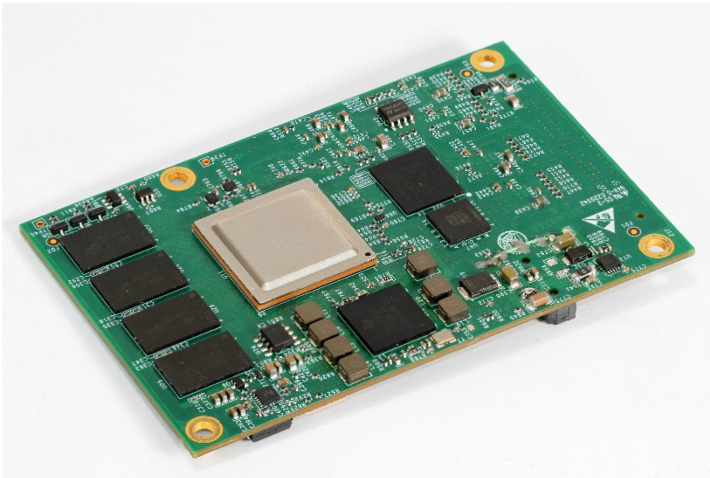
Platinum by Elmo

Go Safer, Smarter, Smaller, Simpler.
Go Platinum.

P-Maestro BLM (Board Level Module)

Integration Design Guide



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April 2024 (Ver. 2.001)

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Catalog Number

P-MAS0 N-BLM

Platinum Line (P)

Hardware Option: (0)

0 = Platinum Maestro BLM

IEC Application Licensed: (N)

N = No IEC license
I = IEC licensed
V = IEC licensed + Visualization option

Revision History

Version	Date	Details
Ver. 1.000	Dec 2017	Initial release
Ver. 1.001	Jan 2018	Update to Part Number
Ver. 1.002	Mar 2018	Update to Part Number
Ver. 1.003	Dec 2018	Update to Part Number
Ver. 1.004	Mar 2019	
Ver. 1.005	Jan 2020	Changed banner; added text symbols and icons
Ver. 2.000	May 2021	Updated template
Ver. 2.001	Apr 2024	Minor text changes

Chapter 1: General Information

1.1 Directives and Standards

The P-Maestro BLM has been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

1.2 Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. The P-Maestro BLM is warranted for a period of 12 months from the date of shipment. No other warranties, expressed or implied – and including a warranty of merchantability and fitness for a particular purpose – extend beyond this warranty.

1.3 Safety and Text Symbols

The following safety symbols are used in this and all Elmo Motion Control manuals:

Warning:
This information is needed to avoid a safety hazard, which might cause bodily injury or death as a result of incorrect operation.

Caution:
This information is necessary to prevent bodily injury, damage to the product or to other equipment.

Important:
Identifies information that is critical for successful application and understanding of the product.

The following symbols are used in this document:

Note:
Information critical to the understanding and\or operating the feature.

Tip:
Information that helps understanding a feature, is good practice or a possible different way of action.

Chapter 2: Product Description

This installation guide describes the P-Maestro BLM Network Motion Controller and the steps for its wiring, installation and power up. Following these guidelines ensures maximum functionality of the system to which it is connected.

2.1 Description

The P-Maestro BLM is Elmo's premium network motion controller. It works in a network based system in conjunction with Elmo's intelligent servo drives to provide a total multi-axis motion control system solution.

The P-Maestro BLM Motion Controller incorporates an integral high-level computational dual-core system (2 x 1.5 GHz) with limitless memory (RAM, ROM, and SD-Card), and onboard additional hardware peripherals.

The P-Maestro BLM shares the motion processing workload with Elmo's SimplIQ and Gold Line drives, forming a distributed motion control system. The best servo and system performance is achieved by combining the Gold Family drives, and the new real-time motion control capabilities of the P-Maestro BLM controller.

The P-Maestro BLM provides:

- Self-sufficient machine motion control – No reliance on connection with PC server
- Time deterministic control over motion, I/Os and processes in the system
- Complete compatibility with recognized networking and communications protocols
- Full, real-time, multi-axis motion synchronization
- Advanced user programming capabilities based on the leading standards
- Unified development platform that streamlines motion control solutions for novice and expert programmers alike

The P-Maestro BLM offers real-time motion control support for full multi-axis system synchronization, using the well-known industry interface PLCopen for Motion Control standard.

Various programming capabilities, such as the IEC-61131-3 standard languages, as well as native C and C++ programming support, dramatically accelerate user-level program execution. Standard solutions are selected for ease of use.

Low-level communication with drives and I/O devices over the device network uses the CAN industry standard (DS 301, DS 401 for I/O devices, and DS 402 for drives and motion device profiles). These are used over standard CAN networks, as well as with the new EtherCAT CoE (CAN over EtherCAT) protocols.

Host interfaces are implemented using industry standard communications protocols, such as Ethernet TCP/IP and higher level protocols such as Ethernet/IP and Modbus.

Standardization in protocols, definitions, and APIs allows users rapid system level integration and opens the system to third party devices on the device network.

Chapter 3: Technical Specifications

3.1 Processor System

Feature	Details
Processor	Computational core system based on Dual Core (2×1.5 GHz)
On Board Flash	4 GByte
RAM	DDR-3, 4 GByte, 64 bit bus width, (Operational at Full Core Rate)
SD Card	Standard SD card

3.2 Communications

Specification	Details
Ethernet for Host	1 Ethernet port 1000 base-T Automatically detected 10/100/1000Mbps CAT5e/6 Cable UDP, Telnet, TCP
EtherCAT Master Field bus	2 Ethernet port 100 base-T for EtherCAT Master. Baud Rate: 100 Mbit/sec CAT5e Cable CoE, EoE, FoE EtherCAT Master with Full redundancy support
CAN for device network	1 Port 1Mbps, with Isolation CANopen master port Maximum Baud Rate of 1 Mbits/sec. **CAN Profile:** DS 301 **Device Profile** (drive and motion control)**:** CAN device profiles, e.g., DS301, DS505, DS402, DS401 (for I/O)
USB 3.0	**Host USB** Supports USB 2.0: Full Speed = 1.5Mbps , Low Speed = 12Mbps, or High Speed = 480Mbps USB 3.0, SuperSpeed = 5Mbps is not supported
USB 2.0	**Device USB** Supports: Full Speed = 1.5Mbps , Low Speed = 12Mbps, or High Speed = 480Mbps
RS-232	1 Standard channel of RS-232

3.3 Communication Interface

Specification	Details
Serial extended IO Bus	Serial bus that Supports up to 24 inputs and 24 Outputs
RS-485 Channels	Interface allows connection of up to 9 RS-485 channels (the user should connect the RS-485 transceiver)
RS-232	Interface to connect a single RS-232 channel (the user should connect the RS-232 transceiver)

3.4 Analog Interface

Specification	Details
ADC (Analog-to-digital converter)	Interface to connector external ADC that supports two Differential or 4 Single Ended Analog inputs: • Resolution of 16 bits • Sample rate 1Mbps • Voltage 3.3V

3.5 Power Supply

Feature	Details
Supply input voltage	Single power supply, 10.8V to 55V
Supply input power	Typical 7.5 W
External 3.3V for user	maximum current = 100mA
External 5V for user	maximum current = 100mA

3.6 Physical Specifications

Feature	Details
Weight	41.0g
Dimensions	97.24 x 62.25mm(3.83” x 2.45”)

3.7 General

Feature	Details
RTC	The Real Time Clock maintains the real time date and hour when the main power source is disconnected. The RTC operates when connected to a SuperCap. When connected to a SuperCap e.g. of capacitance 1.0F/5.0V, and the P-Maestro BLM is connected to a main power source, the SuperCap will automatically recharge.
Internal System BIT	The P-Maestro BLM supports internal hardware BIT (Built-in-tests) procedures to check the system integrity level on each power up
Diagnostic LEDs	EtherCAT and Ethernet activity

3.8 Environmental Conditions

Feature	Details
Operating ambient temperature according to IEC60068-2-2	0 °C to 40 °C (32 °F to 104 °F)
Storage temperature	-20 °C to +85 °C (-4 °F to +185 °F)
Maximum non-condensing humidity according to IEC60068-2-78	90%
Maximum Operating Altitude	2,000 m (6562 feet) It should be noted that servo drives capable of higher operating altitudes are available on request.
Mechanical Shock according to IEC60068-2-27	15g / 11ms Half Sine
Vibration according to IEC60068-2-6	5 Hz ≤ f ≤ 10 Hz: ±10mm 10 Hz ≤ f ≤ 57 Hz: 4G 57 Hz ≤ f ≤ 500 Hz:5G

Chapter 4: P-Maestro BLM Software Specifications

4.1 Operating System

Feature	Details
Linux Operating System	With Elmo's RT extension for real-time motion control support
Motion Programming and Debugging	Native C Programming, running on the target CPU. Compiling and debugging via the Eclipse IDE using GCC under Cygwin.
	IEC 61131-3 with PLCopen Motion Library extension, using Elmo IDE. The following languages are supported:
	Structured text (ST), textual Function block diagram (FBD), graphical Ladder diagram (LD), graphical Sequential function chart (SFC), has elements to organize programs for sequential and parallel control processing.

4.2 Axes

Feature	Details
Axes	Up to 96 axes, allowing mixed single axis, multiple axis and coordinated axes motions
Axis Types	Intelligent Servo Drives (Elmo), supporting both the SimplIQ and Gold lines Operation of Maestro Profiler (real-time master synchronization) as well as non-Maestro profiler modes DS 402 CoE for EtherCAT and standard DS 402 drives for CANopen
Control System Update Rate	**EtherCAT:** Cycle Simultaneous Update Rates: ≥ 250 µs for up to 16 axes 500 µs for 32 axes 1 ms for 64 axes Cycle Jitter: < 1 µs, based on Master DC (Distributed Clock) support, for the full network **CAN:** Cycle Update Rate ≥ 1 ms (CAN physical network limitations only) Cycle Jitter: < 100 µs for CAN Sync message initiation (actual jitter dependent on the CAN network's physical limitations)

4.3 Motion Modes and Interfaces

Feature	Details
The Platinum Maestro motion interfaces use PLCopen Standard	64 bit, real-time, double precision profile calculations, allowing full on-the-fly control over speed, acceleration, deceleration and jerk Complex motion schemes, including look-ahead optimizing of trajectory speed calculations, for complex vector motions Cyclic buffer for 1,000 function blocks (a buffer for 1,000 motion segments). The cyclical buffer removes any practical limit on the number of function blocks
Communication Protocols	**Host:** Ethernet TCP-IP/UDP for operational modes Telnet communication for setup and configuration USB: Using binary protocol (maintenance) Application level: Ethernet-IP/Modbus **Device Network:** EtherCAT: CoE/EoE/FoE, supports distributed clock master CAN: CANopen device profiles, e.g., DS 301, DS 305, DS 402, DS 401 (I/O device profile)
Host and Internal Software Interface	TCP/IP interface from Host Computer. Software Library is provided for easy TCP/IP communication interface. This version will also support Ethernet-IP and Modbus over the TCP-IP. Internal Software libraries, for "C" user programs are provided, to write user code running on the Platinum Maestro target processor (native mode).
Data Recording	8 MB data recording Up to 64 vectors can be recorded simultaneously. Supports more than 10 advanced triggering options and real-time scope capabilities Very fast data upload using Ethernet
Upload/Download Support	Firmware update support (Platinum Maestro and drives) System resource files Axis parameter files

4.4 Drive Communication Bridge Support

Feature	Details
Communication	The Platinum Maestro supports full communication with any specific drive (EtherCAT and CAN) for the purpose of simple tuning or configuration at the drive level, i.e. there is no need for direct communication with the drive.

Feature	Details
Spatial Position-Based Pulse Generation	The Platinum Maestro supports spatial (along the path) position-based pulse generation. This is a unique feature, required for the generation of position-based events in 3D scanning systems. The Platinum Maestro system, with Elmo's intelligent Gold servo drives, can support single axis and spatial enhanced position-based compare functions, resulting in trigger output signals accurate to 1 encoder count along the trajectory path.

4.5 General

Feature	Details
Network Encoders	Supports master based motion on network encoders
Position Error Mapping	Supports 1-D, 2-D, and 3-D position-based error mapping compensation

4.6 Communication Options

The P-Maestro BLM can communicate with a host PC either via a standard Ethernet port or through USB using a binary protocol for maintenance.

The P-Maestro BLM communicates with its network devices using either EtherCAT or CAN networks.

