Opto 22 Procedures: Software Quality Assurance Plan

Background

This plan establishes the responsibilities and processes for developing and modifying software for Opto 22 customers.

Introduction

Opto 22 develops commercial off-the-shelf software products, which are used in conjunction with its hardware products. Once initially released, these software products are usually updated periodically with new features, enhancements, and bug fixes. Multiple software products are typically bundled together to form a suite of products that are developed and released simultaneously. The purpose of a new software product, its required features, and any additions to an existing product, are decided by Opto 22 Management. Management decisions are made in consultation with Opto 22 Sales, Marketing, Product Support, and Engineering departments. Several unrelated projects are typically bundled together into a single release of new features. If time permits, engineers may implement smaller projects at their own discretion, usually from a list of existing customer requests or marketing ideas. Between major releases of software products, Opto 22 typically releases new minor versions (i.e. patches) that contain just bug fixes.

Overview of the OptoTrac System

Trac is an open source, third party, Integrated SCM and Project Management software package. Opto 22 uses Trac and refers to it as the OptoTrac system. All software projects are documented and tracked in the OptoTrac system. OptoTrac can manage both document and project tickets. Developers, Testers, the Documentation department, and Opto 22 Management, all use the OptoTrac system.

OptoTrac is used to document the initial project ideas, requirements, and design decisions. It is also used to track the development, testing, and release phases. Individual software projects, or subcomponents of a larger project, are entered into OptoTrac as work tickets and/or web pages. These tickets can then be attached to a release milestone, assigned to engineers, updated with new information and notes, and assigned to other engineers or testers. Formatted reports can easily be configured to manage information.

Opto 22 Procedures: Software Quality Assurance Plan

Roles and Responsibilities

Opto 22 Management is responsible for developing, revising, implementing, and ensuring compliance with this plan. Opto 22 Management ensures that a software management and control program is established according to this plan, and identifies the departments that must comply with this plan. Opto 22 Management designates individuals or groups responsible for implementing this procedure, and controlling software throughout its life cycle in a traceable, planned, and orderly manner.

Opto 22 Department Leads ensure compliance with this plan through direct implementation, supplemented where necessary by department-level procedure(s).

The **Software Project Lead** creates, reviews, and approves software management and control plans and procedures.

The **Q.A. Lead** reviews the software project deliverables. The Q.A. Lead is assigned by Opto 22 Management and is not associated with the development or acquisition of the software.

The **Independent Tester** performs acceptance testing of the software. The Independent Tester is assigned by Management and is not associated with the development or acquisition of the software.

Risk Management

The software will be designed to minimize or eliminate risk. The risks to be minimized include; the risk of sending, receiving, or displaying incorrect data, the risk of non-recoverable errors on the PC applications, the risk of firmware causing a controller reset, etc. Opto 22 makes every effort to assure that its products are of high quality and are reliable.

Software Life Cycle

The software life cycle defined in the following Procedure provides the basis for planning and implementing a software development and maintenance program. The Procedure sections identify the specific software activities, documentation, and reviews associated with each phase. The number of phases and relative emphasis placed on each phase of software development and maintenance depend upon the nature and complexity of the software. Not all phases apply to all software types; for example, embedded software and commercial off-the-shelf software (COTS) may be exempt from some phases.

Opto 22 Procedures: Software Quality Assurance Plan

Procedure

Planning Phase—Project Initiation

Opto 22 Management

1. Initiate software projects based on customer requests, suggestions from sales and marketing, or identification of internal department needs.
2. Assign Software Project Leads as appropriate for each project.

Software Project Lead

3. Prepare a Statement of Work (SOW). The SOW may be in various forms, such as a document, webpage, or email, and describes the scope of the project.
4. Request Management to review and approve the project, where appropriate.

   If significant changes in scope occur during the life of the project, the SOW shall be revised to accurately reflect the current scope and details of the project.

Opto 22 Management

5. Review the SOW, where appropriate.
6. If not approved, inform the Software Project Lead of the need to revise the SOW, or close the project.
7. If approved, inform the Software Project Lead of the approval and authorize the work to begin.

Software Project Lead

8. When the project is approved, create a unique project identification name/number and location in the Configuration Management System (CMS), herein referred to as the OptoTrac system, for traceability. This project name and location shall be used to store subsequent documentation and configuration items.
9. Make sure the SourceSafe procedures are followed as outlined in *Opto 22 Procedures: Building a Release* (Opto 22 form #1615).
10. Maintain approved planning documents in the OptoTrac system or appropriate database.

Requirements Phase

Software Project Lead

1. Revise the Statement of Work (SOW) to document specific software requirements in sufficient detail to design the software.

Opto 22 Management

2. Review requirements in the revised SOW where appropriate. Inform the Software Project Lead of approval, or of the need for further revision.

Software Project Lead

3. Maintain the revised (and approved, if applicable) SOW in the OptoTrac system under its established project name and location.

Design Phase

Software Project Lead

1. Make the SOW available to the team of Opto 22 employees directly involved in software development and documentation, and in designing tests for the software.
2. Facilitate design review(s) by the team and independent technical reviewers, as applicable.
3. Revise the SOW to add design notes and design decisions made by the team.
4. Continue to maintain the revised SOW in its established location in the OptoTrac system.

Q.A. Lead

5. Review the software design information as specified in the OptoTrac system.
6. Design the software test cases and/or Test Suite, to verify that the software meets the design criteria as specified in the SOW stored in the OptoTrac System.
7. Provide space to record the test results for each test case.
8. Identify the assigned independent tester.
9. Store the Test Suite in the SourceSafe system or in the appropriate network location.

Implementation Phase

NOTE: The Implementation Phase consists of generating software code, initial testing, and generating or supplementing user documentation.

Software Project Lead

1. Work with the team of developers to write the software, per the specifications and requirements of the project as defined in the SOW contained in the OptoTrac system.
2. Perform testing and debugging as necessary to ensure functionality.

3. Work with Technical Publications to ensure that necessary user documentation is either developed or available, according to *Opto 22 Procedures: Technical Documentation* (Opto 22 form #1622).
4. If changes or additions are made during the Implementation Phase to the requirements or design elements, update the previous phase's documentation to reflect the changes or additions.

Acceptance Testing: Newly Developed or Acquired Software

NOTE: For acceptance testing of previously released software, see "Acceptance Testing: Previously Released Software," below.

Q.A. Lead

1. Establish a hardware/software environment for testing that is separate from the development environment and is representative of the production environment.
2. Install the software in the test environment.

Independent Tester

3. Create and/or perform acceptance tests to demonstrate, as appropriate, that the computer program adequately and correctly performs all intended functions, and does not perform any unintended functions.
4. If the software fails the acceptance tests, communicate the results and any notes and observations to the Software Project Lead.
5. If the software tests meet all the acceptance criteria, document the successful completion of the acceptance testing. Store the documentation of the test results in the SourceSafe system.

Software Project Lead

6. If the software test results fail to meet the acceptance criteria, determine the problem and correct the problem.

Acceptance Testing: Previously Released Software

NOTE: This section applies to modifications to previously released software. For all other software types, see "Acceptance Testing: Newly Developed or Acquired Software," above.

Q.A. Lead

1. Establish a hardware / software environment for testing that is representative of the production environment.
2. Install the software in the test environment.
3. Run the test programs on the test candidate software.

Independent Tester

4. Create and/or perform acceptance tests of the modifications to previously released software by subjecting the software to regression testing (where possible) to:

- Detect errors introduced during the modification of the software.
- Verify that the modifications have not caused unintended adverse affects.
- Verify that the modified software still meets specified requirements and corrects those bugs found and closed, as described in *Opto 22 Procedures: Bug Reporting* (Opto 22 form #1618).

5. If the software fails the acceptance tests, communicate the results and any notes and observations to the Software Project Lead.
6. If the software tests meet all the acceptance criteria, document the successful completion of the acceptance testing. Store the documentation of the test results in the SourceSafe system.

Software Project Lead

7. If the software test results fail to meet the acceptance criteria, determine the problem and correct the problem.

Software Documentation Reviews—Independent Technical Reviews

NOTE: Independent technical reviews are performed by individuals who are not associated with the development of the software project being reviewed. In those instances where this level of independence cannot be achieved, an individual associated with the development of the software may perform these activities.

Independent Technical Reviewer

1. Receive and perform review of the submitted documentation in a timely manner. Such documentation shall include the following, as applicable:
2. Check for impacts, and verify adequacy, accuracy, and completeness.
3. Determine if the submitted documents are acceptable or if there are comments and/or recommended changes.
4. If the submitted documents are acceptable, return them to the document author.
5. If there are comments on the documents being reviewed, return them to the document author.

Document Author

6. Provide resolution to comments and revise documents accordingly.

Software Problem Reporting and Resolution

See *Opto 22 Procedures: Bug Reporting* (Opto 22 form #1618).

Configuration Management and Change Control

See *Opto 22 Procedures: Building a Release* (Opto 22 form #1615).

Customer Training

Software Project Lead

1. Notify the Training Lead and the Product Support Group Lead of changes to software.

Training Lead

2. Ensure that training requirements are updated, based on the changes or new features that were reported by the Software Project Lead.

Definitions

Acceptance Test or Testing. The process of exercising or evaluating a system or system component by manual or automated means, to ensure that it satisfies the specified requirements, and to identify differences between expected and actual results in the operating environment.

Computer Program. A combination of computer instructions and data definitions that enables computer hardware to perform computational or control functions.

Condition Adverse to Quality. An all-inclusive term used to refer to any of the following: failures, malfunction, deficiencies, defective items, and non-conformances.

Configuration. An item's physical, functional, and operational characteristics.

Configuration Management. The process that controls the activities and interfaces among design, construction, and maintenance to assure that the configuration is established, approved, and maintained.

Configuration Management System. The collection of electronic and manual systems used to document software management and control per this plan.

Customer. An organization or person that receives a product or service and that may define a feature request or performance requirement.

Error. A condition deviating from an established baseline, including deviations from the current approved computer program and its baseline requirements.

Manager. The head of an organization that is responsible for making important decisions about direction, focus, and general policy.

Nonconformance. A deficiency in characteristic, documentation, procedures, or performance that renders the quality of an item or activity unacceptable or indeterminate.

Operating Environment. A collection of software, firmware, and hardware elements that provide for the execution of computer programs.

Qualification. The process of ensuring that the product and all associated processes are capable of meeting customer requirements. For personnel, the characteristics or abilities gained through education, training, or experience, as measured against established requirements such as standards or tests that qualify an individual to perform a required function.

Quality. The condition achieved when an item, service, or process meets or exceeds the user's requirements and expectations.

Quality Assurance. All those actions that provide confidence that quality is achieved.

Regression Testing. The selective retesting of a software system that has been modified to ensure that any bugs have been fixed, that no other previously working functions have failed as a result of the modifications, and that newly added features have not created problems with previous versions of the software. Also referred to as verification testing, regression testing occurs after a programmer has attempted to fix a recognized problem or has added source code that may have inadvertently introduced errors. It is a quality control measure to ensure that the newly modified code still complies with its specified requirements and that unmodified code has not been affected by the maintenance activity.

Software. Computer programs, procedures, associated documentation, and data pertaining to the operation of a computer system. Software covered by this document includes firmware, documentation, data, and execution control statements.

Software Life Cycle. The activities that comprise the evolution of software from conception to retirement. The software life cycle typically includes software development phases and the activities associated with operation, maintenance, and retirement.

Software Quality Assurance. Planned and systematic actions necessary to provide adequate confidence that a software product conforms to established requirements.

Statement of Work (SOW). The definition or description of the goal or task to be accomplished, including requirements and design notes, if applicable.

Test or Test Case. A set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement.

Test Suite. A standardized collection of test programs (test cases) and documentation for them (where applicable).

Signature

2-2-2009

Date

CEO

Title

DATA SHEET

Form 1106-990524

Part Number	Description
SNAP-LCM4	SNAP Modular M4 Controller

Description

The SNAP-LCM4 is a powerful industrial controller that provides real-time control and communication to input/output (I/O) systems, serial devices, motion controllers, and networks.

Opto 22's fastest controller to date, the SNAP-LCM4 takes advantage of the latest improvements in processor technology to fit today's demanding, high-speed application requirements.

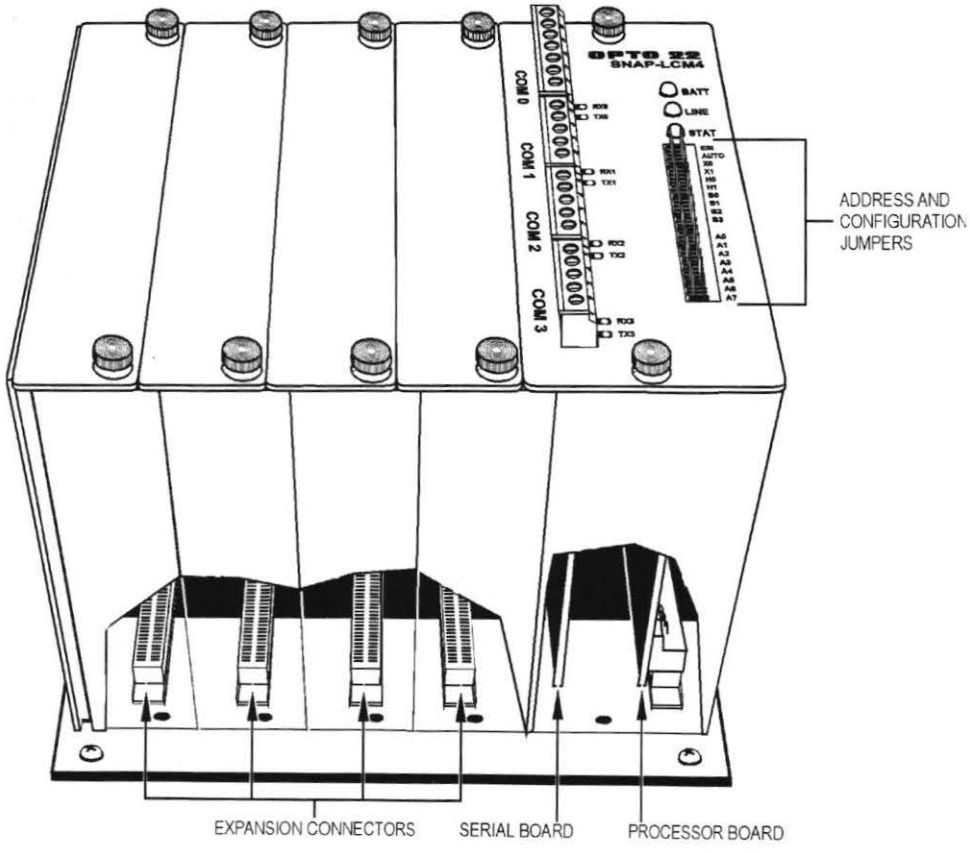
The SNAP-LCM4 modular controller features powerful communications capabilities, built-in diagnostics, a 32-bit processor, and a variety of expansion options. Opto 22 modular controllers are designed to take advantage of the Opto 22 intelligent distributed I/O architecture and provide a solid hardware foundation for Opto 22's FactoryFloor software suite.

The SNAP-LCM4 provides power and performance in a package that integrates seamlessly with other Opto 22 SNAP products. Designed specifically for industrial applications, the controller provides Ethernet, ARCNET, and serial communication options for unmatched flexibility. Serial ports provide an interface with Opto 22 I/O and also with radio modems, cellular modems, and even satellite communications equipment, as well as any third-party serial device.

The SNAP-LCM4 handles program control and host communications with a powerful 32-bit Motorola microprocessor. This processor board is combined with a 4-slot Opto 22 expansion bus (M4BUS).

Standard on-board communication ports include the following:

- One dedicated Opto 22 remote I/O port (2-wire RS-485 with interrupt capability)
- Three RS-232 or RS-485 (2-wire or 4-wire) serial ports, with baud rates up to 115.2 kBd.



Description (continued)

Software

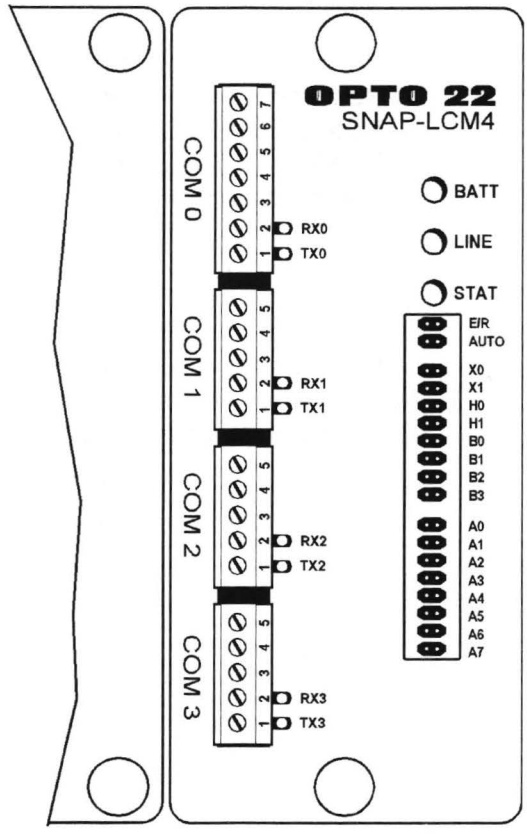
The SNAP-LCM4 is designed to work with FactoryFloor, Opto 22's powerful suite of Microsoft Windows 32-bit software. FactoryFloor consists of four integrated components:

- OptoControl™, a graphical, flowchart-based development environment for machine control and process applications
- OptoDisplay™, an intuitive, shared database, human-machine interface (HMI) and trending package, including alarming
- OptoServer™, a robust, OPC-compliant data server that connects the controller network with the PC network
- OptoConnect™, a bidirectional link between the Opto 22 database in the controller and Microsoft's SQL Server and Access databases.

The SNAP-LCM4 is configured using OptoControl on a PC workstation. OptoControl is an easy to use, self-documenting control environment that uses a plain English command set and a long tagname database that is shared by all FactoryFloor components.

The SNAP-LCM4 controller also works with Opto 22's Classic 16-bit software: Cyrano, Mistic MMI, and Mistic Data Server (MDS).

SNAP-LCM4 Top Cover



Interface Options (M4BUS Expansion Cards)

The M4BUS has four expansion slots to accommodate a variety of communication interface cards. The following modular interface cards provide I/O or network connectivity:

Interface Adapter Card	Use	Current Draw
M4SARC	High-performance coaxial ARCNET	200 mA
M4DUALARC	Dual twisted-pair ARCNET (for HA brains)	150 mA
M4SARCF	Fiber Optic ARCNET	250 mA
M4SARCFR	Fiber Optic ARCNET with repeater	350 mA
M4SENET-100	10/100 Mbps Ethernet (Category 5 UTP)	1.00 A

NOTE: Only one Ethernet card per controller is supported at this time. The Ethernet card currently accommodates 128 sessions, including FactoryFloor, Ethernet brains, and other Ethernet devices.

Description (continued)

I/O Connectivity

Any of the built-in RS-485/422 ports can be used as a serial link to communicate with Opto 22 remote digital and analog I/O units. Up to 4,096 I/O points can be connected to each port.

Power Requirements

The SNAP-LCM4 requires only 5 VDC power, which can be supplied by the Opto 22 SNAP-PS5 power supply. The amount of current required depends upon the M4BUS expansion cards installed (see page 2); the controller itself requires 1.0 amp.

Memory

The RAM is used to store a user's control strategy (program) and data. The flash memory (EEPROM) stores the operating system firmware (kernel) and can also be used to store a control strategy. Memory is not expandable.

RAM: 4 MB (not expandable)
Flash EEPROM: 2 MB (not expandable)

Mounting

For DIN-rail mounting, also order a DIN clip package, part number SNAP-LCM4DIN.

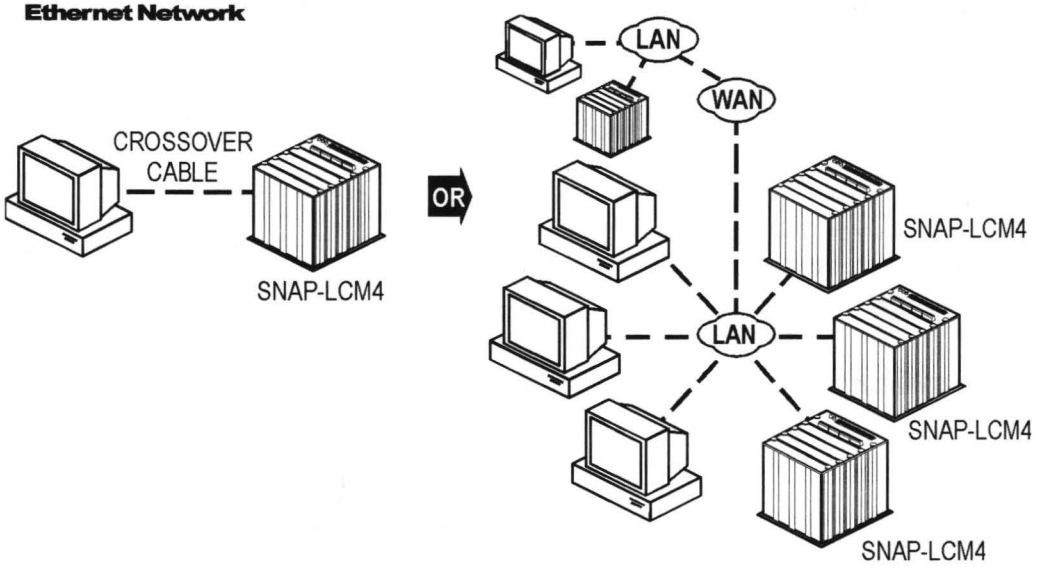
Specifications

Item	Specification
CPU	32-bit Motorola processor IEEE floating-point math co-processor
Memory RAM Flash EEPROM	 4 MB with battery backup (user programs and data), not expandable 2 MB (controller firmware and user programs), not expandable
RAM/clock battery	3.6-volt lithium, non-rechargeable
Communication, base unit	Three RS-232 or RS-485 ports, one dedicated RS-485 remote I/O port with interrupt capability
Real-time clock	Clock/calendar, Epson 64613 with battery backup, Y2K compliant
Power requirements	5VDC ±0.1 VDC at 1 Amp (maximum) without expansion cards
Typical operating temperature	0° C to 70° C
Storage temperature	-40° C to 85° C
Humidity	5% to 95% relative humidity, non-condensing
Software	FactoryFloor (OptoControl, OptoDisplay, OptoServer, and OptoConnect) and Classic software (Cyrano, Mistic MMI, and MDS)
Hard system monitors (including watchdog timer and voltage monitor)	Detect main power supply operation and proper microprocessor operation
Soft system monitors	Program/data corruption Host and I/O communication

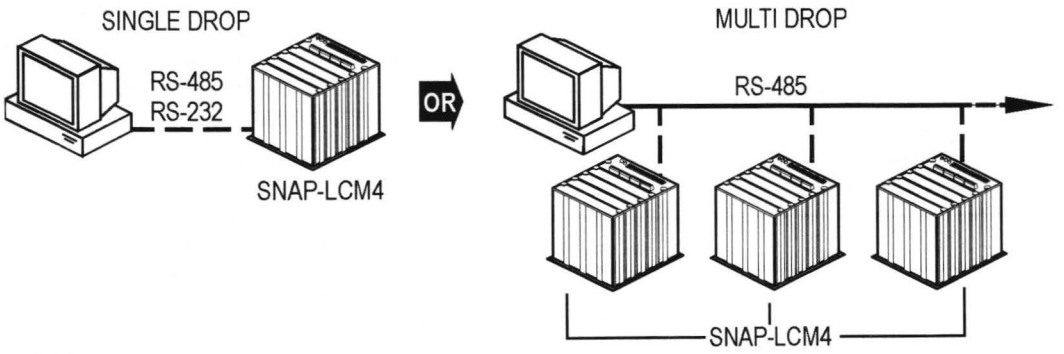
SNAP-LCM4 System Architecture

The SNAP-LCM4 provides a variety of communication options, shown in the diagrams on this and the following page.

Ethernet Network

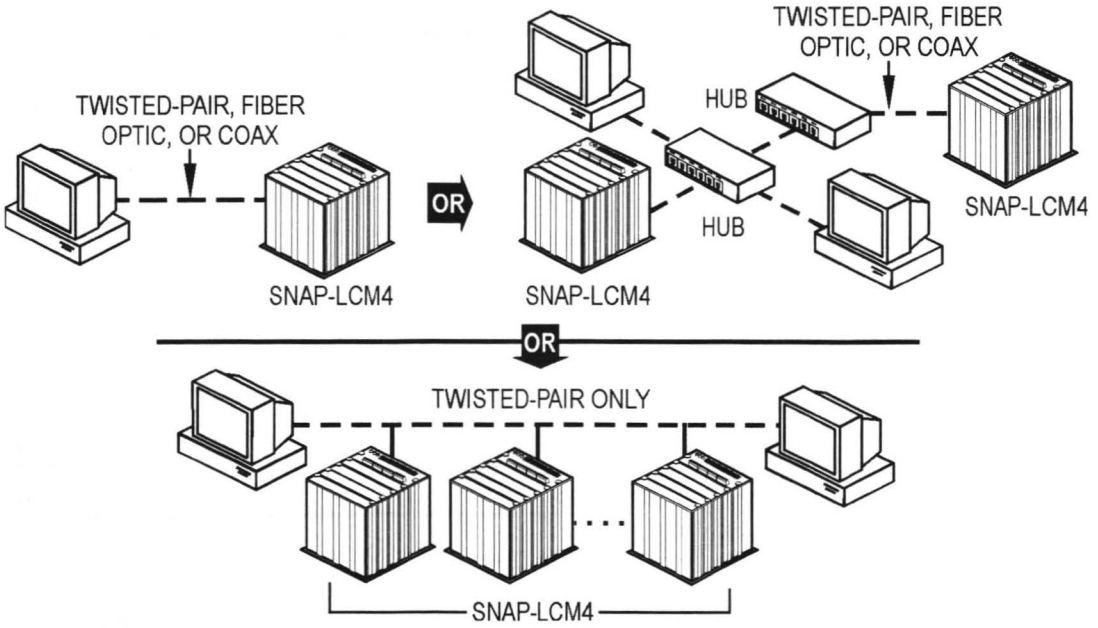


Serial Direct Connection

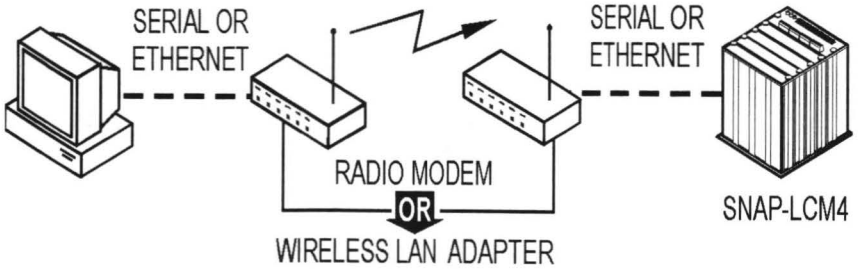


SNAP-LCM4 System Architecture (continued)

ARCNET Network

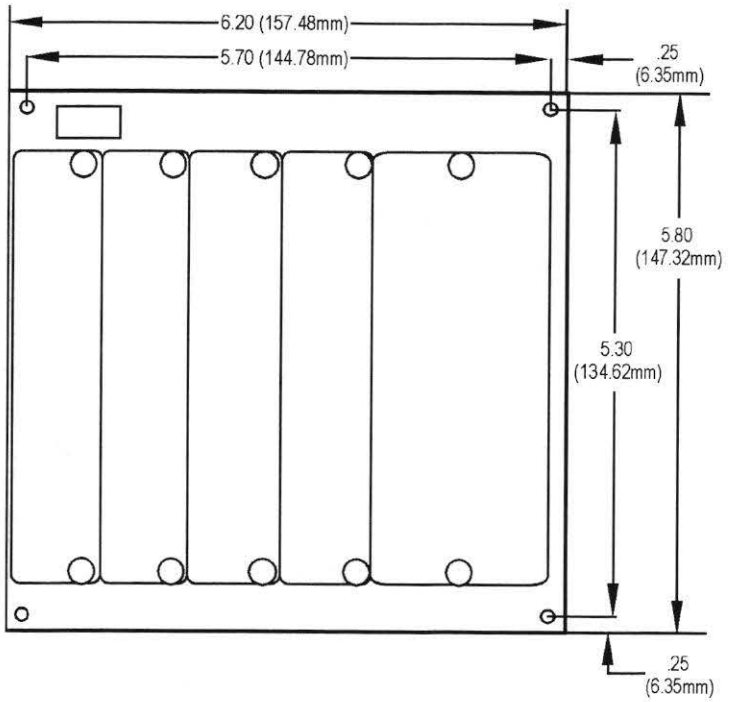


Remote Communication



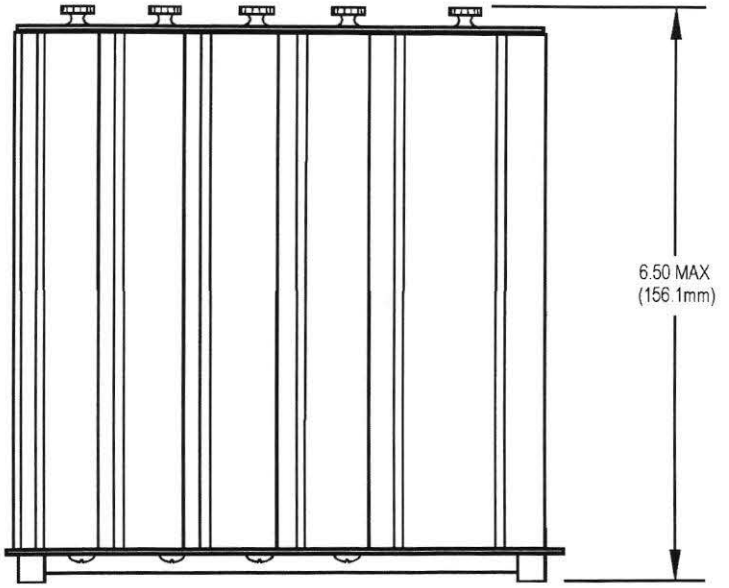
SNAP-LCM4 Dimensions (Panel Mounted)

Top View



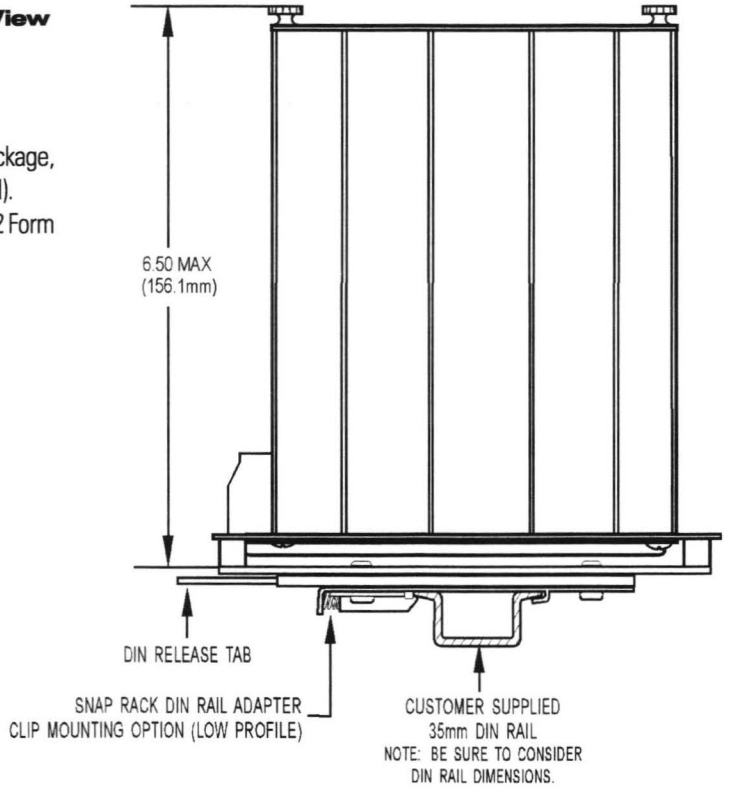
For installation instructions, see Opto 22 Form 1122, *SNAP-LCM4 Installation Guide*.

Side A View



SNAP-LCM4 Dimensions (DIN-Rail Mounted)

Side B View



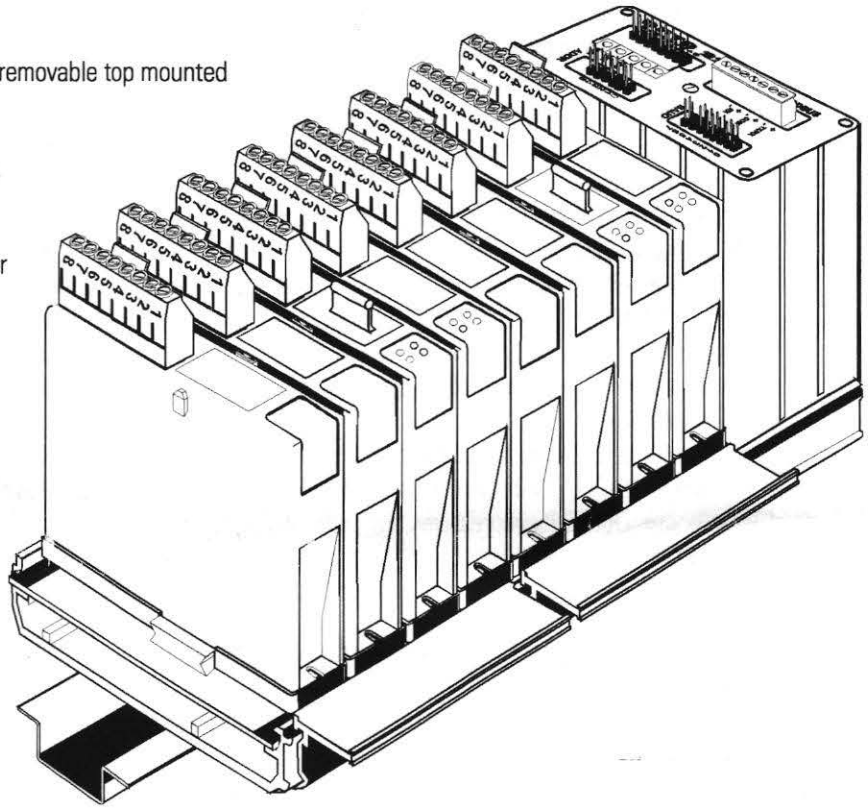
DIN-rail mounting requires a DIN clip package, part number SNAP-LCM4DIN (not included).

For installation instructions, see Opto 22 Form 1122, *SNAP-LCM4 Installation Guide*.

Part Number	Description
B3000	SNAP Analog/Digital Brain Mistic/Optomux Protocol

Features

- Convenient pluggable connector for removable top mounted field wiring.
- Ready access to standard fuses.
- Versatile DIN-rail or panel mounting.
- Single distributed brain does it all - analog, digital, or mixed I/O.
- Highly visible LED status indicator for each channel.
- High-density digital I/O (Four channels per module).
- Mix analog and digital modules on the same rack.
- High-density (dual channel inputs),softwareconfigurable, intelligent analog I/O.
- Handsome snap-on ID plates for channel labels.
- Quick and easy installation - modules "SNAP" securely on racks, no screws required.
- Factory Mutual approved.



Description

The B3000 is a high-performance brain used to remotely control a mix of both analog and digital I/O modules using Opto 22's Snap® "B Series"I/O mounting racks. The B3000 can be used with either an Opto 22 controller or a host computer. On-board intelligence enables many distributed control functions. Since SNAP analog and digital modules have the same footprint, the B3000 brain can be combined with Snap "B Series" racks to provide the world's most powerful and sophisticated I/O handling systems.

The B3000 communicates with a host processor serially over RS485 twisted pair wiring and supports both the advanced Mistic® protocol and the industry-standard Optomux® protocol. Both protocols can support high-speed communication (115 Kbaud). Utilizing the Mistic protocol, advanced I/O processing — including PID calculations (100 millisecond update), pulse width duration measurements (100 microsecond resolution), and high-speed counting (20,000 Hz) — can all be accomplished on separate channels of the same I/O mounting rack. See page 3 for a complete list of mistic functions.

In addition to providing input and output capability, the Optomux protocol also has the ability to perform count, latch, and pulse duration on digital input channels, as well as frequency and pulse functions on digital outputs. The Optomux protocol is also capable of providing input averaging and output waveform functions on analog channels. See page 4 for a complete list of Optomux functions.

The B3000 is compatible with the classic B1 and B2 brains, with a few exceptions. The B3000 adds the ability to communicate with either a 2-wire or 4-wire configuration, at speeds of 115 Kbaud. Classic brains were restricted to 4-wire communications at up to 38.4 Kbaud. The B3000 now supports only the standard 2-pass method of communication with the Optomux protocol.

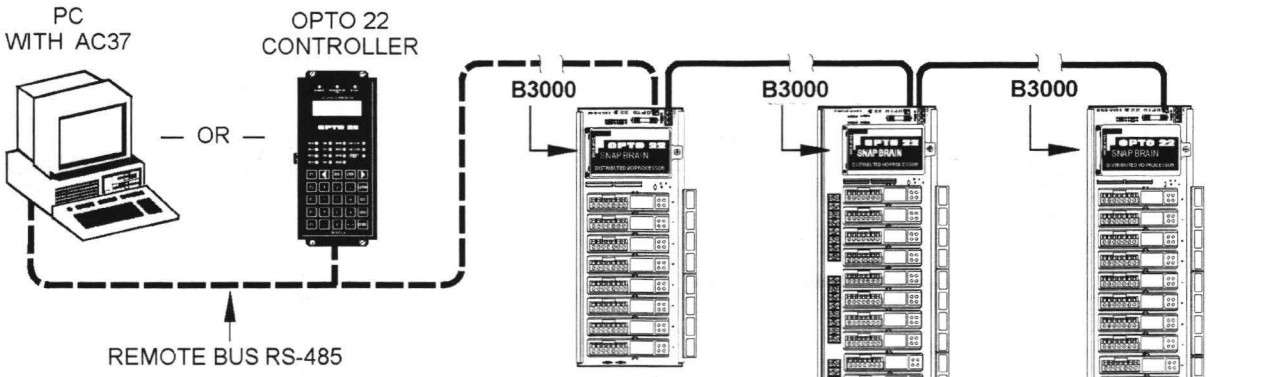
By using the B3000 with the Mistic protocol and a Mistic controller, SNAP I/O customers can take advantage of FactoryFloor®, Opto 22's impressive new suite of Windows® 32-bit software that delivers total control to industrial automation customers. FactoryFloor consists of four integrated components:

- OptoControl™, a graphical, flowchart-based development environment for control solutions
- OptoDisplay™, a graphical, multimedia operator interface package
- OptoServer™, a robust data server that connects the controller network with the PC-based FactoryFloor network.
- Plus OptoConnect™, a drag-and-drop database utility that makes building SQL Server and Access databases a snap.

