

## 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	100 A (70.7 A <sub>RMS</sub> )
Continuous Current	50 A (50 A <sub>RMS</sub> )
AC Supply Voltage	200 - 240 VAC
DC Supply Voltage	255 - 373 VDC





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

- ▲ 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 Mode Switching
- On-the-Fly Gain Set Switching
- ▲ Dedicated Safe Torque Off (STO) Inputs

# 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)

- Halls
- Incremental Encoder
- 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

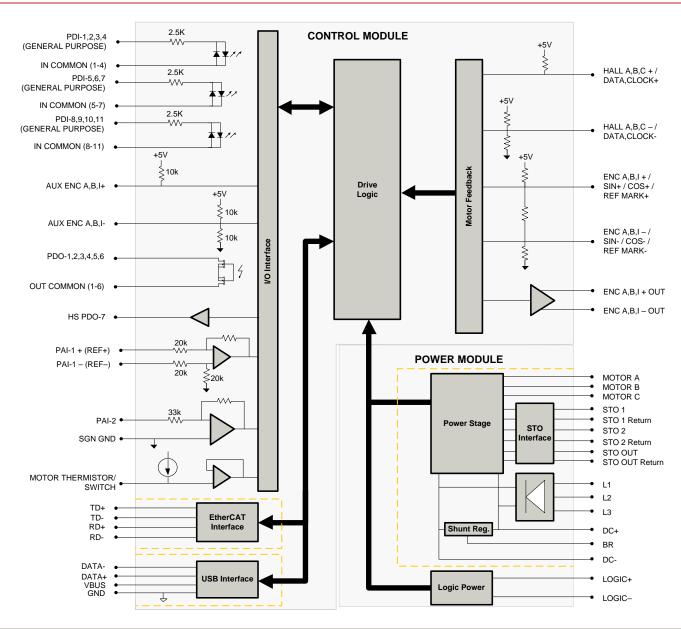
- 1 Motor Thermistor/Switch Input
- 11 General Purpose Programmable Digital Inputs
- 1 High Speed Programmable Digital Output
- 6 General Purpose Programmable Digital Outputs
- 2 Programmable Analog Inputs

