WEBER Controller C5S

V 2.0 / 06.2022

Translation of the original operating instructions

IMPORTANT: Keep for reference.

Contents

1. Preface

1.1. About this operator's manual

These operating instructions are designed to familiarise the user with the machine/system and its designated use.

The operating instructions contain important information concerning use of the machine/system in

- safe
- correct
- efficient

manner.

Observance of these instructions helps to:

- avoid risks,
- reduce repair costs and shutdown periods,
- increase the reliability and lifespan of the machine/system.

The operating instructions must be available at all times wherever the machine is in use. These operating instructions must be read and applied by any person charged with carrying out work with and on the machine, such as

- operation, including setting up, troubleshooting in the course of work,
- care, disposal of oils and consumables,
- maintenance (servicing, inspection, repair)
- transport.

In addition to the operator’s manual, the binding regulations for accident prevention and environmental protection applicable at the place of use must be observed. The recognised technical rules for safe and professional work must be taken into account.

These operating instructions are part of the complete technical documentation of the unit.

Safety instructions, detailed instructions and technical information can be found in the individual chapters of the operator’s manual and the supplier documentation.

The personnel charged with operating the machine must have read the operator’s manual, in particular the chapter on safety, before starting work.

In the following descriptions, numbers in brackets, for example (2), correspond to the respective item number in the associated illustration. The item numbers used in the operator’s manual may differ from the numbering in the assembly drawings of the spare parts list.

1.2. Changes / Copyright

Changes to the technical design and documentation are subject to change without notice. The copyright to these instructions is reserved by WEBER Schraubautomaten GmbH. Duplication, computerised recording and filming of any kind are prohibited without written permission.

1.3. Warranty

WEBER provides a warranty for this unit for the period specified in the order confirmation.

Damage resulting from natural wear, overload, or improper handling is excluded from the warranty. Damage to connected mechanical parts caused by incorrect parameter assignment also considered improper handling.

Damage to the unit caused by material or manufacturing defects will be remedied free of charge through replacement or repair.

In order for claims to be accepted, the unit must be sent in non-disassembled condition to WEBER Wolfratshausen or a WEBER dealer.

1.4. Contact at WEBER

Subjects/concerns	Department	Telephone number
Commissioning, maintenance and adjustment	Service	+49 8171 406 - 480
Commercial topics	Distribution / Head Office	+49 8171 406-0
Technical documentation	Technical documentation	+49 8171 406 - 360

Have the machine number ready

Please have the corresponding machine number ready.

You can find it on the Name plate [▷ 7].

1.5. Name plate

The WEBER components are provided with a name plate.

The following name plates are used:

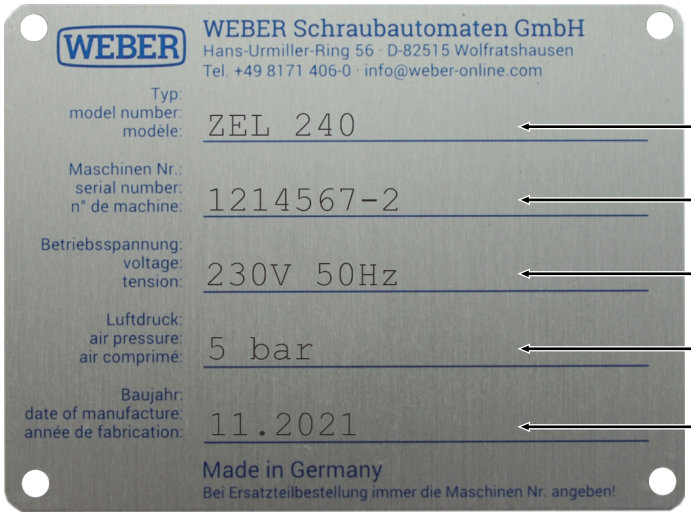


Illustration 1: Name plate – example image 1

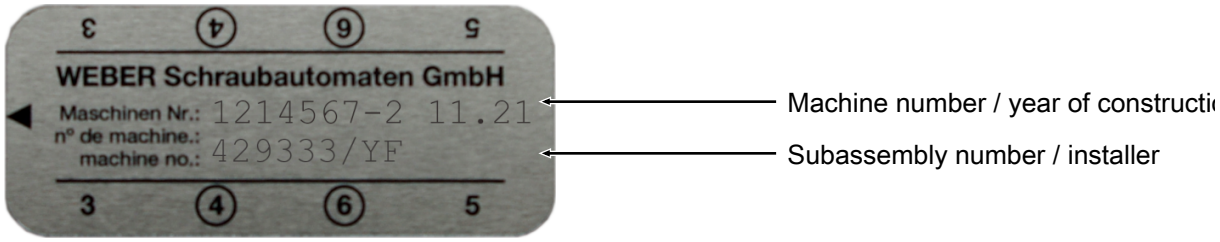


Illustration 2: Name plate – example image 2

1.5.1. Name plate for the C5S screwdriving controller

The name plate is on the rear of the C5S screwdriving controller. In addition to the machine number and the electrical connection values, the type code and the serial number of the controller are listed.

- The controller version is specified in the type code. It must match the operating software:

  C5S-V2.a.b.c
- The following table specifies the individual placeholders in the serial number:

  wxxyyzzz

Placeholder	Description
w	Letter
xx	Year of manufacture of the device
yy	Month of manufacture of the device
zzz	Sequential number

2. Safety

2.1. Hazard classes

The warning notices are classified into the following hazard classes:

Indication of a dangerous situation.

Failure to observe the precautions will result in serious injury or death.

► Instructions for action to avoid the danger

Indication of a dangerous situation.

Failure to observe the precautions may result in serious injury or death.

► Instructions for action to avoid the danger

Indication of a dangerous situation.

Failure to observe the precautions may result in minor or moderate injuries.

► Instructions for action to avoid the danger

Indication of a dangerous situation.

Failure to observe the precautions may result in material damage.

► Instructions for action to avoid the danger

Other notices:

Information about a fact.

A general or specific note with additional information follows.

Environmental notice

An environmental notice follows.

2.2. Hazard symbols

The following prohibition and warning signs as well as mandatory action symbol can be used in the operators manual and on the machine.

- Prohibition sign according to DIN EN ISO 7010

Sign	Meaning	Sign	Meaning
	No access for people with pacemakers or implanted defibrillators		

- Warning sign according to DIN EN ISO 7010

Sign	Meaning	Sign	Meaning
	General warning sign		Pointed object warning
	Warning of electrical voltage		Hot surface warning
	Warning of magnetic field		Laser beam warning
	Hand injury warning		Suspended load warning

- Mandatory action symbol according to DIN EN ISO 7010

Sign	Meaning	Sign	Meaning
	Observe the instruction		Wear hearing protection
	Wear protective helmet		Wear foot protection
	Wear safety goggles		Wear protective gloves

2.3. Structure of the safety and warning notices

The prohibition and warning signs as well as the mandatory action symbol have the following structure:

DANGER

Type and source of danger

Consequences of non-compliance

► Instructions to avoid the danger

2.4. General safety information

The controller is state of the art and built according to recognised safety rules. Nevertheless, danger to life of the user or third parties, or damage to the machine and other property can result.

The controller should be used only when in technically perfect condition and only for its intended purpose, while bearing in mind all the health and safety guidelines and potential dangers, and always in accordance with the operator's manual. Faults that may affect safety must be rectified immediately.

2.5. Intended use

The device may only be used as a controller for a WEBER screwdriving unit and for the applications specified in this operator’s manual. Ensure that all connection values and limit loads specified in the operator’s manual are adhered to.

Any other use or use beyond this is regarded as unintended use. WEBER does not accept any liability for any damage due to unintended use.

2.6. Organisational safety information

Always keep the operator's manual near the controller (in the tool box or the container provided) ready for reference.

Supplement the operator's manual by instructions, including supervisory and reporting requirements to meet specific company requirements, e.g. in terms of work organisation, work processes, personnel employed.

The personnel assigned to work with the controller must have read the operator's manual, in particular the "Safety” chapter, before starting work. This applies particularly to personnel who work on the controller only occasionally, for example, for set-up and maintenance.

Personnel must wear suitable working clothes.

Observe all safety and danger information on the controller and keep in a legible condition.

If safety-related changes occur to the operating characteristics of the controller itself or to the controlled machine, shut down the system immediately and report the fault to the competent authority/person.

Do not make any modifications, additions or conversions to the controller, which could affect safety without the manufacturer's approval. This also applies to installing and setting safety devices.

Spare parts must comply with the technical requirements specified by the manufacturer. This compliance is always guaranteed for original spare parts.

Do not make any changes to programmable control systems (software).

2.6.1. Safety-relevant provisions

General accident prevention regulations, VDE guidelines, fire prevention regulations, and safety and installation instructions must be observed.

Compile a safety concept

The control unit is prepared for installation in an EMERGENCY STOP circuit.

► When designing the higher-level sequence control, a corresponding safety concept must be compiled.

If you have questions regarding safety regulations, please contact WEBER (see the Contact at WEBER [▷ 6] chapter).

2.7. Selection and qualification of personnel; basic responsibilities

Use only trained or instructed personnel to operate the controller. Define responsibilities of the personnel for operation, setup, maintenance, repair clearly.

Installation, test run and work on the controller must only be performed by a trained specialist or by instructed persons under the direction and supervision of a qualified person in accordance with the relevant rules and regulations.

The device has a management of access authorisations for operation, parametrisation and programming. The associated passwords may only be communicated to the persons with the associated qualification. The customer is responsible for assigning passwords.

Training courses on the operation and maintenance of WEBER equipment are offered in-house at WEBER – and on request also on site at the user's premises. Please call our service department for more information (see chapter Preface).

2.8. Safety instructions for working on the machine

Working on the machine

Working on the machine comprises all tasks pertaining to operation, production adjustment, conversion or setting of the screwdriving / process control system and its safety-related equipment, as well as inspection, maintenance and repair.

Adhere to the cleaning and maintenance work specified in the operator's manual, as well as its intervals. Observe specifications for replacing parts/assemblies.

DANGER

Hazards when working on the machine

Risk of injury if the machine is handled incorrectly.

►Only specialists may perform work on the machine.

Work on the machine can also be performed in the factory. Please contact our service department for more information (see the Preface chapter).

DANGER

Risk of injury when connected to electrical power supply

►The device must be switched off before plugging in and unplugging electrical components.

►Disconnect the electrical power supply and secure to prevent a restart prior to working on the device (5 safety rules of electrical engineering).

►Observe the switch-on and switch-off procedures in accordance with the operator's manual.

DANGER

Hazards due to malfunctions

Risk of injury due to inadvertently released energy and unexpected start up of the machine or individual components.

►In the event of malfunctions, disconnect the machine from the compressed air and electrical power supply, and secure to prevent a restart (5 safety rules of electrical engineering).

►Have authorised staff repair faults.

Secure to prevent unexpected start-up

In order to prevent an unexpected machine start-up, measures such as the LoTo procedure (lockout-tagout) must be taken.

- Shut-off the energy and disconnect all sources of energy
- Dissipate stored energy
- Lock the main command equipment (main switch, main valve, etc.) in the “OFF” position with a personal safety lock and remove the key
- Attach a label (sign) to the main command equipment

If these points cannot be complied with for technical reasons, other or equal measures must be taken.

Re-starting the machine

Check the machine condition prior to restarting the machine.

- Loosened screw connections are tight
- All safety equipment is attached and functioning

2.9. Notes on special types of hazard

2.9.1. Electric power

DANGER

Electric shock

During all maintenance work, the machine/system must be disconnected from the power.

Check the disconnected parts for absence of voltage, then ground and short.

Insulate any adjacent live parts.

Maintenance may only be carried out by specially trained and instructed personnel.

Tools are usually not insulated against accidental contact with electricity. Do not use the tools in an environment where a risk of fire or explosion exists.

Tools lying down must not be turned on. Turn off the tool before you start another operation or switch to another work area.

2.9.1.1. Use of residual current devices (RCDs)

The internal circuit of the C5 corresponds to Circuit No.4 shown in DIN EN 50178 VDE 0160:1998-04 Annex A 5.2.11.2.

A pulsed frequency converter that generates smooth DC and AC fault currents with a wide range of frequencies is integrated in the C5 control unit. When the unit is used on a residual current device (RCD), it is therefore recommended that an RCD of Type B (AC/DC sensitive) be used.

When other RCDs are used, spurious tripping or malfunctions of the RCD may occur.

