

Torque measurement wheel WTT-D^x

Manual

Edition 2 - 08.07.2022



Disclaimer of liability

The contents of this documentation have been carefully checked for consistency with the hardware and software systems described. Nevertheless, it is impossible to completely rule out inconsistencies, so that we decline to offer any guarantee of total conformity.

We reserve the right to make technical modifications of the systems.

Copyright

© 2022 imc Test & Measurement GmbH, Germany

This documentation is the intellectual property of imc Test & Measurement GmbH. imc Test & Measurement GmbH reserves all rights to this documentation. The applicable provisions are stipulated in the "imc Software License Agreement".

The software described in this document may only be used in accordance with the provisions of the "imc Software License Agreement".

Open Source Software Licenses

Some components of imc products use software which is licensed under the GNU General Public License (GPL). Details are available in the About dialog.

A list of the open source software licenses for the imc measurement devices is located on the imc STUDIO/imc WAVE installation medium in the folder "*Products\imc DEVICES\OSS*" or "*Products\imc DEVICEcore\OSS*". If you wish to receive a copy of the GPL sources used, please contact our Hotline.

Table of Contents

1 General introduction	5
1.1 Customer support / Hotline	5
1.2 Legal notice	5
1.3 Customized cable manufacturing	8
1.4 Notes regarding this manual	8
2 Safety	9
3 Delivery and operation	12
3.1 After unpacking	12
3.2 Before commissioning	12
3.3 Notes on connecting	14
4 Maintenance and service	16
4.1 Maintenance	16
4.2 Calibration	16
4.3 Storage	16
4.4 Transport	16
5 Introduction	17
6 Technical Components	18
6.1 Sensor with integrated batteries and telemetry unit	18
6.2 Dx Receiver and Control Unit	19
6.3 Antennas for the exterior mirror	20
6.4 Hub adaptor, modified rim	20
7 Installation of the sensor	21
7.1 Overview	21
7.2 Check list for the WTT installation	22
7.3 Observe the WTT configuration and logical numbers	24
7.4 Step-by-Step-Installation	24
8 Quickstart	29
9 Prepare and execute measurement	30
9.1 Useful tips	30
9.2 Perform measurement	34
10 Charge/Change Battery	42
10.1 General	42
10.2 Charge battery	44
10.3 Change battery	45
11 Accessories/options	46
11.1 Batteries	46
11.2 Antennas	46
11.3 Rims and hub adaptor	46
11.4 Calibration	47

12 Technical Specs 48
 12.1 Technical Specs - WTT 48
Index 49

1 General introduction

1.1 Customer support / Hotline

If you have problems or questions, please contact our Customer Support / Hotline.

imc Test & Measurement GmbH

Hotline: **+49 30 467090-26**

E-Mail: hotline@imc-tm.de

Internet: www.imc-tm.de



International partners

You can find the international sales partners on the Internet at



<https://www.imc-tm.com/imc-worldwide/>

You will help us with inquiries if you can name the serial number of your devices as well as the version designation of the software. You should also have this documentation at hand. Thank you very much!

1.2 Legal notice

Quality management

imc Test & Measurement GmbH holds the ISO 9001 certification. You can download the certification and information about our quality system on our website:



<https://www.imc-tm.com/about-imc/quality-assurance>

Warranty

Subject to the general terms and conditions of imc Test & Measurement GmbH.

Liability restrictions

All information and notes in this manual have been compiled taking into account the applicable standards and regulations, the state of the art and our many years of knowledge and experience.

The manufacturer accepts no liability for damage due to:

- Non-observance of the manual
- Non-intended use

Important information for customers who want to make their own adaptors for the sensors

imc also manufactures customer specific adaptors for the sensors against payment, so that the sensors can be installed professionally at the customer's site and used according to the contract.

If customers produce the adaptors on their own request, imc points out the following as a precaution:

- The contractual usability of imc sensors requires that they are installed professionally with custom-made adaptors. Otherwise, the contractual usability and especially the compliance with the specifications given for the sensors cannot be guaranteed.
- The customer's claims for defects against imc for adaptors manufactured by the customer himself extend only to the sensors and not to the adaptors. imc does not assume any liability for defects that the imc sensors can be used with the adaptors manufactured by the customer according to the contract, especially that the specifications given for the imc sensors are met. If the customer makes the adaptors himself, imc is not liable for defects. This does not apply if the customer can prove that his own production is not the cause of the defect.
- Furthermore, the General Terms and Conditions of imc Test & Measurement GmbH apply.

Guarantee

Each device undergoes several quality tests before leaving production. In the process, almost every early failure is detected. Nevertheless, it is possible that a component fails only after a longer period of operation. For this reason, all imc products come with a two-year functional warranty. The prerequisite is that no changes have been made in the device.

Unauthorized intervention in the device voids any warranty claim.

ElektroG, RoHS 2, WEEE, CE

The imc Test & Measurement GmbH is registered with the authority as follows:

WEEE Reg. no. DE 43368136

valid from 24.11.2005

Notes on radio interference suppression

WTT-D^x satisfy the EMC requirements for an use in industrial settings.

WTT-D^x satisfy the EMC requirements for unrestricted use in industrial settings. Any additional devices connected to the WTT-D^x must satisfy the EMC requirements as specified by the responsible authority (within Europe¹) in Germany the BNetzA - "Bundesnetzagentur" (formerly BMPT-Vfg. No. 1046/84 or No. 243/91) or EC Guidelines 2014/30/EU. All products which satisfy these requirements must be appropriately marked by the manufacturer or display the CE certification marking.

Products not satisfying these requirements may only be used with special approval of the regulating body in the country where operated.

All lines connected to the device should not be longer than 30 m and they should be shielded and the shielding must be grounded.

Note

The EMC tests were carried out using shielded and grounded input and output cables with the exception of the power cord. Observe this condition when designing your experiment to ensure high interference immunity and low jamming.

¹ If you are located outside Europe, please refer the appropriate EMC standards used in the country of operation.

FCC Notice

WTT-D^x has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult our imc Hotline or an experienced technician for help.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by imc may void the user's authority to operate this equipment.

1.3 Customized cable manufacturing

To comply with the limits for Class B equipment under Part 15 of the FCC Rules, all signal lines connected to the meter must be shielded and the shield must be connected.

Unless otherwise indicated, all connecting cables must not be long cables as defined by IEC 61326-1 (< 30 m). LAN cables (RJ 45) and CAN bus cables (DSUB-9) are excluded from this. Only cables with suitable properties for the task (e.g. isolation to protect against electric shock) may be used. Independently performed modifications to cables will void the manufacturer's functional warranty.

1.4 Notes regarding this manual

This document provides important notes on using the device. Safe working is conditional on compliance with all safety measures and instructions provided.

Additionally, all accident prevention and general safety regulations pertinent to the location at which the device is used must be adhered to.

These instructions exclusively describe the device, not how to operate it by means of the software!

Explanation of symbols

Reference

... indicates where to find further or related information.

Note

... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

Warning

... indicates a hazardous situation or even a potentially hazardous situation that may result in property hazardous situation that may result in property damage if not avoided.

Attention

... indicates a possible risk of injury.

Help us to improve the documentation and the products:

- Working with the device could be improved by changing the mechanics?
- There are terms or descriptions in the manual or technical data that are incomprehensible?
- What additions and extensions do you suggest?

2 Safety

This section provides an overview of all important aspects of protection of the users for reliable and trouble-free operation. Failure to comply with the instructions and protection notes provided here can result in serious danger.

Responsibility of the operator

Along with the work safety procedures described in this document, the user must also conform to regulations for safety, accident prevention and environmental protection which apply to the work site. If the product is not used in a manner specified by the manufacturer, the protection supported by the product may be impaired.

Operating personnel

This document identifies the following qualifications for various fields of activity:

- *Users of measurement engineering*: Fundamentals of measurement engineering. Basic knowledge of electrical engineering is recommended. Familiarity with computers and the Microsoft Windows operating system. Users must not open or structurally modify the measurement device.
- *Qualified personnel* are able, due to training in the field and to possession of skills, experience and familiarity with the relevant regulations, to perform work assigned while independently recognizing any hazards.

Warning

- **Danger of injury due to inadequate qualifications!**
- Improper handling may lead to serious damage to personnel and property. When in doubt, consult qualified personnel.
- Work which may only be performed by trained imc personnel may not be performed by the user. Any exceptions are subject to prior consultation with the manufacturer and are conditional on having obtained corresponding training.

Special hazards

This segment states what residual dangers have been identified by the hazard analysis. Observe the safety notes listed here and the warnings appearing in subsequent chapters of this manual in order to reduce health risks and to avoid dangerous situations. Existing ventilation slits on the sides of the device must be kept free to prevent heat accumulation inside the device. Please operate your device only in the standard operating orientation.

Danger



Lethal danger from electric current!

