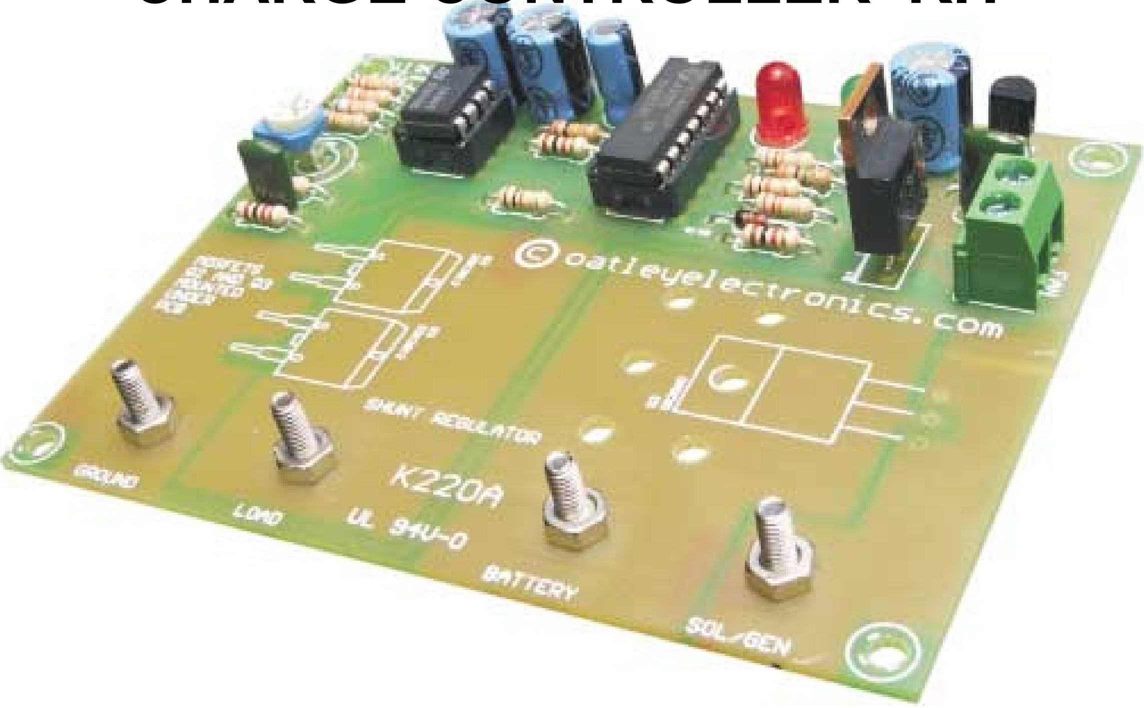
K220A SHUNT REGULATOR / CHARGE CONTROLLER KIT

