Instruction Manual

PRO-160 Series Controllers

PRO-160-S/HC/HV/HCV
Hardware Guide
For control boards 30-41-07

To be read with the Pro-x60 series configuration guide

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1. Introduction

The Pro-160 is an advanced digital PWM motor controller for currents up to 200A. It uses a specialist microprocessor to control a full H-bridge design that does not require relays for reversing. The display provides key information to the operator, and can be mounted separately to the controller if required. It has a full range of features and is easy to configure as required.

This manual covers the hardware aspects of the controller, the separate configuration guide covers how to make changes to the settings.

2. Do's and Don'ts

Warning – the Pro-160 does not have reverse polarity protection. Connecting the battery wires incorrectly WILL destroy the controller.

Do

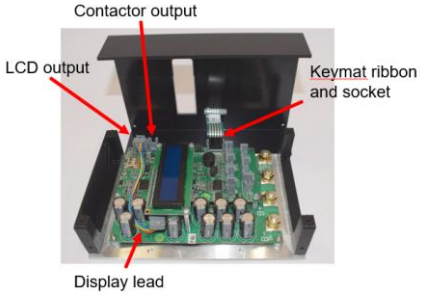
- **Do r**ead the instructions fully before installing.
- **Do** take care to connect the battery wires with the correct polarity.
- **Do** fit a motor suppression capacitor, and ferrite rings.
- **Do** twist the motor wires together if possible.
- **Do** call 4QD if you are uncertain about something.

Do not

- **Do not** allow water to get onto the circuit boards.
- **Do not use with lithium batteries without reading our website article about BMSs.** https://www.4qd.co.uk/docs/using-a-bms-with-a-motor-controller/

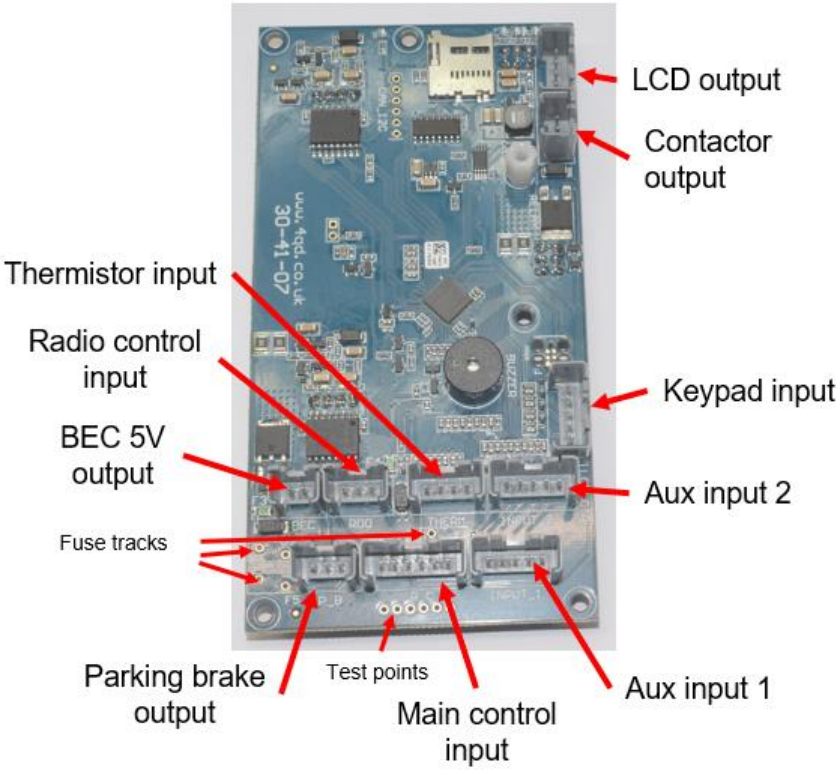
3. Getting Started

- Remove the four screws that hold the cover to the end plates and lift off the cover.
- The Pro-160 is supplied with the keypad ribbon cable not connected to its socket. This should only be plugged in once the Pro-160 has been fixed in position, the control and power connections made, and you are ready to start operation. The keypad socket is marked LCDCTRL.

