

Description

The DigiFlex[®] Performance[™] (DP) Series digital servo drives are designed to drive brushed and brushless servomotors. These fully digital drives operate in torque, velocity, or position mode and employ Space Vector Modulation (SVM), which results in higher bus voltage utilization and reduced heat dissipation compared to traditional PWM. The drive can be configured for a variety of external command signals. Commands can also be configured using the drive's built-in Motion Engine, an internal motion controller used with distributed motion applications. In addition to motor control, these drives feature dedicated and programmable digital and analog inputs and outputs to enhance interfacing with external controllers and devices.

This DP Series drive features an EtherCAT[®] interface for network communication using CANopen over EtherCAT (CoE), and a USB port for drive configuration and setup. Drive commissioning is accomplished using DriveWare[®] 7, available for download at www.a-m-c.com.

All drive and motor parameters are stored in non-volatile memory. The DPE Series Hardware Installation Manual is available for download at www.a-m-c.com.

Power Range	
Peak Current	60 A (42.4 A _{RMS})
Continuous Current	30 A (30 A _{RMS})
AC Supply Voltage	200 - 240 VAC
DC Supply Voltage	255 - 373 VDC





Features

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- 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
- Space Vector Modulation (SVM) Technology
- Fully Digital State-of-the-art Design
- Programmable Gain Settings
- Fully Configurable Current, Voltage, Velocity and Position Limits

MODES OF OPERATION

- Profile Current
- Profile Velocity
- Profile Position
- Cyclic Synchronous Current Mode
- Cyclic Synchronous Velocity Mode
- Cyclic Synchronous Position Mode

COMMAND SOURCE

- ±10 V Analog
- Encoder Following
- Over the Network
- Sequencing
- Indexing
- Jogging

FEEDBACK SUPPORTED (FIRMWARE DEPENDENT)

Dedicated Safe Torque Off (STO) Inputs

Halls

Incremental Encoder

PIDF Velocity Loop

PID + FF Position Loop

Compact size, high power density

16-bit Analog to Digital Hardware

Built-in brake/shunt regulator

On-the-Fly Gain Set Switching

On-the-Fly Mode Switching

- Absolute Encoder (EnDat® 2.1/2.2, Hiperface®, or BiSS C-Mode)
- 1Vp-p Sine/Cosine Encoder (see notes on page 3)
- Auxiliary Incremental Encoder
- Tachometer (±10 VDC)

INPUTS/OUTPUTS

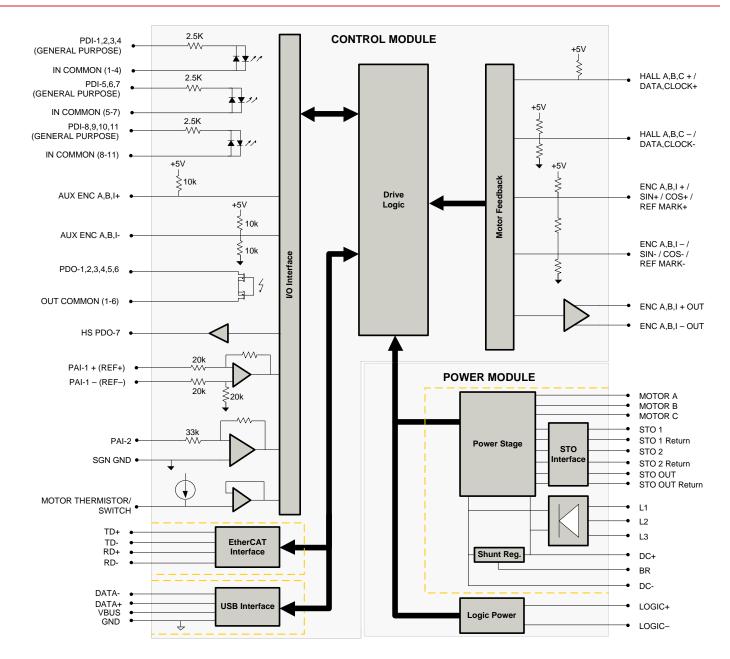
- 1 Motor Thermistor/Switch Input
- 11 General Purpose Programmable Digital Inputs
- 1 High Speed Programmable Digital Output
- 6 General Purpose Programmable Digital Outputs
- 2 Programmable Analog Inputs

