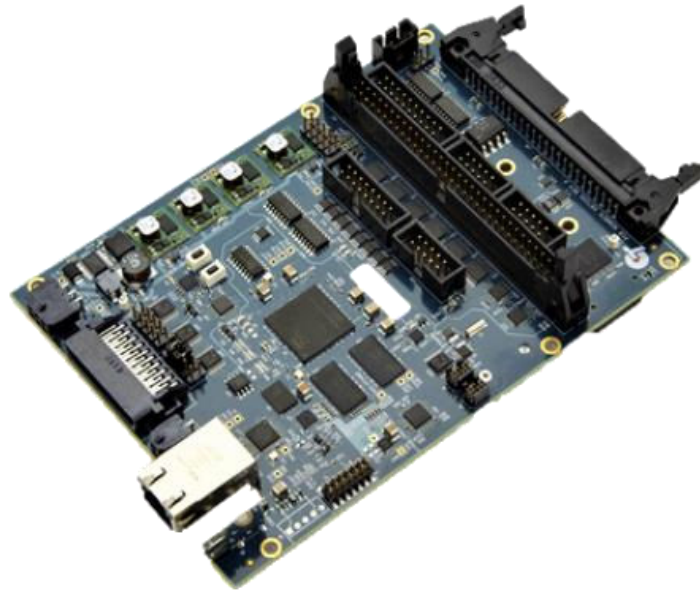# ScanMaster Controller

Advanced Laser Positioning and Control

User Manual

For laser steering systems

Read carefully before using.
Retain for future reference.

Novanta
PHOTONICS

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1 IMPORTANT INFORMATION

For your protection, carefully read these instructions before installing and operating the scan head.

Retain these instructions for future reference.

Novanta reserves the right to update this user manual at any time without prior notification.

If product ownership changes, this manual should accompany the product.

1.1 SAFETY SYMBOLS

This manual uses the following symbols and signal words for information of importance.

⚠ **DANGER**

Indicates a hazardous situation which, if not avoided, will result in serious injury or death.

⚠ **WARNING**

Indicates a hazardous situation which, if not avoided, could result in serious injury or death.

⚠ **CAUTION**

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

❗ **IMPORTANT**

Indicates information considered important but not directly hazard related (e.g. security, hygiene, or equipment or property damage).

1.2   SAFETY LABELS

> ⚠ **DANGER**
>
> Laser radiation
> can cause severe retinal and corneal burns, burns on the skin, and may pose a fire risk.
> - To avoid injury and reduce risk of fire, please follow the control measures and safety guidelines provided by the laser's manufacturer, and those established by your Laser Safety Officer (LSO), Radiation Safety Officer (RSO), or safety department of your business or institution.

> **ESD WARNING**
>
> Electrostatic discharge and improper handling
> can damage MOVIA scan head's electronics.
> - Keep the equipment sealed until it is located at a proper static control station.

1.3   CUSTOMER SUPPORT

Before contacting Novanta for assistance, review appropriate sections in the manual that may answer your questions.

After consulting this manual, please contact one of our worldwide offices between 9 AM and 5 PM local time.

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2 INTRODUCTION

2.1 GENERAL NOTES

Novanta reserves the right to make changes to the products covered in this manual to improve performance, reliability or manufacturability.

Although every effort has been made to ensure accuracy of the information contained in this manual, Novanta assumes no responsibility for inadvertent errors. Contents of the manual are subject to change without notice.

2.2 USING THIS MANUAL

2.2.1 Purpose

This manual provides directions to help users safely and effectively install and operate the ScanMaster Controller (also known as SMC) for various laser processing applications using Galvanometer based laser scanning head and laser. The manual also includes material such as system specifications and optimization guidelines. It is assumed that the reader has a general knowledge of galvos and command controllers.

2.2.2 Scope

This manual covers the SMC board and optional modules only. The optional modules include the SMC-IO-01 Auxiliary I/O Module, the SMC-LSR-01 IPG Laser Adapter, the SMC-LSR-02 SPI Laser Adapter, and the SMC-LSR-04 High-power Laser Adapter, and the SMC-LSR-05 Coherent C70 Laser Adapter.

2.2.3 Revision History

The following table shows the revision history for this document.

Introduction

Table 1 - Revision History

REVISION	DATE	Changes from previous revision
A	December 5, 2014	First release of this manual.
B	November 2, 2015	Added recommended power connection diagram Added Coherent C70 Laser Adapter Fixed errors in High-power Laser Adapter pin-outs
C	December 5, 2016	Updated Aux I/O module outline drawing to show female COM connector Use new CT logo and fixed Japan support e-mail address Added appendix covering the IPG YLP laser adapter Added notes to the high-power laser adapter about mislabeled silkscreen on the Rev C adapter boards Deleted "Future use" references where the feature is now supported Fixed AUX_GPI and AUX_GPO numbering to go from 1-4
D	May 19, 2017	Fixed reference to GP input conditioning in Aux I/O module
E	June 23, 2017	Fixed GPI and GPO pin names on MOTF connectors
F	June 2018	Added additional info on IPG YLP-HP Type B interface Adjusted J3 image to match physical view Added scan-head power supply to wiring recommendation
G	September 2018	Refined the definition of the AUX_READY signal which is renamed to AUX_ERROR_READY_N
H	January 2019	Updated to new format.
J	January 2020	Changed 25P D-Sub M from 25P D-Sub F on the IPG laser adapter Added signal conditioning diagrams for the extended I/O
K	April 2022	Clarified description of AUX_RESET signal Updated GPIO module figures regarding AUX_ERROR_READY_N signal Updated the SPI Laser connector diagram
L	April 2023	RS-485 references in MOTF signaling changed to RS-422 Interlock section added

2.3   WARRANTY INFORMATION

The Customer shall examine each shipment within 10 days of receipt and inform Novanta of any shortage or damage. If no discrepancies are reported, the shipment will be considered as delivered complete and defect-free. Novanta warranties products against defects up to 1 year from manufacture date, barring unauthorized modifications or misuse. Repaired product is warrantied for 90 days after the repair is made, or one year after manufacture date - whichever is longer.

Contact Customer Service at +1-781-266-5700 to obtain a Return Materials Authorization (RMA) number before returning any product for repair.

All orders are subject to the Terms and Conditions and Limited Warranty. Contact your local sales office for the latest version of these documents and other useful information.

Customers assume all responsibility for maintaining a laser-safe working environment. OEM customers must assume all responsibility for CDRH (Center for Devices and Radiological Health) certification.

3 PRODUCT INTRODUCTION

3.1   SYSTEM DESCRIPTION

The SMC is a self-contained controller that provides advanced hardware and software control technology to drive laser scanning systems. The Ethernet-connected SMC board is designed to permit remote embedding and control of a scan head and laser system. It is capable of controlling two scan heads with up to three motion axes each with concurrent laser timing control. It also provides integrated synchronization I/O for connection to factory automation equipment.

Connection to a PC for job download and administrative control is made via Ethernet® network using industry standard TCP/IP protocols. In addition to Ethernet connectivity, the SMC provides external USB connections to support job file distribution via industry standard USB Flash drives. RS232 and RS485 Serial I/O is also provided for, laser control, external automation control, and diagnostic access.

In a typical installation, the SMC is a "smart controller" device, which can be installed remotely in a laser scanning system. Positioning vectors are organized as packets which represent an entire job, or sequential parts of a job. These packets are then sent from a networked PC to the SMC for local processing. The SMC sequentially processes these vectors in real-time and sends them to the laser steering galvo servos as digital signals. Alternatively, the job packets can be saved to FLASH memory on the SMC and the loaded for execution from there.

There is no requirement to dedicate a full-time host PC to a laser scanning system, as the SMC can process vectors while the PC is used for other purposes. In fact, one PC can support multiple SMC-based scanning systems with no loss in performance. This is due to the large amount of buffer memory available on the controller, the use of a separate supervisory processor on the controller to handle network communication processing, and the complete off-loading of time-critical tasks to a second real-time processor on the SMC.

Direct cabling for scan head communication to the SMC is possible for both XY2-100-based scan heads and Novanta LightningTM II scan heads. Laser interfacing is done through a standard 0.1" 50-

pin IDC ribbon-style connector to laser personality cards or cables that present laser-specific connectorization. Direct connection is also possible with sparsely populated pin-in-shell-style connectors. The laser signals are organized such that an IPG YLP fiber laser with type E interface can be directly connected using a ribbon cable.

I/O signals for automation are presented in a 0.1" 20-pin header for easy access. All I/O signals are also presented in an inter-board transition connector that can be direct-connected to an expansion I/O board. This arrangement permits alternate connector usage and additional signal conditioning options.

3.2   FEATURE OVERVIEW

3.2.1   Hardware Features

- Tethered and stand-alone operation for "embedded" installation in scanning equipment
- Dual processor architecture with integrated 100/1000BaseT Ethernet communication capability
- Real-time processing engine for precise, synchronized scanner movement and laser control
- Direct 24-bit GSBus interface to Novanta LightningTM II digital galvo systems
- Standard support of the 16-bit XY2-100 protocol for non-LightningTM II heads
- Dual scan head control via the XY2-100 or GSBus interface
- Software-selectable polarity and timing of six TTL laser control signals
- Two auxiliary analog output channels (12-Bit) 0-10V for control of laser current or pulse intensity
- One 8-Bit TTL digital output port for laser power control
- Four 24V-compatible general-purpose digital outputs
- Four 24V-compatible general purpose optically isolated digital inputs
- Seven 24V-compatible dedicated outputs and optically isolated inputs for system control and external equipment synchronization
- One USB socket and one USB header for portable flash disk access
- 3GBytes of on-board Micro SD card flash for storage of firmware, local jobs, and parameters
- 300MB RAM for downloadable job data storage
- One RS232 serial port for console and smart-display use

- One RS232 serial port for general purpose use
- One RS232 serial port for laser control (included in the laser connector)
- One RS485 serial port for smart-controller motion control
- Two quadrature encoder inputs for Mark-on-the-fly use

3.2.2   Software Features

The SMC is designed with a client-server architectural model. The SMC implements all required server code functions including the broadcast of identification and status information, vector packet handling, command and control communications, and real-time positioning operations. Host-to-SMC communications uses TCP/IP as a transport mechanism over Ethernet.

To simplify integration with third-party application software, a Microsoft Windows-compatible Application Programming Interface (API) is provided. Two API formats are supported: .NET and Win32 DLL. The APIs take care of all network connection requirements, and they abstract many of the discrete functions of the module into higher-level vector-oriented instructions.

While this document describes the low-level EC1000 compatible XML API, the recommended interface for new application development for the SMC is Novanta's high-level ScanMaster API. This API provides a high-level hardware abstraction, graphical file importing and advanced shape rendering. In addition to these features, the ScanMaster API permits access to ScanScript, the powerful embedded scripting language feature that enables flexible automation integration and local rendering of bar codes, text, and various other shapes. This capability is very useful in structuring custom applications that require real-time rendering of serial numbers and data-codes as in some mark-on-the-fly situations.

In addition to the programming interface DLLs, example code and administrative management tools are provided to facilitate setup, configuration, and calibration.

3.3   TECHNICAL SPECIFICATIONS

Table 2 - Technical Specifications

Category	Feature	Specification	
Galvo control	Axes	XY2-100	3 (X, Y, Z), 1 standard + 1 with optional Auxiliary I/O board
		LightningTM II direct	3 (X, Y, Z) x 2 heads
	Position command output	XY2-100	16-bit (-32768 to +32767) industry standard
		XY2-100 Novanta extended	20-bit (-524288 to +524287) for appropriately configured LightningTM II scan heads
		LightningTM II direct GSBus	24-bit (-8388608 to +8388607) LightningTM II compatible protocol
		Dual scan head operation supported using separate correction tables with the same command stream	
	Status sensing	XY2-100	Standard 16-bit status decoding
		XY2-100 Novanta extended	Standard plus direct in-position sensing for appropriately configured LightningTM II scan heads
		LightningTM II direct	Real-time servo-produced status and variable monitoring
Laser control	Digital output signals	15, software programmable polarity and timing	
		LASER_ENABLE	Asserted a programmable time prior to a sequence of mark instructions and de-asserted after a programmable period of laser inactivity
		LASER_GATE	Asserted when the laser is active

Table 2 - Technical Specifications

Category	Feature	Specification	
		LASER_MOD1	Programmable laser modulation or Q-switch pulse stream
Laser control (continued)	Digital output signals (Conti.)	LASER_MOD2	Programmable laser modulation or Q-switch pulse stream, 180 degrees phase shifted from LASER_MOD1
		LASER_MOD3	Programmable laser modulation; used for first pulse suppression or programmable modulation source for synchronous operation
		LASER_POINTER	Laser pointer control signal
		LASER_DATA[7..0]	Digital data representing the laser power setting
		LASER_DATALATCH	Strobe signal asserted when the LASER_DATA[7..0] value changes
	Electrical	5 volt TTL compatible, 32mA source, 64mA sink	
	Resolution	20ns (LASER_GATE, LASER_MOD[3..1])	
	Analog output signals	LASER_ANALOG0	Normally mapped to the laser power setting; can be optionally made independent
		LASER_ANALOG1	Independent setting
	Electrical	0 – 10V, 33 ohm source impedance, 10mA max	
	Digital status input	LASER_STAT[5..0]_ISO	General purpose status read back
	Electrical	Optically isolated, 5- to 24V-compatible, 1mA min, 5mA max, 4.7K ohm current limiting provided	
	Digital sync input	LASER_STAT6_ISO	High-speed laser sync input

Table 2 - Technical Specifications

Category	Feature	Specification	
Laser control (continued)	Electrical	Optically isolated, 5- to 24V-compatible, 5mA min, 15mA max NOTE: Current limiting not provided.	
	Serial communication	LASER_RX LASER_TX	RS-232. Provided for configuration and status access to appropriately equipped lasers
Automation interfaces	User inputs	4, programmable polarity and level or edge sensitivity	
		AUX_GPI[4..1]	A marking job may contain an instruction that pauses execution until one of these signals is asserted by external equipment.
	Electrical	Optically isolated, 5 to 24V source or sink, 1mA min, 5mA max, 4.7K ohm current limiting provided	
	User outputs	4, programmable polarity	
		AUX_GPO[4..1]	A marking job instruction may specify the state of any of these signals.
	Electrical	Open-collector, reverse bias protected, 1K ohm pull-up to 5V, 24V capable, 500mA sink.	
	System Status	4, dedicated function outputs	
		AUX_BUSY	Asserted when a BeginJob instruction is executed, and de-asserted when an EndJob instruction is executed
		AUX_LASING	Asserted when marking is in progress
		AUX_ERROR_READY_N	Asserted if an error is detected; un-asserted means system ready.

Table 2 - Technical Specifications

Category	Feature	Specification		
	System Status (Conti.)	AUX_JOBACTIVE	Asserted if a job is active but not necessarily marking yet, e.g. waiting on a trigger input	
	Electrical	Open-collector, reverse bias protected, 1K ohm pull-up to 5V, 24V capable, 500mA sink.		
Automation interfaces (continued)		3, optically isolated inputs		
	System synchronization	AUX_START	A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment. Note that this function can also be achieved using the AUX_GPI[4..1] and START signals.	
		AUX_RESET	Causes the card to execute a soft reset forcing a complete re-initialization of the firmware	
		AUX_ABORT	Causes the job execution control logic to abort the current job and return to an idle state; useful upon detection of an interlock break	
	Electrical	Optically isolated, 5 - 24V source or sink, 1mA min, 5mA max, 4.7K ohm current limiting provided		
		START	A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment. Note that this function can also be achieved using the AUX_START and AUX_GPI[4..1] signals.	
	Electrical	Optically isolated, 5V sink only		
	Conveyor tracking	2 channels, digital quadrature input (A & B phases per channel)		

Table 2 - Technical Specifications

Category	Feature	Specification
		AUX_AMOTF [1..0]_DP AUX_BMOTF [1..0]_DN	Used for tracking objects in motion and automatically compensating for that motion while marking. Also known as marking-on-the-fl. Compensation can be software configured to be applied to either the X- or Y-axis
	Electrical	RS-422 differential, 110-ohm termination, optional 887-ohm pullup/down resistors on the negative differential input to support TTL encoders
Safety	Laser Interlock	2 inputs. Laser interlock signals are passed through the laser interface connector and made accessible on the main board through a separate connector. The connector is optionally configurable to provide a default interlock assertion as required by an attached laser. NOTE: Signals are not actively monitored.
	Ethernet	100/1000 BaseT-compatible
Communication	Serial Ports	1 RS-232, RTS/CTS interface capable, reserved for future smart touch-panel user interface access 1 RS-232, RTS/CTS interface capable, for general use (included in the AUX connector) 1 RS-232, Rx/Tx only, for serial communication to a laser (included in the laser connector) 1 RS-485, Rx/Tx only, for smart-stepper controller access (included in the AUX connector)
Peripherals	USB	1 USB 2.0 host port for access to external Flash memory disks or other peripherals 1 USB 2.0 header for remote location of USB connector
Electrical	DC Power	+15 - 48 volts, 6W. Attached USB devices may add an additional 5W consumption. Optional 24V for optical isolation circuits

Table 2 - Technical Specifications

Category	Feature	Specification
Mechanical	Length x Width	6.0" x 4.2"
	Mounting holes	6, 0.125" diameter, see outline drawing for locations

4 INSTALLATION

4.1   STORAGE AND OPERATION ENVIRONMENT

4.1.1   Important

In order to avoid damage or destruction of mechanical components or the electronic hardware, review the following warnings during the design phase, installation and commissioning:

> ### ❗ IMPORTANT
>
> The electronic hardware contains semiconductor components that are sensitive to electrostatic discharge (ESD). Improper handling can severely damage the electronic hardware. Read Paragraph 4.1.2 for details on proper handling.

Protect the SMC from mechanical stress, humidity, dust, and thermal damage. Storage temperature is -20° C to +60° C. Operating temperature is 15 to 40° C.

The SMC is designed for installation in any convenient location in a system. Remote connection/programming and download control is achieved via an Ethernet connection.

4.1.2   Electrical ESD safety

The ScanMaster Controller is sensitive to ESD. Handle it with care; improper handling can damage to these electronics

> ### ⚠ ESD WARNING
>
> - Novanta has implemented procedures and precautions for handling these components, and we encourage our customers to do the same. Upon receiving your components, note that they are packaged in an ESD-protected container with the appropriate ESD warning labels. Keep the components sealed until they are located at a proper static control station.

A proper static control station includes:

- A soft grounded conductive tabletop or grounded conductive mat on the tabletop.
- A grounded wrist strap with the appropriate (1Meg) series resistor connected to the tabletop mat and ground.
- An adequate earth ground connection such as a water pipe or alternating current (AC) ground.
- Conductive bags, trays, totes, racks, or other containers for storage of ESD-sensitive components.
- Properly grounded power tools.

Personnel handling ESD items should wear ESD protective garments and ground straps.

Note: Equipment returned to the factory must be shipped in antistatic packaging.

4.2   MECHANICAL LAYOUT

The SMC uses standard 0.1" pitch connectors to permit direct attachment of ribbon cables or discrete terminated cables. An optional Auxiliary I/O module can be attached in a daughter-card or cable arrangement to expose signals in Phoenix Contact industrial automation connectors. Lasers are connected via a 50-pin connector located at the edge of the SMC module. Various laser adapter cards can be attached to this connector, either directly or by a ribbon cable. The following figure shows a fully assembled SMC with Auxiliary I/O and the High-power Laser Adapter for industrial laser system integration.

