M3 3-Axis Module CANopen MP3

3-AXIS DIGITAL DRIVE FOR SERVO & STEPPER MOTORS

Servo Control Modes
- Profile Position-Velocity, Interpolated Position, Homing
- Indexer, Point-to-Point, PVT
- Camming, Gearing
- Position/Velocity/Torque

Stepper Control Modes
- Cyclic Synchronous Position (CSP)
- Profile Position-Velocity-Torque, Interpolated Position, Homing
- Position (Microstepping)
- Position/Velocity/Torque (Servo Mode)
- Indexer, Point-to-Point, PVT
- Camming, Gearing

Command Interface
- CANopen
- ASCII and discrete I/O
- Stepper commands
- ±10V or PWM velocity/torque (servo mode)
- Master encoder (Gearing/Camming)

Communications
- CANopen
- RS-232

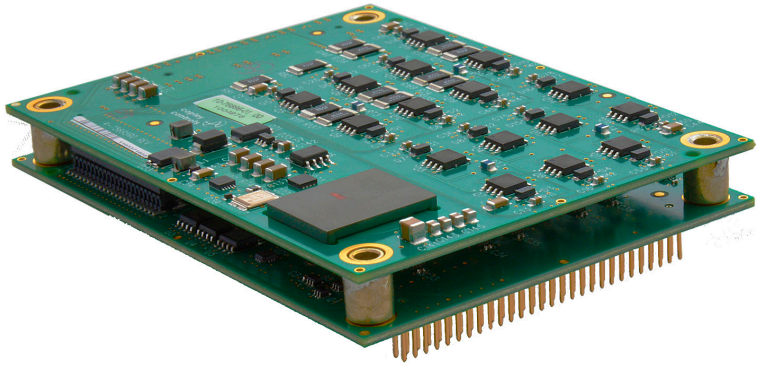
Feedback
- Digital quad A/B/X encoder
- Absolute encoders
- Sin/Cos encoders
- Digital Halls

I/O Digital
- 18 HS inputs
- 3 MOSFET outputs
- 3 CMOS HS outputs

I/O Analog
- 3 ±10V inputs

I/O SPI
- 1 HS input
- 3 CMOS HS outputs

Dimensions: mm [in]
- 101.6 x 85.1 x 21 [4.0 x 3.35 x 0.80]



Model	Ic	Ip	Vdc
MP3-090-10	5	10	14~90

DESCRIPTION

Multinet MP3 is a 3-axis, high-performance, DC powered drive for position, velocity, and torque control of stepper and motors via CANopen. Using advanced FPGA technology, the *MP3* provides a significant reduction in the cost per node in multi-axis CANopen systems.

Each of the three axes in the *MP3* operate as *CANopen* nodes under CiA-402 for motion control devices. Supported modes include: Profile Position-Velocity, Interpolated Position Mode (PVT), and Homing.

Servo mode of steppers allows CANopen or digital PWM control of position/velocity/torque. In microstepping mode stepper command pulses and master encoder for camming or gearing is supported.

Eighteen high-speed digital inputs with programmable functions are provided. There are six CMOS high-speed outputs. Three MOSFET outputs that are 24V compatible can power motor brakes.

An SPI port is provided with one high-speed input and three high-speed digital outputs. If not used for SPI, the input and outputs are programmable for other functions.

An RS-232 serial port provides a connection to Copley's CME2 software for commissioning, firmware upgrading, and saving configurations to flash memory. The CANopen port is optically isolated.

Drive power is transformer-isolated DC from regulated or unregulated power supplies. An AuxHV input is provided for "keep-alive" operation permitting the drive power stage to be completely powered down without losing position information, or communications with the control system.

GENERAL SPECIFICATIONS

Test conditions: Load = Bipolar stepper: 2 mH + 2 Ω per phase. Ambient temperature = 25°C, +HV = HV_{max}

MODEL	MP3-090-10	
OUTPUT POWER (each axis)		
Peak Current	10 (7.07)	Adc (Arms-sine), ±5%
Peak time	1	Sec
Continuous current	5 (3.53)	Adc (Arms-sine) per phase (Note 1)
Maximum Output Voltage	Vout = HV*0.97 - Rout*Iout	
INPUT POWER (module)		
HVmin~HVmax	+14 to +90	Vdc Transformer-isolated
Ipeak	30	Adc (1 sec) peak
Icont	15	Adc continuous (Note 1)
Aux HV	+14 to +90 Vdc , <tbd> W max with all encoders powered, <tbd> W max with no encoders	
PWM OUTPUTS		
Type	Dual H-bridge MOSFET , 12.5 kHz center-weighted PWM, space-vector modulation	
PWM ripple frequency	25 kHz	
CONTROL MODES SERVO		
CANopen: Profile Position/Velocity/Torque, Interpolated Position (PVT), Homing		
Analog ±10 Vdc velocity/torque, 12-bit resolution		
Digital PWM velocity/torque		
Digital position: CW/CCW, Pulse/Direction, Quadrature A/B		
Discrete I/O: Camming, internal indexer and function generator		
CONTROL MODES STEPPER		
CANopen: Profile Position/Velocity (/Torque in servo mode), Interpolated Position (PVT), Homing		
Analog ±10 Vdc velocity (/Torque in servo mode), 12-bit resolution		
Digital PWM velocity (/Torque in servo mode)		
Digital stepper position commands, CW/CCW, Pulse/Direction, Quadrature A/B		
Discrete I/O: Camming, internal indexer and function generator		
COMMAND INPUTS		
Type	CANopen, galvanically isolated from drive circuits	
Signals & format	CAN_H, CAN_L, CAN_GND	
Device ID Selection	Programmable, or via digital inputs	
Analog	±10 Vdc, torque/velocity control, 12-bit resolution	
Digital	High speed inputs for PWM velocity/torque and stepper/encoder position commands	
Camming	Quad A/B digital encoder	
DIGITAL CONTROL		
Digital Control Loops	Current, velocity, position. 100% digital loop control	
Sampling rate (time)	Current loop: 12.5 kHz (80 µs), Velocity & position loops: 2.5 kHz (400 µs) See note 2.	
Commutation	Sinusoidal, field-oriented control for stepper motors	
Modulation	Center-weighted PWM with space-vector modulation	
Bandwidths	Current loop: 2.5 kHz typical, bandwidth will vary with tuning & load inductance	
HV Compensation	Changes in bus voltage do not affect bandwidth	
Minimum load inductance	200 µH line-line	
ANALOG INPUTS		
Number	3	
Type	±10 Vdc, 12-bit resolution, differential	
DIGITAL INPUTS		
Number, type	19, 74LVC14 Schmitt trigger, V_T+ = 1.1~2 Vdc, V_T- = 0.8~1.5 Vdc, V_H+ = 0.3~1.2 Vdc	
[IN1~18]	High-speed (HS) digital, 100 ns RC filter, 10 kΩ pull-up to +3.3 Vdc, 7V tolerant	
[IN19]	SPI port MISO input, 47 ns RC filter, 10 kΩ pull-up to +3.3 Vdc, 7V tolerant	
Halls	9, 74HC14 Schmitt trigger, V_T+ = 2.5~3.5 Vdc, V_T- = 1.3~2.2 Vdc, V_H+ = ±0.7~1.5 Vdc	
	High-speed (HS) digital, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, 24V tolerant	
Functions	Default functions are shown above, programmable to other functions	
DIGITAL OUTPUTS		
Number	9	
[OUT1~3]	Open-drain MOSFET with 1 kΩ pull-up with series diode to +5 Vdc	
	300 mAdc max, +30 Vdc max. Functions programmable	
	External flyback diodes required for driving inductive loads	
[OUT4~9]	SPI port MOSI, SCLK, SS1 signals, 74AHCT240 line drivers; +5 Vdc tolerant;	
	Output current:-8 mA source @ V_{OH} = 2.4V, 6 mA sink at V_{OL} = 0.5V	
Functions	Default functions are shown above, programmable to other functions	
DC POWER OUTPUT		
Number	3	
Ratings	+5 Vdc, 500 mA max each output, thermal and short-circuit protected	
RS-232 PORT		
Signals	RxD, TxD, Gnd for operation as a DTE device	
Mode	Full-duplex, DTE serial port for drive setup and control, 9,600 to 115,200 Baud	
	Baud rate defaults to 9,600 after power-on or reset. Programmable to 19,200, 57,600, 115,200	
Protocol	ASCII or Binary format	

Notes:

1) Forced-air cooling may be required for operation at full output power on all axes.

2) Default settings for current and position loop frequencies. User programmable for other frequencies.

GENERAL SPECIFICATIONS

FEEDBACK (each axis)		
Incremental:		
Digital Incremental Encoder	Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required) 5 MHz maximum line frequency (20 M counts/sec) MAX3097 differential line receiver with fault detection for A, B, X inputs	
Analog Incremental Encoder	Sin/cos format (sin+, sin-, cos+, cos-), differential, 1 Vpeak-peak, ServoTube motor compatible, BW > 300 kHz Digital Index (X, /X) input	
Absolute:		
SSI	Clock (X, /X), Data (S, /S) signals	
EnDat	Clock (X, /X), Data (S, /S), sin/cos (sin+, sin-, cos+, cos-) signals	
Absolute A	Tamagawa Absolute A, Panasonic Absolute A Format, Sanyo Denki Absolute A SD+, SD- (S, /S) signals, 2.5 or 4 MHz, 2-wire half-duplex communication Status data for encoder operating conditions and errors	
BiSS (B&C)	MA+, MA- (X, /X), SL+, SL- (S, /S) signals, 4-wire, clock output from BEL, data returned from encoder	
Secondary:		
	3 MAX3362 differential line receiver/transmitters, programmable as incremental encoder A/B/X, or absolute full-duplex X (clock) and S (data), or half-duplex X (clock/data)	
Halls	9 74HC14 Schmitt trigger, V_T+ = 1.8~3.5 Vdc, V_T- = 1.0~2.2 Vdc, V_H+ = 0.47~1.47 Vdc	
MOTOR CONNECTIONS (each axis)		
Phase U, V, W	PWM outputs to 3-phase ungrounded Wye or delta connected brushless motors, or DC brush motors	
Phase A, /A, B, /B	Dual PWM H-bridge outputs for each axis to drive stepper motors with bipolar windings Output functions are individually programmable to drive servo or stepper motors	
Encoders	See FEEDBACK section above	
Hall & encoder power	See DC POWER OUTPUTS section	
PROTECTIONS		
HV Overvoltage	+HV > HV_{max}	Drive outputs turn off until +HV < HV_{max} (See Input Power for HV_{max})
HV Undervoltage	+HV < +14 Vdc	Drive outputs turn off until +HV > +14 Vdc
Drive over temperature	Heat plate > 70°C.	Drive outputs turn off
Short circuits	Output to output, output to ground, internal PWM bridge faults	
I^2T Current limiting	Programmable: continuous current, peak current, peak time	
Motor over temperature	Digital inputs programmable to detect motor temperature switch	
Feedback Loss	Inadequate analog encoder amplitude or missing incremental encoder signals	
MECHANICAL & ENVIRONMENTAL		
Size mm [in]	101.6 x 85.1 x 21 [4.0 x 3.35 x 0.80]	
Weight	MP3: 0.09 kg [0.20 lb], MP3 + DevKit: 0.38 kg [0.84 lb]	
Ambient temperature	0 to +45°C operating, -40 to +85°C storage	
Humidity	0 to 95%, non-condensing	
Vibration	2 *g* peak, 10~500 Hz (sine), IEC60068-2-6	
Shock	10 *g*, 10 ms, half-sine pulse, IEC60068-2-27	
Contaminants	Pollution degree 2	
Environment	IEC68-2: 1990	
Cooling	Forced air cooling may be required for continuous power output	

AGENCY STANDARDS CONFORMANCE (PENDING)

In accordance with EC Directive 2004/108/EC (EMC Directive)

EN 55011: 2009/A1:2010	CISPR 11:2009/A1:2010 Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment – Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement Group 1, Class A
EN 61000-6-1: 2007	Electromagnetic Compatibility (EMC) – Part 6-1: Generic Standards – Immunity for residential, Commercial and Light-industrial Environments

In accordance with EC Directive 2006/95/EC (Low Voltage Directive)

IEC 61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

Underwriters Laboratory Standards

UL 61010-1, 2nd Ed.: 2008	Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements

UL File Number E249894

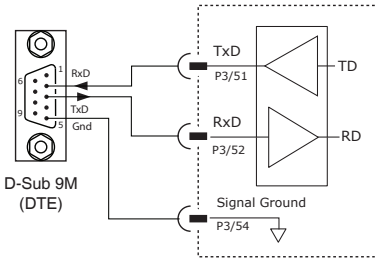
CME2 SOFTWARE

Drive setup is fast and easy using *CME 2* software. All of the operations needed to configure the drive are accessible through this powerful and intuitive program. Auto-phasing of brushless motor Hall sensors and phase wires eliminates "wire and try". Connections are made once and *CME 2* does the rest thereafter. Encoder wire swapping to establish the direction of positive motion is eliminated.
Motor data can be saved as .CCM files. Drive data is saved as .CCX files that contain all drive settings plus motor data. This eases system management as files can be cross-referenced to drives. Once a drive configuration has been completed systems can be replicated easily with the same setup and performance.

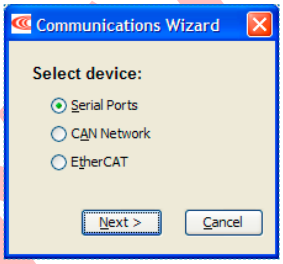
RS-232 COMMUNICATIONS

The MP3 is configured via a three-wire, full-duplex RS-232 port that operates as a DTE from 9,600 to 115,200 Baud. CME 2 software communicates with the drive over this link for commissioning and adjustments.
When operating as a stand-alone drive that takes command inputs from an external controller, CME 2 is used for configuration. When operated as a CAN node, CME 2 is used for programming before and after installation in a CAN network. The MP3 can also be controlled via CME 2 while it is in place as a CAN node. During this process, drive operation as a CAN node is suspended. When adjustments are complete, CME 2 relinquishes control of the drive and returns it to the CAN node state. Multiple drives can communicate over a single RS-232 port by daisy-chaining the master drive to other drives using CAN cables. The master drive does the RS-232 communication with the system and echoes the commands to the other drives over the CAN bus.

RS232 PORT



CME2 -> TOOLS -> COMMUNICATIONS WIZARD



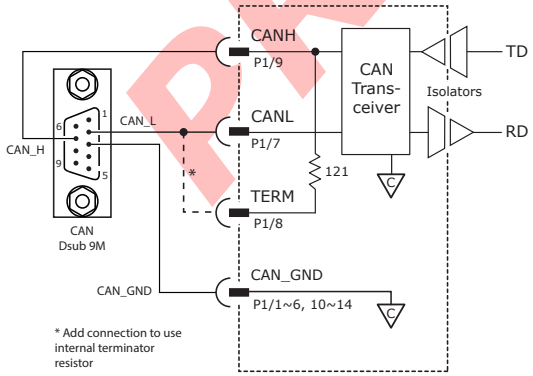
CANOPEN COMMUNICATIONS

Based on the CAN V2.0b physical layer, a robust, two-wire communication bus originally designed for automotive use where low-cost and noise-immunity are essential, CANopen adds support for motion-control devices and command synchronization. The result is a highly effective combination of data-rate and low cost for multi-axis motion control systems. Device synchronization enables multiple axes to coordinate moves as if they were driven from a single control card.

The MP3 uses the CAN physical layer signals CANH, CANL, and GND for connection, and CANopen protocol for communication.
Before installing the drive in a CAN system, it must be assigned a CAN Node-ID (address). A maximum of 127 CAN nodes are allowed on a single CAN bus. Up to seven digital inputs can be used to produce CAN Node-IDs from 1~127, or the Node-ID can be saved to flash memory in the module. Node-ID 0 is reserved for the CANopen master on the network.

CANOPEN CONNECTIONS

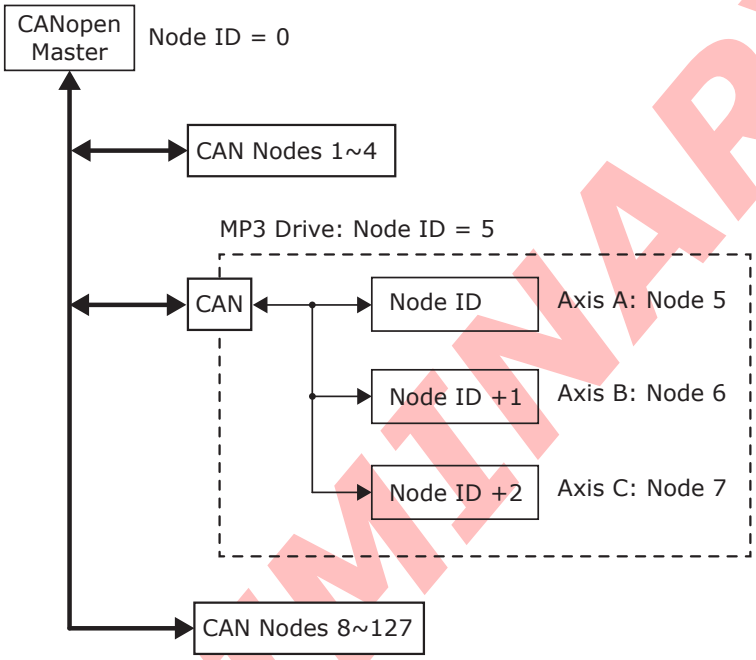
The graphic below shows connections between the MP3 and a Dsub 9M connector on a CAN card. If the MP3 is the last node on a CAN bus, the internal terminator resistor can be used by adding a connection on the PC board as shown. The node Node-ID of the MP3 may be set by using digital inputs, or programmed into flash memory in the drive.



