CORTAB

- Cortab Service Kit

Service Manual

Version 002

Innovation with Integrity

NMR

This manual was written by

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For further technical assistance on the CORTAB unit, please do not hesitate to contact your nearest BRUKER dealer or contact us directly at:

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1 About

1.1 This Manual

This manual is intended to be a reference guide for Bruker certified service engineers. It provides detailed information about the installation, maintenance and service and overall use of the Bruker device.

The figures shown in this manual are designed to be general and informative and may not represent the specific Bruker model, component or software/firmware version you are working with. Options and accessories may or may not be illustrated in each figure.

Carefully read all relevant chapters before working on the device!

This manual describes parts and procedures relevant to the device version it is delivered with. For older hardware, please refer to the manual supplied at the time.

1.2 Policy Statement

It is the policy of Bruker to improve products as new techniques and components become available. Bruker reserves the right to change specifications at any time.

Every effort has been made to avoid errors in text and figure presentation in this publication. In order to produce useful and appropriate documentation, we welcome your comments on this publication. Support engineers are advised to regularly check with Bruker for updated information.

Bruker is committed to providing customers with inventive, high quality products and services that are environmentally sound.

1.3 Symbols and Conventions

Safety instructions in this manual are marked with symbols. The safety instructions are introduced using indicative words which express the extent of the hazard.

In order to avoid accidents, personal injury or damage to property, always observe safety instructions and proceed with care.

⚠ CAUTION

This combination of symbol and signal word indicates a possibly hazardous situation which could result in minor or slight injury unless avoided.

NOTICE

This combination of symbol and signal word indicates a possibly hazardous situation which could result in damage to property or the environment unless avoided.

This symbol highlights useful tips and recommendations as well as information designed to ensure efficient and smooth operation.

2 Introduction

This service manual is intended to be used by Bruker trained and authorized service technicians. It contains the information about the CORTAB Service Kit: installation, working principles and troubleshooting.

2.1 Concept

When a spectrometer is installed, and each time the spectrometer transmitter path changes, a procedure called CORTAB (CORrection TABles) needs to be performed. This procedure generates a table of correction factors that are automatically applied to the transmitter for all observed nuclei. These correction factors make the power output effectively linear over the whole frequency range.

Because the transmitter power is effectively linear, pulse lengths and power levels can be accurately calculated for a given nucleus based on a known 90° pulse length. The calculations for these pulse lengths and power levels for a given probe are stored in the PROSOL (PRObe SOLvent dependencies) table.

The **CORTAB SERVICE KIT** is used for the automatic transmitter output calibration procedure for Bruker **AVANCE II or newer** spectrometers. The calibration with the CORTAB Service Kit requires TopSpin version 3.0 and for systems with this TopSpin version or higher, the calibration is mandatory!

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i Since the release of firmware version 20111020_1548, it is also possible to use the CORTAB Service Kit for non-automatic power measurement on older spectrometers and/or older versions of TopSpin.

2.2 Limitation of Liability

All specifications and instructions in this manual have been compiled taking account of applicable standards and regulations, the current state of technology and the experience and insights we have gained over the years.

The manufacturer accepts no liability for damage due to:

- Failure to observe this manual
- Improper use
- Deployment of untrained personnel
- Unauthorized modifications
- Technical modifications
- Use of unauthorized spare parts

The actual scope of supply may differ from the explanations and depictions in this manual in the case of special designs, take-up of additional ordering options, or as a result of

the latest technical modifications.

The undertakings agreed in the supply contract as well as the manufacturer's Terms and Conditions and Terms of Delivery and the legal regulations applicable at the time of conclusion of the contract shall apply.

2.3 Before You Begin

This service manual contains information and safety information that are necessary for the use and servicing of the CORTAB Service Kit.

All maintenance and repairs are to be accomplished using the information in this manual. At the same time references over general maintenance and care from the User Manual are also to be followed.

Read the safety notices carefully before using the kit.

Information for ordering spare parts is available in the chapter "Packing List" on page 15.

2.4 Minimum Qualifications for Service Personnel

Type of Task	Personnel	Training and Experience
Transportation	No special requirements.	No special requirements.
Installation	Bruker certified personnel only.	Technically skilled, with a good knowledge of the application field.
Routine Use		
Daily Maintenance		
Setup and optimization of program		
Preventive Maintenance		
Servicing		

Table 2.1 Overview Installation and Operation Requirements for Personnel

2.5 The Bruker Service

Our customer service division is available to provide technical information. See "Contact" on page 41 for contact details.

In addition, our employees are always interested in acquiring new information and experience gained from practical application; such information and experience may help improve our products.

2.6 Transport to Manufacturer

When the CORTAB Service Kit must be returned to the manufacturer for repair or service, use the original packaging for transportation. Enclose a detailed failure description if applicable.

Introduction

3 Safety

This section provides an overview of all the main safety aspects involved in ensuring optimal personnel protection and safe and smooth operation.

Non-compliance with the action guidelines and safety instructions contained in this manual may result in serious hazards.

Read these safety instructions carefully and make them accessible to anyone working with the **CORTAB Service Kit**.

3.1 Intended Use

The device has been designed and constructed solely for the intended use described here. Intended use also includes compliance with all specifications in this manual.

Any use which exceeds or differs from the intended use shall be considered improper use. No claims of any kind for damage will be entertained if such claims result from improper use.

3.2 Important Safety Information

⚠ CAUTION

Material damage hazard from incorrect usage!

Incorrect usage of the CORTAB service kit can lead to incorrect calibration and damage to the probe.

- ▶ Only use the CORTAB service kit in connection with the Topspin 3.0 software or higher versions.
- ▶ Only use the CORTAB service kit with Bruker NMR spectrometer's from Avance II and newer spectrometers.

⚠ CAUTION

Material damage hazard from strong magnetic fields!

Strong magnetic fields may damage the CORTAB box.

- ▶ The CORTAB box must be used outside of the 5 Gauss line.
- ▶ Magnetic fields may negatively influence the calibration.

⚠ CAUTION

Personal injury or material damage hazard from unauthorized personnel!

Unauthorized personnel who do not meet the requirements described in this manual will not be familiar with the dangers in the working zone.

- The CORTAB service kit is exclusively used by trained Bruker authorized service engineers.
- Unauthorized persons must be kept away from the working zone.
- If in doubt, address the persons in question and ask them to leave the working zone.
- Cease work while unauthorized persons are in the working zone.

⚠ WARNING

Electrical hazard from electrical shock

A life threatening shock may result when the housing is open during operation.

