



# **DX Gearless Brushless (DX-GB-AS) Installation Manual**

by



*GBK64947 Issue 1, September 2003*

# About this Manual

*This manual has been designed to help you install and configure a Dynamic DX Gearless Brushless (DX-GB-AS) powerchair control system. There are no guidelines for specific applications, and should be read in conjunction with the Installation Manuals for all other DX Modules present in the system.*

*If there is a specific requirement for your application, please contact Dynamic Controls or one of the sales and service agents, as we can assist you to configure the DX-GB-AS for this application.*

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



## **Notes:**

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



## **Programming notes:**

*This icon denotes the paragraph refers to the programming of the DX-GB-AS.*

*The DX-GB-AS is not user serviceable. Specialized tools are necessary for the repair of any DX-GB-AS 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.*

*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.*

*Dynamic and the Dynamic logo are trademarks of Dynamic Controls.*

*All other brand and product names, fonts, and company names and logos are trademarks or registered trademarks of their respective companies.*

*Dynamic owns and will retain all trademark rights and Dynamic or its licensors own and will retain all copyright, trade secret and other proprietary rights, in and to the documentation.*

*All materials contained within this manual, in hard-copy or electronic format, are protected by copyright laws and other intellectual property laws.*

*© Copyright 2003 Dynamic Controls. All rights reserved.*

# Contents

<b>1</b>	<b>Introducing the DX-GB-AS .....</b>	<b>1</b>
<b>2</b>	<b>Installation and Testing .....</b>	<b>3</b>
2.1	DX-GB-AS Mounting .....	3
2.2	Connections and Wiring .....	4
2.2.1	Cable and Connector Pinouts .....	5
2.2.2	Battery Connections .....	6
2.2.3	Motor and Park Brake Connections .....	7
2.2.4	DXBUS Connections .....	8
2.3	Drive Control Input (DCI) and OBC Connections .....	8
2.3.1	DCI – Analog Mode .....	9
2.3.2	DCI – Digital Mode.....	10
2.3.3	DCI Examples.....	10
2.4	Motor Calibration .....	12
2.5	Testing the Installation.....	12
<b>3</b>	<b>Programming the DX-GB-AS.....</b>	<b>15</b>
3.1	Introduction.....	15
3.2	Description of Parameters .....	16
3.2.1	Modified UCM Parameters .....	16
3.2.2	Unused UCM Parameters.....	18
3.2.3	DX-GB-AS Parameters.....	18
<b>4</b>	<b>Diagnostics.....</b>	<b>21</b>
4.1	Introduction.....	21
4.2	Diagnostics Tools .....	21
4.3	Flash Codes .....	22
4.4	User Advice and Error Codes.....	23
4.4.1	User Advice List.....	24
4.4.2	Error Codes .....	24
<b>5</b>	<b>Specifications.....</b>	<b>27</b>
5.1	Electrical Specifications.....	27
5.2	Physical Specifications.....	28
<b>6</b>	<b>Appendices.....</b>	<b>29</b>
6.1	Programmable Parameters List.....	29
6.2	Intended Use and Regulatory Statement.....	32
6.3	Maintenance .....	32
6.4	Warranty.....	33
6.5	Safety and Misuse Warnings.....	33
6.6	Electromagnetic Compatibility (EMC) .....	35
6.7	Contact Details .....	36