WARNING

Electric shock due to malfunctions on the residual current device (RCD)

Residual current devices that are not specifically intended for use in consumers with DC and AC fault currents of different frequencies may not trip in the event of a fault current in the worst case scenario.

► Select type B residual current devices (AC/DC sensitive).

2.9.1.2. Leakage current

The device exhibits a leakage current as a result of the internal filter circuit that must be integrated to comply with EMC standards. The leakage current at 50 Hz that occurs during operation is less than or equal to 3.5 mA.

For determination of the leakage current, an equivalent leakage current measurement cannot be used because the device contains components that have voltage-dependent conductance values. The leakage current must be determined using direct or indirect measurement according to a configuration defined in IEC60990 (VDE 0106-102) Figure 6. The measurement must be made when the unit is in operating condition.

WARNING

High leakage current

due to faulty protective conductor system

► Disconnect the device from the electrical power supply immediately

As a pulsed frequency converter is used in the C5, additional leakage currents occur outside of the mains frequency.

2.9.2. Behaviour in the event of a fault

Faults are displayed on the user interface.

WARNING

Functional impairment to the device

► As soon as the device is no longer in working order or the fault-free condition of the device is in doubt, the energy supply to the device must be interrupted.

WARNING

Unclear controller operating states

► If the operating state is not displayed or is unclear, work on the system must be stopped immediately and the maintenance personnel informed.

3. Unpacking, installation and storage

3.1. Unpacking

- Use any sharp or pointed objects for unpacking.
- Avoid shocks and blows.
- Do not pull on electrical cables.
- Do not squeeze or crush any electrical cables or connectors.
- Check the delivery for completeness and damage.
- Inform WEBER and the logistics/shipping company immediately of any detected damage.

3.1.1. Taking back of packaging materials (VerpackG)

The packaging materials are selected according to environmentally compatible and disposal aspects and are therefore recyclable.
Returning the packaging to the material cycle saves raw materials and reduces waste.

German Packaging Act (VerpackG)

The VerpackG obliges all manufacturers and distributors of packaging to take it back free of charge after it has been placed on the market and to ensure proper utilisation.

Packaging take-back by WEBER:

The packaging material shall be taken back at the place of dispatch of the goods. The customer shall bear the costs of the return transport of the packaging to the place of return. The return takes place exclusively during WEBER's business hours. The returned packaging must be clean, free of foreign matter and separated according to type.

Independent disposal of packaging materials:

The packaging contains valuable raw materials and recyclable materials. Please dispose of the individual packaging materials in an environmentally friendly manner and in accordance with local regulations.

3.2. Installation

The device must be installed on a sufficiently stable base and protected from impact and vibration.

The permissible environmental conditions specified in the technical data must be adhered to.

Strong magnetic fields in the direct vicinity of the unit can cause interference and jeopardise operational reliability.

The mechanical components are connected to the device via the accompanying cables. Do not allow cables to be crushed, kinked, are subjected to tension. Take the cable lengths into consideration when selecting the installation location. The smallest bending radius for the individual cables must not exceed 10 times the cable diameter. To avoid crosstalk, the cables must not be routed in the immediate environment of power cables of other devices or plant units.

Information on the designation of the male and female connections can be found in the section Overview of connections.

DANGER

Fatal electric shock

Switch off the unit before connecting or disconnecting electrical components.

Pull out the mains plug before opening the housing.

3.3. Storage

The control unit should be kept dry and protected against aggressive media if lengthier intermediate storage is foreseen. Shocks, vibration, frost and extreme temperature and humidity fluctuations should be avoided.

4. Operation

4.1. Basic concept

This device is a screwdriving controller that operates with a brushless EC drive. The C5S should be integrated into a higher-level controller (PLC) in order to coordinate the assembly process.

Depending on the application, various screw processes can be programmed and the associated parameters assigned.

The parameters are set via the USB interface on the C5S. A PC with the C5S operating software, which is connected to the C5S is required for this.

4.2. Switching on

The main switch of the control unit that allows the device to be disconnected from the mains is integrated on the plug for the mains cable. A connection cable in the relevant country design is provided. First plug this cable into the device and then into the electrical power supply.

After switching on at the main switch, the 3 LEDs on the device indicate the status and a `friction offset test` is performed to check the spindle and the power drive. If this is successful, the green LED illuminates.

The device is now ready for production and can be controlled via the interface. To do this, the automatic signal must be set on the customer interface. For further information regarding control, see the Interface description [▷ 47] chapter.

If a fault occurs, refer to the Fault messages [▷ 45] chapter for information on appropriate diagnostics and remedies.

4.3. Friction offset test

After switching on the control unit, a `friction offset test` is completed. The purpose of this test is to verify that the complete screwdriving spindle, including the drive, is in working order. During the test, the motor moves the screwdriving spindle in both directions of rotation for a defined period. If a fault occurs, e.g., the friction of the screwdriving spindle is too high, a corresponding message is displayed and the control unit outputs an error. If an error occurs, the red LED illuminates.

If a PC is connected to the operating software, the result of the `friction offset test` can be read after the `friction offset test` is complete.

Even if the controller is not switched off and on daily, ensure that a `friction offset test` is performed at least once a day in order to guarantee that the screwdriving mechanics are checked regularly. To do so, select the `Start friction offset test` button in the `Manual start` menu or start program 0 via the customer interface (digital or bus).

4.4. Status LEDs

The three status LEDs on the device indicate the device's current operating state.

LED	Status	Meaning	Remark
green	On	The last screwdriving was OK.	When starting a screwdriving or a friction offset test, the green or yellow LED extinguishes.
yellow	Flashing	Screwdriving is currently being performed.	
	On	The last screwdriving was NOK.	
red	Off	No fault, the device is ready.	
	Flashing	The controller performs initialisation.	
	On	A fault or an error occurred. For diagnostics, the PC can be connected to the operating software in order to find out the case of the error. For further information, see the List of errors and faults [▷ 45] chapter.	

4.5. Operating software

The operating software enables parameters to be set and diagnostics to be performed on the C5 controller.

4.5.1. Downloading the software from WEBER

The software is available on the WEBER Schraubautomaten GmbH website:

- Download link: https://www.weber-online.com/downloads/
- Select the device C5 V2
- Download software package `C5 V2.0 Software`

This is a packed file with subdirectories that contain the installation files. Unpack the files to a separate directory on your PC.

4.5.1.1. System requirements

To run the software, the PC on which the software is to be installed has to meet the following requirements:

- Windows 7 SP 1 or higher
- .NET Framework 4.5.1 or higher
- USB 2.0 port or higher

4.5.1.2. USB driver

The `USB Driver` directory contains the USB driver for the C5. For further information regarding installing the driver, see the USB driver installation [▶ 17] chapter.

4.5.1.3. C5S operating software

The operating software for the C5S is in the C5S directory. Use the installation file with the version that matches the device. The precise version of the C5 is specified on the name plate. Please use the software version that is identical to the C5.

For further information regarding installation, see the Installing the C5S operating software [▶ 20] chapter.

4.5.1.4. WSK3 curve display software

The WSK3 directory contains the software that can be used to open and display the curve files saved by the C5. For further information regarding the WSK3 software, see the manual for the WSK3 software.

4.5.2. Connecting to the device

4.5.2.1. USB driver installation

In order to establish the USB connection to the C5 controller, the required driver must be installed once on the PC. The driver is created by FTDI and is integrated as a virtual COM port.

- Start `C5 V2 Driver.exe`

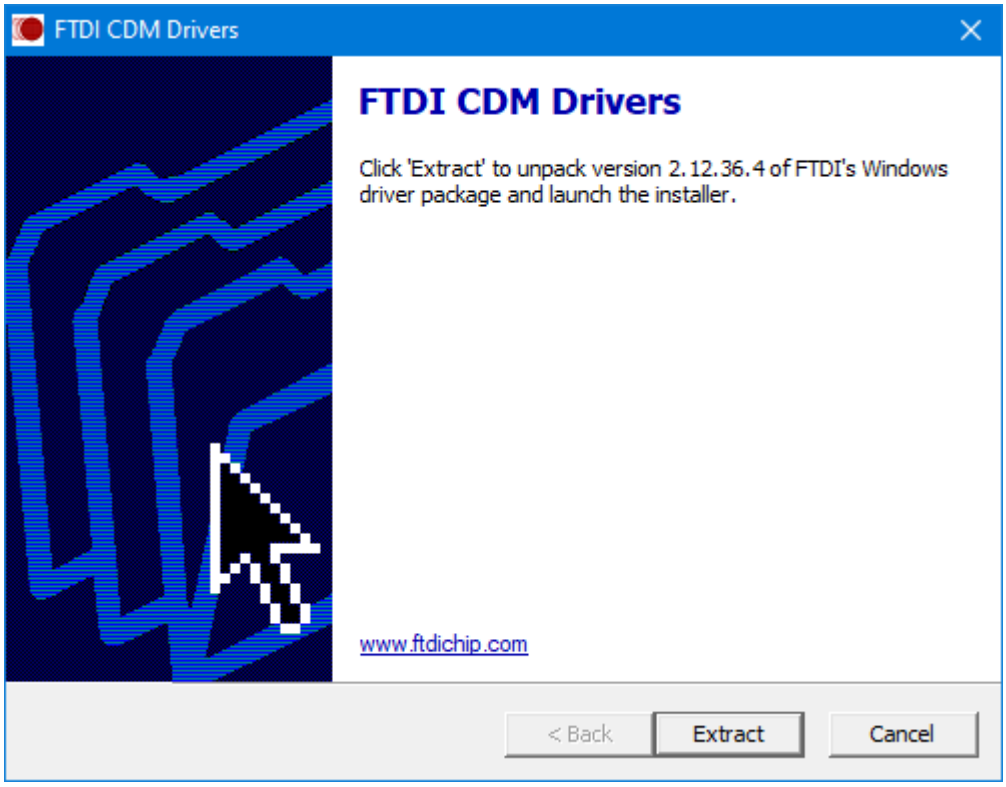


Illustration 3: Extract the file

- Use the `Extract` button to extract the files

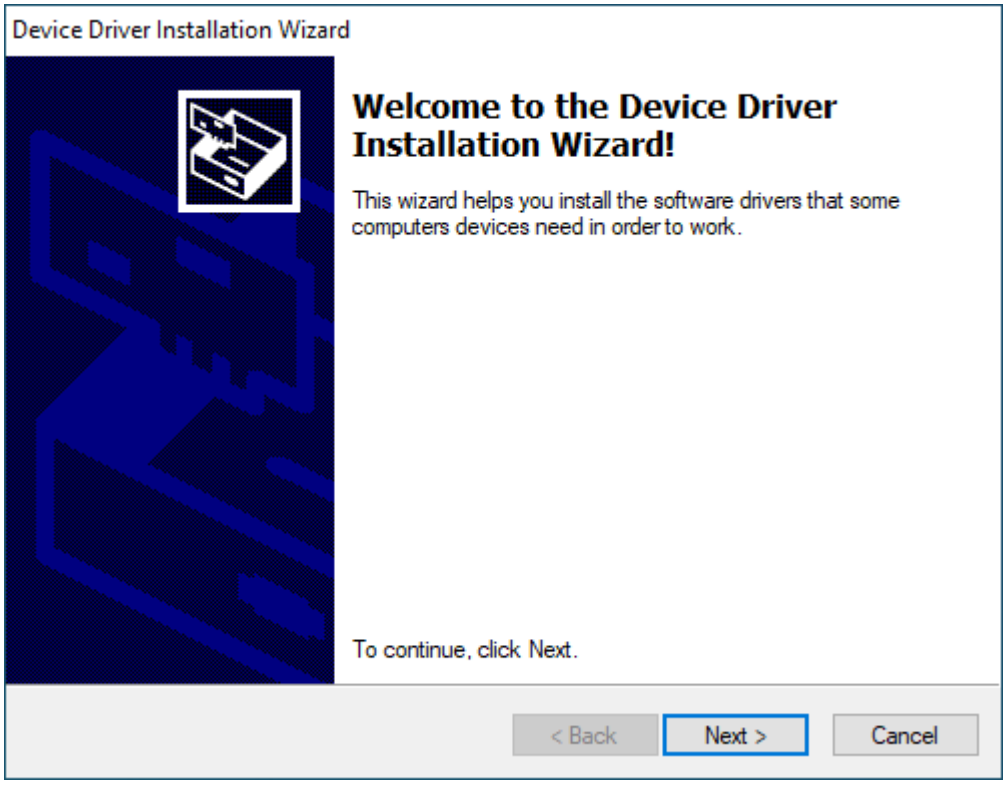


Illustration 4: Install the software driver

- Use the `Next` button to continue installation.

