Operation and Maintenance Instructions

Contents

1 Design, Function and Operation

1.1 General

Base Radio Unit 1 (BRU1) is a complete one-channel compact radio base station which uses 8 kbps data signalling. The BRU1, which is intended for indoor operation, is a link between the mobile terminals and the area exchanges in the Mobitex Network. All parts are integrated in the unit, see *Figure 1*.
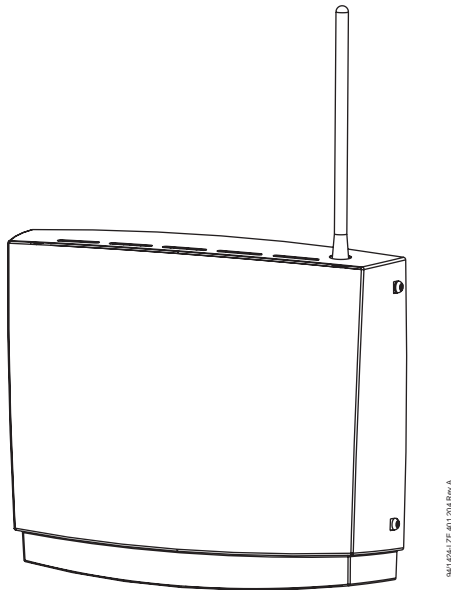
Figure 1   BRU1

This section describes the design, function and operation of the BRU1.

During normal operation, all actions necessary for the operation and check of the BRU1 are carried out at the Network Control Centre (NCC). When operating the BRU1 on site, the following equipment is required:

- Portable PC including VT-100 emulation software.

- Console Cable TSRA 902 0190 (or equivalent) for connection of the terminal to the BRU1 connector "CONSOLE".

- FBTEST

For a description on how to connect the portable PC to the BRU1, please refer to *chapter 1.3.2 "Shutdown Procedure"*.

1.2   BRU1 connections and indicators
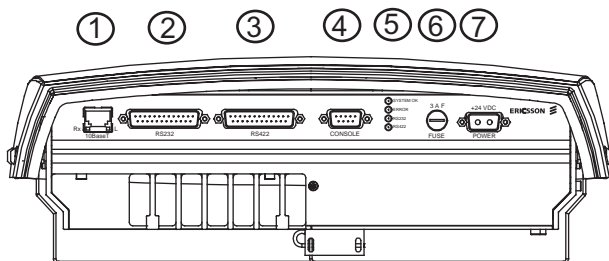
Figure 2   BRU1 external connections and indicators.

1.   Ethernet Connection (and ethernet LED indicators)
2.   Modem Connection RS232C
3.   Modem Connection RS422B
4.   Console Connection
5.   LED indicators
6.   Fuse
7.   Power connector

The table below gives a brief description of the BRU1 connections used. The position numbers found in the "Position" column refer to the corresponding position numbers in *Figure 2*.

Pos.	Connector	Type of Connector	Description
1	Ethernet	RJ-45	Connection to superior node via Ethernet
2	RS-232C	25p DSUB female	Connection to superior node via RS232
3	RS-422B	25p DSUB female	Connection to superior node via RS422B
4	Console	9p DSUB female	Connection used for Nodop terminal
5	Quad LED indicator	-	System OK (green) Internal H/W Error (red) RS232 (yellow) RS422 (yellow)
6	Fuse holder		
7	Power connector	2p DSUB	DC power input. +24V, 2A.

1.3   Start-Up and Shutdown Procedures

Note: When starting up the BRU1 after installation, follow the
                instructions in *Node Hardware Library/BRU1/Commissioning
                Procedure*.

1.3.1   Start-Up Procedure

When starting up the BRU1, do the following:

1.   Connect the power cable to the BRU1.

2.   Check that the "System OK" green LED is lit. This indicates that all the
       internal power supply is OK.

Check, after a few seconds, that the "Internal H/W Error" red LED is not lit.
This inicates that no severe internal hardware alarm have been raised.

Note: The warm-up time for the BRU1 is required to be at least 10
                minutes, before the transmitter is activated. Specifications for the
                BRU1 are valid after this period.

