ASIC/2-7540

Installation Manual

By ASI Controls

March 2006

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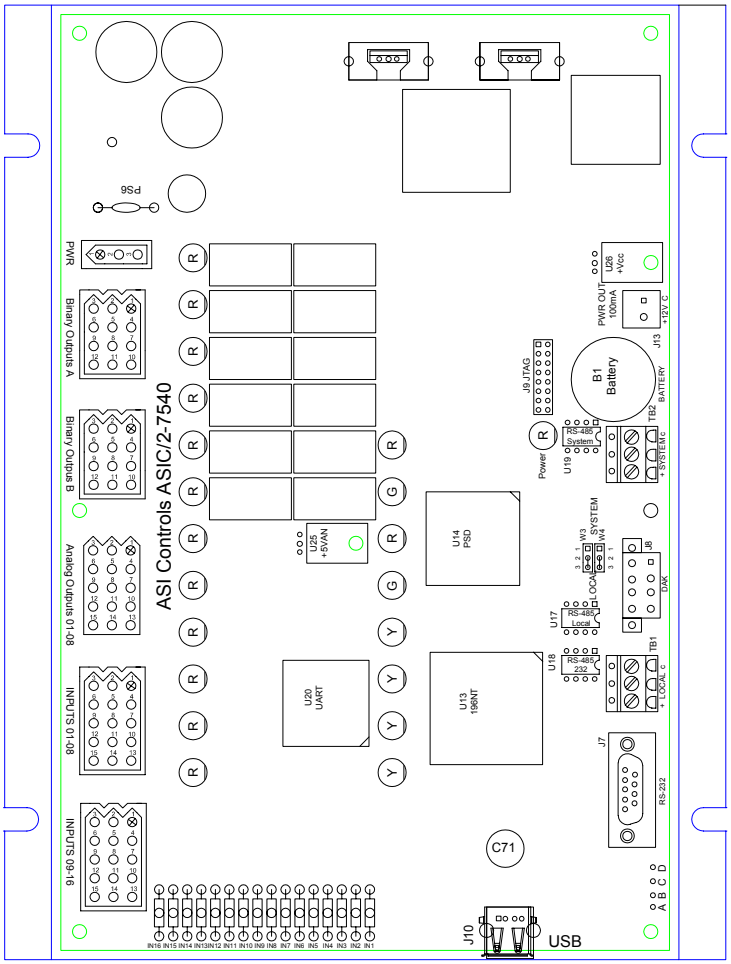
ASIC/2-7540 Installation

Overview

This Installation Manual describes the mounting and wiring specifications for the ASIC/2-7540 Configurable Unitary Controller

The ASIC/2-7540 Configurable System Controller represents a new generation of communicating distributed direct digital control for unitary equipment and building systems. The ASIC/2-7540 controller is designed to be hardware and configuration compatible with the ASIC/2-7040.



The ASIC/2 controller uses a 16-bit microprocessor and is programmed with standard control objects such as Inputs, Outputs, Schedules, Logic Blocks, Timers, Alarms and

Data Logging/Trending, etc. More advanced objects such as PID Loop Control, Electrical Demand Management, and Optimum Start are also included. The Boiler and Cooling Tower objects have been restored.

These objects are selected, configured, and linked together to customize the control sequence to the application requirement. Configuration data is stored in non-volatile NVRAM memory.

The ASIC/2-7540 has 12 relay outputs for complete electrical isolation, and 8 analog outputs for 0 to +10 Vdc capable of driving 20 mA.

The ASIC/2-7540 has 16 universal analog/binary inputs with 10 bit resolution.

For backward compatibility, support is also included for an optional DAK-002 LCD display and keypad.

Each ASIC/2 has a hardware clock for stand-alone operation. Multiple 8-day schedules allow modification of setpoints and system operation based on day of week or holiday.

Two way communications enable information to be transmitted throughout the control system providing coordination and easy access to all points. User interface communication is supported through the ASI OPC Server.

Two independent communication buses are included on each ASIC/2-7540. The local bus provides communications for direct integration of zone terminal controllers with building operations. The token passing system bus allows for multiple controllers to share system wide data, such as fan status and outdoor temperature, in a timely manner.

The ASIC/2-7540 includes an RS-232 Monitor that can be used to communicate on the local bus or system bus depending on jumper settings.

ASIC/2-7540 Agency Approvals

Class 2 Operation

The ASIC/2-7540 is designed for Class 2, 24 Vac or 15 to 48 Vdc operation.

UL Listing

The ASIC/2-7540 is listed under UL-916, Energy Management Equipment, UL File E123287.

Power Input – Class2, 24 Vac, or 24 to 48 Vdc
Analog Input – Class 2,
Analog Output- Class 2,
Binary Relay output - 24 Vac, 24 Vdc 5A Inductive, 2 A, General Use
Ambient – 40 ^{o}C (104 ^{o}F) Maximum

CE

The ASIC/2-7540 passed compliance testing for with CE requirements: CISPR11:1990/EN55011:1991 Emission, Class A: Industrial, Scientific and Medical Equipment, and EN 50082-1/1996 Generic Immunity Standard when used with shielded communication wire.

FCC

All ASI Products have been tested to be in accordance with FCC requirements, CISPR 22.. The ASIC/2-7540 complies with of the FCC Part 15 (CISPR 22) Class A.

A Class A digital device is a device that is marketed for use in a commercial, industrial or business environment,exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

ISO 9002

The ASIC/2-7540 is manufactured in an ISO 9002 certified facility.

ASIC/2-7040 ASIC/2-7540 Comparison

The differences between the ASIC/2-7040 and ASIC/2-7540 are highlighted in **bold**.

	ASIC/2-7040	ASIC/2-7540
Control Power		
Power Supply:	Isolated Transfomer	**Isolated Switching**
Supply Voltage:	24 Vac +/- 15%, 50/60 Hz	24 Vac +/- 15%, 50/60 Hz **or +/– 24 to48 Vdc**
Power Consumption:	24 VA (plus loads)	18 VA (plus loads)
Protection:	1 A Fuse, MOV	**PS6, 0.75 A Polyswitch, MOV**
Binary Outputs 12	Form "A" Relay SPST N.O.	Form "A" Relay SPST N.O.
Voltage Rating:	24 Vac, 24Vdc	24 Vac, 24Vdc
Current Rating:	2 A General	2 A General
Analog Outputs 8	Analog 0-10Vdc	Analog 0-10Vdc
Current Rating:	5.0 mA at 10Vdc	**20 mA at 10Vdc**
Protection:	Optional TVS Kit	**TVS, 10 V, 600W peak** **12V, 100 mA max**
Inputs 16	Universal Analog/Binary 0 - 5 Vdc	Universal Analog/Binary 0 - 5 Vdc
Power Input Output	Molex connectors	Molex connectors
RS-485 Communications	Screw Terminals	Screw Terminals
System Bus Baud Rate:	Up to 19,200 baud	Up to 19,200 baud
Local Bus Baud Rate:	Up to 9600 baud	**Up to 19,200 baud**
	Simulated UART	**UART,U20, TL16C450**
Protection:	1/8 A pico fuse,	**100 mA Polyswitch**
Transient Protection:	500 mW-s TVS, 7 V BiPolar	500 mW-s TVS, 7 V BiPolar
RS-232 Communications	RS-232 DB-9 Connector	RS-232 DB-9 Connector
Optional Ethernet:	Via ASI EtherLink	**USB Ethernet Adapter(future)**
Optional Modem:	Modem & Null-Modem Adapter	**USB Modem Adapter(future)**
Other		
Indication:	21 LEDs	21 LEDs
Microprocessor:	Intel 80C196KB , 12.288 MHz	**Intel 80C196NT, 20 MHz**
Memory:	Firmware, 64 KBytes EPROM	**Firmware, 128 KBytes Flash**
	Volatile, 23 KBytes RAM	Volatile, 30 KBytes RAM
	Non-volatile, 23 KBytes EEPROM	**Non-volatile, 30 kbytes NVRAM**
Hardware Clock:	DALLAS Time in a Can	**RTC with Battery Backup**
Physical		
Dimensions with base:	7.7" x 10.2" x 2.5" (WxLxH)	**7.7" x 10.2" x 1.75" (WxLxH)**
	196 mm x 259 mm x 64 mm	196 mm x 259 mm x **44 mm**
Mounting on center:	7.2" x 7.2" (183 mm x 183 mm)	7.2" x 7.2" (183 mm x 183 mm)
Weight:	4.4 lb (2.0 kg)	**3.22 lb (1.46 kg)**
Environmental	0 to 40 ºC (32 to 104 ºF)	0 to 40 oC (32 to 104 oF)
UL Listing	UL-916	UL-916
	Class 2 Device, Pilot Duty	Class 2 Device, Pilot Duty

ASIC/2-7540 Product History

Flash Upgrade

The ASIC/2-7540 can be upgraded using the In-Field Flash Utility Programmer, Flash Dev, which is available for download from the ASI Website Integrator Center: http://www.asicontrols.com/integrator/asic_2_7540/ The software allows users to upgrade the firmware over the RS-485 communication bus or over Etherlink/2 Ethernet communications.

Technical Note 26, Flash Device describes how to install and use the software and Technical Note 30, ASIC/2-7540 Firmware Upgrade, describes what is required to upgrade the ASIC/2-7540 firmware are also available on the website.

Note: FW754a1.3 should **NOT** be used to upgrade prototype controllers with the Compact Flash slot

ASIC/2-7540 FW754A

ASIC/2-7540 FW754a Ver 1.3h Release 2006-02-17 PN70025-04 ECO-395

- Fixes problem with input reads at 256, 512, 768 raw counts

Note: All earlier versions should be upgraded.

- Fixes FW754a12 bug that caused random clearing of bits in memory
- Fixes problem with DAK Passwords
- Adds product validation (7540) to Flash download messages
- Adds autodetect of specific USB devices
  USB Ethernet Device: Hawking HUF11, Hawking HUF2, LinkSYS USB100M
  USB Modem: Best Data 56USB-P
- Adds USB Device Type parameter;
  0=Autodetect, 1=Ethernet, 2=Modem, 3=Memory
- Adds USB watchdog to prevent lockups

WARNING: Do **NOT HOT SWAP** USB Devices. It can cause reset of controller, and in some cases loss of configuration data.

