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## Technical Report No. 713114780

Revision: 5

dated 2023-09-01

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Test object: Modular wheelchair control system  
Type: enAble® X1

Test specifications: ISO 7176-14:2022 (only applicable clauses) \*  
\* (for specification of tested clauses refer to chapter 3.5 of this Report)

Purpose of examination: Testing according to the test specifications.

Test result: The test results show that the presented product is in compliance with the specified requirements.

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## 1 Description of the test subject

The enAble X1 vehicle control system is designed for operation of a power wheelchair. Various input devices can be used interchangeably to meet diverse needs. The system is highly programmable and can be configured for different languages.

Each device has its own module specific parameters. These parameters are stored in the dataflash of the particular module. The enAble X1 modules work together over a CANopen based bus system running a proprietary CAN protocol. The enAble X1 can be used for all types of wheelchairs and can be adapted to most wheelchair configurations.

There exist different module configurations and designs indicated by additional suffix to the module names. All modules have the same hard- and software architecture based on CAN. The different module configurations, accessories and calibration setups do not differ from the assessed architecture.

A hand control or advanced display module is the primary module and every enAble X1 system wheelchair must have one. There is a range of alternative remotes, each of which has a different mix of functions that the user can control.

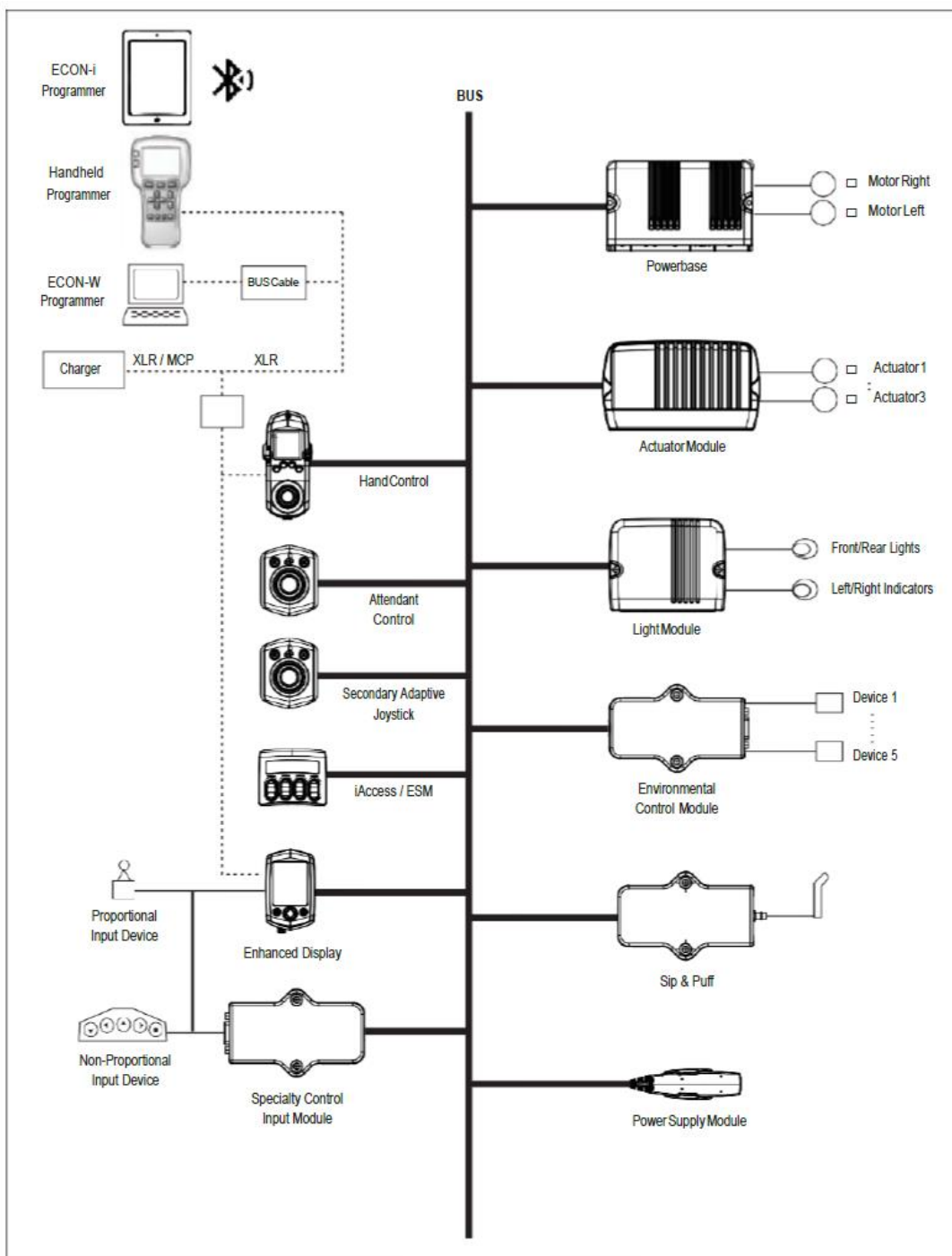
In addition to a primary module any enAble X1 system can also have further secondary modules installed. This enables the user to have a choice of different input devices on the wheelchair.

