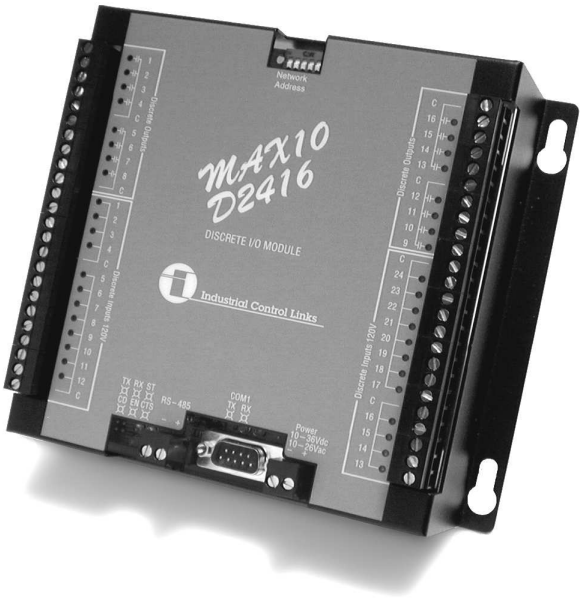
Technical Reference Manual

MAXIO DIO

Distributed Discrete I/O Module



- 24 optically isolated Discrete Inputs
- 12/24V and 120/240V (DI) models
- 4 Discrete Inputs support high-speed pulses and encoders (> 5KHz)
- 16 10A Relay Outputs
- Support for Modbus RTU, BrickNet peer-to-peer, and DF1 communications
- Back-to-back I/O bridge – Master Mode
- Dual serial ports; RS-232/485 and internal radio or 2nd RS-232/RS-485 port
- Modular I/O Expansion to 10,000 points over 5,000ft.
- Built-in transition, rate and runtime totalizers
- Store & Forward repeating extends the reach of wireless systems
- 10 to 36Vdc, 10 to 26Vac power; use low-cost transformers
- LED I/O status indicators
- COM and CPU watchdog timers
- Programmable Power Management
- -40oC to +75oC Operating Temperature Range
- 3-year factory warranty

MAXIO DIO

Technical Reference Manual

Copyright Notice

Acknowledgments

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In This Manual . . .

This manual provides the technical hardware information required for system design and installation of MAXIO DIO modules.

If you have just purchased a MAXIO DIO module, we hope that you are as pleased using it as we have been developing it.

If you are reading this manual looking at a future purchase, we hope that you will consider a MAXIO I/O module when you have an application that needs rugged I/O expansion or distributed discrete inputs and outputs.

Support

If you have questions or need help with an application, we hope that you'll take advantage of our free technical support. Simply call us at:

(800) 888-1893

If you need to send us a fax, use either:

(530) 888-1300 or (530) 888-7017

If you prefer e-mail, especially if you want to send us a sample of a program or other files, you can e-mail us at:

support@www.iclinks.com

For additional technical information including datasheets, manuals and software, visit our web site at:

www.iclinks.com

Certifications

EtherLogic Advanta is tested to the following certifications:

North America:

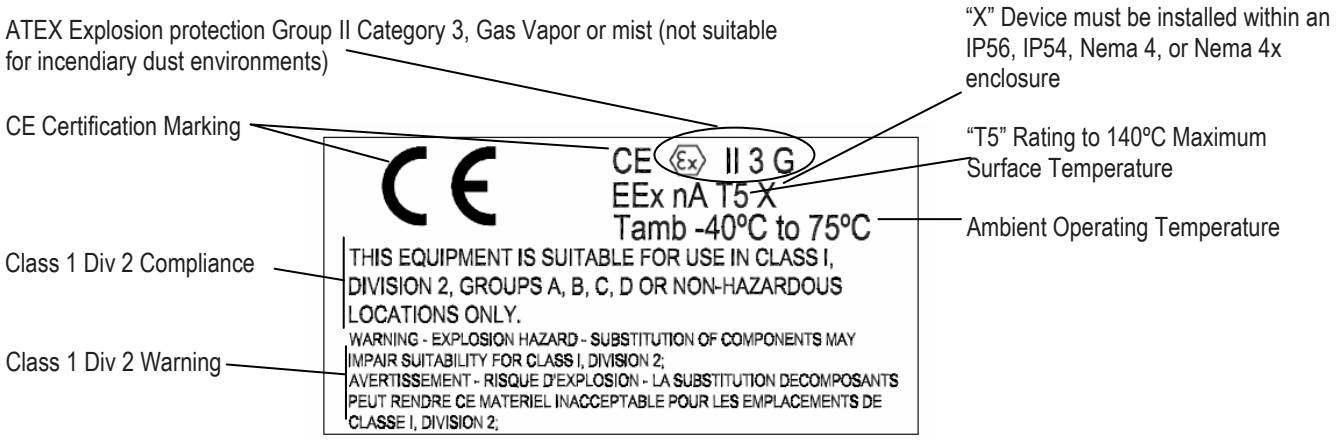
UL 508, CSA 142, ANSI/ISA-12.12.01-2000: April , CSA-C22.2 NO. 213-MI987 (R 1999); Class I Division 2 Groups A, B, C, and D: by INTERTEK.

European Union:

EN 60079-15: Sept 2003 ATEX Group II Category 3 Gas Vapor or Mist Explosion protection

Protection Type nA: In normal and some abnormal conditions, the equipment is not capable of igniting an explosive gas atmosphere.

All certified Etherlogic models come with the following compliance marking tag.



Contents

Introduction

MAXIO DIO modules are easy-to-use distributed discrete input/output (I/O) devices used for industrial and municipal monitoring and control. These modules can be interconnected with ScadaFlex or EtherLogic controllers for I/O expansion, connected to Programmable Logic Controllers (PLCs) or PC computers as rugged field I/O, or used with radios or leased-line modems to serve as low-cost Remote Terminal Units (RTUs).

MAXIO DIO modules provide 24 Discrete Inputs and 16 Discrete Outputs, . These modules come two base configurations, with either 12/24V or 120V Discrete Inputs. Four of the discrete inputs have user configurable filtering, that when disabled, allows the MAXIO module to respond to DC pulse signals in excess of 5KHz for high speed counting. These inputs may also be configured to support quadrature shaft encoders.

Modular I/O Expansion

MAXIO modules provide a very modular means of adding I/O capacity as needed, without the extra cost, wasted space and constraints of card racks. Need more I/O? Pop in a module. Want to add some inputs and outputs a few hundred yards away? String a single twisted pair of wires to a remote MAXIO module and you're up and running!

Built-in Networking

MAXIO modules come network-ready with a dual-function, RS-232 and RS-485 serial communications interface. The RS-485 port can be used for low-cost 2-wire networking, with up to 254 modules distributed over 5,000 ft. The RS-232 port provides a simple point-to-point interface to radios and modems as well as PCs. An optional second RS-232/RS-485 interface may be ordered for the internal serial port, supporting redundant communications networks in high "uptime" systems.

Wireless I/O

MAXIO modules may be ordered with a choice of internal 900MHz or 2.4GHz spread spectrum radios. Going wireless gives MAXIO modules a range of 10 to 20 miles, or even further using the built-in store & forward repeater feature. Adding an internal radio does NOT disable the RS-232/RS-485 interface, so a local PC or HMI panel can access the I/O module simultaneous with radio communications; ideal for system installation and testing!

Open Architecture

MAXIO modules support the Modbus RTU protocol, one of the most common protocols used in control systems. This protocol is supported by thousands of other hardware and software products including all of the common PC-based

MMI software packages from manufacturers such as Wonderware, Intellution, Iconics, and National Instruments.

Peer-to-peer Communications

For true peer-to-peer operation MAXIO modules support ICL's BrickNet protocol for use with ICL EtherLogic and ScadaFlex Plus controller families. Protocol detection between Modbus and BrickNet is automatic.

Back-to-back I/O bridge – Master Mode

MAXIO modules support a back-to-back I/O mirroring operation. This "Master mode" feature allows for the inputs on one module to be mirrored as outputs on a remote module, and visa versa. This setup is designed to work with only a two-unit network.

Local I/O Processing

MAXIO modules perform local I/O processing to off-load time-sensitive operations from a Host system.

MAXIO DIO modules totalize input transitions and runtime, and calculate pulse rates for every input. Applications include using digital pulse output meters for precise totalized flow and wattage calculations, as well as real-time flow rate and power usage information. Runtime is widely used for wear leveling between pumps or motors, and as the basis of an equipment preventive maintenance program. These modules can also be commanded to flash individual outputs at a precise periodic rate independent of communications and I/O scan rates, primarily for visual alarm annunciation.

Wide Power Range and Low Power Operation

MAXIO modules are designed for use in solar and battery backed applications. They operate over a wide range of AC and DC power and have built-in features to minimize their power usage. For example, the bright LEDs used to indicate the state of each of the inputs and outputs can represent a significant portion of the modules power consumption. The host controller can instruct the MAXIO module to disable the status LEDs when they are not needed, saving a significant amount of power.

Rugged I/O

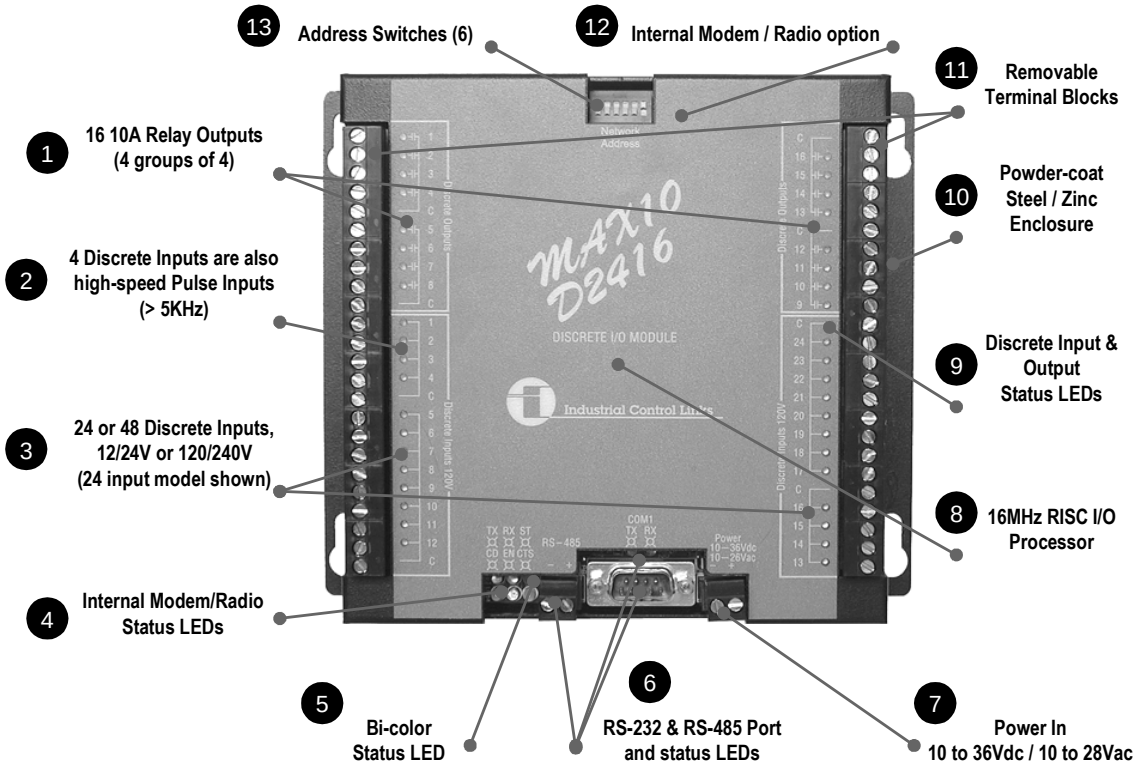
All Power, I/O and communications interfaces are protected against over-loads, transients, surges, and reverse polarity. Self resetting polymer fuses are used extensively, so that when the fault condition is corrected, the module automatically resumes normal operation.

Industry Leading Warranty

MAXIO modules are backed by an industry leading 3-year factory warranty.

MAXIO DIO Familiarization

The diagram below highlights the main physical features of the MAXIO DIO Module that are discussed in the remainder of this manual.



1 6 10-amp Relay Outputs

MAXIO DIO modules have heavy-duty relay contacts rated for 10 amps, up to 240V AC, and 5 amps, up to 30Vdc. The relay outputs are arranged in groups of 4 (maximum combined current for any group is 15 amps).

2 4 High-speed Pulse/Encoder Inputs

Four of the MAXIO DIO Discrete Inputs have software configurable filtering. When filtering is minimized on these inputs, the module can count pulses at rates exceeding 5KHz. These inputs may be used in pairs to support up to two quadrature shaft encoders in motion control and mobile applications.

