Serial System Controller

Operation and Maintenance Manual

Effective: January, 2001

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018-332-C0-002, Rev. B
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Overview: The purpose of the Serial System Controller Operation and Maintenance Manual is to detail system features, installation, operation, and maintenance procedures. It is written primarily for the system operator.

NOTE: Alpha Technologies' products are subject to change through continual improvement processes. Therefore, specifications and/or design layouts may vary slightly from descriptions included in this manual. Updates to the manual will be issued when changes affect form, fit or function.

Keep these instructions for future reference.

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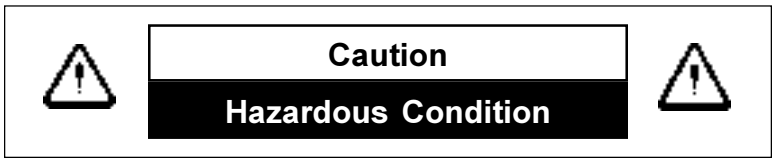
Safety Symbols Used in this Manual



To reduce the risk of electrical shock, injury or death caused by explosion of fuel or moving parts, and to ensure the safe operation of this unit, the following symbols have been placed throughout the manual. Where these symbols appear, servicing must be performed only by qualified personnel.

Dangerous Voltage
This symbol indicates a "dangerous voltage" exists in this area of the product. Use caution whenever working in the area to prevent electrical shock.

Attention
This symbol indicates important installation, operation or maintenance instructions. Always follow these instructions closely.

Safety Precautions

- The Serial System Controller (SSC) must be serviced only by qualified personnel.
- Remove all rings, watches and other jewelry before servicing batteries or installing the SSC.
- Verify the voltage requirements of the equipment to be protected (load), the AC input voltage to the power supply (line), and the output voltage of the system prior to installation.
- The utility service panel must be equipped with a properly rated circuit breaker for use with this power supply.
- When connecting the load, DO NOT exceed the output rating of the system.
- Always use proper lifting techniques whenever handling units, modules or batteries.

Battery Safety Notes

Chemical Hazards

Any gelled or liquid emissions from a Valve-Regulated Lead-Acid (VRLA) battery is electrolyte which contains dilute sulfuric acid which is harmful to the skin and eyes; is electrically conductive; and is corrosive. If electrolyte contacts the skin, wash immediately and thoroughly with water. If electrolyte enters the eyes, wash thoroughly for 10 minutes with clean water or a special neutralizing eye wash solution and seek immediate medical attention. Neutralize any spilled electrolyte with the special solutions contained in a "spill kit" or with a solution of 1 lb. Bicarbonate of soda to 1 gallon of water.

Fire, Explosion, and Heat Hazards

Lead acid batteries can contain an explosive mixture of hydrogen gas which can vent under overcharging conditions. Do not smoke or introduce sparks in the vicinity of the battery. Prior to handling the batteries, touch a grounded metal object, such as the rack, to dissipate any static charge that may have developed in your body. Do not charge batteries in a sealed container. The individual batteries should have 0.5 inches of space between them to allow for convection cooling. If contained, assure the container or cabinet and room have adequate ventilation to prevent an accumulation of potentially dangerous gas.

Contact Information

General product information
and customer service
7:00 AM to 5:00 PM Pacific Time
1-800-863-3930

To obtain complete technical support
7:00 AM to 5:00 PM Pacific Time
or
For after-hours *emergency* support
7 days per week, 24 hours a day
1-800-863-3364

Instructions for Returns

Returns for Repair
For units that must be returned for repair, Alpha requires a Return Material Authorization (RMA). An RMA can be obtained from Alpha Customer Service, using either method listed below:

- Download the necessary forms directly from Alpha's Web site, under "Customer Service": **www.alpha.com**
- Or call (800) 322-5742 for assistance.

Clearly mark the RMA on the unit's original shipping container. If the original container is not available, make sure the unit is packed with at least three inches of shock absorbing material to prevent shipping damage.

NOTE: *Do not* use popcorn-type material. Alpha Technologies is not responsible for damage caused by improper packing on returned units.

In addition to the returned unit, please include a copy of the power supply maintenance log and any information relevant to the power supply failure.

Returns for Credit

For returns for credit, call (800) 322-5742.

1.1 Theory of Operation

The Serial System Controller (SSC) manages and provides status monitoring for powering systems that contain single or multiple (up to six) power supplies, and a generator. It coordinates battery charging, individual battery monitoring, and self-testing for individual components in the system. Using a serial interface, Alpha's Engine Control Module (ECM) communicates with the SSC to manage generator operation.

The SSC coordinates the following control functions of the power supply system:

- Battery charging
- System self-test
- Low battery shutdown of inverters
- Initiation of low battery disconnect
- Monitoring of system configuration
- Battery temperature monitoring
- Acquisition and maintenance of data from all units in the system
- Response to queries from a digital transponder
- Monitoring of individual battery voltage
- Maintenance of critical parameters in nonvolatile memory
- Four user-defined discrete outputs, one input

SSC to serial transponder communication supports: HMS022 for individual power supplies; HMS022 for the generator system; Alpha power system status; Alpha individual power supply and extended status; and Alpha generator configuration and extended status.