The enAble X1 system can be programmed by a handheld programmer, PC programmer or mobile applications. It provides an interface to CURTIS products for testing, diagnostics parameter adjustments and firmware updates.

### 1.1 Technical Data

Type	enAble X1
Nominal battery voltage	24 V <sub>DC</sub>
Voltage operating range	17 – 33 V <sub>DC</sub>
Nominal current limit	up to 120 A
Brake current	1.5 A (each motor)
Degree of protection	Min. IPX4

## 1.2 System Module combination overview



### 1.3 Possible enAble X1 – Pride System Modules

Model Description	Shortform	Model-No.
Powerbase 120A	PB120-x1	1760-3509
Powerbase 75A	PB75-x1	1760-1009 #
Powerbase 75A, drive only	PB75-D-x1	1760-1609 #
Powerbase 75A, 2 actuators	PB75-A2-x1	1760-1209 #
Powerbase 90A	PB90-x1	1760-2009 #
Powerbase 90A, 2 actuators	PB90-A2-x1	1760-2209
Handcontrol	HC-Qx1	1761-0009
Handcontrol lights	HCL-Qx1	1761-0109 #
Handcontrol Standard (XLR)	HCS-x1	1761-2509
Handcontrol Standard (XLR & MCP)	HCS-x1	1761-2519 #
Handcontrol Standard (MCP)	HCS-x1	1761-2529 #
Handcontrol Basic (XLR)	HCB-x1	1761-4009
Handcontrol Basic (XLR & MCP)	HCB-x1	1761-4019 #
Handcontrol Basic (MCP)	HCB-x1	1761-4029 #
<i>Handcontrol Basic, 2 actuators (XLR)</i>	<i>HCB-A-x1</i>	<i>1761-4209 *</i>
Handcontrol Basic, 2 actuators (XLR & MCP)	HCB-A-x1	1761-4209 #
Handcontrol Basic, 2 actuators (MCP)	HCB-A-x1	1761-4229 #
<i>Handcontrol Basic, 2 actuators, lights (XLR)</i>	<i>HCB-AL-x1</i>	<i>1761-4309 * #</i>
Handcontrol Basic, 2 actuators, lights (XLR & MCP)	HCB-AL-x1	1761-4319 #
Handcontrol Basic, 2 actuators, lights (MCP)	HCB-AL-x1	1761-4329 #
Stand Alone Joystick	SAJ-Qx1	1762-1109
Attendant Control	AC-Qx1	1762-2109 #
Advanced Display	AD-Qx1	1763-3409
Advanced Actuator Module	AAM5-x1	1764-5009
Lights & Actuator Module	AAM2L-x1	1765-2109
1 Actuator Module	AAM1-x1	1765-5009 #
2 Actuator Module	AAM2-x1	1765-5009 #
Light Module	LM-X1	1765-0109 #
3 Actuator / Light Module	AM3L-x1	1765-5209
3 Actuator Module	AM3-x1	1765-5009 #
2 Actuator Module	AM3-x1	1765-4009 #
1 Actuator Module	AM3-x1	1765-3009 #
Light Module LED	LML-x1	1765-0209
Power Supply Module	PSM-x1	1766-1109
Sip & Puff Module	SPM-x1	1767-0009
Speciality Control Input Module	SCIM-x1	1767-1009
Enhanced Switch Module, flat	ESM8-F-x1	1768-4009
Enhanced Switch Module, toggle	ESM8-T-x1	1768-4109 #
Environmental Control Module	ECM5-x1	1766-0209