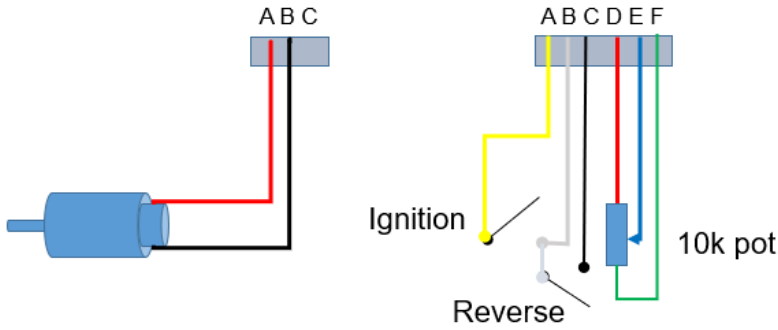


4. Control Connections

The control sockets are all on the smaller control board shown below.



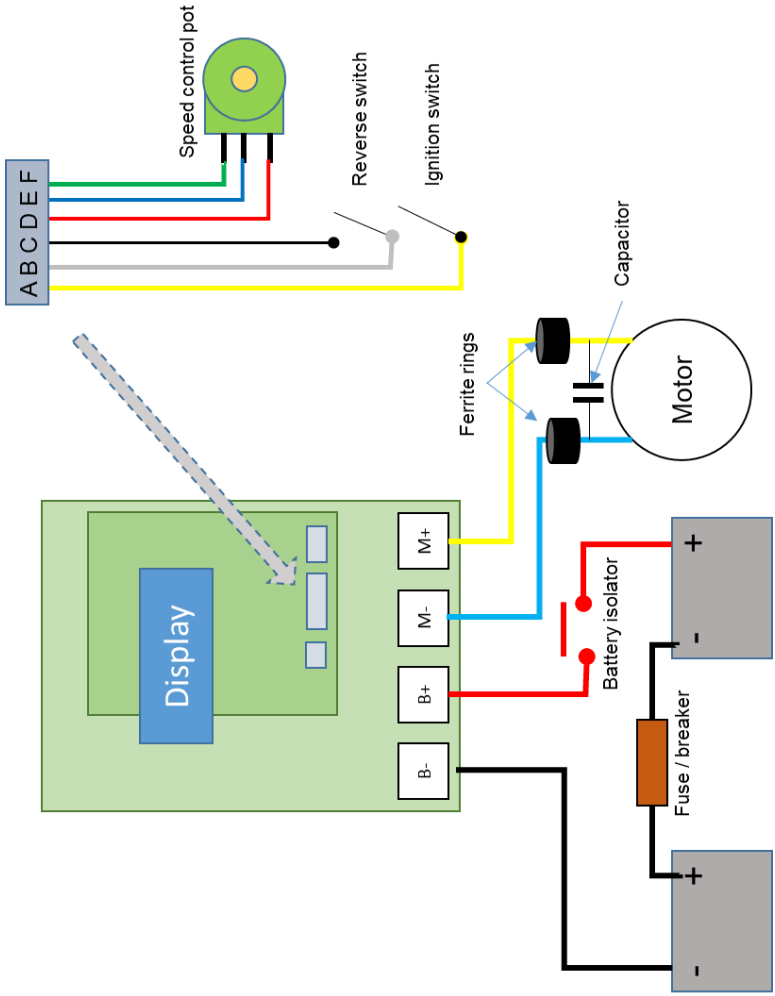
The main control input and parking brake should be wired as shown below



On the main control input Pin A provides the B+ voltage out to the ignition switch. Pin B looks for B+ as the signal to switch on. Pin C looks for B+ as the signal for reverse. Pin D provides a 5V feed to a potentiometer. Pin E is for the wiper of the pot or a voltage input [0 – 5V]. Pin F is ground. There is a video on our website that explains this in more detail [“The 6 pin connector explained”].

