input Type and Range Select (Bits 5 ... 8, Group 1; Bits 9 ... 12, Group 2)

Register 4x + 1 is a second control word, used to select:

- Data format
- Integration time
- CJC type
- RTD type

The following figure illustrates the control word 40XXX + 1 - Bits 1 ... 4 and 11 ... 16.



Data Format (Bits 1 and 2, Group 1; Bits 3 and 4, Group 2)

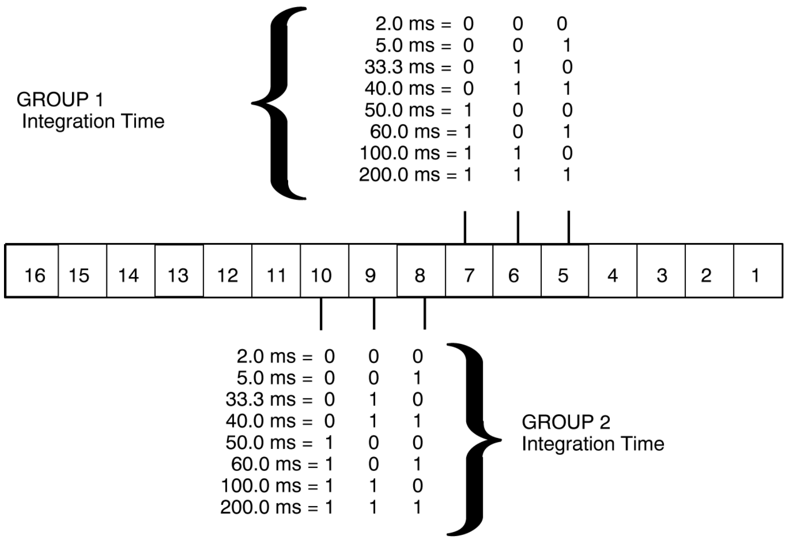
The data format you should select depends on your application. The available data formats are shown in the illustration(s) that follow.

CJC Type (Bit 11, Group 1; Bit 12, Group 2)

All thermocouples require Cold Junction Compensation (CJC) to work correctly. The only time you should select no CJC for a group is when you want to apply the CJC value of one group to the other, as explained in Section 6.3.3 for two groups of thermocouples with external CJC.

RTD Type (Bit 14)

When configured for RTD operation, only one two-wire, three-wire, or four-wire RTD is allowed per group.
The following illustration shows the control word 4x + 1 - Bits 5 ... 10.



Integration Time (Bits 5 ... 7, Group 1; Bits 8 ... 10, Group2)

Shorter integration times should be used in areas with low electrical noise, and longer integration times should be used in areas with high electrical noise. Typically, 33.3 ms (minimum) is used with 60 Hz noise, and 40.0 ms (minimum) is used with 50 Hz noise.
A211/212 display mode ranges are listed in the following table.

Range	**Display Modes**			
	12-Bit	**15/16-Bit**	**IEEE 754 Floating Point (16-bit)**	
+/- 50 mVDC	4095	32767	5.0 E-02 VDC	<- high value
	2048	0	0	<- middle value
	0	-32768	-5.0 E-02	<- low value
+/- 500 mVDC	4095	32767	0.5 VDC	
	2048	0	0	
	0	-32768	-0.5	
+/- 2000 mVDC	4095	32767	2.0 VDC	
	2048	0	0	
	0	-32768	-2.0	
+/- 5000 mVDC	4095	32767	5.0 VDC	
	2048	0	0	
	0	-32768	-5.0	
+/- 10,000 mVDC	4095	32767	10.0 VDC	
	2048	0	0	
	0	-32768	-10.0	
4 to 20 mA	4095	N/A	N/A	
	2048			
	0			
-20 to +20 mA	N/A	32767	+2.0 E-02 A	
		0	0	
		-32768	-2.0 E-02	
J Type	4095	65535	7.60 E02 de grees C	1.400 E03 de grees F
	2048	32768	3.80 E02	7.16 E02
	0	0	0	3.2 E01
K Type	4095	65535	1.000 E03 de grees C	1.832 E03 de grees F
	2048	32768	5.00 E02	9.32 E02
	0	0	0	3.2 E01

T Type	4095	65535	4.00 E02 de grees C	7.52 E02 de grees F
	2048	32768	1.50 E02	3.02 E02
	0	0	-1.00 E02	-1.48 E02
E Type	4095	65535	1.000 E03 degrees C	1.832 E03 degrees F
	2048	32768	5.00 E02	9.32 E02
	0	0	0	3.2 E01
R Type	4095	65535	1.750 E03 degrees C	3.182 E03 degrees F
	2048	32768	1.125 E03	2.057 E03
	0	0	5.00 E02	9.32 E02
S Type	4095	65535	1.750 E03 degrees C	3.182 E03 degrees F
	2048	32768	1.125 E03	2.057 E03
	0	0	5.00 E02	9.32 E02
B Type	4095	65535	1.800 E03 degrees C	3.272 E03 degrees F
	2048	32768	11.150 E03	2.102 E03
	0	0	5.00 E02	9.32 E02
100 ohms RTD 385m	4095	65535	8.00 E02 de grees C	1.472 E03 degrees F
	2048	32768	3.00 E02	5.72 E02
	0	0	-2.00 E02	-3.28 E02
100 ohms RTD 392m	4095	65535	8.00 E02 de grees C	1.472 E03 degrees F
	2048	32768	3.00 E02	5.72 E02
	0	0	-2.00 E02	-3.28 E02

WARNING

Extreme out-of-range voltage.

Operating the ADU 21X at an extreme out-of-range voltage (many times greater than the specified range) can permanently damage the module.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

ADU 211/212 Universal Analog Input Module Input Registers

Introduction

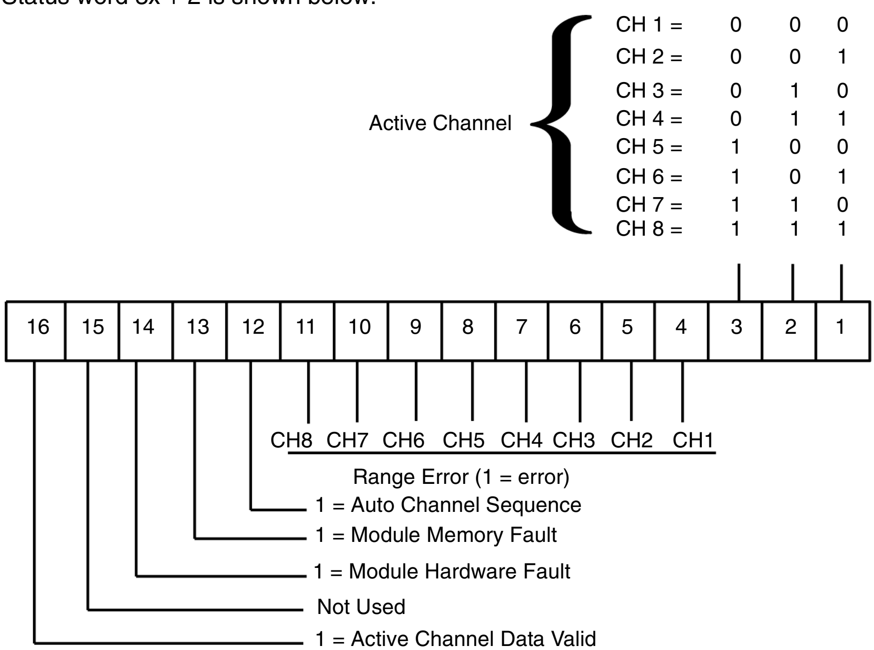
The input registers provide channel and status information to the PLC:
The input registers for the ADU 211/212 are:

Input Register	Function
3x	Read Data, Channels 1-8, Integer or IEEE 754 (LowWord)*
3x + 1	Read Data, Channels 1-8, IEEE 754 (High Word)*
3x + 2	Status Word
* Using IEEE 754 floating point notation requires two 3x input registers (3x and 3x + 1).	

Status Word 3x + 2

This register is a module operating status word, used to:
- Inform the PLC which input channel is active
- Indicate range errors for each of the eight channels
- Monitor the auto-sequence mode
- Indicate module memory faults
- Indicate faults in module hardware

Status word 3x + 2 is shown below:



Read Data Registers 3x and 3x + 1

These registers display the data collected from the field source. Data from each channel may be displayed on demand (through ladder logic) or in auto-sequence mode by the ADU 211/212 module. See *Sequentially Reading ADU 211/212 Universal Analog Input Module Channel Data, p. 96*

Channel Range Error (Bits 4... 11)

These bits go ON (= 1) if the associated channel experiences one of these conditions:

- A thermocouple input is open (only if a pull-up resistor is used) or over- or under-range
- an RTD input is over-range or has open excitation
- a 12-bit Current input is less than or equal to 3.6 mA or greater than 20 mA +2 percent minimum
- a signed 15-bit or IEEE 754 floating point Current input is less than -20 mA -2 percent minimum, or greater than 20 mA +2 percent minimum
- a Voltage input is over- or under-range

An input is out-of-range if it exceeds the specified range by at least 2 percent.

Auto-Sequence Mode (Bit 12)

The ADU 211/212 module can scan and display the data for each input channel automatically. Bit 12 monitors the auto-sequence mode: when ON (= 1), the module is cycling through the eight input channels at a fixed interval. See *Sequentially Reading ADU 211/212 Universal Analog Input Module Channel Data, p. 96* for more information.

Module Memory Valid (Bit 13)

This bit is used to inform the PLC that the module has detected a memory parity/checksum error in its firmware. If this bit is OFF (0), all memory conditions are normal. If this bit is ever ON (1), the module's data or configuration is in question and you should initiate a self-test, power cycle the module, or replace the module.

Module Error (Bit 14)

This bit is turned ON (1) when a hardware failure is detected within the module (the amber LED may also be flashing). If this bit is ON (1), the module must be power cycled. If the bit does not clear (0) after a power cycle, the module should be replaced.

Channel Data Ready (Bit 16)

If ON (1), the data from the active channel (identified in bits 1... 3) is ready to be read by the PLC. In Auto-Sequence Mode, the Channel Data Ready Bit cycles ON and OFF as new data values are written to the input registers. Any ladder logic acquiring data in the Auto-Sequence Mode should ensure that the Channel Data Ready Bit is set when data is read. See the following section for an application example.

Sequentially Reading ADU 211/212 Universal Analog Input Module Channel Data

Auto Sequence Mode

Setting the Control Word 4x auto-sequence enable bit (bit 4) ON (1) causes the ADU 211/212 to scan all eight input channels at a fixed rate: every 240 msec (per channel) if the Group 1 integration time is 2, 5, 33.3, or 40 msec (total cycle time is 2 seconds); 520 ms if the integration time is longer (total cycle time is 4 seconds). The Channel Active bits (bits 1... 3) in Status Word 3x + 2 identify which channel the module is currently reading. Before accepting this data, you should verify that the Channel Data Ready Bit (bit 16) in Status Word 3x + 2 is ON (1). A ladder logic example is shown below. Register(s) 3x (and 3x + 1 for IEEE 754 Floating Point) provide the actual data to the processor for the channel being scanned.

Note: For RTD applications, use only the data provided by Channel 1 (for Group 1) or Channel 5 (for Group 2); the module will use the other channels for its own calculations. Therefore, the Auto Sequence mode should not be used for RTD applications.

User-Defined Scan Mode

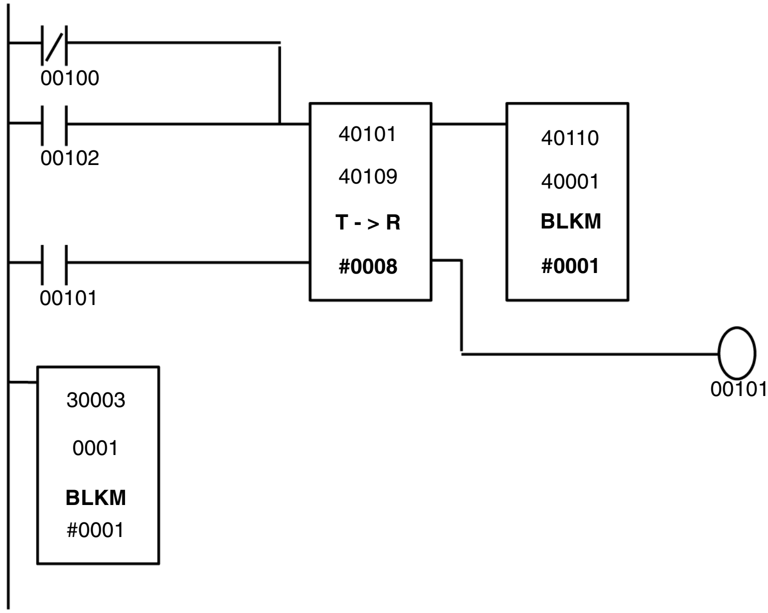
Some users may prefer to read input channel data at a faster or slower rate than is provided by Auto-Sequence. For example, you may want to scan Channels 1... 4 only, and read Channels 5... 8 less frequently or directly. The ladder logic shown in Figure 39 through Figure 45 is one way to do this.

Note: In user-defined scan mode, the auto-sequence enable bit (bit 4) in Control Word 4x must be disabled (0).

Note: For application specific concerns refer to the ADU 211/212 Universal Analog Input Module Application Notes.

Ladder Login Screen #1

Ladder Logic Screen #1 is shown below.



The first two rungs of ladder in Figure 39 can be used independently to sequence through the input channels. In this example, a T   R move is shown. Note that the Source Table must be entered by the user; here, the desired configurations have been loaded into registers 40101. 40108. Each of these registers must contain the proper bit settings to select one of eight input channels on the ADU 21X, as well as to define the group range. In this example, the Type J thermocouple mode will be used.

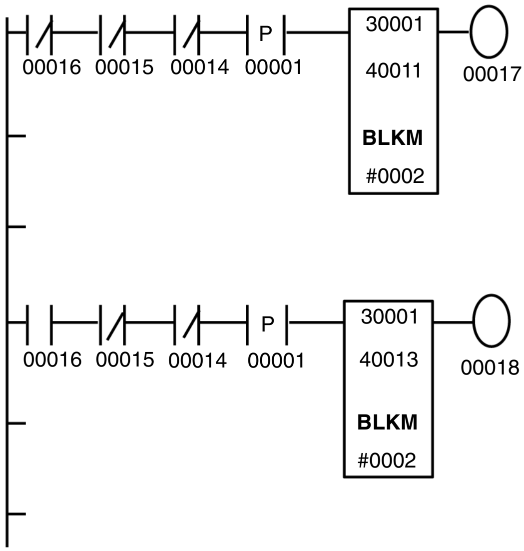
Loading 0662 hex into Control Word 40001 selects channel 3 and configures Groups 1 and 2 for Type J thermocouple. The corresponding binary bit pattern is 0000-0110-0110-0010. The appropriate words from the source table are transferred into register 40110.

The contents of register 40110 are then block moved into Control Word 40001. This happens eight times, moving the eight predefined configuration words into Control Word 40001 of the ADU 211, effectively selecting and moving all eight input readings into holding registers.

The remaining ladder shown (Figure 40 through Figure 45) illustrates a way to move validated data into independent holding registers. This lets you view and use all channel data at once. In this example, the processor continuously refreshes and loads validated data into the holding registers. In this fashion, ladder logic effectively de-multiplexes the ADU 211/212, making it appear as though each channel really had its own 3x data register.

Ladder Login Screen #2

Ladder Logic Screen #2 is shown below.

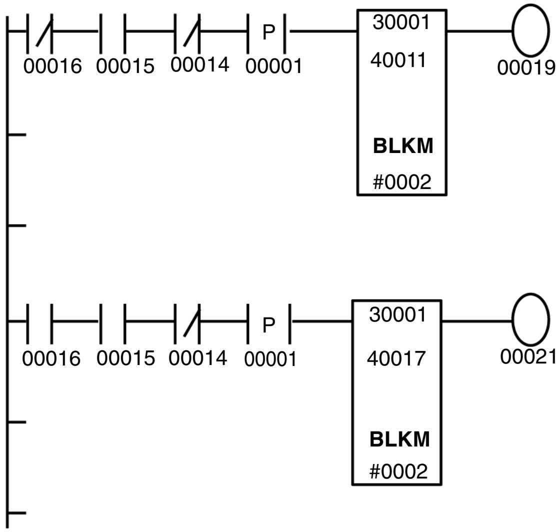


Register 30003 defines the ADU 211/212 Operating Status Word. Using the BLKM function to transfer this word into discrete outputs 00001... 00016 lets you monitor the Channel Active Bits and the Data Ready Bit. Properly decoding bits 00014... 00016 and the Data Ready bit 00001 lets you transfer register 30001 data (the data currently being read) into holding registers for each unique input channel. In this example, two consecutive words are moved for each channel, enabling you to display floating point data if desired. For all other data formats, you only need to move one word.

In Ladder Logic Screen #3, the block move for Channel 1 uses three normally closed contacts, corresponding to the channel select bits (bits 00014... 00016). When these three bits are OFF (0), Channel 1 is the active channel. When the Data Ready bit is ON (1), the contents of registers 30001 and 30002 are moved into holding registers 40011 and 40012.

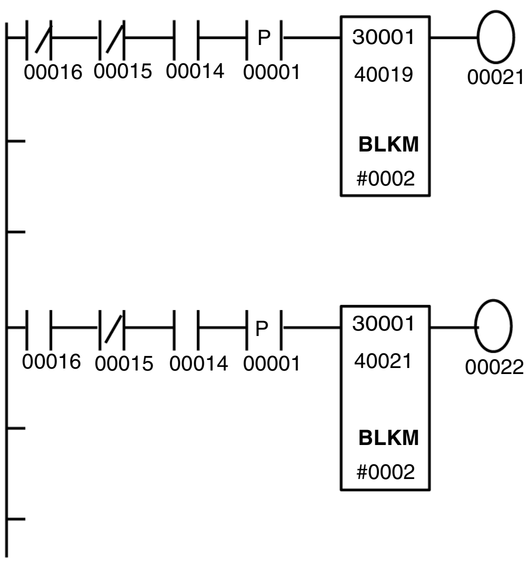
Ladder Login Screen #3

Ladder Logic Screen #3 is shown below.



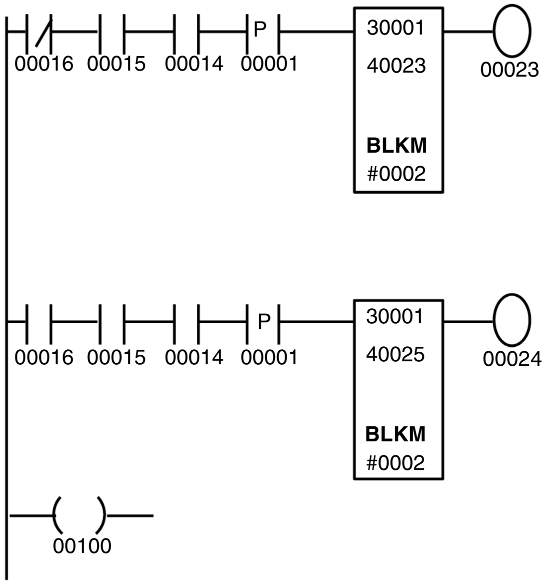
Ladder Login Screen #4

Ladder Logic Screen #4 is shown below.



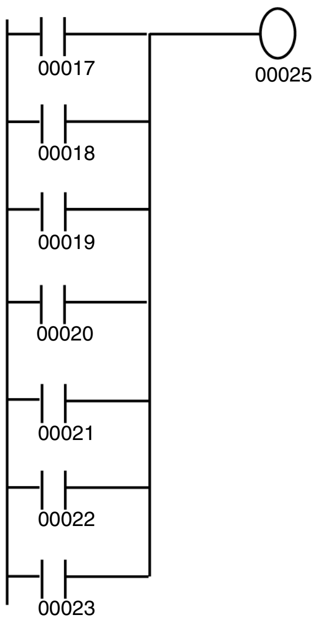
Ladder Login Screen #5

Ladder Logic Screen #5 is shown below.



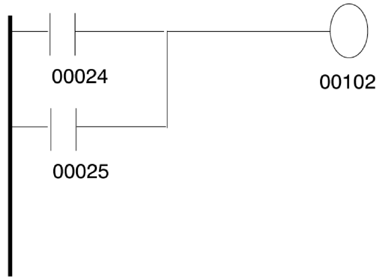
Ladder Login Screen #6

Ladder Logic Screen #6 is shown below.



Ladder Login Screen #7

Ladder Logic Screen #7 is shown below.



Source and Results

The source table and results of de-multiplexing are shown below.

40001	1667 Hex	30001	77.69141
40002	0DBA Hex	30003	
1000000000000000			
40101	1660 Hex	40011	77.69141
40102	1661 Hex	40013	78.02434
40103	1662 Hex	40015	78.04122
40104	1663 Hex	40017	78.29878
40105	1664 Hex	40019	77.93331
40106	1665 Hex	40021	78.20962
40107	1666 Hex	40023	78.37278
40108	1667 Hex	40025	78.25163

Format: Decimal Online Range: 1

The source table is shown above for this example in Registers 40101... 40108. The results of the demultiplexing are shown in Registers 40011, 40013, 40015, 40017, 40019, 40021, 40023, and 40025 for input Channels 1... 8, respectively. You can move the data to any eight consecutive registers for integer data formats. If floating point data is desired, then two consecutive destination registers are required for each input.

In this example, the ADU 211/212 was configured for Type J thermocouples as defined by register 40001. The demultiplexed holding registers for the eight input channels are displaying temperature in degrees Fahrenheit using the floating point data format.

The ADU 21X is I/O mapped as: 30001-30003 input registers, 40001-40003 output registers, and binary. You can call up the built-in help screens at any time by highlighting "ADU 211" and then pressing <ALT><H> for more information about the module.

ADU 211/212 Universal Analog Input Module Troubleshooting

Introduction

This section provides instructions for detecting and correcting ADU 211/212 operating problems. The following topics are covered in this section:
- LEDs
- Invalid Data
- Testing the System
- Built-in Tests

Amber LEDs

The amber LED on the front of the module provides module status information about the health of the module. A blinking amber LED indicates one of these faults:
- Module watchdog fault
- Module watchdog fault at startup
- Module RAM failure at startup
- Bus interface failure at startup
- Module ROM failure
- Module processor fault at startup
- General module error

If the amber LED begins blinking, try restarting the ADU 21X. If the blinking continues, call Technical Support at 1-800-468-5342.

Green LEDs

The green LED provides status information about the module's readiness. After the module is powered up, the green LED should begin blinking. If not, check the power connections.

After the module has established communications with the PLC, the green LED should stop blinking and remain ON. If not, ensure that the PLC has been powered up.

Note: Do not run PLC without power applied to the module.

Note: For application specific concerns refer to the *ADU 211/212 Universal Analog Input Module Application Notes, p. 84*

Invalid Data

If the module seems to be providing invalid data to the PLC, check:
- Field wiring connections, DIP switch settings, and register settings.
- Integrity of the source device and connections.
- Signal cables are not placed on or near high voltage (120 Vac or higher) control wiring. If the signal cables must pass high voltage cables, make sure that the signal cables pass the high voltage cables at 90degree angle.

If electrical interference seems to be the problem, try to place the module as far as possible from the P120 power supply and relay output modules. These products may generate electrical interference during operation. This won't affect the ADU 21X but may induce noise on the incoming channel wiring.

Testing the System

For thermocouple applications, you can test the system by temporarily short circuiting each thermocouple at the terminal block-use some wire to connect the + lead to the - lead. Short circuiting a thermocouple channel should cause that channel to read the ambient temperature-i.e., the temperature at the CJC thermistor if CJC is enabled-if not, check the terminal connections and DIP switch settings.
For RTD applications, you can test the system by enabling the internal 250 ohms shunts. Shunting an RTD channel should cause that channel to read approximately 409 degrees C (768 degrees F).

Built-in Tests

The ADU 21X has built-in tests that can be enabled to check out the module's control electronics. These tests are performed automatically every time the module is powered up, but they can also be run after the module is on-line. Setting the appropriate bits ON (1) will cause the module to enter a self-test mode.

> **Note:** When bits 16, 15, or 14 are set ON, the green LED blinks continuously until these bits are set OFF. When bits 16... 14 are set OFF, the module may need to be restarted.

To terminate the self-test mode, simply reset the Built-in Test Enable bit (bit 14 in Control Word 4x) OFF (0). Bits 15 and 16 determine the type of test that will be executed.

BIT 16	BIT 15	BIT 14	Elements Tested
0	0	0	None (tests disabled)
0	1	1	ADU 21X Microprocessor, Dual-Port RAM, ROM, Watchdog Circuit, Ready and Run LEDs, Power Supply
1	0	1	EEPROM, Bus Interface Unit, Analog signal conditioning, Isolation communications, Power Supply, Module firm ware

If the ADU 21X fails any of these tests (amber LED blinks), restart the module. If it continues to fail, call Technical Support at 1-800-468-5342.

ADU 211/212 Universal Analog Input Module Specifications

Table of Specifications

The following table contains a list of ADU 211/212 specifications.

Module Topology	Number of Inputs	8 (2 for RTD)
	Number of Groups	2
	Points/Group	4 (1 for RTD)
	Isolation	Channel-to-bus: 500 volts, 25 micro A max. leakage at 60 Hz. Channel-to-channel: +/- 30 Vdc max.
Required Loadable	SW-IODR-001	
Power Supplies	Ext. Source Requirement	20-30 Vdc for the ADU 211: none for the ADU 212
	Consumption	2.5 VA typical, 4.0 VA (167 mA at 24 Vdc nominal) maxi mum for the ADU 211
	Power Dissipation	2.5 VA typical, 3.0 VA maxi mum for the ADU 212
	Internal 5 V from PAB	less than 80 mA (TTL loading) for the ADU 211: 450 mA typical, 600 mA maximum for the ADU 212
DIN Rail Grounding	less than 0.1 ohms	
Input protection	Analog multiplexer resident clamps and FETs	
Input Impedance	10 M ohms typical	
Signal Inputs	Thermocouple	
	J:	0 to 760 degrees C (32 to 1400 degrees F)
	K:	0 to 1000 degrees C (32 to 1832 degrees F)
	T:	-100 to 400 degrees C (-212 to 752 degrees F)
	E:	0 to 1000 degrees C (32 to 1832 degrees F)
	R:	+500 to 1750 degrees C (932 to 3182 degrees F)
	S:	+500 to 1750 degrees C (932 to 3182 degrees F)
	B:	+500 to 1800 degrees C (932 to 3272 degrees F)
	RTD	3- or 2/4-wire 100 ohms, 385 or 392 alpha
		-200 to 800 degrees C
	Voltage	+/-50, 500, 2000, 5000, and 10,000 mVDC
	Current	4-20 mA (12 bit)
		+/- 20 mA (16-Bit and IEEE 754)
I/O Map	Register 3x/4x	3 in/3 out

Integer Resolution	1 part in 4096 counts (12-bit display) 1 part in +32767 to -32768 counts (16-bit)	
IEEE754 FP resolution (engineering units)	Thermocouple: (use non-grounded type TCs)	0.7 degrees C or better
	RTD:	0.15 degrees C or better
	Voltage:	0.035 percent of full scale or better
	Current:	0.035 percent of full scale or better
Accuracy	Thermocouple at module with fixed 0 degrees C CJC	
	J:	+/- 1.5 degrees C (2.7 degrees F)
	K:	+/- 2.0 degrees C (3.6 degrees F)
	T:	+/- 3.0 degrees C (5.4 degrees F)
	E:	+/- 1.2 degrees C (2.2 degrees F)
	R:	+/- 7.0 degrees C (12.5 degrees F)
	S:	+/- 7.0 degrees C (12.6 degrees F)
	B:	+/- 15.0 degrees C (27.0 degrees F)
	RTD at module	100 ohms Platinum, 385 alpha: +/- 0.40 degrees C typical, +/- 1.0 degrees C maximum
		100 ohms Platinum, 392 alpha: +/- 0.40 degrees C
	Voltage at module	50 mVDC: +/- 0.40 percent of full scale
		0.5, 2, 5 & 10 VDC: +/-0.11 percent of full scale
	Current	4 to 20 mA: +/- 0.20 percent of full scale
		+/- 20 mA: +/- 0.20 percent of full scale
Linearization	Thermocouple:	IPTS-68 Standard, NBS MN-125
	RTD:	JIS C 1604, DIN 43760 and IEC 751
Open Circuit Detect	Thermocouple (external 22-47 M ohms resistors required for individual open circuit detection)	
Cold Junction Compensation	10 k ohms internal or external thermistor or fixed value, +/-1.7 degrees C (3.1 degrees F) typical, +/-4.1 degrees C (7.4 degrees F) maximum accuracy	
RTD Excitation	200 micro A typical	
Signal Integration Time	2, 5, 33.3, 40, 50, 60, 100 and 200 msec (group selectable)	
Single Channel Update Time	(Integration x 1.5) + 10.0 msec typical	

Common Mode Rejection	68 dB typical at 50 or 60 Hz with integration time set at greater than 100 msec	
Calibration	Automatic and continuous	
Temperature	Operating: 0 to 60 degrees C (32 to 140 degrees F)	
	Storage: -40 to 85 degrees C (-40 to 185 degrees F)	
Relative Humidity	0 to 95 percent at 60 degrees C, non-condensing	
Vibration	3 rotational axes 2G RMS, 10 to 57 Hz 15-minute scan (1 octave per minute)	
Shock	30G for 11 msec, 1/2 sine, 3 orthogonal axes	
Packaged Free Fall	3 feet (1 meter), 5 iterations each side	
Cooling	Free air convection	
EMI Susceptibility	27 to 500 mHz 10 volt/meter (per subset IEC 801-3)	
Fast Transient	+/- 1.0 kV (per subset IEC 801-2)	
Electrostatic discharge	8 kV, 10 discharges, no damage	
Dimensions	(W x H x D)	1.6 x 5.6 x 4.5 in. 40.3 x 145.0 x 117.5 mm
	Weight	0.80 lb (360 g) max.
Power Connections	60/75 copper (Cu)	
Torque	4.5 inch-pounds on set screws	
Agency Approvals	ADU 211 & ADU 212	UL 508; CSA 22.2 No.142; FM Class I, Div 2**; and European Directive EMC 89/336/EEC Standards
**This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, and D, or non-hazardous locations only.		

WARNING

Substitution Warning

Substitution of components may impair suitability for Class 1, Division 2.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

ADU 214 Analog Input Module

7

At a Glance

Purpose

This Chapter gives an overview of the ADU 214 Analog Input Module. This is followed by the physical characteristics of the module; installation and configuration procedures; and, lastly, the specifications of the ADU 214 Module.

⚠	**WARNING**
	Operative Failure Alert The ADU 214 module will only operate properly when used with an A984, E984, or Micro 512/612 controller. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

Note: Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

What's in this Chapter?

This chapter contains the following topics:

Overview of the ADU 214 Analog Input Module

Physical Characteristics

The ADU 214 module is used for measuring analog data, and provides up to 8 non-isolated inputs. The main characteristics of the module follow.

Tip: This module is suitable for use on Compact 984 with memory size of 4K or more.

- Four 4-wire analog inputs. These inputs can be used for 2-wire measurement, thus allowing up to 8 unipolar inputs, 4 bipolar voltage inputs, or combinations of both.
- Several measuring ranges that may be individually selected and mixed for each input:

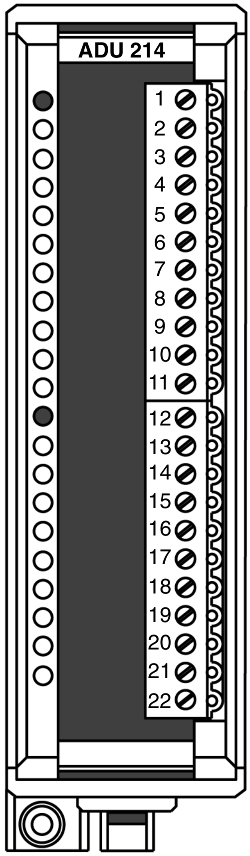
The following Measuring Ranges apply to the ADU 214 Analog Input Module.

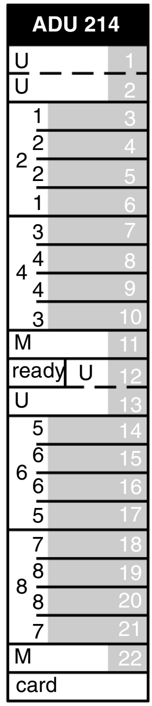
Voltage measurement	0 ... 0.5, 0 ... 1, 0 ... 5, 0 ... 10 V, 0.1 ... 0.5, 0.2 ... 1, 1 ... 5, 2 ... 10 V, 0.5, 1, 5, 10 V
Current measurement (External precision resistor required)	0 ... 5, 0 ... 10, 0 ... 20 mA, 1 ... 5, 2 ... 10, 4 ... 20 mA, 5, 10, 20 mA
RTD Temperature measurement	-160/-60 ... +160 degrees C (resolution ≤ 0.02 degrees C) -200 ... +320 degrees C (resolution ≤ 0.04 degrees C) -200 ... +640 degrees C (resolution ≤ 0.08 degrees C)
Resistance measurement	0 ... 100, 0 ... 200, 0 ... 500 Ω,, 0 ... 1000, 0 ... 2000 Ω

The PLC model determines the available ranges. Refer to the tables in this chapter.

Note: Only the 15 Bit + sign resolution is supported when using the E984-258/265/275/285 PLC models. The 12, 13 and 15 Bit + sign resolutions are all supported when using the A984-1xx, E984-24x/251/255 PLC models.

The following illustration is of the Front View and Label of the ADU 214 Module

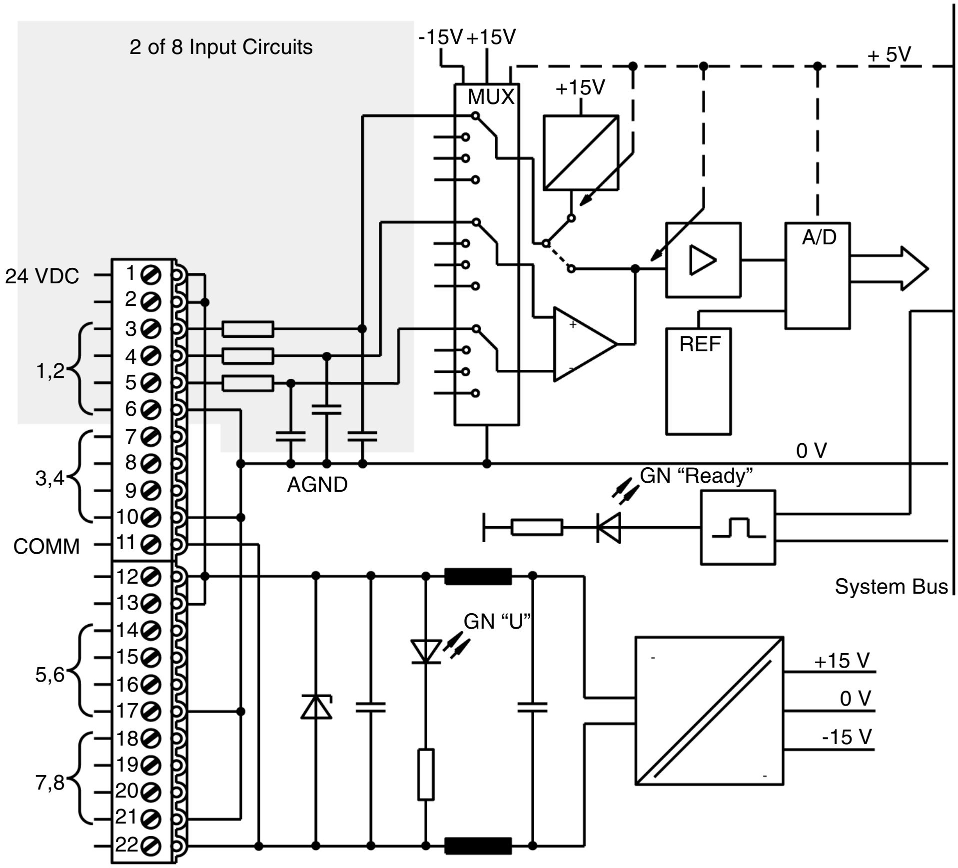




- Broken wire testing of all 4-wire lines and self-calibration using built-in reference resistances and reference voltages
- Measuring ranges for voltage, current, temperature, and resistance can be set individually for each input
- Switch-selectable 50 ... 60 Hz operation noise suppression

Simplified Schematic

The following is a simplified schematic for the ADU 214 Module.



LEDS

The ADU 214 has two front panel LEDs:

- One green LED opposite Terminal 1 indicating the module is receiving 24 V power
- One green LED opposite Terminal 12 indicating the module's processor is running

Conversion Values

Overview

The following tables provide ADU 214 conversion values for unipolar voltage inputs, bipolar voltage inputs, current inputs, temperature inputs, and resistance inputs.

Conversion Values of Unipolar Voltage Inputs, Part 1

The following table shows Conversion Values of Unipolar Voltage Inputs.

0...0.5 V	**0...1 V**	**0...5 V**	**0...10 V**	**0.1...0.5 V**	**0.2...1 V**	**1...5 V**	**2...10 V**
<-0.008	<-0.016	<-0.08	<-0.16	<+0.052	<+0.104	<+0.52	<+1.04
				+0.052	+0.104	+0.52	+1.04
-0.008...	-0.016...	-0.08..	-0.16..	+0.094...	+0.187...	+0.936...	+1.87...
-0.000	-0.000	-0.00	-0.00	+0.099	+0.199	+0.99	+1.99
0	0	0	0	0.1	0.2	1	2
0.000 02	0.000 03	0.000 16	0.000 31	0.100 0	0.200 0	1.000 1	2.000 3
0.000 25	0.000 5	0.002 5	0.005	0.100 2	0.200 4	1.002	2.004
0.000 5	0.001	0.005	0.01	0.100 4	0.200 8	1.004	2.008
0.005	0.01	0.05	0.10	0.104	0.208	1.04	2.08
0.025	0.05	0.25	0.50	0.12	0.24	1.20	2.40
0.05	0.10	0.50	1.00	0.14	0.28	1.40	2.80
0.25	0.50	2.50	5.00	0.30	0.60	3.00	6.00
0.50	1.00	5.00	10.00	0.50	1.00	5.00	10.00
0.500 0...	1.000 0...	5.000...	10.000...	0.500...	1.000...	5.00...	10.00...
0.511 9	1.023 9	5.119	10.239	0.509	1.019	5.09	10.19
≥0.512	≥1.024	≥5.12	≥10.24	>0.509	>1.019	>5.09	>10.19
NOTE: Numbers **not in** parentheses = range with + limit.							

Conversion Values of Unipolar Voltage Inputs, Part 2

Conversion Values of Unipolar Voltage Inputs continue in the following table.

15-BIT	13-BIT	12-BIT	NOTES
-32,767			underflow error
0 (-3,840) 0 (-512) 0 (-1)			overload range
0 +1 +16 +32 +320 +1 600 +3 200 +16 000 +32 000	4096 8096	2048 4048	rated value Linear Range rated value
+32 001... +32 766			 overload range
+32 767	8191	4095	overflow error
NOTE: Numbers **in** parentheses = range with ± limit.			

Conversion Values of Bipolar Voltage Inputs, Part 1

The following table shows Conversion Values of Bipolar Voltage Inputs:

0.5 V	1 V	5 V	10 V
≤–0.512	≤–1.024	≤–5.12	≤–10.24
–0.511 9 ... –0.500 0	–1.023 ... –1.000	–5.119 ... –5.000	–10.239 ... –10.000
–0.50 –0.25 –0.05 –0.025 –0.005 –0.000 5	–1.00 –0.50 –0.10 –0.05 –0.01 –0.001	–5.00 –2.50 –0.50 –0.25 –0.05 –0.005	–10.00 –5.00 –1.00 –0.50 –0.10 –0.01
–0.000 25 0 +0.000 02 +0.000 25 +0.000 5 +0.005 +0.025 +0.05 +0.25 +0.50	–0.000 5 0 +0.000 03 +0.000 5 +0.001 +0.01 +0.05 +0.10 +0.50 +1.00	–0.002 5 0 +0.000 16 +0.002 5 +0.005 +0.05 +0.25 +0.50 +2.50 +5.00	–0.005 0 +0.000 31 +0.005 +0.01 +0.10 +0.50 +1.00 +5.00 +10.00
+0.500 0 ...	+1.000 0 ...	+5.000 ...	+10.000 ...
+0.511 9	+1.023 9	+5.119	+10.239
≥+0.512	≥+1.024	≥+5.12	≥+10.24

Conversion Values of Bipolar Voltage Inputs, Part 2

Conversion Values of Bipolar Voltage Inputs continue in the following table:

*15-BIT	13-BIT	12-BIT	NOTES
–32 767			underflow error
-32 766 -32 001			overload range
-32 000 -16 000 -3 200 -1 600 -320 -32 -16 0 +1 +16 +32 +320 +1 600 +3 200 +16 000 +32 000	96 4096 8096	48 2048 4048	rated value Linear Range rated value
+32 001 ... +32 766			 overload range
+32 767	8191	4095	overflow error

Note: *Only the 15 Bit + sign resolution is supported when using the E984–258/265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

Conversion Values of Current Inputs, Part 1

The following table shows Conversion Values of Current Inputs:

0...10 mA	0...20 mA	2...10 mA	4...20 mA	20 mA
<–0.16	<–0.32	<+1.04	<+2.08	≤–20.479
				–20.478 ...
				–20.000
		+1.04 ...	+2.08 ...	
–0.16...	–0.32...	+1.87 ...	+3.74 ...	
–0.00	–0.00	+1.99	+3.99	
				–20.00 –10.00 –2.00 –1.00 –0.20 –0.02 –0.01
0	0	+2	+4	0
+0.005	+0.01	+2.004	+4.008	+0.01
+0.01	+0.02	+2.008	+4.016	+0.02
+0.1	+0.20	+2.08	+4.16	+0.20
+0.5	+1.00	+2.40	+4.80	+1.00
+1	+2.00	+2.80	+5.60	+2.00
+5	+10.00	+6.00	+12.00	+10.00
+10.0	+20.00	+10.00	+20.00	+20.00
+10.000...	+20.000...	+10.00...	+20.00...	+20.000...
+10.239	+20.478	+10.19	+20.38	+20.478
≥+10.24	≥+20.479	>+10.19	>+20.38	≥+20.479

Conversion Values of Current Inputs, Part 2

Conversion Values of Current Inputs continue in the following table:

*15-BIT	13-BIT	12-BIT	NOTES
–32 767			underflow error
-32 766 -32 001 0 (-3 840) 0 (-512) 0 (-1)			overload range
-32 000 -16 000 -3 200 -1 600 -320 -32 -16	96	48	rated value
0 +1 +16 +32 +320 +1 600 +3 200 +16 000 +32 000	4096 8096	2048 4048	Linear Range rated value
+32 001 ... +32 766			 overload range
+32 767	8191	4095	overflow error
NOTE: Numbers **in** parentheses = range with ± limit			

Note: *Only the 15 Bit + sign resolution is supported when using the E984–258/265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

Conversion Values of Temperature Inputs, Part 1

The following table shows Conversion Values of Temperature Inputs:

-60 ... +160°C	-160 ... +160°C	-200 ... +320°C	-200 ... +640°C
<–60	<–160	<–200	<–200
	–160		
	–100	–200	
–60	–60	–120	
–50	–50	–100	–200
–16	–16	–32	–64
0	0	0	0
+0.005	+0.005	+0.01	+0.02
+0.08	+0.08	+0.16	+0.32
+0.16	+0.16	+0.32	+0.64
+8	+8	+16	+32
+16	+16	+32	+64
+80	+80	+160	+320
+160	+160	+320	+640
+160.005 ...	+160.005 ...	+320.01 ...	+640.02 ...
+163.83	+163.83	+327.66	+655.32
≥+163.84	≥+163.84	≥+327.67	≥+655.34

Conversion Values of Temperature Inputs, Part 2

Conversion Values of Temperature Inputs continue in the following table:

*15-BIT	13-BIT	12-BIT	NOTES
–32 767			measuring range underflow (error)
-32 000	96	48	rated value
-22 000			
-12 000			
-10 000			
-3 200			
0	4096	2048	Linear Range
+1			
+16			
+32			
+320			
+1 600			
+3 200			
+16 000			
+32 000	8096	4048	rated value
+32 001 ...			
+32 766			overload range
+32 767	8191	4095	measuring range overflow error

Note: *Only the 15 Bit + sign resolution is supported when using the E984–258/265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

Conversion Values of Resistance Inputs, Part 1

The following table shows Conversion Values of Resistance Inputs:

0...100Ω	**0...200Ω**	**0...500Ω**	**0...1000Ω**	**0...2000Ω**
<–1.6	<–3.2	<–8	<–16	<–32
0...–1.6	0...–3.2	0...–8	0...–16	0...–32
0	0	0	0	0
0.003	0.006	0.015	0.03	0.06
0.05	0.1	0.25	0.5	1
0.1	0.2	0.5	1	2
1	2	5	10	20
5	10	25	50	100
10	20	50	100	200
50	100	250	500	1000
100	200	500	1000	2000
100.00 ...	200.00 ...	500.01 ...	1000.03 ...	2000.06 ...
102.39	204.78	511.97	1023.94	2047.88
≥102.40	≥204.79	≥511.98	≥1023.97	≥2047.94

Conversion Values of Resistance Inputs, Part 2

Conversion Values of Resistance Inputs continue in the following table:

*15-BIT	13-BIT	12-BIT	NOTES
–32 767			underflow error
0			overload range
0	4096	2048	rated value
+1			
+16			
+32			
+320			
+1 600			linear range
+3 200			
+16 000			
+32 000	8096	4048	rated value
+32 001 ...			
+32 766			overload range
+32 767	8191	4095	overflow error
NOTE: Numbers **in** parentheses = range with ± limit.			

Note: *Only the 15 Bit + sign resolution is supported when using the E984–258/265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

Configuration - Concept

Configured Registers - Modsoft

The ADU 214 module requires two sequental 4X command registers and 3 sequental 3X status registers all Traffic Copped as BIN. Selecting a channel number higher than 8, or one already included in a channel pair measurement, will result in an ILLEGAL 4X COMMAND" bit to be set in the 3X register response.

The following table shows Configured Registers for the ADU 214 Module.

Registers	Contents
4x	50x Decimal, with x = Channel 1 ... 8
4x + 1	Configuration Command (Refer to *Register Configuration Commands - Modes - Modsoft, p. 124*)
3x	Configure Command Response (see *Invalid Commands - Modsoft, p. 127*
3x ,+ 1	0
3x + 2	0

4X output register commands, and resultant 3X register formats are:

- For unipolar measurements, select Channel 1 ... 8 and enter decimal 1 ... 28 for the configuration code in register 4x + 1.
- For bipolar measurements, channel pairs are wired on the field connector, and are also configured in pairs. Either channel of the pair may be selected. For these measurements, the even channel must be used in the 4x read command. The odd channel will be indicated not active or not valid in the 3x status register, and will display zero in its data register. For example, channel pairs are 1/2, 3/4, 5/6, and 7/8. To configure the top input for bipolar operation, select either 1 or 2 for the x value in the 50x command, and enter decimal 33 to 36 for the configuration code in register 4x + 1.
- For RTD or resistance measurements, channel pairs are wired on the field connector and are also configured in pairs. Either channel of the pair may be selected. For these measurements, the even channel must be used in the 4x read command. The odd channel will be indicated not active or valid in the 3x status register, and will display zero in its data register. For example, channel pairs are 1/2, 3/4, 5/6, and 7/8. To configure the top input for these measurements, select either 1 or 2 for the x value in the 50x command, and enter decimal 64 ... 95 (RTD) or 96 ... 116 (Ω) for the configuration code in register 4x + 1.
- If backplane or field power is lost, the module must be reconfigured.

Register Configuration Commands - Modes - Modsoft

The following tables indicate the 4X+1 Register Configuration Commands, for the ADU 214 Module, in its various modes.

Commands (Decimal)	Ranges		
Two-wire Unipolar Mode			
1	0 ... 10 V		
2	0 ... 5 V		
3	0 ... 1 V	0 ... 20 mA*	0 ... 10 mA**
4	0 ... 0.5 V	0 ... 10 mA*	0 ... 5 mA**
9	2 ... 10 V		
10	1 ... 5 V		
11	0.2 ... 1 V	4 ... 20 mA*	2 ... 10 mA**
12	0.1 ... 0.5 V	2 ... 10 mA*	1 ... 5 mA**
17	0 ... 10 V		
18	0 ... 5 V		
19	0 ... 1 V	0 ... 20 mA*	0 ... 10 mA**
20	0 ... 0.5 V	0 ... 10 mA*	0 ... 5 mA**
25	2 ... 10 V		
26	1 ... 5 V		
27	0.2 ... 1 V	4 ... 20 mA*	2 ... 10 mA**
28	0.1 ... 0.5 V	2 ... 10 mA*	1 ... 5 mA**
Note: When using Commands 17 ... 28, the message CHANNEL INVALID is displayed if READ 15 BIT command is used.			
Two-wire Bipolar Mode			
33	+ 10 V		
34	+ 5 V		
35	+ 1 V	+ 20 mA*	+ 10 mA**
36	+ 0.5 V	+ 10 mA*	+ 5 mA**
* = 50Ω required across input ** = 100Ω required across input			

Register Configuration Commands - Detectors - Modsoft

The table below gives Register Configuration Commands for the ADU 214 Module, by Four-Wire Temperature Detector.

