



**Analog Interface Unit**

**Operation Manual**

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### **SAFETY WARNING**

**Before installing this product:  
Turn off and disconnect all power.**

### **SAFETY WARNING**

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## SECTION 1

## GENERAL INFORMATION

### Introduction



The Analog Interface Unit, or AIU, is an interface device that provides the user of a ProScale measurement system with a method of generating an analog DC output voltage that is proportional to the currently displayed ProScale position. This output can be used with an A/D converter input on a PLC or other device that utilizes an analog input signal.

### Basic Theory of Operation

The AIU converts the digital position signal from the ProScale Readout and compares it to an internal pre-programmed set of lower and upper position limits. The AIU uses a ratio utilizing these factors and generates an analog output via a 12-bit digital-to-analog converter. This provides 4096 discrete voltage steps over the defined measurement range.

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## Specifications

Dimensions:	2.75 x 3.38 x 2.27 In. (70 x 86 x 57 mm)
Power:	12-24 VDC @ 100mA (max)
Power connector:	Terminal Screw Block
Input:	Synchronous serial BCD (Mitutoyo Digimatic®)
Output:	0 - 5 or 0 - 10 VDC, 60 mA

## Terminal Block

Position 1	Positive 12 to 24 VDC
Position 2	Ground
Position 3	Analog voltage output
Position 4	Ground
Position 5	Programmable output, active LOW (encoder failure or Readout SEND button)

## Mounting

The AIU is mounted via a standard 35 mm wide DIN rail. This can be either 7.55 mm or 15 mm height. A quick release latch can be disengaged using a small flat screwdriver and pulling on the latch tab located on the bottom of the AIU housing

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## Making Connections

**NOTE:** DO NOT APPLY POWER UNTIL ALL CONNECTIONS HAVE BEEN COMPLETED.

1. Connect 12 to 24 VDC to terminals 1 and 2.

Terminal 1 is positive.

Terminal 2 is ground and must share common ground with the PLC.

2. Connect the analog output terminals 3 and 4 to the analog input of the PLC or other control device.

Terminal 3 is positive.

Terminal 4 is ground.

3. Optionally, connect the programmable output on terminal 5 to a digital input of the PLC or control device.

4. Connect the 10 pin cable between the ProScale Readout SPC Output and the AIU Input. The cable connectors are keyed for proper alignment.

5. Remove the snap-on cover from the AIU by squeezing the sides of the top cover and set the analog output configuration jumper

JP3 across pins 1 & 2 for 0-10 volts output

JP3 across pins 2 & 3 for 0-5 volts output.

6. Optionally, install a jumper on JP2 for a supply voltage pull-up if needed on the output.

If JP2 is left open, the AIU will provide a ground signal when an encoder fault/SEND button is active. When normal, the output is high impedance.

If a jumper is installed on JP2, the normal output will be pulled up to the supply voltage via a 10K ohm resistor.

7. Apply power to the AIU. The two indicators should momentarily light up to indicate operation. If the ProScale Readout is connected properly, the status LED will illuminate.

## Calibration and Position Limit Setting

Complete the following procedure to calibrate the ProScale and the AIU for position measurement.

1. Set the position offset of the ProScale Readout using the PLUS (+), DATUM and MINUS (-) buttons. See the ProScale user's manual for additional information regarding this procedure.
2. Move the Encoder on the scale to the point that will be the minimum position of travel. Press the **Lower Limit** pushbutton on the AIU. The limit switch activation LED will momentarily illuminate.
3. Move the Encoder on the scale to the point that will be the maximum position of travel. Press the **Upper Limit** pushbutton on the AIU. The limit switch activation LED will momentarily illuminate.

The AIU is now calibrated with the ProScale Readout. When the displayed position is at or below the programmed lower limit, the analog output will be approximately 0 VDC (typically about 3-4 millivolts.) When the displayed position is at or above the programmed upper limit, the analog output will be at either 5 VDC or 10 VDC depending on the setting of jumper JP3. Displayed positions between the lower and upper limits will generate an analog output proportional to distance from the current position and the lower limit.