1.3.2   Shutdown Procedure

To ensure minimal traffic and data loss when the power to the node has to be
shut down, always perform the following shutdown procedure:

1.   Connect the portable PC via the console cable, TSRA 902 0190, to the port
       "CONSOLE" of the BRU1.

2.   Press **<RETURN>** to get the NODOP prompt **NODOP>**

Note: If the node has just started, it will take a little while before
                NODOP is functioning.
                To ignore requested username and password, press **<RETURN>**.

3.   Give the command **SET CONSOLE ON** on the NODOP terminal.

4.   Give the command **HALT 120** on the NODOP terminal.

5.   When you are asked to verify the command, enter **Y**.

6.   The shutdown procedure will stop all incoming traffic and close all open files. A message will be displayed on the console terminal when the node may be switched off.

1.3.3   Restarting the BRU1 (Warm Start)

Restart (RESET) of the entire node can be performed.

•   By command from an NCC operator.

•   By the NODOP command **BOOT MASTER 10 YES** using a terminal.

Note: Restarting a node may result in traffic and data loss, make sure to take appropriate precautions.

1.3.4   Manual Restart of the BRU1

A manual restart (reset) of the BRU1 can only be performed by disconnecting/ connecting of the power.

1.4   Network Connections

1.4.1   General

There are three alternative line interfaces for connection to a superior node:

• **Ethernet** (10Base-T, 10 MBps)

• balanced **serial** interface V.11 (RS422B)

• unbalanced **serial** interface V.28 (RS232C).

The choice between Ethernet and serial interface is a config parameter in NCC, whereas the choice between balanced serial interface and unbalanced serial interface, is made in FBTEST. For serial interface selection see *Node Hardware Library/BRU1/FBTEST Reference Manual*

The selected serial communication type is indicated by the two yellow Network Leds. See table below

Function	RS422 LED	RS232 LED
RS422	ON	OFF
RS232	OFF	ON

Note that the serial communication type does not reflect whether or not Ethernet/serial communication is selected. This selection is performed in NCC (Config parameter).

There are two LED indicators which are integrated in the Ethernet connector

Function	Green LED	Yellow LED
LINK	On = Good link Off = No link	-
RX	-	Ethernet acivity on RX

1.5   Alarms

The BRU1 includes the following hardware alarms:

Alarm	Description
Temp alarm HIGH	ambient temp. exceeds +40 °C.
Temp alarm LOW	ambient temp. is below +5°C.
Temp alarm HIGH SHUTOFF	ambient temp. exceeds +45 °C (radio transmitter turned off)
Temp alarm LOW SHUTOFF	ambient temp. is below ±0°C (radio transmitter turned off)
DC alarm 5V	Internal DC failure on 5V
DC alarm 8V	Internal DC failure on 8V
DC alarm 15V	Internal DC failure on 15V
Reflection alarm	Output RF power/Voltage Standing Wave Ratio exceeding alarm limit set.
Radio OFF	Unspecified Transmitter or Receiver failure.
Low output power alarm	Output power below alarm limit set.
External alarm 1	For customer use.

Note: If the ambient temperature exceeds +55 °C the internal DC/DC power supply is switched off.

2   Maintenance

2.1   General

This section describes how to carry out scheduled, visual and preventive maintenance on the BRU1 on site.

The scheduled, visual and preventive maintenance is carried out to increase the operational reliability of the electrical and mechanical parts of the BRU1.

If any problems occur while following the procedures in this section, please refer to *3 Troubleshooting*.

For BRU1 model **19** maintenance is carried out every:

•   6 Months (Radio Unit Reference Oscillator)

Note: If the BRU1 has to be switched off, the shutdown procedure described in *1.3 Start-Up and Shutdown Procedures*, must be followed before power-off is performed. If not, important data may be lost and the subsequent start-up time may be significantly increased.

