

## Manual

### **Antenna Coupler**

**R&S® CMU-Z10**

1150.0801.10

### **RF Shielding Cover for R&S® CMU-Z10**

**R&S® CMU-Z11**

1150.1008.02

### **Bluetooth® Antenna**

**R&S® CMU-Z12**

1150.1043.02

### **USB Feed Through**

**R&S® CMU-Z13**

1159.1200.20

### **Extra N Connector for R&S® CMU-Z10**

**R&S® CMU-Z14**

1200.1205.02

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## Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, you must observe all instructions and warnings given in this operating manual.



1. In order to comply with local EMC regulations, in some places it may be necessary to have the RF shielding cover R&S® CMU-Z11 in place and latched when using the antenna coupler R&S® CMU-Z10 or the Bluetooth® antenna R&S® CMU-Z12. It is the user's responsibility to ensure that the coupler R&S® CMU-Z10 and the antenna R&S® CMU-Z12 is used in compliance with local regulations.
2. The RF sealing cord supplied with R&S® CMU-Z11 is an expendable part that must be exchanged if it is visibly worn out or damaged.
3. The shielding cover must be latched and the transport lock must be fixed whenever the R&S® CMU-Z10/-Z11 is carried or transported.
4. The shock absorber is to protect the antenna coupler, the shielding cover and the RF sealing cord from damage and the user from injury when the cover is closed. Never use the shielding cover R&S® CMU-Z11 without the shock absorber fixed on both sides. Defective shock absorbers must be replaced.
5. Keep your fingers and any of the connecting cables away from the coupler so that you cannot squeeze them when closing the shielding cover.



## Short Description of R&S® CMU-Z10/.../-Z14

The R&S® CMU-Z10/-Z11/-Z12/-Z13/-Z14 test equipment is a complete solution for simple coupling and interference-free testing of mobile phones (MS) in the complete frequency range between 770 MHz and 2.2 GHz.

- R&S® CMU-Z10 is the basic broadband antenna coupler.
- The RF shielding cover R&S® CMU-Z11 upgrades the antenna coupler to a fully enclosed RF shielded chamber.
- The *Bluetooth*® antenna R&S® CMU-Z12 can be integrated into the antenna coupler or used separately.
- The USB Feed Through R&S® CMU-Z13 can be mounted instead of the DATA THROUGH connector or the *Bluetooth*® antenna in order to test a USB data connection between the MS under test and a PC in parallel to the RF connection.
- The Extra N Connector R&S® CMU-Z14 can be mounted instead of the *Bluetooth*® antenna in order to provide an additional RF feed through; see section *Two-Cell Test Scenarios* on p. 9.

The physical properties of the test equipment and the technical specifications are described in the data sheet. The following pages are to describe the different components and connectors of the test system and their use. They also describe the upgrade of an antenna coupler R&S® CMU-Z10 with the RF shielding cover R&S® CMU-Z11, measurement and correction of the coupling factors, and the performance test.

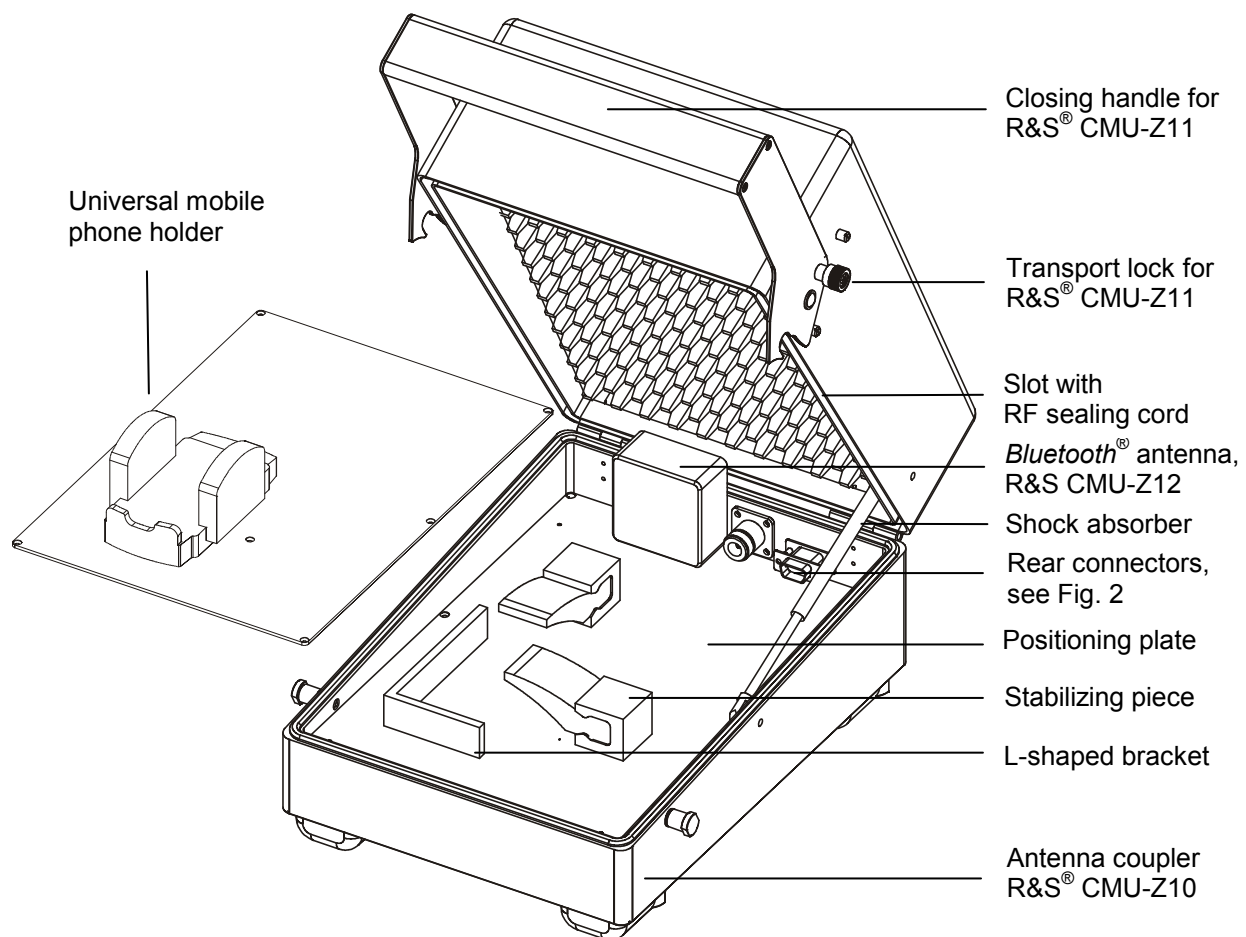


Fig. 1 R&S® CMU-Z10/-Z11/-Z12

## Rear Connectors

On its rear side the antenna coupler R&S® CMU-Z10 is equipped with two N connectors for input and output of RF test signals, a sub-D connector for input and output of DC, AF or data signals, and an additional N connector if the *Bluetooth*® antenna (R&S® CMU-Z12) or Extra N Connector (R&S® CMU-Z14) is fitted.