- Contact with conducting parts is associated with immediate lethal danger.
- Damage to the insulation or to individual components can be lethally dangerous.

Therefore:

- In case of damage to the insulation, immediately cut off the power supply and have repair performed.
- Work on the electrical equipment must be performed exclusively by expert electricians.
- During all work performed on the electrical equipment, it must be deactivated and tested for static potential.

Injuries from hot surfaces!



- Devices from imc are designed so that their surface temperatures do not exceed limits stipulated in EN 61010-1 under normal conditions.

Therefore:

- Surfaces whose temperature can exceed the limits under circumstances are denoted by the symbol shown at left.

Industrial safety

This certification has the sole purpose of releasing imc from the obligation to have the electrical equipment tested prior to first use (§ 5 Sec. 1, 4 of DGUV Regulation 3). This does not affect guarantee and liability regulations of the civil code.

For repeat tests, a test voltage that is 1.5 times the specified working voltage should be used to test the isolation for the highly isolated inputs (e.g. measurement inputs for high-voltage applications).

* previously BGV A3.

Observe notes and warnings

Devices from imc have been carefully designed, assembled and routinely tested in accordance with the safety regulations specified in the included certificate of conformity and has left imc in perfect operating condition. To maintain this condition and to ensure continued danger-free operation, the user should pay particular attention to the remarks and warnings made in this chapter. In this way, you protect yourself and prevent the device from being damaged.

Read this document before turning on the device for the first time carefully.

Warning

Before touching the device sockets and the lines connected to them, make sure static electricity is diverted to ground. Damage arising from electrostatic discharge is not covered by the warranty.

3 Delivery and operation

3.1 After unpacking

The delivery must be checked for completeness and transport damage immediately upon receipt. In case of externally visible transport damage, proceed as follows:

- Do not accept the delivery or accept it only with reservations,
- Note the extent of the damage on the transport documents/delivery bill of the carrier,
- Initiate a complaint.

After unpacking, check the unit for mechanical damage and loose parts inside. If there is transport damage, imc customer service must be informed immediately. The unit must then not be put into operation.

Check the supplied accessories for completeness according to the scope of delivery.



Complain about any defect as soon as it is detected. Claims for damages can only be asserted within the applicable complaint periods.

3.2 Before commissioning

Before using the WTT-D^x, the user must have read and understood the manual, especially the instructions for installation and use. Of particular importance are the hub and rim adaptors, which must be inspected and maintained according to the instructions in this manual - before and after each test drive.

The bolts used must be tightened according to the specification. After heavy force or long test drives, the strength of all wheel nuts and adaptor bolts must be checked to ensure safe and reliable operation. Loose fasteners can damage system components.

Rims that have been subjected to extreme endurance tests on the test track must not be used for further driving tests.

Before putting the WTT-D^x into operation, the user must have read and understood the instruction manual, especially its information concerning installation and operation. Safe working is conditional on compliance with all safety measures and instructions provided. It is particularly important that the hub and rim adaptors and the wheel bolts are inspected and maintained – before and after each test drive.

Assembly bolts must be properly tightened according to specification. Following extreme loading or extended tests the tightness of all lug nuts and rim/hub adaptors bolts should be re-checked to ensure safe and reliable operation. Loose fasteners can lead to damage of system components.

Rims which have been subjected to extreme durability test loads on the proving ground test track must not be used for further test drives on public roads. Operation of the WTT-sensor in public traffic is at the user's own risk.



Warning

WTT-D^x test equipment on public roads

Driving with WTT-D^x test equipment on public roads is done at the sole risk of the user/purchaser.

It should be clearly understood that the proper use of WTT testing equipment normally involves short-term vehicle dynamic and durability tests under specially prepared proving ground and test track road conditions. The data obtained is then most often used to establish load profiles and spectra for use on fatigue machines, tire testing / rim test and road load simulation rigs.

Any driving tests which replicate vehicle misuse such as colliding with the curb, driving over open road gullies, or on extreme road conditions may significantly reduce the working life of your WTT-D^x. In order to keep the mechanical stress on the sensor as low as possible, restrict these kind of tests to a minimum.

The WTT-D^x may only be used to set up test rigs for suspension durability or tire tests. As soon as the desired load profile has been programmed, the WTT-D^x is to be removed from the test rig. Under no circumstances the device is to be used as a sensor in the feedback loop of a test rig for a longer period of time!

Additionally, the WTT-D^x is not designed for extensive long-term tests with dozens or hundreds of test-track loops, e.g. for durability tests of suspension and tires. Such tests may only be performed with standard wheels, as is usual in the development of WTTs and simulators.

The WTT-D^x is waterproof according to IP67. In order to protect the electronic components from ingress of moisture, the device has to be cleaned and put into a dry environment immediately after usage in rain or in moist conditions. Do not store the sensors in a moist environment.

Do not store the WTT-D^x in a moist environment!

3.3 Notes on connecting

3.3.1 Precautions for operation

Certain ground rules for operating the system, aside from reasonable safety measures, must be observed to prevent danger to the user, third parties, the device itself and the measurement object. These are the use of the system in conformity to its design, and the refraining from altering the system, since possible later users may not be properly informed and may ill-advisedly rely on the precision and safety promised by the manufacturer.

Note

If you determine that the device cannot be operated in a non-dangerous manner, then the device is to be immediately taken out of operation and protected from unintentional use. Taking this action is justified under any of the following conditions:

- I. the device is visibly damaged,
- II. loosed parts can be heard within the device,
- III. the device does not work,
- IV. the device has been stored for a long period of time under unfavorable conditions (e. g. outdoors or in high-humidity environments).

1. Observe the specs in the chapter "Technical Specs " and the application hints about the individual system in order to prevent damage to the unit through inappropriate signal connection.
2. Note when designing your experiments that all input and output leads must be provided with shielding which is connected to the ground ("CHASSIS") at one end in order to ensure high resistance to interference and noisy transmission.
3. Unused, open channels (having no defined signal) should not be configured with sensitive input ranges since otherwise the measurement data could be affected. Configure unused channels with a broad input range or short them out. The same applies to channels not configured as active.
4. Avoid prolonged direct exposure to sunlight.

3.3.2 Important Safety Considerations

Safety of all persons operating or observing test vehicles is a **primary concern** when using WTT-D^x. Please regard the following safety considerations:

- It is strongly recommended to create and use a check list of critical items and operations that must be verified before and after each test routine.
- **Integration and installation is to be done by a qualified and trained person.** It is recommended to inspect and test the installation by a second qualified person to verify compliance with the requirements.
- For measurements with wheel force transducers, the standard wheels of the test vehicle are replaced by the WTT-D^x.

Attention

Proper installation, tightening of all fasteners and continuous strength checks are extremely important for the safety of all parties involved.

- The following **components must properly tightened and checked on a regular basis**: lug nuts and/or lug bolts, test rim attachment bolts, hub adaptor attachment bolts, attachment bolts of stator unit, fastening of stator cable.
- **Upon completion of testing**, the remaining tightness of all fasteners is to be checked. Usage of the WTT-D^x with loose fasteners is a safety risk and may lead to unprecise measurement data.

Reference

Please observe [important information for customers](#) ⁵ who want to make their own adaptors for the sensors.

4 Maintenance and service

4.1 Maintenance

No special maintenance is required. Corrective work may only be carried out by imc Test & Measurement GmbH. If you have any complaints, please enclose a note with the device containing a brief description of the fault. If the name and telephone number of the sender are also written on the note, this will help us to process the complaint quickly.

4.2 Calibration

The manufacturer recommends a yearly calibration of the WTT-D^x sensors. For further information on the calibration process, please contact [imc or your local distributor](#) .

