



DX-SLM Servo Steering and Lighting Module



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DX-SLM Servo Steering and Lighting Module



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1 Introduction

The Servo Steering and Lighting Module (SLM) controls the steering and lighting for servo steered power wheelchairs. It is part of a DX System also comprising a DX Power Module and a DX Remote as a minimum system.



Example of Minimum DX System with the SLM

The servo wheelchair has one motor for steering, and either one or two motors to provide the driving power of the wheelchair. The DX Remote controls both functions. If two drive motors are used then a dual channel DX Power Module (DX2-PMAxx) is required. If only one drive motor is used then a single channel DX Power Module (DX-PMB2-S) is required.

The lighting consists of sidelights and turn indicators. The indicators can be flashed together to provide a hazard warning. The DX Remote also controls the lights.

The SLM has two standard DX BUS connectors so that it may be connected to the DX System.

This manual, and others listed in Section 2, must be read and understood. For more information, please contact Dynamic Controls or one of the sales and service agents listed at the back of this manual.





2 Related Documentation

A DX based wheelchair control system may comprise between two and sixteen DX compatible modules depending on the application. Each DX compatible module has its own Installation Manual, which describes the installation requirements of that particular module.

This manual describes the installation of the SLM only and must be read in conjunction with the:

- DX System Manual
- Relevant DX Remote Installation Manual
- DX Power Module (PM) Installation Manual
- DX Hand Held Programmer (HHP) Manual
- Wizard User Manual
- Installation Manuals for all other DX modules to be used in your system.



Important Notes:

- 1. Read this Manual carefully before installing or operating your DX control system.
- 2. 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.
- 3. 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.
- 4. The latest version of this manual can be downloaded from the Dynamic Controls website: <u>www.dynamiccontrols.com</u>





3 General Description

The SLM is designed to enable the DX System to run on a servo steered power wheelchair, with lights. The wheelchair will have: a servo motor, a position sense potentiometer, a steering release microswitch, one or two drive motors with integral park brakes, a 24 V battery supply, and optional 24 V lights.

The DX system will comprise of a minimum of a DX Remote, a DX Power Module, a SLM and may also have up to 13 other DX modules.

The DX BUS is used to control and monitor all DX Modules. The DX Power Module has two identical DX BUS connectors and is connected in a chain type arrangement with the SLM. The SLM can be powered from an independent 24 V power supply, but low power steering requirements can be powered from the DX BUS 24 V supply. The lighting can also be supplied from the DX BUS, or from the 24 V wheelchair battery. See section 5.4.3 and 5.4.4.

In a servo system, the speed and direction data from a DX Remote is passed to the SLM rather than directly to the DX Power Module. The SLM processes the speed data and then sends it directly to the DX Power Module. The direction signal is processed by the SLM and applied to the servo steering motor. A position sense potentiometer tells the SLM the steering position.

A microswitch is attached to the steering clutch so that when the clutch is released for manual wheelchair manoeuvring, the system is inhibited and will not drive. When the clutch is restored, the system must be turned off then on again to drive.

The DX System allows up to five preset Drive Programs to be selected, depending on the type of remote. Each Drive Program contains an associated Steering Program that defines the maximum steering lock available for safe driving at different speeds. The SLM controls the steering lock to conform to the Steering Program, and also controls the speed output, so that the speed cannot exceed that allowable for a particular lock.

The SLM can control a full lighting system of sidelights (front and rear) and indicator lights (left and right). The activation of the lights is via the DX Remote.

The SLM can be used with a two channel (70 or 90 A per channel) DX Power Module (DX2-PMAxx) or a single channel 160 A DX Power Module (DX-PMB2-S). If only one drive motor is used in the system then the DX-PMB2-S should be used.





3.1 General Features

The SLM has the following general features:

- Servo output capable of supplying 5 A continuous and 30 A peak to a 24 V servo actuator.
- Fully DX BUS compatible.
- Two identical DX BUS sockets for Daisy Chain connection to the DX System.
- Powered by a 24 V wheelchair battery via the DX BUS connection, or directly from the battery for high current applications.
- Fully programmable for optimum driving performance.
- Electromagnetically compatible:
 - not susceptible to high levels of RFI
 - emitting low levels of RFI
 - protected against high levels of ESD.
- Compact case for mounting under the wheelchair seat.

3.2 Safety and Protection Features

The SLM has the following safety and protection features:

- Motor current limit and current limit timeout set to prevent overheating of motors.
- Thermal protection to reduce current limit.
- Short circuit protection of all inputs and outputs except between motor and battery negative while driving.
- Open circuit motor detection when not driving.
- Driving is inhibited if steering clutch is disengaged.
- Over voltage, under voltage and reverse battery protected.
- Detection of broken steering position feedback potentiometer connections or short circuit of the potentiometers' terminals.
- Driving inhibit if Steering Module is not connected and responding.
- Compliance with ISO 7176 requirements.
- Controlled power down in event of DX BUS disconnection or communication failure.
- Hazard lights can be operated by an external switch.
- Hazard lights will operate automatically if communication with the DX Remote is lost while turned on.
- Indicator flash rate will double if a rear indicator bulb has failed (incandescent lamps only).
- Sidelights will come on if battery charger is over-charging the batteries or during regenerative braking if the battery cannot absorb the regenerated power.





4 Specifications

4.1 Electrical Specifications

Power Supply Input

Symbol	Parameter	Min	Nom	Max	Units
VBAT	Battery voltage	18.0	24.0	32.0	V
la	Quiescent Current (No servo load)			150	mA
lo	Operating Current (+ servo load)			250	mA
I _{DXBUS}	DX BUS Current (RMS Continuous to entire system)			12	А

Servo Motor + / - Output

Symbol	Parameter	Min	Nom	Max	Units
SM+	Output Voltage (when not in current limit)	VBA	T-1.2V	V_{BAT}	V
Iav	Continuous Average Current (over programmable time period)	5			А
Î	Peak Output Current (for up to 5 seconds)			30	А

Servo Pot Input / Output

Symbol	Parameter		Nom	Max	Units
SP+	Pot Supply + Output Voltage (Open circuit)		5.0	5.5	V
SP-	Pot Supply - Output Voltage 0.0				V
Z _{SP+}	SP+ Output impedance 950 1 K		1050	Ohms	
Z _{SP-}	sp. SP- Output Impedance		10		Ohms
Z _{SP}	Acceptable Pot Impedance	4 K	10 K	12 K	Ohms

