

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

Isolator488

IEEE 488 Bus Isolator

USER'S MANUAL



IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146 • (440) 439-4091

Warranty Information

Your IOtech warranty is as stated on the *product warranty card*. You may contact IOtech by phone, fax machine, or e-mail in regard to warranty-related issues.

Phone: (440) 439-4091, fax: (440) 439-4093, e-mail: sales@iotech.com

Limitation of Liability

IOtech, Inc. cannot be held liable for any damages resulting from the use or misuse of this product.

Copyright, Trademark, and Licensing Notice

All IOtech documentation, software, and hardware are copyright with all rights reserved. No part of this product may be copied, reproduced or transmitted by any mechanical, photographic, electronic, or other method without IOtech's prior written consent. IOtech product names are trademarked; other product names, as applicable, are trademarks of their respective holders. All supplied IOtech software (including miscellaneous support files, drivers, and sample programs) may only be used on one installation. You may make archival backup copies.

FCC Statement



IOtech devices emit radio frequency energy in levels compliant with Federal Communications Commission rules (Part 15) for Class A devices. If necessary, refer to the FCC booklet *How To Identify and Resolve Radio-TV Interference Problems* (stock # 004-000-00345-4) which is available from the U.S. Government Printing Office, Washington, D.C. 20402.

CE Notice



Many IOtech products carry the CE marker indicating they comply with the safety and emissions standards of the European Community. As applicable, we ship these products with a Declaration of Conformity stating which specifications and operating conditions apply.

Warnings, Cautions, Notes, and Tips



Refer all service to qualified personnel. This caution symbol warns of possible personal injury or equipment damage under noted conditions. Follow all safety standards of professional practice and the recommendations in this manual. Using this equipment in ways other than described in this manual can present serious safety hazards or cause equipment damage.



This ESD caution symbol urges proper handling of equipment or components sensitive to damage from electrostatic discharge. Proper handling guidelines include the use of grounded anti-static mats and wrist straps, ESD-protective bags and cartons, and related procedures.

Specifications and Calibration

Specifications are subject to change without notice. Significant changes will be addressed in an addendum or revision to the manual. As applicable, IOtech calibrates its hardware to published specifications. Periodic hardware calibration is not covered under the warranty and must be performed by qualified personnel as specified in this manual. Improper calibration procedures may void the warranty.

Quality Notice



IOtech has maintained ISO 9001 certification since 1996. Prior to shipment, we thoroughly test our products and review our documentation to assure the highest quality in all aspects. In a spirit of continuous improvement, IOtech welcomes your suggestions.

Isolator488
Instruction Manual

Part No. Isolator488-901

Revision 1.2

December 1991

IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146 • (440) 439-4091

IMPORTANT!
READ THIS BEFORE INSTALLATION!

WARNING

The enclosure of the Isolator488 Bus Isolator is internally connected to earth ground through the power cord. However, the shield of the IEEE 488 cables attached to the Isolator488 and signal ground pins may be at a high voltage with respect to earth ground. Be sure to remove power from all devices in your system before handling IEEE 488 cables connected to the Isolator488. Failure to follow this warning may result in personal injury or death.

IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146 • (440) 439-4091

Table of Contents

Section 1	INTRODUCTION	Page
1.1	General Description	1.1
1.2	Available Accessories	1.1
1.3	Specifications	1.2
1.4	Abbreviations	1.3

Section 2	GETTING STARTED	Page
2.1	Inspection	2.1
2.2	Configuration	2.1
2.3	Modifications	2.4
2.4	Line Voltage Selection	2.7
2.5	Hardware Installations	2.9
2.6	Operation	2.10
2.6.1	BusLoading	2.11
2.6.2	Cabling Length	2.11
2.6.3	Signal Line Direction	2.12
2.6.4	Parallel Polling	2.13
2.6.5	Passing Control	2.13

Section 3	IEEE 488 Primer	Page
3.1	History	3.1
3.2	General Structure	3.1
3.3	Send It To My Address	3.5
3.4	Bus Management Lines	3.5
3.4.	Attention (ATN)	3.5
3.4.2	Interface Clear (IFC)	3.6
3.4.3	Remote Enable (REN)	3.6
3.4.4	End Or Identify (EOI)	3.6
3.4.	Service Request (SRQ)	3.6
3.5	Handshake Lines	3.7
3.5.1	Data Valid (DAV)	3.7
3.5.2	Not Ready For Data (NRFD)	3.7
3.5.3	Not Data Accepted (NDAC)	3.7
3.6	Data Lines	3.8
3.7	Multiline Commands	3.8

Section 3 (cont.)		Page
3.7.1	Go To Local (GTL)	3.8
3.7.2	Listen Address Group (LAG)	3.9
3.7.3	Unlisten (UNL)	3.9
3.7.4	Talk Address Group (TAG)	3.9
3.7.5	Untalk (UNT)	3.9
3.7.6	Local Lockout (LLO)	3.9
3.7.7	Device Clear (DCL)	3.9
3.7.8	Selected Device Clear (SDC)	3.10
3.7.9	Serial Poll Disable (SPD)	3.10
3.7.10	Serial Poll Enable (SPE)	3.10
3.7.11	Group Execute Trigger (GET)	3.10
3.7.12	Take Control (TCT)	3.10
3.7.13	Secondary Command Group (SCG)	3.10
3.7.14	Parallel Poll Configure (PPC)	3.11
3.7.15	Parallel Poll Unconfigure (PPU)	3.11
3.8	More On Service Requests	3.11
3.8.1	Serial Poll	3.12
3.8.2	Parallel Poll	3.12

Section 4	SERVICE INFORMATION	Page
4.1	Factory Service	4.1

Appendix A	Character Codes and IEEE Multiline Messages

Introduction

1.1 GENERAL DESCRIPTION

The Isolator488 increases the number of IEEE instruments and devices allowable on the bus from 15, including the controller, to 28 while also providing optical isolation between the system controller and devices on the isolated bus. Since the Isolator488 does not occupy a bus address, its operation is entirely transparent to the IEEE controller. The IEEE standard defines 31 valid primary bus addresses. Therefore, no special software or bank switching is necessary to access the additional devices allowed by the Isolator488. The Isolator488 and has no effect on bus data transfer rates.

