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Made In USA

RAPTOR SERIES

HIGH PERFORMANCE MOTOR DRIVES

OWNER'S MANUAL
for model # Raptor 600
RAPTOR SERIES DC MOTOR CONTROLLER

Serial #_____

FEATURES

Goof Proof control wiring - connections are high voltage fault tolerant
Non Contact inductive throttle position sensing, 100 million cycle life
Rev limiter regulates RPM at selected maximum speed
Tachometer Drive output, operates "4-cylinder" tachs
50-100mS Shift Blanking for crash-box or automatic transmissions
Failed open, short and floored-on-startup throttle lockout
External battery contactor control with capacitor precharge delay
Microprocessor controlled, forced air cooled
Tach Sensor, Throttle Sensor and Remote Display included

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1. Raptor 600 Product Overview

Thank you for purchasing this DC Power Systems motor controller. We design and manufacture products for High Performance Electric Vehicles. This motor controller employs the latest generation of power MOSFETs to provide extremely low on resistance, resulting in a high current capacity and extreme efficiency. A microprocessor based control system monitors numerous functions, and allows user selection of motor RPM limit and throttle ramping. Reliable contactorless throttle position sensing is employed, with open, shorted and "Floored" throttle detection interlock, all without pots or microswitches to wear out. Thermostatically controlled fan forced air cooling is provided with gradual over temperature shutdown. A 3 LED dash mountable remote indicates "ON", "Wide Open Throttle" and "Overtemp". An optical sensor mounted to the motor provides RPM feedback, used for the Rev Limit and to drive an optional 4 cylinder tachometer. The controller employs a High Side switching topology, meaning it switches the B+ input to the motor. Control of an external battery contactor allows the controllers on-board filter capacitor bank to precharge prior to engagement of battery power.

2. Required Accessories

For your safety and that of others, some basic precautionary measures must be employed when designing, working on, and driving electric vehicles. This may be old hat, but the good design harpy won't let them pass without saying 'em again:

Use a contactor in the battery circuit, rated for the amperage and voltage of the system.

Use a fuse rated for the voltage and available fault current of the battery.

A secondary disconnect, accessible to the driver, must be employed. This can be a circuit breaker, switch or separable connector system.

Use wire rated for the current & voltage of your system. Generally, 2/0 welding cable is acceptable for light (<800lbs) battery strings, but 4/0 is recommended for severe duty applications where sustained high current (>400Amps) is expected.

Controllers have failure modes which can result in runaway (stuck throttle) conditions. This controller has been designed to prevent and preclude as many of those from ever occurring as possible. However, it could still happen, according to Murphy's Law. Please follow the Recommended Controller Wiring System document in this manual. Failure to do so could result in damage to the controller, and serious injury or death to vehicle occupants or bystanders.

3. Recommended installation guidelines

There are several good books on the subject of electric vehicle conversion and design. Read them and save yourself the hassle of repeating other people’s mistakes. The purpose of these instructions is not to detail EV conversion or represent one companies products ahead of another, but to provide guidance on the correct application of the motor control system. The schematic below shows the recommended system interconnections and accessories. Included with the controller is a Tach Sensor, Remote Display and Throttle Position Sensor.

See back of manual for full size drawing

3.1 Battery Contactor

The main battery contactor needs to be chosen for it's ability to carry the intended continuous battery current, and to interrupt the peak battery pack DC voltage. The controller is designed to operate contactors with 12VDC coils and a maximum continuous coil current of 4A . When the controller is turned on, it begins to charge the internal filter capacitor to the positive battery bus voltage. After a 1.5 second delay, the controller switches the contactor coil lead to ground, energizing the contactor.

3.2 Main Fuse

The main fuse needs to be sized to protect the wiring in the drive system. Use the smallest amperage rating fuse which you can get away with. The following are key parameters to observe when specifying a fuse:

Fuse DC voltage rating must be greater than the peak battery voltage.

