Title:	E84 SPC Controller Hardware Technical Reference Manual	
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Revision History

Revision	Change / Release Number	Signature / Date
2.C	~ Corrected BAUD Rate and Address tables	*Andrew Giusti* / 11/26/18
2.B	~ Updated images of SPC Hardware Revision 2	*Andrew Giusti* / 4/26/10
2.A	~ Added description of new hardware supporting additional auxiliary inputs.	*Andrew Giusti* / 4/13/10
1.B	~ Added E23 Mode description and setting to Operation Mode Selection.	*Andrew Giusti* / 3/20/08
1.A	~Split Technical Reference Manual into separate hardware and software manuals.	*Andrew Giusti* / 4/13/07

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1 Introduction

The E84 Serial to Parallel Controller (SPC), Get Control part number KLA01102, provides a complete E84 interface solution, ready for integration into Equipment Front End Modules (EFEM's) that are not equipped with an internal E84 solution.

This document details the SPC's hardware, including the SPC Enclosure. Note that SPC Revision 2 specific hardware features are only available when running firmware version 4.0 or greater. When configured for legacy installations, some Revision 2 features will be unavailable. Contact GCI Support for more details (support@getcontrol.com).

For details on the SPC's software and serial API, refer to the E84 SPC SW Tech Ref Manual.

2 Specifications

Table 1 - SPC Specifications

Dimensions	Physical	3.00" x 7.00" x 0.60" (max)
Operating Conditions	Temperature Humidity Altitude	0 to 40°C 5 to 90% (non-condensing) up to 10,000 feet
Storage Conditions	Temperature Humidity Altitude	-20 to 60°C 5 to 90% (non-condensing) up to 40,000 feet
Weight	Gross	2.5 Oz
Power	+18 to +30 VDC	200mA total 100mA max SPC 100mA max E84
Interface Signals	Parallel I/O Serial	E84-compatible EIA/TIA-232

3 Physical Description

The E84 SPC consists of a single printed circuit card utilizing SMD technology. All connectors are through-hole mount. P/N KLA01102 is shipped inside an aluminum housing.

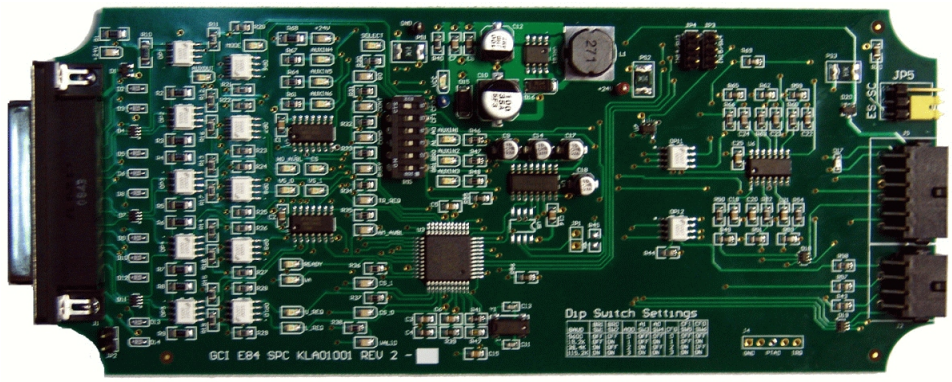


Figure 1 - SPC Circuit Board Revision 2

The E84 SPC provides passive E84-compatible I/O signals to interface with a factory AMHS. The I/O signals consist of three ports. An RS-232 serial port provides the software application interface.

Figure 2 - SPC Enclosure

3.1 Parallel I/O Port Connector DB-25 Female

Table 2 - E84 Female DB-25 Connector

Pin	Signal	Pin	Signal
1	L_REQ	14	VALID
2	U_REQ	15	CS_0
3	VA[3]	16	CS_1
4	READY	17	AM_AVBL[3]
5	VS_0[3]	18	TR_REQ
6	VS_1[3]	19	BUSY
7	HO_AVBL	20	COMPT
8	ES	21	CONT
9	NC[1]	22	NC[1]
10	SELECT[2]	23	+24V (Fused)
11	MODE[2]	24	+24V COM (GND)
12	GO[2]	25	Signal COM (Outputs)
13	NC[1]	Shell	GND

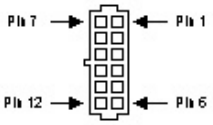
Notes: 1 - Not Connected
2 - Reserved signals used to support optical transceiver.
3 - Signal used to support passive OHS vehicles only such as stockers.