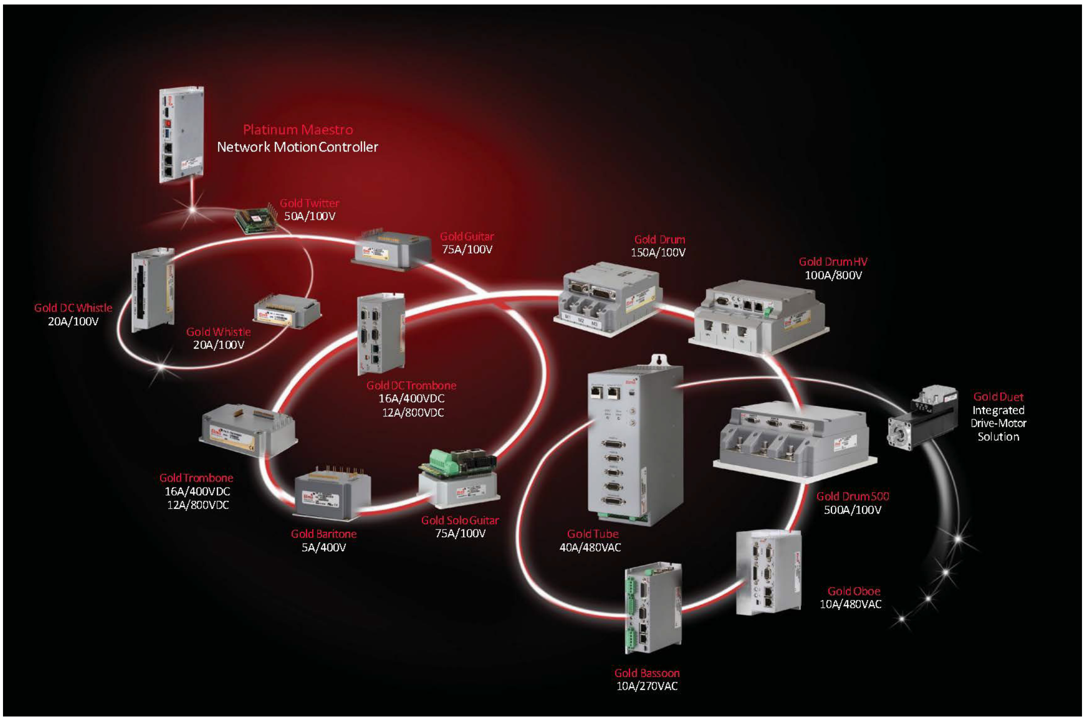


Figure 1: The P-Maestro BLM Network Connections

Chapter 5: System Architecture

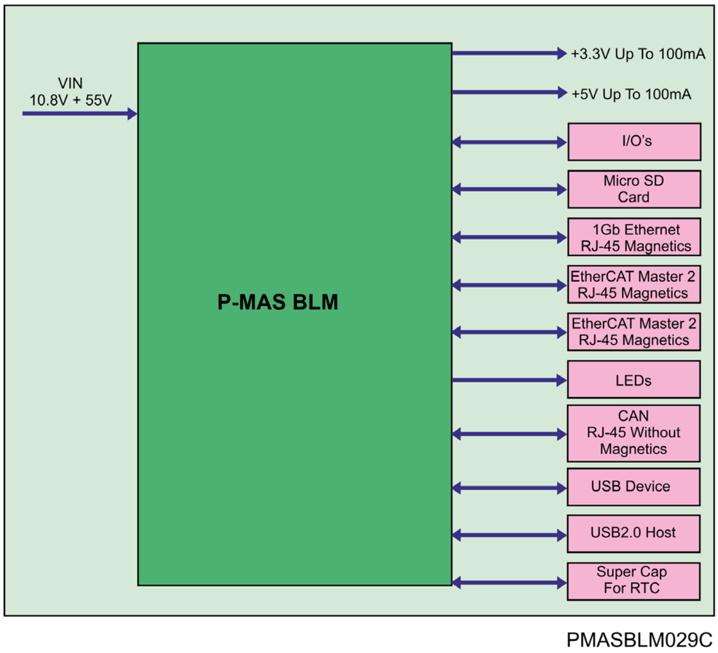


Figure 2: P-Maestro BLM BLM Connections System Block Diagram

5.1 Related Documents

This document describes the PMAS-BLM hardware connections, and is part of the set of assembly documents. This set includes the following:

- PMAS-BLM Integration Design Guide
- Schematic drawings in ORCAD 17.2 and PDF.
- The following drawings are to be found within the manual compressed document collection:
  - PMAS_BLM_V1.DSN (for reference only)
  - PMAS_BLM_V1.pdf (for reference only)
  - PMAS-BLM symbol for Algero (pmas_blm_v1.dra, pmas_blm_v1.psm)
  - PMAS-BLM DXF (pmas_blm_v1.dxf)

When this manual is used in conjunction with the Drive Software series of manuals it describes everything necessary to get the P-Maestro BLM up and running.

Chapter 6: Assembly

This chapter describes the pin to pin connections between the P-MAS BLM and the PCB.

6.1 Pin Connectors

6.1.1 Power Supply

Function	Supply	
Pin Name	**J5**	
Type	Socket 10 pin, 2 rows, 0.5mm	
No	**Name**	**Description**
B1	VIN	Main power input of the P-MAS BLM Interface
B2	VIN	Main power input of the P-MAS BLM Interface
B3	VIN	Main power input of the P-MAS BLM Interface
B4	VIN	Main power input of the P-MAS BLM Interface
B5	COMRET	Common Return
B6	COMRET	Common Return
B7	COMRET	Common Return
B8	COMRET	Common Return
B9	COMRET	Common Return
B10	COMRET	Common Return
B11	5V	5V output for the user usage Maximum current consumption 100mA
B12	5V	
B13	5V	
B14	5V	
B15	5V	
B16	VDD_SD	SD Card Supply Voltage
B17	VDD_3V3	3.3V output for the user usage Maximum current consumption 100mA
B18	VDD_3V3	
B19	PE	Protective Earth
B20	VBAT	For RTC

Function	Supply
Connector	

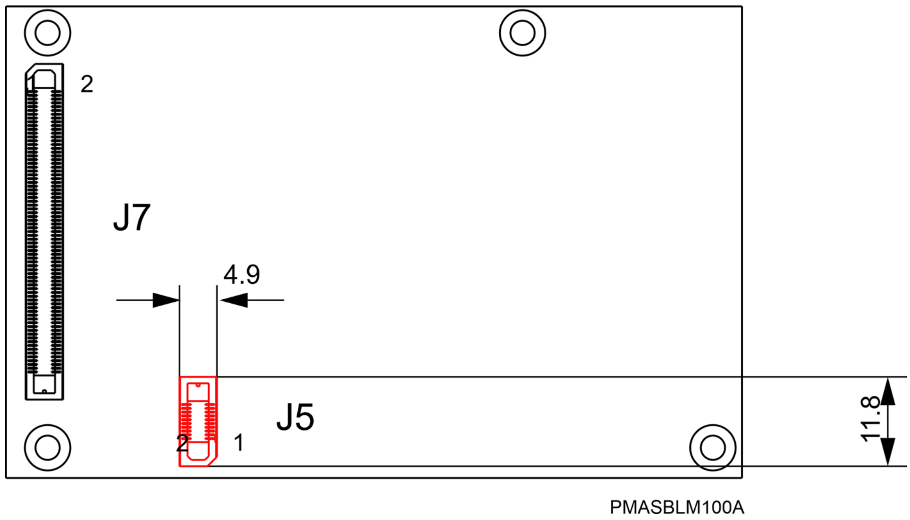


Table 1: Supply Pin Connector

6.1.2 Communication and I/O

Function	Communication and I/O		
Name	**J7**		
Type	Socket 75 pin, 2 rows, 0.5mm		
No	**Name**	**Type**	**Description**
A1	COMRET	PWR	Common Return
A2	USB_DEVICE_VBUS	PWR	5V Input for USB Device
A3	Not Used (NU)		Leave unused
A4	USB2_DP	I/O	USB2 Data+
A5	NU		Leave unused
A6	USB2_DM	I/O	USB2 Data-
A7	COMRET	PWR	Common Return
A8	COMRET	PWR	Common Return
A9	NU		Leave unused
A10	USB3_DP	I/O	USB2 Data+
A11	NU		Leave unused
A12	USB3_DM	I/O	USB2 Data-
A13	COMRET	PWR	Common Return
A14	COMRET	PWR	Common Return
A15	NU		Leave unused
A16	NU		Leave unused
A17	NU		Leave unused
A18	NU		Leave unused
A19	COMRET	PWR	Common Return
A20	COMRET	PWR	Common Return
A21	NU		Leave unused
A22	NU		Leave unused
A23	NU		Leave unused
A24	NU		Leave unused
A25	COMRET	PWR	Common Return
A26	COMRET	PWR	Common Return
A27	TRD3-	I/O	1Gb Ethernet Data 3-

Function	Communication and I/O		
No	**Name**	**Type**	**Description**
A28	CAN_L	I/O	CAN_L bus line (dominant low)
A29	TRD3+	I/O	1Gb Ethernet Data 3+
A30	CAN_H	I/O	CAN_H bus line (dominant high)
A31	COMRET	PWR	Common Return
A32	CAN_RET	PWR	CAN Communication Return
A33	TRD2-	I/O	1Gb Ethernet Data 2-
A34	LED1_STATUS	O	LED 1 Status
A35	TRD2+	I/O	1Gb Ethernet Data 2+
A36	LED2_STATUS	O	LED 2 Status
A37	COMRET	PWR	Common Return
A38	SD_DAT2	I/O	SD_Card data 2
A39	TRD1-	I/O	1Gb Ethernet Data 1-
A40	SD_DAT3	I/O	SD_Card data 3
A41	TRD1+	I/O	1Gb Ethernet Data 1+
A42	SD_CMD	I/O	SD_Card Command
A43	COMRET	PWR	Common Return
A44	SD_CLK	I/O	SD_Card Clock
A45	TRD0-	I/O	1Gb Ethernet Data 0-
A46	SD_DAT0	I/O	SD_Card data 0
A47	TRD0+	I/O	1Gb Ethernet Data 0+
A48	SD_DAT1	I/O	SD_Card data 1
A49	COMRET	PWR	Common Return
A50	SD_CD	I	SD_Card Detect
A51	LED0_LINK100	O	Ethernet link 100 Mbps
A52	NU		Leave unused
A53	LED2_LINK1000	O	Ethernet link 1000 Mbps
A54	NU		Leave unused
A55	LED1_LINK_ACT	O	TX/RX Activity
A56	NU		Leave unused
A57	LED_ECT_RUN	O	EtherCAT Status LED - EtherCAT Run

Function	Communication and I/O		
No	**Name**	**Type**	**Description**
A58	NU		Leave unused
A59	LED_ECT_ERR	O	EtherCAT Status LED - EtherCAT Error
A60	NU		Leave unused
A61	COMRET	PWR	Common Return
A62	NU		Leave unused
A63	PHY0_TX+	O	EtherCAT Master1 Transmit Data+
A64	COMRET	PWR	Common Return
A65	PHY0_TX-	O	EtherCAT Master1 Transmit Data-
A66	NU		Leave unused
A67	COMRET	PWR	Common Return
A68	NU		Leave unused
A69	NU		Leave unused
A70	COMRET	PWR	Common Return
A71	NU		Leave unused
A72	NU		Leave unused
A73	PHY1_TX+	O	EtherCAT Master2 Transmit Data+
A74	NU		Leave unused
A75	PHY11_TX-	O	EtherCAT Master2 Transmit Data-
A76	COMRET	PWR	Common Return
A77	COMRET	PWR	Common Return
A78	NU		Leave unused
A79	PHY00_RX+	I	EtherCAT Master1 Receive Data+
A80	NU		Leave unused
A81	PHY00_RX-	I	EtherCAT Master1 Receive Data-
A82	COMRET	PWR	Common Return
A83	PHY0_LED_SPEED	O	EtherCAT Master1 LED Speed
A84	PHY1_RX+	I	EtherCAT Master2 Receive Data+
A85	PHY0_LED_LINK_ACT	O	EtherCAT Master1 LED LINK/ACT
A86	PHY1_RX-	I	EtherCAT Master2 Receive Data-
A87	NU		Leave unused

Function	Communication and I/O		
No	**Name**	**Type**	**Description**
A88	COMRET	PWR	Common Return
A89	NU		Leave unused
A90	NU		Leave unused
A91	PHY1_LED_SPEED	O	EtherCAT Master2 LED Speed
A92	NU		Leave unused
A93	PHY1_LED_LINK_ACT	O	EtherCAT Master2 LED LINK/ACT
A94	COMRET	PWR	Common Return
A95	IO10_TX	O	TXn – Transmit line, where n=10. TXn should be connected to external RS-485 transceiver
A96	RS232_TX1	O	RS232_TX1
A97	IO9_TX	O	TXn – Transmit line, where n=9. TXn should be connected to external RS-485 transceiver
A98	IO5_TX	O	TXn – Transmit line, where n=5. TXn should be connected to external RS-485 transceiver
A99	RS232_RX1	I	RS232_RX1
A100	IO4_RX	I	RXn – Receive line, where n=4. RXn should be connected to external RS-485 transceiver
A101	IO9_DIR	O	DIRn – Direction line, where n=9. DIRn should be connected to external RS-485 transceiver
A102	IO2_TX	O	TXn – Transmit line, where n=2. TXn should be connected to external RS-485 transceiver
A103	IO4_TX	O	TXn – Transmit line, where n=4. TXn should be connected to external RS-485 transceiver
A104	NU		Leave unused
A105	NU		Leave unused
A106	NU		Leave unused
A107	ADC_SDOB	I	Channel B Serial data output from ADC