Four-wire Temperature detector	
64	-60 ... +160 o C with Ni 100
65	-160 ... +160 o C with Pt 100
66	-200 ... +320 o C with Pt 100
67	-200 ... +640 o C with Pt 100
68	-60 ... +160 o C with Ni 200
69	-169 ... +160 o C with Pt 200
70	-200 ... +320 o C with Pt 200
71	-200 ... +640 o C with Pt 200
72	-60 ... +160 o C with Ni 500
73	-160 ... +160 o C with Pt 500
74	-200 ... +320 o C with Pt 500
75	-200 ... +640 o C with Pt 500
76	-60 ... +160 o C with Ni 1000
77	-160 ... +160 o C with Pt 1000
78	-200 ... +320 o C with Pt 1000
79	-200 ... +640 o C with Pt 1000

Register Configuration Commands follow, for Two- and Three-wire Temperature detector - with wire compensation (10 Ω)

80	**-60 ... +160 o C with Ni 100**
81	-160 ... +160 o C with Pt 100
82	-200 ... +320 o C with Pt 100
83	-200 ... +640 o C with Pt 100
84	-60 ... +160 o C with Ni 200
85	-160 ... +160 o C with Pt 200
86	-200 ... +320 o C with Pt 200
87	-200 ... +640 o C with Pt 200
88	-60 ... +160 o C with Ni 500
89	-160 ... +160 o C with Pt 500
90	-200 ... +320 o C with Pt 500
91	-200 ... +640 o C with Pt 500
92	-60 ... +160 o C with Ni 1000
93	-60 ... +160 o C with Ni 100

80	**-60 ... +160 o C with Ni 100**
94	-200 ... +320 o C with Pt 1000
95	-200 ... +640 o C with Pt 1000

Register Configuration Commands - Resistance Measuring - Modsoft

The following table provides Register Configuration Commands for the ADU 214 Module, by form of resistance measuring.

Four-wire Resistance measuring	
96	0 ... 500 Ω
97	0 ... 500 Ω
98	0 ... 500 Ω
99	0 ... 1000 Ω
100	0 ... 2000 Ω
Two-wire Resistance measuring with wire compensation (10 Ω)	
112	0 ... 100 Ω
113	0 ... 200 Ω
114	0 ... 500 Ω
115	0 ... 1000 Ω
116	0 ... 2000 Ω

Register Configuration Commands - Read Values - Modsoft

The following table addresses Read Configuration Values for the ADU 214 Module.

Read Configuration	
4X	**4YX** Decimal, with Y and X = Channels to be read (1 ... 8)
4X+1	Not used
3X	Configure Command Response (Refer to *Invalid Commands - Modsoft, p. 127*)
3X+1	Channel X Configuration
3X+2	Channel Y Configuration

Read Values Table appears next.

Read 12-bit Value	
4X	**4YX** Decimal, with Y and X = Channels to be read (1 ... 8)
4X+1	Not used
3X	Configure Command Response (Refer to *Invalid Commands - Modsoft, p. 127*)
3X+1	Channel X Measurement
3X+2	Channel Y Measurement

Read 13-bit Value	
4X	**2YX** Decimal, with Y and X = Channels to be read (1 ... 8)
4X+1	Not used
3X	Measure Command Response (Refer to *Invalid Commands - Modsoft, p. 127*)
3X+1	Channel X Measurement
3X+2	Channel Y Measurement
Read 15-bit Value	
4X	**3YX** Decimal, with Y and X = Channels to be read (1 ... 8)
4X+1	Not used
3X	Measure Command Response (Refer to *Invalid Commands - Modsoft, p. 127*)
3X+1	Channel X Measurement
3X+2	Channel Y Measurement

The Read Module Status table for the ADU 214 follows.

Read Module Status	
4X	**000** Decimal
4X+1	Not used
3X	Configure Command Response (Refer to *Invalid Commands - Modsoft, p. 127*)
3X+1	0
3X+2	0

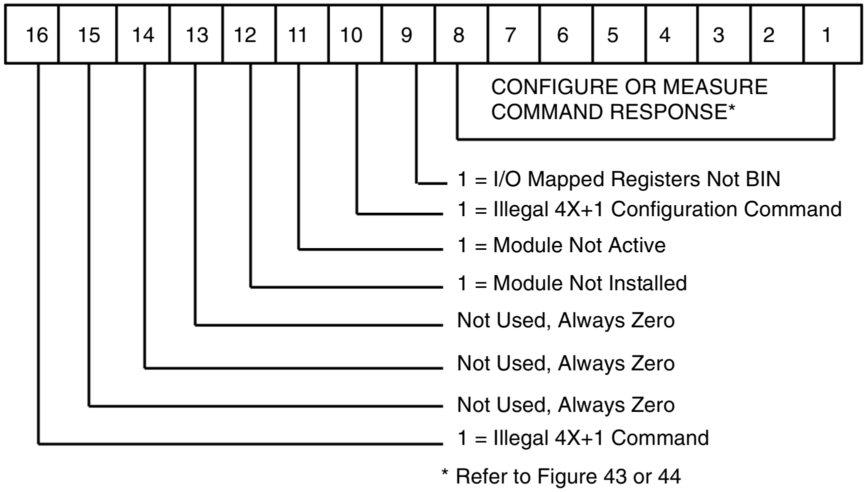
Invalid Commands - Modsoft

Invalid 4X register commands, and valid commands other than "READ MODULE STATUS" - that are issued when the module is not ready - result in the responses described below.

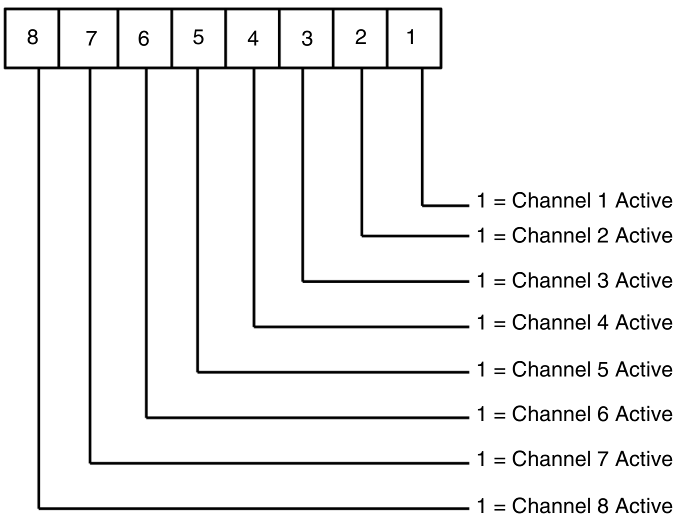
The following is a table of invalid commands, for the ADU 214 Module.

Invalid Commands	
3X	General Status (Bits 9 - 16 only, Bits 1 - 8 = 0); refer to *Invalid Commands - Modsoft, p. 127*
3X+1	0
3X+2	0

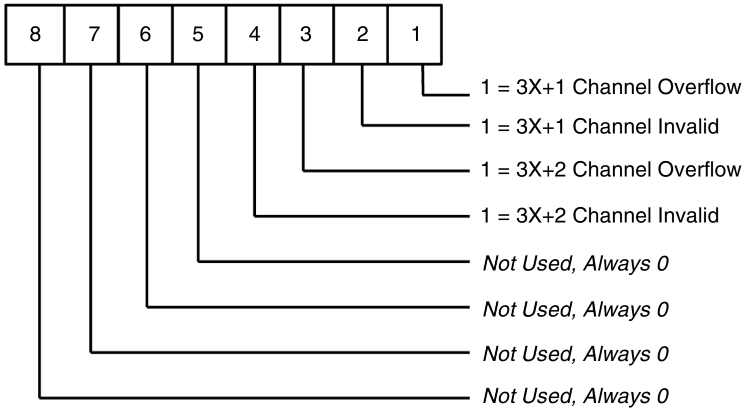
The following figure represents the 3x Status Register.



The following illustration is the Configure Command Response for the ADU 214 Analog Module.



Next is the MEASURE COMMAND Response.



*** For inactive channels: Overflow = 0, Invalid = 1**

The following figure is the Data Input Register Structure for the ADU 214 Analog Module.

3x + 1 Data Input Register

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

3x + 2 Data Input Register

Installation

Introduction

The following information describes how to install the ADU 214.

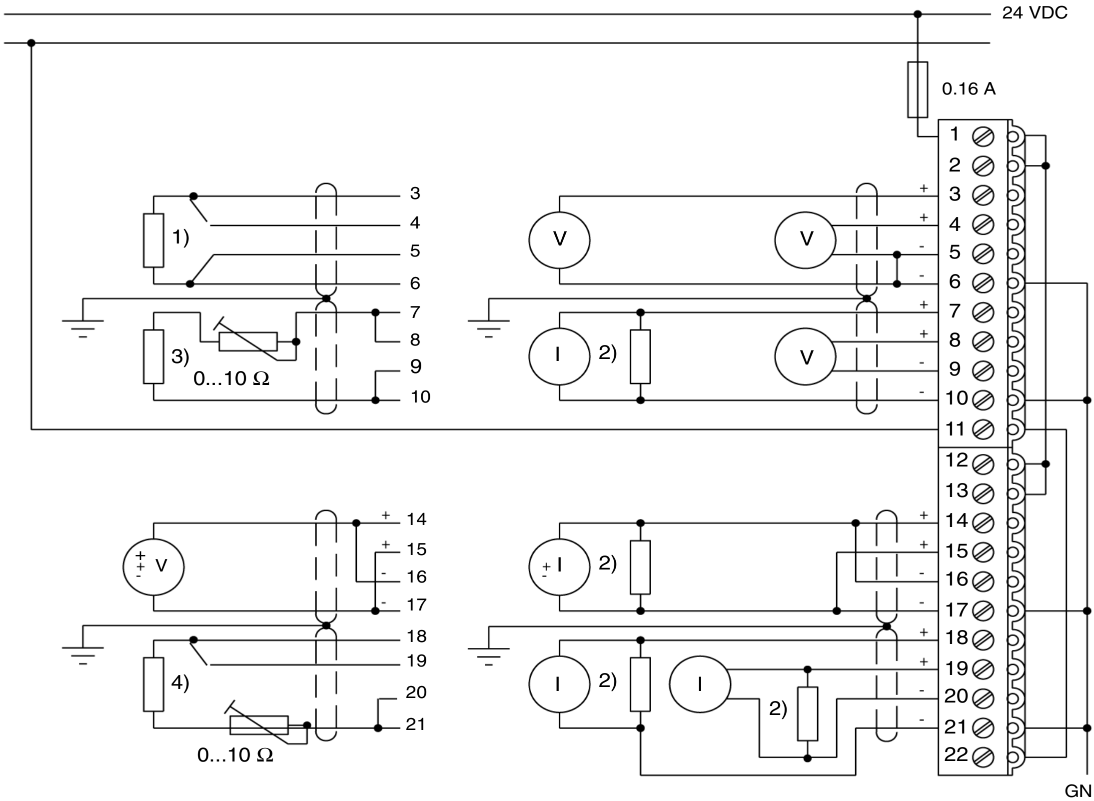
Installation Overview

installing the ADU 214 module consists of:

- Field wiring the module for the application selected
- Setting the DIP switches for appropriate AC noise suppression and contact fretting requirements
- I/O mapping and configuring the module to fit its application

Field Wiring

The following illustration is a Wiring Diagram for the ADU 214 Module.



1) Four-wire RTD (Pt 100 ... 1000, Ni 100 ... 1000) or resistance (0 ... 2000 Ω)
2) External reference resistance 50 or 100Ω, 0.1%, 0.125Ω for current measurement
3) Two-wire RTD (Pt 100 ... 1000, Ni 100... 1000) with 10Ω compensation
4) Three-wire RTD (Pt 100 ... 1000, Ni 100 ... 1000) with 10Ω compensation

Note: For general wiring and set-up instructions, refer to the *984-A120 Compact Programmable Controllers User Guide (GM-A984-PCS)*.
- Foil-shielded cables (2 or 4 x 0.5 mm twisted pair per channel) must be used for connections. All channels can be run within one joint shielded cable.
- If RTD detectors are connected with 4 wires (e.g., Ni 100, Pt 100), conductors for current and voltage path must be twisted in pairs.
- The connections between the shield and ground must be as short as possible (<20 cm) at one end. If higher noise levels exist, the cable shield must be grounded at both ends.
- The cable must be kept a minimum distance of >0.5 m away from power lines or similar sources of electrical interference.
- When using two- or three-wire RTD configurations, the ADU 214 requires an external adjustable 10 Ω series resistor in the RTD loop. This compensates for the unknown lead resistance, since the normal compensatory lead pair is missing. To calibrate the channel for the RTD configurations with 10 Ω compensation (configuration commands 80-95 decimal), perform the steps in the following procedure.

Note: Refer to *Configuration - Concept, p. 123* for information on how to select the two- or three-wire RTD operating mode.

Calibrating the Channel for RTD Configurations Procedure

To calibrate the channel for the RTD configurations with 10 Ω compensation.

Step	Action
1	Set up the RTD loop with the adjustable 10 Ω in the circuit and short the end of the wire run.
2	Configure the appropriate ADU 214 channel for 0-100 Ω input (configuration command decimal 96).
3	Adjust the 10 Ω potentiometer for a channel input reading of 3200 in the 15-bit mode-i.e., read 15 BIT VALUE, or the 4x Function Code Register = 3YX.

Accuracy Errors

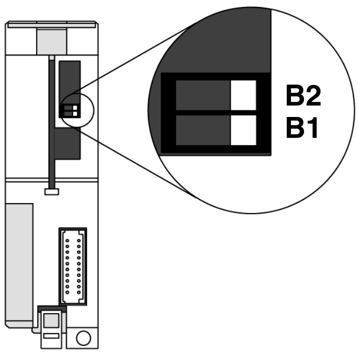
For PT100 measurements, if lead resistance is known to be less than 1 Ω, the uncompensated 4-wire configuration commands 64 ... 79 may be used and the 10 Ω adjustable resistor left out of the circuit. No calibration is required, but the accuracy errors listed in the following table can be expected.

Accuracy Errors

Lead Resistance	Error
1.0 Ω	+2.605 C
0.10 Ω	+0.255 C
0.01 Ω	+0.0255 C

DIP Switch Settings

The following illustration shows the locations of the DIP Switches.



OFF ON

B1 50 Hz noise suppression (as shipped)

B1 60 Hz noise suppression

B2 Fretting switched on (as shipped)

B2 Fretting switched off

Noise Suppression (DIP Switch B1)

The ADU 216 provides suppression of ac power frequencies on the peripheral lines. The module is shipped with 50 Hz suppression, and can be switched to 60 Hz suppression with DIP switch B1.

Fretting (DIP Switch B2)

Fretting prevents an increase of contact resistance on peripheral connections. Fretting is accomplished by outputting 10 V across the contacts at defined time intervals. The resulting current (flowing for 1 ms) is limited to < 8 mA. The contacts of the active inputs are fretted cyclically every 30 min. The fretting process is selected with DIP switch B2.

ADU 214 Input Module Specifications

Specifications

The following information describes the ADU 214 Input Module specifications.
The following table provides ADU 214 Specifications for: Power Supply; Required Loadable; Inputs; and I/O Map.

Power Supply	External Supply	24 Vdc typical 70 mA, maximum 150 mA
	Internal Power Supply (via system bus)	5 Vdc typical 45 mA, maximum 100 mA
	Power Dissipation	2 Ω typical, maximum 3 Ω
Required Loadable	SW-IODR-001 (See *Requirements for CE Compliance, p. 779*)	
Inputs	Number	4 Inputs (4-pole/2-pole) temperature/resistance 4 Inputs, two-wire current/voltage bipolar or 8 Inputs, two-wire current/voltage unipolar; inputs may be mixed
	Potential Isolation	Non-isolated, channel-to-channel
I/O Map	Register 3x/4x	3 in/2 out

The following table shows the Voltage Measurements for the ADU 214 Module.

Voltage Measurement	Input Impedance	>1 M Ω	
	Unipolar Measuring Ranges	0 ... 0.5 V, 0 ... 1 V, 0 ... 5 V, 0 ... 10 V, 0.1 ... 0.5 V, 0.2 ... 1 V, 1 ... 5 V, 2 ... 10 V	
	Bipolar Measuring Ranges	+0.5 V, +1 V, +5 V, +10 V	
	Resolution	approx. 0.003% of final value, 15-bit plus sign	
	Measuring Fault at 25°C	For measuring ranges 0.5 V / 1 V	±0.02% of Measuring Range Final Value (MFV), ±0.15% of Measured Value (MV)
		For measuring ranges 5 V/10 V	±0.01% of MFV, ±0.02% of MV
	Measuring Fault at 0 ... 60°C	For measuring ranges 0.5 V/1 V	±0.10% of MFV, ±0.35% of MV
		For measuring ranges 5 V/10 V	±0.02% of MFV, ±0.11% of MV
	Typical Measuring Error	≤0.5 above maximal errors	
	Inphase Voltage Range (Differential input for voltage measuring) Voltage of each input against GND	≤+11 V	
	In-phase suppression	≥60 dB	
	Maximum Overvoltage Static (1 Input for each module)	+30 V (24V power supply ON) +20 V (24V power supply OFF)	
	Maximum Overvoltage Dynamic	+50 V for ≤100 ms	

This table gives the Current Measurements for the ADU 214 Module

Current Measurement	Measuring ranges with external 50 Ω reference resistance 0.1%, 0.1 Ω, TC 25 ppm	0 ... 10 mA (0 ... 0.5 V), 0 ... 20 mA (0 ... 1 V), 2 ... 10 mA (0.1 ... 0.5 V), 4 ... 20 mA (0.2 ... 1 V), ±10 mA (+0.5 V), ±20 mA (±1 V)
	Measuring ranges with external 100 Ω measuring resistance 0.1%, 0.1 Ω, TC 25 ppm	0 ... 5 mA (0 ... 0.5 V), 0 ... 10 mA (0 ... 1 V), 1 ... 5 mA (0.1 ... 0.5 V), 2 ... 10 mA (0.2 ... 1 V), ±5 mA (±0.5 V), ±10 mA (±1 V)
	Resolution	Approximately 0.003% of final value, 15-bit plus sign
	Critical values	See the various tables that descirbe Voltage Ranges. Load capacity of reference resistance must be considered, i.e., 50 Ω 0.1 Ω maximum 40 mA continuous

The following table describes Temperature Measurement for the ADU 214 Module

Temperature Measurement (RTD 4-wire wire)	Input impedance	>1 M Ω		
	Resolution	< 0.012% of Final Value ≥ 13 Bit + sign		
	Measuring ranges with Pt 100 Pt 200, Pt 500, Pt 1000	-160 ... +160°C, resolution ≤0.02°C -200 ... +320°C, resolution ≤0.04°C -200 ... +640°C, resolution ≤0.08°C		
	Measuring ranges with Ni 100 Ni 200, Ni 500, Ni 1000	Measuring Fault at 25°C (excluding inaccuracy of detector) for measuring ranges -60 / -160 ... +160°C	with Pt 100 ... Pt 1000	±0.35°C (= ±0.22 % of Measuring Range Final Value MFV)
			with Ni 100 ... Ni 1000 for measuring range -200 ... +320°C	±0.3°C (= ±0.2 % of MFV)
			with Pt 100 ... Pt 1000 for measuring range -200 ... +640°C	±0.5°C (= ±0.16 % of MFV)
			with Pt 100 ... Pt1000	±0.8°C (= ±0.13% of MFV)
		Measuring Fault at 0 ... 60°C for measuring ranges -60 / -160 ... +160°C	with Pt 100, Ni 100	±0.8°C (= ±0.5 % of MFV)
			with Pt 200, Pt 500, Pt 1000	±0.65°C (= ±0.4 % of MFV)
			with Ni 200	±0.5°C (= ±0.32 % of MFV)
			with Ni 500, Ni 1000	±0.45°C (= ±0.3 % of MFV)
		Measuring Fault at 0 ... 60°C for measuring range -200 ... +320°C	with Pt 100	±1.1°C (= ±0.35 % of MFV)
			with Pt 200	±0.95°C (= ±0.3 % of MFV)
			with Pt 500, Pt 1000	±0.9°C (= ±0.28 % of MFV)
		Measuring Fault at 0 ... 60°C for measuring range -200 ... +640°C	with Pt 100	±1.6°C (= ±0.25 % of MFV)
			with Pt 200	±1.5°C (= ±0.23 % of MFV)
			with Pt 500, Pt 1000	±1.4°C (= ±0.22 % of MFV)

The following table displays Resistance Measurement (4-wire wire), for the ADU 214 Module.

Resistance Measurement (4-wire wire)	Input Impedance	>1 M Ω	
	Measuring Ranges	0 ... 100 Ω, 0 ... 200 Ω, 0 ... 500 Ω, 0 ... 1000 Ω, 0 ... 2000 Ω	
	Resolution	≤ 0.005% of final value, >14 Bit	
	Measuring Fault at 25°C for measuring range 100 ... 2000 Ω	±0.1% of Measuring Range Final Value (MFV)	
	Measuring Fault at 0 ... 60°C	for measuring range 100 Ω	±0.30% of MFV
		for measuring range 200 Ω	±0.25% of MFV
		for measuring range 500...2000 Ω	±0.20% of MFV
	Constant current	Approx. 1.5 mA for measuring range 0 ... 2000 Ω; approx. 2.5 mA for measuring ranges 0 ... 100 Ω, 0 ... 200 Ω, 0 ... 500 Ω 0 ... 1000 Ω	

The following table addresses various aspects of the ADU 214 Module: Input Characteristics; Connections; Weight; and Agency Approvals.

Dynamic Characteristics of Inputs	Conversion time for all 8 inputs	300 ms max
	Input Delay Time constant for HF suppression	0.12 ms, typ
	Measurement Integration Time	20 or 16.66 ms switchable
	Selectable AC Power Interference Suppression for f = n x 50/ 60 Hz	n = 1, 2 ...push-pull interferences>60 dB (peak value of interference voltage and measuring voltage ≤ final value x 1.1)
Connections	4-wire Cable Length	max. 50 m for voltage detector
	2-wire Cable Length	max. 100 m for voltage detector
	4-wire Line Resistance	max. 25 Ω for each conductor
	4-wire Line Capacitance	max. 10 nF for each conductor
Weight	.5lb (.22kg)	
Agency Approvals	UL 508; and CSA 22.2 No.142	

ADU 216 Analog Input Module

8

At a Glance

Introduction

This chapter describes the ADU 216 analog input module.

What's in this Chapter?

This chapter contains the following topics:

What Is the ADU 216 Analog Input Module?

Brief Product Description

The ADU 216 is an eight-channel analog input module with opto-isolation, designed to be used in thermocouple temperature and low-voltage measurement applications. It performs analog-to-digital conversions using a dual-slope integrating conversion method, converting analog input signals into digital values based on the principle of successive approximation.

Note: Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW—IODR—001) for proper operation when using certain PLCs (A984—1xx, E984—24x/251/255) with Modsoft.

The ADU 216 module has the following features:
- Operates off the 5 V supply voltage provided internally over the I/O bus, with no user-supplied external power source required.
- 16-bit resolution
- All eight channels are periodically strobed with a 1 mA current pulse to detect and report open circuits.

Note: You may use an ADU 257 module with its DIP switch set to the ADU 216 mode. In this mode the ADU 257 module performs just like an ADU 216 module.

WARNING

Compatibility Warning

The ADU 216 module will operate properly only when used with an A984, E984, or Micro 512/612 controller.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

ADU 216 Analog Input Module Conversion Ranges

Introduction

The PLC model determines the ranges.

Conversion Ranges

A table is provided below for each of the following:
- A984-1xx and E984-24x/251/255
- E984-258/265/275/285

The ranges for A984-1xx and E984-24x/251/255 are listed below.

Signal	Conversion	Resolution
K Thermocouple	(NiCrNi, IEC 584)	0.05 degrees C
J Thermocouple	(FeCuNi, IEC 584)	0.05 degrees C
Unipolar voltage	(linear)	1.11 micro V

The ranges for A984-1xx and E984-24x/251/255 are listed below.

Input (J TC degrees C)	**Input (K TC degrees C)**	**Input (L TC C)**	**Decimal Value 15bits+sign**	**Operating Results**
<-210	<-270	<-200	0	Under range
	-270		27368	Rated value range
-210	-210		28568	
-200	-200	-200	28768	
0	0	0	32768	
+900	+900	+900	50768	
+1200	+1200		56768	
	+1370		60168	
>+1200	>+1370	>+900	+65535	Over range

Selection of the correct input conversion algorithm is done via the application program and the 4x holding register that is I/O mapped to this module (see *ADU 216 Analog Input Module Programming Modes, p. 147*.

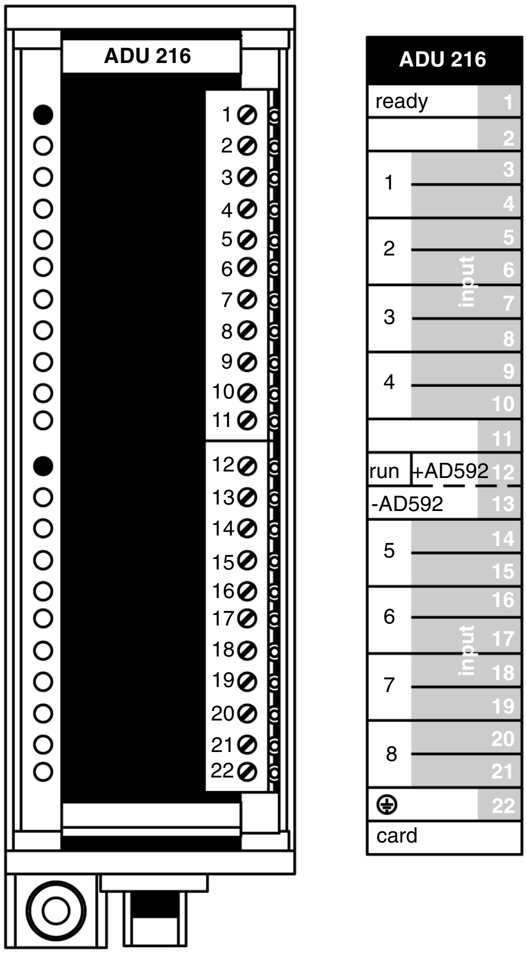
Note: The ADU 216 module has open wire detection. If a channel is not wired, the READY (fault) LED will illuminate.

Note: The ADU 216 does not support bipolar mode.

ADU 216 Analog Input Module Physical Characteristics

Front View

The ADU 216 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be completed with information such as the signal values, etc., in the spaces provided.
The following illustration shows a front view of the ADU 216 including the label.



LEDs

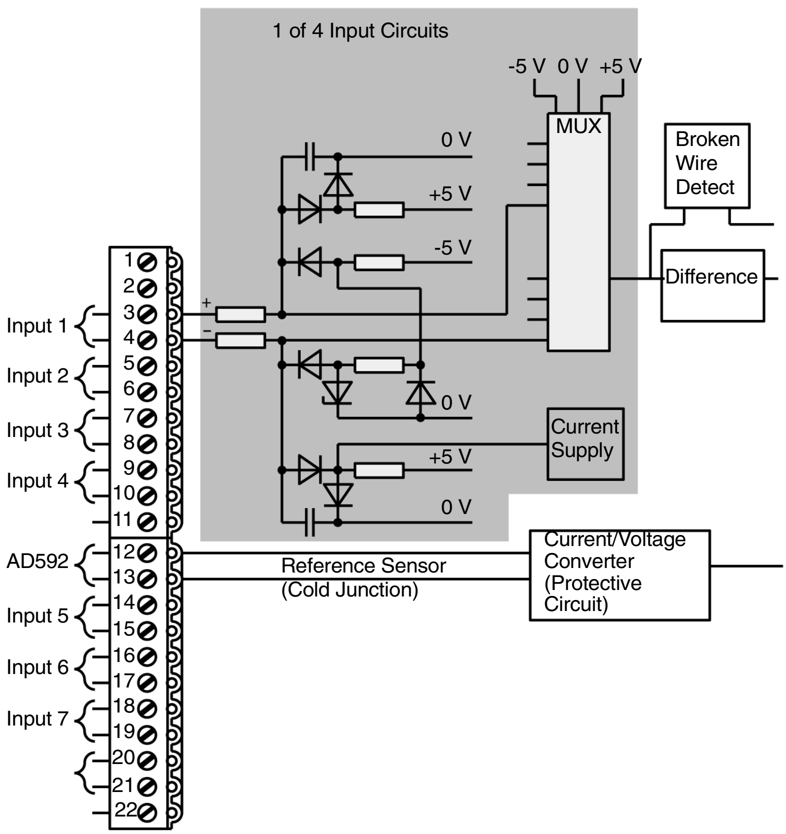
The ADU 216 has two green LEDs.

- READY (fault): One LED opposite terminal #1, if on or flashing, indicates that the on-board processor detected a fault condition, such as over range, open circuit, and so forth. For more information, see the Note.
- RUN: One green LED opposite terminal #12, if on, indicates that the on-board processor was initialized properly and is operating normally (i.e., continuously resetting the watchdog timer controlling the LED), and that the PLC is communicating with the module.

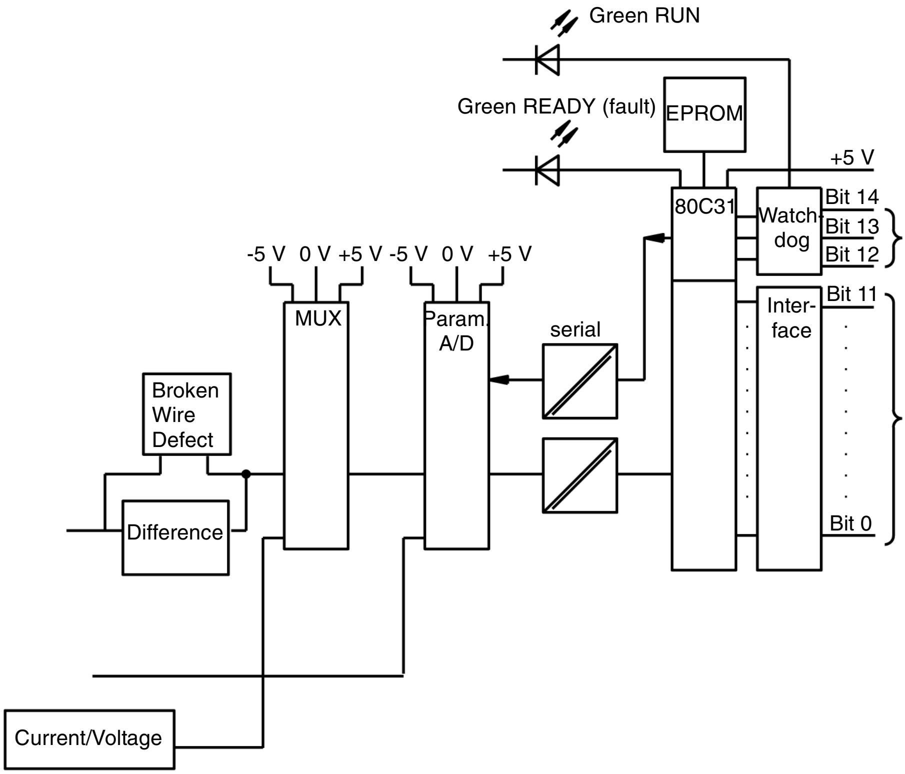
Note: Although the LED opposite terminal #1 is labeled READY, it actually indicates a fault condition. Note that this LED may be either green or red, but its function remains the same regardless of its color.

Simplified Schematic

The following illustration is a simplified schematic for the ADU 216.



Block Diagram The following illustration is a block diagram for the ADU 216.



ADU 216 Analog Input Module Configuration

Introduction

The following items must be addressed when configuring the ADU 216:
- The module must be I/O Mapped as five 30XXX Input Registers and one 40XXX Output/Control Register, and Binary data type.
- Make connections and assignments of input addresses.
- Identify overall mode of operation, type of input, and error indication.
- Cabling guidelines.

Note: You may not use both type J and type K thermocouples with the same module.

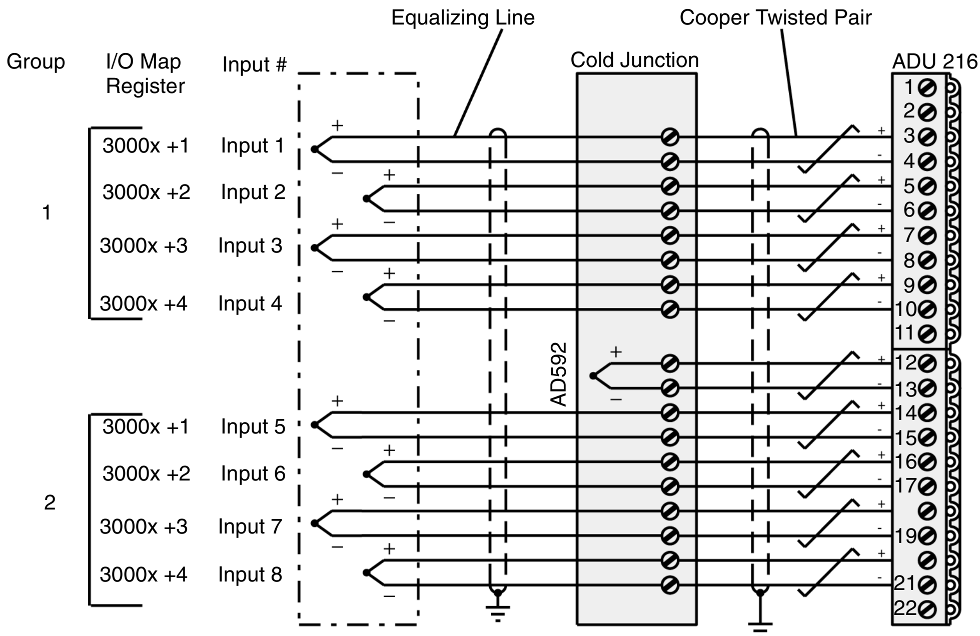
Note: The measured temperatures using type J or type K thermocouples must be higher than the reference sensor (cold junction) temperature to produce proper results.

Cabling

Shielded, twisted pair cable (2 or 4 x 0.5mm per channel) should be used. All channels can be connected with a common shielded cable.

Note: Unused inputs must be short circuited (jumper supplied).

An ADU 216 wiring example and associated registers for inputs is provided below.



Note: Voltages induced into cables (noise, etc.) must not exceed + 0.5 V measured at the input terminal versus GND.

Note: The reference sensor (cold junction) is factory-installed between terminals 12 and 13. For greater distances between the ADU 216 and the object of temperature measurement, the sensor can also be mounted at the remote terminal as shown (remember to observe correct polarity). The cable should be shielded twisted-pair to reduce susceptibility to induced noise signals.

ADU 216 Analog Input Module Programming Modes

Raw Module Data

The ADU 216 module provides unipolar data.
Data modes are outlined below.

Modes	Unipolar
Full Scale	0 ... 65535 Dec 0 ... FFFF Hex
Analog Value	0 ... 728.155 V
Value per Digit	1.11 micro V

Binary Example relates to the module. Modsoft loadables may change these values.

BINARY EXAMPLES:

15		3	2	1	0		Unipolar
0	...	0	1	1	0	=	$6 \times 1.11\ \mu V = 6.66\ \mu V$
0	...	1	0	0	1	=	$9 \times 1.11\ \mu V = 9.99\ \mu V$

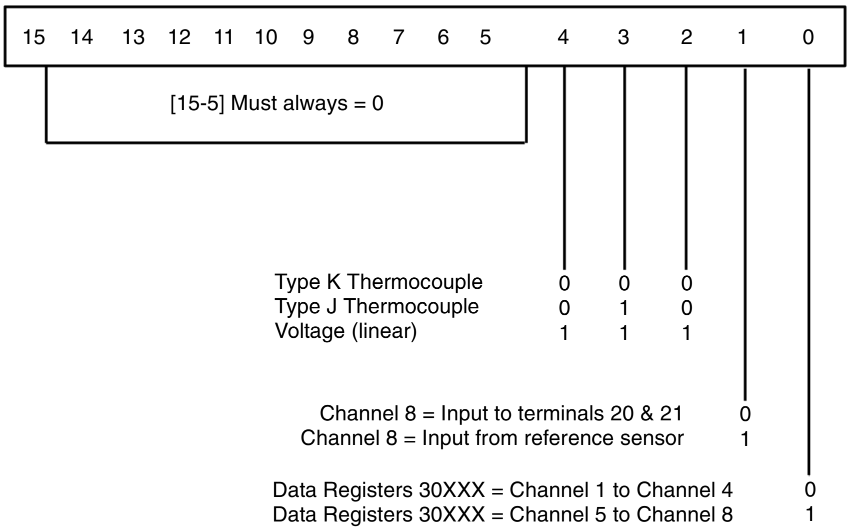
General

The ADU 216 is an 8-channel analog input module. The module operates in one of several modes, and the type of input signal that it processes is software selectable. The mode and signal type are set by the Traffic Copped 40XXX output register. Five sequential 30XXX registers must also be Traffic Copped. The first register is used to read module operating status, and the remainder contain data from four of the eight channel inputs (the control register determines which inputs are reflected in the 30XXX input registers). Channel input data is updated every 1.5 seconds.

40XXX Control Register

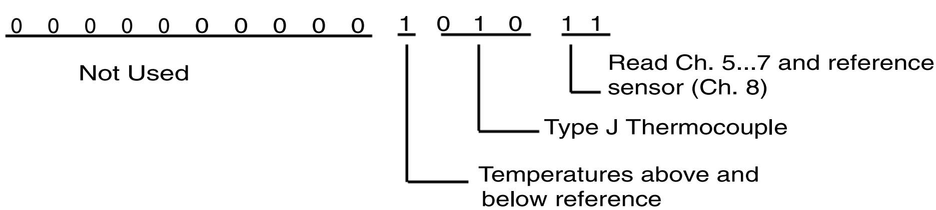
Bits in the ADU 216 control word and their meanings are shown in the following illustration.

40XXX CONTROL WORD



Bits 2 ... 4 must not be changed during operation. However, bits 0 and 1 may be changed during operation. Bits 5 ... 15 must always be set to 0.

Example:



30XXX Status and Data Registers

The figure above (bits in the ADU 216 control word and their meanings) describes the bit significance of the first 30XXX input register which displays the module status. The next four registers contain data representative of the individual channel input values. Refer to *Types of Modes and Their Functions, p. 151* for information on the values that may be expected.
Data values are the result of the type of input signal selected and the module operating mode selected.

Traffic Cop Registers	**Data**
30XXX	Module Status Information
30XXX + 1	Ch #1 Data/Ch #5 Data
30XXX + 2	Ch #2 Data/Ch #6 Data
30XXX + 3	Ch #3 Data/Ch #7 Data
30XXX + 4	Ch #4 Data/Ch #8 Data

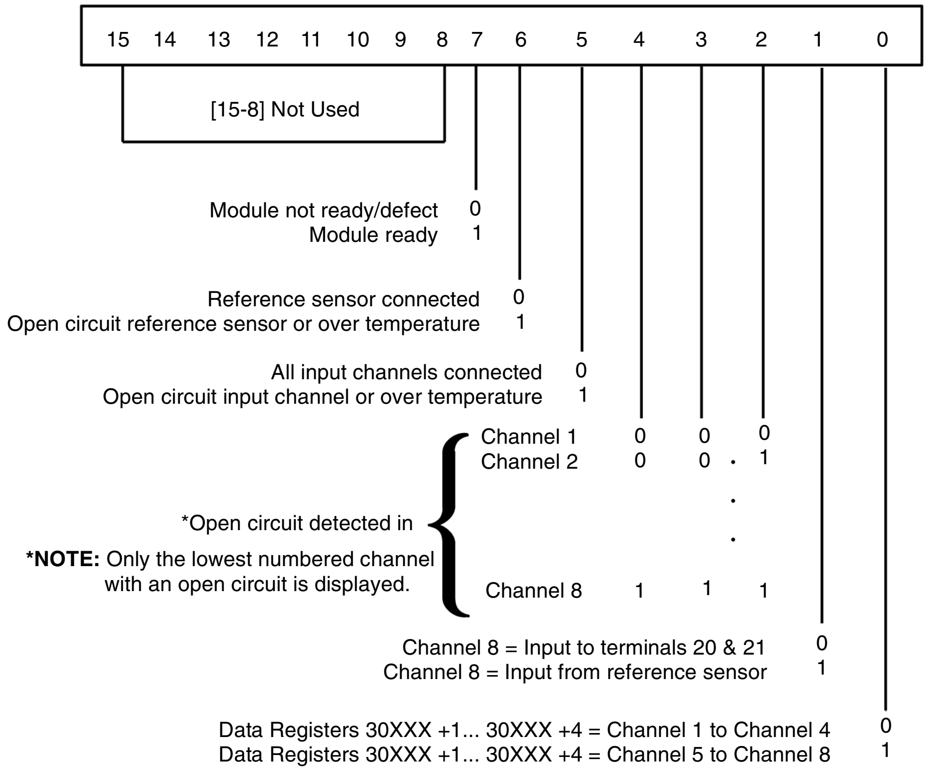
Channel #8 data can be either the result of the input signal applied to terminals 20 and 21, or the reference sensor (cold junction) connected to terminals 12 and 13 depending on the bit settings in the 40XXX control register. To use Channel #8 (30xxx + 4) as the reference sensor (cold junction) value, ensure Bits 0 and 1 are set to a one.

Note: The module scan rate is 1.5 seconds when you change the control word. It may take up to 1.5 seconds until the requested information is available in the status word. Therefore, the measured values taken within this time frame is invalid.

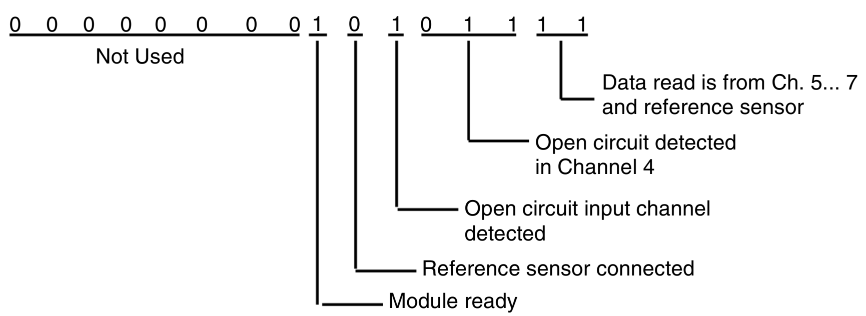
Note: The values of the 3x register(s) always reflect the reference sensor value (cold junction) of unused (jumpered) inputs.

Bits in the ADU 216 status word and their meanings are illustrated below.

3x Status Register



The following figure shows the Bits in the ADU 216 Control Word and their meanings



Types of Modes and Their Functions

When power is first applied to the module, it will be in a state equivalent to that before power down. As long as power to the unit is maintained, the operating mode of the module will be unchanged through a stop/start cycle.
When the module goes out of range-either over or under range-and then returns to a valid operating range, the module will resume proper operations unless your out-of-range condition reaches or exceeds the safe operating range of +30 VDC.

	CAUTION
⚠	**Unit Overload Hazard** We do not recommend measuring high ohmic voltage sources, because the ADU 216 may heat up the sensor. **Failure to follow this precaution can result in injury or equipment damage.**

	WARNING
⚠	**Unit Damage Hazard** Operation at an extreme out-of-range voltage - at or beyond +30 Vdc - will cause permanent damage to the module. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

ADU 216 Analog Input Module Calibration

Introduction

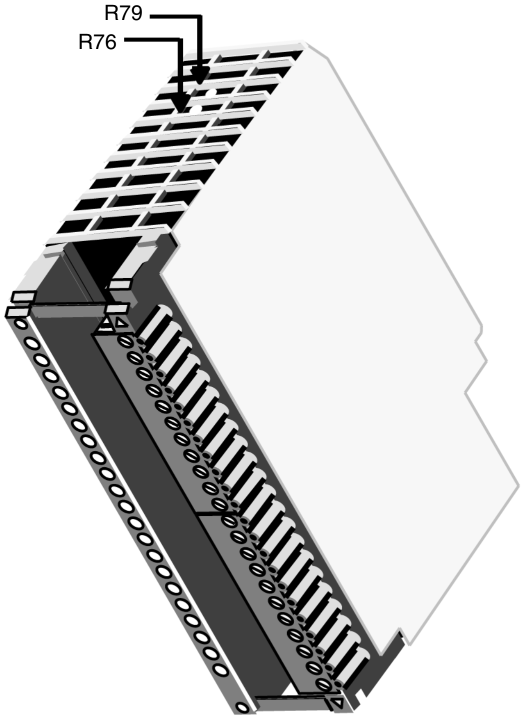
	CAUTION
⚠	**Calibration caution.** Modicon recommends that units requiring recalibration be returned to the factory, since inaccuracies could be due to faulty components. However, users who wish to perform their own calibration should use the following procedure. **Failure to follow this precaution can result in injury or equipment damage.**

By adjusting the two potentiometers on the top of the ADU 216 module, you can calibrate the signal conversion of the eight input channels and the reference sensor. In this procedure, R76 is used to calibrate the input channels, and R79 is used to calibrate the compensation by the reference sensor. Items required for calibration are:

- A dc Power Supply (+ 72.8 mV)
- A precision thermometer

Calibrating the Analog Input Channels

The following illustration shows the location of the potentiometers on the ADU 216.



Procedure for Adjusting Potentiometers

The following is the procedure for adjusting the potentiometers:

Step	Action
1	Connect a DC source (+72.800 mV) to one input channel. Set the module for Voltage Input (linear). Adjust R76 for a reading of FFF2 Hex.
2	Set the module read the reference sensor input at Channel 8.
3	Measure the exact temperature of the AD592 reference sensor element.
4	Adjust the reading for Channel 8 with R79 to the temperature measured in Step 3 (divide the reading by 20 for the module resolution of 0.05 degrees C/digit).

ADU 216 Analog Input Module Specifications

Table of Specifications

The following table contains a list of ADU 216 specifications.

Module Topology	Number of Channels	8	
	Data Format	Voltage or temperature value	
	Isolation	Channel-to-Bus: +/- 300 Vdc Non-isolated channel-to-channel	
Required Load able	SW-IODR-001		
Power Supply	Internal Source (from I/O bus)	5 Vdc, 100 mA typ., 150 mA max.	
	Power Dissipation	0.5 Ohm typical; 1 Ohm max.	
Voltage and Thermocouple Input Capabilities	Linear Measuring Range	Unipolar	0 to 72.8 mV (1.1 micro V/digit)
	Ranges	Type J: Ambient ... 1100degrees C Type K: Ambient ... 1370 degrees C	
	Compensated Measuring Range	Type J, K Thermocouple; resolution 0.05 degrees C	
	Max. Input Impedance	≤ 500 ohms for Thermocouple and cold junction sensor	
	Cold Junction Sensor Type	AD 592 CN, -26 degrees C ... +106 degrees C	
	Noise Voltage of the in put to Common	+/- 0.5 V maximum	
	Wire Size, Max.	One wire: 14 AWG	
		Two wires: 20 AWG	
I/O Map	Register 3x/4x	5 in/1 out	
A/D Conversion	Conversion Time	1.5 seconds for all 8 inputs, maximum	
	Resolution	16-bit, unipolar	
	In-range Error Limit	@ 25 degrees C ambient	0.1% of input value +/- 0.15 degrees C
		@ 0 ... 60 degrees C ambient	+/- 0.3% of input value +/- 0.75 degrees C (with calibration of compensation by reference sensor input)
Noise Suppression	Common Mode Rejection	55 dB @ 50 Hz, 60 Hz, 1 kHz minimum	
Operating Temperature	0 ... 60 degrees C (32 ... 140 degrees F)		
Relative Humidity	0 ... 95% (non-condensing) @ 60 degrees C		
Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)	
	Weight	330 g (.725 lb.)	
Agency Approvals	UL 508; and CSA 22.2 No.142 Standards		

Overview of the ADU 257 Analog Input Module

9

At a Glance

Purpose

The purpose of this chapter is to describe the ADU 257 analog input module.

What's in this Chapter?

This chapter contains the following topics:

What is the ADU 257 Analog Input Module?

Brief Product Description

The ADU 257 is an eight-channel thermocouple or four-channel RTD input module with opto-isolation. The ADU 257 provides linearization for Thermocouples and Resistance Temperature Device inputs. The ADU 257 operates at extended temperature and has the following characteristics:

- Thermocouple types B,E,J,K,N,R,S,T are supported.
- RTD types Pt100,200,500,1000 American, Pt100,200,500,1000, and Ni100,200,500,1000 are supported.
- 2-wire, 3-wire, 4-wire RTD connections are supported.
- Linear ranges include 0... 4000 Ohms and +/-100mV.
- 12-bit, 16-bit, 15-bit plus sign, and 32-bit resolutions are available for all inputs.
- Both Celsius and Fahrenheit temperature units are available.
- Factory installed CJC sensors (AD592) provide ambient temperature at the ADU 257s location. The CJC sensor temperature values are stored in two 3x input registers for your application needs.
- Errors noted via the Concept I/O Map Status Word.
- The module may be used in two different modes via a DIP switch -- either as an ADU 257, or as an ADU 216.