OptoControl is the cornerstone of Opto 22's FactoryFloor software and is the programming environment that leverages all the power of Opto 22's distributed hardware platform. OptoControl utilizes the distributed control capability of the B3000 brain and takes advantage of the graphical Windows 95 or NT interface to make it easy to configure, design, and troubleshoot your control system.

Opto 22's OptoDriver Toolkit™ may be used for direct communications from a host PC to the B3000. The toolkit includes new 32-bit Windows drivers, Windows 16-bit drivers, and Opto 22's classic DOS drivers. The kit also provides the files, documentation, and real-world examples needed to write Microsoft® Windows and DOS software applications. Programmers can access the Opto 22 I/O hardware using high-level languages such as Microsoft Visual C++™ or Microsoft Visual Basic®.

B3000 Mistic System Architecture

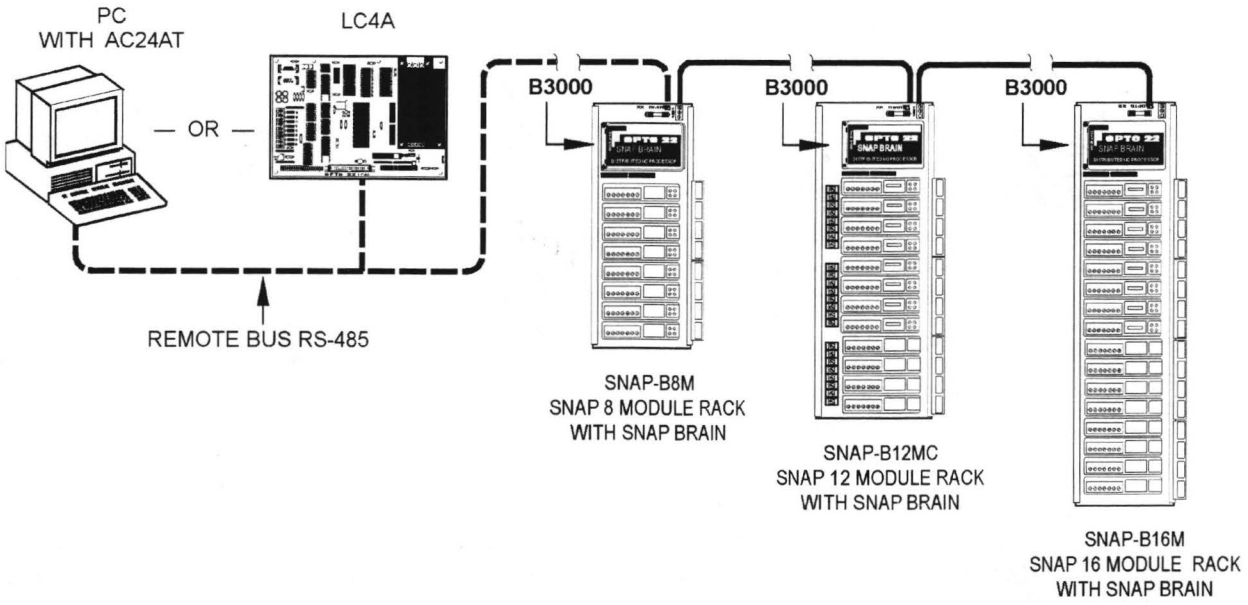


Mistic Functions

Digital	Analog
Input latching (10 µsec)	PID loop control
Timing (1 msec resolution)	High/Low limit monitoring
Counting (32 bit)	Thermocouple linearization
Totalizing	Digital filtering
Output timing (1 msec resolution)	Ramping
Pulse generation (1 msec resolution)	Waveform generation
Time proportional output (100 msec minimum period)	Programable offset and gain
Frequency measurement (up to 20 Khz)	Engineering unit scaling
Event reactions	Square root extraction
Pulse measurment	Event reactions
Period measurement	

Notes:
1. PID loops do not cross address boundaries.
2. PID loops can only be configured on analog addresses. There is a maximum of 8 PID loops per analog address.
3. Event reactions do not cross address boundaries.

B3000 Optomux System Architecture



Optomux Functions

Digital	Analog
Input latching	Input Averaging
Time Delays (10ms resolution)	High/Low Limit Testing
Pulse Generation (10ms resolution)	Waveform Generation
Counting (16 bit)	High/Low Limit Recording
Pulse Duration	Programmable Offset & Gain

Specifications

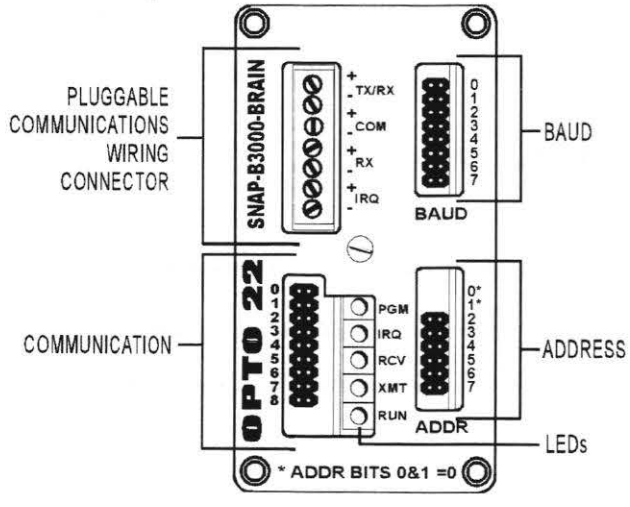
General

Operating Specifications

Power Requirements	5.0 VDC ± 0.1 VDC @ 1.0A max.
Operating Temperature	0° to 70°C, 95% humidity, non-condensing
Communications Interface	RS-485/422, 2- or 4-wire, twisted pair(s), with shield
Data Rates	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, and 115200 baud
Range: Multidrop	Unlimited. (Up to 3,000 feet or 32 stations maximum between repeaters)
LED Indicators	RUN (Power On), RCV (Receive), XMT (Transmit), (IRQ) Interrupt, and (PGM) Program
Options: Jumper Selectable	Address Communication baud rate CRC/Checksum Binary/ASCII Mistic/Optomux Emulation

Connectors And Jumpers

Top View: B3000 (cover removed)



Specifications

Serial Communication Cables

The following cables are recommended for RS-485/422 serial communications. Although you may elect to use other cables, keep in mind that low capacitance (less than 15 pF/ft.) is important for high-speed digital communication links. The cables listed below are all 24-gauge, 7x32 stranded, with 100-ohm nominal impedance and a capacitance of 12.5 pF/ft.

Select from the following two-, three-, and four-pair cables, depending on your application needs. All will yield satisfactory results. It is recommended that you choose a cable with one more pair than your application requires. Use one of the extra wires, rather than the shield, for the common.

Two-Pair:

- Belden P/N 8102 (with overall shield)
- Belden P/N 9729 (individually shielded)
- Belden P/N 8162 (individually shielded with overall shield)
- Manhattan P/N M3475 (individually shielded with overall shield)
- Manhattan P/N M39249 (individually shielded with overall shield)

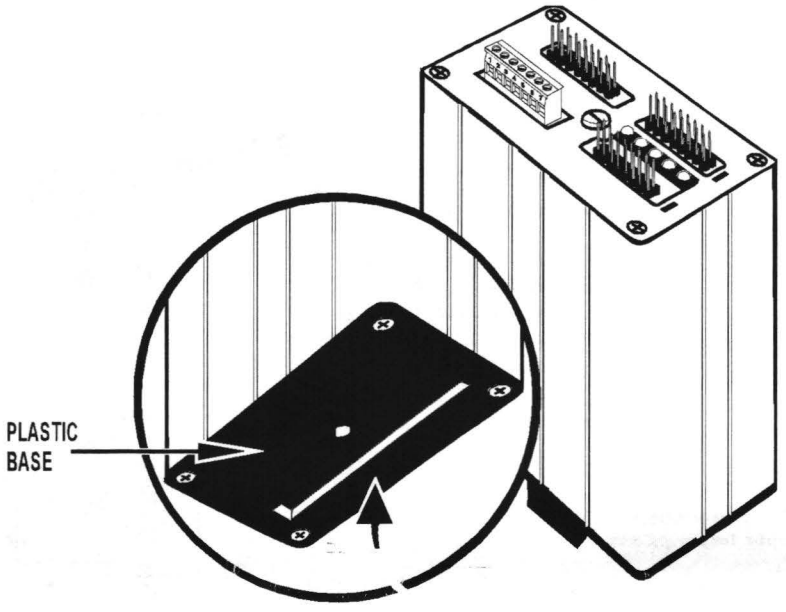
Three-Pair:

- Belden P/N 8103 (with overall shield)
- Belden P/N 9730 (individually shielded)
- Belden P/N 8163 (individually shielded with overall shield)
- Manhattan P/N M3476 (individually shielded with overall shield)
- Manhattan P/N M39250 (individually shielded with overall shield)

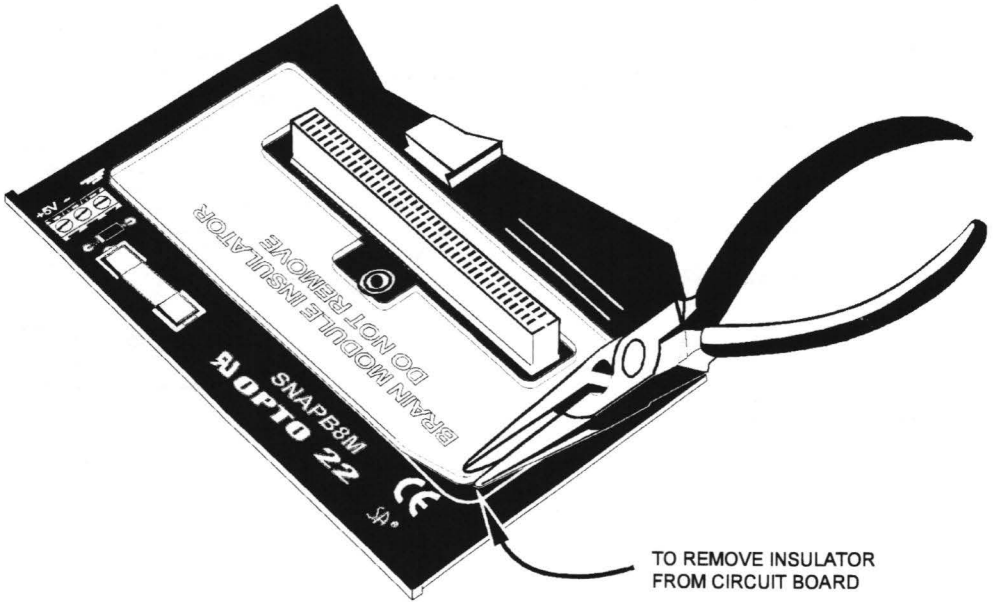
Four-Pair:

- Belden P/N 8104 (with overall shield)
- Belden P/N 9728 (individually shielded)
- Belden P/N 8164 (individually shielded with overall shield)
- Manhattan P/N M3477 (individually shielded with overall shield)
- Manhattan P/N M39251 (individually shielded with overall shield)

IMPORTANT!

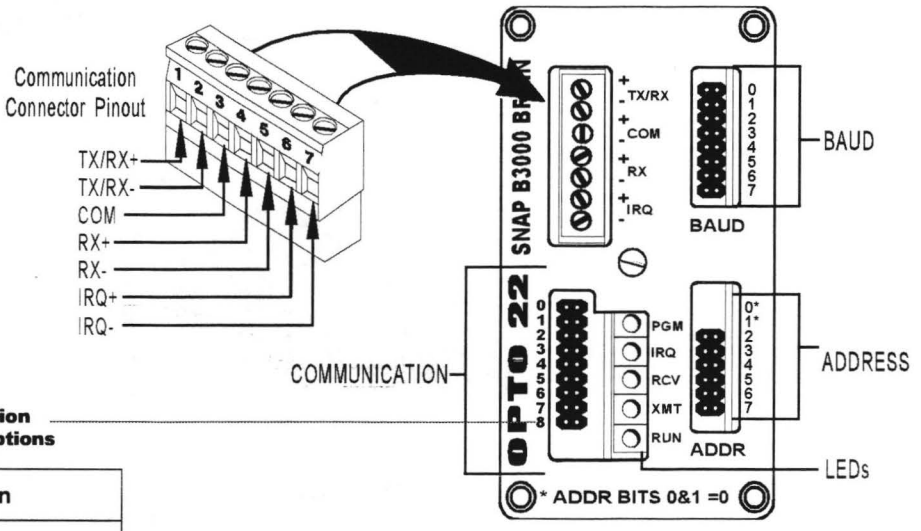


PLEASE NOTE:
IF YOUR SNAP-BRAIN BOARD FEATURES A ***PLASTIC BASE,***
YOU MUST REMOVE THE ***PLASTIC INSULATOR*** FROM
THE CIRCUIT BOARDS, AS SHOWN IN DIAGRAM BELOW.



Specifications

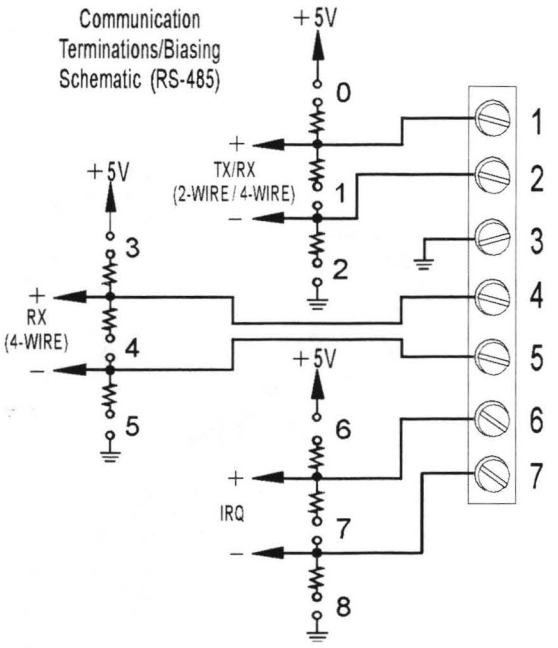
Communication Jumpers/Wiring



Communication Jumper Descriptions

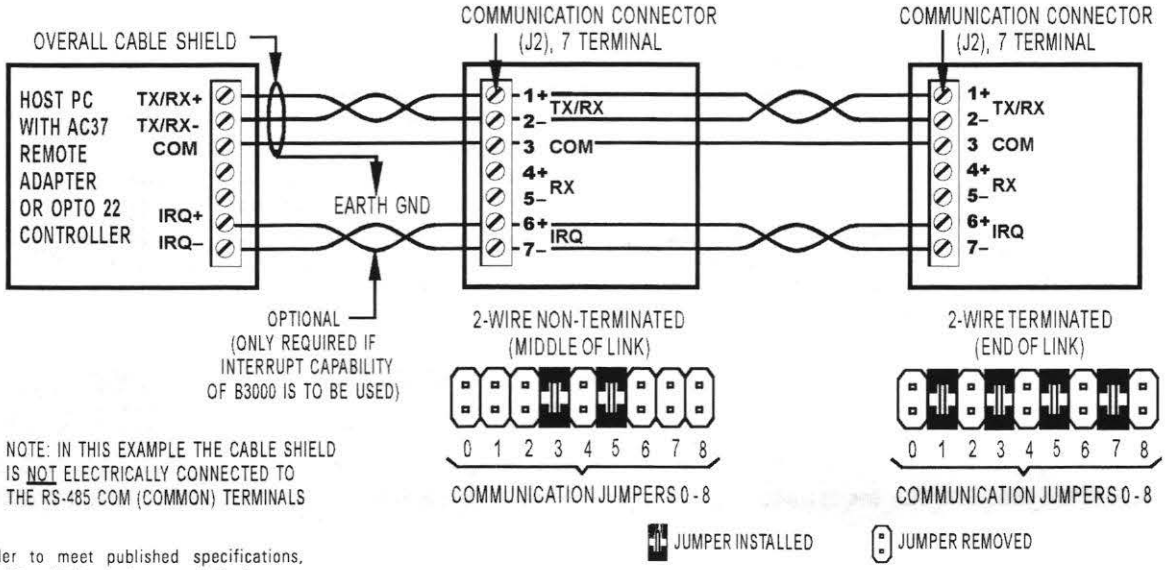
Jumper	Description
0	Pull-up for TX/RX+
1	Terminator for TX/RX
2	Pull-down for TX/RX-
3	Pull-up for RX+
4	Terminator for RX line
5	Pull-down for RX line
6	Pull-up for IRQ+
7	Terminator for IRQ
8	Pull-down for IRQ-

Note: When changing jumper settings, the new settings will not take effect until the next time the unit is powered up.



Mistic Communication Jumpers/Wiring

STANDARD 2-WIRE CONFIGURATION

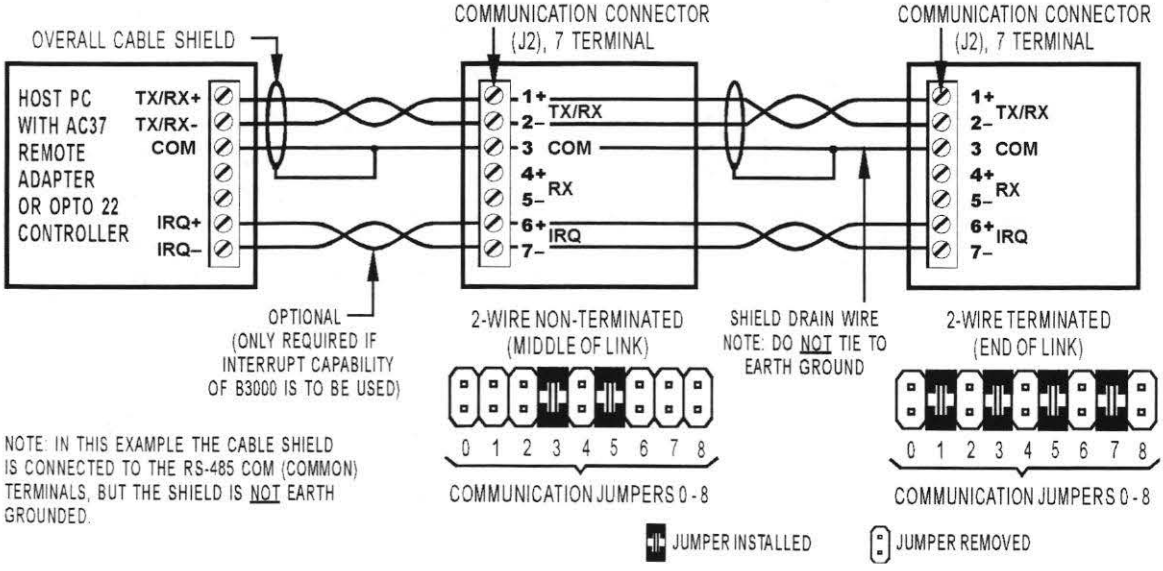


NOTE: IN THIS EXAMPLE THE CABLE SHIELD IS NOT ELECTRICALLY CONNECTED TO THE RS-485 COM (COMMON) TERMINALS

In order to meet published specifications, the RS-485 serial link requires two terminations, one at each physical end of the serial link. **Star configuration is not allowed.** In order to use a star configuration, use Opto 22 Part No. AC38A/B.

ALTERNATE 2-WIRE CONFIGURATION

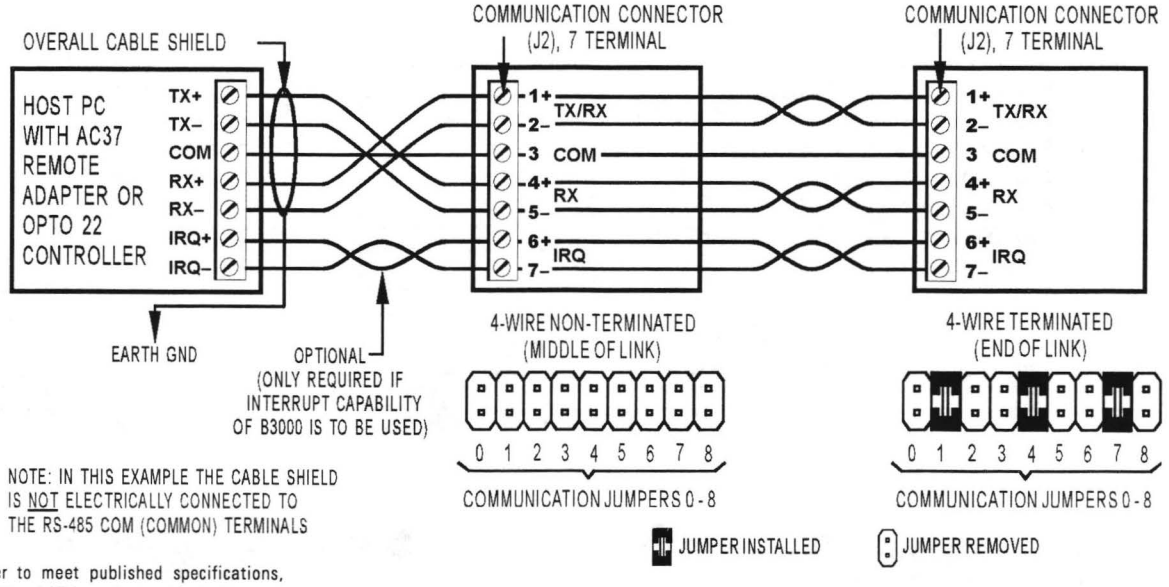
(ACCEPTABLE FOR MOST CONDITIONS)



NOTE: IN THIS EXAMPLE THE CABLE SHIELD IS CONNECTED TO THE RS-485 COM (COMMON) TERMINALS, BUT THE SHIELD IS NOT EARTH GROUNDED.

Mistic Communication Jumpers/Wiring (Continued)

STANDARD 4-WIRE CONFIGURATION

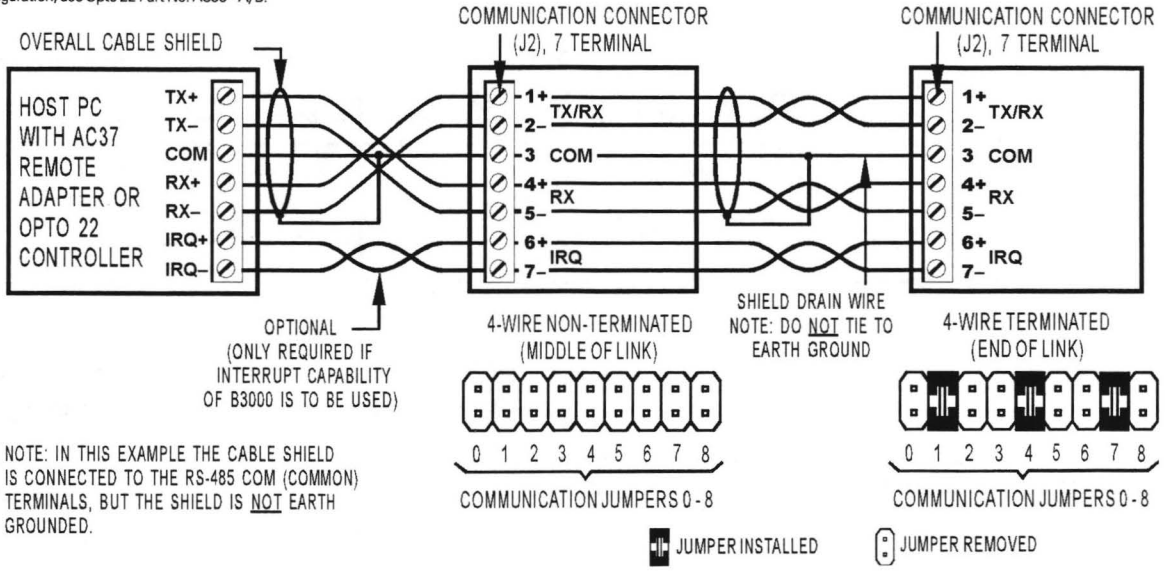


NOTE: IN THIS EXAMPLE THE CABLE SHIELD IS NOT ELECTRICALLY CONNECTED TO THE RS-485 COM (COMMON) TERMINALS

In order to meet published specifications, the RS-485 serial link requires two terminations, one at each physical end of the serial link. **Star configuration is not allowed.** In order to use a star configuration, use Opto 22 Part No. AC30•A/B.

ALTERNATE 4-WIRE CONFIGURATION

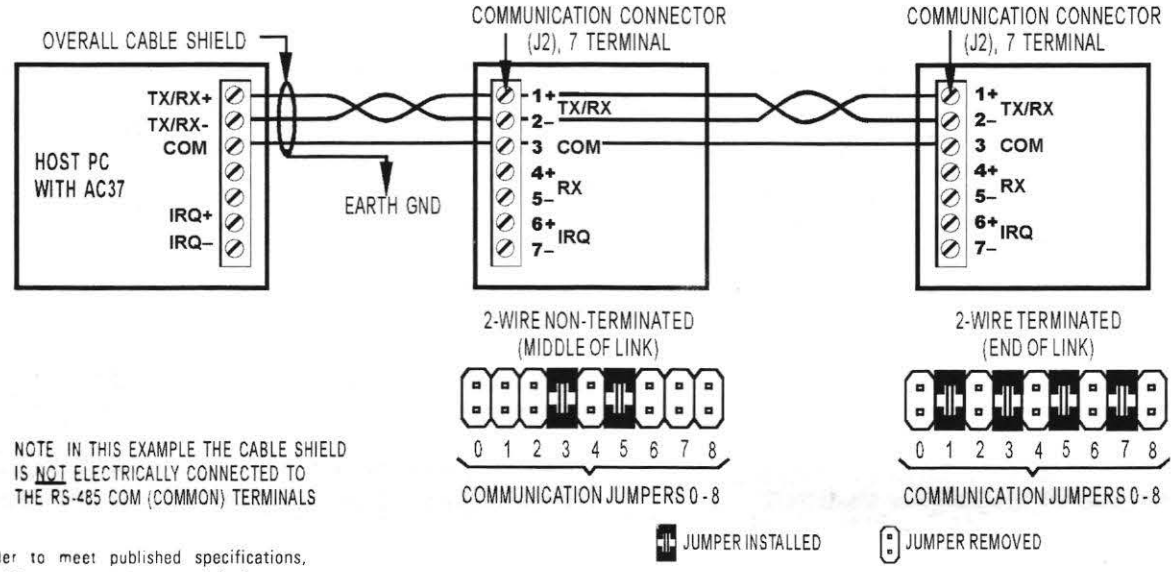
(ACCEPTABLE FOR MOST CONDITIONS)



NOTE: IN THIS EXAMPLE THE CABLE SHIELD IS CONNECTED TO THE RS-485 COM (COMMON) TERMINALS, BUT THE SHIELD IS NOT EARTH GROUNDED.

Optomux Communication Jumpers/Wiring

STANDARD 2-WIRE CONFIGURATION

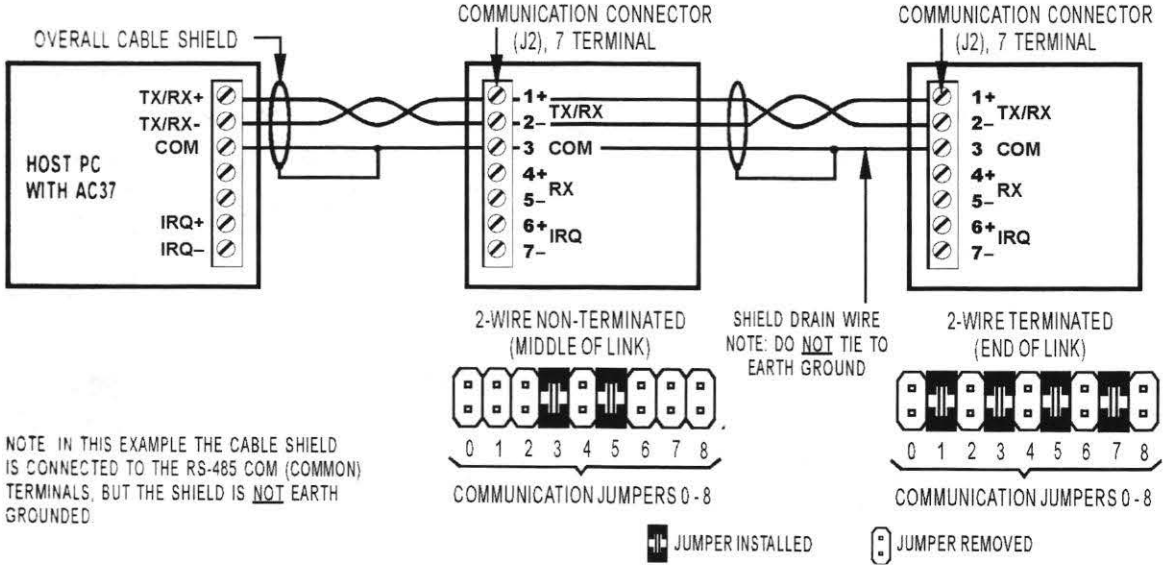


NOTE IN THIS EXAMPLE THE CABLE SHIELD IS NOT ELECTRICALLY CONNECTED TO THE RS-485 COM (COMMON) TERMINALS

In order to meet published specifications, the RS-485 serial link requires two terminations, one at each physical end of the serial link. **Star configuration is not allowed.** In order to use a star configuration, use Opto 22 Part No. AC38A/B.

ALTERNATE 2-WIRE CONFIGURATION

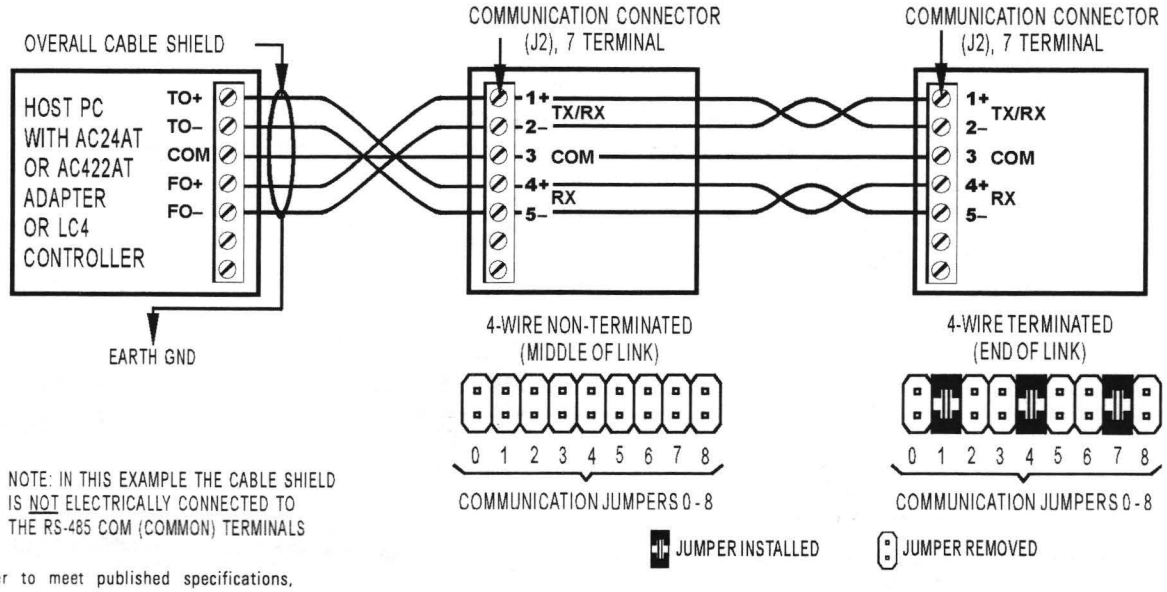
(ACCEPTABLE FOR MOST CONDITIONS)



NOTE IN THIS EXAMPLE THE CABLE SHIELD IS CONNECTED TO THE RS-485 COM (COMMON) TERMINALS, BUT THE SHIELD IS NOT EARTH GROUNDED.

Optomux Communication Jumpers/Wiring (Continued)

STANDARD 4-WIRE CONFIGURATION

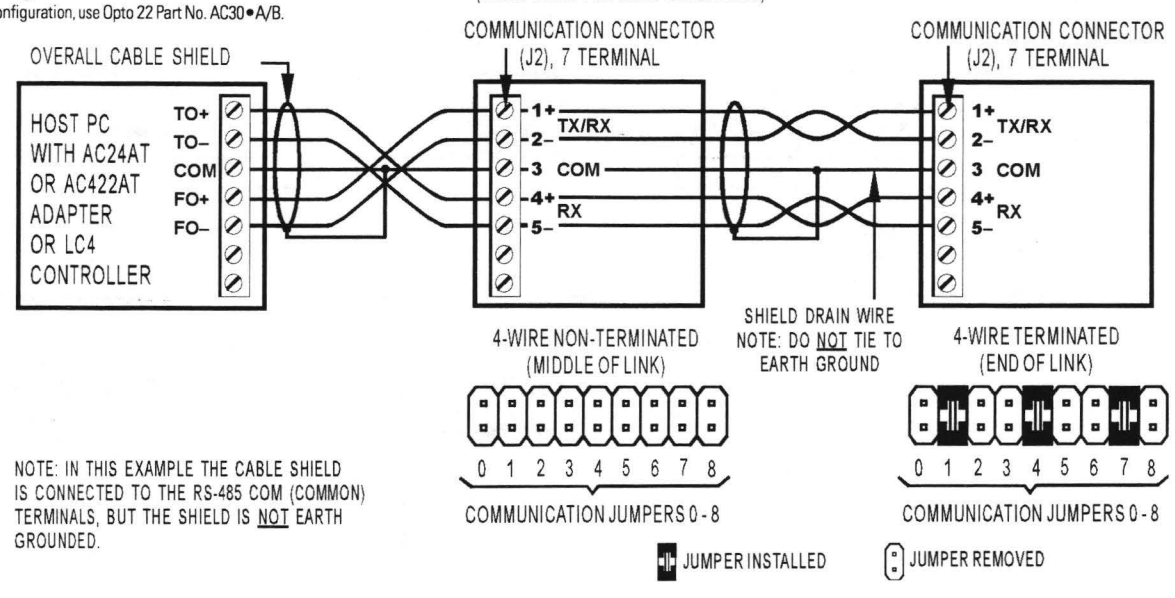


NOTE: IN THIS EXAMPLE THE CABLE SHIELD IS NOT ELECTRICALLY CONNECTED TO THE RS-485 COM (COMMON) TERMINALS

In order to meet published specifications, the RS-485 serial link requires two terminations, one at each physical end of the serial link. **Star configuration is not allowed.** In order to use a star configuration, use Opto 22 Part No. AC30•A/B.

ALTERNATE 4-WIRE CONFIGURATION

(ACCEPTABLE FOR MOST CONDITIONS)



NOTE: IN THIS EXAMPLE THE CABLE SHIELD IS CONNECTED TO THE RS-485 COM (COMMON) TERMINALS, BUT THE SHIELD IS NOT EARTH GROUNDED.

Baud/Address Jumpers, LED Descriptions

Note: When changing jumper settings, the new settings will not take effect until the next time the unit is powered up.

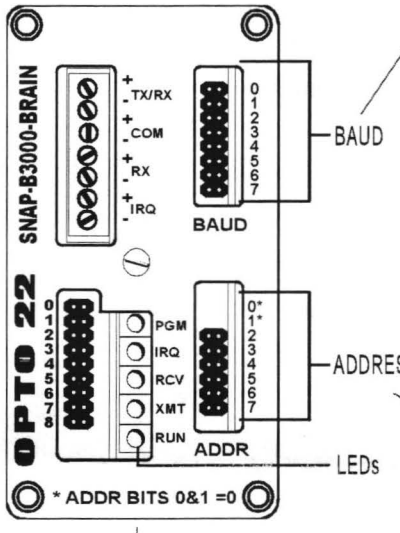


Table 1: Baud Rate Jumpers (0 - 3)

BAUD RATE	JUMPER POSITION 3	2	1	0
115.2 KBaud (factory default setting)	■	■	■	□
76.8 KBaud	■	■	□	■
57.6 KBaud	■	■	□	□
38.4 KBaud	■	□	■	■
19.2 KBaud	■	□	■	□
9600 Baud	■	□	□	■
4800 Baud	■	□	□	□
2400 Baud	□	■	■	■
1200 Baud	□	■	■	□
600 Baud	□	■	□	■
300 Baud	□	■	□	□

Baud 4
Binary ■ (Default)
ASCII □ (Required Setting for Optomux)

Baud 5 Data verification
CRC16 ■ (Default)
Checksum Modulo 256 □ (Required Setting for Optomux)

Baud 6 Protocol
Mistic □ (Default)
Optomux ■ (Required Setting for Optomux)

Baud 7
Unused □

■ =JUMPER INSTALLED

Table 2: Address Table

	7 6 5 4 3 2		7 6 5 4 3 2		7 6 5 4 3 2		7 6 5 4 3 2
0	□□□□□□	64	■□□□□□	128	□□□□□□	192	■■□□□□
4	□□□□□■	68	■□□□□■	132	□□□□□■	196	■■□□□■
8	□□□□■□	72	■□□□■□	136	□□□□■□	200	■■□□■□
12	□□□□■■	76	■□□□■■	140	□□□□■■	204	■■□□■■
16	□□□■□□	80	■□□■□□	144	□□□■□□	208	■■□■□□
20	□□□■□■	84	■□□■□■	148	□□□■□■	212	■■□■□■
24	□□□■■□	88	■□□■■□	152	□□□■■□	216	■■□■■□
28	□□□■■■	92	■□□■■■	156	□□□■■■	220	■■□■■■
32	□□■□□□	96	■□■□□□	160	□□■□□□	224	■■■□□□
36	□□■□□■	100	■□■□□■	164	□□■□□■	228	■■■□□■
40	□□■□■□	104	■□■□■□	168	□□■□■□	232	■■■□■□
44	□□■□■■	108	■□■□■■	172	□□■□■■	236	■■■□■■
48	□□■■□□	112	■□■■□□	176	□□■■□□	240	■■■■□□
52	□□■■□■	116	■□■■□■	180	□□■■□■	244	■■■■□■
56	□□■■■□	120	■□■■■□	184	□□■■■□	248	■■■■■□
60	□□■■■■	124	■□■■■■	188	□□■■■■	252	■■■■■■

■ = JUMPER INSTALLED □ = NO JUMPER

Table 3: LED Description Table

LED	Description
PGM	LED will be on during Flash memory upgrade. Normally LED is off.
IRQ	Processor interrupt request currently active.
RCV	Processor is currently receiving data on communication line.
XMT	Processor is currently transmitting data on communication line.
RUN	Power on Processor (at least 4.75 VDC)

Address Configuration Notes:

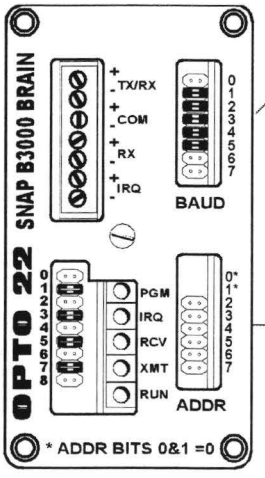
1. Jumper positions 0 and 1 have no provision to install jumpers. These jumper positions are always set open by default.
2. See Figure 1-1 on page 18 for B3000 SNAP I/O mapping.