COMPLIANCES & AGENCY APPROVALS

- UL
- cUL
- RoHS
- TÜV Rheinland® (STO)
- CE Pending



BLOCK DIAGRAM



Information on Approvals and Compliances

c 🕰 us	US and Canadian safety compliance with UL 508c, the industrial standard for power conversion electronics. UL registered under file number E140173. Note that machine components compliant with UL are considered UL registered as opposed to UL listed as would be the case for commercial products.
COMPLIANCE	RoHS (Reduction of Hazardous Substances) is intended to prevent hazardous substances such as lead from being manufactured in electrical and electronic equipment.
TÜVRheinland CERTIFIED	Functional Safety STO is TÜV Rheinland® certified and meets requirements of the following standards: • EN ISO 13849-1 Category 4 / PL e • EN IEC 61800-5-2 STO (SIL 3) • EN62061 SIL CL3 • IEC 61508 SIL 3



SPECIFICATIONS

		Specifications
Description	Units	Value
Rated Voltage	VAC (VDC)	240 (339)
AC Supply Voltage Range	VAC	200 - 240
AC Supply Minimum	VAC	180
AC Supply Maximum	VAC	264
AC Input Phases ¹	-	3
AC Supply Frequency	Hz	50 - 60
DC Supply Voltage Range ²	VDC	255 - 373
DC Bus Over Voltage Limit	VDC	420
DC Bus Under Voltage Limit	VDC	205
Logic Supply Voltage	VDC	20 - 30 (@ 850 mA)
	VDC	
Safe Torque Off Voltage		24 (±6)
Maximum Peak Output Current ³	A (A _{RMS})	60 (42.4)
Maximum Continuous Output Current ⁴	A (A _{RMS})	30 (30)
Maximum Continuous Power @ Rated Voltage ⁵	W	9662
Maximum Continuous Power Dissipation @ Rated Voltage	W	509
Internal Bus Capacitance	μF	1120
External Shunt Resistor Minimum Resistance	Ω	20
Minimum Load Inductance (Line-To-Line)7	μH	600
Switching Frequency	kHz	14
	%	100
Maximum Output PWM Duty Cycle	70	
Low Voltage Supply Outputs	-	+5 VDC (250 mA)
		Specifications
Description	Units	Value
Communication Interfaces ⁸	-	EtherCAT® (USB for Configuration)
Command Sources	-	±10 V Analog, Encoder Following, Over the Network, Sequencing, Indexing, Jogging
Feedback Supported ⁹	-	Halls, Incremental Encoder, Absolute Encoder (EnDat® 2.1/2.2, Hiperface®, or BiSS C-Mode),
		1Vp-p Sine/Cosine Encoder, Auxiliary Incremental Encoder, Tachometer (±10 VDC)
Commutation Methods	-	Sinusoidal, Trapezoidal
Modes of Operation		Profile Current, Profile Velocity, Profile Position, Cyclic Synchronous Current, Cyclic Synchronous
		Velocity, Cyclic Synchronous Position
Motors Supported	-	Closed Loop Vector, Single Phase (Brushed, Voice Coil, Inductive Load), Three Phase (Brushless)
Hardware Protection	-	40+ Configurable Functions, Over Current, Over Temperature (Drive & Motor), Over Voltage, Short
Des manuelle, Diviteller et (Outrate (DDIs/DDOs)		Circuit (Phase-Phase & Phase-Ground), Under Voltage
Programmable Digital Inputs/Outputs (PDIs/PDOs)	-	11/7
Programmable Analog Inputs/Outputs (PAIs/PAOs)	-	2/0
Primary I/O Logic Level	-	24 VDC
Current Loop Sample Time	μs	71.4
Velocity Loop Sample Time	μs	142.9
Position Loop Sample Time	μs	142.9
Maximum Sin/Cos Encoder Frequency	kHz	200
Maximum Sin/Cos Interpolation	-	2048 counts per sin/cos cycle
Internal Shunt Regulator		Yes
-	-	
Internal Shunt Resistor	-	No
		al Specifications
Description	Units	Value
Agency Approvals	-	RoHS, UL/cUL, TÜV Rheinland® (STO), CE Pending
Size (H x W x D)	mm (in)	256.5 x 182.6 x 83.7 (10.1 x 7.2 x 3.3)
Weight	g (oz)	2812.3 (99.2)
Heatsink (Base) Temperature Range ¹⁰	°C (°F)	0 - 75 (32 - 167)
Storage Temperature Range	°C (°F)	-40 - 85 (-40 - 185)
Cooling System	-	Natural Convection
Form Factor	-	Panel Mount
AUX. COMM Connector	-	5-pin, Mini USB B Type port
COMM Connector	-	Shielded, dual RJ-45 socket with LEDs
FEEDBACK Connector	-	15-pin, high-density, female D-sub
AUX. ENCODER Connector	-	15-pin, high-density, male D-sub
I/O Connector	-	26-pin, high-density, female D-sub
+24V LOGIC Connector	-	2-port, 5.08 mm spaced, enclosed, friction lock header
FAN Connector	-	2-port, 5.08 mm spaced, enclosed, friction lock header
MOTOR POWER Connector	-	4-port, 10.16 mm spaced, enclosed, friction lock header
AC POWER Connector	-	4-port, 10.16 mm spaced, enclosed, friction lock header
DC POWER Connector	-	4-port, 10.16 mm spaced, enclosed, friction lock header
STO Connector	-	8-port, 2.0 mm spaced, enclosed, friction lock header
Notes Can operate on single-phase AC (208 VAC minimum) as long 1. Can operate on single-phase AC (208 VAC minimum) as long 2. Large inrush current may occur upon initial DC supply connec 3. Capable of supplying drive rated peak current for 2 seconds v 4. Continuous Arms value attainable when RMS Charge-Based Lin 5. P = (DC Rated Voltage) * (Cont. RMS Current) * 0.95 6. ADVANCED Motion Controls recommends using an external fu 7. Lower inductance is acceptable for bus voltages well below m 8. EtherCAT® is a registered trademark and patented technolog 9. Contat ADVANCED Motion Controls for 1Vp-p Since/Cosine En 10. Additional cooling and/or heatsink may be required to achieve	tion to DC Bus. ith 10 second foldback iting is used. se in series with the shi aximum. Use external in y, licensed by Beckhoff coder feedback availabi	to continuous value. Longer times are possible with lower current limits. unt resistor. A 5 amp motor delay fuse is typical. nductance to meet requirements. Automation GmbH, Germany.