ASIC/2-7540 FW754a Ver 1.2n Release 2006-02-03 PN70025-03 ECO-394

DO NOT USE: FW754a12 has a bug that caused random clearing of bits in memory

ASIC/2-7540 FW754a Ver 1.1e Released 2005-11-02 PN70025-02 ECO-390

- Input Tri-MUX and Quad-Mux types must now have the new value for two successivereads before the present value is changed.
  Adds new parameter INP Attr-6 LO Byte Temporary Value.
- Fixes Notify Dial manager strings.
- USB-Ethernet UDP/IP connection preliminary and not released.
- Adds IP Parameters and expands System object size
  Note: Object sizes have changed. When upgrading from 1.0 to 1.1 Application Configuration must be reloaded to the controller
- Adds messages to IP Port. MT=0x7D for allocation download, MT=0x3F, M1=1 Synchronize, MT=0x90 for object write.

ASIC/2-7540 FW754a Ver 1.0b Released 2005-08-10

- Includes security bit for protection.
- Initial Production Release

ASIC/2-7540 FW754a Rev 0.5 Not-Released 2005-04-20

- Adds new Boot loader FW7540 Ver 0.2

About This Document

This ASIC/2-7540 Installation Manual, DOC-1646, was produced using *Doc-To-Help*®, by Component One, LCC. This manual and Windows™ help system was last revised on 2006-03-01. ASI Controls is always working to improve our products. Should you have any questions, or suggestions that would help our products better meet your needs, or that would help us serve you better, please call, write, or e-mail to:

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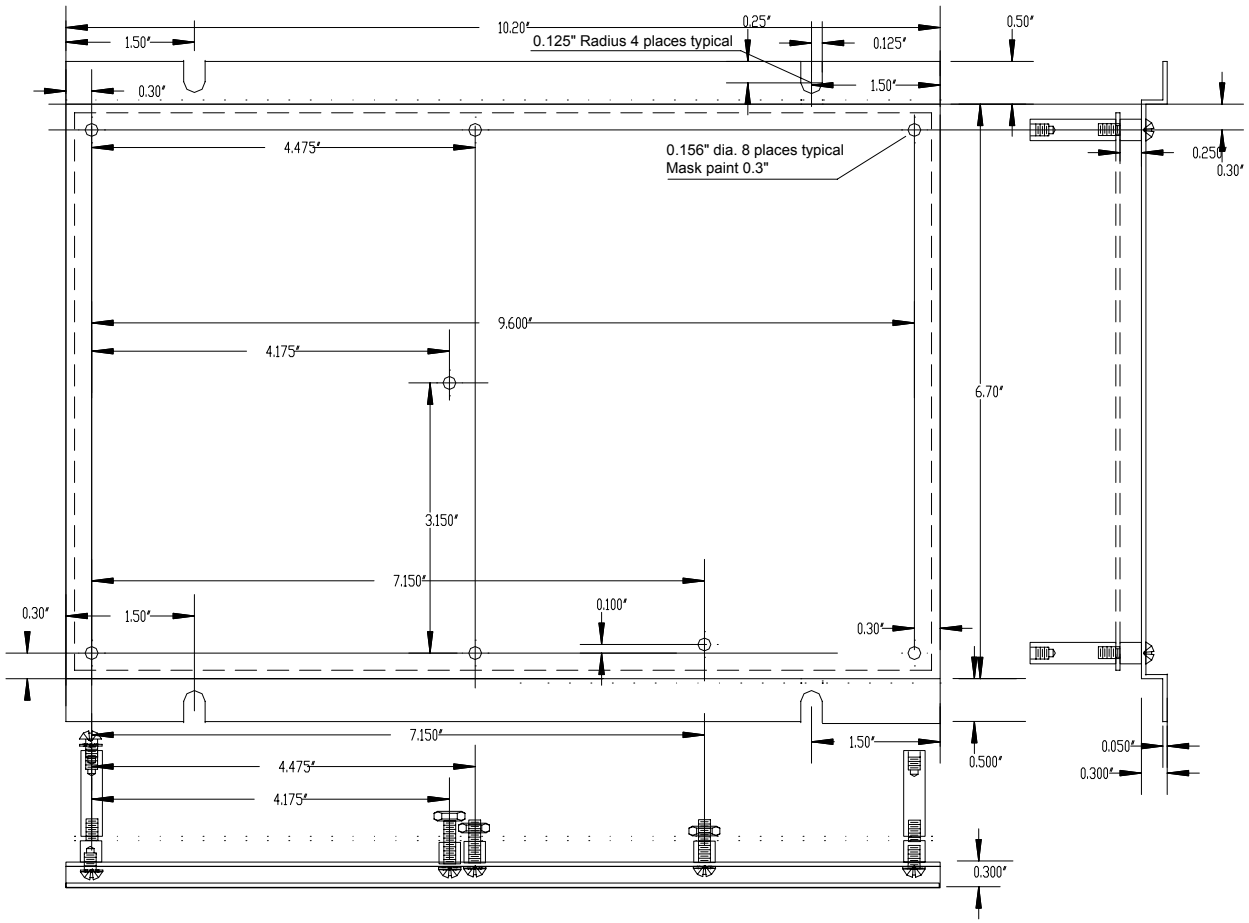
ASIC/2-7540 Hardware

Controller Mounting

The controller is mounted in a two part folded sheet metal enclosure and base. The base can be mounted to either metallic or nonmetallic surfaces.



ASIC/2-7540 Sheet Metal Base (all dimensions in inches)

To mount the controller base, follow the procedure outlined below:

- Locate the controller where it is to be mounted.
- Use the mounting slots as templates to mark the location of the 4 holes. Mounting centers are 7.20" by 7.20".

o Pre-drill the mounting holes.

WARNING: Never drill mounting holes with the controller electronics inside the enclosure! Metal shavings can short out and damage the controller circuitry.

o Install the 4 screws and tighten.

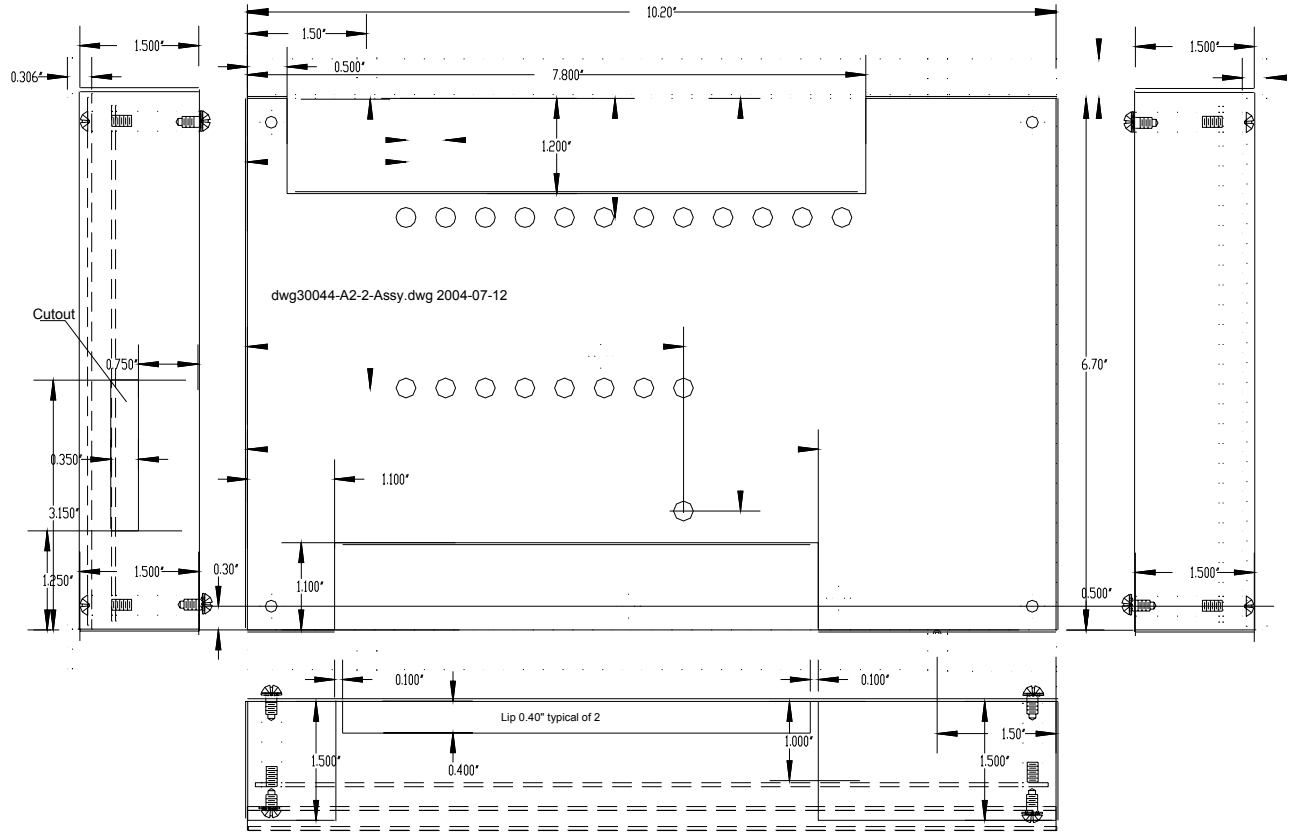
NOTE: If mounted on a non-metallic surface, be sure that the unit is properly connected to building ground.

Dimensions

The overall dimensions of the controller are10.20" x 7.70" x 1.75" as shown. The controller weighs 3.2 lbs (1.46 kg). .

ASIC/2-7540 Enclosure Cover

The controller has a folded sheet metal cover which is designed so that connections can be made without removing the cover.



ASIC/2-7540 Sheet Metal Cover (all dimensions in inches)

Removing the Cover

If it is necessary to change pull-up resistors, then the cover of the controller can be removed by removing the 4 corner mounting screws.

:

Controller Connections

The controller is shipped fully assembled with a two part enclosure. All connections to the controller can be made without removing the cover.

Connections are made by means of Molex connectors, J1 through J6, by two part screw terminal blocks, TB1 and TB2, and DE-9 RS-232 connector J7, and 8 pin mini-Molex connector J8.

Molex Wiring Harness MWH-74

ASI has available a Molex Wiring Harness for the ASIC/2-7040 and ASIC/2-7540 that contains mating connectors for input, output, and power wiring. Each connector has color-coded twisted pairs of 36 " flying leads.