- The power supply voltage must correspond to the information listed in "External Power Supply Data" on page 37.
- In case of malfunction during operation, stop the device, disconnect the power supply.
- Do not use the device if the power cord, or the device itself have visible damages.
- Inappropriate or improper repairs may result in malfunction.
- Never disassemble the device or try to repair it. Repairs and disassembly should only be carried out by Bruker, see also "Contact" on page 41.
- The CORTAB kit power supply is driven by line voltage. If the power supply no longer works properly, it should be replaced.

4 Tool Requirements

There are no special tool requirements for installation when TopSpin 3.0 or later, and an AVANCE II or newer spectrometer are used.

To use the CORTAB Service Kit as a manual power measurement tool on older spectrometers, and/or older versions of TopSpin, you will need the following:

- Firmware version 20111020_1548 for the CORTAB Service Kit (released on November, 24th 2011) or newer.
- A computer with an Ethernet connection. This computer can be the spectrometer host computer if an AVANCE II spectrometer or newer is used with TopSpin 2.0 or newer.
- DHCP software installed on the computer (included with TopSpin 2.0).
- A Web browser installed on the computer.

Tool Requirements

5 Installation

The CORTAB Service Kit (P/N H118564) consists of the following parts:

Part Number	Description	Quantity
H118155	CORTAB Service Box	1
1801411	Power Supply	1
3000	Power Cord	1
83026	Ethernet Cable (1:1)	1
57033	Rohde & Schwarz NRP-Z11 Power Meter	1
57034	USB Adapter for NRP-Zxx	1
1803177	Aluminum Carrying Case 440 x 330 x 140 mm	1

Table 5.1 CORTAB Service Kit Parts List

Figure 5.1 Contents of the CORTAB Service Kit

5.1 Installing the CORTAB Service Kit

1. Unpack the parts contained in the CORTAB service kit case.
2. Connect the N-connector of the Rohde & Schwarz power meter to the front panel of the CORTAB box.
3. Connect the USB adapter cable from the Rohde & Schwarz power meter to the USB power meter connector on the front panel of the CORTAB box.
4. Using the network cable provided, connect the CORTAB box to the spectrometer network switch (located in the console). For manual measurement on spectrometers older than AVANCE II, or with TopSpin older than 3.0, connect the CORTAB box to your computer (see "Manual Measurement" on page 33 for details).
5. Remove the RXAD cable from the HPPR(2) and connect it to the BNC Receiver connector on front of the CORTAB box.
6. Up to 4 preamplifier modules or transmitters can be connected to the rear panel of the CORTAB box. For each preamplifier, remove the N-connector from the probe and connect it to the rear panel of the CORTAB box (begin with INPUT 1).

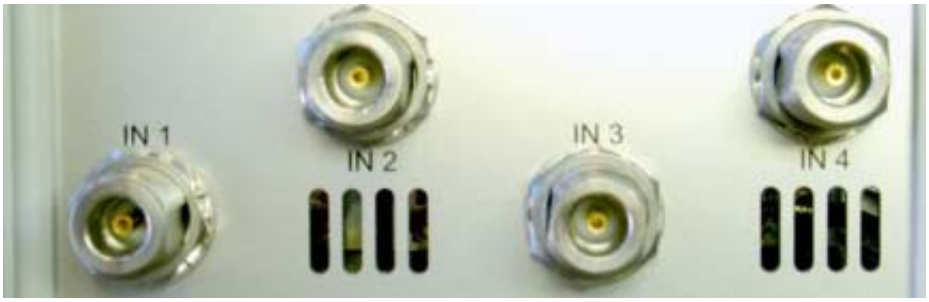


Figure 5.2 CORTAB SERVICE BOX Rear Panel

7. Connect the power cable to the power supply.
8. Connect the power supply cable to the 12V IN connector on front of the CORTAB box.
9. Connect the power supply cable to the power source.

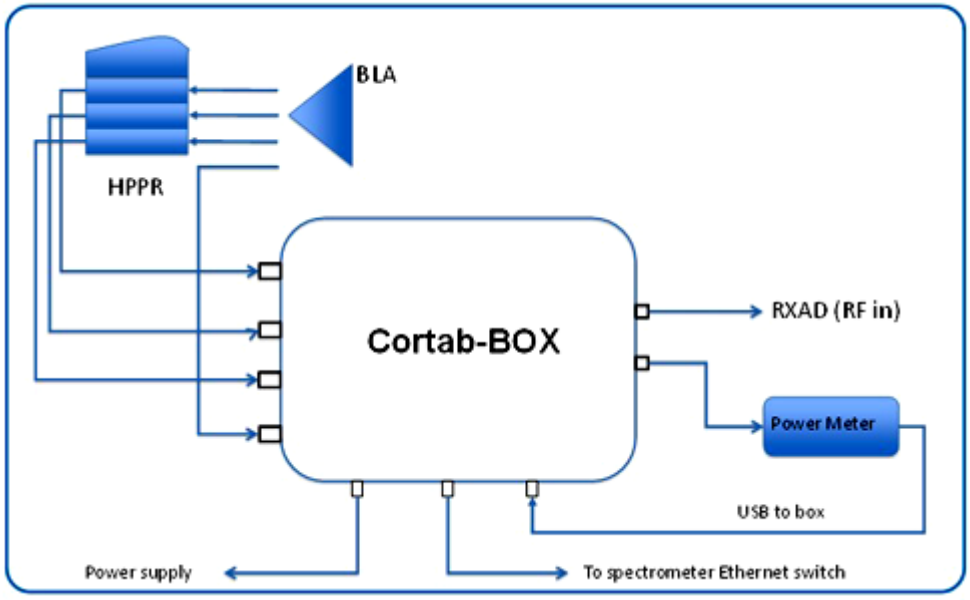


Figure 5.3 Overview of the CORTAB Box Connections

6 Technical Description

6.1 RF Input

Through the use of Radio Frequency (RF) relays, up to four transmitter inputs can be selected. The relay switching operation between these inputs is monitored by the firmware via separate contacts. The dual direction coupler splits the RF into separate signals for the power meter and the spectrometer receiver.