Status:

Active



PIN FUNCTIONS

	COMM – EtherCAT Communication Connector			
Pin	Name	Description / Notes	Ι/Ο	
1	RD+	Receiver + (100Base-TX)	I	
2	RD-	Receiver - (100Base-TX)	I	
3	TD+	Transmitter + (100Base-TX)	0	
4	RESERVED	•	-	
5	RESERVED	-	-	
6	TD-	Transmitter - (100Base-TX)	0	
7	RESERVED	-	-	
8	RESERVED	•	-	
9	RESERVED	-	-	

		I/O – Signal Connector	
Pin	Name	Description / Notes	1/0
1	PDO-1	General Purpose Programmable Digital Output (120 mA maximum)	0
2	PDO-2	General Purpose Programmable Digital Output (120 mA maximum)	0
3	PDO-3	General Purpose Programmable Digital Output (120 mA maximum)	0
4	OUT COMMON	Digital Output Common (1-6)	OCOM
5	GROUND	Ground	GND
6	PDO-4	General Purpose Programmable Digital Output (120 mA maximum)	0
7	PDO-5	General Purpose Programmable Digital Output (120 mA maximum)	0
8	HS PDO-7	High Speed Programmable Digital Output	0
9	PDO-6	General Purpose Programmable Digital Output (120 mA maximum)	0
10	PDI-1	General Purpose Programmable Digital Input	I
11	PDI-2	General Purpose Programmable Digital Input	I
12	PDI-3	General Purpose Programmable Digital Input	1
13	PDI-4	General Purpose Programmable Digital Input	I
14	IN COMMON	Digital Input Common (1-4)	ICOM
15	IN COMMON	Digital Input Common (5-7)	ICOM
16	PDI-5	General Purpose Programmable Digital Input	1
17	PDI-6	General Purpose Programmable Digital Input	I
18	PDI-7	General Purpose Programmable Digital Input	I
19	PDI-8	General Purpose Programmable Digital Input	1
20	PDI-9	General Purpose Programmable Digital Input	I
21	PDI-10	General Purpose Programmable Digital Input	I
22	PDI-11	General Purpose Programmable Digital Input	1
23	IN COMMON	Digital Input Common (8-11)	ICOM
24	PAI-1+	Conorol Durages Differential Dragrammable Analog Input	1
25	PAI-1-	General Purpose Differential Programmable Analog Input	I
26	GROUND	Ground	GND

