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Compumotor

CE

PK2 Packaged Stepper Drive User Guide

1600.062.07—January, 1997

Compumotor Division
Parker Hannifin Corporation
p/n 88-007546-01A October 1997

Parker
Automation

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CE

PK2 Packaged Stepper Drive

User Guide

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IMPORTANT INFORMATION FOR USERS

Installation and Operation of Digiplan Equipment

It is important that Digiplan motion control equipment is installed and operated in such a way that all applicable safety requirements are met. Note that it may be necessary for the completed installation to comply with the Low Voltage Directive or Machinery Directive. It is your responsibility as an installer to ensure that you identify the relevant safety standards and comply with them; failure to do so may result in damage to equipment and personal injury. In particular, you should study the contents of this user guide carefully before installing or operating the equipment.

The installation, set-up, test and maintenance procedures given in this User Guide should only be carried out by competent personnel trained in the installation of electronic equipment. Such personnel should be aware of the potential electrical and mechanical hazards associated with mains-powered motion control equipment - please see the safety warning below. The individual or group having overall responsibility for this equipment must ensure that operators are adequately trained.

Under no circumstances will the suppliers of the equipment be liable for any incidental, consequential or special damages of any kind whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this user guide.



SAFETY WARNING

High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. ***KEEP WELL CLEAR*** of any machinery driven by stepper or servo motors. Never touch any part of the equipment while it is in operation.

This product is sold as a motion control component to be installed in a complete system using good engineering practice. Care must be taken to ensure that the product is installed and used in a safe manner according to local safety laws and regulations. In particular, the product must be enclosed such that no part is accessible while power may be applied.

If the equipment is used in any manner that does not conform to the instructions given in this User Guide, then the protection provided by the equipment may be impaired.

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Since Digiplan constantly strives to improve all of its products, we reserve the right to modify equipment and user guides without prior notice. No part of this user guide may be reproduced in any form without the prior consent of Digiplan.

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User Guide Change Summary

The following is a summary of the primary changes to this user guide since the last version was released. This user guide, version 1600.062.07, supersedes version 1600.062.06.

When a user guide is updated, the new or changed text is differentiated with a change bar in the outside margin (this paragraph is an example). If an entire chapter is changed, the change bar is located on the outside margin of the chapter title.

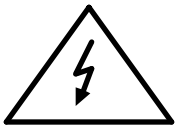
Major changes introduced at revision 07 are:

Change of mains fuse type for the 115V version

Warning symbols used on the PK2 series of drives have the following meanings:



Refer to the accompanying documentation



Risk of electric shock



Hot surface



Protective conductor terminal

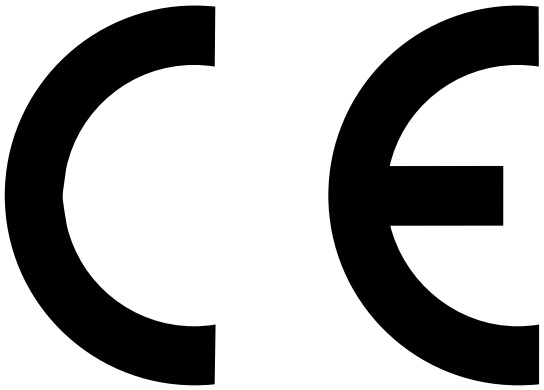


Alternating current



Frame or chassis terminal

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Product Type: **PK2 Packaged Stepper Drive**

The above product is in compliance with the requirements of directives

- **73/23/EEC** **Low Voltage Directive**
- **93/68/EEC** **CE Marking Directive**

The PK2 drive is sold as a complex component to professional assemblers, as a component it is not compliant with Electromagnetic Compatibility Directive 89/336/EEC.

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Chapter 1. GENERAL DESCRIPTION

Introduction

The PK2 bipolar stepper drive is a packaged version of the SD2 model, and has been designed primarily for single-axis applications. It is suitable for most positioning applications and operates with a wide range of motors. Incorporated in the drive is a toroidal mains transformer, and all power supply components necessary for direct operation from the AC mains supply. There is also an 8-way DIL switch which enables the drive operating conditions to be programmed, and a protection circuit guards against short circuits across or between motor windings (not to ground). Additional features include an internal oscillator, multi-turn preset controls and standby circuit.

Two versions are available: PK2/115V and the PK2/230V. It is not possible to change the voltage setting.