*\*additional System Modules approved in 2023*

*# stuffing options*

## 1.4 Possible enAble X1 – Generic System Modules

Model Description	Shortform	Model-No.
Powerbase 120A, expandable	PB120-E-x1	1760-3501
Powerbase 75A	PB75-x1	1760-1001
Powerbase 75A, drive only	PB75-D-x1	1760-1601 #
Powerbase 75A, 2 actuators	PB75-A2-x1	1760-1201 #
Powerbase 90A	PB90-x1	1760-2001 #
Powerbase 90A, 2 actuators	PB90-A2-x1	1760-2201 #
<i>Handcontrol Standard (XLR)</i>	<i>HCS-x1</i>	<i>1761-2501 *</i>
Handcontrol Standard (XLR & MCP)	HCS-x1	1761-2511 #
Handcontrol Standard (MCP)	HCS-x1	1761-2521 #
<i>Handcontrol Basic (XLR)</i>	<i>HCB-x1</i>	<i>1761-4001 *</i>
Handcontrol Basic (XLR & MCP)	HCB-x1	1761-4011 #
Handcontrol Basic (MCP)	HCB-x1	1761-4021 #
<i>Handcontrol Basic, 2 actuators (XLR)</i>	<i>HCB-A-x1</i>	<i>1761-4201 *</i>
Handcontrol Basic, 2 actuators (XLR & MCP)	HCB-A-x1	1761-4201 #
Handcontrol Basic, 2 actuators (MCP)	HCB-A-x1	1761-4221 #
<i>Handcontrol Basic, 2 actuators, lights (XLR)</i>	<i>HCB-AL-x1</i>	<i>1761-4301 * #</i>
Handcontrol Basic, 2 actuators, lights (XLR & MCP)	HCB-AL-x1	1761-4311 #
Handcontrol Basic, 2 actuators, lights (MCP)	HCB-AL-x1	1761-4321 #
<i>Display Module (with backup camera)</i>	<i>DM-x1</i>	<i>1763-1401 *</i>
<i>Display Module (without backup camera)</i>	<i>DM-x1</i>	<i>1763-2401 * #</i>
Stand Alone Joystick	SAJ-Qx1	1762-1101 #
Attendant Control	AC-Qx1	1762-2101 #
Advanced Display	AD-Qx1	1763-3401
Advanced Actuator Module	AAM5-x1	1764-5001
Lights & Actuator Module	AAM2L-x1	1765-2101
3 Actuator / Light Module	AM3L-x1	1765-5201
3 Actuator Module	AM3-x1	1765-5001 #
<i>Servo / Light Module</i>	<i>SM2L-x1</i>	<i>1765-9201 *</i>
Light Module LED	LML-x1	1765-0201
Power Supply Module	PSM-x1	1766-1101
Sip & Puff Module	SPM-x1	1767-0001
Speciality Control Input Module	SCIM-x1	1767-1001
Enhanced Switch Module, flat	ESM8-F-x1	1768-4001
Enhanced Switch Module, toggle	ESM8-T-x1	1768-4101 #
Environmental Control Module	ECM5-x1	1766-0201

