

DX™

DX-GB Gearless Brushless

Installation Manual

About this Manual

This manual has been designed to help you install and configure a Dynamic DX-GB powerchair control unit for a 'generic' brand powerchair. For this reason there are no guidelines for specific applications.

This manual must be read in conjunction with all other relevant DX-System manuals.

If there is a specific requirement for your application, please contact Dynamic Controls or one of the sales and service agents, to assist you.

Throughout this manual there are a few symbols that will help you quickly identify the purpose of the paragraph that follows:



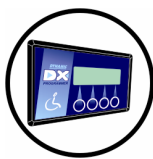
Notes & Precautions:

*Notes provide supporting information for the previous paragraph or section that **should** be followed in order to install, configure, and use the product safely and efficiently.*



Warnings:

*Warnings provide important information for the previous paragraph or section that **must** be followed in order to install, configure, and use the product safely and efficiently.*



Programming notes:

This icon denotes that the paragraph refers to the programming.

*The term '**programming**' used throughout this manual refers to adjusting parameters and configuring options to suit an application. 'Programming' does not change or alter any software within the controller and is performed using a controlled programming tool available only to authorised personnel.*

*The term '**accessory**' used throughout this manual refers to equipment that is ancillary to the main functioning of the control system. It does not refer to an accessory of the wheelchair. The control system is a component of the wheelchair.*

DX is not user serviceable. Specialized tools are necessary for the repair of any component.

Do not install, maintain or operate this equipment without reading, understanding and following this manual – including the Safety and Misuse Warnings – otherwise injury or damage may result.

Due to continuous product improvement Dynamic reserves the right to update this manual. This manual supersedes all previous issues, which must no longer be used.

Dynamic reserves the right to change the product without notification.

Any attempt to gain access to or in any way abuse the electronic components and associated assemblies that make up the powerchair system renders the manufacturer's warranty void and the manufacturer free from liability.

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Contents

1	Introduction.....	7
1.1	The DX system.....	7
1.2	The DX-GB Gearless Brushless controller	8
2	Installation and Testing	10
2.1	DX-GB Mounting	10
2.2	Connections and Wiring.....	11
2.2.1	Cable and Connector Pin-outs.....	12
2.2.2	Battery Connections	12
2.2.3	Motor and Park Brake Connections.....	14
2.2.4	DX BUS Connections	14
2.3	Drive Control Input (DCI) and OBC Connections.....	15
2.3.1	DCI – Analog Mode	16
2.3.2	DCI – Digital Mode	16
2.3.3	DCI Examples	16
2.4	Motor Calibration.....	18
2.5	Testing the Installation.....	18
3	Programming	20
3.1	Introduction	20
3.2	Description of Parameters.....	21
3.2.1	Modified System Drive Parameters.....	22
3.2.2	DX-GB Specific Parameters	24
3.3	DX-GB parameter access list	27
3.3.1	Hand Held Programmer (HHP) parameter list	27
3.3.2	Wizard parameter access list	27
4	Diagnostics.....	33
4.1	Introduction	33
4.2	Diagnostics Tools.....	33
4.3	Flash Codes.....	34
4.4	User Advice and Error Codes.....	35
4.4.1	User Advice List	36
4.4.2	Error Codes	36
5	Specifications.....	38
5.1	Specifications of the DX-GB controller.....	38
5.1.1	Electrical specifications.....	38
5.1.2	Physical Specifications.....	39
5.2	Specifications of the Euro GB Motor	40
5.2.1	Electrical and mechanical specifications	40
5.2.2	Performance charts	41
5.2.3	Physical specifications.....	42

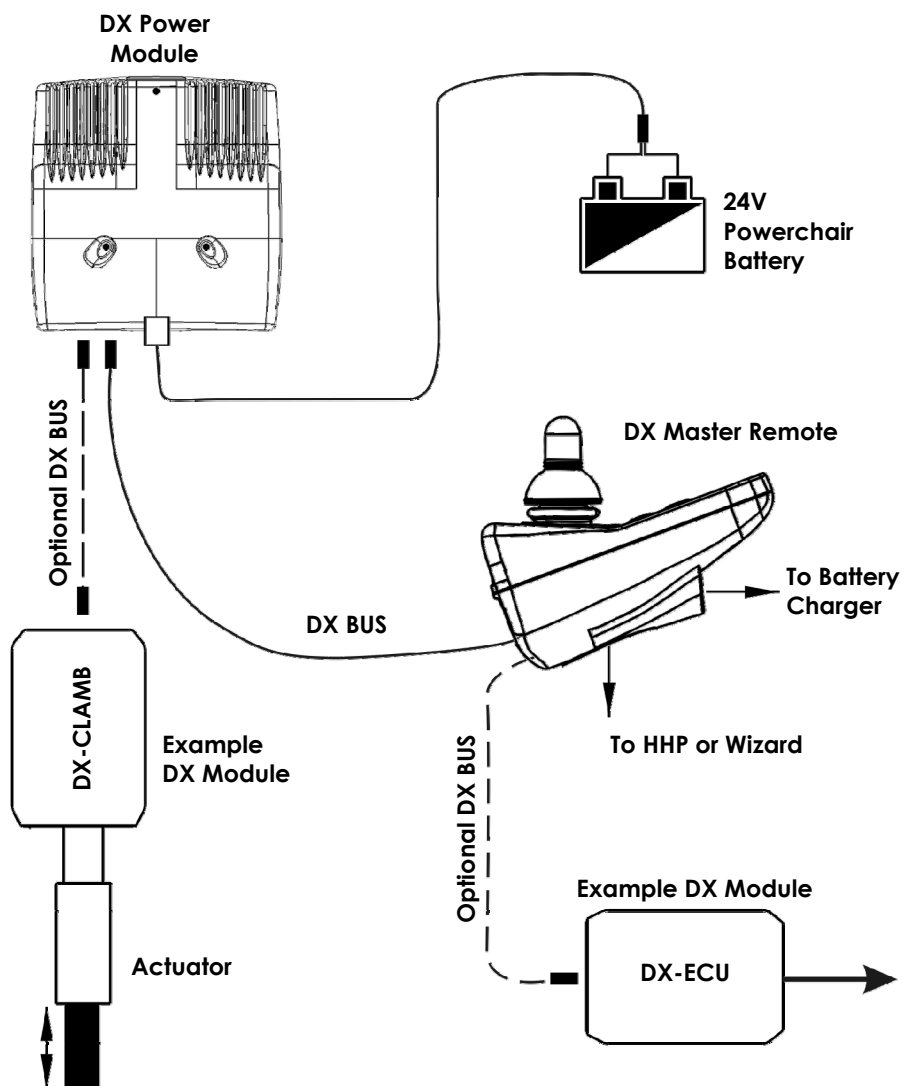
6	Appendices	43
6.1	Programming Accessories.....	43
6.2	Intended Use and Regulatory Statement	44
6.3	Maintenance.....	45
6.4	Warranty.....	46
6.5	Safety and Misuse Warnings	47
6.6	Electromagnetic Compatibility (EMC).....	49
6.7	Environmental Statement.....	50

1 Introduction

1.1 The DX system

DX is a modular, expandable power wheelchair control system. This modularity allows the system to be expanded and customized to particular end-user needs and handles the requirements from basic driving to full environmental control. A power module and a master remote are required along with a DX BUS cable to form the base of any DX system. A variety of modules are available to access additional functions and features.

An example DX system:



1.2 The DX-GB Gearless Brushless controller

The Dynamic DX Gearless Brushless Power Module (DX-GB) is a DX BUS compatible module that converts signals generated by a DX Remote into high current outputs. These outputs drive the motors that control the powerchair speed and direction. The combination of a DX-GB and DX Master Remote give an exceptionally smooth, powerful, and safe drive system.

The DX-GB has been designed specifically for use with Gearless Brushless motors, an alternative to conventional brushed motors commonly in use today. Supplying up to 100-Amps per phase, the DX-GB is perfect for the control of a wide range of powerchair configurations, including front, mid, and rear wheel drive.



Warning:

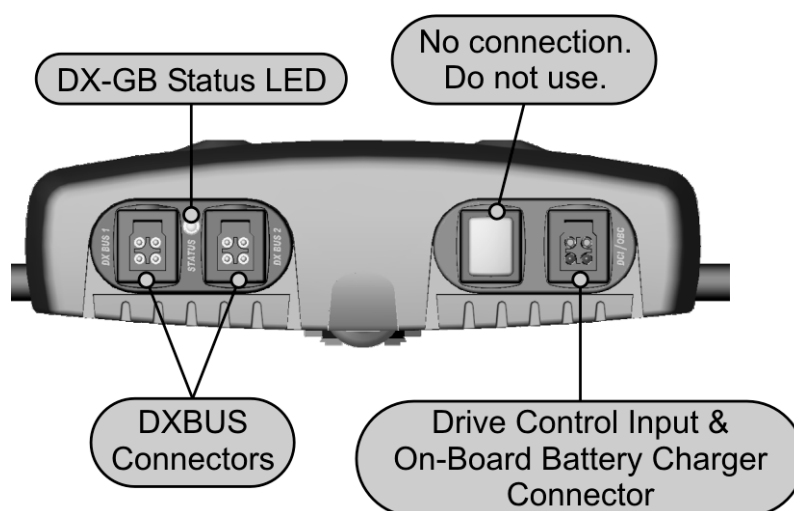
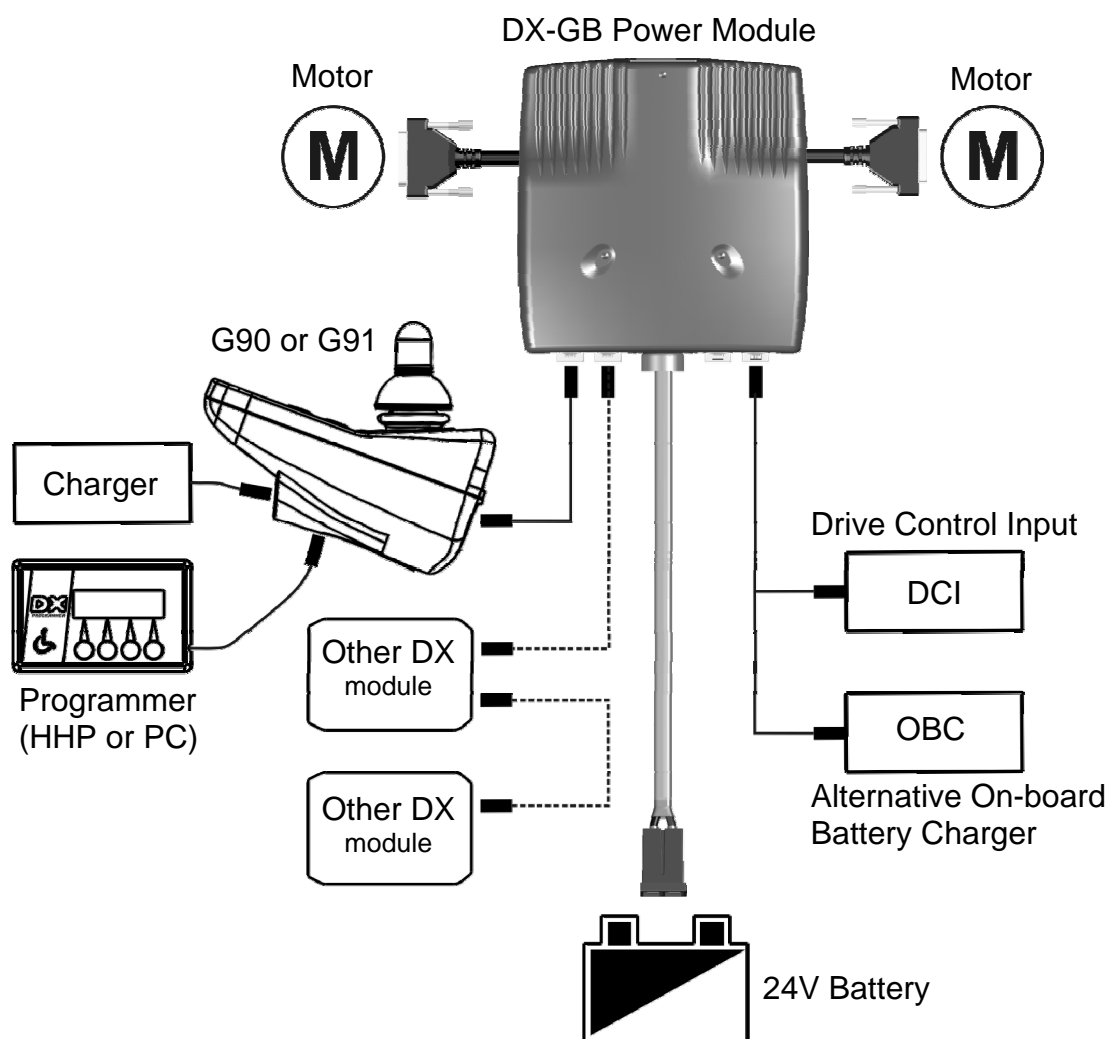
DX-GB is ONLY compatible with DX Systems containing recent Master Remotes like the DX-REMG90(x,) the DX-REMG91 or later. Contact Dynamic to check compatibility with other variants or custom remotes.

The DX-GB is fully programmable to cater for the wide range of powerchair types and user needs. Correct installation and programming are essential to ensure optimum performance and safety.



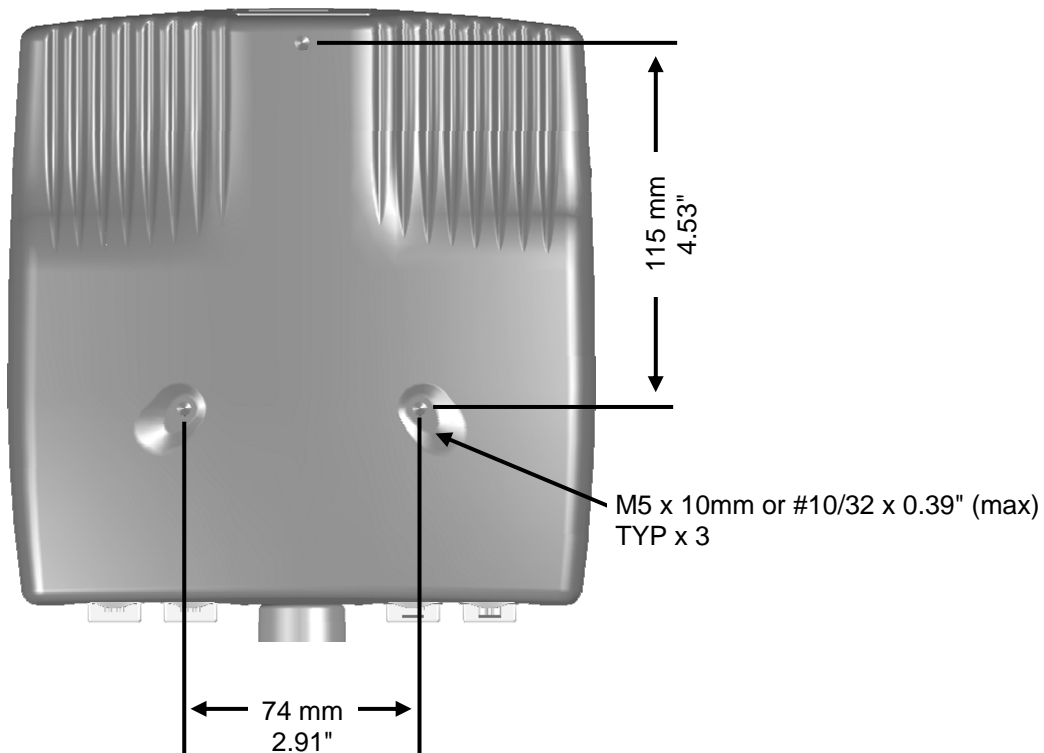
A DX wheelchair control system comprises of two or more compatible modules. Each module has its own installation manual.

This manual describes the DX-GB only and therefore must be read in conjunction with the other DX Modules to be used in your application.

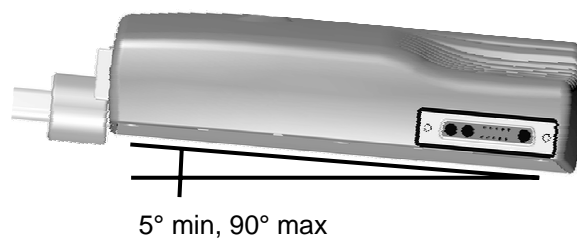


2 Installation and Testing

2.1 DX-GB Mounting



- The DX-GB must be mounted with the lid-down and at a minimum incline of 5° from horizontal.



- The position and orientation must give maximum mechanical protection to the DX-GB.
- Mount the DX-GB out of the path of water splashes from the wheels or the motor housing. Make sure the DX GB will never be immersed in water.
- Protect the front (connector panel) of the DX-GB from direct splashing.
- Failure to adhere to the mounting orientations specified might lead to water ingress, which can result in system malfunction and long-term damage to the unit.

- For peak performance, locate the DX-GB so that air can flow over and around the case.
- Make sure that the mounting position minimizes bending and flexing stresses on the motor cables, especially with moving motor/wheel suspension.
- Use all three mounting points to attach the DX-GB.
- The use of M5 or #10/32 screws that engage up to 10mm/0.39" into the case is recommended.



Warning:

Regardless of mounting orientation, protect powerchair wiring and connectors from the risk of damage, water splashes and/or water ingress, and route the cabling so that water will not run down into the connector system. The use of cable boots is highly recommended.

Do not mount the DX-GB in a position where the user can come into continuous contact with the unit. The case temperature can exceed 41°C.

2.2 Connections and Wiring

The DX-GB has two connector plates located along the front panel of the case that contain DX BUS (x2) and Drive Control Input (DCI) connections. The batteries, motors and park brakes are connected using the cables extending from the case.



Chair design and specification shall ensure that the motor and controller cannot be overloaded in normal use and intended operating environment, to ensure that adequate braking torque is available at all times.

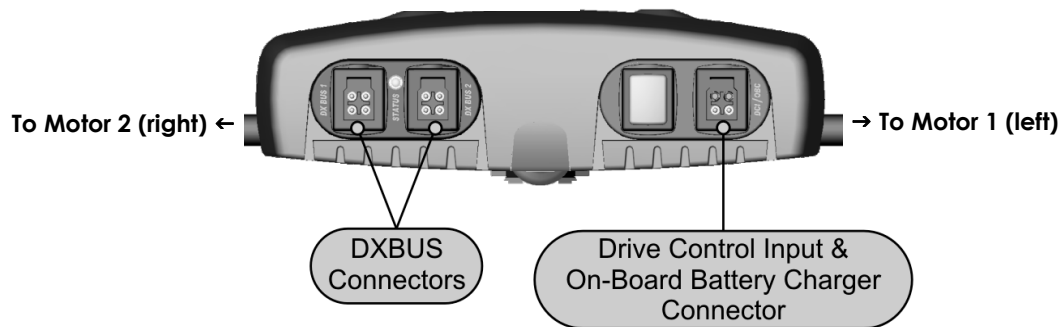
Ensure that all wiring is suitably restrained to prevent snagging.

Connecting looms must have connector housings fitted to prevent incorrect connections.

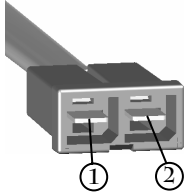
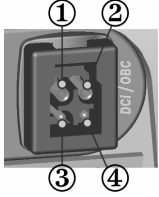
Before making any connections to the DX-GB, disable the powerchair by one of the following means to prevent accidental movement:

- *Place the battery circuit breaker in the open position or remove the battery fuse,*
- *Disconnect the motor or batteries, and/or*
- *Elevate the drive wheels.*

2.2.1 Cable and Connector Pin-outs

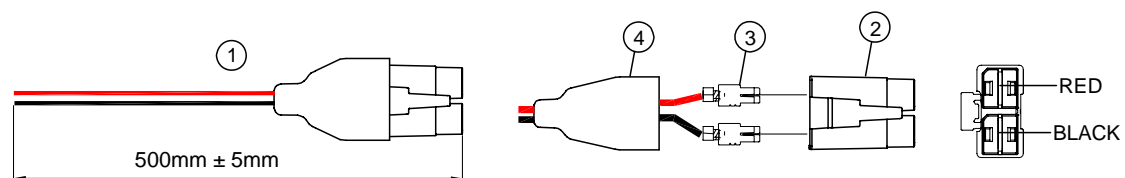


All connectors viewed from front. Pin numbers are for reference only. Actual pin numbers on mating connector housings may differ from those given below.