Jumper Examples - Mistic & Optomux

Note: When changing jumper settings, the new settings will not take effect until the next time the unit is powered up.

Jumper Settings When Used As Mistic Brain

Mistic
2-wire
115.2 Kbaud
CRC-16
Binary
Address 0



0-3 = 115.2 Kbaud
4 = Binary
5 = CRC 16
6 = Mistic protocol

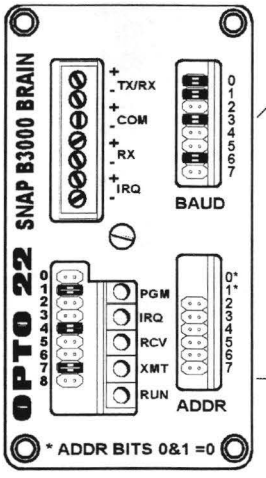
Address 0

2-wire mode
This is the last unit on the communication link.

JUMPER INSTALLED JUMPER REMOVED

Jumper Settings When Used As Optomux Brain

Optomux
4-wire
38.4 kbaud
checksum 256
Ascii
address 0



0-3 = 38.4 Kbaud
4 = ASCII
5 = Checksum 256
6 = Optomux protocol
* Optomux protocol requires ASCII and checksum 256.

Address 0

4-wire mode
This is the last unit on the communication link.

JUMPER INSTALLED JUMPER REMOVED

B3000 I/O Mapping

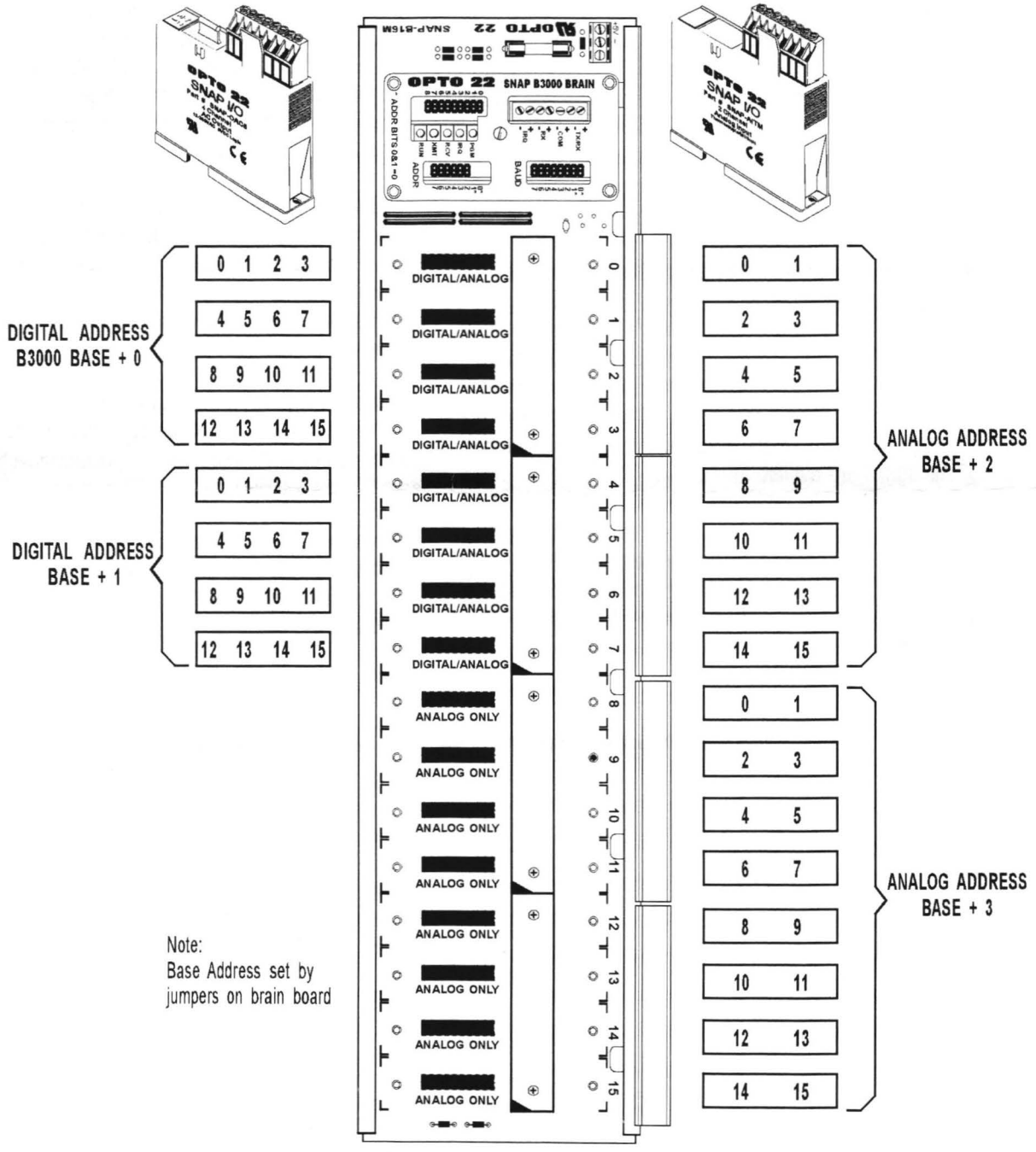


Figure 1-1: SNAP I/O Rack

B3000 I/O Mapping (Continued)

The B3000 is connected to a SNAP B Series I/O rack, which can hold either 8, 12, or 16 SNAP modules. Digital modules (either input or output) contain four channels of I/O. Analog input modules contain two channels and analog output modules currently contain two channels. Both analog and digital modules can be on the same rack.

A B3000 is capable of addressing a maximum of 32 channels of digital I/O and 32 channels of analog I/O. However, the I/O mounting racks will not accommodate 32 channels of both digital and analog. The actual number of channels available depend on the combination of modules chosen. For example, the SNAP-B16M rack can mount 16 modules. Up to eight of these modules can be digital, providing 32 channels of digital I/O. The remaining eight module positions can be analog, providing up to 16 channels of analog I/O. If all 16 modules are analog, up to 32 channels of analog I/O are available.

I/O on the B3000 is divided into four addresses of I/O (two digital I/O and two analog I/O). The digital addresses are base+0 and base+1. The analog addresses are base+2 and base+3. Therefore, if a SNAP brain is configured at address 12, the digital addresses would be 12 and 13 and the analog would be 14 and 15.

First Four Module Positions (0-3):

Each position can hold either a digital or an analog module. They can be all analog, all digital, or any mix of both. These four positions constitute the 16 digital channels of digital address base + 0, and the first eight analog channels of analog address base + 2.

Second Four Module Positions (4-7):

Each position can hold either a digital or an analog module. They can be all analog, all digital or any mix of both. These four positions constitute the 16 digital channels of digital address base + 1, or the second eight analog channels of analog address base + 2.

Third Four Module Positions (8-11):

These positions can hold analog modules only. These four positions constitute the first eight analog channels of analog address base + 3.

Fourth Four Module Positions (12-15):

These positions can hold analog modules only. These four positions constitute the second eight analog channels of analog address base + 3.

The layout is illustrated in Figure 1-1 on the previous page.

OptoControl B3000 SNAP I/O Configuration

If you configure a digital module on the digital address base + 0 at the first module location, that will preclude you from configuring an analog module on analog address base + 2 at the first module location, as analog channels 0 and 1 of analog address base + 2 overlap with digital channels 0,1,2, and 3 of digital address base + 0. This fact will be indicated in OptoControl by text in the Configure I/O Points dialog, which will display information in the Name field for analog channels 0 and 1 stating that those channels are used by a SNAP digital module, and will specify the name of that I/O unit address.

Digital

When configuring the unit, select B3000 Snap Digital as the Type in the Add I/O Unit dialog.

The digital addresses are base+0 and base+1. If the SNAP brain is configured at address 12 (base), the digital addresses would be 12 and 13 .

When a point is configured, OptoControl automatically creates and configures the other three points in the module. For example, if a digital SNAP point is added at channel 5, then identical points are created at channels 4, 6, and 7. Unique names are created for these new points, based on the name entered for the original point. You can then modify the name, as well as the description, features, default, and watchdog for each channel independently. If the module type of one digital point is changed, then the module type of all other points in that module are automatically changed.

Analog

When configuring the unit, select B3000 SNAP Analog as the Type in the Add I/O Unit dialog.

The analog addresses are base+2 and base+3. If the SNAP brain is configured at address 12 (base), the analog addresses would be 14 and 15.

Inputs:

When an input is configured, OptoControl automatically creates and configures the other input channel on that module. The name of the other channel can then be modified, as well as the description, default, and watchdog fields. The module type and scaling cannot be modified.

Outputs:

Single-channel analog output modules use two analog channels, but they contain only one channel of output. Only the even-numbered channel is usable, e.g., 0, 2, 4, etc. The odd-numbered channel is not valid. Opto 22 also produces 2-channel analog output modules.

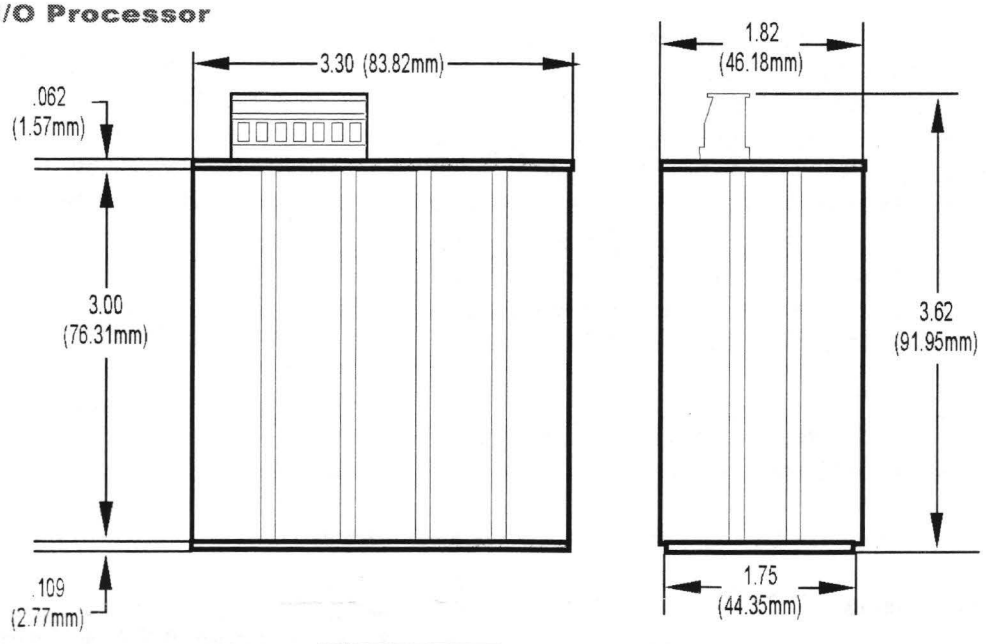
Other Notes

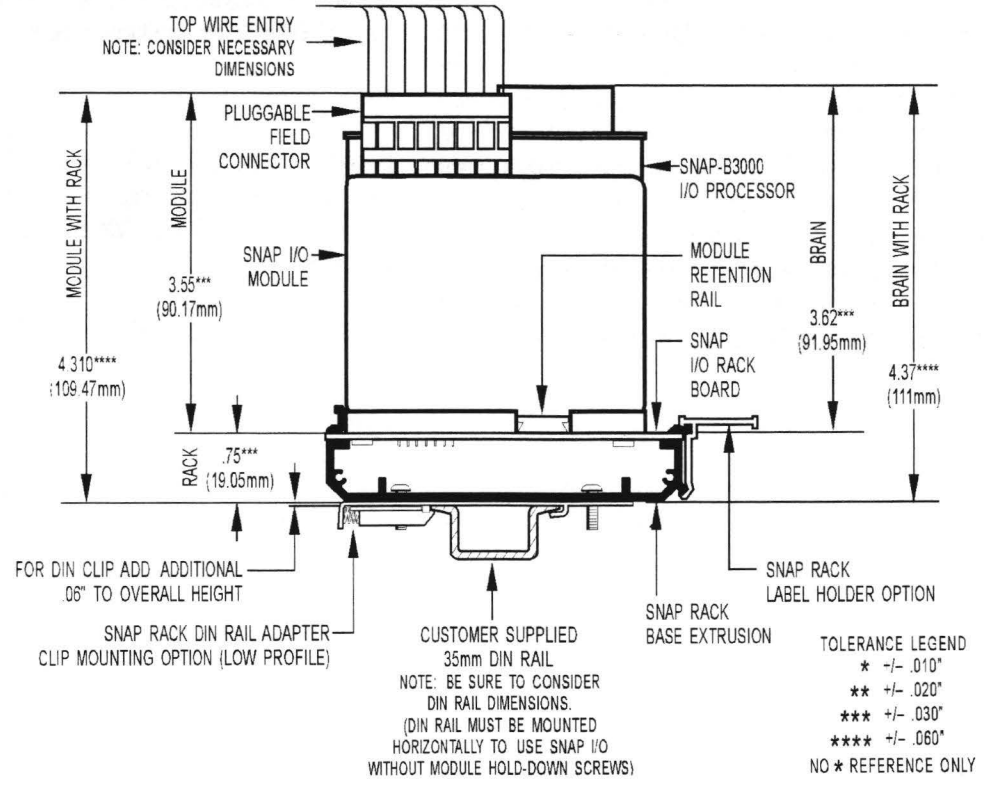
Event/reactions and PID Loops can only operate on points in the same address group. They behave just like standard I/O in this sense, and cannot cross address boundaries. For example, a PID loop cannot use an input on Address Base + 2, to control an output on Base + 3.

Up to 127 event/reactions can be configured per SNAP address.

Dimensional Drawings

B3000 I/O Processor





Assembly

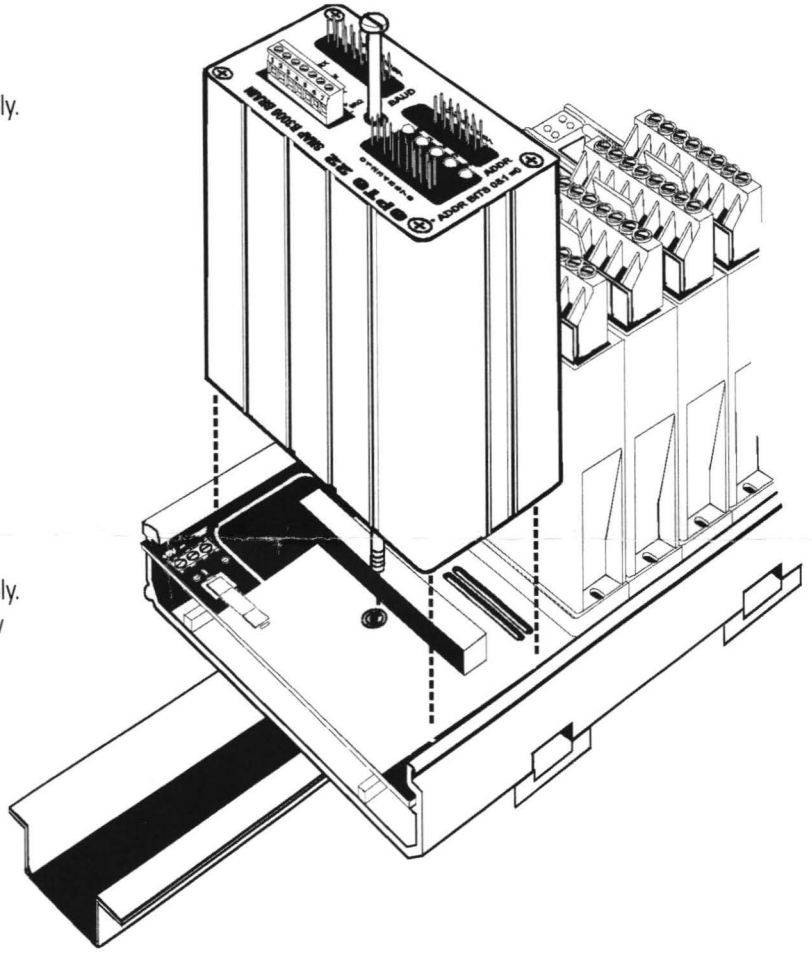
Brain

To install brain onto B Series rack:

1. Turn off power from rack assembly.
2. Align brain connector with mating connector on rack.
3. Seat brain onto connector.
4. Use integral hold-down screw to secure in position.
   DO NOT OVERTIGHTEN!

To remove brain from B Series rack:

1. Turn off power from rack assembly.
2. Loosen integral hold-down screw on brain.
3. Pull up on brain.



I/O MODULES
SNAP
DIGITAL OUTPUT MODULES

OPTO 22
DATA SHEET
Form 1144-010524

Description

Opto 22 SNAP digital output modules are designed to work with SNAP D-series or SNAP B-series racks. These modules are also compatible with SNAP Ethernet I/O. Customers can choose from AC or DC models. SNAP digital's 4-channel-per-module packaging delivers high density. All solid-state modules provide 4,000 volts of optical isolation from the field side to the logic side.

All SNAP digital modules have removable top-mounted connectors to provide easy access for field wiring. All operate on 5 VDC control logic. Each digital module features integral channel-specific LEDs for convenient troubleshooting and maintenance. SNAP digital I/O is 200 percent factory-tested and is UL and CE approved. In addition, part numbers ending in FM are Factory Mutual approved.

SNAP output modules are used to switch up to four separate AC or DC loads. Output modules that are fused use a standard fuse with a convenient handle for easy replacement. DC outputs are available in either a source or sink configuration. AC outputs are zero voltage turn on and zero current turn off for transient-free switching. The dry contact modules allow switching of low power signals where signal integrity must be maintained, or where zero leakage current is a requirement.

SNAP-OAC5MA and SNAP-ODC5MA are special modules featuring manual-on/manual-off/automatic switches, ideal for diagnostic testing of control applications. The switches override output from the application, so you can quickly check field device wiring. These modules each contain four isolated channels.

The SNAP-OAC5-i, SNAP-ODC5-i, and SNAP-ODC5A-i modules provide four isolated output channels.

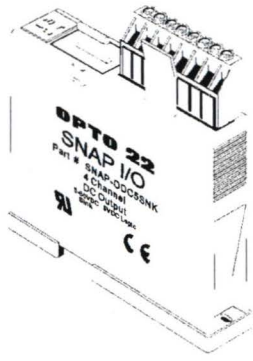
Dry contact modules are not solid-state devices. They use reed relays, which are electro mechanical devices. These modules do not provide optical isolation. Current rating for dry contact modules depends on the voltage they are used with, as shown in the graph on page 10.

Part Numbers	Description	Pages
SNAP-OAC5	SNAP 4-channel 12–250 VAC output, 5 VDC logic	2, 4
SNAP-OAC5MA*	SNAP 4-channel isolated 12–250 VAC output, 5 VDC logic with manual/auto switch	2, 5
SNAP-OAC5FM	SNAP 4-channel 12–250 VAC output, 5 VDC logic	3, 4
SNAP-OAC5-i*	SNAP 4-channel isolated 12–250 VAC output, 5 VDC logic	2, 6
SNAP-OAC5-iFM	SNAP 4-channel isolated 12–250 VAC output, 5 VDC logic	3, 6
SNAP-ODC5SRC	SNAP 4-channel 5–60 VDC output, 5 VDC logic source	7, 11
SNAP-ODC5SRCFM	SNAP 4-channel 5–60 VDC output, 5 VDC logic source	9, 11
SNAP-ODC5SNK	SNAP 4-channel 5–60 VDC output, 5 VDC logic sink	7, 12
SNAP-ODC5SNKFM	SNAP 4-channel 5–60 VDC output, 5 VDC logic sink	9, 12
SNAP-ODC5R*	SNAP 4-channel dry contact output, normally open	7, 13
SNAP-ODC5RFM	SNAP 4-channel dry contact output, normally open	9, 13
SNAP-ODC5R5	SNAP 4-channel dry contact output, normally closed	7, 13
SNAP-ODC5R5FM	SNAP 4-channel dry contact output, normally closed	9, 13
SNAP-ODC5MA*	SNAP 4-channel isolated 5–60 VDC output, 5 VDC logic with manual/auto switch	8, 14
SNAP-ODC5-i	SNAP 4-channel isolated 5–60 VDC output, 5 VDC logic	8, 15
SNAP-ODC5-iFM	SNAP 4-channel isolated 5–60 VDC output, 5 VDC logic	10, 15
SNAP-ODC5A-i*	SNAP 4-channel isolated 5–200 VDC output, 5 VDC logic	8, 15
SNAP-ODC5A-iFM	SNAP 4-channel isolated 5–200 VDC output, 5 VDC logic	10, 15
SNAP-ODC5ASNK*	SNAP 4-channel 5–200 VDC output, 5 VDC logic sink	8, 12
SNAP-RETN4	SNAP 4-module retention rail (OEM)	-----
SNAP-RETN4B	SNAP 4-module retention rail, 25-pack (OEM)	-----
SNAP-RETN6	SNAP 6-module retention rail (OEM)	-----
SNAP-RETN6B	SNAP 6-module retention rail, 25-pack (OEM)	-----
SNAP-FUSE4AB	SNAP 4-amp fuse, 25-pack	-----
SNAP-MODFUSEH	SNAP digital output module fuse holder, 10-pack	-----

* UL approval pending

Features

- Four channels per module
- Convenient pluggable wiring terminals
- Powered by a single 5-volt supply
- Channel-specific LEDs
- Operating temperature: 0° to 70° C
- UL and CE approved
- Factory Mutual approved (part numbers ending in FM)



Opto 22 • 43044 Business Park Drive • Temecula, CA 92590 • Phone: (909) 695-3000 • (800) 321-OPTO • Fax: (909) 695-3095 • Internet: www.opto22.com
Inside Sales: (800) 452-OPTO • Product Support: (800) TEK-OPTO • (909) 695-3080 • Fax: (909) 695-3017 • E-mail: support@opto22.com • FaxBack: (800) 474-OPTO

Specifications

AC Output Modules

AC OUTPUT MODULE	SNAP-OAC5	SNAP-OAC5MA	SNAP-OAC5-i
Key Feature	--	Diagnostic switches Four isolated channels	Four isolated channels
Field Side Ratings (each channel)			
Line Voltage - Maximum	250 VAC	250 VAC	250 VAC
Line Voltage - Nominal	120/240 VAC	120/240 VAC	120/240 VAC
Current Rating 0°C to 70°C Ambient	3 amps per module	3 amps per module	3 amps per module
One Cycle Surge	80 amps peak (50/60Hz)	80 amps peak (50/60Hz)	80 amps peak (50/60Hz)
Minimum Load Current	20 mA	20 mA	20 mA
Output Voltage Drop	1.6 volts maximum @ 0.75 amps	1.6 volts maximum @ 0.75 amps	1.6 volts maximum @ 0.75 amps
Off-state Leakage at Nominal Voltage - 60 Hz	2.5 mA @ 240 VAC 1.25 mA @ 120 VAC	2.5 mA @ 240 VAC 1.25 mA @ 120 VAC	2.5 mA @ 240 VAC 1.25 mA @ 120 VAC
Peak Blocking Voltage	500 volts	500 volts	500 volts
Operating Frequency	25-65 Hz	25-65 Hz	25-65 Hz
dV/ dt - Off-state	200 volts/msec	200 volts/msec	200 volts/msec
dV/ dt - Commutating	Snubbed for rated 0.5 power factor load	Snubbed for rated 0.5 power factor load	Snubbed for rated 0.5 power factor load
Fuse (Common to all Channels)	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A	Has four isolated channels. User must provide own fusing.	Has four isolated channels. User must provide own fusing.
Channel-to-channel Isolation	Not applicable	300 VAC (1500 V transient)	300 VAC (1500 V transient)
Logic Side Ratings			
Pickup Voltage	4 VDC @ 5.5 mA	4 VDC @ 5.5 mA	4 VDC @ 5.5 mA
Dropout Voltage	1 VDC @ <500 mA	1 VDC @ <500 mA	1 VDC @ <500 mA
Control Resistance	220 ohms	220 ohms	220 ohms
Logic Supply Voltage	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum
Module Ratings			
Number of Channels Per Module	4	4	4
Turn-on Time	1/2 cycle maximum (zero volts crossover)	1/2 cycle maximum (zero volts crossover)	1/2 cycle maximum (Zero Volts Crossover)
Turn-off Time	1/2 cycle maximum (zero current crossover)	1/2 cycle maximum (zero current crossover)	1/2 cycle maximum (zero current crossover)
Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)
Temperature	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage

Specifications

AC Output Modules - Factory Mutual Approved

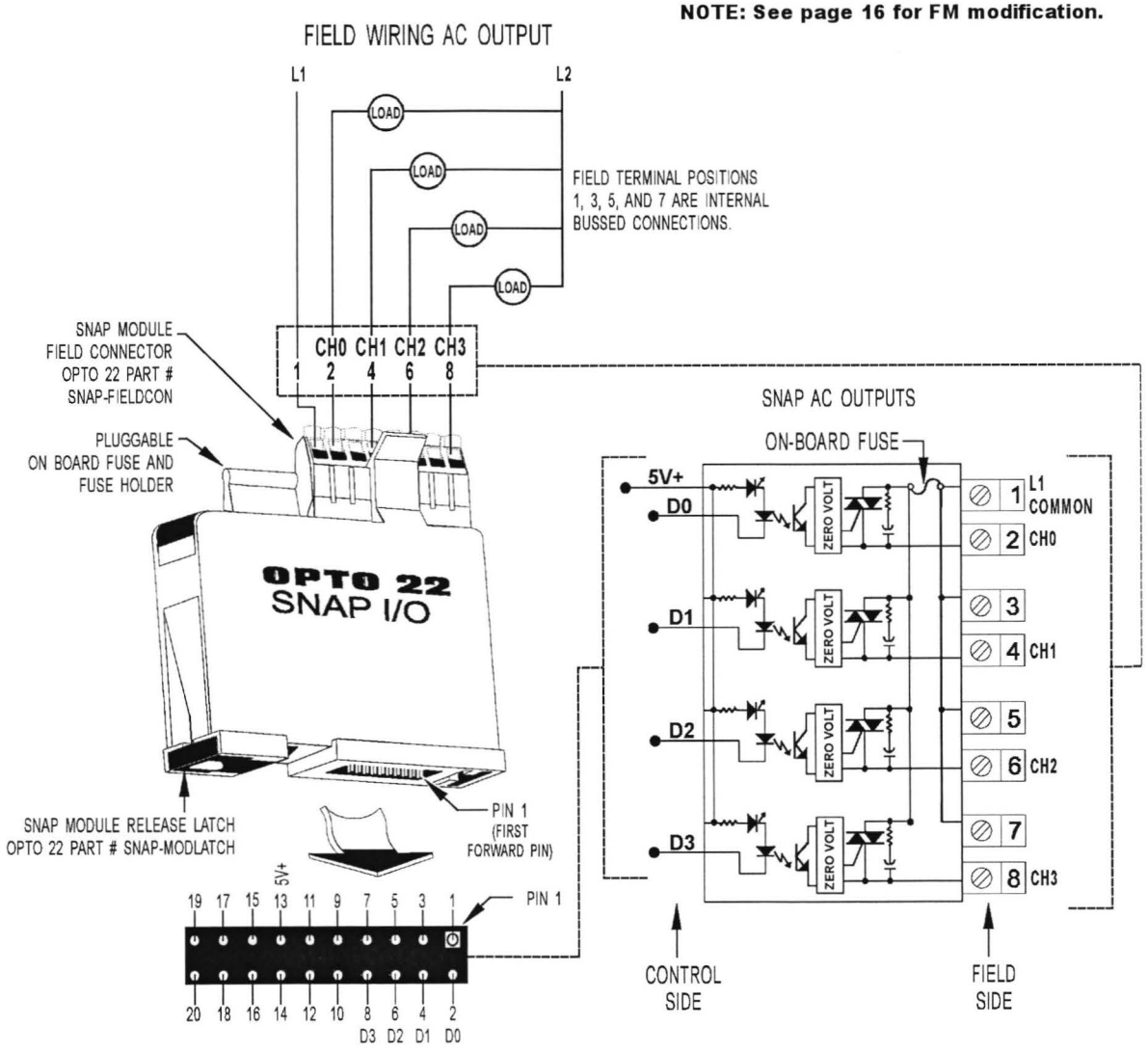
AC OUTPUT MODULE	SNAP-OAC5-FM	SNAP-OAC5-i-FM
Key Feature	Factory Mutual approved	Four isolated channels Factory Mutual approved
Field Side Ratings (each channel)		
Line Voltage - Maximum	250 VAC	250 VAC
Line Voltage - Nominal	120/240 VAC	120/240 VAC
Current Rating 0°C to 70°C Ambient	3 amps per module	3 amps per module
One Cycle Surge	80 amps peak (50/60Hz)	80 amps peak (50/60Hz)
Minimum Load Current	20 mA	20 mA
Output Voltage Drop	1.6 volts maximum @ 0.75 amps	1.6 volts maximum @ 0.75 amps
Off-state Leakage at Nominal Voltage - 60 Hz	2.5 mA @ 240 VAC 1.25 mA @ 120 VAC	2.5 mA @ 240 VAC 1.25 mA @ 120 VAC
Peak Blocking Voltage	500 volts	500 volts
Operating Frequency	25-65 Hz	25-65 Hz
dV/ dt - Off-state	200 volts/msec	200 volts/msec
dV/ dt - Commutating	Snubbed for rated 0.5 power factor load	Snubbed for rated 0.5 power factor load
Fuse (Common to all Channels)	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A	Has four isolated channels. User must provide own fusing.
Channel-to-channel Isolation	Not applicable	300 VAC (1500 V transient)
Logic Side Ratings		
Pickup Voltage	4 VDC @ 5.5 mA	4 VDC @ 5.5 mA
Dropout Voltage	1 VDC @ <500 mA	1 VDC @ <500 mA
Control Resistance	220 ohms	220 ohms
Logic Supply Voltage	5VDC ± 0.25 VDC	5VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum
Module Ratings		
Number of Channels per Module	4	4
Turn-on Time	1/2 cycle maximum (zero volts crossover)	1/2 cycle maximum (zero volts crossover)
Turn-off Time	1/2 cycle maximum (zero current crossover)	1/2 cycle maximum (zero current crossover)
Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)
Temperature	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage

Part Number	Description
SNAP-OAC5	4-channel AC output 12–250 VAC 5 VDC logic
SNAP-OAC5FM	4-channel AC output 12–250 VAC 5 VDC logic, Factory Mutual approved

Schematics

SNAP-OAC5 Output Module

NOTE: See page 16 for FM modification.

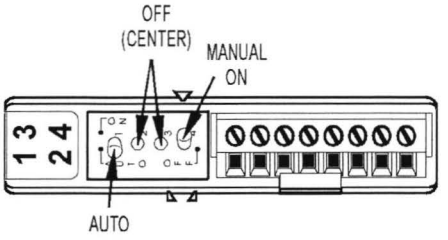


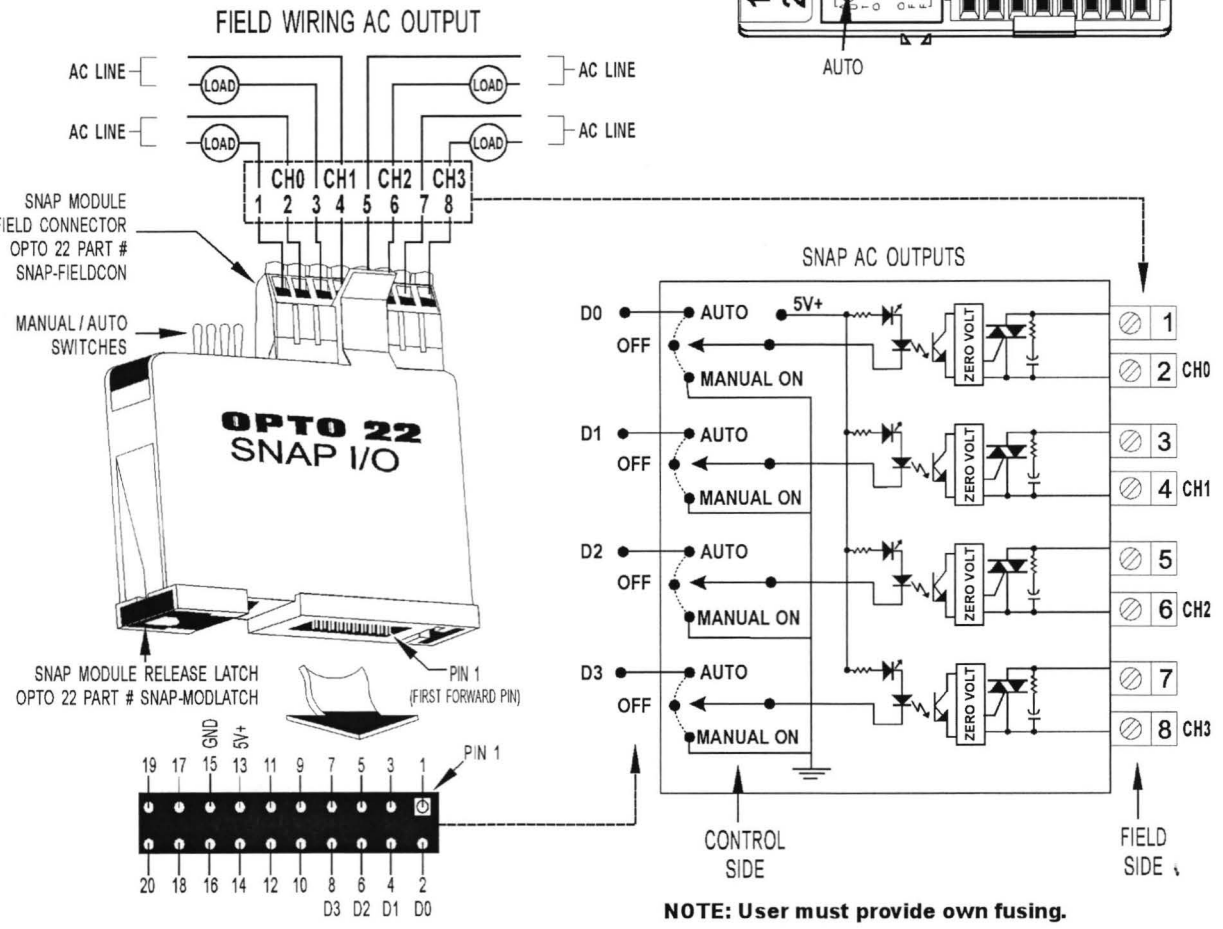
SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Part Number	Description
SNAP-OAC5MA	4-channel isolated AC output 12–250 VAC, 5 VDC logic, with manual/auto switch

Schematics

SNAP-OAC5MA Output Module With Manual/Auto Switches





SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

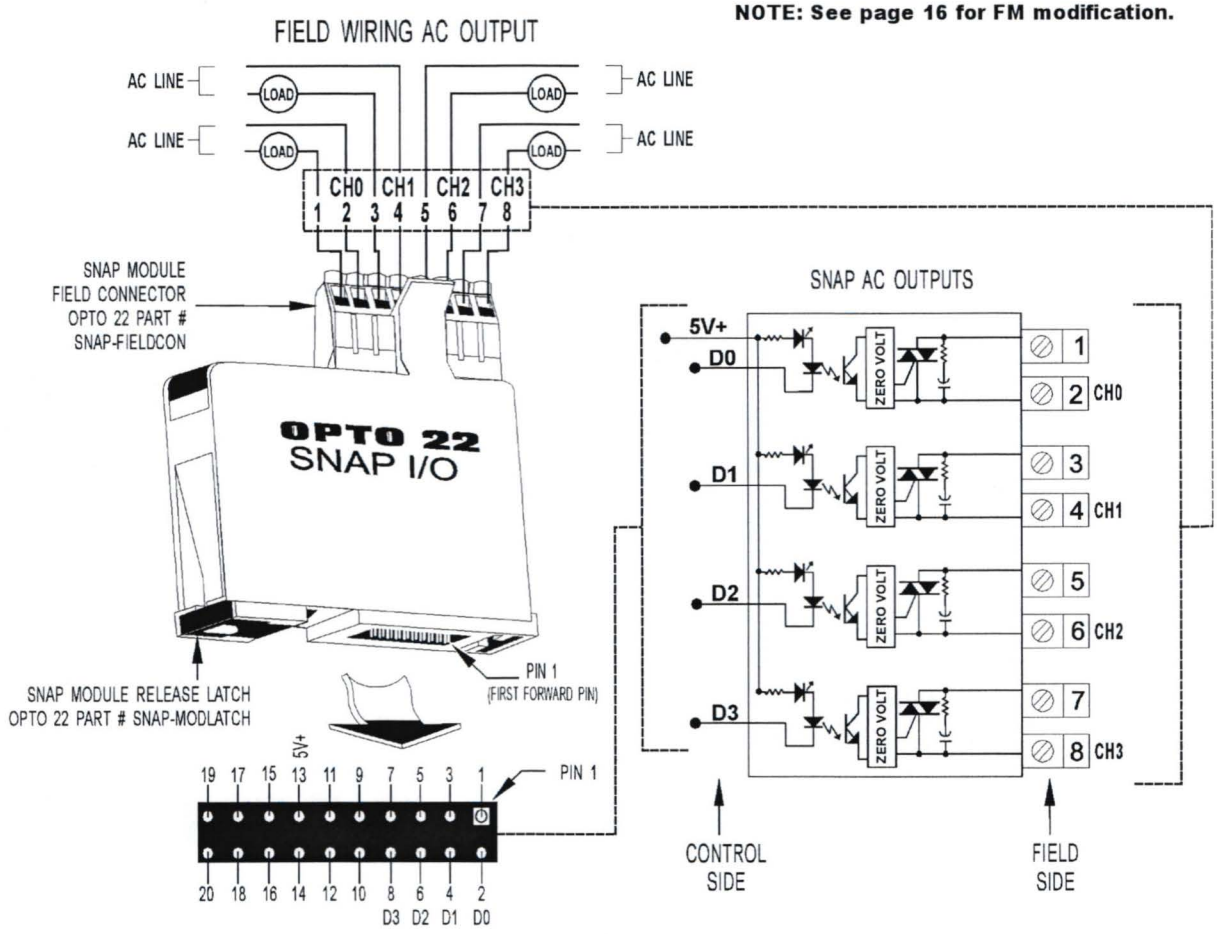
NOTE: User must provide own fusing.

