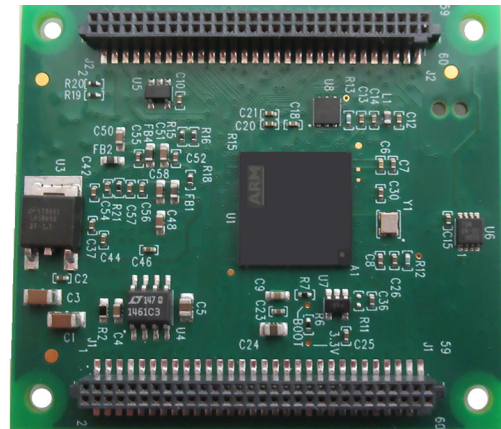


**AFS Advanced Feature Set**

- Micro-module mounts to user PC boards
- Programmable Filters on Analog Inputs
- Quad Incremental Encoder Input
- CVM/CPL Programming
- 250us Update Rate
- 80 Digital I/O
- 12 Analog Inputs
- 2 Analog Outputs
- 2 EtherCAT Interfaces
- 1 RS-232 Interface
- 1 Module Status LED (RED/GREEN)
- 2 EtherCAT Status LEDs (RED & GREEN)
- 2 LINK/ACT LEDs (GREEN)
- 1 Reset
- Dimensions: in [mm]  
2.00 x 2.25 x 0.36 in. [50.8 x 57.2 x 9.2 mm]
- Weight 4.8 oz (136 g)

**ETHERCAT INTERFACE**

- EtherCAT IEEE 802.3 Compliant
- Supports 100BASE-TX



**ECT-IPM-01**

**Description**

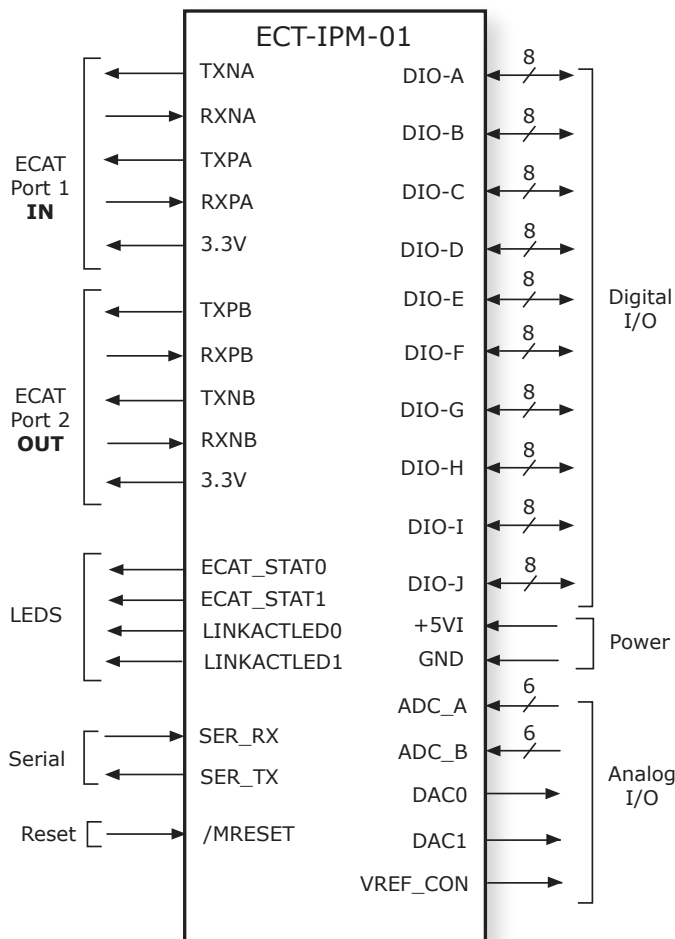
The ECT-IPM-01 is a PC board-mounting card used to add I/O to an EtherCAT distributed control network. The ECT-IPM-01 combines configurable digital I/O points with dedicated analog and digital inputs and outputs to enhance the distributed control networks using Copley’s EtherCAT servo drives and stepper drives.

Ten 8-bit ports are configurable as digital inputs or outputs. Twelve A/D ports convert 0-3 Vdc signals into 12-bit values. Two 12-bit DAC outputs are analog in nature.

The ARM/microcontroller is the same type that is used in Copley’s digital motion products and has the same software interface.

The card supports the EtherCAT bus at 100 Mbit/sec and RS-232 communications to 115,200 Baud.

Component count and cost are minimized by placing communication transceivers and I/O buffering off the ECT-IPM-01 where they can be optimized as part of the user PC board design.



Note: In the above diagram, the DIO-D and DIO-H are configurable as PWM outputs or GPIO.

## GENERAL SPECIFICATIONS

### INPUT POWER

Supply Voltage	+5 Vdc $\pm$ 0.5 Vdc
Supply Current	500 mAdc typical, 1 Adc max.