Two IEEE ports are provided. One connects directly to the controller's IEEE bus, the other to an additional 14 instruments, printers, plotters and specialized peripherals which may need to be optically isolated from the system controller.

1.2 AVAILABLE ACCESSORIES

Additional accessories that can be ordered for the Isolator488 include:

123-0900	Instruction Manual
CA-7-1	1.5 foot IEEE 488 cable
CA-7-2	6 foot IEEE 488 cable
CA-7-3	6 foot Shielded IEEE 488 cable
CA-7-4	Reverse entry 6 foot IEEE 488 cable
CN-20	Right Angle IEEE 488 adapter, male and female
CN-21	IEEE 488 connector Extender, male and female
CN-22	IEEE 488 multi-tap bus strip, four female connectors wired in parallel.
CN-23	IEEE 488 panel mount feed-through connector, male and female

1.3 SPECIFICATIONS

PROPAGATION DELAYS:				
Local to Remote Talker				
Data Lines	85	nS typ.,	120	nS Max.
Command Lines	90	nS typ.,	125	nS Max.
Remote to Local Talker				
/ATN to Local Data	355	nS typ.,	475	nS Max.
/ATN to Local DAV	155	nS typ.,	2075	nS Max.
Data Lines	85	nS typ.,	120	nS Max.
Command Lines	90	nS typ.,	125	nS Max.
Parallel Poll Response	140	nS typ.,	205	nS Max.

SIGNAL LINE DIRECTIONS:	
Data Lines:	
DIO1 - DIO7	Bidirectional
Handshake Lines:	
DAV, NRFD, NDAC	Bidirectional
Command Lines:	
SRQ, ATN, REN, IFC	To Local Bus
ATN	To Remote Bus
EOI	Bidirectional
CONNECTORS:	Two IEEE 488 connectors with metric studs
INDICATORS:	LED for Power
POWER:	105-125V or 210-250V,50, 60 Hz; 20 VA MAX.
ENVIRONMENT:	0 to 50 °C; 0 to 70% RH
DIMENSIONS:	425 mm deep x 45 mm wide x 208 mm high. (16.75 "x 1.75 "x 8.20 ")
WEIGHT:	2.1 kg (4.6 lbs)
CONTROLS:	Power switch
SUPPLIED ACCESSORIES:	Power cable and manual
ISOLATION:	IEEE 488 common on Controller Bus to IEEE 488 common on Instrument Bus: 1600 volts peak maximum @ sea level to 10,000 ft. 0 - 70° C, and 0 - 80% RH non-condensing OR 500 Vac maximum, 10^5V-Hz

Specifications are subject to change without notice.

1.4 Abbreviations

The following IEEE 488 abbreviations are used throughout this manual.

addr n	IEEE bus address "n"
ATN	Attention line
CA	Controller Active
CR	Carriage Return
data	Data String
DCL	Device Clear
GET	Group Execute Trigger
GTL	Go To Local
LA	Listener Active
LAG	Listen Address Group
LF	Line Feed
LLO	Local Lock Out
MLA	My Listen Address
MTA	My Talk Address
PPC	Parallel Poll Configure
PPU	Parallel Poll Unconfigure
SC	System Controller
SDC	Selected Device Clear
SPD	Serial Poll Disable
SPE	Serial Poll Enable
SRQ	Service Request
TA	Talker Active
TAD	Talker Address
TCT	Take Control
term	Terminator
UNL	Unlisten
UNT	Untalk
*	Unasserted

GETTING STARTED

2.1 Inspection

The Isolator488 was carefully inspected, mechanically and electrically, prior to shipment. When you receive the interface, carefully unpack all items from the shipping carton and check for any obvious signs of physical damage which may have occurred during shipment. Report any damage to the shipping agent immediately. Remember to retain all shipping materials in the event that shipment back to the factory becomes necessary.

Every Isolator488 is shipped with the following....

• **Isolator488**	IEEE Bus Isolator
• **123-0900**	Instruction Manual
• **123-0800**	Accessory Kit (includes power cable, fuse, and rack mounting hardware)

2.2 Configuration

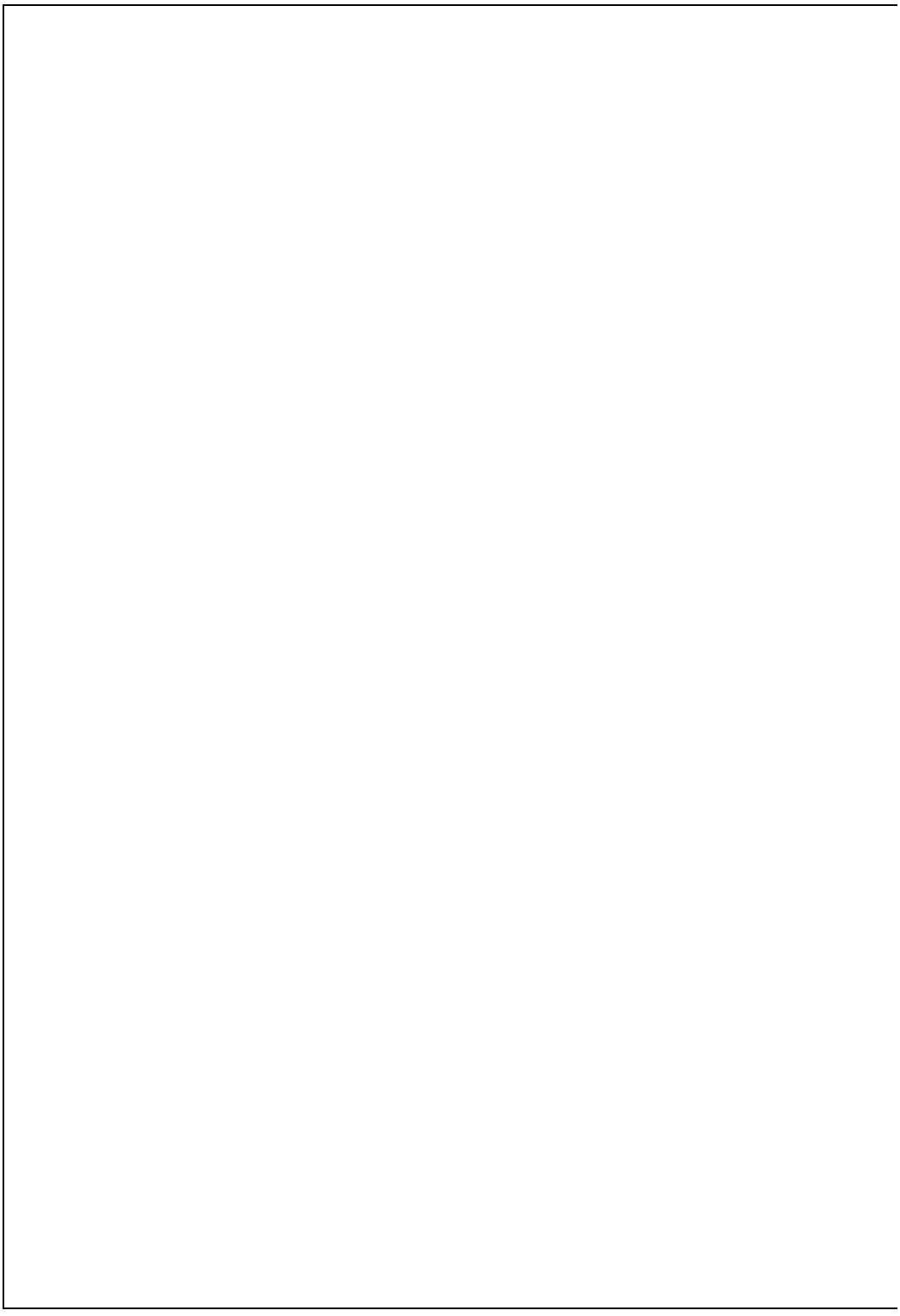
Before using the Isolator488, you should be aware of the connections between the IEEE digital commons, the shield lines on each bus, and earth ground. The following information is provided so that you can determine if the factory configuration is appropriate for your application or if some changes need to be made prior to use.