Part Number	Description
SNAP-OAC5-i	4-channel isolated AC output 12–250 VAC, 5 VDC logic
SNAP-OAC5-iFM	4-channel isolated AC output 12–250 VAC, 5 VDC logic, Factory Mutual approved

Schematics

SNAP-OAC5-i Isolated Output Module

NOTE: See page 16 for FM modification.



SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

NOTE: User must provide own fusing.

Specifications

DC Output Modules

SOURCE AND SINK	SNAP-ODC5SRC	SNAP-ODC5SNK	SNAP-ODC5R	SNAP-ODC5R5
Key Feature	Load sourcing	Load sinking	Dry contact Normally open	Dry contact Normally closed
Field Side Ratings (each channel)				
Line Voltage - Range	5–60 VDC	5–60 VDC	0–100 VDC 0–130 VAC*	0–100 VDC 0–130 VAC*
Line Voltage - Nominal	5–48 VDC	5–48 VDC	--	--
Current Rating 0°C to 70°C Ambient	3 amps per module	3 amps per module	0.5 amps switching*	0.5 amps switching*
Surge Current	5 amps peak for 1 second	5 amps peak for 1 second	1.5 amps carry @ 6.6 volts	1.5 amps carry @ 6.6 volts
Minimum Load	20 mA	20 mA	0 mA	0 mA
Output Voltage Drop	1.6 volts maximum @ 0.75 amps	1.6 volts maximum @ 0.75 amps	0 volts	0 volts
Off-state Leakage	1 mA @ 60 VDC	1 mA @ 60 VDC	0 mA	0 mA
Peak Blocking Voltage	60 VDC	60 VDC	100 VDC / 130 VAC	100 VDC / 130 VAC
Fuse (Common to all Channels)	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A	Has four isolated channels. User must provide own fusing.	Has four isolated channels. User must provide own fusing.
Channel-to-channel Isolation	Not applicable	Not applicable	300 VAC (1500 V transient)	300 VAC (1500 V transient)
Logic Side Ratings				
Pickup Voltage	4 V @ 5.5 mA	4 V @ 5.5 mA	4 V @ 5.5 mA	4 V @ 5.5 mA
Dropout Voltage	1 VDC	1 VDC	1 VDC	1 VDC
Control Resistance	220 ohms	220 ohms	220 ohms	220 ohms
Logic Supply Voltage	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum	50 mA maximum
Module Ratings				
Number of Channels Per Module	4	4	4	4
Turn-on Time	50 µsec	50 µsec	500 µsec	500 µsec
Turn-off Time	100 µsec	100 µsec	500 µsec	500 µsec
Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)	1,500 volts (transient)	1,500 volts (transient)
Temperature	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage

* The power rating of the dry contact module must not exceed 10 VA under steady state or momentary in-rush conditions.
For voltages at or below 20 volts, the current limit is 0.5 amps. For voltages above 20 volts, the maximum allowable current is determined by the following equation: $\frac{10\ VA}{Voltage}$ = Current maximum. See rating curve on page 9.

Specifications

DC Output Modules

SNAP DIGITAL DC OUTPUT—LOGIC SOURCE AND SINK	SNAP-ODC5MA	SNAP-ODC5-i	SNAP-ODC5A-i	SNAP-ODC5ASNK
Key Feature	Diagnostic switches Four isolated channels	Four isolated channels	Four isolated channels	Load sinking
FIELD SIDE RATINGS (each channel)				
Line Voltage - Range	5–60 VDC	5–60 VDC	5–200 VDC	5–200 VDC
Line Voltage - Nominal	5–48 VDC	5–48 VDC	5–200 VDC	5–200 VDC
Current Rating 0°C to 70°C Ambient	2 Amps per Module 0.5 Amps per Channel	3 Amps per Module	3 Amps per Module	3 amps per module
Surge Current	1.5 Amps peak for 1 second	5 Amps peak for 1 second	5 Amps peak for 1 second	5 amps peak for 1 second
Minimum Load	20 mA	20 mA	20 mA	20 mA
Output Voltage Drop	1.6 V max. @ .75 Amps	1.6 V max. @ .75 Amps	1.6 V max. @ .75 Amps	1.6 volts maximum @ 0.75 amps
Off-State Leakage	1 mA @ 60 VDC	1 mA @ 60 VDC	1 mA @ 200 VDC	1 mA @ 200 VDC
Peak Blocking Voltage	60 VDC	60 VDC	200 VDC	200 VDC
Fuse (common to all channels)	Has four isolated channels. User must provide own fusing.	Has four isolated channels. User must provide own fusing.	Has four isolated channels. User must provide own fusing.	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A
Channel-to-channel Isolaton	300 VAC (1500 V transient)	300 VAC (1500 V transient)	300 VAC (1500 V transient)	Not applicable
LOGIC SIDE RATINGS				
Pickup Voltage	4 V @ 5.5 mA	4 V @ 5.5 mA	4 V @ 5.5 mA	4 V @ 5.5 mA
Dropout Voltage	1 VDC	1 VDC	1 VDC	1 VDC
Control Resistance	220 ohms	220 ohms	220 ohms	220 ohms
Logic Supply Voltage	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum	50 mA maximum
MODULE RATINGS				
Number of Channels per Module	4	4	4	4
Turn On Time	50 µsec	50 µsec	100 µsec	100 µsec
Turn Off Time	100 µsec	100 µsec	750 µsec	750 µsec
Isolation (Field Side to Logic Side)	4,000 Volts (transient)	4,000 Volts (transient)	4,000 Volts (transient)	4,000 Volts (transient)
Temperature	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage

Specifications

DC Output Modules (FM Models)

SOURCE AND SINK	SNAP-ODC5SRCFM	SNAP-ODC5SNKFM	SNAP-ODC5RFM	SNAP-ODC5R5FM
Key Feature	Load sourcing Factory Mutual approved	Load sinking Factory Mutual approved	Dry contact Normally open Factory Mutual approved	Dry contact Normally closed Factory Mutual approved
Field Side Ratings (each channel)				
Line Voltage - Range	5–60 VDC	5–60 VDC	0–100 VDC 0–130 VAC*	0–100 VDC 0–130 VAC*
Line Voltage - Nominal	5–48 VDC	5–48 VDC	--	--
Current Rating 0°C to 70°C Ambient	3 amps per module	3 amps per module	0.5 amps switching*	0.5 amps switching*
Surge Current	5 amps peak for 1 second	5 amps peak for 1 second	1.5 amps carry @ 6.6 volts	1.5 amps carry @ 6.6 volts
Minimum Load	20 mA	20 mA	0 mA	0 mA
Output Voltage Drop	1.6 volts max.@ 0.75 amps	1.6 volts max.@ 0.75 amps	0 volts	0 volts
Off-state Leakage	1 mA @ 60 VDC	1 mA @ 60 VDC	0 mA	0 mA
Peak Blocking Voltage	60 VDC	60 VDC	100 VDC / 130 VAC	100 VDC / 130 VAC
Fuse (Common to all Channels)	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A	250 VAC - 4A 5x20 mm Fast-acting Bell Fuse Part No. BEL 5HF4 Opto 22 Part No. SNAP-4A	Has four isolated channels. User must provide own fusing.	Has four isolated channels. User must provide own fusing.
Channel-to-channel Isolation	Not applicable	Not applicable	300 VAC (1500 V transient)	300 VAC (1500 V transient)
Logic Side Ratings				
Pickup Voltage	4 V @ 5.5 mA	4 V @ 5.5 mA	4 V @ 5.5 mA	4 V @ 5.5 mA
Dropout Voltage	1 VDC	1 VDC	1 VDC	1 VDC
Control Resistance	220 ohms	220 ohms	220 ohms	220 ohms
Logic Supply Voltage	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum	50 mA maximum
Module Ratings				
Number of Channels Per Module	4	4	4	4
Turn-on Time	50 µsec	50 µsec	500 µsec	500 µsec
Turn-off Time	100 µsec	100 µsec	500 µsec	500 µsec
Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)	1,500 volts (transient)	1,500 volts (transient)
Temperature	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage

* The power rating of the dry contact module must not exceed 10 VA under steady state or momentary in-rush conditions.
For voltages at or below 20 volts, the current limit is 0.5 amps. For voltages above 20 volts, the maximum allowable current is determined by the following equation: $\frac{10\ VA}{Voltage}$ = Current maximum. See rating curve on page 9.

Specifications

DC Output Modules (FM Models)

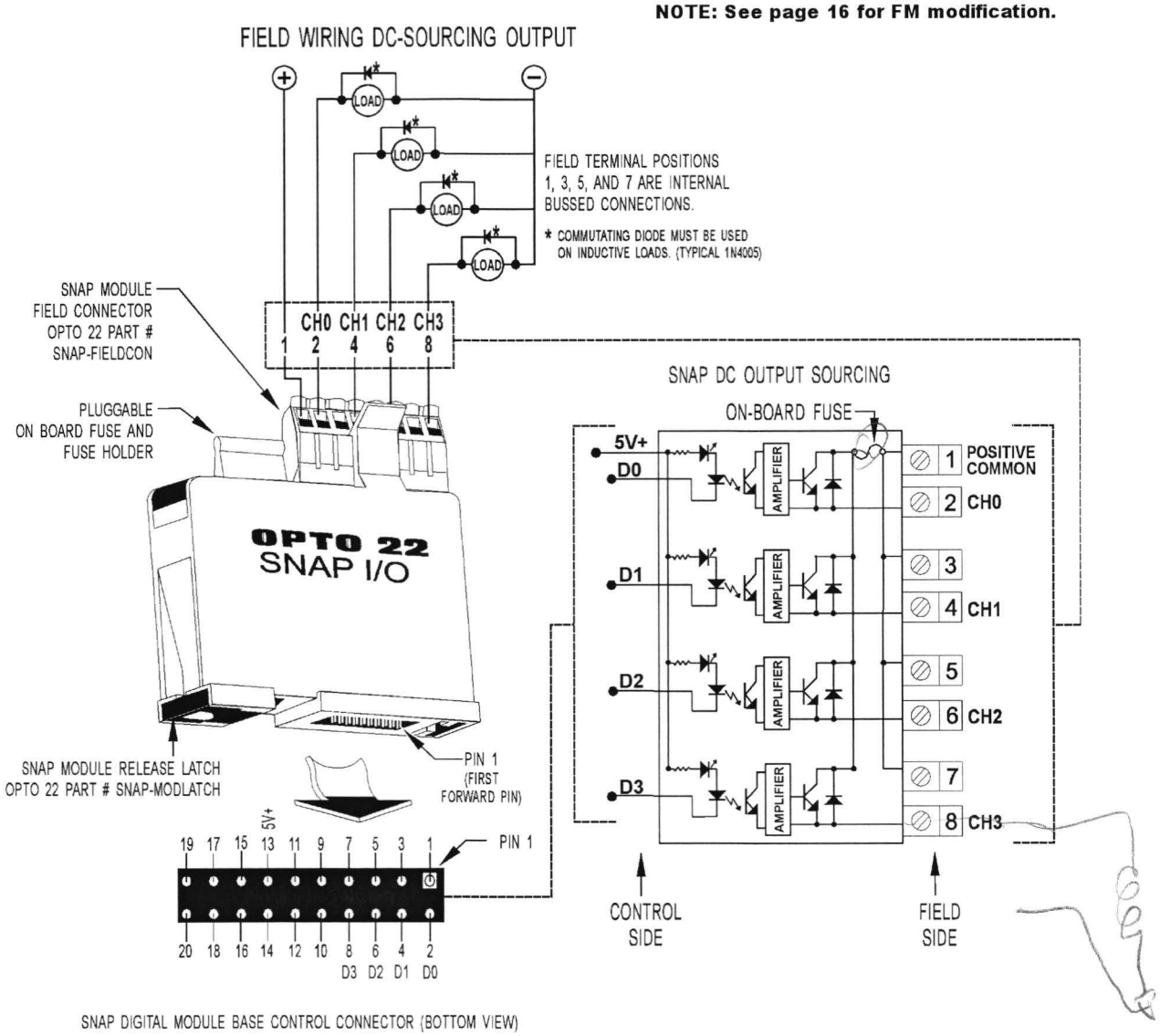
SOURCE AND SINK	SNAP-ODC5-iFM	SNAP-ODC5A-iFM
Key Feature	Four isolated channels Factory Mutual approved	Four isolated channels Factory Mutual approved
Field Side Ratings (each channel)		
Line Voltage - Range	5–60 VDC	5–200 VDC
Line Voltage - Nominal	5–48 VDC	5–200 VDC
Current Rating 0°C to 70°C Ambient	3 amps per module	3 amps per module
Surge Current	5 amps peak for 1 second	5 amps peak for 1 second
Minimum Load	20 mA	20 mA
Output Voltage Drop	1.6 volts max.@ 0.75 amps	1.6 volts max.@ 0.75 amps
Off-state Leakage	1 mA @ 60 VDC	1 mA @ 200 VDC
Peak Blocking Voltage	60 VDC	200 VDC
Fuse (Common to all Channels)	Has four isolated channels. User must provide own fusing.	Has four isolated channels. User must provide own fusing.
Channel-to-channel Isolation	300 VAC (1500 V transient)	300 VAC (1500 V transient)
Logic Side Ratings		
Pickup Voltage	4 V @ 5.5 mA	4 V @ 5.5 mA
Dropout Voltage	1 VDC	1 VDC
Control Resistance	220 ohms	220 ohms
Logic Supply Voltage	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum
Module Ratings		
Number of Channels Per Module	4	4
Turn-on Time	50 µsec	100 µsec
Turn-off Time	100 µsec	750 µsec
Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)
Temperature	0° to 70°C, operating -30° to 85°C, storage	0° to 70°C, operating -30° to 85°C, storage

Part Number	Description
SNAP-ODC5SRC	4-channel DC output 5–60 VDC logic source
SNAP-ODC5SRCFM	4-channel DC output 5–60 VDC logic source, Factory Mutual approved

Schematics

SNAP-ODC5SRC
Output Module - Sourcing

NOTE: See page 16 for FM modification.



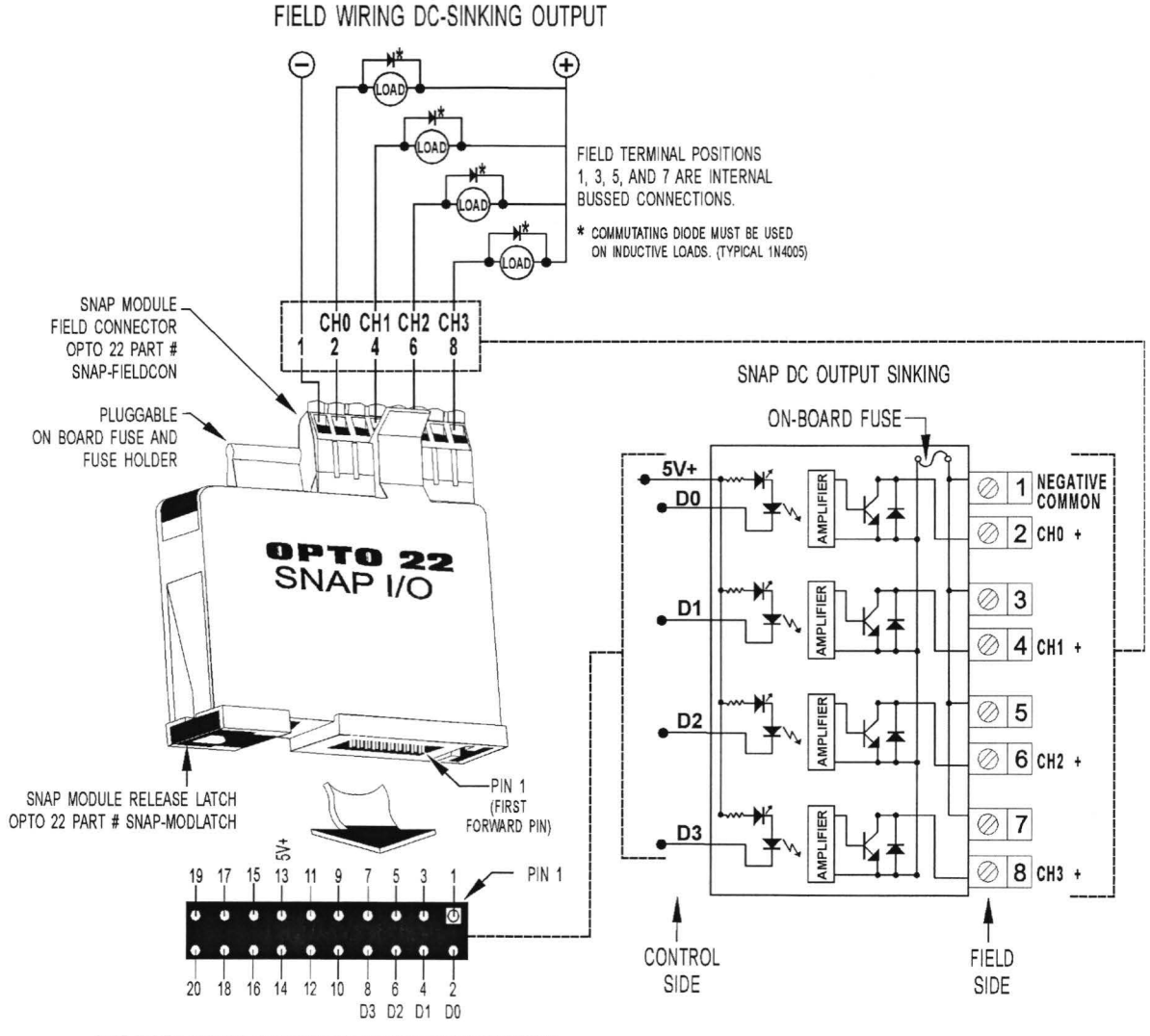
SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Part Number	Description
SNAP-ODC5SNK	4-channel DC output 5–60 VDC logic sink
SNAP-ODC5SNKFM	4-channel DC output 5–60 VDC logic sink, Factory Mutual approved
SNAP-ODC5ASNK	4-channel DC output 5–200 VDC logic sink

NOTE: See page 16 for FM modification.

Schematics

SNAP-ODC5SNK and SNAP-ODC5ASNK Output Module - Sinking

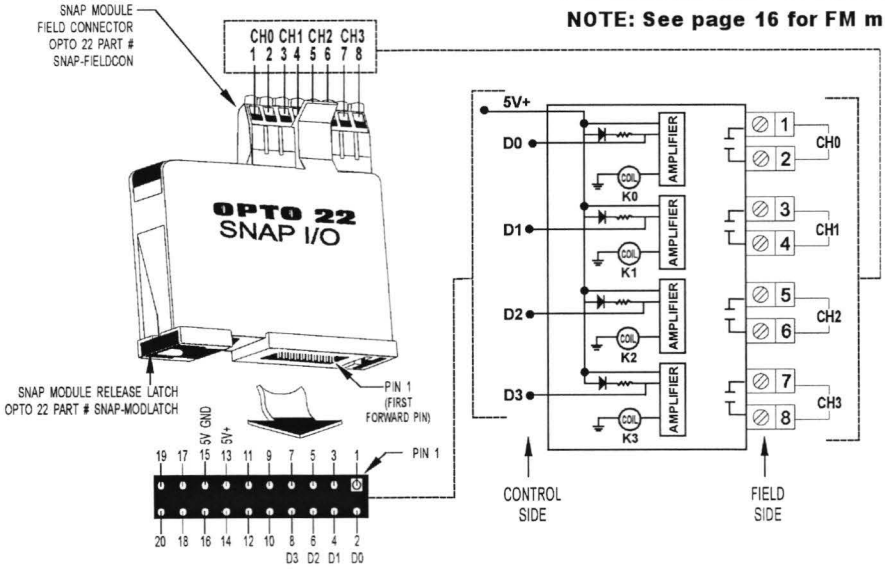


Part Number	Description
SNAP-ODC5R	4-channel dry dontact output, normally open
SNAP-ODC5R5	4-channel dry contact output, normally closed
SNAP-ODC5RFM	4-channel dry contact output, normally open, Factory Mutual approved
SNAP-ODC5R5FM	4-channel dry contact output, normally closed, Factory Mutual approved

Schematics

SNAP-ODC5R Dry Contact Module

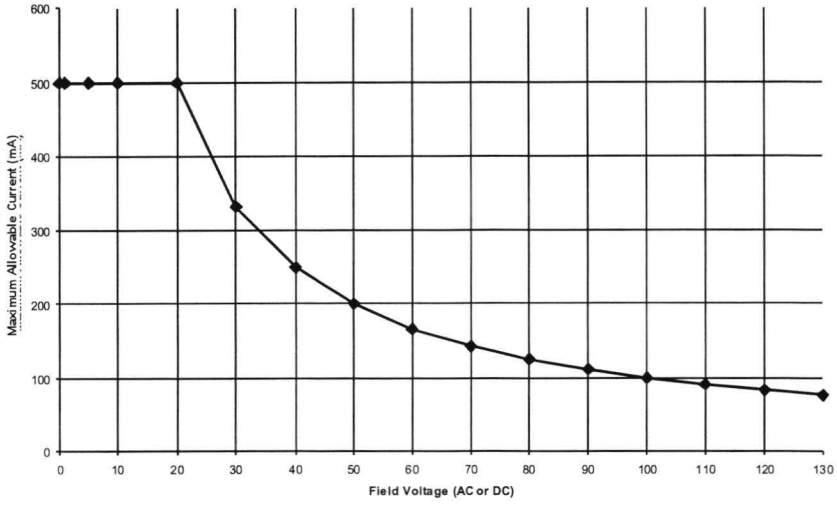
FIELD WIRING DRY CONTACT OUTPUT



SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

NOTE: See page 16 for FM modification.

10 VA RATING FOR REED RELAY (DRY CONTACT) MODULES



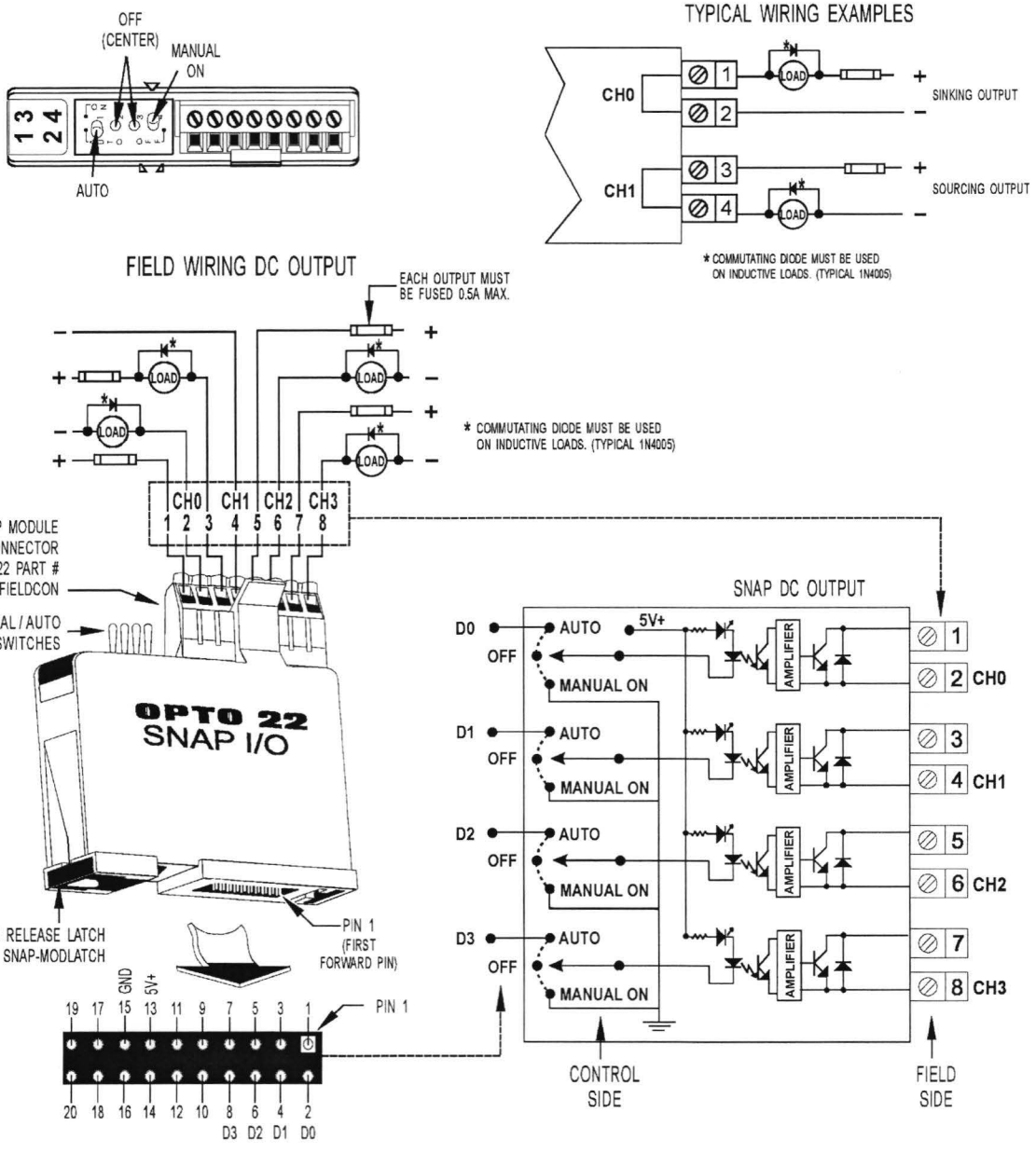
Current Limit at Key Voltages	
V	mA
5	500
12	500
24	416
100[1]	100
120	83
130[2]	76

Note 1: Maximum DC voltage is 100 VDC.
Note 2: Maximum AC voltage is 130 VAC.

Part Number	Description
SNAP-ODC5MA	4-channel isolated DC output 5–60 VDC, 5 VDC logic, with manual/auto switch

Schematics

SNAP-ODC5MA Output Module With Manual/Auto Switches



SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

NOTE: User must provide own fusing.

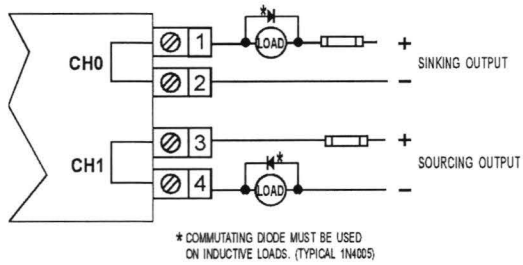
Part Number	Description
SNAP-ODC5-i	4-channel isolated DC output 5–60 VDC, 5 VDC logic
SNAP-ODC5A-i	4-channel isolated DC output 5–200 VDC, 5 VDC logic
SNAP-ODC5-iFM	4-channel isolated DC output 5–60 VDC, 5 VDC logic, Factory Mutual approved
SNAP-ODC5A-iFM	4-channel isolated DC output 5–200 VDC, 5 VDC logic, Factory Mutual approved

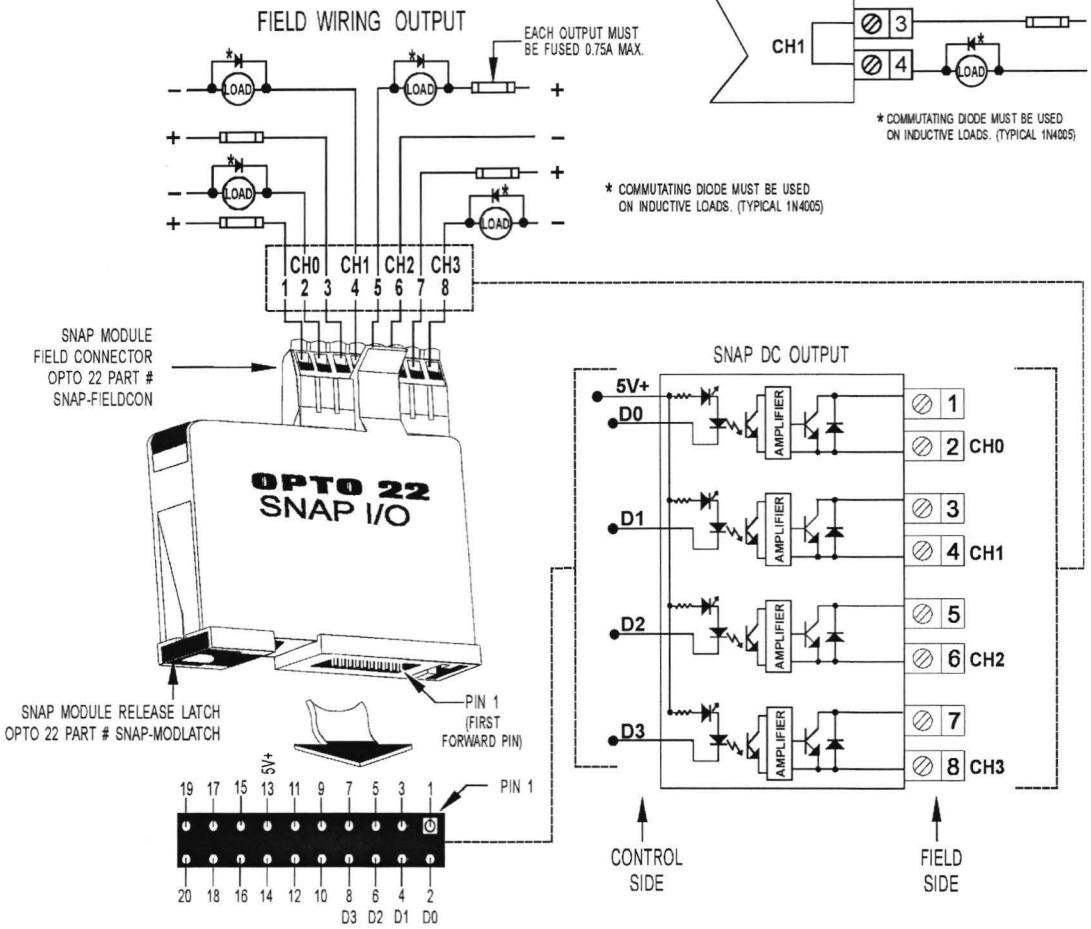
Schematics

SNAP-ODC5-i and SNAP-ODC5A-i Isolated Output Module

NOTE: See page 16 for FM modification.

TYPICAL WIRING EXAMPLES



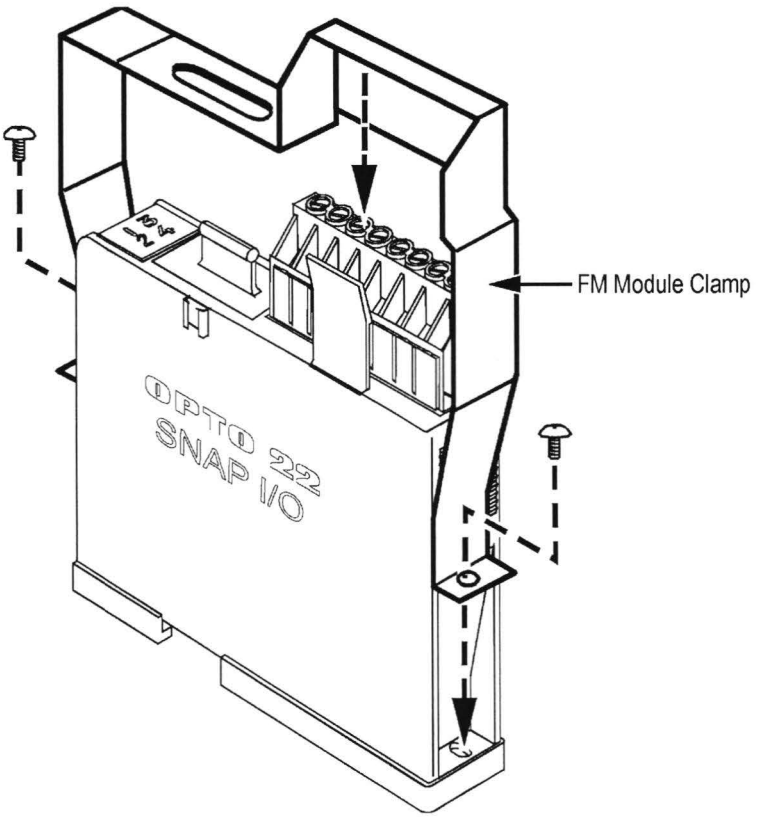


SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

NOTE: User must provide own fusing.

Factory Mutual Modification

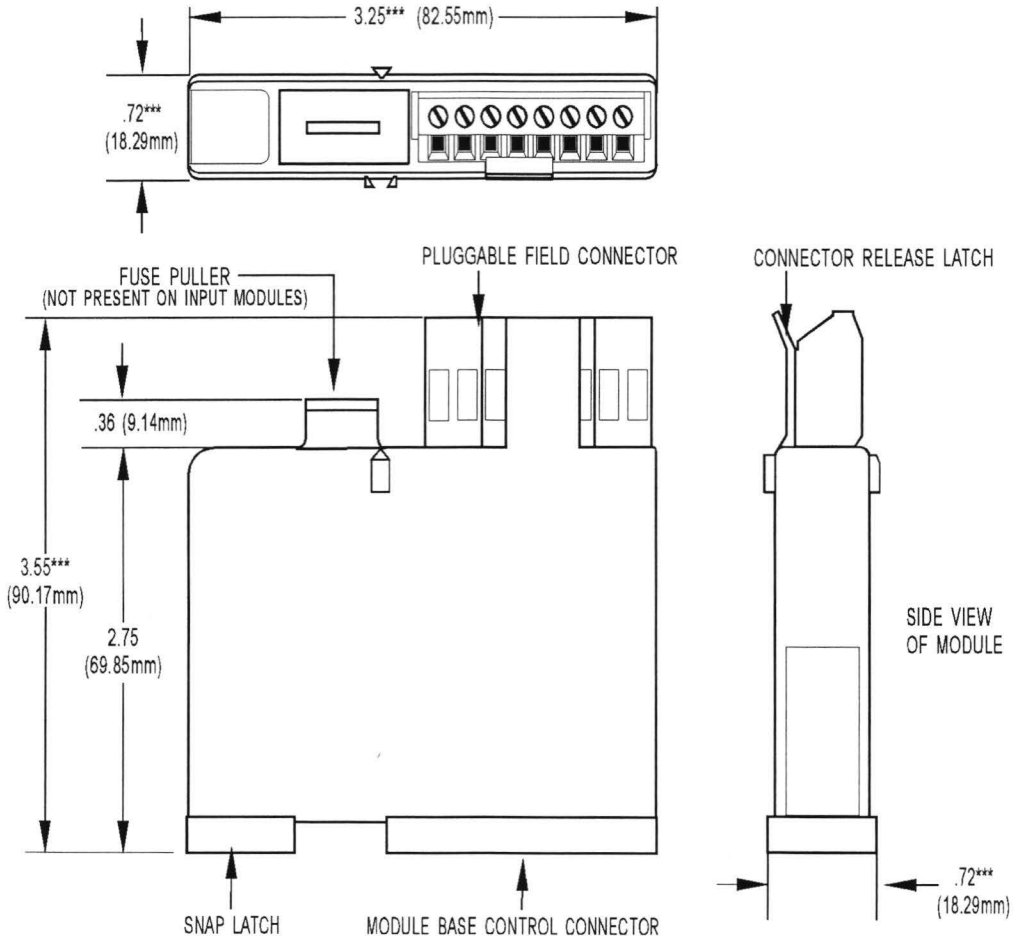
All modules with part numbers ending in FM are Factory Mutual approved with the installation of the FM Module Clamp, as shown below.