NOTE: XM2 power supplies must have firmware 3.01 or higher for SSC to operate.

1.1.1 Battery Charging

Each XM2 has a battery charger capable of delivering a maximum current to the battery string. XM2s in a system configuration typically share a single string of batteries, and each provides its maximum charging current to the string after a major discharge event. Since this may damage the batteries, the SSC determines the number of power supplies in the system, and limits the individual power supply chargers so that the maximum charging current is never exceeded. The maximum charging current for a battery string can be calculated by using the following formula:

Maximum Charging Current <= (Battery Capacity / 5)

For example, total charger current of 100 Amp Hour batteries cannot exceed 20 Amps. If a system contains five power supplies, each will be limited to 4 Amps maximum.

The SSC waits for a unit in the system to transition into FLOAT mode, then watches system charging current drop below a threshold, based on the number of power supplies in the system. It then forces all of the XM2 power supplies into FLOAT mode to complete the battery charge.

1.1 Theory of Operation, *continued*

1.1.2 System Self-Test

System self-test is either initiated by expiration of the Auto Test Countdown timer, or by asserting the Self-Test switch via the digital transponder interface.

Prior to the test sequence, the SSC will:

- Verify that all XM2s are operating in line mode
- Check the battery capacity and number of strings
- Query the XM2 General Status alarms

The test will not run if:

- Any power supply is in standby mode when the self-test begins
- Either the battery capacity or number of strings has been programmed to zero
- Any power supply alarm is active

After the above conditions have been met, the SSC will begin the test sequence. During the test, the SSC will:

- Disable all battery chargers
- Initiate a self-test in a single power supply

Note: Each XM2 auto-test runs to completion before the SSC requests self-test of the next power supply. Each XM2 in the system is cycled through its test sequence. If any XM2 reports self-test failure, the device address of that unit will be reported in the SSC Test Failed alarm.

- Checks to see if a generator is installed in the system (when switch #3 is in the ON position)
- Asks the SSC to run a self-test of the engine generator (when switch #3 is in the ON position)
- Turns all battery chargers back on

Test duration is programmed into each XM2 by the SSC. When the Auto-Test Interval in the master XM2 is reprogrammed, the new value will be detected by the SSC, which in turn will reprogram all other XM2s in the system.

1.1 Theory of Operation, *continued*

1.1.3 Low battery Shutdown of Inverters

Each XM2 attempts to protect the batteries in a system from deep discharge that can permanently damage them. The XM2 will disable its inverter when the battery voltage drops below a threshold referred to as End of Discharge (EOD). The SSC will monitor each XM2 for an EOD flag. If and when it receives an EOD indication, the SSC will disable all inverters in the system simultaneously.

XM2s are equipped with a sleep mode that disables the logic power supply. This protects the batteries from further discharge. The SSC monitors the DC bus voltage after inverters have been disabled, and instructs all XM2s to enter sleep mode when the voltage drops below a fixed value. At this point, all XM2s, the SSC and the digital transponder are off, and will remain off until battery voltage recovers, or AC line returns.

1.1.4 Enclosure Monitoring

The SSC monitors cabinet intrusion sensors and will report an alarm via the digital transponder interface when a door opens. This alarm can be disabled by pressing the Reset switch on the SSC 3 times within 30 seconds of opening the door. The alarm can also be disabled by pressing the Tamper Disable software switch via the digital transponder. The tamper alarm is reactivated when all doors on the cabinet are closed, or after 60 minutes has elapsed.

