

MODELS CSMSTRSX AND CSMSTRGT - Enhanced Modular Controller Series

Master



- PROVIDES ENHANCED FEATURES FOR DATA ACQUISITION OR MULTI-ZONE PID CONTROL APPLICATIONS
- WEBSERVER PROVIDES WORLDWIDE ACCESS TO DATA LOGS AND VIRTUAL HMI
- VIRTUAL HMI OFFERS BUILT-IN PC-BASED SCADA FUNCTIONALITY
- PERFORMS HIERARCHICAL CONTROL OF OTHER MODULES IN THE MODULAR CONTROLLER SERIES
- STORES MODULE CONFIGURATION INFORMATION, AND AUTOMATICALLY REPROGRAMS REPLACED MODULES
- EXTENSIVE BUILT-IN DRIVER LIST ALLOWS EASY DATA MAPPING TO PLCs, PCs, AND SCADA SYSTEMS
- INDEPENDENT SERIAL PORTS PROVIDE VIRTUALLY UNLIMITED INTEGRATION METHODS
- 10 BASE-T/100 BASE-TX ETHERNET CONNECTION PROVIDES NETWORKING CAPABILITY
- SUPPORTS UP TO 16 MODULAR CONTROLLER SERIES MODULES
- COMPACTFLASH® SLOT ALLOWS PROCESS DATA TO BE LOGGED DIRECTLY TO CSV FILES



FOR USE IN HAZARDOUS LOCATIONS:
 Class I, Division 2, Groups A, B, C, and D



GENERAL DESCRIPTION

The Model CSMSTR is a communications and control platform designed for use with Modular Controller Series slave modules. The CSMSTR uses a proprietary high speed serial protocol to communicate, via backplane connection, with up to 16 slave modules. Through the same connection, the Master also provides power to the modules.

When powered up, the CSMSTR automatically identifies and addresses connected slave modules. By storing the configuration information of all of the modules, the CSMSTR is able to automatically configure modules if they are replaced.

The Master provides high-speed RS232/422/485 communication ports and an Ethernet port for connection to PCs, PLCs, and SCADA systems. An extensive list of master and slave protocol drivers are available to

allow the CSMSTR to share and exchange variable data with external devices. The 10 Base-T/100 Base-TX Ethernet port can also be used to connect and share data with other devices at high speeds. The virtual HMI feature allows you to create and control an HMI from any networked PC. An onboard CompactFlash slot provides storage for the Master's built-in data logger.

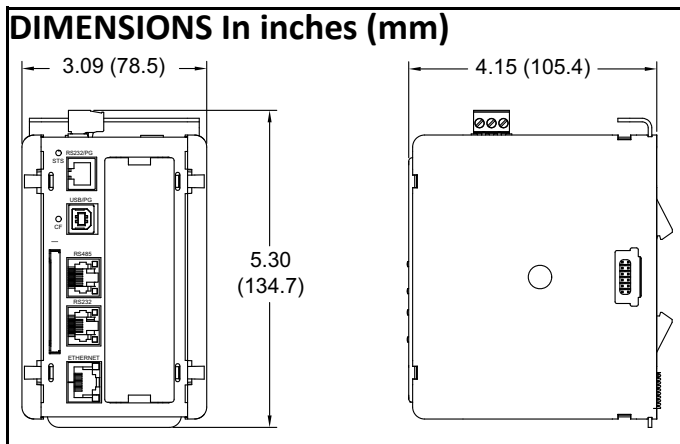
The design of the Modular Controller Series high density packaging and DIN rail mounting saves time and panel space. The controller snaps easily onto standard top hat (T) profile DIN rail.

SOFTWARE

The CSMSTR is programmed with Crimson® 2.0 software for Windows® 2000 or later platforms. The software is an easy to use, graphical interface which provides a means of communication configuration, as well as commissioning and calibration of new systems.

CONTENTS OF PACKAGE

- CS Master
- Termination Plug
- Terminal block for connecting power
- Rubber End Cap



CompactFlash is a registered trademark of CompactFlash Association.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended.



CAUTION: Risk of Danger.

Read complete instructions prior to installation and operation of the unit.



