No. 60012, Issue 7. October 1998

DYNAMIC™

DX™ Modular Mobility System

DX Combined Lighting and Actuator Module (CLAM) Installation Manual

Order/Part Number for this Manual : GBK60012 issue 7

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 not continue to be used.

3. Any attempt to gain access to or in any way abuse the electronic components and associated assemblies that make up the wheelchair control system renders the Manufacturer's Warranty void and the Manufacturer free from liability.

Contents

1 Introduction

The DX Combined Lighting and Actuator control Module (CLAM) is designed to control lighting and up to five actuators on a power wheelchair. It has three (two turn indicators and a side light) outputs for lights and five high current outputs for actuator control. CLAM is used in conjunction with a DX User Control Module (UCM) which is linked to it by the DXBUS. It has two identical DXBUS connectors and is controlled and monitored via the DXBUS interface. It can draw power from the power supply of the bus provided the current drawn is less than the 12 Amp DXBUS rating.

The actuator driving outputs are suitable for controlling 24 Volt actuators. The driving voltage can be reversed to extend and retract each actuator and one actuator output at a time can be energised. A “soft” start feature is provided by increasing the available output current progressively after an output is energised. In conjunction with the UCM, a current limit trip for each actuator output is provided. This can be used to provide a simple automatic end-of-travel detection mechanism for some types of actuators. Also in conjunction with the UCM a time out is provided which can be used to protect actuators against over heating. All actuator outputs are fully protected against short circuits and voltage transients.

A three level speed control input is provided which, in conjunction with the UCM, can be used as an interlock to prevent unsafe speeds when actuators adversely affect the wheelchair's stability. A low voltage level allows normal wheelchair speeds, a medium level allows slow speeds and a high level disables the wheelchair.

The lighting outputs drive two turn indicators which are flashed at 75 flashes per minute. Under the control of the UCM these outputs can be used as turn indicators or as a hazard warning. All lighting outputs are fully protected against short circuits and voltage transients.

The CLAM incorporates simple diagnostic capabilities. The electronics are housed in a compact enclosure sealed against water, dust and tampering.

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 CLAM only and must be read in conjunction with the :

- DX Power Module (PMB) Installation Manual;
- DX Hand Held Programmer (HHP) Manual;
- Dynamic Wizard Installation Sheet / Online Help;
- Installation Manuals for all other DX Modules to be used in your system.

Installation Manual Re-order Information
(Please quote this information when re-ordering this manual)

DX Combined Lighting and Actuator Module (DX-CLAM) - GBK60012

3 Features

3.1 General Features

- Powered by a 24 Volt wheelchair battery either via DXBUS connection for a total (lighting and actuator) supply current less than 12 Amps, or directly from the battery if the supply current can exceed 12 Amps;

- Digital communications bus interface (DXBUS compatible) with remote wake up and remote “kill” inputs via DXBUS;

- Two identical DXBUS sockets;

- Speed control input (used to immobilise or reduce available wheelchair speed);

- Connection to lighting, actuators and speed control input via custom 21 pin connector;

- Three lighting outputs;

- Five reversing high current actuator driving outputs;

- Electromagnetically compatible:
  - emitting low levels of RFI;
  - protected against high levels of ESD;

- Compact, rugged enclosure sealed against water and dust ingress to IP54.

3.2 Safety and Protection Features

- Actuator control outputs protected against external short circuits to either battery terminal or other CLAM outputs;
- Lighting outputs protected against external short circuits to either battery terminal or other outputs;
- Reverse battery protected;
- Detection of lighting and actuator output faults;
- Detection of short circuit lighting outputs;
- Protection against DXBUS disconnection or communications failure.

4 Specifications

4.1 Electrical Specifications

T_{amb} = -25 to 50°C, V_{BAT} = 24.0 V unless otherwise specified.

Symbol	Parameter	Conditions	MIN	NOM	MAX	UNITS
P_Q	Quiescent Power	All outputs OFF		1.5	2.0	W
P_{SB}	Standby Power	CLAM "OFF"			24	mW
Turn Indicator Outputs						
I_{TIO}	Continuous output current				1.0	A
V_{TIO}	Output voltage	Output ON, I_{TIO} = 0.5A, T_{amb} 20°C			0.5	V
Side Light Output						
I_{SLO}	Continuous output current				2.0	A
V_{SLO}	Output voltage	Output ON, I_{SLO} =1.0A, T_{amb} 20°C			0.5	V
Actuator Outputs (5)						
I_{AO}	Peak output current	Output ON, Duration 1 minute. Initial case temperature 20°C.		10.0		A
I_{AO}	Continuous output current	Output ON		3.0		A
V_{AO}	Output voltage	I_{AO} = 0.5 A	22.0	22.8		V
Speed Control Input						
V_{STOP}	Stop voltage	Pin 6 with respect to Pin 8	4.3		5.0	V
V_{SLOW}	Slow Voltage	Pin 6 with respect to Pin 8	2.2		3.8	V
V_{NORMAL}	Normal Voltage	Pin 6 with respect to Pin 8	0.1		1.8	V
$V_{SPEED\ FAULT}$	Fault voltage	Pin 6 with respect to Pin 8			0.1	V

4.2 Physical Specifications

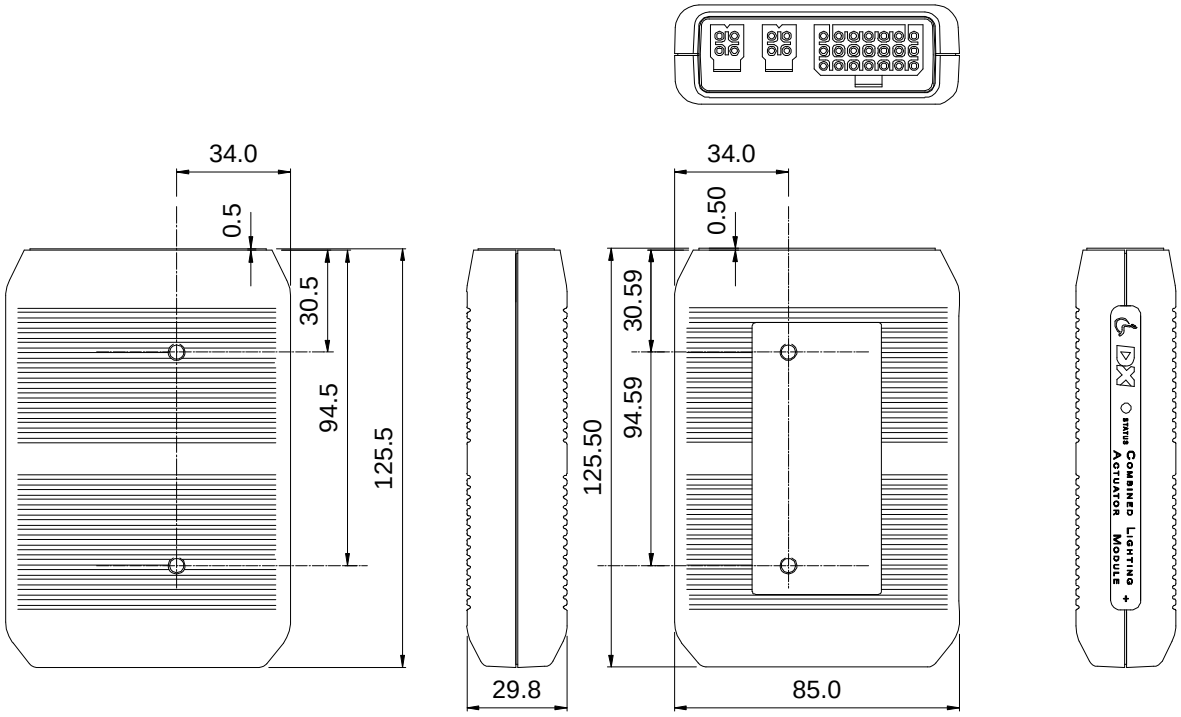
Size: 125 * 85 * 29mm

Weight: 0.25 kg

Mounting: Chassis and tube mounting with optional brackets

Case material: Pressure die cast aluminium, powder coat finish

Case sealing: IP54, tamper proof



CLAM Configuration

4.3 Environmental Specifications

Parameter	Minimum	Nominal	Maximum	Units
Operating ambient temperature range	-25		50	°C
Storage temperature range	-25		70	°C
Operating and storage humidity	0		90	%RH
RFI Susceptibility	IEC 801-3, level X, ISO7176 part 14 (pending)			
RFI Emissions	TBD			
ESD	IEC 80102, level X			
Vibration Specification	BS2011: part 2Fd and BS7527: section 3.5, class 5M3			
Standards	The DX-CLAM has been designed to meet the requirements of prEN12184 : 1997 (pending).			

5 Installation

5.1 CLAM Activation

The CLAM is an output device which operates according to instructions received from either a DX Remote or another DX module, for example an Actuator Remote Control (ARC). Each DX Remote has different facilities and not all support actuator control. Some DX Remotes will provide actuator control using the joystick, while others will have buttons assigned to this function. The operation of the CLAM is therefore very dependent on what remote it is used with, and the programmable options that are set up for it. In cases where the remote can not control the actuators, another DX module like the ARC must be used.

Please consult the User Manual for the DX Remote or other DX Module used in your CLAM application.

5.2 General

Installing a CLAM requires the following steps :

1. Mounting the CLAM	Refer Section 5.3
2. Connecting the CLAM to the rest of the DX system	Refer Section 5.4
3. Connecting the devices (lights, actuators, etc.)	Refer Section 5.5
4. Determining voltage source	Refer Section 5.6
5. Connecting Slow / Stop Options	Refer Section 5.7
6. Programming the CLAM related parameters	Refer Section 6.0

Compatibility with Power Wheelchairs

The model DX Series power wheelchair controller will function on those wheelchairs equipped with the following specifications:

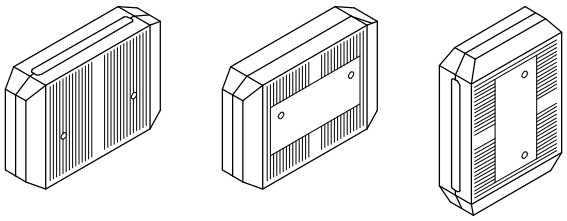
- Motor resistance from 0 to 0.5 ohms;
- Motor voltage from 20V to 30V;
- Batteries greater than 20Ah lead acid;
- Peak motor current 60A - 80A max. per motor output (model dependant);
- 12V or 24V Park Brake;

(Note: 12V motors can be used if the controller is programmed to half speed).