3.2 SPC Connectors

The SPC provides two connectors for external wiring. Both mating connectors are supplied.

3.2.1 SPC Connector A

Connector A is a 12-Pin AMP Micro MATE-N-LOK connector with mating connector AMP P/N 1-794617-2 (supplied). This connector provides pins for supply power (+24 VDC and ground), the RS-232 interface, the Auxiliary Output, and Auxiliary Inputs 1, 2, and 3. The following figure details the pin-out of this connector.

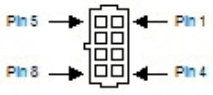


PIN	Signal Description	Signal Description	PIN
7	OUTPUT -	OUTPUT +	1
8	GND	Input 3	2
9	GND	Input 2	3
10	GND	Input 1	4
11	RX	TX	5
12	GND	+24 VDC	6

Figure 3 - SPC Connector A

3.2.2 SPC Connector B

Connector B is an 8-Pin AMP Micro MATE-N-LOK connector with mating connector AMP P/N 794617-8 (supplied). This connector provides pins for internal +24 VDC and ground, along with + / - Auxiliary Inputs 4, 5, and 6. The following figure details the pin-out of this connector.



PIN	Signal Description	Signal Description	PIN
5	Input 4 +	Input 4 -	1
6	Input 5 +	Input 5 -	2
7	Input 6 +	Input 6 -	3
8	GND	+24 VDC	4

Figure 4 - SPC Connector B

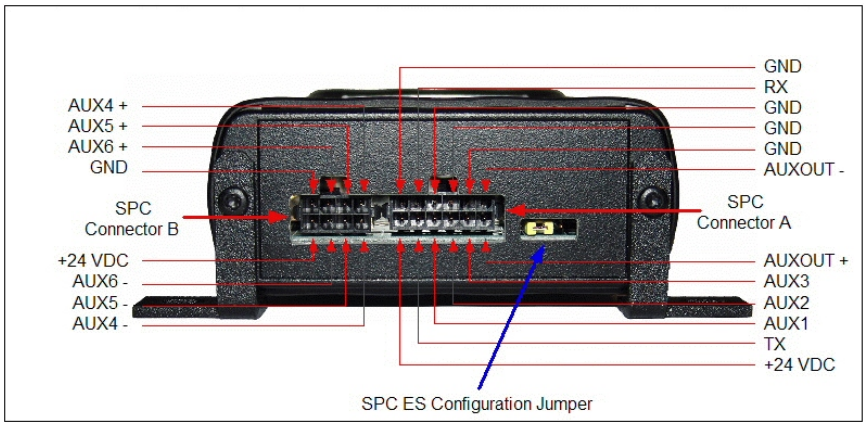


Figure 5 - SPC Connectors

3.2.3 SPC ES Configuration Jumper

SPC firmware provides configuration options that allow the AUX4 input to be used as a Light Curtain Status input. Additional configuration options define the SPC's behavior when the Light Curtain Status indicates a Blocked condition. Typically, when the Light Curtain becomes Blocked, the E84 outputs ES and HO_AVBL are turned OFF. Normally, the SPC handles this under firmware control. The SPC firmware detects the change on the AUX4 input, then turns it's ES and HO_AVBL signals off.

Some fabs require a hardware interlock on the ES signal when the Light Curtain is Blocked. The SPC provides an optional hardware circuit (enabled using a jumper) that gates the ES signal using the Light Curtain Status input.

The SPC ES Configuration Jumper is a three pin jumper next to the SPC Connector B. If the jumper is placed on the left two pins, the ES output is fully under firmware control. If the jumper is placed on the right two pins, the Light Curtain Status input gates the ES signal, keeping it OFF whenever the Light Curtain Status input is OFF.

Based on configuration options, the SPC firmware will still shut it's ES and HO_AVBL outputs OFF when the Light Curtain becomes blocked.

