OM Instructions

Contents

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1 Design, Function and Operation

1.1 General

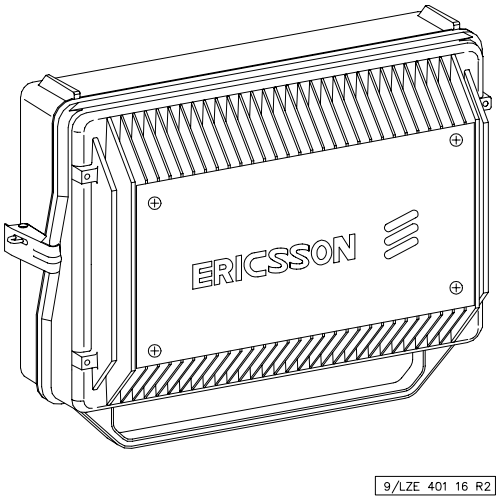

Figure 1 BRU3 (exterior).

This section describes the design, function and operation of the Mobitex Base Radio Unit 3 (BRU3).

During normal operation, all actions necessary for the operation and check of the BRU3 are carried out at the Network Control Centre (NCC). When operating the BRU3 on site, the following equipment is required:

- Portable PC including VT-100 emulation software.
- FE Console Cable TSRA 902 0190 for connection of the terminal to the BRU3 connector "P1-CONSOLE".
- FBTEST

For a description on how to connect the portable PC to the BRU3, please refer to *Shutdown Procedure* in the *Start-Up and Shutdown Procedures* section below.

BRU3 is a complete one-channel compact radio base station which uses 8 kbps data signalling and is designed for the 400, 800 or 900 MHz band. The BRU3, which may be installed both outdoors and indoors, is a link between the mobile terminals (MOB) and the area exchanges (MOX) in the MOBITEX Network.

1.2 Mechanical Parts

The BRU3 consists of two main mechanical parts, the FE Case Bottom Frame (FBF) and FE Case Top Frame (FTF).

The FBF is fixed on site. This part has weather-protected throughputs for the cabling, the FE Connection Board (FNB), the FE Power Supply Unit (FPU) and the FE Battery Unit (FBU) for power supply backup.

The other part, the FTF, is hinged to the bottom part and works as a cover and cooling flange, offering good thermal management for the BRU3. The FTF includes the FE Computer Board (FCB), the FE Modem Board (FMB), the FE Radio Board (FRB), the FE Filter Module (FFM) and the FE Heating Unit (FHU).

The BRU3 is lockable to prevent unauthorized access to the unit. To avoid corrosion, the painted white mechanical parts are made of corrosion-resistant material.

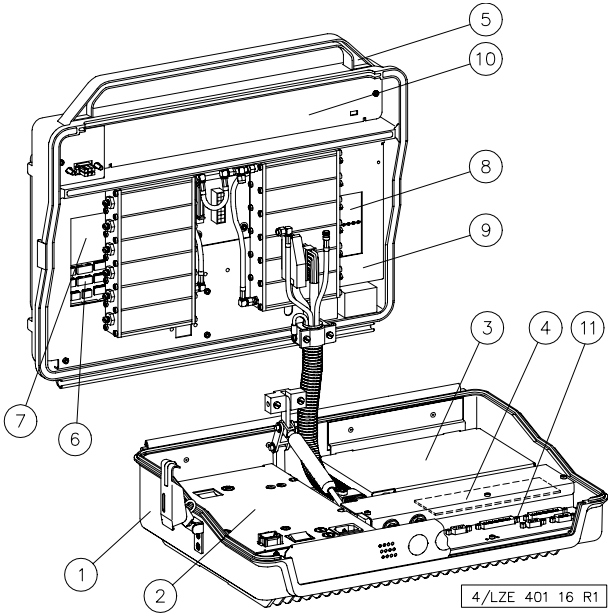

Figure 2 BRU3 (interior).

1 FE Case Bottom Frame (FBF)
2. FE Power Supply Unit (FPU)
3. FE Battery Unit (FBU)
4. FE Adaptation Board (FAB)
5. FE Case Top Frame (FTF)
6. FE Computer Board (FCB)
7. FE Modem Board (FMB)
8. FE Radio Board (FRB)
9. FE Filter Module (FFM)
10. FE Heating Unit (FHU)
11. FE Connection Board (FNB)

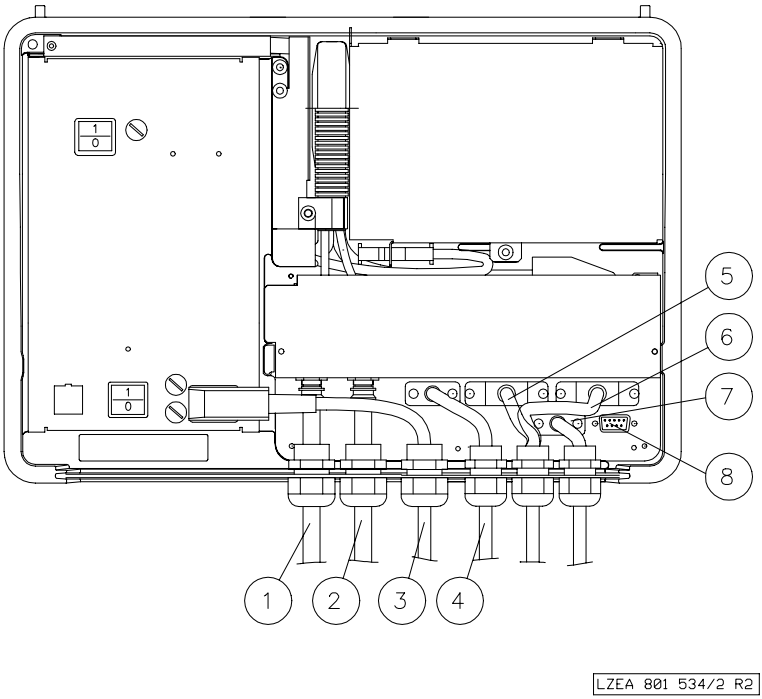

Figure 3 BRU3 external connections.

1. RX Antenna
2. TX Antenna
3. Power Connection
4. Telephone Line Connection
5. Modem Connection RS422C
6. Modem Connection RS232C
7. Alarm Connection
8. Console Connection

Pos 2 is used as the antenna connection when a combined RX/TX antenna is used.
The table below gives a brief description of the BRU3 connections used. The position numbers found in the “Position” column refer to the corresponding position numbers in *Figure 3*.