4.3 Storage

When storing the WTT-D^x, it has to be protected against:

- Electrostatic charging (which may lead to destruction of electronic parts)
- Humidity (which leads to corrosion)

Permissible **storage temperature**: -10...40 °C



Note

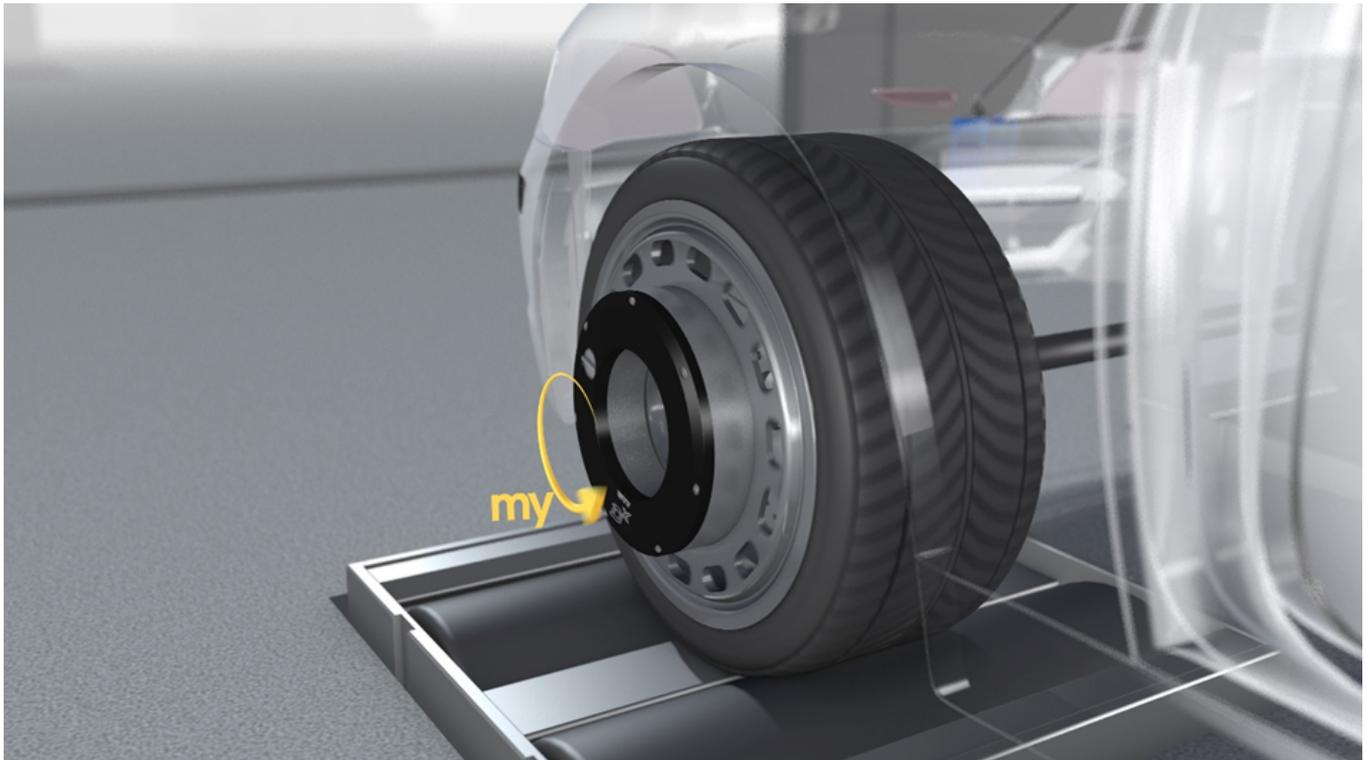
Storage

The cables required for operation of the WTT-D^x sensors must be stored without kinks. The individual modules must not be damaged mechanically when being packed.

4.4 Transport

Only transport the device in the original packaging or in suitable packaging that provides protection against impact and shock. In case of damage, please inform the [customer service](#)  immediately. Transport damage is excluded from the warranty claim.

5 Introduction



With the WTT-Dx, you measure the drive or braking torque (M_y) at the wheels of road vehicles - in road tests and on the test bench. Due to the extremely low zero drift of the sensor technology, the high signal quality is maintained over a wide temperature range: Even during dynamic driving maneuvers that lead to strong heating of the sensor, the WTT-Dx delivers highly precise measurement data. To take into account the ever-increasing vehicle weights in automotive engineering, the mechanical stability of the measuring body has been designed to withstand several times the vehicle life of heavy SUVs.

The extremely compact sensor is not only waterproof (IP67), but thanks to the integrated telemetry unit incl. battery supply, it does not require any superstructures or cables.

Your advantages at a glance

- Highly dynamic, stable measurement signal due to temperature compensated strain gauge sensor technology
- Compact design with free access to the wheel bolts thanks to integrated telemetry unit
- Waterproof sensor (IP67) with cooling-optimized design
- Robust digital telemetry link for highest transmission reliability
- Central configuration and control of all measuring wheels via the control unit, output as synchronous data stream
- Calibration with quantification of sensor crosstalk
- Seamless integration into your measurement hardware via standard interfaces: CAN, analog, Ethernet

6 Technical Components

6.1 Sensor with integrated batteries and telemetry unit



Fig. 1: Torque measurement wheel WTT-C^x



Reference

Please find [here the technical specs](#) 

6.2 Dx Receiver and Control Unit



Fig. 2: Dx-RCI (front panel)



Fig. 3: Dx-RCI (sockets rear side)

6.3 Antennas for the exterior mirror



Fig. 4: antennas for the mirror

6.4 Hub adaptor, modified rim



Fig. 5: WTT hub adaptor (left) and modified rim (right)

The hub adaptors and modified rims have been manufactured according to your specifications. For further information concerning your individual application, please contact imc or your local distributor.

7 Installation of the sensor

7.1 Overview

The ring-shaped measuring wheel (WTT) with the sensor system is mounted between the wheel hub and modified rim by means of a hub adaptor and is thus in the direct path of the mechanical force transmission. The inner ring and outer ring of the measuring wheel body are connected internally with bending beams, which are deformed by the force transmission. This deformation is recorded with strain gauge sensor technology. The hub adaptor is also referred to as the inner adaptor, the modified rim as the outer adaptor.

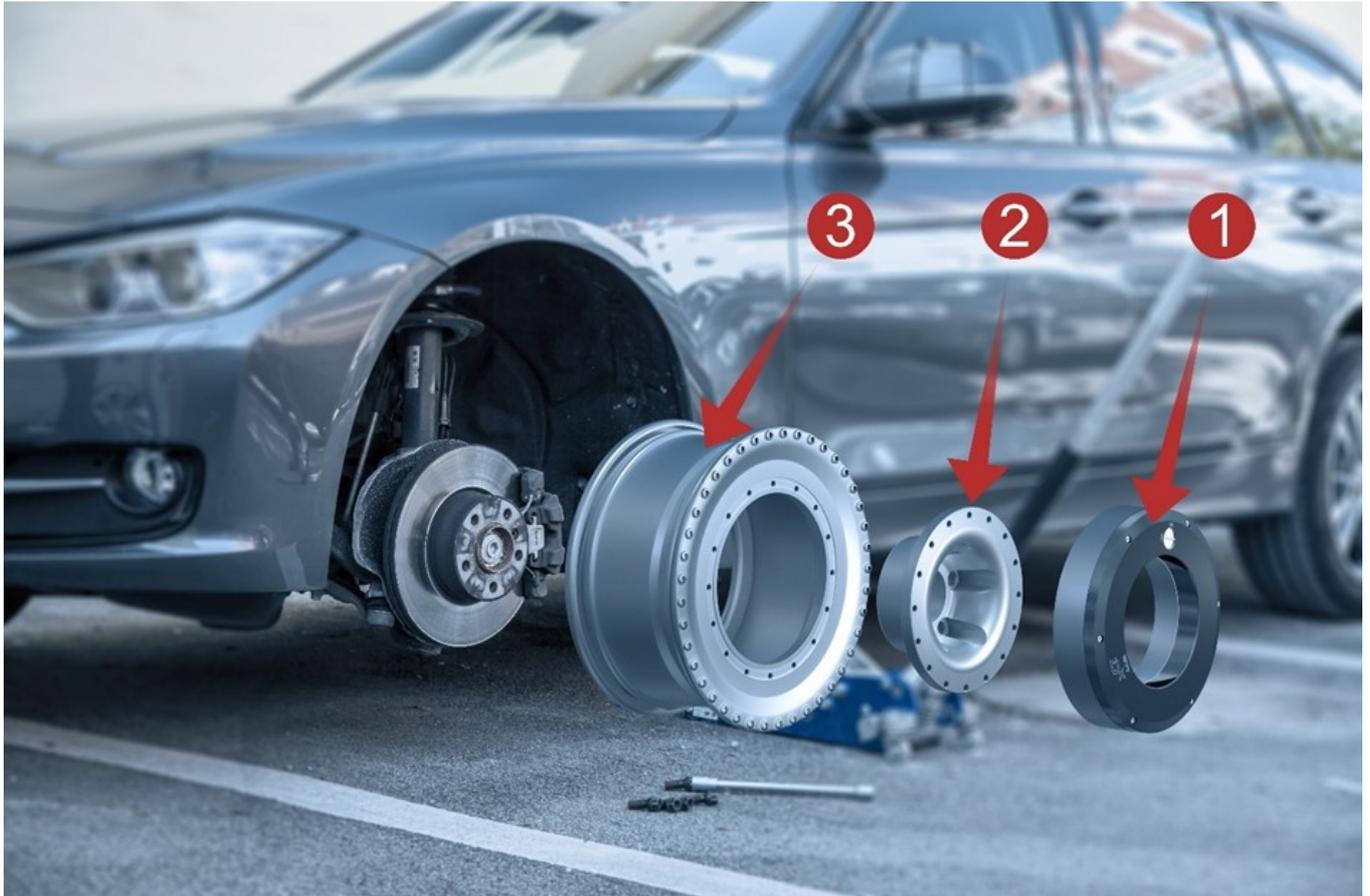


Fig. 6: WTT-D^x mounting scheme

Legend for the Fig. 6:

