SNAP I/O WIRING GUIDE

Form 1403-040427—APRIL, 2004

OPTO 22

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Table of Contents

Introduction **1**

SNAP Mounting Racks **2**

Racks Without Terminal Strips 3

Racks with Terminal Strips 3

SNAP Power Supplies **4**

Primary Power Supply 4

Determining Power Requirements 4

Wiring the Primary Power Supply 6

Loop Power Supply 7

SNAP Brains **9**

SNAP I/O Modules **10**

Module Wiring Diagrams 10

Digital Input Modules 11

Digital Output Modules 12

Analog Input Modules 15

Analog Output Modules 24

Serial Communication Modules 27

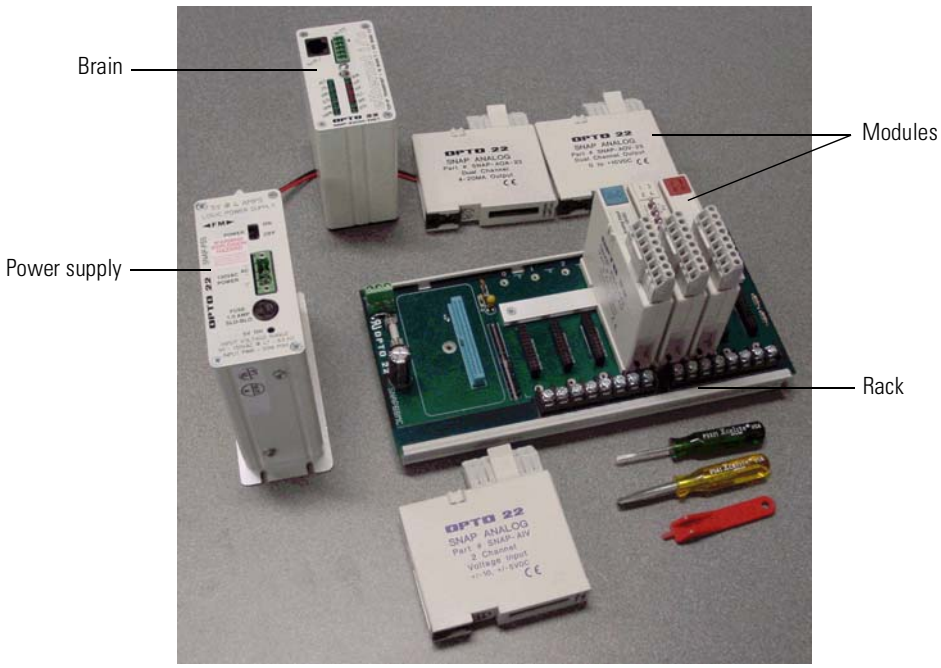
SNAP PID Module 30

SNAP I/O™ Wiring Guide

Introduction

This document includes wiring diagram examples for assembling your SNAP I/O system and attaching it to the devices it will monitor and control. The system includes the SNAP brain and SNAP I/O modules mounted on a SNAP rack, powered by a SNAP power supply. (SNAP controllers are not included in this document.)

Example: SNAP Ultimate I/O system partly assembled



This document includes basic wiring information for SNAP racks, power supplies, brains, and I/O modules. For more information, see the data sheet and the installation or user's guide for your specific products.

SNAP Mounting Racks

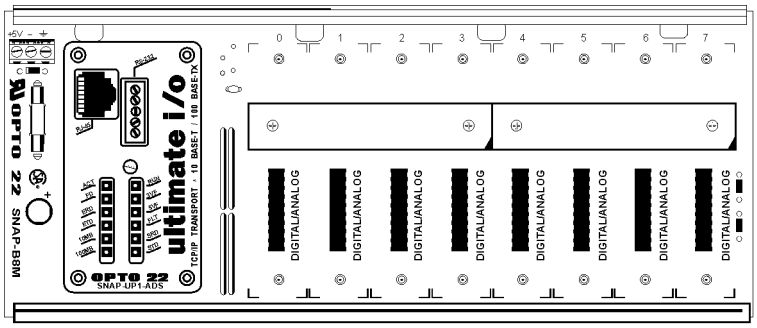
SNAP mounting racks can hold a SNAP brain and up to 4, 8, 12, or 16 SNAP modules.

The following table shows SNAP rack and brain compatibility.

Brain Part Number	Compatible Racks	Rack Description
SNAP-UP1-ADS SNAP-B3000-ENET SNAP-ENET-RTC SNAP-WLAN-FH-ADS B3000 SNAP-B4 SNAP-B6 SNAP-HA SNAP-BRS SNAP-BRS-HA SNAP-BRS-HA-J SNAP-B3000-MODBUS	SNAP-B4M	4-module mixed
	SNAP-B8M	8-module mixed
	SNAP-B8MC	8-module mixed, terminal block
	SNAP-B8MC-P	8-module mixed, pluggable terminal block
	SNAP-B12M	12-module mixed (digital in positions 0–7 only)
	SNAP-B12MC	12-module mixed (digital in positions 0–7 only), terminal block
	SNAP-B12MC-P	12-module mixed (digital in positions 0–7 only), pluggable terminal block
	SNAP-B16M	16-module mixed (digital in positions 0–7 only)
	SNAP-B16MC	16-module mixed (digital in positions 0–7 only), terminal block
	SNAP-B16MC-P	16-module mixed (digital in positions 0–7 only), pluggable terminal block
SNAP-UP1-D64 SNAP-ENET-D64 SNAP-PDPRS64	SNAP-D64RS	16-module digital only (limited digital functions)
SNAP-UP1-M64 SNAP-ENET-S64	SNAP-M16	4-module mixed (limited digital functions)
	SNAP-M32	8-module mixed (limited digital functions)
	SNAP-M64	16-module mixed, digital in any position (limited digital functions)
SNAP-UP1-ADS (newer model)	SNAP-N8M	8-module mixed; accommodates remote communication adapter
	SNAP-N12MC	12-module mixed (digital in positions 0–7 only); accommodates remote communication adapter

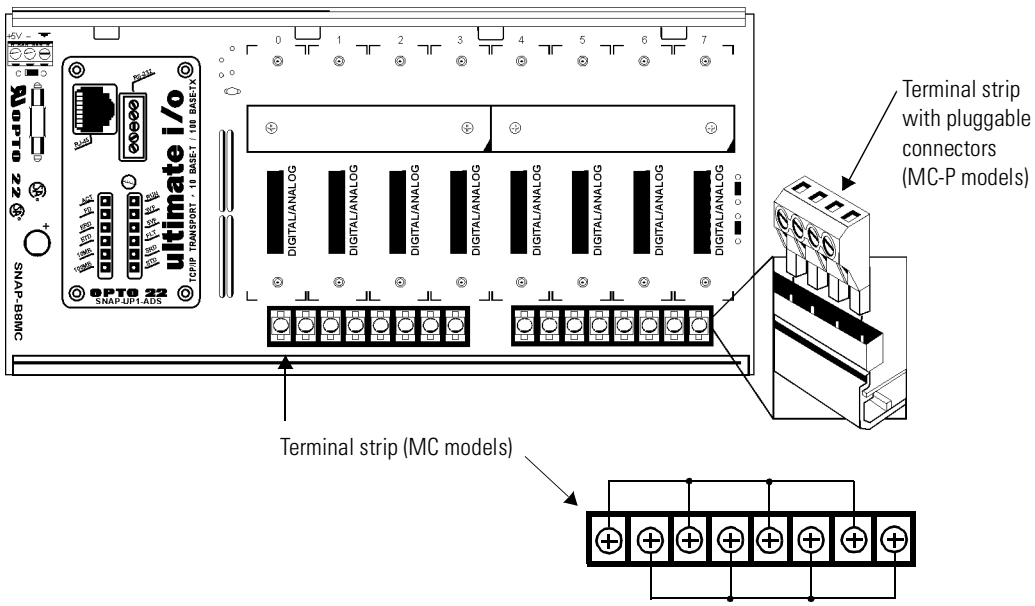
Racks Without Terminal Strips

SNAP racks come either with or without a common terminal strip. The following diagram shows a rack without a terminal strip. For this type of rack, all wiring connections are made to the field connectors on the top of each module (wiring diagrams begin on page 10). A brain is shown on this rack, but the modules have not been inserted yet.



Racks with Terminal Strips

If your rack has a terminal strip, you can use it for field wiring common connections, such as loop power distribution, or low-current applications. The following diagram shows a rack with a terminal strip (MC rack models); the smaller diagram shows the optional terminal strip with pluggable connectors (MC-P rack models). Terminal strips do not connect to SNAP modules; depending on your application, you may need to install wiring from the terminal strip to the module. (Again, the rack is shown with a brain but with no modules.)



SNAP Power Supplies

Primary Power Supply

NOTE: For a more general discussion of using power supplies with Opto 22 systems, see Opto 22 form #1271, a technical note available on our Web site at www.opto22.com.

SNAP racks use a 5 VDC power source (5 VDC [-0.0, +0.1] at minimum 4.0 Amps recommended). For systems using AC source voltage, the SNAP-PS5 or SNAP-PS5U power supply is recommended. For DC systems, such as those using DC backup power, the SNAP-PS5-24DC offers DC-to-DC power.

In general, we recommend you **use an independent, isolated, regulated power supply locally with each rack**. Local isolated supplies offer these advantages:

- Short supply conductors, which minimize losses
- Power redundancy, so the failure of a single supply causes only a single rack failure, not a total system failure
- Fewer voltage drops and ground loops. (Voltage drops and subsequent ground loops may occur when power is distributed over a large system.)

Always **use a separate power supply for the field side of the I/O**. Using the rack supply for field actuation and monitoring defeats the isolation the I/O module offers and therefore increases the chance of a ground loop within the control system. Additionally, a sudden change of current on the field side can cause undesirable voltage fluctuations that may interfere with the computer's operation.

Determining Power Requirements

Both the SNAP-PS5 and the SNAP-PS5-24DC power supplies provide 5 VDC power for loads up to 4 Amps. The SNAP-PS5U provides 5 VDC for loads up to 5 Amps. In most cases this power is sufficient for a SNAP brain, a rack, and the associated I/O modules. However, some combinations of modules, especially special-purpose modules, may require additional power. You can use the following tables to help determine power needs for your I/O units.

Brain Power Requirements

Brain	Power Req. (Amps)*
SNAP Ultimate brains (all models)	1.000
SNAP Ethernet brains (except SNAP-WLAN-FH-ADS)	0.800
SNAP-WLAN-FH-ADS (Wireless Ethernet brain)	1.500
SNAP Simple I/O brains	0.500
B3000 (serial SNAP brain) SNAP-D64RS	0.500
SNAP-B3000-Modbus SNAP ARCNET brains	1.000
SNAP-B4 SNAP-B6	1.000 1.500 if terminated

*Current from 5-volt supply

I/O Unit (Brain, Rack, and I/O Modules) Power Requirements Worksheet

Item	Number	X Power Req. (Amps)	Total Power Required (Amps)†
SNAP brain (Enter Amps from Brain Power Requirements table)	1		
SNAP-IDC5-SW digital input module SNAP-IDC5-SW-NC digital input module		0.200	
All other digital input and output modules		0.050	
SNAP-AICTD analog input module SNAP-AICTD-4* analog input module All analog output modules		0.150	
SNAP-AIARMS analog input module SNAP-AIVRMS analog input module SNAP-AIMA and AIMA-4* analog input modules SNAP-AITM and AITM-2 analog input modules SNAP-AIMV-4* and AIMV2-4* analog input modules SNAP-AIV and AIV-4* analog input modules		0.170	
SNAP-AIRTD analog input module SNAP-AIR40K-4* analog input module SNAP-AIRATE analog input module		0.190	
SNAP-AIPM power monitoring module*		0.100	
Isolated analog input modules (part numbers ending in -i or iSRC)		0.200	
Serial modules*		0.250	
PID modules**		0.250	
Total			

* Can be used with SNAP Simple, SNAP Ethernet, and SNAP Ultimate brains
** Can be used with SNAP Ethernet and SNAP Ultimate brains only
† Current from 5-volt supply

IMPORTANT: For a SNAP-PS5 or a SNAP-PS5-24DC power supply, the total power required must not exceed 4 Amps. For a SNAP-PS5U, the total power required must not exceed 5 Amps.