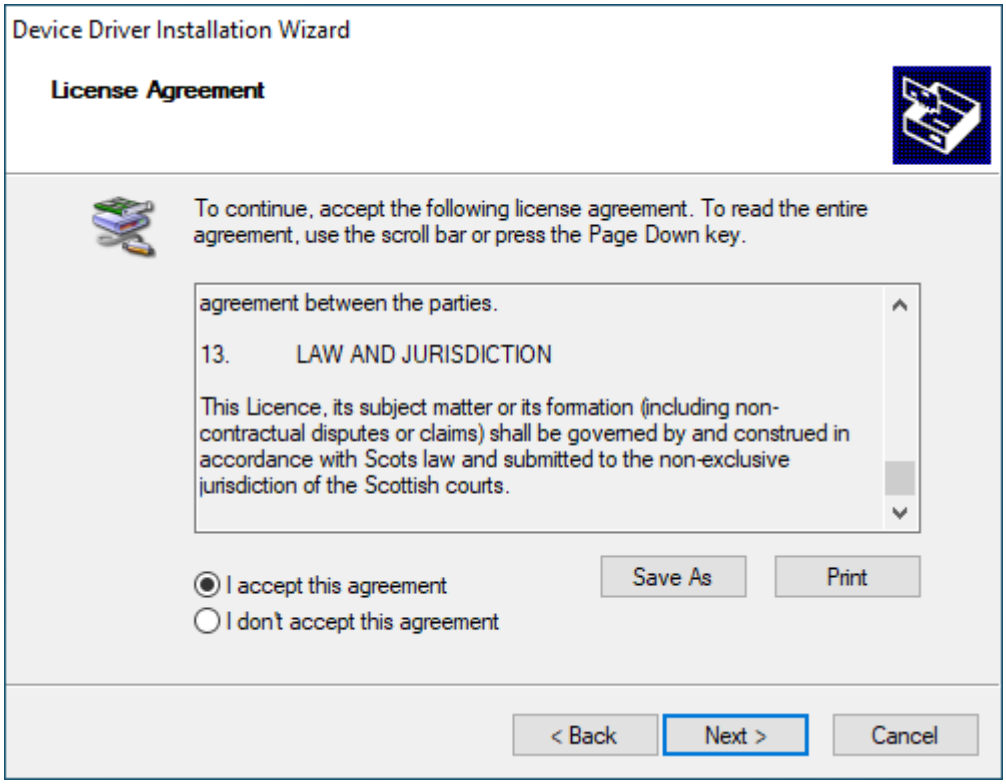


Illustration 5: License agreement

- Accept the license agreement and use the `Next` button to complete installation.

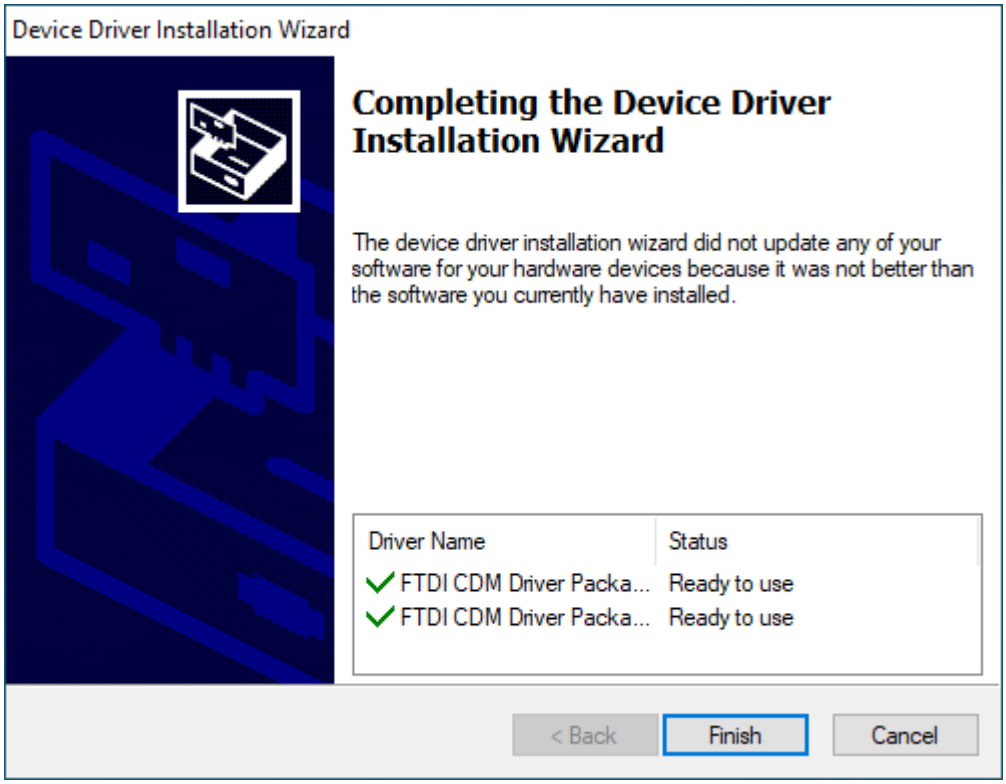


Illustration 6: Finish

- `Finish` driver installation.
- After the driver has been installed, the C5 can be connected to the PC.

4.5.2.2. Mini USB cable

The C5 is connected to the PC via a USB cable. The USB cable provided or a standard mini USB cable can be used for this.

4.5.2.3. Displaying the connection

In the device Manager, the device is displayed in the `Connections (COM & LPT)` as a `USB Serial Port`.

4.5.3. Installing the C5S operating software

- Execute the Windows Installer `C5S_Setup.msi`

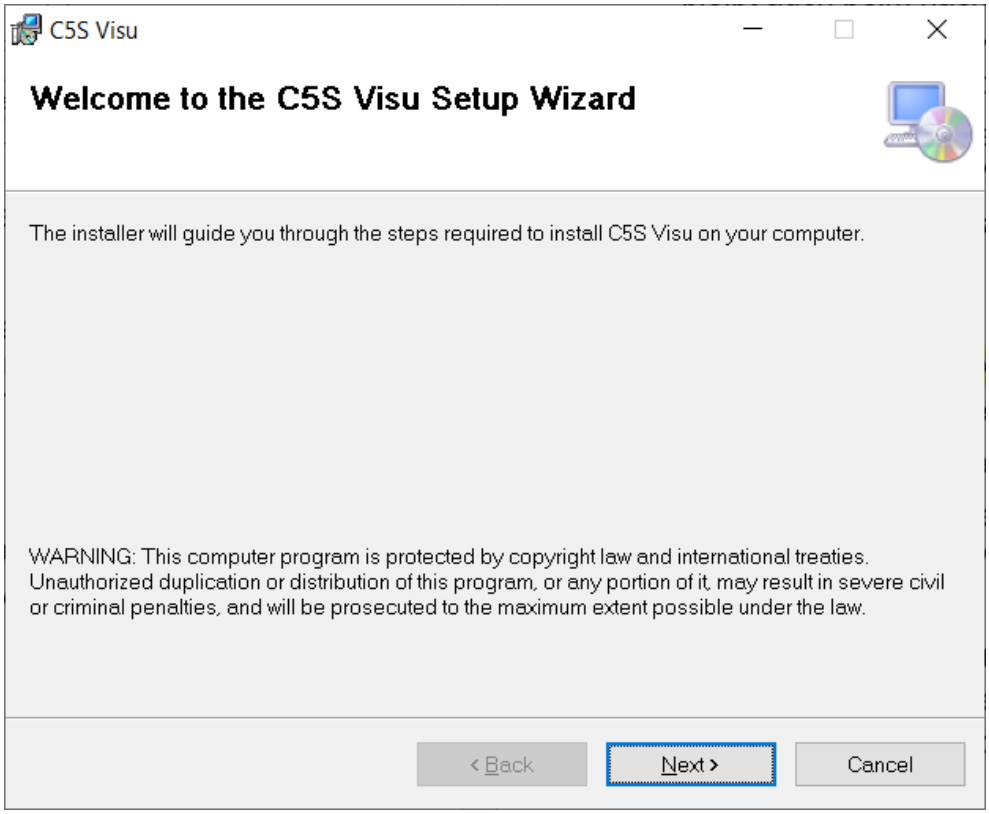


Illustration 7: Execute C5S_Setup

- Use the `Next` button to continue installation.

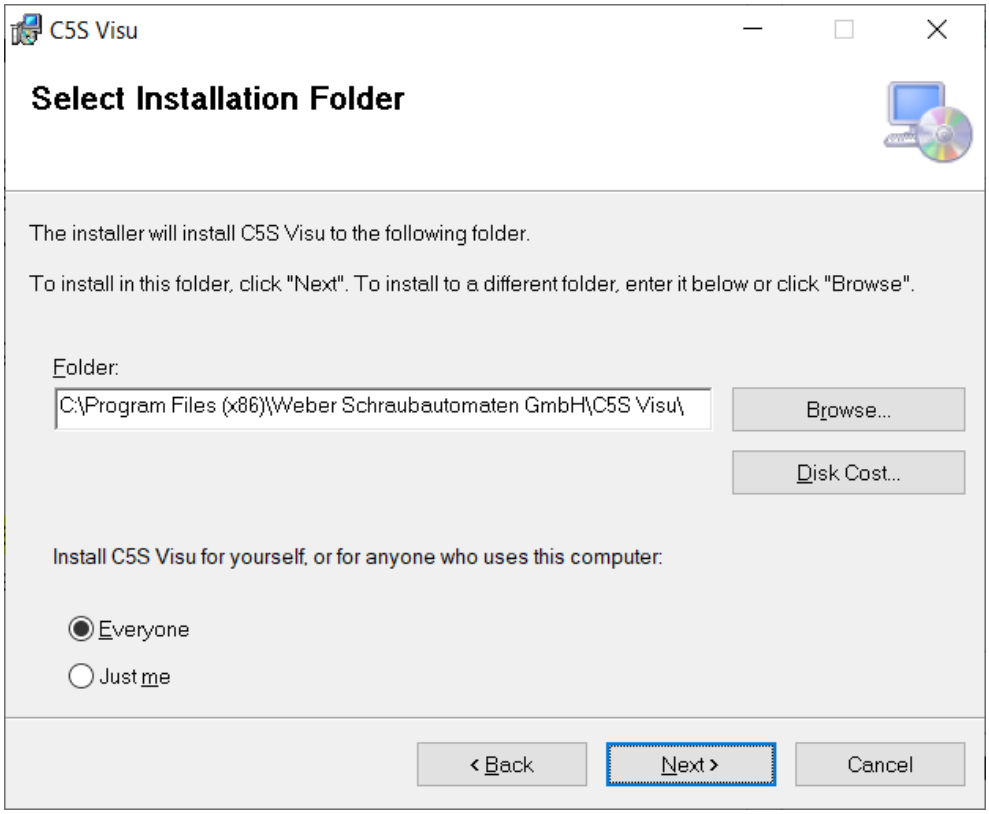


Illustration 8: Customise the installation directory and the group of people

- If necessary, customise the installation directory and the group of people.
- Use the `Next` button to continue installation.