### DIGITAL I/O

Number : Function	80 : I/O in ten 8-bit ports: DIO_A~DIO_J are programmable by port as inputs or outputs.
Internal Pull-up/Pull-down Resistors	Typical 40 kOhm (All I/O except DIO_I3), typical 10 kOhm (DIO_I3)
Input Voltage LO	-0.3 < VIL < +1 Vdc
Input Voltage HI	+2.3 < VIH < +5.5 Vdc
Input Voltage Max	+6.0 Vdc
Output Voltage HI	+2.4 < VOH < +3.3 Vdc @ -8 mA (All I/O except DIO_F6), +2.4 < VOH < +3.3 Vdc @ -3mA (DIO_F6)
Output Voltage LO	0.0 < VOL < +0.4 Vdc @ 8mA (All I/O except DIO_F6), 0.0 < VOL < +0.4 Vdc @ 3mA (DIO_F6)
External Circuits (optional)	Schmitt-trigger buffer/inverter with RC filters for digital inputs, buffer/inverters for digital outputs

### ANALOG INPUTS

Number	12 A/D converters in two 6-inputs/banks, 12-bit resolution, 36 MHz max. ADC clock frequency Max. sampling time 16 $\mu$ s, max sampling rate is 3.75 Msps
Reference Voltage	3.00 Vdc, supplied by voltage reference on the ECT-IPM-01 PC board
Reference Current	10 mA max. available from J2-13 for external circuits
Input Voltage Range	0.3 to 2.7 Vdc (0.1 Vref to 0.9 Vref) recommended, 0 to Vref Vdc max.
External Circuits (optional)	Op-amp with output clamped to Vref max. to scale and amplify user signals to A/D input voltage range

### ANALOG OUTPUTS

Signals	DAC0, DAC1
Mode	D/A converters, 12-bit monotonic outputs, DNL of $\pm$ 2 LSB, INL of $\pm$ 4 LSB

### PWM OUTPUTS

Signals	DIO_D and DIO_H ports can optionally be configured as PWM outputs.
Mode	8 ms~1 $\mu$ s (125 Hz~1MHz) 0~100% duty-cycle

### ETHERCAT PORT

Format	100BASE-TX, Microchip LAN9252 EtherCAT Slave Controller with integrated PHYs, Input & Output
Data	IEEE 802.3/802.3u compliant
Address Selection (two methods):	Programmable to flash memory or set through input pins, select 1 to 15 pins to set the node alias.
External Circuit required	Ethernet magnetics
Isolation	Isolated from signal ground. Max. voltage vs. ground: 32 Vdc, Rated impulse voltage: $\geq$ 250 VDC

### ETHERCAT CONFIGURATION INPUTS

Number : Function	Up to 15 digital inputs are for the EtherCAT node address.
Input Voltage LO	-0.3 < VIL < +0.8 Vdc
Input Current LO	Pull-up resistor enabled: -200 $\mu$ A min., -100 $\mu$ A typ, -500 $\mu$ A max. when VIN = 0 Vdc Pull-up resistor disabled: $\pm$ 2.5 $\mu$ A max. when VIN = 0 Vdc
Input Voltage HI	+2.0 < VIH < +5.5 Vdc
Input Voltage Max	+6.0 Vdc
External Circuits required	Schmitt-trigger buffer/inverter with RC filters for digital inputs, buffer/inverters for digital outputs

### ETHERCAT STATUS LED OUTPUTS

Number	4: ECAT_STAT0, ECAT_STAT1, LINKACTLED0, LINKACTLED1
Output Current HI	-4 mA @ 2.4 Vdc
Output Current LO	+4 mA @ 0.4 Vdc
External Circuit required	Four buffer/inverters with sufficient current to drive red/green LEDs

### RS-232 PORT

Signals	RxD, TxD, Gnd
Mode	Full-duplex, serial communication port for IO Module setup and control, 9,600 to 115,200 Baud
Protocol	Binary or ASCII formats
External Circuit required	RS-232 transceiver

### MECHANICAL & ENVIRONMENTAL

Size	2.00 x 2.25 x 0.36 in. (50.8 x 57.2 x 9.2 mm) Weight: 4.8 oz (136 g)
Ambient Temperature	0 to +45 °C operating, -40 to +85 °C storage
Humidity	0 to 95 %RH, non-condensing, operating and storage
Contaminants	Pollution Degree 2
Environment	IEC 60068-2
Cooling	Convection

**AGENCY STANDARDS CONFORMANCE**

*In accordance with EC Directive 2014/30/EU (EMC Directive)*

EN 55011	CISPR 11:2003/A2:2006 Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement Group 1, Class A
EN 61000-6-2:	Electromagnetic Compatibility (EMC) - Generic Standards, Immunity Standard for Industrial Environments

*Restriction of the Use of Certain Hazardous Substance (RoHS)*

Directive 2011/65/EU (RoHS II) and its amendments 2015/863 (REACH Compliant)

