Penny+Giles Drives Technology

Pilot+ Digital Powerchair Control System

Technical Manual
SK74328/2

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PILOT+ DIGITAL POWERCHAIR CONTROL SYSTEM

CHAPTER 1: OPERATION

1.0 Introduction

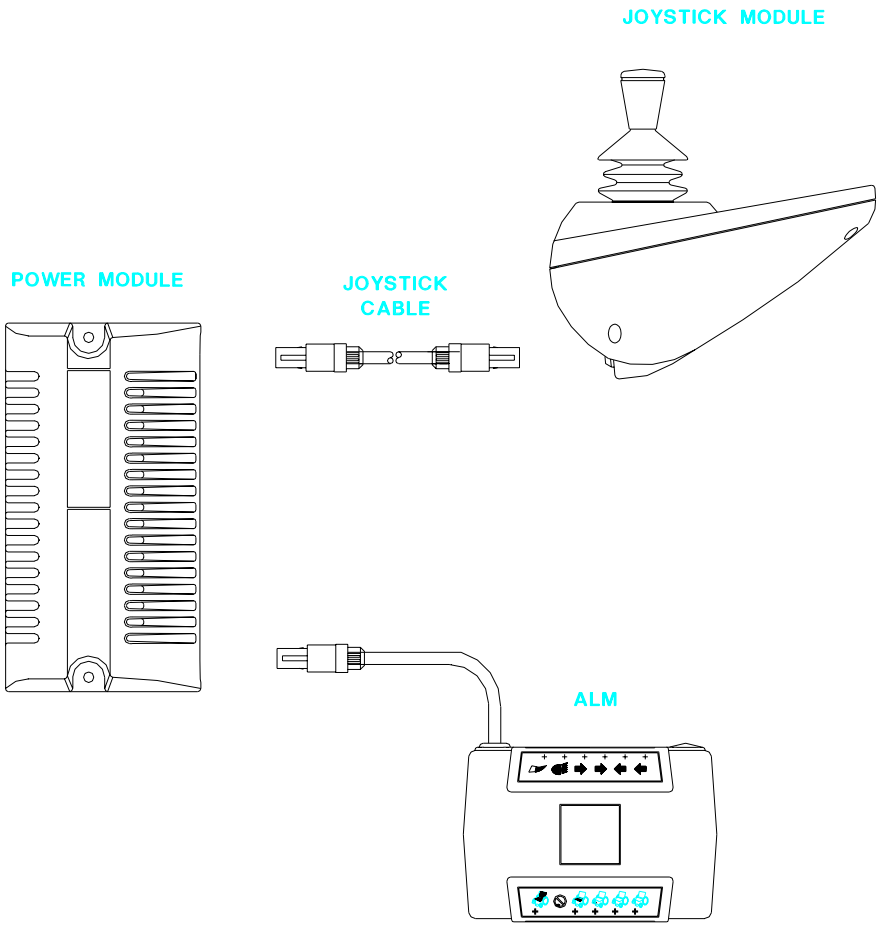
The relevant contents of this chapter should be included in the wheelchair operating guide. Further copies are available from Penny & Giles in both written or disk (Word for Windows*) format. Copies should not be made without the express permission of Penny & Giles.

The operation of the Pilot+ wheelchair control system is simple and easy to understand. The control system incorporates state-of-the-art electronics, the result of many years of research, to provide you with ease of use and a very high level of safety. In common with other electronic equipment, correct handling and operation of the unit will ensure maximum reliability.

Please read this chapter carefully - it will help you to keep your wheelchair reliable and safe.

2.0 General

A Pilot+ control systems comprises of two or three modules - Joystick Module, Power Module and Actuator and Lighting Module (ALM). The ALM is only required if the wheelchair is fitted with lights or seat adjustment actuators. The diagram below shows the modules and the connections between them.



* trademark gratefully acknowledged

2.1 Handling

Avoid knocking your control system and especially the joystick. Be careful not to strike obstacles with the control system or joystick when you drive. Never drop the control system.

When transporting your wheelchair, make sure that the control system is well protected. Avoid damage to cables.

2.2 Operating Conditions

Your control system uses industrial-grade components throughout, ensuring reliable operation in a wide range of conditions. However, you will improve the reliability of the control system if you keep exposure to extreme conditions to a minimum.

Do not expose your control system or its components to damp for prolonged periods. If the control system becomes contaminated with food or drink clean it off as soon as possible.

2.3 Cleaning

Clean the control system and the joystick with a cloth dampened with diluted detergent. Be careful when cleaning the joystick.

Never use abrasive or spirit-based cleaners.

3.0 Controls

The Pilot+ system has two versions of Joystick Module - with and without lighting control - refer to page 1:4 to see which type you have fitted to your wheelchair. Most of the controls are common to both modules, however, the lighting, turn indicator and hazard warning controls are only included on the Joystick Module with lighting control. Each of the controls is explained below.

3.1 On/Off Switch and Battery Gauge

The on/off switch applies power to the control system electronics, which in turn supply power to the wheelchair's motors. Do not use the on/off power switch to stop the wheelchair unless there is an emergency. (If you do, you may shorten the life of the wheelchair drive components).

The battery gauge shows you that the wheelchair is switched on. It also indicates the operating status of the wheelchair. Details are given in section 8.0.

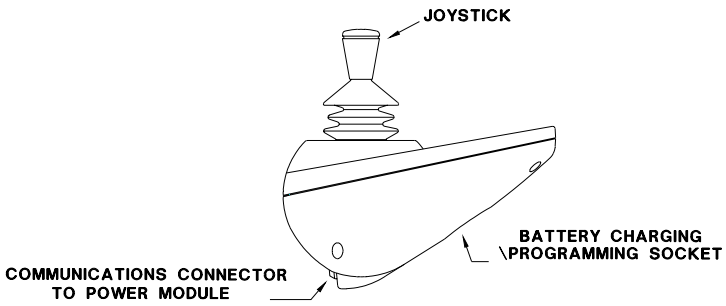
When the wheelchair is switched on, each of the LEDs on the Joystick Module will briefly illuminate. If any of the LEDs do not illuminate, contact your service agent.

3.2 Security Key

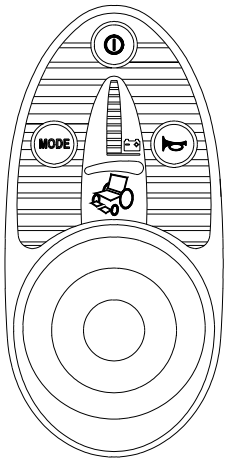
The security key can be used to lock the wheelchair to prevent unauthorized use. To lock the wheelchair it must be switched on, the key should then be inserted into and withdrawn from the battery charging socket, the wheelchair will now be locked.

To unlock the wheelchair, firstly switch it on. The maximum speed indicator will ripple up and down but driving will not be possible. The key should now be inserted into and withdrawn from the battery charging socket, the wheelchair can now be driven.

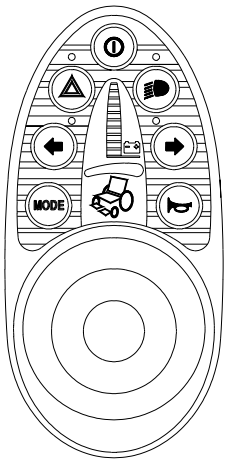
Joystick Module Details



Joystick Module without Lighting

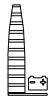


Joystick Module with Lighting



Controls

ON/OFF SWITCH


BATTERY GAUGE

MAXIMUM SPEED INDICATOR

MODE SWITCH

HORN SWITCH

ACTUATOR INDICATOR

LIGHTS SWITCH AND LED

LEFT TURN INDICATOR SWITCH AND LED

RIGHT TURN INDICATOR SWITCH AND LED

HAZARD WARNING SWITCH AND LED

3.3 Joystick

The joystick controls the speed and direction of the wheelchair. The further you push the joystick from the center position the faster the wheelchair will move. When you release the joystick the brakes are automatically applied.

3.4 Maximum Speed Indicator

This is a gauge that shows the maximum speed setting of the wheelchair. There are five speed settings - step 1 is the lowest speed and step 5 is the highest speed. For details of how to change the maximum speed setting, see section 3.5.

3.5 Mode Switch

The mode switch is used to make maximum speed changes and to change between wheelchair operation modes.

If the mode switch is operated whilst you are driving the maximum speed setting will be increased by one step. Each successive operation of the mode switch will increase the setting, when the setting is at 5 the next mode switch operation will put the setting to 1. The diagram below explains this action.

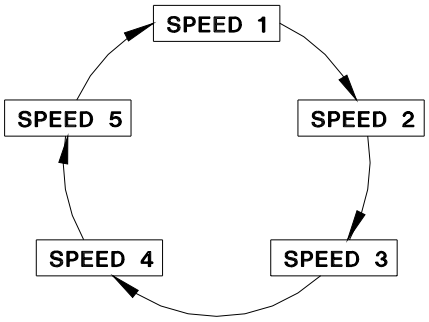


Fig. 1 Operation of Mode Switch Whilst Driving

If the mode switch is operated when the joystick is centered, the control system operation mode will be changed. There are three modes - drive, speed adjustment and actuator adjustment. The diagram below explains this action.

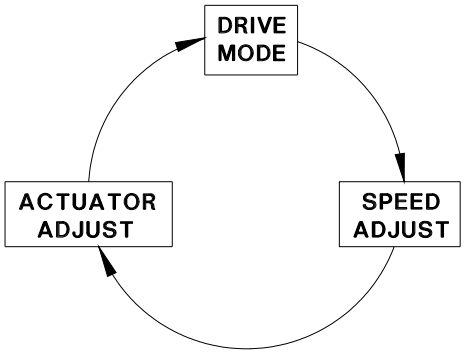


Fig. 2 Operation of Mode Switch Whilst Joystick Centered

3.5.1 Speed Adjustment Mode

When the control system is in this mode the maximum speed indicator will flash. The maximum speed can be adjusted by left or right movements of the joystick. Left will decrease the speed setting, right will increase it. Forward or reverse movements of the joystick will take you back into drive mode.