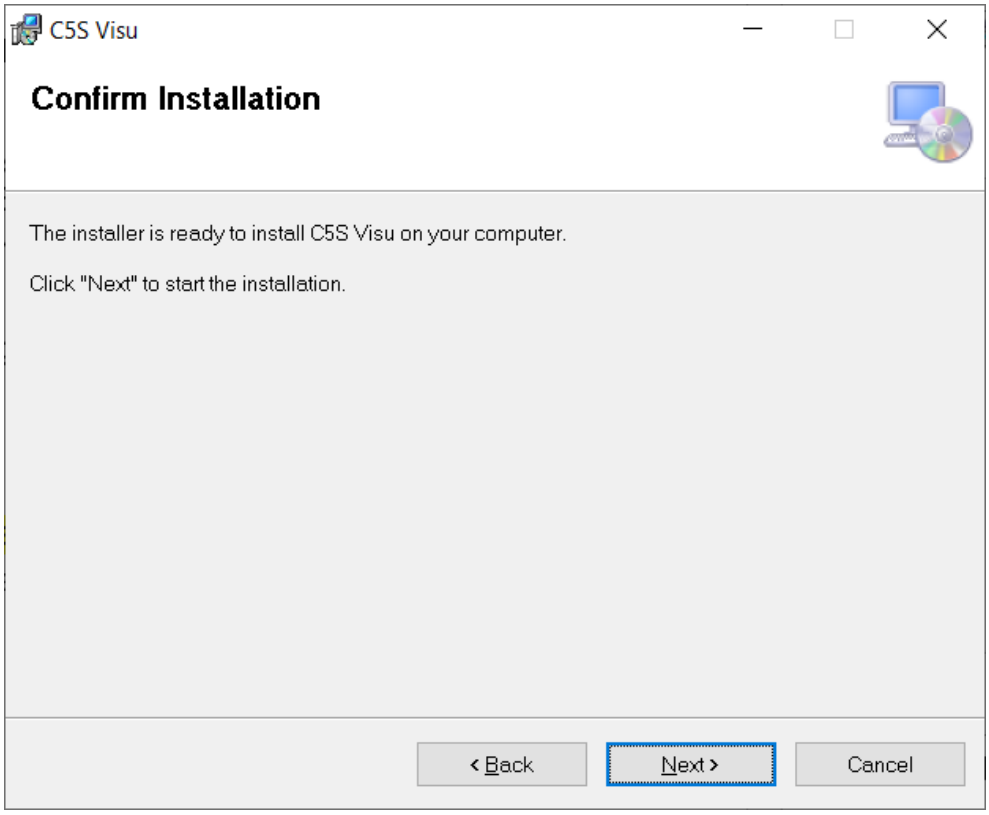


Illustration 9: Start installation

- Use the `Next` button to continue installation.

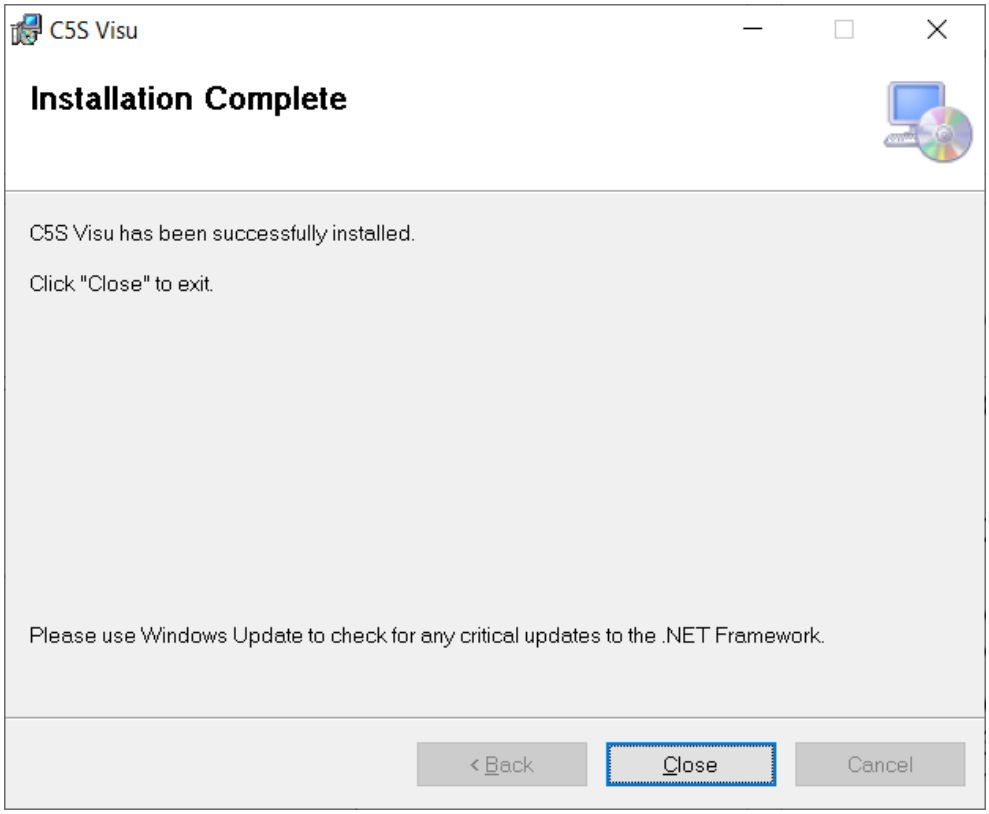


Illustration 10: Close C5S_Setup

- Use the `Close` button to complete installation.

4.6. Menu and function description of the operating software

Double-click the shortcut to C5S.exe to start the software.

4.6.1. Connection screen

The connection screen enables the connection to the C5 to be established.

4.6.1.1. Help

Help can be used to call the operator's manual.

4.6.1.2. Log IN and password protection

The operating software has access protection that only allows trained staff to make changes to the C5 controller. The password is `406` and cannot be changed.

Click the `Log In` button to open password entry. After the password has been entered, the operating software connects to the C5 controller.

Use the corresponding button to `Log Out` of the software.

4.6.1.3. Connection

In order to select the correct COM port, the `Search` button can be used to call the search function that displays the connected C5 devices.

Click the listed controller to select the required device. The COM number that is recognised is transferred and is retained when the software is started the next time.

If the COM number is known, the required device can be selected directly from the drop-down list.

In order to connect to the selected device, the user must log in to the operating software. The user then accesses the menu screen for the C5.

If the device is unplugged or switched off, the software loses the connection. This may cause error messages regarding the connection. The connection must be re-established in this case.

4.6.2. Main menu screen

Current status information for the C5S is displayed on the main menu screen.

- Results data for the last screwdriving
  - Results of a `friction offset test`.

    The display is updated automatically with each new result. The program number and the type of the executed program are shown at the top.
  - If the results are `NOK`, the next row is used to output the NOK reason.
- The respective individual results are displayed underneath.

Results of friction offset test:

Name	Unit	Meaning
`Left friction torque`	-	Maximum current-based torque that occurred during anti-clockwise rotation
`Right friction torque`	-	Maximum current-based torque that occurred during clockwise rotation
`Left friction angle`	°	Angle achieved during anti-clockwise rotation
`Right friction angle`	°	Angle achieved during clockwise rotation
`Screwdriving duration`	s	Execution time of the `friction offset test`

A failed `friction offset test` results in a fault being issued automatically.

Results of normal program start:

Name	Unit	Meaning
`Current-based torque`	-	`OK` case: Maximum current-based torque that occurred in the last executed step, i.e., in Step 1 in the case of one-step programs and in Step 2 in the case of two-step programs
		`NOK` case: Current value of current-based torque when `NOK` reason occurred
`Angle`	°	Angle value reached starting from the set threshold torque (in two-step diagrams, the value always comes from the second step)
`Depth`	Analogue depth sensor: mm	Analogue depth value reached at shut-off
	Digital depth sensor -	Status of the digital depth sensor at shut-off point
`Pre-torque`	-	In one-step programs: Current-based torque reached at the shut-off point, for both `OK` and `NOK` screwdrivings (current-based torque overshoots during coasting are not taken into consideration here)
		In two-step programs: Current-based torque reached in the first step at the shift point (in the case of `NOK` in the first step, this value is the same as the current-based torque shown in the first row)
`Screwdriving duration`	s	Execution time of the screwdriving program

Faults and errors that occurred are shown on the bottom part. The fault is also acknowledged here.

The buttons on the right can be used to open the relevant submenus.

The `Close connection to C5` button ends the connection to the C5S controller and opens the main menu. The connection must always be ended before unplugging or switching off the device.

Status information is listed at the bottom of the display.

Status bar:

Name	Meaning
`Operating status`	`Manual`: There is no external lock with the automatic signal.
	`Auto`: The controller is locked via the customer interface, the device test cannot be executed.
`EMERGENCY STOP`	`EMERGENCY STOP`: The safety circuit is broken.
`Error status`	`Error`: An error is present. If an error is present, it must be acknowledged after its cause has been eliminated.

The user can select the language using the language switch in the right status bar.

4.6.3. Programs

The programming screen lists all screwdriving programs including the relevant diagram type, which are stored on the controller.

The programs are marked by selecting a row.

4.6.3.1. Edit program

Program settings can be adjusted using the `Edit program` button or by double-clicking the required program.

- For new programs (the diagram type is not yet defined), a list of possible diagrams is displayed. Select the corresponding program type here.
- For existing programs, all parameters that can be edited are displayed here.

The description of the various program types (diagrams) is provided in the Screwdriving diagrams [▶ 36] chapter.

The diagram type for a program cannot be changed retroactively. If a different diagram type is required, a new program must be created.

Use the `Save and back` button to save the settings and store them in the C5S controller.

Use the `Discard` button to not save any changes made to the program.

Performing program changes

We recommend not making any program changes while a program is being executed.

► Stop automatic mode if program changes are to be made.

4.6.3.2. Copy program

The current program selected is copied to the clipboard. It is therefore possible to copy the program to a different location.

4.6.3.3. Insert program

Use the `Insert program` to insert the program stored on the clipboard in a different place in the program list.

Overwrite program

If there is a different program in the target location, this program is overwritten with the program stored on the clipboard.

4.6.3.4. Delete program

Use the `Delete program` button to delete a program. All parameters in the selected program are reset.

Start deleted program

If the higher-level controller starts a program with reset parameters, a fault occurs.

4.6.3.5. Back

The `Back` button opens the higher menu level.

4.6.4. System settings

The `System settings` menu lists all parameters for the C5 controller. The parameters are described in the System settings [▶ 27] chapter.

- The `Spindle` group enables the feed spindle parameters to be adjusted.
- The `System` group lists the WEBER machine number and the device name.
  - The device name can be adjusted.
  - The device name is also displayed in the C5 list when connecting. This makes assignment easier.

4.6.5. File functions

The file functions enable data from the C5 controller to be stored on the PC and vice versa.

The directory in which the data is stored is displayed at the top and can be changed.

4.6.5.1. Save curve

Use the `Save curve` button to save the process curve from the last screwdriving as a WSK3 curve. The WEBER WSK3 software is required to view the curve. The curve displays the rotation speed, current-based torque, depth and angle.

The curve display can be used for diagnostics on the screwdriving process.

Maximum recording time

The maximum recording time is 4.5s per screwdriving procedure. If the procedure takes longer, recording ends after 4.5s.

4.6.5.2. Save settings

Use the `Save settings` button to save all C5 settings to a file. This can be used to create a backup of the data.

4.6.5.3. Load settings

Use the `Load settings` button to read all settings into the C5 from a file. This enables a file that was saved as specified in the Save settings [▶ 25] chapter to be loaded back into the device.

Save and load

Only the data that was saved from this device can be loaded back into the device. A transfer from one device to another is not available.

4.6.5.4. Import programs

Use the `Import programs` button to read all program data into the C5 controller from a file. This enables program data to be transferred from one device to another. Saving the data is described in the Save settings [▶ 25] chapter.

4.6.5.5. Export settings

Use the `Export settings` button to save all C5 controller settings to an `.rtf` file. This Rich Text file can be opened on a PC using a word processor and printed out if necessary.

This file is used to document the C5 settings. WEBER recommends documenting the settings after making changes so that the values can always be restored.

4.6.5.6. Back

The `Back` button opens the higher menu level.

4.6.6. Device test

Diagnostic functions can be executed using the C5 controller in the device test.

Signal colour	Meaning
Red	Low (0V)
Green	High (24V)

Execute device test

The device test can only be executed when the automatic signal is low.

4.6.6.1. Spindle

The following data is displayed for the screwdriving spindle:

Data	Description			
Angle	Displays the angle of the screwdriving motor.			
Rotation speed	Displays the rotation speed of the screwdriving motor.			
Torque	Displays the current torque on the screwdriving motor.			
Analogue depth	The analogue depth displays the value of the analogue depth sensor (optional).			
TM1	Displays the status of digital depth sensor 1 (optional)			
TM2	Displays the status of digital depth sensor 2 (optional)			
Servo State	The servo state displays the internal status of servo regulation. This value can help during error diagnostics.			
	0, 1:	Initialised	5:	Stop
	2, 3:	Ready	6, 7:	Errors
	4:	Working		
Maximum motor current	The maximum motor current for the rotation in test mode is specified here. If the value is too low, the screwdriving drive may not have enough power to reach the set rotation speed.			
Target rotation speed	Enter the screwdriving drive's rotation speed that is to be used for rotation in test mode. Negative values indicate a reversed direction of rotation.			

The screwdriving drive can be actuated and stopped using the `Motor start` and `Motor stop` buttons.

The screwdriving spindle or the screwdriving spindle's motor can also be rotated manually if necessary.