Function	Communication and I/O		
No	**Name**	**Type**	**Description**
A108	IO2_RX	I	RXn – Receive line, where n=2. RXn should be connected to external RS-485 transceiver
A109	IO9_RX	I	RXn – Receive line, where n=9. RXn should be connected to external RS-485 transceiver
A110	IO2_DIR	O	DIRn – Direction line, where n=2. DIRn should be connected to external RS-485 transceiver
A111	IO10_DIR	O	DIRn – Direction line, where n=10. DIRn should be connected to external RS-485 transceiver
A112	IO5_RX	I	RXn – Receive line, where n=5. RXn should be connected to external RS-485 transceiver
A113	IO8_DIR	O	DIRn – Direction line, where n=8. DIRn should be connected to external RS-485 transceiver
A114	IO10_RX	I	RXn – Receive line, where n=10. RXn should be connected to external RS-485 transceiver
A115	SR_CLOCK	O	Clock of Serial extended IO Bus
A116	NU		Leave unused
A117	SR_PLOAD	O	Load of Serial extended IO Bus
A118	NU		Leave unused
A119	IO4_DIR	O	DIRn – Direction line, where n=4. DIRn should be connected to external RS-485 transceiver
A120	IO6_TX	O	TXn – Transmit line, where n=6. TXn should be connected to external RS-485 transceiver
A121	ADC_SDOA	I	ADC Channel A Serial data output from ADC
A122	SR_DS_EXT_OUT	O	Data out of Serial extended IO Bus

Function	Communication and I/O		
No	**Name**	**Type**	**Description**
A123	IO8_RX	I	RXn – Receive line, where n=8. RXn should be connected to external RS-485 transceiver
A124	IO6_RX	I	RXn – Receive line, where n=6. RXn should be connected to external RS-485 transceiver
A125	ADC_SDI	O	Serial data input for ADC
A126	NU	I/O	Leave unused
A127	IO7_TX	O	TXn – Transmit line, where n=7. TXn should be connected to external RS-485 transceiver
A128	IO6_DIR	O	DIRn – Direction line, where n=5. DIRn should be connected to external RS-485 transceiver
A129	IO1_TX	O	TXn – Transmit line, where n=1. TXn should be connected to external RS-485 transceiver
A130	NU		Leave unused
A131	IO7_DIR	O	DIRn – Direction line, where n=7. DIRn should be connected to external RS-485 transceiver
A132	NU		Leave unused
A133	IO1_RX	I	RXn – Receive line, where n=1. RXn should be connected to external RS-485 transceiver
A134	NU		Leave unused
A135	NU		Leave unused
A136	ADC_CLOCK	O	CLOCK for ADC
A137	SR_DS_EXT_IN	I/O	Data input of Serial extended IO Bus
A138	IO7_RX	I	RXn – Receive line, where n=7. RXn should be connected to external RS-485 transceiver
A139	IO1_DIR	O	DIRn – Direction line, where n=1. DIRn should be connected to external RS-485 transceiver

Function	Communication and I/O		
No	**Name**	**Type**	**Description**
A140	IO5_DIR	O	DIRn – Direction line, where n=5. DIRn should be connected to external RS-485 transceiver
A141	ADC_RD/CONVST	O	ADC Read data/ Conversion start
A142	IO8_TX	O	TXn – Transmit line, where n=8. TXn should be connected to external RS-485 transceiver
A143	SR_OEn	O	Output enable of Serial extended IO Bus
A144	ADC_BUSY	I	ADC Converter busy indicator
A145	RSTOUTn	O	Reset
A146	NU		Leave unused
A147	NU	I	Connect 3KOhm Pull Down (to COMRET)
A148	NU	I	Connect 3KOhm Pull Up (to VDD_3V3)
A149	NU	I	Connect 3KOhm Pull Down (to COMRET)
A150	NU	I	Connect 3KOhm Pull Down (to COMRET)
Connector			

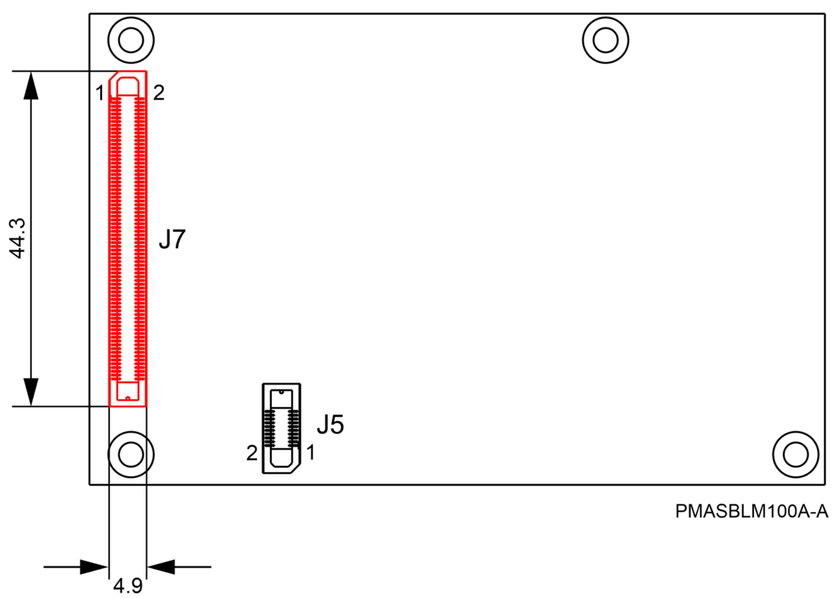


Table 2: Communication and I/O Pin Connectors

6.2 Mechanics

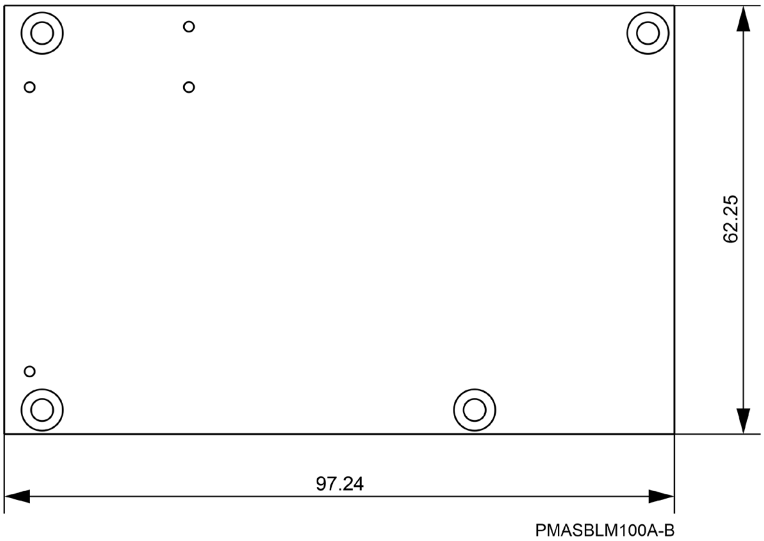


Figure 3: Pin Physical Dimensions

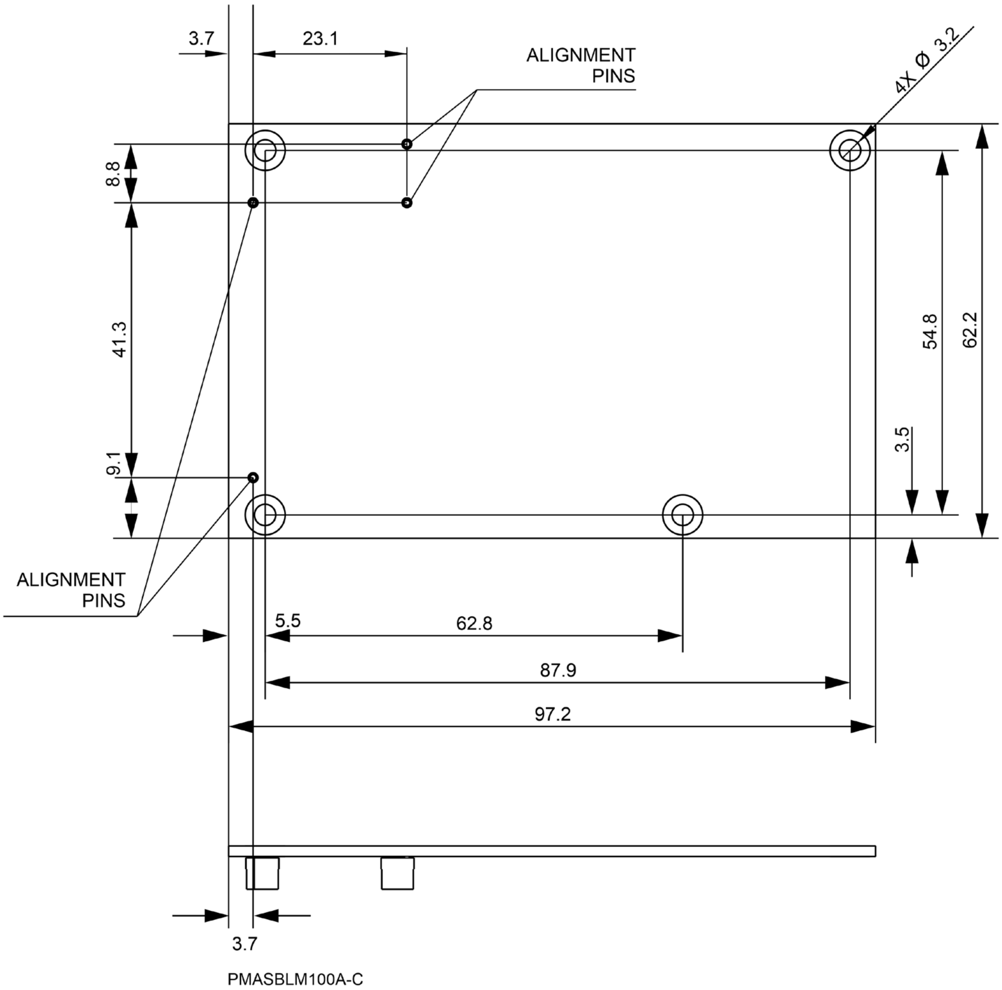
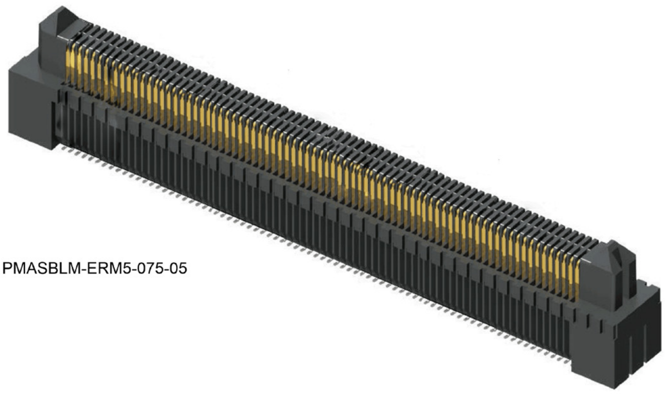


Figure 4: Pin Detail Measurements

6.2.1 Mating Connector Types

Mating Connector	Details
Power Connector 10 pin, 2 rows, 0.5mm	 PMASBLM-ERM5-010-05 **Samtec ERM5-010-05.0-L-DV-K-TR**
Communication & I/O Connector 75 pin, 2 rows, 0.5mm	 PMASBLM-ERM5-075-05 **Samtec ERM5-075-05.0-L-DV-K-TR**

6.3 CAN Communication

6.3.1 Overview

Typically, the CANbus is set with a pair of twisted wires. The Bus ends are terminated with a 120 ohm resistor at each end. This results in a bus load of 60 ohm. Close matching of the termination resistor with the cable impedance ensures that the data signals are not reflected at the bus ends.

It must be emphasized that the CANbus is actually a “3 wires” communication, especially out of the board. Theoretical the number of units that can be connected to the CAN bus is not limited. However, the total actual number of units that can be connected will be limited by the delay times and the bus loads in the bus lines.

The CANbus includes the following signals: CAN_L, CAN_H, and GND. Make sure that the GND signal also connected via the cable. Figure 5 displays the general CAN connectivity.