Installation
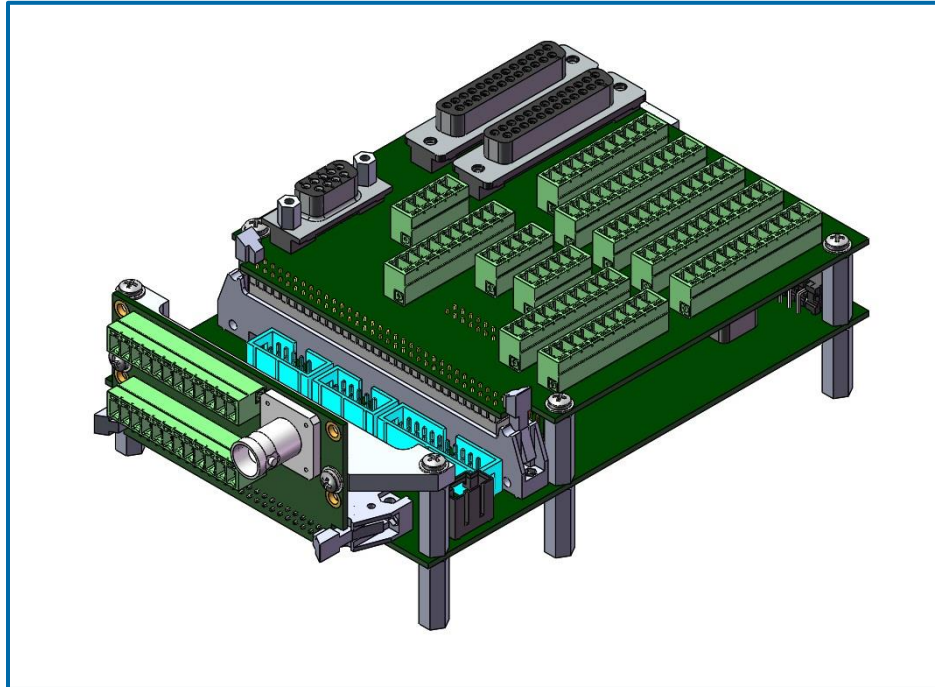
Figure 1 - SMC, Auxiliary I/O, and High-power Laser Adapter Assembly
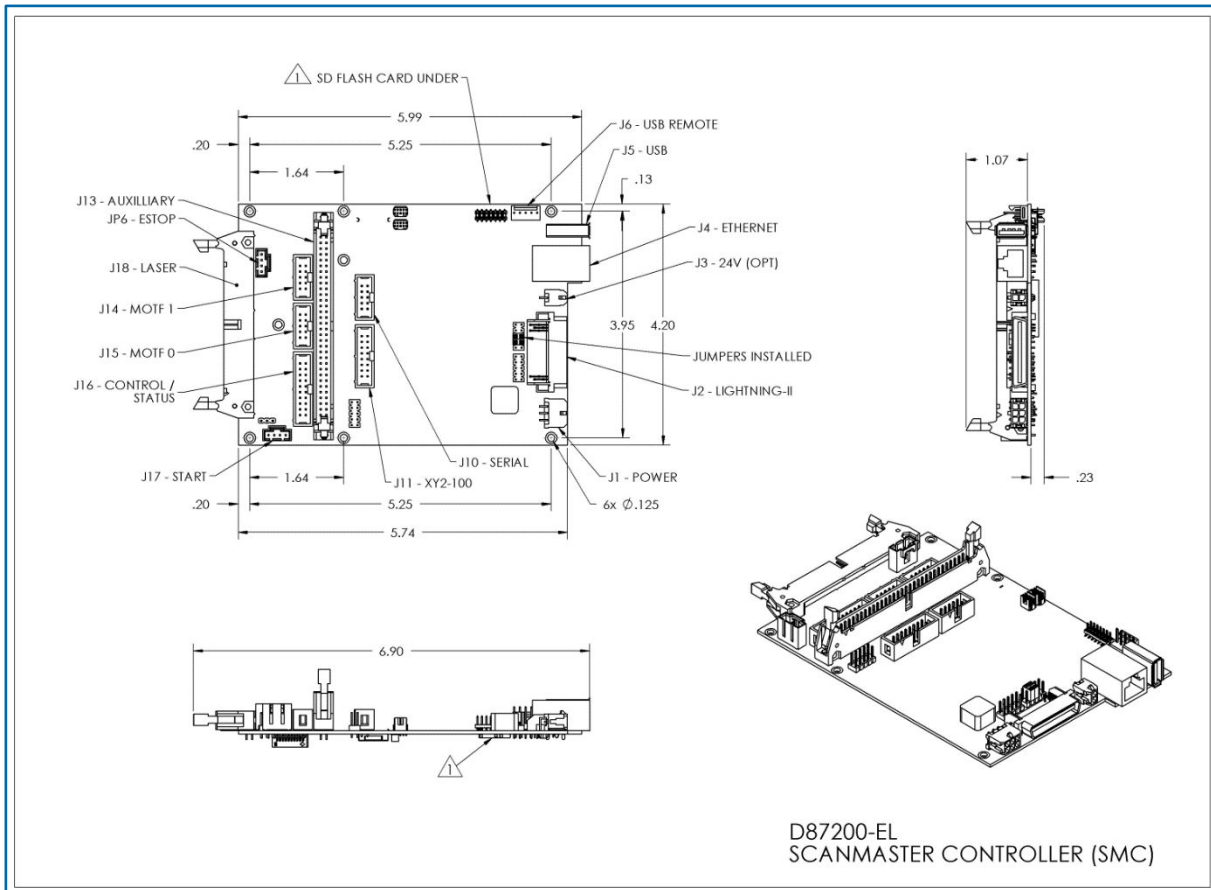
Figure 2 - SMC Main Module Mechanical Layout

4.3   SYSTEM CONFIGURATION

Figure 3 - SMC Interconnection Options on page 15 shows how the SMC can be connected to lasers, automation equipment, and scan heads.

Software support is provided through the ScanMaster Designer Editor, the ScanMaster API high-level .NET programming interface, or the ScanMaster Controller XML Software Development Kit. The last is an EC1000 backwards-compatible low-level API that uses standard XML text to configure the SMC and perform scanning jobs.

SMC-LSR-01
IPG YLP Laser interface cable

SMC-LSR-02
SPI G4 Laser adaptor

SMC-LSR-03
Synrad CO2 Laser adaptor

SMC-LSR-04
High-power Laser adaptor

SMC-LSR-05
Coherent C70 Laser adaptor

SMC-IO-01
Auxilliary I/O Module

CAT5 Ethernet cable
(commercially available)

SMC-CMD-02
XY2-100 Scanner cable

SMC-PWR-01
Power cable

SMC-CMD-01
GSBus Adaptor

+

XY2-100
Extension cable

CameraLink cable
(commercially available)

+

+

XY2-100 Based
Scan-head

CTI Lightning-2
Based Scan-head

Figure 3 - SMC Interconnection Options

4.4   CONNECTOR CROSS-REFERENCE

Table 3 - SMC Connector Part Number Reference

SMC Board Connector	Purpose	Pin spacing and Rows by Columns	Mfg.	Board Connector Part Number	Mating Cable or Connector/Pins
J1	Input power	3mm: 2 X 3	Molex	43045-0602	Novanta Cable 712-808611 Molex Part Number 43025-0600
J2	Lightning^{TM} II GSBus	0.050": 2 X 20	Molex	71661-2040	Contact Novanta applications for information.
J3	24V Opto Power	3mm: 2 X 1	Molex	43045-0202	Molex Part Number 43025-0200
J4	Ethernet	RJ-45*	Stewart	SI-51005-F	CAT-5 Ethernet Cable
J5	USB	USB Type A*	FCI	73725-0110BLF	USB 2.0 Cable
J6	USB Remote	0.1": 1 x 5	Molex	22-23-2051	Molex 50-57-9404 Pins: Molex 16-02-0103 Recommended Cable: Bulgin PX0843/A or equivalent
J10	Serial Port	0.1": 2 X 5	3M	30310-6002HB	RS-232 Connector Novanta Cable D10571-024
J11	XY2-100	0.1": 2 X 8	3M	30316-6002HB	XY2-100 Connector Novanta Cable D10578

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* This table cell contains the pin style—rather than the pin

Table 3 - SMC Connector Part Number Reference

SMC Board Connector	Purpose	Pin spacing and Rows by Columns	Mfg.	Board Connector Part Number	Mating Cable or Connector/Pins
J13	AUX I/O	0.1": 2 X 32	3M	N3764-6302RB	TE Connectivity 1-102387-2 Pins TE Connectivity 6-87756-8
J14	MOTF1	0.1": 2 X 5	3M	30310-6002HB	3M 3473-6000
J15	MOTF0	0.1": 2 X 5	3M	30310-6002HB	3M 3473-6000
J16	Control/Status	0.1": 2 X 10	3M	30320-6002HB	3M 3421-6000
J17	Start	0.1": 1 X 4	3M	705-43-0003	Molex 50-57-9404 Pins Molex 16-02-0103
J18	Laser	0.1": 2 X 25	3M	N3433-5302RB	TE Connectivity 1-102387-0 Pins TE Connectivity 6-87756-8
JP6	Estop	0.1": 1 X 4	3M	705-43-0003	Molex 50-57-9404 Pins Molex 16-02-0103

4.5   SMC MODULE CONNECTOR PINOUTS

This section contains pinout drawings and connectivity details for the SMC Board.

Note: In the following tables, each pin number in blue font (e.g.,) is a hyperlink. Click on a pin number to go to the signal conditioning diagram for that pin. (Pin numbers that appear in black font (e.g.,) are not hyperlinks.)

4.5.1   Power Signal Pinouts (Connectors J1 and J3)

The following figure contains the pinout drawing for Connector J1 and Connector J3 (Power Signals). The differential voltage between V+ and V- must be in the range of 15 – 48V. The +24V input is optional and is designed to conveniently supply digital I/O optical isolators on the Auxiliary I/O board.
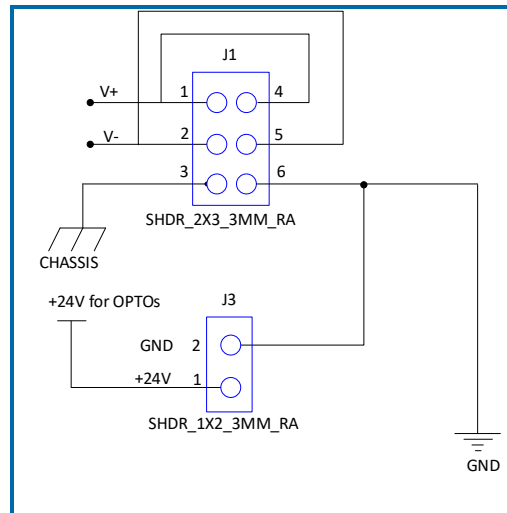
Figure 4 - Connectors J1 and J3 (Power) Pinouts

Power supply connections should be made as shown in the following figure:
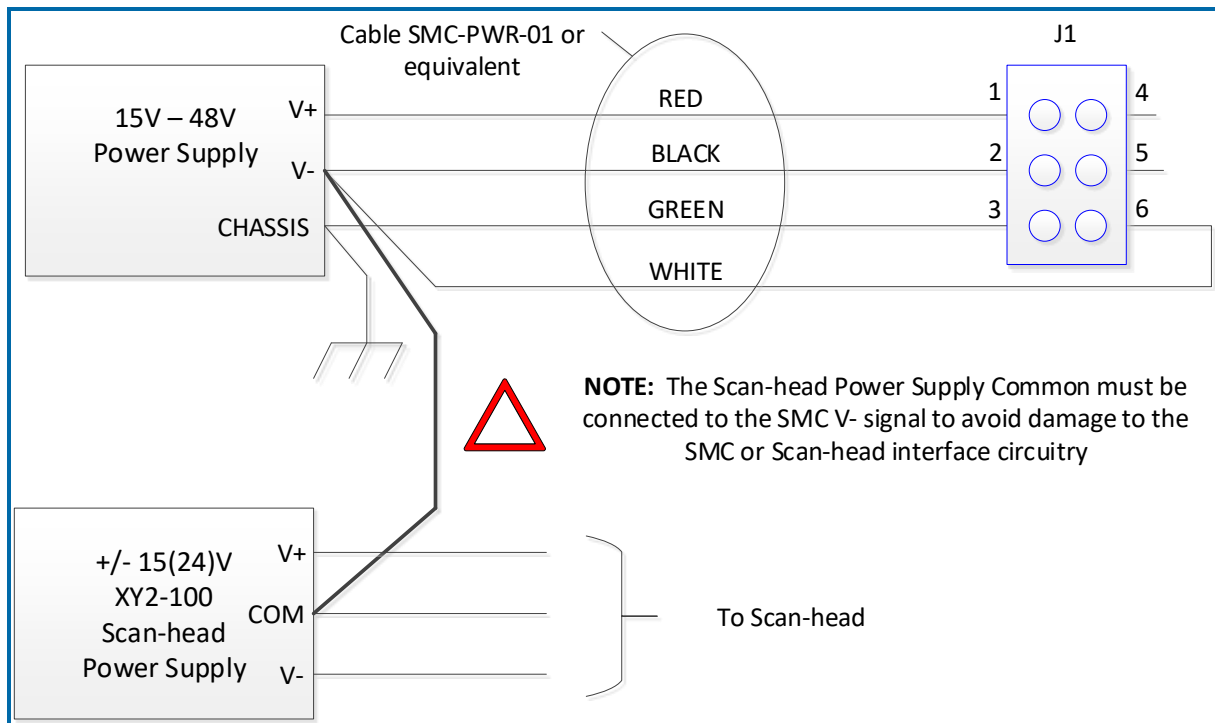
Figure 5 - Recommended Power Supply Connections

The following tables contain full descriptions of the signals on the J1 Connector and the J3 Connector.

Table 4 - Connector J1 (Power) Signal Descriptions

Pins 1 – 3		Pins 4 – 6	
V+ 15-48 Volts referenced to V-	①	④	V+ 15-48 Volts referenced to V-
V- Return for V+ **Note:** This pin and Pin 6 (GND) should be at the same voltage level.	②	⑤	V- Return for V+
CHASSIS Expected to be tied to earth ground	③	⑥	GND Digital ground reference **Note:** This pin and Pin 2 (V-) should be at the same voltage level.

Table 5 - Connector J3 (+24 Signal) Signal Descriptions

Pins 1 – 2	
+24V Customer optical isolator supply	①
GND Digital ground reference	②

4.5.2   Serial RS-232 Signal Pinouts (Connector J10)

The following figure contains the pinout drawing for Connector J10 (RS-232).

Note: This pinout does not match the 10-pin serial header pinout of all PC motherboards.
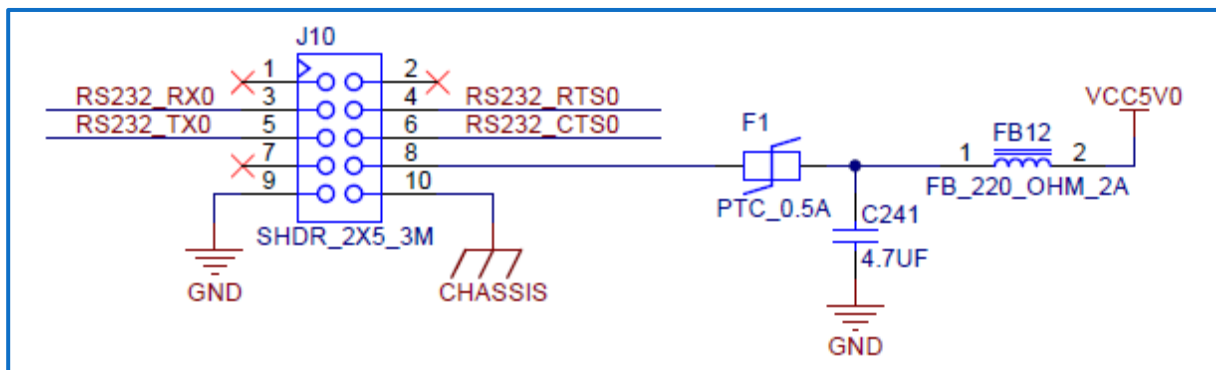
Figure 6 - Connector J10 (RS-232) Pinouts

The following table contains a full description of the signal for each pin in the J10 Connector.

Table 6 - Connector J10 (RS-232) Signal Descriptions

Odd-numbered Pins (1 – 9)	Even-numbered Pins (2 – 10)
N/C — ① Reserved for future use	② — N/C Reserved for future use
RS232_RX0 — ③ Data input from connected device	④ — RS232_RTS0 Request to send to connected device
RS232_TX0 — ⑤ Data output to connected device	⑥ — RS232_CTS0 Clear to send from connected device
N/C — ⑦ Reserved for future use	⑧ — VCC5V0 Fused 5V
GND — ⑨ Digital ground reference	⑩ — CHASSIS Expected to be tied to earth ground

4.5.3 XY2-100 Signal Pinouts (Connector J11)

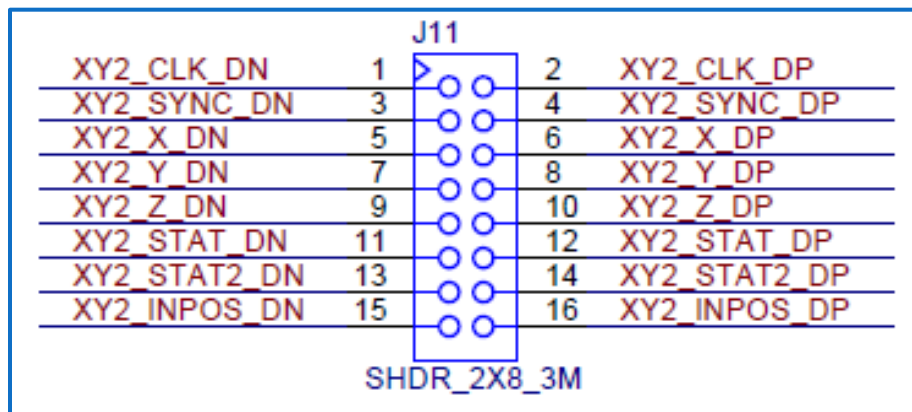The following figure contains the pinout drawing for Connector J11 (XY2-100).

Figure 7 - Connector J11 (XY2-100) Pinouts

The following table contains a full description of the signal for each pin in the J11 Connector.

Table 7 - Connector J11 (XY2-100) Signal Descriptions

Odd-numbered Pins (1 – 15)		Even-numbered Pins (2 – 16)	
XY2_CLK_DN 2MHz Clock - negative	1	2	XY2_CLK_DP 2MHz Clock - positive
XY2_SYNC_DN Frame sync - negative	3	4	XY2_SYNC_DP Frame sync - positive
XY2_X_DN X Data - negative	5	6	XY2_X_DP X Data - positive
XY2_Y_DN Y Data - negative	7	8	XY2_Y_DP Y Data - positive
XY2_Z_DN Z Data - negative	9	10	XY2_Z_DP Z Data - positive
XY2_STAT_DN Status Data - negative	11	12	XY2_STAT_DP Status Data - positive
XY2_STAT2_DN Status 2 Data – negative (Reserved)	13	14	XY2_STAT2_DP Status 2 Data – positive (Reserved)
XY2_INPOS_DN In position – negative (Lightning^{TM} II)	15	16	XY2_INPOS_DP In position – positive (Lightning^{TM} II)

4.5.4   Auxiliary Signal Pinouts (Connector J13)

The following figure contains the pinout drawing for Connector J13 (Auxiliary).

Note: This connector uses ejectors to facilitate removal of an attached cable or module. Care must be taken during insertion to avoid damaging the ejectors.
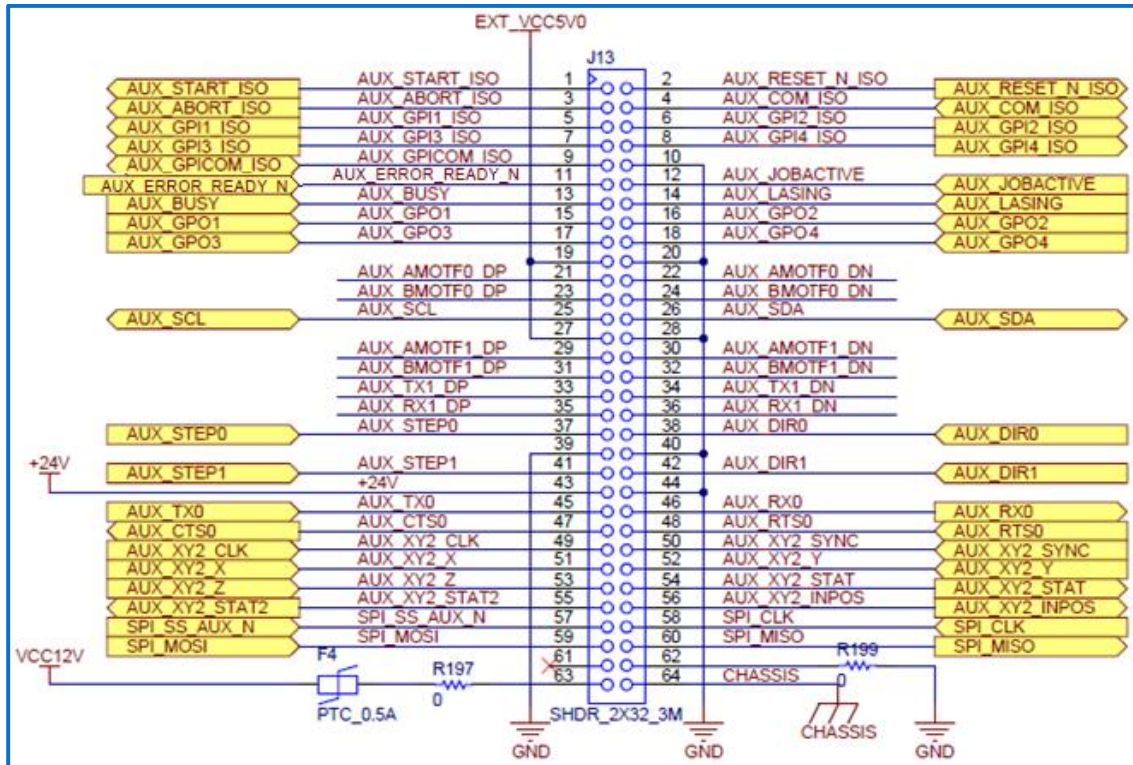
Figure 8 - Connector J13 (Auxiliary) Pinouts

The following table contains a full description of the signal for each pin in the J13 Connector.

