DX™

Modular
powerchair control system

dynamic™

DX SYSTEM MANUAL

About this Manual

This manual can help you understand and install the Dynamic Controls DX System.
It describes the general principle, but it gives no guidelines for specific applications. If there is a specific requirement for your application, please contact Dynamic Controls or one of the sales and service agents, to assist you.

This manual must be read together with all other relevant DX Module or DX component manuals, as well as all applicable Dynamic TSBs, application notes and service instructions.

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

Notes & Precautions:

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

Warnings:

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

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

*The term **'accessory'** used in this manual refers to equipment that is ancillary to the main functioning of the DX system. It does not refer to an accessory of the powerchair. The DX System is a component of the powerchair.*

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

Do not install, maintain or operate this equipment without reading, understanding and following this manual – including the Safety and Misuse Warnings – otherwise injury or damage may result. This manual contains integration, set-up, operating environment, test and maintenance information needed in order to ensure reliable and safe use of the DX System.

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

Dynamic reserves the right to change the product without notification.

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

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Contents

1 Introduction to the DX System

The DX-system is a modular powerchair control system. This modularity makes it possible to design a powerchair that can meet the requirements of any user - requirements that can range from simple drive-only control to full environmental control. Just add additional modules when requirements grow.

The heart of the DX System

The most basic DX control system consists of two parts:

A DX Power Module, connects to the battery and to the motors

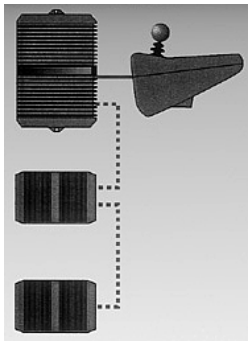
A DX Master Remote

The Master Remote is the brain of the DX System. Every DX System must have one, and only one. There are several different Master Remotes available to choose from: with joystick, without joystick, chin remote, attendant remote, etc.

DX System extensions

In addition to the Power Module and the Master Remote, many other remotes and modules are available to extend the DX System, like:

- Secondary Remotes, for example: attendant remotes, sip ‘n puff, finger steering
- Switch input modules
- Lighting and Seating control modules
- Environmental control modules



The DX System can be extended to a maximum of 16 modules.

DX System connections

All modules are connected to each other by a DX BUS cable. Most DX Modules have two DX BUS connector sockets. That way you can connect another DX part easily.

DX BUS is an interface (the way the modules "talk" to each other) based on the CAN interface, which is widely used in the automotive industry. CAN is well known for its reliability and its fault detection. DX BUS inherits this reliability, and even improves on it.

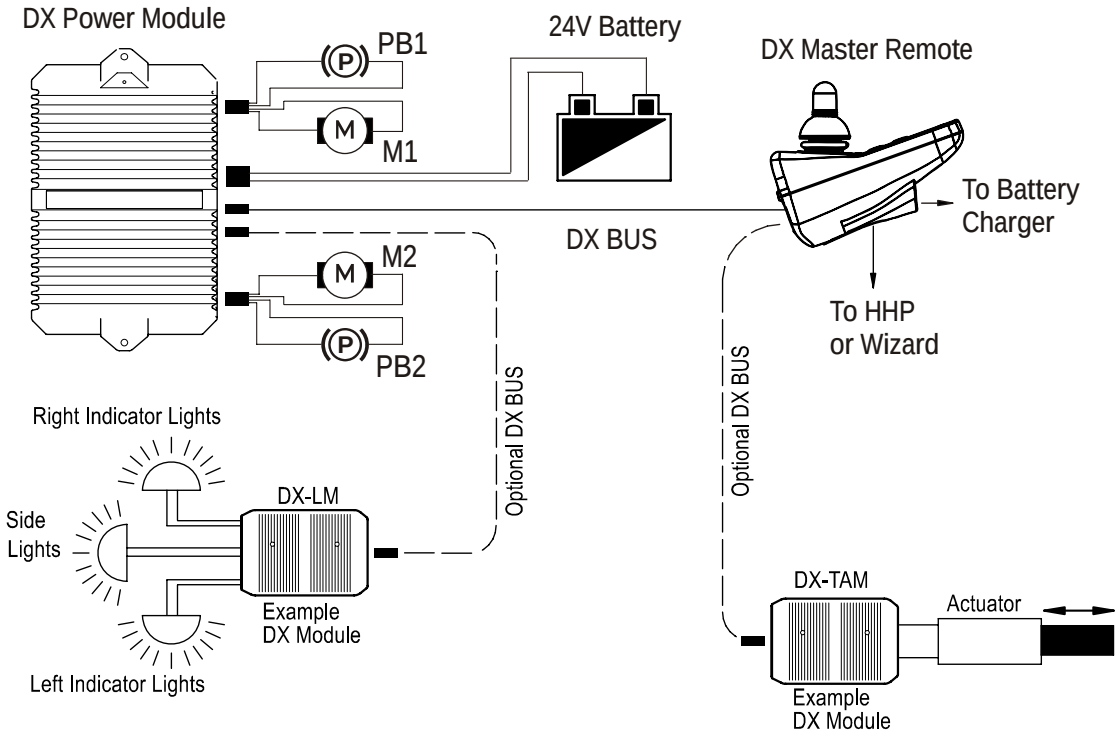
One system fits all

Start out with a simple system and add the modules you need at the time they become available, or when the application requirements grow. See the Dynamic Controls product catalogue for the latest additions to the product range.

2 A typical DX powerchair setup

A standard powerchair installation with the DX System consists of the following electrical parts:

	The Batteries (section 2.2)
	The Motors (section 2.3)
	The Parkbrakes (section 2.4)
	A DX Power Module (chapter 4)
	A DX Master Remote (chapter 5)
	The DX BUS cables (section 3.1)
	Optional: Actuator or Lighting Modules (chapter 6)



2.1 Installation procedure

To install the DX System safely:

- First read and understand the DX System manual and the manuals of all the used DX components.
- Mount all the electrical parts of the powerchair setup (motors, parkbrakes, batteries, DX Modules and remotes) on the powerchair. See the manuals of the used DX Modules for the physical dimensions and mounting recommendations.
- Do not connect any cables before all the parts of the DX System are mounted.
- Connect the DX Power Module to the rest of the DX System with the DX BUS cables (see section 2.1.1 for general wiring recommendations).
- Cover any unused DX BUS sockets with a GME64909 DX BUS Connector Cover.
- Connect the DX Power Module to the motors (see section 2.3.2) and the park brakes (see section 2.4.2).
- Connect the DX Power Module to the batteries (see section 2.2.4.1).
  Do not turn on the DX System yet.
- Lift the powerchair off the ground and check the installation thoroughly (see section 8.1)
- Program the system to the requirements of a particular powerchair or user (see chapter 7).
- Test the system for functionality and safety (see chapter 8).

Warning:

Do not connect the '+' terminal of the battery to the DX System until the powerchair is completely wired and ready for testing as described in the Testing section (chapter 8).

2.1.1 General wiring recommendations

- Keep all cables as short as possible.
- Try to run wires in pairs or bunches.
- Do not route the motor cables near the motor case, where possible.
- Avoid wire loops, especially loops of single wires instead of wire pairs.
- Fasten cables to the powerchair frame to prevent strain on the connectors.
- Do not leave electrical connections unnecessarily exposed.
- Make sure that all vehicle sub-frames are electrically connected.
- To minimise electromagnetic emissions by the motor brushes, it may be necessary to fit capacitors between the brush holders and the motor case. Make sure that the leads are kept as short as possible. A suitable capacitor is 4n7, 250V Polypropylene.
- For low-current signals, do not use wire sizes smaller than 0.5 mm²/AWG20, because smaller wires are physically not strong enough for this application.
- For best electrical performance, the wire size must be as large as possible.

Maximum Wire Current	Recommended Minimum Wire Size
Power Module	
60A	3 mm² / AWG 12
80A	4 mm² / AWG 11
100A	6 mm² / AWG 9

The Power Module wire sizes above are appropriate for cable lengths up to 400 mm / 15". For longer cables, increase the wire size by 0.5 mm² for every additional 200 mm / 7.5" in length. Generally, the larger the wire size, the better the powerchair performance will be.

- Do not use damaged or abused cables. A damaged cable can potentially produce localised heat, sparks or arcing and as such it can cause a fire.
- Protect all cables against possible contact with flammable material.
- Where possible, the installation must prevent and/or discourage the user to disconnect the DX BUS cable.

Warning:

1. *Route the cables and fasten all DX components in a position so that the cables, the connectors and the connector sockets do not allow water entry or suffer from physical strain, abuse or damage, like cutting or crushing. Take particular care on powerchairs with movable structures like seat raise/tilt or swing-away arms. Make sure that the cables do not extend from the powerchair so that they can not be caught or damaged by external objects.*
2. *The DX BUS cable distributes 24V power to the DX modules, even when the system is switched off. Avoid short circuit between the DX BUS cable pins whenever a DX BUS connector is removed from its socket. Make sure that the DX BUS connector can not reach potential shorting points. If any protruding, bare metal screws or pins are within reach of a DX BUS cable end, cover or plastic-coat them to make sure that they do not cause short circuits between DX BUS cable pins. Disconnect all the cables of the powerchair at the powered end whenever units are replaced or moved.*
3. *The user maintenance schedule and the service instructions of the powerchair must include the appropriate inspection and maintenance requirements for the connectors and the cables.*

2.2 The batteries

The batteries provide the energy for the powerchair to drive. The batteries are connected to the DX Power Module. The DX Power Module sends the energy of the batteries to the motors and to the other modules.

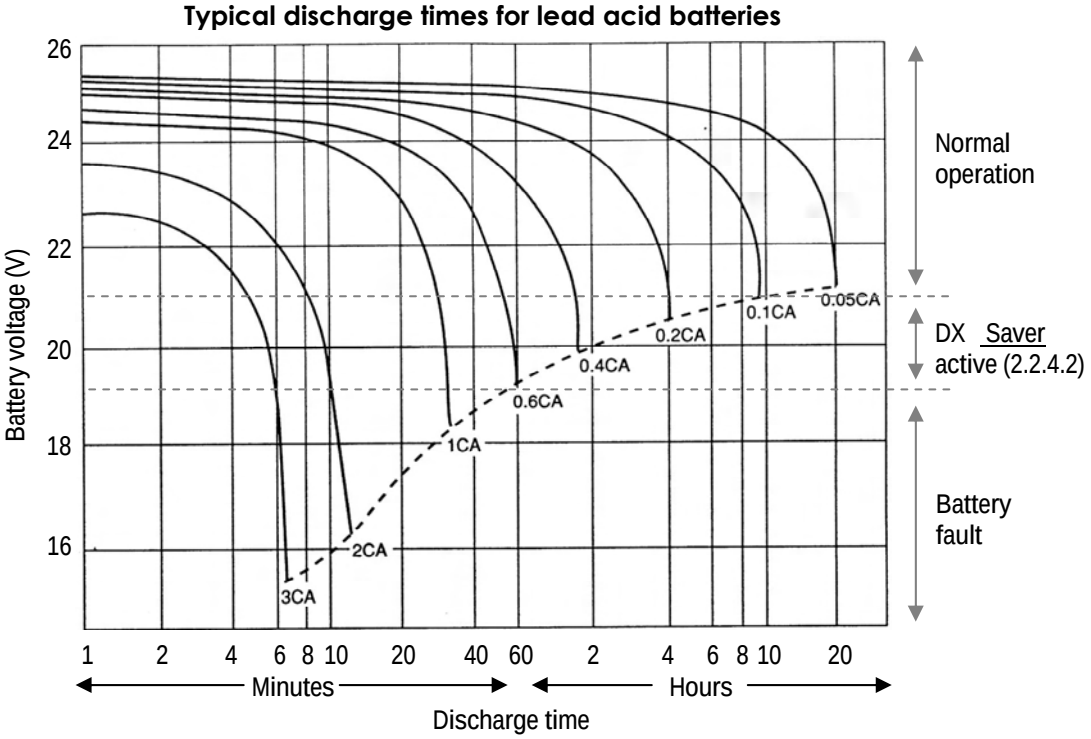
The batteries must be operated and maintained according to the instructions of the battery manufacturer.

2.2.1 Battery type

- 24V (commonly 2 x 12V)
- Lead-Acid / Deep Cycle Gel Cell
- Rated capacity: 20 – 120 Ah (dependent on application and Power Module)

2.2.2 Battery capacity

Choose a battery capacity that is compatible with the intended use. This ensures that the required chair range and/or operating time is achieved.



The rated capacity in Ampere-hours (Ah) of a battery is usually specified for a 20 hour discharge rate (or 0.05 CA, a current of 5% of the rated capacity). A higher continuous discharge current dramatically reduces the available battery capacity. As the graph shows, when the discharge current equals the rated capacity (1 CA),

the battery does not last the expected one complete hour, but only 30 minutes, giving an actual available capacity of only 50%.

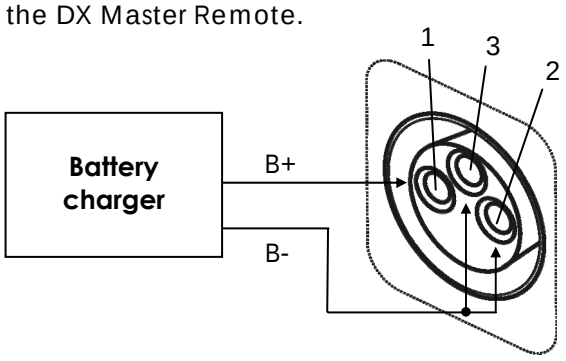
Rated capacity	Average discharge current	Actual capacity
20 Ah	40 A (2 CA)	5 Ah (25%)
20 Ah	20 A (1 CA)	10 Ah (50%)
20 Ah	12 A (0.6 CA)	12 Ah (60%)
20 Ah	8 A (0.4 CA)	15 Ah (75%)
20 Ah	1 A (0.05 CA)	20 Ah (100%)

Notes:

1. *Dynamic Controls recommends to use batteries with a capacity that is at least twice as high as the average discharge current.*
2. *New batteries often start with only 80% of their rated capacity. After a few charging cycles the capacity will increase to 100%.*
3. *Deep discharging or overcharging dramatically decreases the capacity of the battery. This damage is permanent, the battery will never return to its original capacity.*
   See also section 9.5: Battery warning conditions.

2.2.3 Battery charging

The battery charging socket of the DX System is a 3-pin XLR type normally located on the DX Master Remote.



Pin	Signal
1	Battery Positive (B+)
2	Battery Negative (B-)
3	Drive Inhibit

The Drive Inhibit signal makes sure that the powerchair does not drive when the batteries are being charged. This signal must be provided within the battery charger plug as a connection between pin 2 and pin 3. Ensure that the battery charger is compatible with this configuration before connecting it to the charging socket.

When turned on during charge, DX Master Remotes that have a 7-segment display will show a dash to indicate that the powerchair is inhibited to drive. It is still possible to use accessory functions like actuators.

Once the Battery Charger displays a 'full' battery charge, the battery charger plug may be removed.

Notes:

1. *For the exact location of the battery charging socket, see the manual of the Master Remote that is used.*
2. *It is recommended to leave the system off while charging when possible. A load during charging – especially a large load like the use of actuators - can cause some battery chargers to think that the battery is more empty than that it actually is. Dependent on the specifications of the battery charger, this can result in overcharging and possible battery damage. Read the manual of the used battery charger for more information.*
3. *Overcharging dramatically decreases the lifespan of a battery.*

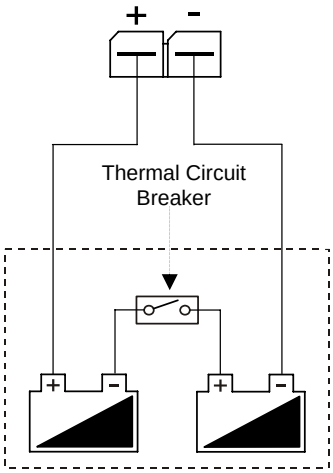
Warnings:

1. *Do not disconnect the batteries or open the circuit breaker during charging. See the manual of the battery charger for more information.*
2. *If during charging the battery gauge starts to flash to indicate an overvoltage condition, immediately turn off either the battery charger or the DX System.*
3. *To remove the charger plug, pull in the direction of the cable. Do not try to turn the plug.*
4. *The battery charger used must be correctly selected and adjusted according to the instructions of the battery manufacturer. Failure to do so can damage or destroy the batteries, give poor range, or be potentially dangerous.*

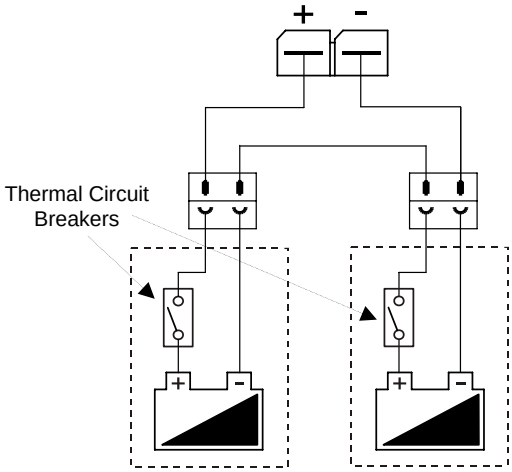
2.2.4 Battery protection

2.2.4.1 Thermal circuit breakers

To protect the batteries and the system cables from external short circuits, a thermal circuit breaker or fuse must be installed between the batteries and the rest of the system - as close as possible to the batteries. If the two batteries are permanently wired together in a single battery box, the best position for the circuit breaker is between the two batteries. If the batteries are separated in individual battery boxes, each battery requires its own circuit breaker.



Single Battery Box



Separate Battery Boxes

The circuit breaker or fuse must be of the slow acting type. The rating of the circuit breaker must be appropriate for the power requirement, including the total weight of the chair, the battery capacity and the wiring.

2.2.4.2 Battery Saver

If the battery Voltage falls below 21V, the DX System reduces the performance of the powerchair. This

- protects the battery
- gives the powerchair a longer range before the battery is completely empty
- gives the user a physical warning that the battery is almost empty before the battery is damaged.

2.2.4.3 High Voltage Rollback

High Voltage Rollback is a battery protection feature that is especially useful for users who have to drive downhill often.

When a powerchair drives downhill, the Power Module sends the generated motor current to the battery. However, if the battery is fully charged already, it can not accept the generated current anymore. This causes the battery voltage to become too high, which can cause damage to the battery or the controller.

High Voltage Rollback gradually decreases the speed of the powerchair until the battery can accept more current. The deceleration of the powerchair gives a timely physical warning to the user to take corrective action, like turning on the lights or slowing down.

High Voltage Rollback can be enabled with the Wizard (see 4.3.4.6).

2.3 The motors

The wheel motors control the powerchair speed and direction. The motors are connected to the DX Power Module.

Note:

If one of the motors is not connected to the DX Power Module, the DX System detects a Motor Fault (see 9.6) and prevents driving.

2.3.1 Motor types

Drive motor type	Motor resistance	Current	Power Module	Min. wire size
24V DC*	0 – 0.5 Ω	2 x 60A	DX-PMB	3 mm²
		2 x 75A	DX2-PMA75L	4 mm²
		2 x 80A	DX-PMB2	4 mm²
		1 x 120A (2x 60A parallel)	DX-PMB-S	3 mm² (two wires in parallel, each carrying 60A)
24V AC Gearless Brushless	N/A	2 x 100A	DX-GB	6 mm²

*12V DC motors can be used if the controller is programmed to half speed.

Notes:

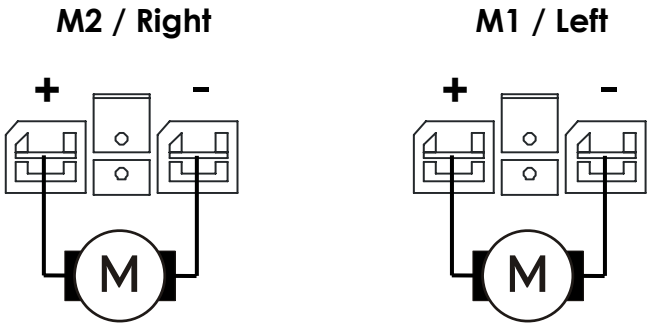
1. *The motor wire sizes above are appropriate for motor loom lengths up to 400 mm. For longer looms, increase the wire size by 0.5 mm² for every additional 200 mm length. Generally, the larger the wire size, the better the powerchair performance.*
2. *The chosen size and length of the motor wires can affect the optimum setting of the **Load Compensation** parameter (see section 4.3.2.3).*
3. *Gearless Brushless motors and the DX-GB Power Module are not covered in this manual. Any reference to motors or motor connectors in this manual is referring to DC motors and the applicable Power Modules. Read the DX-GB manual for more information about the Gearless Brushless system.*

Warning:

*The Power Module **must** be correctly configured for the applicable motor resistance with the **Load Compensation** parameter, see section 4.3.2.3. Failure to set this parameter correctly can be dangerous for the powerchair user, because the chair can become uncontrollable.*

2.3.2 Motor connections

The DC motor cables must be connected to the Motor/Parkbrake connectors of the DX Power Module.



Notes:

1. *Keep the motor cables as short as practical to minimise voltage drops in the cable.*
2. *If the **Left/Right Motor Swap** parameter (see section 4.3.2.7) is set to Swap instead of Normal, the Power Module will assign M1 to the Right motor and M2 to the Left motor.*
3. *If the **Motor Invert** parameter (see section 4.3.2.8) is set to Yes instead of No, the polarity of the + and - terminals will be swapped.*

2.3.3 Motor resistance

The resistance of different motor types varies typically between 20 and 350 mΩ.

The DX Power Module **must** know what the motor resistance is because the motor resistance determines the internal voltage drop in the motor when the motor is under high load (when the motor needs a lot of current to do a task).

If the voltage inside the motor drops too much, the performance of the powerchair will be decreased:

- It will feel unresponsive
- It will slow down or stop when it tries to go up a slope or up a sidewalk edge.

The DX **Load Compensation** feature compensates for the voltage drop in the motor. If the motor has a high resistance, the Power Module applies a higher voltage to the motor terminals in high load conditions. This prevents a loss of performance.

To find out how to determine the motor resistance and how to program Load Compensation, see section 4.3.2.3.

2.4 The parkbrakes

The parkbrakes make sure that the powerchair does not move when it is not actively driven or when the power is turned off.

For safety, parkbrakes are always applied unless they are actively released, either by the Power Module or manually with a parkbrake release switch.

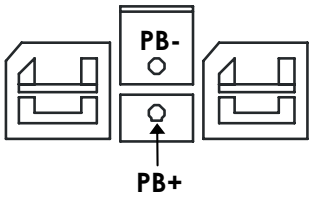
> ***Note:***
>
> *If the parkbrakes are not connected to the DX Power Module, the DX System detects a Parkbrake Fault (see 9.6) and prevents driving.*

2.4.1 Parkbrake types

- Fail-safe electro-magnetic parkbrakes attached to each motor
- 24V or 12V
- 1A – 2A maximum current per parkbrake (dependent on the Power Module used, see the PM manual for the correct specification)

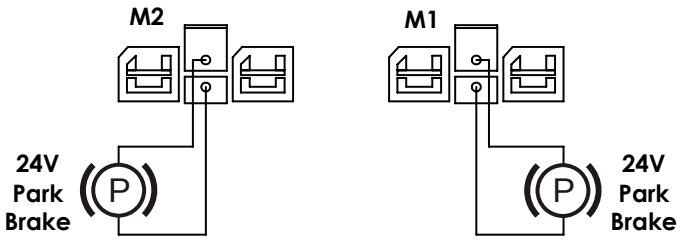
2.4.2 Parkbrake configurations

The parkbrake connection pins are located in the motor connectors of the DX Power Modules.



2.4.2.1 Two 24V parkbrakes – Dual, M1 and M2

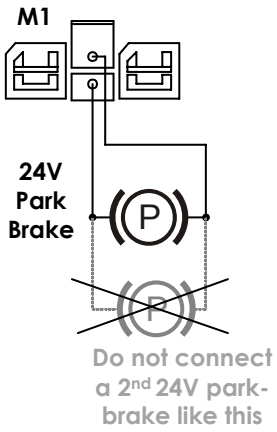
In the dual configuration each parkbrake is driven from a separate output.



For this configuration the DX Power Module **Park Brake** parameter (see section 4.3.3.1) must be set to **Dual**.

2.4.2.2 One 24V parkbrake – Single, M1 only

In the single configuration the parkbrake is driven from the M1 output only.



For this configuration the DX Power Module **Park Brake** parameter (see section 4.3.3.1) must be set to **Single**.

Warning:

Do not connect a second 24V parkbrake in parallel to M1, because an open circuit fault in only one of the two parkbrakes can not be detected. Always use the dual configuration for two 24V parkbrakes.

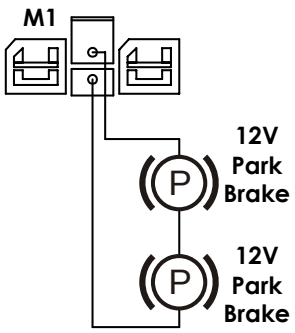
Note:

1. *If in this configuration the parkbrake is connected to M2 instead of M1, a Left Parkbrake Fault (flash code 5) will occur.*
2. *If the **Park Brake** parameter is set to **Dual** in this configuration (with no parkbrake connected to M2), a Right Parkbrake Fault (flash code 6) will occur.*

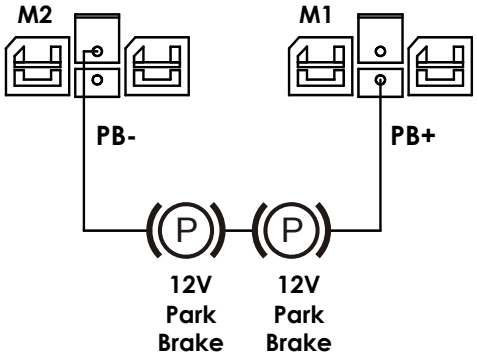
See also section 9.6: Flash codes

2.4.2.3 Two 12V parkbrakes

If the powerchair has two 12V parkbrakes, both can be driven from a single 24V output by connecting the 12V parkbrakes in series. Alternatively, the 12V parkbrakes can be connected to both parkbrake outputs. In the latter case the parkbrakes will be driven from the PB+ output of M1.



12V parkbrakes configuration 1



12V parkbrakes configuration 2

For both these configurations the DX Power Module **Park Brake** parameter (see section 4.3.3.1) must be set to **Single**.

Notes:

Configuration 1: if the park brakes are connected to M2 instead of M1, a Left Parkbrake Fault (flash code 5) will occur.

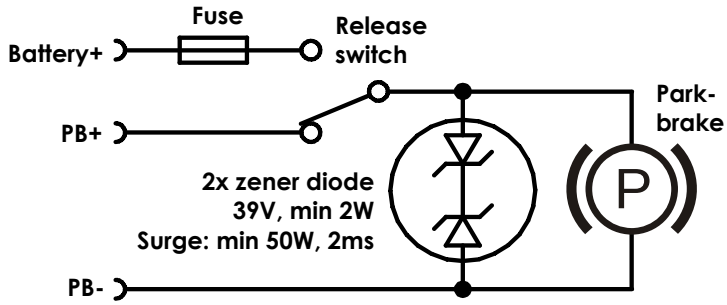
Configuration 2: if PB+ is connected to M2 instead of M1, a Left Parkbrake Fault (flash code 5) will occur.

*Both configurations: if the **Park Brake** parameter is set to **Dual**, a Right Parkbrake Fault (flash code 6) will occur.*

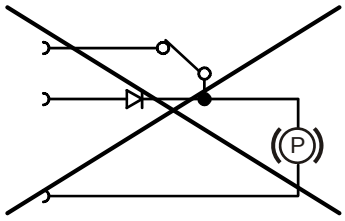
See also section 9.6: Flash codes

2.4.3 Manual parkbrake release switch

Manually operated parkbrake release switches must be fitted together with a suitable suppression device across each parkbrake.



Always fit a suppression device



Do NOT connect like this

The suppression device prevents the generation of high voltage transients causing possible damage to the Power Module or to the parkbrake release switch itself.

Some suitable suppression devices are:

Motorola	Philips
3EZ39D5	BZX70C36
3EZ36D5	BZX70C39
1N5365A	BZT03C36
1N5366A	BZT03C39

2.4.4 Mechanical parkbrake release

To make it possible to manually push the chair if the battery is empty, some form of mechanical clutch or parkbrake release is required. For safety, if the parkbrake is mechanically released the chair must not be able to drive.

One way to achieve this is to put a switch that disconnects the parkbrake from the Power Module in the mechanical parkbrake release. When the parkbrake is disconnected from the Power Module a Parkbrake Fault will occur and the powerchair will not be able to drive.

2.4.5 Parkbrake operation and programming

For safety, parkbrakes are always mechanically applied in their electrical "off"-state. This makes sure that the parkbrakes do not consume energy when the powerchair is turned off. It also makes sure that the powerchair does not roll away if the battery becomes empty on a slope.

To release the parkbrake, it must be "energised" (switched on), either by the Power Module or manually with a parkbrake release switch.

- Energise a parkbrake to release it
- De-energise a parkbrake to apply the brake.

2.4.5.1 Electrical delay

When the powerchair stops, the parkbrakes will be applied. However, the parkbrakes must not be applied too early. The parkbrakes must not engage

- if the powerchair stops to change direction (for example forward to reverse)
- before the powerchair has come to a halt after high deceleration
- before the powerchair has come to a halt when parking on a slope

The **Neutral to PB Delay** parameter (see section 5.3.10.2) is the delay between zero speed demand and the moment that the parkbrakes are de-energised.

The correct value of this parameter is dependent on the mechanics of the parkbrake that is used on the chair. The delay must be longer for fast acting parkbrakes.

This parameter is set by the powerchair manufacturer for specific powerchair types. It cannot be adjusted by dealers.