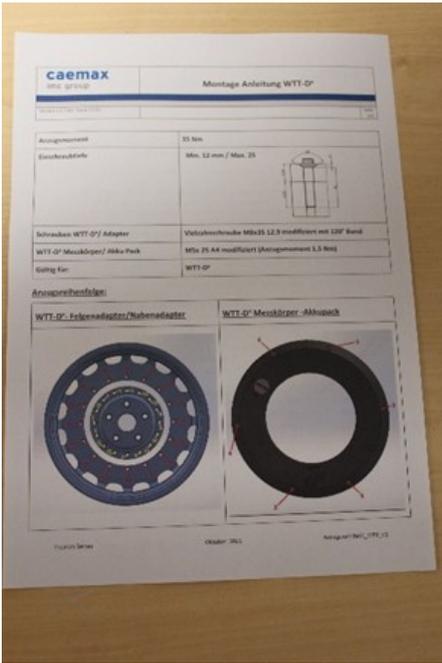
- 1 WTT-D^x
- 2 modified rim
- 3 hub adaptor

7.2 Check list for the WTT installation

Required materials and tools (copy template)

Component	example photo	available
WTT with integrated batteries and telemetry unit		<p>left front wheel: SN:</p> <p>right front wheel: SN:</p> <p>left rear wheel: SN:</p> <p>right rear wheel: SN:</p>
Wheel hub adaptor		<p>left front wheel: type:</p> <p>right front wheel: type:</p> <p>left rear wheel: type:</p> <p>right rear wheel: type:</p>
Specially made rim on which the tire is already mounted		<p>left front wheel: type:</p> <p>right front wheel: type:</p> <p>left rear wheel: type:</p> <p>right rear wheel: type:</p>

Required materials and tools (copy template)

Component	example photo	available
Torque wrench (up to 35 Nm) with extension and 12 edge nut size 8		
Screws (according to screwing instructions)		
Screwing instructions in the current version		
Cable tie / adhesive tape		

7.3 Observe the WTT configuration and logical numbers

imc usually delivers a complete WTT system already preset. The delivery includes a WTT system overview as standard, in which it is noted which WTT (serial number) is assigned to which logical number (LN1, LN2, ...) and to which place in the measurement setup (sketch). To keep the presets valid, we recommend to install the wheels in the indicated arrangement.

The presets, both for each individual WTT and for the CAN messages, are linked to the logical numbers. If you now attach, for example, the WTT that was intended for the left front wheel to the right front wheel, the presets will no longer be correct and you will have to reprogram the system, including the CAN messages. Otherwise, your measurement data cannot be assigned.

If you deliberately choose a different arrangement on site than recommended, please consult the D^x telemetry system manual for reprogramming.

7.4 Step-by-Step-Installation

Screwing of external adaptor and WTT

Screw the modified rim (= external adaptor) to the WTT. It is essential to observe the current screwing instructions. The tire must already be mounted on the rim.



Attention

Observe the screwing instructions

It is mandatory that the screws are attached in accordance with the **current screwing instructions**.



Note

If necessary, place the sensor on a soft, compliant surface (e.g. rubber mat) to tighten the screws in order to prevent damage to the lid and sensor.

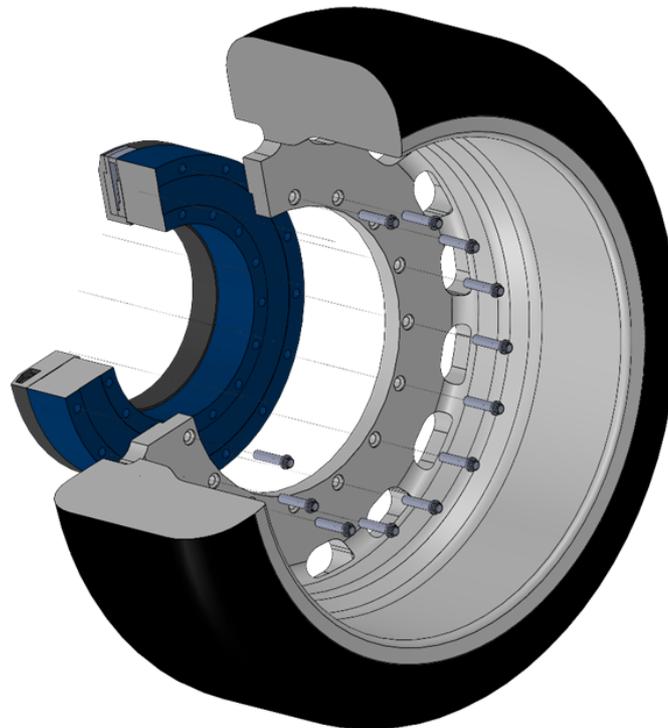


Fig. 7: Screw the modified rim (= external adaptor) to the WTT (blue).

Screwing of inner adaptor and WTT

Now screw the hub adaptor (= inner adaptor) to the WTT. It is mandatory to observe the current screwing instructions.

 Attention

Observe the screwing instructions

It is mandatory that the screws are attached in accordance with the **current screwing instructions**.

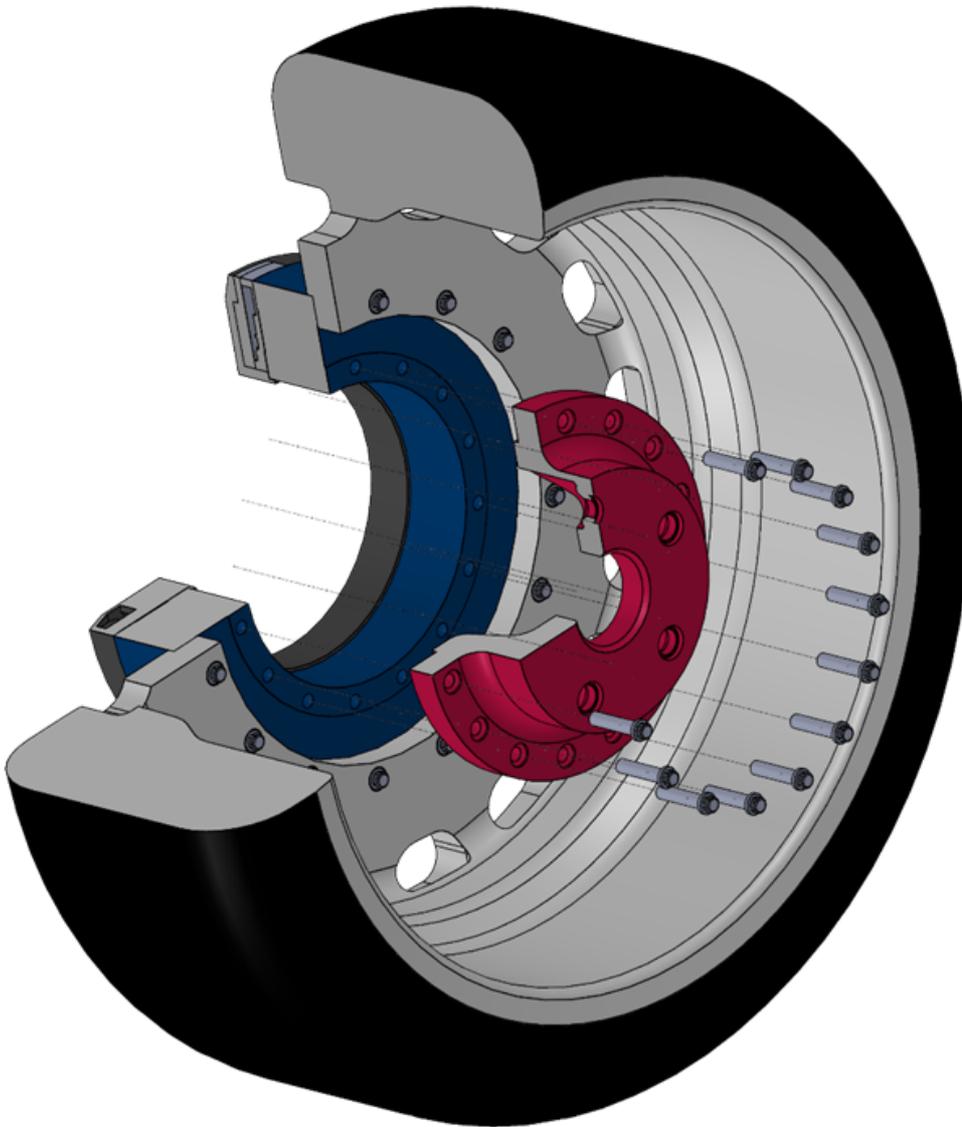


Fig. 8: Screw the hub adaptor (= inner adaptor; red) with the WTT (blue).