4.6.6.2. Customer interface

The digital customer interface can be checked.

The inputs for the C5 controller, which are output by the higher-level controller are displayed here.

The outputs from the C5 controller, which go to the higher-level controller can be triggered here for test purposes.

Signal display in device test

The signals from the higher-level controller are only displayed in the device test. A reaction to the signals does not take place.

4.6.6.3. Friction offset test

Use the `Friction offset test` button to execute a friction offset test on the spindle. A description of this is provided in the Friction offset test [▷ 16] chapter.

4.7. System settings

The following parameters apply to all screwdriving programs in the C5S screwdriving controller.

Parameter	Value range
Gear factor	1 - 100
Maximum spindle rotation speed	1 - 6000 rpm
Maximum current-based torque	0.1 - 1000
Analogue depth scaling	0 - 100 mm/V
Release angle	00 - 45°
Point for depth reached	0 – 1000mm
Motor inverse	0 - 1
Fixed program when starting	0 - 15
Motor size	100W, 400W, 750W

NOTICE

Damage to property after changed spindle data

Only expert personnel are permitted to change the spindle data. Changes to the spindle data may cause errors during operation or damage to the system.

The following chapters describe the parameters individually.

4.7.1. Gear factor

This value defines the transmission factor of the gear that is installed after the motor. The following formula shows the relationship between the motor rotation speed, gear factor and the resulting spindle rotation speed:

$$N_{Spindle} = \frac{N_{Motor}}{\text{Gear factor}}$$

This value must be set according to the gear used (see gear inscription).

Gear factor without gear

The gear factor for a power drive assembly without a gear is 1.0.

4.7.2. Maximum spindle rotation speed

This value defines the maximum spindle rotation speed in the screwdriving programs. It limits the rotation speed in the screwdriving programs to the value set here. This prevents invalid high rotation speeds in the screwdriving programs.

NOTICE

Damage to property if the spindle rotation speed is too high

The value for the maximum spindle rotation speed in the C5S screwdriving controller must not exceed the maximum rotation speed for the screwdriving spindle itself.

The following table shows the maximum rotation speeds for the WEBER screwdriving spindles.

Screwdriving spindle	Maximum rotation speed
SA03	2500 rpm
SA10	2500 rpm
SA30	1500 rpm

4.7.3. Maximum current-based torque

This value defines the maximum current-based torque in the screwdriving programs. It limits the current-based torque in the screwdriving programs to the value set here. This prevents invalid high current-based torques in the screwdriving programs.

NOTICE

Damage to property due to overloading the spindle mechanism

The value for the maximum current-based torque for the C5S screwdriving controller must not exceed the maximum torque for the screwdriving spindle itself (the spindle mechanism component with the lowest maximum torque is decisive here).

4.7.4. Analogue depth scaling

This value defines whether an analogue or a digital depth sensor is used on the screwdriving spindle.

- In the event of an analogue depth sensor, the scaling must be entered in mm/V.
  - For example, if a sensor with a measuring range of 64mm supplies a signal between 0 and 10V, the scaling is 6.4mm/V.
- If digital depth sensors are installed on the screwdriving spindle, the value must be set to 0.

4.7.5. Release angle

This value defines the angle for release processes in which the bit is rotated in the opposite direction after a final tightening.

Maximum release angle

The selected value should be just large enough that the torsions of spindle and bit can be reduced without generating any counter torque on the screw.

4.7.6. Point for depth reached

This value specifies the states in which the `Depth reached` signal is output on the customer interface.

Value	Description
= 0	The `Depth reached` signal is output at the end of the first step.
> 0	The `Depth reached` signal is set when the analogue depth exceeds the set value

The signal can be used to shut off the spindle vacuum or to generate the `Screw ejected safely` status.

4.7.7. Motor inverse

This parameter can be used to invert the motor direction. A 1 switches inversion on.

In certain gear arrangements, a clockwise motor direction of rotation can cause the spindle to rotate anti-clockwise. In this case, the parameter must be set to 1.

If the screwdriving device works with left-hand thread fasteners, the direction of rotation can also be inverted.

Torque tightening

Torque tightening can only ever be performed at positive rotation speeds.

One direction of rotation per controller

It is not possible to tighten right-hand threads and left-hand threads using one controller.

4.7.8. Fixed program when starting

The program can be selected via the customer interface or be prepopulated directly with a fixed program.

Program-selection	Meaning
≠ 0	• Selection via the customer interface is suppressed. • The system works with the preset program number. • This is beneficial if no program changeover is required.
= 0	• The program is selected via the customer interface. • The higher-level controller can call various programs. • This is beneficial if the system is to react to various screwdriving processes, component types or component heights.

4.7.9. Motor size

The motor size must be selected to suit the motor installed on the screwdriving spindle. There are currently 3 possible motor types: 100W, 400W and 750W.

Changing the motor size

If the motor size is changed, the device must be switched off and back on. The new motor size is only recognised when switching the device on.

The `Motor size` parameter can only be changed by WEBER personnel.

5. Notes on screwdriving and parameters

5.1. Measurement of current-based torque

The motor current of the drive that occurs during the screwing operation is determined by the controller and evaluated. This current is proportional to the torque and is referred to as "current-based torque". The current-based torque must not be regarded as transducer-measured torque and is therefore indicated without units.

5.1.1. Current-based torque correction factor

The conversion factor from motor current to current-based torque is stored in the C5S screwdriving controller. If a control measurement using a torque sensor shows that the current-based torque does not match the torque precisely enough, the `Current-based torque correction factor` can be adjusted in the screwdriving programs.

The following formula can be used to determine the correction factor f_{new} if the real torque M_S is known from a control measurement with a calibrated torque sensor:

$$f_{new} = \frac{M_S \cdot f_{old}}{M_T}$$

Abbreviation	Description
f_{new}	New current-based torque correction factor that must be entered in the program
M_S	Torque measured using a calibrated torque sensor
M_T	Target current-based torque in the screwdriving program
f_{old}	Previous current-based torque correction factor in the program

Damage to property due to overloading the spindle mechanism

The maximum torque for the C5S screwdriving controller must not exceed the maximum torque for the screwdriving spindle itself (the spindle mechanism component with the lowest maximum torque is decisive here).

► The user must check whether the current-based torque for the C5S screwdriving controller matches the real torque for each screwdriving application.

► A regular control measurement is recommended. In order to achieve higher precision, the real torque should be determined over several cycles.

5.1.2. Current-based torque result values

There are two current-based torque result values when normal programs (not `friction offset tests`) are executed.

- `Current-based torque`
- `Pre-torque`

These values are shown in the results display and have different meanings, depending on the diagram type used and the result type (`OK` or `NOK`):

`Current-based torque`:

If `OK`, the maximum current-based torque that occurred in the last executed step, i.e., in Step 1 in the case of one-step programs and in Step 2 in the case of two-step programs is specified here. If `NOK`, the current-based torque at the time that the `NOK` occurred is shown here.

`Pre-torque`:

In one-step programs, the `pre-torque` is the current-based torque reached at the shut-off point, for both `OK` and `NOK` screwdrivings.

In two-step programs, however, it is the current-based torque reached in the first step at the shift point. In the event of an `NOK` result in the first step, this value is the same as that specified above `Current-based torque`.

5.1.3. Current suppression time

During acceleration or deceleration of the EC motor, correspondingly high currents occur. However, these currents must not be interpreted as current-based torque, because they do not produce torque on the screw.

In order to ensure that the acceleration or deceleration processes are complete, the controller awaits the reduction of the current to zero within a specified current suppression time.

The current suppression time ensures that this motor current is not used as torque on the bit during acceleration and deceleration of the drive. During this time, the current-based torque is output at zero in the curves.

Because the use of the current suppression time is not appropriate for all screw processes, it is not used in some cases. The following table shows the corresponding overview:

Diagram type	Start of step 1	Start of step 2
1	Yes	Yes
2	Yes	No
3	Yes	Yes
4	Yes	Yes
5	Yes	-
6	Yes	-
7	Yes	Yes

NOK current suppression time exceeded:

The NOK `Current suppression time exceeded` occurs in cases in which an acceleration process has not been completed within a certain time period. This happens, for example, when the drive must accelerate against a load torque.

We recommend not loading the drive with larger load torques from the application during the period that the current suppression time is active.

Possible causes for the message:

- The ramp time setting for acceleration of the motor is so long that a torque already occurs on the screw while the motor is accelerating (e.g., due to a starting forming operation or screw head contact).
- Due to a speed shift (e.g., via depth sensor) that is too late, a torque occurs on the screw during the acceleration or deceleration phase of the motor (e.g., due to a starting forming operation or screw head contact).
- The screw is already tightened.

Remedy:

- Shorten ramp times
- Change the depth sensor setting in such a way that the speed shift occurs in time before the screw head contact.
- Ensure that only a minimum torque is present during accelerations and decelerations.

5.2. Analog or digital depth

There are two options for recording the screwdriving depths on a spindle: using one analog depth sensor or two digital depth sensors.

Analog depth sensor:

When an analog depth sensor is used, the `Analog depth scale` value must be entered in the `Spindle constants` according to the sensor data sheet. As a result, the respective depth value entries for the speed shift and depth monitoring are activated in the individual screwdriving strategies. The sensor is connected to the unit via the connection `X4.1 AnD`. The main advantage of the analog depth sensor is that it allows different depth values to be set in each program, enabling different screwdriving depths to be easily realised.

For repositioning of the depth sensor, for example after a tool change, an online display of the depth value is available in the `Test mode/ Sensor test` menu. If a suitable reference depth within the sensor measuring range is approached with the bit, the sensor can be mechanically fixed at the desired position. The instruction manual for the analog depth sensor must be observed, and the permitted torque of the locking screw must not be exceeded. In most cases, the measuring range of the sensor is significantly less than the possible spindle stroke, since the operating range is only within a small defined range of the spindle stroke. There are various sensor lengths available to fit the length of the required operating range. The sensor must be adjusted according to the desired operating range.

Digital depth sensors:

When digital depth sensors are used, the `Analog depth scale` value must be set to 0 in the `Spindle constants`. Two digital depth sensors are provided for this case. In strategies in which a depth shift is intended, the `Digital depth DS1` depth sensor is used automatically. A shift then occurs as soon as `Digital depth DS1` is On (1). In strategies in which depth monitoring is possible, it is possible to assign parameters to specify whether the `Digital depth DS2` depth sensors must be On (1) or Off (2) at the end of the step or not used.

The sole exception is strategy 4. In this strategy, depth monitoring is possible in both steps. `Digital depth DS1` is used for the depth monitoring in step 1.

5.3. Target parameters

All target and default parameters are referred to as target parameters. Different target parameters are used depending on the diagram type. In the individual descriptions for the diagram types, the parameters used in each case are specified along with their respective value range.

The following table lists all possible target parameters with their respective description:

Parameter	Step	Description
Rotation speed	1, 2	Desired step speed. Observe the information in the Tightening speed for final tightening [▶ 34] chapter.
Slope for speed changes	1, 2	Defines the acceleration or deceleration rate of the drive (also see the Slope for speed change chapter).
Switch point at current-based torque	1	A shift to the second step occurs as soon as this current-based torque value is reached.
Shift point at analogue depth	1	A shift to the second step occurs as soon as this depth value is reached.
Shift point at angle	1	A shift to the second step occurs as soon as this angle value is reached. The angle value starts at 0 as soon as the set threshold torque is reached.
Target current-based torque parameter	1, 2	Target current-based torque of screwdriving
Target angle parameter	1, 2	Target angle of screwdriving. The angle value starts at 0 as soon as the set threshold torque is reached.
Threshold torque to start angle measurement	1, 2	Angle measurement starts as soon as this current-based torque is reached. This parameter is used for the target or monitoring angle.

Parameter	Step	Description
Additional angle	1	Defines the additional angle of rotation after reaching the respective target parameter. Can be used for fine adjustment for depth screwdrivings.

5.4. Monitoring parameters

Different monitoring parameters are used depending on the diagram type. In the individual descriptions for the diagram types, the parameters used in each case are specified along with their respective value range.

All “Minimum” parameters are always checked at the end of the step. The respective value must have been reached or exceeded. Otherwise the NOK result is generated.

By contrast, all “Maximum” parameters are monitored continuously. If the respective value is exceeded, the screwdriving process is cancelled immediately, the motor is stopped, and the NOK result is generated.