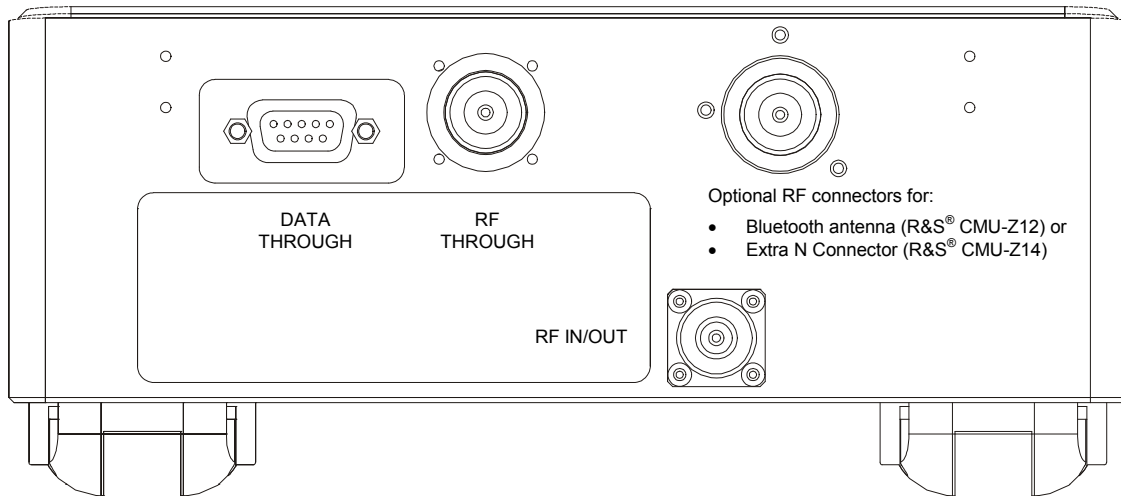


Fig. 2 R&S® CMU-Z10 rear connectors

### Description of the connectors

To test a mobile with the antenna coupler, the test instrument is connected to the coupler via the *RF IN/OUT* connector:

***RF IN/OUT*** Standard bi-directional N female connector for antenna coupler R&S® CMU-Z10

The following connectors can be used to connect the AF and RF circuit of a mobile station that is tested in the shielded chamber but without using the antenna coupler (to be used with option R&S® CMU-Z11).

***DATA THROUGH*** 9-pin or 15-pin sub-D female connector for the DC, AF or data signals of the MS under test

***RF THROUGH*** Bi-directional N female connector for the RF circuit of the MS under test

The last RF connector is used to test *Bluetooth*® devices in the shielded chamber. It is available if option R&S® CMU-Z12, *Bluetooth*® antenna, is fitted. Otherwise the opening for the connector is closed with a metal plate.

### Optional connectors

***Bluetooth*® Antenna** The *Bluetooth*® antenna (R&S® CMU-Z13) can be mounted to the right of the RF THROUGH connector; see section [Mounting the Bluetooth® Antenna](#) on p. 19.

***USB Feed Through*** The USB Feed Through (R&S® CMU-Z13) can be mounted instead of either the DATA THROUGH connector or the *Bluetooth*® antenna (see section [Mounting the USB Feed Through](#) on p. 19.).

**Tip:** *For the test of a USB data connection, the two possible connector positions are equal. Just replace the connector that you do not need for parallel tests.*

***Extra N Connector*** The Extra N Connector (R&S® CMU-Z14) can be mounted to the right of the RF THROUGH connector, instead of the *Bluetooth*® antenna; see section



*Mounting the* on p. 19. The purpose of the Extra N Connector is described in section *Two-Cell Test Scenarios* on p. 9.

**Connection to test instrument and DUT**

R&S® CMU-Z10 is supplied with one RF cable with 2 N male connectors for connection to a test instrument (e.g. R&S® CMU 200) via *RF IN/OUT*, *RF THROUGH* or the *Bluetooth®* connector.

The *DATA THROUGH* connector is for connection to a test instrument using an appropriate cable (not supplied with the shielding chamber).

The USB Feed Through must be connected to the external computer and the MS under test using two appropriate, shielded USB cables according to standard USB 2.0.

**Note: Connecting USB cables and shielding**

*The USB Feed Through causes no radiation that might impair the shielding effect of the chamber. To avoid interference from the external connecting line, use a shielded USB cable that is equipped with EMI ferrite attenuators.*

**Note:** *The RF transmission and the coupling factors depend on the RF connection between the antenna coupler and the RF input/output of the test instrument (R&S® CMU 200). It is recommended to use the high-quality RF cable supplied with R&S® CMU-Z10 for the connection. See also section *Coupling Factors* on p. 10.*

## Two-Cell Test Scenarios

The Extra N Connector (R&S® CMU-Z14) represents an additional RF feed through that allows you to supply the MS / UE under test with two independent RF signals. The second RF signal may be provided by an external signal source emulating a second cell. With this test setup it is possible to perform two-cell tests, e.g. the receiver transmit diversity tests for HSDPA channels described in standard 3GPP TS 34.121.

A typical test setup containing the R&S CMU200 plus an R&S SMU Vector Signal Generator is shown below. The signal generator is used as a baseband fader. For more information refer to the application note 1MA87, "Testing HSDPA UE RX Diversity":

[http://www2.rohde-schwarz.com/en/service\\_and\\_support/Downloads/Application\\_Notes/?query=1MA87&type=20&downid=1005](http://www2.rohde-schwarz.com/en/service_and_support/Downloads/Application_Notes/?query=1MA87&type=20&downid=1005)