Molex Connector Kit MCK-003

As part of the UL Listing of the controller ASI provides a Molex Connector Kit MCK-003 for use with the ASIC/2-7040 and ASIC/2-7540 controllers. The MCK-003 has the mating connectors and Molex female pins to make power, input, and output connections. The ASIC/2-7540 does not require a Communication Jumper Assembly.

MCK-003 (ASIC/2-7540) ASI PN- 14368
Includes:

- 2 - 15 Pin Molex Receptacle (Inputs)
- 2 - 12 pin Molex Receptacle (Binary Outputs)
- 1 - 3 pin Molex Receptacle (Power)
- 1 - 15 Pin Molex Plug (Analog Outputs)
- 72 - Molex Female Terminals (0.093")

The mating Molex receptacles to J1, J2, J4 and J5 plugs for Power, Inputs and Binary Outputs on the board use standard 0.093" female terminals which are inserted into the 3-, 9-, 12-, or 15-pin Molex plug connectors. The mating Molex plug to receptacle J3 forAnalog Outputs on the board also uses standard 0.093" female terminals that are inserted into the 15-pin Molex receptacle connectors. All output terminations should be made using 16 to 22 gauge stranded or solid wire using Molex pin connectors.

24 Vac Power is connected to the three pin Plug connector J6: J6 is ASI PN-11093, Molex 10-18-1032. The mating cable receptacle connector is Molex 03-09-1032, ASI PN-11097

Relay Outputs are connected to the 12 pin Molex Plug connectors J4and J5. J4 and J5 are ASI PN-11049, Molex 03-09-2121. The mating cable receptacle connector is Molex 03-09-1126, ASI PN-11095

Inputs are connected to the 15 pin Molex Plug connectors J1 and J2. J1 and J2 are ASI PN-11054, Molex 03-09-2154. The mating cable receptacle connector is Molex 03-09-1157, ASI PN-11094

Analog Outputs are connected to the 15 pin Molex Receptacle connector J3. J3 is ASI PN-11094, Molex 03-09-1157. The mating cable plug connector is Molex 03-09-2154, ASI PN-11054

Molex Tools

Molex Crimping Tool MCT-001 (0.093")

Molex Crimping Tool Molex PN 11-01-0084 for use with 0.093" terminals, Molex PN 01-09-1119 .

Molex Removal Tool MRT-001 (0.093")

Molex Removal Tool Molex PN 11-03-0006 for removing 0.093" pins, Molex PN 01-09-1119 from recepticals.

Molex Crimping Tool MCT-002 (0.062")

Molex Crimping Tool Molex PN 11-01-0008 for use with 0.062" terminals, Mini-Molex PN 02-06-1103 .

Molex Removal Tool MRT-002 (0.062")

Molex Removal Tool Molex PN 11-03-0002 for removing 0.062" pins, Mini-Molex PN 02-06-1103, from recepticals.

Other Considerations

Environmental Considerations

The controller must be installed where the temperature remains between 32F (0 C) and 122 F (50C), and the relative humidity remains between 10% and 95%, non-condensing.

The controller cover is designed to be installed inside another enclosure which provides adequate protection from the environment.

WARNING: Ambient operating conditions inside the enclosure must remain within the operating specifications.

EMI Noise Considerations

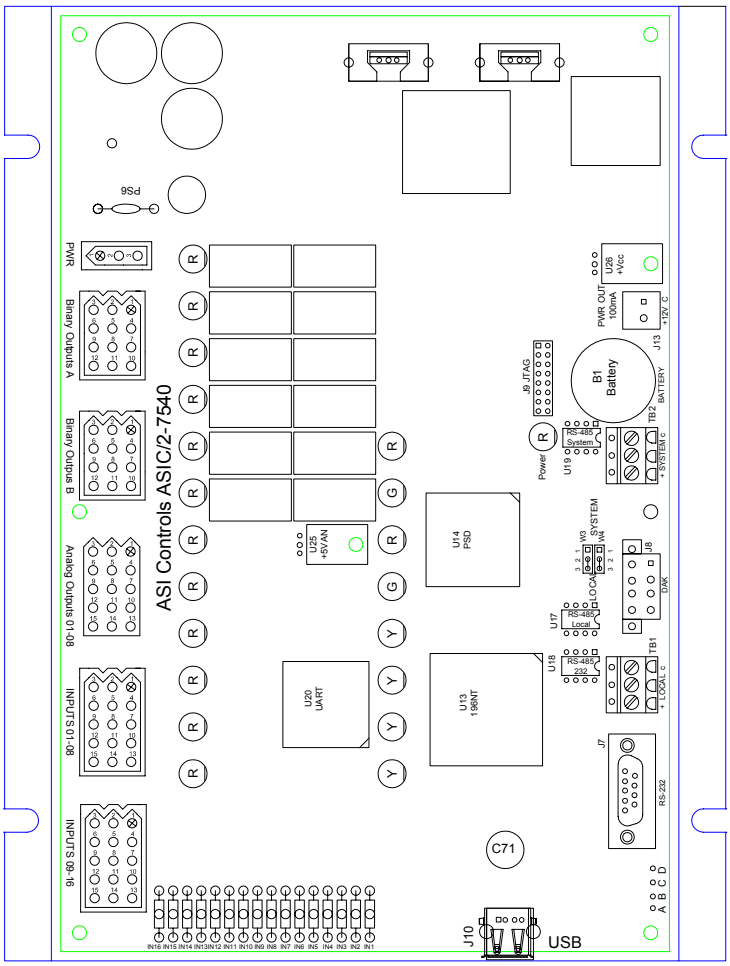
The controller is connected electrically to its enclosure with a metal screw and support. The enclosure is designed to shield the controller from Electro Magnetic Interference (EMI). However, whenever possible, the controller should be mounted outside of high voltage compartments and away from other sources of EMI. Common sources of EMI are high voltage devices (greater than 24 Vac) such as contactors, transformers, motors, light ballasts, and high voltage wires.

ASIC/2-7540 Wiring

General Wiring Considerations

This section describes controller input, output, and power wiring details. There should not be any power to the controller or any component connected to the controller when wiring it. Connecting or disconnecting wires to or from the controller while it has power can cause controller malfunction or damage the equipment that it is connected to.

The discussion in this chapter assumes that the controller is positioned with the Molex connectors along the left hand side.



General Concerns

Route input, output, power and communication wire neatly inside the enclosure. Avoid looping excess wire. Use tie-wraps to dress and bundle loose groups of wires.

CAUTION: Do NOT bundle communication or input wiring with output and power wiring. It can disrupt communication and/or interfere with controller input measurements.

Make sure all connections to the controller are mechanically tight. Intermittent contact of connections can cause excessive electrical noise. Always route controller wiring separate from high voltage wiring to reduce the possibility of excessive EMI noise.

The ASIC/2-7540 is listed under UL-916, Energy Management Equipment, UL File E123287.

Controller Power

The power connections are located on the three-pin Molex connector J6. J6 is Molex 03-09-2032. The mating connector is Molex 03-09-1032. The controller has an isolated switching power supply and can use 24 Vac +/- 15% at 50 or 60 Hz, or 24 to 48 Vdc.

Relay Outputs

Relay Outputs wiring are connected to the 12 pin Molex connectors J4 and J5. J4 and 5 are Molex 03-09-2121. The mating connector is Molex 03-09-1126.

Note that the order of binary outputs is different than the ASIC/2-7000. Connector J4 has BO-01, B-02, BO-09 through BO-12. Connector J5 has BO-03 through 08.

Analog Outputs

Analog voltage outputs are connected to the 15-pin Molex Receptacle connector J3. J3 is ASI PN-11094, Molex 03-09-1157. The mating cable plug connector is Molex 03-09-2154, ASI PN-11054

Inputs

Inputs are connected to the 15 pin Molex Plug connectors J1 and J2. J1 and J2 are ASI PN-11054, Molex 03-09-2154. The mating cable receptacle connector is Molex 03-09-1157, ASI PN-11094

CAUTION: The common input connection is identical with the building ground. The common of the input MUST be referenced to building ground.

System Bus Communication

Communication connections are located along the right edge. The two wire RS-485 System bus communication is connected to the two part three terminal block plug TB2 (TB2 -1 HI, TB2-2 LO,. The Common connection, TB2-3, is available to terminate the shield if shielded communication wire is used. Note: Shielded wire is not recommended. The three terminal block plug TB2 is ALTECH AK-130/3, 30.303.

Local Bus Communication

Communication connections are located along the right edge. The two wire RS-485 local bus communication is connected to the two part three terminal block plug TB1, (TB1 -1 HI, TB1-2 LO,). The Common connection, TB1-3, is available to terminate the shield if shielded communication wire is used. Note: Shielded wire is not recommended. The three terminal block plug TB2 is ASI PN 11116, ALTECH AK-130/3, 30.303.

DAK Communication

The Display and Keypad DAK-002 connects to the ASIC/2-7540 through the 8 position mini-molex connector, J8. The DAK commmunicates with the controller on the local bus.

RS-232 Monitor

The operator access is through the 9 pin RS-232 Monitor, DE-9 Connector J7. The Lap-top RS-232 COM port may be connected directly to J7 to establish communication with the local bus or system bus depending on the settings of jumpers, W3 and W4.

CAUTION: Never leave an unterminated RS-232 cable connected to the ASIC/2-7040 as it will interfere with communication.

Lightning Protection

The controller has diode protection on the inputs, and over-voltage protection on the 24 Vac power, and transorbs and fuse protection on communication. It is generally resistance to normal surges and dips in voltage.

Lightning is very difficult to protect against.

1. Surge suppressors are marginal in their capacity to protect against a true strike or near strike. They have limited surge energy limits that can easily be overcome and then they are passive.
2. MOV's are slow and not intended to protect against lightning. Lightning induced energies can easily far exceed the waveforms that the protectors can clamp.
3. The only true lightning protection is a gas-tube type. These can conduct for extended periods of time, once ignited. They appear to solve the problem but the tend to be expensive. .

Control Power and Grounding

This section describes connection of control power and grounding of the controller. Specific examples are provided where needed.

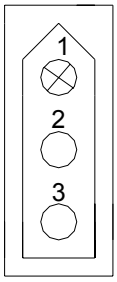
Power supply

The controller has an isolated switching power supply and can use 24 Vac +/- 15% at 50 or 60 Hz or 24 to 48 Vdc.

