

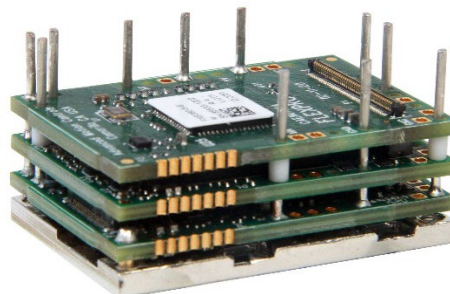
FXE060-5-EM

FlexPro® Series

Product Status: Active

SPECIFICATIONS

Current Peak	10 A
Current Continuous	5 A
DC Supply Voltage	10 – 55 VDC
Network Communication	EtherCAT



The **FXE060-5-EM** is a FlexPro® series Extended Environment servo drive with IMPACT™ architecture.

The **FXE060-5-EM** offers full tuning control of all servo loops and is designed to drive brushed and brushless servo motors, and closed loop stepper motors. The drive accepts a variety of external command signals, or can use the built-in Motion Engine, an internal motion controller used with Sequencing and Indexing commands. Programmable digital and analog I/O are included to enhance interfacing with external controllers and devices.

The **FXE060-5-EM** features an EtherCAT® interface for network communication using CANopen over EtherCAT (CoE) and USB connectivity for drive configuration and setup. All drive and motor parameters are stored in non-volatile memory.

IMPACT™ (Integrated Motion Platform And Control Technology) combines exceptional processing capability and high-current components to create powerful, compact, feature-loaded servo solutions. IMPACT™ is used in all FlexPro® drives and is available in custom products as well.

The **FXE060-5-EM** conforms to the following specifications and is designed to the Environmental Engineering Considerations as defined in MIL-STD-810F.

EXTENDED ENVIRONMENT PERFORMANCE

Ambient Operating Temperature Range	-40°C to +95°C (-40°F to +203°F)
Thermal Shock	-40°C to +95°C (-40°F to +203°F) within 3 min.
Relative Humidity	0 to 95%, Non-Condensing
Vibration	25 Grms for 5 min. in 3 axes
Altitude	-400m to +25000m
Contaminants	Pollution Degree 2

FEATURES

- CoE – Based on DSP-402 Device Profile for Drives and Motion Control
- Synchronization using Distributed Clocks
- Position Cycle Times down to 100µs
- Four Quadrant Regenerative Operation
- Programmable Gain Settings
- PIDF Velocity Loop
- Extended Environmental Ratings
- Compact Size, High Power Density
- On-the-Fly Mode Switching
- On-the-Fly Gain Set Switching
- Dedicated Safe Torque Off (STO) Inputs
- Space Vector Modulation (SVM) Technology

Feedback Supported	<ul style="list-style-type: none"> • Absolute Encoder <ul style="list-style-type: none"> ◦ BiSS C-Mode ◦ EnDat 2.2 • Incremental Encoder • Hall Sensors • Aux Incremental Encoder • Tachometer (±10V) 	Motors Supported	<ul style="list-style-type: none"> • Three Phase • Single Phase • Stepper 	Modes of Operation	<ul style="list-style-type: none"> • Profile Modes • Cyclic Synchronous Modes • Current • Velocity • Position
Command Sources	<ul style="list-style-type: none"> • Over the Network • ±10V Analog • Sequencing • Indexing • Jogging • Step & Direction • Encoder Following 	Inputs / Outputs	<ul style="list-style-type: none"> • 4 Programmable Digital Inputs • 3 Programmable Digital Outputs • 1 Programmable Analog Input 	Agency Approvals	<ul style="list-style-type: none"> • RoHS • MIL-STD-810F (as stated) • MIL-STD-1275D (optional) • MIL-STD-461E (optional) • MIL-STD-704F (optional) • MIL-HDBK-217 (optional)

The diagram illustrates the system architecture for the FXE060-5-EM. At the center is the **Drive Control Logic**, which is connected to several key components:

