

# 5304 Analog Output Module

Installation, Operation and Maintenance  
Setup Manual

5/19/2011



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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## Safety Information

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 or serious injury.

### **WARNING**

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

### **CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate.

### **CAUTION**

**CAUTION** used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage..

**PLEASE NOTE**

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

**BEFORE YOU BEGIN**

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

 **CAUTION****UNINTENDED EQUIPMENT OPERATION**

Verify that all installation and set up procedures have been completed.

Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.

Remove tools, meters, and debris from equipment

**Failure to follow these instructions can result in death, serious injury or equipment damage.**

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

**OPERATION AND ADJUSTMENTS**

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

## About The Book

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### At a Glance

#### Document Scope

This manual describes operation and maintenance of the 5304 Four Channel Analog Output module.

#### Validity Notes

This document is valid for all versions of the 5304 Four Channel Analog Output module.

#### Product Related Information

 <b>WARNING</b>
<b>UNINTENDED EQUIPMENT OPERATION</b>
The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter and apply this product.
Follow all local and national safety codes and standards.
Failure to follow these instructions can result in death, serious injury or equipment damage.

#### User Comments

We welcome your comments about this document. You can reach us by e-mail at [technicalsupport@controlmicrosystems.com](mailto:technicalsupport@controlmicrosystems.com).

## Overview

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The Model 5304 analog output module adds four analog outputs to the 5000 input/output (I/O) system. Up to 16 Model 5304 modules may be connected to the 5000 I/O bus for a total of 64 analog outputs.

The 5304 outputs can control valve actuators, motor speed controllers, temperature controllers or any device requiring an analog control signal.

The 5304 module generates either current or voltage outputs. In current mode, it can generate either 0 to 20mA outputs or 4 to 20mA outputs. A configuration switch selects the output range. In voltage mode, the outputs can be either 0 to 5V or 0 to 10V. The configuration switch will then select the ranges 1 to 5V and 2 to 10V respectively.

The output resolution is 12 bits over the full range. Outputs are isolated from logic circuits, for protection against voltage transients and high common mode voltages.

The 5304 module requires an external 12 to 24 volt DC power supply to power the output circuitry.

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## Installation

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The installation of the 5304 analog output module requires mounting the analog output module on the 7.5mm by 35mm DIN rail and connecting the analog output module to the system I/O Bus. Refer to the **System Configuration Guide** for complete information on system layout, I/O Bus cable routing and analog output installation.

**For ATEX and IECx applications only:**

This equipment is to be installed in an enclosure certified for use, providing a degree of protection of IP54 or better. The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating. A T4 rating is acceptable.

## Field Wiring

The 5304 Analog Output module provides analog outputs. These outputs are isolated from the I/O Bus 5V power supply. These outputs are not isolated from each other as they share a common return.

An external 24V supply powers the isolated output circuits. This is usually the same power supply that powers current loop transmitters in the system. A power supply normally sources this power. A wide range of voltages is tolerated. Refer to section **Specifications** of this manual for details.

Recommended field wiring for the 5304 modules is shown in **Figure 1: 5304 Typical Field Wiring**.

The 12-24V supply connects to terminals 1 and 2. Observe correct polarity. See section **DC Power Supply Requirements** for application suggestions when selecting this power supply.

- The first output connects to terminals 3 and 4. Observe correct polarity.
- The second output connects to terminals 5 and 6. Observe correct polarity.
- The third output connects to terminals 7 and 8. Observe correct polarity.
- The fourth output connects to terminals 9 and 10. Observe correct polarity.

Controller, modem and I/O modules use screw termination style connectors for termination of field wiring. They accommodate solid or stranded wires from 22 to 12 AWG.

The connectors are removable. This allows module replacement without disturbing the field wiring. Leave enough slack in the wiring for the connector to be removed.

Remove power before servicing unit.

To remove the connector:

- Pull the connector away from the board. Apply even pressure to both ends of the connector.

To install the connector:

- Line up the pins on the module with the holes in the connector.
- Push the connector onto the pins. Apply even pressure to both ends of the connector.