Steering Clutch Switch

Symbol	Parameter	Min	Nom Max	Units
Vlo	Low level switch voltage (Microswitch closed)	0	0.5	V
VHI	High level switch voltage (Microswitch open)	3.5	5.0	V





Lighting Specification

Symbol	Parameter	Min	Nom	Max	Units	
Turn India	Turn Indicator Outputs (each output)					
Vtio	Output Voltage	VBAT-1	VBAT-0.1	V_{BAT}	V	
I _{TIO}	Continuous Output Current		2.3	2.5	А	
Sidelight (Head / Tail Light) Output						
Vslo	Output Voltage	VBAT-1	VBAT-0.1	V_{BAT}	V	
Islo	Continuous Output Current		2.3	2.5	A	





4.2 Mechanical Specifications

Size:	210 * 123 * 38 mm
Weight:	0.530 Kg
Mounting:	M5 screws four places, or placed in tray
Case material:	Aluminium sheet, powder coat finish
Case sealing:	Tamper proof, IP54 if mounted as per mounting instructions







SLM Configuration

4.3 Environmental Specifications

Symbol Parameter	Min	Max	Units	
Operating ambient temperature range	-25	50	°C	
Storage temperature range	-25	70	°C	
Operating and storage humidity	0	90	%RH	
Durability	ISO7176 part 14			
Vibration Specification	120 minutes @ 4 g's random vibration without damage			





5 Installation

5.1 Introduction

Installing a SLM requires the following steps:

1.	Mounting the SLM	Refer Section 5.2
2.	SLM Connection with the DX system	Refer Section 5.3
3.	SLM 21 Way Connector	Refer Section 5.4
4.	SLM Servo Connector	Refer Section 5.5
5.	Programming the SLM related parameters	Refer Section 7.0

5.2 Mounting

Optimum mounting orientation

Fit the SLM with the top label facing up.



Unacceptable Mounting Orientation

Do **not** mount with connectors facing up. Do **not** mount with the top label facing down.



Other orientations are acceptable.





Securing the SLM

The SLM can be mounted using the four mounting holes and mounting screws provided, or placed in a suitable tray. Do not use screws that protrude into the SLM case by more than 12 mm.



The SLM must be mounted in a position that offers the maximum protection from water and mechanical abuse. Since there are no user accessible controls on the SLM, it can be mounted in a position which is inaccessible to the user e.g. under the seat.



Note:

For ease of diagnosis, it is recommended that the SLM be mounted where the SLM Status LED can be seen without having to remove covers.





5.3 SLM Connection with the DX System

5.3.1 DX BUS Connections





Note:

If only one DX BUS connector is used on the SLM and the remaining connector is accessible to the wheelchair user, a GPL65009 DX BUS Connector Cover should be fitted to the unused connector. This complies with the ISO 7176-14 standard.

Like all other DX Modules, the SLM is connected to the DX system using the DX BUS. Refer to the DX System Manual for more information regarding DX BUS cables.



Note:

The order and positioning of the SLM within the DX system is important and **must** be based on the rules discussed in section 5.3.2 and 5.3.3.





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5.3.2 DX Module Interconnection Topology Options

The battery and DX Power Module combination are always considered the heart of a DX system. Other DX Modules can be arranged in several ways:





DX modules normally have one or two DX BUS sockets for system interconnections. Smaller DX modules may have a permanently mounted cable terminated in a DX BUS plug, rather than DX sockets.

The star and mixed topologies both require the use of one or more DX BUS Expanders (DX-SKT-X3). The DX-SKT-X3 may be purchased from Dynamic Controls or a Dealer.

For lowest cost and simplicity the in-line topology is generally preferred, provided the DX BUS length and voltage drop requirements described below can be met.



5.3.3 DX BUS Length and Voltage Drop Restrictions

Due to signal distortion that increases with increasing DX BUS length, the total length of all DX BUS cables must not exceed 15 metres in any topology.

Two of the DX BUS's four cores (DXB+ and DXB-) are used to supply power to the modules and to the loads connected to them. A Positive Temperature Coefficient (PTC) device in the Power Module limits the total DX BUS current to 12 A, this protects the DX BUS wiring and connectors. The topology and cable lengths used may reduce the DX BUS's upper limit to below 12 A.

For correct DX System operation the voltage drop on the DX BUS's DXB- wire due to return currents, must not exceed 1.0 V between any two modules within the DX System. Use a topology and module placement that reduces this voltage drop as low as reasonably possible.

Voltage drops occur along the DX BUS due to the return of current to the battery through the small but finite resistance of the DX BUS cable and connectors.

A DX BUS connector can be modelled as:



 R_{ct} = contact resistance = 5 mOhm R_{ca} = cable resistance (B-) = 8.5 mOhm / metre





Example:

Consider a Power Module connected to an SLM via five other DX Modules using 1 metre cables.



Example of DX Module interconnection

The total resistance of the 0 V return path, between the Power Module and SLM is: $6 X (2 * R_{ct} + R_{ca}) = 111 \text{ mOhms}$

This means that the maximum load that the SLM can drive and not exceed the 1.0 V drop requirement is 1 / 0.111 = 9 A.

If, for example, the servo motor and lighting that the SLM is required to drive has a peak current of 10 A, the interconnection order of the DX modules will have to be changed to place the SLM closer to the Power Module.

The above example illustrates a fundamental rule of DX Module interconnection: all DX Modules that connect to high current loads (e.g. actuators / motors and lights) must be connected as close to the Power Module as possible.

The above example is simplified and does not include current to other DX Modules. The DX BUS maximum current rating of 12 A is for the entire DX System.

Operation of the SLM at its maximum rating of 30 A peak current is not possible from the DX BUS supply. To supply greater than the 12 A DX BUS current see section 5.4.4.





This favours topologies such as:



Multi-star Topology





5.4 SLM 21 Way Connector

5.4.1 21 Way Connector Pin Definitions



Pin	Function
1	DX BUS -
2	Side Lights -
3	Left Indicator -
4	Right Indicator -
5	Alternative Lighting +
6	Hazard In
7	Hazard Out
8	Battery -
9	Steering Power +
14	Battery - (spare)
15	DX BUS +
16	Lighting +

Note: Other pins unused.

