



## Instruction Manual

# PRO-160 Series Controllers

PRO-160-S/HC/HV/HCV

Rev 3, Firmware Version 2.2

## Contents

Section	Page	Section	Page
1. Introduction.....	2	12. Forward / Reverse Settings .....	9
2. Do's and Don'ts .....	2	13. General Settings .....	9
3. Getting Started.....	2	14. Input configuration .....	10
4. Control Connections .....	3	15. Using the “learn” function .....	10
5. Auxiliary Input 1 .....	4	16. Power-up options .....	11
6. Auxiliary Input 2.....	4	17. Firmware update .....	11
7. Thermistor Input .....	5	18. Mounting .....	12
8. Radio Control Input and BEC ....	5	19. Display mounting.....	13
9. Power Connections .....	6	20. Default profile settings.....	14
10. Display.....	7	21. Specifications .....	15
11. Programming .....	7	22. Service.....	16

# 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 very easy to configure if required.

# 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

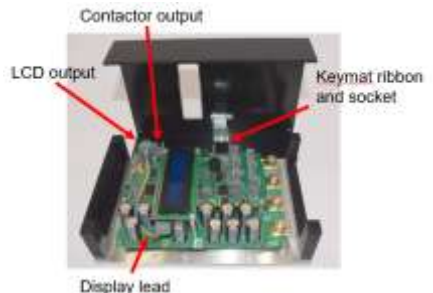
- **Do** read the instructions fully before installing.
- **Do** take care to connect the battery wires with the correct polarity
- **Do** fit a motor suppression capacitor, and ferrite rings.
- **Do** twist the motor wires together if possible.
- **Do** call 4QD if you are uncertain about something

## Do not

- **Do not** allow water to enter the box.

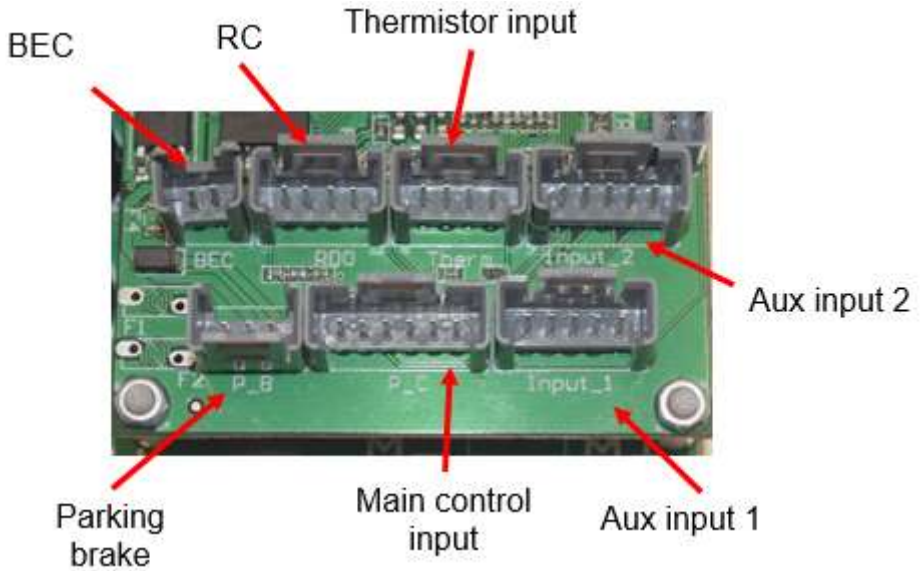
# 3. Getting Started

- First remove the four screws that hold the cover to the end plates and lift off the cover.
- The Pro-160 is supplied with the keymat ribbon cable not connected to its socket. We recommend only plugging this in once the Pro-160 has been fixed in position, the control and power connections made, and you are ready to start operation.

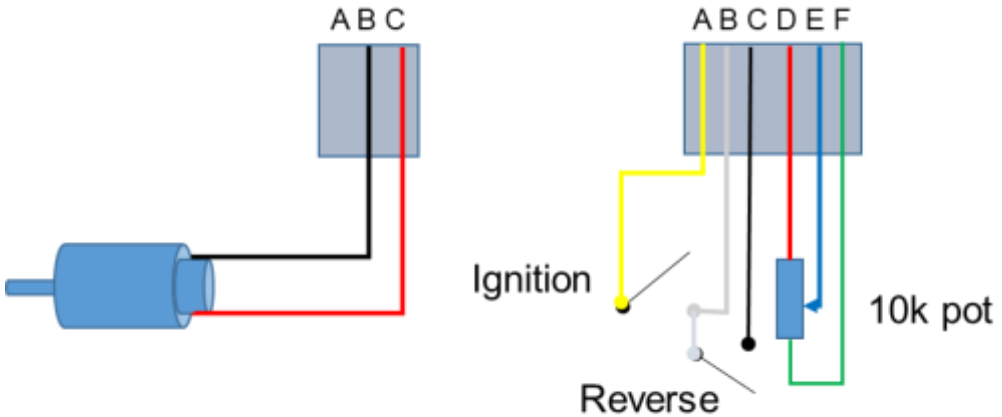


## 4. Control Connections

The control input sockets are shown below.