Dimensional Drawing

All Models Except MA

Top View of Module



TOLERANCES LEGEND

* +/- .010" ** +/- .020"

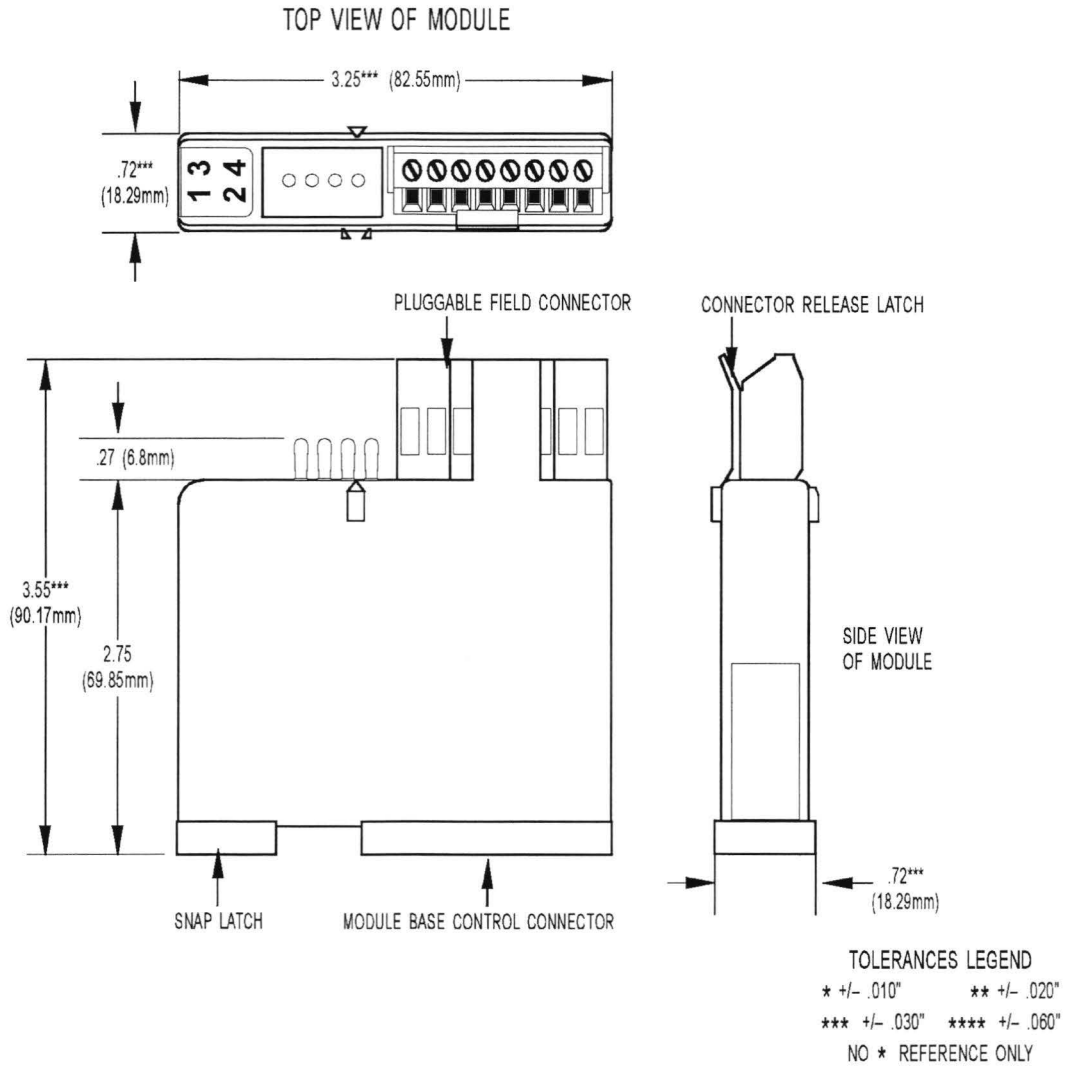
*** +/- .030" **** +/- .060"

NO * REFERENCE ONLY

Dimensional Drawing

All MA Models

Top View of MA Module



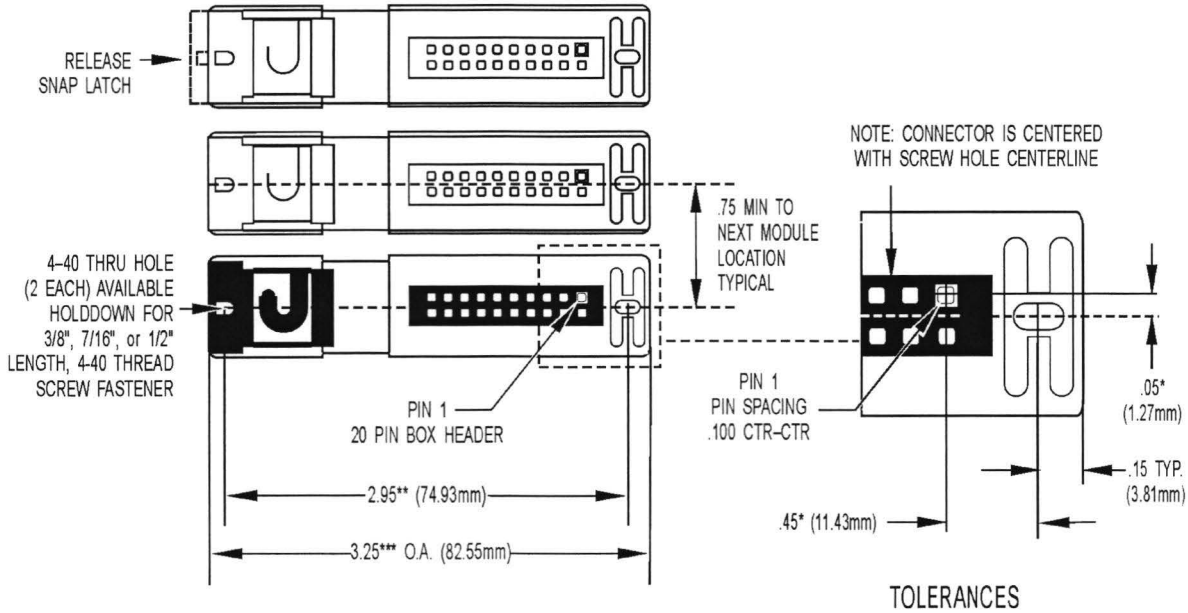
TOLERANCES LEGEND

* +/- .010" ** +/- .020"
*** +/- .030" **** +/- .060"
NO * REFERENCE ONLY

Dimensional Drawing

All Models

Bottom View of Module Base



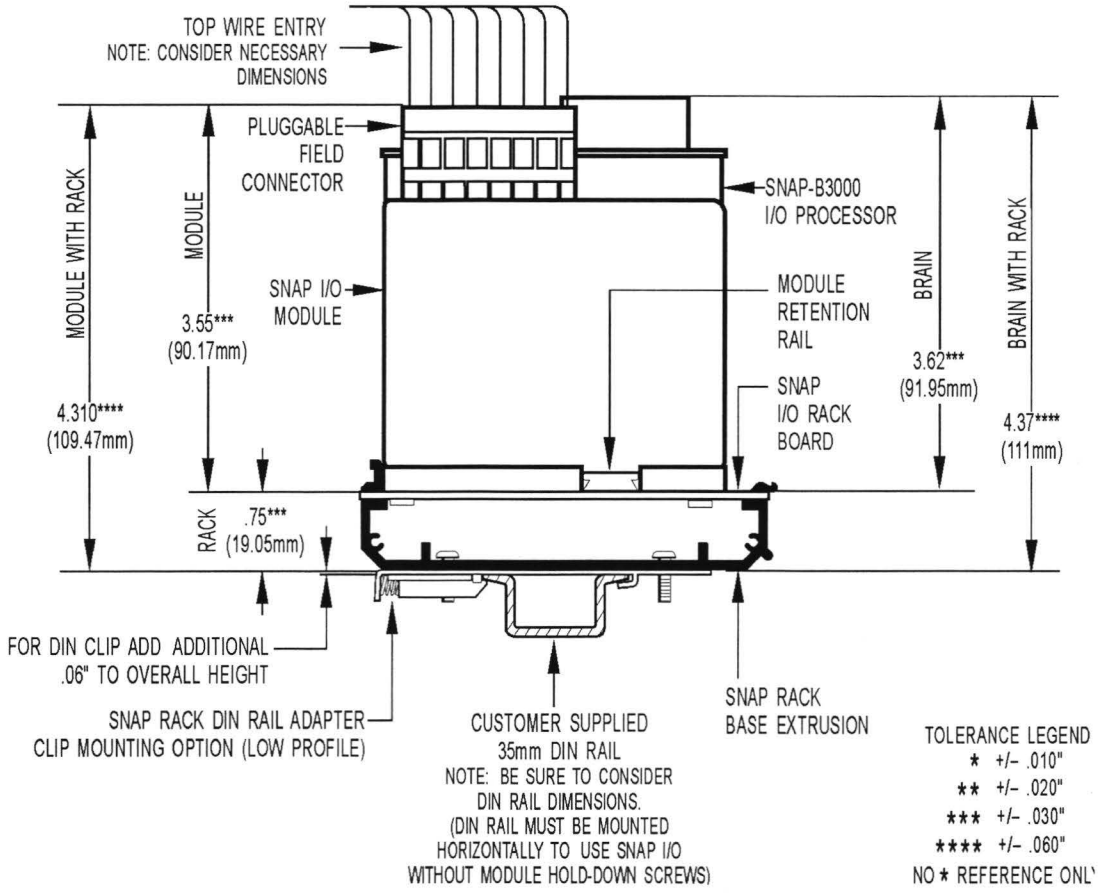
TOLERANCES
* +/- .010"
** +/- .020"
*** +/- .030"
NO * REFERENCE ONLY

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Dimensional Drawing

All Models

SNAP Digital Module Mounted on SNAP Rack



I/O MODULES
SNAP
DIGITAL INPUT MODULES

OPTO 22
DATA SHEET
Form 773-010206

Description

SNAP digital input modules are designed to work with SNAP D-series or SNAP B-series racks and can sense either AC or DC signals. All SNAP digital input modules are compatible with SNAP Ethernet I/O™. SNAP digital's 4-channel-per-module packaging delivers high density with 4,000 volts of optical isolation from the field side to the logic side.

All SNAP digital modules have removable top-mounted connectors to provide easy access for field wiring. All operate on 5 VDC control logic. Each digital module features integral channel-specific LEDs for convenient troubleshooting and maintenance. SNAP digital I/O is 200 percent factory-tested and is UL and CE approved. In addition, part numbers ending in FM are Factory Mutual approved.

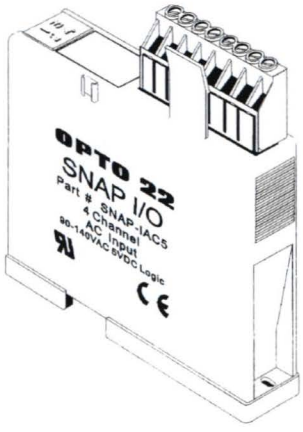
SNAP input modules are used to sense the on or off status for AC or DC voltages from such sources as proximity switches, push buttons, or auxiliary contacts.

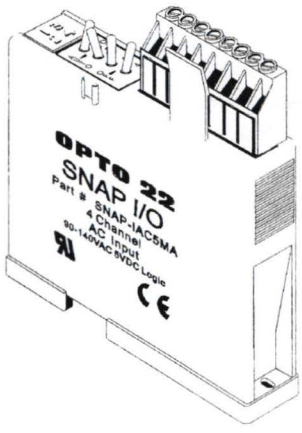
The SNAP-IDC5-SW and SNAP-IDC5-SW-NC modules supply power to an external dry contact switch and sense switch closure (SNAP-IDC5-SW) or opening (SNAP-IDC5-SW-NC).

SNAP-IAC5MA and SNAP-IDC5MA are special modules featuring manual-on/manual-off/automatic switches, ideal for diagnostic testing of control applications. The switches override input from field devices, so you can quickly determine whether a problem lies in the application or in the device.

Part Number	Description
SNAP-IAC5	SNAP 4-channel 90–140 VAC input, 5 VDC logic
SNAP-IAC5A	SNAP 4-channel 180–280 VAC input, 5 VDC logic
SNAP-IAC5MA	SNAP 4-channel isolated 90–140 VAC input, VDC logic, with manual/auto switches
SNAP-IAC5FM	SNAP 4-channel 90–140 VAC/DC input, 5 VDC logic
SNAP-IAC5AFM	SNAP 4-channel 180–280 VAC input, 5 VDC logic
SNAP-IDC5	SNAP 4-channel 10–32 VDC input, 5 VDC logic
SNAP-IDC5D	SNAP 4-channel 2.5–28 VDC input, 5 VDC logic
SNAP-IDC5-FAST	SNAP 4-channel high-speed 2.5–16 VDC input, VDC logic
SNAP-IDC5-FAST-A	SNAP 4-channel high-speed 18–32 VDC input, 5 VDC logic
SNAP-IDC5MA	SNAP 4-channel isolated high-speed 10–32 VAC input, 5 VDC logic, with manual/auto switches
SNAP-IDC5-SW*	SNAP 4-channel switch status input, normally open
SNAP-IDC5-SW-NC*	SNAP 4-channel switch status input, normally closed
SNAP-IDC5FM	SNAP 4-channel 10–32 VDC input, 5 VDC logic
SNAP-IDC5DFM	SNAP 4-channel 2.5–28 VDC input, 5 VDC logic
SNAP-RETN4	SNAP 4-module retention rail (OEM)
SNAP-RETN4B	SNAP 4-module retention rail, 25-pack (OEM)
SNAP-RETN6	SNAP 6-module retention rail (OEM)
SNAP-RETN6B	SNAP 6-module retention rail, 25-pack (OEM)
SNAP-FUSE4AB	SNAP 4-amp fuse, 25-pack

* UL approval pending





Features

- Four channels per module
- 4,000-volt transient isolation
- Convenient pluggable wiring terminals
- Powered by a single 5-volt supply
- Channel-specific LEDs
- Operating temperature: 0° to 70° C
- UL and CE approved
- Factory Mutual approved (part numbers ending in FM)

Opto 22 • 43044 Business Park Drive • Temecula, CA 92590 • Phone: (909) 695-3000 • (800) 321-OPTO • Fax: (909) 695-3095 • Internet: www.opto22.com
Inside Sales: (800) 452-OPTO • Product Support: (800) TEK-OPTO • (909) 695-3080 • Fax: (909) 695-3017 • E-mail: support@opto22.com • FaxBack: (800) 474-OPTO

Specifications

AC Input Modules

SNAP Digital AC Modules	SNAP-IAC5	SNAP-IAC5A	SNAP-IAC5MA
Key Feature	--	--	Diagnostic switches
Field Side Ratings (each channel)			
Nominal Input Voltage	120 VAC/VDC	240 VAC/VDC	120 VAC/VDC
Channel-to-channel isolation	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)
Input Voltage Range	90–140 VAC/VDC	180–280 VAC/VDC	90–140 VAC/VDC
Turn-on Voltage	90 VAC/VDC	180 VAC/VDC	90 VAC/VDC
Turn-off Voltage	35 VAC/VDC	35 VAC/VDC	35 VAC/VDC
Input Resistance	169 K ohms (nominal)	305 K ohms (nominal)	169 K ohms (nominal)
Logic Side Ratings			
Logic Output Voltage	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 400 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 400 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 400 mA sourcing
Logic Supply Voltage*	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum
Negative True Logic Output Drive	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL
Module Ratings			
Number of Channels Per Module	4	4	4
Turn-on Time	30 msec	30 msec	30 msec
Turn-off Time	30 msec	30 msec	30 msec
Optical Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)
Temperature	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage

* When used in conjunction with a brain, the brain requires 5 VDC ± 0.1 VDC.

Specifications

DC Input Modules (except SNAP-IDC5-SW and SNAP-IDC5-SW-NC)

See page 5 for SNAP-IDC5-SW and SNAP-IDC5-SW-NC specifications and wiring.

SNAP Digital AC & DC Modules	SNAP-IDC5	SNAP-IDC5D	SNAP-IDC5-FAST *	SNAP-IDC5-FAST-A **	SNAP-IDC5MA
Key Feature	--	–	High-speed	High-speed	Diagnostic switches
Field Side Ratings (each channel)					
Nominal Input Voltage	24 VAC/VDC	5 VDC	5 VDC	28 VDC	24 VAC/VDC
Channel-to-channel isolation	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)
Input Voltage Range	10–32 VAC/VDC	2.5–28 VDC	2.5–16 VDC	18–32 VDC	10–32 VAC/VDC
Turn-on Voltage	10 VAC/VDC	2.5 VDC	2.5 VDC	18 VDC	10 VAC/VDC
Turn-off Voltage	3 VAC/VDC	1 VDC	1 VDC	5 VDC	3 VAC/VDC
Input Resistance	15 K ohms (nominal)	3 K ohms (nominal)	440 ohms (nominal)	8 K ohms (nominal)	15 K ohms (nominal)
Logic Side Ratings					
Logic Output Voltage	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 0.4 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 0.4 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 0.4 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 0.4 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 400 mA sourcing
Logic Supply Voltage***	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum	50 mA maximum	50 mA maximum
Negative True Logic Output Drive	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL
Module Ratings					
Number of Channels Per Module	4	4	4	4	4
Turn-on Time	5 msec	1 msec	.025 msec*	.025 msec**	5 msec
Turn-off Time	15 msec	1 msec	.025 msec*	.025 msec**	15 msec
Optical Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)
Temperature	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage

* At 20kHz, 5Vp-p square wave input, 50% duty cycle.
** At 20kHz, 28Vp-p square wave input, 50% duty cycle.
*** When used in conjunction with a brain, the brain requires 5 VDC ± 0.1 VDC.

Specifications

AC and DC Input Modules (FM models)

SNAP Digital AC & DC Modules	SNAP-IAC5FM	SNAP-IAC5AFM	SNAP-IDC5FM	SNAP-IDC5DFM
Key Feature	Factory Mutual approved	Factory Mutual approved	Factory Mutual approved	Factory Mutual approved
Field Side Ratings (each channel)				
Nominal Input Voltage	120 VAC/VDC	240 VAC/ VDC	24 VAC/VDC	5 VDC
Channel-to-channel isolation	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)	300 VAC (1,500 V transient)
Input Voltage Range	90–140 VAC/VDC	180–280 VAC/VDC	10–32 VAC/VDC	2.5–28 VDC
Turn-on Voltage	90 VAC/VDC	180 VAC/VDC	10 VAC/VDC	2.5 VDC
Turn-off Voltage	35 VAC/VDC	35 VAC/VDC	3 VAC/VDC	1 VDC
Input Resistance	169 K ohms (nominal)	305 K ohms (nominal)	15 K ohms (nominal)	3 K ohms (nominal)
Logic Side Ratings				
Logic Output Voltage	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 400 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 400 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 0.4 mA sourcing	<.5 V max. (on) @ 2 mA sinking 2.7 V min. (off) @ 0.4 mA sourcing
Logic Supply Voltage*	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC	5 VDC ± 0.25 VDC
Logic Supply Current	50 mA maximum	50 mA maximum	50 mA maximum	50 mA maximum
Negative True Logic Output Drive	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL	TTL 74 Series = 1 UL TTL 74LS Series = 5 UL
Module Ratings				
Number of Channels Per Module	4	4	4	4
Turn-on Time	30 msec	30 msec	5 msec	1 msec
Turn-off Time	30 msec	30 msec	15 msec	1 msec
Optical Isolation (Field Side to Logic Side)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)	4,000 volts (transient)
Temperature	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage	0°C to 70°C, operating -30°C to 85°C, storage

*When used in conjunction with a brain, the brain requires 5 VDC ± 0.1 VDC.

SNAP-IDC5-SW and SNAP-IDC5-SW-NC Modules

Description

The SNAP-IDC5-SW and SNAP-IDC5-SW-NC modules provide four channels of contact status input. Each module supplies 15 volts of power to an external dry contact switch. The SNAP-IDC5-SW senses switch closure; the SNAP-IDC5-SW-NC senses switch opening. Each user-supplied switch is connected with two wires. Because these modules include power for the switch, they are particularly cost-effective when labor costs for wiring external power are high.

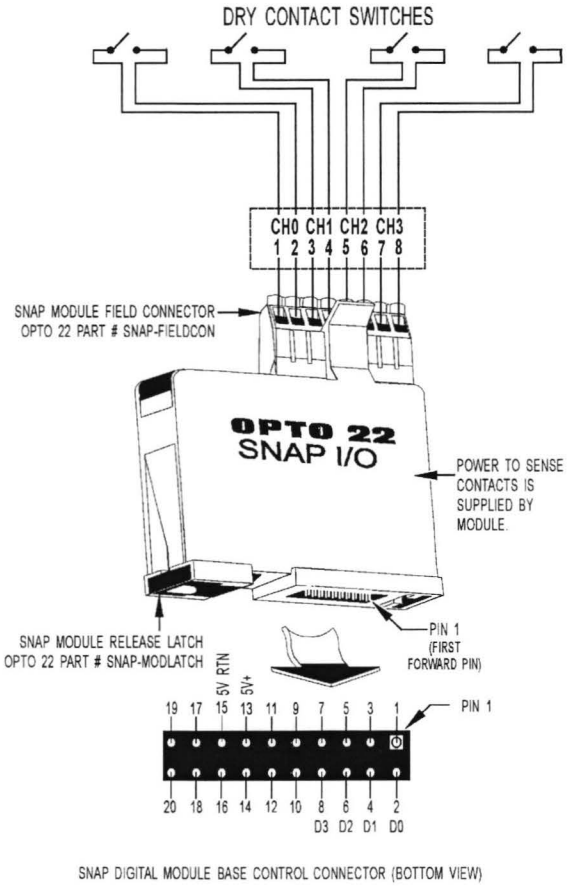
Typical switches for use with these modules are switched status sensors (level sensors, pressure indicators, etc.), magnetic reed switches (used on doors or windows for burglar alarms), snap-action micro switches, the auxilliary switches on motor starters, and most relay contacts.

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.

Specifications

Field Side Ratings (each channel)	
Open Circuit Voltage (Switch Open)	15 VDC typical
Short Circuit Current (Switch Closed)	7 milliamps nominal
Minimum Off Resistance	>20 K ohms
Maximum Allowable On Resistance (Wire + Contact Resistance)	500 ohms
Logic Side Ratings	
Logic Output Voltage for SNAP-IDC5-SW (normally open)	<0.5 V max. (switch closed; LED on) @ 2 mA sinking 2.7 V min. (switch open; LED off) @ 0.4 mA sourcing
Logic Output Voltage for SNAP-IDC5-SW-NC (normally closed)	<0.5 V max. (switch open; LED off) @ 2 mA sinking 2.7 V min. (switch closed; LED on) @ 0.4 mA sourcing
Maximum Operating Common Mode Voltage (Field Term to Logic Connector)	250 V
Power Requirements	5 VDC (±0.25) @ 200 mA
Module Ratings	
Number of Channels Per Module	4
Turn-on Time	5 msec
Turn-off Time	25 msec
Channel-to-channel Isolation	None
Input-to-output Isolation	1500 V AC/DC
Temperature	0°C to 70°C, operating -30°C to 85°C, storage

SNAP-IDC5-SW and SNAP-IDC5-SW-NC Wiring Diagram

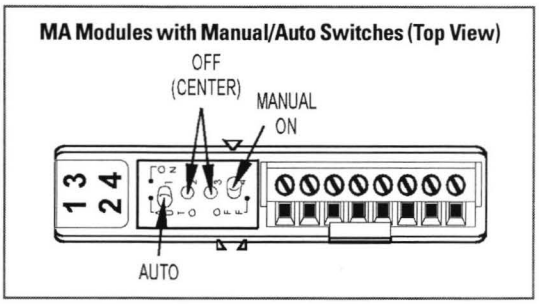


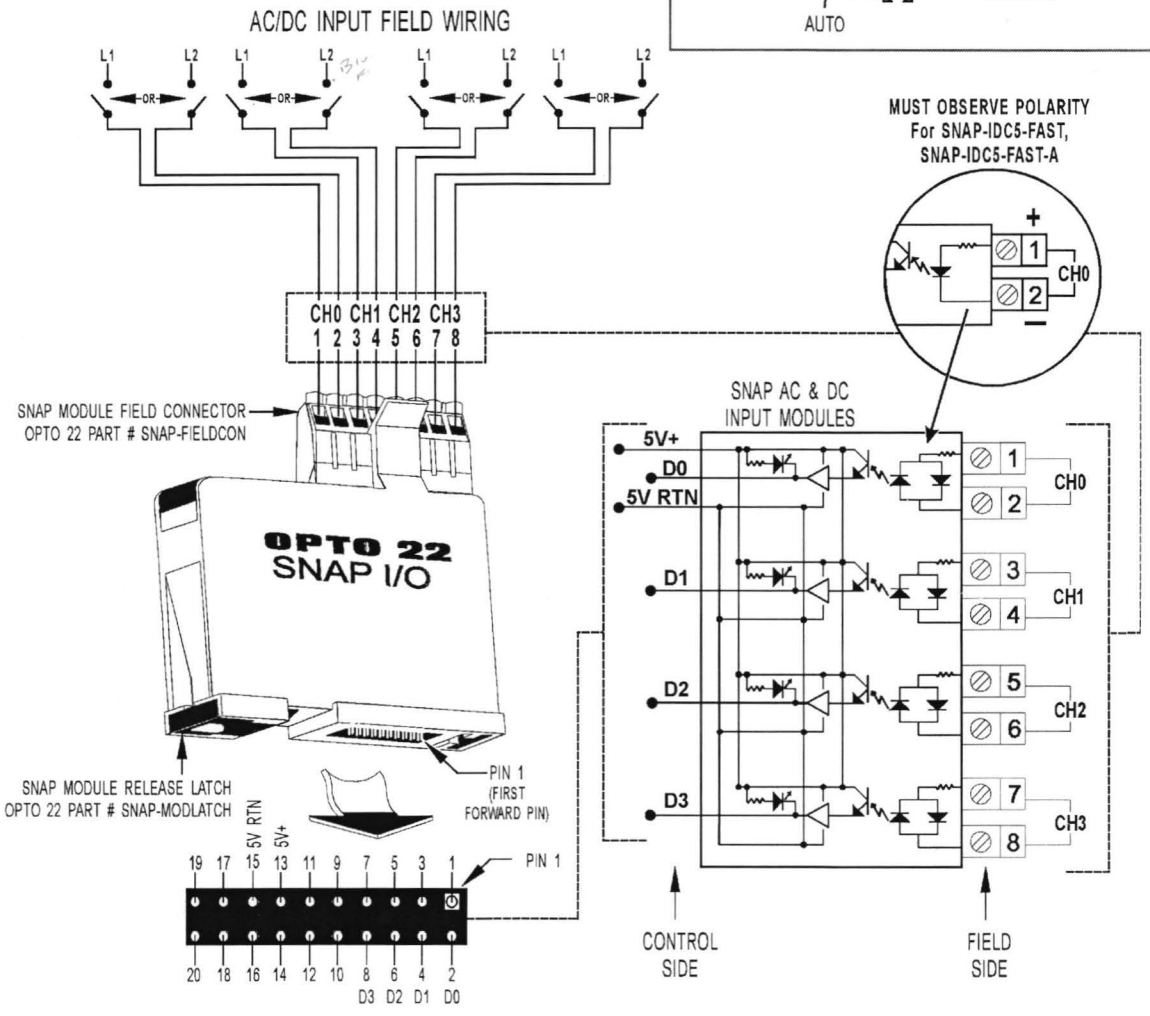
SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Schematics

Most AC and DC Input Modules

See previous page for SNAP-IDC5-SW and SNAP-IDC5-SW-NC wiring diagram.
See next page for Factory Mutual modification.

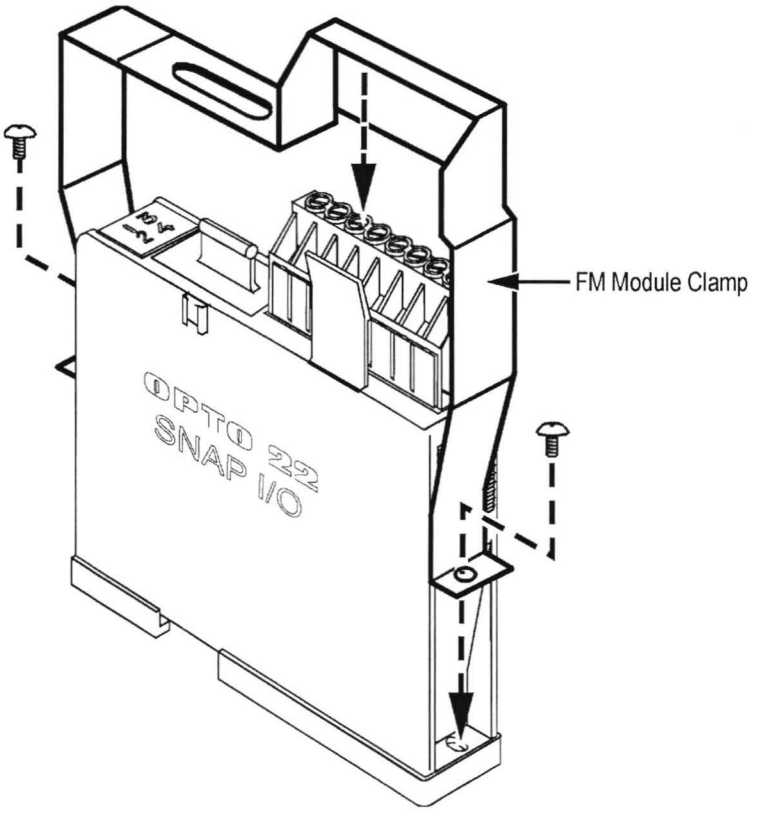




SNAP DIGITAL MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

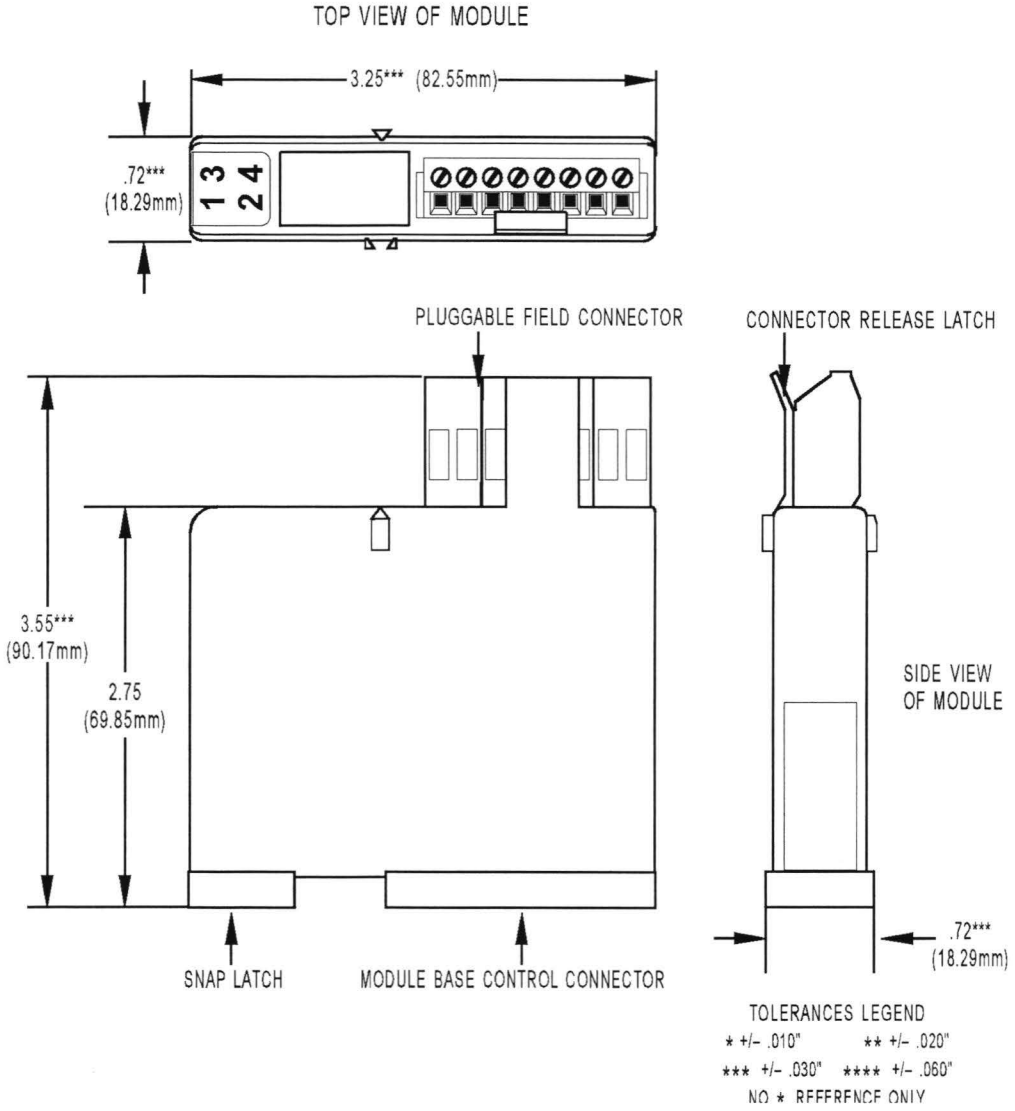
Factory Mutual Modification

All modules with part numbers ending in FM are Factory Mutual approved with the installation of the FM Module Clamp, as shown below.



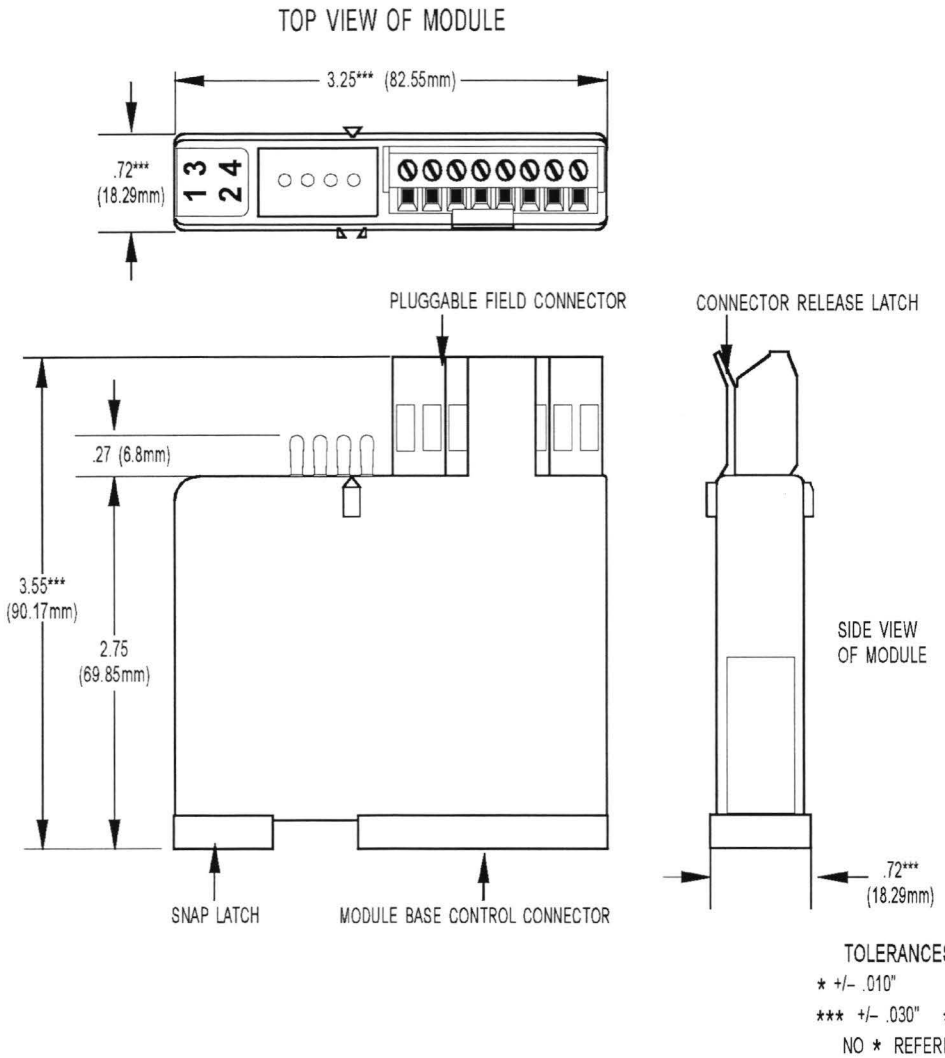
Dimensional Drawing

All Modules Except MA



Dimensional Drawing

All MA Modules



TOLERANCES LEGEND

* +/- .010" ** +/- .020"

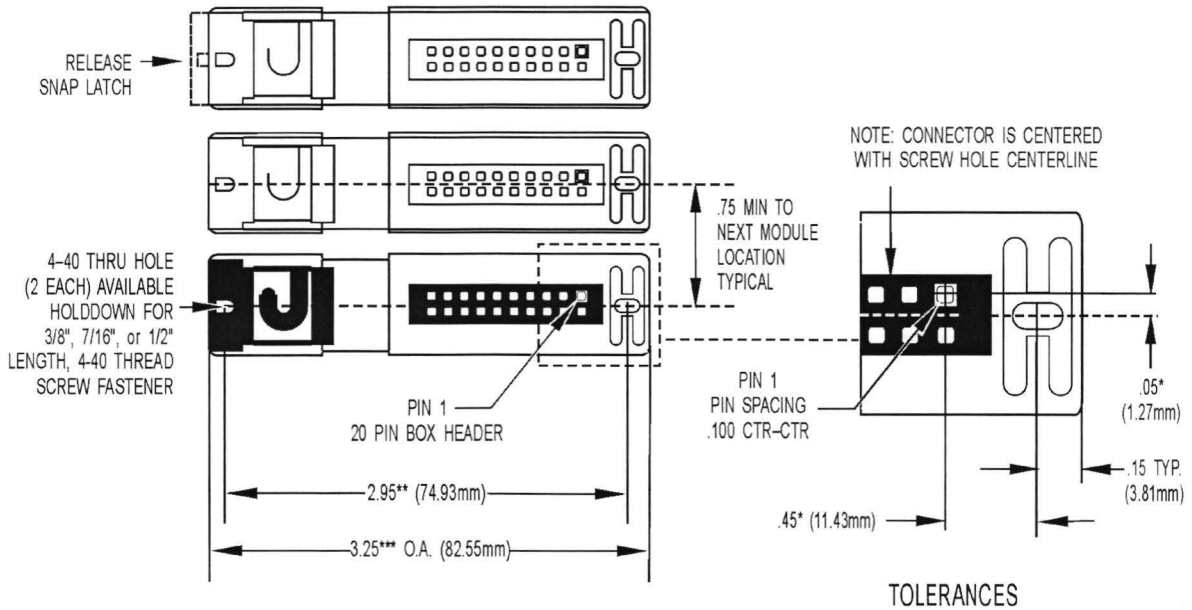
*** +/- .030" **** +/- .060"

NO * REFERENCE ONLY

Dimensional Drawing

All Models

Bottom View of Module Base



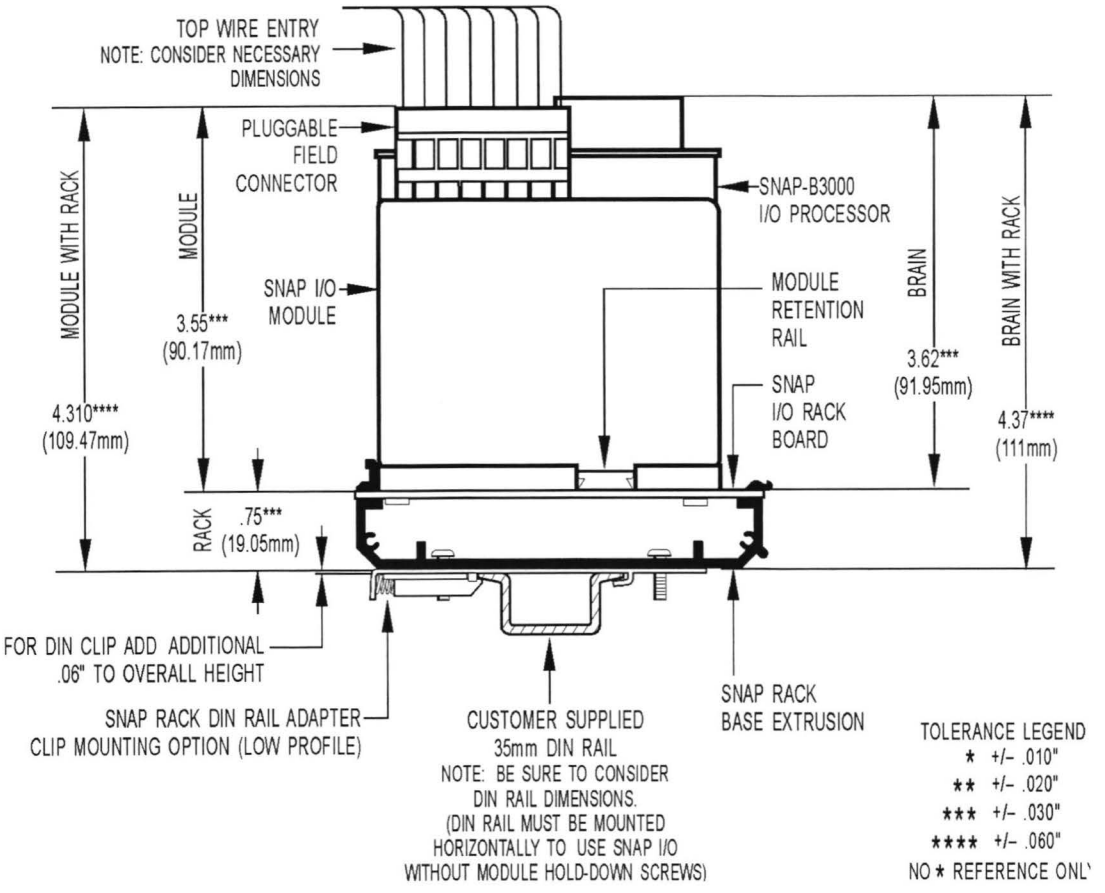
TOLERANCES
* +/- .010"
** +/- .020"
*** +/- .030"
NO * REFERENCE ONLY

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Dimensional Drawing

All Models

SNAP Digital Module Mounted on SNAP Rack



OPTO 22

DATA SHEET

Form 1065-010315

I/O MODULES
SNAP
ANALOG INPUT MODULES

Overview

The SNAP analog input modules are part of Opto 22's SNAP I/O system. All SNAP analog input modules are compatible with SNAP Ethernet I/O. All two-channel modules can be used with SNAP B-series mounting racks and SNAP brains. Four-channel modules can be used only with B-series racks and SNAP Ethernet I/O and SNAP wireless LAN I/O brains.