The monitoring parameters should be set appropriately based on screwdriving experiments in order to obtain a usable difference between good-quality and poor-quality screwdrivings. The automatic evaluation of the process quality can only function with appropriate limits.

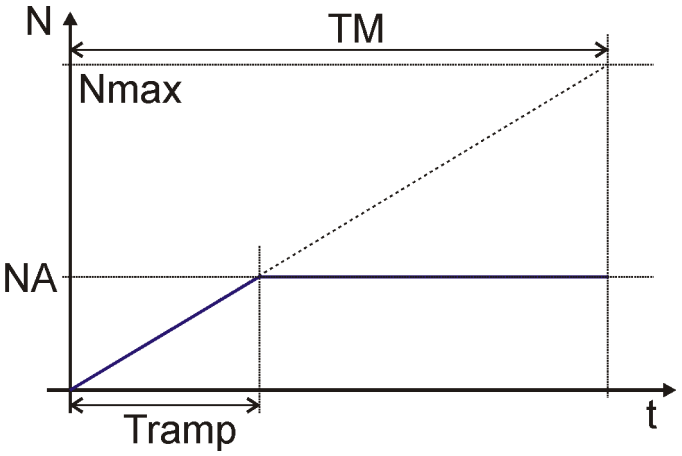
The following table lists all possible monitoring parameters with their respective description:

Parameter	Step	Description
`Threshold torque to start angle measurement`	1, 2	Angle measurement starts as soon as this torque is reached. This parameter is used for the target or monitoring angle.
`Minimum angle`	1, 2	The value set here, at a minimum, must have been reached when the step target is reached. Angle measurement starts when the threshold torque is reached.
`Maximum angle`	1, 2	This value specifies the maximum allowed angle. Measuring takes place starting from the threshold torque. If the value is exceeded, the process is aborted immediately with NOK.
`Minimum current-based torque`	1, 2	This current-based torque, at a minimum, must exist at the end of the step. This can be used, for example, to detect a pilot hole that is too big in the case of self-forming screws.
`Maximum current-based torque`	1, 2	Maximum permitted current-based torque. If the value is exceeded, the process is aborted immediately with NOK. This can be used, for example, to detect a pilot hole that is too small in the case of self-forming screws.
`Minimum step time`	1	If a step is completed too fast, this can be an indication of a missing screw, a pilot hole that is too large, or similar.
`Maximum step time`	1, 2	If the step target is not reached within the defined time, screwdriving is terminated with NOK. This always occurs when the target parameter is not reached and no other maximum criterion is exceeded.
`Minimum analogue depth`	1, 2	This input is suitable for detecting screws that are not fully inserted (blind hole, thread too short, thread fault, etc.). This depth, at a minimum, must be reached when the step target is reached.
`Maximum analogue depth`	1, 2	This can be used to monitor whether the screw has been screwed in too far (or no component was present, etc.). Overwriting the value results in an immediate abort with NOK.
`Depth check with TM1`	1	Here, the digital depth sensor TM1 is used for the optional depth check. With this setting, the status (0 or 1 can be chosen) of the signal when the step target value is reached can be monitored. Alternatively, this monitoring can also be deactivated.

Parameter	Step	Description
`Depth check with TM2`	2	For a description of the function, see `Depth check with TM1`.

5.5. Slope for speed change

The slope is always set in reference to the maximum rotation speed of the drive. This means that the slope at which the rotation speed changes is always the same even if the rotation speed setting is changed.



As a result, the effective ramp time (Tramp) for an entry value (TM) is defined by the set rotation speed (NA).

To calculate the ramp time (Tramp), the following formula applies:

$$T_{ramp} = \frac{TM \cdot NA}{N_{max}}$$

The maximum drive rotation speed N_{max} is 6000 / gear factor. The gear factor is defined in the `Spindle data`.

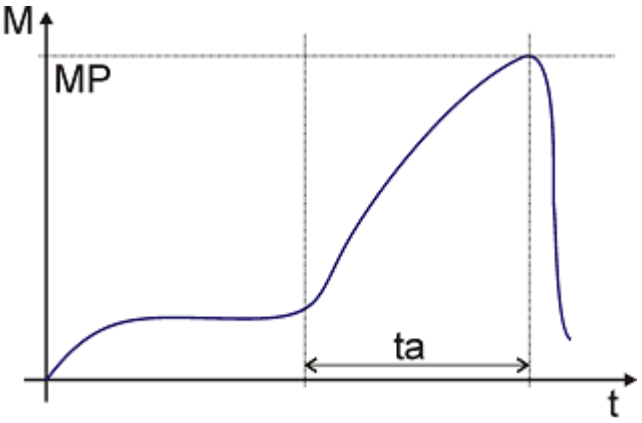
The `Slope for speed changes` should always be set in such a way to ensure that the acceleration of the spindle does not generate any undesired torque resulting in shut-off.

- If the ramp time is too short, torque peaks will result during acceleration and deceleration.
- Ramp times that are too long extend the process time unnecessarily or cause the rotation speed reduction to be too late before the screw head contact.

5.6. Tightening speed for final tightening

The tightening speed used to tighten a screw to its final torque value should be set in such a way that the final tightening is achieved within a tightening time (ta) of 0.1 to 0.2 s. This ensures that the desired shut-off accuracy is achieved and that, in spite of that, screwdriving does not take an unnecessarily long time.

The following diagram illustrates the relationship with a torque vs. time curve:



The final tightening begins when the screw head makes contact and ends when the final torque value is reached. In the screwdriving curve, the beginning is recognised by the torque rise. The time in between is called the tightening time (ta).

- If the rotation speed setting is too high, the tightening time is too short, which reduces the shut-off accuracy.
- If the rotation speed setting is too low, the tightening time is unnecessary long without a corresponding noticeable improvement in the shut-off accuracy.

5.7. Note on threshold torque to start angle

If the `Threshold torque to start angle` parameter is set to 0 in the strategies, a threshold evaluation is not performed and the angle measurement starts immediately at the start of the step.

If a value other than 0 is set, the angle measurement is started in the step as soon as the entered torque is exceeded.
If the threshold value is not reached in a process before the target value is reached, the screwing operation is evaluated as NOK and the reason: `Threshold torque not reached` is output. Therefore, for the torque target value, in particular, the threshold torque must be sufficiently less than the target value. In addition, an abrupt torque increase to the target value will prevent the threshold torque from being reached beforehand. Here, the speed of the drive may have to be reduced in order to slow down the torque increase.

5.8. Dwell time

There is no dwell time for this device class because the drive switches to braking when the target value is reached and thus no further measurement of the current-based torque is possible.

5.9. Release

The release is performed automatically for all current-based torque screwdrivings in order to release the residual torque. Therefore, the motor current is used to ensure that the screwdriving can never be loosened. The `Release angle` is set in the `Spindle data`. There is no release in processes 3, 4, 6.

6. Screwdriving diagrams

A maximum of 15 screwdriving programs can be saved in the C5S screwdriving controller. One of the 7 stored screwdriving diagrams can be selected and individual parameters assigned for each program.

The following screwdriving diagrams are available:

Type	Designation
1	Drive to depth 1 + additional angle then tighten to current-based torque with angle monitor then release
2	Drive to current-based torque then tighten to current-based torque with angle monitor then release
3	Drive to depth 1 then turn to angle with current-based torque monitor
4	Drive to current-based torque then turn to angle with current-based torque monitor
5	Tighten to current-based torque with angle monitor then release
6	Turn to angle with current-based torque monitor
7	Drive to angle and tighten to current-based torque

The programs can be started via the customer interface in automatic mode.

The various screwdriving cycles are explained below with a description of possible applications and the associated parameter list. For information on adjusting the parameters, see page.

Screwdriver in left-handed rotation

If the screwdriver is to turn in left-handed rotation, both the rotation speed and angle values must be assigned as negative values (not possible for all diagrams).

Ramp time specification

The specified ramp time always relates to the ramp from 0 to 100% of the maximum rotation speed.

6.1. Type 1: Drive to depth 1 + additional angle then tighten to current-based torque with angle monitor then release

This diagram type is used for fast screwdriving followed by tightening to current-based torque. Due to the speed shift, the screwdriving is broken down into two parts. When screwing in, the higher rotation speed shortens the screw-in time. When tightening, a higher shut-off accuracy during final tightening can be achieved.

It is important that the depth sensor setting is approximately 1-2 revolutions before screw head contact so that the drive has time to reach the lower rotation speed and component tolerances can be compensated for. Final tightening at an increased rotation speed must be avoided at all costs.

With the additional angle, the high rotation speed continues to be maintained after shutting the depth sensor off until the angle is reached. This enables the shift point to be adjusted more precisely using the additional angle.

Parameters for screwdriving cycle type 1

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	0 - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Shift point at analogue depth	LP1	mm	0 - l	For analogue depth only
Minimum current-based torque	MI-1		-m - m	
Maximum current-based torque	MI+1		0.0 - m	
Minimum step time	T-1	sec	0.0 - 15.0	
Maximum step time	T+1	sec	0.0 - 15.0	
Additional angle	WP1	de-grees	0 - 36000	
Rotation speed	NA2	rpm	0 - n	
Target current-based torque parameter	MIP2		0.0 - m	
Threshold torque to start angle measurement	MIS2		0.0 - m	
Minimum angle	A-2	de-grees	0 - 36000	
Maximum angle	A+2	de-grees	0 - 36000	
Maximum step time	T+2	sec	0.0 - 15.0	
Minimum analogue depth	L-2	mm	0 - l	For analogue depth only
Maximum analogue depth	L+2	mm	0 - l	For analogue depth only
Depth check with TM2	CL2	-		no must be 1 must be 0 (only for digital depth)

6.2. Type 2: Drive to current-based torque then tighten to current-based torque with angle monitor then release

This diagram type can be used instead of diagram type 1 if a depth sensor cannot be used.

However, the disadvantage of this diagram type is that if the current-based torque increases quickly at screw head contact, it may not be possible to effectively reduce the rotation speed for the final tightening.

It is important to set the slope for speed changes to 0 here.

Parameters for screwdriving cycle type 2

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	0 - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Threshold torque to start angle measurement	MIS1		0.0 - m	
Minimum angle	A-1	de-grees	0 - 36000	
Maximum angle	A+1	de-grees	0 - 36000	
Switch point at current-based torque	MIP1		0.0 - m	
Minimum step time	T-1	sec	0.0 - 15.0	
Maximum step time	T+1	sec	0.0 - 15.0	
Rotation speed	NA2	rpm	0 - n	
Target current-based torque parameter	MIP2		0.0 - m	
Threshold torque to start angle measurement	MIS2		0.0 - m	
Minimum angle	A-2	de-grees	0 - 36000	
Maximum angle	A+2	de-grees	0 - 36000	
Maximum step time	T+2	sec	0.0 - 15.0	
Minimum analogue depth	L-2	mm	0 - l	For analogue depth only
Maximum analogue depth	L+2	mm	0 - l	For analogue depth only
Depth check with TM2	CL2	-		no must be 1 must be 0 (only for digital depth)

6.3. Type 3: Drive to depth 1 then turn to angle with current-based torque monitor

This diagram type is suitable for driving a screw to a defined depth. The depth is preset on the depth sensor and adjusted to the exact dimension with the angle.

The higher rotation speed in the first step causes fast screwing in. The lower rotation speed in the second step is used to approach the desired depth precisely.

Parameters for screwdriving cycle type 3

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	0 - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Shift point at analogue depth	LP1	mm	0 - l	For analogue depth only
Minimum current-based torque	MI-1		-m - m	
Maximum current-based torque	MI+1		0.0 - m	
Minimum step time	T-1	sec	0.0 - 15.0	
Maximum step time	T+1	sec	0.0 - 15.0	
Rotation speed	NA2	rpm	-n - n	
Target angle parameter	WP2	de-grees	-36000 - 36000	
Minimum current-based torque	MI-2		-m - m	
Maximum current-based torque	MI+2		-m - m	
Maximum step time	T+2	sec	0.0 - 15.0	
Minimum analogue depth	L-2	mm	0 - l	For analogue depth only
Maximum analogue depth	L+2	mm	0 - l	For analogue depth only
Depth check with TM2	CL2	-		no must be 1 must be 0 (only for digital depth)

L-2 and L+2 are checked at the end of the process.

6.4. Type 4: Drive to current-based torque then turn to angle with current-based torque monitor

This diagram has two main application areas:

Setting a screw at a defined opening position (example: electrical terminals). The screw is first driven to a current-based torque. In the process, the screw comes to an end stop at which the screw cannot be turned further. From there, a negative rotation speed is used to reverse the screw a negative angle, which realises the desired degree of opening.

