

DC MOTOR SPEED CONTROL KIT

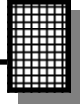


Ramsey Electronics Model No.

MSC1

Got a DC motor that's not the right voltage or speed for your application? How can you keep a motor from stalling in a high load part of a cycle? Your motor speed control will put these worries behind you. Control your motor with pulse width modulation.

- Controls DC motor speed without lowering torque.
- Uses integrated circuits for pulse duration with a power FET transistor for worry-free high current operation.
- Front panel adjustable speed control.
- Runs on 6-15 VDC. Controls motors from 3-50 volts at up to 10 amps!
- Informative manual answers questions on theory, hook-ups and uses - enhances resale value, too!
- A fun and exciting kit that is not only useful but educates too!
- Clear, concise assembly instruction carefully guide you to a finished kit that works the **FIRST** time!



PARTIAL LIST OF AVAILABLE KITS

RAMSEY TRANSMITTER KITS

- FM25, MP3FM FM Stereo Transmitters
- AM1 AM Transmitter
- TV6 Television Transmitter
- FM100 Professional FM Stereo Transmitter

RAMSEY RECEIVER KITS

- FR1 FM Broadcast Receiver
- AR1 Aircraft Band Receiver
- SR2 Shortwave Receiver
- AA7 Active Antenna
- SC1 Shortwave Converter

RAMSEY HOBBY KITS

- SG7 Personal Speed Radar
- SS70A Speech Scrambler
- BS1 "Bullshooter" Digital Voice Storage Unit
- AVS10 Automatic Sequential Video Switcher
- WCT20 Cable Wizard Cable Tracer
- LABC1 Lead Acid Battery Charger
- ECG1 Heart Monitor
- STC1 Stereo Transmitter Companion

RAMSEY AMATEUR RADIO KITS

- DDF1 Doppler Direction Finder
- HR Series HF All Mode Receivers
- QRP Series HF CW Transmitters
- CPO3 Code Practice Oscillator
- QRP Power Amplifiers

RAMSEY MINI-KITS

Many other kits are available for hobby, school, scouts and just plain FUN. New kits are always under development. Write or call for our free Ramsey catalog.

MOTOR SPEED CONTROL KIT INSTRUCTION MANUAL

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KIT ASSEMBLY AND INSTRUCTION MANUAL FOR

MSC1 MOTOR SPEED CONTROL

TABLE OF CONTENTS

Introduction to the MSC1	4
How it works	4
Parts list.....	5
Parts Layout diagram	6
Schematic diagram.....	6
MSC1 Assembly instructions	7
Initial testing	9
Troubleshooting.....	10
Ramsey kit warranty.....	11



RAMSEY ELECTRONICS, INC.
590 Fishers Station Drive
Victor, New York 14564
Phone (585) 924-4560
Fax (585) 924-4555
www.ramseykits.com

INTRODUCTION TO THE MSC1 MOTOR SPEED CONTROL KIT:

Many times when designing or fabricating small mechanical projects one will use "junkbox" DC motors to power their inventions. Problem is, more times than not the motors spin at the wrong rate for our application! We could gear the motor for the proper speed, but this is usually beyond the scope of what we can accomplish in the basement workshop. Or, we could measure the current that the motor draws, and determine a series resistor value (...remember Ohm's law !) to insert to "drop" the motor supply voltage and slow the motor down. The problem with that approach is that if the load on the motor increases, the motor's operating current also increases, creating a larger voltage "drop" across that series resistor and supplying less voltage to the motor terminals when it is needed most. This "vicious circle" usually results in the motor stalling at high load conditions. So what we need is a controller that will give the motor a "kick" of full supply voltage for a variable amount of time to achieve the proper speed without the series dropping effect.

This exact scenario was encountered here at our shop while designing a parts cutting machine for our kits. This wonderful little circuit worked so well that we decided that we would offer it as a Ramsey hobby kit, and so the motor speed control was created.

NOTE TO NEWCOMERS: If you are a first time kit builder you may find this manual easier to understand than you may have expected. Each part in the kit is checked off as you go, while a detailed description of each part is given. If you follow each step in the manual in order, and practice good soldering and kit building skills, the kit is next to fail-safe. If a problem does occur, the manual will lead you through step by step in the troubleshooting guide until you find the problem and are able to correct it.