1.2 Indicators & Connections

1.2.1 Front Panel Layout, Serial System Controller (SSC)

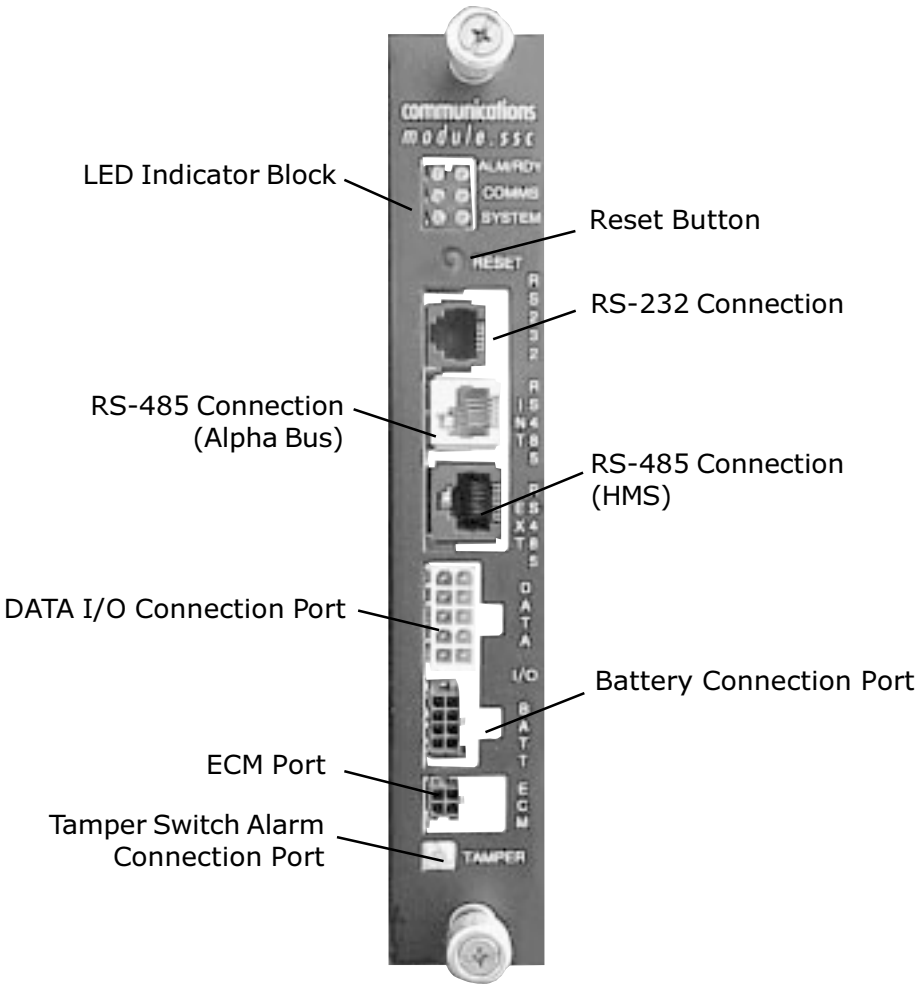


Figure 1-1; Alpha Technologies' Serial System Controller (SSC)

1.2.2 Diagram: The SSC in a Power System

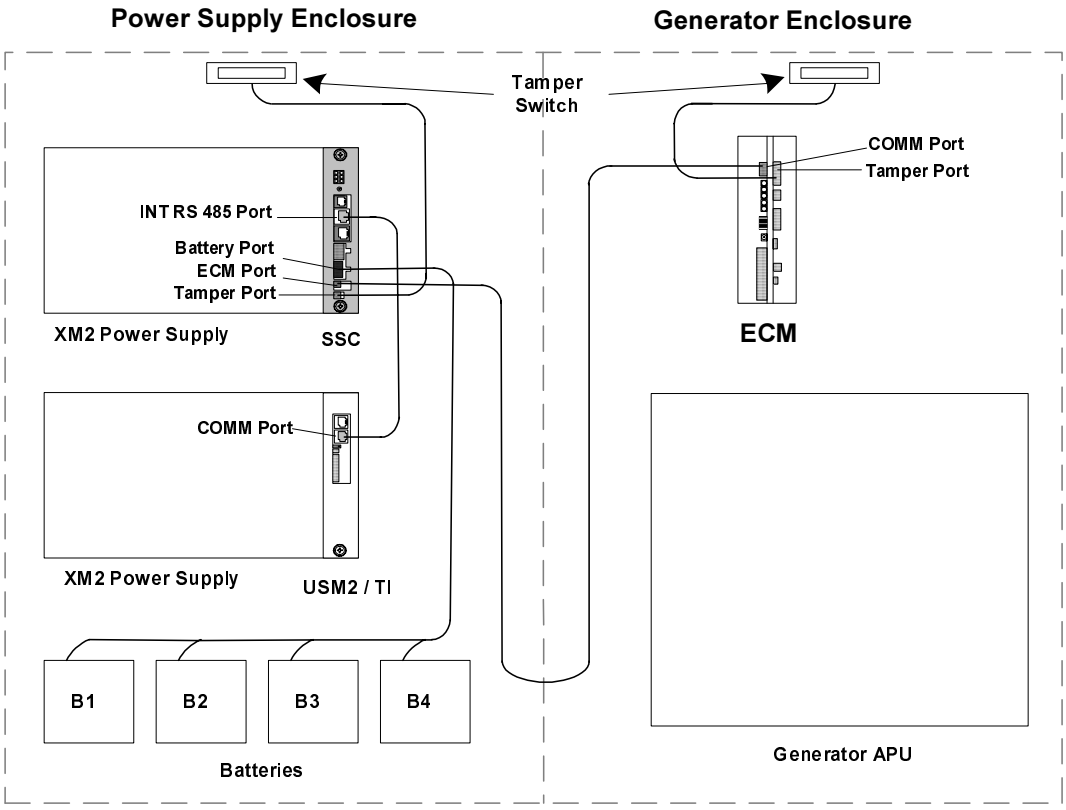


Figure 1-2; SSC Shown in Basic Power System

1.2 Indicators & Connections, *continued*

1.2.3 LED Indicators

The SSC *Alarm* LED reflects system level alarms. When a system level alarm is active, all LEDs will periodically (every ten seconds) turn off, and an alarm code will be displayed. (See section entitled "Alarm LEDs" for more information.)

