The Eagle E-Series™

E3 and Accessories

EAGLE RESEARCH® CORPORATION

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Revision History

Revision Date	Initials	Notes
1/20/2016	SMC	Initial Release
3/2/2016	SMC	Updated
4/27/2016	SMC	Update
1/20/2017	SMC	Corrected Memory and Processor Information

Introduction

Overview

The Eagle E-Series™ is Eagle Research Corporation®'s next generation of the XA-Series™ product line. With faster communication speeds and more memory, the E-Series™ is the perfect choice for many applications. It is an intelligent, compact, rugged, and reliable industrial microprocessor controlled computer designed for real time remote data acquisition and control applications. It can execute multiple processes including tasks such as complex math functions, control algorithms, etc., without host intervention.

The E3 is the first processor released in the Eagle E-Series™ product line. This board is the next generation, premium version of the XARTU/1™. Typical applications will include complete automation for all industry segments; upstream, downstream and midstream; with gate stations, large multi-run metering stations, custody transfer points, compressor stations, tank batteries, well pad automation and more. The E3 can calculate natural gas corrected volumes using AGA-3, AGA-5, AGA-7, AGA-8, AGA-9 (using AGA-7), AGA-11 (using AGA-7) and NX-19 reports. Eagle Research is committed to providing a complete solution for all gas flow, stream, and control applications.

Flexibility, Expandability, and Reliability are the major factors in the E3 design. Some of the features include flexible memory, IO, power, and communications schemes including support for HEXASCII, MODBUS, and various other custom protocols upon request. With onboard USB and Ethernet ports the E3 can communicate at extremely high speed.

A harsh environment tolerance is one of the E3 strengths. The operating temperature can range from -40C to 70C (-40F to 160F). The E3 is housed in a polycarbonate enclosure which allows the RTU to exist where the work must be done, eliminating costly signal conditioning or expensive long sensor runs.

The E3 is normally fed with a 7-30VDC supply. An optional 120/240 VAC unit includes an uninterruptible power supply. Should AC power be lost, the UPS will sense the failure, automatically switch to battery power, and continue to operate at full capacity. Other power supply options include solar arrays and thermoelectric generators for sites without conventional power.

The standard E3 configuration includes two I^2C connections, optional Ethernet, optional USB, two configurable RS232 or RS485 serial communication ports, digital outputs, optional solid state relays, pulse inputs, digital inputs, RTD, and analog inputs. With the optional E3-Extender, two more serial communication ports are added along with more digital inputs, pulse inputs, digital outputs, OPTO's, Analog Inputs, Analog outputs and another RTD. Along with the E3-Extender, other auxiliary devices are available for Analog outputs, OPTO modules and serial ports.

The optional operator interface is a one-line or four-line liquid crystal display, and 26-key keypad with ten user-definable function keys. This allows users to examine and/or change process data items and diagnose problems at the remote site without a local host or terminal. A 3-key keypad will also be available when a full 26-key keypad is not needed.

Reliability

The Eagle E-Series™ is ruggedly built to perform in a variety of industrial environments. Care is taken to maximize reliability by applying a urethane conformal coating to all circuit boards, utilizing a hermetically sealed keypad and display, and providing polycarbonate housing.

Hazardous Location Classifications

Eagle Research Corporation® is currently in the process of obtaining certification for mounting the E3 in Class I, Division 2 hazardous locations. Refer to the NFPA Electrical Code Book for more information.

Four-Year Warranty

Eagle Research Corporation® warrants the products it manufactures to be totally free from any defects in materials and workmanship under normal operation and use. Eagle Research agrees to repair or replace any instrument that is defective due to faulty workmanship or material, if returned to our factory with shipping charges prepaid, within four years of original purchase.

Returns

When a faulty product cannot be repaired in the field, contact Eagle Research Corporation® for an RMA number and for return information. Packaging and shipping criteria will be established at that time.

IMPORTANT REMOVE ANY REPLACEABLE BATTERY OR BATTERY PACK FROM ANY UNIT PRIOR TO ITS RETURN SHIPPING. DAMAGE CAUSED BY LOOSE BATTERIES WITHIN UNITS WILL NOT BE COVERED BY THE MANUFACTURER, AND MAY VOID ANY WARRANTY THE UNIT IS STILL UNDER.

Enclosure

The E-Series™ uses a polycarbonate enclosure that is more rigid which allows the RTU to withstand harsh environments. This new enclosure also allows more mounting options within the unit so that the space inside can be maximized. Along with being more rigid the enclosure also has a metal door hasp that can be padlocked for added security.

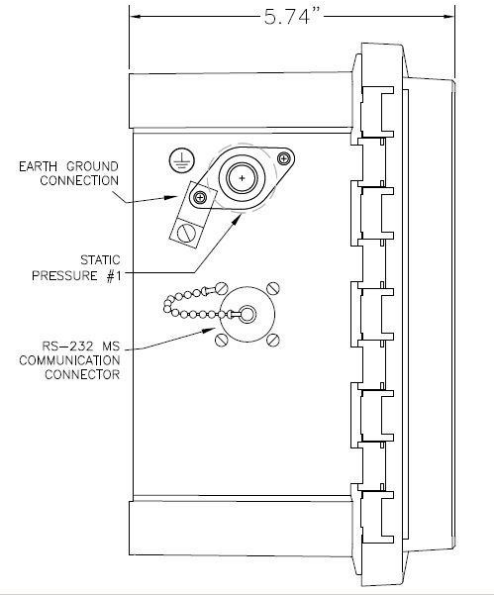


Figure 1: Enclosure Example 1

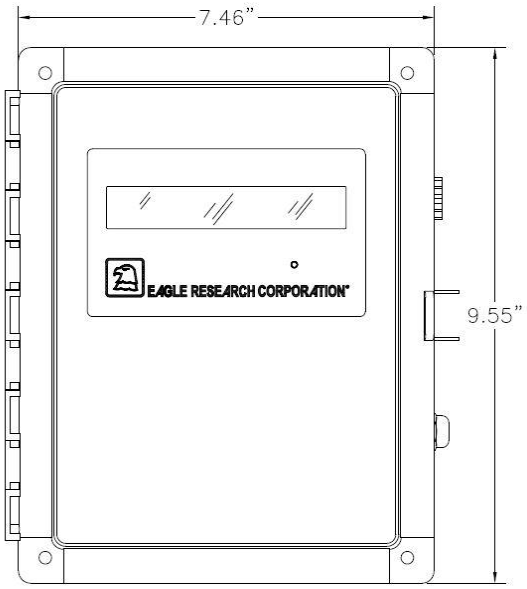


Figure 2: Enclosure Example 2

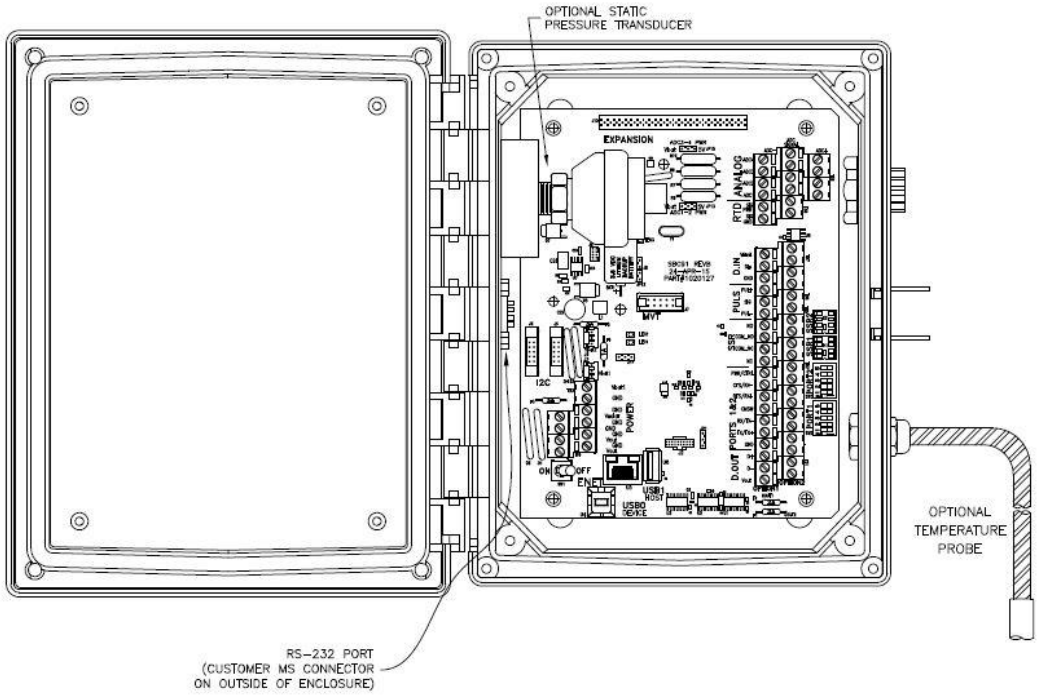


Figure 3: Enclosure Example 3

Specifications

Processor……..ARM-Dual Core 32 Bit at 48MHz
SRAM Memory……4 MB
SPI Flash memory……...4 MB
A/D……16-Bit Analog to Digital Conv. With Software HART Filtering

Operating Temperature……-40 to 70C (-40F to 160F)

Input Voltage (VBAT)……7-30VDC
Input Current (VBAT)……..To Be Determined

Solar Input Voltage (Vsolar)……22VDC
Solar Input Current MAX……2Amps
Solar Panel Size MAX……20 Watt

Operating Current (mA)……...50mA @ 12VDC
Sleep Current (uA)……..80uA @ 12VDC

Output Voltage (Vout)……Equals Vin (7-30VDC)
Output Current MAX (Vout)……3Amps

Analog Input Voltage……..0-5VDC

Digital Output Voltage……30VDC Max
Digital Output Current……2Amps

Digital Input Voltage……...5VDC

Pulse Input Voltage (Supply PWR)……3.3VDC
Pulse Input Form A High Speed MAX Frequency……150 KHz
Pulse Input Form A Low Speed MAX Frequency……160 Hz

Power Options

The Eagle E3 offers a variety of power options to allow for ease and flexibility from site to site. The Eagle E3 offers: Internal Battery Power; External Uninterruptible Power Supply; External Solar Power Array or Supply; or some combination of these. In addition to the primary operating power for the E3, there is an onboard backup battery to maintain unit memory and clock.

Internal Battery Power

Several internal battery packs are available for supplying primary power to the E3. The two basic kinds are **Alkaline** (non-rechargeable) and **Lead-Acid** (rechargeable).

Alkaline packs are typically used alone, without external power, and provide a one-time supply until drained of energy. Alkaline battery life is determined by a number of factors, such as frequency of calculations and communication, cabinet temperature, etc. Connections on the E3 processor board are arranged such that, as one battery pack begins to lose power, a second pack may be connected before the first is removed, thus providing uninterrupted power.

Lead-Acid batteries are rechargeable, and are typically used with an external power supply – such as a solar array. With normal operating conditions, lead-acid batteries and their associated external supplies should provide long periods, up to 5 years, of unattended power to the unit. This would be more suitable for remote locations.

External Power Supply

There are two basic kinds of external power supplies, **Uninterruptible Power Supplies (UPS)** and **Solar Power Supplies (SPS)**. In either case these supplies are designed to be uninterruptible; but the UPS is typically powered by an AC line voltage, where SPS power comes from a solar array. Both types usually have an internal, rechargeable battery that provides power during outages (in the case of UPS), and darkness (in the case of SPS).

Uninterruptible Power Supplies (UPS) are typically fed by a 120 or 240 Volt AC supply, providing 12 Volts DC out, and backed by a 2.2 Amp-hour (or higher) rechargeable lead acid battery. Other forms of energy are available to power a UPS.

Solar Power Supplies (SPS) are fed by a solar array (panel) providing 1 to 64 watts of power to a rechargeable battery. While selected system size depends on geographical location, degree of sun exposure, equipment power consumption, site obstructions, and customer preferences, most E3 applications require only a 20-watt system. Solar systems may be self-contained units mounted independently of the E3, or simply a local solar array that charges a battery within the E3 enclosure.

Onboard Backup Battery

The onboard lithium backup battery on the E3 maintains power for approximately ten years to the memory section and the real time clock of the processor board when primary operating power is not present. Note that when power is applied the backup battery is not being used. Operation and interactivity with the processor is not available when the backup battery alone is in use.

Input Power

If the unit is **internally battery powered only**, check the type of battery pack being used (it should be a non-rechargeable alkaline) and connected as follows: Plug it into either J3 or J4, white MTA connector close to terminal 10, to power up the E3. When it is time to replace the pack, a second pack may be plugged into the other connector before removing the first so power is not interrupted. Due to diode isolation between J3 and J4, the batteries cannot supply power to each other (shown below).

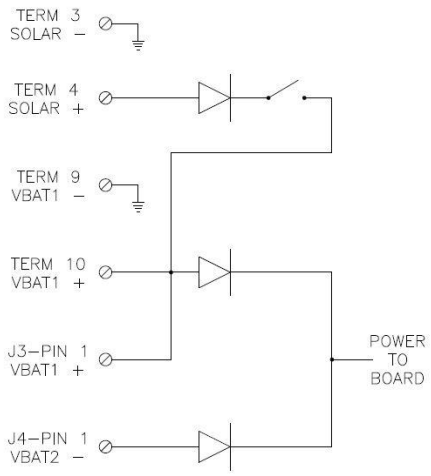


Figure 4: Power Input Schematic

If the unit is **solar powered** with a local solar array feeding directly into the E3, follow this procedure. **First -** connect the internal lead-acid (rechargeable) battery pack to J3 or terminals 9 and 10. **Next** - connect the (+) lead of the solar array to terminal 4 (VSOLAR) and the (-) lead to terminal 3 (GND). Use the reverse procedure to power the unit down, disconnecting the solar array wires first.

NOTE: The maximum wattage for the onboard solar charger is 20 Watts. Do not use a panel larger than 20 Watts. If a panel larger than 20 Watts is needed then a separate charger should be used.

Do not connect the internal lead-acid battery to J4, as charging will not occur. **If, for any reason, an alkaline battery pack is used in this application, DO NOT plug it into J3 as damage may occur.**

If the unit is **externally powered** by either an UPS or a SPS, remove power from its source, connect its (+) and (-) output wires into terminals 10 (VBAT1) and 9 (GND) of terminal block TB3 respectively, and reconnect its source.

Power Input Description	E3 Terminal	Description
GND	3 (TB4)	Ground
Vsolar	4 (TB4)	Connection for Solar Panel – 20 Watt Max (1 Amp) – Protected by fuse F3 (3 Amp)
GND	5 (TB4)	Ground
GND	6 (TB4)	Ground
GND	7 (TB4)	Ground
GND	8 (TB4)	Ground
GND	9 (TB3)	Ground
Vbat1	10 (TB3)	Processor Power Input – 7 to 30 VDC – Protected by fuse F4 (1 Amp)
VBAT1	J3	Primary Battery Pack Connection – 7-30VDC – Protected by fuse F4 (1 Amp)
VBAT2	J4	Secondary Battery Pack Connection – 7-30VDC – Protected by fuse F4 (1 Amp)

Table 1: Input Power Terminals

E-Tip: The E3 is not Powering Up

If the E3 is not powering up first check to see if there is adequate voltage, between 7-30VDC, coming into the processor board, terminals 9 and 10, switch on. Next, check the voltage on both sides of the fuse F4 with respect to ground. Ground can be taken from any of the ground terminals on TB4 (terminals 5-8). The voltage on both sides of the fuse should be very close to the input power. If the voltage is not present, remove power from the E3, remove fuse and check for continuity. If the fuse is blown, discard the bad fuse and replace it with a new 1 Amp fuse.

E-Tip: The Battery is not being Charged

If the battery is not being properly charged first check to make sure the solar panel is outputting adequate voltage and current. To check, remove the solar panel wires from terminals 3 and 4 and measure the voltage. This is the open circuit voltage which should be labeled on the back side of the panel. If this voltage is close to the voltage specified on the back of the panel then connect the solar panel wires back to terminals 3 and 4. Next check the fuse F3 (3 Amp). Measure the voltage on both sides of the fuse with respect to ground. The voltage on both sides of the fuse should be close to the voltage on terminals 3 and 4. If the voltage is not present, remove power from the E3, remove fuse and check for continuity. If the fuse is blown, discard the bad fuse and replace with a 3 Amp fuse.

Output Power

Two terminals are provided on the E3 to provide power to external devices such as radios, cell modems or other field equipment. The output voltage is dependent upon the input voltage; for example, if 12VDC is powering up the E3 then the output voltage would be very close to 12VDC. Vout is protected by a 3 Amp Fuse (F5). Any device being powered up by Vout should not exceed 3 Amps. If more than one device is being powered up by Vout then the total current draw between those devices should not exceed 3 Amps. **Do not use these terminals for the application of power to the E3.**

Power Output Description	E3 Terminal	Description
Vout	1 (TB4)	Voltage Output – Protected by Fuse F5 (3Amp)
Vout	2 (TB4)	Voltage Output – Protected by Fuse F5 (3Amp)
GND	5-8 (TB4)	Ground

Table 2: Output Power Terminals

E-Tip: No Voltage on Vout

If a devices is connected to Vout but is not powering up, first check the fuse, F5. Check the fuse by placing the negative lead of a volt meter on a ground, terminals 5-8. Measure the voltage on both sides of the fuse with respect to ground. The voltage on both sides of the fuse should be close to the voltage on terminals 3 and 4. If the voltage is not present, remove power from the E3, remove fuse and check for continuity. If the fuse is blown, discard the bad fuse and replace with a 3 Amp fuse.

Communications - USB

The E3 is equipped with two USB 2.0 compliant connections; High Speed Device Type B and Full Speed Host Type A.

The High Speed Type B (U4) is used for connecting a laptop for configuring and communicating with the E3.

The Full Speed Host Type A (6) connection is for future development.

Note: Before connecting to an E3 with USB a USB driver must be installed on the computer being used. The USB driver is located on www.eagleresearchcorp.com/Support/Downloads.

E-Tip: USB Port Not Communicating

Verify that the proper Com Port is selected for the USB device being used. This can be found under Device Manager on your computer.

Note that the Device USB driver will need to be loaded. Contact Eagle Research Corporation® for assistance.

Communications - Ethernet

The available on board Ethernet TCP-IP port supports up to 8 simultaneous connections using communication speeds of 10/100 Mbps. To use the Ethernet port connect an Ethernet cable into the RJ45 connector, U5. The Ethernet port can be configured for Static or DHCP communications. Ethernet configurations such as Static or DHCP, fixing the IP address, setting the Gateway Router and Masking can be found in section 402 in the System Settings. Refer to the System Settings section or System Settings manual for more information.

To easily locate the IP address of the unit use Virtual Keypad or Keypad with Display. Click on the conf button then the Eagle Logo to bring up the Special Functions menu. Use the arrow keys to navigate to Diagnostics then press enter. Once in Diagnostics mode press 9 to view the MAC Address, press 9 again to view the IP address. Continue pressing 9 to scroll through the different items.