*In accordance with EC Directive 2014/35/EU (Low Voltage Directive)*

*IEC/UL 61010-1:2010 3rd Ed. Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use*

*Underwriters Laboratory Standards*

UL 61010-1,2010: 3rd Ed. Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

UL File Number E168959

UL Recognized (Canada and US)



*RoHS Directive 2011/65/EU is now part of the CE marking procedure.*

## GENERAL SPECIFICATIONS

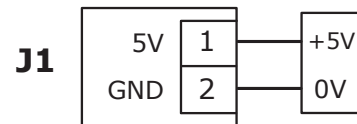
### OVERVIEW

The ECT-IPM-01 operates under EtherCAT (Ethernet for Control Automation Technology). It can be configured and controlled through both serial and EtherCAT network interfaces. The serial interface uses the same protocol and commands as those used by the Accelnet and Stepnet families of digital servo drives. The ECT-IPM-01 signals connect to the ARM and they are low-voltage, low-current types that depend on user-supplied circuits for filtering, isolation, and voltage-scaling. Examples of such circuits are shown along with the functional diagrams of the various I/O functions. The ECT-IPM-01 EtherCAT hardware can be summarized as follows:

- 80 Digital I/O in ten 8-bit ports, all are configurable as input or output
- 12 A/D converters in two 6-bit ports plus a 3.00 Vdc reference output
- 2 Outputs for EtherCAT status LEDs
- 2 Outputs for EtherCAT Link/Act LEDs
- 1 Module status LED
- 1 Dedicated input for device reset
- 2 12-bit D/A converters
- 16 PWM output or 6 quad-encoder input ports:
  - Bank H can be 8 PWM outputs or 4 quadrature inputs.
  - Bank D can be 8 PWM outputs or 2 quadrature inputs.
- (DIO\_A ~ DIO\_J)
- (ADC\_A, ADC\_B, VREF)
- (ECAT\_STAT0, ECAT\_STAT1)
- (LINKACTLED0, LINKACTLED1)
- (RED/GREEN Bicolor)
- (/MRESET)
- (DAC0, DAC1)

### 5V INPUT

Power for the ECT-IPM-01 must be 5.0 Vdc  $\pm$ 0.5 Vdc. Current requirements are 500 mA, typical. All circuits on the ECT-IPM-01 are non-isolated and will share a common electrical ground with circuits to which it connects.



### ETHERCAT NODE ALIAS

DIO\_I and DIO\_J ports contain the Node Alias (Node Address). Fifteen bits 0~14 support the node alias up to 32K.

- Inputs from Bank J are treated as the lower 8 bits of the alias. J0 is bit 0, J7 is bit 7.
- Inputs from Bank I are treated as the upper 7 bits of the alias. I0 is bit 8, I6 is bit 14.

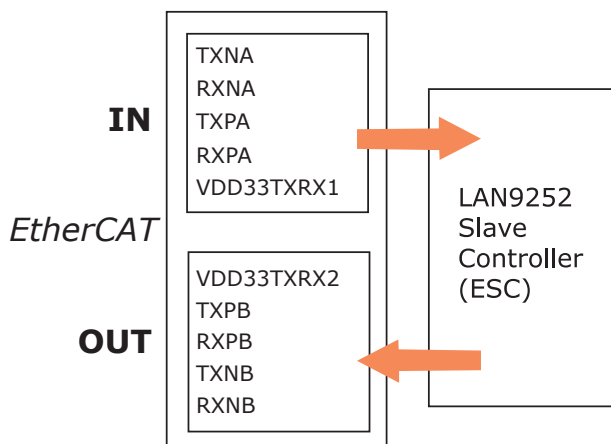
These inputs are sampled on power-up. After that, the inputs can be used for other purposes.

J2

DIO_I0	37	38	DIO_I1
DIO_I2	39	40	DIO_I3
DIO_I4	41	42	DIO_I5
DIO_I6	43	44	DIO_I7
DIO_J0	45	46	DIO_J1
DIO_J2	47	48	DIO_J3
DIO_J4	49	50	DIO_J5
DIO_J6	51	52	DIO_J7

### ETHERCAT COMMUNICATIONS

The module uses the Microchip LAN9252 as the ESC (EtherCAT Slave Controller). It has dual integrated Ethernet PHYs and each of these has a full-duplex 100BASE-TX transceiver and supports 100 Mbps (100BASE-TX) operation. The LAN9252 is compliant with IEEE 802.3/802.2u (Fast Ethernet). It supports HP Auto-MDIX, allowing the use of direct-connect or cross-over LAN cables.