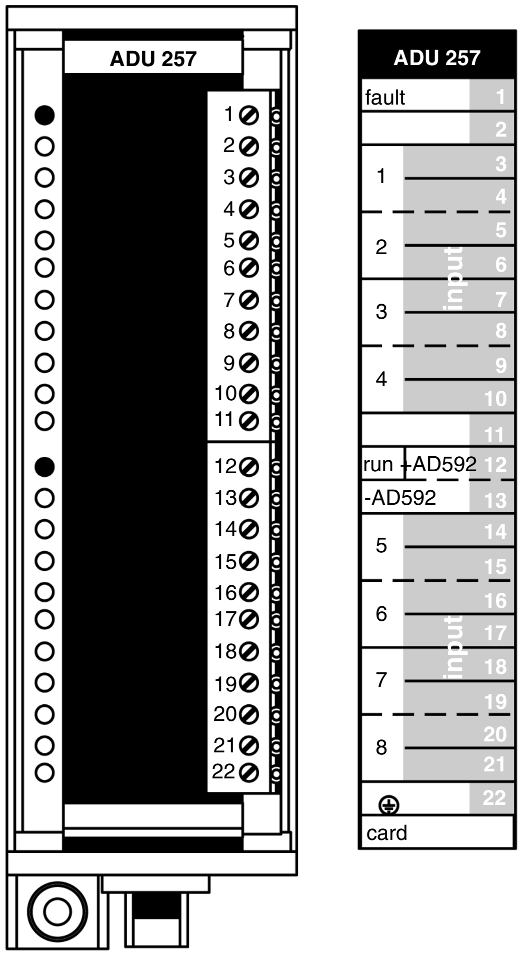
> **Note:** The ADU 257 mode requires Concept 2.2 (or higher) panel software. The ADU 216 mode requires Modsoft 2.6.1 (or higher) panel software and the ADU 216.DAT Loadable (available on the Modicon.com website).

- Input selection and range can be set independently via the panel software.

ADU 257 Analog Input Module Physical Characteristics

Illustration

The ADU 257 can be installed in any I/O slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.
A front view with the ADU 257 label is provided below.



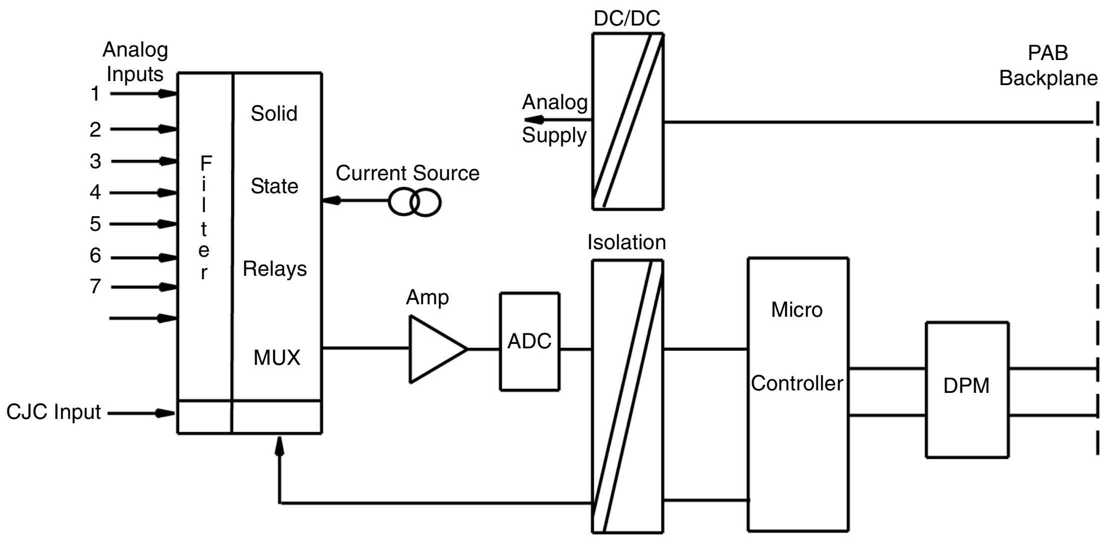
LEDs

The following table contains descriptions of the ADU 257 LEDs.

LED#	LED Name	Color	Function
1	Fault	Red	Pertains to a fault: ON= Fault detected (over range, under range, broken wire) OFF=No fault detected
12	Run	Green	Pertains to the processor operation: ON=Processor operating between the ADU 257 and the PLC without fault OFF=Fault in processor operation

Block Diagram

A block diagram for the ADU 257 is provided below.



Installing the ADU 257 Analog Input Module

Introduction

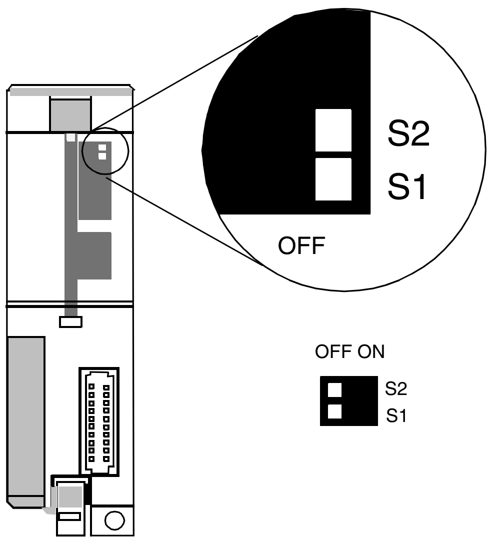
The following procedures are necessary when installing the ADU 257:
- Set DIP switches.
- Make connections and assign input addresses.
- I/O map the module as 20-3x input registers.
- Identify overall mode of operation and type of input.

Setting Switches

The module may be used in two different modes (ADU 216 or ADU 257). Switch 1 is used to set the mode. The ADU 257 is shipped with Switch 1 in the OFF position -- in ADU 257 mode.

The module may be used with broken wire detection activated or deactivated. Switch 2 is used to activate or deactivate broken wire detection.The ADU 257 is shipped with Switch 2 in the OFF position -- with broken wire detection active.

The following illustration shows the ADU 257, with both switches OFF (S1 OFF = ADU 257 mode, S2 OFF = broken wire detection activated).



DIP Switch Settings for S1 and S2:

Broken wire detection active=OFF or No broken wire detection=ON

ADU 257 mode=OFF or ADU 216 mode=ON

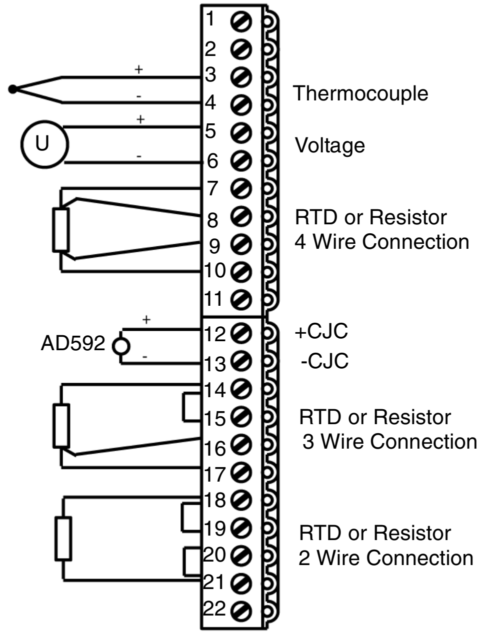
(When input is configured as 100mV range, the broken wire detection is ALWAYS OFF)

To change to ADU 216 mode, move Switch 1 to the ON position. For details on the ADU 216 Analog Input module, refer to the chapter for that module.

> **Note:** The ADU 257 mode requires Concept 2.2 (or higher) panel software. The ADU 216 mode requires Modsoft 2.6.1 (or higher) panel software and the ADU 216.DAT Loadable (available on the Modicon.com website).

Wiring Diagram

An ADU 257 wiring diagram is provided below.



Note: The factory installed cold junction sensor located between terminals 12 and 13 may be mounted at a remote terminal for greater distances between the ADU 257 and the object of temperature measurement. Please observe correct polarity.

ADU 257 Isolated Analog Input Module Operation

Introduction

The ADU 257 is an eight-channel analog input module. Its field connector is wired depending on the type of input to be measured, either TC or RTD. Two connections are used per RTD; therefore, only four channels may be used. Otherwise, you have eight channels available for TC devices or linear measurements. Any of the inputs may be either TC, linear, or RTD, and any combination of the three may be used. The module can operate in one of several modes, and the input channel ranges are individually selectable. The mode and ranges are set via the panel software. Channel input data is updated every 800 ms. When power is first applied to the module, its inputs are inactive.

I/O Map

The ADU 257 requires 20-3x input registers addressed in sequence, beginning with two module status 3x registers, 16 data channel 3x registers (channels 1... 8), and two cold junction sensor 3x registers

I/O Map Registers	Data
3x	Input status word
3x + 1	Input status word
3x + 2	Input #1 data (low word)
3x + 3	Input #1 data (high word)
... ...	... ...
3x + 17	Input #8 data (low word)
3x + 18	Input #8 data (high word)
3x + 19	Input #9 data (cold junction sensor) (low word)
3x + 20	Input #9 data (cold junction sensor) (high word)

Conversions

The following tables detail the various voltage and current conversions for the ADU 257 module.

+/- 100mV Range and Data Display Format					
Millivoltage	12 bit	16 bit	15 bit + sign high resolution	IEEE 754 floating point	Range
<+102.4mV	+4095	+65535	+32767	+1.024 E02	Overrange
>+100mV... +102.4mV	+4095	+65535	+32001... +32766	+1.0 E02... +1.024 E02	Pos. tolerance range
+100mV	+4095	+65535	+32000	+1.0 E02	
0mV	+2048	+32768	0	0	Nominal
-100mV	0	0	-32000	-1.0 E02	
<-100mV... -102.4mV	0	0	-32001... -32766	<-1.0 E02... -102.4 E02	Neg. tolerance range
<-102.4mV	0	0	-32767	-1.024 E02	Underrange

0... 4000Ω

0... 4000Ω Range and Data Display Format

Resistance	12 bit	16 bit	15 bit + sign high resolution	IEEE 754 floating point	Range
>4095Ω	+4095	+65535	+32767	+4.096 E03	Overrange
>4000... 4095Ω	+4095	+65535	+32001... +32766	>+4.0 E03... +4.095 E03	Pos. tolerance range
4000Ω	+4095	+65535	+32000	+4.0 E03	Nominal
0Ω	0	0	0	0	
	0	0	-2	-2.0 E00	Broken wire

IEC 751 Pt100,200,500,1000 -200... +850 C

IEC 751 Pt100,200,500,1000 -200... +850 C (-328... +1562 F) Range and Data Display Format

RTD	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+850C (+1562F)	+4095	+65535	+8501 (+15621)	8.501 E02 (1.5621 E03)	Overrange
+850C (+1562F)	+4095	+65535	+8500 (+15620)	8.500 E02 (1.562 E03)	Nominal
0 (+32F)	+780	+12483	0 (+320)	0 (3.20 E01)	
-200C (-328F)	0	0	-2000 (-3280)	-2.00 E02 (-3.28 E02)	
<-200C (-328F)	0	0	-2001 (-3281)	-2.001 E02 (-3.281 E02)	Underrange
	0	0	-2002 (-3282)	-2.002 E02 (-3.282 E02)	Broken wire

SAMA (US) Pt100,200,500,1000 -200... +650 C

SAMA (US) Pt100,200,500,1000 -200... +650 C (-328... +1112 F) Range and Data Display Format

RTD	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+600C (+1112F)	+4095	+65535	+6001 (+11121)	6.001 E02 (1.113 E03)	Overrange
+600C (+1112F)	+4095	+65535	+6000 (+11120)	6.000 E02 (1.112 E03)	Nominal
0C (+32F)	+1024	+16384	0 (+320)	0 (3.20 E01)	
-200C (-328F)	0	0	-2000 (-3280)	-2.00 E02 (-3.28 E02)	
<-200C (-328F)	0	0	-2001 (-3281)	-2.001 E02 (-3.281 E02)	Underrange
	0	0	-2002 (-3282)	-2.002 E02 (-3.282 E02)	Broken wire

DIN43760 Ni100,200,500,1000 -60... +250 C

DIN43760 Ni100,200,500,1000 -60... +250 C (-76... +482 F) Range and Data Display Format

RTD	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+250C (+482F)	+4095	+65535	+2501 (+4821)	2.501 E02 (4.821 E02)	Overrange
+250C (+482F)	+4095	+65535	+2500 (+4820)	2.500 E02 (4.820 E02)	Nominal
0C (+32F)	+793	+12684	0 (+320)	0 (3.20 E01)	
-60C (-76F)	0	0	-600 (-760)	-6.00 E01 (-7.6 E01)	
<-60C (-76F)	0	0	-601 (-761)	-6.01 E01 (-7.61 E01)	Underrange
	0	0	-602 (-762)	-6.02 E01 (-7.62 E01)	Broken wire

Thermocouple Type R,S -50... +1768 C

Thermocouple Type R,S -50... +1768 C (-58... +3214.4 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+1768C (+3214.4F)	+4095	+65535	+17681 (+32146)	1.7681 E03 (3.2146 E03)	Overrange
+1768C (+3214.4F)	+4095	+65535	+17680 (+32144)	1.7680 E03 (3.2144 E02)	Nominal
0C (+32F)	+113	+1802	0 (+320)	0 (3.20 E01)	
-50C (-58F)	0	0	-500 (-580)	-5.00 E01 (-5.80 E01)	
<-50C (-58F)	0	0	-501 (-582)	-5.01 E01 (-5.82 E01)	Underrange
	0	0	-502 (-584)	-5.02 E01 (-5.84 E01)	Broken wire

Thermocouple Type B +50... +1800 C

Thermocouple Type B +50... +1800 C (+122... +3272 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+1800C (+3272F)	+4095	+65535	+18001 (+32722)	1.8001 E03 (3.2722 E03)	Overrange
+1800C (+3272F)	+4095	+65535	+18000 (+32720)	1.8000 E03 (3.2720 E03)	Nominal
50C (+122F)	0	0	+500 (+1220)	5.00 E01 (1.220 E02)	
<50C (+122F)	0	0	+499 (+1218)	4.99 E01 (1.218 E02)	Underrange
	0	0	+498 (+1216)	4.98 E01 (1.216 E02)	Broken wire

Thermocouple Type J -210... +1200 C

Thermocouple Type J -210... +1200 C (-346... +2192 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+1200C (+2192F)	+4095	+65535	+12001 (+21922)	1.2001 E03 (2.1922 E03)	Overrange
+1200C (+2192F)	+4095	+65535	+12000 (+21920)	1.2000 E03 (2.1920 E03)	Nominal
0C (+32F)	+610	+9761	0 (+320)	0 (3.20 E01)	
-210C (-346F)	0	0	-2100 (-3460)	-2.100 E02 (-3.460 E02)	
<-210C (-346F)	0	0	-2101 (-3462)	-2.101 E02 (-3.462 E02)	Underrange
	0	0	-2102 (-3464)	-2.102 E02 (-3.464 E02)	Broken wire

Thermocouple Type T -270... +400 C

Thermocouple Type T -270... +400 C (-454... +752 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+400C (+752F)	+4095	+65535	+4001 (+7522)	4.001 E02 (7.522 E02)	Overrange
+400C (+752F)	+4095	+65535	+4000 (+7520)	4.000 E02 (7.520 E02)	Nominal
0C (+32F)	+1650	+26410	0 (+320)	0 (3.20 E01)	
-270C (-454F)	0	0	-2700 (-4540)	-2.700 E02 (-4.540 E02)	
<-270C (-454F)	0	0	-2701 (-4542)	-2.701 E02 (-4.542 E02)	Underrange
	0	0	-2702 (-4544)	-2.702 E02 (-4.544 E02)	Broken wire

Thermocouple Type E -270... +1000 C

Thermocouple Type E -270... +1000 C (-454... +1832 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+1000C (+1832F)	+4095	+65535	+10001 (+18322)	1.0001 E03 (1.8322 E03)	Overrange
+1000C (+1832F)	+4095	+65535	+1000 (+18320)	1.0000 E03 (1.8320 E03)	Nominal
0C (+32F)	+871	+13933	0 (+320)	0 (3.20 E01)	
-270C (-454F)	0	0	-2700 (-4540)	-2.700 E02 (-4.540 E02)	
<-270C (-454F)	0	0	-2701 (-4542)	-2.701 E02 (-4.542 E02)	Underrange
	0	0	-2702 (-4544)	-2.702 E02 (-4.544 E02)	Broken wire

Thermocouple Type K -270... +1372 C

Thermocouple Type K -270... +1372 C (-454... +2501.6 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+1372C (+2501.6F)	+4095	+65535	+13721 (+25018)	1.3721 E03 (2.5018 E03)	Overrange
+1372C (+2501.6F)	+4095	+65535	+13720 (+25016)	1.3720 E03 (2.5016 E03)	Nominal
0C (+32F)	+673	+10776	0 (+320)	0 (3.20 E01)	
-270C (-454F)	0	0	-2700 (-4540)	-2.700 E02 (-4.540 E02)	
<-270C (-454F)	0	0	-2701 (-4542)	-2.701 E02 (-4.542 E02)	Underrange
	0	0	-2702 (-4544)	-2.702 E02 (-4.544 E02)	Broken wire

Thermocouple Type N -270... +1300 C

Thermocouple Type N -270... +1300 C (-454... +2372 F) Range and Data Display Format

TC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+1300C (+2372F)	+4095	+65535	+13001 (+23722)	1.3001 E03 (2.3722 E03)	Overrange
+1300C (+2372F)	+4095	+65535	+13000 (+23720)	1.3000 E03 (2.3720 E03)	Nominal
0C (+32F)	+704	+11270	0 (+320)	0 (3.20 E01)	
-270C (-454F)	0	0	-2700 (-4540)	-2.700 E02 (-4.540 E02)	
<-270C (-454F)	0	0	-2701 (-4542)	-2.701 E02 (-4.542 E02)	Underrange
	0	0	-2702 (-4544)	-2.702 E02 (-4.544 E02)	Broken wire

Cold Junction Sensor AD592 -25... +105 C

Cold Junction Sensor AD592 -25... +105 C (-13... +221 F) Range and Data Display Format

CJC	12 bit	16 bit	15 bit + sign 0.1C (0.1F)	IEEE 754 floating point	Range
>+125C (+257F)	+4095	+65535	+1051 (+2212)	1.051 E02 (2.212 E02)	Overrange
+125C (+257F)	+4095	+65535	+1050 (+2210)	1.050 E02 (2.210 E02)	Nominal
0C (+32F)	+683	+10923	0 (+320)	0 (3.20 E01)	
-25C (-13F)	0	0	-250 (-130)	-2.50 E01 (-1.30 E01)	
<-25C (-13F)	0	0	-251 (-132)	-2.51 E01 (-1.32 E01)	Underrange
	0	0	-252 (-134)	-2.52 E01 (-1.34 E01)	Broken wire

ADU 257 Analog Input Module Specifications

Table of Specifications

The following table contains a list of ADU 257 specifications.

Module Topology	Number of channels	8 TC, 4 RTD
	Data Format	TC, RTD, mV linear, Ohms linear inputs
	Isolation test voltage channel to channel	400Vdc maximum via solid state relays
	Isolation test voltage channel to bus	500Vac maximum
	Isolation test voltage channel to earth	500Vac maximum
Power Supply	Internal Source (from I/O bus)	5VIO; 120mA typical
I/O Map	Register 3x/4x	20 in/0 out
TC Inputs	TC types	B,E,J,K,N,R,S,T
	Linear Measuring Range	+/-100mV
	CJC sensor	Factory installed reference sensor to terminals 12 and 13
	Cold junction sensor type (factory installed)	AD 592 CN, -26 degrees C ... +106 degrees C
	Overload protection	+30Vdc continuously
	Resolution	12Bits, 16Bits, 15Bits plus sign, 32Bits
	Accuracy for TC ranges @ 0 ... 60 degrees C, includes CJC, offset, gain error	For J,K,N,E,T types: +/-2 degrees C +/-0.1 percent of reading (+/-1.5 degrees C for temp. less than 100) (assumes no delta between CJC and CJ sensor)
	Accuracy for TC ranges @ 0 ... 60 degrees C, includes CJC, offset, gain error	For S,R,B types: +/-4 degrees C +/-0.1 percent of reading (assumes no delta between CJC and CJ sensor)

RTD Inputs	RTD types	2/3/4 wire IEC Pt100/200/500/1000, 2/3/4 wire American Pt100/200/500/1000, 2/3/4 wire Ni100/200/500/1000
	Linear Measuring Range	0 ... 4000 ohms
	Overload protection	+30Vdc continuously
	Resolution	12Bits, 16Bits, 15Bits plus sign, 32Bits
	Accuracy for RTD ranges @ 25 degrees C ambient temperature	0.5 degrees C
	Accuracy for RTD ranges @ 60 degrees C ambient temperature	0.9 degrees C
	Derating of accuracy for -25 ... +70 degrees C	1.25C
Dynamic Characteristics of Inputs	Conversion time for all inputs	800mS maximum
	Interference voltage suppression (main suppression) for f=nx50 or 60Hz	n=1,2 ...
	Common-mode rejection	less than 110dB
Physical Characteristics	Format	1 slot
	Dimensions (W x H x D)	40.3 x 145 x 117.5 mm 1.6 x 5.6 x 4.5 in
	Weight	320g, 0.710 lb
	Wire Size	1-14AWG, 2-20AWG
Environmental Characteristics	Operating Temperature	-40 ... +70 degrees C
Agency Approvals	ADU 257: VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards	
	ADU 257C: VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards	

AS-BDEA 203 Profibus-DP Coupler Module Description

10

At a Glance

Overview

This chapter describes the AS-BDEA Profibus-DP Coupler Module.

What's in this Chapter?

This chapter contains the following topics:

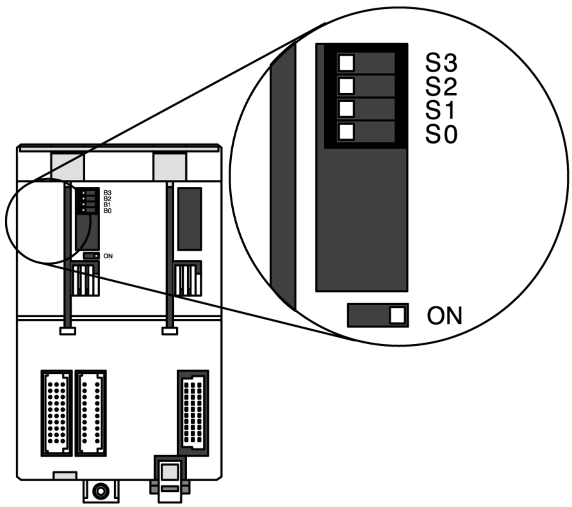
Configuration

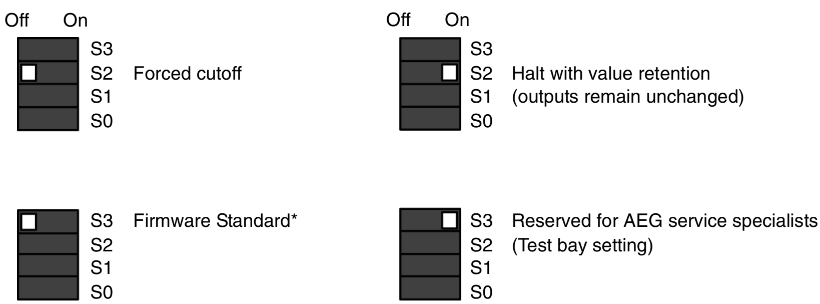
Overview

To configure the AS-BDEA the following tasks must be performed

Settings (Slave Address, Disconnection Behavior)

Slave Address-The slave address (node address) is to be set on the front panel "x10, x1" rotary switches. Addresses from 1 ... 99 are allowed (0=as shipped).
Disconnection Behavior- See the following figure for disconnection behavior. Switches S0 and S1are meaningless.





* As shipped

I/O Expansion Limitations

Arbitrary I/O combinations are only possible with discrete I/O modules. Use of analog I/O modules restricts total data volume to a particular level. Total data volume is the sum of data from the PROFIBUS master to the AS–BDEA 203 (D out), and from the AS–BDEA 203 to the PROFIBUS master (D in).The feasibility of a particular combination can be verified with the followingtables. The first table lists data volume by respective module (D out / D in) in bytes.The data volume of all employed modules through the AS–BDEA 203 to the PROFIBUS master (D in sums) must </= 244 bytes.
In accordance with the (D in) data volume, this table permits the data volume calculation for PROFIBUS master to AS–BDEA 203 (D out). With the second table the (D out) data volumes of all employed modules is to be checked against the max. permissible (D out) data volume.
Data volume by module

Module	**D In Data Volume (Bytes)**	**D Out Data Volume (Bytes)**
DEP 208, DEP 210, DEP 211	1	0
DAP 204, DAP 208, DAP 210	0	1
DAP 212, DAP 220, DAP 292	1	1
DEO 216, DEP 214, DEP 215, DEP 216, DEP 217, DEP 218, DEP 220, DEP 296, DEP 297, DEX 216	2	0
DAO 216, DAP 216, DAP 217, DAP 218, DAX 216	0	2
DAU 202	0	4
DAU 208	0	16
ADU 204, ADU 205	10	0
ADU 206,ADU 216	10	1
ADU 210	10	4
ADU 214	18	8

Max permissible "D Out" data volume in respect to "D In" data volume.

Data In Data volume Sums (Bytes)	**Max Data Out Volume Sums (Bytes)**
241...244	144
233...240	152
225...232	160
217...224	168
209...216	176
0...208	184

Subtrack Mounting Slot

Enter system relevant power supply information in the label inlay.Noise immunity can be improved when by–pass capacitors are installed at the power supply module U and M terminals.

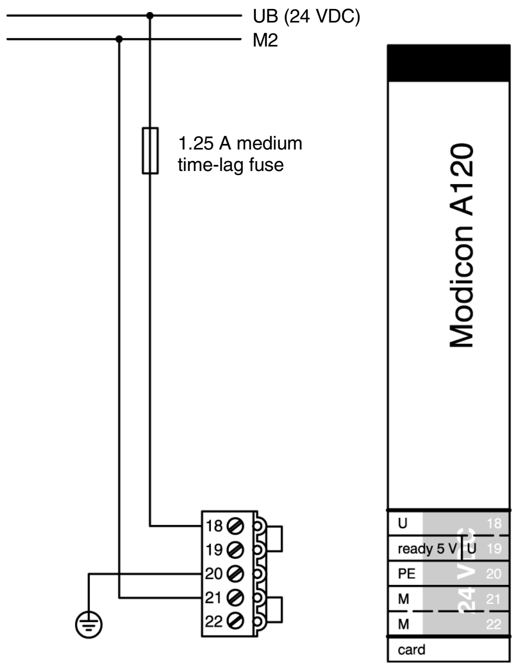
Power Supply Connection

CAUTION

The module’s integrated power supply is non–isolated. Improper connection, e.g. absence of the M2 connection, can lead to module destruction.

Failure to follow this precaution can result in injury or equipment damage.

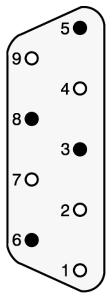
Enter system relevant power supply information in the label inlay. Noise immunity can be improved when by–pass capacitors are installed at the power supply module U and M terminals.



Profibus Connection

The PROFIBUS port utilizes varied Sub–D9 plug connectors:

- 490 NAD 911 02 for transmission rates up to 12 Mbps.
- PBS1 for transmission rates up to 500kbps.
  The individual installation steps are to be carried out in adherence with the accompanying user documentation.



Pin	Signal	Function
3	RxD/TxD-P	Receive/transmit data (+)
5	DGND	Signal ground
6	VP	+5 VDC supply
8	RxD/TxD-N	Receive/transmit data negated (-)

● Pin occupied

○ N/C

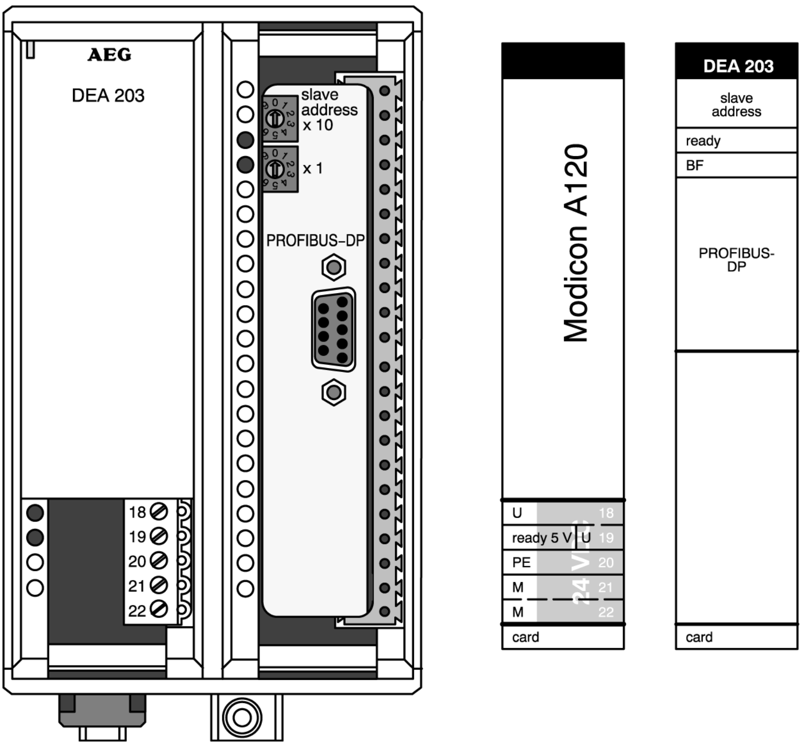
Features and Functions

Overview

The AS–BDEA 203 is a PROFIBUS–DP coupling module adhering to DIN 19 245 Parts 1 and 3 with integrated (non–isolated) power supply. It is used to drive the remote I/O modules of the Modicon TSX Compact family. It provides a 5 VDC supply at 1.6 A for the modules on the parallel I/O bus.

The AS–BDEA 203 can address a maximum of 18 I/O modules (288 I/Os) via the subracks DTA 200, DTA 201 or DTA 202. With the exception of intelligent modules, all analog and discrete Compact I/O modules can be employed. When analog modules are utilized, there is a particular total data volume which may not be exceeded.

The device master data file from the 381 SWA 000 00 diskette must be utilized for AS-BDEA 203 configuration.

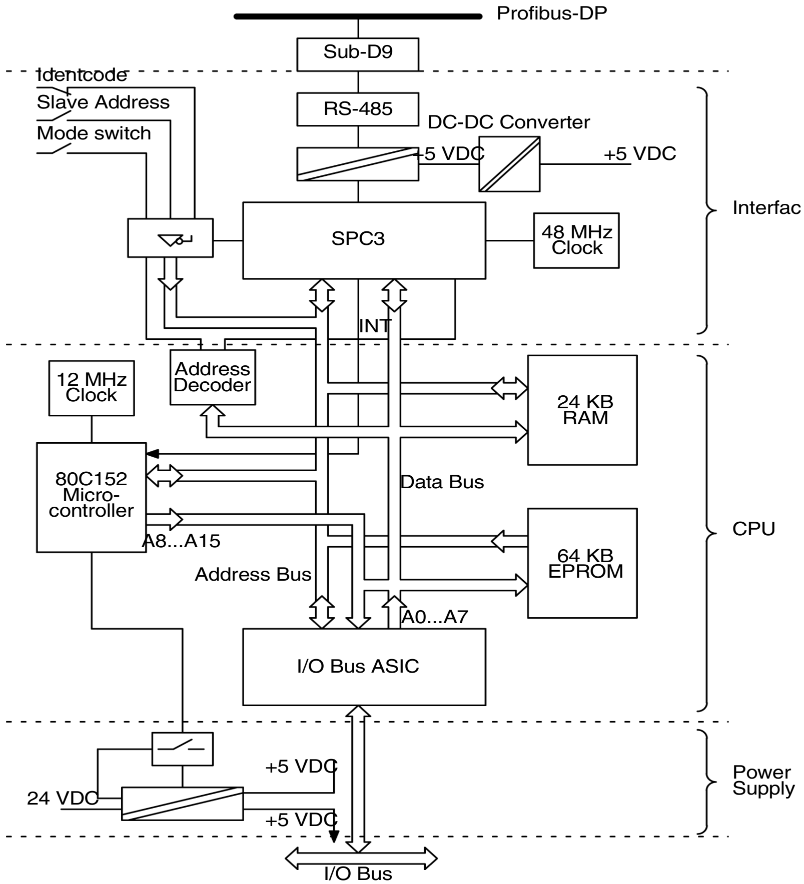


Features

- Standardized, isolated PROFIBUS Port
- Transmission rates of up to 12 Mbps
- Automatic adaptation to master transmission rate setting
- Slave address adjustment per rotary switch
- DIP switch adjustment of disconnection behavior

Functional Details

The AS–BDEA 203 serves as the coupling element between the PROFIBUS–DP and the internal I/O bus.
The set disconnection behavior is activated by watchdog when PROFIBUS communication is interrupted longer then the supervision time set by the master.
The AS–BDEA 203 collects messages from the associated modules and reports these further to the master as diagnostic information.



Diagnosis

Overview

The module front plate contains the following displays:

No	Label Inlay Identifier	Color	Function
18 (left)	U	Green	24 VDC supply prsent
19 (left)	ready 5V	Green	module ready for service, 5VDC output voltage present
3 (right)	ready	Green	Coupler ready
4 (right)	BF	Red	Bus coupling faulty (bus failure), Probable cause: The AS–BDEA is not parameterized and in-itialized, the PROFIBUS–DP protocol is not running

Technical Specifications

AS-BDEA 203

Assignment

System	TSX Compact (A120, 984)
Module Area	Slot 0 of DTA 200 primary backplane
Identicode	Hex A203, entry through the device master data file type 381 SWA 000 00

Power Supply

External input voltage	UB = 24 VDC, max. 0.85 A
Primary fusing	1.25 A medium time–lag fuse
Power on current	20 A, time constant = 1 ms
Tolerances, limiting values	Refer to the TSX Compact User Manual, "Technical Specifications"
Reference potential M	M2
Protective earth	PE
Secondary voltage	5.15 VDC, max. 1.6 A, non–isolated
Buffering time	Typically 5 ms for 24 VDC
Overload protection	Through current limiting

Data Interface

Profibus-DP	Through a potential–free RS–485 interface up to 12 Mbps
Pin assignments	Refer to PROFIBUS Connection Figure
Back plane	Parallel I/O bus, refer to TSX Compact User Manual, "Technical Specifications"

Processor

Processor type	Intel 80C152 / 12 MHz
Data memory	32 KB RAM
Firmware	64 KB EPROM

Mechanical Design

Module	Standard double–size module
Format	3 HE, 16 T
Weight	Approx. 500 g

Connection Styles

Power Supply	5–pole screw/plug–in terminal block
Profibus	Sub–D9 socket, matching to 490 NAD 911
Back plane	2 plug connectors 1/3 C30M, 1 socket connector 1/3 R30F

Environmental Characteristics

Regulations	Meets VDE 0160, UL 508
System data	Refer to TSX Compact User Manual, "Technical Specifica-tions"
Permissible ambient temperatures	0 ... +60 degrees C.
Power dissipation	Typically 6 W

Profibus- DP

Specifications for the AS-BDEA 203 on the Profibus-DP.

Transmission Specifications

Nodes per bus	Max. 32
Bus lengths, transmission rates	• max 1.2 km at 9.6 kbps or at 19.2 Kbps or at 93.75 Kbs • max 1 km at 187.5 Kbps • max 0.5 km at 500 Kbps • max 0.2 r at 1.5 Kbps • max 0.1 km at 3 Mbps or at 6 Mbps or at 12 Mbps rigid
Bulk transmission media	Shielded twisted pair (S–UTP)KAP PROFIB, PROFIBUS cable up to 12 Mbps, rigid
Connection interface	Adhering to EIA RS–485
Cable termination	As per Norm 390 / 220 / 390 W
Stub cabling	None
Data security	Hamming distance, HD = 4

Bus Specifications

Node type	Slave
Node Addresses	1...99

Operation

DP Bus Byte Output	Output reference 0x (Boolean, packed Output Reference 4x (Integer8, unpacked; Unsigned8, un-packed;RAW, packed e.g. ASCII)
DP Bus Byte Input	Input Reference 1x (Boolean, packed) Input Reference 3x (Integer8, unpacked; Unsigned8, un-packed; RAW, packed e.g. ASCII)
Bus Word Output	Output Reference 0x (Boolean) Output Reference 4x (Integer16 = Unsigned16 = RAW)
Bus Word Input	Input Reference 1x (Boolean) Input Reference 3x (Integer16 = Unsigned16 = RAW)

BKF 201 (16W) & (64W) InterBus S Master Module

11

At a Glance

Introduction

The information in this chapter describes the BKF 201 (16W) & (64W) InterBus S Master Module.

What's in this Chapter?

This chapter contains the following topics:

What Is the BKF 201 (16W) & (64W) InterBus S Master Module?

Brief Product Description

The BKF 201 links the Compact PLC and the Remote bus nodes. The following lists describes the key features of the BKF 201:
- Up to 63 3x input register and 63 4x output register data words can be addressed for a total of 126 TIOs (63 input TIOs and 63 output TIOs), with 16 Bits each within an Interbus frame
- Supports up to 15 BKF 201 modules in the BKF 201 (16) (Ident Code 92) mode or up to 3 BKF 201 modules in the BKF 201 (64) (Indent Code 93) mode
- Use and Programming for the BKF 201 is done via the RS 232C-port of the PLC, therefore saving a port on the BKF 201
- All outputs are automatically set to 0 (zero) upon detection of configuration errors or other bus problems
- A restart can be performed manually or automatically after error correction
- Changes to the Interbus S configuration are easy (Fast "Plug and Play")
- Monitoring of the module using a watchdog function
- Mode settings using two DIP switches
- The Interbus S status is shown via the modules LEDs

Interbus loop nodes are not supported.
Modules with Peripheral Communication Protocol (PCP) Channel (1, 2, and 4 PCP words within the Interbus loop) can be used in the BKF 201. However, the BKF 201 does not support the PCP Channel.

Note: Interbus loop nodes are not supported.

Note: Modbus with Peripheral Communication Protocol (PCP) Channel (1, 2, and 4 PCP words within the Interbus loop) can be used in the BKF 201. However, the BKF 201 does not support the PCP Channel.

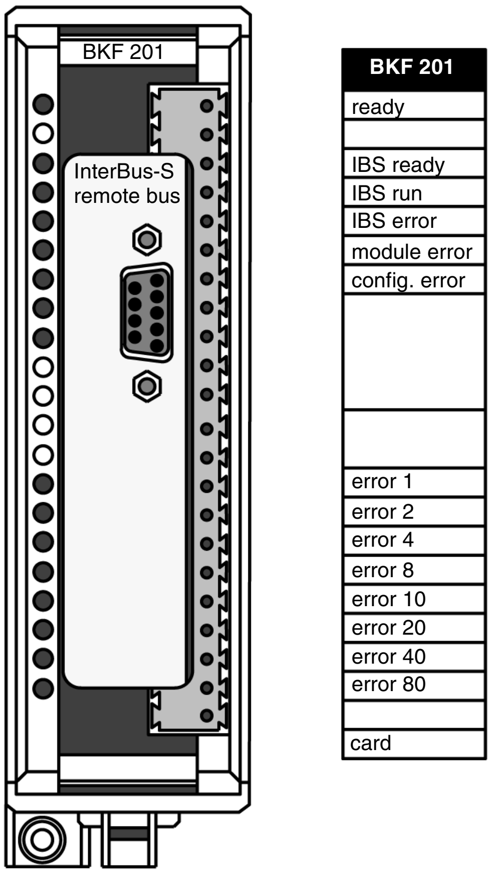
Physical Characteristics of the BKF 201 (16W) & (64W) InterBus S Master Module

Overview

The following information describes the physical characteristics of the BKF 201.

Front View and Label

The following figure shows the front view of the BKF 201 and the label.



LEDs

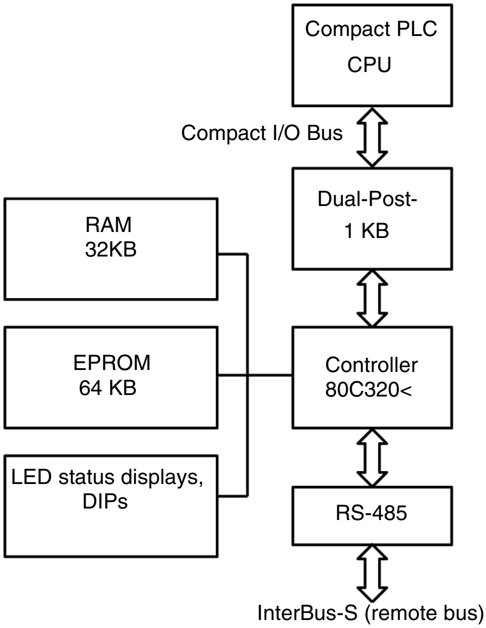
The following table describes the BKF 201 LED displays.

LED #	LED Name	Color	Function
1	ready	Green	Module ready for service
3	IBS ready	Green	Interbus ready for service
4	IBS run	Green	Interbus transmission active
5	IBS error	Red	Interbus transmission error
6	Module error	Red	Module error (on Interbus slave device)
7	config. error	Red	The configuration changed during operation, or an error occurred during loading of the configuration.
14 15 16 17 18 19 20 21	error 1 error 2 error 4 error 8 error 10 error 20 error 40 error 80	Red	Displays the physical number of the Interbus node with error condition (BCD, Node # = sum of error numbers displayed).* See also, the *Front View and Label, p. 185*. No display: Neither error nor node number can be found.

Note: *For example, if device#6 (node#6) has a error condition LED#15 (error 2) and LED#16 (error 4) turn red. Add the two together (error 2 + error 4= 6). This indicates that the error condition pertains to device#6 (node#6).

Block Diagram of the BKF 201

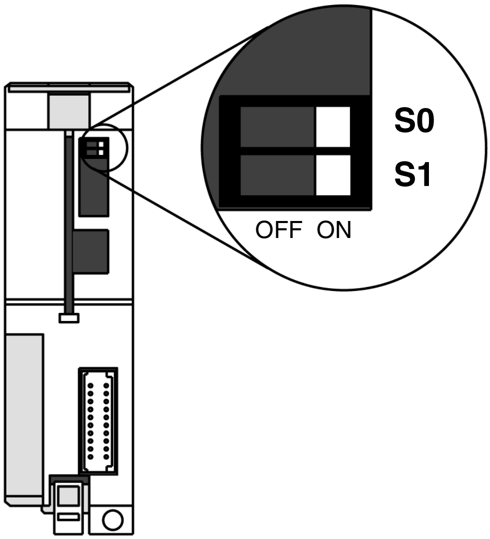
The following figure describes the architecture of the BKF 201.



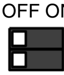
Switch Settings for the BKF 201

Operating Mode

The following figure shows the DIP Switch Settings for the operating mode. The switches are located on the rear of the BKF 201.



DIP Switch Setting for S0 and S1:

OFF ON	Ident-Code	Module	3x Input words	4x Output words	Programming with
 S0 S1	**99**	reserved	reserved	reserved	reserved
 S0 S1	**92**	BKF201(16)	1 3x status word & 15 3x data words	1 4x control word & 15 4x data words	Concept 2.1 and higher
 S0 S1	**93**	BKF201(64)	1 3x status word & 63 3x data words	1 4x control word & 63 4x data words	Concept 2.1 and higher
 S0 S1	not used (default settings for field testing by manufacturer only)				

Installation of the BKF 201 (16W) & (64W) Interbus Master Module

Overview

The following information describes how to install the BKF 201.

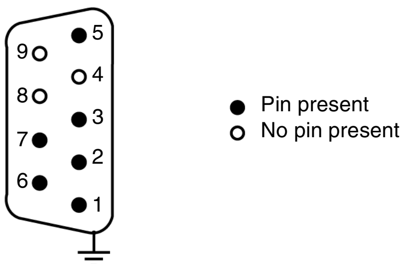
Operating Mode

If the operating mode for the BKF 201 module is set to BKF 201 (16) (Indent Code 92), the module can reside in any I/O slot in any backplane (DTA 201 or DTA 202). In contrast, if the operating mode for the BKF 201 module is set to BKF 201 (64) (Indent Code 93), the module can reside only in an I/O slot in the primary backplane (DTA 200).

Interbus Connection

Refer to the *Interbus S Quantum 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).
The following diagram shows the pin assignments as viewed from the solder side.

Interbus remote bus



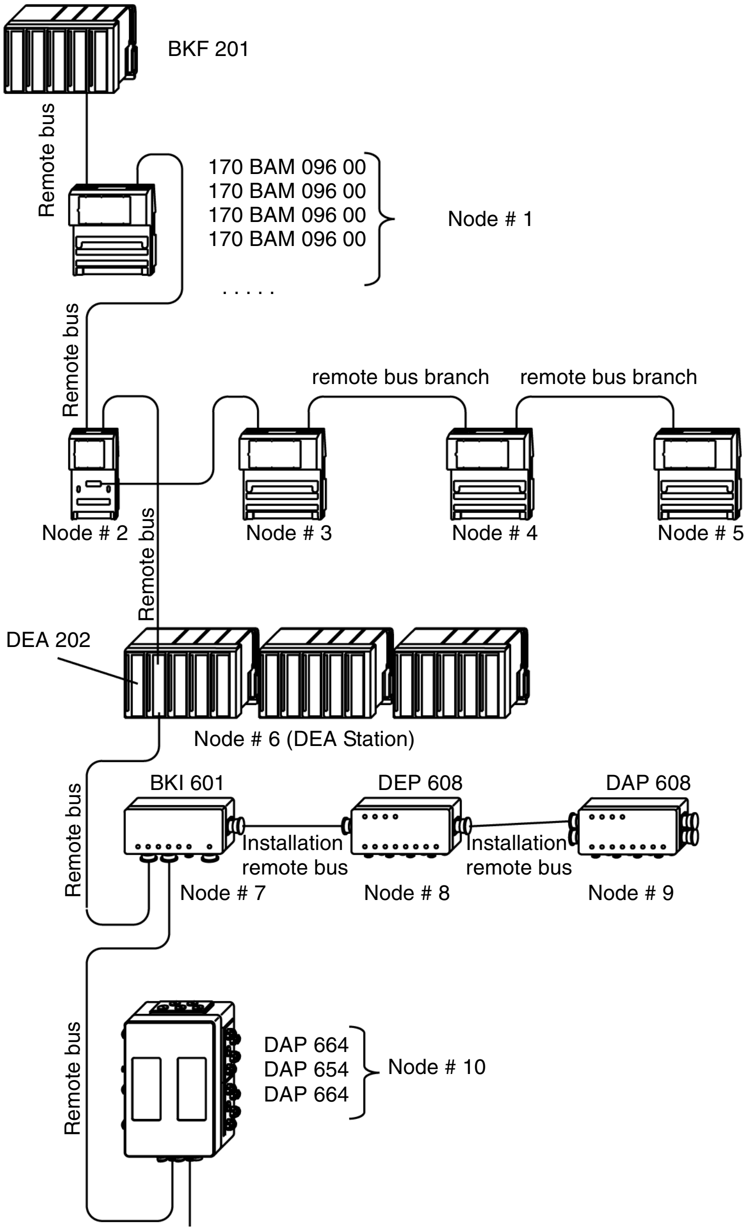
The following table shows the pinout assignments.

Socket	Signal	Function
1	DO	Transmit data (+)
2	DI	Receive data (+)
3	GND	Reference ground
5	5 V Out	For Fiber Optic Interface
6	DO	Transmit data (-)
7	DI	Receive data (-)

Note: When using branch interfaces, it is not possible to group and to handle errors (that is, turning off the branch in case of error).
For example, a branch interface is useful when using a fiber-optic interface because most slaves do not provide power for this type of interface. Additionally, a branch interface is required to connect slaves to peripheral buses, or to install remote buses.

Hardware Configuration of the BKF 201

The following figure illustrates an example BKF 201 hardware layout showing nodes.



Operation of the BKF 201 Master Module: I/O Map

BKF 201(16) Operating Mode

The BKF 201(16) (Ident Code 92) module requires a total of 16 3x input registers and a total of 16 4x output registers. The first 3x input register is the Status Word and the following 3x input registers are Data Words starting with 3x+1 and ending with 3x+15. The first 4x output register is the Control Word and the following 4x output registers are Data Words starting with 4x+1 and ending with 4x+15. Refer to the other information in this map.

BKF 201(64) Operating Mode

The BKF 201(64) (Ident Code 93) module requires a total of 64 3x input registers and a total of 64 4x output registers. The first 3x input register is the Status Word and the following 3x input registers are Data Words starting with 3x+1 and ending with 3x+63. The first 4x output register is the Control Word and the following 4x output registers are Data Words starting with 4x+1 and ending with 4x+63. Refer to the other information in this map.