2.4.5.2 Mechanical delay

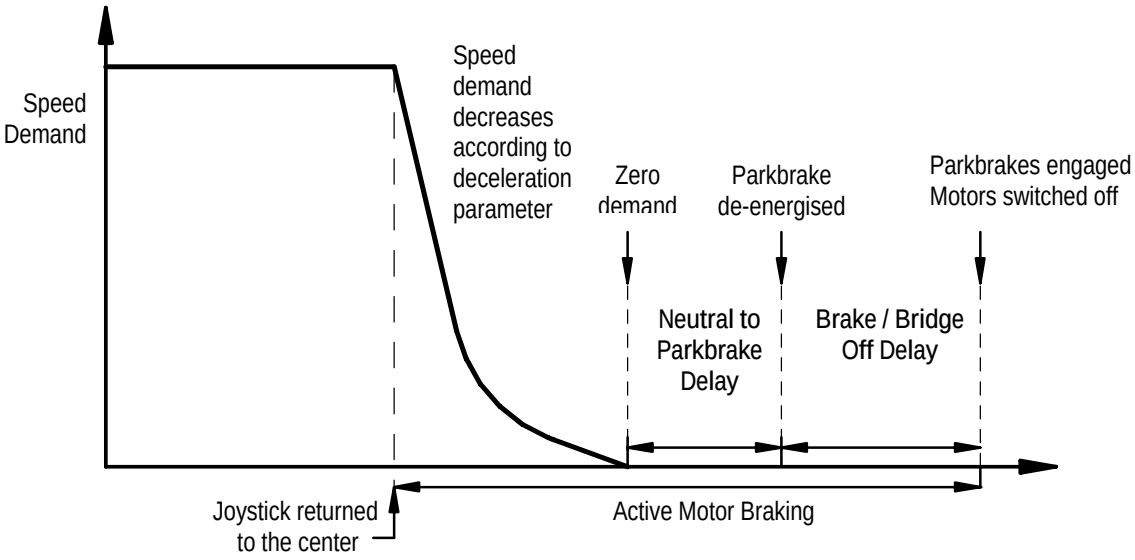
There is a significant delay between the moment that the parkbrake is de-energised and the moment that the parkbrake actually engages mechanically. This delay becomes important when the powerchair decelerates and stops. When the powerchair has stopped, it will take some time before the parkbrakes are actually engaged.

The Power Module uses the motors to brake and hold the powerchair during the time that the parkbrakes are not engaged (active motor braking). The motor braking time can be programmed with the Brake / Bridge Off Delay parameter (section 4.3.3.2).

After the time defined in the Brake / Bridge Off Delay parameter the Power Module will switch off the motors.

Warning:

*Make sure that the **Brake / Bridge Off Delay** time is greater than the mechanical delay of the parkbrakes used. The parkbrakes must engage **before** the motors turn off, or the chair will roll away.*



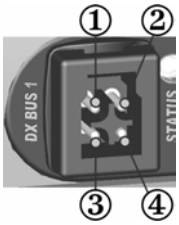
3 The DX BUS

DX BUS is the interface (the way the modules "talk" to each other) that connects all the DX components together.

The DX BUS interface is based on CAN-Bus technology, which is commonly used in safety critical applications like automotive and industrial control networks. CAN provides extremely robust data reliability with excellent error detection and correction capabilities. This makes the DX BUS a safe and fault tolerant data network.

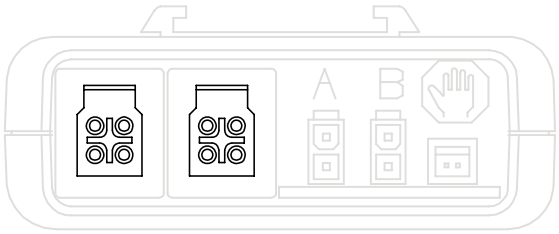
The DX BUS also distributes power to the DX Modules and can safely carry up to 12 Ampere continuously.

DX BUS Connector Pinout



Pin	Function
1	Communications – CANL
2	Communications – CANH
3	DXB+ (24 V, fused)
4	DXB- (0 V)

CAN-H and CAN-L are used for communication between the modules.
DXB+ and DXB- supply power to the modules and to the loads connected to them.
The maximum continuous current over the DX BUS DXB+ and DXB- wires is 12A.



Most DX devices have two DX BUS connectors

Notes:

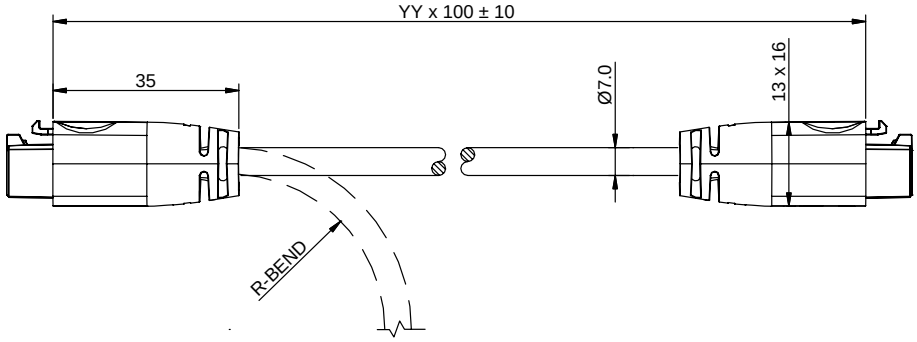
Dynamic recommends to fit unused DX BUS connectors with a GME64909 DX BUS Connector Cover. This also complies with ISO 7176 requirements.

3.1 The DX BUS cable

Cable specifications - straight cable

The part number of the straight cable is GSM630YY, where YY = the length in 100 mm.

DX BUS cable straight		
Length		Part/Order number
300 mm	1 ft	GSM63003
500 mm	1' 8"	GSM63005
1.0 m	3' 3"	GSM63010
1.5 m	4' 11"	GSM63015
2.0 m	6' 7"	GSM63020
2.5 m	8' 2"	GSM63025
DX BUS cable with Ferrite bead to improve EMC		
2.0 m	6' 7"	GSM63020F



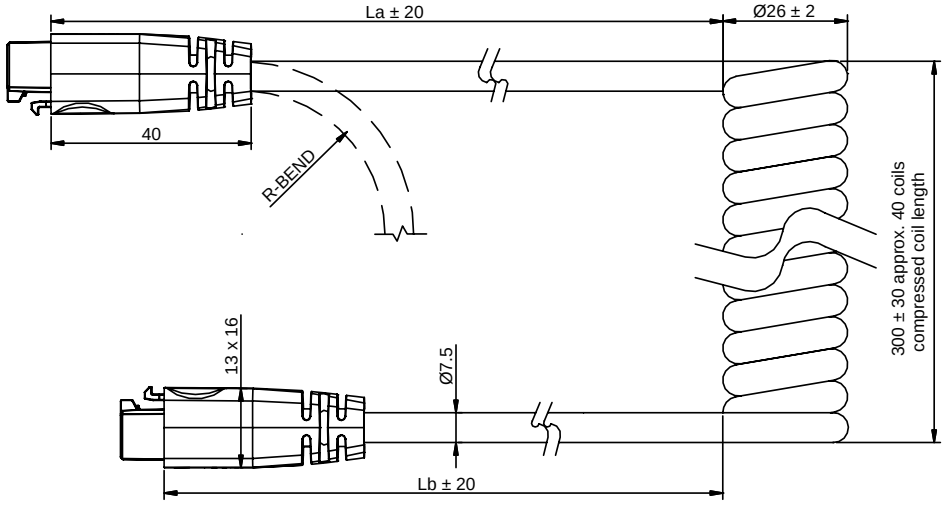
Parameter	Value
Contact Resistance (per contact) As per IEC 512-2, Positronic	3 mΩ nom, 7 mΩ max
Wire resistance @ 20°C DXB+ DXB-	 15.1 mΩ/m, 4.6 mΩ/ft 8.5 mΩ/m, 2.6 mΩ/ft
Operating Current (DXB+/DXB-)	12 A nom, 20 A RMS max
Connector Latch Holding Force	40 N min
Cable Strain	100 N max (accidental, non-repetitive)
Cable Flex Force	10 N max
Minimum Cable Bend Radius Flexing values for (T > –10°C/14°F)	10 mm / 0.39 inch - fixed installation 25 mm / 1 inch - occasional flexing 50 mm / 2 inch - frequent flexing
Operating Temperature (ambient, fixed installation)	–25°C to +50°C –13°F to +122°F
Cable Temperature Rating	80°C / 176°F (internal operating temp)

Warning:

The specified bend/flex radiuses are minimum values and must be considered as a guideline only. Where frequent flexing is part of the intended application, the installer must ensure an appropriate bend/flex radius for the intended and foreseeable environmental conditions. Extreme cold temperatures considerably reduce cable flexibility. Appropriate life testing must be carried out to determine/confirm the expected service life and inspection and maintenance schedule.

Cable specifications – curly cable

DX BUS Curly Cable			
Tail Length La	**Coil Length**	**Tail Length Lb**	**Part/Order number**
200 mm / 8 inch	300 mm / 1 ft	200 mm / 8 inch	GSM63051
500 mm / 1'8"	300 mm / 1 ft	200 mm / 8 inch	GSM63052



Parameter	Value
Contact Resistance (per contact) As per IEC 512-2, Positronic	3 mΩ nom, 7 mΩ max
Wire resistance @ 20°C DXB+ DXB-	 15.1 mΩ/m, 4.6 mΩ/ft 8.5 mΩ/m, 2.6 mΩ/ft
Curly Cable electrical length	2.3 m / 7'6" nom for the coiled section
Operating Current (DXB+/DXB-)	12 A nom, 20 A RMS max
Connector Latch Holding Force	40 N min
Cable Strain	100 N max (accidental, non-repetitive)
Spring Force - extension refers to the coiled section	< 20N @ 2x extension (T > 10°C/50°F) < 50N @ 2x extension (T > –10°C/14°F) < 30N @ 3x extension (T > 10°C/50°F)
Minimum Cable Bend Radius Flexing values for (T > –10°C/14°F)	20 mm / 0.8 inch - fixed installation 30 mm / 1.2 inch - occasional flexing 50 mm / 2 inch - frequent flexing
Operating Temperature (ambient, fixed installation)	–25°C to +50°C –13°F to +122°F
Cable Temperature Rating	80°C / 176°F (internal operating temp)

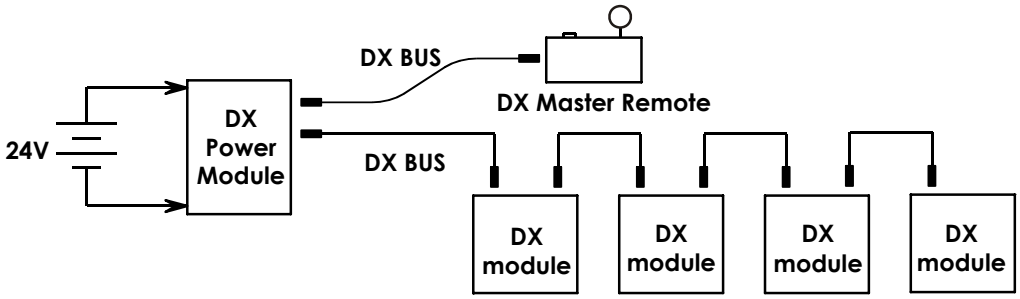
Warnings:

1. *Do not extend the spring coils below 0°C. Do not extend the coils farther than 2x compressed length below 10°C, or 3x compressed length above 10°C. Avoid extension above 3x compressed length because this can cause a permanent stretching of the coil.*
2. *Make sure that no spring force is applied to the DX BUS connector; fasten a strain relief or cable tie on or near to the coiled section of the cable.*

3.2 DX BUS Module connection layout

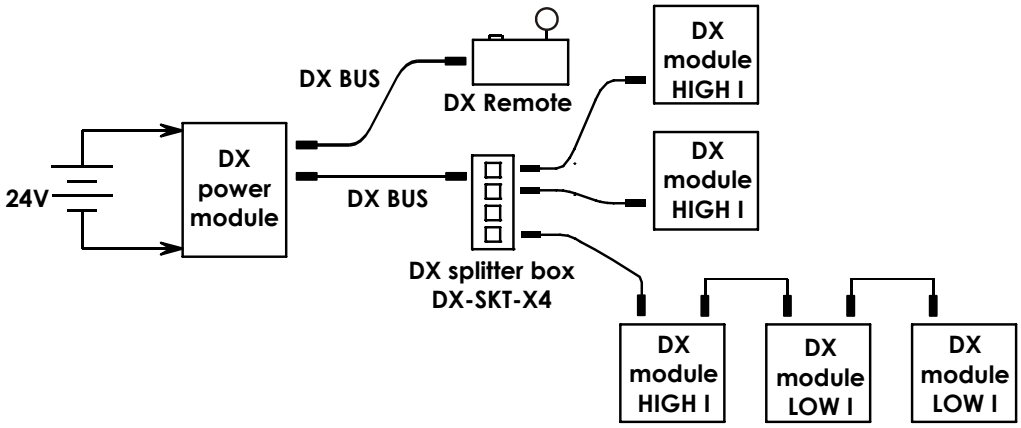
DX Modules normally have one or two DX BUS sockets for system interconnections. Smaller DX Modules can have a permanently mounted cable ending in a DX BUS plug, instead of DX sockets.

The optimum connection layout is dependent on the type of modules that are present in the DX System. Low-current modules can be connected in series. This provides a low-cost and simple solution.



DX modules connected in series

Because of the internal resistance of the DX BUS cable, high-current modules can cause a voltage drop on the DX BUS when they are connected far away from the Power Module. For this reason all high-current DX Modules (for example actuators and lights) must be connected as close to the Power Module as possible, preferably in parallel.



High-current DX modules connected in parallel

Note:

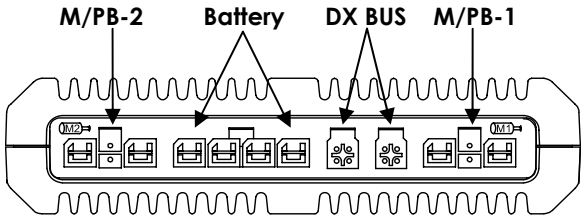
The total length of all DX BUS cables together must not exceed 15 m.

4 The DX Power Module

The DX Power Module converts the speed and direction signals generated by a DX Remote into high current outputs. These outputs drive the motors and activate the parkbrakes.

The Power Module must be connected to:

- The DX BUS (see chapter 3)
- The battery (see section 2.2)
- The motors (see section 2.3)
- The parkbrakes (see section 2.4).



The Power Module is fully programmable for a wide range of powerchair types and user needs.

4.1 General Power Module features

- Digital motor control
- Supply Voltage compensation
- Motor resistance and load compensation (see 4.3.2.3)
- Tracking (veer) compensation (see 4.3.2.5)
- Smart current limiting and temperature limiting (see 4.3.2.1 and 4.3.4.7)
- Left/Right Motor swap option to facilitate motor cabling (see 4.3.2.7)
- Motor connector polarity swap for different motor polarity options (see 4.3.2.8)
- Single or dual parkbrakes (see 2.4.2)
- Programmable parkbrake delay (see 4.3.3.2)
- Dynamic braking in neutral
- Protected against external events such as:
    - reverse battery polarity
    - battery undervoltage and overvoltage (see 4.3.4.6)
    - motor or parkbrake overload (see 4.3.2.9)
    - external short circuits
- Extensive range of powerchair system safety and protection features such as:
    - open circuit motor detection
    - open and short circuit Park Brake detection
    - controlled speed reduction to a stop if a fault is detected (see 4.3.2.6)
    - protected against runaway in the event of an internal hardware failure

- Electromagnetically compatible:
  - low RF emissions
  - high immunity to RF transmissions
- Built-in diagnostics with status LED and fault logging
- Watchdog, CPU, ROM and RAM testing at power up
- Compact, rugged enclosure with robust mounting points
- Environmentally compatible (sealed to IP54)

Warning:

This manual gives a description of a generic DX System and Power Module use. It must be read together with the installation manual of the actual Power Module that is installed on the powerchair.

Correct installation and programming are essential to ensure optimum performance and safety.

4.2 Available Power Modules

DX			
Power Module	**Current**	**Motor type**	**Lighting**
DX-PMB	60A dual	24V DC	no
DX-PMB2	80A dual	24V DC	no
DX-PMB-S*	120A single (2x 60A parallel)	24V DC	no
DX-GB**	100A dual	24V ***AC***	no

* The PMB-S has its two motor and Park Brake channels driven in parallel, for a single motor output with twice the current of each channel of a standard Power Module. The PMB-S is used in DX Systems with only one drive motor, like many servo steered powerchair systems.

** The DX-GB drives gearless brushless AC motors. The DX-GB is not covered in this manual.

4.3 Power Module programmable parameters

Warning:

Do not try to program the Power Module before you have read

- *The programming chapter of this manual*
- *The manual of the specific Power Module*

4.3.1 List of parameters

Key: ✓ Editable at this level (see section 7.1.2.1: Dongle versions)

👁 Viewable at this level

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Motors							
Current Limit	10 – 80A	40 A	-,A	-	👁	👁	✓
Hardware Current Limit Scaler	0 – 100 %	100 %	-,A	-	👁	👁	✓
Load Compensation	0 – 500 mΩ	0 mΩ	-,A	✓	✓	✓	✓
Temp Dependant Load Comp	No / Yes	No	A	-	👁	👁	✓
Veer Compensation	-10 - +10 %	0 %	-,A	✓	✓	✓	✓
Emergency Deceleration	25 - 100 %	75 %	-,A	-	👁	👁	✓
Left/Right Motor Swap	Normal / Swap	Normal	-,A	-	👁	👁	✓
Left Motor Invert	No / Yes	No	-,A	-	👁	👁	✓
Right Motor Invert	No / Yes	No	-,A	-	👁	👁	✓
Stall Timeout	No / Yes	Yes	-,A	-	👁	👁	✓
Stall Time	5 – 50 s	15 s	-,A	-	✓	✓	✓
Motor I2T Protection	No / Yes	No	-,A	-	-	-	👁
Motor I2T Threshold	10 – 90 %	33 %	-,A	-	-	-	👁
Motor I2T Time Scale	10 – 200 decimal	32 dec	-,A	-	-	-	👁
Maximum Motor Temp	70 – 200 °C	130 °C	-,A	-	-	-	👁
Motor Continuity Test	No / Yes	Yes	-,A	-	👁	👁	✓
Maximum Motor Volts	24 – 30 V	26 V	-,A	-	👁	👁	✓
Input Demand Scaler	50 – 100 %	95 %	-,A	-	👁	👁	✓
Park Brakes							
Park Brake	Single / Dual	Dual	-,A	-	👁	👁	✓
Brake / Bridge Off Delay	100 – 1000 ms	500 ms	-,A	-	👁	👁	✓
Test Park Brake Driving	No / Yes	Yes	A	-	👁	👁	✓

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Battery							
Battery Guess Maximum	24.2 – 28.8 V	25 V	-,A	-	👁	👁	✓
Battery Guess Minimum	22.3 – 26.2 V	22.7 V	-,A	-	👁	👁	✓
Battery Guess Recover	0 – 30 decimal	15 dec	-,A	-	👁	👁	✓
Voltmeter Battery Gauge	No / Yes	No	A	-	✓	✓	✓
Slow Batt Time Scale Driving	No / Yes	No	A	-	👁	👁	✓
Batt Gauge Ramp Up Rate	10 – 1600 s	120 s	A	-	👁	👁	✓
Batt Gauge Ramp Down Rate	10 – 1600 s	90 s	A	-	👁	👁	✓
Batt Gauge High Threshold	0.1 – 33.4 V	33.4 V	A	-	👁	👁	✓
Batt Gauge Failing Threshold	0.1 – 6.6 V	0.1 V	A	-	👁	👁	✓
High Voltage Warning	No / Yes	Yes	A	-	👁	👁	✓
High Voltage Rollback	No / Yes	No	A	-	👁	👁	✓
High Voltage Threshold			A	-	👁	👁	✓
Internal Setup							
Temperature Rollback Minimum	40 – 75 °C	50 °C	-,A	-	👁	👁	✓
Temperature Rollback Maximum	50 – 85 °C	70 °C	-,A	-	👁	👁	✓
Halve Turning Gain	No / Yes	No	A	-	👁	👁	✓

Note:

1. *Wizard 5 uses the value of the **Halve Turning Gain** parameter to determine the Power Module Revision (Rev –, or Rev A). Set this parameter to Yes if you want to use the Rev A parameters. If the Halve Turning Gain parameter is set to No, the Wizard will assume that the program is meant for a "Rev–" Power Module, and will return all Rev A parameters to their default values before it writes the parameters to the Power Module.*
2. *The **Load Compensation** and **Veer Compensation** parameters should be set using the HHP. The adjustable range for these two parameters can be limited by the Wizard.*

4.3.2 Motors

4.3.2.1 Current Limit

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Current Limit	10 – 80A	40 A	-,A	-	👁	👁	✓

The **Current Limit** is the maximum sustained current that the Power Module is programmed to deliver to the motor.

To protect the electronics of the Power Module, the maximum current will be reduced further if the Power Module becomes too hot, dependent on the setting of the **Temperature Rollback** parameters (see 4.3.4.7).

Warning:

*Do not set **Current Limit** too high for the type of motor used.*

4.3.2.2 Hardware Current Limit Scaler

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Hardware Current Limit Scaler	0 – 100 %	100 %	-,A	-	👁	👁	✓

Normally the **Current Limit** parameter (see 4.3.2.1) limits the current to the motor. However, the Current Limit software algorithm has a slow response time, which allows fast high-current transients to slip through. Fast high-current transients can de-magnetise low current motors, resulting in motor damage.

To protect the motors from fast high-current transients, additional to the slower software algorithm a very fast hardware algorithm is provided. This algorithm can be programmed with the **Hardware Current Limit Scaler** parameter.

The value of **Hardware Current Limit Scaler** is given as a percentage of the nominal current rating of the Power Module. For maximum motor protection, set this value to match the value of the **Current Limit** parameter.

Current Limit (see 4.3.2.1)	Hardware Current Limit Scaler	Maximum transient current
80 A	100 %	80 – 120A
60 A	75 %	60 – 90 A
40 A	50 %	40 – 60 A
25 A	31 %	25 – 37 A

Settings for a Power Module with a nominal current rating of 80 A

The actual maximum transient current is dependent on the temperature of the Power Module. If the Power Module is warm, the limit is equal to the value set with **Hardware Current Limit Scaler.** If the Power Module is cold, the limit can be up to 50% higher.

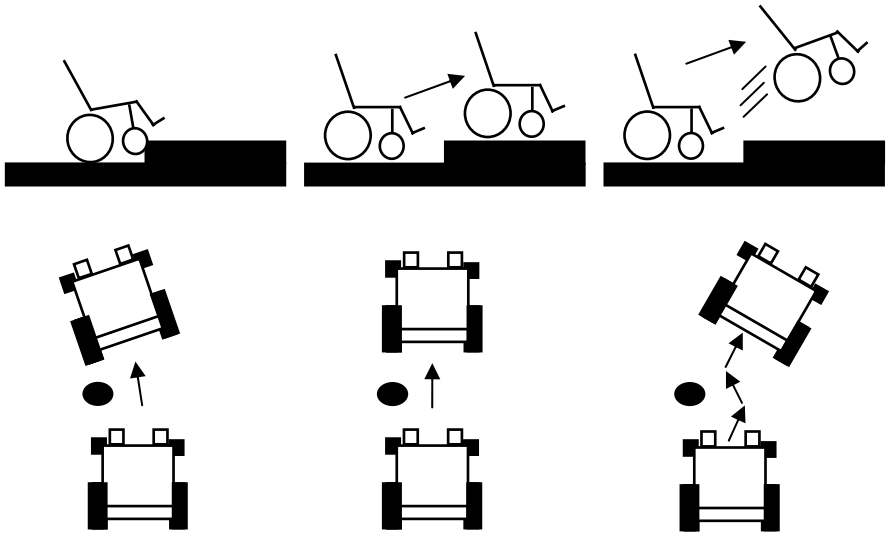
Warning:

*Do not set the **Hardware Current Limit Scaler** lower than the software **Current Limit**. This will result in a Stall Timeout Fault (see 9.6) and an emergency stop.*

4.3.2.3 Load Compensation

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Load Compensation	0 – 500 mΩ	0 mΩ	-,A	✓	✓	✓	✓

Load Compensation automatically compensates for changes in motor speed when the chair drives over loads such as sidewalks, curbs or slopes. Correct Load Compensation is important for all chairs to reach acceptable performance, especially when a chair has switched controls, for example a scanner or Sip and Puff.

Load compensation	Too low	Correct	Too high
Chair behaviour	• Drives like it is going through thick mud • Slows down when it goes up a sidewalk edge or up a ramp • Slows down with heavier users • Changes direction when it drives over a bump • Changes direction when the weight of the user shifts.	• Drives smoothly • Keeps the speed reasonably constant. Only slightly slows down on a slope. • Keeps the direction constant. Only slightly changes direction when it drives over a bump.	• Drives very rough • Hard to steer or control, vibrates • Swerves when it drives over a bump. • Motor becomes hotter than normal very easily, decreased motor life
			

Set **Load Compensation** to the correct motor resistance value of the used motor (for motor resistance see section 2.3.3).

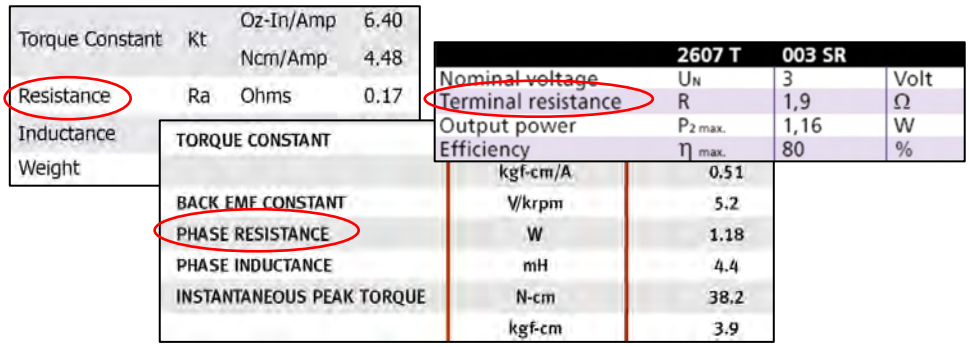
Determining the motor resistance

There are three ways to determine the motor resistance:

1. Look at the motor data that is provided by the manufacturer of the motor.
2. Measure the motor resistance.
3. Look at the powerchair behaviour.

1. Find the resistance of a motor in the motor data sheets

- Look for "Motor Resistance", "Terminal resistance", "Minimum stall resistance", "Armature winding resistance" or "Winding resistance" or "R". Use this value directly when it is given in milliOhms, mOhms or mΩ. Multiply by 1000 when it is given in Ohms or Ω.

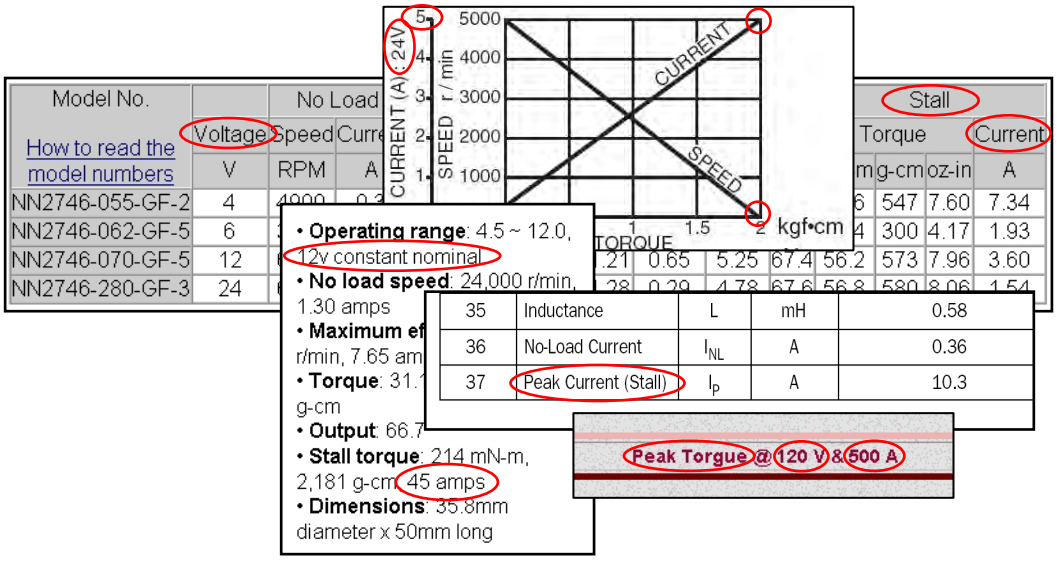


Torque Constant	Kt	Oz-In/Amp	6.40
		Ncm/Amp	4.48
Resistance	Ra	Ohms	0.17
Inductance			
Weight			

	2607 T	003 SR	
Nominal voltage	U_N	3	Volt
Terminal resistance	R	1,9	Ω
Output power	$P_{2\,max.}$	1,16	W
Efficiency	$\eta_{max.}$	80	%

TORQUE CONSTANT		
	kgf-cm/A	0.51
BACK EMF CONSTANT	V/krpm	5.2
PHASE RESISTANCE	W	1.18
PHASE INDUCTANCE	mH	4.4
INSTANTANEOUS PEAK TORQUE	N-cm	38.2
	kgf-cm	3.9

- Look for the "Stall Current", sometimes this is located under "Stall Torque" or "Peak Torque". In the motor graph it is the current when the speed is zero. The motor resistance is the nominal voltage divided by the stall current.



Model No.		No Load			Stall			
How to read the model numbers	Voltage	Speed	Curre		Torque			Current
	V	RPM	A		mg-cm	oz-in		A
NN2746-055-GF-2	4	4000	0.3		547	7.60		7.34
NN2746-062-GF-5	6				300	4.17		1.93
NN2746-070-GF-5	12				573	7.96		3.60
NN2746-280-GF-3	24				580	8.06		1.54

CURRENT (A) : 24V
SPEED r / min
CURRENT
SPEED
TORQUE
kgf•cm

- **Operating range**: 4.5 ~ 12.0, 12v constant nominal
- **No load speed**: 24,000 r/min, 1.30 amps
- **Maximum ef** r/min, 7.65 am
- **Torque**: 31.1 g-cm
- **Output**: 66.7
- **Stall torque**: 214 mN-m, 2,181 g-cm, 45 amps
- **Dimensions**: 35.8mm diameter x 50mm long

35	Inductance	L	mH	0.58
36	No-Load Current	I_{NL}	A	0.36
37	Peak Current (Stall)	I_P	A	10.3

Peak Torque @ 120 V & 500 A

Motor resistance = Nominal Voltage / Stall Current
In the example above: 12V / 45A = 0.266 Ω = 266 mΩ

2. Measure the resistance of a motor

Tools needed

- One 12V battery (capacity 20 Ah or more), or a 12V DC power supply that can deliver at least 20A
- A resistance of approximately 1 Ohm - 100 Watt, for example:
  - A high power resistor
  - Extra motors in series
  - 50m/150ft of 1 mm² or AWG18 wire (for example 25m/75ft AC copper extension cord or copper speaker wire that is shorted at one end)
  - 75m/250 ft of AWG16 wire (for example a 37m/125 ft AC copper extension cord or copper speaker wire that is shorted at one end)

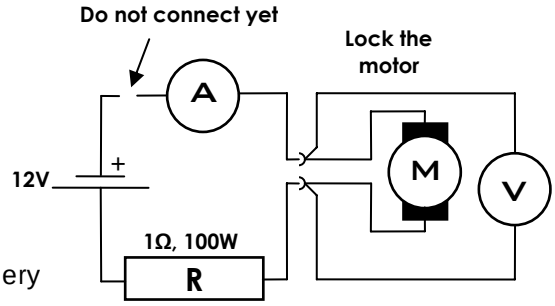
- One Voltage meter
- One Ampere meter that can measure at least 20A (for example: a clamp meter)

- The motor

Procedure

1. Lock the motor so that the shaft can not turn (for example with the parkbrake). If you use additional motors as resistors, lock those too.