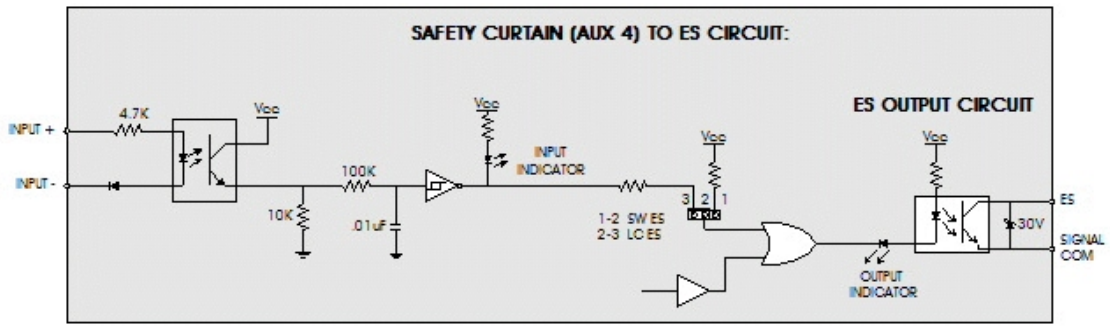


Figure 6 - Safety Curtain to ES Circuit

Note, when using the LC ES setting, with the SPC configured to turn ES and HO_AVBL OFF on a Light Curtain Blocked condition, the hardware circuit will turn ES OFF before the firmware can turn the HO_AVBL signal OFF. There will be a small delay (less than 5 milliseconds) between ES OFF and HO_AVBL OFF.

3.3 Auxiliary Inputs

Auxiliary Inputs 1, 2, and 3 are active-low standard CMOS (3V On, 0.9V Off) inputs. They provide a 10K pull-up to +5V, and are de-bounced with an RC circuit and a Schmidt Trigger input buffer. The inputs are designed to work with open collector outputs from a typical sensor amplifier.

Auxiliary Inputs 4, 5, and 6 are active-high (3V On, 0.9V Off) inputs. The inputs are designed to work with PNP output circuits.

Auxiliary Input configuration is set using the

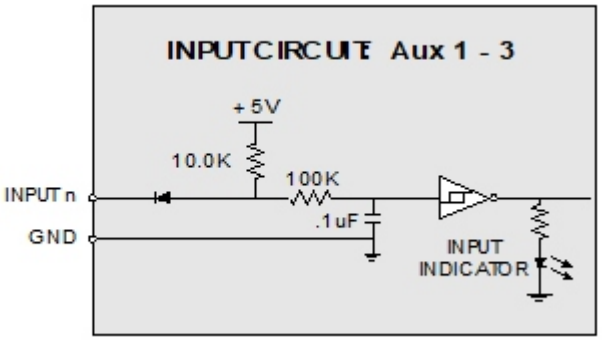


Figure 7 - Auxiliary Input Circuit - AUX1 - AUX3

Set Configuration Options command. This command was previously implemented as *setcfg* (prior to SPC Firmware version 3.0). This implementation is deprecate and replaced with *cfgset* to support the new auxiliary inputs. Support for the old implementation (*setcfg*) is maintained for backward compatibility. Refer to the SPC SW Technical Ref Manual for details.

Depending on parameters of the *cfgset* command, along with dip switch settings (see Section 5.2.3), auxiliary inputs 1, 2, ,and 3 can be defined as FOUP Placement, FOUP Presence and FOUP Clamp Status inputs. Auxiliary inputs 4, 5, and 6 do not depend on dip switch settings, and are configured solely through the *cfgset* and *sethand* commands.

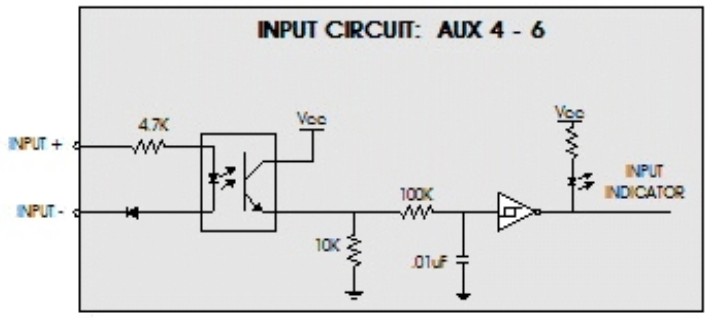


Figure 8 - Auxiliary Input Circuit - AUX4 - AUX6

3.3.1 Detecting Auxiliary Input Status

When an input is active, the SPC's firmware reports a '1' for the associated bit in the response to the **Read Auxiliary Inputs Sensors** (rdsens) and **Read Clamp Status** (rdclamp) commands.

Auxiliary Inputs 1, 2, and 3 are active low. When all three inputs are low (Placement and Presence), the firmware indicates that a FOUP or carrier is properly placed. When all FOUP inputs are high (or open and pulled up), the firmware indicates that a FOUP or carrier does not exist. When the Clamp Status input is low, the firmware indictes that the clamp is engaged. When the Clamp Status input is high (or open and pulled up), the firmware indicates that the Clamp is released.