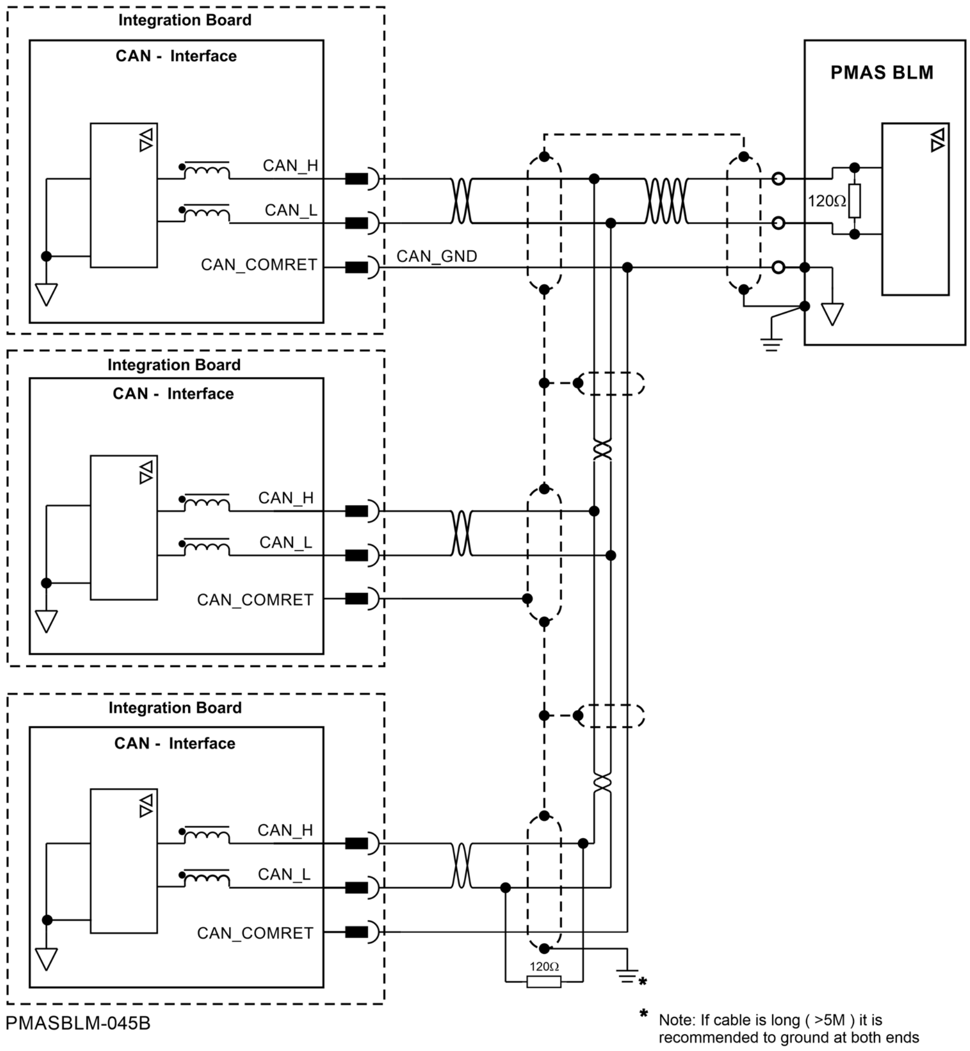


Figure 5. CANbus Connections

Important:
A 120 Ω termination resistor should be connected at each end of the network cable.

6.3.2 CAN Speed

The CAN Bus standard specifies the Max theoretical cable length @1Mbits/sec as 40 m. However, the CAN is determined by various factors such as:

- Loop delays of the connected bus nodes and the delay of the bus lines, consist of:
  - CAN controller and Transceiver Delays (vary between 30÷150 nano-sec)
  - Optional Isolation Delays (vary between 20÷75 nano-sec)
  - Typical Bus line delays
  - Delay connector
- Differences in bit time quantum length due to relative oscillator tolerance between nodes.
- Signal amplitude drop due to the series resistance of the bus cable and the input resistance of bus nodes.

In order to analyze the actual max cable length and number of nodes that can be safely used in a specific configuration, all the above factors should be taken into consideration.

6.3.3 CAN Interface

The CAN Interface block includes common mode choke and CAN Bus Protector for ESD and other harmful transient voltage events. Figure 6 describes an example for the P-MAS-BLM connected to the RJ-45 in the PCB.

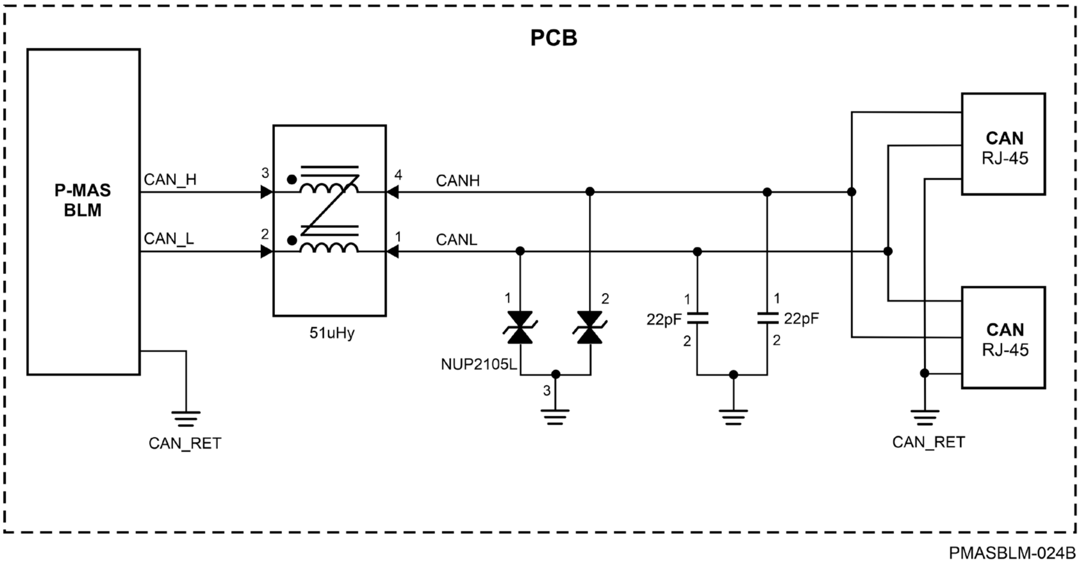


Figure 6: P-MAS-BLM CAN interface connected to RJ-45

6.3.4 CAN Communication over the PCB

Figure 7 describes the connections between the:

- PMAS-BLM to the External CAN network via J-45
- Connection to the drive module as in the G-Whistle or G-Trombone via PCB. The PMAS-BLM is connected to one of the CAN Interfaces, either Isolated or non-isolated.
- The CANBUS (CANH, CANL) passes into the PCB to the other drive module, and also connects to the RJ-45 for CAN Devices external connectivity.

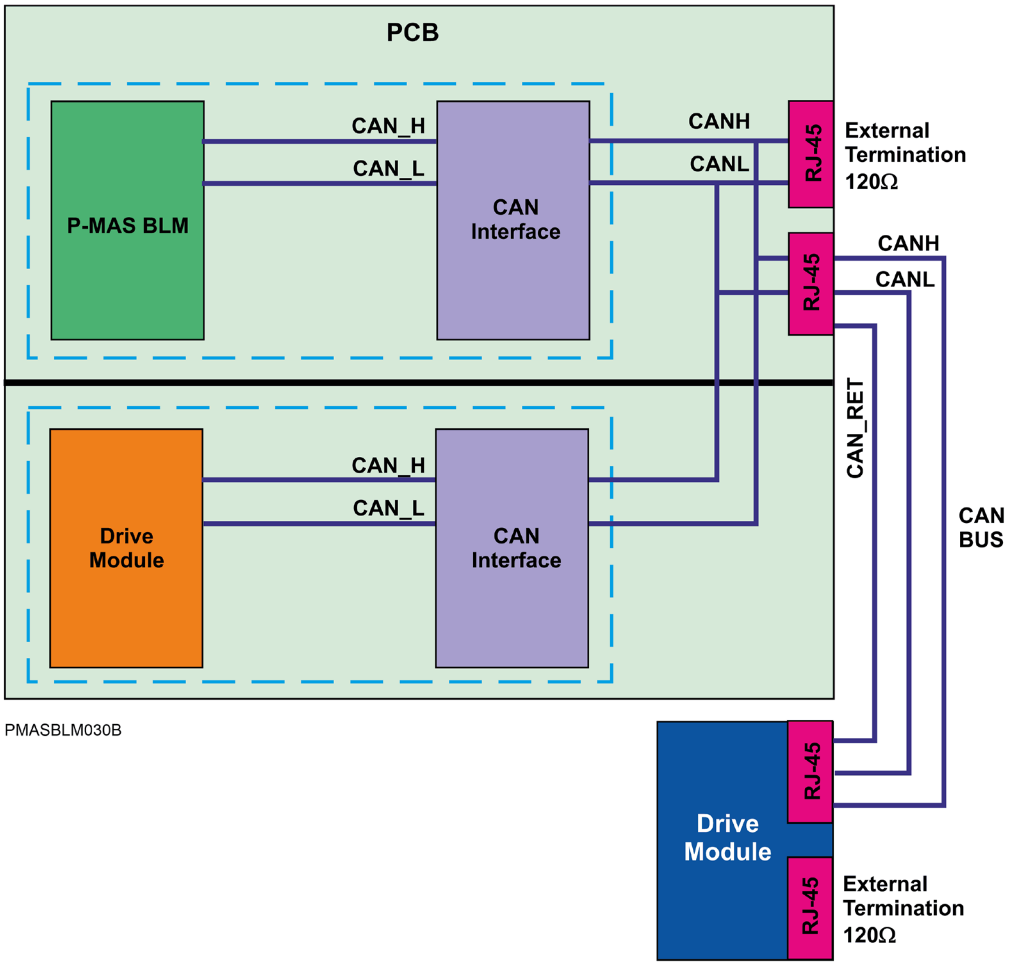


Figure 7: P-MAS-BLM Connections to the External CAN network via RJ-45 and also to Drive Module

6.4 USB Device Connections

The following is the USB 2.0 device pin description:

USB Pin	I/O	Description
USB2_DP	I/O	USB Data+
USB2_DM	I/O	USB Data-
USB_DEVICE_VBUS	I	Monitor for the USB voltage

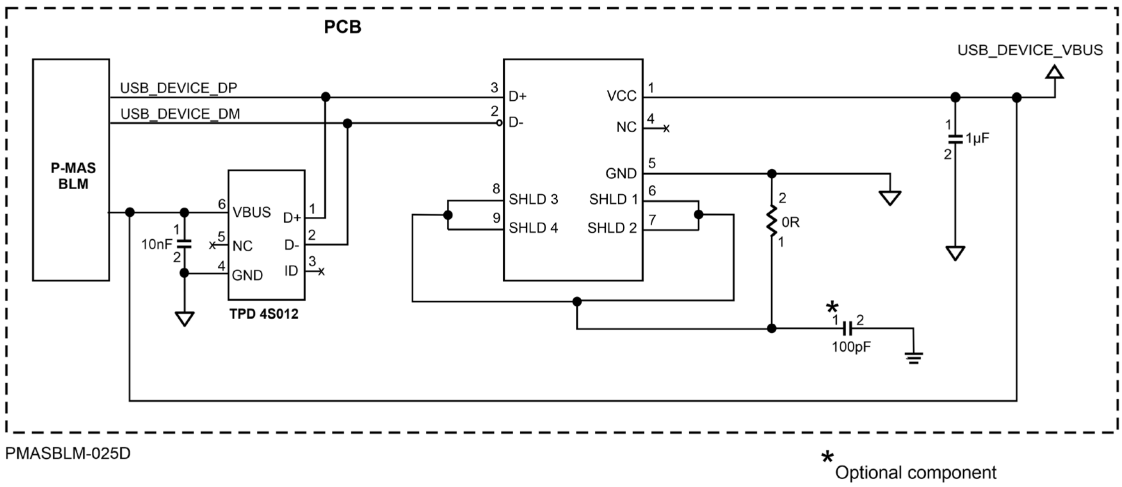


Figure 8: USB Device implementation

6.5 USB Host Connections

The following is the USB 3.0 Host pin description:

USB Pin	I/O	Description
USB3_DP	I/O	USB Data+
USB3_DM	I/O	USB Data-
USB_HOST_VBUS	O	5V Output for USB Devices (up to 100mA)