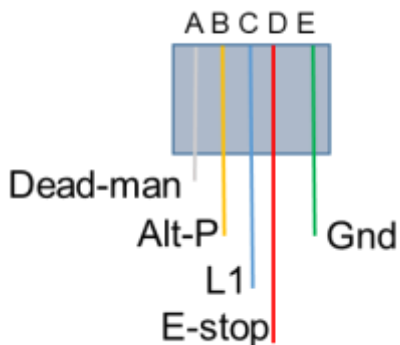


The main control input and brake should be wired as shown below [they are compatible with Pro-120/150 and DNO/VTX installations].



## 5. Auxiliary Input 1

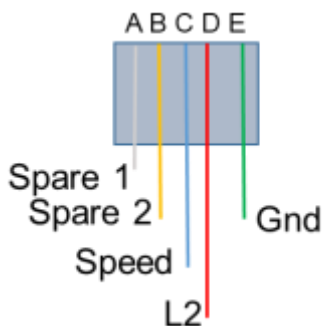
Has the following functions.



- A - Deadman's handle.** 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 the signal is removed.
- 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 signal present. This allows easy switching between any two profiles.
- C - Limit 1.** If this pin is connected to Gnd then the Pro-160 will invoke the behavior defined for this limit. This will be available in version 2.3.
- D - Emergency stop.** If this pin is connected to Gnd then the Pro-160 will stop immediately. It will not start up again until the signal is removed, and the ignition has been turned off / on.

## 6. Auxiliary Input 2

Has the following functions.



### C - Speed

Looks for a 5V pulse for speed sensing application. These inputs will be live in version 2.3. See website for more details

## 7. Thermistor Input

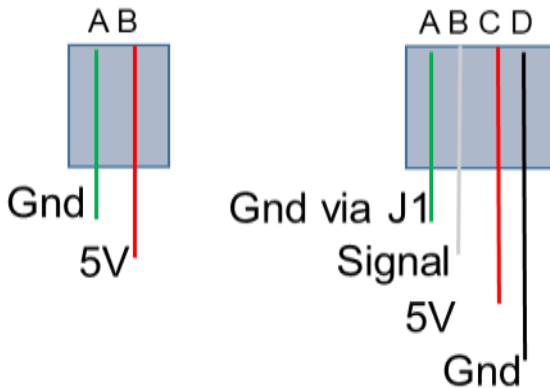
Can be used to connect external thermistors to monitor external temperatures.



**B & D - Thermistors** 2 and 3 should be 4QD part number 39-B0. If the Pro-160 detects thermistor[s] it will show the approximate temperature readings on the display.

## 8. Radio Control Input and BEC

The Pro-160 will accept a standard hobbyist radio control servo signal directly from a receiver. The receiver should be connected to pins B, C, and D. Pin D is linked to pin A by Lk1, this can be removed if a 4 wire radio connection is required.



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

The RDO port can act as a BEC for currents up to 1A. Pin B of the adjacent BEC port can be used in parallel to increase this to 2A if required.

## 9. 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**

To reduce 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 should 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.

### **Failsafe**

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

## 10. Display

The Pro-160 has a 2 line display to display useful information during operation and programming. A display adaptor board is available that allows the display and / or keypad to be mounted remotely from the Pro-160.

During operation the display will show information in this format

Volts	Duty cycle	Motor current
Profile	Temp	Battery current

Volts = battery voltage.

Volts = battery voltage.

Duty cycle = % of battery voltage being applied to the motor [- = reverse].

Motor current in amps.

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

Temp = temperature in °C. Prefix c denotes controller temp, b denotes battery temp, m denotes motor temp.\*b and m only displayed if additional thermistors are fitted.

Battery current in amps. Please note the difference between this and motor current.

