PMR1 Solenoid Point Motor/Relay Driver   MAR 2003

Introduction

This accessory is designed to be layout mounted, adjacent to the point to be controlled. It is functionally similar to the original PMD1 accessory (see TB G16/13), but provides a DPDT relay in addition to the original design, now uprated in Issue 2 to give 5A switching capability. Screw terminal blocks are used for all external connections, though 'pluggable' versions could be fitted if desired. The relay contacts can be used for several purposes, including local track and 'frog' (crossing) switching and point position correspondence. The point position is controlled with a single low-current switched input, allowing simple On/Off toggle switches or their solid-state equivalents to be used to set the direction. From this, it can be seen that the PMR1 is suitable for use with manually operated systems, as well as remote control systems such as RPC. A separate input connection is provided in Issue 2 for the relay coil, allowing the relay to be switched either directly by the point control input (by connecting the two inputs together) or via an auxiliary switch attached to the point itself or its motor. The second option provides the possibility for more accurate correspondence between actual point position and the associated rail polarity switching.

One of the main features of the design is that heavy currents are kept local to the PMR1 and motor coils, enabling much thinner and cheaper cable to be used for power distribution, as well as for the control wire, which is simply connected to 0V for one direction (Reverse) or left Open Circuit for the opposite direction (Normal). The application example shown in TB G16/21 for the PMD1 applies equally to the PMR1, with the bonus of a relay for added flexibility. Greater consideration must be given to the power supply current capability when using PMR1's, as each 'Reversed' point adds another relay coil load to the supply. Although each relay only needs about 20mA, these can quickly add up to a considerable total on larger layouts, though it is unlikely that more than 50% of points will be 'Reversed' at any one time. Ideally, the supply should be able to cope with the worst case (100% 'Reversed') with plenty of spare for recharging the capacitors.

Interface Specifications

- Power Requirements   +20 to +28V DC preferred, +24V nominal @ 20mA per unit (Relay current)
- Control Inputs   Open Collector Compatible (Connect to 0V or leave Open Circuit)
- Coil Outputs   Direct Coil connection to double-acting solenoid motors
- Connectors   Screw terminal blocks for all functions
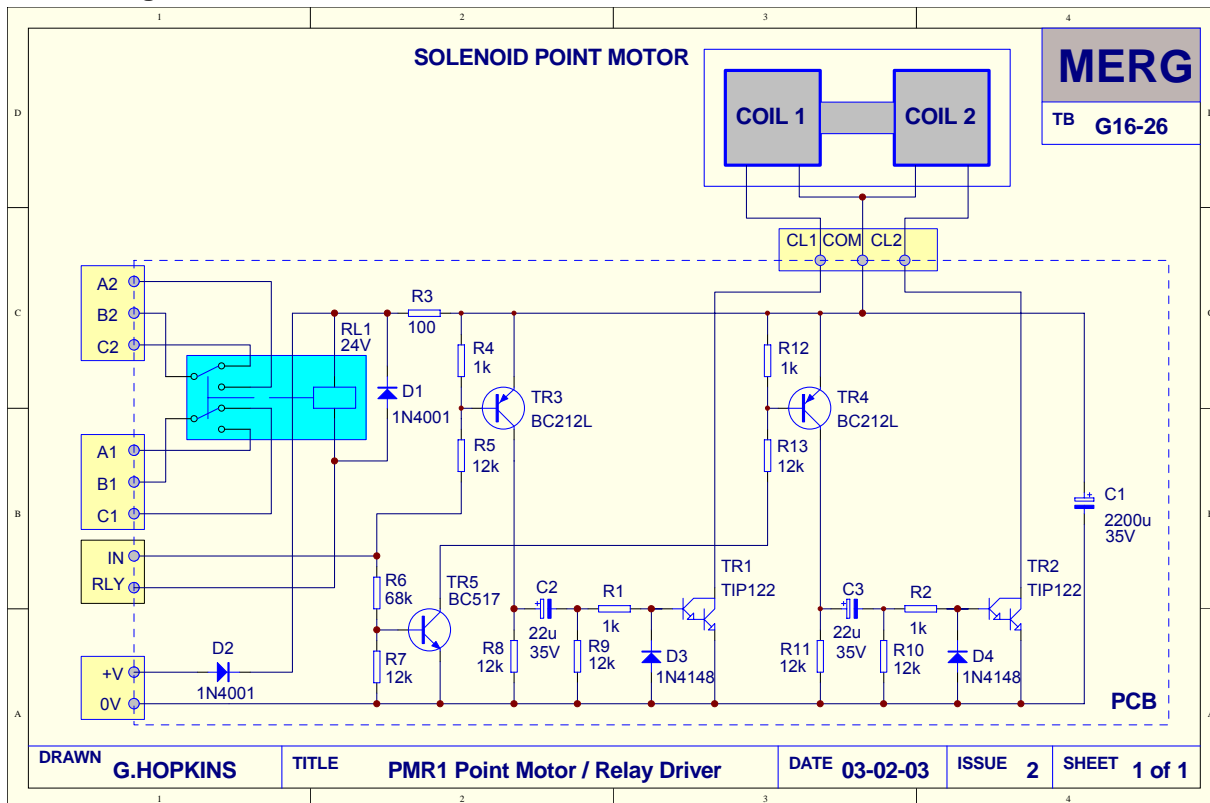
Circuit Description (Please note some component references have been renumbered since Issue 1)