FEEDBACK – Feedback Connector *

Pin	Incremental Encoder	Absolute Encoder	1Vp-p Sin/Cos Encoder	Description / Notes	1/0
1	HALL A+	DATA-	HALL A+	Differential Hall A+/ Differential Data Line (BiSS: SLO-)	I
2	HALL B+	CLOCK+	HALL B+	Differential Hall B+ / Differential Clock Line (BiSS: MA+)	I
3	HALL C+	N/C	HALL C+	Differential Hall C+	I
4	ENC A+	SIN +	SIN +	Differential Encoder A / Differential Sine Input (Leave open for BiSS and	I
5	ENC A-	SIN -	SIN -	EnDat 2.2)	I
6	ENC B+	COS +	COS +	Differential Encoder B/ Differential Cosine Input (Leave open for BiSS and	I
7	ENC B-	COS -	COS -	EnDat 2.2)	I
8	ENC I+	REF MARK+	REF MARK +	Differential Encoder Index / Differential Reference Mark (Leave open for BiSS	I
9	ENC I-	REF MARK-	REF MARK -	and EnDat 2.2)	I
10	HALL A-	DATA+	HALL A-	Differential Hall A- / Differential Data Line (BiSS: SLO+)	I
11	HALL B-	CLOCK-	HALL B-	Differential Hall B- / Differential Clock Line (BiSS: MA-)	I
12	SGND	SGND	SGND	5V Return (Signal Ground)	SGND
13	+5V OUT	+5V OUT	+5V OUT	+5V Encoder Supply Output. Short-circuit protected. (250mA)	0
14	THERMISTOR	THERMISTOR	THERMISTOR	Motor Thermal Protection	
15	HALL C-	N/C	HALL C-	Differential Hall C	

*Note: Feedback supported (Incremental Encoder, Absolute Sin/Cos Encoder, or 1Vp-p Sin/Cos Encoder) will be dependent on firmware. Contact ADVANCED Motion Controls for 1Vp-p Sin/Cos Encoder feedback availability.



DPEANIU-C060A400

	AUX. ENCODER – Auxiliary Encoder Connector				
Pin	Name	Description / Notes	1/0		
1	ENC A+ OUT / RESERVED	Buffered Encoder Channel A Output* or Reserved.	0		
2	ENC A- OUT / RESERVED	Builered Encoder Channel A Output of Reserved.	0		
3	ENC B+ OUT / RESERVED	Buffered Encoder Channel B Output* or Reserved.	0		
4	AUX ENC A+	Auviliant Encoder Input (For single orded signal locus parative terminal enco)	1		
5	AUX ENC A-	Auxiliary Encoder Input (For single ended signal leave negative terminal open)	I		
6	AUX ENC B+	Augustion - Encoder langest (Encoder and a standard standard langest to section to encode a section	1		
7	AUX ENC B-	Auxiliary Encoder Input (For single ended signal leave negative terminal open)	I		
8	AUX ENC I+	A without Franciscular to device the figure to a standard size of the second standard second	I		
9	AUX ENC I-	Auxiliary Encoder Index Input (For single ended signal leave negative terminal open)	I		
10	ENC B- OUT / RESERVED	Buffered Encoder Channel B Output* or Reserved.	0		
11	ENC I+ OUT / RESERVED	Buffered Encoder Index Output* or Reserved.	0		
12	SGND	Signal Ground	SGND		
13	+5V OUT	+5 VDC User Supply	0		
14	PAI-2	Programmable Analog Input (12-bit Resolution)	I		
15	ENC I- OUT / RESERVED	Buffered Encoder Index Output* or Reserved.	0		

*Buffered encoder output only available with incremental encoder or 1Vp-p sin/cos encoder feedbacks. 1:1 input-to-output ratio, 5V square wave output. Reserved pins for all other feedbacks.