Specification

Drive circuit	Bipolar chopper-regulated with overload protection
Switching sequence	Full step or half step
Nominal output current	2A/phase (current may be set to lower value by means of DIL switch)
Drive supply voltage	36v DC
Suitable motor type	4, 6, or 8-lead (5-lead not suitable) Hybrid or Permanent magnet
Minimum motor inductance	1mH
Nominal chopping freq.	15kHz
Internal oscillator	Slow (not ramped) 40-1,000 steps/sec
Speed ranges	Fast (ramped) 400-10,000 steps/sec
Acceleration time	60mS
Deceleration time	30mS These times may be increased by fitting additional capacitor
Fault output circuit	Open-collector NPN transistor
Fault output logic levels	Low (transistor switched to 0v) +1v max. at 25mA max. High (transistor off) + 24v max.
Input impedance	4K7 pull-up to +12v

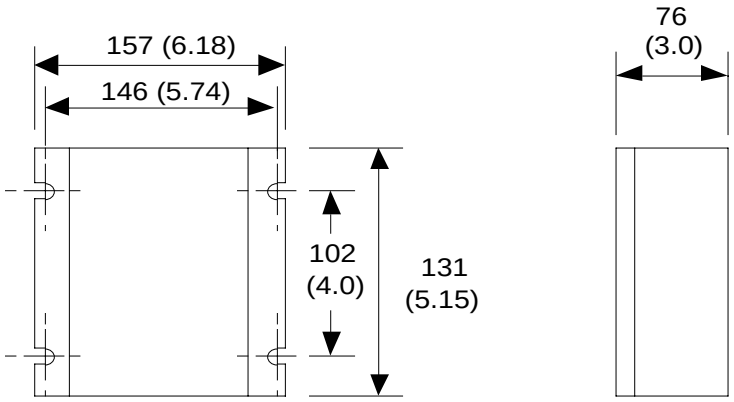
Table 1-1. PK2 Specifications

AC mains input PK2/115V PK2/230V	 110 - 120V AC (±10%) 220 - 240V AC (±10%)
Input frequency range	47 - 63Hz
Input power	100VA
Ambient temperature range	0°-40°C

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Dimensions	157mm x 76mm x 131mm
Weight	2Kg

Table 1-1. PK2 Specifications (continued)



Dimensions in mm(inches)

Figure 1-1. Dimensions in mm (inches)

Fuse Ratings

One internal fuse is fitted to the drive power supply circuit. This is a 32mm time lag type with the following rating:

FS1 (motor supply DC fuse) 3.15A T LBC 6.3 x 32mm

There is also a mains fuse in the IEC mains input socket, accessible from outside the enclosure, with the following rating:

For the 230V version

Mains connector fuse 1A T HBC 5 x 20mm

For the 115V version

Mains connector fuse 2A T HBC 5 x 20mm

LED Functions

There are two LEDs on the front of the drive, and their functions are as follows:

"Power" LED (green): Indicates that power is applied to the drive.
"Fault" LED (red): Indicates that a fault condition has arisen.

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Chapter 2. INSTALLATION

Installation

Mounting

PK2 drives must be installed by competent personnel familiar with the the installation, commissioning and operation of motion control equipment. In the final application the equipment must be enclosed to prevent the operator coming into contact with any high voltages.

The PK2 drives are not EMC compliant, they are sold as a complex component for use by professional assemblers of motion control systems.

Metal equipment cabinets offer the most advantages for siting the equipment since they can provide operator protection, EMC screening and can be readily fitted with interlocks arranged to remove all AC power when the cabinet door is opened.

The drive may be mounted in any orientation. However, there are a number of factors to be borne in mind when deciding on the location.

(a) The ambient temperature range for safe operation is 0°-40°C. However, for continuous or high duty cycles and in applications where the shaft power is more than 15 watts, forced cooling may be necessary. It is therefore preferable for the drive to be mounted on open rails to allow the maximum unobstructed air flow.

(b) Where there is a considerable distance between the control system and the motor, the drive should generally be located as close to the control system as possible. Long motor leads seldom present a problem as long as they have a low resistance, but low-level control signals may become prone to pickup or crosstalk problems over long distances.

(c) For setting up purposes, it is desirable to have easy access to the front panel of the drive. However, in the final installation, operator access should be prevented.

A disconnect device must be provided which isolates all mains supply current-carrying conductors. If the mains supply is permanently connected, a switch or circuit breaker must be included in the wiring. It must be placed close to the equipment (less than 1 metre) and marked as the disconnecting device for the equipment.

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Specifications

The operational temperature range for the drive system is:

- Operating Temperature: 0° to 40°C (32° to 102°F)
- Relative Humidity: 0% to 95% (non-condensing)
- Storage Temperature: -40° to 85°C (-40° to 185°F)

Refer to the manufacturer's environmental specifications for the maximum motor case temperature when it is in operation. This may be a hazard to system operators.