Battery Cable Connector Pin-out		
	Pin	Function
	1	Battery Negative (Black)
	2	Battery Positive (Red)
Drive Control Input (DCI) and OBC Connector Pin-out		
	Pin	Function
	1	Inhibit (female)
	2	DCI Input (female)
	3	Battery Positive (male)
	4	Battery Negative (male)

2.2.2 Battery Connections

The DX-GB Battery Cable is terminated with a DK-type battery connector and has two terminals - battery positive (red) and battery negative (black). Simply plug the connector of the mating battery cable into the Shark battery connector.



1	GSM80204	Assembled Loom
2	GME80016	Battery Connector housing
3	GCN8002	Spade Terminal 6-10 mm ² (2)
4	GCN0787	Connector boot CPL001
	Wire diameter	minimum 6 mm ² / 10 AWG recommended 8 mm ² / 8 AWG



The final connection to the Battery Positive (+) terminal must not be made until the powerchair is completely wired and ready for testing as described in the Testing section.

The DX-GB has been designed to perform optimally with either Lead- Acid or Gel Cell 24 V deep cycle batteries.

Ensure that the battery capacity and the battery charger rating are sufficient to not restrict the high performance needs of the system. Peak performance capability is important to ensure safe control of the wheelchair.



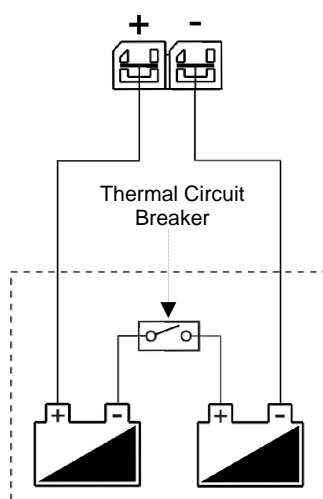
Warning:

A thermal circuit breaker or fuse must be installed between the batteries and the rest of the system wiring - as close as possible to the batteries - to protect both the batteries and the system wiring against short circuits.

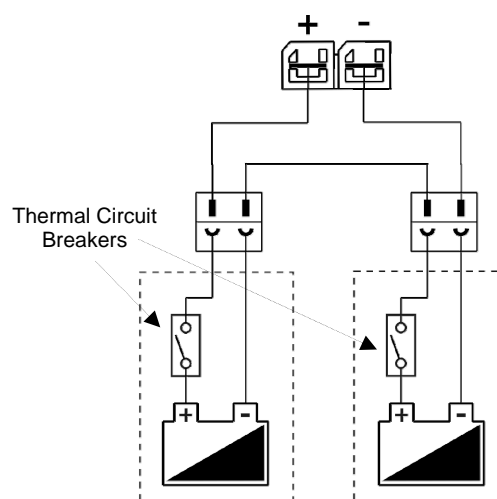
The circuit breaker or fuse must be of the slow acting type. The rating of the circuit breaker must be of appropriate size for the total chair weight, battery capacity and wiring. A rating of 40A – 70A is recommended.

Position of the circuit breaker

If the two batteries are permanently wired together (single battery box), the best position for the circuit breaker is between the two batteries. If the batteries are separated (individual battery boxes), each battery requires a circuit breaker.



Single Battery Box



Separate Battery Boxes

2.2.3 Motor and Park Brake Connections

The DX-GB has two motor cables (left and right) that plug directly into the motors.

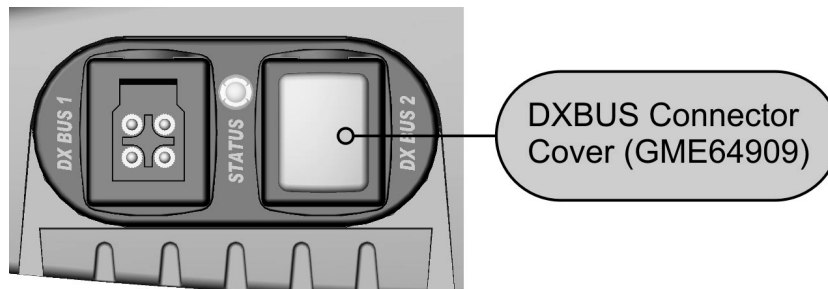


Programming note:

You can program the DX-GB to swap the motor connections, if necessary.

2.2.4 DX BUS Connections

The DX-GB communicates with the rest of the DX system through the DX BUS. The DX BUS also supplies power to every other DX Module.



Warning:

If only one DX BUS connector is used on the DX-GB, a blanking plate must be fitted to the unused connector. DCL Part/Order Number GME64909 DX-GB Connector Cover Plate can be used.

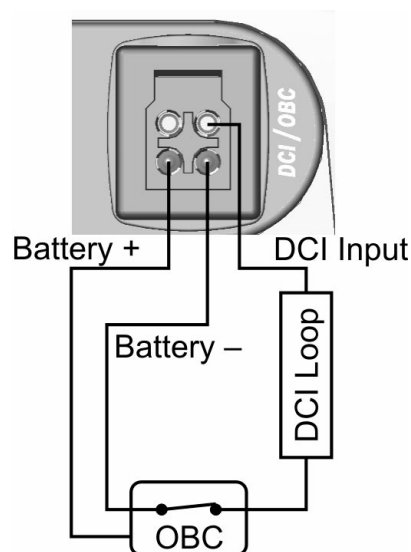
2.3 Drive Control Input (DCI) and OBC Connections

The DX-GB provides support for an On-board Battery Charger (OBC), an 'inhibit', and a 'speed limit' function (either digital or analog) through the Drive Control Input (DCI) socket as shown to the right. The On-board Battery Charger supports up to 12 Amperes (RMS) directly through the connector.

The DCI allows the powerchair speed and configuration to be adjusted depending on the resistance of the DCI "Loop".

- **Inhibit** - Prevents the powerchair from driving, typically when the chair is being charged, or when a seat is raised or tilted.
- **Speed Limit – Digital mode** - Automatically limits drive speed to a pre-programmed value, typically when a seat is raised or tilted and driving too fast may be dangerous. The value to which it slows down is programmable.
- **Speed Limit – Analog mode** - Automatically limits the drive speed to a value proportional to the resistance of the DCI Loop. For example, the further a seat is tilted the slower the chair will drive.

To determine the function of the DCI, an appropriate resistance must be placed across the DCI Input pin and the Battery Negative pin. Depending on the resistance value, the DX-GB will inhibit or limit the chair speed.



Warning:

The switch configuration must ensure that driving is inhibited when the chair is being charged.



Note:

The On-board Battery Charger (OBC) must have a normally closed Inhibit output. If the OBC has a normally open Inhibit output, connect this to the Inhibit pin of the OBC/DCI connector instead. Check your OBC documentation for product specifications.

If the DCI/OBC connector is not used, a blanking plate must be fitted. Use the DX-GB Connector Cover Plate, Part/Order Number GME64909.



Programming note:

The DCI function can be enabled and disabled. If disabled, the DCI connector can be left un-terminated and the chair will drive normally.

2.3.1 DCI – Analog Mode

When the Digital Input setting is set to 'No', the DCI will limit the drive speed of the chair to a value proportional (linear) to the resistance of the DCI Loop, typically through use of an analog potentiometer. A loop resistance of 220 ohms will have no effect on the chair speed, while a value of 56 ohms will cause the chair to slow down to the value set in Reduced Speed.

	Normal	Speed Limit	Inhibit	Swivel + Speed Limit	Inhibit
	Nominal DCI Loop Resistance (± 5%)				
Resistance (Ω)	0 (>560)*	56 - 220	330	(56 – 220) + 330 (450 nominal)	>560 (0)*

* When Standard/Fail-safe is set to 'Safe', Normal and Inhibit functions will be swapped.

2.3.2 DCI – Digital Mode

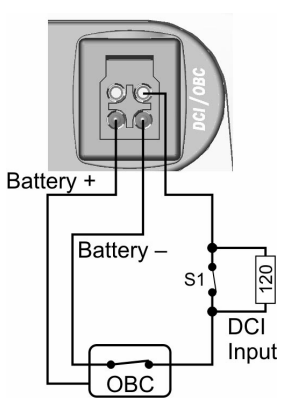
When the Digital Input setting is set to 'Yes', the DCI will limit the drive speed of the chair to the value set in Reduced Speed. This will typically be implemented through the use of an actuator-out-of-position switch.

	Normal	Speed Limit	Inhibit	Swivel + Speed Limit	Inhibit
	Nominal DCI Loop Resistance (± 5%)				
Resistance (Ω)	0 (>560)*	120	330	(120 + 330 (450 nominal)	>560 (0)*

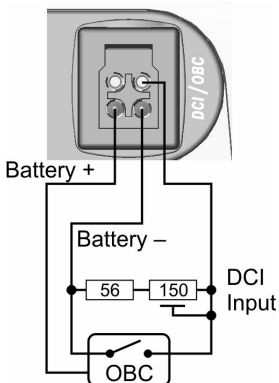
* When Standard/Fail-safe is set to 'Safe', Normal and Inhibit functions will be swapped.

2.3.3 DCI Examples

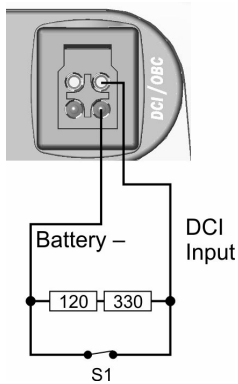
Example 1

		<p>A powerchair has a seat raise function and an On-board Battery Charger (OBC).</p> <p>The DX-GB will automatically limit the speed to 60% when the seat is raised (S1), and inhibit drive when the OBC is plugged in.</p> <p>When plugged in, an internal switch in the OBC will activate causing an open circuit (>560 ohms).</p>	
Digital Input	Yes	Standard/Fail-safe	Safe
Swivel Enable	Off	Ext. Speed Pot Min	25%
Enable DCI Speed Limit	Yes	Reduced Speed	60%

Example 2

		<p>A powerchair has a seat raise function and an On-board Battery Charger (OBC).</p> <p>The DX-GB will automatically limit the speed by an amount proportional to the seat height, and inhibit drive when the OBC is plugged in.</p> <p>When plugged in, an internal switch in the OBC will activate causing a closed circuit (<10 ohms).</p>	
Digital Input Swivel Enable Enable DCI Speed Limit	No Off Yes	Standard/Fail-safe Ext. Speed Pot Min Reduced Speed	Std 25% 0%

Example 3

		<p>A powerchair has a swivel function.</p> <p>The DX-GB will automatically reconfigure itself for FWD when the seat is swivelled 180° and automatically limits the speed to 80% (S1).</p>	
Digital Input Swivel Enable Enable DCI Speed Limit	Yes On Yes	Standard/Fail-safe Ext. Speed Pot Min Reduced Speed	Safe 25 80%



Warning:

The switch configuration must ensure that driving is inhibited when the chair/seat is in an undefined position (e.g. partially swivelled).