J2

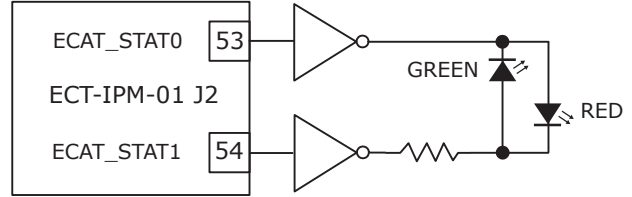
Signal	Pin	Function
TXNA	1	Transmit Line 1-
RXNA	2	Receive Line 1-
TXPA	3	Transmit Line 1+
RXPA	4	Receive Line 1+
VDD33TXX1	5	EtherCAT +3.3V
VDD33TXX2	6	EtherCAT +3.3V
TXPB	7	Transmit Line 2+
RXPB	8	Receive Line 2+
TXNB	9	Transmit Line 2-
RXNB	10	Receive Line 2-

### ECAT STATUS LEDS

ECAT\_STAT0 and ECAT\_STAT1 show the status of the ECT-IPM-01. The circuit shown here is located on the user's PC board and will produce the LED colors in the table as shown. The values for the op-amps, resistor, and LEDS are chosen by the user.

ECAT_STAT1	ECAE_STAT0	LED
0	0	Off
0	1	Green
1	0	Red
1	1	Off

J2

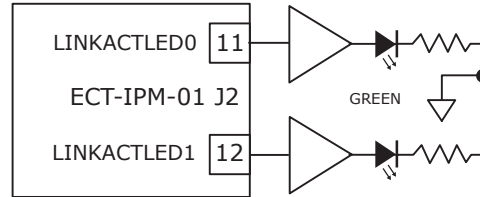


### LINK/ACT LEDS

LINKACTLED0 and LINKACTLED1 are used for driving external LEDs to show the status of the EtherCAT communication. The circuit shown here is located on the user's PC board and will produce the LED colors in the table as shown. The values for the op-amps, resistor, and LEDS are chosen by the user.

LINKACTLED0	LINKACTLED1	LED
0	0	Off
0	1	Green
1	0	Green
1	1	Green

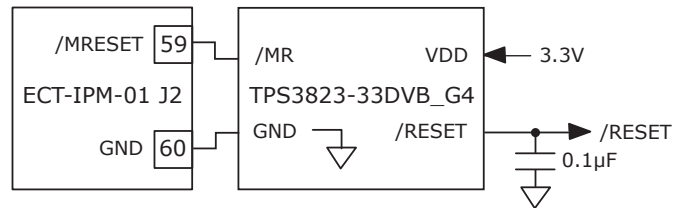
J2



### RESET INPUT

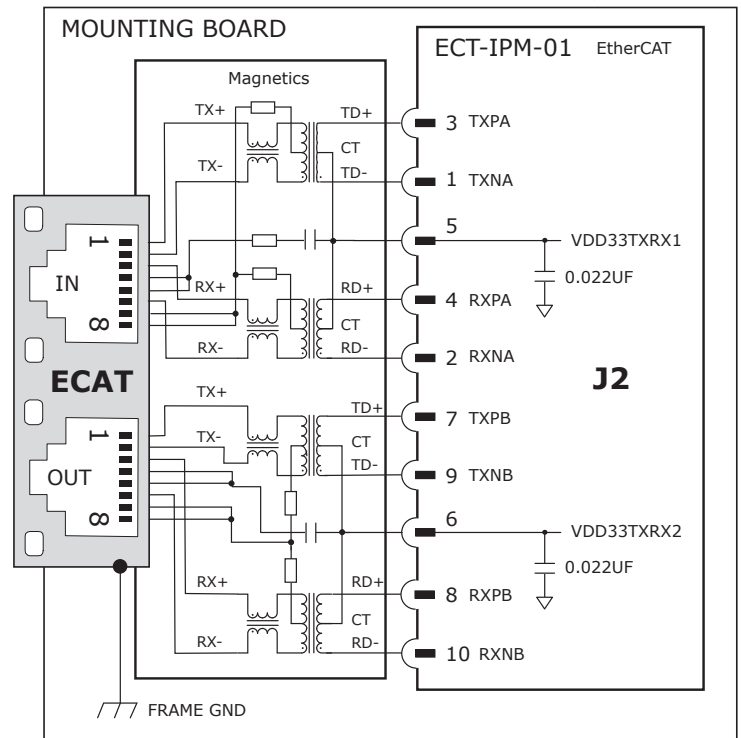
The /MRESET input connects to an internal supply voltage supervisor with a threshold voltage of 2.93 Vdc. If /MRESET is <2.93 Vdc, the /RESET signal to the ARM will be asserted. When /MRESET is >3.12 Vdc, the /RESET signal will be removed after a 200 ms delay. Grounding the /MRESET input will hold the ARM in a reset state. When the /RESET input is open, the ARM will operate normally as long as VDD is >3.12 Vdc.

J2



### ETHERCAT PORT

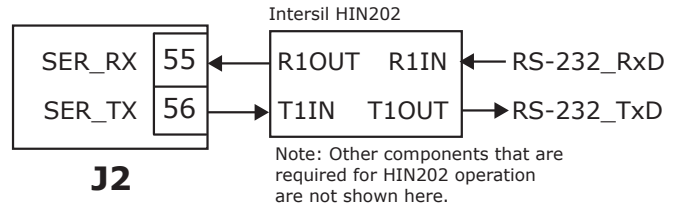
The mounting board diagram is an example that shows the connections between the ECT-IPM-01 and a mounting board using a Halo HFJ12-E2450ERL Dual socket connector that accepts ECAT cables.