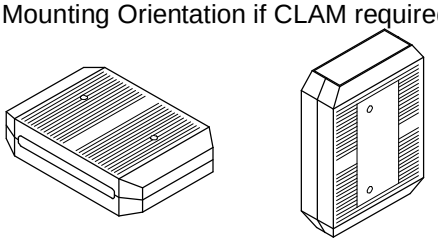
5.3 Mounting

5.3.1 Environmental Protection

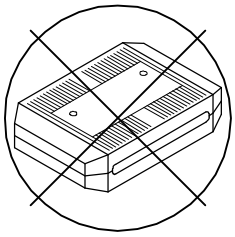
The CLAM must be mounted in a position which offers the maximum protection from water and mechanical abuse. The CLAM provides protection up to IP54 when mounted in the recommended orientation as shown below, but other orientations can be used if environmental conditions are sheltered.



Recommended Mounting Orientation if CLAM required to meet IP54 rating



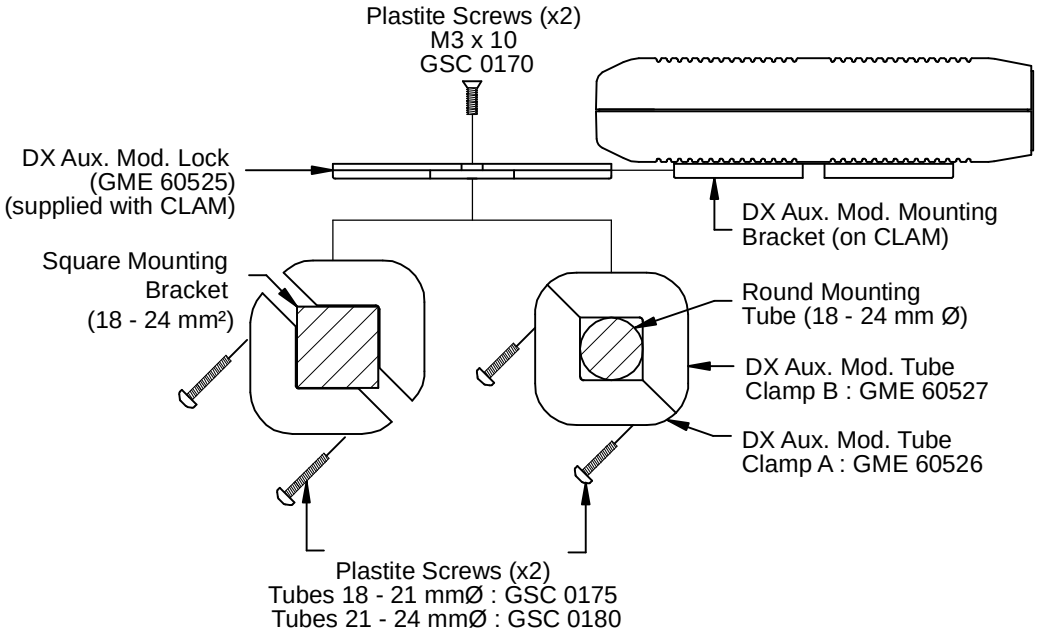
Acceptable Mounting Orientation - splash proof only



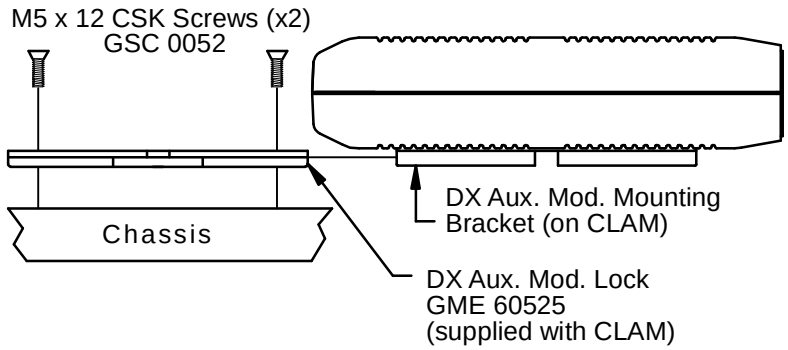
Unacceptable Mounting Orientation if CLAM exposed to any water

5.3.2 Securing the CLAM

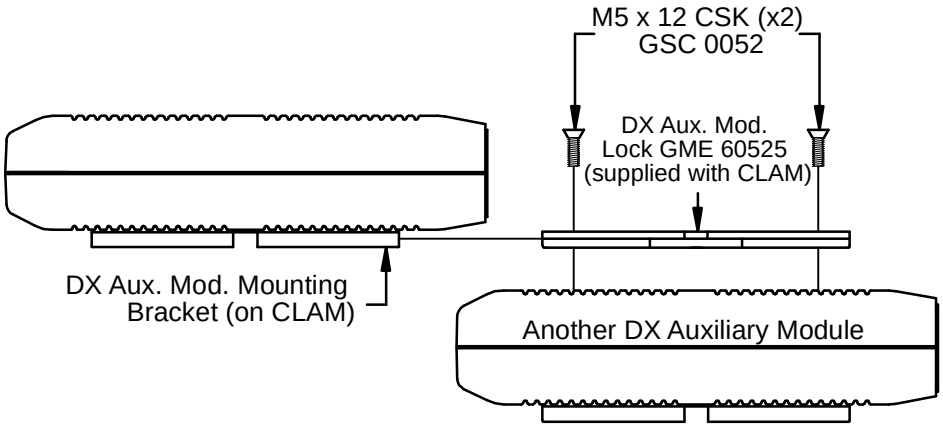
The CLAM is supplied fitted with a DX Aux Mod Mounting Bracket. This allows the CLAM to be chassis mounted, tube mounted, or mounted to another DX Auxiliary Module as follows :



Round or Square Tube Mounting



Chassis Mounting

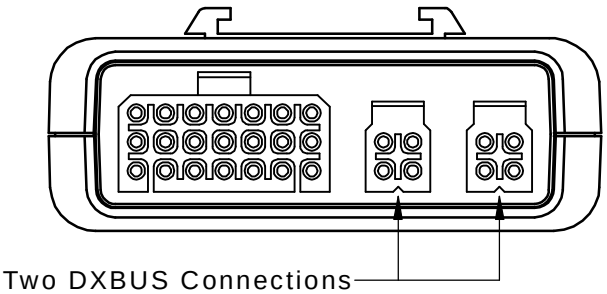


Mounting on other Auxiliary Modules

5.4 CLAM Connection with the DX System

5.4.1 DXBUS Connections

Like all other DX Modules the CLAM is connected to the DX system using the DXBUS.



Note : When only one DXBUS connector is used on the CLAM and the remaining connector is accessible to the wheelchair user, a dummy socket should be fitted to the unused connector. A GCN0792 DXBUS Connector Housing can be used. This will comply with ISO7176.

DXBUS Cables are available in the following standard lengths :

DXBUS Cable, Straight, 0.12M Part/Order Number GSM630012
DXBUS Cable, Straight, 0.3M Part/Order Number GSM63003
DXBUS Cable, Straight, 0.5M Part/Order Number GSM63005
DXBUS Cable, Straight, 1.0M Part/Order Number GSM63010
DXBUS Cable, Straight, 1.5M Part/Order Number GSM63015

Other cable lengths in multiples of 0.1M are available on request.

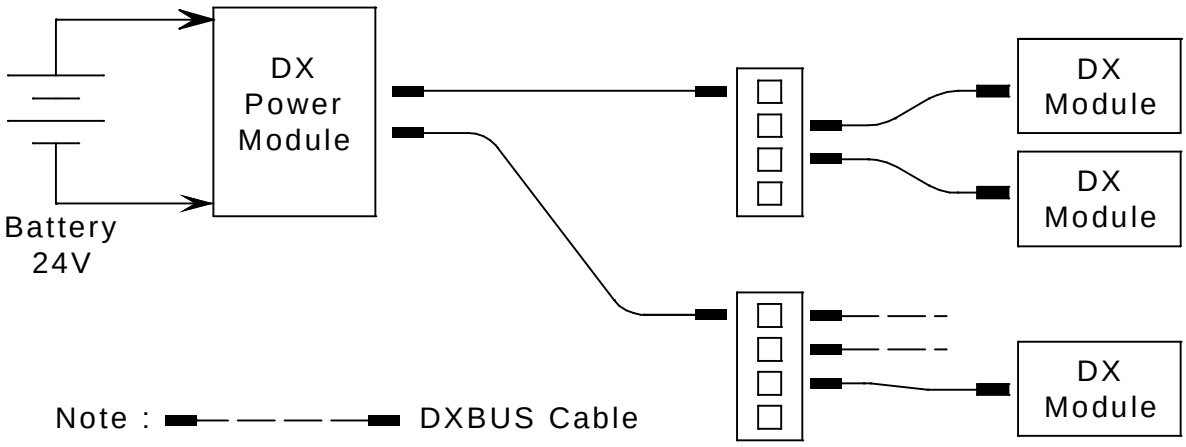
DXBUS cables are also available fitted with a ferrite bead to improve Electromagnetic Compatibility (EMC).