- I/O Interface:** Receives inputs from PDI 1,2,3,4 (with a 10k pull-up to +5V), PD0 1,2,3 (via a buffer), PAI+ (with a 20k pull-up), PAI- (with a 50k pull-up), and V_{OFFS} (via a 20k pull-up). It outputs to ENC 1+, ENC 1-, ENC 2+, and ENC 2- (via buffers).
- STEP/DIR Input:** Receives STEP/DIR+ and STEP/DIR- signals.
- Feedback Interface:** Receives HALL A,B,C (via a 10k pull-up to +5V) and MOTOR THERMISTOR (via a 0.5mA current source and a buffer). It outputs to GND.
- Power Supply Line:** Provides power to the system, including HIGH VOLTAGE, GND, LOGIC POWER, and LOGIC GND. It also includes STO Circuitry for STO 1, STO 2, and STO 2 Return.
- USB Interface:** Connects to USB +5V, DATA+, DATA-, and USB GND.
- EtherCAT Interface:** Connects to TX+, TX-, RX+, and RX-.

The system is powered by a **Logic Supply Line** and a **Power Supply Line**. The **Power Supply Line** also provides power to the **STO Circuitry** and the **Feedback Interface**.

**RoHS
Compliant**

MIL-STD-810F

MIL-STD-1275D

MIL-STD-461E

MIL-STD-704F

MIL-HDBK-217

Reliability Prediction of Electronic Equipment (MTBF) – (optional)

SPECIFICATIONS

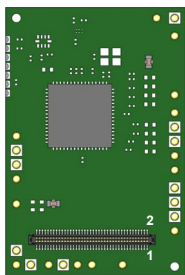
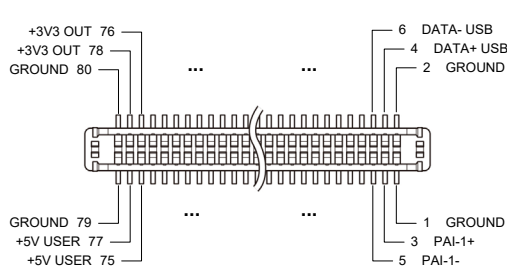
Electrical Specifications		
Description	Units	Value
Nominal DC Supply Input Range	VDC	12 – 48
DC Supply Input Range	VDC	10 – 55
DC Supply Undervoltage	VDC	8
DC Supply Overvoltage	VDC	58
Logic Supply Input Range (optional)	VDC	10 – 55
Safe Torque Off Voltage (Default)	VDC	5
Minimum Required External Bus Capacitance	μF	500
Maximum Peak Current Output ¹	A (Arms)	10 (7.1)
Maximum Continuous Current Output ²	A (Arms)	5 (5)
Efficiency at Rated Power	%	99
Maximum Continuous Output Power	W	272
Maximum Power Dissipation at Continuous Current	W	3
Minimum Load Inductance (line-to-line) ³	μH	150 (@ 48VDC supply); 75 (@24VDC supply); 40 (@12VDC supply)
Switching Frequency	kHz	20
Maximum Output PWM Duty Cycle	%	83
Control Specifications		
Description	Units	Value
Communication Interfaces ⁴	-	EtherCAT® (USB for configuration)
Command Sources	-	±10 V Analog, Over the Network, Sequencing, Indexing, Jogging, Step & Direction, Encoder Following
Feedback Supported	-	Absolute Encoder (BiSS C-Mode, EnDat 2.2), Hall Sensors, Incremental Encoder, Auxiliary Incremental Encoder, Tachometer (±10V)
Commutation Methods	-	Sinusoidal, Trapezoidal
Modes of Operation	-	Profile Modes, Cyclic Synchronous Modes, Current, Velocity, Position
Motors Supported ⁵	-	Three Phase (Brushless Servo), Single Phase (Brushed Servo, Voice Coil, Inductive Load), Stepper (2- or 3-Phase Closed Loop)
Hardware Protection	-	40+ Configurable Functions, Over Current, Over Temperature (Drive & Motor), Over Voltage, Short Circuit (Phase-Phase & Phase-Ground), Under Voltage
Programmable Digital Inputs/Outputs	-	4/3
Programmable Analog Inputs/Outputs	-	1/0
Primary I/O Logic Level	-	5 VDC, not isolated
Current Loop Sample Time	μs	50
Velocity Loop Sample Time	μs	100
Position Loop Sample Time	μs	100
Maximum Encoder Frequency	MHz	20 (5 pre-quadrature)
Mechanical Specifications		
Description	Units	Value
Size (H x W x D)	mm (in)	38.1 x 25.4 x 15.8 (1.50 x 1.00 x 0.60)
Weight	g (oz)	22.7 (0.8)
Ambient Operating Temperature Range ⁶	°C (°F)	-40 – 95 (-40 – 203)
Storage Temperature Range	°C (°F)	-50 – 100 (-58 – 212)
Thermal Shock	°C (°F)	-40 – 95 (-40 – 203) within 3 min
Relative Humidity	-	0-95%, non-condensing
Vibration	Grms	25 for 5 minutes in 3 axes
Altitude	m	-400 – 25000
Contaminants	-	Pollution Degree 2
Form Factor	-	PCB Mounted
P1 SIGNAL CONNECTOR	-	80-pin 0.4mm spaced connector
TERMINAL PINS	-	26x Terminal Pins

