Section 1. INTRODUCTION

Product Description

The PDS-E series of EMC compliant single-axis packaged ministep drives consists of the PDS13E & PDS15E, with peak current ratings of 3A and 5A respectively. A further 5A version, known as the PDS15E-D is also available with a built-in regenerative dump circuit. PDS-E series drives are high-performance, MOSFET, chopper-regulated stepper drives designed for optimum performance in low and medium power applications. A recirculating chopper regulator improves operating efficiency, minimizes power consumption, and reduces motor and drive heating. They are powered Direct On-Line (DOL) from mains supplies of 110V to 240V (nominal) AC. An internal switch mode power supply is used, incorporating Power Factor Correction (PFC) to minimise distortion of the AC supply.

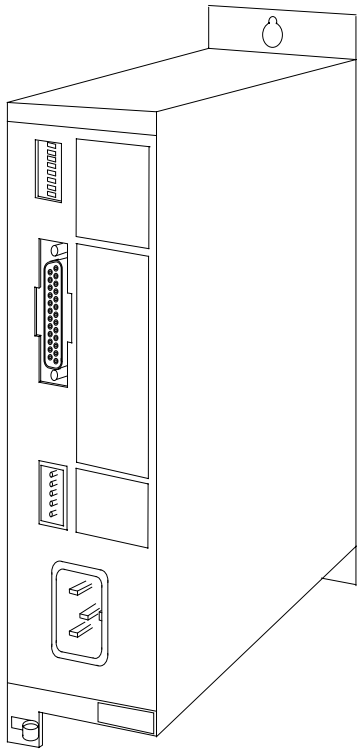


Figure 1-1. PDSE Drive

The PDS-E series of drives have 4 selectable resolutions between 400 steps/rev and 4000 steps/rev, set using the front panel switches.

Motor short-circuit protection is assured across and between phases and between any phase and earth. If a wiring fault occurs the drive fault LED will be lit up - see ***Maintenance and Troubleshooting***.

The drives are suitable for use with EMC compatible hybrid and permanent magnet stepping motors having 4, 6, or 8 leads.

The drives can be used as stand alone units with separate control inputs and motor connection/power inputs. An on-board clock can be used to control drive motion or an external step direction source can be used.

The step, direction and shutdown differential inputs are fully opto isolated for maximum noise immunity. The PDS-E series of drives have improved input noise immunity compared with the PDS13 and PDS15/PDS15-D series. These noise immunity improvements may require minor connection changes (detailed in the Installation section) to make a PDS-E drive a plug-in replacement for an existing PDS13 or PDS15/PDS15-D drive.

The system may be configured to allow the clock signal to be provided by the drive's internal clock source. Two separate programmable speeds are available. These are set by front panel pots marked “Fast” and “Slow”, a third pot allows adjustment of the acceleration and deceleration times. The speed control potentiometers may be mounted remotely via the front panel D-type connector.

The internal clock source signal is brought out to the drive control connector for monitoring purposes.

The drive and integral power supply are contained in one compact enclosure, cooled by natural convection. Wall or panel vertical mounting is recommended to allow access to the front panel connectors and controls.

Section 2. GETTING STARTED

Drive Switch Settings

SWITCH NUMBER	FUNCTION	COMMENTS
1	Selftest	Default OFF
2	Standby current reduction	Default ON
3	INT/EXT speed control	Default ON
4, 5	Step resolution	Default all OFF
6, 7, 8	Peak current setting	Default all ON

Table 2-1. Switch Settings

Selftest Switch1

The selftest switch is used to check the operation of the drive. Set to the ON position to cause the motor to rotate at the slow speed potentiometer setting. The default setting of selftest is OFF i.e. not selected.

Standby Switch 2

Switch 2 determines the level of standby current. With switch 2 ON, current will reduce by 50% at standby. With switch 2 OFF, current will reduce to 80% of programmed value at standby.

Switch 3

Turn the switch ON for internal speed control or OFF for external speed control. **This switch must be ON to enable the self test facility, if external speed potentiometers are not connected.**

Step Resolution Switch 4, 5

DIP Switches 4 and 5 determine the step resolution of the drive, as defined in Table 2-2. Note: cycle the power for switch settings to take effect.

SWITCH SETTINGS		RESOLUTION IN STEPS/REV
4	5	
ON	ON	400
ON	OFF	1000
OFF	ON	2000
OFF	OFF	4000

Table 2-2. Step Resolution SettingsPeak Current Setting Switch 6, 7, 8

DIP Switches 6, 7 and 8 determine the peak current setting of the drive, as defined in Table 2-3.

SWITCH SETTINGS			PDS13E PEAK CURRENT	PDS15E PEAK CURRENT
6	7	8		
ON	ON	ON	3.0A	5.0A
OFF	ON	ON	2.7A	4.6A
ON	OFF	ON	2.4A	4.3A
OFF	OFF	ON	2.1A	3.9A
ON	ON	OFF	1.8A	3.6A
OFF	ON	OFF	1.5A	3.2A
ON	OFF	OFF	1.2A	2.9A
OFF	OFF	OFF	0.9A	2.5A

Table 2-3. Peak Current Settings

Acceleration/Deceleration Rate Adjustment

The acceleration and deceleration rates of the drive are controlled by the front panel acceleration control, which provides a range of 20 to 500 rev/sec/sec.

Preliminary Testing

Initially do not make any connections to the 25-way D-type connector. With power OFF, ensure that switch 3 is in the ON position and that the motor is connected correctly. Set the SLOW potentiometer to its mid-way position (the potentiometers are all 20 turn). Apply power and check the motor for holding torque. The red FAULT LED should be OUT and the green POWER LED should be LIT. If all is well, close switch 1 and the motor will start turning. The velocity can be varied by rotating the SLOW potentiometer (clockwise increases velocity). The success of this preliminary test confirms correct drive-motor wiring. Power down and turn OFF switch 1.

If you wish, you can now plug in your Compumotor Indexer cable and test the drive using the indexer. Alternatively, by making the wiring connections shown in Figure 3-7 you can operate the drive via the internal clock source.