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



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

SPECIFICATIONS

- POWER:** 24 VDC \pm 10%
400 mA min. (1 module)
3.5 Amps max. (16 modules + Expansion Card)
Must use NEC Class 2 or Limited Power Source (LPS) rated power supply.
- COMMUNICATIONS:**
USB/PG Port: Adheres to USB specification 1.1. Device only using Type B connection.



WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.

Serial Ports: Format and Baud Rates for each port are individually software programmable up to 115,200 baud.

RS232/PG Port: RS232 port via RJ12

COMMS Ports: RS422/485 port via RJ45, and RS232 port via RJ12

DH485 TXEN: Transmit enable; open collector, $V_{OH} = 15$ VDC,
 $V_{OL} = 0.5$ V @ 25 mA max.

Ethernet Port: 10 BASE-T / 100 BASE-TX

RJ45 jack is wired as a NIC (Network Interface Card).

- LEDs:**
STS – Status LED indicates condition of master.
TX/RX – Transmit/Receive LEDs show serial activity.
Ethernet – Link and activity LEDs.
CF – CompactFlash LED indicates card status and read/write activity
- MEMORY:**
On-board User Memory: 4 Mbytes of non-volatile Flash memory.
On-board SDRAM:
CSMSTRSX: 2 Mbytes
CSMSTRGT: 8 Mbytes
Memory Card: CompactFlash Type II slot for Type I and Type II cards.
- REAL-TIME CLOCK:** Typical accuracy is less than one minute per month drift.
Battery: Lithium Coin Cell. Typical lifetime of 10 years at 25 °C.
A “Battery Low” system variable is available so that the programmer can choose specific action(s) to occur when the battery voltage drops below its nominal voltage.
This unit is NOT field serviceable. All work must be done by a

qualified technician.

6. ENVIRONMENTAL CONDITIONS:

Operating Temperature Range: 0 to 50 °C

Storage Temperature Range: -30 to +70 °C

Operating and Storage Humidity: 80% max relative humidity, non-condensing, from 0 to 50 °C

Vibration to IEC 68-2-6: Operational 10 to 150 Hz, 1 g.

Shock to IEC 68-2-27: Operational 25 g.

Altitude: Up to 2000 meters

7. CONSTRUCTION:

Case body is burgundy high impact plastic and stainless steel. For indoor use only. Installation Category II, Pollution Degree 2.

8. POWER CONNECTION:

Removable wire clamp screw terminal block.
Wire Gage Capacity: 24 AWG to 12 AWG
Torque: 4.45 to 5.34 in/lb (0.5 to 0.6 N-m)

9. MOUNTING:

Snaps onto standard DIN style top hat (T) profile mounting rails according to EN50022 -35 x 7.5 and -35 x 15.

10. CERTIFICATIONS AND COMPLIANCES:

Check each module's specifications to determine system compliance.

CE Approved

EN 61326-1 Immunity to Industrial Locations

Emission CISPR 11 Class A

Safety requirements for electrical equipment for measurement, control, and laboratory use:

EN 61010-1: General Requirements

EN 61010-2-030: Particular Requirements for Testing and Measuring Circuits

EN 61010-2-201: Particular Requirements for Control Equipment

RoHS Compliant

UL Listed: File #E302106

UL Hazardous: File #E317425

ABS Certificate #09-HS426719-B-4-PDA

11. WEIGHT:

15.1 oz (456.4 g)



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

HARDWARE INSTALLATION

DIN rail should be mounted horizontally so that the unit's ventilation holes are vertical in relation to cabinet orientation. A minimum clearance of 1 inch (25.4 mm) should be maintained above and below the unit in order to ensure proper thermal regulation.

The unit shall be installed inside a UL Listed Industrial Control Panel or similar type of enclosure. A minimum 3.2 mm distance shall be maintained between the hazardous live parts of the equipment and accessible parts of the fire/electrical enclosure.