2. Connect the motor, the Volt meter, the Ampere meter, the resistor and the battery together as shown in the schematic. Do **NOT** connect the positive terminal of the battery yet.



Include the motor cables (but not the connector) in the Voltage measurement

3. Put the Voltage meter and the Ampere meter in a position where you can read them both at the same time

4. Set the range of the Voltmeter to 10V and the range of the Ampere meter to 20A

5. Perform the measurement

   a. Connect the positive terminal of the battery and wait until the readings on the meters are stable (typically one to three seconds)
   b. Quickly read the value on the Voltage meter and the Ampere meter
   c. Disconnect the battery immediately after you have read the meters.

Warning:

Try to disconnect the battery within 5 seconds to make sure that the motor or the resistor does not heat up too much.

6. If the current that you have measured is less than 8A, either use a 24V battery or use half the resistor value and repeat the measurement. For a good measurement the current should be between 8A and 20A.

7. The motor resistance is the voltage divided by the current:

$$\text{Motor resistance} = \frac{\text{Measured Voltage at the motor connector}}{\text{Measured Current}}$$

8. Lock the motor shaft in a different position and repeat the procedure from step 5. Measure the resistance for at least five different positions of the shaft to reduce the chance that the brushes do not make good contact with the rotor.

   When you have used extra motors as resistance, you do not have to change the shaft position of those motors as well.

9. Use the lowest measured resistance and decrease it by 20% to compensate for temperature variations and age variations. Multiply the found resistance by 1000 (for ***milli***ohm) and program this value into the Load Compensation parameter with either the HHP or the Wizard.

10. Test the powerchair behaviour with this Load Compensation setting. Drive up a slope or a sidewalk edge. If Load Compensation has the correct value:
    - The chair only slightly slows down when it goes up the slope/edge
    - The chair only slightly changes direction when it goes up the slope/edge.

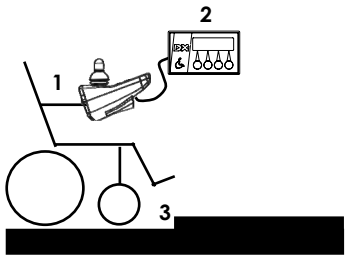
Notes:

1. *If the motor is connected to the battery longer than 5 seconds, the motor becomes warm. If the motor is warm, let the motor cool down before you do the next measurement.*
2. *A new motor usually has a higher motor resistance than a motor that has been used for some time, because the motor brushes that are inside the motor do not make optimal contact until they are "worn in". If possible, perform this procedure when the motor has been used for several hours.*
3. *Extremely low ambient temperatures can affect the motor resistance. If the powerchair has been in the garage on a cold day, the response when it is turned on can be a bit rough. This rough behaviour stops as soon as the motor heats up. If the powerchair will be used in extremely low ambient temperatures decrease Load Compensation accordingly.*
4. *If the found motor resistance is 100 mΩ or less, perform the same measurements with a warm motor. Use the lowest value of all measurements.*

3. Determine the motor resistance by looking at the powerchair behaviour

Tools needed

1. A powerchair with a DX System fitted
2. A Hand Held Programmer (HHP)
3. A bump or a sidewalk edge that you can drive up to

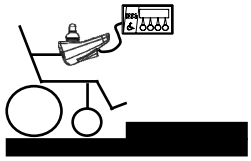


Procedure

Summary

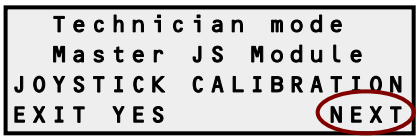
- Set **Load Compensation** to a low value.
- Drive the powerchair into a Load and increase the motor resistance value until the powerchair does not slow down.

Step by step



1. Turn the DX System ON
2. Position the powerchair in front of the edge
3. Connect the HHP to the DX Master Remote
4. Enter Technician Mode (see section 7.1.1.1, 'HHP Technician Mode')

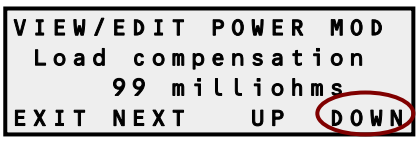
5. Press NEXT

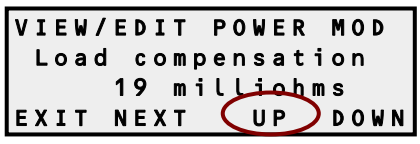


6. Press YES

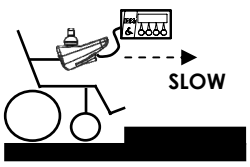
7. Press NEXT

8. Press DOWN or UP to set the motor resistance to **20 milliohms**

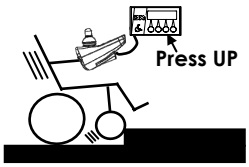




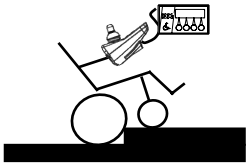
9. Push the joystick slightly forward to drive at a VERY LOW SPEED
10. Keep the joystick in exactly the same position all the time



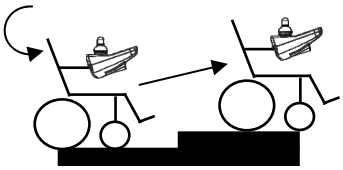
11. The chair will probably stop when you arrive at the edge, but still keep the joystick in exactly the same position.
12. Press the UP button on the HHP until you can feel that the front wheels try to pull up the edge. Every time you press UP you will feel this more.



13. Press “UP” SLOWLY until the chair smoothly climbs over the edge with the joystick still in exactly the same position as in step 11.

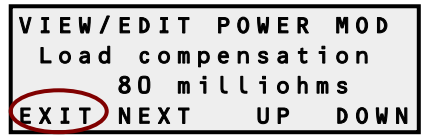


14. Turn the powerchair around and drive to the location of step 1
15. Push the joystick forward to go over the edge. If load compensation has the correct value, the chair will not slow down much, it will go smoothly over the edge.



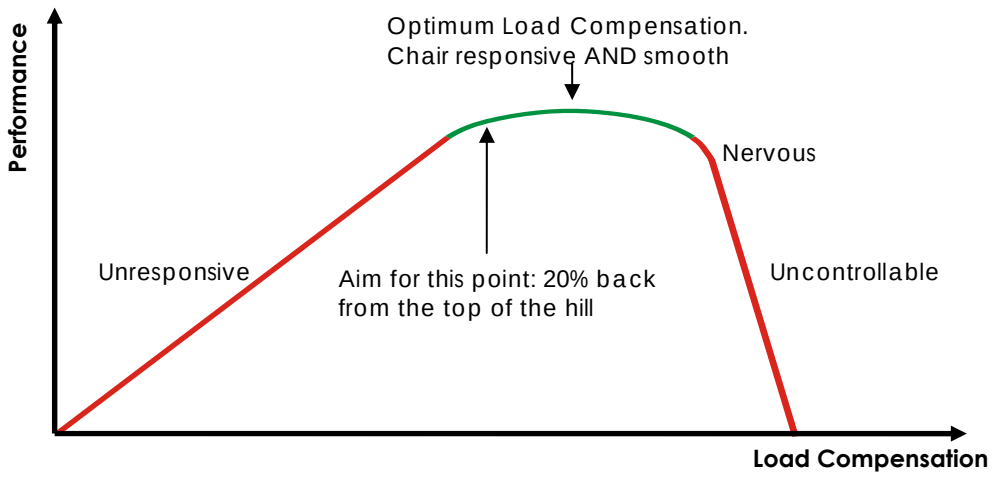
16. Press EXIT to save the motor resistance

17. Turn the DX System OFF
18. Disconnect the HHP.



Notes:

1. *This test procedure causes the motor to become hot. For this reason the resulting value for **Load Compensation** is too high. Reduce Load Compensation by 20% to make sure that the powerchair is not uncomfortable to drive when the motor is cold.*
2. *A new motor usually has a higher motor resistance than a motor that has been used for some time, because the motor brushes that are inside the motor do not make optimal contact until they are "worn in". If possible, perform this procedure when the motor has been used for several hours.*



4.3.2.4 Temp Dependent Load Comp

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Temp Dependent Load Comp	No / Yes	No	-,A	-	👁	👁	✓

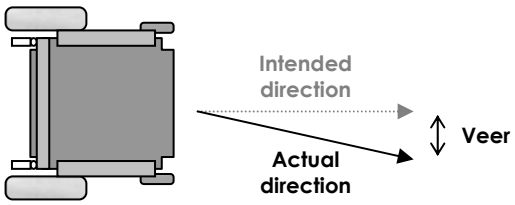
Temperature Dependent Load Compensation calculates the correct **Load Compensation** values for different temperatures of the Power Module. This will make sure that Load Compensation does not become too high when the Power Module is cold, or too low when the Power Module is hot.

4.3.2.5 Veer Compensation

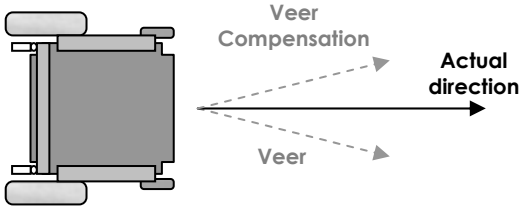
Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Veer Compensation	-10 - +10 %	0 %	-,A	✓	✓	✓	✓

If the two motors of the powerchair do not perform exactly the same, the chair will not drive in a straight line. The chair will slightly change its direction (veer) when it drives forward.

Veer Compensation calculates how much the chair must correct its direction to go in a straight line.



The chair does not drive straight when the performance of the two motors is not equal



The chair now drives straight because Veer Compensation corrects the direction

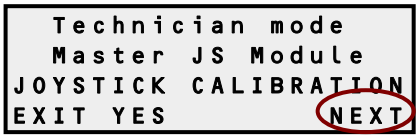
Notes:

1. *Adjust this parameter every time a motor is replaced.*
2. *Other factors than motor performance can cause chair veer, for example bent frames, flat tyres or faulty castor wheels. Correct these problems at the source, do not use **Veer Compensation**.*
3. *Do not use **Veer Compensation** to compensate for out-of-centre joystick deflection by the user.*

Adjusting Veer compensation with the HHP

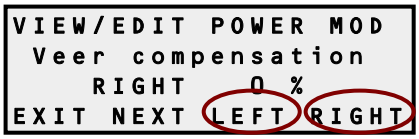
1. Turn the DX System ON
2. Connect the HHP to the DX Master Remote
3. Enter Technician Mode (see section 7.1.1.1: HHP Technician Mode)

4. Press NEXT

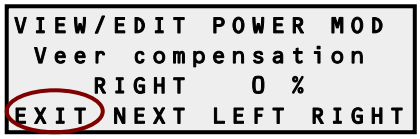


5. Press YES

6. Press LEFT or RIGHT until the powerchair drives in a straight line when the joystick is deflected forward



7. Press EXIT to save the Veer Compensation value



8. Turn the DX System OFF
9. Disconnect the HHP

4.3.2.6 Emergency Deceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Emergency Deceleration	25 - 100 %	75 %	-,A	-	👁	👁	✓

Emergency Deceleration sets the rate at which the powerchair comes to a halt when

- a fault that requires an emergency stop occurs
- the user switches off the system while driving.

If Emergency Deceleration is set to a higher value, the powerchair will stop in a shorter time period. The optimum value depends on the powerchair type, the preference of the manufacturer and the regulations that apply to the country of use.

Test this parameter by switching off the system while driving.

Warning:

The powerchair can tip over or throw the user out of the chair when this parameter is set too high.

4.3.2.7 Left/Right Motor Swap

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Left/Right Motor Swap	Normal / Swap	Normal	-,A	-	👁	👁	✓

If set to Swap, this parameter swaps the Left and Right motor outputs of the Power Module. Swapping the motor outputs allows the cabling between the Power Module and the motors to be optimised for particular Power Module mounting orientations.

Parameter value	Normal	Swap
Motor connection	Left motor → M1 Right motor → M2	Left motor → M2 Right motor → M1

Note:

Most Fault messages and Diagnostic messages ignore the value of this parameter. Left Motor/Parkbrake fault is always the motor/parkbrake connected to M1, Right Motor/Parkbrake fault is always the motor/parkbrake connected to M2.

4.3.2.8 Motor Invert

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Left Motor Invert	No / Yes	No	-,A	-	👁	👁	✓
Right Motor Invert	No / Yes	No	-,A	-	👁	👁	✓

If these parameters are set to Yes, they swap the polarity of the motor connector (see section 2.3.2, Motor connections): '+' will become '–' and '–' will become '+'.

Note:

1. *If you invert only one of the two motors, the performance of the DX System will be reduced. This situation is not recommended for long term use.*
2. *The Left Motor can refer to M1 or M2, dependent on the Left / Right Motor Swap setting.*

4.3.2.9 Motor Stall

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Stall Timeout	No / Yes	Yes	-,A	-	👁	👁	✓
Stall Time	5 – 50 s	15 s	-,A	-	✓	✓	✓

If the joystick is deflected but the powerchair can not drive because

- It is on a slope that is too steep
- It tries to climb up a curb that is too high
- It is trapped

the maximum current (as set by the **Current Limit** parameter, see section 4.3.2.1) will flow through the motors continuously, because the motors are still trying to drive. This situation is called motor stalling.

Motor stalling can cause motor damage when the motor becomes too hot. To prevent motor damage, **Stall Timeout** disables drive after **Stall Time** seconds of maximum continuous current.

If a stall timeout has occurred, the powerchair will not drive and Flash Code 11 (see 9.6) will be displayed on the System Status LED of the DX Master Remote. To reset the system, switch it off and switch it back on again.

Note:

Some safety standards specify a particular Stall Time.

4.3.2.11 Motor Continuity Test

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Motor Continuity Test	No / Yes	Yes	-,A	-	👁	👁	✓

Every time before the powerchair starts to drive, **Motor Continuity Test** checks that the motors connections are not loose.

Always set this parameter to 'Yes', except if motor faults occur because

- the motor brushes frequently lose contact after the motor has stopped
- the motor resistance is higher than approximately 1 Ω, which causes the Power Module to think that the motor has an open circuit.

4.3.2.12 Maximum Motor Volts

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Maximum Motor Volts	24 – 30 V	26 V	-,A	-	👁	👁	✓

Maximum Motor Volts sets the maximum voltage that the Power Module will apply to the motor.

Note:

If local regulations require that the powerchair speed is limited to a specific value, use this parameter to set a speed limit for a particular chair type (for specific motors and a specific wheel diameter).

If the momentary battery voltage is less than the programmed **Maximum Motor Volts** value (for example when the battery is almost empty), then the battery voltage itself is the maximum applied voltage at 100% speed demand.

See also section 5.3.1: Speed and acceleration principles.

4.3.2.13 Input Demand Scaler

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Input Demand Scaler	50 – 100 %	95 %	-,A	-	👁	👁	✓

The **Input Demand Scaler** scales down the Speed Demand that the Power Module receives from the UCM (see also section 5.3.1: Speed and acceleration principles). This makes sure that the powerchair does not slow down when it changes direction.

To adjust the direction of the powerchair when the chair travels forward, the Power Module speeds up one wheel while it keeps the speed of the other wheel constant. The Power Module can only speed up one wheel if that wheel is not turning at maximum speed already.

If both wheels are turning at maximum speed, the Power Module must *slow down* one wheel to change direction. This slows down the whole powerchair during the turn, which can be annoying.

An **Input Demand Scaler** value of 95% limits the maximum speed of the chair to 95% of the maximum achievable speed during normal driving. This leaves 5% of the maximum wheel speed reserved for turning.

The **Input Demand Scaler** is also useful to further slow down a chair when the minimum speed settings of the Drive Profiles are still too fast.

4.3.3 Park Brakes

4.3.3.1 Park Brake

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Park Brake	Single / Dual	Dual	-,A	-	👁	👁	✓

Single – Only parkbrake output M1 is active. Do not use parkbrake output M2.

Dual – Parkbrake output M1 and M2 are both active.

See section 2.4.2: Parkbrake configurations for more information on how to connect the parkbrakes.

4.3.3.2 Brake / Bridge Off Delay

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Brake / Bridge Off Delay	100 – 1000 ms	500 ms	-,A	-	👁	👁	✓

The Power Module uses the motors to brake the powerchair during the time that the parkbrakes have been de-energised but have not engaged mechanically. This braking method is called active motor braking.

When the parkbrakes have been de-energised, the Power Module applies active motor braking for the time defined by the **Brake / Bridge Off Delay** parameter. After this time the Power Module will switch off the motors.

The correct value of this parameter is dependent on the mechanics of the parkbrake that is used on the chair.

Warning:

*Make sure that the **Brake / Bridge Off Delay** value is greater than the time it takes for the parkbrakes to mechanically engage when they have been electrically de-energised. The parkbrakes must engage before the motors turn off, or the powerchair will roll away.*

See also section 2.4.5: Parkbrake operation and programming.

4.3.3.3 Test Park Brake Driving

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Test Park Brake Driving	No / Yes	Yes	A	-	👁	👁	✓

Yes – The park brakes are periodically checked for open-circuit while the chair is driving. Some parkbrakes produce a noise during this test, which can annoy the user.

No – The park brakes are not checked for open-circuit while the chair is driving, only before the chair starts to drive.

The parkbrake *short*-circuit test it is not affected by the value of this parameter. The short-circuit test will still be performed while driving.

4.3.4 Battery

4.3.4.1 Battery Guess

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Battery Guess Maximum	24.2 – 28.8 V	25 V	-,A	-	👁	👁	✓
Battery Guess Minimum	22.3 – 26.2 V	22.7 V	-,A	-	👁	👁	✓
Battery Guess Recover	0 – 30 decimal	15 dec	-,A	-	👁	👁	✓

These battery parameters can optimise the accuracy of the Battery Gauge.

Battery Guess Maximum is the voltage at which the DX System thinks that the battery is completely full. The Battery Gauge will show 100% battery capacity at this voltage.

Battery Guess Minimum is the voltage at which the DX System thinks that the battery is completely empty. The Battery Gauge will show 0% battery capacity at this voltage.

Battery Guess Recover is the maximum voltage drop of the battery during driving. If the powerchair stops driving, the battery voltage will again increase to its original level. This increase in voltage does not mean the battery has been charged, just that the powerchair has stopped driving. **Battery Guess Recover** is the maximum voltage increase expected of the battery after driving when no charging has occurred. If the battery voltage rises by more than this value while the DX System is off, the Battery Gauge will be updated.

Normally these parameters should be left at the factory pre-set values.

4.3.4.2 Voltmeter Battery Gauge

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Voltmeter Battery Gauge	No / Yes	No	A	-	✓	✓	✓

No – The Battery Gauge shows an estimate of the remaining battery capacity.

Yes – The Battery Gauge shows the battery voltage as an indication of the battery capacity. This means that the shown value can decrease momentarily during high load situations (for example: when driving up a slope).

4.3.4.3 Slow Batt Time Scale Driving

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Slow Batt Time Scale Driving	No / Yes	No	A	-	👁	👁	✓

If **Voltmeter Battery Gauge** (4.3.4.2) has the value 'Yes', **Slow Batt Time Scale Driving** determines the responsiveness of the voltmeter battery gauge.

No – The Battery Gauge has a fast response. This can result in a nervous display when the powerchair drives over different loads.

Yes – The Battery Gauge has a slow and stable response.

If **Voltmeter Battery Gauge** has the value 'No', the value of **Slow Batt Time Scale Driving** is ignored.

4.3.4.4 Batt Gauge Ramp Rate

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Batt Gauge Ramp Up Rate	10 – 1600 s	120 s	A	-	👁	👁	✓
Batt Gauge Ramp Down Rate	10 – 1600 s	90 s	A	-	👁	👁	✓

These parameters help to smooth out changes in the battery voltage caused by short temporary charging or a temporary heavy load.

Battery Gauge Ramp Up Rate is the minimum time it takes the Battery Gauge to go from the minimum position to the maximum position. Do not set this longer than the time it takes to fully charge the batteries.

Battery Gauge Ramp Down Rate is the minimum time it takes the Battery Gauge to go from the maximum position to the minimum position.

4.3.4.5 Batt Gauge Threshold

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Batt Gauge High Threshold	0.1 – 33.4 V	33.4 V	A	-	👁	👁	✓
Batt Gauge Failing Threshold	0.1 – 6.6 V	0.1 V	A	-	👁	👁	✓

If the batteries are being charged for only a short period of time, the battery voltage will still rise as long as no large current is drawn from the batteries (for example: when the DX system is switched on after charging). This can mislead the battery gauge into thinking that the batteries are full, when in fact, they are not.

To make sure that the battery gauge does not show the wrong information, the battery level information is saved when the DX System is turned off. When the System is turned on again, the new level of the battery is compared to the old level. If the new level is very different from the old level, the old level is displayed on the battery gauge, unless the current battery level is higher than **Batt Gauge Failing Threshold**, or lower than **Batt Gauge High Threshold**.

4.3.4.6 High Voltage parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
High Voltage Warning	No / Yes	Yes	A	-	👁	👁	✓
High Voltage Rollback	No / Yes	No	A	-	👁	👁	✓
High Voltage Threshold	28 / 30 V	28 V	A	-	👁	👁	✓

If **High Voltage Warning** has the value 'Yes', and the voltage of the batteries rises above the value of **High Voltage Threshold**, the battery gauge will flash to warn the user that the batteries are being overcharged.

High Voltage Rollback gradually decreases the maximum speed of the powerchair when the battery voltage rises above 30 Volt. This is especially useful when the user is driving downhill. See also section 2.2.4.3: High Voltage Rollback.

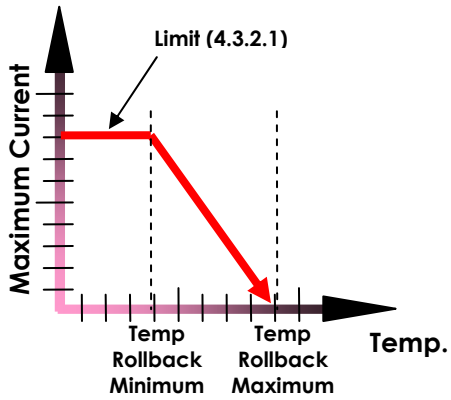
4.3.4.7 Temperature Rollback

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Temperature Rollback Minimum	40 – 75 °C	50 °C	-,A	-	👁	👁	✓
Temperature Rollback Maximum	50 – 85 °C	70 °C	-,A	-	👁	👁	✓

To protect the Power Module from overheating, a thermal roll-back algorithm reduces the output current when the Power Module becomes too hot.

Temperature Rollback Minimum is the temperature at which the thermal roll-back starts.

Temperature Rollback Maximum is the temperature at which the thermal roll-back limits the output current to zero.



4.3.4.8 Halve Turning Gain

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Halve Turning Gain	No / Yes	No	A	-	👁	👁	✓

Halve Turning Gain halves the values of the **Turning Speed @ Maximum** (5.3.7.9) and the **Turning Acceleration** (5.3.7.11) parameters for every Drive Profile (for more information on Drive Profiles see 5.3.2).

This allows lower turning speeds and acceleration without a loss of resolution.

Enabling **Halve Turning Gain** is particularly useful for high speed chairs and Front Wheel Drive chairs where low turning speeds are required.

See also **Non-Linear Turn** (section 5.3.7.13).

Note:

*Wizard 5 uses the value of the **Halve Turning Gain** parameter to determine the Power Module Revision (Rev –, or Rev A). Set this parameter to Yes if you want to use the Rev A parameters. If the Halve Turning Gain parameter is set to No, the Wizard will assume that the program is meant for a "Rev–" Power Module, and will return all Rev A parameters to their default values before it writes the parameters to the Power Module.*

5 The DX Master Remote

Warning:

This manual describes a generic DX System and Master Remote use. It must be read together with the installation manual of the actual Master Remote that will be installed on the powerchair.

5.1 Introduction

The Master Remote is the central building block in a DX System. Every DX System must have one, and only one Master Remote.

The DX Master Remote

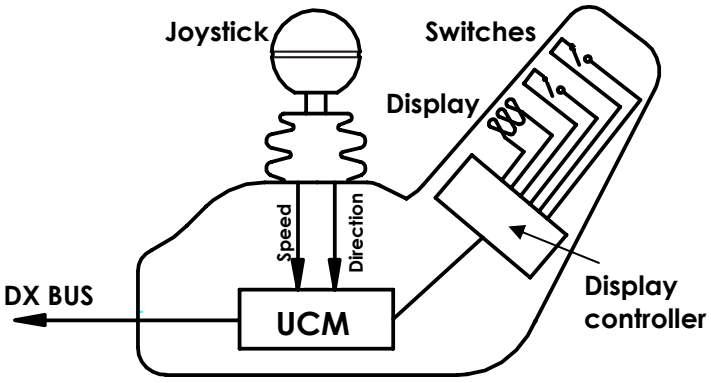
- Acts as the primary user interface
  - Has the system on/off switch
  - Reads user commands (joystick movement, button pushes, switches)
  - Communicates these commands to the applicable DX Modules through the DX BUS
  - Displays the system status to the user via the System Status LED
- Controls the status of the DX System
- Stores and controls up to six Drive Profiles (see section 5.3.2)
- Backs up all system parameters
- Restores system parameters if a module has been replaced (see section 7.3)
- Provides a DX System programming socket for the HHP or the Wizard.

A range of Master Remotes is available for different applications and end-user requirements.

The Master Remote is fully programmable to suit a wide range of powerchair types and user needs. Correct installation and programming are essential to ensure optimum performance and safety.

A Master Remote consists of two major sub-components:

- the User Control Module (UCM)
- the Physical User Interface.



5.1.1 The User Control Module (UCM)

The UCM is the brain, or the main computer, of the DX System. The UCM is built into every Master Remote.

The UCM is responsible for

- System wake-up and shutdown
  (the UCM is connected to the system on/off switch)
- System safety, diagnostics, status and fault codes
- System backup and restore
- DX BUS testing and operation
- Reading the input commands (desired speed and direction, actuator position switches) from the Physical User Interface and all external remotes and modules
- Generating the output commands (calculated speed and direction, actuator control) and sending these over the DX BUS to the Power Module and fitted auxiliary modules
- all system drive algorithms
- all programmable system parameters.
- RS232 serial communication with programming tools (HHP or Wizard)

The UCM has had several software revisions:

- - (dash)
- A
- C

The available parameters and their meaning are slightly different between software versions. See the programming section for a list of all parameters.

5.1.2 The physical user interface

The physical user interface translates the physical inputs (buttons, joystick) into electrical signals it sends to the UCM. It also translates the electrical outputs of the UCM to visible or audible user signals (LEDs, displays, the horn).

The Physical User Interface always consists of

- the housing
- the System Status LED

And optionally

- a joystick
- a display
- a battery gauge
- a battery charger socket
- buttons and knobs
- connectors for external switches

Most Master Remotes have their own user input device in the form of a joystick, but this is not always the case. For example: the G91 does not have a joystick, it depends on either a Secondary Remote or a set of switches to obtain direction and speed commands.

Most Master Remotes have their own display with battery gauge and system status information. Some Master Remotes however, such as the chin remote and the tray remote, do not have their own display, they only have a System Status LED.

5.2 Available Master Remotes

5.2.1 Master Remotes with joystick

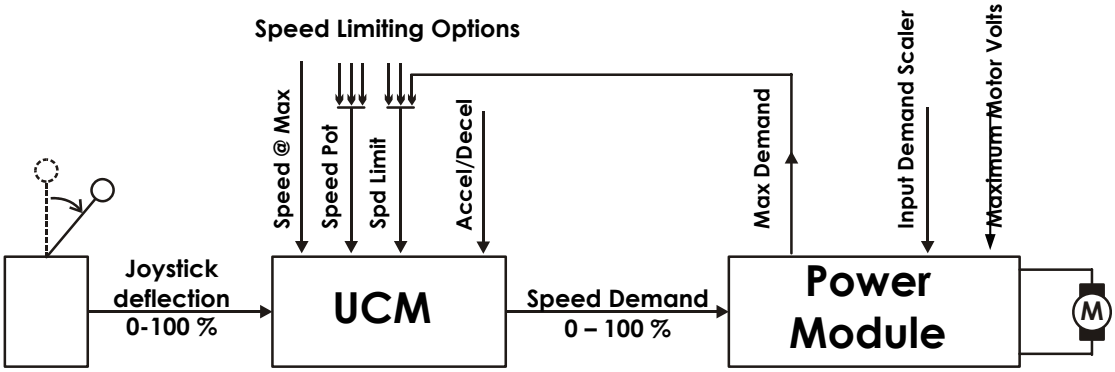
Master Remote	Application
 DX-REMG90A DX-REMG90T	Advanced driving Advanced seating Highly customisable Switched control available Joystick only menu control available Environmental control G90A: two sockets to connect external switches G90T : two toggle switches
 DX-REM34 Dolphin Remote	Advanced Driving Seating and lighting All actuators directly accessible from keypad
 DX-REM41 DX-REM41S Dolphin Tray Remote	Advanced Driving Seating and lighting All actuators directly accessible from keypad
 DX-REM32 Chin Remote	Chin control Drive only: Joystick, on/off switch, Speedpot No display No battery charger socket, only a programming socket
 DX-REM35 Tray Remote	Drive only: Joystick, on/off switch, Speedpot No display No battery charger socket, only a programming socket
 DX-ACU3 Attendant Control Unit	Master Remote joystick for attendant use. Switch to take control / release control Can control chair, charging and actuators. Optionally use Secondary Remote for user control.