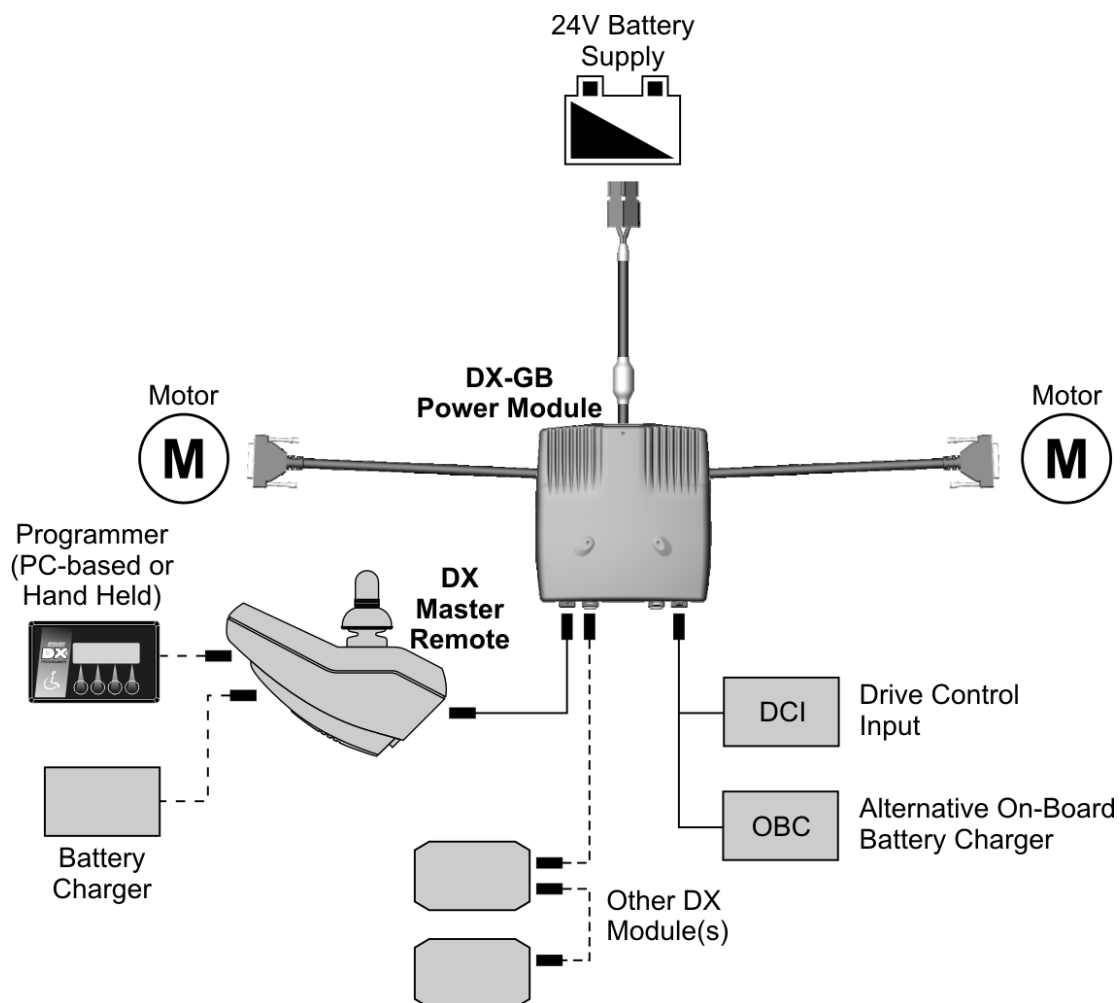


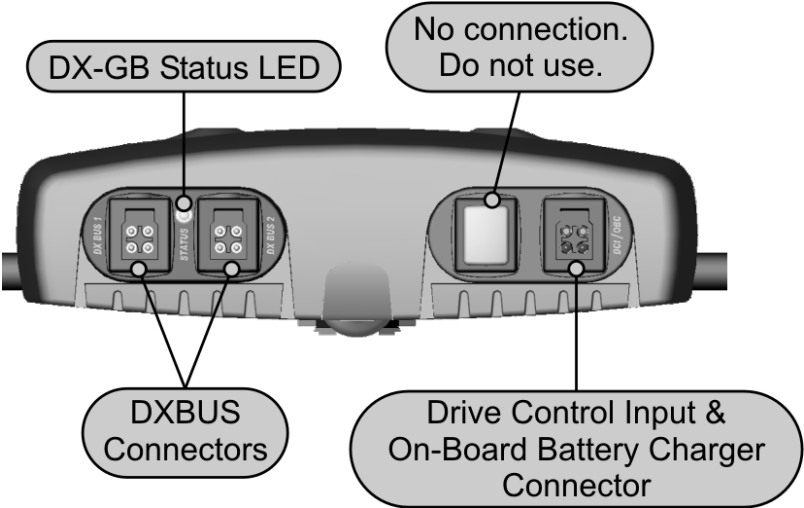
# 1 Introducing the DX-GB-AS

The Dynamic DX Gearless Brushless Power Module (DX-GB-AS) is a DXBUS 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-AS and DX Master Remote give an exceptionally smooth, powerful, and safe drive system.

The DX-GB-AS has been designed specifically for use with Gearless Brushless motors, an alternative to conventional brushed motors commonly in use today. Supplying 100-Amps per phase, the DX-GB-AS is perfect for the control of a wide range of powerchair configurations, including front, mid, and rear wheel drive. **A DX-GB-AS system is only compatible with DX Systems containing the DX-Rem24 master remote (version SC or later).**

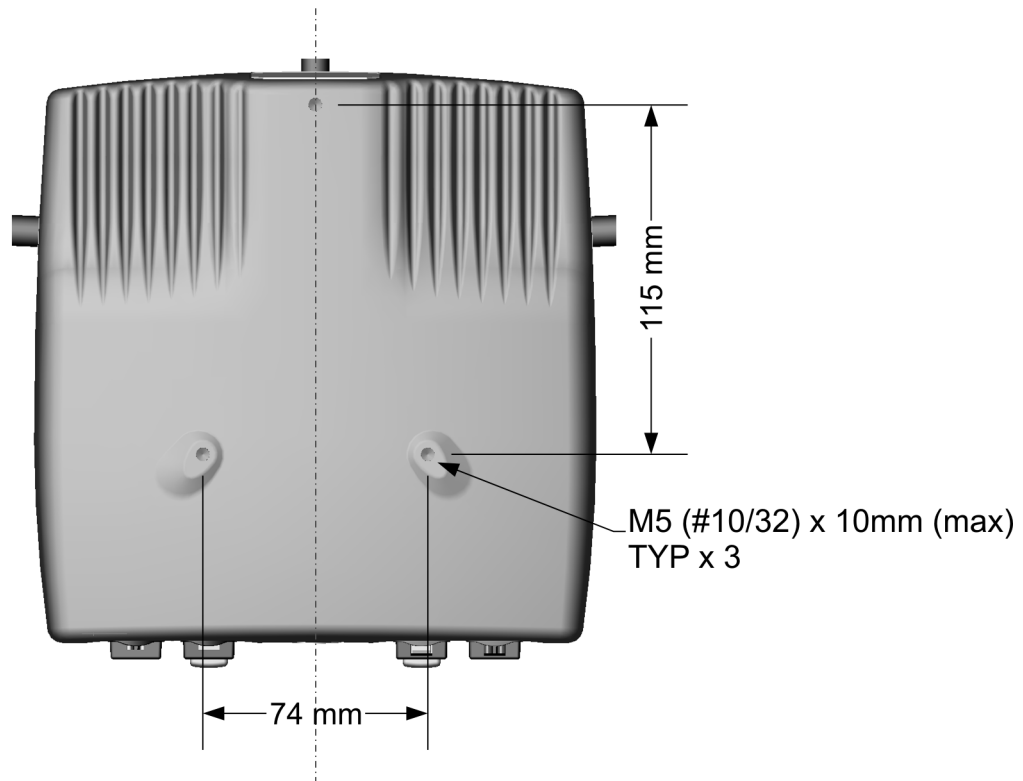
The DX-GB-AS is fully programmable to cater for the wide range of powerchair types and user needs. Correct installation and programming are essential to ensure optimum performance and safety.



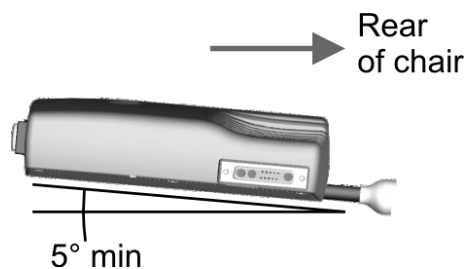


## 2 Installation and Testing

### 2.1 DX-GB-AS Mounting



- The DX-GB-AS should be mounted with the lid-down and at a minimum decline of (5°) from horizontal.
- The battery cable should extend towards the rear of the chair.



- The position and orientation should give maximum mechanical protection to the DX-GB-AS.
- Mount the DX-GB-AS out of the path of water splashes from wheels or cowling.
- Protect the front (connector panel) of the DX-GB-AS from direct splashing.