Table 8 - Connector J13 (Auxiliary) Signal Descriptions

Odd-numbered Pins (1 – 63)	Even-numbered Pins (2 – 64)
AUX_START_ISO ⎯⎯ ① A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment. **Note:** This function can also be achieved using the AUX_START and START signals.	② ⎯⎯ AUX_RESET_N_ISO Causes the card to execute a soft reset forcing a complete re-initialization of the firmware.
AUX_ABORT_ISO ⎯⎯ ③ Causes the job execution control logic to abort the current job and return to an idle state. **Note:** This signal is useful upon detection of an interlock break.	④ ⎯⎯ AUX_COM_ISO Optical isolator common for signals AUX_START_ISO, AUX_RESET_N_ISO, and AUX_ABORT_ISO

Table 8 - Connector J13 (Auxiliary) Signal Descriptions

Odd-numbered Pins (1 – 63)		Even-numbered Pins (2 – 64)	
AUX_GPI1_ISO A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment.	5	6	AUX_GPI2_ISO A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment.
AUX_GPI3_ISO A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment.	7	8	AUX_GPI4_ISO A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment.
AUX_GPICOM_ISO Optical isolator common for signals AUX_GPI[1..4]_ISO	9	10	GND Digital ground reference
AUX_ERROR_READY_N When de-asserted (LOW) indicates that system is booted up and ready for normal operation. Is asserted (HIGH) on power-up or after a HW exception is detected.	11	12	AUX_JOBACTIVE Asserted if a job is active but not necessarily marking yet (e.g., waiting on a trigger input).
AUX_BUSY Asserted when a BeginJob instruction is executed; de-asserted when an EndJob instruction is executed.	13	14	AUX_LASING Asserted when marking is in progress. It is de-asserted when an EndJob instruction is executed.
AUX_GPO1 A marking job WriteDigital instruction may specify the state of this signal.	15	16	AUX_GPO2 A marking job WriteDigital instruction may specify the state of this signal.
AUX_GPO3 A marking job WriteDigital instruction may specify the state of this signal.	17	18	AUX_GPO4 A marking job WriteDigital instruction may specify the state of this signal.
EXT-VCC5V0 Fused 5 Volts available for logic on an Auxiliary I/O board	19	20	GND Digital ground reference

Table 8 - Connector J13 (Auxiliary) Signal Descriptions

Odd-numbered Pins (1 – 63)			Even-numbered Pins (2 – 64)
AUX_AMOTF0_DP Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "A" phase differential signal or a 5V TTL signal.	21	22	AUX_AMOTF0_DN Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "A" phase differential signal.
AUX_BMOTF0_DP Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "B" phase differential signal or a 5V TTL signal.	23	24	AUX_BMOTF0_DN Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "B" phase differential signal.
AUX_SCL Reserved for future use	25	26	AUX_SDA Reserved for future use
EXT-VCC5V0 Fused 5 Volts available for logic on an Auxiliary I/O board	27	28	GND Digital ground reference
AUX_AMOTF1_DP Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "A" phase differential signal or a 5V TTL signal.	29	30	AUX_AMOTF1_DN Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "A" phase differential signal.
AUX_BMOTF1_DP Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "B" phase differential signal or a 5V TTL signal.	31	32	AUX_BMOTF1_DN Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "B" phase differential signal.
AUX_TX1_DP Differential RS-485 serial transmit data to smart-stepper motor controllers - positive	33	34	AUX_TX1_DN Differential RS-485 serial transmit data to smart-stepper motor controllers - negative
AUX_RX1_DP Differential RS-485 serial receive data from smart-stepper motor controllers - positive	35	36	AUX_RX1_DN Differential RS-485 serial receive data from smart-stepper motor controllers - negative

Table 8 - Connector J13 (Auxiliary) Signal Descriptions

Odd-numbered Pins (1 – 63)		Even-numbered Pins (2 – 64)
AUX_STEP0 Step control signal for a programmable stepper motor	37 ⬩ 38	AUX_DIR0 Direction control signal for a programmable stepper motor
GND Digital ground reference	39 ⬩ 40	GND Digital ground reference
AUX_STEP1 Step control signal for a programmable stepper motor	41 ⬩ 42	AUX_DIR1 Direction control signal for a programmable stepper motor
+24V Customer-supplied optical isolator voltage. Same as J3 pin 1	43 ⬩ 44	GND Digital ground reference
AUX_TX0 Differential serial port interface for smart-stepper motor controllers	45 ⬩ 46	AUX_RX0 Differential serial port interface for smart-stepper motor controllers
AUX_CTS0 Serial port Clear to Send (input).	47 ⬩ 48	AUX_RTS0 Serial port Request to Send (output).
AUX_XY2_CLK Port 2 XY2-100 Clock **Note:** Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.	49 ⬩ 50	AUX_XY2_SYNC Port 2 XY2-100 Sync Note: Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.
AUX_XY2_X Port 2 XY2-100 X Data **Note:** Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.	51 ⬩ 52	AUX_XY2_Y Port 2 XY2-100 Y Data Note: Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.

Table 8 - Connector J13 (Auxiliary) Signal Descriptions

Odd-numbered Pins (1 – 63)		Even-numbered Pins (2 – 64)	
AUX_XY2_Z Port 2 XY2-100 Z Data **Note:** Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.	53	54	AUX_XY2_STAT Port 2 XY2-100 Status Note: Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.
AUX_XY2_STAT2 Port 2 XY2-100 Status 2 (reserved) **Note:** Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.	55	56	AUX_XY2_INPOS Port 2 XY2-100 In Position **Note:** Before use with a scan head this signal must be signal conditioned with differential drivers and receivers.
SPI_SS_AUX_N Reserved for future use	57	58	SPI_CLK Reserved for future use
SPI_MOSI Reserved for future use	59	60	SPI_MISO Reserved for future use
N/C Reserved for future use	61	62	GND Digital ground reference
VCC12V 12V source for use with analog circuitry	63	64	CHASSIS Expected to be tied to earth ground

4.5.5   MOTF-1 Signal Pinouts (Connector J14)

The following figure contains the pinout drawing for Connector J14 (MOTF-1).
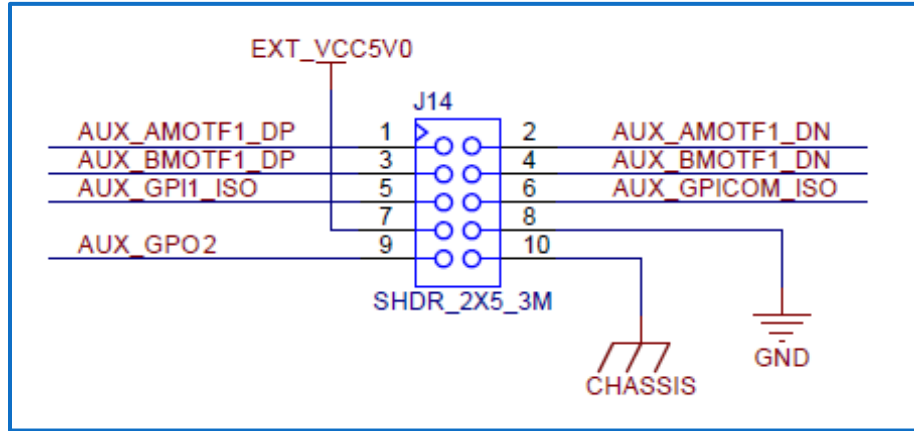
Figure 9 - Connector J14 (MOTF-1) Pinouts

The following table contains a full description of the signal for each pin in the J14 Connector. These signals are replicated from the Auxiliary I/O connector J13.

Odd-numbered Pins (1 –9)	Even-numbered Pins (2 – 10)
AUX_AMOTF1_DP Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "A" phase differential signal or a 5V TTL signal. ⓵	② AUX_AMOTF1_DN Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "A" phase differential signal.
AUX_BMOTF1_DP Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "B" phase differential signal or a 5V TTL signal. ⓷	④ AUX_BMOTF1_DN Secondary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "B" phase differential signal.
AUX_GPI1_ISO External trigger input. ⑤	⑥ AUX_GPICOM_ISO Isolator common for General Purpose inputs
EXT_VCC5V0 5 Volts available for encoder power ⑦	⑧ GND Digital ground reference
AUX_GPO2 A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment. ⑨	⑩ CHASSIS Expected to be tied to earth ground

4.5.6 MOTF-0 Signal Pinouts (Connector J15)

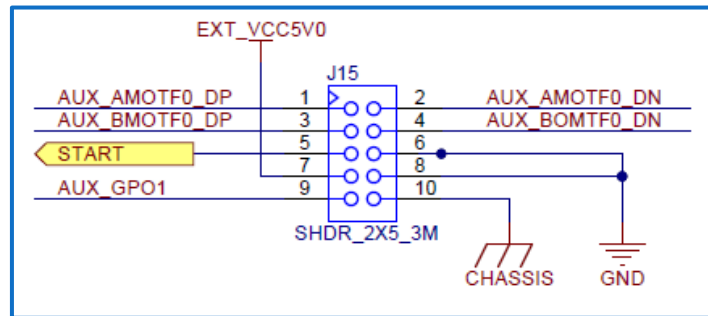The following figure contains the pinout drawing for Connector J15 (MOTF-0)

Figure 10 - Connector J15 (MOTF-0) Pinouts

The following table contains a full description of the signal for each pin in the J15 Connector. These signals are replicated from the Auxiliary I/O connector J13.

Table 10 - Connector J15 (MOTF-0) Signal Descriptions

Odd-numbered Pins (1 –9)	Even-numbered Pins (2 – 10)
AUX_AMOTF0_DP ⑴ Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "A" phase differential signal or a 5V TTL signal.	⑵ AUX_AMOTF0_DN Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "A" phase differential signal.
AUX_BMOTF0_DP ⑶ Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 positive "B" phase differential signal or a 5V TTL signal.	⑷ AUX_BMOTF0_DN Primary mark-on-the-fly encoder input. Expected to be connected to an RS-422 negative "B" phase differential signal.
START External trigger input ⑸ Note: This function can also be achieved using the AUX_START_ISO and AUX_START signals.	⑹ GND Digital ground reference
EXT_VCC5V0 ⑺ 5 Volts available for encoder power	⑻ GND Digital ground reference
AUX_GPO1 General purpose output ⑼	⑽ CHASSIS Expected to be tied to earth ground

4.5.7 Control Signal Pinouts (Connector J16)

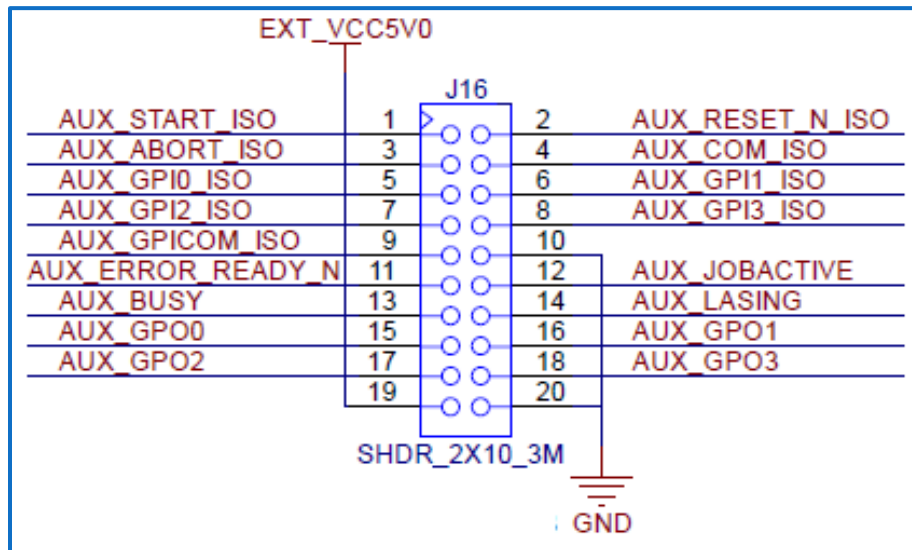The following figure contains the pinout drawing for Connector J16 (Control Signals).

Figure 11 - Connector J16 (Control) Pinouts

The following table contains a full description of the signal for each pin in the J16 Connector.

Table 11 - Connector J16 (Control) Signal Descriptions

Odd-numbered Pins (1 – 19)	Even-numbered Pins (2 – 20)
AUX_START_ISO — (1) A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment. Note: This function can also be achieved using the AUX_START and START signals.	(2) — AUX_RESET_N_ISO Causes the SMC to execute a soft reset forcing a complete re-initialization of the firmware. This signal must be actively driven to activate: If AUX_COM_ISO is tied to GND then drive to VCC. If AUX_COM_ISO is tied to VCC then drive to GND. Note: The board may take up to 30 seconds to reinitialize.
AUX_ABORT_ISO — (3) Causes the job execution control logic to abort the current job and return to an idle state. This signal must be activated using the Interlock enable commands of the SMC software. See the SMC Software Reference Manual for details. Note: This signal is useful upon detection of an interlock break.	(4) — AUX_COM_ISO Optical isolator common for signals AUX_START_ISO, AUX_RESET_N_ISO, and AUX_ABORT_ISO
AUX_GPI1_ISO — (5) A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment.	(6) — AUX_GPI2_ISO A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment.
AUX_GPI3_ISO — (7) A marking job may contain an instruction that causes a pause in execution until this signal is asserted by external equipment.	(8) — AUX_GPI4_ISO A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment.
AUX_GPICOM_ISO — (9) Isolator common for General Purpose inputs	(10) — GND Digital ground reference

Table 11 - Connector J16 (Control) Signal Descriptions

Odd-numbered Pins (1 – 19)		Even-numbered Pins (2 – 20)	
AUX_ERROR_READY_N When de-asserted (LOW) indicates that system is booted up and ready for normal operation. Is asserted (HIGH) on power-up or after a HW exception is detected.	11	12	AUX_JOBACTIVE Asserted if a job is active but not necessarily marking yet (e.g., waiting on a trigger input).
AUX_BUSY Asserted when a BeginJob instruction is executed; de-asserted when an EndJob instruction is executed.	13	14	AUX_LASING Asserted when marking is in progress.
AUX_GPO1 A marking job instruction may specify the state of this signal.	15	16	AUX_GPO2 A marking job instruction may specify the state of this signal.
AUX_GPO3 A marking job instruction may specify the state of this signal.	17	18	AUX_GPO4 A marking job instruction may specify the state of this signal.
EXT_VCC5V0 5 Volts available for logic on customer board	19	20	GND Digital ground reference

4.5.8   External Trigger Pinouts (Connector J17)

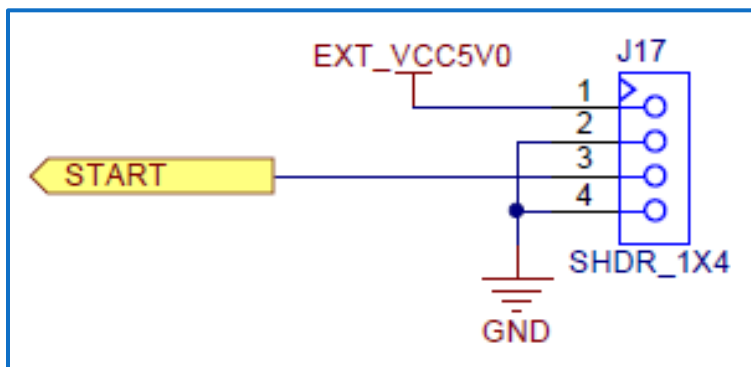The following figure contains the pinout drawing for Connector J17 (External Trigger).

Figure 12 - Connector J17 (External Trigger) Pinouts

The following table contains a full description of the signal for each pin in the J17 Connector.

Table 12 - Connector J17 (External Trigger) Signal Descriptions

Pins 1 – 4		
EXT_VCC5V0 5 Volts available for logic on customer board	————————	1
GND Digital ground reference	————————	2
START A marking job may contain an instruction that pauses execution until this signal is asserted by external equipment. Note: This function can also be achieved using the AUX_START and AUX_START_ISO signals.	————————	3
GND Digital ground reference	————————	4

4.5.9   Laser Signal Pinouts (Connector J18)

The following figure contains the pinout drawing for Connector J18 (Laser Signals).

Note: This connector uses ejectors to facilitate removal of an attached cable or laser adapter module. Care must be taken during insertion to avoid damaging the ejectors.
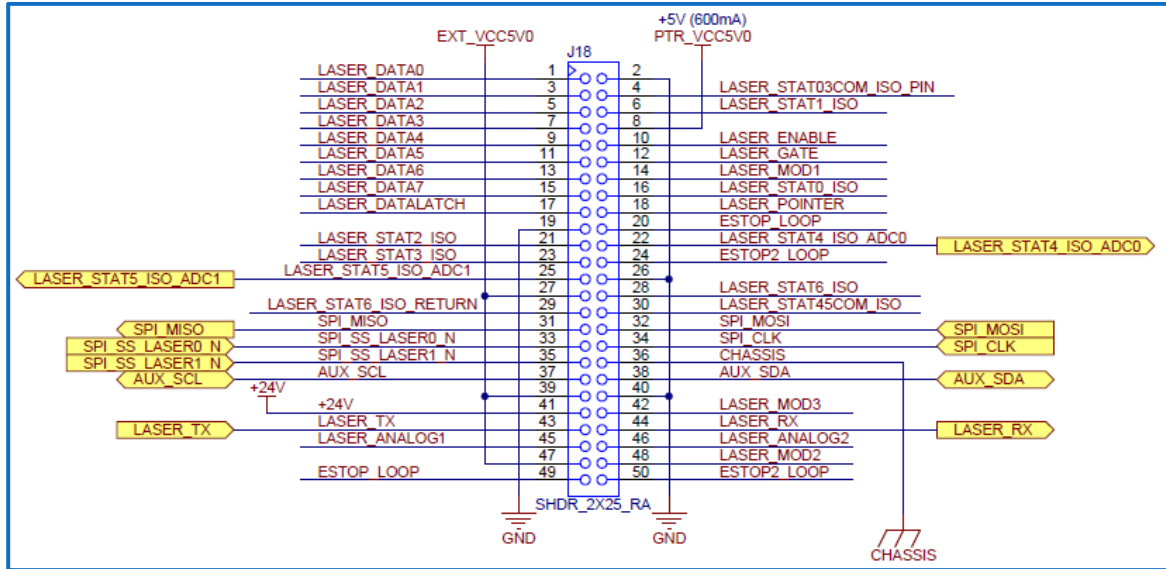
Figure 13 - Connector J18 (Laser) Pinouts

The following table contains a full description of the signal for each pin in the J18 Connector.

Table 13 - Connector J18 (Laser) Signal Descriptions

Odd-numbered Pins (1 – 49)		Even-numbered Pins (2 – 50)	
LASER_DATA0 Digital data representing a laser power setting	1	2	GND Digital ground reference
LASER_DATA1 Digital data representing a laser power setting	3	4	LASER_STAT03COM_ISO_PIN Optical isolation common for status signals 0 - 3
LASER_DATA2 Digital data representing a laser power setting	5	6	LASER_STAT1_ISO General purpose status read back. See notes on Interlock behavior, below.
LASER_DATA3 Digital data representing a laser power setting	7	8	PTR_VCC5V0 5 Volts available for laser pointer power
LASER_DATA4 Digital data representing a laser power setting	9	10	LASER_ENABLE Asserted a programmable time prior to a sequence of mark instructions; de-asserted after a programmable period of laser inactivity.

Table 13 - Connector J18 (Laser) Signal Descriptions

Odd-numbered Pins (1 – 49)	Even-numbered Pins (2 – 50)
LASER_DATA5 — (11) Digital data representing a laser power setting	(12) — LASER_GATE Asserted when the laser is active.
LASER_DATA6 — (13) Digital data representing a laser power setting	(14) — LASER_MOD1 Programmable laser modulation or Q-switch pulse stream
LASER_DATA7 — (15) Digital data representing a laser power setting	(16) — LASER_STAT0_ISO General purpose status read back. See notes on Interlock behavior, below.
LASER_DATALATCH — (17) Strobe signal asserted when the LASER_DATA[7 - 0] value changes	(18) — LASER_POINTER Laser pointer control signal
GND — 19 Digital ground reference	20 — ESTOP_LOOP Used to access laser interlock
LASER_STAT2_ISO — (21) General purpose status read back. See notes on Interlock behavior, below.	(22) — LASER_STAT4_ISO_ADC0 Dual purpose pin for accessing digital status or an analog input
LASER_STAT3_ISO — (23) General purpose status read back	24 — ESTOP2_LOOP Used to access laser interlock.
LASER_STAT5_ISO_ADC1 — (25) Dual purpose pin for accessing digital status or an analog input	26 — GND Digital ground reference
EXT_VCC5V0 — 27 5 Volt source for use in laser signal conditioning circuitry	(28) — LASER_STAT6_ISO High-speed laser sync input
LASER_STAT6_ISO_RETURN — (29) Current return for LASER_STAT6	30 — LASER_STAT45COM_ISO Optical isolator common for signals LASER_STAT4_ISO_ADC0 and LASER_STAT5_ISO_ADC1
SPI_MISO — 31 Reserved for future use	32 — SPI_MOSI Reserved for future use
SPI_SS_LASER0_N — 33 Reserved for future use	34 — SPI_CLK Reserved for future use

Table 13 - Connector J18 (Laser) Signal Descriptions

Odd-numbered Pins (1 – 49)			Even-numbered Pins (2 – 50)	
SPI_SS_LASER1_N Reserved for future use	35	36	CHASSIS Expected to be tied to earth ground	
AUX_SCL Reserved for future use	37	38	AUX_SDA Reserved for future use	
EXT_VCC5V0 5 Volt source for use in laser signal conditioning circuitry	39	40	GND Digital ground reference	
+24V Connected to customer-supplied 24 volts on Connector J3 NOTE: Current limiting is not provided.	41	42	LASER_MOD3 Programmable laser modulation; used for first pulse suppression or as a programmable modulation source for synchronous operation.	
LASER_TX Provided for configuration and status access to RS-232-equipped lasers	43	44	LASER_RX Provided for configuration and status access to RS-232-equipped lasers	
LASER_ANALOG1 Normally mapped to the laser power setting; can be optionally made independent.	45	46	LASER_ANALOG2 Independent setting for laser power	
EXT_VCC5V0 5 Volt source for use in laser signal conditioning circuitry	47	48	LASER_MOD2 Programmable laser, 180 degrees phase shifted from LASER_MOD2	
ESTOP_LOOP Used to access laser interlock	49	50	ESTOP2_LOOP Used to access laser interlock	

4.5.10 Notes on Interlock Setup

LASER_STAT[2 – 0]_ISO can be configured by the software to generate an interlock exception if an inappropriate signal level is received. See the SMC Software Reference Manual for details on how to configure this behavior.