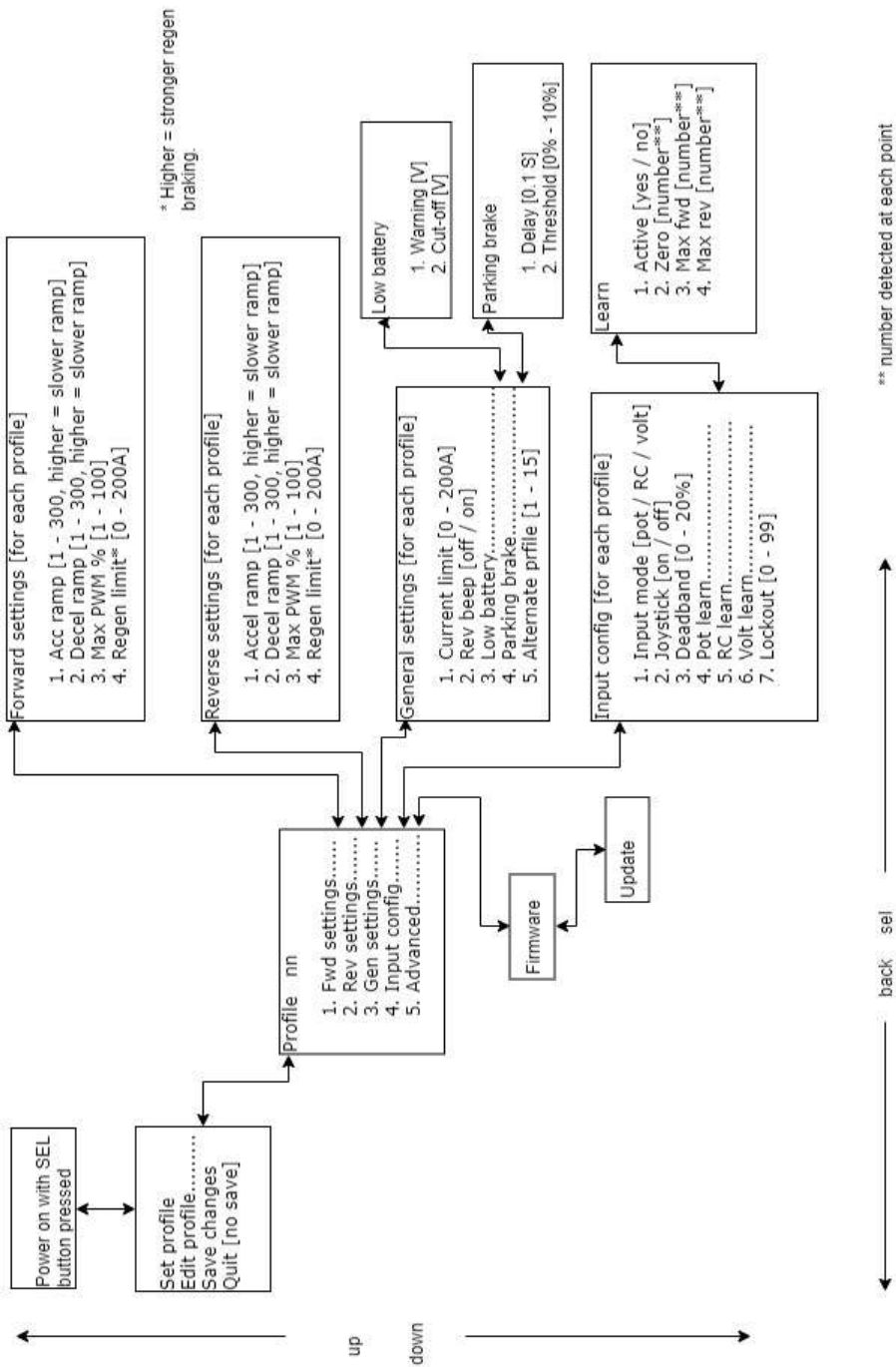
The display will also show any alert or fault information.

## 11. Programming

The Pro-160 has 15 profiles, 14 of which can be edited to suit the user. Each profile has a number of settings which control various aspects of the controller's behavior. We have configured the first 9 profiles with values that are a good starting point for the most popular applications, full details are in the table at the end of the manual.

It is not possible to make changes to profile 01, to save changes you must first select another profile.

To edit the settings the SEL button should be held down while turning on the ignition, you can then navigate through the options and settings as shown in the menu structure below. Remember to use the menu option to save changes.





## 12. Forward / Reverse Settings

- 12.1 “Accel ramp”. Sets the time taken to reach Max PWM. 1 - 300 corresponds to 0.1 - 30 seconds.
- 12.2 “Decel ramp”. Sets the time taken to slow down to zero. 1 - 300 corresponds to 0.1 - 30 seconds.
- 12.3 “Max PWM”. Sets the percentage of maximum power that can be applied.
- 12.4 “Regen limit”. Sets the upper limit of the regen braking current. This works in conjunction with “Decel ramp” to control the braking effect.

