

User's manual
for
channel selective repeater
MRx41



B0003AHA

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LIST OF UNIT SPECIFIC ABBREVIATIONS

ALC	Automatic Level Control
ARFCN	Absolute Radio Frequency Channel Number
BCCH	Broadcast Control Channel
BITE	Built In Test Equipment
BTS	Base Transceiver Station
DL	Downlink
ETS	European Telecommunication Standard
ICE	Interference Cancellation Equipment
Id.-No.	MIKOM part number
I ² C-Bus	Inter Integrated Circuit Bus (Philips)
LMT	Local Maintenance Timeout
O.C.	Open Collector
OMC	Operation and Maintenance Centre
NiCd	Nickel Cadmium
MR	Mikom repeater
MS	Mobile Station
Rev .	Revision
REPxxxxV1.xx RF	repeater software xxxx version 1.xx , e.g. REP1012 V1.04
RF	Radio Frequency
RSSI	Receive Signal Strength Indication
RTC	Real Time Clock
SDA	Serial Data Line of I ² C-Bus
SCL	Serial Clock Line of I ² C-Bus
UL	Uplink
UPS	Uninterruptible Power Supply
VCC	Repeater internal DC voltage (+ 5V) for logic devices

CONTENTS OF DELIVERY

Qty1 Repeater MRx41

Qty1 User's manual for channel selective repeater MRx41

Qty 1 Software manual for REP1012V1.xx

Qty1 Set of test protocols consisting of an electrical acceptance test protocol and a safety test protocol applying to the power supply

Qty1 Spare parts kit containing:

- 1 control cable RS232, DB9 female / DB9 female, 3m
- 3 socket head cap screws M3.0 x 30
- 2 tallow-drop screws M5.0 x 25
- 2 tallow-drop screws M2.0 x 6
- 2 tallow-drop screws M3.0 x 5
- 4 straight pins 3.0 x 25
- 2 fuses 2.0 A
- 2 O-ring 4 x 2 mm
- 2 Tyraps
- Silicon heat conducting paste
- 4 special nuts M4
- 1 O-ring 63 x 2 mm
- 1 fuse 10 A (F)

Tools

- 1 hex socket key, size 2.5
- 1 Torx key
- 1 hex socket screw key , size 4, long

Qty1 Wall mounting sheet

HEALTH AND SAFETY WARNINGS

- ☞ **Note:** The electrical installation has to be performed in accordance with the safety regulations of the local authorities. Due to safety reasons the electrical installation must be performed by qualified personnel. The cover of this unit should not be opened while power is applied. Subsequent installation, commissioning and maintenance activities that require the unit to be powered with the cover open shall only be carried out by suitably qualified personnel.

- ☞ **Note:** The grounding of the unit has to be performed by all means. A grounding bolt is provided at the outside of the cabinet in order to connect the earth bonding cable.

- ☞ **Note:** Make sure that a suitable mounting surface is used. Only adequate manpower is allowed to handle the system.

- ☞ **Note:** ESD precautions have to be observed! Before maintenance work use the available grounding system to connect ESD protection measures.

- ☞ **Note:** Due to power dissipation the repeater may heat up the air volume inside the cabinet and reach a very high temperature. Therefore it is recommended to mount the repeater in the vertical plane to a wall or a mast without additional enclosure to provide sufficient ventilation. Between the housing and the wall a minimum distance must be kept in order to provide air circulation.

- ☞ **Note:** Close the repeater housing only after a thorough control of the cable layout, in order to avoid any damage of the cables.

PREAMBLE

Repeaters are an essential part of an efficient and effective wireless system. They can enhance outdoor coverage as hole fillers, provide coverage extension service on highways, canyons and in tunnels at the fraction of the cost of a new cell site. MIKOM is a leading manufacturer of repeaters. They provide excellent electrical characteristics, they are light-weight and easy to install. Hence, the MIKOM repeater is the preferred solution.

Your repeater has been built using highly reliable materials. A comprehensive quality assurance has been applied to all fabrication steps. This secures constant quality of the product. Every repeater leaves the factory only after a thorough final acceptance test, accompanied by a test certificate, which warrants perfect function. The acceptance test protocol is subject of the delivery and it is fixed to the repeater lid in order to provide a quick reference for the user.

Any intervention has to be performed by authorised persons only. If you need technical assistance with the repeater MRx41 contact your local sales office (see table 1-1) or MIKOM directly at following address:

MIKOM GmbH
Industriering 10
86675 Buchdorf
Germany
Tel: +49 (0) 90 99 - 6 90
Fax: +49 (0) 90 99 - 69 31
email: sales@mikom.com
http://www.mikom.com

Under consideration of all references given in this manual, the repeater should be taken into service without any complications and should operate trouble-free for a long time.

LIST OF INTERNATIONAL SALES OFFICES

<p>Allen Telecom Inc.</p> <p>30500 Bruce Industrial Parkway Cleveland, Ohio 44 139-3996 USA</p> <p>Phone: +1 (440) 349-8400 FAX: +1 (440) 349-8407</p>	<p>Allen Telecom Pty Ltd</p> <p>6 Stuart Street Padstow NSW 2211 Australia</p> <p>Phone: +61 (2) 9774-4200 FAX: +61 (2) 9774-4500</p>	<p>Forem France</p> <p>Z.I. des Ebisoires 78370 Plaisir France</p> <p>Phone: +33 (1)30-79-15-30 FAX: +33 (1) 30-55-55-37</p>
<p>FOREM S.p.A.</p> <p>Via Archimede N. 22/24 20041, Agrate Brianza Milan Italy</p> <p>Phone: +39 (039)605-41 FAX: +39 (039) 605-4477</p>	<p>AT Singapore</p> <p>80 Marine Parade Road #19-1 Parkway Parade Singapore 449269</p> <p>Phone: +65 (345) 8022 FAX: +65 (345) 8033</p>	<p>AT China</p> <p>CITIC Building, # 11-04 19 Jianguomenwai Avenue Beijing China 100004</p> <p>Phone: +86 (10) 6508-3088 FAX: +86 (10)6508-3066</p>
<p>AT Canada</p> <p>1815 Ironstone Manor, # 12 Pickering, Ontario L1W 3W9 Canada</p> <p>Phone: +1 (905) 839-3474 FAX: +1 (905) 839-4663</p>	<p>FOREM UK</p> <p>Unit D Castle Industrial Park Pear Tree Lane Newbury, Berkshire U.K. RG 14 2EZ</p> <p>Phone: +44 (1635) 569-695 FAX: +44 (1635) 569-463</p>	<p>AT Hong Kong</p> <p>1603 Remington Center, 23 Hung To road, Kwun Tong, Kowloon Hong Kong</p> <p>Phone: +852 (2389) 1844 FAX: +852 (2389) 4864</p>
<p>AT India</p> <p>B-256 Ground Floor. Chittaranjan Park New Delhi 110019</p> <p>Phone: +91 (11) 696-3918 FAX: +91 (11) 652-1648</p>	<p>MIKOM Switzerland</p> <p>Tiergartenweg 1 4710 Balzthal Switzerland</p> <p>Phone: +41 (6238) 61260 FAX: +41 (6238) 61261</p>	<p>MIKOM Austria</p> <p>Himbergerstr. 7/3/1 2320Schwechat Austria</p> <p>Phone: +43 (1) 706 – 3999 FAX: +43 (1) 706 – 39999</p>

table 1-1 List of international sales offices

1 Introduction

1.1 *Intended purpose*

Cellular telephone systems transmit signals in two directions between base stations and mobile telephones within the signal coverage area.

If weak signal transmissions occur within the coverage area because of indoor applications, topological conditions or distance from the transmitter, a repeater is used to extend transmission range. In the downlink path the repeater will pickup the signal from a donor antenna of an existing cell, amplifies and re-transmits it into the desired dark spot. In the uplink direction the repeater will receive signals from mobile stations present in its coverage area and re-transmits them to the corresponding base station.

1.2 *About the MRx41*

The repeater MRx41 is a channel selective amplifier, which bi-directionally amplifies signals between mobile stations and a base station in the GSM900, GSM1800 und PCS1900 mobile telephone system. It can provide highly selective amplification of up to 8 channels, thus enabling radio coverage in regions where satisfactory quality of communication is disabled.

MRx41 modules can also be combined with other MRx41 repeater modules in order to create a combines GSM900, GSM1800 or PCS1900 repeater system. Other modules, operating in TACS, ETACS and AMPS are available as well. When different modules are combined, a common antenna terminal and a common control interface is available. The basic unit is capable of 2 channels and easily expandable by adding 2-channel extension units delivered in separate cabinets.

The repeater can be set locally or remotely. For modem operation different interfaces are available. The design of the repeater comprises a large number of functions which the operator may monitor via terminal emulation program or the Mikom OMC software platform. An easy to understand and easy to learn communication language supports the operator to query status reports from the repeater or to change settings.

☞ **Note:** **It is not possible to combine MRx41 units / modules with MRx40 units / modules.**

2 Functional description

The repeater MRx41 can be delivered as an one channel system, expandable up to an 8 channel system by means of extension units connected to the main unit.

The following block diagrams shall illustrate the different configurations.

Configuration of an one channel system

Figure 2-1 illustrates the configuration of an one channel system which consists of one basic module (channel 1).

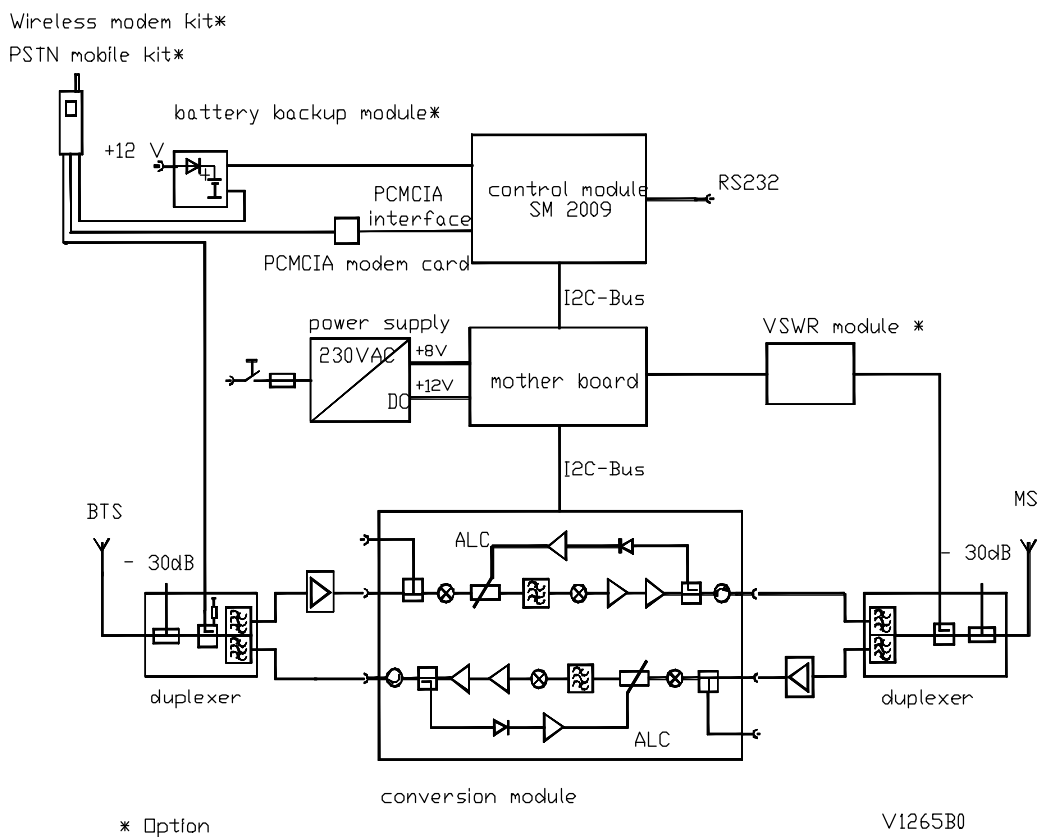


figure 2-1 One channel system

Configuration of a two channel system

Figure 2-2 illustrates the configuration of a two channel system, containing one basic module and one extension module.

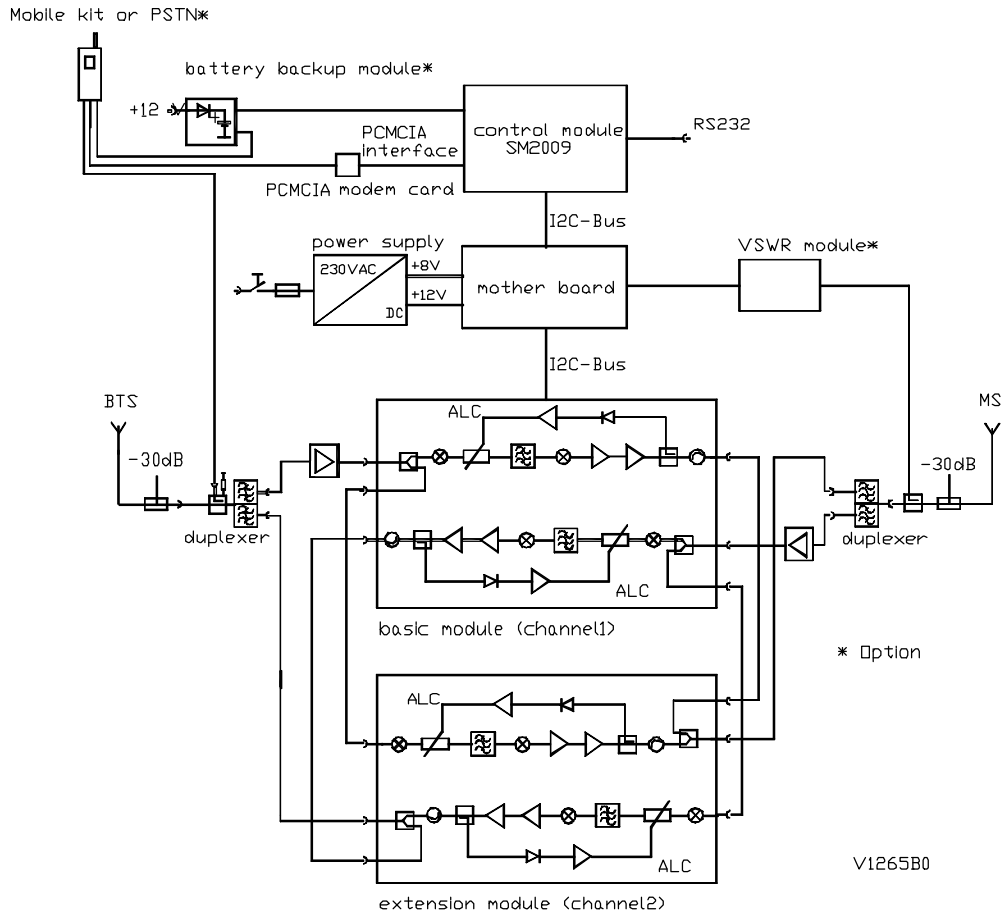


figure 2-2 Configuration of a two channel system

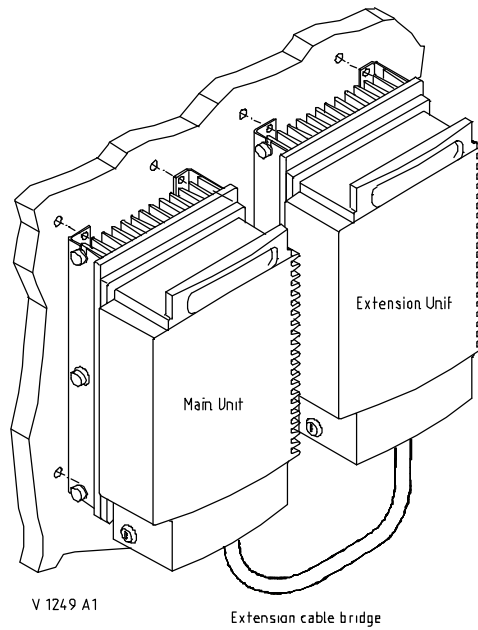


figure 2-3 Main unit with connected extension unit

Configuration of a 4 channel system

Figure 2-3 illustrates the configuration of a 4 channel system. For the configuration of 3 or 4 channels it is necessary to install a combiner module in the main unit. The block diagram describes the connection between the channel modules and the combiner module. The mother board and the control module are not included in the figure below.