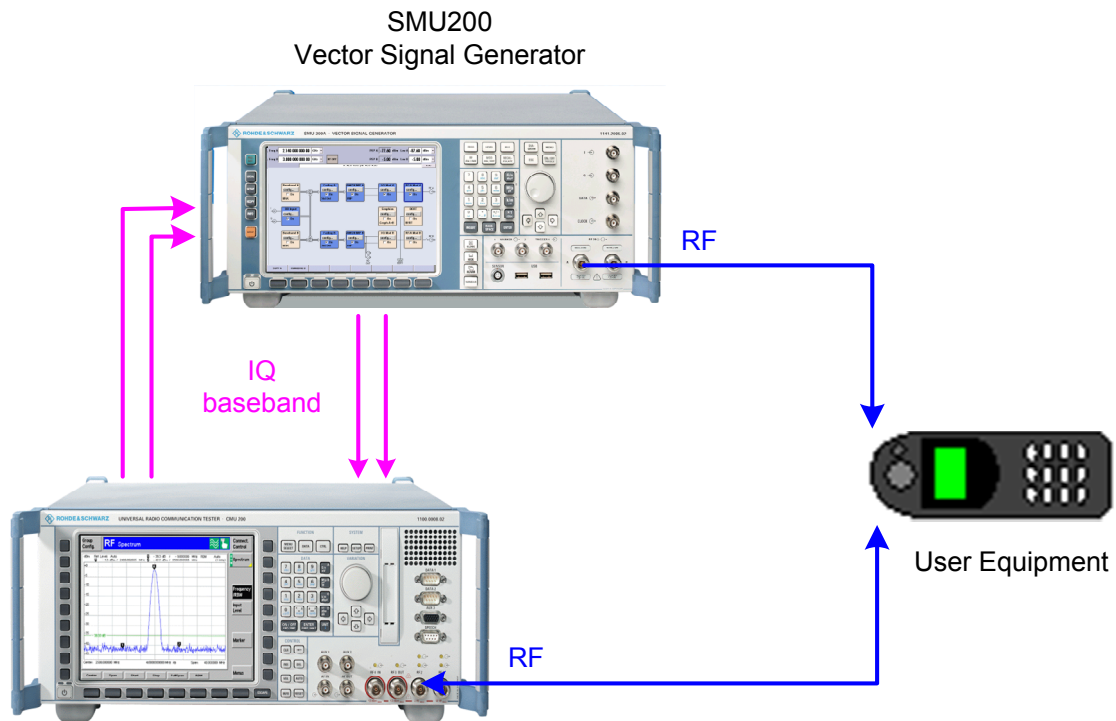


Fig. 3 Test setup for receiver transmit diversity

## Coupling Factors

The RF signal from the MS under test is attenuated on its way from the antenna coupler to the test instrument. Analogously the RF generator signal from the test instrument is received by the MS under test with a definite attenuation. We define the coupling factors for the two signal directions as the difference between transmitted and received powers:

*Output coupling factor/dB* = <RF generator level of the R&S® CMU 200>/dBm  
 – <Received input level determined by the MS (RxLev)>/dBm

*Input coupling factor/dB* = <Transmitter output power of the MS>/dBm  
 – <RF input power measured at the R&S® CMU 200>/dBm

Once the coupling factors are known for a given mobile type and RF connection they can be reported to the R&S® CMU 200 as external attenuation factors (*Ext. Att. Input, Ext. Att. Output*). The tester will then correct all power measurements by the reported input coupling factor and increase its RF generator level to compensate for the output coupling factor.

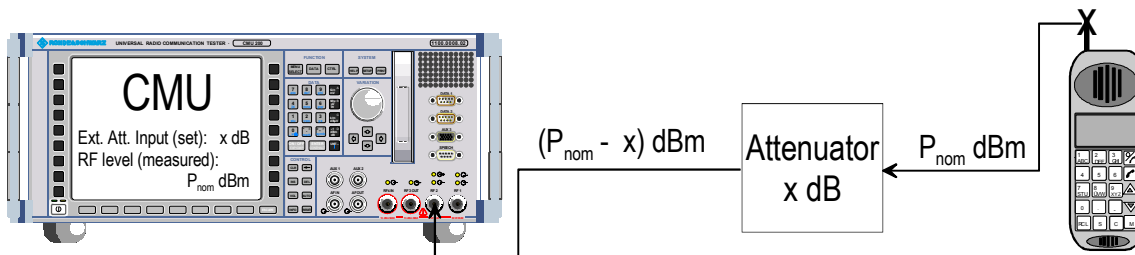
**Note:** The coupling factors depend on the position of the MS antenna relative to the active coupling zone of the antenna coupler and therefore on the mobile type (for more information see data sheet). Compiling a complete list of coupling factors for all mobile types is not practicable, however, it is sufficient to determine the coupling factors once for all mobiles of the same type.

In order to re-use the coupling factors for different mobiles of the same type, they must be put into exactly the same position on the positioning plate or in the mobile phone holder; see section [Replacing the Positioning Plate](#) on p. 18. Moreover, to exclude any additional source of errors the coupling factors for a particular mobile type must be determined using a fully functional and proven device ("golden" mobile phone).

The sign of the input and output coupling factors was chosen in accordance with the definition of external input and output attenuation factors (Ext. Att. Input, Ext. Att. Output) in the R&S® CMU 200.

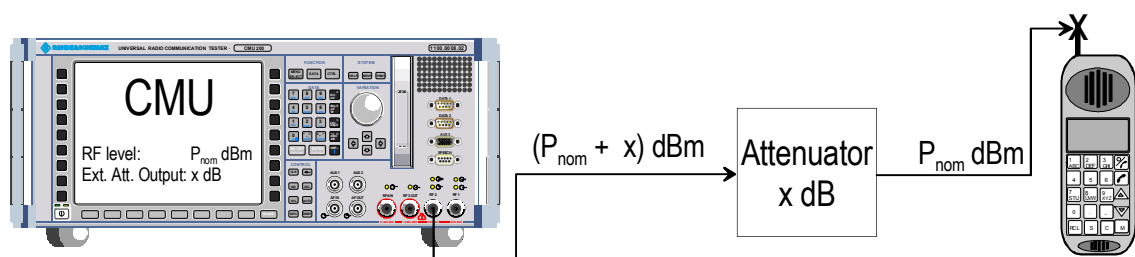
## Input Coupling Factor (→ Ext. Att. Input)

If an external input attenuation is reported to the instrument, all levels measured are referred to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.



## Output Coupling Factor (→ Ext. Att. Output)

If an external output attenuation is reported to the instrument, the output signal level is referred to the input of the DUT, the generator level is therefore shifted with respect to the actual level at the output connector of the CMU. The default value for the generator power and the level ranges for the RF outputs are also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.



## Determining the Coupling Factors

External input and output attenuation factors can be set in the *RF*  $\leftrightarrow$  tab of the *Connection Control* menu, which is provided for all network tests. The procedure of determining the coupling factors is analogous for all networks. As an example, we'll list the steps involved for a GSM mobile phone and a WCDMA UE.