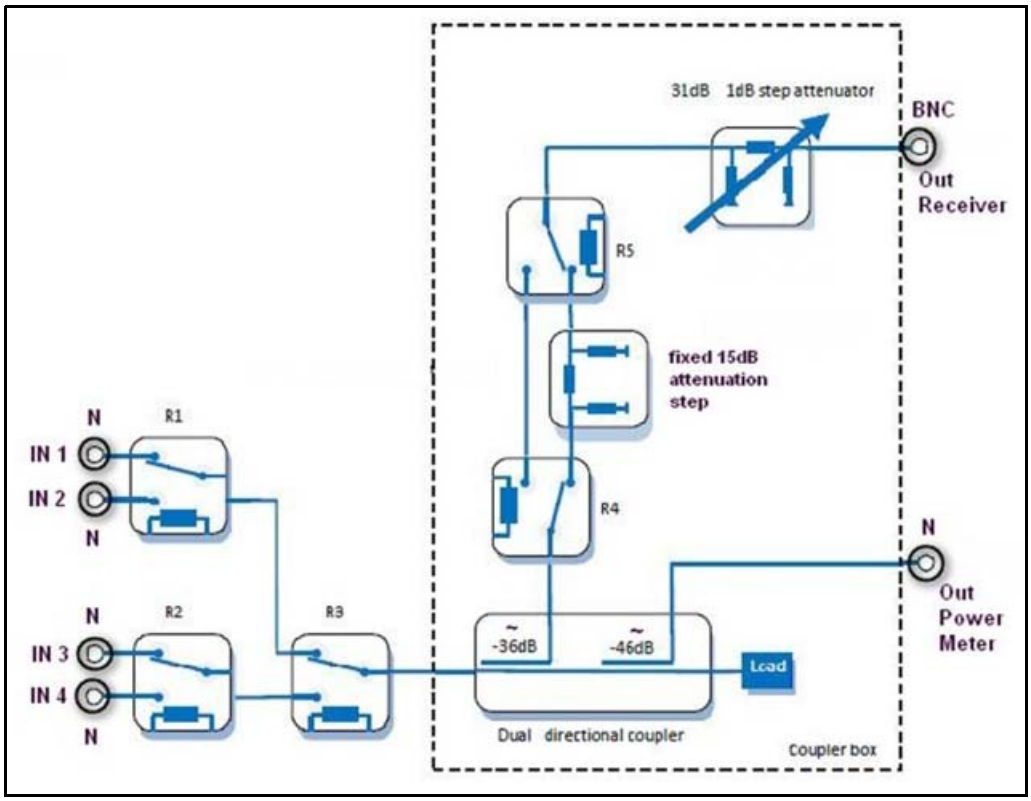


Figure 6.1 CORTAB Service Box RF Block Diagram

In offline mode, when the power supply is disconnected, the CORTAB box default input is IN 1.

6.2 Attenuation

The 4 transmitter paths to the power meter are calibrated and the attenuation for the power meter input is about 46 dB.

The coupler attenuation to the spectrometer input is about 36 dB. In addition, a switchable 15 dB attenuator can attenuate the signal, and a second switchable 1 dB step attenuator can attenuate the signal in a range between 0 and 31 dB. Thus, the complete range of attenuation is between approximately 36 and 82 dB.

When the CORTAB Box is offline or booting, both attenuator‘s are set to maximum attenuation.

6.3 CORTAB Box Digital Interface

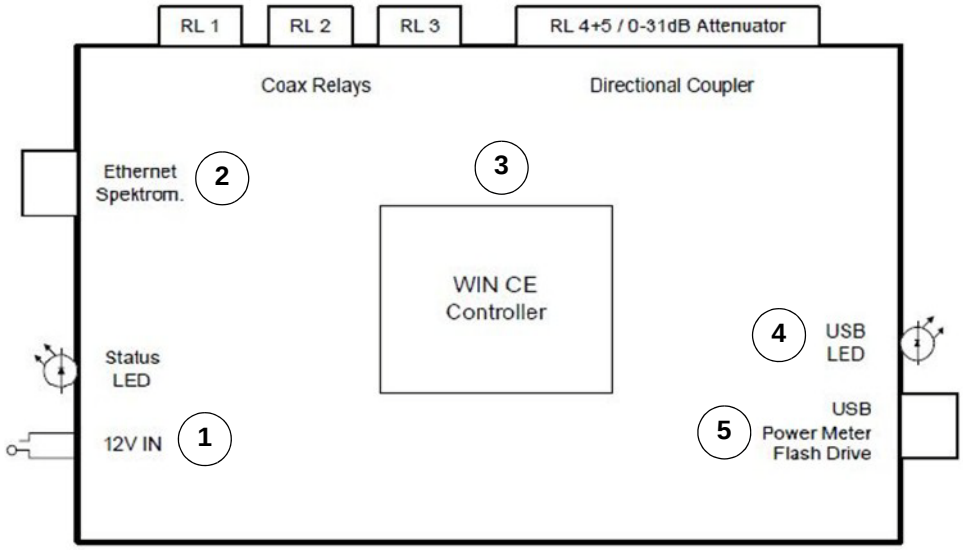


Figure 6.2 CORTAB Service Box Digital Interface

1 Power is supplied via an external wide-range 12V power supply.

2 The CORTAB service box is connected to the spectrometer via an Ethernet connection.

3 The service box controller is the logical connection between the CORTAB software in the spectrometer and the active components:

- RF relays
- Switchable attenuator‘s
- The power meter

4 The LED near the USB port indicates if the connection to the power meter or the USB memory stick was successful.

5 The RF power meter is connected to the CORTAB box with an USB connector. Firmware updates and log file storages can be accomplished with an USB memory stick using this port.

The spectrometer software controls the CORTAB measurement based on the respective spectrometer requirements:

- Number of channels
- Existing transmitters
- Output power
- The required frequencies

7 Operation

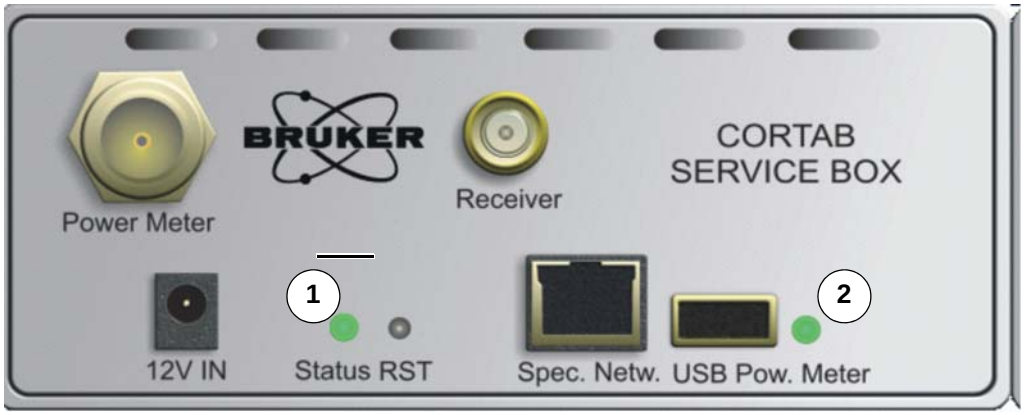
7.1 Before You Begin

Before you use the CORTAB service kit:

1. Verify that the CORTAB service kit has been installed correctly (see "Installation" on page 15).
2. Read the "Important Safety Information" on page 11.