3x Input Registers

The following table describes the 3x Input Registers (1 3x Status Word & Up to 15 3x Data Words) or (1 3x Status Word & Up to 63 3x Data Words).

State RAM	Bit 15-8	Bit 7-5	Bit 4-0
3xxxxx (Status Word)	Config. Checksum; see *3x Configuration Checksum Byte Structure (High Byte), p. 192*	0 not used	Status; see *3x Configuration Checksum Byte Structure (High Byte), p. 192*
3xxxxx +1	Process data - Input word 1		
3xxxxx +2	Process data - Input word 2		
3xxxxx +3	Process data - Input word 3		
3xxxxx +4	Process data - Input word 4		
:	:		
3xxxxx + 15BKF201 (16)	Process data - Input word 15 BKF201 (16) mode		
:	:		
3xxxxx + 15BKF201 (64)	Process data - Input word 63 BKF201 (64) mode		

3x Configuration Checksum Byte Structure (High Byte)

The following table describes the 3x Status Word, High Byte for Configuration Checksum Error #. For information about the meanings of the LEDs, see *LEDs, p. 186*.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Function
				8	4	2	1	Decimal value of block 1 (max. 9), same meaning as LEDs #14 ... #17
80	40	20	10					Decimal value of block 2 (max. 90), same meaning as LEDs #18 ... #21

Note: For example, if device#6 (node#6) has a error condition, LED#15 (error 2) and LED#16 (error 4) turn red. Add the two together (error 2 + error 4= 6). This indicates that the error condition pertains to device#6 (node#6).

3x Status Byte Structure (Low Byte)

The following table describes the 3x Status Word, Low Byte for Status. For information about the meanings of the LEDs, see *LEDs, p. 186*.

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Function
				1	**"IBS ready"** (same meaning as LED#3) Interbus ready to use (no "IBS error" or "config. error")
			1		**"IBS run"** (same meaning as LED#4) Process data exchange on the Interbus
		1			**"IBS error"** (same meaning as LED#5)A bus error occurred. Possible causes: Broken cable, short circuit, a node lost power, data transfer was interrupted. In case of a permanent interruption, the BKF will trace the node, which was interrupted.
	1				**"Module error"** (same meaning as LED#6) Module error of a node (slave). Current error does not stop the Interbus.
1					**"config. error"** (same meaning as LED#7) Interbus configuration error. Possible causes: The configuration could not be determined after power-on of the BKF 201 (node not ready for operation, cabling wrong, etc.) The configuration was changed during operation. An example would be the removal of a node. The standard configuration checksum does not concur with the actual configuration checksum, when Bit 6 was set in the control byte.

4x Output Registers

The following table describes the4x Output Registers (1 4x Control Word and up to 15 4x or (1 4x Control Word & up to 63 4x Data Words).

State RAM	Bit 15-8	Bit 7-0
4xxxxx (Control Word)	Config. Checksum; see *4x Control Byte Structure (Low Byte), p. 195*	Status; see *4x Control Byte Structure (Low Byte), p. 195*
4xxxxx +1	Process data - Input word 1	
4xxxxx +2	Process data - Input word 2	
4xxxxx +3	Process data - Input word 3	
4xxxxx +4	Process data - Input word 4	
:	:	
4xxxxx + 15 BKF201 (16)	Process data - Input word 15 BKF201 (16) mode	
:	:	
:	:	
4xxxxx + 63 BKF201 (64)	Process data - Input word 63 BKF201 (64) mode	

4x Standard Configuration Checksum Byte Structure (High Byte)

The following table describes the 4x Control Word, High Byte for Configuration Checksum.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Function
x	x	x	x	x	x	x	x	Enter your bus configuration checksum returned by the BKF 201 upon initialization into this register and set Bit 6 =1 (check config.) in (4x control word low byte) to compare configuration input (3x status config. check sum, high byte) to (4x control word low byte check sum). When they do not match Bit 4 (config. error) results in (3x status low byte).

4x Control Byte Structure (Low Byte)

The following table shows the 4X Control Word, Low Byte for Control.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Function
							0	Not used
						1		**"alarm-stop"** Setting Bit 1 stops the Interbus immediately, and all outputs are set to zero. While this Bit is set, all other control bits have no effect. Inputs are held in last state.
					1			**"start-cycle"** Starts the data transfer to the nodes. If the bit is cleared, no more data cycles are performed through the BKF master, and the outputs of the nodes are "frozen", meaning that the input information will stay resident in the signal memory. If alarm-stop Bit1=1, then the bus stops and all outputs are turned off.
				1				**"quit-error"** Confirms errors occurred ("IBS error", "module error", "config. error"). Setting this bit permanently results in immediate error acknowledgment. Therefore, it should not be used during normal operation. When an error occurs and the network problem is corrected, this bit needs to be set to confirm and clear the error condition. If alarm-stop Bit1=1, then quit-error is not active.
			0					Not used
		1		1				**"get-configuration"** Determine new Interbus configuration. This is useful, if for example a node is removed/added to the Bus, meaning Bit 4 of status byte (config. error) = 1. When checking for a new configuration, all other bits must be = 0, except you must set Bit 3=1.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Function
	1							**"check-configuration"** When Bit 6 is set, the BKF compares the checksum of the 4x control high byte and the standard configuration (3x status word, high byte checksum). In case of no match, the INTERBUS is stopped and Bit 4 (config. error) is set in the (3x status word, low byte for status). Make sure, the standard configuration checksum was entered into the (4x control word, high byte for standard config. checksum) prior to setting bit 6(check-config). The checksum is determined by reading the checksum of the actual configuration in the (3x status word, high byte checksum).
1								**"show-configuration"** Display of: Number of Interbus nodes, total number of Input/Output words, Identcode and the number of the process data words of the nodes in the signal memory (3x data words, up to 15 for BKF202(16) (Ident code 92), and up to 63 for BKF202(64) (ident code 93)). NOTE: All other bits must be=0.

Show Configuration

The following table is an example using the show configuration feature. This function is available only if the 4x control word bits are set as follows: Bit 7=1 (show configuration), Bit 1=0 (alarm-stop), Bit 2=0 (start-cycle)

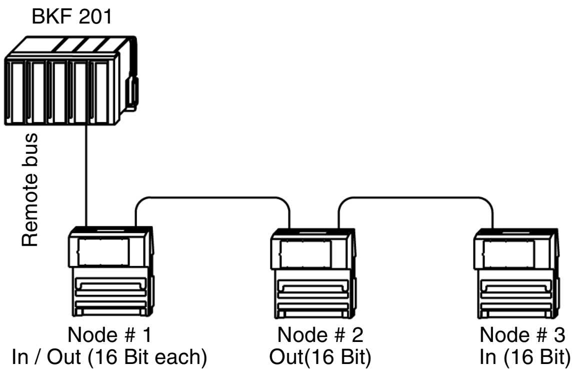
State RAM	Bit 15-8	Bit 7-5	Bit 4-0
3xxxxx (Status Word)	Config. Checksum; see *3x Status Byte Structure (Low Byte), p. 193*	0 (not used)	Status; see *3x Status Byte Structure (Low Byte), p. 193*
3xxxxx +1	0		Number of IBS nodes (slaves)
3xxxxx +2	Number of process 3x input data words		Number of process 4x input data words
3xxxxx +3	Number of process data words of slave 1		Ident code of slave 1
3xxxxx +4	Number of process data words of slave 2		Ident code of slave 2
3xxxxx + 15BKF201 (16)	Number of process data words of slave 13		Ident code of slave 13
3xxxxx + 15BKF201 (64)	Number of process data words of slave 61		Ident code of slave 61

> **Note:** The number of process data words also includes the Peripheral Communication Protocol (PCP) communication words, if slaves with PCP Channel are used. Unlike other Interbus masters, these PCP communication words are also reflected in the signal memory.

Example of Hardware and I/O Mapping for the BKF 201

BKF 201 Module Using TIO Modules as Nodes

This is an example of how to use three TIO modules as nodes off the BKF 201 module. Notice the correlation between the hardware and I/O mapping structure shown in the tables that follow the figure.



The following tables show the data structure of the 3x input registers and 4x output registers, as well as the hardware configuration for the three TIO devices/nodes shown in the figure.
The following table describes the 3x Input I/O Mapping Presentation.

Config. -checksum	Status byte
Inputs 1 ... 16 of node 1	
Inputs 1 ... 16 of node 3	

The following table describes the 4x Output I/O Mapping Presentation.

Stand. config. -checksum	Control byte
Outputs 1 ... 16 of node 1	
Outputs 1 ... 16 of node 2	

Specifications

Specifications

The following table lists specifications for the BKF 201 (16W) & (64W) InterBus S Master Module.

Power supply	
Internally through I/O-Bus	5VDC I/O Bus, 190mA typically, 250mA max. (w/o fiber-optic Interface)
Data Interface	
Field bus	as RS 485 port, non-isolated (150Ohm)
Processor	
Processor type	Dallas 80C320 / 32 MHz
Data memory	32KB RAM
Firmware	64KB EPROM
I/O Map	
Register 3x/4x	16 in/16 out BKF-201 (16W)
	64 in/64 out BKF-201 (64W)
Physical Structure	
Module	Standard-size module
Format	I Slot
Weight	210 g
Type of Connection	
Remote bus	Sub-D9 socket (9 pins)
Backplane	Plug connector1/3 C30M
Environmental Characteristics	
Regulations	VDE 0160, UL 508
Power dissipation	1.3W max., typically 1W

BKF 202 InterBus S Slave Module

12

At a Glance

Introduction

The purpose of this chapter is to describe the BKF 202 InterBus S slave Module.

What's in this Chapter?

This chapter contains the following topics:

What Is the BKF 202 InterBus S Slave Module?

Brief Product Description

The BKF 202 links the Compact PLC and the Remote Bus nodes. The following list describes the key features of the BKF 201:

- Up to 15 3x input register and up to 15 4x output register data words can be exchanged with an Interbus S master.
- Monitoring of the module using a watchdog function.
- Mode settings using a rotary switch and two DIP switches.
- The Interbus S status is shown via the module's LEDs.
- Supports up to 15 BKF 202 modules in the BKF 202 (Indent Code 94) mode.

Note: The BKF 202 module does not support Peripheral Communication Protocol (PCP) channels.

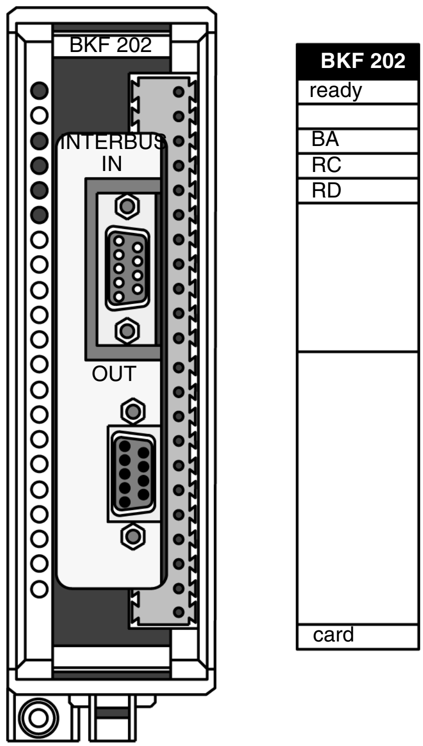
Physical Characteristics of the BKF 202 InterBus S Slave Module

Overview

The following information describes the physical characteristics of the BKF 202.

Front View and Label

The following figure shows the front view of the BKF 202 and the label.



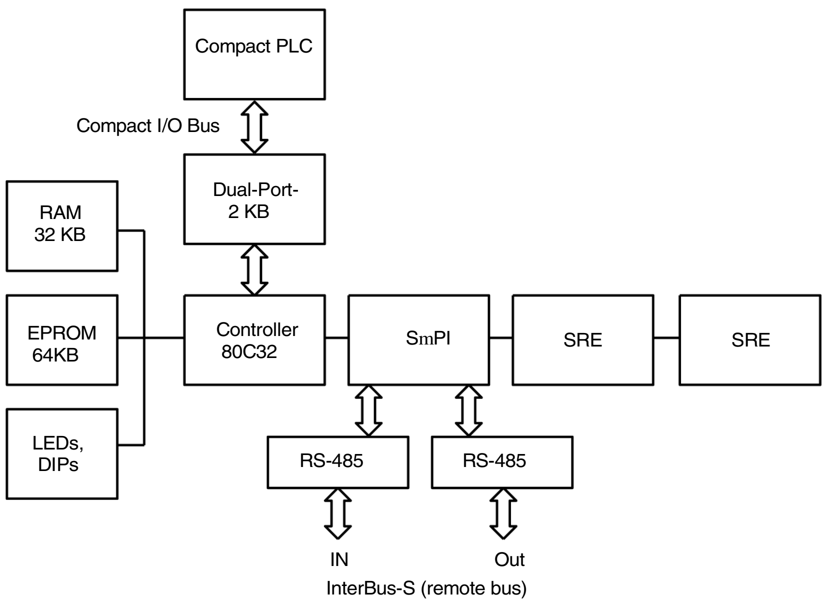
LED Displays

The following table describes the LED displays for the BKF 202.

LED #	LED Name	Color	Function
1	READY	Green	Operating mode on: Current power for internal logic within the allowable range and the module has not been reset to mode off: Current power missing or outside of the allowable range, or module has been reset
3	BA	Green	bus active on: Data telegrams are transmitted off: Data telegrams are not transmitted
4	RC	Green	Remote Bus Check on: incoming remote bus connection is correct and the Bus Reset of the Busmaster is inactive off. incoming remote bus connection is wrong/not corrected or the Bus Reset of the Bus Reset of the Busmaster is active
5	RD	Red	Remote Bus Disabled on: Extended remote bus is switched off off: Extended remote bus is not turned off

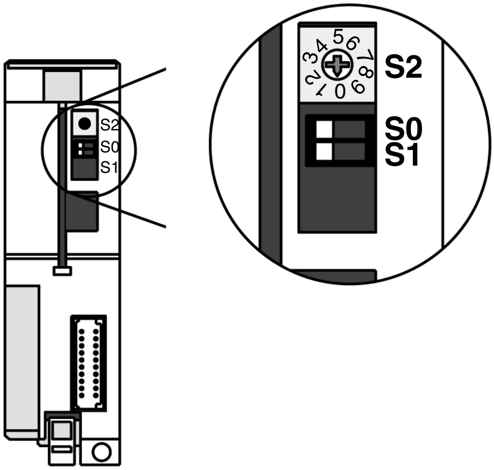
Block Diagram of the BKF 202

The following block diagram provides an overview of the BKF 202 architecture.



Switch Settings for the BKF 202 InterBus S Slave Module

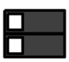
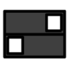
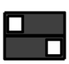
Operating Mode The following figure shows the Rotary Switch settings and the Dip Switch settings for the operating mode. The switches are located on the rear of the BKF 202.



Rotary Switch Settings for S2:

Switch position	Number of words
1	2 words
2	4 words
3	6 words
4	8 words
5	10 words
6	12 words
7	14 words
8	16 words (15 data words)
9	not used
0	not used

DIP Switch Setting for S0 and S1:

OFF ON		Ident-Code	Module	3x Input words	4x Output words	Programming with
	S0 S1	reserved	reserved	reserved	reserved	reserved
	S0 S1	94	BKF202	1 3x status word & 15 3x data words	1 4x control word & 15 4x data words	Concept 2.1 and higher
	S0 S1	reserved				
	S0 S1	not used (default settings for field testing by manufacturer only)				

Installation of the BKF 202 InterBus S Slave Module

Overview

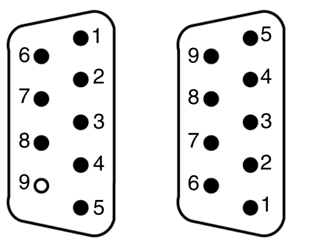
The following information describes how to install the BKF 202.

Interbus Connection

The BKF 202 modules located at the inline sites on the Interbus remote bus cable have two connections. One connection is for the incoming bus cable; the other is for the outgoing bus cable. BKF 202 modules located at the end sites on the network cable have only one connection. This is for the incoming bus cable.
You should have a complete cabling diagram for your network installation, showing the cable routing path and methods of securing the cables. It should identify incoming and outgoing cables at each BKF 202 module site.

Pin Placements

The following figure shows the pin placements as viewed from the solder side.



Sub-D9 Port
“in” (top)

Sub-D9 Port
“out” (bottom)

Pin	Signal	Meaning
1	DO	Transmit data (+)
2	DI	Transmit data (+)
3,4	GND	reference ground
5,8		(5 V Out) for Opto. Sub.
6	DO	Transmit data (-)
7	DI	Receive data (-)
9*	RBST	Plug identifier

*) incoming remote bus = not used

● Pin present

○ No pin present

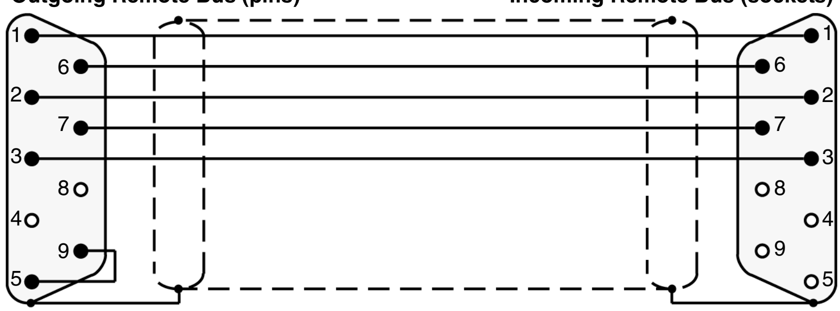
Cabling

Modicon provides two prefabricated Interbus cables (170 MCI 101 00, 1m, 39 inches) and (170 MCI 007 00, 11.5cm, 4.5 inches). Each cable has two connectors for direct interconnection between two modules. Modicon also provides a connector kit (170 XTS 009 00) for use with user supplied cables. The kit contains one pin and one socket connector.

Please note the following general requirements.

- The maximum remote bus cable length is 13 km (8mi.). The cable length between two remote bus nodes must not exceed 400 m (1200 ft).
- The connectors for the outgoing bus are always pins, those for the incoming remote bus are always sockets.
- Connect the cable shield to the connector.
- You need a 5 wire cable, twisted pair type, shielded cable for the remote bus. We recommend a Belden 8103 cable or equivalen; this cable is available by the meter (KAB 3225 LI).

Wire the connectors of the remote bus cable as shown in the following figure.



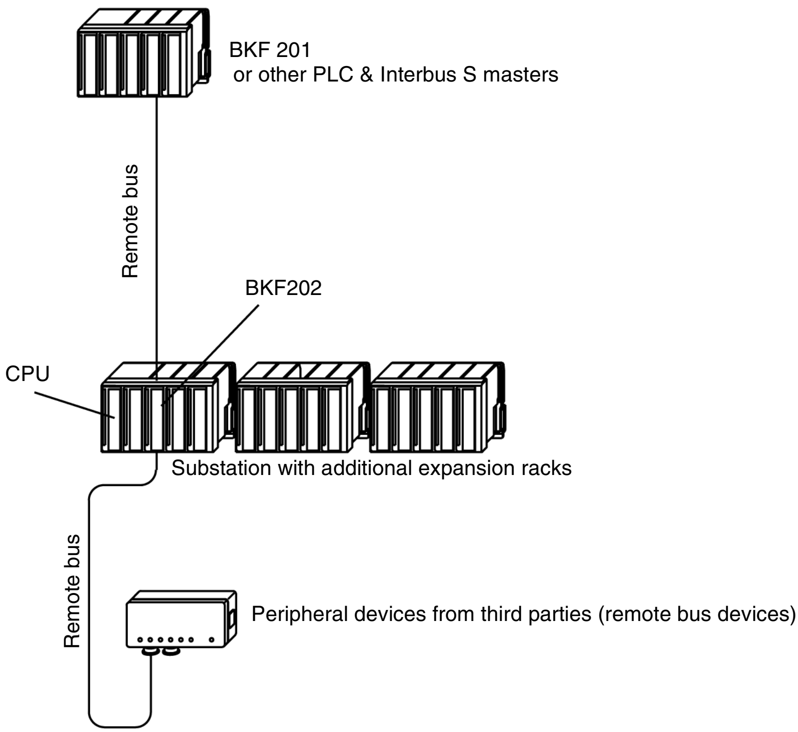
The following tables show the pinouts for the Interbus cable construction. The information in the first table describes pinouts for an outgoing remote bus connection; the second table describes the pinouts for an incoming remote bus connection.

Pin	Wire Color	Connection outgoing remote bus
1	yellow	DO: Data Out
2	grey	DI: Data In
3	brown	Common
4		GND: Reference conductor, fiber optic adapter
5		Vcc: Power supply for fiber optic adapter.
6	green	DO_N: Data Out Negated
7	pink	DI_N: Data In Negated
8		Vcc: Additional power supply for fiber optic adapter
9		Plug identification

Pin	Wire Color	Connection incoming remote bus
1	yellow	DO: Data Out
2	grey	DI: Data In
3	brown	Common*
4		GND*: Reference conductor, fiber optic adapter
5		Vcc*: Power supply for fiber optic adapter.
6	green	DO_N: Data Out Negated
7	pink	DI_N: Data In Negated
8		Vcc*: Additional power supply for fiber optic adapter
9		(not used)
		* = physically isolated

Hardware Configuration of the BKF 202

The following figure illustrates an example BKF 202 hardware layout showing nodes.



Operation of the BKF 202 InterBus S Slave Module

I/O Map

The BKF 202 module requires a total of 16 3x input registers and a total of 16 4x output registers. The first 3x input register is the Status Word, and the following 3x input registers are Data Words starting with 3x+1 and ending with 3x+15. The first 4x output register is the Control Word, and the following 4x output registers are Data Words starting with 4x+1 and ending with 4x+15. Refer to the other information in this map.

3x Input Registers

The following table describes the 3x Input Registers (1 3x Status Word & Up to 15 3x Data Words) or (1 3x Status Word & Up to 63 3x Data Words).

State RAM	Bit 8-15	Bit 7-4	Bit 3	Bit 2	Bit 1	Bit 0
3xxxxx (Status Word)	Number of words; see *Front View and Label, p. 203*	0 (not used)		RD	RC	BA
				For more information, see *3x Status Word Byte Structure, p. 209*		
3xxxxx +1	Process data - Input word 1					
3xxxxx +2	Process data - Input word 2					
3xxxxx +3	Process data - Input word 3					
3xxxxx +4	Process data - Input word 4					
:	:					
3xxxxx + 15	Process data - Input word 15					

3x Status Word Byte Structure

The following table describes the 3x Status Word Byte Structure.

State RAM	Bit 7-4	Bit 3	Bit 2	Bit 1	Bit 0	Function
3xxxxx (Status Word)	**0 (not used)**				**1**	**BA; see *LED Displays, p. 204***
				1		RC; seeseee*LED Displays, p. 204*
			1			RD; see see*LED Displays, p. 204*

4x Output Registers

The following table describes the4x Output Registers (1 4x Control Word & Up to 15 4x or (1 4x Control Word & Up to 63 4x Data Words)

State RAM	Bit 15 : Bit 2	Bit 1	Bit 0
4xxxxx (Control Word)	-	PLC-Stop Module Faults	Module Error)
		See *4x Control Word Byte Structure, p. 210*	
4xxxxx +1	Process data - Output word 1		
4xxxxx +2	Process data - Output word 2		
4xxxxx +3	Process data - Output word 3		
4xxxxx +4	Process data - Output word 4		
:	:		
4xxxxx +15	Process data - Output word 15		

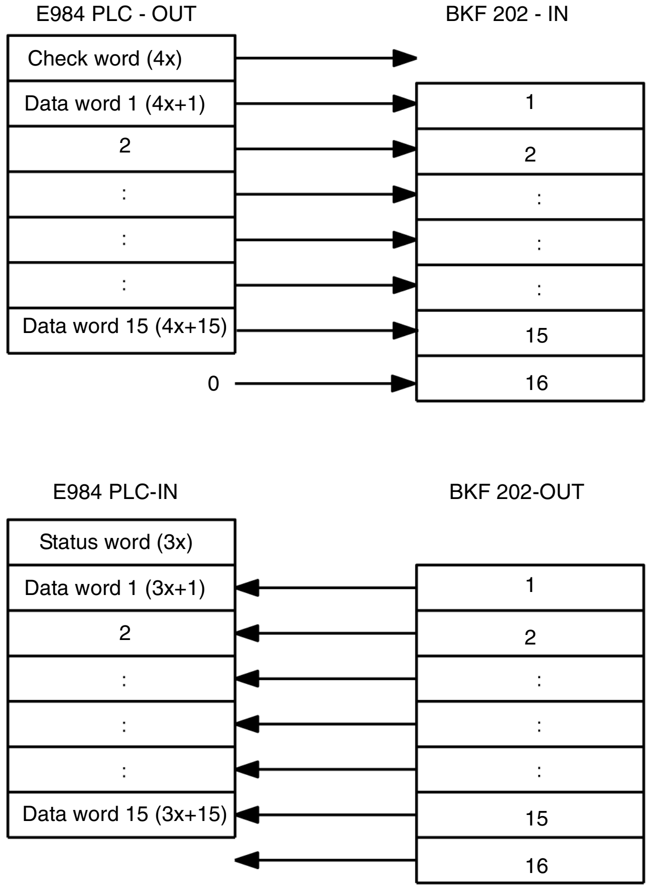
4x Control Word Byte Structure

The following table shows the 4x Control Word Byte Structure.

State RAM	Bit 15-2	Bit 1	Bit 0	Function
4xxxxx (Control Word)	(not used)		1	Module Error Setting Bit 0 transmits a "Module-Error" to the Interbus master.
		1		PLC-Stop Module Faults: Setting of Bit 1 transmits a "Module-Error" to the Interbus master, when the PLC is stopped.

Interbus Bi-Directional Communication between the E984 PLC and the BKF 202 IBS Slave Module

The following figure shows the process data exchange between the PLC and the Interbus.



Specifications of the BKF 202 InterBus S Slave Module

Specifications

The following table lists specifications for the BKF 202 InterBus S Slave Module.

Power supply	
Internally from I/O-Bus	5VDC, 300 mA max. (w/o fiber-optic Interface)
Data Interface	
Field bus	as RS 485 Interface remote in: potentialfree 150 Ohm remote out: potentialbound 150 Ohm
Processor	
Processor type	80C32 16 MHz
Data memory	32KB RAM
Firmware	64KB EPROM
I/O Map	
Register 3x/4x	16 in/16 out
Physical Characteristics	
Module	in standard-size case
Format	I Slot
Weight	250 g
Type of Connection	
Remote bus	9-pin DSUB socket/connector bar
Backplane	Connector bar 1/3 C30M
Environmental Characteristics	
Regulations	VDE 0160, UL 508
Permissible ambient temperature	0 ... +60 degrees C.
Power dissipation	max. 1.5W
Option	Fiber-optic adapter

DAO 216 Discrete Output Module

13

At a Glance

Purpose

The purpose of this chapter is to describe the DAO 216 discrete output module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAO 216 Discrete Output Module?

DAO 216 Discrete Output Module

WARNING

Operational Hazard

The DAO 216 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

The DAO 216 is a discrete output module with 16 independent 24 Vdc output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in one group of 16 outputs. The outputs are not isolated.

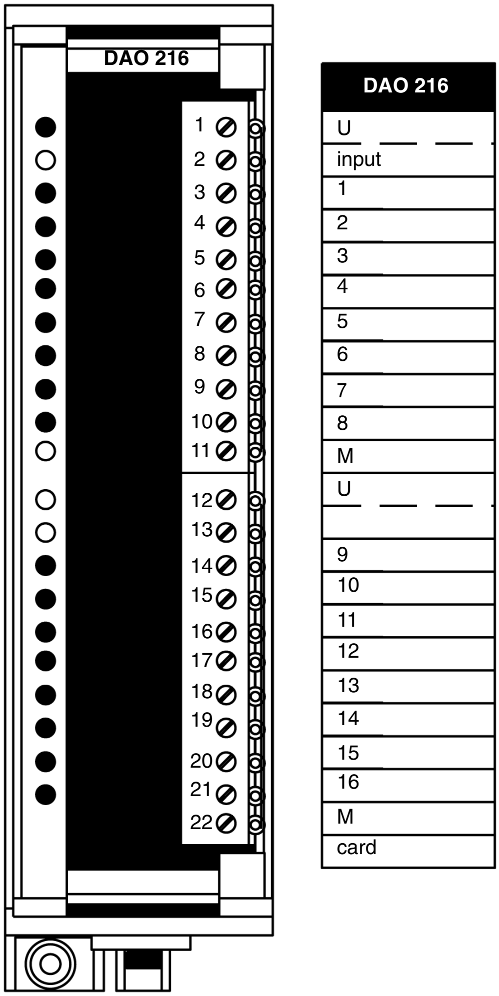
The DAO 216 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and field connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided. Refer to the diagram in *LEDs, p. 215*

DAO 216 Discrete Output Module Physical Characteristics

LEDs

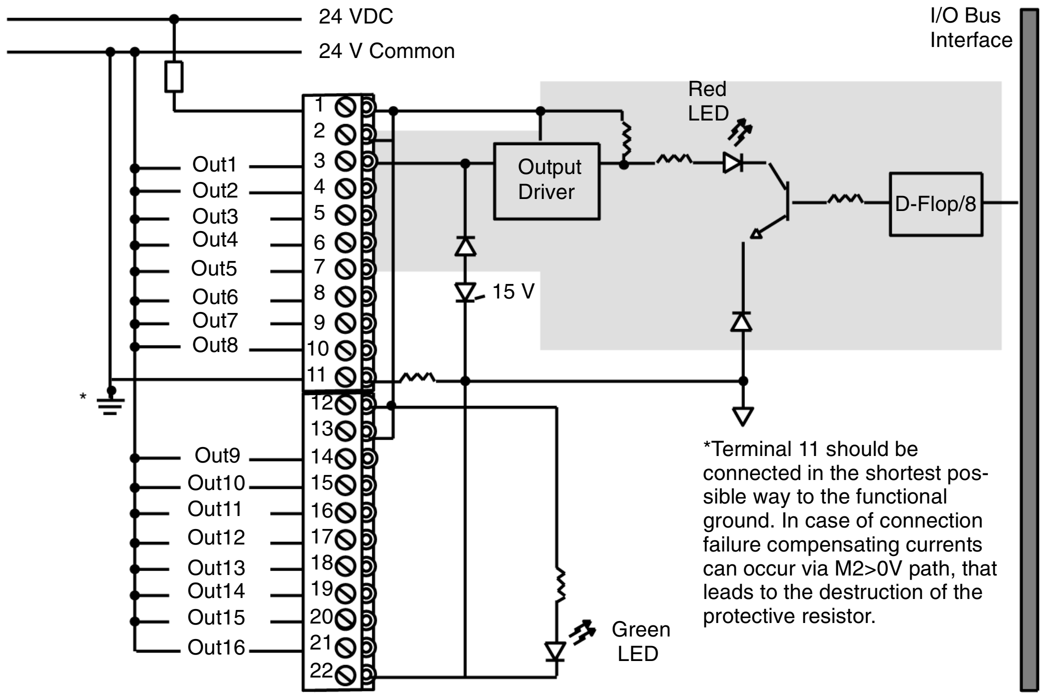
The DAO 216 has 17 LEDs. One green LED opposite terminal screw #1 indicates presence of external working voltage to the 16 outputs (ON = voltage available; OFF = voltage not available). There are 16 red LEDs opposite terminal screws 3 ... 10 and 14 ... 21, indicating when ON that 24 Vdc is present at the adjacent discrete output.

Front View and Fill-in Label of the DAO 216 Module



Simplified Schematic

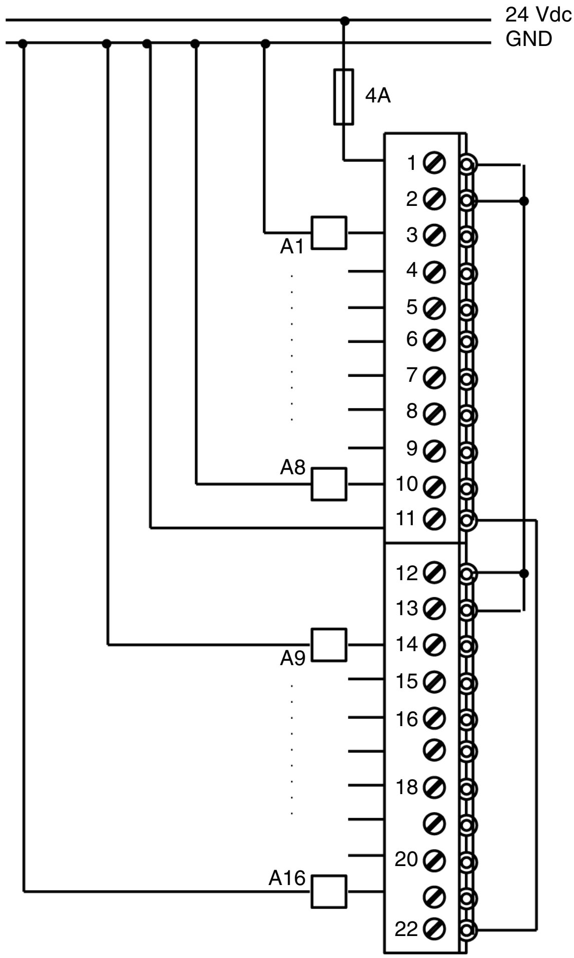
Simplified Schematic for the DAO 216 Output Module



*Terminal 11 should be connected in the shortest possible way to the functional ground. In case of connection failure compensating currents can occur via M2>0V path, that leads to the destruction of the protective resistor.

Wiring Diagram

Wiring the DAO 216



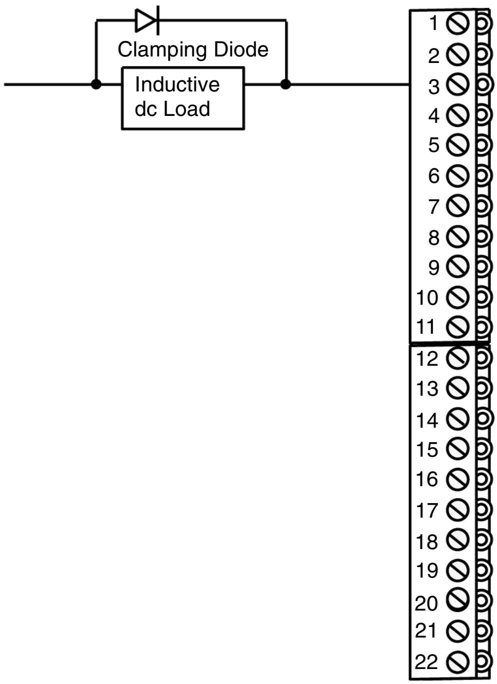
Protecting the DAO 216 Discrete Output Module from Inductive Back EMF

Instructions

If you have inductive loads on longer lines with logic elements located in the output loads, it is essential to install an external clamping diode in parallel with the operating coil to protect the module from reverse EMF.

Clamping Diode

Clamping Diode on an Inductive Load



DAO 216 Discrete Output Module Specifications

DAO 216 Specifications

The following table contains a list of DAO 216 specifications

Module Topology	Number of Outputs	16
	Number of Groups	1
	Points/Group	16
	Isolation	No isolation provided
Power Supplies	External Source Requirement	24 Vdc (20 to 30 Vdc), 5 A @30 Vdc
	Internally Provided Source	5 V from I/O bus, 30 mA max.
	Internal Power Dissipation	5 W (typical)
Electrical Characteristics	Operating Mode	True High
	ON State Signal Level	Source voltage minus 3 V
	OFF State Signal Level	0 ... +2 V, less than 1mA
	Load Current/Output	10 mA ... 500 mA
	Max Load Current/Module	4 A
	Response Time	less than 1 msec.
	Reverse-EMF Protection	Built-in circuitry limits inductive spikes to a maximum of -15 V
	Switch Capacity for Bulbs	Max. 5 W (Surge current = Nor mal current x 10)
	OFF-ON Operations	1000/hour for inductive load @ maximum load current
	Wire Size/Terminal	One wire = 14 AWG
		Two wires = 20 AWG
I/O Map	Discrete 1x/0x	0 in/16 out
Dimensions	W x H x D	40.3 x 145 x 117.5mm (1.6 x 5.6 x 4.5 in)
	Weight	250 g (.55 lb)
Agency Approval	VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Stan dards	

Overview of the DAP 204 Relay Output Module

14

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 204 Relay Output Module.

What's in this Chapter?

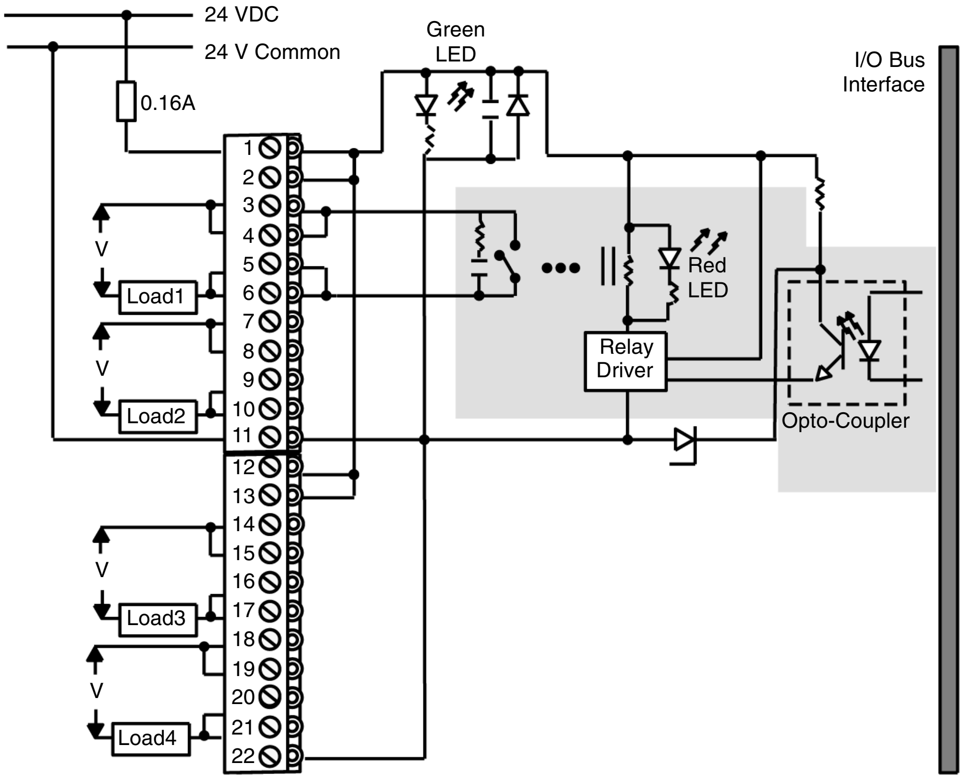
This chapter contains the following topics:

What is the DAP 204 Relay Output Module?

Brief Product Description

The DAP 204 is a four point relay output module. It utilizes logic signals within the PLC to activate four independent, individually isolated, normally open relay contacts. Source voltage for any output load may be 24 ... 154 Vdc or 24 ... 250 Vac.

Wiring Diagram and Simplified Schematic for the DAP 204 Output Module



DAP 204 Relay Output Module LEDs

LEDs

The DAP 204 has five LEDs. One green LED opposite terminal screw 1 indicates the presence of relay coil voltage when ON. Four red LEDs opposite terminal screws 3, 7, 14, and 18 indicate when ON that the relay coils are energized at outputs 1 ... 4, respectively, and suggest that the contacts are closed and the loads energized. These LEDs are in parallel with the relay coils, not the load.

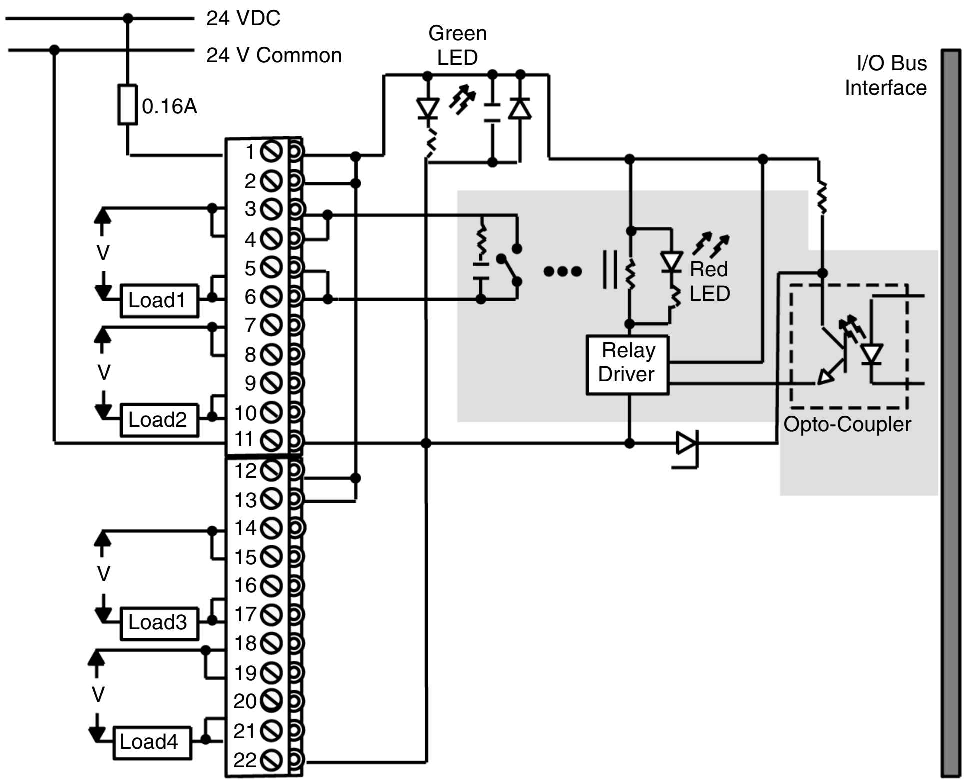
DAP 204 Relay Output Module Field Wiring

Introduction

Field wiring to each output connects to a double screw terminal. This module requires power from an external 24 Vdc source to support the relay driver (even if all the outputs switch ac power).

DAP 204 Relay Output Module

A wiring diagram and simplified schematic for the DAP 204 relay output module is provided below.



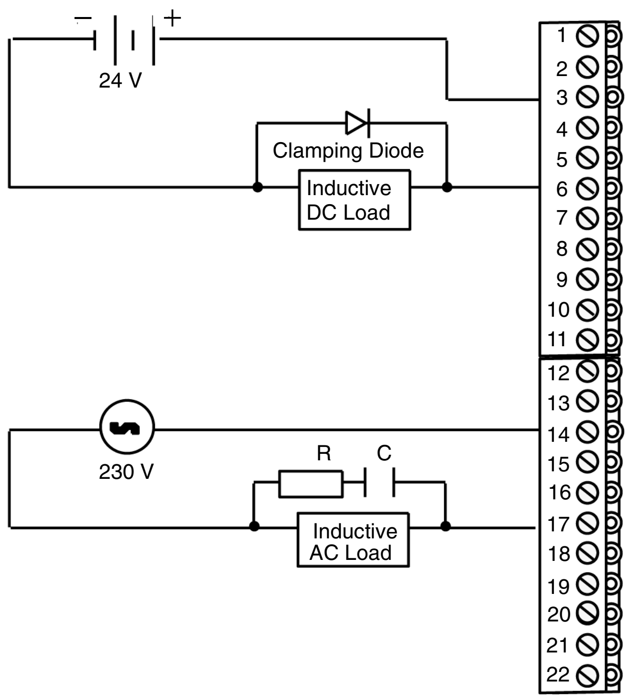
Protecting the DAP 204 Relay Output Module from Inductive Back EMF

Instructions

In order to increase the service life of your contacts and protect the DAP 204 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

Illustration of Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



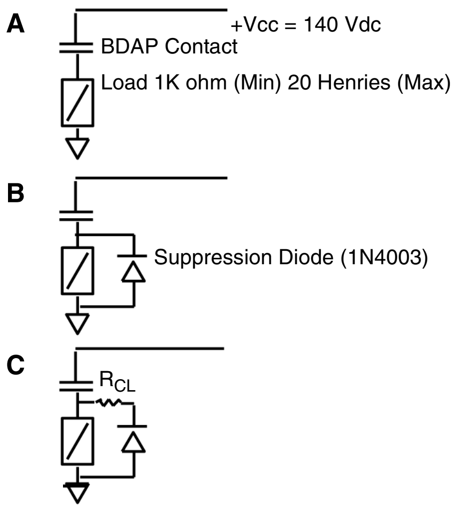
Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a voltage rating two or three times greater than the supply voltage.

Values may be:

25 ... 70 mH	.50 microF
70 ... 180 mH	.25 microF
180 mH	.10 microF

Snubber resistors may be 1 ... 3 ohms, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.
Operational range options are shown in the following diagram.



Calculations:
Given: Vcc = 140Vdc
I (Max) = .15 A
Then: R(L)(Min) = 140/.15 = 1Kohm
Since L/R = .02 Sec, and R = 1Kohm
Then L(Max) = (.02) X 1000 = 20H

Voltage rating of diode = 1.5 X Vcc
Current rating of diode = 2 X I (Max)
Must be “slow,” rectifier, vs logic

R_{CL} = Current Limiting Resistor (.5 Load R)
Here, 470 ohms
If carbon film, .25 watt,
If metal film, .50 watt

A shows the consequences of ohmic load and L/R ratios
B shows the application of the suppression diode
C shows the application of a current limiting resistor in series with the diode to protect the diode from contact bounce

DAP 204 Relay Output Module Specifications

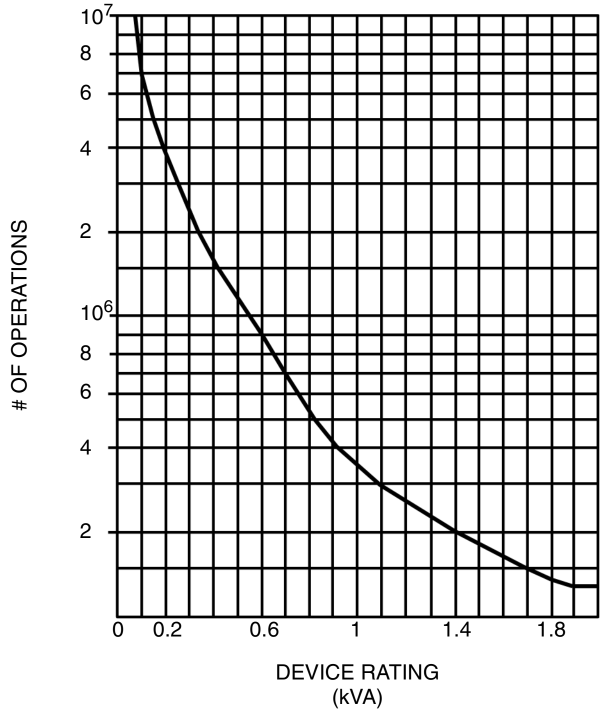
DAP 204 Specifications

The following table contains a list of DAP 204 relay output module specifications.