CIRCUIT DESCRIPTION:

At the heart of the motor speed control are two 555 timer / oscillator integrated circuits. The first, U1, oscillates at a 400 Hz rate. This is the "clock" frequency for our circuit. U2, the other 555 timer is configured as a pulse width modulator. By changing the control voltage on pin 5, the duty cycle (on versus off time) of the output can be controlled. The pulse width modulated output is then fed to the gate of the high current MOSFET which does the actual controlling of the motor current. Another advantage in using the FET is that a separate power supply can be used to run the motor independently of the controller power supply, as long as the power supply "grounds" are tied together.

MSC1 MOTOR SPEED CONTROL PARTS LIST

RESISTORS

- 2 470 ohm (yellow-violet-brown)(R1,4)
- 1 2.2K ohm(red-red-red)(R7)
- 1 8.2K ohm (grey-red-red)(R2)
- 1 10K ohm (brown-black-orange)(R6)
- 1 33K ohm (orange-orange-orange)(R5)
- 1 10K ohm potentiometer (PC mount)(R3)

CAPACITORS

- 6 .1 uF disc (marked .1 or 104)(C1-6)

SEMICONDUCTORS AND IC'S

- 1 2N3904 NPN transistor (Q1)
- 1 1N4002 diode (marked with band)(D1)
- 2 555 timer IC (8 pin DIP)(U1,2)
- 1 Power FET (marked MTP3055E or P16NF06)(Q2)

OTHER COMPONENTS

- 1 PC mount DPDT push button switch (S1)
- 1 PC mount 6 pin MOLEX type connector (J1)
- 1 MSC1 printed circuit board

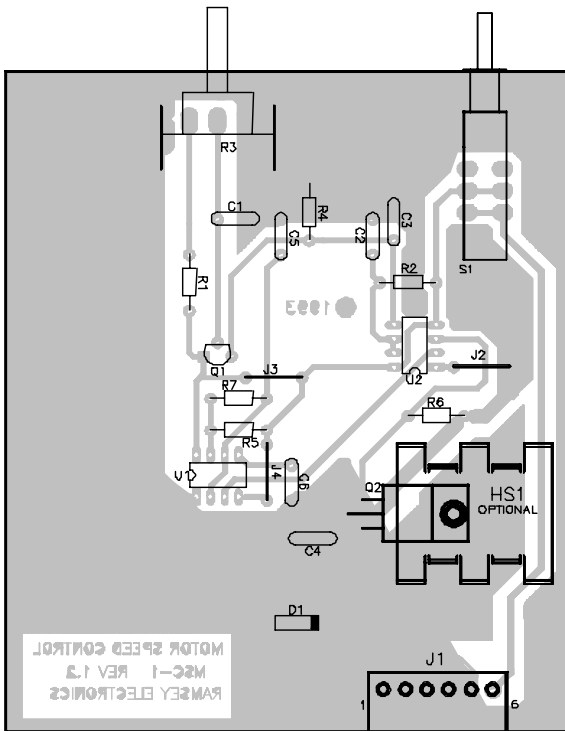
RAMSEY Learn-As-You-Build KIT ASSEMBLY:

We have a twofold "strategy" for the order of the following kit assembly steps. First, we install parts in physical relationship to each other, so there's minimal chance of inserting wires into wrong holes. Second, whenever possible, we install in an order that fits our "Learn-As-You-Build" Kit building philosophy.

For each part,our word 'install' means:

1. Pick the correct part value to start with.
2. Insert it into the correct PC board location.
3. Orient it correctly, which means: please follow the PC board drawing and the written directions for all parts where there's a right way and a wrong way to solder it in. (Diode bands, electrolytic

MSC1 PARTS LAYOUT DIAGRAM



capacitor polarity, transistor shapes, dotted or notched ends of IC's, and so forth.)