Notes

1. Capable of supplying drive rated peak current for 2 seconds with 5 second foldback to continuous value. Longer times are possible with lower current limits.
2. Continuous A_{rms} value attainable when RMS Charge-Based Limiting is used.
3. Lower inductance is acceptable for bus voltages well below maximum. Use external inductance to meet requirements.
4. EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
5. Maximum motor speed for stepper motors is 600 RPM. Consult the hardware installation manual for 2-phase stepper wiring configuration.
6. Additional cooling and/or heatsink may be required to achieve rated performance.

PIN FUNCTIONS

P1 – Signal Connector				P1 – Signal Connector			
Pin	Name	Description / Notes	I/O	Pin	Name	Description / Notes	I/O
1	GROUND	Ground	GND	2	GROUND	Ground	GND
3	PAI-1+	Differential Programmable Analog Input or Reference Signal Input (12-bit Resolution)	I	4	DATA+ USB	USB Data Channel	I/O
5	PAI-1-		I	6	DATA- USB		I/O
7	THERMISTOR	Motor Thermal Protection.	I	8	GROUND	Ground	GND
9	GROUND	Ground	GND	10	SCLA	I ² C Data Signals for Addressing, Network Error LED, and Bridge Status LED. See Hardware Manual for more info.	O
11	ENC 1 DATA+ / A+	Differential Data Line for Absolute Encoders (BiSS: SLO+/-) or Differential Incremental Encoder A.	I/O	12	SDAA		I/O
13	ENC 1 DATA- / A-		I/O	14	HALL A	Single-ended Commutation Sensor Inputs	I
15	ENC 1 CLK+ / B+	Differential Clock Line for Absolute Encoders (BiSS: MA+/-) or Differential Incremental Encoder B.	I/O	16	HALL B		I
17	ENC 1 CLK- / B-		I/O	18	HALL C		I
19	GROUND	Ground	GND	20	GROUND	Ground	GND
21	ENC 1 REF+ / I+	Differential Reference Mark for Absolute Encoders (Leave open for BiSS) or Differential Incremental Encoder Index.	I	22	ENC 2 A+	Differential Incremental Encoder A.	I
23	ENC 1 REF- / I-		I	24	ENC 2 A-		I
25	RESERVED	Reserved. Do not connect.	-	26	ENC 2 B+	Differential Incremental Encoder B.	I
27	RESERVED	Reserved. Do not connect.	-	28	ENC 2 B-		I
29	RESERVED	Reserved. Do not connect.	-	30	ENC 2 I+	Differential Incremental Encoder Index.	I
31	PDI-1	Programmable Digital Input	I	32	ENC 2 I-		I
33	PDI-2	Programmable Digital Input	I	34	PDO-1	Programmable Digital Output (TTL/8mA)	O
35	PDI-3	Programmable Digital Input	I	36	PDO-2	Programmable Digital Output (TTL/8mA)	O
37	PDI-4	Programmable Digital Input	I	38	PDO-3	Programmable Digital Output (TTL/8mA)	O
39	GROUND	Ground	GND	40	GROUND	Ground	GND
41	TX- IN	Transmit Line IN (100 Base TX)	I	42	TX- OUT	Transmit Line OUT (100 Base TX)	O
43	TX+ IN		I	44	TX+ OUT		O
45	RX- IN	Receive Line IN (100 Base TX)	I	46	RX- OUT	Receive Line OUT (100 Base TX)	O
47	RX+ IN		I	48	RX+ OUT		O
49	+3V BIAS IN	+3V Supply for Transformer/Magnetics Bias	O	50	+3V BIAS OUT	+3V Supply for Transformer/Magnetics Bias	O
51	LINK/ACT IN	Link and Activity Indicator for IN port. Function based on protocol specification. See Hardware Information below.	I/O	52	LINK/ACT OUT	Link and Activity Indicator for OUT port. Function based on protocol specification. See Hardware Information below.	I/O
53	STATUS	Run State Indicator for Network. Function based on protocol specification. See Hardware Information below.	I/O	54	RESERVED	Reserved. Do not connect.	-
55	RESERVED	Reserved. Do not connect.	-	56	RESERVED	Reserved. Do not connect.	-
57	RESERVED	Reserved. Do not connect.	-	58	RESERVED	Reserved. Do not connect.	-
59	GROUND	Ground	GND	60	GROUND	Ground	GND
61	RESERVED	Reserved. Do not connect.	-	62	RESERVED	Reserved. Do not connect.	-
63	RESERVED	Reserved. Do not connect.	-	64	RESERVED	Reserved. Do not connect.	-
65	RESERVED	Reserved. Do not connect.	-	66	RESERVED	Reserved. Do not connect.	-
67	RESERVED	Reserved. Do not connect.	-	68	STEP	Step Input.	I
69	RESERVED	Reserved. Do not connect.	-	70	DIR	Direction Input.	I
71	RESERVED	Reserved. Do not connect.	-	72	RESERVED	Reserved. Do not connect.	-
73	+5V_OUT	+5VDC unprotected supply (See Note 1)	O	74	RESERVED	Reserved. Do not connect.	-
75	+5V_USER	+5VDC User Supply for feedback and local logic (See Note 1)	O	76	+3V3 OUT	+3.3VDC Supply Output for local logic signals (100 mA max)	O
77	+5V_USER		O	78	+3V3 OUT		O
79	GROUND	Ground	GND	80	GROUND	Ground	GND