5.2.2 Master Remotes without joystick

Master Remote	Application
 DX-REMG91 DX-REMG91S	Mounting close to the face of the user to optimise visibility Advanced driving, seating, lighting and environmental control 3-quadrant RIM, switched or proportional Optional joystick control with Secondary Remote Bi-directional actuator control Highly customisable Accessory Shortcut Key gives access to the last used function G91S provides single switch scanning
 DX-MASTERSW Switch Interface	Switched Drive (4 directions) + one switched On/Off control Optional joystick/attendant control with Secondary Remote
 DX-SCR Specialty Controls	Advanced menu-driven driving and environmental control Joystick operation with Secondary Remote Joystick-only control Joystick + Mode button control Single Switch Scanning control

5.3 Programmable parameters

5.3.1 Speed and acceleration principles



5.3.1.1 Speed Demand

When the user deflects the joystick or presses a drive control switch, the UCM (see section 5.1.1) converts the Joystick Deflection value into a Speed Demand value. The UCM then sends this Speed Demand value to the Power Module. The Speed Demand value is given as a percentage of the mechanical top speed of the powerchair.

The actual achievable mechanical top speed (in km/h) of any particular powerchair depends on factors like

- the wheel size
- the motors
- the gear used
- the available battery voltage
  (batteries that are almost empty have a lower maximum output voltage).

The mechanically achievable top speed varies greatly between powerchair models. For this reason the Speed Demand value is given as a percentage of that mechanical top speed.

For example:

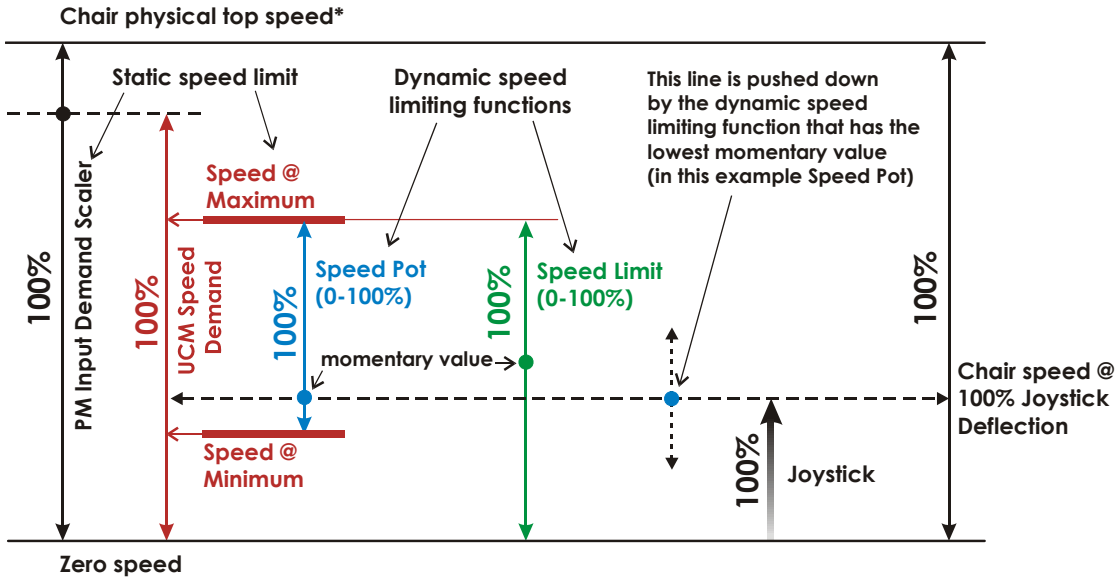
- A chair that has a mechanical top speed of 12 km/h will drive at approximately 6 km/h when the Speed Demand is 50%*.
- A chair that has a mechanical top speed of 8 km/h will drive at approximately 6 km/h when the Speed Demand is 75%*.

*When the **Input Demand Scaler** and the **Maximum Motor Volts** parameters are both set at their maximum value. See next section for more details.

5.3.1.2 Speed limiting options

The DX System offers many options that limit the available Speed Demand range to suit safety requirements as well as the preferences of the user. These options can be grouped into five categories:

- the Maximum Motor Volts parameter
- the Input Demand Scaler parameter
- the Speed @ Maximum parameter
- the Speed Pot function
- the Speed Limit function.



*** The 'Chair physical top speed' is limited by either the available battery voltage or the Maximum Motor Volts parameter, whichever has the lowest momentary value.**

The **Maximum Motor Volts** parameter (4.3.2.12) sets the maximum Voltage that the Power Module will apply to the motor. The **powerchair manufacturer** can use this parameter to limit the 'Chair physical top speed' to a calculated speed limit for a particular chair type (for specific motors and a specific wheel diameter).

The **Input Demand Scaler** parameter (4.3.2.13) allows the **Power Module** to scale down the Speed Demand that the UCM requires. A reduced Speed Demand creates extra steering headroom if a turn is requested at full speed (because steering is normally done differentially, with one wheel turning faster than the other one).

The **Speed @ Maximum** parameter can be adjusted by the **dealer** to set a maximum UCM Speed Demand value for the chair, suitable for a specific user. Every Drive Profile has its own Speed @ Maximum setting for forward, reverse and turning to allow different speed limits for different circumstances (indoors, outdoors).
For more information on Drive Profiles, see section 5.3.2.

The **Speed Pot** function is adjusted by the **user** to decrease the maximum speed of the chair according to his/her needs at the time. The adjustable value has a range of 0-100%. A Speed Pot value of 100% means that the maximum speed is equal to the **Speed @ Maximum** parameter. A Speed Pot value of 0% means that the maximum speed is equal to the **Speed @ Minimum** parameter. Therefore Speed @ Minimum actually means: The *Maximum Speed* when the *Speed Pot* function has the value zero.

The Speed Pot function gets its input from a group of parameters:

- A mechanical analogue speed pot (0-100%)
- A digital speed pot on the Master Remote (0-100%)
- The **Chair Speed** parameter (5.3.9.1) on the HHP (0-10, converted to 0-100%)
- The DX BUS Speed Pot parameter (0-100%). Any DX Module can take control of this parameter via the DX BUS.

The actual output value of the Speed Pot function will be the lowest of all the parameters above.

The **Speed Limit** function allows **DX Modules** to limit the maximum speed when necessary. For example: when the seat is raised, the speed of the chair must be limited. The adjustable range (0-100%) is a percentage of the Speed @ Maximum parameter.

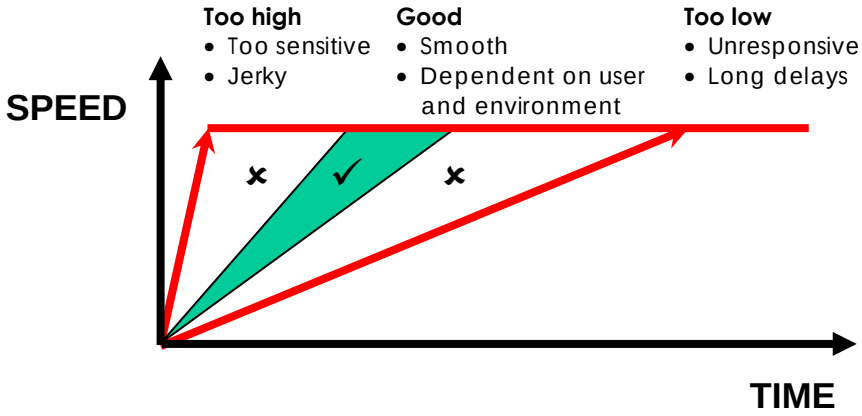
The Speed Limit function gets its input from a group of parameters:

- CLAM Slowdown (5.3.10.1)
- The DX BUS Slow parameter. Any DX Module can take control of this parameter via the DX BUS.
- Maximum Demand Indicator (MDI). The Power Module indicates to the UCM when it cannot fulfil the Speed Demand, for example when the user tries to go up a slope that is too steep, or when the battery voltage would become higher than the Maximum Motor Volts parameter (4.3.2.12).
- Internal stability algorithms that momentarily limit the speed for safety reasons.

The actual output value of the Speed Limit function will be the lowest of all the parameters above.

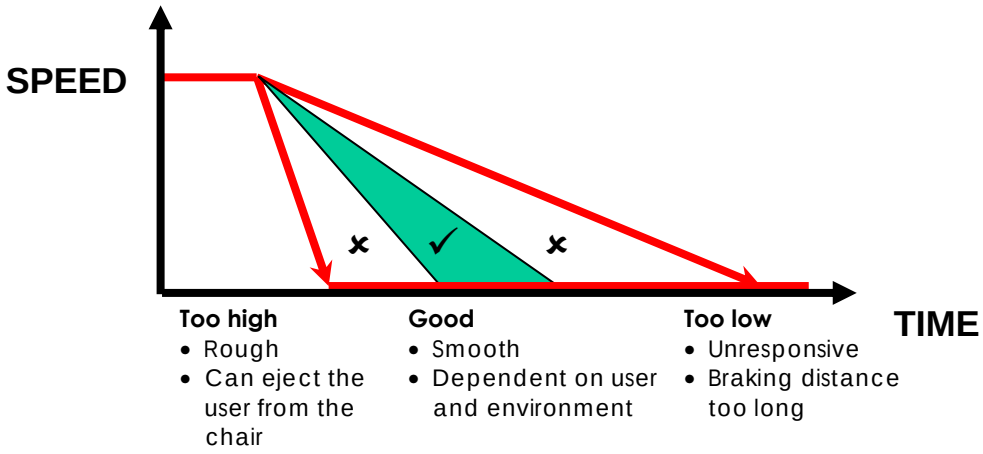
5.3.1.3 Acceleration and deceleration

Acceleration is the rate at which the speed increases when the joystick is pushed out of the centre position.



The acceleration of the powerchair can be adjusted with the **Forward Acceleration** (5.3.7.3), the **Reverse Acceleration** (5.3.7.7) and the **Turning Acceleration** (5.3.7.11) parameters.

Deceleration is the rate at which the speed decreases after the joystick has been returned to the centre position.



The deceleration of the powerchair can be adjusted with the **Forward Deceleration** (5.3.7.4), the **Reverse Deceleration** (5.3.7.8) and the **Turning Deceleration** (5.3.7.12) parameters.

Note:

The UCM applies the acceleration and deceleration algorithms to the Speed Demand value after the speed limiting functions.

Warning:

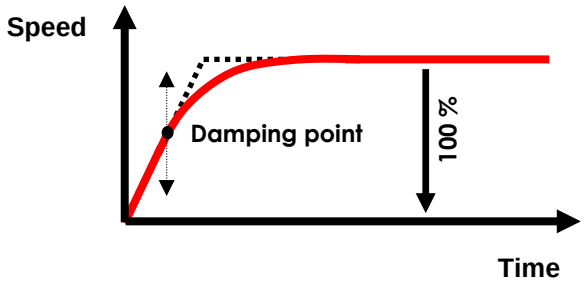
Too high or too low acceleration / deceleration settings can result in potentially dangerous chair behaviour and lead to injury.

Damping Point

When the powerchair almost reaches the desired speed, the acceleration / deceleration rate (that initially is given by the applicable acceleration / deceleration parameter of the previous page) is slowly decreased to zero. This prevents a sudden change in acceleration once the desired speed is reached.

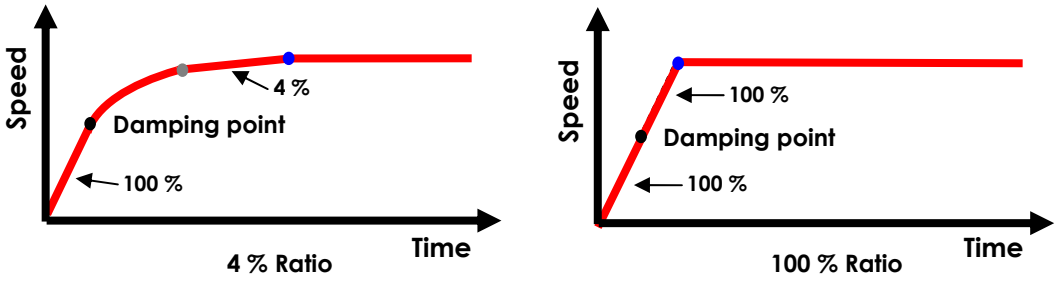
Use the **Speed Damping** and **Turn Damping** parameters (see 5.3.7.16) to adjust the point where the damping starts.

0%: No damping
100%: Maximum damping.



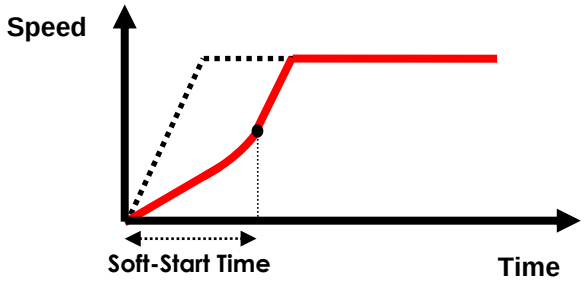
The **Min To Max Decel Ratio** parameter (section 5.3.7.17) defines the slope at the end of the curve before the final speed is reached, as a percentage of the acceleration / deceleration slope before damping has started.

4%: The end acceleration / deceleration is 4% of the acceleration / deceleration before damping, which gives a very smooth curve.
100%: The end acceleration / deceleration is 100% of the acceleration / deceleration before damping, which effectively results in no damping at all.



Soft-Start Acceleration

The Damping Point only affects the end of the acceleration curve in most cases. To provide a smooth start from a standstill when the joystick is suddenly deflected to 100% (for example with a switched joystick) use **Soft-Start Acceleration** (see 5.3.9.2) in combination with the **Soft-Start Time** parameter (see 5.3.8.6).



5.3.2 Drive Profiles

5.3.2.1 The principle

A Drive Profile is a set of parameters which

- define the maximum speed and the responsiveness (acceleration and deceleration) of the chair
- select the desired input source, such as the joystick of the Master Remote, a secondary joystick or external switches.

Drive Profiles can provide access to multiple control sources, define indoor and outdoor driving modes or simply provide a digital speed pot by programming a range of preset maximum speeds.

The DX system can store up to 6 Drive Profiles. Each Drive Profile can be independently customised to provide varying levels of speed and responsiveness.

Drive Profiles						
	Prof 1	Prof 2	Prof 3	Prof 4	Prof 5	ACU
Forward Speed @ Maximum (%)	40	50	65	80	100	60
Forward Acceleration (%)	40	40	40	40	40	40
Forward Deceleration (%)	60	60	60	60	60	60
Reverse Speed @ Maximum (%)	30	40	50	60	70	50
Reverse Acceleration (%)	35	35	35	35	35	35
Reverse Deceleration (%)	70	70	70	70	70	70
Turning Speed @ Maximum (%)	25	30	45	50	50	40
Turning Acceleration (%)	40	40	40	40	40	40
Turning Deceleration (%)	60	60	60	60	60	60

Some of the Drive Profile parameters as they appear in the Wizard

Dependent on the features of the Master Remote in use and its programming, the user can choose Drive Profile 1-5 with

- the Drive Profile selection buttons on the Master Remote
- the joystick on the Master Remote or the Secondary Remote
- the ARC buttons or switches (see 6.6.3.4)
- external Drive Profile selection switches, if fitted.

DX-ACU1

Drive Profile 6 is intended for use with an Attendant Control Unit (ACU), and is called the ACU profile. Drive Profile 6 is automatically selected when an ACU that is in the 'Attendant Mode' is connected to the DX System. When the ACU is disconnected, or when it returns to the 'User Mode', the powerchair automatically returns to the Drive Profile that was selected when the ACU became active (see the ACU User Manual for more details).

5.3.2.2 Drive Profile 0

Drive Profile 0 has all parameters set the same as Drive Profile 1, but prevents the powerchair from driving. This is a safety feature required by some regulatory authorities to prevent a sudden change in speed when progressing from Drive Profile 1 (normally the slowest), down to Drive Profile 5 (normally the fastest) when **Wrap Profiles** is enabled (see section 5.3.8.2).

Drive Profile 0 can be used for its ability to inhibit driving, particularly when used for Actuator Mode (when actuators are enabled).

Enable Drive Profile 0 with the **Allow Non-Driving Profile** parameter (5.3.8.4).

5.3.2.3 Speed setting recommendations

Each Drive Profile has its own Maximum Speed, Acceleration and Deceleration settings for forward, reverse and turning. These settings can be adjusted so that the different Drive Profiles either

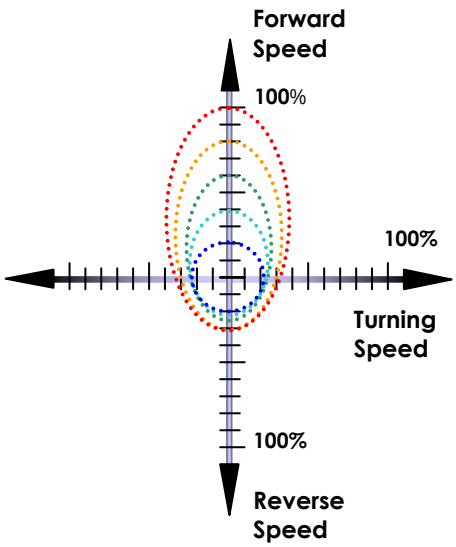
- act as a digital Speed Pot, or
- cater for the different needs in different environments, for example indoors or outdoors.

It is common practice to program Drive Profile 1 as the slowest profile and Drive Profile 5 as the fastest profile.

Programming Drive Profiles as a digital Speed Pot

- Forward speed should have a large linear range between drive profiles
- Reverse and turning speed should change only slightly for faster drive profiles
- **Grip** (see 5.3.7.15) should be decreased for faster drive profiles to maintain chair stability.

Drive Profile	Maximum Forward Speed	Maximum Reverse Speed	Maximum Turning Speed	Grip (5.3.7.15)
1	20 %	20 %	20 %	100%
2	40 %	20 %	20 %	85%
3	60 %	25 %	25 %	70%
4	80 %	30 %	30 %	55%
5	100 %	30 %	35 %	40%
Drive Profile	**Minimum Forward Speed**	**Minimum Reverse Speed**	**Minimum Turning Speed**	
All	5 %	5 %	5 %	-



Programming Drive Profiles for different environments

- Turning speed can be higher for indoor drive profiles, because fast turning at low speed can be helpful indoors to drive around objects.
- Fast turning at high forward speed can be dangerous, so the fast outdoor drive profile should have a lower turning speed.

Drive Profile	Type	Maximum Forward Speed	Maximum Reverse Speed	Maximum Turning Speed	Grip (see 5.3.7.15)
1	Home	20 %	20 %	20 %	80 %
2	Mall	40 %	20 %	40 %	40 %
3	Outdoor wet	60 %	30 %	20 %	25 %
4	Outdoor dry	60 %	30 %	20 %	80 %
5	Outdoor fast	100 %	30 %	10 %	80 %

Warning:

The recommended parameter values are a guideline only. Testing is required to verify suitability for individual chair designs and user preference.

Note:

*Adjust the **Load Compensation** parameter (4.3.2.3) to the correct motor resistance value **before you program the Drive Profile speed settings**. Load Compensation controls the behaviour of the motor. The behaviour of the motor changes the performance of all speed and acceleration parameters. If you adjust the Load Compensation parameter after you have set the speed parameters, you will probably have to re-adjust many speed parameters again.*

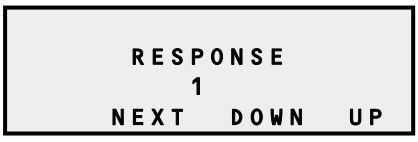
5.3.2.4 Single Drive Profile mode

Normally Drive Profiles are used to customise a chair to the comfort and driving habits of one user. If a chair is frequently shared between users, **Single Profile Mode** (see 5.3.10.4) in combination with **Chair Speed Enable** (see 5.3.10.3) can be useful.

Single Drive Profile mode makes it easy to quickly adapt a chair to different users or situations without the need for extensive programming. When the HHP is plugged in, the therapist or carer can easily adjust the overall Chair Speed and select the desired Drive Profile (such as the Drive Profile for user X, or the Drive Profile for indoor use).

The user can not change the Drive Profile, because the Profile Select buttons work as a digital Speed Pot for the Drive Profile that is currently active, they do not change the active Profile. This makes sure that the user does not accidentally change the Drive Profile to the Profile of another user, or the fast outdoor Profile when indoors.

The first HHP screen changes the overall Chair Speed



The second HHP screen changes the Drive Profile (called Response)

5.3.3 Two or more joysticks: choosing the joystick source

Every Drive Profile has its own external joystick setting.

Select the joystick to use for each Drive Profile with the **Joystick Source** parameter (see section 5.3.8.7).

This parameter can be adjusted with the HHP and the Wizard.

5.3.4 Reducing the movement to operate the joystick

Normally a DX powerchair will reach full speed only when the joystick is pushed as far as it can mechanically go (for example when it hits the restrictor plate).

For some users it may be difficult or impossible to move the joystick to the end point. In these cases the **Short Throw Travel** parameter (5.3.7.14) can reduce the amount of deflection (and therefore pressure) required to achieve full speed. The dealer or therapist can adjust this parameter to suit the physical abilities of specific users.

For actuator operation, the **Joystick Switch Threshold** parameter (5.3.10.16) can reduce the amount of deflection that is needed before the switch function is activated.

Warning:

*When you adjust **Short Throw Travel**, use **Short Throw Shape** to make sure that the user can not request full forward speed and full turn speed at the same time. See section 5.3.7.14 for more details.*

5.3.5 Chair stability

The DX System has several options to increase the stability of a powerchair.

- The **Grip** parameter (see 5.3.7.15) defines the physical grip of the powerchair. Set this parameter low for Drive Profiles that are used on slippery surfaces.
- The Chair Stability Parameters (see 5.3.7.18) are useful to make sure that the powerchair does not lose control when it tries to make a turn at high speed.
- The Steering stability parameters (see 5.3.7.19) can help the user to steer straight and to prevent steering delays when the chair is driving at full speed.

See also section 7.4: Programming and testing a DX chair for stability.

5.3.6 List of parameters

Key: ✓ Editable at this level (see section 7.1.2.1: Dongle versions)

👁 Viewable at this level

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Drive Profiles							
Forward Speed @ Maximum	10 – 100 %	N/A	-,A,C	✓	✓	✓	✓
Forward Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓
Forward Acceleration	10 – 70 %	40 %	-,A,C	✓	✓	✓	✓
Forward Deceleration	15 – 100 %	60 %	-,A,C	✓	✓	✓	✓
Reverse Speed @ Maximum	10 – 100 %	N/A	-,A,C	✓	✓	✓	✓
Reverse Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓
Reverse Acceleration	10 – 70 %	70 %	-,A,C	✓	✓	✓	✓
Reverse Deceleration	15 – 100 %	30 %	-,A,C	✓	✓	✓	✓
Turning Speed @ Maximum	20 – 100 %	N/A	-,A,C	✓	✓	✓	✓
Turning Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓
Turning Acceleration	10 – 70 %	40 %	-,A,C	✓	✓	✓	✓
Turning Deceleration	15 – 100 %	70 %	-,A,C	✓	✓	✓	✓
Turn Damping	10 – 100 %	40%	C	-	✓	✓	✓
Non-Linear Turn	No / Yes	No	C	-	👁	✓	✓
Short Throw Shape	100 – 200 %	200 %	C	-	✓	✓	✓
Short Throw Travel	100 – 200 %	100 %	C	-	✓	✓	✓
Grip	5 – 100 %	100%	C	✓	✓	✓	✓
Damping Point	10 – 100 %	40 %	-,A	✓	✓	✓	✓
Speed Damping	5 – 100 %	40 %	C	-	✓	✓	✓
Min To Max Decel Ratio	4 – 100 %	20 %	-,A,C	-	✓	✓	✓
Speed x Turn for Grip	5 – 100 %	100 %	C	-	👁	👁	✓
Accel Out Of A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓
Accel Into A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓
Turning @ Full Speed	5 – 100 %	100 %	C	-	👁	👁	✓
Turning Accel @ Full Speed	100 – 300 %	100 %	C	-	👁	👁	✓

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Drive Profile Options							
Maximum Profile Number	1 - 5	5	-,A,C	-	✓	✓	✓
Wrap Profiles	No / Yes	Yes	A,C	-	👁	👁	✓
Change Profile While Driving	No / Yes	No	-,A,C	-	✓	✓	✓
Allow Non-Driving Profile	No / Yes	No	-,A,C	-	👁	👁	✓
Sleep Timeout	1 – 60 min	5 min	-,A,C	-	✓	✓	✓
Soft-Start Time	0 – 1000 ms	0 ms	A,C	-	✓	✓	✓
Joystick Source (RJM)	No / Yes	No	-,A	✓	✓	✓	✓
Joystick Source	Master ACU RJM Display ARC ExtNV1 ExtNV2 None	Master	C	-	✓	✓	✓
Joystick Swap Forward / Reverse	No / Yes	No	A,C	✓	✓	✓	✓
General User Options							
Speed Pot Scaler	20 – 100 %	100 %	-,A	-	✓	✓	✓
Chair Speed	0 – 10	10	C	✓	✓	✓	✓
Soft-Start Acceleration	No / Yes	No	A,C	-	✓	✓	✓
Neutral Maximum	10 – 50 %	10 %	-,A,C	-	✓	✓	✓
Disable OONAPU Faults	No / Yes	No	A,C	-	✓	✓	✓
Drive Delay After Power-up	0-10	0 s	C	-	✓	✓	✓
Lock Enable	No / Yes	No	-,A,C	-	✓	✓	✓
Sleep Mode Enable	No / Yes	No	-,A,C	-	✓	✓	✓
Power-up Profile Number	1 - 7	7	C	-	👁	✓	✓
Enable Joystick Wakeup	No / Yes	Yes	C	-	✓	✓	✓

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
System Settings							
CLAM Slowdown	0 – 100 %	20 %	-,A,C	-	👁	✓	✓
Neutral to PB Delay	20 – 5000 ms	100 ms	-,A,C	-	👁	👁	✓
Chair Speed Enable	No / Yes	No	C	-	👁	✓	✓
Single Profile Mode	No / Yes	No	C	✓	👁	✓	✓
CANH Power Switch	No / Yes	Yes	C	-	👁	✓	✓
CAN Terminator	No / Yes	Yes	C	-	👁	✓	✓
UCM Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓
Rotate UCM Joystick	No / Yes	No	C	-	👁	✓	✓
ACU Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
ACU Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓
ACU has Momentary Switch	No / Yes	No	C	-	👁	✓	✓
ACU Momentary Switch Timeout	No / Yes	Yes	C	-	👁	✓	✓
RJM Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
RJM Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓
RJM has Analog Joystick	No / Yes	Yes	C	-	👁	✓	✓
Joystick Switch Threshold	20 – 80 %	50 %	C	-	✓	✓	✓

5.3.7 Drive Profiles parameters

These parameters have to be set for every Drive Profile:

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Forward Speed @ Maximum	10 – 100 %	N/A	-,A,C	✓	✓	✓	✓
Forward Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓
Forward Acceleration	10 – 70 %	40 %	-,A,C	✓	✓	✓	✓
Forward Deceleration	15 – 100 %	60 %	-,A,C	✓	✓	✓	✓
Reverse Speed @ Maximum	10 – 100 %	N/A	-,A,C	✓	✓	✓	✓
Reverse Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓
Reverse Acceleration	10 – 70 %	70 %	-,A,C	✓	✓	✓	✓
Reverse Deceleration	15 – 100 %	30 %	-,A,C	✓	✓	✓	✓
Turning Speed @ Maximum	20 – 100 %	N/A	-,A,C	✓	✓	✓	✓
Turning Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓
Turning Acceleration	10 – 70 %	40 %	-,A,C	✓	✓	✓	✓
Turning Deceleration	15 – 100 %	70 %	-,A,C	✓	✓	✓	✓
Turn Damping	10 – 100 %	40%	C	-	✓	✓	✓
Non-Linear Turn	No / Yes	No	C	-	👁	✓	✓
Short Throw Shape	100 – 200 %	200 %	C	-	✓	✓	✓
Short Throw Travel	100 – 200 %	100 %	C	-	✓	✓	✓
Grip	5 – 100 %	100%	C	✓	✓	✓	✓
Damping Point	10 – 100 %	40 %	-,A	✓	✓	✓	✓

These parameters are set for all drive profiles at once:

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Speed Damping	5 – 100 %	40 %	C	-	✓	✓	✓
Min To Max Decel Ratio	4 – 100 %	20 %	-,A,C	-	✓	✓	✓
Speed x Turn for Grip	5 – 100 %	100 %	C	-	👁	👁	✓
Accel Out Of A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓
Accel Into A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓
Turning @ Full Speed	5 – 100 %	100 %	C	-	👁	👁	✓
Turning Accel @ Full Speed	100 – 300 %	100 %	C	-	👁	👁	✓

5.3.7.1 Forward Speed @ Maximum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Forward Speed @ Maximum	10 – 100 %	N/A	-,A,C	✓	✓	✓	✓

Sets the forward speed of the powerchair when the joystick is fully deflected forward and the Speed Pot is in its Maximum position.

This parameter must be set for every Drive Profile.

See also section 5.3.2.3: Speed setting recommendations.

5.3.7.2 Forward Speed @ Minimum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Forward Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓

Sets the forward speed of the powerchair when the joystick is fully deflected forward and the Speed Pot is in its Minimum position.

This parameter must be set for every Drive Profile.
This parameter partially replaces the **Speed Pot Scaler** parameter (see 5.3.9.5).

See also section 5.3.2.3: Speed setting recommendations.

5.3.7.3 Forward Acceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Forward Acceleration	10 – 70 %	40 %	-,A,C	✓	✓	✓	✓

Sets the rate at which the forward speed increases after the joystick has been deflected forward. 10% results in a very slow increase, 70% results in a very quick increase.

See also section 5.3.1.3 : Acceleration and deceleration.

5.3.7.4 Forward Deceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Forward Deceleration	15 – 100 %	60 %	-,A,C	✓	✓	✓	✓

Sets the rate at which the forward speed decreases after the joystick has been returned to the centre. 15% results in a very slow stop, 100% results in an instant stop.

See also section 5.3.1.3 : Acceleration and deceleration.

Warning:

Setting the Deceleration too low or too high can result in an unsafe powerchair. Test thoroughly after programming to make sure that the powerchair complies with regulatory requirements such as ISO7176 and the GMD-TND Homologation Directive R04 for maximum allowable braking distance.

5.3.7.5 Reverse Speed @ Maximum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Reverse Speed @ Maximum	10 – 100 %	N/A	-,A,C	✓	✓	✓	✓

Sets the reverse speed of the powerchair when the joystick is fully deflected backward and the Speed Pot is in its Maximum position.

This parameter must be set for every Drive Profile.

See also section 5.3.2.3: Speed setting recommendations.

5.3.7.6 Reverse Speed @ Minimum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Reverse Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓

Sets the reverse speed of the powerchair when the joystick is fully deflected backward and the Speed Pot is in its Minimum position.