3 24 Discrete Inputs, 12/24V or 120240V

MAXIO DIO modules come with 24 discrete inputs that can be ordered for use in either 12/24V or 120/240V control systems.

4 Internal Radio/2nd Serial Port Communications Status LEDS

Transmit and Receive Data LED indicators show network communications activity to confirm operation and

assist in system troubleshooting.

5 Bi-color Status LED

A bi-color status LED shows that the module is powered and operating normally (green) or has shut down the outputs because of a communications link failure (red). The LED flashes (red or green) when the I/O Status LEDs have been disabled.

6 RS232 and RS-485 Main Communications Port

MAXIO I/O modules have a dual interface primary communications port; RS-232 for short connections to PCs and external modems/radios, and RS-485 for low-cost 2-wire networking up to nearly a mile.

7 Wide Range AC/DC Power

MAXIO I/O Modules accept AC power (10 to 26V) or DC power (10 to 36V). The internal power is regulated and transient protected, so low-cost power supplies or transformers can be used reliably.

8 8 MHz RISC I/O Processor

Fast microprocessor for responsive communications and I/O processing, totalizing and timing of discrete input signals, and programmable flashing of discrete outputs. The microprocessor program is kept in nonvolatile flash memory (no battery!) that can be updated in seconds via the RS-232 port.

9 Discrete I/O Status LEDs

All discrete inputs and outputs have amber LED status indicators right next to their field wiring terminal block connections to simplify system test and troubleshooting.

10 Tough Powder-coated Zinc-plated Steel Enclosure

Extremely long lasting dual coating for harsh environments

11 Hot-swappable Removable Terminal Blocks

The I/O, Power and Communication terminal blocks and connectors can be safely removed and reinserted easily, without taking your system down.

12 Internal Radio or 2nd Serial Port

MAXIO I/O modules have an extra serial port for an optional radio or extra RS-232/RS-485 interface. The internal port is truly independent and can be used simultaneously with the main RS-232/RS-485 port. The second serial port simplifies local support of distributed I/O systems as well as systems that require redundant I/O network communications.

13 Network Address Switches

DIP switches are used for field addressing MAXIO I/O modules. Up to 64 modules can be addressed with the switches, expandable to 255 modules via the I/O module “toolbox” configuration software.

Installation

Mechanical Installation

MAXIO DIO are designed to be installed in a protective enclosure with the appropriate NEMA rating for the environment that the controller will be used. Typical NEMA ratings are as follows:

North America:

Indoor applications only: NEMA 1 Indoor or Outdoor applications: NEMA 4, 4X or 12 rated enclosures.

European Union:

Must be installed inside IP54 or IP56 rated enclosures.

The enclosure material must be a minimum of 1.14mm (0.045”) thick. Typically, the controller is mounted vertically in such an enclosure on a steel back plate. If an alternative mounting scheme is used, it is recommended that the controller be mounted on a noncombustible surface.

CAUTION: If the controller is mounted on or above a combustible surface (such as a wood backboard), a plate of at least 1.43mm (0.056”) galvanized or 1.6mm (0.063”) uncoated steel extending at least 150mm (5.9”) beyond the controller on all sides must be installed.

MAXIO DIO modules are designed to be secured to a mounting surface with four #10 screws in a 4.75” x 6.5” rectangular pattern. A scale mounting template is included on the inside of the back cover of this manual.

Electrical Installation

All field wiring connections to and from the MAXIO DIO modules, except for RS-232 connections, are made via removable terminal blocks.

Class 1 Division 2 Group A, B, C, and D Requirements

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.

WARNING - EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;

AVERTISSEMENT - RISQUE D’EXPLOSION – LA SUBSTITUTION DECOMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2;

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS;

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DÉCONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

WARNING - EXPLOSION HAZARD – BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT- RISQUE D'EXPLOSION –AFIN D'ÉVITER TOUT RISQUE D'EXPLOSION, S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX AVANT DE CHANGER LA BATTERIE.

NOTE: The terminal block screws must be tightened to 7 lb-in.

Diagrams in the following sections provide examples for discrete I/O and power wiring. The following wiring guidelines must be followed:

- **Stranded conductors from #14 to #26 AWG, or solid conductors from #12 to #26AWG consisting of either copper or copper-clad aluminum is permitted.**
- **Wires must be rated for 240V, 90oC and suitably current rated. Wire insulation must be a minimum of 0.9mm (0.031") thick if subjected to movement, flexing or handling during use or maintenance.**
- **Wires shall be routed away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and the like.**
- **Clamps and guides, if used, shall be provided with smooth, well-rounded edges.**
- **Wiring that is subject to flexing during servicing such as that from a stationary part to a part mounted on a hinged door shall be provided with additional insulation at any point where flexed.**
- **Additional insulation, if used, shall be insulating tubing, or a wrapping of not less than two layers of insulating tape. All must be a minimum of 90ºC and 240V.**
- **All splices and connections must be mechanically secure and provide electrical continuity**
- **Conductors are also not to be grouped.**

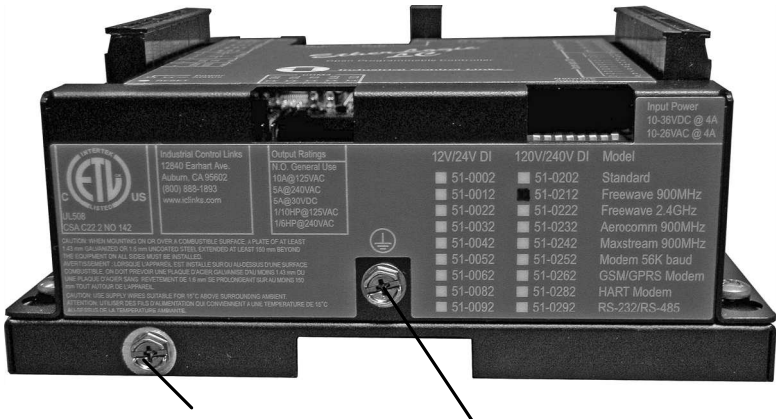
CAUTION: Use supply wires suitable for 15oC above surrounding ambient

ATTENTION: Utiliser des fils d'alimentation qui conviennent a une temperature de 15oC au-dessus de la temperature ambiente.

Grounding

The steel enclosure of the MAXIO DIO module must have a bonding conductor (14AWG or heavier copper wire) that connects the module case to the enclosure with less than 0.1 ohms of resistance. A green #10 grounding screw is provided on the end of the module for attaching the bonding conductor.

If a DIN-rail mounting plate (option) is used, that plate must also have a bonding conductor attaching it to the equipment enclosure. A green #10 screw is provided on the mounting plate for this purpose.



Optional DIN-Rail Mounting Plate Grounding Screw

Module Grounding Screw

Discrete Inputs

MAXIO Discrete Inputs are used to monitor the state of switches, relays contacts, motor starter auxiliary contacts and any other on/off type sensor signals. The inputs are optically isolated to avoid ground loop effects and prevent damage from transients and power surges on the input lines. There are a total of 24 discrete inputs.

Signal Types and Levels

MAXIO DIO modules have a unique input design that accepts both AC and DC signals. The inputs are not sensitive to signal polarity, supporting DC sensors with either “sinking” or “sourcing” output configurations as well as switch contacts with AC or DC signals. MAXIO DIO modules can be ordered in either “low-voltage” (12/24V) or “high voltage” (120/240V) configurations. These designations only affect the Discrete Inputs and their input rating, not the discrete (relay) outputs.

In the low voltage (12/24V) model, input levels of 9 volts (AC/DC) or greater is considered to be “ON”. Input levels of 6 volts (AC/DC) or less are considered OFF. The low voltage (12/24V) model can accept signal levels of up to 50 volts (AC/DC). The 120/240V model responds to inputs of 75V or greater as an “ON”, 50V or less as an “OFF”.

LED Input Status Indicators

Every discrete input has an LED indicator to show the current ON or OFF state of the input. To conserve power, the LED status indicators may also be forced OFF under program control. The module status LED (“ST”) flashes when the discrete input and output status LEDs have been disabled.

Input Filtering

The discrete input modules have filtering that rejects spurious noise and limits the maximum counting rate to 40Hz with DC pulses, up to 10Hz with AC signals. On the first four inputs, the filtering may be disabled under program control to support high-speed counting to greater than 5KHz.

Pulse Totalization

MAXIO DIO modules count ON transitions on every input. This facilitates reliable pulse totalization that is not sensitive to communications rates and I/O scan time. This feature can be used for very accurate flow and wattage totalization. The pulse totalizers are 32-bit counters that count up to 4,294,836,225 ON transitions before they “roll over” to zero again. The counters can be reset to zero, or any preset to any value, at any time.

Runtime Totalization

MAXIO DIO modules monitor the runtime (ON time) for every input point, providing reliable “down-to-the-second” measurement of how long an input has been “ON”. This information is useful for scheduling equipment maintenance and wear leveling. For example, to maximize pump life in a multi-pump system, runtime can be used to determine which pump should be used next based on which pump has the lowest runtime.

The runtime totalizers are 32-bit registers, meaning that the totalizers count seconds, up to 4,294,836,225 before they “roll over” to zero again. The runtime totalizers can be reset to zero or preset to a value at any time by simply writing to the appropriate register.

Pulse Rate Calculation

MAXIO DIO modules calculate the input pulse rate for every input. With the appropriate sensors, this can be used to show “real-time” flow, usage rates, and speeds. A software settable “gate” time determines the measurement interval over which the input pulses are counted. The gate time is the measurement update interval. Longer gate times provide greater measurement resolution, but the measured value is updated less frequently. Once the gate time has expired, each totalized count is stored in a rate register for that discrete input, and a new set of rate measurements are automatically started.

The rate registers are unsigned 16-bit registers (maximum value of 65,535). Be sure to select a gate time that will avoid “overflowing” a rate register. For example, if the maximum expected pulse rate is around 5KHz, than the gate time should be set to 10 seconds or less (5KHz x 10 seconds = 50,000 counts).

Field Wiring

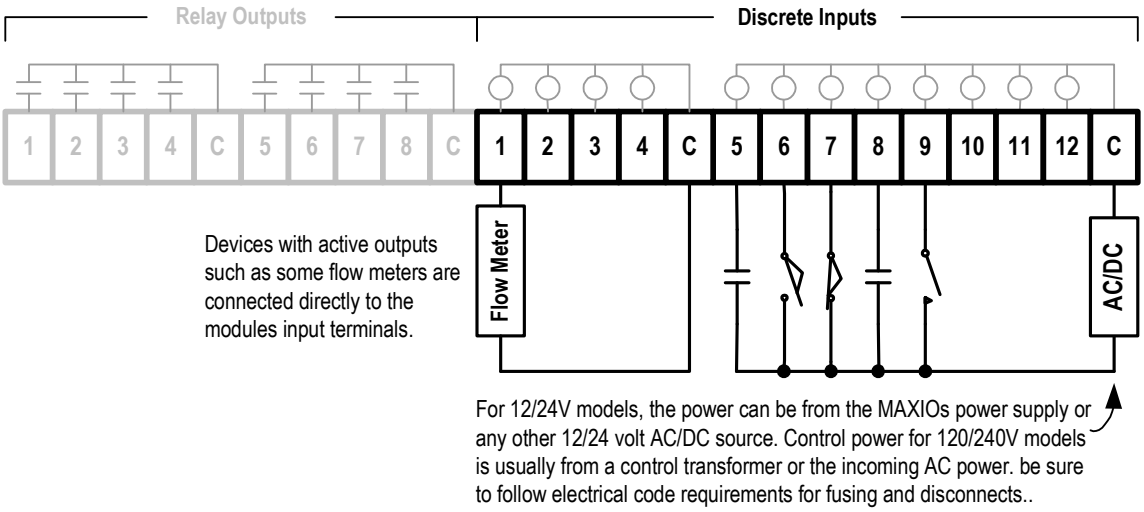
Connections from field sensors terminate on a pair of 22 position removable terminal blocks at the MAXIO DIO module. The pin out is the same for both the 12/24V and the 120/240V MAXIO DIO models.

The 24 discrete inputs of a MAXIO DIO module have shared commons that group the inputs into two sets of four inputs and two set of 8 inputs. This minimizes the amount of jumpering of “commons” required for most systems while still having the flexibility of wiring in relatively small blocks of I/O to isolated circuits.