Wiring the Primary Power Supply

Use one power supply per I/O unit. Use 14 AWG wire.

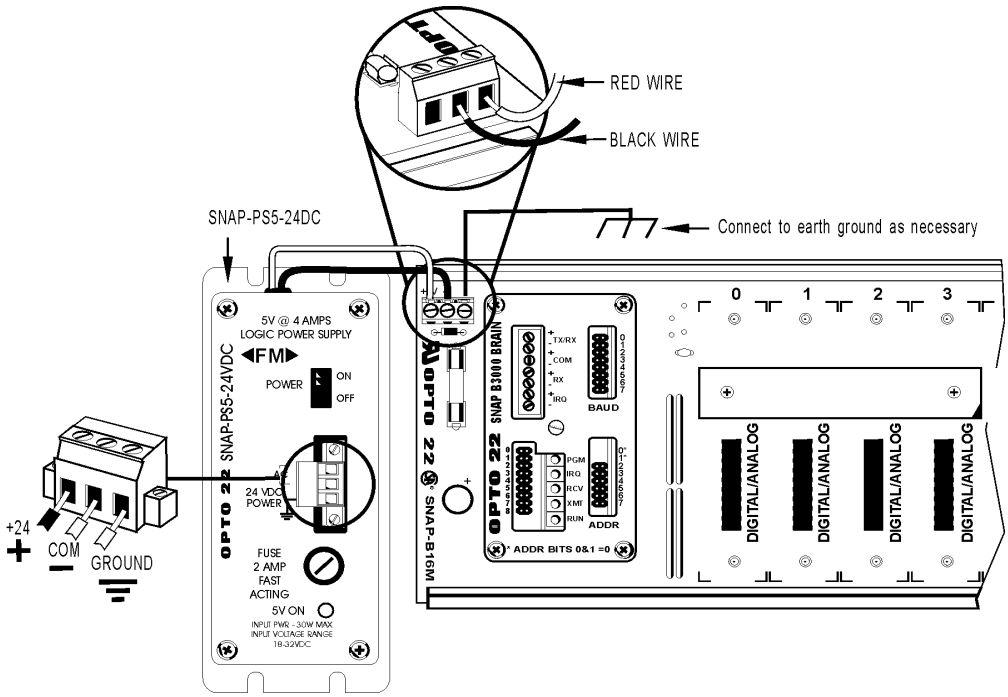
1. Mount the SNAP-PS5 or SNAP-PS5-24DC power supply so that the attached red and black power wires will reach the + and – power terminals on the SNAP mounting rack.

2. Using the power terminals on the SNAP mounting rack, attach the red wire to the + terminal and the black wire to the – terminal. Connect the ground terminal on the SNAP rack to ground.

3. For the SNAP-PS5 (not illustrated): Using the removable input power connector on top of the power supply, apply 120 volts AC power between the two terminals marked "AC." Connect the ground terminal to ground.

4. For the SNAP-PS5U (not illustrated): Using the removable input power connector on top of the power supply, apply 240 or 120 volts AC power between the two terminals marked "AC." Connect the ground terminal to ground.

5. For the SNAP-PS5-24DC (illustrated below): Using the removable input power connector on top of the power supply, apply 24 volts DC power between the two terminals marked "±DC." Connect the ground terminal to ground.



Loop Power Supply

Some analog modules (SNAP-AIMA, SNAP-AIMA-4, and SNAP-AIMA-i) also require a current loop supply, which can be provided by the SNAP-PS24 or the SNAP-PS24U. Both offer 24 volts of DC loop power, the SNAP-PS24 at .75 A and the SNAP-PS24U at 1.25 A. Follow these steps to wire loop power supplies.

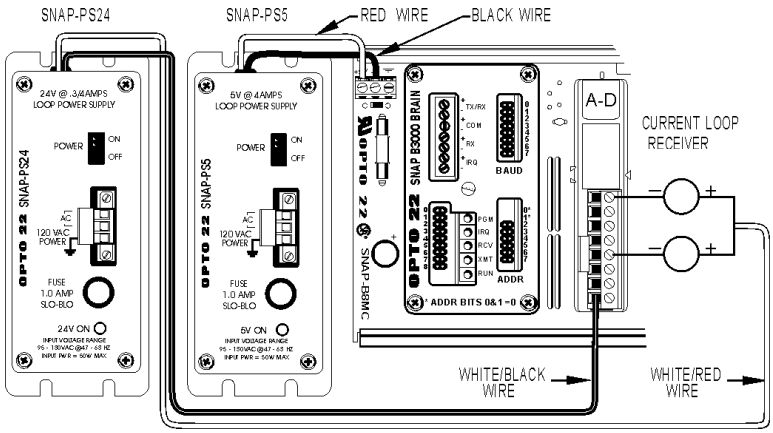
1. Mount the SNAP-PS24 or SNAP-PS24U power supply in a location where the attached output power wires will reach the field connector for SNAP analog modules or, if you are using an MC or MC-P mounting rack, the terminal strip on the rack.

   The white and red wire is the positive wire (24 VDC). The white and black wire is the negative wire (24 VDC return).

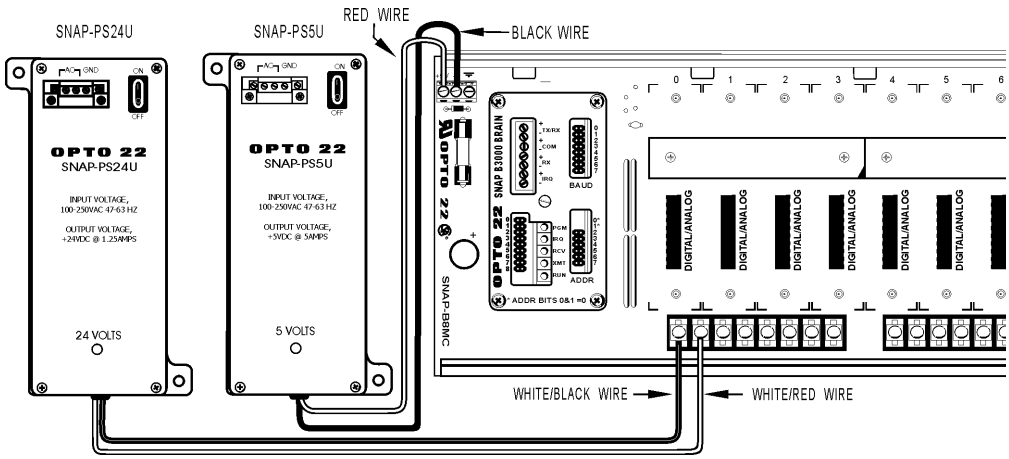
2. If you are wiring directly to the module, see the wiring diagram for the specific module you are using (page 17 and page 18).

   Examples for an input module are shown in the following diagrams.

   SNAP-PS24



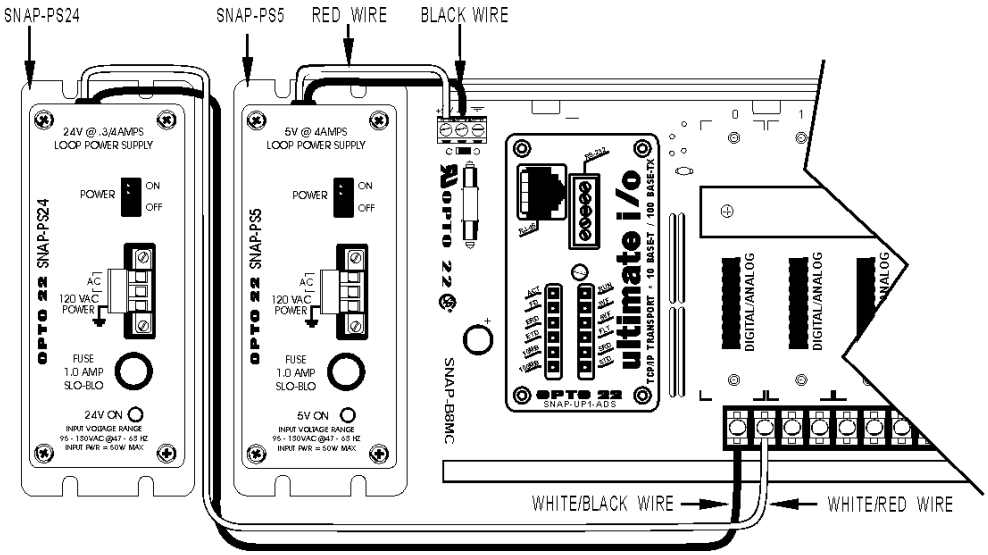
   SNAP-PS24U



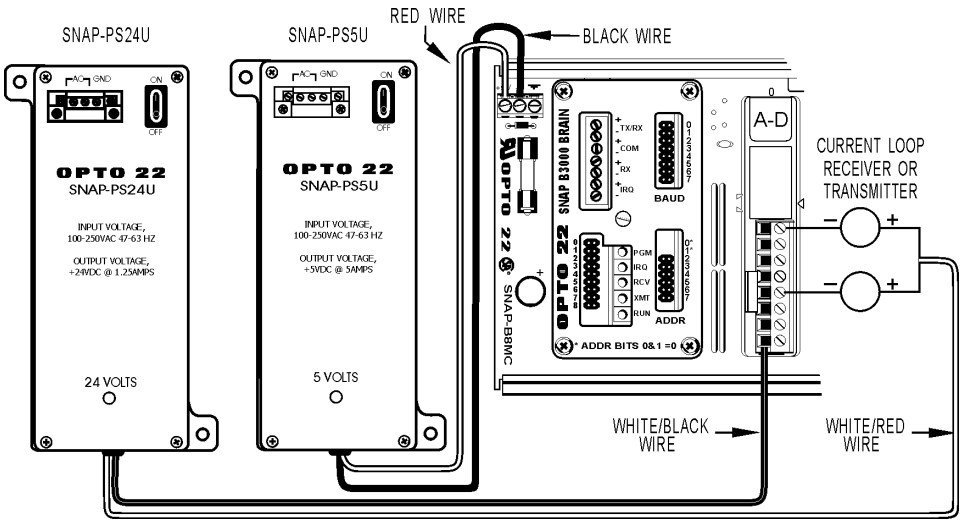
3. If you are wiring to a rack with a field wiring terminal strip (models MC and MC-P), see Opto 22 form 784 for specific loop power wiring information.

   Examples are shown in the following diagrams:

SNAP-PS24



SNAP-PS24U



4. Connect the ground terminal to ground. Using the removable input power connector on top of the power supply, apply 120 volts of AC power between the two terminals marked AC.

SNAP Brains

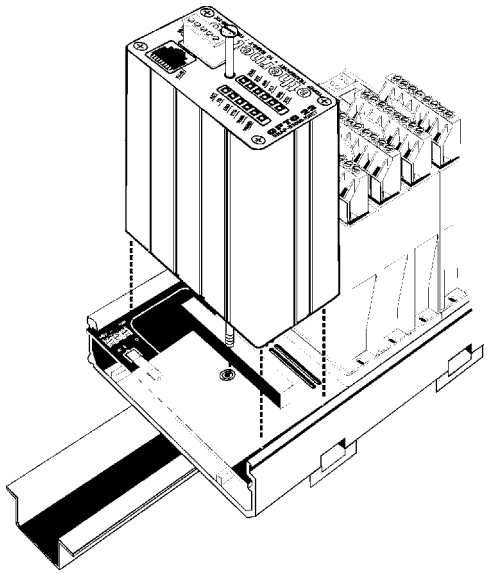
1. Assemble the rack, power supply, and modules according to the directions that came with them.