5.4.2 21 Way Connector Wires and Terminations

To build a matching connector

To build a matching connector to fit to the 21 way connector, the parts are :

DX 21W Plug Housing DX 21W Boot DX Positronics Contact, FC114N2 (Lge) DX Positronics Contact, FC116N2 (Med) DX Positronics Contact, FC120N2 (Sml) Part/Order Number GCN 0796* Part/Order Number GCN 0795* Part/Order Number GCN 0793* Part/Order Number GCN 0797 Part/Order Number GCN 0794*

The DX Positronics Contacts are crimp terminals.

*Included in DX-SLM Loom Connector Kit Part/Order Number DXLOOM-SLM





Wire Sizes

The minimum wire sizes that must be used are:

Function	Wire Size (minimum)	Terminal Part*
DX BUS -	1.0 mm ²	FC116N2
Side Lights -	0.5 mm²	FC120N2
Left Indicator -	0.5 mm²	FC120N2
Right Indicator -	0.5 mm²	FC120N2
Alternative Lighting +	1.0 mm ²	FC116N2
Hazard In	0.5 mm²	FC120N2
Hazard Out	0.5 mm²	FC120N2
Battery -	1.0 mm ² motors < 10 A	FC116N2
	2.0 mm ² motors ≥ 10 A	FC114N2
Steering Power +	1.0 mm ² motors < 10 A	FC116N2
	2.0 mm ² motors \geq 10 A	FC114N2
DX BUS +	1.0 mm ²	FC116N2
Lighting +	1.0 mm ²	FC116N2

* Positronic Industries Ltd

5.4.3 Power Supply from the DX BUS

The DX BUS is suitable for powering low speed servomotors and lighting, where the DX System current requirement is less than the 12 A DX BUS rating.



To power the lighting and servomotor from the DX BUS, links must be inserted to short the DX BUS - pin to the Battery - pin, and the DX BUS + pin to the Steering Power and Lighting + pins.





5.4.4 Power Supply from the Battery

When the servomotor and lighting require more current than the 12 A DX BUS has available, the SLM must be powered directly from the battery, and both battery negative terminals on the SLM must be used.



(b) Dual Battery Box

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Note:

- 1. Heavy lines denote 3 mm² or heavier wire. All other wires from the 21-way connector are as specified in section 5.4.2.
- 2. Refer to the relevant DX/DX2 Power Module Installation Manual.

Thermal circuit breakers must be installed in the battery wiring to protect the batteries, wiring loom, and SLM from external short circuits. If the two batteries are permanently





wired together (single battery box), the best position for this circuit breaker is between the two batteries. If the batteries are individually plugged together (separate battery boxes), each battery requires a circuit breaker. Separate lighting and driving circuit breakers are used, so that a fault, which causes a circuit breaker to operate, will not disable both lighting and driving.

Note:

Battery negative has two connections to the SLM. This is to ensure that a break in one battery connection will not disable driving or lights.

Battery Type

The DX System is designed to perform optimally with either Lead-Acid or Gel Cell deep cycle batteries. Consult Dynamic Controls for other battery types. It is recommended that two 12 V batteries with capacity greater than 20 A hours be used.

5.4.5 SLM Connection to Lights

There are three lighting outputs: Pin 2 Side Lights -

Pin 3 Left Indicators -Pin 4 Right Indicators -

The Side Light Output

This output is used to power head and taillights. Multiple bulbs can be connected to the output in parallel, as shown in the following diagram. The output is active pull-down when the light is turned on.

The Left and Right Indicator Outputs

These outputs are also active pull-down when the light is turned on. Again, multiple bulbs can be connected to each output.

Power Source

Pin 5 is connected to Pin 16 internally. This allows the lights to be supplied with power from Pin 5 or Pin 16.



Example of Lighting Wiring







Note:

If a DX2-PMAxxL is used, the lighting can be split between the Power Module and the DX-SLM. For example, the DX-SLM can drive the front indicators and side lights while the DX2-PMAxxL drives the rear indicators and side lights.

Hazard Switch

An external Hazard Switch can be connected between Pins 6 and 7. When this switch is closed, both indicator outputs will flash synchronously at a rate of 75 flashes per minute.







5.5 SLM Servo Connector

5.5.1 Servo Connector Pin Definitions



5.5.2 Servo Connector Wires and Terminations

To build a matching connector

To build a matching connector to fit the Servo Connector, the parts are:

AMP Mate-N-Lok Connector Housing	AMP Part Number 1-480704-0* (DCL Part Number GCN 0201)
Amp Universal Mate-N-Lok Contact	AMP Part Number 350690-1*
For 0.5 mm ² wires	(DCL Part Number GCN 0202)
Amp Universal Mate-N-Lok Contact	AMP Part Number 350547 (solid pin)
For 1.0 and 2.0 mm ² wires	AMP Part Number 350705 (split pin)

* One housing and four 0.5mm contacts are included in the DX-SLM Loom Connector Kit, Part Number DXLOOM-SLM.

Wire Sizes

The minimum wire sizes that must be used are:

Function	Wire Size (minimum)	Terminal Part
Motor -	1.0 mm ² motors < 10 A	AMP 350547 (solid pin)
	2.0 mm ² motors > 10 A	AMP 350705 (split pin)
Common Ground	0.5 mm²	AMP 350690
Position Sense Pot +	0.5 mm²	AMP 350690
Motor	1.0 mm ² motors < 10 A	AMP 350547 (solid pin)
	2.0 mm ² motors <u>></u> 10 A	AMP 350705 (split pin)
Clutch Switch	0.5 mm²	AMP 350690
Position Sense Pot Wiper	0.5 mm ²	AMP 350690

5.5.3 SLM Connection to Servo Devices





When the steering wheels are centred, there should be equal resistance between the Position Sense Pot wiper and each end of the pot. Small differences can be overcome during calibration (refer to the Programming section).



The motor wiring should be such that when pin 4 is positive with respect to pin 1, the servomotor turns the pot so that the pot wiper (pin 6) is driven towards pot + (pin 3).



6 Operation

6.1 SLM Activation

The SLM is operated by a DX Remote. Each DX Remote has different facilities and not all support a full lighting system. The operation of the lighting is therefore very dependent on what remote it is used with.

Please consult the User Manual for the DX Remote used in your SLM application.



7 Programming



Warning:

Incorrect or inappropriate programming of a DX System may put the wheelchair into a dangerous state.

Dynamic Controls accept no responsibility or liability for accidents caused by incorrect programming.

This chapter must be read and understood before attempting to program a DX System containing an SLM.

7.1 Introduction

The driving performance of an SLM is dependent on its programming. An SLM can be adjusted for a particular application and the driving performance defined to suit the requirements of an individual.