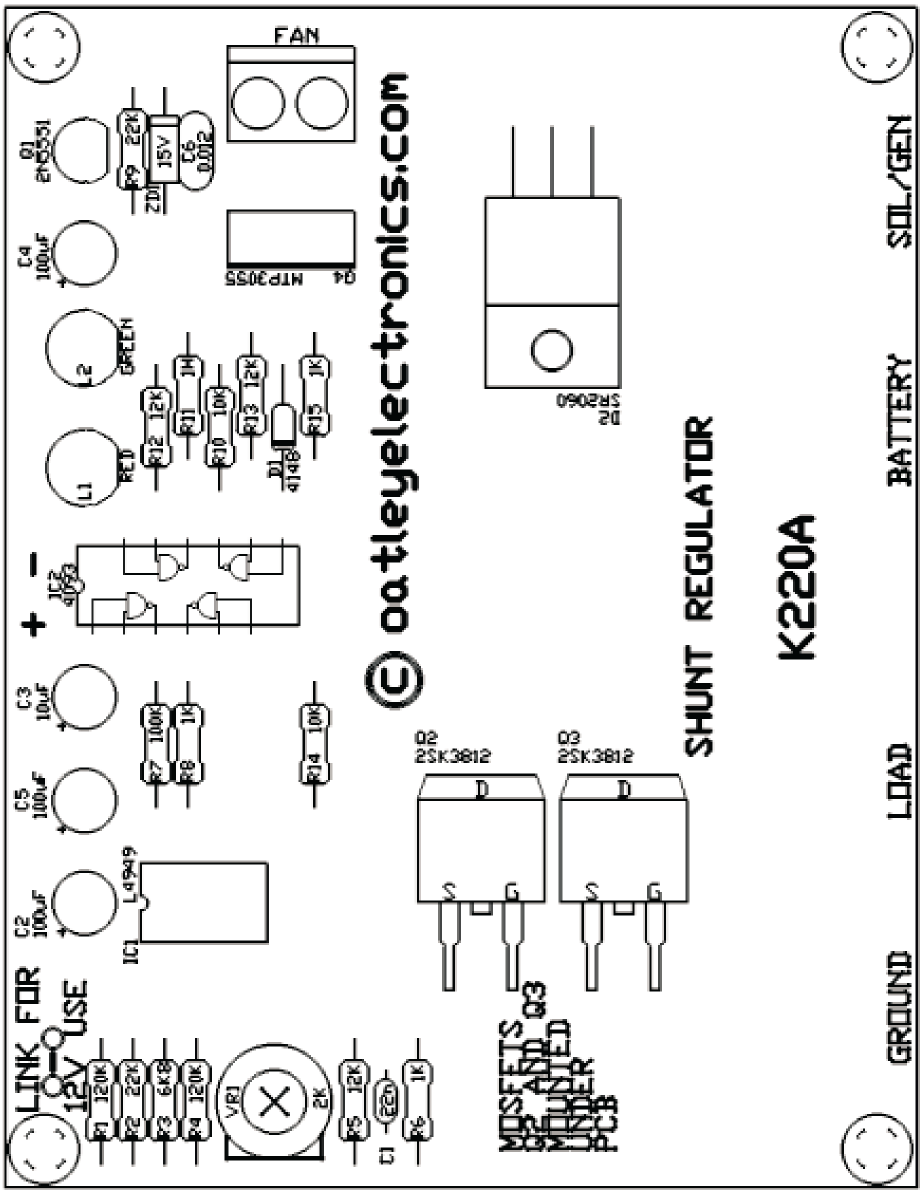


NOTE
Please make sure that you read and understand these notes and that all components are present as per the parts list before starting construction.

K220A 12/24V SHUNT REGULATOR KIT
This kit is designed to control the charge of a battery by applying a load such as a heating element etc. across the battery. The kit is simply connected by two wires to the terminals of a battery, and another two wires to an external load. The load is applied only when the battery voltage exceeds a preset value, and it does not matter by what means the battery is being charged. There is a provision made for an optional isolation diode. This would be necessary if the battery is being charged by solar panel/s: Prevents the solar panel slightly discharging the battery during the night.

Circuit description
At the heart of the circuit is IC2 (L4949) which is an integrated 5.0V voltage regulator with a very low dropout voltage & additional functions such as power-on reset & input voltage sense. In this circuit the voltage sensing comparator section of this IC & the 5V regulator are used.
Pin 2 is the input pin for the battery sensor section of the IC. When the voltage at this pin falls to 1.24V the open collector output pin 7 is pulled internally to ground and C3 charges quickly via R8. Thus when the battery voltage is low there is a logic "0" at the inputs of gates IC2: A and IC1: B. Because of the inverter action of these gates their outputs are both at logic "1". And the output of gate IC2:C is at logic "0"….Q3 is turned off and Q4 is turned on thus resulting in a low voltage at the gates of the MOSFETS: The MOSFETS are turned off and the loads applied to their drains are not activated. Therefore when the battery voltage is low there are no loads applied across the battery by this circuitry.
Transistor Q1 in conjunction with R9 and ZD1 serve as a simple series regulator.
Actually if the supply voltage is below 15.2V the supply voltage delivered to IC1 would be approximately 1.2V less than the battery voltage. For a battery voltage above 15.2V the output voltage would be regulated at 13.8V. This supply does not need regulation but the this circuitry is included so that the output voltage does not exceed 28V (Max for IC1) as this would be possible in a 28V system.
When the shunts are dissipating power (Battery voltage high) the output of IC2:B is a logic "0" and capacitor C4 is discharged via R10 and the forward biased diode D3. The output from IC2:D is at a logic "1" and the MOSFET Q2 is turned on: Fan runs. When the battery voltage goes low the output of gate IC2:C goes high and the

