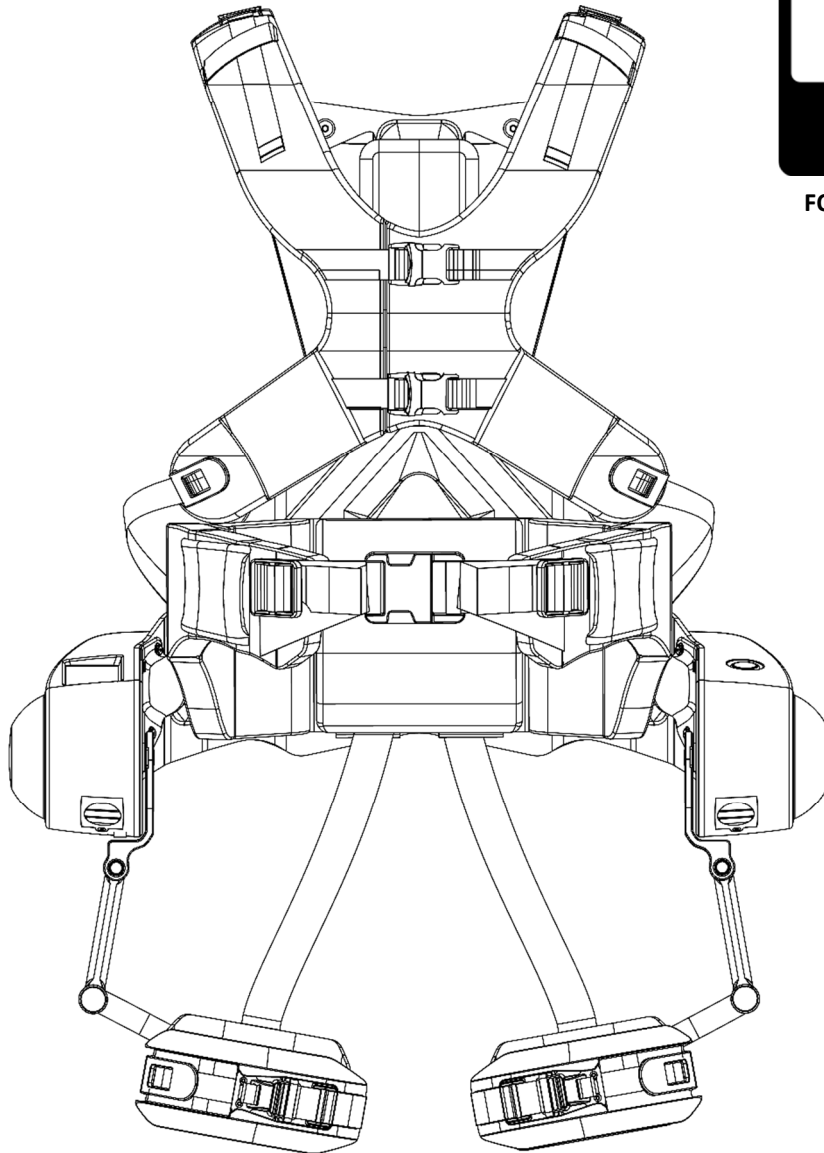




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FOR THE ONLINE MANUAL



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# CRAY X

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INSTRUCTION MANUAL

Copy of the German original - as of 18.01.2023

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# INSTRUCTION MANUAL

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# 1 INTRODUCTION



**IMPORTANT** To ensure the safe operation of the *Cray X*, it is essential to read this manual. Keep this manual in a safe place.

For more information, please refer to the online version of the instruction manual at **www.germanbionic.io**. You will receive the login details for the website separately.

## 1.1 Purpose

The *German Bionic Cray X* exoskeleton is a human-machine system that combines human intelligence with machine power. It supports or amplifies the wearer's movements in an active-assistive capacity, thus minimizing the risk of occupational accidents and injuries due to excessive strain. The *German Bionic Cray X* was specially designed for the manual lifting of heavy goods and tools and to reduce associated compression forces in the lower back.