The SLM is programmed at the time of manufacture with factory settings defined by the wheelchair manufacturer (OEM) and Dynamic Controls. Some parameters may be modified later using the HHP, for individual user requirements. If more than one type of wheelchair is to be used by the customer, each wheelchair type may have its own set of optimum settings.

Non-module specific programming of a DX System is contained in the Power Module and DX Remote Installation Manuals. A servo steered DX System with one drive motor, uses a single channel DX-PMB2-S, while a two drive motor system uses a DX2-PMAxx. These are programmed appropriately at the time of manufacture (see the relevant Power Module Installation Manual).

The DX Remote can access as many as five drive programs, which are treated differently in a servo steered DX System. The settings contained in these programs must be selected with reference to this SLM Installation Manual. In addition, three lighting parameters must be set in the DX Remote program if lighting functions are required.

7.1.1 Adding an SLM to the DX System

Any DX Remote can be used to control either conventional or servo steered DX Systems. When changing to a servo steered system, select a servo wheelchair template and modify it to suit the requirements of the wheelchair type.

Similarly, to change a DX Remote from a servo to a conventional application, select a conventional wheelchair program to edit as required and download to the DX Remote.





7.2 DX Remote Wizard Parameters

Key: ✓ Editable at this level (see section 7.1.2.1 of the DX System manual)
 ✓ Viewable at this level



Note:

Refer to the Wizard User Manual and the DX System Manual for detailed operating instructions.

Parameters related to the SLM contained in the DX Remote program fall into two categories:

- 1. Lighting Parameters and
- 2. Drive Program parameters.

7.2.1 Lighting Parameters

The lighting parameters must be enabled so that lights will operate.

7.2.1.1 Side Lights Enable

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Side Lights Enable	Yes/No	Yes	-	6	~	✓

If set to 'yes', sidelights (front and rear) are enabled. If set to 'no', there will be no response to a DX Remote sidelight button being pressed (other than a beep for some varieties of remotes).

7.2.1.2 Indicators Enable

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Indicators Enable	Yes/No	Yes	-	6	~	~

If set to 'yes', indicators are enabled. If set to 'no', there will be no response to a DX Remote indicator button being pressed (other than a beep for some varieties of remotes).

7.2.1.3 Hazard Lights Enable

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Hazard Lights Enable	Yes/No	Yes	-	6	~	~

If set to 'yes', hazard lights are enabled. If set to 'no', there will be no response to a DX Remote hazard light button being pressed (other than a beep for some varieties of remotes).





7.2.2 Drive Program Parameters

The DX System supports up to five Drive Programs. The Drive Programs are defined in the DX Remote programming as factory settings specified by the customer. The Drive Programs govern the driving performance of the wheelchair as suitable for different environmental conditions.

The DX Remote Drive Programs are covered in the relevant DX Remote Installation Manual. Three Drive Program Parameters are however treated differently in the servo steered DX System.

7.2.2.1 Turning Speed @ Maximum

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Turning Speed @ Maximum (%)	10 - 100 %	-	\checkmark	\checkmark	~	~

The maximum speed available when the joystick is fully deflected left or right.

The value assigned to Maximum Turning Speed is not a single performance setting, but a pointer to select one of eight Steering Programs: see section 7.3.1. The Steering Programs are defined by the Wizard in the SLM wheelchair program.

The Maximum Turning Speed value selects a Steering Program as follows:

- 10 49 % selects Steering Program 1
- 50 54 % selects Steering Program 2
- 55 59 % selects Steering Program 3
- 60 64 % selects Steering Program 4
- 65 69 % selects Steering Program 5
- 70 74 % selects Steering Program 6
- 75 79 % selects Steering Program 7
- 80 100 % selects Steering Program 8

The Steering Programs values can be conventionally assigned so that Steering Program 1 causes the slowest possible turning, progressing up to Steering Program 8 causes the fastest possible turning. If this recommendation is followed, Maximum Turning Speed appears to have the same affect in a servo steering application as in a conventional system

7.2.2.2 Turning Acceleration

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Turning Acceleration (%)	10 - 70 %	40 %	~	~	~	~

The rate of response when the joystick is deflected left or right from neutral. A value of 10% gives slow response, 70% gives fast response.

This defines the rate at which the SLM attempts to respond to a large increase in steering lock. A small increase in lock demand is approached at the maximum possible acceleration. The lock demand at which this parameter is used is set by the Wizard in the SLM wheelchair program by the Turning Acceleration Point parameter.





7.2.2.3 Turning Deceleration

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Turning Deceleration	15 - 100 %	70 %	~	~	~	~

The rate of response when the joystick is deflected left or right towards neutral. A value of 15% gives slow response, 100% gives fast response.

This defines the rate at which the SLM attempts to respond to a large decrease in steering lock. A small decrease in lock demand is approached at the maximum possible deceleration. The lock demand at which this parameter is used is set by the Wizard in the SLM wheelchair program, by the Turning Acceleration Point parameter.

Note:

The Turning Deceleration value is normally set as high or higher than the Turning Acceleration value. An inadequate Turning Deceleration value can result in an unsafe wheelchair condition.





7.3 SLM Wizard Parameters

Key: ✓ Editable at this level (see section 7.1.2.1 of the DX System manual)
 ✓ Viewable at this level



Note:

Refer to the Wizard User Manual and the DX System Manual for detailed operating instruction.

Refer to section **7.4 Calibrating the SLM using the HHP** for HHP operating instructions.

7.3.1 Steering Program Parameters

For each of the eight Steering Programs (Program 1 - Program 8) there are 12 Steering Profile parameters which define the Turning Speed @ Maximum: see section 7.2.

7.3.1.1 Maximum Speed Parameters

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Maximum Forward Speed @ 25 % Turn	35 - 100 %	50 %	-	9	9	~
Maximum Forward Speed @ 50 % Turn	25 - 100 %	50 %	-	9	9	~
Maximum Forward Speed @ 75 % Turn	20 - 100 %	50 %	-	9	9	~
Maximum Forward Speed @100 % Turn	15 - 100 %	50 %	-	9	9	~
Maximum Reverse Speed @ 25 % Turn	35 - 100 %	50 %	-	9	٩	~
Maximum Reverse Speed @ 50 % Turn	25 - 100 %	50 %	-	9	9	~
Maximum Reverse Speed @ % 75 Turn	20 - 100 %	50 %	-	٩	٩	~
Maximum Reverse Speed @ 100 % Turn	15 - 100 %	50 %	-	0	0	~





The first eight parameters define the maximum forward and reverse speeds for four non-zero turning positions: 25, 50, 75 and 100% turning. The greater the turning %, the less the assigned speed value should be. It is assumed that a safe speed is the same for left and right turning.