Fuse current rating: Maximum 1000 Amp. Most high current fuses have very long (2 minutes or more) tolerance to 10 - 30% overloads. Even an 800A fuse likely won't fail in a 1200A vehicle application, because you'll rarely draw those high currents for extended times.

Fuse interrupt current (AIC) rating shall be greater than the batteries short circuit current. Get the short circuit current from the battery specification, and make sure the fuse can open a fault of this magnitude.

Some installations use multiple fuses at various points in the battery pack, a good idea if there is a possibility of an interpack short circuit.

3.3 Safety Disconnect

The safety disconnect provides a way to disconnect the battery pack from the controller and contactor. It may be a circuit breaker, a mechanical switch, or a large removable connector. Make sure it is rated for the current capacity and DC Voltage of your system. Some installations disconnect both the positive and negative leg of the battery pack, a very good idea. For runaway motor protection, however, opening at least one battery lead creates redundancy of the battery contactor function, a minimum safety requirement.

3.4 Drive Motors

The motor controller is designed to operate with series wound brush commutated DC motors rated for operation from 48 - 156VDC. Operation with shunt or compound wound motors is possible, and with permanent magnet types.

3.5 Tachometers

The DC Power Systems motor controller provides an easy interface to most "4-Cylinder" tachometers requiring two pulses per revolution. The tach driver is intended to operate tachs requiring a grounded signal for triggering. Those requiring a high voltage pulse to trigger them will not work.

3.6 Auxiliary Fusing

Two auxiliary circuits to the motor controller should be fused. The 12V signal from the ignition circuit (Red wire) should be fused at a maximum of 5A. The controller draws less than 0.1A from this input. The main battery + input should be fused for 5A @ 250VDC. This fuse needs to be of the slow blow type, as the controller can draw a pulse current of ~12A during the precharge cycle.

3.7 Optional Main Battery Power On

An optional input for race only applications allows the controller to be powered from the main battery pack. When this is used, you don't need 12V control power. Connect to Battery + with a suitable switch.

4. Controller Installation

Choose a location outside the drivers compartment to mount the controller. Any mounting position except "fan up" is acceptable, but a horizontal surface is preferred. Protect the controller from direct contact with rain and airborne water. Mount the controller as close to the motor as is reasonably possible. Ideally, your motor leads should be less than 4 feet long. Often it is possible to place the controller above the motor on a plate, allowing free airflow into and out of the controller while protecting it from road spray. Do not place the controller in a zero clearance compartment, or one without at least 200CFM of airflow.

The fan sucks air in, blowing it across the heatsink to where it exits the controller below the bus bars.

Place the controller such that any "ram air" effect causes an increase in air pressure on the fan side of the controller. But, make sure water can't enter the controller!

High current wiring to the motor controller should use 5/16" mounting hole ring terminals of solid copper. Bolt them to the controller using 5/16" hardware. Place sleeving or heatshrink over the terminals once secured to provide electrical insulation.

The green connector block is removable for easy assembly. Use 18 - 14AWG 300V rated wire to route the control wiring from the various connections to the terminal block.

4.1 Throttle Sensor Mounting

The throttle sensor employs a scheme for measuring a change in the solenoid's inductance as the position of the slug is changed. The "Off" position for the solenoid is with the slug fully inserted. Increasing throttle PWM (Power) occurs as the slug is pulled from the solenoid. Mount the sensor such that stepping on the throttle causes the slug to pull out of the solenoid. Try to get about 1/2" of slug travel over the throttles working range, however it isn't critical. Neither is it critical for the slug to return to fully seated position to achieve "Off", as the controller automatically calibrates itself every time it's powered up. Use of multiple throttle return springs is required. If one lets go and it's all you had, you might get a wild ride!