The mains input to the drive must be Installation Category II maximum.

PK2 drives can be used in a Pollution Degree 2 environment i.e., one in which only non-conductive pollution occurs.

You should install the drive system in an enclosure to protect it against atmospheric contaminants such as oil, moisture, dirt and to prevent operator access. In the USA, the National Electrical Manufacturers Association (NEMA) has established standards that define the degree of protection that electrical enclosures provide. The enclosure should conform to NEMA Type 12 standards if the intended environment is industrial and contains airborne contaminants. Proper layout of components is required to ensure sufficient cooling of equipment within the enclosure.

Mains Supply

Using a minimum wire size of 24/0.2mm (18AWG) and the connector supplied, the supply should be made to terminals marked L and N, and the earth to the terminal marked E. Use approved mains cable for the supply and keep it separate from the motor and signal wiring.

The equipment must be earthed.

Two versions of the drive are available:

PK2/115V
PK2/230V

The voltage setting cannot be changed.

Motor Connections

Use16/0.2mm (20 AWG, CSA 0.5mm^2) wire (or larger) for motor connections.

Connect the motor leads to terminals 1A, 1B, 2A and 2B using the connection data supplied. Connect one phase of the motor to terminals 1A and 1B, and the other phase to terminals 2A and 2B. To reverse the direction of rotation relative to the direction control input, interchange the connections to 1A and 1B (see page 11).

It can be seen in Figure 2-1 that the motor windings may be connected either in series or parallel. The preferred connection

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mode depends on the application since the performance characteristics differ (see Figure 2-2).

Series connection gives double the ampere-turns of a single coil at a given current and there is therefore a significant increase in low-speed torque. However, the inductance per phase is increased to four times the inductance of one coil, causing the high-speed torque to drop off more rapidly.

Parallel connection on the other hand results in less torque at low speeds, but the torque will be maintained to higher stepping rates. The maximum power obtainable from the motor is greater in the parallel mode. With a six-lead motor, the two halves of each winding cannot be connected in parallel. However, using one half of each winding produces the same torque as an equivalent 8-lead motor connected in parallel. The advantage of parallel connection is a reduction in resistive losses which allows a higher current to be used.

It is most important that any unused motor leads are individually insulated, and under no circumstance should they be joined together unless this is specified in the motor connection data. Do not attempt to use a 5-lead motor with this drive.

NOTE: If the PK2 was sold with a QM or RM motor (sold in the USA) refer to the "Digiplan Motor User Guide" supplied with the motor, or call Digiplan USA. This motor user guide contains complete wiring and current information for these motors.

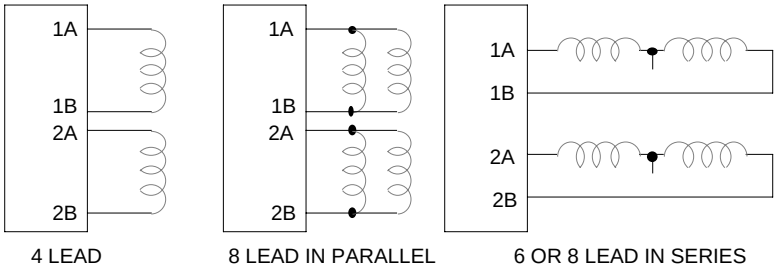
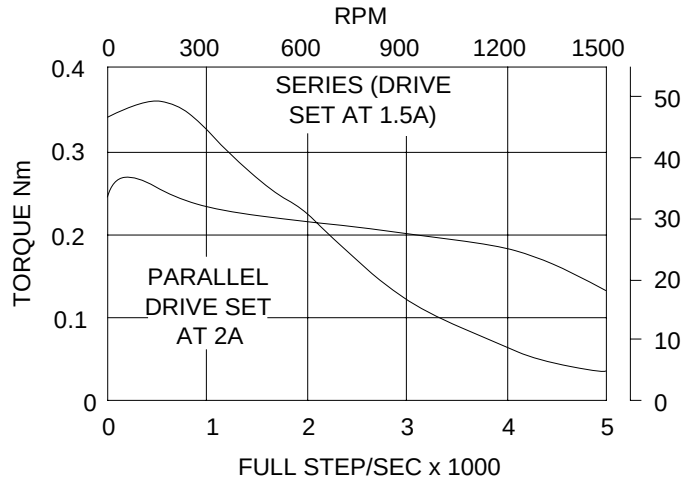