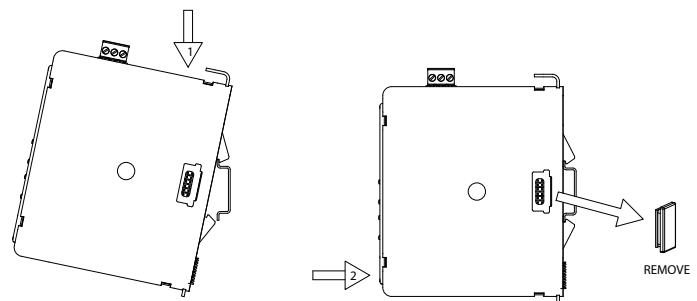


Figure 1 - Attach CSMSTR Master To DIN Rail and Remove Rubber End Cap

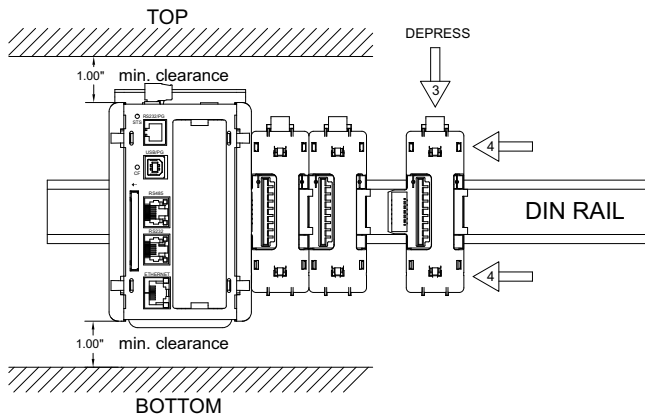


Figure 2 - Attach Slave Bases To DIN Rail

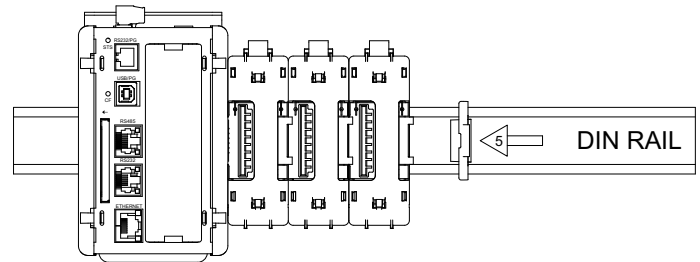


Figure 3 - Attach Termination Plug*

* Supplied with CSMSTR Master Module.

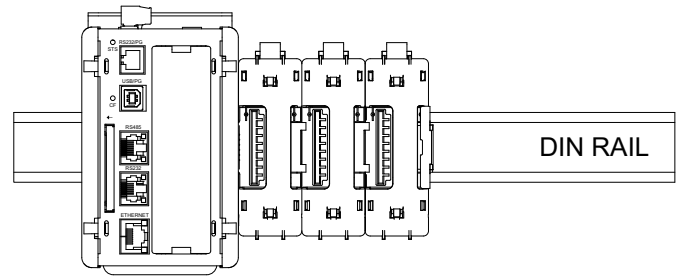
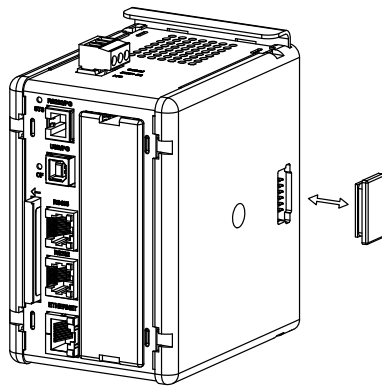


Figure 4 - Installation Complete

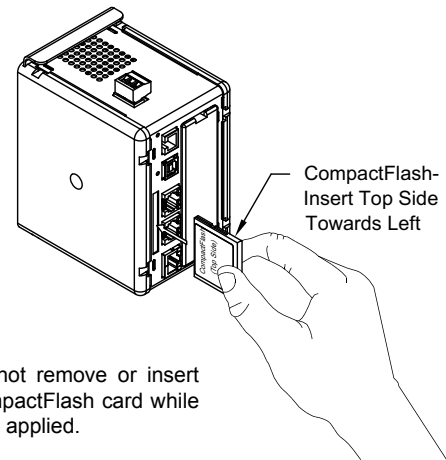
PROTOCOL CONVERSION

Mount the Master as shown under Hardware Installation Figure 1 above. Install the rubber end cap. The end cap protects the pins from damage. Configure the Master for zero modules.