4.2 Tachometer Sensor Mounting

The tachometer sensor employs an infrared optical source and detector. It is designed to sense a reflective white surface, from about 1/4" distance. The sensor can be used to measure either a rotating shaft or the backside of a flywheel. To prepare a shaft for use, first choose a mounting location that places the "eye" end of the sensor about a 1/4" from the shaft. Clean that area of the shaft and paint it with high temperature flat black enamel. Next, paint two 90 degree patches of white enamel over the black, 180 degrees apart. They need to be wider than the sensor. The result is two alternating white patches on the motor shaft. Note that the patches don't have to be exactly 180 degrees apart, nor exactly 90 degrees in duration. 20 is accurate enough. If detecting from the surface of a flywheel, use at least two inch long white patches painted 180 degrees apart. Plug the sensor connector into the RJ style jack labeled "TACH IN". The sensor has an LED that illuminates when it detects a white surface, it extinguishes when a black surface faces the sensor.

If erratic tachometer readings or erratic RPM limiting occurs, clean the sensor face. Also check the sensor gap and adjust it so that the sensor LED blinks on and off as the shaft is rotated. The optimum gap for the sensor is directly In the middle of its sensing range, about 1/4" (5mm). With the motor circuit disconnected, energize the controller. Rotate the motor shaft so the white surface faces the sensor. Slide the sensor closer and then farther away from the motor shaft. Observe the range where the LED stays on, mark the midpoint. Now, power down the controller. Wait 5 minutes for the internal capacitors in the controller to bleed down. Verify the controller is de-energized by measuring 0 volts across the +/- battery terminals of the controller. Mount the sensor in the mid point of the working range. Reconnect motor.

4.3 Remote Display

The remote display panel is a simple status display of the motor controller. Choose a driver visible location for the remote. Drill a small hole to pass the phone cord through and mount the remote with the attached sticky tape.

The Green LED indicates "Power On", and that the unit is ready to operate. This LED should always illuminate and stay on after a 1.5 second boot-up delay at power up.

The Yellow LED illuminates when the throttle is wide open or "Floored". This indicates that the controller is no longer switching and is delivering maximum power to the motor. Should the LED not come on during a full throttle condition, this indicates that the controller is in peak current limit. You're trying to pull more amps through it than it can deliver. A yellow LED on the controller itself also indicates full throttle. It only works if the remote is disconnected.

The Red LED indicates the controller is in thermal cutback. If the power transistor temperature

exceeds 110C, the controller begins to limit maximum available power by folding back the PWM. Try shifting to a lower gear and allowing the motor RPM to increase, or check for obstructed airflow to the controller.

If all of the LEDs on the remote illuminate at once, the controller has detected a hazardous fault condition and shut down. Either the unit is miswired, and the capacitor precharge circuit is not able to precharge the internal filter caps, or an overtemperature condition exists within the controller. The fan will run in this state, so wait * a minute, then turn the power off and back on. If this occurs during a new installation, check the high power wiring.

4.4 Shift Blanking

The Raptor 1200 includes an input for disabling the normal PWM output for a brief period of time to permit no-load shifting of automatic transmissions. When 12V is applied to this input, the output of the controller turns off for either 50 or 100mS (dipswitch setting). Upon completing the delay, the output is re-engaged at the prior PWM value. The delay is a one-shot type of function. When you apply 12V to the shift blanking input, the controller executes the delay, then returns to its previous state. You have to remove the 12V signal and reapply it before another shift blanking cycle will occur.

5.Calibration

There are several adjustments for tailoring the controller, maximum throttle PWM, maximum battery current, RPM limit and throttle ramp rate.