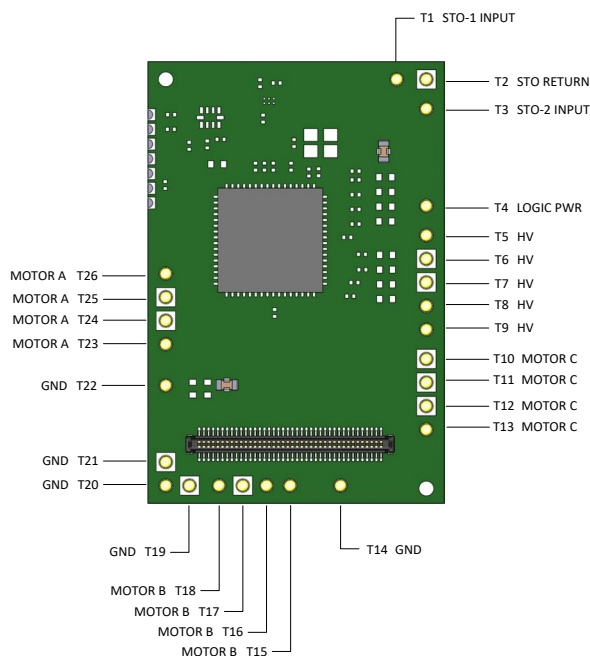
Connector Information	80-pin, 0.4mm spaced connector		
Mating Connector Details	PANASONIC: P/N AXT380224		
Mating Connector Included with Drive	No		

Notes

- Total current through pins P1-73/75/77 should not exceed 300mA, while no single pin should be loaded more than 150mA.

TERMINAL PIN LOCATIONS

The 26 Terminal Pins provide connection to the high power drive signals. Terminal Pins must be soldered to an interface board.