COMPACTFLASH® CARD

CompactFlash socket is a Type II socket that can accept either Type I or II cards. Use cards with a minimum of 4 Mbytes and formatted to a maximum of 2 Gbytes (see Note box) with the Master's CompactFlash socket. Cards are available at most computer and office supply retailers. CompactFlash cards can be used for configuration transfers, data logging, and trending.



Note: Do not remove or insert the CompactFlash card while power is applied.

Information stored on a CompactFlash card can be read by a card reader attached to a PC. This information is stored in IBM (Windows®) PC compatible FAT16 file format.

NOTE

For reliable operation of this and other Red Lion products, one of the following brands of CompactFlash card must be used...

- | | | |
|------------|-----------------|-----------|
| SimpleTech | SMART® Modular | swissbit® |
| SanDisk® | Silicon Systems | |

Not all of the above manufacturers offer CompactFlash cards recognized to UL standards, which may be required for your application. Although Red Lion Controls products limit use of CompactFlash card memory to 2 GB, cards with a larger capacity can be used. They MUST be formatted to 2 GB and use the FAT 16 file system. It is recommended to format the CF card using the format utility from within Crimson.

POWER SUPPLY REQUIREMENTS

It is very important that the power supply is mounted correctly if the unit is to operate reliably. Please take care to observe the following points:

- The power supply must be mounted close to the unit, with usually not more than 6 feet (1.8 m) of cable between the supply and the master. Ideally, the shortest length possible should be used.
- The wire used to connect the master's power supply should be at least 22-gage wire. If a longer cable run is used, a heavier gage wire should be used. The routing of the cable should be kept away from large contactors, inverters, and other devices which may generate significant electrical noise.
- A power supply with an NEC Class 2 or Limited Power Source (LPS) and SELV rating is to be used. This type of power supply provides isolation to accessible circuits from hazardous voltage levels generated by a mains power supply due to single faults. SELV is an acronym for "safety extra-low voltage." Safety extra-low voltage circuits shall exhibit voltages safe to touch both under normal operating conditions and after a single fault, such as a breakdown of a layer of basic insulation or after the failure of a single component has occurred.

Visit www.redlion.net for a complete list of our PSDR Series of NEC Class 2 power supplies.

EMC INSTALLATION GUIDELINES

Although Red Lion Controls products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
 - a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
 - b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
 - Fair-Rite part number 0443167251 (Red Lion Controls #FCOR0000) Line Filters for input power cables:
 - Schaffner # FN2010-1/07 (Red Lion Controls #LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
 - a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.

- b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most Red Lion products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.

Red Lion part numbers: Snubber: SNUB0000

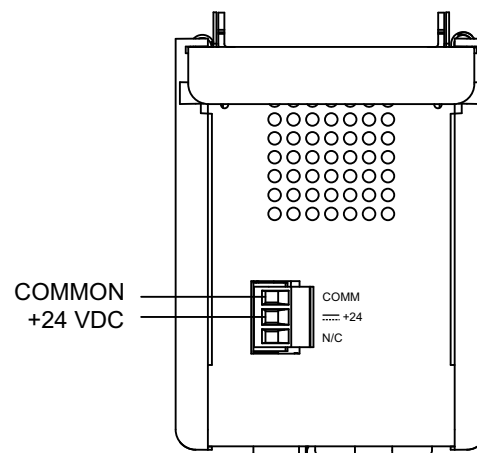
Varistor: ILS11500 or ILS23000

7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit www.redlion.net/emf for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion products.

WIRING

POWER CONNECTION



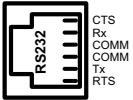
WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT WHILE CIRCUIT IS ALIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.



INPUT AND OUTPUT (I/O) WIRING MUST BE IN ACCORDANCE WITH CLASS I, DIV. 2 WIRING METHODS AND IN ACCORDANCE WITH THE AUTHORITY HAVING JURISDICTION.