CME2 -> Basic Setup -> Operating Mode Options

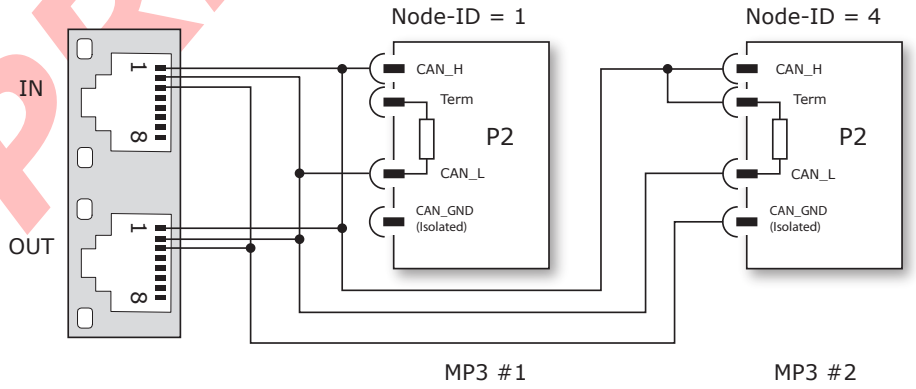
CANOPEN DEVICE ID SWITCHES

The Node-ID of the MP3 can be set in flash memory, or read from 16-position switches via an SPI port. An SPI port circuit and switches is included in the MP3 Development Kit. Users can add this circuit to their own mounting boards. The Node ID can be set in flash memory using Copley CME2 software.
On a CAN network, the MP3 will appear as three consequtive nodes. When the "base" Node-ID is configured either via SPI or flash programming, it will address Axis A. Then, Axes B, and C will be automatically assigned Node-ID's based on the base ID. The Axis-B ID will be Axis-A ID +1. Axis-C will be Axis-A +2.
Whatever Node-ID is assigned to the MP3, a total of three IDs with consecutive values will result. In the graphic below, the base ID of the MP3 is set to 5 resulting in IDs of 5,6, and 7 for the three axes. Node-ID 0 is reserved for the CANopen Master, and the maximum Node-ID allowed is 127. This leaves ID 1~4, and 8~127 available for use by other devices on the network.



CANOPEN CONNECTIONS FOR MULTIPLE MODULES

The graphic below shows two MP3 wired to a CAN network. The lowest Node-ID allowable on a CAN network is 1 which will allocate IDs 1,2, and 3 for MP3 #1. MP3 #2 must have a minimum Node-ID equal to Node-ID#1+3 which equals 4 as shown.

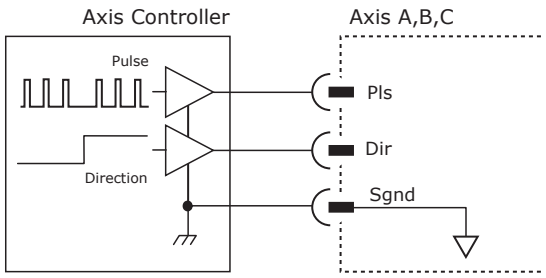


DIGITAL COMMAND INPUTS

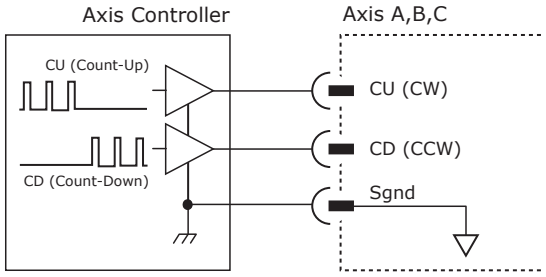
Digital commands are single-ended format and should be sourced from devices with active pull-up and pull-down to take advantage of the high-speed inputs. The active edge (rising or falling) is programmable for the Pulse/Dir and CU/CD formats.

DIGITAL POSITION

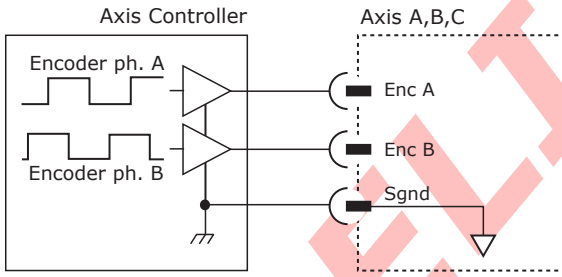
PULSE & DIRECTION



CU/CD (PULSE UP / PULSE DOWN)

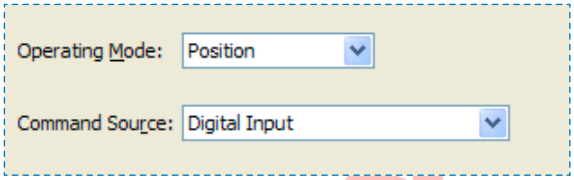


QUAD A/B ENCODER



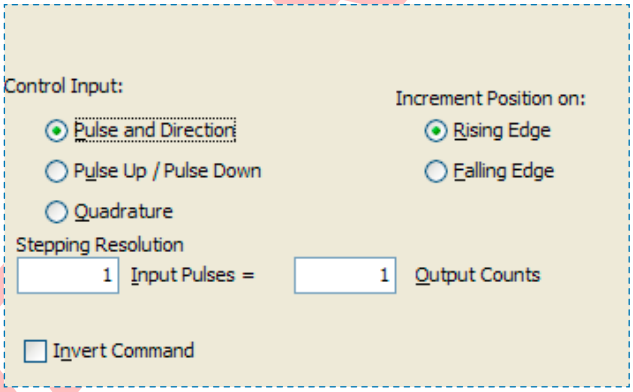
HOW IT LOOKS IN CME2

CME2 -> Basic Setup -> Operating Mode Options



HOW IT LOOKS IN CME2

CME2 -> Basic Setup -> Operating Mode Options



This screen shows the configuration screen for Pulse & Direction. CU/CD and Quad A/B encoder are selectable on this screen, too.

SIGNALS & PINS

The pins in the chart are on connector P2. The functions shown are the defaults. These can be programmed for other functions.

Functions			Axis A		Axis B		Axis C	
			P3 Pins	Signal	P3 Pins	Signal	P3 Pins	Signal
Enc A	Pulse	CW	27	[IN5]	33	[IN11]	39	[IN17]
Enc B	Dir	CCW	28	[IN6]	34	[IN12]	40	[IN18]

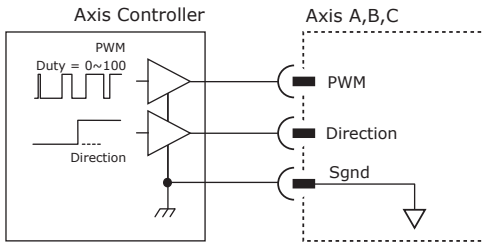
Note:

1) The functions shown for [IN5~6], [IN11~12], and [IN17~18] apply when they are used as digital command inputs for position control. These inputs are programmable if not used for these functions.

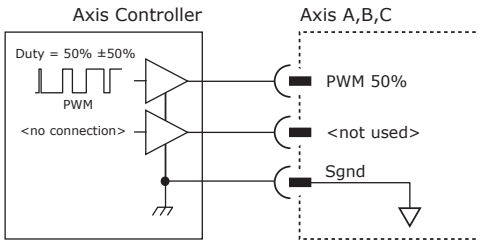
DIGITAL COMMAND INPUTS (CONT'D)

DIGITAL TORQUE, VELOCITY

PWM COMMAND (100% DUTY CYCLE)

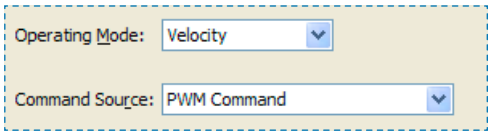


PWM COMMAND (50% DUTY CYCLE)

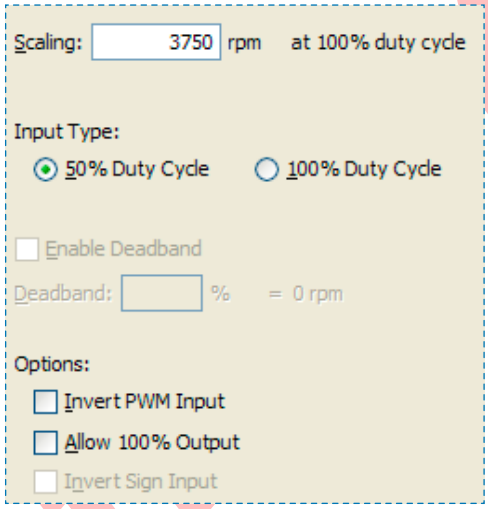


HOW IT LOOKS IN CME2

CME2 -> Basic Setup -> Operating Mode Options



CME2 -> Main Page-> PWM Command



This screen shows the 50% Duty Cycle selection. Other modes are selectable via radio buttons and pull-down menus for Operating Mode and Command Source.

SIGNALS & PINS

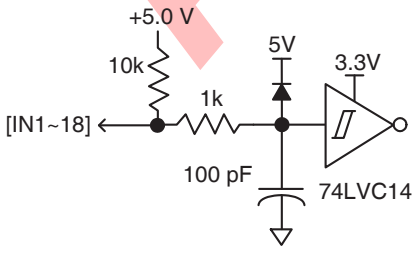
The pins in the chart are on connector P2

Function		Axis A		Axis B		Axis C	
		P3 Pins	Signal	P3 Pins	Signal	P3 Pins	Signal
PWM	PWM 50%	27	[IN5]	33	[IN11]	39	[IN17]
Polarity	n/a	28	[IN6]	34	[IN12]	40	[IN18]

Note:
1) The functions shown for [IN5~6], [IN11~12], and [IN17~18] apply when they are used as digital command inputs for position control. These inputs are programmable if not used for these functions.

DIGITAL COMMAND INPUTS

HIGH SPEED INPUTS [IN1~18]
5V tolerant



HI/LO DEFINITIONS: INPUTS

Input	State	Condition
IN1~19	HI	Vin >= 1.1~2.2 Vdc
	LO	Vin <= 0.8~1.5 Vdc
	Vhys	0.3~1.2 Vdc

INPUTS

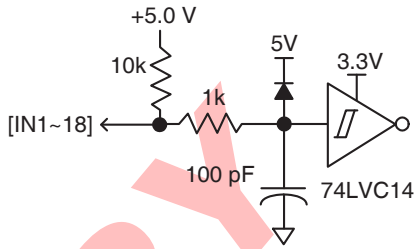
DIGITAL INPUTS

MP3 has 19 high-speed digital inputs, all of which have programmable functions.
They are compatible with 5V logic and have 100 ns R/C filters when driven by devices with active pull-up/pull-down outputs.

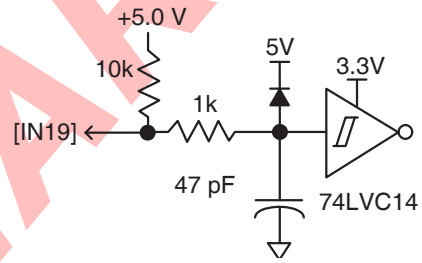
Programmable functions of the digital inputs include:

- Drive Enable
- Positive Limit switch
- Negative Limit switch
- Digital Command Inputs
- Home switch
- Drive Reset
- Motion abort

HIGH-SPEED DIGITAL INPUTS
+5 VDC MAX



HIGH-SPEED DIGITAL INPUT
SPI PORT MISO SIGNAL
+5 VDC MAX



SIGNALS & PINS

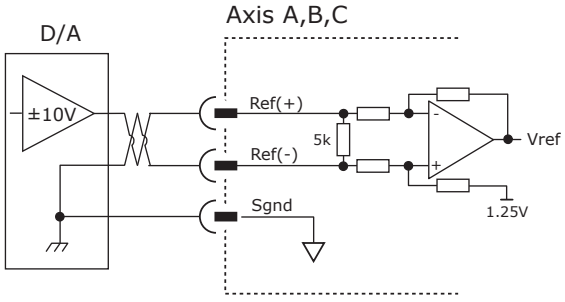
The pins in the chart are on connector P2. The functions shown are the defaults.
All of these inputs can be programmed for other functions.
P2 Signal Ground pins are: 1, 2, 21, 22, 41, 42, 53, 54.

Functions					Axis A		Axis B		Axis C	
					P3 Pins	Signal	P3 Pins	Signal	P3 Pins	Signal
Enable					23	[IN1]	29	[IN7]	35	[IN13]
Pos Limit					24	[IN2]	30	[IN8]	36	[IN14]
Neg Limit					25	[IN3]	31	[IN9]	37	[IN15]
					26	[IN4]	32	[IN10]	38	[IN16]
Enc A	Pulse	CW	PWM	PWM 50%	27	[IN5]	33	[IN11]	39	[IN17]
Enc B	Dir	CCW	Polarity	n/a	28	[IN6]	34	[IN12]	40	[IN18]
SPI Port MISO input									52	[IN19]

ANALOG INPUTS

The analog inputs have a ±10 Vdc range. As reference inputs they can take position/velocity/torque commands from a controller.

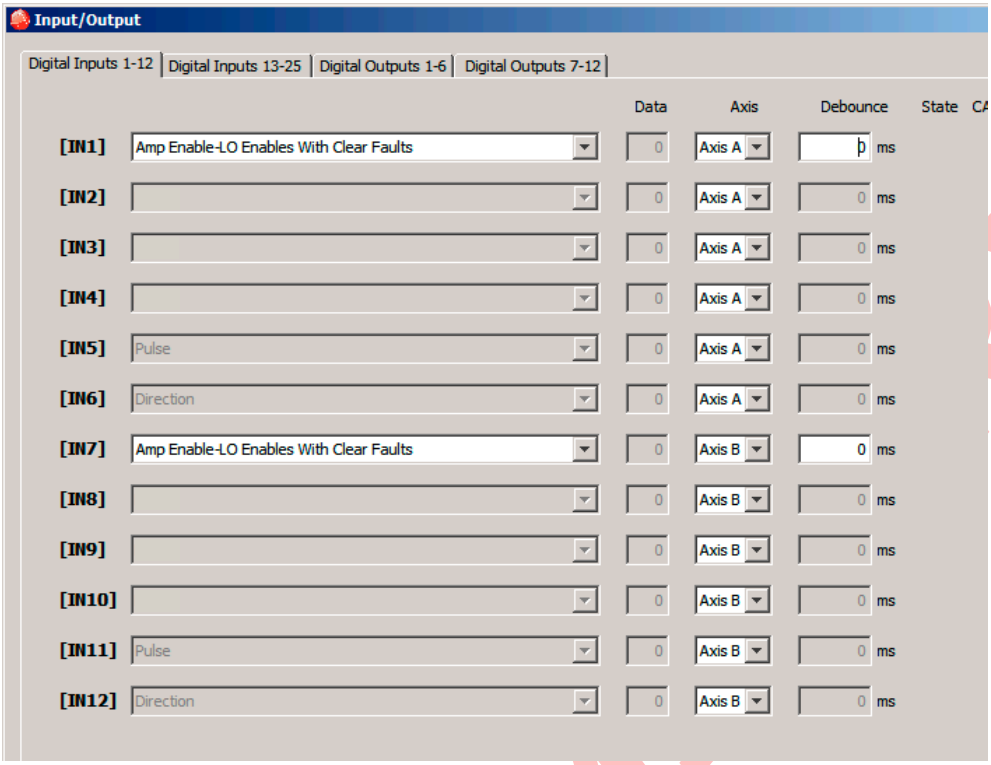
Functions	Axis A	Axis B	Axis C
	P3 Pins	P3 Pins	P3 Pins
Ref(+)	3	5	7
Ref(-)	4	6	8



DIGITAL INPUT DETAILS

HOW IT LOOKS IN CME2

CME2 -> Main Page-> Input/Output -> Digital Inputs 1-12



Notes:
The functions for all of the inputs are programmable. The functions shown above are defaults for the combinations listed below:

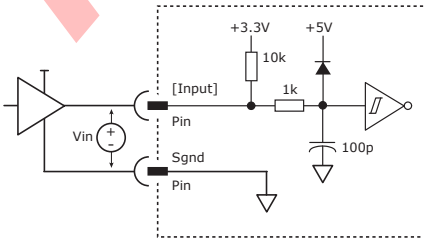
- [IN1] and [IN7] are the defaults for the Axis-A and Axis-B Enable functions.
- [IN2~4] and [IN8~10] are typically used for pos/neg limit switches, and Home switch.
- [IN5~6] and [IN11~12] are the digital command input defaults for position, velocity, or torque control.