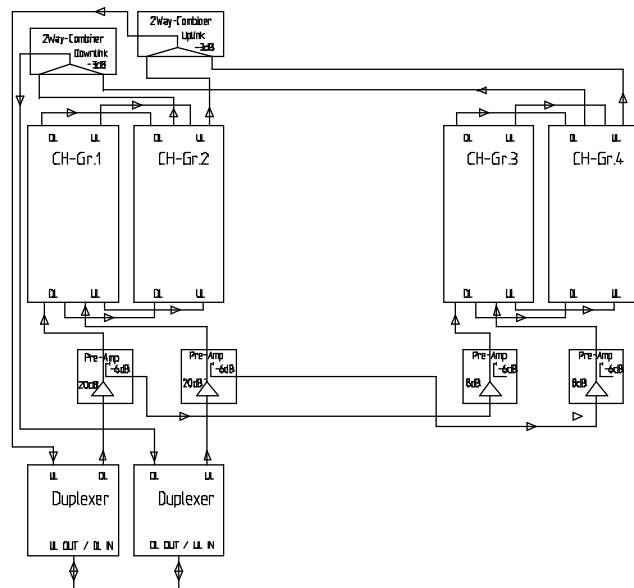


figure 2-4 Configuration of a 4 channel system

Configuration of a 6 channel system

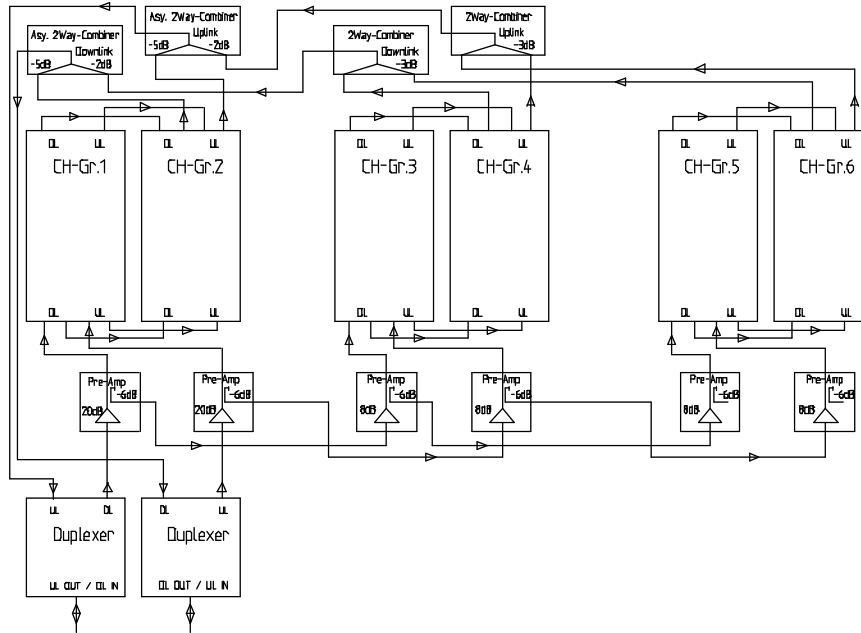


figure 2-5 Configuration of a 6 channel system

Configuration of an 8 channel system

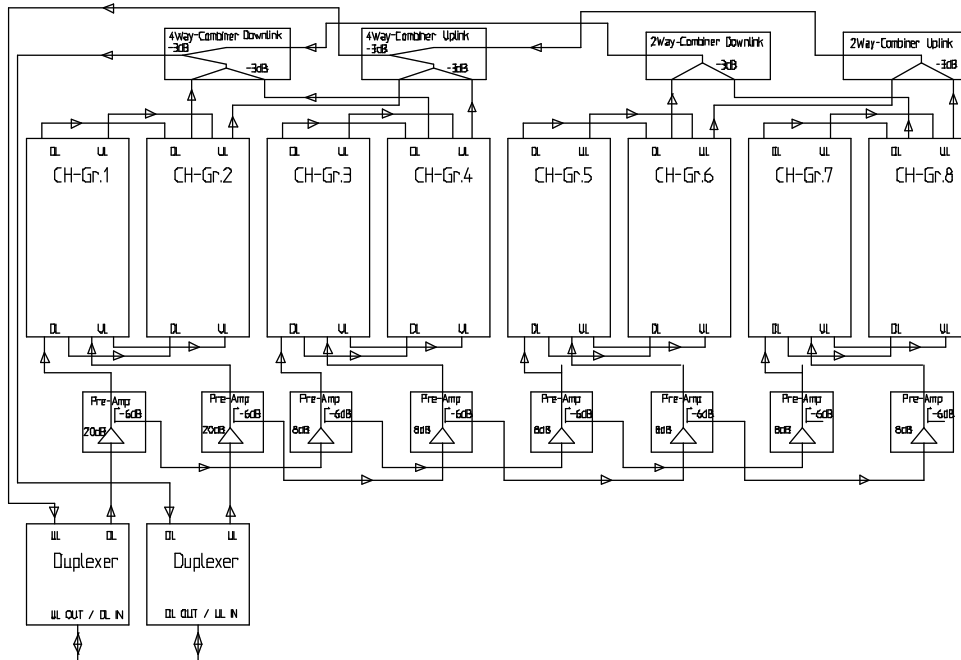


figure 2-6 Configuration of an 8 channel system

2.1 Channel modules

Two different types of conversion modules have been designed.

1. **Basic module: Channel 1, 3, 5 and 7**
2. **Extension module: Channel 2, 4, 6 and 8**

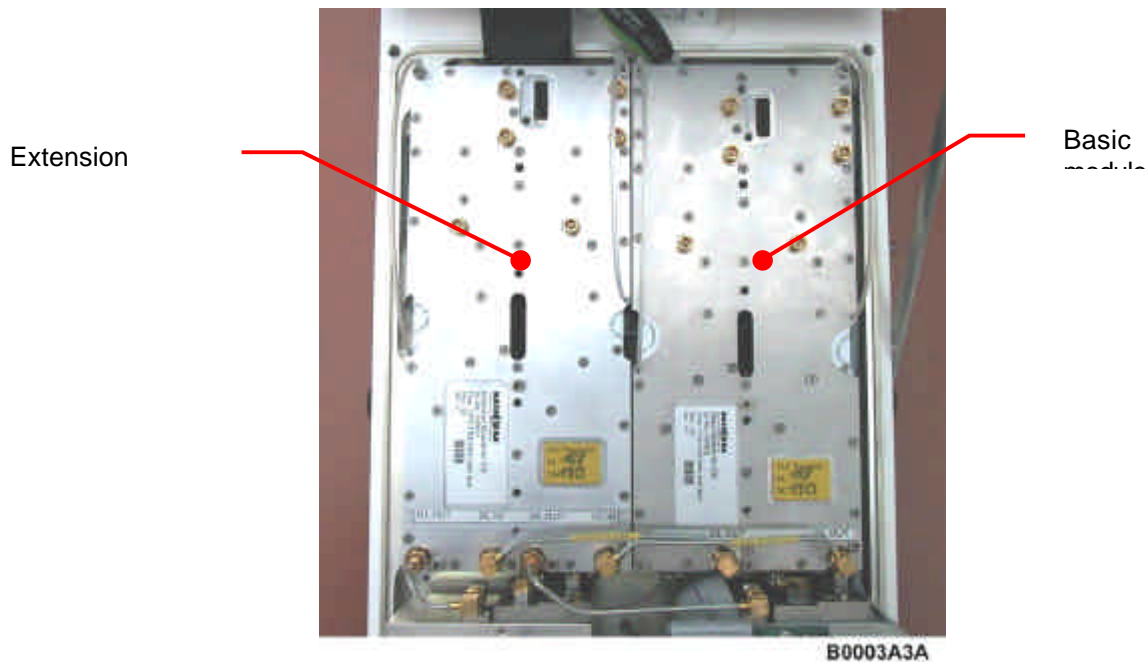


figure 2-7 Top view of basic / extension module

The repeater consists of two amplifier chains, which are connected antiparallel. The receive path of one direction is connected to the transmit path of the other direction by a frequency separation unit, in the following denominated as a duplexer, which combines both signals to an antenna.

The task of the conversion modules is to amplify the receive signals and to convert them into an intermediate frequency. The signals, then, proceed a filter stage comprising of highly selective filters, and run through a digital controllable attenuator. The attenuation can be set in steps of 2 dB, locally or remotely. By using the same synthesizer frequency, that was used to convert the signals down to intermediate frequency, the intermediate frequency is mixed up to the original frequency.

The synthesizer is controlled via an I²C-Bus. In case of a breakdown in mains, gain and frequency data are non-volatile stored in an EEPROM on board.

The filters of the MRx41 series have the bandwidth of a GSM900; GSM1800 or PCS1900 channel.

The RF output is protected by limiting the output power with an ALC circuitry inside the module.

High stability against intermodulation is achieved by isolators before and after the combiner amplifiers, which inhibits crosstalk into the other amplifier path, thus preventing the generating of parasitic mixing products. The combiner is followed by a duplexer.

Note: For the exchange of a channel module or the installation of a new channel module, the slave address of the synthesizer has to be set (see chapter 8.8).

2.2 Termination module

To install a repeater system with an odd channel number (e.g. 1, 3, 5 or 7 channels) a termination module has to be installed instead of an extension module. This is necessary in order to keep the gain balance, otherwise the last channel provides 3 dB more gain and output power.

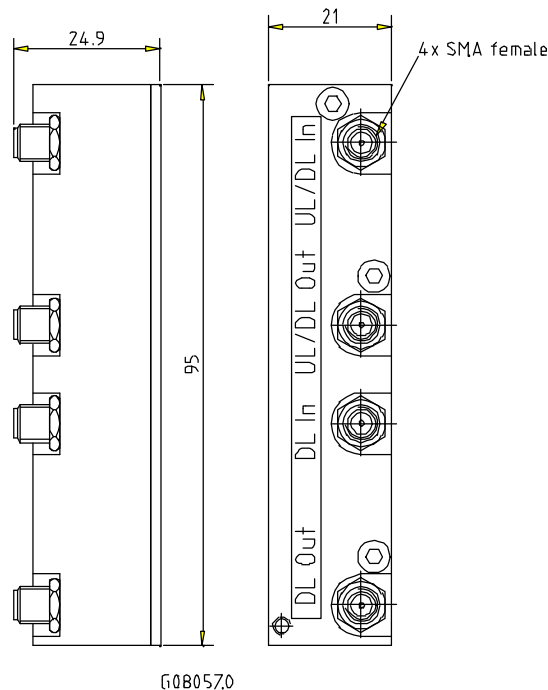


figure 2-8 Mounting drawing of the termination module

2.3 Mother board

The function of the mother board is the communication between the conversion modules and the control module via the I²C-Bus but also the support of all necessary DC voltages and connections. All signals are recognized from the mother board logic. Furthermore each repeater unit has an allocated address set by means of a rotary switch. The address of the repeater has been set already in the factory. The rotary switch is located on the left-hand side of the mother board on top of the board.

Note: Don't adjust this switch unless it is necessary.

Configuration of the rotary switch to set the address of the repeater unit.

0 = Main Unit	(channel 1 and 2)
1 = Extension Unit 1	(channel 3 and 4)
2 = Extension Unit 2	(channel 5 and 6)
3 = Extension Unit	(channel 7 and 8)
4...F	Do not use!

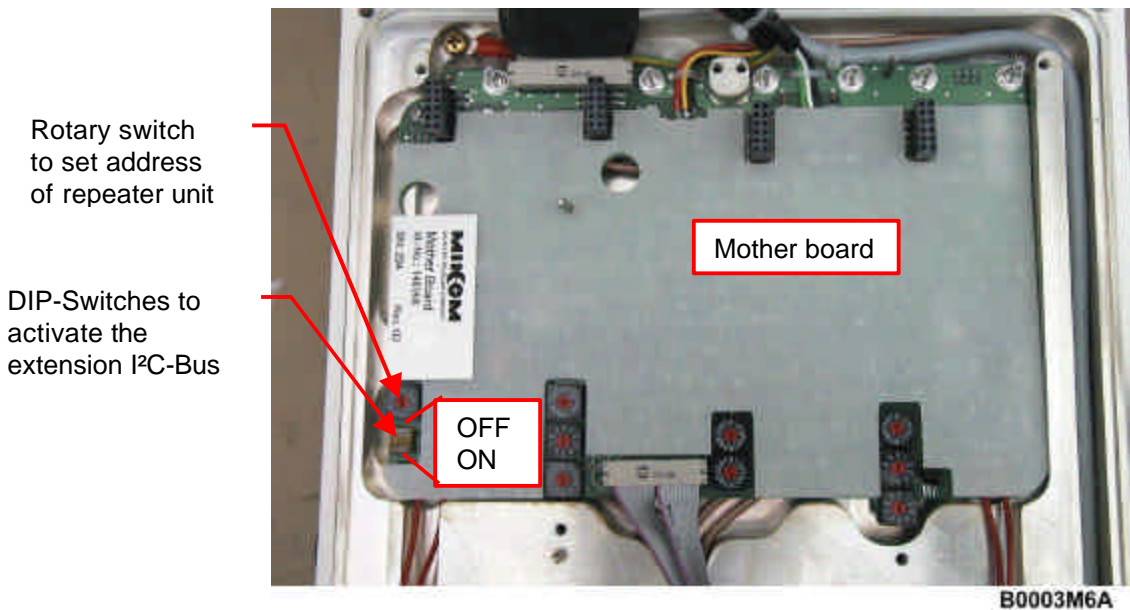


figure 2-9 Top view of the mother board

2.4 Control module SM2009

The control module SM2009 is a DOS compatible micro computer. The whole communication between the operator and the repeater can be done via the control module. By using either the RS232 interface or the PCMCIA slot and a mobile the repeater can be controlled locally or remotely by using a VT100 terminal, or a PC emulating the VT100 terminal.

Gain of uplink and downlink can be controlled, channels can be set and status messages can be received remotely.

The data transfer between the control module SM2009 and the mother board is realised by the I²C-Bus.

The I²C-Bus concept was developed by Philips for the serial connection of integrated circuits within one device. Two wires, SDA - serial data and SCL - serial clock, carry information between the devices connected to the bus. The MRx41 I²C-Bus concept is working with a bit rate of 1.5 kbit/s. All configuration parameters are stored non-volatile in an EEPROM on the control module, so that in case of a power supply failure all user settings can be restored completely.

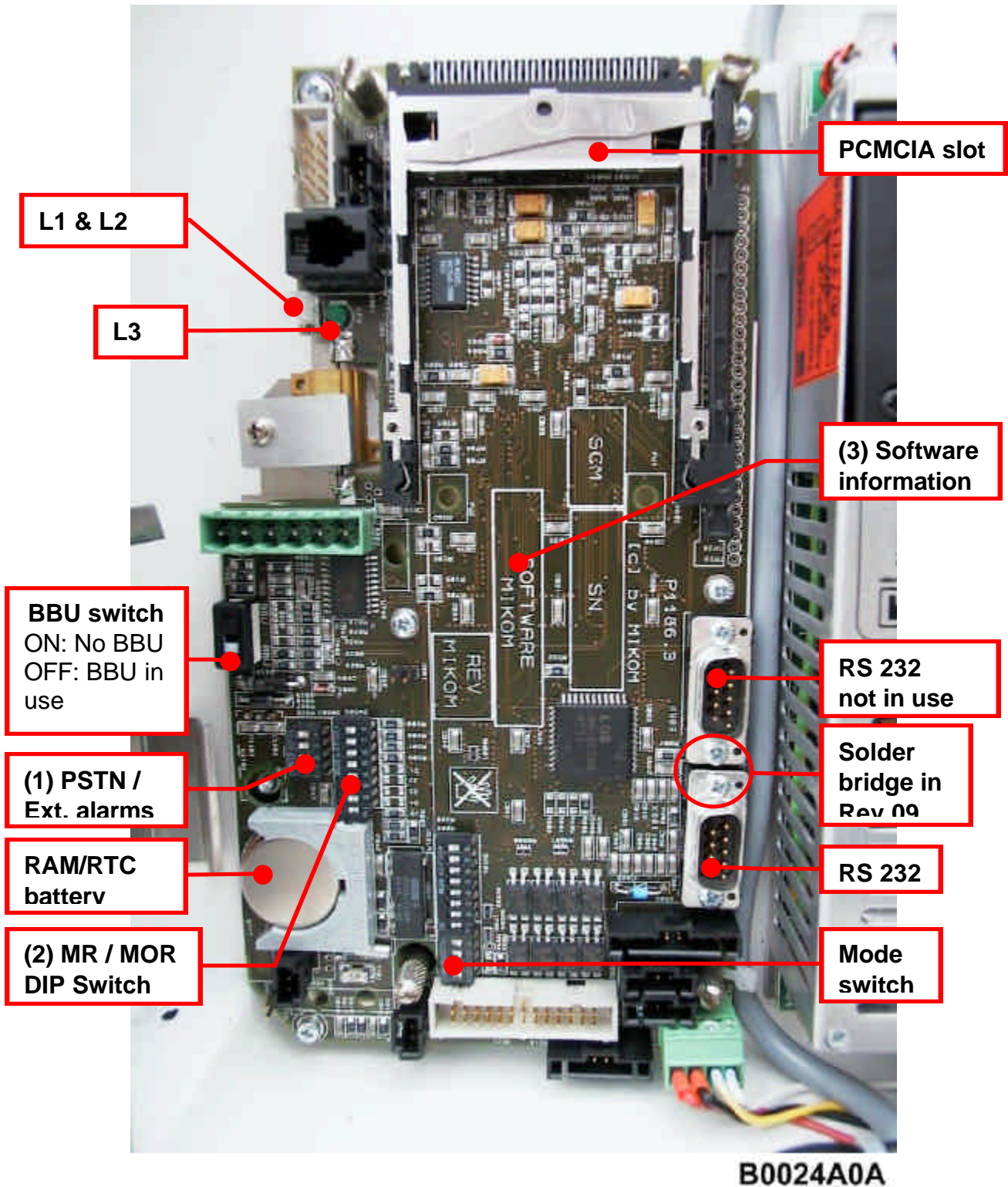


figure 2-10 Topview of control module
(See comments at following page)

- (1) External alarms or PSTN modem selection by DIP-Switches
- (2) Configuration DIP-Switches for MR or MOR (Master Unit) repeater
- (3) Fixed location for labels (control module Id.- No., revision stage, repeater software, serial number)

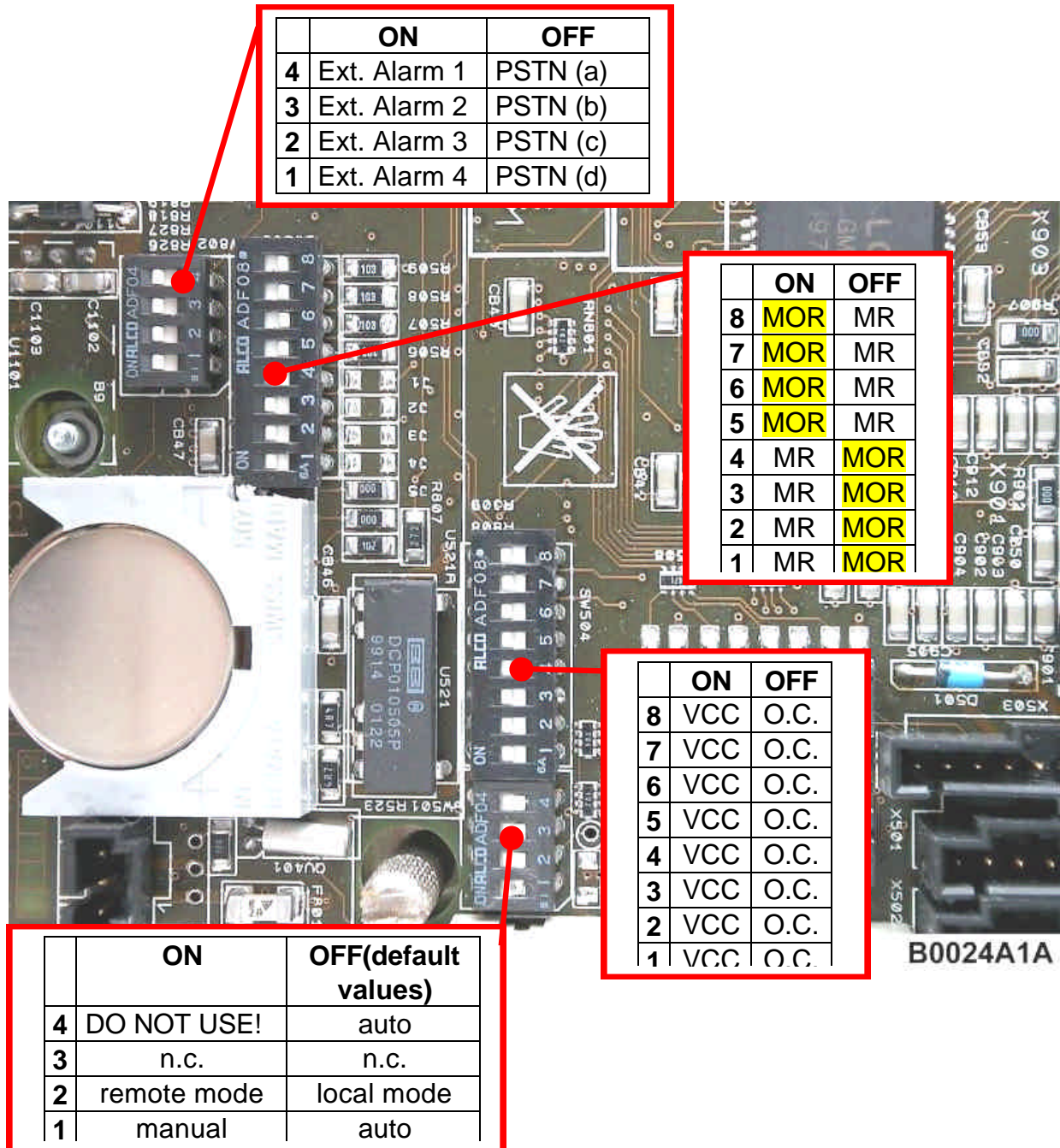


figure 2-11 DIP-Switch settings

2.5 Duplexer

The receive path of one direction is connected to the transmit path of the other direction by a frequency separation unit, in the following denominated as a duplexer, which combines both signals to an antenna.