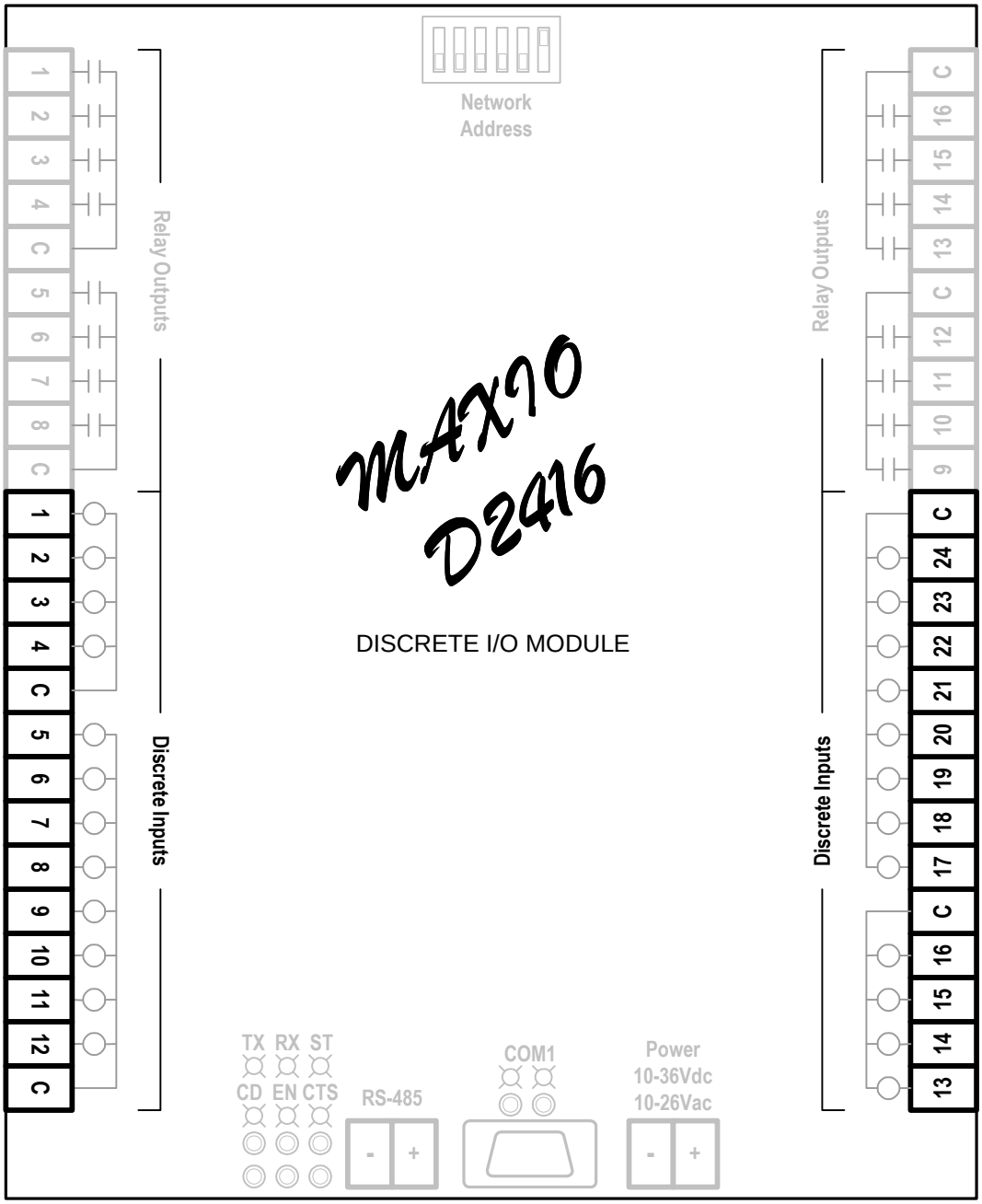
The discrete inputs are passive and require an active voltage to be switched between their common and the input signal connections. Devices that actively provide a signal output are simple connected between the appropriate common connection and an input connection on the module. The discrete inputs are not sensitive to polarity and directly support either AC or DC signal inputs.

Simple contact closure connections are supported by wiring one side of a power source to the appropriate common. The switches are wired between the module inputs and a field common connection that goes back to the other output of the power source as shown below. The module inputs are isolated from the input power. For 12/24V models, the power source for the inputs can safely be the same power supply that powers the MAXIO module.

Be sure to follow electrical code requirements for fusing and circuit disconnects.



MAXIO Discrete Inputs - Field Wiring Example



MAXIO Discrete Inputs - Terminal Block Layout

NOTE: The terminal block screws must be tightened to 7 lb-in.

Please refer to the preceding installation section for additional electrical wiring requirements.

Discrete Outputs

MAXIO discrete relay outputs are used to operate motor starters, lights, annunciators and any other type of on/off control device. The outputs are “dry” relay contacts with built-in snubbers to reduce contact arcing. The outputs can switch both low-voltage (12/24V) and high-voltage (120V/ 240Vac), AC or DC loads. There are a total of 16 discrete outputs.

Flash Function

MAXIO DIO modules provide a programmable flash function for each discrete output. By setting control bits, the outputs can flash at a configurable rate that is not sensitive to communications rates and I/O scan time. The flashing rate may be set to an on/off period of 20mS (10mS on/10mS off) or 50Hz, to 655.35 seconds in 10mS increments.

I/O Status LED Control

MAXIO DIO modules have a control bit, that when set, forces OFF the I/O status LEDs to minimize power consumption in low-power applications. Since the I/O status LEDs are normally only used when someone has the cabinet open and is working on the system, the DIO status LEDs can be powered off most of the time (if all 40 status DIO LEDs are turned ON, they require a total of nearly 2 watts of power!).

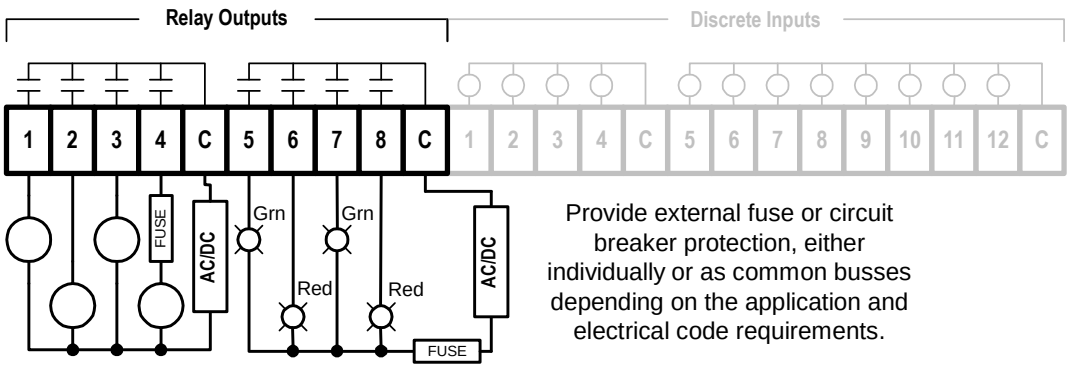
Field Wiring

The MAXIO DIO module outputs are “Form A” (normally open) type “dry” relay contacts that require an active supply voltage on one side of the load, while the relay output from the controller switches the other side of the load to the opposite supply leg. The relays can switch up to 10A (refer to load ratings below). To simplify field wiring, the outputs are grouped into four sets of four outputs each. Each set has a pre-wired common.

Even though each of the relay contacts has up to a 10-amp rating, the switching capacity of outputs that share a common is limited to the 15-amp rating of the common terminal block terminal. For example, if you are switching an 8 amp load on one of the outputs with a shared common, the sum of all of the other loads sharing that common must not exceed 7 amps, for a total of 15 amps. The 15A limit applies to both AC and DC circuits.

No fusing or overload protection is provided within the I/O module for the discrete outputs. External protection should be included in the output circuits to protect both the relay contacts and the loads that they control. Typically, large loads are fused individually, while smaller loads can share a fused line. Be sure to follow electrical code requirements for fusing and circuit disconnects.

Typical Discrete Output wiring is shown below:

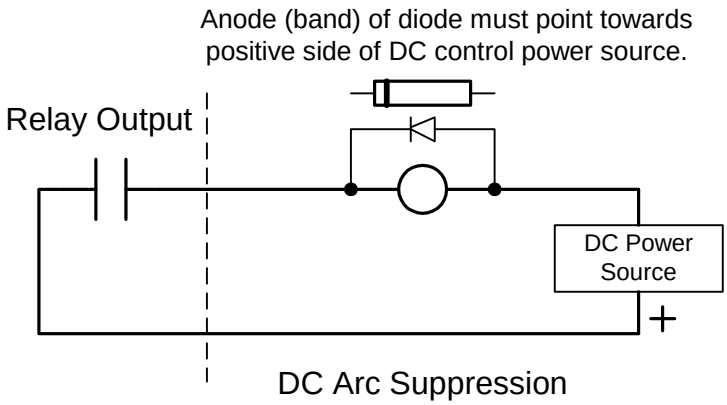


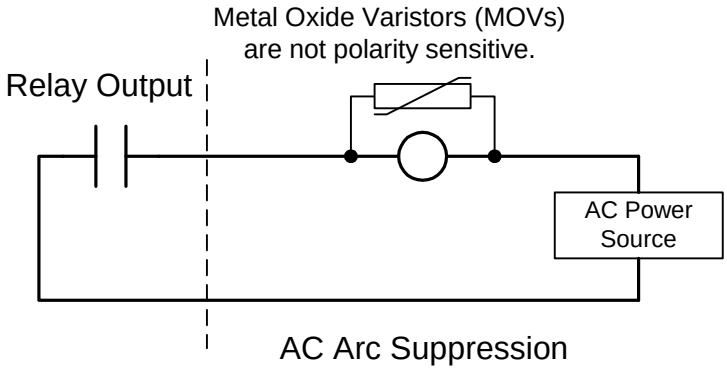
Discrete Outputs – Field Wiring Example

NOTE: The terminal block screws must be tightened to 7 lb-in.

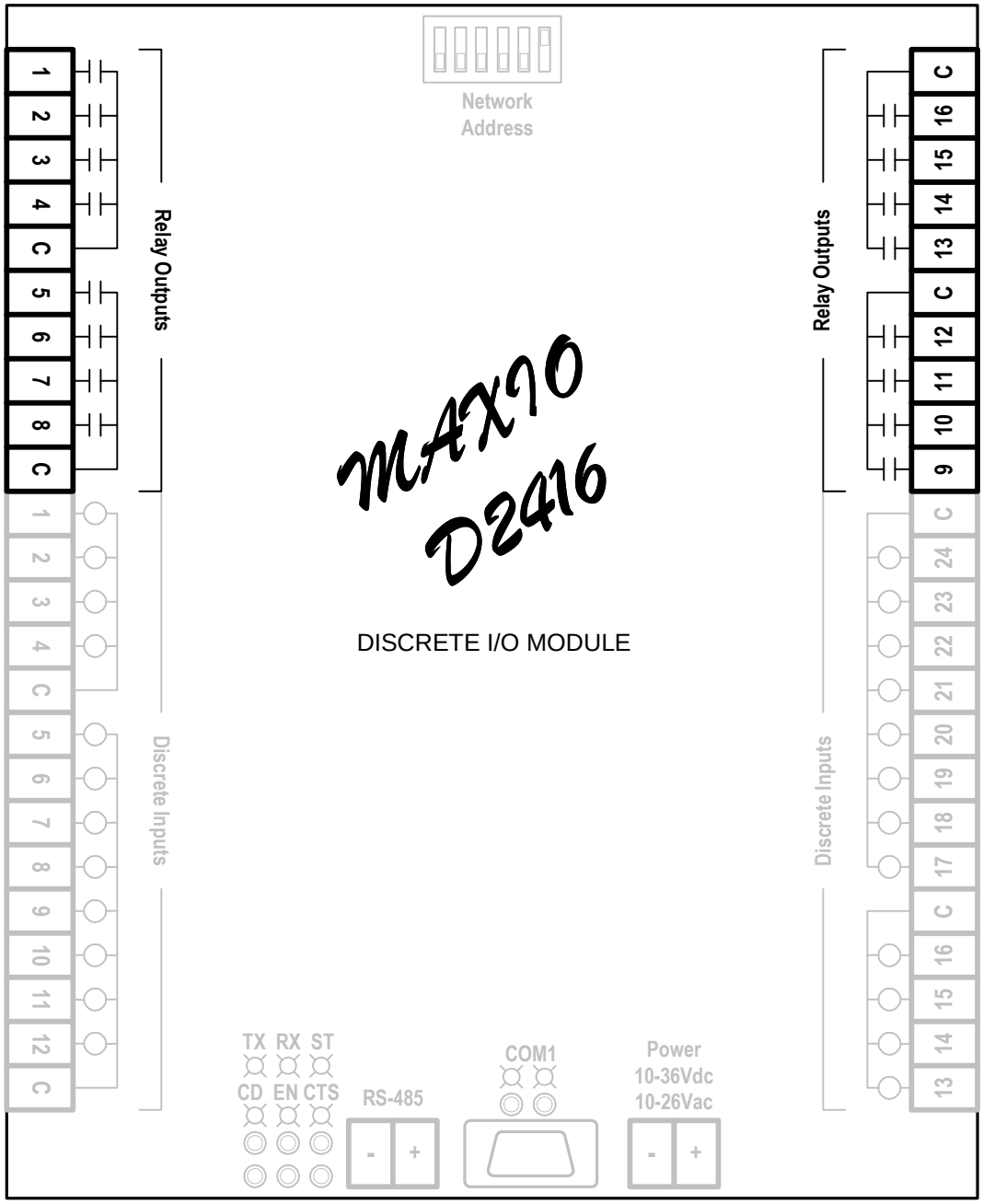
Please refer to the preceding installation section for additional electrical wiring requirements.