Pin	Name	Description / Notes	I/O
T1	STO-1 INPUT	Safe Torque Off – Input 1	I
T2	STO RETURN	Safe Torque Off Return	STORET
T3	STO-2 INPUT	Safe Torque Off – Input 2	I
T4	LOGIC PWR	Logic Supply Input (10 – 55VDC) (optional). When using a separate logic power supply, turn on the logic supply first before turning on the main power supply	I
T5	HV	DC Supply Input (10-55VDC). Minimum 500µF external capacitance required between HV and POWER GND.	I
T6	HV		I
T7	HV		I
T8	HV		I
T9	HV		I
T10	MOTOR C	Motor Phase C. All provided motor phase output pins must be used.	O
T11	MOTOR C		O
T12	MOTOR C		O
T13	MOTOR C		O
T14	POWER GND	Ground.	GND
T15	MOTOR B	Motor Phase B. All provided motor phase output pins must be used.	O
T16	MOTOR B		O
T17	MOTOR B		O
T18	MOTOR B		O
T19	POWER GND	Ground.	GND
T20	POWER GND		GND
T21	POWER GND		GND
T22	POWER GND		GND
T23	MOTOR A	Motor Phase A. All provided motor phase output pins must be used.	O
T24	MOTOR A		O
T25	MOTOR A		O
T26	MOTOR A		O

Terminal Pin Details

Safe Torque Off (STO) Inputs

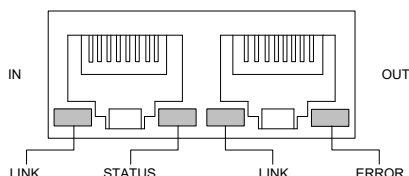
The Safe Torque Off (STO) inputs are dedicated +5VDC sinking single-ended inputs. For applications not using STO functionality, disabling of the STO feature is required for proper drive operation. STO may be disabled by following the STO Disable wiring instructions as given in the hardware installation manual. Consult the hardware installation manual for more information.

HARDWARE INFORMATION

LED Functionality

LINK/ACT IN (P1-51); LINK/ACT OUT (P1-52); STATUS (P1-53);

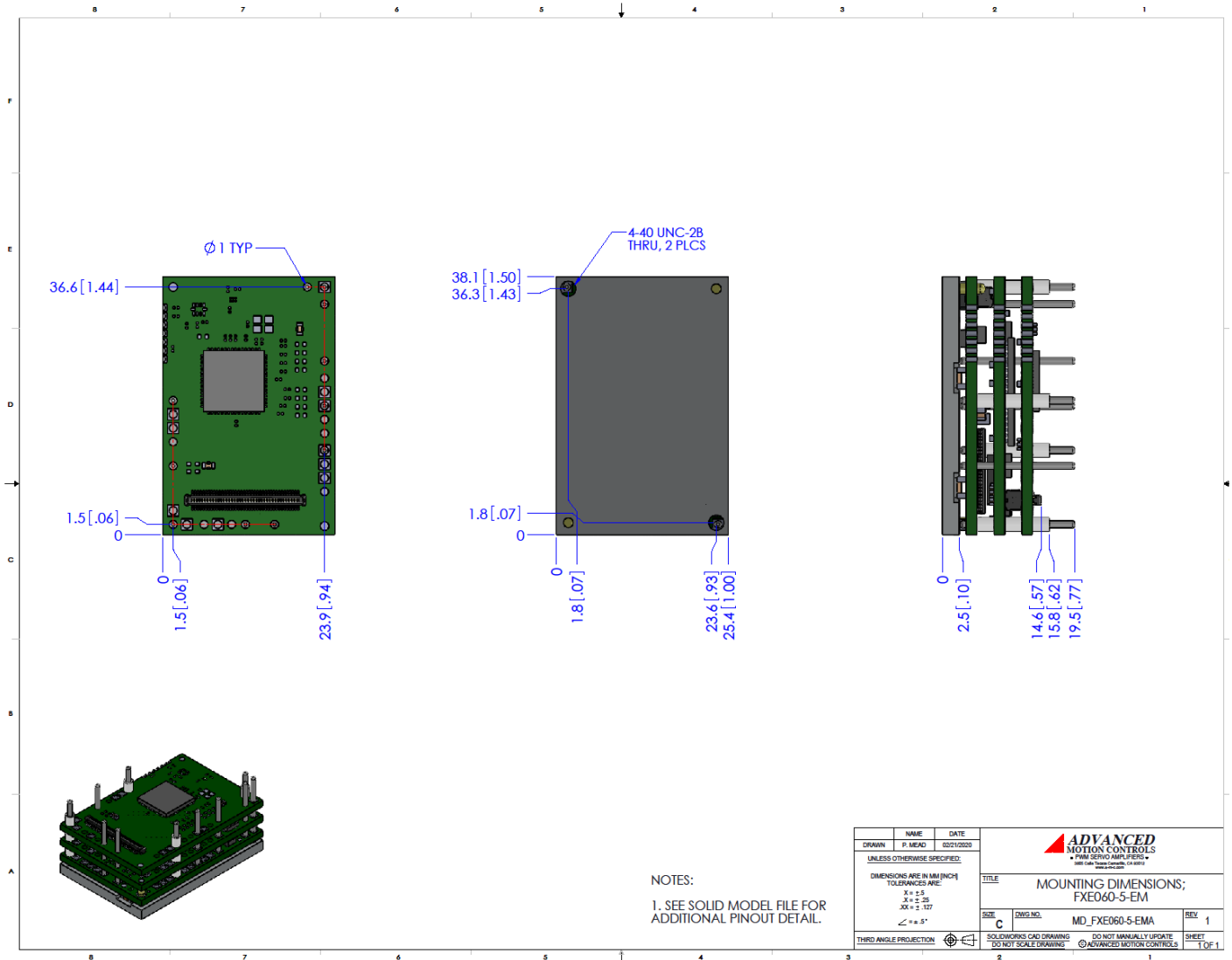
The LINK/ACT IN, LINK/ACT OUT, and STATUS pins serve as EtherCAT network indicators. On a standard RJ-45 connector used with EtherCAT network topology, the typical EtherCAT network indicator LED locations are as shown in the below diagrams. **Note that the drive features signals for connection to LEDs on an RJ-45 connector, but the connector itself is not included on the drive. The Development Card assembly FD060-5-EM features a built-in RJ-45 connector with LEDs for this purpose.**