DIGITAL INPUT PINS AND FUNCTIONS

Functions					Axis A		Axis B	
					P3 Pins	Signal	P3 Pins	Signal
Enable					23	[IN1]	29	[IN7]
Positive Limit Switch					24	[IN2]	30	[IN8]
Negative Limit Switch					25	[IN3]	31	[IN9]
Home Switch					26	[IN4]	32	[IN10]
Enc A	Pulse	CW	PWM	PWM 50%	27	[IN5]	33	[IN11]
Enc B	Dir	CCW	Polarity	n/a	28	[IN6]	34	[IN12]

HIGH SPEED DIGITAL INPUTS [IN1~IN12]

5V tolerant



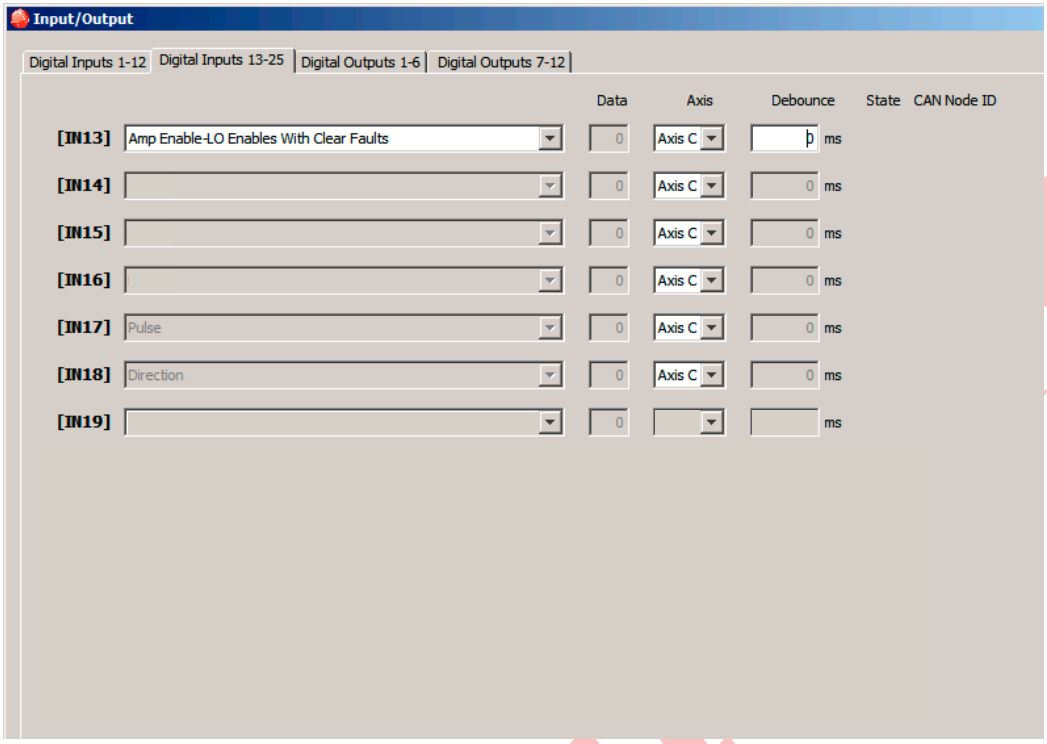
HIGH SPEED DIGITAL INPUTS [IN1~IN12]
5V tolerant

Input	State	Condition
IN1~12	HI	Vin >= 1.1~2.2 Vdc
	LO	Vin <= 0.8~1.5 Vdc
	Vhys	0.3~1.2 Vdc

DIGITAL INPUT DETAILS

HOW IT LOOKS IN CME2

CME2 -> Main Page-> Input/Output -> Digital Inputs 13-19



Notes:

The functions for all of the inputs are programmable. The functions shown above are defaults for the combinations listed below:

- [IN13] is the default for the Axis-C Enable function.
- [IN14~16] are typically used for pos/neg limit switches, and Home switch.
- [IN17~18] are the digital command input defaults for position, velocity, or torque control.
- [IN19] is the MISO input when SPI is used.

DIGITAL INPUT PINS AND FUNCTIONS

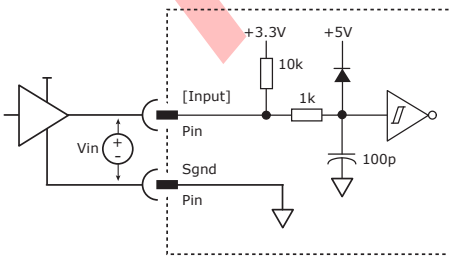
Functions					Axis C	
					P3 Pins	Signal
Enable					35	[IN13]
Positive Limit Switch					36	[IN14]
Negative Limit Switch					37	[IN15]
Home Switch					38	[IN16]
Enc A	Pulse	CW	PWM	PWM 50%	39	[IN17]
Enc B	Dir	CCW	Polarity	n/a	40	[IN18]
SPI MISO					52	[IN19]

HI/LO DEFINITIONS: INPUTS

Input	State	Condition
IN13~19	HI	Vin >= 1.1~2.2 Vdc
	LO	Vin <= 0.8~1.5 Vdc
	Vhys	0.3~1.2 Vdc

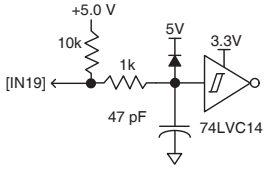
HIGH SPEED DIGITAL INPUTS [IN13~IN18]

5V tolerant



HIGH SPEED INPUT [IN19] SPI MISO

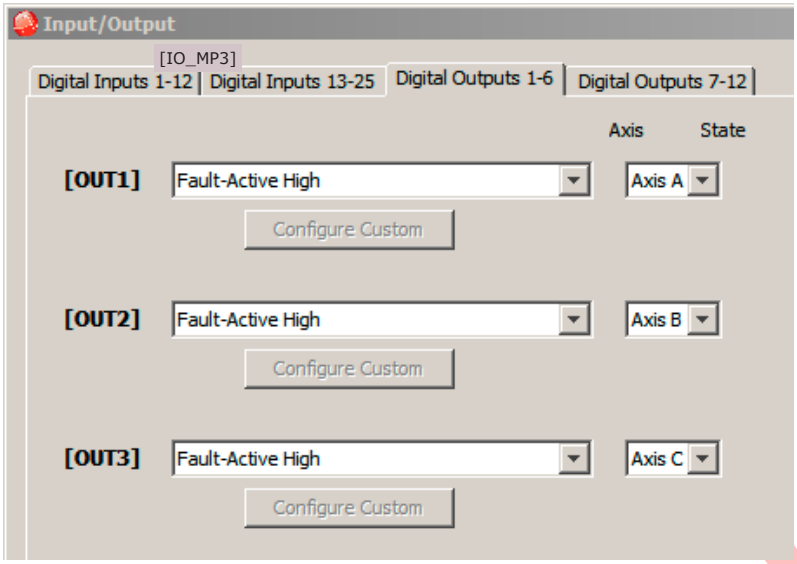
5V tolerant



DIGITAL OUTPUT DETAILS

HOW IT LOOKS IN CME2

CME2 -> Main Page-> Input/Output -> Digital Outputs 1-6



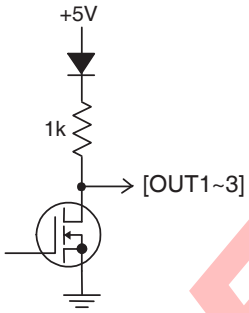
HI/LO DEFINITIONS: OUTPUTS 1~3

Output	State	Condition
OUT1~3	HI	MOSFET OFF
	LO	MOSFET ON

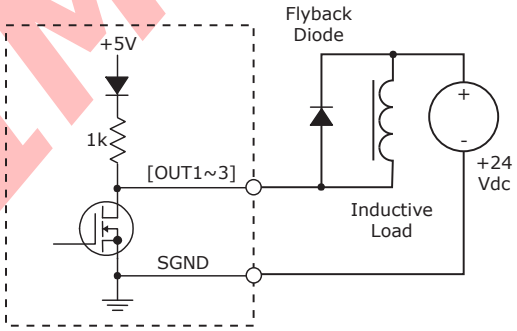
MOSFET OUTPUTS & PINS

Function	P3 Pin
[OUT1]	43
[OUT2]	44
[OUT3]	45

MOSFET DIGITAL OUTPUTS



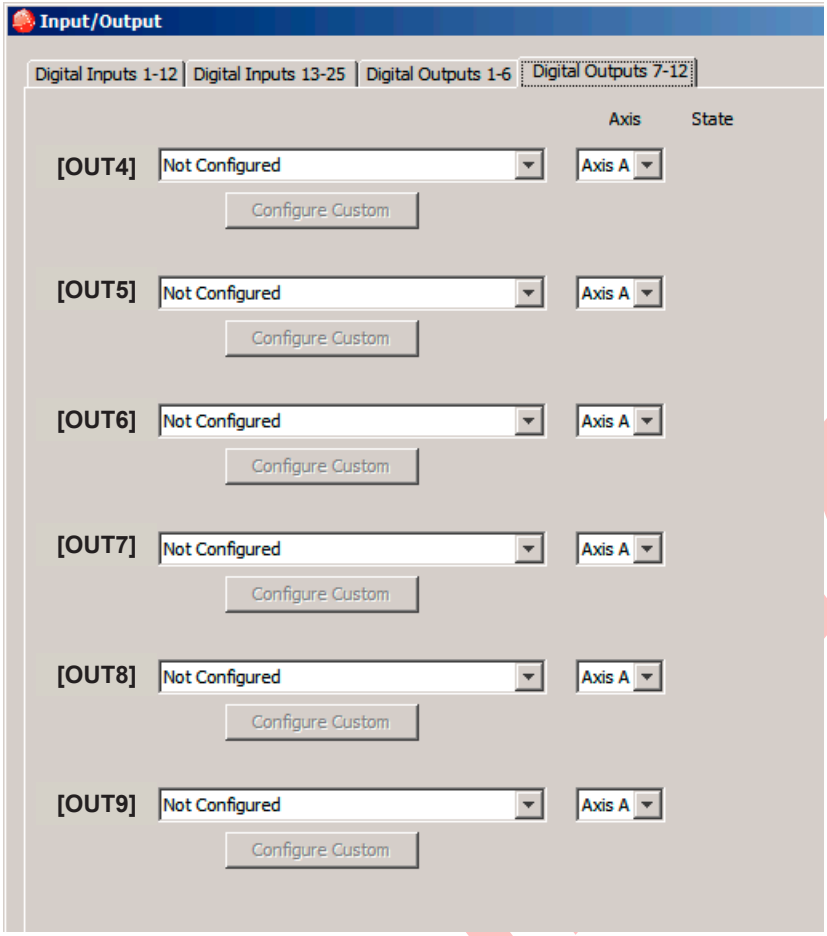
MOSFET DIGITAL OUTPUTS: INDUCTIVE LOADS



DIGITAL OUTPUT DETAILS

HOW IT LOOKS IN CME2

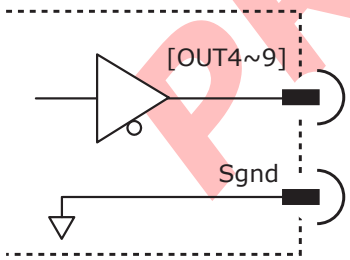
CME2 -> Main Page-> Input/Output -> Digital Outputs 4-9



HIGH SPEED DIGITAL OUTPUTS [OUT4~9]

74HCT125

5V max



SPI OUTPUTS & PINS

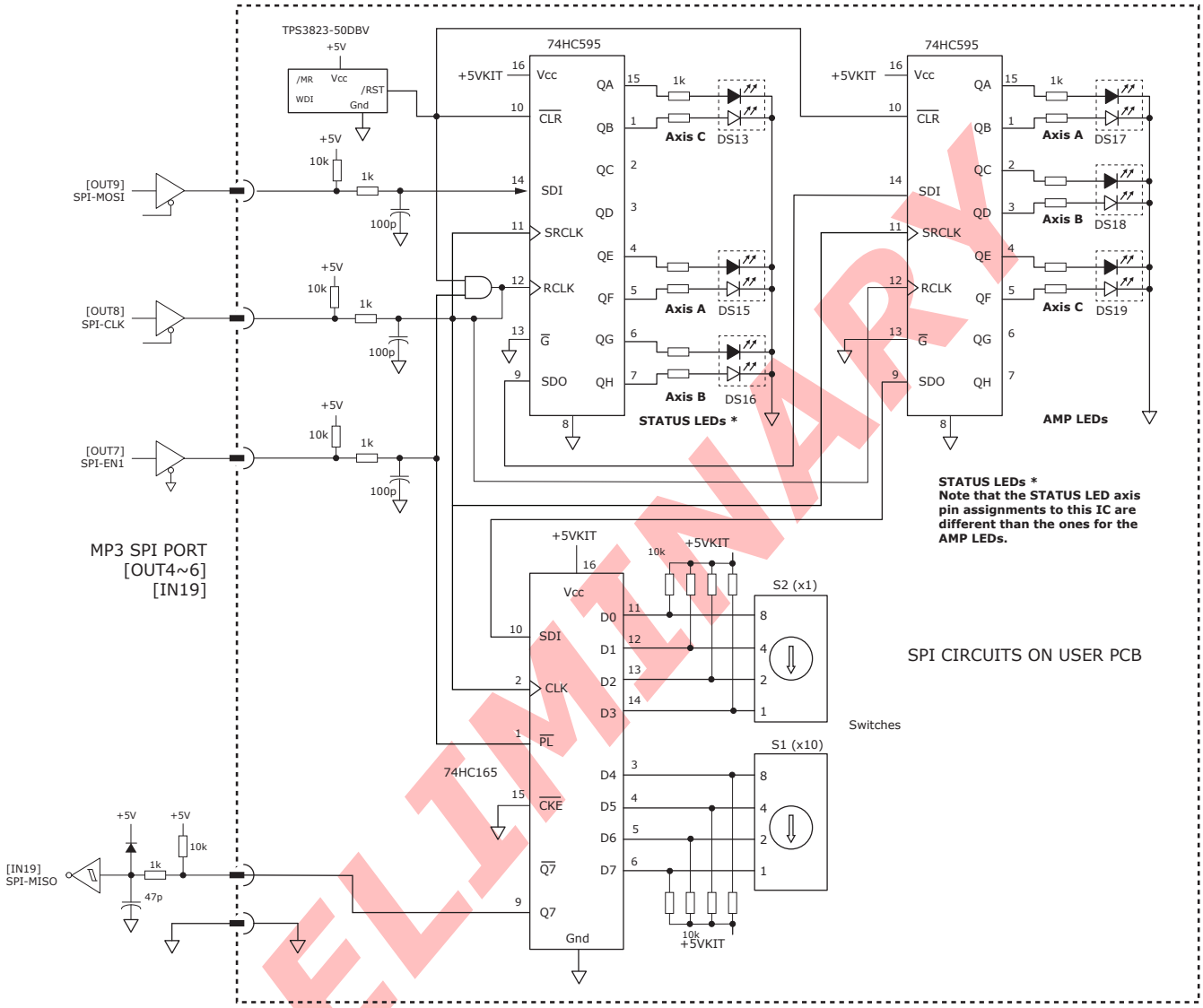
Output	P3 Pin	SPI Signals
[OUT4]	46	
[OUT5]	47	
[OUT6]	48	
[OUT7]	49	SPI EN1
[OUT8]	50	SPI Clock
[OUT9]	51	SPI MOSI

HI/LO DEFINITIONS: OUTPUTS

Output	State	Condition
OUT4~9	HI	Vout >= 2.2 Vdc
	LO	Vout <= 0.8 Vdc

SPI PORT

This graphic shows all of the SPI port outputs and input together. The connections shown are those used on the MP3 Development Kit as an example of the port's usage for inputs and outputs.



HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
[OUT7~9]	HI	Vout >= 2.2 Vdc
	LO	Vout <= 0.8 Vdc

SIGNALS & PINS

Output	P2 Pin	SPI Signals
[OUT7]	49	SPI EN1
[OUT8]	50	SPI Clock
[OUT9]	51	SPI MOSI
[IN19]	52	SPI MISO

If these signals are not used for the SPI port , they are programmable for other functions.

MOTOR CONNECTIONS`

Motor connections consist of: phases, Halls, encoder, thermal sensor, and brake. The phase connections carry the drive output currents that drive the motor to produce motion. The Hall signals are three digital signals that give absolute position feedback within an electrical commutation cycle of brushless motors. Encoder signals give position feedback and are used for velocity and position modes, as well as sinusoidal commutation. A thermal sensor that indicates motor overtemperature is used to shut down the drive to protect the motor. A brake can provide a fail-safe way to prevent movement of the motor when the drive is shut-down or disabled.

QUAD A/B INCREMENTAL ENCODER WITH FAULT PROTECTION

Encoders with differential line-driver outputs provide incremental position feedback via the A/B signals and the optional index signal (X) gives a once per revolution position mark. The MAX14891 receiver has differential inputs with fault protections for the following conditions:

Short-circuits line-line: This produces a near-zero voltage between A & /A, B & /B, and X & /X which is below the differential fault threshold.

Open-circuit condition: A 121Ω terminator resistor will pull the inputs together if either side (or both) is open. This will produce the same fault condition as a short-circuit across the inputs.

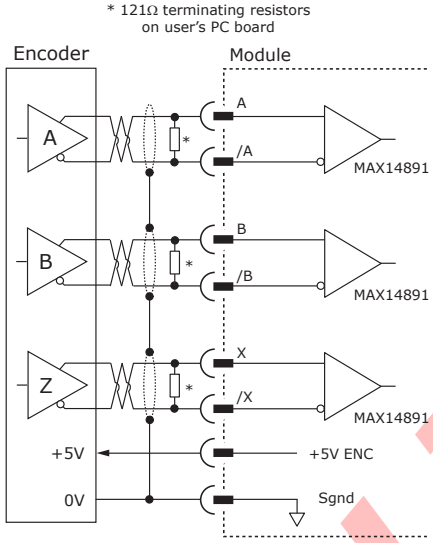
Low differential voltage detection: This is possible with very long cable runs and a fault will occur if the differential input voltage is < 200mV.

±25kV ESD protection: The MAX14891 has protection against high-voltage discharges using the Human Body Model.

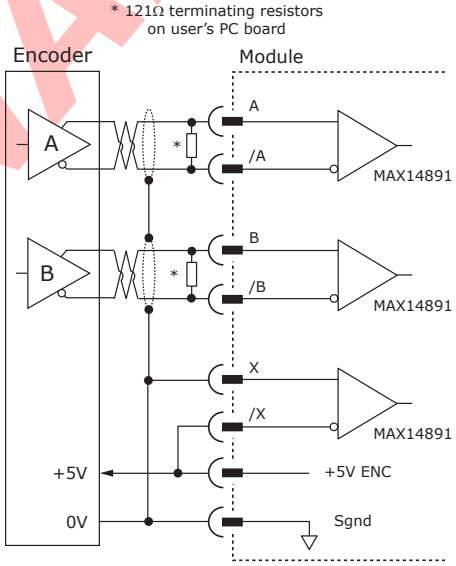
Extended common-mode range: A fault occurs if a single input voltage is outside of the range of -18.5V to +18.5V

If encoder fault detection is selected (CME2 main page, Configure Faults block, Feedback Error) and an encoder with no index is used, then the X and /X inputs must be wired as shown below to prevent the unused index input from generating an error for *low differential voltage detection*.