Wheelchairs with a lower maximum speed should have higher Maximum Forward Speed and Maximum Reverse Speed settings than faster wheelchairs as they are at less risk of tipping over. It is reasonable, for slower wheelchairs, to set Maximum Forward and Maximum Reverse Speed @ 25% Turn (and possibly 50% Turn) to 100%.

As a general guide: speed at 25% turn should be twice that at 100% turn; speed at 50% turn should be 1.4 times that at 100% turn; and speed at 75% turn should be 1.2 times that at 100% turn.

Values are assigned to these eight parameters for each of the eight Steering Profiles.

The maximum forward and reverse speeds at zero turning are defined by the standard Drive Program parameters.

7.3.1.2 Turning Acceleration Point

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Turning Acceleration Point	0 - 100 %	50 %	-	9	9	\checkmark

Defines the minimum error between the turning demand and the actual turning angle at which the Turning Acceleration and Turning Deceleration parameters apply.

7.3.1.3 Maximum Servo Motor Speed

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Maximum Servo Motor Speed	10 - 100 %	50 %	-	6	9	\checkmark

The maximum servo motor speed possible, values are assigned to these parameters for each of the eight Steering Profiles





7.3.1.4 Maximum Turn @ 100% Speed

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Maximum Turn @ 100% Speed	10 - 100 %	50 %	-	6	6	~

The purpose of this parameter is to give finer control of the wheelchair when travelling at high speed. The lower the setting, the less sensitive the joystick will be. This also helps reduce the effects of inadvertent joystick movement when travelling over rough terrain.

At 100 % speed, the turning angle is limited to the value of this parameter. As the speed reduces, the available turning angle is allowed to increase.

The higher the value of this parameter, the higher the speed that the turning angle scaling begins, and the less the turning angle is limited.

The lower the value, the lower the speed that the turning angle begins to be scaled, and the greater the limiting of the turning angle. A lower value is suitable for high speed (10 km / h) wheelchairs, and higher values (up to 100 %) are suitable for slower wheelchairs.

Values are assigned to these parameters for each of the eight Steering Profiles.

7.3.1.5 Steering Scalar

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Steering Scalar	0 - 100 %	50 %	-	6	6	~

The Steering Scalar value scales the % turning so that 100 % turning occurs closer to neutral.



If the Steering Scalar is set to 0 %, the joystick must be deflected to point 'a' to achieve 100 % turning.

A Steering Scalar value of 100 % will double the % turning so that 100 % turning will occur at point 'b', mid way between neutral and point 'a'. Further deflection towards point 'a' will not give any increase in turning.

A higher value is more suitable for diamond shape joystick restrictor plates, a lower value for square, round or octagonal restrictor plates.

The purpose of this adjustment is to allow full lock to be achieved with some wheelchair speed; therefore higher values are more suitable for slower wheelchairs and lower values for high speed wheelchairs.





7.3.2 Steering Motor Parameters

7.3.2.1 Straighten at Start

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Straighten at Start	Yes / No	Yes	-	-	-	✓

If set to 'yes', the steering wheels will straighten when the DX System is turned on.

7.3.2.2 Waggle Test

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Waggle Test	On / Off	Off	-	-	-	~

If set to 'on', a Waggle Test is performed when the DX System is turned on. This test involves the steering wheels turning one way, then the other, before returning to the original position. If the Straighten at Start parameter is set to 'yes', then the wheels will return to the centre position.

7.3.2.3 Waggle Time

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Waggle Time	20 - 5100 ms	1000 ms	-	-	-	\checkmark

The time taken to perform (and thereby the severity of) the Waggle Test. Refer to the Waggle Test parameter.

7.3.2.4 Steer Error Reduce

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Steer Error Reduce	50 - 95 %	90 %	-	-	-	~

Every 20 milliseconds the voltage at the Position Sense Pot is checked and any error added to a Cumulative Steering Error value. Prior to this addition, the Cumulative Steering Error is scaled by the Steer Error Reduce value.

The higher the Steer Error Reduce value, the more quickly the Cumulative Steering Error is likely to accumulate. If it goes above a preset threshold (refer to the Steer Error Threshold parameter) a Steering Error (SLM Flash Code 3) is produced (refer to Diagnostics section 8).

7.3.2.5 Steer Error Threshold

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Steer Error Threshold	10 - 100 %	50 %	-	-	-	>

If the Cumulative Steering Error reaches the Steer Error Threshold, a Steering Error (SLM Flash Code 3) is displayed by the SLM (refer to Diagnostics section 8).





7.3.2.6 Current Limit

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Current Limit	4 - 40 A	10 A	-	-	-	~

The current limit for the servo motor. The SLM will ensure that no more than the stated current will go through the servo motor.

7.3.2.7 Veer (right +ve) (Steps)

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Veer (right +ve) (Steps)	±127 Steps	0 Steps	~	~	~	~

The adjustment of the neutral steering position so that the wheelchair does not veer when the joystick is pushed directly forwards or backwards.

The veer adjustment is to correct small offsets in the straight-ahead position of the position feedback potentiometer. Large offsets should be corrected mechanically first. See section 5.5.3.

7.3.2.8 Stall Timeout

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Stall Timeout	Yes / No	Yes	-	6	6	~

If set to 'yes', driving is disabled after Stall Time if in current limit.

A Stall Timeout Fault (Flash Code 11) is displayed by the SLM (refer to Diagnostics section 8).

7.3.2.9 Stall Time

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Stall Time	1 - 50 sec	15 sec	-	6	6	~

The stall timeout delay. If the current limit is exceeded for more than this time a Stall Timeout Fault (SLM Flash Code 11) will be displayed by the SLM (refer to Diagnostics section 8).

7.3.2.10 Motor Speed

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Motor Speed	20 - 5100 ms (0.02 - 5.1 sec.)	400 ms	~	6	6	~

The time taken for the servomotor to travel the full range from left lock to right lock, and visa versa.

This is calibrated using the HHP





7.3.2.11 Motor Damping Factor

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Motor Damping Factor	0 - 100 %	10 %	-	-	_	~

The speed of response of the servomotor.

Warning:

For slow motors this value should be low and for fast motors the damping should be high.



An unsuitably high or low motor damping value can make the wheelchair unstable.