The following is a list of terms and their definitions as used in this manual:

Isolation	The ability of the Isolator488 to break the electrical connection between the shields and digital commons of its IEEE 488 ports while allowing the transfer of data.

Earth Ground	The Ground terminal on the AC power cable. This is internally connected to the chassis of the Isolator488.
Controller Port	The IEE 488 port labeled CONTROLLER on the rear panel of the Isolator488. The system controller must be connected to this port. Instruments may also be connected to this port, but instruments placed in the CONTROLLER port will not be isolated from the system controller.
Instrument Port	The IEEE488 port labeled INSTRUMENTS on the rear panel of the Isolator488. Instruments may be connected to this port. Instruments connected to the Instrument Port may be isolated from devices on the Controller Port depending on the internal configuration of the Isolator 488.
Controller Common	The logic common connection on the Controller Port. Pins 18, 19, 20, 21,22, 23, and 24 of the Controller Port are all connected to Controller Common.
Instrument Common	The logic common connection on the Instrument Port. Pins 18, 19, 20, 21, 22, 23, and 24 of the Controller Port are all connected to Instrument Common.
Controller Shield	The Shield connection (Pin 12) on the Controller Port.
Instrument Shield	The Shield connection (Pin 12) on the Instrument Port

The factory configuration of the Isolator488 is as follows:



As shown in the preceding diagram, the Isolator488 is shipped with a 'soft ground' consisting of a 1 MΩ resistor in parallel with a 0.01 µF capacitor between local Common and Earth Ground. This configuration should be suitable for most applications. If you wish to make any changes to this configuration, follow the steps given below.

2.3 Modifications

The Isolator488, as shipped from the factory, is configured for the typical use of the unit which is to isolate the instrument port from Earth ground and from Controller common. The factory configuration should be used unless you have a significant variation in your application beyond galvanic isolation devices on the Instrument port. If the factory configuration is not appropriate for your application, the following procedures may be undertaken to modify the Isolator488. It is necessary to open the enclosure to make any of the following changes. If yoou have any questions about a particular change, please contact the applications department at (440) 439-4091.

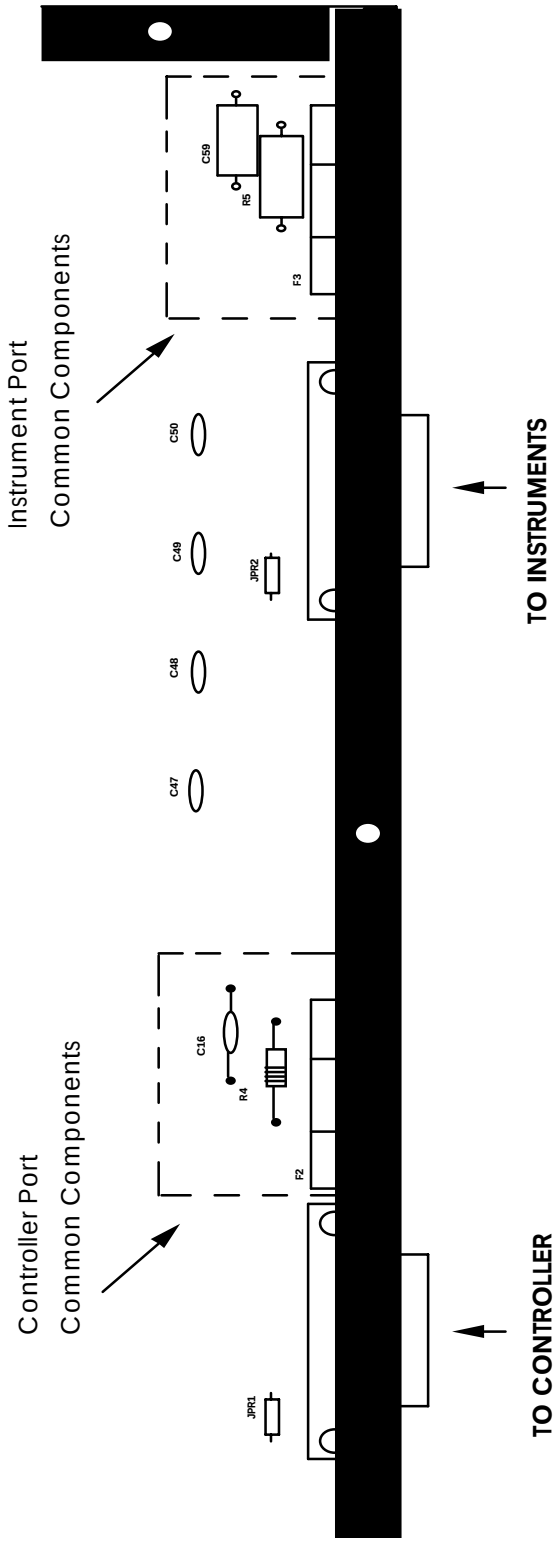
1. Disconnect the power cord from the AC line and from the Isolator488. Disconnect any IEEE cables prior to disassembly.