Auxiliary Inputs 4, 5, and 6 are active high. AUX4 can be configured (using the `sethand` command) as a Light Curtain Status input.

3.4 Auxiliary Output

The SPC provides one open collector output, 50mA, 30V max.

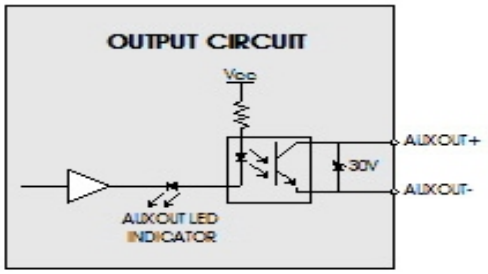


Figure 9 - Auxiliary Output Circuit

4 Installation

Mount the SPC Enclosure, and connect wiring harnesses to the two SPC Connectors.

The SPC ships with a default baud rate of 9600, with **Sensors Enabled**. To select an alternate configuration, change the SPC's dip switches. To access the dip switches, remove the small grommet from the top plate (between the COMP and PLAC_1 labels). A small screw driver can be inserted through this hole and used to change dip switch settings. If necessary, the top cover can be removed by removing the center top screw, and loosening one of the end caps.

Figure 10 - SPC Enclosure

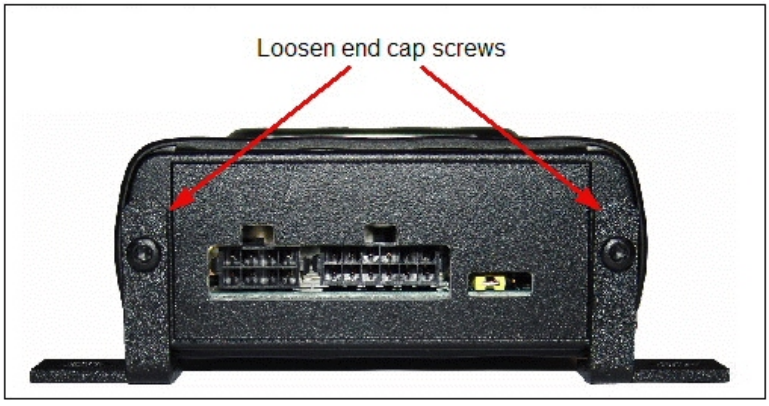


Figure 11 - SPC Enclosure End Cap

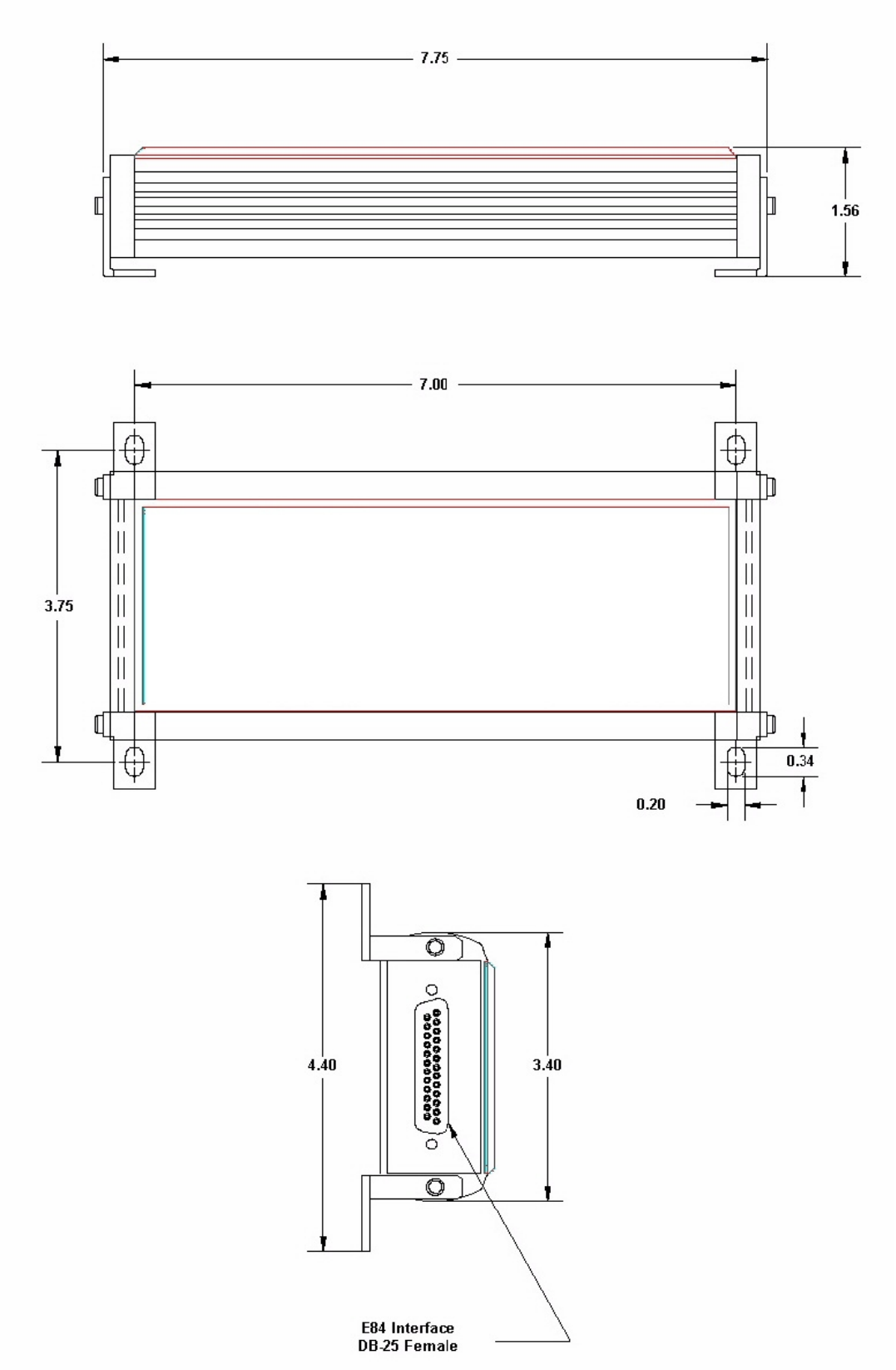


Figure 12 - SPC Enclosure Mounting Dimensions

5 Circuit Description

The following sections describe each circuit section in detail:

5.1 Serial Interface

The built-in serial communications interface (SCI) module provides full duplex, asynchronous, NRZ serial communications. The Baud rate is switch-selectable from 9600 to 115.2K Baud. Communications is configured as 8 data bits, 1 stop bit, and no parity.

5.2 Configuration Dip Switches

A bank of 6 dip switches are provided for setting system configuration options. Two switches control the SPC's BAUD rate selection. Two switches control the operation mode. Two switches control the SPC's Address (when assembled for RS-485 communications). Note that when configured for RS-485 communications, the SPC's AUX4 and AUX5 inputs are disabled. The two Address switches are disabled when the SPC is configured for RS-232 communications.

Dip Switches are read during system initialization. Dip Switch changes while the SPC is powered on do not take affect until the next power cycle.