<table>
<tr><td rowspan="4">Module Topology</td><td>Number of Relay Outputs</td><td colspan="2">4</td></tr>
<tr><td>Number of Groups</td><td colspan="2">4</td></tr>
<tr><td>Points/Group</td><td colspan="2">1</td></tr>
<tr><td>Isolation</td><td colspan="2">Four individually isolated relay contacts</td></tr>
<tr><td rowspan="3">Power Supplies</td><td>External Source Requirement</td><td colspan="2">24 Vdc, 150 mA maximum</td></tr>
<tr><td>Internally Provided Source</td><td colspan="2">5 V from I/O bus @ 25 mA max.</td></tr>
<tr><td>Internal Power Dissipation</td><td colspan="2">2 W (typical)</td></tr>
<tr><td rowspan="5">Electrical Characteristics</td><td>Output Voltage Ranges</td><td colspan="2">24 ... 154 Vdc; 24 ... 250 Vac</td></tr>
<tr><td>Operating Mode</td><td colspan="2">Normally Open</td></tr>
<tr><td>Response Time</td><td colspan="2">10 ms (typical)</td></tr>
<tr><td rowspan="2">Wire Size/Terminal</td><td colspan="2">One wire: 14 AWG</td></tr>
<tr><td colspan="2">Two wires: 20 AWG</td></tr>
<tr><td>Environmental Characteristic</td><td>Operating Temperature</td><td colspan="2">-25 ... +70 degrees C (-13 ... +158 degrees F)</td></tr>
<tr><td rowspan="10">Output Characteristics</td><td rowspan="3">Load Currents @ 230 Vac</td><td colspan="2">2 A continuous (maximum, resistive load)</td></tr>
<tr><td colspan="2">4 A instantaneous (maximum, resistive load)</td></tr>
<tr><td colspan="2">1 A continuous (maximum, Cos = 0.5)</td></tr>
<tr><td rowspan="7">Load Current @ dc</td><td rowspan="3">Working Voltage @ 24 Vdc</td><td>2 A continuous maximum (resistive load)</td></tr>
<tr><td>4 A instantaneous maximum (resistive load)</td></tr>
<tr><td>1 A continuous maximum (L/R* = 30 ms)</td></tr>
<tr><td rowspan="2">Working Voltage @ 60 Vdc</td><td>1 A continuous maximum (resistive load)</td></tr>
<tr><td>0.6 A maximum (L/R* = 30 ms)</td></tr>
<tr><td rowspan="2">Working Voltage @ 140 Vdc</td><td>0.3 A continuous (resistive load)</td></tr>
<tr><td>0.15 A (L/R* = 20 ms)</td></tr>
</table>

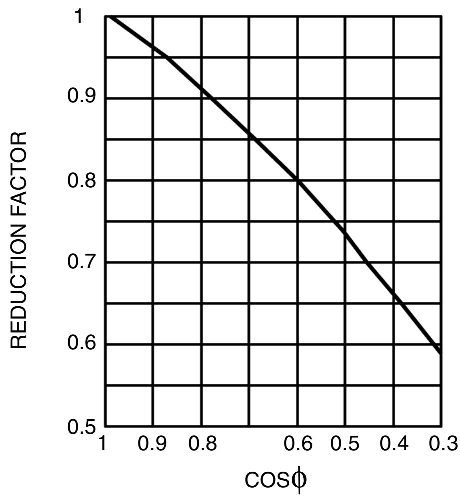
	Wetting Current	5 mA for closed contacts	
	Leakage	1 mA	
	Internal Protective Circuitry	68 ohms +15 nF in parallel with each contact	
* L = Load Inductance in Henries; R = Load Resistance in ohms			
I/O Map	Discrete 1x/0x	0 in/8 out	
Service Life of Contacts	Mechanical switching cycles	20,000,000	
	Electric switching cycles	10,000,000 @ 230 Vac/0.2 A	
		(Resistive Loads)	7,000,000 @ 230 VAC / 0.5 A
			8,000,000 (typical) @ 30 VDC / 2 A, with clamping diode
			1,000,000 (typical) @ 60 VDC / 1 A, with clamping diode, 3000 cycles/hr max
	Electric switching cycles	5,000,000 @ 230 Vac/0.5 A	
		(Inductive Loads, Cos = 0.5*)	
	Overload Protection	Should be provided externally	

Service Life for Resistive Loads



The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos f: Effective number of operations = # of operations (resistive load) x reduction factor:

Reduction Factor for Inductive Loads



Cos = Watts divided by VA.

Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	240 g (0.52 lb)
Agency Approvals	VDE 0160; UL 508; and CSA 22.2 No.142 Standards	

Overview of the DAP 208/258 Relay Output Module

15

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 208/258 relay output module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 208/258 Relay Output Module?

Brief Product Description

The DAP 208/258 is an eight point relay output module. It utilizes logic signals within the controller to activate eight individually isolated, normally open relay contacts. Source voltage for any output load may be 24 ... 154 Vdc or 24 ... 250 Vac.

DAP 208/258 Relay Output Module LEDs

LEDs

The DAP 208/258 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of relay coil voltage when ON. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate when ON that the relay coils are energized at outputs 1 ... 8, respectively, and suggest that the contacts are closed and the loads energized. These LEDs are in parallel with the coils, not the load.

DAP 208/258 Relay Output Module Field Wiring

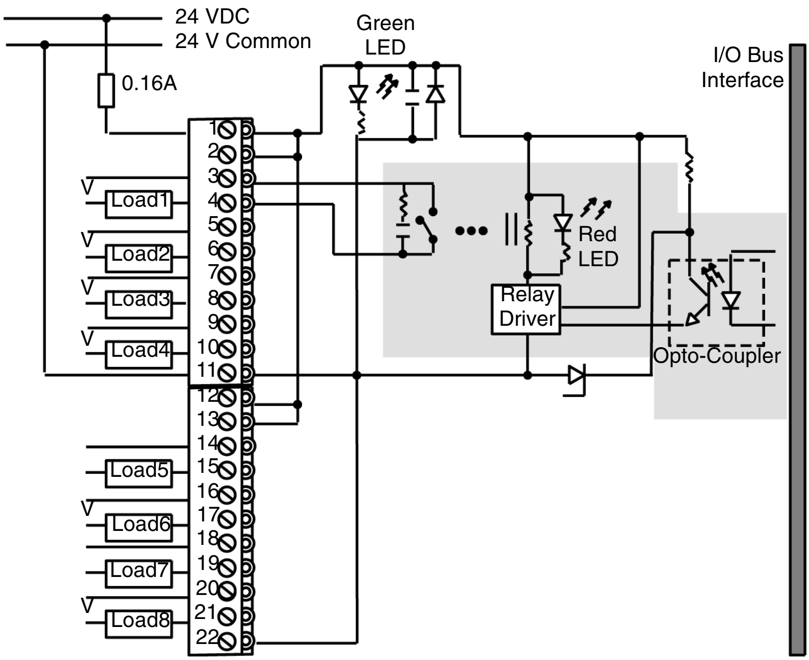
Introduction

Field wiring to each output connects to a double screw terminal. This module requires power from an external 24 Vdc source to support the relay driver (even if all the outputs use ac power). The DAP 258 functions just like the DAP 208 except that the DAP 258 operates at extended temperature.

Note: DAP 258 model is available with conformal coating. The conformal coating model is DAP 258C and it meets Railway standard EN 50 155.

DAP 208/258 Wiring Diagram and Simplified Schematic

A wiring diagram and simplified schematic for the DAP 208/258 relay output module is provided below.



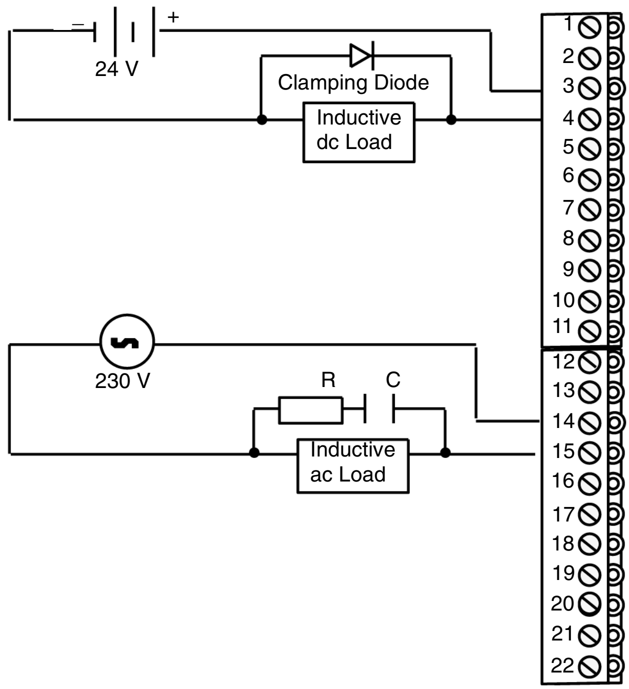
Protecting the DAP 208/258 Relay Output Module from Inductive Back EMF

Instructions

To increase the service life of your contacts and protect the DAP 208/258 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.

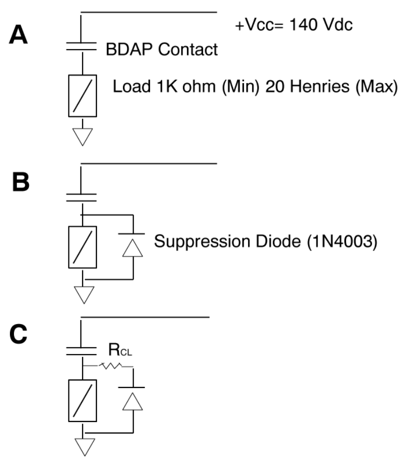


Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a voltage rating two or three times greater than the supply voltage.
Values may be:

Load Inductance	Capacitance
25 ... 70 mH	.50 microF
70 ... 180 mH	.25 microF
180 mH	.10 microF

Snubber resistors may be 1 ... 3 W, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.
Operational Range Options Using 140 Vdc Example



Calculations:
Given: Vcc= 140Vdc
I (Max)= .15 A

Then: R(L)(Min)= 140/.15=1Kohm
Since L/R=.02 Sec, and R=1Kohm,
Then L(Max)= (.02) X 1000=20H

Voltage rating of diode = 1.5 X Vcc
Current rating of diode = 2 X I (Max)
Must be "slow", rectifier, vs logic

$R_{CL=}$ Current Limiting Resistor (.5 Load R)
Here, 470 ohms
If carbon film, .25 watt,
If metal film, .50 watt

A shows the consequences of ohmic load and L/R ratios
B shows the application of the suppression diode
C shows the application of a current limiting resistor in series with the diode to protect the diode from contact bounce

DAP 208/258 Relay Output Module Specifications

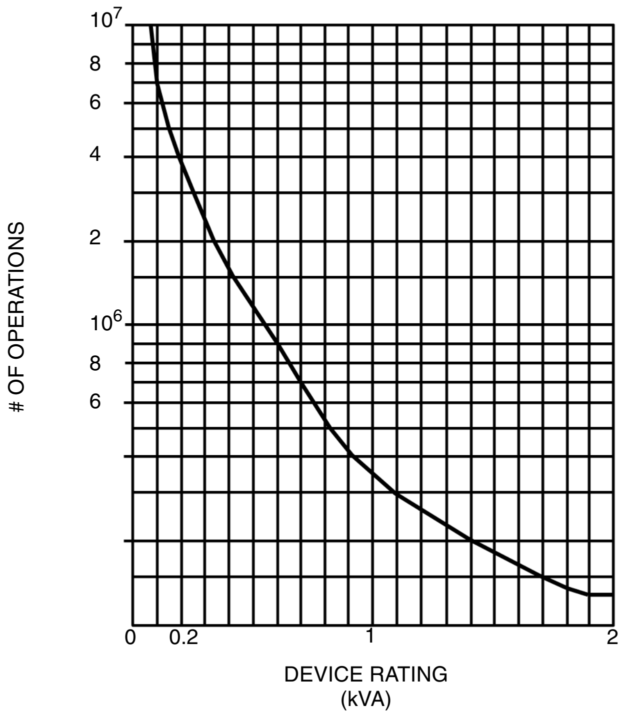
DAP 208/258 Tables and Diagrams

The following table contains a list of DAP 208/258 relay output module specifications.

Module Topology	Number of Relay Outputs	8	
	Number of Groups	8	
	Points/Group	1	
	Isolation	Eight individually isolated relay contacts	
Power Supplies	External Source Requirement	24 Vdc, 150 mA maximum	
	Internally Provided Source	5 V, less than 60 mA from I/O bus	
	Internal Power Dissipation	2 W (typical)	
Electrical Characteristics	Output Voltage Ranges	24 ... 154 Vdc; 24 ... 250 Vac	
	Operating Mode	Normally Open	
	Response Time	10 ms (typical)	
	Wire Size/Terminal	One wire: 14 AWG	
		Two wires: 20 AWG	
Environmental Characteristic	Operating Temperature	0 ... 60 degrees C for DAP 208 -40 ... +70 degrees C for DAP 258	
Output Characteristics	Load Currents at 230 Vac	2 A continuous (maximum, resistive load)	
		4 A instantaneous (maximum, resistive load)	
		1 A continuous (maximum, Cos = 0.5)	
	Load Current at dc	Working Voltage @ 24 Vdc	2 A continuous maximum (resistive load)
			4 A instantaneous maximum (resistive load)
			1 A continuous (maximum, Cos = 0.5)
		Working Voltage @ 60 Vdc	1 A continuous maximum (resistive load)
			0.6 A maximum (L/R* = 30 ms)
		Working Voltage @ 140 Vdc	0.3 A continuous (resistive load)
			0.15 A (L/R* = 20 ms)
	Wetting Current	5 mA for closed contacts	

	Leakage	1 mA	
	Internal Protective Circuitry	68 ohms +15 nF in parallel with each contact	
	Overload Protection	Should be provided externally	
		* L = Load Inductance in Henries; R = Load Resistance in ohms	
I/O Map	Discrete 1x/0x	0 in/8 out	
Service Life of Contacts	Mechanical switching cycles	20,000,000	
	Electric switching cycles	10,000,000 @ 230 Vac/0.2 A	
		(Resistive Loads)	7,000,000 @ 230 VAC / 0.5 A
			8,000,000 (typical) @ 30 VDC / 2 A, with clamping diode
			1,000,000 (typical) @ 60 VDC / 1 A, with clamping diode, 3000 cycles/hr max
	Electric switching cycles	5,000,000 @ 230 Vac/0.5 A	
		(Inductive Loads, Cos = 0.5)	

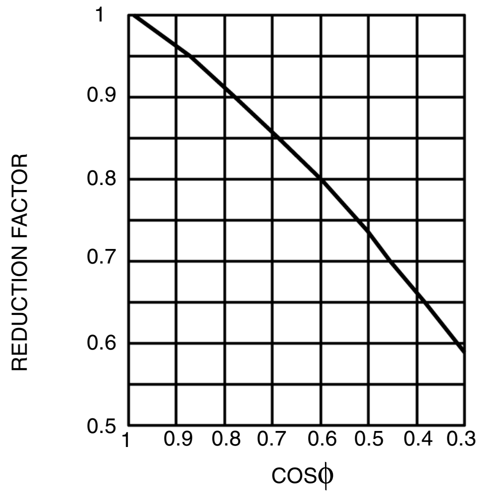
The following graph shows Service LIfe for Resistive Loads.



SERVICE LIFE FOR RESISTIVE LOADS

The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

The chart below shows Reduction Factor for Inductive Loads.



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	240 g (0.52 lb)
Agency Approvals	DAP 208: VDE 0160; UL 50; CSA 22.2 No.142; and FM Class I, Div 2 Standards	
	DAP 258C: Railway standard EN 50 155: EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*). UL 50; CSA 22.2 No.142; and FM Class I, Div 2 pending	

Overview of the DAP 209 Output Module

16

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 209 output module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 209 Output Module?

Brief Product Description

The DAP 209 is a discrete output module with eight independent 120 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module is structured in one group of eight outputs, each output electrically isolated from the I/O bus by an opto coupler.

DAP 209 Output Module LEDs

LEDs

The DAP 209 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of AC line voltage when ON. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate an AC ON condition for load at the field wiring side of the system for outputs 1 ... 8, respectively. Depending on local conditions, users may notice LEDs on unused outputs exhibiting a dim glow. To eliminate this condition, connect a 39K ohms, 1/2 W resistor from the unused output terminal to ac neutral.

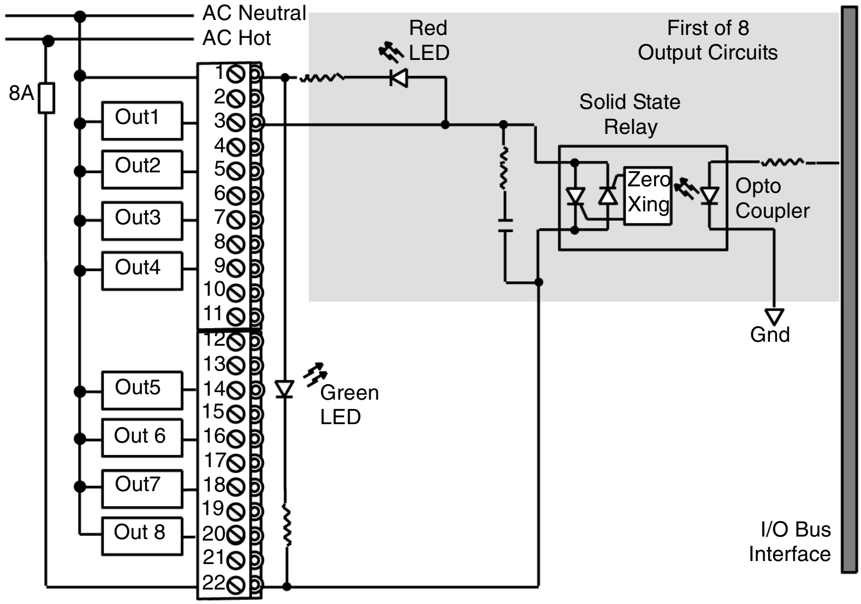
DAP 209 Output Module Field Wiring

Introduction

The DAP 209 is a discrete output module with eight independent 120 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module is structured in one group of eight outputs, each output electrically isolated from the I/O bus by an opto coupler.

Wiring Diagram for DAP 209

A wiring diagram and simplified schematic for the DAP 209 output module is provided below.



DAP 209 Output Module Specifications

DAP 209 Tables of Specifications

The following tables contain DAP 209 output module specifications.

Module Topology	Number of Outputs	8
	Number of Groups	1
	Points/Group	8
	Isolation	Optocoupler on each output point
Power Supplies	External Source Requirement	120 Vac
	Internally Provided Source	5 V from I/O bus; 55 mA max.
	Internal Power Dissipation	2 W (typical)
Electrical Characteristics	Working Voltage Range	85 ... 138 Vac continuous, 47 ... 63 Hz
	Output Voltage	150 Vac RMS maximum for 10 s 200 Vac RMS maximum for 1 cycle
	Operating Mode	True High
	OFF State Leakage Current	1.9 mA maximum
	ON State Voltage Drop	1.5 Vac RMS maximum
	Load Current	Up to 1 A/channel 5 mA mini mum
	Response Time	8.34 ms maximum @ 60 Hz
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
I/O Map	Discrete 1x/0x	0 in/8 out
Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	450 g (1 lb)
Agency Approvals	VDE 0160; UL 508; and CSA 22.2 No.142 Standards	

DAP 209 Load Current (Amps)@60 Degrees C, Ambient

Number of Outputs in Use	**Max. Allowable Load/Output @ 60 degrees, Ambient**
8	0.6 A
6	0.67A
4	0.71 A
2	0.87 A
1	1.0 A

DAP 209 1 A Load Current vs. Temperature

Number of Outputs @ 1 A	Allowable Ambient Temperature
8	35 degrees C
6	40 degrees C
4	45 degrees C
2	51 degrees C
1	60 degrees C

Overview of the DAP 210 Output Module

17

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 210 output module.

What's in this Chapter?

This chapter contains the following topics:

DAP 210 Output Module LEDs

LEDs

The DAP 210 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of system power to the module. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate that the output points have been enabled on the module's logic side.

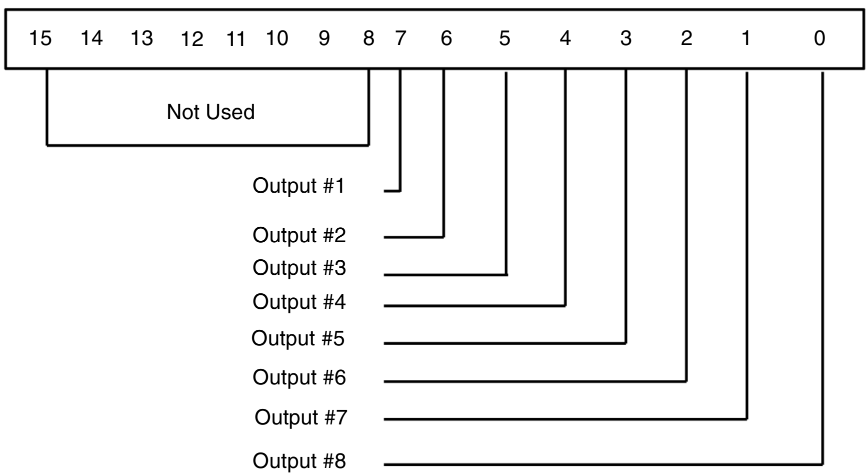
CAUTION

Operational Hazard

Each output group is fused to protect against catastrophic failure. For protection against triac failure, each output must be individually fused with a fast-acting fuse rated at 1.5 times user continuous current (fuse must not exceed 2 A).

Failure to follow this precaution can result in injury or equipment damage.

The following diagram illustrates bit assignment for the DAP 210 output module.



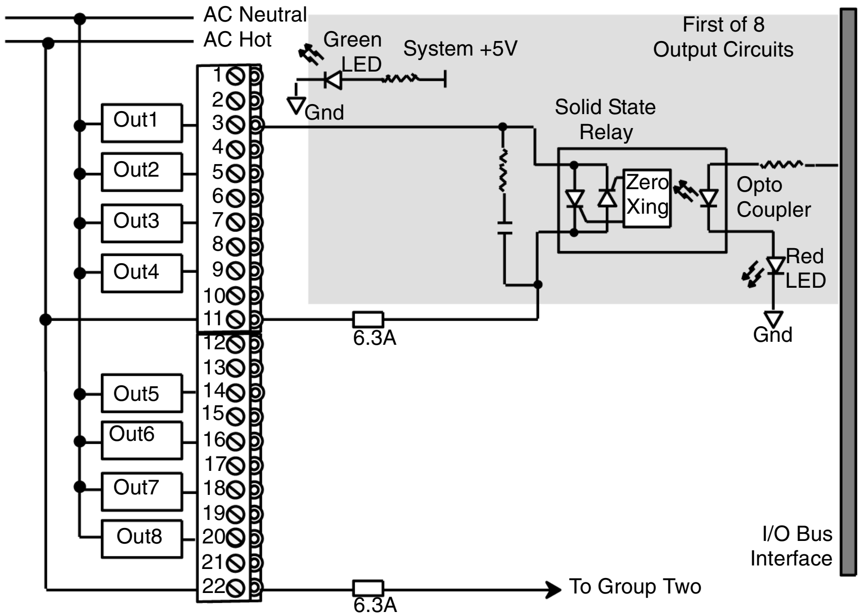
DAP 210 Output Module Field Wiring

Introduction

The DAP 210 is a discrete output module with two independent groups of four 24 ... 230 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module outputs are optically isolated from the system.

DAP 210 Wiring Diagram

A wiring diagram and simplified schematic for the DAP 210 output module is provided below.



DAP 210 Output Module Specifications

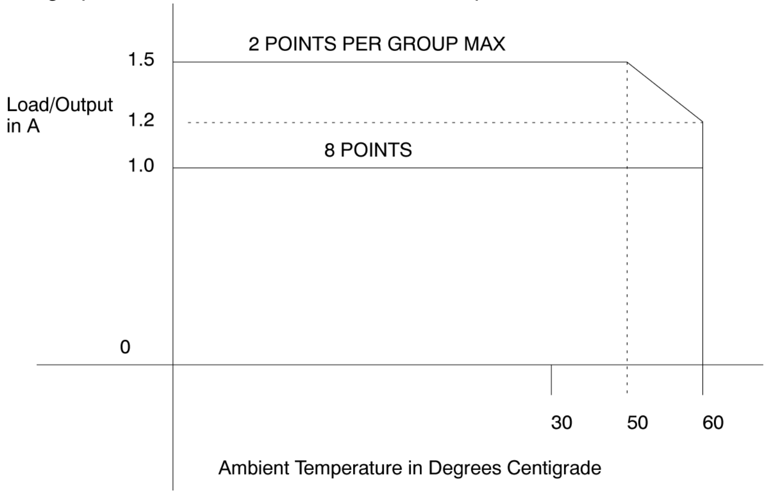
DAP 210 Specifications

The following table and illustrations contain DAP 210 output module specifications.

Module Topology	Number of Outputs	8
	Number of Groups	2
	Points/Group	4
	Isolation	Field to bus; 1500 Vac RMS @ 47 ... 63 Hz, 2500 Vdc, both for a period of 60 s without breakdown
Power Supplies	*External Source Requirement	24 ... 230 Vac, 47 ... 63 Hz
	Internally Provided Source	5 V, less than 70 mA from the I/O bus
	Power Dissipation	7.2 W with all points ON
	Fusing (per group)	One 250 Vac, 6.3 A time-lag fuse (Wickmann TR5-T Fuse; Modicon Part # 57-0110-000)
Electrical Characteristics	*Working Voltage Range	24 ... 230 Vac continuous, 47 ... 63 Hz
	Maximum Output Voltage	300 Vac RMS maximum for 10 s 400 Vac RMS maximum for 1 cycle
	Operating Mode	True High
	OFF State Leakage Current	3.75 mA maximum
	ON State Voltage Drop	1.5 Vac RMS maximum
	Maximum Load Current	Up to 1.0 A/channel (see graph)
	Maximum Surge Current	15 A/1 cycle, 1 surge/min maximum
	Minimum Load Current	50 mA RMS
	Response Time	8.34 ms maximum OFF to On and ON to OFF @ 60 Hz
	Maximum Rate of Applied DV/DT	400 V/msec
	Maximum Rate of Commutating DV/DT	5 V/micros
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
I/O Map	Discrete 1x/0x	0 in/8 out
Environmental	Operating Temperature	0 ... 60 degrees C
	Storage Temperature	-40 ... +80 degrees C
	Humidity	0 ... 95 percent relative humidity @ 0 ... 60 degrees C

Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
Weight	1 lb (.45kg)	
*Agency Approvals	VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards	
*The module is labelled both as a 24 VAC to 115 VAC or 24 VAC to 230 VAC. When used in a VDE 0160 environment the voltage range is reduced to 24 VAC to 115 VAC. When used in a non VDE 0160 environment the module meets specification IEC 1131; UL 508; and CSA 22.2 No.142 and operates over the full range of 24 VAC to 230 VAC.		

The graph below shows DAP 210 Power Output.



What is the DAP 210 Output Module?

Brief Product Description

The DAP 210 is a discrete output module with two independent groups of four 24 ... 230 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module outputs are optically isolated from the system.

	WARNING
⚠	**Operational Hazard** The DAP 210 module will only operate properly when used with an A984, E984, or Micro 512/612 controller. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

Overview of the DAP 211 Combined I/O Module

18

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 211 combined I/O module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 211 Combined I/O Module?

Brief Product Description

Note: Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The DAP 211 is a 120 Vac, mixed I/O (4 binary isolated input points/4 binary isolated short-circuited protected Triac output points) module. An external operating voltage of 120 Vac for sensor supply (inputs) and an external working voltage of 120 Vac for the outputs must be provided.
The DAP 211 module is unique in its design. It may be used in two different applications:

1. Non-voted (single) application, where the DAP 211 monitors its own outputs using a single module.
2. Voted (dual) application, where the output of the first DAP 211 is monitored through an input of the second DAP 211 using a two-module configuration.

When used for voted (dual) applications, such as clutch and brake, the modules operate in pairs. That is, the interconnection of two modules makes it possible for the output of the first module to be monitored through an input of the second module. This results in logical states.

Note: This module corrects a current problem of false indication of inputs being in the on" state due to leakage currents in monitored output systems as applied in safety circuits like clutch and brake I/O circuits.

DAP 211 Combined I/O Module Logical Input Routine

Logical States for Voted (Dual) Operations

The five possible outputs for module 1 appear at the top of the table. The five possible outputs for module 2 appear on the left side of the table. The input states for module 2 and module 1 appear in the center as noted.

		Module 1				
Output States		Triac On	Triac as Diode	AUX Broken	Load Broken	Triac Off
Module 2	Triac On	Module2=H Module1=H	Module2=H Module1=H	Module2=L Module1=H	Module2=H Module1=H	Module2=H Module1=H
	Triac as Diode	Module2=H Module1=H	Module2=H Module1=H	Module2=H Module1=H	Module2=H Module1=H	Module2=H Module1=H
	AUX Broken	Module2=H Module1=L	Module2=H Module1=H	Module2=H Module1=H	Module2=L Module1=L	Module2=H Module1=H
	Load Broken	Module2=H Module1=H	Module2=H Module1=H	Module2=L Module1=L	Module2=H Module1=H	Module2=H Module1=H
	Triac Off	Module2=H Module1=H	Module2=H Module1=H	Module2=H Module1=H	Module2=H Module1=H	Module2=L Module1=L
KEY: H=High, L=Low, Triac On= Traic is on or defected (shorted), Triac as Diode= Triac is defected, works as a diode (any direction), AUX Broken= AUX connection between the 2 modules is broken, Load Broken= Load connection between the 2 modules is broken.						

For voted (dual) applications, ensure the two modules are wired as shown in DAP 211 Combined I/O Module Field Wiring. The logical states table is an absolute MUST in programming/configuration, since only those modules with a defined operating state have a "LOW-LOW" combination.

DAP 211 Combined I/O Module Error Checking Procedure for Output States

Error Checking Procedure

Perform the following steps to ensure you have no output errors:

Step	Action
1	Set all outputs to OFF. Input 1 and Input 2 must be low, if not you have an error.
2	Test Output 1: Output 1 is set to ON, Output 2 remains at OFF. Result Input 1 is HIGH (input 2 is not tested in this step), if not, you have an error.
3	Test Output 2: Output 2 is set to ON, Output 1 remains at OFF. Result Input 2 is HIGH (input 1 is not tested in this step), if not, you have an error.
4	Set all outputs to OFF: Input 1 and Input 2 must be low, if not, you have an error.
5	If no error, start the press.

DAP 211 Combined I/O Module Setup Options

Setup Options

The way you setup your DAP 211 depends upon the application. Refer to the wiring diagram for Non-Voted (Single) applications. This application requires one PLC and one DAP 211 module. Refer to the wiring diagram for Voted (Dual) applications. This application requires two PLCs and two DAP 211 modules.

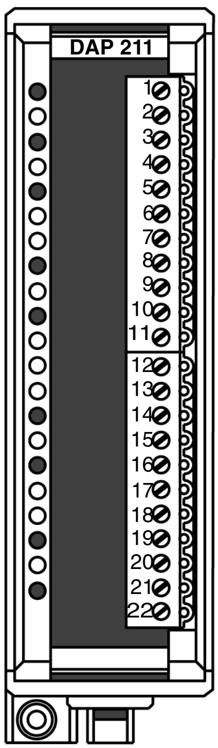
DAP 211 Combination I/O Module LEDs

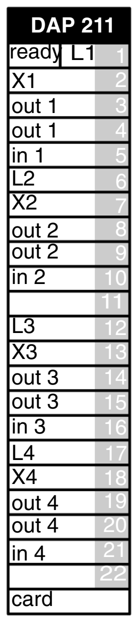
LEDs

The DAP 211 module has LEDs opposite terminal screws 1 ... 22.

Location of LED	Label	Color	Description
1	Ready	Green	Working voltage of 4 out puts: On: Working voltage exist Off: No working voltage
3, 8, 14, 19	Out1 ... Out4	Red	Output signals: On: Output=1 Off: Output=0
5, 10, 16, 21	In1 ... In4	Red	Input signals: On: Input=1 Off: Input=0

A front view with DAP 211 label is provided below.





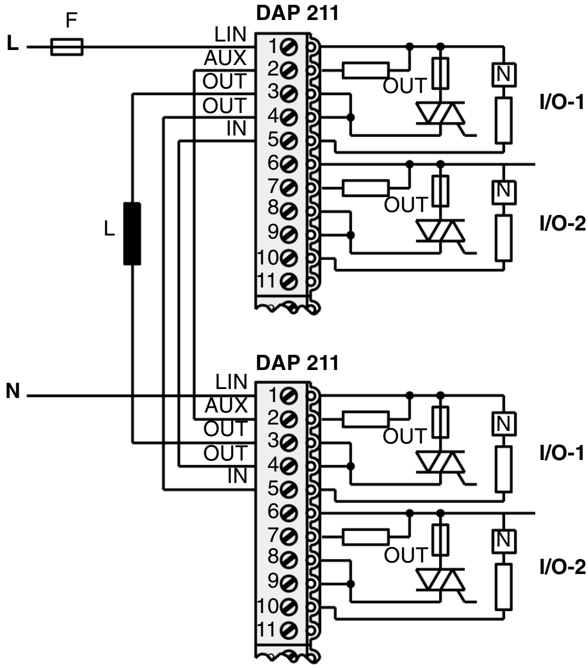
DAP 211 Combined I/O Module Field Wiring

Setup Options

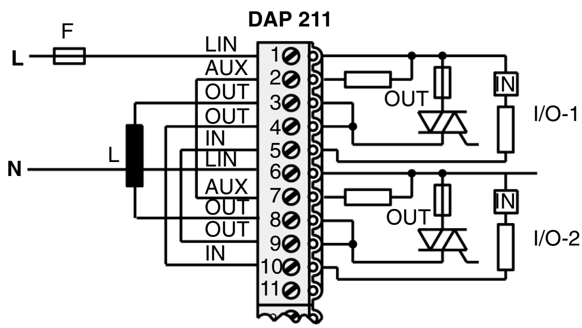
The way you setup your DAP 211 depends upon the application. Non-voted (single) applications require one PLC and one DAP 211 module. Voted (dual) applications require two PLCs and two DAP 211 modules.

Wiring Diagrams for DAP 211

A DAP 211 wiring diagram for voted (dual) applications is provided below.



A DAP 211 wiring diagram for non-voted (single) applications is provided below.



DAP 211 Combined I/O Module Specifications

Table of Specifications for DAP 211

The following table contains DAP 211 combined I/O module specifications.

Module Topology	Number of Inputs	4 (separated from logic through optical coupler)
	Number of Triac Outputs	4
	Number of Groups	4
	Points/Group	1 in/1 out
Required Loadable (for Modsoft ONLY)	SW-IODR-001	
	Isolation	One group is isolated from the other group. Within a group there is no isolation between inputs and outputs.
Power Supplies	External Sensor Requirement	120 Vac
	External Working Requirement	120 Vac
	Internally Provided Source	5 V from I/O bus; 35 mA typical
	Power Dissipation	5 W typical
Input Characteristics	Sensor Power Supply	120 Vac -15 percent, +10 percent @ 47 ... 63 Hz
	Signal Rated Value	120 Vac
	Input Delay	1 period
	Type of Networking	Potential isolation per group (group=1 input/1output)
Output Characteristics	Working Voltage	120 Vac -15 percent, +10 percent @ 47 ... 63 Hz for all 4 outputs
	Allocation	Short-circuit protection by internal fuse
	Type of Networking	Potential isolation per group (group=1 input/1output)
I/O Map	Discrete 1x/0x	4 in/4 out
Environmental Characteristics	Operating Temperature	0 ... 60 degrees C
Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	190 g (.4 lb.)
Agency Approvals	VDE 0160; UL 508; CSA 22.2 No. 142, European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards	

Overview of the DAP 212/252 Combined I/O Module

19

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 212/252 combined I/O module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 212/252 Combined I/O Module?

Brief Product Description

The DAP 212/252 is a 24 Vdc, mixed I/O (8 points in/4 relays out) module. It senses eight discrete input signals received by field sensing devices-such as pushbuttons, limit switches, or other 24 Vdc sources-and converts those signals into logic that can be used by the controller. It utilizes logic signals within the controller to activate four independent and individually isolated normally open relay contacts. The module requires power from an external 24 Vdc source to operate. The DAP 252 functions just like the DAP 212 except that the DAP 252 operates at extended temperature -40 ... +70 degrees C.

Note: DAP 252 model is available with conformal coating. The conformal coating model is DAP 252C and it meets Railway standard EN 50 155.

DAP 212/252 Combined I/O Module LEDs

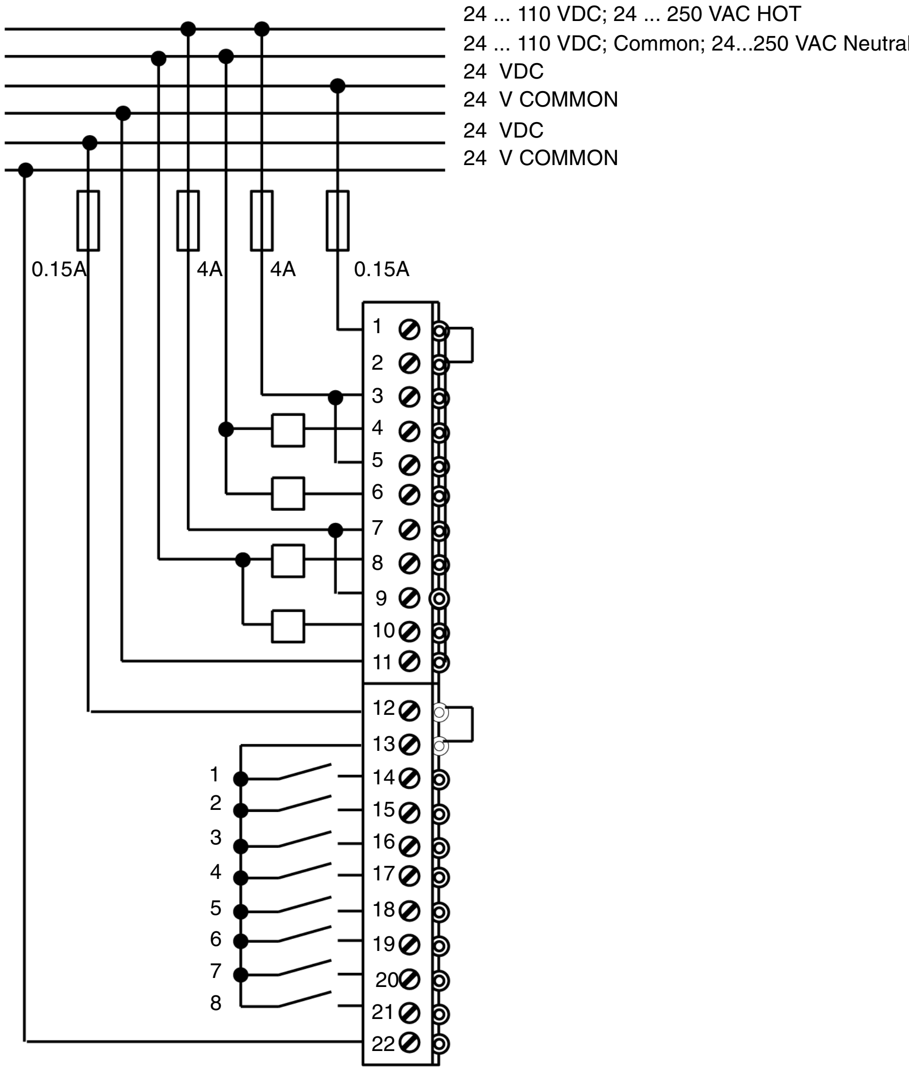
LEDs

The DAP 212/252 module has two green LEDs opposite terminal screws 1 and 12; when one of these LEDs is ON, it indicates power available to the input or output points directly below it. Below terminal screw 1 are four red LEDs opposite terminal screws 3, 5, 7, and 9 indicating relay output points 1 ... 4, respectively. Below terminal screw 12 are eight red LEDs opposite terminal screws 14 ... 21 indicating inputs 1 ... 8, respectively.

DAP 212/252 Combined I/O Module Field Connections

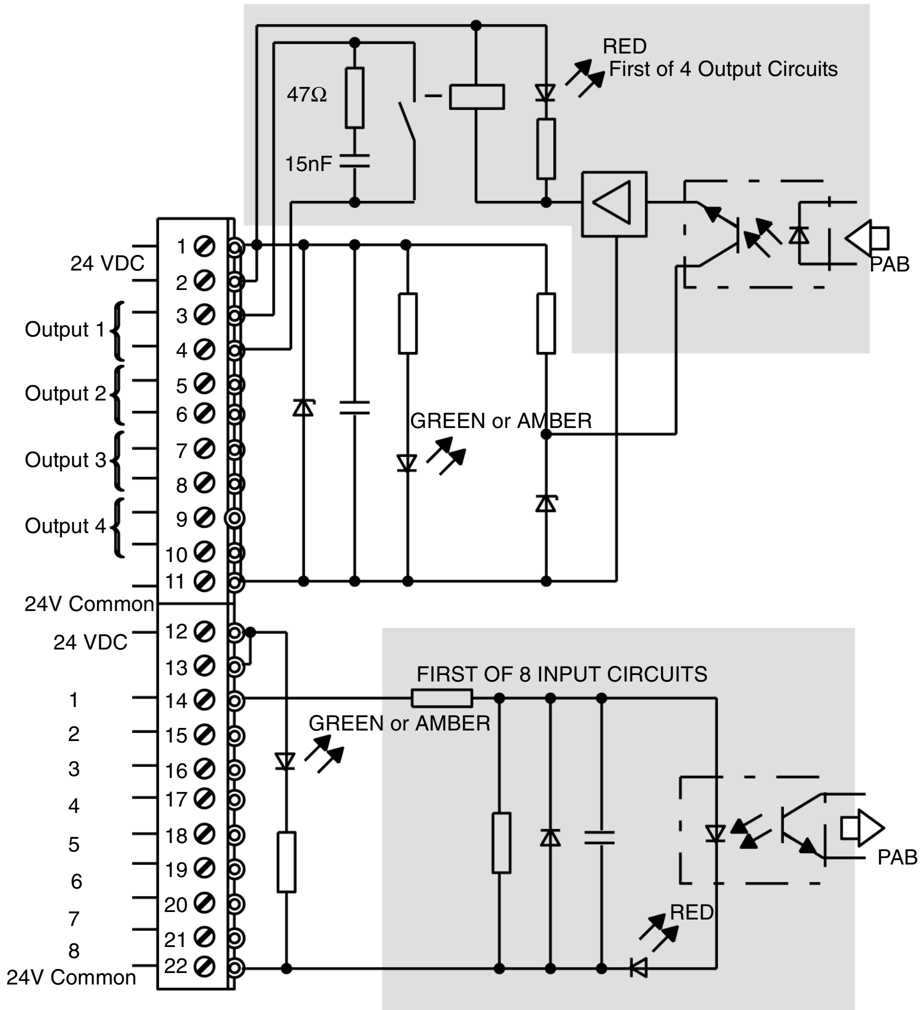
DAP 212/252 Wiring Diagram

A wiring diagram for the DAP 212/252 combined I/O module is provided below.



Simplified Schematic

A simplified schematic for the DAP 212/252 combined I/O module is provided below.



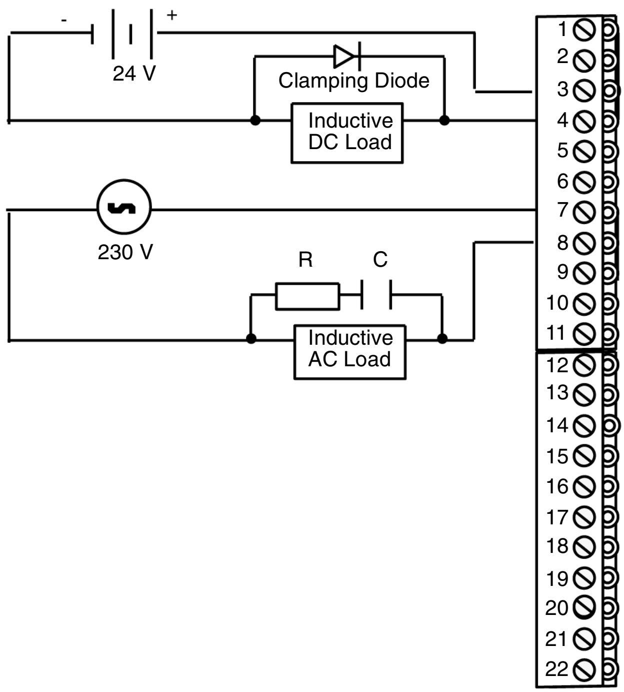
Protecting the DAP 212/252 Combined I/O Module from Inductive Back EMF

Instructions

To increase the service life of the relay output contacts and protect the DAP 212/252 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

Illustration of Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a rating two or three times greater than the supply voltage.
Values may be:

Snubber Values	
Load Inductance	**Capacitance**
25 ... 70 mH	.50 microF
70 ... 180 mH	.25 microF
180 mH	.10 microF

Note: To I/O Map the DAP 252 module in Modsoft you must select DAP 212. Both modules share a host driver and have similar characteristics.

DAP 212/252 Combined I/O Module Specifications

Module Specifications

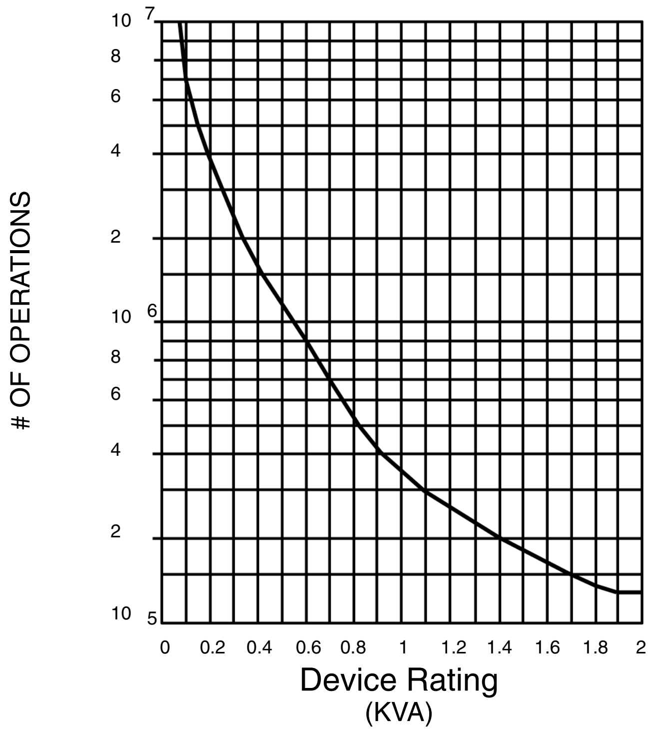
The following tables and diagrams contain DAP 212/252 combined I/O module specifications.

Module Topology	Number of Inputs	8
	Number of Relay Outputs	4
	Number of Groups	2
	Points/Group	8 in/4 out
	Isolation	Relay output contacts are individually isolated; the input group is isolated from the out put group
Power Supplies	External Source Requirement	24 Vdc, 150 mA maximum
	Internally Provided Source	5 V from I/O bus; 25 mA max.
	Internal Power Dissipation	2 W (typical)
Input Characteristics	Working Voltage Range	20 ... 30 Vdc
	Signal Rated Value	+24 V
	ON State Signal Level	+12 V ... +30 V
	OFF State Signal Level	-2 V ... +5 V
	Input Wetting Current	7 mA
	Input Current	4 mA @ 24 V; 6 mA @ 37 V
	Response Time	4 ms (typical) for DAP212 7 ms (typical) for DAP252
	Operating Mode	True High
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
Output Characteristics	Output Voltage Ranges	24 ... 110 Vdc; 24 ... 250 Vac
	Operating Mode	Normally Open
	Response Time	10 ms (typical)
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
	Load Currents at 115/230 Vac	2 A continuous (maximum, resistive load)
		4 A instantaneous (maximum, resistive load)
		1 A continuous (maximum, Cos = 0.5)
	Load Current at 24 Vdc	2 A continuous maximum (resistive load)
		4 A instantaneous maximum (resistive load)
		1 A continuous maximum (L/ R* = 30 ms)

DAP 212/252 Specifications (continued)

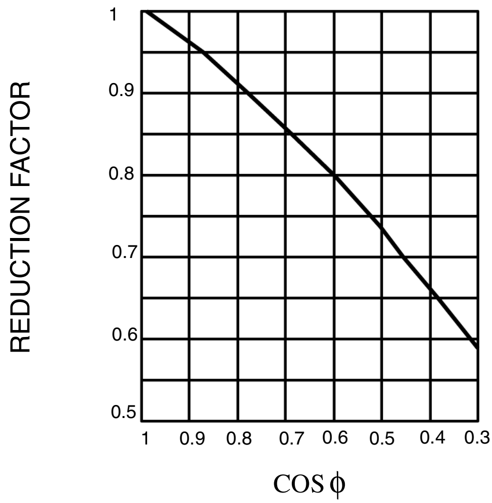
Output Characteristics (continued)	Load Current at 60 Vdc	1 A continuous maximum (resistive load)
		0.6 A maximum (L/R* = 30 ms)
	Load Current at 110 Vdc	0.45 A continuous maximum (resistive load)
		0.25 A maximum (L/R* = 30 ms)
	Wetting Current	5 mA for closed contacts
	Leakage	1 mA
	Internal Protective Circuitry	68 ohms +15 nF in parallel with each contact
	Overload Protection	Should be provided externally
Environmental Characteristics	Operating Temperature	0 ... 60 degrees C for DAP212 -40 ... +70 degrees C for DAP252
I/O Map	Discrete 1x/0x	8 in/4 out
* L = Load Inductance in H R = Load Resistance in ohms		
Service Life of Relay Contacts	Mechanical switching cycles	20,000,000
	Electric switching cycles (Re sistive Loads)	10,000,000 @ 230 VAC / 0.2 A 7,000,000 @ 230 VAC / 0.5 A, 8,000,000 (typical) @ 30 VDC / 2 A, with clamping diode, 1,000,000 (typical) @ 60 VDC / 1 A, with clamping diode, 3000 cycles/hr max
	Electric switching cycles (In ductive Loads, Cos = 0.5)	5,000,000 @ 230 VAC / 0.5 A

This chart shows the Service Life for Resistive Loads.



The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

This chart shows the Reduction Factor for Inductive Loads.



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	190 g (.4 lb)
Agency Approvals	DAP 212: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards	
	DAP 252C: Railway standard EN 50 155: EMC 89/336/EEC. UL 50; CSA 22.2 No.142; and FM Class I, Div 2 pending	

Overview of the DAP 216/216N Discrete Output Module

20

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 216/216N discrete output module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 216/216N Discrete Output Module?

Brief Product Description

The DAP 216/DAP216N is a discrete output module with 16 independent 24 Vdc output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in two group of eight outputs, each output electrically opto-isolated from the I/O bus, and each group is protected against short circuit and overload.

Note: The AS-BDAP-216 has been enhanced. The enhancements have resulted in the AS-BDAP-216 being superseded by the AS-BDAP216N.