The task of the duplexer (see figure 12-2 Layout of the repeater heat sink) is to isolate uplink from downlink, i.e. isolate transmit path from receive path. The pass bandwidth of the duplexer is the required width of the uplink band and the downlink band respectively in the GSM1800 and PCS1900 band.

2.6 Combiner

After passing through the final stage the signals of all channel groups will be combined from the combiner module in the UL and in the DL path. The combiner is only equipped from 3 channels up to 8 channels and will be followed by the duplexer. A combiner is not required in an one or two channel repeater.

2.7 Measuring aids

With the built-in RF probe signals can be applied or detected. The probes provide a coupling factor of 30 dB. This facilitates measurements under all operational conditions, while an antenna or a dummy load may be connected. Each duplexer is equipped with one coupler.

2.8 Power supply

The power supply is provided by 230 Vac (optionally 115 Vac or 48 Vdc or 24 Vdc) mains power. The following figure shows the mounting position of the power supply in the repeater lid. The secondary voltage is + 8 Vdc for the channel modules and the mother board logic, + 12 Vdc for the control module. The power supply can be switched on or off by means of an external switch. The modules of the repeater are voltage free if the power supply is switched off.

Note: To switch the whole repeater voltage free, you have to disconnect the power lead from mains.

The power supply is factory-set (with load) to the following voltages and must not be changed:

- 7.8 V \pm 0.1 V
- 12.4 V \pm 0.1 V

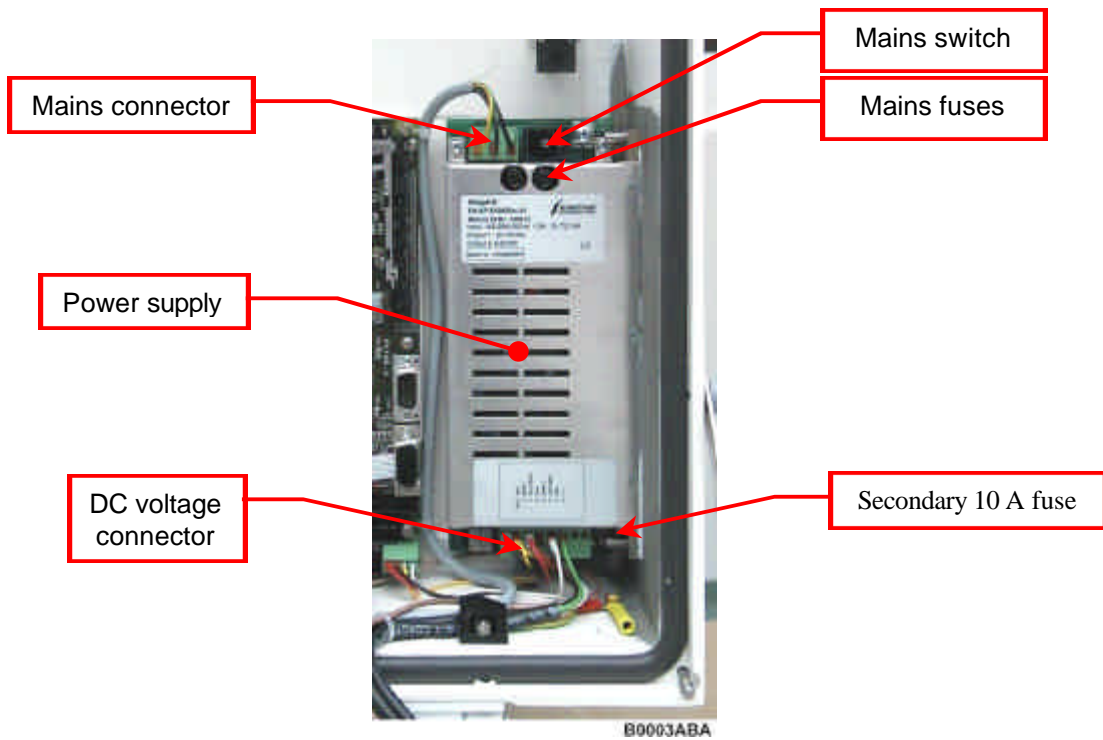


figure 2-12 Mounting position of the power supply

3 Functions and features

3.1 Channel selectivity

The selectivity of the conversion modules is achieved by highly selective filters, designed to meet the requirements of a 200 kHz channel and is necessary in order not to amplify adjacent channels.

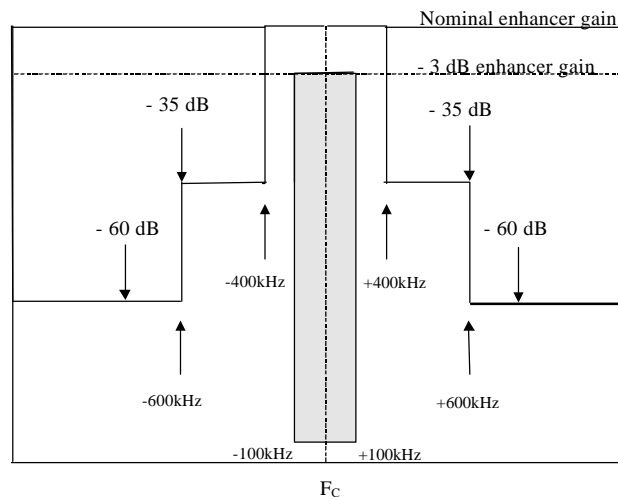


figure 3-1 Channel selectivity

3.2 DL output power

This feature measures the output power in the DL output path of the repeater. If the output power falls below a certain level an alarm can be released. The power level and the mask for the alarm can be set by the customer.

The feature shows the provider the output power of the repeater and thus an optimum of output power can be achieved.

The alarm can be forwarded to an OMC, so that faults and irregularities can be recognised and eliminated rather quick.

Technical data:

Measuring range (see figure 3-2) + 20 dBm to max. output power (+ 33 dBm)
 in steps of 2 dB from + 20 dBm to + 30 dBm
 and in steps of 1 dB from + 30 dBm to max.
 output power (+ 33 dBm)

Alarm threshold can be set in the measuring range

Requirements:

The power output option can be implemented in each MIKOM repeater provided the repeater operates channel selective in the DL.

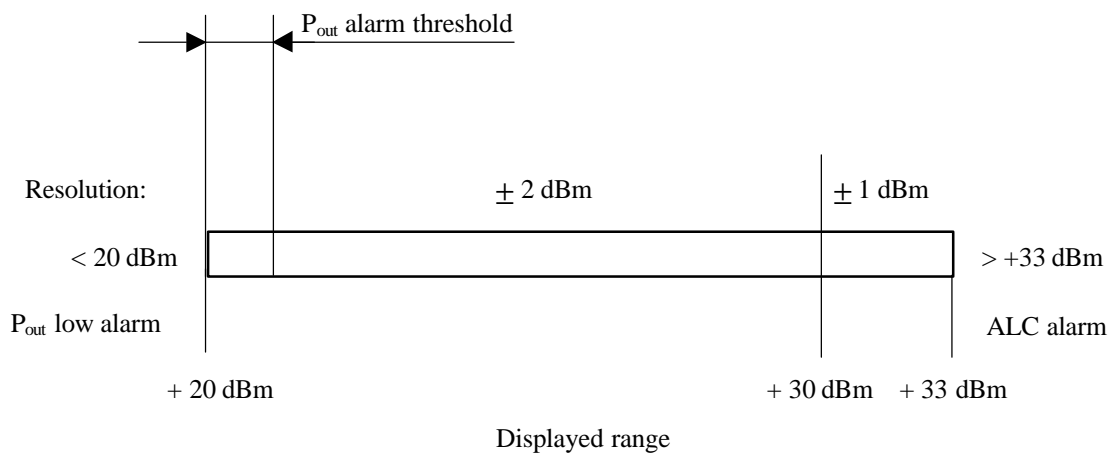


figure 3-2 Measuring range

3.3 ALC

In order to protect the amplifiers from overload and to prevent the system to generate spurious emission, the amplifiers have an Automatic Level Control, designed to limit the output power to a constant value (max. output power). A part of the output power is decoupled, rectified, amplified and used to control an attenuator network in the conversion modules. In order to avoid oscillation, the control amplifier has an integrating characteristic.

The threshold for the ALC can be set manually for each motherboard. The ALC settings affect both modules on the motherboard for UL and DL separately. The ALC threshold will be set in the factory and can be found on the test data sheet of the repeater. In case a new module will be mounted or a module will be exchanged the values for the ALC threshold in each link have to be compared. In case they are different the higher value has to be set. An increase of the input signal results in an increase of the output signal. If the output power exceeds the required power, an ALC alarm is triggered.

3.4 BITE and alarms

The Built-In Test concept comprises the monitoring of the power supplies, the operational currents in the conversion modules, the mother board and the remote control interface. Furthermore the temperature of the repeater is monitored.

There are three multicoloured LEDs mounted on the control module. The LED L3 indicates the presence of +12 Vdc in the repeater. Every alarm is indicated by failure LEDs, L1 and L2 together (simultaneously), mounted on the control module (see chapter 2.4).

In case a hardware failure is detected the concerning hardware module has to be replaced. If all alarms have been acknowledged the summary error LEDs are set back from red to green indication.

Note: In case of mains power failure all data of the alarm history list are lost.

In case, a remote alarm should be required, a potential free relay contact can be used, which is situated on the connecting board.

The following list comprises all available alarms in the repeater. These alarms may occur in the alarm history list.

NO.	ALARM NAME	ALARM ACTIVE STATUS
1	AMPLIFIER BIAS	FAILURE

2	POWER SUPPLY 8 V	FAILURE
3	POWER SUPPLY 12 V	FAILURE
4	POWER SUPPLY MAINS	FAILURE
5	SYNTH	FAILURE
6	DOOR	OPEN
7	VSWR**	ALARM
8	ALC	FAILURE
10	ACCU VOLTAGE**	LOW
11	LITHIUM BATTERY VOLTAGE	LOW
12	OVERTEMP	
13	PWROUT	LOW
13	RSSI**	LOW
14	INVALID LOGIN ATTEMPT	
15	I2C	FAILURE
16	OSCILLATION**	ALARM
17	GAIN REDUCTION**	WARNING
18*	EXT. ALARM 1**	FAILURE
19*	EXT. ALARM 2**	FAILURE
20*	EXT. ALARM 3**	FAILURE
21*	EXT. ALARM 4**	FAILURE

* Alarm default settings are changeable by software.

** Only available if option is activated by factory.

table 3-1 List of all available alarms

3.4.1 Handling of alarms

As soon as the software recognises a valid alarm, a message can be transmitted to the OMC.

If the repeater is operating in **modem mode** the alarm message 'MIKOM> REPEATER REQUIRES OPERATOR ATTENTION' will be sent via modem to the terminal or the OMC. The first of two stored telephone numbers will be dialled. In case a connection cannot be established the second telephone number will be dialled. If this should be unsuccessful as well, the call will be repeated after a pre-set delay. Default setting is 10 minutes. The repetition cycle can be set by software.

The alarm check routine is searching every 10 seconds for alarms (polling principal). To decide whether an alarm is a valid alarm it must remain for 5 polling cycles, only then it will be recognized and entered in the alarm history. As soon as the alarm is valid the contacts of the alarm relay at the mother board are set. Additionally two summary error LEDs are set to red light to indicate an alarm. These LEDs are mounted on the control module (see figure 12-3).

The entry in the alarm history describes the alarm type, the time and the date when it occurred. It is not possible to locate the defect module, only the reason.

Entered alarms in the alarm list can be acknowledged by simply ringing back and typing a software command. It is also possible to acknowledge alarms in local mode. Acknowledged alarms will be indicated with '-ACK'. As soon as the alarms have been acknowledged the alarm relay will be reset and the summary LEDs switch back to green light again.

If the same alarm cause occurs again, it will be entered in the alarm list (not acknowledged) after 5 polling cycles. An already acknowledged alarm must have an interruption of at least 5 polling cycles to be detected by the software as a new alarm. Only then the alarm will be entered again in the alarm history (not acknowledged). There exists no command to delete the alarm history.

The alarm list has a capacity of about 50 alarm entries. If more alarms occur the oldest message will be deleted first (FIFO principle).

In the software exists no alarm clear message, i.e., the repeater sends no message to the terminal or the OMC if an alarm has disappeared by itself.

3.4.2 Status report

Two instructions enable the operator to get the information of the system status. Typing GET commands will be responded by a listing of all settings of the repeater. STATUS will be responded by a listing of all individual status information, which can be monitored only but not influenced by SET commands.

The complete listing of the dialogue language with the processor of the control module including the instructions to and the messages from the system is available as a separate software manual.

3.4.3 Severity levels

This parameter defines five levels of severity for an alarm and can be set in the alarm mask (detailed description in the software manual). The severity levels indicate how the capability of the managed object has been affected.

The levels are described below and are ordered from most severe to least severe:

- Critical: The critical severity level indicates that a service affecting condition has occurred and an immediate corrective action is required to restore the capability of the managed object.
- Major: The major severity level indicates that a service affecting condition has developed and an urgent corrective action is required. Such a severity can be reported, for example, when there is a severe degradation in the capability of the managed object and its full capability must be restored.
- Minor: The minor severity level indicates the existence of a non-service affecting fault condition and that corrective actions should be taken in order to prevent a more serious failure. Such a severity can be reported, for example, when the detected alarm condition is not currently degrading the capability of the managed object.
- Warning: The warning severity level indicates the detection of a potential or impending service affecting failure before any significant effect has been caused. Action should be taken to further diagnose and correction of the problem shall prevent a more serious service affecting failure.
- Disable: The disable severity level indicates that the detected failure has no influence on the system and shall not be sent to the terminal or the OMC.

☞ **Note: No entry in the alarm history.**

4 Optional equipment

Following options are available for the MRx41.

4.1 Remote control via line modem or wireless modem

Three different modem types are available.

- PSTN modem (DigiTel 34P), line modem
- Siemens M1 modem; GSM900 mobile kit, wireless modem
- GSM1800 mobile kit, wireless modem
- Mobile kit PCS1900

The repeater will be delivered with a preset init string. This init string was used for internal tests. In case no connection can be established check the local conditions and change the init string if necessary.

The following list contains the description of the AT commands:

&F	Sets modem to factory configuration
E0	Echo OFF
S0=1	Auto answer ON; the GSM module / M1 modem goes off-hook after the first ringing signal.
S7=60	Waiting time for connection after dialing; permissible values are from 0 ... 60.
B13	Setting to 9600 bps asynchronous mode (M1 specific)
\ N6	Auto reliable operation (uses RLP), non transparent (M1 specific)
\ N0	Standard operation, no error correction, transparent (M1 specific)
+CBST=7,0,1	Set bearer service type to 9600 bps. Non-transparent connection (uses RLP)
X3	Not waiting for dial tone; usually used at PABX.
&K4	Enables XON / XOFF flow control
*P1	To switch on the mobile, used for wireless modems in combination with PCMCIA card

table 4-1 List of AT commands

4.1.1 PSTN modem

A Hayes compatible PSTN modem can be connected to the control module SM 2009 by the control cable, which is subject of the delivery schedule.

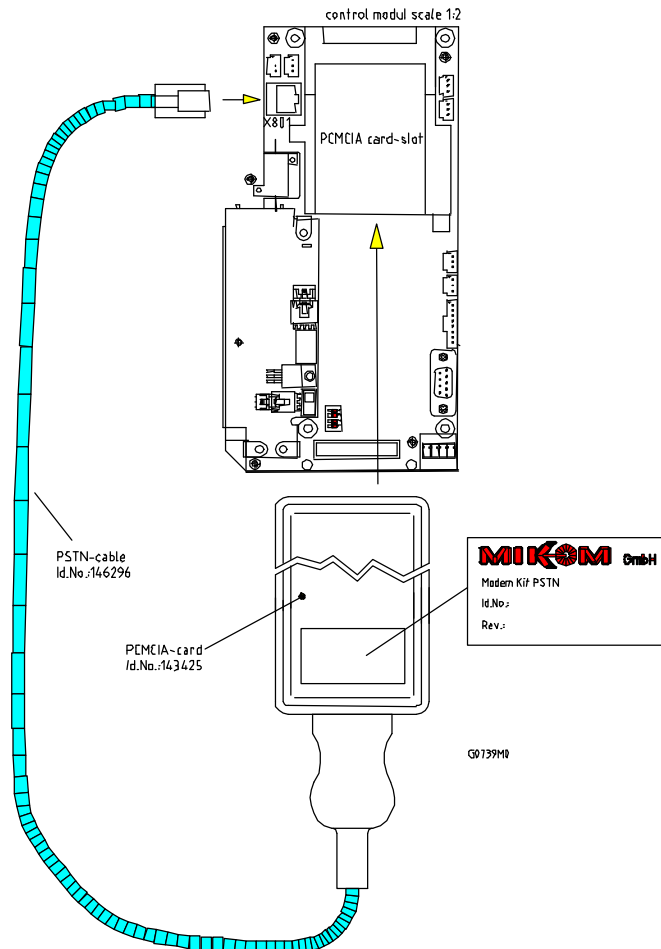


figure 4-1 Mounting position of PSTN modem kit

A possible initialisation string for the PSTN modem is:

AT&F X3 E0 S0=2

The telephone cable of a line modem has to be fed through a labelled grommet of the connector panel and has to be connected to the clamps, mounted on the connecting board (see figure 4-4).

For the standard modem type DigiTel 34P use clamps 2 and 3 to connect a and b telephone line.

Control module SM2009 - cable connection modem PCMCIA

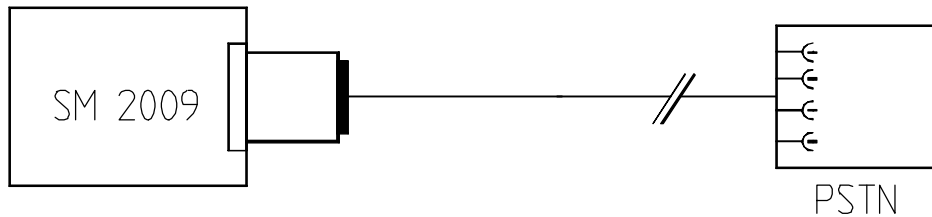


figure 4-2 Connection of control module and PSTN modem

Note: External alarms are not available, if a PSTN modem is used and vice versa.