Figure 2-1. Motor Connection Methods

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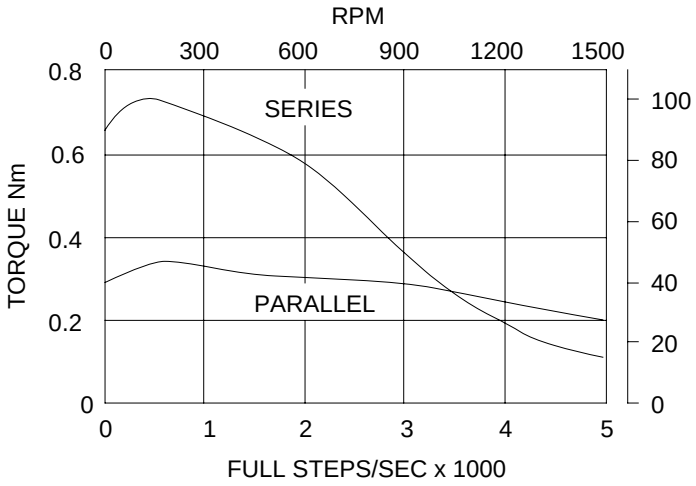


Figure 2-2. Typical Performance Characteristic Curves

Motor Cable The recommended gauge for PK2 drives is greater or equal to 0.5mm^2. Use a cable containing four conductors plus the braided screen. The temperature rating of the cable must be greater than or equal to the motor case temperature and should be at least 80°C.

Motor Earth The motor body must be reliably earthed.

WARNING: The case of a motor can become very hot. Precautions may need to be taken to prevent operator contact.

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N.C. - no connection.

MAKE	TYPE	1A	1B	2A	2B	NOTES
Evershed & Vignoles	6-lead	Red	Green	Blue	Yellow	Brown & Black N.C.
	8-lead	Red	Green	Blue	Yellow	Link Grey & Pink, link White & Violet
	T.box	1	3	4	2	Link 5 & 6, link 7 & 8
Sigma	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
Astrosyn, Rapidsyn, Slo-syn	6-lead	Red	Red/Wh	Grn	Grn/Wh	White & Black N.C.
	T.box (x6)	1	3	4	5	2 & 6 N.C.
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	8-lead	Red	Yel	Pink	Blk	Link Blue & violet, link White & Grey
	T.box	1	2	3	4	Link 5 & 6, link 7 & 8
G.E.C.	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/Blk & Wh/Org, Link Wh/Red & Wh/Yel
	T.box	6	5	8	7	Link 1 & 3, link 2 & 4
Zebotronics	T.box	1	4	5	8	Link 2 & 3, link 6 & 7
Oriental	6-lead	Black	Green	Red	Blue	Yellow & White N.C.
Sonceboz	8-lead	Green	Grn/Wh	Red	Red/Wh	Link Org & Blk/Wh, link Black & White
Japan Servo	6-lead	Red	Blue	Green	Yellow	2 x White N.C.
Escap	8-lead	Brown	Org/Wh	Red	Yel/Wh	Link Brn/Wh & Org, Link Red/Wh & Yellow.
Bodine	8-lead	Brown	Orange	Yellow	Red	Link Wh/Brn & Wh/Org, link Wh/Yel & Wh/Red.
	T.box	1	3	4	2	Link 5 & 7,link 6 & 8
Digiplan/Compumotor RM Motor	8-lead	Black	Orange	Red	Yellow	LinkWh/Blk & Wh/Org. Link Wh/Red & Wh/Yel
Digiplan/Compumotor QM Motor	8-lead	Red	Black	White	Green	Link Yel & Blue Link Org & Brown

Table 2-1. Motor Connection Data - Windings in Series

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

MAKE	TYPE	1A	1B	2A	2B	NOTES
Evershed & Vignoles	6-lead	Red	Brown	Blue	Black	Grn & Yellow N.C.
	8-lead	Rd & Pink	Grn & Grey	Blue & Violet	Yel & White	
	T.box	1 & 6	3 & 5	4 & 8	2 & 7	
Sigma	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	
Astrosyn, Rapidsyn, Slo-syn	6-lead	Red	Black	Green	White	Red/Wh & Grn/Wh N.C.
	T.box(x6)	1	6	4	2	3 & 5 N.C.
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	8-lead	Rd & Blue	Yel & Violet	Wh & Pink	Black & Grey	
	T.box	1 & 6	2 & 5	3 & 8	4 & 7	
G.E.C.	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	
Zebotronics	T.box	1 & 2	3 & 4	5 & 6	7 & 8	
Oriental	6-lead	Black	Yellow	Red	White	Grn & Blue N.C.
Sonceboz	8-lead	Grn & Blk/Wh	Or & Grn/Wh	Red & White	Blk & Red/Wh	
Japan Servo	6-lead	Red	White*	Green	White*	
Escap	8-lead	Brn & Orange	Brn/Wh & Org/Wh	Red & Yellow	Red/Wh & Yel/Wh	
Bodine	8-lead	Brn & Wh/Or	Wh/Brn & Orange	Yel & Wh/Red	Wh/Yel & Red	
	T.box	1 & 7	3 & 5	4 & 6	2 & 8	
Digiplan/Compumotor RM Motor	8-lead	Black & Wh/Or	Orange & Wh/Black	Red & Wh/Yellow	Yellow & Wh/Red	
Digiplan/Compumotor QM Motor	8-lead	Red & Blue	Blk & Yellow	Wh & Brn	Green & Org	

