

Mclennan Servo Supplies Ltd.



Bipolar Stepper Motor Translator User Handbook

PM542

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SAFETY NOTICE!

Motor drive systems are inherently hazardous. Even a small motor, if coupled to a leadscrew, gearbox, or any other form of mechanism that provides a mechanical advantage, can generate considerable force and could cause serious injury. Incorrect operation can also lead to damage to the motor or associated machinery.



Caution

STATIC SENSITIVE DEVICES

This unit has static sensitive devices. Observe handling precautions: Hold card by edges only. Do not touch connector pins. Ship only in anti-static packaging.

1.0 Overview

This unit is designed to be an economic and compact bipolar drive for stepper motors. It conforms to the international 3U extended Eurocard standard. They are ideally suited for use with the 4 phase permanent magnet or NEMA size 23 & 34 HS series hybrid stepper motors with current ratings from 0.5 to 2.0 amps per phase. The ability to operate with rail voltages up to 30 V DC provide enhanced high speed performance with a choice of full step or half step phase control when improved low speed and mid range stability is achieved.

1.1 Features

- Chopped constant current power stages provide increased performance and reduced current consumption.
- Full or half step phase control logic.
- Suitable for 4, 6 & 8 lead size 15 to 34 hybrid and permanent magnet stepper motors.
- Current settings from 0.5A to 2A per phase, set by on board DIP switches.
- Automatic or externally controlled reduced current setting for operating motor in stationary condition.
- Opto-isolated control inputs.
- On board selection of full step/half step control.
- On board motor direction reversal.
- Heatsink overtemperature sensor with selectable automatic drive shutdown.
- On board ramping oscillator for manual control.
- Front panel status LED indicator
- Opto-isolated drive healthy status output.
- Standard 100 x 220mm extended EUROCARD format.
- PM542 is a standard MSE542 fitted with a front panel for fitting in a 3U rack.

2.0 Specifications

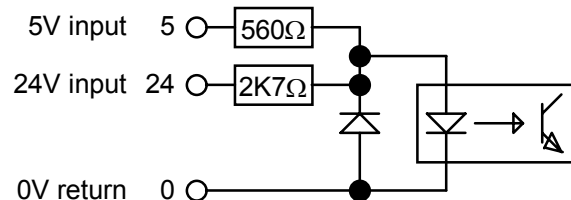
Supply:	24V DC nominal (20-32V).
Motor output:	2 phase bipolar, chopped constant current.
Current/phase:	0.5 to 2.0 amps/phase; set by on board switches.
Reduced current:	Approximately 20 - 25% of set current.
Reduced current control:	Automatic at standstill switch selectable or by external control input.
Step logic:	Full or half step; selected by on board switch.
Step control:	Opto-isolated input. 20KHz maximum, 6 μ S minimum pulse width.
Direction control:	Opto-isolated input. Sense of direction reversed by on board switch.
Enable control:	Opto-isolated input. Enable or disable selected by on board switch.
Oscillator control:	Opto-isolated inputs. OSC-RUN - Starts oscillator running. OSC-HIGH - Selects BASE speed or HIGH speed.
Oscillator speed control:	BASE set by on board pot (2-600Hz). HIGH set by external pot (600-15KHz). RAMP rate set by on board pot.
Thermal protection:	80°C thermal sensor. Automatic latched drive disable selected by on board switch. Reset on power on.
Status LED:	GREEN - Drive OK and enabled. YELLOW - Drive not enabled. RED - Fault (overtemperature).
Status output:	Opto-isolated output. 10mA maximum. On when OK.
Opto-isolated inputs:	3-5V or 10-30V inputs. Fully isolated.
Packaging:	3U high extended Eurocard for 19" rack mounting. 7E wide. 228 x 100 x 34 mm without front panel 245 x 128 x 35 mm with front panel

Warning!

Do not connect or disconnect the motor whilst the unit is powered.

3.0 Drive Control Features

This unit has opto-isolated control input that may be controlled by either 5V (nominal) signals or by 24V (nominal) signals, depending on which input terminal is used. To energise the input with a 5V signal, apply the signal between the 5 and 0 terminals. To energise the input with a 24V signal, apply the signal between the 24 and 0 terminals.



The PM542 is designed to be used either by external clock and direction signals or by the on board oscillator.

For information concerning step size selection, direction reversal, automatic power reduction, thermal shutdown and enable polarity see the **Configuration** section of this manual.

There is a front panel mounted status LED. It indicates the following states:

- GREEN - Drive OK and enabled.
- YELLOW - Drive not enabled.
- RED - Fault (overtemperature).

3.1 Use with external step and direction signals

Where the motor is to be controlled by an external controller, the step (clock) pulse and direction control outputs of the controller should be connected to the inputs of the PM542. Details of how to connect them are given in the **Installation** section of this manual.