2.2 Equipment Required

To carry out maintenance on the BRU1 on site, the following equipment is required:

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 (or equivalent) for connection of the PC to the BRU1 "CONSOLE" port

- Frequency counter 1 GHz
  Degree of accuracy: 0.01 ppm

- FBTEST software (normally installed in the BRU1)

- RF Power Meter

- Multimeter

- RF Attenuator 1 GHz, 30-50 dB

- Mobitex radio modem

Note: The antenna connector of the BRU1 is an SMA RF connector.

2.3 Documentation Required

To carry out maintenance on the BRU1 on site, the following documentation is required:

- *BRU1* Manual (*Mobitex NTE Client Library/Node Hardware Library/ BRU1*)

- *Node Software Library (Mobitex NTE Client Library/Node Software Library)*

- *BRU1 - Site documentation*

Note: The *Site Documentation* is not included in the electronically published version of the *Mobitex NTE Client Library* but is delivered on paper together with the hardware.

2.4   Maintenance to be Performed

2.4.1   Visual and Preventive Maintenance

Radio Unit Reference Oscillator

In the BRU1, the reference oscillator checks the channel unit frequency. Thus, adjustment check of the reference oscillator, in accordance with the following procedure, implies check of the channel unit frequency accuracy.

Note: Only authorized personnel are allowed to adjust the frequency of the reference oscillator.

Requirements

The measurement must be carried out on the correct carrier frequency for the site.

The carrier wave must not have a frequency error exceeding 0.1 ppm.

The reference oscillator must have been powered up at least 30 minutes before the test is started.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software

- Frequency counter 1 GHz (degree of accuracy: 0.01 ppm)

- RF attenuator 1 GHz, 30-50 dB.

Test procedure

1.   Put the BRU1 in command mode by pressing **!!!** when the following text appears:

```
REVISION : BOOT R1B
Virtual thumb wheel position: Command mode
CPU type:                    MC68030

Press  !!! within 5 seconds, to change current thumb wheel value:
0 - Normal position operation
```

```
1 - Test (should not be used)
2 - Boot from RAM-disks (MS-DOS format)
3 - Not defined, reserved
4 - Boot from SCSI-disks
5 - Boot from PROM-disks
6 - Boot from old PROM-disk
7 - Command position operation
8 - Not defined, reserved

Enter choice (0..8): 7
```

2.   Connect the frequency counter via the RF attenuator to the BRU1 antenna. connection.

3.   Use FBTEST to set the transmitter carrier frequency to correct value for the site. Please refer to *Node Hardware Library/BRU1/FBTEST Reference Manual*.

4.   Select the power corresponding to 0 dB attenuation of the transmitter.

5.   Start the transmitter.

Read the frequency measured on the frequency counter display. Check the result against the requirements specified.

2.5 Function Check

2.5.1 General

The Function Check includes checking BRU1 boards, transmitter, receiver, antenna and hardware alarms.

Furthermore, the Function Check may be used as an extended hardware commissioning test, as a complement to the hardware commissioning procedure.

2.5.2 Equipment Required

To carry out the Function Check, the following equipment is required:

- Power meter

- Multimeter

- RF signal generator 1 GHz with a built-in GMSK-modulator. (Alternatively, you may use a RF signal generator 1 GHz together with the Ericsson test modem LPBA 109 08. See *chapter 2.5.6 "Bit Errors at high Signal Levels"* for more information.)

- 1 pc of Radio Communication test set, including
  - RF signal generator 1GHz, with external FM DC input
  - Modulation Meter.

- FBTEST software

2.5.3   FBTEST Board Test

Check of BRU1 boards

Requirements

It is recommended that a Medium board test of all BRU1 boards should be carried out before taking the BRU1 into operation.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software.

Test procedure

1.   Use FBTEST to set up two test cycles.

2.   Run the test cycles.

3.   Check the result on the terminal display.

2.5.4   Channel Unit Output Power

Check of the transmitter channel unit output power
Requirements

For tolerances, please refer to the tables below:

900 MHz, 1W version:

Power 900 MHz	Attenuation (dB)	Tolerance (+dB)	Tolerance (-dB)
1.0W	0	1.5	1.5
0.5W	-3	1.5	1.5
250mW	-6	2.0	3.0
125mW	-9	2.0	3.0

Measurements must be carried out on the correct carrier frequency for the site.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software

- Output power meter
  19, 1W version: 20 mW - 5W
  Degree of accuracy: better than ±0.5 dB

- Coaxial cable.