The *Ready* LED flashes at a rate of 1 Hz to indicate that the SSC software is running normally. Generally, this LED is only turned off while alarm codes are being displayed.

The External Bus *Comms* LED (on left) indicates active communication on the external RS-485 or RS-232 interface. Generally, this interface is where a Digital Transponder connects to the SSC.

The System Bus *Comms* LED (on right) indicates active internal communications.

The Left *System* LED is not used at the time of this publication.

The Right *System* LED flashes to remind the user of a pending tamper alarm. After 30 seconds, the alarm will activate if not disabled. Once the tamper alarm is activated, it will remain on until either: the Reset switch is pressed 3 times consecutively; the door is closed again; or the alarm is disabled through status monitoring.

The Right *System* LED also indicates the number of devices (XM2s and SSCs) actively communicating with the SSC on the Alpha Bus.

Figure 1-3; LED Block, Reset Switch

1.2.4 Reset Switch

Performs two functions:

- Latches the system configuration
- Disables the tamper alarm

When all devices are properly communicating on the Alpha Bus, *latch* the system configuration by pressing and holding the Reset switch for 3 seconds or longer. (*Latching* tells the SSC: "Remember the configuration of the system as it is right now.") At the end of the 3-second period, all LEDs will flash quickly to indicate successful latching of the system. If this step is not taken by the user, the SSC will automatically do it 30 minutes after power-up.

Note: The SSC does not remember system configuration when it loses power. If any device on the Alpha Bus stops communicating with the SSC, or any device is added to the bus after the system configuration is verified, the SSC will generate a *Communications Failure* alarm.

1.2 Indicators & Connections, *continued*

1.2.5 Serial Communications Interfaces

The SSC has four serial communications interfaces: the internal RS-485; the external RS-485; the external RS-232; and the ECM port.

1.2.5.1 Internal RS-485

This interface connects the SSC to each XM2 power supply in the system. The SSC coordinates all system activity and status through the interface. An offset modular cable is connected from this interface to an XM2 in the system. Additional offset modular cables connect each subsequent XM2 in a daisy chain. A USM2 or USM-TI option installed in each XM2 contains two modular connectors to support this setup. XM2 units can be connected in any order.

1.2.5.2 External RS-485

This interface connects the SSC to an external monitoring device such as an RF transponder. This interface supports two data protocols; the SCTE HMS022 Power-Supply-to-Transponders Interface and the System Communications Interface (SCI). The SCTE HMS022 open standard supports basic power supply and generator status. The SCI is an Alpha proprietary "extension" to HMS022 and supports product-specific status, configuration, and control features beyond the scope of the SCTE standard. Consult the specific status monitoring vendor for products compliant with SSC interface standards.

1.2.5.3 External RS-232

Identical to the RS-485 HMS Bus port, this interface responds to the HMS022 protocol (and extensions). It supports local access to status and diagnostics, through a PC running Alpha's Power System Monitor (PSM) application software. (*Contact Alpha Technologies for pricing and availability of the PSM application software.*)

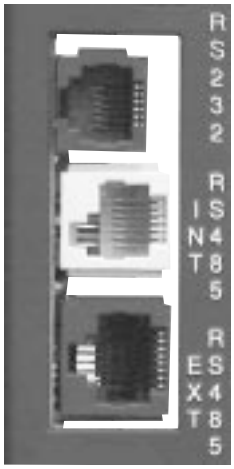


Figure 1-4; RS-232 and Alpha/HMS Bus RS-485 Connectors

1.2 Indicators & Connections, *continued*

1.2.5 Serial Communications Interfaces, *continued*

1.2.5.4 ECM Port

This interface connects the SSC to the Engine Control Module (ECM) in an AlphaGen generator system. The SSC coordinates all generator activity and status monitoring through this interface.

The ECM port is a 4-pin terminal block:

Pin #	Description
1	ECM ≈ 8V
2	+ RS-485
3	- RS-485
4	ECM Ground

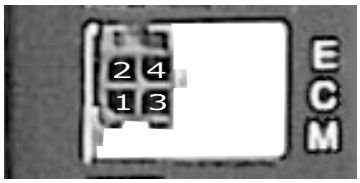


Figure 1-5; ECM Port on SSC

Note: The ECM connection is separate and isolated from the power supply internal bus, and has its own connector.

Note: When Alpha standard cable is **not** used for the ECM connection, it is necessary to install the opposite end of the non-Alpha cable into the ECM, at the port labeled COMM. To do this, install wire #1 into pin-out #1 on the terminal block, using a small slotted screwdriver. (Verify that the same wire numbers are used in both ends of the connection.) Install wires 2 through 4 in the same manner.