SNAP analog requires a minimum number of module types to support a full range of analog input requirements. These software-configurable modules handle a wide variety of signal levels. They provide high resolution (0.004% of nominal range) for precise signal levels, as well as two- or four-channel packaging for high density. All SNAP analog modules are factory calibrated and 200 percent tested.

SNAP analog input modules have an on-board microprocessor to provide module-level intelligence, which makes them an ideal choice for Original Equipment Manufacturers (OEMs). For additional information about standalone operation of SNAP analog modules, please refer to Opto 22 form #876, *SNAP I/O Module Integration Guide*. For dimensional drawings, see pages 20–22.

Transformer and Optical Isolation

All SNAP analog input modules are transformer isolated as well as optically isolated from all other modules and from the SNAP brain. The channels on the modules in this data sheet are **not** isolated from each other, however. (If you need isolated modules, see Opto 22 form #1182.)

Optical isolation provides 4,000 volts of transient protection for sensitive control electronics from real-world industrial field signals.

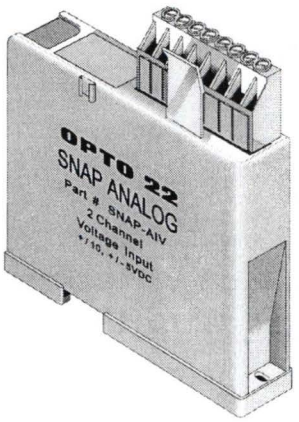
Transformer isolation prevents ground loop currents from flowing between field devices and causing noise that produces erroneous readings. Ground loop currents are caused when two grounded field devices share a connection, and the ground potential at each device is different.

IMPORTANT: Since these analog input modules provide two or four single-ended input channels with a common reference, the channels are not isolated from each other. (See Opto 22 form #1182 for isolated modules.)

Part Number	Description	See page
Two-Channel Modules		
SNAP-AIARMS	2-channel 0 to 10 amp RMS AC/DC input	2
SNAP-AIVRMS	2-channel 0 to 250 V RMS AC/DC input	4
SNAP-AICTD	2-channel analog temperature input - ICTD	5
SNAP-AIMA	2-channel analog current input -20 mA to +20 mA	7
SNAP-AIRATE	2-channel 0–25,000 Hz analog rate input	10
SNAP-AITM	2-channel analog type E, J, or K thermocouple or -150 mV to +150 mV input or -75 mV to +75 mV input	14
SNAP-AITM-2	2-channel analog type B, C, D, G, N, T, R, or S thermocouple or -50 mV to +50 mV DC input or -25 mV to +25 mV DC input	15
SNAP-AIRTD	2-channel 100-ohm platinum RTD input	16
SNAP-AIV	2-channel analog voltage input -10 VDC to +10 VDC	18
Four-Channel Modules		
SNAP-AICTD-4	4-channel analog temperature input - ICTD	5
SNAP-AIMA-4	4-channel analog current input -20 mA to +20 mA	7
SNAP-AIR40K-4	4-channel analog thermistor input	9
SNAP-AIMV-4	4-channel -150 mV to +150 mV input or -75 mV to +75 mV input	12
SNAP-AIMV2-4	4-channel -50 mV to +50 mV input or -25 mV to +25 mV input	13
SNAP-AIV-4	4-channel analog voltage input -10VDC to +10VDC	18

Analog Input Modules

- Resolution = 0.004% of nominal range
- Two or four single-ended inputs per module

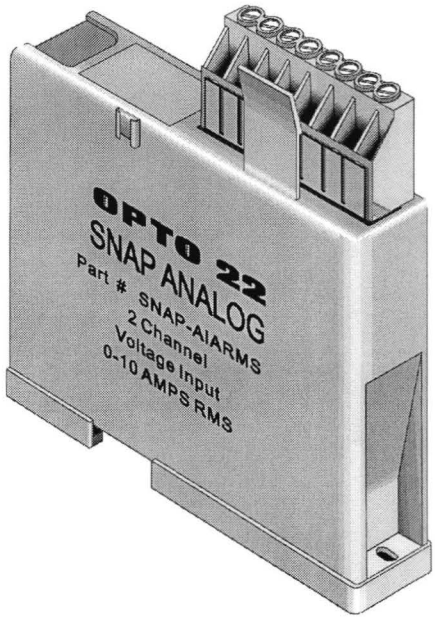


Features

- Rugged packaging
- Convenient pluggable wiring
- Powered by a single 5-volt supply
- Out-of-range indication
- Operating temperature 0° to 70° C
- Accepts up to 14 AWG wire.
- Factory calibrated, no user adjustment necessary

Part Number	Description
SNAP-AIARMS	2-channel 0 to 10 amp RMS AC/DC input

0 to 10 amp RMS AC/DC Input Module



Description

The SNAP-AIARMS module provides an input range of 0 to 10 amps RMS AC/DC. An ideal input is the 5-amp secondary of a standard current transformer used to monitor AC line current.

The SNAP-AIARMS module may be used to monitor AC current to greater than a 100-amp range, using a current transformer of suitable ratio.

Specifications

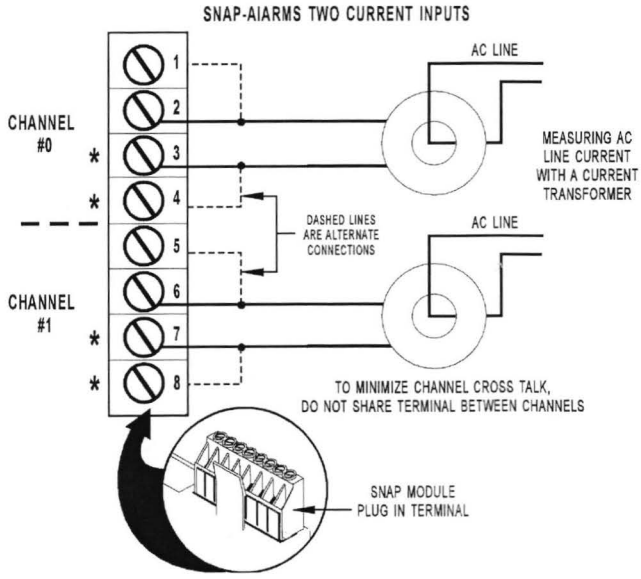
Input Range	0 to 10 amp RMS AC/DC
Imput Over Range	To 11 amps
Input Resistance	0.005 Ω
Maximum Input	11 amps AC/DC
Accuracy (AC)	±8 mA and ±0.2% reading
Resolution	400 µA
DC Reversal	±16 mA (0.16%)
Input Response Time (Step Change)	5% (12.5 V) in 100 mS 63.2% (158 V) in 200 mS 99% (248 V) in 1200 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB at 60 Hz
Maximum Operating Common Mode Voltage	250 VAC
Power Requirements	5 VDC (±0.15 V) at 170 mA
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

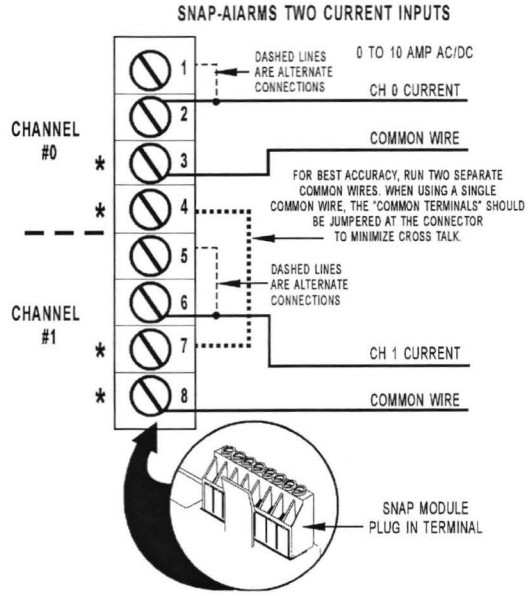
IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

0 to 10 Amp RMS AC/DC Input Module Wiring Diagrams

Two possible wiring diagrams are shown.

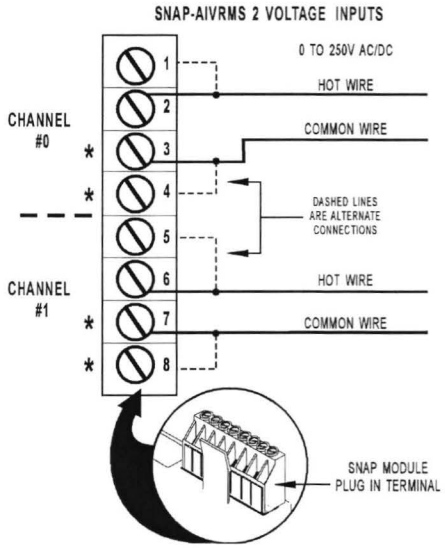
Terminals 3, 4, 7, and 8 share a common connection inside the module. **Make sure you observe polarity** when connecting the second channel. To avoid a potentially hazardous short, double-check wiring before turning on the current to be monitored.

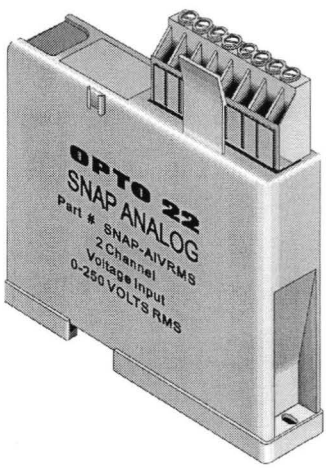




Part Number	Description
SNAP-AIVRMS	0 to 250 V RMS AC/DC

0 to 250 Volt RMS AC/DC Input Module





Description

The SNAP-AIVRMS module provides an input range of 0 to 250 volts AC or DC. The SNAP-AIVRMS module may be used to monitor 120/240-volt AC/DC and 12/24/48-volt AC/DC system voltage.

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.

Specifications

Input Range	0 to 250 V RMS AC/DC
Input Over Range	To 275 V
Input Resistance	1 M Ω
Accuracy	±0.2 V and ±0.2% reading
Resolution	10 mV
DC Reversal	± 0.4 V (.16%)
Input Response Time (Step Change)	5% (12.5 V) in 100 mS 63.2% (158 V) in 200 mS 99% (248 V) in 1200 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Operating Common Mode Voltage	250 VAC
Power Requirements	5 VDC (±0.15 V) at 170 mA
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

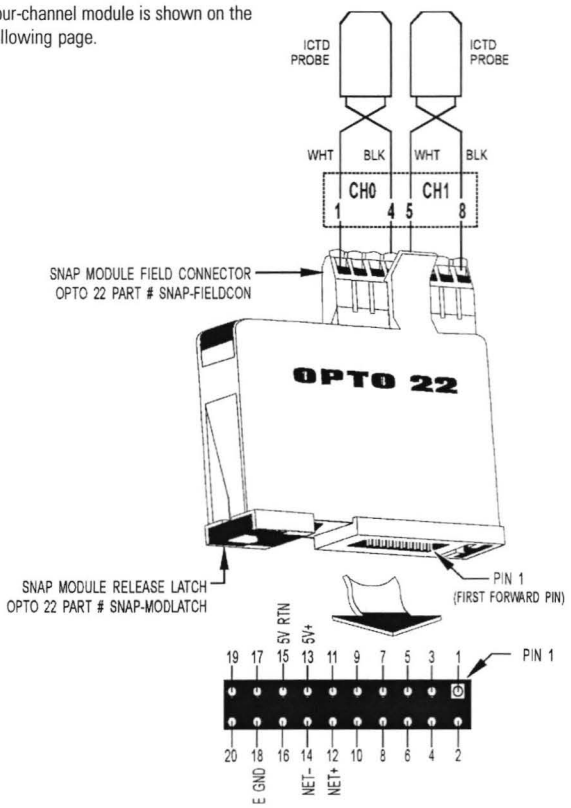
IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

ICTD Temperature Input Module

Part Number	Description
SNAP-AICTD	2-channel analog temperature input - ICTD
SNAP-AICTD-4	4-channel analog temperature input - ICTD

SNAP-AICTD
(Two channels)

Four-channel module is shown on the following page.



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Description

The SNAP-AICTD and SNAP-AICTD-4 modules provide temperature input data from any industry-standard Integrated Circuit Temperature Device (ICTD). The SNAP-AICTD has two channels, and the SNAP-AICTD-4 has four channels. The four-channel module can be used only with the SNAP-B3000-ENET Ethernet brain.

The simple two-wire connections are made to the pluggable terminal strip on top of the module. Up to 2,000 feet of ordinary hook-up wire is used to connect the sensor to the input terminal strip.

Both modules are compatible with all industry-standard ICTD probes, including the AD-590 family from Analog Devices and Opto 22's part number ICTD.

Specifications

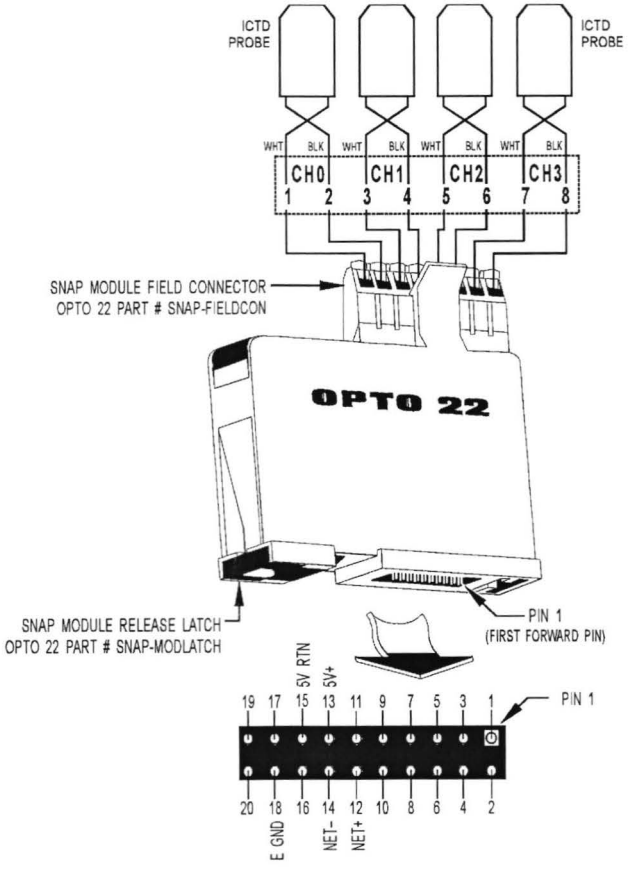
Input Range with ICTD Probe	-40° C to +100° C
Resolution	0.017° C
Accuracy with ICTD Probe	±0.8° C
Sensitivity	1.0 µA/° C
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Operating Common Mode Voltage	750 VDC or peak AC
Power Requirements	5 VDC (± .015) @ 150 mA
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

ICTD Temperature Input Module (continued)

SNAP-AICTD-4
(Four Channels)

Two-channel module is shown on the previous page.



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

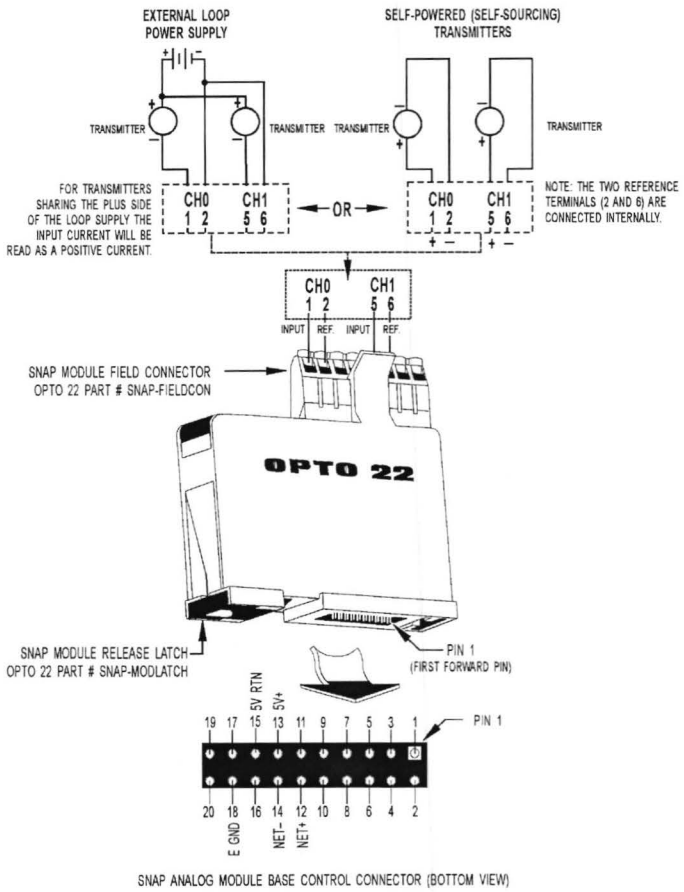
IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Current Input Module -20mA to +20mA

Part Number	Description
SNAP-AIMA	2-channel analog current input -20mA to +20mA
SNAP-AIMA-4	4-channel analog current input -20mA to +20mA

Transmitter Loop Current Field Wiring SNAP-AIMA (Two Channels)

Four-channel module is shown on the following page.



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Description

The SNAP-AIMA and SNAP-AIMA-4 modules provide an input range of -20mA to +20mA. The SNAP-AIMA has two channels, and the SNAP-AIMA-4 has four channels. The four-channel module can be used only with SNAP Ethernet I/O and SNAP wireless LAN I/O brains. These modules DO NOT supply loop excitation current.

Since all inputs share a common reference, the module must be installed at the beginning or end of a typical 4 to 20mA loop. If you are using both standard and self-sourcing transmitters, either put the transmitters on different modules, or use different power supplies.

If you need channels that are isolated from each other on the same module, see Opto 22 form #1182.

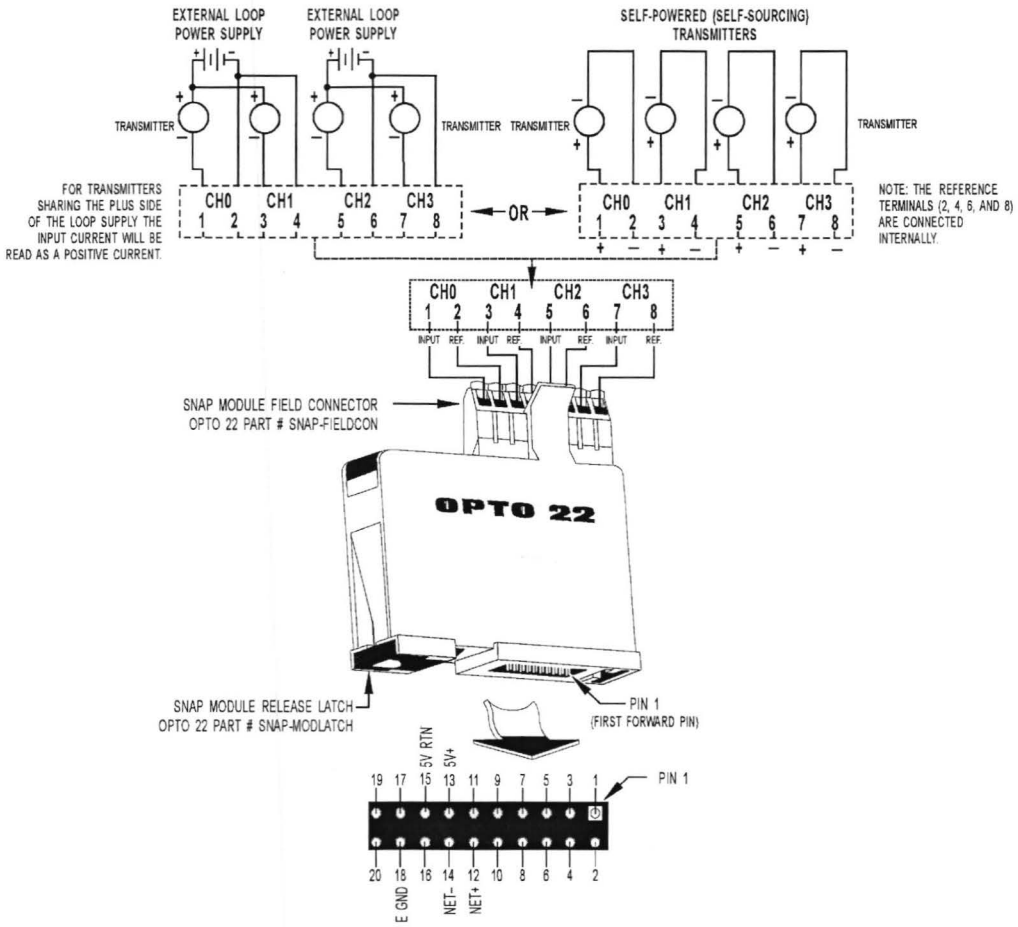
Specifications

Input Range	-20mA to +20mA
Resolution	0.8 µA
Input Response Time (% of span/delta I/delta time)	99.9 %/19.9mA/10 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Survivable Input	36 mA or 9 VDC
Maximum Operating Common Mode Voltage (Field Term to Logic Connector)	750 VDC or peak AC
Accuracy	0.05% (10 µA)
DRIFT: Gain Temperature Coefficient	30 PPM/°C
DRIFT: Offset Temperature Coefficient	15 PPM/°C
Power Requirements	5 VDC (±0.15) @ 170 mA
Input Resistance - Single Ended	200 ohms (each channel)
Ambient Temperature: Operating Storage	0° C to 70° C -25° C to 85° C

Current Input Module -20mA to +20mA (continued)

Transmitter Loop Current Field Wiring
SNAP-AIMA-4 (Four Channels)

Two-channel module is shown on previous page.



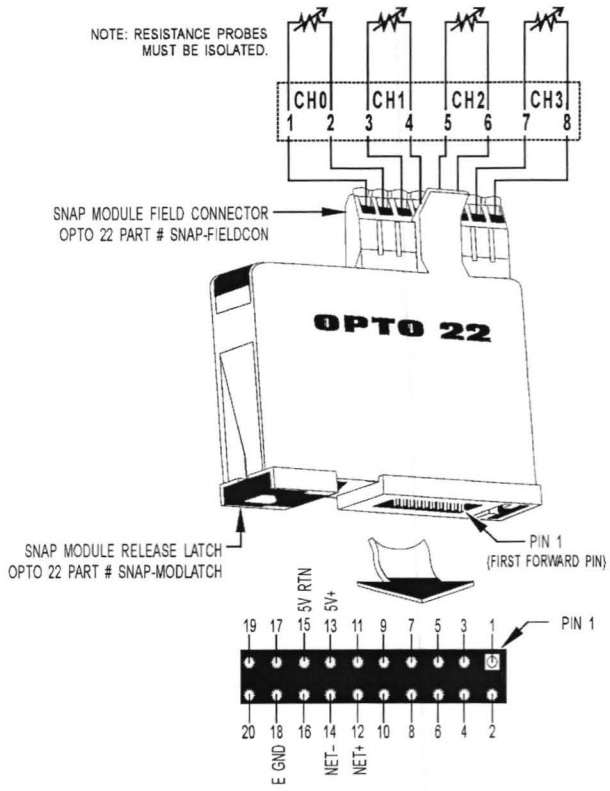
SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Thermistor Input Module
0–40 K, 0–20K, 0–10K, or 0–5 K Ohm

Part Number	Description
SNAP-AIR40K-4	4-channel analog thermistor input

SNAP-AIR40K-4



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Description

The SNAP-AIR40K-4 module provides four channels of analog to digital conversion, ideal for thermistors used in HVAC applications or for reading the resistance of potentiometer input. The module can be used only with SNAP Ethernet I/O and SNAP wireless LAN I/O brains.

The default input range is 0 to 40 K Ohms. The module can also be configured for 0 to 20 K, 0 to 10 K, or 0 to 5 K Ohms.

NOTE: Resistance probes must be isolated from each other.

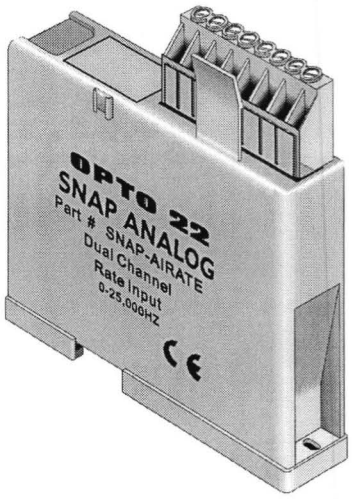
Specifications

Input Range	0 to 40,000 Ohms 0 to 20,000 Ohms 0 to 10,000 Ohms 0 to 5,000 Ohms
Resolution	1.6 Ohm @ 40 K Ohms 0.8 Ohm @ 20 K Ohms 0.4 Ohm @ 10 K Ohms 0.2 Ohm @ 5 K Ohms
Input Filtering	-3 dB @ 3.2 Hz
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Operating Common Mode Voltage	500 volts DC or peak AC
Accuracy	0.1% ± 40 Ohms @ 40 K Ohms 0.1% ± 20 Ohms @ 20 K Ohms 0.1% ± 10 Ohms @ 10 K Ohms 0.1% ± 5 Ohms @ 5 K Ohms
DRIFT: Gain Temperature Coefficient	30 PPM/ °C
DRIFT: Offset Temperature Coefficient	15 PPM/ °C
Power Requirements	5 VDC (±0.15) @ 190 mA
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

0 to 25,000 Hz Analog Rate Input Module

Part Number	Description
SNAP-AIRATE	0–25,000 Hz analog rate input



Description

The SNAP-AIRATE module provides two channels of frequency-to-digital conversion. The nominal input range is 0 to 25,000 Hz with an over-range capability to 27,500 Hz. Nine volts through a 4.7 K ohm pull-up resistor are provided internally for use with devices that have open collector outputs. This feature eliminates the need for the user to provide the pull-up voltage supply and associated wiring, barrier strips, etc.

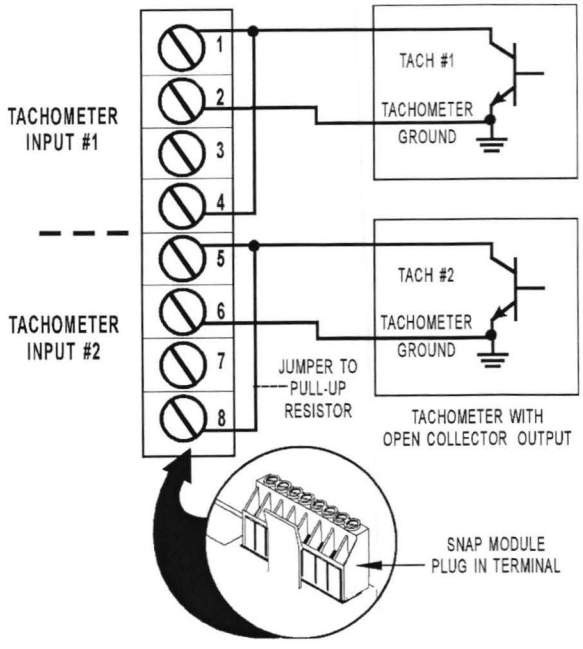
The module works with TTL, CMOS, and open collector outputs. Truly a two-wire hookup, the SNAP-AIRATE module is ideally suited for use with a tachometer.

Specifications

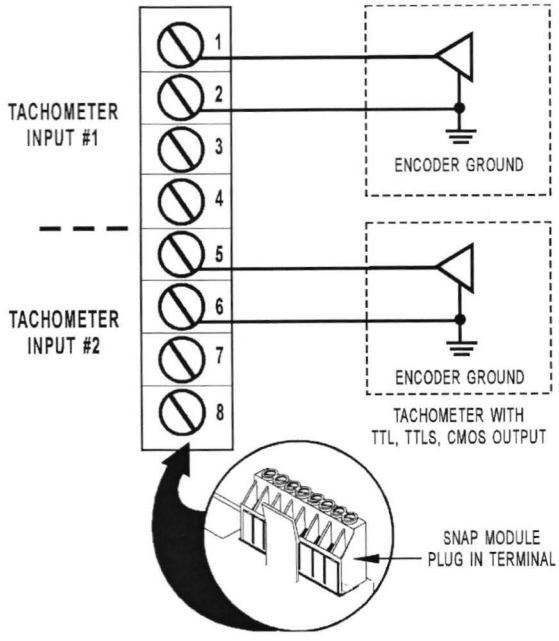
Nominal Input Range	0 to 25,000 Hz
Input Over Range	To 27,500 Hz
Resolution	1 Hz
Input Response Time (% of span / Δ Hz / Δ time)	10.0% / 2,500 Hz / 0.1 sec 63.2% / 15.8 K Hz / 0.9 sec 99.0% / 24.75 K Hz / 4.2 sec
DC Common Mode Rejection	> -120 dB
AC Common Mode Rejection	> -120 dB at 60 Hz
Maximum Operating Common Mode Voltage	250 VDC or peak AC
Accuracy (% full scale)	±4 Hz or ±0.5% of the input frequency (whichever is greater)
Drift Gain Temperature Coefficient Offset Temperature Coefficient	 200 ppm / °C 50 ppm / °C
Input Parameters Coupling Input Amplitude Sine wave Square wave	 Single-ended AC (capacitor coupled) 2.5 V to 24 V p-p 0.5 V to 24 V p-p
Minimum Pulse Width	18 µsec
Input Impedance Pull-up Voltage Pull-up Resistor	50 K ohms AC coupled (-input to +input) (Both inputs share the same reference point.) 6 to 9 V 4.7 K ohms
Power Requirements	5 VDC (±0.15 V) at 190 mA
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

0 to 25,000 Hz Analog Rate Input Module Wiring Diagrams

SAMPLE WIRING DIAGRAM #1



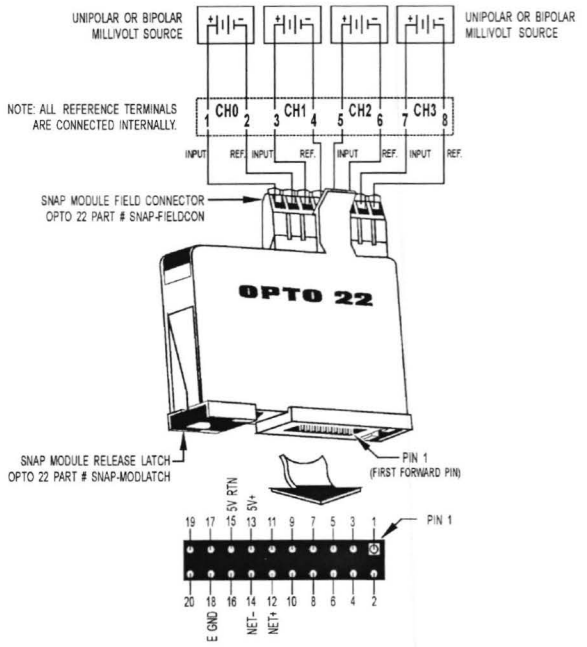
SAMPLE WIRING DIAGRAM #2



Millivolt Input Module

Part Number	Description
SNAP-AIMV-4	4-channel -150 to +150 mV input or -75 to +75 mV input

SNAP-AIMV-4



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Description

The SNAP-AIMV-4 module provides four channels of analog to digital conversion. This module can be used only with SNAP Ethernet I/O and SNAP wireless LAN I/O brains.

Each channel on the module can be configured for -150 mV DC to +150 mV DC or -75 mV DC to +75 mV DC.

Note that all inputs share the same reference terminal.

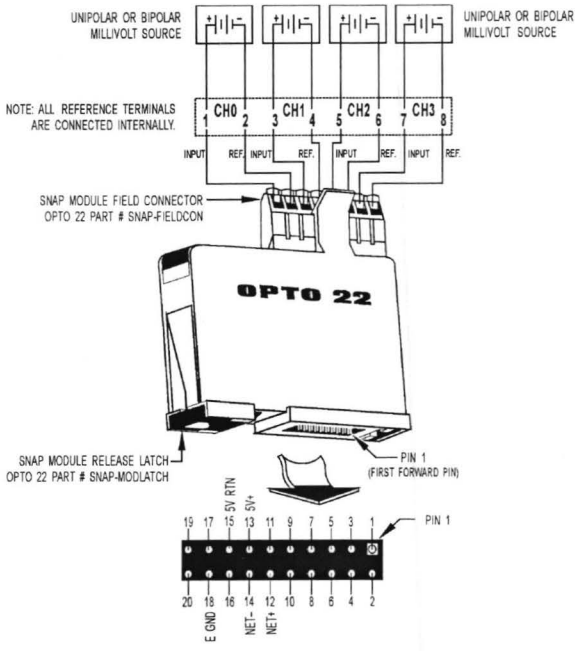
Specifications

Input Range	From -150 mV to +150 mV From -75 mV to +75m V
Resolution	6 µV from -150 mV to +150 mV 3 µV from -75 mV to +75m V
Input Filtering	-3 dB @ 7 Hz
Input Response Time (% of span/delta V/delta time)	63.2%/95 mV/23 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Survivable Input	±15 volts
Maximum Operating Common Mode Voltage (Field term to logic connector)	500 volts DC or peak AC
Accuracy	0.06% (90 µV) @ 150m V (full scale) 0.1% (75 µV) @ 75 mV (full scale)
DRIFT: Gain Temperature Coefficient	3 µV / °C
DRIFT: Offset Temperature Coefficient	2 µV / °C
Power Requirements	5 VDC (±0.15) @ 170 mA
Input Resistance - Single Ended	100 M Ω (each channel)
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

Millivolt Input Module

Part Number	Description
SNAP-AIMV2-4	4-channel -50 to +50 mV input or -25 to +25 mV input

SNAP-AIMV2-4



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Description

The SNAP-AIMV2-4 module provides four channels of analog to digital conversion. This module can be used only with SNAP Ethernet I/O and SNAP wireless LAN I/O brains.

Each channel on the module can be configured for -50 mV DC to +50 mV DC or -25 mV DC to +25 mV DC.

Note that all inputs share the same reference terminal.