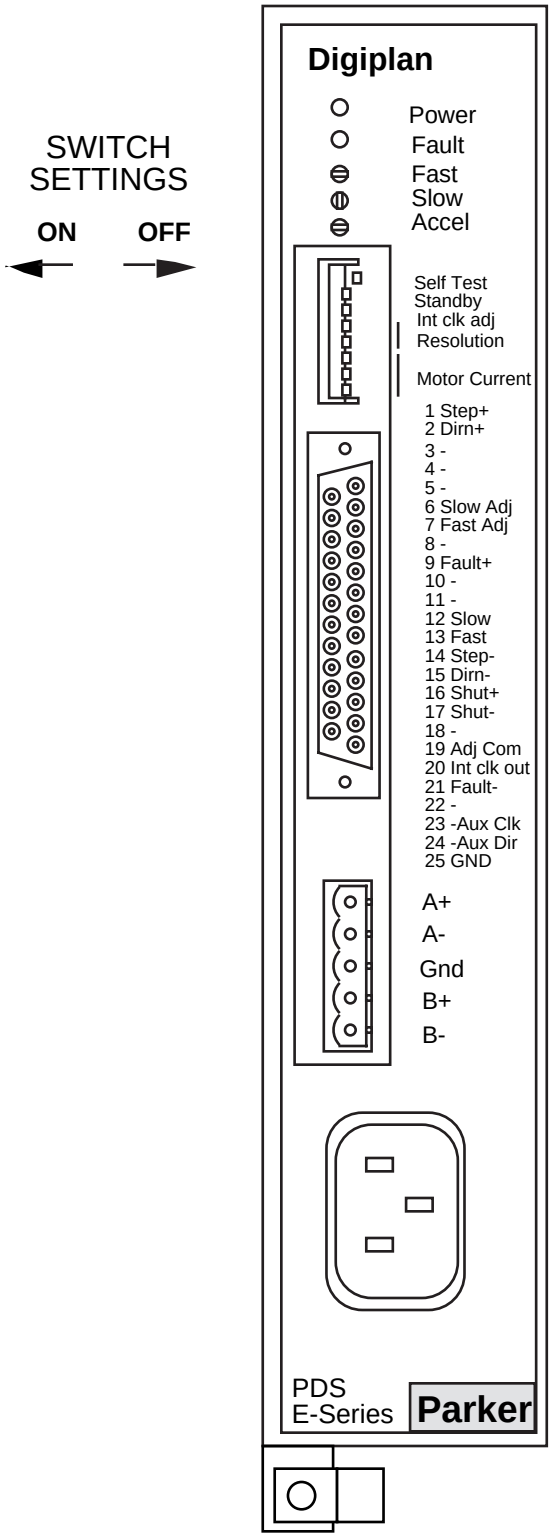


Figure 2-1. Front Panel Layout

Section 3. INSTALLATION

Precautions

During installation, take the normal precautions against damage caused by electrostatic discharges. Earthed wrist straps should always be worn.

Power Connections

Input power is taken directly from AC supplies via the front panel mounted IEC 3-way mains inlet socket. A mating connector is supplied with the drive. Connect the terminals marked L and N to the AC supply live and neutral respectively, and the terminal marked E to earth.

Motor Wiring EMC Requirements

You should wire the motor using 1mm^2 5-core screened cable with a high-quality braided screen. Cables using a metallised plastic bandage for an earth screen are unsuitable and in fact provide very little screening. There is a problem in terminating the screen in a mechanically stable manner and the screen itself is comparatively fragile - bending it round a tight radius can seriously affect the screening performance.

There must be no break in the 360° coverage that the screen provides around the cable conductors. If a connector must be used it should retain the 360° coverage, possibly by the use of an additional metallic casing where it passes through the bulkhead of the enclosure. The cable screen must *not* be bonded to the cabinet at the point of entry. Its function is to return high-frequency switching current back to the drive. This may require mounting the connector on a sub-panel insulated from the cabinet, or using a connector having an internal screen which is insulated from the connector housing.

Within the cabinet itself, all the motor cables should lie in the same trunking as far as possible. They must be kept separate from any low-level control signal cables. This applies particularly where the control cables are unscreened and run close to the drive.

Motor-end connections

At the motor end, the motor cable screen must form a continuous and complete shield of the motor wires by connecting directly to the metal motor housing. It is preferable to use motors with internally mounted screw terminations, where provision has been made for a conductive gland to connect the motor cable screen to the motor body. If flying-lead motors are used, it is important that the unscreened leads are converted into a braided-screen cable within 100mm conductor length of the motor body. A separate terminal box may be used for this purpose but the braided cable screen must be properly strapped to the motor body using a suitable metal P-clip. The loop created at the motor end of the cable by the exposed motor leads, between where the cable screen is bonded to the motor body and the leads enter the motor body, must be made as small as possible. Take the drive ground connection to the motor earth stud.

Drive-end connections

Fit the ferrite absorber supplied over the motor cable. Connect the five leads in the motor cable to the motor connector as shown in Fig. 3-1. Expose a short length of the cable screen and anchor it to the drive using the metal P-clip located below the mains input connector. Locate the absorber between the P-clip and the motor connector, retaining it in place with the heat-shrink sleeving supplied. The specification of the absorber is in the following section. To protect the motor connector against electrostatic discharges, fit the self-adhesive insulated strip supplied over the screw terminals (please note that this is an interim solution pending availability of a suitable cover).

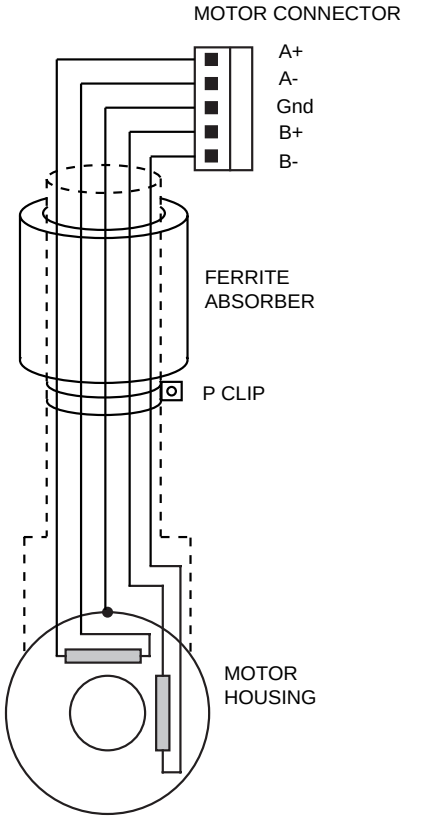


Figure 3-1. PDSE Drive Motor Connections

Ferrite absorber specifications

The absorbers described in these instructions are made from a low-grade ferrite material which has high losses at radio frequencies. They therefore act like a high impedance in this waveband.

The recommended components are produced by Parker Chomerics and are suitable for use with cable having an outside diameter up to 10mm. The specification is as follows:

Chomerics part number	H8FE-1115-NC
Outside diameter	17.5mm
Inside diameter	10.7mm
Length	28.5mm
Impedance at 25MHz	80Ω
Impedance at 100MHz	120Ω
Curie temperature	130°C (the device should not be operated near this temperature)

Handling and installing the ferrite absorbers

Take care when handling the absorbers - they can shatter if dropped on a hard surface. For this reason the suggested method of installation is to use a short length of 19mm diameter heat-shrink sleeving. This gives a degree of physical protection while the cable is being installed. The sleeving should have a shrink ratio of at least 2.5:1. Cable ties may be used as an alternative, however they give no physical protection to the absorber.

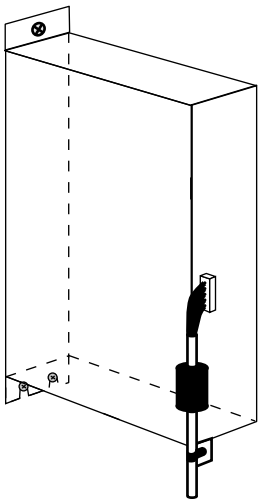


Figure 3-2. Motor wiring installation

Motor Selection

To maintain EMC compliance, the wiring guidelines given in the previous section must be followed. This should be kept in mind when the motor is selected. In particular, if the motor is fitted with flying leads or screened cable with a foil screen, this must be replaced with braided-screen cable as described.

