"We're in Control"

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See us via the Internet: http://www.4QD.co.uk Email to: esupport@4QD.co.uk

Instruction manual

1QD range of Motor Controllers

Introduction

4QD's 1QD range are motor speed controllers for battery operation covering the range of currents up to 100 amps intermittent. Two voltage options are commonly available: 24v and 12v. 36v and 48v versions can be supplied to order. They are high frequency chopper drivers giving full motor control from zero to full speed. They use MOSFETs in state-of-the-art high frequency circuitry to give best possible performance and battery economy.

The simplest possible configuration is shown in section 6. However our drives are used for many different purposes and we therefore give a lot of extra information in this manual - which may make it seem to be more complicated than it is. Please don't be put off but read the manual quickly through before you start. This should introduce you to what you can do with our controllers and clarify what we are trying to say. If you have any queries, please contact us at 4QD since it is only by listening to your comments that we can improve our product and the instructions we give.

Contents

Models

2 models are available, for different currents and in four voltage ratings.

	35 Amps	70 Amps
12v	1QD 35 12v	1QD 70A 12
24v	1QD 35 24	1QD 70 24
36v	1QD 35 36	1QD 35 36
48v	1QD 35 48	1QD 70 48

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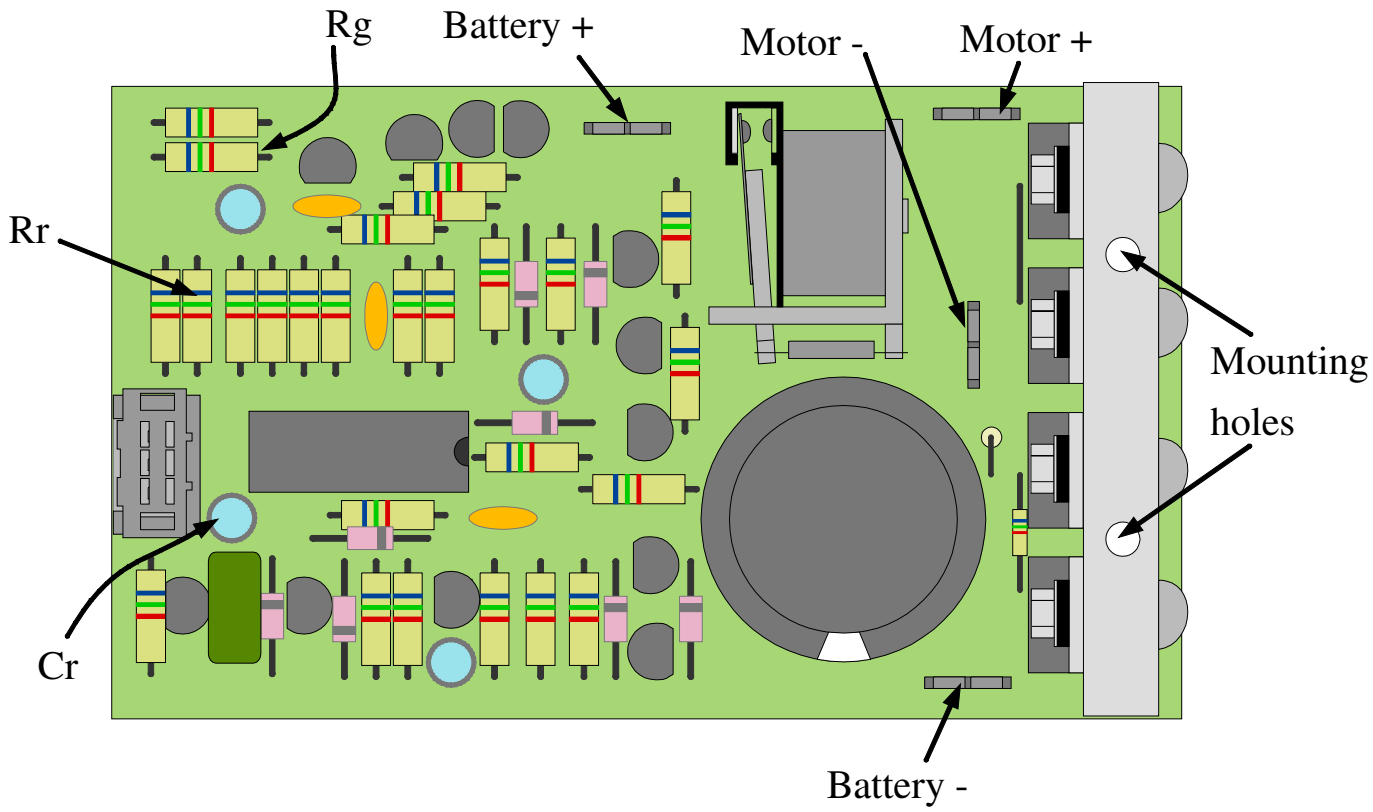
Features