LINK/ACT IN and LINK/ACT OUT are used to drive the corresponding LINK IN and LINK OUT LEDs on a typical RJ-45 connector. The STATUS pin is used to drive the Status LED. The ERROR LED is driven by the I²C Data signals (P1-10/12). Consult the hardware installation manual for recommended wiring connections. The LED Function Protocol tables below describe typical LED functionality.

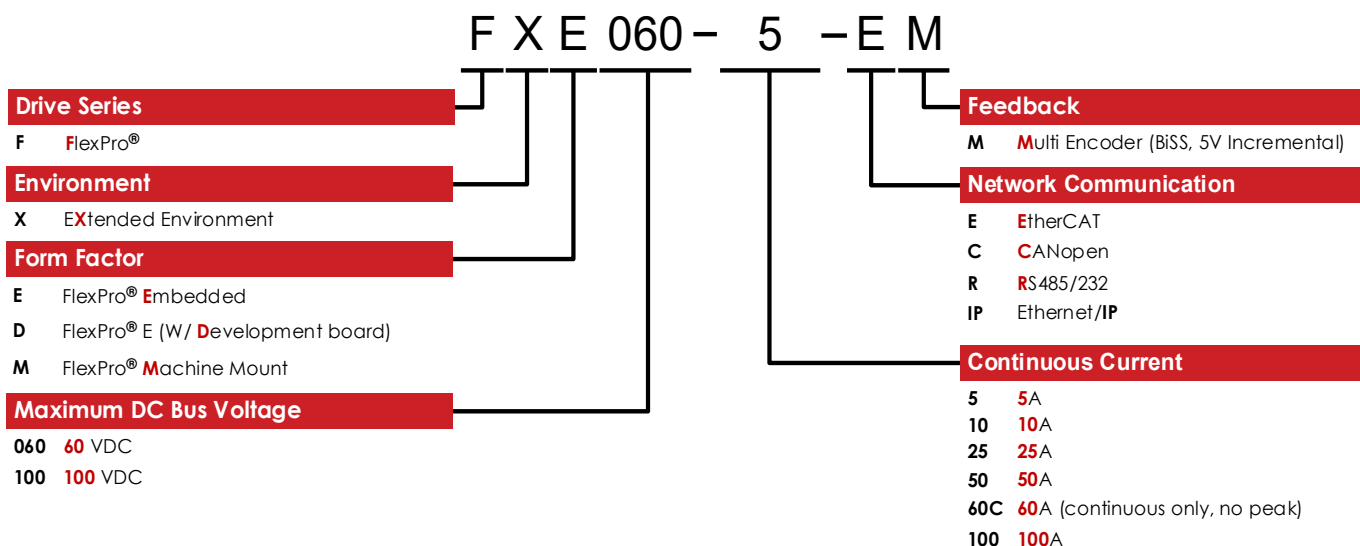
LINK/ACT LEDS		
LED State	Description	
Green – On	Valid Link - No Activity	
Green – Flickering	Valid Link - Network Activity	
Off	Invalid Link	
STATUS LED		
LED State	Description	
Green – On	The device is in the state OPERATIONAL	
Green – Blinking (2.5Hz – 200ms on and 200ms off)	The device is in the state PRE-OPERATIONAL	
Green – Single Flash (200ms flash followed by 1000ms off)	The device is in state SAFE-OPERATIONAL	
Green – Flickering (10Hz – 50ms on and 50ms off)	The device is booting and has not yet entered the INIT state, or The device is in state BOOTSTRAP, or Firmware download operation in progress	
Off	The device is in state INIT	
ERROR LED		
LED State	Description	Example
Red – On	A PDI Watchdog timeout has occurred.	Application controller is not responding anymore.
Red – Blinking (2.5Hz – 200ms on and 200ms off)	General Configuration Error.	State change commanded by master is impossible due to register or object settings.
Red – Flickering (10Hz – 50ms on and 50ms off)	Bootling Error was detected. INIT state reached, but parameter "Change" in the AL status register is set to 0x01:change/error	Checksum Error in Flash Memory.
Red – Single Flash (200ms flash followed by 1000ms off)	The slave device application has changed the EtherCAT state autonomously: Parameter "Change" in the AL status register is set to 0x01:change/error.	Synchronization error; device enters SAFE-OPERATIONAL automatically
Red – Double Flash (Two 200ms flashes separated by 200ms off, followed by 1000ms off)	An application Watchdog timeout has occurred.	Sync Manager Watchdog timeout.