capacitor begins to charge via R11: Fan runs for about 1 minute after the loads are switched off.
The hysterisis when the battery float is set to 15V is approximately 1 volt: That is when the battery reaches its float voltage of 15V the load will not be disconnected until the battery voltage drops to 14V. Reducing the value of R16 to 220K or less can increase this hysterisis.
The MOSFETS provided (2SK3812) have an extremely low on resistance and a current rating of 110A. For a power dissipation of 0.5W in each MOSFET a current of 23A can be passed. MOSFET as applied in this example the power dissipation in each MOSFET would be 180 milliwatts.
With a gate voltage of 4.5V the on resistance of a 2SK3812 is 3.7 milliohms.



Construction tips
Start by fitting and soldering the lowest profile components such as the 1/4W resistors, working you way up to the LEDs. Pay particular care with the installation of the SM8303 IC. Bend the leads to fit the holes in the PCB with a small pair of pliers before fitting the IC to the PCB. The SM8303 must be screwed to the PCB to help cool the IC.

NOTES FOR MAKING DUMMY LOADS…
Rewound electric jug elements were used for making dummy loads for this kit. These elements are available from supermarkets and hardware stores. These elements are made with coiled resistance wire that is wound around a ceramic former. Phoenix made the particular ones we used in our prototype: Phoenix Mini Jug Assembly, Cat. No. E.J.2.
The resistance of this unmodified element is 34 ohms. Remove the wire from the former and stretch the wire so that it is straight. Bring the two ends of the wire together and to fold it in half so that there are two strands of wire side by side. A this stage it is best to twist the two wires together with an electric drill: Hold one end in a vice and the other end in the chuck of an electric drill. Since each of the half lengths of the original wire have a resistance of 17 ohms (34/2) the total resistance of the 2 paralleled haves would be 8.5ohms.
To say make a 4A-60W load for a 12V battery that floats at say 15V a resistance of 3.75ohms is required. Simply cut the length of the paralleled wires to a length that would have this resistance. This can be measured with an ohmmeter. Don’t forget to cut the wire a little longer than required to allow for the termination.
Wind & re-terminate the wire back onto the ceramic former.
Rather than waste the energy generated by loads you may consider using them to heat a room or water.