   CAUTION: *Make certain that you have the correct SNAP rack for the brain you are using.* ***Using the wrong rack will severely damage the brain.*** *See page 2 for brain and rack compatibility.*

2. Remove the brain from its packaging.

3. Turn off power to the rack assembly.

4. Align the brain connector with the mating connector on the mounting rack, as shown in the diagram at right.



5. Seat the brain onto the connector and use the hold-down screw to secure the brain in position. Do not overtighten.

6. Using Category 5 or superior solid unshielded twisted-pair cable, connect the brain in one of the following ways:

   - (Recommended for initial configuration) Connect to a PC directly, using an Ethernet crossover cable.
   - Connect to a standard 10BASE-T or 100BASE-TX Ethernet network that has a PC on the same subnet as the brain and does NOT have a Dynamic Host Configuration Protocol (DHCP) server.

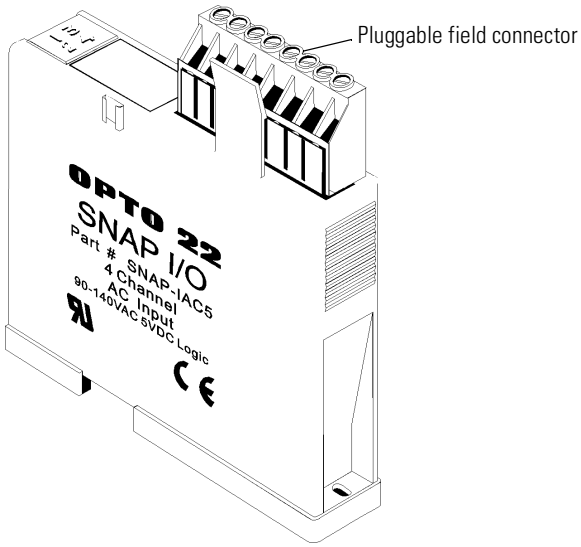
   Maximum cable or segment length is 100 meters; minimum cable length is one meter.

7. Follow instructions in the brain data sheet or user's guide for communications wiring and jumper settings, if applicable.

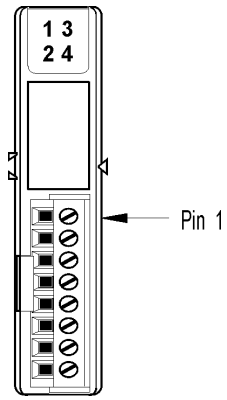
SNAP I/O Modules

Most SNAP input and output modules have a top-mounted, pluggable field connector for easy access when the module is installed on the SNAP mounting rack. The following diagrams show the field connector and the location of pin 1.

SNAP Module



Top View of Module



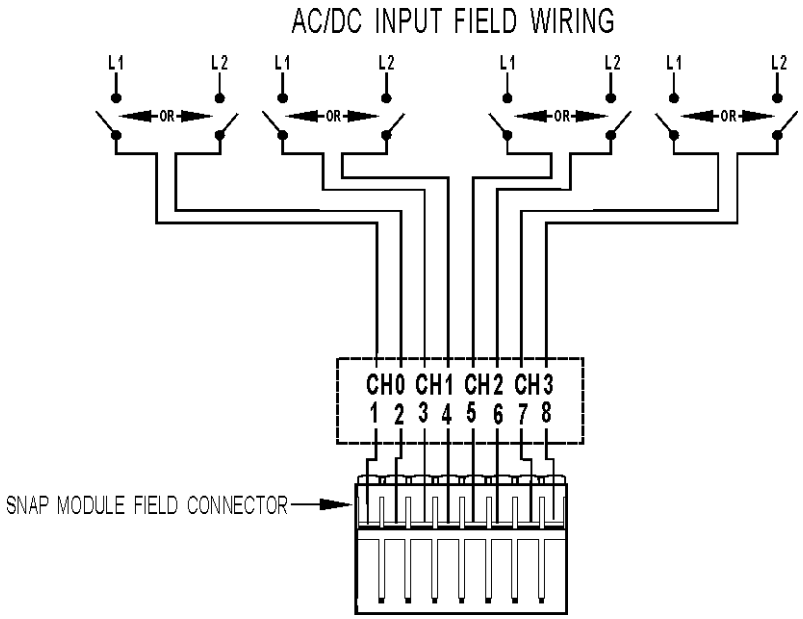
Module Wiring Diagrams

Module wiring diagrams begin on the following pages:

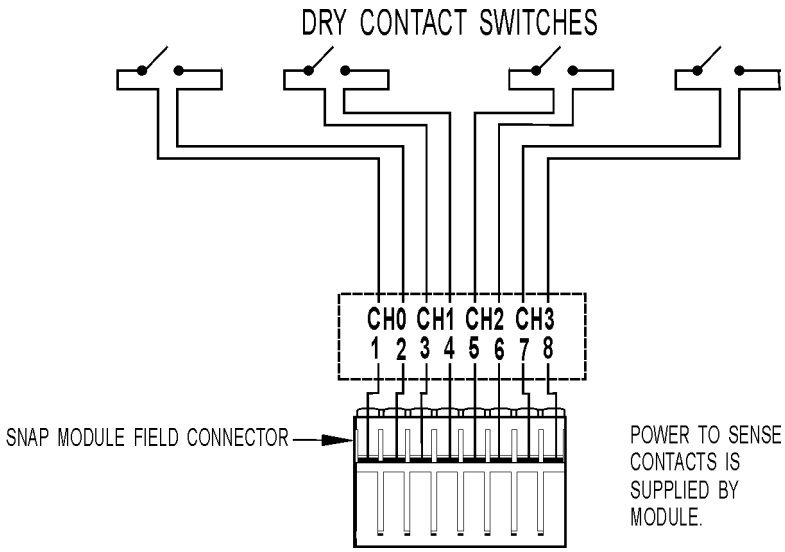
Digital input modules	page 11
Digital output modules	page 12
Analog input modules	page 15
Analog output modules	page 24
Serial communication modules	page 27
PID modules	page 30

Digital Input Modules

Wiring for most digital input modules (except SNAP-IDC5-SW and SNAP-IDC5-SW-NC)



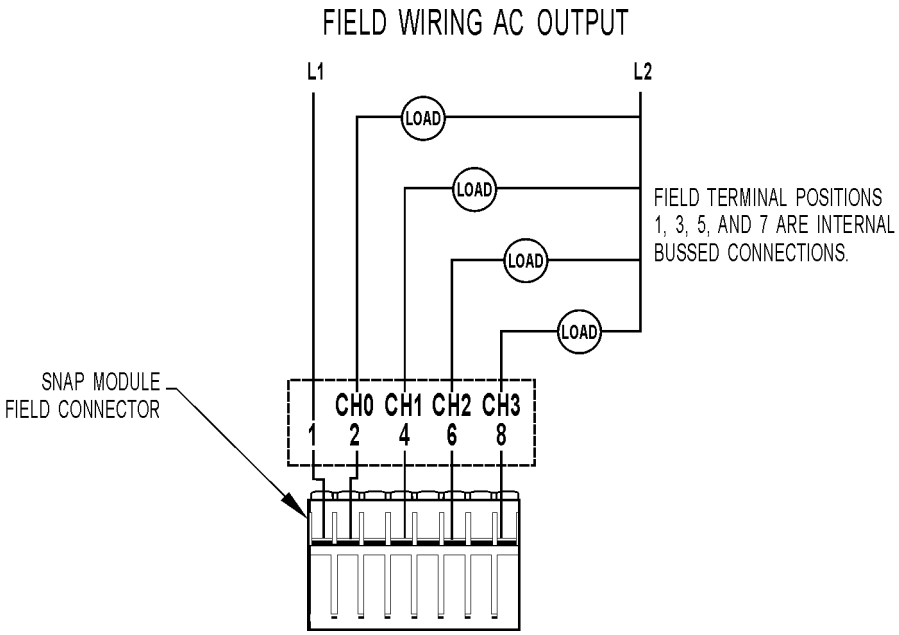
Wiring for SNAP-IDC5-SW and SNAP-IDC5-SW-NC digital input modules



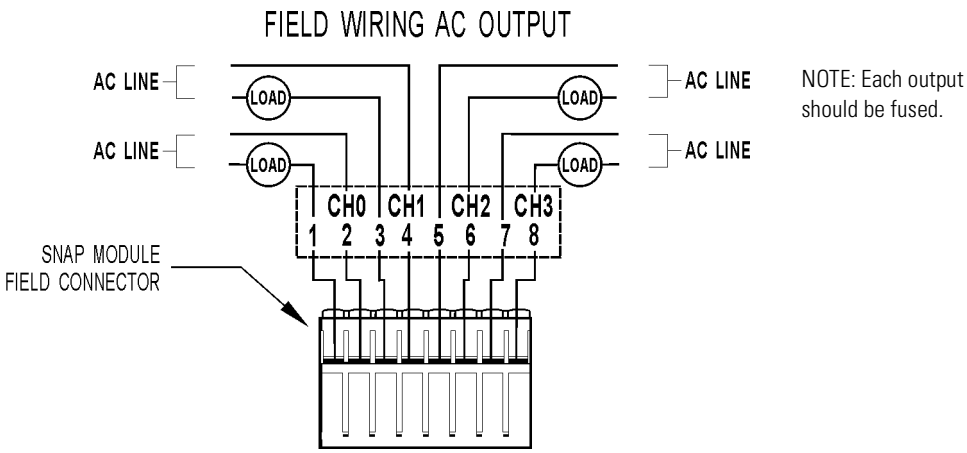
CAUTION: The SNAP-IDC5-SW and SNAP-IDC5-SW-NC inputs are not intended to be used with contacts that are connected to any external user-supplied voltage or currents.