Power supply specifications for the controller are:

Supply Voltage: 24 Vac +/- 15%, 50/60 Hz
or +/- 24 to 48 Vdc
Power Consumption: 25 VA plus other loads
Under Voltage Protection: 70% +/- 10% line voltage brownout detect.
Fuse Protection: 3AG, 1 Amp, 250 Vac fuse on primary.

Power



J6

24 Vac / +/- 48 Vdc Hot	J6-1
Ground	J6-2
Vac / Vdc Common	J6-3

Power Terminations

The power and ground terminations should be made to terminals 1, 2 and 3 using wire no larger than 16 gauge and no smaller than 20 gauge stranded or solid wire. When making terminations with stranded wire, be particularly careful that all strands of wire are terminated inside the connector. Loose strands can short out power.

J6-1, 24 Vac hot
J6-2, Ground if connected to non-metallic surface
J6-3, 24 Vac common.

LED indication

The power LED is located near the right edge of the controller . When 24 Vac is applied to terminals J1-1 and J1-3, the LED will light indicating power.

Controller Power Protection

The controller incorporates self-resetting polyswitch, PS6, to protect controller circuitry. The polyswitch is located next to the 24 Vac power connections.

Specification: ASI PN14033
Type Polyswitch RayChem, RXE075,
Rating: 750 mA, 60 V

Power is protected from surges by a Metalic Oxide Varistor, MOV1

Specification:ASI PN 17083
Type MOV, RayChem, ROV14 -680K-S,
Rating: 68 V

Primary Power

Power to the controller must be free of electrical noise. The source of the 24 Vac must be connected directly to Molex terminals J6-1 and J6-3. The secondary side must NOT share a common circuit path with any relay circuits. The 24 Vac power to the relays and contactor coils must be run separately, connecting directly at the transformer.

To ensure that power remains relatively free of electrical noise, the primary side of the 24 Vac transformer must be connected directly to the primary power source. Avoid any common circuit paths with heavy switched loads, high current fuses or long wire runs. Large inrush currents and switched load currents are characteristic of these primary circuits and can cause substantial fluctuations in voltage to the primary side of the control transformer, adversely affecting controller performance.

In circuits powered by a multiphase source, the preferred way to power the controller is using a 277V/24Vac transformer connected to an unused phase of the source and neutral.

If a 480V/24Vac transformer must power the controller, phases that experience the least amount of power drain from inductive loads should be used. It is important to avoid phases which are on the contactor or switched side of the load.

CAUTION: Always turn power OFF before replacing the primary fuse and connecting or disconnecting controller power leads.

Building Ground

The controller must be solidly connected to the building electrical ground to ensure proper operation of the controller. The controller is grounded to the enclosure. If the enclosure is attached to a metal surface that is connected to building ground, then this is sufficient. The controller can also be connected to building ground through Molex terminal J6-2. Signal common (J1-4, 5,6,10,11,12,14) and (J2-4, 5,6,10,11,12,14), analog output common (J3-4,5,6,10,11,12,14) and Ground (J6-2) are connected together on the circuit board. The ground wire should be made of copper.

Controller grounding should adhere to Article 250 of the National Electrical Code on grounding and all local codes.

WARNING: Failure to properly connect the controller to building ground may cause controller malfunction.

Controller Outputs

The controller has 12 binary outputs and 8 analog outputs. This section describes the controller output wiring specifications.

General Output Wiring Considerations

The output connections are located through Molex connectors along the left side of the board. Analog output connections are labeled J3-1 through J3-15. Relay outputs are labeled J4-1 through J4-12 and J5-1 through J5-12. The functional assignment of outputs depends on the controller configuration.

CAUTION: Always turn power off before replacing fuses and connecting or disconnecting outputs.

The mating Molex receptacles to J1 through J6 plugs for Power, Inputs and Outputs on the board use standard 0.093" female terminals which are inserted into the 3-, 9-, 12-, or 15-pin molex plugs or recepticles. A Molex Connector Kit MCK-003 is available for each controller.

All output terminations should be made using 16 to 22 gauge stranded or solid wire using Molex pin connectors. When making terminations with stranded wire, be particularly careful that all strands of wire are terminated inside the connector. Loose strands can short out power.

The controller analog outputs are designed to work without shielded wire, when the output wiring is NOT run in conjunction with AC power wiring, large power consuming or large power generating equipment. When the analog output wiring is run in conjunction with other AC wiring, etc., shielded cable is required. The shield should be connected to the controller signal ground. Tape back the shield at the other end of the wire.

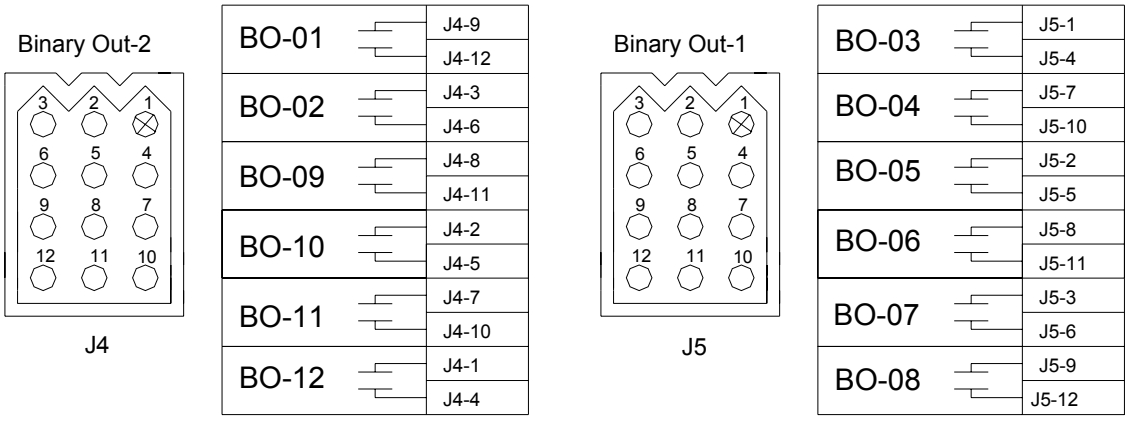
CAUTION: Only terminate the shield to ground at the controller. Do NOT terminate the shield at both ends of the wire.

Relay Output Wiring

The controller provides 12 normally open relay contacts 5A, 24 Vac available on Molex connectors J4 and J5. These must be wired to the appropriate contactors for unit operation. The specific assignment of the binary outputs depends on the type of controller personality, heat pump, air conditioner, or fan coil.

Output specifications for outputs Relay 1 - 12 are:

Contact Type:	Form "A" (SPST) Normally Open, Dry Contacts
Contact Rating:	24 Vac, 2 ampere general
Minimum Pulse Duration:	0.1 seconds



Indicator LEDs

The outputs are form "A", normally open, dry contacts. Each relay has an LED which indicates whether the control sequence has turned the output ON or OFF. The LED indicates the controller commanded state of the output. When the LED is ON, the dry contact is commanded closed. When the LED is OFF, the dry contact is commanded open.

The ASIC/2-7040 has 4 indicator LEDs, LED-1, LED-2, LED-3, and LED-4, which can be configured as binary outputs, BO-13, BO-14, BO-15, and BO-16. There are no relays associated with these outputs. They may be configured to represent various alarm and status conditions to the operator.

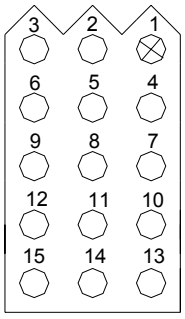
Indicator Lights

A	BO-13	Amber LED 1
A	BO-14	Amber LED 2
A	BO-15	Amber LED 3
A	BO-16	Amber LED 4

Analog Outputs

For Analog outputs, the primary input is a range of values, typically 0 to 255 which generates an analog voltage output. The controller provides eight analog outputs with an output range of 0 to 10 Vdc.

Analog Outputs



J3

AO-1	J3-1
AO Common	J3-4
AO-2	J3-7
AO Common	J3-10
AO-3	J3-9
AO Common	J3-12
AO-4	J3-2
AO Common	J3-5
AO-5	J3-8
AO Common	J3-11
AO-6	J3-3
AO Common	J3-6
AO-7	J3-13
AO Common	J3-14
AO-8	J3-15
AO Common	J3-12

Analog output specifications on J4 are:

Range: 0 to to 10 Vdc
Resolution/Accuracy: 8 bits/0.4 % full scale
Drive Current Rating: 20 mA at 10 V.

Each Analog Outputs is protected by Transient Voltage Suppressor, TVS 7, .. ,TVS13.

Specification: ASI PN 17082
Type TVS, LittleFuse, ROV14 -680K-S,
Rating: 10 V, 600 W peak pulse 10/1000 µs waveform.

The analog voltage outputs are all referenced to the board ground, J6-2. Any device that is controlled from an analog output must also share this same electrical common. For example, a transducer that is used to drive a motorized damper has a control signal on contact (X) that is referenced to a common signal on contact (T1). Contact, T1 must be connected to the 24 Vac common of the controller.

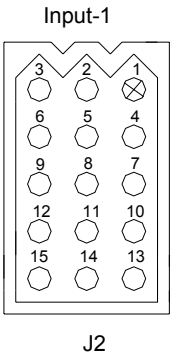
Signal common (J1-4,5,6,10,11,12,14) and (J2-4,5,6,10,11,12,14), analog output common (J3-4,5,6,10,11,12,14) and Ground (J6-2) are connected together on the circuit board.

ASIC/2-7540 Input Wiring

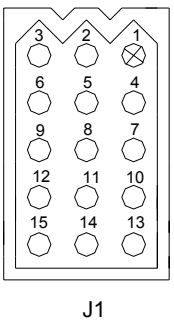
The controller has 16 inputs which are used for analog, binary, and thermistor inputs. This section describes the ASIC/2-7040 input wiring specifications. It includes possible input wiring configurations and details on hardware selectable options. Typical controller input wiring is shown below. The ASIC/2-7040 has configurable inputs that depend on the specific application.

Input Connections

Input connections 1 - 8 are located on Molex connector J2 and Input connections 9 - 16 are located on Molex connector J1 along the left hand side of the board. Signal common (J1-4,5,6,10,11,12,14) and (J2-4,5,6,10,11,12,14), analog output common (J3-4,5,6,10,11,12,14) and Ground (J6-2) are connected together on the circuit board.