The following communication mode between control module and VT100 is initially set for the use of a Hayes-compatible modem.

9600 baud - 8 bit - no parity - 1 stopbit

These settings can only be changed after connection to the terminal. If a different modem has to be used or if the quality of the line does not allow to use the set parameters, the settings have to be changed in PC mode. This is the same for all other parameters, which can be set previously for modem mode by software.

4.1.2 Siemens M1 for GSM900, wireless modem kit

The Siemens M1 modem can be connected to the RS232 port of the control module SM2009 by a 9-pin ribbon cable which is subject of the delivery schedule.

4.1.3 Motorola modem for GSM1800, wireless modem kit

The wireless modem kit consists of the Motorola mobile (Traveller) in combination with the PCMCIA modem card (CELlect1).

4.1.4 Nokia modem for PCS1900, wireless modem kit

The wireless modem kit consists of the Nokia mobile (Traveller) in combination with the PCMCIA modem card (CELlect1).

All types of modems, independent of the system, will be mounted in the repeater lid accessible from the outside of the housing. The cables will be fed into the housing.

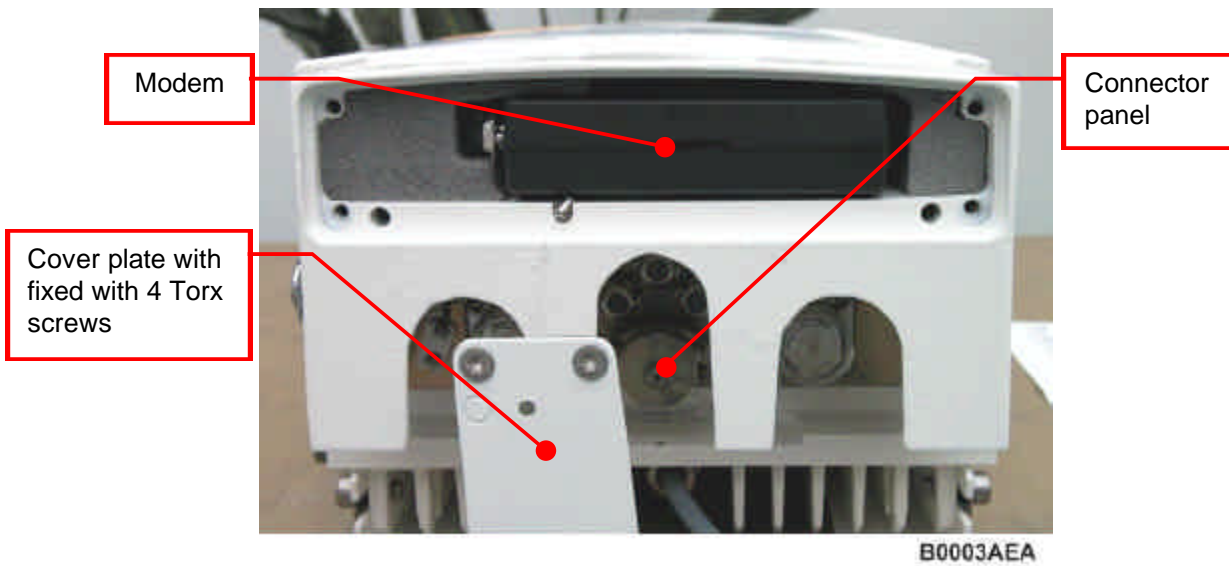


figure 4-3 Mounting position of PSTN- and wireless modem

A possible init string for the Siemens M1 modem (GSM900) is:

AT E0 S0=1 B13 S7=60 \N6

A possible initialisation string for the Motorola modem (GSM1800) is:

AT&F &K4 E0 S0=2 *P1 \N0+CBST=7,0,1

These are the standard init strings of both systems. If no connection can be established check the local conditions and change the init string if necessary.

The antenna connection for the wireless modem is on the duplexer (BTS side).

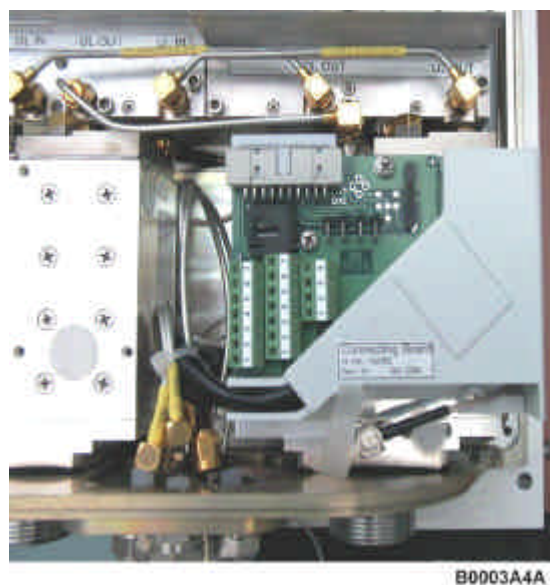


figure 4-4 Connection of the antenna cable

If one of the modems will be used the mode switch 2 of switch on the control module has to be set to position ON (see figure 2-11 DIP-Switch settings). To switch back from local mode to modem mode, disconnect the PC cable from the control module and connect the ribbon cable of the modem to the RS232 port.. Don't forget to switch back the DIP-Switch 2 to position ON.

There are two different possibilities to supply modem with DC power.

1. In case a battery backup module is installed, connect the DC connector to the battery backup module (see figure 4-5 Battery backup module).
2. If no battery backup module is installed, connect the DC connector directly to the control module (see figure 2-10 Topview of control module).

4.2 Battery backup module for modem and control module

Battery backup is provided for the control module to transmit alarm information in case of power failure. The battery type is a NiCd 8.4V/300 mAh. The battery backup is sufficient to support multiple dial out attempts via modem in case of 'system engaged' or other communication problems for at least ten minutes under normal environmental conditions.

The module is directly plugged into the control module. During the charging process a green LED V7 on the module indicates, that the battery is charged at the moment. After finishing the process the LED V7 will be switched off.

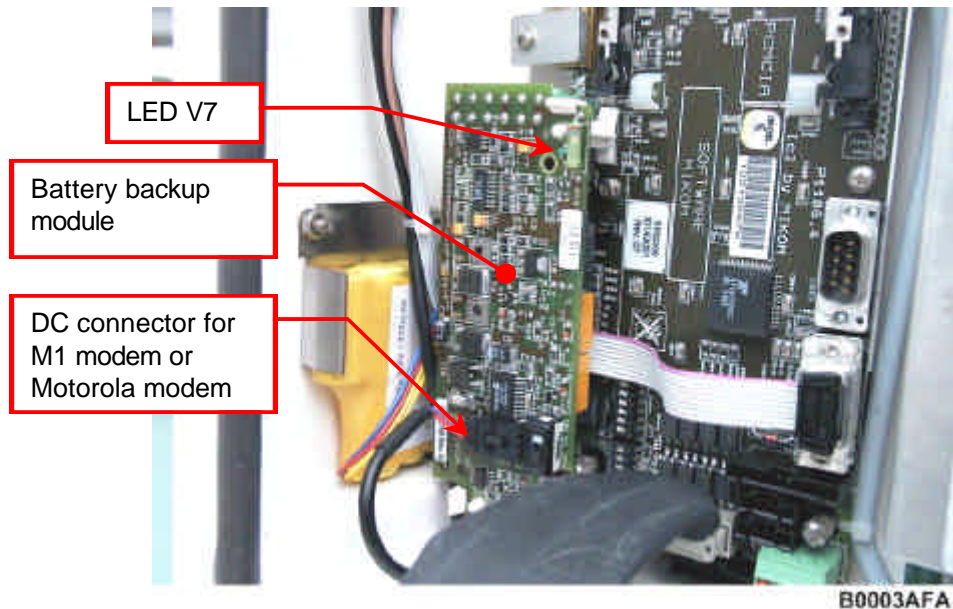


figure 4-5 Battery backup module

To activate the battery backup module a switch has to be set which is located on the control module (see figure 2-10 Topview of control module).

Switch	NO BBU	BBU
	No battery backup module installed	Battery backup module installed

4.3 LED kit

To get a summary alarm indication at the outside of the repeater it is possible to install a LED kit at the connector panel of the repeater. This LED is visible at the outside of the repeater.

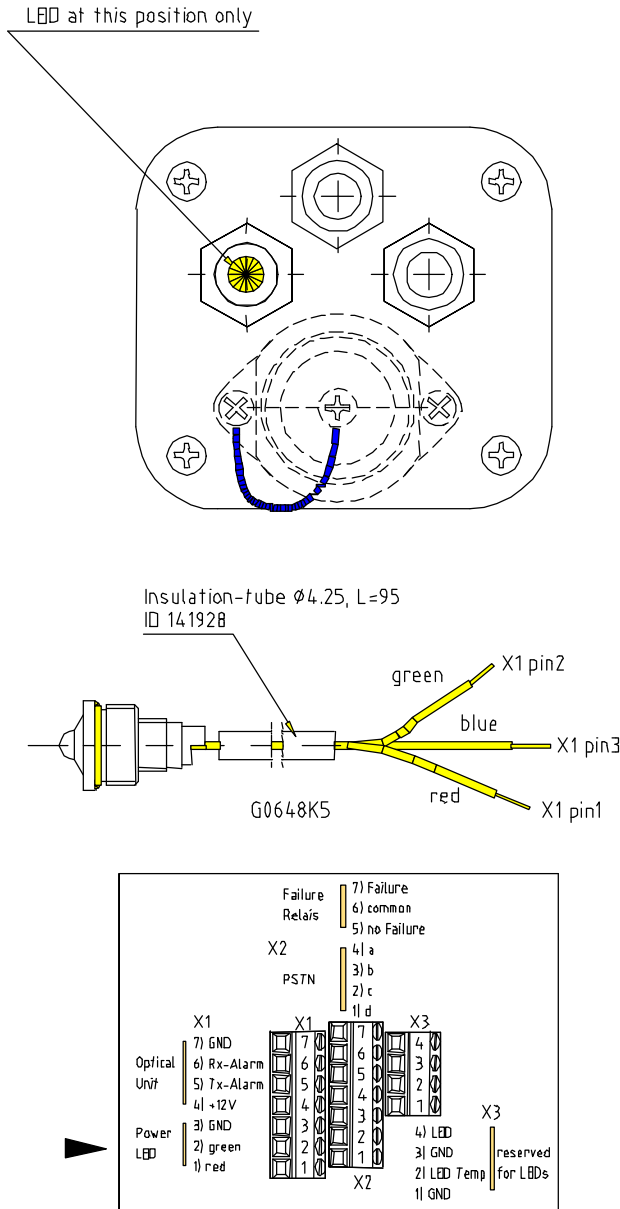


figure 4-6 LED kit

4.4 VSWR module

The VSWR module measures the voltage standing wave ratio of the DL output antenna port. If the VSWR falls below approximately 13 dB an alarm is released.

This enables the provider to know the status of the cable to the antenna. If a cable is defective the VSWR will decrease and the alarm will be released. The alarm can be forwarded to an OMC, so that faults and irregularities can be recognised and eliminated rather quick.

Technical data:

VSWR	
Measuring range	5 to 15 dB
Frequency range:	whole frequency range of the repeater <ul style="list-style-type: none"> • 925 to 960 MHz in GSM900/EGSM • 1805 to 1880 MHz in GSM1800 • 1930 to 1990 MHz in PCS1900
Alarm	if VSWR < 13 dB \pm 1 dB

Requirements:

The VSWR option can be implemented in each MIKOM repeater. (Installation of the option on site not possible!)

4.5 Traffic statistic module

The traffic statistic module is available for MIKOM repeaters, working channel selective in the uplink path. With this option the network operator gets statistical information about the efficiency and traffic load of the repeater operating in the network. The processing and evaluation of the data takes place in the control module of the repeater together with the required software.

 **Note: Traffic will be measured for each channel separately.**

The software reads in defined time intervals whether there is a signal above a specified threshold level on the respective channels or not. This data is assigned to definite values and these values are read till the next full hour. An average value is then created and stored in a data list. Date and time of the measurement is given with this list as well. When executing the respective command the list shows the traffic load in percent for each hour of the day which is also called performance data.

An example for the performance data from 0 o'clock to 4 o'clock is given in the following:

Measurement-time	Performance-data
00 h	***
01 h	2 %
02 h	5 %
03 h	10 %
04 h	21 %

Since the snapshots are not done synchronously to the time slots, there is statistically a certain chance to read every time slot in each RF channel several times.

In case a conversion module is in power down mode, it will not be included in the traffic calculation. Only enabled channels will be taken into consideration.

Technical data:

Threshold	- 95 dBm to - 75 dBm \pm 3dBm t.b.d. by the customer in steps of 1 dB
Stepwidth of traffic load indication	1 %
Time interval for values	each full hour

Requirements:

The Traffic Statistics option can be ordered with each MIKOM repeater provided the repeater operates channel selective in the uplink. Can be installed on site and has to be enabled by Mikom (service).

4.6 ICE module

ICE has been developed to enhance the antenna isolation. This feature enables repeaters to provide coverage in areas where they were previously not effective due to physical site limitations, which caused insufficient antenna isolation. Antenna isolation is the RF loss measured from the donor antenna to the coverage antenna. The path between these two antennas is a limitation on the repeater. If the gain of an on-frequency repeater exceeds the path loss, feedback in the form of oscillation occurs. The isolation is usually dominated by the direct path loss from one antenna to the other, but multipath can contribute to or even dominate antenna isolation. ICE cancels the signal from the primary feedback path, thus allowing the gain of the repeater to be increased.

For the installation of a repeater with the ICE module it is unnecessary to measure the antenna isolation.

Different types of ICE modules exist depending on the installation delay option. The following table displays the delay in dependence on the cable length and the distance between the antennas.

1. If it is possible to calculate the total cable length, the customer can choose the ICE module with the corresponding delay option.
2. If it is not possible to calculate the total cable length it is possible to choose the ICE module with all possible delay options.

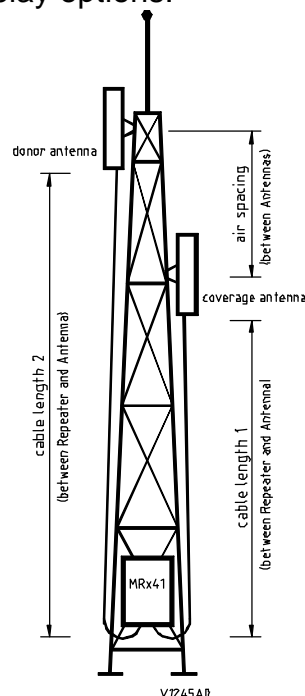


figure 4-7 Cable length and antenna spacing

The following table is valid for a velocity factor of 0.88 representing standard coaxial cable with foam dielectric (e.g. 1/2", 7/8").

AS* [m]	2	4	6	8	10	12	14	16	18	20	22	24	26	Delay option
CL* [m]	8.0 -	6.2 -	6.0 -	8.0 -	10.0 -	12.0 -	14.0 -	16.0 -	18.0 -	-	-	-	-	270 ns
	34.4 -	32.6 -	30.9 -	29.1 -	27.4 -	25.6 -	23.8 -	22.1 -	20.3 -	20.0 -	22.0 -	24.0 -	26.0 -	370 ns
	60.8 -	59.0 -	57.3 -	55.5 -	53.8 -	52.0 -	50.2 -	48.5 -	46.7 -	45.0 -	43.2 -	41.4 -	39.7 -	470 ns
	87.2 -	85.4 -	83.7 -	81.9 -	80.2 -	78.4 -	76.6 -	74.9 -	73.1 -	71.4 -	69.6 -	67.8 -	66.1 -	570 ns
	> 87.2	> 85.4	> 83.7	> 81.9	> 80.2	> 78.4	> 76.6	> 74.9	> 73.1	> 71.4	> 69.6	> 67.8	> 66.1	570 ns

The following table is valid for a velocity factor of 0.66 representing standard coaxial cable with PE / PU dielectric (e.g. RG223, RG8, RG214, RG58).

AS* [m]	2	4	6	8	10	12	14	16	18	20	22	24	26	Delay option
CL* [m]	6.0 -	4.7 -	6.0 -	8.0 -	10.0 -	12.0 -	14.0 -	16.0 -	-	-	-	-	-	270 ns
	25.8 -	24.5 -	23.2 -	21.8 -	20.5 -	19.2 -	17.9 -	16.6 -	18.0 -	20.0 -	22.0 -	24.0 -	26.0 -	370 ns
	45.6 -	44.3 -	43.0 -	41.6 -	40.3 -	39.0 -	37.7 -	36.4 -	35.0 -	33.7 -	32.4 -	31.1 -	29.8 -	470 ns
	65.4 -	64.1 -	62.8 -	61.4 -	60.1 -	58.8 -	57.5 -	56.2 -	54.8 -	53.5 -	52.2 -	50.9 -	49.6 -	570 ns
	> 65.4	> 64.1	> 62.8	> 61.4	> 60.1	> 58.8	> 57.5	> 56.2	> 54.8	> 53.5	> 52.2	> 50.9	> 49.6	570 ns

*AS: Antenna spacing = the main isolation determining path

*CL: Cable length = total length of both cables (repeater → donor antenna CL1, repeater → coverage antenna CL2)

If, due to the cable length, two different ICE modules are possible, the module with the higher delay option should be used.

☞ **Note:** The ICE module will be recognized automatically and must not be activated by software.

☞ **Note:** If the software feature 'Automatic Gain Setting' is active, the set attenuation has to be the same value for all channels in UL and DL.

☞ **Note:** Also channels in power down mode have to be set to the same attenuation like the channels in operation to guarantee a proper function.

Settings according to the software commands can be found in the software manual.

4.7 RSSI module

The RSSI module provides the monitoring of the receive level of a BTS to a repeater. It measures the input level of the BCCH channel in the downlink which is achieved by detecting the RF and converting the level in an ADC into a digital value. The processing and evaluation of the data takes place in the control module of the repeater together with the required software.

The RSSI module in combination with the software and the control module provides the possibility to release an alarm. This alarm can be forwarded to a defined phone number or to the OMC if the repeater is equipped with a modem or a mobile phone. The alarm level can be set by the customer by means of the software. This enables the provider to know the status of his network and to control it if necessary. Faults and irregularities can thus be recognised and eliminated.

Technical data:

Level range	- 80 dBm to - 30 dBm ± 3 dBm
Stepwidth	1 dB
Threshold for alarms	t.b.d. within the level range

Requirements:

The RSSI option can be ordered with each MIKOM repeater provided the repeater operates channel selective in the DL. Hardware can be installed on site. Software has to be enabled by Mikom (service).

4.8 External alarms (for control module Rev. 07 and higher)

With the following option it is possible to monitor 4 external alarms via the repeater software. Hence the status of the connected device, e.g. UPS , can be monitored.