DAP 216/216N Discrete Output Module LEDs

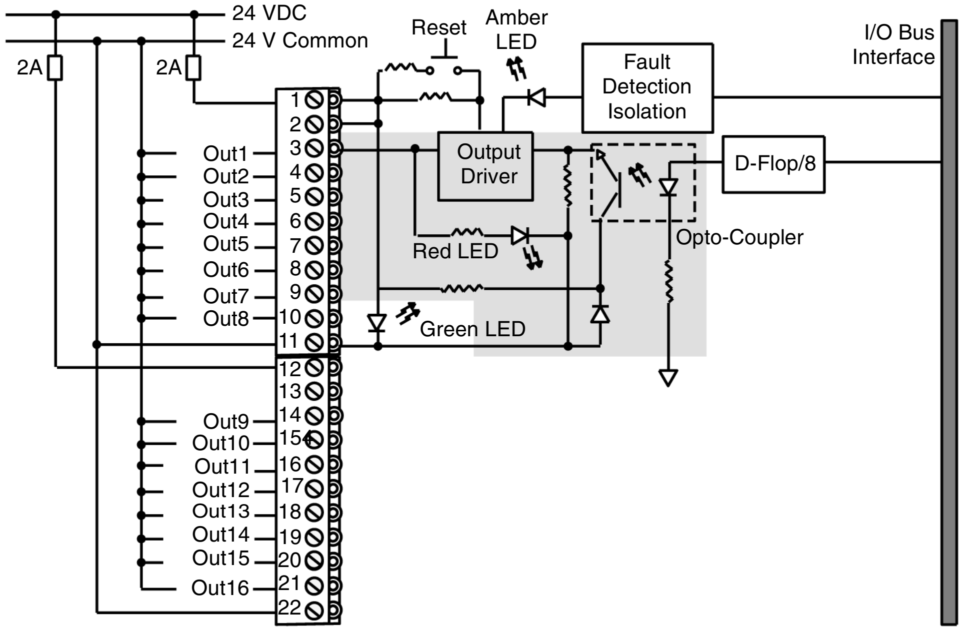
LEDs

The DAP 216/DAP216N has 20 LEDs. Two green LEDs opposite terminal screws 1 and 12 indicate when ON that working voltage is available to the two groups of eight discrete outputs below them. Two amber LEDs opposite terminal screws 2 and 13 go ON to indicate a short circuit or overload problem in the output group below them. There are 16 red LEDs opposite terminal screws 3 ... 10 and 14 ... 21, indicating when ON that the adjacent discrete output is in an ON condition.

DAP 216/216N Field Wiring

Wiring Diagram and Simplified Schematic for DAP 216/216N

A wiring diagram and simplifed schematic for the DAP 216/DAP216N is provided bleow.



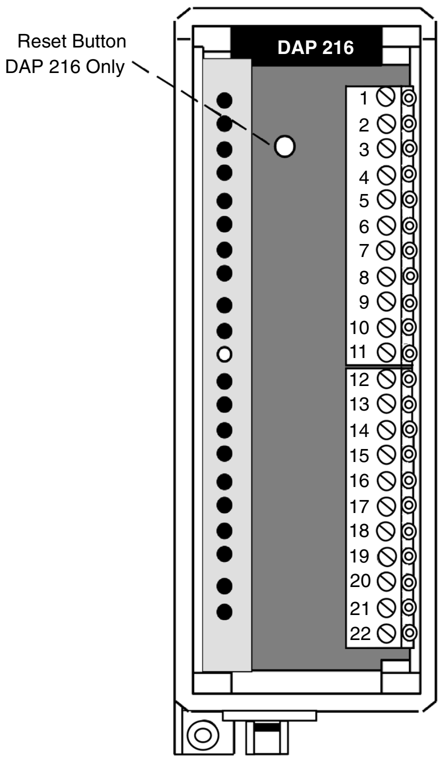
Resetting the DAP 216 Module After an Overload of Short Circuit

Instructions

A short circuit or overload condition will cause an output point to turn itself off. The degree of overcurrent that causes the device to shut off is determined by thermal characteristics unique to the individual point switching device. When overheated due to overload conditions, the device turns off to protect itself.
The two amber LEDs display short circuit or overload conditions on the two discrete output groups. After you have taken corrective measures to remove the cause of the overload or short circuit, push the yellow reset button on the front of the module to reactivate it.

Front View of DAP 216/DAP 216N Module

A front view with DAP 216 label is provided below.



Note: No reset button exists on DAP 216N.

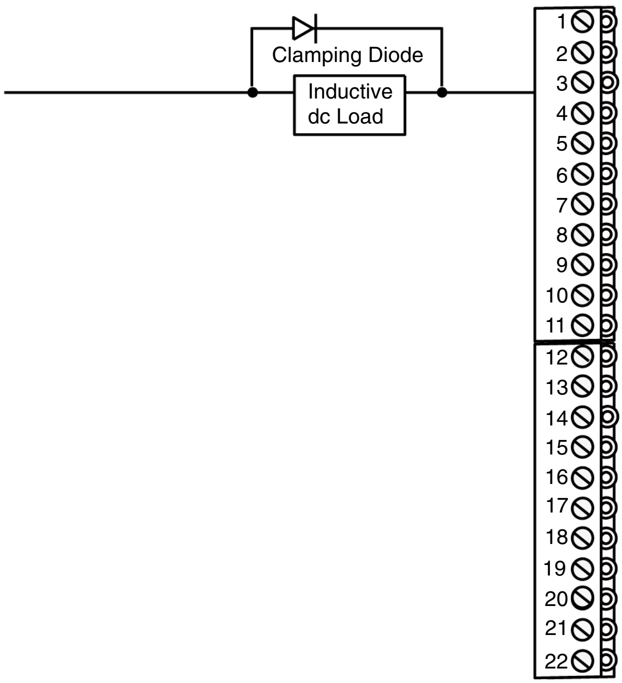
Protecting the DAP 216/216N Discrete Output Module from Inductive Back EMF

Instructions

If you have inductive loads on longer lines with logic elements located in the output loads, install an external clamping diode in parallel with the operating coil to protect the module from reverse EMF.

Clamping Diode on an Inductive Load

The following illustration is an example of clamping diode on inductive loads.



Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be 70 ... 100 V.

DAP 216N Discrete Output Module Differences

Introduction

Note: The AS-BDAP-216 has been enhanced. The enhancements have resulted in the AS-BDAP-216 being superseded by the AS-BDAP216N.

WARNING

Over Current Hazard.

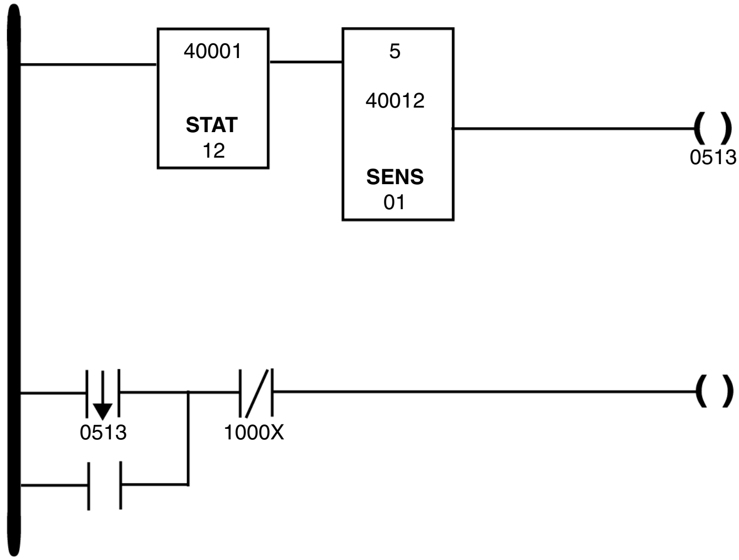
In the event of an enabled output sensing an over current condition, the output will disable, until the over current condition is removed. The output will then re-enable itself, if still set ON in the logic program.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

1. The manual reset button of the BDAP-216 has been replaced by a solid state retry on a shorted output.
2. The module restarts field devices automatically when the output is set ON in the User Logic and the detected field over current condition is removed. Refer to the user logic example in the figure below if detection and manual reset is still desired.
3. You may now apply the full 0.5A per point for 4A per Group and 8A per Module.
4. The input impedance of the electronic circuity that handles the 24Vdc power for the outputs was lowered to accommodate long runs of the power supply cable. As a result, the inrush current draw from the power supply is increased from about 6A for 2 microseconds to 54A for 12 microseconds. This increase, however, is well below the inrush current that the module draws from the external power supply when outputs are switched on.

User Logic Example

A user logic example to detect module overload condition is provided below.



Each Compact I/O Module returns a Health Bit to the controller when in use. This bit is a single bit in a register that shows the slot position of the module and its status. When the module is functioning correctly this bit is set to "1". User logic can be attached to the state of this bit to hold the logic associated with this module in an OFF condition until an operator pushes a switch to reactivate the user logic.
In the illustration above, a STAT function is used to read 12 registers of which register 12 is the status word for the modules in the primary rack 1. The BDAP216N has been placed in slot number 5, so a SENS function block is used to sense bit 5 of this register. The output is tied to coil 0513 which turns OFF when the module becomes unhealthy. To trap this condition even if coil 0513 turns ON again, it is latched into coil 0514. This coil can then be used by the programmer as an enable/ disable to ladder logic associated with the BDAP216N in this particular slot and particular process. The user logic is restarted by the operator pressing a button attached to input 1000X.

Note: The BDAP216N will automatically restart and reset the Health Bit when the overload condition is removed. This network only holds the reset condition of any user logic programmed OFF under the control of coil 0514 in the above example.

DAP 216/216N Discrete Output Module Specifications

DAP 216/216N Specifications

The following table contains a list of the DAP 216/216N discrete output module specifications.

Module Topology	Number of Outputs	16
	Number of Groups	2
	Points/Group	8
	Isolation	Each point opto-isolated from the I/O bus Each output group isolated from the other
Power Supplies	External Source Requirement	24 Vdc
	Internally Provided Source	5 V,less than 50 mA from the I/O bus
	Internal Power Dissipation	1 W (typical)
Electrical Characteristics	Operating Mode	True High
	ON State Signal Level	External supply -3V
	OFF State Signal Level	0 ... +2 V, less than 1mA
	Load Current/Output	0.5 A max.
	Max Load Current/Group	2 A (DAP 216), 4 A (DAP 216N)
	Response Time	less than 1 ms
	Reverse-EMF Protection	Clamping diode recommended across inductive loads.
	Switch Capacity for Bulbs OFF-ON Operations at Maxi mum Power	5 W (surge current = normal current x 10) 1000/h (inductive load @ maximum load current) 100/s (resistive load) 8/s (max imum lamp load)
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
I/O Map	Discrete 1x/0x	0 in/16 out
Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	220 g (.5 lb)
Agency Approval	VDE 0160; UL 508; and cUL Standards	

Overview of the DAP 217 Discrete Output Module

21

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 217 discrete output module.

Note: Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 217 Discrete Output Module?

Brief Product Description

The DAP 217 is a discrete output module with 16 independent 5 ... 24 Vdc sink output circuits. It can operate relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in two group of eight outputs, each output electrically opto-isolated from the I/O bus.

DAP 217 Discrete Output Module LEDs

LEDs

The DAP 217 has 18 LEDs. Two green LEDs opposite terminal screws 1 and 12 indicate when ON that working voltage is available to the two groups of eight discrete outputs below them. There are 16 red LEDs opposite terminal screws 3 ... 10 and 14 ... 21, indicating when ON that the adjacent discrete output is in an ON condition.

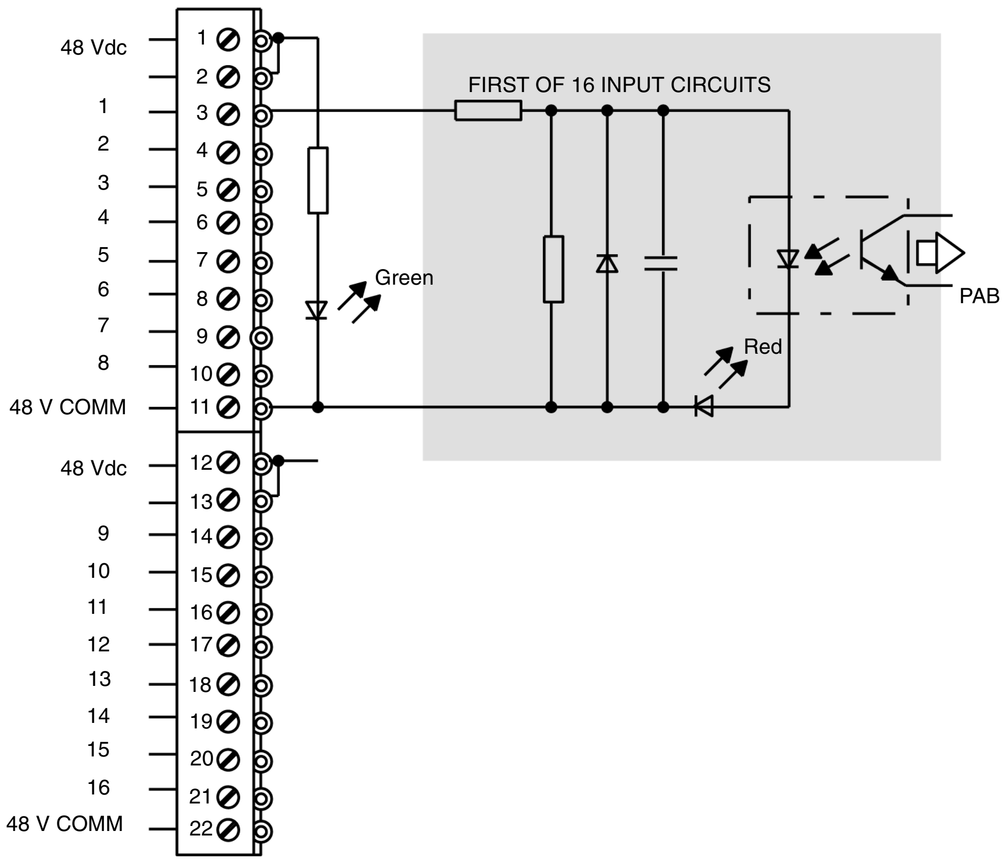
DAP 217 Discrete Output Module Field Wiring

Introduction

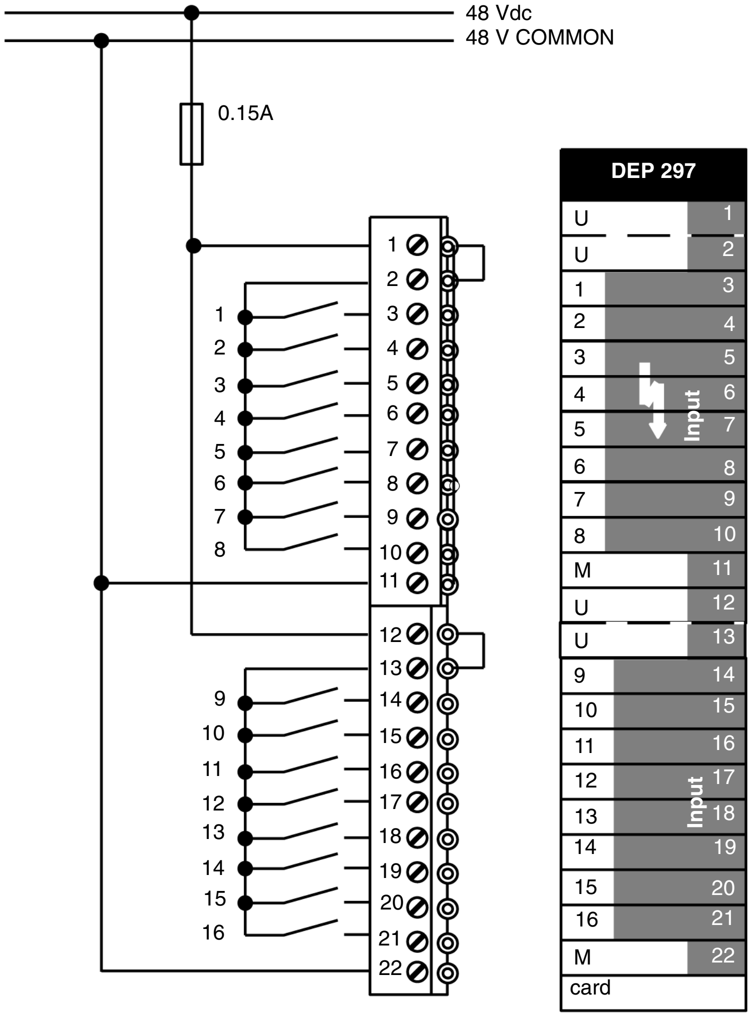
The DAP 217 is a discrete output module with 16 independent 5 ... 24 Vdc sink output circuits. It can operate relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in two group of eight outputs, each output electrically opto-isolated from the I/O bus.

Simplified Schematic

A simplified schematic for the DAP 217 is provided below.



Wiring Diagram A wiring diagram for the DAP 217 is provided below.



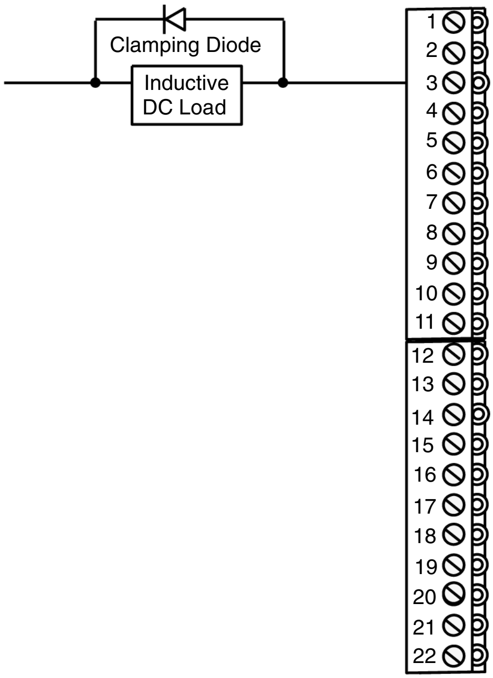
Protecting the DAP 217 Discrete Output Module from Inductive Back EMF

Instructions

If you have inductive loads on longer lines with logic elements located in the output loads, install an external clamping diode in parallel with the operating coil to protect the module from reverse EMF.

Clamping Diode on an Inductive Load

The following illustration is an example of a clamping diode on an inductive load.



Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be 70 ... 100 V.

DAP 217 Discrete Output Module Specifications

DAP 217 Specifications

The following table contains a list of DAP 217 discrete output module specifications.

Module Topology	Number of Outputs	16
	Number of Groups	2
	Points/Group	8
	Isolation	Each point opto-isolated from the I/O bus Each output group isolated from the other
Required Loadable	SW-IODR-001 (See *Requirements for CE Compliance, p. 779*)	
Power Supplies	External Source Requirement	5 ... 24 VDC
	Internally Provided Source	5 V, 60 mA max. from the I/O bus
	Internal Power Dissipation	3.5 W (typical)
Electrical Characteristics	Operating Mode	True Low
	Output OFF	5 Vdc (External Source)
	Output ON	less than or equal to 0.7V @ 4 mA
	Load Current/Output	0.1 A up to 0.3 A when the total current of 0.8 A per group is not exceeded
	Max Load Current/Group	0.8 A max.
	Off State Leakage Current	less than or equal to 100 mi croA/point
	Response Time	less than 1 ms
	Reverse-EMF Protection	Clamping diode recom mended across inductive loads.
	Switch Capacity for Bulbs OFF-ON Operations at Maximum Power	Surge current = normal cur rent x 10 2/s (inductive load @ maximum load current) 100/s (resistive load) 8/s (maximum lamp load)
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
I/O Map	Discrete 1x/0x	0 in/16 out
Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	220 g (.5 lb)
Agency Approval	VDE 0160; UL 508; and CSA 22.2 No.142 Standards	

Overview of the DAP 218 Output Module

22

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 218 output module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 218 Output Module?

Brief Product Description

The DAP 218 is a discrete output module with two independent groups of eight 24 ... 240 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 0.5 A/output. The module outputs are optically isolated from the system.

	WARNING
⚠	**Operational Hazard** The DAP 218 module will only operate properly when used with an A984, E984, or Micro 512/612 controller. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

DAP 218 Output Module LEDs

LEDs

The DAP 218 has 17 LEDs. One green LED opposite terminal screw 1 indicates the presence of bus power to the module. Sixteen red LEDs opposite terminal screws 3 ... 10 and 14 ... 21 indicate that the output points have been enabled on the module's logic side.

CAUTION

Fuse Protection Hazard

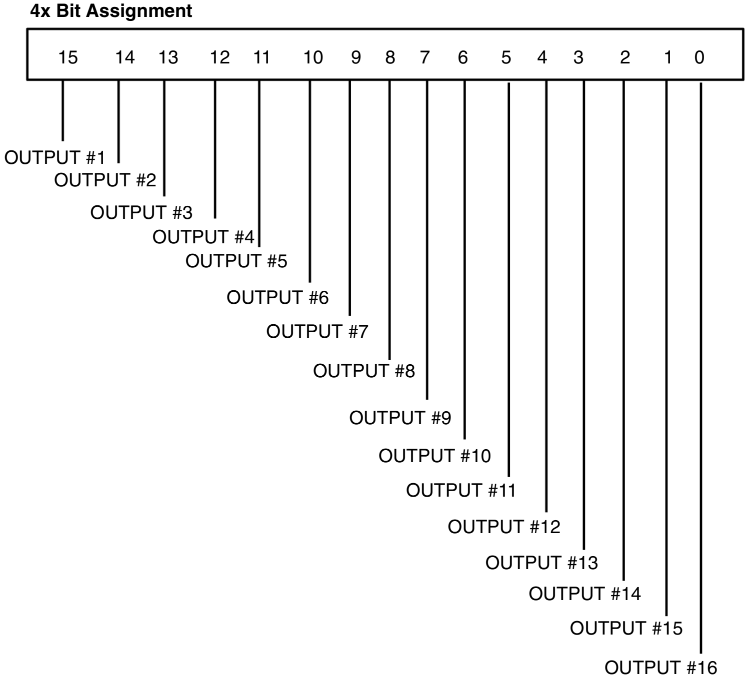
Each output group is fused to protect against catastrophic failure. For protection against triac failure, each output must be individually fused with a 1 A fast-acting fuse.

Failure to follow this precaution can result in injury or equipment damage.

4x Bit Assignment

A bit assignment diagram for the DAP 218 output module is provided below.

4x Bit Assignment



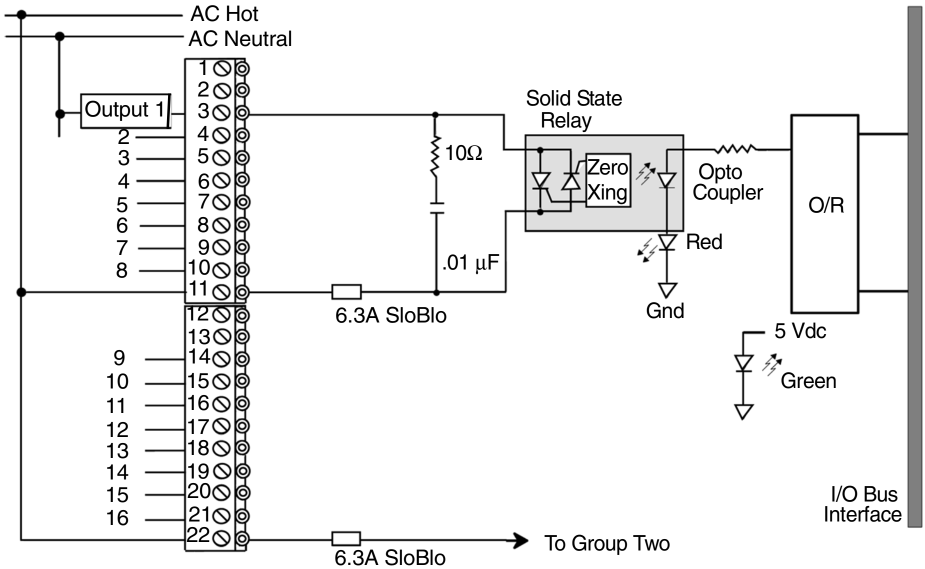
DAP 218 Output Module Field Wiring

Introduction

The DAP 218 is a discrete output module with two independent groups of eight 24 ... 240 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 0.5 A/output. The module outputs are optically isolated from the system.

Wiring Diagram and Simplified Schematic

A wiring diagram and simplified schematic for the DAP 218 is provided below.



DAP 218 Output Module Specifications

DAP 218 Table of Specifications

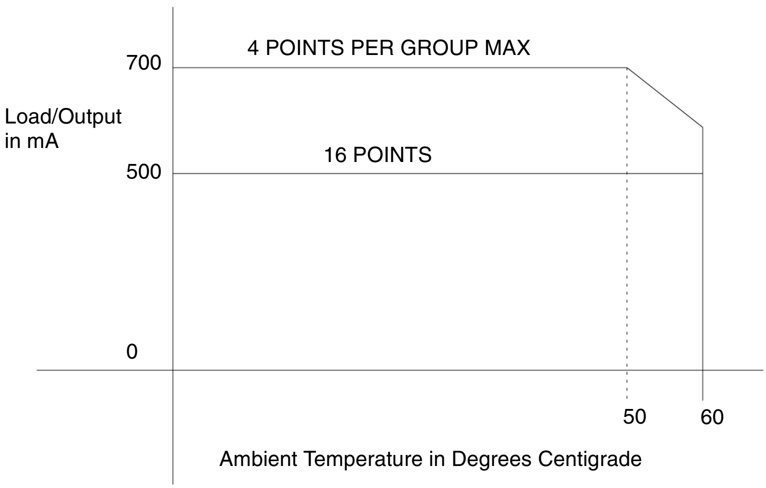
The following table contains a list of DAP 218 output module specifications.

Module Topology	Number of Outputs	16	
	Number of Groups	2	
	Points/Group	8	
	Isolation	Field to bus; 1780 Vac RMS @ 47-63 Hz, or 2500 VDC, both for a period of 60 s without breakdown	
Power Supplies	*External Source Requirement	24 ... 230 Vac, 47 ... 63 Hz	
	Internally Provided Source	5 Vdc from I/O bus; 175 mA maximum	
	Power Dissipation	13 W with all points ON	
	Fusing (per group)	One 250 Vac, 6.3 A time-lag fuse (Wickmann TR5-T Fuse; Modicon Part # 57-0110-000)	
Electrical Characteristics	*Working Voltage Range	24 ... 240 Vac continuous, 47 ... 63 Hz	
	Maximum Output Voltage	300 Vac RMS maximum for 10 s 400 Vac RMS maximum for 1 cycle	
	Operating Mode	True High	
	OFF State Leakage Current	3.75 mA maximum	
	ON State Voltage Drop	1.5 Vac RMS maximum	
	Maximum Load Current	Up to 0.5 A/channel	
	Maximum Surge Current	15 A/output, 1 cycle max., 1 surge/min	
	Minimum Load Current	30 mA RMS	
	Response Time	8.34 ms maximum OFF -> ON and ON -> OFF @ 60 Hz	
	Switch Point	+/- 10 Vac of zero line crossing	
	Maximum Rate of	Applied DV/DT	400 V/micros
		Commutating DV/DT	5 V/micros
	Wire Size/Terminal	One wire: 14 AWG	
		Two wires: 20 AWG	
I/O Map	Discrete 1x/0x	0 in/16 out	
Environmental	Operating Temperature	0 ... 60 degrees C	
	Storage Temperature	-40 ... +80 degrees C	
	Humidity	0 ... 93 perc ent relative humidity, noncondensing, @ 0 to 60 degrees C	

Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	900 g (2 lb)
*Agency Approvals	VDE 0160; UL 508; and CSA 22.2 No.142 Standards; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards	
*The module is labelled both as a 24 VAC to 115 VAC or 24 VAC to 230 VAC. When used in a VDE 0160 environment the voltage range is reduced to 24 VAC to 115 VAC. When used in a non VDE 0160 environment the module meets specification IEC 1131; UL 508: and CSA 22.2 No.142 and operates over the full range of 24 VAC to 230 VAC.		

Illustration

A DAP 218 power output graph is provided below.



Overview of the DAP 220/250 Combined I/O Module

23

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 220/250 combined I/O module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 220/250 Combined I/O Module

Brief Product Description

The DAP 220/250 is a 24 Vdc, discrete mixed eight-point input/eight-point output module. The DAP 250 functions just like the DAP 220 except that the DAP 250 operates at extended temperature.

Note: DAP 250 model is available with conformal coating. The conformal coating model is DAP 250C and it meets Railway standard EN 50 155.

CAUTION

Equipment Hazard

Modicon recommends using two separate power sources with the DAP 220/250-one for outputs and one for inputs-in order to avoid electrical switching noise.

Failure to follow this precaution can result in injury or equipment damage.

Note: Inputs do not work if output supply is disconnected.

DAP 220/250 Combined I/O Module LEDs

LEDs

The DAP 220/250 module has 19 LED displays. It has two green LEDs, one opposite terminal screw 1, which indicates when ON that working voltage is available to the group of eight discrete outputs directly below it, and one opposite terminal screw 12, which indicates when ON that working voltage is available to the group of eight discrete inputs below it. There is also an amber LED opposite terminal screw 2 that goes ON to indicate a short circuit or overload problem in the output group below it.
There are 16 red LEDs. Eight LEDs are opposite terminal screws 3 ... 10; when ON, they indicate that the discrete outputs adjacent them are in an ON condition, and eight opposite terminal screws 14 ... 21 which indicate when ON that the discrete inputs adjacent to them are in an ON condition.

WARNING

Operational Hazard

If the short/overload protection device in the DAP 220/250 senses an error condition, the module becomes "unhealthy." When Executive Software Prom Combination 1001, Revision B, is installed in the 984 C951 PCB, all other outputs will retain their last healthy status, except the shorted/overloaded channel, until the failure is cleared. If Prom Combination 1002 or higher is installed, the healthy outputs may be manipulated at will.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

DAP 220/250 Combined I/O Module Field Wiring

Introduction

The DAP 220/250 is a 24 Vdc, discrete mixed eight-point input/eight-point output module. The DAP 250 functions just like the DAP 220 except that the DAP 250 operates at extended temperature.

Note: DAP 250 model is available with conformal coating. The conformal coating model is DAP 250C and it meets Railway standard EN 50 155.

CAUTION

Operational Hazard

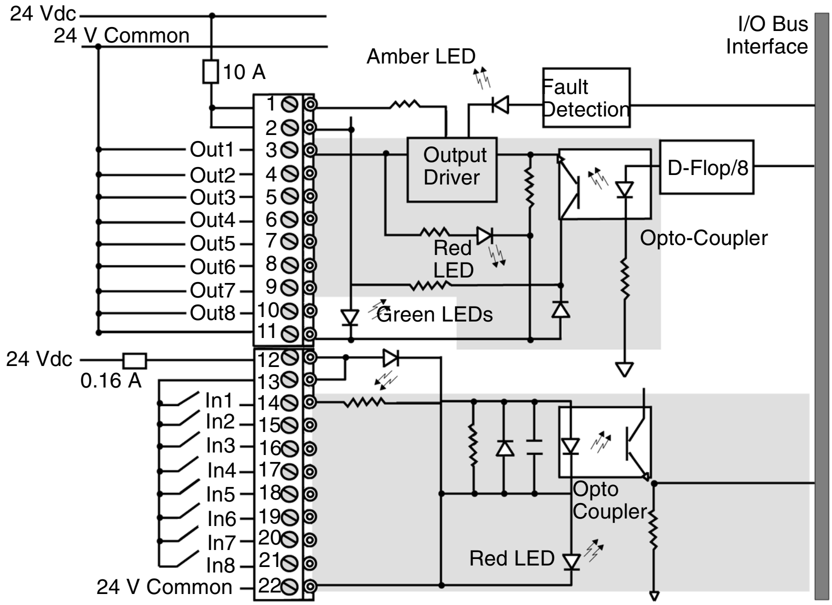
Modicon recommends using two separate power sources with the DAP 220/250-one for outputs and one for inputs-in order to avoid electrical switching noise.

Failure to follow this precaution can result in injury or equipment damage.

Note: Inputs do not work if output supply is disconnected.

Wiring Diagram and Simplified Schematic for DAP 220/250

A wiring diagram and simplified schematic for the DAP 220/250 is provided below.



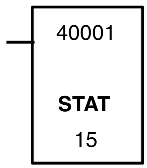
DAP 220/250 Combined I/O Module Recovery After Error

Instructions

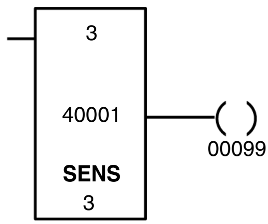
The protective device will eventually recover from the fail state if the cause of failure is removed, and the module will become healthy. If the error condition still exists, it will cause the module to shut down again. To avoid damage to the module, the logic shown in the following diagrams may be used to clear the failed output.

Ladder Logic Examples

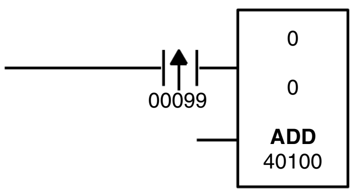
The following diagram is a DAP 220/250 Ladder Logic Example for Prom Combination 1001.



The STAT block will put the module health information for the 4 racks in registers 40012 ... 40015.

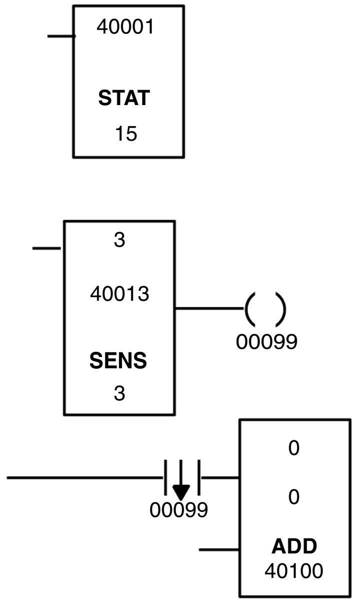


Coil 99 is turned ON when the module in Rack 2, Slot 3 becomes healthy.



If register 40100 is traffic copped to the DAP 220 in Rack 2, Slot 3, when it becomes healthy again the 0 in register 40100 will be written to the module.

The following illustration is a DAP 220/250 Ladder Logic Example for Prom Combination 1002.



The STAT block will put the module health information for the 4 racks in registers 40012 ... 40015.

Coil 99 is turned OFF when the module in Rack 2, Slot 3 becomes unhealthy.

If register 40100 is traffic copped to the DAP 220 in Rack 2, Slot 3, when it becomes unhealthy, the 0 in register 40100 will be written to the module.

DAP 220/250 Combined I/O Module Specifications

Table of Specifications for DAP 220/250

The following table contains a list of DAP 220/250 combined I/O module specifications.

Module Topology	Number of Inputs	8
	Number of Outputs	8
	Number of Groups	2
	Points/Group	8
	Isolation	Each point opto-isolated from the I/O bus.
Power Supplies	External Source Requirement	20 ... 30 Vdc
	Internal Source Requirement	less than 60 mA @ 5 V from I/O bus
	Internal Power Dissipation	2 W (typical)
Input Characteristics	ON State Signal Level	+12 V ... +30 V
	OFF State Signal Level	-2 V ... +5 V
	Input Wetting Current	7 mA @ 24 Vdc; 8.5 mA @ 30 Vdc
	Response Time	4 ms (typical)
	Operating Mode	True High
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
Output Characteristics	Operating Mode	True High
	ON State Signal Level	External Supply - 0.4V
	OFF State Signal Level	0 ... 2 V, less than 1mA
	Load Current/Output	10 mA ... 2 A
	Max Load Current/Group	8 A
	Response Time	less than 1 ms
	Reverse EMF Protection	Clamping diode recommended across inductive loads, or if load current exceeds 1A
	Switch Capacity for Bulbs OFF -> ON Operations @ Maxi mum Power	10W (Max Surge Current = Nor mal Current x 10) 1000/hour inductive load 100/s resistive load 10/s bulb load
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
Environmental Characteristics	Operating Temperature	0 ... 60 degrees C for DAP220 -40 ... +70 degrees C for DAP250
I/O Map	Discrete 1x/0x	8 in/8 out

Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	220 g (.48 lb.)
Agency Approvals	DAP 220: VDE 0160; UL 50; CSA 22.2 No.142; and FM Class I, Div 2 Standards	
	DAP 250C: Railway standard EN 50 155: EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*). UL 50; CSA 22.2 No.142; and FM Class I, Div 2 pending	

Overview of the DAP 253 Combined I/O Module

24

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 253 combined I/O module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 253 Combined I/O Module?

Brief Product Description

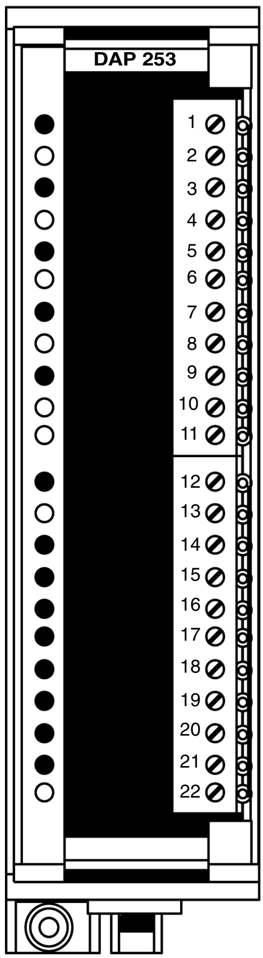
The DAP 253 is an extended temperature, 110 Vdc +/-40 percent, eight-point isolated input/four-point relay output module. The full operational range of this module is 66 ... 154 Vdc for inputs. Relay voltage and current ratings are documented in the specifications of this module. It senses eight discrete input signals received by field sensing devices such as pushbuttons, limit switches, or other dc input sources and converts those signals into logic that can be used by the PLC. It utilizes logic signals within the PLC to activate four independent and individually isolated normally open relay contacts.
The module requires power from an external 24 Vdc source to operate the relay outputs. The operating temperature range of this module, -25 ... +70 degrees C (-13 ... +158 degrees F), exceeds typical module operating temperatures of 0 ... 60 degrees C.

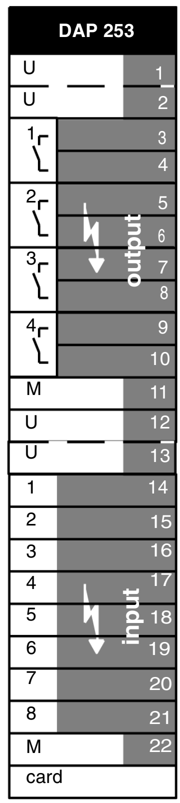
Note: The DAP 253 model is available with conformal coating. The conformal coating model is DAP 253C.

DAP 253 Combined I/O Module LEDs

DAP 253 LEDs

The DAP 253 module has two amber LEDs opposite terminal screws 1 and 12; when one of these LEDs is ON, it indicates power available to the input or output points directly below it. Below terminal screw 1 are four red LEDs opposite terminal screws 3, 5, 7, and 9 indicating the signal condition of relay output points 1 ... 4, respectively. Below terminal screw 12 are eight red LEDs opposite terminal screws 14 ... 21 indicating the signal condition of inputs 1 ... 8, respectively.
A front view with DAP 253 label is provided below.

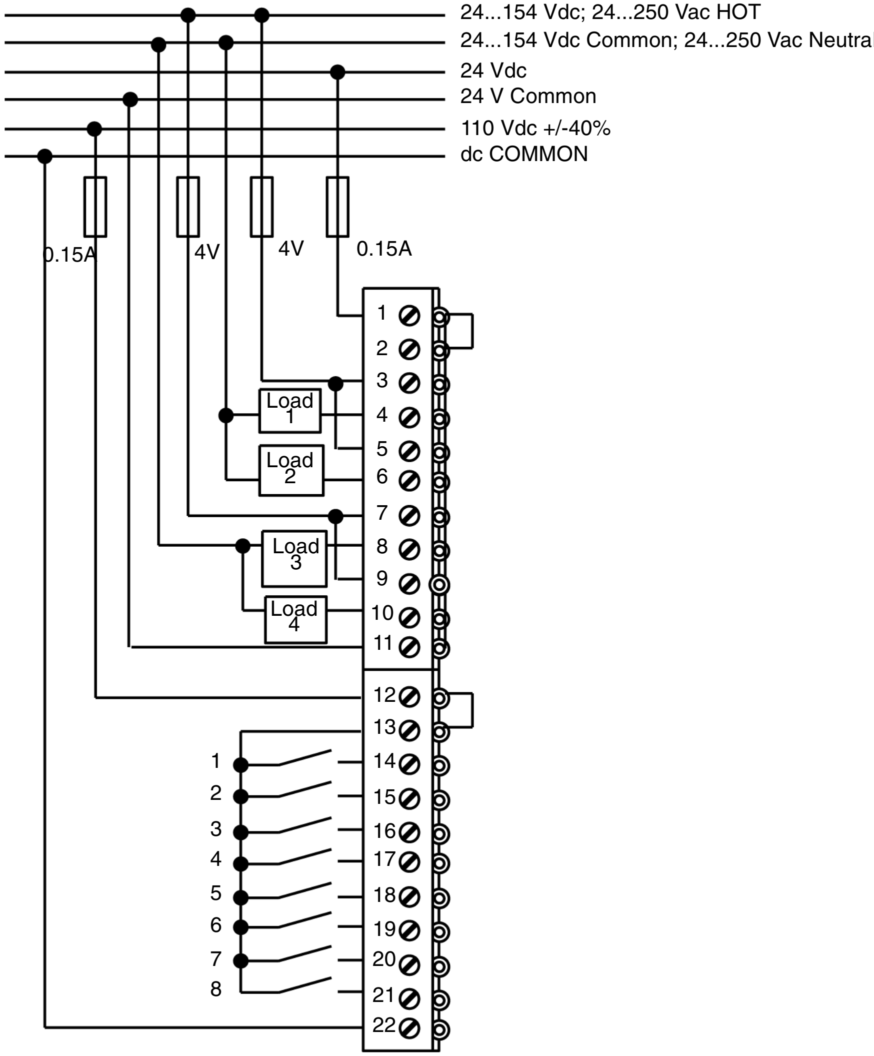




DAP 253 Combined I/O Module Field Wiring

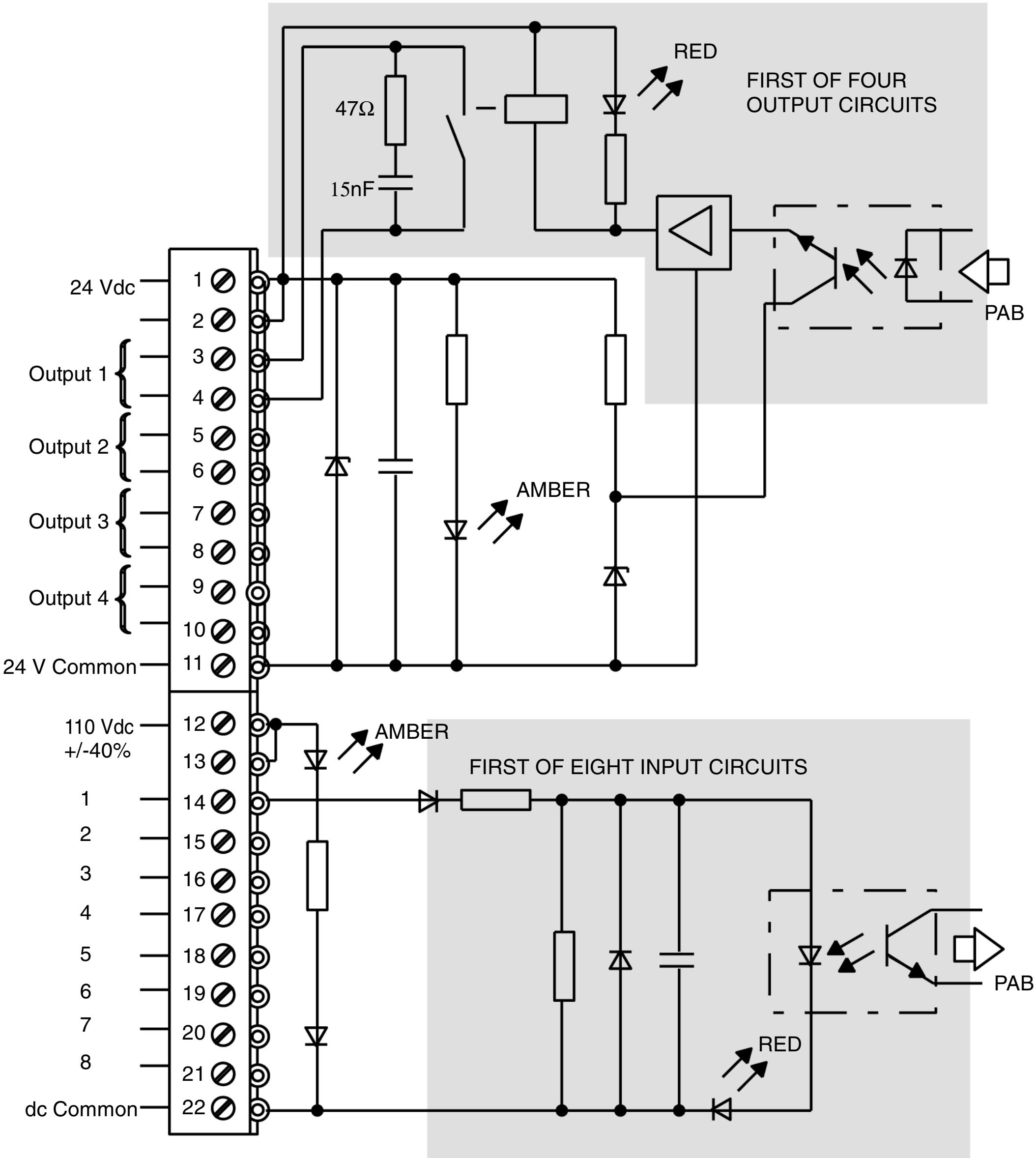
Wiring Diagram for DAP 253

A wiring diagram for the DAP 253 combined I/O module is provided below.



Simplified Schematic for DAP 253

A simplified schematic for the DAP 253 combined I/O module is provided below.



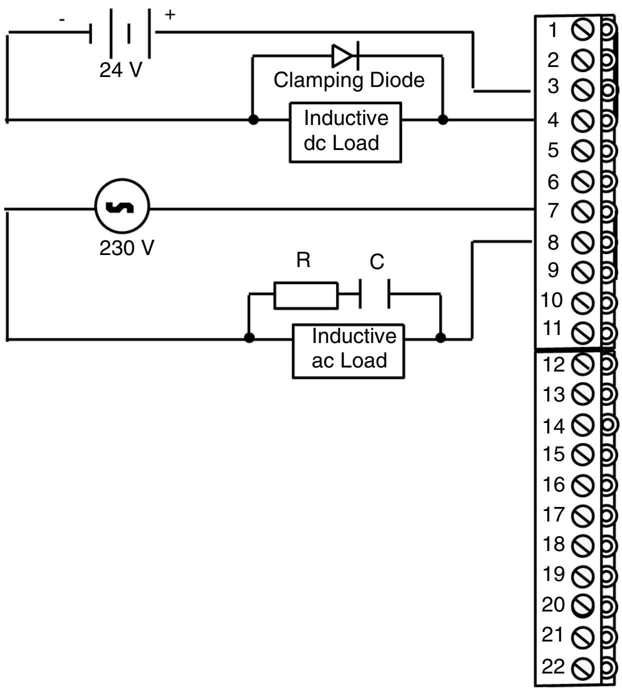
Protecting the DAP 253 Combined I/O Module from Inductive Back EMF

Instructions for DAP 253

In order to increase the service life of the relay output contacts and protect the DAP 253 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

Illustration of Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



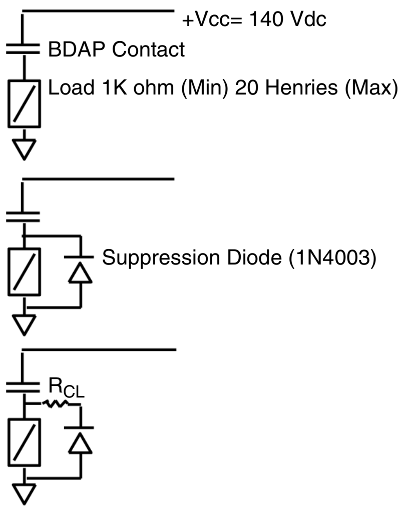
Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a rating two or three times greater than the supply voltage.
Values may be:

Snubber Values	
Load Inductance	Capacitance
25 ... 70 mH	.50 microF
70 ... 180 mH	.25 microF
180 mH	.10 microF

An example of Operational Range Options Using 140 Vdc is provided below.