If motors other than those listed are to be used please contact Digiplan.

Usually optimum performance will be obtained when the current rating of the motor is between 1 and 1.5 times the drive rating (refer to specification). For maximum high speed torque a motor rating of 7.5A peak should be used with the PDS15E, 4.5A with the PDS13E. The drives can be derated to accommodate motors with lower current ratings however, the high speed torque will be reduced.

Do not use a drive setting which gives an output current greater than the motor rating.
With 4 lead motors the bipolar rating is quoted and this should match the criteria stated above.

With 6 lead motors the unipolar rating is quoted, but for best performance with the PDS-E Drives the centre tap of each winding should be left unconnected and the connections made between the winding ends. This will give a bipolar rating 70% of the quoted motor unipolar rating.

With 8 lead motors the bipolar rating of the motor, which is normally quoted refers to a parallel winding connection. With the windings connected in series the current rating of the motor connection will be 50% that of the bipolar rating, and the motor will give improved low-speed torque, but reduced high-speed torque.

Please note that under exceptional operating conditions, for instance prolonged running at high speed, under certain fault conditions or if the drive current setting is too high, the motor temperature may become higher than normal. This may represent a safety hazard if the operator has access to the motor.

Regenerative Power Dump Option

Applications which involve rapid deceleration of high-inertia loads may require that the drive is fitted with a power dissipation circuit. The PDS15E-D has the same electrical specification as the PDS15E but incorporates a power dump with a continuous rating of 15 watts (170 watts peak). You will need the PDS15E-D in the following situation:

Metric formula - if the deceleration time $\mathbf{t<\{J\omega^2 - 0.1\}}$

where t is the deceleration time in seconds
J is the total system inertia in Kg-m^2
ω is the maximum speed in revolutions per second

Imperial formula - if the deceleration time $\mathbf{t<\{0.02J\omega^2 - 100\}}$

where t is the deceleration time in milliseconds
J is the total system inertia in oz-in^2
ω is the maximum speed in revolutions per second

If the expression in brackets is negative, the power dump option is not required. This option is strongly recommended for size 42 (106) motors.

Note that a program to calculate if a power dump is required is available from Compumotor and Digiplan Technical Support departments (Windows 3.1 required). This program is also available on Compumotor's Bulletin Board Service (Tel: 707/584-4059 in USA).

Long Motor Leads

Using a motor with long leads will cause the cabling resistance to become significant when compared to the resistance of the motor.

The DC volt drop of the cable and motor connection when measured at the drive, should not exceed 5 volts in order to limit power dissipation in the drive and maintain maximum system performance.

To maintain EMC compatibility, the motor leads must be assembled and connected as defined under ***Motor Wiring EMC Requirements***.

The cable used must have an insulation rating of greater than 500V RMS.

Motor Connections

Motor connection details can be determined from Tables 3-1 and 3-2. For example, Figure 3-3 shows the connection required to be made to a STEBON SDT 852-150-90 motor with its windings connected in parallel. The motor is viewed from the terminal box end with the end plate removed.

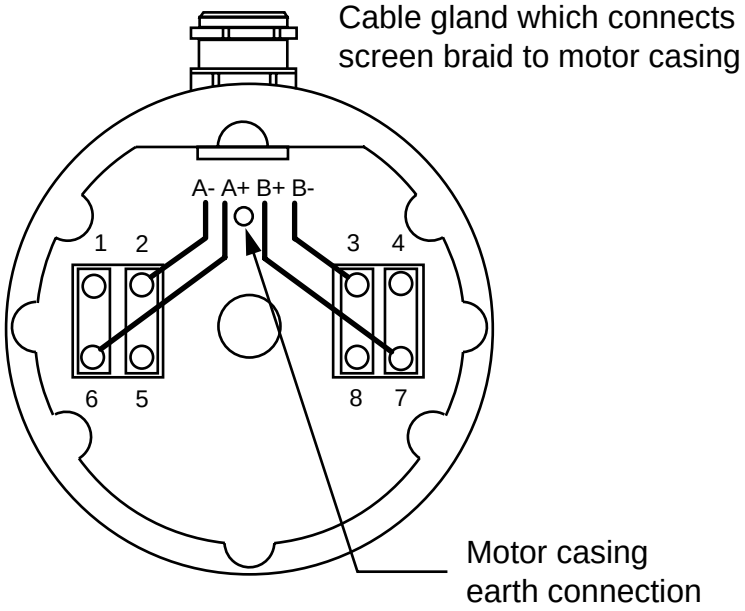


Figure 3-3 Connections for a STEBON Motor

N.C. - no connection.

MAKE	TYPE	A+	A–	B-	B+	NOTES
Pacific Scientific	6-lead	Black	Orange	Red	Yellow	White/Blk/Org, White/Red/Yel N.C.
	8-lead	Black	Orange	Red	Yellow	Link Wh/Blk & Wh/Org Link Wh/Red & Wh/Yel
	T.box	1	3	2	4	Link 5 & 6,link 7 & 8
Slo-syn	8-lead	Red	Red/Wh	Grn	Grn/Wh	Link Black & White, link Org & Blk/Wh
	T.box (x8)	1	3	5	4	Link 2 & 6, link 7 & 8
Stebon, Digiplan SM	8-lead	Red	Yel	Pink	Blk	Link Blue & violet, link White & Grey
	T.box	1	2	3	4	Link 5 & 6, link 7 & 8
M.A.E.	6-lead	Grn/Wh	Grn	Red	Red/Wh	White & Black N.C.
	8-lead	Black	Orange	Red	Yellow Link Wh/Red & Wh/Yel	Link Wh/Blk & Wh/Org,
	T.box	6	5	8	7	Link 1 & 3, link 2 & 4
Digiplan/Compumotor	4-lead	-	-	-	-	Internally wired in parallel
OEM Series	8-lead	Red	Black	Green	White	Link blue & yellow Link orange & brown
Digiplan/Compumotor QM & S Motors	8-lead	Red	Black	White	Green	Link Yel & Blue Link Org & Brown
Digiplan/Compumotor QM & S Motors (except 106-205)	T.box	1	3	4	5	Link 2 & 6 Link 7 & 8
Digiplan/Compumotor QM & S106-205	T.box	1	3	7	8	Link 5 & 6 Link 2 & 4

Table 3-1. Motor Connection Data - Windings in Series

For 6-lead motors, connections shown are for one half-winding.
N.C. - no connection.