The motor will move one step each time the STEP input is energised. The direction of movement is set by the DIRECTION input. If the sense of direction is wrong for your application, then it may be reversed by the DIRECTION REVERSE switch.

3.2 Use with on board oscillator

The on board oscillator may be used for manual switch control or PLC type control outputs. There are three control inputs associated with this; OSC-RUN, OSC-HIGH and DIRECTION. There are also the external SPEED pot and the on board MAX, RAMP and BASE pots.

When the OSC-RUN input is energised, with the OSC-HIGH input not energised, the motor will start to move at the speed set by the BASE speed pot. The direction of movement is set by the DIRECTION input. If the sense of direction is wrong for your application, then it may be reversed by the DIRECTION REVERSE switch.

If the OSC-HIGH input is energised, whilst the OSC-RUN is also energised, the speed will accelerate up to the speed set by the external SPEED pot. The acceleration is at the rate set by the RAMP pot. If the OSC-HIGH input is de-energised, then the speed will decelerate back down to the BASE speed at the RAMP rate.

If the OSC-HIGH input is permanently energised, then when the OSC-RUN input is energised, the speed will start at the BASE speed and ramp up to the SPEED pot setting. When the OSC-RUN is de-energised the speed will ramp back down to the BASE speed and then stop.

If the DIRECTION input is changed whilst the motor is moving at the high speed, then the speed will ramp down to the BASE speed before the motor direction is reversed and the speed will ramp back up to the high speed.

The high speed is set by the external SPEED pot. This pot is scaled by the MAX on board pot. The range of the SPEED pot is therefore between the BASE speed and the full scale speed set by the MAX pot.

If the SPEED pot is varied whilst the motor is moving at the high speed, then the motor speed will ramp to the new speed at the rate set by the RAMP pot.

The STEP input may be used to single step the motor, but the input should be filtered to avoid stepping on switch contact bounce.

3.3 Use of other control inputs or status output

The ENABLE input is used to enable or disable the drive. The polarity of this input is set by switch 5 of the DIP switch (see **Configuration** section of this manual). When the drive is disabled, no power is applied to the motor outputs.

When the POWER REDUCTION (PWR-RDN) input is energised, the output current is reduced to between 20 - 25% of the level set by the DIP switches. This control independent of the automatic power reduction switch (PR).

The HEALTHY output is an opto-isolated status output. This output is on when the drive is OK, but is off when the heatsink is overtemperature or when the drive has shutdown (thermal shutdown).

The Step and Direction outputs are open collector outputs to 0V. These may be used to show position on an external counter, when using the internal oscillator.

4.0 Installation

4.1 Physical installation

The drive is constructed on a single EXTENDED EUROCARD standard printed circuit board. The dimensions of the PCB are 100mm x 220mm. It is designed for mounting in a 3U high 19" rack and is normally fitted with front panel that is 7HP (approx. 1.4") wide.

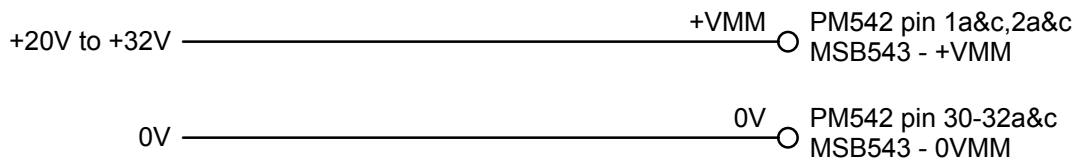
Connections are made via a 64 pin DIN41612 type C connector. A mating half connector may be fitted in the 19" rack or preferably use a Mclennan PCB motherboard. The MSB543 motherboard has been designed for easy installation of the PM542 and other stepper motor translator drives. It has the DIN41612 socket on one side and plug-in screw terminals on the other for external connections.

Ensure that there is plenty of ventilation for this unit. It should be mounted with the heatsink fins vertical, and enough free space around it to allow unimpeded air movement.

4.2 Power supply connections

The unit requires a single unregulated DC supply of between 20 and 32V.

CAUTION: THIS UNIT MUST NOT BE REVERSE POLARISED!



The following Mclennan power supply units are available for this unit.