Test procedure

1.   Connect the output power meter to the BRU1 antenna connection.

2.   Use FBTEST to set the correct transmitter carrier frequency for the site.

3.   Use FBTEST to select the desired power level.

4.   Start the transmitter.

5.   Read the power measured on the output power meter display. Check the result against the requirements specified. Note that cabel attenuation must also be considered.

6.   Select a new power level and repeat the measurement procedure.

Note: This adjustment of power level is only temporary. Normally the adjustment of output power is set via a configuration file.

2.5.5   Transmitter Deviation

Check of transmitter frequency deviation

Requirements

The sine wave 1 kHz shall give the frequency deviation of ± 2.0 kHz $+ 5.0\%$. The measurements must be carried out on the correct carrier frequency for the site.

Test equipment

•   Portable PC including VT-100 emulation software

•   Console cable TSRA 902 0190 or equivalent

•   FBTEST software

•   Deviation meter 900 MHz
    Degree of accuracy: better than $\pm 3.0\%$.

Test procedure

1.   Connect the deviation meter to the BRU1 antenna connection.

2.   Use FBTEST to set the correct transmitter carrier frequency for the site.

3.   Select the power level to -6 dB attenuation of the transmitter.

4.   Select modulation test sequence.

5.   Start the transmitter.

6.   Read the deviation frequency measured on the deviation meter display. Check the result against the requirements specified.

2.5.6   Bit Errors at high Signal Levels

Check of the bit error rate at high signal levels

Requirements

The measurement should be carried out within a time period of 60 seconds. The RF signal level to the receiver should be -81 dBm. The tolerated failure rate during the test period is set to 0 or 1 error. The measurement should be repeated with a RF signal of -31 dBm. The above measurements must be carried out on the correct carrier frequency for the site.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software

- Alternative 1 or 2 described below.

Alternative 1

- Ericsson test modem LPBA 109 08

- RF signal generator 1 GHz. The RF signal generator must include an input for external modulation with a lower limiting frequency of 0 Hz. The frequency must be able to modulate with DC voltage. Degree of frequency accuracy: 0.01 ppm. The RF output signal level must be adjustable between -123 dBm and -3 dBm.
  Accuracy: Better than 1 dB.

Alternative 2

- RF signal generator 1 GHz with a built-in GMSK-modulator. The generator must be able to generate the 511 bit PRBS signal used when measuring the bit error rate. (Using this alternative excludes the Ericsson test modem specified above.)
  Accuracy: Better than 1 dB.

Test procedure

1. Connect the signal generator to the BRU1 antenna connection.

2. Use FBTEST to set the receiver channel number corresponding to the correct carrier frequency.

3. Set the signal generator's carrier frequency to the receiver's nominal carrier frequency.

    The GMSK modem supplies the RF signal generator with an analog pseudo-random signal which matches the test signal called M2 in the ETSI specification. This signal modulates the RF signal generator. (In case the RF signal generator is equipped with a built-in GMSK modem the external GMSK modem is excluded.) The receiver demodulated signal BER, is calculated by the BRU1 logic.

4. Start the bit error measurement using FBTEST.

5. Adjust the RF signal level sent to the receiver to -81 dBm. Check the bit error rate during a period of one minute.

6. Check the result against the requirements specified.

7. Set a new (- 31 dB) RF signal level on the signal generator and the BRU1, and repeat the measurement procedure.

2.5.7   Receiver Sensitivity

Check of the receiver sensitivity
Requirements

The receiver sensitivity is defined as the RF level on the receiver antenna connection which generates a BER value of 1%. The RF signal sent to the receiver should be modulated with the M2 test signal with a frequency deviation of ±2.00 kHz. At 1% BER, the signal level to the receiver should be -113 dBm, or better. At a signal level of -107 dBm to the receiver antenna connection, the BER value should be better than 0.01%.