Communications – Serial Ports

The E3 Processor is equipped with two serial ports that can independently be configured for RS-232 or RS-485, 2-wire or 4-wire, communications. These serial ports are set to a default baud of 115,200Bd. Higher speeds can be set in the Hardware configuration settings but care must be taken when using higher speeds. Cable length and the field device can limit the use of higher baud rates. The

recommended maximum communication speed for the serial ports is 115,200 baud due to cable lengths and field devices. By configuring the serial ports in the hardware settings the user can optimize and customize their communications by using Talon™, Field Manager™ or a keypad. Serial Port 1 and Serial Port 2 can directly interface to cell modems, radios and other field equipment allowing an operator to configure and collect data with an industry- standard portable computer. Port 1 and Port 2 are located on Terminal Block 2, starting at terminals 14 and 41 respectively, and are configured using switch 2 and switch 3 respectively. The table below shows how to configure the ports using the dipswitches.

Dipswitch Number	Dipswitch Position	Function	Notes
1	ON	RS-232 Enabled	
	OFF	RS-485 Enabled	
2	ON	Ties RX+ to TX+	Use for RS-485 2-wire mode
	OFF	Disconnects RX+ & TX+	Use for RS-485 4-wire mode Leave in the OFF position for use with RS-232
3	ON	Ties RX- to TX-	Use for RS-485 2-wire mode
	OFF	Disconnects RX- & TX-	Use for RS-485 4-wire mode Leave in the OFF position for use with RS-232
4	ON	Connects a 14.7K resistor between TX+ and TX-	See **NOTE 1** about terminating resistors
	OFF	Disconnects Terminating Resistor	See **NOTE 1** about terminating resistors Leave in the OFF position for use with RS-232
5	ON	Connects a 120 OHM resistor between RX+ and RX-	See **NOTE 1** about terminating resistors
	OFF	Disconnects Terminating Resistor	See **NOTE 1** about terminating resistors Leave in the OFF position for use with RS-232

Table 3: Serial Ports

NOTE1: The termination resistors, associated with dip switch 4 and 5, are a requirement of RS-485. However, they are not typically needed at the baud rates available. The resistors add a significant amount of current consumption, and should therefore only be used when required. Instances that may benefit from the use of these resistors include noisy environments and those installations with very long wire runs between receivers. These resistors, when used, should be installed only in those units at extreme ends of the installation.

RS-232

Typically RS-232 communications are used for short distances, up to 100ft. In most applications, RS-232 is used for internal communications within the unit, such as cell modems, or between two devices that are next to each other.

The RS-232 ports are also equipped with Power Control. Power Control can be configured to turn an external device on and off if the device has a power control line. This allows the E3 to conserve power. Power Control is set up in the System Configuration Settings and in the database.

Terminal Description	RS-232 PORT1 Terminals	RS-232 PORT2 Terminals
GND	14	40
TX →	15	41
RX ←	16	42
CMSW	17 (Address: 7.1)	43 (Address: 7.2)
RTS →	18	44
CTS ←	19	45
PWR CTRL	20 (Address: 6.1)	46 (Address: 6.2)

Table 4: RS232 Serial Port Terminals

E-Tip: RS-232 Device not Communicating

Several settings can cause the RS232 communications to not work properly. If an RS232 device is unable to communicate with the E3 follow the steps listed below:

Step 1: Check the Dip Switch Settings

Verify that the dip switch settings are set for RS232. They should be set as follows:

	On	Off
1	X	
2		X
3		X
4		X
5		X

Step 2: Check the Baud Rate

Make sure that the baud rate between the E3 and the external device matches. For example if a cell modem has a baud rate of 115,200Bd then the baud rate for the E3 port that it is connected to should be set to 115,200Bd. The baud rate is set by going into the System Settings. Refer to the System Settings section for more information.

Step 3: Check the Wiring

Verify that the external device is wired properly to the E3 port. With the device wires disconnected from the E3, measure the voltage on the TX and RX wires with respect to ground. The wire that has -5VDC to -15VDC should be wired to RX terminal on the E3.

Port 1	Port 2	Description
14	40	Ground
15	41	Tx (Transmit) →
16	42	Rx (Receive) ←
17	43	CMSW
18	44	RTS →
19	45	CTS ←
20	46	Power Control

Step 4: Check Voltages

With the external device wired to the E3 use a volt meter to check the voltages on the RX and TX terminals with respect to ground. There should be -5VDC to -15VDC on both the RX and TX terminals.

RS-485

Typically RS-485 is used for communications outside of the box for distances up to 4,000 feet. RS-485 is great for noisy environments and can also be used for Multi-Drop communications.

Ports 1 and 2 can be set up for RS-485 2-wire and RS-485 4-wire by using SW2 and SW3. See NOTE1 above about using the terminating resistors.

Terminal Description	RS-485 PORT1 Terminals	RS-485 PORT2 Terminals
GND	14	40
TX+ →	15	41
TX- →	16	42
CMSW	17 – Not Used with RS-485	43 – Not Used with RS-485
RX+ ←	18	44
RX- ←	19	45
PWR CTRL	20 – Not Used with RS-485	46 – Not Used with RS-485

Table 5: RS485 Serial Port Terminals

E-Tip: RS-485 Device not Communicating

Step 1: Check the Dip Switch Settings

Verify that the dip switch settings are set for RS-485. They should be set as follows (Note that the following dip switch settings are not using the terminating resistors):

RS-485, 2-Wire

	On	Off
1		X
2	X	
3	X	
4		X
5		X

RS-485, 4-Wire

	On	Off
1		X
2		X
3		X
4		X
5		X

Step 2: Check the Baud Rate

Make sure that the baud rate between the E3 and the external device matches. For example if an odorizer has a baud rate of 115,200Bd then the baud rate for the E3 port that it is connected to should be set to 115,200Bd. The baud rate is set by going into the System Settings. Refer to the System Settings section for more information.

Step 3: Check the Wiring

Verify that the polarity is correct on the signal lines and that the wires are making contact to the terminals.

Port 1	Port 2	Description
14	40	Ground
15	41	TX+
16	42	TX-
17	43	N/A
18	44	RX+
19	45	RX-
20	46	N/A

Step 4: Termination Resistors

For noisy environments or long wire runs between receivers, termination resistors may need to be enabled. The resistors add a significant amount of current consumption, and should therefore only be used when required. These resistors, when used, should be installed only in those units at extreme ends of the installation.

Step 5: Database:

Check the database and verify that the proper port is enabled. Verify that other processes are not using the same port for other functions.

Communications – I^2C

The I^2C communication bus allows for expansion of auxiliary devices within the unit. Two 10-position I^2C connectors are available, easily allowing auxiliary devices to be added such as a display, Expansion Serial Port or Analog Out card. Up to 16 devices can be connected on the I^2C bus; 4 Expansion Serial Ports, 1 Display Board, and up to 11 other devices. Although multiple devices can be daisy changed along the I^2C bus, the I^2C ribbon cable should not exceed 3 feet. Refer to the Accessories section for more information on the I^2C expansion products.

E-Tip: I^2C Device not Working Properly

If the I^2C devices are not working properly then one of the devices on the I^2C bus might be bad. To determine if one of the I^2C devices is corrupting the I^2C bus; remove all items on the bus then slowly add each device back until the devices begin to fail again. This will help eliminate the bad module.

Digitals

The Digital section of the E3 Processor is located along the lower right had side of the board. This section contains two Form A / Form C Pulse Input high and low speed, two dual Form A and Form B OR a single Form C Solid State Relays, two Digital Outputs and two Digital Inputs.

Digital – Digital Outputs

The E3 Processor has two Digital Outputs. Each Digital Out is protected by a 2 Amp fuse, F1 (Dout2) and F2 (Dout1). Vout is located on the same terminal block (TB1) so that power can easily be brought over to Dout+ (D+). Primarily the Digital Out is used to turn devices on and off, such as radios.

To use the Digital Out to turn on and off devices jumper Dout+ (D+) to Vout, connect the load to Dout- (D-) and the other end of the load to ground, which can be found on TB4.

Field Manager™ and/or Talon™ software can be used to turn on/off the Digital Outputs.

	Digital Out Terminal Description	**E3 Terminal Location**
Digital Out 1	Vout (Vout ≈ Vbat)	11

Protected by Fuse F2 (2A) Software Address: 2.1	Dout1- (D-)	12
	Dout1+ (D+)	13
Digital Out 2 Protected by Fuse F1 (2A) Software Address: 2.2	Vout (Vout ≈ Vbat)	37
	Dout2- (D-)	38
	Dout2+ (D+)	39

Table 6: Digital Output

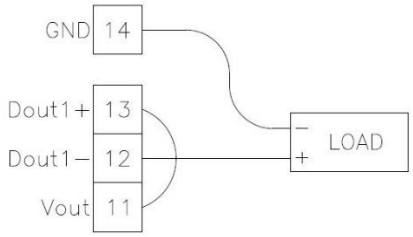


Figure 5: Example Digital Output Wiring

E-Tip: Digital Out

If the Digital Out is not turning on and off the desired device follow the steps below:

Step 1: Check Wiring
Verify that the device is properly wired, refer to Table 6.

Step 2: Check Software
Verify that the software is set up properly to turn on the device. For trouble shooting purposes turn Dout to always on. Remember to change the Dout settings when finished trouble shooting so the battery does not get drained. The pulse on and/or off times may also be set to a too small of an interval. Try adjusting on and off times to larger values.

Step 3: Check Voltage
Measure voltages on terminal 11, 12 and 13 with respect to ground, terminal 14. Terminals 11, 12 and 13 voltages should read close to Vin.

Step 4: Check Fuses
Both digitals are protected by a 2 Amp fuse. If the digital out is turned on, measure the voltage on both sides of the fuse, F2 (Dout1) and F1 (Dout2). The voltage should be close to Vin. If voltage is only on one side of the fuse, then the fuse is blown and needs replaced. If voltages is not found on either side of the fuse then check to make sure the digital is turned on.

Digital – Solid-State Relays

The E3 Processor has the option of using two pluggable Solid State Relays (SSR) that can be used mainly for pulse outputs. Each Solid State Relay has independent Form A and Form B outputs OR a single Form C output.

	SSR1 (K1) Terminals	**SSR2 (K2) Terminals**
NC (Normally Closed)	21	47
COM_NC	22	48
COM_NO	23	49
NO (Normally Open)	24	50

Table 7: Solid-State Relays

Field Manager™ and/or Talon™ software can be used to turn on/off the Solid State Relays.

	Output Type	Software Address
Solid State Relay 1	SSR1_A (Form A)	3.1
	SSR1_B (Form B)	3.2
	SSR1_AB (Form C)	3.3
Solid State Relay 2	SSR2_A (Form A)	3.4
	SSR2_B (Form B)	3.5
	SSR2_AB (Form C)	3.6

Table 8: Solid State Relay Addressing

Dual Form A / Form B

The E3 Processor has the option of using the Solid State Relays as a dual Form A and Form B pulse outputs. Form A pulse outputs are Normally-Open (NO), when in their natural state. When activated the switch closes, sending the signal to the field device. Form B pulse outputs are Normally-Closed (NC), when in their natural state. When activated the switch opens, disconnecting signal from the field device.

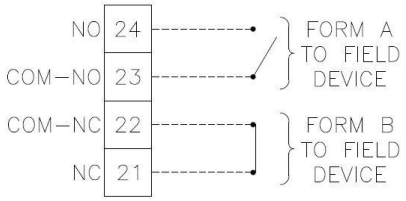


Figure 6: Example Solid-State Relay Wiring

E-Tip: Form A and Form B

To test From A, activate the output and measure the resistance across common (COM_NO) and NO. The resistance should be less than 50ohms.

To test Form B, activate the output and mreaure the ressistance across common (COM_NC) and NC. The resistance should show as open.

Form C

The Solid State Relay can easily be converted from a dual Form A and Form B relay to a single Form C relay simply by connecting COM_NO (Terminal 23 or 49) to COM_NC (Terminal 22 or 48) as shown in the diagram below. Form C combines Form A and Form B so that it has two primary sides and one common.

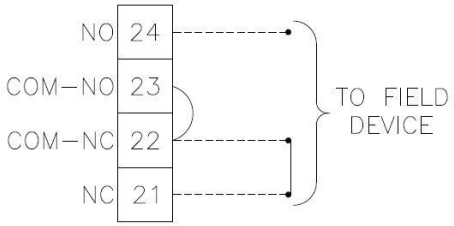


Figure 7: Example Form C Wiring

E-Tip: Form C

To test From C, activate the output and measure the resistance across common (COM_NO) and NO. The resistance should be less than 50ohms. Measure the resistance across common (COM_NO) and NC. The resistance should show as open.

Digital – Pulse Inputs

The E3 Processor comes standard with two Pulse Inputs. Each pulse input is software programmable for From A or Form C, High and low speed. These Pulse Inputs can be used as simple counters for index or turbine inputs. The table below shows the signal input limits for Form A and Form C, High Speed and Low Speed, with High Speed and Low Speed resistors enabled.

Form A High Speed	
Low Speed Resistor	Signal Input Limit ~20 KHz
High Speed Resistor	Signal Input Limit ~20 KHz
Form A Low Speed	
Low Speed Resistor	Signal Input Limit ~100 KHz
High Speed Resistor	Signal Input Limit ~250 KHz
Form C High Speed	
Low Speed Resistor	Signal Input Limit ~20 KHz
High Speed Resistor	Signal Input Limit ~20 KHz
Form C Low Speed	
Low Speed Resistor	Signal Input Limit ~300 KHz
High Speed Resistor	Signal Input Limit ~300 KHz

For Advanced programming enable the Pulse Input by using the corresponding software address.

	Terminal Description	E3 Terminal
Pulse Input 1 Software Address: 5.1	PUL1- (Low – Set)	25
	PUL1 (Common)	26
	PUL1+ (High – Reset)	27
Pulse Input 2 Software Address: 5.2	PUL2- (Low – Set)	51
	PUL2 (Common)	52
	PUL2+ (High – Reset)	53

Table 9: Pulse Inputs

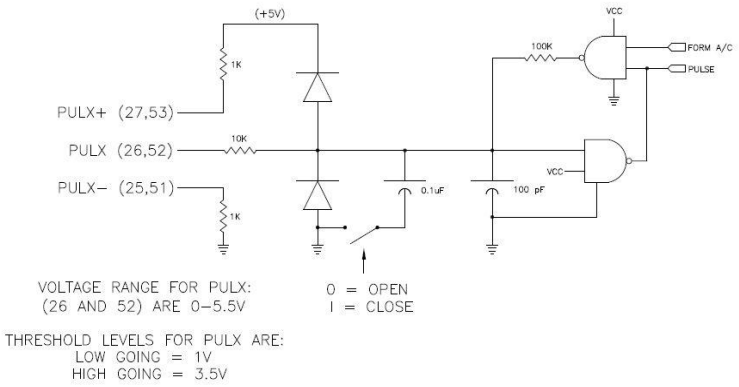


Figure 8: Pulse Input Schematic

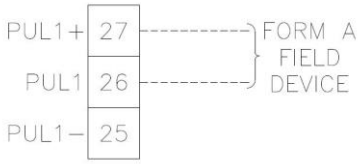


Figure 9: Example Pulse Input Form A Wiring

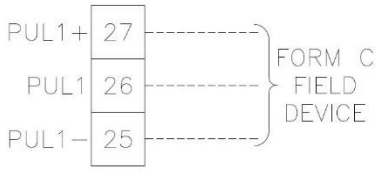


Figure 10: Example Pulse Input Form C Wiring

E-Tip: Pulse Inputs

Verify that the application is set up properly according to the configuration of the pulse coming in. If testing the pulse for Form A then short PUL- and PUL (common) momentairly. The counts should increase. If testing for form C then momentairly short PUL- to PUL (common) then PUL+ to PUL (common). The counts should increase.

Digital – Digital Inputs

The E3 Processor has two Digital Inputs. These inputs are used to present a field status to the processor, such as an alarm or status input. Vlimit is available next to the digital inputs to provide low current wetting voltage to prevent oxidation on switch contacts. Vlimit is equal to Vin through a 1K Ohm resistor (Vlimit = Vin through 1K resistor).

For Advanced programming enable the Digital Input by using the corresponding software address.

	Terminal Description	SBC91 Terminal
Digital Input 1 Software Address: 1.1	GND	28
	Din1	29
	Vlimit1	30
Digital Input 2 Software Address: 1.2	GND	54
	Din2	55
	Vlimit2	56

Table 10: Digital Inputs

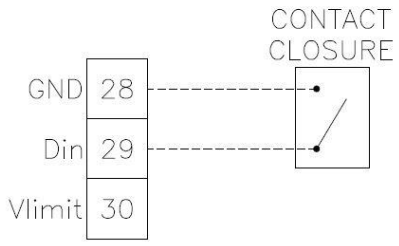


Figure 11: Example Digital Input Wiring 1

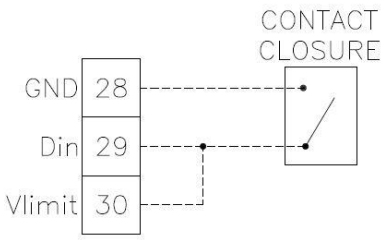


Figure 12: Example Digital Input Wiring 2

E-Tip: Digital Inputs

Short Din and GND, the logic level should appear as 1. When Din and GND are disconnected then the logic level should appear as a 0. Field Manager™ and/or Talon™ software can be used to configur and verify the Digital Input.

Analog

The Analog section of the E3 Processor is located in the upper right hand corner of the board. This section contains four configurable Analog Inputs along with one RTD temperature probe input. In addition to the Analog Input, there is a built in box temperature and supply voltage input that can be read.

Analog – RTD Input

The E3 Processor includes one 100 ohm platinum RTD (Resistance Temperature Detector) coefficient 0.00385, input with 3-wire lead compensation and ground shield connection. The RTD is a 16-bit resolution input with analog sampling capability and can be software calibrated. The RTD input can measure temperatures from -40 to 160°F. Connect the RTD to terminals 31, 32, 57 and 58 as shown below.

RTD Input Description	SBC91 Terminal Location
GND (Ground)	31
PWR (Power)	32
SIG (Signal)	57
SIG (Signal)	58

Table 11: RTD Input

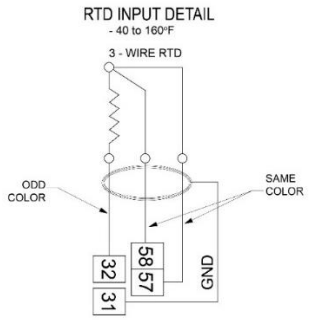


Figure 13: Example RTD Input Wiring

E-Tip: RTD Input

The best way to test an RTD Input is by using an RTD Simulator for 100 ohm and coefficient 0.00385. Connect the RTD Simulator according to the diagram above. Change the temperature on the RTD Simulator and verify that the application reads the proper values. Connect the temperature probe back to the RTD Input and verify the reading.

Analog – Analog Inputs

The E3 includes four general-purpose, 4-20 mA or 0-5 VDC analog inputs. These are 16-bit resolution inputs with analog sampling capability. All analog inputs can be software calibrated. Jumpers JP13 & JP15 determine the voltage input to power the transmitters or transducers. They provide supply voltage (7-30 VDC) when positioned to the left (Vbat), and 5 VDC reference voltage when positioned to the right (5V). JP13 governs ADC1 & ADC2 and JP15 governs ADC3 and ADC4. An external supply can also be connected to channels used when the jumper is removed.

For transmitters that output a 4-20mA signal the brown 250 OHM dropping resistor must be installed. Wire the power wire of the transmitter to ADC+ and the signal wire to ADC Signal. ADC- should not be connected.