Pos.	Connector	Type of Connector	Connection To/From
3	MAINS INLET	IEC	120/230V AC input from the BRU3 site power supply.
1	RX ANT.	TNC	Signals from the receiving antenna (RX).
2	TX ANT. ALT. RX/TX ANT.	TNC	Signals to the transmitting antenna TX. Signals to/from the combined RX/TX antenna.
4	P3-TELEPHONE	9p d-sub	Telephone line connection.
5	P5-RS422B	25p d-sub	Connection to MOX via balanced serial interface RS422B.
6	P4-RS232C	25p d-sub	Connection to MOX via un-balanced serial interface RS232C
7	P2-ALARM	9p d-sub	Connection used for external alarm. Defined by the operator.
8	P1-CONSOLE	9p d-sub	Connection used for Console/ NODOP terminal.

1.3 Start-Up and Shutdown Procedures

Note! When starting up the BRU3 after installation, follow the instructions under *Hardware Commissioning Procedure* and *Software Commissioning Procedure* in the *Commissioning Procedure* section of the *BRU3 - General* module.

1.3.1 Start-Up Procedure

When starting up the BRU3, do as follows:

1. Set the "MAINS SWITCH" located on the FE Power Supply Unit (FPU) to position "1".

2. Set the "BATTERY SWITCH" located on the FPU to position "1".

3. Check that the yellow status LEDs are lit on the FE Computer Board (FCB) and the FPU.

4. Check, after a few seconds, that no red alarm LEDs are lit on the FCB or FPU.

Note! The warm-up time for the BRU3 is required to be at least 30 minutes, before the transmitter is activated. Specifications for the BRU3 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 FE Console Cable TSRA 902 0190 to the port "P1-CONSOLE" on the FE Connection Board (FNB).

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.

3. Give the command HALT 120 on the NODOP terminal.

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

5. 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 BRU3 (Warm Start)

Restart (RESET) can be performed either of the entire node or of certain units.

- By command from an NCC operator.
- By the NODOP command **BOOT** using a terminal.
- Manually for different units.
- Automatically, by the software for the different units.

1.3.4 Manual Restart of the BRU3

The manual restart procedure below should be used only if NODOP does not respond to any command. Otherwise, use the NODOP **BOOT** command.

Pressing the reset button will cause an immediate restart of the BRU3, without ensuring a proper node shutdown. The restart may result in loss of user traffic and data.

The reset button (SW1) is located on the FE Computer Board (FCB).

After the restart, the BRU3 will be reinitiated, implying logical connection of all serial communication.

1.3.5 Manual Restart of a BRU3 in Stand Alone Mode

This is short description on how to boot the BRU3 using a PC and a terminal program. When the connection is up and running (use 19200 bps 8N1), cold start the BRU3 by switching the power on and off. After a short while, some text will be displayed on the terminal.

Steps 1-7 below describe how to download software from the PC to the BRU3. These steps are required only if no main software is present on the BRU3 disks.

To check if the main software is present on the disks, use the command “DI”. Check if there is a “.mfe” (like the one stated in step 6) file on either of the disks wp1:, wp2:, wp3:, etc. The name for the disks (wp1, etc.) that are present can be seen at the start-up.

Note! Do not forget the colon “:” after the disk name.

File names stated in the instruction are only examples of file names and should be replaced by correct names.

1. On request, enter **!!!** and set the thumb wheel in position 7 for the command prompt (CMD>).

2. Type ASY at the CMD> prompt.

3. Send the config (config.bin) with the terminal program using zmodem.

4. When the download is finished, the BRU3 will reboot.

5. Get the BRU3 into software transfer mode again by following steps 1 and 2 (if you do not already have a CMD> prompt).

6. Send the main software (main_sw.mfe) with the terminal program using zmodem.

7. When the download is finished, the BRU3 will reboot.

8. Get the BRU3 into software transfer mode again by following steps 1 and 2 (if you do not already have a CMD> prompt).

9. Type “B WP2: MAIN_SW.MFE” at the prompt.

10. The BRU3 should reboot and you will receive the CMD> prompt. Type “B WP2: MAIN_SW.MFE” again and the BRU3 will reboot once more.

11. When the second reboot is finished, the BRU3 will display “USERNAME:”.
(It may take a while for the BRU3 to warm up)

12. Press enter twice to get past the USERNAME and PASSWORD prompts.

13. Issue the command “SET BOOT MASTER WP2: MAIN_SW.MFE Y” at the NODOP prompt.

14. Check that the software is installed permanently by issuing the NODOP command “SHOW BOOT”.

The following step can now be performed, but in your case it should not be necessary:
Enter **!!!** and set the thumb wheel in position 0 for normal mode.

Note! If the main software is still present on the WP2: disk, steps 3-8 may be omitted. You can check if the software is present by issuing the command DI at the command prompt (that is, right before step 2).

1.4 Network Connections

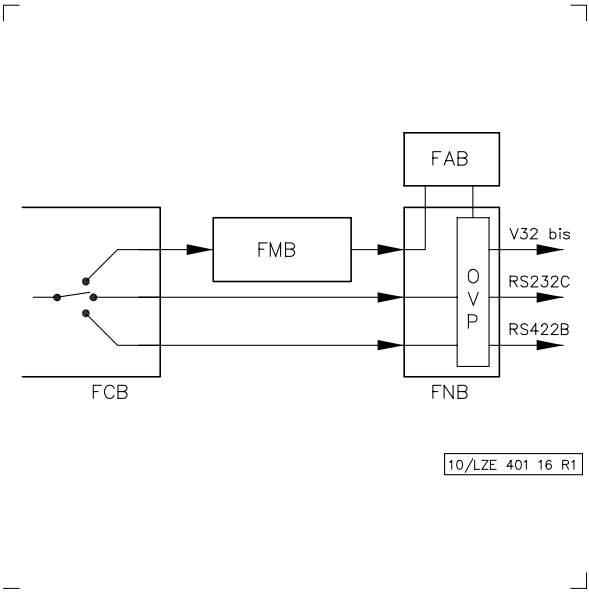

Figure 4 Line interface block diagram.

1.4.1 General

There are three alternative line interfaces for connection to MOX:

- telephone modem V.32
- balanced serial interface V.11 (RS422B)
- unbalanced serial interface V.28 (RS232C).

The choice between telephone modem, balanced serial interface and unbalanced serial interface, is made via hardware strapping, i.e., only one line interface alternative is available at a time. In some BRU3 variants the telephone modem is not applicable which means that only a balanced serial interface and an unbalanced serial interface are available.

The hardware strapping is made by setting switch 2 (SW2) on the FE Computer Board as follows:

Switch 2			
SW2:1	SW2:2	SW2:3	Comments
Open or Closed	Open	Open	V.32bis
Open	Open	Closed	V.28 (RS232)
Closed	Open	Closed	V.11 (RS422)
Other alternatives not allowed.			