The relay contacts of MAXIO DIO modules have built-in snubbers to reduce arcing that degrades the contacts and can cause premature relay failure, especially when controlling inductive loads such as relays and motor starters. Even with snubber protection, some people choose to incorporate the added protection of transient suppression diodes across DC coils, and Metal Oxide Varistors (MOVs) or other clamping devices across AC coils. DC Power Source Relay Output Anode (band) of diode must point towards positive side of DC control power source.





When using diodes (DC circuits), be sure to observe the polarity of your connections. A reversed connection will actually cause a short circuit! Metal Oxide Varistors (MOVs) may be used for AC and DC circuits, and are not polarity sensitive.



MAXIO Discrete Outputs - Terminal Block Layout

NOTE: The terminal block screws must be tightened to 7 lb-in.

Please refer to the preceding installation section for additional electrical wiring requirements.

Communications Interfaces

The most common serial communications standards for SCADA and industrial control systems are RS-232 for short point-to-point connections and RS-485 for longer distance networked communications. MAXIO I/O Modules have a dual-interface primary serial port with both RS-232 and RS-485 interfaces. Only one interface (RS-232 or RS-485) may be used at a time.

RS-232 Serial Communications Interface

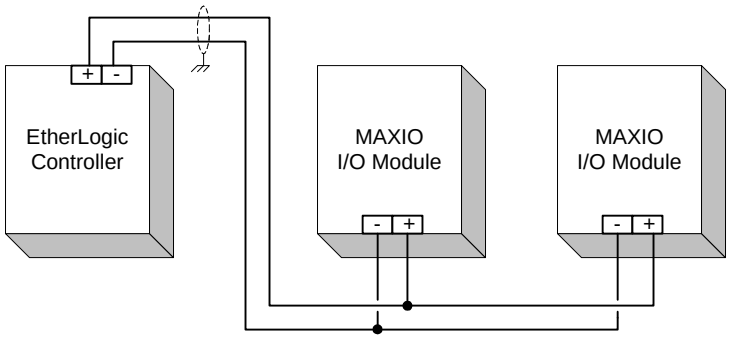
On a MAXIO I/O Module, the RS-232 serial interface is a simple 3-wire configuration. It does not require, or support, any modem control lines. The RS-232 port connections are available on a male 9-pin “D” connector with transmit, receive and ground pin assignments identical to a PC computer. To connect a MAXIO I/O module to a PC computer, a “null modem” cable is required to “cross over” the transmit and receive data lines.

RS-485 Serial Communications Interface

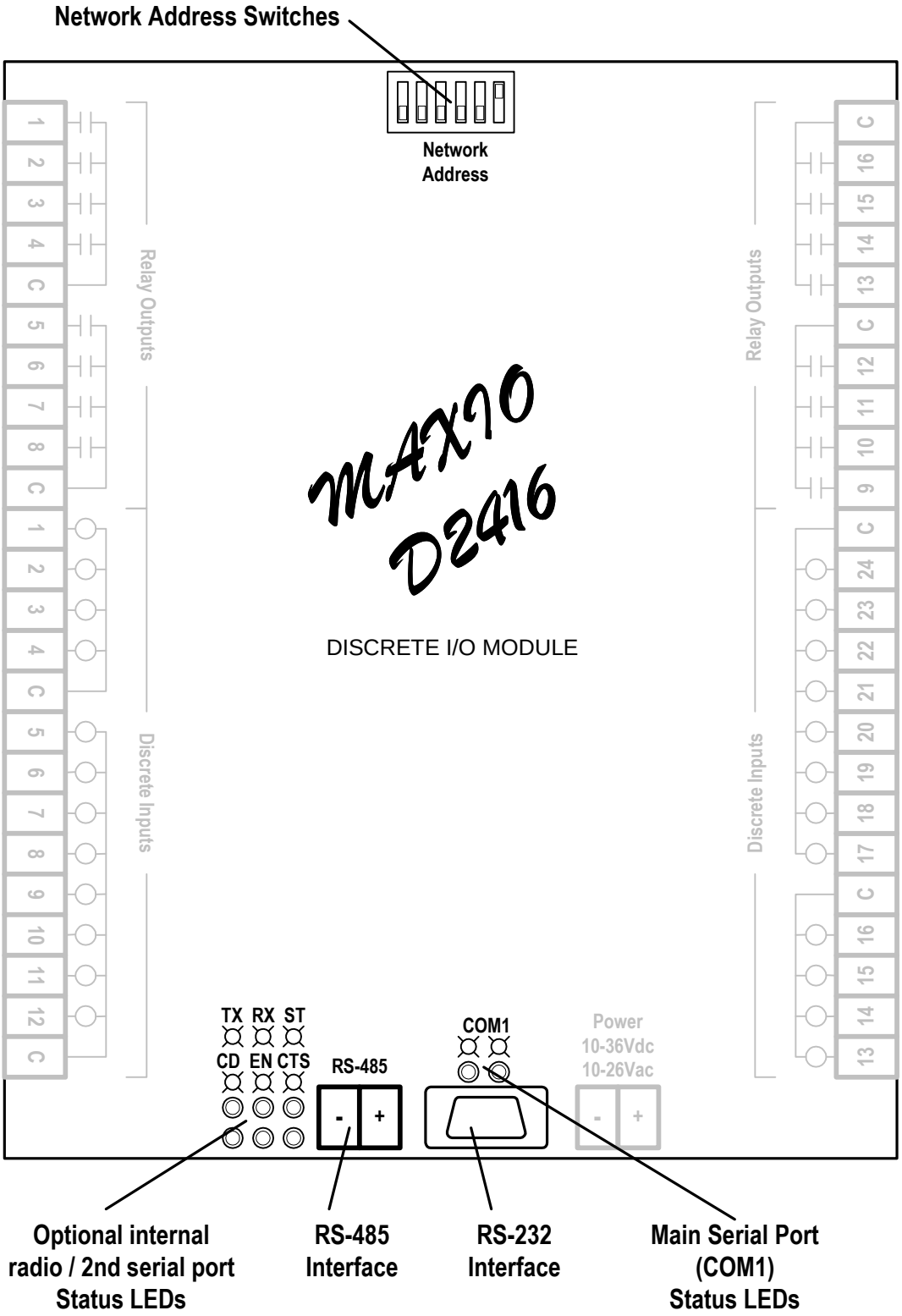
RS-485 is a 2-wire communications interface designed for networked operation spanning distances of up to 5,000 ft. MAXIO I/O modules are frequently used with EtherLogic and ScadaFlex Plus Controllers for I/O expansion. These controllers have one or more RS-485 ports. RS-485 is popular because of its two-wire simplicity, superior noise rejection and operating distance.

Up to 254 MAXIO I/O modules may be connected on a single RS-485 net-work, distributed over several thousand feet. Although the original RS-485 standard allowed for only 32 devices on a network, the RS-485 interface in MAXIO I/O modules (as well as ScadaFlex Plus and EtherLogic Controllers) is specially designed to allow up to 254 devices to share the same network. With up to 40 I/O points per module, a network of 254 MAXIO DIO modules provides over 10,000 I/O points!

A two-pin removable terminal block is used for the RS-485 connections on a MAXIO I/O module . A typical RS-485 network uses a twisted pair cable. If the cable is shielded (recommended for most installations), the shield should be connected to earth ground at ONLY ONE END of the cable.



Connect the wiring exactly as shown (+ to + to +, - to -to -). Unlike traditional RS-485 networks, external termination resistors SHOULD NOT be used since termination is al-ready built into the I/O modules and controller.



MAXIO I/O Module - Communications Connectors, LEDs and Address Switches

2nd Serial Communications Interface

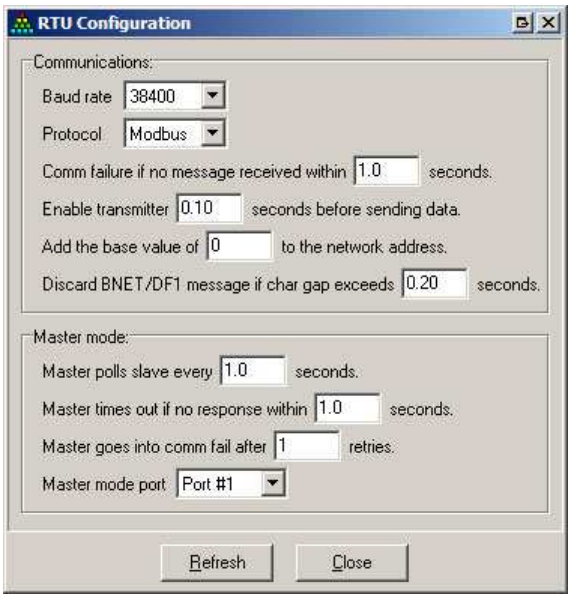
In addition to the primary RS-232/RS-485 interface, MAXIO I/O Modules have a second serial channel to support an internal spread spectrum radio for wireless communications, or a second RS-232/RS-485 port to support an external radio or redundant hardwired network communications. The 2nd serial port operates independently of the primary port.

Network Addressing

The network address of a MAXIO I/O module is set by a 6-position DIP switch at the top of the module. These 6 switches can be set to 64 different address combinations (note that 0 is NOT a valid address). Every module MUST have a unique address on the network. MAXIO I/O modules may be configured to addresses above 63 by setting a “base value” with the ScadaFlex I/O toolbox software. The base address value is added to the value set in the switches, effectively shifting the range of the addresses switches “up” by the base address value. For example, if the base address is set to 100, then the DIP switch will address the module to network ad-dresses from 100 to 163. For diagnostic purposes, MAXIO I/O modules al-ways respond to address 255 in addition to the user selected address.

RTU Configuration with the I/O Toolbox: Communications

The ScadaFlex I/O Toolbox is used to con-figure and exercise MAXIO I/O modules when they are connected to a PC computer. The settings that configure the basic communications parameters are accessed via the RTU Configuration window shown here.



Baud Rate: This parameter sets the communications character rate, from 2400 to 115,200 baud.

Protocol: This parameter sets the communications protocol, either Modbus or DF1.

Comm Fail Time: This parameter sets the timeout value for a communications failure. The MAXIO I/O module will sense a communications failure if a valid message is not received from a Host within the specified time period. The timeout time can be set from 0 (disabled) to 6553.5 seconds (109 minutes). When a communications failure is detected, the modules main Status LED (“ST”) turns RED and all outputs are forced OFF.

Transmit Enable Lead Delay: This parameter sets the time from when the RS-485 transmitter is enabled to when the first byte of data is sent, forcing a “quiet”

period after the transmitter turns ON. Set this value to 0 for most RS-485 networks, as well as for RS-232 operation.

Network Base Address: This parameter sets the base address added to the value in the DIP switches to determine the modules network address.

BrickNet/DF1 Character Gap Timeout: this parameter sets the timeout value for the BrickNet and DF1 character gap. The acceptable range is 0.1 to 2.0 seconds.

RTU Configuration with the I/O Toolbox: Master Mode

The MAXIO DIO can work in a back-to-back "Master" mode. When this feature is used, I/O points on a set of MAXIOs are mirrored. DIs are mapped from the master unit to available DOs on the slave. DIs on the slave unit are mapped to DOs on the master. This feature is disabled by default and must be configured in the ScadaFlexIO Toolbox before use. In addition, the master unit must have its address set to zero through the address switches located on the front of the unit.

Master Poll Time: This parameter sets the time value for how often the master unit will poll the slave and read/write data. Valid values range from 0 to 6553.5 seconds.

Master Time Out: This parameter sets the time value for how long the master will wait before a message times out and is discarded and either a retry or failure is triggered. Valid values range from 0 to 6553.5 seconds

Master Retries: This parameter sets the number of times the master unit will *retry* a message before going into COM fail mode. Valid values range from 0 to 255.

Master Mode Port: This parameter set the port that master mode will utilize. Select "disabled" to disable the master mode feature. Select "Port #1" to use either RS-232 or RS-485. Select "Port #2" to use the internal COM port used by the internal radio or extra RS-232/485 expansion card option. (Master Mode cannot be used in conjunction with RS-232.)

When using the Port #1 setting, be sure to use the RS-485 port.