PROGRAMMING PORTS

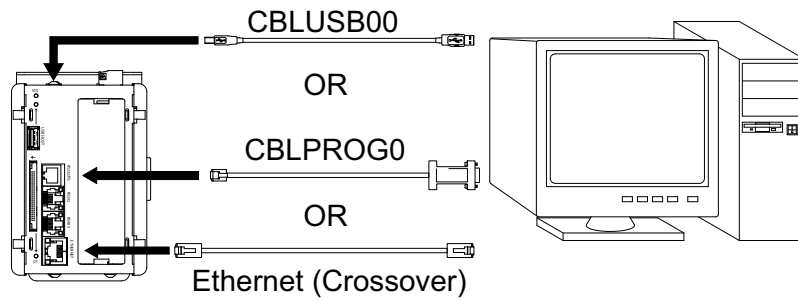
RS232/PG



USB/PG

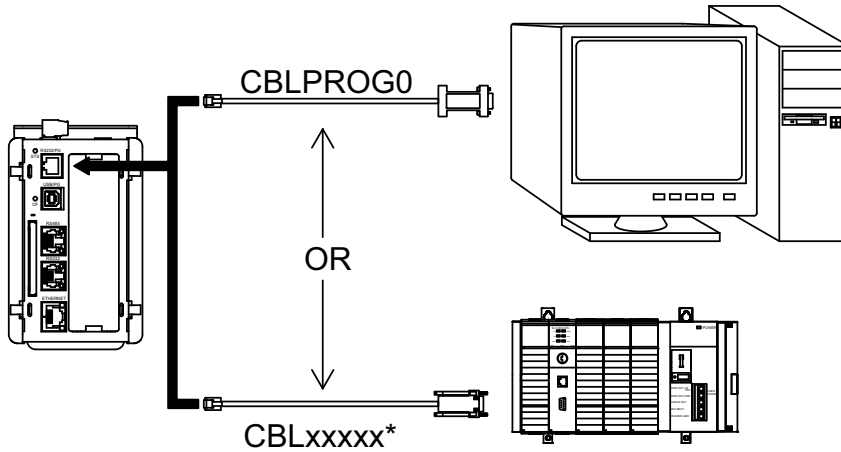
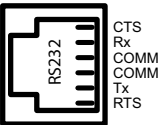


ETHERNET

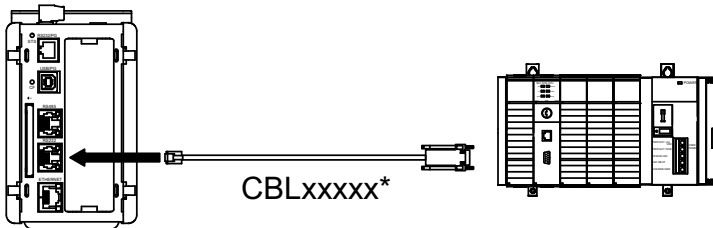
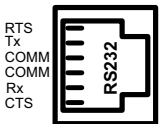


COMMUNICATION PORTS

RS232/PG

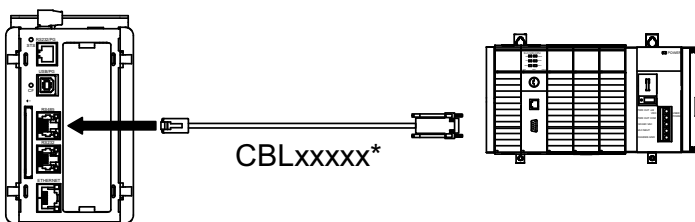
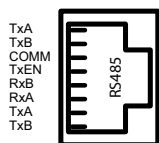


RS232



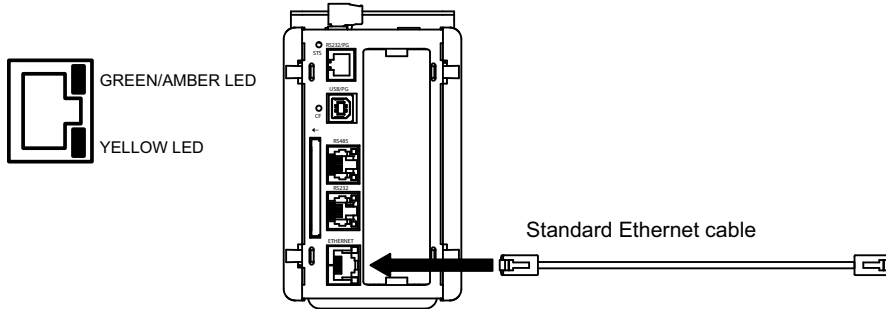
* Use appropriate communications cable. See Ordering Information for descriptions of the available cables.