Mounting Board Connections Diagram

**SERIAL COMMUNICATIONS**

The ECT-IPM-01 supports full-duplex serial communications using the RS-232 protocol at 9,600 to 115,200 Baud. Binary or ASCII formats are supported. An external RS-232 transmitter/receiver is required in order to convert the TTL signals of the ECT-IPM-01 into higher-voltage, RS-232 compliant signals. A typical device is the Intersil HIN202 Transmitter/Receiver. It operates from +5V and generates the required voltages from on-chip charge pumps and external capacitors.



**DIGITAL I/O (DIO\_A0~DIO\_J7)**

The ECT-IPM-01 has 80 digital I/O pins arranged in ten ports of eight pins each. Within a port, there are additional options that are selectable on a per-pin basis. The DIO\_A~DIO\_J ports are configurable as inputs or outputs:

- |                                 |                         |
|---------------------------------|-------------------------|
| Input Port Selections:          | Output Port Selections: |
| • Invert                        | • Invert                |
| • Pull-up or pull-down resistor | • Power up state HI     |
| • De-bounce time (ms)           | • Open-drain            |
| • Enable Fault                  |                         |

DIO\_D and DIO\_H can be optionally configured as PWM outputs or quadrature inputs. Ports I and J can optionally be used to set the EtherCAT alias on startup.

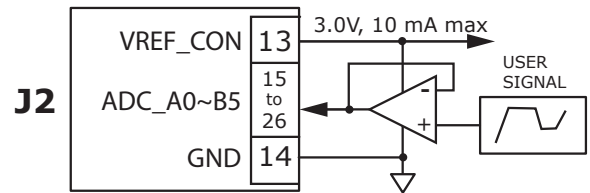
Example: I/O 4 in J1

DIO_D0	29	30	DIO_D1
DIO_D2	31	32	DIO_D3
DIO_D4	33	34	DIO_D5
DIO_D6	35	36	DIO_D7

See page 7 for all Digital I/O.  
DIO\_A~DIOG (DIO1 ~ DIO7) are on J1  
DIO\_H~DIOJ (DIO8~DIO10) are on J2

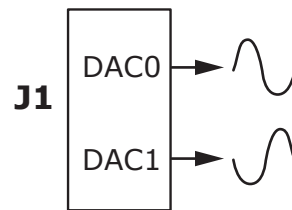
**ANALOG INPUTS**

There are 12 A/D converters in two, six-input banks. All have 12 bit resolution with an input voltage range of 0 to 3.00 Vdc which is supplied by an on-board precision reference. The absolute maximum input voltage is 4.0 V. For best results, inputs should be scaled from 10% to 90% of Vref (3.00 Vdc). Circuit designs using op-amps powered from 3.3 Vdc not only limit the A/D input voltage to a safe level, but EtherCAT incorporates anti-aliasing filters and DC offsetting so that bipolar voltages can be offset to Vref/2 with the 10% and 90% (0.3 and 2.7 Vdc) points used and negative and positive full-scale. This feature allows for some small headroom about the min/max voltages. Unused inputs should be connected to AGND. The reference voltage VREF\_CON is brought out to J2 for the user's circuits.



**ANALOG OUTPUTS**

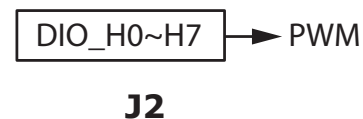
Two, 12-bit buffered DAC outputs convert digital signals into analog voltage signals. External amplification recommended to supply sufficient current. Dual DAC outputs can output simultaneously or independently.



**PWM OUTPUTS**

DIO\_D and DIO\_H can be configured as PWM outputs or GPIO.