### a) Preparatives (GSM or WCDMA)

1. Connect the bidirectional RF connector *RF IN/OUT* of your antenna coupler R&S® CMU-Z10 to the bidirectional RF connector RF 2 of the R&S® CMU 200, preferably using the high-quality RF cable RG 214 supplied with R&S® CMU-Z10.
2. Put a fully functional and proven MS into a well-defined position relative to the coupler; see note in section *Coupling Factors* on p. 11: Fix it on the positioning plate using the stabilizing pieces and the L-shaped bracket or fix it in the *Universal Mobile Phone Holder* mounted on the other plate of the antenna coupler; see section *Replacing the Positioning Plate* on p. 18.
3. Switch on the R&S® CMU 200 and the MS.

### b) GSM coupling factors

1. For a GSM MS, access the *GSMxxx-MS* function group (where xxx corresponds to the GSM band of your MS), *Signalling* test mode, to establish a call between the R&S® CMU 200 and the MS, setting the MS to a definite Power Control Level (PCL).

A PCL 15 for a GSM900 mobile phone corresponds to a nominal transmitter output power of 13 dBm. For more information refer to your operating manual for software options GSM400/850/900/1800/1900-MS for CMU-B21 (R&S® CMU-K20/-K21/-K22/-K23/-K24), stock no. 1115.6088.12.

2. Open the *Overview* menu to display all measurement results that are relevant for determining the coupling factors.

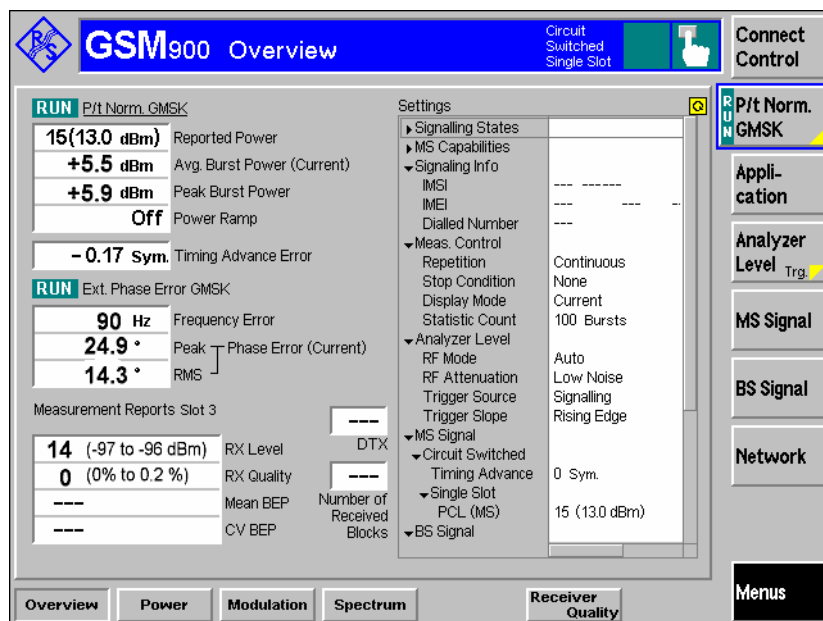


Fig. 4 GSM900 Signalling: Overview menu

3. To determine the output coupling factor of your proven mobile phone, subtract the reported *RX Level* at the MS from the output level of the CMU (*BS Signal* – *TCH Level* – *Used TS*). In the example of Fig. 4 above, assuming a *Used TS* level of –90 dBm, the output coupling factor equals to (96.5 – 90.0) dB = 6.5 dB.

4. To determine the input coupling factor of your proven mobile phone, subtract the measured *Avg. Burst Power (Current)* from the *Reported Power* of the MS. In the example of Fig. 4 above, the input coupling factor equals to  $(13.0 - 5.5) \text{ dB} = 6.5 \text{ dB}$ .
5. Press the *Connect. Control* softkey and the *AF/RF* ↻ hotkey to report the coupling factors to the R&S® CMU 200. Set the *Ext. Att. Output* equal to the output coupling factor and the *Ext. Att. Input* equal to the input coupling factor (see Fig. 5 below).

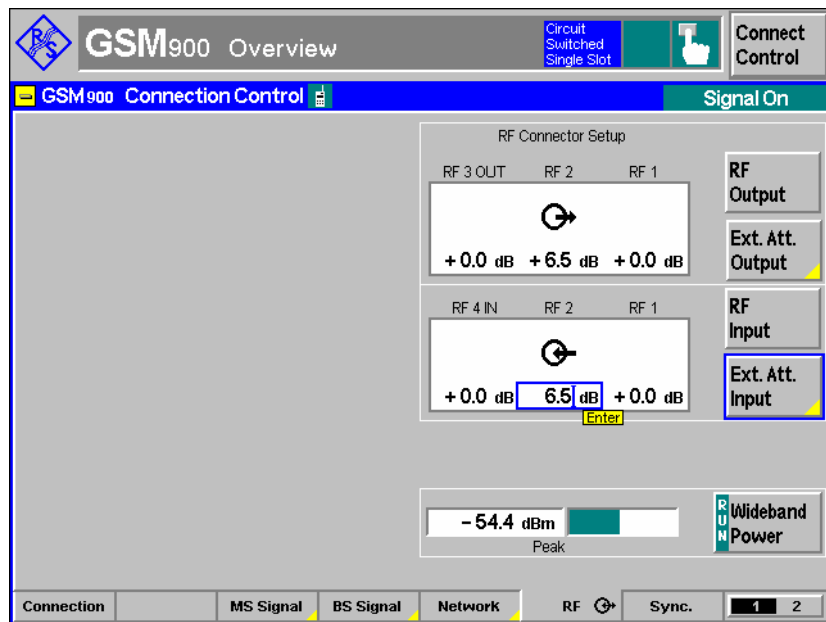


Fig. 5 GSM900 Signalling: AF/RF ↻ tab

### c) WCDMA coupling factors

1. For a WCDMA UE, access the *WCDMA UE* function group, *Signalling* test mode, to establish a call between the R&S® CMU 200 and the UE. Note the power class (1 to 4) of your UE, which is displayed in the *Connection* tab of the *Connection Control* menu.
2. Open the *Receiver Quality* measurement menu and select *Application – UE Report*.

The UE reports various parameters characterizing the quality of the radio link, in particular the CPICH RSCP (Received Signal Code Power) of the current cell.