The above measurements must be carried out on the correct carrier frequency for the site.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software

- Alternative 1 or 2 described below.

Alternative 1:

- Ericsson test modem LPBA 109 08

- RF signal generator 1 GHz. The RF signal generator must include an input for external modulation with a lower limiting frequency of 0 Hz. The frequency must be able to modulate with DC voltage. Degree of frequency accuracy: 0.01 ppm. The RF output signal level must be adjustable between -123 dBm and -3 dBm.
  Accuracy: Better than 1 dB.

Alternative 2:

- RF signal generator 1 GHz with a built-in GMSK modulator. The generator must be able to generate the 511 bit PRBS signal used when measuring bit errors. (Using this alternative excludes the Ericsson test modem specified above.
  Accuracy: Better than 1 dB.)

Test procedure

1.   Connect the signal generator to the BRU1 antenna connection.

2.   Use FBTEST to set the receiver channel number corresponding to the correct carrier frequency.

3.   Set the signal generator's carrier frequency to the receiver's nominal carrier frequency.

     The GMSK modem supplies the RF signal generator with an analog pseudo random signal matching the test signal M2. This signal modulates the RF signal generator. (In case the RF signal generator is equipped with a built-in GMSK modem the external GMSK modem is excluded.) The receiver-demodulated signal BER, is calculated by the BRU1 logic.

4.   Start the bit error measurement using FBTEST.

5.   Adjust the RF signal level sent to the receiver until the BER value is stabilized to 1.0%

6.   Check the result against the requirements specified.

7.   Repeat the measurement procedure and adjust the RF signal level sent to the receiver until the BER value is stabilized to 0.01%.

8.   Check the results.

2.5.8 Receiver Sensitivity at Frequency Deviation

Check of the receiver sensitivity when the incoming RF signal deviates from the requirements specified

Requirements

The RF signal sent to the receiver must be modulated with the M2 test signal. The frequency deviation should rate 95% of the normal deviation, ±1.90 kHz. The RF signal frequency offset should be 1.45 kHz. The measurement should be performed with both positive and negative offset on the centre frequency. At 1% BER, the RF signal level sent to the receiver should be -113 dBm, or better. The above measurements must be carried out on the correct carrier frequency for the site§.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software

- Alternative 1 or 2 described below.

Alternative 1:

- Ericsson test modem LPBA 109 08

- RF signal generator 1 GHz. The RF signal generator must include an input for external modulation with a lower limiting frequency of 0 Hz. The frequency must be able to modulate with DC-voltage. Degree of frequency accuracy: 0.01 ppm. The RF output signal level must be adjustable between - 123 dBm and -3dBm.
  Accuracy: Better than 1 dB.

Alternative 2:

- RF signal generator 1GHz with a built-in GMSK-modulator. The generator must be able to generate the 511 bit PRBS signal used when measuring bit errors. (Using this alternative excludes the need of the Ericsson test modem specified above.)
  Accuracy: Better than 1 dB.

Test procedure

1. Connect the signal generator to the BRU1 antenna connection.

2. Use FBTEST to set the receiver channel number corresponding to the correct carrier frequency.

3. Set the signal generator's carrier frequency to the receiver's nominal carrier frequency, including offset.

    The GMSK modem supplies the RF signal generator with an analog pseudo-random signal that matches the test signal M2. This signal modulates the RF signal generator. (In case the RF signal generator is equipped with a built-in GMSK modem, the external GMSK modem is excluded.) The receiver demodulated signal BER, is calculated by the BRU1 logic.

4. Start the bit error measurement using FBTEST.

5. Adjust the RF signal level sent to the receiver until the BER value is stabilized to 1.0%

6. Check the result against the requirements specified.

7. Set a new receiver frequency on the signal generator and the BRU1, and repeat the measurement procedure.

2.5.9　Antenna input Signal

Check of the receiver signal strength level

Requirements

The RF signal generator must be unmodulated. Measurement range: -113 dBm to -53 dBm, in steps of 10dB. The measured accuracy on the RSSI-signal may deviate by up to ±5dB. The above measurement must be carried out on the correct carrier frequency for the site.