2.4 Motor Calibration

Every time the DX-GB Power Module or either motor is replaced or swapped, the motors must be re-calibrated to match the DX-GB. Without calibration, the motors may not perform as expected. Motor Calibration is done using the DX Hand Held Programmer (DX-HHP).

The Motor Calibration function is located within *Technician Mode – DX-GB* on the DX-HHP.



Note:

Before Motor Calibration, raise the powerchair drive wheels off the ground using blocks under the powerchair frame. To reduce the risk of injury, we recommend using a lifting device.

2.5 Testing the Installation

To ensure that the powerchair meets a minimum level of safety, the following procedure must be undertaken to ensure that the powerchair operates safely.

This procedure must be carried out in a spacious environment and with due regard to any possible unexpected powerchair movement in the event of faulty installation.

1. Raise the drive wheels off the ground using blocks under the powerchair frame so that the drive wheels can turn freely.



Note:

To reduce the risk of injury, we recommend using a lifting device.

2. Recheck all wiring, paying particular attention to battery polarities.
3. Make the final connection to the Battery Positive (+) terminal and close the circuit breakers.



Note:

If the used master remote is not pre-programmed with the intended chair program, download the program for this chair with the Dynamic Wizard.

4. Press the Power button to turn the DX system on. Ensure it turns on correctly.

**Note:**

The first time the DX Master Remote is turned on, the System Status LED will flash a fault. This is because the DX Master Remote must download its information to the DX-GB. Wait 10 seconds before turning the DX Master Remote off, wait 10 seconds, then turn it back on to clear the fault.

5. Check that the DX-GB Status LED is on steady. If this is still flashing, the motors may require calibration or the DX-GB may be faulty. Refer to the Diagnostics section.
6. Press the Power button again to turn the DX system off. Ensure it turns off correctly. Press the power button again to turn the DX system back on.
7. Turn each drive wheel by hand to check that the park brakes are engaged. The wheels should not move. If the wheels turn, operate the park brake release mechanism to engage the park brakes.
8. Calibrate the motors if necessary.
9. Push the joystick slightly out of neutral and listen for the "click" as the park brakes disengage.
10. Move the joystick in all directions and ensure that the wheels respond smoothly and in the correct direction.
11. Release the joystick to neutral and listen for the click of the park brakes re-engaging.
12. Go through the check sequences for the DX Master Remote and other connected DX Modules. These will be located in the installation manuals for each product.
13. Turn off the DX system and remove the blocks from under the powerchair.
14. Turn the DX system back on and set the speed to its slowest setting.
15. Sit in the powerchair and drive in all directions slowly, checking for precise and smooth control.
16. Repeat at higher speeds and for all other Drive Programs. Check if the chair performs as expected for the selected program.
17. Drive the wheelchair on a 1 : 6 ramp and check for normal power, smoothness and parking.
18. Repeat testing as required until chair performance is as expected.

**Note:**

Some Drive Programs may not be suitable for testing indoors.

3 Programming

**Warning:**

Performance adjustments should only be made by professionals in the health care field or by persons fully conversant with the adjustment process and the user's capabilities.

Incorrect settings, or programming in an unsafe location, can cause injury to the operator or bystanders, or damage to the vehicle or surrounding property.

After the vehicle has been configured, check to make sure the vehicle performs to the specifications entered in the programming procedure. If the vehicle does not perform to specifications, reprogram it. Repeat this procedure until the vehicle performs to specifications. If the intended operation cannot be achieved, contact your service agent.

Ensure that deceleration parameters are always higher than acceleration parameters for a safe response.

It is the health care professionals responsibility to ensure that the user is capable both of cognitively understanding and physically operating the programmed features and functions.

With inappropriate programming settings, certain features and options may not be accessible or perform as expected.

3.1 Introduction

The DX-GB is fully programmable for a variety of powerchair configurations and users. All programmed values are also stored in the DX Master Remote. In the event the DX-GB is replaced, there is no need to reprogram the DX system. If the Master Remote is replaced, the DX-GB can simply be reprogrammed with an identical powerchair program.

**Note:**

If the DX-GB or the motors are replaced, the motors will require re-calibration for the new combination.

The PC-based Wizard is the preferred tool to program a DX system. You can use either the Hand Held Programmer (HHP) or the Wizard to make parameter value adjustments.

In a factory environment, the Wizard is the required tool for initial programming of the chair. The HHP is required to calibrate the motors and can be used to make minor adjustments for a specific user.

**Note:**

The Wizard needs the DX-GB database update to recognize the DX-GB. Make sure you have the latest version of the Wizard database installed. The latest version is available for download on the Dynamic website: www.dynamiccontrols.com.

**Warning:**

Always test the vehicle after programming to ensure that the intended operation is achieved.

3.2 Description of Parameters

**Note:**

The DX-GB drive algorithm differs from the standard DX system drive algorithm for 24V DC motors. Some parameters are re-used, but behave similar, not the same. Other DX system drive parameters are ignored or replaced by specific DX-GB drive parameters.

The DX system drive parameters that are re-used are listed in section 3.2.1: Modified System Drive Parameters.

The DX-GB specific drive parameters are listed in section 3.2.2: DX-GB Specific Parameters.

A full list of DX-GB related parameter names and access restrictions can be found in section 3.3: DX-GB parameter access list.

The following parameters are those that affect the set-up and configuration of the DX-GB and are typically set up for a powerchair type, rather than any particular powerchair user.

**Note:**

In the case a particular parameter is ignored by the DX-GB, its parameter description displayed by the Wizard is not applicable. Section 3.3 lists which parameters are ignored.

The parameter name displayed on the hand held programmer may be different to that displayed by the Wizard.

3.2.1 Modified System Drive Parameters

Setting	Description
Drive Profiles	
Forward Speed @ Maximum	Sets the maximum forward speed for the selected profile when the selected joystick is pushed fully forward. Set to a low value for a lower maximum speed, for example when setting an indoor driving profile. Set to a higher value for faster driving, for example when setting an outdoor driving profile.
Forward Speed @ Minimum	Sets the maximum forward speed of the chair with the joystick fully forward and either Chair Speed set to minimum or the DCI speed pot at minimum.
Forward Acceleration*	Programs the forward acceleration rate. Set to a lower value for soft and gentle wheelchair drive performance.
Forward Deceleration*	Programs the forward deceleration rate. Set to lower values for soft and gentle wheelchair drive performance. This value must always be greater than "Forward Acceleration".
Reverse Speed @ Maximum	Sets the maximum reverse speed for the selected profile when the selected joystick is pushed fully backwards. High settings are not recommended.
Reverse Speed @ Minimum	Sets the maximum speed of the chair in reverse with the joystick fully backwards and either Chair Speed set to minimum or the DCI speed pot at minimum.
Reverse Acceleration*	Programs the reverse acceleration rate. Set to lower values for soft and gentle wheelchair drive performance.
Reverse Deceleration*	Programs the reverse deceleration rate. Set to lower values for soft and gentle wheelchair drive performance. This value must always be greater than the programmed "Reverse Acceleration".

Setting	Description
Drive Profiles	
Turning Speed @ Maximum	Sets the maximum turning speed for the selected profile when the selected joystick is pushed fully left or fully right. Set to a low value for a slower controlled wheelchair drive performance particularly when driving indoors.
Turning Speed @ Minimum	Sets the maximum turning speed of the chair with the joystick fully sideways and either Chair Speed set to minimum or the DCI speed pot at minimum.
Turning Acceleration*	Sets the maximum turning acceleration rate. Set to lower values for soft and gentle wheelchair drive performance.
Turning Deceleration*	Sets the maximum turning deceleration rate. Set to lower values for soft and gentle wheelchair drive performance. This value must always be greater than the programmed "Turning Acceleration".



***Note:**

The Speed Damping and Turn Damping parameters are ignored by the DX-GB.

In a standard DX system, Speed Damping and Turn Damping are applied to reduce the acceleration or deceleration when the powerchair almost reaches the desired speed. This provides a smooth transition between acceleration and end speed.

The DX-GB drive algorithm does not use Speed Damping and Turn Damping, it uses its own parameters. Refer to section 3.2.2: DX-GB Specific Parameters.

3.2.2 DX-GB Specific Parameters

Setting	Description
Joystick	
Joystick Speed Progression	How non-linear the speed response is to the joystick position, with 0 giving a linear response. This has no effect on the maximum speed. Used to allow fine low-speed control.
Joystick Direction Progression	How non-linear the turning response is to the joystick position, with 0 giving a linear response. This has no effect on the maximum turning rate. Used to allow fine low-speed control.
Max J/S Speed+Dir	<p>Similar to the Mk-II UCM's "Max Speed+Dir" profiled parameter. The lower of the two limits will be used, but this parameter is provided mainly for use with earlier UCMs, which do not have a "Max Speed+Dir" profiled parameter.</p> <p>A value of 100% is the most restrictive, giving a diamond-shaped response, while a value of 200% gives no restriction and allows a square-shaped response. Values in between give an octagonal response. Can be used to prevent the chair speeding up in turns.</p>
Drive Control Input	
Digital Input	Selects whether the Drive Control Input (DCI) operates as a Digital Input or an Analog Input. Select "Digital" unless a potentiometer or multiple resistor values are used.
Standard/Fail-safe	Drive Control Input (DCI) Standard/Fail-safe determines the sense of the DCI input. "Standard" allows driving with nothing connected to the DCI. "Fail-safe" inverts this so an open-circuit DCI inhibits driving and a short-circuit DCI allows driving normally.
Swivel Enable	Enables support for a chair swivel feature implemented using the Drive Control Input.
Ext. Speed Pot Min	External Speed Potentiometer Minimum Speed - sets the maximum speed when the external speed potentiometer is at its minimum position.
Enable DCI Speed Limit	Enables support for the Reduce Speed feature implemented using the Drive Control Input.
Reduced Speed	Maximum Speed if a "Slow" condition is present, either from the Drive Control Input or from another module.