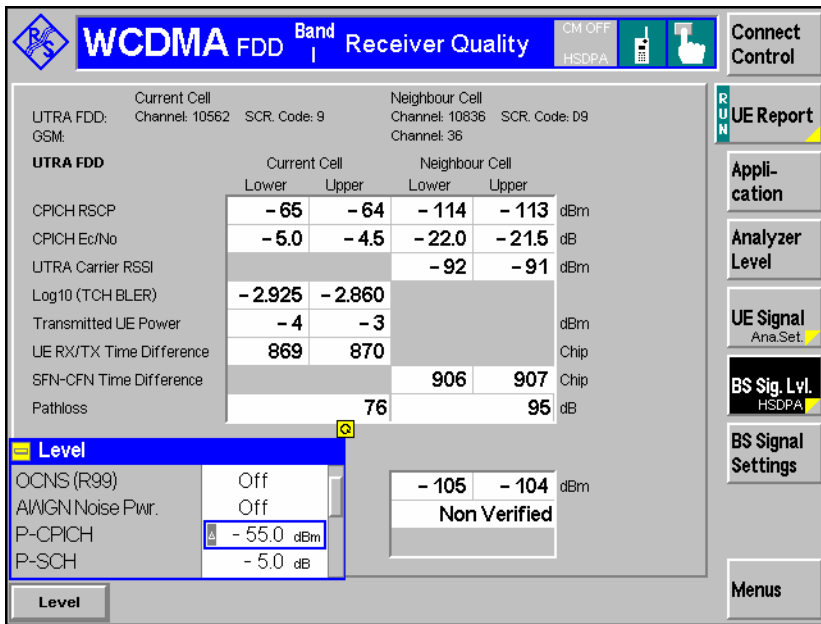


Fig. 6 WCDMA Signalling: UE Report menu

- To determine the output coupling factor of your proven mobile phone, subtract the reported *CPICH RSCP* of the current cell from the P-CPICH output level of the CMU (*BS Signal Lvl. – Level – P-CPICH*). In the example of Fig. 6 above, the output coupling factor equals to  $(64.5 - 55.0)$  dB = 9.5 dB.
- Open the *Power* measurement menu and select *Application – Maximum Power* to command the UE to transmit at its maximum power.

The maximum UE transmitter output power depends on the UE power class; it is +33 dBm for power class 1, +27 dBm for power class 2, +24 dBm for power class 3, and +21 dBm for power class 4 UEs.

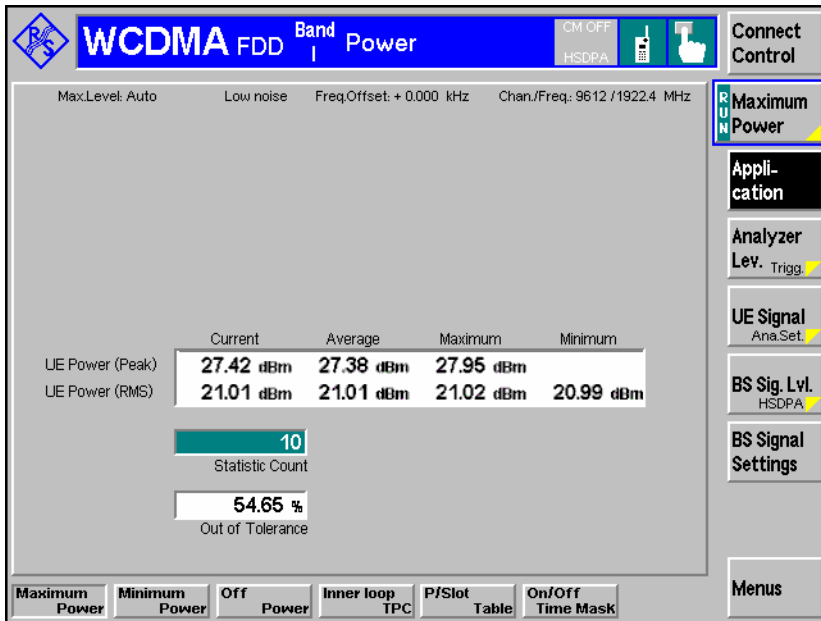


Fig. 7 WCDMA Signalling: Maximum Power menu

- To determine the input coupling factor of your proven UE, subtract the measured *UE Power (RMS)* (preferably, the *Average* value) from the nominal maximum UE transmitter output power. In the

example of Fig. 7 above, assuming a power class 3 UE, the input coupling factor equals to approx.  $(24 - 21) \text{ dB} = 3 \text{ dB}$ .

- Press the *Connect. Control* softkey and the *AF/RF*  $\rightarrow$  hotkey to report the coupling factors to the R&S® CMU 200. Set the *Ext. Att. Output* equal to the output coupling factor and the *Ext. Att. Input* equal to the input coupling factor (see Fig. 5 above).