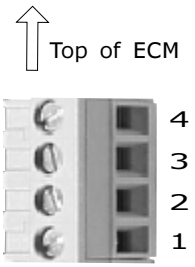


Figure 1-6; ECM COMM Port

1.2 Indicators & Connections, *continued*

1.2.6 SSC/Power Supply Interconnection

The SSC can communicate with up to six additional power supplies by means of a connection between the RS-485 Internal connector and the COMM connector of the next Communications Module, as shown below. Each succeeding power supply may be linked via a connection from the SYS connector to the COMM connector.

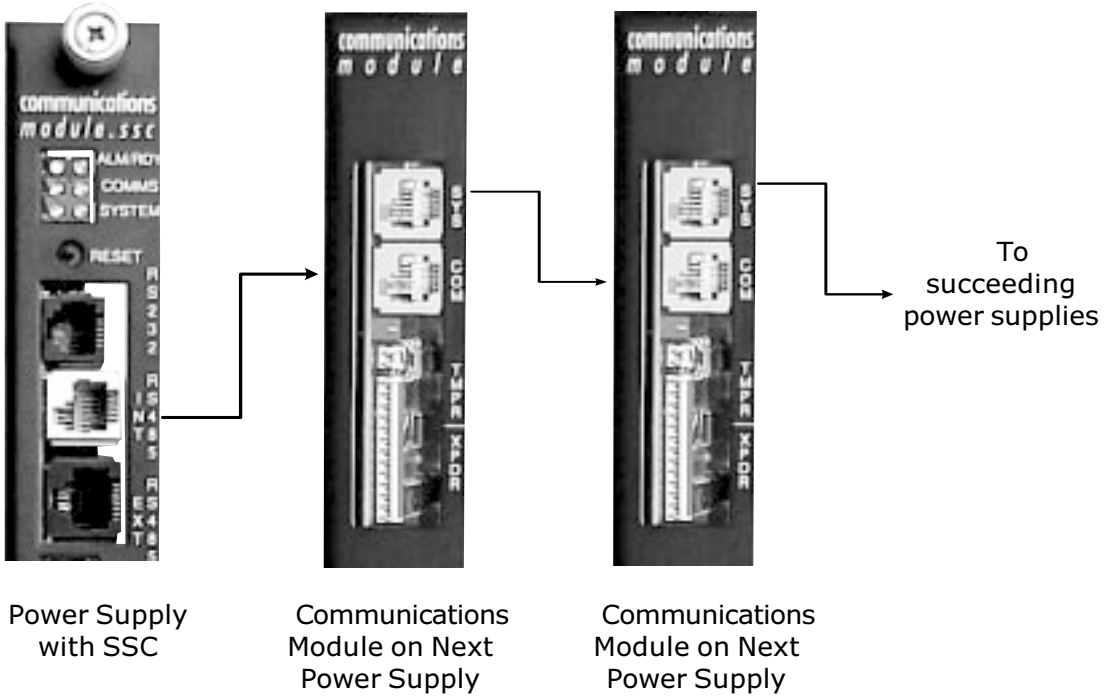


Figure 1-7; Configuration for Multiple Power Supplies

1.2 Indicators & Connections, *continued*

1.2.7 Data I/O Port

The Data I/O port consists of a 10-pin user-definable set of contact closures. It contains one discrete input, and four discrete outputs, both read by the external communication ports. The output signals are contact closure to its return pin on activation. The input signal is activated by a short between pins 6 and 7.

The location and function of each pin is illustrated in the figures below.

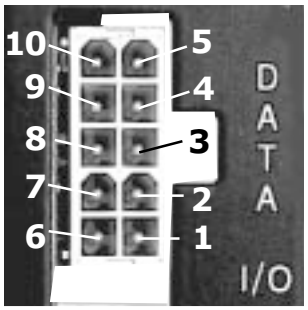


Figure 1-8; Data I/O Connector

Pin #	Input/ Output	Standard Use	Transponder Use *(note 1)*	Active State
1	Output	Output #4	System Inverter status	Contact Closure
2	Output	Output #4 return	Inverter status return	
3	Output	Output #3	AC line status	Contact closure
4	Output	Output #3 return	AC line status return	
5	Output	Output #2	Minor alarm *(note 2)*	Contact closure
6	Input	Input #1	System test *(note 3)*	Close to pin 7
7	Ground	Input #1 return	System test return	
8	Output	Output #1	Major alarm *(note 4)*	Contact closure
9	Output	Output #1 return	Major alarm return	
10	Output	Output #2 return	Minor alarm return	

Table 1-1; Digital Inputs and Outputs

1.2 Indicators & Connections, *continued*

1.2.7 DATA I/O port, *continued*

Notes from table 1-1:

Note 1 This mode is selected by turning SSC configuration switch #1 ON.

Note 2 Minor alarms* indicate:
- Battery system fault
- Enclosure intrusion (tamper)
- Communication fault
- System configuration fault
- System self-test failure

Note 3 A short between pins 6 and 7 will initiate a system self-test. The test will run until it is complete, or until the pins become open.