Test equipment

- Portable PC including VT-100 emulation software

- Console cable TSRA 902 0190 or equivalent

- FBTEST software

- RF signal generator 1 GHz. Degree of frequency accuracy: 0.01 ppm. The RF output signal level must be adjustable between -123 dBm and -3 dBm, with an accuracy of ±1dB.

Test procedure

Note:　　The transmitter has to be switched off before starting the test procedure.

1. Connect the signal generator to the BRU1 antenna connection.

2. Use FBTEST to set the receiver channel number corresponding to the correct carrier wave frequency.

3. Set the signal generator's carrier wave frequency to the receiver's nominal carrier wave frequency. The signal generator carrier wave must be modulated.

4. Change the RF signal generator output level throughout the measurement range in steps of 10 dB.

5. Check the result against the requirements specified.

2.5.10 Hardware Alarm Status

Check of alarm status in BRU1

Requirements

All alarms shall be in NORMAL mode, defined as follows:

Alarm	Status
External alarm 1	For customer use
DC alarm 15V	INACTIVE (OFF)
DC alarm 8V	INACTIVE (OFF)
DC alarm 5V	INACTIVE (OFF)
Temp alarm LOW SHUTOFF	INACTIVE (OFF)
Temp alarm HIGH SHUTOFF	INACTIVE (OFF)
Temp alarm LOW	INACTIVE (OFF)
Temp alarm HIGH	INACTIVE (OFF)
Radio OFF	INACTIVE (OFF)
Reflection alarm	INACTIVE (OFF)
Low output power alarm	INACTIVE (OFF)

Test equipment

- Portable PC including VT-100 emulation software
- Console cable TSRA 902 0190 or equivalent
- FBTEST software.

Test procedure

1.   Select "STATUS OVERVIEW" on the Main Menu of FBTEST.

2.   Read the alarm status obtained on the terminal screen. Check the result
      against the requirements specified.

3   Troubleshooting

3.1   General

This section provides information on the measures to be taken if errors should be found in the BRU1. The section describes the measures to be taken on site.

Most of the measures carried out during troubleshooting generate alarms at the NCC, and also, will effect the node's function. Therefore, the NCC operator shall always be consulted before any measure is carried out on site.

The service personnel must be familiar with the BRU1 units before using this section. For information about each unit, please refer to *1 Design, Function and Operation*.

Should the instructions herein not sufficiently provide the requested help in order to locate and/or remedy the error, please contact your local Field Support Centre (FSC).

For information regarding how to trouble-shoot software errors, please refer to the *Node Software User's Guide* in the *Node SW - Operation and Maintenance* module.

Note: If the BRU1 has to be switched off, the shutdown procedure described in *1.3 Start-Up and Shutdown Procedures*, must be followed before power off is performed. If not, important data may be lost and the subsequent start-up time may be significantly increased.

3.2   Troubleshooting guide

3.2.1   LED indicators

The BRU1 has 6 LED indicators which can be used for troubleshooting:

LED	Status
SYSTEM OK	ON = power ok OFF = internal DC failure FLASHING = FBTEST running
ERROR	ON = Internal H/W error OFF = No failure
RS232	ON or OFF depending on configuration
RS422	ON or OFF depending on configuration
LINK (RJ-45 Connector)	LINK indicator for Ethernet ON = Good link; OFF = No link
RX (RJ-45 Connector)	Ethernet activity on RX

At power-up or software reset the Quad LED indicators are lit with a certain pattern which can be used for basic troubleshooting:

SYSTEM OK	ERROR	RS232	RS422	Possible cause/Action
OFF	ON	OFF	ON	Severe hardware error, CPU or data bus error: Replace unit.
OFF	OFF	OFF	OFF	Check power source and fuse.
ON	ON	-	-	Internal hardware error: If possible check failure cause in FBTEST
OFF	ON	-	-	Internal DC/DC failure: Replace unit.