4. Solder all connections unless directed otherwise. Use enough heat and solder flow for clean, shiny, completed connections. Don't be afraid of ANY pen-style soldering iron having enough heat to damage a component.
5. Trim or "nip" excess wire lengths after soldering.

NOTE: Save some of the longer wire scraps nipped from resistors and capacitors. These will be used to form wire jumpers (JMP1, etc.) to be soldered in just like parts during these construction steps.

FIRST ASSEMBLY STEPS

Since you may appreciate some "warming up" soldering practice as well as a chance to put some "landmarks" on the MSC1 PC-board, we first will install some "hardware" components, to make the up-down, left-right orientation of the PC board as clear as possible.

- 1. Install J1, the 6 pin MOLEX type jack. Be sure that the open end of the connector faces toward the outside circuit board.
- 2. Moving to the front of the PC board, now install R3, the 10K trimmer potentiometer. Gently guide the three legs through the PC board mounting holes.
- 3. Install switch S1. Make sure that it is pushed flat to the PC board before soldering .
- 4. Install C3, .1 uF disc capacitor [marked .1 or 104]. Note: since all capacitors in the rest of this kit will be identical, they will just be described by their part number (i.e. C1, C2, etc.).
- 5. Install C2, .1uF disc capacitor.
- 6. Install R4, 470 ohm [yellow-violet-brown].
- 7. Install C5, .1uF disc capacitor.
- 8. Install C1, .1uF disc capacitor. Remember to save some of the leads that you've cut. They will be used for "jumper" wires later.
- 9. Install R1, 470 ohm [yellow-violet-brown].

- ❑ 10. Install Q1, the 2N3904 transistor. The component placement drawing clearly shows how the flat side of the transistor points in relation to other parts. To install, press the three leads in place as far as they will go without forcing it. The wires may be spread as needed to hold it in place before soldering. Don't hesitate to use sufficient soldering heat to make good connections.
- ❑ 11. Install R2, 8.2K ohm [marked grey-red-red].
- ❑ 12. Install U2, the 555 8 pin IC. Use care when inserting the IC into the circuit board, as not to bend one of the pins so it does not pass through the circuit board. Note also that one end of the IC is marked by a dot, notch or a band; this end *must* be oriented as shown on the PC board layout diagram.
- ❑ 13. Using a scrap component lead, form a "jumper" wire to insert in the printed circuit board. Install it in the JMP 2 position. Jumpers act as electronic "bridges" carrying signals over PC traces underneath.
- ❑ 14. Form and install another jumper wire in the JMP 3 position.

You've now completed the pulse width modulator section of the controller. Now that wasn't so bad, was it! Now is a good time to take a step back, check component placement and soldering. Use a bright light and a magnifying lens to help. Be certain that there are no solder "bridges" between component leads or foil runs. Make sure all component leads are trimmed, and resolder any connection that is less than perfect.

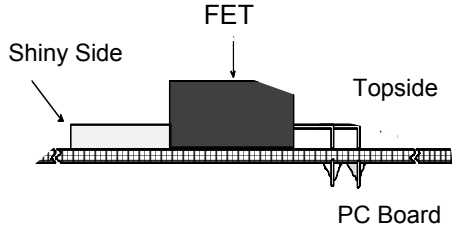
- ❑ 15. Install R7, 2.2K ohm [red-red-red].
- ❑ 16. Install R5, 33K ohm [orange-orange-orange].
- ❑ 15. Install R6, 10K ohm [brown-black-orange].
- ❑ 16. Install C6, a .1 uF disc capacitor.
- ❑ 17. Using a scrap component lead, form a "jumper" wire to insert in the printed circuit board. Install it in the JMP 4 position.
- ❑ 18. Install C4, the last .1 uF disc capacitor.
- ❑ 19. Install U1, the other 555 timer 8 pin IC. Note that one end of the IC is marked by a dot, notch or a band; this end *must* be oriented as shown on the PC board layout diagram.
- ❑ 20. Install D1, 1N4002 diode. Notice the band on the one end of the diode. Be sure to orient it as shown in the parts placement diagram.
- ❑ 21. Install Q2, the MTP3055E or P16NF076 FET transistor. See the parts

placement diagram for proper orientation. Notice that the component mounts "flat" to the circuit board. This is to provide you with a convenient heat sinking point (if needed) for the output transistor.

fig 1

CONGRATULATIONS

Your motor driver is complete. Take one more good hard look at component placement and your soldering job. Make sure all leads have been trimmed as not to bend and "short" out against adjacent parts. Be aware that 95% of kit repairs are due to improperly placed parts and poor soldering. Also, in the following steps the circuit will be energized and component damage can result from improper assembly.