7.2 CORTAB Service Box Front Panel

The CORTAB service box has two status LED‘s.



1. Device Status LED
2. USB Status LED

Figure 7.1 CORTAB Service Box Front Panel

The **Device Status LED** next to the power supply connector displays the device status:

- An orange LED indicates the device is starting up.
- A green LED indicates the device is ready.
- A red LED indicates an error has occurred. In this case try to restart the device, if the color stays red the box may be malfunctioning.

The **USB Status LED** next to the USB port has only one color:

- Green. The LED will light and remain on when the device connected to the USB port has been accepted by the service box.

Note: Use only USB memory sticks and the USB cables from the NRP-Z11 and NRP-Z21 power meters with the CORTAB service box!

After connecting/disconnecting a device to/from the USB port there can be a delay of up to 15 seconds until the USB LED turns on/off.

7.3 Before Starting a CORTAB Experiment

Before starting the CORTAB experiment in TopSpin be sure that:

- The box is powered on and the LED state is green.
- A supported power meter is connected to the USB port and has been recognized, i.e. the USB LED is green.
- The power meter is connected to the power meter output of the box.
- The **cf** command in TopSpin has been executed one time with the CORTAB box connected.

7.4 Starting a CORTAB Experiment

1. In TopSpin enter **cortab** on the command line.

➨ The command *cortab* opens a window from which amplifier and receiver correction tables for acquisition can be created:

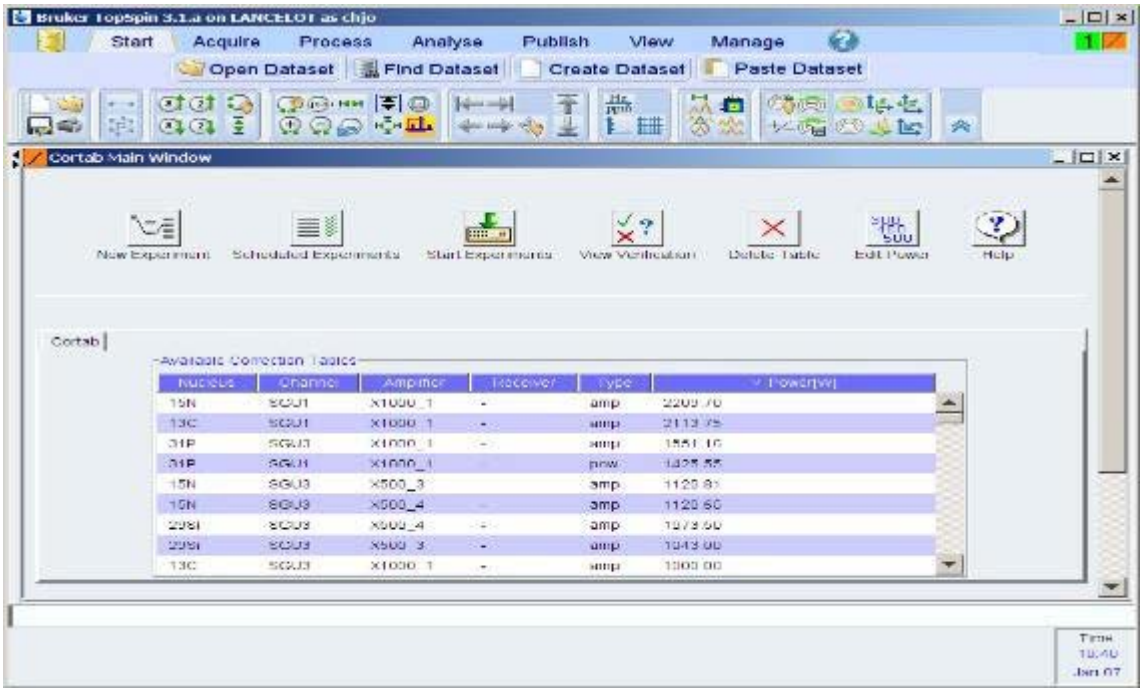


Figure 7.2 TopSpin CORTAB Main Window

Before this window is opened, you are prompted for the NMR Administrator password.

2. Enter the NMR Administrator password.
3. If you are not familiar with the CORTAB experiment refer to the next section "CORTAB Help in TopSpin":

7.5 CORTAB Help in TopSpin

Start TopSpin and enter **help cortab** in the command line to get further information about performing the CORTAB experiment.

Operation

8 Maintenance

In case of malfunction the CORTAB service box must be returned to and repaired by Bruker France. After the repair, the box will be recalibrated by Bruker before it is redistributed.

The power meter must likewise be repaired by the manufacturer Rohde & Schwarz.

8.1 Firmware Update

When the CORTAB service box contains a firmware version older than 20111020_1548, you will need to return the box to BRUKER France for calibration. Boxes returned for calibration will always be updated with the newest firmware.

Beginning with firmware version 20111020_1548 it is possible to perform a firmware update from the embedded web pages of the CORTAB Service Box. For this you will need to connect the CORTAB Service Box to a spectrometer computer (see "Installing the CORTAB Service Kit" on page 16), or to a service computer (see "Manual Measurement" on page 33).

8.1.1 Procedure for a Firmware Update

1. Connect the CORTAB Box to the spectrometer or computer.
2. Plug in the power supply and wait until the CORTAB Box status LED switches to green.
3. Open the CORTAB Box embedded web pages:

   If the CORTAB box is connected to the spectrometer, use the **ha** command in TopSpin.

   If the CORTAB box is connected to another computer, find out which IP Address has been assigned by the DHCP server to the CORTAB box and copy it in your internet browser **Address Bar**.

➥ The following page will be displayed:

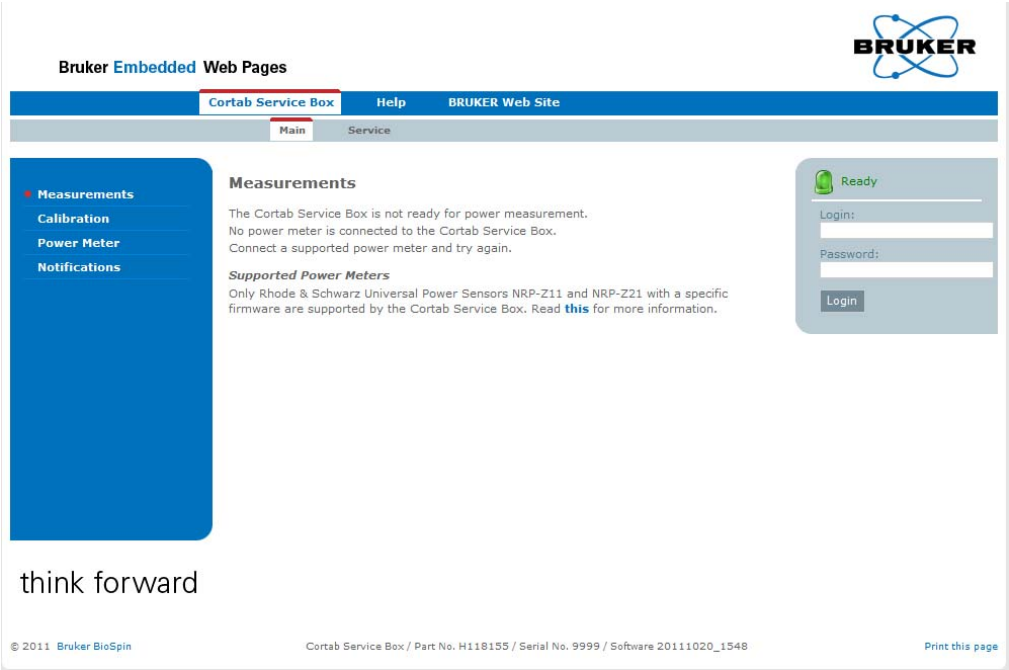


Figure 8.1 Bruker Embedded Web Pages: Measurements Window

4. Click on **Service** in the gray menu bar, then on the **Firmware Update** item in the vertical menu on the left.

➥ The following window should be displayed:

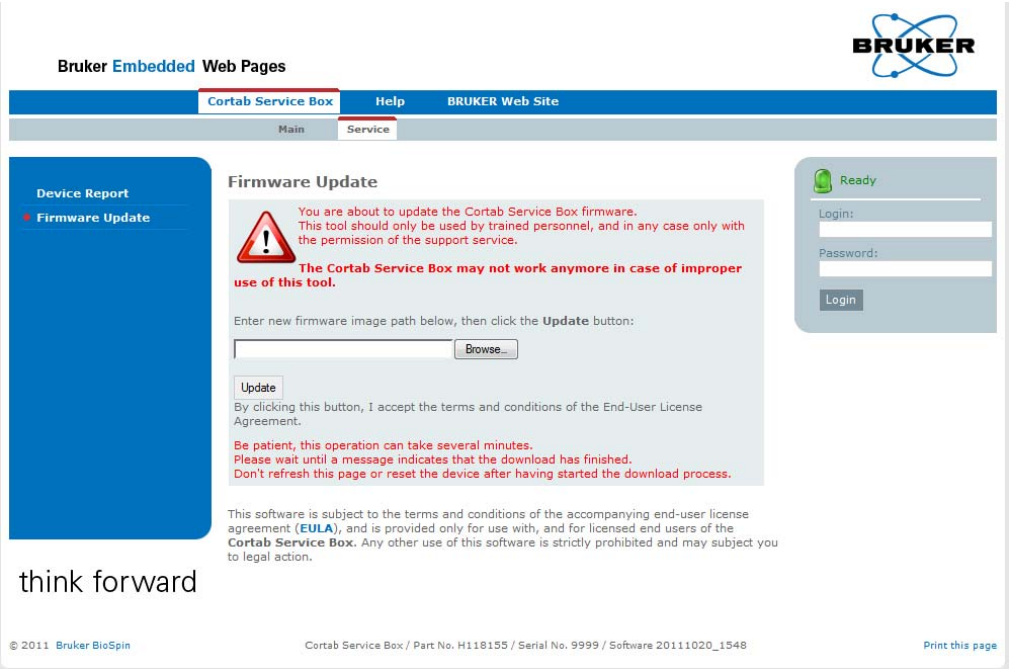


Figure 8.2 Bruker Embedded Web Pages: Firmware Update Window

5. Click on the **Browse…** button and choose the firmware file with which the CORTAB Box should be updated.

Note: Firmware can be downloaded from: ftp://ftp.bruker.de/pub/nmr/AUTOMATION/CORTABBOX/

6. Click the **Update** button.

➥ The following page appears:

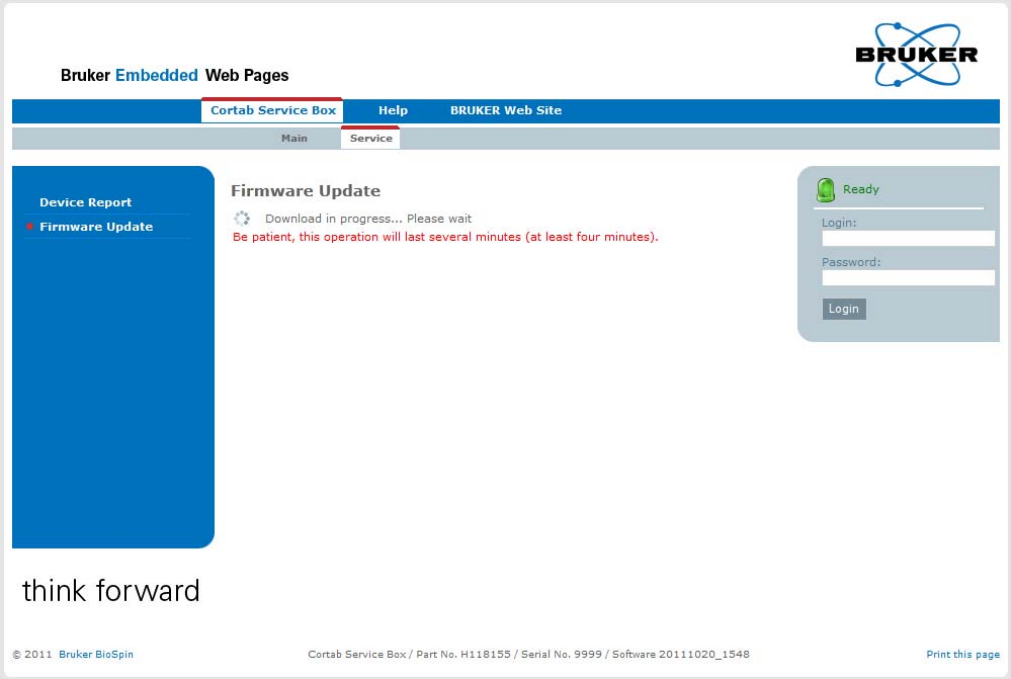


Figure 8.3 Bruker Embedded Web Pages: Downloading in the Firmware Update Window

7. The update will take about 5 minutes, during this process the status LED on the CORTAB box front panel will switch to orange. This means that the new firmware is being written to the CORTAB Box internal memory.

Never disconnect the power supply during this operation, as the box may no longer boot and will need to be returned to BRUKER for repair.