For proper enabling of the LASER_STAT signals, the LASER_STAT03COM_ISO_PIN, LASER_STAT45COM_ISO and JP3 must be configured correctly. In the standard SMC configuration, LASER_STAT03COM_ISO and LASER_STAT45COM_ISO are connected internally as shown below. JP3 provides a convenient means for routing the combined LASER_STAT commons to SMC ground by putting a jumper between pins 2 and 3. In this configuration, it is expected that the customer ground and SMC ground are connected together at the power supplies, and the LASER_STAT signals are driven actively high (5 – 24V) to turn on the signal.

If no jumper is provided, then the signal LASER_STAT45COM_ISO (J18.30) must be connected to the customer system ground or power, depending on the sense of the LASER_STAT signal logic at the customer end. For instance, if the status signals are actively driven high to assert a logic level (positive logic) then connect this pin (J18.30) to the customer GND. If the status signals are sinking to assert (negative logic), then connect this pin to the customer 24V supply. In these cases, the SMC ground and the customer grounds are isolated for these purposes.
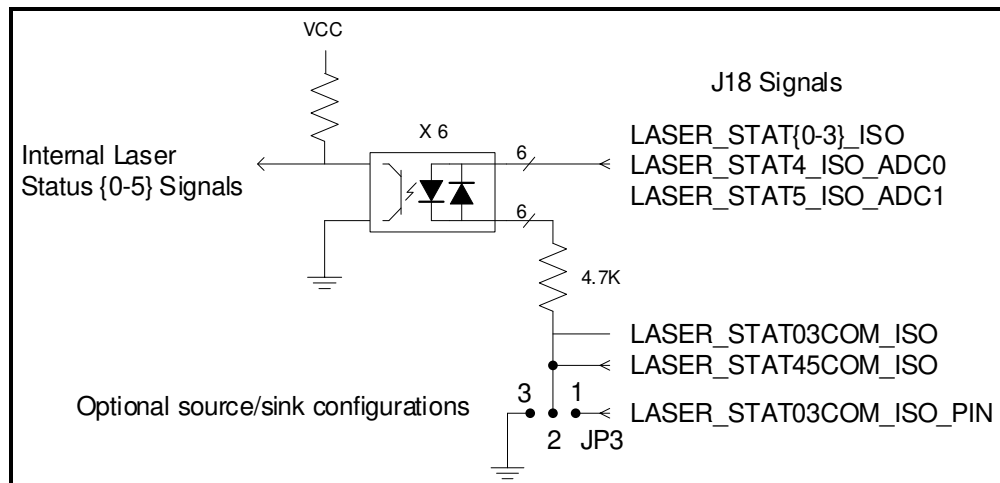

Figure 14 - LASER_STAT Signal Conditioning

The AUX_ABORT signal is also treated as an interlock signal. See section 4.6.5 System Control Inputs – J13 and J16, for details on how the signals are interfaced to the SMC. As with the LASER_STAT45COM_ISO signal, the signal AUX_COM_ISO (J11.4) must be connected to the customer system ground or power, depending on the sense of the AUX_ABORT and other control signal logic at the customer end.

4.5.11 E-STOP (Connector JP6)

This connector provides access on the SMC base board to the laser connector J18 ESTOP_LOOP and ESTOP2_LOOP signals. The ESTOP_LOOP pin on Connector JP6 goes to Pins 20 & 49 on Connector J18. Likewise, The ESTOP2_LOOP pin on Connector JP6 goes to Pins 24 & 50 on Connector J18

This connector permits a PLC to access to the Interlock/Safety control signal for the laser when direct cabling between the laser and the SMC (e.g. IPG-YLP) or SMC Laser Adapter (e.g. SPI) is used. VCC and GND signal are provided on the connector to facilitate pulling the ESTOP_LOOP to an appropriate state when the interlock is being bypassed.

The following figure contains the pinout drawing for the E-STOP connector JP6.

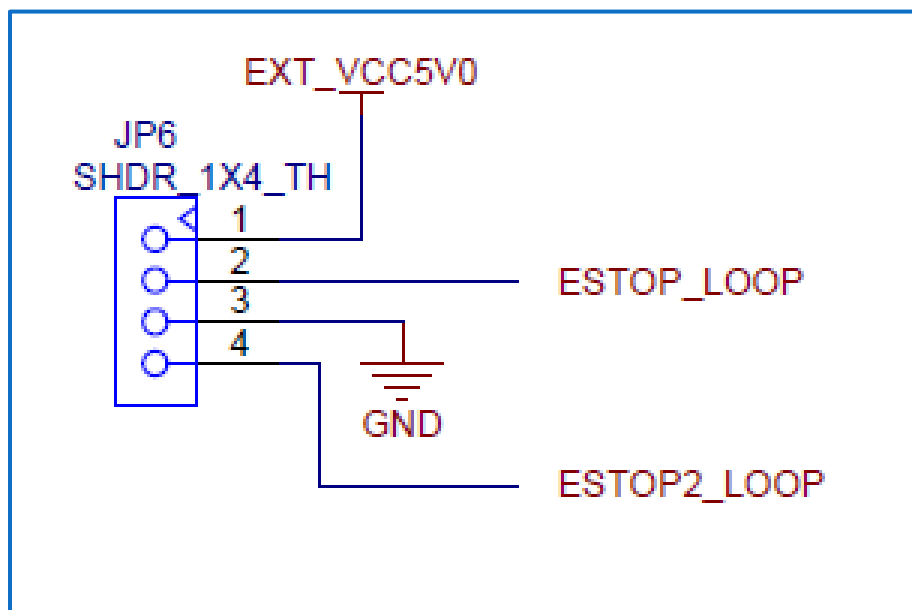**Note**: There is no active monitoring by the SMC of the ESTOP_LOOP signal.

Figure 15 - Connector JP6 (E-STOP) Pinouts

The following table contains a full description of the signal for each pin in the JP6 Connector.

Table 14 - Connector JP6 (E-STOP) Signal Descriptions

Pins 1 – 4
EXT_VCC5V0 _____ ① SMC supplied +5V source
ESTOP_LOOP _____ ② Signal ESTOP_LOOP on J18 pins 20 and 49
GND _____ ③ Digital ground reference
ESTOP2_LOOP _____ ④ Signal ESTOP2_LOOP on J18 pins 24 and 50

4.5.12 USB Port 1 Pinouts (Connector J5)

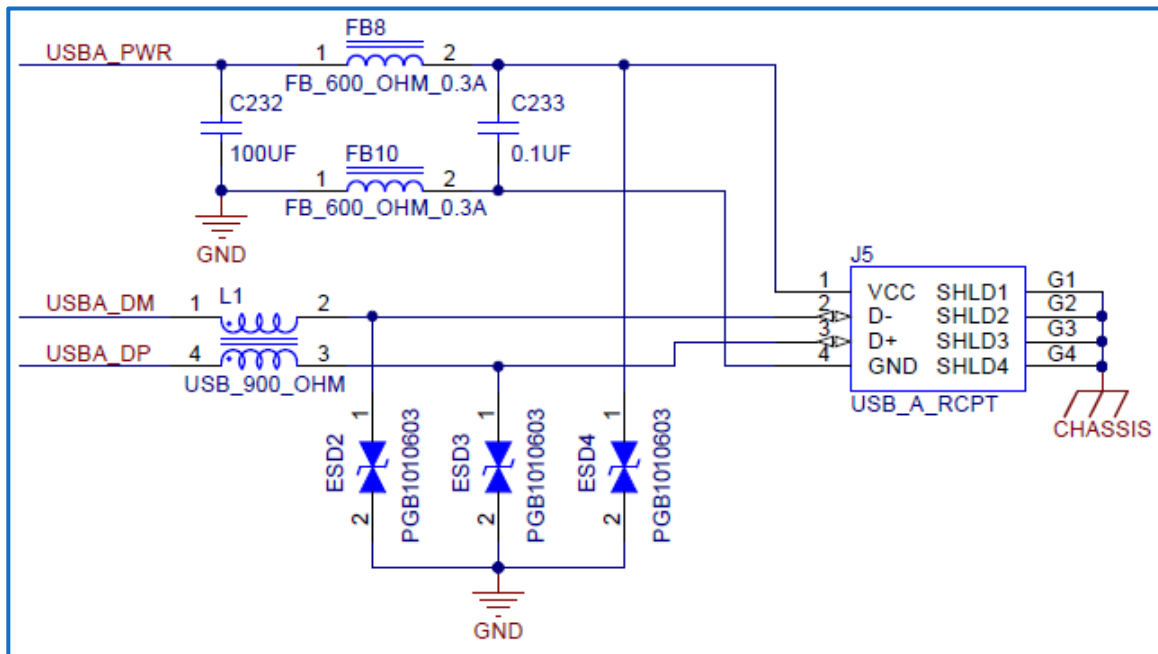The following figure contains the pinout drawing for the standard USB Port 1 Connector J5.

Figure 16 - Connector J5 (USB Port 1 Pinouts)

The following table contains a full description of the signal for each pin in the J5 Connector.

Table 15 - Connector J5 (USB Port 1 Header) Signal Descriptions

Pins 1 – 4
USBA_PWR ———————— ① Standard USB Type A power pin
USBA_DM ———————— ② Standard USB Type A data minus
USBA_DP ———————— ③ Standard USB Type A data plus
GND ———————— ④ Standard USB Type A Ground

4.5.13 USB Port 2 Header Pinouts (Connector J6)

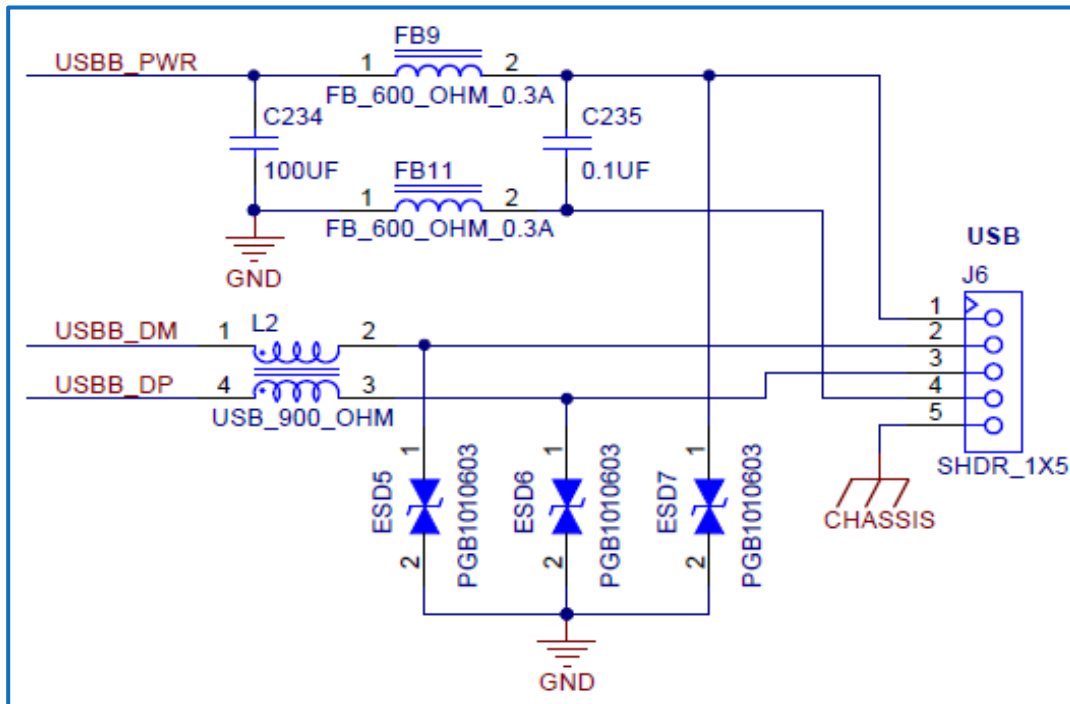The following figure contains the pinout drawing for the optional Connector J6 (USB Port 2 Header).

Figure 17 - Connector J6 (USB Port 2 Header) Pinouts

The following table contains a full description of the signal for each pin in the J6 Connector.

Table 16 - Connector J6 (USB Port 2 Header) Signal Descriptions

Pins 1 – 5
USBB_PWR Standard USB Port 2 power pin   1
USBB_DM Standard USB Port 2 data minus   2
USBB_DP Standard USB Port 2 data plus   3
GND Standard USB Port 2 Ground   4
CHASSIS Expected to be tied to earth ground   5

4.6   SIGNAL CONDITIONING

The following figures illustrate the signal conditioning for the various signal groups of the SM.

4.6.1   Mark-on-The-Fly Inputs – J14 and J15
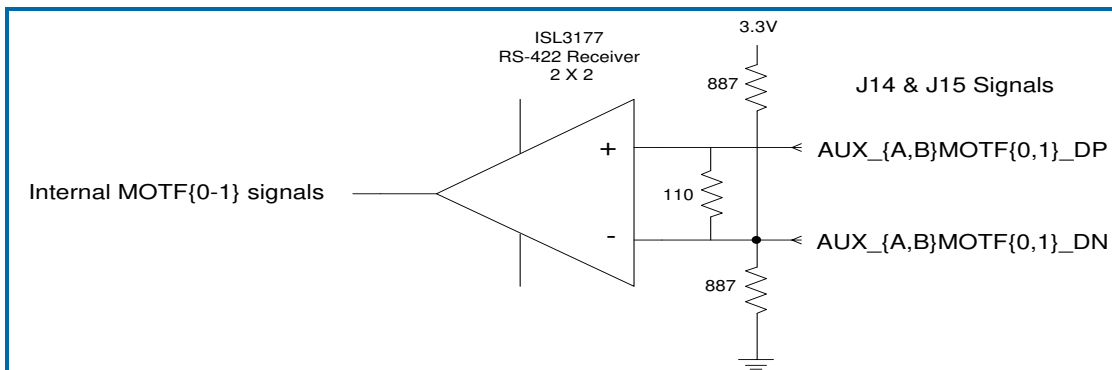
Figure 18 - Signal Conditioning for Mark-on-the-Fly Inputs (J14 and J15)

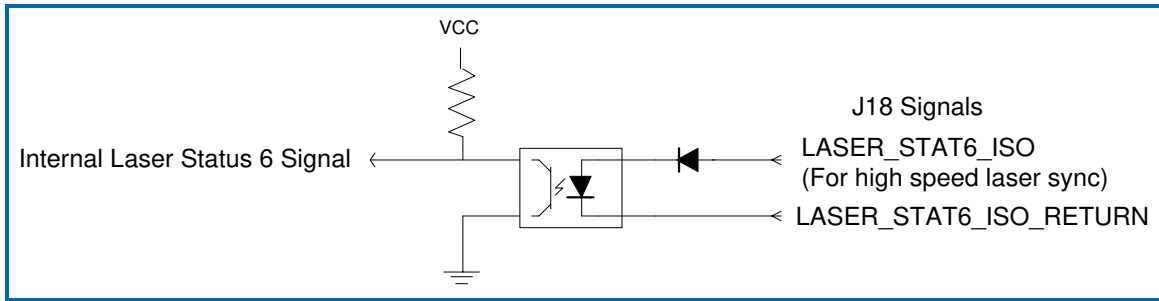### 4.6.2   High-speed Laser Synchronization – J18

Figure 19 - Signal Conditioning for High-speed Laser Synchronization (J18)

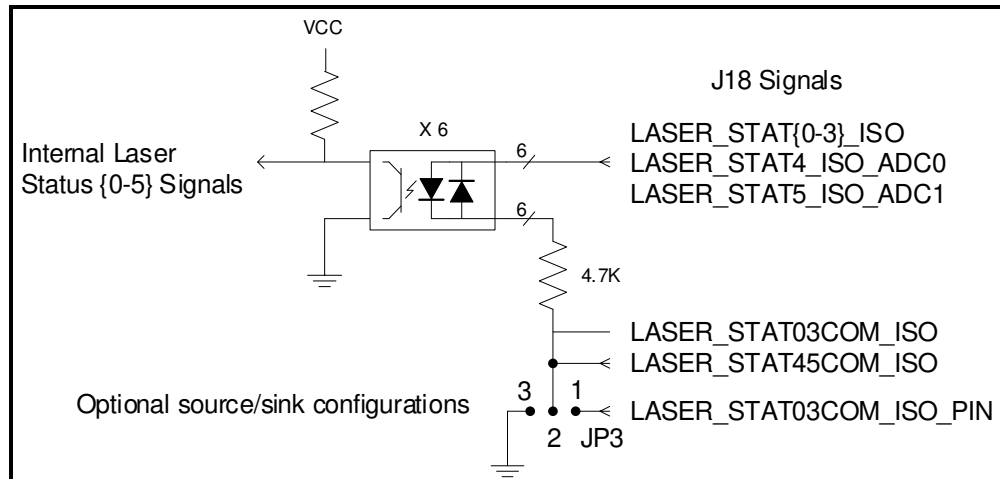### 4.6.3   Laser Status 0-5 Signals – J18

Figure 20 - Signal Conditioning for Laser Status 0-5 Signals (J18)

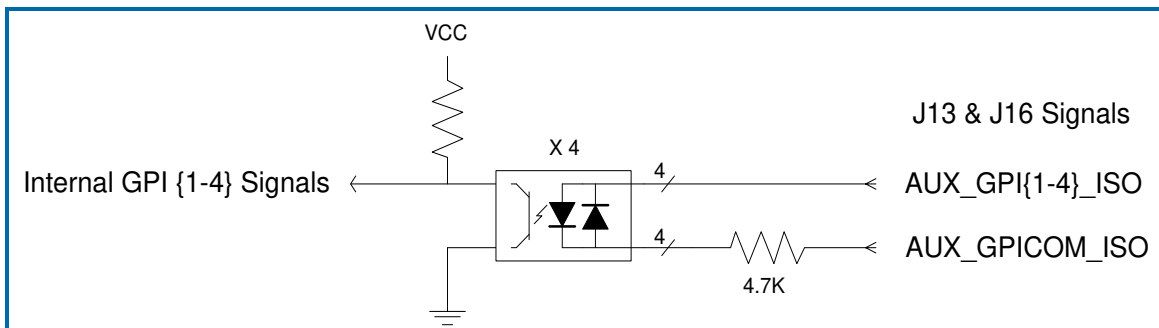### 4.6.4   General Purpose Inputs – J13 and J16

Figure 21 - Signal Conditioning for General Purpose Inputs (J13 and J16)

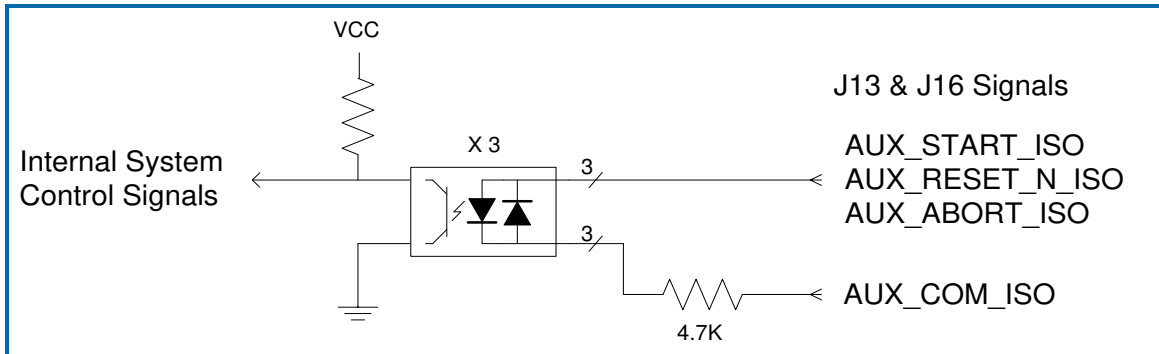### 4.6.5   System Control Inputs – J13 and J16

Figure 22 - Signal Conditioning for System Control Inputs (J13 and J16)
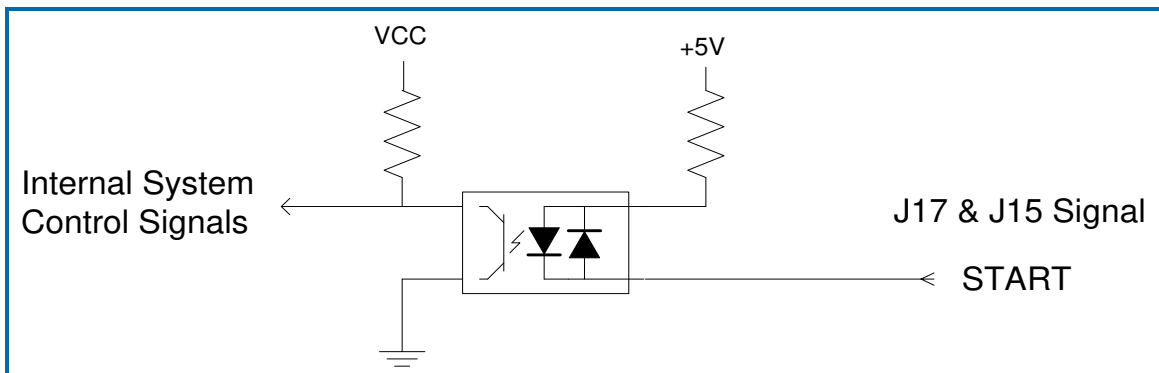
4.6.6   START Input – J17 and J15

Figure 23 - Signal Conditioning for START Input (J17 and J15)