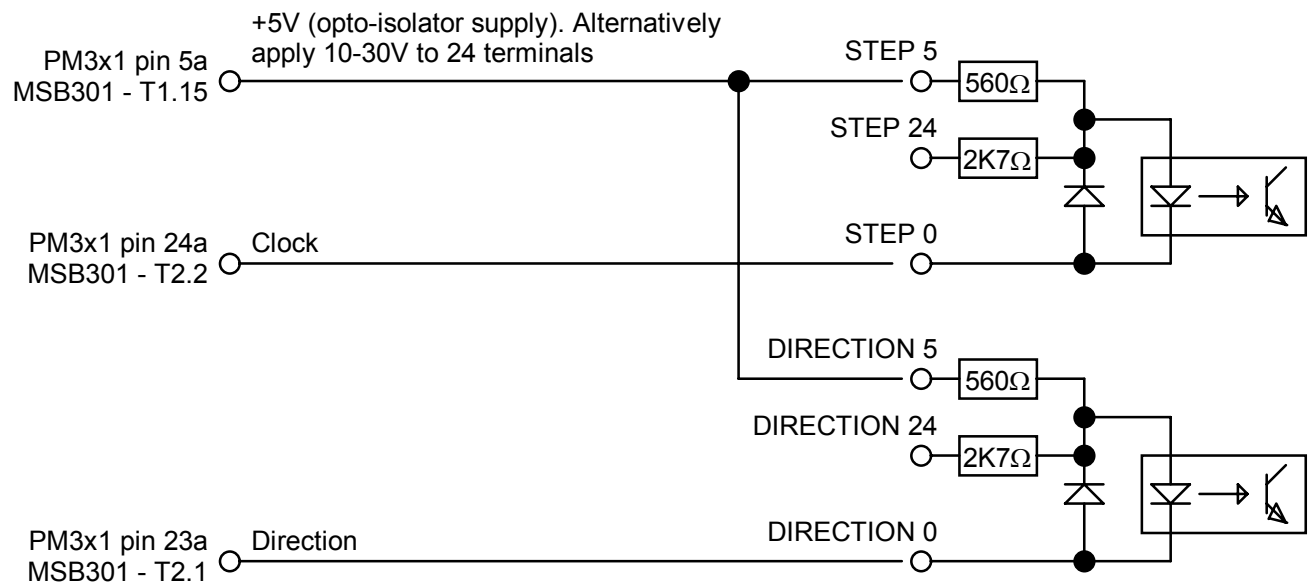
PSU	Nominal Voltage	Current
MSE171, PM171	30V	3A
MSE172, PM172	24V	6A
MSE173, PM173	24V	12A

4.3 Connections using external step and direction signals

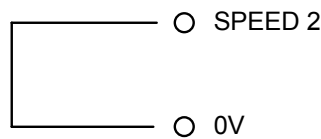
The step (clock) pulse signal should be connected so that current passes through the opto-isolated STEP input, when a motor step is required.

The direction signal should be connected so that current passes through the opto-isolated DIRECTION input, to select the required direction of motor movement.

For example, if using open-collector step and direction outputs of a Mclennan PM600 (PM301, PM341 or PM381) stepper motor controller, the opto-isolators may be supplied by the controller's 5V output and the outputs connected to the opto-isolators return.

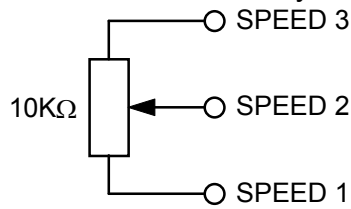


Important: If the on board oscillator is not used, the RAMP and BASE pots should be set fully clockwise. The SPEED pot 2 (wiper) input should be externally connected to 0V.

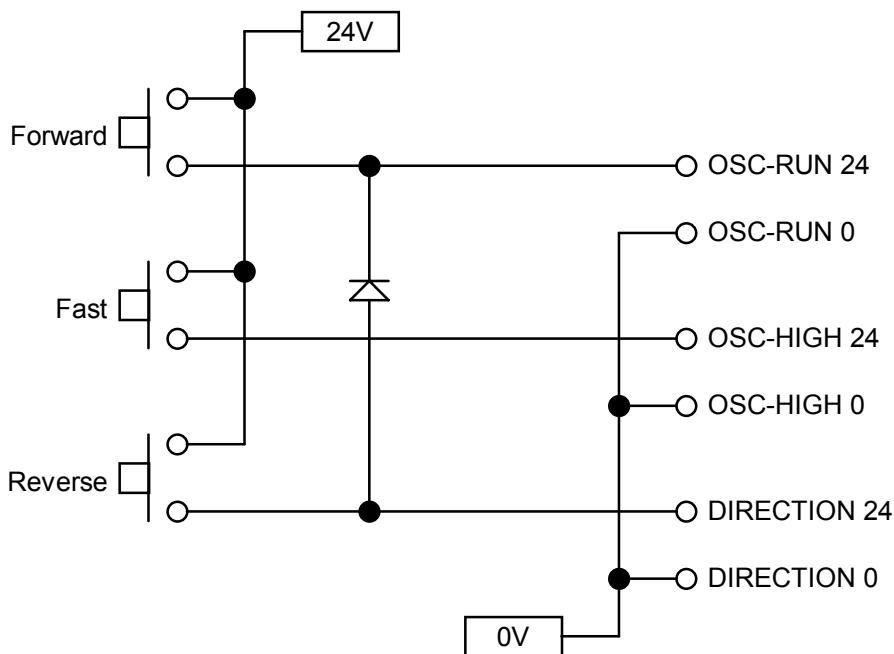


4.4 Connections using on board oscillator

A 10KΩ potentiometer should be connected externally to set the high speed.