Specifications

Input Range	From -50 mV to +50 mVDC From -25 mV to +25 mVDC
Resolution	2 µV from -50 mV to +50 mV 1 µV from -25 mV to +25 mV
Input Filtering	-3 dB @ 2.4 Hz
Input Response Time (% of span/delta V/delta time)	63.2%/31.5 mV/66 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Survivable Input	±15 Volts
Maximum Operating Common Mode Voltage (Field term to logic connector)	500 volts DC or peak AC
Accuracy	0.1% (50 µV) @ 50 mV (full scale) 0.2% (50 µV) @ 25 mV (full scale)
DRIFT: Gain Temperature Coefficient	5 µV / °C
DRIFT: Offset Temperature Coefficient	2 µV / °C
Power Requirements	5 VDC (±0.15) @ 170 mA
Input Resistance, Single Ended	100 M Ω (each channel)
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

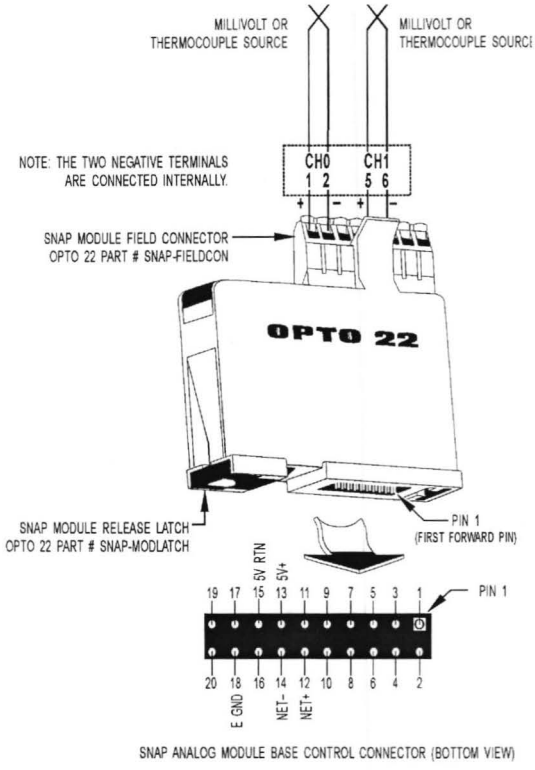
Part Number	Description
SNAP-AITM	2-channel analog type E, J, or K thermocouple or -150 mV to +150 mV input or -75 mV to +75 mV input

Thermocouple/Millivolt Input Module

Thermocouple Polarity and Range

Type	-	+	Range
E	RED	PURPLE	-270°C to +1,000° C
J	RED	WHITE	-210°C to +1,200° C
K	RED	YELLOW	-270°C to +1,372° C

SNAP-AITM



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Description

The SNAP-AITM module provides two channels of analog to digital conversion. Each channel on the module can be configured for -150 mV DC to +150 mV DC or -75 mV DC to +75 mV DC, or for type E, J, or K thermocouple operation.

Since both inputs share the same reference terminal, use isolated probes for thermocouple inputs. If you need isolated channels on the same module, see Opto 22 form #1182.

Specifications

Input Range	From -150 mV to +150m V From -75 mV to +75 mV
Resolution	6 µV from -150 mV to +150m V 3 µV from -75 mV to +75 mV
Cold Junction Temperature Compensation	Automatic when used with B3000
Input Filtering	-3 dB @ 7 Hz
Input Response Time (% of span/delta V/delta time)	63.2%/95 mV/23 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Survivable Input	±15 volts
Maximum Operating Common Mode Voltage (Field term to logic connector)	500 volts DC or peak AC
Accuracy	0.06% (90 µV) @ 150 mV (full scale) 0.1% (75 µV) @ 75 mV (full scale)
DRIFT: Gain Temperature Coefficient	5 µV / °C
DRIFT: Offset Temperature Coefficient	2 µV / °C
Thermocouple Accuracy [°C] (from factory) After user gain and offset commands	± 2.0 E, J, and K ± 0.8
Power Requirements	5 VDC (±0.15) @ 170m A
Input Resistance - Single Ended	100 M Ω (each channel)
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

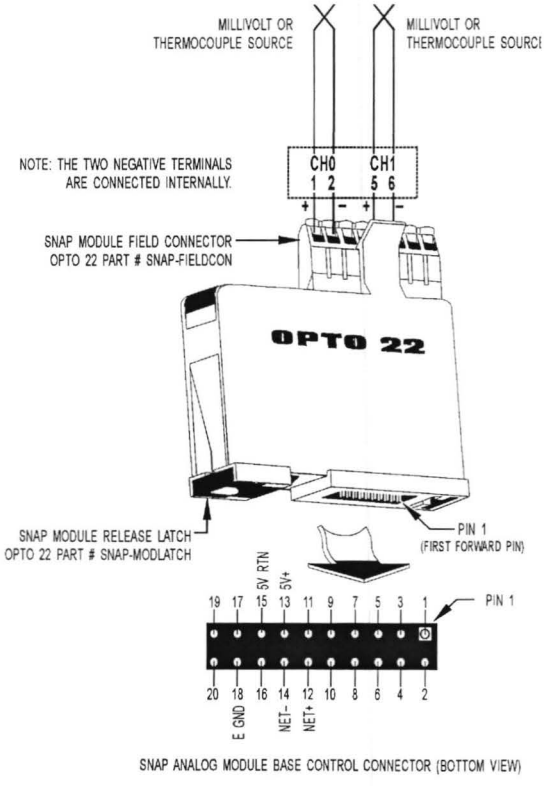
Thermocouple/Millivolt Input Module

Part Number	Description
SNAP-AITM-2	2-channel analog type B, C, D, G, N, T, R, or S thermocouple or -50 mV to +50 mVDC input or -25 mV to +25 mVDC input

Thermocouple Polarity and Range

Type	-	+	Range
B	RED	GRAY	+42° C to +1,820° C
C, D, G	RED	WHITE	0° C to +2,320° C
N	RED	ORANGE	-270° C to +1,300° C
R, S	RED	BLACK	-50° C to +1,768° C
T	RED	BLUE	-270° C to +400° C

SNAP-AITM-2



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Description

The SNAP-AITM2 module provides an input range of ±50 mV, ±25 mV, or Type B, C, D, G, N, T, R, or S thermocouple.

Since both inputs share the same reference terminal, use isolated probes for thermocouple inputs. If you need isolated channels on the same module, see Opto 22 form #1182.

Specifications

Input Range	From -50 mV to +50 mVDC From -25 mV to +25 mVDC
Resolution	2 µV from -50 mV to +50 mV 1 µV from -25 mV to +25 mV
Cold Junction Temperature Compensation	Automatic when used with B3000
Input Filtering	-3 dB @ 2.4 Hz
Input Response Time (% of span/delta V/delta time)	63.2%/31.5 mV/66 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Survivable Input	±15 Volts
Maximum Operating Common Mode Voltage (Field term to logic connector)	500 Volts DC or Peak AC
Accuracy	0.1% (50 µV) @ 50 mV (full scale) 0.2% (50 µV) @ 25 mV (full scale)
DRIFT: Gain Temperature Coefficient	5 µV / °C
DRIFT: Offset Temperature Coefficient	2 µV / °C
Thermocouple Accuracy [°C] (from factory) After user gain and offset commands	B, R, S C, D, G T, N ±5 ±4 ±3 ±3 ±2 ±2
Power Requirements	5 VDC (±0.15) @ 170 mA
Input Resistance, Single Ended	100 M Ω (each channel)
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

RTD Input Module

Part Number	Description
SNAP-AIRTD	2-channel 100-ohm platinum RTD input

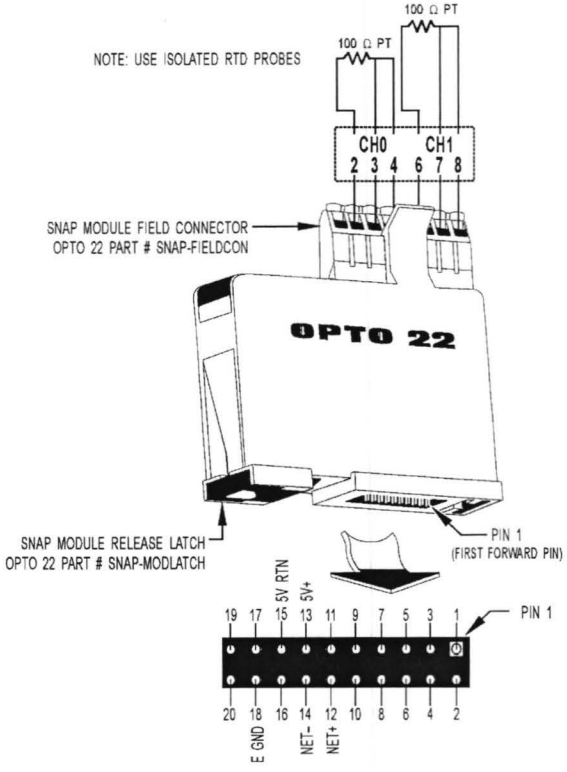
Description

The SNAP-AIRTD module provides a nominal input range of -200° to +850° C.

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

RTD Input Module

See additional wiring details on the following page.



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

Specifications

3-wire RTD Input	100-ohm platinum ∝ = 0.00385
Input Temperature Range	-200° to +850° C (-328° to +1,562° F)
Span	400 ohms
Resolution (average)	0.042° C (0.016 ohms)
Input Filtering	-3 dB @ 0.1 Hz
Input Response Time (% of span/delta temp/delta time)	63.2 % / 598° C / 25 mS
Lead Compensation	Automatic when used with B3000
DC Common Mode Rejection	> -120 dB
AC Common Mode Rejection	> -120 dB at 60 Hz
Excitation (typical)	1.25 mA constant current
Maximum Lead Resistance	>40 ohms single wire (all leads to be equal resistance)
Maximum Fault Voltage @ Input (Between any 2 Field Wires)	±15 volts DC or peak AC
Maximum Operating Common Mode Voltage (Field term to logic connector)	500 volts DC or peak AC
Accuracy	0.6° C
Power Requirements	5 VDC (±0.15) @ 190 mA
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

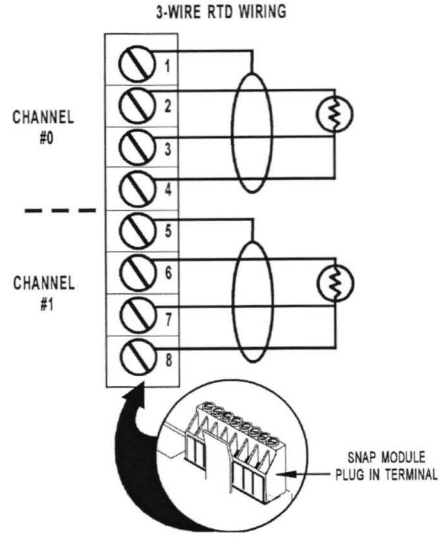
IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

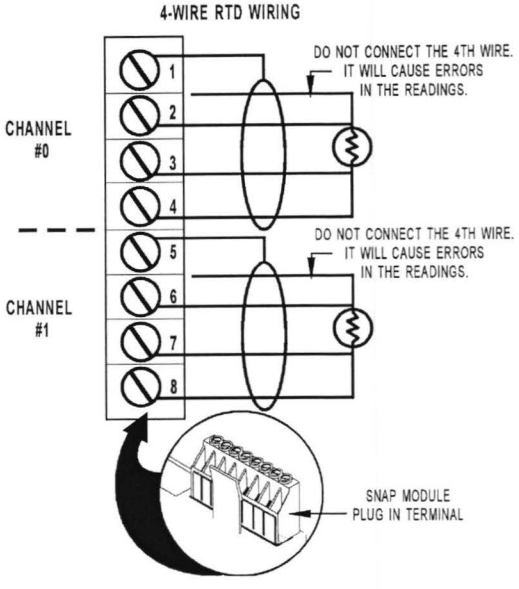
SNAP AIRTD Wiring

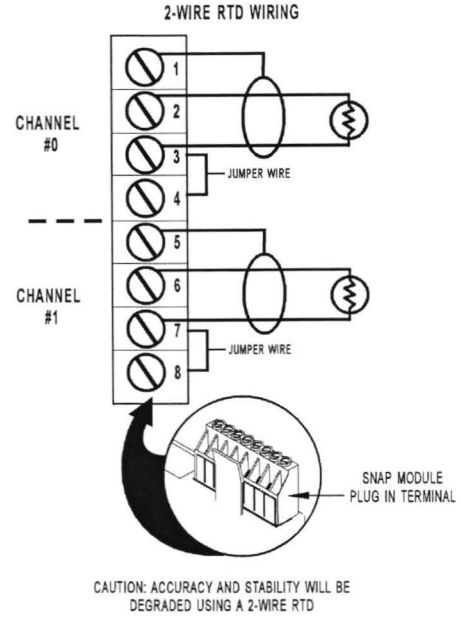
The SNAP-AIRTD is designed for three-wire connections, shown in the diagram at right.

If you use a four-wire connection (shown in the diagram below), DO NOT connect the fourth wire, as it will cause errors in the readings.

Two-wire connections are shown in the diagram below right. However, two-wire connections are NOT recommended, as they will degrade accuracy and stability.





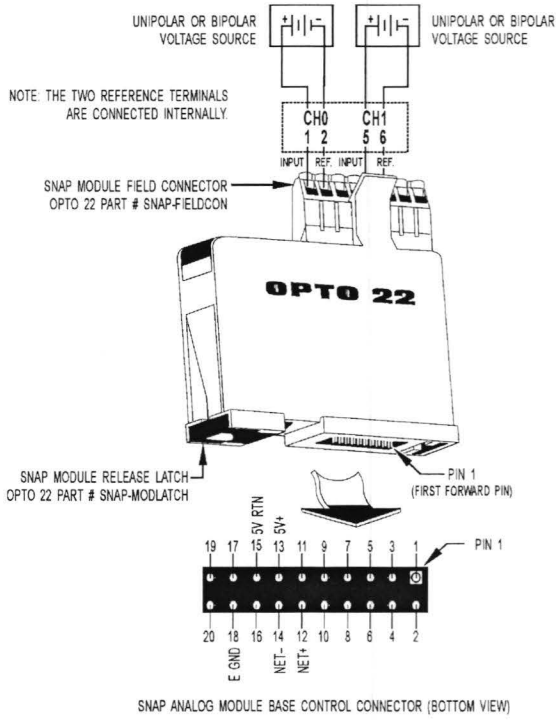


Voltage Input Module -10VDC to +10VDC or -5VDC to +5VDC

Part Number	Description
SNAP-AIV	2-channel analog voltage input -10 VDC to +10V DC
SNAP-AIV-4	4-channel analog voltage input -10 VDC to +10V DC

SNAP-AIV (Two Channels)

Four-channel module is shown on the following page.



SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Description

The SNAP-AIV and SNAP-AIV-4 modules can be configured for either -10 VDC to +10 VDC or -5 VDC to +5 VDC operation on each channel. The SNAP-AIV provides two channels, and the SNAP-AIV-4 provides four channels. The four-channel module can be used only with SNAP Ethernet I/O and SNAP wireless LAN I/O brains.

Note that all channels share a common reference terminal. If you need two isolated channels on the same module, see Opto 22 form #1182.

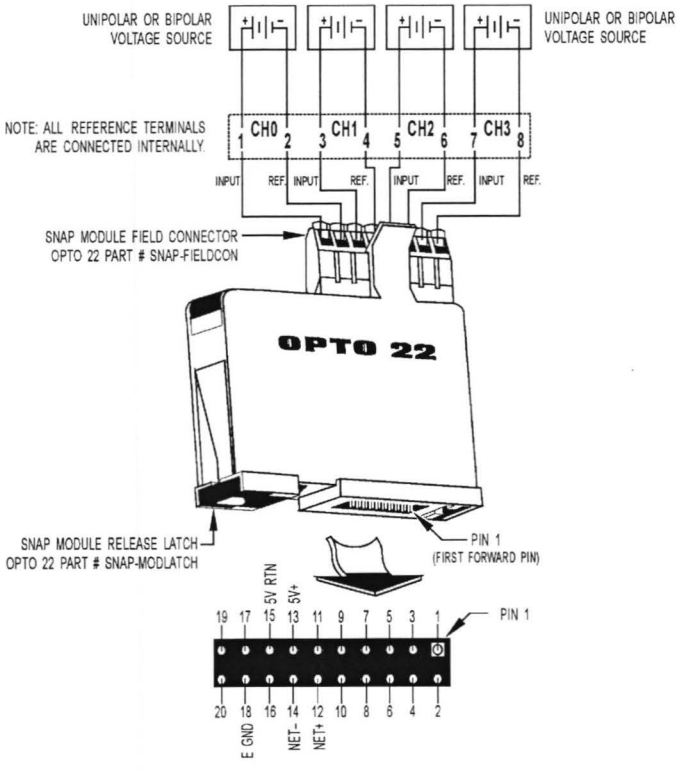
Specifications

Input Range	From -10 volts to +10 volts From -5 volts to +5 volts
Resolution	0.4 mV when configured -10 volts to +10 volts 0.2 mV when configured -5 volts to +5 volts
Input Filtering	-3 dB @ 64 Hz
Input Response Time (% of span/ DV / Dt)	63.2% / 6.7 V / 10 mS
DC Common Mode Rejection	>-120 dB
AC Common Mode Rejection	>-120 dB @ 60 Hz
Maximum Survivable Input	220 VAC or 300 VDC
Maximum Operating Common Mode Voltage (Field term to logic connector)	500 volts DC or peak AC
Accuracy	0.05%, 5 mV @ 10 VDC 2.5 mV @ 5 VDC
Gain Temperature Coefficient	30 PPM/°C
Offset Temperature Coefficient	15 PPM/°C
Power Requirements	5 VDC (±0.15) @ 170 mA
Input Resistance - Single Ended	1 M Ω (each channel) (Both inputs share the same reference point.)
Ambient Temperature: Operating Storage	 0° C to 70° C -25° C to 85° C

Voltage Input Module
-10VDC to +10VDC or -5VDC to +5VDC (continued)

SNAP-AIV-4 (Four Channels)

Two-channel module is shown on previous page.



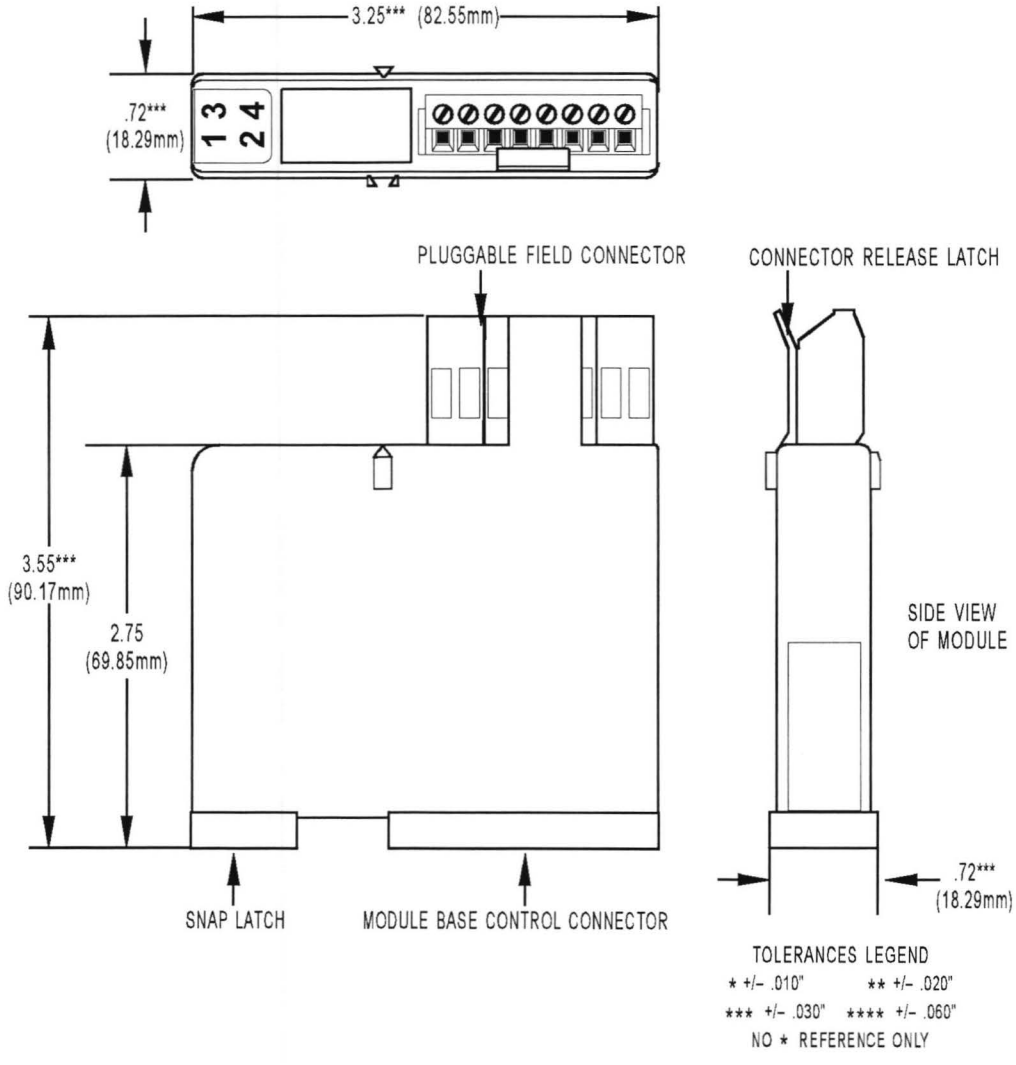
SNAP ANALOG MODULE BASE CONTROL CONNECTOR (BOTTOM VIEW)

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Dimensional Drawings

All Modules

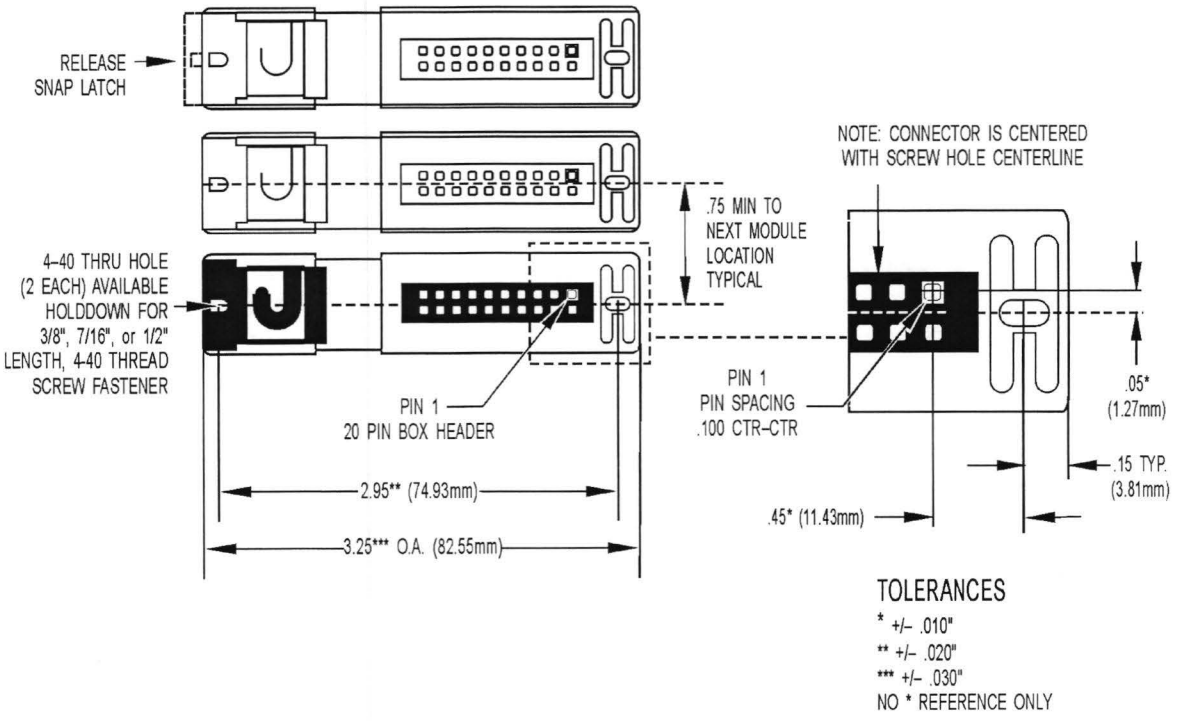
Top and Side Views



Dimensional Drawings

All Modules (Continued)

Bottom View of Module Base



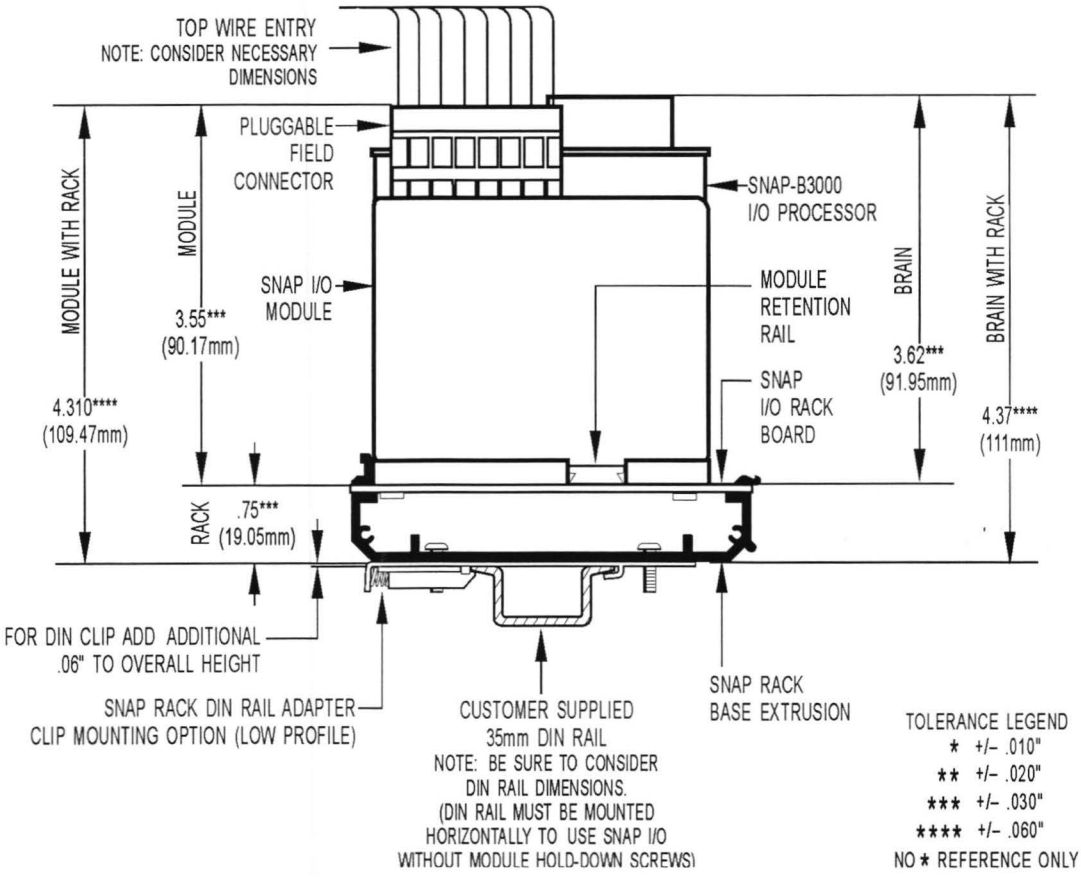
TOLERANCES
* +/- .010"
** +/- .020"
*** +/- .030"
NO * REFERENCE ONLY

IMPORTANT: The mounting rack connector has 24 pins; the module connector has 20 pins. The extra pins on the mounting rack connector prevent misalignment of the module during installation.

Dimensional Drawings

All Modules (Continued)

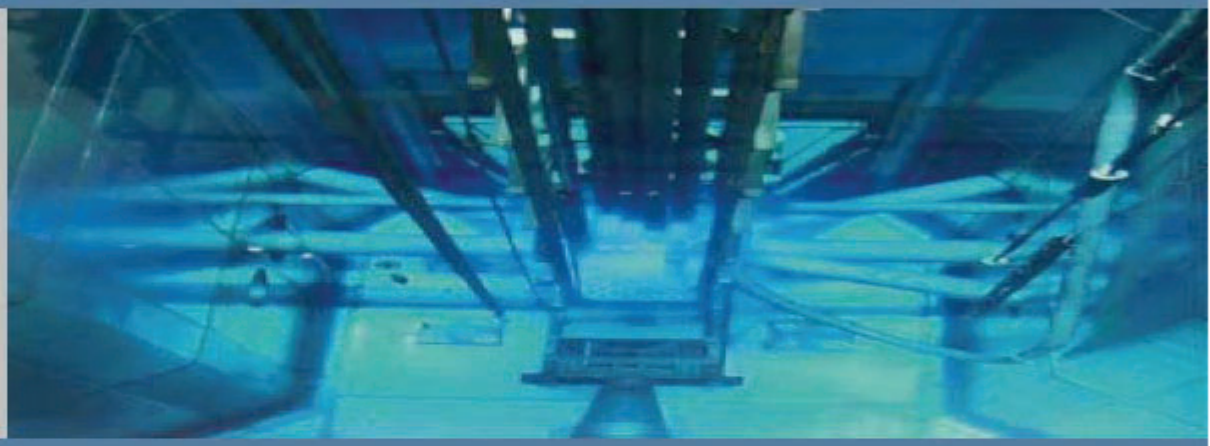
SNAP Analog Module Mounted on SNAP Rack



Neutron Flux Monitoring Systems

Instruction Manual: 1126 For UMASS Lowell

Document number 1126 Rev. /



Part of Thermo Fisher Scientific

Thermo SCIENTIFIC

Neutron Flux Monitor
Instruction Manual No. 1126, Rev. /

UMASS Lowell

July 2019

Thermo Fisher Scientific
10010 Mesa Rim Road
San Diego, CA 92121

Document Written by DANIEL MILLER _____ Date 7-9-19
(Print) (Sign)

Approvals:

Engineering Manager Jackson Gilmore _____ Date 7-11-19
(Print) (Sign)

Program Manager Gabrielle McElroy _____ Date 7/11/19
(Print) (Sign)

Quality Assurance Manager Greg Hicks _____ Date 7/11/19
(Print) (Sign)

ThermoFisher
SCIENTIFIC

QUALITY ASSURANCE PROGRAM MANUAL

Revision 22
October 11, 2018

Analytical Instruments Group
Chemical Analysis Division
Field and Safety Instruments

10010 Mesa Rim Road

San Diego, CA 92121-2912

TABLE OF CONTENTS

Prepared & Approved By: _____ **Date:** 1/22/2019
Quality Assurance Manager

Reviewed & Approved By: Christopher A. Cascella **Date:** 07FEB2019
General Manager/Site Leader

Approved By: _____ **Date:** 27FEB2019

Approved By: _____ **Date:** 4 MAR 19

ThermoFisher SCIENTIFIC

The world leader in serving science

June 27, 2019

University of Massachusetts at Lowell
Pinanski
205 Riverside St
Lowell, MA, 01854

Attention to: Lynne Winnett / REGAN

Subject:	Certificate of Conformance
References:	Purchase Order: L000511734 Rev. 0. Thermo Fisher Scientific Sales Order No. 190408
Attachments:	Configuration Record Test Reports

Thermo Fisher, San Diego certifies that the equipment listed on the attached Configuration Record complies with all requirements of the initial purchase order and applicable specifications.

Final inspections and tests required to verify conformance have been performed according to Thermo Fisher Scientific, San Diego's Quality Assurance Program Revision 22, dated 10/11/2018.

There are no limited shelf life items provided with this order and no other special in-storage maintenance is required.

Please feel free to contact me if there are any questions.

Gregory Hicks
Quality Assurance
(858) 882-1345 direct phone
Greg.Hicks@thermofisher.com.

Approval: Date:

Approval: Date:

PURPOSE: This procedure establishes a program for checking, documenting, and reviewing changes to instrumentation software and trip point settings.

SCOPE: This procedure applies to the General Atomics NMP-1000 Linear Power Channels.

RESPONSIBILITIES: A licensed reactor operator or senior reactor operator shall be responsible for checking software configuration and reporting changes in accordance with this procedure.

REFERENCE DOCUMENTS:

1. UMLRR License Technical Specifications
2. Calibration Procedure CP-2: Linear Power Channel Check and Calibration
3. Administrative Procedure AP-6: 10CFR 50.59 Screenings and Evaluations

ASSOCIATED MATERIAL:

CP-2 Check and Calibration Form

PROCEDURE

Any change in the software configuration of equipment covered by the scope of this procedure shall be treated as a design change and subject to 10CFR 50.59 review as required by Technical Specification (TS) 6.2.3.

1. The most current software version number shall be documented and maintained in the control room.

2. Following replacement, repair, or modification, a calibration shall be performed in accordance with Calibration Procedure CP-2 before the equipment is considerable operable and returned to service.

3. The software version shall be checked and verified against the documented current software version as part of a routine or non-routine Technical Specification required calibration of the equipment. The software version shall be noted on the CP-2 calibration form.

   NOTE: Procedure forms are not considered part of the procedure and do not require review under TS 6.2.3. However, any change to the procedure form shall be reviewed and approved by the TS Level 2.

4. For a discrepancy in the software version, the equipment shall be taken out of service and shall be immediately reported to the TS Level 2.

5. The Level 2 shall contact the manufacturer for all information related to the change.

6. The 10CFR 50.59 review shall be performed and documented in accordance with UMLRR Administrative Procedure AP-6.

7. If the review concludes a license amendment is not required, a channel calibration and channel test shall be performed.

8. Operations personnel shall receive training on the effects of the software change, if any, and such training shall be documented.

9. Instrumentation trip point settings shall be per Standing Order SO-5.

End of Procedure

Reviewed 06/14/2005

Initials MS

STANDING ORDER #5

SET POINTS FOR VARIOUS SCRAMS AND ALARMS

Alarms and scrams are set at values more conservative than those required by Technical Specifications. The following are the settings for the various safety channels as presently set. If these settings need to be adjusted to some other value, permission from the Reactor Supervisor or CRO is required.

Channel	Alarm	Scram	LSSS	normal values
hi neutron flux	≤105%	≤120%	125%	not to exceed 100%
short period	≥15 sec.	≥7 sec.	3 sec.	>30 seconds
low pool level	≥24.6 ft (~5" below pool gutters)	≥24.5 ft (6" below pool gutters)	24.25 ft (9" below pool gutters)	
coolant flow	≥1500 gpm	≥1400 gpm	1170 gpm	1600 gpm
core low flow	≥90%	≥80%	n/a	100%
core inlet temp	≤100 F	≤104 F	108 F	70-90 F
core outlet temp	≤104 F	≤108 F	n/a	70-90 F
pool temp	≤100 F	≤104 F	108 F	70-90 F
hi voltage failure				
Pico's, LOGN		≥700V	500V	800 v
SUC		≥600V	500V	700 v
conductivity	≤2.0 uMhos		5 uMhos/month-avg	

startup channel blade inhibit ≥3 cps (LSSS 2 CPS)

Bobek, Leo

From: Priddie, Gregg <Gregg.Priddie@ga.com>
Sent: Wednesday, July 17, 2019 2:03 PM
To: Bobek, Leo
Subject: RE: RE: password

Hi Leo,

In response to the topic on the password for the TRIGA system. As you noted the user name and password referenced in the first part of this email has to do with the console software and nothing to do with any individual instrument (specifically the NMP here). There is no password associated with the NMP itself. Hope that answers your inquiry. Anything else please let me know.

Gregg Priddie
Director of Energy Products
Product Lines
General Atomics
Electomagnetic Systems Group (GA-EMS)
858-676-7325 work phone
858-386-2184 mobile phone
858-964-7008 work fax
16530 Via Esprillo
San Diego, CA 92127

Gregg Priddie

From: Bobek, Leo <Leo_Bobek@uml.edu>
Sent: Tuesday, July 16, 2019 10:48 AM
To: Priddie, Gregg <Gregg.Priddie@ga.com>
Subject: -EXT-FW: RE: password

Hello Gregg,

Perhaps there is one question you can answer right away. See discussion below related to the NMP1000 netburner in one of the draft RAIs. I believe the user ID and password referred to in the procedure they mention below (reference to specific document attached) is related to the **GA Console** and not the **NMP1000**.

Am I correct in assuming the NMP1000 netburner does not have a user ID and password?

Thank you.

Leo

From: Hardesty, Duane [mailto:Duane.Hardesty@nrc.gov]
Sent: Tuesday, July 16, 2019 1:23 PM
To: Bobek, Leo; Helvenston, Edward
Cc: Muhlheim, Michael David
Subject: RE: RE: password

Thanks for this Leo.

The description of what the interface does is somewhat disconcerting. It talks about the main i/f to other NMP-1000 components, to the touch screen, and I/F to a remote maintenance computer. All access control issues. Please ask GA (and describe in RAI response) what is done with the USER ID/PW combination after the MOD54415 validation is complete and if there are potential adverse results if the PW is used by an end-user or unauthorized user) to access the stated functionality.

Thanks,
Duane

From: Bobek, Leo <Leo_Bobek@uml.edu>
Sent: Tuesday, July 16, 2019 1:12 PM
To: Hardesty, Duane <Duane.Hardesty@nrc.gov>; Helvenston, Edward <Edward.Helvenston@nrc.gov>
Subject: [External_Sender] RE: password

Took me a while to find the source of what you sent, but looks to be from one of the GA validation procedures. It is not in the NMP-1000 User Manual, which explains why I was not aware of it. This is obviously not something UML staff would do. I assume you still want the question answered even though we have no way of performing this procedure?

GENERAL ATOMICS
ELECTRONIC SYSTEMS

NetBurner-MOD54415 Ethernet Core Module
Validation Summary Report
20130207001-RPT, Revision 2

1 INTRODUCTION

The purpose of this document is to present, in summary, the results of NetBurner-MOD54415 Module, validation efforts as obtained by the execution of the 20130207001 NetBurner-MOD54415 Module Validation Plan Rev2.

2 TOOL OVERVIEW

NetBurner-MOD54415 Core Module is a single board computer with Ethernet connectivity from NetBurner Inc. The NetBurner module is used as the main processor which provides the digital interfaces to other components in the GA-ESI's NLX-1000 and NMP-1000 Nuclear Instrument Channels. NetBurner module is chosen for its variety of communication protocols offered. One of the MOD54415 serial ports is intended to interface the NLX-1000/NMP-1000's touch screen display module. The other MOD54415 module's serial port is intended to interface to a remote maintenance computer for setup and programming the MOD54415. An Ethernet port is used to communicate with external console. The NetBurner other data I/O including the SPI and GPIO are intended as chip select for GPIO expansion and the later for external watchdog timer and external ADC inputs.

No previous version of this tool will be decommissioned.

3 SCOPE

The scope of this validation effort included the testing of applicable feature of NetBurner-MOD54415 as described by the requirements listed with Table 3-1 of the Validation Plan.

From: Hardesty, Duane [mailto:Duane.Hardesty@nrc.gov]
Sent: Tuesday, July 16, 2019 12:12 PM
To: Helvenston, Edward; Bobek, Leo
Subject: FW: password

2.72.6 PROCEDURE STEPS

2.72.6.1 Set Up

SWLD.STP.01

2.72.6.2 Start

None

2.72.6.3 Proceed and Measure

CONS-16

Fail 1) Connect the hardware per the Block Diagram in Figure 2 in Appendix 1 of Console System TEST PLAN.