RS485

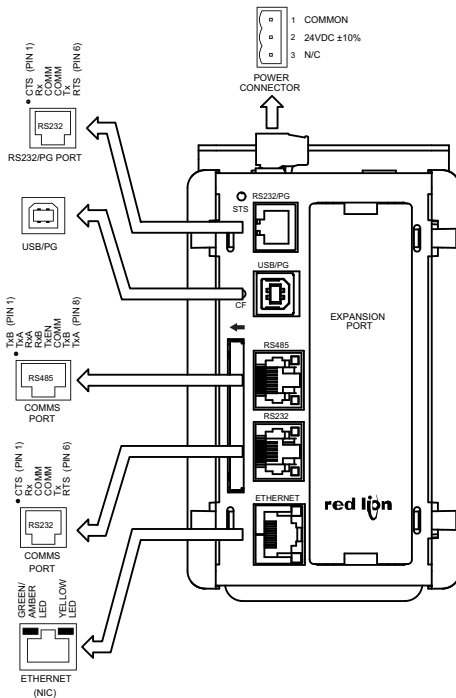


WARNING: Do **NOT** use a standard DH-485 cable to connect this port to Allen Bradley equipment.

PORT 3 - ETHERNET CONNECTION



MASTER PORT PIN OUTS



TROUBLESHOOTING

If for any reason you have trouble operating, connecting, or simply have questions concerning your new Master, contact Red Lion's technical support.

Email: support@redlion.net
Website: www.redlion.net
Inside US: +1 (877) 432-9908
Outside US: +1 (717) 767-6511

COMMUNICATING WITH THE MASTER

CONFIGURING A MASTER

The Master is configured using Crimson 2.0 software. Crimson software is available as a no charge download from Red Lion's website. Crimson updates for new features and drivers are posted on the website as they become available. By configuring the Master using the latest Crimson version, you are assured that your unit has the most up to date feature set. Crimson software can configure the Master through the RS232/PG port, USB/PG port, Ethernet or CompactFlash. The USB/PG port is connected using a standard USB cable with a Type B connector.


The driver needed to use the USB port will be installed as part of Crimson configuration. The RS232/PG port uses a programming cable made by Red Lion to connect to the DB9 COM port of your computer. If making your own cable, refer to the "Master Port Pin Outs" for wiring information.

The CompactFlash can be used to program a Master by placing a configuration file and firmware on the CompactFlash card. The card is then inserted into the target Master and powered. Refer to the Crimson 2.0 literature for more information on the proper names and locations of the files.

CABLES AND DRIVERS

Red Lion has a wide range of cables and drivers for use with many different communication types. A list of these drivers and cables along with pin outs is available from Red Lion's website. New cables and drivers are added on a regular basis. If making your own cable, refer to the "Master Port Pin Outs" for wiring information.

USB, DATA TRANSFERS FROM THE COMPACTFLASH CARD



WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.

In order to transfer data from the CompactFlash card via the USB port, a driver must be installed on your computer. This driver is installed with Crimson software and is located in the folder C:\Program Files\Red Lion Controls\Crimson 2.0\Device\ after Crimson 2.0 is installed. This may have already been accomplished if your Master was configured using the USB port.

Once the driver is installed, connect the Master to your PC with a USB cable, and follow "Mounting the CompactFlash" instructions in the Crimson 2.0 user manual.

Note that using the USB port for frequent data transfers is not recommended. For frequent data transfers it is recommended that the Ethernet connection be used. Through the Ethernet connection a web page can be set up to view logged data. Refer to the Crimson 2.0 manual for details.

Note: The USB port is for system set-up and diagnostics and is not intended for permanent connection.

ETHERNET COMMUNICATIONS

Ethernet communications can be established at either 10 BASE-T or 100 BASE-TX. The Master's RJ45 jack is wired as a NIC (Network Interface Card). For example, when wiring to a hub or switch use a straight-through cable, but when connecting to another NIC use a crossover cable.