- PWM frequency (period): 125Hz ~ 1MHz (8ms ~ 1µs)
- PWM duty cycle: 0~100%



CONNECTOR PINS & SIGNALS: ETHERCAT-IO-MODULE

		J1			J2				
	Signal	J1 Pin	J1 Pin	Signal	Signal	J2 Pin	J2 Pin	Signal	
5V Input	+5VI	1	2	GND	TXNA	1	2	RXNA	
D/A	DAC0	3	4	DAC1	TXPA	3	4	RXPA	
	DIO_A0	5	6	DIO_A1	VDD33TXRX1	5	6	VDD33TXRX2	ECAT PORT
Port A	DIO_A2	7	8	DIO_A3	TXPB	7	8	RXPB	
I/O 1	DIO_A4	9	10	DIO_A5	TXNB	9	10	RXNB	
	DIO_A6	11	12	DIO_A7	LINKACTLED0	11	12	LINKACTLED1	ECAT LEDS *
	DIO_B0	13	14	DIO_B1	VREF_CON	13	14	GND	
Port B	DIO_B2	15	16	DIO_B3	ADC_A0	15	16	ADC_A1	
I/O 2	DIO_B4	17	18	DIO_B5	ADC_A2	17	18	ADC_A3	
	DIO_B6	19	20	DIO_B7	ADC_A4	19	20	ADC_A5	A/D (Analog)
	DIO_C0	21	22	DIO_C1	ADC_B0	21	22	ADC_B1	
Port C	DIO_C2	23	24	DIO_C3	ADC_B2	23	24	ADC_B3	
I/O 3	DIO_C4	25	26	DIO_C5	ADC_B4	25	26	ADC_B5	
	DIO_C6	27	28	DIO_C7	+5VI	27	28	GND	+5V
	DIO_D0	29	30	DIO_D1	DIO_H0	29	30	DIO_H1	
*** Port D	DIO_D2	31	32	DIO_D3	DIO_H2	31	32	DIO_H3	Port H ***
I/O 4	DIO_D4	33	34	DIO_D5	DIO_H4	33	34	DIO_H5	I/O 8
	DIO_D6	35	36	DIO_D7	DIO_H6	35	36	DIO_H7	
	DIO_E0	37	38	DIO_E1	DIO_I0	37	38	DIO_I1	
Port E	DIO_E2	39	40	DIO_E3	DIO_I2	39	40	DIO_I3	Port I
I/O 5	DIO_E4	41	42	DIO_E5	DIO_I4	41	42	DIO_I5	I/O 9
	DIO_E6	43	44	DIO_E7	DIO_I6	43	44	DIO_I7	
	DIO_F0	45	46	DIO_F1	DIO_J0	45	46	DIO_J1	
Port F	DIO_F2	47	48	DIO_F3	DIO_J2	47	48	DIO_J3	Port J
I/O 6	DIO_F4	49	50	DIO_F5	DIO_J4	49	50	DIO_J5	I/O 10
	DIO_F6	51	52	DIO_F7	DIO_J6	51	52	DIO_J7	
	DIO_G0	53	54	DIO_G1	ECAT_STAT0	53	54	ECAT_STAT1	Status LEDs *
Port G	DIO_G2	55	56	DIO_G3	SER_RX	55	56	SER_TX	RS-232 **
I/O 7	DIO_G4	57	58	DIO_G5	NC	57	58	NC	
	DIO_G6	59	60	DIO_G7	/MRESET	59	60	GND	Reset

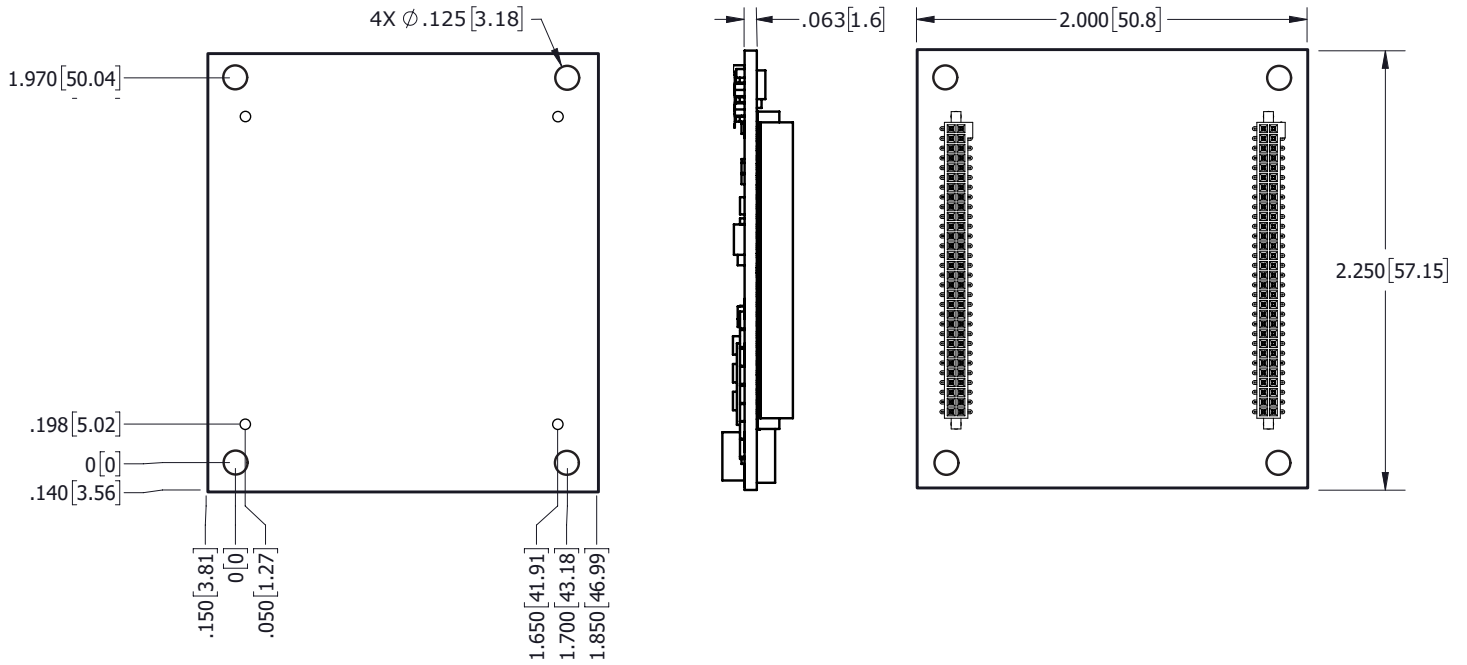
Note: Connectors J1 and J2 are located on the side of the ECT that plugs into two sockets on the mounting board.