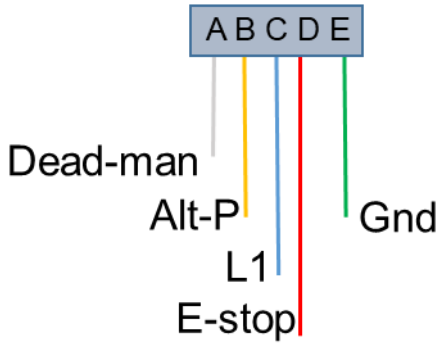
5. Simple wiring diagram

This diagram shows the basic connections needed to get the Pro-160 running.



6. Auxiliary Input 1

Has the following functions.



A - Deadman's handle. There are 2 modes of deadman operation. In "std" if this pin is connected to Gnd then the Pro-160 will follow the active profile ramp down to zero, it will ramp up again when Gnd is removed. In "safe" this pin must be connected to Gnd for operation to start.

B - Alternate profile. If this pin is connected to Gnd the Pro-160 will start up in the alternate profile defined in the profile that was operating without the Gnd present. This allows easy switching between any two profiles.

C - L1. If this pin is connected to Gnd then the Pro-160 will behave as follows…

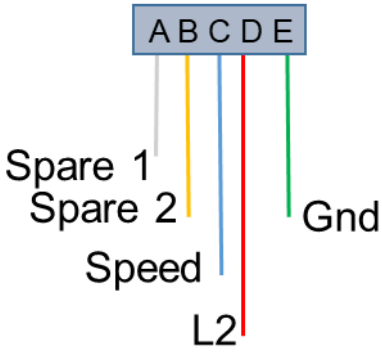
- If push button operation is selected as the throttle input mode, grounding L1 will start forward operation. In PB1 mode this will be up to the speed set by the max PWM setting, in PB2 mode*, up to the speed set by the pot input.
- If limit switch operation is selected [advanced settings] grounding L1 will select forward operation.

D - Emergency stop. There are 2 modes of emergency stop operation. In "std" if this pin is connected to Gnd then the Pro-160 will follow the profile e-stop ramp down to zero, it will not start up again until the Gnd is removed, and the ignition has been turned off / on. In "safe" mode, this pin must be connected to Gnd for operation to start, disconnecting it will trigger the emergency stop.

* PB2 mode available in software version 2.5.3 and later.

7. Auxiliary Input 2

Has the following functions.



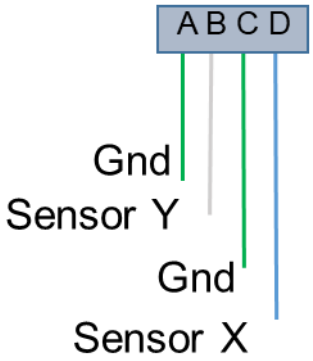
C - Speed. This pin can be used with our speed sensor kit [part number SEN-SPD] for top speed limiting. The sensor is powered by the BEC supply and delivers a 5V pulse proportional to the speed of the shaft that the magnet is attached to.

D – L2. If this pin is connected to Gnd then the Pro-160 will behave as follows…

- If push button operation is selected as throttle input mode, grounding L2 will start reverse operation. In PB1 mode this will be up to the speed set by the max PWM setting, in PB2 mode*, up to the speed set by the pot input.
- If limit switch operation is selected [advanced settings] grounding L2 will select reverse operation.

8. Thermistor input

Can be used to connect 1 or 2 sensors to monitor external temperatures.



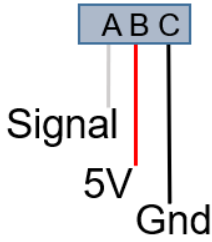
Sensors X and Y should be 4QD part number SEN-TMP.

Sensor X is connected to C and D, Sensor Y to A and B.

Once the sensors have been installed they must be enabled in the profile menu.

9. Radio Control Input

The Pro-160 will accept a standard hobbyist radio control servo signal directly from a receiver. The receiver should be connected to pins A, B, and C of the RDO socket.



The Pro-160 is pre-programmed to work with the majority of radio receivers. Profiles 7 and 8 are configured for RC single ended and RC joystick use respectively. Depending on your radio system you may need to use the RC learn function to properly match the Pro-160 to your receiver output.