Modbus Communications

MAXIO I/O modules support the Modbus RTU communications protocol. This protocol was originally developed for Modicon Programmable Logic Controllers (PLCs). Now, Modbus is supported by nearly any PLC and RTU, and most HMI/MMI software packages. MAXIO I/O modules can be used in a large number of existing systems and will work without special drivers with many different "Hosts".

MAXIO I/O modules support the following four standard Modbus data types:

Data Type	Modbus Type	Description
Status	10xxx	Read Only bits
Coils	00xxx	Read/Write bits
Input Registers	30xxx	Read Only 16-bit values
Holding Registers	40xxx	Read/Write 16-bit values (two combined for 32-bit values)

Note: Do not confuse the Modbus Type with the command codes used to access the various data types.

Both the single and multiple element forms of the Modbus commands that access these data types are supported. For example, there is a command to read or write a single Holding Register, and another command to access a block of Holding Registers. MAXIO I/O modules support both forms.

The totalizers in MAXIO I/O modules are 32-bit registers. These registers are accessible as two consecutive 16-bit Modbus registers. The Most Significant (high order) portion of the 32-bit value is accessed in the first register, immediately followed by a second register with the Least Significant (low order) portion of the 32-bit value. 32-bit values should always be accessed with the Read/Write multiple registers form of Modbus messaging so that both portions of the 32-bit value are read together in a single message.

MAXIO I/O modules allow up to 128 registers of any type to be accessed in a single message. Be careful to only access valid registers. In general, messages that access unassigned registers are rejected as invalid messages, unless they are reserved for future use.

Detailed information on the Modbus protocol is available at: **www.modbus.org**

Store & Forward

MAXIO I/O modules can be used in radio based systems. To extend the effective range of radio systems, MAXIO I/O modules may be configured to digitally repeat messages destined for other locations that are not directly accessible to the Modbus Master. Although the Modbus standard has no definition for this function, MAXIO I/O modules use a simple form of block address translation to support Store & Forward operation within the Modbus specification framework.

The following "rules" are used for Store and Forward operation:

- The network addresses to be translated and forwarded must be in a single contiguous block of addresses.
- The translated addresses must be unique and NOT include the local RTUs address.
- The Master must be capable of ignoring the messages generated with translated addresses (ICL controllers do this automatically). Some Modbus Masters may not like seeing what appears to be a response message with a different address. Since the repeater is by definition “in radio range”, the Master is certain to “see” these messages.

MAXIO I/O modules have three holding registers that control the Store and Forward address translation functions; an “Incoming Base Address” register, an “Outgoing Base Address” register, and a “Block Size” register.

When a message is received by a MAXIO I/O module, it first checks to see if the message is intended for itself. If not, it then checks to see if the message falls within the Incoming range of addresses (Incoming Base through Incoming Base + Block Size - 1) or within the Outgoing range of addresses (Outgoing Base through Outgoing Base + Block Size - 1).

If a message falls within the Incoming Range, then the module knows that the message came from the Master (or a previous repeater en route from the Master) and it translates the address to the Outgoing Range, calculates a new message CRC check block, and retransmits the modified message. Likewise, if a message falls within the Outgoing Range, then the module knows that the message came from a downstream module (or a previous repeater) and it translates the address to the Incoming Range, calculates a new message CRC check block, and retransmits the modified message back towards the Master.

There is no limit to the number of repeater hops that can be used other then the total number of available addresses (254).

The Store and Forward parameters are set in their own configuration window in the ScadaFlex I/O Toolbox program. In the example shown, addresses from 100 to 109 (block size of 10) will be translated to addresses of 200 to 209. Note that setting any of the three parameters to 0 disables Store and Forward operation.

Modbus Register Map

MAXIO DIO modules use the following Modbus register map:

STATUS (Read Only Input Bits - Modbus Type 10xxx)

Start	*End*	*Description*
001	024	Discrete Inputs 1 through 24

COILS (Read/Write Output Bits - Modbus Type 00xxx)

Start	*End*	*Description*
001	016	Discrete Outputs 1 through 16
017	032	Flash Enables 1 through 16

INPUT REGISTERS (Read Only 16-bit - Modbus Type 30xxx)

Start	*End*	*Description*
001	024	Input Rate Registers - Discrete Inputs 1 through 24
248	249	Reserved - ICL Test ONLY
250	-	Input Voltage (power) x 10 (143 = 14.3 volts)
251	254	Reserved - ICL Test ONLY
255	-	Firmware Revision
256	-	Device ID (12/24V = 6151, 120V = 6152)

HOLDING REGISTERS (Read/Write 16-bit - Modbus Type 40xxx)

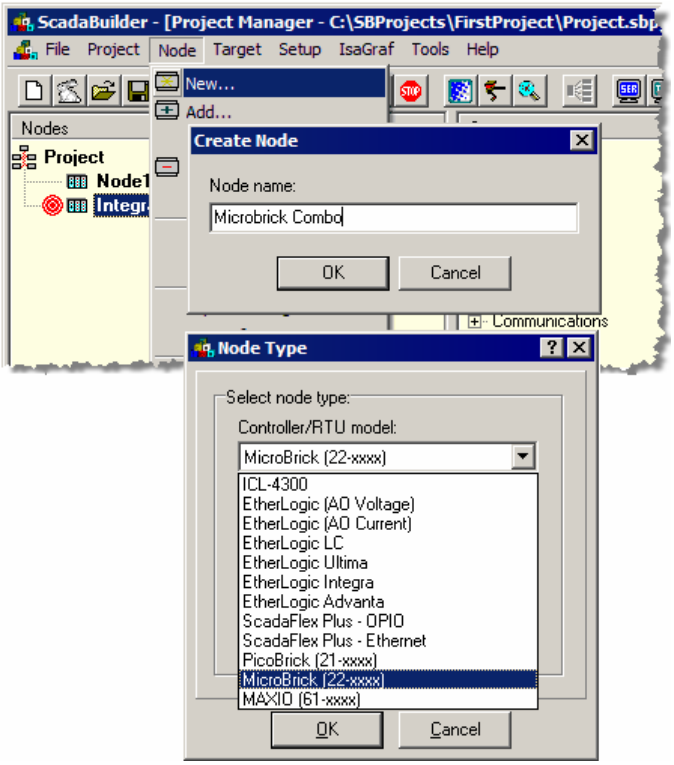
Start	*End*	*Description*
001	048	32-bit transition totalizers - Discrete Inputs 1 through 24 (2 registers per input channel, MSW first)
065	112	32-bit runtime totalizers - seconds - Discrete Inputs 1 through 24 (2 registers per input channel, MSW first)
129	-	DI Rate Gate Time in seconds (time period over which input pulses are totalized for rate calculation)
130	-	DI Filter select (Bit Map filter selects, 1 = OFF = Fast, bits 0 to 3 control filtering for DI 1 - 4)
131	-	Output Flash Rate ON/OFF time (half duty cycle) in 10ms increments
149	-	Input Power (voltage) calibration numerator (denominator = 65,535)
244	-	Network Base address (added to value in DIP switches to calculate final network address, default = 0)
245	-	Store & Forward - Incoming Base Address
246	-	Store & Forward - Outgoing (remapped) Base Address
247	-	Store & Forward - Address Range (block size)
248	-	Communications Watchdog Timer (10mS increments)
249	-	Xmit Enable Delay (Xmit Enable to Xmit Data in 10mS increments)
253	-	Baud Rate Index (0 = 2400, 1 = 4800, 2 = 9600, 3 = 19200, 4 = 38400, 5 = 115200)
254	-	Status Register (0001h = restarted, 0002h = comm. timed out)
255	-	Reserved - Test Register - ICL Test ONLY
256	-	Reserved - Control Register - ICL Test ONLY

BrickNet Communications

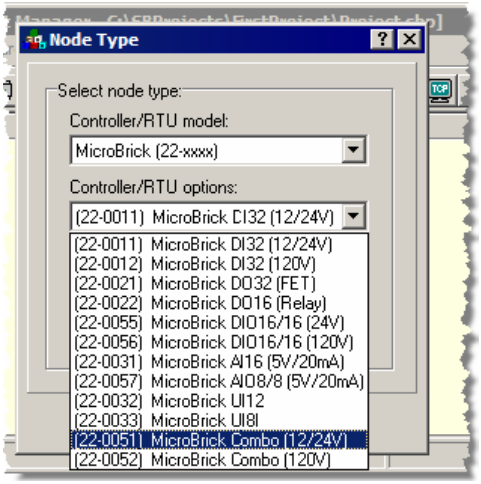
All I/O Expansion modules available from ICL talk ICL's BrickNet Protocol. ScadaBuilder (ICL's controller programming software) is aware of the register map of every I/O module and can access those registers directly by name and block.

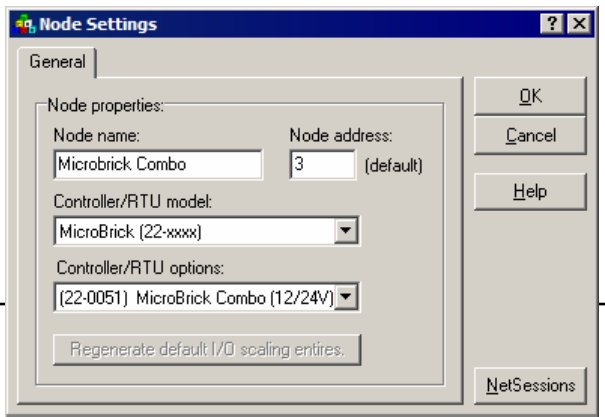
To utilize this feature, you first have to create a new Node in the ScadaBuilder project where you want to use the I/O module. We will use a MicroBrick Combo module for this exercise but the concepts are the same for all other *PicoBricks, MicroBricks, MAXIO's and ScadaFlex RTU's. Your I/O device may differ from that shown here but the concepts are exactly the same.*

To create a MicroBrick Combo Node, select the Node | New menu. Enter a name a click OK.



Select the MicroBrick type (or whatever your device might be by model number).



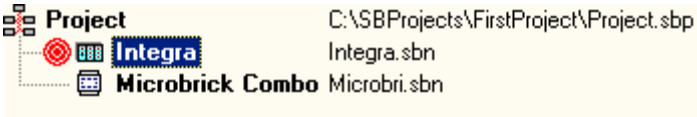


Enter a Node address that is something other than what you main controller's address is going to be. See Creating a BrickNet Session in the ScadaWorks Technical Reference Manual for details.

You should have a project that looks something like the following:

Create a BrickNet Network Session.

See Creating a Bricknet Session in the ScadaWorks Technical Reference Manual for details.

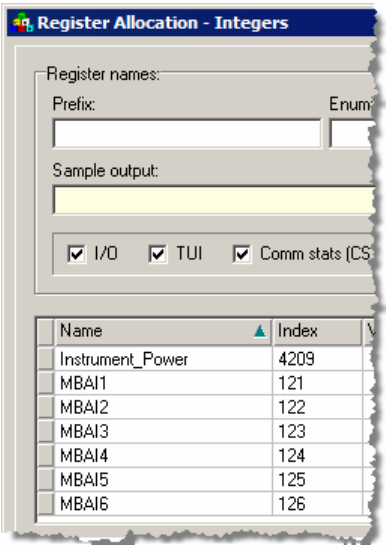


You must create registers to store locally the I/O points of the combo module. Declare the following points in the Registers section of the Setup window of ScadaBuilder. See the Registers section of the ScadaWorks Technical Reference Manual for details.