*\*additional System Modules approved in 2023*

*# stuffing options*

## 1.5 Comparison of Pride System and Generic System

### 1.5.1 Mechanics

- Modules with the same short form, e.g. PB75-x1, are mechanically identical.
- Modules with the designation «expandable», e.g. PB120-E-x1, are technically identical to the «non-expandable» variants, e.g. PB120-x1.
- Modules that have a stuffing options mark (#) are assembly variants of a module. They can be distinguished mechanically by different front panels and connector assemblies, toggle or flat switches or cable shape (not electrical).

### 1.5.2 Hardware

- For modules with the same short form, e.g. PB75-x1, the hardware is identical.
- For modules with the designation «expandable», e.g. PB120-E-x1, the hardware is identical to the «non-expandable» variant, e.g. PB120-x1.
- Modules that have a stuffing options mark (#) are equipment variants of a module. The equipped functions have electrically identical functionality. They can differ electromechanically through different connector assemblies.

## 1.6 Maximum Module combination

The minimum and maximum configuration depends on the primary module.

## 1.7 System compatibility (Primary Module AD-Qx1)

The maximum system configuration consists of the following modules:

- 1 PB120-x1
- 1 AD-Qx1
- 1 HC-Qx1 or HC-L-Qx1
- 1 SAJ-Qx1
- 1 AC-Qx1
- 1 SPM-x1
- 2 Actuator Modules (AAM5-x1 / AAM1-x1 / AAM2-x1 / AAM2L-x1 / AM3-x1 / AM3L-x1)
- 1 Light Module (LM-x1 / LML-x1)
- 1 SCIM-x1
- 1 ESM8-F-x1 or ESM8-T-x1
- 1 ECM5-x1
- 1 CAS-L
- 1 CAS-R
- PSM-x1 (no firmware)

### 1.8 System compatibility (Primary Module HCS-x1)

If the Handcontrol, type HCS-x1 (Handcontrol Standard) is the primary module, the following modules are compatible:

- PB120-x1
- 1 HCS-x1
- 1 AC-Qx1
- 2 Actuator Modules (AAM5-x1 / AAM1-x1 / AAM2-x1 / AAM2L-x1 / AM3-x1 / AM3L-x1)
- 1 Light Module (LM-x1 / LML-x1)
- 1 ESM8-F-x1 or ESM8-T-x1
- 1 CAS-L
- 1 CAS-R
- PSM-x1 (no firmware)

### 1.9 System compatibility (Primary Module HCB-x1)

If the Handcontrol, type HCS-x1 (Handcontrol Standard) is the primary module, the following modules are compatible:

- 1 Power base (PB75-D-x1 / PB75-x1 / PB75-A2-x1 / PB90-x1 / PB90-A2-x1)
- 1 HCB-x1
- 1 AC-Qx1
- 1 Actuator Modules (AM3-x1 / AM3L-x1 / AM3-2-x1)
- 1 Light Module (LML-x1 / AM3L-x1)
- PSM-x1 (no firmware)

### 1.10 System compatibility (Primary Module DM-Qx1)

The maximum system configuration consists of the following modules:

- 1 PB120-x1
- 1 DM-x1
- 1 HCS-x1
- 1 SAJ-Qx1
- 1 AC-Qx1
- 1 SPM-x1
- 2 Actuator Modules (AAM5-x1 / AM3-x1 / AM3L-x1)
- 1 SM2L-x1
- 1 Light Module (LM-x1 / AM3L-x1 / SM2L-x1)
- 1 SCIM-x1
- 1 ESM8-F-x1 or ESM8-T-x1
- 1 ECM5-x1
- PSM-x1 (no firmware)

### 1.11 Minimum module combination

The system shall at least include one primary module and one powerbase (PB).