- Failure to adhere to the mounting orientations specified might lead to water ingress, which could result in system malfunctions and long-term damage to the unit.
- For peak performance, locate the DX-GB-AS so that air can flow over and around the case.
- A position close to the batteries and motor is recommended to reduce the length of high-current wires.
- Use all three mounting points to attach the DX-GB-AS.
- The use of M5 (#10/32) socket cap screws that engage up to 10mm into the case is recommended.



*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-AS in a position where the user can come into contact with the unit. The case temperature can exceed 41°C.*

---

## 2.2 Connections and Wiring

The DX-GB-AS has two connector plates located along the front panel of the case that contain DXBUS (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 the motor and controller cannot be overloaded in normal use and intended operating environment, to ensure adequate braking torque is available at all times.*

*Ensure that all wiring is suitably restrained to prevent snagging.*

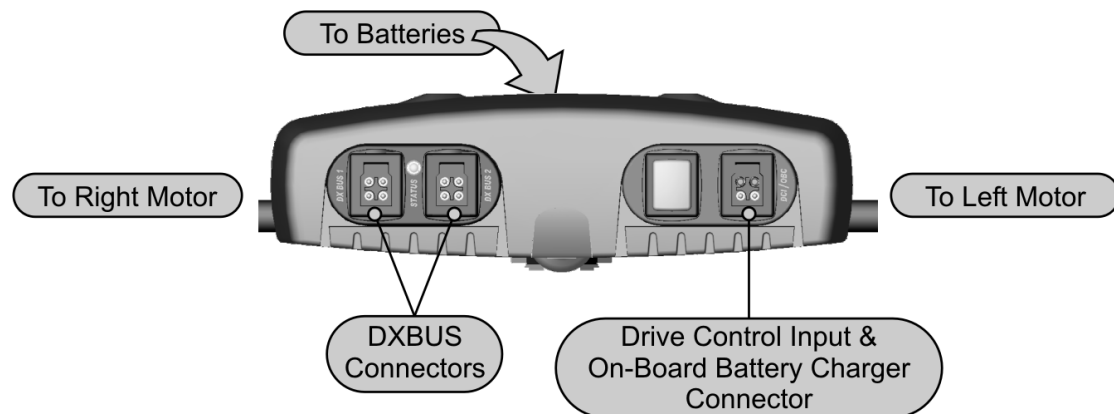
*Connector housings must be fitted to prevent incorrect connections.*

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

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

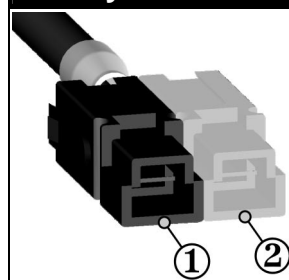


## 2.2.1 Cable and Connector Pinouts



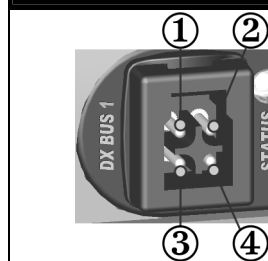
All connectors viewed from front. Pin numbers are for reference only. Actual pin numbers on mating connector housings may differ from those given below.

### Battery Cable Connector Pinout



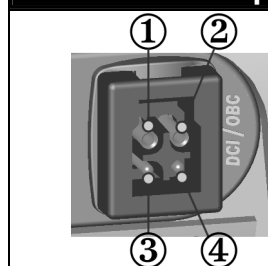
Pin	Function
1	Battery Negative (Black)
2	Battery Positive (Red)

### DXBUS Connector Pinout (x2)



Pin	Function
1	Communications – CANL (male)
2	Communications – CANH (male)
3	Battery Positive (male)
4	Battery Negative (male)

### Drive Control Input (DCI) and OBC Connector Pinout



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-AS Battery Cable is terminated with an Anderson PowerPole 75 connector and has two terminals - battery positive (red) and battery negative (black). Simply plug the connector of the mating battery cable into the Anderson connector.

A thermal circuit breaker must be installed between the batteries and the Power Module - as close as possible to the batteries - to protect both the batteries and the system wiring. 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.



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

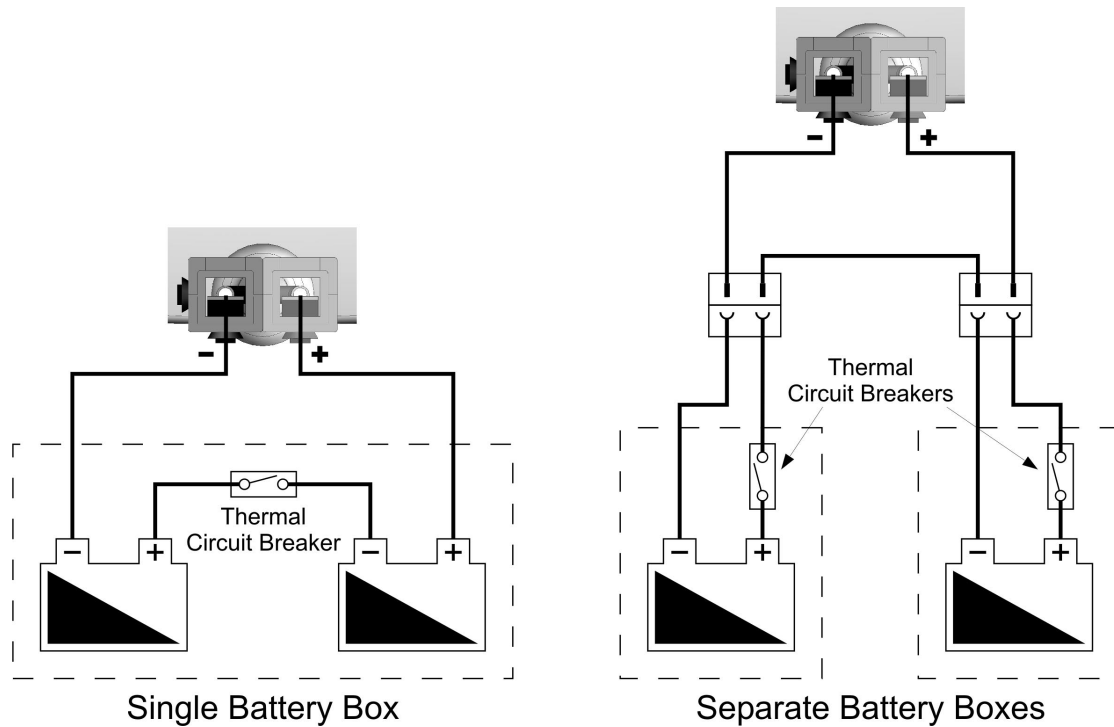
*The DX-GB-AS has been designed to perform optimally with either Lead-Acid or Gel Cell 24 V deep cycle batteries, rated between 30 - 120 Amp hours.*