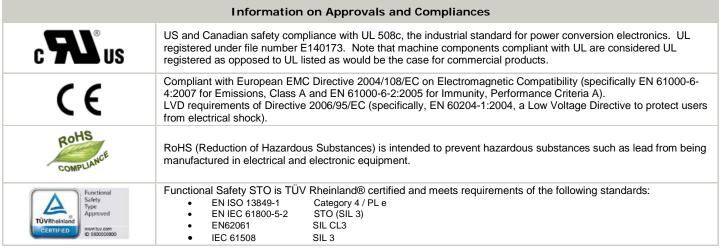
# COMPLIANCES & AGENCY APPROVALS

- UL
- cUL
- CE Class A (LVD)
- CE Class A (EMC)
- TÜV Rheinland® (STO)
- RoHS



## **BLOCK DIAGRAM**







## **SPECIFICATIONS**

Power 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 <sup>1</sup>	-	3		
AC Supply Frequency	Hz	50 – 60		
	VDC	255 - 373		
DC Supply Voltage Range <sup>2</sup> DC Bus Over Voltage Limit	VDC	420		
Ţ.				
DC Bus Under Voltage Limit	VDC VDC	205		
Logic Supply Voltage		20 - 30 (@ 1 A)		
Safe Torque Off Voltage	VDC	24 (±6)		
Maximum Peak Output Current³	A (A <sub>RMS</sub> )	100 (70.7)		
Maximum Continuous Output Current <sup>4</sup>	A (A <sub>RMS</sub> )	50 (50)		
Maximum Continuous Power @ Rated Voltage <sup>5</sup>	W	16103		
Maximum Continuous Power Dissipation @ Rated Voltage	W	848		
Internal Bus Capacitance	μF	1120		
External Shunt Resistor Minimum Resistance	Ω	25		
Minimum Load Inductance (Line-To-Line) <sup>7</sup>	μH	600		
Switching Frequency	kHz	10		
Maximum Output PWM Duty Cycle	%	100		
Low Voltage Supply Outputs	-	+5 VDC (250 mA)		
		Specifications		
Description	Units	Value		
Communication Interfaces <sup>8</sup>	-	EtherCAT® (USB for Configuration)		
Command Sources	-	±10 V Analog, Encoder Following, Over the Network, Sequencing, Indexing, Jogging		
Feedback Supported <sup>9</sup>	-	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 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	100		
Velocity Loop Sample Time	μs	200		
Position Loop Sample Time	μs	200		
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		
	Mechanica	al Specifications		
Description	Units	Value		
Agency Approvals	-	CE Class A (EMC), CE Class A (LVD), cUL, RoHS, UL, TÜV Rheinland® (STO)		
Size (H x W x D)	mm (in)	256.5 x 182.6 x 135.3 (10.1 x 7.2 x 5.3)		
Weight	g (oz)	3560.7 (125.6)		
Heatsink (Base) Temperature Range <sup>10</sup>	°C (°F)	0 - 75 (32 - 167)		
Storage Temperature Range	°C (°F)	-40 - 85 (-40 - 185)		
Cooling System		Forced 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		
	as long as output now	ver does not exceed 3kW maximum. Current limits are de-rated to 30A cont. / 60A peak.		

- Can operate on single-phase AC (208 VAC minimum) as long as output power does not exceed 3kW maximum. Current limits are de-rated to 30A cont. / 60A peak.
- Large inrush current may occur upon initial DC supply connection to DC Bus.

  Capable of supplying drive rated peak current for 2 seconds with 10 second foldback to continuous value. Longer times are possible with lower current limits.

  Continuous A<sub>rms</sub> value attainable when RMS Charge-Based Limiting is used.

  P = (DC Rated Voltage) \* (Cont. RMS Current) \* 0.95

  ADVANCED Motion Controls recommends using an external fuse in series with the shunt resistor. A 5 amp motor delay fuse is typical. 2. 3. 4.

- Lower inductance is acceptable for bus voltages well below maximum. Use external inductance to meet requirements. EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Contact ADVANCED Motion Controls for 1Vp-p Sine/Cosine Encoder feedback availability.

- Additional cooling and/or heatsink may be required to achieve rated performance.



# **PIN FUNCTIONS**

	COMM – EtherCAT Communication Connector			
Pin	Name	Description / Notes	I/O	
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	-	-	

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	I
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	I
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	I
20	PDI-9	General Purpose Programmable Digital Input	
21	PDI-10	General Purpose Programmable Digital Input	I
22	PDI-11	General Purpose Programmable Digital Input	I
23	IN COMMON	Digital Input Common (8-11)	ICOM
24	PAI-1+	Conoral Burnaga Differential Brogrammoble Angles Input	Į.
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	I/O
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)	1
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	I
15	HALL C-	N/C	HALL C-	Differential Hall C	I

\*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.



	ALIX	/ FNCODED Assertions Francisco				
	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	Bulleted Efficade Chariffer A Output of Reserved.	0			
3	ENC B+ OUT / RESERVED	Buffered Encoder Channel B Output* or Reserved.	0			
4	AUX ENC A+	Auxiliary Encoder Input (For single ended signal leave negative terminal open)	I			
5	AUX ENC A-	Auxiliary Encoder input (i or single ended signal leave negative terminal open)	I			
6	AUX ENC B+	Auxiliary Encoder Input (For single ended signal leave negative terminal open)	I			
7	AUX ENC B-	Auxiliary Encoder imput (i or single ended signal leave negative terminal open)	I			
8	AUX ENC I+	Auxiliary Encoder Index Input (For single ended signal leave negative terminal open)	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			

<sup>\*</sup>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	1/0
1	LOGIC GND	Logic Supply Ground	SGND
2	LOGIC PWR	Logic Supply Input	I

Fan Power Connector				
Pin	Name	Description / Notes	I/O	
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				
Pin	Name	Description / Notes	I/O	
1	L1	AC Constitute of (There Blees) Fotografic delegation delegation and delegations	I	
2	L2	AC Supply Input (Three Phase). External 20 A time delay fuses are recommended in series with the AC input lines.	I	
3	L3	with the AC input lines.	I	
4	CHASSIS	Chassis Ground	CGND	