## 2 Order

### 2.1 Date of Purchase Order

The update-testing of the modular wheelchair control system, type enAble X1 has been carried out per purchase order of Curtis Instruments AG dated 2023-06-16.

### 2.2 Date of Receipt of Test Subject

Testing of the modular wheelchair control system has been updated by adding new modules frequently. The first testing was performed in 2016 followed by regularly system updates and adding more modules.

The detailed documentation of these tests is kept in file at TÜV SÜD Product Service.

The latest testing of the system was performed with the following test samples delivered to the test laboratory as shown below:

- 2023-07-05, HAN-740611-1, DM-x1 (Display Module)
- 2023-07-05, HAN-740613-1, PB120-x1 (Powerbase)
- 2023-07-05, HAN-740612-1, AC-x1 (Attendant Control)
- 2023-07-05, HAN-740614-1, S2ML-x1 (Servo Module)
- 2023-07-05, HAN-740615-1, Multiplier cable (6-pole bus cable)

## 3 Remarks

### 3.1 Remarks to product

The product has been designed for specific customers and their individual purposes. It is not intended for generic use. For this reason, no general installation instruction exists but adequate information will be provided for each customer individually.

### 3.2 Remarks to testing

This testing is an enhancement of the previous approved control system containing various changes and updates in hard- and software. See also "Revision History".

### 3.3 Remarks to documentation of software life-cycle processes

Execution of software development and maintenance meets intent of EN 62304:2006 (as required per clause 12.9 of wheelchair standard EN 12184:2022) and is based on a layered V-model approach. The assessment of the submitted control system and the associated documents showed that the enAble X1 system meets the requirements of functional safety, as far as applicable.



### 3.4 Remarks to installation manual

The user manual has been examined according to the minimum requirements described in the product standard. The manufacturer is responsible for the accuracy of further particulars as well as of the composition and layout.

### 3.5 Specification of tested clauses

According to the manufacturers order the referenced standard ISO 7176-14:2022 has not been applied in full since the product is a control system and some of the clauses can only be tested with electric powered wheelchairs. With this testing the following clauses have been tested and approved for the enable X1 system:

- ISO 7176-14, clause 7.1: Single fault conditions
- ISO 7176-14, clause 7.2.3.4: Leakage current
- ISO 7176-14, clause 8.1: On/off switch
- ISO 7176-14, clause 8.3: Control signal at switch on
- ISO 7176-14, clause 8.5: Over-discharge protection
- ISO 7176-14, clause 8.6: Controller over-voltage protection
- ISO 7176-14, clause 8.8.2.3: Indication that battery set is nearing depletion
- ISO 7176-14, clause 8.9: Drive inhibit during charging
- ISO 7176-14, clause 8.14: Symbols used
- ISO 7176-14, clause 8.16: Software faults
- ISO 7176-14, clause 8.18: Wireless technology
- ISO 7176-14, clause 9.1: Electrical isolation
- ISO 7176-14, clause 9.8: Resistance to ignition (UL 94 V-0 classification)
- ISO 7176-14, clause 12.1: Interchangeability of connectors
- ISO 7176-14, clause 13.1: Ingress of liquids (IPX4)
- ISO 7176-14, clause 14.1: Reversed polarity
- ISO 7176-14, clause 14.2: Integrity of enclosures (IK10 impact test)
- ISO 7176-14, clause 15: Accompanying documents & IFU



Product Service

#### 4 Revision History

- Rev. 0: initial version
- Rev. 1: approval of additional modules
- Rev. 2: editorial change only (specification of tested clauses)
- Rev. 3: editorial change only (system components specification)
- Rev. 4: approval of additional modules
- Rev. 5: approval of additional modules

#### 5 Summary

The test results show that the presented product is in compliance with the specified requirements.

TÜV SÜD Product Service GmbH  
Report checked

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