Setting	Description
Drive Performance	
True-Track (Torque)	Sets the accuracy of the control loop response at higher speeds. Higher values give more precise control but may feel harsh and require more power from the battery.
Tremor Range	Dampens (or softens) the chair reaction to joystick commands. Higher values give smoother but less responsive drive performance.
Speed Filter	Provides additional speed damping of the chair reaction to small joystick movements. Change this value <u>only</u> if Tremor Range and the acceleration/deceleration settings do not provide sufficient speed damping and must not normally be changed from default. Higher values give smoother but less responsive drive speed performance.
Slam Braking	Slam Braking Deceleration Rate. When the joystick is moved in the opposite direction to the direction of travel, the controller will take this to be a signal to increase the deceleration rate. This parameter sets the higher deceleration rate.
Stall Time	Sets the length of the stall timeout.
Turn Ramp Accel	Turn Ramp Acceleration. Set to zero if an analog input is used, such as a conventional joystick. Set to non-zero to soften the response to step changes in input, such as from a switch input.
Turn Ramp Decel	Turn Ramp Deceleration. Set to zero if an analog input is used, such as a conventional joystick. Set to non-zero to soften the response to step changes in input, such as from a switch input.
Accelerated Speed Filter	<p>While damping of chair performance to joystick movements is required when driving the chair (see Tremor Range and Speed Filter), this may not be preferable when the user wants to stop the chair. When the joystick is released to neutral, the Accelerated Speed Filter setting will be used instead of the Speed Filter setting. This means Accelerated Speed Filter can be set to a more responsive value causing the chair to respond and therefore stop more quickly.</p> <p>Lower values give more responsive stopping performance and must be set lower than Speed Filter.</p>

Setting	Description
Battery	
Voltmeter Battery Gauge	Changes the battery level gauge display to use a voltmeter style display rather than the standard battery gauge which tries to determine the battery capacity.
Slow Batt Time Scale Driving	When using the voltmeter-style battery gauge, enabling this parameter will lessen the responsiveness of the gauge, damping down any voltage 'wavering'.
High Voltage Warning	Allows the high voltage warning to be disabled. This warning is normally indicated by a flashing battery gauge.
High Voltage Threshold	Toggles between 28V and 30V for the battery high voltage warning (if enabled).
Motor	
Invert Speed	Used to correct the driving direction when the left and right motor leads are transposed, such as when the controller is mounted with its "Left" (M1) side to the right side of the wheelchair. If this is set the wrong way, the chair will turn correctly but forward/reverse will be incorrect.

3.3 DX-GB parameter access list

3.3.1 Hand Held Programmer (HHP) parameter list

Parameter
Joystick Speed Progression
Joystick Direction Progression
True-Track (Torque)
Tremor Range

3.3.2 Wizard parameter access list

Key: ✓ Editable at this level Lite: Dealer level dongle
 👁 Viewable at this level Std: Enhanced dealer level dongle
 ☒ Not available at this level Adv: OEM level dongle


























Note:

1. Greyed-out parameters are ignored by the DX-GB.
2. Only parameters relating to the DX-GB are listed.








Parameter	Wizard		
	Lite	Std	Adv
Master Remote Parameters			
Drive profiles			
Forward Speed @ Maximum	✓	✓	✓
Forward Speed @ Minimum	✓	✓	✓
Forward Acceleration (Speed Damping N/A)	✓	✓	✓
Forward Deceleration (Speed Damping N/A)	✓	✓	✓
Reverse Speed @ Maximum	✓	✓	✓
Reverse Speed @ Minimum	✓	✓	✓
Reverse Acceleration (Speed Damping N/A)	✓	✓	✓
Reverse Deceleration (Speed Damping N/A)	✓	✓	✓

Parameter	Wizard		
	Lite	Std	Adv
Turning Speed @ Maximum	✓	✓	✓
Turning Speed @ Minimum	✓	✓	✓
Turning Acceleration (Turn Damping N/A)	✓	✓	✓
Turning Deceleration (Turn Damping N/A)	✓	✓	✓
Turn Damping	✓	✓	✓
Non-Linear Turn	👁	✓	✓
Short Throw Shape	✓	✓	✓
Short Throw Travel	✓	✓	✓
Grip	✓	✓	✓
Speed Damping	✓	✓	✓
Min to max decel ratio	✓	✓	✓
Speed x Turn for Grip	👁	👁	✓
Accel out of a Turn for Grip	👁	👁	✓
Accel into a Turn for Grip	👁	👁	✓
Turning @ Full Speed	👁	👁	✓
Turning Accel @ Full Speed	👁	👁	✓
Drive profile options			
Maximum profile number	✓	✓	✓
Change profile while driving	✓	✓	✓
Soft-Start Time	✓	✓	✓
Joystick Source	✓	✓	✓
Joystick Swap Forward/Reverse	✓	✓	✓
General User Options			
Chair Speed	✓	✓	✓
Soft-Start Acceleration	✓	✓	✓
Neutral maximum	✓	✓	✓
Drive Delay after Power-Up	✓	✓	✓

Parameter	Wizard		
	Lite	Std	Adv
System Settings			
CLAM slowdown		✓	✓
Neutral to PB delay			✓
Chair Speed Enable		✓	✓
Single Profile Mode		✓	✓
UCM Joystick Swap Left/Right		✓	✓
Rotate UCM Joystick		✓	✓
ACU joystick Swap Left/Right		✓	✓
RJM joystick Swap Left/Right		✓	✓
RJM has analog joystick		✓	✓
DX-GB Parameters			
Joystick			
Joystick Speed Progression	✓	✓	✓
Joystick Direction Progression	✓	✓	✓
Max J/S Speed+Dir	✓	✓	✓
Drive Control Input			
Digital Input			✓
Standard/Fail-safe			✓
Swivel Enable			✓
Ext. Speed Pot Min	✓	✓	✓
Enable DCI Speed Limit			✓
Reduced Speed			✓
Drive Performance			
Halve Turning Gain	☒	☒	☒
Input Demand Scaler			
True-Track (Torque)	✓	✓	✓

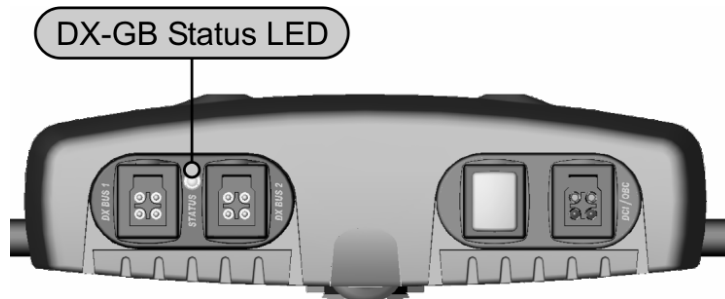
Parameter	Wizard		
	Lite	Std	Adv
TremorRange	✓	✓	✓
Speed Filter	✓	✓	✓
Slam Braking	✓	✓	✓
Accel Stop Y	👁	👁	👁
Accel Stop X	👁	👁	👁
Reduced Turn Speed	👁	👁	👁
Reduce Turn Start	☒	☒	👁
Reduce Turn Full	☒	☒	👁
Max SpeedTurn	☒	☒	👁
Speed Accel Scaler	☒	☒	👁
Turn Accel Scaler	☒	☒	👁
Emergency Decel Time	👁	👁	👁
Max PID	👁	👁	👁
PID Speed 1	👁	👁	👁
PID Speed 2	👁	👁	👁
Stall Time	👁	👁	✓
Stall Min Movement	☒	☒	👁
Stall Current	☒	☒	👁
Turn Ramp Accel	✓	✓	✓
Turn Ramp Decel	✓	✓	✓
Accelerated Speed Filter	✓	✓	✓
SlamStopTime	☒	☒	☒
Battery			
Battery Guess Maximum	👁	👁	👁
Battery Guess Minimum	👁	👁	👁
Battery Guess Recover	👁	👁	👁

Parameter	Wizard		
	Lite	Std	Adv
Voltmeter Battery Gauge			✓
Slow Batt Time Scale Driving			✓
Batt Gauge Ramp Up Rate			
Batt Gauge Ramp Down Rate			
Batt Gauge High Threshold			
Batt Gauge Falling Threshold			
High Voltage Warning			✓
High Voltage Threshold			✓
Motors			
Invert Speed			✓
Motor Direction Swap			
Boost Current Limit			
Motor Pole Pairs			
Motor Maximum RPM			
No-Boost Current Limit			
Min Battery Current Limit			
Regenerative Current Limit			
Max Ambient Temp			
I2T Max Battery			
I2T Cool Battery			
Boost Enable Ramp			
Boost Disable Ramp			

Parameter	Wizard		
	Lite	Std	Adv
Park Brake			
Park Brake Test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Park Brake Hold-off Time	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Drop-In Current	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Lowered Park Brake Current	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Park Brake Voltage	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Park Brakes Release Time	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Park Brakes Drop-in Time	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

4 Diagnostics

4.1 Introduction



A flashing DX-GB Status LED indicates that an abnormal condition is detected somewhere on the powerchair. The DX system provides fault information for the motors, the park brakes, the batteries, the cabling and the DX modules themselves.

The nature of the abnormal condition is indicated by a **flash code**. This is a sequence of flashes, separated by a pause, followed by a repetition of the sequence. The number of flashes relates to the condition. For instance, four flashes of the DX-GB Status LED, a pause, followed by four flashes, etc. indicates a Right Motor fault. Five flashes would indicate a Left Park Brake fault.

Depending on the severity of the condition, the powerchair may be prevented from driving. In some cases the chair may be allowed to drive, but at a reduced speed (limp mode).



Note:

The Flash Code displayed on the DX-GB may be different to that displayed by the DX System Status LED located on the DX Master Remote.

4.2 Diagnostics Tools

Hand Held Programmer

The Hand Held Programmer will display the fault code and a description of the fault when it is plugged into your Master Remote while an abnormal condition exists.

DYNAMIC Wizard

Wizard is the preferred diagnostics tool in the workshop environment, providing a full fault history and shows any current faults.

If, after analyzing the data, the condition cannot be diagnosed, it is possible to print, save or e-mail a Status Report to a Dynamic service centre for further analysis.

4.3 Flash Codes

Flash codes indicate the nature of an abnormal condition directly from the DX-GB Status LED. The table below describes diagnostic information for the DX-GB flash codes.