	AUX. COMM - USB Communication Connector				
Pin	Name	Description / Notes	1/0		
1	VBUS	Supply Voltage	0		
2	DATA -	Data -	I/O		
3	DATA +	Data +	I/O		
4	RESERVED	•	-		
5	USB GND	USB Ground	UGND		

Logic Power Connector			
Pin	Name	Description / Notes	I/O
1	LOGIC GND	Logic Supply Ground	SGND
2	LOGIC PWR	Logic Supply Input	I

	Fan Power Connector				
Pin	Name	Description / Notes	1/0		
1	FAN GND	Fan Ground	GND		
2	FAN PWR	Fan Power Input	I		

	Motor Power Connector				
Pin	Name	Description / Notes	1/0		
1	CHASSIS	Chassis Ground	CGND		
2	MOTOR A	Motor Phase A	0		
3	MOTOR B	Motor Phase A	0		
4	MOTOR C	Motor Phase B	0		

	AC Power Connector				
Pi	in	Name	Description / Notes	I/O	
1	1	L1	AO Querch Jacob (These Dhese) Esternal QQ A time delay function and a dia amina	I	
2	2	L2	AC Supply Input (Three Phase). External 20 A time delay fuses are recommended in series with the AC input lines.	I	
3	3	L3		I	
4	4	CHASSIS	Chassis Ground	CGND	

	DC Power Connector				
	Pin	Name	Description / Notes	I/O	
	1	DC-	Power Ground	PGND	
	2	DC+	DC Power Input	I	
-[3	DC+	External Shunt Resistor Connection. Connect resistor between DC+ and BR.	-	
1	4	BR	External Shuft Resistor Connection. Connect resistor between DC+ and BR.	-	

	STO – Safe Torque Off Connector				
Pin	Name	Description / Notes	1/0		
1	STO OUTPUT	Safe Torque Off Output	0		
2	STO 24V DISABLE	24V Supply Output for STO Disable. Internal use only.	0		
3	STO-1 RETURN	Safe Torque Off 1 Return	STORET1		
4	STO-1	Safe Torque Off – Input 1	I		
5	STO-2 RETURN	Safe Torque Off 2 Return	STORET2		
6	STO-2	Safe Torque Off – Input 2	I		
7	STO GND DISABLE	Ground for STO Disable. Internal use only.	GND		
8	STO OUT RETURN	Safe Torque Off Output Return	STORETO		



HARDWARE SETTINGS

EtherCAT Station Alias Selector Switches

Switch Diagram	Description				
$\begin{bmatrix} 3^{45} \\ 3^{45} \\ 3 \end{bmatrix} \begin{bmatrix} 3^{45} \\ 3 \end{bmatrix}$	Hexadecimal switch settings correspond to the drive Station Alias. Note that drives on an EtherCAT network will be given an address automatically based on proximity to the host. Setting the switches manually is optional, and only necessary if a fixed address is required.				
	SW1	SW0	Node ID		
	0	0	Address stored in NVM		
Vane Vane	0	1	001		
	0	2	002		
SW0 SW1					
ene en	F	D	253		
	F	E	254		
	F	F	255		

LED Functions (on RJ-45 Communication Connectors)

	LINK LED
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
	The device is booting and has not yet entered the INIT state
Green – Flickering (10Hz – 50ms on	Or Decementary
and 50ms off)	The device is in state BOOTSTRAP
	or Firmware download operation in progress
Off	The device is in state INIT
	ERROR LED

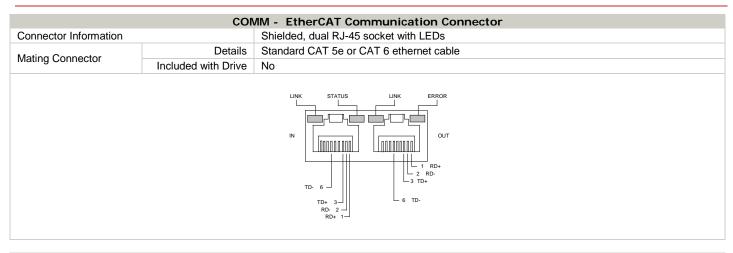
ERROR LED				
LED State	Description	Example		
Red – On	A PDI Watchdog timeout has occurred.	Application controller is not responding anymore.		
Red – Blinking (2.5Hz – 200ms on and 200ms off)	General Configuration Error.	State change commanded by master is impossible due to register or object settings.		
Red – Flickering (10Hz – 50ms on and 50ms off)	Booting 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.		