DXBUS CABLE, Ferrite, 2.0 M Part/Order Number GSM63020F

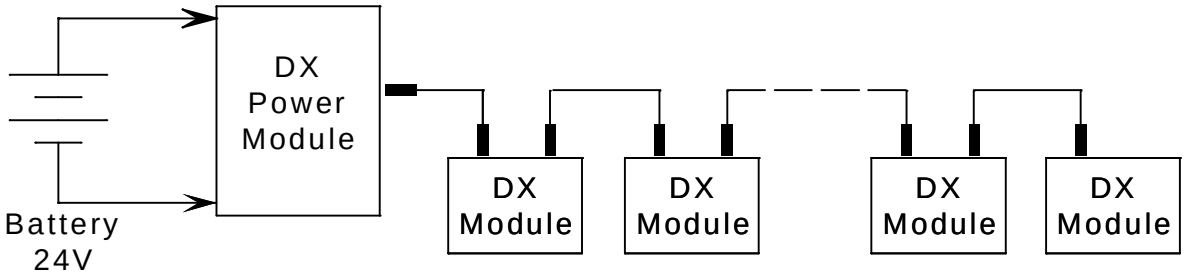
Note : The order and positioning of the CLAM within the DX system is important and **must** be based on the rules discussed in this section.

5.4.2 DX Module Interconnection Topology Options

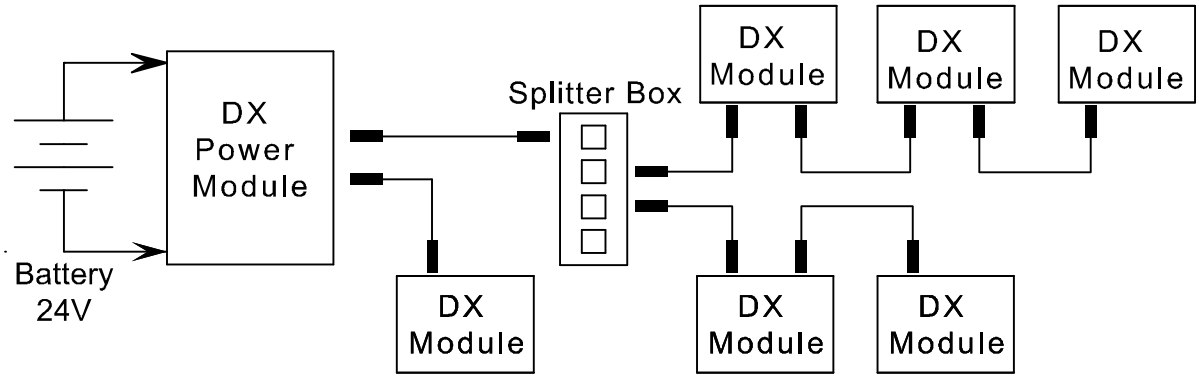
The battery and DX Power Module combination are always considered the heart of a DX system. Other DX Modules can be arranged in several ways :



Star DXBUS Topology



In-line DXBUS Topology



Mixed DXBUS Topology

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

The star and mixed topologies both require the use of one or more DX Splitter Boxes. A Splitter Box is a separate panel of four DXBUS sockets that may be purchased from Dynamic or a Dealer. The DX Splitter Box Part / Order Number is : DX-SKT-X4.

For lowest cost and simplicity the In-line topology is generally preferred, provided the DXBUS length and voltage drop requirements described in the following section can be met.

5.4.3 DXBUS Length and Voltage Drop Restrictions

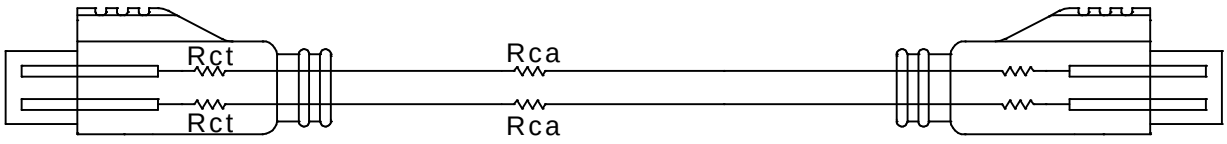
Due to signal distortion that increases with increasing DXBUS length, the total length of all DXBUS cable must not exceed 15 metres in any topology.

Two of the DXBUS'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 DXBUS current to 12A, to protect the DXBUS wiring and connectors. The topology and cable lengths used may reduce the DXBUS's upper limit to below 12A.

The golden rule is that for correct DX operation the voltage drop on the DXBUS's DXB- wire due to return currents must not exceed 1.0V between modules. The topology and module placement that reduces this voltage drop as low as reasonably possible is to be preferred.

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

A DXBUS connector can be modelled as :

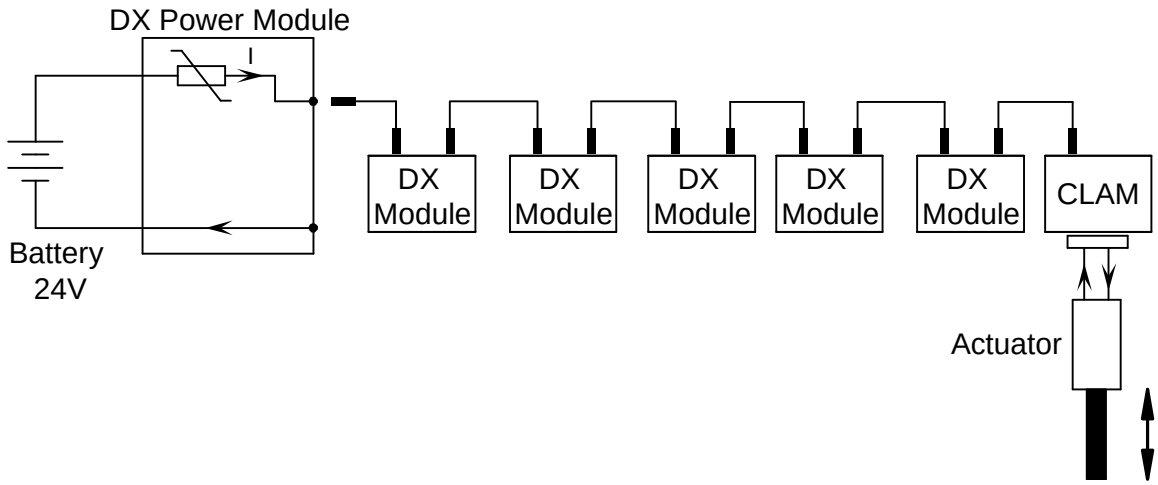


DXBUS Cable Model

R_{ct} = contact resistance = 5 mOhm
R_{ca} = cable resistance = 12 mOhm / metre

Example :

Consider a Power Module to CLAM connection via five other DX Modules using 1 metre cables.



Example of Bad DX Module interconnection

The total resistance of the 0 V return path, between the Power Module and CLAM is :

$$6 \text{ X } (2 * R_{ct} + R_{ca}) = 132 \text{ mOhms}$$

This means that the maximum load that the CLAM can drive and not exceed the 1.0 V volt drop requirement is :

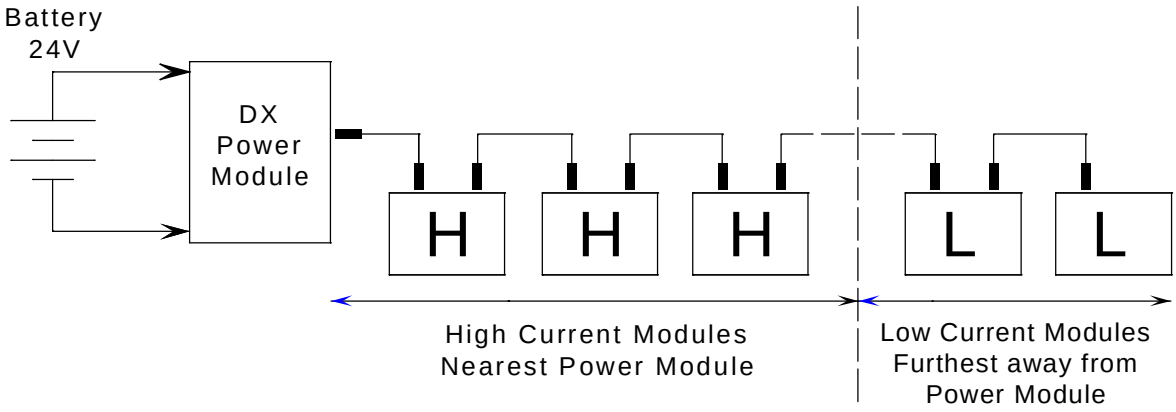
$$1 / 0.132 = 8\text{A}.$$

Thus operation of the CLAM at its maximum rating of 12A is **not** possible in the proposed in-line topology and the interconnection order of the DX modules will have to be changed to place the CLAM as close as possible to the Power Module.

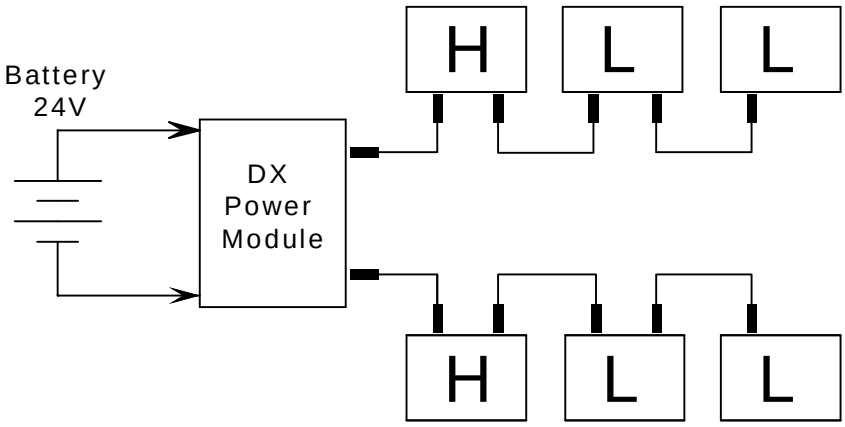
The above example illustrates a fundamental rule of DX Module interconnection.

Rule : All DX Modules that connect to high current loads (e.g. actuators and lights) must be connected as close to the Power Module as possible.