This parameter must be set for every Drive Profile.
This parameter partially replaces the **Speed Pot Scaler** parameter (see 5.3.9.5).

See also section 5.3.2.3: Speed setting recommendations.

5.3.7.7 Reverse Acceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Reverse Acceleration	10 – 70 %	70 %	-,A,C	✓	✓	✓	✓

Sets the rate at which the reverse speed increases after the joystick has been deflected backward. 10% results in a very slow increase, 70% results in a very quick increase.

See also section 5.3.1.3 : Acceleration and deceleration.

5.3.7.8 Reverse Deceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Reverse Deceleration	15 – 100 %	30 %	-,A,C	✓	✓	✓	✓

Sets the rate at which the reverse speed decreases after the joystick has been returned to the centre. 15% results in a very slow stop, 100% results in an instant stop.

See also section 5.3.1.3 : Acceleration and deceleration.

5.3.7.9 Turning Speed @ Maximum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Turning Speed @ Maximum	20 – 100 %	N/A	-,A,C	✓	✓	✓	✓

Sets the turning speed of the powerchair when the joystick is fully deflected sideways and the Speed Pot is in its Maximum position.

This parameter must be set for every Drive Profile.

See also section 5.3.2.3: Speed setting recommendations.

5.3.7.10 Turning Speed @ Minimum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Turning Speed @ Minimum	5 – 100 %	5%	C	✓	✓	✓	✓

Sets the turning speed of the powerchair when the joystick is fully deflected sideways and the Speed Pot is in its Minimum position.

This parameter must be set for every Drive Profile.

See also section 5.3.2.3: Speed setting recommendations.

5.3.7.11 Turning Acceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Turning Acceleration	10 – 70 %	40 %	-,A,C	✓	✓	✓	✓

Sets the rate at which the turning speed increases after the joystick has been deflected sideways. 10% results in a very slow increase, 70% results in a very quick increase.

See also section 5.3.1.3 : Acceleration and deceleration.

5.3.7.12 Turning Deceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Turning Deceleration	15 – 100 %	70 %	-,A,C	✓	✓	✓	✓

Sets the rate at which the turning speed decreases after the joystick has been returned to the centre. 15% results in a very slow stop, 100% results in an instant stop.

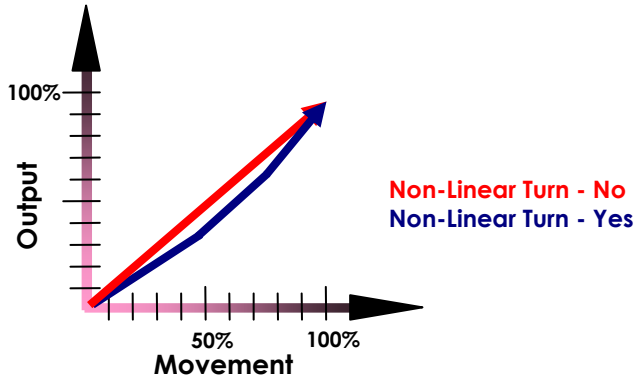
See also section 5.3.1.3 : Acceleration and deceleration.

5.3.7.13 Non-Linear Turn

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Non-Linear Turn	No / Yes	No	C	-	👁	✓	✓

Non-Linear Turn decreases the joystick gain (output/input ratio) for low turning speeds. This gives the user finer steering control at low turning speed, because more movement of the joystick is required to generate the same turning output.

Non-Linear Turn does not change the maximum turning speed, so the powerchair will still be able to turn smoothly, for example on thick carpet.



See also **Halve Turning Gain** (section 4.3.4.8).

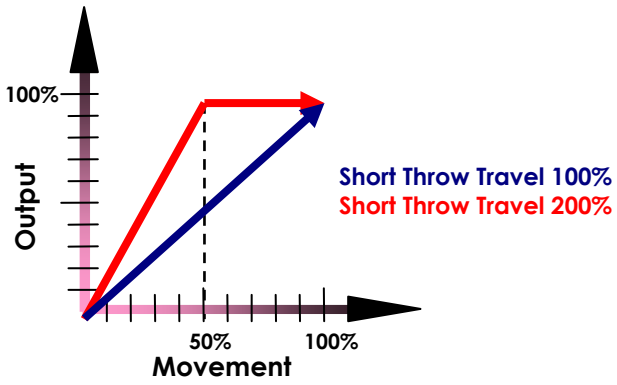
5.3.7.14 Short Throw Travel / Short Throw Shape

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Short Throw Travel	100 – 200 %	100 %	C	-	✓	✓	✓
Short Throw Shape	100 – 200 %	200 %	C	-	✓	✓	✓

Normally a DX joystick will output a 100% Joystick Deflection signal (see 5.3.1) only when the joystick is pushed as far as it can mechanically go (for example when it hits the restrictor plate).

Short Throw Travel increases the joystick gain (output/input ratio) so that less movement of the joystick is required to generate full output. Increasing the joystick gain can be useful in two situations:

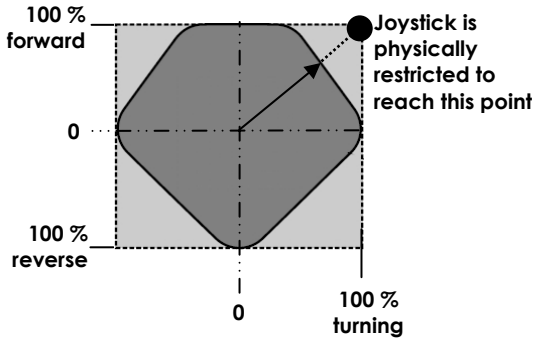
- A small gain increase (up to 105% or 110%) makes sure that a 100% Deflection signal is possible in situations where a joystick has not been or can not be calibrated correctly
- A large gain increase (up to 200%) allows users with very little hand movement full proportional control.



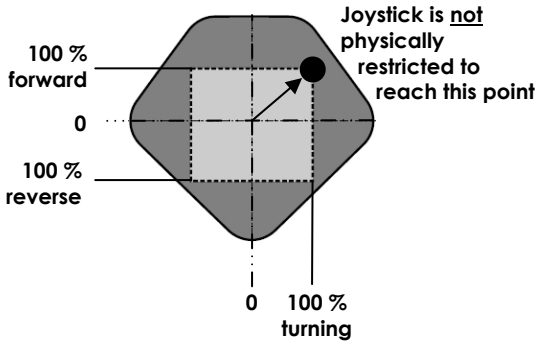
Warning:

*Increasing Short Throw Travel can introduce a **safety risk**, because the mechanical resistor plate does not anymore restrict the joystick before its output reaches 100%. This can cause a situation where the joystick demands full forward speed and full turning speed, which can be dangerous.*

Short Throw Travel 100%

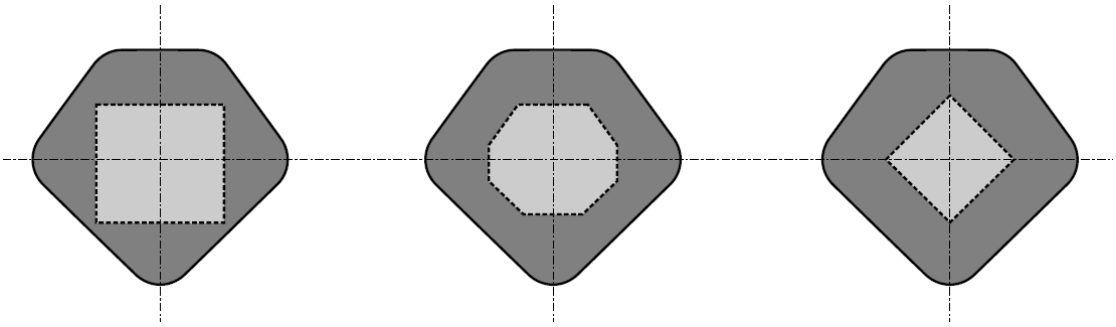


Short Throw Travel 200%



To keep the chair stable, the **Short Throw Shape** parameter can shave the corners off the 'square of movement' that a high Short Throw Travel value has created.

Short Throw Shape 200% **Short Throw Shape 150%** **Short Throw Shape 100%**



A good starting point for a user with limited hand movement/strength can be:

Parameter Name	Value
Short Throw Travel	150%
Short Throw Shape	150%
Joystick Switch Threshold (for actuator control, see 5.3.10.16)	30%

Warning:

These settings are to be used as a guideline only. It is the responsibility of the powerchair manufacturer to make sure the program is safe and suitable for a particular chair configuration.

5.3.7.15 Grip

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Grip	5 – 100 %	100%	C	✓	✓	✓	✓

The Grip parameter defines the overall effect of the Chair Stability Parameters (see section 5.3.7.18).

The Chair Stability Parameters are used by the **powerchair manufacturer** to

- provide a stable chair
- prevent the drive wheels from slipping.

The powerchair manufacturer sets up the Chair Stability Parameters so that the chair is stable an a flat surface with good physical grip.

For each Drive Profile, **the dealer or therapist** can use the **Grip** parameter to indicate to the DX System the kind of surface that this Drive Profile will be used in. If the intended surface offers little physical grip, the value of the **Grip** parameter can be decreased. A low value of **Grip** increases the effect that the Chair Stability Parameters have, so the chair will become more stable on that surface with little physical grip.

Grip parameter value	Use when	Result
100%	Good physical grip No adjustment needed	The Chair Stability Parameters have their actual OEM programmed value
5%	Very little physical grip Maximum stability needed	The effect of the Chair Stability Parameters is increased to provide more stability

Physical grip is the amount of contact that the drive wheels have with the surface that they drive on. With little physical grip the drive wheels slip easily. If the wheels slip, the powerchair is uncontrollable.

For example:

- A chair on a non-slip surface has a high physical grip, so the **Grip** parameter can be set to 100%.
- A Rear Wheel Drive chair on a slippery surface has a low physical grip, so the **Grip** parameter must be set lower.

Note:

*For indoor Drive Profiles, set **Grip** to a low value to prevent skid marks on the floor.*

Warning:

*The correct value for the **Grip** parameter is dependent on the value of the Chair Stability Parameters (programmed by the powerchair manufacturer). Testing is required to verify suitability for individual chair designs and/or users. See also section 7.4: Programming and testing a DX chair for stability.*

5.3.7.16 Damping Point / Turn Damping / Speed Damping

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Damping Point	10 – 100 %	40 %	-,A	✓	✓	✓	✓
Turn Damping	10 – 100 %	40%	C	-	✓	✓	✓
Speed Damping	5 – 100 %	40 %	C	-	✓	✓	✓

When the powerchair almost reaches its desired speed during acceleration or deceleration, the acceleration/deceleration rate is slowly decreased to zero. This prevents a sudden change in acceleration once the desired speed is reached. The **Damping Point** parameter defines when the damping starts.

0%: No damping, 100%: Maximum damping.
For most applications the default value of 40% works fine.

UCM Software versions '–' and 'A' use only the Damping Point parameter: the same value is used for Forward, Reverse and Turning.

In software version 'C' the Damping Point parameter has been replaced with two separate parameters for added flexibility:

- **Speed Damping** (Damping point for forward and reverse)
- **Turn Damping** (Damping Point for turning).

See also section 5.3.1.3: **Acceleration and deceleration**.

Warning:

An unsuitably high or low value can make the powerchair unstable.

5.3.7.17 Min To Max Decel Ratio

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Min To Max Decel Ratio	4 – 100 %	20 %	-,A,C	-	✓	✓	✓

This parameter is used together with the **Damping Point / Turn Damping / Speed Damping** parameters (5.3.7.16). **Min To Max Decel Ratio** defines the slope at the end of the damping curve before the final speed is reached, as a percentage of the acceleration / deceleration slope before damping has started.

4%: The end acceleration / deceleration is 4% of the acceleration / deceleration before damping, which gives a very smooth curve.

100%: The end acceleration / deceleration is 100% of the acceleration / deceleration before damping, which effectively results in no damping at all.

Low values are smoother but will also cause more rollback when the powerchair stops on a slope.

See also section 5.3.1.3: **Acceleration and deceleration**.

5.3.7.18 Chair Stability Parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Speed x Turn for Grip	5 – 100 %	100 %	C	-	👁	👁	✓
Accel Out Of A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓
Accel Into A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓

The Chair Stability Parameters can improve the safety, controllability and performance of the powerchair, especially for mechanically unstable chairs like Front Wheel Drive chairs or Mid Wheel Drive chairs. There is not much weight distribution over the drive wheels of these chairs and therefore the wheels can slip easily.

For any chair design, there is a maximum combined value of Speed and Turn for which the chair is stable. A chair may be stable turning slightly while moving at a high speed forward, or it may be stable making a fast turn on the spot, but it may be unstable and lose control when making a sharp turn at a high speed. Loss of control means that the chair's inertia and turn component are such that the tyres lose traction and slide, rendering any action from the controller ineffective.

Traction is affected by many factors, such as

- the chair design
- the wheel base length and width
- the centre of gravity of the chair
- the state and inflation of the tyres
- the friction and slope of the driving surface
- the weight and the position of the user.

The **Speed X Turn for Grip**, **Accel out of a Turn for Grip** and **Accel into a Turn for Grip** parameters together define the mechanical properties that affect the stability of the chair and are set by the **powerchair manufacturer** for each particular chair design.

These parameters are NOT designed to be tuned for specific users.

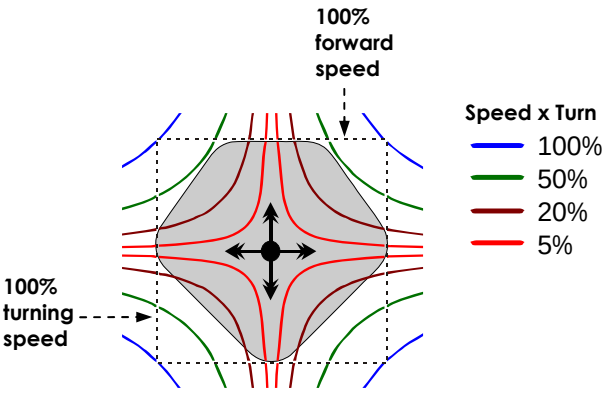
Note:

*The overall effect of the chair stability parameters is dependent on the value of the **Grip** parameter (5.3.7.15).*

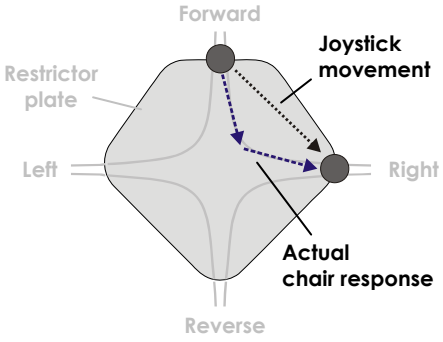
*The **Grip** parameter can be adjusted by the dealer or therapist and as such it must not be used by the powerchair manufacturer to control the stability of the powerchair.*

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Speed x Turn for Grip	5 – 100 %	100 %	C	-	👁	👁	✓

Speed X Turn for Grip is the absolute maximum speed/turn product for which the chair is stable on a surface with good grip. The DX System limits the turning speed when the forward speed is too high, and it limits the forward speed when the turning speed is too high.



The speed limiting does not limit the physical joystick position, but it limits the chair response. For example, with a 5% **Speed X Turn for Grip** value, if a powerchair travels at full speed forward and the joystick suddenly demands a sharp right turn, the chair will first slow down before it starts to turn.



Note:

The actual chair response can be limited by other factors or parameters (for example the acceleration parameters, the damping point or the other chair stability parameters), and therefore the actual response path can be inside the limit curves. The path will never go outside the limit curve, however.

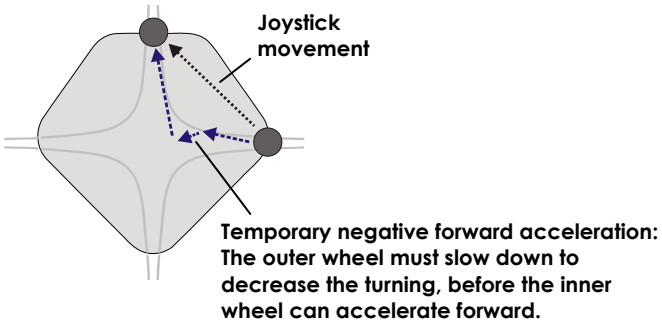
Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Accel Out Of A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓

When a user of a Front Wheel Drive chair requests fast acceleration forward while the chair is turning, the chair stability will be reduced. On Front Wheel Drive chairs, acceleration forward causes less weight on the drive wheels because the weight shifts backwards. Less weight on the drive wheels means that these wheels loose traction more easily. At the same time, the acceleration request demands the wheels to apply more forward force to speed up the chair.

The increase of forward force demand combined with less traction reduces the stability of the chair. To compensate for the reduced stability, the DX System constantly calculates the traction on each drive wheel and then limits the momentary value of the forward acceleration dependent on the value of **Accel out of a Turn for Grip**.

- A value of 0% does not affect forward acceleration at all
- A value of 200% limits the forward acceleration heavily.

A very heavy acceleration limit may even temporarily limit the forward acceleration to a negative value, effectively demanding deceleration or slowing down in spite of the user requesting the forward speed to be increased.



Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Accel Into A Turn For Grip	0 – 200 %	100 %	C	-	👁	👁	✓

When the user of a Front Wheel Drive chair requests an increase in turning speed while the chair is moving forward (for example by requesting a turn when the chair is travelling straight ahead), the chair stability will be reduced. The turn acceleration will cause the weight to shift toward the outer drive wheel and away from the inner drive wheel. The inner drive wheel will therefore loose traction more easily. As the outer drive wheel speeds up to make the turn, and the inner drive wheel slowly loses traction, the powerchair can end up spinning.

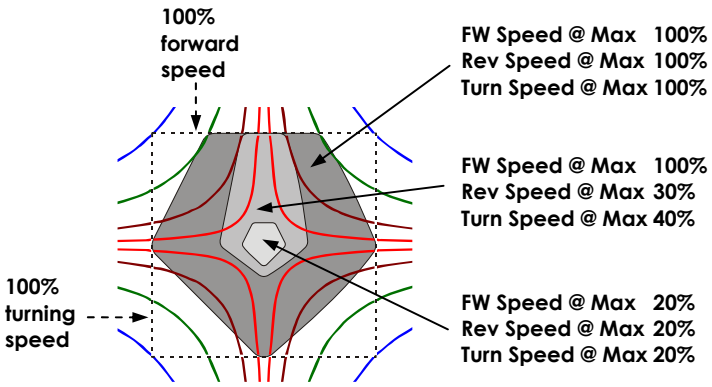
To prevent the powerchair from spinning, the DX System constantly calculates the traction on each drive wheel and then limits the momentary value of the turning acceleration dependent on the value of **Accel into a Turn for Grip**.

- A value of 0% does not affect the turning acceleration at all
- A value of 200% limits the turning acceleration heavily.

The influence of the Drive Profile Maximum Speed settings

The actual shape of the physical resistor plate overlaid on the speed graph depends on the **Speed @ Maximum** parameters of a particular Drive Profile (see 5.3.2) and the momentary setting of the Speed Pot.

In slow Drive Profiles or with low Speed Pot settings, the actual speed demand may never reach the value where it would cause the chair to become unstable, so in that particular Drive Profile the chair stability parameters may never have to intervene.



Testing

Because the stability of a particular chair design depends on so many factors, it is almost impossible to calculate the correct values of the chair stability parameters beforehand. For this reason it is recommended to derive the suitable value of these parameters by actually physically testing their effect on the chair stability of a particular chair, and adjusting the values as necessary. See section 7.4: Programming and testing a DX chair for stability.

A possible starting point to prevent Front Wheel Drive powerchairs from spinning could be:

Parameter Name	Value
Speed X Turn for Grip	65%
Accel out of a Turn for Grip	150%
Accel into a Turn for Grip	150%

Warning:

Any given settings are to be used as a guideline only.

- *It is the responsibility of the powerchair manufacturer to make sure that the program is safe and suitable for a particular chair configuration.*
- *It is the responsibility of the dealer or therapist to check and make sure that the settings of a chair for a particular user are safe and appropriate for that user.*

5.3.7.19 Steering stability parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Turning @ Full Speed	5 – 100 %	100 %	C	-	👁	👁	✓
Turning Accel @ Full Speed	100 – 300 %	100 %	C	-	👁	👁	✓

If the powerchair travels at full speed, the chair can easily "snake". When the powerchair snakes, it slightly changes direction from left to right.

The powerchair "snakes" at full speed

Two different events can cause snaking:

1. When the chair travels straight forward at full speed, small unintentional joystick movements (for example when the chair drives over a bump and the hand of the user shifts) can cause the chair to veer off. The user then over-corrects the direction which results in snaking of the powerchair. At full speed, a reduction of joystick sensitivity can help the user to keep the chair straight.

   Turning @ Full Speed changes the value of the **Turning Speed @ Maximum** parameter (see 5.3.7.9) when the joystick is pushed full forward.
   - A value of 100% has no effect
   - A value of 50% reduces steering at full speed by 50%.

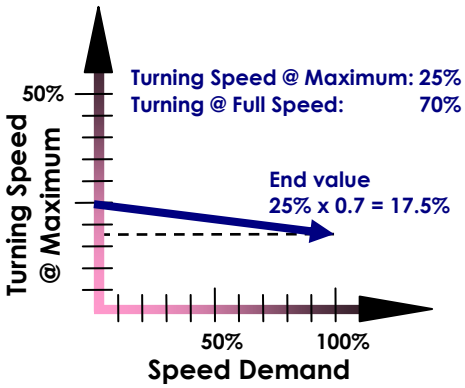
2. If the user *does* want to change direction slightly when travelling at full speed, the acceleration damping of the **Damping Point** (see 5.3.7.16) in combination with the Chair Stability Parameters (5.3.7.18) can cause a steering delay. The user does not feel the chair turning and deflects the joystick further, effectively over-steering. When the chair catches up it turns too far and the user has to correct again. This also results in snaking of the powerchair. A faster turning response helps to prevent this kind of behaviour.

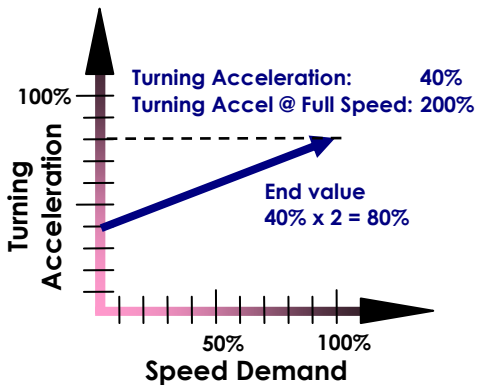
   Turning Accel @ Full Speed changes the value of the **Turning Acceleration** parameter (see 5.3.7.11) when the joystick is pushed full forward. A value above 100% achieves a more responsive turn characteristic at high speed. This compensates the Damping Point effect for small sideways joystick deflections.
   - A value of 100% has no effect
   - A value of 200% doubles the turning acceleration at full speed.

Note:

*A low value of the **Turn Damping** parameter (see 5.3.7.16) can also prevent steering delays .*

The **Turning @ Full Speed** and **Turning Accel @ Full Speed** parameters change the values of their own source parameters linearly dependent on the momentary UCM Speed Demand value, (see 5.3.1.1), not on the joystick deflection.





If **Turning @ Full Speed** has a low value, increase the value of **Turning Accel @ Full Speed** to minimise steering delays.

A possible starting point to prevent powerchairs from snaking:

Parameter Name	Value
Turning @ Full Speed	70%
Turning Accel @ full Speed	200%

Warning:

These settings are to be used as a guideline only. It is the responsibility of the powerchair manufacturer to make sure that the program is safe and suitable for a particular chair configuration.

5.3.8 Drive Profile Options parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Maximum Profile Number	1 - 5	5	-,A,C	-	✓	✓	✓
Wrap Profiles	No / Yes	Yes	A,C	-	👁	👁	✓
Change Profile While Driving	No / Yes	No	-,A,C	-	✓	✓	✓
Allow Non-Driving Profile	No / Yes	No	-,A,C	-	👁	👁	✓
Sleep Timeout	1 – 60 min	5 min	-,A,C	-	✓	✓	✓
Soft-Start Time	0 – 1000 ms	0 ms	A,C	-	✓	✓	✓
Joystick Source (RJM)	No / Yes	No	-,A	✓	✓	✓	✓
Joystick Source	Master ACU RJM Display ARC ExtNV1 ExtNV2 None	Master	C	-	✓	✓	✓
Joystick Swap Forward / Reverse	No / Yes	No	A,C	✓	✓	✓	✓

5.3.8.1 Maximum Profile Number

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Maximum Profile Number	1 - 5	5	-,A,C	-	✓	✓	✓

Sets the number of Drive Profiles that is available to the user.

See also section 5.3.2: Drive Profiles.

5.3.8.2 Wrap Profiles

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Wrap Profiles	No / Yes	Yes	A,C	-	👁	👁	✓

If this parameter has the value 'Yes', the Drive Profiles will wrap around when the Drive Profile is changed.

Wrap Profiles	Drive Profile progression
No	1 → 2 → 3 → 4 → 5 → 5 → 5 → 5... 5 → 4 → 3 → 2 → 1 → 1 → 1 → 1...
Yes	1 → 2 → 3 → 4 → 5 → 1 → 2 → 3... 5 → 4 → 3 → 2 → 1 → 5 → 4 → 3...

If the **Allow Non-Driving Profile** parameter (5.3.8.4) has the value 'Yes', Drive Profile 0 appears between Profile 5 and 1.

The function of Wrap Profiles varies between the different DX Master Remotes and the way they are configured. The **Wrap Profiles** parameter is ignored in certain configurations. Refer to the manual of the Master Remote used. Make sure that the product functions as expected after making changes.

5.3.8.3 Change Profile While Driving

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Change Profile While Driving	No / Yes	No	-,A,C	-	✓	✓	✓

No: the powerchair must be stopped before the Drive Profile can be changed.

Yes: the Drive Profile can be changed while driving.

Warning:

Do not enable this parameter if

- *Adjacent Drive Profiles have very different speed settings*
- *Wrap Profiles is enabled*
- *The DX System has a secondary input device (RJM, ARC, etc). The powerchair will halt suddenly when the Drive Profile is changed from one that uses the Master Remote to one that uses the secondary input device.*

5.3.8.4 Allow Non-Driving Profile

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Allow Non-Driving Profile	No / Yes	No	-,A,C	-	👁	👁	✓

Enables Drive Profile 0.

Drive Profile 0 has all parameters set the same as Drive Profile 1, but it prevents the powerchair from driving. This profile can be useful during the operation of actuators, because it makes sure that the powerchair does not suddenly start to move after the actuator operation is completed.

Note:

Some Master Remotes (for example the G90 and G91) automatically disable driving when the actuator mode is entered. These Remotes do not have Drive Profile 0, and the value of ***Allow Non-Driving Profile*** *is ignored. Refer to the manual of the Remotes in question for more details.*

5.3.8.5 Sleep Timeout

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Sleep Timeout	1 – 60 min	5 min	-,A,C	-	✓	✓	✓

If sleep mode is enabled with the **Sleep Mode Enable** parameter (see section 5.3.9.8), **Sleep Timeout** sets the number of minutes of inactivity after which the DX System goes to sleep.

Sleep Timeout can be set separately for each Drive Profile.

5.3.8.6 Soft-Start Time

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Soft-Start Time	0 – 1000 ms	0 ms	A,C	-	✓	✓	✓

Soft-Start Time sets the time during which **Soft-Start Acceleration** is active.

Soft-Start Acceleration (see 5.3.9.2) temporary reduces the acceleration rate when the chair starts driving from a standstill. This reduces the jerk when starting, particularly with high acceleration rates or high load compensation settings.

Soft-Start Time can be set separately for each Drive Profile.

If **Soft-Start Acceleration** is not enabled, the value of the **Soft-Start Time parameter** is ignored.

See also section 5.3.1.3: Acceleration and deceleration.

5.3.8.7 Joystick Source

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Joystick Source (RJM)	No / Yes	No	-,A	✓	✓	✓	✓
Joystick Source	Master ACU RJM Display ARC ExtNV1 ExtNV2 None	Master	C	✓	✓	✓	✓

Rev -,A:
Selects whether the Drive Profile will use the built-in joystick of the Master Remote or an external RJM-based input control device. The ACU can only be used in Drive Profile 6.

Rev C:
In this revision every Drive Profile can have its own type of Secondary Remote (RJM, ACU and ARC). Simply choose the joystick that is applicable for each Drive Profile.

There can not be more than one joystick of the same type simultaneously connected to the DX System. For example: one RJM-type joystick, an ACU and an ARC can be simultaneously connected, but not two RJM-type joysticks. RJM-type joysticks include: all DX-RJM joysticks, switch modules and the Sip and Puff module.

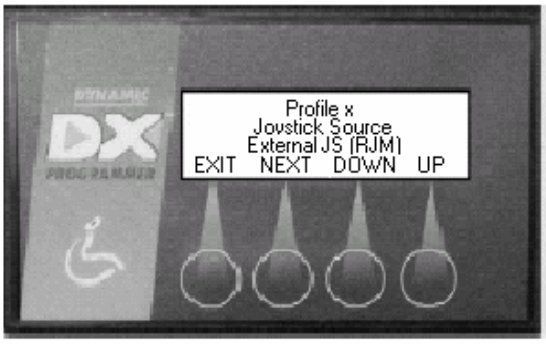
Some Master Remotes do not use Display, ExtNV1 or ExtNV2. Refer to the manual of the Master Remote in question for more details.

All revisions:
If you select ACU, make sure that the **ACU Enable** parameter (5.3.10.9) is set to 'Yes'.
If you select RJM, make sure that the **RJM Enable** parameter (5.3.10.13) is set to 'Yes'.

If a Drive Profile is selected that has the RJM as the Joystick Source, and the RJM is not connected to the DX System, a Module Fault (flash code 1) will occur.

HHP Selection of the Joystick Source (Rev. C)

- Connect the alternate input device, DX-RJM, DX-5SW etc.
- Switch on the DX System and select the desired Drive Profile with a Mode button.
- Insert the HHP and cycle through the available options (Speed/Acceleration etc.)
- The final option will be the Joystick Source, as shown below.



- Press Up/Down to select the input device, Exit to confirm.

5.3.8.8 Joystick Swap Forward / Reverse

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Joystick Swap Forward / Reverse	No / Yes	No	A,C	✓	✓	✓	✓

This parameter reverses the direction of the DX Master Remote's built-in joystick.

Parameter Value	Deflection	Driving direction
No	Forward	→ Forward
	Reverse	→ Reverse
Yes	Forward	→ Reverse
	Reverse	→ Forward

Use this parameter if the DX Master Remote is mounted in a reverse orientation.