Legend: The labels with asterisks are identified below.

- \* LEDS are external.
- \*\* Serial: External circuit required.
- \*\*\* Configurable as PWM outputs or GPIO.
- \*\*\*\* EtherCAT node alias is read on power-up.



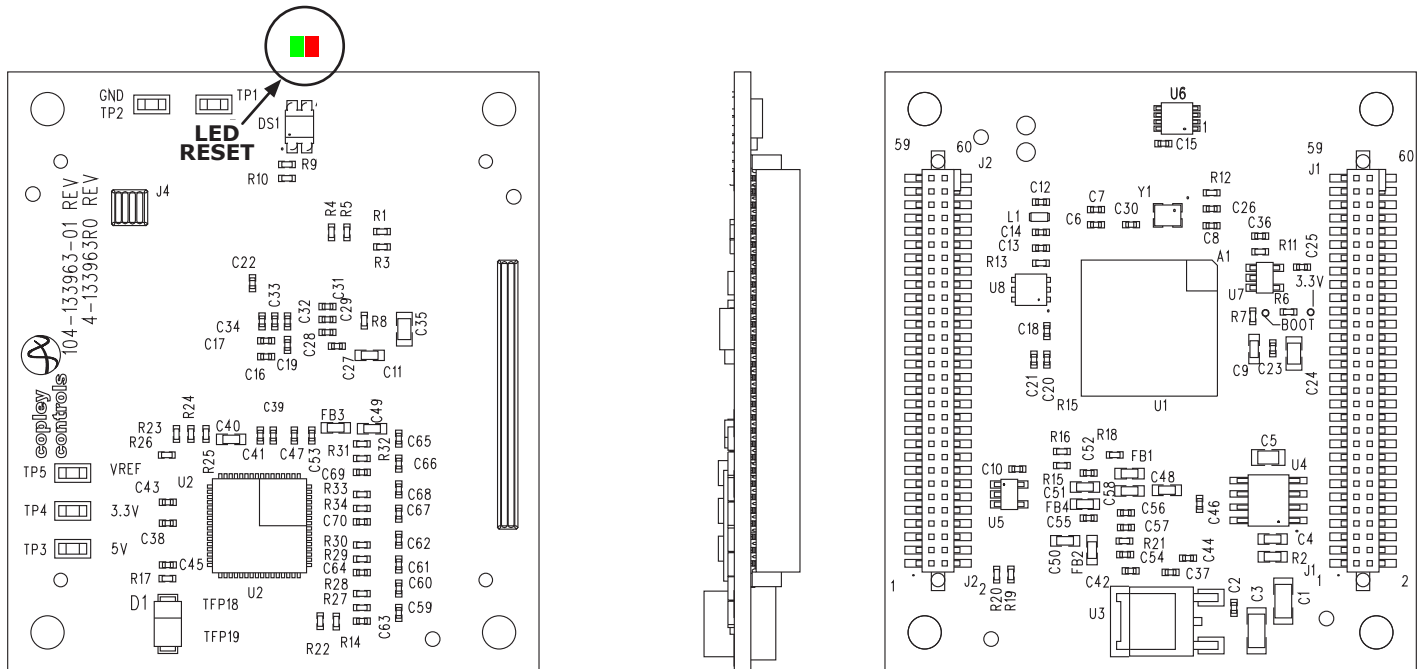
MODULE DIMENSIONS



Module Dimensions

MODULE ASSEMBLY

The following diagrams show the EtherCAT Module. It is a single PCB with Samtec mounting connectors.  
Part Number: Samtec SFM-130-02-SM-D-A.