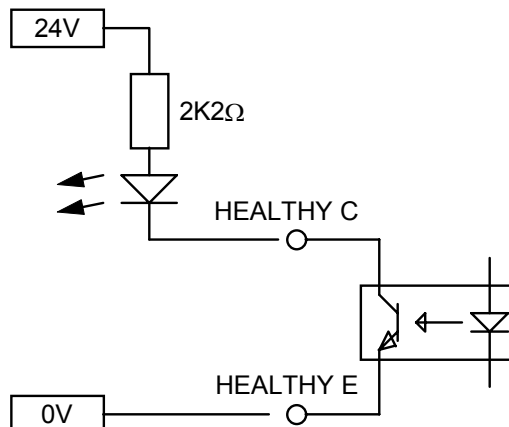
The on board oscillator may be controlled by manual control switches. This following example uses three pushbuttons; one to move forward, one to move backward, and one to select the high speed. If the base speed movement is not required, then the high speed switch may be replaced by a link.



4.5 Connections for other control inputs and status output

The ENABLE and PWR_RDN inputs may be connected in the same manner as the other inputs shown above.

The HEALTHY output may be used to illuminate an external LED to show that the drive is OK



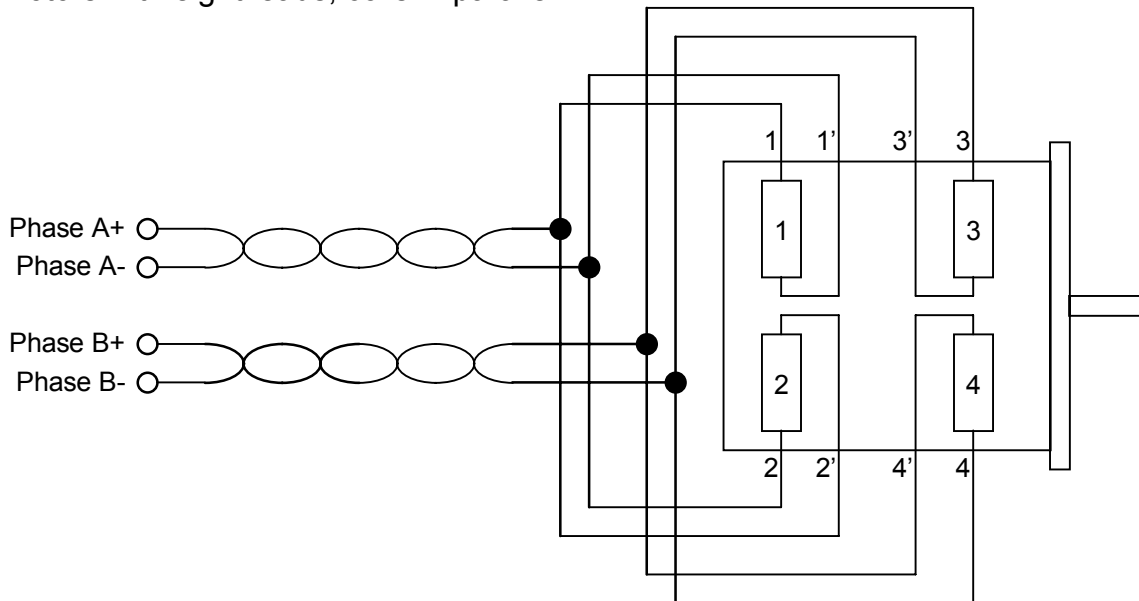
4.6 Motor connections using twisted wires.

To produce the minimum amount of radiated noise, the motor leads should be of a twisted construction as shown below.