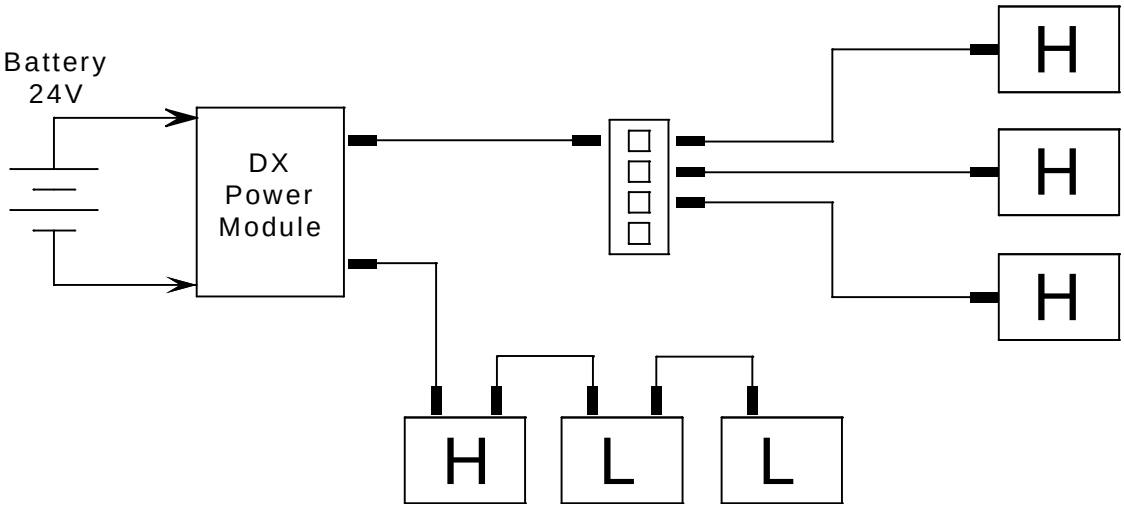
This favours topologies such as :



Rationalised In-line Topology



Two way star Topology

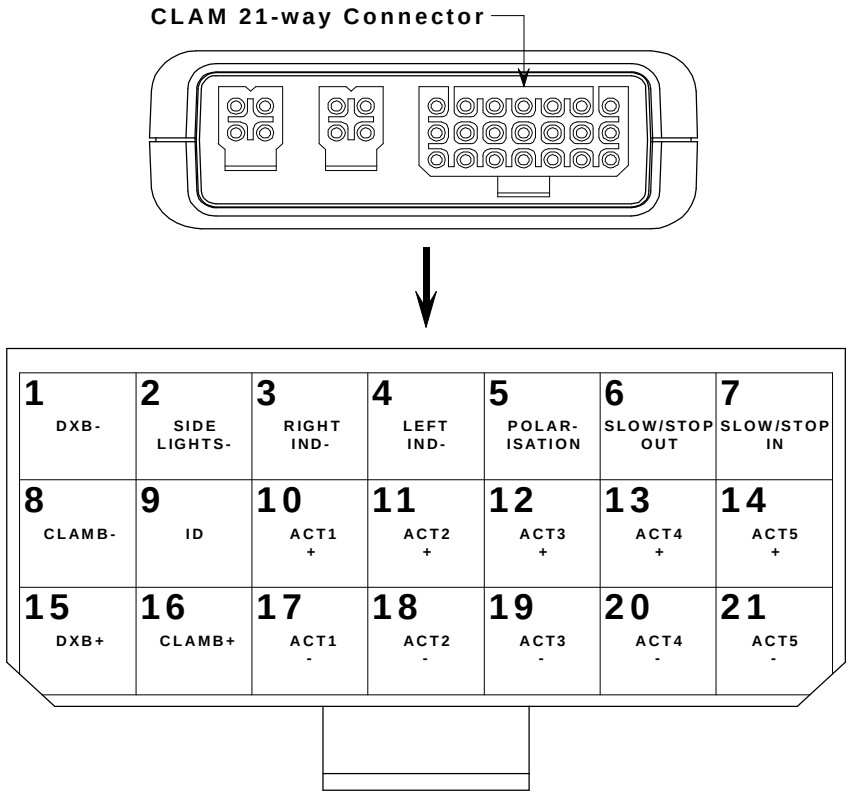


Multi Star Topology

5.5 CLAM Connection to Actuators / Lighting

5.5.1 21-Way Connector Pin-out

All field connections from the CLAM to actuators / lighting is via its 21-way connector. The pin-out is as follows:



21-Way Connector Pin-out

For additional requirements, Part Numbers are :

DX 21-way Plug Housing	Part / Order Number GCN 0796
DX 21-way Plug Boot	Part / Order Number GCN 0795
DX Positronics Contact, FC114N2 (Lge)	Part / Order Number GCN 0793
DX Positronics Contact, FC120N2 (Sml)	Part / Order Number GCN 0794

Contacts GCN 0793 and GCN 0794 are crimp terminals suitable for terminating 1.5 - 2.5 mm² and 0.25 - 0.5 mm², respectively.

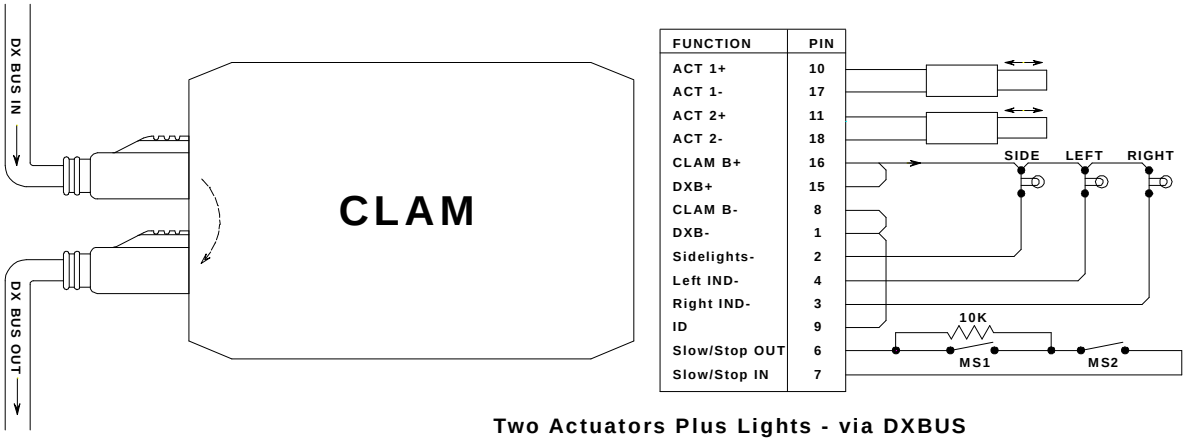
5.5.2 Pin Descriptions

Pin	Description
ACT1+, ACT1- ACT2+, ACT2- ACT3+, ACT3- ACT4+, ACT4- ACT5+, ACT5-	The positive and negative output pins for the five actuators. “+” corresponds to a positive voltage appearing on this pin in response to an “UP” or “EXTEND” from the actuator control.
CLAM B+, CLAM B-	The supply input to the CLAM. For supply of the CLAM via the DXBUS loop (DXB+ to CLAM B+ and DXB- to CLAM B-). For supply of the CLAM directly from the battery, connect the battery positive directly to CLAM B+ and the battery negative directly to CLAM B-.
DXB+, DXB-	DXBUS supply output. For looping back into CLAM B+ and CLAM B- if CLAM supply via the DXBUS is required.
ID	Must always be connected to CLAM B-.
Side Light	Side light (Head/Tail light) output. Active pull down when light turned on. Other side of bulb must be connected to CLAM B+.
Left Indicator	Left Indicator output. Active pull down when light turned on. Other side of bulb must be connected to CLAM B+.
Right Indicator	Right Indicator output. Active pull down when light turned on. Other side of bulb must be connected to CLAM B+.
Slow Stop IN Slow Stop OUT	Used to form the resistance modulated loop used to implement the slow/stop feature. Refer 5.7 for details.

5.5.3 Typical CLAM Wiring Diagrams

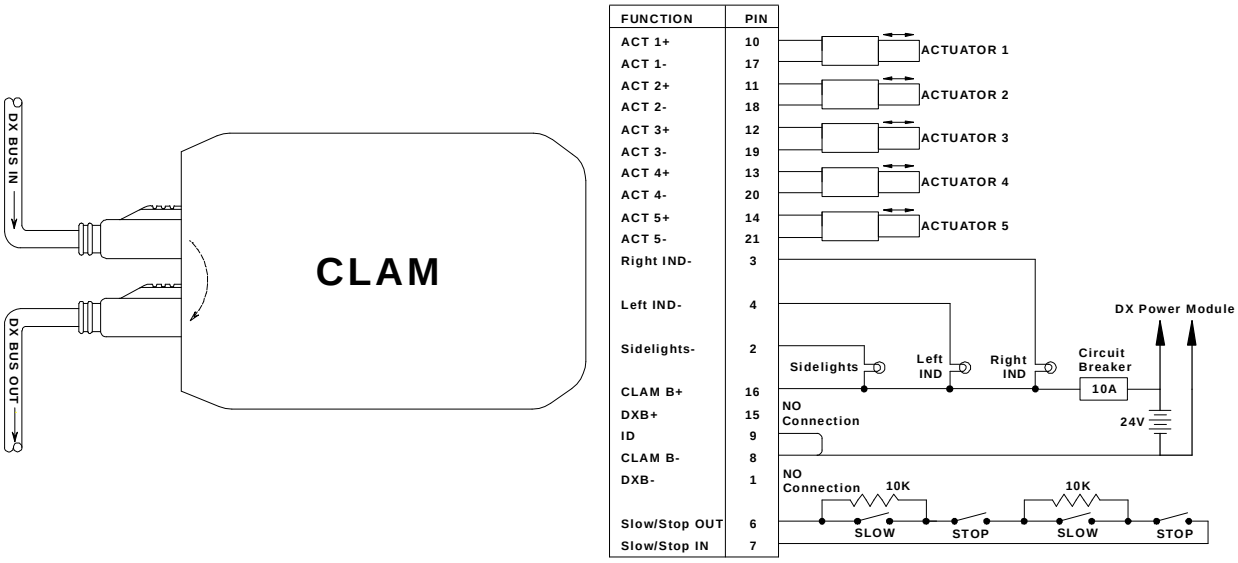
Below are typical CLAM wiring diagrams which support,

- full lighting control;
- two actuator control, where Actuator 1 causes chair slow down, and Actuator 2 causes chair stop;
- CLAM / Actuator / Lighting current sourced from the DXBUS.