7.3.2.12 Motor I²T Protection

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Motor I ² T Protection	On / Off	Off	-	-	-	6

If set to 'on', Motor I²T Protection is enabled.

I²T parameters define the thermal characteristics of the motors used in wheelchair. The OEM must provide sample motors or detailed motor specifications to Dynamic Controls. Dynamic will then provide recommended setting to ensure correct motor protection against overheating.

7.3.2.13 Motor I²T Threshold

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Motor I ² T Threshold	10 - 90 %	33 %	-	-	-	6

I²T parameter, see above.

7.3.2.14 Motor Time Scale (Decimal)

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Motor Time Scale (Decimal)	20 - 255	50	-	-	-	9

I²T parameter, see above.

7.3.2.15 Maximum Motor Temperature

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Maximum Motor Temperature	70 - 200 °C	130 °C	-	-	-	9

The maximum motor temperature used for I²T protection of the motor.

I²T parameter, see above.





7.3.3 Steering Position Feedback Pot Parameters



7.3.3.1 Left Lock

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Left Lock	5 - 95 %	25 %	~	-	-	~

The ratio of the Position Sense Pot Wiper voltage to the full pot voltage when the steering wheels are moved as far left as is mechanically possible.

A physical limitation calibrated using the HHP - refer to section 7.4.

7.3.3.2 Right Lock

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Right Lock	5 - 95 %	75 %	~	-	-	\checkmark

The ratio of the Position Sense Pot Wiper voltage to the full pot voltage when the steering wheels are moved as far right as is mechanically possible.

A physical limitation calibrated using the HHP - refer to section 7.4.



Note:

The Left and Right Lock parameters must not both be above nor both be below 50%. Typically, one will be around 25% and the other around 75%, so that the total will be around 100%.





7.3.3.3 Lock Margin

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Lock Margin	0 - 50 %	2 %	-	-	-	~

The lock margin voltage ratio; added or subtracted to Left and Right physical Locks. It should be set so that the SLM will target the positions of maximum steering deflection when the joystick is deflected fully left or right.

It must be set higher than the Pot Tolerance parameter to avoid an error when the wheelchair is in full left or right lock.

7.3.3.4 Pot Tolerance

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Pot Tolerance	0 - 50 %	1 %	-	-	-	✓

Specifies the tolerance of the Left Lock and Right Lock in % of total pot travel. If the pot position falls within this tolerance then a Steering Fault (SLM Flash Code 3) is displayed by the SLM (refer to Diagnostics section 8). This value is typically set to half the Lock Margin Value.

7.3.3.5 Maximum Pot End Voltage

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Maximum Pot End Voltage	3203 - 5000 mV (3.2 - 5 V)	4804 mV	-	-	-	✓

The maximum allowable voltage at the + end of the position sense potentiometer. If the voltage exceeds this value, a Steering Fault (SLM Flash Code 3) is displayed by the SLM. A suggested value is 4.75V for a 10K ohm potentiometer.

(Refer to Diagnostics section 8)

7.3.3.6 Minimum Pot End Voltage

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Minimum Pot End Voltage	2988 - 4833 mV (3 - 4.9 V)	4492 mV	-	-	-	~

The minimum allowable voltage at the + end of the position sense potentiometer. If the voltage is less than this value, a Steering Fault (SLM Flash Code 3) is displayed by the SLM.

A suggested value is 4.3V for a 10K ohm potentiometer.

(Refer to Diagnostics section 8)



Warning:

Setting Maximum Pot End Voltage too high, or Minimum Pot End Voltage too low, may prevent some position sense potentiometer faults being detected.





7.3.4 Joystick Restrictor Plate Table

7.3.4.1 Restrict Speed

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Restrict Forward Speed 25 %	60 - 100 %	90 %	✓	-	-	0
Restrict Forward Speed 50 %	40 - 100 %	60 %	~	-	-	۲
Restrict Forward Speed 75 %	20 - 100 %	30 %	~	-	-	۲
Restrict Forward Speed 100 %	0 - 100 %	5 %	~	-	-	۲
Restrict Reverse Speed 25 %	60 - 100 %	75 %	~	-	-	۲
Restrict Reverse Speed 50 %	40 - 100 %	53 %	~	-	-	۲
Restrict Reverse Speed 75 %	20 - 100 %	30 %	~	-	-	٩
Restrict Reverse Speed 100 %	0 - 100 %	5 %	~	-	-	0

The maximum forward and reverse speeds for four non-zero lock positions: 25, 50, 75, and 100 % turning lock.

The physical restrictor plate fitted to the DX Remote is calibrated with these parameters, using the HHP.

If the DX Remote is replaced, these parameters must be recalibrated.

Plate parameters are grouped and calibrated in one operation of the HHP.

7.3.5 Miscellaneous Parameters

7.3.5.1 Speed Scalar

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Speed Scalar	0 - 100 %	0 %	-	-	-	\checkmark

The Speed Scalar value scales the speed so that 100% speed occurs closer to neutral.



If the Speed Scalar is set to 0 %, the joystick must be deflected to point 'c' to achieve 100 % forward or reverse speed.





A Speed Scalar value of 100 % will double the speed demand so that 100 % speed will occur at point 'd', mid way between neutral and point 'c'.

The purpose of this adjustment is to allow full speed to be achieved with some turning deflection.

7.3.5.2 High Voltage Rollback Start

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
High Voltage Rollback Start	24.0 - 33.4 V	29.0 V	-	-	-	\checkmark

Above this battery voltage, the wheelchair speed will be progressively reduced. The purpose is to reduce excessive battery voltage when the wheelchair is driven down a slope.

When the battery voltage exceeds this voltage, the SLM will automatically turn on the side lights to prevent the battery being overcharged. (This feature is most effective when incandescent lamps are fitted.)



Note:

A value of 29 V or greater is recommended to avoid the sidelights coming on when the battery is charging.

7.3.5.3 High Voltage Rollback End

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
High Voltage Rollback End	28.0 - 33.4 V	32.0 V	-	-	-	\checkmark

Above this battery voltage, no driving speed will be available.

This value should be greater than the High Voltage Rollback Start value.

7.3.5.4 Steer Clutch Active

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Steer Clutch Active	High / Low	Low	-	-	-	>

Set to 'low' if clutch input is active low, i.e. input is low if steering disengaged.

Set to 'high' if clutch input is active high.





7.3.5.5 PM Direction Scalar

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
PM Direction Scalar	0 - 100 %	0%	-	-	-	~

For use with two drive motor DX Systems, it compensates for different drive wheel spacing.