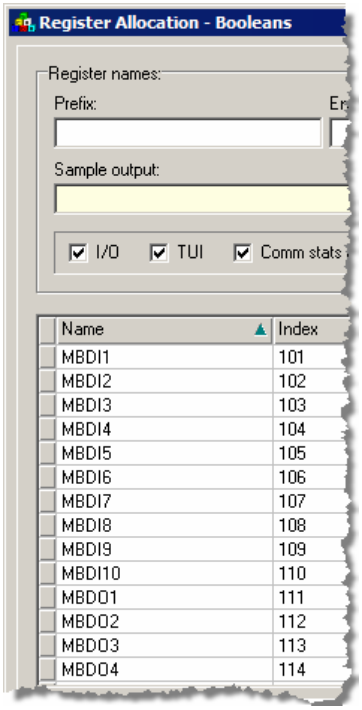
Create the following registers to store the values into:

Booleans	Booleans	Integers
MBDI1 101	MBDO1 111	MBAI1 121
MBDI2 102	MBDO2 112	MBAI2 122
MBDI3 103	MBDO3 113	MBAI3 123
MBDI4 104	MBDO4 114	MBAI4 124
MBDI5 105		MBAI5 1251
MBDI6 106		MBAI6 126
MBDI7 107		
MBDI8 108		
MBDI9 109		
MBDI10 10		

Your Boolean register list should look like this:

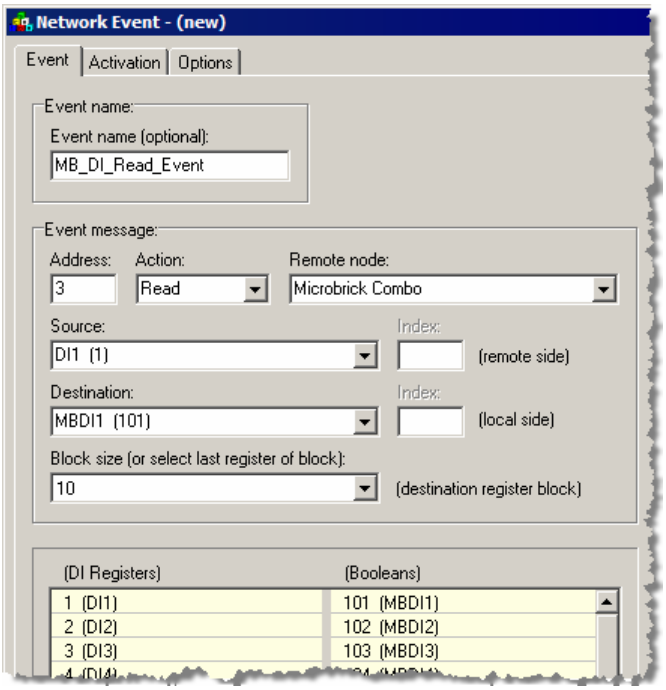


And your integer register list should look like this:



Next we need to create the Network Events.

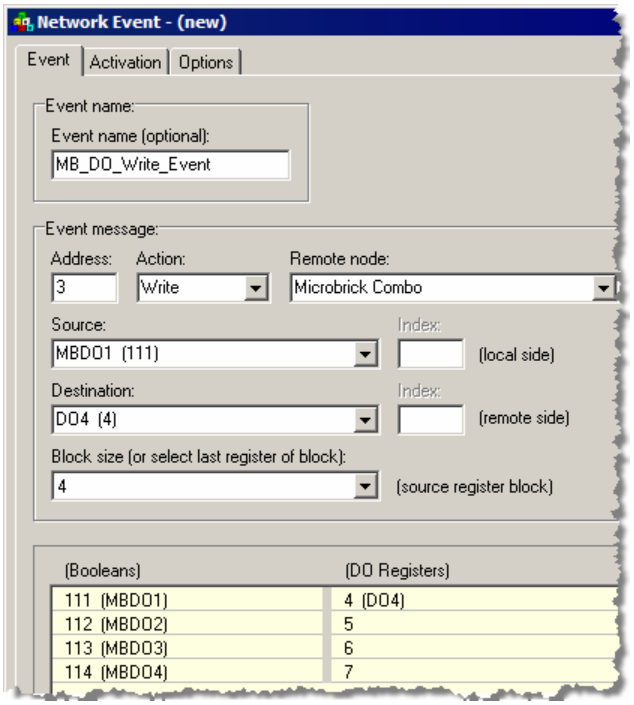
Click on the Events button in the lower right hand corner of the BrickNet Network Session you created above. This will give you the Network Event List. Click on the New button to get the following dialog. See Creating BrickNet Network Events in the ScadaWorks Technical Reference Manual.



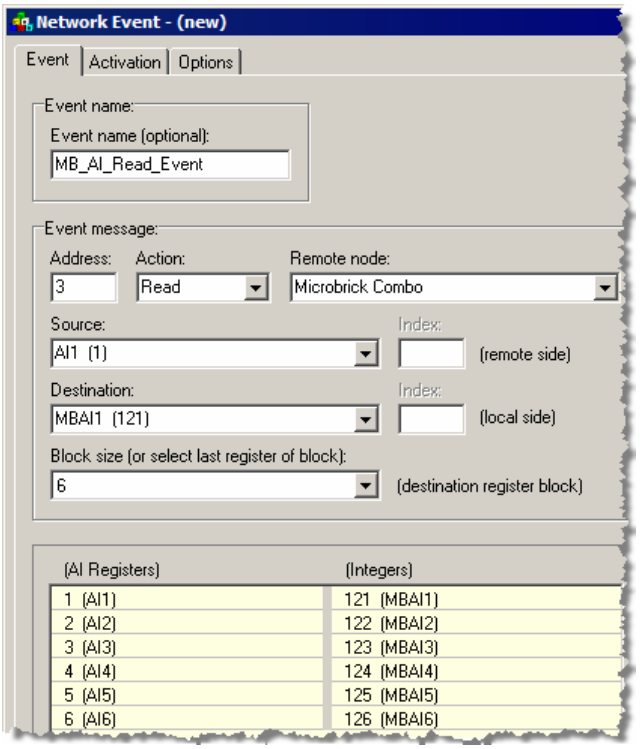
- Name the Event (we will be reading the DI's from the MB Combo.
- Select the Action (Read),
- Select the Remote Node (which is the Module you

setup).

- Select the Destination (this tells ScadaBuilder what data type you are going to use.
- Select the source of the first DI register of the MicroBrick and enter the block size to get all 10 DI's.
- Click on the Activation tab, Enter Cyclic and 1 and click the Add button

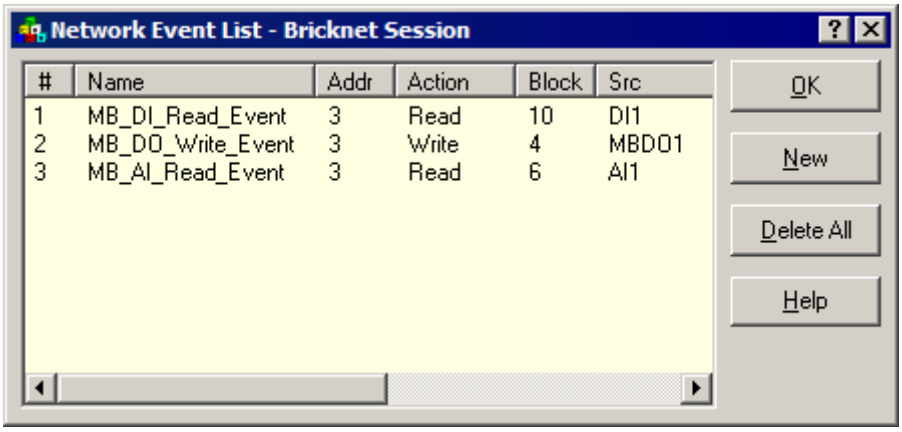


To write to the Digital Outputs of the MicroBrick Combo Module, enter the following with the same Cyclic 1 Activation:



Reading the Analog Inputs on the MicroBrick is the same as reading the DI's only a different data type:

You should now have a Network Event List like the following:



#	Name	Addr	Action	Block	Src
1	MB_DI_Read_Event	3	Read	10	DI1
2	MB_DO_Write_Event	3	Write	4	MBDO1
3	MB_AI_Read_Event	3	Read	6	AI1

Setup Complete. Connect your I/O module to the port defined, make sure the Slave number and baud rate are correct and download the application to the controller.

Consult your hardware manual for the appropriate cabling to connect your I/O module.

Different products have different I/O based on the model number and type. Interfacing to all of them is similar but not exact to what is shown here.

DF1 Communications

Due the installed base of Allen-Bradley programmable logic controllers and the high cost of protocol adapter modules, the DF1 protocol is a popular means of interfacing these PLCs with ICL controllers. In the DF1 protocol, a single Master communicates with up to 254 slaves. Slaves do not send messages on their own; they respond to messages from the Master. DF1 is designed to operate over serial networks; RS-232 for short point-to-point connections, RS-485 for longer distance hard-wired networks, and radios and modems for even longer distances. DF1 can support three types of data; bits, integers and floating point numbers. DF1 over Ethernet is not supported at this time.

MAXIO units can communicate using Allen-Bradley's DF1 protocol using the DH-485 transport layer. This protocol allows the RTU to respond to messages that are sent from a DF1 master device. These messages can read and write information stored in registers.

Data Type	DF1 Type	Description
Digital Input	B3	Read Only bits
Digital Output	N13	Read/Write bits
Analog Input	B7	Read Only 16-bit values
Analog Output	N17	Read/Write 16-bit values

Note: 32-bit registers are not currently supported in ICL's RTU implementation of DF1.

Note: ScadaWorks users will not use the 'N' character when setting up r/w DF1 events. Instead they will select the 'Number' option from the 'Source' dropdown in the network event configuration window and enter in either '13' or '17.'

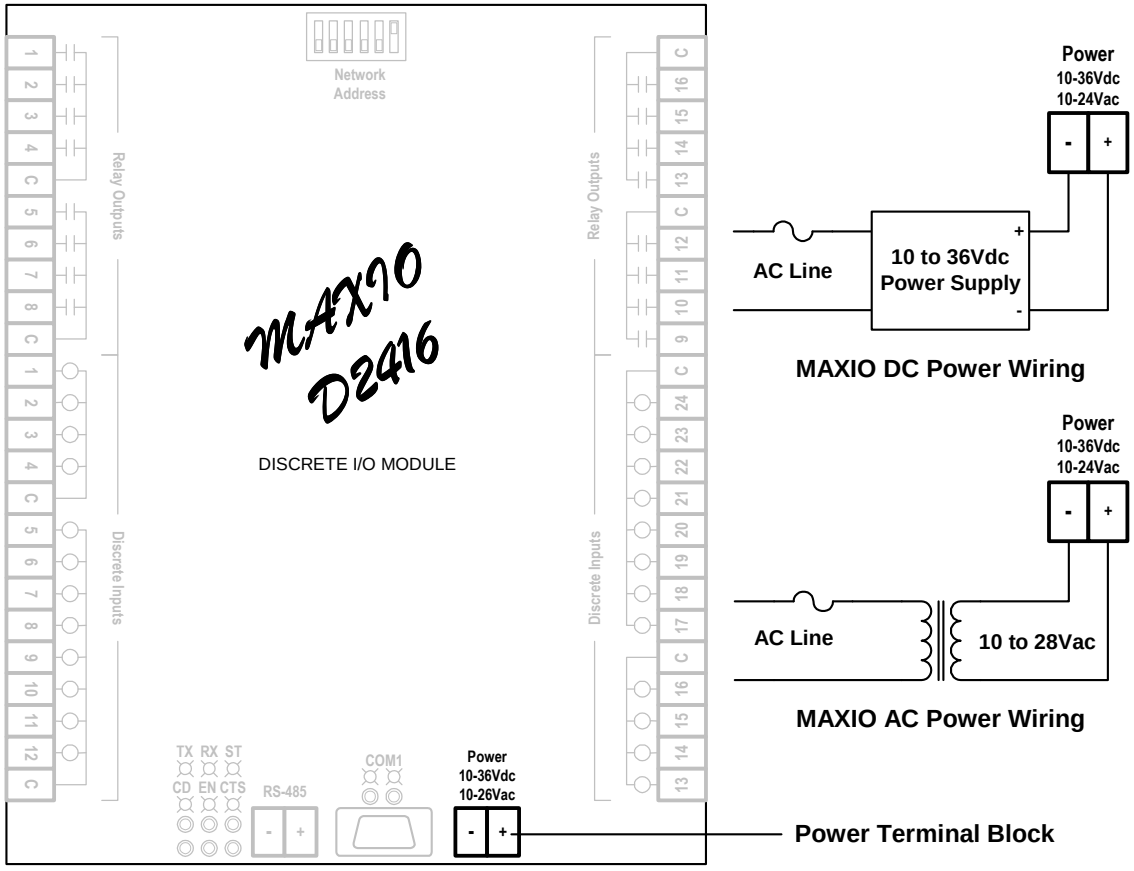
ICL RTUs support the serial, half-duplex version of DF1with CRC error checking. BCC error checking in RTU units is not supported at this time

Power

MAXIO DIO Modules can operate from either AC or DC power. They are typically powered from a 12, 15 or 24 volt DC power supply, or a 12 or 24 volt AC transformer, although they are rated to operate over an even wider range of 10 to 36Vdc or 10 to 26Vac. The incoming voltage level can be read by the Modbus Master.

AC/DC Power Wiring

A MAXIO DIO Module can be powered directly from a transformer or a DC power supply. A transformer is typically the lowest cost installation. If a DC power supply is used, it does not need to be regulated as long as its output doesn't drop below 10Vdc or rise above 36Vdc under all line voltage and load conditions.



Maintenance

MAXIO I/O modules are designed for long-term maintenance-free operation. The only maintenance item for MAXIO DIO modules is possible firmware updates as enhancements are made to the product family.

Firmware Updates

The MAXIO I/O module microprocessor firmware is easily and quickly up-dated using the “Load I/O Firmware” function (under the File menu) in the ScadaFlex I/O Toolbox, or by using a stand-alone Windows Bootloader utility program.