➥ When the update was successful, the following display appears:

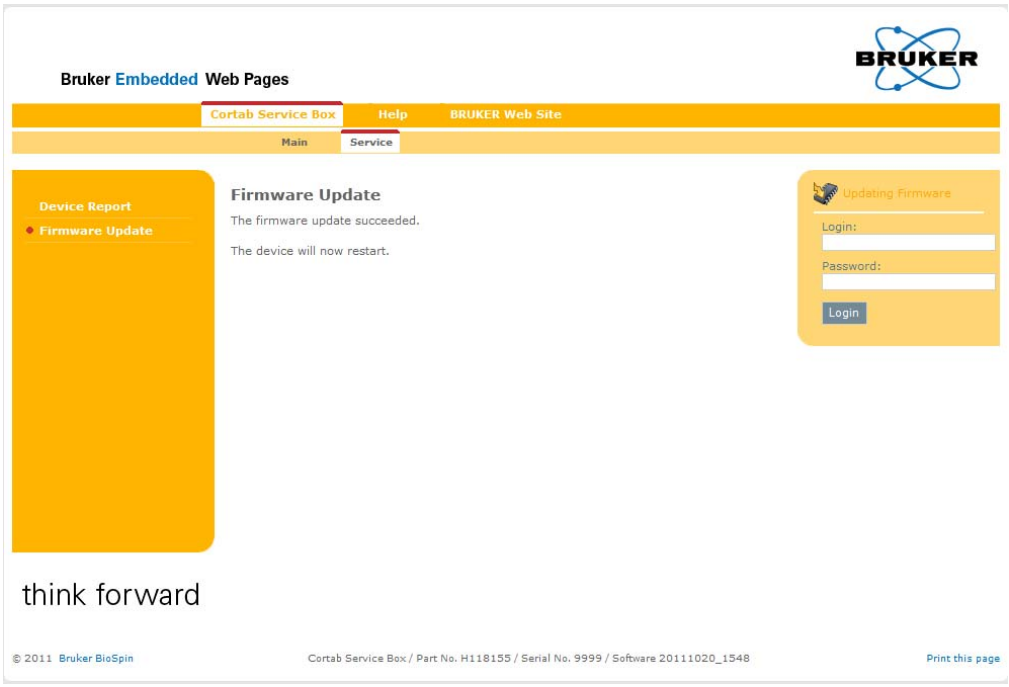


Figure 8.4 Bruker Embedded Web Pages: Firmware Update Finished

➨ Once the status LED turns back to green, the CORTAB Box is ready to operate using the new firmware.

8. Click on the **Cortab Service Box** item in the horizontal menu on the web page.

➨ The software version indicated on the bottom of the web page should now be the same as the new firmware version.

8.2 Device Report

To assist in troubleshooting a device report can be downloaded from the device. The device report file should be sent to BRUKER when reporting issues.

1. Open the embedded web pages and click **Service** in the gray menu bar.

➨ The following display should appear:

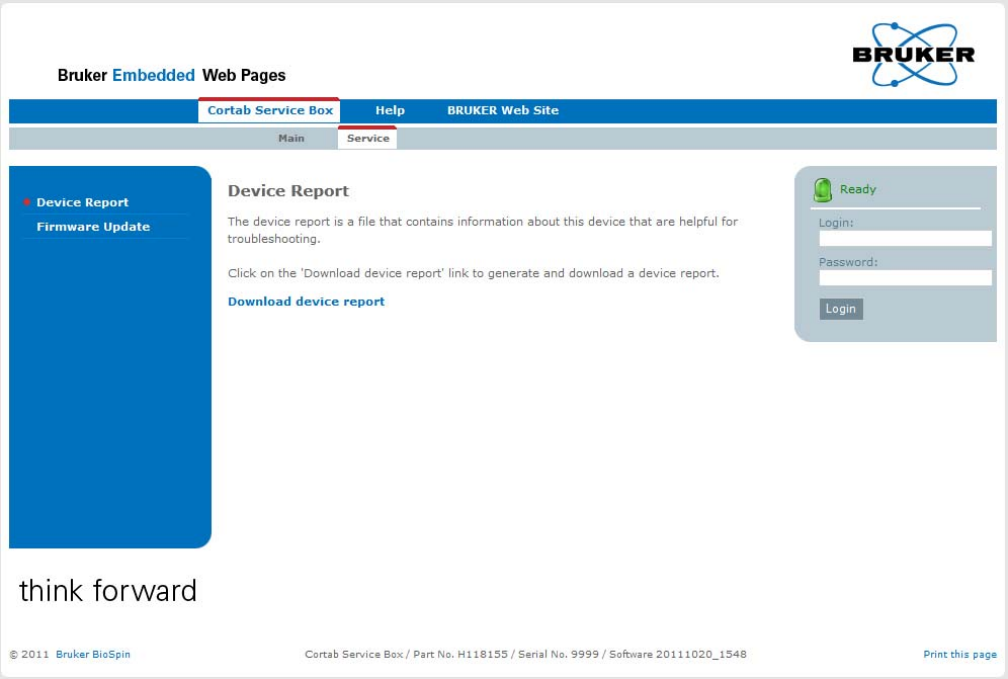


Figure 8.5 Bruker Embedded Web Pages: Device Report Download

2. Click the Download device report link and send the file to BRUKER.

8.3 Calibration

8.3.1 CORTAB Service Box

The CORTAB service box is calibrated by Bruker and the calibration data stored in the CORTAB service box **internal memory. Updating the firmware does not affect the calibration data.**

The CORTAB service box should be calibrated every two years.

8.3.2 Power Meter NRP-Z11 and NRP-Z21

When the CORTAB Service Box is returned for calibration, BRUKER sends the power meter to Rhode & Schwarz for calibration.

If required you can send the power meter to any certified institute for calibration.

The power meter should be recalibrated every two years.

8.3.3 TopSpin and the Calibration

When a calibration warning message appears when starting a CORTAB procedure in TopSpin, the CORTAB Service Box and the connected power meter will need to be recalibrated within three months.

When the calibration for the CORTAB Service Box or the connected power meter expires, TopSpin will block use of the CORTAB. This is to prevent faulty spectrometer calibration.

8.3.4 Detailed Calibration State

Beginning with firmware version 20111020_1548 it is possible to get detailed information about the calibration through the embedded web pages.