* Use correct White for each phase.

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

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Control Signal Connections

All control signals and motor connections are made to a two-part terminal block.

Signal connections should be made with a minimum wire size of 7/0.2mm (24 AWG). To reduce the effect of radiated electrical noise it is suggested to use screened cable for all control signals and care should be taken to ensure that the screen is grounded at one end only.

Description of Terminal Functions

1A, 1B, 2A and 2B: refer to motor connections on page 4.

0v: Use this terminal as the common return point for the control signals.

Fault output: This is an open-collector output which goes high in the event of a drive fault (overload or supply failure). The maximum on-state current is 25mA and the maximum off-state voltage +24v.

If a relay is used at this output, a diode (IN4148 recommended), should be connected across its energising coil, as shown in Figure 2-3, to protect against damage to the output transistor by reverse voltage when the coil is de-energised.

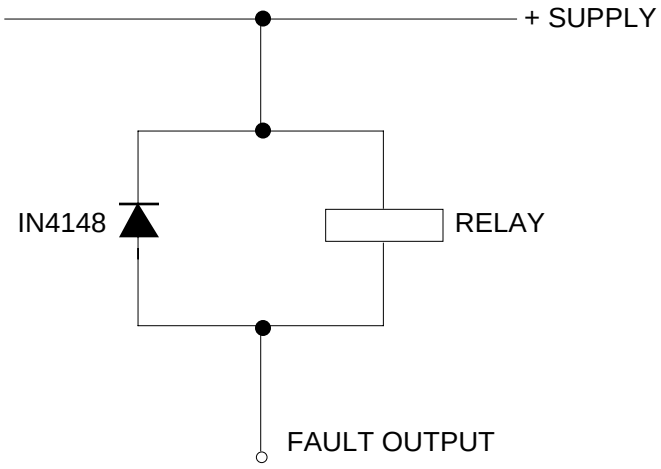


Figure 2-3. Typical Relay Output Circuit

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Energise/Reset: This input enables the motor to be de-energised and also resets a fault condition, provided the cause of the fault has been removed. When the input is taken high, the drive will be de-energised and if it is safe to do so, the motor shaft may be rotated slowly by hand. Taking the input high will also reset a fault condition, and the drive will re-energise when the input returns low. The "energise" switch must be off when this terminal is being used.

Dirn.: Connect to 0v to reverse the direction of motor rotation.

Ck. in: The motor will step following a low-going transition on this input. The input should remain low for at least 10µS. This input is driven from the internal oscillator on the drive but can also be driven from an external source.

Slow: Connect to 0v to run the internal oscillator at the slow rate.

Fast: Connect to 0v to run the internal oscillator at the fast rate.

Fast Adj.: An external potentiometer may be connected between this terminal and Adj. com. to control the fast speed of the internal oscillator. A suitable value for the external resistor is 10K.

Adj. Com.: Common return connection for external speed controls.

Slow Adj.: An external potentiometer may be connected between this terminal and Adj. com. to control the slow speed of the internal oscillator. A suitable value for the external resistor is 100K.

Note that the direction, energise and clock inputs are all pulled-up internally to +12v via a 4K7 resistor. These inputs should therefore be driven from an open-collector output or manual switch as appropriate.

Adjustments

Switch Settings

Beside the terminal block is an 8-way DIL switch for setting the drive operating conditions, and in most applications this will be the only adjustment required.

Switch 1: Energ. Turn on to permanently energise the drive. A fault condition can be reset by momentarily turning switch 1 off.

Switch 2: Mode Turn on to select the full step mode and off to select the half step mode. Do not change the mode of operation whilst the drive is powered-up.

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Switches 3-6: Current set The following table gives the settings of these four switches for various motor currents. The actual motor current will depend partly on winding inductance, a lower inductance giving a lower average current. Note that the drive current is reduced by approximately 50% at standstill.