For transducers that output a 0-5V signal then the brown 250 OHM dropping resistor must be pulled. Wire the power wire of the transducer to ADC+, the signal wire to ADC Signal and the ground wire to ADC-.

The table below shows the terminal wiring for the analog inputs.

	Analog Input Description	**SBC91 Terminal Location**
Analog 1	ADC1+ (Power)	63

Dropping Resistor R6	ADC1 (Signal)	59
	ADC1- (Ground) – No connection for 4-20mA input	33 – No connection for 4-20mA input
Analog 2 Dropping Resistor R7	ADC2+ (Power)	64
	ADC2 (Signal)	60
	ADC2- (Ground) – No connection for 4-20mA input	34 – No connection for 4-20mA input
Analog 3 Dropping Resistor R9	ADC3+ (Power)	65
	ADC3 (Signal)	61
	ADC3- (Ground) – No connection for 4-20mA input	35 – No connection for 4-20mA input
Analog 4 Dropping Resistor R10	ADC4+ (Power)	66
	ADC4 (Signal)	62
	ADC4- (Ground) – No connection for 4-20mA input	36 – No connection for 4-20mA input

Table 12: Analog Input

Analog Addressing

For Advanced programming set the corresponding Analog address in the Analog Process to set up the device to read the Analog values correctly.

Address	Description
1	ADC1
2	ADC2
3	ADC3
4	ADC4
5	ADC5 (E3-Extender Board)
6	ADC6 (E E3-Extender Board)
7	ADC7 (E3-Extender Board)
8	ADC8 (E3-Extender Board)
9	Temperature 1
10	Temperature 2 (E3-Extender Board)
11	Ambient Temperature
12	Supply Volts

Table 13: Analog Addressing

E-Tip: Analog Input

Check voltages. There should be voltage on ADC+ and ADC Signal.

Check the dropping resistor. The brown resistor should be installed for a 4-20mA transducer and removed for a voltage transducer.

MVT

The E3 Processor comes with an onboard MVT (Multi-Variable Transmitter) connector. This allows for an MVT to be plugged directly into the E3 Processor without the need for an interface board. For advanced programming set Mode to 0 and Address to a 1 in the Transmitter Process to set up the MVT.

E3-Extender

The E3-Extender board adds more functionality to the E3 processor simply by plugging directly into the expansion header, J10. This board provides two additional communication ports, three additional Digital Outs, two additional Pulse Inputs, three additional Digital Inputs, two OPTO ports, four additional Analog Inputs, one Analog Output and one additional RTD Temperature Probe Input.

E3-Extender Communications

The E3-Extender adds two additional communication serial ports that can independently be configured for RS-232 or RS-485, 2-wire or 4-wire, communications. These serial ports are set to 115,200 baud depending on the limit of the field device and cable length. The recommended maximum communication speed for the serial ports is 115,200 baud. The baud rate can be adjusted using the System Configuration editor (EEPROM Configuration Editor) in the E3 using Talon™, Field Manager™ or a keypad. Serial Port 3 and Serial Port 4 can directly interface to cell modems, radios and other field equipment allowing an operator to configure and collect data with an industry- standard portable computer. Port 3 and Port 4 are located on Terminal Block 4 (TB4) of the E3-Extender and are configured using switch 1 and switch 2 respectively. The table below shows how to configure the ports using the dipswitches.

Dipswitch Number	Dipswitch Position	Function	Notes
1	ON	RS-232 Enabled	
	OFF	RS-485 Enabled	
2	ON	Ties RX+ to TX+	Use for RS-485 2-wire mode
	OFF	Disconnects RX+ & TX+	Use for RS-485 4-wire mode Leave in the OFF position for use with RS-232
3	ON	Ties RX- to TX-	Use for RS-485 2-wire mode
	OFF	Disconnects RX- & TX-	Use for RS-485 4-wire mode Leave in the OFF position for use with RS-232
4	ON	Connects a 14.7K resistor between TX+ and TX-	See **NOTE 1** about terminating resistors
	OFF	Disconnects Terminating Resistor	See **NOTE 1** about terminating resistors Leave in the OFF position for use with RS-232
5	ON	Connects a 120 OHM resistor between RX+ and RX-	See **NOTE 1** about terminating resistors
	OFF	Disconnects Terminating	See **NOTE 1** about

		Resistor	terminating resistors Leave in the OFF position for use with RS-232

Table 14: E3-Extender Serial Ports

NOTE1: The termination resistors, associated with switches 4 and 5, are a requirement of RS-485. However, they are not typically needed at the baud rates available. The resistors add a significant amount of current consumption, and should therefore only be used when required. Instances that may benefit from the use of these resistors include noisy environments and those installations with very long wire runs between receivers. These resistors, when used, should be installed only in those units at extreme ends of the installation.

RS-232

Typically RS-232 communications are used for short distances, up to 100ft. In most applications RS-232 is used for internal communications within the unit, such as cell modems, or between two devices that are next to each other.

The RS-232 ports are also equipped with Power Control. Power Control can be configured to turn an external device on and off if the device has a power control line. This allows the E3-Extender and E3 to conserve power. Power Control is set up in the System Settings and in the database.

Terminal Description	**RS-232 PORT3 Terminals**	**RS-232 PORT4 Terminals**
GND	97	115
TX →	98	116
RX ←	99	117
CMSW	100 (Address: 7.3)	118 (Address: 7.4)
RTS →	101	119
CTS ←	102	120
PWR CTRL	103 (Address: 6.3)	121 (Address: 6.4)

Table 15: E3-Extender RS232

For troubleshooting tip refer to the **E-Tip: RS-232 Device not Communicating** section.

RS-485

Typically RS-485 is used for communications outside of the box for distances up to 4,000 feet. RS-485 is great for noisy environments and can also be used for Multi-Drop communications.

Ports 3 and 4 can be set up for RS-485 2-wire and RS-485 4-wire by using SW1 and SW2 on the E3-Extender. See NOTE1 above about using the terminating resistors.

Terminal Description	RS-485 PORT1 Terminals	RS-485 PORT2 Terminals
GND	97	115
TX+ →	98	116
TX- →	99	117
CMSW	100 – Not Used with RS-485	118 – Not Used with RS-485
RX+ ←	101	119
RX- ←	102	120
PWR CTRL	103 – Not Used with RS-485	121 – Not Used with RS-485

Table 16: E3-Extender RS485

For troubleshooting tip refer to the **E-Tip: RS-485 Device not Communicating** section.

E3-Extender Digitals

OPTOS

The E3-Extender provides the E3 with two OPTO slots to use for controls. These OPTO slots can provide any combination of DC Out, Relay, DC Input, AC Out, and AC Input. Each OPTO module comes with a built in status LED. Output OPTO modules come with a replaceable integral fuse.

	Terminal Description	Terminal Number
OPTO 1 OPTO 1 Address: 4.1	Ground	122
	OPTO 1 +	123
	OPTO 1 -	124
OPTO 2 OPTO 2 Address: 4.2	Ground	104
	OPTO 2 +	105
	OPTO 2 -	106

Table 17: E3-Extender OPTOs

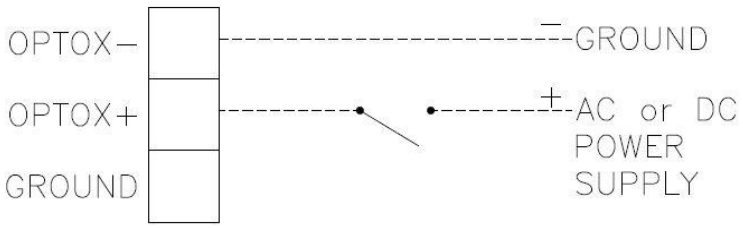


Figure 14: Typical OPTO Input Wiring

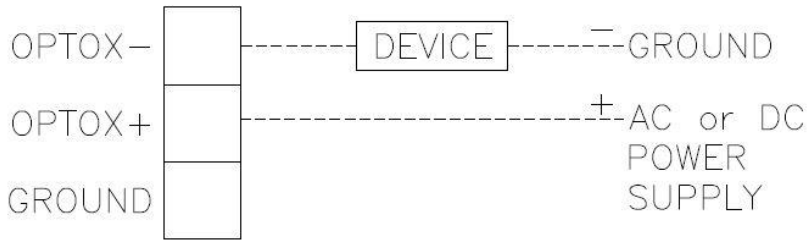


Figure 15: Typical OPTO Output Wiring

Listed below are the available OPTO Module options.

Type	Eagle Part Number	Color	Current (mA)	Integral Fuse	Built in Status LED	Use
No OPTO	--	--	--	--	--	--
DC Out (60VDC, 2A)	2030164	Red		Yes	Yes	Control or switch DC loads
Relay (500mA)	2030165	Red		Yes	Yes	Form A mechanical Relay
DC Input (32VDC)	2030166	White		No	Yes	Detect on/off DC voltage levels
AC Input (90-140VAC)	2030167	Yellow		No	Yes	Detect on/off AC voltage levels
AC Out (120VAC, 2A)	2030168	Black		Yes	Yes	Control or switch AC loads

Table 18: E3-Extender Available OPTO Modules

E-Tip: OPTO

Using a Volt Meter measure the voltage on the OPTO sockets. Socket 5 should have 0VDC and Socket 3 should have 5VDC.

Digital Inputs

The E3-Extender has three additional Digital Inputs. These inputs are used to present a field status to the processor, such as an alarm or status input.

	Terminal Description	SBC91 Terminal
Digital Input 3 Address: 2.3	GND	107
	Din3	108
Digital Input 4 Address: 2.4	GND	89
	Din4	90
Digital Input 5 Address: 2.5	GND	58
	Din5	86

Table 19: E3-Extender Digital Inputs

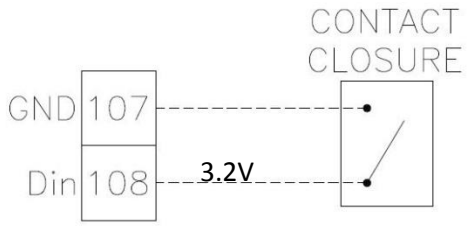


Figure 16: E3-Extender Example Digital Input Wiring

For troubleshooting information refer to the **E-Tip: Digital Input** section.

Pulse Inputs

The E3-Extender adds two additional Pulse Inputs to the E3 processor. Each pulse input is software programmable for From A and Form B or Form C, High and low speed. These Pulse Inputs can be used as simple counters for index or turbine inputs.

	Terminal Description	**SBC91 Terminal**
Pulse Input 3 Pulse Input 3 Address: 5.3	PUL3- (Low – Set)	110
	PUL3 (Common)	111
	PUL3+ (High – Reset)	112
Pulse Input 4 Pulse Input 4 Address: 5.4	PUL4- (Low – Set)	92
	PUL4 (Common)	93
	PUL4+ (High – Reset)	94

Table 20: E3-Extender Pulse Inputs

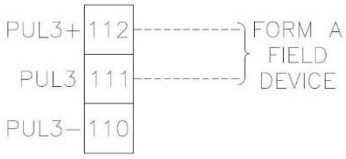


Figure 17: E3-Extender Exampl Pulse Input Form A Wiring

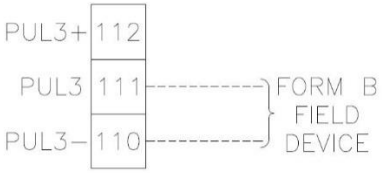


Figure 18: E3-Extender Exampl Pulse Input Form A Wiring

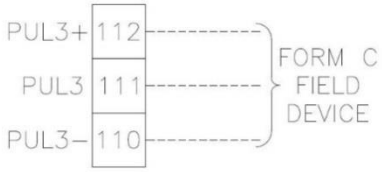


Figure 19: E3-Extender Exampl Pulse Input Form A Wiring

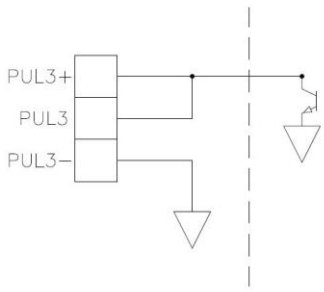


Figure 20: E3-Extender Example Pulse Input Open Collector Wiring

For troubleshooting information refer to the **E-Tip: Pulse Inputs** section.

Digital Outputs

The E3-Extender adds three addition Digital Outs to the E3 processor. Each Digital Out is protected by a 2 Amp fuse, F1 (Dout3), F2 (Dout4) and F3 (Dout5). Primarily the Digital Out is used to turn devices on and off, such as radios.

To use the Digital Out to turn on and off devices jumper Dout+ (D+) to Vout, connect the load to Dout- (D-) and the other end of the load to ground, which can be found on TB4.

For Advanced Programming enter the Digital Out address into the correct process to enable Dgital Output.

	Digital Out Terminal Description	SBC91 Terminal Location
Digital Out 3 Protected by Fuse F1 (2A) Digital Out Address: 2.3	Dout3- (D-)	113
	Dout3+ (D+)	114
Digital Out 4 Protected by Fuse F2 (2A) Digital Out Address: 2.4	Dout4- (D-)	95
	Dout4+ (D+)	96
Digital Out 5 Protected by Fuse F3 (2A) Digital Out Address: 2.5	Dout5- (D-)	87
	Dout5+ (D+)	88

Table 21: E3-Extender Digital Outputs

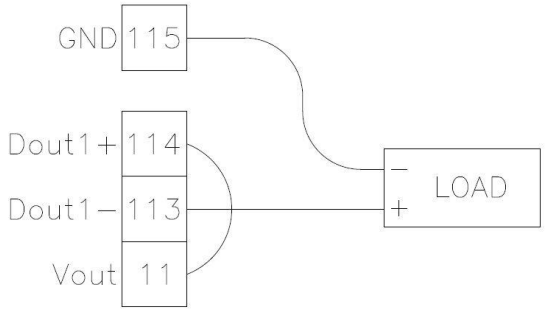


Figure 21: E3-Extender Example Digital Output Wiring

For troubleshooting information refer to the **E-Tip: Digital Out** section.

E3-Extender Analogs

RTD Input

The E3-Extender includes one 100 ohm platinum RTD (Resistance Temperature Detector) coefficient 0.00385, input with 3-wire lead compensation and ground shield connection. The RTD is a 16-bit resolution input with analog sampling capability and can be software calibrated. The RTD input can measure temperatures from -40 to 160°F. Connect the RTD to terminals 71, 72, 77 and 78 as shown below.

RTD Input Description	SBC91 Terminal Location
GND (Ground)	71
PWR (Power)	72
SIG (Signal)	77
SIG (Signal)	78

Table 22: E3-Extender RTD Input

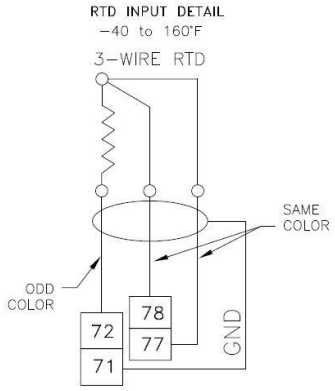


Figure 22: E3-Extender Example RTD Input Wiring

For troubleshooting information refer to the **E-Tip: RTD Input** section.

Analog Input

The E3-Extender provides four additional general-purpose, 4-20 mA or 0-5 VDC analog inputs. These are 16-bit resolution inputs with analog sampling capability. All analog inputs can be software calibrated. Jumpers JP1 & JP2 determine the power input to the transmitters. They provide supply voltage (7-30 VDC) when positioned to the left, Vbat, and reference voltage (5 VDC) when positioned to the right, 5V. JP1 governs ADC5 & ADC6 and JP2 governs ADC7 and ADC8. An external supply can also be connected to channels used when the jumper is removed.

For transmitters that output a 4-20mA signal the brown 250 OHM dropping resistor must be installed. Wire the power wire of the transmitter to ADC+ and the signal wire to ADC Signal. ADC- should not be connected.

For transducers that output a 0-5V signal, the brown 250 OHM dropping resistor must be pulled. Wire the power wire of the transducer to ADC+, the signal wire to ADC Signal and the ground wire to ADC-.

The table below shows the terminal wiring for the analog inputs.

	Analog Input Description	SBC91 Terminal Location
Analog 5 Dropping Resistor R8	ADC5+ (Power)	79
	ADC5 (Signal)	73
	ADC5- (Ground) – No connection for 4-20mA input	67 – No connection for 4-20mA input
Analog 6 Dropping Resistor R11	ADC6+ (Power)	80
	ADC6 (Signal)	74
	ADC6- (Ground) – No connection for 4-20mA input	68 – No connection for 4-20mA input
Analog 7 Dropping Resistor R13	ADC7+ (Power)	81
	ADC7 (Signal)	75
	ADC7- (Ground) – No connection for 4-20mA input	69 – No connection for 4-20mA input
Analog 8 Dropping Resistor R16	ADC8+ (Power)	82
	ADC8 (Signal)	76
	ADC8- (Ground) – No connection for 4-20mA input	70 – No connection for 4-20mA input

Table 23: E3-Extender Analog Input

Analog Addressing

For Advanced Programming enter the Analog address into the Analog process to set up the analog device to read the Analog values correctly.

Addressing	Description
1	AI1
2	AI2
3	AI3
4	AI4
5	AI5 (Expansion Board)
6	AI6 (Expansion Board)
7	AI7 (Expansion Board)
8	AI8 (Expansion Board)
9	Temperature 1
10	Temperature 2 (Expansion Board)
11	Ambient Temperature
12	Supply Volts
13 - 99	Spares

Table 24: E3-Extender Analog Addressing

For troubleshooting information refer to the **E-Tip: Analog Input** section.

Analog Output

The E3-Extender board contains one Analog output, 24VDC Loop Power, optically isolated, precision 4-20mA output. This allows an onboard solution to provide 4-20mA outputs for flow rate, pressure, or numerous other control and monitoring applications.

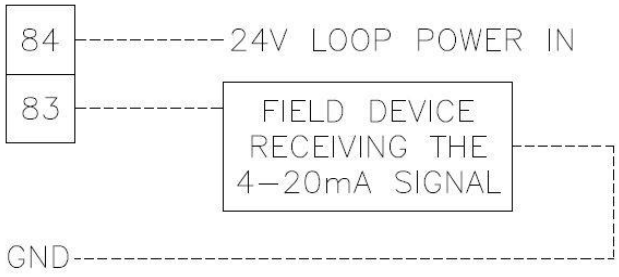


Figure 23: E3-Extender Example Analog Output Wiring

Accessories

Displays

The E-Series™ product line offers two LCD display options; External One-Line Display and External 4-Line Display. The displays are connected to the E3 on board I^2C bus via an I^2C ribbon cable.

The E-Series™ product line offers an optional factory-mounted 26-key keypad. The keypad, along with a display, may be used to access, change, and view programming data and stored information while on site. To access any operating modes, press the keypad key that corresponds to the mode needed:

Conf	This key allows the user to going **configuration** mode. From configuration mode the user is able to view and edit different items within the database.
Jump	The **Jump** key allows the user to quickly navigate throughout the database or system settings. Simply type the PP-SS-II when in configuration mode or the system address when in the system settings menu.
Ent	Press **Enter** to accept an item after it has been edited or to accept an action
Esc	Use the **Escape** key to exit out of menus
Edit	Use the **Edit** key to edit a value
Alrm	The **Alarm** key allows the user to view any active or unacknowledged alarms
cal	Press the cal key to do a zero and span **calibration** from the keypad
Zero	When in calibration mode, press the **zero** key to take the zero point.
span	When in calibration mode, press the **span** key to take the span point.
Eagle Logo	Press the **Function Key** to perform other commands such as entering into the System Configuration settings. The conf key must be pressed before the Function Key to enter into the configuration settings.
↓↑→←	The arrow keys allow the user to scroll through the display parameter list. Use the **←** key to backspace when typing numbers in.
0-9	The number keys 0-9 can be preset as function keys to view previously assigned parameters. Also use the number keys when editing values or jumping to a specific location within the database or hardware settings
.	This key allows the user to enter in a decimal number
+/-	The +/- key allows the user to enter in a positive and negative value.