With either program, the update procedure is the same:

Connect a serial port from your PC or laptop computer to the RS-232 port of the MAXIO I/O module using a null module cable (a null modem cable is supplied with the I/O Toolbox software).

Select a path to were the new firmware was saved on your computer

Select “Start” to start the download.

Cycle power (turn off power, wait a few seconds, and turn power on) to the MAXIO I/O module when prompted

A progress bar will be displayed as the firmware is updated. The update process takes less than a minute.

The new update can be verified by checking the firmware revision level under the Help menu (About . . .) in the ScadaFlex I/O Toolbox. It should match the revision level documented in the new firmware release notes.

ScadaFlex I/O Toolbox

In addition to some of the specific functions mentioned throughout this manual, the ScadaFlex I/O Toolbox is a convenient Windows software tool for exercising all of the inputs, outputs and functions of the MAXIO I/O modules. A separate manual that describes the complete operation of the toolbox program is available, entitled “ScadaFlex I/O Toolbox - Technical Reference Manual” (part# 60292xxx were xxx if the revision level).

Internal Spread Spectrum Radio Option

MAXIO I/O modules are available with internal Spread Spectrum Radios, requiring no license and communicating at rates of up to 115K baud.

The spread spectrum radios used in MAXIO I/O modules may be ordered for operation in either one of two bands designated by the Federal Communications Commission (FCC); 900 MHz (902 to 928MHz) and 2.4GHz ((2.400 to 2.4835MHz). Unlike conventional radio systems that transmit and receive on fixed frequencies, spread spectrum radios “hop” periodically from one frequency to another in a pseudo random pattern. The hopping pattern is user settable, and all radios that are configured to talk to each other follow this pattern, changing frequencies up to 100 times per second. The radios can utilize a total of 112 different frequencies.

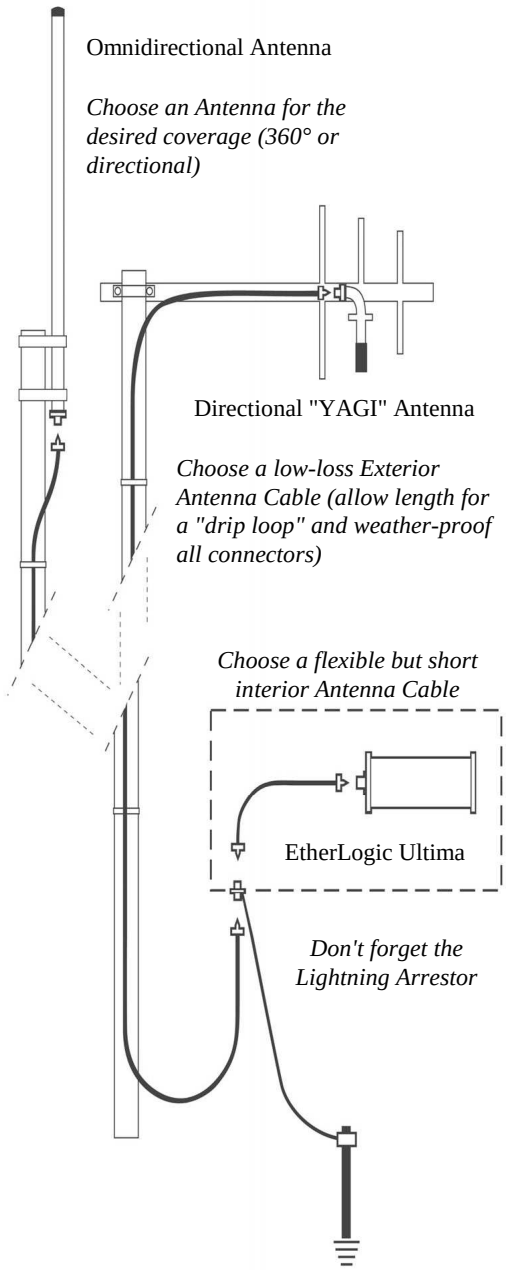
Spread spectrum radios tend to be less affected by outside interference and are more secure than conventional radios because they are constantly changing operating frequency. If a spread spectrum radio encounters interference at a particular frequency, it simply picks up where it left off after hopping to the next frequency a few milliseconds later. The radios offer very high data reliability, utilizing a unique 32-bit error detection and correction scheme to ensure that corrupted data is never passed to the Controller. This protection is above and beyond the protocol level error handling.

The radios embedded in MAXIO I/O modules can deliver up to one watt of RF power, the maximum allowed by law in these frequency bands. This is a lower power than other types of radios operating at fixed licensed frequencies. These spread spectrum radios can have a range of up to 60 miles. The radios have a built-in repeater function, so that each radio can serve as a repeater to relay the messages of other radios located farther out as well as communicating the data from the Controller. There is no limit, other than transmission time, to the number of repeater hops used, so spread spectrum radio networks can provide hundreds of miles of coverage.

The radios in MAXIO I/O modules support real-time on-line diagnostics. The radios can be remotely configured and can even have the microprocessor firmware updated from a Master station. The remote diagnostics capability provides immediate status information for any segment of the radio net-work, including repeater links. This data can include Average signal strength and noise levels, as well as specific signal and noise levels for each of the 112 hopping frequencies. Additional information such as antenna reflections (SWR), operating temperature, and data error rates are available to analyze the performance of each portion of the radio network.

Radio Installation

The internal MAXIO I/O module spread spectrum radio is manufactured by FreeWave Technologies (www.freewave.com) and is functionally similar to their stand-alone FGR series radios without requiring any additional panel space, cabling or integration effort. FreeWave DGR and FGR series radios may be used together with the MAXIO I/O module radio options.



The MAXIO I/O modules radio option uses a female “SMA” type antenna connector. The antenna connector and the radio status lights are located on upper side of the Controller (see below).

Typically, a short, lightweight cable (such as RG-223 or LMR-200) connects between the radio antenna connector and a lightning arrestor in the panel. A lightning arrestor with dedicated ground rod is required for any outdoor installation. The lightning arrestor can also serve as a bulkhead connector to pass through the cabinet wall and transition to heavier, lower-loss type exterior antenna cables such as LMR-400 and LMR-600. These cables then connect to Yagi (directional) or Omni (omnidirectional) antennas. LMR-600 cable has lower loss for longer runs. LMR-400 is cheaper and more flexible, but less than 100ft. of cable can cut the signal strength in half! Heliax has the lowest loss, but is stiff and hard to work with.

Once the radio system has been verified, all exterior connections should be taped and weatherproofed for long-term reliability.

SMA Antenna Connector on side

Radio Configuration

The spread spectrum radio option is automatically connected to the second serial port internal to the module. The port configuration is identical to the configuration of the primary RS-232/RS-485 port. Like any other serial link, the radios operating parameters must be set to match those of the attached serial port in the I/O module. While the serial port parameters are set using The ScadaFlex I/O Toolbox software on a PC, the radio is configured using a PC computer connected to the radio diagnostic serial port close to the antenna connector. Use a "straight through" serial cable. Communicating with the radio requires a terminal emulation program. This can be either the terminal emulator built into the I/O Toolbox software, or the HyperTerminal software that comes with Windows, or similar alternative software. Set the terminal emulation configuration to:

19,200 baud, no parity, 8 data bits and NO flow control

The configuration menus in the radio are accessed by typing "Shift U" (be sure that "Caps Lock" is OFF, then while holding down the Shift key, press the U key). You should see the menu pictured below and the three internal radio status lights near the COM1 connector should be GREEN. Pressing the Escape key several times will cause the radio to return to normal operation.

Radio Configuration - MAIN MENU

When the radio has been placed into configuration mode, the radio status lights will glow green and the Main Menu screen will be displayed:

```
                    MAIN MENU
              Version 2.54 12-05-2005
                 Standard Hop Table
            Modem Serial Number 925-8978

(0)   Set Operation Mode
(1)   Set Baud Rate
(2)   Edit Call Book
(3)   Edit Radio Transmission Characteristics
(4)   Show Radio Statistics
(5)   Edit MultiPoint Parameters
(6)   TDMA Menu
(8)   Chg Password
(Esc) Exit Setup

Enter Choice
```

From this menu, a series of sub-menus are accessed to examine or set operating parameters. The radios are highly configurable, but for most applications, only menus 0 (Set Operation Mode), 1 (Set Baud Rate), 3 (Edit Radio Transmission Characteristics), 5 (Radio Statistics) and 5 (Edit MultiPoint

Parameters) are applicable and discussed in the remainder of this section. A full operations manual for the radios is available.

Radio Configuration - SET OPERATION MODE

The “Set Operation Mode” screen is selected by pressing “0” at the Main Menu. In this screen, the radios basic operating mode is chosen. The screen is depicted below:

```
                        SET MODEM MODE
                 Modem Mode is 2

(0)   Point to Point Master
(1)   Point to Point Slave
(2)   Point to MultiPoint Master
(3)   Point to MultiPoint Slave
(4)   Point to Point Slave/Repeater
(5)   Point to Point Repeater
(6)   Point to Point Slave/Master Switchable
(7)   Point to MultiPoint Repeater
(F)   Ethernet Options
(Esc) Exit to Main Menu

Enter Choice
```

The current operating mode for the radio is always shown at the top of this screen just under the title header.

Of the 9 available operating modes, only three of the modes are typically used with the Ultima Controllers. These three modes are the “Point to Multipoint” operating modes:

Point to Multipoint Master

In this mode, there must be one, and only one Master radio in a system. All of the other radios in the network will operate as slaves to the Master. Typically, the radio in a MAXIO I/O module is a slave, not a Master.

Point to Multipoint Slave

After a single radio has been designated as the Master, the remaining radios in the network must be set as “Slaves” using selection #3 in the menu.

Point to Multipoint Slave/Repeater

To reach outlying areas in the network, the Slave radios can act as repeaters. Slave radios that will also act as repeaters are configured using selection #7 (Point to Multipoint Repeater) in the menu. Be sure to also enable Slave/Repeater operation in Menu #5.

Return to the Main Menu

Once a radios mode has been set, press the ESC (escape key to get back to the Main Menu (only press once, or else you will end up back at the “C>” prompt).

Radio Configuration - SET BAUD RATE

The “Set Baud Rate” screen is selected by pressing “1” at the Main Menu. In this screen, the radios basic serial communication parameters are chosen. The screen is depicted below:

```
                        SET BAUD RATE
                    Modem Baud is 115200

(0)   230,400
(1)   115,200
(2)   76,800
(3)   57,600
(4)   38,400
(5)   19,200
(6)   9,600
(7)   4,800
(8)   2,400
(9)   1,200
(A)   Data, Parity    0
(B)   Modbus RTU      1
(C)   RS232/485       0
(D)   Setup Port      3
(E)   Turn Off Delay  0       Turn On Delay  0
(F)   Flow Control    0
(Esc) Exit to Main Menu
Enter Choice
```

The current communications speed (baud rate) setting for the radio is always shown at the top of this screen, just under the title header. The baud rate can be set to any one of ten standard speeds by simply typing a 0 through 9 corresponding to baud rates of 1,200 baud to 230,400. Any of these speeds may be used with the EtherLogic Ultima controller. The speed selected MUST match the port speed selected using the ScadaFlex I/O Toolbox soft-ware.

Parity

The radio supports the standard “Odd, Even or None” parity selections. For most applications including those using Modbus, 0 or “None” should be used.

Modbus RTU

This parameter should normally be set to “1” (enabled), forcing the radio to keep the integrity of a single message as one packet instead of using multiple packets which does not meet Modbus standard timing requirements.

RS-232/485, Turn Off Delay, Turn On Delay and Flow Control

These are not used in the and must be set to “0”.

Setup Port

Set this parameter to 3. This enables both radio ports for configuration.

Radio Configuration - EDIT RADIO TRANSMISSION CHARACTERISTICS

The “Edit Radio Transmission Characteristics” screen is selected by pressing “3” at the Main Menu. The screen, with typical settings for a SCADA system, is depicted below:

```
                        RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0)   FreqKey          5
(1)   Max Packet Size  8
(2)   Min Packet Size  9
(3)   Xmit Rate        1
(4)   RF Data Rate     3
(5)   RF Xmit Power   10
(6)   Slave Security   0
(7)   RTS to CTS       0
(8)   Retry Time Out 255
(9)   Low power Mode   0
(A)   High Noise       0
(B)   MCU Speed        0
(C)   Remote LED       1
(Esc) Exit to Main Menu

Enter Choice
```

The parameters in this menu are geared towards handling special circumstances and should normally be left as shipped from the factory. One item though; “Remote LEDs”, must be turned on in order to enable the status LEDs located between the COM1 connector and the address switches. Be sure this parameter is set to a 1.