5.3.9 General User Options parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Chair Speed	0 – 10	10	C	✓	✓	✓	✓
Soft-Start Acceleration	No / Yes	No	A,C	-	✓	✓	✓
Neutral Maximum	10 – 50 %	10 %	-,A,C	-	✓	✓	✓
Disable OONAPU Faults	No / Yes	No	A,C	-	✓	✓	✓
Speed Pot Scaler	20 – 100 %	100 %	-,A	-	✓	✓	✓
Drive Delay After Power-up	0-10	0 s	C	-	✓	✓	✓
Lock Enable	No / Yes	No	-,A,C	-	✓	✓	✓
Sleep Mode Enable	No / Yes	No	-,A,C	-	✓	✓	✓
Power-up Profile Number	1 - 7	7	C	-	👁	✓	✓
Enable Joystick Wakeup	No / Yes	Yes	C	-	✓	✓	✓

5.3.9.1 Chair Speed

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Chair Speed	0 – 10	10	C	✓	✓	✓	✓

Chair Speed is a digital Speed Pot parameter. Its value is sent as an input to the global **Speed Pot** function (see section 5.3.1.2: Speed limiting options).

If **Chair Speed** is enabled with the **Chair Speed Enable** parameter (5.3.10.3), its value can be easily edited with the HHP. Otherwise its value can only be set with the Wizard.

5.3.9.2 Soft-Start Acceleration

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Soft-Start Acceleration	No / Yes	No	A,C	-	✓	✓	✓

Soft-Start Acceleration temporary reduces the acceleration rate when the chair starts driving from a standstill. This reduces the jerk when starting, particularly with high acceleration rates or high load compensation settings.

Use the **Soft-Start Time** parameter to set the time during which Soft-Start Acceleration is active (see 5.3.8.6).

5.3.9.3 Neutral Maximum

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Neutral Maximum	10 – 50 %	10 %	-,A,C	-	✓	✓	✓

Neutral Maximum defines how far the joystick must be moved from the centre position before the powerchair starts to move.

If this parameter is increased, the joystick must be deflected more to start driving. This parameter affects all joysticks in the DX System.

5.3.9.4 Disable OONAPU Faults

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Disable OONAPU Faults	No / Yes	No	A,C	-	✓	✓	✓

An **O**ut **O**f **N**eutral **A**t **P**ower **U**p (OONAPU) fault occurs if the joystick is not in the centre position when the DX System is switched on. This makes sure that the powerchair does not suddenly start to drive when the DX System is switched on.

If an OONAPU fault occurs, the System Status LED flashes constantly. The powerchair does not drive. If the joystick is returned to the centre within 4 seconds, the OONAPU fault disappears and the powerchair can drive normally. If the joystick is not returned to the centre within 4 seconds, the OONAPU fault will become a latching fault. To clear a latching fault, the user must switch the DX System off and then on again.

If **Disable OONAPU Faults** has the value 'Yes', the user has unlimited time to return the joystick to the centre. The powerchair will still not drive until the joystick is returned to the centre, but the OONAPU fault will never become a latching fault.

Parameter Value	Result
No	The OONAPU fault becomes a latching fault after 4 seconds. The user must switch off the DX System to clear a latching fault.
Yes	The OONAPU fault never becomes a latching fault. As soon as the joystick is returned to the centre the powerchair is ready to drive.

Users who have difficulty to release the joystick to the centre can also benefit from an increased **Neutral Maximum** (see 5.3.9.3) or an increased **Drive Delay After Power-up** (see 5.3.9.6) setting.

5.3.9.5 Speed Pot Scaler

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Speed Pot Scaler	20 – 100 %	100 %	-,A	-	✓	✓	✓

The **Speed Pot Scaler** sets the maximum forward and reverse speed when the speed pot is in its lowest position. Set to 100% for a Master Remote without Speed Pot.

In Rev. C this parameter has been replaced with the **Forward Speed @ Minimum** and **Reverse Speed @ Minimum** parameters (see section 5.3.7.2).

5.3.9.6 Drive Delay After Power-up

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Drive Delay After Power-up	0-10	0 s	C	-	✓	✓	✓

After the DX System is switched on, the powerchair

- does not drive
- ignores all joystick deflections
- does not generate an OONAPU fault

during the time set with **Drive Delay After Power-up**.

A higher value of **Drive Delay After Power-up** gives the user more time to release the joystick after power-up, before the powerchair starts driving or an OONAPU fault occurs. This can be useful if the user has difficulty in releasing the joystick to the centre, after switching on the DX System.

Users who have difficulty in releasing the joystick to the centre can also benefit from increasing the value of **Neutral Maximum** (see 5.3.9.3), or from setting **Disable OONAPU Faults** (see 5.3.9.4) to 'Yes'.

5.3.9.7 Lock Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Lock Enable	No / Yes	No	-,A,C	-	✓	✓	✓

If the Master Remote has a physical lock (for example a magnetic key) set this parameter to 'Yes'.

Note:

*On some Master Remotes (for example the REM41) the physical lock is always enabled and the value of **Lock Enable** is ignored. Refer to the manual of the Master Remote for more details.*

5.3.9.8 Sleep Mode Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Sleep Mode Enable	No / Yes	No	-,A,C	-	✓	✓	✓

If Sleep Mode is enabled, the DX System goes to sleep after the number of minutes of inactivity set by the **Sleep Timeout** parameter (see 5.3.8.5).

During the sleep mode the DX System is switched off. To switch the system back on

- move the joystick (if the **Enable Joystick Wakeup** parameter is set to 'Yes')
- press any switch on the Master Remote
- press any switch on the selected **Joystick Source** of the active Drive Profile.

Sleep Mode is particularly useful for joystick-only operation. In other situations it is better to switch the system off completely, because the DX System consumes slightly more power in Sleep Mode.

5.3.9.9 Power-up Profile Number

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Power-up Profile Number	1 - 7	7	C	✓*	👁	✓	✓

The **Power-up Profile Number** is the Profile in which the DX System will start when the system is switched on. If **Power-up Profile Number** has the value '7', the DX System will start up with the same Drive Profile that was active when the DX System was powered down.

Power-up Profile Number is also used as the profile of choice when **Single Profile Mode** (see 5.3.10.4) is enabled.

*The HHP can edit this parameter when **Single Profile Mode** and **Chair Speed Enable** (see 5.3.10.3) are both set to 'Yes'. The chosen 'Response' is stored in the **Power-up Profile Number** parameter.

The 'Response' chosen with the HHP is stored in Power-up Profile Number

Note:

*If **Single Profile Mode** is enabled, make sure to only use valid user Drive Profiles for **Power-up Profile Number** (1 to the value of the **Maximum Profile Number** parameter, see section 5.3.8.1).*

5.3.9.10 Enable Joystick Wakeup

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Enable Joystick Wakeup	No / Yes	Yes	C	-	✓	✓	✓

Yes – The System wakes up when the joystick of the active Remote is deflected, or when a switch or a button is pushed.

No – The System does not wake up when a joystick is deflected.
The System only wakes up when a button or a switch is pushed.

Set this parameter to 'No' to make sure that the system does not wake up when the user accidentally deflects the joystick.

Enable Sleep Mode with the **Sleep Mode Enable** parameter (see 5.3.9.8).

5.3.10 System Settings parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CLAM Slowdown	0 – 100 %	20 %	-,A,C	-	👁	✓	✓
Neutral to PB Delay	20 – 5000 ms	100 ms	-,A,C	-	👁	👁	✓
Chair Speed Enable	No / Yes	No	C	-	👁	✓	✓
Single Profile Mode	No / Yes	No	C	✓	👁	✓	✓
CANH Power Switch	No / Yes	Yes	C	-	👁	✓	✓
CAN Terminator	No / Yes	Yes	C	-	👁	✓	✓
UCM Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓
Rotate UCM Joystick	No / Yes	No	C	-	👁	✓	✓
ACU Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
ACU Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓
ACU has Momentary Switch	No / Yes	No	C	-	👁	✓	✓
ACU Momentary Switch Timeout	No / Yes	Yes	C	-	👁	✓	✓
RJM Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
RJM Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓
RJM has Analog Joystick	No / Yes	Yes	C	-	👁	✓	✓
Joystick Switch Threshold	20 – 80 %	50 %	C	-	✓	✓	✓

5.3.10.1 CLAM Slowdown

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CLAM Slowdown	0 – 100 %	20 %	-,A,C	-	👁	✓	✓

Some actuators can place the powerchair in a physical unstable position when they are extended (for example: seat raise actuators). For safety, the Actuator Module can activate a system-wide 'Slow'-state when it receives a signal from an external switch which indicates that the chair is in an unstable position (refer to the manual of the Actuator Module for further details).

The 'Slow'-state reduces the maximum speed of the powerchair. Set the desired maximum speed during this state with the **CLAM Slowdown** parameter. The value of this parameter is a percentage of the **Speed@Maximum** parameter.

The **CLAM Slowdown** value is sent as an input to the global Speed Limit function.

See also section 5.3.1.2: Speed limiting options.

5.3.10.2 Neutral to PB Delay

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Neutral to PB Delay	20 – 5000 ms	100 ms	-,A,C	-	👁	👁	✓

The Neutral to Parkbrake Delay parameter sets the delay between zero speed demand and the moment that the parkbrakes are de-energised.

The correct value of this parameter is dependent on the mechanics of the parkbrake that is used on the chair. The delay must be longer for fast acting parkbrakes.

This parameter is used to make sure that the parkbrakes do not engage

- before the powerchair has stopped at high deceleration
- before the powerchair has stopped when parking on a slope
- if the powerchair stops to change direction (for example forward to reverse)

See also section 2.4.5: Parkbrake operation and programming.

5.3.10.3 Chair Speed Enable

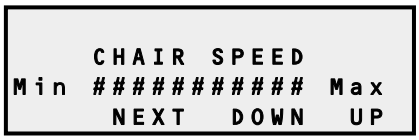
Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Chair Speed Enable	No / Yes	No	C	-	👁	✓	✓

Chair Speed Enable enables the HHP to edit the **Chair Speed** parameter (see 5.3.9.1) and the active Drive Profile/Response in **Single Profile Mode** (see 5.3.10.4).

Chair Speed programming with the HHP simplifies speed programming for the dealer or therapist. Without Chair Speed all the speed parameters must be adjusted for all the Drive Profiles individually.

With Chair Speed enabled, the dealer or therapist can edit the Chair Speed parameter on the HHP to adjust the global chair speed for all Drive Profiles simultaneously. This makes it possible to quickly and easily adjust the overall chair speed with the HHP to suit the capabilities of a specific user.

If Chair Speed is enabled, the first screen that the HHP shows when it is plugged in is the Chair Speed screen:



The number of #s indicates the Chair Speed value.

- Press UP or DOWN to adjust the Chair Speed value. The change will take effect immediately, so it is possible to test the result directly while driving.
- Press NEXT to save the new Chair Speed value.

The value of 0-10 is converted to 0%-100%. After conversion the value is sent as an input to the global Speed Pot function (see section 5.3.1.2: Speed limiting options).

It is possible to give the Chair Speed parameter an initial value with the Wizard.

5.3.10.4 Single Profile Mode

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Single Profile Mode	No / Yes	No	C	-	👁	✓	✓

No –
- The DX System uses all available Drive Profiles (see 5.3.2).
- The Profile Select buttons on the Master Remote select the drive profile.

Yes –
- Only one active Drive Profile
- The active Drive Profile is determined by the **Power-up Profile Number** parameter (see 5.3.9.9).
- The Profile Select Buttons on the Master Remote act as a digital speed pot
- The active Drive Profile can only be changed with the HHP or the Wizard.

Enable Single Profile Mode for powerchairs that are shared between several different users. In Single Profile Mode the users are not able to change the Drive Profile, they can only lower the speed with the digital Speed Pot.

Only the therapist can change the Drive Profile (with the HHP or with the Wizard) to suit a particular user on a particular day.

Notes:

1. *The HHP refers to the **Power-up Profile Number** parameter as **'Response'***
2. *If Single Profile Mode is set to 'Yes', make sure that **Power-up Profile Number** does not have the value 6 or 7.*
3. *For the HHP to be able to change the Drive Profile in Single Profile Mode, **Chair Speed Enable** (see 5.3.10.3) must be set to 'Yes'.*

5.3.10.5 CANH Power Switch

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CANH Power Switch	No / Yes	Yes	C	-	👁	✓	✓

If set to 'No', only the DX Master Remote can switch the system off.

If set to 'Yes', any DX Module (for example the ARC switchbox) can switch the system off via the DX BUS.

5.3.10.6 CAN Terminator

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CAN Terminator	No / Yes	Yes	C	-	👁	✓	✓

For reliable DX BUS communication, the DX System needs two electrical CAN terminators on the DX BUS lines. Normally the Power Module and the UCM Master Remote provide this termination.

If **CAN Terminator** is set to 'Yes', the UCM will apply a CAN terminator to the DX BUS CANH and CANL signal lines. This is the standard setting. Only set **CAN Terminator** to 'No' if there already are two other CAN terminators on the DX BUS.

5.3.10.7 UCM Joystick Swap Left/Right

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
UCM Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓

If the Master Remote is mounted upside-down (for example with chin or tray applications), set **UCM Joystick Swap Left/Right** to 'Yes'.

This parameter only applies to the Master Remote joystick, not to the Remote Joystick Module (RJM) or the Attendant Control Module (ACU) joysticks, or to drive switches connected to the Master Remote. To apply Left/Right joystick swap to the RJM joystick, use the **RJM Joystick Swap Left/Right** parameter (5.3.10.14). To apply Left/Right joystick swap to the ACU joystick, use the **ACU Joystick Swap Left/Right** parameter (5.3.10.10).

5.3.10.8 Rotate UCM Joystick

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Rotate UCM Joystick	No / Yes	No	C	-	👁	✓	✓

If this parameter is set to 'Yes', the joystick operation of the Master Remote is rotated by 90°.

Parameter Value	Deflection		Driving direction
No	Forward	→	Forward
	Right	→	Right
	Reverse	→	Reverse
	Left	→	Left
Yes	Forward	→	Right
	Right	→	Reverse
	Reverse	→	Left
	Left	→	Forward

To rotate the other way around (Forward → Left), set **Joystick Swap Forward / Reverse** (5.3.8.8) and **UCM Joystick Swap Left/Right** (5.3.10.7) to 'Yes' as well.

Use a forward/backward symmetrical restrictor plate (for example a circular or a square restrictor plate) if this parameter is set to 'Yes'.

5.3.10.9 ACU Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ACU Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓

If an Attendant Control Unit (ACU) is fitted, set this parameter to 'Yes' to allow the ACU to take control over the chair.

If no ACU is fitted, setting this parameter to 'Yes' will slightly decrease the performance of the chair, because the DX System will regularly search for the presence of an ACU.

5.3.10.10 ACU Joystick Swap Left/Right

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ACU Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓

Set **ACU Joystick Swap Left/Right** to 'Yes' if the Attendant Control Unit is mounted

- upside-down
- vertically to give forward driving when the joystick is deflected down.

This parameter only applies to the ACU. To apply Left/Right joystick swap to the RJM joystick, use the **RJM Joystick Swap Left/Right** parameter (5.3.10.14). To apply Left/Right joystick swap to the Master Remote joystick, use the **UCM Joystick Swap Left/Right** parameter (5.3.10.7).

5.3.10.11 ACU has Momentary Switch

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ACU has Momentary Switch	No / Yes	No	C	-	👁	✓	✓

The ACU has a switch to tell the Master Remote that it wants to take control of the powerchair. This switch can be

- a latching switch (a switch that stays in the same position after switching), or
- a momentary switch (a switch that returns to its original position, for example a push button).

If the ACU has a momentary switch, set **ACU has Momentary Switch** to 'Yes'.

Note:

The DX-ACU1 is fitted with a latching switch.

5.3.10.12 ACU Momentary Switch Timeout

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ACU Momentary Switch Timeout	No / Yes	Yes	C	-	👁	✓	✓

Yes – When the attendant has not operated the ACU for two minutes, the DX System automatically switches from Attendant Mode to User Mode. This allows the user to resume driving.

No – The DX System remains in the Attendant Mode until the Momentary Switch is pushed to release the control of the powerchair back to the user.

If **ACU has Momentary Switch** (5.3.10.11) is set to 'No', the value of **ACU Momentary Switch Timeout** is ignored. Therefore, this parameter has no effect on the DX-ACU1.

5.3.10.13 RJM Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
RJM Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓

If a Remote Joystick Module (RJM) Secondary Remote is fitted, set **RJM Enable** to 'Yes' to allow the RJM to operate when the Drive Profile has the RJM selected as the **Joystick Source** (5.3.8.7).

If the RJM is not connected, a Module Fault (flash code 1) will occur when a Drive Profile is selected that has the RJM as the Joystick Source.

See section 6.2: Secondary Remotes.

5.3.10.14 RJM Joystick Swap Left/Right

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
RJM Joystick Swap Left/Right	No / Yes	No	-,A,C	-	👁	✓	✓

If the Remote Joystick Module (RJM) is mounted upside-down (for example with chin or tray applications), set **RJM Joystick Swap Left/Right** to 'Yes'.

This parameter only applies to the RJM. To apply Left/Right joystick swap to the ACU joystick, use the **ACU Joystick Swap Left/Right** parameter (5.3.10.10). To apply Left/Right joystick swap to the Master Remote joystick, use the **UCM Joystick Swap Left/Right** parameter (5.3.10.7).

5.3.10.15 RJM has Analog Joystick

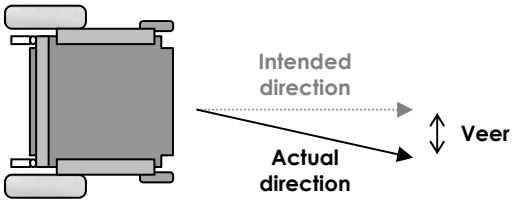
Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
RJM has Analog Joystick	No / Yes	Yes	C	-	👁	✓	✓

The RJM joysticks come in two different versions:

- Proportional control. These joysticks give a gradual 0-100% range.
  For example: the mini joystick or the finger steering control.
- Switched control. These joysticks only give an on/off signal for each direction.
  For example: the Heavy Duty joystick or the Sip and Puff Module.

If the DX System uses a switched joystick, set **RJM has Analog Joystick** to 'No'. If this parameter has the value 'No', the UCM ignores small speed signals and small direction signals from this joystick.

Unwanted small direction signals can be caused by a small analog offset signal when a switched joystick outputs "zero". These small direction signals can cause the powerchair to veer slightly.



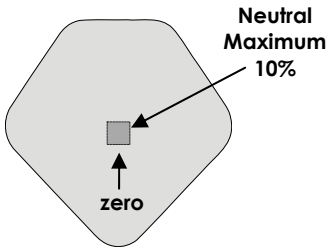
Small direction signals can cause a slight veer

With a proportional joystick the user can correct for any veer by moving the joystick slightly sideways. A switched joystick does not have this capability.

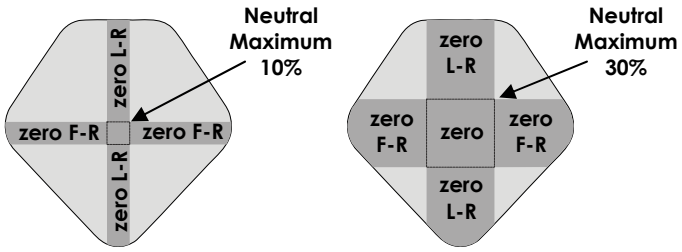
If **RJM has Analog Joystick** has the value 'No', the UCM ignores the small speed and direction signals generated by the joystick processing. This makes sure that the powerchair does not veer.

The size of the "zero"-area is determined by the value of the **Neutral Maximum** parameter (see 5.3.9.3)

RJM has Analog Joystick: Yes



RJM has Analog Joystick: No



Note:

1. *Setting **RJM has Analog Joystick** to 'No' can also help users who have problems to steer straight ahead.*
2. *Veer can also occur if the performance of the two drive motors is not equal. See section 4.3.2.5: **Veer Compensation***

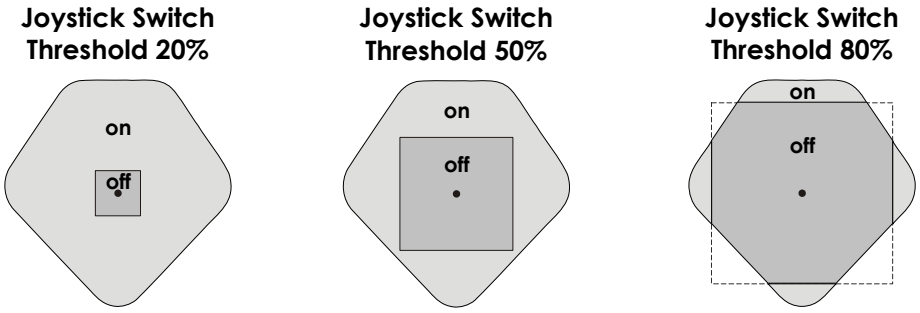
5.3.10.16 Joystick Switch Threshold

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Joystick Switch Threshold	20 – 80 %	50 %	C	-	✓	✓	✓

Some functions such as actuator operation and lighting control can use the joystick as an input switch. **Joystick Switch Threshold** sets the value beyond which the DX System assigns the joystick to be in the "on" position.

Set this parameter lower than 50% to

- allow a forward-sideways or a reverse-sideways switch operation when the restrictor plate does not physically allow this
- allow users with very little hand movement to operate the joystick switches comfortably.



See also section 5.3.4: Reducing the movement to operate the joystick.

6 DX Modules

6.1 Introduction

Including the Power Module and the Master Remote, a DX System can contain up to 16 DX compatible modules dependent on the application.

Available types of DX Modules are

- Remote Joystick Module (RJM),
  - DX-RJM Secondary Remotes
  - Switch modules
- Attendant Control Unit (ACU), joystick with attendant switch and Speed Pot
  - DX-ACU1
- Actuator Remote Control (ARC), 5 channels of extend/retract switches
  - DX-ARC / DX-ARC-SWB
- Servo Steering Motor Modules
  - DX-SLM, for steering servo motor control + lights
- Lighting Modules
  - DX-SLM/ DX-LM/ DX-CLAM
- Actuator Modules
  - DX-CLAM/ DX-TAM
- Environmental Control Unit Modules (ECU)
- DX-KEY Modules enable third party devices to interface with the DX System

The DX System has the option to declare some DX Modules as safety critical. This makes sure that the DX System will not operate when that particular module is not detected during power-up.

Warning:

Each DX Module has its own Installation Manual that describes the installation requirements of that particular module. This chapter gives a brief description of several DX Auxiliary Modules, but it is not a substitute for the manual of those modules. If you have purchased a specific DX Module, read and understand the manual of that module before using the module.

6.1.1 The GPSB/SLIO

Some DX Modules, such as the DX-RJM Secondary Remote joystick, do not perform any processing or storing of parameter values themselves. All the processing for these modules is done in the UCM (see 5.1.1). The modules only read the joystick position and send this through the DX BUS to the UCM.

Because they don't need any local intelligence, these modules have a simple communication device that connects them to the DX BUS. This communication device is internally located on the 'General Purpose SLIO Board' (GPSB) and is called a 'Serial Linked I/O' (SLIO) device.

6.2 Secondary Remotes

A Secondary Remote is a secondary user input device, for example an attendant joystick. A Secondary Remote

- converts user input (the joystick or the switches, dependent on the type of Secondary Remote) to speed and direction signals, and
- sends the speed and direction signals as DX BUS messages to the Master Remote via the DX BUS.

To use a Secondary Remote, select it as the Joystick Source (see 5.3.8.7) in one of the Drive Profiles (see 5.3.2).

6.2.1 Available Secondary Remotes

Secondary Remote	Applications
 DX-ACU1 Dual Control	Attendant joystick Attendant can take drive control with Attendant/User switch Attendant can adjust chair speed
 DX-RJM Remote Joystick Module	Attendant joystick User joystick for Master Remotes without joystick User joystick mountable on the armrest or away from it Compact chin remote
 DX-RJM-HD Heavy Duty Joystick	Users without finer hand movement Situations where a normal joystick can be damaged
 DX-RJM-MINI DX Mini Joystick	Full proportional control with very little movement or force Completely sealed - can be used as a tongue joystick
 DX-RJM-VIC-CCD Finger Steering Control	Zero force optical operation Users with very little strength in their hand/fingers Full proportional control Finger movement of 2 mm per direction is enough
 DX-ACC4 Four Switch Interface	Driven by four momentary switches, Either separate switches or Switches combined in one unit (for example the wafer switch) Provides up to eight driving directions

Secondary Remote	Applications
 DX-5SW 5 Switch Module	Five switch inputs plus extra 'Emergency Stop' input Accepts input devices terminated in a '9-pin D' connector Analog Latch mode gives infinitely adjustable cruise speed 3 momentary modes, 4 latched modes
 DX-SNP Sip and Puff Module	Recognises soft and hard sips and puffs Sip and puff pressures programmable Analog Latch mode gives infinitely adjustable cruise speed 3 momentary modes, 4 latched modes

6.3 DX Steering/Actuator/Lighting Modules

DX Module	Function / Applications
 DX-SLM / DX-SLM-TUV Servo Lighting Module	Drives a separate motor for steering castor wheels Commonly used for high speed outdoor powerchairs 24V, 30A peak, 5A continuous Servo steering 24V lighting (DX-SLM) or 12V regulated lighting (DX-SLM-TUV)
 DX-CLAMB Combined Lighting and Actuator Module	Compact module to connect all common functions: • Five actuators • Front lights, Rear lights • Left and right turning indicators, Hazard lights All power and control signals provided through the DX BUS Soft Start feature provides smooth actuator control Slow/Stop input (for actuator position switches)
 DX-LM-Z / DX-LM-TUV Lighting Module	24V lighting (DX-LM-Z) 12V regulated outputs for TÜV approved lighting (DX-LM-TUV) • Front lights, Rear lights • Left and right turning indicators, Hazard lights Short-circuit and open-circuit detection
 DX-TAM Two Actuator Module	Simple and compact solution for two actuator control All power and control signals provided through the DX BUS Soft Start feature provides smooth actuator control Slow/Stop input (for actuator position switches) Programmable current limits and maximum operation time
 DX-ARC5 Actuator Remote Control	Separate handset for actuator control Ideal for • attendant use • users who can not use the controls of the Master Remote Controls up to 5 seat positioning actuators Actuators can optionally be operated while driving Can be programmed to control horn, lights and driving Needs DX-CLAMB or DX-TAM to operate
 DX-ARC-SWB ARC Switchbox	Controls up to 5 seat positioning actuators Can be programmed to control horn, lights and driving Operates with external switches (DB15 connector) Choose switch combinations and mounting positions freely One extra 24V/1A power supply output

6.4 DX Environmental Control Modules

DX Module	Function / Applications
 DX-ECU Environmental Control Unit	Needs the DX-SCR, the G90 or the G91 Remotes to operate Uses the Secondary driving Remote as input control '8 Output mode' controls up to eight separate devices 'Mouse mode' acts as a mouse mover, fifth switch acts as click Up to two DX-ECU modules in one DX System All outputs are isolated relay contacts
 DX-IRIS2 Infra-Red Transmitter	Learning infra-red remote control 360° transmission Supports GEWA devices Works together with the Specialty Controls Master Remote
 DX-PCMR Infra-Red Mouse Receiver	Receives mouse move commands from the DX-IRIS2 Works alongside the computer's existing mouse Serial port connection USB-Serial converter: DX-USB-COM

6.5 DX Auxiliary Modules

DX Module	Function / Applications
 DX-ACC2 Drive Stop Module	Powerchair lock Makes sure that only authorised people can drive the chair Lighting and actuator functions are still operational when the powerchair is locked
 DX-ACC3 Charger Socket Module	Small charger socket to mount in a convenient place Use with remotes that do not have a charger socket Use as an alternative to the Master Remote charger socket Maximum 8 A charging current

6.6 Programmable parameters

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator Settings (CLAM/TAM)							
CLAM Enable	No / Yes	No	-,A,C	-	👁	✓	✓
CLAM is Critical	No / Yes	No	-,A,C	-	👁	✓	✓
Actuator While Driving	No / Yes	No	-,A,C	-	👁	✓	✓
Actuator 1 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 2 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 3 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 4 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 5 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 1 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 2 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 3 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 4 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 5 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator Timeout	1 – 120 s	30 s	-,A,C	-	👁	✓	✓
Actuator Open Circuit Test	No / Yes	No	-,A,C	-	👁	✓	✓
Joystick Actuators	No / Yes	No	-,A,C	-	👁	✓	✓
Actuator buttons are bi-directional	No / Yes	No	-,A	-	👁	✓	✓
Lighting Settings (CLAM/LM/LMZ)							
CLAM Lighting Enable	No / Yes	Yes	A,C	-	👁	✓	✓
Lighting Module Enable	No / Yes	No	-,A,C	-	👁	✓	✓
Lighting Module is Critical	No / Yes	Yes	C	-	👁	👁	✓
Side Lights Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Indicators Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Hazard Lights Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Remember Hazard State	No / Yes	Yes	C	-	👁	👁	✓

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Remote Control Settings (ARC/RSM)							
ARC Enable	No / Yes	No	-,A,C	-	👁	✓	✓
ARC Always Drives Actuators 1&2	No / Yes	Yes	C	-	👁	✓	✓
ARC Drives Actuators 1&2	No / Yes	Yes	C	-	👁	✓	✓
ARC Drives Actuator 3	No / Yes	Yes	C	-	👁	✓	✓
ARC Drives Actuator 4	No / Yes	Yes	C	-	👁	✓	✓
ARC Drives Actuator 5	No / Yes	Yes	C	-	👁	✓	✓
Environment Control Settings (ECU1/ECU2)							
ECU 1 Enable	No / Yes	No	C	-	👁	✓	✓
ECU 2 Enable	No / Yes	No	C	-	👁	✓	✓
ECU1_1_ENABLE	No / Yes	Yes	C	-	✓	✓	✓
…	…	…	…	…	…	…	…
ECU1_8_ENABLE	No / Yes	Yes	C	-	✓	✓	✓
ECU2_1_ENABLE	No / Yes	Yes	C	-	✓	✓	✓
…	…	…	…	…	…	…	…
ECU2_8_ENABLE	No / Yes	Yes	C	-	✓	✓	✓

6.6.1 Actuator Settings (CLAM/TAM)

6.6.1.1 CLAM Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CLAM Enable	No / Yes	No	-,A,C	-	👁	✓	✓

Set to 'Yes' for CLAM or TAM operation. If this parameter has the value 'No', the DX System does not detect a CLAM or a TAM (even if one is present and connected) and all CLAM-related parameters are ignored.