WARNING

Never open the Isolator488 case while it is connected to the AC line. Internal voltage potentials exist which could cause personal injury or death.

2. Place the Isolator488 on a flat surface. Remove the six screws on top of the case and remove the top cover. Located to the right of the Controller Port IEEE 488 connector are locations for C16, R4, and F2. Located to the right of the Instrument Port IEEE 488 connector are locations for C59, R5, and F3. Refer to the following figure:

Isolator488 Internal View



The following options are available on **each** port:

1. The Shield pin of the IEEE 488 connector (pin 12) may be connected to the logic common of the IEEE 488 connector (pins 18, 19, 20, 21, 22, 23, and 24) or left unconnected.

2. Logic common of IEEE 488 connector (pins 18, 19, 20, 21, 22, 23, and 24) may be connected to the chassis of the Isolator488, connected to the chassis through a soft ground, or left unconnected.

The following changes may be made to the Controller Port:

1. To remove the Controller common from earth ground, remove R4, and C16 by either desoldering the components (the bottom panel or the Isolator488 must be removed in order to do this) or cutting the component leads so that they may be removed. Make note of this change for later reference.

2. To connect Controller common to earth ground, insert a 1/2 amp fuse in the fuse clips labelled F2. The 1/2 amp fuse connects the Controller common to earth ground and limits fault currents to 1/2 amp. Make note of this change for later reference.

3. To connect pin 12 (shield) of the Controller Port to Controller Common, solder a jumper wire in the location labeled JPR1. Make note of this change for later reference.

The following changes may be made to the Instrument Port:

1. To add a soft ground between the Instrument Common and earth ground, insert a 1 MΩ 1/4 watt resistor in the location labelled R5. Insert a 0.01 µF 2kv ceramic capacitor in the location labelled C59. Solder these components in place from the solder side of the circuit board using rosin core solder. The bottom panel or the Isolator488 will need to be removed in order to do this. Make note of these changes for later reference.

2. To connect the Instrument Common to earth ground, insert a 1/2 amp fuse in the fuse clips labelled F3. Make note of this change for later reference.

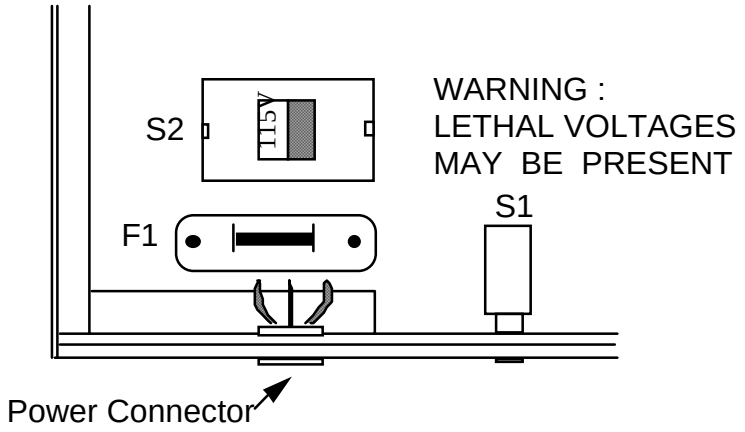
3. To connect pin 12 (shield) of the Instrument Port to Instrument Common, solder a bare jumper wire in the location labeled JPR2. Make note of this change for later reference.

After making any changes to the Isolator488 internal circuitry, be sure to document your changes then carefully reassemble the unit.

2.4 Line Voltage Selection

The Isolator 488 is designed to accept either 105 to 125 volt or 210 to 250 volt, 50 or 60 Hz, AC power. Each unit, when shipped from the factory, is labeled with its input voltage setting. If this setting is not appropriate, the internal voltage selection witch must be changed. Failure to operate the Isolator488 from appropriate power source may result in damage to the unit. To check or change the voltage selection switch disconnect all cables from the Isolator488 and follow the steps below.

Isolator Fuse and Line Voltage Switch Locations



WARNING

Never open the Isolator488 case while it is connected to the AC line. Internal voltage potentials exist which could cause personal injury or death.

1. Place the Isolator488 on a flat surface. Remove the six screws on top of the case and remove the top cover. Located next to the rear panel power connector is switch S2 and fuse F1.

2. Insert the tip of a small screwdriver into the slot of the switch and move the switch to the left or right so that the desired line voltage selection appears on the switch. Make note of the new setting for later reference.

CAUTION

Use the 1/2 amp fuse, FU-1-.5, for 115 volt operation. Use the 1/4 amp fuse, FU-1-.25, for 230 volt operation. Failure to use the correct fuse could result in damage to the Isolator488.

3. Replace the 1/2 amp fuse, FU-1-.5 (for 115 volt operation), with the 1/4 Amp fuse (for 230 volt operation), part number FU-1-.25, that is included in the Isolator488 Accessory Kit.

4. Carefully reassemble the unit.

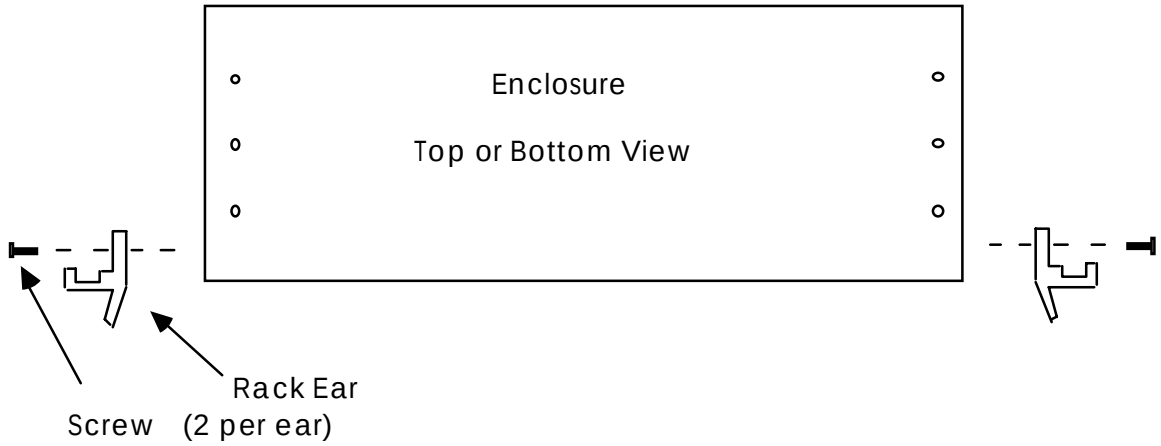
WARNING

The Isolator488 is intended for <u>INDOOR USE ONLY</u>. Failure to observe this warning could result in equipment failure, personal injury or death.