The DIP-Switches on the control module have to be set to position ,EXT. ALARM 1 – 4' (see figure 2-11 DIP-Switch settings).

Note: It is not possible to use 4 external alarms and a PSTN modem at the same time because the PSTN modem needs already two lines. If a PSTN modem is required, two external alarms are available.

The contacts of the alarms can be accessed at clamp X2 and X1 of the connecting board. The electrical connection has to be as follows.

- X2: 1 External alarm 1 (low active)
- X2: 2 External alarm 2 (low active)
- X2: 3 External alarm 3 (high active)
- X2: 4 External alarm 4 (high active)
- X1: 7 Ground

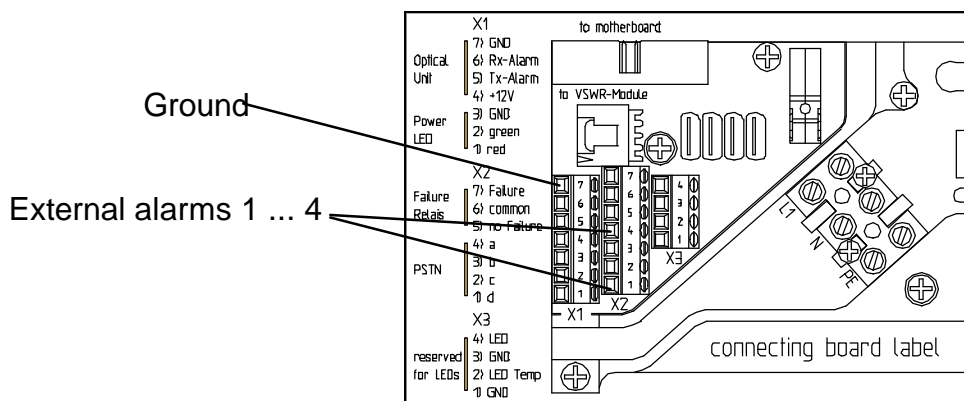


figure 4-8 Configuration of the clamps

Configuration: 5 V / 0.5 mA max. for open collector applications.

All external alarms are normally high without connection. Due to the fact that the external alarms 3 and 4 are high active, they have to be connected to ground to prevent an alarm message.

☞ **Note:** The name for each external alarm and the name for the alarm message can be defined by the customer with the corresponding software command (see software manual).

The following example describes the response for the external alarms to control a UPS.

Example: External alarms if the UPS is active

EXTERNAL ALARM STATUS
UPS alarm active
Battery low !
UPS door open
Battery door open

or External alarms if the UPS is not active

EXTERNAL ALARM STATUS
UPS not active
Battery OK
UPS door closed
Battery door closed

☞ **Note:** A special software blocking must be removed in order to use this option. This can be carried out only by authorised persons from **MIKOM**.

5 Installation

5.1 Mechanical specification

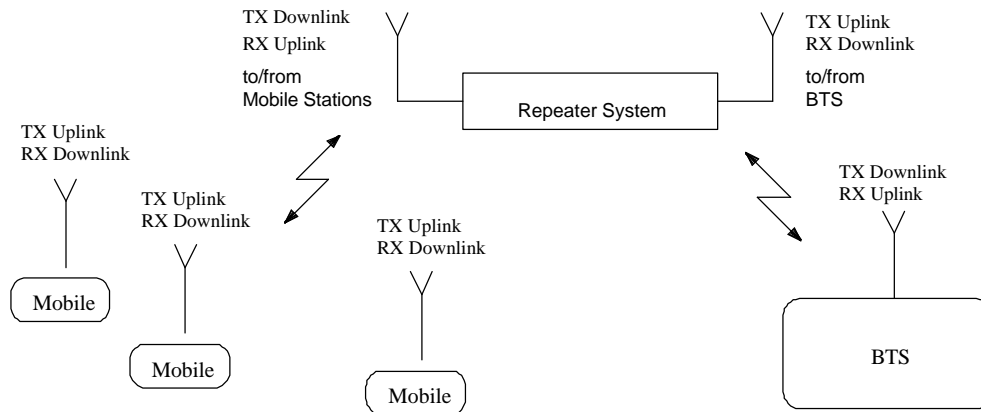


figure 5-1 System description

RF connectors: 2 connectors 7/16 female

Power supply connection: 3 m power cable

Mechanical dimensions of the F - cabinet: 445 × 255 × 167*/185 mm
(height x width x depth)

*without mounting brackets

Weight: approximately 14 kg (15.2 kg with 2
ICE modules) per unit in standard
configuration

The illustration of chapter 12 provides the dimensions and the view of the layout.

5.2 Environment and safety

For detailed information refer to the environment and safety specification leaflet for MIKOM indoor / outdoor cell enhancers, related to ETS 300019 (European Telecommunication Standard).

Operating temperature (normal temperature range): + 5° C ... + 40° C
(extreme temperature range): - 33° C ... + 50° C

Humidity: + 30° C/ 93 %

Protection class: IP 65

5.3 Mechanical installation

The repeater is typically mounted to either a pole or a wall. The mounting hardware used is specific to the type of installation. The unit should be positioned so that it is in a secure location, yet easily accessible for maintenance. There should be enough clearance (1 m radius) for the door to swing completely open and electrical and other connections should be easily accessible. Also note that the bend radius of the cables should not be exceeded when positioning the unit. The repeater shall be mounted in the vertical plane to a wall or a mast, which means the connectors have to show down to the bottom.

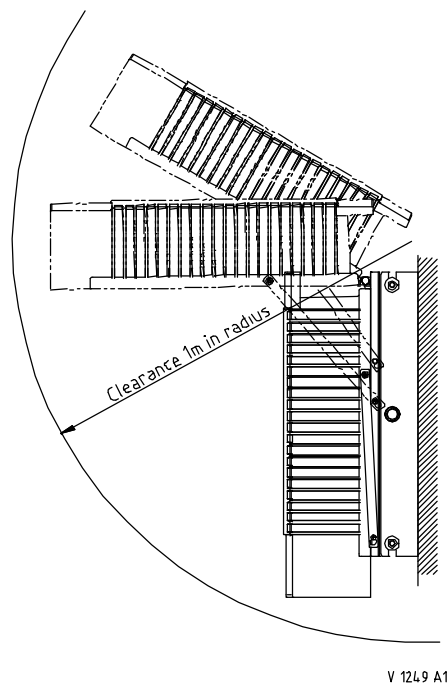


figure 5-2 Clearance distance

Use the mounting brackets, which are part of the delivery. This will guarantee a minimum distance between the wall and the repeater housing. The mounting brackets must be fixed with 4 screws to the wall (brackets) and the cabinet must be fixed with 4 hex socket screws and 2 tyre screws to the mounting brackets.

Check the correspondence of the wall mounting kit and the wall.

☞ **Note:** Due to power dissipation the repeater may heat up the air volume inside the cabinet and reaches a very high temperature. Therefore it is necessary to mount the repeater in the vertical plane to a wall or a mast without additional enclosure to provide sufficient ventilation. Between the housing and the wall a minimum distance must be kept in order to provide air circulation.

☞ **Note:** The weight of the MRx41 is approx. 14 kg in standard configuration.

5.3.1 Wall mounting procedure

1. Dismount first the mounting brackets, which are already mounted to the repeater. Remove the lower screws and the tyre screw completely and loose the upper screws as far as necessary to remove the brackets.
2. Use the wall mounting template to mark the 4 drilling holes on the surface of the wall.
3. Mount the bracket to the wall.
4. Now it is possible to align the housing properly.
5. Screw the housing firmly to the wall by using the tyre bolts , washers and the hex-head bolts M8.

Furthermore the repeater should be mounted in a way that there is free access to the individual units when the door of the repeater is open. Therefore keep a clearance distance of 1m radius.

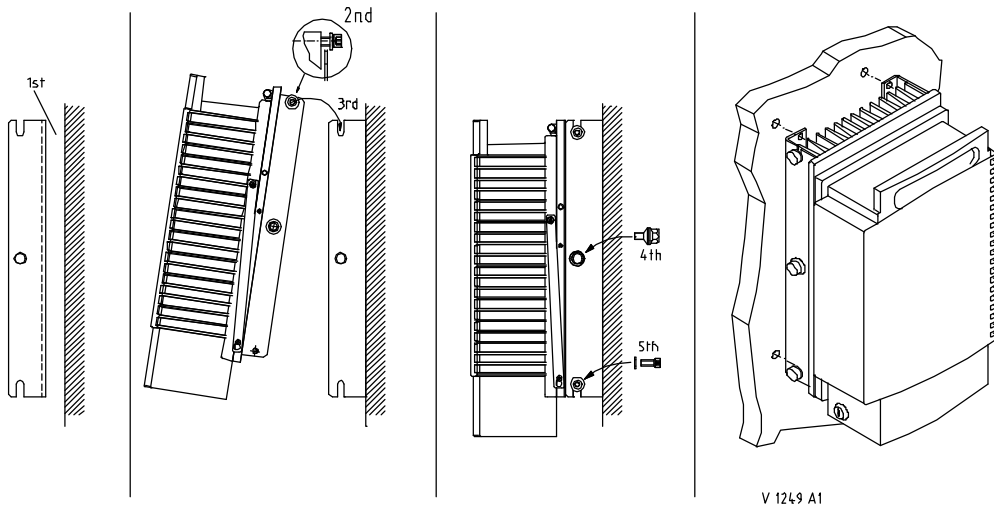


figure 5-3 Wall mount procedure

For the installation of the extension units keep the required distances between the units (see the following figure).

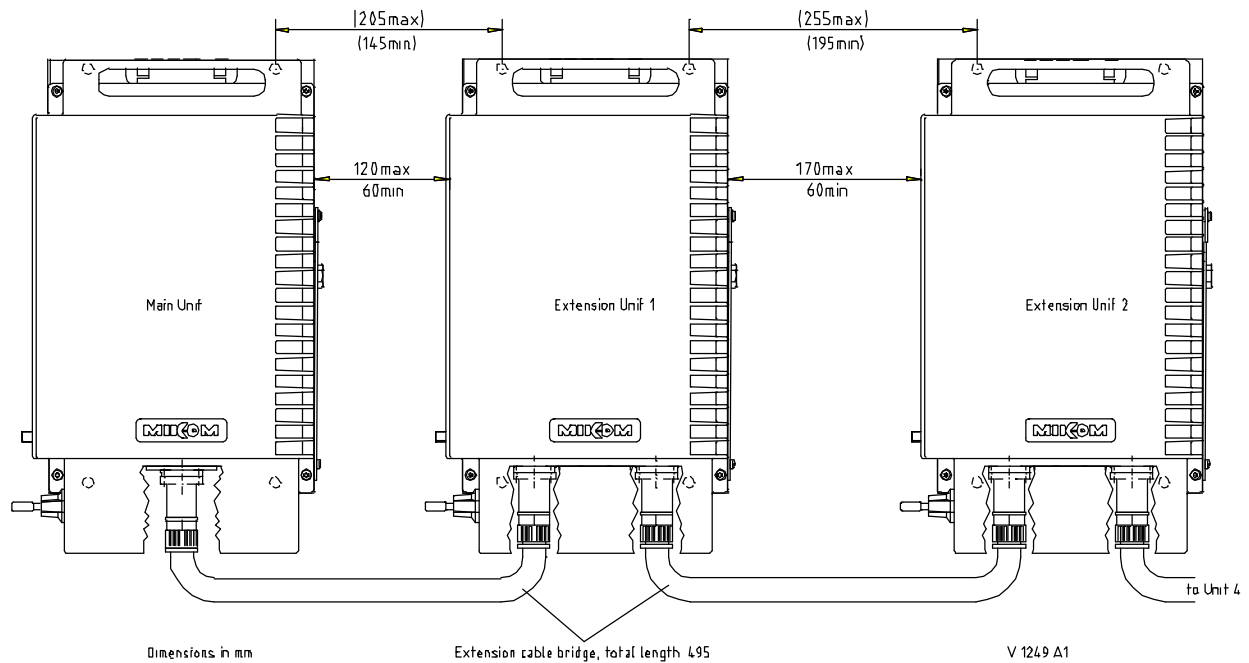


figure 5-4 Distances between main unit and extension units

5.3.2 Pole mounting procedure

Standard mounting hardware can not be used to mount the MRx41 unit to a pole or a mast or other similar structure. Additional hardware must be used for this type of installation. Such pole mounting kit includes:

- 2 threaded rods M8
- 2 U-beam
- mounting material like bolts and nuts

Note: Two pole mounting kits are required to mount this unit to a pole or a mast.

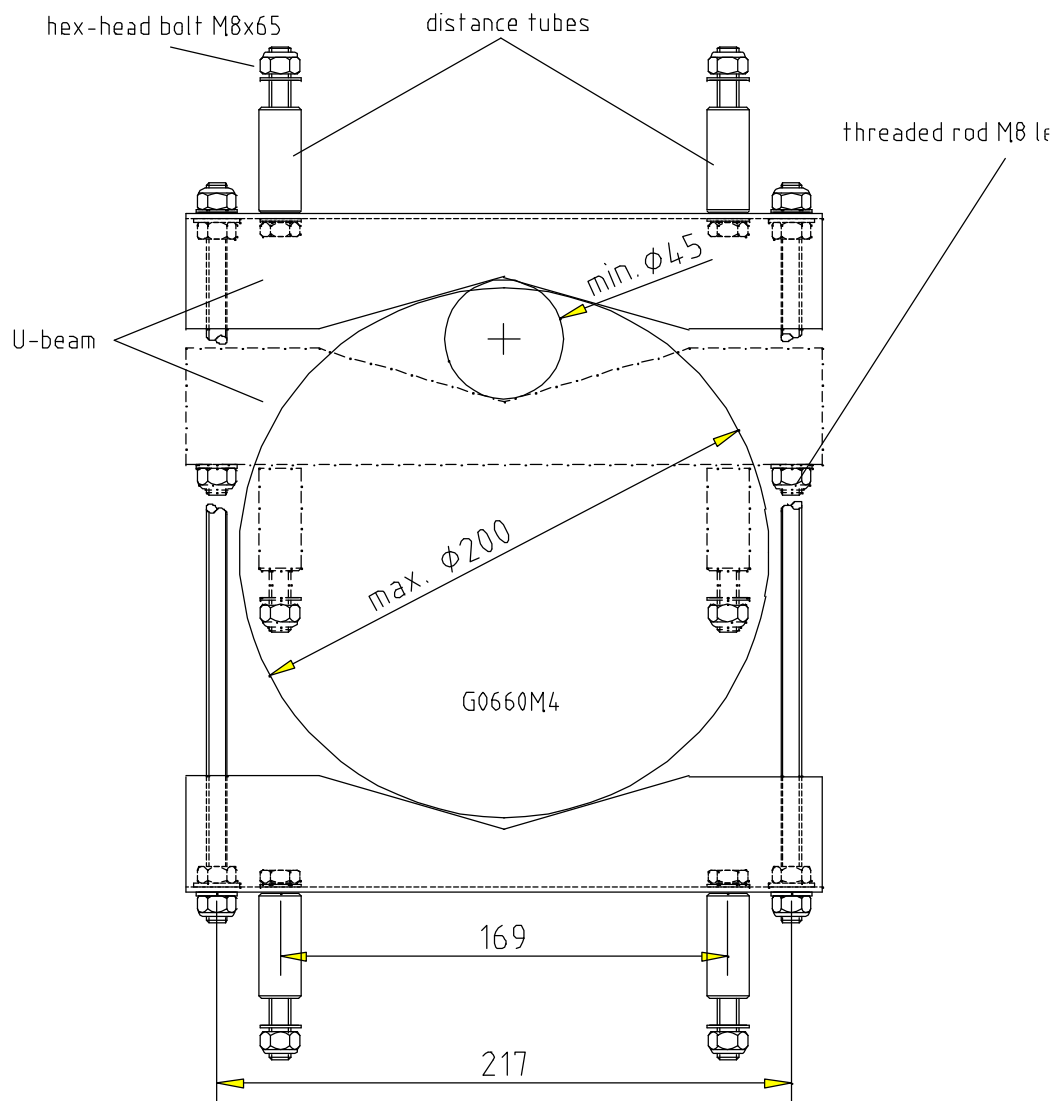


figure 5-5 Pole mounting kit

5.4 Electrical installation

☞ Note:

ESD precautions have to be observed! Before working inside the cabinet use the available grounding system to connect ESD protection measures.

The electrical installation has to be performed in accordance with the safety regulations of the local authorities. Due to safety reasons the electrical installation must be performed by qualified personnel. The cover of this unit should not be opened while power is applied. Subsequent installation, commissioning and maintenance activities that require the unit to be powered with the cover open shall only be carried out by suitably qualified personnel.

5.4.1 Grounding

Grounding has to be performed by all means. An earth bonding cable has to be connected to the grounding bolt provided at the outside of the cabinet on the left side. Don't use the grounding screw for connecting external devices.

The complete grounding bolt is part of the delivery schedule, see the following figure.

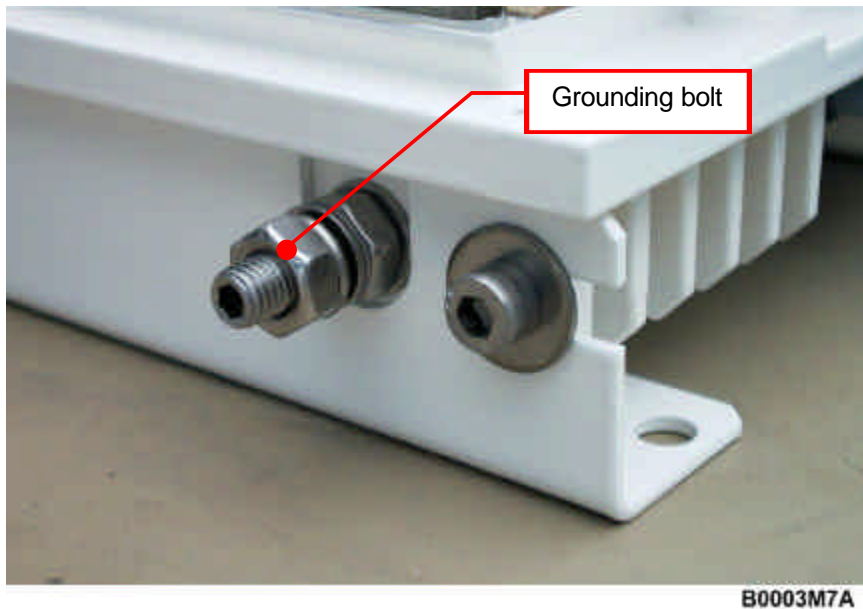


figure 5-6 Grounding bolt

5.4.2 Connection of the antenna cables

The repeater has two female antenna connectors 7/16. For mounting the corresponding cable connectors we recommend to refer to the applicable documentation of the respective connector manufacturer. The bending radius of the antenna cables must remain within its specification. This will warrant proper operation of the system; otherwise changes in the electrical behaviour of the cable might occur which could cause malfunction of the repeater system.