DC Power Connector				
Pin	Name	Description / Notes	1/0	
1	DC-	Power Ground	PGND	
2	DC+	DC Power Input	I	
3	DC+	External Shunt Resistor Connection. Connect resistor between DC+ and BR.	-	
4	BR	External Shuff Resistor Confidention. Confident resistor between DC+ and BR.	-	

STO – Safe Torque Off Connector			
Pin	Name	Description / Notes	I/O
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

# SW0 SW1

## Description

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
0	1	001
0	2	002
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	
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)	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.

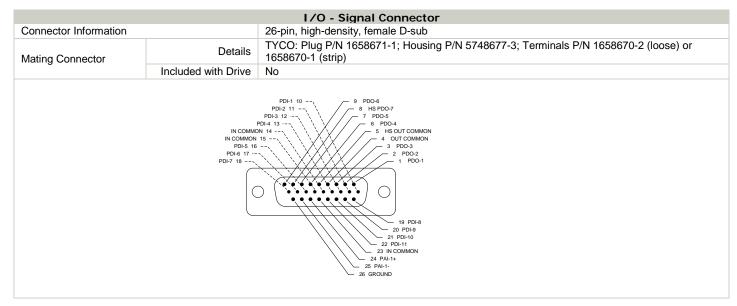
## Safe Torque Off (STO) Inputs

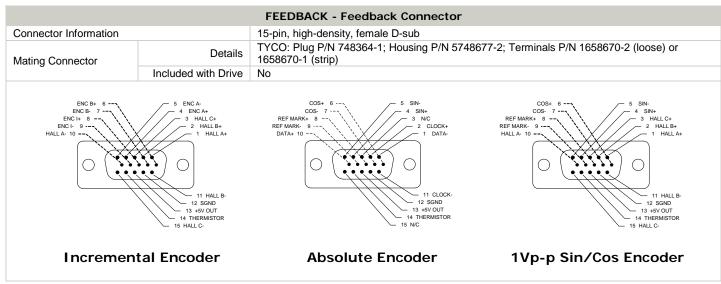
The Safe Torque Off (STO) Inputs are dedicated +24VDC max sinking single-ended inputs. A dedicated STO Disable Key connector is included and should be installed for applications where STO is not required.



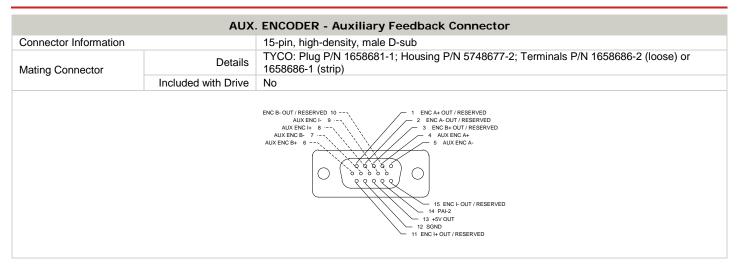
## MECHANICAL INFORMATION

	COMM - EtherCAT Communication Connector		
Connector Information		Shielded, dual RJ-45 socket with LEDs	
Mating Connector	Details	Standard CAT 5e or CAT 6 ethernet cable	
Mating Connector	Included with Drive	No	
		IN STATUS LINK ERROR  OUT  TD- 6  TD- 3  RD- 2  RD- 1	









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  USB GND 5 RESERVED 4 DATA+ 3 DATA- 2 VBUS 1		

Logic Power Connector			
Connector Information		2-port, 5.08 mm spaced, enclosed, friction lock header	
Mating Connector	Details	Phoenix Contact: P/N 1757019	
Mating Connector	Included with Drive	Yes	
2 LOGIC PWR 1 LOGIC GND 1 M A M			

Fan Power Connector			
Connector Information		2-port, 5.08 mm spaced, enclosed, friction lock header	
Moting Connector	Details	Phoenix Contact: P/N 1757019	
Mating Connector	Included with Drive	Yes	
FAN PWR  1 FAN GND  1 FAN GND			