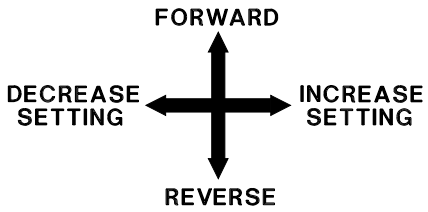


Fig.3 Joystick Operation in Speed Adjustment Mode

Operating the mode switch will put the control system back into drive mode or, if seat adjustment actuators are fitted, actuator adjustment mode.

3.5.2 Actuator Adjustment Mode

When the control system is in this mode the actuator indicator will be illuminated. The section of the wheelchair symbol that is illuminated shows the actuator that is selected for adjustment. To change the selected actuator move the joystick left or right. To make an actuator adjustment move the joystick forwards or backwards.

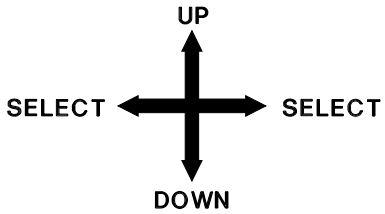


Fig. 4 Operation of Joystick in Actuator Adjustment Mode

Operating the mode switch will put the control system back into drive mode.

3.6 Horn Switch

The horn will sound whilst this switch is depressed.

3.7 Lights Switch and LED

To turn on the wheelchair's lights operate this switch, the associated LED will illuminate.

3.8 Left Turn Indicator Switch and LED

To turn on the wheelchair's left turn indicator operate this switch, the associated LED will flash at the same rate. If the LED flashes rapidly, one of the left turn indicator bulbs is defective, contact your service agent.

3.9 Right Turn Indicator Switch and LED

To turn on the wheelchair's right turn indicator operate this switch, the associated LED will flash at the same rate. If the LED flashes rapidly, one of the right turn indicator bulbs is defective, contact your service agent.

3.10 Hazard Warning Switch and LED

To turn on the wheelchair's hazard warning lamps operate this switch, the associated LED will flash at the same rate. The left and right turn indicator LEDs will also flash

4.0 Getting Ready to Drive

Operate the on/off switch. The battery gauge will blink then turn on after a second.

Check that the maximum speed control is set to a level which suits you.

Push the joystick to control the speed and direction of the wheelchair.

Please note that if you push the joystick before or just after you switch the control system on, the battery gauge will ripple up and down and the wheelchair will not be allowed to move. You must release the joystick to resume normal operation. If you do not release the joystick within five seconds the wheelchair will not be able to move, even if you release the joystick and push it again. The battery gauge will then flash rapidly. You can reset this condition by switching the control system off and on again.

If you do not push the joystick as you switch the wheelchair on and the battery gauge flashes rapidly, then there may be a fault. Refer to section 8.4 for details.

5.0 Tips for Using Your Control system

5.1 Driving - General

Make sure that the control system is mounted securely and that the joystick position is correct. The hand or limb you use to operate the joystick should be supported, for example by the wheelchair arm pad. Do not use the joystick as the sole support for your hand or limb - wheelchair movements and bumps could upset your control.

5.2 Driving Technique

The control system interprets your joystick movements and produces appropriate movements of your wheelchair. You will need very little concentration to control the wheelchair, which is especially useful if you are inexperienced. One popular technique is to simply point the joystick in the direction you want to go. The wheelchair will "home-in" on the direction you push the joystick.

The further you push the joystick away from the rest position, the faster the wheelchair will go.

The intelligent speed control system minimizes the effects of slopes and different types of terrain.

6.0 Precautions for Use

Note: In the event of the wheelchair moving in an unexpected way release the joystick. This action will stop the wheelchair under any circumstances.

6.1 Hazards

Do not drive the wheelchair:

i) beyond restrictions indicated in your wheelchair user manual, for example maximum inclines, curb height etc.

ii) in places or on surfaces where a loss of wheel grip could be hazardous, for example on wet grassy slopes.

iii) if you know that the control system or other crucial components require repair.

WARNING: Although the Pilot+ control system is designed to be extremely reliable and each unit is rigorously tested during manufacture, the possibility of a system malfunction always exists (however small the probability). Under some conditions of system malfunction the control system must (for safety reasons) stop the chair instantaneously. If there is any possibility of the user falling out of the chair as a result of a sudden braking action, it is imperative that a restraining device such as a seat belt is supplied with the wheelchair and that it is in use at all times when the wheelchair is in motion. Penny & Giles accept no liability for losses of any kind arising from the unexpected stopping of the wheelchair, or arising from the improper use of the wheelchair or control system.

7.0 Safety Checks

The electronic circuits in your control system have been designed to be extremely safe and reliable. The on-board microcomputer carries out safety checks at up to 100 times per second. To supplement this safety monitoring you should carry out the following periodic checks.

If the control system fails any of these checks, do not use the wheelchair and contact your service agent.

7.1 Daily Checks

Joystick: With the control system switched off, check that the joystick is not bent or damaged and that it returns to the center when you push and release it. If there is a problem do not continue with the safety checks and contact your service agent.

7.2 Weekly Checks

Solenoid (parking) brake: This test should be carried out on a level floor with at least one metre clear space around the wheelchair.

i) Switch on the control system.

ii) Check that the battery gauge remains on, or flashes slowly, after one second.

iii) Push the joystick slowly forwards until you hear the parking brakes operate. The chair may start to move.

iv) Immediately release the joystick. You must be able to hear each parking brake operate within a few seconds.

v) Repeat the test a further three times, pushing the joystick slowly backwards, left and right.

Connectors: Make sure that all connectors are securely mated.

Cables: Check the condition of all cables and connectors for damage.

Joystick gaiter: Check the thin rubber gaiter or boot, around the base of the joystick shaft, for damage or splitting. Check visually only, do not handle the gaiter.

Mounting: Make sure that all the components of the control system are securely mounted. Do not overtighten any securing screws.

7.3 Servicing

To ensure continued satisfactory service, we suggest you have your wheelchair and control system inspected by your service agent after a period of 1 year from commencement of service. Contact your service agent for details when the inspection is due.

8.0 Status indication

The battery gauge will indicate the status of the control system.

Please note that a number of supposedly faulty control systems returned to us are subsequently found to operate correctly. This indicates that many faults are due to the wheelchair problems rather than the control system.

8.1 Battery Gauge Steady

This indicates that all is well.

8.2 Battery Gauge Flashes Slowly

The control system is functioning correctly, but you should charge the battery as soon as possible.

8.3 Battery Gauge Blinks Once Every 2.5 Seconds

The control system has “gone to sleep” because the joystick has not been operated for a period of time. The time period depends on the programming of the system. To re-start, switch the system off and on again.

8.4 Battery Gauge Flashes Rapidly (even with the joystick released)

The control system safety circuits have operated and the control system has been prevented from moving the wheelchair.

This indicates that there is a fault. Please follow this procedure:

i) Switch off the control system.

ii) Make sure that all connectors on the wheelchair and the control system are mated securely.

iii) Check the condition of the battery.

iv) If you can't find the problem, try using the self-help guide given in section 8.5.

v) Switch on the control system again and try to drive the wheelchair. If the safety circuits operate again, switch off and do not try to use the wheelchair. Contact your service agent.

8.5 Self-Help Guide

If a fault occurs, you can find out what has happened by counting the number of bars on the battery gauge that are flashing.

Here is a list of self-help actions. Try to use this list before you contact your service agent. Go to the number in the list which matches the number of flashing bars and follow the instructions.

1 bar: The battery needs charging or there is a bad connection to the battery. Check the connections to the battery and the check the Power Module battery connector, this is the 2 pole connector situated between the two motor connectors. If the connections are good, try charging the battery.

2 bars: The left hand motor has a bad connection. Make sure that the motor is connected properly and the Power Module connector M1 is secure.

3 bars: The left hand motor has a short circuit to a battery connection. Contact your service agent.

4 bars: The right hand motor has a bad connection. Make sure that the motor is connected properly and the Power Module connector M2 is secure.

5 bars: The right hand motor has a short circuit to a battery connection. Contact your service agent.

6 bars: The battery charger is preventing the control system from driving the wheelchair. Disconnect the charger from the wheelchair.

7 bars: A Joystick Module fault is indicated. Make sure that the joystick is in the rest position before switching on the control system.

8 bars: A Power Module fault is indicated. Make sure that all Power Module connections are secure.

9 bars: The parking brakes have a bad connection. Check the parking brake and motor connections. Make sure the control system connections are secure.

10 bars: An excessive voltage has been applied to the control system. This is usually caused by a poor battery connection. Check the battery and Power Module connections.

If the problem persists after you made the checks described above contact your service agent.

8.6 Slow or sluggish movement

If the wheelchair does not travel at full speed or does not respond quickly enough, and the battery condition is good, check the maximum speed setting. If adjusting the speed setting does not remedy the problem then there may be a non-hazardous fault.

Contact your service agent.

9.0 Battery Gauge

The battery gauge is included to let you know how much charge is left in your batteries. The best way for you to use the gauge is to learn how it behaves as you drive the wheelchair. Like the fuel gauge in a car, it is not completely accurate, but it will help you avoid running out of "fuel".

The battery gauge works in the following way:

When you switch on the control system, the battery gauge shows an estimate of the remaining battery charge.

The battery gauge gives you a more accurate reading about a minute after you start driving the wheelchair.

Note: When you replace worn out batteries, fit the type recommended by the wheelchair manufacturer. If you use another type the battery gauge may be inaccurate.

The amount of charge in your batteries depends on a number of factors, including the way you use your wheelchair, the temperature of the batteries, their age and the way they are made. These factors will affect the distance you can travel in your wheelchair. All wheelchair batteries will gradually lose their capacity as they age.

The most important factor that reduces the life of your batteries is the amount of charge you take from the batteries before you recharge them. Battery life is also reduced by the number of times you charge and discharge the batteries.

To make your batteries last longer, do not allow them to become completely flat. Always recharge your batteries promptly after they are discharged.