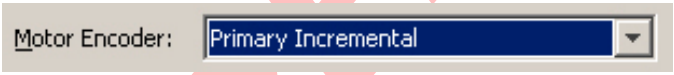
DIGITAL QUADRATURE ENCODER INPUT
5V



A/B CONNECTIONS (NO INDEX)
5V



CME2 -> Motor/Feedback -> Feedback



SIGNALS & PINS

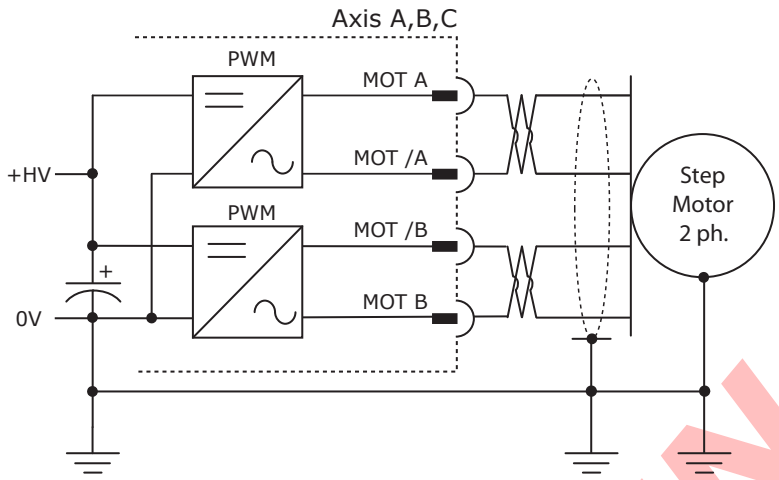
The pins in the chart are on connector P4

Functions	Axis A	Axis B	Axis C
	Pins	Pins	Pins
Enc A	5	19	33
Enc /A	7	21	35
Enc B	9	23	37
Enc /B	11	25	39
Enc X	13	27	41
Enc /X	15	29	43
+5V Out	17	31	45
Signal Gnd	18	32	46

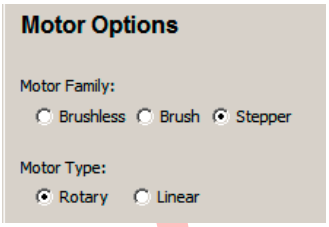
MOTOR CONNECTIONS

STEPPER MOTORS

The drive outputs are two H-bridge PWM inverters that convert the DC bus voltage (+HV) into sinusoidal voltage waveforms that drive the motor phase-coils. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive HV ground terminal for best results.



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Motor Options



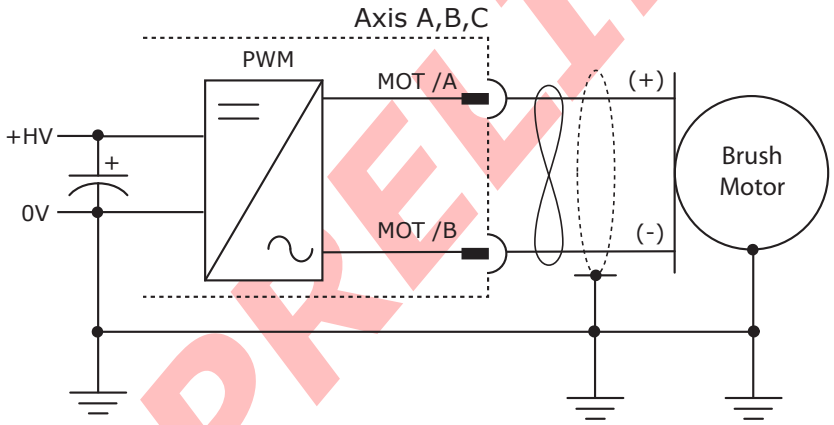
SIGNALS & PINS

The pins in the chart are on connector P1

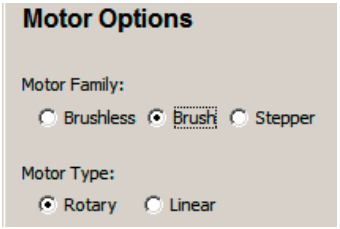
Output	Motor	Axis A	Axis B	Axis C
		Pins	Pins	Pins
Mot A	A	21,22	37,38	53,54
Mot /A	/A	23,24	39,40	55,56
Mot B	B	29,30	45,46	61,62
Mot /B	/B	21,32	47,48	63,64
+HV	1,2,3,4,5,6			
HV COM	11,12,13,14,15,16			
+AuxHV	7			

BRUSH MOTORS

The drive outputs are an H-bridge PWM inverter that convert the DC bus voltage (+HV) into DC voltage waveforms that drive the motor (+) & (-) terminals. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive HV ground terminal for best results.



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Motor Options



SIGNALS & PINS

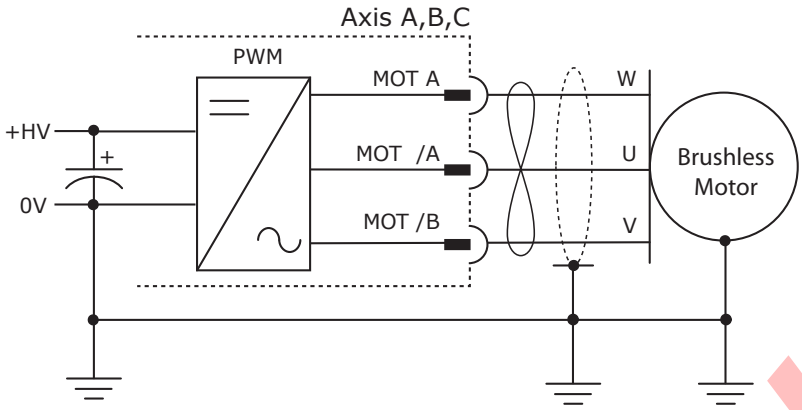
The pins in the chart are on connector P1

Output	Motor	Axis A	Axis B	Axis C
		Pins	Pins	Pins
Mot A	n/c			
Mot /A	(+)			
Mot /B	(-)			
+HV				
0V				
+AuxHV				

MOTOR CONNECTIONS

BRUSHLESS MOTORS

The drive outputs are a 3-phase PWM inverter that converts the DC bus voltage (+HV) into sinusoidal voltage waveforms that drive the motor U-V-W terminals. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive HV ground terminal for best results.



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Motor Options

SIGNALS & PINS

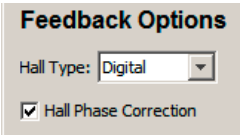
The pins in the chart are on connector P1

Output	Motor	Axis A	Axis B	Axis C
		Pins	Pins	Pins
Mot A	W	21,22	37,38	53,54
Mot /A	U	23,24	39,40	55,56
Mot B	No Connection			
Mot /B	V	31,32	47,48	63,64
+HV	1,2,3,4,5,6			
HV COM	11,12,13,14,15,16			
+AuxHV	7			

DIGITAL HALL SIGNALS

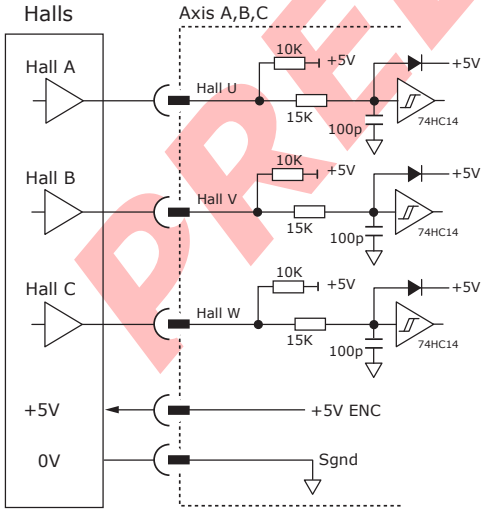
Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much lower frequencies than the motor encoder signals, and are used for commutation-initialization after startup, and for checking the motor phasing after the servo drive has switched to sinusoidal commutation.

HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Feedback Options



Note: Hall phase correction is optional

HALL INPUTS
5V

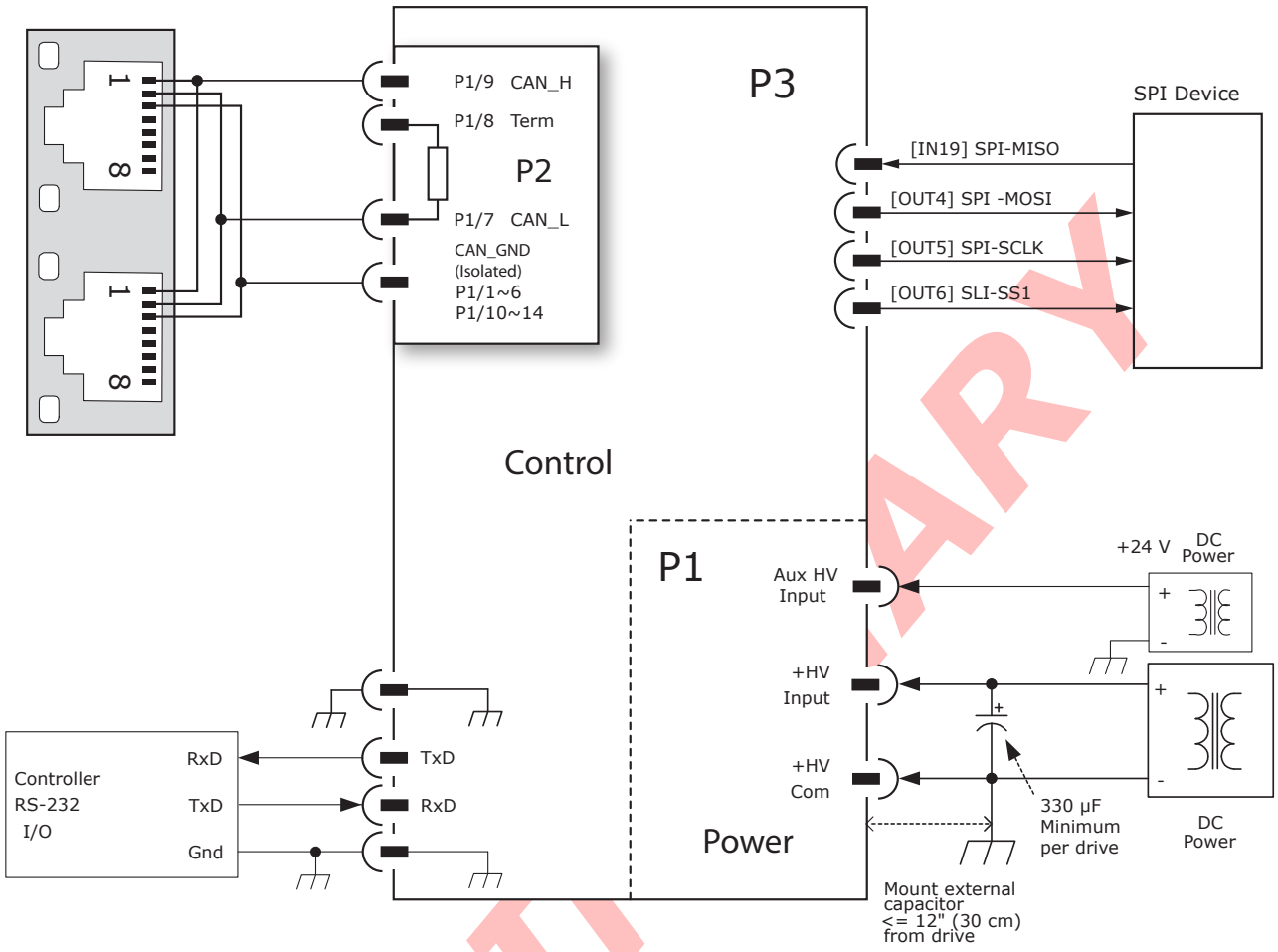


SIGNALS & PINS

The pins in the chart are on connector P4

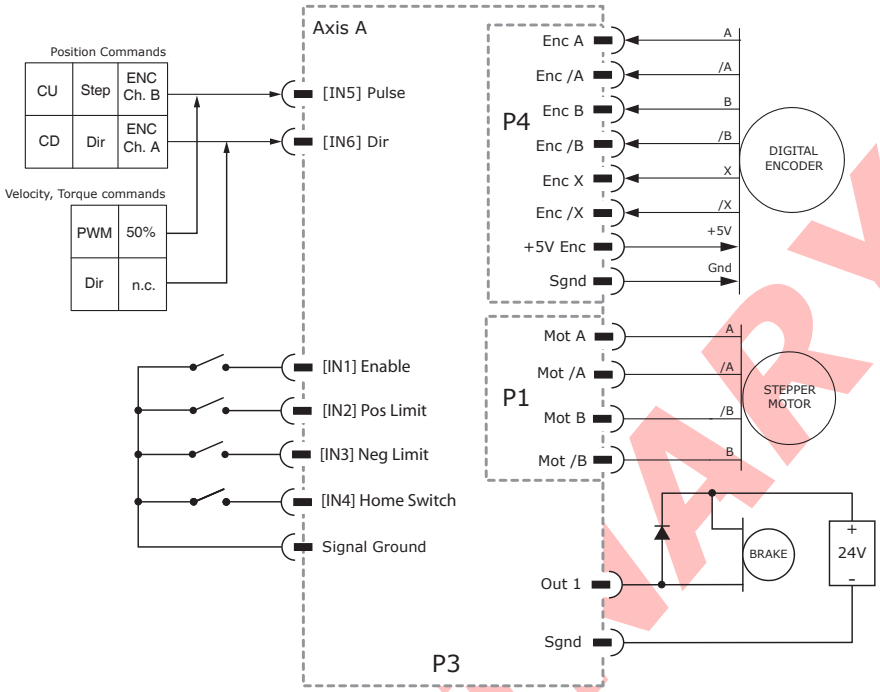
Functions	Axis A	Axis B	Axis C
	Pins	Pins	Pins
Hall U	47	50	53
Hall V	48	51	54
Hall W	49	52	55

COMMON CONNECTIONS FOR ALL AXES



TYPICAL CONNECTIONS

Here is an example using a stepper motor with encoder feedback, driving a linear stage with positive and negative limit switches, and a home switch. Position commands are shown as digital inputs. For EtherCAT operation, these would not be used.



Axis A is shown as an example. The tables below show the pins for the same-named signals for axes B, C, and D.

P3: INPUT SIGNALS & PINS

Functions					Axis A		Axis B		Axis C	
					Pins	Signal	Pins	Signal	Pins	Signal
Enable					23	[IN1]	29	[IN7]	35	[IN13]
Positive Limit Switch					24	[IN2]	30	[IN8]	36	[IN14]
Negative Limit Switch					24	[IN3]	31	[IN9]	37	[IN15]
Home Switch					26	[IN4]	32	[IN10]	38	[IN16]
Enc A	Pulse	CW	PWM	PWM 50%	27	[IN5]	33	[IN11]	39	[IN17]
Enc B	Dir	CCW	Polarity	n/a	28	[IN6]	34	[IN12]	40	[IN18]

Notes:
1) Inputs functions shown for [IN1], [IN7], [IN13] are the default functions. These inputs are programmable if not used for these functions.
2) The functions shown for [IN5~6], [IN11~12], [IN17~18] apply when they are used as digital command inputs for position control. These inputs are programmable if not used for these functions.
3) The functions shown for [IN2~4], [IN8~10], [IN14~16] are typical inputs. These inputs are programmable if not used for these functions.

P4: ENCODER SIGNALS & PINS

Functions	Axis A	Axis B	Axis C
	Pins	Pins	Pins
Enc A	5	19	33
Enc /A	7	21	35
Enc B	9	23	37
Enc /B	11	25	39
Enc X	13	27	41
Enc /X	15	29	43
+5 Vout	17	31	45
Sgnd	18	32	46

P3: MOSFET OUTPUTS & PINS

Output	P3 Pin
[OUT1]	43
[OUT2]	44
[OUT3]	45

The pins in these charts are on connector P3

OUTPUTS

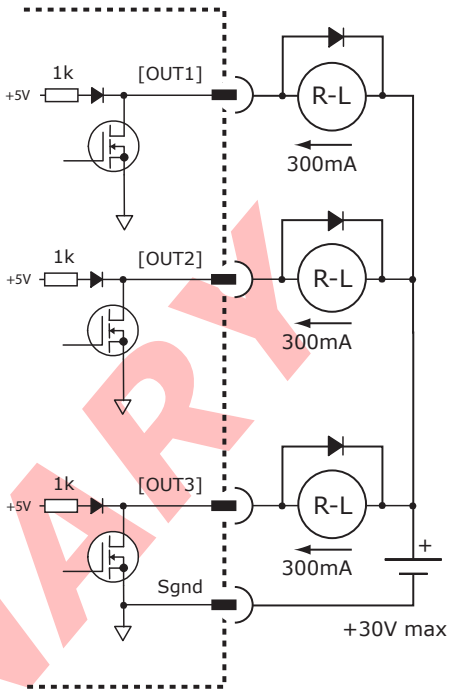
DIGITAL OUTPUTS 1~3

These are open-drain MOSFETs with 1 kΩ pull-up resistors in series with a diode to +5 Vdc. They can sink up to 300 mAdc from external loads operating from power supplies to +30 Vdc. The outputs are typically configured as drive fault and motor brake. Additional functions are programmable. As a drive fault output, the active level is programmable to be HI or LO when a fault occurs. As a brake output, it is programmable to be either HI or LO to release a motor brake when the drive is enabled. When driving inductive loads such as a relay, an external fly-back diode is required. A diode in the output is for driving PLC inputs that are opto-isolated and connected to +24 Vdc. The diode prevents conduction from +24 Vdc through the 1 kΩ resistor to +5 Vdc in the drive. This could turn the PLC input on, giving a false indication of the drive output state.

P3: MOSFET OUTPUTS & PINS

Output	P3 Pin
[OUT1]	43
[OUT2]	44
[OUT3]	45

DRIVING INDUCTIVE LOADS

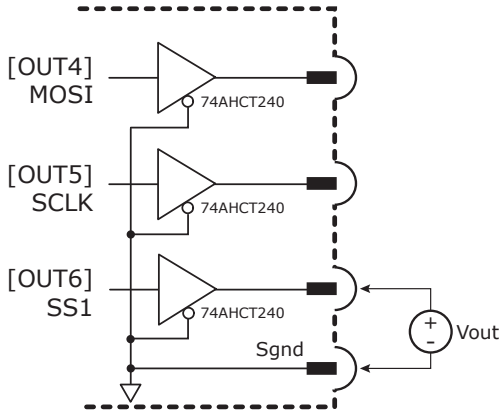


SPI PORT OUTPUTS

Digital outputs [OUT4~6] are CMOS drivers used for the SPI port. Programmable for other functions if not used for SPI port.