The *German Bionic Cray X* exoskeleton connects to the internet via WLAN or LTE (IoT capable). Anonymized device data are continuously collected during use and can be accessed via [www.germanbionic.io](http://www.germanbionic.io).

## 1.2 Warranty for devices included in the scope of delivery

Scope of delivery:

- ▶ *Cray X* exoskeleton
- ▶ Makita 40V battery [BL4025]
- ▶ Opt: Makita charger for 1 battery
- ▶ Instruction manual

The devices included in the scope of delivery each have a 12 month warranty that covers material and functional damage, provided that their use complies with that described in the enclosed or online instruction manual. The exact scope of delivery is indicated on the delivery note.

## 1.3 Warning and information notice contained in the instruction manual



**DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



**WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



**IMPORTANT** Describes a potentially harmful situation which, if not avoided, may result in damage, malfunction and/or failure of the exoskeleton.



**NOTICE** Additional information on how to operate the product.



The symbol is used to represent operating steps.

The general graphical symbols under ISO 3864-2: 2004-10 also apply.

## 2 SAFETY

### 2.1 Intended use

- ▶ The *Cray X* is primarily intended for industrial use.
- ▶ The specifications detailed in “Ambient conditions” and “Specifications” must be observed.
- ▶ The efficient and safe operation of the *Cray X* requires appropriate transport, unpacking and set-up, as well as qualified handling and proper maintenance.
- ▶ Legal accident prevention regulations and other generally accepted safety or occupational health rules must be observed.
- ▶ All repair work must be carried out by the *German Bionic* customer service.
- ▶ Any interventions and modifications, such as opening the covers or any manipulations that might affect the safety technology and functionality of the *Cray X* must be carried out by *German Bionic*.
- ▶ Only original accessories and spare parts may be used, as only they guarantee the safe and malfunction-free operation of the *Cray X*.

### 2.2 Improper use

- ▶ Any use other than that described in section 2.1 is considered improper and will void all liability and warranty claims against the manufacturer.

### 2.3 Operating conditions

The following operating conditions must be observed when using the *Cray X*:

- ▶ The *Cray X* is intended for industrial use.
- ▶ The specifications detailed in “Ambient conditions” and “Specifications” must be observed.
- ▶ Ambient operating temperature: 0 °C to 40 °C
- ▶ Ambient operating humidity: max. 70%
- ▶ Protect from direct sunlight
- ▶ Minimum room width for using the *Cray X*: 113.5 cm
- ▶ Observe minimum height requirement for safe setup
- ▶ Protect from extreme weather conditions (heavy rain, hail, snow, storm) in accordance with the IP54 standard.
- ▶ Use only up to max. 6500 feet above sea level
- ▶ Do not use in salty air.

### 2.4 Responsibility of the operator

The instructions in the manual must be observed in full and without restrictions. In addition to the safety information and instructions provided in this manual, the operator is responsible for:

- ▶ Compliance with local legal regulations, such as accident prevention, general safety and applicable environmental protection regulations.
- ▶ Compliance with inspection and maintenance deadlines
- ▶ The operational safety of the *Cray X*
- ▶ Briefing and training of operating personnel

## 2.5 User requirements

- ▶ The *Cray X* may only be operated by physically able, healthy and authorized users. Users must be sufficiently familiarized with the safety features and have been informed about possible hazards by the operator.
- ▶ Persons under the age of 18 and individuals who are not fully trained are prohibited from operating the *Cray X* and performing maintenance work on the device.
- ▶ Suitable for body heights of 1.55–1.95 m.
- ▶ Pregnant women may not operate the *Cray X*.
- ▶ Persons who are under the influence of alcohol, medication or other drugs that impair response time may not operate the *Cray X*.
- ▶ Users are strongly advised not to wear objects (e.g. necklaces) that can get caught or cause skin irritation.