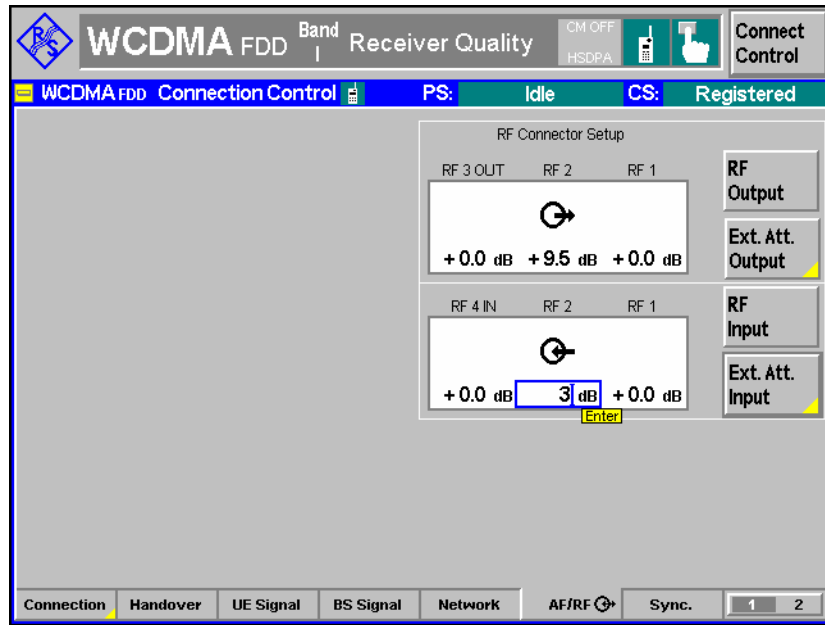


Fig. 8 GSM900 Signalling: AF/RF  $\rightarrow$  tab

## Installation Instructions

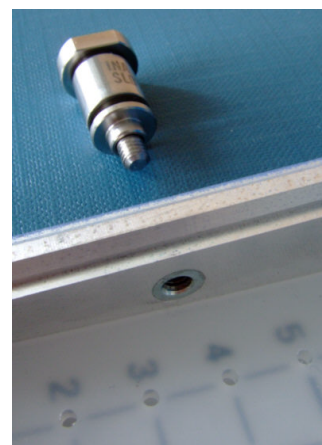
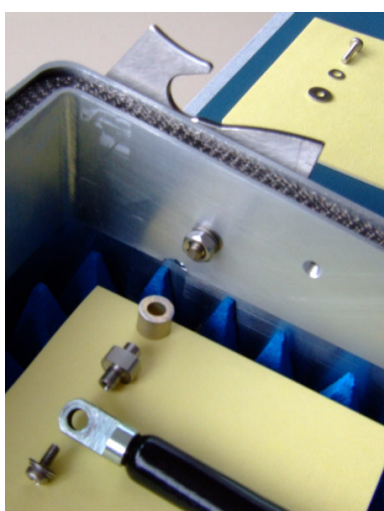
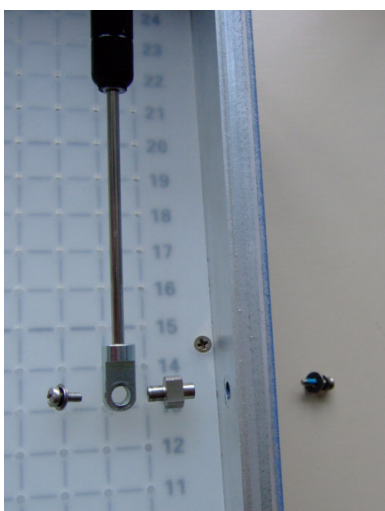
It is recommended to use the antenna coupler R&S® CMU-Z10 together with the shielding cover R&S® CMU-Z11. The shielding cover may even be required in some places to comply with local EMC regulations; see safety instructions on p. 5 of this manual. If the antenna coupler is purchased together with the cover, the shielded chamber comes ready-mounted. The same is true for the *Bluetooth*® antenna R&S® CMU-Z12.

The upgrade of the antenna coupler with the other options is described in the following sections.

### Mounting the RF Shielding Cover

To upgrade an antenna coupler R&S® CMU-Z10 with a shielding cover R&S® CMU-Z11 proceed as follows (see Fig. 9 below):

1. Prepare the shock absorber:  
Stick the long ends of the threaded bushes through the holes of the shock absorber and fix them using the two screws with captive washers (M2.5x6).
2. Insert the axe of the threaded bushes at the tinny end of the shock absorber into the hole of the R&S® CMU-Z10 and fix it with a small Phillips screw (M2.5x10) plus a small and a larger disc.
3. Turn the R&S® CMU-Z10 to its side so that the mounted shock absorber points upwards.
4. Place the other side of the shock absorber together with the additional round bush to the corresponding hole of the shielding cover and fix it with a small Phillips screw (M2.5x10) plus a small and a larger disc.
5. Use the four small (M2.5x10) countersunk screws supplied with R&S® CMU-Z11 to fix the two hinges of the shielding cover to the threads at the rear of the R&S® CMU-Z10. Start with the one at the position opposite to the shock absorber.
6. Fix the protective cover to the hinges using four screws with captive washers (M2.5x6).
7. Turn the R&S® CMU-Z10 back to normal position and fix the bearings for the closing mechanism of the cover on both sides of the antenna coupler using the custom-built screws and discs.





**Caution!**



The shock absorber is to protect the antenna coupler, the shielding cover and the RF sealing cord from damage and the user from injury when the cover is closed. Never use the shielding cover R&S® CMU-Z11 without the shock absorber properly fixed on both sides. Defective shock absorbers must be replaced.