P3: SPI PORT OUTPUTS & PINS

Output	P3 Pin
[OUT4]	46
[OUT5]	47
[OUT6]	48

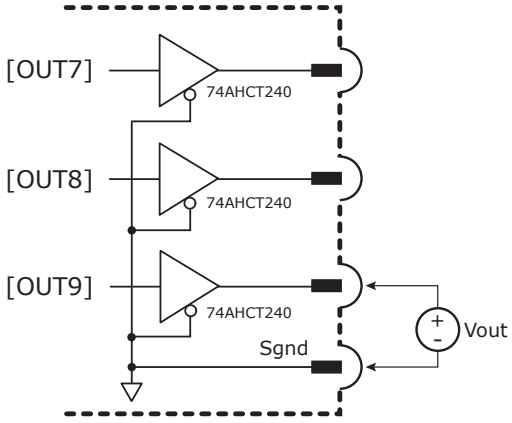


HIGH SPEED OUTPUTS

Digital outputs [OUT7~9] are HI-speed CMOS drivers with programmable functions.

P3: HIGH SPEED OUTPUTS & PINS

Output	P3 Pin
[OUT7]	49
[OUT8]	50
[OUT9]	51

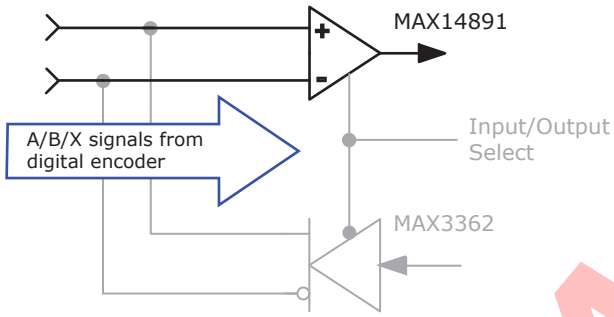


SECONDARY ENCODER

Three transceivers per axis, programmable to support incremental or absolute encoders.

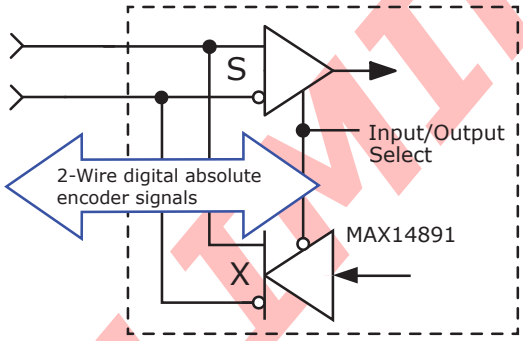
INCREMENTAL ENCODER

6-wire (5v not shown) receivers for A/B/X signals from encoder.



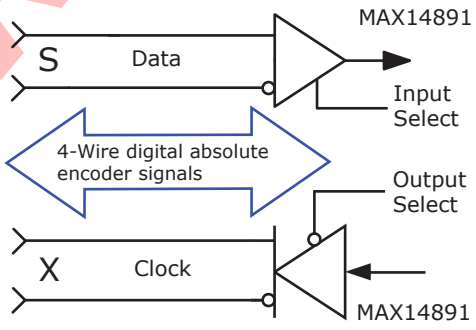
HALF-DUPLEX ABSOLUTE ENCODER

2-wire (5V not shown) send/receive encoder data.
Examples: Absolute A types



FULL-DUPLEX ABSOLUTE ENCODER

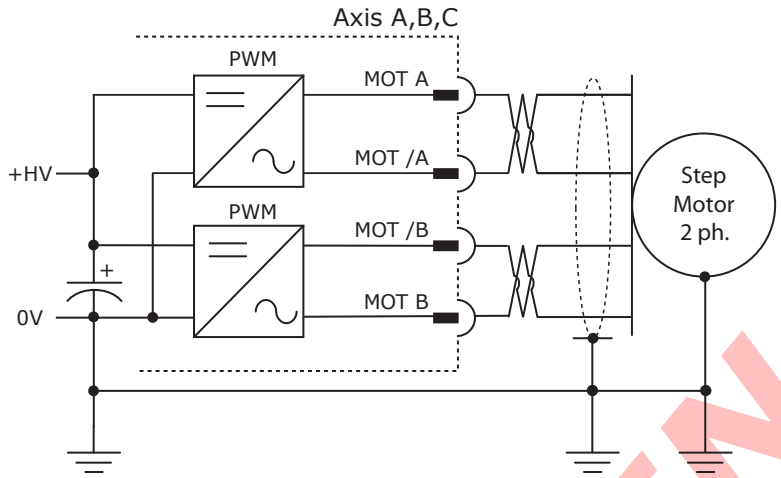
4-wire (5V not shown) connection for separate clock and data channels.
Examples: EnDat, SSI, BiSS



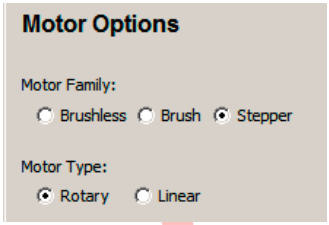
MOTOR CONNECTIONS

STEPPER MOTORS

The drive outputs are two H-bridge PWM inverters that convert the DC bus voltage (+HV) into sinusoidal voltage waveforms that drive the motor phase-coils. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive HV ground terminal for best results.



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Motor Options

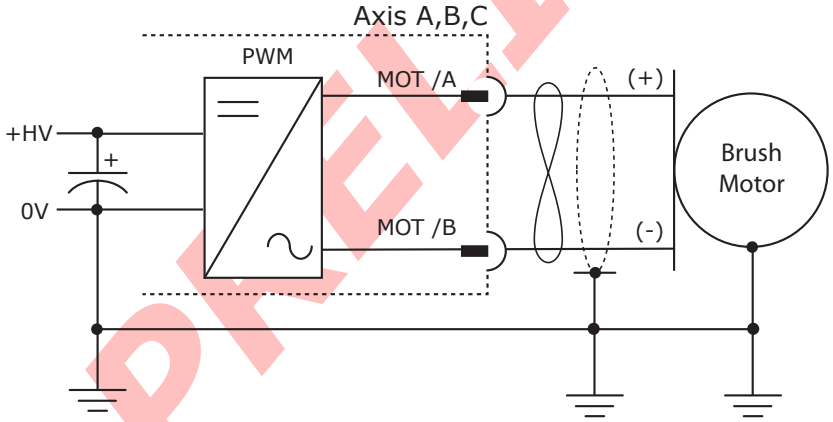


P1: STEPPER OUTPUTS & PINS

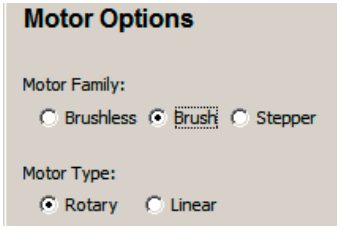
Output	Axis A Pins	Axis B Pins	Axis C Pins
Mot A	21,22	37,38	53,54
Mot /A	23,24	39,40	55,56
Mot B	29,30	45,46	61,62
Mot /B	31,32	47,48	63,64

BRUSH MOTORS

The drive outputs are an H-bridge PWM inverter that convert the DC bus voltage (+HV) into DC voltage waveforms that drive the motor (+) & (-) terminals. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive HV ground terminal for best results.



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Motor Options



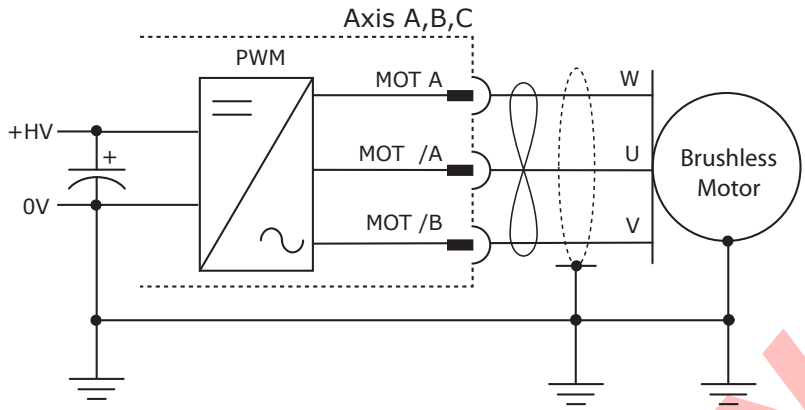
P1: BRUSH OUTPUTS & PINS

Output	Axis A Pins	Axis B Pins	Axis C Pins
Mot /A	23,24	39,40	55,56
Mot /B	31,32	47,48	63,64

MOTOR CONNECTIONS

BRUSHLESS MOTORS

The drive outputs are a 3-phase PWM inverter that converts the DC bus voltage (+HV) into sinusoidal voltage waveforms that drive the motor U-V-W terminals. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive HV ground terminal for best results.



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Motor Options

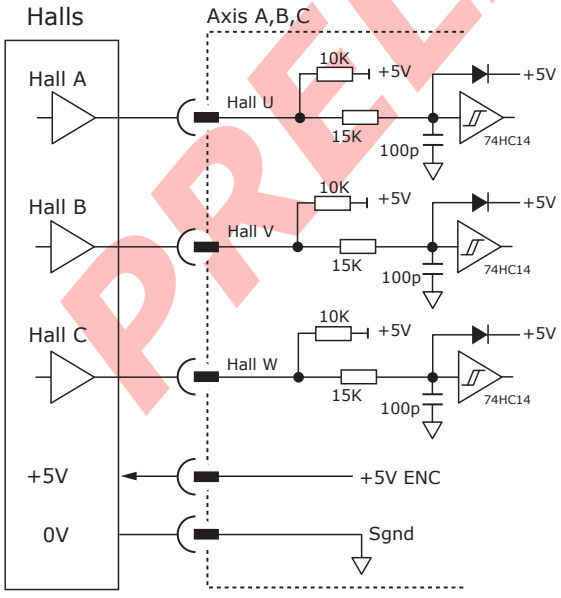
P1: BRUSHLESS OUTPUTS & PINS

Output	Motor	Axis A	Axis B	Axis C
		Pins	Pins	Pins
Mot A	W	21,22	37,38	53,54
Mot /A	U	23,24	39,40	55,56
Mot B	Not used			
Mot /B	V	31,32	47,48	63,64

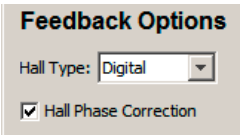
DIGITAL HALL SIGNALS

Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much lower frequencies than the motor encoder signals, and are used for commutation-initialization after startup, and for checking the motor phasing after the servo drive has switched to sinusoidal commutation.

HALL INPUTS
5V



HOW IT LOOKS IN CME2
CME2 -> Basic Setup -> Feedback Options



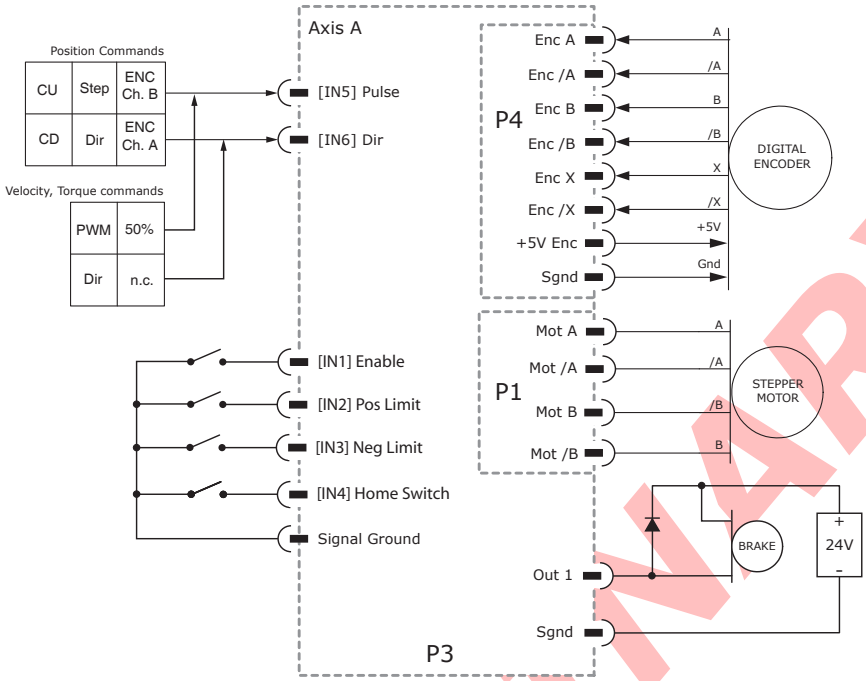
Note: Hall phase correction is optional

P4: HALL INPUTS & PINS

Input	Axis A	Axis B	Axis C
	Pins	Pins	Pins
Hall U	47	50	53
Hall V	48	51	54
Hall W	49	52	55

TYPICAL CONNECTIONS

Here is an example using a stepper motor with encoder feedback, driving a linear stage with positive and negative limit switches, and a home switch. Position commands are shown as digital inputs. For EtherCAT operation, these would not be used.



Axis A is shown as an example. The tables below show the pins for the same-named signals for axes B, C, and D.

P3: INPUT SIGNALS & PINS

Functions					Axis A		Axis B		Axis C	
					Pins	Signal	Pins	Signal	Pins	Signal
Enable					23	[IN1]	23	[IN7]	35	[IN13]
Positive Limit Switch					24	[IN2]	24	[IN8]	36	[IN14]
Negative Limit Switch					24	[IN3]	24	[IN9]	37	[IN15]
Home Switch					26	[IN4]	26	[IN10]	38	[IN16]
Enc A	Pulse	CW	PWM	PWM 50%	27	[IN5]	27	[IN11]	39	[IN17]
Enc B	Dir	CCW	Polarity	n/a	28	[IN6]	28	[IN12]	40	[IN18]

Notes:
1) Inputs functions shown for [IN1], [IN7], [IN13], and [IN19] are the default functions. These inputs are programmable if not used for these functions.
2) The functions shown for [IN5~6], [IN11~12], [IN17~18] and [IN23~24] apply when they are used as digital command inputs for position control. These inputs are programmable if not used for these functions.
3) The functions shown for [IN2~4] are typical inputs. These inputs are programmable if not used for these functions.

P4: ENCODER SIGNALS & PINS

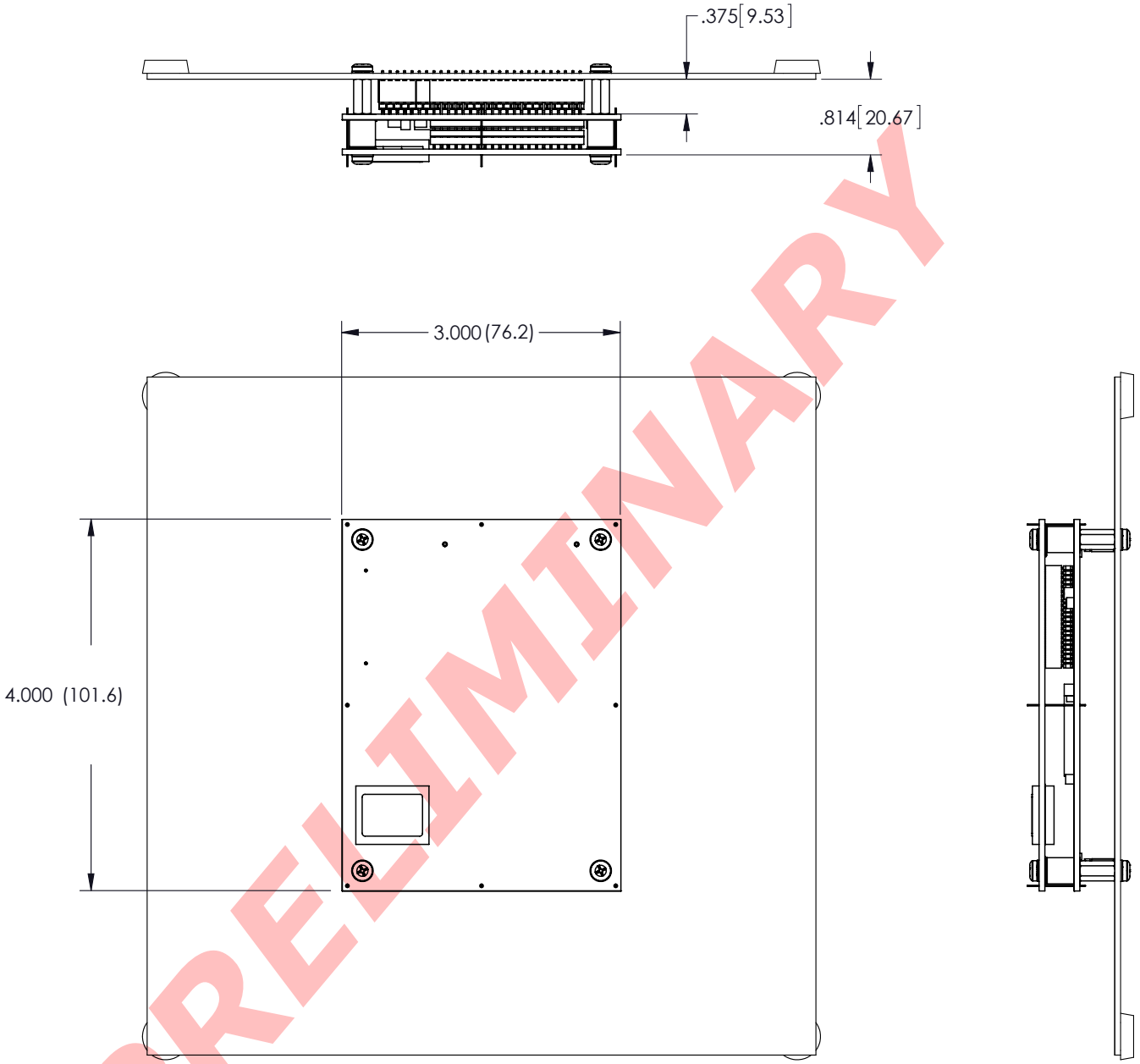
Functions	Axis A	Axis B	Axis C
	Pins	Pins	Pins
Enc A	5	19	33
Enc /A	7	21	35
Enc B	9	23	37
Enc /B	11	25	39
Enc X	13	27	41
Enc /X	15	29	43
+5 Vout	17	31	45
Sgnd	18	32	46