The circuit consists of a Reservoir Capacitor stage (R3, C1), and an Inverter stage (R6, R7, TR5) that is connected between two identical coil driver stages. R7 has been added to the circuit since Issue 1 to increase the tolerance of the 'IN' low level limit to help overcome commonly observed layout wiring deficiencies that can result in variations of the 0V level around the layout relative to the absolute power supply reference. R3 limits the reservoir charging current and helps protect the circuit in the event of any failure. D2 provides reverse polarity protection. The coil of relay RL1 'RLY' may be connected directly to the control input 'IN', or controlled separately by auxiliary switches. Diode D1 provides back-emf protection to the relay coil driving circuit. The default point position jumper links have been omitted for the Issue 2 design.

The description will concentrate on one coil stage, with the second stage references in brackets [ ]. If the input 'IN' is left Open Circuit (O/C), transistor TR3 [TR4] will be held off by R4 [R12]. When the input is connected to 0V, enough current is drawn through R5 [R13] to switch TR3 [TR4] hard on. This, in effect, connects the junction of R8/C2 [R11/C3] instantaneously to the positive supply rail. The other side of C2 [C3] follows this transition, switching Darlington power transistor TR1 [TR2] hard on until C2 [C3] charges via R9/R1/TR1 [R10/R2/TR2]. The Solenoid Coil is thus pulsed by TR1 [TR2] during the charging time of C2 [C3], which is approximately 200ms. The effect of charging the capacitor at such a relatively slow rate (in electronic terms) also removes the need for back-emf protection diodes across the Solenoid Coil as the power transistor switches off quite slowly. If the input is now made Open Circuit again, TR3 [TR4] switches off, and C2 [C3] discharges through R8 [R11]. D3 [D4] limits the negative transition on the base of TR1 [TR2] when the input changes. Three 3-way and two 2-way screw terminal blocks are provided for external connections to the unit. 2-way types provide power supply and input connections; 3-way types are used for point motor coil connections, and relay contact connections – one for each pole. The relay contacts can be used for any purpose up to the rating of the specific relay fitted. A 5A type is normally specified to satisfy both conventional and DCC powered layouts, though relays with higher rated contacts of the same pinout could be used. For compatibility with the Issue 1 version of the PMR1, pads are also provided to allow the fitting of the original smaller BT47 type relay.

Circuit Diagram

| DRAWN | G.HOPKINS | TITLE | PMR1 Point Motor / Relay Driver | DATE | 03-02-03 | ISSUE | 2 | SHEET | 1 of 1 |

Parts List

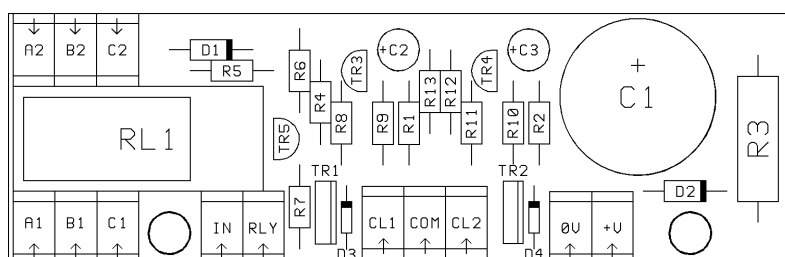| PCB	PMR1 Issue 2	1 off	See below
Resistor	100Ω 3W	1 off	R3
Resistor	1k ¼W	4 off	R1, R2, R4, R12
Resistor	12k ¼W	7 off	R5, R7, R8, R9, R10, R11, R13
Resistor	68k ¼W	1 off	R6
Capacitor	2200µF 35V	1 off	C1
Capacitor	22µF 35V	2 off	C2, C3
Relay	5A DPDT (24V DC coil)	1 off	RL1 (5.08 or 5mm standard pinout)
Diode	1N4001	2 off	D1, D2
Diode	1N4148	2 off	D3, D4
Transistor	TIP122 or equivalent	2 off	TR1, TR2
Transistor	BC212L	2 off	TR3, TR4
Transistor	BC517	1 off	TR5
Terminal Block	2-way	2 off	'IN'/'RLY' and '+V'/'0V'
Terminal Block	3-way	3 off	Point Motor Coils and Relay Contacts
Spacers	M3 x 4mm	2 off	

PCB Layout
(not to scale)
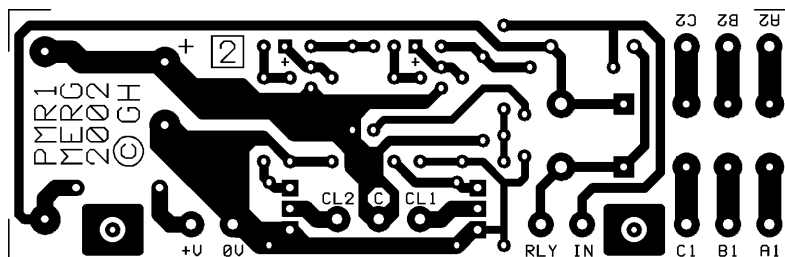
PCB Overlay
(not to scale)

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