## DC Power Supply Requirements

The analog output section requires a DC power supply. The voltage should normally be in the 12-24Vdc range although there are cases where a voltage higher than 12V is necessary. Refer to the specifications for the minimum power input voltage. When a 5V or 10V output is required and the output current approaches the maximum specified it will be necessary to use a power source that is greater than 12V.

The power can be supplied from any one of several sources depending on the application. Control Microsystems controllers that have 12V to 24Vdc power converters or power supplies can be used. External 24Vdc power supplies that are powering other components in the system can be used. 12V batteries can be used in applications subject to the minimum voltages described above and in the specifications.

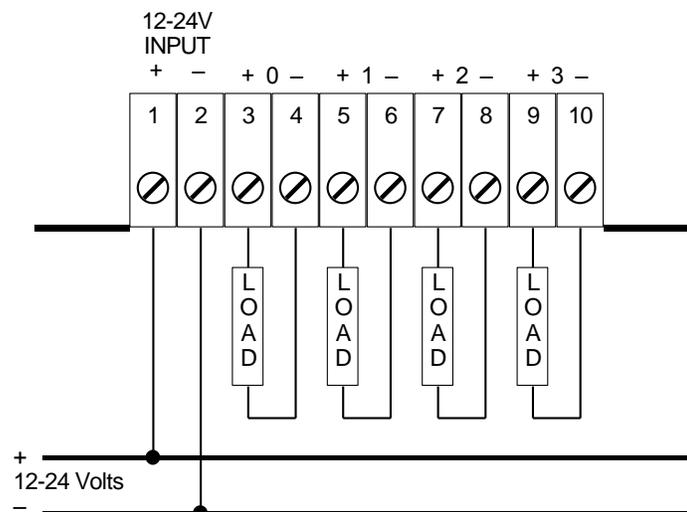


Figure 1: 5304 Typical Field Wiring

## Address Selection

The 5000 I/O bus will support a maximum of twenty I/O (input/output) modules. 5000 I/O module types may be combined in any manner to the maximum

supported by the controller used. The types of input and output modules available are:

- Digital Input modules
- Digital Output modules
- Analog Input modules
- Analog Output modules
- Counter Input modules

Each type of I/O module, connected to the I/O bus, has a unique I/O module address. Different types of I/O modules may have the same module address.

The address range supported by the controller module may restrict the I/O module address range. Refer to the controller manual for the maximum address supported.

The four address switches labeled 8, 4, 2, and 1 set the address.

To set the address:

- Open the four switches by sliding the actuators to the “OFF” position.
- Close the switches that total to the desired address by sliding the actuators to “ON”.

Switch settings for each of the 16 module addresses are shown in **Figure 2: 5304 Analog Output Module Address Switches**