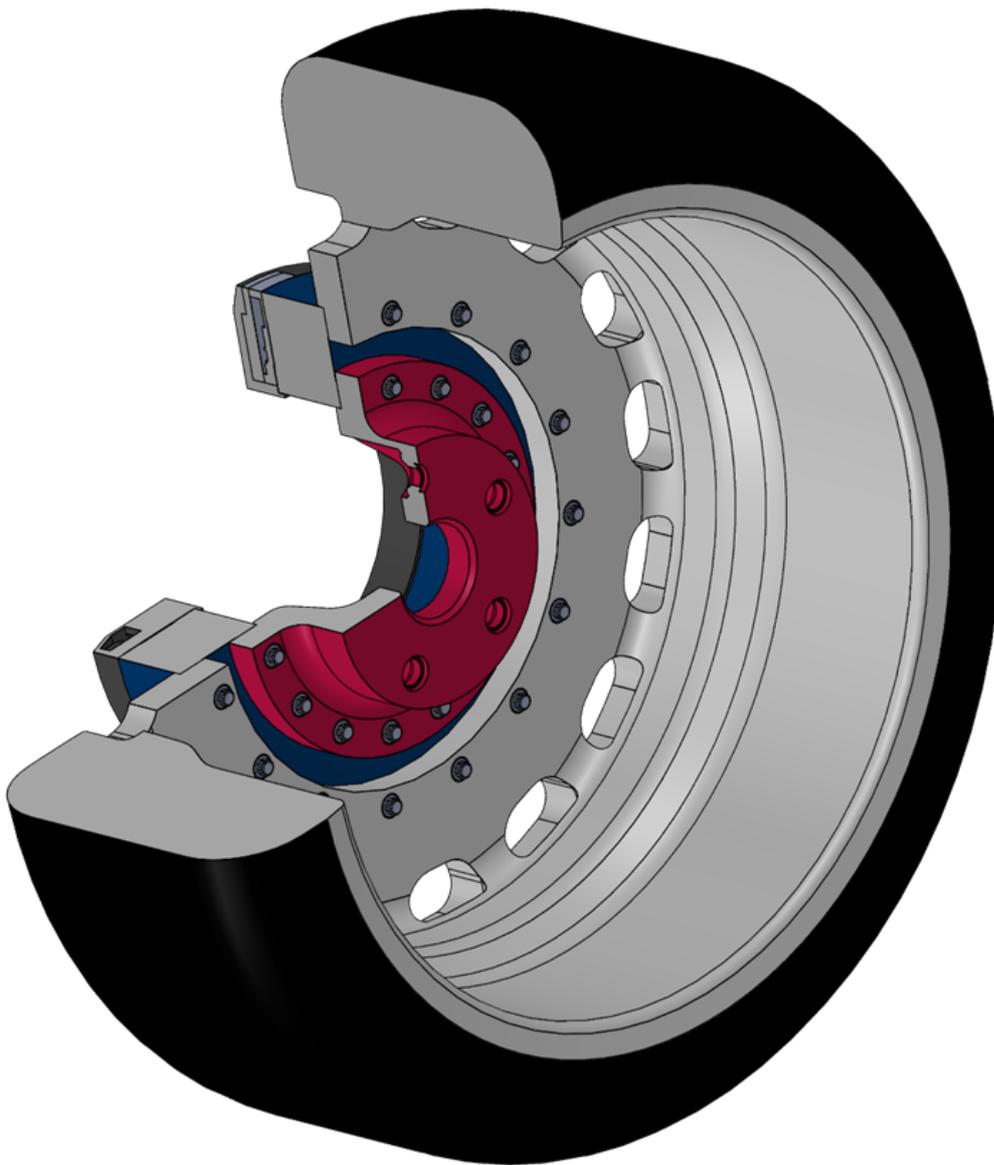


Fig. 9: WTT with hub adaptor and modified rim

Wheel balancing

Now balance the wheel. Check first whether the balancing machine is suitable for wheel adaptation. Additional adaptors may be necessary. For further questions, please contact the imc staff.

Prepare all desired wheels

Prepare all wheels that you want to equip with a WTT according to the points shown so far.

Wheel change

The measurement wheels can now be mounted on the vehicle.



Attention

Safety note: Tightening torque and screw type

The tightening torque and screw type must meet the manufacturer's specifications.



Fig. 10: Installed WTT

Attach the two mirror antennas to the side mirrors of the vehicle using the clamping device.



Fig. 11: Attach the mirror antennas

Guide the antenna cables inside the vehicle and connect them to the Ant 1 & Ant 2 inputs of the D^x-RCI receiver unit.

 **Note**

The antenna inputs of the D^x-RCI are highly sensitive. Connect the antennas when the D^x-RCI is switched off.

8 Quickstart

Since the WTT system is already preset on delivery, a quick start is possible. However, due to legal regulations, the batteries of the WTTs may not be charged. The following steps are therefore required for a quick start:

1. If necessary, charge the batteries of the WTTs (see [chapter "Charge battery"](#)^[44]).
2. Install the WTTs as described in the [chapter "Installing the WTT-Dx"](#)^[21].
3. Install the mirror antennas and then connect them to the D^x-RCI.
4. If you want to record the measurement data, connect a measurement data acquisition system either via the CAN connection or via the analog outputs.

Note

Note: If the D^x-RCI is located at the end of the CAN bus, then a 120-Ω resistor must be inserted between the plug and the socket of the CAN connection.



Fig. 12: CAN terminating resistor



Fig. 13: Plugged CAN terminating resistor

5. Connect the D^x-RCI receiver unit to the power supply.
6. If it does not start automatically, press the button in the center of the scroll wheel for about 5 seconds to turn it on.
7. The D^x-RCI automatically loads the presets from the SD card located in the side slot (from the DEFAULT.dxp file) at startup.
8. Turn on all WTTs by setting the On/Off switch on each WTT to "ON".
9. Go to the measurement mode in the D^x-RCI. To do this, select "Measure->Start" in the menu.
10. Now check whether the reception bars for the WTTs appear at the top edge of the display. Two reception bar graphs should be visible for each WTT.
11. You can read the measured values on the display. If you have connected a measurement data acquisition system, it is now supplied with the measurement data.

9 Prepare and execute measurement

9.1 Useful tips

9.1.1 Configuration via web browser possible

This function makes it possible to parametrize the D^x telemetry system conveniently using your PC instead of the scroll wheel.

To configure the D^x telemetry system via a web browser, the D^x-RCI must be integrated into a network.

You can also establish a local network connection between the D^x-RCI and the measuring computer. To do this, connect the Ethernet interface of the D^x-RCI receiver unit to your measuring computer using an Ethernet cable.

Please note that your computer must be assigned an IP address (protocol IPv4) from the same network segment. The IP address 192.168.000.212 is preset on the D^x-RCI.

For the measuring computer, you then use 192.168.000.100, for example. **For a direct connection, the dynamic address assignment (DHCP) of your measuring computer must be deactivated.**



Warning

In case of a corporate network, please contact your system administrator.

To open the configuration dialog for a direct connection, use one of the following:

- Open the Windows Settings and search for "View network connections"
- Select "View network connections"
- Open Windows' input box by using the keyboard combination [Win+R]
- Enter the following command in the edit box:
control netconnections

The "Network Connections" window appears. Then right-click the mouse over the entry for your network connection and then select the item "Properties" in the context menu once again. Then the Connection Properties window appears.

Select Version 4 of the **Internet Protocol Version 4 (TCP/IP4)** (1) and click on **Properties** (2). Now the current settings are visible. Enter the desired IP address and confirm with OK.