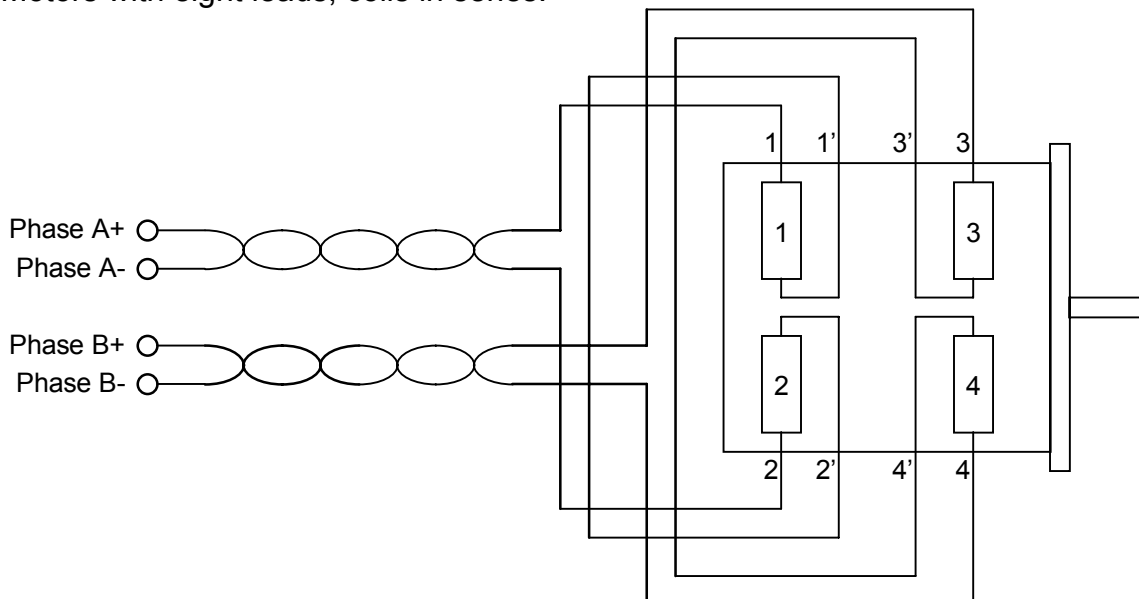
The cable should be screened, with the screen connected to earth at the drive end and to the motor body at the motor end. In some hazardous environments, it is not permissible to earth both ends, because of the risk of high 50Hz circulating currents if the earth loop is cut by strong magnetic fields (in close proximity to very powerful electrical machinery). In this case the earth connection may be made with a 1.0 μ F capacitor rated at 250VAC.

The motor body must be earthed.

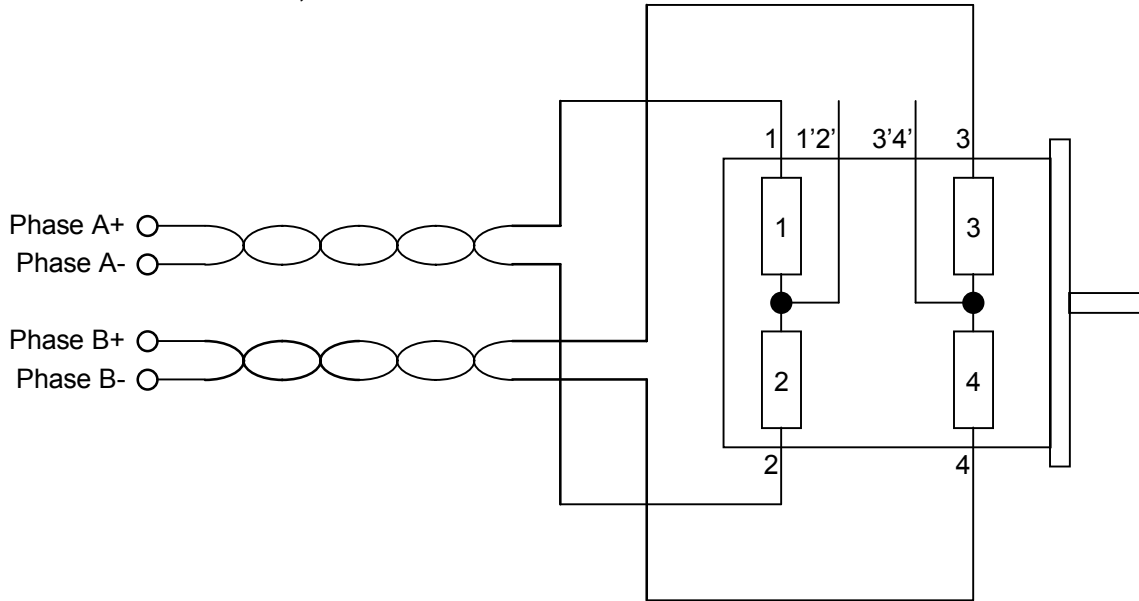
Motors with eight leads, coils in parallel.