IN-1 Common	J2-1
	J2-4
IN-2 Common	J2-7
	J2-10
IN-3 Common	J2-9
	J2-12
IN-4 Common	J2-2
	J2-5
IN-5 Common	J2-8
	J2-11
IN-6 Common	J2-3
	J2-6
IN-7 Common	J2-13
	J2-14
IN-8 Common	J2-15
	J2-14



IN-9 Common	J1-1
	J1-4
IN-10 Common	J1-7
	J1-10
IN-11 Common	J1-9
	J1-12
IN-12 Common	J1-2
	J1-5
IN-13 Common	J1-8
	J1-11
IN-14 Common	J1-3
	J1-6
IN-15 Common	J1-13
	J1-14
IN-16 Common	J1-15
	J1-14

Analog Input Specifications

The analog input specifications are:

Range:	0 - 5 Vdc
Accuracy:	0.1% full scale
Input Impedance:	10 kohms Nominal.

Input Wiring

The controller input connectors are designed to be used with 16 gauge to 24 gauge stranded or solid wire with Molex pin connectors. When making terminations with stranded wire, be particularly careful that all strands of wire are terminated inside the connector. Loose strands can short out inputs.

The mating Molex receptacles to J1 and J2 plugs for Inputs on the board use standard 0.093" female terminals which are inserted into the 15-pin molex plugs. A Molex Connector Kit is included with the ASIC/2-7540 controller as a UL requirements..

CAUTION: The controller inputs are not fused. Connection of inputs that exceed the published specifications may cause permanent damage to the controller.

The controller is designed to work without shielded wire, when the input wiring is NOT run in conjunction with AC power wiring, large power consuming or large power generating equipment. If the input wiring is run in conjunction with other AC wiring, etc., shielded cable is required. The shielded wire should be connected to the controller. Tape back the shield at the other end of the wire.

CAUTION: Only terminate the shield at the controller. Do NOT terminate the shield at both ends of the wire.

Input Pull-up Resistors

The ASIC/2-7040 are provided with pin socketed resistors to configure inputs. The appropriate resistor must be placed in the pin sockets to configure the inputs.

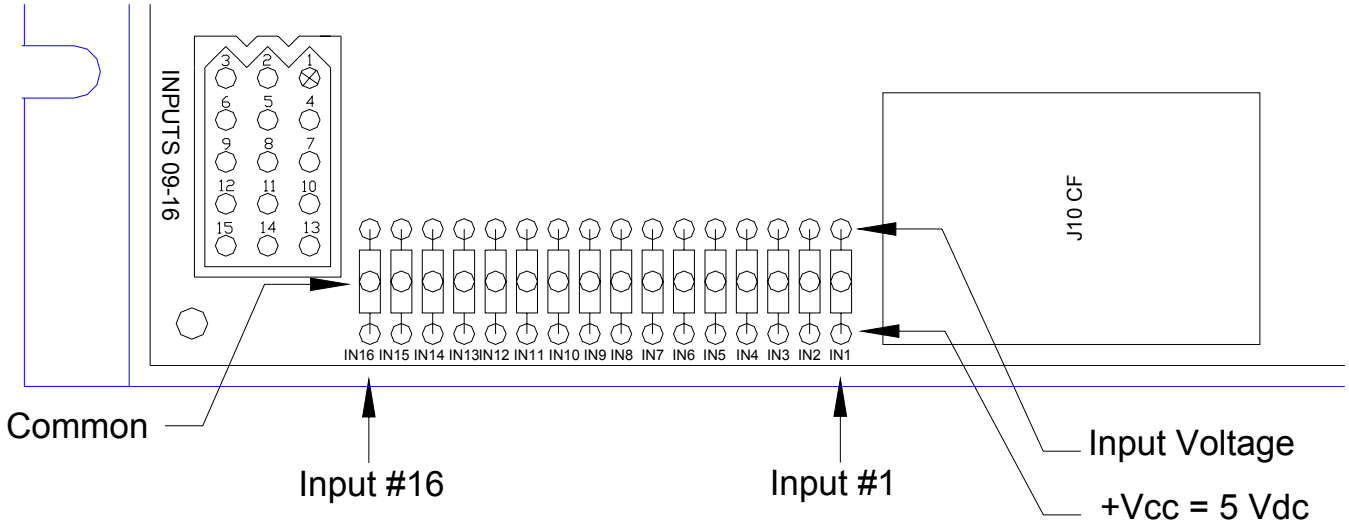
Pull-up resistors are used to pull the input in the direction of the +5 Vdc supply voltage. Parallel resistors are used across the input to common, for example to convert a current signal of 4 to 20 mA to a 1 to 5 Vdc voltage signal.

Factory Pull-up Resistors

R80 = 3.32 kohm IN-01 Pull-up	R88 = 1.82 kohm IN-09 Pull-up
R81 = 3.32 kohm IN-02 Pull-up	R89 = 1.82 kohm IN-10 Pull-up
R82 = 3.32 kohm IN-03 Pull-up	R90 = 1.82 kohm IN-11 Pull-up
R83 = 3.32 kohm IN-04 Pull-up	R91 = 1.82 kohm IN-12 Pull-up
R84 = 3.32 kohm IN-05 Pull-up	R92 = 1.82 kohm IN-13 Pull-up
R85 = 3.32 kohm IN-06 Pull-up	R93 = 1.82 kohm IN-14 Pull-up
R86 = 3.32 kohm IN-07 Pull-up	R94 = 1.82 kohm IN-15 Pull-up
R87 = 3.32 kohm IN-08 Pull-up	R95 = 1.82 kohm IN-16 Pull-up

The location of the pull-up and parallel resistors and other details are shown below. At the bottom of the controller is a row of pull up resistors R80 through R95 that correspond to Inputs #1 through Input #16 respectively. There are three rows of pin sockets, so that the resistors can be removed and inserted without soldering.

The top row of pin sockets is the input voltage connections. The bottom row of pin sockets is the +Vcc connection and is used for pull-up resistors resistors. The middle row of pin sockets is the Common connection and is used for parallel resistors.



Changing Pull-up Resistors

The input configuration resistors may be changed either through the slot at the bottom edge of the cover, or by removing the cover.

To change the configuration of an input, insert the appropriate pull-up or parallel resistors into the pin sockets.

To remove resistors:

- o Turn controller power OFF.
- o Identify the proper resistor.
- o Grip the resistor with a pair of long nose pliers.

- o Gently remove one pin of the resistor.
- o Gently remove the other resistor pin.

To insert resistors:

- o Turn controller power OFF.
- o Identify the proper resistor.
- o Grip the resistor with a pair of long nose pliers.
- o Align and partially insert one pin of the resistor.
- o Align and partially insert the other resistor pin.
- o Confirm both pins are properly aligned.
- o Using the pliers, gently work the resistor into the socket.

Details on location of resistors are covered under one of the following sections specific to the input type. If more resistors are required, they can be purchased from ASI Controls or at a local electronics store. If they are purchased from a local electronics store, they must meet all stated specifications.

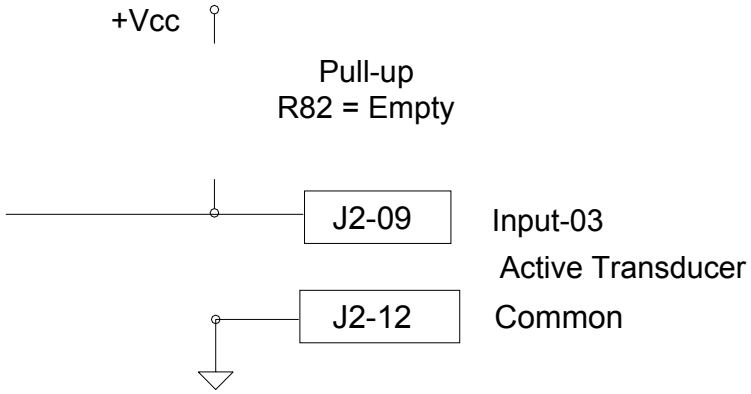
Required Pull-up Resistors

The required pull-up resistor for different Input Type as shown in the table. Active sensors require the removal of the pull up resistor. Binary and thermistor sensors require a pull-up resistor between +Vcc and the input. 4 to 20 mA current transducers require a parallel resistor between the input and common.

Input Type	**Specification**
0 to 5 Vdc	No Pull-up
4 to 20 mA	No Pull-up; 249 ohm to common, 0.1%, 1/4 W, MF
Thermistor, 3 kohm Type II	3.32 kohm, 1%, 1/4 W, MF
Thermistor, 10 kohm Type II	3.32 kohm, or 10 kohm 1%, 1/4 W, MF
Thermistor, 3 kohm Type II	1.82 kohm, 1%, 1/4 W, MF
Binary	(Typical) 1.82 kohm, 1%, 1/4 W, MF
Triple Binary	511 ohm, 1%, 1/4 W, MF External 1.00 kohm 1%,2.00 kohm 1%, and 4.02 kohm 1%,
Quad Binary	511 ohm, 0.1%, 1/4 W, MF External 1.00 kohm 0.1%,2.00 kohm 0.1%, 4.02 kohm 0.1%, and 8.25 kohm 0.1%

Input Type (0 to 5 Vdc)

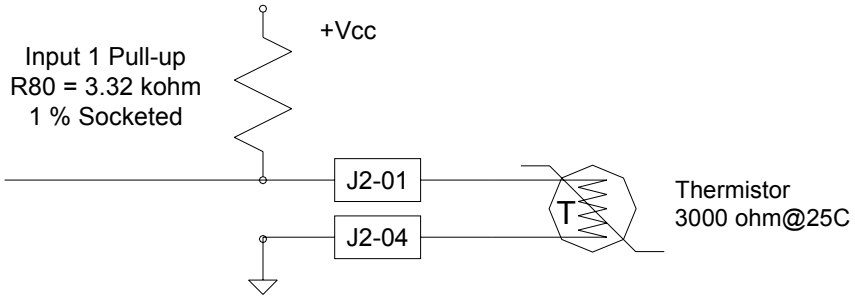
To measure voltage produced by an active input transducer, the pull-up resistor must be removed.



CAUTION: The common input connection is identical with the building ground. The common of the transducer MUST be referenced to building ground.

Input Type (Thermistor)

Thermistors are sensors used for measuring temperature. The resistance of a thermistor changes with respect to temperature. As the resistance changes, the voltage measured across it by the controller changes. The controller uses a voltage divider circuit to measure the voltage across the thermistor. The pull-up resistor required depends upon the temperature range and the thermistor used.