Flash Code	Description	Possible Solution(s)
1	DX-GB Module Fault	<ul style="list-style-type: none">• Turn the system Off and then On again.• Check DX BUS connections and cabling.
2	Accessory or Temperature Fault	<ul style="list-style-type: none">• Turn the system Off, wait a few minutes for the system to cool down, and then turn On again.• If the fault re-occurs, consult your Dynamic Service Centre.
3	Left Motor Fault	<ul style="list-style-type: none">• Check the left motor, connections and cabling.
4	Right Motor Fault	<ul style="list-style-type: none">• Check the right motor, connections and cabling.
5	Left Park Brake Fault	<ul style="list-style-type: none">• Check the left park brake, connections and cabling.
6	Right Park Brake Fault	<ul style="list-style-type: none">• Check the right park brake, connections and cabling.
7	Low Battery Fault	<ul style="list-style-type: none">• Check the battery connections, fuses, circuit breakers and cabling.• Replace the battery.
8	Over-voltage Fault	<ul style="list-style-type: none">• If this occurs during charging, the battery charger may be faulty.• Check the battery connections, fuses, circuit breakers and cabling.
9	CANL Fault	<ul style="list-style-type: none">• Check the DX BUS connections and cabling.
10	CANH or other Network Fault	<ul style="list-style-type: none">• Check the DX BUS connections and cabling.• Turn the Hazard Lights Off, turn the system Off, and then turn the system On again.

Flash Code	Description	Possible Solution(s)
11	Stall Timeout Fault	<ul style="list-style-type: none">• Turn the system Off, wait a few minutes for the system to cool down, and then turn On again.• Ensure wheels turn freely while under no load.• Have the motors checked by a service technician.
12	Module Mismatch	<ul style="list-style-type: none">• Re-program the system.• If the fault re-occurs, consult your Dynamic Service Centre.

4.4 User Advice and Error Codes

If there is an abnormal condition specific to the DX-GB, the HHP may display *User Advice* and/or *Error Codes* within the DX-GB menu. The standard DX-GB menu will be displayed if there is no *Error Code* or *User Advice* found.

The *Error Code* displayed is a two-digit number that relates to a specific error within the DX-GB Power Module, the motors, or associated wiring and connections. These are for service use.

The *User Advice* displayed consists of two lines of text describing the fault condition, and/or how to resolve this condition, for example 'Motor not calibrated' or 'Cycle power & retry'.

4.4.1 User Advice List

The different User Advice items are:

0	No advice, call dealer	1	Switch off and on, retry
2	GB controller failure	3	Check left motor/cabling
4	Check right motor/cabling	5	Current calibration jig fault
6	Current limit test failure	7	Control software failure
8	Left motor calibration, retry	9	Right motor calibration, retry
10	Low battery, recharge	11	Check joystick cabling
12	Current not calibrated	13	Motor not calibrated
14	Motor Terminal Fault	15	Excessive Regenerative Braking
16	Direct Input Error	17	System overheated, allow to cool
18	Voltage on Chair Frame. Check wiring		

4.4.2 Error Codes

The different Error Codes and their meaning are:

1	Good Errors Set	2	Current Left-A Offset Bad
3	Current Left-C Offset Bad	4	Current Right-A Offset Bad
5	Current Right-C Offset Bad	6	Jig Left Offset Bad
7	Jig Right Offset Bad	8	Bad Current Left-A
9	Bad Current Left-C	10	Bad Current Right-A
11	Bad Current Right-C	12	Overcurrent Left-A
13	Overcurrent Left-C	14	Overcurrent Right-A
15	Overcurrent Right-C	16	Jig Current Left Wrong Sign
17	Jig Current Right Wrong Sign	18	Jig Current Left Too Low
19	Jig Current Right Too Low	20	Jig Current Left Too High
21	Jig Current Right Too High	22	Test Current Low Left
23	Test Current Low Right	24	Test Current High Left
25	Test Current High Right	26	Overcurrent Left
27	Overcurrent Right	28	Lag Exceeded Left
29	Lag Exceeded Right	30	PWM Exceeded Left
31	PWM Exceeded Right	32	PComp Exceeded Left

33 PComp Exceeded Right	34 Serial Timeout
35 Wrong Id Range	36 Unknown Command
37 Bad Checksum	38 Undervoltage-15
39 Overvoltage-15	40 Undervoltage
41 Overvoltage	42 Brake Short Left
43 Brake Short Right	44 Timer-A Bad
45 Timer-B Bad	46 AD Not Starting
47 AD Not Ready	48 AD Wrong Timing
49 Hall Left-0 Error	50 Hall Left-1 Error
51 Hall Right-0 Error	52 Hall Right-1 Error
53 No Current Calibration	54 No Motor Calibration
55 Not Calibrated	56 Watchdog Bad
57 Watchdog trigger	58 Wrong Direction
59 Illegal Flash Access	60 Idle Motor Voltage Low
61 Idle Motor Voltage High	62 Power Stage Defect
63 Not applicable for DX-GB	64 Not applicable for DX-GB
65 Not applicable for DX-GB	66 Not applicable for DX-GB
67 Not applicable for DX-GB	68 Not applicable for DX-GB
69 Not applicable for DX-GB	70 Left Motor Plug & Play Error
71 Right Motor Plug & Play Error	72 Left Motor EEPROM Error
73 Right Motor EEPROM Error	74 Battery I2T Overheated
75 Left Motor I2T Overheated	76 Right Motor I2T Overheated
77 Controller Overheated	78 Voltage on Chair Frame

5 Specifications

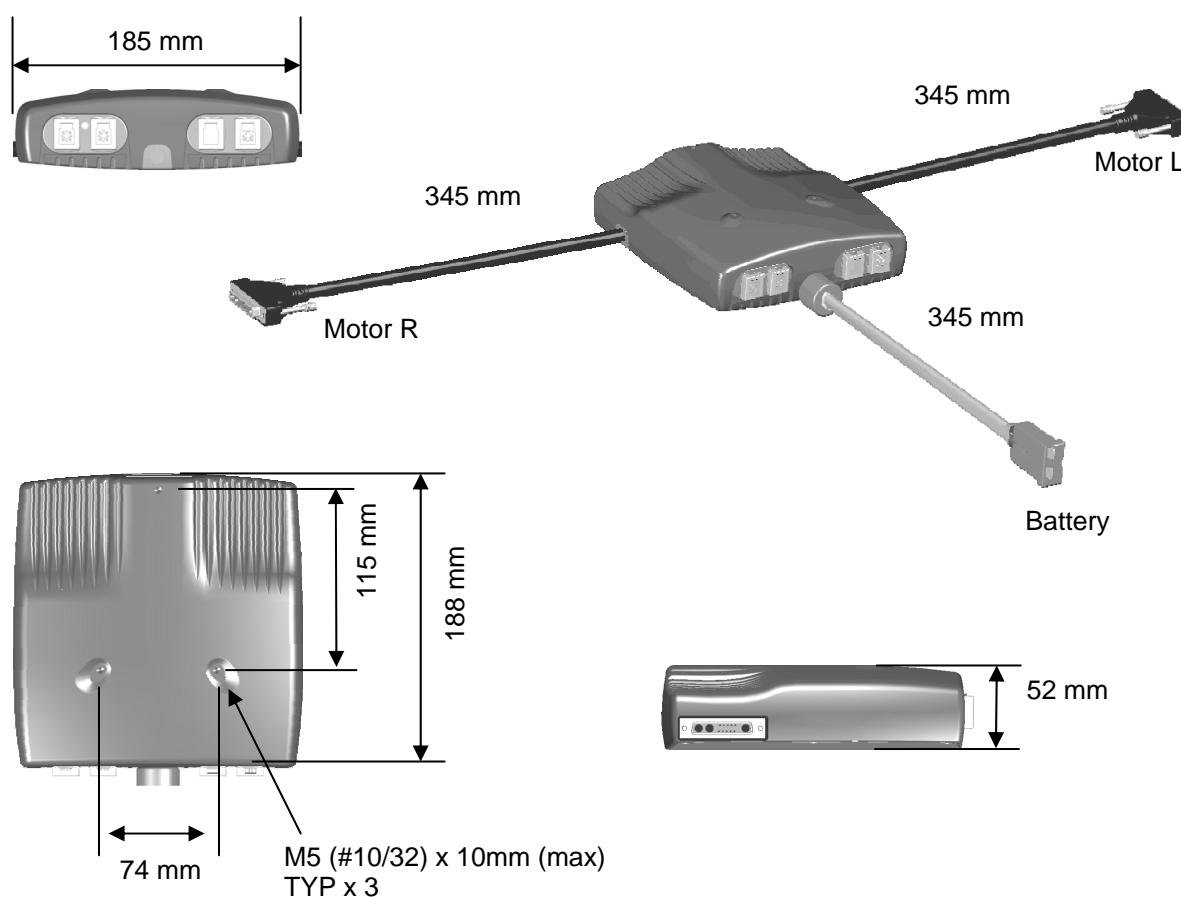
5.1 Specifications of the DX-GB controller

5.1.1 Electrical specifications

Parameter	Description				
Compatible Battery Supply	24V supply (2 x 12V in series), circuit breaker protected, lead acid or gel cell type of recommended minimum capacity 30 Amp hours.				
Compatible Motor	24V AC Gearless Brushless.				
Compatible Park Brake	2 x 24V fail-safe electromagnetic park brakes connected in parallel				
		Min	Nominal	Max	Units
Operating Voltage (V_{batt})		18	24	32	V
Current Rating					
• Peak				100	A
Quiescent Current (at 24 Volts)		12	17	22	mA
Drive Control Input					
• Output Current		9.6	12	14.4	mA
• Working Input Resistance		0		560	Ω
• Open Circuit Output Voltage			10.6	11.6	V
DX BUS Rating					
• CANH, CANL Voltage Range		-0.5		32	V
• Max Output Current (DXB+)		12		18	A (RMS)
Controller Battery Charger Max Current (limited by DX BUS rating)		12		18	A (RMS)

5.1.2 Physical Specifications

Parameter				
Material	Die cast Aluminium			
Finish	Powder coated "Rolling Thunder" (Charcoal/Silver)			
Protection Rating	IPx4			
Product weight	2.160 kg			
Shipping Weight	2.560 kg			
	Min	Nominal	Max	Units
Operating Temperature Range	-25		60	°C
Storage Temperature Range	-40		65	°C
Operating Humidity Range	0		90	%RH




5.2 Specifications of the Euro GB Motor

5.2.1 Electrical and mechanical specifications



Note:

These specifications are for a typical single motor driven by a Dynamic DX-GB controller powered from a 24V power supply.