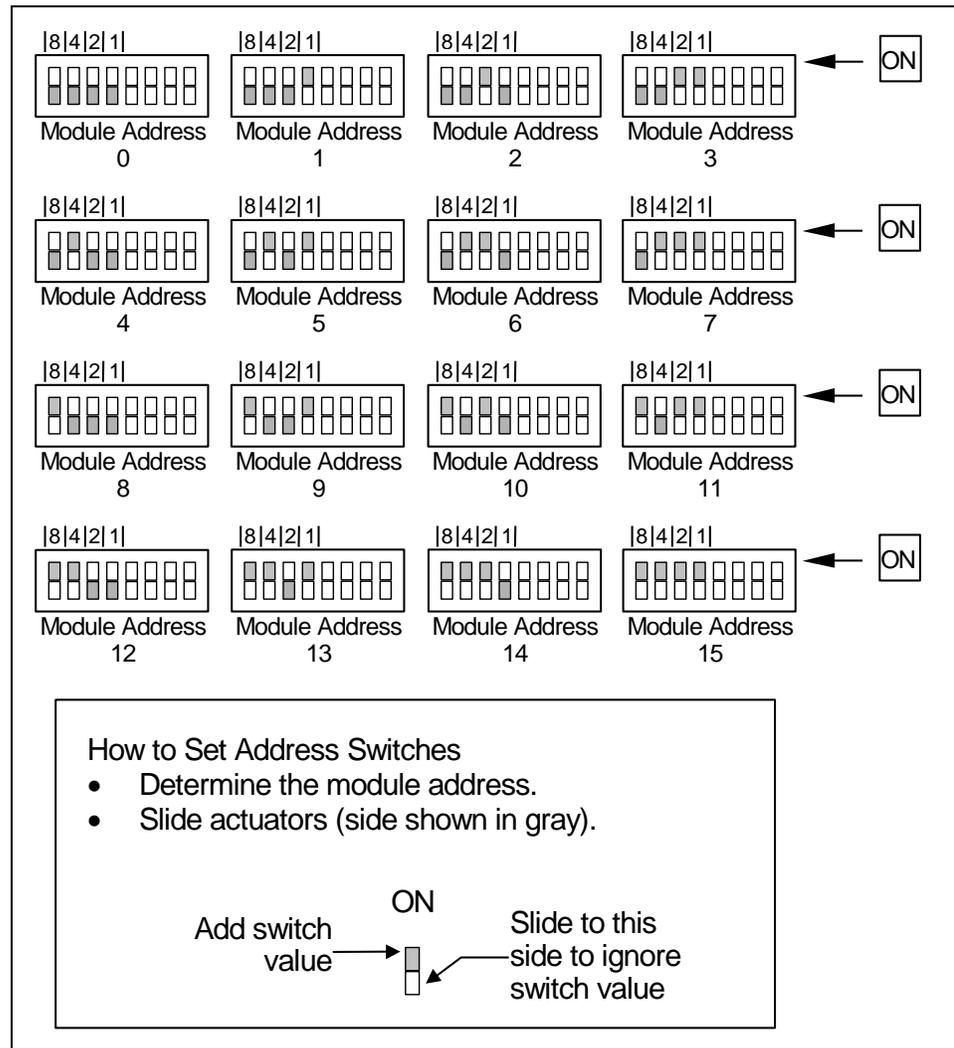


Figure 2: 5304 Analog Output Module Address Switches

## Current/ Voltage Mode Selection

The outputs are calibrated at the factory in either current or voltage mode, depending on module version. An output requires re-calibration upon changing its operating mode. See section **Analog Output Calibration** for details.

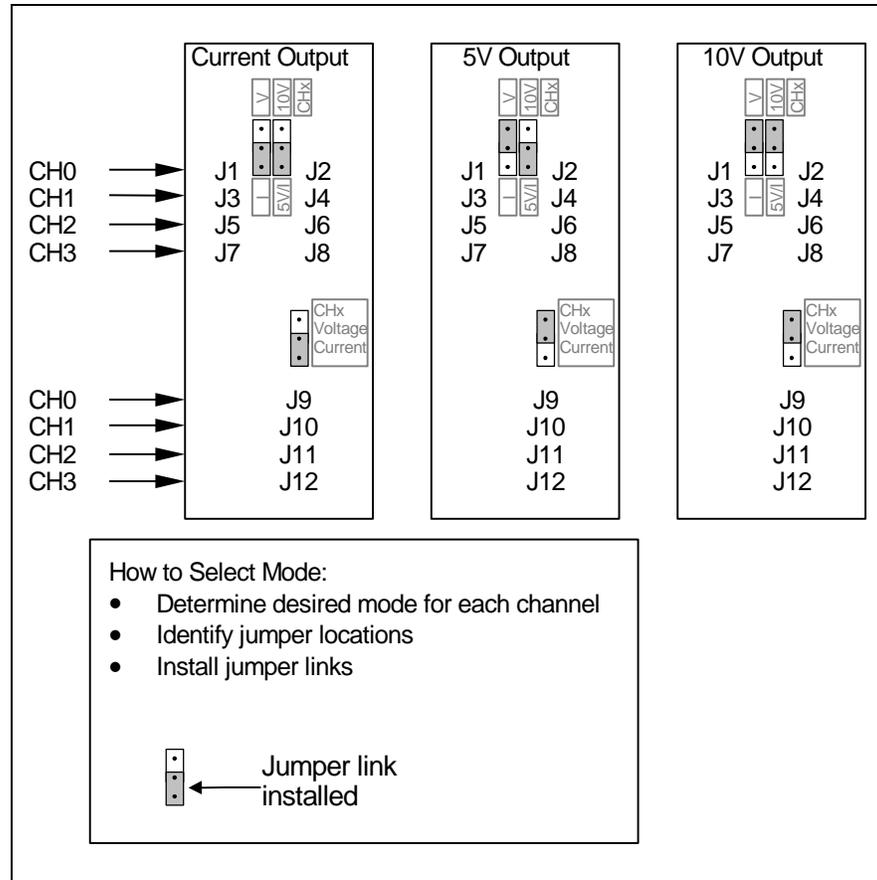
Each output is independently configurable as either a current or a voltage mode output. Furthermore, in voltage mode, two ranges are available: 5V and 10V full scale.