Driving a screw to a pre-torque and then driving it further by a tightening angle. This process enables the screw to be tightened within the range of the yield point.

Parameters for screwdriving cycle type 4

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	0 - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Switch point at current-based torque	MIP1		0.0 - m	
Minimum step time	T-1	sec	0.0 - 15.0	
Maximum step time	T+1	sec	0.0 - 15.0	
Minimum analogue depth	L-1	mm	0 - 1	For analogue depth only
Maximum analogue depth	L+1	mm	0 - 1	For analogue depth only
Depth check with TM1	CL1	-		no must be 1 must be 0 (only for digital depth)
Rotation speed	NA2	rpm	-n - n	
Target angle parameter	WP2	de-grees	-36000 - 36000	
Minimum current-based torque	MI-2		-m - m	
Maximum current-based torque	MI+2		-m - m	
Maximum step time	T+2	sec	0.0 - 15.0	
Minimum analogue depth	L-2	mm	0 - 1	For analogue depth only
Maximum analogue depth	L+2	mm	0 - 1	For analogue depth only
Depth check with TM2	CL2	-		no must be 1 must be 0 (only for digital depth)

L-2 and L+2 are checked at the end of the process.

6.5. Type 5: Tighten to current-based torque with angle monitor then release

This diagram enables a current-based torque to be achieved without a prior speed shift. It is suitable particularly for short screwdriving lengths or for combining with other processes.

Parameters for screwdriving cycle type 5

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	0 - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Target current-based torque parameter	MIP1		0.0 - m	
Threshold torque to start angle measurement	MIS1		0.0 - m	
Minimum angle	A-1	degrees	0 - 36000	
Maximum angle	A+1	degrees	0 - 36000	
Maximum step time	T+1	sec	0.0 - 15.0	
Minimum analogue depth	L-1	mm	0 - l	For analogue depth only
Maximum analogue depth	L+1	mm	0 - l	For analogue depth only
Depth check with TM2	CL1	-		no must be 1 must be 0 (only for digital depth)

6.6. Type 6: Turn to angle with current-based torque monitor

This diagram enables an angle of rotation to be applied in the negative or positive direction. It is suitable particularly for combining with other processes or for unscrewing screws.

Parameters for screwdriving cycle type 6

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	-n - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Target angle parameter	WP1	degrees	-36000 - 36000	
Threshold torque to start angle measurement	MIS1		-m - m	
Minimum current-based torque	MI-1		-m - m	
Maximum current-based torque	MI+1		-m - m	
Maximum step time	T+1	sec	0.0 - 15.0	
Minimum analogue depth	L-1	mm	0 - l	For analogue depth only
Maximum analogue depth	L+1	mm	0 - l	For analogue depth only
Depth check with TM2	CL1	-		no must be 1 must be 0 (only for digital depth)

L-1 and L+1 are checked at the end of the process.

6.7. Type 7: Drive to angle and tighten to current-based torque

This diagram type can be used instead of diagram type 1 if a depth sensor cannot be used. Instead of the shift point at depth, the angle is used to reduce the rotation speed at a position.

It is important that the set screw-in angle leads to a position before screw head contact and that this can be reproduced. This can be achieved by selecting a suitable `Threshold torque to start angle measurement` and the `Target angle parameter`.

If applying and finding the screw are too different, using this diagram is not successful under certain circumstances.

Parameters for screwdriving cycle type 7

Designation	Short form	Unit	Area	Remark
Current-based torque correction factor	FMI		0.5 - 2.0	
Rotation speed	NA1	rpm	-n - n	
Slope for speed changes	TM1	sec	0.0 - 3.0	
Target angle parameter	WP1	degrees	-36000 - 36000	
Threshold torque to start angle measurement	MIS1		-m - m	
Minimum current-based torque	MI-1		-m - m	
Maximum current-based torque	MI+1		-m - m	
Maximum step time	T+1	sec	0 - 15.0	
Rotation speed	NA2	rpm	0 - n	
Target current-based torque parameter	MIP2		0.0 - m	
Threshold torque to start angle measurement	MIS2		0.0 - m	
Minimum angle	A-2	degrees	0 - 36000	
Maximum angle	A+2	degrees	0 - 36000	
Maximum step time	T+2	sec	0 - 15.0	

7. NOK codes

The following table lists the association of the NOK number, abbreviation, and plain text of the NOK results. In addition to results listed in the NOK table below, the following 3 result types can occur, which are not included in the NOK codes:

Number	Text	Description
0	Invalid result	No valid result available
1	OK	The result is OK
2	NOK fault	A fault occurred during screwdriving.

NOK list:

NOK number	Text
3	NOK start aborted
4	Threshold torque not reached in step 1
5	Minimum angle not reached in step 1
6	Maximum angle exceeded in step 1
7	Minimum current-based torque not reached in step 1
8	Maximum current-based torque exceeded in step 1
9	Minimum time not reached in step 1
10	Maximum time exceeded in step 1
11	Minimum depth not reached in step 1
12	Maximum depth exceeded in step 1
13	Depth sensor 1 not reached
14	Minimum current-based torque not reached in step 2
15	Maximum current-based torque exceeded in step 2
16	Threshold torque not reached in step 2
17	Minimum angle not reached in step 2
18	Maximum angle exceeded in step 2
19	Maximum time exceeded in step 2
20	Minimum depth not reached in step 2
21	Maximum depth exceeded in step 2
22	Incorrect state on depth sensor 2
23	Current suppression time exceeded in step 1
24	Current suppression time exceeded in step 2

8. Fault messages

If faults occur, the fault must be acknowledged in order to return the device to a condition in which it is ready to start. It is important to establish the cause of the fault and to first rectify the fault. The cause of the fault is shown in the operating software for the C5S. To do this, the PC must be connected to the operating software on the C5S. The fault is displayed there.

The fault is displayed on the customer interface with the fault signal from the higher-level controller.

A fault can be acknowledged in two ways:

- Via the operating software
- Via the acknowledge fault signal in the customer interface

If no cause can be determined for the error and the error cannot be acknowledged, switch the device off and back on. If this still does not eliminate the error or the error occurs again, contact Weber Service (see the Contact at WEBER [▷ 6] chapter).

8.1. List of errors and faults

The following list shows the possible error and fault messages.

Number	Message	Remark
100	The servo controller has a fault despite acknowledging the error.	Check the cables to the motor.
101	Memory error in the C5S central processing unit. Flash could not be deleted.	Switch off and back on after acknowledging.
102	Memory error in the C5S central processing unit.	Switch off and back on after acknowledging.
103	The settings in the C5S are destroyed. ID1 error.	The settings must be entered again.
104	The settings in the C5S are destroyed. ID2 error.	The settings must be entered again.
110	The default settings could not be saved.	Enter the settings again.
121	The servo controller has a fault. The code specified here states the precise cause and clicking the number displays this in detail in the operating software.	Check the cables to the drive.
130	Communication to the servo regulation is interrupted. CAN error.	Switch off and back on.
140	The servo regulation cannot be initialised.	Switch off and back on.
200	The EMERGENCY STOP circuit is interrupted.	Check the EMERGENCY STOP control to the C5S.
201	The positive friction torque in the negative direction of rotation was exceeded.	Check the spindle mechanism.
202	The negative friction torque in the negative direction of rotation was exceeded.	Check the spindle mechanism.
203	The current suppression time was exceeded during the friction offset test in the negative direction of rotation.	Check the spindle mechanism.
204	The positive friction torque after the negative direction of rotation was exceeded.	Check the spindle mechanism.
205	The negative friction torque after the negative direction of rotation was exceeded.	Check the spindle mechanism.

Number	Message	Remark
206	The current suppression time was exceeded during the friction offset test after the negative direction of rotation.	Check the spindle mechanism.
207	The angle of the friction offset test in the negative direction of rotation is too small.	Check the spindle mechanism.
208	The angle of the friction offset test in the negative direction of rotation is too large.	Check the spindle mechanism.
209	The positive friction torque in the positive direction of rotation was exceeded.	Check the spindle mechanism.
210	The negative friction torque in the positive direction of rotation was exceeded.	Check the spindle mechanism.
211	The current suppression time was exceeded during the friction offset test in the positive direction of rotation.	Check the spindle mechanism.
212	The positive friction torque after the positive direction of rotation was exceeded.	Check the spindle mechanism.
213	The negative friction torque after the positive direction of rotation was exceeded.	Check the spindle mechanism.
214	The current suppression time was exceeded during the friction offset test after the positive direction of rotation.	Check the spindle mechanism.
215	The angle of the friction offset test in the positive direction of rotation is too small.	Check the spindle mechanism.
216	The angle of the friction offset test in the positive direction of rotation is too large.	Check the spindle mechanism.
217	An invalid status occurred during the friction offset test.	Switch off and back on.
290	An invalid program number was specified.	Check the program number.
291	An attempt was made to start an empty program.	Set the program correctly or call the correct program.
292	A program number that contains an invalid type was started.	Delete the program and re-create it.
300	The emergency stop circuit is interrupted.	Check the emergency stop control to the C5S.
301	An invalid status occurred in diagram type 1.	Switch off and back on.
302	An invalid status occurred in diagram type 2.	Switch off and back on.
303	An invalid status occurred in diagram type 3.	Switch off and back on.
304	An invalid status occurred in diagram type 4.	Switch off and back on.
305	An invalid status occurred in diagram type 5.	Switch off and back on.
306	An invalid status occurred in diagram type 6.	Switch off and back on.
307	An invalid status occurred in diagram type 7.	Switch off and back on.

9. Interface description

9.1. Overview of connections

DANGER

Fatal electric shock

Switch off the unit before connecting or disconnecting electrical components.

Pull out the mains plug before opening the housing.

The C5S screwdriver controller has the following connections:

Name	Type	Description
XD1 Power	Built-in inlet connector for non-heating apparatus with integrated main switch and 2-pin fuse	Mains connection for inlet connector cable for non-heating apparatus depending on country design Fuses: T6,3A
XF2 USB-PC	USB mini socket (USB slave)	Connection for PC (operating software)
XG3 SP	4-pin M12 round socket	Input for digital depth sensor TM1 and TM2
XG4 AnD	4-pin M8 round socket	Connection for analogue depth sensor
XG5 IF	Sub-D 25 pin	Customer interface (for pin assignment, see circuit diagram)
XG6 EMG	8-pin round socket EN 60130-9 / DIN 45326	Connection for emergency stop integration
XG8 Encod	10-pin M16 round socket	Encoder connection (motor feedback; for pin assignment, see circuit diagram)
XD9 Motor	4-pin M16 round socket	Connection for motor current (power cable; for pin assignment, see circuit diagram)

9.2. Control via customer interface

The customer interface is used to connect the C5S to a higher-level system PLC. The PLC starts the individual screwdrivings and can process the results supplied by the C5S.

9.2.1. Connecting the control signals

Control and responses on the C5S screwdriving controller are provided by a digital I/O interface.

The digital interface operates with 24V DC supply from the C5S screwdriving controller. An external supply is not to be connected. The internal device 24V is available on the interface and may only be used to supply power to the interface signals.

If the external controller has potential-free signals, the 24V from the C5S screwdriving controller can be used. The C5S must never be used as a power source for other system parts or other electrical consumers.

The reference (0V) to the two controllers must be connected.

The inputs and outputs do not have a separate potential. If electrical isolation from the higher level control system is necessary, the controller integrator must be provide it.

The outputs and inputs operate in a PNP circuit. A signal is On when a level over 20V is present. A signal is Off when a level below 4V is present.

The following table shows the assignment of the digital customer interface on the SUB-D 25 plug:

Sub-D 25-pin	Type	Designation
2	Input	Automatic
3	Input	Acknowledge fault
4	Input	Program PG0
5	Input	Program PG2

Sub-D 25-pin	Type	Designation
6	Input	Reserve input
8	Power supply	+24V from C5S
9	Output	Spare output
10	Output	Depth reached
11	Output	OK
12	Output	No fault
13	Reference	0V
15	Input	Start
16	Input	Spare
17	Input	Program PG1
18	Input	Program PG3
21	Power supply	+24V from C5S
22	Output	Spare output
23	Output	NOK
24	Output	Ready to start
25	Reference	0V

9.2.2. Inputs in the C5S

9.2.2.1. Automatic

The signal defines whether the C5S is in automatic mode. During system operation, the `Automatic` signal is used to enable the controller to become "ready to start" and to accept a process start. However, this release is only effective if the controller is not in `Device test`. Conversely, the `Device test` can no longer be selected when the `Automatic` signal is present (external lock).