## 2.6 Safety features

Both leg connections of the *Cray X* are equipped with mechanical end stops that limit the angle of rotation of the connections around the drive axis to 180°. Limiting the extension of the leg connections protects the wearer from the risk of injury during use of the *Cray X*.

## 2.7 What to do in case of emergency



**WARNING** Malfunctions or improper use of the *Cray X* cause a risk of injury due to uncontrolled movements of the *Cray X*.

### 2.7.1 Activate the emergency stop

- 1 Press the emergency stop switch.  
“Emergency stop activated” appears on the display. The *Cray X* turns off the electric motors and the support function. The leg linkages can still be moved with the user’s own muscle power.
- 2 Eliminate the source of hazard.

### 2.7.2 Release the emergency stop

- 1 Release the emergency stop by turning clockwise.
- 2 Reset the emergency stop by pressing the On/Off button.  
Follow the instructions on the display.

## 2.8 Federal Communications Commission (FCC) statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.



**WARNING:** Changes or modifications not expressly approved by German Bionic could void the user's authority to operate the equipment.

## 2.9 Industry Canada Statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

*Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

## 2.10 ISED Canada ICES-003 Compliance Label

CAN ICES-3 (B)/NMB-3(B)

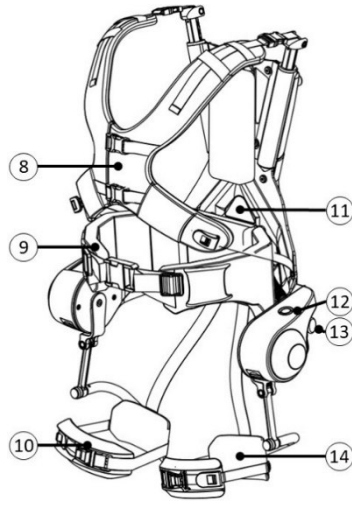
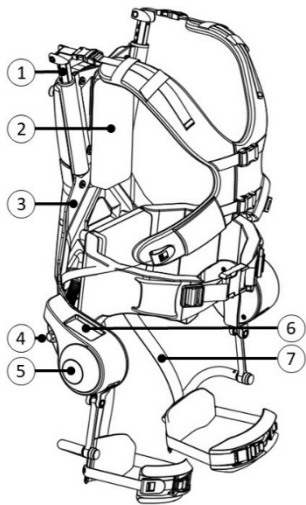
## 2.11 RF Exposure Guidance

In order to comply with FCC / ISED RF Exposure requirements, this device must be installed to provide at least 50 mm separation from the human body at all times.

“Afin de se conformer aux exigences d'exposition RF FCC / ISED, cet appareil doit être installé pour fournir au moins 50 mm de séparation du corps humain en tout temps.”

## 3 DEVICE DESCRIPTION

### 3.1 Cray X



1. Upper chest strap linkage via telescopic rails with safety bolts
2. Back padding
3. Support structure with battery holder
4. Push/turn knob
5. Electric motors
6. Display
7. No-slip strap
8. Chest strap with buckle
9. Hip belt with storage pockets
10. Front leg connection
11. Type label
12. On/off button
13. Emergency stop button
14. Rear leg connection

### 3.2 Type label

The identifying information for the *Cray X* (serial number, model name, etc.) are indicated on the type label. The type label is located on the support structure.

## 4 UNPACKING



**NOTICE** Keep the carton and packing material for storage and subsequent transport.

Carefully remove the packing material and carefully take the components of the scope of delivery out of the carton.

## 5 TRANSPORT



**NOTICE** Keep the carton and packing material for storage and subsequent transport.



1 Remove the battery from the *Cray X*.



2 Use packaging material to protect the *Cray X* from sliding around in the box.



3 Carefully place the components of the scope of delivery in the box.



4 Secure the packed *Cray X* before transport and protect from strong impact and other destructive forces.



5 Also follow the instructions on the box.

## 6 OPERATION



**WARNING** The straps and leg connections can catch on objects → fall and draw-in hazard. Make sure there is enough space (see “2.3 Operating conditions”) and stow all loose ends in the space provided (see online instruction manual “Putting on the *Cray X*”).