The RDO port can provide currents up to 1A.

If you wish to just use RC control, you still need to connect pins A & B on the main control input.

Fail safe operation

The Pro-160 will detect a break in the connection between itself and the radio receiver, or if the signal from the receiver goes out of limits, and will ramp down to zero.

To guard against radio transmitter failure or out of range situations it will be necessary to configure the failsafe facility in the radio receiver.

10. BEC output

The BEC output is a 5V output with a maximum current of 1A. This can be used to provide power to Hall effect type throttles.

11. Power Connections

The power connections are M6 diameter threaded posts. The wire used should be of a diameter appropriate for the load envisaged.

Battery Wiring

Keep the battery wiring as short as possible to reduce the load on the main capacitors.

Motor Wiring [important]

To reduce potentially damaging electrical noise the motor wires should be kept close to each other and twisted together if possible. A 10nF 100V disc ceramic motor suppression capacitor must be fitted across the brushes of the motor. Ferrite rings should be fitted on the motor wires. See the knowledgebase on our website for more information on noise suppression.

If the motor rotates in the wrong direction, swap over the M+ and M- wires.

Battery Circuit Breaker

A circuit breaker or fuse should be fitted in the battery wiring. The rating should be above that of the motors normal operating current.

A battery isolator switch should also be fitted to provide an emergency disconnection capability. In some applications such an isolator is a legal requirement.

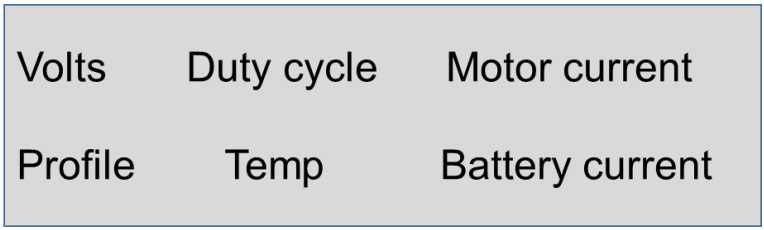
Contactor

The Pro-160 has a contactor output to drive a failsafe contactor [up to 1A] which can provide an emergency disconnection in the event of a controller failure. Details of how to implement this feature are in the knowledgebase on our website.

12. Display

The Pro-160 has a two-line display to display useful information during operation and programming.

During operation the display will show information in this format:



Volts = battery voltage.

Duty cycle = % of battery voltage being applied to the motor.

Motor current[1] = instantaneous motor current in amps [- in reverse].

Profile = profile currently selected [suffix R indicates reverse].

Temp = temperature in ‘C or ‘F. Prefix X / Y denotes sensor X / Y temp, and are only shown if switched on in software. Temperatures below 0’C are shown as “Lo”.

Battery current[2] = average current being drawn from the battery in amps. Note the difference between this and motor current.

The display also shows any alert or fault information.

Notes:

[1] This part of the display can be set to show RPM or speed in mph or kph [Up button].

[2] This part of the display can be set to show power in W or HP, or coulombs [Down button].

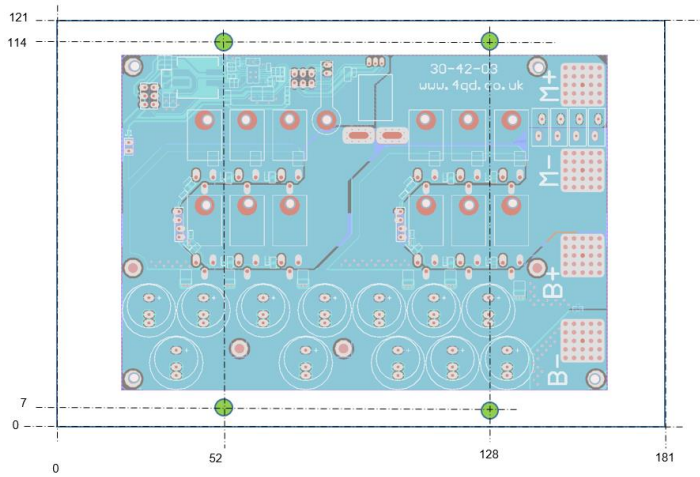
Display adaptors are available that allow the display and / or keypad to be mounted remotely from the Pro-160.