MAKE	TYPE	A+	A–	B-	B+	NOTES
Pacific Scientific	6-lead	Black	Wh/Blk/ Orange	Red	Wh/Red/ Yellow	Or & Yellow N.C.
	8-lead	Black & Wh/Or	Or & Wh/Blk	Red & Wh/Yel	Yel & Wh/Red	
	T.box	1 & 5	3 & 6	2 & 7	4 & 8	
Slo-syn	8-lead	Red & White	Blk & Red/Wh	Grn & Blk/Wh	Org & Grn/Wh	
	T.box(x8)	1 & 2	3 & 6	4 & 7	5 & 8	
Stebon, Digiplan SM	8-lead	Rd & Blue	Yel & Violet	Wh & Pink	Black & Grey	
	T.box	1 & 6	2 & 5	3 & 8	4 & 7	
M.A.E.	6-lead	Grn/Wh	White	Red	Black	Grn & Red N.C
	8-lead	Black & Wh/Or	Or & Wh/Blk	Red & Wh/Yel	Yel & Wh/Red	
	T.box	3 & 6	1 & 5	4 & 8	2 & 7	
Digiplan/Compumotor	4-lead	Red	Black	Green	White	
OEM Series†	8-lead	Red & Blue	Yellow & Black	Green & Orange	Brown & White	
Digiplan/Compumotor QM & S Motors	8-lead	Red & Blue	Blk & Yellow	Wh & Brn	Green & Org.	
Digiplan/Compumotor QM & S Motors (except 106-205)	T.box	1 & 2	3 & 6	4 & 7	5 & 8	
Digiplan/Compumotor QM & S 106-205	T.box	1 & 5	3 & 6	2 & 7	4 & 8	

* Use correct White for each phase. † Size 34 only. Size 23 can only be operated in series.

Table 3-2. Motor Connection Data - Windings in Parallel

Drive Current Setting

SWITCH SETTINGS			PDS13E PEAK CURRENT	PDS15E PEAK CURRENT
6	7	8		
ON	ON	ON	3.0A	5.0A
OFF	ON	ON	2.7A	4.6A
ON	OFF	ON	2.4A	4.3A
OFF	OFF	ON	2.1A	3.9A
ON	ON	OFF	1.8A	3.6A
OFF	ON	OFF	1.5A	3.2A
ON	OFF	OFF	1.2A	2.9A
OFF	OFF	OFF	0.9A	2.5A

Table 3-3. Peak Current Settings

Compumotor S and QM Motor Drive Settings

When using Compumotor 'S' and 'QM' motors you will need to set the PDS-E drive current settings as shown in Table 3-4.

The 'S' motor and 'QM' motor are electrically identical e.g. an S57-51 is the same as QM57-51. In the following table, under motor type, a suffix 'S' refers to series connected and 'P' refers to parallel connected.

Motor Type	PDS13E			PDS15E			Peak Motor Current (Amps)	Rotor Inertia Kg-cm^2 (oz-in^2)
	SW6	SW7	SW8	SW6	SW7	SW8		
S/QM-57-51S	ON	OFF	OFF	*	*	*	1.2	0.088 (0.48)
S/QM-57-51P	ON	OFF	ON	OFF	OFF	OFF	2.3	
S/QM-57-83S	OFF	ON	OFF	*	*	*	1.5	0.234 (1.28)
S/QM-57-83P	ON	ON	ON	OFF	ON	OFF	3.1	
S/QM-57-102S	ON	ON	OFF	*	*	*	1.7	0.32 (1.75)
S/QM-57-102P	ON	ON	ON	ON	ON	OFF	3.5	
S/QM-83-62S	OFF	OFF	ON	*	*	*	2.2	0.64 (3.50)
S/QM-83-62P	ON	ON	ON	OFF	ON	ON	4.4	
S/QM-83-93S	ON	ON	ON	ON	OFF	OFF	2.9	1.23 (6.70)
S/QM-83-93P	X	X	X	ON	ON	ON	5.6	
S/QM-83-135S	ON	ON	ON	ON	ON	OFF	3.5	1.87 (10.24)
S/QM-83-135P	X	X	X	ON	ON	ON	6.9	
S/QM-106-178S	X	X	X	ON†	ON†	ON†	6.0	8.05 (44.0)
S/QM-106-178P	X	X	X	ON†	ON†	ON†	12.0	
S/QM-106-205S	X	X	X	ON†	ON†	OFF†	3.6	9.51 (52.00)
S/QM-106-205P	X	X	X	ON†	ON†	ON†	7.2	
S/QM-106-250S	X	X	X	ON†	ON†	ON†	6.2	12.14 (63.00)
S/QM-106-250P	X	X	X	ON†	ON†	ON†	12.4	

Table 3-4. PDS-E Series Current Drive Settings for Compumotor 'S' and 'QM' Motors

Note * Minimum drive current too high for motor.
X Unsuitable motor/drive combination.
† 106 (42) size motors must use PDS15E-D option (regenerative power dump). PDS13E is 3 amps Peak Max. and PDS15E is 5 amps Peak Max.

Digiplan SM Motor Drive Settings

Table 3-5 lists the PDS-E Drive current settings you need to make when using Digiplan 'SM' and STEBON motors. In Table 3-5, under 'Motor Type', a suffix 'S' refers to series connected and 'P' refers to parallel connected.

Motor Type	PDS13E			PDS15E			Peak Motor Current (Amps)	Rotor Inertia Kg-cm^2 (oz-in^2)
	SW6	SW7	SW8	SW6	SW7	SW8		
SM-57-51S	OFF	OFF	OFF	*	*	*	1.1	0.11 (0.60)
SM-57-51P	OFF	OFF	ON	*	*	*	2.1	
SM-57-83S	OFF	OFF	ON	*	*	*	2.3	0.23 (1.26)
SM-57-83P	ON	ON	ON	OFF	ON	ON	4.7	
SM-57-102S	OFF	OFF	ON	*	*	*	2.3	0.30 (1.64)
SM-57-102P	ON	ON	ON	OFF	ON	ON	4.6	
SM-83-62S	ON	ON	ON	OFF	ON	OFF	3.2	0.60 (3.30)
SM-83-62P	X	X	X	ON	ON	ON	6.4	
SM-83-93S	ON	ON	ON	OFF	OFF	ON	4.0	1.25 (6.83)
SM-83-93P	X	X	X	ON	ON	ON	7.9	
SM-83-135S	ON	ON	ON	ON	ON	OFF	3.8	2.00 (10.93)
SM-83-135P	X	X	X	ON	ON	ON	7.6	
SM-106-140S	X	X	X	OFF†	ON†	ON†	5.0	3.65 (19.96)
SM-106-140P	X	X	X	ON†	ON†	ON†	9.9	

Table 3-5. PDS-E Series Current Drive Settings for Digiplan 'SM' Motors

Note * Minimum drive current too high for motor.
X Unsuitable motor/drive combination.
† 106 (42) size motors must use PDS15E-D option (regenerative power dump). PDS13E is 3 amps Peak Max. and PDS15E is 5 amps Peak Max.

Compumotor OEM Motor Drive Settings

The 34 frame size motors (OEM-83-62/93/135) have identical drive current settings to the 'QM' motors listed in Table 3-4. Size 34 (83) motors are internally wired in Parallel. In Table 3-6, under 'Motor Type', a suffix 'S' refers to series connected. The parallel connection can not be used for size 23 (57) motors.