Digital Output Modules

Wiring for SNAP-OAC5 and SNAP-OAC5FM digital AC output modules

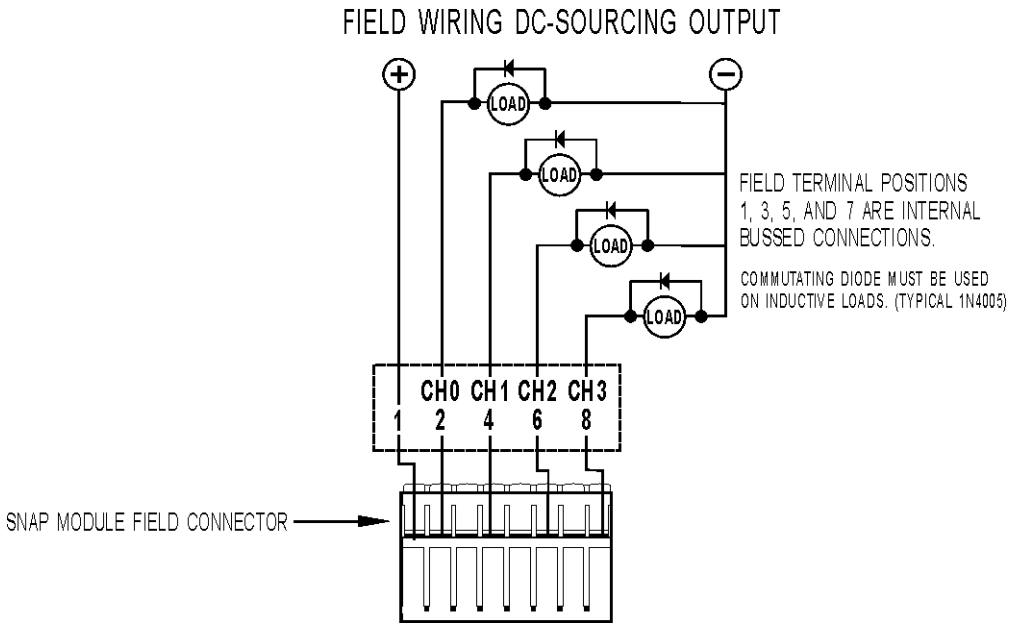


Wiring for SNAP-OAC5MA and SNAP-OAC5-i digital AC output modules

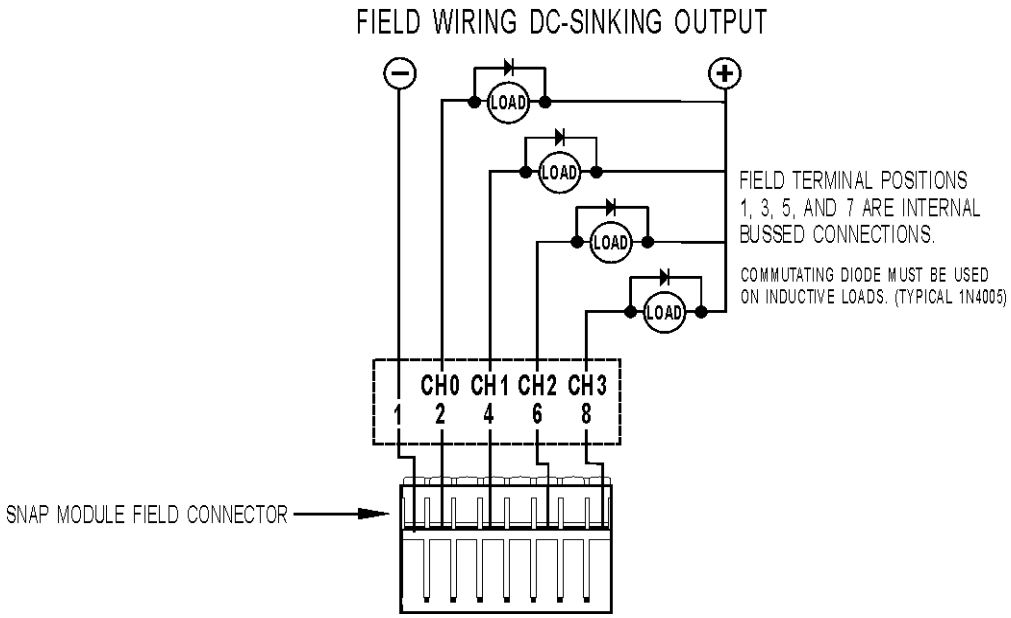


NOTE: Each output should be fused.

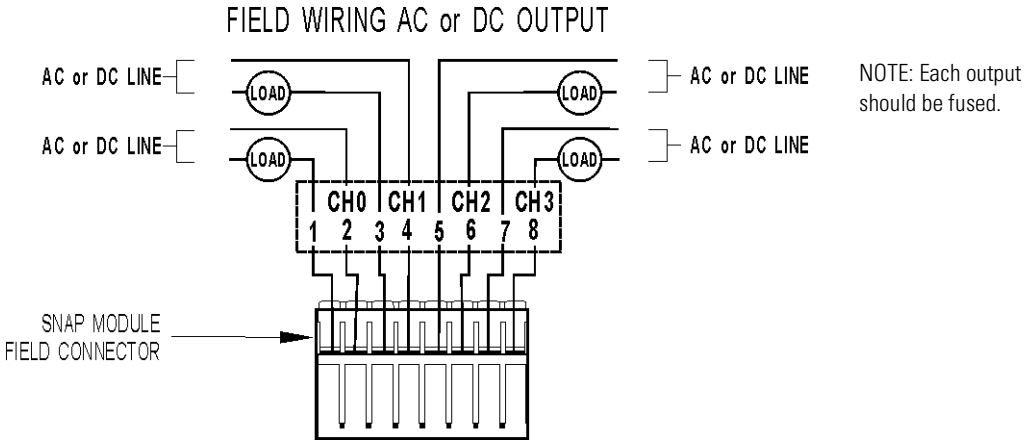
Wiring for SNAP-ODC5SRC and SNAP-ODC5SRCFM digital DC output modules



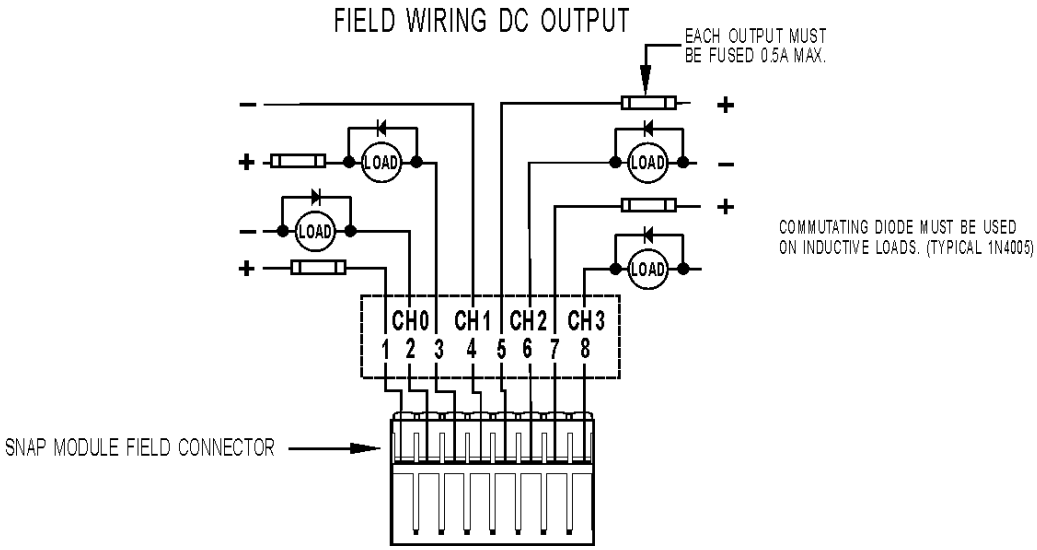
Wiring for SNAP-ODC5SNK, SNAP-ODC5ASNK, and SNAP-ODC5SNKFM digital DC output modules



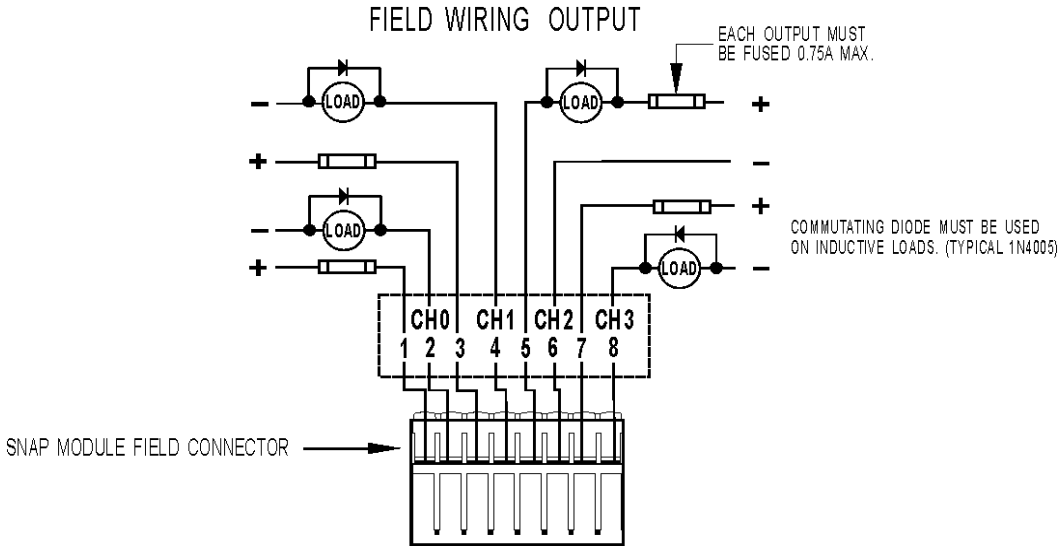
Wiring for SNAP-ODC5R, SNAP-ODC5R5, SNAP-ODC5RFM, and SNAP-ODC5R5FM dry contact output modules



Wiring for SNAP-ODC5MA digital DC output module with manual/auto switches



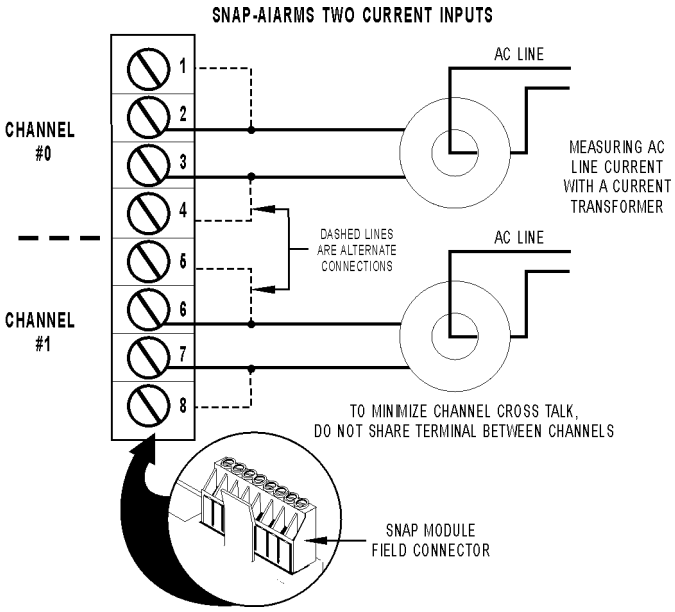
Wiring for SNAP-ODC5-i, SNAP-ODC5A-i, SNAP-ODC5-iFM, and SNAP-ODC5A-iFM isolated digital DC output modules

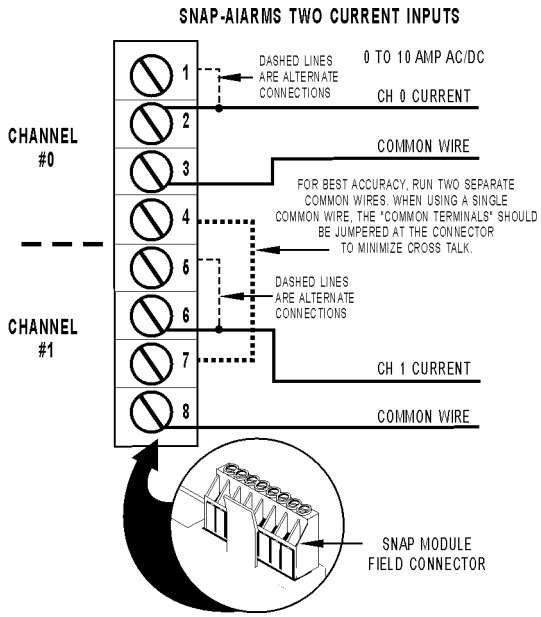


Analog Input Modules

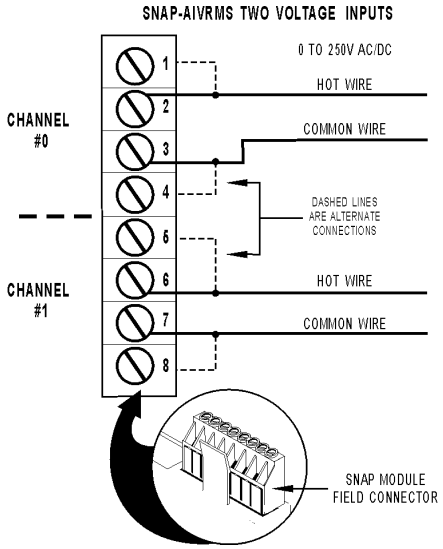
Wiring for SNAP-AIARMS analog amps RMS AC/DC input

Two possible wiring diagrams are shown.
Terminals 3, 4, 7, and 8 share a common connection inside the module. **Make sure you observe polarity** when connecting the second channel. To avoid a potentially hazardous short, double-check wiring before turning on the current to be monitored.