4.6.7   System Control Outputs and General Purpose Outputs – J13 and J16
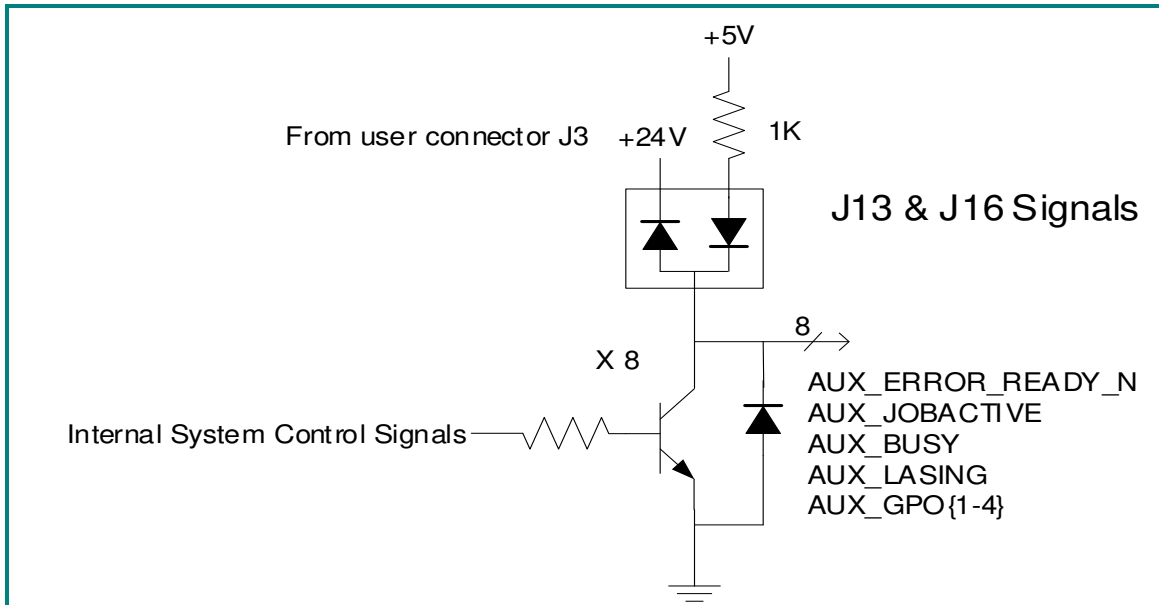

Figure 24 - Signal Conditioning for System Control and General O/P (J13 & J16)

Note: These outputs are pulled up to +5V through a diode for convenience of driving lightly loaded TTL devices. They are intended however to be used as sinking drivers where the load to be driven has one end attached to 24V. The drivers will then switch the connected end of the load to ground. The drivers can sink up to 500mA of current.
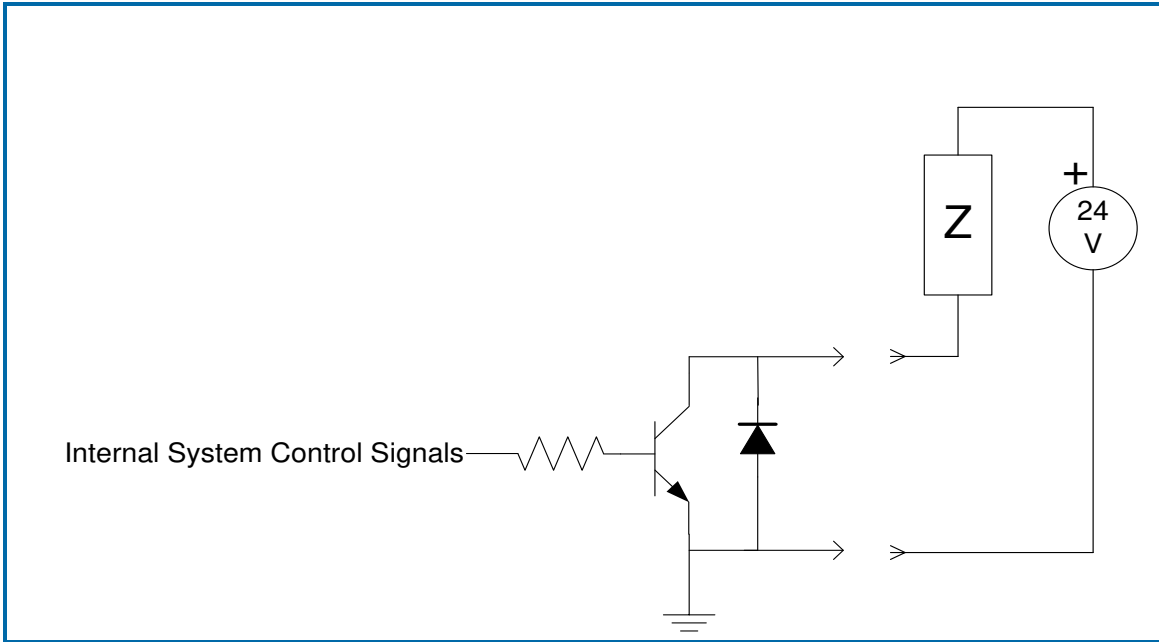
Figure 25 - Expected Usage of Digital Outputs

4.6.8   Laser Control Outputs – J18
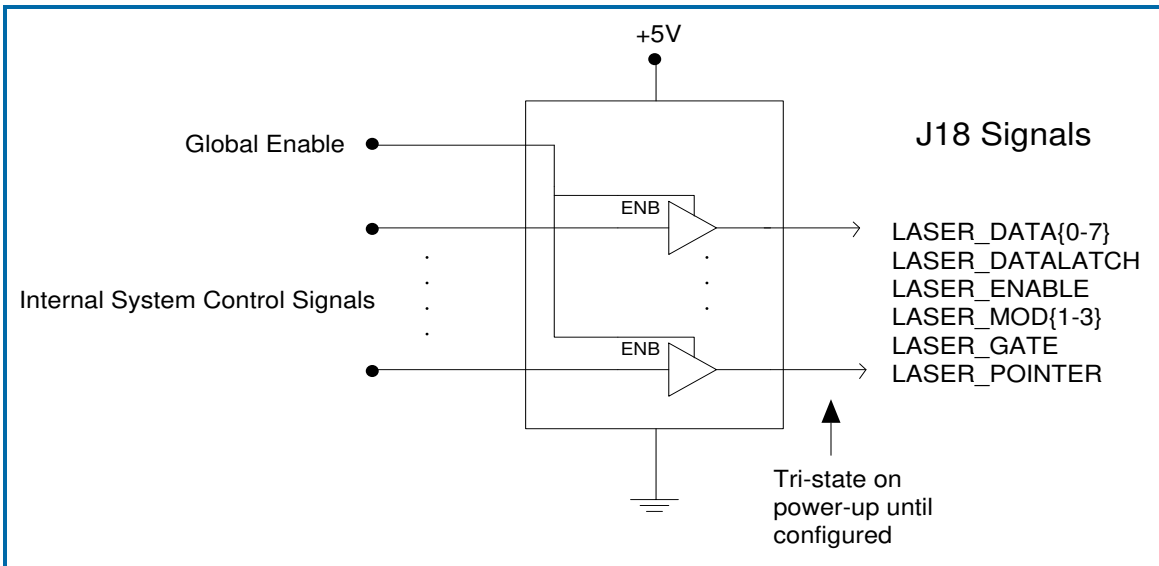

Figure 26 - Signal Conditioning for Laser Control Outputs (J18)

4.6.9   Auxiliary XY2-100 Signals – J13

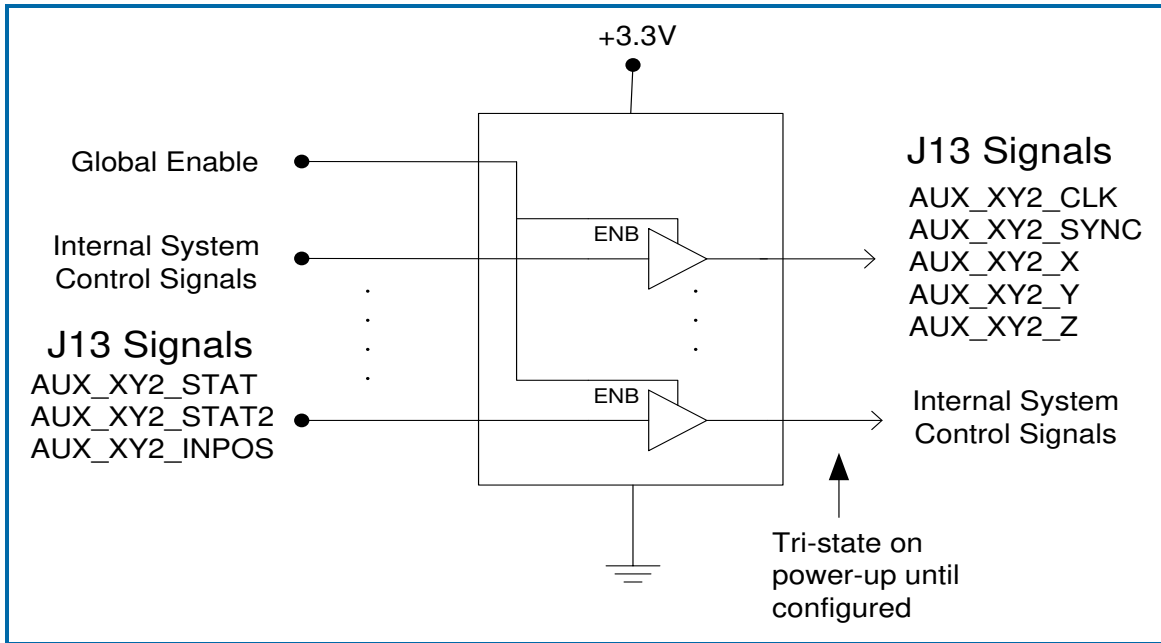Figure 27 - Signal Conditioning for Auxiliary XY2-100 Signals (J13)

5 APPENDIX A - SMC-IO-01 AUXILIARY I/O MODULE

5.1 INTRODUCTION

The Auxiliary I/O module provides additional digital I/O capability to the SMC, and exposes the SMC digital signals using 3.5mm Phoenix Contact industrial-automation-style connectors. The Auxiliary I/O module can be attached to the SMC main module as a plug-in daughter card or via ribbon cables. It has the following features:

- 16 optically isolated, 24V-compatible inputs on two 12-pin plug-in Phoenix Contact strips
- 16 open-collector 5- to 24V-compatible outputs on two 12-pin plug-in Phoenix Contact strips
- Two XY2-100-compatible 25-pin D-Sub connectors for dual scan head operation
- Console COM port access via one 9-pin D-Sub male connector
- RS-485 smart-stepper COM access in a 5-pin plug-in Phoenix Contact strip
- Two step-and-direction motor control ports in dual 5-pin plug-in Phoenix Contact strips
- Two MOTF encoder inputs in dual 10-pin plug-in Phoenix Contact strips
- SMC system control and status pins in dual 10-pin plug-in Phoenix Contact strips

Mating connectors for the 3.5mm Phoenix Contact strips are available from many sources. The screw-type mating connector number is MC 1,5/xx-ST-3,5 where xx is the number of pins.
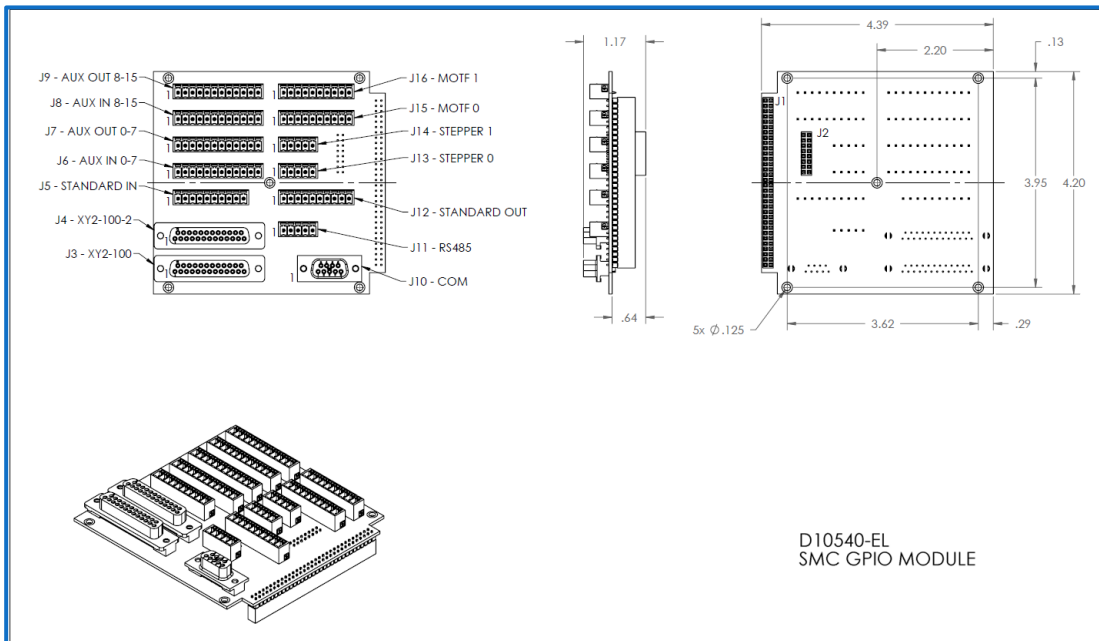
5.2   MECHANICAL LAYOUT

Figure 28 - Auxiliary I/O module outline drawing

Regardless of the product family (Lightning II or ProSeries 2), the mechanical installation of the 3-Axis Scanning System should proceed as described in the following pages.

5.3   CONNECTORS

5.3.1   J3 AND J4 - XY2 - 100 PORTS

Port 1 is the same port as on the XY2-100 Connector of the SMC Main Module. For a description of the XY2-100 Connector of the SMC Main Module, refer to Section 4.5.3 ("XY2-100 Signal Pinouts (Connector J11)") on page 20.

Port 2 is created from the SMC single-ended AUX_XY2 signal set by using differential drivers and receivers.

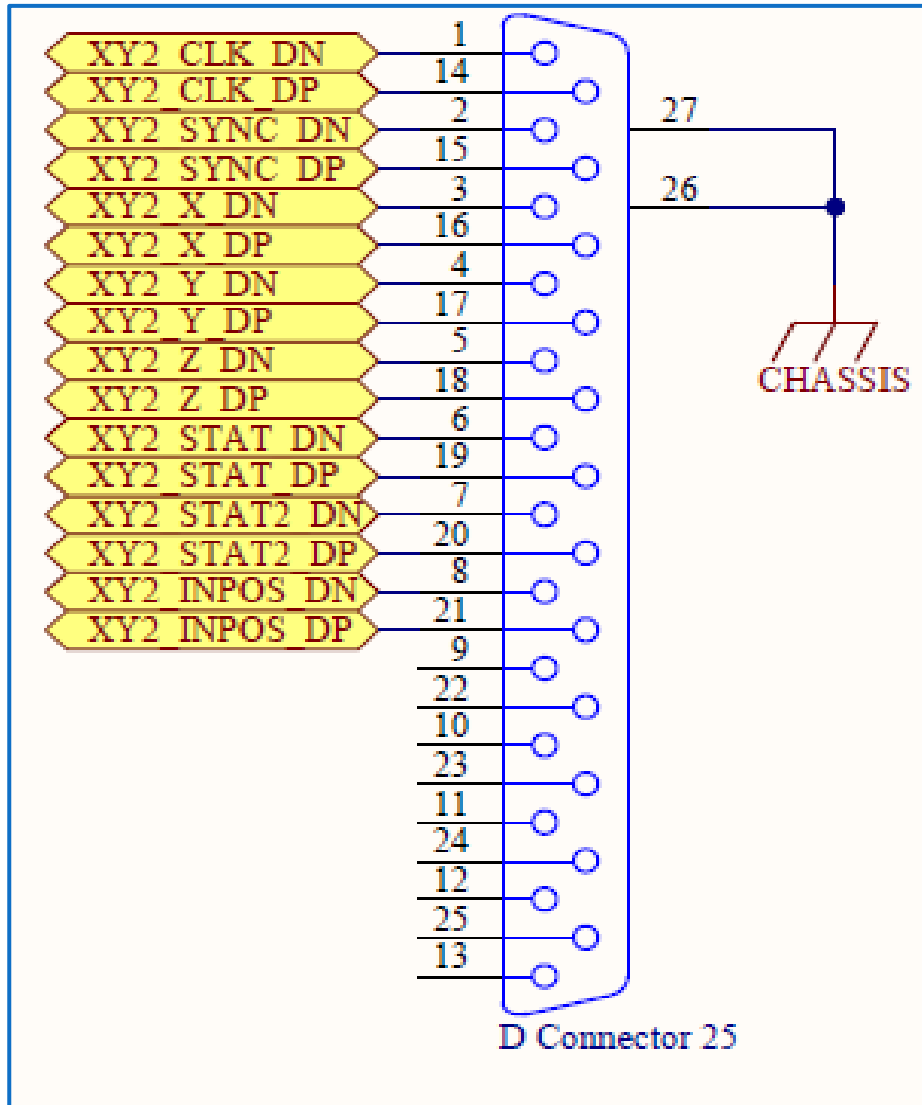**Note**: Pins 26 and 27 in the following drawing are a connector shell.

Figure 29 - J3 XY2-100 Port 1 and J4 XY2-100 Port 2

5.3.2   J11 – RS - 485 Communications

This connector is intended to provide communications to smart stepper motor controllers. The pins on Connector J11 (RS-485 Communications) are described below.
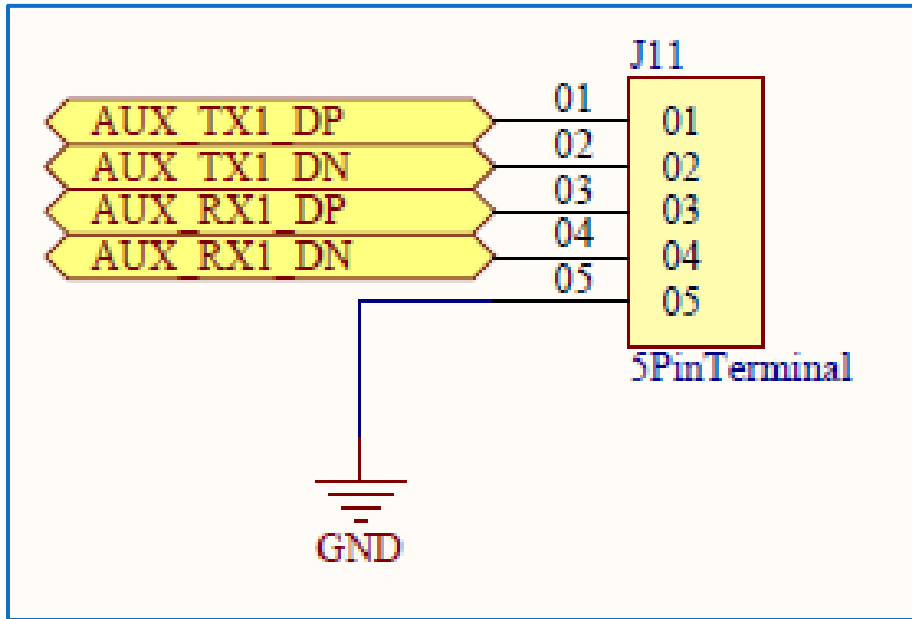
Figure 30 - J11 RS-485 Communications

5.3.3   J10 – RS – 232 Communications

This DB-9F connector provides general purpose RS-232 access to the SMC. Although it presents as a device COM port (DB-9F), in Revision C of the I/O board, it is configured as a Host COM port as shown in the diagram below. It is appropriate in most circumstances to use a null-modem adapter for direct connectivity in a system. A null-modem adapter swaps pins 2 & 3 and 3 & 8, permitting a direct male/female extension cord connection from a PC.

Revision C of the Auxiliary I/O module is supplied with such an adapter pre-assembled to J10.

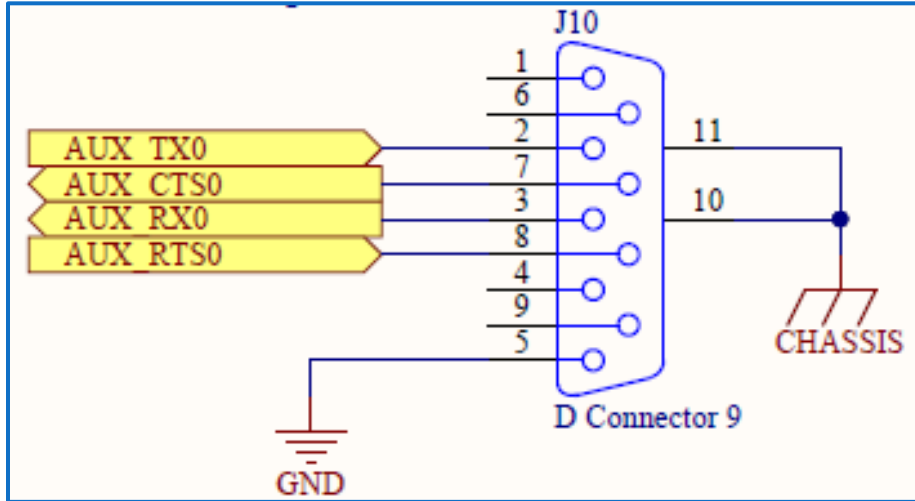**Note**: Pins 10 and 11 in the following drawing are a connector shell.