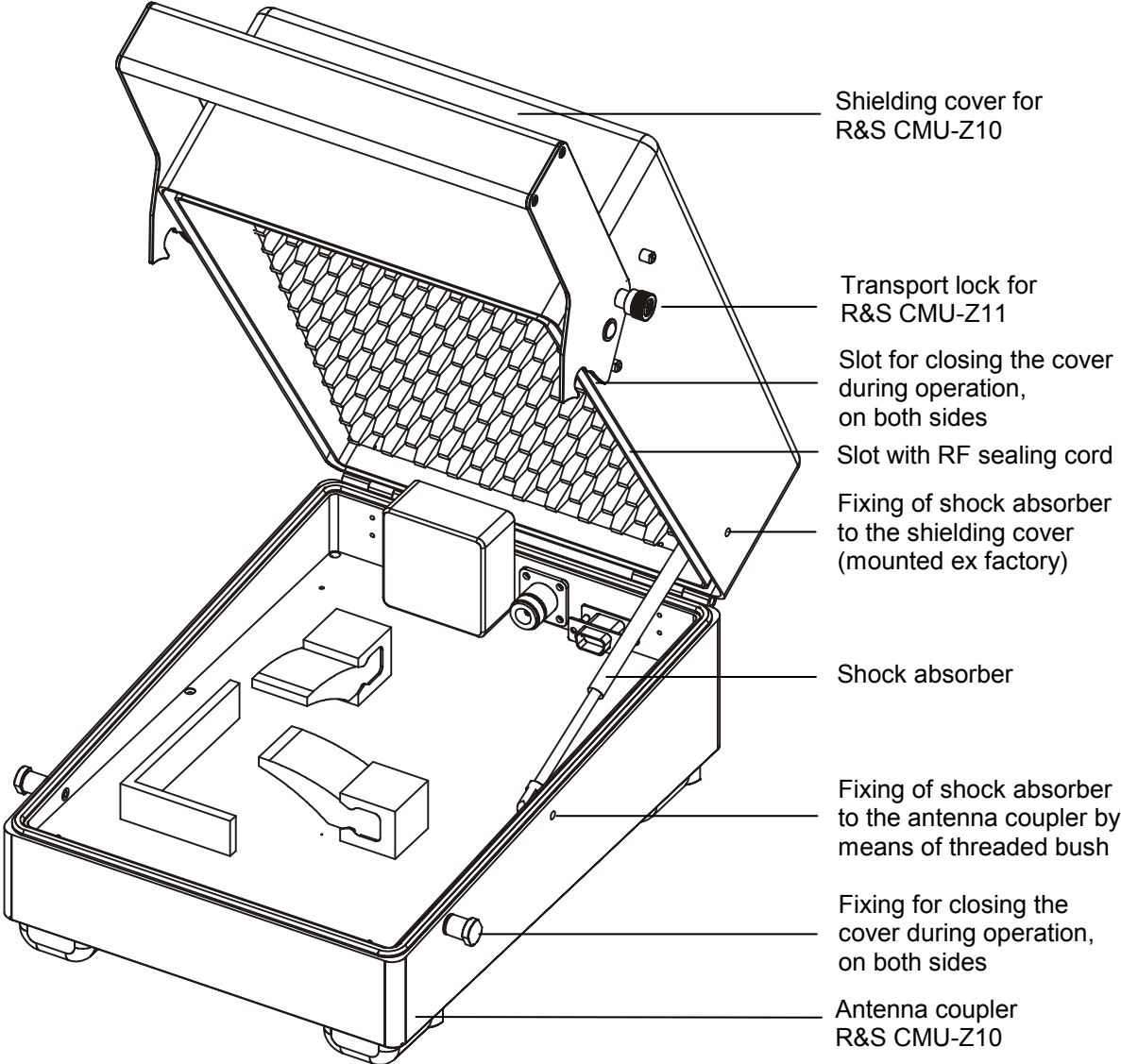


Fig. 9 Mounting the RF shielding cover R&S® CMU-Z11

## Replacing the Positioning Plate

The antenna coupler R&S® CMU-Z10 is delivered with two plastic positioning plates, one with two stabilizing pieces and an L-shaped bracket (see Fig. 1 on p. 7), the other with the *Universal Mobile Phone Holder* mounted. The two plates can be easily exchanged after unscrewing the seven Phillips screws from the top.

The purpose of both positioning plates is to hold different mobile phones in the same well-defined position; see section *Determining the Coupling Factors* on p. 12. You can select the plate according to your mobile type and your preferences:

- The positioning plate with stabilizing pieces and L-shaped bracket has a grid with numbers 1 to 26 and alphabetic characters A to R. The ideal position of the bracket is usually the one with minimum coupling factors. You can move and turn the bracket in order to determine this ideal position for each mobile type (see section *Determining the Coupling Factors* on p. 12) and note the coordinates of the corresponding reference points (e.g. E8 in Fig. 10 below).

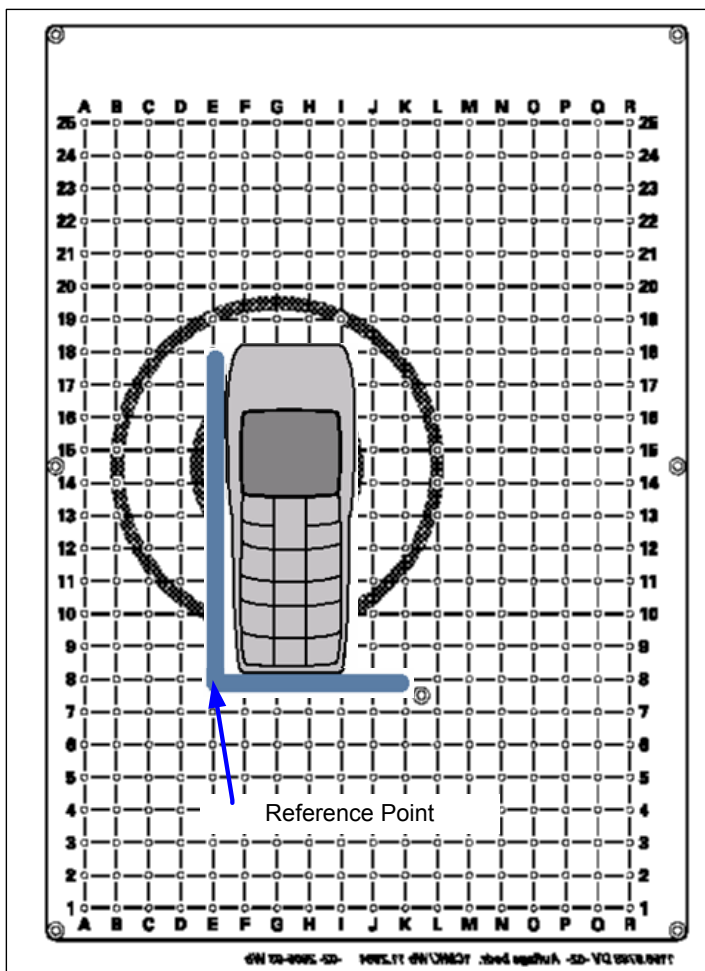


Fig. 10 L-shaped bracket and reference point

- To fix a mobile in the *Universal Mobile Phone Holder* press the button on the left side to open the clamp, place the MS onto the holder with the keyboard upwards, shifting it backwards to the stop, and close the adjustable clamp again.

## Mounting the Bluetooth® Antenna

To upgrade an antenna coupler R&S® CMU-Z10 with a *Bluetooth*® antenna R&S® CMU-Z12 proceed as follows (see Fig. 9 above):

1. Unscrew the three Phillips screws at the rear of the coupler to remove the metal plate covering the opening for the antenna connector (see Fig. 2 on p. 8).
2. Insert the antenna connector into the opening from inside the coupler. The label must be on the upper side of the antenna.
3. Re-use the three Phillips screws and the disks to fix the antenna to the coupler from the outside.

## Mounting the USB Feed Through

The optional USB Feed Through (R&S® CMU-Z13) can be mounted instead of either the DATA THROUGH connector or the Bluetooth® antenna (see section [Rear Connectors](#) on p. 8). Simply remove the DATA THROUGH connector or the Bluetooth® antenna (or mounting cover, if no antenna is mounted) and fix the USB Feed Through from the inside of the chamber. For details and drawings refer to the installation instructions supplied with the option.

**Note:** *Always use shielded cables to connect the USB Feed Through to the external computer and the MS under test (see section [Rear Connectors](#) on p. 8).*

## Mounting the Extra N Connectors

The optional Extra N Connector (R&S® CMU-Z14) can be mounted instead of the Bluetooth® antenna (see section [Rear Connectors](#) on p. 8). Simply remove the Bluetooth® antenna (or mounting cover, if no antenna is mounted) and fix the Extra N Connector from the inside of the chamber. For details and drawings refer to the installation instructions supplied with the option.

## Performance Test

Compliance of the antenna coupler R&S® CMU-Z10 with the rated specifications can be checked by connecting the coupler to a network analyzer using the RF cable supplied with the coupler. The VSWR values are listed in the data sheet. The reflection loss is > 4 dB in the frequency range between 0.77 GHz and 0.87 GHz, > 5.2 dB in the frequency range between 0.87 GHz and 2.2 GHz.

The RF shielding cover R&S® CMU-Z11 complies with the specifications provided that the RF sealing cord is not damaged; see section [Replacing the RF Sealing Cord](#) on p. 19.