Table 25: E-Series™ Keypad Functions

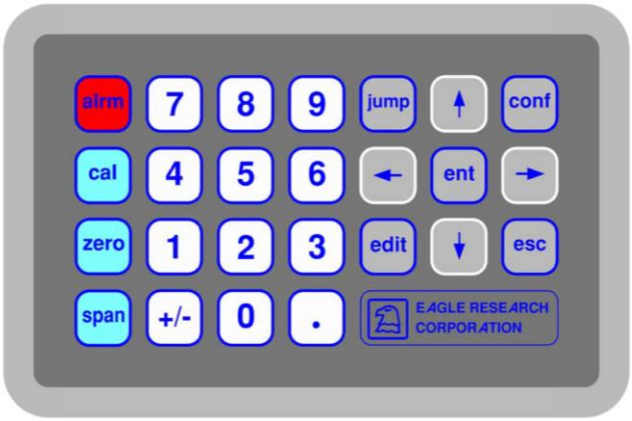


Figure 24: E-Series™ Keypad

By pressing config then the Eagle Logo the user can bring up a menu for special function options. The user can use the arrow keys to scroll through the functions then press enter to select the desired function. The following table shows the different functions.

Function	Description
System Settings	System Settings allows the user to configure certain hardware functions such as communication ports baud rates. For more information on the System Settings and navigating through them, see the System Settings section.
Diagnostics	Diagnostics is used to access Diagnostics Mode. The display shows the processes executing. While in Diagnostics mode press the conf key to view each communication port. Press the conf key again to scroll through the different ports. This allows the user to view the baud rate for each port and communication protocol. Press number 9 for IP Address information. Press zero or Esc to exit Diagnostics mode.
System Info	System Info is used to view Firmware version, Unit Serial Number, Runtime, Number Processes and Free Data Bytes within the unit
User Extras	User Extras is used to toggle the keypad beeps, setting up the four line display and Eagle contact information
Unit Reset	Unit Reset brings up the menu to Reboot the unit, Initialize the settings and clear the database. Note that passwords are required to perform these operations.
Factory Testing	Factory Testing is used to test the Display and keypad.

Table 26: E-Series™ Keypad Special Function List

E-Series™ ESP Expansion (E-ESP)

This board is Eagle's E-Series™ ESP Expansion (Expansion Serial Port) board. It provides an additional serial port with a jumper-selectable RS-232 or RS-485 interface. The E-ESP has minimal operating

currents and supports sleep modes. In addition to the two onboard serial ports and the two serial ports on the E3-Extender board, up to four E-ESP's can be added to a system for a total of 8 serial ports.

The default address for all auxiliary boards is 0. When set to a 0 and connected to a device the board cannot be read. To operate properly, the E-ESP must be set to an address value between 1 and 4 that is unique to the rest of the system. Addresses 1-4 are reserved for the E-ESP and addresses 5-15 are used for all other auxiliary devices.

To set the address on the E-ESP use the SW1 dipswitches, located in the middle of the PCB board, according to the chart below.

SW1 – Board Addressing

Address	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
0	↑	↑	↑	↑	X	X
1	↓	↑	↑	↑	X	X
2	↑	↓	↑	↑	X	X
3	↓	↓	↑	↑	X	X
4	↑	↑	↓	↑	X	X

Table 27: E-Series™ ESP Board Addressing

The E-ESP board has three LED indicators; Enable (EN), Transmit (TX) and Receive (RX). The Enable LED will blink the number of the address, then pauses, then blinks the number of the address again. Example: If the address is set to 3 then the LED will blink 3 times, skips a blink, and then repeats. This allows the user to easily determine the health and address of the E-ESP without having to pull the board out of the enclosure.

The Transmit (TX) and Receive (RX) LED's indicate that the E-ESP is transmitting and receiving data. These LED's are useful when troubleshooting. If only one LED is blinking then that can indicate where the problem might be. Example: if the transmit LED is blinking but the receive LED is not then that indicates that the E-ESP is sending out a message but the device connected to the E-ESP is not transmitting the message back or it is wired wrong and the E-ESP is not receiving the message.

The E-ESP can be configured for RS-232, RS-485 2-wire or RS-485 4-wire by using the dipswitch bank SW2 located along the right edge of the PCB board. To set the dipswitch SW2 for the desired serial communication method use the chart below.

	Master						**Intermediate Slave**						**Final Slave**					
Function	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
RS485 4-Wire (Full Duplex)[1] Point-to-Point	↑	↑	↑	↑	↓[2]	↓[2]	Not Applicable						↑	↑	↑	↑	↓[2]	↓[2]
RS485 4-Wire (Full Duplex)[1] Point-to-Multipoint	↑	↑	↑	↑	↓[2]	↓[2]	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓[2]	↓[2]
RS485 4-Wire (Half-Duplex)[1]	↑	↓	↑	↑	↓[2]	↓[2]	Not Applicable						↑	↓	↑	↑	↓[2]	↓[2]

Point-to-Point																		
RS485 4-Wire (Half-Duplex)[1] Point-to-Multipoint	↑	↓	↑	↑	↓[2]	↓[2]	↑	↓	↑	↑	↑	↑	↑	↓	↑	↑	↓[2]	↓[2]
RS485 2-Wire Point-to-Point	↑	↓	↓	↓	↓[2]	↓[2]	Not Applicable						↑	↓	↓	↓	↓[2]	↓[2]
RS485 2-Wire Point-to-Point	↑	↓	↓	↓	↓[2]	↓[2]	↑	↓	↓	↓	↑	↑	↑	↓	↓	↓	↓[2]	↓[2]
All RS-232 Applications	↓	↑	↑	↑	↑	↑												

Table 28: E-Series™ ESP Dipswitch Settings

NOTE1: Half Duplex is the most common setting for 4-wire RS485 since all currently implemented communication protocols are half duplex. Configuring for half duplex would help reduce the chance of any noise characters being received due to cross talk with transmitting.

NOTE2: The termination resistors, associated with switches 4 and 5, are a requirement of RS-485. However, they are not typically needed at the baud rates available. The resistors add a significant amount of current consumption, and should therefore only be used when required. Instances that may benefit from the use of these resistors include noisy environments and those installations with very long wire runs between receivers. These resistors, when used, should be installed only in those units at extreme ends of the installation.

E-Series™ Analog Output Expansion (E-AO)

The E-Series™ Analog Output Board (E-AO) provides a three-channel, two-wire, optically isolated, precision 4-20mA output signals with a resolution of 2 part in 65536 (26 bit), or 0.00024mA. This module interfaces with the E3 to provide 4-20mA outputs for flow rate, pressure, or numerous other control and monitoring applications. The E-AO board interfaces to the E3 via the standard I^2C serial interface bus. Using the I^2C bus the E3 requests the desired mA output from the E-AO board. An I^2C digital I/O chip is used to send the information to the analog output section of the E3 board. Each E-AO has its own custom enclosure for easy din rail mounting.

The E-AO will function properly in temperatures from –40°F to +160°F, and in conditions of high humidity (including condensing environments). Software calibration of the 4-20 mA output is provided for easy calibration.

The E-AO is simple to install and wire. Simply snap the E-AO into the din rail then connect the E-AO with the other I^2C devices located on the same din rail. Commands are sent to the board via the I^2C bus by the E3. The 4-20mA current loops are simple two-wire connections; +24VDC is connected to the "+" terminal, and the "-", or return terminal, is connected to the field instrument to which the 4-20mA signal is being sent. Ground must come back to the E3 Processor.

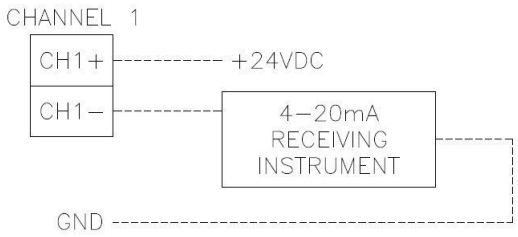


Figure 25: E-AO Example Wiring

The default address for all auxiliary boards is 0. When set to a 0 and connected to a device the board cannot be read. To operate properly, the E-AO must be set to an address value between 5 and 15 that is unique to the rest of the system. Addresses 1-4 are reserved for the E-ESP and addresses 5-15 are used for all other auxiliary devices.

To set the address on the E-AO use the SW1 dipswitches, located in the middle of the PCB board, according to the chart below.

SW1 – Board Addressing

Address	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
0	↑	↑	↑	↑	X	X
1	Reserved for E-ESP Expansion					
2						
3						
4						
5	↓	↑	↓	↑	X	X
6	↑	↓	↓	↑	X	X
7	↓	↓	↓	↑	X	X
8	↑	↑	↑	↓	X	X
9	↓	↑	↑	↓	X	X
10	↑	↓	↑	↓	X	X
11	↓	↓	↑	↓	X	X
12	↑	↑	↓	↓	X	X
13	↓	↑	↓	↓	X	X
14	↑	↓	↓	↓	X	X
15	↓	↓	↓	↓	X	X

Table 29: E-Series™ AO Board Addressing

E-Series™ Digital Expansion (E-Digital)

The E-Digital Expansion board provides the E3 with eight OPTO slots to use for controls. These OPTO slots can provide any combination of DC Out, Relay, DC Input, AC Out, and AC Input. Each OPTO module comes with a built in status LED. Output OPTO module comes with a replaceable integral fuse. The E-Digital Expansion board connects to the E3 via an I^2C cable. Because of the required voltage to operate the OPTO, the E-Digital Expansion board requires its own voltage source. Connect 8-30VDC to terminal 18 or 20 (Vin) and ground to terminals 17 or 19 (GND). Vin is protected to a 1-Amp fuse.

The default address for all auxiliary boards is 0. When set to a 0 and connected to a device the board cannot be read. To operate properly, the E-Digital Expansion board must be set to an address value between 5 and 15 that is unique to the rest of the system. Addresses 1-4 are reserved for the E-ESP and addresses 5-15 are used for all other auxiliary devices.

To set the address on the E-Digital Expansion use the SW1 dipswitches, located in the middle of the PCB board, according to the chart below.

SW1 – Board Addressing

Address	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
0	↑	↑	↑	↑	X	X
1	Reserved for E-ESP Expansion					
2						
3						
4						
5	↓	↑	↓	↑	X	X
6	↑	↓	↓	↑	X	X
7	↓	↓	↓	↑	X	X
8	↑	↑	↑	↓	X	X
9	↓	↑	↑	↓	X	X
10	↑	↓	↑	↓	X	X
11	↓	↓	↑	↓	X	X
12	↑	↑	↓	↓	X	X
13	↓	↑	↓	↓	X	X
14	↑	↓	↓	↓	X	X
15	↓	↓	↓	↓	X	X

Table 26: E-Series™ Digital Expansion Board Addressing

Listed below are the available OPTO Module options.

Type	Eagle Part Number	Color	Current (mA)	Integral Fuse	Built in Status LED	Use
No OPTO	--	--	--	--	--	--
DC Out (60VDC, 2A)	2030164	Red		Yes	Yes	Control or switch DC loads
Relay	2030165	Red		Yes	Yes	Form A mechanical

(500mA)						Relay
DC Input (32VDC)	2030166	White		No	Yes	Detect on/off DC voltage levels
AC Input (90-140VAC)	2030167	Yellow		No	Yes	Detect on/off AC voltage levels
AC Out (120VAC, 2A)	2030168	Black		Yes	Yes	Control or switch AC loads

Table 31: E-Series™ OPTO Modules

E-Series™ System Protection Modules (E-SPM)

The E-Series™ System Protection Module (E-SPM) is designed for easy mounting and changing out when needed. Each channel has a max operating current of 550mA. This can reduce the need to double up channels for higher current applications such as using radios.

Along with higher operating currents on each channel the E-Series™ SPM has passed the IEC-61000-4-5 Level 4 Standard, meaning that the SPM protected and survived voltages over 4,000 Volts.

The E-SPM was designed to easily mount on din rail. Simply snap the assembly onto the din rail then wire the equipment to the pluggable terminal blocks on the equipment side and wire field wiring to the field side of the E-SPM. To swap out an E-SPM the only tool needed is a small screw driver to help pop out the pluggable terminal blocks and to pop plastic housing apart.

Three versions of the E-SPM are available; 4 Channel – 8V which is used to protect communication lines, 4 Channel – 35V which is primarily used for incoming power and 4 Channel – 200V which is used to protect phone lines.

Equipment Side	Field Side	Description
E1	L1	Channel 1
E2	L2	Channel 2
E3	L3	Channel 3
E4	L4	Channel 4
PG	PG	Power Ground*
*All PG terminals are bonded to the protective ground through a ground clip within the assembly. Note that the ground clip is not a substitute for the PG wire at the connector.		

Table 32: E-Series™ SPM Terminals

The table below gives the part numbers for the PCB board, assembly and the description of each item.

SPM PCB Part Number	SPM Enclosure Part Number	Description
90105442	9010555	4 Channels; 8VDC Each
9010543	9010556	4 Channels; 35VDC Each

9010544	9010557	4 Channels; 200VDC Each

Table 33: E-Series™ SPM Part Numbers

E3 and E3-Extender I/O Mapping

The E3 and E3-Extender can easily be configured to maximize the function of the RTU. Below is a list of the I/O Mapping. By mapping these functions in the database the user can conserve power by using only the functions needed and when they are needed. This allows for more control and customization.

Hardware Function	Description	Location	Port Bit
DIN 1	Digital Input 1	E3	1.1
DIN 2	Digital Input 2	E3	1.2
DIN 3	Digital Input 3	E3-Extender	1.3
DIN 4	Digital Input 4	E3-Extender	1.4
DIN 5	Digital Input 5	E3-Extender	1.5
DOUT 1	Digital Output 1	E3	2.1
DOUT 2	Digital Output 2	E3	2.2
DOUT 3	Digital Output 3	E3-Extender	2.3
DOUT 4	Digital Output 4	E3-Extender	2.4
DOUT 5	Digital Output 5	E3-Extender	2.5
SSR1_A	Solid State Relay 1 Form A	E3	3.1
SSR1_B	Solid State Relay 1 Form B	E3	3.2
SSR1_AB	Solid State Relay 1 Form C	E3	3.3
SSR2_A	Solid State Relay 1 Form A	E3	3.4
SSR2_B	Solid State Relay 1 Form B	E3	3.5
SSR2_AB	Solid State Relay 1 Form C	E3	3.6
OPTO 1	OPTO Module 1	E3-Extender	4.1
OPTO 2	OPTO Module 2	E3-Extender	4.2
PUL 1	Pulse Input 1 (Configured as a Digital Input)	E3	5.1
PUL 2	Pulse Input 2 (Configured as a Digital Input)	E3	5.2
PUL 3	Pulse Input 3 (Configured as a Digital Input)	E3-Extender	5.3
PUL 4	Pulse Input 4 (Configured as a Digital Input)	E3-Extender	5.4
PWRCTRL 1	RS232 Power Control 1	E3	6.1
PWRCTRL 2	RS232 Power Control 2	E3	6.2
PWRCTRL 3	RS232 Power Control 3	E3-Extender	6.3
PWRCTRL 4	RS232 Power Control 4	E3-Extender	6.4
CMSW 1	RS232 Com Switch 1	E3	7.1
CMSW 2	RS232 Com Switch 2	E3	7.2
CMSW 3	RS232 Com Switch 3	E3-Extender	7.3
CMSW 3	RS232 Com Switch 4	E3-Extender	7.4

Table 34: E3 and E3-Extender Digital Hardware Addressing

Hardware Function	Description	Location	Port Bit
PUL 1	Pulse Input 1	E3	1.1
PUL 2	Pulse Input 2	E3	1.2
PUL 3	Pulse Input 3	E3-Extender	1.3
PUL 4	Pulse Input 4	E3-Extender	1.4

Table 35: E3 and E3-Extender Pulse Hardware Addressing

Address	Description	Location
1	Analog Input 1 (ADC1)	E3
2	Analog Input 2 (ADC2)	E3
3	Analog Input 3 (ADC3)	E3
4	Analog Input 4 (ADC4)	E3
5	Analog Input 5 (ADC5)	E3-Extender
6	Analog Input 6 (ADC6)	E3-Extender
7	Analog Input 7 (ADC7)	E3-Extender
8	Analog Input 8 (ADC8)	E3-Extender
9	Temperature 1 (RTD)	E3
10	Temperature 2 (RTD)	E3-Extender
11	Ambient Temperature	E3
12	Supply Volts	E3

Table 36: E3 and E3-Extender Analog Hardware Addressing

I^2C Addressing

The I^2C addressing is for any auxiliary device connected to the E3 via an I^2C cable. The first four I^2C address are reserved for E-ESP. I^2C addresses 105-115 are reserved for all other auxiliary devices. To set the address on Auxiliary Devices use the proper dip switch bank, this information is located on the GIS for that device or under the Auxiliary Device section. The auxiliary devices addresses range from 1 to 15. If the device is set to 0 them the E3 will not recognize it. The device must be set to a valid address then power to the unit must be cycled before the E3 will recognize the auxiliary device. Refer to the process manuals for proper placement of the I^2C addresses.

I^2C Address	Auxiliary Device Address	Description
101	1	The first four I^2C addresses are reserved for ESP's
102	**2**	
103	**3**	

104	**4**	
105	5	I^2C addresses 105-115 are for all other devices on the I^2C bus.
106	**6**	
107	**7**	
108	**8**	
109	**9**	
110	**10**	
111	**11**	
112	**12**	
113	**13**	
114	**14**	
115	**15**	

Table 37: I2C Addressing

System Settings

Introduction

The System Settings are primarily used to configure communications. On-board communications such as serial, Ethernet and USB as well as the E-Series™ ESP Expansion cards can all be configure through the System Settings. Other items can also be stored in the System Settings such as board/unit serial numbers, temperature slope and offset, various passwords along with other functions. To access the System Settings use either Virtual Keypad or the built-in Keypad and Display.

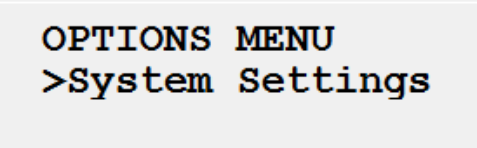
Accessing System Settings

The System Settings can be accessed by using the 26-key Keypad or by using Virtual Keypad in Field Manager™.

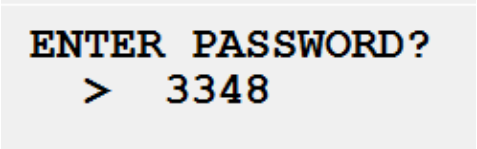
1 – Press the configuration 'conf' button then the function key (Eagle Logo)

2 – Use the arrow keys to scroll through the list to get to System Settings

3 – Press enter 'ent' to select System Settings.



4 – Enter in the password 3348 and press enter "ent".