Nominal current	Switch settings			
	3	4	5	6
2.0A	off	off	off	off
1.8A	off	off	off	on
1.6A	off	off	on	off
1.4A	off	on	off	on
1.2A	off	on	on	on
1.0A	on	off	off	off

See note on page 4 for USA RM and QM motor current settings

Table 2-3. Settings for Switches 3 to 6

Switch 7: Slow The internal slow speed adjustment is in circuit when this switch is on. Turn off when using an external speed control.

Switch 8: Fast The internal fast speed adjustment is in circuit when this switch is on. Turn off when using an external speed control.

Internal Oscillator Ramping

The preset acceleration and deceleration times on the internal oscillator are 60µS and 30µS respectively. These times may be extended by the addition of capacitor C23, a value of 10µF will give approximately double the preset times. Use a dipped tantalum capacitor rated at 25 volts and observe the polarity. The capacitor should be top-soldered to the board, keeping the legs as short as possible. The location for C23 is at the side of the board close to the serial number (see "Removal and Replacement of the Top Cover").

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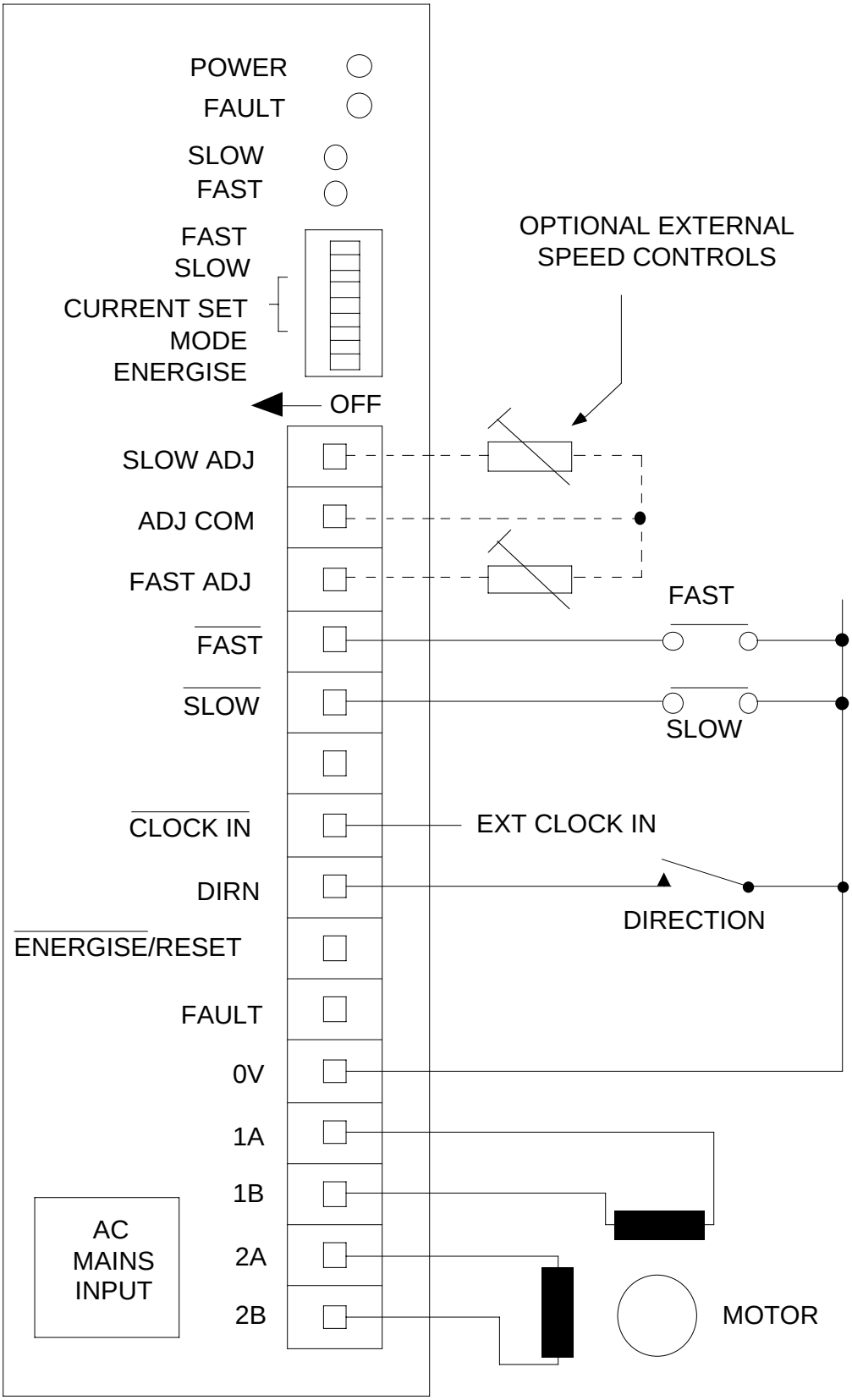