If your battery gauge reading seems to fall more quickly than usual, your batteries may be worn out.

9.1 How to Read a TruCharge Battery Gauge

If the battery gauge shows red, yellow and green, the batteries are charged.

If the battery gauges show just red and yellow, then you should charge the batteries as soon as you can.

If the battery gauge shows just red, either steady or flashing slowly, then you should charge the batteries immediately.

10.0 Battery Charging

To charge the wheelchair batteries connect the charger plug into the battery charging socket on the Joystick Module. You will not be able to drive the wheelchair when the charger is connected.

WARNING: Use only the battery charger that has been supplied with your wheelchair. The use of incorrect chargers could damage the batteries, wheelchair or charger itself.

11.0 Programming

If you find that you cannot find a maximum speed control setting that suits you, the control system can be programmed to meet your needs.

The PP1 is a small hand-held unit which can be plugged into your control system to alter the program. A PP1 may be included with your wheelchair. If a PP1 is not included, your wheelchair distributor or service agent or wheelchair manufacturer will be able to program your control system for you.

If you have a PP1, read the PP1 user guide before you use it.

If you re-program your control system, make sure that you observe any restrictions given in your wheelchair user manual. Note any changes you make for future reference.

WARNING: Programming should only be conducted by healthcare professionals with in-depth knowledge of Penny & Giles electronic control systems. Incorrect programming could result in an unsafe set-up of a wheelchair for a user. Penny & Giles accept no liability for losses of any kind if the programming of the control system is altered from factory pre-set values.

12.0 Joystick Knobs

The knob fitted to your joystick is suitable for most applications. If you would prefer another type, there is a range of alternatives available. Please contact your wheelchair distributor or manufacturer for advice. Do not replace the joystick knob with any unauthorized item - it may cause hazardous operation.

13.0 Servicing

All repairs and servicing must be carried out by authorized service personnel. Opening or making any unauthorized adjustments or modifications to the control system or its components will invalidate any warranty and may result in hazards to yourself or other people, and is strictly forbidden.

WARNING: Penny & Giles accept no liability for losses of any kind arising from unauthorized opening, adjustment or modifications to the Pilot+ control system.

14.0 Warranty

The Pilot+ Control System is covered by a warranty period defined by the wheelchair manufacturer. For details of the warrnty period, please contact your service agent.

The warranty will be void if the Pilot+ Control System has:

Not been used in accordance with the Pilot+ Control System Technicla Manual, SK74328.
Been subject to misuse or abuse.
Been modified or repaired by non-authorized persons.

PILOT+ DIGITAL POWERCHAIR CONTROL SYSTEM

CHAPTER 2: INSTALLATION

1.0 Documentation

1.1 Pilot+ Operation

Study Chapter 1: Operation. It is important that the information in Chapter 1 is supplied with the wheelchair, either as part of the wheelchair user handbook or as a separate document.

This chapter sets out the installation conditions that must be complied with in order to meet the safety requirements of TÜV Product Service (Germany), ISO7176-14 and prEN12184.

If a wheelchair manufacturer's label is placed over the Pilot+ identification label, then to maintain the control system's TÜV approval Penny & Giles must be informed. Penny & Giles will then inform TÜV Product Service.

1.2 Program Settings

All programmable values are stored within the Power Module, therefore, if you change a Joystick Module or ALM there is no need to re-program the system. You must supply the Power Module programmed with the manufacturer's preset settings. Power Modules are always supplied by Penny & Giles with the preset settings shown on the relevant data sheet.

The preset settings are chosen with the wheelchair manufacturer to ensure safe operation and compliance with relevant legal requirements over the whole of the operating range of the joystick and speed control.

The wheelchair must stop within the maximum distance specified for the country in which the wheelchair will be used. TÜV Product Service (Germany) specify the distance to be as stated in prEN12184.

Users with particular disabilities may need very low braking rates. However, if the control system is programmed with a low braking rate, the stopping distance may be more than that specified. If this happens, the maximum speed must be re-programmed so that the stopping distance requirement is satisfied.

State in the wheelchair user handbook that it is the responsibility of the person programming the control system to make sure that the stopping distance requirement is satisfied. If the braking rate is low, the forward and reverse maximum speed settings may need to be re-programmed.

To assist the person in this task, include a graph in the wheelchair user handbook showing the relationship between the maximum forward/reverse speed settings and the forward/reverse braking rate which is required to ensure the correct stopping distance.

It may be possible to program settings which compromise the stability of the wheelchair. Perform suitable tests to establish which programming restrictions are needed to prevent instability. State any programming restrictions in the wheelchair user handbook.

State in the wheelchair user handbook that it is the responsibility of the person programming the control system to make sure that the settings are safe and to note any programming changes that they make.

It is possible for wheelchair manufacturers to limit the values of speeds and accelerations that can be programmed in the field. This facility ensures a safe-operating envelope for the wheelchair can be maintained. These limits are set in the factory by Penny & Giles and can only be altered by Penny & Giles.

WARNING: Programming should only be conducted by healthcare professionals with in-depth knowledge of Penny & Giles electronic control systems. Incorrect programming could result in an unsafe set-up of a wheelchair for the user. Penny & Giles accept no liability for losses of any kind if the programming of the control system is altered from factory pre-set values. Penny & Giles accept no liability for losses of any kind if the drive or stability characteristics of the wheelchair are altered without prior notification and discussion with Penny & Giles.

1.3 Soft-Stop

If the version of Pilot+ you have has the Soft-Stop function enabled (see data sheet), you must ensure that the emergency stopping distance is within the distance specified for the country in which the wheelchair will be used. TÜV Product Service (Germany) specify the distance to be as stated in prEN12184.

1.4 Other Information

You must provide a diagram in the wheelchair user handbook showing the user controls.

In addition, you should include a brief specification of operating supply voltage range and operating temperature range.

2.0 Immobilizing the Wheelchair

2.1 Prevention of Unauthorized Use

TÜV Product Service requires that the wheelchair must have a means of preventing unauthorized use. This function is provided in the Pilot+ Joystick Modules, see chapter 1 section 3.2.

2.2 Charger Interlock

ISO 7176-14 requires you to provide a means of preventing the use of the wheelchair while the batteries are being charged. The charger sockets fitted to the Pilot+ Joystick Modules include an inhibit facility, refer to section 5.1 for further details.

Contact Penny & Giles if you need advice.

2.3 Sleep Mode

The control system can be programmed to “go to sleep” if the joystick is not operated for a period of time, see chapter 3 section 4.8. The sleep state is indicated a by short blink of the TruCharge display once every 2.5 seconds.

To re-start, switch the control system off and on again.

3.0 Power Module Wiring

3.1 General

Study the data sheet for the Power Module to identify the output current, ratings and restrictions

Recommendations for the cross-sectional area, ratings and materials for wiring are given in the table in section 3.2. These depend on the application. You are responsible for establishing the suitability of the particular wiring arrangement used on the wheelchair. Penny & Giles can make general recommendations for wiring to Pilot+ control systems, but Penny & Giles accepts no responsibility for the wiring arrangement used.

Make sure that the connectors you use are reliable under all operating conditions and correctly wired with no short circuits. Do not use unsuitable components - it may result in poor wheelchair reliability.

The power connectors for the Pilot+ Power Module are specially designed by Penny & Giles for wheelchair applications. The crimps are standard AMP Timer parts but the plastic housings are custom. Kits of connectors including the crimps, housings and rubber boots can be purchased from Penny & Giles or directly from the manufacturers, Intech. Intech will also provide a pre-assembled cable service. Intech's details are as below.

Intech
Tel: +44 (0)1427 719025
Fax: +44 (0)1427 717278

The connector part numbers are:

Connector	P&G Reference	Intech Part No.
Battery	D49712 PG-80B	IPG-5202
Motor/Brake	D49713 PG-80M	IPG-5401

Hand tools for crimping and extraction are available from Intech, the references are as below.

Crimp tool for 0.5-1.0mm^2 wire: ICT-249
Crimp tool for 2.5-4.0mm^2 wire: ICT-531
Crimp tool for 4.0-6.0mm^2 wire: ICT-532

Extraction tool for 0.5-1.0mm^2: IET-503
Extraction tool for 2.5-6.0mm^2: IET-552

For details of automatic crimp tools contact Intech.

The diagram on page 2:18 gives details of the Power Module connections.

3.2 Wire Gauge and Types

The table below gives the minimum recommended wire sizes for various Pilot+ Power Module specifications.

These recommendations are derived from well proven field experience of various international wheelchair manufacturers. Nevertheless, it is advised that manufacturers confirm them by carrying out suitable tests. Keep wire lengths as short as possible.

Pilot+ Power Module	Battery Wires	Motor Wires	Brake Wires
50A	4.0mm^2	2.5mm^2	0.5mm^2
80A	6.0mm^2	4.0mm^2	0.5mm^2
100A	6.0mm^2	4.0mm^2	0.5mm^2

Note: Battery and motor wires should have 105ºC rated PVC insulation.

3.3 Battery Connections

The control system incorporates sophisticated current limiting circuitry as protection for the circuits in the control system.

ISO 7176-14 requires you to provide protection against short circuits in the battery wiring and the power loom or the extremely unlikely event of a short circuit in the control system.

Place a suitable circuit breaker in series with the battery supply, for example in the link between two 12V batteries. If your batteries are held in separate enclosures, you must provide a circuit breaker with each of them.

The rating of the circuit breaker must match the capacity of the wiring specified in section 3.2. Suitable circuit breakers are manufactured by Mechanical Products Inc. The table below gives some recommendations for circuit breaker selection. These recommendations are derived from well proven field experience of various international wheelchair manufacturers. Nevertheless, manufacturers must confirm these recommendations by carrying out suitable tests.