P3: MOSFET OUTPUTS & PINS

Output	P3 Pin
[OUT1]	43
[OUT2]	44
[OUT3]	45

MODULE DIMENSIONS

Units in inch (mm)

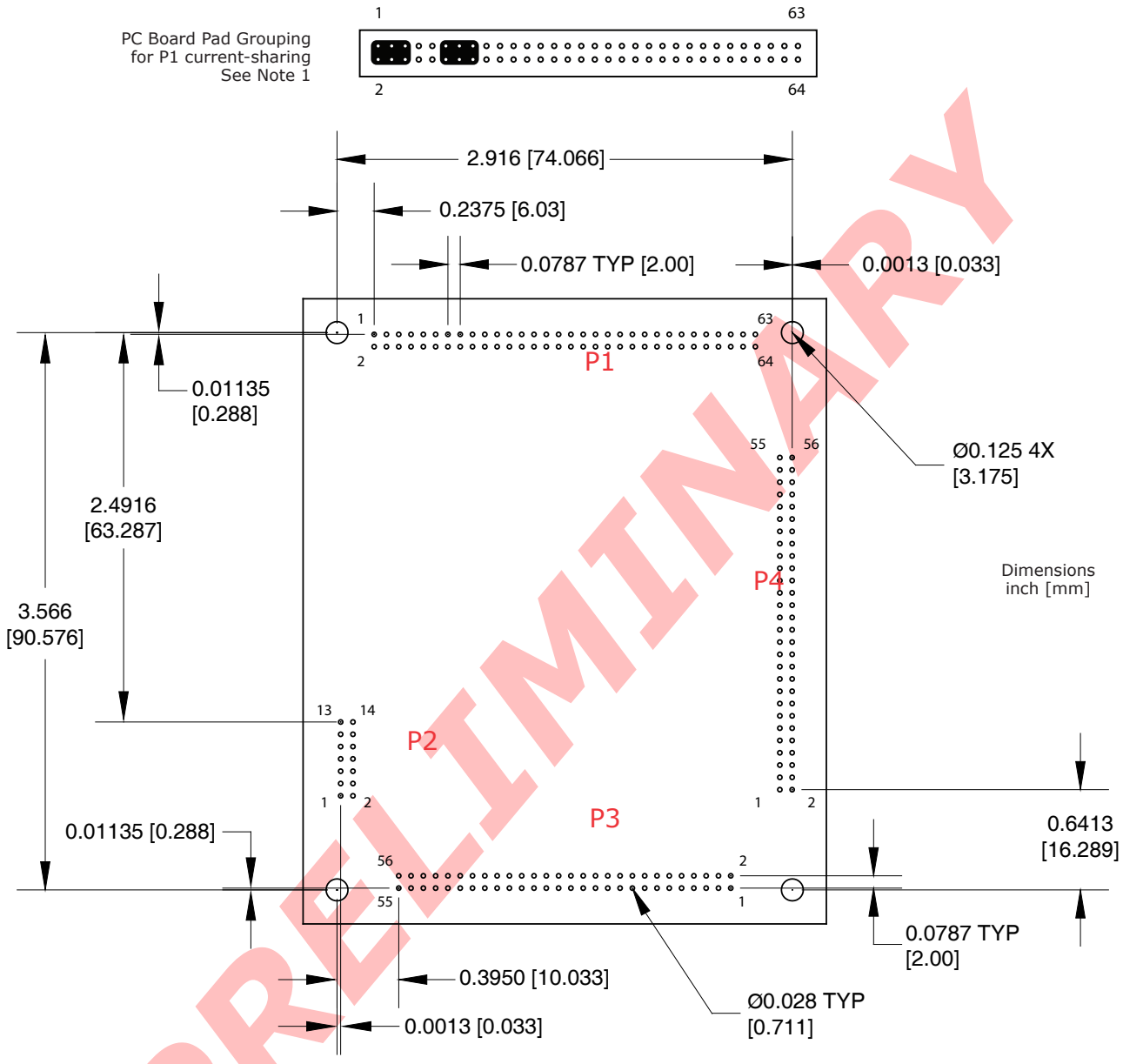


PRINTED CIRCUIT BOARD FOOTPRINT

Dimensions are inch (mm)

TOP VIEW

Viewed from above looking down on the connectors or PC board footprint to which the module is mounted



Mounting Hardware:

Qty	Description	Mfgr	Part Number	Remarks
1	Socket Strip	Samtec	SQW-132-01-L-D	P1: HV, Aux, & Motor
1	Socket Strip	Samtec	SQW-107-01-L-D	P2: EtherCAT port
1	Socket Strip	Samtec	SQW-128-01-L-D	P3: Input/Output
1	Socket Strip	Samtec	SQW-128-01-L-D	P4: Feedback
2	Standoff 6-32 X 1/4”	PEM	KFE-632-8ET	

Notes

1. P1 signals of the same name must be connected for current-sharing (see graphic above).
2. To determine copper width and thickness for P1 signals refer to specification IPC-2221. (Association Connecting Electronic Industries, http://www.ipc.org)

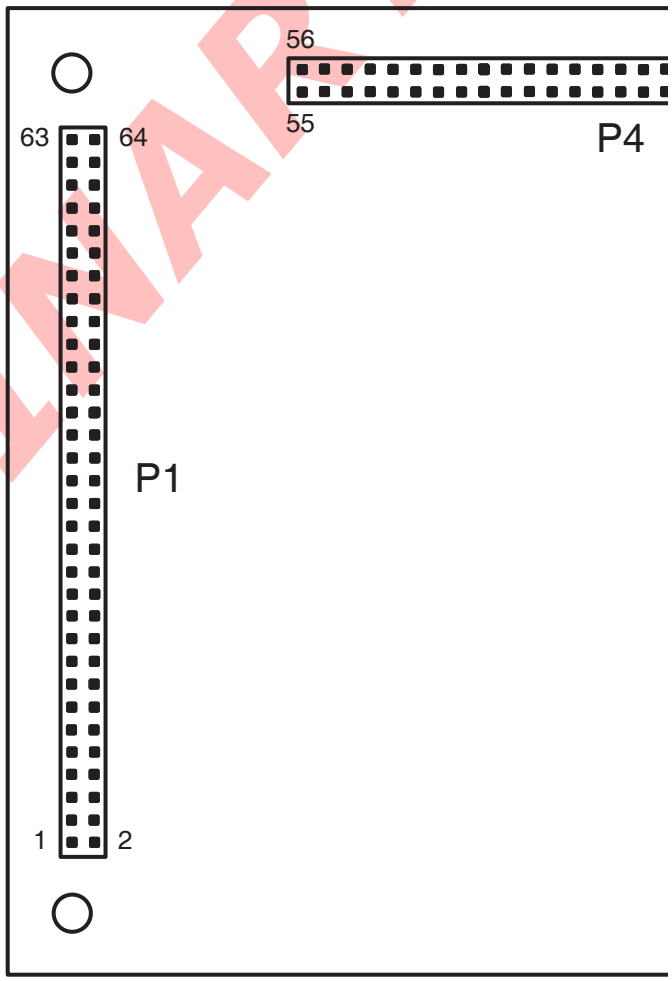
P1 POWER

Mounting board connector:
Samtec SQW-132-01-L-D

Axis	Signal	Pin		Signal	Axis
Axis-C	Mot /B	63	64	Mot /B	Axis-C
	Mot B	61	62	Mot B	
No connections		59	60	No connections	
		57	58		
Axis-C	Mot /A	55	56	Mot /A	Axis-C
	Mot A	53	54	Mot A	
No connections		51	52	No connections	
		49	50		
Axis-B	Mot /B	47	48	Mot /B	Axis-B
	Mot B	45	46	Mot B	
No connections		43	44	No connections	
		41	42		
Axis-B	Mot /A	39	40	Mot /A	Axis-B
	Mot A	37	38	Mot A	
No connections		35	36	No connections	
		33	34		
Axis-A	Mot /B	31	32	Mot /B	Axis-A
	Mot B	29	30	Mot B	
No connections		27	28	No connections	
		25	26		
Axis-A	Mot /A	23	24	Mot /A	Axis-A
	Mot A	21	22	Mot A	
No connections		19	20	No connections	
		17	18		
HV COM		15	16	HV COM	
		13	14		
		11	12		
N.C.		9	10	N.C.	
HVaux		7	8	N.C.	
+HV		5	6	+HV	
		3	4		
		1	2		

TOP VIEW

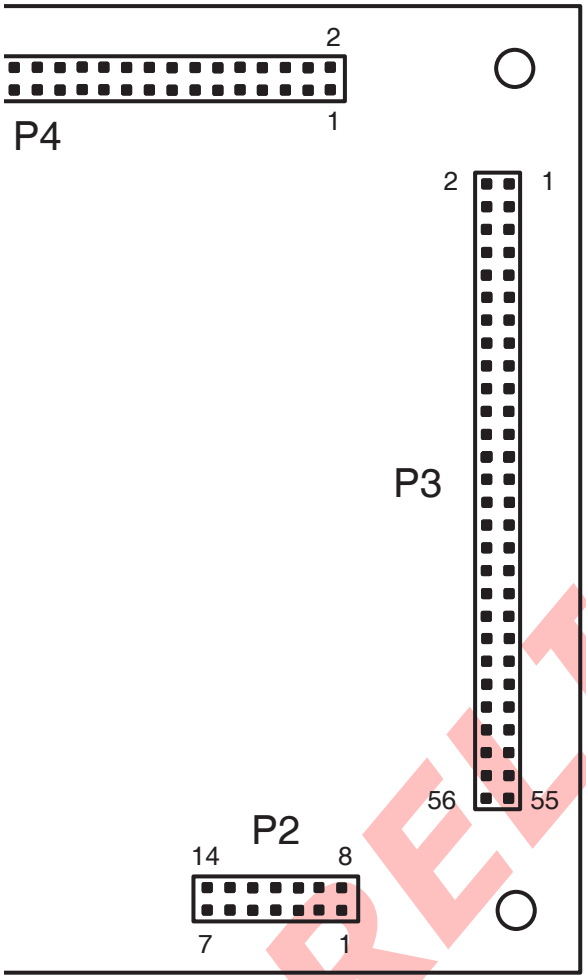
Viewed from above looking down on the connectors or PC board footprint to which the module is mounted



CONNECTOR NAMING (P1, P2, ETC) APPLIES TO THE MP3 MODULE AND NOT TO PC BOARD MOUNTED SOCKETS

TOP VIEW

Viewed from above looking down on the connectors or PC board footprint to which the module is mounted



CONNECTOR NAMING (P1, P2, ETC) APPLIES TO THE MP3 MODULE AND NOT TO PC BOARD MOUNTED SOCKETS

Mounting board connector:
Samtec SQW-107-01-L-D

P3 INPUT/OUTPUT

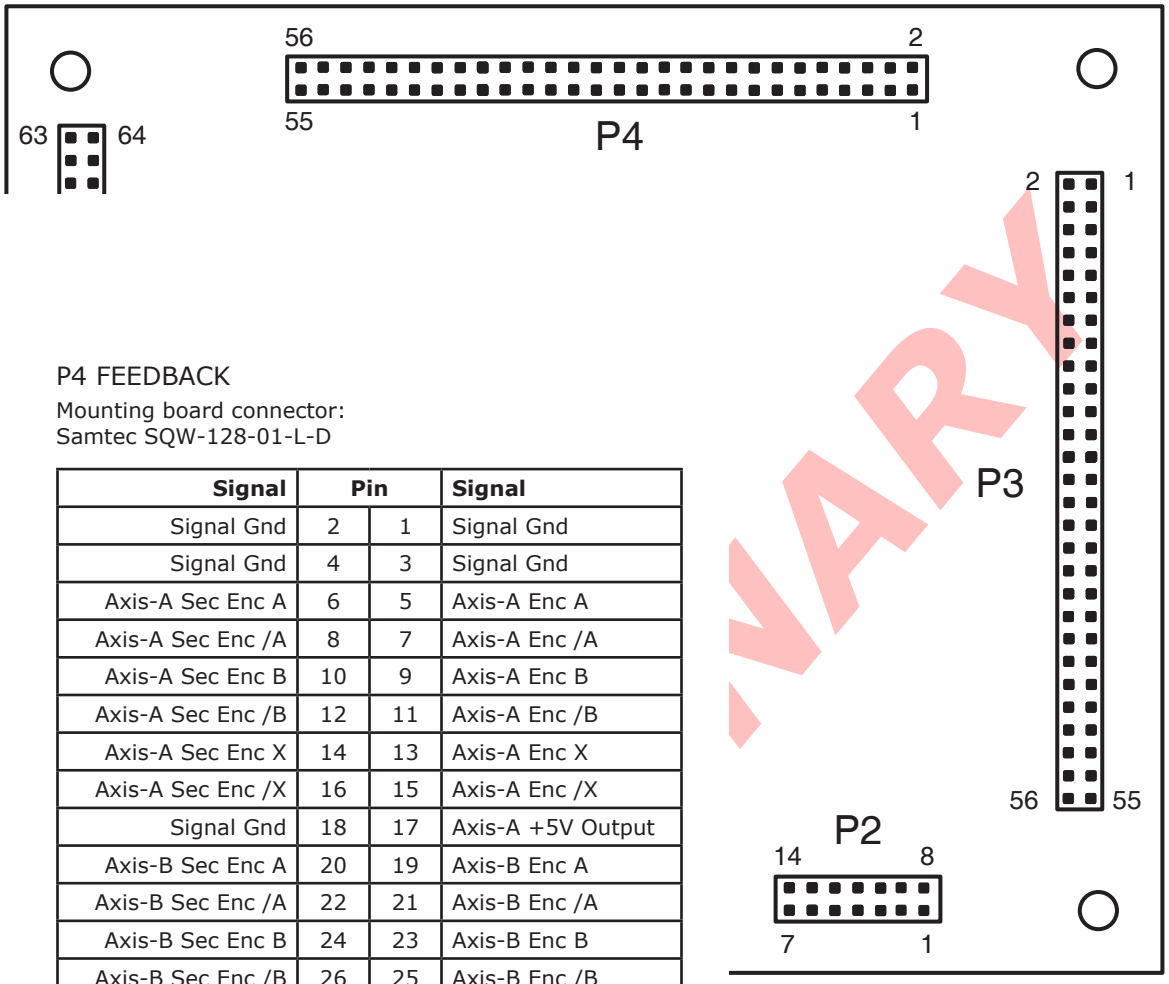
Mounting board connector:
Samtec SQW-128-01-L-D

Signal	Pin		Signal
Signal Gnd	2	1	Signal Gnd
Axis-A Ref(-)	4	3	Axis-A Ref(+)
Axis-B Ref(-)	6	5	Axis-B Ref(+)
Axis-C Ref(-)	8	7	Axis-C Ref(+)
Axis-A Sin(-)	10	9	Axis-A Sin(+)
Axis-A Cos(-)	12	11	Axis-A Cos(+)
Axis-B Sin(-)	14	13	Axis-B Sin(+)
Axis-B Cos(-)	16	15	Axis-B Cos(+)
Axis-C Sin(-)	18	17	Axis-C Sin(+)
Axis-C Cos(-)	20	19	Axis-C Cos(+)
Signal Gnd	22	21	Signal Gnd
Axis-A Hall-U [IN2]	24	23	[IN1] Axis-A Enable
Axis-A Hall-W [IN4]	26	25	[IN3] Axis-A Hall-V
Axis-A Dir [IN6]	28	27	[IN5] Axis-A Pulse
Axis-B Hall-U [IN8]	30	29	[IN7] Axis-B Enable
Axis-B Hall-W [IN10]	32	31	[IN9] Axis-B Hall-V
Axis-B Dir [IN12]	34	33	[IN11] Axis-B Pulse
Axis-C Hall-U [IN14]	36	35	[IN13] Axis-C Enable
Axis-C Hall-W [IN16]	38	37	[IN15] Axis-C Hall-V
Axis-C Dir [IN18]	40	39	[IN17] Axis-C Pulse
Signal Gnd	42	41	Signal Gnd
MOSFET [OUT2]	44	43	[OUT1] MOSFET
SPI MOSI HS [OUT4]	46	45	[OUT3] MOSFET
SPI SS1 HS [OUT6]	48	47	[OUT5] HS SPI SCLK
HS [OUT8]	50	49	[OUT7] HS
SPI MISO [IN19]	52	51	[OUT9] HS
Signal Gnd	54	53	Signal Gnd
RS-232 TxD	56	55	RS-232 RxD

Signal names in this chart are default settings for brushless motors with Halls, position mode, and command source from digital inputs. Digital inputs [IN1~IN19] are programmable for other functions. Outputs [OUT1~OUT9] are programmable for other functions.