Figure 31 - J10 RS-232 Communications

5.3.4   J15 and J16 – MOTF 0 And MOTF 1

The MOTF connectors expose the same signals as the MOTF-0 and MOTF-1 connectors on the SMC Main Module. Refer to the following for descriptions of these signals:

- Figure 31 - (J15 MOTF Port 0 (X) and J16 MOTF Port 1 (Y)).
- Table 11 - Connector J15 (MOTF-0) Signal Descriptions.

Note: EXT_VCC5V0 is an internally supplied voltage.

For proper functioning of AUX_GPI1_ISO, the signal AUX_GPICOM_ISO on Connector J5, Pin 9 must be connected to an appropriate source.
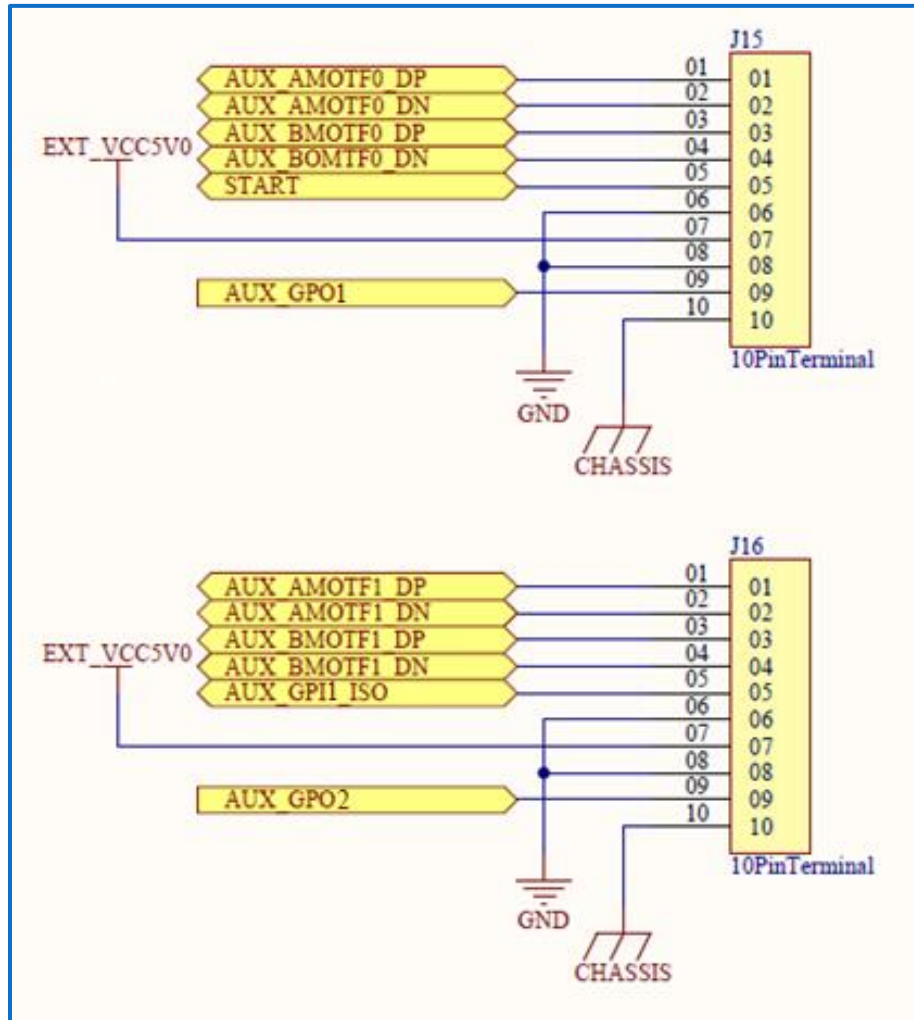
Figure 32 - J15 MOTF Port 0 (X) and J16 MOTF Port 1 (Y)

5.3.5   J6 and J8 – Extended Digital Inputs

These inputs are 5- to 24V-compatible optically isolated inputs. The inputs can be sourcing or sinking depending on the connection of the COM input. The signal conditioning is shown below in Figure 34 - Extended Inputs Signal Conditioning.

Note: EXT_VCC5V0 is an internally supplied voltage. +24V is expected to be externally supplied. This signal is also connected to the SMC main module +24V input, which is described in Section 4.5.1 ("Power Signal Pinouts (Connectors J1 and J3)").

Note: +24V should not be left floating. If a 24V supply is not available, then connect EXT_VCC5V0 to +24V through a diode:
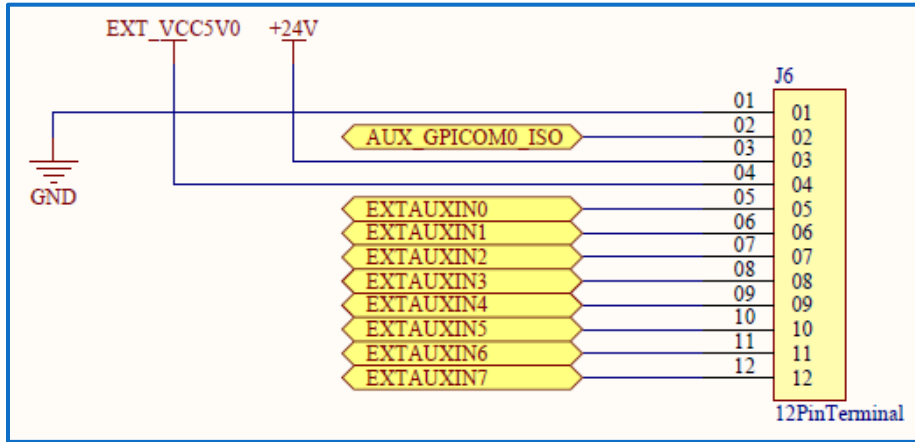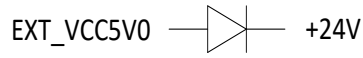

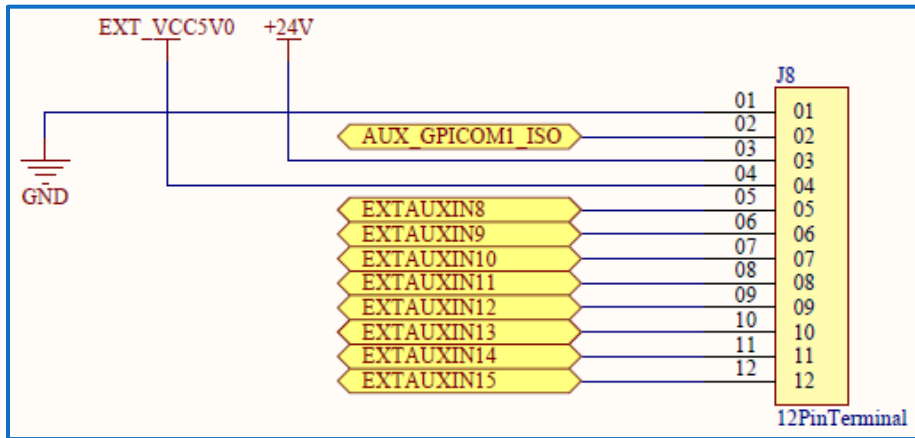Figure 33 - J6 Extended Inputs Bank 0

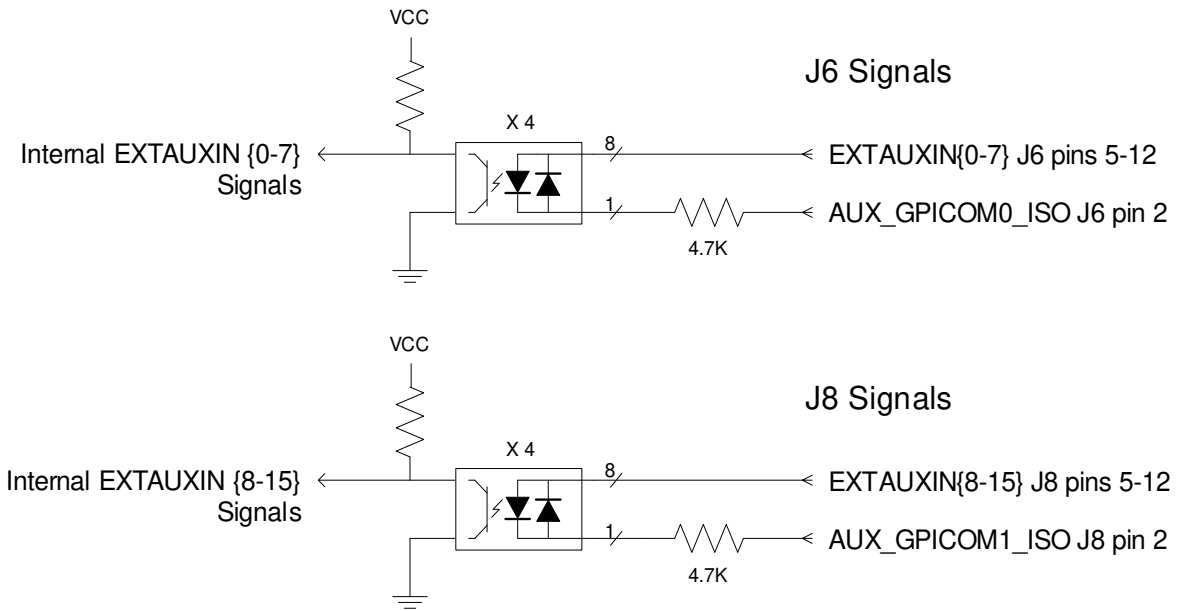Figure 34 - J8 Extended Inputs Bank 1

Figure 35 - Extended Inputs Signal Conditioning

5.3.6   J7 and J9 – Extended Digital Outputs

These outputs are 5- to 24V-compatible open-collector drivers. The signal conditioning is shown below in Figure 37 - Extended Outputs Signal Conditioning. These outputs are pulled up to +5V through a diode for convenience of driving lightly loaded TTL devices, but are intended to be used as sinking drivers where the load to be driven has one end attached to 24V. The drivers will then switch the connected end of the load to ground.

Note: EXT_VCC5V0 is an internally supplied voltage. +24V is expected to be externally supplied. This signal is also connected to the SMC main module +24V input in Section 4.5.1 ("Power Signal Pinouts (Connectors J1 and J3)") on page 17.

Note: +24V should not be left floating. If a 24V supply is not available, then connect EXT_VCC5V0 to +24V through a diode:

Figure 36 - J7 Extended Outputs Bank 0
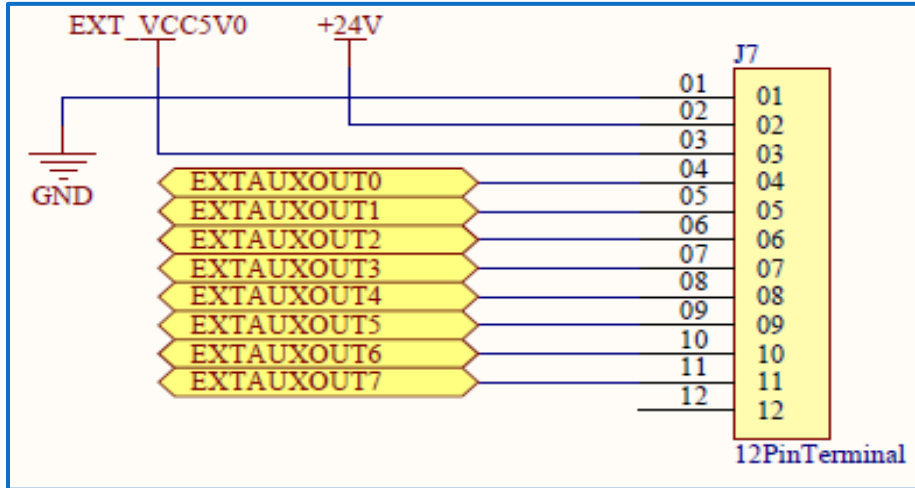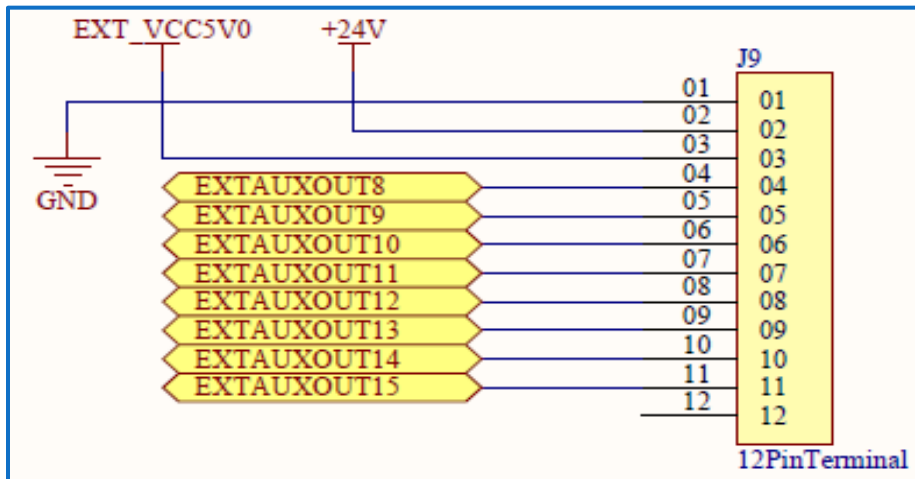

Figure 37 - J9 Extended Outputs Bank 1
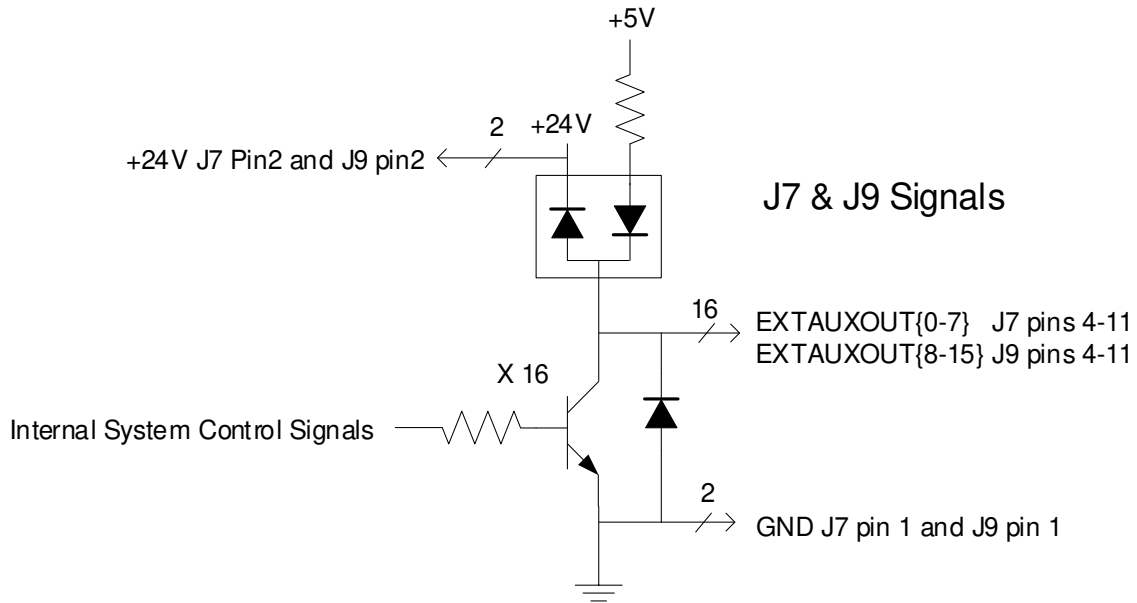
Figure 38 - Extended Outputs Signal Conditioning

5.3.7   J13 and J14 – External Motor Control

Note: These signals are reserved for future use. These ports provide step-and-direction control for external motor drivers. Input support for an end-of-travel flag is also provided.

Note: EXT_VCC5V0 is an internally supplied voltage.
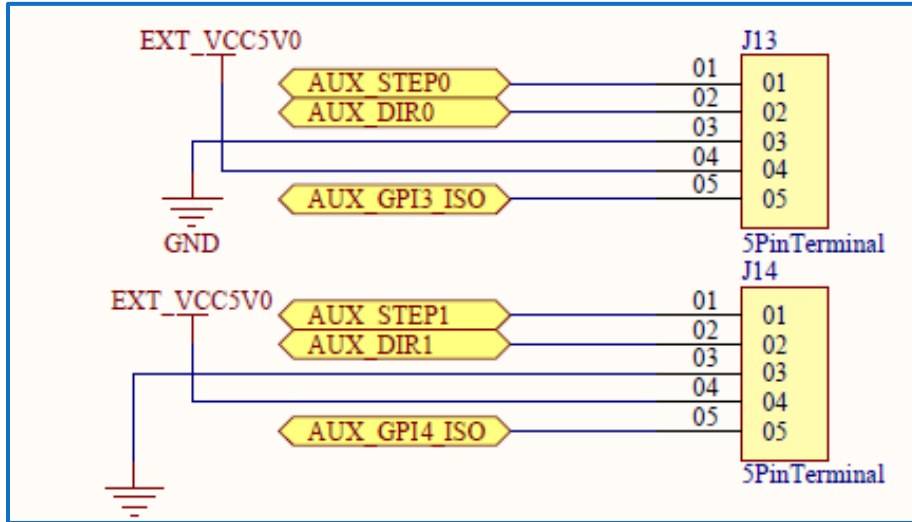
Figure 39 - J13 and J14 External Motor Control Port 0 and Port 1

5.3.8   J5 and J12 - System Control Inputs and Outputs

These signals are the same as those for the Control Signals on Connector J16 of the SMC Main Module. For descriptions of these signals, refer to Table 11 - Connector J16 (Control) Signal Descriptions.
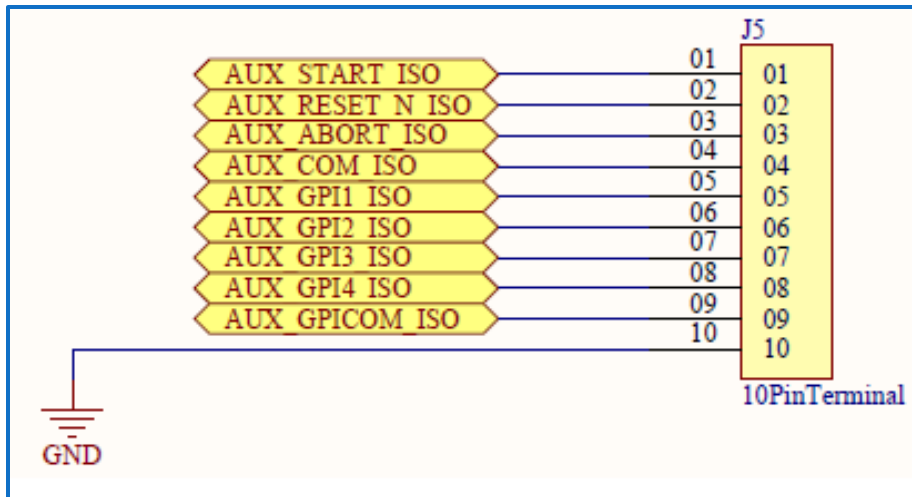
Figure 40 - J5 System Control Inputs

Note: The silkscreen on Rev C of this module incorrectly labels AUX_GPI[1-4] as GPI[0-3]. This is fixed in later revisions.
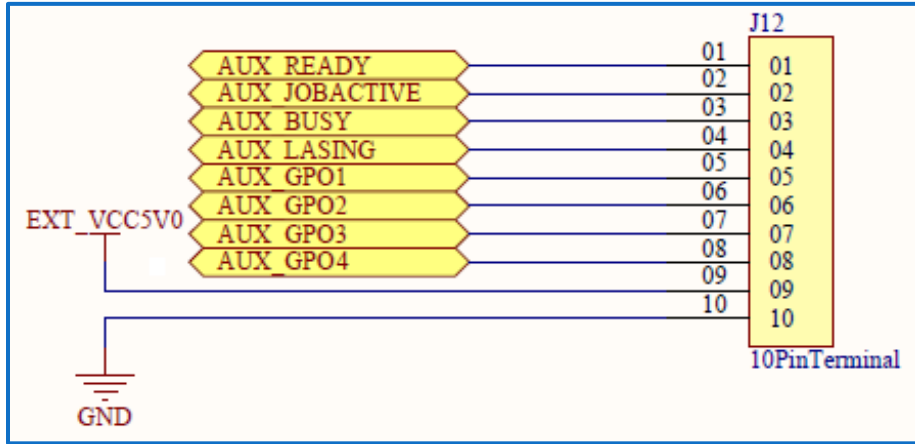
Figure 41 – J12 System Control Outputs

Note: The silkscreen on Rev C of this module incorrectly labels AUX_GPO[1-4] as GPO[0-3]. This is fixed in later revisions.

6 APPENDIX B - SMC-LSR-01 IPG LASER ADAPTER

6.1 INTRODUCTION

The IPG Laser Adapter provides convenient connectivity from the SMC Laser Connector (J18) to the 25-pin D-SUB Connector used by IPG Laser on their low-power YLP models.

The IPG Laser Adapter has the following features:

- Direct plug-in to the SMC Laser Connector (J18)
- Various cable lengths terminating in a bulk-head mountable female 25-pin D-SUB connector.
- Signaling support for the IPG low-power YLP fiber laser family via the 25-pin D-SUB Connector.

NOTE: The SMC-LSR-01 adapter cannot be used without modification with IPG YLP-HP lasers with a Type B interface. The required modifications to this adapter for Type B interface compatibility are described in Table 18 - and Table 19 -. Alternatively, a custom cable can be used between the 25P D-Sub connector of the SMC-LSR-01 adapter and the YLP-HP laser. The pin mappings of such a cable are described in Table 18 - Modifications of SMC-LSR-01 for IPG YLP-HP Type B Connection.