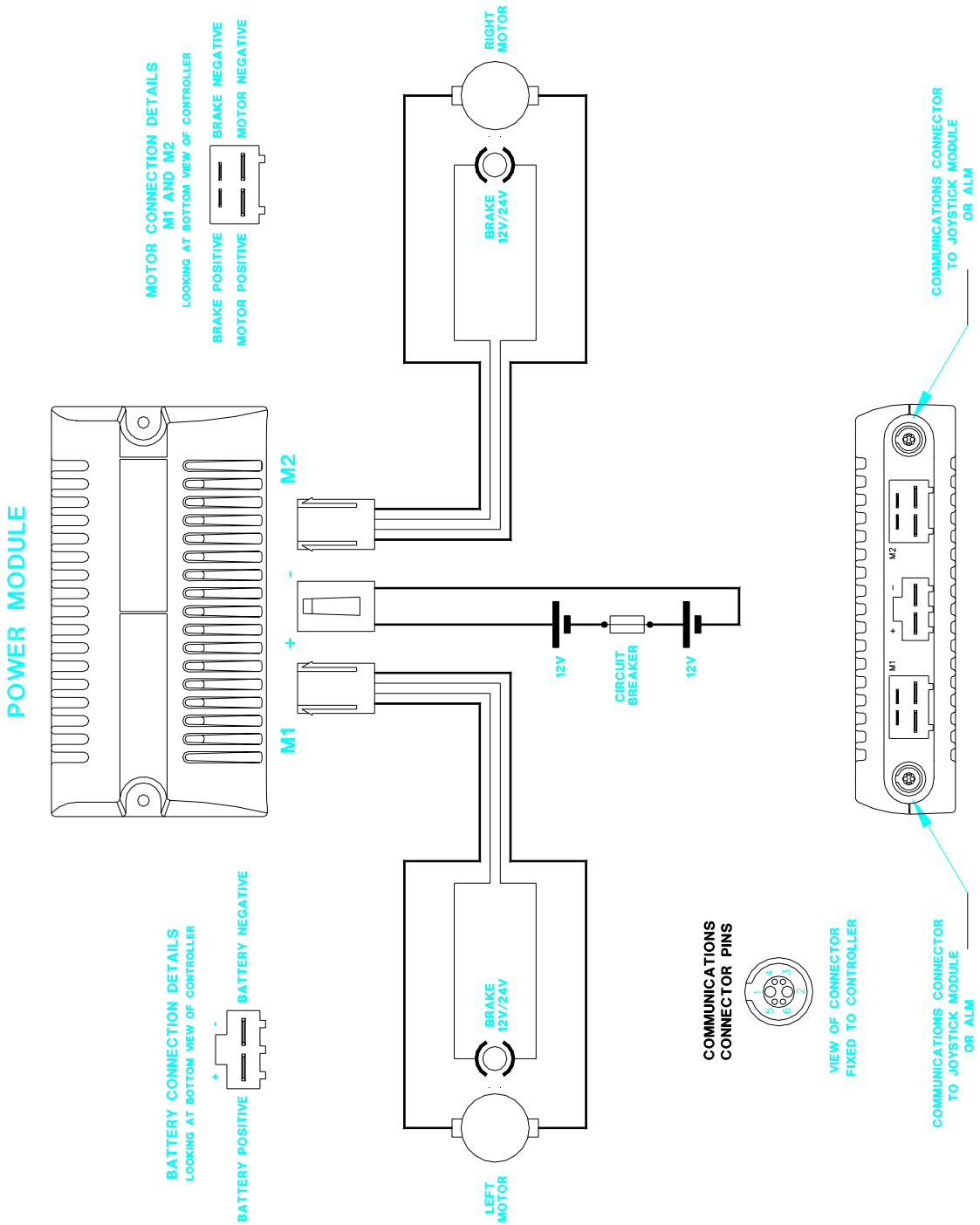
Pilot+ Power Module	Circuit Breaker
50A	MP1648-50A
80A	MP1648-70A
100A	MP1648-70A

ISO 7176-14 states that the minimum operating time for the circuit breaker when the wheelchair is stalled is 15 seconds.

3.4 Motor Connections

If a circuit breaker is fitted in series with a motor, it is essential that the wheelchair assumes a safe condition the moment the circuit breaker operates. You must therefore fit a circuit breaker with an auxiliary switch which disconnects the solenoid brake from the Power Module.

Power Module Connection Diagram



3.5 Inhibit or Speed Limit Connections

If an inhibit or speed limit function is required on the wheelchair, a suitable switch(es) can be connected to the ALM's speed limit input or, if an ALM is not fitted, directly to the Power Module via the spare communications connector. These inputs have 4 levels - set by external resistance - which result in a different values of speed limit. The table below gives further details. The Mid, Slow and Inhibit speed limit values can be changed by factory programming, contact Penny & Giles for more details.

Resistance *	Inhibit Polarity Low **	Inhibit Polarity High **
Short circuit	Inhibit Speed	Normal Speed
22KΩ ± 10%	Slow Speed	Mid Speed
100KΩ ± 10%	Mid Speed	Slow Speed
Open circuit	Normal Speed	Inhibit Speed

* Value of resistance connected between ALM PL2 pins 11 and 12 (see ALM Connection Diagram), or Power Module communications connector pins 2 and 3 (see Power Module Connection Diagram).

** The polarity of the input is programmable, see chapter 3 section 5.11 for programming details. This feature allows maximum flexibility when configuring fail-safe systems.

The inhibit function is implementing by programming the Inhibit Speed limit to a level of zero. When this is done, the input can be set to be latching or non-latching, see chapter 3 section 5.11 for details.

To ensure the wheelchair is always able to turn on difficult surfaces, such as thick carpet, the speed limit for turning speed is never less than the programmed minimum Turning Speed (see chapter 3 section 4.7).

This input requires only a very small current so a wire size of $0.22mm^2$ is suitable.

4.0 Joystick Module Wiring

The Joystick Module is connected to the Power Module with a 6 way cable assembly. Always ensure the cable is correctly mated at both ends by pushing the connectors' outer sleeves until they are fully in position.

Route and secure the cable in such a way as to prevent damage, for example by crushing or cutting.

5.0 Batteries

The control system is designed for operation with 24V lead acid batteries. The batteries may be wet or gel electrolyte types.

Contact Penny & Giles if you need advice on battery selection.

5.1 Battery Charging

The battery charging socket is mounted on the Joystick Module. The charging socket is Neutrik 3 pin type NC3FPP or equivalent, and the maximum charging current is 12A RMS. Only chargers fitted with Neutrik NC3MX plugs should be connected into the Joystick Module. The pin connections of the socket are as below.

Pin	Connection
1	Battery +ve
2	Battery -ve
3	Charge Inhibit

To prevent the wheelchair from driving whilst the charger is connected, pin 3 must be linked to pin 2 inside the charger's plug.

6.0 Drive Motors

The control system is designed to be connected to permanent magnet DC motor, fitted with a suitable gearbox and solenoid brake.

In order to optimize the performance of the wheelchair, the control system must be matched to the motor terminal impedance, see chapter 3 section 5.5. The data sheet may define a motor compensation value (normally 70% of the total motor, cable and connector resistance).

Failure to match the control system with the motors may result in poor control characteristics, in particular speed stability on gradients may be affected.

If you have any doubts about the suitability of a particular motor type or you need advice on measuring motor impedance, contact Penny & Giles.

7.0 Solenoid Brakes

The solenoid brakes can be either 12V or 24V types, however, the control system must be programmed for the correct voltage. Refer to data sheet for the programming details of the control system. Refer to chapter 3 section 5.15 for information on programming.

If the current to either brake is less than 100mA or greater than 1A, a brake fault will be detected.

WARNING: It is essential that the control system is programmed for the correct brake voltage. If it is not, damage may occur to the brakes or the drive performance of the wheelchair may be affected.

8.0 Actuator and Lighting Module (ALM) Wiring

This section is applicable if the wheelchair is fitted with lights or actuators controlled from the Joystick Module.

8.1 General

Study the data sheet for the ALM to identify:

i) the output current, ratings and restrictions
ii) the connector pin assignments

Refer also to the ALM connection diagram on page 2:22.

Recommendations for the cross-sectional area, ratings and materials for wiring will depend on the application. You are responsible for establishing the suitability of the particular wiring arrangement used on the wheelchair. Penny & Giles can make general recommendations for wiring for particular control system types, but Penny & Giles accepts no responsibility for the wiring arrangement used.

Make sure that the connection methods you use are reliable under all operating conditions and correctly wired with no short circuits. Do not use unsuitable components - it may result in poor wheelchair reliability.

8.2 Connection to the Power Module

The ALM is connected to the Pilot+ Power Module with a 6 way cable and connector. Always ensure the cable is correctly mated by pushing the connector's outer sleeve until it is fully in position.

8.3 Connection to the Lights, Actuators and Speed Limit Input

These connection are via spring connectors PL1 and PL2. To connect the wires into each terminal, release the spring pressure by inserting a 3mm screwdriver and levering downwards, then push the wire fully into position. Wire gauges of up to 2.5mm^2 can be accommodated in each terminal. It is recommended that wires are solder tinned.

The ALM connection diagram on page 2:22 shows the terminal identification for PL1 and PL2.

8.4 Lighting Wiring

The lighting output is rated at 42W maximum. Use suitably rated wire to each bulb. The output is self-protecting against wiring and bulb faults and will shut-off if the maximum power rating is exceeded. Likewise, if the output becomes too hot it will shut-off to prevent permanent damage to itself.

TÜV stipulate that, to comply with the StVZO German Road Traffic Regulations, each rear light must be separately fused. You should therefore split the wiring from the ALM output so that each rear light is supplied via a different fuse. It is recommended that an 800mA quick blow fuse is used for the left hand front and rear lights, and that an identical fuse is used for the right hand front and rear lights.