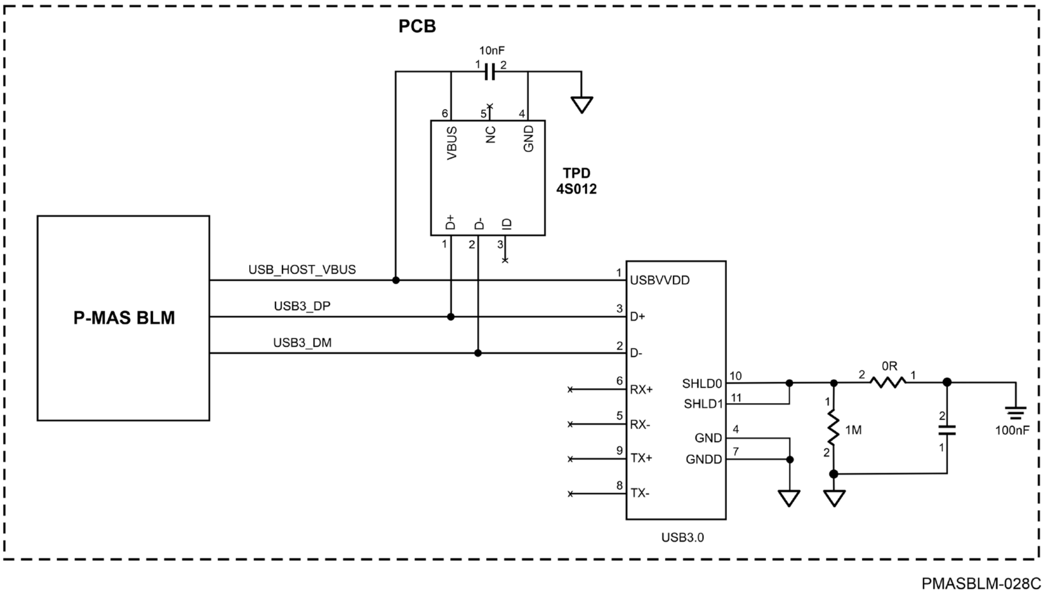


Figure 9: USB Host implementation

6.6 Ethernet Communications

The Ethernet signals are used to connect between the PMAS-BLM and the Host Computer. The following signals originate from the Physical Layer Transceiver (PHY) which provides the Ethernet 1000Base-T.
Pin Descriptions:

Ethernet Pins	I/O	Description
TRD0+	I/O	Differential Transmit/Receive signal Data0+ from the Ethernet PHY to RJ-45 with Magnetic
TRD0-	I/O	Differential Transmit/Receive signal Data0-from the Ethernet PHY to RJ-45 with Magnetic
TRD1+	I/O	Differential Transmit/Receive signal Data1+from the Ethernet PHY to RJ-45 with Magnetic
TRD1-	I/O	Differential Transmit/Receive signal Data1-from the Ethernet PHY to RJ-45 with Magnetic
TRD2+	I/O	Differential Transmit/Receive signal Data2+from the Ethernet PHY to RJ-45 with Magnetic
TRD2-	I/O	Differential Transmit/Receive signal Data2-from the Ethernet PHY to RJ-45 with Magnetic
TRD3+	I/O	Differential Transmit/Receive signal Data3+from the Ethernet PHY to RJ-45 with Magnetic
TRD3-	I/O	Differential Transmit/Receive signal Data3-from the Ethernet PHY to RJ-45 with Magnetic
LED0_LINK100	O	Orange - 100Mbps link
LED2_LINK1000	O	Green - 1000Mbps link
LED1_LINK_ACT	O	Solid Green – Link Up Blinking Green - TX/RX Activity

Figure 10 describes the RJ-45 magnetic connection to the Ethernet port.

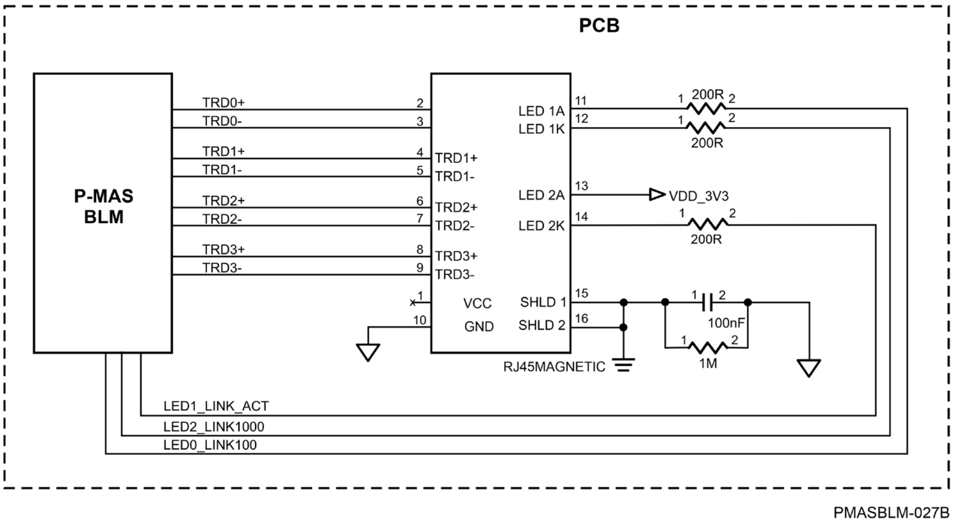


Figure 10: Ethernet implementation

6.7 EtherCAT Communications

There are two EtherCAT ports:

- **EtherCAT Master1 port**: This is the main port. Connect the EtherCAT network to this port. This port should be the first device in the EtherCAT network.
- **EtherCAT Master2 port**: Not used. It is an optional port for future requirements such as redundancy.

6.7.1 EtherCAT Master1 Port

The following signals originate from the Physical Layer Transceiver (PHY) which provides the Ethernet 10Base-T/100Base-TX.

EtherCAT IN Pins	I/O	Description
PHY0_TX+	O	Differential Transmit signal Data+ for EtherCAT Master1 from the Ethernet PHY
PHY0_TX-	O	Differential Transmit signal Date- for EtherCAT Master1 from the Ethernet PHY
PHY0_RX+	I	Differential Receive signal Data+ for EtherCAT Master1 to the Ethernet PHY
PHY0_RX-	I	Differential Receive signal Data- for EtherCAT Master1 to the Ethernet PHY
PHY0_LED_LINK_ACT	O	LED will be ON when the link is OK
PHY0_LED_SPEED	O	Indicates 10Mb/s or 100Mb/s
VDD_3V3	O	+3.3V to the transformer RJ45 connection

6.7.2 EtherCAT Master2 Port

The following signals originate from the Physical Layer Transceiver (PHY) which provides the Ethernet 10Base-T/100Base-TX.

EtherCAT IN Pins	I/O	Description
PHY1_TX+	O	Differential Transmit signal Data+ for EtherCAT Master2 from the Ethernet PHY
PHY1_TX-	O	Differential Transmit signal Date- for EtherCAT Master2 from the Ethernet PHY
PHY1_RX+	I	Differential Receive signal Data+ for EtherCAT Master2 to the Ethernet PHY
PHY1_RX-	I	Differential Receive signal Data- for EtherCAT Master2 to the Ethernet PHY
PHY1_LED_LINK_ACT	O	LED will be ON when the link is OK
PHY1_LED_SPEED	O	Indicates 10Mb/s or 100Mb/s
VDD_3V3		+3.3V to the transformer RJ45 connection

6.7.3 EtherCAT Connectivity to RJ-45

The following figure describes the connectivity of the EtherCAT PHY signals to the RJ-45 connector with magnetic.

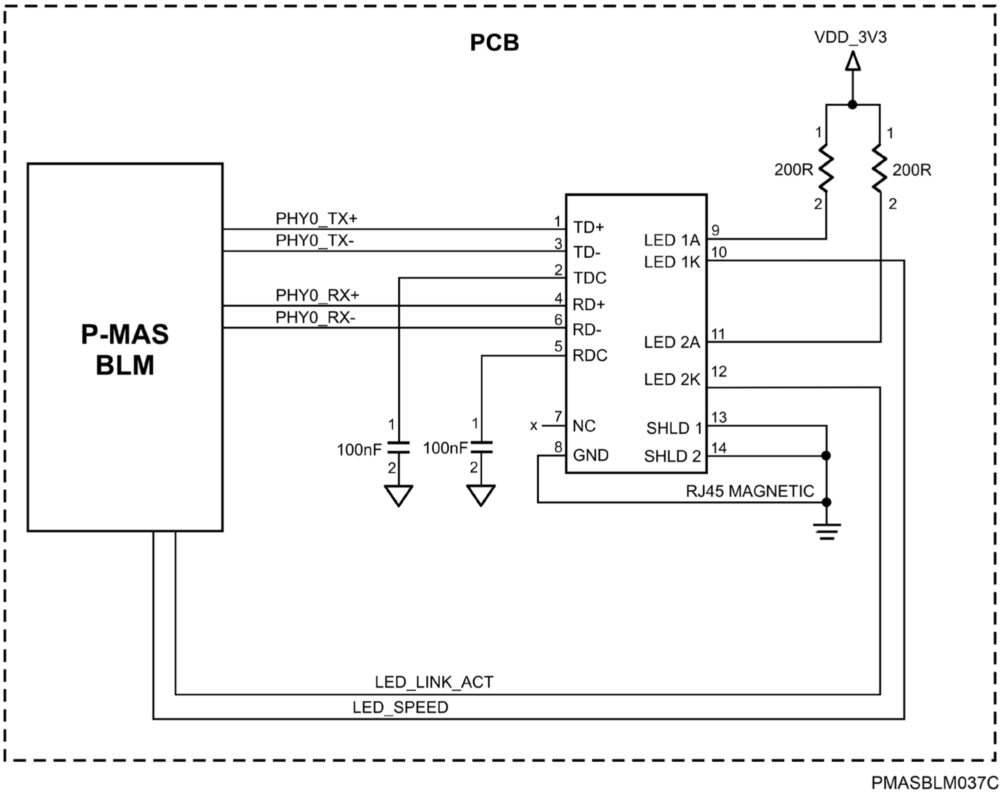


Figure 11: EtherCAT implementation with RJ-45

Figure 12 describes the P MAS-BLM with RJ-45 connected to the EtherCAT Drive Module via the Cable. The PMAS-BLM should be the first device in the EtherCAT network.

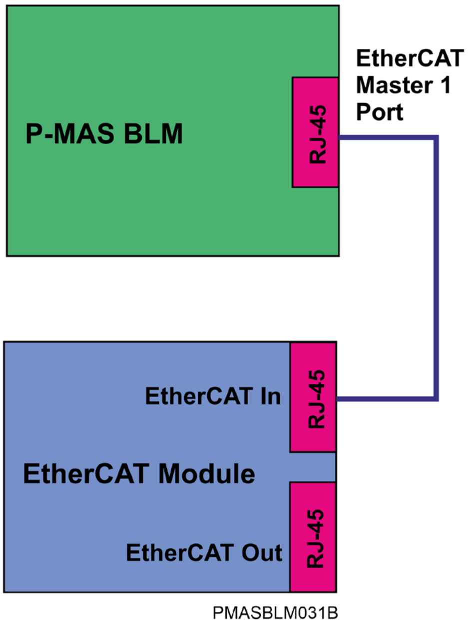


Figure 12: P-MAS-BLM with RJ-45 connected to an EtherCAT module

6.7.4 Connecting the PMAS-BLM EtherCAT Port via the PCB with Capacitive Coupling

When the point to point Ethernet connection is made through a PCB (and not through a cable), the PCB replaces the RJ-45 and the twisted pair cable. The connection between the P-MAS-BLM to the other EtherCAT drive module in the PCB is made with Capacitive Coupling.

Figure 13 describes the EtherCAT network that includes:

- P-MAS BLM connected to EtherCAT Module via PCB with capacitive decoupling. The PHY signals of the P-MAS BLM (PHY0) are connected to the EtherCAT Module, PHY signals of the EtherCAT In, via capacitors. The P-MAS BLM should be the first device in the EtherCAT network.
- The P-MAS BLM TX signals are connected to the EtherCAT ModuleRX signals. Similarly, the P-MAS BLM RX signals connected to the EtherCAT ModuleTX signals.
- EtherCAT Drive Module connected to the EtherCAT Drive Module via the Cable. The cable is connected between the EtherCAT out port of the EtherCAT Drive Module to the EtherCAT In port of the EtherCAT Drive Module.