Motor type	Permanent magnet brushless DC with integral brake	
Rated Voltage	24V DC	
No-load speed @ 100% Input Demand	190 +/- 5rpm	
No-load Current incl. brake	1.7A @ 190rpm	
No-load current – 2 motors + controller	3.5A @ 190rpm	
Rated maximum speed	165rpm @ 11Nm load	
Power Output Maximum	530W @ 108rpm	
Rated Maximum Continuous Torque	22.6Nm @ 150rpm	
Rated Maximum Continuous Current	20A	
Maximum Current	100A	
Torque Constant	1.15Nm/A	
Maximum Winding Temperature	120°C @ 40A	
Brake Static Holding Torque	61Nm	
Maximum Brake Drag Torque	2.3Nm	
Brake Lever Activation Force @ stub	375N	
Noise at Full Speed No Load @ 300mm	58 dBA	
Weight	14.5Kg	
Recommended Wheel/Tire Size	3" X 8"	
Maximum axial force per motor		750 N
Maximum radial force per motor		115 kg
Max recommended total chair design weight		330 kg, including user

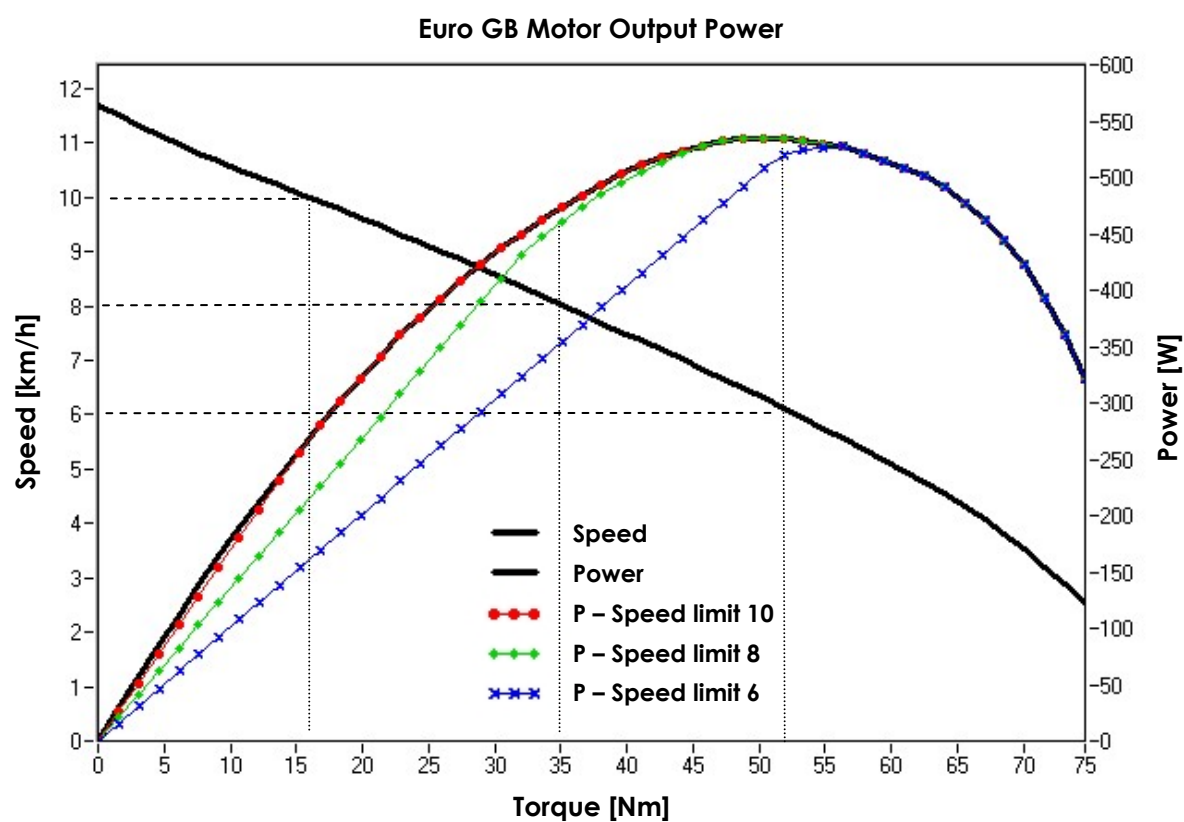
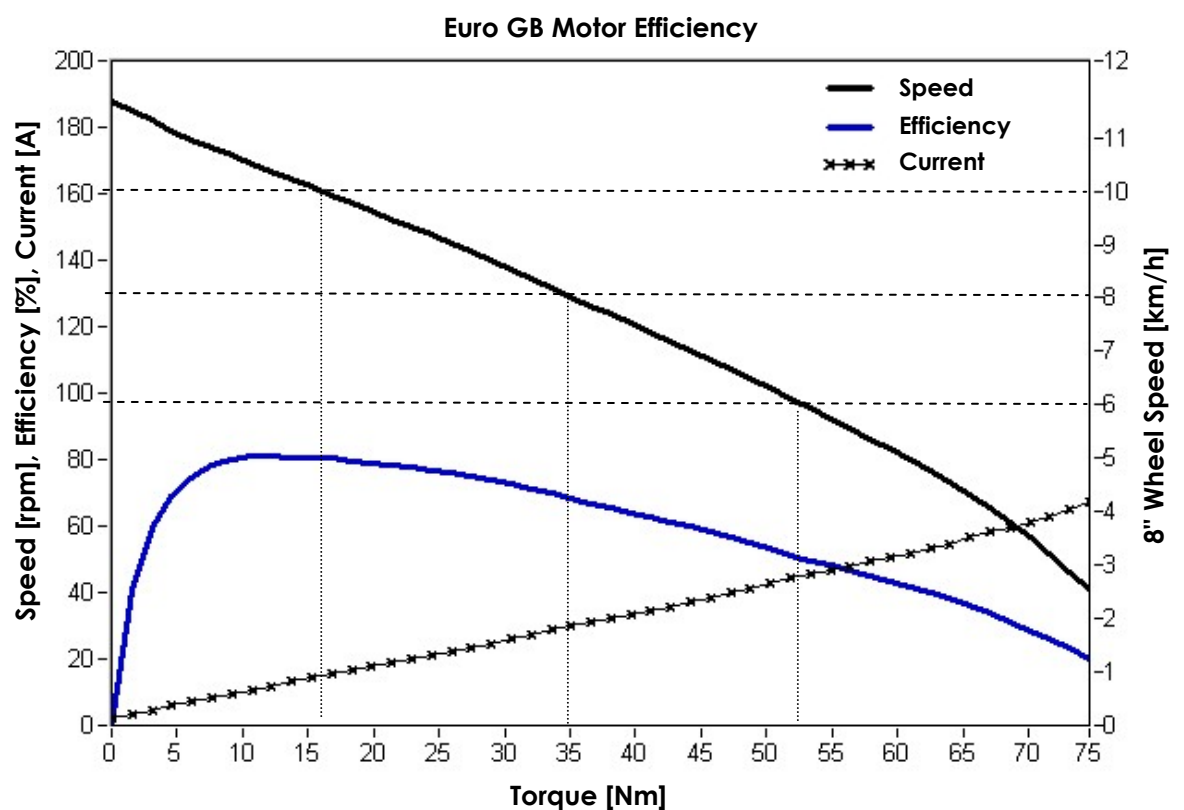


Warning:

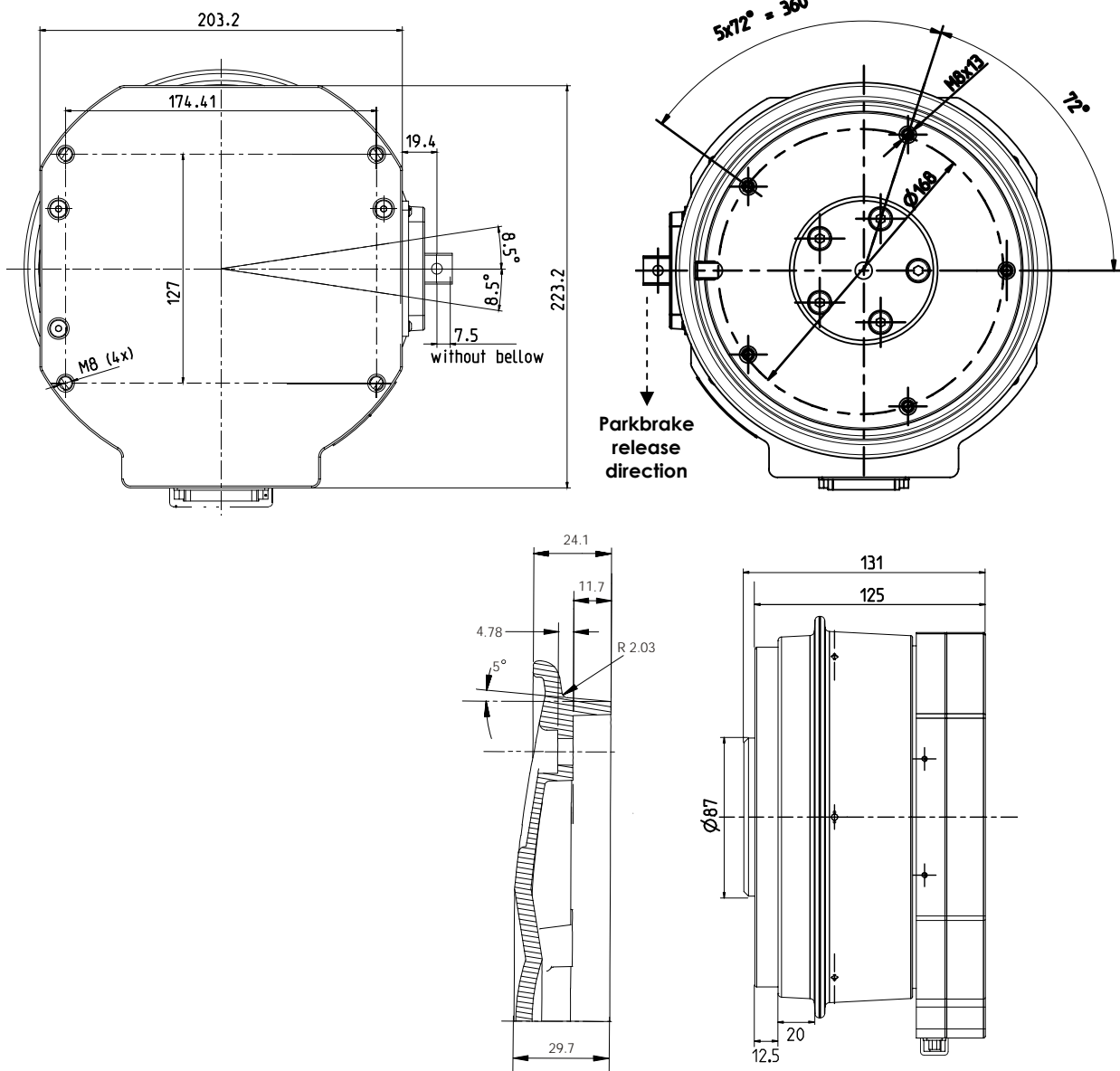
The maximum speed and weight specifications are guidelines only, based on optimum circumstances. The actual achievable maximum design weight is dependent on many factors like the terrain and the slopes the chair will be used on, the suspension type, the chair weight balance and the programmed maximum speed.