Signal	Function
0	The C5S is in manual mode, the device test can be performed. Production mode is not possible.
1	The C5S is in automatic mode. The PLC can control the C5S via the interface. The device test cannot be performed.

The C5S can only be controlled by the PLC in automatic mode.

9.2.2.2. Start

A rising flank of the start signal starts a screwdriving program.

The `Start` signal is only accepted if the device is already `Ready to start` beforehand. If the device is not `Ready to start`, the Start signal will be ignored. Premature withdrawal of the signal will result in an `NOK` start abort.

9.2.2.3. PG0 - PG3

A total of 15 programs + Friction offset test can be selected via the 4 program lines. The program number is coded in binary in 4 bits / lines.

Program 0 is the friction offset test, followed by programs 1 to 15.

The following table shows the binary coding for the relevant programs:

PG3	PG2	PG1	PG0	Program
0	0	0	0	Friction offset test
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3

PG3	PG2	PG1	PG0	Program
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

The program number is only transferred during the rising flank of the start signal.

Program specification via the customer interface

The program specification via the customer interface is only active if no fixed program number is stored in the system parameters (see the System settings [▶ 27] chapter)

9.2.2.4. Acknowledge fault

If a fault is present, it can be acknowledged, either via the customer interface or via the display, **after** its cause has been eliminated.

9.2.3. Outputs on the C5S screwdriving controller

9.2.3.1. No fault

The signal indicates that there is no fault on the device.

9.2.3.2. Ready to start

The `Ready to start` signal is used to signal that the controller is in production mode and is ready for a new process start. The prerequisite is that there is no fault and automatic is present. Production is not possible in the `Device test` submenu, i.e., the controller is not ready to start in these cases. The signal is 0 during the entire screwdriving process.

9.2.3.3. OK/NOK

The two signals indicate whether a screwdriving process was executed successfully (`OK`) or unsuccessfully (`NOK`).

Each time a screwdriving process is completed without a fault, the evaluation of the screwdriving result is output via the customer interface. Two signals are available for this: `OK` and `NOK`. The process ends as one of the two signals changes to 1. The signals are reset to 0 at the next process start.

9.2.3.4. Depth reached

The signal is set if the condition set in the system constants parameters is met. The description of the `Point for depth reached` parameter in the Point for depth reached [▶ 28] chapter explains the functions.

9.3. Timing diagram of customer interface

The following timing diagram provides an example of the signal exchange on the customer interface:

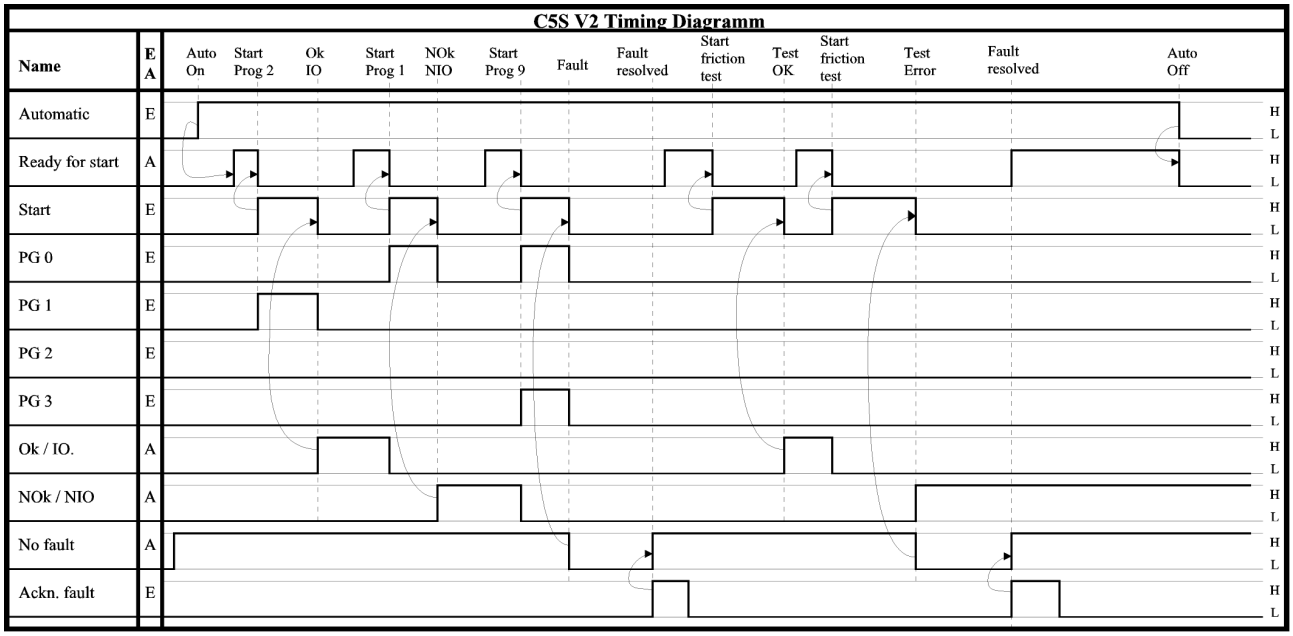


Illustration 11: Signal exchange on the customer interface

9.4. Emergency stop connection

The C5S screwdriving controller is equipped with a two-circuit EMERGENCY STOP circuit. This enables the C5S to be integrated into an existing EMERGENCY STOP circuit in the overall system.

This is recommended if the hazard analysis of the overall plant determines that a hazard exists as a result of the spindle drive. In this case, safe switch-off of the drive (Save Torque Off) may be necessary.

If a shut-off is not required after considering safety issues, the XG6 connection should be bypassed so that the EMERGENCY STOP circuit is closed.

The EMERGENCY STOP option enables stop category 0 to be implemented. If the option is integrated, the required connections to XG6 EMG are lead through.

An electronic STO (safe torque off) circuit is integrated in the C5S screwdriving controller. The wiring is shown in the circuit diagram. If the safety circuit becomes de-energised, the current feed to the drive is switched off in the device. The device indicates this in the status line on the main screen.

DANGER

Plug connections remain live even after STO (safe torque off)

The plug connections and XD9 cables are powered off in this state (STO) but not de-energised.

► Disconnect the device from the mains supply in order to plug the plug connections in, to unplug them and for repairs.

The values that can be achieved with the safety circuit are listed in the technical data.

DANGER

General hazard

EMERGENCY STOP has no effect if the circuit is faulty.

► A specialist must integrate the controller into the higher level EMERGENCY STOP circuit. For more information regarding integrating the controller, see the separate circuit diagram in chapter 10 of the WEBER documentation.

► Contact WEBER Service If necessary → see the Contact at WEBER [▷ 6] chapter.

This variant is represented in the circuit diagram as a scheme that shows how the two-circuit shut-off can be integrated. Please additionally use the feedback in all instances, so that faults in the safety circuit can be detected. Feedback is provided via a potential-free optocoupler output. This only closes when both circuits 1 and 2 are open. If at least one circuit is closed, the optocoupler of the feedback opens.

Pin 5 and pin6 on XG6 may only be used to supply with C5's own safety inputs. This supply enables potential-free contacts from the higher-level circuit.

8-pin socket	Description
1	Circuit 1 +
2	Circuit 1 -
3	Circuit 2 +
4	Circuit 2 -
5	0V C5
6	+24V C5
7	Feedback +
8	Feedback -

9.4.1. Information on switching frequency

The service life of the electronic EMERGENCY STOP circuit is unlimited. Therefore, applications in which the safety circuit is shut off in each part cycle, for example by a light curtain, are possible.

10. Technical data

Electrical connection (according to name plate)	Standard 230 V Type: • Connection for non-heating apparatus with L, N, PE • 230 V ± 10% / 50 – 60 Hz
Fuse	External: ≥ 10 A Category C
	Internal: 6.3AT protective fuses
Electrical device protection class	Protection class 1 (L, N, PE)
Maximum average energy consumption	With 85 W motor: 100 W
	With 320 W motor: 400 W
	With 675 W motor: 750 W
	Without active process: 25 W
Recommendation for residual current circuit breakers (RCD)	RCD Type B (AC/DC sensitive) with ≥ 30 mA
Load of RCD Type B 30 mA	< 25% (length of cable to drive: 6 m)
Device leakage current during operation (typical)	≤ 3.5 mA
Ambient temperature	5° C - 45° C (41° F – 113° F)
Relative air humidity	5% - 85%, non-condensing
Installation height above sea level	0 - 1000m: 100% power
	1000 - 2000m: 70% power
	Do not operate above 2000m
Weight	7.8 kg
Installation	• On the ground (no other installation permitted) • The device must be able to be installed so that it is well ventilated from all sides.
Housing size (H * W * D) in mm	266 * 152 * 332 (without plug)
Installation space (H * W * D) in mm	270 * 220 * 420 (without USB connection to the front)
Degree of protection	IP30
Safety-related key data	according to EN ISO 13849-1:2008-12 • MTTFd: >100 years • DC = 99% • Category 4 • Performance Level e

Operational environment

The C5S meets the applicable EMC directives for industrial technology in the industrial environment.

If used in other areas, appropriate additional measures are required in order to meet the required EMC standards. The device owner is responsible for this.

11. Decommissioning / Dismantling / Disposal

11.1. Decommissioning

In order to shut down the machine, switch it off and secure it to prevent an inadvertent restart.

If there are still workpieces in the machine, they must be removed.

The machine must be marked with a notice that makes it completely clear that the machine is shut down temporarily.

Commissioning

When re-starting the machine, follow the instructions contained in the “Commissioning” section.

11.2. Disassembly and disposal

WARNING

Hazards during dismantling and transport

During dismantling, injuries can be caused by components falling over and during transport with lifting gear by swinging or falling loads.

CAUTION

Hazards when working on the machine

Risk of injury from improper handling of the machine.

►Work on the machine must be carried out by qualified personnel.

To avoid personal injury and/or environmental damage during dismantling and disposal, the following points must be observed:

- Use of appropriate tools
- Sufficiently dimensioned load suspension devices
- Stability of the dismantled machine parts
- Use of personal protective equipment when disposing of lubricants, solvents, preservatives, etc.

11.2.1. Disposal of the machine parts

Proper disposal

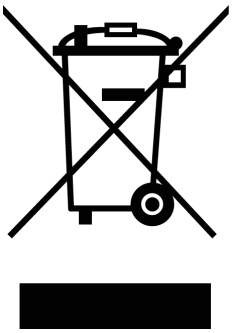
Assemblies and components must be disposed of properly. Improper disposal causes environmental damage.

Dispose of assemblies in accordance with local regulations. Ensure that operating materials are disposed of in an environmentally friendly manner.

The machine is made of:

- Aluminium (e.g. base frame, plates)
- Steel and cast iron (e.g. housing, shafts, gearwheels, bearings)
- Copper (e.g. servomotor and electrical cables)
- Plastic (e.g. electrical cables, cladding)
- Electronic components (e.g. amplifier servo)

11.2.2. Take-back of electronic products (ElektroG)

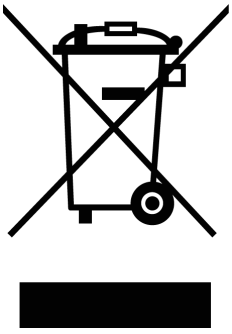


Waste electrical and electronic equipment contains various valuable materials as well as harmful substances that have negative effects on the environment and human health if disposed of improperly. They must not be disposed of with household waste.
Instead, use the option to hand in your old appliance free of charge at regional collection points in Germany. WEBER is registered with the EAR Foundation as a manufacturer and distributor of B2B electrical products (WEEE Reg.No. 70910538).

German Electronic Equipment Act (ElektroG)

The Electronic Equipment Act stipulates that waste electrical equipment must not be disposed of with household waste, but must be collected separately and recycled.

11.2.3. Battery take-back (BattG)



You as the end user are obliged by EU regulation (Battery Act) to return all used batteries and rechargeable batteries; disposal with normal household waste is prohibited.
You can return your used batteries/rechargeable batteries free of charge to the collection points of your municipality, our company or wherever batteries are sold.

Battery Act (BattG)

Act on the marketing, return and environmentally sound disposal of batteries and rechargeable batteries.

12. Change history

Version	Department	Description of the changes	Date
V2.0.0	Draft CS Doku AR	First version	07/04/2022

13. Contact

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