Figure 2-4. Typical Motor and Control Connections

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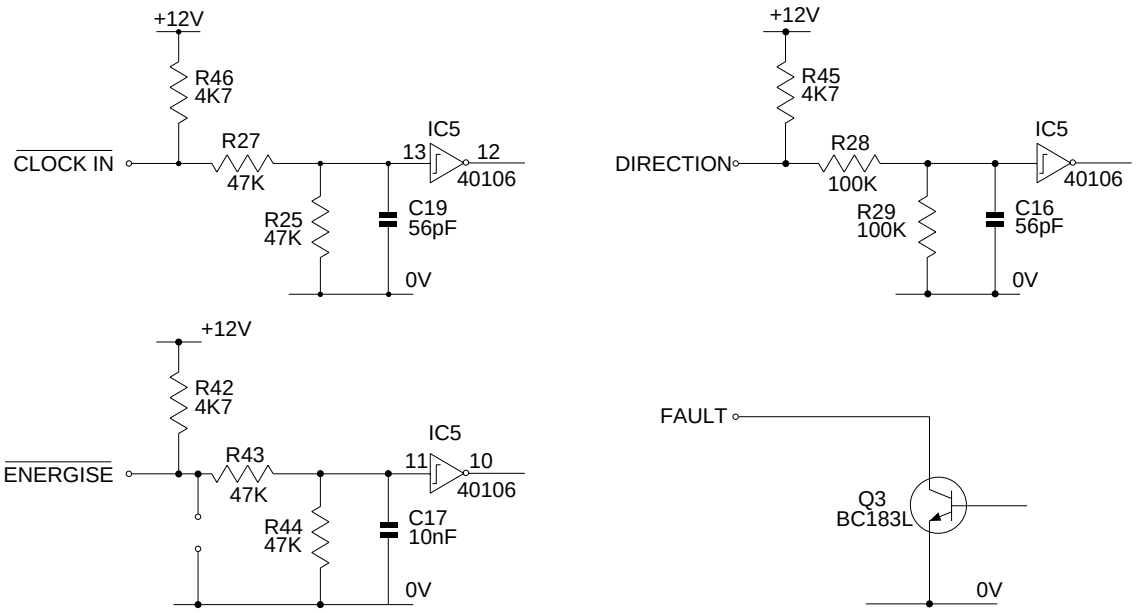