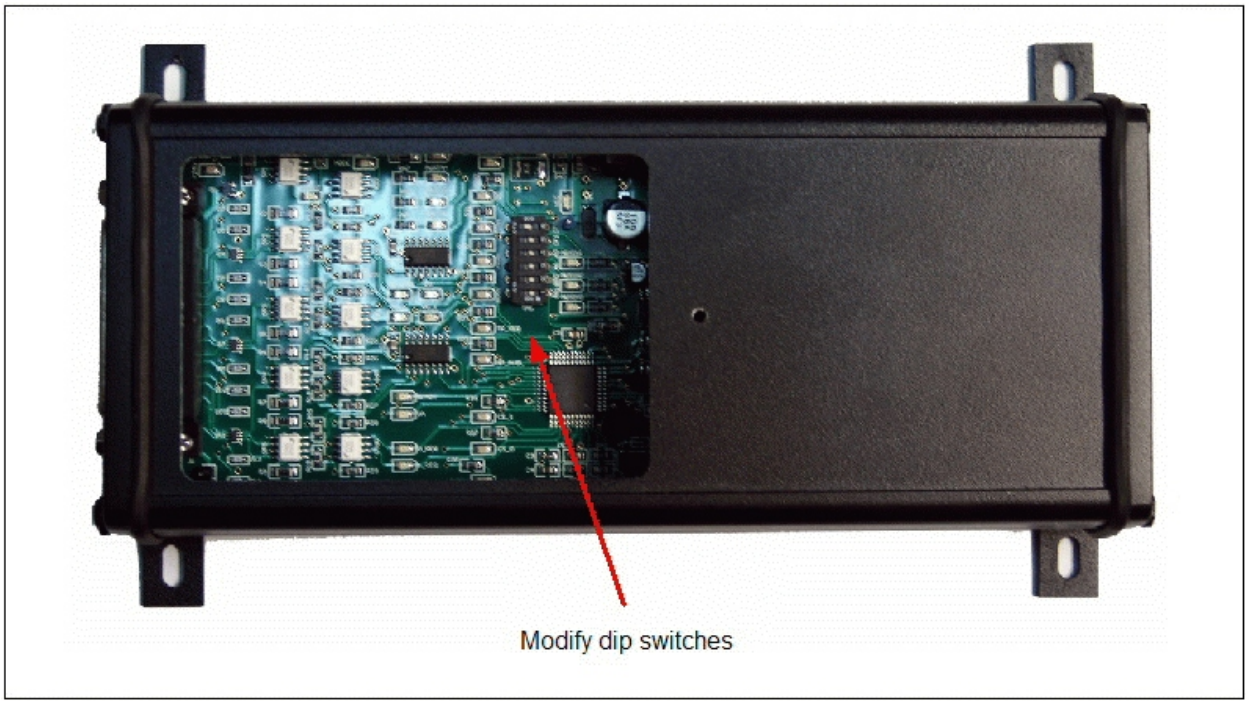


Figure 13 - SPC Dip Switches

5.2.1 BAUD Rate Selection

Two switches of a six-position DIP-switch provide selection of the Baud Rate. The E84 SPC supports 9600, 19.2K, 38.4K, and 115.2K Baud. Note that the Baud Rate only applies to Operation Modes which communicate over the serial port (see Operation Modes below).

Table 3 - Baud Rate Selection

Baud Rate	SW1	SW2
9600	OFF	OFF
19.2K	OFF	ON
38.4K	ON	OFF
115.2K	ON	ON

5.2.2 SPC Address

The SPC can be configured (at the factory) for either RS-232 or RS-485 based communications. When configured for RS-232 communications, there is no need to have an SPC Address defined. In this configuration, the Address Selection switches are disabled.

When configured for RS-485 communications, up to four SPC's can be connected in series on a single communications cable. In this mode, each SPC must have a unique address. In this mode, use the Address Selection switches to set the SPC Address as defined in **Table 4**.

Table 4 - SPC Address Selection

Address	SW3	SW4
0	OFF	OFF
1	OFF	ON
2	ON	OFF
3	ON	ON

Note that when configured for RS-485 communications, the AUX4 and AUX5 inputs are disabled.

5.2.3 Operation Mode Selection

Two switches on the six-position DIP-switch are dedicated to selecting the mode of operation of the SPC.

Sensors Disabled mode indicates that placement and presence sensors are not connected to the SPC. The tool should use the `foup` command to notify the SPC of FOUP status during automated handoffs.

Sensors Enabled mode indicates that placement and presence sensors are wired directly to the SPC. The `foup` command is disabled. FOUP status is determined by the states of the three sensor inputs.

E23 Mode indicates that the SPC is configured to run the E23 communications protocol. E23 is a predecessor of E84. The **E23 Mode** supports two load ports. Sensors are disabled. Contact GCI support for more information on using the SPC in **E23 Mode**.

Standalone Mode indicates that the SPC will operate without an attached host computer. In this mode, the SPC processes automated E84 handoffs, using connected placement and presence sensors for FOUP detection. No serial communications is processed in this mode. This mode is primarily used for "dumb" load ports and storage shelf installations.

Table 5 - Mode Selection

Mode	CFG	SW5	SW6
Sensors Disabled	0	OFF	OFF
Sensors Enabled	1	OFF	ON
E23 Mode	2	ON	OFF
Standalone	3	ON	ON

5.3 Field Upgradable Firmware

A small monitor program is installed in the E84 SPC at the factory. This monitor program provides a method for field upgrades to the SPC firmware. Firmware updates require the PC based (Win2000 / WinXP / Vista compatible) program **gci_fw_update.exe** that communicates with the onboard monitor program.

The monitor program executes in Standalone Mode only. When the board receives power in Standalone Mode, it transmits a request packet, and initiates a 100 mSec timeout. If the SPC does not receive a synchronization code from the PC within that timeout, Standalone Mode will initiate normally.

If the correct synchronization code is received within the 100 mSec timeout period, the onboard monitor program responds with an acceptance code indicating it is available for firmware updates. Additional details on field upgrades to the SPC firmware are provided with the **gci_fw_update** program.