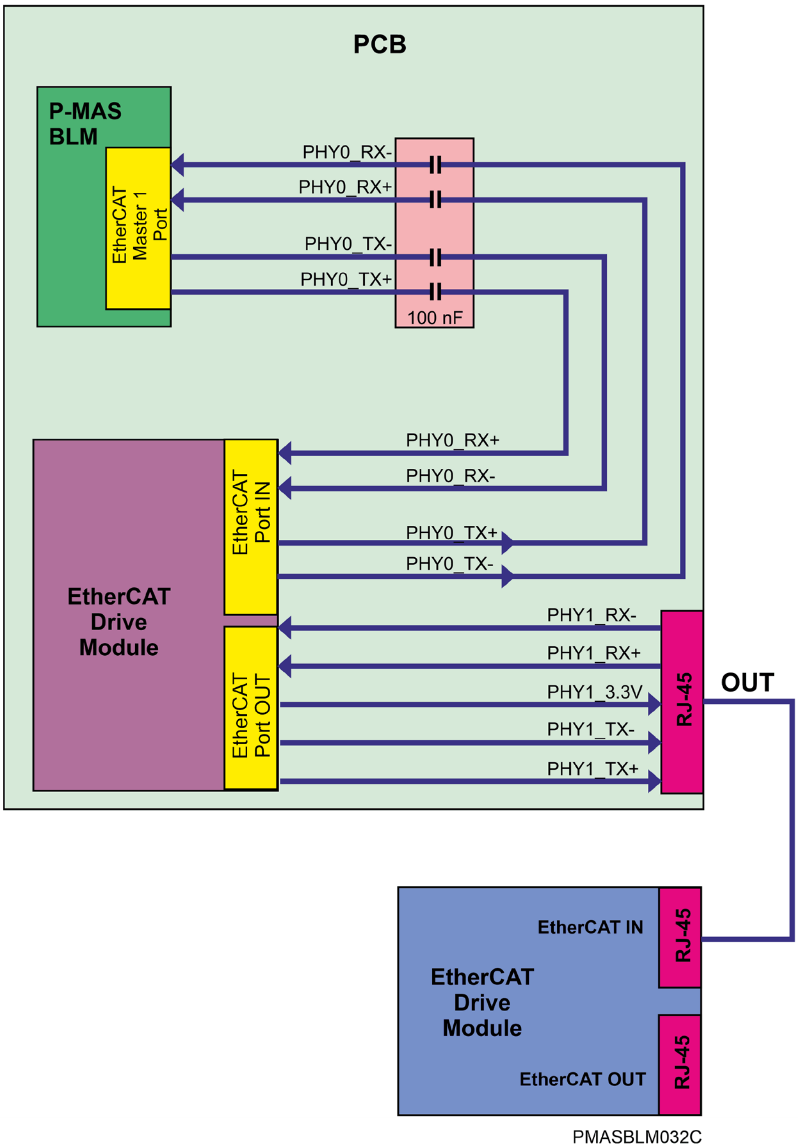


Figure 13: P-MAS-BLM and G-Whistle connections via PCB traces with Capacitors

6.8 Micro SD Card Connections

The following describes the Micro SD card connections:

SD Card Pin	I/O	Description
SD_DAT0	I/O	SD Card Data 0
SD_DAT1	I/O	SD Card Data 1
SD_DAT2	I/O	SD Card Data 2
SD_DAT3	I/O	SD Card Data 3
SD_CMD	I/O	SD Card Command
SD_CLK	O	SD Card Clock
SD_CD	I	SD Card Detection
VDD_SD	PWR	SD Card Supply Voltage

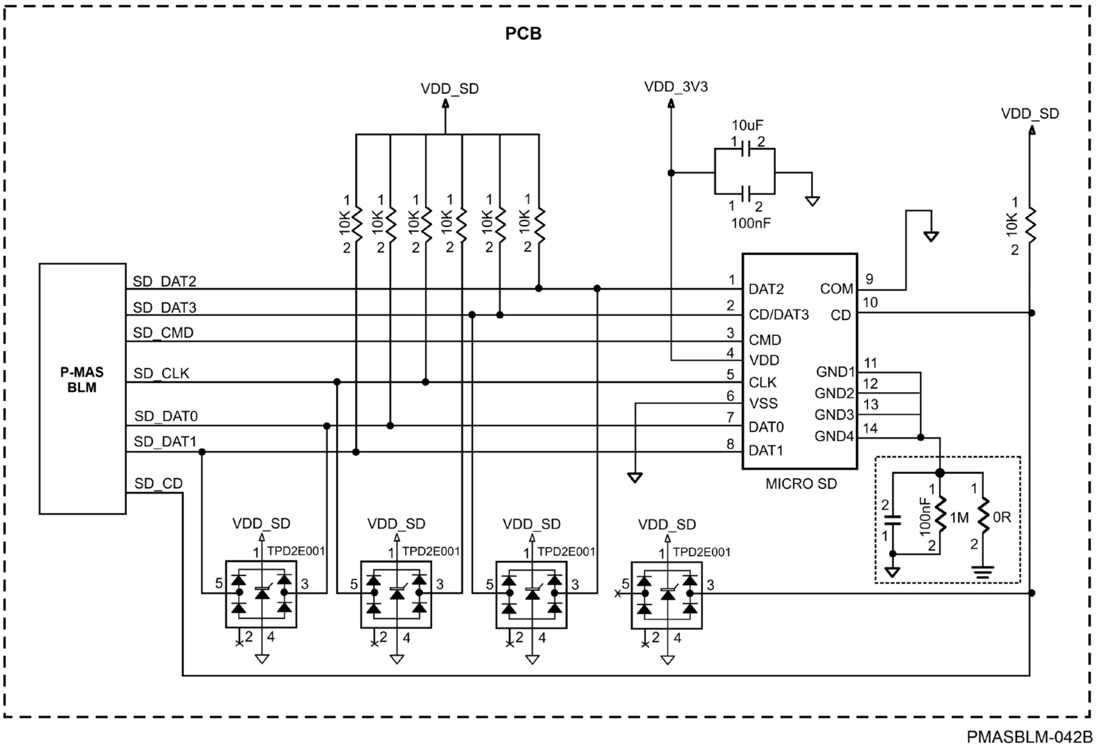


Figure 14: P-MAS-BLM Micro SD Card Connections

6.9 Analog Inputs Interface

The 4 Analog Inputs can be read using a Dual, 1MSPS 16bit, 4x2 Channel Simultaneous Sampling ADC by TI (P/N: ADS8363). For a detailed connection diagram refer to the PMAS_BLM_V1.DSN.

The following describes the Analog Inputs Interface pins:

Pin	I/O	Description
ADC_SDOA	O	Serial data output for converter A
ADC_SDOB	O	Serial data output for converter B
ADC_SDI	I	Serial data input
ADC_CLOCK	I	External clock input
ADC_BUSY	O	Converter busy indicator
ADC_RD/CONVST	I	Read data/ Conversion start

6.10 Extended I/O's Interface (optional)

Optionally, an Extended I/O's interface with up to 24 digital inputs (TTL level) and up to 24 digital outputs (TTL level) may be connected to the P-MAS BLM. The Extended I/O's interface is implemented using parallel to serial and serial to parallel shift registers.

For a detailed connection diagram refer to the drawing PMAS_BLM_V1.DSN.

The following describes the Extended I/O Interface pins:

Pin	I/O	Description
SR_PLOAD	I	**Input:** The PLOAD signal loads the data to the serial shift register. The data is sampled to the serial shift register at the rising edge of the PLOAD. **Output:** The PLOAD latches the data from the serial shift register to the parallel register. The data is latched to the parallel register at the falling edge of the PLOAD.
SR_DS_EXT_OUT	I	This signal is an output data from pin based module to the serial shift register.
SR_OEn	I	Extended outputs enable
SR_DS_EXT_IN	O	This signal is an input data from the serial shift register to the pin based module.
SR_CLOCK	I	The Clock is used as serial shift clock of the input or output serial shift register.

6.11 Differential I/O Interface (optional)

Optionally, up to 9 differential I/O's using RS485 transceivers may be connected to the P-MAS BLM. Each RS485 transceiver interfaces with three P-MAS BLM signals.

For a detailed connection diagram refer to the drawing PMAS_BLM_V1.DSN.

The following describes the Differential I/O Interface pins:

Pin	I/O	Description
IO1_TX	I	I/O 1 Transmit
IO1_RX	O	I/O 1 Receive
IO1_DIR	I	I/O 1 Direction
IO2_TX	I	I/O 2 Transmit
IO2_RX	O	I/O 2 Receive
IO2_DIR	I	I/O 2 Direction
IO4_TX	I	I/O 4 Transmit
IO4_RX	O	I/O 4 Receive
IO4_DIR	I	I/O 4 Direction
IO5_TX	I	I/O 5 Transmit
IO5_RX	O	I/O 5 Receive
IO5_DIR	I	I/O 5 Direction
IO6_TX	I	I/O 6 Transmit
IO6_RX	O	I/O 6 Receive
IO6_DIR	I	I/O 6 Direction
IO7_TX	I	I/O 7 Transmit
IO7_RX	O	I/O 7 Receive
IO7_DIR	I	I/O 7 Direction
IO8_TX	I	I/O 8 Transmit
IO8_RX	O	I/O 8 Receive
IO8_DIR	I	I/O 8 Direction
IO9_TX	I	I/O 9 Transmit
IO9_RX	O	I/O 9 Receive
IO9_DIR	I	I/O 9 Direction
IO10_TX	I	I/O 10 Transmit
IO10_RX	O	I/O 10 Receive

Pin	I/O	Description
IO10_DIR	I	I/O 10 Direction

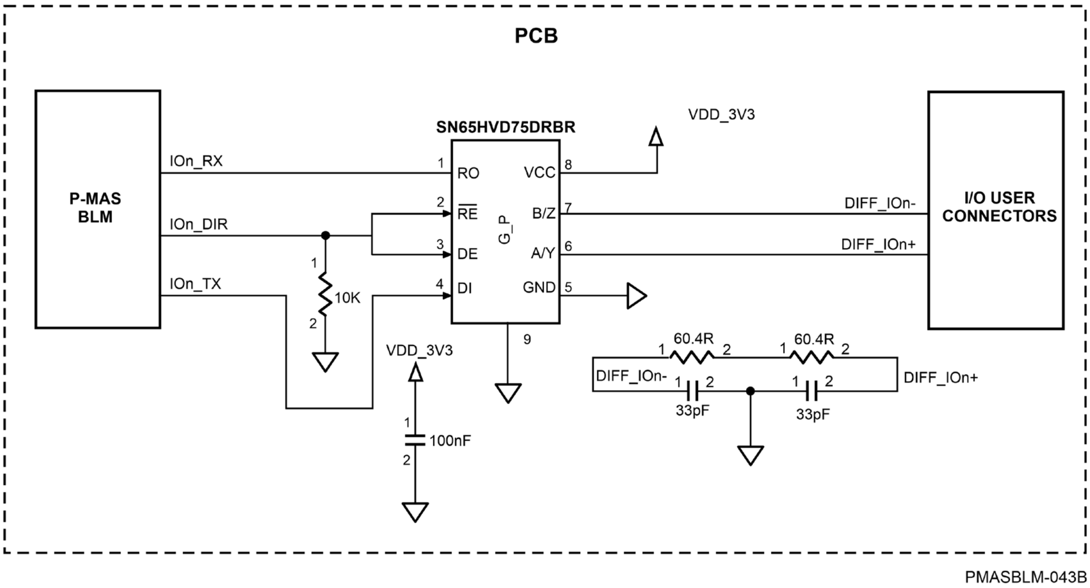


Figure 15: Differential I/O Interface Connections

6.12 RS232 Interface

The RS232 Interface has a single RS232 port to connect with the P-MAS BLM.

For a detailed connection diagram refer to the drawing PMAS_BLM_V1.DSN.

The following describes the RS232 Interface pins:

Pin	I/O	Description
RS232_TX	I	RS232 Transmit
RS232_RX	O	RS232 Receive

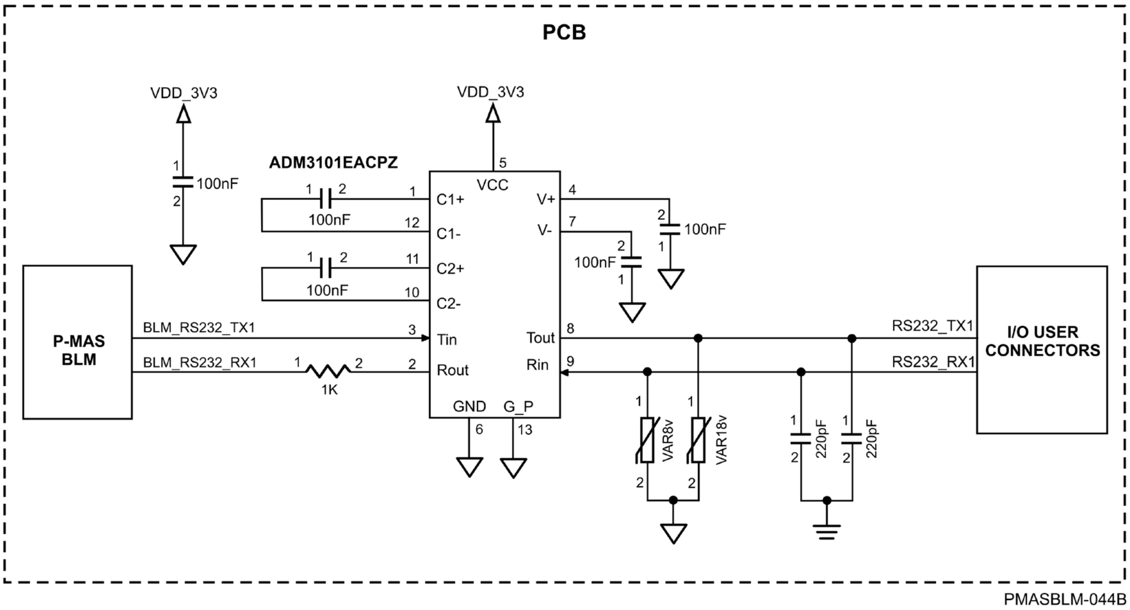


Figure 16: RS232 Interface Connections

6.13 Layout Guidelines

6.13.1 PCB

It is recommended to use at least 4 layers on the PCB, for the routing of the EtherCAT signals. The following is an example of the Stackup:

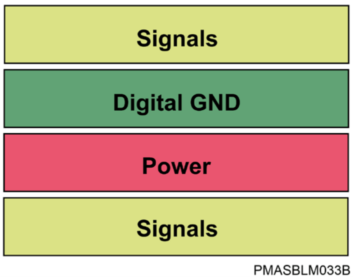


Figure 17: Example of Layered Stackup on PCB

The Digital plan should be continuous and not fragmented.