Determine how much one motor increases and the other decreases in speed when the wheelchair is turning. If this parameter is set to 100 %, the inner drive wheel will have zero speed when turning.

This value has no effect when a DX-PMB2-S is used.

7.3.5.6 Squared Direction Output

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Squared Direction Output	On / Off	Off	-	-	-	~

Set to 'on' if the Power Module (DX2-PMAxx) drives a front motor and a rear motor. Set to 'off' if the Power Module (DX2-PMAxx) drives a left motor and a right motor.

A single channel Power Module (DX PMB2-S) does not use this parameter.

7.3.5.7 Enable Lighting

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Enable Lighting	Enable/Disable	Enable	-	6	✓	~

If set to 'Enable', lighting functions are enabled. If no light is connected an "accessory fault" will be displayed when an attempt is made to turn on the lights.

If set to 'Disable', there will be no response to a DX Remote lighting button being pressed (other than a beep for some varieties of remotes).

7.3.5.8 Lighting Current Test

Parameter	Possible Values	Default	HHP	Lite	Std	Adv
Lighting Current Test	Enable/Disable	Enable	-	6	6	~

The Lighting Current Test checks the current drawn by the left and right indicator circuits and raises a "partial open circuit" fault if this current is too low. This indicates that one of the indicator bulbs has failed.

The indicator circuits need around 20 Watts to pass this test, so Lighting Current Test should be disabled if the indicator circuits have less than 20 Watts of bulbs, for example, when LED bulbs are used, or when only one indicator bulb (per side) is being driven by the SLM.

The side light channel is not affected by this parameter because the DX-SLM module does not check the amount of current being drawn by the side light circuit.





7.4 Calibrating the SLM using the HHP

Twelve SLM parameters must be calibrated to the individual wheelchair system using the HHP. These parameters are all described in section 7.3.

The first four parameters calibrated by the HHP are approached sequentially. The eight Restrictor Plate parameters are grouped and calibrated in one operation of the HHP.

7.4.1 Initial Operation

1. Turn the DX System on and plug the HHP into the Programmer Socket on the DX Remote. The initial screen appears for two seconds.



2. Then the main menu screen reads:



3. Press 'TECH' and a screen will appear to enter the three-digit password.



Press the D1, D2 and D3 buttons to cycle each digit through to the correct password. When the password reads correctly, press the 'EXIT' button.

4. The screen now reads:



5. Press 'NEXT" until the screen reads:







6. Press 'YES'. The display reads:

VIEW/EDIT SERVO MOD						
	Veer compensation					
	Right 0					
EXIT	NEXT	LEFT	RIGHT			

7.4.2 Calibrating Parameters

Pressing 'EXIT' at any point during the calibration procedure will return you to screen

1. Calibrate the Veer Compensation (Veer (right +)) Parameter.



Press 'LEFT' and 'RIGHT' to adjust the value. The range is \pm 127.

Selecting the correct value will require experimentation. When calibration is completed test drive the wheelchair. Select a Veer Compensation value so that the wheelchair does not veer when the joystick is pushed directly forwards or backwards. If the wheelchair veers right, press 'LEFT'; if the wheelchair veers left, press 'RIGHT'.

If a large compensation value is required, the mechanical position of the position sense potentiometer may require adjustment - see section 5.3.3.

Press 'NEXT'.

2. Calibrate the **Right Lock** Parameter. The range is 0 - 100 %.



Press 'UP' and 'DOWN' until steering wheels are moved as far right as is mechanically possible. Press the HHP buttons slowly and firmly, and pause between each press.

Press 'NEXT'.

3. Calibrate the Left Lock Parameter as per the Right Lock Parameter.

Press 'NEXT'.

If the steering motor drives to the wrong lock position during initial setup either:

- reverse both the motor wires and both steering pot end wires (pot + and pot -), or
- use Wizard to swap the Left Lock and Right Lock parameter values,

then try calibration with the HHP again.





4. Calibrate the Motor Speed Parameter.

VIEW/EDIT SERVO MOD					
	Max moto	or speed			
	calibration				
EXIT	NEXT	START			

Press 'START'.

The steering wheels move to their left and right extremes, then return to centre.

Press 'NEXT'.

This calibration should be performed with the normal weight on the chair i.e. while sitting on the chair.

5. Calibrate the Restrictor Plate (Restrict Fwd/Rev Spd) Parameters.

This procedure calibrates the speed for four forward and four reverse turning positions.



Press 'START'.

VIEW/EDIT SERVO MOD					
	Trace joystick				
	outline				
EXIT	SAVE				

Move the joystick around the outer physical extremities of the restrictor plate. Ensure that all corners are pressed into.

Press 'SAVE' to return to the previous screen.

6. Press 'NEXT' to return to 2 or if calibration has been completed,

press 'EXIT' to return to \mathbf{O} , then 'NEXT'.

Unplug the HHP and turn off the DX System.







8 Diagnostics

SLM diagnostics can be examined from two platforms:

- 1. the Flash Codes displayed by the SLM (and DX Remote), and
- 2. the Wizard diagnostics tool.

Wizard provides more detailed information about the nature of the fault.

8.1 Troubleshooting

- The SLM may not run at all, or operate in an unexpected way, if the programmable parameters are not set up correctly. Using the Wizard, examine all the parameters detailed in section 7 to ensure they are correctly set up for your application.
- The sidelights may come on while the battery charger is plugged in. This may be caused by:
 - 1. The Battery Charger overcharging or charging at too high a rate.
 - 2. The SLM is between the Battery Charger and the Power Module and the DX BUS cables are too long. See section 5.3.2.
 - 3. The Wizard parameter High Voltage Rollback Start may be set too low.
- Chair starts to veer, but no flash codes are reported, this may be caused by:
 - 1. Mechanical slipping of the body or shaft of the steering position sense potentiometer.
 - 2. Mechanical slipping of the steering assembly.

These may not be severe enough to generate a steering feedback fault but will require mechanical adjustment.

8.2 Flash Codes

Any fault condition on the DX system will cause the DX Remote's System Status LED (generally the Power On indicator) to flash. Flashing occurs in bursts of flashes separated by a two-second pause. The number of flashes in each burst is referred to as the **Flash Code** and indicates the nature of the fault.

The SLM also detects faults, which it then conveys to the DX Remote. Flash codes are always displayed on the DX System Status LED but in most cases the SLM will also display a flash code on its Status LED. Some SLM flash codes are just a reflection of the flash code on the DX Remote, while others give additional information. Refer to the table following.