5 – To navigate the System Settings use the arrow keys and/or the jump keys as shown in the chart below. If the address of the System Setting is known then the user can press the Jump button and enter in the address in the format of FPP.II, where F is the Family, PP is the Port and II is the Item.

Key Presses	Description	Example
Jump ↑	Jumps to previous whole number	102 → 101

Jump ↓	Jumps to next whole number	101 → 102
↑	Goes to previous item	101.2 → 101.1
↓	Goes to next item	101.1 → 101.2
Jump	JUMP To FPP.II	Enter Address

Table 38: System Setting Arrow Functions

Using the System Settings

The System Settings are arranged in the format of FPP.II, where F represents Family, PP represents Port and II represents the Item number. There are five families in the System Settings; On Board (0), ESP (1), USB (2), Ethernet (3) and System (4). The PP represents the Port within each family except for the System Family, which will be explained later in this document. For example, if the user is setting up port 2 on the E3 then the FPP.II would be 002.II. If the user is setting up an ESP for port 3 then the FPP.II would be 103.II. The II represents the Items within each family. All items under the families On Board, ESP, USB and Ethernet are the same. The System Settings have different items and are explained later in this document.

FPP.II
| || \\----------II: Items – These are the configuration items within each Family
| \ \--------------PP: Port – Port is referred to the communication port being used. The
| System Family does not use ports, but is still represented by
| numerical values. This will be explained later in this document.
\------------------F: Family
0: on Board
1: ESP
2: USB
3: Ethernet
4: System

The On-Board section consists of the System Settings for serial ports 1 and 2 located on the E3 and serial ports 3 and 4 located on the E3-Extender. This section uses addresses 1 through 4. The second section consist of the hardware configuration for four E-ESP's which are connected to the E3 via I^2C connection. This section uses addresses 101-104. The third section is the hardware configuration for the E3 USB port. This section is addressed as 201. Section four consist of the hardware configuration for Ethernet, addresses 301-308. The final section is the system level configuration with the address of 401.

The chart below shows Family and Port addresses.

Family	Port	Family (F) and Port (PP)
On Board	Com 1 (Port 1)	001

(0PP)	Com 2 (Port 2)	002
	Com 3 (Port 3)	003
	Com 4 (Port 4)	004
ESP's (1PP)	ESP 101	101
	ESP 102	102
	ESP 103	103
	ESP 104	104
USB (2PP)	USB	201
Ethernet (3PP)	IP 1	301
	IP 2	302
	IP 3	303
	IP 4	304
	IP 5	305
	IP 6	306
	IP 7	307
	IP 8	308
System (4PP)	System - General	401
	System - Ethernet	402

Table 39: System Settings Family and Ports

The chart below shows the Items located in the On Board, ESP, USB and Ethernet Families. Each Item will be in the same location under each Family and Port (FPP). Some Items are not used in some Families but they are left in the Item list so that it is uniform throughout the System Settings.

Item #	Default Value	Item Name	Item Description
FPP.01	**0**	Config Number	
FPP.02	**0**	Comm X Config Bits 1	
		0 - RTS Disabled	0: Disables RTS
		1 - RTS Enabled	1: Enables RTS
		0 - CTS Disabled	0: Disable CTS
		2 - CTS Enabled	1: Enables CTS
		0 - Packet Radio Off	0: Disables Radio Protocol
		4 - Packet Radio On	1: Enables Radio Protocol
		0 - HexASCII V2 Off	0: Disables "HOST" RTU Handshaking
		8 - HexASCII V2 On	1: Enables "HOST" RTU Handshaking

0 - Metricom Off	0: Disables Metricom Handshaking
16 - Metricom On	1: Enables Metricom Handshaking
0 - Hayes Modem Off	0: Disables Hayes Modem
32 - Hayes Modem On	1: Enables Hayes Modem
0 - Standard Hayes	0: DTR Hangup
64 - Multidrop Hayes	1: +++ Hangup, multidrop enable
0 - Multidrop Slave	Enable/Disable sending hayes init commands to multidrop master
128 - Multidrop Master	
0 - Eagle Read/Write	0: Eagle protocol allows read/write
256 - Eagle Read Only	1: Eagle protocol allows read only access
0 - COMSW > Eagle On	Enables/Disables automatic Eagle protocol when RS232 is grounded
512 - COMSW > Eagle Off	
0 - Auto Baud On	0: Enable autobaud with Hayes / CDPD modems
1024 - Auto Baud Off	1: Disable autobaud with Hayes / CDPD modems
0 - MV 90 I Com Off	0: Disable I command for MV-90
2048 - MV90 I Com On	1: Enable I command for MV-90
0 - NAK Enabled	Set to 1 for 202 or radio where all units listen
4096 - NAK Disabled	0: Enable sending NAK after bad message 1: Disable sending NAK after bad message
0 - Text Reports Off	0: Disable Text Reports
8192 - Text Reports On	1: Allow Sending Text Reports
0 - RS232 Power Save	0: Only powers up RS232 when CMSW is active
16384 - RS232 Always On	1: Keeps RS232 powered up

		0 - WINI CMSW Off	0: Normal Mode Hayes Modem 1: Sierra Wireless CDPD Modem Detect
		32768 - WINI CMSW On	
FPP.03	**0**	Comm X Config Bits 2	
		0 - Valmet Disabled	0: Valmet Disabled on this port 1: Valmet Enabled on this port
		1 - Valmet Enabled	
		0 - MultiOn Dur Com	0: Enable Multitasking during STX…Etx 1: Disable Multitasking during STX..Etx
		2 - MultiOff Dur Com	
		0 - Unique SiteIDs	0: Normal, HexAscii uses SiteID's 1: Unit will respond to any SiteID
		4 - Ignore SiteIDs	
		0 - Hayes Norm Init	0: Normal Hayes Modem Handling 1: Only initialize Hayes Modem with ATZ
		8 - Hayes ATZ Init	
		0 - Use CMSW Normal	0: Normal handling of CMSW 1: Ignore CMSW
		16 - Ignore CMSW	
		0 - Normal Hangup	0: Sned normal Hangup Commands 1: If in Multidrop use AT+++ Commands
		32 - CDPD Mult Hangup	
		0 - No Echo Trig Req	0: No Trigger character required for echo 1: Trigger Character required for echo
		64 - Echo Trig Req	
		0 - No Echo Trig RTS	0: Don't assert RTS on Echo Trig 1: Assert RTS on Echo Trigger
		128 - Echo Trig RTS	
		0 - GPRS Modem Off	0: Use Standard AT type modem 1: Use Special AT Commands GPRS modem
		256 - GPRS Modem On	
		0 - Modem Detect Off	0: Do not use AirLink/Modem Auto Detection 1: Use Automatic Airlink Modem
		512 - Modem Detect On	

			Detection
		0 - MODBUS Disabled	0: Modbus Disabled on this port 1: Modbus Enabled on this port
		1024 - MODBUS Enabled	
		0 - MODBUS RTU	0: Modbus RTU Mode 1: Modbus Ascii Mode
		2048 - MODBUS ASCII	
		0 - Normal RTS Mode	0: Normal RTU Operation 1: Force RTS on during port init.
		4096 - Force RTS On	
		0 - TTS Modem Off	0: Normal Hayes Modem 1: Eagle Text to Speech Modem
		8192 - TTS Modem On	
		0 - Cermetek Normal	0: Normal Cermetek Handling 1: Init with AT+MS=B212, 0, 1200, 1200, 1200, 1200 to force 1200 baud connect, usually used with cell phone. Requires CH1786A
		16384 - Cermetek Fix Baud	
		0 - No Init Hangup	0: Don't reinitialize modem on each Hangup 1: Reinitialize modem on each hangup
		32768 - Init on Hangup	
FPP.04	**0**	Comm X Config Bits 3	
		0 - CTS Normal Act	0: Use standard CTS active level: CTS=True for RS232 High, CMOS low 1: Use inverse CTS active level: CTS=true for RS232 Low, CMOS high
		1 - CTS Inverse Act	
		0 - Zero String Auto	0: Default to no Zero String Commpression. Must be turned on in protocol 1: Force Zero String Compression ON always
		2 - Zero String On	
		0 - CMSW Wakeup On	0: CMSW is latched during wakeup like with external Hayes modem 1: Disable CMSW latching during wakeup, use with MDS when CMSW is used to control the DTR/Sleep pin
		4 - CMSW Wakeup Off	

			on the MDS Radio
		0 - Gen HFT-001 Off	0: Disable Genscape Japan HFT-001 Modem Support
		8 - Gen HFT-001 On	1: Enable Genscape Japan HFT-001 Modem Support
		0 - 8-Bit XOR Check	0: HexAscii Protocol uses 8-bit XOR, auto mode may hange to 16-bit CRC
		16 - 16-Bit CRC Check	1: Force 16-bit CRC checks for HexAscii Protocol
		0 - Modbus Read Write	0: Port has "read/write" Modbus slave access
		32 - Modbus Read Only	1: Port has "read only" Modbus slave access
		0 - Modbus Def Ser	0: Uses 8,N,1 if port is set for Modbus RTU and 7,E,1 if port is set for Modbus ASCII
		64 - Modbus Force 8N1	1: Modbus slave protocol on this port will be forced to use 8 data bits, no parity and one stop bit
		0 - Log Adt Tr Reset	0: Log Audit Trail Reset
		128 - No Log Adt Tr Rst	1: Do not Log Audit Trail Reset
FPP.05	**115200**	Main Baud	Main Communications Baud Rate for Port Select Desired Baud Rate 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
FPP.06	**115200**	CMSW Baud	CMSW Baud Rate for Port Select Desired Baud Rate 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
FPP.07	**10000**	HexAscii Timeout	The amount of time, in seconds, allowed for HexAscii to try to communicate

FPP.08	**2000**	Aux Port Timeout	
FPP.09	**5**	RTS On Time (ms)	How long RTS will stay on for (in ms)
FPP.10	**2**	RTS Off Time (ms)	How long RTS will turn off for (in ms)
FPP.11	**300**	Modem Timeout (s)	The amout of time, in seconds, allowed for the modem to try to connect
FPP.12	**0**	Dial Tone Wait (s)	
FPP.13	**1**	Rings to Answer	Number of rings befor the modem will pick up
FPP.14	**0**	Power Delay	Delay in seconds after power is turned on and before communications will begin
FPP.15	**0**	Power Address 1	
FPP.16	**0**	Power Address 2	
FPP.17	**-1**	Echo Port	Passes Information from Port to Desired Port Enter Desired Port Number
FPP.18	**0**	Echo Trig Char	
FPP.19	**-1**	SIM Card Pin	
FPP.20	**0**	TCP Listen Port	TCP/IP Listens on Por
FPP.21	**0**	Random Dial Delay	
FPP.22	**60**	Clear Chan TO (s)	
FPP.23	**10**	Clear Required (s)	
FPP.24	**0**	Modbus Offset	
FPP.25	**2**	Modbus Msg Delay	

Table 40: System Settings for On-board, ESP, USB and Ethernet

The System Family is broken down into two sections (these sections are represented as PP in FPP), System General and System Ethernet. System General is represented as 401 for FPP and System Ethernet is represented as 402 for FPP. The Items under these sections are different from the On Board, ESP, USB and Ethernet Families.

System General - 401			
FPP.II	**Default Value**	**Item Name**	**Item Description**
401.01	0	Board Serial Number	Serial Number of the Board
401.02	0	Unit Serial Number	Serial Number of the Unit
401.03	0.00703125	Amb Temp Slope	Ambient Temp Slope (calibrated during burn-in)
401.04	32	Amb Temp Offset	Ambient Temp Offset (calibrated during burn-in)
401.05	947332	Clr DB Password	Password for Clearing the Database
401.06	3348	EE Edit Password	Password for Editing System Settings
401.07	4648	Clr All Password	Password for clearing all
401.08	0	Sys_config1	
		0 - Alarm Clear On	Alarm clearing with magnet
		1 - Alarm Clear Off	
		0 - Dis Mode Ed Off	Display mode edit enabled
		2 - Dis Mode Ed On	
		0 - Password Log Off	Allow logging passwords in audit trail
		4 - Password Log On	
		0 - Normal Time Mode	Debug mode to advance the time quickly, 1 hour at a time
		8 - First Time Advanc	
		0 - Auto DLSTIME OFF	True enables auto time changing for Daylight Savings/Standard Time
		16 - Auto DLSTIME On	
		0 - VXD on for wake	True keeps VXD off during wake
		32 - VXD Off for wake	This option only used for Dominion units that were shipped about 10/28/04 built with ECN 35. A future ECN will change the 1N5817 diode to a 1N914 to avoid VXD coming on while in sleep mode at high temperatures. This Item must not be set true in post ECN 35 boards -- If it

			is, VXD will come on while the unit is asleep.
		0 - 2007 DLS Time	0: This selects the new 2007 DST standard where DST starts at 2am on the second Sunday in March and ends on the first Sunday in November 1: Will probably not be used, it selects the old daylight savings time mode established in 1966 when DST started at 2am on the first Sunday of April and ran until 2am on the last Sunday of October.
		64 - 1966 DLS Time	
		0 - Ext Security Off	Returns true if Ext Security is enabled; False if not. Extended Security is a new feature that supports 16 user names and passwords as well as access rights
		128 - Ext Security On	
		0 - Enable Forth	
		256 - Disable Forth	
		0 - G Unique SiteIDs	
		512 - G Ignore SiteIDs	
401.09	**0**	Sys_config2	
		0 - OPTOS Off Sleep	
		1 - OPTOS on Sleep	
401.10	**0**	Sys_config3	
401.11	**4**	EBM800 Addr Port	
401.12	**3**	EBM800 Data Port	
401.13	**1**	EBM800ai del (ms)	
401.14	**17**	Supply Volts Address	
401.15	**0.0471**	Supply Volts Slope	
401.16	**-6.71**	Supply Volts Offset	
401.17	**0**	Solar Charger Addr	

401.18	**0**	Eaves Drop Config	
401.19	**0**	Eaves Drop Show Pt	
401.20	**1**	Eaves Drop On Port	
401.21	**0**	Hr Pulse Out Adr	
401.22	**0**	Host ID	
401.23	**0**	I2CRTC Sec/Day A	

Table 41: System Settings for System General

The System Ethernet section is used for viewing the MAC Address and configuring Ethernet settings

System Ethernet - 402			
FPP.II	**Default Value**	**Item Name**	**Item Description**
402.01	**0x00**	MAC Addr 3	These are read only items. The MAC Address is set in the XA32/5™ at the factory.
402.02	**0x00**	MAC Addr 4	
402.03	**0x00**	MAC Addr 5	
402.04	**1**	Ethernet CFG 1	
		0 - DHCP Disabled	0: Static (Fixed) IP
		1 - DHCP Enabled	1: DHCP Enabled
402.05	**0**	Ethernet CFG 2	
402.06	**0**	Ethernet CFG 3	
402.07	**0**	IP Addr Part 1	IP address of the E3
402.08	**0**	IP Addr Part 2	
402.09	**0**	IP Addr Part 3	
402.10	**0**	IP Addr Part 4	
402.11	**0**	Gateway Part 1	Gateway IP address for a router
402.12	**0**	Gateway Part 2	
402.13	**0**	Gateway Part 3	
402.14	**0**	Gateway Part 4	

402.15	**255**	IP Mask Part 1	IP Address Mask
402.16	**255**	IP Mask Part 2	
402.17	**255**	IP Mask Part 3	
402.18	**0**	IP Mask Part 4	

Table 42: System Settings for System Ethernet

Operating Modes

The E3 operates in any of the following five standard modes; Sleep/Wake-Up, Display, Alarm, Configuration and Calibration. To access these operating modes press the corresponding key on the keypad.

Keypad Key	Operating Mode
Conf	Configuration Mode
Alrm	Alarm Mode
Cal	Calibration Mode
Esc	Return to previous mode

Table 43: Keypad Operating Modes

Sleep/Wake-Up Mode

NOTE: Sleep mode has not been implemented in the E3 yet. Below is a description of how the sleep mode will work once it has been implemented.

In normal operation the E3 maintains a powered down state (sleep mode) to conserve battery life. In this state the outside display shows the first label, **CV XXXXXXXX** for example, where **XXXXXXXX** is the most recent reading prior to the next wake-up interval. The unit executes processes depending upon the user's programmed wake-up interval. Shorter intervals result in more frequent data while longer intervals provide for longer battery life. The scheduled wake-ups result in immediate power-down after performing calculations.

In addition to the scheduled wake-ups for volumetric calculations, the E3 can be brought up from its sleep mode by any of the following actions:

- Connecting a portable computer to the unit's serial communication port (MS connector)
- Pressing any key on the keypad
- Scrolling the external display with a magnet (see the section on DISPLAY MODE)
- Calling the unit via modem

Once the unit is awake, it will automatically power down one minute after the operator stops interacting with it. The E3 can also be forced to enter the sleep mode by pressing the function key (Eagle Logo) then the number 5.

NOTE: The E3 will not go to sleep if a laptop is connected to the unit.

Typically, the E3 remains fully awake and does not enter sleep mode if it is powered with an external power supply. In this case, the Wake-Up Interval parameter is set to a 0 in the database.

Display Mode

In display mode, only limited parameters with assigned labels and function keys can be viewed. With the optional keypad and display, the ↑ and ↓ arrow keys will allow the user to scroll through the display parameter list. The user may use the **jump** key to directly view any of the assigned labels; press **jump** then enter the label number, followed by pressing **ent**. To view previously assigned parameters use the number keys **0-9**. Talon™ or Field Manager™ and/or Talon™ software can be used to assign number keys and labels to any parameter. Also, the local keypad may be used to assign function keys.

Using the Scroll Switch

On units that feature the external display, a magnet may be used to easily access information connecting to the unit. Just below the display, on the right, is a small printed dot on the display window. When the key chain magnet, supplied with these units, is held in the proximity of this dot, the display will vary its information. Each subsequent pass of the magnet over this dot will produce a new parameter display.

When in an alarm condition, the display will be flashing. To clear alarms, hold the magnet against the dot until flashing stops.

Alarm Mode

The E3 can be configured to activate an alarm when certain conditions are met or when user-defined limits are exceeded. Active alarm messages can be configured to show on the E3's display. The unit can also automatically call a host computer running Field Manager™ and the Talon™ Software Suite to report the alarm (see the section on SOFTWARE PACKAGES).

A history log is kept in the E3 on each alarm condition, consisting of the following:

- Current value
- Type of alarm (high, low, etc.)
- Set point value (alarm limit)
- Time of alarm
- Date of alarm
- Time out of alarm
- Date out of alarm
- Extreme value alarm

The E3 can be configured to monitor and alarm on any condition including, but not limited to, the following:

- First Time Power
- AC Power Failure

- Low Supply Volts
- High and Low Flow Rate
- High and Low Pressure
- High and Low Differential Pressure
- High and Low Temperature
- Current Day Flow (Transportation Limit)
- Low Voltage Shutdown
- Box intrusion

NOTE: Additional hardware equipment and configuration may be required for some alarm monitoring applications

Viewing and Clearing Alarms from the Keypad

To enter alarm mode, press the **alrm** key on the optional keypad. In alarm mode the user can view and acknowledge any alarm. If alarms are active, the unit will display the first alarm message. If there are more alarms, they can be viewed by pressing the **alrm** key. Repeatedly pressing the **alrm** key cycles through the active alarm list.