Compliance of the *Bluetooth*® antenna R&S® CMU-Z12 with the technical specifications can be checked by connecting the antenna connector directly to a network analyzer. The VSWR is listed in the data sheet. The reflection loss is > 7.4 dB in the relevant frequency range between 2.4 GHz and 2.5 GHz.

## Replacing the RF Sealing Cord

The RF sealing cord supplied with R&S® CMU-Z11 is an expendable part (order no. 1158.9514.00) that is not under warranty and must be exchanged if it is visibly worn out or damaged. This can be easily done after opening the screw on the outside of the antenna coupler that fixes the shock absorber (see Fig. 9 above).

# Maintenance

The electrical components of the antenna coupler R&S® CMU-Z10 and the *Bluetooth*® antenna do not require any particular maintenance. The mechanical expendable parts are shown in Fig. 11 below.

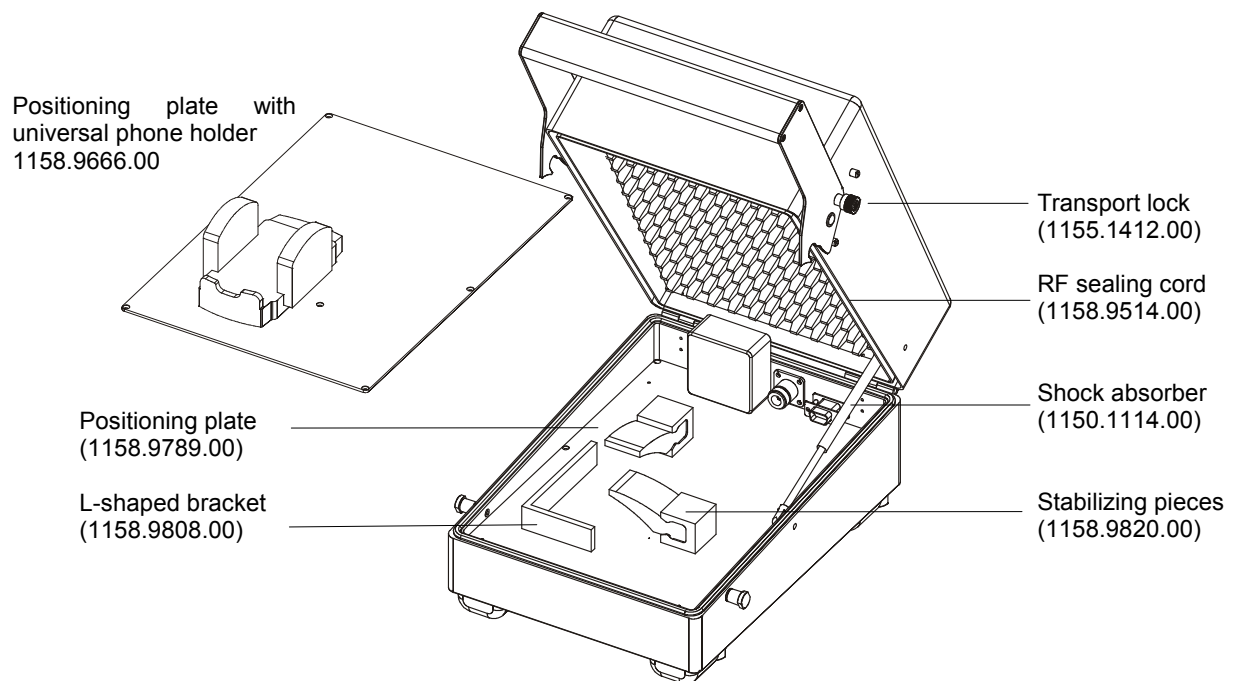
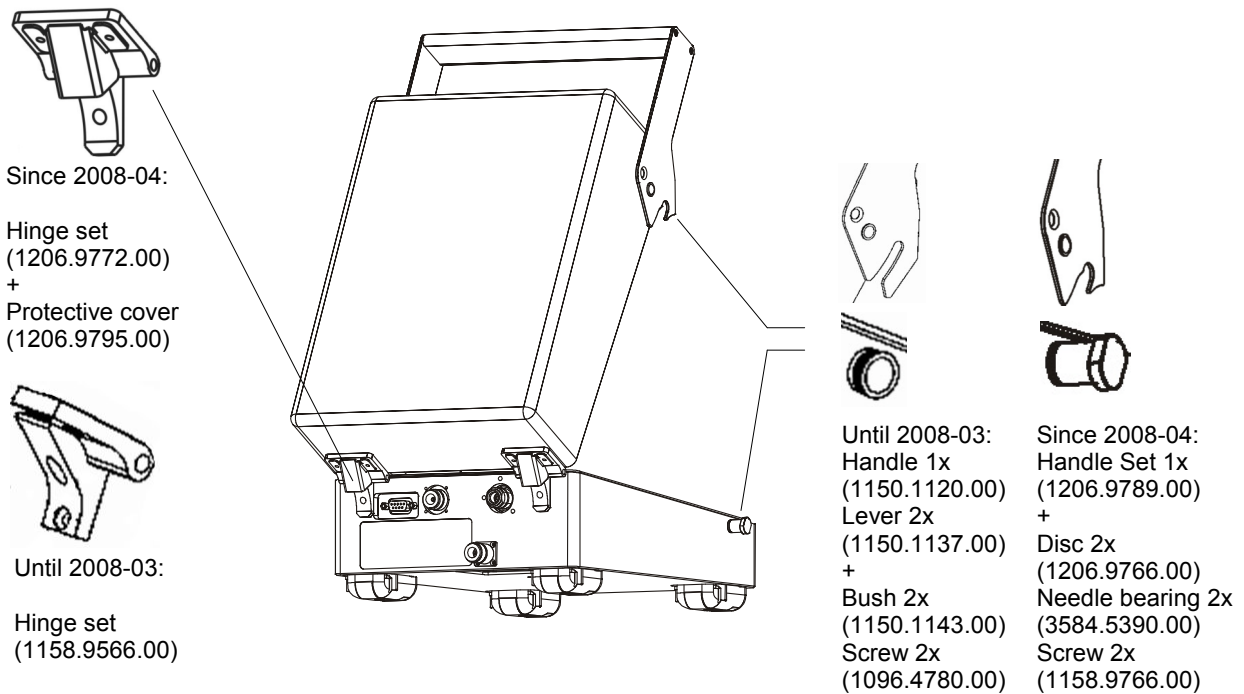


Fig. 11 Mechanical expendable parts with order numbers