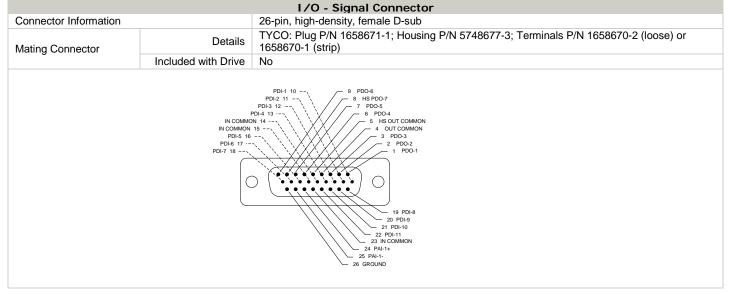
Safe Torque Off (STO) Inputs

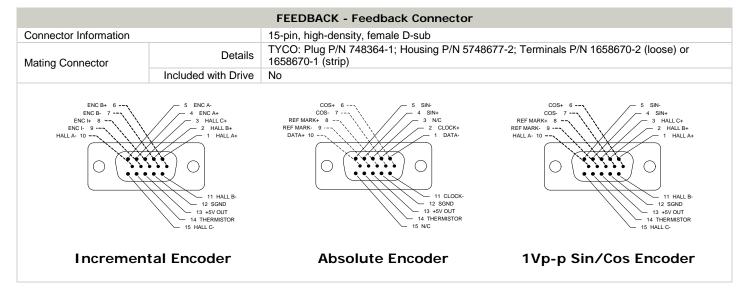
The Safe Torque Off (STO) Inputs are dedicated +24VDC max sinking single-ended inputs. A dedicated STO Disable Key connector is included and should be installed for applications where STO is not required.



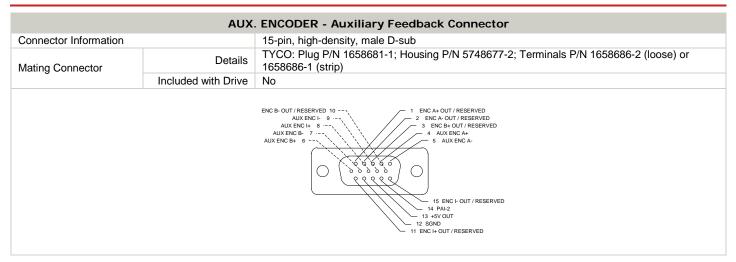
MECHANICAL INFORMATION











AUX. COMM – USB Communication Connector					
Connector Information		5-pin, Mini USB B Type port			
Suggested Mating Cable	Details	TYCO: 1496476-3 (2-meter STD-A to MINI-B ASSY)			
Suggested Mating Cable	Included with Drive	No			
	Suggested Mating Cable Included with Drive No				

Logic Power Connector			
Connector Information		2-port, 5.08 mm spaced, enclosed, friction lock header	
Mating Connector	Details	Phoenix Contact: P/N 1757019	
Maling Connector	Mating Connector Included with Drive Yes	Yes	
2 LOGIC PWR LOGIC GND			

Fan Power Connector			
Connector Information		2-port, 5.08 mm spaced, enclosed, friction lock header	
Mating Connector	Details	Phoenix Contact: P/N 1757019	
Maing Connector	Included with Drive	Yes	
	Included with Drive Yes		



Motor Power Connector				
Connector Information		4-pin, 10.16 mm spaced, enclosed, friction lock header		
Mating Connector	Details	Phoenix Contact: P/N 1913523		
Mating Connector	Included with Drive	Yes		
Included with Drive Yes				