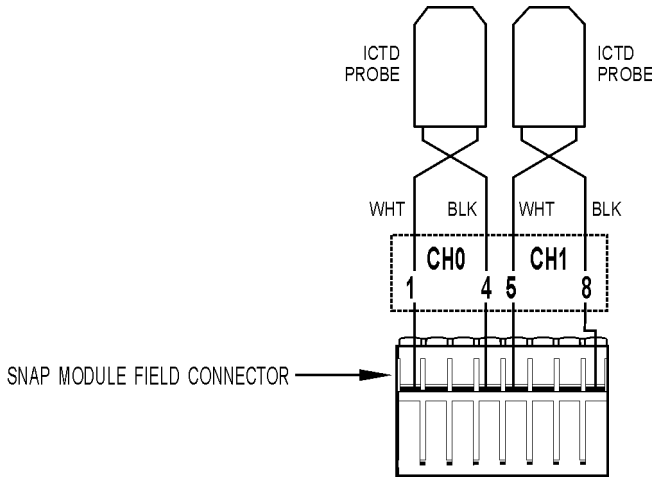


Wiring for SNAP-AIVRMS analog volts RMS AC/DC input



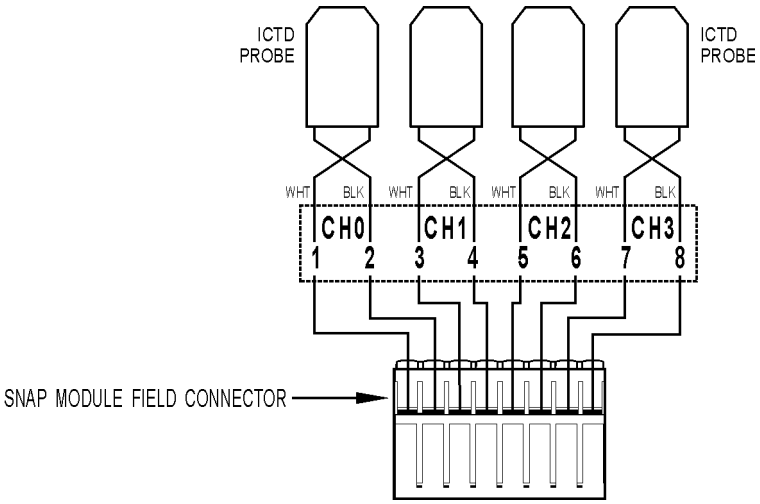
Terminals 3, 4, 7, and 8 share a common connection inside the module. **Make sure you observe polarity** when connecting the second channel. To avoid a potentially hazardous short, double-check wiring before turning on the voltage to be monitored.

Wiring for SNAP-AICTD two-channel analog temperature input



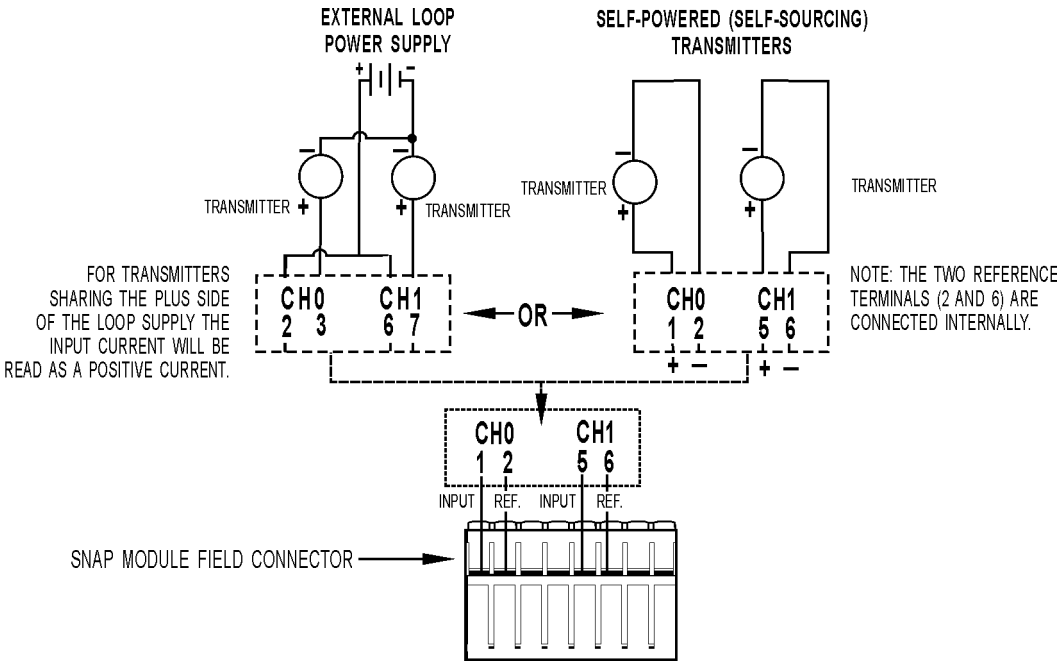
Wiring for SNAP-AICTD-4 four-channel analog temperature input

NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.



Wiring for SNAP-AIMA two-channel analog current input

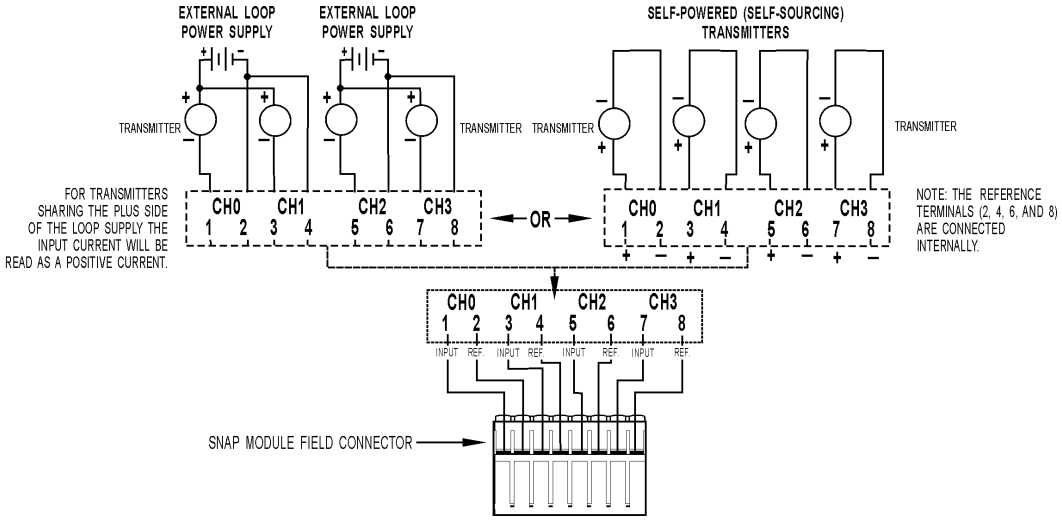
Since all inputs share a common reference, the module must be installed at the beginning or end of a typical 4–20 mA loop. If you are using both standard and self-sourcing transmitters, either put the transmitters on different modules, or use different power supplies. Do not use standard and self-sourcing transmitters on the same module.
This module does NOT supply loop excitation current. See"Loop Power Supply" on page 7.



Wiring for SNAP-AIMA-4 four-channel analog current input

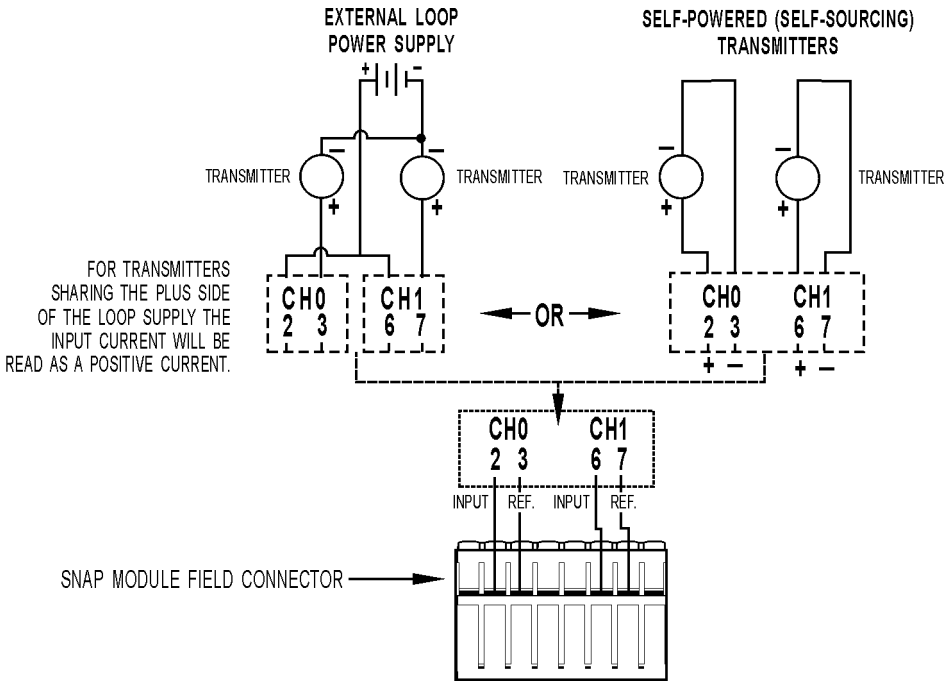
NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.

Since all inputs share a common reference, the module must be installed at the beginning or end of a typical 4–20 mA loop. If you are using both standard and self-sourcing transmitters, either put the transmitters on different modules, or use different power supplies. Do not use standard and self-sourcing transmitters on the same module.
This module does NOT supply loop excitation current. See"Loop Power Supply" on page 7.



Wiring for SNAP-AIMA-i isolated two-channel analog current input

The two channels are isolated from each other.
This module does NOT supply loop excitation current. See"Loop Power Supply" on page 7.

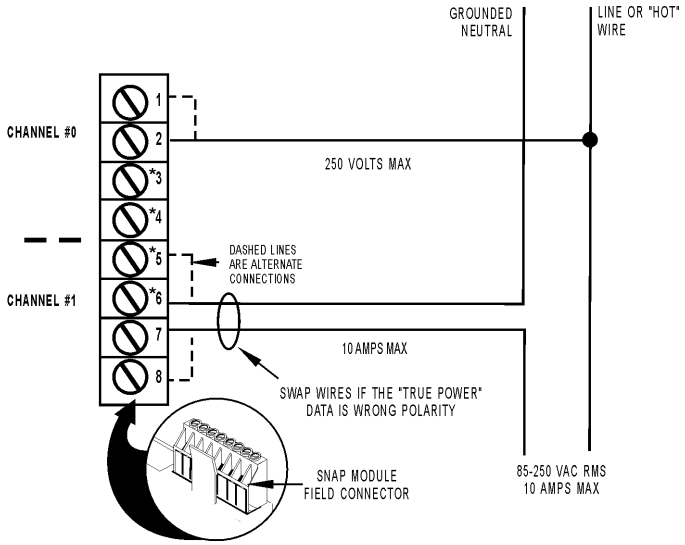


Wiring for SNAP-AIPM analog power monitoring input

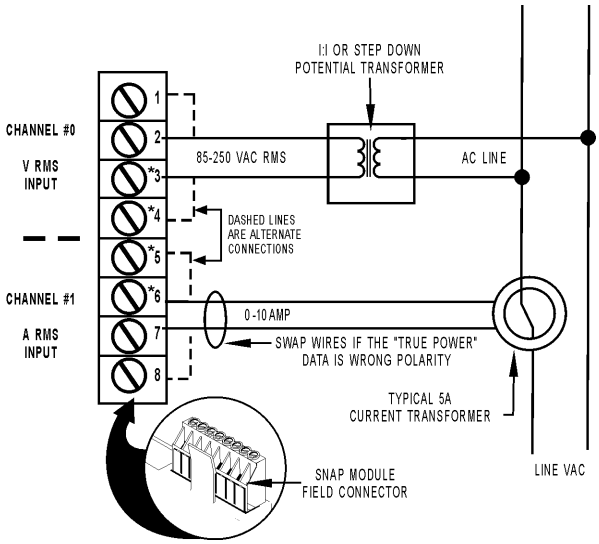
NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only. For more information about this module, see Opto 22 form #1453, the SNAP-AIPM data sheet.