Three jumper links per channel are used to select the operating mode:

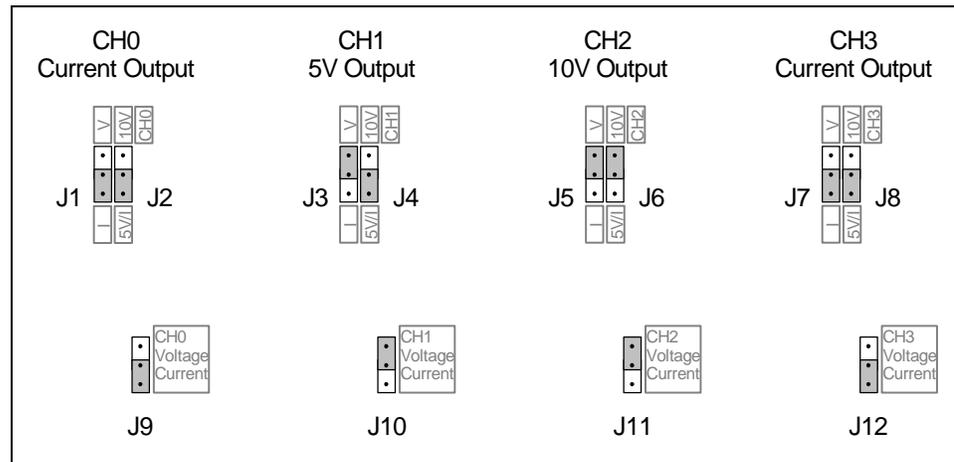
- J1, J2, J9 for Channel 0
- J3, J4, J10 for Channel 1

- J5, J6, J11 for Channel 2
- J7, J8, J12 for Channel 3

The valid configurations are presented in **Figure 3: 5304 Current/ Voltage Mode Selection** and an example is given in **Figure 4: 5304 Mixed Configuration Example**



**Figure 3: 5304 Current/ Voltage Mode Selection**



**Figure 4: 5304 Mixed Configuration Example**

## Output Offset Selection

The 5304 Analog Output Module can be configured to output a 0-20mA or 4-20mA signal when operating in current mode. When configured for voltage mode, the available ranges are 0-5V or 1-5V and 0-10V or 2-10V respectively, depending on the mode selected.

The offset is set independently for each of the four channels.

To select the 0-20mA/ 0-5V/ 0-10V range:

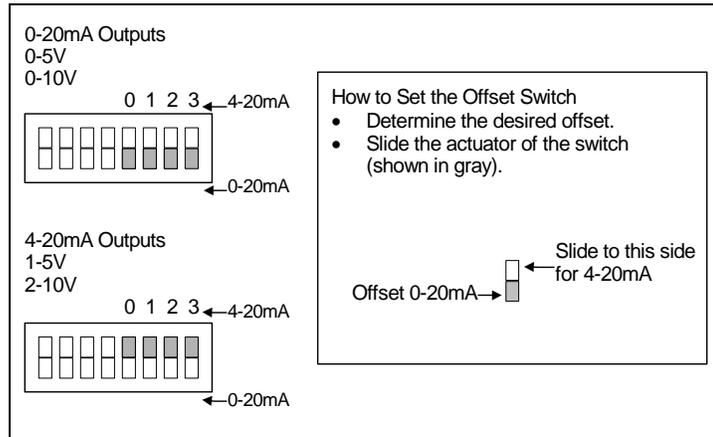
- Slide the actuator of the offset switch to the position labeled 0-20mA.