Most of the other parameters in this screen are used to optimize the radios operation in the event of problems in the field. They improve the operation of the radio in close proximity with other radio networks, in high (radio) noise environments, or to optimize the operation of the radio for certain mixes of data or types of protocols. In general, the radios are plug-and-play and these parameters are best left at the factory settings unless a technical support person recommends changing them. Typically, your radio setup should match the screen pictured above.

Radio Configuration - SHOW RADIO STATISTICS

The “Show Radio Statistics” screen is selected by pressing “4” at the Main Menu. The screen is depicted below:

```
                        MODEM STATISTICS

Master-Slave Distance (m) 0083200

Number of Disconnects      0
Radio Temperature          0
Antenna Reflected Power    0
Transmit Current (mA)   0000
         Local  Remote1 Remote2 Remote3
         J dBm      dBm     dBm     dBm
Noise    0   0
Signal   0   0
Rate %       0
000000

Press <ret> for Freq Table, <Esc> to return to main menu
```

The radio statistics screen shows an accumulated history of information regarding the performance of the radio and the quality of the radio link. Unlike the “real-time” updated information available at the Master, this information is a snapshot that can only be viewed while not operating, but it does provide a local tool to analyze the performance of a radio link.

Master-Slave Distance (m)

This value in meters is valid for distances over 1 Km (0.6 miles)

Radio Temperature

Should be 75 (oC) or less.

Average Noise and Signal Levels

These values are an average across all frequencies. Detailed information by frequency is available by displaying the Frequency Table accessed from this screen (see lower prompt line). Ideally, the noise level should be below “30” and the signal level should be at least “15” more than the noise. Note that this is NOT in dB, but arbitrary units to provide a relative signal strength and noise measurement.

Overall Rcv Rate (%)

This value provides an indication of the quality of the radio link and the impact on data throughput. A good quality link will have an Overall Receive Rate of 75% or better. The radio will not pass erroneous data, but a lower Overall

Receive Rate indicates that data throughput might be affected at higher data rates, such as 115,200 baud.

Radio Configuration - EDIT MULTIPOINT PARAMETERS

The “Editing MultiPoint Parameters” screen is selected by pressing “5” at the Main Menu. The screen, with typical settings for the EtherLogic LC, is depicted below:

```
                    MULTIPOINT PARAMETERS

(0)   Number Repeaters        1
(1)   Master Packet Repeat    3
(2)   Max Slave Retry         9
(3)   Retry Odds              9
(4)   DTR Connect             0
(5)   Repeater Frequency      0
(6)   Network ID             30
(7)   Reserved
(8)   MultiMaster Sync        0
(9)   1 PPS Enable/Delay    255
(A)   Slave/Repeater          0
(B)   Diagnostics             0
(C)   SubNet ID        Disabled
(D)   Radio ID          Not Set
(Esc) Exit to Main Menu

Enter Choice
```

Number of Repeaters

Repeaters extend the range of a radio network at the expense of speed. Any radio can also serve as a repeater. Set this parameter to 1 if you are using ANY repeaters. All radios in the network must have the same setting.

Master Packet Repeat

With a high quality link, set to 0 or 1 for maximum throughput. With a poor quality link, a higher number will improve getting individual messages though at the expense of speed and throughput. For Modbus networks, this value must be set to 3.

Network ID

This parameter helps avoid conflicts with other radio networks. All radios in the network should be set to the same ID value. Other networks must use a different value. Set this to any value below 4095, except the default (255).

Slave/Repeater

Set to 1 if this radio is a repeater as well as a node on the network. Be sure to set the Modem Mode (Menu #2) to (7) Multipoint Repeater also.

Diagnostics

Set to 1 for this radio to provide diagnostic data back to the Master.

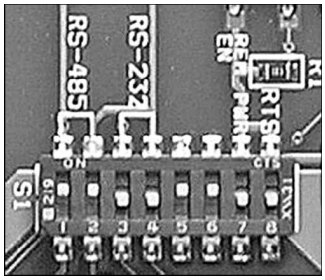
Internal Extra RS-232/RS-485 Port Option

When an internal radio is not required, the internal serial port can be brought out as an extra RS-232 or RS-485 compatible interface with the addition of an optional communications card.

The extra RS-232/RS-485 Port Option has two interface connectors, a standard DB-9 (male) RS-232 connector, and a terminal block for easy field wiring of RS-232 (no modem control) and RS-485 connections. The supported signals and pinouts are as follows:

	DB-9	Terminal Block	
RS-232 Carrier Detect	1	-	
RS-232 Receive data	2	2	
RS-232 Transmit Data	3	1	
RS-232 Data terminal Ready	4	-	
Ground (RS-232 & RS-495)	5	3	
RS-232 Data Set Ready	6	-	
RS-232 Request to Send	7	-	
RS-232 Clear to Send	8	-	
RS-485 +	-	1	
RS-485 -	-	2	
Power Control	-	4	30V 6A FET - ON = Ground, OFF= OPEN

A bank of DIP switches is used to configure the RS-232/RS-485 option. The switches configure the interface signals brought out on the terminal block (RS-232 or RS-485) and select the control signal that operates the power control relay. The switches are accessed via the back controller.



RS-232 on terminal block	Switches 1 & 2 OFF, switches 3 & 4 ON
RS-485 on terminal block	Switches 1 & 2 ON, switches 3 & 4 OFF

Specifications

DISCRETE INPUTS

Quantity	24, grouped as 4 and 8, and 4 and 8		
Input type	Optically isolated with shared isolated commons, AC or DC		
Signal Input Ranges	Range	ON Minimum	OFF Maximum
	12/24V models	9Vac/Vdc	6Vac/Vdc
	120/240V models	75Vac/Vdc	50Vac/Vdc
Maximum input level	50 Vac/Vdc (12/24V models), 250Vac/Vdc (120/240V models)		
DI Pulse Counting Rate	DI #1 through DI#4	40Hz (Filters ON), >5KHz (Filters OFF)	
	DI #5 through DI #24	up to 40Hz (DC Pulse 50% Duty cycle)	
		up to 10Hz (AC switched, 50/60Hz)	

DISCRETE OUTPUTS

Quantity	16
Output type	Relay Contact, Form A (Normally Open)
Output Rating and Contact Life	
General Use (Resistive Loads)	10Amps @125Vac, 5 Amps @250Vac or 30Vdc - 100,000 cycles
Inductive Loads	10Amps @ 277Vac - 10,000 cycles (COS=0.4)
	1/10HP @125Vac, 1/6HP @250Vac -100,000 cycles
Contact Protection	RC Snubber

COMMUNICATIONS

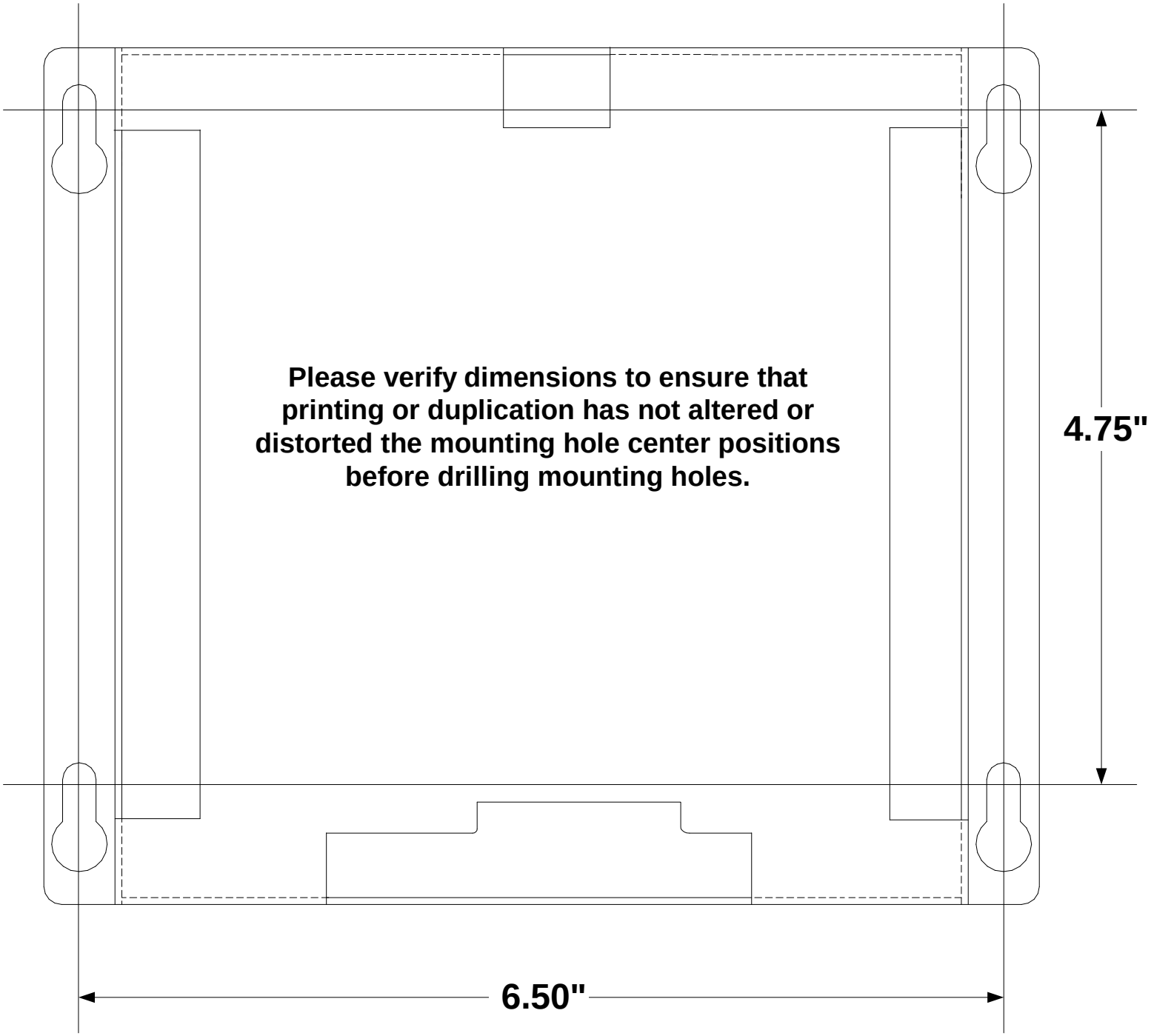
Serial Ports	2 (1 standard + 1 internal)
Communications Baud Rates	2400 baud to 115,200 baud
Serial Port Interfaces	COM #1 RS-232, 9 pin D Male & RS-485, 2-pos. removable terminal block
	COM #2 Optional Internal Radio or 2nd RS-232/RS-485 port:
Protocols	Modbus RTU (slave) or ICL BrickNet (peer-to-peer), auto-detect

COMMUNICATIONS OPTIONS (one per module)

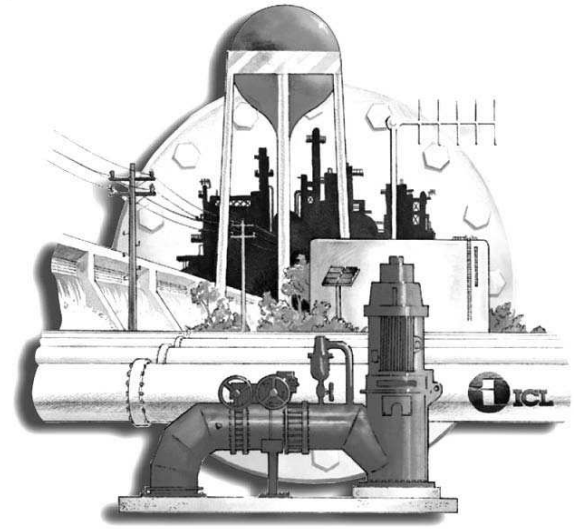
Internal Spread Spectrum Radios	900MHz, 1W, up to 115Kbaud, 2.4GHz, 0.5W, up to 115Kbaud
Serial Comm. Option	RS-232/RS-485 Add-on Port

GENERAL SPECIFICATIONS

Field I/O Wiring Terminations	Removable Terminal Blocks, wiring: #14 to #26 stranded or solid, #12 stranded
Dimensions	7.0" W x 6.0" L x 2.5" D (178mm x 152mm x 64mm)
Power	10 to 36Vdc, 10 to 26Vac
No Inputs or Outputs ON	0.36 Watts typical @ 12vdc, 0.54Watts typical @ 24vdc
Add per Discrete INPUT ON	4mW (I/O status LEDs disabled), 48mW (I/O status LEDs enabled)
Add per Discrete OUTPUT ON	190mW (I/O status LEDs disabled), 235mW (I/O status LEDs enabled)
All Inputs and Outputs ON (LEDs enabled)	5.1 Watts typical @ 12vdc, 5.4 Watts typical @ 24vdc
Operating Temperature and Humidity	-40°C to 75°C (-40°F to 167°F),5 to 95% RH (non-condensing)



Scale = 1:1
MAXIO Mounting Template



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