A slow “Decel ramp” [high number] will generate low regen currents. A low “Regen limit” will allow the motor to coast more.

## 13. General Settings

- 13.1 “Current limit”. Sets the maximum motor current that the Pro-160 will allow. If the motor / load tries to exceed this value the PWM duty cycle stops increasing. This can be used to provide a torque limiting function.
- 13.2 “Reverse beep”. Switches the reversing beeper on or off.
- 13.3 “Low battery”. Allows the alert and cut-off voltages to be set. When the low battery alert activates, the Pro-160 will reduce its maximum speed by 50%.
- 13.4 “Parking brake”. Sets the time delay before the parking brake is applied, and the power threshold that must be reached before the parking brake is released.
- 13.5 “Alternate profile”. Sets the profile to be selected if the Alt-P input is activated, and the Pro-160 re-started.

Note; There is also a “System current limit” which is not user adjustable. If the load tries to exceed this value a message is shown, and the controller will shut down to protect itself.

## 14. Input configuration

- 14.1 “Input mode”. Selects the input to be used. Pot will use the signal applied to pin B of the control port. RC will use the RDO port. Volt will also use the signal on pin B of the control port but the pot fault checks will be disabled.
- 14.2 “Joystick”. Selects either single ended or joystick [center-off / wig-wag] mode.
- 14.3 “Deadband”. Sets the amount of input required before the output starts.
- 14.4 “Pot learn”. See Using the “learn” function [also used for Volt mode].
- 14.5 “RC learn.” See Using the “learn” function.
- 14.6 “Lockout”. Prevents the motor starting if the Pro-160 is switched on with the throttle not at zero. This setting defines the throttle setting above which this occurs. Lockout is disabled in Volt mode.

## 15. Using the “learn” function

The “learn” function allow you to match zero speed, full forward, and full reverse from the Pro-160 to specific input signals from your pot, radio control receiver, or other input source.

- 15.1 Set either “Pot learn” or “RC learn” active [only one per profile].
- 15.2 Select “Learn zero” and press SEL, the Pro-160 will show a number related to the value detected from the pot [or other input].
- 15.3 Set the pot, transmitter stick, or other input to the point you want to have as zero, and press SEL to capture the associated number.
- 15.4 Repeat steps 15.2 – 15.3 for “Learn max forward” and “Learn max reverse”
- 15.5 Use BACK to return to the main menu and then save changes.

Note: If you are not using “Joystick” mode, you should set “Learn max reverse” to the same value as “Learn max forward”. Reverse is then selected by the reverse switch.

## 16. Power-up options

Power on with SEL pressed enters set-up mode.

Power on with BACK pressed displays the software version.

Power on with UP pressed will provide the option to reset to factory defaults.

Power on with DOWN pressed will start up with profile 1. This is an emergency start option to be used should a system 'EEPROM' error occur.