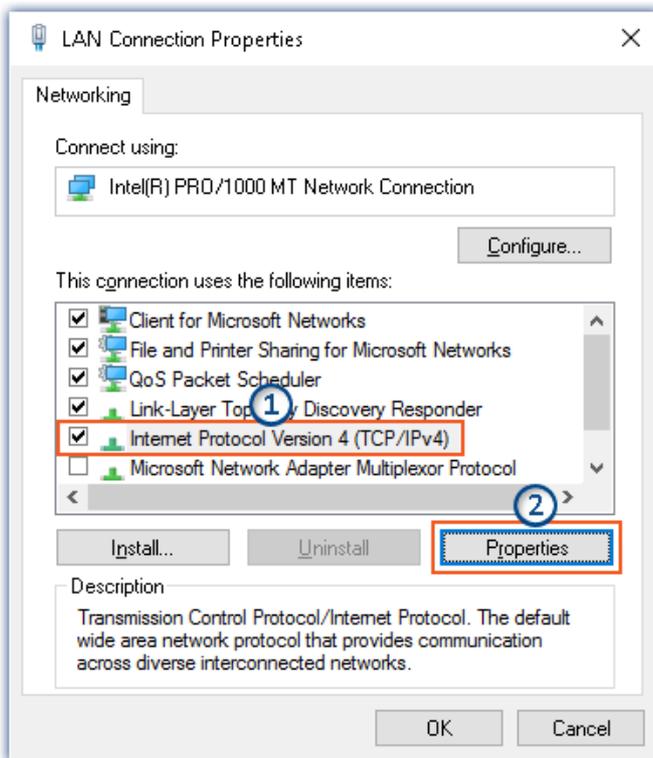


Fig. 14: LAN connection properties

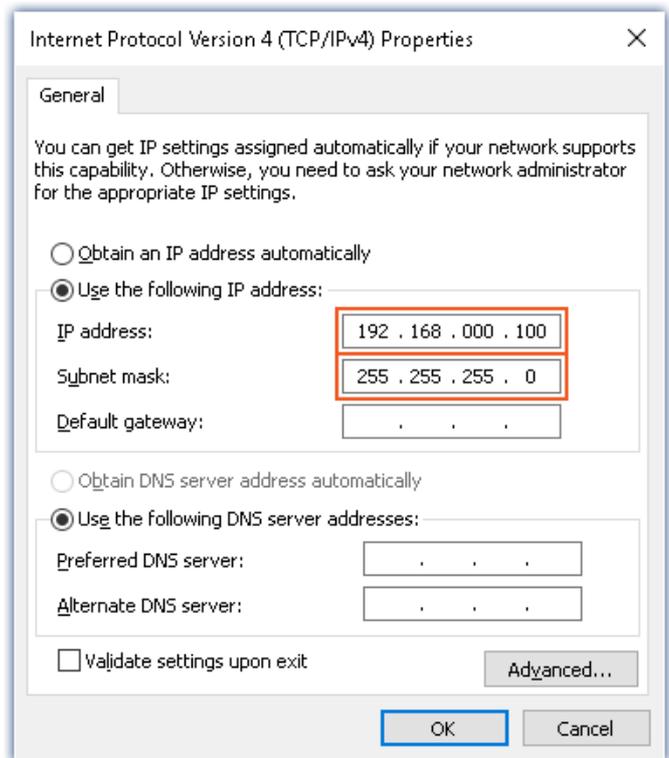


Fig. 15: Set network properties

In rare cases, a firewall on your measuring computer may block the network connection. In this case, contact your system administrator if necessary.

Open any web browser and call up the network address of the Dx-RCI receiver unit (default setting: 192.168.0.212).



Fig. 16: Dx-Start menu

Now you can perform the configuration via your web browser.

Note

The following steps (see Dx-Manual chapter "Integrate new Dx-SCT transmitter unit" to "start measurement") can be performed both on the Dx-RCI receiver unit and via your web browser. Please note that when configuring via the web browser, you must confirm your entries with the Set button so that they are transferred to the Dx telemetry system.

9.1.2 Change radio frequency

If, for example, you are carrying out measurements on a test track where other D^x-Telemetry systems are also running, then it may be necessary to change the radio frequency of your system so that you do not get in each other's way. For the most interference-free operation, the transmit frequencies should be at least 600 kHz apart.

Each WTT has a D^x-SCT transmitter unit inside. The serial number of the D^x-SCT inside is lasered on the on/off switch of the respective WTT.

In the example, let us assume that you are using a complete system with four WTTs and a D^x-RCI receiver unit. Your system is set to 864 MHz, and you want to change the frequency to 870 MHz.

Note that you always set the D^x-SCT transmitting units of all WTTs to the new frequency first, one after the other, and only finally change the D^x-RCI receiving unit to this same frequency. If you choose the other sequence, you will lock yourself out.

1. Switch on the D^x-RCI receiver unit.
2. Switch off all transmitting unit D^x-SCTs except for the D^x-SCT which you want to include (i.e., set only the switch on the corresponding WTT to "ON" whose frequency you want to change at the moment, all other WTTs to "OFF". The frequency of the individual D^x-SCTs will be changed one after the other, therefore only one of your D^x-SCTs should be switched on at the moment).
3. Set the D^x-RCI to the same frequency, in the example 864 MHz, as the D^x-SCT to which you want to establish a connection (in the menu under *Devices* → *Base RCI* → *Radio Frequency*). If you have not yet changed the factory settings, the frequency should already be correct.
4. Search for the D^x-SCT (*Devices* → *Device X* → *Search*). After the *Device found!* message, continue with the configuration.
5. Change the transmit frequency from the D^x-SCT (under *Devices* → *Device X* → *Frequency*) to the desired transmit frequency, in the example 870 MHz. For the most interference-free operation possible, the transmit frequencies should be at least 600 kHz apart.
6. Program the D^x-SCT (*Devices* → *Device X* → *Program*).



Warning

Attention

Due to the changed transmission frequency, this D^x-SCT is now no longer accessible!

9. After the *Program done!* message, switch off the D^x-SCT (by setting the switch on the corresponding WTT to "OFF").
10. Now supply the next D^x-SCT with voltage (by setting the switch on the next WTT to "ON").
11. Repeat steps 2 - 10 with the respective D^x-SCT switched on, for all four WTTs.
12. Now change the transmit frequency of the D^x-RCI (*Devices* → *Base RCI*) to the frequency set for the D^x-SCTs, in the example 870 MHz. Confirm with *Program*.
13. Now switch on all D^x-SCTs (by setting the switch on all WTTs to "ON").
14. Now go to the measurement mode (*Measure* → *Start*) and check whether the reception bar appears for each D^x-SCT.

15. Save the settings in your DXP file (=configuration file). By default, this is the DEFAULT.dxp. When the D^x-RCI receiver unit is restarted, the DEFAULT.dxp configuration file is always read in. If you save your configuration under this file name, it will be available immediately after switching on. Select the *Load/Save* menu item. Under *File Name*: enter the desired file name. Select the *Save* button. Confirm the message *Parameters saved!* with *OK*.

Note

If you select DEFAULT.dxp, this file is automatically read in when the D^x-RCI is restarted.

9.1.3 Validation of the reception levels

Check the reception levels of the mirror antennas.

- To do this, set the On/Off switch to "ON" on the WTTs that are already installed.
- Start the D^x-RCI receiver unit and enter measurement mode there (in the "*Measure* → *Start*" menu).
- Now turn your steering wheel all the way in and start driving slowly on a test track.
- While doing so, observe the reception level display at the top edge of the D^x-RCI display.

9.2 Perform measurement

9.2.1 Connecting data acquisition system to Dx-RCI via CAN

For measurement data acquisition, connect a data acquisition system to the D^x-RCI via the CAN bus.

If the D^x-RCI is located at one end of the CAN bus, a 120-Ω terminating resistor must be inserted between the connection on the D^x-RCI and the cable. The D^x-RCI does not have a built-in CAN terminating resistor.

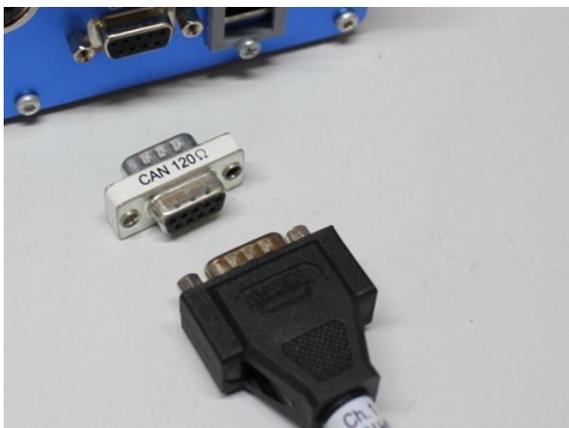


Fig. 17: CAN terminating resistor



Fig. 18: Plugged CAN terminating resistor

9.2.2 Connecting data acquisition system to analog outputs

Connect, if desired, a measurement data acquisition system (also) to the analog outputs. Each analog output can be assigned to a channel. For individual settings, please consult the D^x-Telemetry manual.

9.2.3 Zero adjustment

You have two options for zeroing: Either all wheels hang freely, e.g. if the vehicle is on a lifting platform, or you let the car roll out on a flat surface and then perform the zero adjustment.

For the latter method, zeroing after coasting, please proceed as follows:

Set the car in motion and then let it coast.

When coasting, pay attention to the following:

- do not depress the brake pedal
- do not accelerate
- set the automatic transmission to "Neutral"
- drive in a straight line
- drive on a level and smooth surface.

Carry out the zero adjustment after coming to a standstill.

If the zero adjustment is to be stored in non-volatile memory, you must program the relevant D^x-SCT. This is done by programming channel 1 of the D^x-SCT (*Channels -> (Device X) -> Channel 1 -> Program*). The zero adjustment is then stored in the D^x-SCT.

If you do not program the D^x-SCT in question, the zero adjustment will be lost when the D^x-SCT is switched off.

The settings in the D^x-RCI for a zero adjustment are shown below in detail:

9.2.3.1 Set Autozero

Perform the following steps individually for each WTT, i.e. for each D^x-SCT transmitting unit:

Open the desired channel with *Channels* → (*Device X*) → *Channel X*.