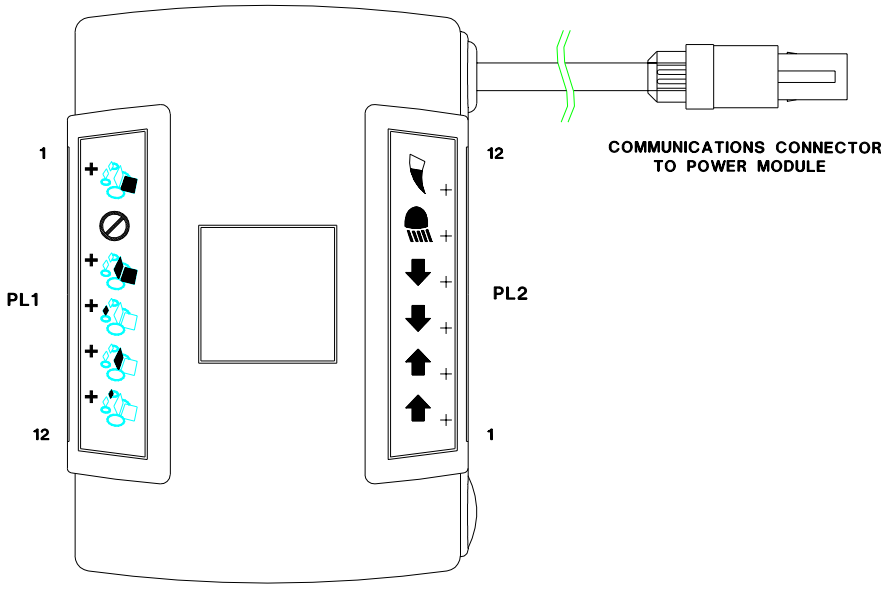
8.5 Indicator Wiring

The left and right indicator outputs are split, inside the ALM, into front and rear; this is to enable detection of an individual bulb failure. All currents referred to hereon in this section are the total of front and rear.

Each indicator output is rated at 42W maximum. Use suitably rated wire to each bulb. The outputs are self-protecting against wiring and bulb faults and will shut-off if the maximum power rating is

exceeded. Likewise, if either output becomes too hot it will shut-off to prevent permanent damage to itself.

ALM Connection Diagram



PL1 [1] [2]

Pin 1	Actuator Channel 1 +	Backrest
Pin 2	Actuator Channel 1 -	Backrest
Pin 3	Actuator Channel 2 +	Spare
Pin 4	Actuator Channel 2 -	Spare
Pin 5	Actuator Channel 3 +	Seat tilt
Pin 6	Actuator Channel 3 -	Seat tilt
Pin 7	Actuator Channel 4 +	Left footrest
Pin 8	Actuator Channel 4 -	Left footrest
Pin 9	Actuator Channel 5 +	Seat height
Pin 10	Actuator Channel 5 -	Seat height
Pin 11	Actuator Channel 6 +	Right footrest
Pin 12	Actuator Channel 6 -	Right footrest

PL2

Pin 12	Speed Limit Input
Pin 11	Speed Limit Input
Pin 10	Lights -
Pin 9	Lights +
Pin 8	Left rear indicator -
Pin 7	Left rear indicator +
Pin 6	Left front indicator -
Pin 5	Left front indicator +
Pin 4	Right rear indicator -
Pin 3	Right rear indicator +
Pin 2	Right front indicator -
Pin 1	Right front indicator +

[1] Not all channels may be active, refer to data sheet for further details.

[2] The channel to function assignments reflect the Penny & Giles standard. If custom Joystick Modules are used then these assignments may change.

Note: If desired, it is possible to use just one indicator "+" connection per side. However, the "-"

connections must be kept separate.

If an indicator bulb fails, the ALM will detect this and flash the remaining bulb for that side at 3Hz as well as sending information to the Joystick Module so that the relevant indicator LED flashes likewise.

It is possible to use 3-wire lighting/indicator clusters with the ALM, but the following conditions must be followed.

i) The negative connection to the cluster must be the indicator negative, not lighting negative.

ii) It is only possible to connect one 3-wire cluster per side, i.e. only the front or rear lights/indicators may be connected in 3-wire configuration.

iii) It is possible to connect to connect all lights/indicators in 3-wire configuration but 4 external diodes need to be fitted. Please contact Penny & Giles for further details.

8.6 Actuator Wiring

Each actuator channel is rated at 10A maximum; however, when both footrests are operated simultaneously the rating is 5A per footrest. If the maximum current is required the wire gauge should be at least 1mm^2. Each actuator output will shut-off if the current from it is greater than 10A.

If the wheelchair is fitted with solid mechanical end-stops at the end of the actuator travel, it is not necessary to fit limit switches as the ALM will detect when the actuator motor has stopped and will cut-off the power to it.

8.7 Speed Limit Input Wiring

Pins 11 and 12 of PL2 can be used as a speed limit or inhibit input, refer to section 3.5 for more details.

This input requires only a very small current so wire gauge of 0.22mm^2 is suitable.

9.0 Bulbs

The ALM is designed to operate with 12V bulbs. The ALM will supply a constant power to the bulbs so that the brightness is not affected by variations in battery voltage.

The lighting output can supply a total power of 42W. Each indicator output can supply 42W.

10.0 Actuator Motors

The ALM is designed to be connected directly to permanent magnet DC motors. Please note the ALM may not be compatible with actuators which have their own over-current detection electronics. Actuator assemblies with slipping clutches may also be unsuitable as the motors will never stall, therefore not allowing the ALM to detect the end-stop. Please contact Penny & Giles if you are unsure.

11.0 Power Module Mounting

11.1 General

Fix the Power Module to the wheelchair chassis using suitable M5 or equivalent hardware.

11.2 Orientation

The function of the Power Module is not sensitive to mounting orientation; however, it should be mounted in such a way that water cannot enter and remain in the connector recesses. It is recommended that the unit is not mounted with the connectors uppermost. The Power Module has an IP54 dust and water resistance rating.

11.3 Position

The Power Module must be mounted in a position where it is not exposed to conditions of water or dust above those specified in ISO7176/9.

The Power Module is designed to withstand levels of shock and vibration experienced when mounted to the chassis of a wheelchair. The Power Module has been tested in accordance with IEC60068-2-29 and –34 for Bump and Random Vibration respectively. Direct impacts onto the unit should be avoided.

The Power Module has excellent thermal performance but, to improve this further, it may be secured against a metal part of the wheelchair chassis. To provide even better thermal performance, a non-silicone thermally conductive paste or pad may be applied between the Power Module and the wheelchair chassis.

Contact Penny & Giles if you need further advice.

11.4 Cables

The cables to the Power Module must be routed and secured in such a way as to prevent damage to them, for example by cutting or crushing.

12.0 Joystick Module Mounting

12.1 General

The Joystick Module should be fitted to a bracket made from 25x4mm or 1”x5/32” stock bar, and secured using two M4x12mm or 8-32UNCx1/2” screws. Be careful not to overtighten the screw. See data sheet for further information.

12.2 Orientation

The Joystick Module must be mounted with the joystick shaft pointing vertically upwards. If you want to use any other mounting attitudes then contact Penny & Giles.

13.0 ALM Mounting

13.1 General

The ALM should be fitted to the wheelchair chassis with 2 off M5x8mm fixing screws. Be careful not to overtighten these screws.

13.2 Orientation

The ALM is not sensitive to mounting orientation except where it is exposed to water or dust. In this situation, to maintain the IP54 rating, the ALM must be mounted so that the fixing screws are lowermost.

13.3 Position

Do not mount the ALM in a position which would expose it to excessive shock or vibration.

13.4 Cables

Route and secure all the cables to the ALM in such a way as to prevent damage to them, for example by crushing or cutting.

14.0 Production Tests

Perform the following tests, in order, on each wheelchair before dispatch.

14.1 Mounting

Make sure that all modules are securely mounted. Do not overtighten any fixing screws.

14.2 Cables and Connectors

Check all cables for damage. Make sure that all connectors are securely mated.

14.3 Joystick and Gaiter

Check that the joystick is not bent or damaged.

Check the thin rubber gaiter or boot, around the base of the joystick shaft, for damage or splitting. Check visually only, do not handle the gaiter.

Check that the joystick returns to the center position when you push and release it.

14.4 Programmed Settings

Make sure that the control system has the correct settings. Refer to chapter 3 or the Programmer User Guide for detailed instructions.

Control systems are always supplied with the settings shown on the relevant data sheet.

14.5 Operational Test (Drive)

This test should be carried out on a level floor with at least one metre clear space around the wheelchair.

i) Switch on the control system.

ii) Check that the battery gauge remains on, or flashes slowly, after one second.

iii) Push the joystick slowly forwards until you hear the solenoid brakes operate. The chair may start to move.

iv) Immediately release the joystick. You must be able to hear each solenoid brake operate within a few seconds.

v) Repeat the test a further three times, pushing the joystick slowly backwards, left and right.

14.6 Test Drive

Drive the wheelchair and make sure that it operates correctly for all settings of the user controls.

14.7 Soft-Stop Test

If the control system has the Soft-Stop function enabled (see data sheet) then it must be tested prior to the wheelchair being dispatched. To do this, drive the wheelchair at full forward speed and switch the control system off. The wheelchair must not stop suddenly, but should decelerate to standstill. In addition, ensure that the requirements in section 1.3 of this chapter are satisfied.

WARNING: This test should be conducted in an open space and a restraining device such as a seat belt should always be used.

14.8 Lights, Indicators and Hazard Lamps Test

If lights are fitted, visually check each bulb for correct illumination.

If indicators are fitted, check each bulb for correct illumination and that the flashrate is 1.5Hz ± 0.5Hz. Disconnect each bulb in turn and check that the remaining bulb for that side flashes at 3Hz ± 0.5Hz.

If hazard lamps are fitted, check each bulb for correct illumination and that the flashrate is 1.5Hz ± 0.5Hz.

14.9 Actuator Test

If actuators are fitted, check each motor for correct direction of movement. Ensure the mechanical end-stops are secure and that they stall the actuator motors, thus operating the ALM's automatic end-stop detection.

14.10 Speed Limit Input Test

If this input is connected, check for correct operation at all speed levels.

15.0 Electromagnetic Compatibility (E.M.C.)

The Pilot+ family has been tested for compliance with EC directive 89/336/EEC, and the E.M.C. requirements of prEN12184, the FDA and the FCC. The guidelines in this section will help you to make sure that your wheelchair installation will easily meet these requirements. You should consider E.M.C. and perform relevant tests as early as possible in the design phase.