5.1 Maximum Throttle

Perform this calibration with the motor disconnected. Turn the CURRENT LIMIT potentiometer fully clockwise (max current). Turn the MAX THROTTLE pot to mid rotation. Turn on the controller and observe the green remote LED comes on. Mash the throttle to the floor, while you have someone adjust the potentiometer on the controller labeled "Max Throttle". Turn the pot clockwise until the Yellow LED on the remote just comes on. Release the throttle and turn the controller off. Turn the controller back on, wait for green LED, then mash the throttle. Make sure the yellow LED comes on. If not, turn the pot clockwise slightly. When the Yellow LED is on, you've got "Full Throttle." If you wish to reduce the maximum available power, this pot can be adjusted counterclockwise so the yellow LED doesn't come on. Now, power down the controller. Wait 5 minutes for the internal capacitors in the controller to bleed down. Verify the controller is de-energized by measuring 0 volts across the +/- battery terminals of the controller. Reconnect motor.

5.2 Current Limit

This adjustment controls the maximum available battery current through the controller. Clockwise increases, counterclockwise decreases the output current. Set it to your preference.

5.3 Dipswitch Settings

The dipswitch controls throttle ramp rate, RPM limit and shift blanking duration.

Dipswitch position 4 controls the throttle ramp rate. Off = Fast, On = Slow.

Dipswitch positions 2 & 3 control RPM limit

RPM LIMIT	DIPSWITCH 3	2
4000 RPM	OFF	OFF
4500 RPM	OFF	ON
5500 RPM	ON	OFF
6500 RPM	ON	ON

Dipswitch position 1 selects the shift blanking delay, OFF = 50mS, ON = 100mS.

6. RATINGS

Input Voltage Range
48 - 156 VDC Nominal (36 - 180 VDC max)
Output Current (Battery)
600A max, 300A sustained @ 40º C ambient
derate 75A per 10º C rise above 40º C
Freewheel current (Motor)
900A max, 350A continuous @ 40º C
Switching Frequency
18Khz
Rev Limit
4000, 4500, 5500, 6500 RPM
Shift Blanking Input
50 or 100mS one-shot PWM dropout
Contactor control
Switches 4A rated 12V coil. Uses vehicle 12V
Operating temperature
-30º C ~ +75º C
Weight
18 lb.
Dimensions
6.75 x 9 x 12 (HxWxL, inches)

LIMITED WARRANTY

DC Power Systems warrants every product it sells to be free from defects in materials or workmanship for a period of 1 year to the original purchaser from the date of purchase. This warranty does not apply to defects due directly or indirectly to misuse, abuse, negligence, accidents, repairs or alterations.

We shall in no event be liable for death, injuries to persons or property or for incidental, contingent or consequential damages arising through the use of our products. DC power systems specifically disclaims the implied warranties of merchantability and fitness for a particular purpose, however some areas do not allow limitations on how long an implied warranty lasts, so the preceding exclusion may not apply to you. This is DC Power Systems sole written warranty, no other warranty is expressed or implied.

In the event you should need warranty repair, Please see the Return Procedure below. DC power systems reserves the right to repair or replace merchandise at its option. DC Power Systems reserves the right to make changes to any of its products or specifications without notice. All sales are final.

Return Procedure

Call DC Power Systems at (360) 676 -9643 or
email: fetsmoke@dcpowersystems.com

Explain the nature of the problem and obtain a Return Authorization number. You pay shipping to us, we pay the return shipping. Package the device in its original container. We are not responsible for damage in shipping.