Testing is required for verifying suitability with individual chair designs.

5.2.2 Performance charts



Given speed is based on a standard 8" tyre with a nominal outer diameter of 330 mm.



6 Appendices

6.1 Programming Accessories

Dynamic DX Programming Accessories

Part Description	DC Part #	Qty/Unit
Wizard Kit – Programming Kit Contains software, cables and adapter (no dongle)	DWIZ-KIT	1
Wizard – Software Only (CD)	DWIZ-SW	1
Wizard Dongles – Parallel port		
OEM/Advanced version	DWD-OEM	1
Enhanced dealer/Standard version	DWD-EDL	1
Dealer/Lite version	DWD-DLR	1
Wizard Dongles – USB port		
OEM/Advanced version	DWD-OEM-U	1
Enhanced dealer/Standard version	DWD-EDL-U	1
Dealer/Lite version	DWD-DLR-U	1
DX Hand Held Programmer	DX-HHP	1



6.2 *Intended Use and Regulatory Statement*

Intended Use

The DX-GB is a component of the DX System intended to provide speed and direction control of dual, compatible 24V brushless motors and release of normally-activated park brakes located on a powerchair.

The DX-GB receives input commands from a DX Master Remote.

The wheelchair manufacturers are provided with all the integration, set-up, operating environment, test and maintenance information needed in order to ensure reliable and safe use of the controller.

Device Classification

Europe

The DX-GB Controller is a component of a Class I medical device as detailed in the Council Directive 93/42/EEC concerning Medical Devices.

USA

The DX-GB Controller is a component of a Class II medical device (Powered Wheelchair) as detailed in 21 CFR § 890.3860.

Compliance and Conformance with Standards

In accordance with the device classification, the DX-GB wheelchair controller is designed to comply with the requirements of the European Medical Device Directive 93/42/EEC and US 21 CFR § 820.30.

The DX-GB Controller has been designed such that the combination of the wheelchair and the DX-GB Controller, along with accessories as applicable, complies with the requirements of the MDD Harmonised standards EN12184 and EN12182 and the FDA Consensus standard ISO 7176 for performance.

However, final compliance of the complete wheelchair system with international and national standards is the responsibility of the wheelchair manufacturer or installer.

6.3 Maintenance

1. All vehicle components must be regularly checked for loose, damaged or corroded connectors, terminals, or cabling. All cables must be restrained to protect them from damage. Damaged components must be replaced.
2. All switchable functions on the Dynamic electronics system must be regularly tested to ensure they function correctly.
3. All Dynamic electronic components must be kept free of dust, dirt and liquids. If necessary, wipe with a cloth dampened with warm water. Do not use solvents or abrasive cleaners.
4. There are no user-serviceable parts in any Dynamic electronic component. Do not attempt to open any case, or undertake any repairs, or warranty will be voided.
5. Where any doubts exist, consult your nearest service centre or agent.



Warning:

If any component is damaged in any way, or if internal damage may have occurred (for example by being dropped), have it checked by qualified personnel before operating.

6.4 *Warranty*

All equipment supplied by Dynamic Controls is warranted by the company to be free from faulty materials or workmanship. If any defect is found within the warranty period, the company will repair the equipment, or at its discretion, replace the equipment without charge for materials and labor.

This Warranty is subject to the provisions that the equipment:

- has been thoroughly checked upon completion of installation, and all programmable options correctly adjusted for safe operation prior to use.
- has been correctly installed.
- has been used solely in accordance with this manual.
- has been properly connected to a suitable power supply in accordance with this manual.
- has not been subjected to misuse or accident, or been modified or repaired by any person other than personnel authorized by Dynamic Controls.
- has been used solely for the driving of electrically powered wheelchairs in accordance with the wheelchair manufacturer's recommendations.

6.5 Safety and Misuse Warnings

The following warnings must be passed on to the end-user before use of the product.

- Do not install, maintain or operate this equipment without reading, understanding and following the proper instructions and manuals, otherwise injury or damage can result.
- No user-serviceable parts inside.
- A warning must be conveyed to the operator that he or she has the responsibility to ensure that the vehicle is kept in a good safe operating condition, and to ensure that components, such as cables, are protected from damage by securing them in optimum positions.
- A warning must be conveyed to the operator that the controller could cause the vehicle to come to a sudden stop. In situations where this might affect the safety of the operator, the fitting and wearing of a seat belt is required.
- Performance adjustments should only be made by professionals in the health care field or by persons fully conversant with the adjustment process and the operator's capabilities. Incorrect settings, or programming in an unsafe location, could cause injury to the operator or bystanders, or damage to the vehicle or surrounding property.
- Performance adjustments should only be made indoors, or outdoors in dry conditions.
- The user should turn the system off before getting in and out of the vehicle.
- Do not operate the vehicle if it behaves erratically, or shows abnormal response, heating, smoke or arcing. Turn the system off at once and consult your service agent.
- If the vehicle drives without demand, press the Power button.
- Ensure that the battery charger used with DX is pin-compatible for drive inhibit. Consult your dealer or vehicle manufacturer.
- If the vehicle speed surges when going down hill, the common reason is the operation of an over-voltage protective device. When running down hill, the braking energy from the motor is sent to the battery, which charges it. However, if the battery is fully charged, it cannot accept the generated energy without dramatically increasing its voltage. If this over-voltage condition were allowed to continue, there would be a risk of damage to the battery or an explosion. To prevent these risks, the controller forces the vehicle to slow down until the battery voltage drops to a safe level, after which it allows the vehicle to speed up again. To prevent speed surging with charged batteries, we advise operators to descend hills slowly.
- No connector pins should be touched, because contamination or damage due to electrostatic discharge might result.
- The controller should not be stored or operated outside of the minimum or maximum temperature ranges specified in this manual.
- Most electronic equipment is influenced by radio frequency interference (RFI). Caution should be exercised with regard to the use of portable communications equipment in the area around such equipment. While Dynamic Controls has made every effort to ensure that RFI does not affect the product performance or safety, very strong signals could still cause a problem. It is the responsibility of the vehicle manufacturer to ensure that the vehicle is tested in accordance with local EMC regulations.
- If RFI causes erratic behavior, turn the vehicle off immediately. Turn the vehicle off before using cell phones or portable communications devices.
- In the event of the system status LED/indicator flashing while driving, the operator must ensure that the system is behaving normally. If not, the system must be turned off and a service agent contacted.
- Report any malfunctions immediately to your service agent.

Service and Configuration Warnings

The following warnings are applicable to the installation technician only.

- Ensure that the battery capacity and the battery charger rating are sufficient to not restrict the high performance needs of the system. Peak performance capability is important to ensure safe control of the wheelchair.
- After the vehicle has been configured, check to make sure the vehicle performs to the specifications entered in the programming procedure. If the vehicle does not perform to specifications, reprogram it. Repeat this procedure until the vehicle performs to specifications. If the intended operation cannot be achieved, contact your service agent.
- The completed installation must be thoroughly checked, and all programmable options correctly adjusted, for safe operation prior to use.

6.6 Electromagnetic Compatibility (EMC)

Dynamic Electronic Controllers have been tested on typical vehicles to confirm compliance with the following appropriate EMC standards:

USA: ANSI/RESNA WC/Vol:2 - 1998 Sec 21

Europe: EN12184:1999 Sec 9.8.1-3

National and international directives require confirmation of compliance on particular vehicles. Since EMC is dependant on a particular installation, each variation must be tested. The guidelines in this section are written to assist with meeting EMC requirements.

Minimizing Emissions

Motors:

- Ensure the leads are kept as short as possible.

Wiring:

- Keep wire lengths as short as practical for a tidy layout.
- Minimize any wire loops, particularly loops of single wires as opposed to wire pairs.
- Endeavour to run wires in pairs or bunches.
- Where practical, secure the cables to the wheelchair frame.

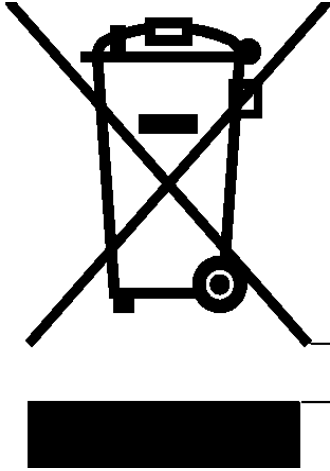
Immunity to Radiated Fields

- Follow the wiring recommendations for minimizing emissions.

Immunity to ESD

- Follow the wiring recommendations for minimizing emissions.
- Ensure all vehicle sub-frames are electrically connected.
- Do not leave connections unnecessarily exposed.

6.7 Environmental Statement



This product has been supplied from an environmentally aware manufacturer.

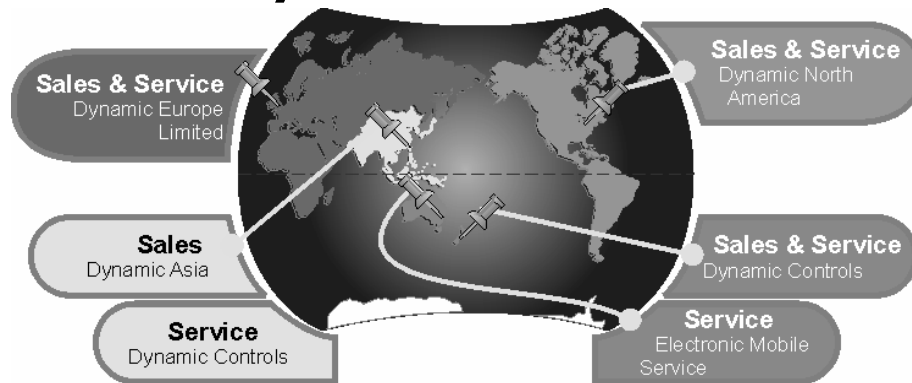
Please be environmentally responsible and recycle this product at the end of its life through your local recycling facility.

This product may contain substances that can be harmful to the environment if disposed of into a landfill.

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