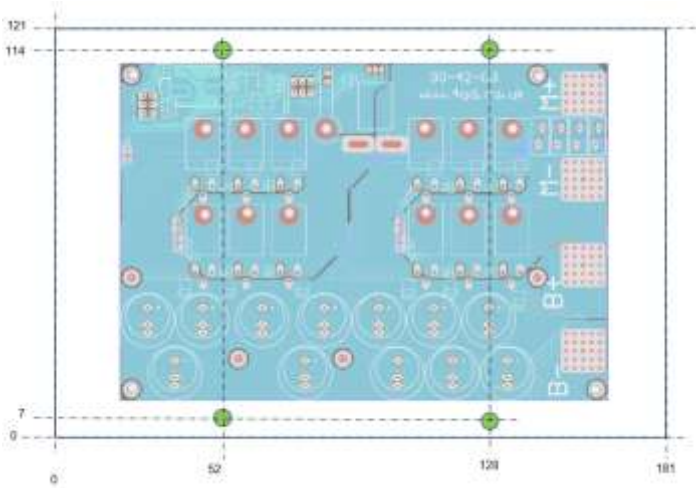
## 17. Firmware update

17.1 Insert a uSD card containing the new software into the card holder.

17.2 Navigate through the advanced menu to “Update” and then follow instructions.

## 18. Mounting

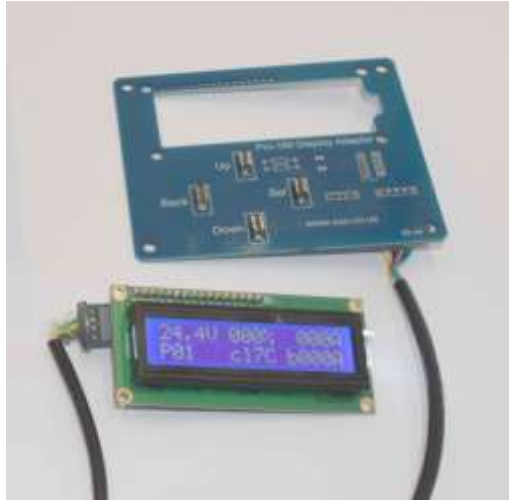
The Pro-160 has 4 M5 threaded mounting holes in the baseplate, shown in green in the diagram below.



If the operating temperature of the Pro-160 regularly gets above 50°C we recommend fitting either additional heatsinking and / or cooling. A cooling fan can be driven from the parking brake socket. Up-rated heatsinks will be available from our website.

## 19. 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 display / adaptor board which combines a display mounting place with an alternative keypad.



The display adaptor board and cables can be found on our website.

## 20. Default profile settings

Parameter	Range	Profile										
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10-15	
Forward acceleration ramp time	0.1 - 30 sec	Default	Small loco	Large loco	Golf buggy	Go kart	Joystick	RC single end	RC joystick	12 V	Custom	50
Forward deceleration ramp time	0.1 - 30 sec	50	50	70	50	20	50	50	50	50	50	50
Maximum forward speed	1 - 100 %	30	30	30	20	10	30	30	30	30	30	30
Maximum forward regen current	0 - 200A	100	100	100	100	100	100	100	100	100	100	100
Reverse acceleration ramp time	0.1 - 30 sec	140A / 200A depending on model										
Reverse deceleration ramp time	0.1 - 30 sec	50	70	100	50	20	50	50	50	50	50	50
Maximum reverse speed	1 - 100 %	30	30	30	20	10	30	30	30	30	30	30
Maximum reverse regen current	0 - 200A	100	50	50	50	100	100	100	100	100	100	100
Current limit [fwd and rev]	0 - 140A / 200A	140A / 200A depending on model										
Reverse beeper on / off	On / off	on	off	off	on	off	off	off	off	off	on	on
Low voltage cut-off	11 - 72 Volts	210	210	210	210	210	210	210	210	210	105	210
Low voltage alert [50% max speed]	11 - 72 Volts	220	220	220	220	220	220	220	220	220	110	220
Parking brake delay	0.1 - 9.9 sec	10	10	10	10	10	10	10	10	10	10	10
Parking brake threshold	0 - 10%	1	1	1	1	1	1	1	1	1	1	1
Alternative profile	0 - 20	0	3	2	0	0	0	0	0	0	0	0
Input method	Pot / RC / Volt	pot	pot	pot	pot	pot	pot	rc	rc	pot	pot	pot
Joystick mode	On / off	off	off	off	off	off	on	off	on	off	off	off
Joystick throttle dead band %	0 - 50%	10	10	10	10	10	10	10	10	10	10	10
Pot learn active	Yes / no	no	no	no	no	no	no	no	no	no	no	no
RC learn active	Yes / no	no	no	no	no	no	no	no	no	no	no	no
Volt learn active	Yes / no	no	no	no	no	no	no	no	no	no	no	no
High pot / RC lockout level	0 - 99%	5	5	5	5	5	5	5	5	5	5	5

## 21. Specifications

	Pro-160			
	160-S	160-HC	160-HV	160-HCV
Nominal voltage range	12 - 48		12 - 84	
Minimum / maximum 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	Forward & reverse top speed			
	Forward and reverse acceleration and deceleration ramps [0.1 - 30S]			
	Drive and regen current			
	Reverse beep			
	Low battery alert and limp home			
	Parking brake behaviour			
	High pot lockout			
	Deadband			
	Input values for zero, full forward & reverse			
Dimensions [mm]	181 x 121 x 50			
Weight [g]	~700g			
Power connections	M6 studs			
Input	5k – 15k pot, RC [PWM], 0 – 4.7V			
Reverse polarity protection	N			
Oversvoltage protection	Y [65V]		Y [95V]	
Pot fault protection	Y			
Thermal protection	Y [also for motor & battery]			
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 (motor)	Diode bridge
Closed loop RPM control	Via software update
Ignition, Electronic	Y
Safety contactor circuit	Y
Heatsink	Standard plus advanced air cooled
Double heading	Y [also comms board coming soon]
Switching frequency	20 kHz
Quadrants	4

## 22. Service

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