A B C



Calculations:
Given: Vcc= 140Vdc
I (Max)= .15 A
Then: R(L) (Min)= 140/.15=1Kohm
Since L/R=.02 Sec, and R=1Kohm
Then L(Max)= (.02) X 1000=20H

Voltage rating of diode = 1.5 X Vcc
Current rating of diode = 2 X I (Max)
Must be “slow”, rectifier, vs logic

$R_{CL=}$Current Limiting Resistor (.5 Load R)
Here, 470 ohms
If carbon film, .25 watt,
If metal film, .50 watt

A shows the consequences of ohmic load and L/R ratios
B shows the application of the suppression diode
C shows the application of a current limiting resistor in series with the diode to protect the diode from contact bounce

Snubber resistors may be 1 ... 3 ohms, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.

Note: To I/O Map the DAP 253 module in Modsoft you must select DAP 212. Both modules share a host driver and have similar characteristics.

DAP 253 Combined I/O Module Specifications

DAP 253 Specifications

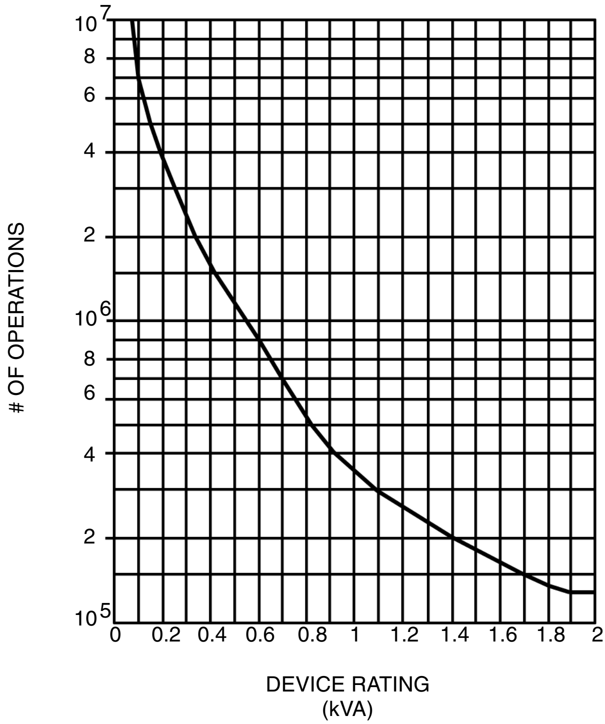
The following tables and diagrams contain DAP 253 combined I/O module specifications.

Module Topology	Number of Inputs	8
	Number of Relay Outputs	4
	Number of Groups	1 in/4 out
	Points/Group	8 in/1 out
	Isolation	Relay output contacts individually isolated Input group isolated from output group
Power Supplies	External Source Requirement	110 Vdc+40 percent, 20 mA @ 24 Vdc, 70 mA
	Internally Provided Source	5 V from I/O bus @ 15 mA maxi mum
	Internal Power Dissipation	2 W (typical)
Input Characteristics	Working Voltage Range	66 ... 154 Vdc
	ON State Signal Level	55 ... 170 V
	OFF State Signal Level	-2 ... +10 V
	Input Current	2.2 mA (typical) @ 110 Vdc
	Response Time	6 ms (typical)
	Operating Mode	True High
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
Environmental Characteristic	Operating Temperature	-25 ... +70 degrees C (-13 ... +158 degrees F)

DAP 253 Specifications (continued)

Output Characteristics	Output Voltage Ranges	24 ... 154 Vdc; 24 ... 250 Vac
	Operating Mode	Normally Open
	Response Time	10 ms (typical)
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
	Load Currents @ 230 Vac	2 A continuous (maximum, resistive load) 4 A instantaneous (maximum, resistive load) 1 A continuous (maximum, Cos = 0.5) 1.5 A / 240 V max (AC11, VDE 0660, part 200)
	Load Current @ 24 Vdc	2 A continuous maximum (resistive load) 4 A instantaneous maximum (resistive load) 1 A continuous maximum (L/R* = 30 ms) 1.5 A / 240 V max (DC11, VDE 0660, part 200)
	Load Current @ 60 Vdc	1 A continuous maximum (resistive load) 0.6 A maximum (L/R* = 30 ms)
	Load Current @ 140 Vdc	0.3 A continuous maximum (resistive load) 0.15 A maximum (L/R* = 20 ms)
	Wetting Current	5 mA for closed contacts
	Leakage	1 mA
	Internal Protective Circuitry	68 ohms +15 microF in parallel with each contact
	Overload Protection	Should be provided externally
I/O Map	Discrete 1x/0x	8 in/4 out
* L = Load Inductance in H; R = Load Resistance in ohms		
Service Life of Relay Contacts	Mechanical switching cycles	20,000,000
	Electric switching cycles (Resistive Loads)	7,000,000 @ 230 Vac/0.5 A 8,000,000 (typical) @ 30 Vdc/2 A, with clamping diode 1,000,000 (typical) @ 60 Vdc/1 A, with clamping diode, 3000 cycles/hr maximum
	Electric switching cycles (Inductive Loads, Cos = 0.5)	5,000,000 @ 230 Vac/0.5 A

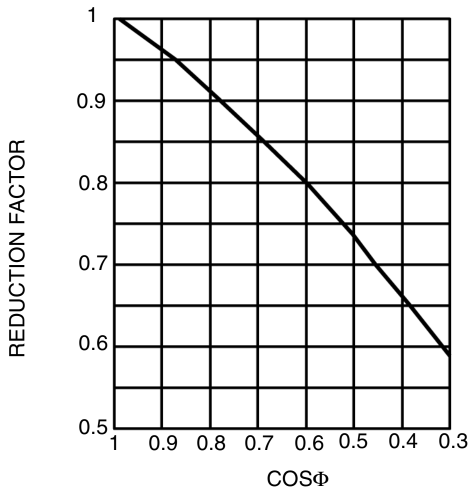
Diagram of Service Life for Resistive Loads.



SERVICE LIFE FOR RESISTIVE LOADS

The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos:
Effective number of operations = # of operations (resistive load) x reduction factor:

Graph of Reduction Factor for Inductive Loads.



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

I/O Map	Discrete 1x/0x	8 in/8 out
Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	240 g (.52 lb.)
Agency Approvals	DAP 253: European Directive EMC 89/336/EEC Standards	
	DAP 253C: Railway standard EN 50 155: European Directive EMC 89/336/ EEC Standards.	

Overview of the DAP 292 Combined I/O Module

25

At a Glance

Purpose

The purpose of this chapter is to describe the DAP 292 combined I/O module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAP 292 Combined I/O Module?

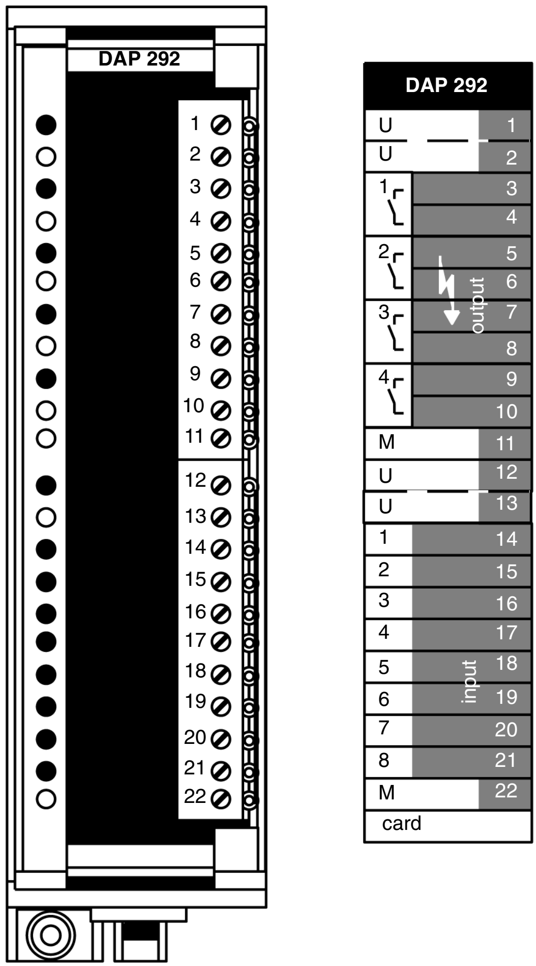
Brief Product Description

The DAP 292 is a 60 Vdc, eight-point isolated input/four-point relay output module. It senses eight discrete input signals received by field sensing devices-such as pushbuttons, limit switches, or other 60 Vdc sources-and converts those signals into logic that can be used by the PLC.
It utilizes logic signals within the PLC to activate four independent and individually isolated normally open relay contacts. The module requires power from an external 24 Vdc source to operate.

DAP 292 Combined I/O Module LEDs

LEDs

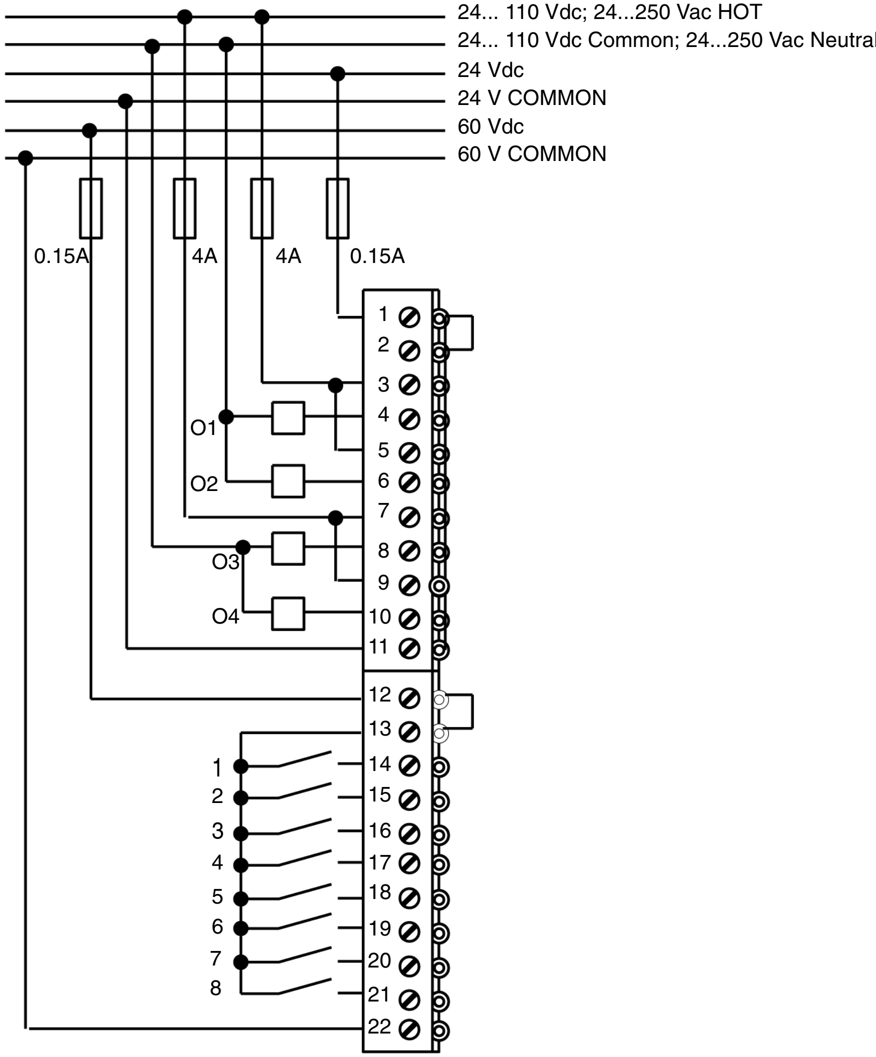
The DAP 292 module has two amber LEDs opposite terminal screws 1 and 12; when one of these LEDs is ON, it indicates power available to the input or output points directly below it. Below terminal screw 1 are four red LEDs opposite terminal screws 3, 5, 7, and 9 indicating the signal condition of relay output points 1 ... 4, respectively. Below terminal screw 12 are eight red LEDs opposite terminal screws 14 ... 21 indicating the signal condition of inputs 1 ... 8, respectively.
A front view with DAP 292 label is provided below.



DAP 292 Combined I/O Module Field Wiring

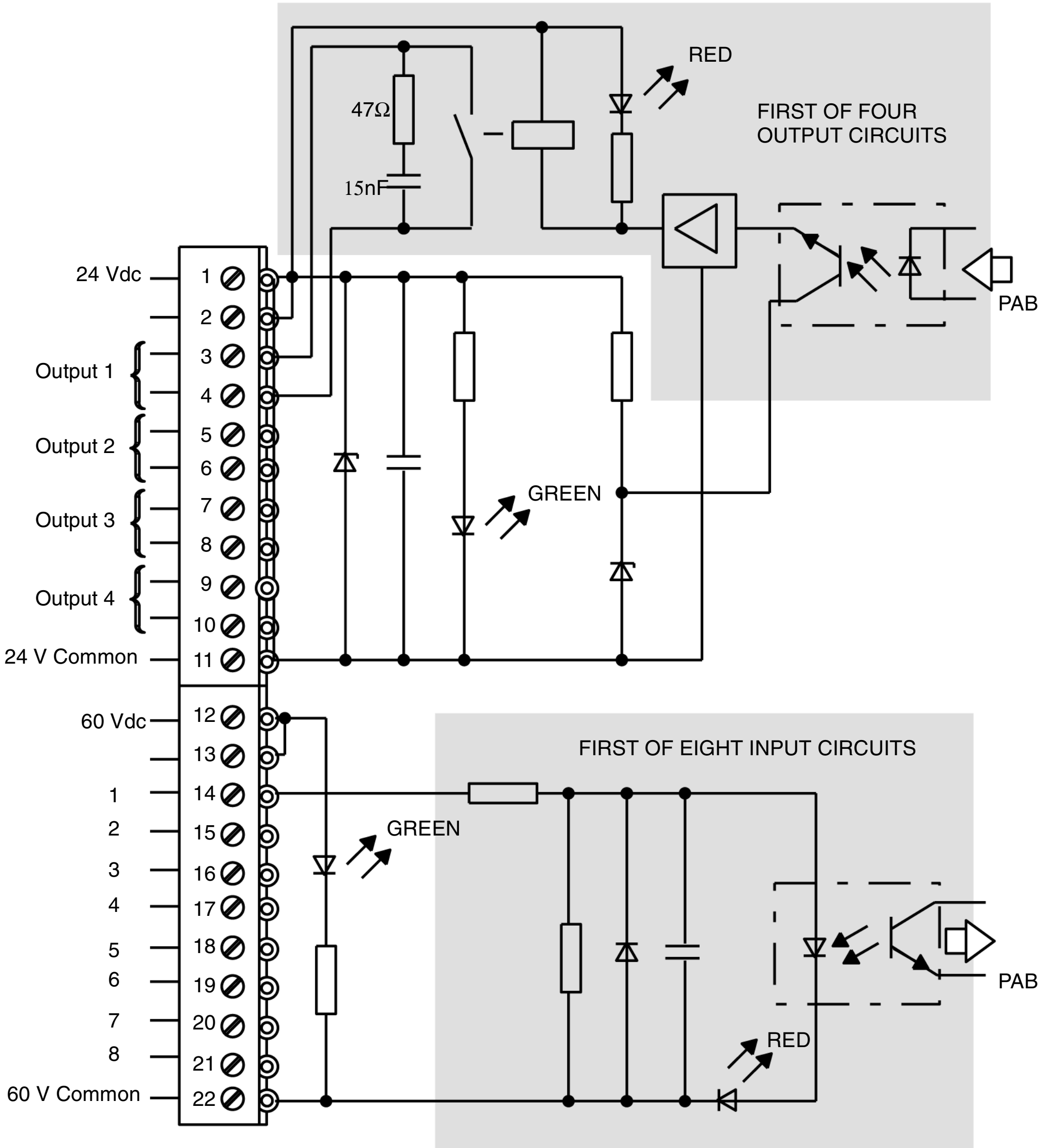
Wiring Diagram for DAP 292

A wiring diagram for the DAP 292 combined I/O module is provided below.



Simplified Schematic for DAP 292

A simplified schematic for the DAP 292 combined I/O module is provided below.



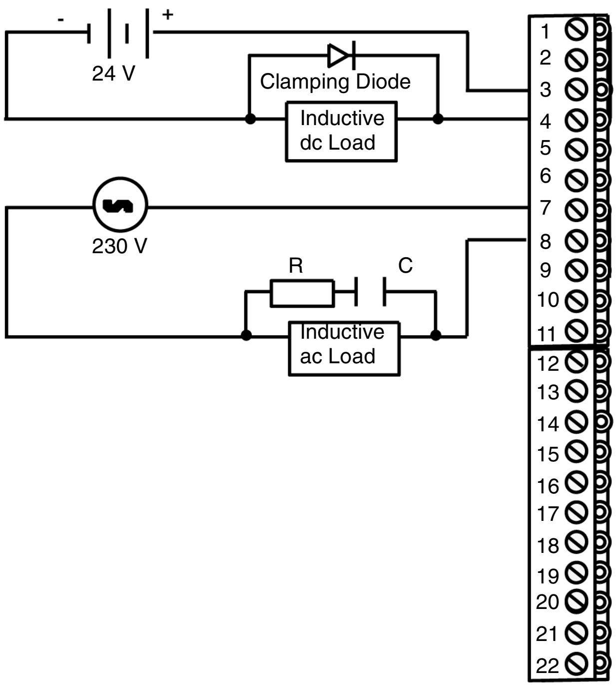
Protecting the DAP 292 Combined I/O Module from Inductive Back EMF

Instructions

In order to increase the service life of the relay output contacts and protect the DAP 292 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

Illustration of Clamping Diode and Snubber Circuit for DAP 292

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a rating two or three times greater than the supply voltage.
Values may be:

Snubber Values	
Load Inductance	Capacitance
25 ... 70 mH	.50 microF
70 ... 180 mH	.25 microF
180 mH	.10 microF

Snubber resistors may be 1 ... 3 ohms, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.

Note: To I/O Map the DAP 292 module in Modsoft you must select DAP 212. Both modules share a host driver and have similar characteristics.

DAP 292 Combined I/O Module Specifications

DAP 292 Tables and Diagrams

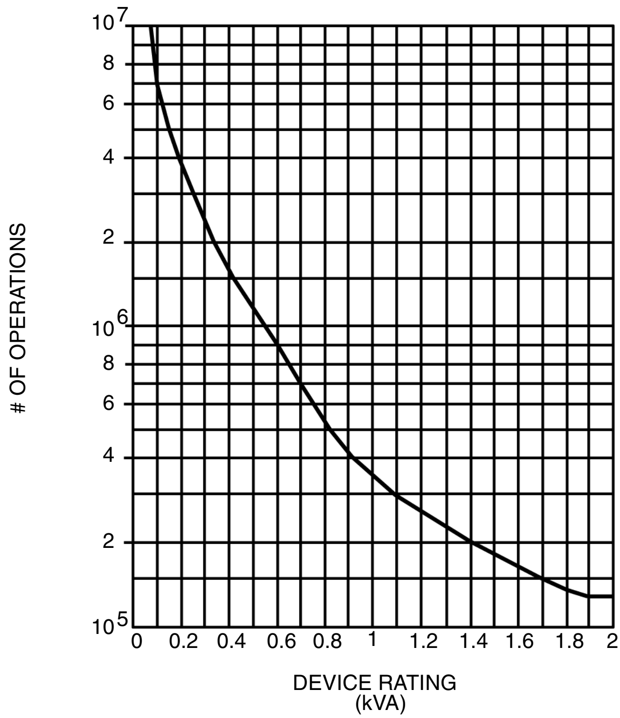
DAP 292 Specifications

Module Topology	Number of Inputs	8
	Number of Relay Outputs	4
	Number of Groups	2
	Points/Group	8 in/4 out
	Isolation	Relay output contacts individually isolated Input group isolated from output group
Power Supplies	External Source Requirement	60 Vdc, 150 mA maximum; 24 Vdc, 150 mA maximum
	Internally Provided Source	5 Vdc from I/O bus; 25 mA maximum
	Internal Power Dissipation	2 W (typical)
Input Characteristics	Working Voltage Range	60 Vdc
	Signal Rated Value	+60 V
	ON State Signal Level	35 ... 70 V
	OFF State Signal Level	-4 ... +13 V
	Input Current	7 mA at 60 V
	Response Time	4 ms (typical)
	Operating Mode	True High
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG

DAP 292 Specifications (continued)

Output Characteristics	Output Voltage Ranges	24 ... 110 Vdc; 24 ... 250 Vac
	Operating Mode	Normally Open
	Response Time	10 ms (typical)
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
	Load Currents @ 230 Vac	2 A continuous (maximum, resistive load) 4 A instantaneous (maximum, resistive load) 1 A continuous (maximum, Cos = 0.5) 1.5 A/240 V max (AC11, VDE 0660, part 200)
	Load Current @ 24 Vdc	2 A continuous maximum (resistive load) 4 A instantaneous max maximum (resistive load) 1 A continuous maximum (L/R* = 30 ms) 1.5 A/240 V max (DC11, VDE 0660, part 200)
	Load Current @ 60 Vdc	1 A continuous maximum (resistive load) 0.6 A maximum (L/R* = 30 ms)
	Load Current @ 110 Vdc	0.45 A continuous maximum (re resistive load) 0.25 A maximum (L/ R* = 30 ms)
	Wetting Current	1 mA
	Internal Protective Circuitry	68 ohms +15 microF in parallel with each contact
	Overload Protection	Should be provided externally
I/O Map	Discrete 1x/0x	8 in/4 out
* L = Load Inductance in Henries; R = Load Resistance in Ohms		
Service Life of Relay Contacts	Mechanical switching cycles	20,000,000
	Electric switching cycles (Resistive Loads)	10,000,000 @ 230 Vac/0.2 A 7,000,000 @ 230 Vac/0.5 A 8,000,000 (typical) @ 30 Vdc/ 2 A, with clamping diode 1,000,000 (typical) @ 60 Vdc/1 A, with clamping diode, 3000 cycles/hr max
	Electric switching cycles (Inductive Loads, Cos = 0.5)	5,000,000 @ 230 Vac/0.5 A

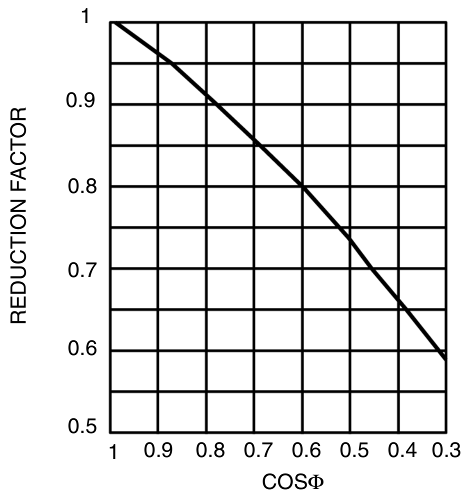
Service Life for Resistive Loads



SERVICE LIFE FOR RESISTIVE LOADS

The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

Reduction Factor for Inductive Loads



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

I/O Map	Discrete 1x/0x	8 in/8 out
Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	240 g (.52 lb.)
Agency Approvals	DAP 253: European Directive EMC 89/336/EEC Standards	
	VDE 0160; UL 508; and CSA 22.2 No. 142 Standards.	

DAU 202/252 Analog Output Module

26

At a Glance

Introduction

This chapter describes the DAU 202/252 analog output module.

What's in this Chapter?

This chapter contains the following topics:

What Is the DAU 202/252 Analog Output Module?

Brief Product Description

The DAU 202/252 is a two–channel analog output module. Each channel supports voltages in the range +10 ... -10 V and currents in the range +20 ... -20 mA. The operations of the DAU 202 and the DAU 252 are alike except for the DAU 252's ability to operate at extended temperatures. The output channels can be isolated individually. The valid output data range is from 0 ... 4000.

Note: The DAU 252 model is available with conformal coating. The conformal coating model is DAU 252C, and it meets Railway standard EN 50 155.

Conversion Ranges

Different PLC models support different temperature ranges. The following tables present the different PLC models and describe the voltage and temperature ranges that they support.
The following table lists operating information for the A984- 1XX and E984- 24x/251/255 PLC models.

Output Signals Voltage	Output Signals Current	Data Count (decimal	Operating Results
-10 V	-20 mA	0	In Range
0 V	0 mA	2000	
+10 V	+20 mA	4000	
0 V	0 mA	4001	Over Range

The following table lists operating information for the E984-258/265/275/285 PLC models.

Voltage (VDC)	Current (mA)	12-bits	15-bits + sign	Range
10.24 ... -10.005	-20.48 ... -20.01	0 47	-32768 -32016	Under-range
-10.00 0 +10.00	-20.00 0 +20.00	48 2048 4048	-32000 0 +32000	Nominal range
+10.005 ... +10.24	+20.01 ... +20.48	4049 4095	+32016 +32752	Overrange

LEDs

The DAU 202/252 has two green LED indicators on its front panel:
- If the LED opposite terminal screw 1 is ON, user-supplied voltage is present.
- If the LED opposite terminal screw 12 is ON, a D/A conversion has occurred.

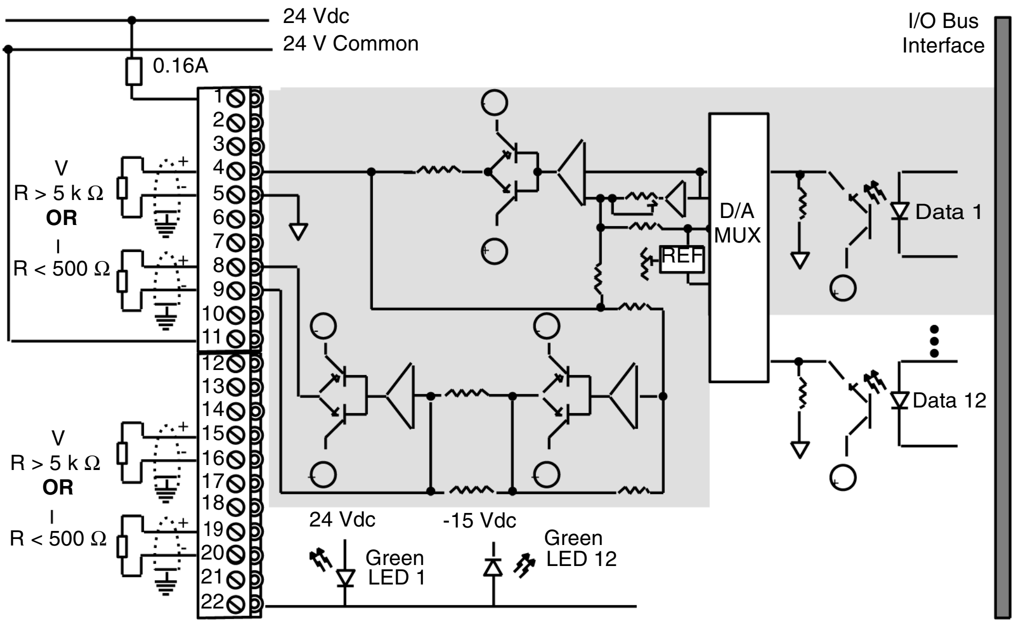
DAU 202/252 Analog Output Module Field Wiring

Introduction

The DAU 202/252 can be field wired to two current output devices, to two voltage output devices, or to one current and one voltage device.

Wiring Diagram

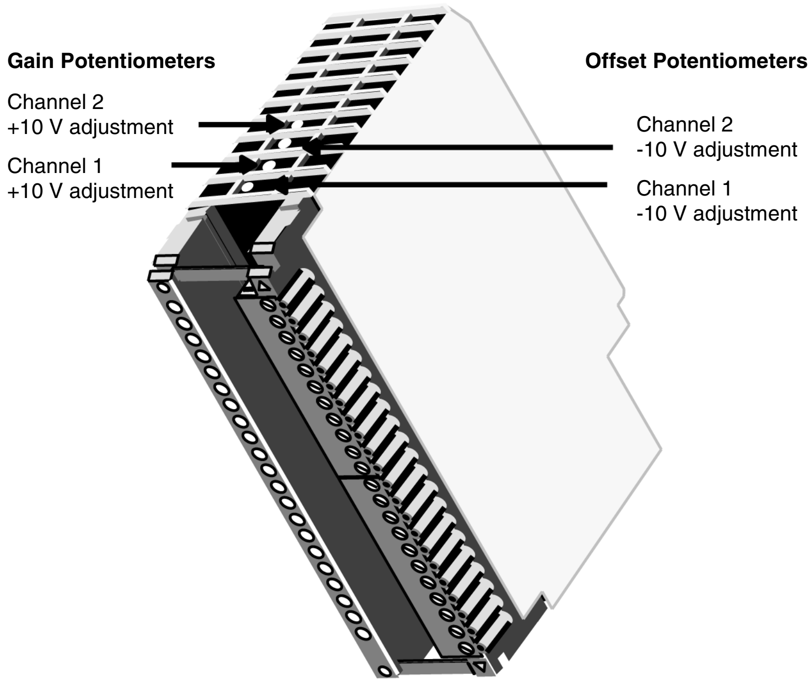
The following illustration is a wiring diagram and simplified schematic for the DAU 202/252 analog output module.



DAU 202/252 Analog Output Module Calibration

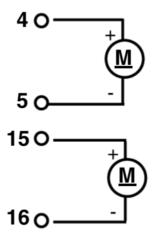
Introduction

By adjusting the four potentiometers on the top of the DAU 202/252 module, you can calibrate the gain and offset on each of the two analog channels over the absolute count range of the module (0 ... 4000).
The following illustration shows the location of the potentiometers on the ADU 202/252.



Procedure for Adjusting the Potentiometers

Use the following procedure to adjust the Potentiometers.t

Step	Action
1	Wire terminal 4 to the positive side and terminal 5 to the negative side of a voltmeter for analog channel 1 (as shown in the following figure.) 
2	Enter 4000 into the module output register and adjust the channel 1 gain potentiometer (+10 V adjustment) for a reading of +10 V on the meter.
3	Enter 0 into the module output register and adjust the channel 1 offset potentiometer (-10 V adjustment) for a reading of -10 V on the meter.
4	Check module operation by entering 2000 into the module output register. The meter reading should be 0 V.
5	To fine-tune the calibration adjustment, you may want to repeat steps 2 ... 4 until you have your best reading. If you are satisfied with the reading, drop a bead of sealing varnish on the two readjusted potentiometers.
6	To calibrate analog channel 2, wire terminal 15 to the positive side and terminal 16 to the negative side of the voltmeter, and repeat steps 2 ... 5 of this procedure, this time making the adjustments to the gain and offset potentiometers for channel 2.

DAU 202/252 Analog Output Module Specifications

Table of Specifications

The following table lists the DAU 202/252 specifications.

Module Topology		
Number of Outputs	2 opto-isolated	700 V Channel-to-Channel
		700 V Channel-to-Bus
Data Format	Two's complement, left justified	
Power Supplies		
Internally Provided Source	5 V, less than 60 mA from the I/O bus	
External Source Requirement	24 Vdc, 150 mA maximum	
Internal Power Dissipation	2 Ω (typical)	
Electrical Characteristics		
Voltage Output	+/- 10 V greater than 5 k ohms	
Current Output	+/- 20 mA less than 500 ohms	
Over Range	Approximately 2.4 percent	
D/A Resolution	11 bits plus sign	
Wire Size	One wire: 14 AWG	
	Two wires: 20 AWG	
Accuracy		
Overall	+/- .4 percent of full scale	
Output Error Range	+/- .6 percent @ 0... 60 degrees C	
Update Interval	Approximately 2 ms/output	
Settling Time	25 ms/output	
Environmental Characteristics		
Operating Temperature	0 ... 60 degrees C for DAU202 -40 ... +70 degrees C for DAU252	
I/O Map		
Register 3x/4x	0 in/2 out	
Dimensions		
W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)	
Weight	300 g (0.6 lb)	
Agency Approvals		
DAU202: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards.		
DAU252C: Railway standard EN 50 155; European Directive EMC 89/336/EEC Standards. UL 508; CSA 22.2 No.142; and FM Class I, Div 2 pending.		

DAU 204 Analog Output Module

27

At a Glance

Introduction

This chapter describes the DAU 204 analog output module.

Note: Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation if using certain PLCs (A984- -1xx, E984- -24x/251/255) with Modsoft.

	WARNING
⚠	**DAU 204 module must be powered when in rack.** Do not leave this module unpowered in the rack. This may affect the proper operation of the CPU and other I/O modules. **Failure to follow this precaution can result in death, serious injury, or equipment damage.**

What's in this Chapter?

This chapter contains the following topics:

What Is the DAU 204 Analog Output Module?

Brief Product Description

The DAU 204 is a 4-channel analog output module designed to control adjustable frequency drives, positioning valves, dampers, and so forth. Each channel can provide either voltage or current loop output, in any one of the following ranges:

- 0 ... 1, 0 ... 5, or 0 ... 10 V and +/-1, +/- 5, or +/-10 V
- 4 ... 20 or 0 ... 20 mA (sourcing)

Note: For proper operation, the module requires power from an external source (250 mA @ 24 Vdc). If an external source is NOT used, the module pulls power from the internal bus and gives a false green LED indication.

DAU 204 Analog Output Module Conversion Ranges

Overview

Different PLC models require different voltage ranges. The following tables present the different PLC models and describe their power requirements and capabilities. Refer to *Controlling Output Signal Levels, p. 356* for ranges for A984- 1XX and E984- 24x/251/255 PLC models.

Conversion Ranges

The following table lists voltage range information -- 0 ...1 VDC, 0 ... 5 VDC, 0 ...10 VDC -- for E984- 24x/258/265/275/285 PLC models.

0 ... 1 VDC	0 ... 5 VDC	0 ... 10 VDC	11-bits	12-bits	15-bits + sign	16-bits	Range
0	0	0	0	0	0	0	Nominal range
0.5	2.5	5	1024	2048	16000	32768	
1	5	10	2047	4095	32000	65520	

The following table lists voltage range information -- 0/4 ... 20 mA -- for E984- 58/ 265/275/285 PLC models.

0 ... 20 mA	4 ... 20 mA	11-bits	12-bits	15-bits + sign	16-bits	Range
0	4	0	0	0	0	Nominal range
10	12	1024	2048	16000	32768	
20	20	2047	4095	32000	65520	

The following table lists voltage range information -- +/- 1 VDC, +/- 5 VDC, +/- 10 VDC -- for E984- 258/265/275/285 PLC models.

+/- 1 VDC	+/- 5 VDC	+/- 10 VDC	11-bits	12-bits	15-bits + sign	16-bits	Range
-1	-5	-10	0	0	-32000	0	Nominal range
0.5	2.5	0	1024	2048	0	32768	
+1	+5	+10	2047	4095	+32000	65520	

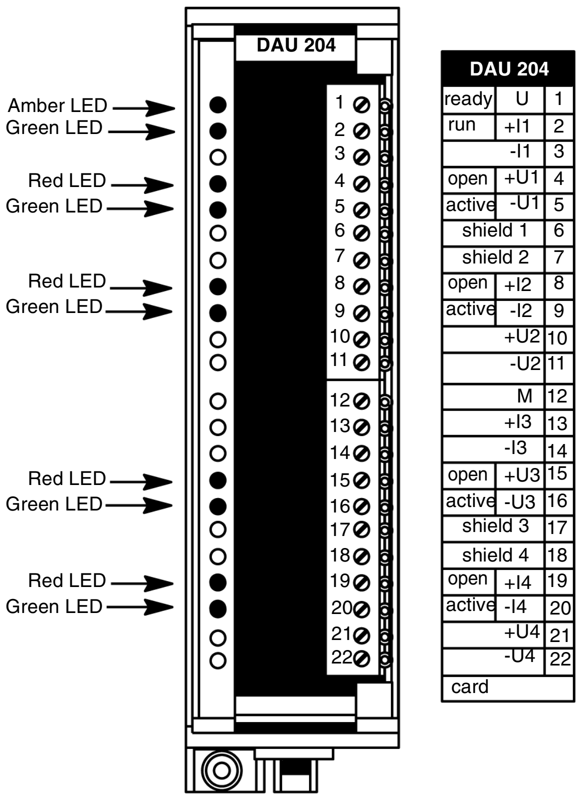
DAU 204 Analog Output Module Special Features

Special Features

The DAU 204 module provides the following features:
- 4 independently configurable channels (i.e., the DAU 204 can provide any combination of voltage and current outputs)
- Group-to-group isolation (channel 1 and 2 are optically and magnetically isolated from channels 3 and 4) to 500 Vac
- True 12-bit resolution (0 ... 4095) on all scales
- High accuracy (+/-0.2 percent of full scale @ 25 degrees C)
- Open current loop (broken wire) detection and warnings via LEDs and registers
- Software calibration (no potentiometers)
- Built-in diagnostics

An additional special feature of the DAU 204 is the outputs. For detailed information, see *Conversion Ranges, p. 342*.

The following figure shows a front view with the DAU 204 label.



DAU 204 Analog Output Module Installation

Overview

The following information describes preparatory tasks to complete before you install the DAU 204.

Before You Install the Module

Before installing the DAU 204, be sure to complete the following items:
- Set the DIP switches.
- Field wire the terminal blocks.

For detailed information about how to complete these tasks, see *DAU 204 Analog Output Module Switch Settings, p. 345*.

CAUTION

You must observe all rack and module power state requirements.

Never insert or remove the DAU 204 from the rack while the rack is powered up or while the module is connected to an external power source or active output device. Failure to observe this precaution can result in equipment damage.

Failure to follow this precaution can result in injury or equipment damage.

Note: After installing the DAU 204, you must load the DAU 204 software driver (SVI.DAT Rev 3, or higher) and set at least one output range via I/O Mapped register (40xxx+4). These registers are described in *DAU 204 Analog Output Module Configuration, p. 353*.

DAU 204 Analog Output Module Switch Settings

Overview

Setting DIP switches must be done before the DAU 204 can be installed. The following information describes how to perform these tasks. For general information about setting DIP switches on the DAU 204, see *DAU 204 Analog Output Module Installation, p. 344*.

CAUTION

You must observe all rack and module power state requirements.

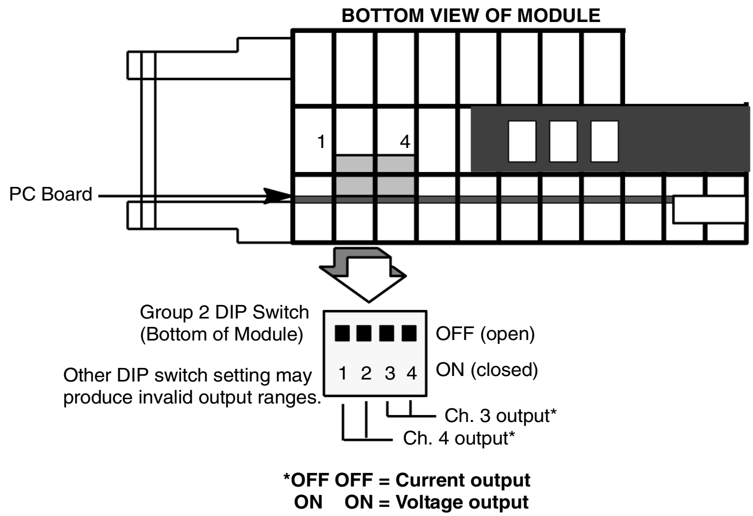
Never change DIP switch settings while the rack is powered or while the module is connected to an external power source or active field device. Failure to observe this precaution can cause unintended equipment operation.

Failure to follow this precaution can result in injury or equipment damage.

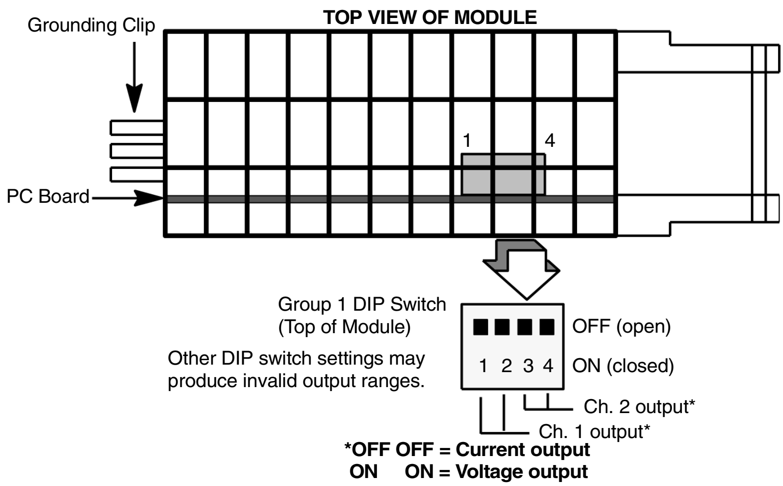
Setting DIP Switches

This procedure describes how the dip switches are set.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>With the DAU 204 not in the rack, find the DIP switches at the top and bottom of the module. (Both views are shown in the following illustrations. Note also that the DIP switches are visible through the vents.) The module ships in current mode.
The following illustration is a bottom view of the module, showing the DIP switch for channels 3 and 4.



The following illustration is a top view of the module, showing the DIP switch for channels 1 and 2.



</td></tr>
</table>

Step	Action
2	Select the output mode for each channel by properly setting the DIP switches (Refer to the preceding figures.) The DIP switch poles located at the top of the module control channels 1 and 2. The switches located on the bottom of the module control channels 3 and 4. Notice that channel 1 is set using poles 1 & 2, and channel 2 is set using poles 3 & 4; but channel 4 is set using poles 1 & 2, and channel 3 is set using poles 3 & 4.

Settings for Unused Channels

It is recommended that unused channels be set to voltage mode. This setting shuts off the red LED current loop error indicator and alarm bit. Alternatively, unused current output channels should be shorted.
You must use both poles together to properly set a channel's mode; not doing so will generate invalid results.

DAU 204 Analog Output Module Field Wiring

Introduction

For this module, use 60/75 copper (Cu) for the power connections and 4.5 in-lb. of torque for the set screws.

To prevent errors in field device operation, follow these guidelines:

- Use shielded, twisted-pair cable (such as Belden 9418).
- Ground the shield of each signal cable at the DAU 204 only. At the other end each signal cable, peel back the shield and insulate it from contact with the signal-carrying wires.
- Route each signal cable as far as possible from sources of electrical noise (such as motors, transformers, contactors and especially AC devices).
- Route the signal cables in a conduit different from the AC and power cables.
- If the signal cables must cross AC or power cables, ensure that they cross at right angles.
- When connecting field devices to the module, keep the unshielded portions of the signal-carrying wires as short as possible.

After wiring the terminal blocks, use the supplied keys to prevent the blocks from being switched inadvertently.

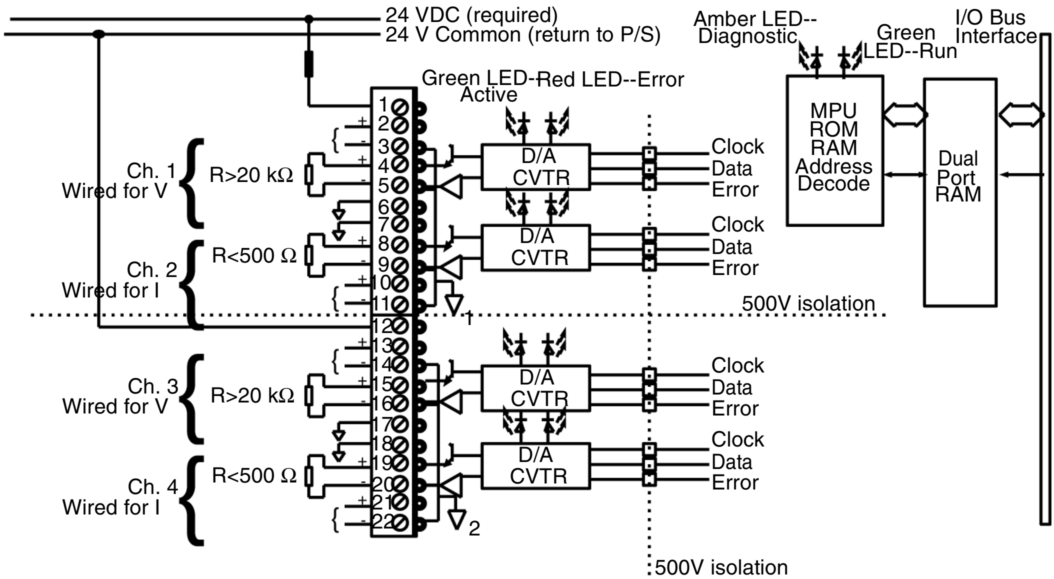
WARNING

Module must be powered while in rack.

Do not leave this module unpowered in the rack. This may affect the proper operation of the CPU and other I/O modules.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

Wiring Diagram The following illustration is a wiring diagram and simplified schematic for the DAU 204 analog output module.



	CAUTION
	Observe all precautions when configuring a channel for current output. When you configure a channel for current output, do not connect anything to that channel's voltage output terminals (and vice versa). Failure to observe these precautions can cause unintended equipment operation. **Failure to follow this precaution can result in injury or equipment damage.**

Note: We recommend that you connect the DAU 204 to the same 24 Vdc power supply used to power the PLC (even if the DAU 204 is in the rack but not being used). If this is not possible, we recommend that you supply power to the PLC before the DAU 204 using a power supply similar to the P120 (quick startup voltage). Failure to observe this precaution can cause abnormal operation.

Note: Ensure that voltage loads driven by the module can tolerate transients during rack and module startup. During startup, transients as great as 2 V may appear on the voltage output terminals for as long as 5 ms due to the characteristics of semiconductor devices. This does not occur with the module's current output terminals.

Note: Terminals 3, 5, 9 and 11 (- current out, and - voltage out) are internally tied as a group. Terminals 14, 16, 20 and 22 (- current out, and - voltage out) are internally tied as a group. Be sure not to cross groups.

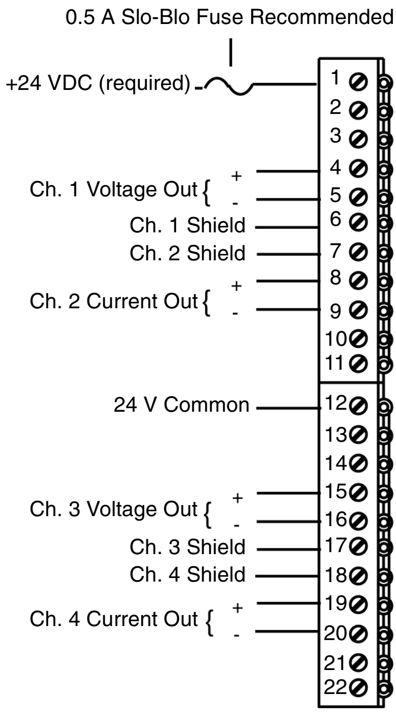
Note: You should short all unused current output terminals to disable the red current loop LEDs and alarm bits.

The following table lists terminal descriptions.

Terminal	Channel	Description
1		+ 24Vdc (required)
2	1	+ current out - current out + voltage out - voltage out shield 1
3		
4		
5		
6		
7	2	shield 2
8		+ current out
9		- current out
10		+ voltage out
11		- voltage out
12		24 V common
13	3	+ current out
14		- current out
15		+ voltage out
16		- voltage out
17		shield 3

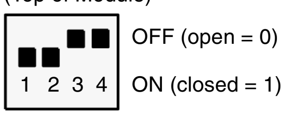
Terminal	Channel	Description
18	4	shield 4
19		+ current out
20		- current out
21		+ voltage out
22		- voltage out

The following illustration is an example of the DAU 204 wired for voltage output on channels 1 and 3 and current output on channels 2 and 4.

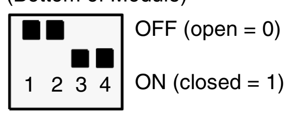


The DIP switch settings for this configuration are shown in the following illustration.

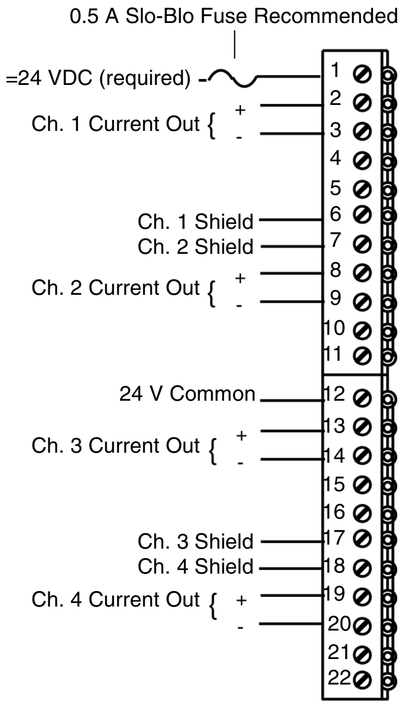
Group 1 DIP Switch
(Top of Module)



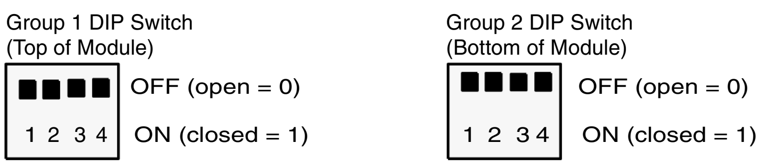
Group 2 DIP Switch
(Bottom of Module)



An example of the DAU 204 wired for current output on all channels (1 through 4) is shown in the following illustration. Turn all DIP switch poles off for this configuration.



For example, to select current output for channels 1 and 3, and current output for channels 2 and 4, set the DIP switch poles as shown in the following illustration.