CAUTION: These terminals share a common connection inside the module. **Make sure you observe polarity** when connecting the second channel. To avoid a potentially hazardous short, double-check wiring before turning on the current to be monitored.

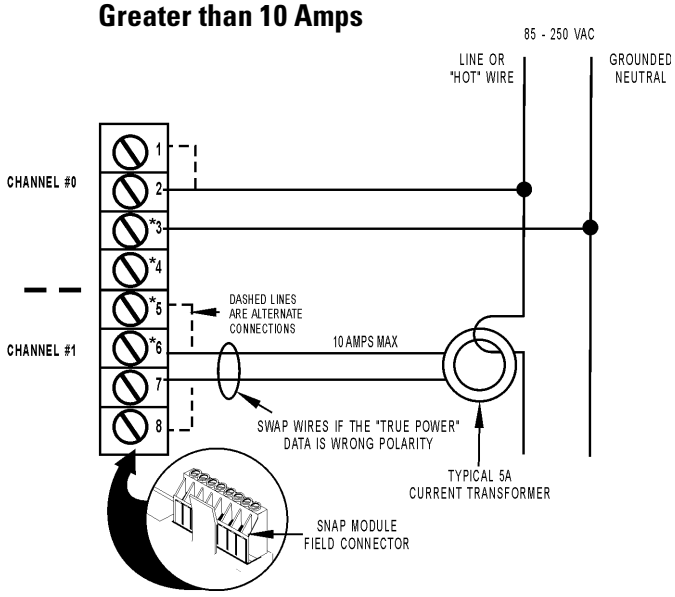
Standard Wiring Diagram



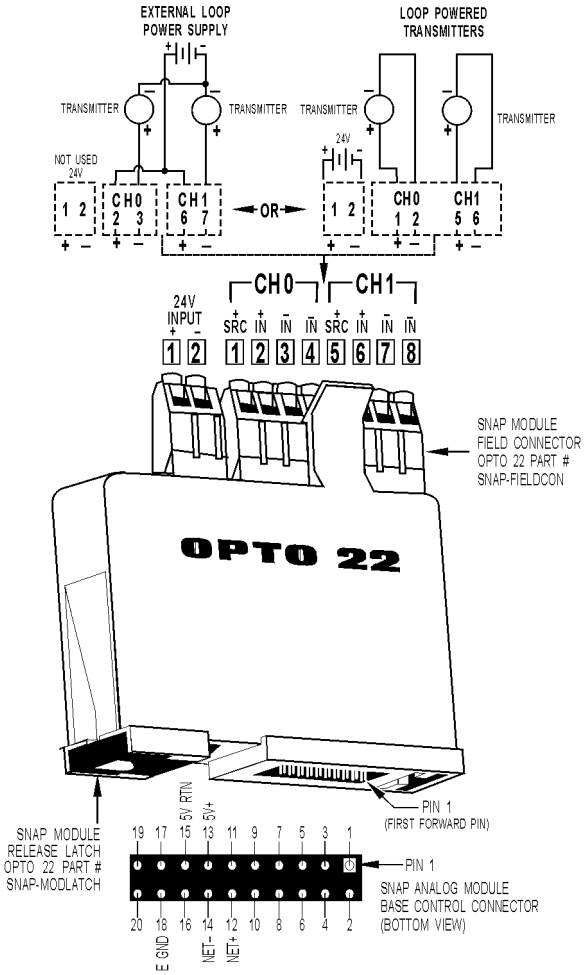
Measuring AC Line Current with a Current Transformer



Measuring AC Line Current Greater than 10 Amps



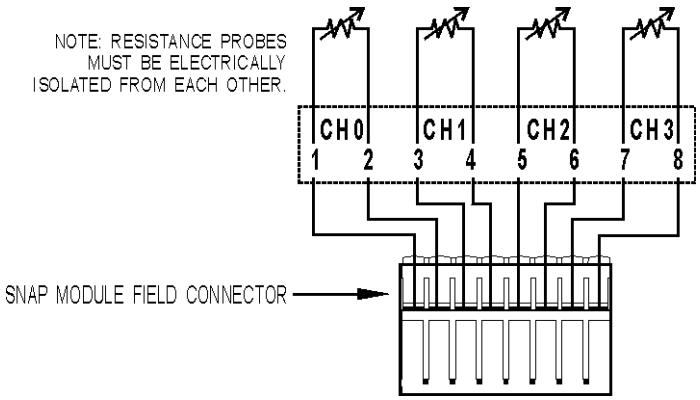
Wiring for SNAP-AIMA-iSRC isolated two-channel analog current input



The two channels are isolated from each other. This module DOES supply loop excitation current.

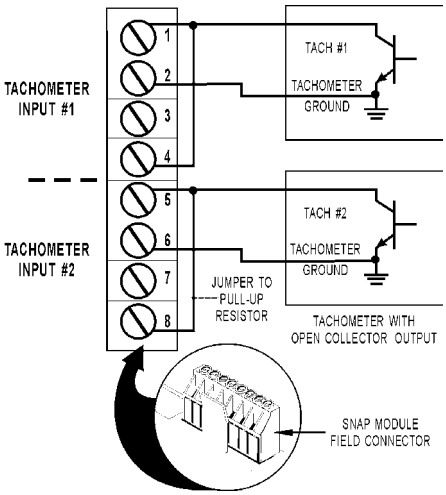
Wiring for SNAP-AIR40K-4 analog thermistor input

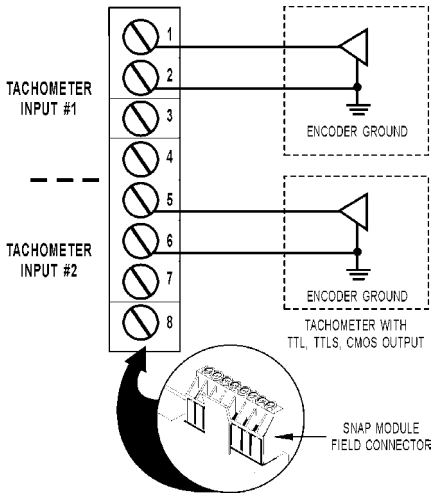
NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.



Wiring for SNAP-AIRATE analog rate input

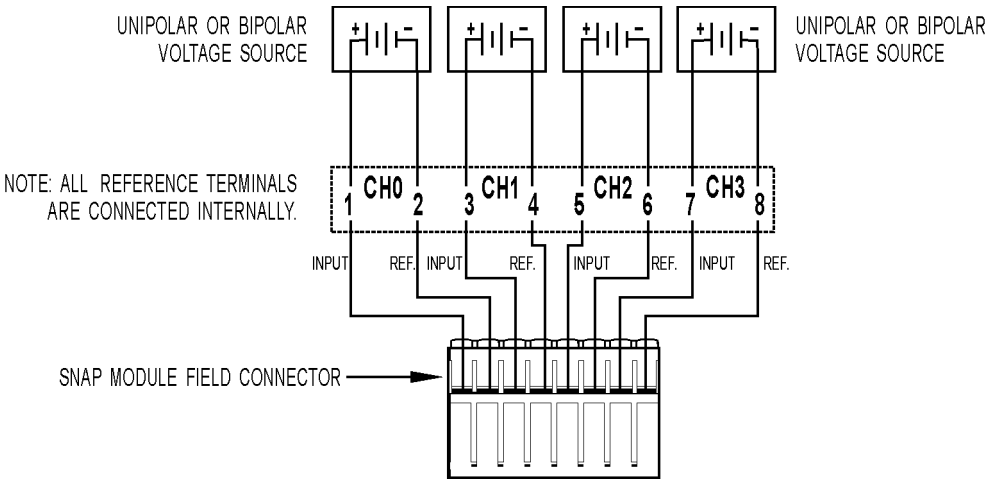
Two possible wiring diagrams are shown:



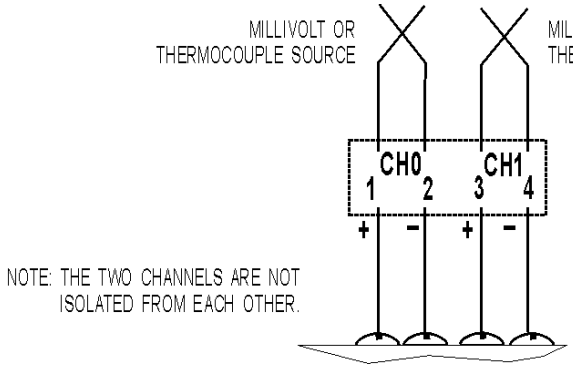


Wiring for SNAP-AIMV-4 and AIMV2-4 analog millivolt inputs

NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.

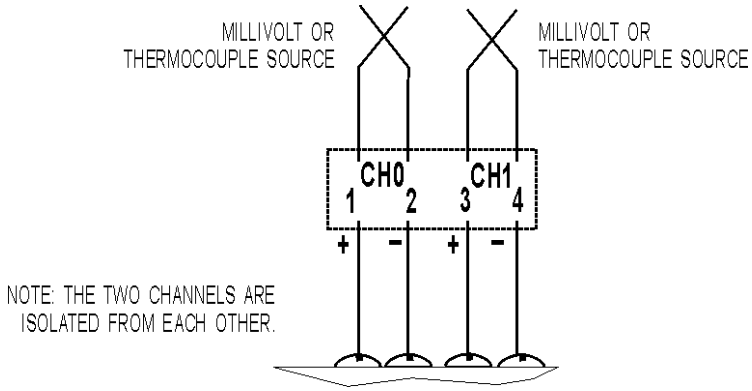


Wiring for SNAP-AITM and SNAP-AITM-2 analog thermocouple/millivolt inputs



Since both inputs share the same reference terminal, use isolated probes for thermocouple inputs.