15.1 Emissions

A typical wheelchair and Pilot+ installation have been type tested and have passed the requirements of CISPR 22 and FCC CFR47 part 15.

Observe the following recommendations to minimize radio frequency emissions:

15.1.1 Motor Suppression

For the drive motors solder a suitable suppression capacitor between the brush holders, inside the motor cases. Keep the capacitor's lead length as short as possible. We recommend a value of 4n7F 250V AC ceramic. The maximum value you should use is 10nF. A typical type is Roderstein WY0472MCMCF0K.

The above should also be applied to actuator motors, if fitted. If it is not possible to fit these capacitors inside the actuator motors, then contact the motor manufacturers for further advice. Alternatively, placing the capacitor externally, but as close as possible to the motor, may have the same effect.

15.1.2 Cables

You do not need to use screened battery and motor looms, but:

i) Keep the length of all wiring to a minimum.

ii) Make sure the loop area of the wiring is minimized. Route the positive and negative wires to each motor together. Route the battery positive and negative wires together. Where possible, route the battery and motor looms together. If fitted, route the lighting, indicator and actuator wires together.

iii) Secure all looms to the wheelchairs chassis over as much of their length as is practical.

iv) Do not use the control system connectors as junction points for the battery connections. Separate junction points away from the Power Module should be provided for the other wheelchair electrical functions.

15.2 Immunity

The Pilot+ control system family has been stringently tested for susceptibility to electromagnetic radiation over the frequency range 26MHz to 1GHz. The installations passed the FDA requirements and the proposed requirements of prEN12184.

Follow the recommendations in section 15.1.2 to ensure maximum immunity to electromagnetic radiation.

15.3 Electro-Static Discharge (E.S.D.)

There are various international standards currently under development for this aspect of the system's performance. At present, most of the standards are specifying the system to be tested to requirements of IEC1000-4-2. Tests are carried out at 8kV air discharge (to non-conductive surfaces) and 6kV contact discharge (to conductive surfaces). The Pilot+ family has been tested to these levels.

If you need advice please contact Penny & Giles.

16.0 Battery Gauge

Refer to Chapter 1 sections 9.0 and 9.1 for how to read the battery gauge.

The battery gauge typically starts to flash slowly when the battery voltage falls below 23.3V whilst the wheelchair is driving on a level surface.
For optimum accuracy of the battery gauge, the control system should be programmed with the approximate nominal capacity of the wheelchair battery. However, accuracy is not greatly affected if the programmed type and capacity do not closely match the battery.

The most important factor affecting the accuracy of the battery gauge is the resistance of the cable and connections between the battery and the Power Module. The control system must be matched approximately to the cable resistance of your wheelchair to make the battery gauge accurate, see chapter 3 section 5.6.1.
As a guide, 2.5mm^2 wire has a resistance of about 8 milliohms per metre; 4.0mm^2 wire has about 5 milliohms per metre and 6.0mm^2 has about 3.3 milliohms per metre. Circuit breakers and connectors usually account for about 15 milliohms.

These values will be chosen at the time the control system is being specified by the wheelchair manufacturer. Like the preset rates, once the values for the battery are decided, they are programmed into control systems during manufacture and should never need changing.

If you need advice, contact Penny & Giles.

PILOT+ DIGITAL POWERCHAIR CONTROL SYSTEM

CHAPTER 3: PROGRAMMING

1.0 Programming For Wheelchair Control systems

The main advantage of using programmable control systems is that they can be easily tailored to the specific needs and capabilities of a particular wheelchair user while taking into account the safe performance characteristics of the wheelchair being used. This means that wheelchairs fitted with a Penny & Giles Pilot+ control system can be readily programmed to be safe under normal driving conditions and also feel secure and comfortable to the user.

The programmable control system achieves this great flexibility by referring to a set of internal parameters which govern factors such as the wheelchair's speed, acceleration and braking. These parameters can be changed over a wide span to suit different wheelchairs and users, using a simple, hand-held programmer. Minimum and maximum limits can be applied to these parameters, thereby ensuring the wheelchair can only be programmed within a certain operating envelope. These limits can only be altered with the agreement of the wheelchair manufacturer and Penny & Giles.

All programmable values are stored within the Power Module, therefore, if you change a Joystick Module or ALM there is no need to re-program the system.

1.1 Important Note

It is possible to set up a control system so that it is unsuitable for some users and possibly even some wheelchairs. Take care when programming a control system and if you need any advice in programming or selecting values, please do not hesitate to contact Penny & Giles.

WARNING: Programming should only be conducted by healthcare professionals with in-depth knowledge of Penny & Giles electronic control systems. Incorrect programming could result in an unsafe set-up of a wheelchair for a user. Penny & Giles accept no liability for losses of any kind if the programming of the control system is altered from factory pre-set values.

2.0 PP1 Programmer

The PP1 is the handheld programmer that Penny & Giles supply for their Pilot+ control systems. Primarily intended for the specialized design and test requirements of wheelchair manufacturers and engineers, the PP1 takes full advantage of the complete programmability of the Pilot+, offering functions not available with less sophisticated control system designs.

The PP1 is a menu-driven programmer which plugs directly into the Pilot+' battery charging socket, and is available in two configurations, suited to different applications.

2.1 Basic PP1 Programmer (PP1a)

The most basic programmer version - the PP1a - is intended for general purpose use. It can set all of the key control system speed, acceleration and braking characteristics, and allows different settings to be tried out while the programmer is still plugged into the control system. A context-sensitive help function is available to guide users through the menus and the PP1 can also display error messages from the Pilot+ control system, allowing any problems with the wheelchair electrical system to be identified and corrected quickly. In addition, the Pilot+ fault log and elapsed time indicator can be read with the PP1a.

2.2 Engineering PP1 Programmer (PP1b)

The engineering version - the PP1b - offers all of the PP1a features but also includes a suite of advanced functions for designers, such as matching the control system to the motor impedance, setting maximum drive current and enabling front or rear wheel drive algorithms. Clearly, the PP1b is a very powerful tool for prototype design work. However, users who program parameters incorrectly do run the risk of damaging control systems or motors, so it should only be used by experts in wheelchair electrical systems.

2.3 PP1 Specifications

Functions	Notes	PP1a	PP1b
Acceleration	Vary from 0 (or factory set min.) to 100 (or factory set max.)	Unit steps	Unit steps
Deceleration	Vary from 0 (or factory set min.) to 100 (or factory set max.)	Unit steps	Unit steps
Tun Acceleration	Vary from 0 (or factory set min.) to 100 (or factory set max.)	Unit steps	Unit steps
Turn Deceleration	Vary from 0 (or factory set min.) to 100 (or factory set max.)	Unit steps	Unit steps
Forward Speed	Vary from 0 (or factory set min.) to 100% (or factory set max.)	1% steps	1% steps
Reverse Speed	Vary from 0 (or factory set min.) to 100% (or factory set max.)	1% steps	1% steps
Turn Speed	Vary from 0 (or factory set min.) to 100% (or factory set max.)	1% steps	1% steps
Sleep Timer	Period of time before control system "goes to sleep". (1 to 10 mins.)	1 min. steps	1 min. steps
Joystick Throw	Joystick deflection for full speed. (25% to 100%)	1% steps	1% steps
Steer Correct	Veer compensation for mis-matched motors	-9 to +9	-9 to +9
Read Timer	Displays hours wheelchair in use	Yes	Yes
Read Fault Log	Displays fault code history	Yes	Yes
Preset Control system	Set drive functions to factory preset values	Yes	Yes
Help Mode	On-line help text.	Yes	Yes
Diagnostics	Reads fault code from Pilot+.	Yes	Yes
Soft Reverse	Prevents wheels digging in when braking in reverse down a slope. Percentage of forward brake rate. (25% to 100%)		1% steps
Current Limit	Maximum and minimum current outputs. (20A to 80A).		1A steps
Foldback Temp.	Reduce current at this temperature (25°C to 70°C), then decrease current linearly until shut down temperature is reached.		1°C steps
Timed Foldback	Reduce current (25% to 100%) after stall time (5s to 10mins) to protect motors.		1% steps & 5s steps
Compensation	Match motor impedance for precise control. (0 to 1Ω).		5mΩ steps
Battery Menu	Match TruCharge display to loom resistance. (0 to 255mΩ).		1mΩ steps
Park Brake Trip[1]	For chairs without brakes.		Yes/No
Front Drive	Select algorithm for front wheel drive.		Yes/No
Fast Brake Rate	Slam braking by pulling joystick in reverse. (0 to 100%).		1% steps
Soft Stop	Controlled braking if control system switched off whilst driving.		Yes/No
Inhibit	Polarity and latched operation of speed limit input		Low/High & Yes/No
Profiles	Set Power Module to operate with drive profiles. (1 to 5)		1,2,3,4 or 5
Swap Motors	Exchanges left and right motor outputs.		Yes/No
Brake Voltage	Solenoid brake voltage (12/24V)		12V or 24V
Min Accel'n %	Vary from 0% to 100%		1% steps
Min Decel'n %	Vary from 0% to 100%		1% steps
Min Turn Acc. %	Vary from 0% to 100%		1% steps
Min Turn Dec. %	Vary from 0% to 100%		1% steps
Clear Timer	Reset elapsed timer		Yes/No
Erase Fault Log	Erases fault code history.		Yes
Preset Engineering Values	Set engineering functions to factory preset values		Yes

[1] see section 2.4.