Motor Type	PDS13E			PDS15E			Peak Motor Current (Amps)	Rotor Inertia Kg-cm^2 (oz-in^2)
	SW6	SW7	SW8	SW6	SW7	SW8		
OEM-57-40S	OFF	ON	ON	OFF	OFF	OFF	2.7	0.07 (0.380)
OEM-57-51S	ON	ON	ON	OFF	ON	OFF	3.3	0.12 (0.650)
OEM-57-83S	ON	ON	ON	ON	ON	OFF	3.8	0.25 (1.360)

Table 3-6. PDS-E Series Current Drive Settings for Compumotor 'OEM' Motors

Signal Connections

All signal connections are made on the 25-way D-type connector. Signal levels etc. are listed in Table 2 and the terminal functions are explained below. For EMC compliance it is important that the mating connector has an earthed metal shroud.

Step + Pin 1 & Step- Pin 14

A pulse on these inputs causes the motor to advance on the leading edge of the pulse (see Figure 3-4). The pulse should be at least 1µs long. Consult your indexer user guide for instructions on how to change the output pulse width.

The Step inputs are configured as TTL opto isolated inputs.

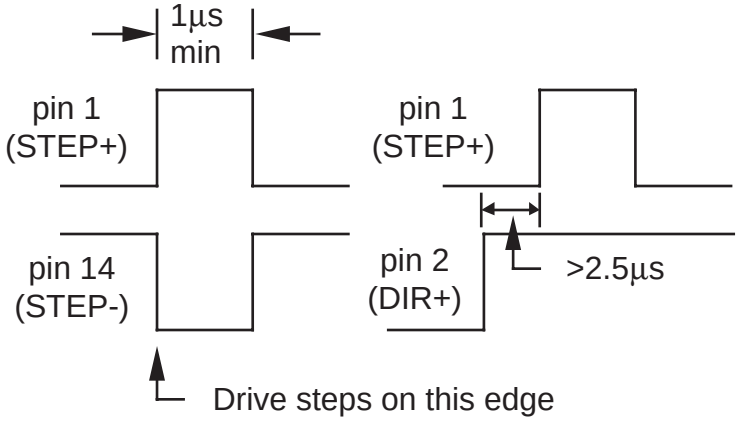


Figure 3-4. STEP Timing Diagram

Direction+ Pin 2 & Direction- Pin 15

These inputs (pins 2 and 15) control the direction of the motor shaft rotation. Changing the level of these inputs changes the direction in which the shaft moves. The logic level at this input needs to be present for at least 2.5µs before the leading edge of the step pulse [transition to STEP+ (high) STEP- (low)]. The Direction inputs are configured as TTL opto isolated inputs.

Slow Rate Adjust (Pin 6)

An external variable resistor (100K Ohm, 10 turn recommended) or a fixed resistor may be connected between this terminal and "Adjust Common" (pin 19) to control the slow speed of the internal clock source. When using external speed controls, turn switch 3 off in order to isolate the internal potentiometers.

Fast Rate Adjust (Pin 7)

An external variable resistor (10K Ohm, 10 turn recommended) or fixed resistor may be connected between this terminal and "Adjust Common" (pin 19) to control the fast speed of the internal clock source. When using external speed controls, turn switch 3 off in order to isolate the internal potentiometers.

Fault (Pin 9 & 21)

This output is a transistor signal which turns on in the event of a fault. See Figure 3-5 for possible external wiring connections.

When a fault occurs, the drive will de-energise. Once the fault has been cleared the drive may be re-energised by either cycling the Shutdown signal or by cycling the power to the drive.

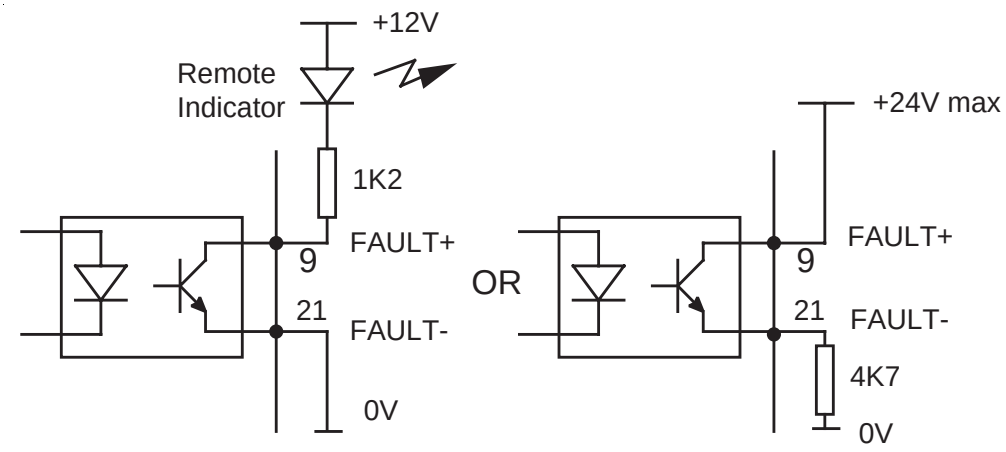


Figure 3-5. Fault Output Examples

Slow Run (Pin 12)

Connect this input to GND directly to run the internal clock source at the slow rate.

Fast Run (Pin 13)

Connect this input to GND directly to run the internal clock source at the fast rate.

Shutdown+ Pin 16 & Shutdown- Pin 17

These differential inputs (pins 16 and 17) are used to energise and de-energise (shutdown) the motor. When the shutdown+ input is taken high and shutdown- is low, the drive is shut down and the motor shaft may be rotated ***slowly*** by hand.

NOTE: Back-driving the motor at excessive speed may damage the drive.

Cycling the shutdown input resets a fault condition, provided the cause of the fault has been removed.

Adjust Common (Pin 19)

Common return connection for external speed controls (nominal +12V).

Internal Clock Out (Pin 20)

This open collector output (NPN transistor) goes low every time the drive sees a step pulse from the internal clock source. It must be pulled up using an external resistor. Pulse width is 1µs, consequently this clock is not compatible with the Aux Clock In on pin 23, since the pulse width is too narrow to pass through the input filter. It cannot therefore be connected to the Aux Clock In on another drive in order to slave two drives from one oscillator. Should you wish to do this, you will need to feed the Internal Clock Out via a differential driver into the Step+/Step- inputs on the second drive.

Aux Clock In (Pin 23)

A low going pulse on this input causes the motor to advance on the leading edge of the pulse (see Figure 3-6). The pulse should be at least 8µs long. Consult your indexer user guide for instructions on how to change the output pulse width.

Aux Direction In (Pin 24)

This input controls the direction of the motor shaft rotation. Changing the level of this input changes the direction in which the shaft moves. The logic level at this input needs to be present for at least 8µs before the leading edge of the step pulse.

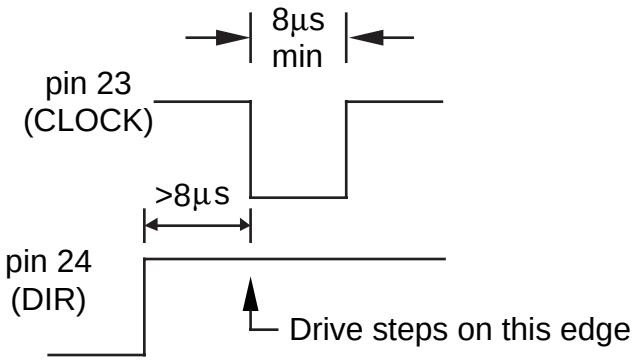


Figure 3-6. Aux CLOCK Timing Diagram

GND (Pin25)

Control signal return.