To configure the controller to accept a thermistor input, install the appropriate pull-up resistor. Avoid long wire runs between the controller and the thermistor whenever possible.

Type II Thermistor inputs, 3000 ohm at 77 F, require either a 3.32 kohm or 1.82 kohm pull-up resistor depending on the analog conversion type.

CAUTION: The common input connection is identical with the building ground.

Input Type (Binary)

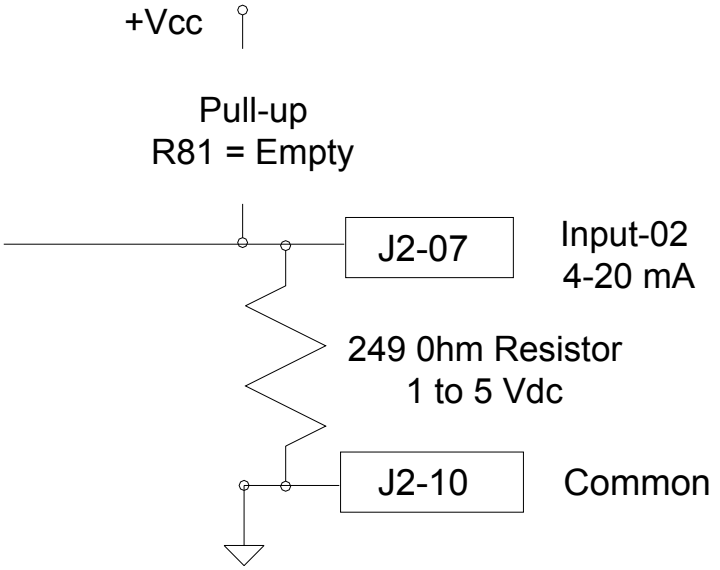
Because of the limited number of inputs of the ASIC/2-7040 binary inputs are often implemented as switches that are placed across or in series with other sensors. The binary inputs require some pull-up resistance.

The binary input open or closed is typically sensed by the input value going outside the high and low alarm limits. The high or low alarm is enabled and the alarm bit is used to monitor the binary input status.

For example; a normally closed proof of fan switch may be placed across the same input as the Discharge Air Temperature. When the fan is off, the contact is closed and the input will read a low resistance value which indicates an abnormally high temperature. This will set the high limit alarm. When the fan starts, the contacts open and the input will read a normal Discharge Air Temperature. The high limit alarm will go away. Thus, the status of the high limit alarm may be used for proof of fan.

Input Type (4 to 20 mA)

A 4 to 20 mA transducer requires the removal of the pull-up resistor and a 249 ohm resistor between the input and common. This will generate a 1 Vdc to 5 Vdc input voltage.

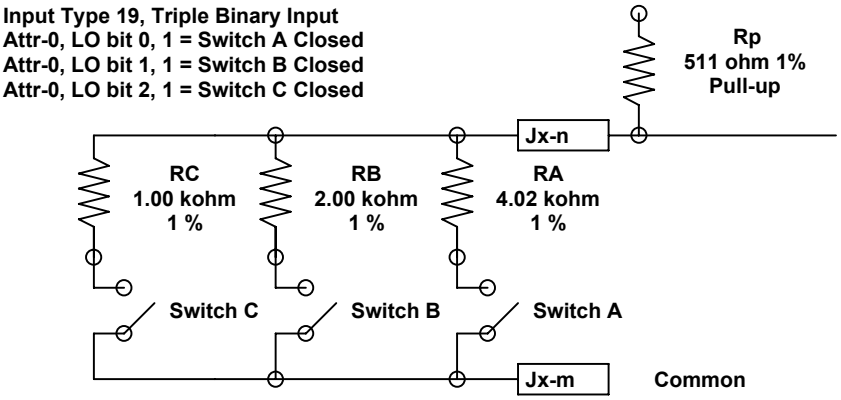


CAUTION: The common input connection is identical with the building ground. The common of the transducer MUST be referenced to building ground.

Triple Binary Input

If the Input type is TRI-BI, Triple Binary Input, 19, then a bit is set depending which of three switches is closed. The three binary inputs consist of normally open switches with one side to common. It requires a pull-up resistor of 511 ohm 1%. The three inputs are:

Switch A in series with RA = 4.02 kohm, 1%, Sets Attr-0, LO bit 0
Switch B in series with RB = 2.00 kohm, 1%, Sets Attr-0, LO bit 1
Switch C in series with RC = 1.00 kohm, 1%, Sets Attr-0, LO bit 2



Testing Triple Inputs : Each triple input should be tested once the resistor tree is connected. There can be variation in the resistance values that could affect your results. Each combination of switch C and B should be tested with switch A open and closed. Consult the ASIC/2 input object definition for details on the operation of triple binary inputs.

Quad Binary Input

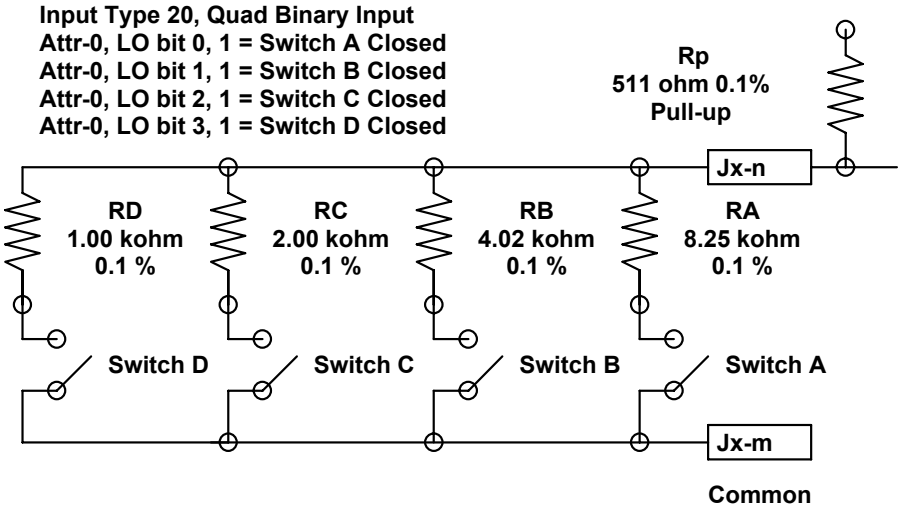
With care, the ASIC/2 can accommodate up to four binary inputs on a single input. It is designated as Input type 20, QUAD-BI, Quad Binary Input.

The quad binary inputs consist of normally open switches with one side to common. It requires a pull-up resistor of 511 ohm 0.1%. The four inputs are:

Switch A in series with RA = 8.25 kohm, 0.1%, Sets Attr-0, LO bit 0
Switch B in series with RB = 4.02 kohm, 0.1%, Sets Attr-0, LO bit 1
Switch C in series with RC = 2.00 kohm, 0.1%, Sets Attr-0, LO bit 2
Switch D in series with RD = 1.00 kohm, 0.1%, Sets Attr-0, LO bit 3

CAUTION: the voltage thresholds for each resistance value are in a narrow range. Please use 0.1% resistors and test configuration thoroughly before applying this input type. Use of Quad Binary Inputs is discouraged.

If 0.1% resistors are un-available precision values may be obtained by using two resistors in parallel and checking the value with a precision 4 digit ohm meter.

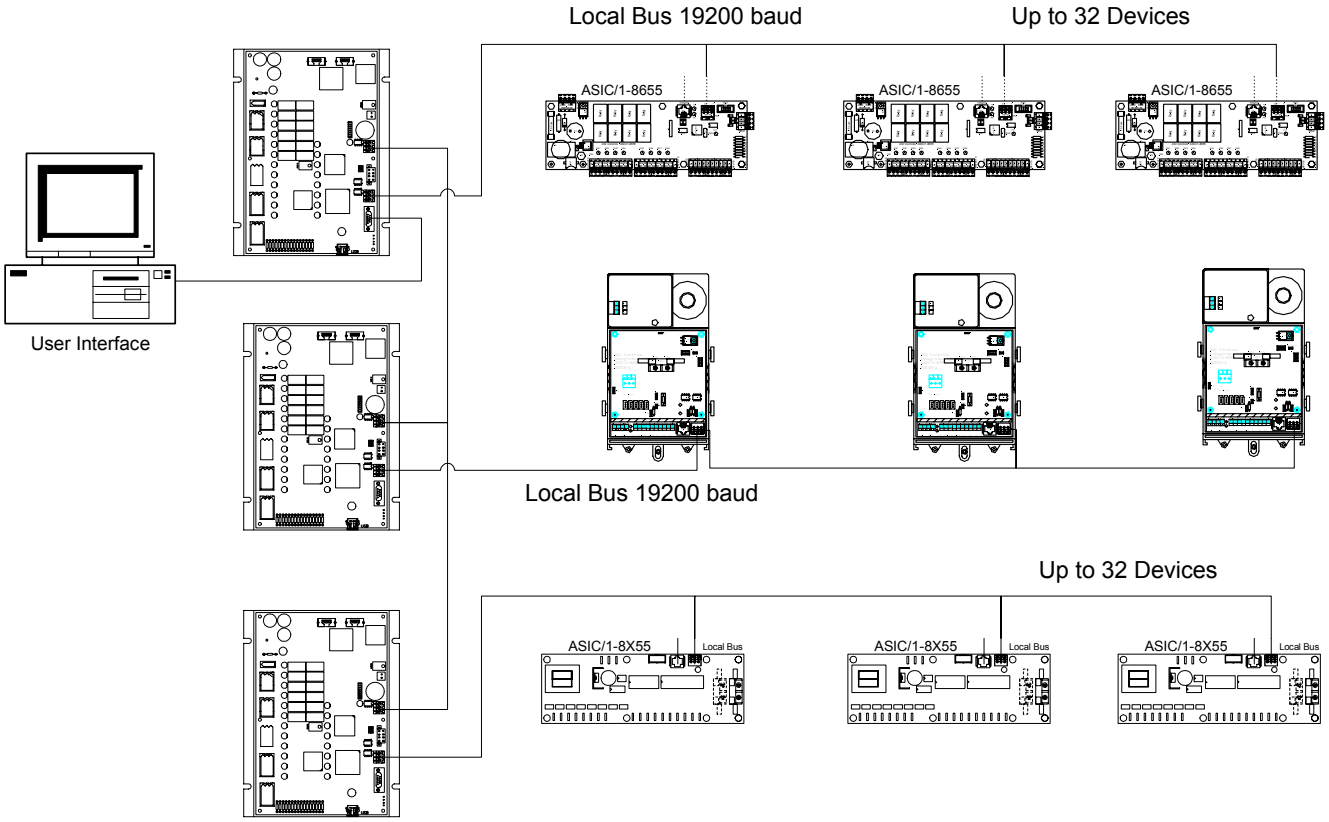


Testing Quad Inputs : Each quad input should be tested once the resistor tree is connected. There can be variation in the resistance values that could affect your results. Each combination of switch D, C, and B should be tested with switch A open and closed. Consult the ASIC/2 input object definition for details on the operation of quad binary inputs.