The diagram shows the 70 amp model. The 35 amp version is the same, but with only 2 MOSFETs.

Speed pot input is via a 3 pin connector, supplied.

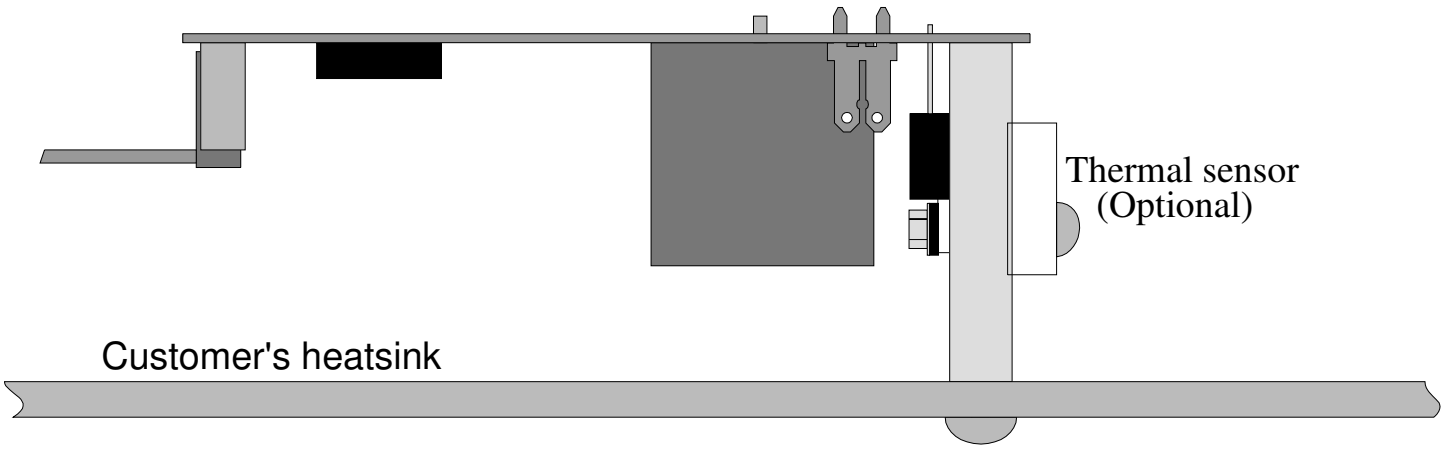
Power & Motor connections are by means of 6.35 blade connectors.

The terminals used will also accept 2.8mm connectors, which can be useful when using several small motors in parallel.

Specifications

Supply voltage	12v or 24v	depends on model	
Supply current	20mA	at zero speed	
Output voltage	0 to 100%	of full speed	
Output current	1QD-35A	35A hot	50A cold
(typical)	1QD-70A	70A hot	100A cold
Switching frequency	20kHz	approximately	
Size	95mm x 55mm x 35mm		
Weight	100g		
Input	1k to 100k pot.		
Integral heatsink	10°C per watt	approx in free air.	
Thermal sensor (optional)	70°C		
Overheat current	10A	35A model	typical
	20A	70A model	typical
Input volts for full speed	4v	approx	
Overvoltage (pot fault detect)	6v	approx	at pot slider

Mounting



The controllers are intended for mounting by the heatsink as in the above diagram. Except in low current applications the heatsink should be in contact with additional metalwork to conduct heat away. The controller is suitable for mounting inside a diecast aluminium box, e.g. RS Components 225-186 or FEC 525-625

Also, make sure the controller can't get wet and if it does, don't connect the battery until you have dried the controller thoroughly. The water won't cause damage **unless the unit is connected to the battery**, when electrolytic corrosion will occur.