MOUNTING DIMENSIONS



NAME	DATE
DESIGNED BY	02/12/2020
UNLESS OTHERWISE SPECIFIED:	
DIMENSIONS ARE IN MM [INCH]	
TOLERANCES ARE:	
X ± .5	
Y ± .25	
Z ± .127	
ANGLE ± .5°	
THIRD ANGLE PROJECTION	
ADVANCED MOTION CONTROLS • PWM SERVO AMPLIFIERS • 8001 South Main Street, Suite 100 West Valley City, UT 84119	
TITLE	MOUNTING DIMENSIONS; FXE060-5-EM
SIZE	C
DWG NO.	MD_FXE060-5-EMA
REV	1
SOLIDWORKS CAD DRAWING DO NOT SCALE DRAWING	DO NOT MANUALLY UPDATE © ADVANCED MOTION CONTROLS
SHEET	1 OF 1

PART NUMBERING AND CUSTOMIZATION INFORMATION



ADVANCED Motion Controls also has the capability to promptly develop and deliver specified products for OEMs with volume requests. Our Applications and Engineering Departments will work closely with your design team through all stages of development in order to provide the best servo drive solution for your system. Equipped with on-site manufacturing for quick-turn customs capabilities, ADVANCED Motion Controls utilizes our years of engineering and manufacturing expertise to decrease your costs and time-to-market while increasing system quality and reliability.

Examples of Customized Products

- | | |
|--|--|
| <ul style="list-style-type: none"> ▲ Optimized Footprint ▲ Private Label Software ▲ OEM Specified Connectors ▲ No Outer Case ▲ Increased Current Resolution ▲ Increased Temperature Range ▲ Custom Control Interface ▲ Integrated System I/O | <ul style="list-style-type: none"> ▲ Tailored Project File ▲ Silkscreen Branding ▲ Optimized Base Plate ▲ Increased Current Limits ▲ Increased Voltage Range ▲ Conformal Coating ▲ Multi-Axis Configurations ▲ Reduced Profile Size and Weight |
|--|--|

Feel free to contact us for further information and details!

Available Accessories

ADVANCED Motion Controls offers a variety of accessories designed to facilitate drive integration into a servo system. Visit www.a-m-c.com to see which accessories will assist with your application design and implementation.

All specifications in this document are subject to change without written notice. Actual product may differ from pictures provided in this document.