TESTING AND OPERATION:

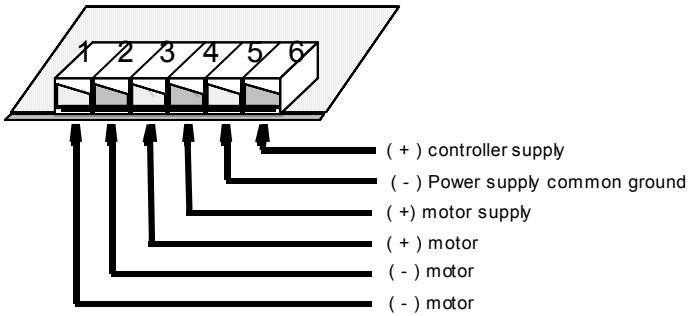
It's now time to check out your motor speed control unit. First connect a suitable 9 - 12 VDC power source to pins 6 and 5 of the MOLEX type connector (see fig 2). Energize the circuit by pressing the on/off switch to the "on" position. The control circuit should only draw 30 - 50 mA while running. This is a fairly good indication that the circuit is operating correctly. If you have access to an oscilloscope you may examine pin 3 of U2 to observe the 400 Hz "clock". You may also look at the gate of the power FET and you should observe a square wave output. As you turn the front panel speed control clockwise, the duration of the "on" portion of the waveform should increase. This corresponds to the amount of time that your motor is energized, the longer the on time, the faster the motor speed.

When connecting the motor to the speed control unit we must first determine if the motor and controller supply are one in the same.

If your supply is to be used for both the motor and controller, simply insert a jumper between pins 6 and 4 of the rear panel connector. This will route the DC to the proper motor connection.

If your motor supply is different than the controller supply, connect the positive (+) terminal of the power supply to pin 4 of the connector.

fig 2



You can tin the end of your wire and place it into the Molex connector so that it makes contact or get a single row of pins and solder your wires to it if you wish.

Power up the unit and the motor should run at a variable speed. This is the first time that any current has been run through the FET transistor, so if any problems occur this is the place to look.

The output FET transistor is rated for a few amperes of current, but if a steady high current application is used you may want to use some type of heatsink on the output transistor. There is ample room provided on the circuit board for this. A mounting hole is also provided for easy heatsink installation. A company such as Digikey or Mouser should have some type of heatsink that would fit.

TROUBLESHOOTING HINTS

While we had hoped that it wouldn't come to this, if you are still having trouble getting your MSC1 to operate please try the following.

Most importantly, check your soldering and parts orientation. Checking your work backwards through the assembly steps is very effective in locating placement errors. Have another pair of eyes check your work; we've all looked at our own mistakes and never even seen them!

Employ logical troubleshooting techniques on the circuit operation. Do I have DC voltage at the switch? Are the front panel controls truly soldered securely to the circuit board traces? This kit includes "jumper" wires, are they all soldered on both ends of the connection?

The Ramsey Kit Warranty

Please read carefully BEFORE calling or writing in about your kit. Most problems can be solved without contacting the factory.

Notice that this is not a "fine print" warranty. We want you to understand your rights and ours too! All Ramsey kits will work if assembled properly. The very fact that your kit includes this new manual is your assurance that a team of knowledgeable people have field-tested several "copies" of this kit straight from the Ramsey Inventory. If you need help, please read through your manual carefully, all information required to properly build and test your kit is contained within the pages!