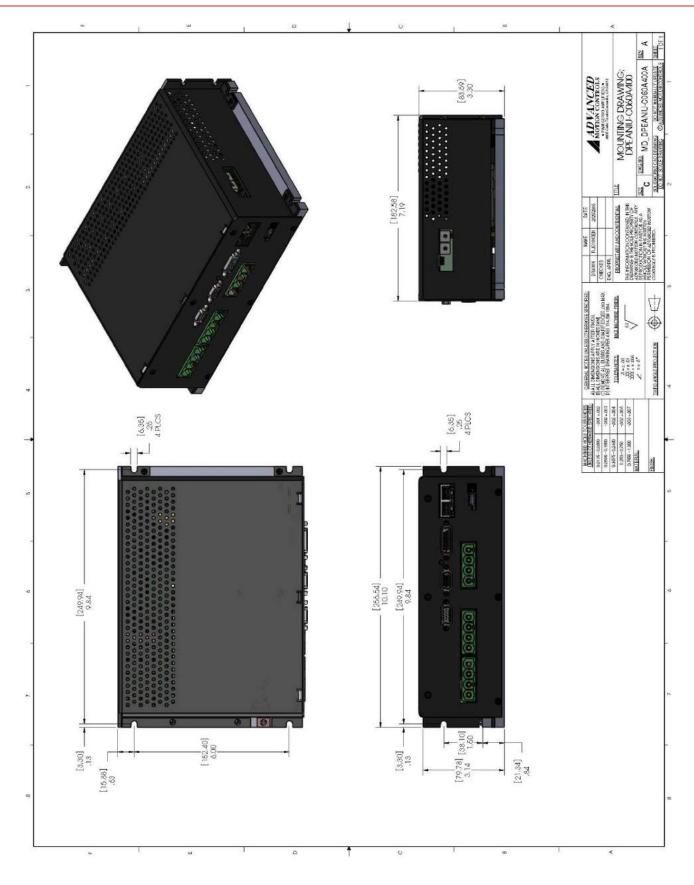
AC Power Connector			
Connector Information		4-pin, 10.16 mm spaced, enclosed, friction lock header	
Mating Connector	Details	Phoenix Contact: P/N 1913523	
Mating Connector	Included with Drive	Yes	

DC Power Connector			
Connector Information		4-pin, 10.16 mm spaced, enclosed, friction lock header	
Mating Connector	Details	Phoenix Contact: P/N 1913523	
Mating Connector	Included with Drive	Yes	

STO – Safe Torque Off Connector			
Connector Information		8-port, 2.00 mm spaced, enclosed, friction lock header	
Mating Connector	Details	Molex: P/N 51110-0860 (housing); 50394-8051 (pins)	
Maing Connector	Included with Drive	No	
	STO-2 RETURN 5 RESERVED 7 STO-OUT RETURN 8 STO-OUT RETURN 8 STO-OUT RETURN 8 STO-2 INPUT 6 4 STO-1 INPUT		

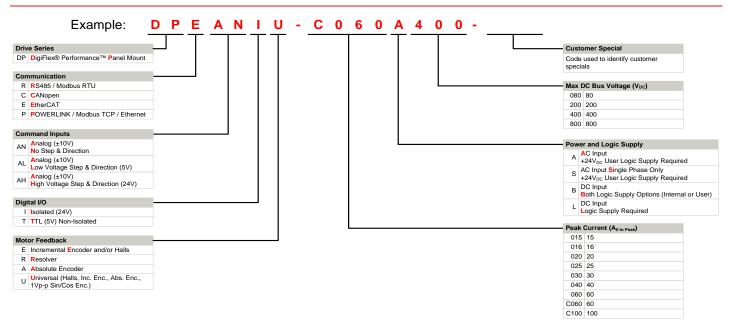


MOUNTING DIMENSIONS





PART NUMBERING INFORMATION



DigiFlex® Performance[™] series of products are available in many configurations. Note that not all possible part number combinations are offered as standard drives. All models listed in the selection tables of the website are readily available, standard product offerings.

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. Feel free to contact Applications Engineering for further information and details.

Examples of Customized Products	
Optimized Footprint	Tailored Project File
Private Label Software	Silkscreen Branding
OEM Specified Connectors	Optimized Base Plate
No Outer Case	Increased Current Limits
Increased Current Resolution	Increased Voltage Range
Increased Temperature Range	Conformal Coating
Custom Control Interface	Multi-Axis Configurations
Integrated System I/O	Reduced Profile Size and Weight

Available Accessories

ADVANCED Motion Controls offers a variety of accessories designed to facilitate drive integration into a servo system. Visit <u>www.a-m-c.com</u> 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.