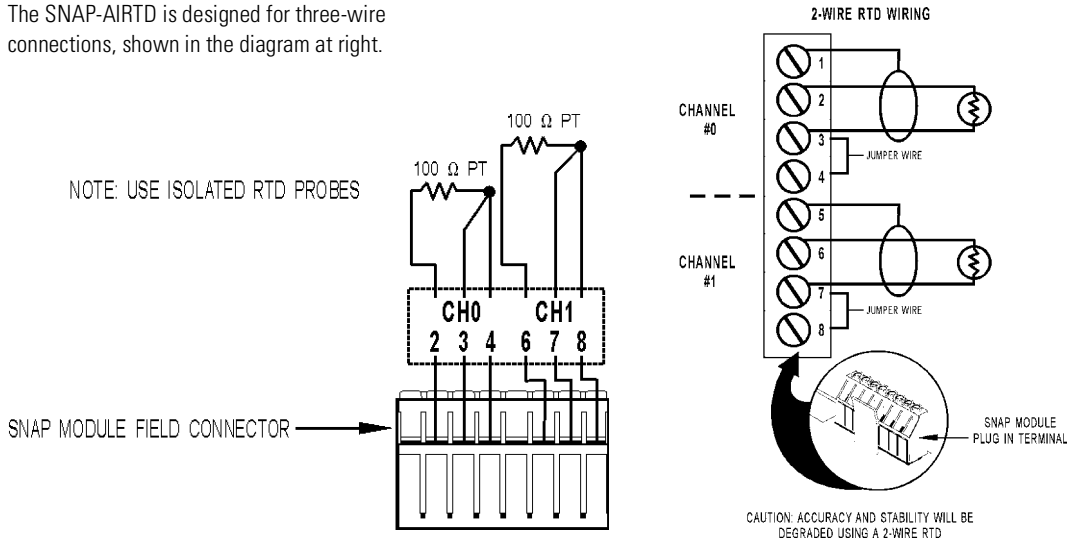
Wiring for SNAP-AITM-i and SNAP-AITM-2-i isolated analog thermocouple/millivolt inputs



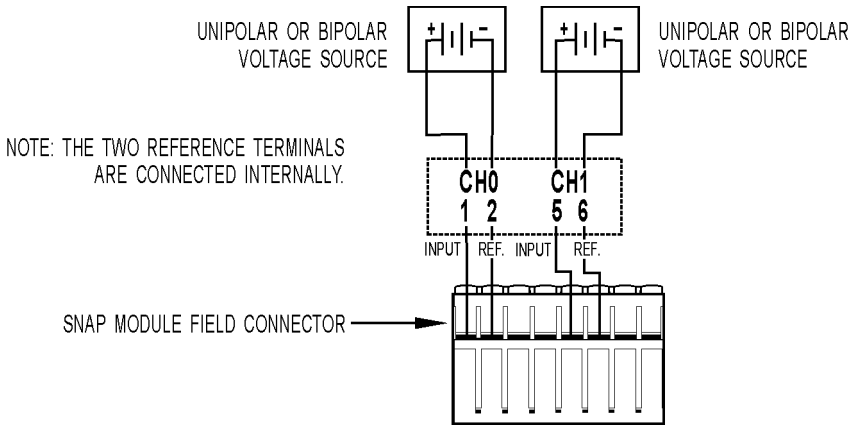
Since these channels do not share any common connections, grounded sensors and field devices may be used with them.

Wiring for SNAP-AIRTD analog RTD input

The SNAP-AIRTD is designed for three-wire connections, shown in the diagram at right.

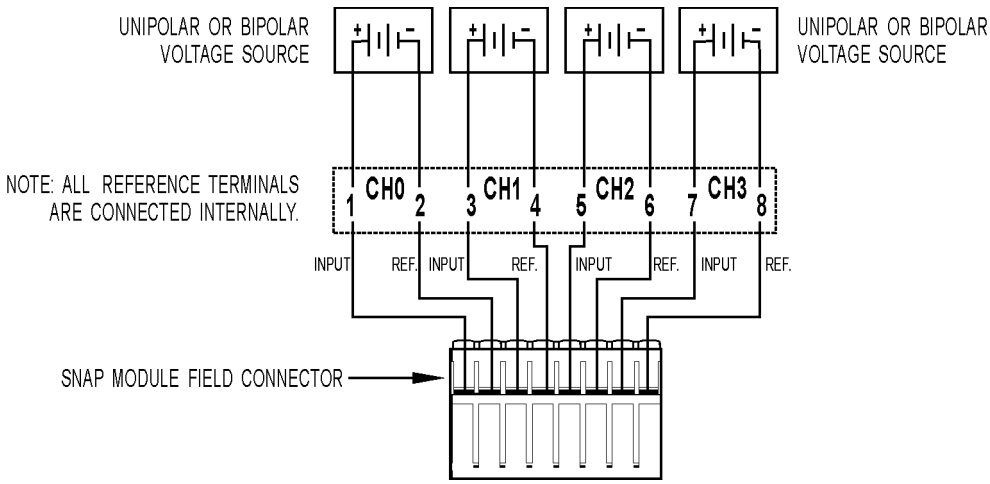


Wiring for SNAP-AIV two-channel analog voltage input

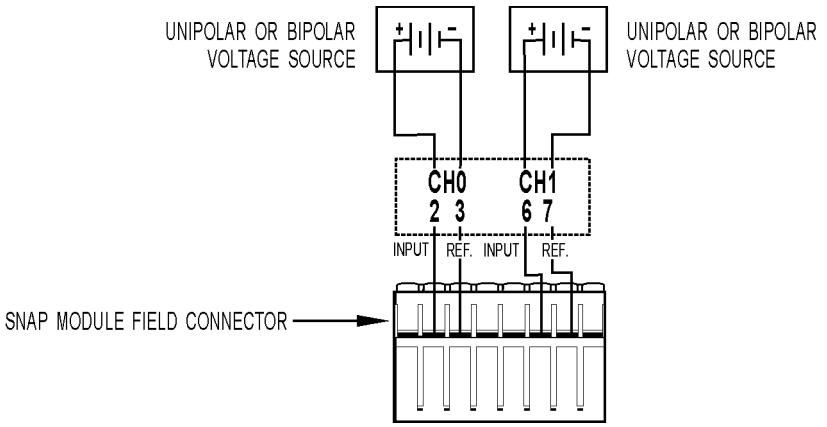


Wiring for SNAP-AIV-4 four-channel analog voltage input

NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.



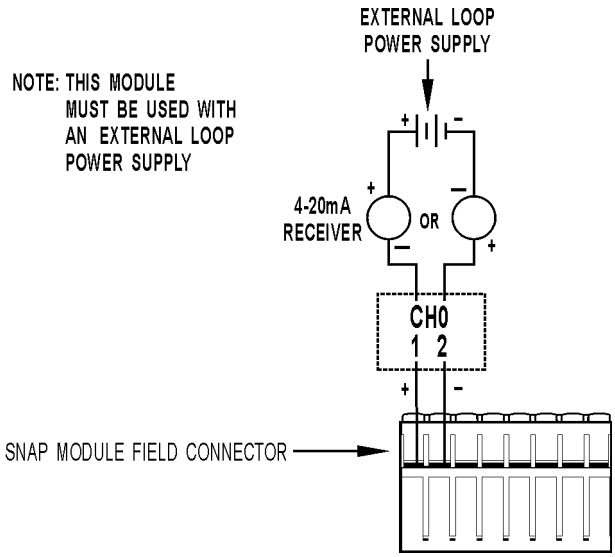
Wiring for SNAP-AIV-i isolated two-channel analog voltage input



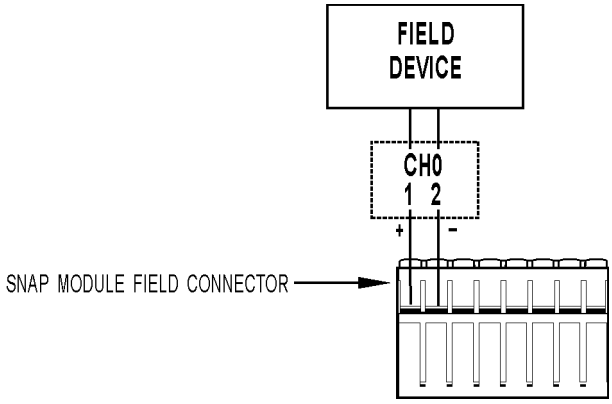
The two channels are isolated from each other. Since these channels do not share any common connections, grounded sensors and field devices may be used with them.

Analog Output Modules

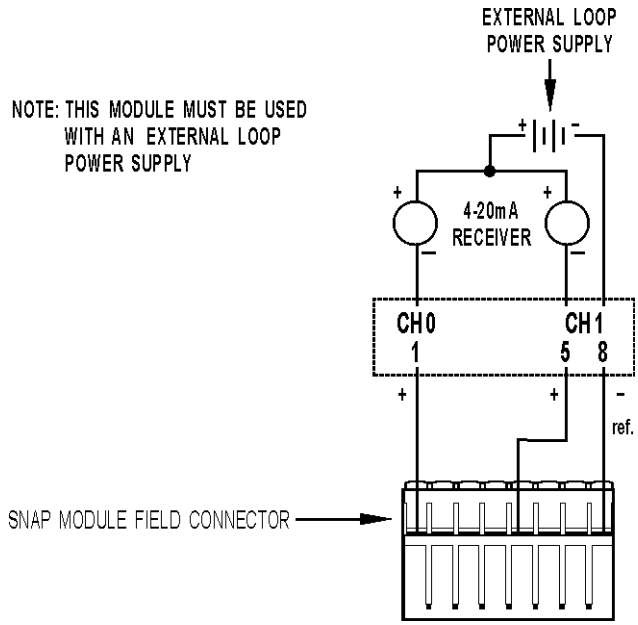
Wiring for the SNAP-AOA-3 single-channel analog current output



Wiring for the SNAP-AOV-5 and SNAP-AOV-7 single-channel analog voltage outputs

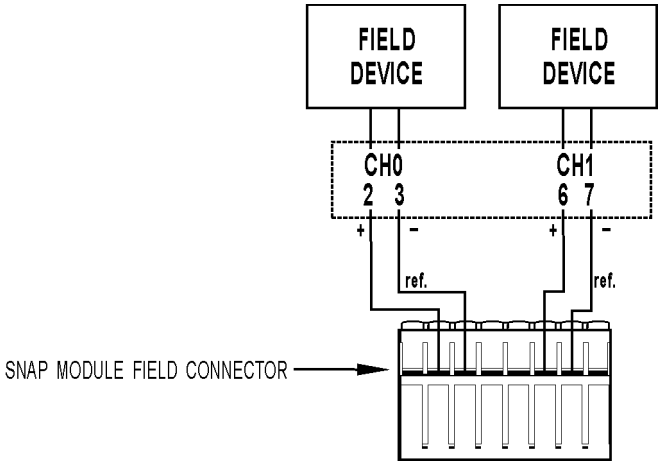


Wiring for the SNAP-AOA-23 dual-channel analog current output



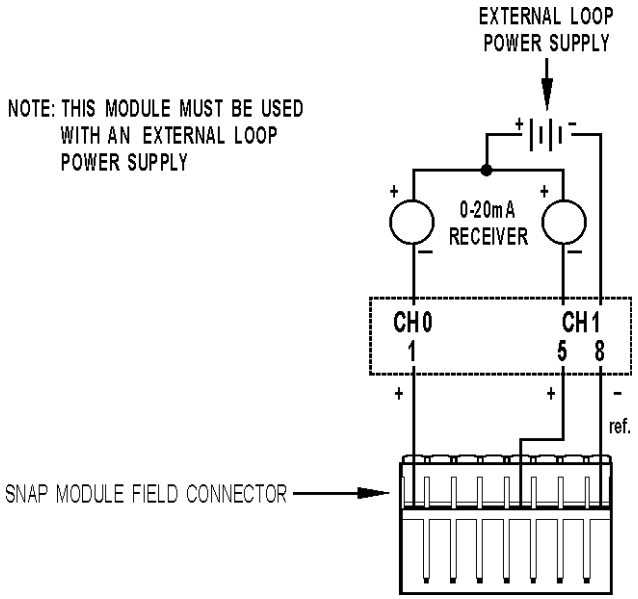
Both channels share a common reference terminal.

Wiring for the SNAP-AOA-25 and SNAP-AOA-27 dual-channel analog voltage output



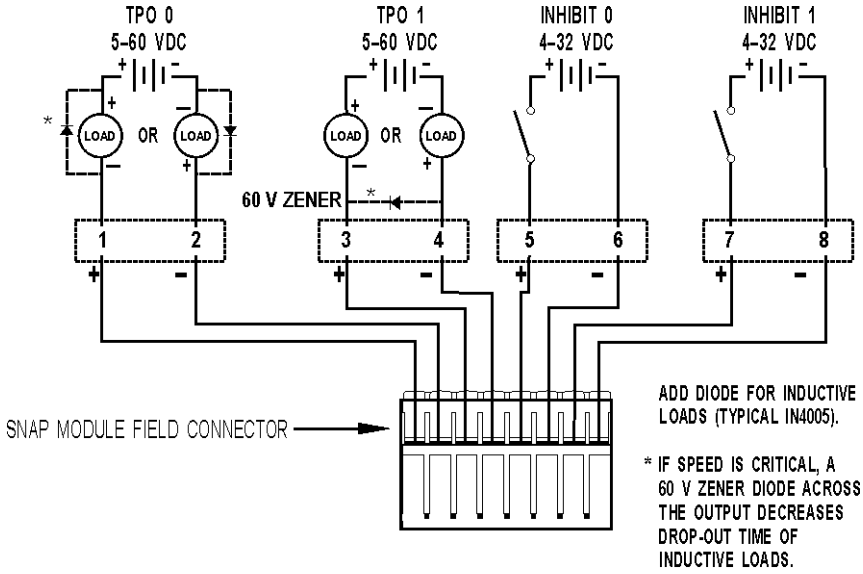
Both channels share a common reference terminal.