SW2:4	Comments
Open	OEM-Strap

1.4.2 Telephone Modem Boards

The telephone modem, which supports the CCITT V.32 and V.32bis standards, consists of two separate boards, the FE Modem Board V.32 (FMB) and the FE Adaptation Board (FAB). Depending on national requirements issued by the telecommunications administration in each country, different versions of the FAB may be used. Also, the information regarding telephone modem in this manual may not be applicable to all BRU3 variants.

Two-wire leased, four-wire leased or switched lines are used for data transmission. The maximum transmission rate is 14 400 bits/sec. The modem is connected to the computer part via a synchronous serial circuit. Asynchronously transferred AT/Hayes commands are used for modem configuration and check.

The software used by the modem is installed from the main processor and stored in a memory.

The FMB does not include a reset button. The FMB and FAB are reset when the main processor is reset.

Connectors

FE Modem Board (FMB)

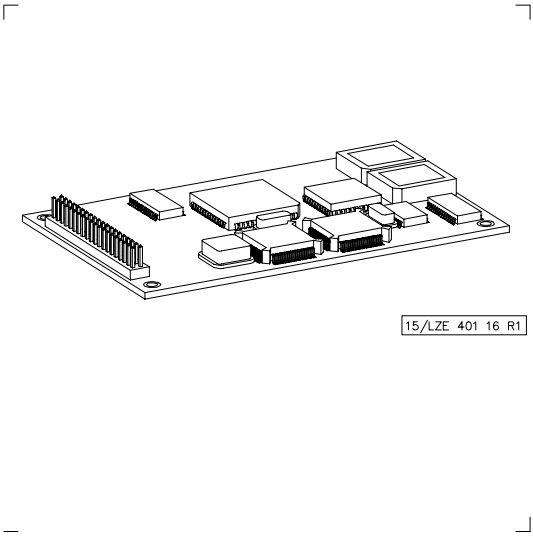

Figure 5 FE Modem Board (FMB).

P1 2x20 pin header with 0.1" module: For connecting the V.24 interface and power from the main board of the BRU3, and also, connection of the analog/digital signals between the FMB and FAB.

FE Adaptation Board (FAB)

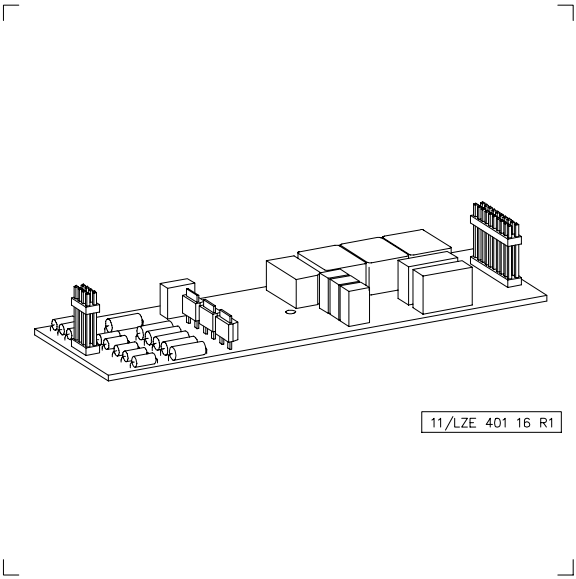

Figure 6 FE Adaptation Board (FAB).

The FE Adaptation Board (FAB) includes two connectors, P1 and P2.

P1 2x10 pin header male connector with 0.1" module used for inter connection to the FMB.

P2 2x4 pin header male connector with 0.1" module used for connection of the various telephone lines.

FE Connection Board (FNB)

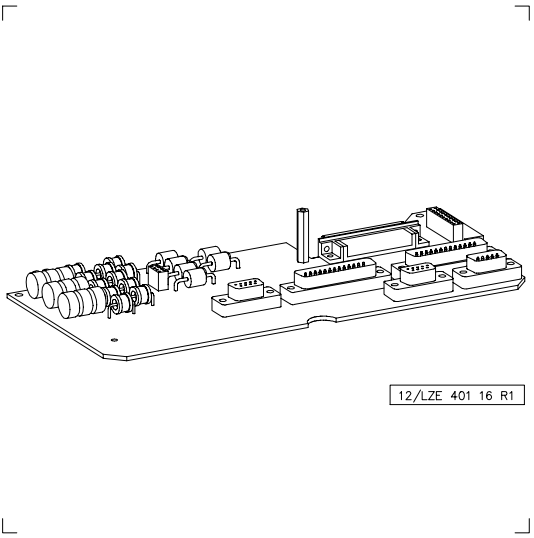

Figure 7 FE Connection Board (FNB).

The FE Connection board (FNB) includes conversion circuits for V.11 and V.28 standards for the serial interfaces. It also includes voltage protection and filters for the modem, the V.11, the V.28 and the console ports.

The FNB contains the following connectors:

P1 9-pole D-SUB male, used for CONSOLE connection

P2 9-pole D-SUB female, used for alarm connections

P3 9-pole D-SUB female, used for connection of telephone lines

P4 (RS232-MOX) 25-pole D-SUB male, used for modem connection.

P5 (RS422-MOX) 25-pole D-SUB male used for modem connection.

1.5 Logic Units

1.5.1 General

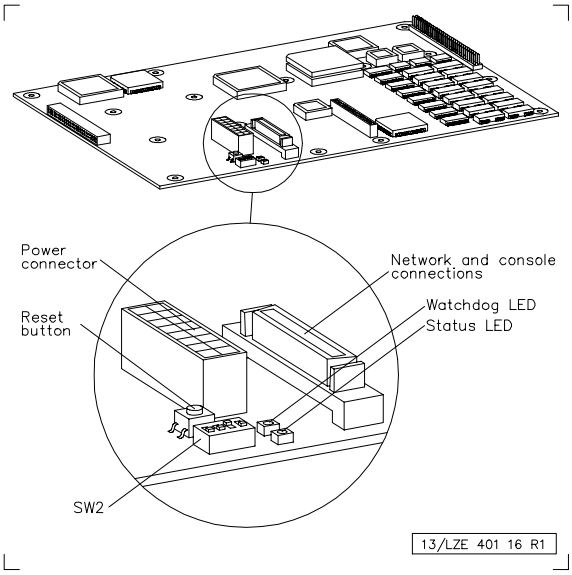

Figure 8 FE Computer Board (FCB).

1.5.2 Connections

The FE Computer Board includes two ports, A and B, for serial communication, both handled by the integrated circuit Z16C35.

Network Connection (Port A)

Port A implies complete synchronous functionality, and also, limited modem support. By the FNB and FMB, this port can be used for V.24/V.28, V.24/V.11 or V.24/V.32.

CONSOLE and NODOP Connection (Port B)

Port B is intended for using a CONSOLE and NODOP via the FNB with the V.24 signals RX and TX.