*Ensure battery and battery charger ratings are sufficient so as to not restrict the high performance needs of the system. Peak performance capability is important to ensure safe control of the wheelchair.*



*An 80-Amp slow-acting, thermal type circuit breaker is suggested.*

*The thermal circuit breaker should have a trip rating no higher than the current limit of the Power Module. Check thoroughly to ensure that it provides the necessary degree of motor protection.*



### 2.2.3 Motor and Park Brake Connections

The DX-GB-AS has two motor cables (left and right) terminated with Cosland 13W3 D-Sub Mixed Signal/Power connectors that plug directly into the motors.



*It is preferable for both connecting motor cables to be of equal length and must be fixed so that there is no possibility that the motor plugs can be accidentally interchanged.*

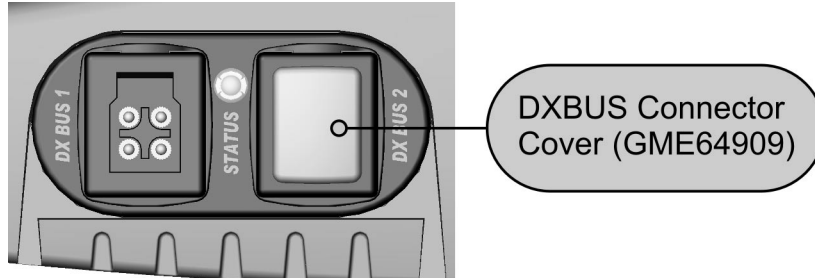
*Where references are made to M1 and M2, these will always refer to the marked left and right motor leads respectively, even if the leads are connected to the opposite motor.*



*If necessary, the motor connections can be swapped when programming.*

## 2.2.4 DXBUS Connections

The DX-GB-AS communicates to the DX Master Remote (and every other DX module) through the DXBUS connectors. The DXBUS also supplies power to every other DX Module.



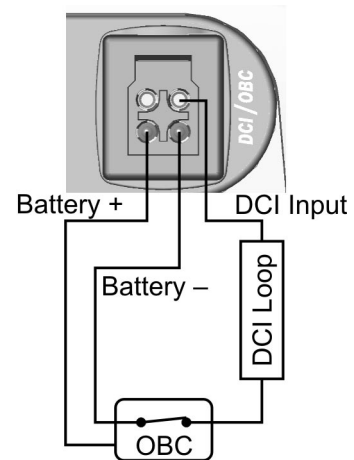
*If only one DXBUS connector is used on the DX-GB-AS and the remaining connector is accessible to the wheelchair user, a blanking plate should be fitted to the unused connector. DCL Part/Order Number GME64909 DX-GB Connector Cover Plate can be used.*

## 2.3 Drive Control Input (DCI) and OBC Connections

The DX-GB-AS 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-AS will inhibit or limit the chair speed.



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



*An On-board Battery Charger (OBC) should be used that has 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 the documentation that came with your OBC for product specifications.*

*If only one connector on the DCI/OBC connector plate is used and the remaining connector is accessible to the wheelchair user, a blanking plate should be fitted to the unused connector. DCL Part/Order Number GME64909 DX-GB Connector Cover Plate can be used.*



*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%)				
<b>Resistance (Ω)</b>	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%)				
<b>Resistance (Ω)</b>	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

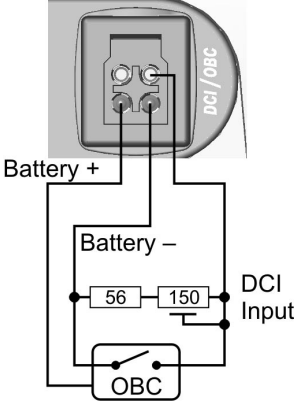
A powerchair has a seat raise function and an On-board Battery Charger (OBC).

The DX-GB-AS will automatically limit the speed to 60% when the seat is raised (S1), and inhibit drive when the OBC is plugged in.

When plugged in, an internal switch in the OBC will activate causing an open circuit (>560 ohms).

<b>Digital Input</b>	Yes	<b>Standard/Fail-safe</b>	Safe
<b>Swivel Enable</b>	Off	<b>Ext. Speed Pot Min</b>	25%
<b>Enable DCI Speed Limit</b>	Yes	<b>Reduced Speed</b>	60%

**Example 2**



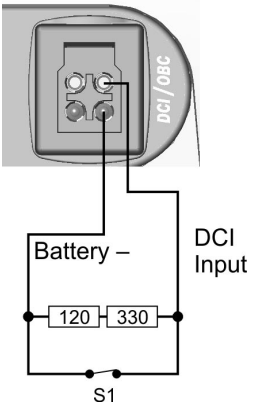
A powerchair has a seat raise function and an On-board Battery Charger (OBC).

The DX-GB-AS will automatically limit the speed by an amount proportional to the seat height, and inhibit drive when the OBC is plugged in.

When plugged in, an internal switch in the OBC will activate causing a closed circuit (<10 ohms).

<b>Digital Input</b>	No	<b>Standard/Fail-safe</b>	Std
<b>Swivel Enable</b>	Off	<b>Ext. Speed Pot Min</b>	25%
<b>Enable DCI Speed Limit</b>	Yes	<b>Reduced Speed</b>	0%

**Example 3**



A powerchair has a swivel function.

The DX-GB-AS will automatically reconfigure itself for FWD when the seat is swivelled 180° and automatically limits the speed to 80% (S1).

<b>Digital Input</b>	Yes	<b>Standard/Fail-safe</b>	Safe
<b>Swivel Enable</b>	On	<b>Ext. Speed Pot Min</b>	25
<b>Enable DCI Speed Limit</b>	Yes	<b>Reduced Speed</b>	80%



*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-AS Power Module or either motor is replaced or swapped, the motors must be re-calibrated to match the DX-GB-AS. 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.