Compatibility of PDS-E Series Drives

PDS-E Series drives have differential Step and Direction inputs which are fully opto-isolated. Unlike the PDS13, PDS15 and PDS15-D Series, these inputs cannot be driven from a single-ended source without an external power supply. To use a single-ended source, use the inputs Aux Clock In (pin 23) and Aux Direction In (pin 24). These inputs are pulled up internally to +12V via a 4K7 resistor and are therefore suitable for driving from an NPN open-collector source.

If you are using the preferred differential drive for the Step and Direction inputs (i.e. true differential driver connected between Step+ and Step-) the PDS-E Series drive can be used with the same connections as the previous version.

Note that to achieve adequate noise immunity with single-ended inputs, signal filtering is used. This limits the minimum pulse width to 8µs and the frequency to 50KHz. Therefore the maximum shaft speed at full resolution (4000 steps/rev) is 750 rpm. The full 3000 rpm range can only be achieved at resolutions of 1000 steps/rev or lower.

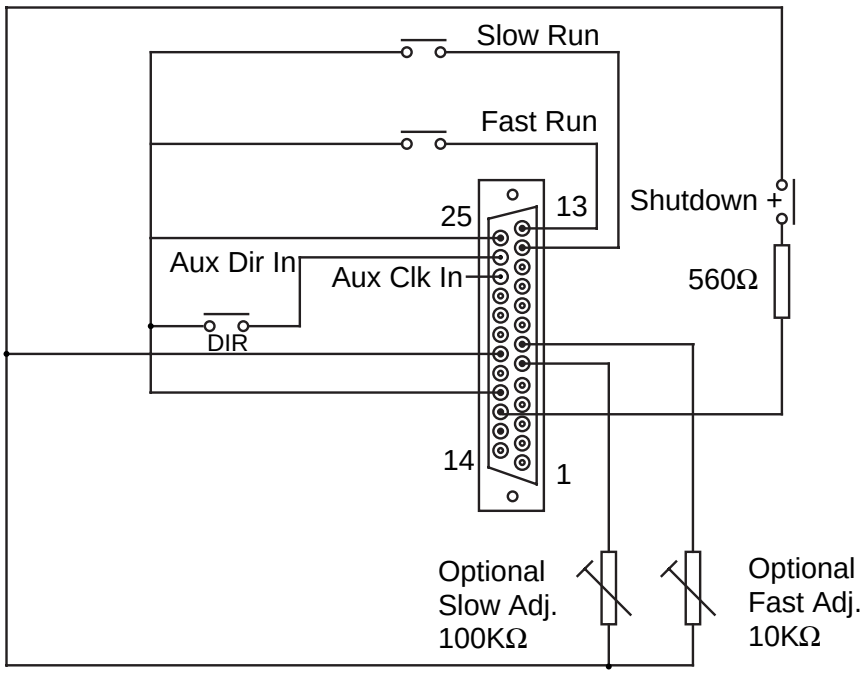
Internal Speed Control

The drive contains a two speed oscillator circuit to allow “jogging” of the motor. This clock source produces a linear ramp up to the FAST speed setting. The SLOW speed setting is not ramped. Three 20 turn potentiometers are provided on the front panel to adjust the settings of the oscillator. The SLOW and FAST presets adjust the frequency of the corresponding range and hence the motor velocity. Note that motor resolution does not effect the velocity setting. Clockwise rotation of a potentiometer produces an increase in motor velocity. The FAST and SLOW potentiometers can optionally be replaced by externally wired, remote potentiometers - see Figure 3-7. These external controls can be used to give a machine operator remote control of the motor.

Clockwise rotation of the ACCEL potentiometer increases the rate of motor ramp up to a maximum possible figure of 500 rps^2. The ACCEL potentiometer can not be replaced by an external variable resistor.

Optional Advance Rate Pot and Switch Connections

Figure 9 shows typical external connections required when using the internal clock source. External variable resistance values of 100KΩ for Slow and 10KΩ for Fast are recommended. When using external speed controls, turn switch 3 off in order to isolate the internal potentiometers.



Note: Screened cable should be used (maximum length 2 metres)

Figure 3-7. Signal Connections

Input Circuits

The Step, Direction and Shutdown inputs are configured as differential TTL compatible opto-isolated inputs with reverse polarity protection. Figure 3-8 shows details of the input circuits used.

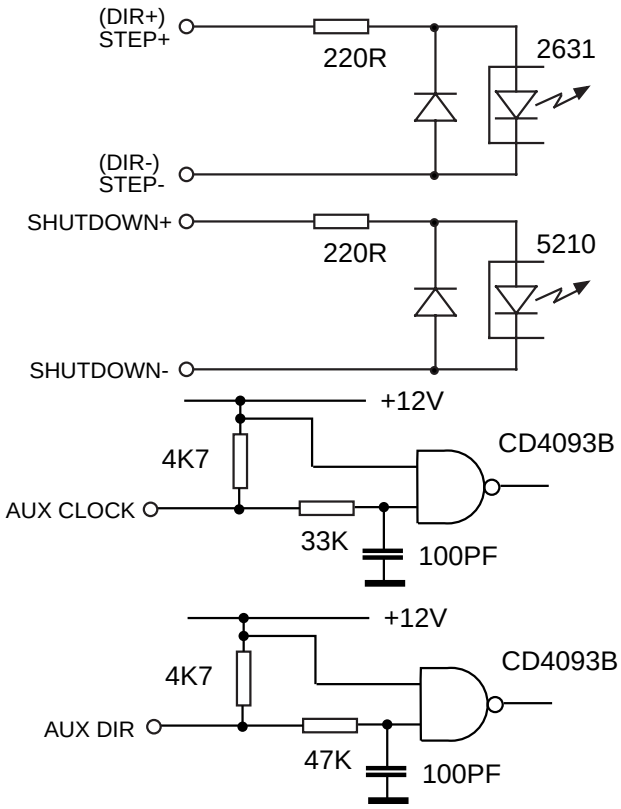


Figure 3-8. Drive Input Circuits

Mechanical/Environmental

Enclosure Considerations

The drive and its switch mode power supply are contained in a single case measuring 270mm (10.6 inches) High, by 55mm (2.2 inches) Wide, by 202mm (8.0 inches) Deep.
Note: Enclosure depth does not take connector dimensions into account. These need an additional 60mm.