		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
		TO THASSIS

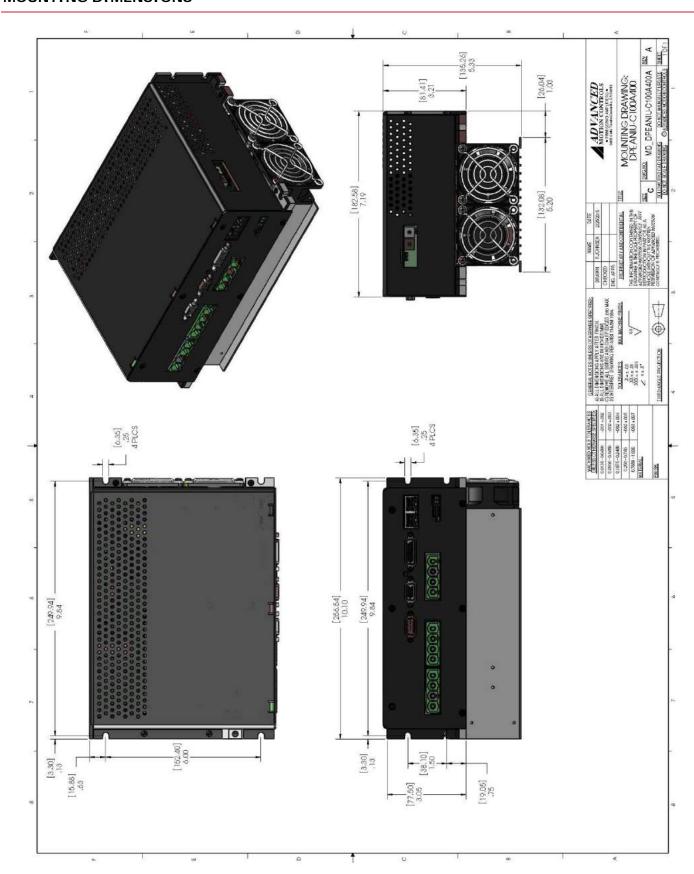
AC Power Connector			
Connector Information		4-pin, 10.16 mm spaced, enclosed, friction lock header	
Matina Connector	Details	Phoenix Contact: P/N 1913523	
Mating Connector	Included with Drive	Yes	
		4 CHASSIS	

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	
		3 DC+ 1 DC.	

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)
	Included with Drive	No
STO-2 RETURN 5 3 STO-1 RETURN 1 STO OUTPUT  STO-OUT RETURN 8 2 RESERVED 5 4 STO-1 INPUT		

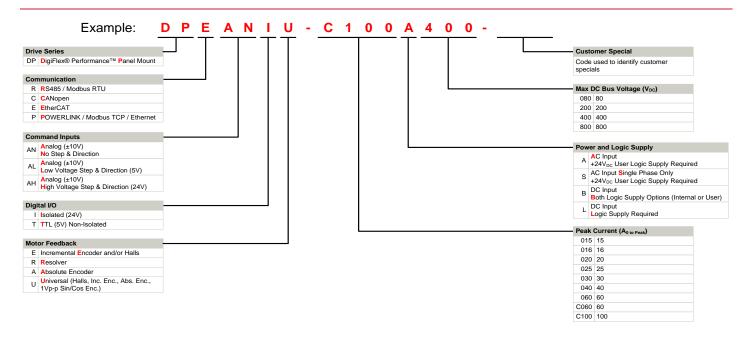


# MOUNTING DIMENSIONS





## 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
- ▲ Private Label Software
- ▲ OEM Specified Connectors
- No Outer Case
- ▲ Increased Current Resolution
- ▲ Increased Temperature Range
- ▲ Custom Control Interface
- ▲ Integrated System I/O

- ▲ Tailored Project File
- ▲ Silkscreen Branding
- Optimized Base Plate
- ▲ Increased Current Limits
- ✓ Increased Voltage Range
- Conformal Coating
- ▲ Multi-Axis Configurations
- ▲ 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 <a href="https://www.a-m-c.com">www.a-m-c.com</a> 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.