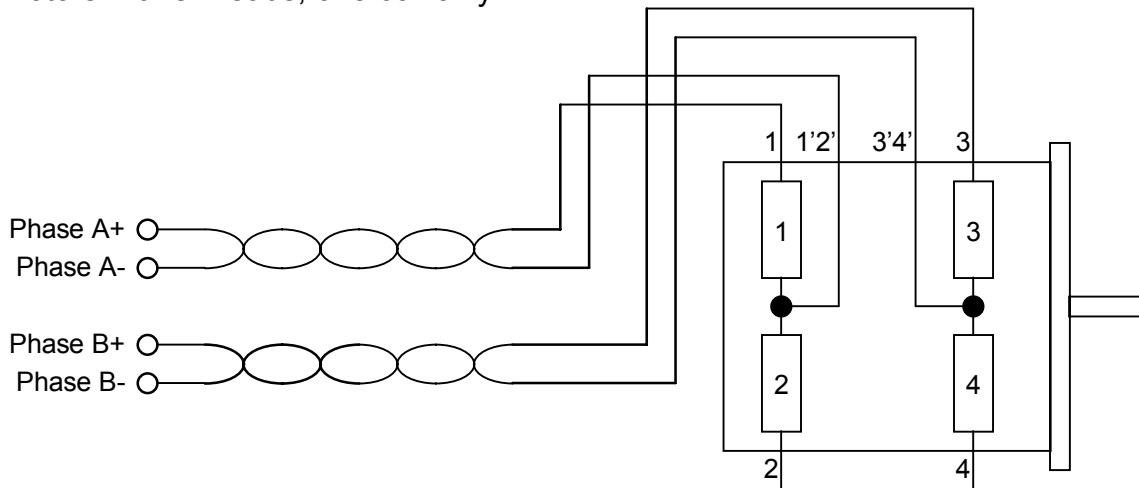
Motors with eight leads, coils in series.



Motors with six leads, coils in series.



Motors with six leads, one coil only.



Motor lead colours for 23HS and 34HS series motors

Phase 1		Phase 2		Phase 3		Phase 4	
1	1'	2	2'	3	3'	4	4'
Red	Black	Red / White	White	Green	Orange	Green / White	White / Black

A MSB543 motherboard is available for easy screw terminal connections and rack mounting of this unit.

5.0 Configuration.

The drive is configured by a single 8 way DIP switch, near the front of the board. There are also front panel adjust pots for setting up the oscillator.

5.1 Control settings

There are five switches for setting up the control of the drive.

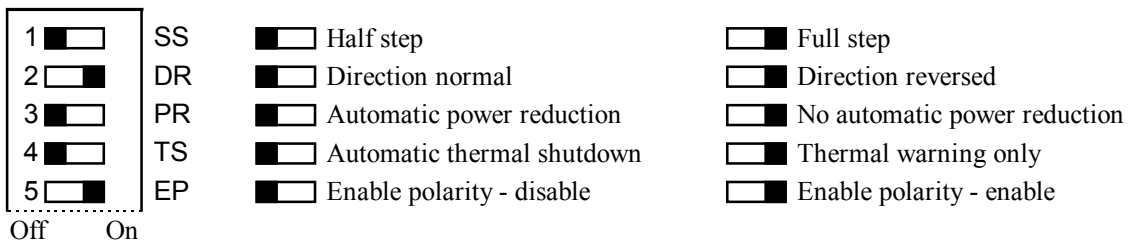
- SS** Step Size Off - Half step (400 steps per revolution with HS type motor)
On - Full step (200 steps per revolution with HS type motor)

- DR** Direction Reverse Off - Direction normal
On - Direction reversed. Used if motor turns the wrong way.

- PR** Power Reduction Off - Automatic power reduction at standstill. At standstill, the output current is reduced to 20-25% of set level.
On - No auto power reduction; current is reduced only by external PWR-RDN control input.

- TS** Thermal Shutdown Off - Automatic thermal shutdown. The drive is latched in a disabled state when the heatsink temperature is too high.
On - No auto thermal shutdown. Thermal sensor is monitored by HEALTHY output.

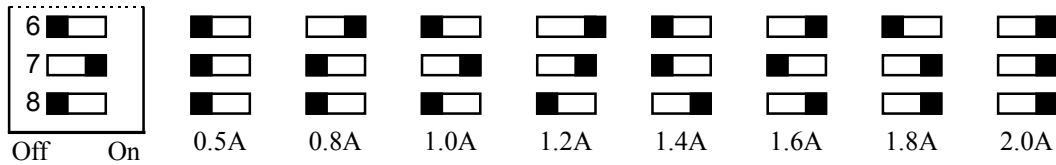
- EP** Enable Polarity Off - Drive is disabled on application of external ENABLE input (drive is enabled when ENABLE input is disconnected).
On - Drive is enabled on application of external ENABLE input.



The above example shown the drive set for half step, with the direction reversed, automatic power reduction and automatic thermal shutdown (recommended) and requiring an external enable signal.