Environmental Specifications

Digiplan recommends you operate and store your PDS-E Drive system under the following conditions:

- Operating Temperature: 0° to 40°C (32° to 104°F), or 0° to 50°C (32° to 122°F) if there is no user access to the case
- Relative Humidity: 0% to 95% (non-condensing)
- Storage Temperature: -40° to 85°C (-40° to 185°F)

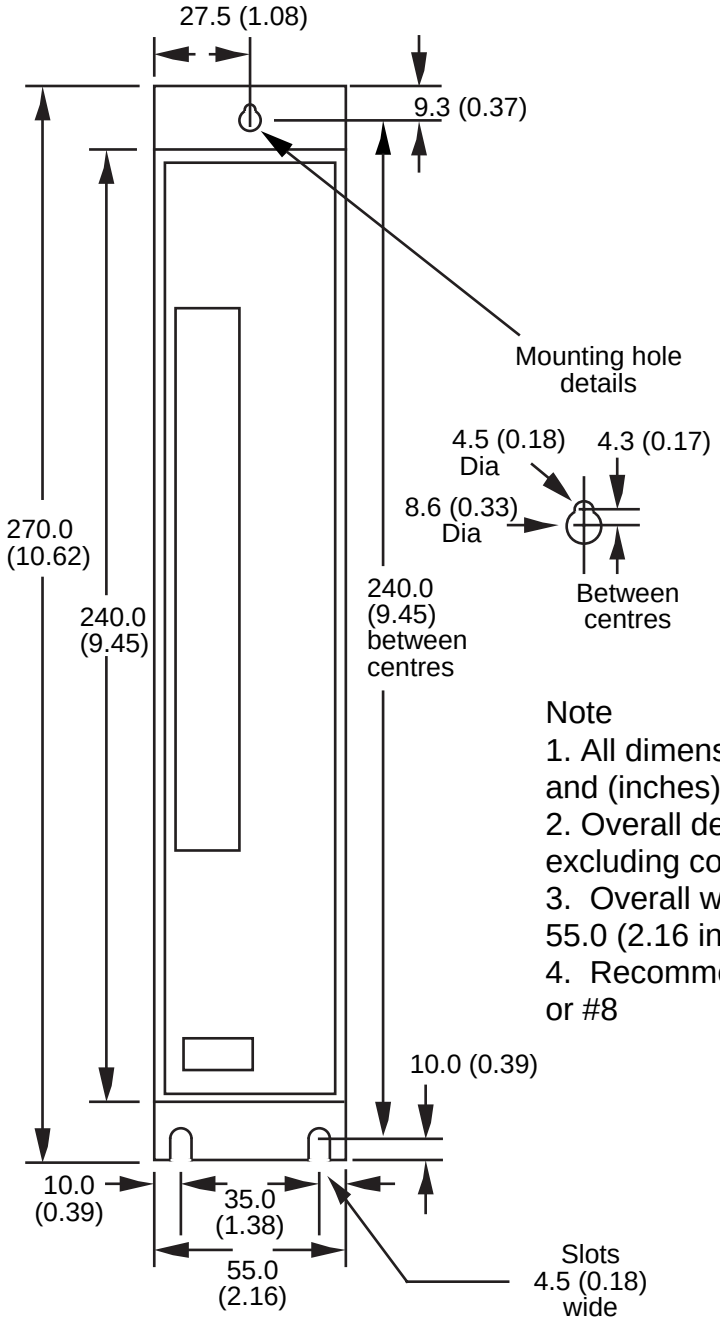
The recommended orientation of the drive enclosure is back panel, vertical mounting.

In exceptional circumstances, such as running the motor continuously at maximum current, forced-air cooling may be needed to maintain the local ambient temperature within specification.

Installation Considerations

The drive should be installed vertically as shown in Figure 3-9. Air vents on the top and bottom panels allow convection cooling. At least 50mm minimum clearance around the air vents is recommended for unobstructed ventilation and reliable operation.

The drive is designed for Installation Category II (see IEC 664). This means that transient voltages on the local mains supply are not expected to exceed 2,500V. The environment should conform to Pollution Degree 2, i.e. no conductive foriegn matter (either solid or liquid) should be allowed to enter the case.



Note
1. All dimensions are given in millimetres and (inches).
2. Overall depth is 190mm (7.5 inches) excluding connectors.
3. Overall width including screw heads 55.0 (2.16 inches)
4. Recommended fixing screw size M4 or #8

Figure 3-9 Drive Mounting Hole Locations

Section 4. HARDWARE REFERENCE

PDS-E Series Drive Specifications

Parameter	Value
Amplifiers	
Type	MOSFET Chopper
Motor resolution	400, 1000, 2000 and 4000 steps/rev (user-selectable)
Protection	
Short circuit	Phase-to-phase, across phases and phase to ground
Peak output current	3A/phase (PDS13E), 5A/phase (PDS15E) - switch reduceable
Standby current reduction	To 80% or 50% of programmed peak value after 100ms (switch-selected)
Maximum stepping rate	200kHz @ 4000 steps/rev (using differential inputs) 50kHz @ 2000, 3000 or 4000 steps/rev (using Aux clock input)
Nominal chopping frequency	20kHz
Command Interface	
STEP/DIR/SHUTDOWN	
Configured as differential opto-isolated inputs	
Drive requirements	3 to 5V differential
max input current	21mA
min input current	10mA
STEP	
Minimum pulse width	1µs
Max. frequency	200kHz
Drive clocks on transition to state ()	STEP+(high) STEP-(low)
DIR	
Shaft reversal on transition	DIR+, DIR-
AUX CLK/DIR	
Configured as single-ended, non-isolated inputs	
Drive requirements	Low <+2V, High 10-12V, (4K7 pull-up to +12V built-in)
AUX CLK	
Minimum pulse width	8µs
Max. frequency	50kHz
AUX DIR	
Shaft reversal on transition	Change of logic state
SHUTDOWN	
Motor shutdown on transition to state ()	SHUTDOWN+(high) SHUTDOWN-(low)

Table 4-1. PDS-E Series Drive Specifications

PDS-E Series Drive Specifications (Continued)

Command Interface continued	
Fault	Unassigned NPN transistor (see figure 7) Active Low (transistor switched to 0V) +1.0V max. @ 5mA max. High (transistor off) +24V max.
Internal clock out	Open collector NPN transistor - emitter connected to drive 0V (GND)
Power up reset time	1 - 2 secs
AC Power input	
Drive supply voltage	95V to 264V AC (absolute limits)
Supply frequency range	47 to 63Hz
Power factor	Better than 0.9 over input voltage range and output power range
Maximum input power	200VA (PDS13E), 300VA (PDS15E)
Input current:	
PDS13E	2A rms max (at 100V)
PDS15E	3A rms max (at 100V)
Recommended supply protection	3A MCB type 'C' characteristics
Internal Clock Source	
Speed range	
Fast	1 rps - 50 rps
Slow	0.05 rps - 2.0 rps
Acceleration/deceleration range	20.0 - 500 rps^2
Internal clock out signal	1µs pulse width (fixed)
Output current range	
PDS13E	0.9A - 3A (300mA steps)
PDS15E	2.5A - 5A (350mA steps)
Standby reduction	50% or 80%
Environmental	
Drive dimensions	Height 270mm(10.6in), Width 55mm (2.2in), Depth 202mm (8in)
Weight	1.9Kgms (4.2lbs)
Operating temperature range	0° - 40°C (32° - 104°F), or 50°C (122°F)if no user access to case
Ingress protection	IP20
Max. power dissipation of drive unit	
PDS13E	18Watts
PDS15E	28Watts
PDS15E-D	43Watts
Motors	
Type	2-Phase hybrid or permanent magnet (normally 1.8°)
Number of leads	4, 6, or 8 (5 lead not suitable)
Minimum Motor Inductance	1mH
Optimum Inductance range	1mH-10mH
Power/Motor connection	refer to ***Installation***