Alarms can be locally acknowledged at the E3 by pressing the **ent** key while a particular alarm message is displayed, or by polling with Talon™ or Field Manager™ software.

When in an alarm condition, the optional external display will be flashing. To clear alarms, hold the magnet against the dot until flashing stops.

Unless the parameter's limits are violated again, the unit will not include acknowledged alarms in its list the next time the user enters alarm mode. To exit alarm mode without acknowledging the alarm, simply press the **esc** key.

First Time Power Alarm

First Time Power alarm is defined as the re-application of power after interruption of the power source. For example, whenever the battery is disconnected and then subsequently reconnected, the unit records the First Time Power event.

Low Supply Volts Alarm

If the supply voltage to the unit falls below the Low Supply Volts Alarm Set-point value, a Low Supply Volts alarm will be initiated. The alarm will remain active until the supply voltage is greater than the Low Supply Volts Alarm Reset parameter. The set-points are user configurable with default values of 8.5 and 8.8 volts respectively for battery powered units.

High Flow Rate Alarm

If the flow rate should exceed the High Flow Rate Alarm Set-point, a **High Flow Rate** alarm will be initiated. The alarm will remain active until the flow rate falls below the High Flow Rate Reset parameter value. The set-points are user configurable with default values of 100000 and 99990 respectively.

Low Flow Rate Alarm

If the flow rate should fall below the Low Flow Rate Alarm Set-point, a **Low Flow Rate** alarm will be initiated. The alarm will remain active until the flow rate rises above the Low Flow Rate Reset parameter value. The set-points are user configurable with default values of -100 and -80 respectively.

High Pressure Alarm

If the gas pressure should exceed the High Pressure Alarm Set-point, a **High Pressure** alarm will be initiated. The alarm will remain active until the pressure falls below the High Pressure Reset parameter value. The set-points are user configurable with default values of 1500 and 1480 respectively.

Low Pressure Alarm

If the gas pressure should fall below the Low Pressure Alarm Set-point, a **Low Pressure** alarm will be initiated. The alarm will remain active until the pressure rises above the Low Pressure Reset parameter value. The set-points are user configurable with default values of -100 and -80 respectively.

High Differential Pressure Alarm

If the differential pressure should exceed the High Differential Pressure Alarm Set-point, a High Differential Pressure alarm will be initiated. The alarm will remain active until the differential pressure falls below the High Differential Pressure Reset parameter value. The set-points are user configurable with default values of 1500 and 1480 respectively.

Low Differential Pressure Alarm

If the differential pressure should fall below the Low Differential Pressure Alarm Set-point, a **Low Differential Pressure** alarm will be initiated. The alarm will remain active until the differential pressure rises above the Low Differential Pressure Reset parameter value. The set-points are user configurable with default values of -100 and -80 respectively.

High Temperature Alarm

If the gas flow temperature should exceed the High Temperature Alarm Set-point, a **High Temperature** alarm will be initiated. The alarm will remain active until the temperature falls below the High Temperature Reset parameter value. The set-points are user configurable with default values of 200 and 180 respectively.

Low Temperature Alarm

If the gas flow temperature should fall below the Low Temperature Alarm Set-point, a **Low Temperature** alarm will be initiated. The alarm will remain active until the temperature rises above the Low Temperature Reset parameter value. The set-points are user configurable with default values of -100 and -80 respectively.

Current Day Flow Alarm (Transportation Limit)

If the current day's total volume should exceed the Current Day High Volume Alarm Set-point, a **Current Day Flow** alarm will be initiated. The alarm will remain active until the value for the current day volume is reset the next day at roll time. The set-points are user configurable with default values of 100000 and 99990 respectively. For transport or interruptible customers, this parameter can be used to alarm when an account has exceeded a predetermined daily volume allocation.

Low Voltage Shutdown Alarm

If the supply voltage should fall to approximately 6.0 volts, an interrupt will be triggered and the unit will enter Low Voltage (Critical) Shutdown mode. **Low Batt** will be displayed on the display. This is an indication that the supply voltage is absolutely too low to operate the unit properly. The battery must be changed at this point or adequate supply voltage applied. In this mode, all operation ceased, and the unit operates in a protective mode. The on-board battery will continue to protect the unit's memory; therefore data prior to entering this mode will be maintained. The supply voltage is monitored constantly and the unit will reset itself should the supply voltage becomes greater than 6.0 volts. If the unit is left alone without applying adequate supply voltage, the battery will continue to drain and the outside display will eventually go blank.

When sufficient supply voltage is applied and the unit is powered up, a **Low Voltage Shutdown** alarm will be recorded.

Configuration Mode

Configuration mode allows the user to set up the E3's initial configuration, change any of the operating parameter values, and set alarm conditions and limits. Talon™ software, Field Manager™ software, or the optional keypad and display is required to perform configuration. Field Manager™ software package is supplied with the unit consisting of Virtual Keypad and other utilities.

Caution: Care must be taken when editing parameters. Improper parameter editing may result in corruption of the database.

To enter configuration mode, press the **conf** key on the optional keypad. If the configuration mode is password protected, the E3 will display **ENTER PASSWORD?** Only a valid password entry would then be given access to this mode. Configuration mode allows the user to set up the E3's initial configuration, change any of the operating parameter values, set alarm conditions and limits, and assign function keys to various parameters. While in the configuration mode, the E3 continues to operate normally. It continues to sample live pressure and temperature values, calculate corrected volume, and collect historical data.

Viewing Parameters

In configuration mode, any parameter value may be viewed. One method is to use the **Jump** key to directly view database items. Press **Jump** and then enter the address of the parameter **(PPSSII)** followed by pressing the **ent** key. The top line on the display is the address **XX-XX-XX** and the bottom line is the value. Function key assignments are still valid, so often-viewed parameters may be accessed in this manner. The right and left arrow keys allow horizontal movement between processes, and the up and down arrow keys allow moving vertically within a process. Pressing **Jump** followed by the **Right Arrow** key will display the same item number in the next section. Likewise, pressing **Jump** followed by the **Up Arrow** key will display the same item number in the previous section. Jumping to assigned labels is also supported as described in Display mode.

Editing Parameters

1. Enter configuration mode by pressing the **conf** key (use the password if required).

2. Display the desired parameter. Press the **jump** key, followed by the address of the parameter. The function keys can also be used to view assigned parameters.

3. With the desired parameter displayed, press the edit key. (The unit will display the current parameter value and prompt for a new value.) Use the keypad to enter the correct value and then press the ent key to execute the change. Pressing the **esc** key when the RTU prompts for the new value will abort the change. Pressing the **ent** key if nothing has been typed, also leaves the parameter unchanged.

Assigning Function Keys

In configuration mode, any item can be assigned to a function key as follows:

1. Enter configuration mode by pressing the **conf** key (use the password, if required).

2. Display the desired parameter. Press & release the **jump** key, followed by the address of the parameter.

3. Assign a function key to the parameter. Press & release the **jump** key, then the **edit** key, and then the desired number key to be assigned to the current item [**0 - 9**].

Audit Trail

The E3 maintains an electronic audit trail file that records all parameter changes and calibrations performed on the unit. Each entry is identified with the date and time the event occurred. The contents of this file cannot be changed, providing a secure, non-editable audit trail.

In the standard E3 configuration, the audit trail is disabled. Audit Trail logging can be enabled by editing address 010313 to **300** at the keypad or by using Talon™ or Field Manager™ software. The maximum memory allowed for audit trail is (300 records * 24 = 7,200).

NOTE: Once the audit trail is enabled (a value greater than "0"), the user cannot disable it without a full unit initialization. Reloading the database will not disable the audit trail.

Once enabled, the E3 maintains the audit trail file with a maximum of 300 records. The information from the unit can be uploaded to a portable or host computer using Talon™ or Field Manager™ software. When the audit trail is full, **Audit Trail Full** will appear if editing is attempted and the E3 will not allow any changes. The audit trail must first be uploaded and reset by Talon™ or Field Manager™ software.

Memory (History Logging)

With a large memory capacity, historical inputs with time and date stamp can be stored. The non-editable history file provides the user with time related data logged in any variation of selectable intervals; minute, daily, weekly, and monthly. An event-driven history mode allows the logging of data when an event occurs (e.g. alarms). An experienced user with Talon™ software can define the type of data and collection period. Since the history data elements are stored in a block of memory, the size has to be assigned at the time the history process is created in the E3; typically when the database is downloaded at the factory.

NOTE: The size of the history block cannot be changed once the history process has been created in the unit. A complete download would be required to reset the database and change the E3's memory assignment.

The memory required to store an entire history process data block is [Max pointers * (Max Record +1) *4].

Data may be collected over cell modems, Ethernet, or on-site through the USB connection or RS-232 serial connection. Talon™ or Field Manager™ software is required for collection. The collected data can then be used for:

- Billing information
- Measurement reports for utility and customer management
- System analysis using flow rate and pressure
- Support for estimating gas volume consumption in cases of meter or instrument malfunction

Calibration Mode

Calibration mode allows the user to calibrate the analog inputs such as differential pressure, static pressure, and temperature. While operating in calibration mode the E3 continues to periodically update volume. The analog input value used for calculations is the value measured when calibration mode was initially entered. Once in calibration mode, the user can perform the following operations:

- Calibrate **zero** only
- Calibrate both **zero** and **span**
- Calibrate **zero shift** for the DP transmitter

Of course, the option to change the calibration reference points is available at all times. Several other features make the software calibration routine attractive and more intuitive. In the E3, unit calibration is software based; there is no need for laborious operator adjustments. Software calibration does away with the need for repetitive potentiometer adjustments, thereby simplifying field calibration procedures.

Installation

Unpacking

1. Thoroughly examine the box to verify it was not damaged in shipping. If you find damage, immediately file a claim with the shipper, as the manufacturer cannot be held responsible for items damaged in transportation and accepted by the customer.

2. Carefully unpack the Eagle E Series device from the shipping container. Verify that the box contains every item listed on the shipping order.

!!! CAUTION !!!
This unit contains certain electronic components that are sensitive to electrostatic discharge (ESD); therefore, proper precautions should be taken during maintenance operations to avoid ESD. It is recommended that the operator first touch the MS connector (RS-232C port) on the side of the unit to dissipate any accumulated static charge. Additional precautions may be taken in order to minimize the possibility of ESD, including the use of a grounding wrist or ankle strap. If these precautions are not taken and the unit is subjected to severe ESD, it may revert to its default state. However, the unit will not exhibit any loss of data or degradation of performance.

Mounting the RTU

Note: For Positive Displacement (Index-Mounted) applications, see Appendix C.
The Eagle E-Series™ mounts directly on a wall or, optionally, on a pipe (see Fig. 3). Mounting feet are provided for wall mounting, and plates with U-bolts are provided for pole mounting. Two-inch rigid iron pipe or conduit is required for pipe mounting. It is recommended that the pipe be placed 18 to 24 inches into the ground in a 6-inch wide sackrete/concrete-filled hole. The length of the 2-inch mounting pipe or conduit will vary according to the site, but typical installations place the RTU at about eye level for ease of operation.

Grounding

Because of the potential for equipment damage and injury to personnel, certain practices should, and often must, be observed when installing E3 systems. Of these practices, proper grounding is possibly the single most important. This section was included to point out general rules and practices, and NOT to supersede those defined in the **National Electrical Code** (NEC) published by the National Fire Protection Association (NFPA), nor the **Classification of Gas Utility Areas for Electrical Installations** booklet published by the American Gas Association (AGA). A sound understanding of Federal, State, and Local laws is fundamental to proper and legal installation work. Eagle Research Corporation® makes no warranties or guarantees on the effectiveness or safety of any technique or suggestion here described. All RTU, electronic utility interface, and gas meter equipment should be kept at the same ground potential so that unexpected voltages anywhere on the system are quickly shunted away to earth. This calls for a common ground rod (or "bed" of grounding materials) to which is securely tied to all equipment chassis, metal cabinets, and intrinsic safety ground brackets. For equipment chassis and metal cabinets, a solid copper ground wire or ground strapping of an approved size and type is

recommended to tie this equipment to the rod(s). For Intrinsic Safety systems it is recommended that two #12 AWG wires be run in parallel from individual ground terminals on each I.S. ground frame. Where more than one rod is used, as when some distance separates equipment, all rods should be bonded together with copper in an approved manner.

References

- National Electrical Code
  - Article 250 - Grounding
  - Articles 500 & 501 - Hazardous (Classified) Locations
  - Article 504 - Intrinsically Safe Systems
- The IAEI Soares' Book on Grounding
- PolyPhaser Corp.'98 catalog of Lightning/EMP & Grounding Solution

Maintenance

As with any device based on solid-state electronics, maintenance of the Eagle E Series should be minimal. However, there are certain guidelines that, if followed, will minimize device failure and increase the product's service life.

Enclosure Maintenance

Enclosure maintenance is a program of routine inspections to ensure the integrity of the door's seal and the various ports in the box's exterior. Excess moisture can ruin an E3 if allowed to accumulate within the enclosure. Although the circuit boards themselves are conformal coated to protect against humidity, the wiring interconnections and various exposed metal surfaces are susceptible to corrosion in extreme cases of interior humidity. Here are some checks you should periodically make of the enclosure:

1. Ensure that the mounting arrangement for the unit is secure and provides a stable platform for termination of the pressure tubing, conduits, etc.

2. Verify the integrity of the enclosure lid seal. Check the lid gasket for deterioration, chemical damage, tears, or compression.

3. Check for damaged cord grips and a missing or damaged MS connector (RS-232 port) cap.

4. Examine the RS-232C port itself. Ensure that the port's mounting screws are secure and provide firm support when attaching a serial cable.

Disposable Battery Packs

The disposable (alkaline) battery pack, under normal operating conditions, will eventually drop below the voltage level needed to maintain unit power. Its lifespan is determined by dozens of variables specific to each unit, and therefore difficult to predict.

To replace the disposable battery pack in the unit:

1. Open the front door by releasing the upper and lower quick-release latches on the device enclosure and swinging the door out.

2. Attach the new battery to the unused connector J3 'VBAT1' or J4 'VBAT2'.

3. Disconnect the old battery from the other connector in the unit. Power, in this case, is never removed from the unit, and no current data is lost due to temporary power down.

4. Remove the old battery from its mounting in the door, and press the new pack firmly into place.

5. Press any key to wake-up the unit and verify that it is fully operational.

6. Properly dispose of the spent battery pack.

Rechargeable Battery Packs (charged by local solar array)

The rechargeable battery pack, under normal operating conditions, should provide as many as 10 years of productive service before needing to be replaced. When it becomes apparent that the rechargeable pack cannot maintain its charge during the hours without sunlight, replacement is in order.

To replace the rechargeable battery pack in the unit:

1. Open the front door by releasing the upper and lower quick-release latches on the device enclosure and swinging the door out.

2. Disconnect the old battery from the J3 'VBAT1' connector in the unit. This will result in a momentary power-down of the E3 that will interrupt any measurements being recorded at the time. No historical records or configuration settings will be lost, though.

3. Remove the old battery from its mounting in the door, and press the new pack firmly into place.

4. Connect the new, fully charged battery to the J3 'VBAT1' connector in the unit. DO NOT CONNECT TO J4 (VBAT2) AS CHARGING WILL NOT OCCURE.

5. Press any key to wake-up the unit and verify that it is fully operational. A **'first time power'** alarm will have been initiated. See the section on ALARM MODE.

Software Packages

Field Manager™

Field Manager™ is a Windows based configuration utility for Eagle Research Corporation® products. The software provides straight-forward support for all hardware in the field, and an easy to use group of functions to assist the user in setting up and configuring the field device, gathering data, viewing alarms, and calibrating transducers. It also features a variety of other useful tools.

Field Manager Plus™

Field Manager Plus adds circular charting to all of Field Manager™'s features. Communication to the Eagle hardware is through an RS232 laptop cable or USB cable. A library of configuration databases simplifies the identification of standard device types in the field. The software matches the field E3 to a device type automatically and displays the appropriate set up forms for the user.

Field Monitor

Field Monitor is a Windows based utility for Eagle Research Corporation® products. The software is Read Only and provides straight-forward support for all hardware in the field, and easy-to-use functions to assist the user in gathering data, and viewing alarms. It also features a variety of other useful tools.

Talon™ Monitor

As part of the Talon™ Software Suite, Talon™ Monitor permits remote device polling using cellular or a wide variety of other communication media. It is a great application for natural gas marketers to provide third party read-only access without editing capability.

Talon SCE™

Eagle Research Corporation® designed the Talon™ family specifically to meet the user's needs, providing software modules for both central office and field operations. Talon™ Software Suite provides application solutions for Natural Gas, Water/Wastewater, Environmental Protection, Stream, and Electrical applications. Industrial/Commercial Measurement, Pressure/Temperature Monitoring, Supervisory Control, and Odorization are but a few of the systems that can benefit from the use of this software.

Talon SCE™ (Single Computer Edition) provides a single computer based software platform to perform the functions often segregated into separate SCADA and Electronic Measurement Systems. The Talon™ family of software gives you the ability to create a powerful host platform that can be tailored and scaled to meet specific and diverse user needs. Flexibility in the software design offers the option to purchase only the software component modules that the customer needs. Talon SCE™ has the ability to

expand the system with additional features by adding new modules in the future when additional customer needs require. The users and groups function offers password access/control for viewing, editing, and other administrative functions. User shift schedules can be entered for alarming and reporting through e-mail, SMS, and voice calls using the optional Alert Server software module. This software is uniquely suited to meet the needs of the small to intermediate size companies. Talon SCE™ is suitable for a reduced scale SCADA system supporting four Serial and one TCP port, but can be expanded for larger applications, polling multiple devices over several communication ports simultaneously.

Talon Enterprise™

Talon Enterprise™ provides a company-wide software network platform to perform the functions that are often segregated into separate SCADA and Electronic Measurement Systems. The Talon™ family of software gives the user the ability to create a powerful host platform that meets specific distributed data collection requirements.

The modular and flexible design offers the option to purchase only the specific modules needed, and the ability to expand the system with additional features by adding new modules as system requirements change. Software modules can be configured for both central office and/or field operations, and then deployed across either a wide area or local area network. The users and groups function offers password access/control for viewing, editing, and other administrative functions. User shift schedules are managed in the software for alarming and reporting through e-mail, SNS, and voice calls using the optional Alert Server module.

In the current energy environment, many companies are scattered across state and international boundaries. Having the ability to distribute Talon Enterprise™ Modules across the network infrastructure puts data collection and management closer to the source of the data, resulting in improved overall system performance.

Talon Lite™

In response to numerous customer request for a reduced cost version of Talon SCE™ that included on screen graphics, Talon Lite™ was launched. Talon Lite™ is packaged with a single TCP/IP Comm Port to permit polling across the Internet with a mobile laptop that included access to a cellular or other mobile data plan or from a single desktop machine with network Internet access. A serial communication pot is included as direct communications. Process programming and Edit Forms may be created as well allowing users to create new applications or modify existing field RTU loads. Parameter changes and other set-points can be edited using the Talon Lite™ software Edit Forms.

Applications

The E-Series™ offers a variety of flexible and configurable options for many different applications. Some of the applications include Electronic Flow measurement (EFM), Electronic Flow Corrections (EFC), Electronic Pressure Recorders (EPR) and Remote Terminal Units (RTU).

Electronic Flow Meter (EFM)

Orifice flow measurement requires the integration of Differential Pressure, Static Pressure and Temperature with adjustments for Specific Gravity and Composition. The EFM contains a full complement of standard Eagle Research processes including API Chapter 21 Compliancy, AGA3 and AGA5 capability and AGA8, Detailed and Gross Methods 1 and 2. The EFM comes complete with an integrated multivariable transmitter for Differential Pressure and Static Pressure along with an RTD (resistance temperature detector). Single and bidirectional measurements are available along with multiple run capability. Data can be read locally on the LCD display or collected with Field Manager™.

Electronic Flow Corrector (EFC)

The E-Series™ product line offers an optional Low Drag Composite Vertical Index (CVI) which uses the E3 as its processor. The EFC provides the user with a low cost mechanical backup to the electronic device. Included in the standard EFC product offering is an internal pressure transducer, an internal RTD (resistance temperature detector), and an external display. The EFC contains a full complement of standard Eagle Research processes, including AGA7 and AGA 8 (Detail and Gross Method 1 & 2) computational functionality. Additional features include complete communications functionality with popular analyzers for energy monitoring requirements. The EFC is a fully functional flow computer capable of Alarm Call-out, Control and a variety of other process related activities. The unit can be interfaced to a wide variety of communication devices such as Radio, Cellular and Satellite modems. Clockwise and counterclockwise meter rotations are handled by a simple reversal of the index in the housing.

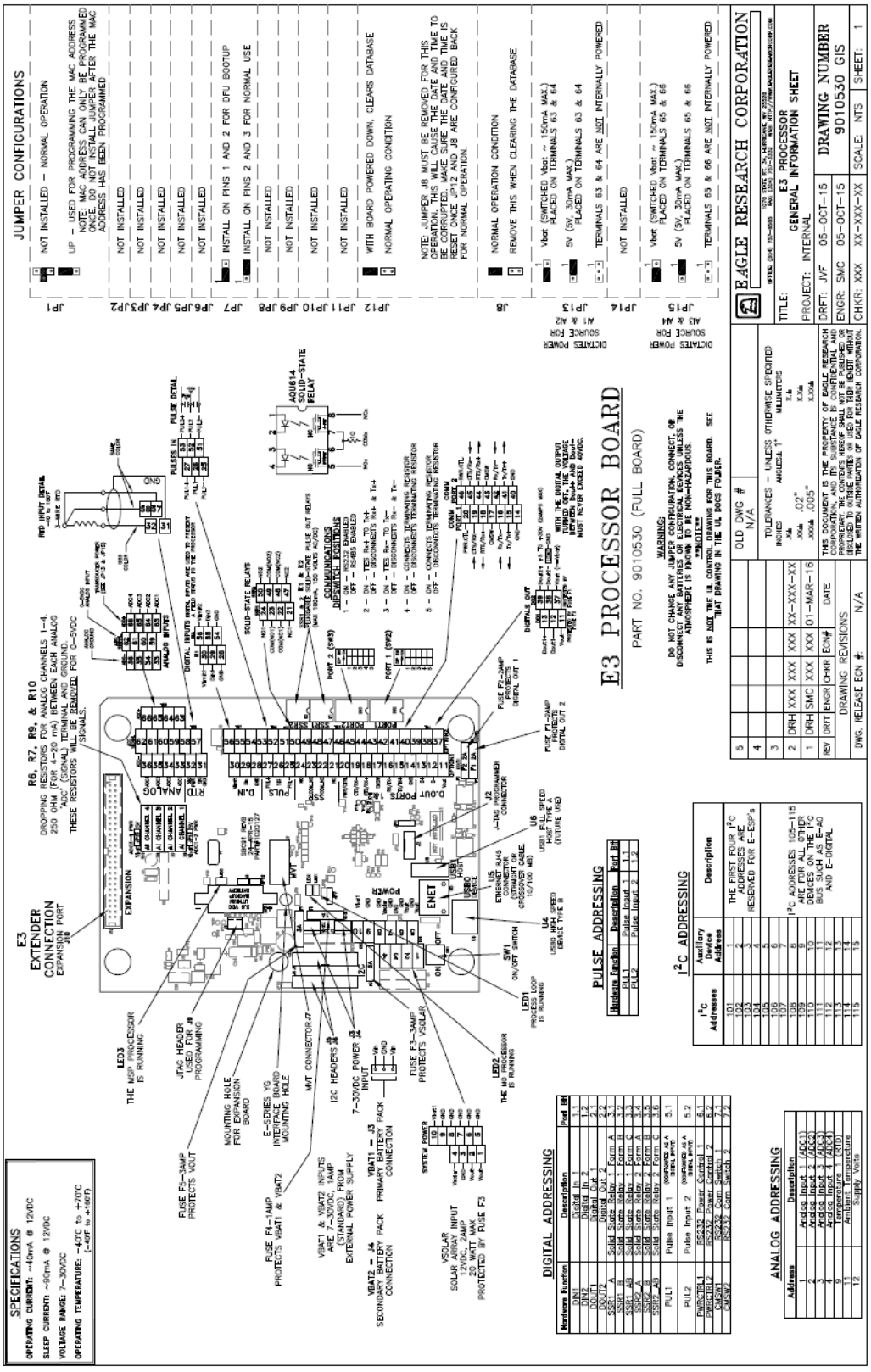
Electronic Pressure Recorder (EPR)

The E-Series™ EPR is a fully function Electronic Pressure Recorder with live pressure and temperature recordings. Flexible configurations are available with multiple pressure, battery, solar and UPS options. The EPR can be used to regulate station monitoring, chart replacement, system end point monitoring for load study, pressure control at critical points, system alarming for pressure and temperature and automated pressure control from one station to another using Talon™ Family Software and Point Transfer Features.

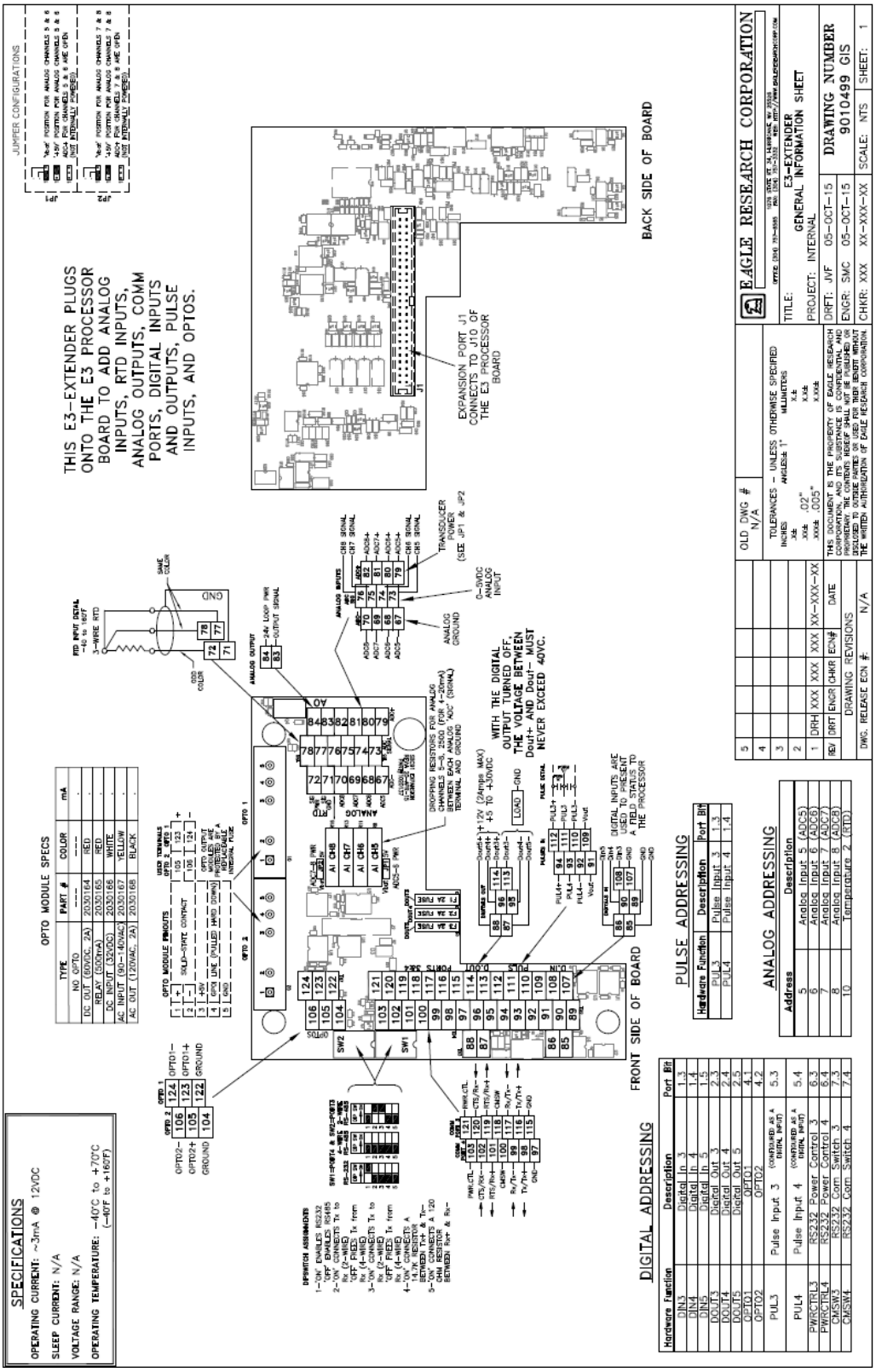
Remote Terminal Unit (RTU)

For more customizable units Eagle Research Corporation® offers the E-Series™ RTU. The RTU is fully customizable with the ability to add expansions such as E-AO, E-ESP and E-Digital. A variety of controls and communications can also be configured into the RTU product line.

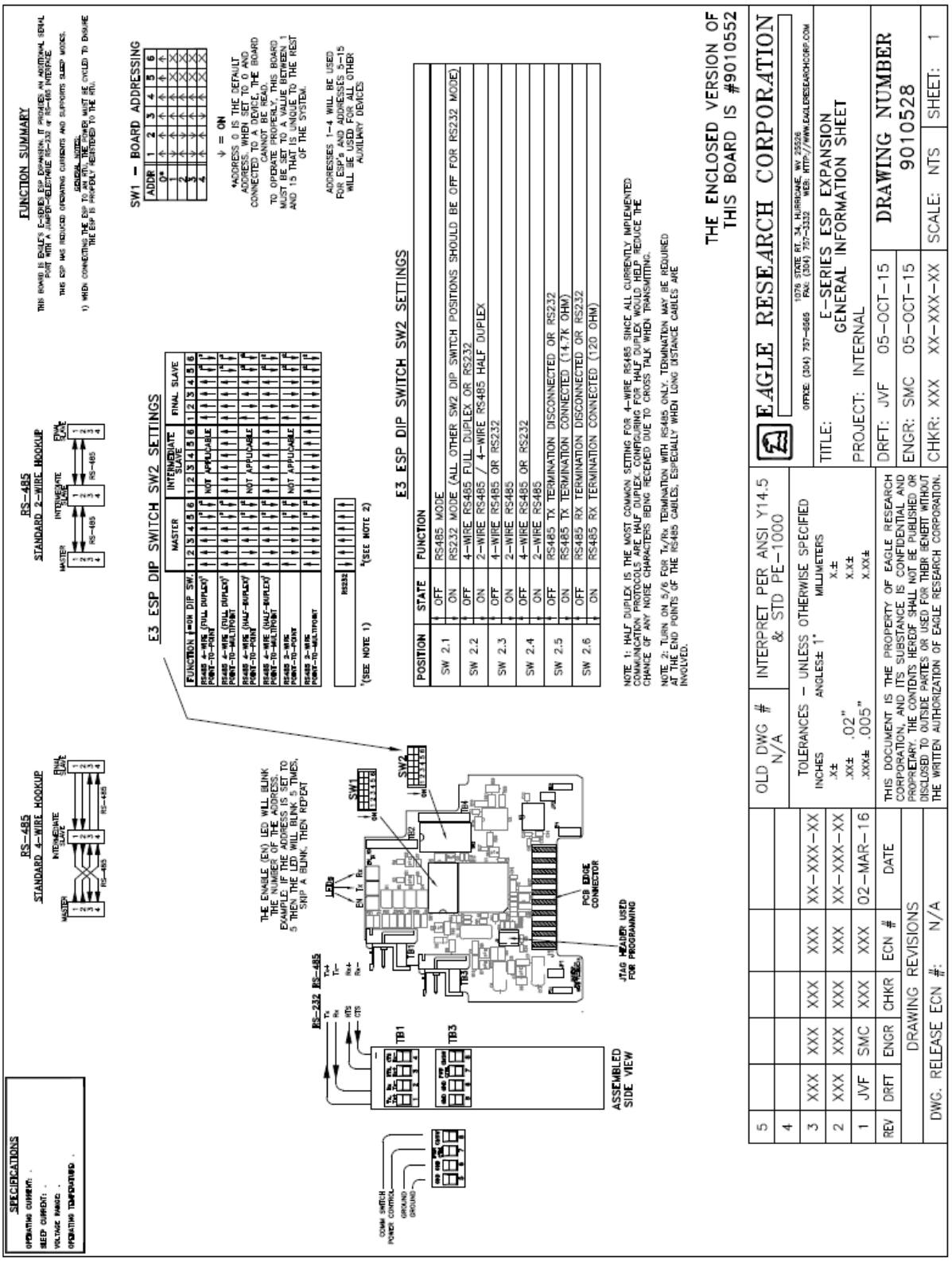
Appendix A – E3 Processor GIS



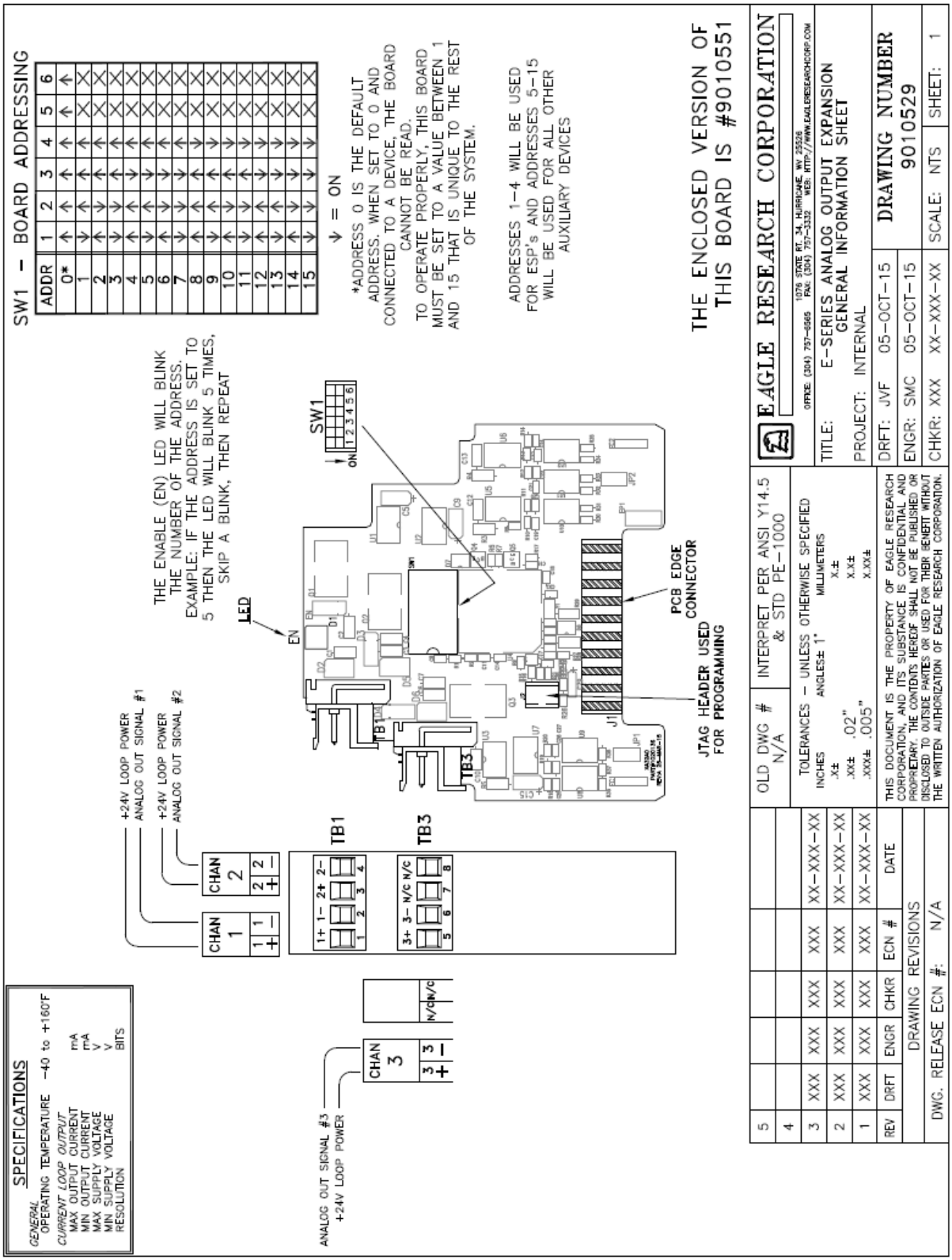
Appendix B – E3-Extender GIS



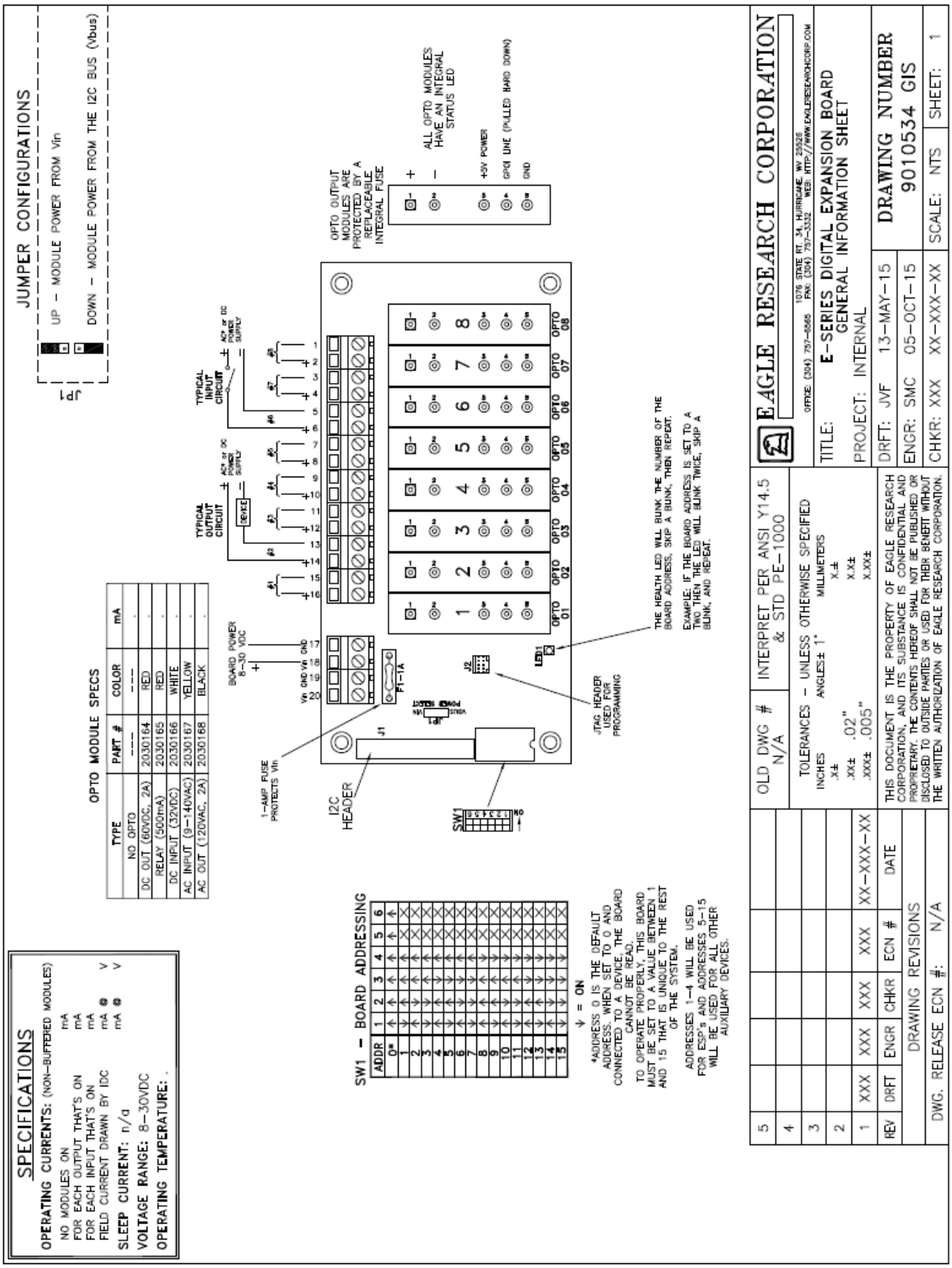
Appendix C – E-Series™ ESP Expansion GIS



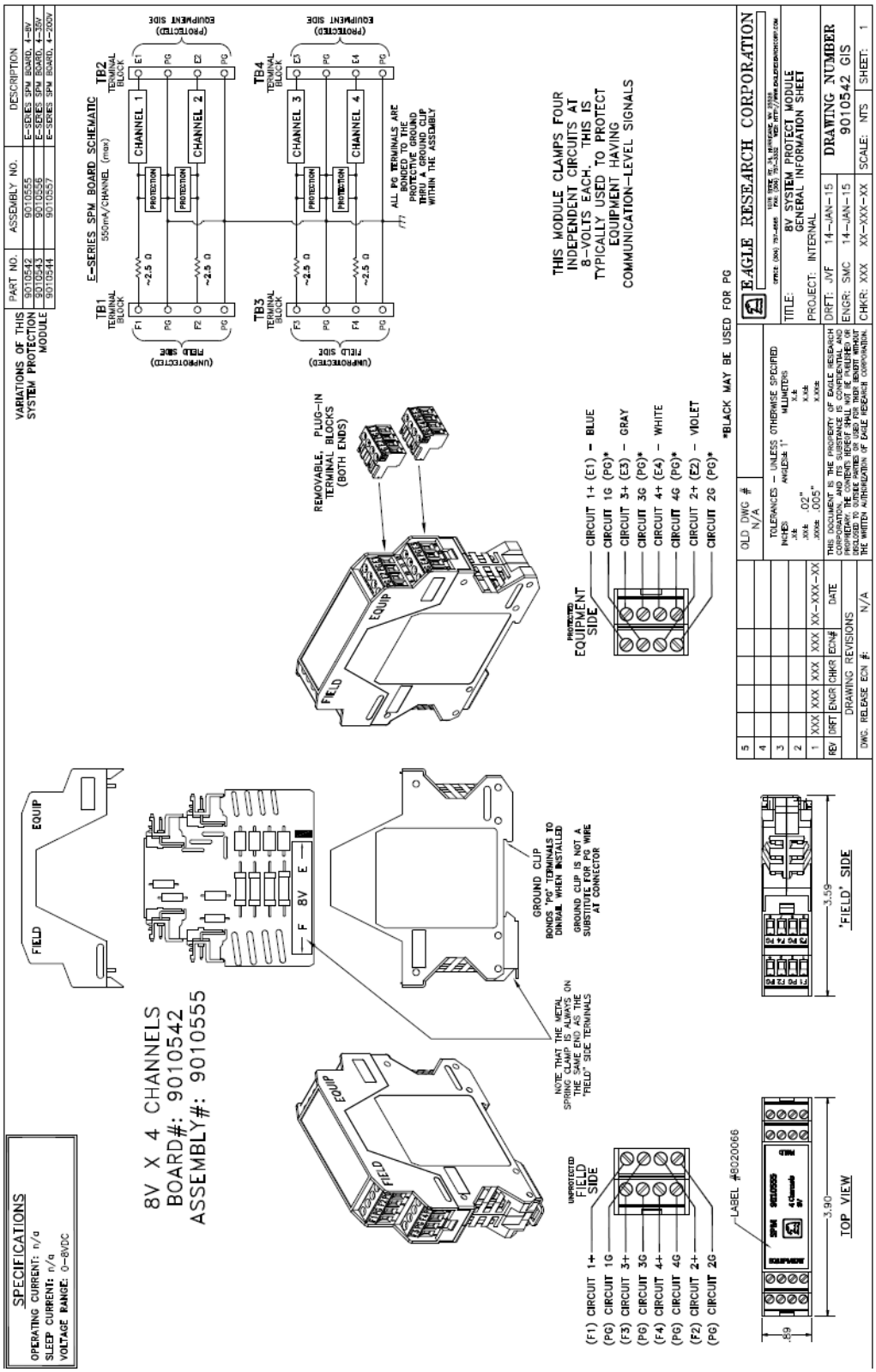
Appendix D – E-Series™ AO Expansion GIS



Appendix E – E-Series™ Digital Expansion GIS

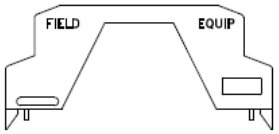


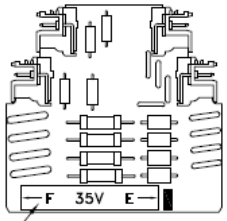
Appendix F – E-Series™ SPM's

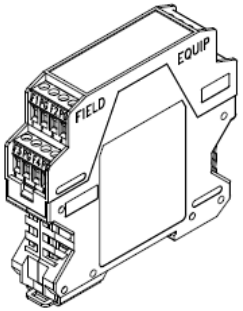


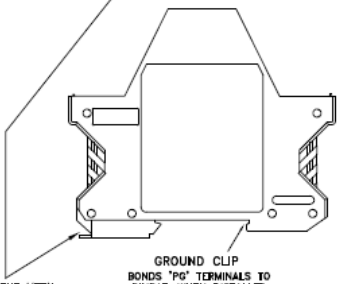
SPECIFICATIONS
OPERATING CURRENT: n/a
SLEEP CURRENT: n/a
VOLTAGE RANGE: 0–35VDC

35V X 4 CHANNELS
BOARD#: 9010543
ASSEMBLY#: 9010556





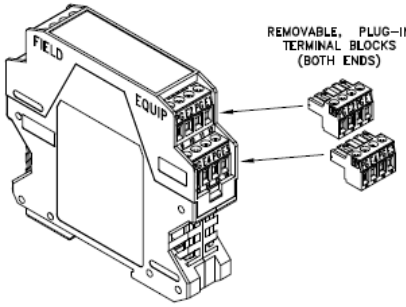




NOTE THAT THE METAL SPRING CLAMP IS ALWAYS ON THE SAME END AS THE "FIELD" SIDE TERMINALS

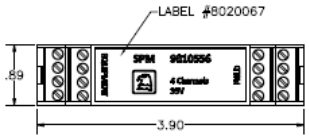
GROUND CLIP
BONDS 'PG' TERMINALS TO DINRAIL WHEN INSTALLED

GROUND CLIP IS NOT A SUBSTITUTE FOR PG WIRE AT CONNECTOR

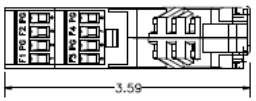


REMOVABLE, PLUG-IN TERMINAL BLOCKS (BOTH ENDS)

UNPROTECTED FIELD SIDE
(F1) CIRCUIT 1+
(PG) CIRCUIT 1G
(F3) CIRCUIT 3+
(PG) CIRCUIT 3G
(F4) CIRCUIT 4+
(PG) CIRCUIT 4G
(F2) CIRCUIT 2+
(PG) CIRCUIT 2G



TOP VIEW



'FIELD' SIDE

PROTECTED EQUIPMENT SIDE
CIRCUIT 1+ (E1) – WHITE/RED
CIRCUIT 1G (PG)*
CIRCUIT 3+ (E3) – YELLOW
CIRCUIT 3G (PG)*
CIRCUIT 4+ (E4) – GREEN
CIRCUIT 4G (PG)*
CIRCUIT 2+ (E2) – ORANGE
CIRCUIT 2G (PG)*

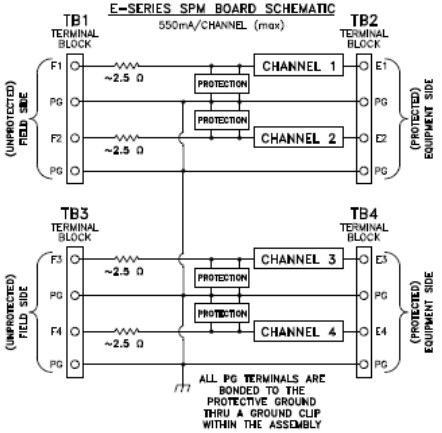
*BLACK MAY BE USED FOR PG

THIS MODULE CLAMPS FOUR INDEPENDENT CIRCUITS AT 35-VOLTS EACH. THIS IS TYPICALLY USED TO PROTECT INCOMING DC POWER

VARIATIONS OF THIS SYSTEM PROTECTION MODULE

PART NO.	ASSEMBLY NO.	DESCRIPTION
9010542	9010555	E-SERIES SPM BOARD, 4-8V
9010543	9010556	E-SERIES SPM BOARD, 4-35V
9010544	9010557	E-SERIES SPM BOARD, 4-200V

E-SERIES SPM BOARD SCHEMATIC
550mA/CHANNEL (max)



REV	DRFT	ENGR	CHKR	ECN#	DATE
5					
4					
3					
2					
1	XXX	XXX	XXX	XXX	XX-XXX-XX

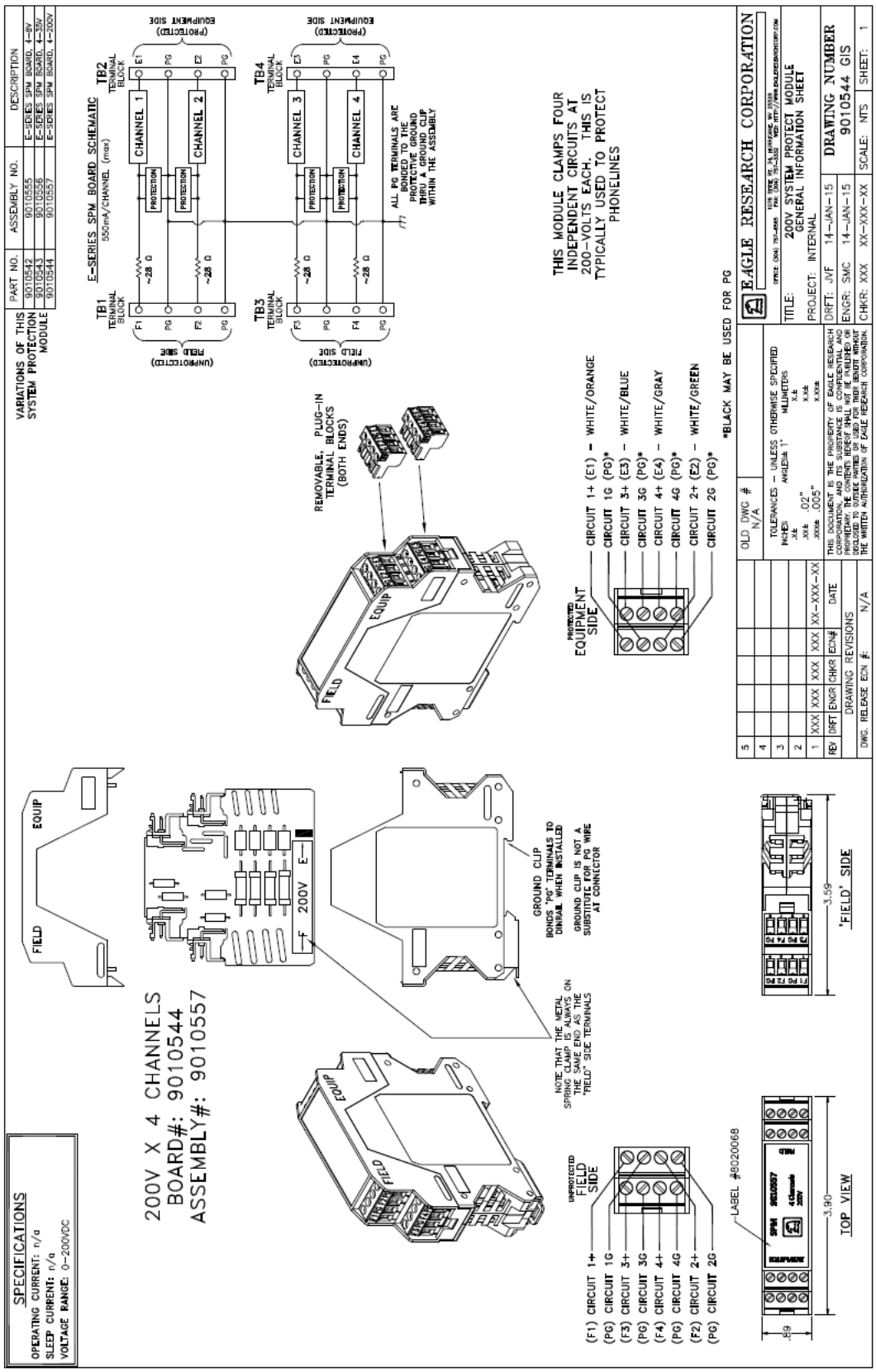
DRAWING REVISIONS
DWG. RELEASE ECN #: N/A

OLD DWG # N/A

TOLERANCES – UNLESS OTHERWISE SPECIFIED
INCHES: .x± ; .xx± .02" ; .xxx± .005"
ANGLES± 1°
MILLIMETERS: x.x± ; x.xx± ; x.xx±

EAGLE RESEARCH CORPORATION
1016 STATE RT. 34, HURRICANE, WV 25526
OFFICE: (304) 757-8565 FAX: (304) 757-3332 WEB: HTTP://WWW.EAGLERESEARCHCORP.COM

TITLE: 35V SYSTEM PROTECT MODULE GENERAL INFORMATION SHEET
PROJECT: INTERNAL
DRFT: JVF 14-JAN-15
ENGR: SMC 14-JAN-15
CHKR: XXX XX-XXX-XX
DRAWING NUMBER 9010543 GIS
SCALE: NTS
SHEET: 1


VARIATIONS OF THIS SYSTEM PROTECTION MODULE
PART NO. 9010542 9010543 9010544 9010557
ASSEMBLY NO. 9010555 9010556 9010557
DESCRIPTION E-SERIES SPM BOARD, 1-48V E-SERIES SPM BOARD, 4-56V E-SERIES SPM BOARD, 4-200V
E-SERIES SPM BOARD SCHEMATIC
550mA/CHANNEL (max)
TB1 TERMINAL BLOCK
TB2 TERMINAL BLOCK
TB3 TERMINAL BLOCK
TB4 TERMINAL BLOCK
CHANNEL 1
CHANNEL 2
CHANNEL 3
CHANNEL 4
PROTECTION
~28 Ω
(UNPROTECTED) FIELD SIDE
(PROTECTED) EQUIPMENT SIDE
ALL PG TERMINALS ARE BONDED TO THE PROTECTIVE GROUND THRU A GROUND CLIP WITHIN THE ASSEMBLY
THIS MODULE CLAMPS FOUR INDEPENDENT CIRCUITS AT 200-VOLTS EACH. THIS IS TYPICALLY USED TO PROTECT PHONELINES
REMOVABLE, PLUG-IN TERMINAL BLOCKS (BOTH ENDS)
CIRCUIT 1+ (E1) – WHITE/ORANGE
CIRCUIT 1G (PG)*
CIRCUIT 3+ (E3) – WHITE/BLUE
CIRCUIT 3G (PG)*
CIRCUIT 4+ (E4) – WHITE/GRAY
CIRCUIT 4G (PG)*
CIRCUIT 2+ (E2) – WHITE/GREEN
CIRCUIT 2G (PG)*
*BLACK MAY BE USED FOR PG
PROTECTED EQUIPMENT SIDE
EAGLE RESEARCH CORPORATION
TITLE: 200V SYSTEM PROTECT MODULE GENERAL INFORMATION SHEET
PROJECT: INTERNAL
DRAFT: JVF 14-JAN-15
ENGR: SMC 14-JAN-15
CHKR: XXX XX-XXX-XX
DRAWING NUMBER 9010544 GIS
SCALE: NTS
SHEET: 1
OLD DWG # N/A
TOLERANCES – UNLESS OTHERWISE SPECIFIED
INCHES ANGLES ± 1° ALL LIMITS .XX ± .02" .XXX ± .005" X.XX ± X.XXX ±
THIS DOCUMENT IS THE PROPERTY OF EAGLE RESEARCH CORPORATION, AND ITS SUBSTANCE IS CONFIDENTIAL AND PROPRIETARY. THE CONTENTS HEREOF SHALL NOT BE PUBLISHED OR DISCLOSED TO OTHER PARTIES OR USED FOR ANY REASON WITHOUT THE WRITTEN AUTHORIZATION OF EAGLE RESEARCH CORPORATION
DRAWING REVISIONS
REV DRFT ENGR CHKR ECN# DATE
1 XXX XXX XXX XXX XX-XXX-XX
DWG. RELEASE ECN #: N/A
SPECIFICATIONS
OPERATING CURRENT: n/a
SLEEP CURRENT: n/a
VOLTAGE RANGE: 0-200VDC
200V X 4 CHANNELS
BOARD#: 9010544
ASSEMBLY#: 9010557
FIELD
EQUIP
200V E-
GROUND CLIP BONDS "PG" TERMINALS TO DINRAIL WHEN INSTALLED
GROUND CLIP IS NOT A SUBSTITUTE FOR PG WIRE AT CONNECTOR
NOTE THAT THE METAL SPRING CLAMP IS ALWAYS ON THE SAME END AS THE "FIELD" SIDE TERMINALS
UNPROTECTED FIELD SIDE
(F1) CIRCUIT 1+
(PG) CIRCUIT 1G
(F3) CIRCUIT 3+
(PG) CIRCUIT 3G
(F4) CIRCUIT 4+
(PG) CIRCUIT 4G
(F2) CIRCUIT 2+
(PG) CIRCUIT 2G
LABEL #8020068
3.90
.69
TOP VIEW
3.99
"FIELD" SIDE

Appendix G – Software

In the development of the E-Series™ product line, Eagle Research Corporation® has used the following open source software libraries; FreeRTOS, lwIP and LPCOpen. The licensing information for each of these can be found at the links listed below.

FreeRTOS – www.freertos.org
lwIP – http://lwip.wiki.com/wiki/License
LPCOpen – www.lpcware.com/lpcopen