1.5.3 LEDs

LED	Colour	Function
Status indicator	Yellow	Lit when the processor is operating OK.
Watchdog alarm	Red	Lit when the Watchdog is released. If so, a reset pulse is generated. The Watchdog LED is lit and the signal WDSTATUS, read by the CPU, peaks.

1.5.4 Reset Button

To enable hardware reset of the FCB and the FMB (Modem Board), and also, the FRB (FE Radio Board), the FCB is equipped with a reset button located next to the LED Status indicator. To reach the button for a reset operation, use a pen or a similar object.

A reset of the FCB may be generated for the following reasons:

1. Power-on reset: The reset is generated at power-on, and also, when a power drop occurs.

2. Switch reset: The reset is activated when the reset button is pressed.

3. Watchdog reset. The reset is activated by the watchdog function if not maintained.

4. CPU reset: The reset is performed by the CPU when a reset instruction is executed. In this specific case no reset of the CPU itself is carried out.

1.6 Radio Units

1.6.1 General

The BRU3 is designed for duplex traffic 8 kbit GMSK modulation on the 400, 800 or 900 MHz band.

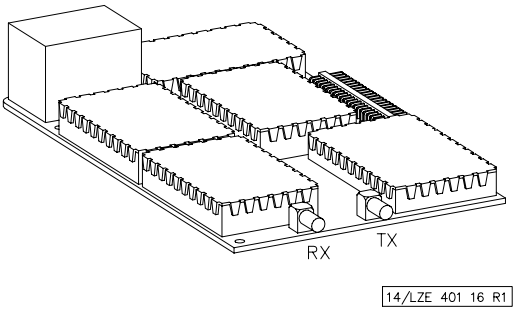

Figure 9 FE Radio Board (FRB) - 900 MHz.

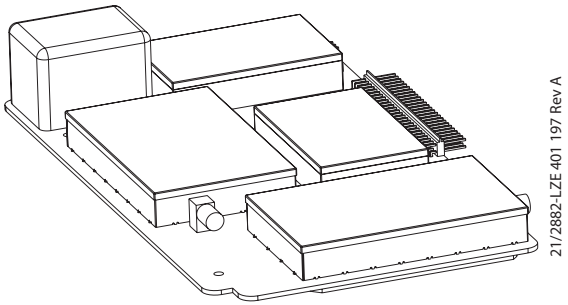

Figure 10 FE Radio Board (FRB) - 800 MHz and 900 MHz.

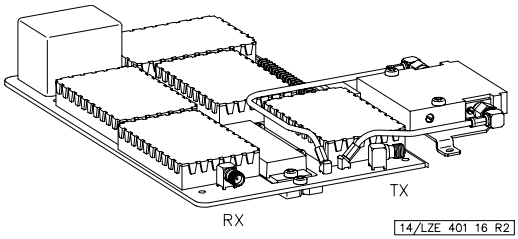

Figure 11 FE Radio Board (FRB) - 400 MHz.

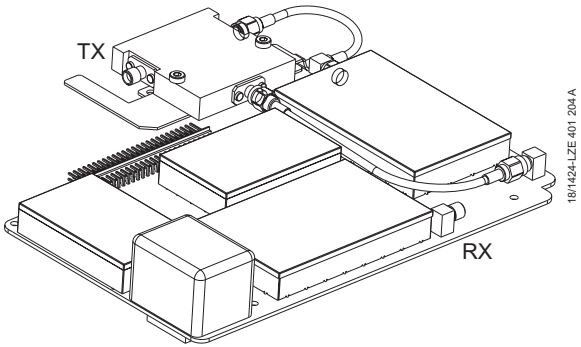

Figure 12 FE Radio Board (FRB) - 400 MHz, ROA 117 8897

1.6.2 Radio Operation

The BRU3 radio units are operated locally on site by using a portable PC and FBTEST. By using FBTEST, it is possible to set TX and RX frequencies, transmitter power, alarm levels, parameters, etc.

Selecting "Radio Operations" on the FBTEST Main menu makes it possible to select between the following submenu alternatives:

1. TRANSCEIVER SETUP MENU
2. MEASUREMENT SETUP MENU
3. TRANSCEIVER CONTROL AND PRESENTATION MENU
4. CALIBRATION
5. RADIO REGISTER EDITOR
6. ADJUSTMENT
7. SETUP

For detailed information on radio operations, please refer to the *FBTEST Reference Manual*.

1.6.3 Reset

To reset the FE Radio board, press the reset button on the FE Computer board resetting both the computer board and radio board.

1.6.4 Connectors

1 connector: For antenna input cable (coaxial)
1 connector: For antenna output cable (coaxial)

For location, see *Figure 9* through *Figure 12*.

1.7 Power Supply

1.7.1 General

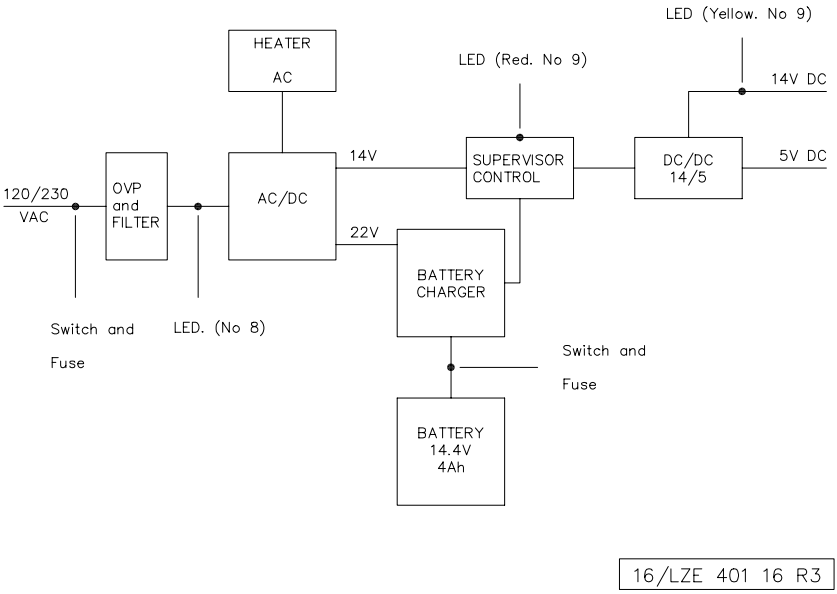

Figure 13 Power supply block diagram.

The BRU3 power supply parts are located in the FE Case bottom frame (FBF). The power supply parts include the FE Power Supply Unit (FPU) and the FE Battery Unit (FBU). The FE Heating Unit (FHU) located in the FE Case Top Frame (FTF), is also regarded as a part of the power supply.

The power supply parts are to be used for:

- Uninterruptible power supply with distribution of 14V and 5V DC to the FCB and FRB
- Lightning protection
- Fused mains feed-through to the FHU.