☞ **Note:** **Do not use a tool to tight the antenna connectors. This might damage the antenna cable or the antenna connector.**

5.4.3 Power connection

Before connecting electrical power to the repeater grounding has to be performed. The repeater is equipped with a firmly connected power cord H07RN-F 3 x 1.5 mm². Due to safety reasons the power supply lead of the repeater has to be provided with a 16 A fuse. In case the length of the power cord should not be sufficient it can be replaced by a longer cable (see 8.3 Replacement of the mains cable).

☞ **Note:** **The diameter of the power supply lead has to be in the range of 9.5 mm max. and 6.5 mm min.**

6 Setting to work

6.1 Preparation

Note: It is not allowed to operate the repeater without termination of the antenna connections! The termination can be performed by the antenna connection as well as a dummy load or the 50-Ohm-terminated connection of a measuring instrument.

The repeater system has its maximum available gain when the attenuation is set to zero. In order to check the function of the repeater system on site it is advisable to operate the repeater system with 50 Ohm termination. This makes it possible to set the necessary gain and to test the set value without the necessity of transmitting on air.

Note: This measurement is not necessary if an ICE module is used.

In order to perform settings the repeater has to be opened. Ensure not to damage the seals on the modules, which are attached to the conversion modules. Please note, there is no warranty if seals are broken.

After taking the repeater into service following signals occur during the boot process.

Internal LED L1		Internal LED L2		Internal LED L3	Cause
red	green	red	green	green	
	-	-	-	●	Power on state, Software boot process starts
Flashes red short time	●	Flashes red short time	●	●	Software boot finished
	●		●	●	Program is running

table 6-1 LED indication

Note: The boot process takes about 3 minutes.

6.2 *Setting of operational parameters*

There are three different possibilities to set the operational parameters:

- **direct manual control by means of rotary switches**
- **local control via RS232 interface and PC as terminal**
- **remote control via line modem or wireless modem and PC or OMC as terminal**

6.2.1 **Manual settings by means of rotary switches**

The manual mode allows the operator to set the required channels and the attenuation by means of rotary switches. With a small screwdriver, which fits through the long holes of the conversion modules, the values can be adjusted by turning the switch carefully to the desired position.

☞ **Note:** To enable manual settings of parameters the mode switch DIP-Switch 1 of the mode switch has to be changed from OFF to ON (see figure 2-11 DIP-Switch settings).

☞ **Note:** Gain can be set independently for the uplink and downlink path for both channels commonly in 2 dB steps. It is not possible to set the gain for each channel separately.

A label on the conversion module, located next to the rotary switch (this label might be fixed to the inner side of the cabinet as well), illustrates the usage of the rotary switch (see figure 6-1 Channel rotary switches and gain setting).

6.2.1.1 Channel setting

The channel for every conversion module can be set easily by means of a rotary switch mounted on the mother board. Using a small screwdriver, which fits through the long hole in the centre of the conversion modules, the channels can be changed by adjusting the rotary switch to the desired number.

The corresponding frequency follows from chapter 12.4 Frequency / ARFCN table.

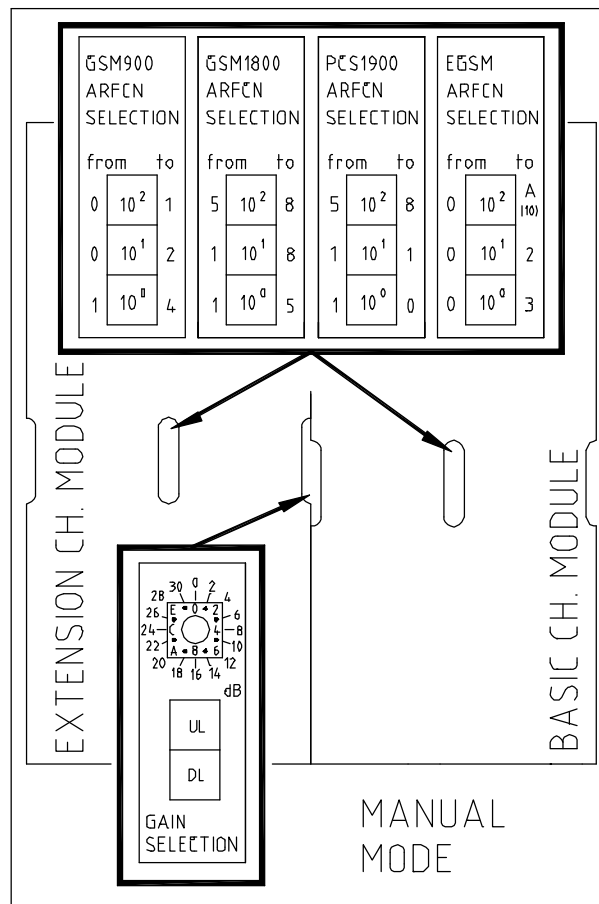


figure 6-1 Channel rotary switches and gain setting

Example:

Presumed the desired ARFCN is 120.

The first rotary switch has to be set to 1 (1×10^2), the second to 2 (2×10^1) and the third remains at 0 (0×10^0).

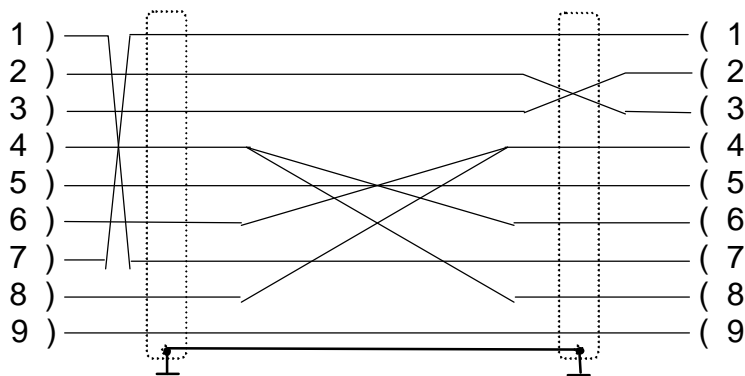
Note: If a non-existing ARFCN is adjusted, the value will not be accepted. The previous valid ARFCN will be kept.

6.2.2 Local settings via personal computer as terminal

Instead of setting operational parameters manually via rotary switches it is also possible to use the functions of the control module. The PC mode will be automatically recognized by the software. The DIP-Switch 2 must be at position OFF.

A VT100 terminal or a PC with VT100 emulation can be connected to the control module SM2009 by a standard RS232 cable, if necessary in connection with an adapter 9 to 25.

Cable connections PC - control module SM2009 (RS232)
SUB-D9-connector (male) - SUB-D)-connector (male)



The following communication mode between control module and VT100 is set initially.

9600 baud - 8 bit - no parity -1 stopbit

These settings can only be changed after connection of the terminal. If all wanted settings have been initialized and a modem has to be used it is recommended to check, whether the settings comply with the capabilities of the modem and the line. Modifications are possible by software commands

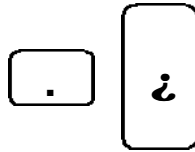
Note: Settings on the repeater can be performed after the following procedure only.

After connecting the PC to the repeater, following procedure is necessary to get access to the program.

MIKOM REPEATER MRx41 - SM2009 - SW: REP1012V1.xx
 ENTER <.> <CR> TO LOGIN

1. Step: Type the two keys (.) FULLSTOP and (↵) ENTER

You have to type the keys:



2. Step: ENTER USER ID

You have to enter: **UserID1** ↵

☞ **Note:** The input is case sensitive, no blanks. After three mistrial follow disconnection. After 5 wrong login attempts the password alarm will be released.

3. Step: ENTER PASSWORD

You have to enter: **P-word1** ↵

☞ **Note:** The input is case sensitive, no blanks. After three mistrial follows disconnection. After 5 wrong login attempts the password alarm will be released.

6.2.3 Remote control via modem

For a detailed description of remote feature of the MRx41 refer to chapter 4.1.

7 Trouble shooting

7.1 Error indication

- = LED on
- = LED off

1. With implemented battery backup module

Internal LED L1		Internal LED L2		Internal LED L3	Cause
green	red	green	red	green	
-	-	-	-	-	No power. Check presence of power at the input; replace fuse according to chapter, check battery backup module
	•		•	•	Indicates a summary failure
	•		•	•	Mains failure, control module is supplied from battery backup module

2. Without battery backup module

Internal LED L1		Internal LED L2		Internal LED L3	Cause
green	red	green	red	green	
-	-	-	-	-	No power. Check presence of power at the input; replace fuse according to chapter 8.2
	•		•	•	Indicates a summary failure

7.2 Boot process

Following signals occur during boot process (see table 6-1 LED indication).The boot process takes about 3 minutes

7.3 Alarm monitoring with the alarm history

Check the alarm history (see table 3-1 List of all available alarms).

1. If a hardware module is damaged, replace corresponding hardware module.
2. Minor alarms with no influence on the system can be cancelled by confirming the alarm with the software command 'alarmackn', e.g., DOOR OPEN.
3. If all alarms have been acknowledged the summary error LEDs will be set back to green indication.
4. In case of mains power failure the contents of the actual alarm history list will be lost.

7.4 Power supply

Factory set output voltages (with load)

- 7.8 V \pm 0.1 V
- 12.4 V \pm 0.1 V

In case of an I²C-Bus error, also check the power supplies. They must be switched **ON**.

7.5 General remarks

- After a software download previous user settings (data default values) might be overwritten. Before you start a software download save all user settings:
 - ARFCN numbers
 - attenuation
 - ALC threshold
 - temperature compensation offset (gain)
 - phone numbers etc.

- If an ALC alarm occurs during installation or commissioning an user error might be the cause, due to wrong measurements, e.g.

ALC: Input level too high → reduce gain

- **RSSI:** Input level too low → check antenna and cables and attenuators

- **Traffic statistic:** Measurement is never zero, it is displaying continuously values even in periods of low traffic loads, e.g. during night.

Cause: Traffic threshold (factory setting -95 dBm) is too low. The traffic module is then measuring only noise.

Solution: Threshold has to be increased (contact factory).

8 Maintenance

8.1 General

☞ **Note:** The repeater does not require preventative maintenance measures.

It is only recommended to replace the RAM/RTC battery after three years usage as a prophylactic measure. The nominal lifetime of this battery is five years under normal environmental conditions.

☞ **Note:** The RAM/RTC battery has to be removed for long term storage.

In the event of a malfunction it is advantageous to check the status of the antenna systems as well as the continuity of the entire cabling including connectors, before replacing the modules.

Maintenance on the repeater shall be performed only by replacing modules. Soldering on printed circuit boards shall be avoided. In order to sustain warranty take care not to damage unintentionally the seals on the modules.

Danger ! Before replacing a module disconnect the repeater from mains and switch off the battery backup module.

The spare parts list, consequently, contains only units, which can be replaced without tuning or complex soldering work. Those units are all MIKOM modules, internal and external cables.

☞ **Note:** Defect parts should only be replaced by original parts from MIKOM. All interventions inside the housing, are at one's own risk. During maintenance ensure that the repeater has been disconnected from mains.

8.2 Replacement of the power supply and mains fuses

☞ **Note:** Ensure that mains are disconnected and the battery backup module is switched off.

The power supply is mounted in the lid of the housing. Open the repeater to get access to the device.

Remove all connected cables from the clamps of the power supply.

The power supply is fastened to the lid of the housing by means of two nuts M4 on the right-hand side. After loosen the screws the power supply can be removed. To open these screws use a key with a mobile element (part of the spare parts kit).

☞ **Note:** Don't forget to put heat conducting paste on the mounting side for installation of a new power supply. Use the heat conducting paste, which is included in the spare parts kit.

The power supply is protected with a secondary 10 A fuse, depending on the power supply type. In case of a power supply failure exchange these fuses. The power supply can be equipped with a power socket, which is protected with two mains fuses, type 2AT/250.

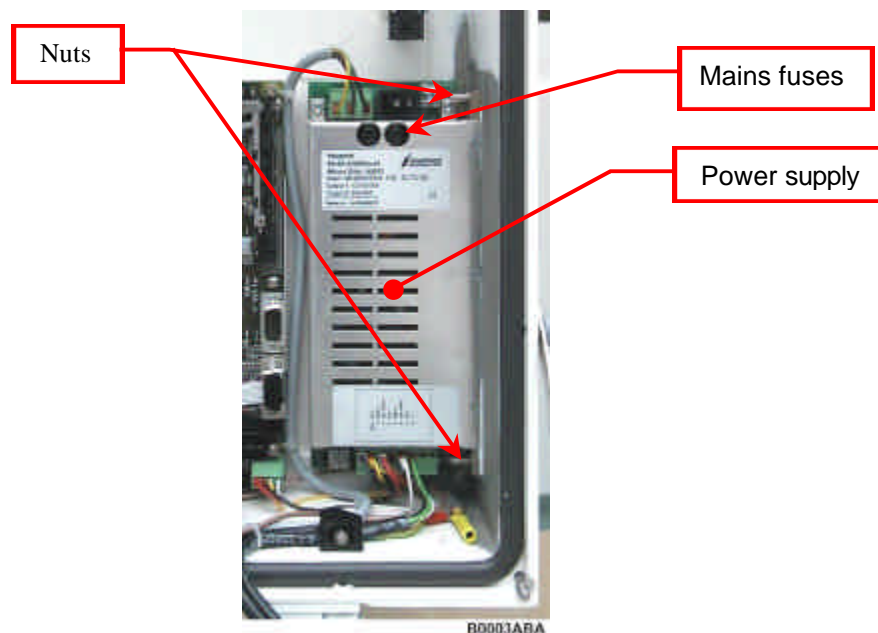


figure 8-1 Mounting position of the power supply and mains fuses

☞ **Note:** Use only fuses of the same type and the same rating when replacing!

8.3 Replacement of the mains cable

The repeater will be delivered with a firmly connected mains cable 3 x 1.5 mm² with the length of 3 m.

Remove the cover plate with the lock. To open the housing, the upper screws have to be removed first and then the lower screws. To close the housing proceed in reverse order. Open the housing by lifting the fixing clamp.

The mains cable is now accessible from the bottom of the heat sink. Open the PG9 threaded joint with a spanner size 17. Inside the housing remove the plastic lid of the connecting board. Unscrew 3 wires L1, N and PE from the clamps on the connecting board.

Strip the isolation of the cable to the length of 180 mm and pull it through the cable gland like depicted in figure 8-2. Inside the housing use the insulated tube.

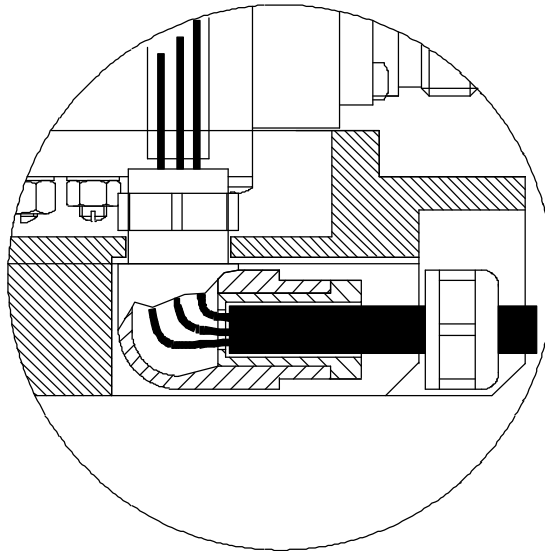


figure 8-2 Cable gland

For the mounting of a new power supply lead proceed in reverse order.

☞ **Note:** The diameter of the power supply lead has to be in the range of 9.5 mm max. and 6.5 mm minimum.

8.4 Replacement of the RAM / RTC battery

This battery is responsible for buffering the real time clock circuit. The RAM/RTC battery of the control module has to be replaced in case of date / time loss or as a preventive measure after approximately three years usage. In case a battery backup module is implemented it has to be removed because the RAM/RTC battery is mounted underneath the module. It is accessible after opening the housing on the left-hand side in the lid. A software alarm is raised when the battery voltage is low.

Note: Before replacing the battery, disconnect the repeater from mains and remove the battery backup module (if available). Don't try to charge this battery. Observe the rules for changing Lithium batteries. Wrong connection or treatment may result in bursting of the battery and dissemination of hazardous substances.

Take off the Lithium battery by means of a small screwdriver, placed between the battery and the battery socket.

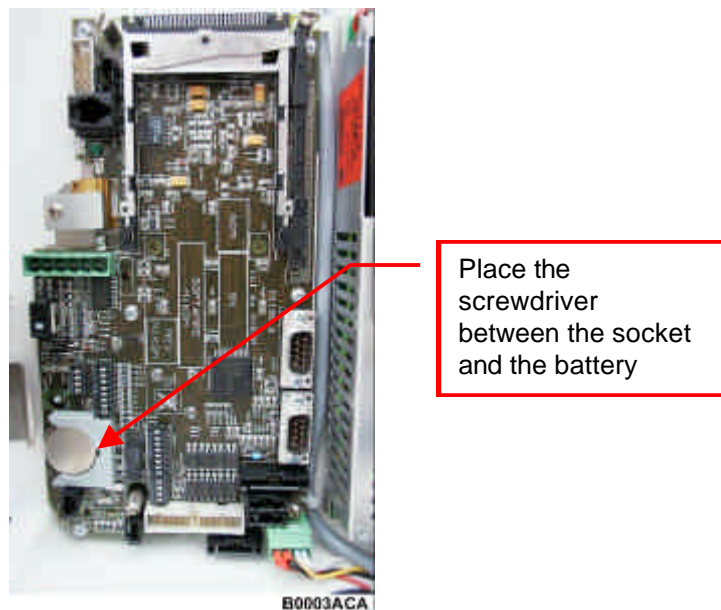


figure 8-3 Position of RAM/RTC battery

8.5 Replacement of the battery backup module (option)

The battery backup module consists of a printed circuit which is plugged into the control module and the accumulator (NiCd 8.4 V, 270 mAh). The accumulator is fixed to the repeater lid on the left-hand side. The accumulators have to be replaced in case of a software alarm or as a preventive measure after approximately one years usage to guarantee full capacity in case of a mains failure. The nominal lifetime of the accumulators is three years.

Note: Before replacing the battery backup module, disconnect the repeater from mains first and switch off the battery backup module.

The battery backup module is accessible after opening the housing on the left-hand side in the lid.

Before dismounting the module from the socket, release the three snap-in lockings. Remove the DC cable (from the wireless modem kit), which is plugged into the battery backup module. Now it is possible to remove the battery backup module by pulling carefully the module. The accumulator can now be removed by placing a small screwdriver between the accumulator and the holding clamp. Insert a new accumulator by pressing the device into the holding clamp. Insert the battery backup module. Finally connect the DC cable of the wireless modem.