2.5 Hardware Installation

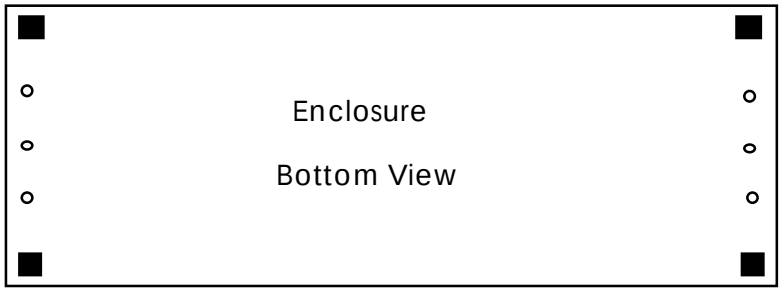
Included with the Isolator488 Bus Isolator are accessories for rack or bench use. If rack mount installation is required, install the two rack ears using the enclosed screws. These ears can be installed so either the front or the rear of the unit faces the front of the rack fixture.

View of Enclosure showing Rack Hardware Installation



If bench installation is required, the rubber feet can be installed on the underside of the unit near each corner.

View of Enclosure Bottom Showing Feet Placement



2.6 Operation

To begin operating the Isolator488, plug the power supply into the rear panel jack. Apply power to the Isolator488 by depressing the rear panel power switch. The front panel POWER LED should turn on.

If the POWER indicator does not light, there may not be any power supplied to the interface. In this event, check to make sure the AC power is supplied to the Isolator488, and that the power cord is properly installed into the unit. If the problem is unresolved, refer to the Service Information section (Section 4) of this manual.

If proper operation is obtained, turn off the Isolator488 and connect the other IEEE 488 devices to each of the Isolator488 ports. Apply power to all devices in the system.

Once all IEEE devices have been connected and powered on, the Isolator488 will allow the system controller to command up to 13 IEEE devices on its Controller Port (in addition to itself and the Isolator488), and up to 14 IEEE devices on the Instrument Port. The Isolator488 has no address of its own, and therefore will operate completely transparent to the system. Be careful not to have two IEEE devices with the same address connected to either ports. Failure to do so will result in the bus 'locking up' when one of the devices is accessed.

2.6.1 Bus Loading

The IEEE 488 specification allows for a maximum of 15 bus loads. The Isolator488 presents one bus load on each port. Therefore, an additional 14 devices can be placed on each the CONTROLLER and INSTRUMENT ports. Because the IEEE controller presents one bus load, a total of 27 instruments, printers, plotters and other peripherals can be accessed from a single IEEE controller.

2.6.2 Cabling Length

The IEEE 488 specification allows for cabling distance between bus devices of 2 meters (approx. 7 feet). The total worst case distance from the two furthest devices is not allowed to exceed 20 meters (approx. 70 feet). The addition of the Isolator488 does not increase this distance.

2.6.3 Signal Line Direction

The signal lines and their direction include....

Data Lines:	
DIO1 - DIO7	Bidirectional
Handshake Lines:	
DAV	Bidirectional
NRFD	Bidirectional
NDAC	Bidirectional
Command Lines:	
SRQ	To Controller Bus
ATN	To Instrument Bus
EOI	Bidirectional
REN	To Instrument Bus
IFC	To Instrument Bus

The majority of the command lines have their signal direction fixed. This forces bus control from the CONTROLLER bus.

When Attention (ATN) is asserted, the data lines, talker handshake line (DAV) and the EOI line direction is forced from the CONTROLLER to the INSTRUMENT port. The listener handshake lines (NRFD and NDAC) are forced from the INSTRUMENT to the CONTROLLER port. The commands are sent through the Isolator488 to the INSTRUMENT port.

When ATN is unasserted, the Isolator488 asserts NDAC on both ports, for a minimum of 200 nanoseconds, while looking for an active talker. If the talker is detected on the CONTROLLER port, the NDAC lines are released and the data and handshake line directions remain unchanged. If the active talker is detected on the INSTRUMENT port, the data line direction is force to the CONTROLLER port and the handshake line directions are reversed. The Isolator488 delays a minimum of 1200 nanoseconds to allow the data lines to settle before releasing the NDAC lines. Once changed, data transfers to 1 megabyte per second are possible.

2.6.4 Parallel Polling

During data transfer operations, the data line transceivers are operated in tri-state. When a parallel poll is detected, the CONTROLLER port transceiver is changed to open-collector and the data line direction is forced from the Instrument Port to the Controller Port. Parallel polling propagation delay through the Isolator488 is typically 85 nanoseconds.

2.6.5 Passing Control

If another device is included in the system which can receive control, it must be placed on the CONTROLLER port. IEEE 488 control can not be passed through the Isolator488.

IEEE 488 Primer

3.1 HISTORY

The **IEEE 488** bus is an instrumentation communication bus adopted by the Institute of Electrical and Electronic Engineers in 1975 and revised in 1978. The **Isolator488** conforms to this most recent revision designated **IEEE 488-1978**.

Prior to the adoption of this standard, most instrumentation manufacturers offered their own versions of computer interfaces. This placed the burden of system hardware design on the end user. If his application required the products of several different manufacturers, then he might need to design several different hardware and software interfaces. The popularity of the **IEEE 488** interface (sometimes called the **G**eneral **P**urpose **I**nterface **B**us or **GPIB**) is due to the total specification of the electrical and mechanical interface as well as the data transfer and control protocols. The use of the **IEEE 488** standard has moved the responsibility of the user from design of the interface to design of the high level software that is specific to the measurement application.