__√_ 2) Power up the UPS

__√_ 3) Verify CCS PC automatically boots.

__√_ 4) Verify UIT PC automatically boots.

__√_ 5) Acknowledge error on chart recorded by pressing OK

__√_ 6) Wait for applications to start.

__√_ 7) Use using Alt-F8 on the CCS to view the CCS application. Verify CCS ap

__√_ 8) Use using Alt-F6 on the DAS to view the DAS application. Verify DAS ap

__√_ 9) Verify UIT has started.

__√_ 10) From the operator menu, select Login and log in using the user name 'ga "gatriga".

__√_ 11) From the blue box located in the top right corner of the graphics display, is logged in and an appropriate user ID is identified.

__√_ 12) Use the Acknowledge button to clear all alert and alarm messages.

Michael D. Muhlheim, Ph.D.
Reactor and Nuclear Systems Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

865-574-0386

Bobek, Leo

From: Gormley, Jerome <Jerome.Gormley@ga.com>
Sent: Friday, July 14, 2017 5:09 PM
To: Bobek, Leo
Cc: Hardesty, Duane (Duane.Hardesty@nrc.gov); Regan, Thomas
Subject: RE: Comment on T9S900D980-FME RevA NMP-1000 Failure Modes Effects Analysis.pdf

I have verified with my software team that the unused code was removed prior to final INL SW build and is thus removed in all product-released code, including the UMass system.
Jerry

From: Bobek, Leo [mailto:Leo_Bobek@uml.edu]
Sent: Tuesday, July 11, 2017 9:28 AM
To: Gormley, Jerome <Jerome.Gormley@ga.com>
Cc: Hardesty, Duane (Duane.Hardesty@nrc.gov) <Duane.Hardesty@nrc.gov>; Regan, Thomas <Thomas_Regan@uml.edu>
Subject: -EXT-FW: Comment on T9S900D980-FME RevA NMP-1000 Failure Modes Effects Analysis.pdf

Jerry,

Please see Duane's question regarding a unused code that was detected and subsequently removed as noted in 4.2.1.2 of the document:

T9S900D980-FME RevA NMP-1000 Failure Modes Effects Analysis.pdf

Duane would like to know if this unused code was removed from subsequent NMP-1000 units, specifically the one sold to UMass.

Thanks.

Leo

From: Duane Hardesty [mailto:commenting@dropboxmail.com]
Sent: Thursday, July 06, 2017 11:12 PM
To: Bobek, Leo
Subject: Comment on T9S900D980-FME RevA NMP-1000 Failure Modes Effects Analysis.pdf

T9S900D980-FME RevA NMP-1000 Failure Modes Effects Analysis.pdf
Comment by Duane Hardesty

View in Dropbox

unused codes were discovered.

Duane Hardesty at 10:52 PM

was this code removed in production sw (i.e., Lowell's delivery?

Bobek, Leo

From: Gormley, Jerome <Jerome.Gormley@ga.com>
Sent: Tuesday, June 20, 2017 3:16 PM
To: Bobek, Leo
Cc: Regan, Thomas
Subject: RE: RE: RE: General Atomics NMP-1000 manual submission
Attachments: NMP UMass mod.zip

Leo and Tom,
Just to clarify the NMP configuration, the unit GA shipped to UMass is identical to the manuals and the INL unit (except perhaps maximum compensating voltage, can't remember which variant you have). However, because UMass has natural and forced circulation modes, we worked with Tom to develop and test one possible solution to enable changing the trip setpoints, per attached docs sent 2/3/2014. This work was not done at GA so I am not sure of the status, and this work is not documented in our manuals at all and is unique to UMass.
Jerry

From: Bobek, Leo [mailto:Leo_Bobek@uml.edu]
Sent: Monday, June 19, 2017 9:57 AM
To: Gormley, Jerome <Jerome.Gormley@ga.com>
Cc: Regan, Thomas <Thomas_Regan@uml.edu>
Subject: -EXT-RE: RE: RE: General Atomics NMP-1000 manual submission

Jerome,

Related to same, I unofficially (using Dropbox) provided NRC's Duane Hardesty with the GA/INL documents related to the NMP and NLW installation at INL (see related message 10/18/16 below). Duane has found this information to be very useful for the preliminary reviews.

The documents in particular include:

T9S900D980-FME RevA NMP-1000 Failure Modes Effects Analysis
NMP-1000 SRS
NLX-1000 SRS
T9S900D940-SYR_RevA NMP-1000
T9S900D950-SYR_RevA NLX-1000

I also provided a scanned copy of the 1990's NMP1000 manual (NMP-1000 LPC E117-1017 Rev1).

To proceed with the NRC review of the NMP and NLW there are a couple of action items.

(1) Could you let me know if GA would accept UMass using the INL documents to apply to our licensing application?

(2) Could you also indicate that these documents are applicable to NMP and NLW units in possession by UMass (i.e., the units are identical to the ones used by INL)?

I can provide you access to the Dropbox so that you can see exactly which documents were unofficially provided and could be used in the formal licensing review.

Most of the documents are marked proprietary and are assumed to contain trade secret or confidential or privileged commercial information that should be withheld from public disclosure.

(3) In order for Lowell to request a formal review and to have NRC withhold the documents under 10 CFR 2.390 would GA be willing to do generate an affidavit for withholding per 10 CFR 2.390 (or alternately add these documents to the current affidavit; GA/EMS-4714, dated February 25, 2016)?

I know this may take some time to get through the GA legal department. Obviously, the sooner the better. Let me know if may provide anything that can assist.

Thank you!

Leo

From: Bobek, Leo
Sent: Monday, June 19, 2017 12:08 PM
To: 'Gormley, Jerome'; Corey Hines (cchines@wsu.edu); Stephen Miller; Regan, Thomas; Yusuf, Siaka (SO)
Subject: RE: RE: RE: General Atomics NMP-1000 manual submission

Hello to All,

It has been awhile since we last communicated on this. Some bad news, and some better news.

First the bad. The NRC has not done anything on the phase-0. There a number of reasons for this that are too lengthy for an email.

The better news is Lowell submitted a description of the NMP and NLW units in our relicensing SAR submitted to NRC in October 2015, anticipating we would have the OK to use the units by the time re-licensing was complete. We continue to use our old NMP and NLI amplifiers. However, an NRC relicensing site visit to Lowell last February triggered the need to review the new NMP and NLW as part of the relicensing. NRC recently has hired a contractor from Oak Ridge to assist with the reviews. Duane Hardesty has put this on his front burner.

In addition to making the review and approval for Lowell, Duane's goal is to update the I&C Interim Staff Guidance, using the experience from Lowell to help streamline the process for other facilities. I have committed to assist him with this, but unfortunately with my other relicensing RAIs, summer time-off, etc. it may be several months before anything is complete on the GA instrumentation reviews.

I will keep you posted.

As always, 50.59 is an option should you choose that method.

Best Regards,

Leo

Leo Bobek
University of Massachusetts Lowell
Radiation Laboratory
1 University Avenue
Lowell MA 01854
978-934-3365

From: Gormley, Jerome [mailto:Jerome.Gormley@ga.com]
Sent: Wednesday, October 19, 2016 12:52 AM
To: Bobek, Leo; Andrew T Smolinski; Corey Hines (cchines@wsu.edu); Stephen Miller; Regan, Thomas; Yusuf, Siaka (SO)
Subject: Re: RE: RE: General Atomics NMP-1000 manual submission

Excellent, thanks for the support all. Obviously GA will support as possible/necessary once the NRC questions start flying.
Jerry

From: Bobek, Leo <Leo_Bobek@uml.edu>
Sent: Tuesday, October 18, 2016 6:20 AM
To: Gormley, Jerome; Andrew T Smolinski; Corey Hines (cchines@wsu.edu); Stephen Miller; Regan, Thomas; Yusuf, Siaka (SO)
Subject: -EXT-RE: RE: RE: General Atomics NMP-1000 manual submission

To update you, INL has passed along all their QA documentation (about 350MB and 26 files). Andy and the folks at INL were very thorough. I'll need to sift through and filter the material for NRC, otherwise it make take them years to review it. I'll make the submittal through the UMass docket and keep you posted.

Leo

From: Gormley, Jerome [mailto:Jerome.Gormley@ga.com]
Sent: Tuesday, September 27, 2016 1:33 PM
To: Bobek, Leo; Andrew T Smolinski; Corey Hines (cchines@wsu.edu); Stephen Miller; Regan, Thomas; Yusuf, Siaka (SO)
Subject: RE: RE: RE: General Atomics NMP-1000 manual submission

He doesn't explicitly suggest but he mentions a Phase 0 below; I would go for that.

From: Bobek, Leo [mailto:Leo_Bobek@uml.edu]
Sent: Tuesday, September 27, 2016 10:31 AM
To: Gormley, Jerome <Jerome.Gormley@ga.com>; Andrew T Smolinski <andrew.smolinski@inl.gov>; Corey Hines (cchines@wsu.edu) <cchines@wsu.edu>; Stephen Miller <stephen.miller@usuhs.edu>; Regan, Thomas <Thomas_Regan@uml.edu>; Yusuf, Siaka (SO) <SOYusuf@dow.com>
Subject: -EXT-RE: RE: RE: General Atomics NMP-1000 manual submission

Jerry,

Did NRC suggest that a licensee should request a formal license amendment, or that a licensee should request an informal "phase-0"?

Thanks.

Leo

From: Gormley, Jerome [mailto:Jerome.Gormley@ga.com]
Sent: Tuesday, September 27, 2016 1:18 PM

To: Andrew T Smolinski; Corey Hines (cchines@wsu.edu); Bobek, Leo; Stephen Miller; Regan, Thomas; Yusuf, Siaka (SO)
Subject: FW: RE: RE: General Atomics NMP-1000 manual submission

All,

Per thread below, the bureaucratic morass continues…the NMP-1000 manual STILL is not in the right hands for NRC review. Apparently we need one of you folks (someone who has a license and a docket) to volunteer to be the first, then the rest can just reference the submission.

It should not be much work since I will send in following emails all the attachments and documents. There are a few larger files that would not go through the NRC filters when I first tried to send electronically so I will send you 5 emails with one attachment each.

Any volunteers?

Also, I know NRC said at TRTR that they would look at the INL/DOE deployment of said device; I believe UMass requested and received a pile of documents from INL related to that. If anyone else wants it, I guess start with Andy at INL or Tom at UMass.

Thanks all, we'll slowly stumble forward…

Jerry

From: Hardesty, Duane [mailto:Duane.Hardesty@nrc.gov]
Sent: Friday, September 23, 2016 2:08 PM
To: Gormley, Jerome <Jerome.Gormley@ga.com>
Subject: -EXT-RE: RE: RE: General Atomics NMP-1000 manual submission

Glad that helped.
I should also point out that the facility that does submit should also cc: their facility PM, too.

Lowell- Spyros Traiforos
WSU – Xiaosong Yin
AFRRI – Cindy Montgomery

From: Gormley, Jerome [mailto:Jerome.Gormley@ga.com]
Sent: Friday, September 23, 2016 5:03 PM
To: Hardesty, Duane <Duane.Hardesty@nrc.gov>
Cc: Adams, Alexander <Alexander.Adams@nrc.gov>
Subject: [External_Sender] RE: RE: General Atomics NMP-1000 manual submission

OK, great, thanks Duane, that helps a lot as I'm a newbie at this aspect of the process.

I will have to go through my licensing folks first but I think it makes sense to have another (probably UMass) submit.

I'll keep you updated.

Best regards,
Jerry

From: Hardesty, Duane [mailto:Duane.Hardesty@nrc.gov]
Sent: Friday, September 23, 2016 1:44 PM
To: Gormley, Jerome <Jerome.Gormley@ga.com>
Cc: Adams, Alexander <Alexander.Adams@nrc.gov>
Subject: -EXT-RE: RE: General Atomics NMP-1000 manual submission

Jerome:
I received the following via email:

(1) Request by GA to withhold information under 10 CFR 2.390 [4714 Letter for GA EMS Affidavit_JG_1.pdf]
(2) 4714 Enc 2_Clean. Pdf (Proprietary version)
(3) 4714 Enc 3_Marked (proprietary version marked for redaction)
(4) 4714 Enc 4_Redacted Redacted version of item (2), above

Because you addressed your initial submission to "whom it may concern" at the Document Control Desk without any reference to a docket number or indication of who the receiving individual (indicated by cc:) should be, I suspect this went into the dead letter office?

You are correct in that GA has to initiate the request and affidavit for withholding as the owner of the information, however, by you (GA) submitting it directly, you are, in a sense, asking for a tropical report (or standard design approval) review, for which I must bill you NRC fees. I am fairly certain that was not your intention.

The other problem is, as submitted, it appears to be unsolicited information. If this is for WSU, Lowell, and AFRRI, one of them should submit it to their docket. Their cover letter should state that they are submitting information to NRC for consideration in connection with NRC licensing or regulatory activities; i.e., a Phase 0 review, an amendment, etc., whatever it is intended to support. Note: All three facilities do not have to submit—only one. Once one of them submits it, the other two can simply reference the ADAMS accession numbers assigned to these submitted documents, when needed.

So, my suggestion is to send the information you sent me to one of the named facilities (i.e., AFRRI, WSU, or Lowell) and have them associate it with their docket with a cover letter and reason for submittal and they send it to Document Control Desk. {*You don't have to otherwise modify anything you did or wrote, so long as they put the facility-specific cover letter on it first when submitting (with me as cc:*).}

I hope that helps. If you have any questions, please feel free to contact me (301-415-3724) or Al Adams (301-415-1127).

Thank you,
Duane

Duane A. Hardesty
Sr. Project Manager - Research & Test Reactors
U.S. Nuclear Regulatory Commission
MS O-12D20
Washington, DC 20555
Phone: (301) 415-3724
fax: (301) 415-1032

From: Gormley, Jerome [mailto:Jerome.Gormley@ga.com]
Sent: Friday, September 23, 2016 2:26 PM

To: Hardesty, Duane <Duane.Hardesty@nrc.gov>
Subject: [External_Sender] RE: General Atomics NMP-1000 manual submission

Duane,

Can you or other staff confirm that you received the referenced manual? We have 3 current and 2 pending customers waiting for review…

Thanks,
Jerry

From: Gormley, Jerome
Sent: Wednesday, August 24, 2016 3:09 PM
To: Duane A. Hardesty (Duane.Hardesty@nrc.gov) <Duane.Hardesty@nrc.gov>
Subject: General Atomics NMP-1000 manual submission

Duane,

I was just informed second-hand that you had not received our manual submission yet…my apologies, it looks like our bureaucracies got the best of us. Per attached we sent it, and it was received by NRC, on 3/1/2016…let me know if you need more info to find the package or need it resent.

Thanks,
Jerry

Jerome E. Gormley, Ph.D.
General Atomics
Electromagnetic Systems Group (GA-EMS)
858-964-6957 work phone
858-524-9608 mobile phone
16530 Via Esprillo
San Diego, CA 92127

DETAILED SPECIFICATIONS FOR NUCLEAR INSTRUMENTATION

1.0 Introduction

The University of Massachusetts seeks to purchase the following Nuclear Instrument channel:

1. Wide Range Neutron Flux Monitoring System:
   - Unguarded Fission Chamber Detector Assembly
   - Cables
   - Signal Processor/Monitor

The channel shall include everything required for operation including connectors, pre-amplifiers, power supplies and all signal processing electronics.

Specific requirements are presented below. Section 2.0 presents generic requirements for the system while Section 3.0 provides detailed specifications for the detector and cable assemblies and Section 4.0 provides detailed specifications for the Monitor.

2.0 Generic Requirements

These requirements pertain to the system:

1. Each system shall be composed entirely of analog circuitry. No micro-processor based circuits are allowed. With the exception of LCD displays, no digital signal processing will be considered. The bid shall have a statement to this effect.

2. All electronics, including power supplies and preamplifiers, for each channel shall be contained in a single 19 inch wide instrument drawer.

3. Compatible cables and connectors shall be provided to connect between the Unguarded Fission Chamber Detector Assembly and the Signal Processing Drawer described herein. The cables must reach at least 110 feet and transmit the signals and high voltage in a clean, noise free fashion.

4. Spare connectors for each drawer connection are to be provided.

5. The purchaser intends to install this equipment under

10CFR50.59. The manufacturer shall provide an explanation of the ability to satisfy this requirement.

6. All equipment shall be powered by standard 117 volt unregulated AC power.

7. Complete manuals and documentation shall be provided for each piece of equipment. The manuals shall include a complete description of the equipment, installation procedures, theory of operation, drawings and schematic diagrams, routine testing and calibration procedures, regular maintenance procedures, and proper use and operation procedures. Errors found in the manuals are to be remedied by the vendor. The manuals are to be clearly written and understandable to the purchaser and shall be in the English language.

8. The vendor shall commit to providing earnest support with regard to equipment-related questions that may arise during the review and approval process for installing the new equipment.

3.0 Detailed Requirements for the Detector and Cable Assemblies

A single unguarded fission chamber shall be housed in a water-tight aluminum housing designed specifically for mounting within a pool-type research reactor with stainless steel flexible metal conduit covering a standard organic insulated coaxial cable assembly. The detector housing and aluminum standpipe configuration will house the detector and coaxial signal cable to the top of the reactor pool. The detector assembly will be electrically isolated from plant ground with insulators. The specifications of the detector and cable assembly are provided below.

Type: Fission Chamber, Unguarded
Active Length: 8.8 inches
Sensitivity: 0.18 cps/nv
Detector Housing: 1.5" O.D., 31" length, Aluminum
Cable: (110 feet to control room) Coaxial cable, housed in rigid Schedule 40 Aluminum Pipe, 1/2" diameter, 6 foot lengths, with flexible stainless steel hose protecting the cable at the top of the pool.

4.0 Detailed Requirements for the Wide Range Signal Processor

The Wide Range Logarithmic Monitor shall be compatible with the Unguarded Fission Chamber Detector Assembly and

interconnecting cables to be provided as specified above.

The unit shall monitor reactor power from a cold shutdown to 200% full power (approximately 10 decades). The channel shall also monitor reactor period.

4.1 General

The drawer shall:

1) be powered from standard 117 VAC unregulated power. (all UMLRR Nuclear Instrumentation is powered by Smart UPS).
2) contain all electronics required for operation including the fission chamber high voltage power supply and pre-amplification stages.
3) Range: 10 decades minimum.

4.2 Monitored Parameters

The drawer shall monitor the following parameters:

1) Source Range Level from 0.1 to 10^5 cps and Reactor Period from -30 to +3 seconds.
2) Wide Range Level from 10^{-8} to 200 % and Reactor Period from -30 to +3 seconds.
3) Power Range Level (Linear) from 0 to 125% full power.

4.3 Displays

The following parameters shall be displayed on the front panel of the instrument drawer:

1) Source Range Level and Reactor Period
2) Wide Range Level and Reactor Period
3) Power Range Level (linear)
4) Trip Setpoints

Each parameter shall be clearly displayed and easy to read. The local displays shall be segmented LCD dual bargraph displays for the monitored variables and the alarm setpoints, and numeric (digital) LCD displays shall be provided on top of the appropriate bargraphs for the monitored variables only. The left bargraph shall show the magnitude of the measured variable and the right bargraph shall show the bistable trip setpoint. Detailed display requirements are presented in the subsections below.

4.3.1 Source Range Level

a) The Source Range Level shall be clearly labeled on a Logarithmic Display over a range of 6 decades to ensure readability. The display shall cover the range of 0.1 to 10^5 cps.

b) The Source Range Level display shall have resolution sufficient to clearly identify an approximate doubling in count rate within any decade.

4.3.2 Wide Range Level

a) The Wide Range Level shall be clearly labeled on a Logarithmic Display over a range of 10 decades to ensure readability. The display shall cover the range of 10^{-8} to 200 %.

b) The Wide Range Level display shall have resolution sufficient to clearly identify an approximate doubling in count rate within any decade.

4.3.3 Reactor Period

a) The Reactor Period shall be clearly labeled to ensure readability. The display shall cover the range of -30 to +3 seconds.

b) There shall be two separate period indications; one to cover the Source Range Level and the other to cover the Wide Range Level. (During start-ups, reactor power may be below the Wide Range Level, and the only reliable Period signal is coming from the Source Range Level.)

4.3.4 Power Range Level

a) The Power Range Level shall be displayed on a linear scale over a minimum range of 0 to 125% full power.

b) The Power Range Level display shall be clearly labeled to ensure readability.

4.3.5 Trip Setpoints

a) Trip point(s) shall be displayed adjacent to its respective parameter and shall be labeled identical to the parameter (as described in the sections above) by

using dual bargraph displays.

b) If more than one trip point is associated with a particular parameter, each trip point may be displayed (one at a time) for that parameter by depressing a switch to select which parameter trip point is to be displayed.

c) A display to indicate drawer operate mode versus test mode shall be provided.

4.4 Outputs

The following outputs shall be provided on the rear panels of the signal processing drawers:

1) A ~~0 to 10 volt~~ 4-20 ma analog output signal to drive strip chart recorders. This signal shall be proportional to the monitored parameter (Source Range Level and Period, Wide Range Level and Period, and Power Range Level). This output signal shall cover the entire range of the monitored parameter and shall be buffered. The actual voltage output span may be different provided an additional circuit is provided to convert the voltage span to the required 0 to 10 V necessary to run the strip chart recorders.

2) Buffered TTL level pulse output shall be provided. This output shall provide one pulse out for each fission chamber pulse received (used to drive a Timer/Scaler or Audilble Count Rate Drawer).

3) Trip signals (see 4.5 below).

4) Three separate isolated outputs, to be used for experimental student data collection and research, shall be provided. The unit will have the capability of housing up to six isolators. The isolated outputs shall provide a ~~0 to 10 V~~ 4- 20 ma output.

4.5 Trips

1) The Wide Range Log Monitor shall have room for four bistable trip circuits, or a total of eight trips (specify how many are needed).

2) Bistable trip circuits shall be provided to handle the trip set points described in Item 4) below. These

trip circuits shall be jumper selectable and adjustable over the entire range of monitoring.

3) Trips must be Form C relay contacts. Each trip relay must actuate upon a trip signal or loss of power. Relays shall be capable of handling 1/2 amp loads at 117 VAC.

4) Adjustable bistable trip signals for the following parameters shall be provided and preset by the vendor.

   a) Count rate less than 3 counts per second.
   b) Forced convection Linear Reactor Power greater than 110 %.
   c) Forced convection Linear Reactor Power greater than 115 %.
   d) Reactor Period less than 15 seconds.
   e) Reactor Period less than 7 seconds.
   f) Non-operate (test mode) trip.
   g) Malfunction trip (loss of drawer power, loss of fission chamber high voltage, loss of drawer power supply).
   h) Intermediated Natural convection Linear Reactor Power greater than 11 %. (UML provides 5 volt ttl signal, normally closed, to initiate this mode).

5) Clear written procedures shall be provided for setting and verifying the trip setpoints.

6) Trip set points shall be conveniently set and verified.

4.6 Self-Test Circuitry

1) Self-test circuitry and internal test signals shall be provided such that each trip set point may be easily verified during the daily pre-start-up instrument check.

2) Self-test circuitry and internal test signals shall be provided such that the operability of each measured parameter may be easily verified by the introduction of a test signal.

4.7 Accuracy and Linearity

1) Source Range Level = ± 2%
2) Wide Range Level = ± 1%
3) Reactor Period = ± 2%
4) Power Range Level = ± 1%

(All accuracies are stated as equivalent linear full scale.)

4.8 Temperature Drift

1) Source Range Level = 0.05%/°C
2) Wide Range Level = 0.04%/°C
3) Reactor Period = 0.05%/°C
4) Power Range Level = 0.04%/°C

4.9 Response Times

1) Source Range Level:

0.1 to 1.0 CPS	28.0 Sec
1.0 to 10.0 CPS	5.6 Sec
10 to 100 CPS	1.1 Sec
100 to 1000 CPS	147.0 mSec
10^3 to 10^4 CPS	16.3 mSec
10^4 to 10^5 CPS	6.5 mSec

2) Wide Range Level:

10^{-8} to 10^{-7}%	28.0 Sec
10^{-7} to 10^{-6}%	5.6 Sec
10^{-6} to 10^{-5}%	1.1 Sec
10^{-5} to 10^{-4}%	147.0 mSec
10^{-4} to 10^{-3}%	16.3 mSec
10^{-3} to 10^{-2}%	6.5 mSec
10^{-2} to 10^{-1}%	9.1 mSec
10^{-1} to 10^{-0}%	8.5 mSec
10^{+0} to 10^{+1}%	9.5 mSec
10^{+1} to 10^{+2}%	9.2 mSec

3) Reactor Period = 3.2 sec
4) Power Range Level = 50.0 msec
5) Bistable Trip = 5.0 msec

5.0 SPARE PARTS TO BE INCLUDED
1) one Preamplifier board
2) one Bistable Trip board
3) one Analog Output board

TRP-1029-23
DE-FOA-0000322

NMP-1000 MULTI-RANGE LINEAR POWER MONITOR

PRICE PROPOSAL

Prepared for
University of Massachusetts - Lowell
Radiation Laboratory
Lowell, MA

from
General Atomics Electronics Systems, Inc. (GA-ESI)
TRIGA Reactors

28 SEPTEMBER 2010

GENERAL ATOMICS
ELECTRONIC SYSTEMS

GENERAL ATOMICS
ELECTRONIC SYSTEMS

TRP-1029-23
28 September 2010

Radiation Laboratory
University of Massachusetts Lowell
1 University Avenue
Lowell, MA 01854

Attention: Mr. Tom Regan

Subject: NMP-1000 Multi-Ranger Linear Channel

Reference: DOE funding opportunity: DE-FOA-0000322

Dear Mr. Regan:

General Atomics Electronic Systems, Inc. (GA-ESI) is pleased to submit this proposal in response to the referenced funding opportunity. GA-ESI proposes to supply the NMP-1000 Multi-Ranger Linear Channel over a 12-month period under a firm-fixed-price (FFP) contract. The price for the proposed NMP-1000 Multi-Ranger Linear Channel is $[redacted]0.

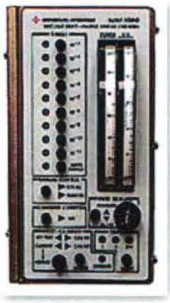
Please contact the undersigned, Program Manager, at (858) 522-8229 (voice) or roy.ray@ga-esi.com (e-mail). Please direct questions on cost or contractual matters to Jeanette Porter, Senior Contract Administrator, at (858) 522-8405 (voice) or jeanette.porter@ga-esi.com (e-mail).

Sincerely,

Roy E. Ray

Roy E. Ray
TRIGA Reactor Program Manager

NMP-1000



The NMP-1000 is an analog, wide range, linear current mode module with range switching. Ranges may be selected either manually or automatically, locally or remotely. Full scale sensitivities from 1 x 10^{-11} to 1 x 10^{-3} A are provided with indication of percent power on a front panel meter, as well as a front panel LED indication of each decade range. For remote operation, a separate panel assembly can be provided with identical range indicating LEDs, display of current and voltage, as well as channel self test functions. Compensation voltage as well as adjustable high voltage power supplies are provided in the module to allow operation with most existing current mode detectors.

SPECIFICATIONS

NMP-1000 LOG WIDE-RANGE CHANNEL

INPUT RANGE	10^{-11} to 10^{-4} A or 10^{-10} A to 10^{-3} A in seven one decade ranges Self-bailing illuminated pushbutton or automatic range switching (manual or auto operator selected). Provision for remote range switching	
LINEARITY (LOG CONFORMITY) + 1% OF THE LINEAR	± 1.0% of full scale upper 5 ranges; ±2.5% of full scale lower 2 ranges	
TEMPERATURE COEFFICIENT	± 0.15% per °C maximum over 10° to 55°C	
CALIBRATION/TEST	2 fixed currents for calibration, 1 adjustable current for multi-range function test and trip testing. HV trip test, test modes selected sequentially by front panel control	
RESPONSE TIME CONSTANTS	1 msec 10^{-8} to 10^{-3} A, 10 msec 10^{-9} to 10^{-8} A; 100 msec to 10^{-11} to 10^{-9}	
OUTPUTS	Remote Meter: 0–10 V full scale Remote Meter: 0–1 mA full scale Recorder: 0–0.1 V full scale	Recorder: 0–1.0 V full scale Optional: 4.0–20 mA full scale High Voltage: +300 to +800 VDC @2.6W Compensation: 0 to–150VDC
BISTABLE TRIPS	High voltage High power level Low power level Period	Adjustable with +5 V logic level and two form C contacts per trip
POWER REQUIRED	117 VAC ± 10% 50/60 Hz @ 1.0 A	

GENERAL ATOMICS
ELECTRONIC SYSTEMS

25 January 2011

University of Massachusetts/Lowell
Purchasing Department
Dugan 200
883 Broadway Street
Lowell, MA 01854-5105

Attention: Ms. Lynne Winnett, Procurement

Subject: Purchase Order 0005232150 Acceptance

Reference: GA-ESI Rough Order Magnitude (ROM) TRP-1029-23
dated 28 September 2010

Dear Ms. Winnett:

General Atomics Electronic Systems, Inc. (GA-ESI) has reviewed the subject Purchase Order for components to the University of Massachusetts/Lowell for the Multi range Linear Channel and accepts the Purchase Order with the following exception:

University of Massachusetts/Lowell PO Terms and Conditions as revised and attached as an enclosure to this correspondence letter.

We request that you review and accept these terms, in writing, prior to GA-ESI processing this order.

If you have any technical questions, please contact Roy Ray at 858-522- 8229. If you have any questions regarding this matter, please contact me 858-522-8211 or e-mail at Debra.Dawson@ga-esi.com.

Sincerely,

Debra Dawson

Debra Dawson
Contracts Administrator

Enclosure: As Noted

cc: R. Ray

TRP-1129-21

NLI-1000 INTERMEDIATE RANGE POWER MONITORING CHANNEL
&
NMP-1000 MULTI RANGE LINEAR POWER MONITORING CHANNEL

ROUGH ORDER OF MAGNITUDE

Prepared for
University of Massachusetts - Lowell
Radiation Laboratory
Lowell, MA

from
General Atomics Electronics Systems, Inc. (GA-ESI)
TRIGA Reactors

23 SEPTEMBER 2011

GENERAL ATOMICS
ELECTRONIC SYSTEMS

GENERAL ATOMICS
ELECTRONIC SYSTEMS

TRP-1129-21
23 September 2011

Radiation Laboratory
University of Massachusetts Lowell
1 University Avenue
Lowell, MA 01854

Attention: Mr. Tom Regan

Subject: NLI-1000 Intermediate Range Power Channel & NMP-1000 Multi Range Linear Power Channel

Dear Mr. Tries:

General Atomics Electronic Systems, Inc. (GA-ESI) is pleased to provide this rough order of magnitude (ROM). GA-ESI proposes to supply the NLI-1000 Intermediate Range Power Channel and NMP-1000 Multi Range Linear Channel within a 6 month period. The price is estimated to be $[redacted].

Contact the undersigned, Program Manager, at (858) 522-8229 (voice) or roy.ray@ga-esi.com (e-mail). Please direct questions on cost or contractual matters to Yvette Lewis, Contracts Administrator, at (858) 522-8337 (voice) or Yvette.lewis@ga.com (e-mail).

This is not an offer to contract, terms and conditions will be negotiated.

Sincerely,

Roy E. Ray
TRIGA Reactor Program Manager

Purchase Order

CHANGE ORDER - REPRINT Dispatch via Print

Purchase Order	Date	Revision	Page
0005232150	12/06/2010	1 - 12/07/2011	1

Payment Terms	Freight Terms	Ship Via
Net 30	FOB Destination	Best Way

Contact:	Phone	Currency
WINNETT, LYNNE	978/934-3366	USD

UMass Lowell
Wannalancit Business Center, Rm. 415
One University Avenue
Lowell MA 01854
United States

Vendor: 0000090767
GENERAL ATOMICS ELECTRONIC SYSTEMS
4949 GREENCRAIG LN
SAN DIEGO CA 92123

Ship To: Attn: Research Administration
UMass Lowell - Pinanski Building
One University Avenue
205 Riverside Street
Lowell MA 01854
Building: PINANSKI HALL
Floor: 00
Room: 000

Bill To: University Of Mass / Lowell
Dugan Hall 200
883 Broadway Street
Lowell MA 01854
United States

Tax Exempt? Y Tax Exempt ID: 043167352

Line-Sch	Description	Quantity	UOM	PO Price	Extended Amt
1- 1	NMP-1000 MULTI RANGE LINEAR CHANNEL (REF# TRP-1029-23)	2.00	EA		[redacted]
	Item Total				
2- 1	NLI-1000 INTERMEDIATE RANGE POWER CHANNEL	1.00	EA		[redacted]
	Item Total				

Total PO Amount [redacted]

All shipments and invoices must be identified with our PO number.
Overshipments will not be accepted unless authorized prior to shipment.

SEE REVERSE SIDE OR FAX COVER SHEET FOR
UNIVERSITY TERMS AND CONDITIONS

Authorized Signature
Signature not required on this order. It has been electronically approved.

From: Gormley, Jerome <Jerome.Gormley@ga.com>
Sent: Friday, February 14, 2014 11:13 AM
To: Regan, Thomas
Subject: FW: UMASS LOWELL

Tom,
Your NMPs are on their way per below. Of course, given the weather, who knows when they'll show up!

I'll have an RMA for you on the NLW+PA+FC soon.

Stay warm and safe!

Jerry

From: Browning, Linda
Sent: Friday, February 14, 2014 7:55 AM
To: Gormley, Jerome
Subject: UMASS LOWELL

TRACKING# 1Z 976 972 03 5211 9603 UPS GROUND SHIPPED 2/13/2014

Linda Browning
General Atomics Electronic Systems, Inc.
(858) 522-8423
linda.browning@ga-esi.com

Bobek, Leo

From: Hines, Corey <cchines@wsu.edu>
Sent: Wednesday, November 4, 2015 4:44 PM
To: Bobek, Leo
Cc: Wall, Donald
Subject: RE: GA NMP1000

Leo,

We would be interesting in pursuing Phase 0 review with you all and the NRC for the new GA channels. The new NMP-1000 seems as good a place as any to start.

We just found out at TRTR that the NMP-1000 is "half digital," whatever that means. I was under the impression we were getting direct replacements for our analog NMP-1000, but turns out that is not the case. We might need to get some more documentation from GA, including their (almost assuredly) proprietary software later down the road for the NRC to sign off on.

In short, yes we would like to help as well in order to get these reviewed. Let us know how we can help going forward.

Thanks,

Corey

C. Corey Hines
Assistant Director, Reactor Operations
Nuclear Radiation Center
Washington State University
Pullman, WA 99164-1300
(509) 335-8317

From: Wall, Donald
Sent: Tuesday, October 27, 2015 6:46 AM
To: Hines, Corey <cchines@wsu.edu>
Subject: FW: GA NMP1000

This could be useful for all of us.
D.

From: Bobek, Leo [mailto:Leo_Bobek@uml.edu]
Sent: Tuesday, October 27, 2015 5:17 AM
To: Wall, Donald; Miller, Stephen
Cc: Regan, Thomas
Subject: GA NMP1000

Don, Steve:

Are either of you interested in collectively approaching NRC for a "Phase 0" discussion to start the approval process for using the new GA NMP 1000 module?

We have included the NMP 1000 in the updated SAR for our re-licensing application submitted to NRC last week. If history is a predictor, the re-licensing will take a year or two, or longer. I would like to have NRC look at the NMPs separately and perhaps issue an OK sooner in case we need to use them.

Might be helpful and quicker if NRC knows there are multiple facilities trying to incorporate the new modules.

Let me know your thoughts.

Thanks.

Leo

Leo Bobek
University of Massachusetts Lowell
Radiation Laboratory
1 University Avenue
Lowell MA 01854
978-934-3365

Bobek, Leo

From: Bobek, Leo
Sent: Monday, November 9, 2015 8:48 AM
To: 'Hardesty, Duane'
Cc: Traiforos, Spyros
Subject: RE: [TRTR-list] NRC Instrumentation and Control Kiosk at 2015 annual TRTR Meeting

Hello Duane,

A few licensees (AFRRI, WSU, UMass) would like to update our General Atomics power monitors. (UMass is not a TRIGA, but we have used GA power monitors since the mid-1990's). The new version of the GA NMP1000 Multi-Range Linear channel uses a microprocessor for automatic range switching.

Both UMass and WSU have received delivery of the new units; however, neither of us plan to install them until we have a "Phase-0" discussion.

AFRRI has a meeting with GA this week and UMass is looking to have a conference call with them.

My question is what information do you need for a Phase-0 discussion/meeting? Also scheduling?

Thanks.

Leo

Leo Bobek
University of Massachusetts Lowell
Radiation Laboratory
1 University Avenue
Lowell MA 01854
978-934-3365

From: trtr-list [mailto:trtr-list-bounces@ecn.purdue.edu] **On Behalf Of** Hardesty, Duane
Sent: Monday, September 28, 2015 5:23 PM
To: trtr-list@ecn.purdue.edu
Subject: [TRTR-list] NRC Instrumentation and Control Kiosk at 2015 annual TRTR Meeting

For those attending the TRTR conference, Norbert Carte, Sr. Technical Reviewer in Division of Engineering, Instrumentation and Control Branch, will be sitting at a table in the exhibit area to answer questions on instrumentation and control updates, upgrades, modifications, etc. on Monday, Tuesday*, and Wednesday* during the TRTR conference.

Please stop by and discuss the Interim Staff Guidance on instrumentation and control, pre-application (phase 0) meetings, and other items of interest in the areas of instrumentation and control for your facility. Your questions will be useful to inform the larger audience on topics of interest and concern in I&C that we can discuss during the panel session on Tuesday.

The hour-long panel on Tuesday will be held during NRC-day for you to ask questions of Norbert, Duane, Al, John, and Patrick.
Norbert and Duane have been the POCs for the ISG and Phase 0 reviews, Al will add the supervisory and historical perspective, Patrick will add his perspective as a PM currently managing an I&C upgrade, and John will provide the inspector perspective.

* Except during NRC day presentations and public meeting

Duane A. Hardesty
Sr. Project Manager - Research & Test Reactors
U.S. Nuclear Regulatory Commission