Open the embedded web pages and select **Calibration** in the vertical menu on the left:

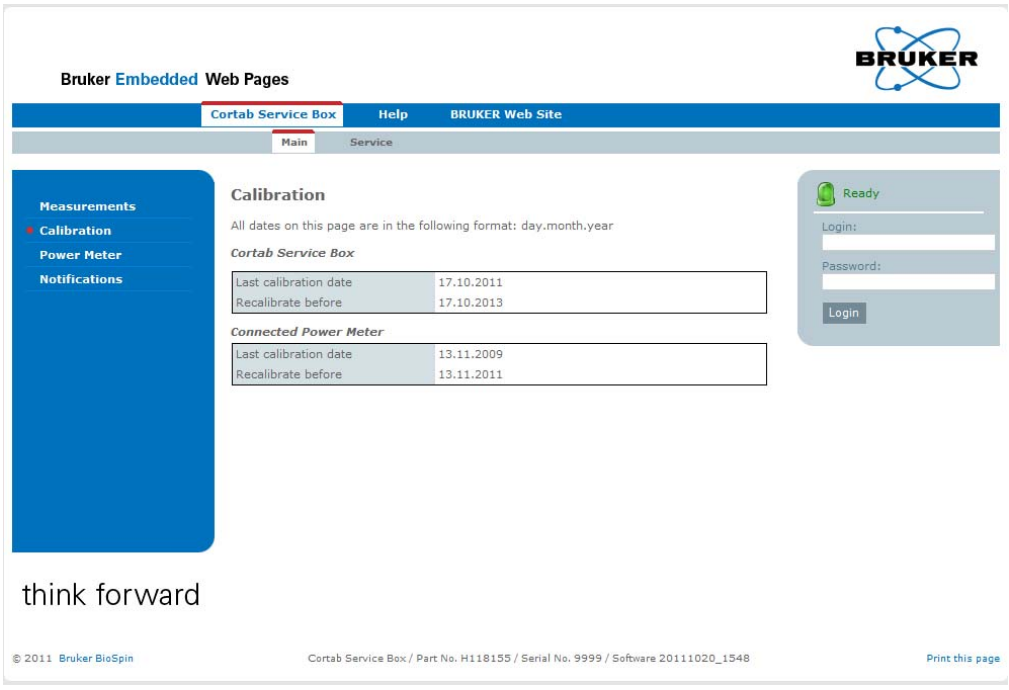


Figure 8.6 Bruker Embedded Web Pages: Calibration

9 Manual Measurement

Manual measurement is provided so that a CORTAB Box can be used to calibrate spectrometers older than AVANCE II and/or running TopSpin version older than 3.0. It then replaces the attenuator used by BRUKER service technicians. There is no automatic CORTAB supported on these spectrometers/TopSpin versions.

9.1 Installation

To be able to perform manual measurement, follow the installation instructions described in "Installing the CORTAB Service Kit" on page 16. If the spectrometer has no Ethernet switch, or is running TopSpin 1.3 or older, you will need to connect the CORTAB Box to a separate computer than the spectrometer host. In this case the computer must have a DHCP server running to provide an IP address for the CORTAB Service Box.

9.2 Measurement

1. Open the CORTAB Box embedded web pages:

   If the CORTAB box is connected to the spectrometer, use the **ha** command in TopSpin.

   If the CORTAB box is connected to another computer, find out which IP Address has been assigned by the DHCP server to the CORTAB box and copy it in your internet browser **Address Bar**.

➥ The following page will be displayed:

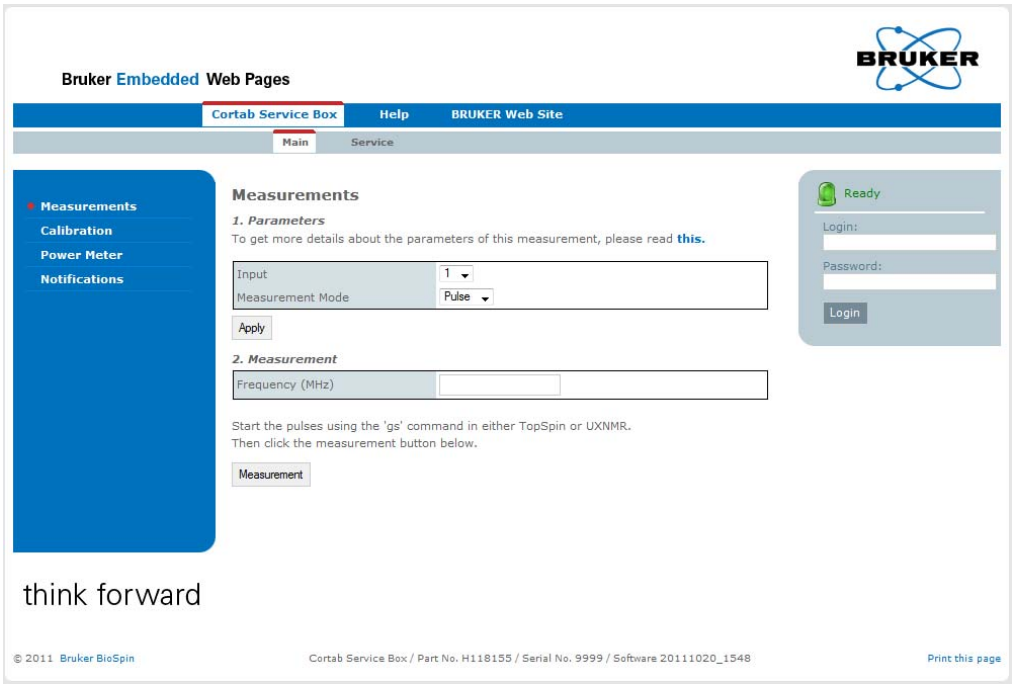


Figure 9.1 Bruker Embedded Web Pages: Measurements

2. Configure the input you are going to work with and the measurement mode.

   When using the spectrometer host computer, use only the pulse measurement mode.

   The CW (Continuous Wave) measurement mode must only be used with signal generators for CORTAB Box test purposes.

   When finished press the **Apply** button, otherwise the parameters will not be applied.

3. Start the pulses using TopSpin or UXNMR with the following parameters:

For nucleus X and 1H:

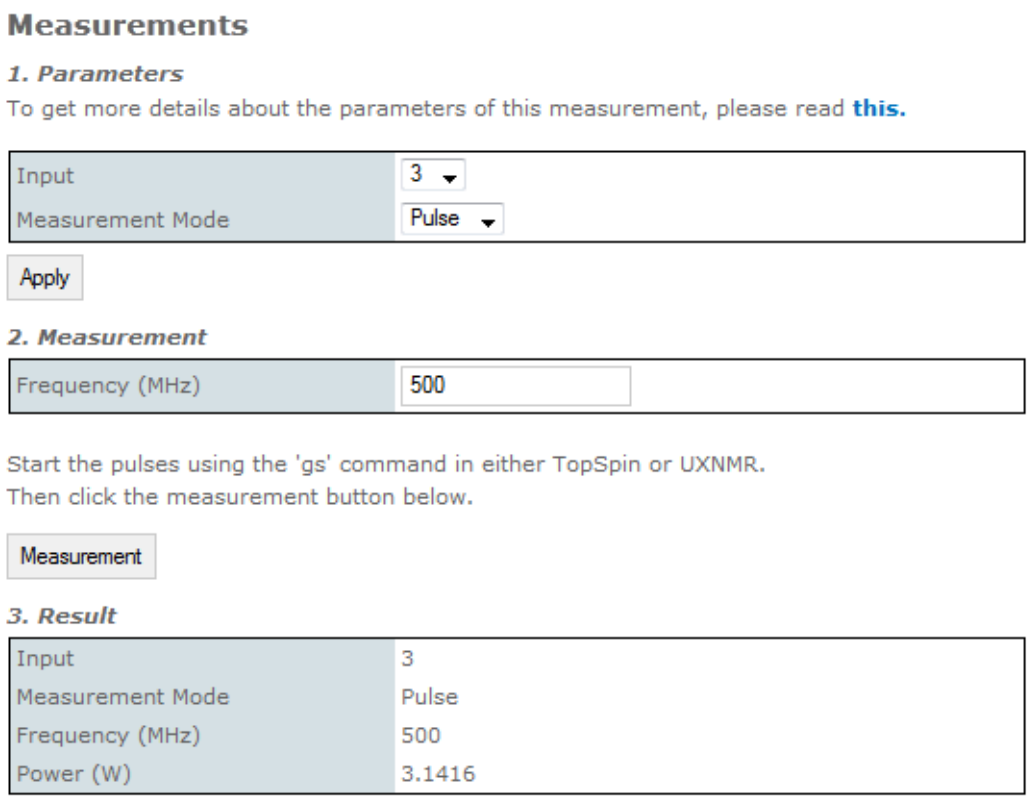
Pulse Program	ZG
SWH	50 KHz
AQ	25 ms
D1	25 ms
P1	100 µs

For nucleus 2H with 2H/TX board or 2H lockswitch:

Pulse Program	zg2h LOCNUC = off
SWH	50 KHz
AQ	25 ms
D1	25 ms
P1	100 µs

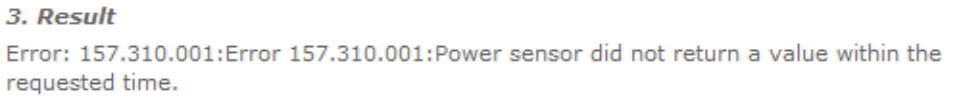
4. Enter the frequency and click the **Measurement** button.

➨ The page will reload and display the measurement results:



The input and measurement mode remains unchanged until the new values have been selected and the **Apply** button is pressed. This allows several measurements to be performed from the same input at different frequencies.

If no power is sensed by the power meter, the page will need about 5 seconds to reload and will display the following message:



In this case verify the input and measurement values and try to apply them. When still no power is sensed by the power meter check the connections to the unit and whether the unit is operating correctly.

10 Technical Data

10.1 CORTAB Service Box (H118155) Data

DC Input

Voltage: 12 VDC; Current: approximately 2.2 A.

2-pole barrel connector (5.5 / 2.1 mm).

USB

USB 2.0 host connector with 500 mA maximum current.

Ethernet

Ethernet standard connector with 100 MBit/s.

RF Transmitter Input

Four RF inputs with N connectors.

Frequency from 5 to 1100 MHz.

Internal VSWR <= 1.15.

Maximum duty cycle of 2% with a maximum power of 2 kW.

The temperature of the internal RF terminator is monitored.

RF Output

Attenuated RF output (BNC) to receiving system (RXAD).

RF output (N) to power meter.

10.2 External Power Supply Data

Input Voltage Range

100 to 240 VAC.

Input Frequency Range

47 to 63 Hz.

Input Current

0.8 A (rms) max. @ 115 VAC, 0.4 A (rms) max. @ 230 VAC.

Leakage Current

3.5 mA maximum.

Inrush Current (cold)

30 A for 115 VAC at max. load, 60 A for 230 VAC at maximum load.

(cold start @ ambient 25 °C).

Input Power Saving

0.5 W maximum at no load at 115 VAC.

Efficiency

> 80.6% average efficiency at 115 VAC.

Hold-up Time

10 mS minimum @ 120 VAC and maximum load.

Over-voltage Protection

Output shuts down and recovers after reset AC power.

Over-current Protection

Output equipped with short circuit protection - auto restart.

Short Circuit Protection

Output can be shorted without damage.

Temperature

Operation 0 to +40 °C, Non-operation -30 to +85 °C.

Humidity

Operation 5 to 90%.

Emissions

FCC Class B, EN55022 Class B.

Dielectric Withstand (Hi-pot) Test

Primary to secondary: 1500 VAC for 1 minute, 10 mA.

DC Output Connector

2.1 x 5.5 mm Center Positive Standard.

10.3 Power Meter Data (R&S NRP-Z11)

Input Frequency Range

10 MHz to 8 GHz.

Input Amplitude Range

-67 dBm to +23 dBm (200 pW to 200 mW).

Dynamic Range

90 dB for CW and modulated signals.

RF Connector

N male.

10.4 Noise Level

The measured noise level is less than 60 dBA.

10.5 Environmental Requirements

The CORTAB service kit should only be used:

- In a standard laboratory environment.
- At a temperature between 15-35°C.
- A relative humidity of a maximum of 80% for temperatures up to 31 °C, linearly decreasing to 67% at a temperature of 35 °C.

The CORTAB service kit should only be stored in an area:

- Similar to a laboratory environment.
- At a temperature between 5-40 °C.
- A relative humidity of a maximum of 80% for temperatures up to 31 °C, linearly decreasing to 50% at a temperature of 40 °C.

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NMR Hotlines

Contact our NMR service centers.

Bruker BioSpin NMR provide dedicated hotlines and service centers, so that our specialists can respond as quickly as possible to all your service requests, applications questions, software or technical needs.

Please select the NMR service center or hotline you wish to contact from our list available at:

http://www.bruker-biospin.com/hotlines_nmr.html

Contact

Appendix A

A.1 Warning Signs

A.2 Figures

A.3 Tables

Bruker BioSpin, your solution partner

Bruker BioSpin provides a world class, market-leading range of analysis solutions for your life and materials science needs.

Our solution-oriented approach enables us to work closely with you to further establish your specific needs and determine the relevant solution package fromour comprehensive range, or even collaborate with you on new developments.

Our ongoing efforts and considerable investment in research and development illustrates our long-term commitment to technological innovation on behalf of our customers. With more than 40 years of experience meeting the professional scientific sector's needs across a range of disciplines, Bruker BioSpin has built an enviable rapport with the scientific community and various specialist fields through understanding specific demand, and providing attentive and responsive service.

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