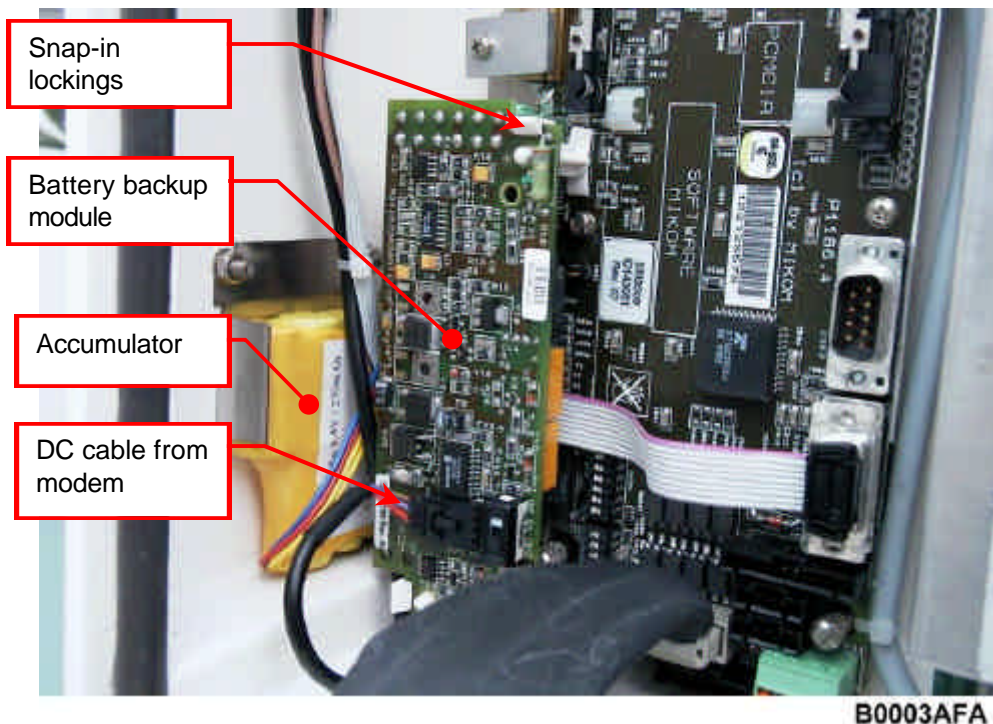


figure 8-4 Battery backup module

*Option

8.6 Duplexer

- Duplexer UL out:

Remove the combiner (if installed).

If the duplexer has to be replaced dismount the connecting board first (see chapter 8.10).

The duplexer and the basic module are mounted close together. It is easier to remove the duplexer by dismounting the basic module first.

Remove the ribbon cable connected to the mother board.

Remove the RF cables on the side of the UL output, by loosening the SMA connector by means of a torque wrench.

Unscrew the four counter sunk screws M3 at the connector panel.

- Duplexer DL out

Remove the RF cables on the DL out, by loosening the SMA connector by means of a torque wrench.

Unscrew the four counter sunk screws M3 at the connector panel.

The duplexer and the extension module are mounted close together. It is easier to remove the duplexer by dismounting the extension module first.

8.7 PSTN modem kit (option)

The modem is situated in the lid of the housing. Push the button on the control module to release the modem and pull the card out of the PCMCIA card holder. Disconnect the PSTN cable which is plugged into the control module. Now it is possible to take out the modem card.

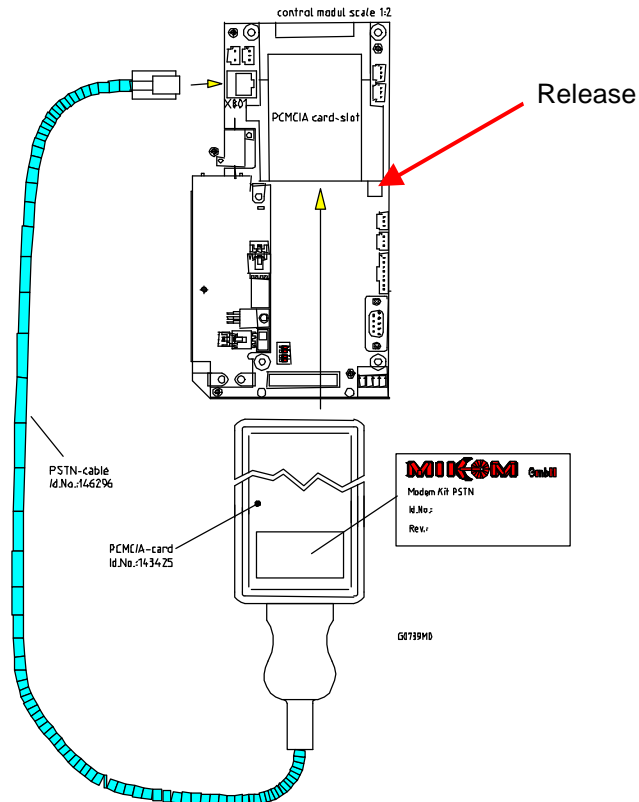


figure 8-5 PSTN modem kit

* Option

8.8 Channel modules

To remove the basic module, disconnect the SMA connectors by means of a torque wrench.

Unscrew six hex socket screws by means of a hex socket key. Pull carefully by means of the mounting strap, fixed on the channel module and take off the module.

To remove the extension module, proceed in the same way.

Note: The basic and the extension modules are not interchangeable

For the exchange of a channel module or the installation of a new channel module, the slave address of the synthesizer has to be set. This can be done by means of hex-coded rotary switches mounted on the bottom side of the modules (see following figure).

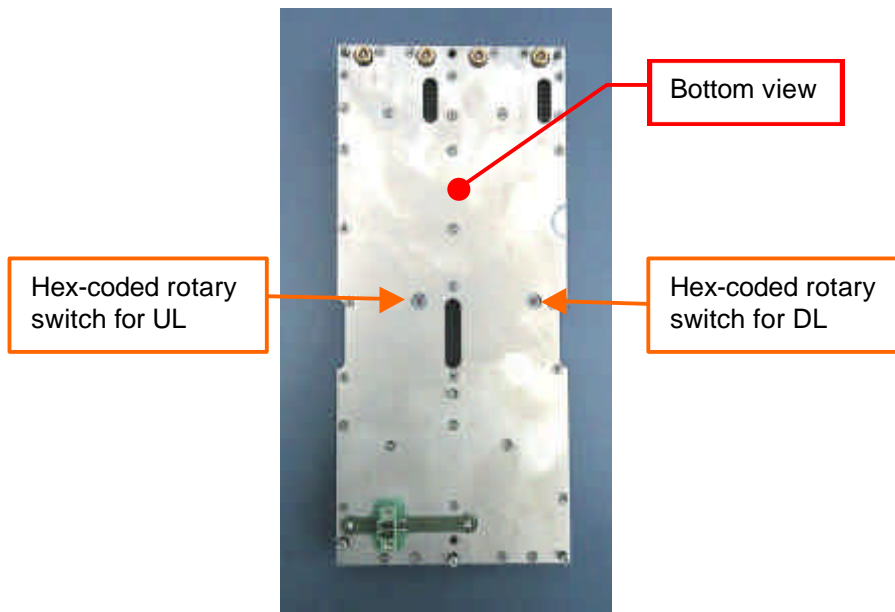


figure 8-6 Position of hex coded rotary switches

The configuration of the slave address for each channel group is as follows:

	Basic Module		Extension Module		
	UL	DL	UL	DL	
Channel 1	0	1	2	3	Channel 2
Channel 3	4	5	6	7	Channel 4
Channel 5	8	9	A	B	Channel 6
Channel 7	C	D	E	F	Channel 8

table 8-1 Configuration of hex-coded rotary switches

8.9 ICE module

Each module requires an own ICE-module. Both have to be adjusted together because they are not compatible with other modules. The ICE module will be mounted on top of the channel module. It is screwed tight by use of 3 hex socket screws. Unscrew these screws and pull at the mounting strap and take off the module.

If an ICE module will be implemented for the first time remove the small lid on top of the basic or extension module. Now it is possible to connect the ICE module to the basic or extension module. Screw it tight by means of 3 hex socket screws.

8.10 Connecting board

The connecting board is mounted on top of the UL duplexer on the right-hand side in the heat sink. Remove the plastic lid which is fixed to the connecting board. The connecting board is screwed to the duplexer by means of three tallow-drop screws M3.

Note: Disconnect repeater from mains first!

Disconnect the ribbon cable, mains cable, the cable to the power supply and grounding cable.

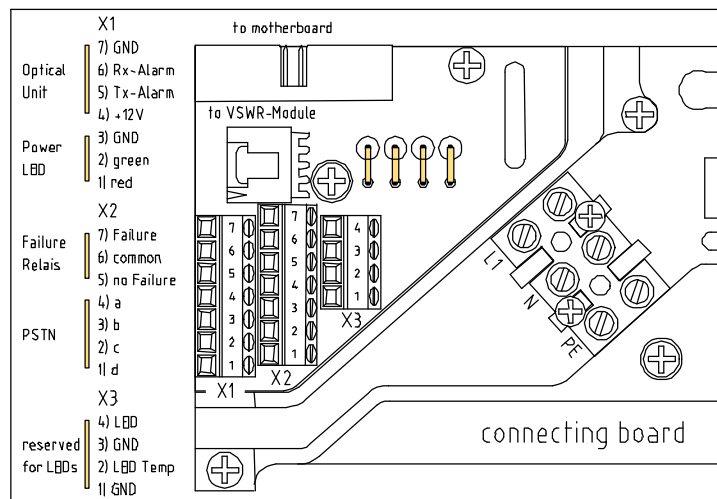


figure 8-7 Connecting board

9 Spare parts list

The following list contains all parts available for the MRx41. The configuration of the delivered unit meets the requirements of the customer and can differ depending on the state of delivery.

9.1 Spare parts for MR341

Designation	Id.-No.		
	MR341 150025	MR341EGSM 150031	MR341GSM- R 150037
Assembly drawing main unit	147612		
Assembly drawing lid	147614		
Assembly drawing RF-cable plan	147619		
Assembly material	149334		
Cable set	147572		
Duplexer UL INPUT	150302	150310	150312
Duplexer DL INPUT	150303	150311	150313
Basic Module for ICE	150120	150120	150122
Extension Module for ICE	150121	150121	150123
Termination Module 3dB	146521		
3dB Option kit	147583	147584	147584
ICE Module for 120MHz all delay times	150656		
ICE Module for 120MHz 570 ns	150655		
ICE Module for 120MHz 470 ns	150654		
ICE Module for 120MHz 370 ns	145061		
ICE Module for 120MHz 270 ns	150653		
Power Supply, 80-130Vac, no plug	152551		
Power Supply, 80-130Vac	149222		
Power Supply, 85-140Vac	151831		
Power Supply, 230Vac \pm 15%, no plug	144306		
Power Supply, 160-320Vac	149221		
Power Supply, 185-320Vac, no plug	148812		
Power Supply, 24Vdc	151965		
M1 Kit 900 MHz	150699		
Mobile Kit GSM/DCS	150698		
Modem Kit PSTN	143112		
Power Out SW-Option	145478		
RSSI SW-Option	148970		
Traffic SW-Option	148971		
Noise Red. SW-option	149233		
Accu SW-option	149235		
VSWR Kit GSM + EGSM	143437		
Ext. Alarms SW-Option	145067		

Battery Backup Module	143052
LED-Kit	145106
Adapter	112425
SW MOB100 V1.10	143055
SW REP1012 V1.10	147926
Mother Board	148968
Connecting Board	142362
Control Unit SM2009	143051
Pole mounting kit	145687
Wall mounting kit	150519
Spare parts kit	143480
Front panel small compl.	152574
Retainer Reed Magnet	144309
DC-cable ready made	147970
AC-cable ready made	143032
Manual REP1012V1.xx	148972
Manual MRx41 (F-cabinet)	148092

9.2 Spare parts for MR441

Designation	Id.-No.			
	MR441 150000	MR441 150006	MR441 150012	MR441 150018
Assembly drawing main unit	147612			
Assembly drawing lid	147614			
Assembly drawing RF-cable plan		147619	147619	147619
Assembly material	149334			
Cable set	147573			
Duplexer UL INPUT	150300	150304	150306	150308
Duplexer DL INPUT	150301	150305	150307	150309
Basic Module for ICE	150102	150608	150608	150102
Extension Module for ICE	150103	150611	150611	150103
Termination Module 3dB	146521			
3dB Option kit	147584			
ICE Module for 120MHz all delay times	150656			
ICE Module for 120MHz 570 ns	150655			
ICE Module for 120MHz 470 ns	150654			
ICE Module for 120MHz 370 ns	145061			
ICE Module for 120MHz 270 ns	150653			
Power Supply, 80-130Vac, no plug	152551			
Power Supply, 80-130Vac	149222			
Power Supply, 85-140Vac	151831			
Power Supply, 230Vac \pm 15%, no plug	144306			
Power Supply, 160-320Vac	149221			
Power Supply, 185-320Vac, no plug	148812			
Power Supply, 24Vdc	151965			
Mobile Kit GSM/DCS	150698			
Modem Kit PSTN	143112			
Power Out SW-Option	145478			
RSSI SW-Option	148970			
Traffic SW-Option	148971			
Noise Red. SW-option	149233			
Accu SW-option	149235			
VSWR Kit DCS	143436			
Ext. Alarms SW-Option	145067			
Battery Backup Module	143052			
LED-Kit	145106			
Adapter	112425			
SW MOB100 V1.10	143055			
SW REP1012 V1.10	147926			
Mother Board	148968			
Connecting Board	142362			

Control Unit SM2009	143051
Pole mounting kit	145687
Wall mounting kit	150519
Spare parts kit	143480
Front panel small compl.	152574
Retainer Reed Magnet	144310
DC-cable conf.	147970
AC-cable conf.	143032
Manual REP1012V1.xx	148972
Manual MRx41 (F-cabinet)	148092

9.3 Spare parts for MR741

Designation	Id.-No.		
	MR741 150595	MR741 150596	MR741 151782
Assembly drawing main unit	147612		
Assembly drawing lid	147614		
Assembly material	149334		
Cable set	147573		
Duplexer UL INPUT	144382	144384	151072
Duplexer DL INPUT	144381	144383	151073
Basic Module for ICE	150591	150593	150593
Extension Module for ICE	150592	150594	150594
Termination Module 3dB	146521		
3dB Option kit	147584		
ICE Module for 120MHz all delay times	150656		
ICE Module for 120MHz 570 ns	150655		
ICE Module for 120MHz 470 ns	150654		
ICE Module for 120MHz 370 ns	145061		
ICE Module for 120MHz 270 ns	150653		
Power Supply, 80-130Vac, no plug	152551		
Power Supply, 80-130Vac	149222		
Power Supply, 85-140Vac	151831		
Power Supply, 230Vac $\pm 15\%$, no plug	144306		
Power Supply, 160-320Vac	149221		
Power Supply, 185-320Vac, no plug	148812		
Power Supply, 24Vdc	151965		
Mobile Kit PCS	150405		
Modem Kit PSTN	143112		
Power Out SW-Option	145478		
RSSI SW-Option	148970		
Traffic SW-Option	148971		
Noise Red. SW-option	149233		
Accu SW-option	149235		
Ext. Alarms SW-Option	145067		
Battery Backup Module	143052		
LED-Kit	145106		
Adapter	112425		
SW MOB100 V1.10	143055		
SW REP1012 V1.10	147926		
Mother Board	148968		
Connecting Board	142362		
Control Unit SM2009	143051		
Pole mounting kit	145687		

Wall mounting kit	150519
Spare parts kit	143480
Front panel small compl.	152574
Retainer Reed Magnet	144310
DC-cable conf.	147970
AC-cable conf.	152024
Manual REP1012V1.xx	148972
Manual MRx41 (F-cabinet)	148092

10 Configuration list

The actual configuration of the repeater system has been entered on a separate list at delivery. This configuration list is subject of the delivery schedule providing actual information of Mikom part number, serial number and revision status of the repeater. Whenever parts should be replaced the user is kindly asked to update the list.

☞ **Note:** **Whenever parts should be replaced the user is kindly asked to update the list.**

11 Appendix

11.1 Electrical specifications MR341

Bandwidth in UL and DL	Up to 25 MHz in the GSM900 band
Number of channels	2 max. (in one F-cabinet)
Bandwidth of a channel	200 kHz min.
Selectivity of a channel	35 dB @ ± 400 kHz; 60 dB @ ± 600 kHz
Channel selection	Manually or controlled remotely
Output power (@ 25° C amb.temp.)	32.5 dBm min. per channel at 2 channels NOTE: The output power per channel will be reduced if the system is upgraded: 3.5 dB power reduction @ 4 channels 5.5 dB power reduction @ 6 channels 7.0 dB power reduction @ 8 channels
Spurious due to intermodulation	- 36 dBm
ALC reaction time	3 msec. (others available on request)
Gain at max. gain setting	85.0 dB @ 2 channels 81.5 dB @ 4 channels 79.5 dB @ 6 channels 78.0 dB @ 8 channels
Tolerance of the gain over full bandwidth and temperature	± 2.0 dB over normal temperature range* ± 3.0 dB over extreme temperature range**
Set range of the gain	30 dB typ. in steps of 2 dB locally or remotely
Tolerance per gain step	± 0.5 dB from 0 to 6 dB attenuation ± 2.0 dB from 8 to 30 dB attenuation
Delay	< 7 μ s (Variation ± 200 ns)
Noise figure	5 dB @ max. gain; 8 dB @ min. gain
Return loss	15 dB (@ 25° C amb. temp.)
Power supply	220...250 Vac / 40...60 Hz; Option: +15...+24 Vdc or ± 48 Vdc or 115 Vac / 40...60 Hz
Power consumption	20 W + 45 W/channel + 8 W / ICE module (efficiency of power supply excluded; 75 % - 90 %)
Connectors	7/16 female; N as an option
Remote control interface	SM 2009

Built in test equipment	Current monitor • synthesizer lock monitor • temperature • ALC active • output power
Alarm forwarding	Potential free relay contact and automatic alarm call via RS232 or PCMCIA interface (via PSTN modem or mobile)
Control functions	Gain • Channel • ALC threshold

11.2 Electrical specifications MR441

Bandwidth in UL and DL	Up to 35 MHz in the GSM1800 band
Number of channels	2 max. (in one F-cabinet)
Bandwidth of a channel	200 kHz min.
Selectivity of a channel	35 dB @ ± 400 kHz; 60 dB @ ± 600 kHz
Channel selection	Manually or controlled remotely
Output power (@ 25° C amb.temp.)	32.5 dBm min. per channel at 2 channels NOTE: The output power per channel will be reduced if the system is upgraded: 3.5 dB power reduction @ 4 channels 5.5 dB power reduction @ 6 channels 7.0 dB power reduction @ 8 channels
Spurious due to intermodulation	- 30 dBm
ALC reaction time	3 msec. (others available on request)
Gain at max. gain setting	85.0 dB @ 2 channels 81.5 dB @ 4 channels 79.5 dB @ 6 channels 78.0 dB @ 8 channels
Tolerance of the gain over full bandwidth and temperature	± 2.5 dB over normal temperature range* ± 3.5 dB over extreme temperature range**
Set range of the gain	30 dB typ. in steps of 2 dB locally or remotely
Tolerance per gain step	± 0.5 dB from 0 to 6 dB attenuation ± 2.0 dB from 8 to 30 dB attenuation
Delay	< 7 μ s (Variation ± 200 ns)
Noise figure	5 dB @ max. gain; 8 dB @ min. gain
Return loss	15 dB (@ 25° C amb. temp.)
Power supply	220...250 Vac / 40...60 Hz; Option: +15...+24 Vdc or ± 48 Vdc or 115 Vac / 40...60 Hz
Power consumption	20 W + 25 W/channel + 8 W / ICE module (efficiency of power supply excluded; 75 % - 90 %)
Connectors	7/16 female; N as an option
Remote control interface	SM 2009
Built in test equipment	Current monitor • synthesizer lock monitor • temperature • ALC active • output power