DAU 204 Analog Output Module Configuration

Introduction

The DAU 204 is configured using the I/O map and its input and holding registers.

I/O Mapping

The DAU 204 uses one 30xxx input register and six 40xxx output registers, I/O mapped as binary (BIN) data.

> **Note:** A software loadable driver (SVI.DAT, Revision 3, or higher) is required to operate this module.

The registers and their functions used by the DAU 204 are shown in the table below, with more details following.

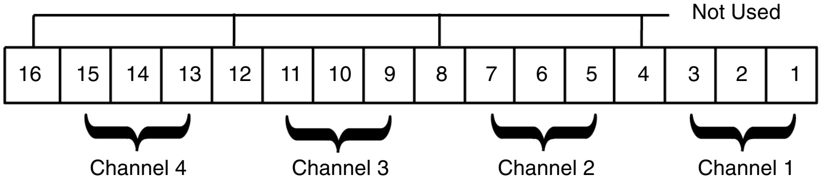
Registers and their functions	
30xxx	Module status word
40xxx	Channel 1 data, output signal levels, 12 bit
40xxx + 1	Channel 2 data, output signal levels, 12 bit
40xxx + 2	Channel 3 data, output signal levels, 12 bit
40xxx + 3	Channel 4 data, output signal levels, 12 bit
40xxx + 4	Control word 0, range select (NOT avail able for E984-258/265/275/285 PLCs)
40xxx + 5	Control word 1, fault state

From the I/O Map screen in Modsoft, you can call up the built-in help screens by highlighting DAU 204 and pressing <ALT><H>.

Setting Output Ranges

Output register 40xxx + 4 controls the output range for each channel.

Output Register 40XXX + 4 (range select)



0	0	0	(0 hex)	= 4...20 mA
0	0	1	(1 hex)	= 0...20 mA
0	1	0	(2 hex)	= 0...1 V
0	1	1	(3 hex)	= ±1 V
1	0	0	(4 hex)	= 0...5 V
1	0	1	(5 hex)	= ±5 V
1	1	0	(6 hex)	=0...10 V
1	1	1	(7 hex)	=±10 V

Note: When using E984-258/265/275/285 PLCs the output ranges are selected using the Parma ... screen in Concept, not the 4x+4 register.

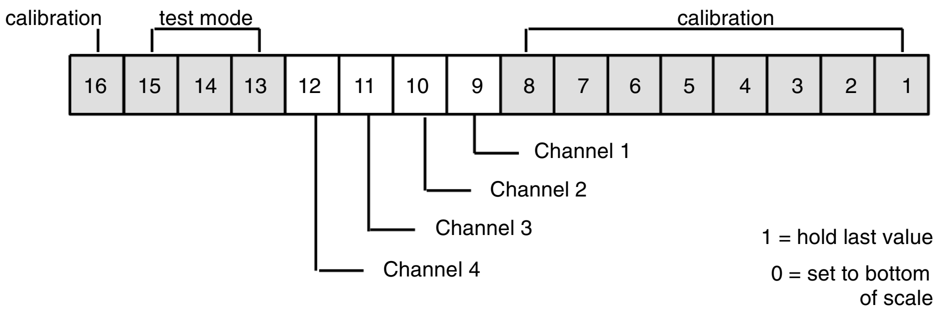
Enabling Hold-Last-Value

Bits 9 through 12 of output register 40xxx + 5 control how the DAU 204 responds to the following fault conditions:

- Communications with the PLC is lost for more than 1 second.
- The PLC is in stopped mode or power is lost.

The following is an illustration of the Enable-Hold-Last-Value Register.

Bits 9...12 of Output Register 40XXX = 5
(enable hold-last-value)



> **Note:** When using E984-258/265/275/285 PLCs the hold-last-value is selected using the Parma ... screen in Concept.

For example, if channel 1 is configured for 4 ... 20 mA operation, and bit 9 of register 40xxx + 5 is set to 0 (bottom of scale), channel 1 will output 4 mA if communication with the PLC is lost. However, if bit 9 were set to 1 (hold last value), channel 1 would output the same signal (value) that was output when communication was lost.

Controlling Output Signal Levels

Output registers 40xxx through 40xxx + 3 control the output signal levels on channels 1 through 4, respectively.
The table below shows how the data in these registers correspond to the output signal for each output range. Register values above 4095 are treated as 4095.

A984-1xx, E984-24x/251/255 PLC Models			
Register Value (decimal)	Unipolar Voltage Output Signal		
	0 ... 1 V	0 ... 5 V	0 ... 10 V
0	0	0	0
2047	0.5	2.5	5
4095	1	5	10
	Bipolar Voltage Output Signal		
	+/-1 V	+/-5 V	+/-10 V
0	-1	-5	-10
2047	0	0	0
4095	1	5	10
	Current Output Signal		
	0 ... 20 mA	4 ... 20 mA	
0	0	4	
2047	10	12	
4095	20	20	

CAUTION

Operational Hazard

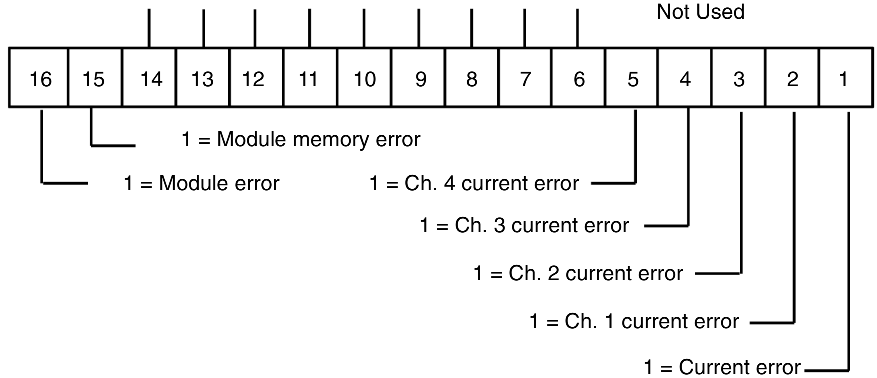
Before bringing field devices on-line, always ensure that you know the value in the registers that control each output channel so that the field devices do not begin operation without your understanding.

Failure to follow this precaution can result in injury or equipment damage.

Monitoring the Module

Input register 30xxx can be used to monitor the DAU 204.

Input Register 30XXX (module status)



A current error indicates an open current loop (broken wire) or a high loop impedance (greater than 500 ohms). Check the field wiring. A module error indicates a fault within the module. Try restarting the module. If the fault continues, call Technical Support at 1-800-468-5342.

DAU 204 Analog Output Module Custom Calibration

Introduction

This procedure is recommended for expert users only. All DAU 204 modules are carefully calibrated at the factory, so the procedure described below is needed **only** if you want to alter the module's calibration for a special application.

Depending on the accuracy desired, this procedure should take less than half an hour. To calibrate the DAU 204, the following materials are needed:

- Processor
- Rack
- Power supply
- Programming software (Modsoft) and computer
- Cable (preferably, shielded, twisted pair cable, such as Belden 9418)
- Multimeter with current measuring capability

Calibrating the Module

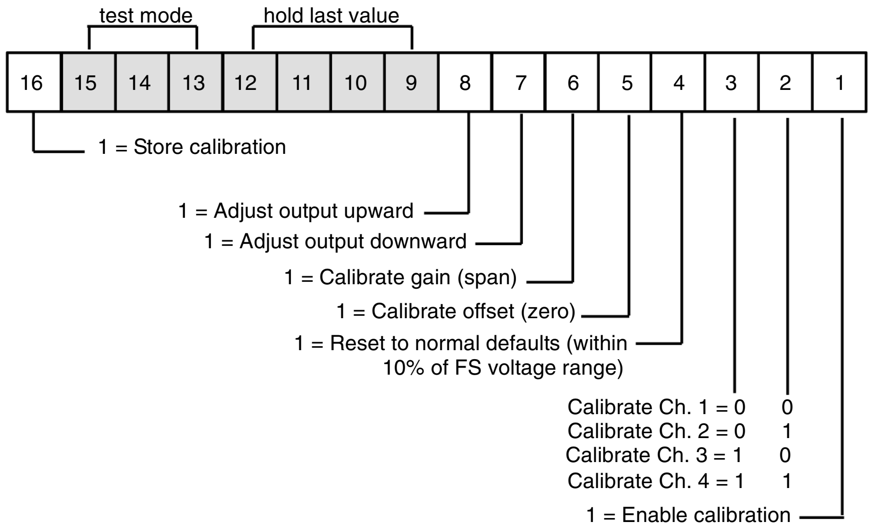
To calibrate the DAU 204 analog output module:

Step	Action
1	Properly install and configure the module for the intended application See *DAU 204 Analog Output Module Installation, p. 344* and *Controlling Output Signal Levels, p. 356*.
2	Set the output data register for the channel you want to calibrate to 4095 decimal (for example, to calibrate channel 1, set output register 40xxx to 4095).
3	Using the multimeter, measure the output for the channel being calibrated.
4	Using output register 40xxx + 5 (defined in the figure below), adjust the output upward or downward. Refer to the channel gain table below for the op codes to use. **Note:** When using E984-258/265/275/285 PLCs the channel calibration is selected using the Parma ... screen in Concept.
5	When the output equals the top of the desired range (for example, 20 mA for 4 ... 20 mA operation), set output register 40xxx + 5 to 0000 hex to stop the output movement.
6	Set the output data register for the channel you want to calibrate to 0 (for example, to calibrate channel 1, set output register 40xxx to 0).
7	Using output register 40xxx + 5, adjust the output upward or downward. Refer to the channel offset table below for the op codes to use.
8	When the output equals the bottom of the desired range (for example, 4 mA for 4 ... 20 mA operation), set output register 40xxx + 5 to 0000 hex to stop the output movement.
9	Repeat steps 2 through 8 until you've achieved the desire accuracy. Repeat these steps for each channel, as desired. To store the calibration in EEPROM, set output register 40xxx + 5 to 8011 hex.

Channel Calibration

The following is an illustration of the Channel calibration register.

Bits 1...8 of Output Register 40XXX + 5 (channel calibration)



Code Tables

The following table gives Op codes to adjust channel gain (span) upward or downward.

	Upward	**Downward**
Channel 1	00A1 hexadecimal	0061 hexadecimal
Channel 2	00A3 hexadecimal	0063 hexadecimal
Channel 3	00A5 hexadecimal	0065 hexadecimal
Channel 4	00A7 hexadecimal	0067 hexadecimal

The following table gives Op codes to adjust channel offset (zero) upward or downward.

Op codes to adjust channel offset (zero) upward or downward		
	Upward	Downward
Channel 1	0091 hexadecimal	0051 hexadecimal
Channel 2	0093 hexadecimal	0053 hexadecimal
Channel 3	0095 hexadecimal	0055 hexadecimal
Channel 4	0097 hexadecimal	0057 hexadecimal

Note: When you replace the module, you will need to perform this procedure again.

To return a channel to an uncalibrated state (before factory calibration i.e. within 10 percent of full scale of voltage range), set output register 40xxx + 5 to the appropriate op code shown in the table below.

Op codes to return channel to uncalibrated state	
Channel 1	0009 hexadecimal
Channel 2	000B hexadecimal
Channel 3	000D hexadecimal
Channel 4	000F hexadecimal

DAU 204 Analog Output Module Indicators

LEDs

The DAU 204 analog output module has three types of LEDs:
- Amber LED -- provides information about the health of the module
- Green LEDs -- provide information about the readiness of the module
- Red LEDs -- provide information about the integrity of each channel (in current mode only)

This chapter explains how to use these and other diagnostic tools to determine the status of the DAU 204 module, and to identify and solve problems if necessary.

Amber LED

The amber LED on the front of the module provides status information about the health of the module. A flashing amber LED indicates a fault in at least one of the following areas:
- Module Watchdog Circuit Fault
- Module Watchdog Circuit Fault at Startup
- Module RAM Failure at Startup
- Bus Interface Failure at Startup
- Module ROM Failure
- Module Processor Fault at Startup
- General Module Error

If the amber LED begins flashing, try restarting the module. If the flashing continues, call Technical Support at 1-800-468-5342.

Green LEDs

The green LED at the top of the module provides status information about the module's readiness. The remaining green LEDs provide status information about the activity on each channel.
After the module is powered up, the green LED at the top of the module should begin flashing. If not, check the power source and connections.

Note: The DAU 204 requires power from an external source (250 mA @ 24 Vdc) to operate. When an external source is NOT used the module pulls power from the internal bus gives a false green LED indication.

WARNING

Operational Hazard

Do not leave this module unpowered in the rack. This may affect the proper operation of the CPU and other I/O modules.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

Next, after the module has established communications with the PLC, the green LED at the top of the module should stop flashing and remain on. If not, ensure that the PLC has been powered up.
The remaining green LEDs should remain on or flash quickly as data is sent over each channel. If these green LEDs ever go off, check the power source and connections.

Red LEDs

The red LEDs provide status information about each channel's integrity in current mode only. A flashing or steady red LED indicates an open current loop (broken wire) or a high loop impedance (greater than 500 ohms). Red LEDs do not function in voltage mode.

Invalid Data

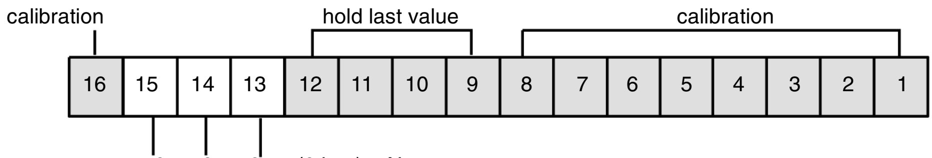
If the module seems to be providing invalid output data:
- Check wiring connections and integrity, DIP switch settings, and register settings.
- Verify the integrity of the field device.
- Make sure the signal cables are not placed on or near high-voltage (120 Vac or higher) cables. If the signal cables must cross high-voltage cables, ensure that the signal cables cross the high-voltage cables at right angles.

If electrical interference seems to be the problem, try placing the module as far as possible from power supplies and relay output modules. These products may generate electrical interference during operation. This interference would not affect the module but may induce noise on the channel wiring.

Built-in Tests

The DAU 204 has built-in tests that are performed automatically when the module is powered up, but they can also be performed after the module is on-line by setting output register 40xxx +5 as shown in the built-in test register (below).

Bits 13...15 of Output Register 40XXX + 5
(built-in tests)



15	14	13	
0	0	0	(0 hex) = No tests
1	0	1	(5 hex) = Category 1
1	1	0	(6 hex) = Category 2 (DAU 204 must be in ±10 V mode)
1	1	1	(7 hex) = Category 3 (DAU 204 must be in 4...20 mA mode)

To stop the built-in tests, simply reset output register 40xxx + 5 to 0000 hexadecimal.

CAUTION

Operational Hazard

Before performing these tests, disconnect any field devices from the DAU 204. Failure to observe this precaution can cause unintended equipment operation.

Failure to follow this precaution can result in injury or equipment damage.

Note: When bits 13, 14, or 15 of the output register 40xxx + 5 are set to 1, the green LED flashes continuously until these bits are reset to 0. After resetting these bits to 0, the module should be restarted.

Note: When using E984-258/265/275/285 PLCs the built-in tests are selected using the Parma ... screen in Concept.

If the DAU 204 fails any of these tests (amber LED flashes), restart the module. If it continues to fail, call Technical Support at 1-800-468-5342.

DAU 204 Analog Output Module Specifications

Table of Specifications

The following table provides DAU 204 Specifications.

Module Topology	Number of Channels	4
	Number of Groups	2
	Points per Group	2
Operating Voltage Ranges	Bipolar	+/-1, +/-5, +/-10 Vdc
	Unipolar	0 ... 1, 0 .. 5, 0 ... 10 Vdc
Operating Current Ranges	Unipolar	0 ... 20, 4 ... 20 mA
Power Supply	External Supply	250 mA @ 24 Vdc
	Internal Power Supply (via system bus)	less than 1 mA (TTL loading)
Required Loadable	SW-IODR-001	
Isolation	Channel 1, 2 to Channel 3, 4	500 V @ 60 Hz
	Channel to Bus	500 V @ 60 Hz
	Channel 1 to 2 and 3 to 4	Not Isolated
Line/Load Impedance	Voltage Output	greater than or equal to 20,000 ohms
	Current Output	less than or equal to 500ohms, less than or equal to 50mH; No max. capacitance but can slew output
Resolution	12 bit (0 ... 4095)	
Accuracy	+/-0.200 percent Full Scale Reading @ 25 degrees C	
Accuracy Drift w/ Temperature	Current Output	+/-0.002 percent FSR/ degrees C typical
		+/-0.005 percent FSR/ degrees C maximum
	Voltage Output	+/-0.006 percent FSR/ degrees C typical
		+/-0.0135 percent FSR/ degrees C maximum
Update Time	5 ms per channel maximum	
Fault Detection	Open current loop (broken wire in current mode)	
MTBF	100,000 hours, minimum, @ 30 degrees C, ground base fixed	
EMI Susceptance	27 ... 500 MHz, 10 V/m	
Electrostatic Discharge	8 kV	

Fast Transient (IEC 801-4)	+/- 1.0 kV	
Surge Withstand	2 kV (Transients, IEC 801-5)	
Operating Conditions	Temperature	0 ... 60 degrees C (32 ... 140 degrees F)
	Humidity	95 percent RH noncondensing @ 60 degrees C
	Chemical Interactions	Can be damaged by strong alkaline (pH greater than 7) solutions
	Vibration	10 ... 57 Hz @ 2 Gs
Storage Conditions	Temperature	-40 ... 85 degrees C (-40 ... 185 degrees F)
	Free Fall	1 m (approx. 39 in)
I/O Map	Register 3x/4x	1 in/6 out 1 in/5 out for (E984-258/265/275/285 Only)
Material	Lexan (Enclosures and Bezels)	
Space Required	1 A120 SMS rack slot	
Dimensions (WxHxD)		40.3 x 145.0 x 117.5 mm
		1.60 x 5.60 x 4.50 in
Weight, Maximum		453 g,
		1 lb.
Agency Approvals	UL 508; CUL; FM Class I, Div 2; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 779*) Standards	

Overview of DAU 208 Analog Output Module

28

At a Glance

Purpose

The purpose of this chapter is to describe the DAU 208 analog output module.

What's in this Chapter?

This chapter contains the following topics:

What is the DAU 208 Analog Output Module?

Brief Product Description

The DAU 208 is an eight-channel +/-10 V analog output module with opto-isolation. Digital-to-analog conversions are performed by a single converter, sequentially multiplexed to the eight output circuits. Outputs are short circuit-proof, and reset themselves after the short is removed.
The DAU 208 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

WARNING

Operational Hazard

The DAU 208 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

Failure to follow this precaution can result in death, serious injury, or equipment damage.

DAU 208 Analog Output Module Conversion Ranges

Introduction

The PLC model determines the available ranges. Refer to the table below. The ranges for the A984-1xx/24x/251/255 PLC models are in *DAU 208 Analog Output Module Specifications, p. 377*.

Conversion Ranges

+/- 10 VDC for E984–258/265/275/285 PLC Models

+/- 10 VDC for E984-258/265/275/285 PLC Models			
+/- 10 VDC	12-bits	15-bits + sign	Range
-10.24 ...	0	-32768	Under-range
-10.005	47	-32016	
-10.00	48	-32000	Nominal range
0	2048	0	
+10.00	4048	+32000	
+10.005 ...	4049	+32016	Overrange
+10.24	4095	+32752	

DAU 208 Analog Output Module Physical Characteristics

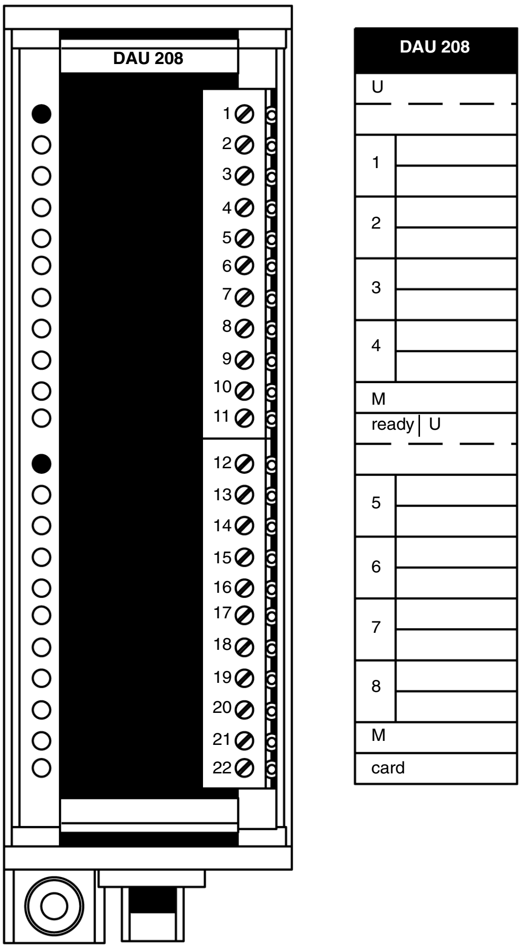
LEDs

The DAU 208 has two green LEDs:

- Opposite terminal #1, indicating the presence of user-supplied 24 Vdc power (ON = power supplied; OFF = power off)
- Opposite terminal #12, indicating operation of the dc-dc converter that powers the D/A circuitry (ON = Ready; OFF = Fault)

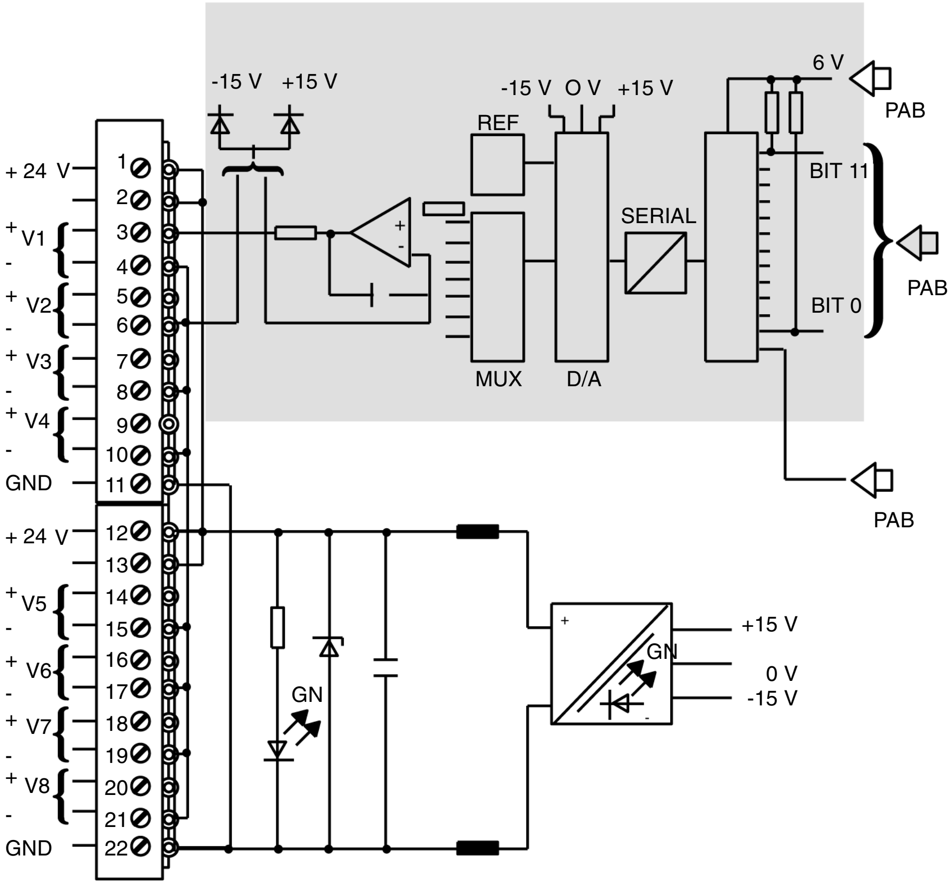
Front View

A front view with DAU 208 label is provided below.



Simplified Schematic

The DAU 208 can be field wired to up to eight voltage output devices.



DAU 208 Analog Output Module Configuration

I/O Mapping

The DAU 208 must be I/O Mapped as eight 4x output registers, and BIN must be set for data type.

Cabling

- Shielded, twisted pair cable (2 or 4 x 0.5 mm/channel) should be used; all channels can be connected with a common shielded cable.
- Connect shield to ground (GND) on one side with a short cable (less than 8 in.).
- Observe a minimum distance of 20 in between the module and power lines or other sources of electrical disturbance.

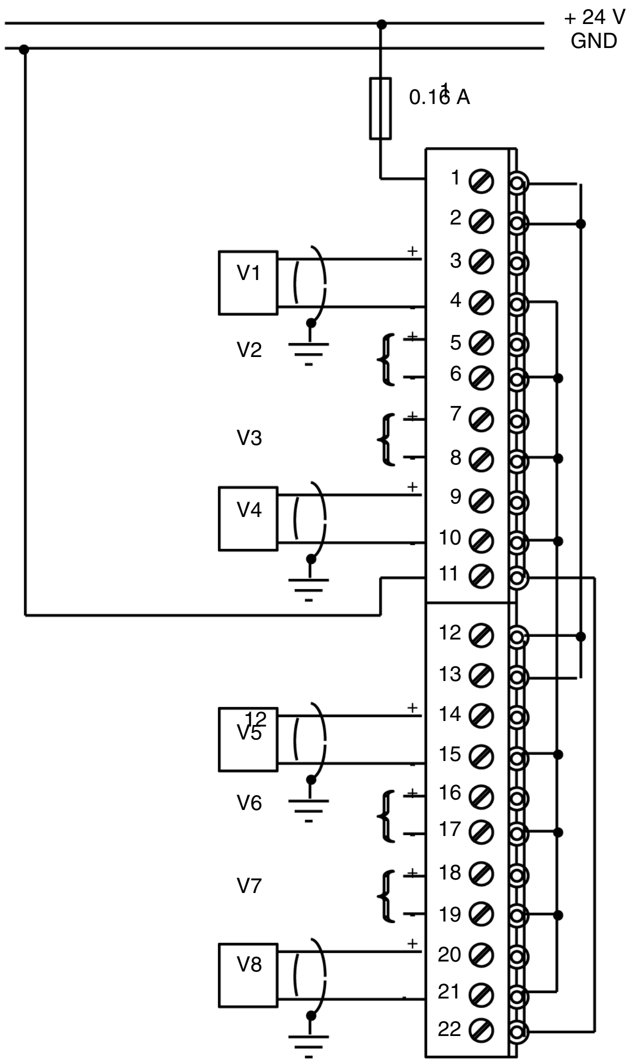
Connection and Assignment of Output Addresses

Note: Detailed Compact 984 cabling and installation instructions are found in the ***984—A120 Compact Programmable Controllers User Guide*** (890 USE 108 00 formerly GM-A984-PCS).

DAU 208 Analog Output Module Field Wiring

Wiring Diagram for DAU 208

After conversion by the DAU 208, words 1 ... 8 are shown as analog values at their respective addresses 1 ... 8, as shown in the following illustration.



DAU 208 Analog Output Module Calibration

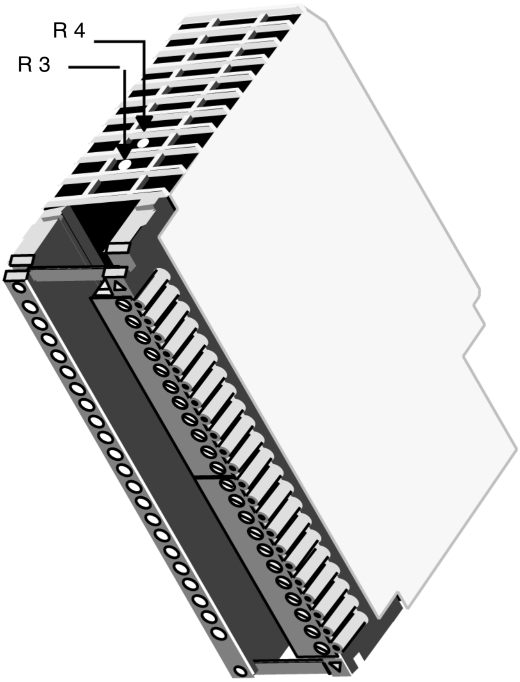
Introduction

	CAUTION
	Calibration Caution Modicon recommends that units requiring recalibration be returned to the factory, since inaccuracies could be due to faulty components. However, users who wish to perform their own calibration should use the following procedure. **Failure to follow this precaution can result in injury or equipment damage.**

By adjusting the two potentiometers located on the top of the DAU 208 module, you can calibrate both the plus and minus ranges for the eight output channels.

Location of DAU 208 Potentiometers

The following illustration shows the location of the potentiometers on the DAU 208.



In this procedure, R4 is used to calibrate the plus output voltage ranges, and R3 is used to calibrate the negative ranges and the zero point. The third potentiometer mounted opposite R3 on a separate PCB is factory preset and should not be adjusted. Its purpose is to establish voltage outputs of the DC-DC supply that powers the module's D/A converter.

Items required for calibration are:

- A 3.3 kW Precision Register
- A Voltmeter with appropriate scale and accuracy of 0.2 ... 0.5 PPM.

Calibrating the Analog Output Channels

Take the following steps to calibrate the analog output channels.

Step	Action
1	Connect the 3.3 k ohms Resistor across Channel 1. Connect the voltmeter across the 3.3 k ohms Resistor and load the Channel 1 register with 4048 decimal. Adjust R4 for a reading of +10 Vdc (+/- 0.5 mV) on the voltmeter.
2	Load the Channel 1 register with 48 decimal. Adjust R3 for a reading of -10 Vdc (+/- 0.5 mV) on the voltmeter.
3	Load the Channel 1 register with 2048 decimal. Adjust R3 for a reading of 0 Vdc (+/- 0.5 mV) on the voltmeter.
4	Move the resistor and voltmeter to the other channels and check outputs. Zero output points should be within +/- 2 mV, and +/-10 Vdc outputs within +/-7 mV.
5	When satisfied with the readings on all eight channels, drop a bead of sealing varnish on both potentiometers’ adjusting screws to secure their settings.

DAU 208 Analog Output Module Specifications

Table of Specifications

The following table contains a list of DAU 208 specifications.

Module Topology	Number of Out puts	8	
	Isolation	Channel-to-Bus	700 Vdc
		Channel-to-External Supply	700 Vdc
	Voltage Output	+/-10 V, greater than 3.3 k ohms	
	Maximum Load Current	3 mA	
	Max. Short Circuit Current	20 mA	
Power Supply	External	24Vdc, 120 mA maximum	
	Internally Provided Source from I/O bus	5 Vdc, 30 mA maximum	
	Power Dissipation	3 Ω	
Voltage Output Capabilities	Linear Measuring Range Conversion Values for the DAU208 A984-1xx, E984-24x/251/255 PLC Models Only		
	Analog Value	Decimal Value	Comments
	-10.24	0	
	-10.00	48	
	-5.00	1048	
	-1.00	1848	
	-0.50	1948	
	-0.10	2028	
	-0.01	2046	
	-0.005	2047	Linear Range
	0.00	2048	
	+0.005	2049	
	+0.01	2050	
	+0.10	2068	
	+0.50	2148	
	+1.00	2248	
	+5.00	3048	
	+10.00	4048	
	+10.24	4095	

A/D Conversion	Conversion Time for All Outputs	1 ms maximum
	Resolution	11 bits plus sign
	Overrange	+/-2.4% (maximum +/-10.24 V)
	Overall Error	+/-0.1% @ 0 ... 605 C
I/O Map	Register 1x/0x	0 in/8 out
Dimensions	W x H x D	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	350 g (.77 lb.)
Agency Approvals	VDE 0160; UL 508; CSA 22.2 No.142 and FM Class I, Div 2 Standards	

Note: If Power is removed from A984 or stopped, the outputs will go to a no output condition.

DEA 202 InterBus S Interface Module

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At a Glance

Introduction

This information in this chapter describes the DEA 202 InterBus S Interface Module.

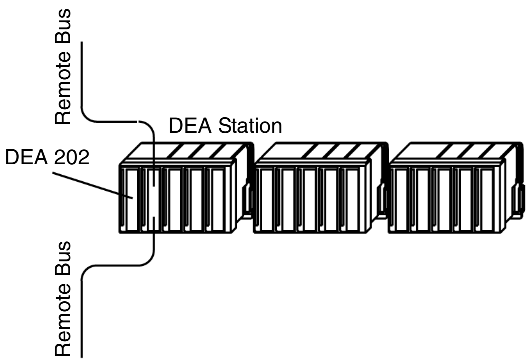
What's in this Chapter?

This chapter contains the following topics:

DEA 202 Features and Functions

Product Overview

The DEA-202 enables A120 series I/O modules to connect to the remote bus in an INTERBUS configuration. For the INTERBUS master, the DEA module is a remote node that can address up to 18 I/O modules (288 I/Os) via the subracks AS-HDTA200, AS- HDTA 201 or AS- HDTA 202.
The DEA 202 comes with an integrated (non-isolated) power supply. It provides a 5 VDC supply at 1.6 A for the modules on the parallel I/O bus.
The following figure shows the DEA 202 InterBus topology.



Features

The following list identifies key features of the DEA 202.
- Coupling module with integrated power supply.
- With the exception of intelligent modules, all analog and discrete Compact I/O modules can be employed.
- The DEA 202 requires 1 word of the packet length for private data. Consequently, a maximum of 31 words remains available for use by the InterBus-S.
- DIP switch default adjustment: Disconnection behavior as well as status and control word processing.

Functional Details

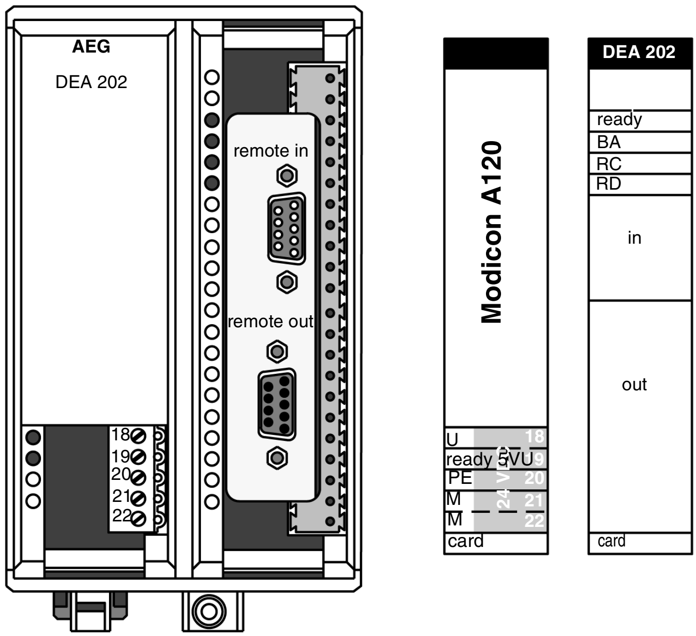
The module serves as the coupling element between the remote bus (CPU connection) and PAB (connection to the I/O modules).
The undervoltage monitoring signal from the primary and secondary voltages is evaluated internally by the module.

Watchdog

The watchdog is a self-monitoring feature of the DEA. It consists of a monoflop with a delay time of about 320 ms. The DEA firmware performs an interrupt triggered control of the monoflop. After successfully powering on, which includes a successful EPROM check and initialization, the monoflop is triggered during program execution.
The delay time of the monoflop cannot be changed. The green "ready" (watchdog) LED goes off if cycle times are greater than the monoflop's delay time. This condition activates the disconnection behavior as determined by DIP switches S2 & S3.

Module Faults

The DEA 202 collects messages from the associated modules and reports these to the master as module faults (refer to the "DEA 202 Status and Fault Messages" section of the *InterBus-S Quantum 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).
The following figure shows the DEA 202 front view and label.



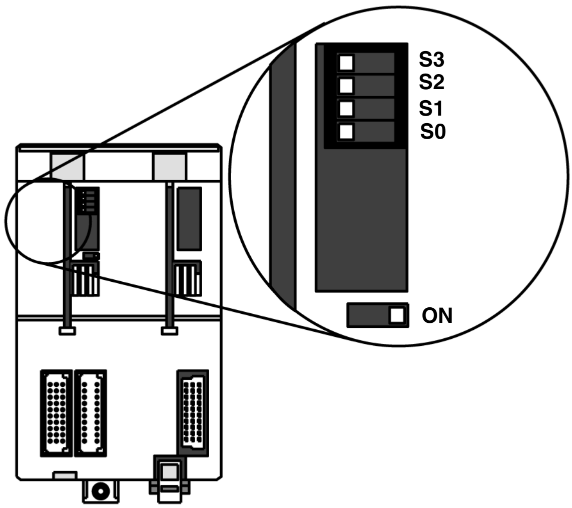
Configuration of the DEA 202

Overview

The following information describes how to configure the DEA 202.

DIP Switch Location and Settings

The following figure shows the location and settings for the DIP switch.



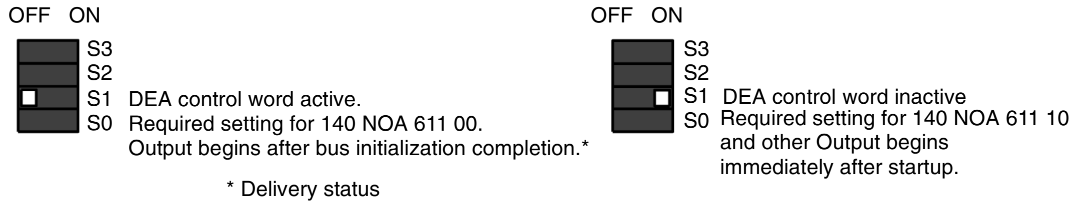
Note: For DEA 202 operation with the 140 NAO 611 00, all DIP switches (S0 ... S3) must be in the "OFF" position.

Status Processing (S0)

The following figure shows the status processing switch settings.

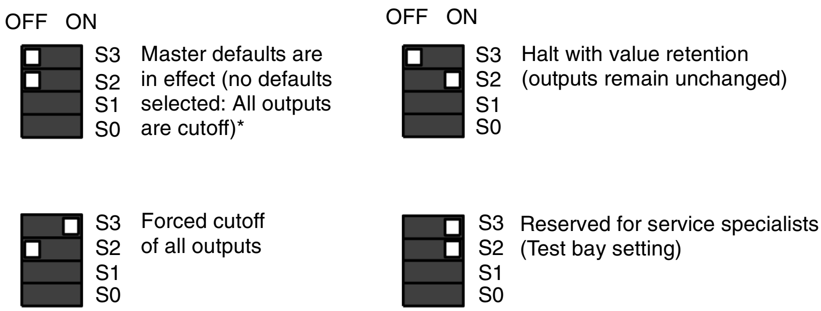
Control Word Processing (S1)

The following figure shows the control word processing switch settings.



Disconnection Behavior (S2, S3)

The following figure shows the disconnection behavior switches and settings.



* As shipped, required setting for operation with a 140 NOA 611 00.

Note: S0 and S1 settings are meaningless.

Subrack Mounting Slot

The module is installed in DTA 200 primary subrack slot 1-1/1-2.
When installing the module, be sure to adhere to the installation steps that are included in the accompanying documentation: *Inter-Bus- -S Quantum 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).

Compatible A120 I/O Modules

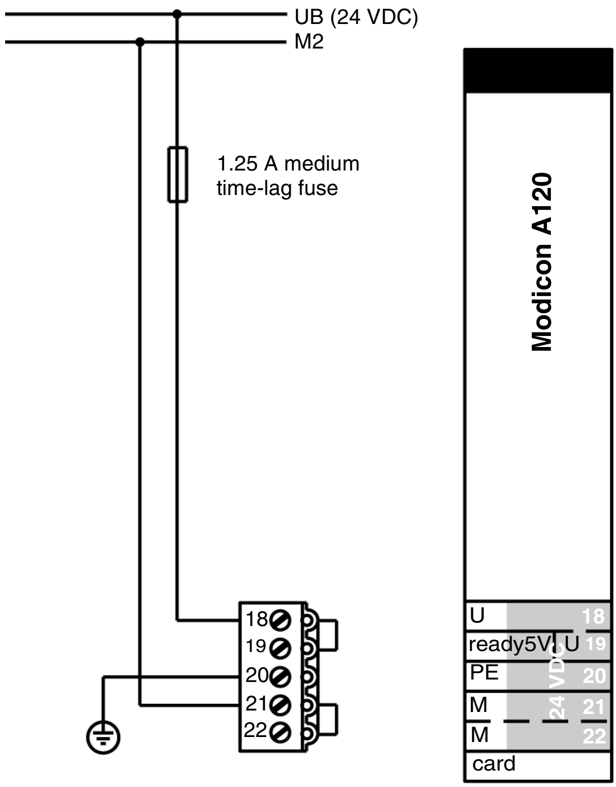
The following table lists the A120 I/O modules that are compatible with the DEA 202 module.

Module Type	Module Number
Discrete Input, 8 point	DEP 208, DEP 209, DEP 210 and DEP 211
Discrete Input, 16 point	DEP 214, DEP 215, DEP 216, DEP 217, DEP 218, DEP 220, DEP 254, DEP 256, DEP 257, DEP 296, DEP 297 and DEO 216,
Discrete Output, 4/8 point	DAP 204, DAP 208, DAP 209, DAP 258 and DAP 210
Discrete Output, 16 point	DAP 216, DAP 217, DAP 218 and DAO 216

Module Type	Module Number
Discrete Input/Output	DAP 212, DAP 220, DAP 250, DAP 252, DAP 253 and DAP 292
Analog Output	DAU 202, DAU 208 and DAU 252
Analog Input	ADU 204, ADU 205, ADU 206, ADU 216*, ADU 210*, ADU 214* ADU 254 and ADU 256
* Although these modules are not available in Concept, they can still be used with the DEA 202.	

Power Supply Connection

The following figure shows a sample DEA 202 power supply connection. You enter the relevant power supply information in the label inlay.

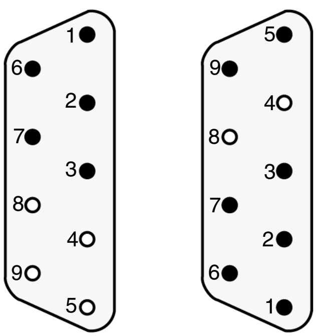


	CAUTION
	Improper connection danger. The module's integrated power supply is non-isolated. Improper connection (for example, absence of the M2 connection), can lead to module destruction. **Failure to follow this precaution can result in injury or equipment damage.**

Note that the noise immunity can be improved if by-pass capacitors are installed at the power supply module U and M terminals.

InterBus-S Connection

Set up the connection according to the "Remote Bus Node Wiring" section of the *InterBus-S 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).
The following figure shows the remote bus port pin assignmentsas viewed from the solder side.



Sub-D9 "in" plug (top)

Sub-D9 "out" socket (bottom)

Pin	Signal	Function
1	DO	Transmit data (+)
2	DI	Receive data (+)
3	GND	Signal ground
5*		(5 VDC Out) cannot be used externally
6	$\overline{DO}$	Transmit data (-)
7	$\overline{DI}$	Receive data (-)
9*	RBST	Plug identifier

*) Incoming remote bus = not used

● Pin present
○ No pin present

DEA 202 LEDs

LED Displays

The following table describes the LED displays, which are located on the module front plate.

No.	Label Inlay Identifier	Color	Function
18 (left)	U	Green	24 VDC supply present
19 (left)	ready 5 V	Green	Module ready for service, 5 VDC output voltage present
3 (right)	ready	Green	Coupler ready
4 (right)	BA	Green	Transfer in progress
5 (right)	RC	Green	"Remote bus check", remote bus input monitoring
6 (right)	RD	Red	"Remote bus disabled", remote bus feed-through terminated (remote bus node diagnosis)

DEA 202 Specifications

Specifications

The following table lists specifications for the DEA 202 InterBus S Interface Module.

Assignment	
System	TSX Compact (A120, 984)
Module area	Slot 1-1/1-2 of DTA 200 primary backplane
I/O Map	
Register 3x/4x	0 in/ 0 out
Power Supply	
External input voltage	UB = 24 VDC, max. 0.85 A
Primary fusing	1.25 A medium time-lag fuse
Power on current	20 A, time constant = 1 ms
Tolerances, limiting values	24VDC external power source, 22 ... 30VDC input, peak value= 33VDC
Reference potential M	M2
Protective earth	PE
Secondary voltage	5.15 VDC, max. 1.6 A, non-isolated
Buffering time	Typically 5 ms for 24 VDC
Overload protection	Through current limiting
Data Interface	
Field bus	Through a potential-free RS-485 interface (serial, symmetric)
Processor	
Processor type	Intel 80C152 / 12 MHz
Data memory	32 KB RAM
Firmware	32 KB EPROM
Mechanical Design	
Module	Standard double-size module
Format	2 slots
Weight	Approx. 500 g
Connections	
Power supply	5-pole screw/plug-in terminal block
Remote bus	Sub-D9 plug and Sub-D9 socket
Back plane	2 plug connectors 1/3 C30M, 1 socket connector 1/3 R30F
Environmental Characteristics	
Regulations	VDE 0160, UL 508; CSA 22.2 No.142, European Directive on EMC 89/336/EEC, and Low Voltage Directive 79/23/EEC Standards.
Permissible ambient temperature	0 ... +60 degrees C
Power dissipation	Typically 6 W

Overview of the DEO 216 Input Module

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At a Glance

Purpose

The purpose of this chapter is to describe the DEO 216 Input module.

What's in this Chapter?

This chapter contains the following topics:

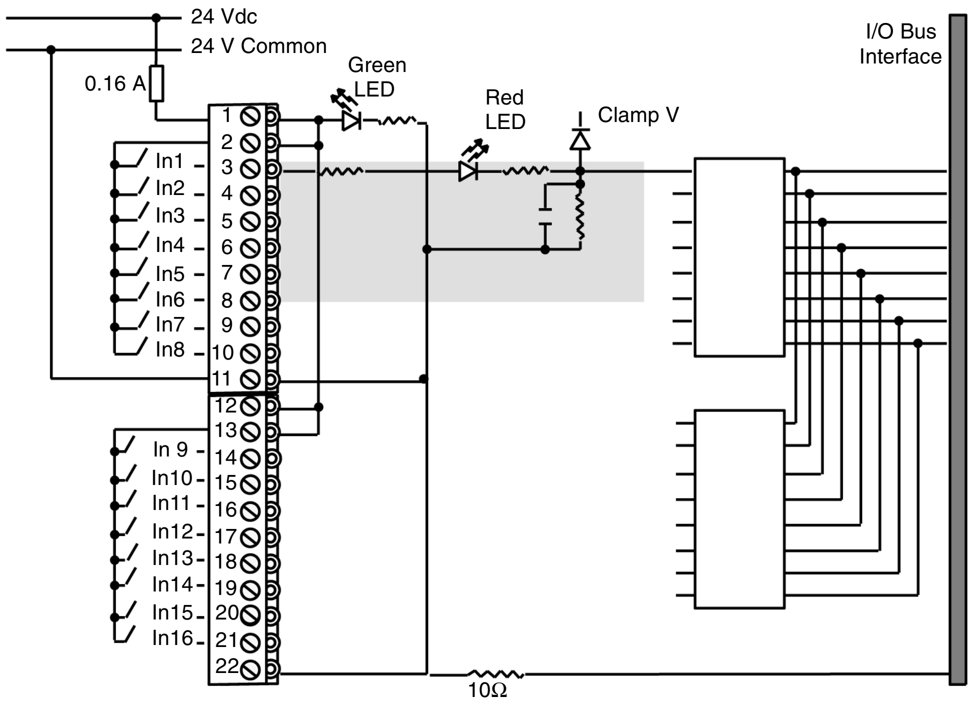
What is the DEO 216 Input Module?

Brief Product Description

The DEO 216 is a 24 Vdc, 16 point discrete input module.
It senses input signals received from field sensing devices such as push-button, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the controller. Signals are field wired in two groups, eight signals per group. DEO 216 inputs are not opto–isolated from the I/O bus.

LEDs

The DEO 216 module has one green LED, opposite terminal screw 1, which indicates when ON that power is available to the 16 inputs below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.
The following figure is a wiring diagram and simplified schematic of the DEO 216 Input module.



Specifications of the DEO 216 Input Module

Specifications for the DEO 216

The following table shows the specifications.

DEO216 Specifications		
Module Topology	Number of Inputs	16
	Number of Groups	1
	Points/Group	16
	Isolation	Not isolated from the I/O bus
Power Supplies	External Source Requirement	20 ... 30 Vdc for eight inputs
	Rated Signal Value	+24 Vdc
	Internally Provided Source	5 V, < 15 mA from I/O bus
	Internal Power Dissipation	2 W (typical)
Electrical Characteristics	ON State Signal Level	+12 ... 30 Vdc
	OFF State Signal Level	-2 ... +5 Vdc
	ON State Input Current	7 mA @ 24 Vdc 8.5 mA @ 30 Vdc
	Response Time	4 ms (typical)
	Operating Mode	True High
	Wire Size/Terminal	One wire: 14 AWG
		Two wires: 20 AWG
I/O Map	Discrete 1x/0x	16 in/0 out
Dimensions	WxHxD	40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in)
	Weight	220 g (.5 lb)
Agency Approvals	VDE 0160; UL 508; and CSA 22.2 No.142 Standards	

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