*Before Motor Calibration, raise the powerchair 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 should be undertaken to ensure that the powerchair operates safely. This procedure should 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 wheels off the ground using blocks under the powerchair frame so that the wheels can turn freely.



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



*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-AS. 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-AS Status LED is on steady. If this is still flashing, the motors may require calibration or the DX-GB-AS 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. Repeat for all Drive Programs.
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.
17. Drive the wheelchair on a 1 : 6 ramp and check for normal power, smoothness and parking.



*Some of the more lively Drive Programs may not be suitable for testing indoors.*



## 3 Programming the DX-GB-AS



*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.*

*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.*

### 3.1 Introduction

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



*If the DX-GB-AS is replaced, the motors will require re-calibration for the new unit.*

Either the PC-based Wizard (v3.5 or above), or the hand held programmer (DX-HHP) could be used to program a DX system. The Wizard is the tool of preference in a factory setting where the programming is typically done in production volumes, whereas the DX-HHP is best suited to the quick and easy adjustment of a small number of parameters.



*If a powerchair is programmed with settings other than default, under some very rare fault conditions default settings could be automatically restored, thereby changing driving characteristics. This could lead to a chair moving in a direction or speed that is not intended. Programmers should consider this risk when programming settings other than default.*

## 3.2 *Description of Parameters*

The following parameters are those that affect the set-up and configuration of the DX-GB-AS and are typically set up for a powerchair type, rather than any particular powerchair user. The parameter name displayed on the hand held programmer may be different to that displayed by the Wizard.

The programming of the DX-GB-AS differs from typical DX systems in that some of the UCM parameters, which normally affect only the Master Remote, have a direct effect on the DX-GB-AS. Only those that differ from normal have been described below. Also, some UCM parameters will have no effect on the DX system whatsoever.

Refer to the Appendices for a full list of parameter names, values and access restrictions.

### 3.2.1 **Modified UCM Parameters**

The following UCM parameters are interpreted differently in a DX-GB-AS from typical DX Systems.

Setting	Description
<b>Drive Profiles</b>	
<b>Forward Speed @ Maximum</b>	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.
<b>Forward Speed @ Minimum</b>	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.
<b>Forward Acceleration</b>	Programs the forward acceleration rate. Set to a lower value for soft and gentle wheelchair drive performance. Set to a higher value for a more responsive "sports" wheelchair performance. When a certain speed is achieved, acceleration is reduced according to the "damping point" setting.
<b>Forward Deceleration</b>	Programs the forward deceleration rate. Set to lower values for soft and gentle wheelchair drive performance and higher values for more responsive "sports" wheelchair drive performance. This value should always be greater than "Forward Acceleration". When the chair has decelerated to a certain speed, deceleration is reduced according to the "Damping Point" setting.

Setting	Description
<b>Reverse Speed @ Maximum</b>	Sets the maximum reverse speed for the selected profile when the selected joystick is pushed fully backwards. High settings are not recommended.
<b>Reverse Speed @ Minimum</b>	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.
<b>Reverse Acceleration</b>	Programs the reverse acceleration rate. Set to lower values for soft and gentle wheelchair drive performance and higher values for more responsive "sports" wheelchair drive performance. When a certain speed is achieved, acceleration is reduced according to the "damping point" setting.
<b>Reverse Deceleration</b>	Programs the reverse deceleration rate. Set to lower values for soft and gentle wheelchair drive performance and higher values for more responsive "sports" wheelchair drive performance. This value should always be greater than the programmed "Reverse Acceleration". When the chair has decelerated to a certain speed, deceleration is reduced according to the "damping point" setting.
<b>Turning Speed @ Maximum</b>	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. Set to a higher value for faster driving particularly when driving out doors. When used on a servo (SLM) chair, this adjustable specifies the particular steering profile (refer to manual).
<b>Turning Speed @ Minimum</b>	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.
<b>Turning Acceleration</b>	Sets the maximum turning acceleration rate. Set to lower values for soft and gentle wheelchair drive performance and higher values for more responsive "sporty" wheelchair drive performance.
<b>Turning Deceleration</b>	Sets the maximum turning deceleration rate. Set to lower values for soft and gentle wheelchair drive performance and higher values for more responsive "sporty" wheelchair drive performance. This value should always be greater than the programmed "Turning Acceleration".

### 3.2.2 Unused UCM Parameters

The following UCM parameters will have no effect on the DX-GB-AS system.

Drive Profiles		
• Turn Damping	• Grip	• Speed Damping
• Non-Linear Turn	• Min to max decel ratio	• Stability for Front Wheel Drive
• 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		
• Soft-Start Time		
General User Options		
• Soft-Start Acceleration		
System Settings		
• Neutral to PB Delay		
Advanced System Settings		
• Battery Saver Enable		

### 3.2.3 DX-GB-AS Parameters

Setting	Description
<b>Joystick</b>	
<b>Joystick Speed Progression</b>	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.
<b>Joystick Direction Progression</b>	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.
<b>Max J/S Speed+Dir</b>	<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>

Setting	Description
<b>Drive Control Input</b>	
<b>Digital Input</b>	Selects whether the Drive Control Input (DCI) operates as a Digital Input or an Analog Input. Select "Digital" unless a potentiometer is used.
<b>Standard/Fail-safe</b>	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.
<b>Swivel Enable</b>	Enables support for a chair swivel feature implemented using the Drive Control Input.
<b>Ext. Speed Pot Min</b>	External Speed Potentiometer Minimum Speed - sets the maximum speed when the external speed potentiometer is at its minimum position.
<b>Enable DCI Speed Limit</b>	Enables support for the Reduce Speed feature implemented using the Drive Control Input.
<b>Reduced Speed</b>	Maximum Speed if a "Slow" condition is present, either from the Drive Control Input or from another module.
<b>Drive Performance</b>	
<b>True-Track (Torque)</b>	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.
<b>Tremor Range</b>	Dampens (or softens) the chair reaction to joystick commands. Higher values give smoother but less responsive drive performance.
<b>Speed Filter</b>	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 should not normally be changed from default. Higher values give smoother but less responsive drive speed performance.
<b>Slam Braking</b>	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.
<b>Stall Time</b>	Sets the length of the stall timeout if the "Stall Timeout" is enabled. TUV allows a maximum of 10 seconds stall timeout.