Two Actuators Plus Lights - via DXBUS

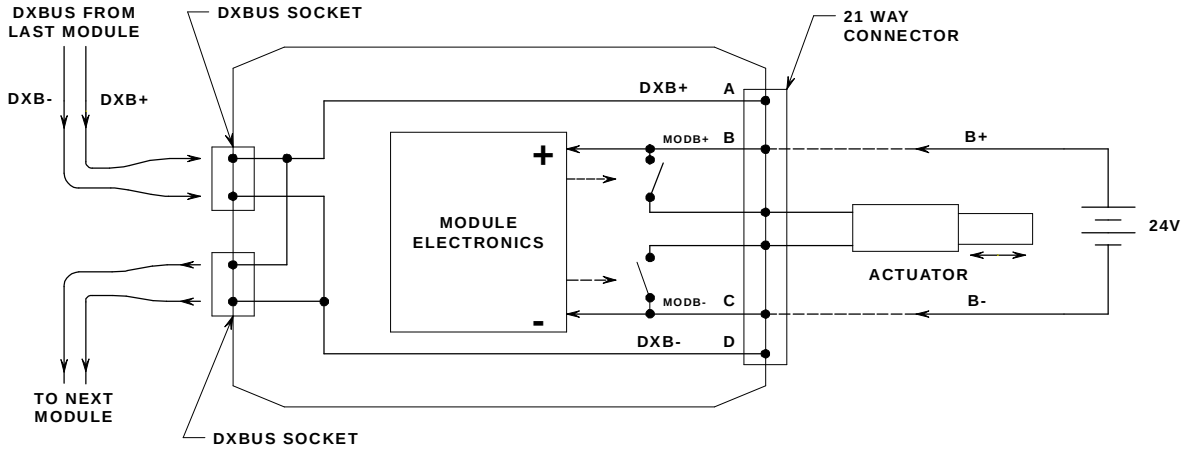
- full lighting control;
- control of 5 actuators;
- CLAM lighting and actuator current, sourced from the battery (section 5.6);
- connection of two actuator position switches which prevent the chair driving and two actuator position switches which limit the chairs speed.



Five Actuators Plus Lights - via Battery

5.6 Battery Supply

All DX modules that can drive heavy loads have an alternative voltage sourcing arrangement that allows the module / load current to be sourced directly from the battery rather than down the DXBUS.



Typical high current DX Module Power supply connections

The module's supply connections are brought out to two pins on the CLAM's 21-way connector. On the generic diagram above, these points are called "MODB+" and "MODB-". The connector pins associated with a specific module would be CLAM B+ / CLAM B- for a CLAM, LM B+ / LM B- for a Lighting Module, etc. The DXBUS supply, DXB+ and DXB-, is also made available on this connector.

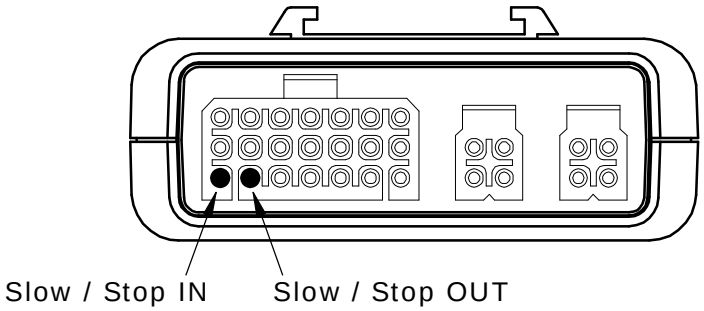
This arrangement allows module / load sourcing either from the DXBUS (by connecting point A to B and C to D), or directly from the battery (by connecting the battery directly to points B and C). The direct battery arrangement gives the dual benefits of allowing current greater than the DXBUS's 12A limit to be sourced, and reducing the DXBUS's DXB- voltage drop, which in turn allows more flexibility with the DX module interconnection topology.

In cases where the DXBUS can supply the current required but where the DXB- drop is marginal, a single direct connection from point C to D to battery negative will effectively parallel the DXBUS DXB- connection. This will give a lower impedance connection with a correspondingly lower voltage drop.

5.7 CLAM Slow / Stop Options

There are some states in which it may be dangerous to allow a wheelchair to drive. A common example of this is when certain actuators are extended or retracted. A back recliner in motion may cause the wheelchair to become unstable and so unsafe if travelling at speed. The CLAM has a Slow / Stop facility which allows the wheelchair to be totally inhibited, or its upper speed limited to a pre-set programmable value. This is a generic feature, independent of the type of DX Remote the CLAM is used with.

For complete manufacturer / dealer flexibility, this feature is implemented using a resistance loop connected between the CLAM's Slow / Stop Out and Slow / Stop In terminals. **Note that an open circuit between the Slow / Stop In and Slow / Stop Out pins will prevent the wheelchair from driving.**



CLAM Slow / Stop Terminals

The resistance of the loop is modulated by external micro-switches and resistors as required for individual applications. See the following section for an example circuit.

The CLAM recognises the following three bands of loop resistance :

1. Stop Band : a resistance greater than 65 KOhms, typically an open circuit, is interpreted as a request for a drive inhibit. This will cause a controlled stop if the chair is moving, or a chair drive inhibit if the chair is already stopped.

2. Slow Band : a medium resistance of between 9.5 KOhms and 52.5 KOhms is interpreted as a request to re-scale the joystick gain so that the maximum speed attainable at maximum joystick deflection is limited to a pre-set value. The speed is ramped down for maximum safety and comfort.

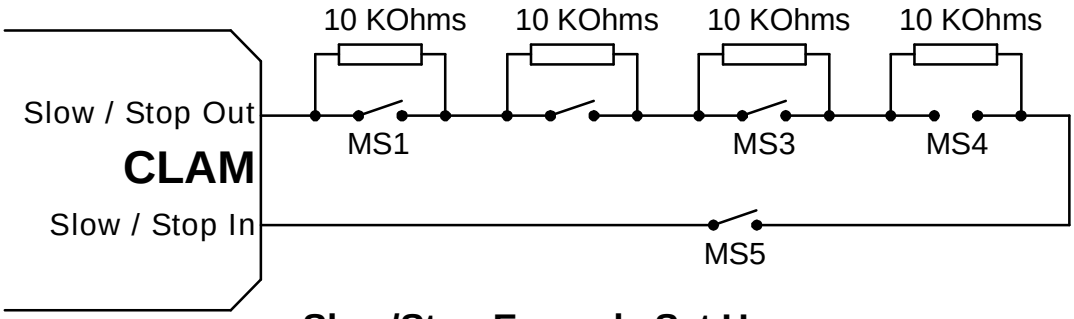
3. Normal Band : a low resistance below 5 KOhms, typically a short circuit, is interpreted as the normal driving condition. A wire link may be connected between the two terminals to provide the short circuit.

When the Slow / Stop loop is in the Slow or Stop band, a Flash Code 2 indication (Accessory Fault) will show on the DX Remote's System Status LED. When the loop is in the Stop band, an inhibit indication is given; see the relevant DX Remote Manual for details.

Transition between the three bands is achieved by using micro-switches to switch resistors in and out of the loop depending on the position of the active device. The suitable location of the micro-switches is determined by the wheelchair manufacturer or dealer. A resistor of 10K (5%, .25W) is recommended for each Slow requirement, up to a maximum of 50K worst case loop resistance (i.e. all Slow micro-switches open).

5.7.1 Slow / Stop Example

The diagram below shows a Slow/Stop loop in which five devices monitored by the CLAM have associated safety micro-switches attached, MS1 - MS5.



Slow/Stop Example Set Up

When all devices are in their home position the micro-switches are all closed and there is no resistance between the Slow / Stop In and Slow / Stop Out CLAM terminals. This is therefore the Normal condition and driving may proceed normally.

If device 5 is operated such that MS5 opens, the loop becomes open circuit and drive is inhibited until the actuator is returned to its home position.

If one or more of devices 1 - 4 are operated, the loop becomes medium resistance (between 10K and 40K) and the drive is not inhibited but the maximum speed is reduced to a preset limit (see section 5.7.2). This condition exists until all micro-switches MS1 - MS4 are closed.

5.7.2 Defining the Slow Speed

The speed to which the chair is limited when in the Slow mode is set using the Wizard with the "CLAM Slow Down" parameter. This is in units of percentage of maximum possible motor voltage (24V nominal) and may be set anywhere between 0 (total stop) and 100% (no effect). See section 6.1.2

6 Programming

6.1 Wizard Programmable CLAM Parameters

Programmable parameters relating to the CLAM are contained in the DX Remote program. This program can be modified using the Wizard (Programming, Configuration and Diagnostics tool).

To view and/or edit these parameters :

1. Enter the Wizard's Main Menu screen as described in the Wizard Installation Sheet.

2. Use the keyboard or the mouse to select the File, Open menu option.

3. Select the "SuperChair, Deluxe" program from the file dialog box.

4. Select the "Edit Module Parameters" menu option.

5. Select either "UCM Remote - Actuator Settings" or "UCM Remote - Lighting Settings".

6. Scroll through the list of parameters and adjust as necessary.

7. Press «Enter» to accept the changes or «Esc» to exit without saving. Select the File, Save menu option. These values will now be part of the Chair Program for the "SuperChair, Deluxe".

Listed on the following pages are the relevant CLAM parameters and their functionality.

6.1.1 CLAM Parameters

Accessibility of the Wizard parameters is dependant on the Dongle level used with the Wizard. See the Wizard Online Help for details about Dongle access. Some parameters can be both viewed and edited by a Wheelchair Manufacturer (OEM) or a Dealer. Other parameters can be viewed but not edited. Some parameters are not displayed for lower level Wizards.

The Wizard parameters related to CLAM operation are mostly grouped together and have the following functions :

6.1.2 Actuator Settings

CLAM Enable State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View / Edit

Must be set to 'Yes' for CLAM operation.

CLAM is Critical State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

If set to 'Yes', CLAM (or TAM) **must** be present in the system and operating normally.