3.2 GENERAL STRUCTURE

The main purpose of the **GPIB** is to transfer information between two or more devices. A device can either be an instrument or a computer. Before any information transfer can take place, it is first necessary to specify which will do the talking (send data) and which devices will be allowed to listen (receive data). The decision of who will talk and who will listen usually falls on the **System Controller** which is, at power on, the **Active Controller**.

The **System Controller** is similar to a committee chairman. On a well run committee, only one person may speak at a time and the chairman is responsible for recognizing members and allowing them to have their say. On the bus, the device which is recognized to speak is the **Active Talker**. There can only be one Talker at a time if the information transferred is to be clearly understood by all. The act of "giving the floor" to that device is called **Addressing to Talk**. If the committee chairman can not attend the meeting, or if other matters require his attention, he can appoint an acting chairman to take control of the proceedings. For the **GPIB**, this device becomes the **Active Controller**.

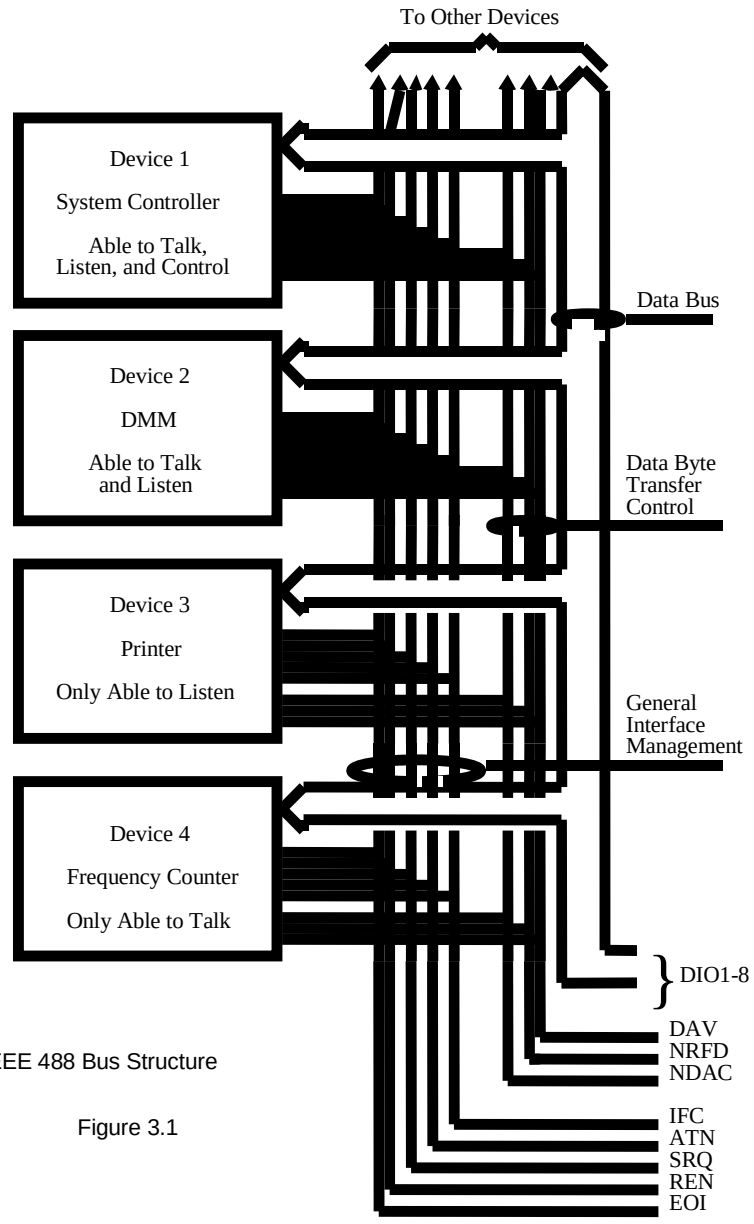
At a committee meeting, everyone present usually listens. This is not the case with the **GPIB**. The **Active Controller** selects which devices will listen and commands all other devices to ignore what is being transmitted. A device is instructed to listen by being **Addressed to Listen**. This device is then referred to as an **Active Listener**. Devices which are to ignore the data message are instructed to **Unlisten**.

The reason some devices are instructed to **Unlisten** is quite simple. Suppose a college instructor is presenting the day's lesson. Each student is told to raise their hand if the instructor has exceeded their ability to keep up while taking notes. If a hand is raised, the instructor stops his discussion to allow the slower students the time to catch up. In this way, the instructor is certain that each and every student receives all the information he is trying to present. Since there are a lot of students in the classroom, this exchange of information can be very slow. In fact, the rate of information transfer is no faster than the rate at which the slowest note-taker can keep up. The instructor, though, may have a message for one particular student. The instructor tells the rest of the class to ignore this message (**Unlisten**) and tells it to that one student at a rate which he can understand. This information transfer can then happen much quicker, because it need not wait for the slowest student.

The **GPIB** transfers information in a similar way. This method of data transfer is called **handshaking**. More on this later.

For data transfer on the **IEEE 488**, the **Active Controller** must …

a) **Unlisten** all devices to protect against eavesdroppers.
b) Designate who will **talk** by **addressing** a device to **talk**.
c) Designate all the devices who are to **listen** by **addressing** those devices to **listen**.
d) Indicate to all devices that the data transfer can take place.



IEEE 488 Bus Structure

Figure 3.1

3.3 SEND IT TO MY ADDRESS

In the previous discussion, the terms **Addressed to Talk** and **Addressed to Listen** were used. These terms require some clarification.

The **IEEE 488** standard permits up to 15 devices to be configured within one system. Each of these devices must have a unique address to avoid confusion. In a similar fashion, every building in town has a unique address to prevent one home from receiving another home's mail. Exactly how each device's address is set is specific to the product's manufacturer. Some are set by DIP switches in hardware, others by software. Consult the manufacturer's instructions to determine how to set the address.

Addresses are sent with **universal** (**multiline**) commands from the **Active Controller**. These commands include **My Listen Address** (MLA), **My Talk Address** (MTA), **Talk Address Group** (TAG), and **Listen Address Group** (LAG).

3.4 BUS MANAGEMENT LINES

Five hardware lines on the **GPIB** are used for bus management. Signals on these lines are often referred to as **uniline** (single line) commands. The signals are active low, i.e. a low voltage represents a logic "1" (asserted), and a high voltage represents a logic "0" (unasserted).