Note 4 Major alarms* indicate:
- System shutdown is imminent
- An XM2 power supply has signaled a major alarm

** See table 3-1, "Alarm LEDs" for more detailed information on alarms.*

1.2 Indicators & Connections, *continued*

1.2.8 Battery Connection Port

The BATT connection (8-pin Mini Mate-n-Lok) is a battery monitoring interface capable of measuring two sets of 36V or 48V battery strings. Pin 1 is always the lowest potential of the battery string.

Pin #	Description
1	Batt -
2	Batt Set #1 12V potential
3	Batt Set #1 24V potential
4	Batt Set #1 36V potential
5 (optional)	Batt Set #2 12V potential
6 (optional)	Batt Set #2 24V potential
7 (optional)	Batt Set #2 36V potential
8 (optional)	+48V potential

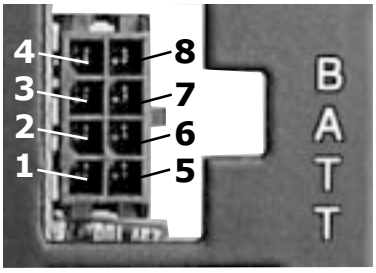


Figure 1-9; Battery Connector

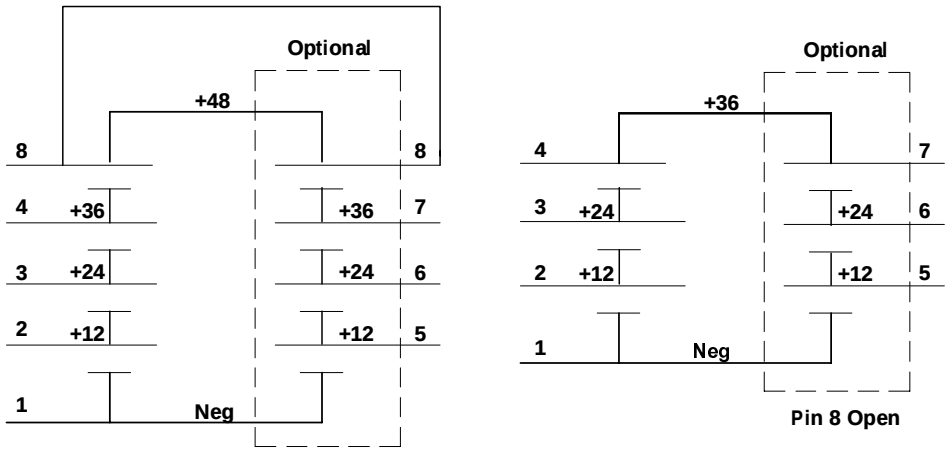


Figure 1-10; Battery Schematic

1.2 Indicators & Connections, *continued*

1.2.9 Tamper

The SSC monitors cabinet intrusion sensors, and will report an alarm via the digital transponder interface when a door opens. The Tamper port (2-pin header) is specifically designed to be compatible with the existing magnetic or mechanical tamper switches in Alpha Technologies' products.

To disable the tamper switch intrusion alarm, press the Reset switch three times within the first thirty seconds of alarm activation. The alarm can also be disabled by asserting the Tamper Disable software switch via the digital transponder. As a safety feature, the SSC will not allow remote control operations if the tamper switch is active or disabled.

The tamper alarm will reset when all doors on the cabinet are closed. In the event that the door is not properly closed, the SSC will re-enable the tamper function after a 60-minute time-out.

Pin #	**Description**
1	Tamper
2	Return (ground)

Figure 1-11; Tamper Switch Pin Arrangement

(Note: Pin-outs are numbered in figure 1-10 for reference only. There is no polarity requirement for this connection.)

1.3 Dip Switch: Switch 1

Switch 1 is used to identify user-configurable options of the SSC. The ON position of the switch indicates that the generator is in the system.

Position	Use
1	Activates the parallel status monitoring option that is described, in detail, in the manual.
2	Not currently used.
3	Defines whether or not the APU (if present) is included in the self-test sequence.
4-8	Not currently used.

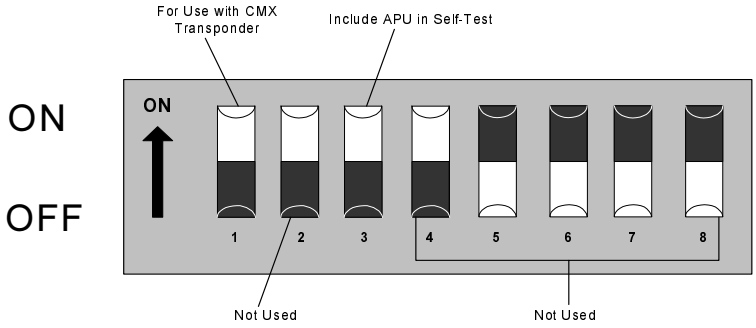


Figure 1-12; Switch 1 - Configuration Switch

2.1 Module Conversion

Note: If the XM2 system already has a Serial System Controller (SSC) module installed, proceed to section 2.3, "Smart Display Setup Menu."