1.7.2 FE Power Supply Unit (FPU)

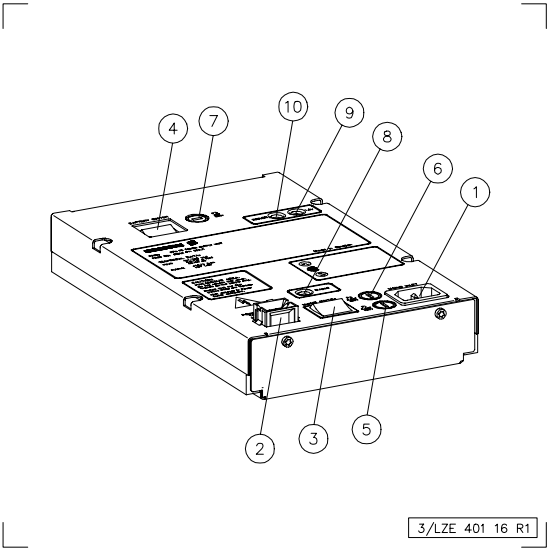

Figure 14 FE Power Supply Unit (FPU).

1. 120 or 230V AC input
2. Power outlet to heater
3. Mains switch
4. Battery switch
5. Fuse 1, 6.3AT 250V
6. Fuse 2, 6.3AT 250V
7. Fuse 3, 6.3AF 250V
8. Mains, status indicator LED
9. 14V, status indicator LED
10. Error, alarm LED

The FE Power Supply Unit (FPU) distributes power to the modem, logic, radio and heating units.

To secure uninterrupted power function, a battery charge check checks that the batteries maintain the highest capacity possible. Failure due to low charging is also reported to the FCB.

Connectors

Connector	Type	To/From
MAINS INLET	J1	120 or 230V AC power input to the FPU
POWER OUTLET TO HEATER	J2	120 or 230V AC power output to the FHU
POWER OUTLET INT. SUPPLY	J3	Power output to the FCB (5V and 14.7V) and power input from the FBU (14.7V)

Switches

Switch	Function
MAINS SWITCH	AC power supply on/off switch
BATTERY SWITCH	Battery power supply on/off switch

LEDs

LED	Colour	Function
MAINS	Yellow	Lit when incoming 120 or 230V AC power is OK.
+14V	Yellow	Lit when +14V DC and +5V DC power distribution to the radio unit and the DC/DC module is OK.
ERROR	Red	Sum alarm indicates a power failure in the FPU if one or more of the following causes occur: 1. +14V and/or +5V DC failure. 2. Charging current too low. 3. Fuse F3 is broken. 4. S1 - "ON", S2 - "OFF" and the battery is connected. NOTE! This cause is not applicable for R3 or later FPU versions.

Note! The red "ERROR" LED will also be lit if the mains voltage is too low and the battery is discharged.

Note! The red "ERROR" LED and the yellow "+14" LED will flicker if the FPU is not correctly connected.

Fuses

Fuse	Type	Safety device for
F1 6.3AT 250V	6.3AT 5x20 mm	Mains input
F2 6.3AT 250V	6.3AT 5x20 mm	
F3 6.3AF 250V	6.3AF 5x20 mm	Power to/from the FBU

1.7.3 FE Battery Unit (FBU)

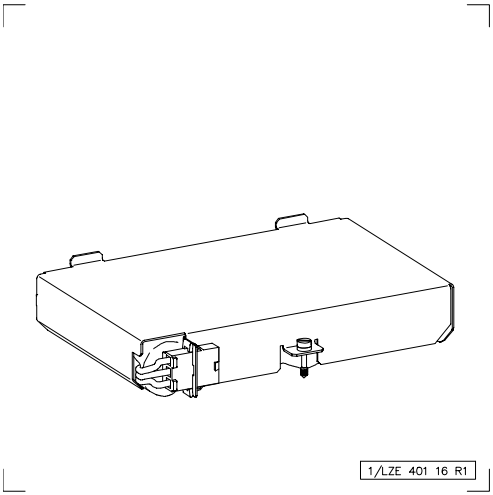

Figure 15 FE Battery Unit (FBU).

The FE Battery Unit (FBU) is located in the case bottom frame. The FBU includes a battery pack of 12 NiCd cells 1.2V 4Ah, with extended temperature range. The battery pack is designed to withstand continuous charge.

The battery unit will start supplying the BRU3 with power when the main power supply goes below 90/198V. The unit is able to supply the BRU3 with power for 30 minutes (**39xx**) and 15 minutes (**34xx and 38xx**) respectively.

A temperature sensor is included in the battery pack to ensure that the charging current is not too strong when the temperature is high or low. The sensor is connected to the charger in the FPU.

For information on how to perform a battery test, please refer to *2.4 Maintenance to be Performed* in this section.

Connector

The FBU includes a 3-pin snap-in connector for connection to the FPU.

1.7.4 FE Heating Unit (FHU)

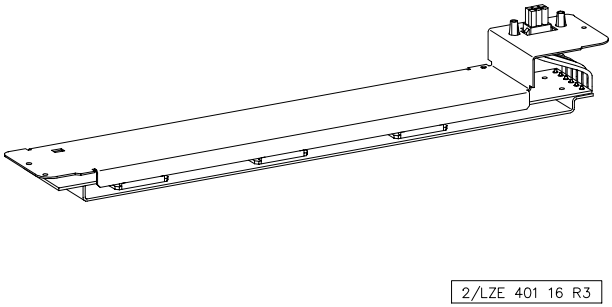

Figure 16 FE Heating Unit (FHU).

The FE Heating unit (FHU) is located in the FE Case Top Frame (FTF). The FHU ensures that the temperature inside the BRU3 is within the requested limits.

The unit consists of the FE Heating Board (FHB) including a heating regulator and a overheating protection device.

When the temperature on the surface of the FTF is about 25 °C or lower, the FHU starts heating the BRU3.
If the temperature should rise to about 55 °C, due to temperature regulating failure, the overheating protection will cut of the power supply to the FHU.

Connectors

The FHU includes a 6-pin connector for incoming AC from the Power supply unit.

1.8 Alarms

The BRU3 includes the following hardware alarms:

Alarm	Description
Temperature alarm HIGH	Inside temp. exceeds +70 °C.
Temperature alarm LOW	Inside temp. is below -20 °C.
Shut off	Alarm signal indicates immediate BRU3 shut-off due to Temp. alarm.
AC alarm	Unspecified AC failure.
DC alarm	Unspecified DC failure. Low or high +14V or/and +5V.
Battery charge alarm	Charge failure, low charging current. Usual causes: 1. Battery switch off. 2. Battery fuse (No.3) broken. 3. Battery charger out of order. 4. Battery pack out of order.
Reflection alarm	Output RF power/Voltage Standing Wave Ratio exceeding alarm limit set.
Transmitter/Receiver alarm	Unspecified Transmitter or Receiver failure.
Low output power alarm	Output power below alarm limit set.
External alarm 1	For customer use.
Case alarm	The alarm is used for checking that the BRU3 is closed, i.e. a physical access check.