6.6.1.2 CLAM is Critical

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CLAM is Critical	No / Yes	No	-,A,C	-	👁	✓	✓

Yes – The DX System does not allow the powerchair to drive and generates a Module Fault (flash code 1) if
- the DX System can not detect a CLAM or a TAM in the system, or
- the communication with the CLAM or TAM is lost

No – The DX System considers the CLAM or TAM as optional and allows the powerchair to drive normally, independent on the presence of a CLAM or a TAM in the system.

CLAM is Critical is normally set to 'No', unless the SLOW/STOP input of the CLAM or TAM is used to inhibit driving.

If **CLAM Enable** (6.6.1.1) has the value 'No', the value of **CLAM is Critical** is ignored.

6.6.1.3 Actuator While Driving

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator While Driving	No / Yes	No	-,A,C	-	👁	✓	✓

Yes –
- The actuators can be operated while the powerchair is driving
- If **Joystick Actuators** (6.6.1.8) also has the value 'Yes', pressing a particular actuator button will stop the powerchair and select that actuator. Then the joystick can be used to retract or extend the actuator. Pressing the same actuator button again deselects the actuator and driving can resume.

No –
- While driving, the actuator buttons are ignored until the joystick is returned to the centre position and the powerchair has stopped driving
- Once the powerchair has stopped and the user has selected an actuator, the powerchair can not drive until the user has deselected the actuator again.

6.6.1.4 Actuator 1 - 5 Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator 1 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 2 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 3 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 4 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓
Actuator 5 Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓

Setting the value of these parameters to 'Yes' enables the corresponding actuator. If an actuator is not enabled, its actuator select buttons are ignored and the actuator will not be present in the actuator menu (if the used DX Master Remote has an actuator menu).

The DX-TAM has only two actuator channels, A and B. Channel A responds to the controls for actuator 1, 3 and 5, and channel B responds to the controls for actuator 2 and 4. This makes it flexible to assign the two actuators to the correct channel when the control buttons have predefined icons. To avoid confusion, do not enable more than two channels when using the TAM.

If **CLAM Enable** (6.6.1.1) has the value 'No', the value of all **Actuator Enable** parameters is ignored.

6.6.1.5 Actuator 1 - 5 Current Limit

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator 1 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 2 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 3 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 4 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓
Actuator 5 Current Limit	2.1 - 14 A	6.1 A	-,A,C	-	👁	✓	✓

If the current that flows through the actuator exceeds the value of **Actuator Current Limit**, the actuator will be turned off automatically.

Actuator Current Limit has two functions:

- It protects the actuator against high currents
- It can be used as an end-of-travel detection when the actuator does not have an end-of-travel switch itself.

6.6.1.6 Actuator Timeout

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator Timeout	1 – 120 s	30 s	-,A,C	-	👁	✓	✓

Actuator Timeout sets the maximum time that the user can operate any actuator continuously in one movement. If the maximum time is exceeded when an actuator is operated, the actuator is de-activated and the user must turn the actuator off before he or she can operate that actuator again.

The timeout makes sure that the actuators do not become too hot when an actuator is stuck and the **Actuator Current Limit** (6.6.1.5) is not exceeded or enabled.

6.6.1.7 Actuator Open Circuit Test

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator Open Circuit Test	No / Yes	No	-,A,C	-	👁	✓	✓

Before a selected actuator starts to operate, it is tested for open circuit (open circuit can happen when the actuator is not connected or damaged). If the test fails, Flash Code 2 (DX Accessory Fault) will be displayed. The powerchair still drives normally but all the actuators will not function.

Set this parameter to 'Yes' for important or critical actuator functions.

6.6.1.8 Joystick Actuators

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Joystick Actuators	No / Yes	No	-,A,C	-	👁	✓	✓

Yes – The joystick operates the actuator (extend/retract)

No – The switches on the Master Remote or the ARC operate the actuator

If the ARC is present in the DX System, this parameter is normally set to 'No'.

Note:

Some Master Remotes can select the actuator with joystick left/right movement and operate the actuator with joystick forward/backward movement. Refer to the installation manual of the particular Master Remote.

6.6.1.9 Actuator buttons are bi-directional

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Actuator buttons are bi-directional	No / Yes	No	-,A	-	👁	✓	✓

Yes – One actuator button or 'joystick forward' toggles between up/extend and down/retract

No – One actuator button or 'joystick forward' performs up/extend, a second actuator button or 'joystick reverse' performs down/retract

If the ARC is present in the DX System, this parameter is normally set to 'No'.

Note:

In UCM software Rev C this parameter has moved to the 'Remote Specific Options' section.

6.6.2 Lighting Settings (CLAM/LM/LMZ)

The lighting of a powerchair normally consists of

- Indicators:
  Two yellow lights that can be used individually as left/right indicators and together as hazard lights.
- Side lights:
  White lights that are mounted either at the front, the side or the back of the powerchair.

Several modules can control the lighting of the powerchair:

- The DX-SLM (Servo and Lighting Power Module)
- The DX-CLAM (Lighting + Actuators)
- The DX-LM (Lighting Module)

Note:

The SLM, CLAM and LM can not be used simultaneously to control the powerchair lights, only one of them can be enabled at a time.

6.6.2.1 CLAM Lighting Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
CLAM Lighting Enable	No / Yes	Yes	A,C	-	👁	✓	✓

If a DX-CLAMB is fitted and it controls the powerchair lights, set **CLAM Lighting Enable** to 'Yes'. Set to 'No' in all other cases.

6.6.2.2 Lighting Module Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Lighting Module Enable	No / Yes	No	-,A,C	-	👁	✓	✓

If a Lighting Module (DX-LM-Z or DX-LM-TUV) is fitted and it controls the powerchair lights, set **Lighting Module Enable** to 'Yes'. Set to 'No' in all other cases.

6.6.2.3 Lighting Module is Critical

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Lighting Module is Critical	No / Yes	Yes	C	-	👁	👁	✓

Yes – The DX System does not allow the powerchair to drive and generates a Module Fault (flash code 1) if
- the DX System can not detect a Lighting Module in the system, or
- the communication with the Lighting Module is lost

No – The DX System considers the Lighting Module as optional and allows the powerchair to drive normally, independent of the presence of a Lighting Module in the system.

6.6.2.4 Side Lights Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Side Lights Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓

If set to 'Yes', head and tail lights can be operated with the light switch of the Master Remote. The appropriate lighting module must also be enabled.

6.6.2.5 Indicators Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Indicators Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓

If set to 'Yes', the indicators can be operated with the left and right indicator switches of the Master Remote. The appropriate lighting module must also be enabled.

6.6.2.6 Hazard Lights Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Hazard Lights Enable	No / Yes	Yes	-,A,C	-	👁	✓	✓

If set to 'Yes', the hazard lights can be operated with the hazard light switch of the Master Remote. The appropriate lighting module must also be enabled.

6.6.2.7 Remember Hazard State

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
Remember Hazard State	No / Yes	Yes	C	-	👁	👁	✓

Yes – If the hazard lights were on when the DX System was turned off, they will be switched on again when the DX System is turned on.

No – The hazard lights are always off after the DX System is turned on.

6.6.3 Remote Control Settings (ARC/RSM)

6.6.3.1 ARC Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ARC Enable	No / Yes	No	-,A,C	-	👁	✓	✓

Yes – The user can use the ARC when it is present in the DX System.

No – The ARC is not operational, even when it is present in the DX System.

Note:

For version '–' and 'A':
*If **ARC Enable** is set to 'Yes', set **Joystick Actuators** (6.6.1.8) to 'No'. Otherwise the ARC will not work correctly.*

For Version 'C':
***ARC Enable** and **Joystick Actuators** can both be set to 'Yes'. If both are set to 'Yes', the user can use either the joystick or the ARC to operate the actuators. However, during the operation of an actuator the user can not switch between the ARC and the joystick. Using the ARC and the joystick simultaneously to operate the same actuator will cancel the actuator operation that is in progress.*

6.6.3.2 ARC Always Drives Actuators 1&2

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ARC Always Drives Actuators 1&2	No / Yes	Yes	C	-	👁	✓	✓

Yes – The ARC always drives actuator 1 and 2 with its top four switches.

No – The top four switches of the ARC can be used as a switched joystick, **if** the **Joystick Source** parameter (5.3.8.7) has the value 'ARC'.

6.6.3.3 ARC Drives Actuators 1&2 in Profile 0

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ARC Drives Actuators 1&2 in Profile 0	No / Yes	Yes	C	-	👁	✓	✓

Yes – The ARC drives actuator 1 and 2 with its top four switches in Drive Profile 0, but works as a switched joystick in other Drive Profiles, **if** the **ARC *Always* Drives Actuators 1&2** parameter (6.6.3.2) has the value 'No'.

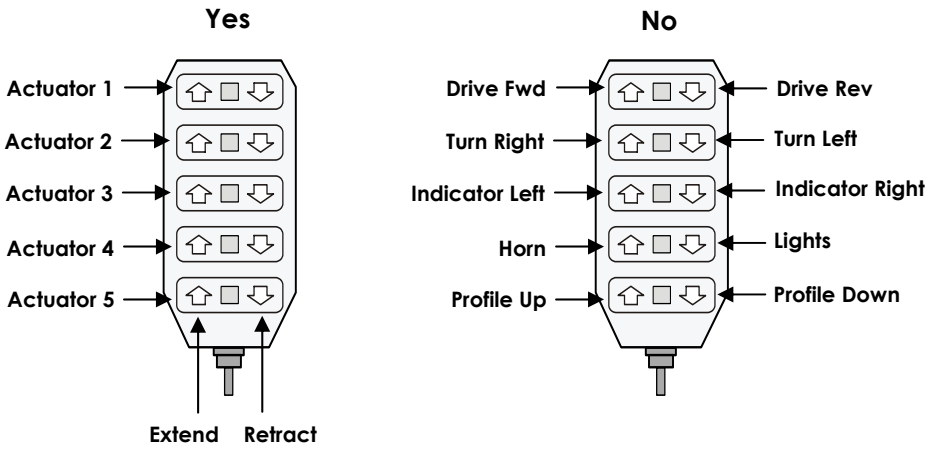
No – The ARC works always as configured with the **ARC Always Drives Actuators 1&2** parameter.

6.6.3.4 ARC Drives Actuator 3, 4, 5

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ARC Drives Actuator 3	No / Yes	Yes	C	-	👁	✓	✓
ARC Drives Actuator 4	No / Yes	Yes	C	-	👁	✓	✓
ARC Drives Actuator 5	No / Yes	Yes	C	-	👁	✓	✓

Yes – The chosen actuator channel on the DX-ARC or the DX-ARC-SWB drives the actuator.

No – The chosen actuator channel on the DX-ARC or the DX-ARC-SWB has another function, see drawing.



6.6.4 Environment Control Settings (ECU1/ECU2)

6.6.4.1 ECU Enable

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ECU 1 Enable	No / Yes	No	C	-	👁	✓	✓
ECU 2 Enable	No / Yes	No	C	-	👁	✓	✓

The DX System supports a maximum of two DX-ECU modules. Each of these modules has eight channels that can be controlled.

It has become customary to use ECU1 as a mouse mover module and ECU2 as an environment control module.

Note:

The number of ECU Modules and Channels that can be used depends on the Master Remote. Some Master Remotes only support one ECU, and some do not support DX-ECU Modules at all. Refer to the specifications in the manual of your Master Remote.

6.6.4.2 ECU Channel ENABLE

Parameter	Possible Values	Default	Rev	HHP	Lite	Std	Adv
ECU1_1_ENABLE	No / Yes	Yes	C	-	✓	✓	✓
…	…	…	…	…	…	…	…
ECU1_8_ENABLE	No / Yes	Yes	C	-	✓	✓	✓
ECU2_1_ENABLE	No / Yes	Yes	C	-	✓	✓	✓
…	…	…	…	…	…	…	…
ECU2_8_ENABLE	No / Yes	Yes	C	-	✓	✓	✓

Each DX-ECU channel can be individually enabled or disabled.

7 DX programming

Warning:

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

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

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

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

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

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

DX is a fully programmable system that can be optimised for particular chair types and to suit the driving environment and preferences of individual users.

DX can be programmed at 3 points:

During manufacturing by Dynamic – Default Programs

Prior to shipping, each module is loaded with appropriate default settings.

By the Powerchair Manufacturer (OEM)

OEMs use the PC-based "**Wizard**" programming tool (see section 7.1.2) to develop programs optimised for particular powerchair models. Each program defines the technical attributes necessary to match the controller to the chair (current limits etc), as well as a drive performance that suits the typical user. The resulting programs may be copied into each DX System as part of the chair production process.

In the field by the Dealer or Therapist

Either a Hand Held Programmer (**HHP**, see section 7.1.1) or the Wizard can be used to tune the typical driving performance to a drive performance optimised for the individual chair user, including selection of the input device.

7.1 Programming tools

The programming socket on the Master Remote provides an RS232 serial connection for communication between the programming tools and the DX Modules.

If the Master Remote has no programming socket, use the XLR Charging socket on the Master Remote for programming with the DWIZ-ADAPT converter.

7.1.1 The Hand Held Programmer (HHP)

The DX Hand Held Programmer (HHP) is the programming tool often used by dealers, allowing easy adjustment of a few commonly adjusted Drive Program parameters.

Warning:

*The DX-HHP is for use **only** by powerchair manufacturers and their authorised dealers. It is **not** for use by the powerchair user. Dealers may only program parameters as instructed by the powerchair manufacturer.*

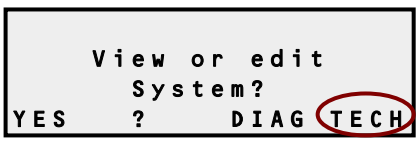
The DX-HHP Manual should be read and understood before attempting to use the HHP.

7.1.1.1 HHP Technician Mode

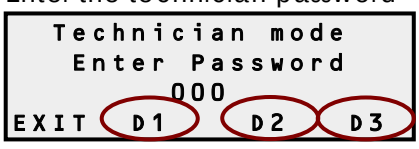
Some parameters are protected, they can only be accessed in Technician Mode.

To enter technician mode on the HHP:

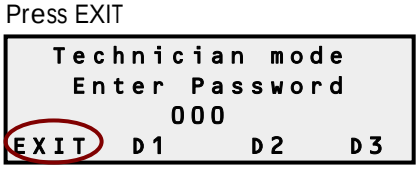
1. Turn the DX System ON
2. Connect the HHP to the DX Master Remote
3. Press TECH



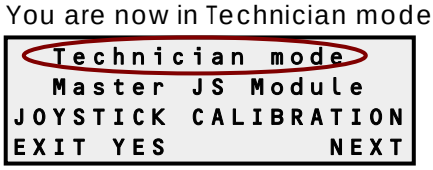
4. Enter the technician password



5. Press EXIT



6. You are now in Technician mode.



7.1.2 The PC-based Wizard program

The Wizard is a PC-based tool suited to programming production runs of identical powerchairs or modules, or one-off highly customised powerchairs.

7.1.2.1 Dongle versions

The Wizard requires a hardware security key (dongle) to write parameters to a controller. Without dongle the Wizard can still display parameter values and diagnostic messages, but nothing can be edited or written to a controller. The Wizard dongle is available in several versions. The version of the dongle determines the level of access to the powerchair parameters.

Dongle level	Wizard View Mode	Application
OEM	Advanced	Used by the powerchair manufacturer. Gives write access to a wide range of parameters.
Enhanced Dealer	Standard	Parameters that the powerchair manufacturer wants to keep control of can be viewed, but not edited. Parameters that relate to powerchair accessories (for example actuators) can still be edited.
Dealer	Lite	A limited range of parameters can be viewed. Only a few parameters can be edited. Parameters that may cause hazards or require special expertise to set can not be edited.
Factory	Write	Used in a factory setup to program production powerchairs. No parameters can be edited. Only pre-composed programs can be written to a controller.

Warning:

The Wizard is a very powerful tool and as such requires well trained operators and a disciplined approach to usage and distribution.

It is up to the powerchair manufacturer to determine whether they will allow distribution of Wizards to dealers.

7.1.3 Programming accessories ordering information

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

7.2 Localised parameter storage

The parameters of the DX System are stored in several locations:

- The Master Remote (these parameters are also called UCM parameters)
- The Power Module
- Each intelligent DX Module stores its own parameters

The Master Remote stores all parameters that relate to speed, direction and user preferences, for example:

- Speed, acceleration and deceleration parameters
- Joystick sensitivity parameters
- Drive profiles

The Power Module stores the parameters that are needed to keep the system safe, and to convert the speed and direction commands of the Master Remote to the correct voltage and the correct current needed to drive the motors. For example:

- Maximum temperature parameters
- Parkbrake test and motor test parameters
- Load Compensation,
  compensates for a powerful or a weak motor
- Veer Compensation,
  compensates if the two motors used are not behaving exactly the same.

Intelligent DX Modules store their own parameters, for example:

- The 5-switch and the Sip and Puff secondary remotes
- The IRIS infrared transmitter

7.3 Auto Download

The DX Master Remote stores a backup copy of the parameters of all other DX Modules that are present in the DX System. After a DX Module is replaced, the DX Master Remote detects that the parameters of the new module do not have the same values as the parameters of the old module. The Master Remote will then automatically download (copy) the backup values of the old module to the new module. This makes sure that the new module behaves exactly the same as the old module.

After you have replaced a module, you must give the DX System time to perform the Auto Download:

1. Turn the DX System off
2. Wait 10 seconds
3. Turn the system on again
4. Wait until the DX Master Remote has copied the backup parameter values to the new module. When the Auto Download has finished, the DX Master Remote Status LED displays Flash Code 1 (Module Fault).
5. Turn the system off
6. Turn the system on again

The system now starts up with the new downloaded values and is ready to use.

Note:

If the Status LED does not display Flash Code 1 after the system has been switched on, the Auto Download has finished correctly and the system does not need a restart.

Warning:

When the DX Master Remote itself is replaced, the new remote will perform an Auto Download of its own "backup" parameters to all other DX Modules. This can result in incorrect and dangerous programming because the new DX Remote can have the wrong parameter values for the powerchair it has been placed on.

After you have replaced a DX Master Remote, reprogram the parameters of all the other DX Modules to the correct values.

See also section 7.5: Retain the settings with a Master Remote replacement.

7.4 Programming and testing a DX chair for stability

The best results when programming a DX chair will be obtained when the person who programs the chair physically tests the settings on the chair in question, and adjusts the settings based on the observed physical chair behaviour. The following procedure can help to create a familiarity with how a chair physically reacts to different parameter values, and if followed from beginning to end it makes sure that later parameter adjustments will not conflict with earlier made adjustments.

Note:

The following procedure should be done on a finalised chair, which means that all components and accessories of the chair are mounted and installed correctly, so that the chair geometry or weight will not be changed after the testing.

Warning

*The following procedure tests the stability of the chair, which means that it seeks the point where the chair becomes unstable. This is potentially dangerous. Take **extreme** care not to make the chair actually lose control and perform these tests in a wide open space. Careless testing or testing in an unsafe location could cause severe injury to the operator/ tester or bystanders, or damage to the vehicle or surrounding property.*

It is the responsibility of the operator/ tester to assess his/her own safety and the safety of others, and to take appropriate precautions and safety measures before performing these tests.

Safety measures may include but are not limited to:

- *Making sure that the chair can not tip over during an emergency stop on a slope, for example by fitting a foot plate*
- *Wearing personal safety protection (helmet, knee pads, etc.)*
- *Not wearing a seat belt if there is a chance that the chair may roll over on top of the tester.*

1. Preparation

a. Determine the motor resistance and set **Load Compensation** (4.3.2.3) to the correct value.
b. Set the **Input Demand Scaler** (4.3.2.13) to the desired value.

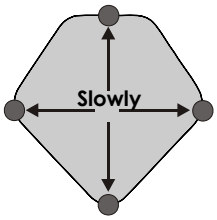
Power Module parameters such as Load Compensation and the Input Demand Scaler affect the performance of all other speed and acceleration parameters and as such it is important to set these parameters correctly before programming anything else. If these parameters are changed after the chair has been set up, the complete programming and testing procedure must be repeated.

c. Enable **Halve Turning Gain** (4.3.4.8). This makes steering more precise. Enabling this parameter is also required to enable the use of all UCM Rev. C parameters, including the chair stability parameters.

2. Speed programming and testing

a. Program the static speeds (the **Speed @ Maximum** parameters) of the Drive Profiles (5.3.2). Before programming these speeds, consider the intended use of the drive profiles (as digital speed pot or as environmental profile), because this will change your options later in the process. For a possible starting point look at the Speed setting recommendations (5.3.2.3).

Sit in the chair, if the chair has a Speed Pot set it to 100%, and test the different speed settings for every Drive Profile.

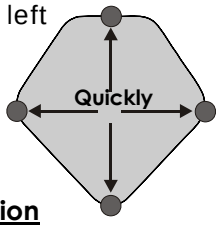


b. SLOWLY deflect the joystick fully forward, fully backward, fully left and fully right (no positions in between), until the chair has reached its top speed for that profile.
c. Check that the final speed in every position feels comfortable and is suitable for the intended application for that Drive Profile.

3. Acceleration programming and testing

a. Program the forward, reverse and turning acceleration and deceleration (5.3.1.3) for each Drive Profile. Set **Speed Damping** (5.3.7.16) to 40% and **Turn Damping** to the same value as the **Turning Speed @ Maximum** parameter.

Sit in the chair and test the different acceleration / deceleration settings.



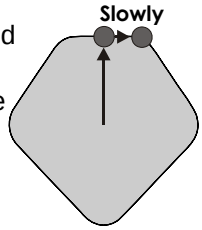
b. QUICKLY deflect the joystick fully forward, fully backward, fully left and fully right (no positions in between).
c. Check that the transition from standstill to the final speed is smooth.
   - If the total transition is too fast or too slow, adjust the applicable acceleration or deceleration parameter.
   - If there is a jerk at the start, enable **Soft-Start Acceleration** (5.3.9.2) and increase **Soft-Start Time** (5.3.8.6) for a smoother start.
   - If there is a big jerk at the end of the acceleration or deceleration, increase **Speed Damping** or **Turn Damping**.
   - If there is a small jerk at the end of the acceleration or deceleration, decrease **Min To Max Decel Ratio** (5.3.7.17)

Note:

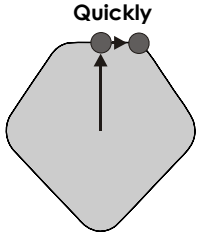
*Low values of **Min To Max Decel Ratio** will be smoother but can also cause a longer braking distance because the chair keeps on moving slowly for some time before it finally stops.*

4. Steering control programming and testing

Drive the chair to a **flat open space with good grip**. Sit in the chair and select the fastest Drive Profile. Set **Grip** (5.3.7.15) and **Speed x Turn for Grip** (5.3.7.18) to 100%.



a. Deflect the joystick fully forward. Wait until the chair has reached its maximum speed.
b. While keeping the joystick deflected forward, SLOWLY move the joystick 25° to the side. Check that the chair turns comfortably.
   - If the chair turns too sharply, decrease **Turning @ Full Speed** (5.3.7.19) until the chair turns comfortably.



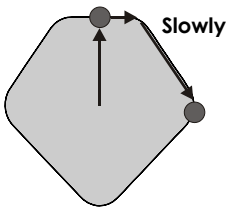
c. Return the joystick to full forward, and now QUICKLY move the joystick 25° to the side. Check that there is no unacceptable steering delay.
   - If there is a steering delay at full speed, either increase **Turning Accel @ Full Speed** or decrease **Turn Damping**.

Note:

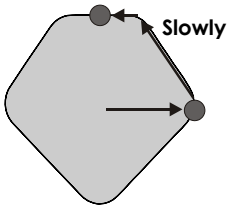
*Decreasing **Turn Damping** may introduce a jerk at the end of the turning acceleration / deceleration curve.*
See Acceleration programming and testing (previous section).

5. Chair stability programming and testing

Drive the chair to a **flat open space with good grip**. Sit in the chair and select the fastest Drive Profile. Set **Grip** and **Speed x Turn for Grip** to 100%.



a. Deflect the joystick fully forward. Wait until the chair has reached its maximum speed.
b. SLOWLY move the joystick along the side of the physical restrictor plate from the forward position fully to the side position. Check that the chair does not lose control.
   - If the chair loses control (starts spinning uncontrollably or almost tips over), decrease **Speed x Turn for Grip** (5.3.7.18) until the chair does not lose control over the full range of joystick positions. It is OK when the chair almost loses control at some point, as long as it does not really lose control.



c. Stop the chair and deflect the joystick fully sideways. Wait until the chair has reached its maximum turning speed.
d. SLOWLY move the joystick along the side of the physical restrictor plate from the side position fully to the forward position.
e. Check that the chair does not lose control.
   - If the chair loses control, decrease **Speed x Turn for Grip** further until the chair does not lose control over the full range of joystick positions. Again, it is OK when the chair almost loses control at some point, as long as it does not really lose control.

f. Stop the chair and set **Grip** to 80%*.
g. Repeat steps 5a to 5e. With a Grip setting of 80%* the chair should turn comfortably over the full range of joystick positions.
   - If the chair does not turn comfortably, decrease **Speed x Turn for Grip** further until the chair does turn comfortably.

Note:

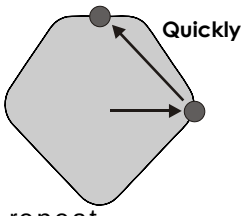
For the powerchair manufacturer, the appropriate **Grip value to use for steps 5f to 5m depends on the target user group of the tested powerchair.*

- *A **Grip** value of 80% can be a good starting point for general use. When conditions and user ability allow it the Grip parameter can be increased, trading stability for increased response.*
- *A **Grip** value of 100% makes sure that the chair maintains maximum stability on the tested surface. The dealer can only decrease the Grip value, which will increase the stability of the chair further. This setting can be appropriate for switched joystick or scanner users, or for users who do not have the capability to react to different circumstances. For normal use this may make the chair too slow.*
- *A **Grip** value of 50% can be a starting point for sport chairs where users can, want to and have to react to dangerous conditions themselves.*

The powerchair manufacturer could produce three different templates with these different settings, so the dealer may choose the appropriate template for a specific user. The Grip parameter setting in these templates should be no higher than the value used during the process that is described here. This makes sure that the chair is reasonably safe when it is first programmed by the dealer.

Leave the **Grip** parameter at 80%*.

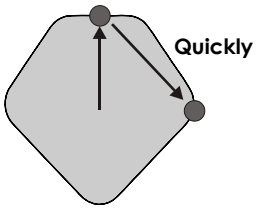
h. Stop the chair and deflect the joystick fully sideways. Wait until the chair has reached its maximum turning speed.
i. QUICKLY move the joystick from the side position fully to the forward position.
j. Check that the chair does not lose control.
   - If the chair loses control (starts spinning uncontrollably or almost tips over), decrease **Speed x Turn for Grip** and repeat the test (quick joystick movement from side to forward).
   - If decreasing **Speed x Turn for Grip** does not help or when it makes the chair too slow, increase **Accel Out Of A Turn For Grip** until the chair does not almost lose control.



Note:

*Very high settings of **Accel Out Of A Turn For Grip** can cause the chair to slow down in order to decrease turning speed before it accelerates forward.*

k. Stop the chair and deflect the joystick fully forward. Wait until the chair has reached its maximum speed.
l. **Quickly** move the joystick from the forward position fully to the side position.
m. Check that the chair turns comfortably.



- If the chair loses control (starts spinning uncontrollably or almost tips over), decrease **Speed x Turn for Grip** and repeat the test (quick joystick movement from forward to side).
- If decreasing **Speed x Turn for Grip** does not help or when it makes the chair too slow, increase **Accel Into A Turn For Grip** until the chair does not almost lose control.

The chair now has a good stability on a flat surface with good grip.

Note:

*If there is a chance that the chair will be used with a switched joystick or with a reduced joystick movement setting (**Short Throw Travel / Short Throw Shape**, see 5.3.7.14), repeat step 4 and steps 5a to 5m with **Short Throw Travel** at 200%. If during these tests chair instability problems are encountered, decrease **Short Throw Shape** until the chair is stable again.*

Next, setup the chair under bad conditions. Drive the chair to the **worst environment it is going to be used in** (for example wet grass, a polished test floor or a slippery slope). Select the "Outdoor Wet" Drive Profile and set the **Grip** to 50%.

n. Check that the chair is able to handle this surface at all. Drive and turn **very slowly** and check that the chair is controllable manually.
   - If the chair **is not stable** on this surface while driving very slowly (for example because the tyres provide almost no traction at all, or the centre of gravity of the chair is so high that the chair almost tips over when standing still), **do not test any further** on this surface because if the chair itself is not stable, the DX System can not make it stable. Include in the user manual that the chair can not be driven on this type of surface.
   - If the chair **is stable** on this surface while driving very slowly, proceed.

o. Slowly increase the forward speed and/or the turning speed manually (by carefully moving the joystick) until the chair almost loses control. Each time that the chair almost loses control, decrease the value of the **Grip** parameter until the chair does not lose control for that joystick position. Repeat increasing the speed (by moving the joystick further) and decreasing the **Grip** until you can slowly move the joystick to every possible joystick position without the chair losing control.
   - If decreasing the **Grip** value does not help or when **Grip** has to be set below 20%, decrease **Speed x Turn for Grip.**
   - If the effects of the **Grip** parameter are so extreme that the chair becomes too slow when turning, increase the **Grip** value slightly and
     - decrease **Short Throw Shape** or
     - decrease the **Speed @ Maximum** parameter values for this "Outdoor Wet" Drive Profile.

The chair is now ready to test the maximum settings on this surface as described in steps 5a to 5e and 5h to 5m.

p. **CAREFULLY** repeat steps 5a to 5e and 5h to 5m. Check that the chair does not lose control.
   - If the chair loses control, decrease the value of the **Grip** parameter until the chair does not lose control.
   - If decreasing the **Grip** value does not help or when it has to be set below 20%, or when the chair becomes too slow when turning, either
     - increase the values of **Accel Out Of A Turn For Grip** or **Accel Into A Turn For Grip**, or
     - decrease **Short Throw Shape** or
     - decrease the **Speed @ Maximum** parameter values for this Drive Profile.

Note:

*Do not set **Grip** lower than 20% when setting up the chair for a bad surface. A lower value does not leave any headroom for the dealer or therapist to decrease **Grip** further for patients who think the current setting is too scary.*

Warning

*Take **EXTREME** care when performing the bad grip tests. Do NOT perform the tests at full speed immediately. Start turning at a slow forward speed and in subsequent tests progressively increase the forward speed before a turn is started until the chair almost becomes unstable.*

Careless testing or testing in an unsafe location could cause serious injury to the operator or bystanders, or damage to the vehicle or surrounding property.