Note: During this procedure, backup capability may be temporarily lost.

Module Conversion Procedure:

1. Disconnect any status monitoring cables/harnesses connected to the front panel of the existing module. (Module shown for illustrative purposes only.)

2. Verify that the battery breakers are OFF.

3. Disconnect the battery cable connections.

4. Unscrew the captive mounting/grounding screws located on the lower front panel (and top right, if applicable) of the Inverter Module (IM).

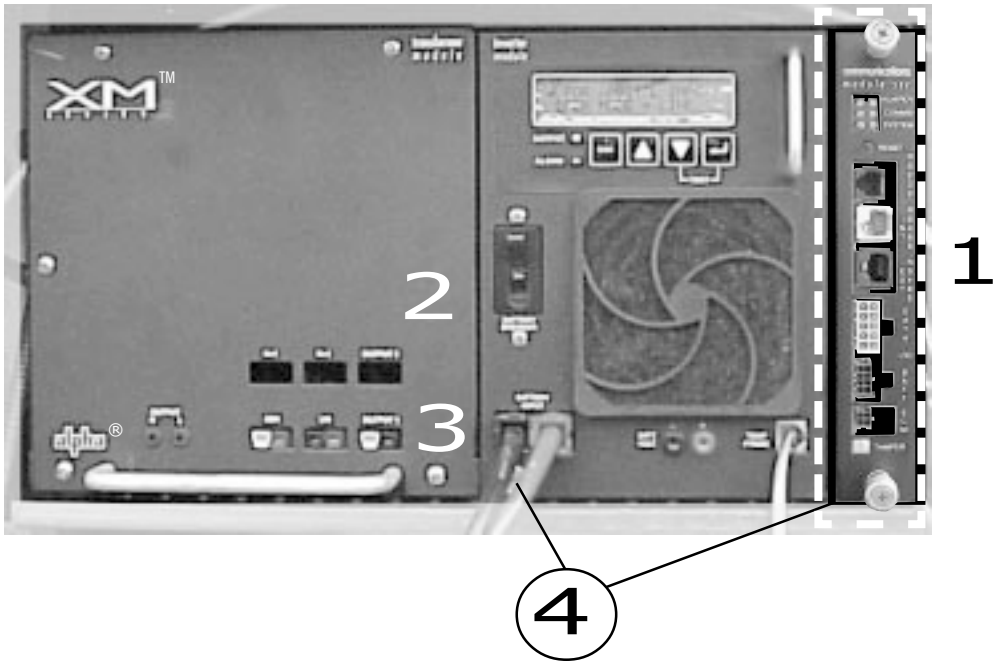


Figure 2-1; Location of Communications Module in XM2 Power Supply

2.1 Module Conversion, *continued*

Module Conversion Procedure, *continued*

5. Slide the Inverter Module (IM) out from the chassis.

6. Remove the existing COMM module (Universal Status Monitor) housing from the IM.

7. The unit is now ready to receive the Serial System Controller.

Figure 2-2; Preparing Inverter Module to Receive SSC

2.2 SSC Installation

SSC Installation Procedure:

1. Carefully align the 2x9 header plastic standoffs of the SSC card to the IM, and position the board over the two nylon standoffs.

2. Reattach with the 2 screws from the existing COMM module.

3. Slide the IM into the chassis.

4. Plug the Tamper, ECM, BATT, DATA I/O, and RS-485 (internal/ external), cables into their respective connectors.

5. Plug in the XM2 Battery Connector and turn ON the Battery Breaker.

6. The XM2 and SSC will begin their initialization sequence.

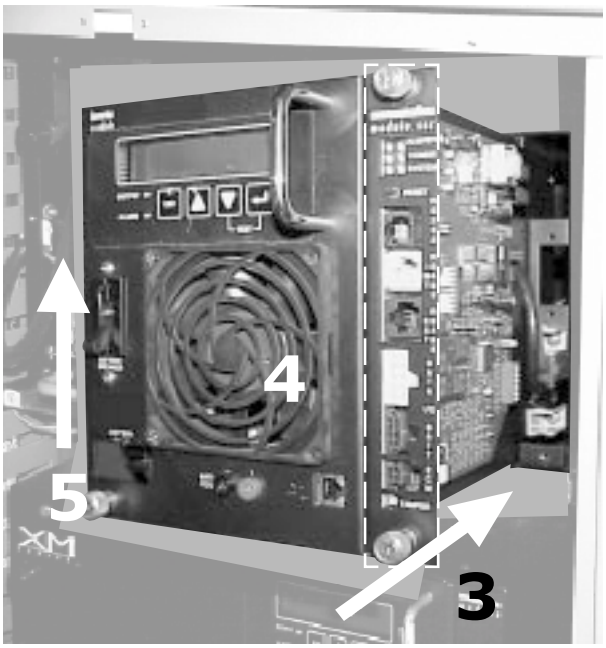


Figure 2-3; Inverter Module with SSC Installed

2.3 System Configuration

Communication between the SSC, ECM and XM2s takes place through the RS-485 Alpha Bus.