Take care that there is adequate clearance between the underside of the board and any other metalwork: if the board or any components touch metal this could cause a failure.

See also page 7

Power Connections

Battery wiring

Battery connections to the controller are shown in the diagram above.

Polarity The 1QD has a relay present to protect against reverse polarity battery. If the battery is reversed the relay will not operate and the circuit will be protected. Do not sustain reverse polarity indefinitely or a resistor will burn out.

Wire size. Use heavy duty wire for the battery, and make them as short as possible. This also applies to the battery linking wire on 24v systems. 4mm wire is ‘officially’ rated to handle 41 amps continuously. At 100 amps it gets too hot to touch within about 60 seconds but so will the controller so 4.0mm² wire will be quite alright for the 75 amp version and 42.5mm² will suffice for the 35 amp version. Thicker wire will cause no problems, so use the thickest you have.

Use of wire that is too long (and/or too thin) will cause loss of power, but more importantly the decoupling capacitor (see ‘features’ diagram above) and their leads will heat up. Under extreme conditions (especially with 75 amp version) the capacitor can disintegrate. Heat will shorten the operating life of the capacitor. Once the capacitor fails the switching action of the MOSFETs generates high voltage spikes across the power connections to the board. These spikes can be high enough to destroy the MOSFETs. A battery which is partially discharged may also have much the same effect as long battery leads.