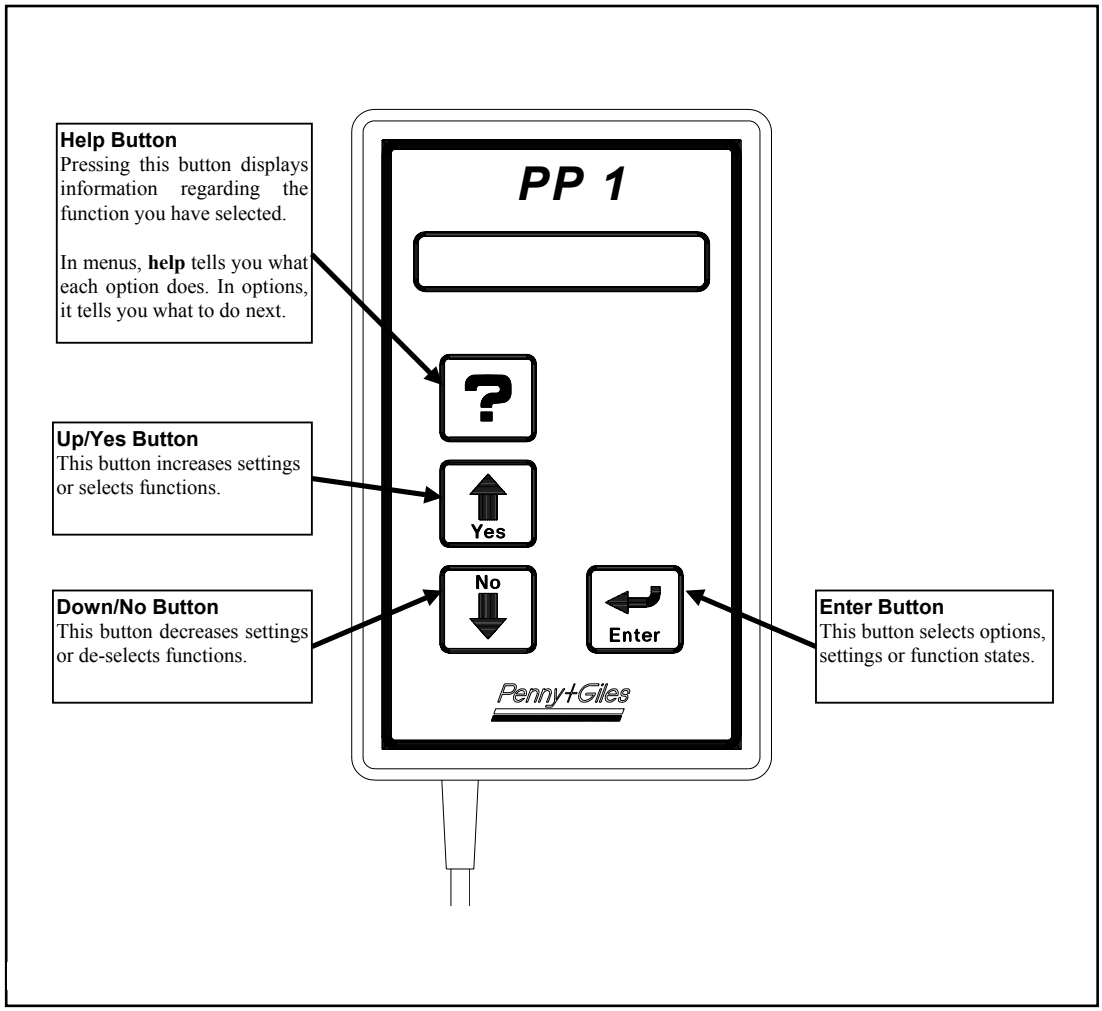
2.4 Important Note

Resetting parameters to non-compatible values could damage control systems and motors, and invalidate any warranties. ***Current Limit*** should never be set to a value greater than the values recommended for the Power Module you have, and ***Park Brake Trip*** should only be disabled on those chairs without solenoid brakes. Contact Penny & Giles if there is the slightest doubt. On a more general note, it is possible to set up a control system so that it is unsuitable for some users or even some wheelchairs. If you need any advice on programming, please do not hesitate to contact Penny & Giles.

3.0 Using The PP1

Please read this guide carefully before using the PP1 Programmer. Setting parameters to incorrect values could damage control systems and motors, and invalidate any warranties. In particular, ***Current Limit*** should never be set to a value greater than the recommended control system maximum.

3.1 PP1b Keypad Layout & Description



3.2 Connection

To program, you can connect the PP1 to the Pilot+, via the charging socket on the Joystick Module, if the system is either on or off. You can also drive with the PP1 connected.

Please note, for safety reasons, accessing some critical parameters will cause the control system to trip. This is indicated by the TruCharge display rippling up and down. This is intentional and the control system can be simply reset by switching off then on again.

To use the PP1 to view fault codes and messages, connect it to the control system when the control system has tripped. Note, if a trip occurs when the PP1 is already connected, then no diagnostic information will appear.

If you wish to program but the PP1 is showing diagnostic information, press the ***ENTER*** key and the PP1 will go into programming mode.

IMPORTANT: When the PP1 is connected to the Pilot+, the electromagnetic compatibility (E.M.C.) performance of the wheelchair may be affected. Disconnect the PP1 as soon as programming is complete and do not use the PP1 in environments which are E.M.C. sensitive.

4.0 Root Menu

The ROOT menu, which is included in both the PP1a and PP1b contains all the parameters which set the normal drive characteristics of the wheelchair. It is also possible to read the fault log and elapsed timer. Each parameter is explained in the following paragraphs.

4.1 Acceleration ?

Adjusts the value for forward and reverse acceleration of the wheelchair, from 0 to 100 in steps of 1. A higher value gives faster acceleration. This programmed value of acceleration occurs when the Joystick Module has speed setting 5 selected. Its value at other settings depends on the value of the ***Min Accel'n %*** parameter, see section 5.15.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value to be higher than this limit, contact Penny & Giles.

4.2 Deceleration ?

Adjusts the value for forward and reverse deceleration (or braking) of the wheelchair, from 0 to 100 in steps of 1. A higher value gives faster deceleration. This programmed value of deceleration occurs when the Joystick Module has speed setting 5 selected. Its value at other settings depends on the value of the ***Min Decel'n %*** parameter, see section 5.16.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value to be higher than this limit, contact Penny & Giles.

4.3 Turn Accel'n ?

Adjusts the value for turning acceleration of the wheelchair, from 0 to 100 in steps of 1. A higher value gives faster acceleration. This programmed value of acceleration occurs when the Joystick Module has speed setting 5 selected. Its value at other settings depends on the value of the ***Min Turn Acc. %*** parameter, see section 5.17.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value to be higher than this limit, contact Penny & Giles.

4.4 Turn Decel'n ?

Adjusts the value for turning deceleration (or braking) of the wheelchair, from 0 to 100 in steps of 1. A higher value gives faster deceleration. This programmed value of deceleration occurs when the Joystick Module has speed setting 5 selected. Its value at other settings depends on the value of the ***Min Turn Dec.%*** parameter, see section 5.18.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value to be higher than this limit, contact Penny & Giles.

4.5 Forward Speed ?

Adjusts the minimum and maximum values for forward speed of the wheelchair, from 0 to 100% in steps of 1%. A higher value gives a faster speed. The minimum value occurs when the Joystick Module has speed setting 1 selected, and the maximum value occurs at speed setting 5.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

4.6 Reverse Speed ?

Adjusts the minimum and maximum values for reverse speed of the wheelchair, from 0 to 100% in steps of 1%. A higher value gives a faster speed. The minimum value occurs when the Joystick Module has speed setting 1 selected, and the maximum value occurs at speed setting 5.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

4.7 Turning Speed ?

Adjusts the minimum and maximum values for the turning speed of the wheelchair, from 0 to 100% in steps of 1%. A higher value gives a faster speed. The minimum value occurs when the Joystick Module has speed setting 1 selected, and the maximum value occurs at speed setting 5.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

4.8 Sleep Timer ?

Sets the period of time before the control system will "go to sleep" if the joystick is not operated. The time can be set between 1 and 10 minutes in steps of 1 minute. If the time is set to 0 the system will never "go to sleep".

4.9 Joystick Throw ?

This allows you to program the control system so that full speed can be reached with a reduced joystick movement (throw). This is particularly useful for wheelchair users with limited hand or arm movement.

The adjustment can be made manually or by programming actual values.

4.9.1 Manual Adjustment

When the ***ENTER*** key is pressed the current setting for joystick throw in the forward direction will be displayed. If the joystick is displaced in the forward direction beyond 25%, then the actual joystick position will be displayed. Operation of the ***ENTER*** key will store the value displayed on the screen. This method can therefore be used to interactively set up the joystick throw with the wheelchair user.

The process is repeated for joystick reverse, left and right positions.

4.9.2 Programming Adjustment

When the ***ENTER*** key is pressed the current setting for joystick throw in the forward direction will be displayed. Operation of the ***UP*** or ***DOWN*** keys will change this setting, operation of the ***ENTER*** key will store the setting.

The process is repeated for joystick reverse, left and right positions.

4.10 Steer Correct ?

This factor compensates for any mismatching of motors to ensure that the wheelchair drives directly forward when the control system's joystick is being pushed directly forward.

It is normally set to zero but may be varied from -9 to +9 in increments of 1. If the chair is veering to the left, you should increase the setting. If the chair veers to the right, decrease the setting. If ***Swap Motors*** is set, this logic will be reversed, see section 5.13.

4.11 Read Timer ?

The Pilot+ has a timer which records how long the wheelchair is in use. The timer runs whenever the joystick is moved away from the center position, and stops when the joystick is returned. The timer records the number of hours the wheelchair has been in use.

To reset the timer see section 5.19

4.12 Read Fault Log ?

The Pilot+ has a fault log facility which stores the number of occurrences of the last eight faults.

This allows you to view the contents. The display format is as below.

1: Code 2C00, #1
2: Code 3C00, #3
no more entries

This reads line by line as.

Line 1 - fault code 2C00 has occurred once
Line 2 - fault code 3C00 has occurred three times
Only two fault types recorded.

To clear the fault log refer to section 5.21.

4.13 Preset Unit ?

Selecting this sets all ROOT menu parameters to their default values. These default values are decided between Penny & Giles and the wheelchair manufacturer.

5.0 Engineer Menu ?

Selection of this enters the engineering menu and allows you to adjust the technical performance parameters or functions of the control system. Each parameter or function is described below.