For information regarding the setting of alarm limits, please refer to *1.7 Power Supply* in this section.

2 Maintenance

2.1 General

This section describes how to carry out scheduled, visual and preventive maintenance on the BRU3 on site.

The scheduled, visual and preventive maintenance is carried out to increase the operational reliability of the electrical and mechanical parts of the BRU3.

If running a Function Check on a BRU3 mounted outdoors, it is recommended that the check be carried out under weather-protected conditions for the service personnel and test equipment used.

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

For **38xx** and **39xx** maintenance is carried out every:

- 6 Months (Radio Unit Reference Oscillator and Battery Test)

For **34xx** maintenance is carried out every:

- 12 Months (Radio Unit Reference Oscillator)
- 6 Months (Battery Test)

Note! If the BRU3 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 BRU3 on site, the following equipment is required:

- Portable PC including VT-100 emulation software
- FE Console Cable TSRA 902 0190 for connection of the PC to the BRU3 "P1-CONSOLE" port
- Frequency counter 1 GHz
  Degree of accuracy: 0.01 ppm
- Set of screw drivers
- FBTEST software (normally installed in the BRU3)

2.3 Documentation Required

To carry out maintenance on the BRU3 on site, the following documentation is required:

- *BRU3* Manual (the *BRU3* modules in the *Mobitex NTE Client Library*)
- *Node SW - Operation and Maintenance* module
- *Node SW - Installation and Commissioning* module
- *BRU3 - Site documentation* module

Note: The *Site Documentation* module 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 BRU3, 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 (**38xx** and **39xx**) or 0.2 ppm (**34xx**).

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
- FE Console Cable TSRA 902 0190
- FBTEST software
- Frequency counter 1 GHz (degree of accuracy: 0.01 ppm)
- RF attenuator 1 GHz, 30-50 dB.

Test procedure

Note! To carry out the test and adjustment procedure, the BRU3 has to be switched off. Please refer to the shutdown procedure described in this section.

1. Connect the frequency counter via the RF attenuator to the BRU3 TX ANT. connection.

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

3. Select the power, which corresponds to -6 dB attenuation of the transmitter.

4. Start the transmitter.

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

Adjustment

Use FBTEST for transmitter adjustment.

FE Computer Board (FCB)

- Check that the Watchdog alarm LED is not lit.
- Check that the CPU status indicator is lit (yellow light).

FE Power Supply Unit (FPU)

- Check that the sum alarm LED is not lit.
- Check that the AC and DC status indicator LEDs are lit (yellow light).
- Check the power cable and connector for damage. Replace if necessary.

2.4.2 Battery Test

Every 6 months, and always before visiting a BRU3 site for regular maintenance work, it is recommended to perform a battery test. The battery test, which is described below, is executed from NODOP or from OM at the NCC.

Description

The Battery Test is performed by switching the node power supply to battery power supply and measuring the time for the battery to get discharged below a certain limit. When the limit is reached, the node power is switched back to normal power supply and an alarm is sent to the NCC.

Requirements

The time for the battery test is defined by the operator.

Test procedure

1. Start the test by the OM/NODOP command ACTIVATE BATTERY_TEST. The node power supply is switched to battery power and the time for the batteries to get discharged is measured.

   When the batteries are discharged, the node power is switched back to normal power supply and an alarm is sent to the NCC.

2. Read the measured value on the display. The OM/NODOP command SHOW BATTERY_TEST presents the result of both the current, and last completed, battery test.

   Recommended:
   39xx: 30 min. (15 min. for the 6W version)
   34xx and 38xx: 15 min.

3. Check the result against the requirements specified.

4. Replace the battery unit, if necessary.

Note! The battery should be in operation for at least 60 hours before an initial battery test may be performed for the first time after power-up.

A battery test cannot be started under the following conditions:

- A battery test is already running
- The temperature inside the BRU3 is not within the range 20-40 °C
- The batteries are already discharged
- The Node back-up time is out of range.

2.5 Function Check

2.5.1 General

In addition to the regular Check and Visual and Preventive Maintenance program previously described, a Function Check, which is described below, may be performed if so requested by the operator.

The Function Check includes checking BRU3 boards, transmitter, receiver, antennas and hardware alarms.

Furthermore, the Function Check may be used as an extended hardware commissioning test as a complement to the hardware commissioning procedure previously described in this manual.

2.5.2 Equipment Required

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

- Power meter
- Multimeter
- Ericsson test modem LPBA 109 08 or RF signal generator 1 GHz with a built-in GMSK-modulator
- 1 pc of Radio Communication test set, including
  - RF signal generator 1GHz, with external FM DC input
  - Modulation Meter.

2.5.3 Check of Internal Power Supply (Mains and Battery)

Check of internal power supply

Requirements

The required value of the internal power supply should be:

with mains supply:
5V ±0.2V, 8V ±0.5V and 14.7V ±0.3V.

with Battery supply:
5V ±0.2V, 8V ±0.5V and 14.1V ±0.3V, using fully charged batteries.

Test equipment

- Voltmeter

Test procedure (Mains supply)

1. Set the Main switch to position "1". Make sure that the yellow LEDs, MAINS and +14V, are lit.

2. Measure the voltage in the FCB measure points marked "+14V", "+5V" and "+8V".

3. Read the value measured on the voltmeter display. Check the result against the requirements specified.

Test procedure (Battery supply)

1. Make sure that the "BATTERY SWITCH" on the FPU is in position "1". The yellow LED indicating "14V" on the FPU should be lit.

2. Set the "MAINS SWITCH" on the Power supply unit to position "0". Make sure the yellow LED "MAINS" is not lit.

3. Measure the voltage in the FCB measure points marked "+14V", "+5V" and "+8V".

4. Read the value measured on the voltmeter display. Check the result against the requirements specified.

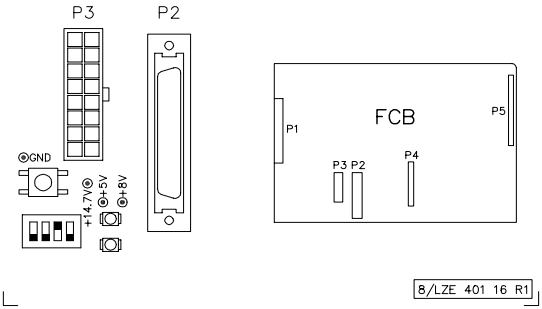

Figure 17 Measurement points on FCB.