6.13.2 Connection to RJ-45 with Magnetic

The digital ground planes **should not** be placed under the RJ-45.

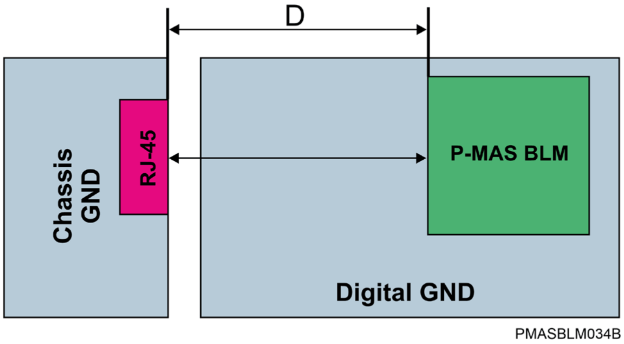


Figure 18: RJ-45 Layout

The P-MAS BLM should be placed as close as possible to the magnetic. If there are limitations on the PCB layout, preventing the P-MAS BLM from being positioned close to the magnet, then the trace length from the P-MAS BLM to the magnetic should not be longer than 5 inches (D).

6.13.3 Connection with Capacitor

The digital ground planes **should** be placed under the capacitor parts.

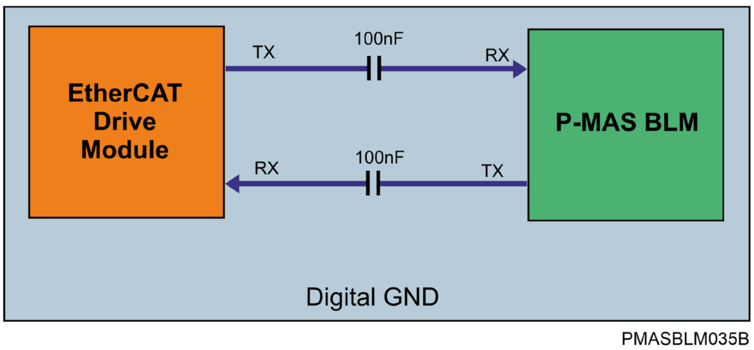


Figure 19: Transform Layout

6.13.4 EtherCAT Differential Signal Layout Guidelines

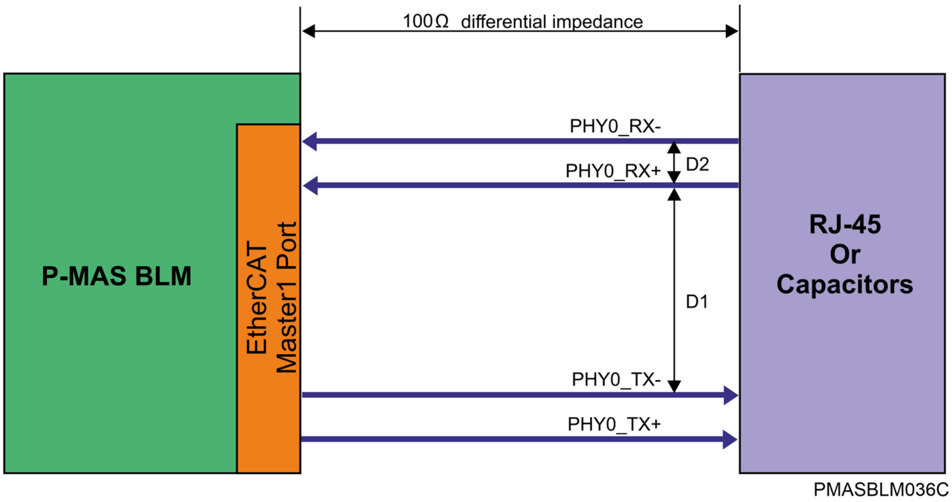


Figure 20: EtherCAT Differential Signal Layout

- The following is a guide to the differential signal layout
- The differential pairs (PHY0_TX±, PHY0_RX±) should be designed to a 100 ohm ± 10% differential impedance according to the PCB manufacturer stackup (D2).
- The trace width should be determined by the required trace impedance according to the PCB manufacturer stackup.
- The spacing D1 between the differential pairs should be as large as possible.
- Route the differential pairs as straight as possible, maintaining them in parallel for differential pairs.
- Route the differential pairs symmetrically, at equal lengths and close together whenever possible.
- Do not route digital signals under the magnetic parts
- Avoid using VIAS on the traces of the differential pairs.
- Avoid routing the signal trace at a right-angle. Instead route it using multiple 45˚ angles.

6.13.5 1GB Ethernet Differential Signal Layout Guidelines

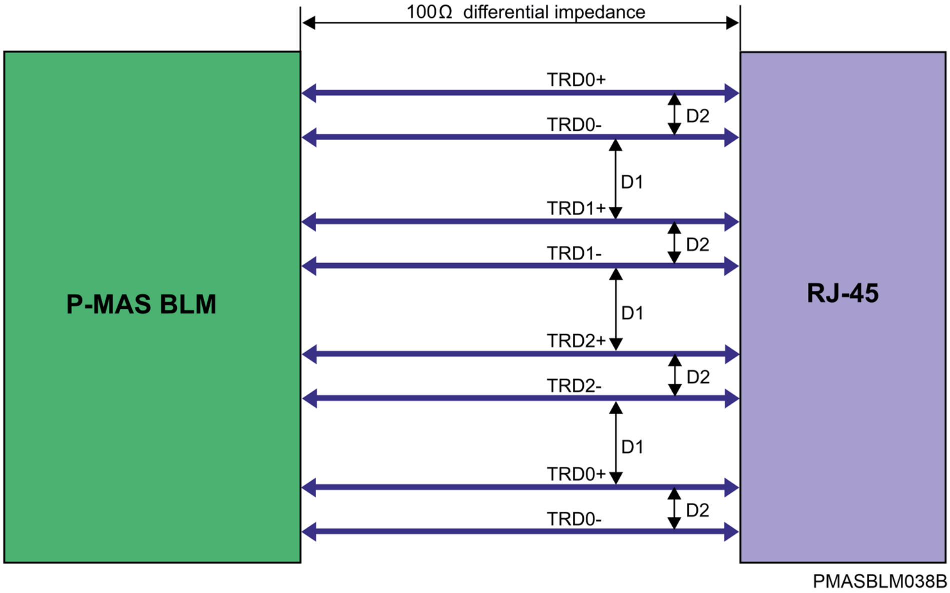


Figure 21: 1GB Ethernet Differential Signal Layout

The following is a guide to the differential signal layout

- The differential pairs (TRD0±, TRD1±, TRD2±, and TRD3±) should be designed to a 100 ohm ± 10% differential impedance according to the PCB manufacturer stackup (D2).
- The trace width should be determined by the required trace impedance according to the PCB manufacturer stackup.
- The spacing D1 between the differential pairs should minimum 50mils.
- The spacing between the differential pairs to other high speed periodic signals should be minimum 50 mils.
- Keep the differential pairs as short as possible.
- Length matching between differential pairs ±15mils
- Length matching of differential pair 5 mils maximum
- Route the differential pairs as straight as possible, maintaining them in parallel for differential pairs.
- Route the differential pairs symmetrically, at equal lengths and close together whenever possible.
- Do not route digital signals under the magnetic parts
- Avoid using VIAS on the traces of the differential pairs.
- Avoid routing the signal trace at a right-angle. Instead route it using multiple 45˚ angles.

6.13.6 USB Host/Device Differential Signal Layout Guidelines

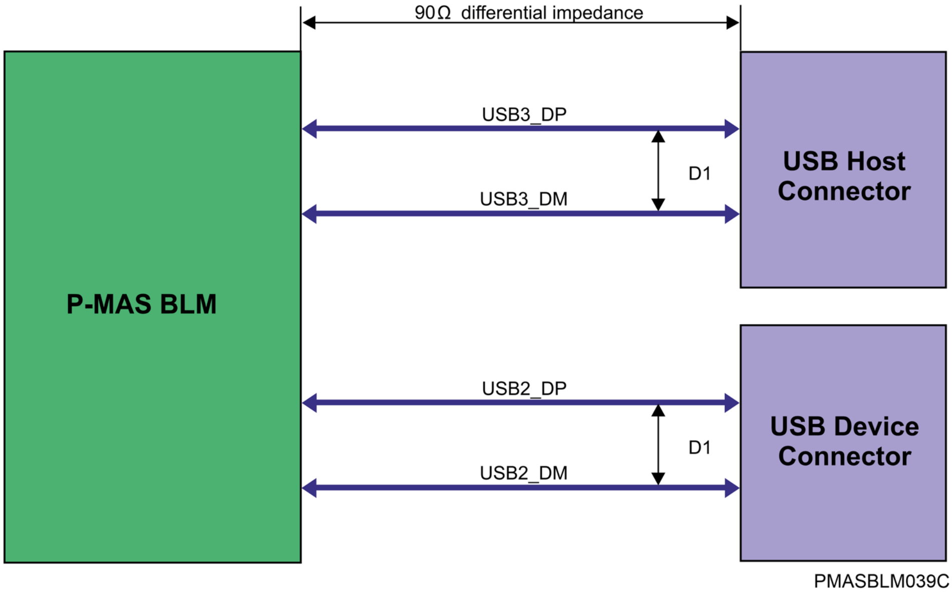


Figure 22: USB Host/Device Differential Signal Layout

The following guidelines are recommended:

- The differential pairs should be designed to a 90 ohm ± 10% differential impedance according to the PCB manufacturer stuck up (D1).
- The trace width should be determined by the required trace impedance according to the PCB manufacturer stuck up.
- The spacing between the differential pairs to other high speed periodic signals should be minimum 50 mils.
- Keep the differential pairs as short as possible.
- Route the differential pairs as straight as possible, maintaining them in parallel for differential pairs.
- Route the differential pairs symmetrically, at equal lengths and close together whenever possible.
- Do not route digital signals under the magnetic parts
- Avoid using VIAS on the traces of the differential pairs.
- Avoid routing the signal trace at a right-angle. Instead route it using multiple 45˚ angles.

6.13.7 CAN Layout Guidelines

The following guidelines are recommended:

- Locate the CAN Bus Protector Diodes, Common Mode Choke and filter capacitor close to the CAN Connector.
- The length traces of the CAN Bus Protector Diodes should be as short as possible.
- For optimum layout, there should be an inner ground layer. This is optimal from the immunity point of view.
- The digital ground planes should not be placed under the magnetic parts (common mode choke)
- The CAN lines are differential lines. They should be routed together and as close as possible.
- Do not route digital signals under the magnetic parts (Common mode choke)

6.13.8 Micro SD Card Layout Guidelines

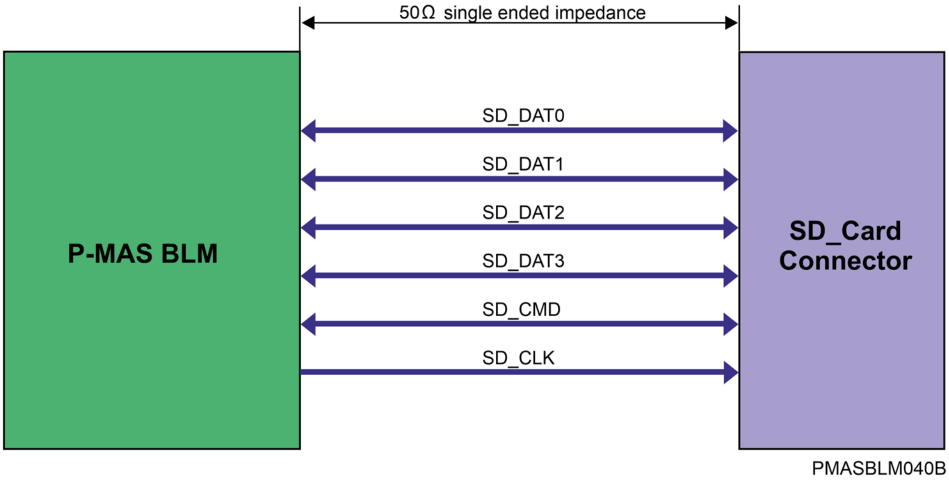


Figure 23: Micro SD Card Signal Layout

The following guidelines are recommended:

- The SD_CARD single ended traces should be designed to a 50 ohm ± 10% impedance according to the PCB manufacturer stuck up.
- The trace width should be determined by the required trace impedance according to the PCB manufacturer stuck up.
- Keep the traces as short as possible.
- Length matching between the traces ±10mils
- Route the traces as straight as possible.
- Do not route digital signals under magnetic parts.
- Avoid routing the signal traces at a right-angle. Instead route it using multiple 45˚ angles.