Setting	Description
<b>Turn Ramp Accel</b>	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.
<b>Turn Ramp Decel</b>	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.
<b>Accelerated Speed Filter</b>	<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 should be set lower than Speed Filter.</p>
<b>Battery</b>	
<b>Voltmeter Battery Gauge</b>	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.
<b>Slow Batt Time Scale Driving</b>	When using the voltmeter-style battery gauge, enabling this parameter will lessen the responsiveness of the gauge, damping down any voltage 'wavering'.
<b>High Voltage Warning</b>	Allows the high voltage warning to be disabled. This warning is normally indicated by a flashing battery gauge.
<b>High Voltage Threshold</b>	Toggles between 28V and 30V for the battery high voltage warning (if enabled).
<b>Motor</b>	
<b>Invert Speed</b>	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.
<b>Motor Direction Swap</b>	Inverts the turning direction. Do not use to correct the joystick left-right sense - correct in Master Remote (UCM) instead. Only required for unusual motors or driving arrangements.

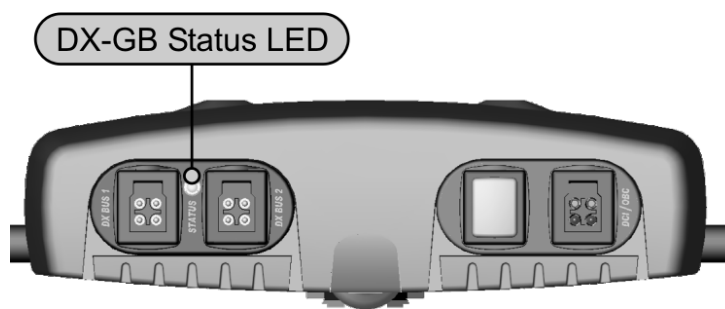


## 4 Diagnostics



*The DX-GB-AS is not user serviceable. Specialized tools are necessary for the repair of any DX component.*

### 4.1 Introduction



A flashing DX-GB-AS Status LED indicates there is an abnormal condition somewhere on the powerchair. The components that DX provides fault information for include, the motors, the park brakes, the batteries, the cabling and the DX modules themselves. The Flash Code displayed on the DX-GB-AS may be different to that displayed by the DX System Status LED located on the DX Master Remote.

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-AS 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 or may not allow driving. In some cases the chair may be allowed to drive but in a reduced speed ('limp') mode.

### 4.2 Diagnostics Tools

While the DX-GB-AS Status LED indicates the abnormal condition, a hand held programmer or the Wizard will provide more detailed information on the fault.

## Hand Held Programmer

Plugging a hand held programmer into the DX programming socket (located on the DX Master Remote) when an abnormal condition exists will cause the DX System fault to be shown on the display. Any abnormal conditions specific to the DX-GB-AS will cause *Error Codes* and *User Advice* to be displayed within the DX-GB menu.

## Wizard

The Wizard is the most preferable diagnostics tool in a workshop type environment, displaying the diagnostic details in a more user-friendly way. Additionally, the Wizard provides a full fault history, as well as providing full textual descriptions of each flash code.

If after analysing the data, the condition cannot be diagnosed, it is possible to print or save a Status Report for further analysis or distribution to a service centre.

---

## 4.3 Flash Codes

Flash codes indicate the nature of an abnormal condition directly from the DX-GB-AS Status LED. Without the use of any servicing tools, the condition can be simply diagnosed.

Flash Code	Description	Possible Solution(s)
1	DX-GB Module Fault	<ul style="list-style-type: none"> <li>• Turn the system Off and then On again.</li> <li>• Check DXBUS connections and cabling.</li> </ul>
2	Accessory or Temperature Fault	<ul style="list-style-type: none"> <li>• Turn the system Off, wait a few minutes for the system to cool down, and then turn On again.</li> <li>• If the fault re-occurs, consult your Dynamic Service Centre.</li> </ul>
3	Left Motor Fault	<ul style="list-style-type: none"> <li>• Check the left motor, connections and cabling.</li> </ul>
4	Right Motor Fault	<ul style="list-style-type: none"> <li>• Check the right motor, connections and cabling.</li> </ul>
5	Left Park Brake Fault	<ul style="list-style-type: none"> <li>• Check the left park brake, connections and cabling.</li> </ul>
6	Right Park Brake Fault	<ul style="list-style-type: none"> <li>• Check the right park brake, connections and cabling.</li> </ul>

Flash Code	Description	Possible Solution(s)
7	Low Battery Fault	<ul style="list-style-type: none"> <li>Check the battery connections, fuses, circuit breakers and cabling.</li> <li>Replace the battery.</li> </ul>
8	Over-voltage Fault	<ul style="list-style-type: none"> <li>If this occurs during charging, the battery charger may be faulty.</li> <li>Check the battery connections, fuses, circuit breakers and cabling.</li> </ul>
9	CANL Fault	<ul style="list-style-type: none"> <li>Check the DXBUS connections and cabling.</li> </ul>
10	CANH or other Network Fault	<ul style="list-style-type: none"> <li>Check the DXBUS connections and cabling.</li> <li>Turn the Hazard Lights Off, turn the system Off, and then turn the system On again.</li> </ul>
11	Stall Timeout Fault	<ul style="list-style-type: none"> <li>Turn the system Off, wait a few minutes for the system to cool down, and then turn On again.</li> <li>Ensure wheels turn freely while under no load.</li> <li>Have the motors checked by a service technician.</li> </ul>
12	Module Mismatch	<ul style="list-style-type: none"> <li>Re-program the system.</li> <li>If the fault re-occurs, consult your Dynamic Service Centre.</li> </ul>

---

## 4.4 User Advice and Error Codes

If there is an abnormal condition specific to the DX-GB-AS, 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 will be a two-digit number that relates to a specific error within the DX-GB-AS Power Module, the motors, or associated wiring and connections. These are predominantly for service use.

The HHP may also provide two lines of advice (*User Advice*) on how to possibly solve the current condition, such as 'Motor not calibrated' or 'Cycle power & retry'.