ASIC/2-7540 Communications

ASI Communications Network

Each controller in the ASI family is designed to give efficient operation either in a free standing, stand-alone mode, or in a network in communication with other controllers or a host user interface. Preprogrammed ASIC/1 controllers manage the operation of individual terminal or unitary equipment. ASIC/2 Controllers are configured for the unique requirements of each application. Each ASI controller has its own daily event schedule and control sequence and operates the equipment without communication or intervention.



Because all configuration data is stored in non-volatile static memory, the sequence automatically restarts after a power outage. A controller with a real time clock can broadcast time to re-synchronize all controllers on the network.

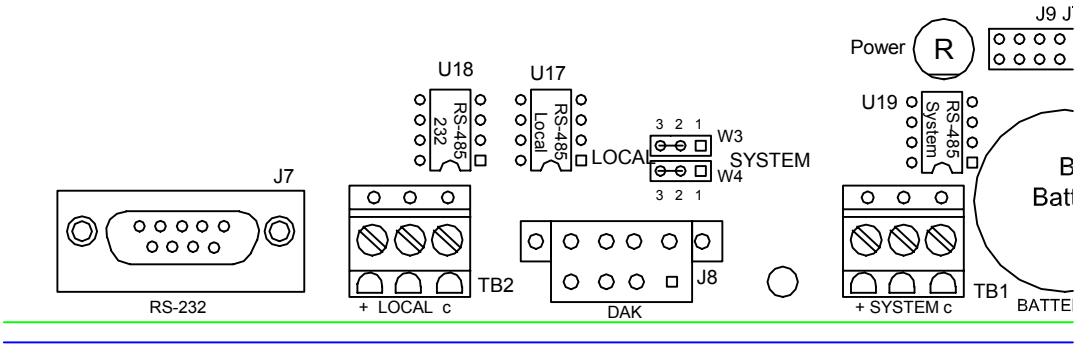
Overall system performance can be improved by sharing of information between controllers throughout the network. ASI controller products can be networked together to

provide as small or as large a system as needed to meet the requirements of the job. Communication access for a user interface, such as a building management system, can be made through a permanent connection or over remote dial-up modem Access to the system enhances system performance through operator interaction.

Each ASI Controller has an operator access to allow direct communication with that controller. ASIC/1 controllers have an access jack on the WS-0XX wall sensor.

All controllers listen and respond to messages sent to their address. ASIC/1's and ASIC/2 controllers can be mixed on the single communication bus. If more than 32 controllers are used then RS-485 repeater must be used.

ASIC/2-7540 RS-485 Wiring



Communications between ASI controllers are carried on a 2-wire RS-485 communication bus. The ASIC/2-7540 has two separate communication busses: A System bus which may be used for time, notify and remote points between ASIC/2 controllers; and a local bus which is used for polling of and broadcast to ASIC/1 controllers.

Route input, output, power and communication wire neatly inside the enclosure. Avoid looping excess wire. Use tie-wraps to dress and bundle loose groups of wires.

> CAUTION: Do NOT bundle communication or input wiring with output and power wiring. It can disrupt communication and/or interfere with controller input measurements.

Make sure all connections to the controller are mechanically tight. Intermittent contact of connections can cause excessive electrical noise. To reduce the possibility of excessive EMI noise, always route controller wiring separate from high voltage wiring..

The communication connections are located on the right edge of the controller include:

- o System Bus Communication, TB1
- o Local Bus Communication, TB2
- o Communication Protection
- o RS-232 Monitor Port, J7

System Bus Communication, TB1

The ASIC/2-7540 supports system bus baud rates of 1200, 9600, and 19,200 baud. For short wire runs it can communicate at 38,400 baud. Communication connections are located along the right edge. The two wire RS-485 System bus communication is connected to the two part three terminal block plug, TB1. The common connection, TB1-3, is available to terminate the shield if shielded wire is used. Note: Shielded wire is not recommended. The three terminal block plug TB1 is ALTECH AK-130/3, 30.303.

The screw terminals are designed to be used with 16 gauge to 24 gauge stranded or solid wire. When making terminations with stranded wire, be particularly careful that all strands of wire are terminated inside the connector. Loose strands can short out communication.

Each of the communication wires is labeled with a "+" and "-" sign indicating polarity. The "+" or HI is connected to TB1-1. The "-" or LO is connected to TB1-2. It is important that polarity of the communication wiring is maintained throughout the communication network. Maintaining consistent wiring color codes throughout the communication network helps prevent mis-wiring.

Local Bus Communication, TB2

Each ASIC/2-7540 has a separate local communication bus and local bus address for communicating only with the local side. The ASIC/2-7540 supports local bus baud rates of 1200, 9600, and 19,200 baud. Communication on the local bus is independent of the system bus unless the ASIC/2-7540 has been configured to pass messages originating on the system bus through to the local bus.

Once the local address is established, the ASI Expert software can communicate with the controller through the RS-232 port.

Communication connections are located along the right edge. The two wire RS-485 local bus communication is connected to the two part three terminal block plug TB2. The common connection, TB2-3, is available to terminate the shield if shielded wire is used. Note: Shielded wire is not recommended. The three terminal block plug TB2 is ALTECH AK-130/3, 30.303.

Each of the communication wires is labeled with a "+" and "-" sign indicating polarity. The "+" or HI is connected to TB2-1. The "-" or LO is connected to TB2-2. It is important that polarity of the communication wiring is maintained throughout the communication network. Maintaining consistent wiring color codes throughout the communication network helps prevent mis-wiring.

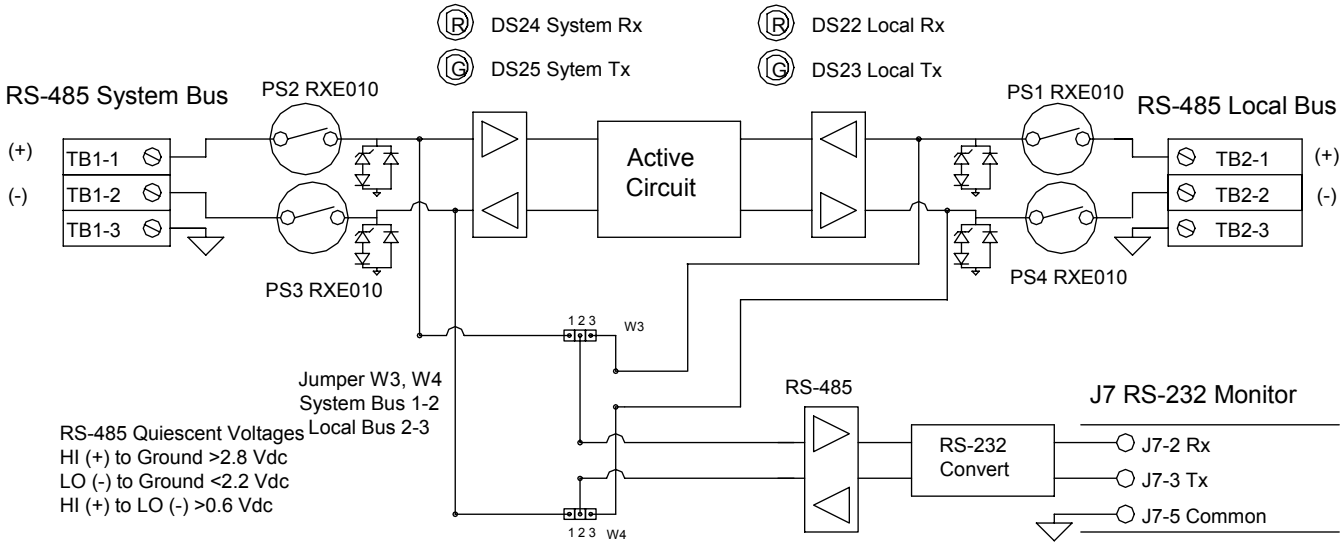
Local Bus Polling and Broadcast

ASIC/2 controllers can manage system operation by polling terminal and unitary controllers on the local bus. Each of up to 32 terminal or unitary controllers on each system controller are continually interrogated for the latest status, alarm, or other information. The aggregated results of this polling process are available to the ASIC/2 System controller to modify control operation.

The ASIC/2-7540 System Controllers can affect system operation by initiating broadcast messages on the local bus addressed to terminal and unitary controllers. Messages such as Go To Occupied State, Demand Limit, Emergency, etc. may be broadcast on the local bus, as the result of logical decisions made by the controller. Broadcast may be to group addresses, or globally to all controllers on a local bus.

ASIC/2-7540 Communication Schematic

The figure below shows the schematic of the internal communication connections of the ASIC/2-7540 Controller



RS-485 Communication Protection

The controller communication circuitry incorporates 100 mA self resetting polyswitches and 7 Volt Transient Voltage Suppressors to protect controller circuitry The polyswitches protect the controller against mis-wiring of communication to a power source. The TVSs protect the controller circuitry against large voltage transients.

Each RS-485 connection is protected by polyswitch , PS1, .. ,PS4.

Specification: ASI PN14021
Type Polyswitch RayChem, RXE010,
Rating: 100 mA, 60 V

Each RS-485 connection is protected by Transient Voltage Suppressor, TVS 1, .. ,TVS4.

Specification: ASI PN 17009
Type TVS, Microsemi P5KE7.0CA,
Rating: 7 V, Bipolar 500 W peak pulse 10/1000 µs waveform.

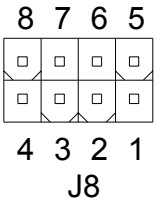
The RS-485 chips for System Bus, U18, :Local Bus, U17, and RS-232 Monitor Port, U19, are socketed so that should excessive voltage, for example by lightning, damage the chip, it can be replaced in the field. Replacements are available from ASI.