Chapter 7: Heat Dissipation

For full power output capability the P-Maestro BLM is designed to be mounted on an external heat-sink. It is highly recommended that the "Wall" on which the P-Maestro BLM is mounted will have heat dissipation capabilities.

Elmo recommends using the Thermal Pads (PN IMT-30GWHI01) supplied in the module kit. To apply the Thermal Pads do the following before connecting a heat sink (optional) to the P-Maestro BLM:

1. Remove the back-adhesive cover from a Thermal Pad and stick the pad to the P-Maestro BLM as shown in Figure 24.
   Repeat the above step 1 for the remaining Thermal Pads (Figure 24)

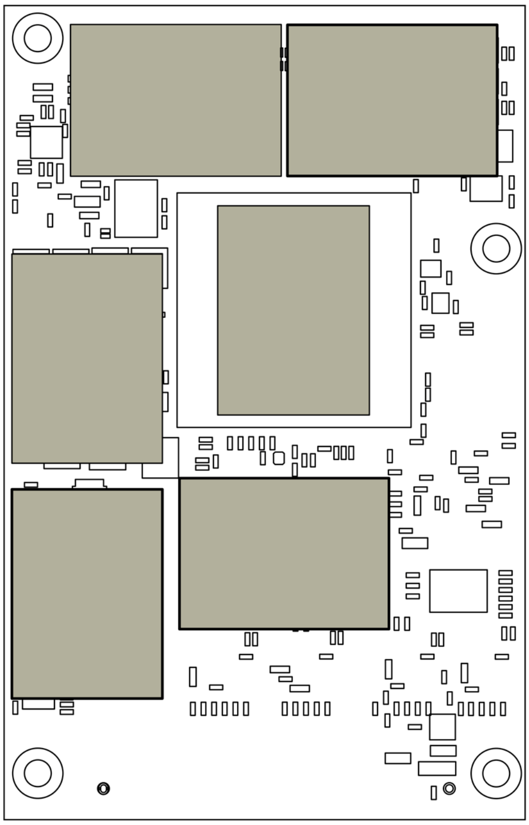


Figure 24: Mounting the Thermal Pads

2. Install/Mount a heat sink to the front of the P-Maestro BLM to cover the Thermal Pads
Make sure that the gap between the Heat Sink and the P-Maestro BLM is **5.0mm** as shown in Figure 25.

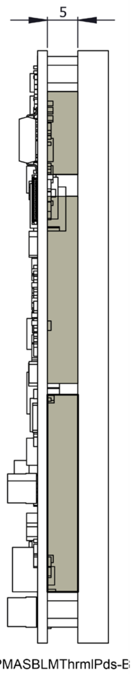
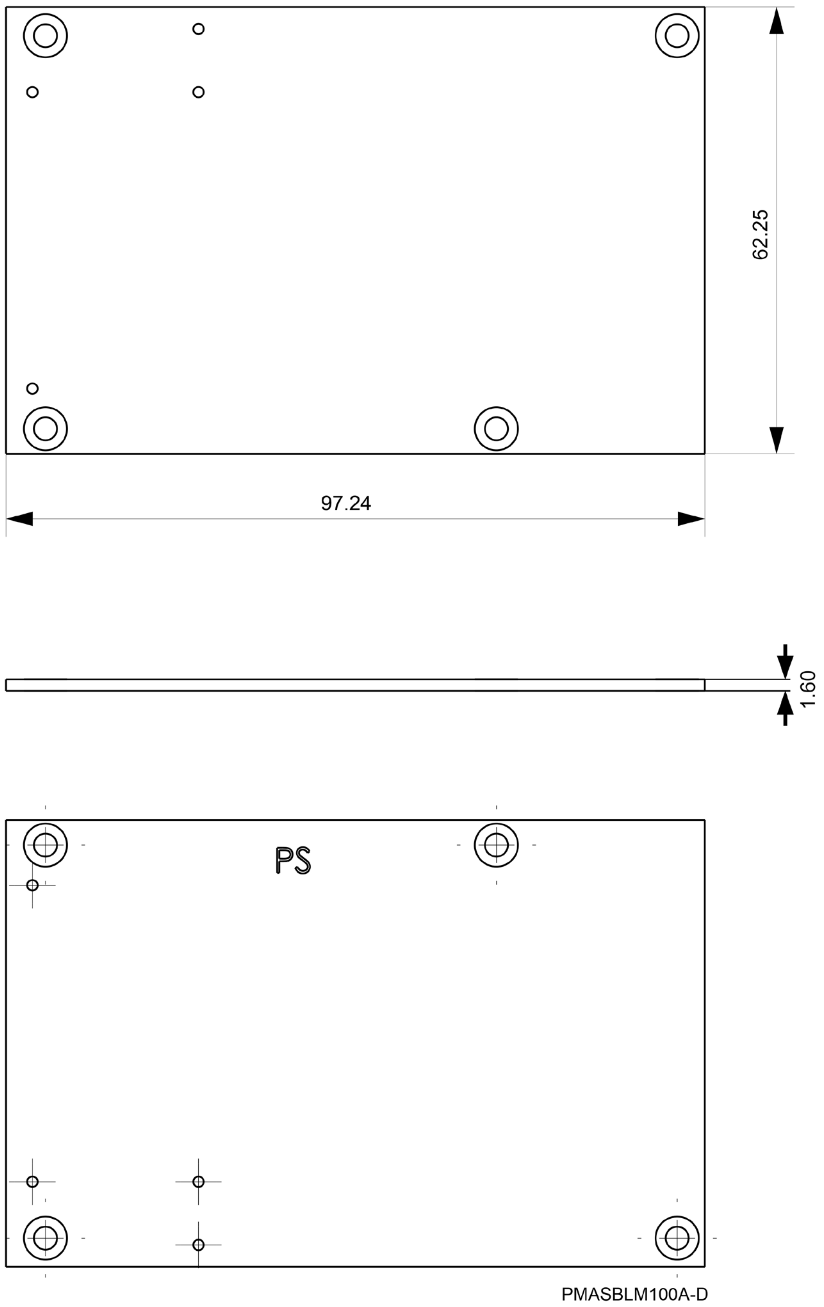
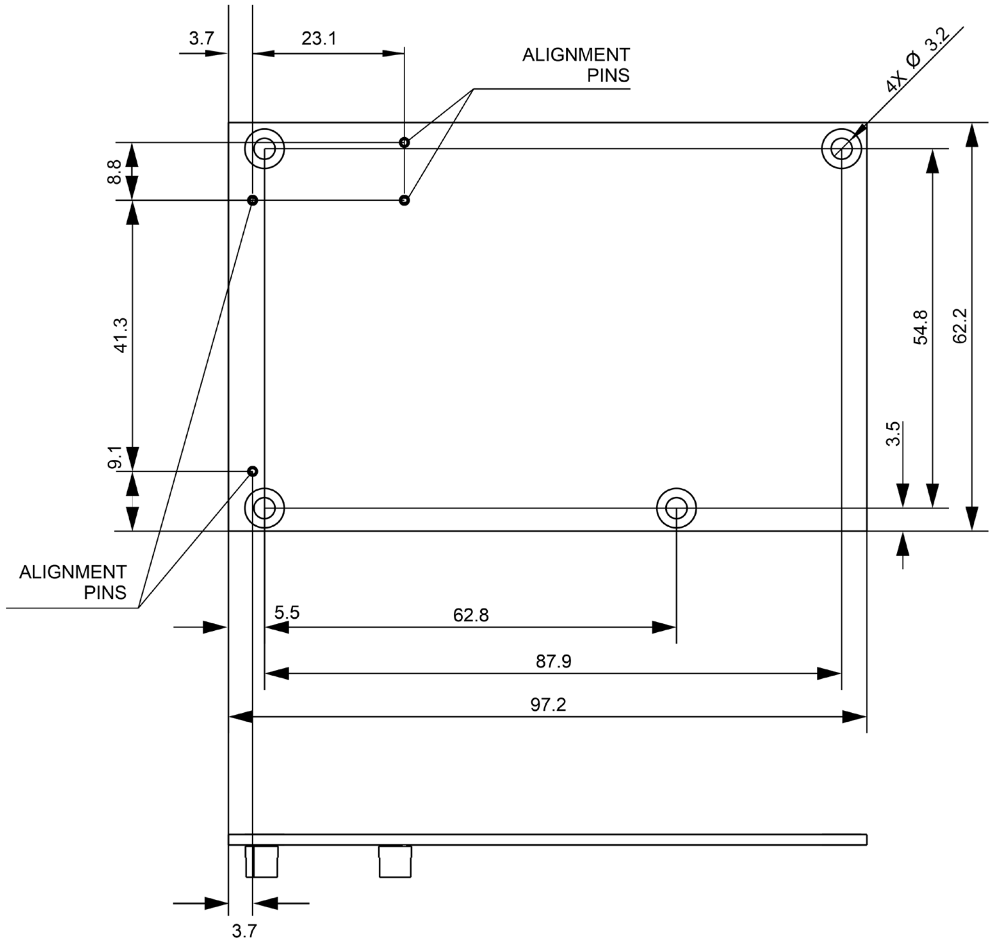


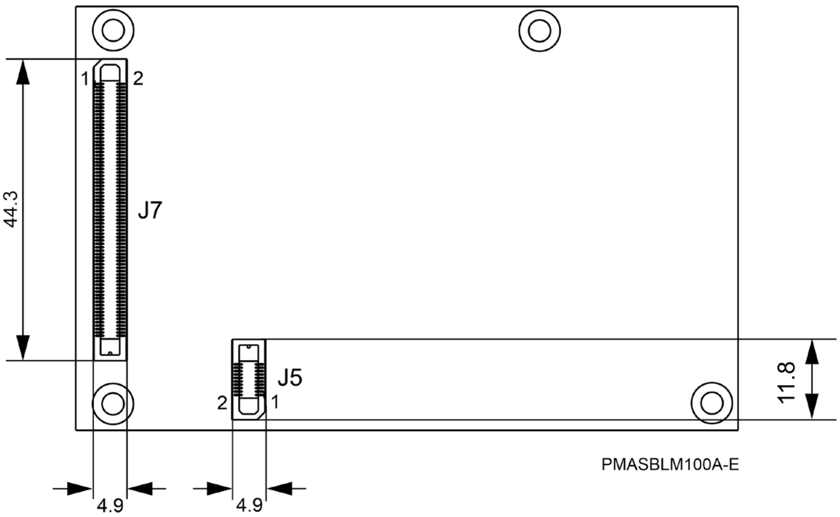
Figure 25: Defining the gap between the Heat Sink and Thermal Pads

Chapter 8: P-Maestro BLM Dimensions





PMASBLM100A-C



PMASBLM100A-E

Chapter 9: Compliance with Standards

The P-Maestro BLM network motion controller has been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

9.1 Low Voltage Directive

Specification	Details
The related standards below apply to the performance of the motion controller as stated in the environmental conditions paragraph 3.8 Environmental Conditions. The P-Maestro BLM does not require UL compliance, as its maximum voltage is 32 VDC.	
In compliance with **EN 60204-1**	Low Voltage Directive 73/23/EEC
In compliance with **CE 2006/95/EC**	Low-voltage directive 2006/95/EC

9.2 Other Compliant Standards

Quality Assurance	
ISO 9001:2008	Quality Management
Design	
• IPC-D-275 • IPC-SM-782 • IPC-CM-770	Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
Reliability	
MIL-HDBK- 217F	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.)
Workmanship	
In compliance with **IPC-A-610**, level 3	Acceptability of electronic assemblies
PCB	
In compliance with **IPC-A-600**, level 3	Acceptability of printed circuit boards
Packing	
In compliance with **EN 100015**	Protection of electrostatic sensitive devices
Environmental	
In compliance with **2002/96/EC**	Waste Electrical and Electronic Equipment regulations (WEEE) **Note:** Out-of-service Elmo drives should be sent to the nearest Elmo sales office.
In compliance with **2002/95/EC** (effective July 2006)	Restrictions on Application of Hazardous Substances in Electric and Electronic Equipment (RoHS)

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