13. Programming

The PRO-160 has up to 15 profiles that can be configured with different operating parameters. It will run in profile 1 by default. It is easy to change the profiles and parameters. Please refer to the PRO-x60 series configuration guide.

14. Mounting

The Pro-160 has 4 M5 threaded mounting holes in the baseplate, shown in green in the diagram below.



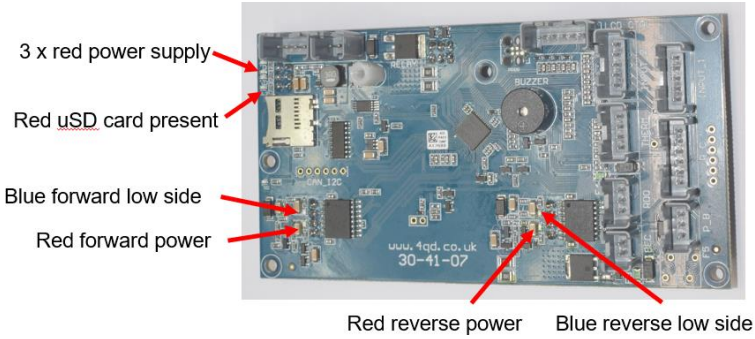
If the operating temperature of the Pro-160 regularly gets above 70’C we recommend fitting additional heatsinking and / or cooling. A cooling fan can be driven from the parking brake or contactor socket. More details on heat dissipation are in the knowledgebase on our website.

15. Display mounting

The LCD display can be detached from its normal place on the control board and mounted in a more convenient location for the operator. There is an optional remote display box.

16. Lights

Rev 7 of the control board includes a number of LEDs that indicate the following



17. Fault finding

The Pro-160 has a set of fault codes and warning messages. If it is beeping then it is telling you it has detected a problem. These codes are listed in the configuration guide and also in the Support / Knowledgebase / Pro-160 section of our website.

There is a full troubleshooting guide in the Support / Troubleshooting / Pro-160 section of our website which includes advice on how to find common installation problems.

There are three fuse tracks in the connections to the main control input, these are shown in the diagram in section 4 and aim to restrict damage in the event of a wiring fault. If a fuse track is blown, a self-resetting fuse may be fitted or a single strand of 1A fuse wire.

18. Service

The Pro-160 has a 12 month warranty. Please see the service section of our website for full details.

19. Specifications

Technical Specification				
	Pro-160			
	160-S	**160-HC**	**160-HV**	**160-HCV**
Nominal voltage range	12 - 48		12 - 84	
Minimum / max voltage	10.5 - 65		10.5 - 96	
Motor current A [max]	140	200	140	200
Motor current A [1 minute]	140	200	140	200
Motor current A [continuous]	Depends on cooling			
Programmable parameters	See parameter table			
Dimensions [mm]	181 x 121 x 50			
Weight [g]	~700g			
Power connections	M6 studs			
Input	5k – 25k pot, RC [PWM], 0 – 4.7V			
Reverse polarity protection	N			
Overvoltage protection	Y [65V]		Y [95V]	
Pot fault protection	Y [50k]			
Thermal protection	Y @ 75'C [also for 2 external sensors]			
Joystick/Wig-wag input	Y			
Radio Control	Y			
Parking brake	1A max, delay and threshold programmable			
Inhibit function	Emergency stop input			
Other inputs	Deadman, alt profile, speed, 2 x thermistor, 2 x limit, 2 x spare			
Powerdown state	Diode bridge across motor			

Technical Specification				
	Pro-160			
	160-S	**160-HC**	**160-HV**	**160-HCV**
Closed loop RPM control	Via software update			
Ignition, electronic	Y			
Safety contactor circuit	1A max			
Heatsink	Standard [advanced air cooled soon]			
Double heading	Y [also comms board coming soon]			
Switching frequency	20 kHz			
Quadrants	4			