K220AParts list

Resistors

3 X 1K - 1/4W

1 X 6K8 - 1/4W

2 X 10K - 1/4W

3 X 12K - 1/4W

2 X 22K - 1/4W

1 X 100K - 1/4W

2 X 120K - 1/4W

2 X 1M - 1/4W

1 X 2K Trimpot

Capacitors

1 X 22n Green-cap

1 X 0.012uF Green-cap

1 X 10uF Electrolytic cap

3 X 100uF Electrolytic cap

Semiconductors

1 X 2N5551 Transistor

1 X MTP3055 MOSFET

2 X 2SK3812 MOSFET

1 X 15V Zener Diode

1 X L4949 IC

1 X 4093 IC

1 X LED Green

1 X LED Red

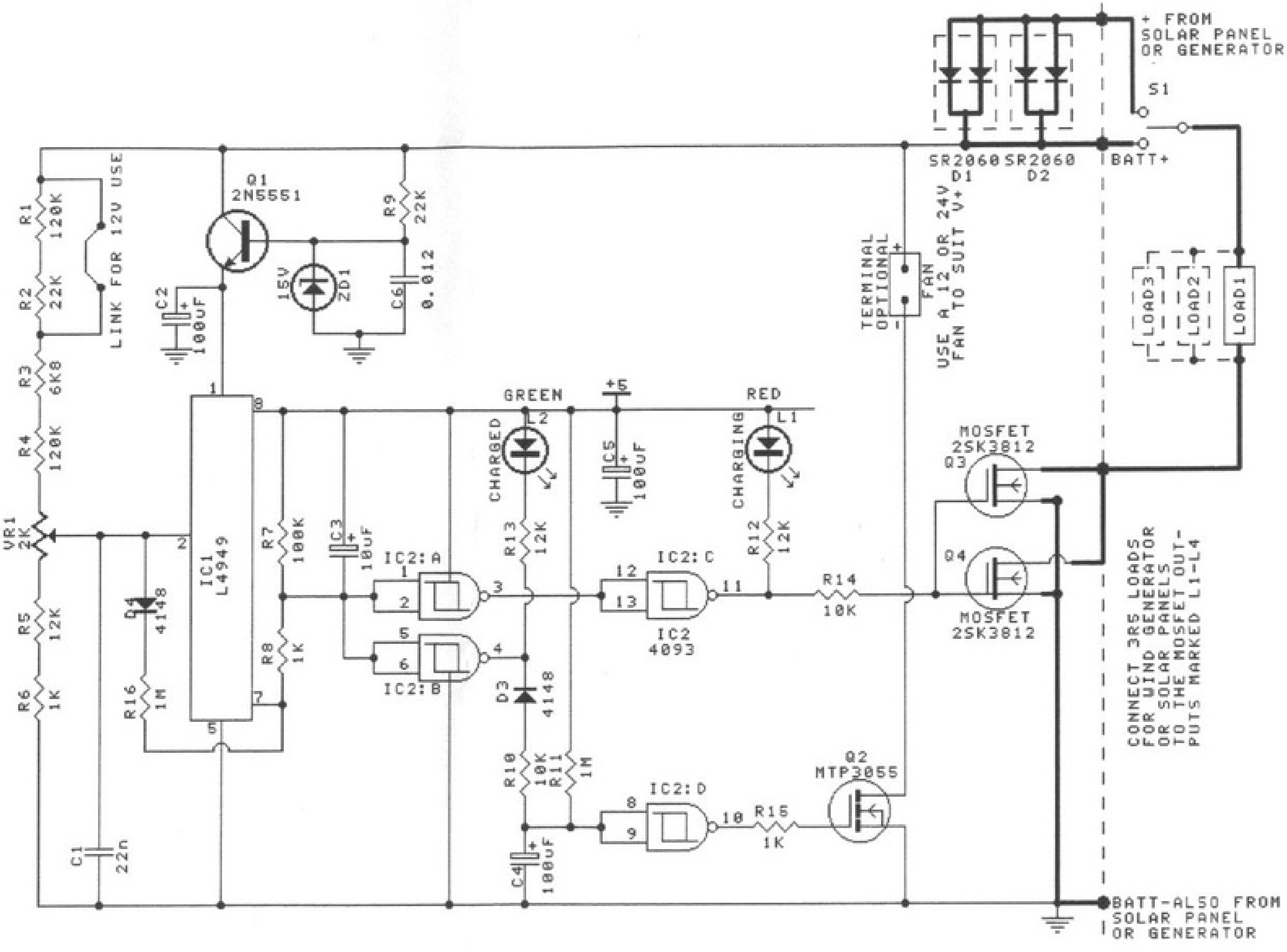
1 X 4148 Signal Diode

Misc.

1 X PCB Coded K220A

1 X Weather-proof box

1 X 3 Way Screw Terminal



To correct a mistake on the PCB, scrape the green solder resist from a small area of this track until you see a bright copper colour then place a solder bridge as shown here.