1. DEFECTIVE PARTS: It's always easy to blame a part for a problem in your kit, Before you conclude that a part may be bad, thoroughly check your work. Today's semiconductors and passive components have reached incredibly high reliability levels, and it's sad to say that our human construction skills have not! But on rare occasions a sour component can slip through. All our kit parts carry the Ramsey Electronics Warranty that they are free from defects for a full ninety (90) days from the date of purchase. Defective parts will be replaced promptly at our expense. If you suspect any part to be defective, please mail it to our factory for testing and replacement. Please send only the defective part(s), not the entire kit. The part(s) MUST be returned to us in suitable condition for testing. Please be aware that testing can usually determine if the part was truly defective or damaged by assembly or usage. Don't be afraid of telling us that you 'blew-it', we're all human and in most cases, replacement parts are very reasonably priced.

2. MISSING PARTS: Before assuming a part value is incorrect, check the parts listing carefully to see if it is a critical value such as a specific coil or IC, or whether a RANGE of values is suitable (such as "100 to 500 uF"). Often times, common sense will solve a mysterious missing part problem. If you're missing five 10K ohm resistors and received five extra 1K resistors, you can pretty much be assured that the '1K ohm' resistors are actually the 'missing' 10 K parts ("Hum-m-m, I guess the 'red' band really does look orange!") Ramsey Electronics project kits are packed with pride in the USA. If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual as supplied with the basic kit by Ramsey, please write or call us with information on the part you need and proof of kit purchase

3. FACTORY REPAIR OF ASSEMBLED KITS:

To qualify for Ramsey Electronics factory repair, kits MUST:

1. NOT be assembled with acid core solder or flux.
2. NOT be modified in any manner.
3. BE returned in fully-assembled form, not partially assembled.
4. BE accompanied by the proper repair fee. No repair will be undertaken until we have received the MINIMUM repair fee (1/2 hour labor) of \$25.00, or authorization to charge it to your credit card account.
5. INCLUDE a description of the problem and legible return address. DO NOT send a separate letter; include all correspondence with the unit. Please do not include your own hardware such as non-Ramsey cabinets, knobs, cables, external battery packs and the like. Ramsey Electronics, Inc., reserves the right to refuse repair on ANY item in which we find excessive problems or damage due to construction methods. To assist customers in such situations, Ramsey Electronics, Inc., reserves the right to solve their needs on a case-by-case basis.

The repair is \$50.00 per hour, regardless of the cost of the kit. Please understand that our technicians are not volunteers and that set-up, testing, diagnosis, repair and repacking and paperwork can take nearly an hour of paid employee time on even a simple kit. Of course, if we find that a part was defective in manufacture, there will be no charge to repair your kit (But please realize that our technicians know the difference between a defective part and parts burned out or damaged through improper use or assembly).

4. REFUNDS: You are given ten (10) days to examine our products. If you are not satisfied, you may return your unassembled kit with all the parts and instructions and proof of purchase to the factory for a full refund. The return package should be packed securely. Insurance is recommended. Please do not cause needless delays, read all information carefully.

**MSC1 DC MOTOR SPEED CONTROL
Quick Reference Page Guide**

Introduction to the MSC1..... 4
How it works 4
Parts list..... 5
Parts Layout diagram 6
Schematic diagram..... 6
MSC1 Assembly instructions..... 7
Initial testing..... 9
Troubleshooting..... 10
Ramsey kit warranty..... 11

REQUIRED TOOLS

- Soldering Iron Ramsey WLC100
- Thin Rosin Core Solder Ramsey RTS12
- Needle Nose Pliers Ramsey MPP4 or RTS05
- Small Diagonal Cutters Ramsey RTS04
<OR> Technician's Tool Kit TK405

TOTAL SOLDER POINTS

81

**ESTIMATED ASSEMBLY
TIME**

**Beginner 2.3 hrs
Intermediate 1.3 hrs
Advanced..... 1.0 hrs**

ADDITIONAL SUGGESTED ITEMS

- Holder for PC Board/Parts Ramsey HH3
- Desoldering Braid Ramsey RTS08
- Digital Multimeter Ramsey M133

Price: \$5.00
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Assembly and Instruction manual for:
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590 Fishers Station Drive
Victor, New York 14564
Phone (585) 924-4560
Fax (585) 924-4555
www.ramseykits.com**