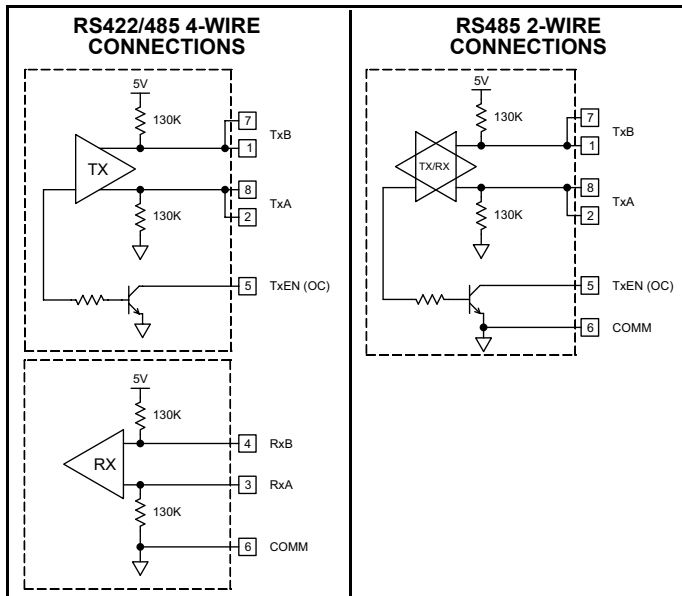
Refer to the Crimson manual and Red Lion's website for additional information on Ethernet communications.

RS232 PORTS

The Master has two RS232 ports. There is the RS232/PG port and the COMMS port. Although only one of these ports can be used for programming, both ports can be used for communications with a PLC. The RS232/PG port can be used for either master or slave protocols.

RS422/485 COMMS PORT

The Master has one RS422/485 port. This port can be configured to act as either RS422 or RS485.



Note: All Red Lion devices connect A to A and B to B. Refer to www.redlion.net for additional information.

DH485 COMMUNICATIONS

The Master's RS422/485 COMMS port can also be used for Allen Bradley DH485 communications.

WARNING: DO NOT use a standard DH485 cable to connect this port to Allen Bradley equipment. A cable and wiring diagram are available from Red Lion.

LEDs

STS – STATUS LED

The green Status LED provides information regarding the state of the Master, as well as the rest of the system. This includes indication of the various stages of the start-up routine (power-up), and any errors that may occur.

Startup Routine

	INDICATION
Rapidly Flashing	Master is currently running the boot loader and/or being flash upgraded by Crimson software.
Steady	Master is operating properly.

Error States

LED	INDICATION
1 blink, pause, repeat	One or more slave modules are missing from the system. Master and installed modules will perform normally in this state.
2 blinks, pause, repeat	Missing configuration, or configuration being updated by Crimson program
3 blinks, pause, repeat	Quantity of module bases does not match configuration file. Master will not communicate with the modules until the error is corrected.
4 blinks, pause, repeat	Termination plug not installed, or one or more bases are malfunctioning. Master will not communicate with the modules until the plug is reinstalled, and power is cycled.

CF LED

LED	INDICATION
Off	No CompactFlash Card is present.
Steady	Valid CompactFlash card is present.
Flashing Rapidly	CompactFlash card is being checked.
Flickering	Unit is writing to the CompactFlash, either because it is storing data, or because the PC connected via the USB port has locked the drive. ¹
Flashing Slowly	Incorrectly formatted CompactFlash card present.

1. Do not turn off power to the unit while this light is flickering. The unit writes data in two minute intervals. Later Microsoft operating systems will not lock the drive unless they need to write data; Windows 98 may lock the drive any time it is mounted, thereby interfering with logging. Refer to "Mounting the CompactFlash" in the Crimson 2.0 User Manual.

USER COMMUNICATION PORTS - TX/RX LEDS

LED	INDICATION
GREEN	Transmitting
RED	Receiving

Note: LEDs are not available on the Programming Port: RS232/PG.