To be able to perform a zero adjustment for this channel in measurement mode, place a check mark next to *Autozero*. This is the default setting.

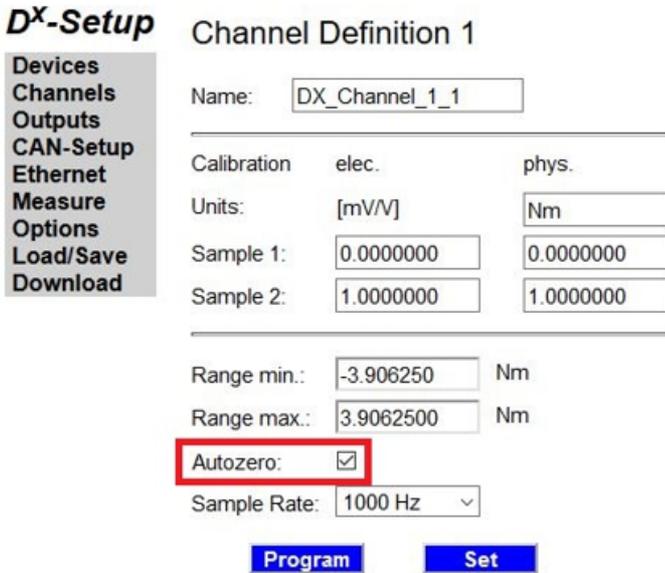


Fig. 19: Set check mark at Autozero (screen shot web browser)

When configuring via a web browser, click *Set* to apply the settings.

During the measurement (started via *Measure* → *Start*), an Autozero can now be triggered. To do this, press the *Autozero* button. Wait until the process is completed. The measured variable must be stable during the adjustment process.

The channels for which the check mark for *Autozero* is not set remain unchanged.

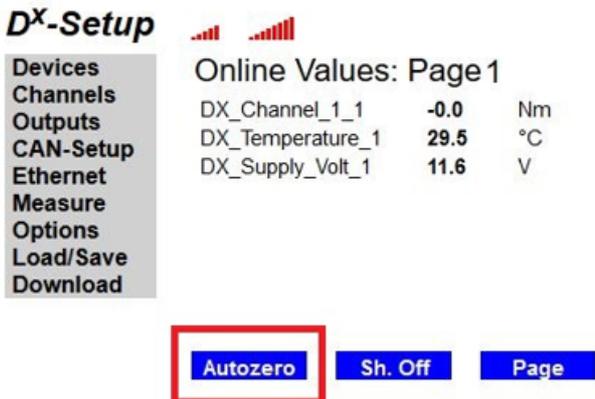


Fig. 20: Trigger Autozero during measurement (screen shot web browser)

Note

The measured parameter (variable) must be stable during the adjustment process.

If the adjustment is to remain permanently stored in the D^x-SCT transmitter unit, the corresponding channel must be programmed after the zero adjustment (*Channels* → (*Device X*) → *Channel X* → *Program*).

D^x-Setup Channel Definition 1

Devices
Channels
Outputs
CAN-Setup
Ethernet
Measure
Options
Load/Save
Download

Name:

Calibration	elec.	phys.
Units:	<input type="text" value="[mV/V]"/>	<input type="text" value="Nm"/>
Sample 1:	<input type="text" value="0.0000000"/>	<input type="text" value="0.0000000"/>
Sample 2:	<input type="text" value="1.0000000"/>	<input type="text" value="1.0000000"/>

Range min.: Nm

Range max.: Nm

Autozero:

Sample Rate:

Fig. 21: Program channel (screen shot web browser)

Note

The zero adjustment can be permanently stored in the D^x-SCT by programming any channel of the D^x-SCT.

9.2.3.2 Cancel Autozero

To delete a stored zero balance value again, open the desired channel with *Channels* → (*Device X*) → *Channel X*.

Remove the check mark from *Autozero*.

***D^x*-Setup**

Devices
Channels
Outputs
CAN-Setup
Ethernet
Measure
Options
Load/Save
Download

Channel Definition 1

Name:

Calibration	elec.	phys.
Units:	<input type="text" value="[mV/V]"/>	<input type="text" value="Nm"/>
Sample 1:	<input type="text" value="0.000000"/>	<input type="text" value="0.000000"/>
Sample 2:	<input type="text" value="1.000000"/>	<input type="text" value="1.000000"/>

Range min.: Nm

Range max.: Nm

Autozero:

Sample Rate: ▾

Fig. 22: Remove check mark from Autozero (screen shot web browser)

When configuring via a web browser, click *Set* to apply the settings.

Now reprogram the channel with *Channels* → (*Device X*) → *Channel X* → *Program*.

D^X-Setup Channel Definition 1

Devices
Channels
Outputs
CAN-Setup
Ethernet
Measure
Options
Load/Save
Download

Name:

Calibration	elec.	phys.
Units:	<input type="text" value="[mV/V]"/>	<input type="text" value="Nm"/>
Sample 1:	<input type="text" value="0.0000000"/>	<input type="text" value="0.0000000"/>
Sample 2:	<input type="text" value="1.0000000"/>	<input type="text" value="1.0000000"/>

Range min.: Nm

Range max.: Nm

Autozero:

Sample Rate:

Fig. 23: Program channel (screen shot web browser)

Now the previously saved alignment is canceled again.

If you want to trigger an Autozero again, open the desired channel with *Channels* → (*Device X*) → *Channel X*. Now check the *Autozero* box again.

Note

To delete a stored zero balance value again, remove the check mark from *Autozero* and reprogram the channel.

In order to be able to carry out a new *Autozero*, then set the checkmark at *Autozero* again and reprogram the channel.

9.2.4 Zero adjustment remotely via CAN message

It is also possible to trigger a zero adjustment remotely via a CAN message.

To set this, go to the *CAN Setup* → *Rem. Ctrl* menu in the D^x-RCI receiver unit.

The screenshot shows two configuration sections: 'Autozero Message' and 'Shunt Message'. Each section has an 'Id' field with '0x300', a 'hex' checkbox (checked), an 'active' checkbox (unchecked), a 'Bit Position' field, and a 'Length=1' label. In the 'Autozero Message' section, the 'Bit Position' is '0'. In the 'Shunt Message' section, the 'Bit Position' is '8'. An 'OK' button is located at the bottom center of the dialog.

This function allows other devices to remotely activate the "Autozero" function or the "Test Shunt" on your D^x system.

Id: Enter here the desired CAN-Id for the "Autozero Message" in decimal or hexadecimal.
(Autozero Message)

Id: Enter here the desired CAN-Id for the "Shunt Message" in decimal or hexadecimal.
(Shunt Message)

hex: Switching the CAN-Id from decimal to hexadecimal

active: Activate the message. Only if this box is selected, the message is received via the CAN bus.

Bit Position: Specifies the bit position for the remote messages (autozero and shunt).
One bit is required in each case:

Shunt: Change from 0 => 1 switches shunt on.
Change from 1 => 0 switches shunt off.

Autozero: Change from 0 => 1 triggers Autozero.

To be able to trigger an Autozero again, the bit must first be set to 0 again.



Warning

Attention

- For a permanent change of the settings, the configuration must be saved via the Load/Save menu item.
- Whenever changes are made to a CAN message, *CAN-Setup*→*General*→*write* must also be executed to rewrite the DBC file.

9.2.5 Start measurement

9.2.5.1 Measurement and Configuration mode

The switched-on D^x-RCI receiver unit is always in one of two modes:

- In measurement mode (*Measure* → *Start*), data is processed and transmitted to the CAN bus.
- In configuration mode, you can program the D^x-RCI receiver unit and the D^x-SCT transmitter unit. No measurement data is transmitted here.

To ensure consistent data, the measurement mode is exited as soon as you leave the *Measure* → *Start* page using the scroll wheel or via the network connection.

Warning

A new call of the D^x configuration menu via your network connection automatically directs you to the D^x start page. The system interrupts the data transmission and switches to configuration mode. Therefore, make sure during the measurement that there is no new access to the D^x-RCI via the network. To do this, disconnect the Ethernet cable, for example.

9.2.5.2 Start measurement

In the *Measure* menu item, select the *Start* subitem. The system now switches to the measuring mode.

9.2.5.3 Switch Online-Display

In the web browser, you can switch between the 5 online displays by clicking *Page*. On the D^x-RCI receiver unit, press the "up" and "down" keys of the scroll wheel to switch between the online views.

9.2.5.4 Cancel measurement

To exit the measurement mode, press the *Cancel* button on the D^x-RCI receiver unit. You can cancel the measurement via the web browser by clicking on any menu item.