To select the 4-20mA/ 1-5V/ 2-10V range:

- Slide the actuator of the offset switch to the position labeled 4-20mA.

The outputs of the module will be 0mA or 0V during a system reset, regardless of the offset setting. When the system reset is over, the outputs will go to 0mA/ 0V/ 0V or 4mA/ 1V/ 2V, as configured by the mode and offset settings.

The switch setting for the output offset is shown in **Figure 5: 5304 Output Offset Switch**.



**Figure 5: 5304 Output Offset Switch**

## Operation and Maintenance

### Data Format

5000 analog output modules use 16 bit, signed numbers. Modules with less than 16 bit resolution normalize the data into the 16 bit format.

The 5304 module has a 12 bit, unipolar, digital to analog (D/A) converter. There are 4096 D/A counts in the output signal range.

The module can be configured for either 0-20mA/ 0-5V/ 0-10V or 4-20mA/ 1-5V/ 2-10V output range.

### 0-20mA/ 0-5V/ 0-10V Output Range

The table below shows the output currents and voltages for several data values when the offset switch is set 0-20mA.

The output is  $\text{Data} / 32768 \times \text{Range}$ .

Data	Current(mA)	Voltage (V) (5V full scale)	Voltage (V) (10V full scale)
0	0	0	0
8192	5	1.25	2.5
16384	10	2.5	5
24576	15	3.75	7.5
32760	19.995	4.9988	9.9976

### 4-20mA/ 1-5V/ 2-10V Output Range

The table below shows the output currents and voltages for several data values when the offset switch is set 4-20mA.

The output:

$$(\text{Data} / 32768 \times (\text{Range} - \text{Offset})) + \text{Offset}$$

where

$$\text{Range} = 20\text{mA}, 10\text{V} \text{ or } 5\text{V}$$

$$\text{Offset} = 4\text{mA}, 2\text{V} \text{ or } 1\text{V}.$$

Data	Current (mA)	Voltage(V) (5V full scale)	Voltage (V) (10V full scale)
0	4	1	2
8192	8	2	4
16384	12	3	6

Data	Current (mA)	Voltage(V) (5V full scale)	Voltage (V) (10V full scale)
24576	16	4	8
32760	19.996	4.999	9.998

## Maintenance

This module requires no routine maintenance. If the module is not functioning correctly, contact Control Microsystems Technical Support for more information and instructions for returning the module for repair.

## Troubleshooting

Condition	Action
Outputs are 0mA/ 0V.	Check the 12-24V power.
The full scale output is less than 20mA in current mode.	Check the 12-24V power. Check that the load resistance is within specification.
The full scale output is less than 5V/ 10V in voltage mode.	Check the 12-24V power. Check that the load resistance is within specification.
Reading is constant.	Check that the analog output is not forced.
The output is 4mA when a value of 0 is output. 0mA was expected.	The 4-20mA output offset is selected. Select the 0-20mA offset.
The output is 0mA when a value of 0 is output. 4mA was expected.	The 0-20mA output offset is selected. Select 4-20mA offset.
The voltage output reading seems to be about half what is expected.	Check the load resistance is within the specification. Check the output is not a 5V one, instead of 10V.
The output seems to be uncalibrated at high output values. This improves somewhat as lower values are output.	Check the load resistance is within the specification. Check the output is a current mode one.
The output seems to be uncalibrated at small output values. This improves as larger values are output.	Check the setting of the output offset switch. The wrong output offset is probably selected.

## Analog Output Calibration

The 5304 Analog Output module is calibrated at the factory and should not require periodic calibration. Calibration may be necessary if the module has been repaired as a result of damage or if the outputs have been reconfigured.