If set to 'No', the wheelchair will drive normally with no CLAM attached. Providing that safety micro-switches are not required and all CLAM parameters have been preprogrammed, this is a useful factory setting. It allows a CLAM to be added later to wheelchair systems that do not have one fitted, without needing the HHP or Wizard.

CLAM Slow Down Range : 0 - 100 % Default : 20 %
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

Set to a required percentage of maximum wheelchair speed allowed when an actuator is active. For this facility to be used the hardware of the wheelchair must be arranged as described in section 5.7.

Actuator 1 Enable State : yes / no Default : yes
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

If set to 'Yes', Actuator 1 is enabled.

If the Actuator 1 Enable parameter is set to ‘No’, there will be no response to a DX Remote actuator button being pressed (other than a “beep” on some varieties of DX Remotes).

Actuator buttons can be disabled if the DX Remote used in a system has more actuator buttons than the number of actuators fitted to the wheelchair.

Actuator 2 Enable State : yes / no Default : yes
Actuator 3 Enable
Actuator 4 Enable
Actuator 5 Enable
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

Up to five actuators can be enabled using the Wizard, with different current limits. A DX Remote with up to five actuator selection possibilities can select an actuator and it will then be assigned the pre-programmed current limit for that number actuator.

Actuator 1 Current Limit Range : 3 - 12Amps Default : 6 amps
Actuator 2 Current Limit
Actuator 3 Current Limit
Actuator 4 Current Limit
Actuator 5 Current Limit
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

Sets the current trip point for each actuator between the allowable range of 3 - 12A. See sections 6.1.5 and 6.1.6 for details.

Actuator Timeout Range : 1 - 120 seconds Default : 30 seconds
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

Sets the maximum time a wheelchair user can continuously operate any actuator.

Actuator Open Circuit Test State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : Not Available

When set to 'Yes', an open circuit at the actuator output pins of the CLAM will cause a Flash Code 2 to be displayed (see section 7). The wheelchair will still drive.

ARC Enable State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View / Edit

Set to 'Yes' if an ARC (Actuator Remote Control) is to be used for actuator control. Set to 'No' if actuators are controlled by buttons or the joystick on a DX Remote.

Joystick Actuator State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View / Edit

Set to 'No' if button operation of actuators is required.

Set to 'Yes' if joystick operation of actuators is required. An actuator button will now select the actuator but will not cause it to operate. If the wheelchair is driving when an actuator is selected, it will stop driving.

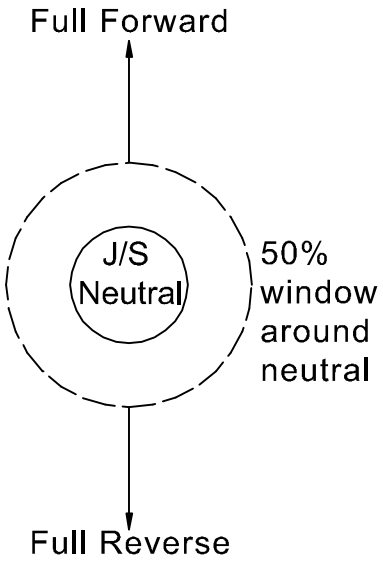
Refer to section 6.1.4 Actuator Control.

Num Actuator Buttons State : one / two Default : two
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View / Edit

When set to ‘1’, pressing one button or moving the joystick forward, will toggle between the actuator up/extend and actuator down/retract with each repetition of the action.
Set to ‘2’ if one button or joystick forward is used for actuator up/extend and a second button or joystick down is used for actuator down/retract.

Refer to section 6.1.4 Actuator Control.

Actuator While Driving State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only



If set to 'No', the wheelchair will not drive while an actuator is being operated. If the wheelchair is driving, the actuator command will be ignored until the joystick returns to neutral.

If set to 'Yes', pressing the actuator button will stop the wheelchair from driving and select the actuator. The joystick can not be used to operate the actuator until it has returned to within the 50% window around neutral.

If the Joystick Actuator parameter is set to 'No', actuators can be operated irrespective of the driving state of the wheelchair.

6.1.3 Lighting Settings

Lighting Module Enable State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

Set to 'No' if Combined Lighting Actuator (CLAM) based lights are used. Set to 'Yes' for Lighting Module (LM) operation.

CLAM Lighting Enable State : on / off Default : on
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

Set to ‘On’ for CLAM operation, ‘Off’ in all other cases.

Side Lights Enable State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

If set to ‘Yes’, Side Lights, if fitted, can be operated. If set to ‘No’, there will be no response.

Indicators Enable State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

If set to ‘Yes’, Indicators, if fitted, can be operated. If set to ‘No’, there will be no response.

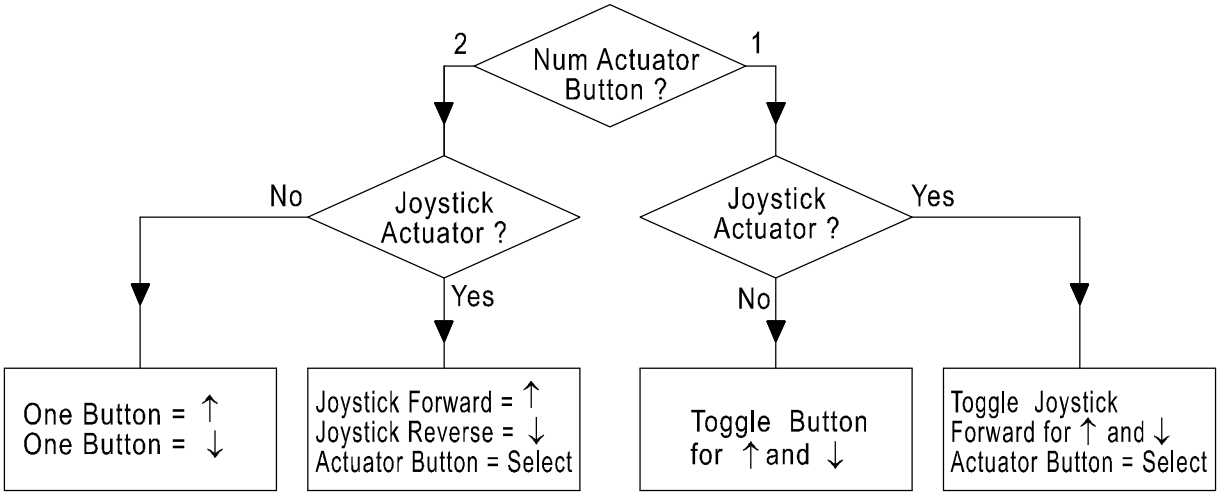
Hazard Lights Enable State : yes / no Default : no
OEM Access : View / Edit
Enhanced Dealer Access : View / Edit
Dealer Access : View only

If set to ‘Yes’, Hazard Lights, if fitted, can be operated. If set to ‘No’, there will be no response.

6.1.4 Actuator Control

Some DX Remotes have two buttons available for control of each actuator while some have only one. Those with two buttons may still be set up to operate the actuator using just one button. Similarly the ARC, which has two buttons per actuator, may be set up to use only one button per actuator, or can be used for selection of the actuator only if the 'Joystick Actuator' parameter is set to Yes.

↑ = up or extend
↓ = down or retract



Button / Joystick Wizard Selection

6.1.5 Actuator Current Limits

Most actuators require over current protection to prevent burn out, damage to magnets and/or mechanical components. Each actuator has a current limit independently set to between 3A and 12A, which will cause the actuator output to shut down if the current limit set for that actuator is exceeded. The shut down condition disappears when the actuator is retracted but will reappear if the actuator is again extended and the cause of the fault still exists.

The manufacturer of the actuator is the best source for determining the correct current limit for an actuator. Actuators that use micro-switches to stop the actuator at each end of the stroke may have their current limit set quite high. The current limit will then act as secondary protection in the event of micro-switch failure or actuator overload.

The current limit feature may be used as an automatic end-of-travel for actuators without micro-switches. When the actuator hits the fixed mechanical end stop the current will rapidly rise. When current limit is reached the actuator will stop. This method is not recommended for actuators with marginal power output for the intended load. The current limit needs to be set higher than the maximum expected load current under normal conditions, for example, with fully charged batteries and maximum load applied. This will prevent nuisance trips, but must not exceed the maximum allowed current specified by the actuator manufacturer.

$$I_{\substack{\text{maximum}\\\text{expected}\\\text{load current}}} < I_{\substack{\text{current}\\\text{limit}\\\text{setting}}} \leq I_{\substack{\text{manufacturers}\\\text{maximum}\\\text{current spec.}}} < I_{\substack{\text{DXBUS}\\\text{maximum}\\\text{(see section 5.4.3)}}}$$

6.1.6 Actuator Current Limits - Alternative Formula

If the difference between the 'Maximum Expected Load Current' and the 'Manufacturers Maximum Current Specification' is too tight to be assured of a correct value, this formula should be used. This formula also takes into account the effect of temperature on the actuator and any related current value changes.

1) Measure or determine from the actuator specifications the maximum current the actuator will draw in normal operation under worst case conditions:
- largest "normal" mechanical load;
- highest expected battery voltage (30V);
- lowest operational temperature.