P2 ETHERCAT PORT

Signal	Pin		Signal
Shield	2	1	Shield
Tx2 Term	4	3	Tx2+
Tx1+	6	5	Tx2-
Tx1-	8	7	Tx1 Term
Rx2 Term	10	9	Rx2+
Rx1+	12	11	Rx2-
Rx1-	14	13	Rx1 Term



P4 FEEDBACK

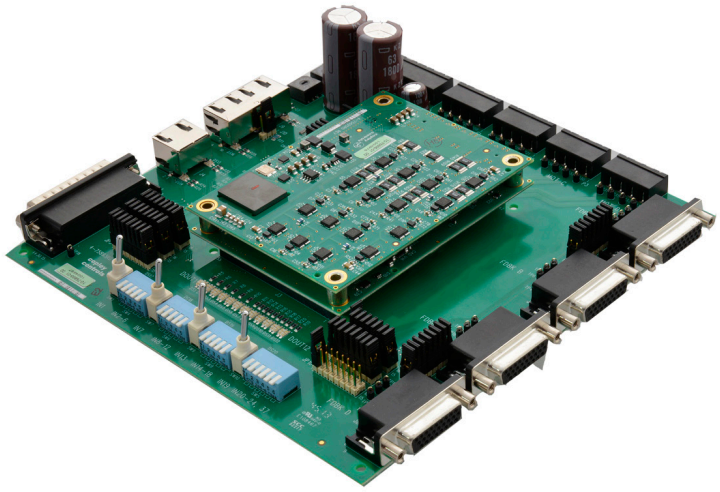
Mounting board connector:
Samtec SQW-128-01-L-D

Signal	Pin		Signal
Signal Gnd	2	1	Signal Gnd
Signal Gnd	4	3	Signal Gnd
Axis-A Sec Enc A	6	5	Axis-A Enc A
Axis-A Sec Enc /A	8	7	Axis-A Enc /A
Axis-A Sec Enc B	10	9	Axis-A Enc B
Axis-A Sec Enc /B	12	11	Axis-A Enc /B
Axis-A Sec Enc X	14	13	Axis-A Enc X
Axis-A Sec Enc /X	16	15	Axis-A Enc /X
Signal Gnd	18	17	Axis-A +5V Output
Axis-B Sec Enc A	20	19	Axis-B Enc A
Axis-B Sec Enc /A	22	21	Axis-B Enc /A
Axis-B Sec Enc B	24	23	Axis-B Enc B
Axis-B Sec Enc /B	26	25	Axis-B Enc /B
Axis-B Sec Enc X	28	27	Axis-B Enc X
Axis-B Sec Enc /X	30	29	Axis-B Enc /X
Signal Gnd	32	31	Axis-B +5V Output
Axis-C Sec Enc A	34	33	Axis-C Enc A
Axis-C Sec Enc /A	36	35	Axis-C Enc /A
Axis-C Sec Enc B	38	37	Axis-C Enc B
Axis-C Sec Enc /B	40	39	Axis-C Enc /B
Axis-C Sec Enc X	42	41	Axis-C Enc X
Axis-C Sec Enc /X	44	43	Axis-C Enc /X
Signal Gnd	46	45	Axis-C +5V Output
Axis-A Hall-V	48	47	Axis-A Hall-U
Axis-B Hall-U	50	49	Axis-A Hall-W
Axis-B Hall-W	52	51	Axis-B Hall-V
Axis-C Hall-V	54	53	Axis-C Hall-U
Signal Gnd	56	55	Axis-C Hall-W

DESCRIPTION

The Development Kit provides mounting and connectivity for one MP3 drive. Solderless jumpers ease configuration of inputs and outputs to support their programmable functions. Switches can be jumpered to connect to digital inputs 1~19 so that these can be toggled to simulate equipment operation. LED's provide status indication for the digital outputs, encoder A/B/X/S signals, and Hall signals. Test points are provided for these signals, too, making it easy to monitor these with an oscilloscope.

Dual EtherCAT connectors make daisy-chain connections possible so that other EtherCAT devices such as Copley's Accelnet Plus or Xenus Plus EtherCAT drives can easily be connected. Rotary switches are provided to set the EtherCAT slave Node-ID (address).



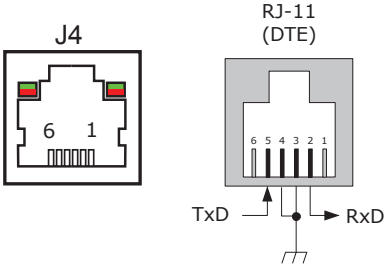
RS-232 CONNECTION

The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an EtherCAT network. CME 2™ software communicates with the drive over this link and is then used for complete drive setup. The EtherCAT Node-ID that is set by the rotary switch can be monitored, and a Node-ID offset programmed as well.

The RS-232 connector, J8, is a modular RJ-11 type that uses a 6-position plug, four wires of which are used for RS-232. A connector kit is available (SER-CK) that includes the modular cable, and an adaptor to interface this cable with a 9-pin RS-232 port on a computer.

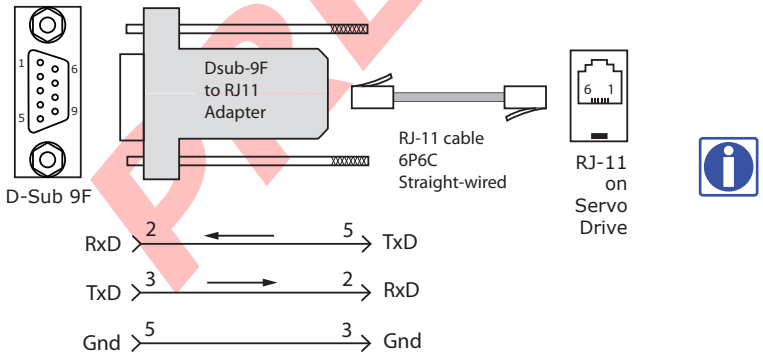
The LEDs on J4 are for the EtherCAT network status of Axes A, B, and C and are not associated with the RS-232 port function.

J8 SIGNALS



SER-CK SERIAL CABLE KIT

The SER-CK provides connectivity between a D-Sub 9 male connector and the RJ-11 connector J8 on the Development Kit. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses common modular cable to connect to the DevKit. The connections are shown in the diagram below.



Don't forget to order a Serial Cable Kit SER-CK when placing your order for an MP3 Development Kit!

DEVELOPMENT KIT INDICATORS (LEDS)

The AMP status LEDs DS17~19 at switches SW1, 7, and 13 show the operational state of each axis of the MP3.
The STATUS LEDs on J9 show the state of the EtherCAT NMT (Network Management) state-machines of each axis in the drive.
Details on the NMT state-machine can be found in the EtherCAT Programmers Manual, §3.1: http://www.copleycontrols.com/Motion/pdf/EtherCATProgrammersManual.pdf

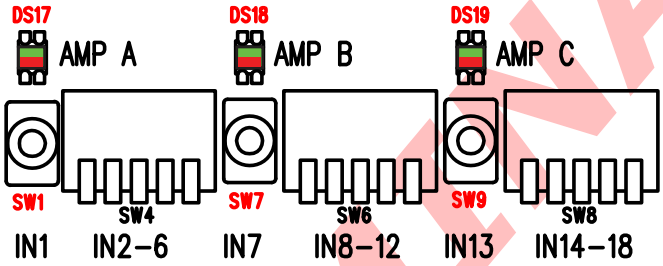
AMP LEDS

Three bi-color LEDs show the states of each axis of the MP3 by changing color, and either blinking or remaining solid.
The possible color and blink combinations are:

- *Green/Solid:* Drive OK and enabled. Will run in response to reference inputs or EtherCAT commands.
- *Green/Slow-Blinking:* Drive OK but NOT-enabled. Will change to *Green/Solid* when enabled.
- *Green/Fast-Blinking:* Positive or Negative limit switch active. Drive will only move in direction not inhibited by limit switch.
- *Red/Solid:* Transient fault condition. Drive will resume operation when fault is removed.
- *Red/Blinking:* Latching fault. Operation will not resume until drive is Reset.

Drive Fault conditions. Faults are programmable to be either transient or latching:

- Over or under-voltage
- Motor over-temperature
- Encoder +5 Vdc fault
- Short-circuits from output to ground
- Drive over-temperature
- Internal short circuits
- Short-circuits from output to output



STATUS LEDS

Three bi-color LEDs on J9 & J4 give the state of the NMT state-machine of each axis by changing color, and either blinking or remaining solid. The possible color and blink combinations are:

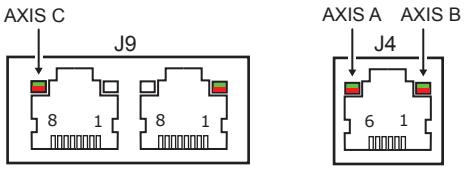
RUN (GREEN)

- *Off* — *Init*
- *Blinking* — *Pre-operational*
- *Single-flash* — *Stopped*
- *On* — *Operational*

ERROR (RED)

- *Off* — *No error*
- *Blinking* — *Invalid configuration, general configuration error*
- *Single Flash* — *Warning limit reached*
- *Double Flash* — *Error Control Event (guard or heartbeat event) has occurred*
- *Triple Flash* — *Sync message not received within the configured period*
- *On* — *Bus Off, the CAN master is bus off*

NETWORK STATUS LEDs



Note: Red & green led on-times do not overlap.
LED color may be red, green, off, or flashing of either color.

DEVELOPMENT KIT ETHERCAT NODE ID (ADDRESS)

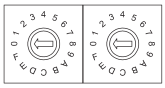
On a EtherCAT network, each device must have unique, non-zero Node-ID. In the MP3 DevKit, this is provided by two 16-position rotary switches with hexadecimal encoding. These can set the Node-ID of the drive's Axis A from 0x01~0xFF (1~255 decimal). The chart shows the decimal values of the hex settings of each switch.

CME2 -> Amplifier -> Network Configuration

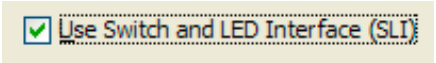
Example 1: Find the switch settings for decimal Node-ID 107 (0x6B):

1) Find the highest number under SW21 that is less than 107 and set SW21 to the hex value in the same row: 96 < 107 and 112 > 107, so SW21 = 96 = Hex 6
2) Subtract 96 from the desired Node-ID to get the decimal value of switch SW22 and set SW22 to the Hex value in the same row: SW22 = (107 - 96) = 11 = Hex B
3) This example will produce the following CAN addresses for the MP3:
   Axis A = 107 (0x6B), Axis B = 108 (0x6C), Axis C = 109 (0x6D), Axis D = 110 (0x6E)

SW7 SW8

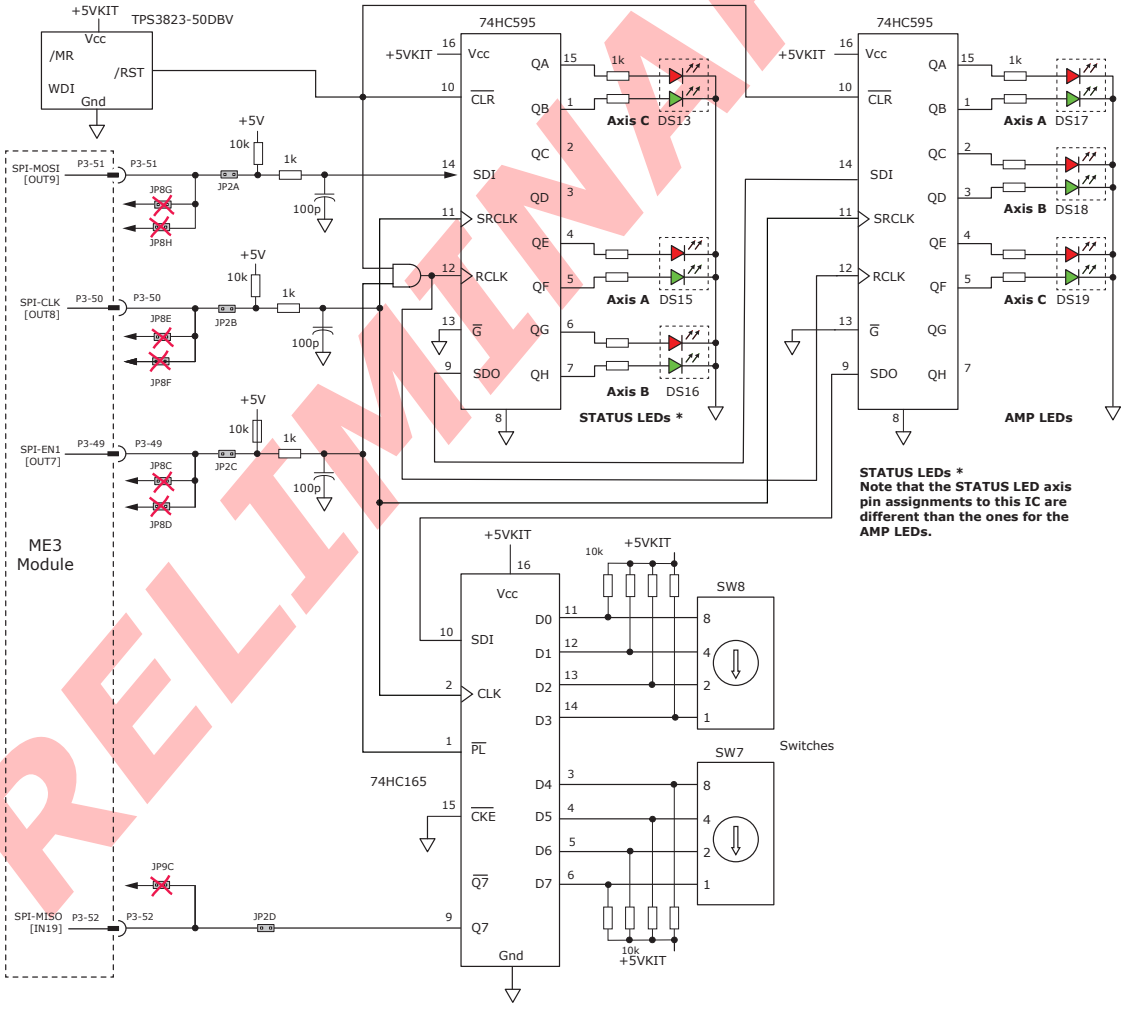


CME2 -> Input/Output -> Digital Outputs



EtherCAT Node-ID Switch Decimal values

	SW2	SW3
HEX	DEC	
0	0	0
1	16	1
2	32	2
3	48	3
4	64	4
5	80	5
6	96	6
7	112	7
8	128	8
9	144	9
A	160	10
B	176	11
C	192	12
D	208	13
E	224	14
F	240	15



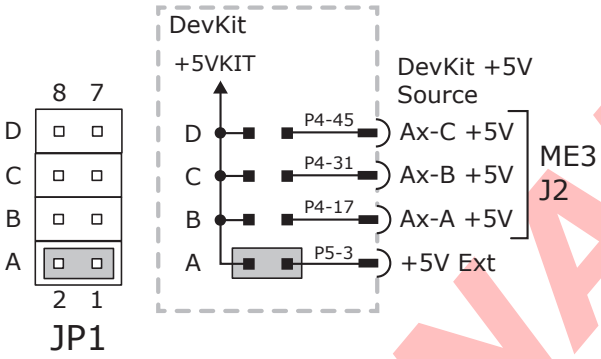
EtherCAT NODE-ID (ADDRESS) SWITCH CONNECTIONS

This graphic shows the connections to the EtherCAT Node-ID switches and to the status LEDs for the MP3 and EtherCAT. The switches are read once after the drive is reset, or powered-on. When changing the settings of the switches, be sure to either reset the drive, or to power it off-on. Outputs [OUT7,8,9] and input [IN19] operate as an SPI (Switch & LED Interface) port which reads the settings on the EtherCAT Node-ID switches, and controls the LEDs on the serial and EtherCAT port connectors. The jumpers marked with red "X" should be removed so that SW18, or external connections to the signals do not interfere with the operation of the SPI port.

DEVELOPMENT KIT+5V POWER

The encoder +5VENC power on the feedback connectors J5~J7 is connected directly to the Ax-A, Ax-B, and Ax-C power outputs from the MP3.

The SPI port components on the DevKit that drive the LEDs and read the Node-ID (address) switches connects to the signal +5VKIT.
And the +5VKIT connects to a jumper on JP1 that selects a source of the +5V power.
This can be powered from either the Ax-A, Ax-B, and Ax-C +5V power from the MP3, or from an external +5V power supply that connects to P5-3.
The default "A" position (on JP1 pins 1~2) selects the external +5V power source for +5VKIT.
Moving the jumper to the B, C, or D positions (pins 3~4, 5~6, 7~8) selects the axis +5V from the MP3 as the power source for the +5VKIT.
As noted below, only one jumper should be used to select the source of power for +5VKIT.