10 Charge/Change Battery

10.1 General



Fig. 24: WTT with battery and loosened partial cover (exploded view)

1. Whenever you want to charge or change the battery, first set the On/Off switch of the WTT to "OFF".
2. Always charge or change the battery when it is dry. If the partial cover is removed, the WTT is no longer tight.
3. Only charge the battery at an ambient temperature between 0 °C and 60 °C.
4. The outer screws on the battery can be loosened, but not pulled out. This prevents you from losing a screw.
5. Also when changing the battery, first set the On/Off switch to "OFF", loosen the partial cover and pull out the plug; only then loosen the remaining screws.
6. The partial cover has a pin, marked red in the [figure 25](#)⁴³. This pin MUST be present, otherwise the partial cover may come loose at high speeds.

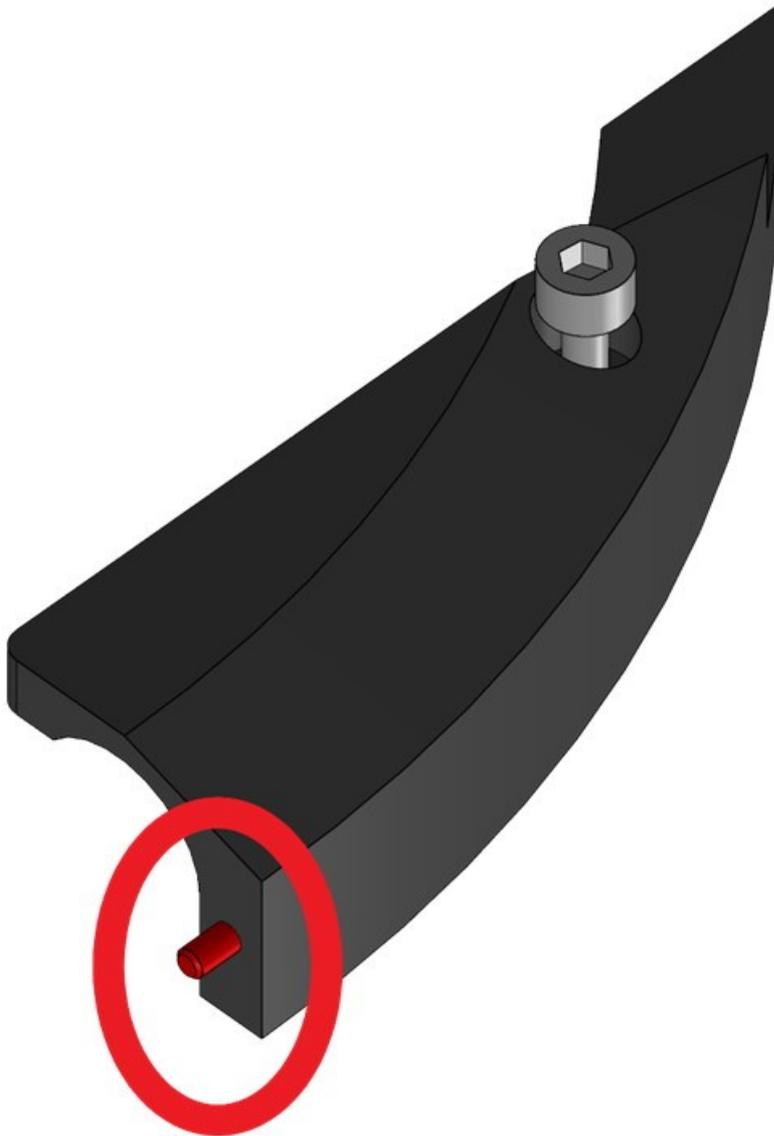


Fig. 25: Partial cover with a marked pin

10.2 Charge battery



Fig. 26: Remove the partial cover and load the battery

1. There is a partial cover next to the on/off switch. It can be recognized visually because it is very slightly separated.
2. Loosen the screw of the partial cover. It can be loosened, but not pulled out.
3. Slide the partial cover to the side and remove it.
4. Unplug the connector, which is now accessible.
5. Connect the charger instead.
6. Wait until the battery is charged. Then the LED on the charger lights up green. For everything else, please refer to the enclosed manual.
7. Disconnect the charger plug.
8. Reconnect the plug inside.
9. Reattach the partial cover. This has a pin on the side that protrudes somewhat. This pin **MUST** be present, otherwise the partial cover may come loose later at higher speeds. So slide the part cover on and make sure that the pin is threaded in.
10. Tighten the screw again with the tightening torque according to the current screwing instructions.
11. The WTT is ready again. If necessary, set the on/off switch to "ON".

10.3 Change battery



Fig. 27: Change battery

1. Set the switch on the WTT to "OFF".
2. There is a partial cover next to the on/off switch. It can be recognized visually because it is very slightly offset.
3. Loosen the screw of the partial cover. It can be loosened, but not pulled out.
4. Slide the partial cover to the side and remove it.
5. Unplug the connector, which is now accessible.

Warning

Attention

Also when changing the batteries, first pull out the plug; only then loosen the remaining screws.

6. Now loosen the remaining 5 screws. They can also be loosened, but not pulled out.
7. Now the battery - the entire black ring - can be removed.
8. Attach the replacement battery. Make sure that everything is dry and clean and that the battery lies flat.
9. Do not yet screw in the screw for the partial cover. Screw in the remaining 5 screws with a tightening torque according to the current screwing instructions.
10. Connect the plug inside.
11. Replace the partial cover. This has a pin on the side that protrudes somewhat. This pin **MUST** be present, otherwise the partial cover can come loose later at higher speeds. So slide the part cover to the side and make sure that the pin is threaded in.
12. Tighten the screw again according to the current screwing instructions.
13. The WTT is ready again. If necessary, set the On/Off switch to "ON".

11 Accessories/options

11.1 Batteries

imc offers additional batteries for the WTT that are easy to change. This allows you to have one battery in operation while the other is charging.

11.2 Antennas



Fig. 28: Antennas for the exterior mirror of a car (front and rear)

imc offers mirror antennas for the D^x telemetry system. This allows you to receive your measurement data outside the vehicle and pass it through to the D^x-RCI receiver unit inside the car.

11.3 Rims and hub adaptor



Fig. 29: Hub adaptor and modified rim

Through imc you can purchase rims and hub adaptors designed according to your specifications. For this, please contact us at [imc customer service](#) .

11.4 Calibration

The manufacturer recommends annual calibration of the WTT!



Reference

For further information on calibration, contact imc directly at hotline@imc-tm.de or your responsible distributor.

12 Technical Specs

12.1 Technical Specs - WTT

Parameter	Value	Remarks
Measured Variable	axial torque M_y	
Signal transmission	digital-telemetry	
Measurement range	$M_y = \pm 3000 \text{ Nm}$	optional $\pm 6000 \text{ Nm}$
Bandwidth	max. 1 kHz	
Nonlinearity	<0.5 %	of applied load
Hysteresis	<0.5 % FS	
Crosstalk	<0.5 %	of applied load
Sensor diameter	300 mm	
Sensor weight	approx. 4.75 kg	with telemetry unit
Material of sensor	aluminum	
Min. rim- \varnothing	13"	
Max. hub- \varnothing	6" with adapter	
Operating temperature	-10 °C to +60 °C -30 °C to +65 °C	standard batteries special batteries
Max. velocity	250 km/h	
Max. acceleration	50 g	
Protection class	IP67 (waterproof)	
Mounting and balancing	free access to wheel bolts	
Power supply	rechargeable battery, approx. 50 hrs operating time	
Autozero	remote control	
Signal output	CAN, analog	

Inputs for Voltage-signals: 1 differential input and 1 single ended input		
Parameter	Value	Remarks
Measurement range	$\pm 0.2 \text{ V}$ to $\pm 22 \text{ V}$	
Accuracy	0.01 % FS	
Resolution	16 Bit	
Sampling rate	max. 4.8 kHz	per channel
Antialiasing filter	6-pol Butterworth filter	cut-off frequency 1/5 of sampling rate

Input for temperature signal		
Parameter	Value	Remarks
Measurement range	-40 °C to +85 °C	type K

Index

A

Autozero 36

B

Battery

change 45

charge 44

C

Cable 8

Calibration 16

CAN 34

Check list 22

Components

antennas 20

Dx Receiver 19

hub adapters 20

modified rim 20

Sensor with integrated batteries 18

Condensation 12

Customer support 5

D

Dx Configuration menu

CAN-Setup - Rem. Ctrl 40

Dx-RCI via CAN 34

H

Hotline 5

I

Industrial safety 10

Industrial safety regulation 10

Installation

step by step 24

L

Liability 5

M

Maintenance 16

N

Norms

ISO 9001 5

RoHS 2 6

O

Operating personnel 9

Q

Quickstart 29

S

Safety 15

Service 16

Special hazards 10

Standards

IATA 16

Storage 16

Symbols 8

T

Transport 16

U

Unpacking 12

W

Warranty 5

Z

Zero adjustment 35