

Electric Control Line Motor Controller

The Electric Control Line Motor Controller has been designed to provide timed control of an electric motor in a control line model.

Features

- Small size, 40 x 33 x 20 mm
- Timed motor runs
- Low voltage cut out
- Start and Stop buttons
- 5 to 15 cells
- 10 to 50 Amps
- Current rating is continuous
- Can drive a one horse power motor
- Uses readily obtainable parts
- Can be built by anyone with basic soldering skills

Circuit Description

The motor run timer circuit is built around IC1, a CMOS version of the 555 timer set up to operate as a triggerable monostable. When the Start button is pressed, a negative going pulse is generated which triggers IC1. The output of IC1 drives the gates of T4 to T9 positive to turn the Mosfets on. This in turn powers the motor. As this occurs, the Discharge output of IC1 is switched off and R2 begins to charge C2. When the voltage across C2 reaches 66% of the supply voltage, IC1 switches off T4 to T9, and hence the motor stops. By selecting different values for R2, the motor run time can be selected. The run time is determined by the equation $T=1.1 \times R2 \times C2$. As C2 is 100uF, the equation becomes $T=0.00011 \times R2$, where the value of R2 is in ohms.

The low voltage cut out circuit is built around T1 and T2. D1 is a zener diode whose breakdown voltage is selected to cause the circuit to reset IC1 when the battery voltage drops below a preset threshold. In normal operation, D1 passes a current that keeps T2 switched on and this in turn holds T1 in the off condition. T1's collector voltage rises to the supply voltage and IC1's reset input remains inactive. When the battery voltage drops, D1 no longer passes a current and T1 switches off, T2 switches on, and IC1 is placed into a reset condition. This overrides the timing function and stops the motor. R14 and C5 filters out reset pulses of less than one second. D4 allows fast charging of C5, while retaining the slow discharge characteristic. The Stop button was added to improve the safety of the controller by allowing the motor to be stopped quickly in the event of accidental triggering.

The power supply for the circuit is derived from the battery. D3 provides reverse polarity protection for the electronics. L1 and C3 filter noise from the incoming power. For 5 to 10 cell systems, R13, T3, and D2 are not installed. For 11 to 15 cell systems, R13, T3, and D2 are installed and the circuit operates as a voltage regulator with an output of around 12 volts.

The number of Mosfets used to switch the motor current is selected based on the expected motor current. The power dissipation of each Mosfet is limited to 1 watt to prevent overheating. Two selections are shown in the table based upon the On resistance of the Mosfet. The 0.022 ohm type of Mosfet is readily available, cheap, and a good choice for controllers up to 40 amps. The 0.01 ohm types are required for 50 amp controllers, but could be harder to find and more expensive. For 5 and 6 cell systems, the IRLZ44N Mosfet is recommended as this type switches fully on at a lower gate voltage. The other types listed may not fully switch on and overheat.

The wiring diagram for the battery, controller, and motor shows a Diode connected across the motor terminals. The diode acts as a noise and voltage spike suppressor.

Construction

The controller is constructed on prototyping board known as stripboard or veroboard and has a hole and track spacing of 2.54mm. Select the number of cells and the current rating, and determine the components for the controller. If not all Mosfets are fitted, leave out the corresponding resistors. Cut the board to the corresponding size shown in the construction diagrams. The axial leaded components are mainly placed on end to reduce the size of the controller. An IC socket is recommended for IC1. Prepare the board for the components by cutting the tracks where shown with a 3 to 3.5mm drill bit. Some tracks will need to be cut with a sharp knife. Fit the uninsulated wire links first, followed by the smaller components, and finishing with the Mosfets and insulated wire links. Place extra solder along the -BATTERY and -MOTOR tracks.

Testing

Wire a 12 volt automotive globe (two in series for more than 10 cells) in place of the motor and connect the controller to the battery. Press the Start button and the globe should light. Pressing the Stop button should cause the globe to go out. Check the run time. Component tolerances will cause a small variation from the times shown in the table.

Installation

Install the controller in the model as necessary. If possible, arrange for a flow of air across the Mosfets to aid in cooling. S1 and S2 can be fitted to a small piece of board and attached to the outside of the model.

Parts List

Component Value	Number	Part Designation
100R 0.25W 5% Resistor	2	R5,R6,R15
1K 0.25W 5% Resistor	1**	R13
10K 0.25W 5% Resistor	9*	R1,R3,R4,R7,R8,R9,R10,R11,R12
100K 0.25W 5% Resistor	1	R14
* 0.25W 5% Resistor	1*	R2
100nF Mono Ceramic Capacitor 2.54mm spacing	1	C1
100nF Mono Ceramic Capacitor 2.54mm spacing	3**	For unsuppressed motors
1uF/63V RB Electro Capacitor	1	C4
10uF/63V RB Electro Capacitor	1	C5
100uF/25V RB Electro Capacitor	2	C2,C3
BZX79C* 400mW Zener Diode	1*	D1
BZX79C13V 400mW Zener Diode	1**	D2
1N4004 Diode	1	D3
1N4148 Diode	1	D4
1N5822 Diode	1	
1 milliHenry RF Choke	1	L1
PCB Mount Tactile Membrane Switch/Pushbutton	2	S1,S2
BC547 Transistor	2	T1,T2
BC547 Transistor	1**	T3
* Mosfet	6*	T4 – T9
ICM7555/TLC555 IC (CMOS 555)	1	IC1
8 Pin Machine Pin IC Socket	1	
Stripboard/Veroboard	1	
Fuse and Fuseholder	1	
Heavy Duty Cable		

R = Ohms

* See tables for part values

** For 11 to 15 Cells only

Component Suppliers (Perth, Western Australia)

Most of the parts such as resistors, capacitors, diodes, transistors and Mosfets are available from the suppliers listed below. Some parts may need to be obtained from a specific supplier and these are as shown below.

Diodes and Mosfets

World Wide Electronic Components

47 George Street

Kensington

www.iinet.net.au/~worcom

RF Chokes

Altronics

174 Roe Street

Perth

Jaycar Electronics

326 Newcastle Street

Northbridge

Dick Smith Electronics

Switches

Altronics

174 Roe Street

Perth

0.01 ohm and low turn on voltage Mosfets

RS Components

26 Walters Drive

Osborne Park