There are eight potentiometers for calibration of the analog outputs – two for each channel. Potentiometers Gain0, Gain1, Gain2, Gain3 adjust the gain of

channels 0 through 3 respectively, while Offset0, Offset1, Offset2, Offset3 adjust the offset of channels 0 through 3 respectively.

Calibration requires that you write values to the analog output module. Refer to the documentation for the controller module for details.

### Current Outputs Calibration

It is assumed that channels are current outputs. To calibrate the current outputs of the 5304 Analog Output module:

1. Connect the 5304 to a controller module. Apply 24 volts to the 5304 terminal block on terminals 1 and 2, observing polarity.
2. Set the output range to 0-20mA.
3. Output a data value of 32752 to each channel.
4. Measure the output current of channel 0 in series with a 250 $\Omega$  load resistor. Adjust the Gain0 potentiometer for an output of 19.990mA.
5. Repeat step 4 for outputs 1, 2 and 3 using the GAIN1, GAIN2 and GAIN3 potentiometers.
6. Output a data value of 816 to each channel.
7. Measure the output current of channel 0 in series with a 250 $\Omega$  resistor. Adjust the Offset0 potentiometer for an output of 498 $\mu$ A.

Repeat step 7 for outputs 1,2 and 3 using the Offset1, Offset2 and Offset3 potentiometers.

### 5V Outputs Calibration

It is assumed that all channels are configured as 5V voltage outputs. To calibrate the 5V outputs of the 5304 Analog Output module:

1. Connect the 5304 to a controller module. Apply 24V to the 5304 terminal block on terminals 1 and 2, observing polarity.
2. Set the output range to 0-5V, by setting the range switch to the 0-20mA position.
3. Output a data value of 32736 to each channel.
4. Measure the output voltage of channel 0. Adjust the Gain0 potentiometer for an output of 4.995V
5. Repeat step 4 for outputs 1, 2 and 3 using the Gain1, Gain2, Gain3 potentiometers.
6. Output a data value of 816 to each channel.
7. Measure the output voltage of channel 0. Adjust the Offset1 potentiometer for an output of 0.125V.

Repeat step 7 for outputs 1,2 and 3 using the Offset1, Offset2 and Offset3 potentiometers.

## 10V Outputs Calibration

It is assumed that channels are configured as 10V voltage outputs. To calibrate the 10V outputs of the 5304 Analog Output module:

1. Connect the 5304 to a controller module. Apply 24V to the 5304 terminal block on terminals 1 and 2, observing polarity.
2. Set the output range to 0-10V, by setting the range switch to the 0-20mA position.
3. Output a data value of 32736 to each channel.
4. Measure the output voltage of channel 0. Adjust the Gain0 potentiometer for an output of 9.990V.
5. Repeat step 4 for outputs 1, 2 and 3 using the Gain1, Gain2, Gain3 potentiometers.
6. Output a data value of 816 to each channel.
7. Measure the output voltage of channel 0. Adjust the Offset1 potentiometer for an output of 0.249V.

Repeat step 7 for outputs 1,2 and 3 using the Offset1, Offset2 and Offset3 potentiometers.

For custom modules having mixed output configurations each channel is calibrated separately, following the corresponding procedure.

## Specifications

**Disclaimer:** Control Microsystems reserves the right to change product specifications. For more information visit [www.controlmicrosystems.com](http://www.controlmicrosystems.com).