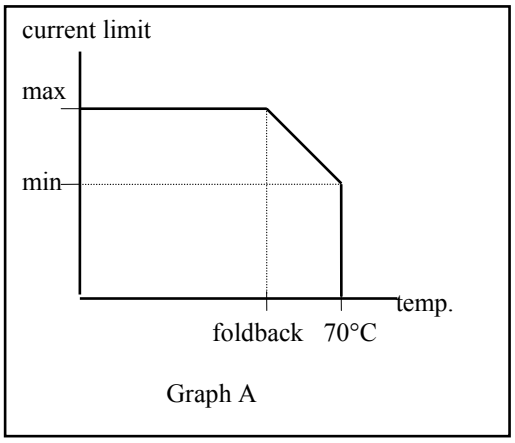
5.1 Soft Reverse ?

This sets the reverse braking rate. Reverse braking is normally 70% of forward braking to prevent the chair's tendency to topple when stopping in reverse on a gradient.

You can set the reverse braking between 25% and 100% of forward braking.

5.2 Current Limit ?

This sets the maximum and minimum current output for the control system. The current output is dependent on the internal temperature of the Power Module. Graph A (below) shows the relationship.



Graph A

Pilot+ Power Modules are available in two power ratings - 50A and 80A. The table below shows the recommended maximum to minimum relationships.

Max. Current Limit	Min. Current Limit
50A	40A
80A	60A

You can set the maximum and minimum current outputs between 20A and the maximum permitted upper value in steps of 1A.

5.3 Temp. Foldback ?

This is the internal Power Module temperature at which the current output starts to reduce, see Graph A. The table below shows the maximum value of temperature for each Power Module type.

Max. Current Limit	Temp. Foldback
50A	55°C
80A	55°C

IMPORTANT - the temperature value should never be set to more than the maximum possible for each control system type. Doing so will invalidate the warranty and affect the long term reliability of the control system.

5.4 Timed Foldback ?

This function allows a measure of protection for motors when they get into a stalled condition. You can set a 'Stall Time' of between 5 seconds and 10 minutes in 5 second increments after which time the maximum current limit is reduced to a percentage of the maximum current. This percentage (Foldback %) may be set between 25% and 100% of the current limit maximum in 1% steps.

After a fixed Reset Period of 5 x (Stall Time), the current limit will be allowed to return to the current limit maximum, if demanded. This reset period is to allow the motor(s) sufficient time to cool.

e.g. Power Module has current limit of 80A, stall time of 15 seconds and foldback % of 25%. This means that, if the motors are stalled, after 15 seconds the current output of the Power Module will reduce to 25% of 80A = 20A. After 5 x 15s = 75s, the current output will return to 80A.

5.5 Compensation *?*

This matches the control system to different motor types in order to achieve optimal performance and control. Penny & Giles recommend that you set this value to not more than **70%** of the resistance of the motor armature and all cables and connectors to it.

IMPORTANT - never set to greater than 70%.

Motor manufacturers should be able to supply figures for armature resistance, and typical cable and connectors would be about 40mΩ.

5.6 Battery Menu ?

5.6.1 Battery Cable ?

This sets the value of cable and connector resistance between the control system and the batteries. The value corresponds to the total resistance in both the positive and negative paths.

You can set this between 0mΩ and 255mΩ in steps of 1mΩ.

5.6.2 Gauge Cal ?

This allows further fine calibration of the TruCharge battery gauge. This is normally set at the factory and should not need adjustment. Please contact Penny & Giles if you are considering altering this factor.

5.6.3 Back to E Menu ?

This returns you to the ENGINEER Menu

5.7 Park Brake Trip ?

This tells the control system whether or not to trip if one or both of the solenoid brakes become disconnected or are not fitted. You can turn this function on or off.

IMPORTANT - this function should only ever be turned off if there are no solenoid brakes fitted to the wheelchair.

5.8 Front Drive ?

This selects special front wheel drive control software. You can turn this on or off.

It is possible for wheelchair manufacturers, in conjunction with Penny & Giles, to change the driving characteristics of the front wheel drive software, please contact Penny & Giles for further details.

5.9 Fast Brake Rate ?

This sets the deceleration rate for fast braking. Fast braking is when the joystick is pulled to the reverse position to effect a faster stop. You can set the fast brake rate between 0 and 100. If this value is set lower than the normal ***Deceleration*** rate, then the latter rate will be used.

5.10 Soft Stop ?

This selects whether the soft-stop facility is enabled. Soft-stop means that if you switch the control system off whilst driving, the wheelchair will steadily decelerate to standstill.

You can turn this function on or off.

IMPORTANT - if this function is on, you must ensure that the emergency stopping distance is within the distance specified for the country in which the wheelchair will be used. TÜV Product Service (Germany) specify the distance to be as stated in prEN12184.

5.11 Set Inhibit ?

This sets the operation of the speed limit input. This input can also be used as an inhibit input if the Inhibit Speed limit value is set to zero, see chapter section 3.5 for more details.

There are two options associated with this function - polarity and latching.

active low - This is the polarity of the input. It can be set to yes or no. The table below shows the effect of the input on wheelchair speed for the two settings.

Speed Limit Input Resistance	Inhibit Polarity Low (active low = yes)	Inhibit Polarity High (active low = no)
Short circuit	Inhibit Speed	Normal Speed
22KΩ ± 10%	Slow Speed	Mid Speed
100KΩ ± 10%	Mid Speed	Slow Speed
Open circuit	Normal Speed	Inhibit Speed

latched - This determines whether the control system trips when an inhibit signal (Inhibit Speed = 0) is received. It can be set to yes or no. Yes gives a trip condition and the system must be switched off and on again to reset. No means that drive can be resumed as soon as the inhibit signal is removed.

The settings for Inhibit, Slow and Mid Speed limits are factory programmable, if you want to alter these values please contact Penny & Giles.

5.12 Profiles ?

This function can only be used with customer specific Joystick Modules which support drive profiles. The Pilot+ generic Joystick Modules are not designed to operate with drive profiles, consequently, this value should be set to 0. For further information, please contact Penny & Giles.

5.13 Swap Motors?

This swaps the motor output connections, M1 and M2, on the Power Module. Normally M1 is for the left motor and M2 for the right motor.

You can select between yes and no. If set to yes, M1 will be for the right motor and M2 for the left motor. If set to no, the normal condition will apply.

Note, if you swap the motor connections the TruCharge motor diagnostic information will need to be interpreted differently, see chapter 1 section 8.5. The function of ***Steer Correct*** will also be reversed, see section 4.10.

5.14 Brake Voltage ?

This sets the voltage output from the Power Module to the solenoid brakes. You can select either 12V or 24V.

WARNING: It is essential that the control system is programmed for the correct brake voltage. If it is not, damage may occur to the brakes or the drive performance of the wheelchair may be affected.

5.15 Min Accel'n % ?

Adjusts the minimum value for forward and reverse acceleration of the wheelchair. It is programmed in increments of 1% of the ***Acceleration*** value. This percentage of the ***Acceleration*** value occurs when the Joystick Module's speed setting is at 1. For example: if ***Acceleration*** is set at 80 and ***Min Accel'n %*** is set at 25% then when the speed setting is 1, acceleration will be 25% x 80 = 20; and when the speed setting is 5, the acceleration will be 80. Speed settings 2, 3 and 4 will interpolate linearly between 20 and 80 - i.e. acceleration values of 35, 50 and 65 respectively. If ***Min Accel'n %*** is set at 100%, then acceleration will not vary as the speed setting is changed.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

5.16 Min Decel'n % ?

Adjusts the minimum value for forward and reverse deceleration (or braking) of the wheelchair. It is programmed in increments of 1% of the ***Deceleration*** value. This percentage of the ***Deceleration*** value occurs when the Joystick Module's speed setting is at 1. For example: if ***Deceleration*** is set at 80 and ***Min Decel'n %*** is set at 25% then when the speed setting is 1, deceleration will be 25% x 80 = 20; and when the speed setting is 5, deceleration will be 80. Speed settings 2, 3 and 4 will interpolate linearly between 20 and 80 - i.e. deceleration values of 35, 50 and 65 respectively. If ***Min Decel'n %*** is set at 100%, then deceleration will not vary as the speed setting is changed.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

5.17 Min Turn Acc.% ?

Adjusts the minimum value for turn acceleration of the wheelchair. It is programmed in increments of 1% of the ***Turn Accel'n*** value. This percentage of ***Turn Accel'n*** value occurs when the Joystick Module's speed setting is at 1. For example: if ***Turn Accel'n*** is set at 80 and ***Min Turn Acc.%*** is set at 25% then when the speed setting is 1, acceleration will be 25% x 80 = 20; and when the speed setting is 5, the acceleration will be 80. Speed settings 2, 3 and 4 will interpolate linearly between 20 and 80 - i.e. turn acceleration values of 35, 50 and 65 respectively. If ***Min Turn Acc.%*** is set at 100%, then acceleration will not vary as the speed setting is changed.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

5.18 Min Turn Dec.% ?

Adjusts the minimum value for turn deceleration (or braking) of the wheelchair. It is programmed in increments of 1% of the ***Turn Decel'n*** value. This percentage of ***Turn Decel'n*** value occurs when the Joystick Module's speed setting is at 1. For example: if ***Turn Decel'n*** is set at 80 and ***Min Turn Dec.%*** is set at 25% then when the speed setting is 1, acceleration will be 25% x 80 = 20; and when the speed setting is 5, the acceleration will be 80. Speed settings 2, 3 and 4 will interpolate linearly between 20 and 80 - i.e. turn deceleration values of 35, 50 and 65 respectively. If ***Min Turn Dec.%*** is set at 100%, then acceleration will not vary as the speed setting is changed.

Some Power Modules may be factory programmed to limit the value of this parameter. If you want to set the value outside these limits, contact Penny & Giles.

5.19 Clear Timer ?

This allows you to reset the timer to 0 hours.

5.20 Erase Fault Log?

This allows you to clear the fault log after a successful repair.

5.21 Preset Eng Values ?

Selecting this sets all ENGINEER menu parameters to their default values.

5.22 Back to root ?

This takes you back to the ROOT menu.

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