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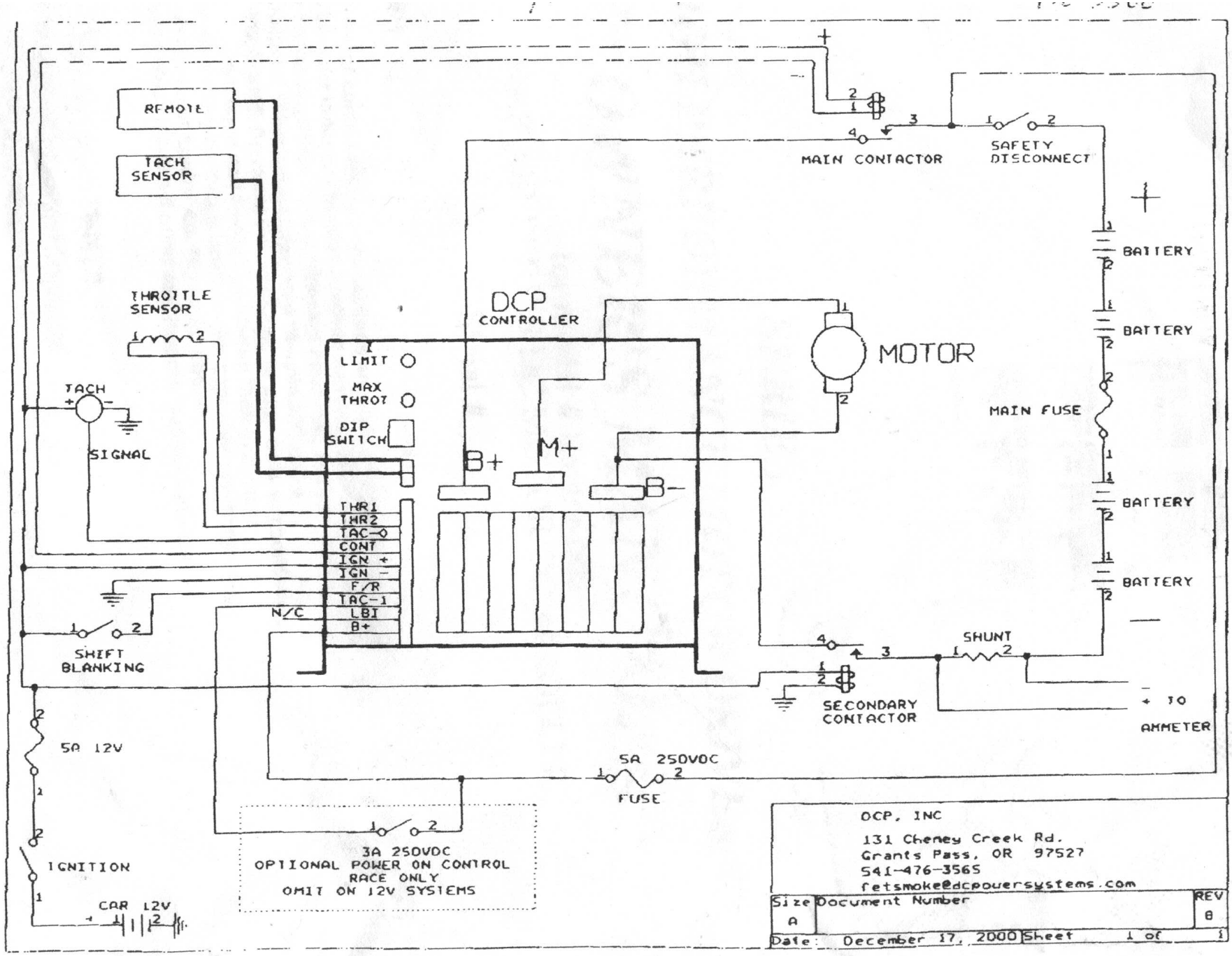
REMOTE
TACH SENSOR
THROTTLE SENSOR
TACH
SIGNAL
SHIFT BLANKING
5A 12V
IGNITION
CAR 12V
DCP CONTROLLER
LIMIT
MAX THROT
DIP SWITCH
B+
M+
B-
THR1
THR2
TAC-0
CONT
IGN +
IGN -
F/R
TAC-1
N/C
LBI
B+
MOTOR
MAIN CONTACTOR
SAFETY DISCONNECT
BATTERY
BATTERY
MAIN FUSE
BATTERY
BATTERY
SHUNT
SECONDARY CONTACTOR
+ TO AMMETER
5A 250VDC
FUSE
3A 250VDC
OPTIONAL POWER ON CONTROL
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