5.2 Current settings

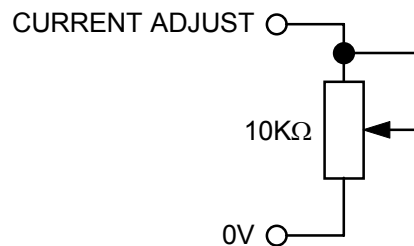
The motor phase current may be set to the required value using on board switches as shown below. Since the motor winding inductance may affect the actual current applied by the drive, the actual phase current applied to the motor should be checked during commissioning when the motor is in a stationary condition.



This example shows a selected current of 1.0 amps per phase.

Important: When using greater than 1.4A, use either automatic power reduction or forced air cooling.

If necessary, adjustment of the set value may be obtained by using a 10KΩ potentiometer or a resistor connected between the CURRENT ADJUST input (IA) and 0V. This will allow an adjustment range of between 25% and 80% of the current value set on the switches. This will however increase the ratio of current reduction (using automatic power reduction or external power reduction input) to above the normal 25%.



5.3 Oscillator set-up

There are three pots that are accessible through the front panel, for setting up the oscillator.

MAX This sets the scaling of the external speed control pot. Turning this clockwise will increase the full scale speed and anti-clockwise will reduce it.

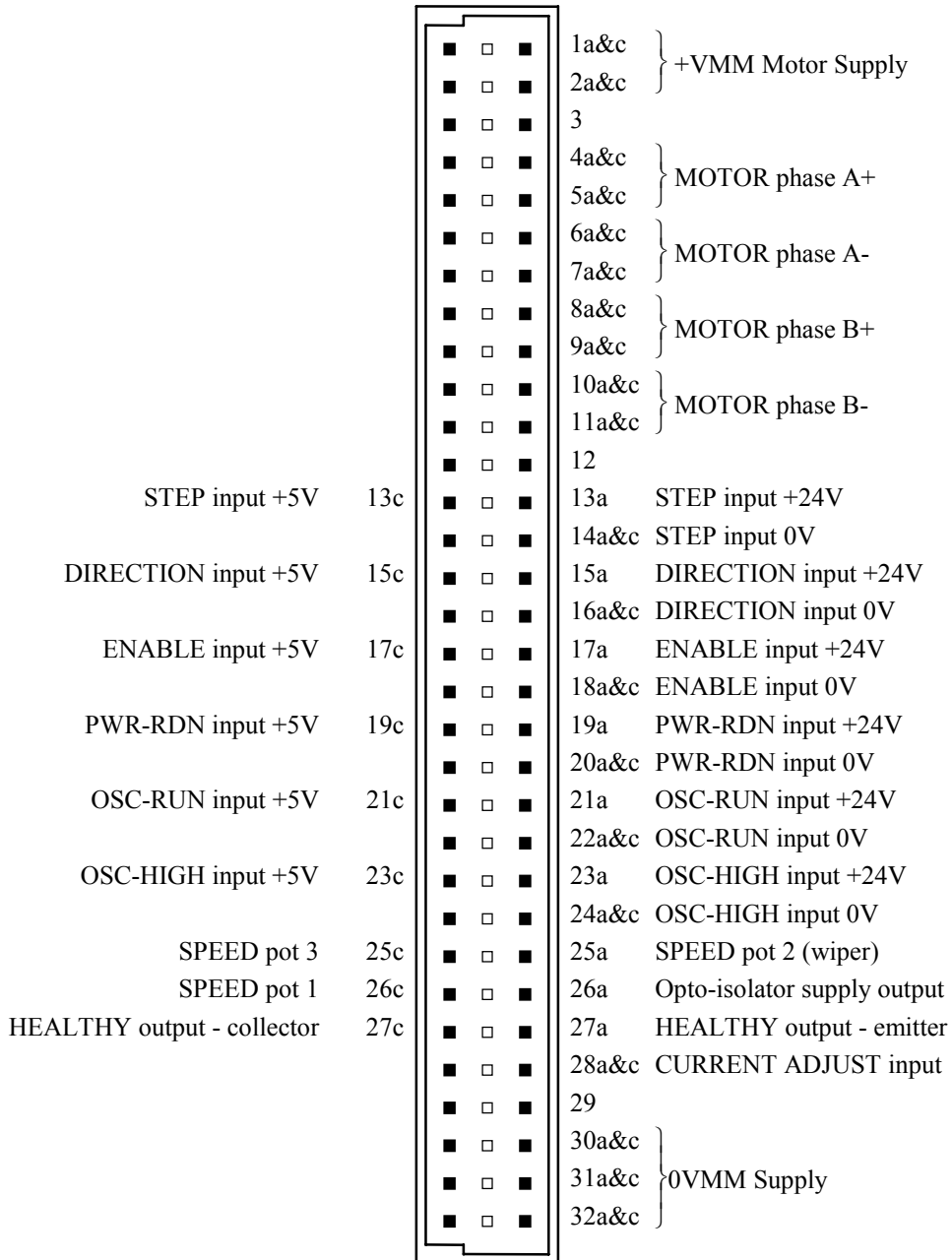
RAMP This sets the ramp rate when changing speed. Turning this clockwise will increase the rate of acceleration and deceleration and anti-clockwise will reduce it.