6.2 MECHANICAL LAYOUT
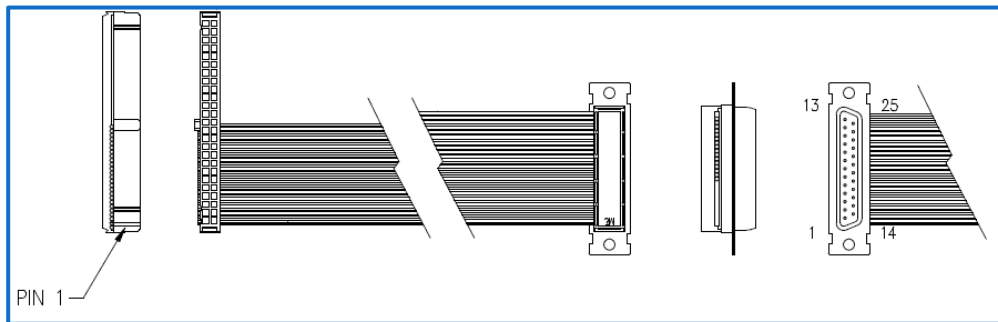
Figure 42 - IPG Laser Adapter Cable Mechanical Layout

6.3   CONNECTORS

6.3.1   Laser Signal Mappings

SMC and IPG signals and connector pin mappings are identified in the following table.

J18 Pin	Color	SMC Signal	25-Pin D-Sub Pin	IPG YLP (Type D)	IPG YLP (Type E)
1	BRN	LASER_DATA0	1	c	D0
2	RED	GND	14	Ground	Ground
3	ORG	LASER_DATA1	2	D1	D1
4	YEL	LASER_STAT03COM_ISO_PIN	15	5Vout	5Vout
5	GRN	LASER_DATA2	3	D2	D2
6	BLU	LASER_STAT1_ISO	16	ALARM1	ALARM1
7	PUR	LASER_DATA3	4	D3	D3
8	GRY	PTR_VCC5VO	17	5V house-Keeping	5VRG
9	WHT	LASER_DATA4	5	D4	D4
10	BLK	LASER_ENABLE	18	EE	EE
11	BRN	LASER_DATA5	6	D5	D5
12	RED	LASER_GATE	19	Modulation	EM
13	ORG	LASER_DATA6	7	D6	D6
14	YEL	LASER_MOD1	20	Sync	Sync
15	GRN	LASER_DATA7	8	D7	D7
16	BLU	LASER_STAT0_ISO	21	ALARM0	ALARM0
17	PUR	LASER_DATALATCH	9	Latch	Latch
18	GRY	LASER_POINTER	22	Guide	RG

19	WHT	GND	10	Modulation Return	Digital In Reserved
20	BLK	ESTOP_LOOP	23	EMstop	AuxOFF
21	BRN	LASER_STAT2_ISO	11	ALARM2	ALARM2
22	*RED*	LASER_STAT4_ISO_ADC0	24	Digital In Reserved	Digital In Reserved
23	ORG	LASER_STAT3_ISO	12	Digital Out Reserved	Digital Out Reserved
24	*YEL*	ESTOP2_LOOP	25	Reserved	Reserved
25	GRN	LASER_STAT5_ISO_ADC1	13	Digital In Reserved	Digital In Reserved

Table 17 - IPG Laser Adapter Cable Signal Mappings

NOTE: The expectation is that a PLC or other suitable control mechanism will be connected to the SMC JP6 connector and be responsible for safety and fault-mode clearing. See section 4.5.11 E-STOP (Connector JP6) for details.

6.3.2   SMC-LSR-01 Usage with IPG YLP-HP Type B Interface

SMC-LSR-01 is intended to be used with IPG low-power YLP type fiber lasers. A similar connection scheme is used with IPG YLP-HP high-power fiber lasers with a Type B interface, but with important differences that prevents direct cabling using this cable adapter without modification. shows how this cable can be modified or can serve as a guide for creating a discrete wired custom cable.

If cable modification is not desirable, then a custom cable can be used between the SMC-LSR-01 adapter 25P D-Sub connector and the laser. The required cable connections are shown in.

Table 18 - Modifications of SMC-LSR-01 for IPG YLP-HP Type B Connection

J18 Pin	Color	SMC Signal	25-Pin D-SUB Pin	IPG YLP-HP (Type B)
1	BRN	LASER_DATA0	1	D0
2	RED	GND	14	Ground
3	ORG	LASER_DATA1	2	D1
4	YEL	LASER_STAT03COM_ISO_PIN Cut this wire	15	Reserved
5	GRN	LASER_DATA2	3	D2
6	BLU	LASER_STAT1_ISO	16	ALARM0
7	PUR	LASER_DATA3	4	D3
8	GRY	PTR_VCC5V0	17	PS
9	WHT	LASER_DATA4	5	D4
10	BLK	LASER_ENABLE	18	EE
11	BRN	LASER_DATA5	6	D5
12	RED	LASER_GATE	19	EM
13	ORG	LASER_DATA6	7	D6
14	YEL	LASER_MOD1	20	Sync
15	GRN	LASER_DATA7	8	D7
16	BLU	LASER_STAT0_ISO	21	ALARM1
17	PUR	LASER_DATALATCH	9	Latch
18	GRY	LASER_POINTER	22	GL
19	WHT	GND	10	Undefined
20	BLK	ESTOP_LOOP	23	AStop
21	BRN	LASER_STAT2_ISO	11	ALARM2
22	RED	LASER_STAT4_ISO_ADC0 Cut this wire	24	Reserved
23	ORG	LASER_STAT3_ISO	12	ALARM3
24	YEL	ESTOP2_LOOP Cut this wire near the 50P connector	25	Reserved
25	GRN	LASER_STAT5_ISO_ADC1 Cut this wire near the 50P connector	13	Reset

NOTE: Connect the cut GRN wire attached to the 25P D-SUB pin 13 to the cut YEL wire attached to the 50P connector pin 24. E-STOP connector JP6 should be used to access the laser AStop (ESTOP_LOOP) and Reset (ESTOP2_LOOP) signals for laser enabling and fault reset. See section 4.5.11 E-STOP (Connector JP6) for details.

Table 19 - Custom Cable Pinouts for IPG YLP-HP Type B Interface

SMC-LSR-01 25P D-Sub Pin	SMC Signal	Custom cable 25-Pin D-Sub Pin	IPG YLP-HP (Type B)
1	LASER_DATA0	1	D0
14	GND	14	Ground
2	LASER_DATA1	2	D1
15	*DO NOT CONNECT*	15	Reserved
3	LASER_DATA2	3	D2
16	LASER_STAT1_ISO	16	ALARM0
4	LASER_DATA3	4	D3
17	PTR_VCC5V0	17	PS
5	LASER_DATA4	5	D4
18	LASER_ENABLE	18	EE
6	LASER_DATA5	6	D5
19	LASER_GATE	19	EM
7	LASER_DATA6	7	D6
20	LASER_MOD1	20	Sync
8	LASER_DATA7	8	D7
21	LASER_STAT0_ISO	21	ALARM1
9	LASER_DATALATCH	9	Latch
22	LASER_POINTER	22	GL
10	*DO NOT CONNECT*	10	Undefined
23	ESTOP_LOOP	23	AStop
11	LASER_STAT2_ISO	11	ALARM2

24	*DO NOT CONNECT*	24	Reserved
12	LASER_STAT3_ISO	12	ALARM3
13	*DO NOT CONNECT*	25	Reserved
25	ESTOP2_LOOP	13	Reset

NOTE: SMC connector JP6 provides PLC access to the laser AStop (ESTOP-LOOP) and Reset (ESTOP2-LOOP) signals.   See section 4.5.11 E-STOP (Connector JP6) for details.

7 APPENDIX C – SMC-LSR-02 SPI LASER ADAPTER

7.1 INTRODUCTION

The SPI Laser Adapter provides convenient connectivity from the SMC Laser Connector (J18) to the 68-pin High-density Connector used by SPI Lasers on their G3 and G4 models.

The SPI Laser Adapter has the following features:

- Direct plug-in to the SMC Laser Connector (J18)

Note: Remote connection is available in an alternate configuration.

- Access to the SPI Laser interlock signals
- Signaling support for the SPI G3/G4 fiber laser families via the 68-pin High-density Connector.

7.2   MECHANICAL LAYOUT
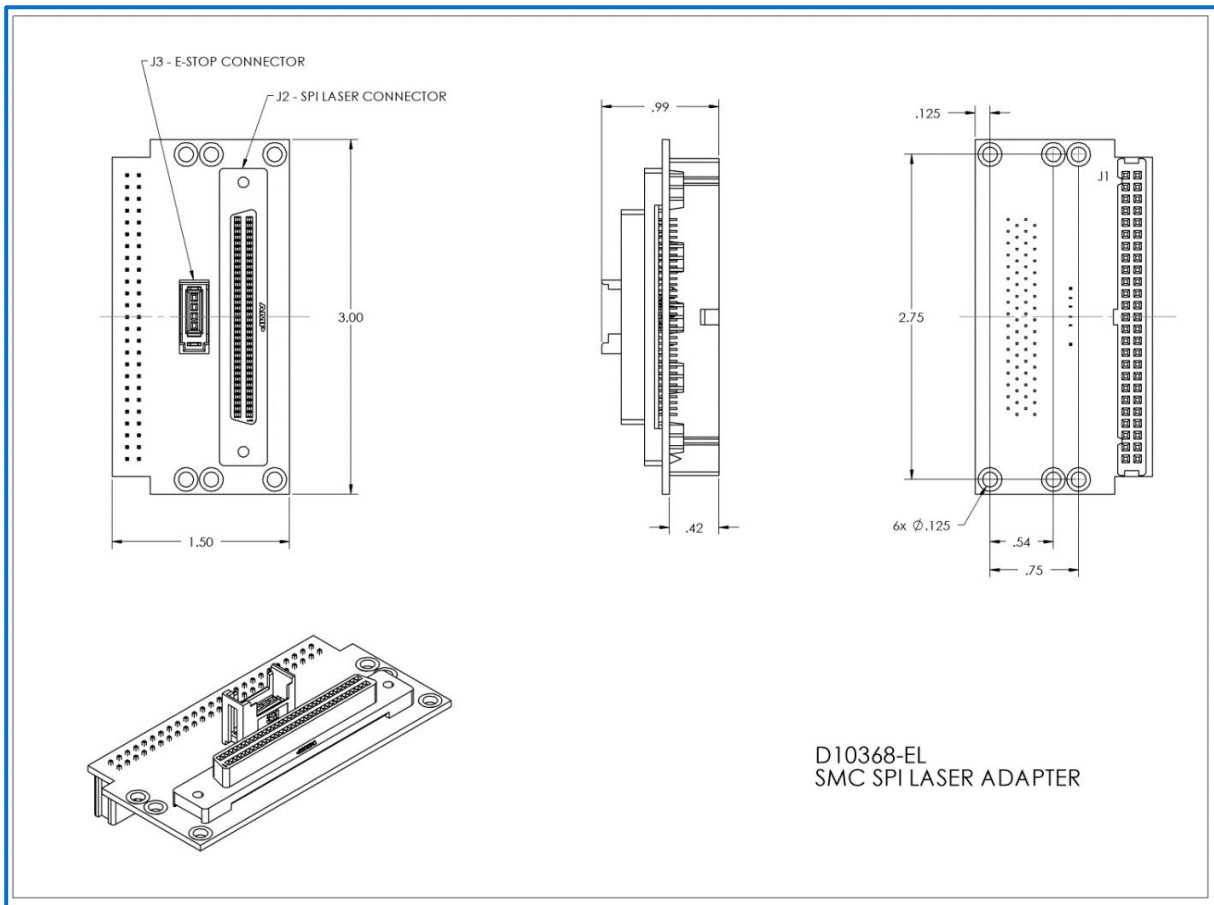
Figure 43 - SPI Laser Adapter Mechanical Layout

7.3   CONNECTORS

7.3.1   J2 SPI Laser Connector

SMC signals are identified in the yellow off-page symbols. Signals that are labeled but not connected to an off-page symbol are not used in this design.
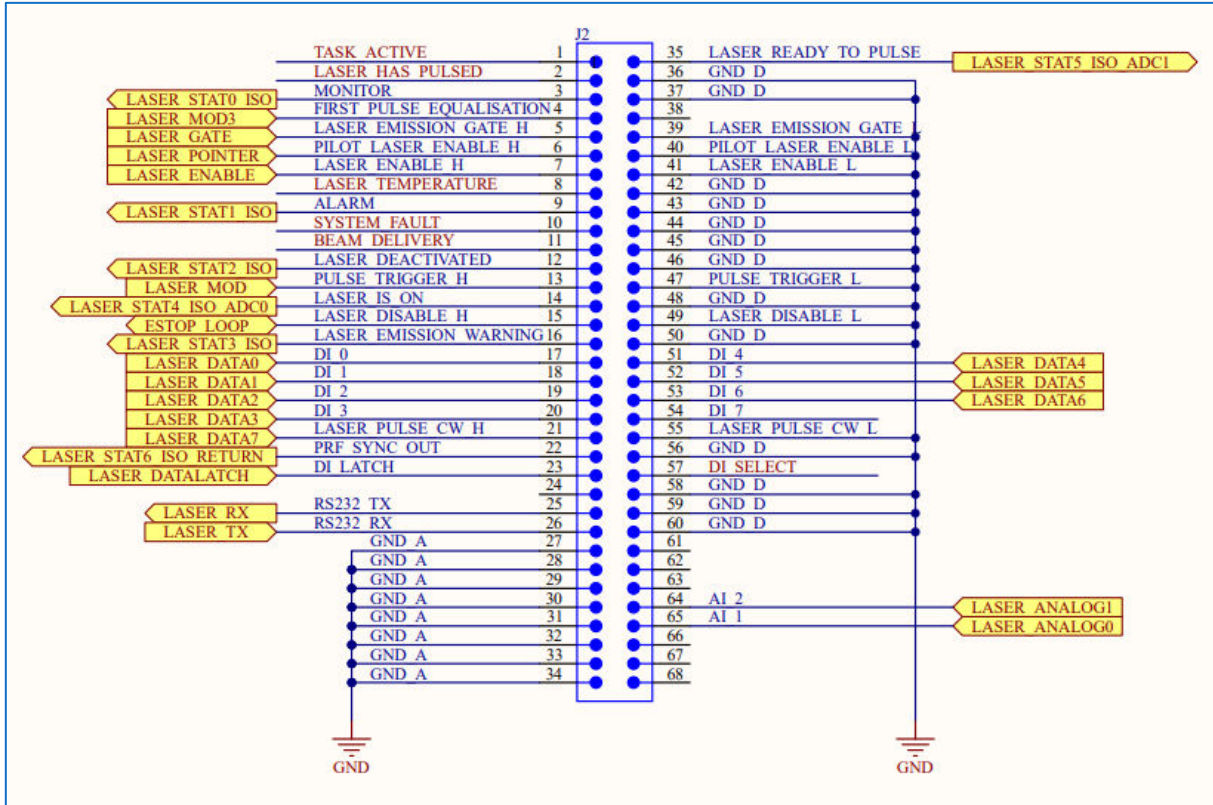
Figure 44 - SPI Laser Connector Signal Assignments

7.3.2   J3 E-STOP Connector

The E-STOP Connector provides access to the SPI LASER_DISABLE_H signal. With an appropriate
jumper inserted, the laser can be enabled without external interlock circuitry. The ESTOP_LOOP
signal is also connected to the SMC through the J18 connector on the SMC. See section 4.5.11 E-
STOP (Connector JP6) for details.

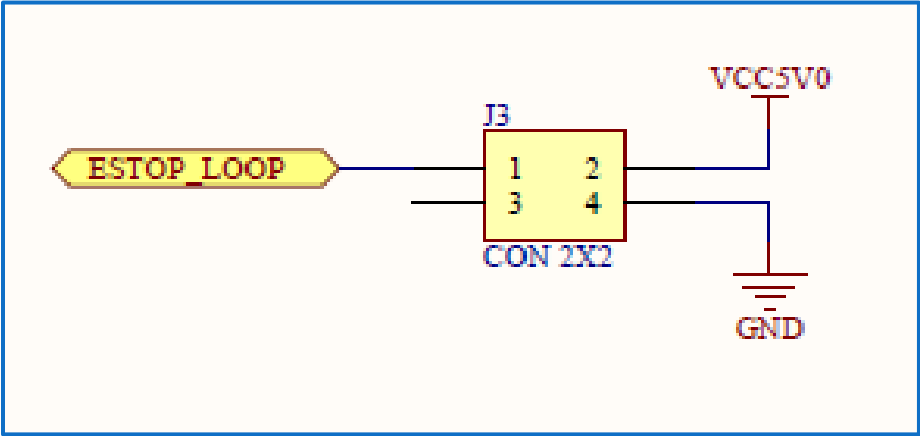Board Connector Type: 3M 37204-62A3-004PL

Mating Connector: 3M 37104-B101-00E-MB

Figure 45 - E-STOP Connector Signal Assignments

8 APPENDIX D - SMC-LRS-04 HIGH-POWER LASER ADAPTER

8.1 INTRODUCTION

The High-power Laser Adapter provides convenient connectivity from the SMC Laser Connector (J18) to industrial automation-style connectors. A subset of the SMC digital laser control signals has been reconditioned to drive 24V circuitry, which is typically seen in high-power fiber lasers from IPG and in differential drive circuitry for CO2 lasers from Coherent. In addition, the High-power Laser Adapter provides a local laser modulation signal that is remotely switchable and adjustable to facilitate laser alignment for CO2 lasers.

The High-power Laser Adapter has the following features:

- 24V digital laser modulation, gate and power signals, and a differential RS-485 modulation signal exposed on two 12-pin 3.5mm plug-in Phoenix Contact strips
- Single-ended 5V TTL modulation signal exposed on a BNC connector
- Local laser modulation generation with remotely switchable on/off and power (duty-cycle)

Mating connectors for the 3.5mm Phoenix Contact strips are available from many sources. The screw-type mating connector number is MC 1,5/xx-ST-3,5 where xx is the number of pins.
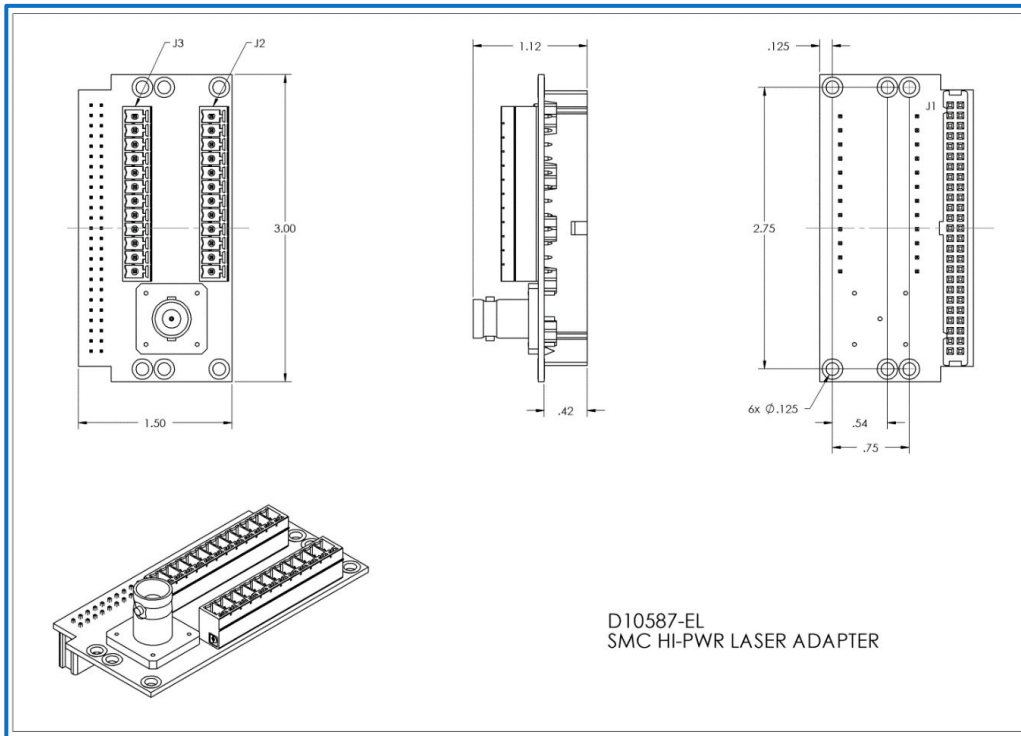
8.2   MECHANICAL LAYOUT

Figure 46 - High-Power laser adapter mechanical layout

8.3   CONNECTORS

The laser signals from the SMC High-power Laser Adapter are exposed on three connectors: two 12-pin Phoenix Contact strips and one BNC connector.

Note: Pins 6, 7, and 8 are incorrectly labeled on Rev C of the adapter module. The following table has the correct pin assignments. This is fixed on later revisions of the adapter card.