#### 4.4.1 User Advice List

The different User Advice items are:

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

#### 4.4.2 Error Codes

The different Error Codes and their meaning are:

<b>1</b> Good Errors Set	<b>2</b> Current Left-A Offset Bad
<b>3</b> Current Left-C Offset Bad	<b>4</b> Current Right-A Offset Bad
<b>5</b> Current Right-C Offset Bad	<b>6</b> Jig Left Offset Bad
<b>7</b> Jig Right Offset Bad	<b>8</b> Bad Current Left-A
<b>9</b> Bad Current Left-C	<b>10</b> Bad Current Right-A
<b>11</b> Bad Current Right-C	<b>12</b> Overcurrent Left-A
<b>13</b> Overcurrent Left-C	<b>14</b> Overcurrent Right-A
<b>15</b> Overcurrent Right-C	<b>16</b> Jig Current Left Wrong Sign
<b>17</b> Jig Current Right Wrong Sign	<b>18</b> Jig Current Left Too Low
<b>19</b> Jig Current Right Too Low	<b>20</b> Jig Current Left Too High
<b>21</b> Jig Current Right Too High	<b>22</b> Test Current Low Left
<b>23</b> Test Current Low Right	<b>24</b> Test Current High Left
<b>25</b> Test Current High Right	<b>26</b> Overcurrent Left
<b>27</b> Overcurrent Right	<b>28</b> Lag Exceeded Left
<b>29</b> Lag Exceeded Right	<b>30</b> PWM Exceeded Left
<b>31</b> PWM Exceeded Right	<b>32</b> PComp Exceeded Left
<b>33</b> PComp Exceeded Right	<b>34</b> Serial Timeout

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



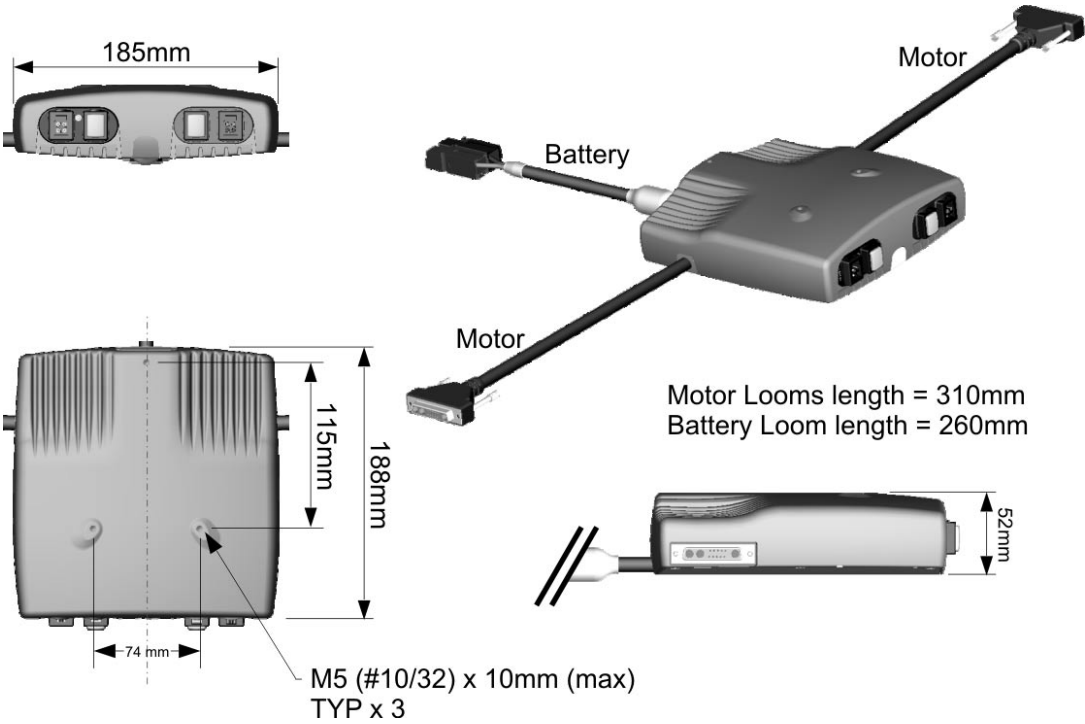
## 5 Specifications

### 5.1 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	Volts
Current Rating				
• Peak			100	Amps
Quiescent Current (at 24 Volts)	12	17	22	mAmps
Drive Control Input				
• Output Current	9.6	12	14.4	mAmps
• Working Input Resistance	0		560	Ohms
• Open Circuit Output Voltage		10.6	11.6	Volts
DXBUS Rating				
• CANH, CANL Voltage Range	-0.5		32	Volts
• Max Output Current (DXB+)	12		18	Amps (RMS)
Controller Battery Charger Max Current (limited by DXBUS rating)	12		18	Amps (RMS)

5.2 Physical Specifications

Parameter				
Material	Die cast Aluminium			
Finish	Powder coated "Rolling Thunder" (Charcoal/Silver)			
Protection Rating	IPx4			
Shipping Weight	1.9kg			
	Min	Nominal	Max	Units
Operating Temperature Range	-25		60	°C
Storage Temperature Range	-40		65	°C
Operating Humidity Range	0		90	%RH





## 6 Appendices

### 6.1 Programmable Parameters List

Parameter	Values	Units	Default	Hand Held Programmer	Wizard – Dealer	Wizard – Enh. Dealer	Wizard – OEM
<b>Joystick</b>							
Joystick Speed Progression	0 – 100	%	25	✓	✓	✓	✓
Joystick Direction Progression	0 – 100	%	25	✓	✓	✓	✓
Max J/S Speed+Dir	100 – 200	%	150		✓	✓	✓
<b>Drive Control Input</b>							
Digital Input	yes – no	-	yes		O	O	✓
Standard/Fail-safe	std – safe	-	std		O	O	✓
Swivel Enable	on – off	-	off		O	O	✓
Ext. Speed Pot Min	0 – 100	%	0		✓	✓	✓
Enable DCI Speed Limit	yes – no	-	no		O	O	✓
Reduced Speed	0 – 49	%	10		O	O	✓