Wiring for the SNAP-AOA-28 dual-channel analog current output



Both channels share a common reference terminal.

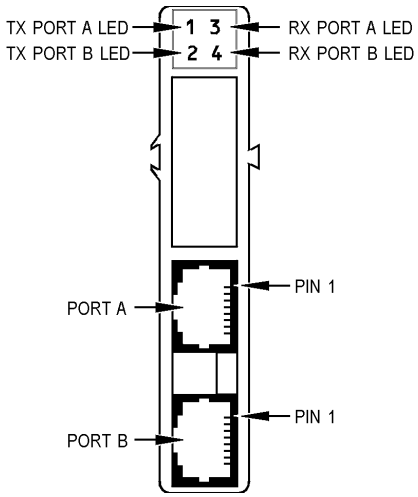
Wiring for the SNAP-AOD-29 dual-channel analog time-proportional digital output



Serial Communication Modules

Wiring for the SNAP-SCM-232 serial communication module

NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.



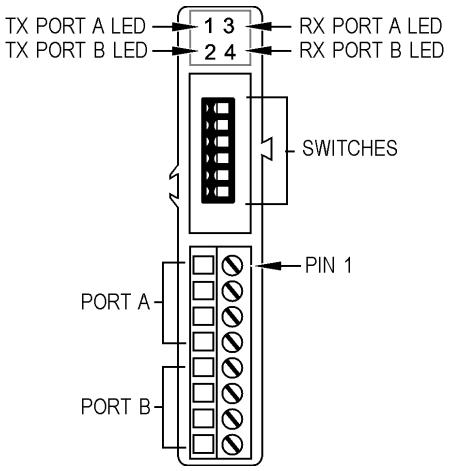
Pinouts for RJ-45 connectors on the SNAP-SCM-232:

1	Not used
2	RX (receive data)
3	TX (transmit data)
4	RTS (request to send)
5	GND (signal ground)
6	Not used
7	Not used
8	CTS (clear to send)

Refer to Opto 22 form #1191, the *SNAP Serial Communication Module User's Guide*, for more information.

Wiring for the SNAP-SCM-485-422 serial communication module

NOTE: Use with SNAP Simple, SNAP Ethernet, or SNAP Ultimate brains only.



Pinouts for Two-Wire SNAP-SCM-485

Pin	Port	Description
1	A	Vcc
2	A	TX/RX +
3	A	TX/RX -
4	A	Sig Gnd
5	B	Vcc
6	B	TX/RX +
7	B	TX/RX -
8	B	Sig Gnd

Pinouts for Four-Wire SNAP-SCM-485

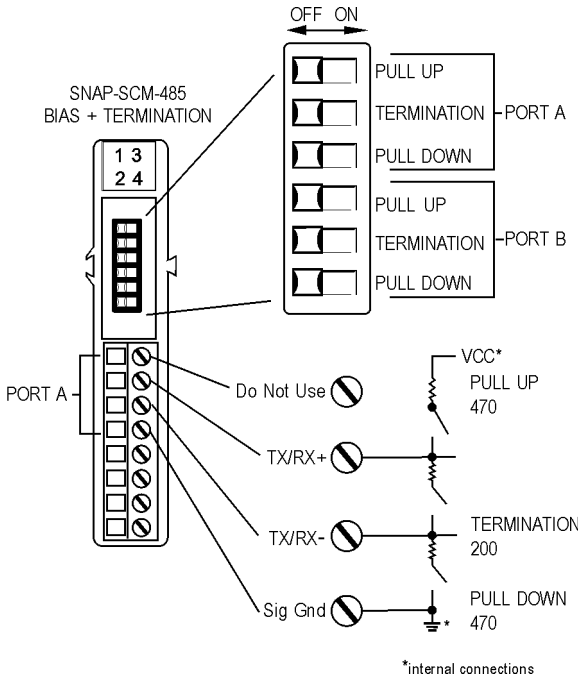
Pin	Port	Description
1	A	Vcc
2	A	TX +
3	A	TX -
4	A	Sig Gnd
5	A	Vcc
6	A	RX +
7	A	RX -
8	A	Sig Gnd

NOTE: Vcc on the SNAP-SCM-485 is 5 VDC and is supplied by the module itself. Do not use this voltage to power another device, as it can interfere with normal module operation.

Use the small switches on the top of the module to provide bias or termination on the RS-485 network as required. If the port is physically the first or last device on the RS-485 network, provide termination by moving the Term switch to ON. Also provide bias at one point on the network by moving both the Up and Down switches to ON.

Bias and termination switches are shown in the diagram at right.

Refer to Opto 22 form #1191, the *SNAP Serial Communication Module User's Guide*, for more information.

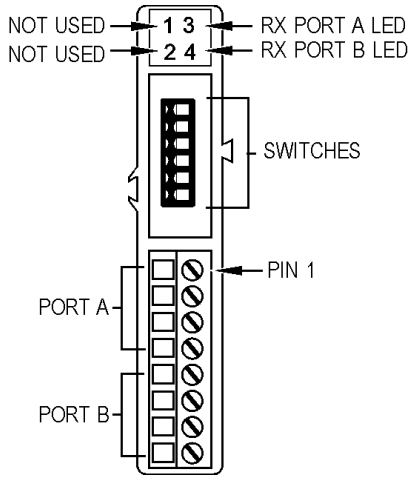


NOTE: Vcc on the SNAP-SCM-485 is 5 VDC and is supplied by the module itself. Do not use this voltage to power another device, as it can interfere with normal module operation.

Wiring for the SNAP-SCM-W2 serial communication module

NOTE: Use with SNAP Ethernet or SNAP Ultimate brains only.

SNAP-SCM-W2 Top View



Pinouts for SNAP-SCM-W2

Pin	Port	Color	Description
1	A	Black	Common
2	A	White	Data One
3	A	Green	Data Zero
4	A	--	Not used
5	B	Black	Common
6	B	White	Data One
7	B	Green	Data Zero
8	B	--	Not used

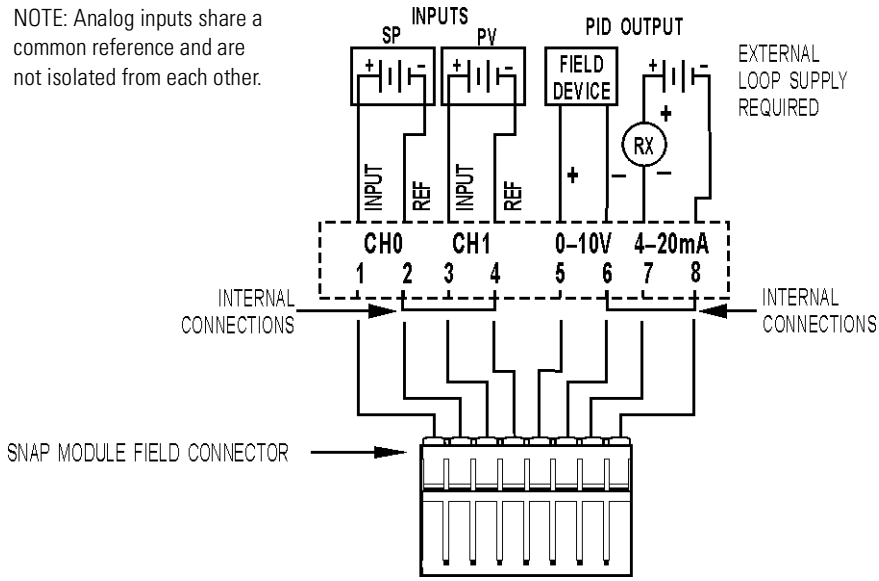
SNAP PID Module

Connect PID output wiring as shown in the diagram below. If you want to use PID setpoint and process variable analog inputs from external sources with the SNAP PID module, also connect PID setpoint inputs to channel 0 and process variable inputs to channel 1, as shown.

PID output can be 4–20 mA current and 0–10 VDC voltage outputs, both of which share a common negative terminal. PID output is calculated by the module and then sent simultaneously to both current and voltage outputs as a percent of output scale. This PID output can be analog or TPO signals (if TPO is selected, both current and voltage outputs are switched from 0% to 100%).

NOTE: Use SNAP PID modules with SNAP Ethernet or SNAP Ultimate brains only.

Wiring for the SNAP-PID-V module



Index

A

analog input modules
  power requirements, 5
  wiring, 15
analog output modules
  power requirements, 5
  wiring, 24

B

brain
  installing, 9
  power requirements, 5
  rack compatibility, 2

C

current loop power supply, wiring, 7

D

digital input modules
  power requirements, 5
  wiring, 11
digital output modules
  power requirements, 5
  wiring, 12

I

I/O modules
  analog input, 15
  analog output, 24
  basic diagram, 10
  digital input, 11
  digital output, 12
  power requirements, 5
  wiring, 1
installing
  brain on rack, 9
  I/O modules, 10
  mounting rack, 2
  power supplies, 4

L

loop power supply, 7

M

mounting rack
  wiring, 2

P

PID modules
  power requirements, 5
  wiring, 30
power monitoring module, 19
power supply
  current loop, 7
  determining requirements, 4
  wiring, 4

R

rack for I/O modules
  wiring, 2

S

serial modules
power requirements, 5
wiring, 27
SNAP-AIARMS, 15
SNAP-AICTD, 16
SNAP-AICTD-4, 17
SNAP-AIMA, 17
SNAP-AIMA-4, 18
SNAP-AIMA-i, 18
SNAP-AIMA-iSRC, 20
SNAP-AIMV2-4, 21
SNAP-AIMV-4, 21
SNAP-AIPM, 19
SNAP-AIR40K-4, 20
SNAP-AIRATE, 21
SNAP-AIRTD, 22
SNAP-AITM, 22
SNAP-AITM-2, 22
SNAP-AITM-2-i, 22
SNAP-AITM-i, 22
SNAP-AIV, 23
SNAP-AIV-4, 23
SNAP-AIV-i, 24
SNAP-AIVRMS, 16
SNAP-AOA-23, 25
SNAP-AOA-25, 26
SNAP-AOA-27, 26
SNAP-AOA-28, 26
SNAP-AOA-3, 24
SNAP-AOD-29, 27
SNAP-AOV-5, 25
SNAP-AOV-7, 25
SNAP-IDC5-SW, 11
SNAP-IDC5-SW-NC, 11
SNAP-OAC5, 12
SNAP-OAC5FM, 12
SNAP-OAC5-i, 12
SNAP-OAC5MA, 12
SNAP-ODC5A-i, 15
SNAP-ODC5A-iFM, 15
SNAP-ODC5ASNK, 13
SNAP-ODC5-i, 15
SNAP-ODC5-iFM, 15
SNAP-ODC5MA, 14
SNAP-ODC5R, 14
SNAP-ODC5R5, 14
SNAP-ODC5R5FM, 14
SNAP-ODC5RFM, 14
SNAP-ODC5SNK, 13
SNAP-ODC5SNKFM, 13
SNAP-ODC5SRC, 13
SNAP-ODC5SRCFM, 13
SNAP-PID-V, 30
SNAP-SCM-232, 27
SNAP-SCM-485, 28
SNAP-SCM-W2, 29

W

wiring diagrams for SNAP I/O, 1