2.5.4 FBTEST Board Test

Check of BRU3 boards

Requirements

It is required that a Medium board test of all BRU3 boards should be carried out before taking the BRU3 into operation. No errors are accepted.

Test equipment

- Portable PC including VT-100 emulation software
- FE Console Cable TSRA 902 0190
- FBTEST software.

Test procedure

1. Use FBTEST to set up two test cycles.
2. Run the test cycles.
3. Read the result on the terminal display. Check the result against the requirements specified.

2.5.5 Channel Unit Output Power

Check of the transmitter channel unit output power

Requirements

The nominal output power differs depending on the BRU3 version purchased. For tolerances, please refer to the tables below:

900 MHz, 3W version:

Power 900 MHz	Attenuation (dB)	Tolerance (+dB)	Tolerance (-dB)
3.0W	0	1.5	1.5
1.5W	-3	1.5	1.5
800mW	-6	1.5	1.5
400mW	-9	1.5	1.5
200mW	-12	1.5	1.5
100mW	-15	2.0	3.0
50mW	-18	2.0	3.0
25mW	-21	2.0	3.0

Measurements must carried out on the correct carrier frequency for the **39xx**.

800 MHz, and 900 MHz, 6W version:

Power 800 MHz	Attenuation (dB)	Tolerance (+dB)	Tolerance (-dB)
6.0W	0	1.5	1.5
3.0W	-3	1.5	1.5
1.5W	-6	1.5	1.5
800mW	-9	1.5	1.5
400mW	-12	1.5	1.5
200mW	-15	2.0	3.0
100mW	-18	2.0	3.0
50mW	-21	3.0	3.0

Measurements must carried out on the correct carrier frequency for the 38xx.

400 MHz:

Power 400 MHz	Attenuation (dB)	Tolerance (+dB)	Tolerance (-dB)
6.0W	0	1.5	1.5
3.0W	-3	1.5	1.5
1.5W	-6	1.5	1.5
800mW	-9	1.5	1.5
400mW	-12	1.5	1.5
200mW	-15	2.0	3.0
100mW	-18	2.0	3.0
50mW	-21	2.0	3.0

Measurements must be carried out on the correct carrier frequency for the **34xx**.

Test equipment

- Portable PC including VT-100 emulation software
- FE Console Cable TSRA 902 0190
- FBTEST software
- Output power meter
  39xx, 3W version: 20 mW - 5W
  38xx, and 39xx, 6W version: 50 mW - 10W
  34xx: 50 mW - 10W
  Degree of accuracy: better than ±0.5 dB
- Coaxial cable.

Test procedure

1. Connect the output power meter to the BRU3 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.
6. Select a new power level and repeat the measurement procedure.

Note! The adjustment of output power is normally carried out via NCC.

2.5.6 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
- FE Console Cable TSRA 902 0190
- FBTEST software
- Deviation meter 900 MHz, 800 MHz or 400 MHz
  Degree of accuracy: better than ±3.0%.

Test procedure

1. Connect the deviation meter to the BRU3 TX ANT. connection.
2. Use FBTEST to set the correct transmitter carrier frequency for the site.
3. Select the power level which corresponds 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.

2.5.7 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 -11 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
- FE Console Cable TSRA 902 0190
- 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 BRU3 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 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 BRU3 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 three minutes.

6. Check the result against the requirements specified.

7. Set a new (- 11 dB) RF signal level on the signal generator and the BRU3, and repeat the measurement procedure.

2.5.8 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 -117 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
- FE Console Cable TSRA 902 0190
- 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 BRU3 TX ANT. 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 BRU3 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%.

2.5.9 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 -114 dBm, or better. The above measurements must be carried out on the frequencies listed under *Measurement Frequencies* in the *Introduction and Product Specification* section of the *BRU3 - General* module.

Test equipment

- Portable PC including VT-100 emulation software
- FE Console Cable TSRA 902 0190
- 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 - 10 dBµV emf and + 110 dBµV emf.
  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 BRU3 TX ANT. 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 BRU3 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 BRU3, and repeat the measurement procedure.

2.5.10 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
- FE Console Cable TSRA 902 0190
- 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 is started.

1. Connect the signal generator to the BRU3 RX ANT. 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.

2.5.11 Transmitter Antenna VSWR

Check of the Voltage Standing Wave Ratio (VSWR).

Requirements

The power level must be set to a level corresponding to a feeder loss (Lf) of 0 dB, i.e., maximum output power. At maximum output power the required VSWR value should be < 2.0.

The measurement of the VSWR value should be carried out on the frequency for the site. It is important to use an external power meter. The internal power meter is only intended to give an indication of the VSWR value and to make it possible to generate an alarm when a configurable level has been exceeded. The absolute accuracy of the internal power meter depends on the antenna and cable configuration.

The VSWR values measured at the antenna connector must be adjusted to the feeder loss of the installation according to the table below.

Feeder Loss, Lf [dB]	Required VSWR	Required Return Loss, PF-PR [dB]	VSWR Alarm Level	Return Loss Alarm Level [dB]
0	< 2.0	> 10	3.5	5
1	< 1.7	> 12	2.6	7
2	< 1.5	> 14	2.1	9

Note! The VSWR alarm levels are the recommended values. The individual settings for each BRU3 is decided by the operator.

Test equipment

- Portable PC including VT-100 emulation software
- FE Console Cable TSRA 902 0190
- FBTEST software
- External Power Meter

Test procedure

1. Connect the transmitter antenna feeder to the external power meter and then the power meter via cable (RG 214) to the Tx Antenna connector on the FNB.

2. On request, enter **!!!** and set the virtual thumb wheel to position 7.

3. Use FBTEST to set the transmitter channel number corresponding to the correct carrier frequency.

4. Turn on the transmitter output power by means of FBTEST.

5. Measure the PF and PR value using the external power meter.

6. Calculate the VSWR value by using the following formula, or the nomogram in *Figure 18*.

   VSWR = (x + 1)/(x - 1), x = 10E((PF - PR)/20)

   For example if VSWR = 1.5, then PF - PR = 14 dB.

7. Estimate the total feeder loss of the installation and use the corresponding row in the table above to check that the measured VSWR value (received from the nomogram in *Figure 18* or the formula above) complies with the required VSWR value.

8. Note the feeder loss, the measured VSWR value and the corresponding VSWR alarm level in the Commissioning Test Record. The VSWR alarm level shall be set using NETREG in NCC.