**NOTE: If the offset of the ProScale Readout is reconfigured, the AIU's upper and lower limits must also be reconfigured. Failure to do so will result in unexpected output from the AIU.**

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## Calculating the Voltage per Step

As stated earlier, a 12-bit digital-to-analog converter generates the analog output of the AIU. This yields 4096 discrete steps for the position range of the measuring system.

To calculate the linear distance per step, divide the range of motion of the ProScale by 4096. For example:

Lowest measurement position: 1.500 inches

Highest measurement position: 7.750 inches

Range of motion: 6.250 inches

Distance per step =:  $6.250 / 4096 = .00152$  inches per step.

Next, determine the voltage per step of the AIU. This depends on the analog output voltage range setting of JP1.

JP3 set for 10 volt output yields: .00244 volts per step.

JP3 set for 5 volt output yields: .00122 volts per step.

If the AIU were generating an analog output of 2.999 volts with the voltage range set to 10 volts, the calculated position of the ProScale would be:

$2.999 \text{ volts} / .00244 \text{ volts per step} = 1229 \text{ steps (rounded)}$ .

$1229 \text{ steps} \times .00152 \text{ Inches per step} = 1.868 \text{ inches}$ .

## Calculating the Current Position:

Starting position: 1.500 inches (set in Step 1 Calibration)

+ 1.868 inches (as calculated in the example above)

= a new position of 3.368 inches

**NOTE:** Rounding errors can have an effect on the calculations. The actual calculated position should have been 3.374 inches if rounding had not been used. The error is .17%

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## Considerations in A/D Conversions

The resolution of the A/D converter being used by the PLC or control device will have a direct impact on the measurement and conversion capabilities of the system.

In the previous example, the voltage per step was calculated using the 12-bit resolution capability of the AIU. If the PLC or control device utilizes an A/D converter with a different resolution, then that resolution must be used.

As an example, if the PLC's A/D converter resolution was only 10-bit, then the voltage per step would be:

10 volt range / 1024 = .00976 volts per step

5 volt range / 1024 = .00488 volts per step

This results in less resolution capability and thus less position accuracy capability when calculating the ProScale Measurement System's position. In summation, the resolution of the PLC's A/D converter should be at least 12-bit or higher to provide maximum conversion accuracy.

## Programmable Output

The AIU has a programmable output that can be used for either an encoder fault output or an output that activates when the SEND key is pressed on the ProScale Readout.

When configured for Encoder Fault, the output of the AIU will transition low (ground) when the SPC signal from the Readout is interrupted.

When configured for the Readout SEND button, the output will transition low for approximately 100 milliseconds when the SEND button is depressed on the ProScale Readout. This can be useful in signaling the PLC when a measurement sample is to be completed and/or recorded.

The unit can be configured for either mode by the following:

Encoder Fault output –Jumper on JP5 to pins 1-2.

Readout SEND Button - Jumper on JP5 to pins 2-3.

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## Limit Setting Switches Enable/Disable

The limit setting switches can optionally be disabled once the limit positions have been set. This functionality is controlled by jumper JP4.

Limit Setting Switches **Enabled** – Jumper on JP4 pins 1-2.

Limit Setting Switches **Disabled** – Jumper on JP4 pins 2-3.

## Re-establishing Factory Defaults

The AIU has the option of restoring factory default values in non-volatile memory if necessary. To activate this feature, complete the following:

1. Remove power from the AIU.
2. Depress and hold both the UPPER and LOWER limit switches while re-applying power.
3. Release the limit switches.

## Factory Default Values

Lower Position Limit – 0.000 inches

Upper Position Limit – 4.000 inches

## Powering a ProScale Readout

You may power a ProScale Readout directly from the AIU via the SPC cable thereby eliminating the need for batteries in the Readout.

To enable this feature, move the jumper JP4 inside the ProScale Readout to the ‘External Power’ setting.

**Note:** This feature is available only when using the General Purpose Readout.

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