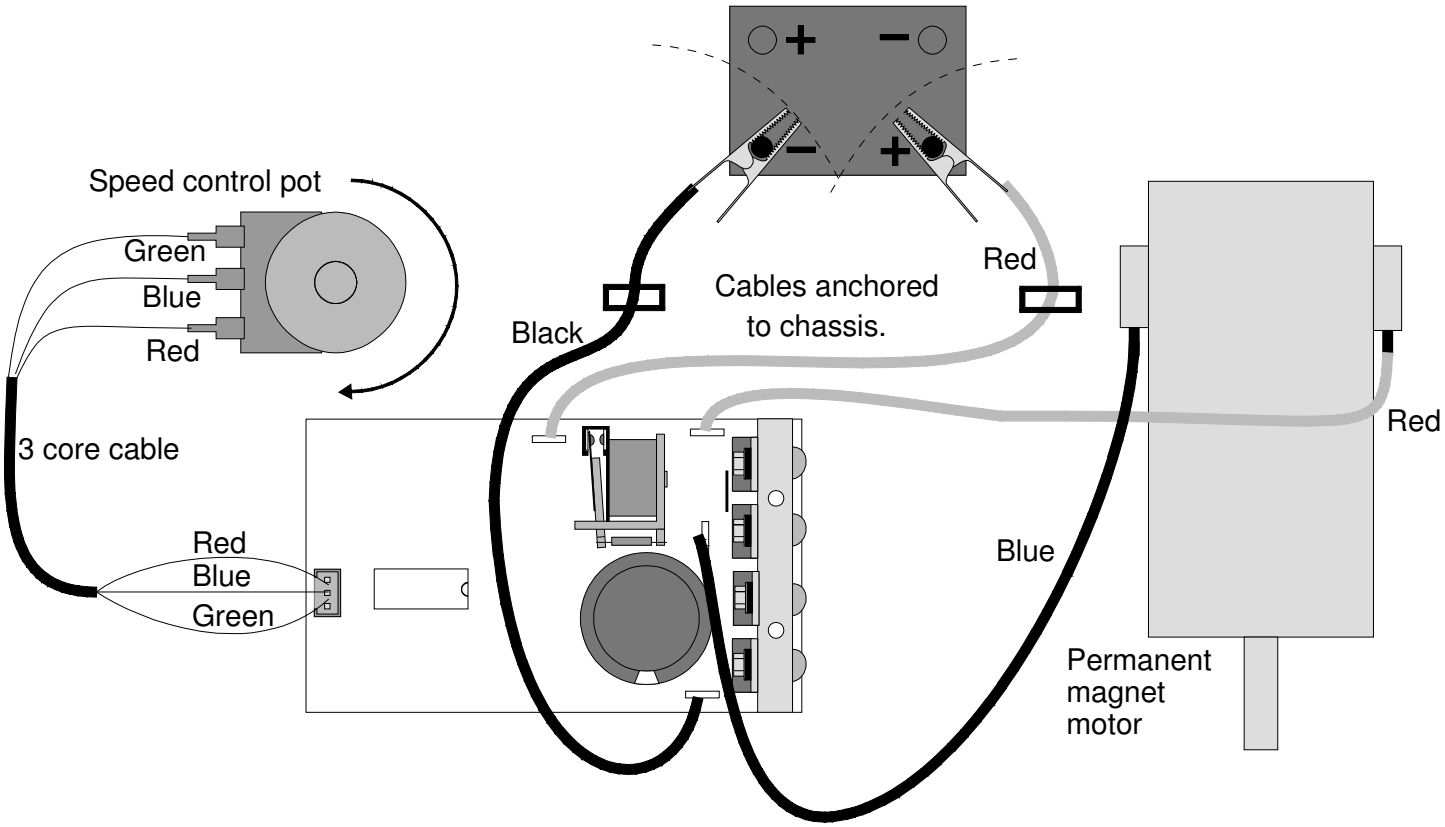
Motor wiring

This is not so critical as battery wiring: too long and/or too thin wire will cause a loss of maximum current, will get hot and will waste battery power but will not damage the controller. However, wire which is too thick will do no harm either so we recommend the same wire for the motor as for the battery.

Circuit breaker

A circuit breaker may be fitted if required. The main advantage is that it will enable the battery or motor to be disconnected in the event of an emergency or for security. A circuit breaker will not protect the drive in the event of a fault: MOSFETs fail far faster than a circuit breaker can operate.

You could fit a breaker in the battery lead: take care not to increase the wiring length too much. Also, certain types of breaker can have the same effect as increased battery lead length. A breaker in the motor may therefore be best: it will enable you to quickly disconnect the motor in an emergency. Also with the motor disconnected, freewheeling becomes possible. It is also possible to get a battery isolator switch. These are normally fitted to lorries, buses and boats to isolate the battery in an emergency.



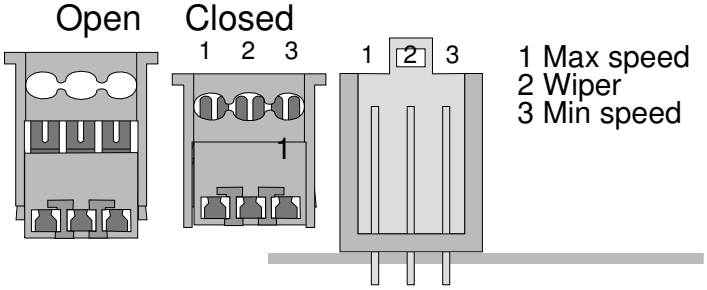
Controls

Speed pot

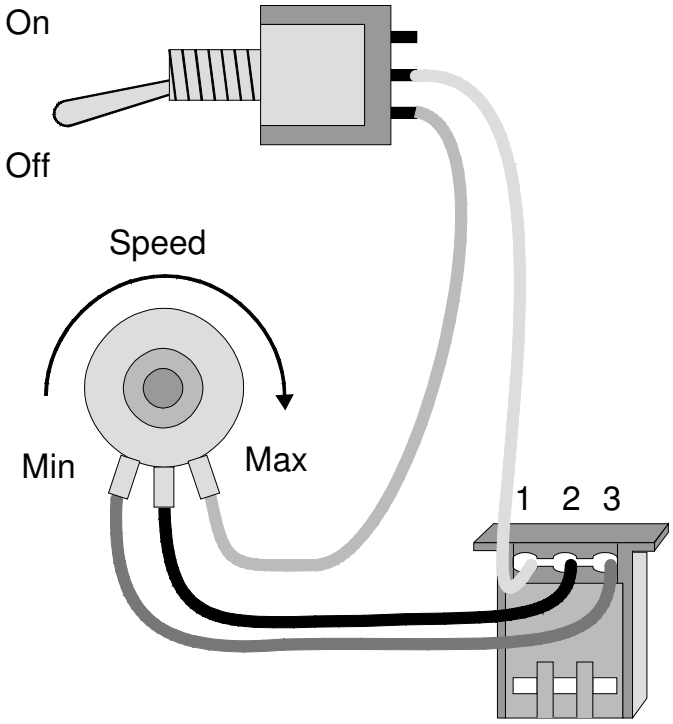
You should use a 10K linear pot. Other values from 1K to 100K, linear or log, could be used but will require a resistor to be changed (see 'Adjustments').