9. Turn off the transmitter output power by means of FBTEST.

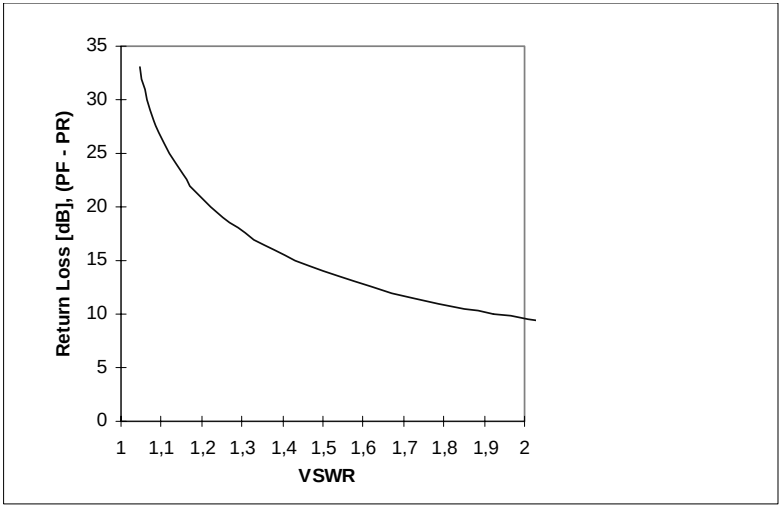

Figure 18 VSWR nomogram.

2.5.12 Hardware Alarm Status

Check of alarm status in BRU3

Requirements

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

Alarm	Status
EXT_ALM1	(External Alarm 1)
INACTIVE (ON)	CASE_ALM
(Open Case Alarm)	INACTIVE (OFF)
LOWTMP	(Temperature Alarm LOW)
INACTIVE (OFF)	HIGHTMP
(Temperature Alarm HIGH)	INACTIVE (OFF)
CHERR	(Battery Charge Alarm)
INACTIVE (OFF)	DCERR
(DC Alarm)	INACTIVE (OFF)
ACERR	(AC Alarm)
INACTIVE (OFF)	TxRxError
(Transmitter/Receiver Fault Alarm)	INACTIVE (N)
VSWR	(Reflection Alarm)
INACTIVE (N)	Low Tx power
(Low Output Power Alarm)	INACTIVE (N)

Test equipment

- Portable PC including VT-100 emulation software
- FE Console Cable TSRA 902 0190
- FBTEST software.

Test procedure

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

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 BRU3. 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 BRU3 units before using this section. For information about each unit, please refer to *1 Design, Function and Operation* in this section.

In most cases, faults are caused by units not working properly, or switches set to invalid positions.

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 BRU3 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 Power Supply Units

3.2.1 FE Power Supply Unit (FPU)

Indication: "MAINS" LED* is not lit.	
Possible cause	**Action**
MAINS SWITCH set to "0".	Set MAINS SWITCH to "1".
Fuse(s) F1-F2 defective.	Replace fuse(s).
Incoming power cable/ connector defective.	Replace incoming power cable/connector.
Incoming AC power failure.	Check site AC power distribution.
FPB defective.	Replace FPU if necessary.

* Is lit when incoming 120/230V AC power is OK.

Indication: "14V" LED** is not lit.	
Possible cause	**Action**
Fuse(s) F1-F3 defective.	Replace fuse(s).
Cable/connectors between FPU and FBU defective or not connected to the FCB.	Replace cable/connectors.
Low power in Battery pack.	Check Battery pack power level. Recharge the Battery.

** Is lit when the 14V DC power distribution to the radio unit and the DC/DC module is OK.

Indication: "ERROR" LED* is lit.	
Possible cause	**Action**
Fuse(s) F1-F3 defective.	Replace fuse(s).
Cable/connectors between FPU and FBU defective or not connected to the FCB.	Check cable/connectors. Replace if necessary.
FPB defective.	Replace the BRU3 if necessary.

* Indicates an unspecified power or charger failure in the FE Power Supply Unit (FPU).

3.2.2 FE Battery Unit (FBU)

The FE Battery Unit (FBU) does not include LEDs for alarm or status indication. For troubleshooting the FBU, please refer to *3.2.1 FE Power Supply Unit (FPU)* in this section.

3.3 Logic and modem units

3.3.1 FE Computer Board (FCB)

Indication: STATUS indicator LED* is not lit.	
Possible cause	**Action**
Power failure.	Check power distribution on FCB, measure point "5V". Reset BRU3 via FCB reset button: 1) If BRU3 starts, run FBTEST Board Test for further check. 2) If BRU3 does not start, replace the BRU3.
FCB defective.	Run FBTEST Board Test, (please refer to the *FBTEST Reference Manual*). Replace the BRU3 if FCB is found to be defective.

* Is lit when the processor is operating normally.

Indication: WATCHDOG alarm LED** is lit.	
Possible cause	**Action**
Hardware fault on FCB.	Run FBTEST Board Test, (please refer to the *FBTEST Reference Manual*). If FCB is found to be defective, replace the BRU3.
Software error.	Contact your local Field Support Centre (FSC) for further assistance.

** The Watchdog is released.

3.3.2 FE Modem Board (FMB) & FE Adaptation Board (FAB)

Note! The FE Modem Board and the FE Adaptation Board do not include LEDs for alarm or status indication.

Indication: Modem out of order or working improperly.	
Possible cause	**Action**
Incorrect modem setup in FBTEST.	Check modem setup in FBTEST Modem menu.
Incorrect dip switch setting on FCB.	Check dip switch (SW2) setting on FCB.
Cables/Connectors not properly connected.	Check cables/connectors. Replace if necessary.
FMB or FAB defective.	Run FBTEST Board Test. Replace FE Case Top Frame if FMB is found to be defective. Replace BRU3 complete if FAB is found to be defective.

3.3.3 FE Connection Board (FNB)

Note! The FNB does not include LEDs for alarm or status indication.

Indication: Connections/connectors defective.	
Possible cause	**Action**
FNB defective.	Run FBTEST Board Test. To run extended FNB test, plugs must be adapted to the RS422 and RS232 connections on FNB. Replace BRU3 complete if FNB is found to be defective.

3.4 Radio units

3.4.1 FE Radio Board (FRB)

Note! The FRB does not include LEDs for alarm or status indication.

Indication: Radio units out of order or working improperly.	
Possible cause	**Action**
FRB defective.	Run FBTEST Board Test including FCB. Replace FE Case Top Frame if FRB or FCB is found to be defective. If no fault is found, please refer to *2.5 Function Check* in this section, describing a number of radio tests possible to perform by using FBTEST. Replace the BRU3 if necessary.
Antenna cables or connections defective.	Check antenna cables and connections. Replace if necessary.

3.5 FE Heating Unit (FHU)

3.5.1 FE Heating Board (FHB)

Note! The FHB does not include LEDs for alarm or status indication.

Indication: Heating unit out of order or working improperly.	
Possible cause	**Action**
Low temperature inside the BRU3.	Check the heating unit (probably out of order). Replace the BRU3.
No power distribution to FHU.	Check FHU connection to FPU. Replace connector if necessary.