7.5 Retain the settings with a Master Remote replacement

The DX Master Remote stores a backup of all the programmable DX parameter values. If the DX Master Remote is replaced, all the original parameter values are lost because the new DX Master Remote will overwrite the original parameter values with its own "backup" values (see Auto Download, 7.3).

To prevent the loss of the old parameter values, use the Wizard program to

- backup all the parameter values of the old Master Remote to the PC
- write the backup values from the PC to the new Master Remote.

Wizard reads and writes **all** the parameter values from and to the Master Remote, even the values of the parameters that are not accessible with the dongle in use.

7.5.1 Replacement with the same type Master Remote

If the Master Remote is broken and it is replaced with exactly the same type Master Remote, it is enough to read the values from the old Master Remote and to write these values back to the new Master Remote.

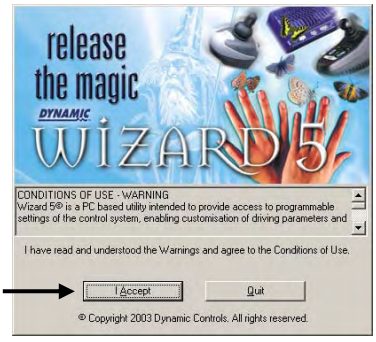
1. Connect the old Master Remote to the PC and start up the Wizard

a) Connect the old Master Remote to the PC

b) Switch on the Master Remote

c) Start the Wizard

d) Read the conditions of use.
If you understand and accept the conditions of use,
Click → 'I Accept'



1d →

e) Enter the dongle password, if required.

f) Wait until the status window shows Controller connected

- If the status window is still empty after 30 seconds, there is no connection between the Master Remote and the PC.

The status window →

2. Read the parameter values from the old Master Remote into the Wizard

a) **Click →**  or use the menu: **Tools → Read from Controller**

- If the status window shows The controller is not connected, there is no connection between the Master Remote and the PC.

b) Wait until the progress bar is full 

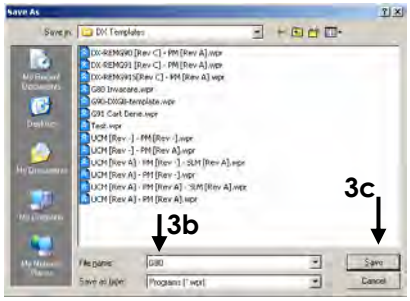
- The Wizard now shows the parameters of the old Master Remote →

3. Save the parameters from the Wizard to the hard disk

a) **Click →**  or **File → Save As**

b) Type a file name (for example G80)

c) **Click → 'Save'**



4. Print the parameters for later reference

a) **File → Print**

5. Switch off the old Master Remote and replace it with the new Master Remote

a) Switch off the old Master Remote

b) Disconnect the old Master Remote from the PC

c) Disconnect the old Master Remote from the DX BUS

d) Connect the new Master Remote to the DX BUS

e) Connect the new Master Remote to the PC

f) Switch on the new Master Remote

g) Wait until the status window shows Controller connected

6. Write the parameter values of the old Master Remote to the new Master Remote

a) **Click →**  or **Tools → Write to Controller**

b) Wait until the progress bar is full 

7. Restart the DX System

a) Switch off the Master Remote

b) Wait 10 seconds

c) Switch on the Master Remote

d) If the Master Remote shows Flash Code 1, repeat steps 7a, 7b and 7c

The new Master Remote is now programmed with the values of the old Master Remote.

8. Check that the new values are correct

a) Read the written values back from the Master Remote (see steps 2a and 2b)

b) Compare the parameter values to the print that you have made in step 4.

Note:

If you have doubts about the suitability of a program that is already loaded into a chair, contact the manufacturer of the chair. Complete DX System programs can be easily sent by email. This makes the process of sending and downloading settings efficient and straightforward.

Warning:

*After programming or reprogramming the DX System, **always** test the vehicle to make sure that it drives safely and that the performance is appropriate to the needs and the capabilities of the user. For the correct testing procedure see chapter 8.*

7.5.2 Replacement with another type Master Remote

If the Master Remote is replaced by another type Master Remote with different features (for example: a REMG80 is replaced by a REMG91), the parameter set that is backed up by the Wizard must be converted to the new Remote version and type before it can be written back.

> ***Note:***
>
> *You need an Enhanced Dealer level or an OEM level dongle to convert the version or the type of a parameter set.*

1. **Follow step 1a – 5g of the previous section (7.3.1)**

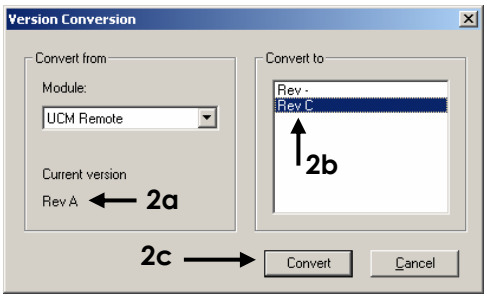
2. **Convert the software version of the old parameter set to the software version of the new Master Remote**

   a. **Tools → Change Module Version**
   You can see the software version of the UCM (5.1.1) of the old Master Remote below **'Current version'**

   b. Select the software revision of the UCM of the **new** Master Remote. For all recent Master Remotes (G90, G91) this must be **Rev C**

   c. **Click → 'Convert'**

   d. **Click → 'OK'**

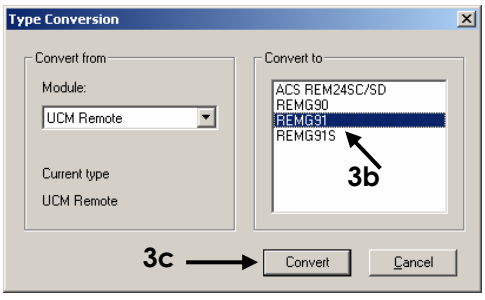


3. **Convert the module type of the old parameter set to the module type of the new Master Remote**

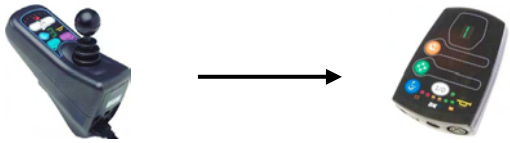
   a. **Tools → Change Module Type**

   b. Select the Type of the **new** Master Remote. For this example (REMG80 → REMG91), select **REMG91**

   c. **Click → 'Convert'**



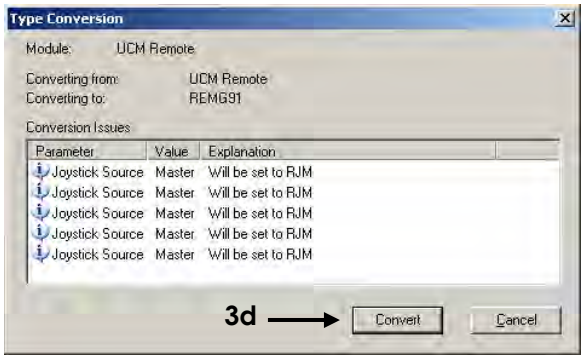
In this example the conversion is from a Master Remote *with* a joystick (REMG80) to a Master Remote *without* a joystick (REMG91).



REMG80 **REMG91**

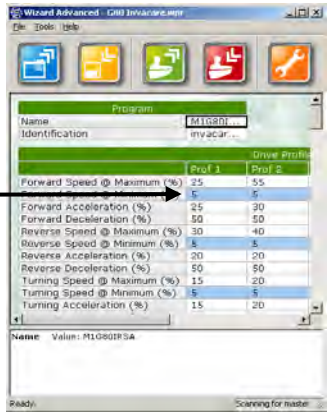
Wizard detects that the new Master Remote does not have a joystick and sets the **Joystick Source** parameter (5.3.8.7) for every Drive Profile to the external joystick (Remote Joystick Module, RJM).

d. If you accept the changes, **Click → 'Convert'**



The parameter set is now converted to the new Master Remote type.

The blue parameters were not present in the old Master Remote.



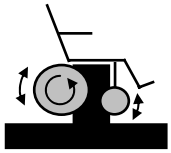
e. **Check** that **all** parameters have the correct values. For easy reference, use the printout that you have made of the old values

4. Resume at step 6 of the previous section (7.3.1)

8 Testing

8.1 Before testing

- Make sure that all the DX Modules in your DX System have been installed correctly, as specified in the individual Installation Manuals.
- If the Master Remote does not have a joystick (for example the DX-REMG91), connect a suitable DX Secondary Remote input device to the DX System, for example the DX-RJM.
- Check that all cables are connected correctly. Check especially that the polarities of the batteries, the motors and the parkbrakes are connected correctly and that the polarities are not swapped.
- When the DX System is turned on for the first time, the programmable parameters have an unknown value. Therefore the powerchair can be dangerous and uncontrollable when it is turned on. To make sure that the powerchair does not suddenly start to drive when you turn it on, **put blocks under the powerchair frame to lift the wheels off the ground.** Check that the wheels can turn freely.



- Make the final connection to the Battery positive (+) terminal and close the circuit breakers.
- Program the DX Master Remote for the appropriate powerchair application.

Warning:

Do not connect the '+' terminal of the battery to the DX System until the powerchair is lifted off the ground.

To prevent the risk of injury, Dynamic Controls recommends the use of a lifting device when lifting the powerchair off the ground.

8.2 The testing procedure

1. Turn on the DX System with the power switch. Check that the System Status LED on the Master Remote is on and does not flash.
2. If the Status LED of the Master Remote shows flash code 1 (Module Fault):
    a. turn off the DX System
    b. wait 10 seconds
    c. turn the DX System back on.
    d. If the System Status LED still shows flash code 1, a real Module Fault has occurred (see section 9.6: Flash codes).

3. Use all the buttons (not the joystick) on the Master Remote to check that they operate correctly. Check that the display changes as expected.

4. If the Master Remote has a horn, press the horn button. Check that the horn operates correctly.

5. Turn the DX System ON and OFF several times and listen. Check that the parkbrakes do not click. Leave the DX System ON.

6. Turn each drive wheel by hand to check that the parkbrakes are switched on. It must not be possible to turn the wheels.

7. Push the joystick slightly out of the centre position. Check that the parkbrakes switch off (they will click when they switch off).

8. Move the joystick in all directions. Check that the wheels move smoothly in the correct direction.

9. Release the joystick back into the centre position. Check that the parkbrakes switch on again (they will click when they switch on).

10. Turn off the system and remove the blocks from under the chair.

Warning:

Carry out the following procedure in a large open environment, preferably outdoors. Make sure that the powerchair can not crash into objects. Be prepared for unexpected powerchair movement in the event of a faulty installation.

If the powerchair becomes uncontrollable, turn the DX System off for an emergency stop.

11. Turn the system on. Select the slowest Drive Profile.

12. Sit in the powerchair and drive the chair SLOWLY (small joystick movement) in all directions. Check for precise, smooth and progressive control.

13. Drive the chair FAST (large joystick movement) in all directions. Check for smooth and progressive control and effective dynamic braking.

14. Select the fastest Drive Profile and repeat steps 12 and 13.

15. Drive the chair full speed FORWARD. Check that the chair moves forward in a straight line (the chair does not go to the left or to the right).

16. Drive the chair full speed REVERSE and check that you go backward in a straight line.

Note:

Rear wheel drive chairs often are unstable in reverse, which can cause the chair to drive in circles even when the joystick is central, reverse.

17. Drive full speed FORWARD and move the joystick from left to right along the front edge of the joystick restrictor plate, to check that you can still steer the chair.

18. Drive full speed FORWARD and then release the joystick to the centre. Check that the chair decelerates smoothly and in a straight line. Check that the parkbrakes switch on as soon as the chair stops.

19. Drive full speed in REVERSE and then release the joystick into the centre. Check that the chair decelerates smoothly and in a straight line. Check that the parkbrakes switch on as soon as the chair stops.

20. Drive full speed FORWARD and move the joystick into full reverse. Check that the chair decelerates smoothly and in a straight line before it moves in reverse.

21. Drive full speed in REVERSE and move joystick into the straightforward position. Check that the chair decelerates smoothly and in a straight line before it moves in a forward direction. Note: Deceleration in reverse is slower.

22. Drive forward SLOWLY and switch the power switch OFF. Check that the chair stops instantly.

23. Push the joystick a little bit forward and switch the power switch ON. Check that the chair does not drive. Release the joystick to the centre for 3 seconds. Check that after 3 seconds the chair drives normally.

24. Move the joystick forward just enough to release the park brake and check the creep speed. Repeat in reverse.

25. Accelerate up a 1:6 ramp. Check for normal power, smoothness and parking.

26. Reverse down the ramp and release the joystick when you are still on the ramp. Check that the rollback is not too much and that the park brakes switch on.

27. Accelerate up the ramp again, then reverse down the ramp to test good control.

28. Perform the tests that are described in the Testing sections of the Installation Manuals of all other DX Modules that are installed on the powerchair.

29. Repeat testing and programming of the DX System until the performance of the powerchair is as expected.

30. Park the powerchair in a safe location and turn off the DX System.

9 Diagnostics

The DX System indicates its status in several ways:

- Battery Warning conditions are shown on the **Battery Gauge** (if fitted). During warning conditions the chair is usually able to drive normally.
- Other warnings and fault conditions are shown as System Flash Codes (see section 9.6) on the **System Status LED**, which is located on the Master Remote. During fault conditions the chair will either not drive or drive slowly.
- In addition, each DX Module has its own **Module Status LED** that flashes when that module has a fault condition. DX Module Flash Codes can be different from the DX System Flash Codes. Look in the manual of the DX Module in question for more information.

Both warning conditions and fault conditions can be diagnosed with the Hand Held Programmer or the Wizard.

9.1 Limp Mode

If the DX System detects a fault that does not demand the powerchair to be stopped completely, it will go to 'Limp Mode'. This is a reduced speed mode that recognises problems, but allows the powerchair user to drive slowly towards a safe environment where the problem can be investigated.

Warning:

If the DX System is displaying a fault or the chair enters Limp Mode, do not operate the powerchair except to reach a safe environment. Proceed extremely carefully because the chair performance may be significantly different. Have the chair serviced by an authorised service agent.

9.2 Stuck Power Button

If the power button is pushed and not released, the DX System does not switch on and the System Status LED flashes constantly.

- If the power button is released within a few seconds, the System Status LED stops flashing and the System starts up normally.
- If the power button is not released within a few seconds, the system switches off.

9.3 Out Of Neutral At Power Up (OONAPU)

An **O**ut **O**f **N**eutral **A**t **P**ower **U**p (OONAPU) condition occurs if the joystick is not in the centre position when the DX System is switched on, or when an inhibit condition is removed (for example: a battery charger is disconnected). This makes sure that the powerchair does not suddenly start to drive.

If an OONAPU condition exists, the System Status LED flashes constantly. The powerchair does not drive. If the joystick is returned to the centre within 4 seconds, the OONAPU condition disappears and the powerchair can drive normally. If the joystick is not returned to the centre within 4 seconds, the OONAPU condition will become a latching fault. To clear a latching fault, the user must switch the DX System off and then on again.

If a user can not easily release the joystick back to the centre, use the Disable OONAPU Faults parameter (see 5.3.9.4).

9.4 Diagnostic tools

Hand Held Programmer (HHP)

When you plug an HHP into the DX System when an abnormal condition exists, the HHP will display the detected fault on its screen.

The PC-based Wizard program

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

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

9.5 Battery warning conditions

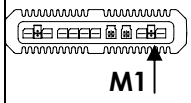
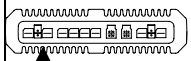
The **Battery Gauge** (if the used Master Remote has one) flashes its LEDs to indicate a battery warning. The number of LEDs that flash indicate the type of the warning.

Flashing LEDS	Description	Warning condition / Cause / Action
All	**Battery High Warning**	**Warning condition:** The battery voltage has exceeded 28V. The powerchair will drive normally during this condition. The warning will reset when the battery voltage drops below 28V. **Cause:** The powerchair is on charge and/or the batteries are full or faulty. **Action:** Turn off the power of the battery charger. If the batteries are faulty, replace the batteries. **Cause:** The powerchair is travelling down a slope with full batteries. **Action:** Turn on the lights (if fitted) and slow down.
Red + Yellow	**Battery Low Warning**	**Warning condition:** The battery voltage has dropped below 23.3V, when the joystick is in the centre (the powerchair does not drive). This warning usually happens together with a 'Low Capacity' Warning. **Cause:** If the Battery Gauge flashes with orange or green LEDs lit, but the cause is not because of a Battery High warning, the battery or the battery wiring may be faulty. **Action:** Check the cables and wiring. **Cause:** If the Battery Gauge flashes with just a few LEDs after the powerchair has stopped, the battery may be too small for the powerchair type, or the battery may be old or damaged. **Action:** Recharge the batteries. If recharging does not help, replace the batteries.
Red	**Low Capacity Warning**	**Warning condition:** The calculated battery capacity is below 10%. The powerchair will drive normally during this fault. This warning usually happens together with a 'Battery Low' Warning. **Cause:** The batteries are in reserve capacity range. Battery capacity will reduce rapidly. **Action:** Recharge the Batteries. The warning will not reset until the batteries are recharged.

9.6 Flash codes

If a fault condition exists, the System Status Led on the Master Remote displays a Flash Code. A flash code is a specific number of short flashes, followed by a pause.

Flash Code	Fault source	Meaning
1	DX Module	An Auto Download (see 7.3) has occurred. • Turn off the DX System, then turn it on again. The DX System is not programmed correctly. • Reprogram the DX System. The DX BUS connection of a DX Module is faulty • Check the DX BUS cables and the DX BUS connections. • Replace the cables when necessary. If the Status LED on another Module is flashing too, there may be an internal fault in that Module. • Reprogram the faulty Module. • If reprogramming does not help, replace the faulty Module. An expected critical module is not detected (for example the DX Lighting Module, see also 6.6.1.2 or 6.6.2.3). • Check that the 'is critical'-parameters have the correct value • Check the DX BUS connections and (if applicable) the power connections of the critical module • Replace the critical module
2	DX Accessory	A DX Module with a Slow/Stop input (for example a CLAMB) is set to slow or stop. This may not be a fault, it is probably caused by the seat position being extended. Flash Code 2 is shown to indicate that the chair may go slower than expected. • Move the seat back to the neutral position. There is a fault in an accessory device attached to a DX Module (excluding the Power Module). For example: -a disengaged clutch -a light bulb is short circuit or open circuit -an actuator terminal is shorted to Battery '+'. • Check all accessory devices connected to your DX System.

Flash Code	Fault source	Meaning
3 4	Motor 1 / L  M1 Motor 2 / R  M2	The motor is not connected to the Power Module, or there is a short-circuit in the motor connection. • Check that the motor cables are not loose or damaged • Disconnect the motor plug from the Power Module and o Check with a multi meter that there is no connection between the motor pins and the parkbrake pins. o Measure the resistance between the motor pins. This should roughly be the motor + cable resistance (neither open-circuit nor short-circuit). • The motor brushes may be worn or too stiff o Turn the wheels to reconnect o Replace the motor brushes or the motor
5 6	Parkbrake 1 (M1/Left) Parkbrake 2 (M2/Right)	Parkbrake 1 fault: A single parkbrake is connected to M2 instead of M1. • Connect the single parkbrake to M1. Parkbrake 2 fault: The Park Brake parameter (4.3.3.1) has the value 'Dual' when a single parkbrake is used. • Set the Park Brake parameter to 'Single' with the Wizard. Parkbrake 1 or Parkbrake 2 Fault (if the above does not apply): The parkbrake is not connected to the Power Module, or there is a short-circuit in the parkbrake connection. • Disconnect the Motor/Parkbrake plug from the Power Module and o Check with a multi meter that there is no connection between the motor pins and the parkbrake pins o Check with a multi meter that there is no open-circuit between the parkbrake pins. **Note:** a mechanical parkbrake release can also cause a parkbrake fault, see section 2.4.4: Mechanical parkbrake release

Note: these faults are not affected by the **Left/Right Motor Swap** (4.3.2.7) setting. Flash code 3 or 5 always means the motor or parkbrake that is connected to the M1 connector.

When a Motor Fault or a Parkbrake Fault occurs:

- Swap the motor/parkbrake connectors, if they are not keyed.
  - If the chair has two parkbrakes, you can simply swap the motor connectors on the Power Module, if the motor connectors are not keyed.
  - If the chair has only one parkbrake, this method can not be used. Swapping the connectors will result in a M1 Parkbrake Fault with only one parkbrake, because a single parkbrake must always be connected to M1.
- When after swapping the fault moves from Motor 1/Parkbrake 1 to Motor 2/Parkbrake 2 or vice versa, the fault is caused by the motor/parkbrake or by the cables. Only when the fault does not move after swapping, the Power Module itself can be faulty.

Flash Code	Fault source	Meaning
7	Low Battery	The battery voltage is too low: it has fallen below 17V. The most probable cause of this fault is a loose battery terminal. • Check the batteries, the battery terminals, the cables, the fuses and the thermal circuit breakers • Batteries may be empty: charge the batteries • Batteries may be damaged or too small: replace the batteries
8	Over Voltage	The battery voltage has exceeded 32V. • The batteries may be overcharged. • If driving downhill, slow down and turn on the lights (if fitted). • Enable High Voltage Rollback (see also 2.2.4.3). If this fault occurs during battery charging, the battery charger is defective or not adjusted correctly. • Check that the open circuit voltage of the battery charger is in accordance with the limits of the battery manufacturer, and is less than 32V. If this fault occurs during regenerative braking (when stopping or travelling down a slope) and the batteries are not full, the battery connector may make intermittent contact. During a lost connection the braking energy can not be routed towards the battery, therefore the system voltage becomes too high. • Check the battery cables and connectors.
9 10	DX BUS cable fault: CANL wire CANH wire	An invalid voltage has been detected on the DX BUS CANH or CANL line. This fault condition results in Limp Mode (see 9.1) • Check the DX BUS cables for damage. • Check that there is no short-circuit between the pins of the DX BUS cable. An open-circuit 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, sometimes Flash Code 10 occurs. • Turn off the Hazard Lights, turn off the DX System then turn the DX System on again.
11	Stall Timeout	The motor current has been at, or close to, current limit for longer than the Stall Timeout parameter value. • The motors may not be strong enough for the chosen route (the route is too steep). o Turn off the DX System, let it cool down, then turn it back on again and choose another route. • The wheels may be rubbing on the frame. o Make sure that the wheels can turn freely. • The motors may be faulty. o Have the motor(s) checked by a service technician.
12	Module Mismatch	The data in the DX System for a DX Module is corrupt or incompatible with that module. • Reprogram the DX System. There is a compatibility problem between two or more DX Modules in the DX System. The powerchair will be disabled. • Consult your Dynamic Service Centre.

10 Appendices

10.1 Intended Use and Regulatory Statement

Intended Use

The DX System is a family of components intended to control powered wheelchairs. The DX System offers flexibility in integrating compatible input and output devices and provides extensive adaptability to meet specific user needs through optimal programmability.

The DX System is intended to operate powered wheelchairs utilising 24V motors with integrated parkbrakes.

Device Classification

Europe

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

USA

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

Compliance and Conformance with Standards

In accordance with the device classification, the DX System and its components are designed to comply with the requirements of the European Medical Device Directive 93/42/EEC and 21 CFR § 820.30.

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

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

10.2 Maintenance

1. All vehicle components must be regularly checked for loose, damaged or corroded connectors, terminals, or cabling. All cables must be restrained to protect them from damage. Damaged components must be replaced.

2. All switchable functions on the Dynamic electronics system must be regularly tested to make sure that they function correctly.

3. All Dynamic electronic components must be kept free of dust, dirt and liquids. If necessary, wipe with a cloth dampened with warm water. Do not use solvents or abrasive cleaners.

4. There are no user-serviceable parts in any Dynamic electronic component. Do not attempt to open any case or undertake any repairs, or warranty will be voided.

5. Where any 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.

10.3 Warranty

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

This Warranty is subject to the provisions that the equipment:

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

10.4 Safety and Misuse warnings

Warnings to be included in the User Manual

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

- Do not install, maintain, or operate this equipment before you have read and understood all the instructions and all the manuals for this product and all the other products that you use or install together with this product. Follow the instructions of the manuals. If you do not follow all instructions, injury or damage can be the result.
- Do not try to open or disassemble any case - there are no user-serviceable parts inside.
- The operator has the responsibility to keep the vehicle in a good safe operating condition. To protect all the components (for example the cables) from damage, the operator must fasten them in optimum positions.
- Immediately turn the system off and consult your service agent if the vehicle
    - Is damaged
    - Does not behave the same every time
    - Does not respond normally, the way you expect it to
    - Becomes hotter than normal
    - Smokes
    - Arcs
    - Does not change its speed when you adjust the speed reduction pot or the speed reduction switch (if one is available on your vehicle)
    - Displays a fault on its fault indicator and the system does not perform normally.
- Turn the system off
    - When you do not use it
    - Before you get in or get out of the vehicle
    - Before you use a mobile phone or a portable communications device near the vehicle
    - If your vehicle drives by itself or against your will. When you turn the system off the vehicle will halt.
- Do not drive the vehicle if the system indicates that the battery is low. If the battery becomes completely empty it will be damaged, and the vehicle will stop suddenly, possibly in dangerous locations such as the middle of the road.
- If the vehicle loses electric power, it is important that the operator can call for assistance.
- Advise the operator to go downhill slowly. When the vehicle drives downhill, the controller sends the brake energy from the motor to the battery. This charges the battery. However, if the battery is fully charged, it can not accept the generated energy anymore. When this happens there is a risk of damage to the battery or an explosion. To prevent this risk, the controller forces the vehicle to slow down until the battery can accept more energy. After this it allows the vehicle to speed up again. The result of this will be sudden speed changes of the vehicle. To prevent these speed changes with fully charged batteries, the operator must decrease the speed of the vehicle when he is going downhill.
- Do not touch the connector pins. If you touch the pins, they can become dirty or they can be damaged by electrostatic discharge.
- Inform the operator that the controller can cause the vehicle to come to a sudden stop. If this can be dangerous to the operator, the installer must install a seat belt, and the operator must wear this seat belt.
- Operation of a vehicle on steep slopes can be dangerous. Before you drive up or down a slope, make sure that the slope does not exceed the capability of the vehicle.
- Do not use the park brake release on a slope.

- Make sure that the controller does not become colder or hotter than the minimum and maximum temperatures specified in this manual.
- Most electronic equipment is influenced by Radio Frequency Interference (RFI). Be careful when portable communications equipment is used in the area around such equipment. Dynamic Controls has made every effort to make sure that RFI does not change the behaviour of the controller, but very strong signals can still cause a problem. The vehicle manufacturer has the responsibility to make sure that the vehicle is tested according to local EMC regulations.
- Performance adjustments must only be made by healthcare professionals, or by persons who completely understand the adjustment process and the capabilities of the operator. Wrong settings, or programming in a location that is not safe, can cause injury to the operator or bystanders, or damage to the vehicle or surrounding property.
- Performance adjustments must only be made indoors, or outdoors in dry conditions.
- After you have configured the vehicle, check to make sure that the vehicle performs to the specifications entered in the programming procedure. If the vehicle does not perform to specifications, reprogram it. Repeat this procedure until the vehicle performs to specifications. If the wanted operation cannot be reached, contact your service agent.

Service and Configuration Warnings

The following warnings are applicable to the installation technician and the dealer or the therapist who supplies the vehicle to the end user.

- It is the responsibility of the installer to make sure that accessories that are connected to the wires of the vehicle do not interfere with the operation of the controller.
- Make sure that the battery charger that is used with the vehicle has a drive inhibit function that is correctly connected for use with the controller. If you are not sure, ask your dealer or vehicle manufacturer.
- Do not use the vehicle frame as the earth return. Any electrical low-resistance connection to the frame is a safety risk and is not allowed by international safety standards.
- To make sure that the left motor and the right motor are not swapped, the motor connectors must not be interchangeable. Keying or labelling of motors is therefore recommended.
- If the vehicle loses electric power, it is important that an attendant is able to move the vehicle easily.
- After you have completed the installation, check it thoroughly. Correctly adjust all programmable options before the vehicle is used.
- The dealer, therapist or other agent who supplies the vehicle to the end user has the responsibility to make sure that the vehicle is correctly configured for the needs of that user. This must be confirmed by letting the user test-drive the vehicle in a safe area together with their agent.

10.5 Electromagnetic Compatibility (EMC)

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

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

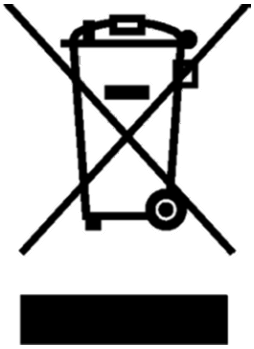
Europe: EN12184: 1999 Sec 9.8.1-3

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

10.6 Minimising emissions

To minimise emissions and to maximise the immunity to radiated fields and ESD, follow the General wiring recommendations in section 2.1.1.

10.7 Environmental statement



This product has been supplied from an environmentally aware manufacturer.

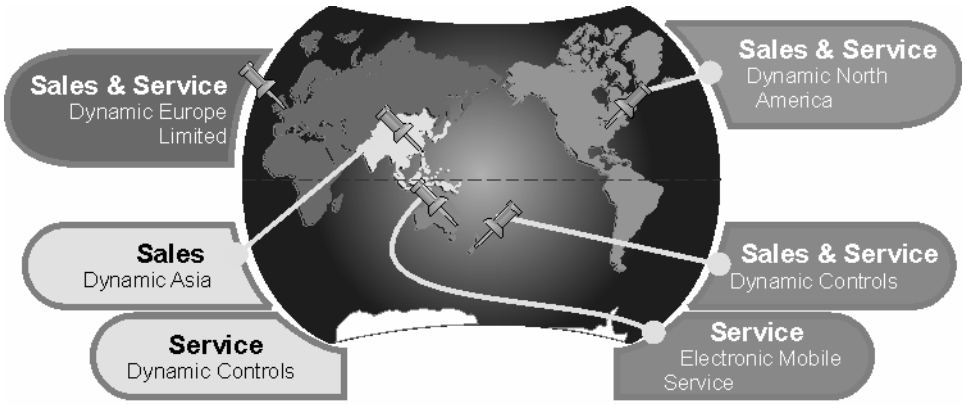
Please be environmentally responsible and recycle this product at the end of its life through your local recycling facility.

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

Contact Details

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

www.dynamiccontrols.com



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