Faults that affect the safety of the wheelchair will cause the wheelchair to stop, while less critical ones will be indicated but allow the wheelchair to continue driving. Some faults will automatically clear when the fault condition is removed (non-latched) while others are latched and must be cleared by turning the DX System off and then on again.

If the suggested action does not remove the fault, contact a Dynamic Sales and Service Centre (listed at the back of this manual).





DX System Status LED Flash Code	SLM Status LED Flash Code	Likely Cause of Fault and Possible Action		
1	1	Module Fau	ult	
		Cause:	Connections between DX Modules may be faulty, or there may be an internal fault in the SLM.	
		Action:	 Check DX BUS connections and replace where necessary. Replace SLM. Consult an approved Dynamic Service Agent 	
1	2	Motor Fault		
		Cause:	A servo motor fault has been detected.	
		Action:	Check wiring to motor.Check servo motor for a short or open circuit.	
2	3	Steering Fa	ult*	
		Cause:	Connections between DX Modules may be faulty, or there may be an internal fault in the SLM.	
		Action:	 Check the Pot Shaft is not slipping, or the Pot body turning. Check the Pot for short and open circuits between pins. Ensure that the clutch is engaged and not slipping. Ensure that there is no excessive load on the steering system. Check the servo motor connector and wiring 	



*Note:

If the Steering Fault only occurs when large steering movements are requested, the SLM's motor speed parameter may need to be recalibrated using an HHP.





DX System Status LED Flash Code	SLM Status LED Flash Code	Likely Cause of Fault and Possible Action			
2	4	Lighting Fa	ult		
		Cause:	1. A fault is detected in the lighting circuits.		
			 Indicator lights are flashing faster than normal. 		
			 LED lamps have been fitted to the indicator lights but the Lighting Current Test parameter has not been set to "Disable". 		
		Action:	 Check the lighting circuitry for shorts and open circuits. Check side and indicator bulbs. 		
2	5	Clutch Rele	eased		
		Cause:	The clutch switch is or has been in the released position.		
		Action:	 Re-engage the clutch if necessary and turn the DX System off then on. Check the servo motor connector and wiring. Check the operation of the clutch switch. 		
7	7	Low Batter	y Voltage Fault		
		Cause:	The battery voltage has fallen below 17 V.		
		Action:	 Check battery connections and terminals. Check fuses have not blown or circuit breakers tripped. Replace battery if worn out. 		
9	9	CANL Fault	t		
		Cause:	 An invalid voltage has been detected on the DX BUS CANL line. Communication is not possible using the CANL wire. 		
		Action:	 Check the continuity of the DX BUS cable. Check for shorts between DX BUS pins. An open or short circuit on another DX module can cause this fault. 		



DX System Status LED Flash Code	SLM Status LED Flash Code	Likely Caus	se of Fault and Possible Action
10	10	CANH Fault	
		Cause:	1. An invalid voltage has been detected on the DXBUS CANH line.
			 Communication is not possible using the CANH wire.
			 Hazard lights were already turned on when the DX System was turned on.
		Action:	 Check the continuity of the DXBUS cable. Check for shorts between DXBUS pins. An open or short circuit on another DX module can cause this fault. If the Hazard Lights were already switched on when the DX System was turned on, Flash Code 10 and Limp Mode (slow driving) may result.
			To clear this fault, turn the Hazard Lights off, then turn the DX System off then on again.
11	11	Stall Timeout Fault	
		Cause:	The servo motor current has been at or close to current limit for longer than the Stall Timeout parameter value.
		Action:	• Turn the DX System off then on again.

8.3 Wizard Diagnostics

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

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





9 Maintenance

- 1. All Dynamic electronic components should be kept free of dust, dirt and liquids. For cleaning the product, use a cloth dampened with warm soapy water. Do not use chemicals, solvents or abrasive cleaners, as this may cause damage to the product.
- 2. All vehicle components should be regularly checked for loose, damaged or corroded components such as connectors, terminals, or cabling. All cables should be restrained to protect them from damage. Damaged components should be replaced.
- 3. All switchable functions on the Dynamic electronics system should be regularly tested to ensure they function correctly.
- 4. There are no user-serviceable parts in any Dynamic electronic component. Do not attempt to open any case or undertake any repairs, else warranty will be voided.
- 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.





10 Safety and Misuse Warnings

All warnings throughout this Installation Manual must be read and understood. If in doubt ask for advice.

This DX component must not be used other than in the manner described in this Installation Manual.

The completed installation must be thoroughly checked, and all programmable options must be correctly adjusted for safe operation prior to use.

Pass on to user:

A warning must be conveyed to the wheelchair user that the controller could cause the chair to come to a sudden stop. In situations where this may affect the safety of the user, this will require the fitting and wearing of a seat belt.

The DX control system is fully programmable to optimise performance and safety. Do not operate the wheelchair unless you have full control. Ensure that the chair is correctly programmed for your needs and environment and ask your dealer to adjust if necessary. Always choose a Drive Program that you feel safe with and that is compatible with your environment.

Do not operate the DX System if it behaves erratically, or shows abnormal heating, smoke or arcing. Turn the system off, disconnect the battery or open the battery overload switch, and consult your Service Agent.

Do not operate the DX System if the battery is nearly flat as a dangerous situation may result due to loss of power in an inopportune place.

Ensure the controller is turned off when not in use.

No connector pins should be touched, as contamination or damage due to electrostatic discharge may result. Dummy sockets in unused DX BUS connectors should be left in place unless a new module is added to the system.

Report any malfunctions immediately to your Service Agent.





11 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 correctly installed.
- has been thoroughly checked upon completion of installation, and all programmable options correctly adjusted for safe operation prior to use.
- has been used solely in accordance with this manual and the DX System Manual.
- has been properly connected to a suitable power supply in accordance with this manual and the DX System Manual.
- has not been subjected to misuse or accident, or been modified or repaired by any unauthorised personnel.
- has been used solely for the driving of electrically powered wheelchairs in accordance with the intended use and the recommendations of the wheelchair manufacturer.



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Dynamic Controls is the world's leading manufacturer of electronic controls for power wheelchairs and scooters. DYNAMIC was established in 1972 and is headquartered in New Zealand. Regional centres are located in Europe, United States, Asia, and Australasia.

ISO 13485 certified -DYNAMIC goes above and beyond industry standard expectations to ensure customers receive the best products possible.



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