3.4.1 Attention (ATN)

ATN is one of the most important lines for bus management. If Attention is asserted, then the information contained on the data lines is to be interpreted as a multiline command. If it is not, then that information is to be interpreted as data for the **Active Listener**s. The **Active Controller** is the only bus device that has control of this line.

3.4.2 Interface Clear (IFC)

The **IFC** line is used only by the **System Controller**. It is used to place all bus devices in a known state. Although device configurations vary, the **IFC** command usually places the devices in the Talk and Listen Idle states (neither **Active Talker** nor **Active Listener**).

3.4.3 Remote Enable (REN)

When the **System Controller** sends the **REN** command, bus devices will respond to remote operation. Generally, the **REN** command should be issued before any bus programming is attempted. Only the **System Controller** has control of the **Remote Enable** line.

3.4.4 End or Identify (EOI)

The **EOI** line is used to signal the last byte of a multibyte data transfer. The device that is sending the data asserts **EOI** during the transfer of the last data byte. The **EOI** signal is not always necessary as the end of the data may be indicated by some special character such as carriage return.

The **Active Controller** also uses **EOI** to perform a **Parallel Poll** by simultaneously asserting **EOI** and **ATN**.

3.4.5 Service Request (SRQ)

When a device desires the immediate attention of the **Active Controller** it asserts **SRQ**. It is then the Controller's responsibility to determine which device requested service. This is accomplished with a **Serial Poll** or a **Parallel Poll**.

3.5 HANDSHAKE LINES

The **GPIB** uses three handshake lines in an "I'm ready - Here's the data - I've got it" sequence. This handshake protocol assures reliable data transfer, at the rate determined by the slowest Listener. One line is controlled by the Talker, while the other two are shared by all Active Listeners. The handshake lines, like the other **IEEE 488** lines, are active low.

3.5.1 Data Valid (DAV)

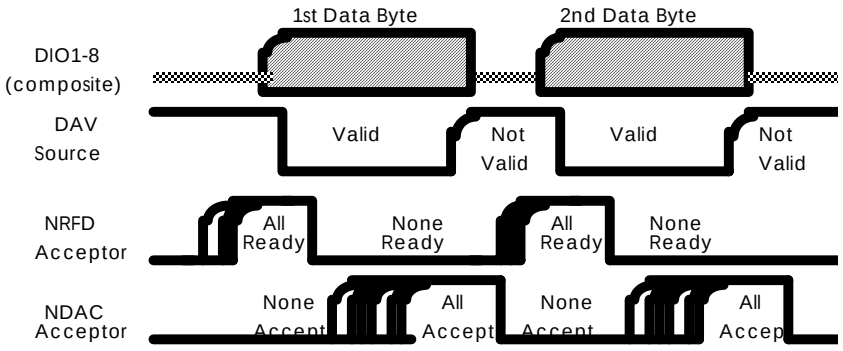
The **DAV** line is controlled by the **Talker**. The **Talker** verifies that **NDAC** is asserted (active low) which indicates that all Listeners have accepted the previous data byte transferred. The **Talker** then outputs data on the bus and waits until **NRFD** is unasserted (high) which indicates that all Addressed Listeners are ready to accept the information. When **NRFD** and **NDAC** are in the proper state, the **Talker** asserts **DAV** (active low) to indicate that the data on the bus is valid.

3.5.2 Not Ready for Data (NRFD)

This line is used by the **Listeners** to inform the **Talker** when they are ready to accept new data. The **Talker** must wait for each **Listener** to unassert this line (high) which they will do at their own rate when they are ready for more data. This assures that all devices that are to accept the information are ready to receive it.

3.5.3 Not Data Accepted (NDAC)

The **NDAC** line is also controlled by the **Listeners**. This line indicates to the **Talker** that each device addressed to listen has accepted the information. Each device releases **NDAC** (high) at its own rate, but the **NDAC** will not go high until the slowest Listener has accepted the data byte.



IEEE Bus Handshaking

3.6 DATA LINES

The **GPIB** provides eight data lines for a bit parallel/byte serial data transfer. These eight data lines use the convention of **DIO1** through **DIO8** instead of the binary designation of **D0** to **D7**. The data lines are bidirectional and are active low.

3.7 MULTILINE COMMANDS

Multiline (bus) commands are sent by the **Active Controller** over the data bus with **ATN** asserted. These commands include addressing commands for talk, listen, Untalk and Unlisten.

3.7.1 Go To Local (GTL)

This command allows the selected devices to be manually controlled. ($01)

3.7.2 Listen Address Group (LAG)

There are 31 (0 to 30) listen addresses associated with this group. The 3 most significant bits of the data bus are set to 001 while the 5 least significant bits are the address of the device being told to listen.

3.7.3 Unlisten (UNL)

This command tells all bus devices to Unlisten. The same as Unaddressed to Listen. ($3F)

3.7.4 Talk Address Group (TAG)

There are 31 (0 to 30) talk addresses associated with this group. The 3 most significant bits of the data bus are set to 010 while the 5 least significant bits are the address of the device being told to talk.

3.7.5 Untalk (UNT)

This command tells bus devices to Untalk. The same as Unaddressed to Talk. ($5F)

3.7.6 Local Lockout (LLO)

Issuing the **LLO** command prevents manual control of the instrument's functions. ($11)

3.7.7 Device Clear (DCL)

This command causes all bus devices to be initialized to a pre-defined or power up state. ($14)

3.7.8 Selected Device Clear (SDC)

This causes a single device to be initialized to a pre-defined or power up state. ($04)

3.7.9 Serial Poll Disable (SPD)

The **SPD** command disables all devices from sending their Serial Poll status byte. ($19)

3.7.10 Serial Poll Enable (SPE)

A device which is Addressed to Talk will output its Serial Poll status byte after **SPE** is sent and **ATN** is unasserted. ($18)

3.7.11 Group Execute Trigger (GET)

This command usually signals a group of devices to begin executing a triggered action. This allows actions of different devices to begin simultaneously. ($08)

3.7.12 Take Control (TCT)

This command passes bus control responsibilities from the current **Controller** to another device which has the ability to control. ($09)

3.7.13 Secondary Command Group (SCG)

These are any one of the 32 possible commands (0 to 31) in this group. They must immediately follow a talk or listen address. ($60 to $7F)

3.7.14 Parallel Poll Configure (PPC)

This configures devices capable of performing a **Parallel Poll** as to which data bit they are to assert in response to a **Parallel Poll**. ($05)

3.7.15 Parallel Poll Unconfigure (PPU)

This disables all devices from responding to a **Parallel Poll**. ($15)

3.8 MORE ON SERVICE REQUESTS

Most of the commands covered, both uniline and multiline, are the responsibility of the **Active Controller** to send and the bus devices to recognize. Most of these happen routinely by the interface and are totally transparent to the system programmer. Other commands are used directly by the user to provide optimum system control. Of the uniline commands, **SRQ** is very important to the test system and the software designer has easy access to this line by most devices. Service Request is the method by which a bus device can signal to the **Controller** that an event has occurred. It is similar to an interrupt in a microprocessor based system.