This value is referred to as I_{NORM}

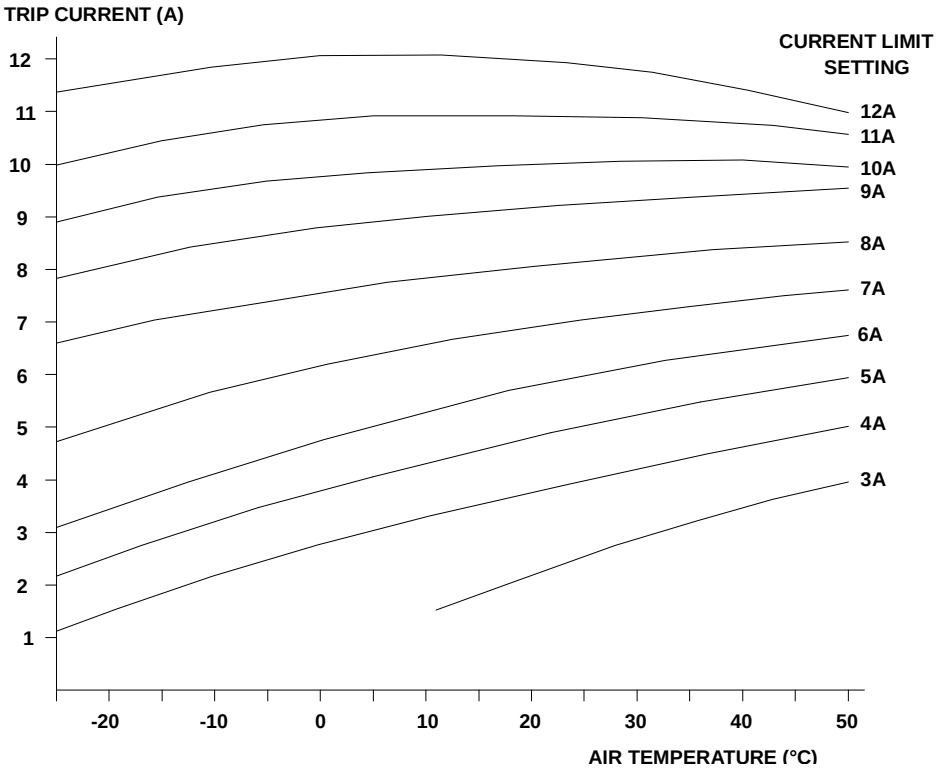
2) Measure or determine from the actuator specifications the minimum current the actuator will draw under stall conditions:
- stalled actuator;
- lowest expected battery voltage (18V);
- highest operational temperature.

This value is referred to as I_{STALL}

3) Entering a current limit value of "I" causes the CLAM to current limit at the nominal value of "I", but with the following tolerances:

a) Nominal Tolerance of current limit value.
The actual current limit may differ from the value entered in the Wizard by ± 2 amps.
For instance, setting a value of 8A can give an actual current value of between 6A and 10A.

b) Temperature dependency of current limit value.
There may be an additional inaccuracy from the nominal current limit value due to changing temperature of the CLAM. Consult the following family of curves to determine the spread of current limit over the expected temperature range.



Typical relationship between current limit and temperature

The entered value must be chosen so that:

a) At the lowest operational temperature, and at the "-2A" tolerance, the actuator does not nuisance trip under normal conditions.

b) At the highest operational temperature, and at "+2A" tolerance, the actuator will reliably trip under stall conditions.

The best value is chosen as follows:

1) Draw horizontal lines at the I_{STALL} and I_{NORM} values.

2) Draw vertical lines at the lowest and highest operational temperature values.

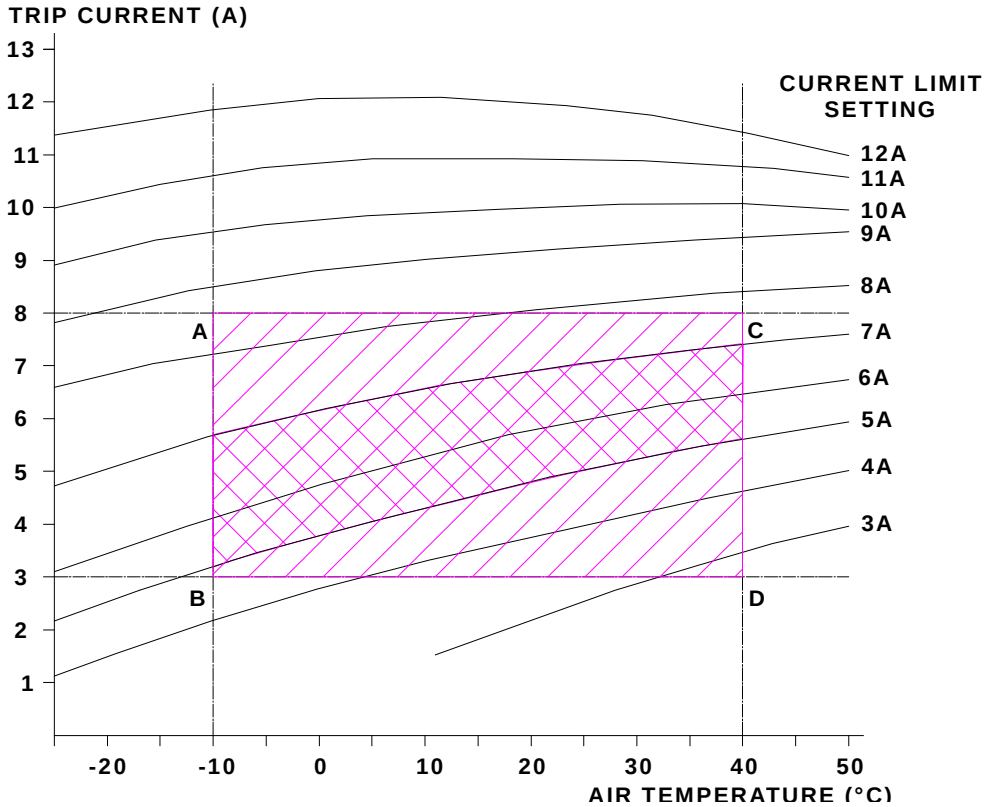
3) Find the most central 3 curves that pass through the area contained within the resulting corners "A" and "B", and "C" and "D".

4) The current value of the middle of these 3 curves is the best current setting.

For example,

I_{STALL} = 8
I_{NORM} = 3
T_{LOW} = -10 degrees
T_{HIGH} = +40 degrees

It can be seen that the most appropriate current limit value to enter is 6A.



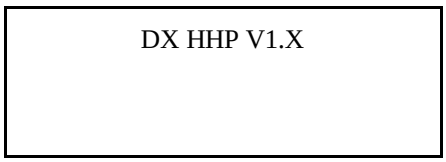
Selecting appropriate current limit setting

6.2 HHP Programmable CLAM Parameters

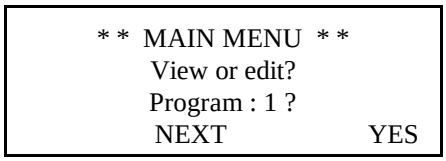
A DX System must have a parameter set in order to use a CLAM with the system. This parameter is called "CLAM Enable / Disable" and is accessible using the DX HHP (Hand Held Programmer). If the CLAM is later removed from the DX System and the parameter remains set to Enable, the system may still function normally, depending on other parameters (see section 6.1).

To Enable/Disable a CLAM, proceed as follows :

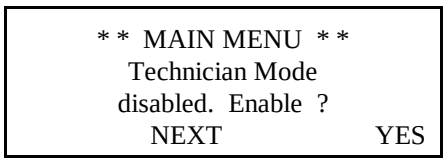
1. Plug HHP into the Programmer Socket on the DX Remote and turn the DX System on. The initial screen appears for two seconds.



2. Then the main menu screen appears.

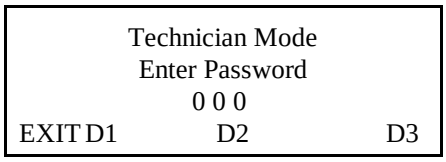


3. Press 'NEXT' until the Technician Mode screen appears.



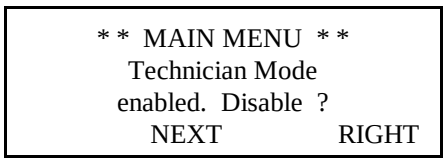
Pressing 'YES' toggles this screen between Technician Mode Enabled and Technician Mode Disabled. If disabled, press 'YES' to enable.

4. Press 'NEXT' and a password screen will appear. Enter the three digit password.

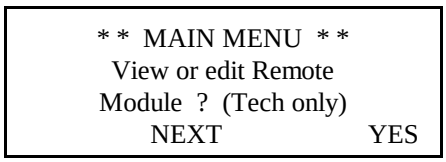


Press the D1, D2 and D3 buttons to cycle each digit through to the correct password. When the password reads correctly, press the 'EXIT' button.

5. The screen now reads :

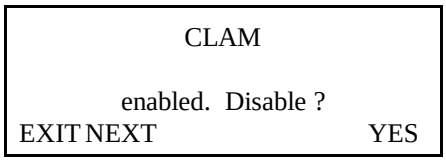


6. Press 'NEXT' until the screen reads :



Press 'YES'.

7. Press 'NEXT' until the screen reads :



Press 'YES' to toggle Enabled / Disabled. Setting the CLAM to 'Enabled' allows the CLAM to be used in the DX System.

8. When required state is shown, press 'EXIT'. The parameter setting is now saved. Unplug the HHP and turn off the DX System.

7 Diagnostics

7.1 DX System Fault Handling

Any fault condition on the DX system will cause the DX Remote's System Status indicator (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.

There are only two DX faults that are CLAM related. These are :

- Flash Code 1 : DX Module Fault
- Flash Code 2 : DX Accessory Fault

Refer to the DX Remote Installation Manual for a full list of Flash Codes.

Faults that affect the safety of the chair will cause the chair to stop, while less critical ones will be indicated but allow the chair 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 controller off, wait 5 seconds, then turn the system on again.

7.2 CLAM Specific Faults

7.2.1 General CLAM Connection Faults

CLAM connection faults usually result in a DX Module Fault (Flash Code 1) on the DX Remote's System Status LED. If the CLAM will not operate or operates incorrectly, check :

1. The CLAM's Status indicator is on steady. It is situated within the "D" of the DX symbol on the CLAM label. If it is off when the system is turned on, the CLAM, or the DXBUS connection to it, is faulty.

   Note that the CLAM is controlled by the DX Remote and is not able to detect and indicate all possible faults.

2. Check the reliability of the DXBUS plug connection to the remainder of the DX system.

3. Replace either the CLAM or the DXBUS cable where necessary.

7.2.2 CLAM Programming Related Faults

The CLAM 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 6.1 to ensure they are correctly set up for your application.