Parameter	Values	Units	Default	Hand Held Programmer	Wizard – Dealer	Wizard – Enh. Dealer	Wizard – OEM
<b>Drive Performance</b>							
True-Track (Torque)	0 – 100	%	30	✓	✓	✓	✓
Tremor Range	0 – 100	%	39	✓	✓	✓	✓
Speed Filter	0 – 100	%	43		O	✓	✓
Slam Braking	25 – 100	%	67		✓	✓	✓
Stall Time	0 – 21.2	Seconds	8.2		O	O	✓
Turn Ramp Accel	0 – 100	%	0		O	✓	✓
Turn Ramp Decel	0 – 100	%	0		O	✓	✓
Accelerated Speed Filter	0 – 100	%	22		O	✓	✓
<b>Battery</b>							
Voltmeter Battery Gauge	yes – no	-	no		O	O	✓
Slow Batt Time Scale Driving	yes – no	-	no		O	O	✓
High Voltage Warning	yes – no	-	yes		O	O	✓
High Voltage Threshold	28V – 30V	Volts	28V		O	O	✓
<b>Motor</b>							
Invert Speed	yes – no	-	yes		O	O	✓

Parameter	Values	Units	Default	Hand Held Programmer	Wizard – Dealer	Wizard – Enh. Dealer	Wizard – OEM
Motor Direction Swap	yes – no	-	no				✓

✓ Editable at this level

○ Viewable at this level

---

## 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-AS receives input commands from a DX Master Remote.

### **Regulatory Statement**

In accordance with the device classification, the DX-GB-AS 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-AS Controller has been designed such that the combination of the wheelchair and the DX-GB-AS 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 should be regularly checked for loose, damaged or corroded connectors, terminals, or cabling. All cables should be restrained to protect them from damage. Damaged components should be replaced.
2. All switchable functions on the Dynamic electronics system should be regularly tested to ensure they function correctly.
3. All Dynamic electronic components should 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 claims will be affected.
5. Where any doubt exists, 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 labour.

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 someone 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

### Warnings to be included in the User Manual

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

- *Chair design and specification shall ensure the motor and controller cannot be overloaded in normal use and intended operating environment, to ensure adequate braking torque is available at all times.*
- *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 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 cause problems, 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 behaviour, turn the vehicle off immediately. Turn the vehicle off before using cell phones or portable communications devices.*
- *In the event of the fault 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.

- *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, 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**

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, tie cables to wheelchair frame.

### **Immunity to Radiated Fields**

Follow the wiring recommendations for minimizing emissions.

### **Immunity to ESD**

Follow the wiring recommendations for minimizing emissions.

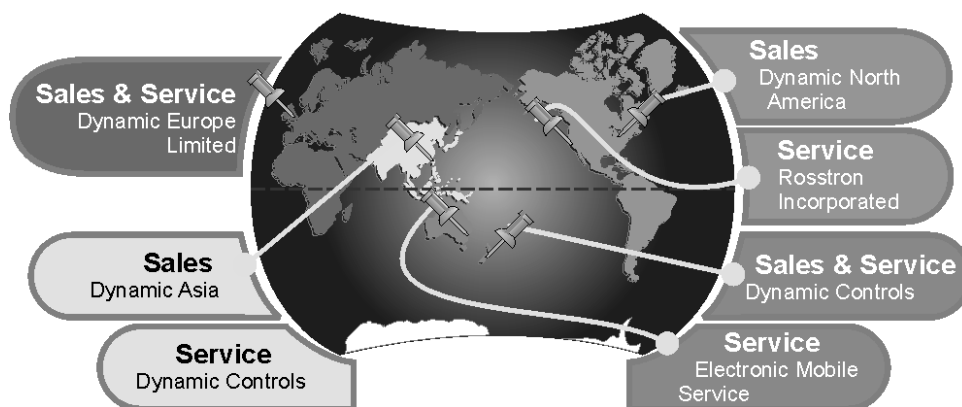
Ensure all vehicle sub-frames are electrically connected.

Do not leave connections unnecessarily exposed.

## 6.7 Contact Details

Dynamic has a global network of sales and service centres. Please contact your nearest Dynamic representative for Sales and/or Service advice, or contact us directly through our web site:

<http://www.DynamicMobility.co.nz>



<b>New Zealand - Head Office</b> <b>Dynamic Controls</b> 17 Print Place    Tel: Int. +64 3 962 2519 PO Box 1866    Fax: Int. +64 3 962 2966 Christchurch New Zealand Email: <a href="mailto:info@dynamic-controls.co.nz">info@dynamic-controls.co.nz</a>	<b>Australia - Service Agent</b> <b>Electronic Mobile Service</b> 46 Berripa Close    Tel: Int. +61 2 9887 2824 North Ryde    Fax: Int. +61 2 9887 2114 Sydney, NSW Australia 2113 Email: <a href="mailto:fredems@ozemail.com.au">fredems@ozemail.com.au</a>
<b>Europe - Sales &amp; Service</b> <b>Dynamic Europe Ltd.</b> 8 Lisle Avenue    Tel: Int. +44 1562 820 055 Kidderminster    Fax: Int. +44 1562 742 720 DY11 7DL United Kingdom Email: <a href="mailto:sales@dynamic.eu.com">sales@dynamic.eu.com</a>	<b>Asia - Sales</b> <b>Dynamic Controls Asia</b> Floor 4-3, No. 59,    Tel: Int. +886 955 335 243 Tien Hsiang Rd    Fax: Int. +886 2 2598 1562 Chung Shan District Taipei 104 Taiwan R.O.C. Email: <a href="mailto:sgoh@dynamic-controls.co.nz">sgoh@dynamic-controls.co.nz</a>
<b>North America - Sales &amp; Service</b> <b>Dynamic North America</b> 31335 Industrial Parkway, Suite 2 North Olmsted    Tel: Int. +1 440 979 0657 Ohio 44070    Fax: Int. +1 440 979 1028 USA Email: <a href="mailto:sales@dynamic-controls.com">sales@dynamic-controls.com</a>	<b>North America - Service</b> <b>Rosstron Inc.</b> 1521 W. 259th St    Tel: Int. +1 310 539 6293 Harbor City    Fax: Int. +1 310 539 4078 CA 90710 USA Email: <a href="mailto:rosstron@earthlink.net">rosstron@earthlink.net</a>