ETHERNET LEDS

LED	INDICATION
YELLOW (Solid)	Link Established
YELLOW (Flashing)	Network Activity
GREEN	10 BASE-T Communications
AMBER	100 BASE-TX Communications

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Master Module	CSMSTR ¹	Modular Controller Master, Multi Comms ports and Ethernet	CSMSTRV2
		Modular Controller Master with multiple protocol converter, Ethernet and expansion slot	CSMSTRLE
		Modular Controller Master with multiple protocol converter, data logger, web server with Virtual HMI up to QVGA (320 x 240) size and expansion slot	CSMSTRSX
		Modular Controller Master with multiple protocol converter, data logger, web server with Virtual HMI up to VGA (640 x 480) size and expansion slot with increased SDRAM	CSMSTRGT
Communications Cables (10 feet)	CBL	RS232 Programming Cable	CBLPROG0
		USB Cable	CBLUSB00
		Communications Cables ¹	CBLxxxx
Software	SFCRM2	Crimson 2.0 ² , Modular Controller Manual, and Download Cable	SFCRM2MC
Power Supply	PSDR	DIN Rail Mounted Power Supply	PSDRxxxx
Accessories	XCCN	CANopen option card for Modular Controller or Data Station Plus	XCCN0000
	XCDN	DeviceNet option card for Modular Controller or Data Station Plus	XCDN0000
	XCHSPA	GSM/HSPA+ Modem Option Card ³ for Modular Controller or Data Station Plus	XCHSPA00
	XCPB	PROFIBUS option card for Modular Controller or Data Station Plus	XCPBDP00
	XCRS	RS232/485 option card for Modular Controller or Data Station Plus	XCRS0000
	G3CF	CompactFlash Card ⁴	G3CFxxxx
	ANT	2G/3G 3" hinged antenna	ANT-TG090113
		2G/3G/4G LTE low profile direct permanent mount antenna, IP67 rated	ANT-G30B108111
		2G/3G 4.5" whip magnetic mount antenna, IP65 rated	ANT-GA107201111
		2G/3G low profile direct permanent mount antenna, IP65 rated	ANT-G21B301111
		Rail Stops (Qty 2)	RSRSTP00
		Replacement Base	CSBASE00
		Replacement Termination Plug	CSTERM00
	Replacement Rubber End Cap	CSBUNG00	

Note: Certain modules are not suitable for use in Hazardous locations. Check each module's specifications prior to installation.

¹ Visit www.redlion.net for a complete list of PID modules, data acquisition modules, communications drivers and cables.

² Use this part number to purchase Crimson on CD with a printed Modular Controller Manual, USB cable, and RS-232 cable. Otherwise, download at no charge from www.redlion.net.

³ Antenna is NOT included with the card. Must be purchased separately if needed.

⁴ Industrial grade two million write cycles. SMART Modular Technologies model SG9CF (UL Listed Directory Category NWGQ)

LIMITED WARRANTY

(a) Red Lion Controls Inc., Sixnet Inc., N-Tron Corporation, or Blue Tree Wireless Data, Inc. (the "Company") warrants that all Products shall be free from defects in material and workmanship under normal use for the period of time provided in "Statement of Warranty Periods" (available at www.redlion.net) current at the time of shipment of the Products (the "Warranty Period"). **EXCEPT FOR THE ABOVE-STATED WARRANTY, COMPANY MAKES NO WARRANTY WHATSOEVER WITH RESPECT TO THE PRODUCTS, INCLUDING ANY (A) WARRANTY OF MERCHANTABILITY; (B) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; OR (C) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.** Customer shall be responsible for determining that a Product is suitable for Customer's use and that such use complies with any applicable local, state or federal law.

(b) The Company shall not be liable for a breach of the warranty set forth in paragraph (a) if (i) the defect is a result of Customer's failure to store, install, commission or maintain the Product according to specifications; (ii) Customer alters or repairs such Product without the prior written consent of Company.

(c) Subject to paragraph (b), with respect to any such Product during the Warranty Period, Company shall, in its sole discretion, either (i) repair or replace the Product; or (ii) credit or refund the price of Product provided that, if Company so requests, Customer shall, at Company's expense, return such Product to Company.

(d) **THE REMEDIES SET FORTH IN PARAGRAPH (c) SHALL BE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDY AND COMPANY'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN PARAGRAPH (a).**