**CAUTION** Residual risk: Skin abrasions/risk of falling during use  
The *Cray X* must be properly fastened (see online instruction manual).



**CAUTION** Unexpected movements if operating modes are mixed up → risk of stumbling. Check the current mode on the display before every use and switch modes if necessary.



**CAUTION** Unusual movements when climbing a ladder → risk of falling.  
Do not climb ladders with the *Cray X*.



**CAUTION** Incorrect positioning of the straps → tension in the neck and back.  
Follow the instructions in the online instruction manual “Putting on the *Cray X*”.



**CAUTION** Body contact with the *Cray X* → Skin irritation. Allergic reactions may occur. The following materials were used in the *Cray X*:

- ▶ Cover: PA12
- ▶ Support structure: Carbon fiber-reinforced plastic (CFRP)
- ▶ Display cover: Polycarbonate (PC).

Avoid direct skin contact in case of allergy.

Wear long-sleeved outerwear and long pants.



**CAUTION** Leaving the battery in the *Cray X* when not in use → risk from uncontrolled motor movements. Remove the battery from the device after use.  
Follow the battery manufacturer’s storage instructions.



**IMPORTANT** Excessive humidity, dusty environment → electric motor damage.  
Pay attention to the ambient conditions.



**IMPORTANT** This device is not suitable for use in residential environments and may not provide adequate radio reception in these surroundings.



**NOTICE** Do not remove the battery from the *Cray X* until the device has properly shut down.



**NOTICE** For optimal comfort, the support structure is adapted to the wearer’s body and personal requirements using adjustable straps (see online instruction manual “Putting on the *Cray X*”).



**NOTICE** If the straps are too loose during use of the exoskeleton or it is uncomfortable to wear, check that the *Cray X* has been fitted correctly and tighten the straps if necessary.



**NOTICE** Special care is required when climbing stairs.



The *Cray X* provides the following functions:

- ▶ Active, electric motor-powered support for the wearer
  - ▶ Power transmission through leg connections and a chest strap
  - ▶ Supporting torque depending on movement speed and selected settings
- ▶ Provision of anonymized movement data via the *German Bionic* IO platform

## 6.1 Donning/Fastening



**NOTICE** Users who are familiar with the *Cray X* can preadjust the length of relevant straps (shoulder, pelvis, legs).



**NOTICE** It is very important to ensure that the hip belt is optimally positioned, as it carries most of the total load. Care should be taken to ensure that the axis of rotation of the motor is aligned with that of the hip joint.

## 7 DECOMMISSIONING/STORAGE



**NOTICE** Leaving the battery in the *Cray X* when not in use → risk from uncontrolled motor movements. Always remove the battery of the *Cray X* for storage. Also follow the instructions of the battery manufacturer.

### 7.1 Decommissioning



**NOTICE** Follow the manufacturer's instructions for decommissioning the battery.



1 Remove the battery from the holder (see online instruction manual).



2 Store the *Cray X* in a clean, dry and flat place (refer to the specifications for storage).

### 7.2 Storage



**NOTICE** Keep the carton and packing material for storage and subsequent transport.



**NOTICE** Follow the storage instructions in the *Cray X* specifications.



**NOTICE** Follow the manufacturer's instructions for storing the battery.



1 Carefully place all the components of the scope of delivery in the box.



2 Secure the contents with the packing material.



3 Close the carton.



4 Store the carton in a dry and safe place.

## 8 DISPOSAL

According to the European Directive 2012/19/EU, waste electrical and electronic equipment must be collected separately and recycled in an environmentally friendly manner. For the disposal of the rechargeable battery, also follow the enclosed Makita manual. Old devices must not be disposed of in the municipal waste.