Specification: ASI PN 15004
Type RS-485, National DS3695N, 8-pin dip,
ASI Order Number: RS-485.

DAK Communication (ASIC/2-7540)

The DAK connector is included for backward compatibility. The Display and Keypad DAK-002 connects to the ASIC/2-7540 through the 8 position mini-molex connector, J8. The DAK communicates with the controller on the local bus.

Note: The outputs on the DAK communication plug are same for the ASIC/2-7540 and ASIC/2-7040 FW740C and FW740E series of boards



DAK Communication

Local Bus +(DAK)	J8-1
Local Bus -(DAK)	J8-2
Monitor +	J8-3
Monitor -	J8-4
System Bus +	J8-5
System Bus -	J8-6
+ 12 Vdc (DAK)	J8-7
Common (DAK)	J8-8

If a DAK Access Plug is not used with the controller, then no connection is necessary.

RS-485 Installation Rules

RS-485 communication is highly noise resistant. However, to avoid communication problems, a few basic rules must be followed. Taking the time to make sure communication wiring is installed properly in the beginning helps avoid communication problems latter. Make sure and use the following communication installation rules:

- Install only communication cable which meets the ASI Controls stated specifications.
- If the communication wiring in run in conjunction with AC power wiring, shielded wire should be used.
- Do not physically stress the communication cables, especially when pulling the communication cable around sharp bends and over rough surfaces.
- Avoid splicing communication cables. Use continuous pieces of cable between controllers.
- If possible, keep communication wiring away from electrical noise sources such as power wiring, large power consuming or power-generating equipment, etc.. If possible cross power wiring at right angles.
- If communication cables employ modular RJ-11 jacks, use factory fabricated and tested cables. Note that there are different modular RJ-11 type jacks designed for use with stranded wire cables and modular RJ-11 type jacks designed for use with solid wire cables. The two cable/connector combinations are NOT interchangeable.
- Do NOT exceed 32 controllers on the local communication bus. If more than 32 controllers are connected together, use an RS-485 ASI Converter/Repeater to repeat the signal.

RS-485 Communication Wire Specification

Shielded communication wire is required to meet CE certification. However even if CE certification is not required, shielded wire should be used if the communication bus wiring is run in conjunction with AC power wiring or is subject to electrical noise.

Communication wire should meet the following specifications:

Shielded Pair Specification

Wire:	22-24 gage, solid/stranded
# of conductors:	2, twisted pair
Nominal Capacitance	
Between Conductors:	24 pF/ft
Between 1 Conductor and Shield:	42 pF/ft

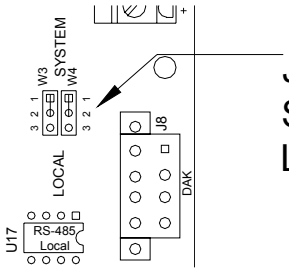
Plenum Rated Cable meets these specifications and is described as follows: Tinned copper conductors; Teflon(TM) insulated; conductors cabled; Beldfoil (TM) aluminum; polyester shield with 85% tinned copper braid shield; 150V NEC 725 Class 2 for use in air plenums; non-conduit.

Note: We do not recommend using wire with more than one pair! If communication wire has more than 1 pair, then the other wires should be terminated at ground on one end to prevent induced noise.

RS-232 Monitor Port

ASIC/2-7540 has an RS-232 monitor port that gives access to the controller to the System or Local bus, based on the settings of jumpers W3 & W4. The RS-232 port has the proper control of transmit and receive so that it may successful drive the communication bus with many controllers.

Note: the ASIC/2-7040 and ASIC/2-8040 could only talk to one or two controllers through the RS-232 monitor port.

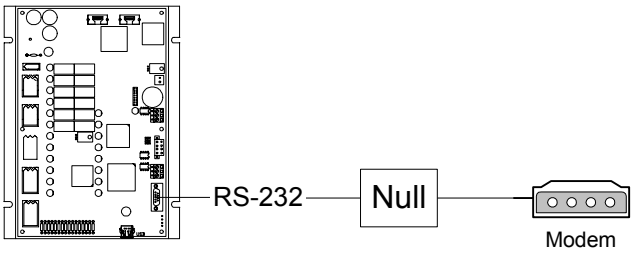


Jumper W3 &W4
System Bus 1-2
Local Bus 2-3

CAUTION: Never leave an unterminated RS-232 cable connected to the ASIC/2-7540 as it will generate reflections that can interfere with communication.

RS-232 Modem Access

For systems consisting of a single controller a telephone modem is directly connected to system bus through the RS-232 port of the ASIC/2-7540, using a null modem cable.



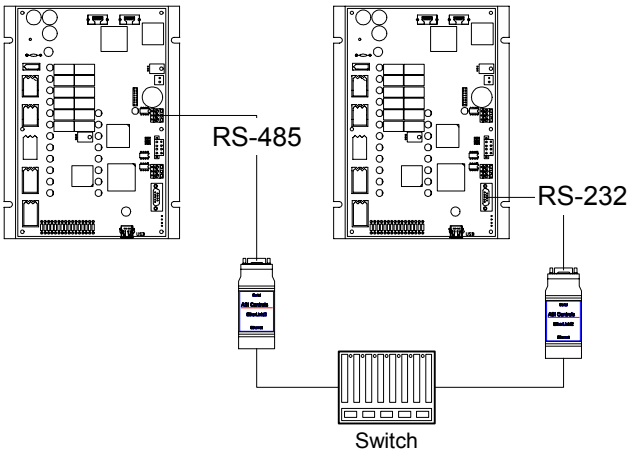
When dialing into a controller connected to a modem, and when setting up a modem to use dial out, it is important that BOTH modems are set with the correct modem AT commands. Consult the ASI Tech Note for the correct initialization strings.

Note: Please consult the modem Users' Manual for the correct parameters for your modem. Modem commands vary from model to model. For further information about newer modems, contact techsupport@asicontrols.com .

When an ASIC/2-7540 dials out through a modem, the destination modem that is receiving dial-out messages is typically connected to a computer running ASI Monitor software.

EtherLink/2 Connection

If System or Local bus pass-thru is required, then you may connect the ASIC/2-7540 using and ASI EtherLink/2 device. The EtherLink/2 has an IP Address and Port and communicates to the ASIC/2 via the RS-232 Monitor Port, or directly by RS-485 to the system bus.

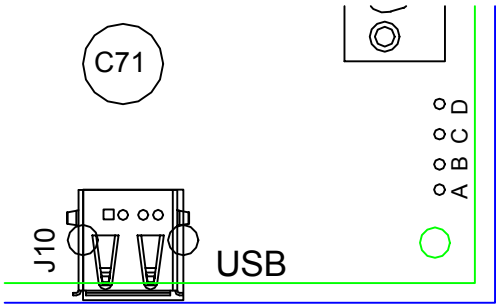


USB Connectivity

The ASIC/2-7540 has a USB Host port that allows the controller to communicate with certain USB Devices. The USB device communicates directly to the ASIC/2-7540 independent of the System or Local RS-485 busses .

The ASIC/2-7540 does NOT support ASI message pass-through from the USB device to the System or Local busses.

CAUTION: Do Not HOT SWAP USB Devices! It can result in reset of the controller, and in some cases loss of configuration memory.

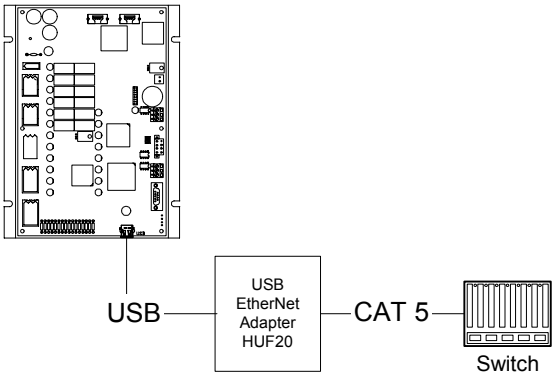


The controller FW754a1.3 and later, knows about and can autodetect specific USB Devices:

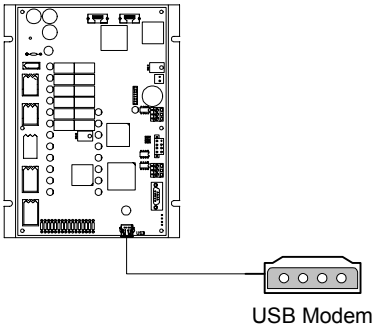
- USB Ethernet Device: Hawking HUF11, Hawking HUF2, LinkSYS USB100M
- USB Modem: Best Data 56USB-P

Other Devices may work, but are not guaranteed: You may specify in the configuration the USB Device Type; 0=Autodetect, 1=Ethernet, or 2=Modem and see if the device will work.

The USB Ethernet device is configured with IP Addresses and Ports in the System Object of the controller. Ethernet Notify messages are enabled in the Notify Object. The Ethernet Adapter obtains its power and IP Address and other configuration information from the controller. It can be directly plugged into the USB adapter or on a short USB extension cable. It connects to the Ethernet Switch using a standard CAT 5 Ethernet cable.



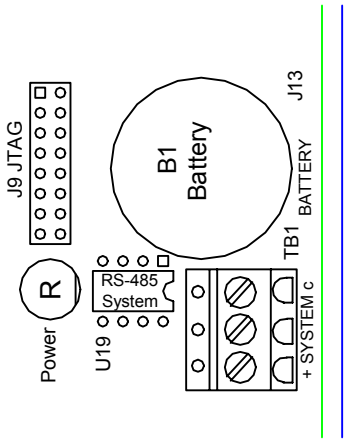
The USB Modem device is configured in the Dial Manager and is enabled by setting the USB Modem Enable parameter in the System Object. It must be enabled for the Modem to answer incoming calls.



Battery, B1

Battery B1 is used to back-up the Real-Time Hardware Clock and the Non Volatile RAM Memory, NVRAM used to store the configuration. The battery is sized to last for 10 years or longer.

CAUTION: Do not remove the battery with power disconnected or you will loose your configuration.



Lithium batteries, even these types of coin batteries, have proven to be a serious risk of fire if a reverse current is ever applied to the battery. Due to the possibility of fire hazard **Replace Battery With Panasonic Part No BR2032 Only.** Use of Another Battery May Present A Risk of Fire Or Explosion

CAUTION: Battery May Explode If Mistreated. Do Not Recharge, Disassemble Or Dispose Of In Fire.