Figure 2-5. Internal Logic Interface Circuit

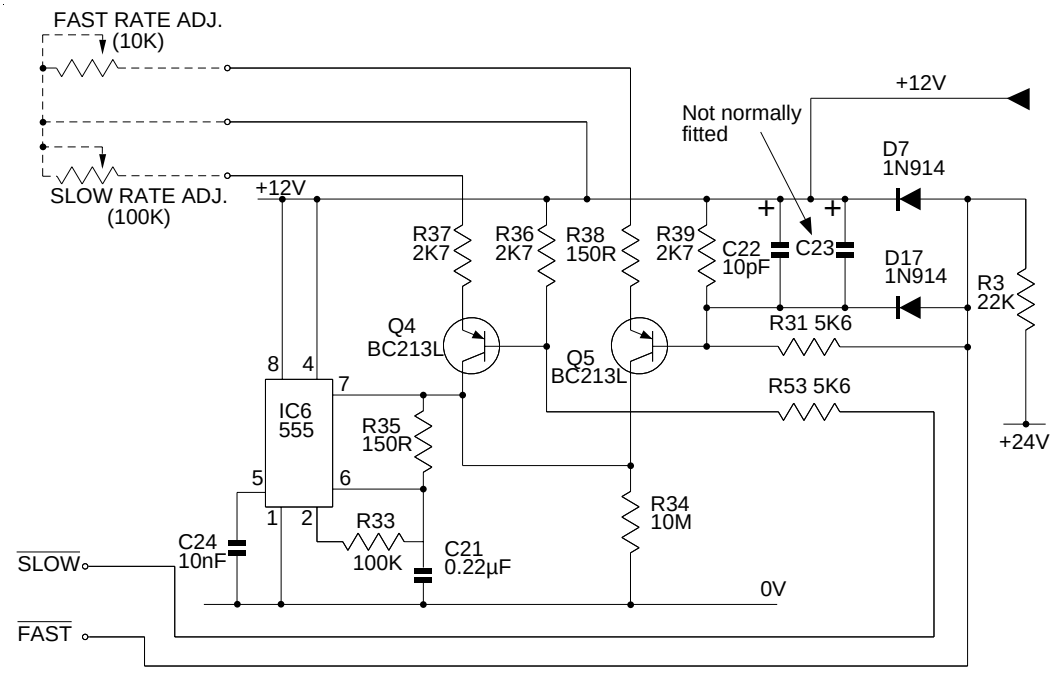


Figure 2-6. Internal Oscillator Circuit

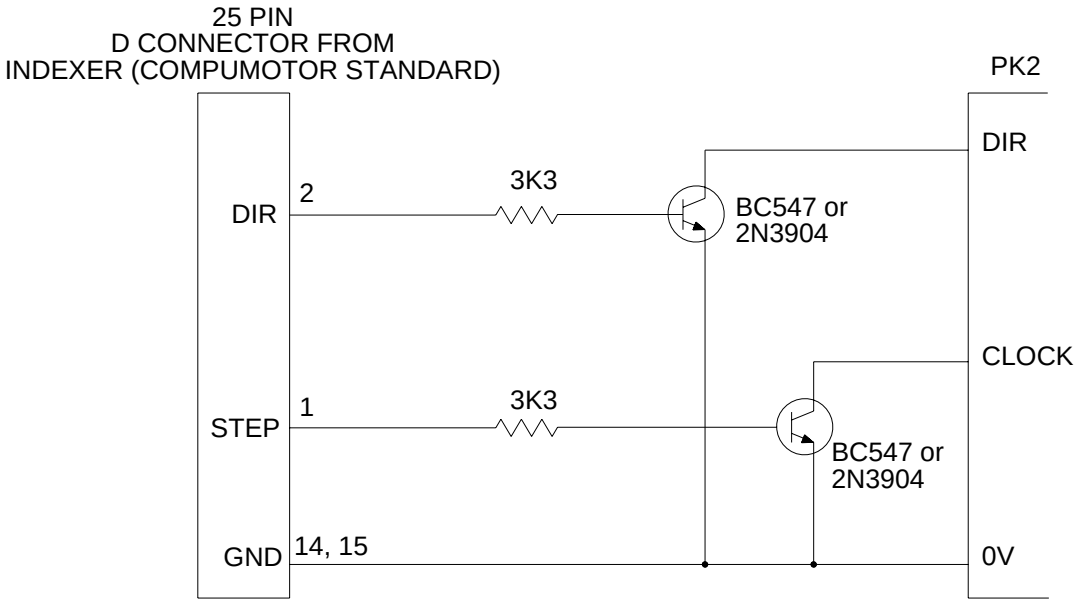


Figure 2-7. Suggested Wiring Diagram for Interfacing a Compumotor or 5V TTL Indexer with a PK2

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Chapter 3. TROUBLESHOOTING

General

In order to minimise field failures all PK2 drive modules are soak tested at high temperature. Nevertheless the occasional failure may still occur and the following guide will enable the cause of the fault to be located. Take care, unexpected motion may occur at any time whilst troubleshooting motion control equipment.

Fault-Finding Guide

If there is no response from the motor, check which LEDs are illuminated.

Green LED

Illumination of this LED indicates that there is supply to the drive. Non-illumination of the LED implies a power supply failure. Should this be the case, check that the AC supply is present. If OK, switch off, remove the cover and check the fuses on the card. If these are fine, then there is probably an internal failure within the power supply circuitry, and the drive should be returned to the manufacturers for repair.

Red LED

Illumination of this LED indicates an overload fault. Switch off, disconnect the motor and switch on again. If the the LED is still on, the drive is faulty. If not check for short circuits or crossed motor connections. A very low inductance motor could also cause the drive to trip out, if this is suspected try connecting the motor in series. Note that the current rating of the motor is halved when changing from parallel to series.

If the red LED is off and the green LED is on, and there is still no response from the motor, check that switch 1 is on (see page 9). If OK, then there is probably an internal failure and the drive should be returned for repair.

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Removal and Replacement of the Top Cover

The removal of the cover is easily achieved in the following manner:-

(a) Ensure that all supplies have been switched off and capacitors have time to discharge. Remove the AC mains plug and the 15-way connector.

(b) Remove the four M4 x 10mm bolts which secure the back panel.

(c) Unscrew the two upper M4 x 10mm bolts which hold the front panel to the top cover. The top cover can now be removed complete with the PCB. It is unnecessary to disconnect the transformer leads.

(d) When replacing the top cover, take care to relocate the LEDs correctly in the front panel.

Returning the System

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).

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