## 9 MAINTENANCE

For maintenance of operational safety, the prescribed deadlines for inspection, cleaning and maintenance work must be observed.



**NOTICE** Please refer to the complete maintenance and washing instructions provided in the online manual.

### 9.1 Maintenance schedule

		A	B	C	D	E
Complete <i>Cray X</i>	Visual inspection	●				
Battery	Visual inspection	●				
Straps and buckles	Visual inspection	●				
Back padding	Clean		●	●		
Chest strap	Clean/wash		●	●		
Front leg connection	Clean		●	●		
Rear leg connection	Clean		●	●		
Hip belt	Clean		●	●		
Chest strap	Replace				●	
Padding, rear leg connection	Replace				●	
Padding, front leg connection	Replace				●	
Back padding	Replace				●	
Complete <i>Cray X</i>	Maintenance by manufacturer					●

A: Before starting work; B: After end of work; C: As required; D: In case of damage; E: Annually

### 9.2 Annual maintenance

The *Cray X* is sent to the manufacturer for annual maintenance. Maintenance can also be carried out on site if previously arranged with a service employee from *German Bionic*.

- 1 Arrange an annual maintenance visit with *German Bionic*.
- 2 Prepare the *Cray X* for transport (see "TRANSPORT").
- 3 Close the carton and send it to the manufacturer.

Annual maintenance by qualified technicians from the manufacturer includes:

- ▶ Comprehensive wear check of electronics and electric motors
- ▶ Comprehensive wear check of all belts and straps with their fastening systems
- ▶ Function test

# 10 FAULTS AND MALFUNCTIONS

## 10.1 Faults

Error message	Cause	Corrective action
"Emergency stop activated" appears on the display.	The emergency stop switch was triggered.	Turn clockwise to release the emergency stop. Follow further instructions.
"Motors switched off" appears on the display.	The motors have overheated and have therefore been switched off to cool down.	The motors will remain switched off for two minutes to allow the temperature to go down and then turn on again automatically.
"Motor error" appears on the display.	An error has occurred in the motor system.	Press the push/turn knob to confirm the error. The <i>Cray X</i> needs to be recalibrated.
"Battery low" appears on the display.	The battery charge has dropped below 10%.	Switch off the <i>Cray X</i> , remove the battery, charge it and insert a fully charged battery (see online instruction manual).
"Error/restart required [...]" appears on the display.	Restarting the motor did not solve the problem.	The <i>Cray X</i> must be switched off and restarted.

## 10.2 Malfunctions

Symptom	Cause	Corrective action
The <i>Cray X</i> won't start after pressing the on/off button.	The battery charge level is too low.	Remove the battery from its holder and charge it.
Unintentional shutdown of the <i>Cray X</i> .	The battery charge level is too low.	Remove the battery from its holder and charge it.

# 11 SPECIFICATIONS

<b>Dimensions W x L x H</b>	mm	634 x 432 x 990
<b>Weight</b> (including replaceable parts, e.g. battery, chest strap, padding)	kg	8.88
<b>Power</b>	W	2 x 100
<b>Operating voltage</b>	V	40
<b>Battery life</b> (depending on battery, operating mode)	hr	up to 8
<b>Load support</b>	kg	up to 30
<b>Ambient operating temperature</b>	°C	0 to 40
<b>Ambient storage temperature</b>	°C	0 to 40
<b>Ambient operating humidity</b>	%	max. 70
<b>Ambient storage humidity</b>	%	max. 70
<b>Average airborne noise emission</b>	dB (A)	<80
<b>Max. airborne noise emission</b>	dB (A)	<100
<b>Protection class</b>	IP	54
<b>Fire protection class</b>	UL	94
<b>UMTS bands</b> <b>B1/B2/B4/B5/B6/B8/B19</b>	dBm	25
<b>LTE bands</b> <b>B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/ B26/B28/B66/B34/B38/B39/B40/B41</b>	dBm	25
<b>Wi-Fi 2.4 GHz</b>	dBm	20