Most intelligent bus peripherals have the ability to assert **SRQ**. A DMM might assert it when its measurement is complete, if its input is overloaded or for any of an assortment of reasons. A power supply might **SRQ** if its output has current limited. This is a powerful bus feature that removes the burden from the **System Controller** to periodically inquire, "Are you done yet?". Instead, the **Controller** says, "Do what I told you to do and let me know when you're done" or "Tell me when something is wrong."

Since **SRQ** is a single line command, there is no way for the **Controller** to determine which device requested the service without additional information. This information is provided by the multiline commands for **Serial Poll** and **Parallel Poll**.

3.8.1 Serial Poll

Suppose the **Controller** receives a service request. For this example, let's assume there are several devices which could assert **SRQ**. The **Controller** issues an **SPE** (Serial Poll enable) command to each device sequentially. If any device responds with DIO7 asserted it indicates to the **Controller** that it was the device that asserted **SRQ**. Often times the other bits will indicate why the device wanted service. This **Serial Polling** sequence, and any resulting action, is under control of the software designer.

3.8.2 Parallel Poll

The **Parallel Poll** is another way the **Controller** can determine which device requested service. It provides the who but not necessarily the why. When bus devices are configured for Parallel Poll, they are assigned one bit on the data bus for their response. By using the Status bit, the logic level of the response can be programmed to allow logical OR/AND conditions on one data line by more than one device. When **SRQ** is asserted, the **Controller** (under user's software) conducts a **Parallel Poll**. The **Controller** must then analyze the eight bits of data received to determine the source of the request. Once the source is determined, a **Serial Poll** might be used to determine the why.

Of the two polling types, the **Serial Poll** is the most popular due to its ability to determine the who and why. In addition, most devices support **Serial Poll** only.

Service Information

4.1 FACTORY SERVICE

IOtech maintains a factory service center in Cleveland, Ohio. If problems are encountered in using the Expander488 you should first telephone the factory. Many problems can be resolved by discussing the problems with our applications department. If the problem cannot be solved by this method, you will be instructed as to the proper return procedure.

$00 0 NUL	$10 16 DLE	$20 32 SP 00	$30 48 0 16	$40 64 @ 00	$50 80 P 16	$60 96 ` SCG	$70 112 p SCG
$01 1 SOH GTL	$11 17 DC1 LLO	$21 33 ! 01	$31 49 1 17	$41 65 A 01	$51 81 Q 17	$61 97 a SCG	$71 113 q SCG
$02 2 STX	$12 18 DC2	$22 34 " 02	$32 50 2 18	$42 66 B 02	$52 82 R 18	$62 98 b SCG	$72 114 r SCG
$03 3 ETX	$13 19 DC3	$23 35 # 03	$33 51 3 19	$43 67 C 03	$53 83 S 19	$63 99 c SCG	$73 115 s SCG
$04 4 EOT SDC	$14 20 DC4 DCL	$24 36 $ 04	$34 52 4 20	$44 68 D 04	$54 84 T 20	$64 100 d SCG	$74 116 t SCG
$05 5 ENQ PPC	$15 21 NAK PPU	$25 37 % 05	$35 53 5 21	$45 69 E 05	$55 85 U 21	$65 101 e SCG	$75 117 u SCG
$06 6 ACK	$16 22 SYN	$26 38 & 06	$36 54 6 22	$46 70 F 06	$56 86 V 22	$66 102 f SCG	$76 118 v SCG
$07 7 BEL	$17 23 ETB	$27 39 ' 07	$37 55 7 23	$47 71 G 07	$57 87 W 23	$67 103 g SCG	$77 119 w SCG
$08 8 BS GET	$18 24 CAN SPE	$28 40 (08	$38 56 8 24	$48 72 H 08	$58 88 X 24	$68 104 h SCG	$78 120 x SCG
$09 9 HT TCT	$19 25 EM SPD	$29 41) 09	$39 57 9 25	$49 73 I 09	$59 89 Y 25	$69 105 i SCG	$79 121 y SCG
$0A 10 LF	$1A 26 SUB	$2A 42 * 10	$3A 58 : 26	$4A 74 J 10	$5A 90 Z 26	$6A 106 j SCG	$7A 122 z SCG
$0B 11 VT	$1B 27 ESC	$2B 43 + 11	$3B 59 ; 27	$4B 75 K 11	$5B 91 [27	$6B 107 k SCG	$7B 123 { SCG
$0C 12 FF	$1C 28 FS	$2C 44 , 12	$3C 60 < 28	$4C 76 L 12	$5C 92 \ 28	$6C 108 l SCG	$7C 124 | SCG
$0D 13 CR	$1D 29 GS	$2D 45 - 13	$3D 61 = 29	$4D 77 M 13	$5D 93] 29	$6D 109 m SCG	$7D 125 } SCG
$0E 14 SO	$1E 30 RS	$2E 46 . 14	$3E 62 > 30	$4E 78 N 14	$5E 94 ^ 30	$6E 110 n SCG	$7E 126 ~ SCG
$0F 15 SI	$1F 31 US	$2F 47 / 15	$3F 63 ? UNL	$4F 79 O 15	$5F 95 _ UNT	$6F 111 o SCG	$7F 127 DEL SCG
ACG	UCG	LAG		TAG		SCG	

ACG = Addressed Command Group
UCG = Universal Command Group
LAG = Listen Address Group
TAG = Talk Address Group
SCG = Secondary Command Group

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP