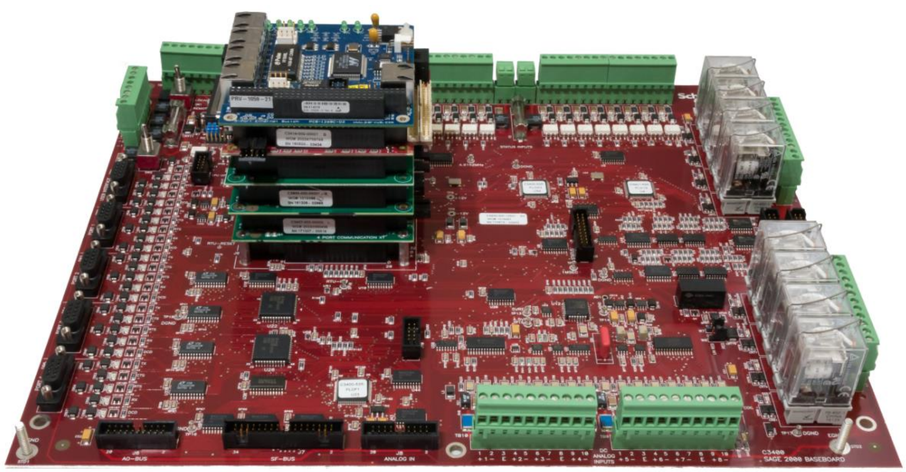
SAGE 4400 Operation & Maintenance Manual

SAGE RTU Product Line
California Proposition 65

Version : 1.0
Date : 09-Aug-2018

Identification

Product name:	SAGE RTU Product Line
References involved:	C3400 (SAGE 2400), C3800 (3030 M), C3700 (SAGE 1410), C3500 (SAGE 1430), C3600 (SAGE 1450), C3810 (LANDAC II), C3812 (SAGE 4400), C3414, C3132, C3133, C3140, C3230, C3231, C3232, C3233, C3235, C3241, C3243, C3244, C3247, C3248, C3263, C3320, C3321, C3322, C3330, C3360, C3429, C3430, C3432, C3437, C3438, C3476, C3831, C3835, C3861, C3439, C3442, C3443, C3444, C3445, C3446, C3447, C3448, C3449, C3450, C3451, C3452, C3453, C3454, C3455, C3456, C3457, C3459, C3460, C3462, C3464, C3465, C3466, C3467, C3468, C3469, C3470, C3471, C3472, C3473, C3474, C3475, C3477, C3478, C3479, C3480, C3481, C3482, C3484, C3485, C3486, C3487, C3488, C3489, C3490, C3491, C3492, C3493, C3494, C3495, C3530, C3532, C3534, C3550, C3551, C3552
Country - State	USA - California



California Proposition 65 Warning Statement for California Residents

⚠ **WARNING**: This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Details of the supplier:

Supplier / Manufacturer :	Schneider Electric USA, Inc.
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Phone :	+1 (713) 920–6800
Web site :	www.sage-rtu.com www.schneider-electric.com

1 Introduction

This user manual describes the operation and maintenance of the SAGE 4400 Substation Automation Platform.

1.1 General Functions

The SAGE 4400 is designed to be the optimum "Substation Automation Platform". It is designed to meet the complex requirements of the modern integrated substation by providing features that make it easier to interface with a broad range of IEDs as well as having the horsepower to run a wide range of automation applications.

Configuration

Equipped with a powerful browser based user-interface, its user-friendly configuration tools allow it to manage data with simple and intuitive click, drag and drop procedures. There is no special software to load or keep track of. The only requirement is a PC with a web browser (Chrome or IE). Configuration tools include features for auto-configuration and the ability to build custom templates for standard configurations making it easy to integrate IEDs with the data set you desire. Other features make analog scaling both powerful and flexible, eliminating the headaches of mapping data with different resolutions and scaling factors to the same port.

The SAGE 4400 includes Schneider Electric's entire protocol library enabling it to talk to a wide range of IEDs and master stations without added costs and without limitations (i.e., any comm. port can be configured by the user to talk any available protocol).

Communications & I/O

The SAGE 4400 has sixteen (16) RS232 communications ports complete with LEDs for positive visual indication of data activity, two Ethernet ports and a separate port for an external Dial-up modem, making it a compact yet powerful communications platform. In addition, the SAGE 4400 supports up to via I/O expansion cards:

- 224 Digital Inputs
- 256 1MS SOE
- 256 Analog Input
- 128 T/C Momentary or Latching Controls for picking up I/O points not available from IEDs
- Digital Output Bus connector

Built specifically with relay integration in mind, the SAGE 4400 has features that allow for pass thru connections from either the Ethernet or Dial-up port to any other port. Precision timing can be provided via GPS receiver or IRIG-B signals and bussed to all the serial ports.

Computation

In addition to its communications capabilities, the SAGE 4400 is equipped with a powerful CPU and plenty of memory for running automation applications. Every SAGE 4400 includes an IEC 61131 compliant Programmable Logic Controller runtime engine, which allows the user to build custom closed-loop logic algorithms for everything from simple "if-then" operations to sophisticated auto-sectionalizing schemes.

Climate

The SAGE 4400 meets or exceeds the requirements for survival in the harsh electrical environment of a utility substation. Based on field proven technology, the SAGE 4400 is tested against IEEE and ANSI surge withstand and fast transient specifications. It comes in a rugged metal enclosure intended for mounting into a standard 19-inch rack or relay panel. Power options include standard 10-33 VDC input power sources. The SAGE 4400 is specifically designed to make integrating IEDs in an electrical substation simple, secure, and ready for the next wave of substation automation applications.

General Operational Considerations

Note: The initial setup is for a Username of "Admin" and a Password of "Telvent1!".

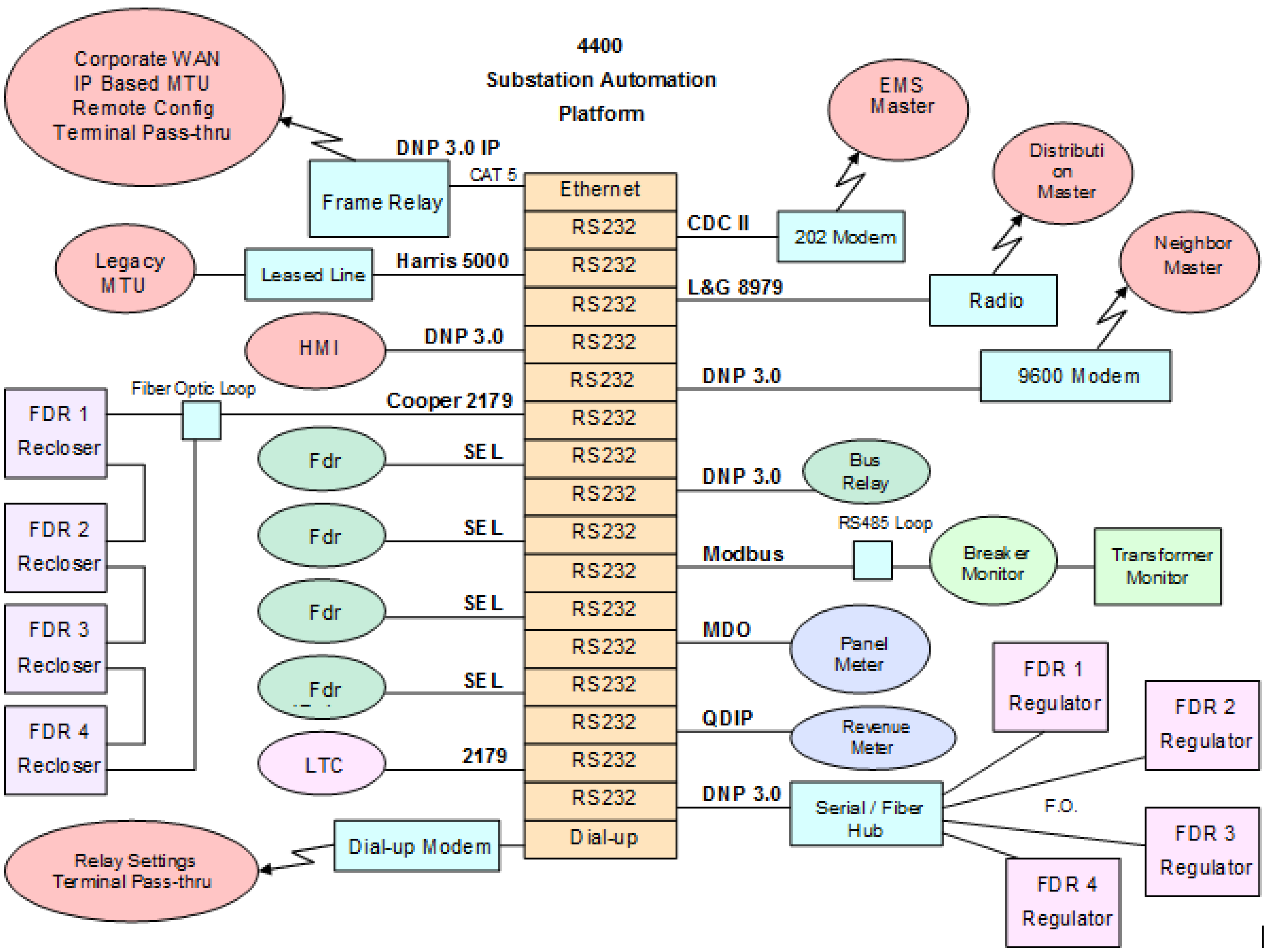
Note: With the release of firmware J0 and later, the initial TCP/IP address is now 192.168.1.1.

Note: For the latest manual, please see our website.

http://www.sage-rtu.com

Figure 1-1 shows the SAGE 4400 with a broad range of devices, communications mediums and protocols. While not necessarily a configuration one might design on purpose, it shows the power of the SAGE 4400 and the possibilities it brings to the table. Most utilities have a wide range of new and legacy devices that need to be pulled together to form a functioning system. The SAGE 4400 meets the challenge without closing the door to future advancements. The SAGE 4400 is the perfect platform to pull everything together while leaving a clear and easy migration path into the future.

Figure 1-1 Substation Integration



The Theory of Operation chapter should be used in conjunction with the schematics and printed circuit assembly drawings. The drawings also include bills of material for those users wishing to perform component level repair of failed assemblies.

Figure 1-2 SAGE 4400 Front View

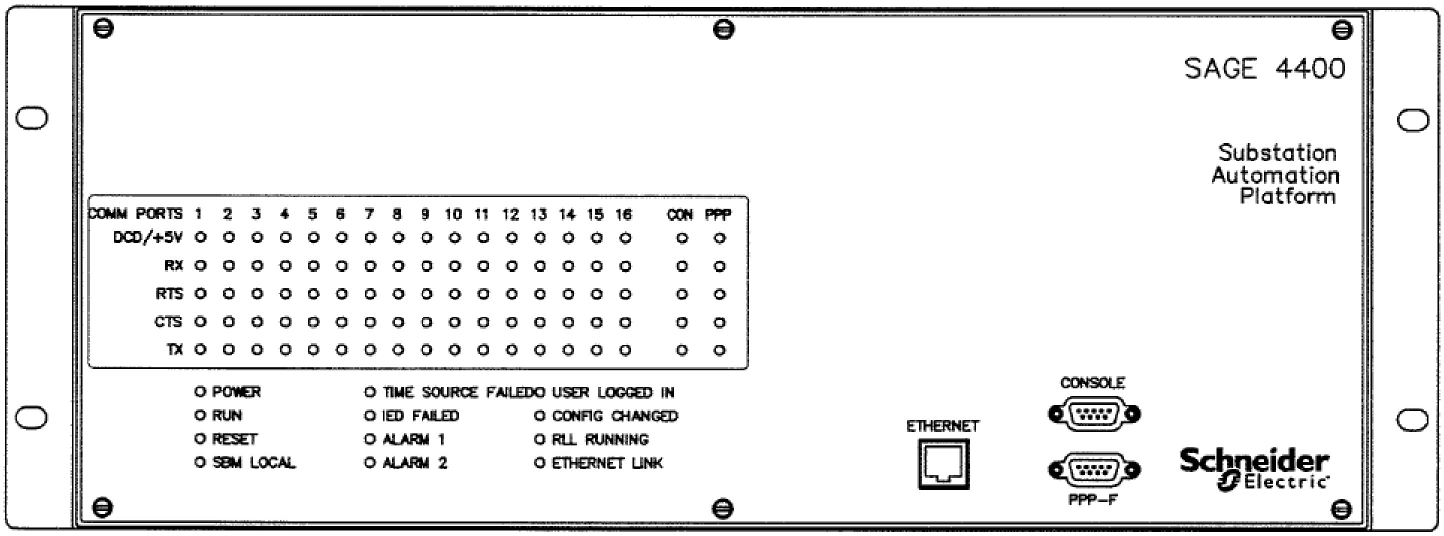
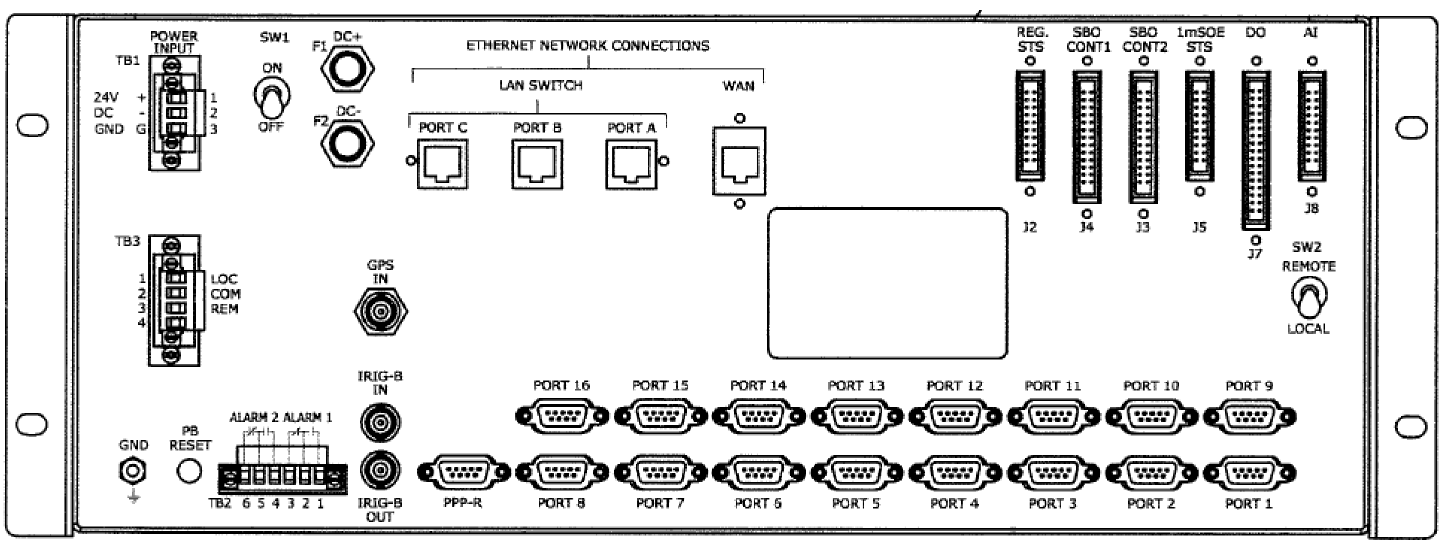


Figure 1-3 SAGE 4400 Rear View



1.2 Rear Panel Functions

Power Input

This is the power input according to the variance for the particular SAGE 4400. The choices at time of purchase are: 10-33VDC. There is a switch to disable power to the RTU adjacent to the input terminal block.

Analog Input Expansion

Using XT boards, up to 256 analog points.

Digital Input Expansion

Using XT boards, up to 224 status points or Form A accumulators (112 Form C accumulators).

1msSOE Status Expansion

Using XT boards, up to 256 1ms SOE status points

SBO Control Expansion

Using XT boards, up to 128 SBOs using two 64 point connectors.

Digital Output Expansion

Using XT boards, up to 256 Digital Output points, or Raise/Lower Controls

Remote/Local Switch

There is a Remote / Local switch with External Switch Status. In Local position, disables all hardware and IED controls.

Fused, Switched Power Input and Grounding Bar

A power switch has been added to the 4400. Also, fuses for the power input come standard. A grounding stud is also available.

PB Reset

Push Button Reset.

Alarm 1 & 2 Output

Form C outputs for Alarms.

IRIG-B In & IRIG-B Out

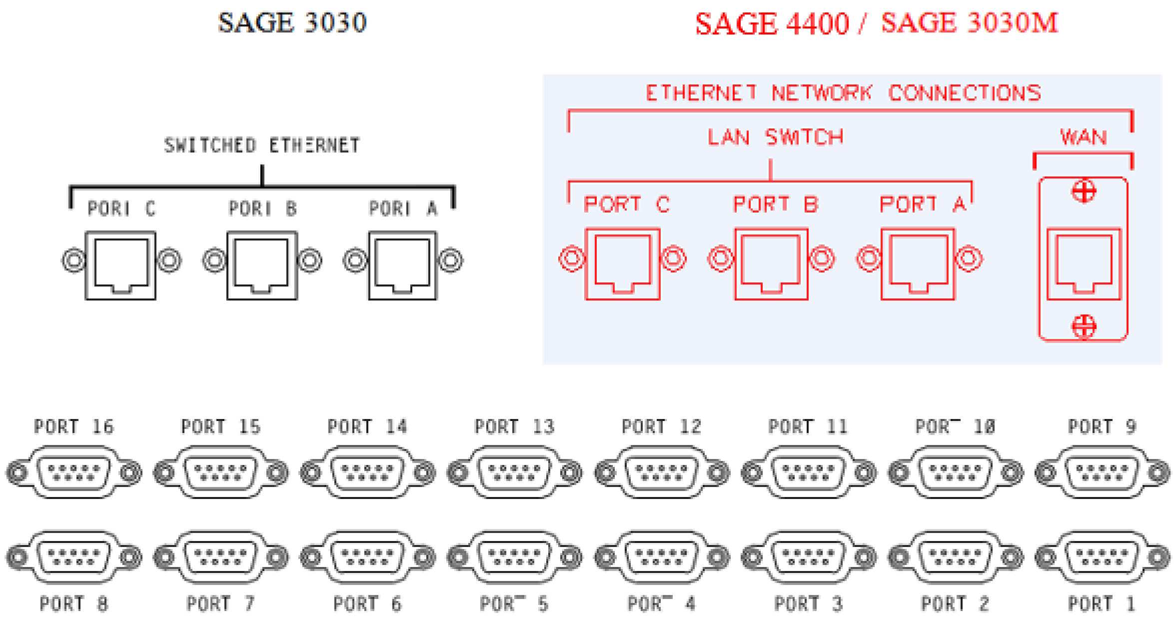
IRG-B input and output are available from these two ports.

GPS In

Antenna connector for optional GPS module.

PPP-R

Point to Point Protocol connector. The –R simply means Rear panel. There is also a front panel PPP port connected in parallel.



Switched Ethernet or LAN Switch

Three ports for optional Switched Ethernet. The main Ethernet port is on the front panel.

WAN

The port for the secondary Ethernet port.

Ports 1 Through 16

Sixteen serial ports for communications with IEDs and/or masters.

1.3 Features

The SAGE 4400 uses the latest electronic technology for reliability, speed and maintainability. It is intended for use where limited on-board I/O is acceptable, yet is capable of polling a wide variety and number of IEDs or other devices.

The SAGE 4400 has the following new features:

- Web Browser “UIF” User InterFace configuration tool
    - Uses Chrome or Internet Explorer.
- Full MTU / IED Protocol Library Standard
- Built-in dual 10/100 MB Ethernet ports
- 16 Built-in RS232 Communications Ports
- Dedicated User Configuration Port
- Dedicated Serial Dial-up Port
- Over 100 LEDs for positive visual indications

1. Power, Run, Reset, Local, Time Source Failed, IED Failed, User Logged IN, Config Changed, RLL Running, Ethernet Link, Alarms 1 & 2

2. Communications LEDs (RX, TX, RTS, CTS, and DCD/+5V on each port)

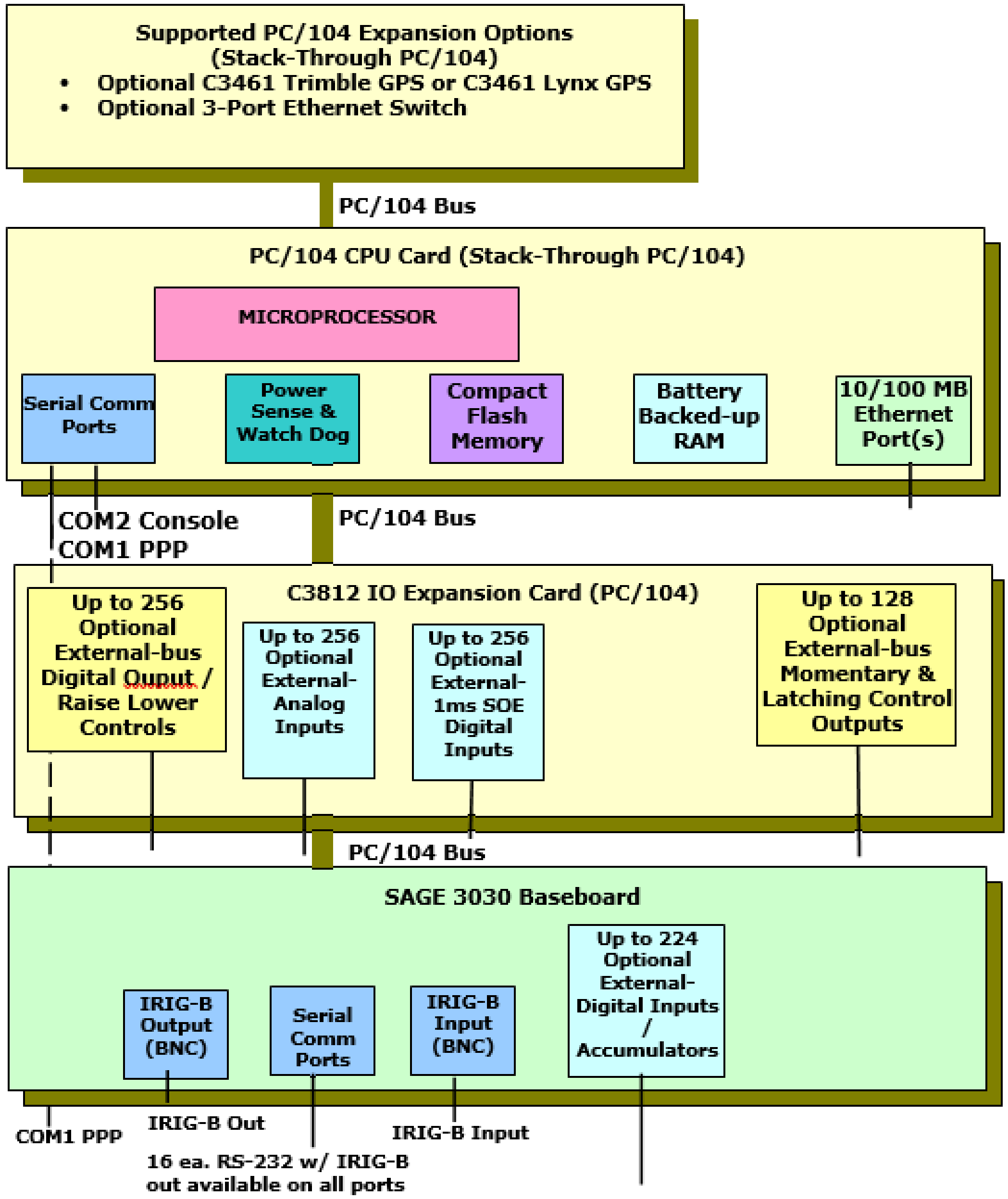
- Continuous IRIG-B output with built-in bus to all comm. ports for IRIG-B, GPS, RTC, or Protocol time synchronization
- Rugged relay style metal enclosure for easy mounting
- PC/104 Bus Architecture
- Designed specifically for Electric Utility Applications
- (Meets IEEE 472, ANSI C37.90 SWC & C3790.1 standards)
- Optional – Internal GPS Receiver
- Optional – Internal 3 Port Ethernet Switch

1.4 Architecture

Figure 1-4 shows a simplified block diagram of the SAGE 4400 Baseboard that illustrates its general architecture and major components. The basic SAGE 4400 consists of a Baseboard and a PC104 based I/O board assembly providing additional I/O functionality and power regulation.

Additionally, the open architecture of the PC/104 interface provides for expanded functions. You may add a PC/104 GPS receiver and/or a 3-port Ethernet switch.

Figure 1-4 SAGE 4400 Simplified Block Diagram



1.5 Graphical User Interface (GUI)

The SAGE 4400 is easily configured using the standard web browser. The physical connection may be made in one of four ways:

- Ethernet connection using an Ethernet crossover cable directly to the front panel Ethernet port
- Ethernet connection to a network, locally or remotely
- PPP connection using a null-modem cable to the PPP-F or PPP-R port
- Console – this method commonly used to read and/or change IP address

See the config@WEB Secure Software Users Guide for details on connections.

The GUI is designed around the classical client/server model. A web browser is all you need for your client (PC) and you can browse any Device product or any version of that product that supports our web interface. All configuration data is stored on the SAGE 4400 in the form of Extensible Markup Language (XML). XML data is served up to the browser within HTML pages or transformed into HTML via Extensible Stylesheet Language (XSL). In either case data is presented to the user in an intuitive format using common design elements like forms, Radio Buttons, Spin Boxes, Alert Boxes, etc. for much of the data entry.

The GUI supports File Transfer Protocol (FTP), or Secure FTP on the Secure Firmware, to transfer files to/from the SAGE 4400 and the client. The file types include Device applications, Web pages, Configuration files, and the operating system. In short, every file within one SAGE 4400 can be transferred to another 4400 or parts of the 4400 file system can be upgraded as needed. This provides a powerful means of performing firmware upgrades or configuration changes.

1.6 Point Mapping

The substation products of today must interface to a wide Varity of I/O and industry standard IEDs. This creates within the SAGE 4400 a large database of points that must be transferred to one or more master stations.

The SAGE 4400 GUI supports an intuitive drag and drop point mapping scheme. Each point within the SAGE 4400 is named and scaled with user definable names and values. Scaling is used for local data display as well as protocol count scaling for conversion of data from one protocol to another.

1.7 Communications

The SAGE 4400 supports a large suite of communication protocols over many different types of communications media. Two Ethernet ports and sixteen (16) RS232 ports come as standard hardware. Three switchable Ethernet ports are optional. Also supported is an IRIG-B input on BNC. IRIG-B output is supported on all 16 RS-232 ports.

The UIF is a dedicated RS232 port that supports Point-to-Point Protocol (PPP). This port can be used for initial setup, local maintenance and configuration updates.

All SAGE substation automation products support multiple Device and IED protocols. This allows for data to be mapped from IEDs to multiple masters via different Device protocols. Example: If you were replacing your current master station software that talks Series V protocol with a system that supports DNP, your Device could talk to both the old master and the new master at the same time. This provides an excellent means of replacing legacy RTU/MTU equipment without interruption to data acquisition.

An emerging need for substation products is SCADA protocols to communicate over Ethernet all the way down to the Device. The SAGE 4400 supports DNP, Modbus, over Ethernet.

1.8 Relay Ladder Logic (RLL)

The SAGE 4400 supports a RLL Runtime Target that accepts applications that can be developed using any one of the five IEC 61131-3 languages plus flow Charting. Programs are developed on an application workbench that runs only on the client. Fully developed/debugged programs can be downloaded into the SAGE 4400 and activated for execution.

RLL applications have access to all the data within the Device and make use of the powerful mapping capabilities of the GUI. Output data from RLL applications can be viewed in real time data displays.

1.9 Packaging

The SAGE 4400 is packaged in an enclosure measuring 11” deep by 7” high by 19” wide. The enclosure is suitable for mounting in a standard 19” rack, or in a panel (with suitable depth). For practical purposes, the clearance for depth must include room for appropriate cables.

1.10 Protection

All terminations contain any transient protection required for the particular input function. In addition to this, relays include matrix and kick-back diodes and digital inputs include current limiting resistors.

2 Specifications

2.1 Size

ENCLOSURE 19"x 10.5"x 7" metal chassis
Fits standard 19"rack/relay panel

Figure 2-1 4400 Front View

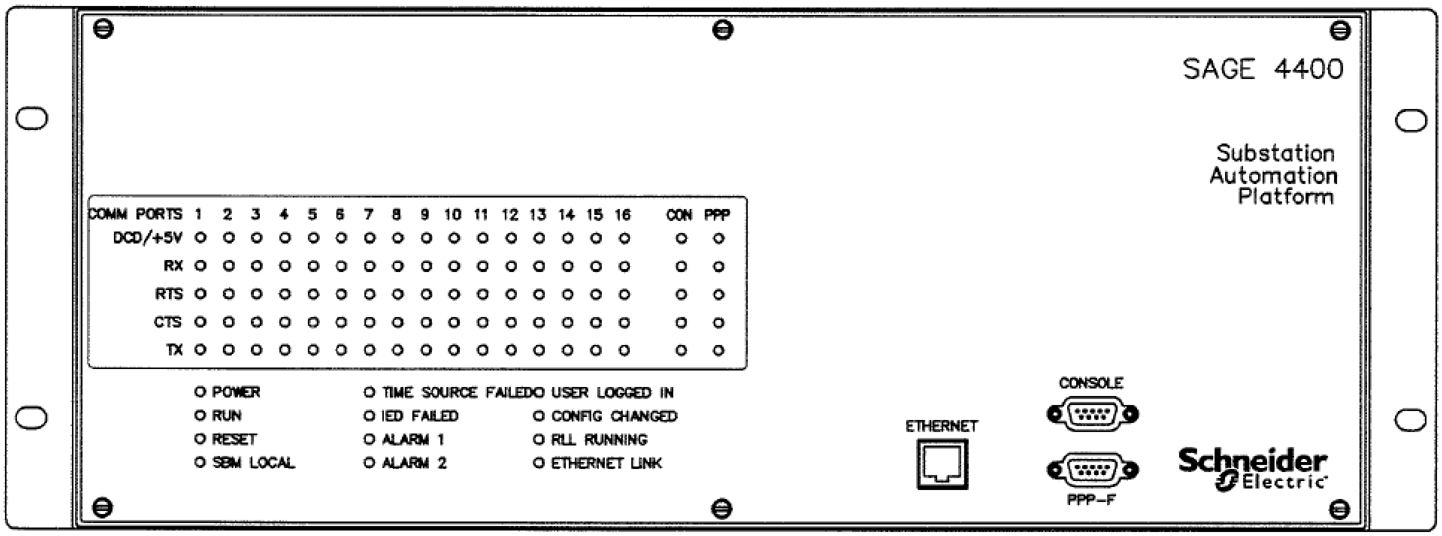
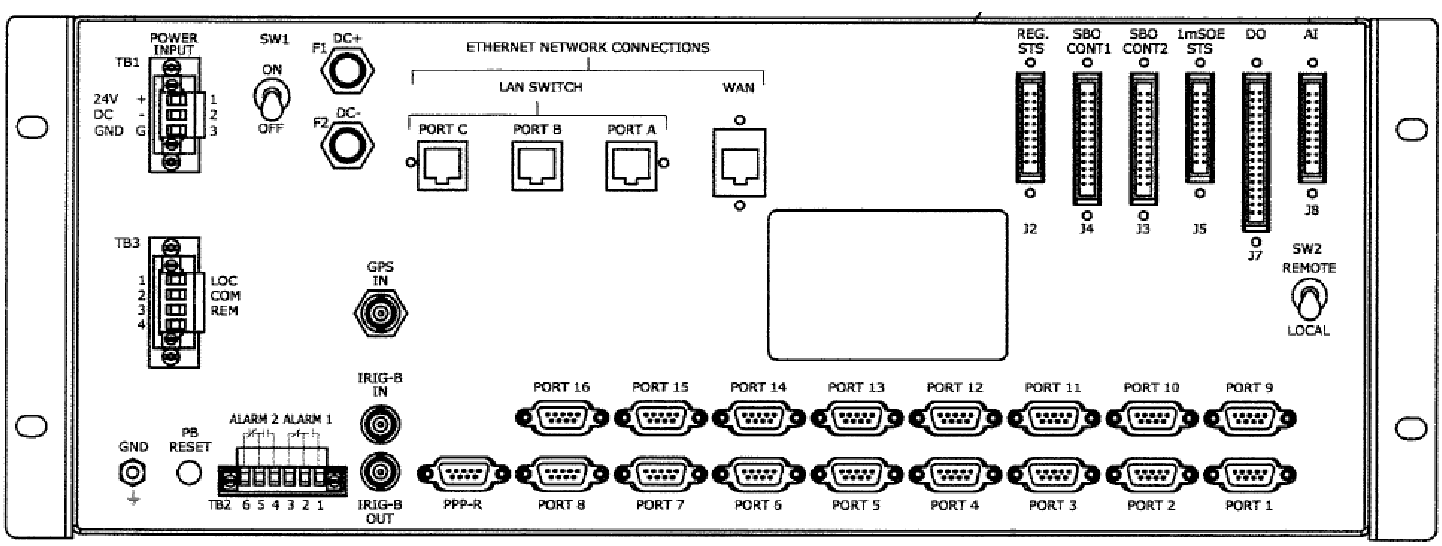


Figure 2-2 4400 Rear View



2.2 Visual Indications

COMMUNICATIONS	5 LEDs per RS-232 port (DCD/+5V, RX, RTS, TX, CTS)
OTHER INDICATIONS	Power, Run, Reset, Local, Time Source Failed, IED Failed, User Logged IN, Config Changed, RLL Running, Ethernet Link, Alarms 1 & 2

2.3 User Computer Requirement

OPERATING SYSTEM	Windows XP or later with Internet Explorer or Chrome. If using XML to Excel macro, Microsoft Office 2003 or above.

2.4 Environmental

OPERATING TEMPERATURE	-40 to +85° C
RELATIVE HUMIDITY	5% to 95%, non-condensing
TRANSIENT PROTECTION	All user field connections designed to pass IEEE 472-1974, ANSI C37.90.1-1989 ANSI C37.90-1979 (R1982)

2.5 CPU/Memory

Please refer to the CPU Manual for CPU/Memory Specifications

2.6 User Interface

WEB BROWSER	Chrome or Internet Explorer
ETHERNET	10/100BASE-T (RJ45)
PPP	RS232C 38.4kbps

2.7 Communications

ETHERNET	Two built-in 10/100BASE-T (RJ45) auto-negotiate (will adjust to the speed and half/full duplex of the connecting device)
SERIAL	16 RS-232C (DB-9) Ports
CONSOLE	RS232C (DB-9)
DIAL-UP	RS232C (DB-9)
SERIAL SPEEDS	300-19,200 bps (38,400 for PPP)
PROTOCOLS	Synchronous and asynchronous, bit & byte

2.8 C3463 PCA Ethernet 10/100 5-Port Switching Hub (Optional)

ETHERNET	C3463-000-00001 includes five built-in 10/100BASE-T (RJ45) auto-negotiate (will adjust to the speed and half/full duplex of the connecting device). Two RJ45 connections for internal routing, 4-pin Molex connections interface to rear mounted C3805-000-00001 Ethernet Hub Terminator Board.

2.9 Power Requirements

INPUT VOLTAGE	10-33 VDC only

Power Consumption

Input Voltage	Typical Power Consumption	Max Power Consumption @ Rated Temperature
10 – 33 VDC	12 Watts	20 Watts

Note: Power consumption is measured at the Power Input terminals on the back panel.

INPUT/OUTPUT ISOLATION	1500 VDC minimum

2.10 Alarm Outputs

CONTACT FORM	Form C
MAX OUTPUT POINTS	2
CONTACT RATINGS	30 VDC @ 2A, 129 VDC @ 500 MA

2.11 IRIG-B Input

MODULATED/DEMODULATED FORMAT	Accepts IRIG-B signal through BNC connector

2.12 IRIG-B Output

DEMODULATED	Available on all 16 Communications ports
FORMAT	Pins 4&6 on RS-232C (DB-9)
DEMODULATED	Available on BNC connector

2.13 GPS Receiver – Option

Requires C3461 or C3861-000-00001 PC104 GPS Module along with Antenna Kit.

2.14 RS232 Power (Selectable)

5VDC	Configurable on all 16 Comm ports
FORMATS	Pin 1 on RS-232C (DB-9)
POWER AVAILABLE	5W Max Total

2.15 Logic Capabilities

IEC 61131 compliant PLC runtime engine. Many built in applications for doing Boolean logic, Calculations, and Data Transfer are available with the standard firmware.

2.16 Digital Inputs

(Requires optional external termination (XT) module and status wetting supply as required)

2.16.1 Status Inputs

ISOLATION	Optically isolated, 1500VDC
LOOP VOLTAGES	12, 24, 48, and 129VDC
DEBOUNCE	20 msec nominal
CONFIGURATION	2 terminals per point (+ and -)
MAX INPUTS	224
POWER	Baseboard and XT excitation
INDICATORS	One LED per point.
XT DIMENSIONS	16pt 5x8 inch, 32pt 5x8 inch & 32pt 7x19 inch

2.16.2 Accumulator Inputs

ACCUM. FORMATS	FA, FC (1 or 2 counts/cycle)
ACCUM. INPUT RATE	20 pps max.
MAX INPUTS	224 Form A or 112 Form C

2.16.3 SOE Inputs

ACCURACY	5ms, leading edge tagged
DEBOUNCE	20ms fixed

2.17 1MS SOE

(Requires optional external termination (XT) module and status wetting supply as required)

Based on the C3835 1MS-SOE PC104 expansion card. This uses the latest revision of the Analog Devices ADSP2185N processor. The C3812 1MS-SOE subsystem can time tag 256 1MS-SOE points. This connects to existing standard Status Input cards available from Schneider Electric.

ISOLATION	Optically isolated, 1500VDC
LOOP VOLTAGES	12, 24, 48, and 129VDC
CONFIGURATION	2 terminals per point (+ and -)
MAX INPUTS	256
POWER	Baseboard and XT excitation
INDICATORS	One LED per point.
XT DIMENSIONS	16pt 5x8 inch, 32pt 5x8 inch & 32pt 7x19 inch

2.18 Analog Inputs

INPUT TYPE	Differential
INPUT RANGES	±5VDC, 0-5VDC, 1-5VDC, ±1mA, 0-1mA, 4-20mA, 10-50mA
RESOLUTION	12 bits (11 bits plus sign)
COMPREHENSIVE ACCURACY	±0.25% FS between –40° and +85°C
REFERENCE VOLTAGES	±4.500V
CONVERSION RATE	All analogs once per second
COMMON MODE RANGE	±10V
COMMON MODE REJECTION	80 dB @ 50/60Hz
NORMAL MODE REJECTION	60 dB @ 50/60Hz
INPUT RESISTANCE	10M ohm or greater
MAX INPUTS	256
XT CONFIGURATION	2 terminals per point (+ and -) with a shared shield ground.

2.19 SBO Control Outputs

(Requires optional external termination (XT) modules)

DURATION	Software programmable in 5 msec. increments
MOMENTARY	KUP type 1FC/2FA 10A @ 240VAC or 10A @ 28VDC. KUEP type 1FC 3A @ 150VDC, 2FA 5A @ 150VDC, 1FX 10A @ 150 VDC.
LATCHING	KUL type 1FC/2FA 10A @ 240VAC or 10A @28VDC.
RELAY INSTALLATION	Socketed
MAX OUTPUT POINTS	2 x 64 T/C Pairs = 128 T/C Pairs (256 coils)
XT DIMENSIONS	4pts / 6.4x8 inch card & 8pt 7x19 inch

2.19.1 Digital Ouput Bus

The Special Function Bus is used to expand the I/O capabilities of the SAGE 4400. The SFB signals appear on J6 and J7.

Table 2-1 Special Function Bus Pin Assignments

Pin	Signal	Pin	Signal	Pin	Signal
1	DGND	13	B-S-A2	25	B-SFBSEL2
2	+5V	14	B-S-A3	26	B-SFBSEL3
3	+15V	15	SFB0	27	B-SFBSEL4
4	RTU-RESET#	16	SFB1	28	B-SFBSEL5
5	BWR/RD#	17	SFB2	29	B-SFBSEL6
6	EXT-1MSEC	18	SFB3	30	B-SFBSEL7
7	BWR-RD#	19	SFB4	31	-15V
8	No Connection	20	SFB5	32	+5V
9	BSTB	21	SFB6	33	DGND
10	DGND	22	SFB7	34	DGND
11	B-S-A0	23	B-SFBSEL0		
12	B-S-A1	24	B-SFBSEL1		

RTU-RESET#

A signal provided by the Baseboard. It is asserted whenever the RTU is being reset, which includes periods when the 5V supply is outside of acceptable thresholds. This signal is active when it is low and is pulled low on each XT.

BWR/RD#

A signal provided by the Baseboard to specify whether data is being written to or read from the XT. A high logic state (+5V) indicates a write from the Baseboard to an XT. This line must be high if data is to be written to the XT, or low if data is to be read. This signal should be left in the low (read) state when unused.

EXT-1MSEC

A precision 1kHz frequency clock driven by the Baseboard.

BSTB

It is provided primarily to support the Analog Output bus, which is a subset of the Special Function Bus. It is asserted high after all addresses are selected on the AO bus.

B-S-A0 to B-S-A3

Address lines, used for decoding and selecting one of 16 addresses on a single XT board. Each address may be used for read or write.

SFB0-SFB7

Bi-directional data lines for reading or writing.

B-SFBSEL0 to B-SFBSEL7

Are used to select one of 8 XTs. A maximum of 8 full size XTs of any mixture of types can be attached to the special function bus. Note that certain types of XTs, such as the Digital Output, use jumpers to allow the use of a pair of half size XTs in place of a full point count XT.

3 Installation

This chapter describes the normal installation and operation procedures for the SAGE 4400 Substation Automation Platform. Prior to installing the 3030, we recommend that you perform a preliminary functional test to verify that the configuration is correct for the intended site and also to check for any undetected shipping damage. Preliminary testing should be performed after the 4400 has been setup using the information in the previous chapters.

3.1 General Installation Procedure

3.1.1 Rack Installation

As shown in Figure 3-1, the SAGE 4400 is made to be mounted in a standard 19” rack assembly. The case is 7” tall and 10.25” deep. All that is needed is four screws. No special ventilation is needed.

The procedures for connecting field wiring to the RTU are provided in the following sections.

Caution: The printed circuit assembly contains CMOS devices and is sensitive to static discharge. Boards should be handled only at a grounded workstation. Avoid touching the electronic components, jumpers, connectors, or the exposed etches on the boards.

Figure 3-1 SAGE 4400 Dimensions

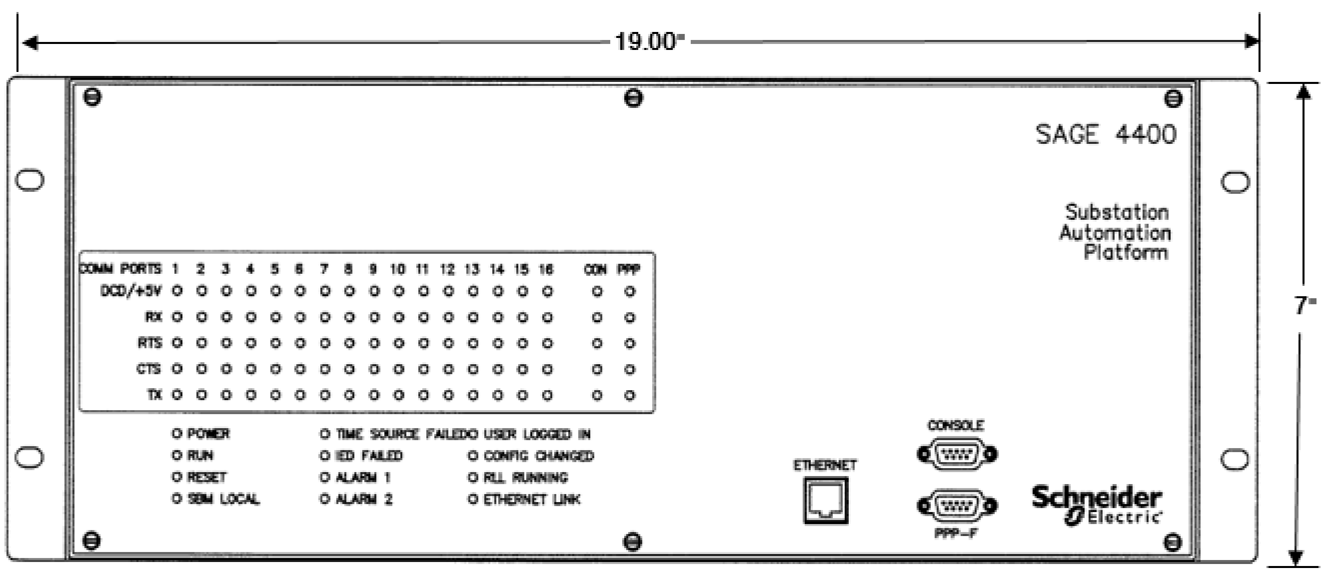
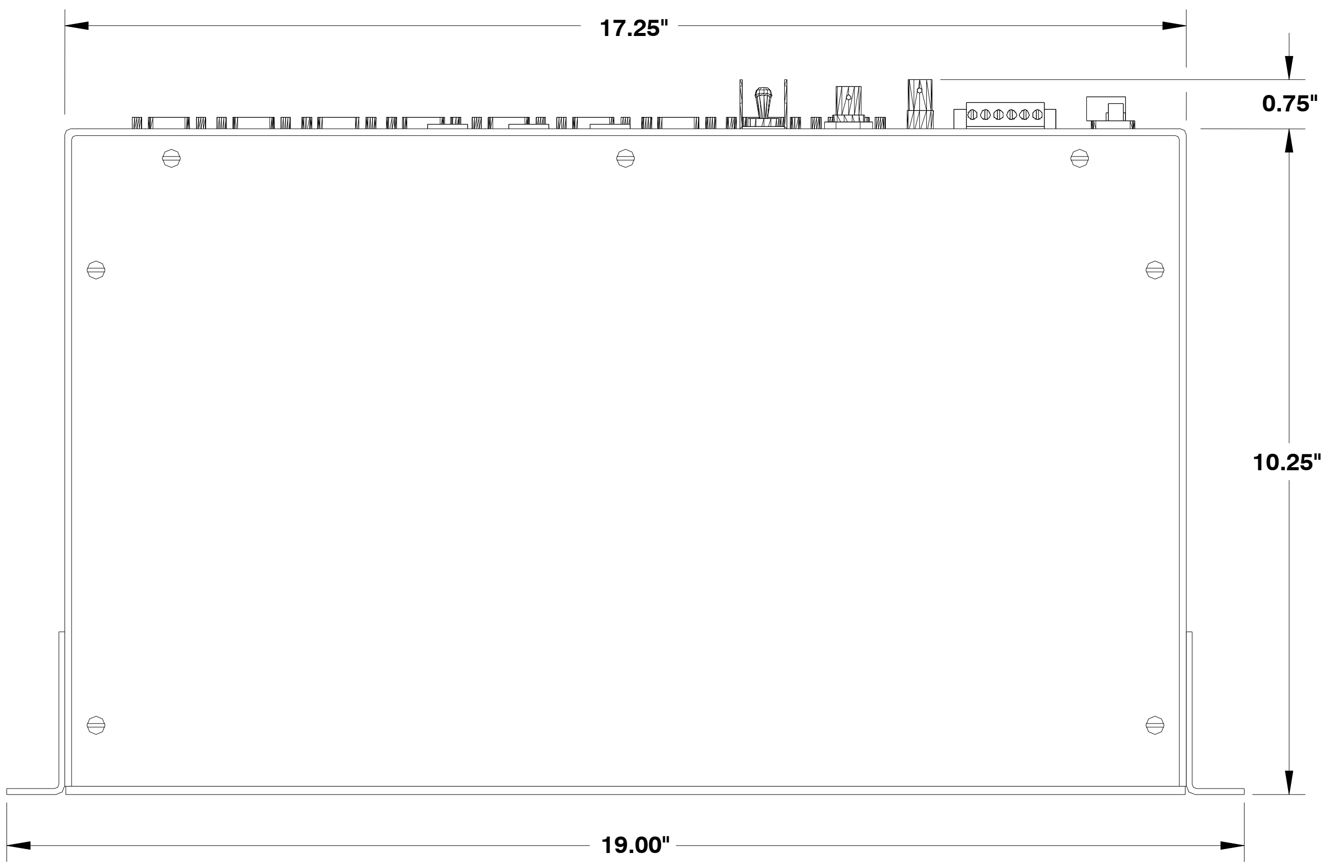


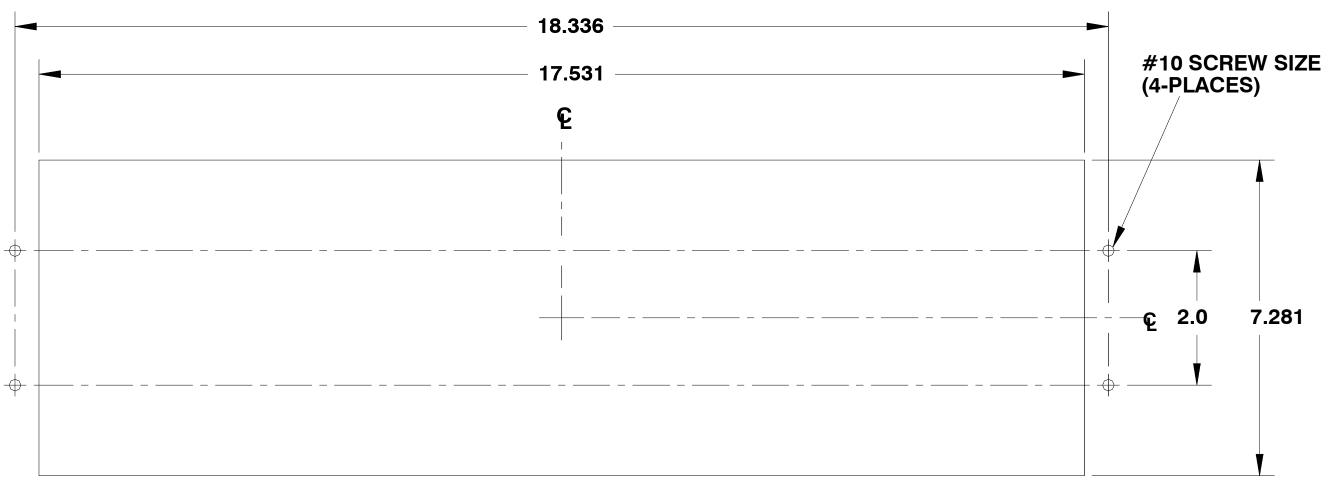
Figure 3-2 SAGE 4400 Dimensions



3.1.2 Panel Installation

The SAGE 4400 may also be installed in a panel, provided there is enough depth behind the panel to accommodate the 4400 plus cable connections. Follow the cutout and hole-tapping template shown in Figure 3-3.

Figure 3-3 SAGE 4400 Panel Mounting Template



3.1.3 User Interface Connections

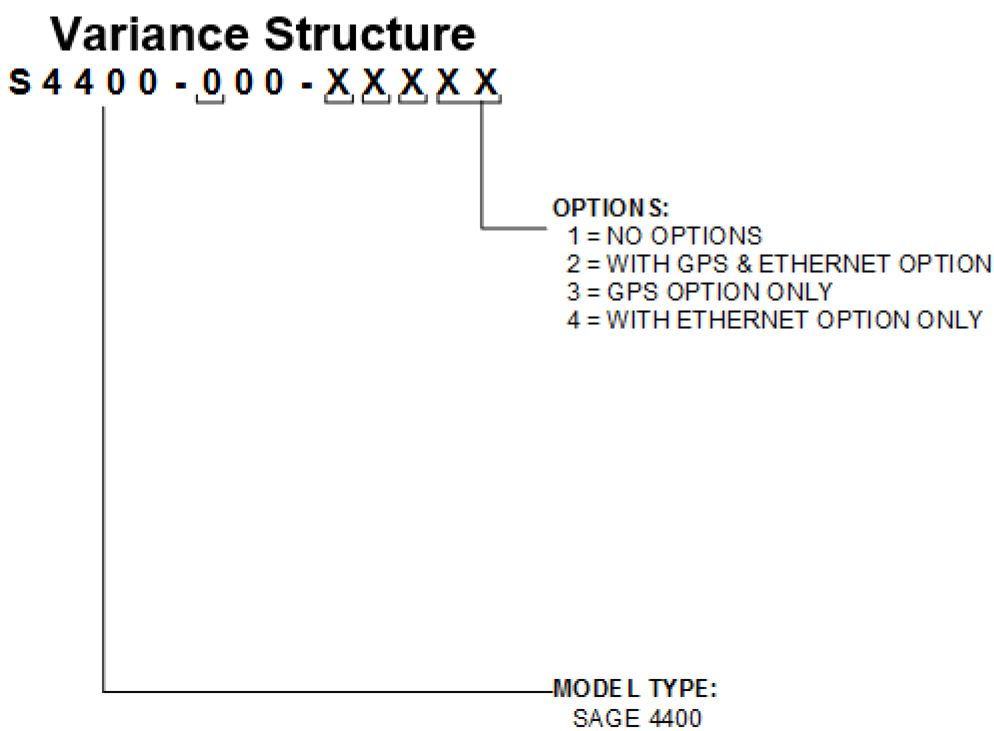
There are four physical ways to connect to the SAGE 4400:

- Ethernet connection to a network using a Straight-through cable to the CPU card
  - Best way to gain remote access
- Ethernet connection locally using an Ethernet crossover cable to the CPU card
  - Best way to gain local access
- PPP (Point-to-Point Protocol) connection using a null-modem cable to the UIF port
  - Moderately slow; can still access RTU locally or even remotely with a dedicated comm. Channel
- Console – this method commonly used to read and/or change IP address

Both the PPP and the Ethernet connections use the same GUI running on a web browser. The difference is that the PPP connection runs at 38,400 baud; the Ethernet connection runs at 10/100MB. When dealing with a GUI, obviously the faster connection is much better. Therefore, the primary connection to the RTU is Ethernet.

See Internet Explorer Requirements for SAGE RTU's for a list of supported and configuration requirements.

3.2 Variance Structure



3.3 Ethernet Ports

The 4400 is equipped with one standard Ethernet port on the front panel. If your variance has Option 2 or 4 it means that you have Switched Ethernet. Switched Ethernet provides three more Ethernet ports on the rear panel as shown in

Switched Ethernet is a method of increasing the number of available Ethernet ports while at the same time ensuring that traffic flow (throughput) is optimized. The switched Ethernet card is "smart" because it can recognize whether you have a straight-through or cross-over Ethernet cable attached to one of the switched ports, and compensate accordingly. As a matter of good configuration practice, we recommend that you always use a cross over cable when accessing the SAGE 4400 directly, as shown in Figure 3-4. and always use straight through cables when connecting through a network.

In addition to the standard Ethernet port and the Switched Ethernet, the 4400 is equipped with a WAN Ethernet port on the rear panel. This port uses a separate NIC (Network Interface Card) from the standard and the switched ports and thus must be accessed by a separate IP address. This port allows the 4400 to be a component of another network.

Figure 3-4 Recommended Direct Connections with a Switched Ethernet Card

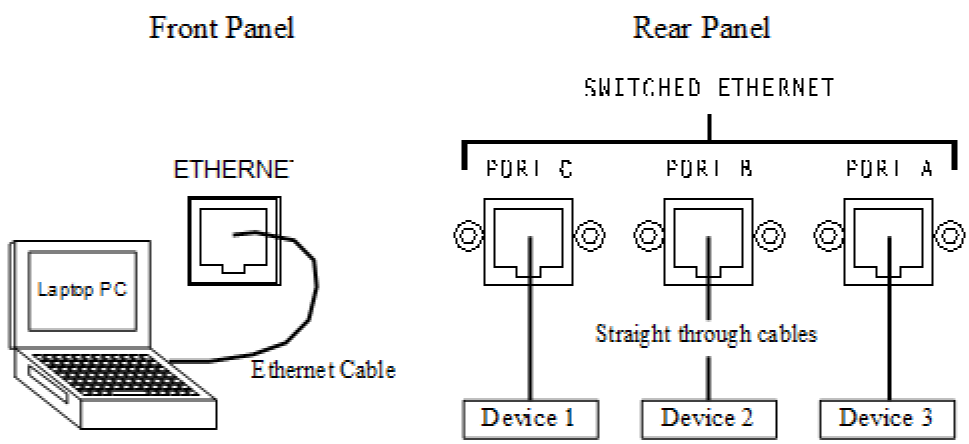


Figure 3-5 SAGE 4400 Front View

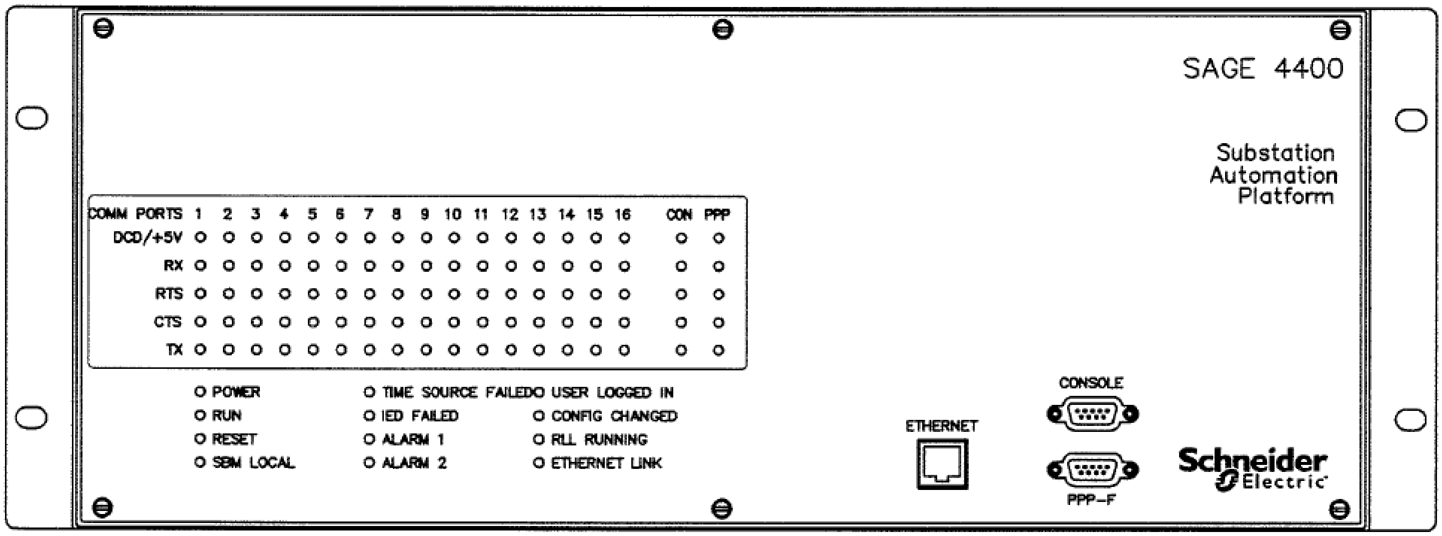
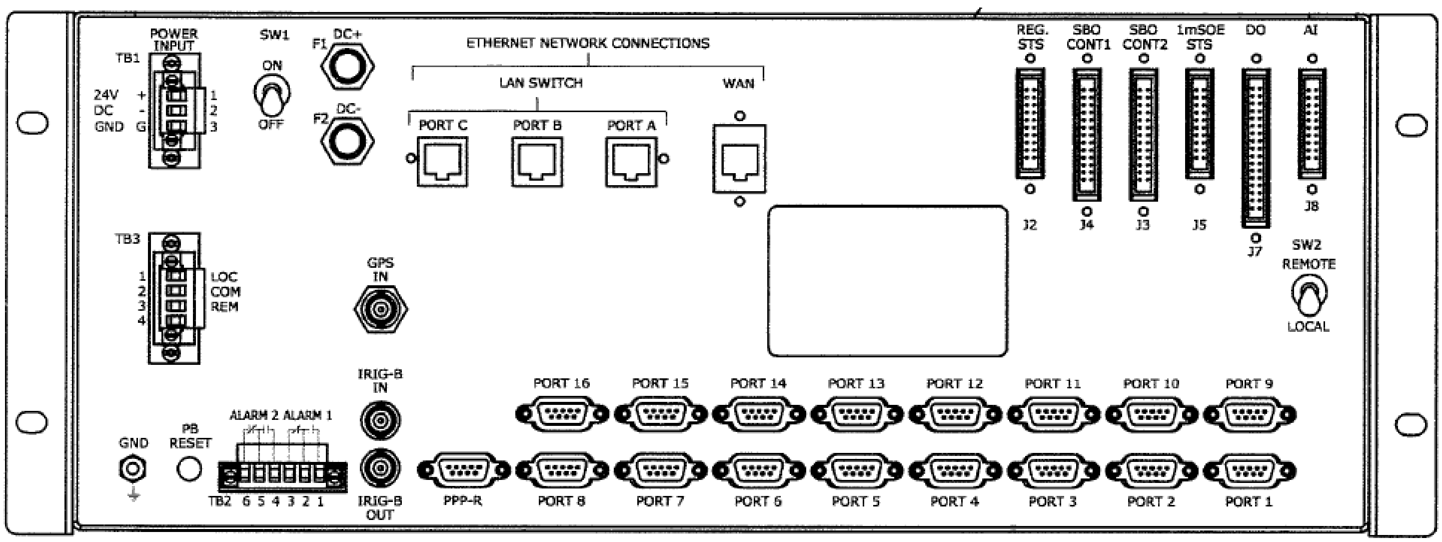


Figure 3-6 SAGE 4400 Rear View



3.4 Serial Ports

3.4.1 Front Panel (Console & PPP)

The SAGE 4400 has two RS232 connectors on the front panel. One is the Console, the other is PPP-F (Point to Point Protocol). The F is a reminder that there are two PPP ports; one on the Front, one on the Rear. The Front and Rear PPP ports are meant as a convenience; they are in parallel. Electrically, there is only one PPP port.

Figure 3-7 Console & PPP DB9 Pin-out

Signal	Pin #	Description	Type	Console	PPP
DCD	1	Data Carrier Detect	Input		X
RX#	2	Receive Data	Input	X	X
TX#	3	Transmit Data	Output	X	X
DTR	4	Data Terminal Ready	Output		X
DGND	5	Ground	N/A	X	X
DSR	6	Data Set Ready	Input		X
RTS	7	Request To Send	Output		X
CTS	8	Clear To Send	Input		X
RI	9	Ring Indicator	N/A		

X = Active

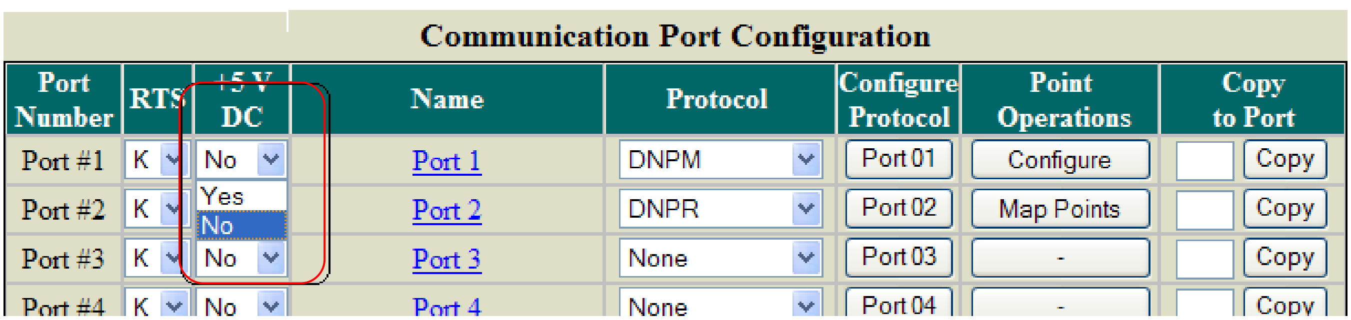
3.4.2 Rear Panel (Serial Ports)

There are 17 RS232 connectors on the Rear Panel. One of the connectors is PPP, which is in parallel with the PPP connector on the front (see above). The other 16 serial ports are used for connections to IEDs and/or MTUs.

Figure 3-8 Serial Port DB9 Pin-out

Signal	Pin #	Description	Type
DCD	1	Data Carrier Detect *	Input
PWR		+5V for aux comm. devices *	Output
RX#	2	Receive Data	Input
TX#	3	Transmit Data	Output
IRIGB	4	Timing signal	Output
DGND	5	Ground	N/A
IRIG_GND	6	IRIG Ground	N/A
RTS	7	Request To Send	Output
CTS	8	Clear To Send	Input
RI	9	Ring Indicator	N/A

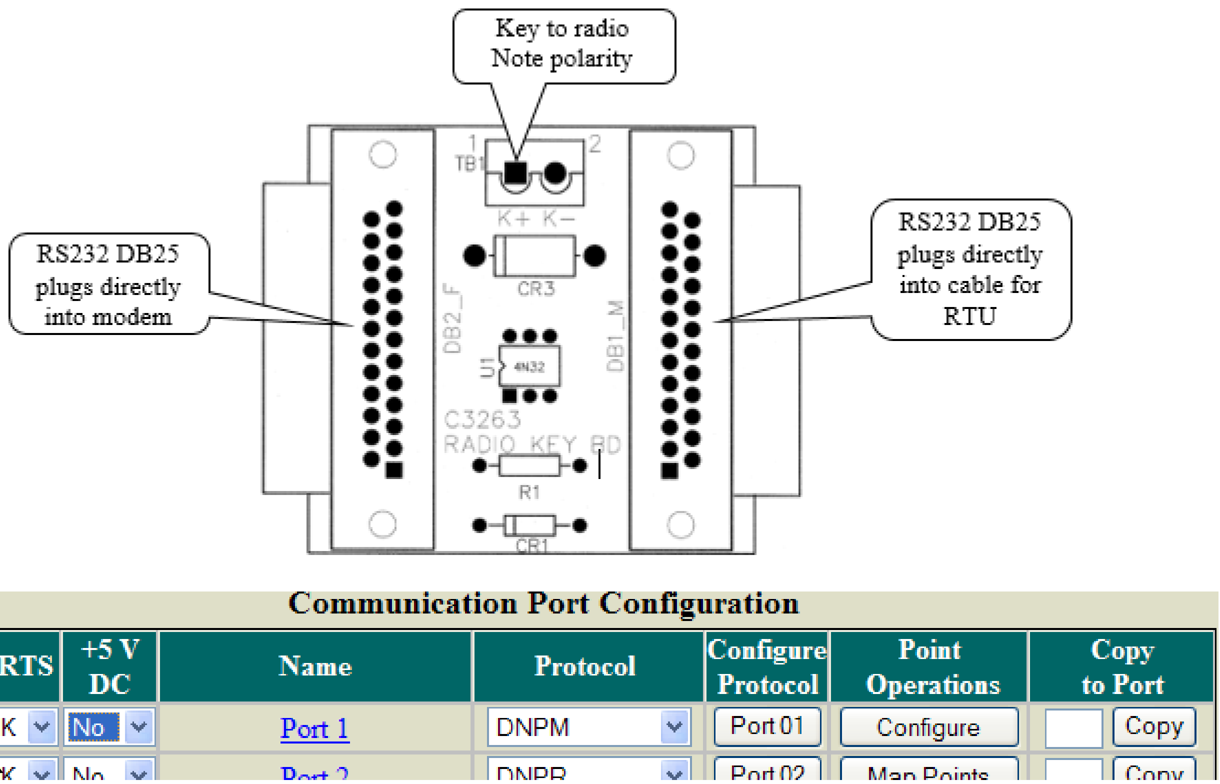
* Selectable for either DCD or PWR – “No” for DCD, “Yes” for PWR. The default is “No”. See Communication Port Configuration below.



3.4.3 Radio Keying Option

Some communications devices require an open collector output to key the device for data transmission. The config@WEB RTUs do not have this output on their baseboards. The optional C3263 Radio Keying Module provides an optically isolated open collector output to perform this function. Configure the RTS (Request to Send) to K (for Keyed) in the Communications Port Configuration to control this output. The module is installed as shown in the figure below.

Figure 3-9 C3263 Radio Keying Board Installation

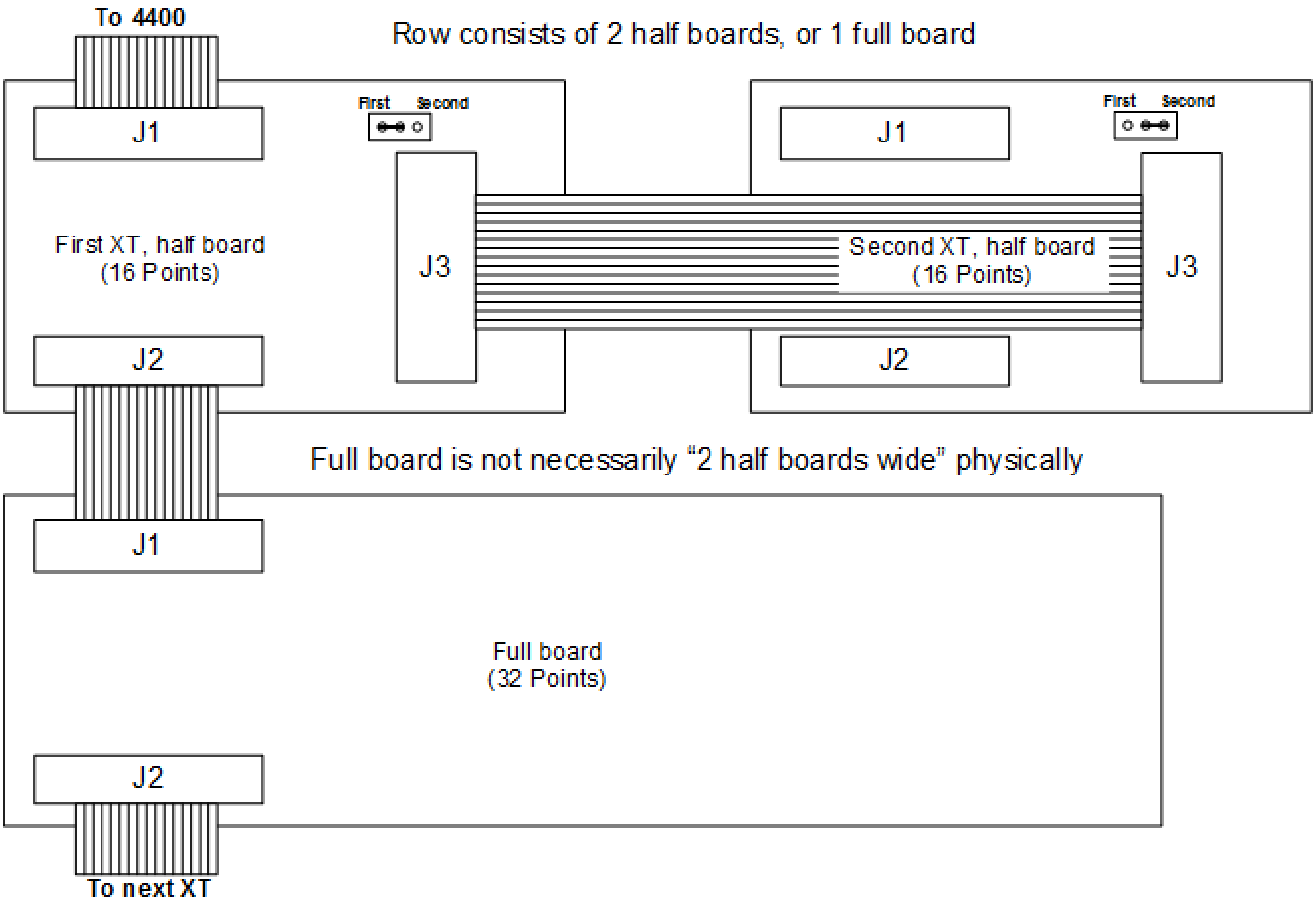


Note: RTS (Request to Send) in the Communications Port Configuration must be in the K (Keyed) position for the C3263 Radio Keying Board to work. The RTS time may be controlled with the CTS Delay (no RTU reset required after change) in the Communication Channel Configuration.

3.5 Expansion Board Connections

Whether it's Digital Input Expansion, or SBO Control Expansion, the layout and ribbon cable connections follow the principles shown in Figure 3-10.

Figure 3-10 Expansion Board Connections



3.5.1 Digital Input Expansion (Reg Status J2) (1ms SOE J5)

Note: Requires optional external termination (XT) module.

The SAGE 4400 uses the same digital input termination hardware for both status and accumulator inputs. The SAGE 4400 XT connection is on the rear panel.

The DI XTs are connected together with standard ribbon cables in a daisy chain. The first XT is connected from the DI Expansion connector on the 4400 rear panel to J1 on the XT. Subsequent XTs are daisy chained together (J2 to J1) until a total of 224 input points has been reached.

In the case of a 16 input XT (half board), J3 of the first board is tied to J3 of the second 16 point XT. The first C3232 requires address jumper W1 to be in the First position and the next C3232 to have W1 in the Second position. The excitation voltage is provided by the field input power and is pre-wired to the DI XTs and is common bussed to all of the input circuits.

Digital inputs are added using one of the three types of digital input XTs. The C3232 IS2 DI XTs (Figure 3-14) provide 16 inputs each and the C3132 and C3432 (Figure 3-14) and (Figure 3-13) have 32 inputs each. All digital inputs include individual LEDs that are illuminated when the corresponding contact is closed.

Figure 3-11 C3432 32-Point DI XT

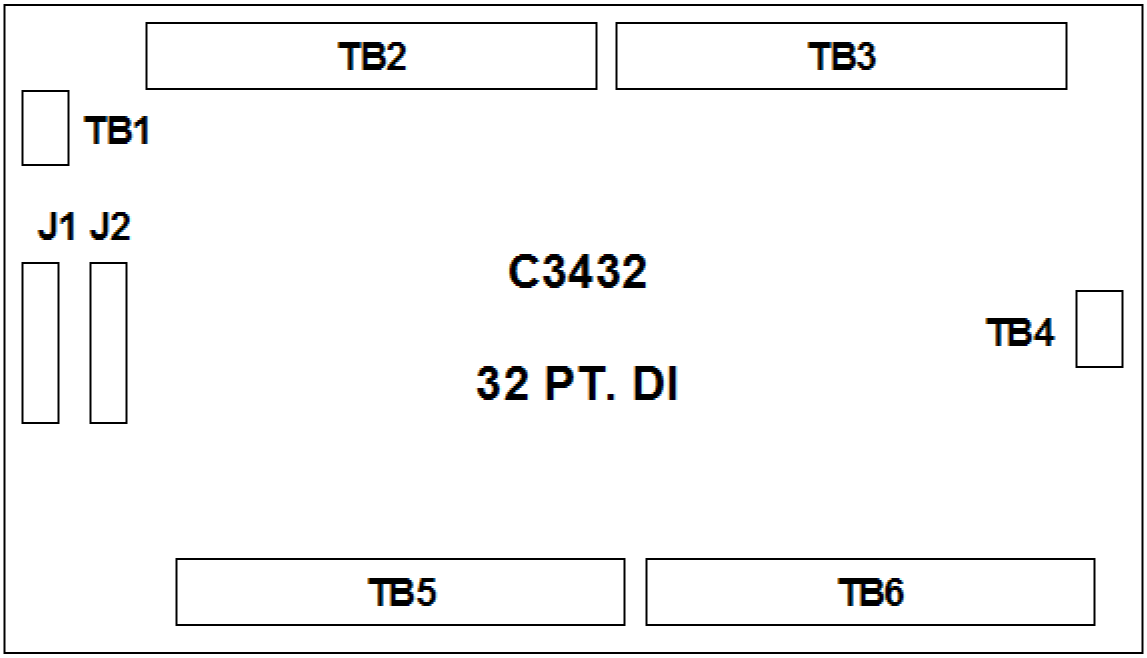
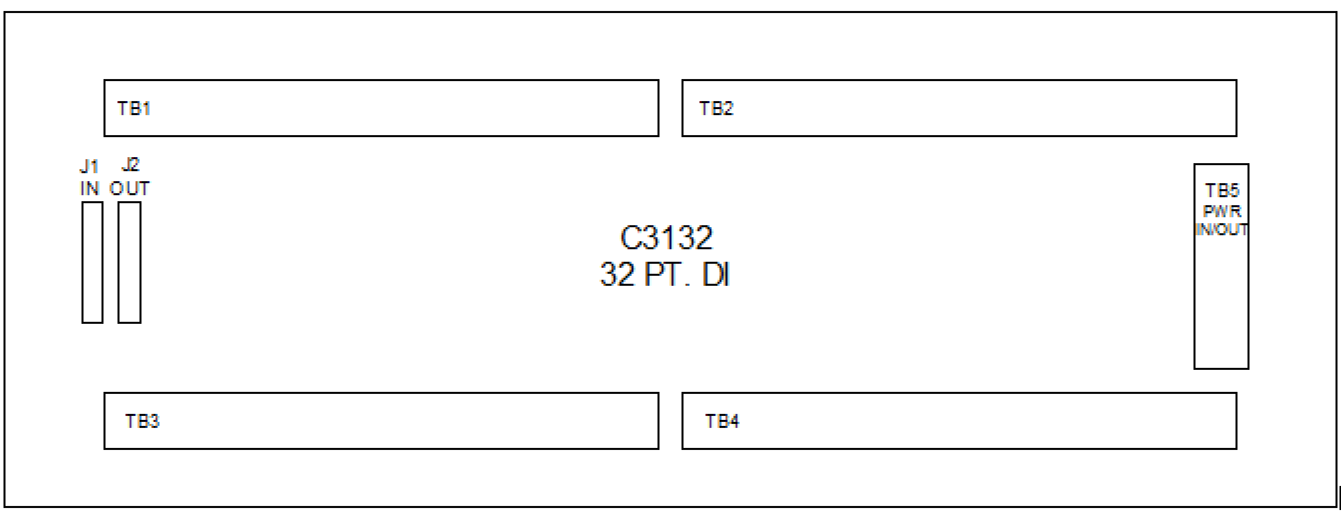
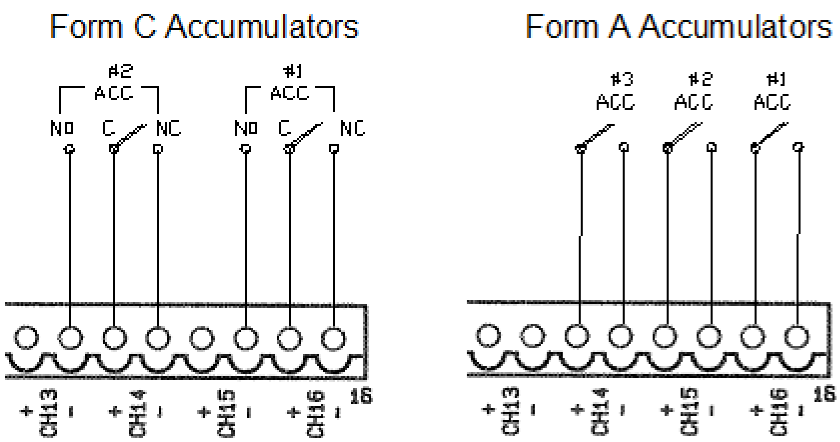


Figure 3-12 C3132 32-Point DI XT



The DI XT provides two terminals for each digital input. The "+" sign indicates the terminal which connects to the wetting voltage. These “+” terminals are all wired together on the XT. The other terminals connect to the opto-coupler. Form A accumulators require one digital input (two wires) each and are hooked up the same as status inputs. Form C accumulators require two digital inputs (typically three wires) each and should be wired according to the example in the left side of Figure 3-13. Note that either positive terminal in the input pair can serve as the common terminal.

Figure 3-13 Accumulator Input Field Wiring



The C3232-IS2-0000X DI XT allows individual input circuit selection for a positive or negative bussed excitation source as well as non-bussed individual circuit excitation. Refer to Figure 3-14 for input circuit jumper locations. The XT is shipped with all the input jumpers in the "I" isolated input position. This selection requires the monitored circuits to supply the excitation voltage to the input point. The plus or minus XT bus is selected by placing one of the jumpers in the "B" position to select either the positive or negative voltage. Both input jumpers in the "B" position are considered an illegal condition since the input will always be active. Figure 3-15 shows the equivalent circuits for each possible selection.

Figure 3-14 C3232-IS2 DI XT

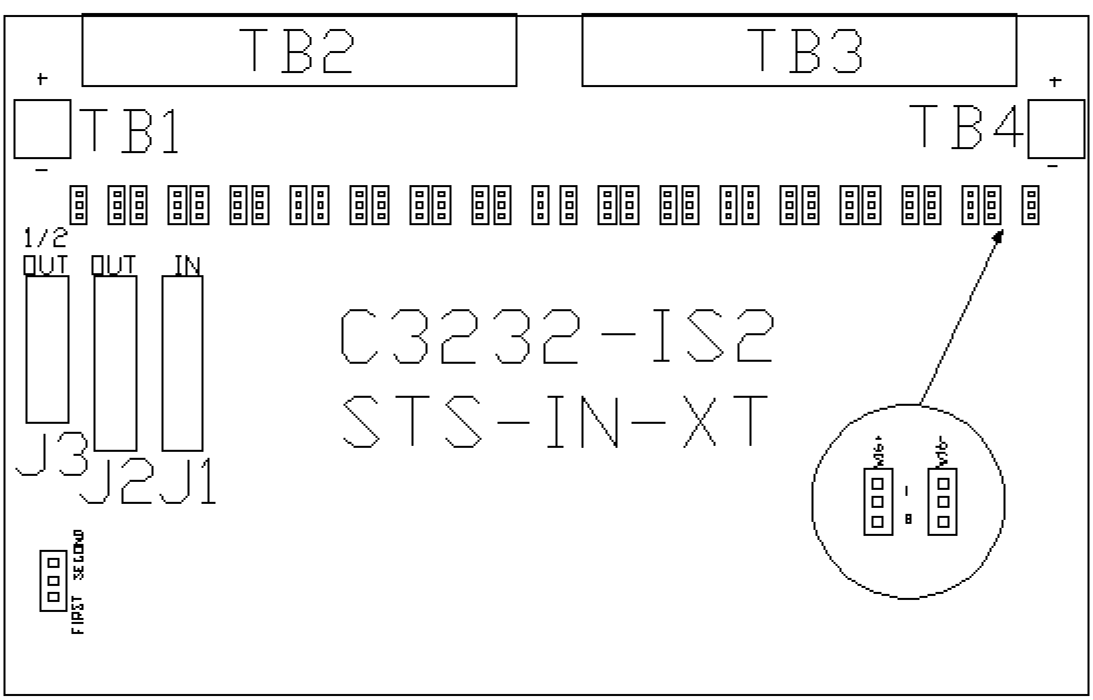
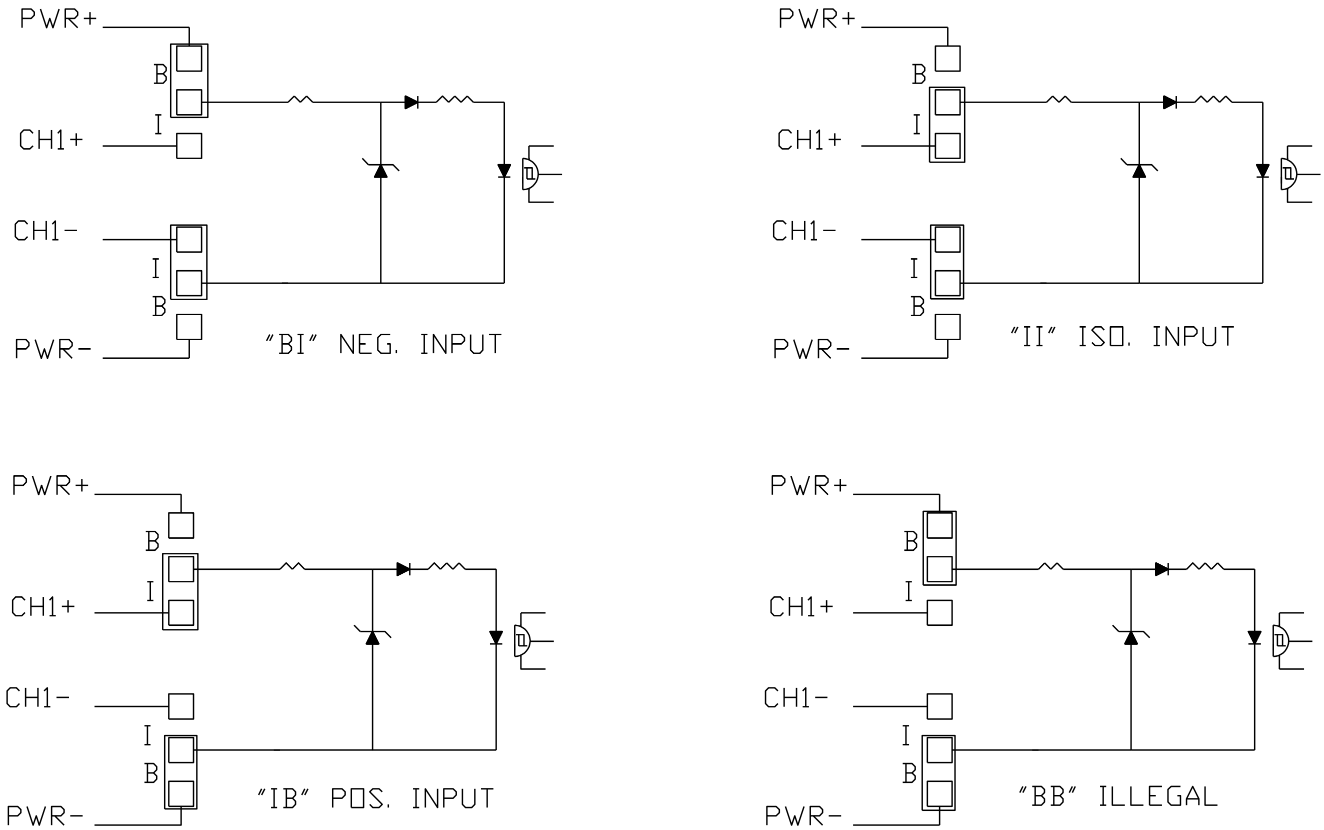


Figure 3-15 C3232-IS2 Jumper Positioning



3.5.2 Analog Input XT

Refer to the following schematic drawings located in the SAGE 2000 RTU Operation & Maintenance Manual (C3400-AAA-00002):

- C3140-002-Rev-X, Schematic LD Analog Input XT 16PT
- C3230-002-Rev-X, Schematic M/1C 16PT Analog-In XT
- C3430-002-Rev-X, Schematic S2K 16PT Analog In XT
- C3241-002-Rev-X, Schematic M/1C Analog Input Module

The Analog Input XTs are available as an 8 X 5 or an 19" rack mount board that contain terminations for 16 analog channel inputs. Fourteen 16 input XTs can be connected to provide 256 inputs including the 8 Baseboard inputs. Each 16 input XT is provided with an address jumper to select either the first or second 16 point board for each pair of boards.

All analog inputs are high impedance while their outputs are differential to match the circuits on the Baseboard. The multiplexer, buffer amplifiers and input protection circuits on the XTs are identical to those on the Baseboard.

The board select and channel select input signals enter the XT on J1. These board address lines are rotated on each XT. This allows the next board in the daisy chain to accept the correct address without requiring address select jumpers. These signals exit the board on J2. J3 is a half board output connector and allows a second C3230 board to be connected as a pair. Jumper W1 provides address selection for the "FIRST" or "SECOND" position.

The multiplexer switches both the positive and negative inputs to each channel to allow for differential inputs. Channel selection is decoded by U3 and U4. The 5VDC used for these digital circuits is generated by a regulator (VR1) from the +15V. This isolates the board from other digital supplies for additional noise immunity.

Each rail of the multiplexer outputs is buffered and then isolated from the analog bus by a switch. These switches are controlled by the SW signal that is active when the board is selected for the proper half determined by jumper J1.

3.5.3 SBO Control Expansion (SBO Cont #1, J4) (SBO Cont #2, J3)

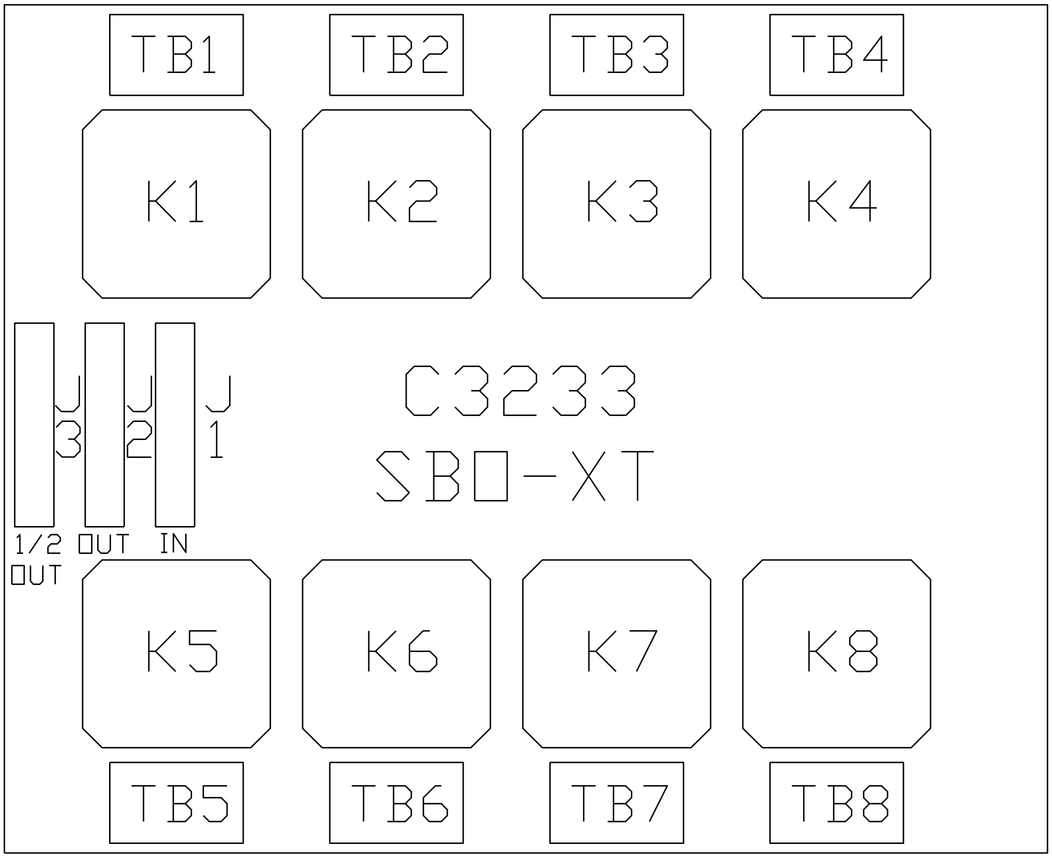
The rear panel of the SAGE 4400 includes two SBO Control Expansion connectors. Each connector, using ribbon cables in a daisy-chain connection, up to 64 SBOs (128 coils) may be added to the 4400 for a total of 128 SBO pairs.

The first SBO XT connector J4 is attached to the SBO Control Expansion connector on the rear panel of the 4400. The first 64 Trip Close pairs will be daisy chained from this connector. The second bank of 64 Trip Close connectors is daisy chained from SBO Connector J3 on the 4400.

3.5.3.1 C3233 SBO XT

The C3233 panel mount SBO XT (Figure 3-16) holds eight KUP-type momentary or 4 KUL-type latching-relays. When equipped with momentary-relays, it provides four momentary SBO control outputs and when equipped with latching-relays, it provides four latching outputs. It can also be equipped with KUEP-type relays for high-current DC applications. Its normal contact arrangement is a dual form A for KUP with KUL-type relays and single form X with KUEP-type relays. The SBO XTs are connected together with standard ribbon cables in a daisy-chain. J3 of a C3233 XT is attached to J1 of the next half size XT, while J2 is tied to J1 of the next XT in the daisy chain.

Figure 3-16 C3233 SBO XT

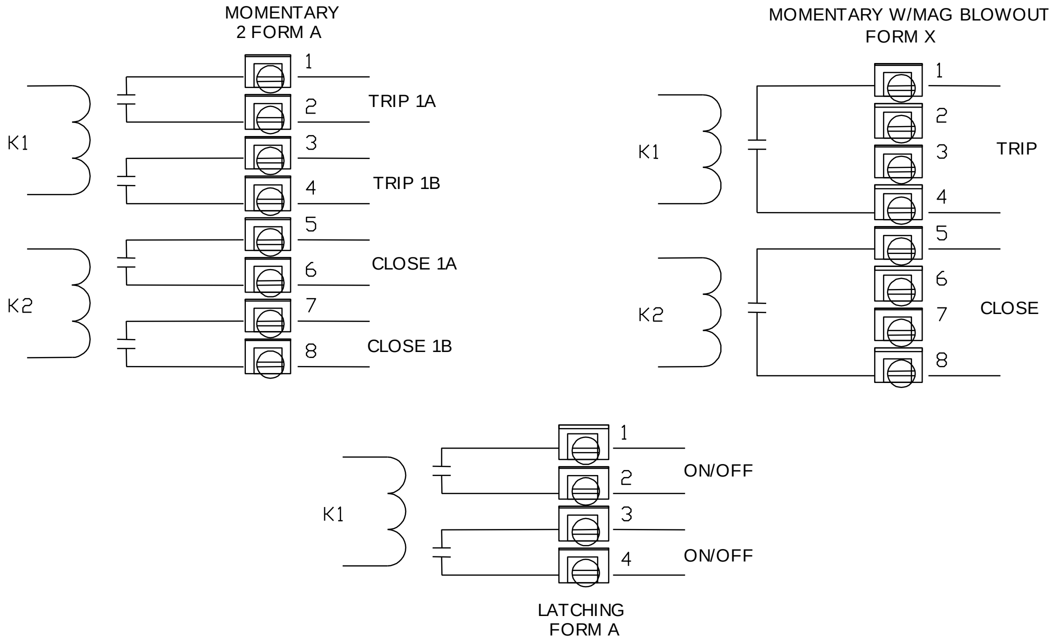


In a typical installation, the uppermost XT contains the first four or eight outputs, the next lower XT contains the next group of outputs, and so on. The typical SBO XTs are equipped with relays rated for 10A at 240VAC or 24VDC. For applications that require that higher DC voltages be switched, KUEP-type relays with magnetic blowout must be used. These relays have a contact rating of 10A at 150VDC and their standard contact arrangement is form X.

⚠WARNING
WARNING: KUP and KUL type relays should not be used to switch 125VDC devices, even if the current is significantly less than 10A. The contact rating of these relays is greatly reduced at high DC voltages and the relay is subject to failure if the maximum current is exceeded. Consult the factory if you are unsure of the suitability of the relays installed on your SBO XTs.

Figure 3-17 illustrates the hookup procedure for the first output for the various versions of the SBO XT. The momentary and latched output functions shown (trip/close and on/off) are arbitrary; the master station that commands the RTU determines the actual functions. The firmware simply treats the SBO XT as a group of 8 or 16 relay coils without regard to their assigned functions.

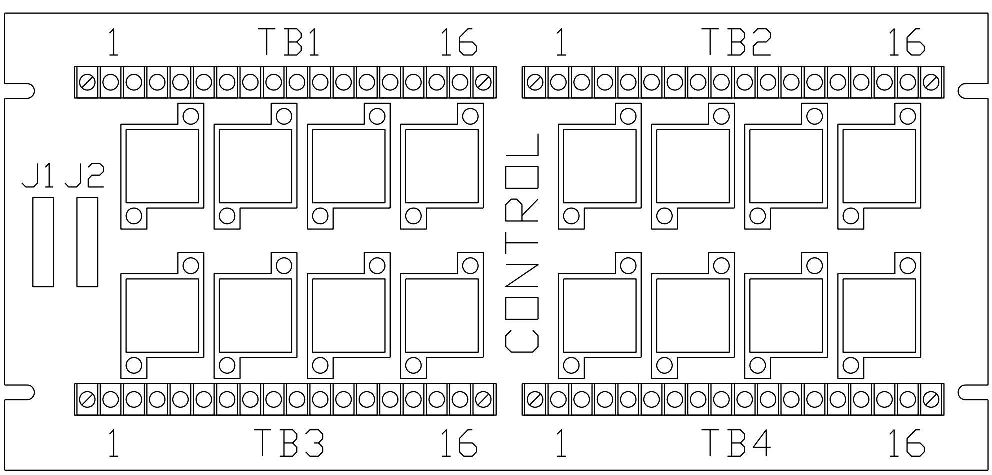
Figure 3-17 SBO XT Field Wiring



3.5.3.2 C3133 SBO XT

The C3133 19-in. rack mount SBO XT (Figure 3-18) provides eight momentary-control outputs, in the form of 16 KUP or KUEP type momentary-relays. All relays are installed in sockets with mechanical restraints and have associated LEDs to indicate when a specific relay coil is energized. This XT is cabled onto the SBO bus by connecting the ribbon cable from the 4400 rear panel connector or OUT connector of a previous XT to the J1 (IN) connector of the C3133. The J2 (OUT) connector is used to connect to the next XT on the SBO bus.

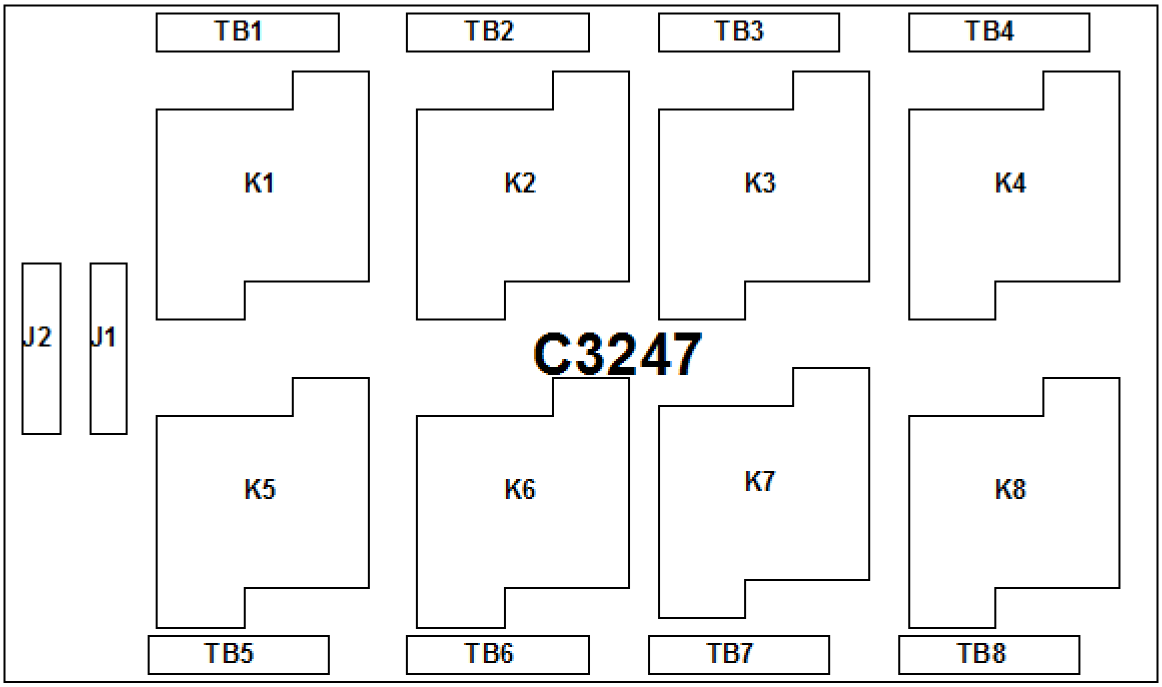
Figure 3-18 C3133 SBO XT 8 Trip/Close Points



3.5.3.3 C3247 SBO XT

The C3247 eight-point latching relay board (Figure 3-19) provides two Form C contacts per point. This XT always contains 24VDC KUL type relays installed in sockets with mechanical restraints. This panel mount board, which is 8 x 6.5-inches, may be installed in any position, just like the C3233 SBO XT. If this XT is connected as a second half to the C3233 SBO XT, only the first four points are used. This XT is cabled onto the SBO bus by connecting the ribbon cable from the 4400 rear panel connector or OUT connector of a previous XT to the J1 (IN) connector of the C3247. The J2 (OUT) connector is used to connect to the next XT on the SBO bus. Two LEDs (LATCH/RESET) are provided per point, with one of the LEDs illuminating during the relay energize time to indicate the new state of the relay.

Figure 3-19 C3247 Latching SBO Diagram



3.5.4 Digital Output Bus

Refer to the following schematic drawings located in the SAGE 2000 RTU Operation & Maintenance Manual:

- C3231-002-Rev-X, Schematic M/1C Digital Output XT 16Pt
- C3243-002-Rev-X, Schematic M/1C Raise/Lower Control BD

When you use the Baseboard relays as parallel outputs (not SBOs), it is necessary to install a shunt on the jumper posts of W15. This shunt bypasses the source driver for CEXEC0, tying the line directly to +24V. This is necessary because the source drivers are incapable of driving 8 relays simultaneously, which may be required for digital outputs. In this case, only the CSELx signals need to be enabled to energize a relay. The CEXC0 signal is used for the baseboard relays or the eighth XT execute if the baseboard relays are disabled.

The DO XT (C3231) is an 8 X 5 board that has 16 digital output relays. This XT is considered to be a half board since two of them can take up the space of a full size, 32 relay XT. Up to eight DO XT boards may be addressed by the SAGE 4400 for a total of 256 output relays. The DO, SOE, ACI, SFB AO, and PCI XTs share the special function bus so the aggregate sum of these full sized boards is eight. The relay contacts are capable of switching resistive loads to 10A at 28VDC or 240VAC. A single set of form C contacts are provided for each point. J3 of the first C3231 is cabled to J1 of the second XT. The W1 jumper is placed between pins 1 and 2 of the second half board to be used.

The C3243 is a 19" board with 16 latching relays used for raise/lower controls. A Raise commands latches the Raise relay. Each Raise relay is subsequently unlatched when a Lower command for that channel is executed.

3.6 Alarm Outputs (TB2)

The SAGE 4400 has two Form C outputs on the rear panel for alarms. From the config@WEB interface, you may configure these alarms to be activated by any DI. See Chapter 2 Specifications for contact ratings.

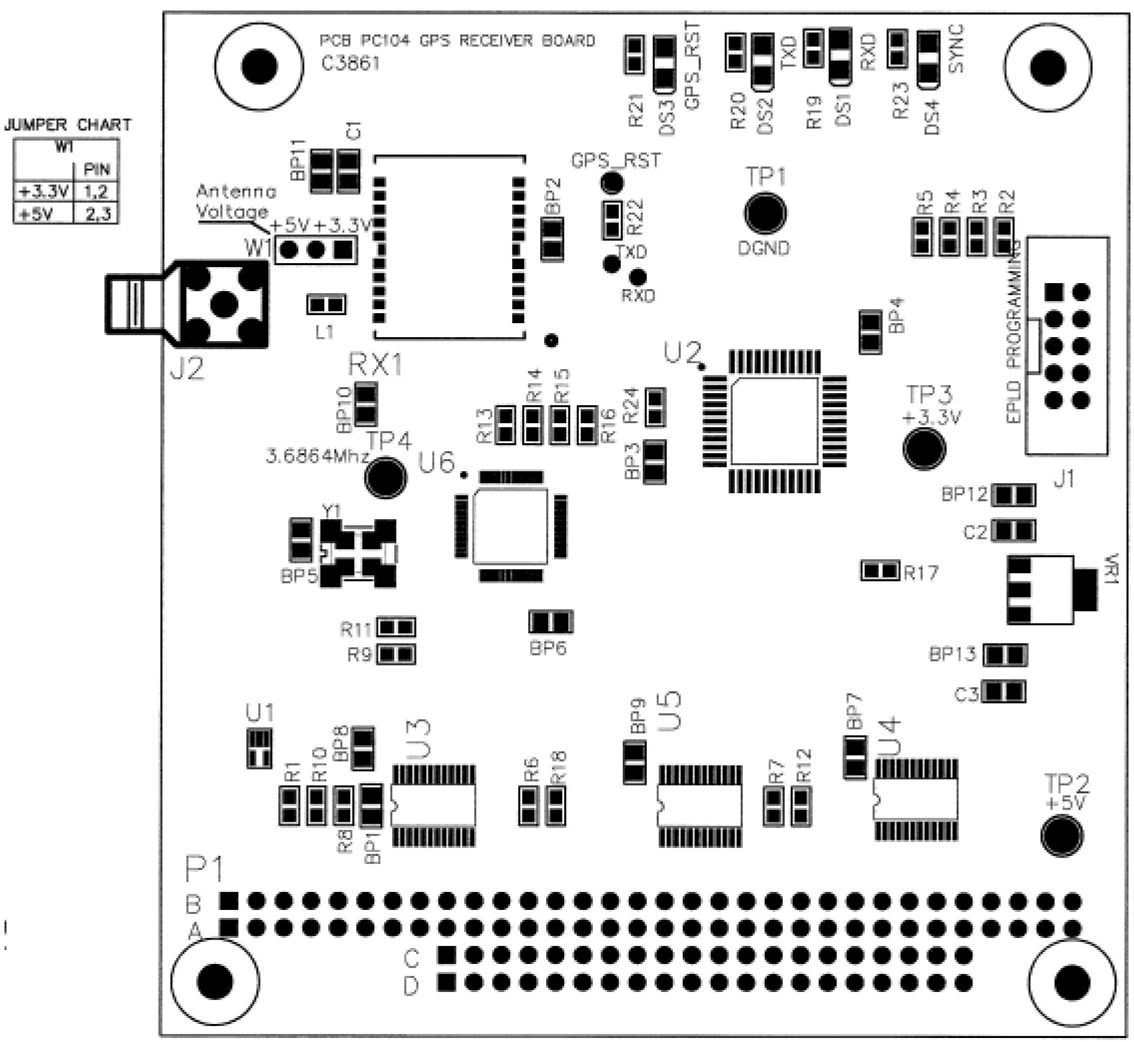
3.7 Remote/Local Switch (SW2 / TB3)

The Remote/Local switch on the rear panel disables all controls for hardware and IEDs when the switch is in the Local position. For normal controls operation, keep the switch in the Remote position. TB3 provides dry contact points for the remote / local switch for external monitoring.

3.8 GPS In

This connector on the rear panel is for a GPS antenna, if the variance supports the GPS option.

Figure 3-20: C3861 PC104 GPS Module



3.9 IRIG-B In & IRIG-B Out

IRIG-B input and output are available from these two ports on the rear panel. Use RG58 coaxial cable for connections between devices for the IRIG-B signal.

3.9.1 IRIG-B signal as an Input to the RTU

If the RTU IRIG-B system is connected to a IRIG-B source, it must provide a B 0 2 X or B 1 2 X Time Code Format signal to the RTU.

Modulation/Frequency (First Digit of IRIG-B Time Code Format)

0 - Pulse Width Code

1 - Sine Wave, Amplitude Modulated

Frequency/Resolution (Second Digit of IRIG-B Time Code Format)

2 - 1kHz/1ms

Coded Expressions (Third Digit of IRIG-B Time Code Format)

0 through 7 is acceptable. The RTU IRIG-B system uses only the BCDtoy (Binary-Coded-Decimal time-of-year) Coded Expressions part of the IRIG-B data stream. The BCDtoy is included in Coded Expressions 0 to 7 of the IRIG-B data stream.

3.9.2 IRIG-B signal output from the RTU

If the RTU IRIG-B system is driven by a time source in the RTU, the Time Code Format is B 0 2 2.

Modulation/Frequency (First Digit of IRIG-B Time Code Format)

0 - Pulse Width Code

Frequency/Resolution (Second Digit of IRIG-B Time Code Format)

2 - 1kHz/1ms.

Coded Expressions (Third Digit of IRIG-B Time Code Format)

2 - BCDtoy

3.9.3 IRIG-B Reference

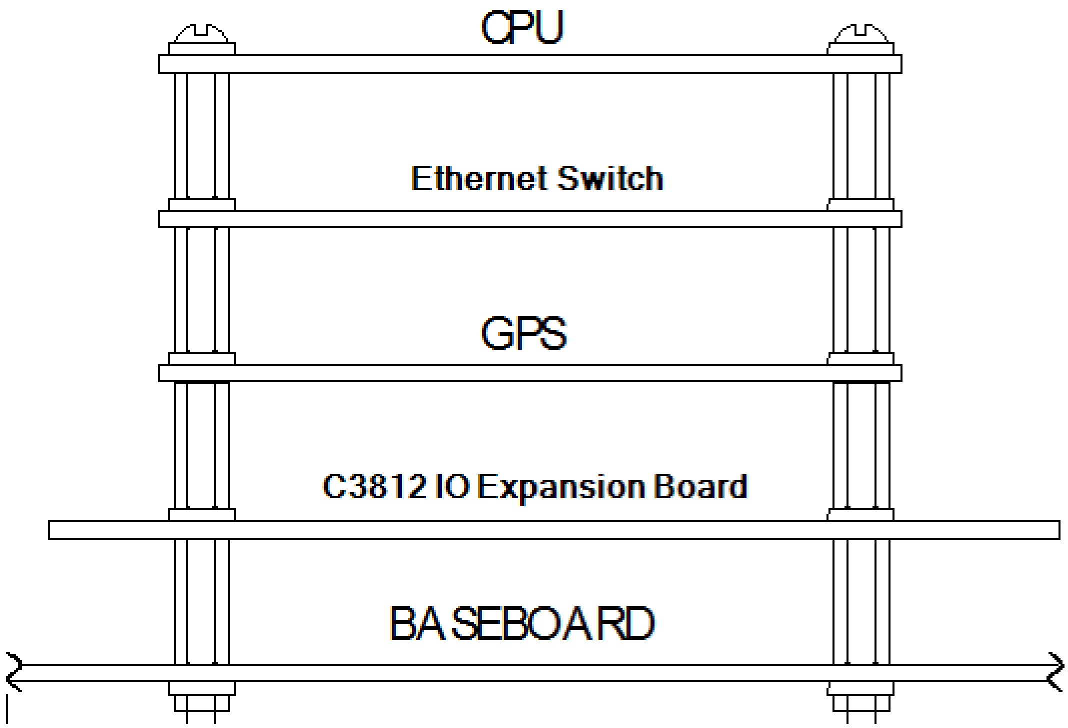
The following is a link to the IRIG Standard 200-04 document for IRIG Serial Time Code Formats.

https://wsmrc2vger.wsmr.army.mil/rcc/manuals/200-04/TT-45.pdf

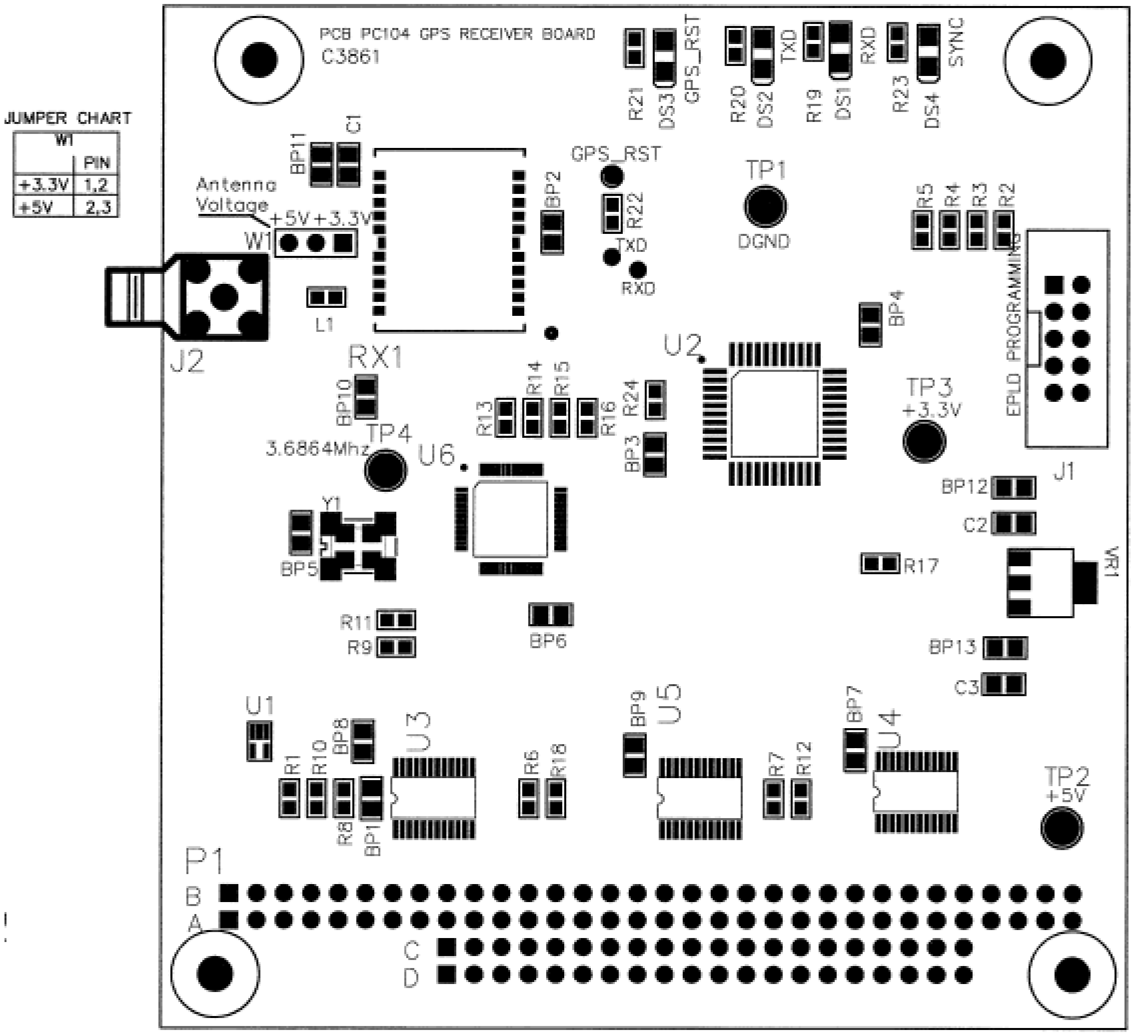
3.10 PC/104 Expansion Installation

If the SAGE 4400 was purchased without options, and you later want to upgrade for extra Ethernet ports, GPS, notice that the PC/104 boards must be stacked with the CPU always on top.

Figure 3-21 PC/104 Board Stacking



3.10.1 C3861 GPS PC/104 Jumper Configuration for W1

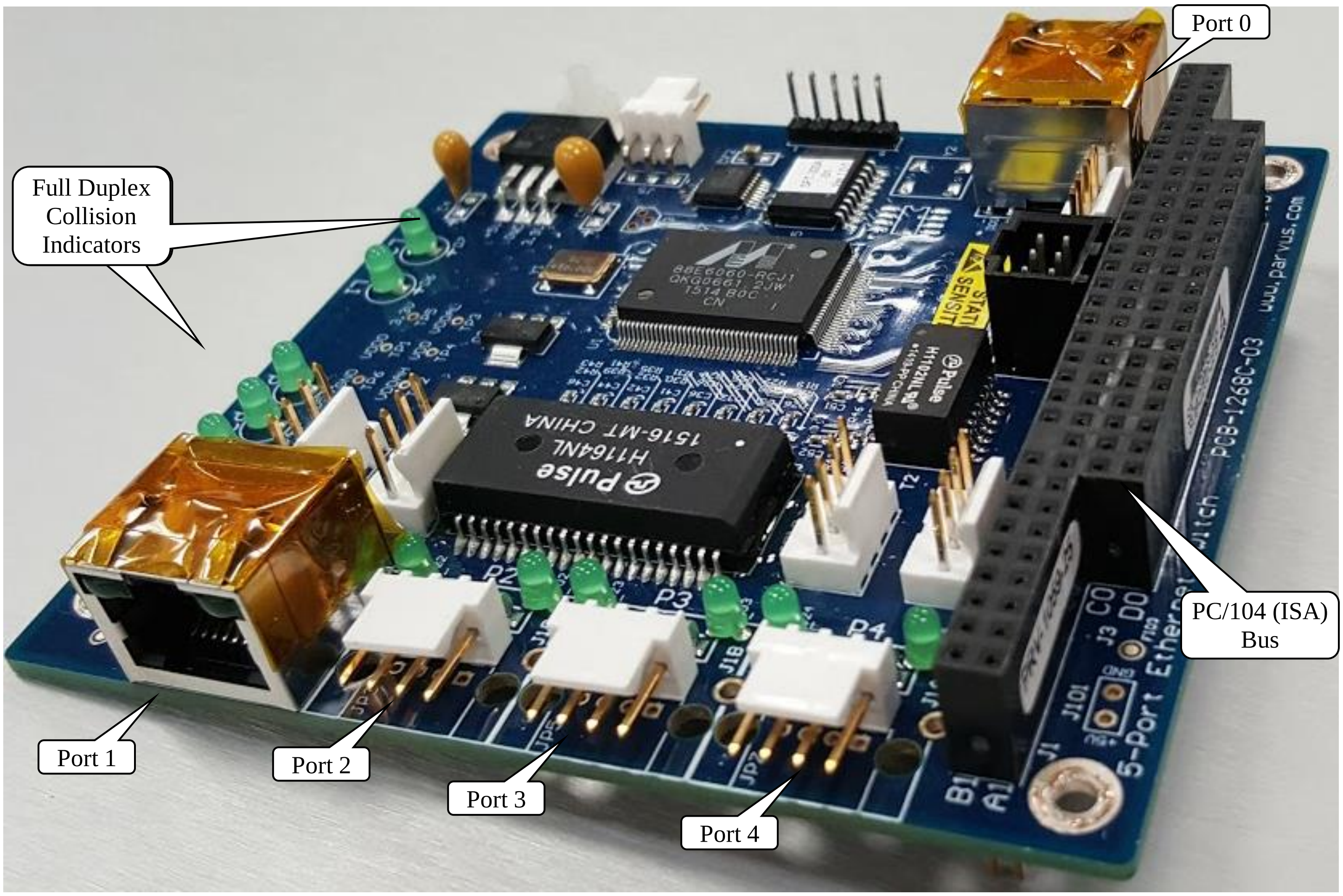


Note: The GPS antenna RG-58 coaxial cable must be no longer than 75 feet. Use a higher grade cable if you need a cable such as **LMR400** for runs longer than 75 feet.

3.10.2 C3463 PCA Ethernet 10/100 5-Port Switching Hub (Optional)

The optional C3463 5-Port Ethernet switching hub expands the number of Ethernet ports to five. There is no special software needed, but because of clearance restrictions, the card must be installed on top.

Figure 3-22 C3463 5-Port Ethernet Switching Hub



4 Maintenance

This chapter describes maintenance procedures for the SAGE 4400. Those users who desire a more thorough technical understanding of the SAGE 4400 should refer to the Theory of Operation chapter which contains detailed descriptions of each module, and to the Drawings chapter, which contains complete schematics, bills of materials, and printed circuit board assembly drawings.

The following equipment is recommended for performing routine maintenance and repair on SAGE 4400 RTUs:

- General-purpose 3-1/2 digit DMM
- General-purpose oscilloscope

The SAGE 4400 requires no routine adjustments.

4.1 Comm Port Diagnostics

The RTU includes a built-in test routine that allows limited testing of the communication ports. Click the Command tab, then click Serial Comm. You will see a screen similar to Figure 4-1.

Figure 4-1 Command Communications Port Data

Command Communication Port Data

Port Number	RTS	+5V	Name	Protocol	Command Port Data	Test Mode
Port #1	K	No	Series V to Master	Series V	Port Data	Normal
Port #2	K	No	Port 2	DNPM	Port Data	Normal
Port #3	K	No	Port 3	None	Port Data	Normal
Port #4	K	No	Port 4	None	Port Data	Normal
Port #5	K	No	Port 5	None	Port Data	Normal
Port #6	K	No	Port 6	None	Port Data	Normal
Port #7	K	No	Port 7	None	Port Data	Normal
Port #8	K	No	Port 8	None	Port Data	Normal
Port #9	K	No	Port 9	None	Port Data	Normal
Port #10	K	No	Port 10	None	Port Data	Normal
Port #11	K	No	Port 11	None	Port Data	Normal
Port #12	K	No	Port 12	None	Port Data	Normal
Port #13	K	No	Port 13	None	Port Data	Normal
Port #14	K	No	Port 14	None	Port Data	Normal
Port #15	K	No	Port 15	None	Port Data	Normal
Port #16	K	No	Port 16	None	Port Data	Normal

Back

Under the Test Mode heading, select the type of test you wish from the pull-down menu for the port of interest. The choices and the meaning of each type of test are listed below. See Table 4-1 for the expected results for each test.

Normal

In the normal mode, the selected comm channel functions normally. Each channel will be in this mode when the display is called up. Each channel is automatically restored to this mode when you exit from the display or the RTU is reset.

Mark

In the mark mode, the selected comm channel outputs a continuous stream of ones. Marks for the RS-232 channel are low (negative) voltage pulses, and low frequency (1,200Hz) for any attached 202 modem.

Space

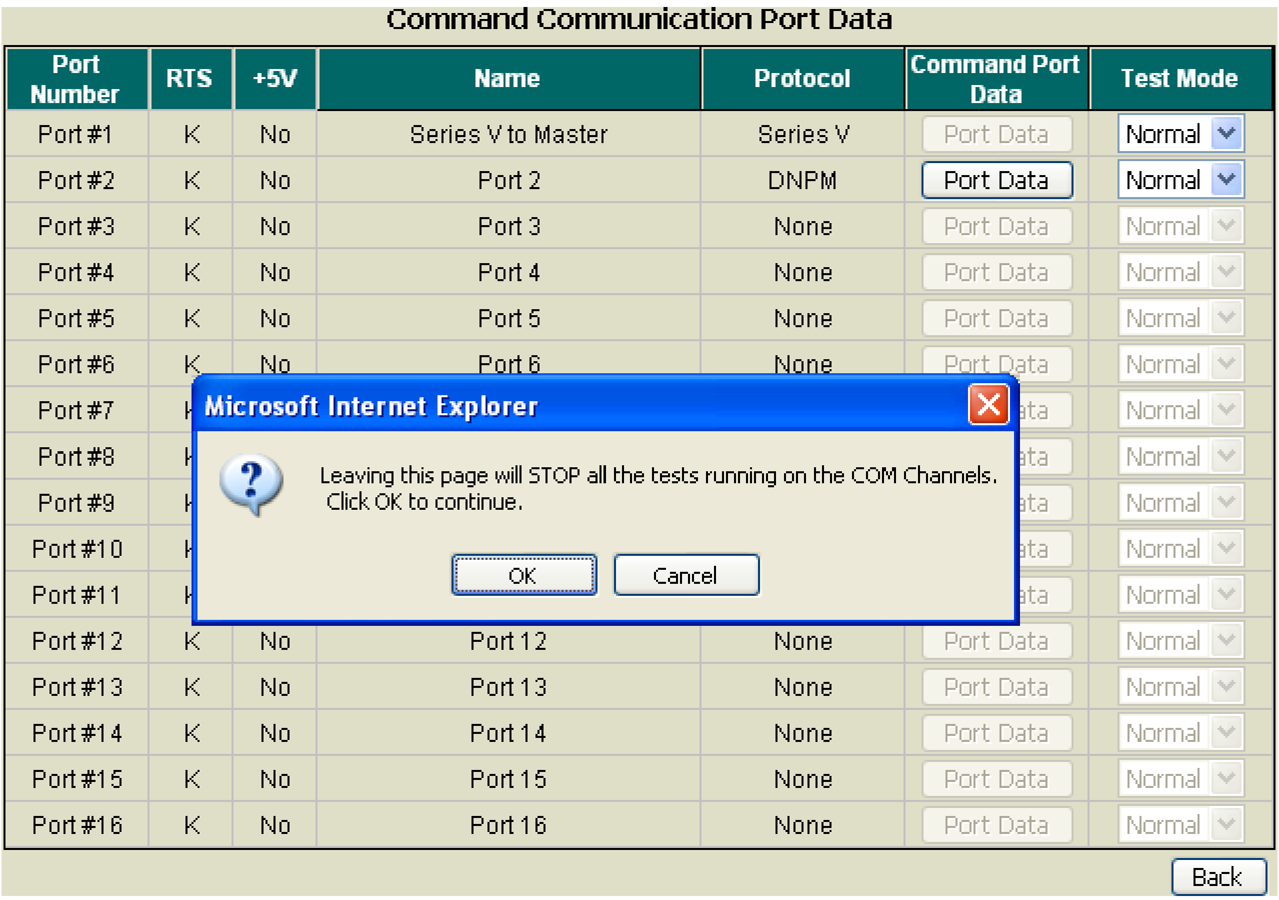
In the space mode, the selected comm channel outputs a continuous stream of zeros. Spaces for the RS-232 channel are high (positive) voltage pulses, and high frequency (2,200Hz) for any attached 202 modem.

Alt

In the Alt mode, the selected comm channel outputs a continuous stream of alternating ones and zeros at the baud rate originally selected for the channel.

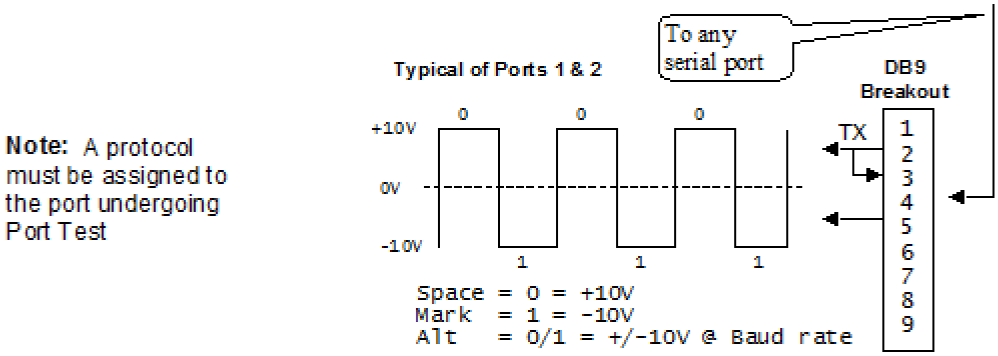
You may use a scope to see the outputs on the ports under test as shown in Table 4-1. Notice that the test mode will terminate and return to Normal mode if you leave this screen with the pull-down menus in anything other than Normal, as shown in Figure 4-2.

Figure 4-2 Clicking the Back Button While in Test



Use a jumper between pins 2 & 3 as shown in Figure 4-3 to get the values shown in the Figure.

Figure 4-3 Comm Port Testing



While doing the Port Test, the LEDs on the front panel will light according to the following table.

Table 4-1 Port Test LEDs

Test Mode Function	Front Panel LEDs
Normal	All LEDs OFF
Mark	RTS ON
Space	TX, RX, & RTS ON
Alt	Same as Space, but TX & RX dimmer

4.2 Troubleshooting

This section includes a brief guide to troubleshooting some of the more common problems that could occur in the SAGE 4400. If you are troubleshooting to the component level, the use of the Theory of Operation chapter and the Drawings chapter will be helpful.

4.2.1 LED Display

The LEDs on the front panel are a prime troubleshooting aid. Below is a typical example of the LED activity.

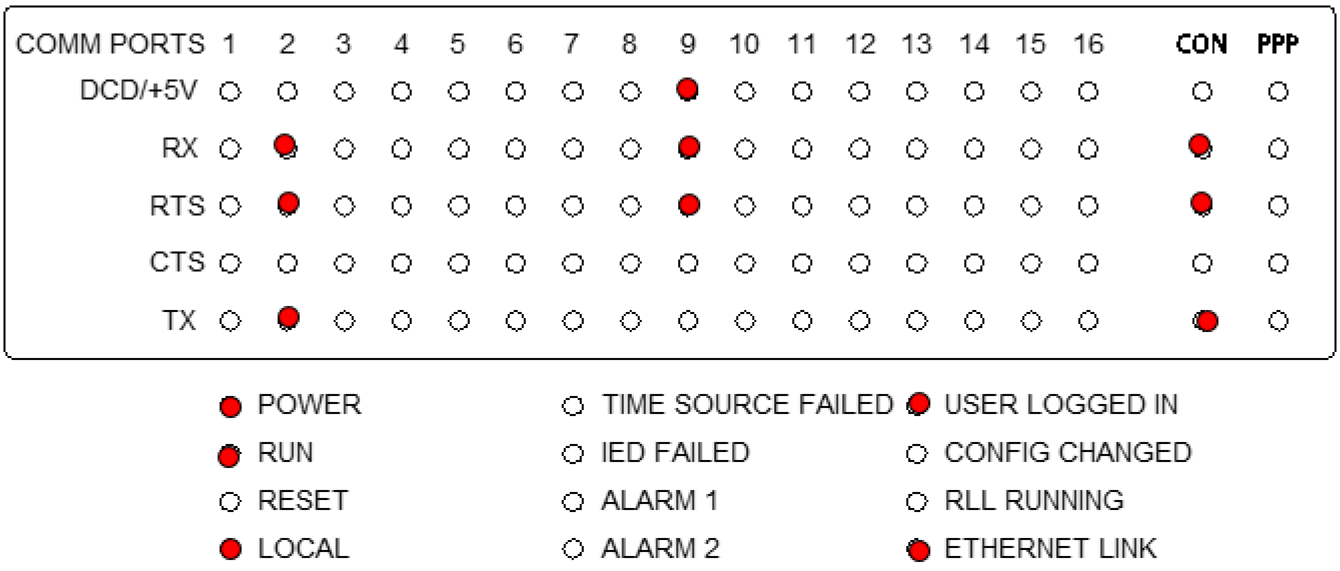


Figure 4-4 Front Panel LEDs

There is a set of Comm lights for every serial port, including the Console and the PPP ports. The lights have the following meanings.

DCD/+5V

Dual meaning: DCD (Data Carrier Detect) in, or +5V out. Write as required.

RX

Receive. This hardware driven LED indicates activity on the Receive pin (pin 2) of this port's RS232 connector.

RTS

Request To Send. This hardware driven LED indicates activity on the Request to Send pin (pin 7) of this port's RS232 connector.

CTS

Clear To Send. This hardware driven LED indicates activity on the Clear to Send pin (pin 8) of this port's RS232 connector.

TX

Transmit. This hardware driven LED indicates activity on the TX pin (pin 3) of this port's RS232 connector.

The LEDs beneath the Comm lights show conditions for many other functions in the 4400.

POWER

This hardware driven LED indicates whether or not the 4400 has power. Normally on.

RUN

This software driven LED indicates whether or not the 4400 CPU is running. Look for the signature “heartbeat”; that is, a fast blink. A “steady ON” light means the 4400 is in either Safe mode or Crash Recovery mode. No light means the CPU is not running. Normally blinking.

RESET

This hardware driven LED illuminates while the the unit’s reset signal is asserted. Normally off.

LOCAL

Local control. This software driven LED indicates the position of the Local/Remote switch. In Local, all hardware and IED control functions are disabled. Normally off.

TIME SOURCE FAILED

This software driven LED indicates that one or more of the configured time sources are in a failed state. Normally off.

IED FAILED

This software driven LED indicates that one or more of the configured IEDs is in a failed communications state. Normally off.

ALARM 1

This hardware driven LED indicates that the Alarm 1 relay has been energized. Normally off.

ALARM 2

This hardware driven LED indicates that the Alarm 2 relay has been energized. Normally off.

USER LOGGED IN

This software driven LED indicates that one or more user sessions is currently active. Normally off.

CONFIG CHANGED

This software driven LED indicates that a configuration XML file has been sent to the 4400 and the 4400 has not yet been reset making the new XML file active. Normally off.

RLL RUNNING

This software driven LED indicates that an ISaGRAF RLL program has been downloaded into the RTU and is currently active. Caution should be taken in that control operations may occur without notice depending on the functions built into the RLL program. Normally off.

ETHERNET LINK

This software driven LED indicates that the Ethernet circuit located on the CPU card has detected a valid link to another Ethernet device.

> **Note:** If the optional Switched Ethernet PC/104 card is installed, the Ethernet Link indication will always show a valid Ethernet connection.

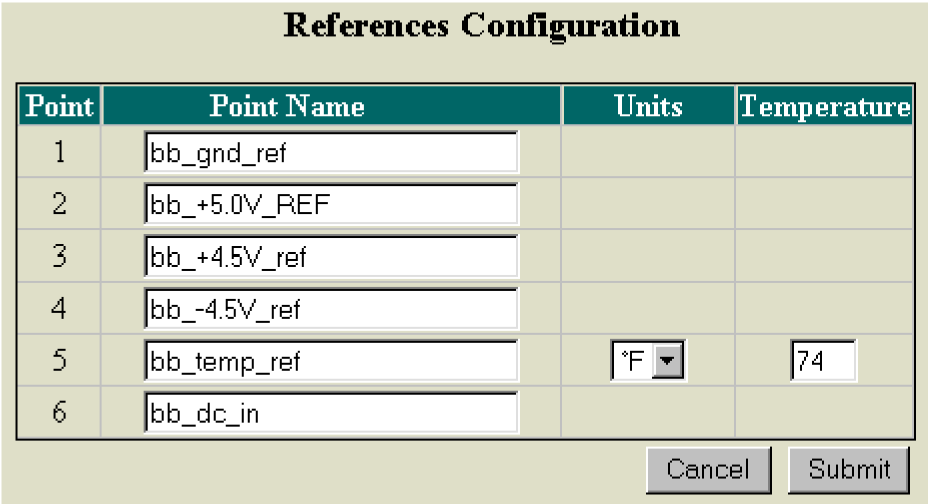
4.2.2 Data Display

You can use the Data Display Menu to monitor the operation of input and output devices. The Data Display can be compared to the LEDs as a means of status verification.

4.3 Temperature Calibration

The References Configuration screen allows you to set the temperature units (°F or °C) and correct the temperature reading. This step should not be done remotely because you must enter the current correct temperature at the RTU. See below. Click Submit when you are satisfied with the configuration, or Cancel to back out of the function without saving.

Figure 4-5 References Configuration



References Configuration

Point	Point Name	Units	Temperature
1	bb_gnd_ref		
2	bb_+5.0V_REF		
3	bb_+4.5V_ref		
4	bb_-4.5V_ref		
5	bb_temp_ref	°F	74
6	bb_dc_in		

Cancel Submit

5 Theory of Operation

This section provides detailed technical design information on the SAGE 4400 and its various external modules, including design of the firmware and hardware. Use this chapter if you want to troubleshoot and repair to component-level on the modules. This section is based on the simplified block diagrams included with the text.

Use the schematic drawings and printed circuit assembly drawings in the Drawings chapter of this manual for a more detailed study.

5.1 Basic Architecture

The SAGE 4400 uses the PC104 interface for its CPU interface. This makes it easy to upgrade your device as application needs change. The I/O complement is fixed. However, its 16+ communication ports, coupled with a large suite of IED protocols, allow concentration of many types of data from down-stream devices.

5.1.1 PC/104 Architecture

The open architecture of the PC/104 bus interface provides for expanded functions. You may add a PC/104-based GPS receiver.

The PC/104 architecture is a compact version of the IEEE P996 (PC and PC/AT) bus, optimized for the unique requirements of embedded systems applications. The PC/104 bus derives its name from the 104 signal contacts on the two bus connectors (64 pins on P1, plus 40 pins on P2). The main differences from the IEEE P996 are:

1. Reduced form-factor (3.550 x 3.775 inches)
2. Self-stacking, eliminating need for backplanes or card cages
3. Minimized component count and power consumption (typically 1-2 watts per module) and reduced bus drive requirement (typically 4 mA)

5.2 SAGE 4400 Microprocessor Overview

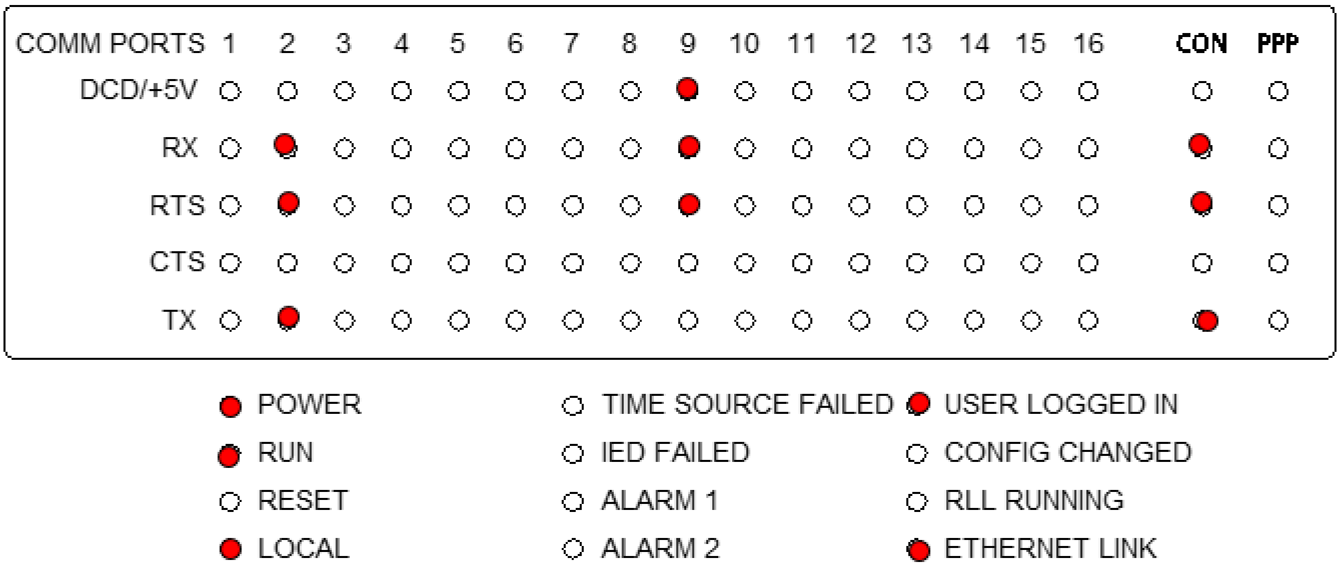
Please refer to the C3414 CPU Manual.

5.3 Hardware Design

5.3.1 LEDs

The LEDs on the front panel are a prime troubleshooting aid. Below is a typical example of the LED activity.

Figure 5-1 Front Panel LEDs



There is a set of Comm lights for every serial port, including the Console and the PPP ports. The lights have the following meanings.

DCD/+5V

Dual meaning: DCD in, or +5V out. Write as required.

RX

Receive. This hardware driven LED indicates activity on the Receive pin (pin 2) of this port's RS232 connector.

RTS

Request To Send. This hardware driven LED indicates activity on the Request to Send pin (pin 7) of this port's RS232 connector.

CTS

Clear To Send. This hardware driven LED indicates activity on the Clear to Send pin (pin 8) of this port's RS232 connector.

TX

Transmit. This hardware driven LED indicates activity on the TX pin (pin 3) of this port's RS232 connector.

The lower LEDs show conditions for many other functions in the 4400.

POWER

This hardware driven LED indicates whether or not the 4400 has power. Normally on.

RUN

This software driven LED indicates whether or not the 4400 CPU is running. Look for the signature “heartbeat”; that is, a one-second blink. If this light is not blinking (that is, either steady ON or steady OFF), the CPU is either in Safe mode, Crash Recovery mode, or is not running. Normally blinking.

RESET

This hardware driven LED illuminates while the the unit’s reset signal is asserted. Normally off.

LOCAL

This software driven LED indicates the position of the Local/Remote switch. In Local, all hardware and IED control functions are disabled. Normally off.

TIME SOURCE FAILED

This software driven LED indicates that one or more of the configured time sources are in a failed state. Normally off.

IED FAILED

This software driven LED indicates that one or more of the configured IEDs is in a failed communications state. Normally off.

ALARM 1

This hardware driven LED indicates that the Alarm 1 relay has been energized. Normally off.

ALARM 2

This hardware driven LED indicates that the Alarm 2 relay has been energized. Normally off.

USER LOGGED IN

This software driven LED indicates that one or more user sessions is currently active. Normally off.

CONFIG CHANGED

This software driven LED indicates that a configuration XML file has been sent to the 4400 and the 4400 has not yet been reset making the new XML file active. Normally off.

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ETHERNET LINK

This software driven LED indicates that the Ethernet circuit located on the CPU card has detected a valid link to another Ethernet device.

5.3.2 PC/104 Bus Interface/Connector

The bus interface connector is compatible with the PC/104 Consortium specification.

Contact the Consortium at:

PC/104 Consortium
849 Independence Ave., Suite B
Mountain View, CA 94043
Phone: 650.903.8304
Fax: 650.967.0995
Email: info@pc104.org

The PC/104 standard is available on the web in downloadable PDF format at:

URL: http://www.pc104.org

5.3.3 Communication Ports

The SAGE 4400 has sixteen (16) RS232 communications ports complete with LEDs for positive visual indication of data activity, and two other RS232 ports for Console and PPP. Baud rates are individually selected by port for rates between 300 baud and the maximum baud rate allowed by the protocol. The Console port is dedicated at 9600 baud.

Additionally, the 4400 can have up to five 10/100MBit Ethernet ports, depending on the variance. All ports are capable of supporting synchronous and asynchronous protocols and in synchronous modes can receive both the TX and RX clocks to support their data.

All RS232 communication ports share a common interrupt and receive a 14.7458 MHz clock. The internal clock gives them the ability to receive and transmit data at up to 115.2 K.

5.4 Select Before Operate

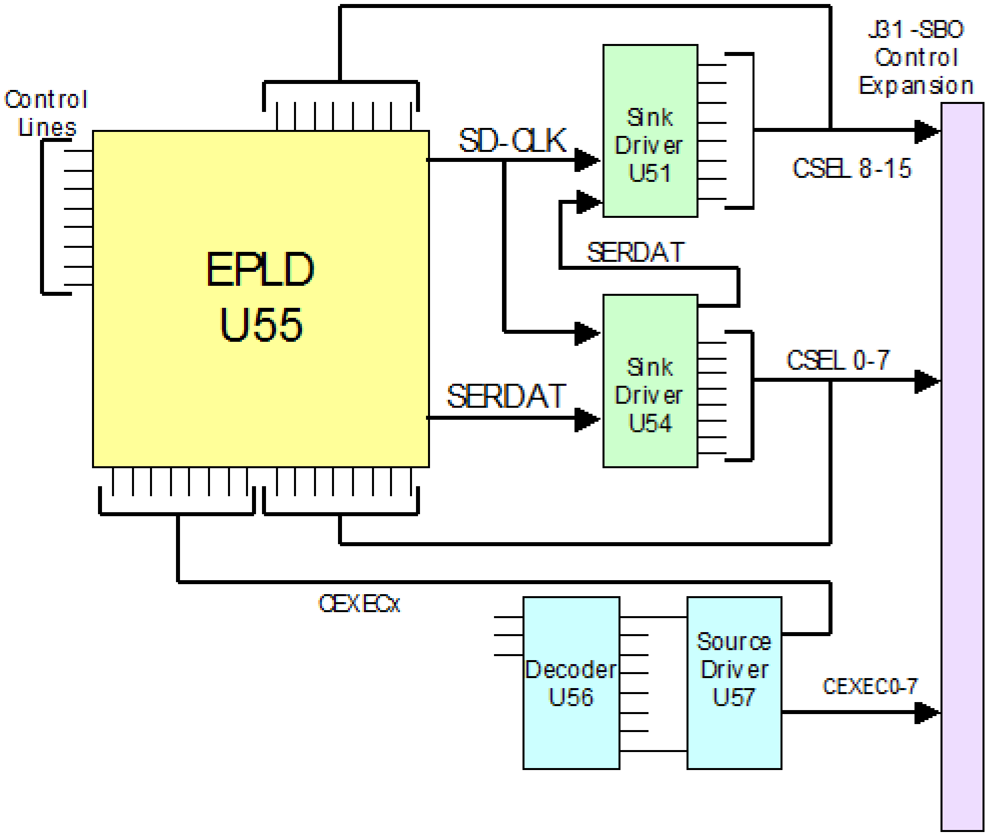
The SBO interface uses 8 source drivers and 16 sink drivers. The source drivers can only be selected one at a time. A serial-in, parallel-out shift register feeds the 16 sink drivers, and allows all the sink drivers to be asserted simultaneously if desired.

All drivers have feedback resistor networks which allow the SAGE 4400 to monitor correct relay driver selection before execution is enabled. The SBOs are controlled by an Erasable Programmable Logic Device (EPLD). The sink drivers control the CSEL0 - CSEL15 lines. The source drivers control CEXEC0 – CEXEC7.

The relay driver matrix (16 X 8) can handle a maximum of 64 SBO points. Each SBO consists of a TRIP and a CLOSE relay. SBOs are limited to one at a time by hardware and firmware.

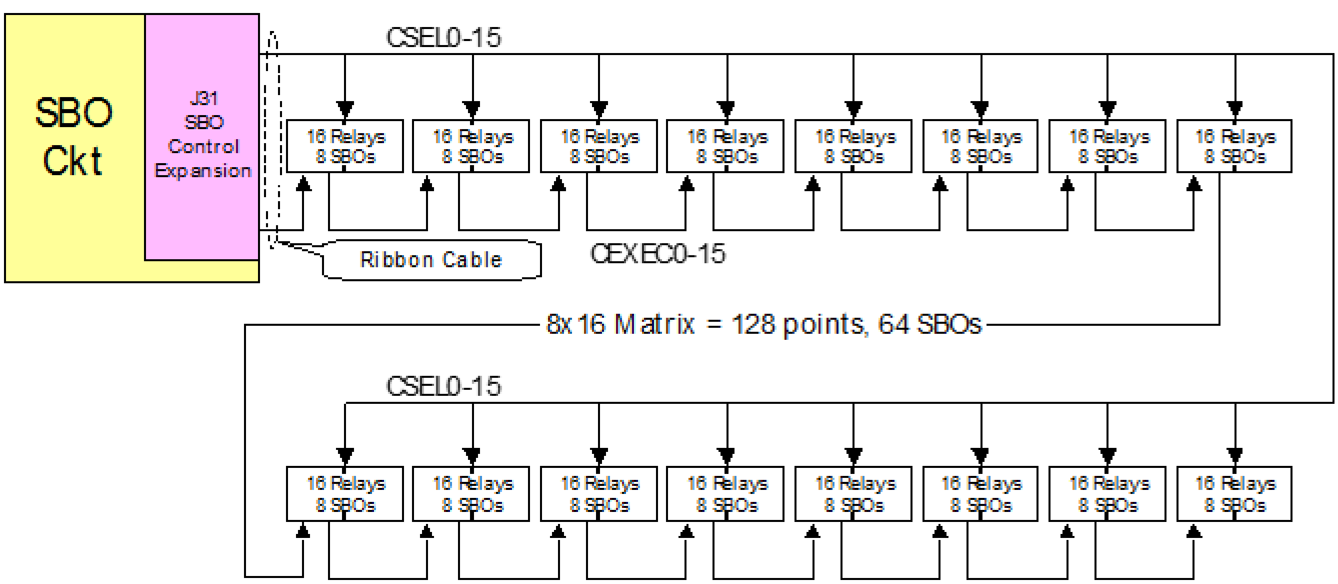
There are two of these circuits within the SAGE 4400. One is located on the C3800 Baseboard, (SBO CONT 2) and another identical circuit located on the C3812 board, (SBO CONT 1).

Figure 5-2 SBO Block Diagram



Another view of SBO addressing is shown in Figure 5-3.

Figure 5-3 SBO Matrix

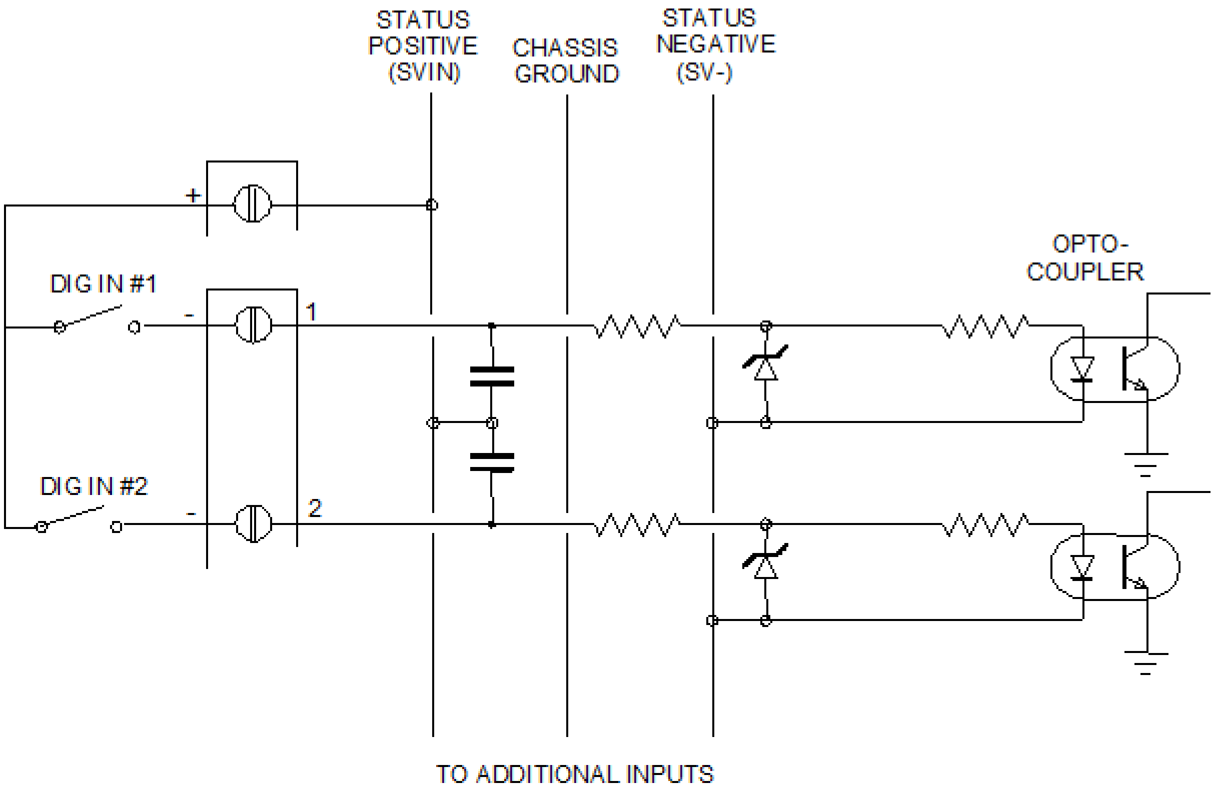


5.5 Digital Input Expansion

The digital input subsystem accepts contact closure inputs as field status or low speed accumulator inputs. All inputs are optically isolated, and debounced by the firmware. Input processing is determined by the input assignment as status or accumulator, and is also firmware controlled. This allows the same hardware to be used for both types of inputs. Figure 5-4 is a simplified schematic of a typical digital input on an XT.

The baseboard digital inputs are organized in 2 banks of 8 bits. The baseboard digital inputs are interfaced to the data bus D7-D0 to DI-7 by U2 and U3. Data is allowed to settle before data onto the bus is read. A new status bank is selected by reading the I/O address of the requested status bank, ignoring the data, reading the same I/O address again, then processing the data.

Figure 5-4 Typical Digital Input



5.5.1 Firmware Debounce Algorithm

The Digital Inputs are processed through a digital filter to prevent erroneous Changes Of State (COS) being reported because of contact bounce. The inputs are sampled each 5 msec. Any input that does not match the state of the previous scan is time stamped and stored as a possible COS. A 20 msec counter is started for the suspect input. When the 20 msec expires, the point is again sampled. If it has remained steady it is considered to be a valid COS. The COS flag is set and the status buffer is set to the new point condition. A hardware RC network on each digital input provides additional filtering.

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SAGE 4400 Operation & Maintenance Manual

For Reference Only

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1.1		Fix some references and name		Chris Kerr	Manager, RTU S/W Engineering
1.2	08-10-18	Added California Prop 65 Warning		Chris Kerr	Offer Manager - SAGE