BASE This sets the BASE oscillator speed. This is the speed when the OSC-RUN input is active, but not the OSC-HIGH input. It also sets the speed that the motor may be stopped, started or the direction changed. Turning this clockwise will increase the base speed and anti-clockwise will reduce it. This should ideally be set below the pull-in rate of the motor drive combination, but above the primary resonance frequency range.

If the oscillator is not used, the RAMP and BASE pots should be set fully clockwise.

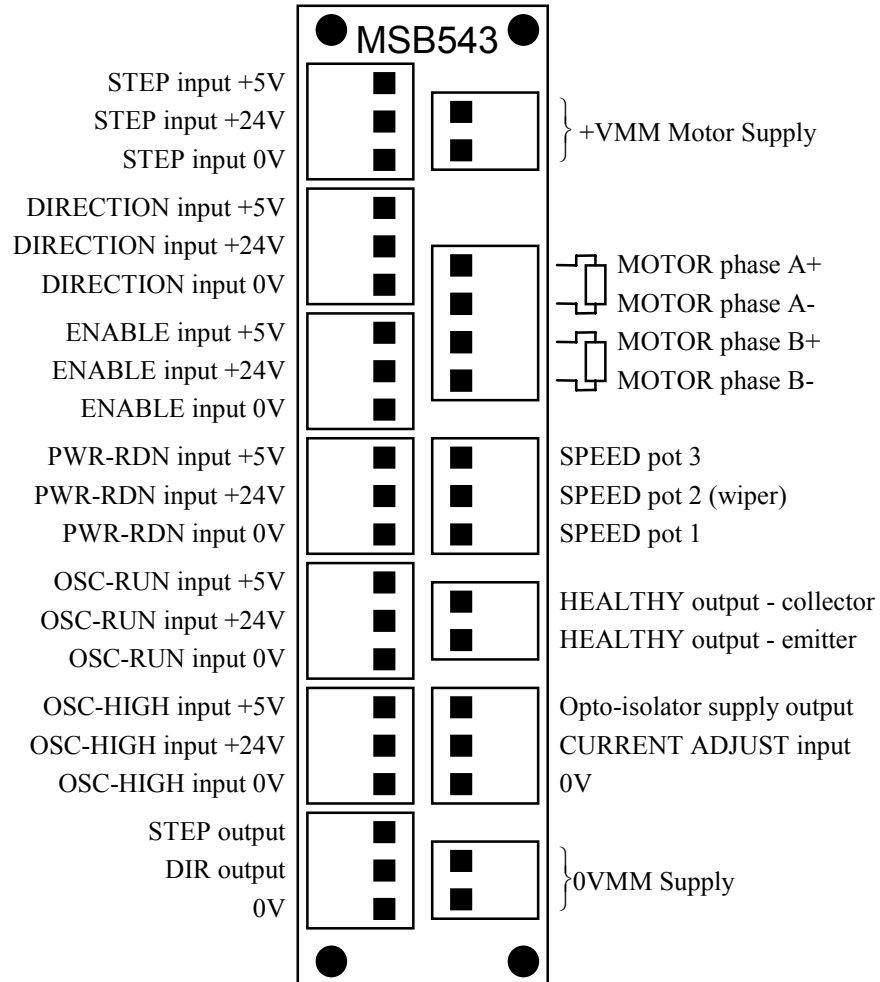
6.0 PM542 Rear Connector Pin Assignments

CONNECTOR: DIN 41612, 64 way a & c rows. PIN VIEW.



7.0 MSB543 Motherboard

The MSB543 motherboard has been designed for easy installation of the PM542 and other stepper motor translators. Connections are made via plug-in screw terminals.



8.0 Limitations of Use

This unit is designed to drive a bipolar stepper motor.

Good engineering practices should be employed when using this product.

The operating temperature should be between 0°C and 30°C.

Users should take suitable precautions in the application of this product, to ensure that the overall system complies with EN50081-1 and EN50082-1 (EMC directive).

These products should not be put into service until the machinery in which they are incorporated has been declared in conformity with the provisions of The Supply of Machinery (Safety) Regulations 1992 and The Supply of Machinery (Safety) (Amendment) Regulations 1994 (Machinery directive).

Motor control systems are inherently hazardous. Even a small motor, if coupled to a leadscrew, gearbox, or any other form of mechanism that provides a mechanical advantage, can generate considerable force and could cause serious injury. Incorrect operation can also lead to damage to the motor or associated machinery.