<b>Output Points</b>	Four
<b>Output Modes</b>	Current mode, jumper link selectable Voltage mode, 5V full scale, jumper link selectable Voltage mode, 10V full scale, jumper link selectable
<b>Output Signal Ranges</b>	0-20mA or 4-20mA, switch configurable 0-5V or 1-5V, switch configurable 0-10V or 2-10V, switch configurable
<b>Output Type</b>	Single ended regulation on positive side with common negative return
<b>Maximum Load Resistance in Current Mode</b>	1000 $\Omega$ with 24V DC loop power 400 $\Omega$ with 12V DC loop power 250 $\Omega$ with 9V DC loop power
<b>Minimum Load Resistance in Voltage Mode</b>	2k $\Omega$ for 10V full scale, with min 20V power applied 1k $\Omega$ for 5V full scale, with min 15V DC power applied
<b>Isolation</b>	500Vac field to logic
<b>D/A Resolution</b>	12 bits over the 0-20mA/ 0-5V/ 0-10V ranges
<b>Absolute Accuracy</b>	+/- 0.05 % of full scale at 25°C (77°F) +/- 0.2 % of full scale over temperature range
<b>Noise and Ripple</b>	0.04% maximum
<b>Transient Protection</b>	600 watt transient suppressor on each output and power input 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
<b>Response Time</b>	2ms typical to 90% signal change
<b>Addressing</b>	DIP switch configurable
<b>5V Power Requirements</b>	6 mA minimum. 25mA maximum. Note: This current is a function of controller, I/O size and data.
<b>DC Power Requirements</b>	15mA quiescent plus 80mA max. in current mode 15mA quiescent plus 20mA max. in voltage mode
<b>DC operating voltage limits</b>	9V or (20mA x load resistance) + 4V (which ever is greater) in current mode (1.5 x Range / load resistance) + Range + 2.5V in

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	voltage mode 30V maximum. UL508 rated 13.75-28Vdc. Class 2.
<b>Terminations</b>	10 pole, removable terminal block 12 to 22 AWG, 15 amp contacts Screw termination - 6 lb.-in. (0.68 Nm) torque
<b>Dimensions</b>	4.25 inch (108 mm) wide 4.625 inch (118 mm) high 1.75 inch (44 mm) deep
<b>Mounting</b>	7.5 x 35 DIN rail
<b>Packaging</b>	Corrosion resistant zinc plated steel with black enamel paint
<b>Environment</b>	5% RH to 95% RH, non-condensing -40°C to 70°C -40°F to 158°F

## Approvals and Certifications

<b>Hazardous Locations - North America</b>	<p>Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations. Temperature Code T4</p> <p>UL Listed and CSA approved to the following standards:</p> <ul style="list-style-type: none"> <li>• CSA Std. C22.2 No. 213-M1987 - Hazardous Locations.</li> <li>• UL Std. No. 1604 - Hazardous (Classified) Locations.</li> </ul>
<b>Hazardous Locations - Europe</b>	<p>ATEX II 3G, Ex nA IIC T4</p> <p>per EN 60079-15, protection type n (Zone 2)</p>
<b>Hazardous Locations</b>	<p>IECEX, Ex nA IIC T4</p> <p>per IEC 60079-15, protection type n (Zone 2)</p>
<b>ATEX and IECEX Applications only</b>	<p>This equipment is to be installed in an enclosure certified for use, providing a degree of protection of IP54 or better. The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating. A T4 rating is acceptable.</p> <p>For products using Solid State Relays (5415, 5606 and 5607 modules and SCADAPack using 5606 and 5607 modules) A T4 rating is acceptable for maximum loads of 2A. When 3A loads are connected to the Solid State Relays, the maximum ambient rating is lowered to 50°C in order to maintain the T4 rating.</p>
<b>Safety</b>	<p>CSA (cCSAus) certified to the requirements of: CSA C22.2 No. 142-M1987 and UL916. (Process Control Equipment, Industrial Control Equipment) in Canada and USA.</p> <p>UL (cULus) listed: UL508 (Industrial Control Equipment)</p>
<b>Digital Emissions</b>	<p>FCC47 Part 15, Subpart B, Class A Verification</p> <p>EN61000-6-4: 2007 Electromagnetic Compatibility Generic Emission Standard Part2: Industrial Environment</p> <p>C-Tick compliance. Registration number N15744.</p>
<b>Immunity</b>	<p>EN61000-6-2: 2005 Electromagnetic Compatibility Generic Standards Immunity for Industrial Environments</p>
<b>Declaration</b>	<p>This product conforms to the above Emissions and Immunity Standards and therefore conforms with the requirements of Council Directive 2004/108/EEC (as amended) relating to electromagnetic compatibility and is eligible to bear the CE mark.</p> <p>The Low Voltage Directive is not applicable to this product.</p>