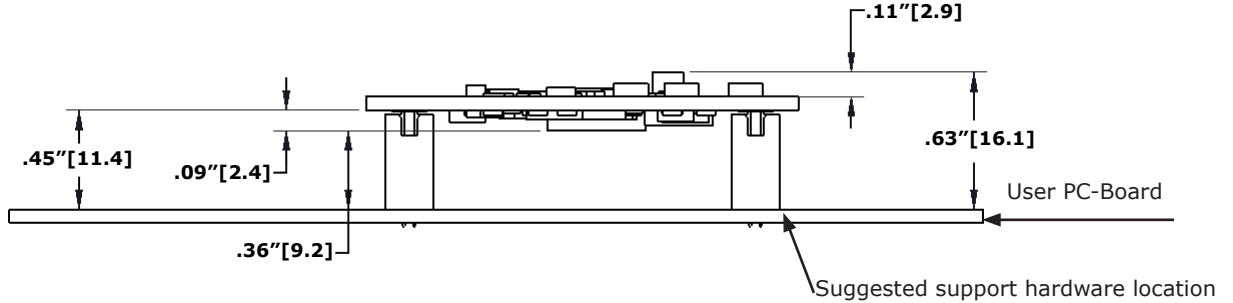
Module Assembly Diagram



**PC BOARD MATING CONNECTORS**

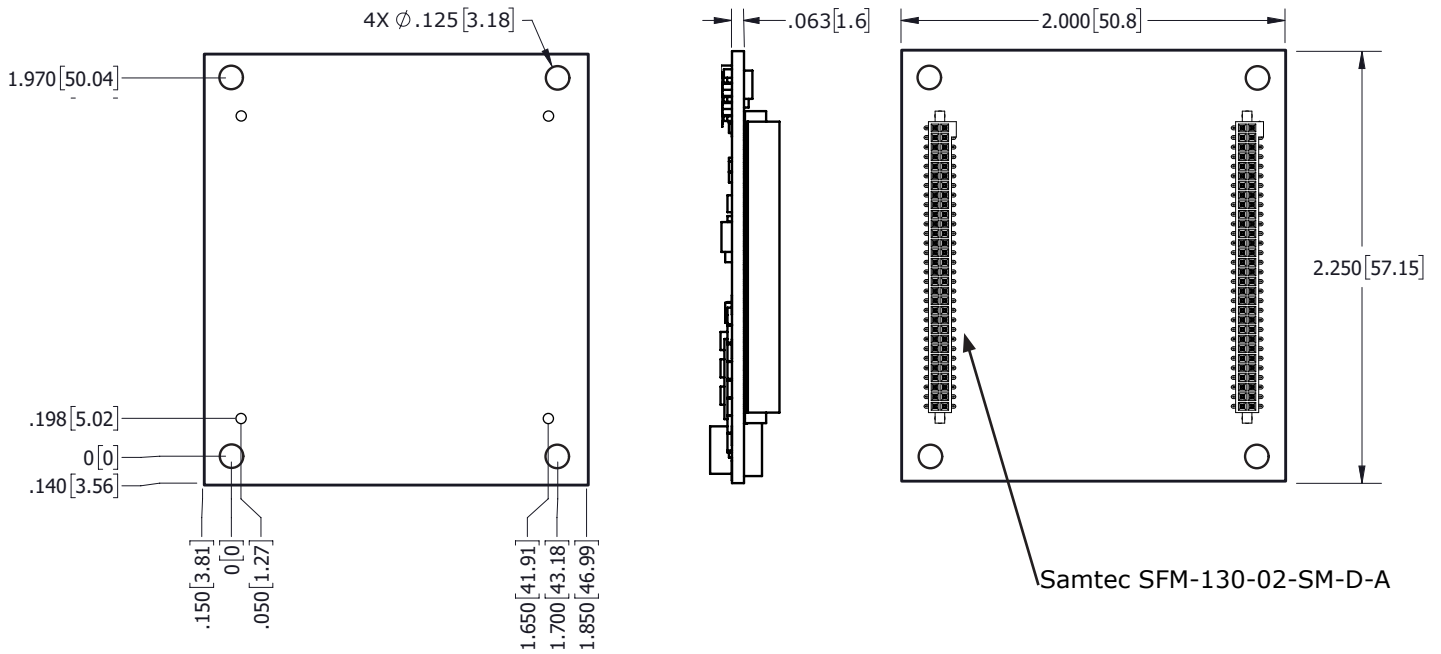
These connectors are .050" pitch headers and are available in through-hole or SMT configurations. The SAMTEC (Part Number: SFM-130-02-SM-D-A) is what is populated on the ECT-IPM-01. When selecting the mating connector, select the TFM mate appropriate for the stacking height of the application. Note: Select the appropriate support hardware based on the mated stack height you choose. The TFM Part Number: TFM-130-31-SM-D-A is depicted in the user PC-Board view below.

**MODULE FRONT VIEW DIMENSIONS**



**ECT-IPM-01 Front View**

**MODULE MOUNTING DIMENSIONS**



**Module Dimensions**

**ORDERING GUIDE**

PART NUMBER	DESCRIPTION
ECT-IPM-01	EtherCAT Input/Output Processor

16-134680 Document Revision History

Revision	Date	Remarks
AA	5/16/23	Initial release to Agile for revision tracking. Update to include ECT-IPM-01 module information.
00	8/4/23	Production Release