Table 4-1. PDS-E Series Drive Specifications (Continued)

Control I/O Signal Specification

Pin	Name	I/O	Min. on State Current	Max. Current	Nominal Voltage	Signal Levels	Comments
1 14	STEP+ STEP-	I	10mA	21mA	5V	TTL	note 1, 2, 4
2 15	DIRECTION+ DIRECTION-	I	10mA	21mA	5V	TTL	note 1, 2
6	Slow Adjust	I	-	20mA	12V	-	-
7	Fast Adjust	I	-	20mA	12V	-	-
9 21	Fault+ Fault-	O	-	5mA (at 1.0V)	24V	Unassigned transistor 26V max.	Active Low under fault condition note 3
12	Slow Run	I	-	2.5mA	12V	Low <+2V High = O/C	Active low
13	Fast Run	I	-	2.5mA	12V	Low <+2V High = O/C	Active low
16 17	Shutdown+ Shutdown-	I	10mA	21mA	5V	TTL	note 2
19	Adjust Common	O	-	20mA	12V	-	-
20	Internal clock out	O	-	15mA	24V	Open collector Low <250mV @ I_C 10mA	Active low
23	Aux Clock In	I	-	2.5mA	12V	Low <+2V High = O/C	Active low note 2, 5
24	Aux Direction In	I	-	2.5mA	12V	Low <+2V High = O/C	note 2, 6
25	GND	I/O	-	-	-	-	Signal return

Table 4-2. Control I/O Signal Specification

note 1 Do not change state of ‘DIRECTION+’ and ‘DIRECTION-’ inputs within 2.5µs of STEP transition to STEP+ high, STEP- low.
note 2 See Figure 10 for input circuit.
note 3 See Figure 7 for output circuit.
note 4 Mininum pulse width 1µs, maximum frequency 200kHz.
note 5 Mininum pulse width 8µs, maximum frequency 50kHz.
note 6 Do not change the state of ‘AUX DIRECTION’ within 8µs of ‘AUX CLOCK’ transition from high to low.

Fuses

PDS-E drives are fitted with fuses which limit circuit damage in the event of a fault occurring, they are not user replaceable. If the drive fails to operate correctly or you suspect a fuse has blown return the drive for repair. See ***Returning The System*** in the ***Maintenance and Troubleshooting*** section. Warranty is void if the case is opened.

Section 5. MAINTENANCE & TROUBLESHOOTING

Maintenance

Routine maintenance is not necessary, but occasional checking of the following points is recommended.

Motor Maintenance
Periodically check the motor to ensure that no bolts or couplings have become loose during operation, and check the motor cable or leads periodically for signs of wear. Do not make very tight bends or pull on the cable during normal operation. Check all cable connectors.

Drive Maintenance
Check that the drive is clear of loose material and has a free flow of air through the ventilation slots. Enclosures must be connected to earth ground to provide a low-impedance path for ground-fault or noise-induced currents. Check the security of the ground connections.

Fuses

PDS-E drives are fitted with fuses which limit circuit damage in the event of a fault occurring, they are not user replaceable. If the drive fails to operate correctly or you suspect a fuse has blown return the drive for repair. Warranty is void if the case is opened.

Troubleshooting

Fault LED

The red LED indicates one of the following fault conditions:

1. Motor wiring short-circuit either across phases or between phases.
2. Motor wiring short-circuit phase to GND (earth).
3. Motor supply overvoltage or undervoltage.
4. Internal supply failure.
5. Drive internal overtemperature.

The fault LED will also light up if the motor is decelerating a high - inertia load too quickly. The drive will shut down under this condition. If this occurs, you can either reduce the deceleration rate/load inertia, or use a PDS15E-D (power dump option). See INSTALLATION section for more information on the regenerative power dump option.

Note that the fault LED comes on momentarily when power is removed from the drive. This is caused by the supply rails dropping below a safe operating level, and is an indication that the fault circuitry is functioning correctly. You should always ensure that the fault LED is extinguished before re-applying the power.

Motor Fails to Move

Test the motor to see if it has holding torque. If there is no holding torque, here are some probable causes:

- There is no power.
- Current DIP switch selection is not set properly.
- There are bad connections or bad cables in the motor circuit. Disconnect the power to the drive and remove the motor connector. Using a meter, check the continuity in the motor circuit between pins A+ and A- of the motor connector. Repeat for pins B+ and B-.
- Check the resistance of the motor and cables to make sure that shorts do not exist between phases or to earth GND. The resistance across each motor phase should be consistent and there should be no connection between motor phases and between each phase and earth ground.
- Check the motor cables for signs of damage.
- The shutdown input may be active.
- If the power LED is out and the motor will not energise, the drive must be returned for repair.

If the unit has holding torque and the motor shaft still fails to move, here are some possible causes:

- The load is jammed. You should *hear* the drive attempting to move the motor. Remove power from the driver and verify that you can move the load manually away from the point of the jam.
- Clock pulses are not reaching the drive, or the signal levels are inadequate. If possible, check the signal levels with an oscilloscope. Try running the motor using the self-test switch.

Motor Stalls

A motor stall during acceleration may be caused by one or more of the following factors:

- The torque requirements may be excessive.
- The acceleration ramp may be too steep - lower acceleration may be required. Check the torque/speed curves in the published data and make sure you are trying to run the motor within the system capabilities.
- The load inertia and rotor inertia may be grossly mismatched.

If the motor stalls during the constant velocity portion of a move, the shaft and/or coupler may be damaged or binding due to improper coupling or excessive motor load.

A stall may occur if the switch setting for the motor current selection is incorrect. The motor may not be receiving enough current to drive the load.

Motor is Jerky or Weak

Check that there are no mechanical problems at the load causing variable loading conditions. Disconnect the motor from the load and run it without a load connected. Check the switch current settings.

Motor Overheats

If the motor exceeds its maximum motor case temperature rating, failure will eventually result. Check your switch settings to ensure that the current setting is correct for the motor you are using.

Motor Runs the Wrong Way

Turn off the power and interchange the connections between A+ and A- on the motor connector.

Internal Clock Source Won't Run

If no external speed controls are used, check that switch 3 is ON so that the internal potentiometers are functional.

Self Test Fails to Run Motor

See above.

Returning the System

In the event that the drive is considered to be faulty, it should be returned for repair. Do not attempt to open the case - there are no user-serviceable parts inside. Opening the case not only voids the warranty but may also invalidate the EMC compliance.

Contact the Parker Automation Technology Centre or the machinery manufacturer who supplied the product. Equipment for repair should NOT be returned directly to Digiplan without prior authorisation. Repairs will be carried out by Digiplan but will be processed via your supplier.

Digiplan may at their discretion authorise direct shipment to and from Poole or Rohnert Park, but only by prior arrangement with your supplier. Existing UK and USA customers who purchase equipment directly from Digiplan should contact Poole or Rohnert Park for further information (contact numbers are at the front of this User Guide).

Index