To set power supply addresses (*Refer to section 2.4, "Smart Display Setup Menu for more information"*):

1. Beginning at the Normal Operations menu of the LCD on the power supply, press the ENTER key twice. This brings the user into an Auto-Scroll Setup menu.

2. Look for the Parameter named DEVICE ADDRESS.

3. Press the ENTER key to select the item for editing.

4. Use the UP arrow key to increase the displayed value, or the DOWN arrow key to decrease the value. Pressing and holding either the UP or DOWN arrow keys for more than two seconds while in edit mode will change the value more quickly.

    - Set address of each power supply in valid range, defined as 1-6.
    - The SSC will not recognize any power supply with address 0, or any address greater than 6. Other addresses will generate the configuration alarm and be ignored.
    - The unit that is given the lowest device address is identified as the master XM2. The master XM2 is used for system programming, and controls the remaining XM2s in the system. (The master XM2 does *not* need to be the unit that houses the SSC.)

5. Press the ENTER key when the desired value is displayed. This will access an additional display, which gives the operator a chance to back out of the programming mode (ESCAPE), and not save the new value, or to accept and save the new value into memory by pressing the ENTER key.

Note: XM2 device addresses **must be set** for the SSC to function, and XM2 Software must be version 3.01 or later.

2.4 Smart Display Setup Menu

The Setup Menu contains the following items:

Top Line (provides additional information)

- SET UP MENU
- ↓↑ TO MANUAL SCROLL
- <ESC> TO ADD'L INFO

Second Line (cycles through the following parameters):

Parameter	Default	Range	
		Minimum	Maximum
FLOAT V/C	2.25	2.1V/Cell	2.35V/Cell
ACCEPT V/C	2.35	2.2V/Cell	2.45V/Cell
TEMP COMP	3mV/Cell/°C	0mV/Cell/°C	5mV/Cell/°C
BATT CAPACITY	100 Ah	0 Ah	1,000 Ah
SELF TEST	OFF	ON or	OFF
TEST INHIBIT	--	7 days	7 days
TEST INTERVAL	30 days	0 days	360 days
TEST COUNTDOWN	0 days	0 days	365 days
TEST DURATION	10 minutes	5 minutes	180 minutes
FREQ RANGE	3.0 Hz	1.0 Hz	6.0 Hz
TAP SWITCH	YES	NO or	YES
PIM OPTION	YES	NO or	YES
OUTPUT 1	ON	ON or	OFF
OUTPUT 2	ON	ON or	OFF
OVER CURR 1	15.0 A	3.0 A	30.0 A
OVER CURR 2	15.0 A	3.0 A	30.0 A
RETRY DELAY	60 seconds	5 seconds	301 seconds
RETRY LIMIT	20	0	40
OVER CURR TOL	3 seconds	1 second	10 seconds
N+1 VALID	NO	NO or	YES
STANDBY TIME	0 minutes	0 minutes	## minutes
STANDBY EVENTS	0 events	0 events	## events
SET DEFAULTS	NO	NO or	YES
CODE VER	3.01		
XM_ CLASS VER	3		
DEVICE ADDRESS	0	0	15
SELECT LANGUAGE	ENGLISH	FRENCH	SPANISH

3.1 Alarm LEDs

Specific alarms will be displayed as a count of flashes on the *Alarm* LED, as shown on the table below. Note that major alarms are labeled; all others are minor alarms.

Flash Count	Alarm	Reason
1	System Shutdown Imminent ***Major Alarm***	System is running on inverter, and battery voltage is getting low
2	Battery System Fault	High battery voltage; battery missing (reported by XM2s or battery interface connector); battery capacity is set to zero; max battery delta voltage
3	Cabinet Intrusion	Tamper switch has triggered alarm, and has not been disabled by the user
4	Communication Fault	System is not reporting as configured; SSC does not recognize the configured system; lost or missing device
5	System Configuration Fault	Temp probe missing or moved; unconfigured XM2; an XM2 is set to zero (factory default); power supplies differ on input line status; battery capacity has been set to zero with batteries in the system
6	System Self-Test Failure	Was not able to complete a self-test; all XM2s in the system are *not* in line mode; SSC major alarms are present; battery capacity is set to zero
7	An XM2 is Reporting Alarm Status ***Major Alarm***	(Refer to display on alarming power supply.)
8	The ECM is Reporting Alarm Status ***Major Alarm***	(Refer to LED indicators on ECM user interface.)

Table 3-1; Alarm LEDs

If more than one alarm is active, there will be a pause during which all LEDs are off before the next alarm code is flashed. Note that only system level alarms are displayed in this manner. For individual XM2 alarms refer to the display on the alarming power supply. Specific alarm information associated with generator operation may be obtained from the SSC through the digital transponder interface.

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