8.3.1   J2 - Laser Signal Set 1

Table 20 - Laser Signal Set 1

Pins (1 – 12)	
+24V This pin provides external voltage to the high-voltage digital signal drivers. It is also connected to the SMC 24V connector J3.	1
LASER_ENABLE_BUF High-voltage buffered version of the SMC LASER_ENABLE signal	2
LASER_GATE_BUF High-voltage buffered version of the SMC LASER_GATE signal	3
LASER_MOD1_BUF High-voltage buffered version of the SMC LASER_MOD1 signal	4
LASER_POINTER_BUF High-voltage buffered version of the SMC LASER_POINTER signal	5
GND Digital and analog ground reference NOTE: Incorrectly labeled as "ANA" on Rev C silkscreen	6
LASER_ANALOG1 0 to 10V analog laser power control NOTE: Incorrectly labeled as "ANA_GT" on Rev V C silkscreen	7
LASER_ANALOG1_GATED 0 to 10V analog laser power control switching between 0V and the set voltage synchronous with the LASER_GATE signal NOTE: Incorrectly labeled as "GND" on Rev C silkscreen	8
LASER_LOCAL_MOD_SUPPLY Voltage source for external circuitry that control local modulation behavior	9
LASER_LOCAL_MOD_CONTROL Analog input control signal for regulating the duty-cycle of a local 10KHz modulation source	10
LASER_LOCAL_ENABLE_N If switched to GND, the local laser modulation source will be applied to the differential LASER_MOD outputs on J3 and to the BNC connector. If not connected, the SMC LASER_MOD1 modulation will be selected.	11

Pins (1 – 12)	
GND Digital ground reference	⎯ (12)

8.3.2   J3 - Laser Signal Set 2

Table 21 - Laser Signal Set 2

Pins (1 –12)	
+24V This pin provides external voltage to the high-voltage digital signal drivers. It is also connected to the SMC 24V connector J3.	⎯ (1)
GND Digital ground reference	⎯ (2)
LASER_STAT4_ISO_ADC0 Digital status or 0 to 10V analog input port	⎯ (3)
LASER_STAT5_ISO_ADC1 Digital status or 0 to 10V analog input port	⎯ (4)
LASER_STAT45_COM_ISO Measurement reference for 3 and 4	⎯ (5)
LASER_TX RS-232 transmit signal from the SMC	⎯ (6)
LASER_RX RS-232 receive signal to the SMC	⎯ (7)
LASER_MOD_DP RS-485 differential positive output of LASER_MOD	⎯ (8)
LASER_MOD_DN RS-485 differential negative output of LASER_MOD	⎯ (9)
LASER_SYNC_DP RS-485 differential positive input of a laser sync signal. May also be driven with a single-ended TTL input. After buffering, this drives the SMC LASER_STAT6_ISO signal.	⎯ (10)

Pins (1 –12)	
LASER_SYNC_DN RS-485 differential negative input of a laser sync signal	⎯⎯ (11)
GND Digital ground reference	⎯⎯ (12)

8.3.3   J5 - BNC Laser Modulation Output
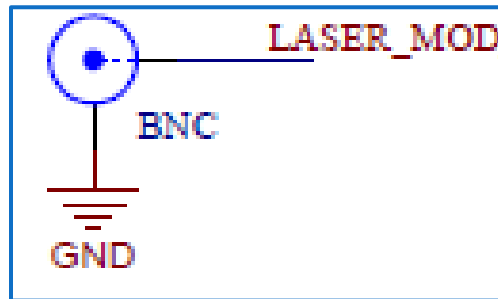
Figure 47 - J5 BNC Laser Modulation Output

8.4   LOCAL LASER MODULATION CONTROL

This High-power Laser Adapter provides support for generating a laser modulation signal without the SMC being involved. This mode of operation is intended for service applications where remote control of the laser on/off state and power are needed during optical system alignment. It is possible to connect a cable with a potentiometer and open/close switch to use this mode. When the switch is closed, the local modulation feature is enabled. The variable resistor adjusts the duty cycle of the pulse waveform, and hence the laser power. The following figure illustrates how to attach an external cable assembly that enables this feature.

Note: This modulation control only affects the differential modulation outputs LASER_MOD_DP and LASER_MOD_DN on Connector J3 and the single-ended modulation output LASER_MOD on BNC Connector J5.
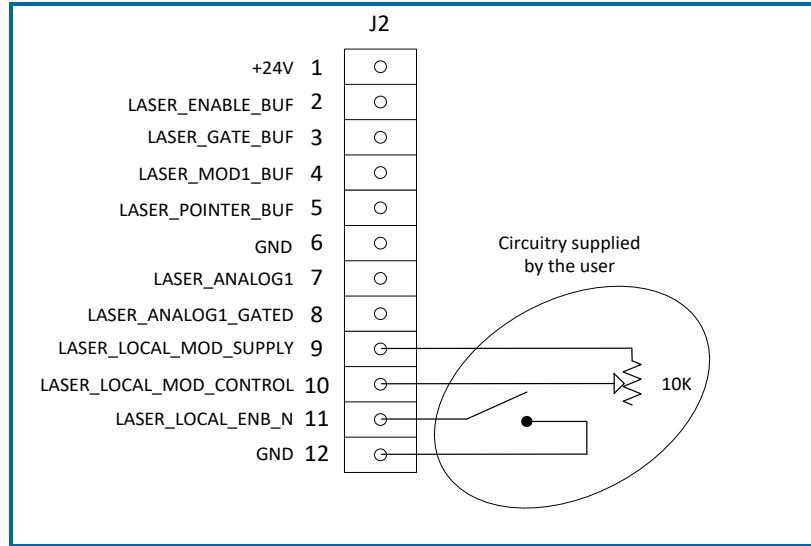
Figure 48 - Remote Modulation Control Configuration

8.5 SELECTIVE PULL-UP/PULL-DOWN OF CONTROL SIGNALS

By default, the main laser control signals are actively pulled down to ground through 20K resistors as shown in the following figure. If necessary, jumper selectable pull-up resistors may be applied to permit setting these signals to a high state during power-up cycles. The use of these jumpers is laser specific. Please consult your laser manual for best practices in this regard.
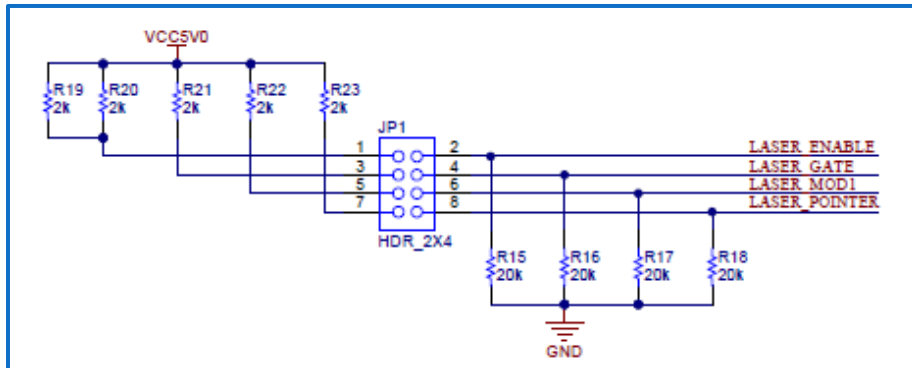

Figure 49 - Control Signal Pull-up/Pull-down Configuration

9 APPENDIX E - SMC-LSR-05 COHERENT C70 LASER ADAPTER

9.1 INTRODUCTION

The Coherent C70 Laser Adapter provides convenient connectivity from the SMC Laser Connector (J18) to industrial automation-style connectors and to the RJ45 connector used with the Coherent model C70 CO_2 laser. Status signals from the RJ45 are reconditioned to drive 24V circuitry to facilitate monitoring by a PLC. In addition, the Coherent C70 Laser Adapter provides a local laser modulation signal that is remotely switchable and adjustable to facilitate laser alignment for CO_2 lasers.

The Coherent C70 Laser Adapter has the following features:

- Direct laser signaling support via a RJ45 connector
- Reconditioning of TTL laser status signals to 24V to permit PLC interfacing
- Local laser modulation generation with remotely switchable on/off and power (duty-cycle)

Mating connectors for the 3.5mm Phoenix Contact strips are available from many sources. The screw-type mating connector number is MC 1,5/xx-ST-3,5 where xx is the number of pins.

9.2   MECHANICAL LAYOUT
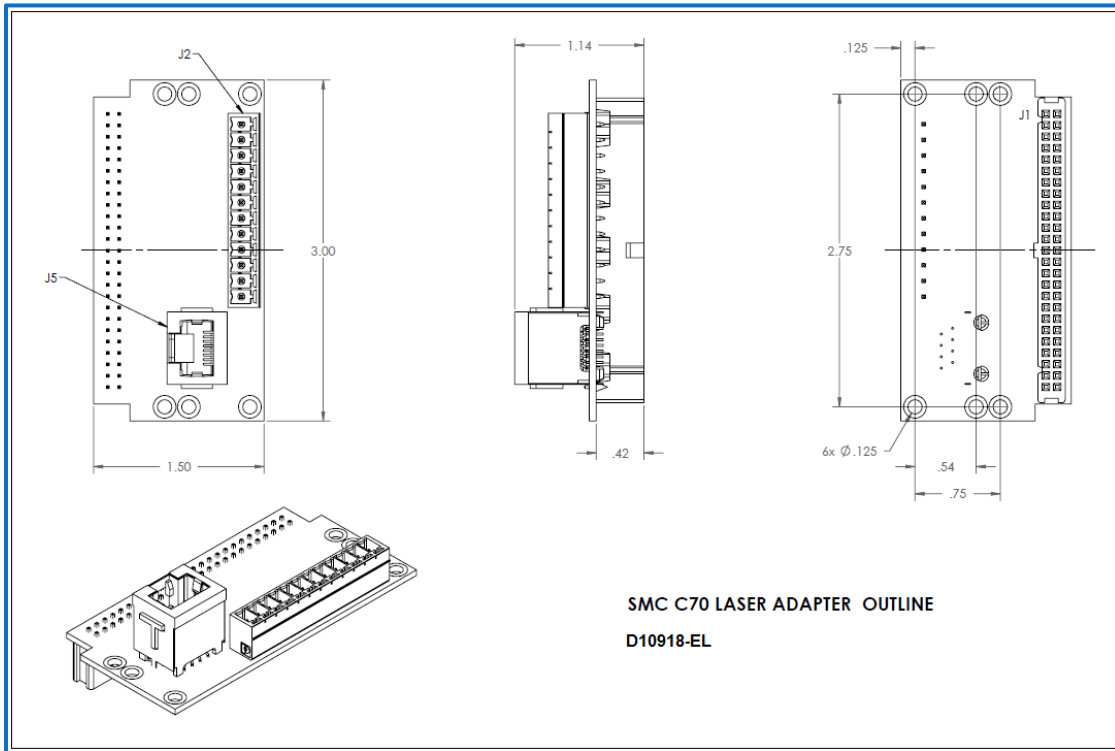
Figure 50 - Coherent C70 Laser Adapter Mechanical Layout

9.3   CONNECTORS

The laser signals from the Coherent C70 Laser Adapter are exposed on two connectors: one 8-pin RJ45 connector, and one 12-pin 3.5mm Phoenix Contact strip

9.3.1   J5 - RJ-45 Laser Control Signals

Table 22 - RJ-45 Laser Control Signals

Pins (1 – 8)
LASER_MOD_OUT Laser modulation signal ── ①

Pins (1 – 8)		
+15V_IN +15V supply voltage from the laser	——	2
LASER_OK_IN Laser OK signal from the laser	——	3
TEMP_OK_IN Temperature OK signal from the laser	——	4
VOLTAGE_OK_IN Voltage OK signal from the laser	——	5
GND Digital ground reference	——	6
LASER_ENB_OUT Laser enable	——	7
GND Digital ground reference	——	8

9.3.2 J2 - Auxiliary Laser Control Signals

Table 23 - Auxiliary Laser Control Signals

Pins (1 –12)		
N/C Reserved	——	1
LASER_ENABLE_BUF 24V capable buffered laser enable signal. This can originate from the SMC if in normal mode or locally if in local control mode.	——	2
LASER_OK_BUF 24V capable buffered version of the LASER_OK_IN signal from J5	——	3
TEMP_OK_BUF 24V capable buffered version of the TEMP_OK_IN signal from J5	——	4

Pins (1 –12)	
VOLTAGE_OK_BUF 24V capable buffered version of the VOLTAGE_OK_IN signal from J5	—— (5)
GND Digital ground reference	—— (6)
CHASSIS Chassis ground reference	—— (7)
LASER_MOD_OUT Laser modulation signal. Same as J5 pin 1	—— (8)
LASER_LOCAL_MOD_SUPPLY Voltage source for external circuitry that control local modulation behavior	—— (9)
LASER_LOCAL_MOD_CONTROL Analog input control signal for regulating the duty-cycle of a local 10KHz modulation source	—— (10)
LASER_LOCAL_ENABLE_N If switched to GND, the local laser modulation source will be applied to the LASER_MOD_OUT outputs on J5 pin 1 and to J2 pin 8. If not connected, the SMC LASER_MOD1 modulation will be selected.	—— (11)
GND Digital ground reference	—— (12)

9.4   LOCAL LASER MODULATION CONTROL

The Coherent C70 Laser Adapter provides support for generating a laser modulation signal without the SMC being involved. This mode of operation is intended for service applications where remote control of the laser on/off state and power are needed during optical system alignment. It is possible to connect a cable with a potentiometer and open/close switch to use this mode. When the switch is closed, the local modulation feature is enabled. The variable resistor adjusts the duty cycle of the pulse waveform, and hence the laser power. The following figure illustrates how to attach an external cable assembly that enables this feature.
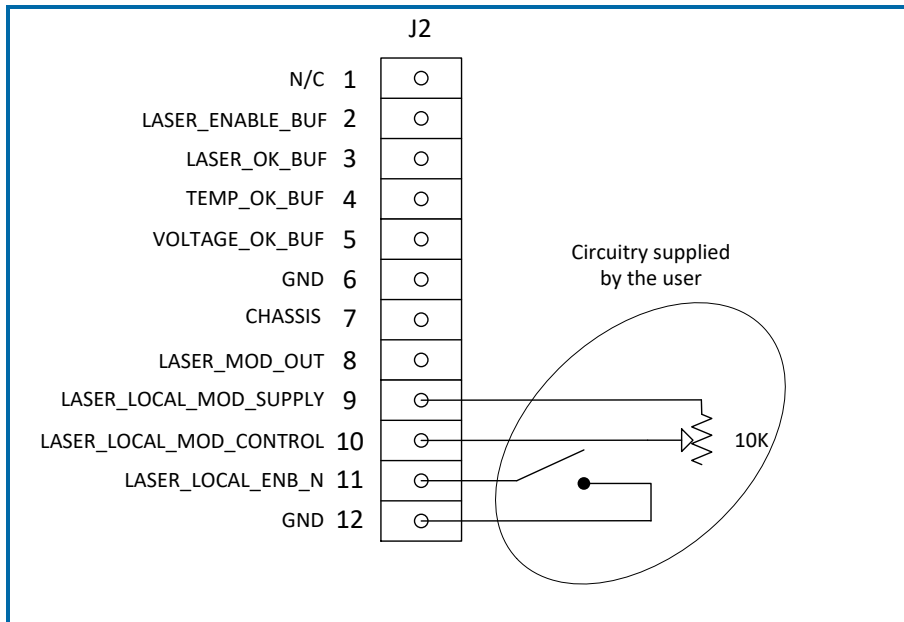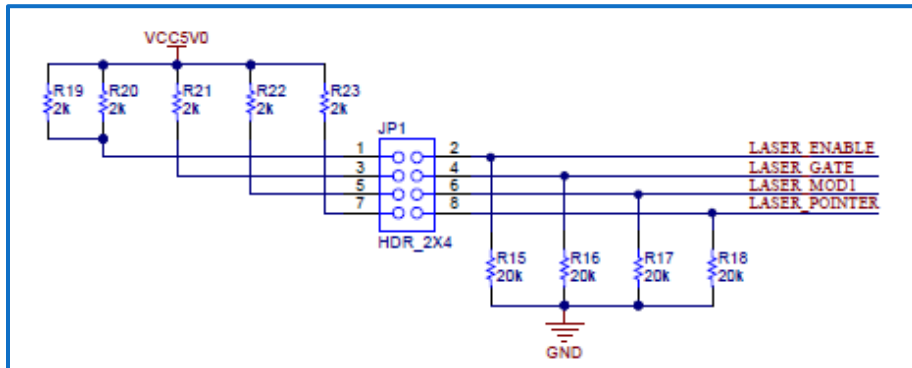
Figure 51 - Remote Modulation Control Configuration

Pull-up/Pull-down of Control Signals to support disabling the assertion state of the laser signals on power-up, there are four jumpers that can be applied to pull-up these signals when they are not being actively driven as is the case during a power-up cycle.

10   APPENDIX F - XY2-100 PROTOCOL INTERFACE

The XY2-100 Serial Link (also known as Serial Link 1 and XYZ-100) is a synchronous TIA/EIA-422-B differential digital interface for communication of three 16-bit position words and a single 16-bit status word for 2- and 3-Axis servo applications

10.1   CONNECTIONS AND SIGNAL DESCRIPTIONS

Typically, a female connector is used by a position data receiver such as a scan head, and may optionally include differential power as shown in below table. However, this power distribution is not supported by the SMC.

Signaling is differential 3.3-5V TIA/EIA-422-B. Sync and data are sampled on the falling edge of the clock and must observe a 50ns setup and 50ns hold. The voltage of a logical "1" is V+LINE >V-LINE.

Table 24 - DB-25 Connector to an XY2-100-based Scan Head

	XY2-100: DB-25 CK: clock, 2MHz nominal SYNC: indicates start of 20-bit data word XCH: 20-bit X-axis data send YCH: 20-bit Y-axis data send ZCH: 20-bit Z-axis data send STATOU1T: 20-bit status return V+: +15V to +24V (not supplied by SMC) GND: Common reference for V+ and V- V-: -15V to -24V (not supplied by SMC)

10.2   CLOCK

The Clock is transmitted by the position data generator, 20 cycles per frame. Its nominal frequency is 2MHz.

10.3   SYNC

The frame Sync is a single logical "0" pulse, once per frame, transmitted by the position data generator one clock cycle prior to the first bit of the frame.

10.4   X, Y, & Z DATA

The X, Y, & Z Data are three 20-bit serial data streams consisting of a 3-bit control code, one 16-bit position word (unsigned, MSB first), and a parity bit (even parity).
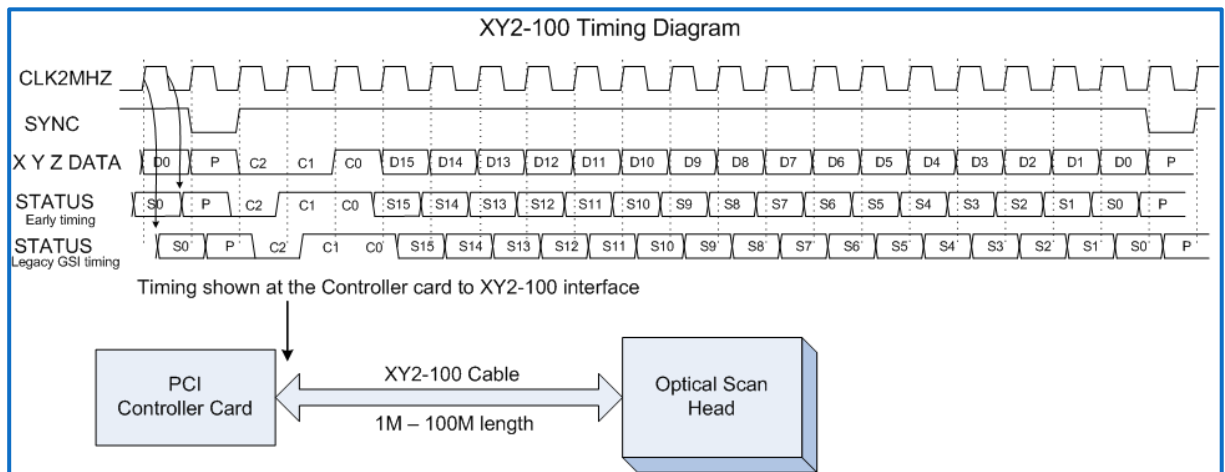

Figure 52 - X2-100 Timing Diagram

Improper control codes, parity error, or a missing sync on the 21st clock cycle will cause the position data word for the affected channel to be discarded. As the following table shows, 001 is the only supported control code.

Table 25 - Control Codes

Control Bits [2:0]	Function
0 0 0	Reserved
0 0 1	16-bit position data follows
0 1 0	Reserved
0 1 1	Test (reserved)
1 x x	20-bit Novanta Extended Precision data follows (odd parity, reserved)

10.5   STATUS DATA

The Status Data is a 20-bit serial data stream consisting of a 3-bit control code, one 16-bit status word, and a parity bit (even parity). The SMC latches the Status received from the Scan Head on the falling edge of the 2MHz CLK.

The SMC also generates Even Parity on 2-Axis status. Both formats are shown in the following table.

Table 26 - Status Data Formats

Bit	2-axis status	3-axis status
C2	0	0
C1	1	0
C0	1	1
S15	Power Status	X Error Status (X Servo Ready)
S14	Temperature Status	X Temperature Status

Table 26 - Status Data Formats

Bit	2-axis status	3-axis status
S13	In-field	X Tracking Error
S12	X Position Acknowledge	0
S11	Y Position Acknowledge	Y Error Status (Y Servo Ready)
S10	1	Y Temperature Status
S9	0	Y Tracking Error
S8	1	0
S7	Power Status	Z Error Status (Z Servo Ready)
S6	Temperature Status	Z Temperature Status
S5	In-field	Z Tracking Error
S4	X Position Acknowledge	0
S3	Y Position Acknowledge	Serial Link X Parity Error
S2	1	Serial Link Y Parity Error
S1	0	Serial Link Z Parity Error
S0	1	Serial Link Clock Error
Par	x (no parity)	even parity

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1040-0011 Revision L

May 2023