7.3 Connected Device Faults

Faults with devices connected to the CLAM usually result in a DX Accessory Fault (Flash Code 2) on the DX Remote's System Status indicator. Possible causes are:

Actuator open circuit	Micro-switches are commonly used to terminate actuator movement at its end and this condition can not be detected or indicated if the "Actr Open Cir Test" parameter is set to 'No'. If set to 'Yes' then a non-latching DX Accessory Fault will occur either when a micro-switch is open, or if the actuator becomes open circuit for any other reason.
Actuator short circuit	All actuator outputs are protected by the "Actuator ILim" current limit feature. However, since this feature is commonly used to sense detection of actuator end stops, exceeding the current limit is not considered a fault and does not initiate a fault condition.
Either actuator terminal to Battery + or -	Causes a latching DX Accessory Fault. The fault must be removed and the wheelchair turned off and on again to clear the fault.
Light Bulb open circuit	Causes a non-latching DX Accessory Fault. Detected on attempted activation of the light.
Light Bulb output short to B+ or 0V	Causes a latching DX Accessory Fault. Detected on activation of each light.
Slow/Stop Loop out of "Normal" band	This causes a DX Accessory Fault although the Slow / Stop feature is used in normal operation. The fault indication is given to remind the user that the cause of the wheelchair slowing or stopping is intentional, rather than a fault requiring a service call. If however the connections to the Slow / Stop pins have become disconnected, or nothing has ever been connected, Flash Code 2 will be displayed and the wheelchair will not drive until this condition is rectified.

8 Abbreviations

Abbreviation	Expansion / Explanation
ACU	Attendant Control Unit. A DX Module containing a joystick that is used by someone other than the person in the wheelchair to control the wheelchair.
ARC	Actuator Remote Control. A DX Module consisting of switches to control up to five actuators.
CAN	Controller Area Network
CANH	Controller Area Network High line. One of the four wires which make up the DXBUS.
CANL	Controller Area Network Low line. One of the four wires that make up the DXBUS.
CLAM	Combined Lighting and Actuator Module. A DX Module with five actuator and three lighting outputs.
DX	Dynamic Control Modular Mobility System
DXBUS	The DX System communication CAN communication lines plus power supply to DX Modules.
ESD	Electrostatic Discharge
HHP	Hand Held Programmer. The HHP can be used by both DX System and all DLxxUxxx Controllers.
ISO	International Standards Organisation
LED	Light Emitting Diode
LM	DX Lighting Module. A DX Module with lighting outputs.

Abbreviation	Expansion / Explanation
OEM	Original Equipment Manufacturer. Generally refers to the wheelchair manufacturer.
OONAPU	Out Of Neutral At Power Up. A fault condition produced if the DX System is turned on while the joystick is not in the neutral (non-driving) position.
PM(x) / PMB(x)	DX Power Module. The DX Module that produces the DX System output to the motors and park brakes.
RFI	Radio Frequency Interference.
RJM	Remote Joystick Module. A DX Module that contains a joystick only, and can be used to control the wheelchair instead of the DX Remote used in the DX System.
TAM	Two Actuator Module. A DX Module with two actuator outputs.
TÜV	A German Safety Standards Authority.
UCM	User Control Module. The core component of all DX Remotes. The name is sometime used interchangeably with DX Remote.
Wizard	A PC based Programming, Configuration and Diagnostics tool used by the DX System.

9 CLAM Accessory Parts List

Part / Order Number	Part Name	Page Reference
GBK60007	DX-HHP Installation Manual	2
GBK61163	Dynamic Wizard Installation Sheet	2
GBK63824	DX-PMB Installation Manual	2
GME60525	DX Aux. Mod. Lock	10-11
GME60526	DX Aux. Mod. Tube Clamp A	10
GME60527	DX Aux. Mod. Tube Clamp B	10
GSC0052	M3 x 8 CSK Screw	10-11
GSC0170	M3 x 10Plastite Screw	10
GSC0175	M3 x 12 Plastite Screw	10
GSC0180	M3 x 16 Plastite Screw	10
GCN0792	DXBUS (dummy) Connector Housing	11
GSM630012	DXBUS Cable, straight 0.12 M	12
GSM63003	DXBUS Cable, straight 0.3 M	12
GSM63005	DXBUS Cable, straight 0.5 M	12
GSM63010	DXBUS Cable, straight 1.0 M	12
GSM63015	DXBUS Cable, straight 1.5 M	12
GSM63020F	DXBUS Cable, Ferrite, 2.0 M	12
DX-SKT-X4	DX Splitter Box	13
GCN0793	DX Positronics Contact, FC114N2, (Lge)	17
GCN0794	DX Positronics Contact, FC114N2, (Sml)	17
GCN0795	DX 21-way Plug Housing	17
GCN0796	DX 21-way Plug Boot	17

See Dynamic Controls or a Sales and Service Agent for information regarding other parts and their availability.

10 Revision Changes

This section lists the changes implemented into this manual from previous revisions.

Page / Section	Change	Approval
Section 16	EMS phone number changed	PCO 2754
Section 11	Disclaimer added	PCO 2766
Section 12	Electromagnetic Compatibility Section added	PCO 2766
Section 14	Safety and Misuse Warnings rewritten	PCO 2766
Various	Reformatted and content reviewed.	

11 Product Disclaimer

Dynamic Controls Ltd. products built today allow our customer's vehicles to conform to national and international requirements.

In particular to:	**ISO7176-9**	Climatic Tests for Electric Wheelchairs.
	ISO7176-14	Power and Control Systems for Electric Wheelchairs.
	ISO7176-21	Requirements and test Methods for Electromagnetic Compatibility of Electric Powered Wheelchairs and Scooters.

However the performance of controllers fitted to wheelchairs and scooters is very dependant on the design of the scooter or wheelchair so final compliance must be obtained by the vehicle manufacturer for their particular vehicle. No component compliance certificate issued by Dynamic Controls Ltd. relieves a wheelchair / scooter manufacturer from compliance testing their particular vehicles.

If Dynamic Controls Ltd. controllers are fitted to vehicles or applications other than wheelchairs and scooters, testing to appropriate standards for the particular application must be completed as ISO7176 may be inappropriate.

12 Electromagnetic Compatibility (EMC)

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

Emissions:	**CISPR22, class B**
Susceptibility:	**IEC1000-4-3**
ESD:	**IEC1000-4-2**

Compliance levels and set-up as per **ISO 7176, part 21.**

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.

Minimising Emissions

Motors : Motor brushes generate electromagnetic emissions. It may be necessary to fit capacitors between the brush holders and motor case. Ensure the leads are kept as short as possible.
A suitable capacitor is 4n7, 250V Ceramic.

Wiring : Keep wire lengths as short as practical for a tidy layout.
Minimise 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 minimising emissions.

Immunity to ESD

Follow the wiring recommendations for minimising emissions.
Ensure all vehicle sub-frames are electrically connected.
Ensure speed setting potentiometers are electrically connected to the vehicle frame.
Do not leave connections unnecessarily exposed.

13 Maintenance

- The DX System should be regularly checked for integrity. Loose, damaged or corroded connectors or terminals, or damaged cabling should be replaced.

- All switchable functions on the DX System should be regularly tested to ensure they function correctly.

- All DX System components should be kept free of dust, dirt and liquids. If necessary wipe with a cloth dampened with warn water or alcohol. Do not use solvents or abrasive cleaners.

- Where any doubt exists, consult your nearest Service Centre or Agent.

- There are no user-serviceable parts in any DX System component - do not attempt to open any case.

Warning : If any DX 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.

14 Safety and Misuse Warnings

Do not install, maintain or operate this equipment without reading, understanding and following the proper instructions and manuals, otherwise injury or damage may result.

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

A warning must be conveyed to the wheelchair operator 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.

Performance adjustments should only be made by professionals of the health care field or persons fully conversant with this process and the drivers capabilities. Incorrect settings could cause injury to the driver, bystanders, damage to the chair and surrounding property.

After the wheelchair has been set up, check to make sure that the wheelchair performs to the specifications entered in the programming procedure. If the wheelchair does not perform to specifications, turn the wheelchair off immediately and re-program. Repeat procedure until the wheelchair performs to specifications.

Do not operate the DX System if it behaves erratically, or shows abnormal response, 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 your 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.

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 the manufacturer has made every effort to ensure that RFI does not cause problems, very strong signals could still cause a problem. If RFI causes erratic behaviour, shut the wheelchair off immediately. Leave off while transmission is in progress.

In the event of a fault indicator flashing while driving (battery gauge and/or Status LED), the user 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.

15 Warranty

All equipment supplied by Dynamic Controls Ltd 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.

The Warranty is subject to the provisions that the equipment:

- 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 authorised by Dynamic Controls Ltd.
- Has been used solely for the driving of electrically powered wheelchairs in accordance with the wheelchair manufacturer's recommendations.

16 Sales and Service Information

For Sales and Service advice, or in case of any difficulty, please contact:

Head Office

Dynamic Controls Limited
Print Place
Christchurch
New Zealand

Telephone: Int. 64 3 338 0016
Fax: Int. 64 3 338 3283

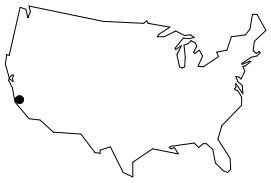
Australia

Electronic Mobile Service (EMS)
46 Berripa Close
North Ryde, Sydney
NSW Australia 2113

Tel. 24 hr: Int. 61 2 9887 2824
Pager: Int. 61 2 9963 1778
Fax: Int. 61 2 9887 2114

North America

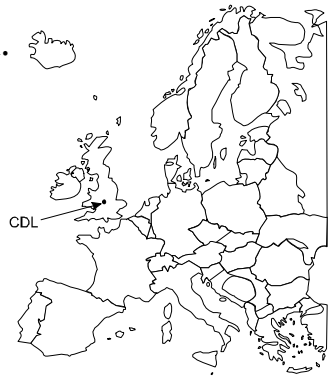
Rosstron Inc
1521 W. 259th St
Harbor City, CA 90710
USA



Telephone: Int. 1 310 539 6293
Fax: Int. 1 310 539 4078

Europe

Controls Dynamic Ltd.
Lisle Avenue
Kidderminster
DY11 7DL
United Kingdom



Telephone: Int. 44 1562 820 055
Fax: Int. 44 1562 742 720

Note : The controller should be clearly labelled with the manufacturer's service agent's telephone number.