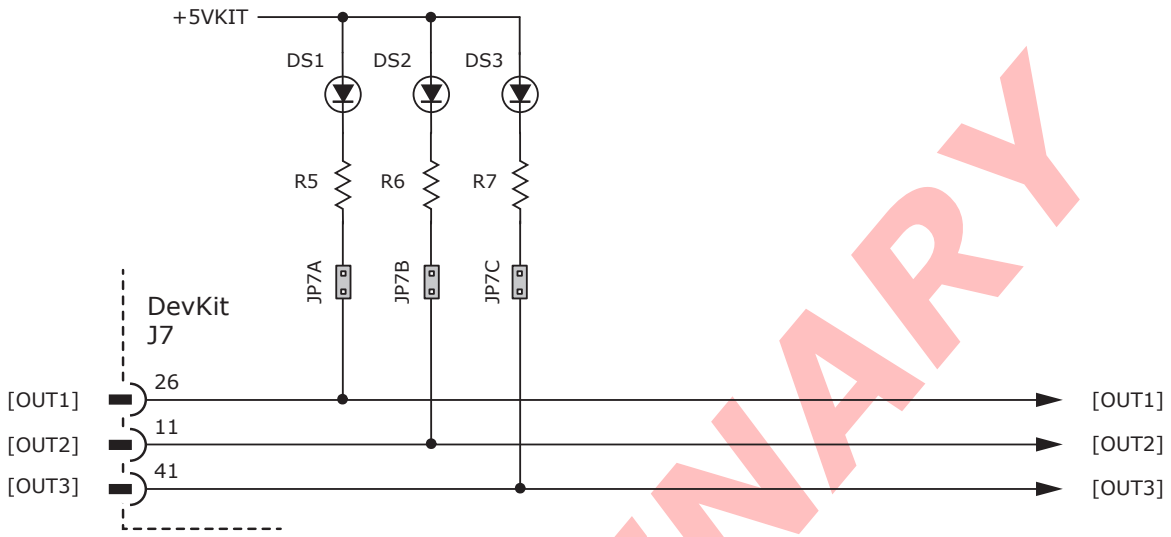
IMPORTANT: ONLY ONE SHORTING PLUG CAN BE USED ON JP1

USE OF MORE THAN ONE PLUG WILL DAMAGE 5V POWER SUPPLIES IN THE MP3

DEVELOPMENT KIT OUTPUTS

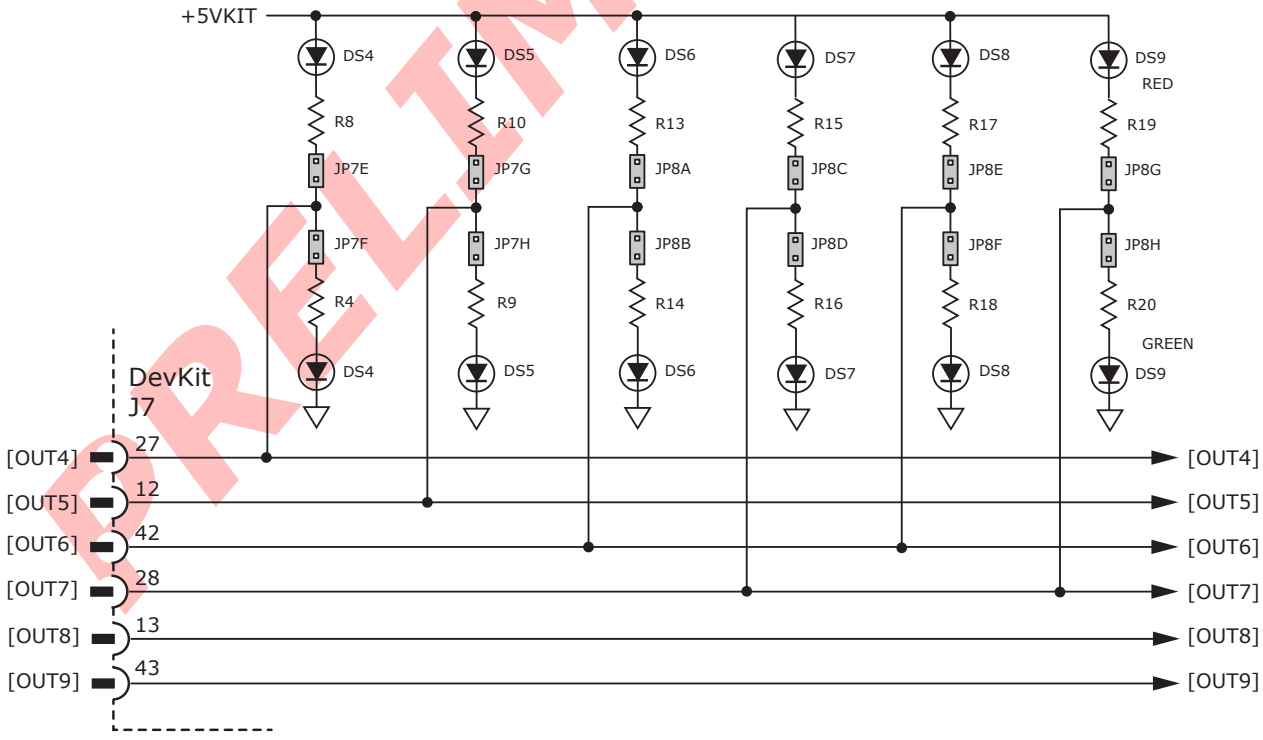
MOSFET OUTPUTS

There are three MOSFET outputs that can drive controller logic inputs or relays. If relays are driven, then flyback diodes must be connected across their terminals to clamp overvoltages that occur when the inductance of the relay coil is suddenly turned off. LED indicators connected to the outputs will be ON when the output is MOSFET is ON and the output voltage will be near 0V. Outputs 1,2, & 3 are MOSFET types that sink current when ON, and appear as open-circuit when OFF. When these outputs are ON a red LED is turned on. When the outputs are OFF, the red LED is off. The green LED is not used on these outputs.



LOGIC OUTPUTS

Outputs 4~9 are CMOS types that pull up to 5V or down to ground. When these outputs go high it turns on the green LED. When they are low, the red LED is turned on.

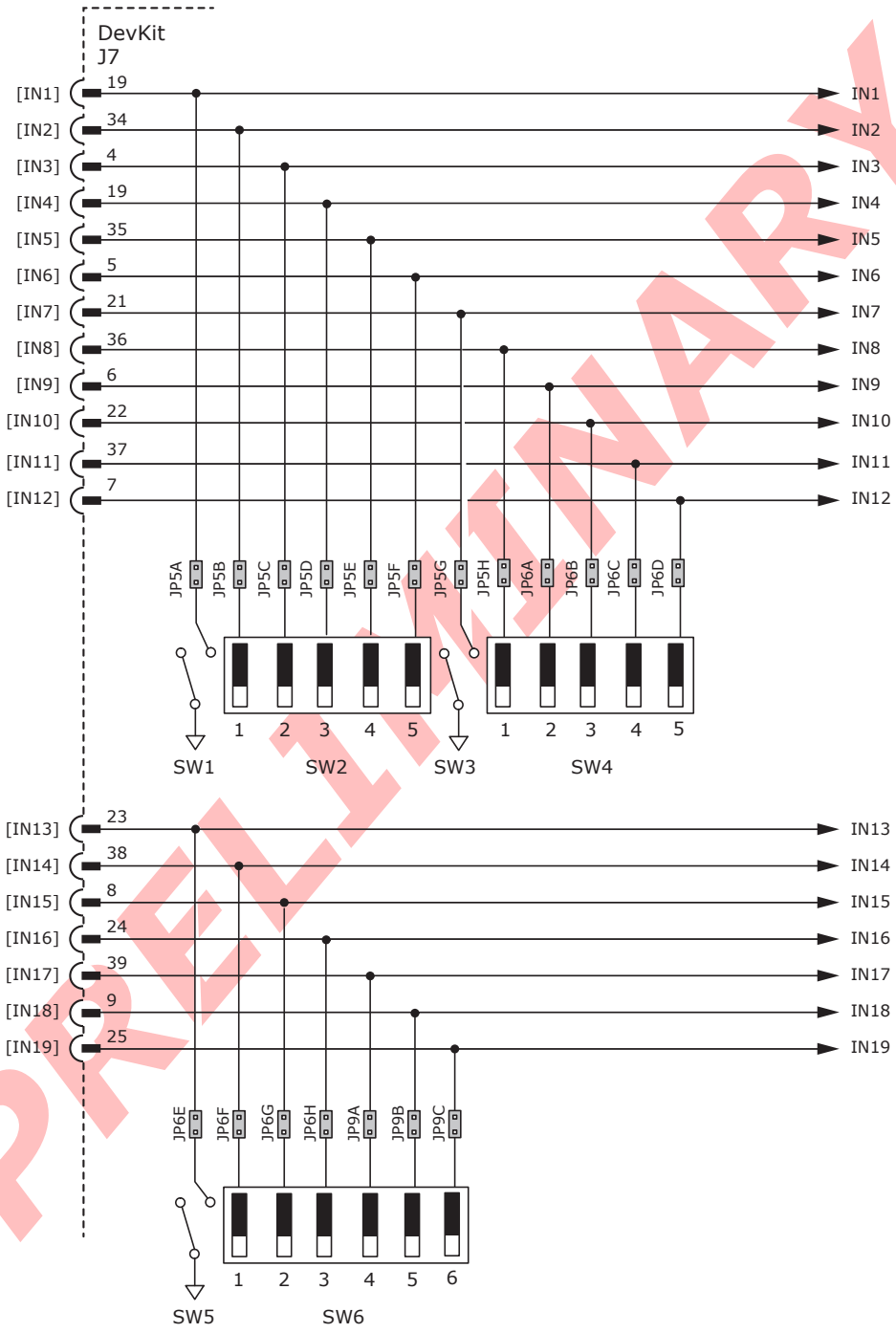


LOGIC INPUTS & SWITCHES

The Development Kit has jumpers that can connect the MP3 digital inputs to switches on the kit, or to the Control connector J7.

As delivered, all of these jumpers are installed as shown. If connecting to external devices that actively control the level of an input, it is desirable to disconnect the switch which could short the input to ground.

For example, if [IN1] is connected to an external device for the Enable function, then jumper JP5A should be removed to take the switch SW1 out of the circuit. The figure below shows these connections.



DEVELOPMENT KIT CONNECTORS

The Development Kit mounts a single MP3 module and enables the user to test and operate the MP3 before it is mounted onto a PC board in the target system.

J11 AXIS A | J10 AXIS B | J9 AXIS C FEEDBACK

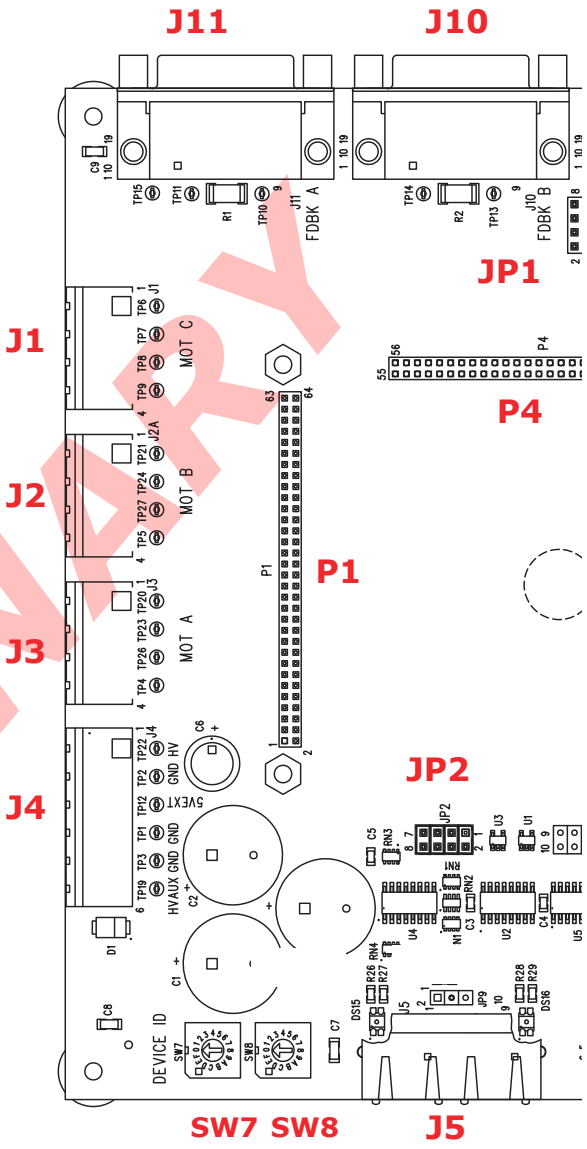
PIN	SIGNAL
26	Signal Gnd
25	Signal Gnd
24	N.C.
23	N.C.
22	N.C.
21	Cos(+)
20	Cos(-)
19	Sin(+)

PIN	SIGNAL
18	Sin(-)
17	+5VENC
16	Signal Gnd
15	Enc S
14	Enc /S
13	Enc A
12	Enc /A
11	Enc B
10	Enc /B

PIN	SIGNAL
9	Enc X
8	Enc /X
7	Motemp *
6	+5VENC
5	Signal Gnd
4	Table 1 (below)
3	
2	
1	Frame Gnd

This shows the Motemp signals on the axis feedback connectors J9~J11,and the ME3 pins they connect to.

Function	Axis A	Axis B	Axis C	Conn
Motemp	28	34	40	P3
	IN6	IN12	IN18	
Jumper	JP4-A	JP4-B	JP4-C	



J1: AXIS C MOTOR
J2: AXIS B MOTOR
J2: AXIS A MOTOR

Connector, Euro, 4 Terminal, 5.08 mm

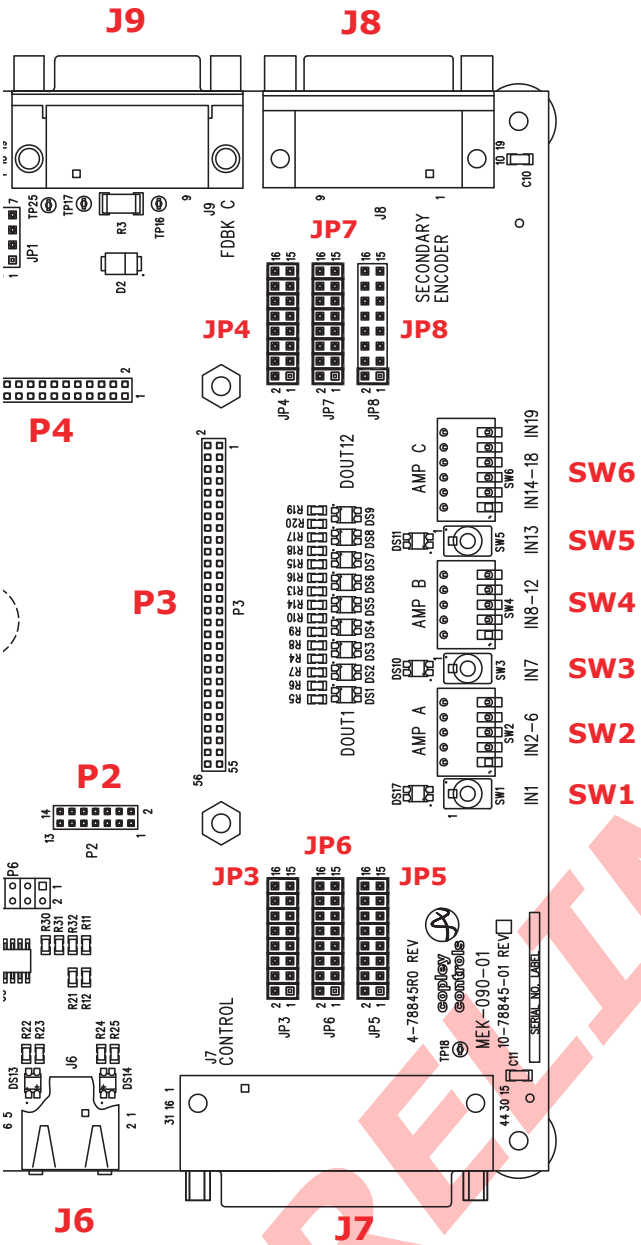
Signal	Pin
Motor A	1
Motor /A	2
Motor B	3
Motor /B	4

J4: HV, AUX, GND

Connector, Euro, 5 Terminal, 5.08 mm

Signal	Pin
+HV	1
HV Gnd	2
+5V Ext	3
Sgnd	4
HV Gnd	5
HV Aux	6

DEVELOPMENT KIT CONNECTORS



SW 1,3,5: ENABLE INPUTS

Axis ->	Axis A	Axis B	Axis C
Enable	SW1	SW3	SW5
Input	[IN1]	[IN7]	[IN13]
Jumper	JP5-A	JP5-G	JP6-E

DIP SWITCH INPUT CONNECTIONS

SW# / Axis ->	SW2 / A		SW4 / B		SW6 / C	
1	[IN2]	JP5-B	[IN8]	JP5-H	[IN14]	JP6-F
2	[IN3]	JP5-C	[IN9]	JP6-A	[IN15]	JP6-G
3	[IN4]	JP5-D	[IN10]	JP6-B	[IN16]	JP6-H
4	[IN5]	JP5-E	[IN11]	JP6-C	[IN17]	JP3-A
5	[IN6]	JP5-F	[IN12]	JP6-D	[IN18]	JP3-B
6	SW6 is not on these DIP switches				[IN19]	JP3-C

J8 SECONDARY FEEDBACK

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
26	Ax-C Enc B	18	Ax-C /B	9	Ax-C Enc X
25	Ax-C Enc A	17	Ax-C /A	8	Ax-C Enc /X
24	Signal Gnd	16	Ax-C +5V	7	Signal Gnd
23	Ax-B Enc B	15	Ax-B Enc /B	6	Ax-B Enc /X
22	Ax-B Enc A	14	Ax-B Enc /A	5	Ax-B Enc X
21	Signal Gnd	13	Ax-B +5V	4	Signal Gnd
20	Ax-A Enc B	12	Ax-B Enc /B	3	Ax-A Enc /X
19	Ax-A Enc A	11	Ax-A Enc /A	2	Ax-A Enc X
		10	Ax-A +5V	1	Frame Gnd

J7: CONTROL

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
15	Signal Gnd	30	Ax-A +5V	44	Ax-B +5V
14	N.C.	29	Ax-C +5V	43	[OUT9]
13	[OUT8]	28	[OUT7]	42	[OUT6]
12	[OUT5]	27	[OUT4]	41	[OUT3]
11	[OUT2]	26	[OUT1]	40	Signal Gnd
10	Signal Gnd	25	[IN19]	39	[IN17]
9	[IN18]	24	[IN16]	38	[IN14]
8	[IN15]	23	[IN13]	37	[IN11]
7	[IN12]	22	[IN10]	36	[IN8]
6	[IN9]	21	[IN7]	35	[IN5]
5	[IN6]	20	[IN4]	34	[IN2]
4	[IN3]	19	[IN1]	33	Signal Gnd
3	Ax-C Ref(-)	18	Ax-B Ref(-)	32	Ax-A Ref(-)
2	Ax-C Ref(+)	17	Ax-B Ref(+)	31	Ax-A Ref(+)
1	Frame Gnd	16	Signal Gnd		

ORDERING INFORMATION

MASTER ORDERING GUIDE

MP3-090-10	*Multinet Plus MP3* stepper drive, 5/10A, 14~90 Vdc
MPK-090-03	Development Kit for *Multinet Plus MP3*

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16-01568 Document Revision History

Revision	Date	Remarks
00	October 18, 2016	Initial version

Note: Specifications subject to change without notice