The controller may also be fed from a voltage source (4.5v for full speed) when a 10K resistor must be fiitted between pins 1 and 3 to replace the pot.

Connections are shown in the diagram.



The mating connector supplied is suitable only for 7/0.2 wire. (7 strands of 0.2mm² wire). It an Insulation Displacement Connector (IDC): do not strip the insulation from the wires, simply push them into the top part of the open connector and squeeze it closed in a vice or with suitable parallel action pliers. As you do this the tines of the contacts bite through the insulation to make contact with the conductors. Wire which is too thin will not make contact. Wire which is too thick will damage the tines. You can re-open a closed connector by gently moving the tabs at the sides of the top cover outwards to disengage the latches while lifting the cover slightly, one side at a time.



On/Off switch

When the pot is at zero speed the relay in the 1QD switches off, reducing current consumption to about 20mA which is insignificant.

However if the potentiometer is disconnected, circuitry in the controller switches it off (zero current consumption). Therefore a switch in series with the top of the speed pot (pin 1 of the IDC) will act as an 'ignition' switch.

Adjustments

Adjustments There are no adjustments on board but several performance parameters can be altered by value changes. However this should only be undertaken by the technically proficient - 4QD's guarantee will not cover damage done by inexpert modification.

Gain

The controller will reach full speed at about 4½v on the pot slider. The resistor Rg (on the features diagram) is in series with the pot, fed from the full battery voltage.

For use with a 10K pot, suggested values are as shown below. This will give full speed somewhere around 80% of the pot rotation so that it will give full speed with a flat battery.

Voltage	Pot	Rg
12v	10K	10 K ‡
24v	5K	22 K ‡
24v	10K	39K
36v	10K	68 K

‡ - standard values

This resistor may be changed as required. Increasing this value will mean than the pot must be turned up more to get full speed, decreasing it will give full speed before pot reaches full rotation. Lower value pots require a lower value resistor. You can of course fit this resistor external to the board, in series with the top of the pot.. Beware of using too low a value since the pot fault protection circuit will turn the circuit off if the input voltage is too high (above 6v on wiper).

Current limit

This is pre-set: it can be altered by a value change. However, this can get quite technical so contact 4QD for assistance.

Acceleration ramp

This is preset: it is present to make the speed change smoothly when the speed pot is altered suddenly. It can be altered by a value change. For those with electronic experience, the ramp is controlled by a 10µ capacitor and a 100K resistor (shown as Cr and Rr in the features diagram). The 10µ may be decreased (or even removed for really fast response), or increased for slower response. The controller has no braking so a diode is used (next to Rr) to give a fast deceleration time so that the controller does not cause the motor to over run.

Heat & Heatsinking

The rated current output of the controllers is with the heatsink hot. When cold they will give considerably more current. Thus the 35 amp version will in fact give about 50 amps when cold. This is OK because the MOSFETs used are rated at 60 amps continuous with a case temperature of 25°C. As the MOSFETs warm up their allowable current reduces so that at a case temperature of 100 they can (only!) handle 45 amps continuous. The current limiting used in 4QD's controllers senses the MOSFET temperature and automatically adjusts. However, running the controllers at full current will cause speedy heating.

However, at some temperature (well above 100°C) the MOSFETs will become unsafe, so we suggest that, during initial use, you keep a note of the heatsink temperature and, if it becomes much too hot to touch, take appropriate steps, either by mounting the 1QD onto additional heatsinking or, better still, fit a higher rated drive since heat is wasted battery power and a larger drive will waste less.

Optionally a thermal sensor is available which shuts the controller down to a safe, low current if the heatsink gets too hot.

Service & Guarantee

All 4QD's products carry the normal 12 month guarantee.

Outside the guarantee period, or when the fault is caused by misuse, we will repair the controller at a fixed price. Full details are on our ww site, in the Service section.

The user's attention is drawn to the high current crimp connectors: especially at high currents, or with many insertions, these connectors can become high impedance. This will cause then to heat up, the controller to loose power and the decoupling capacitors to be over stressed and to heat up. We suggest therefore that you periodically check these connectors for any sign of trouble.

Also, from time to time, check the decoupling capacitors for heating. Apart from too long or too thin wiring, heating may also be a sign of an inadequate battery, a partially flat battery or ageing capacitors.