Alarm forwarding	Potential free relay contact and automatic alarm call via RS232 or PCMCIA interface (via PSTN modem or mobile)
Control functions	Gain • Channel • ALC threshold

11.3 Electrical specifications MR741

Bandwidth in UL and DL	Up to 35 MHz in the PCS1900 band
Number of channels	2 max. (in one F-cabinet)
Bandwidth of a channel	200 kHz min.
Selectivity of a channel	35 dB @ ± 400 kHz; 60 dB @ ± 600 kHz
Channel selection	Manually or controlled remotely
Output power (@ 25° C amb.temp.)	32.5 dBm min. per channel at 2 channels NOTE: The output power per channel will be reduced if the system is upgraded: 3.5 dB power reduction @ 4 channels 5.5 dB power reduction @ 6 channels 7.0 dB power reduction @ 8 channels
Spurious due to intermodulation	- 13 dBm
ALC reaction time	3 msec. (others available on request)
Gain at max. gain setting	85.0 dB @ 2 channels 81.5 dB @ 4 channels 79.5 dB @ 6 channels 78.0 dB @ 8 channels
Tolerance of the gain over full bandwidth and temperature	± 2.5 dB over normal temperature range* ± 3.5 dB over extreme temperature range**
Set range of the gain	30 dB typ. in steps of 2 dB locally or remotely
Tolerance per gain step	± 0.5 dB from 0 to 6 dB attenuation ± 2.0 dB from 8 to 30 dB attenuation
Delay	< 7 μ s (Variation ± 200 ns)
Noise figure	5 dB @ max. gain; 8 dB @ min. gain
Return loss	15 dB (@ 25° C amb. temp.)
Power supply	220...250 Vac / 40...60 Hz; Option: +15...+24 Vdc or ± 48 Vdc or 115 Vac / 40...60 Hz
Power consumption	20 W + 25 W/channel + 8 W / ICE module (efficiency of power supply excluded; 75 % - 90 %)
Connectors	7/16 female; N as an option
Remote control interface	SM 2009

Built in test equipment	Current monitor • synthesizer lock monitor • temperature • ALC active • output power
Alarm forwarding	Potential free relay contact and automatic alarm call via RS232 or PCMCIA interface (via PSTN modem or mobile)
Control functions	Gain • Channel • ALC threshold

* normal temperature range: + 5° C to + 40° C;

** extreme temperature range: - 33° C to + 50° C.

11.4 Options for MRx41

OPTIONS	MRx41
<i>Downlink options</i>	
VSWR (Voltage standing wave ratio)	VSWR can be measured. The threshold for the VSWR alarm is 13 dB \pm 1 dB.
Remote control	To remotely control RF and optical Repeaters different interfaces are available: RS232 wire connection, PSTN and wireless modems. MIKOM offers a unique Repeater OMC software package based on a windows platform; it can also support an Unix interface to forward alarms. This OMC software provides network, configuration and fault management.
Battery backup	Repeater battery backup is available for 20 minutes and 2 hours. Further backup times are available as well. If backup is only required for the control interface and the modem, low capacity batteries are available to operate controller and modem for at least 10 minutes.
RSSI	Input level of the BCCH channel is measured and displayed through a terminal software or the MIKOM Repeater OMC. Level range is - 80 to - 30 dBm.
I.C.E.	Interference Cancellation Equipment for electronic improvement of antenna isolation and stability control by software. I.C.E. electronically improves antenna isolation more than 20 dB.
<i>Uplink options</i>	
Traffic statistics module	Traffic load for each uplink channel is indicated in time intervals of 60 minutes. It is monitored in steps from 1...100 %, through terminal software or MIKOM Repeater OMC software package.
Noise management	Reduces the gain of the Repeater for time slots not in use. This reduces the noise power injection into the BTS.
I.C.E.	Interference Cancellation Equipment for electronic improvement of antenna isolation and stability control by software. I.C.E. electronically improves antenna isolation more than 20 dB.

All data is subject to change without notice!

12 Installation

12.1 Drawing of the repeater

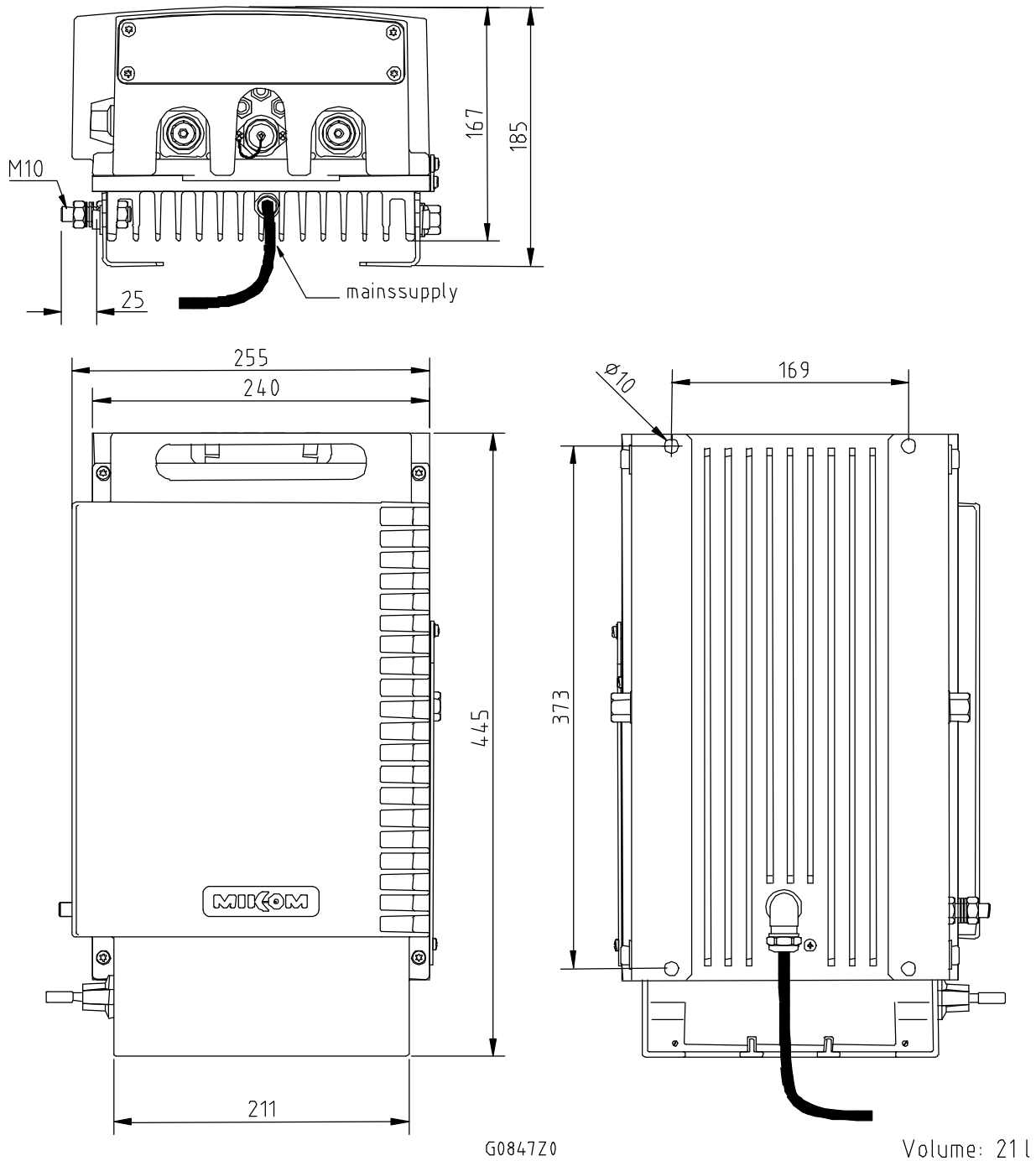


figure 12-1 Installation drawing

12.2 Layout of the repeater (heat sink)

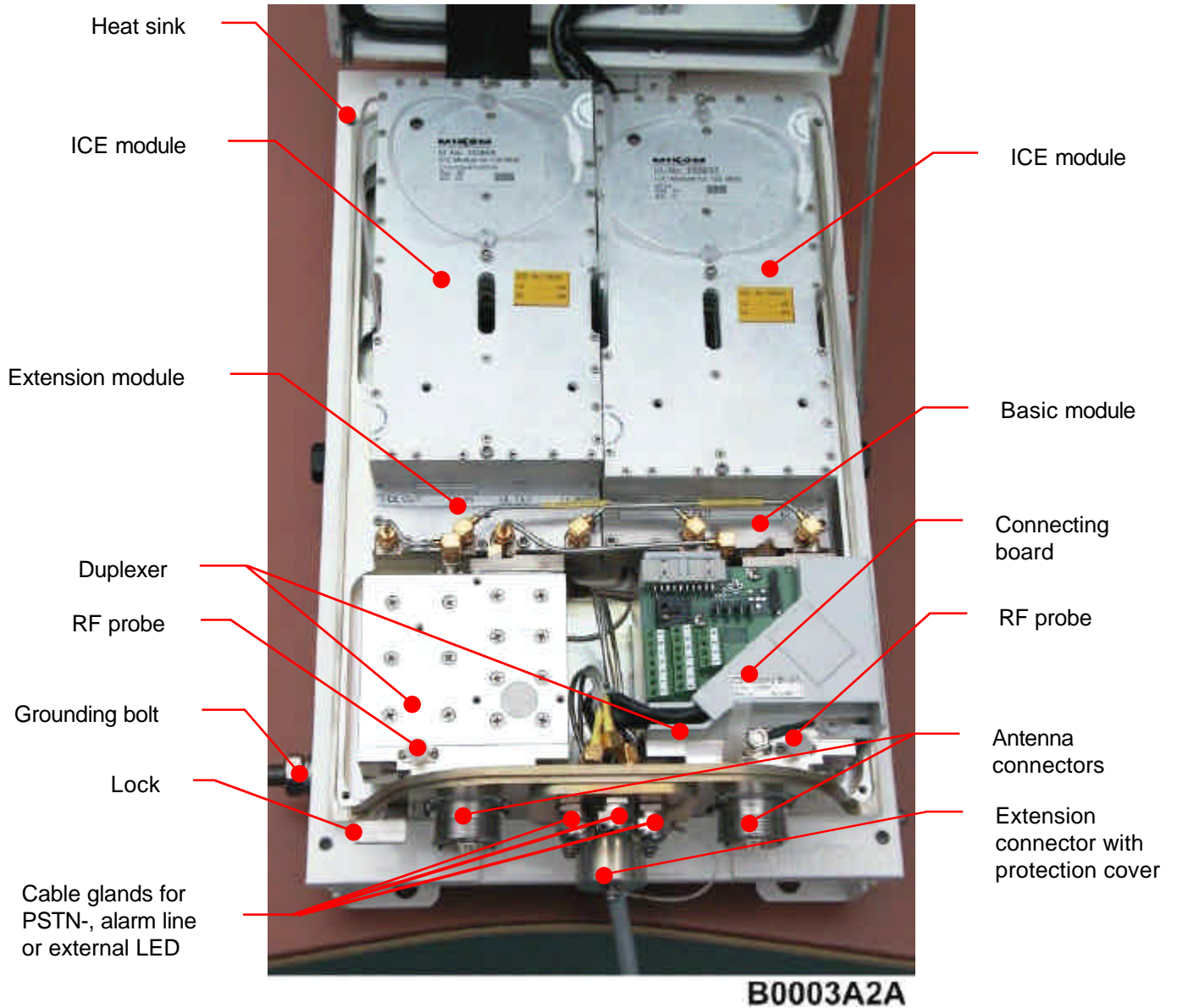


figure 12-2 Layout of the repeater heat sink

12.3 Layout of the repeater (lid)

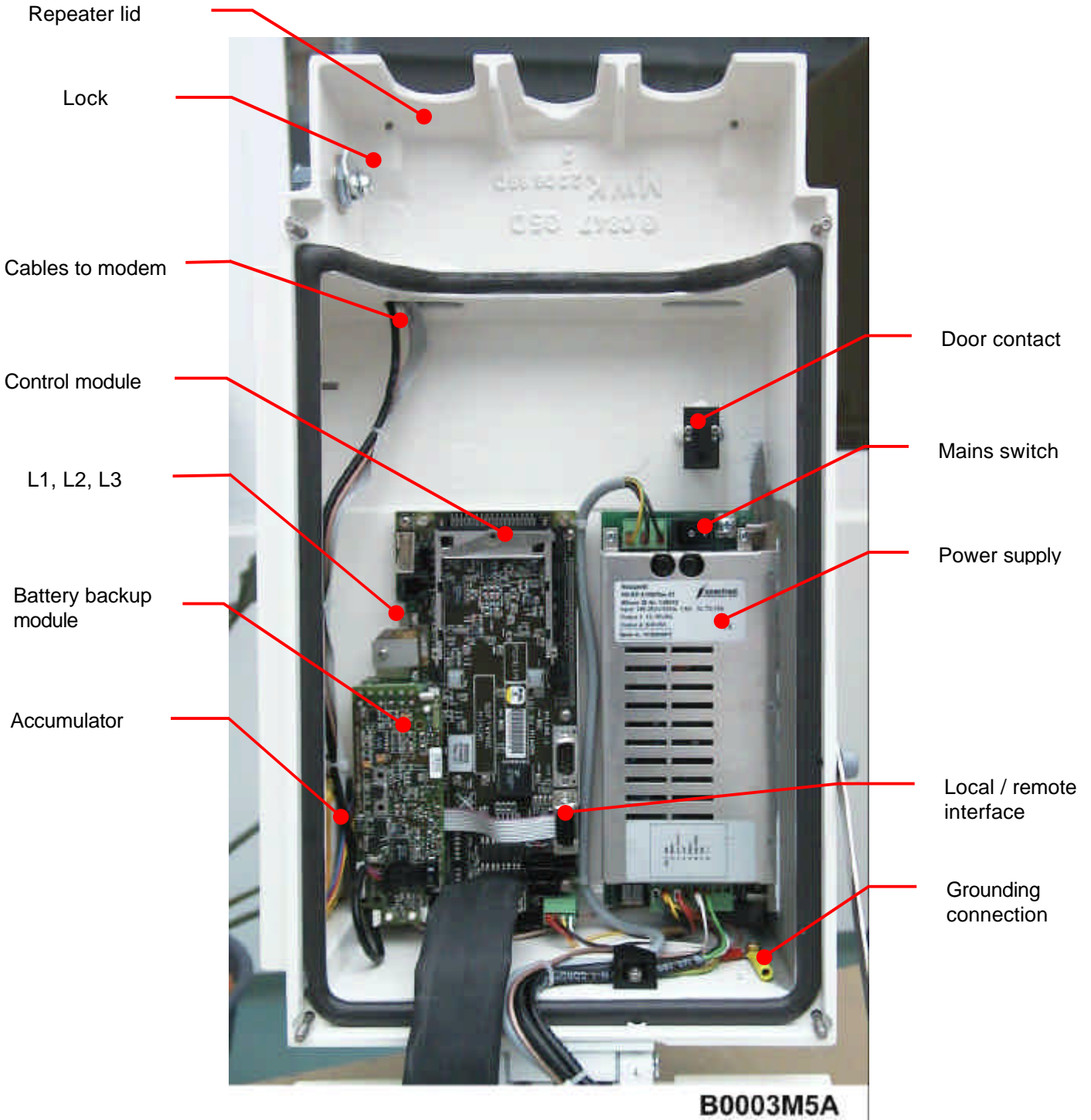


figure 12-3 Layout of the repeater

12.4 ARFCN / Frequency tables for MR341, MR441 and MR741

The following table provides all information about ARFCN and its corresponding frequencies for the **MR341** for UL and DL.

ARFCN number	Frequency MHz UL	Frequency MHz DL	ARFCN number	Frequency MHz UL	Frequency MHz DL
1	890.2	935.2	41	898.2	943.2
2	890.4	935.4	42	898.4	943.4
3	890.6	935.6	43	898.6	943.6
4	890.8	935.8	44	898.8	943.8
5	891.0	936.0	45	899.0	944.0
6	891.2	936.2	46	899.2	944.2
7	891.4	936.4	47	899.4	944.4
8	891.6	936.6	48	899.6	944.6
9	891.8	936.8	49	899.8	944.8
10	892.0	937.0	50	900.0	945.0
11	892.2	937.2	51	900.2	945.2
12	892.4	937.4	52	900.4	945.4
13	892.6	937.6	53	900.6	945.6
14	892.8	937.8	54	900.8	945.8
15	893.0	938.0	55	901.0	946.0
16	893.2	938.2	56	901.2	946.2
17	893.4	938.4	57	901.4	946.4
18	893.6	938.6	58	901.6	946.6
19	893.8	938.8	59	901.8	946.8
20	894.0	939.0	60	902.0	947.0
21	894.2	939.2	61	902.2	947.2
22	894.4	939.4	62	902.4	947.4
23	894.6	939.6	63	902.6	947.6
24	894.8	939.8	64	902.8	947.8
25	895.0	940.0	65	903.0	948.0
26	895.2	940.2	66	903.2	948.2
27	895.4	940.4	67	903.4	948.4
28	895.6	940.6	68	903.6	948.6
29	895.8	940.8	69	903.8	948.8
30	896.0	941.0	70	904.0	949.0
31	896.2	941.2	71	904.2	949.2
32	896.4	941.4	72	904.4	949.4
33	896.6	941.6	73	904.6	949.6
34	896.8	941.8	74	904.8	949.8
35	897.0	942.0	75	905.0	950.0
36	897.2	942.2	76	905.2	950.2
37	897.4	942.4	77	905.4	950.4
38	897.6	942.6	78	905.6	950.6
39	897.8	942.8	79	905.8	950.8
40	898.0	943.0	80	906.0	951.0

81	906.2	951.2	103	910.6	955.6
82	906.4	951.4	104	910.8	955.8
83	906.6	951.6	105	911.0	956.0
84	906.8	951.8	106	911.2	956.2
85	907.0	952.0	107	911.4	956.4
86	907.2	952.2	108	911.6	956.6
87	907.4	952.4	109	911.8	956.8
88	907.6	952.6	110	912.0	957.0
89	907.8	952.8	111	912.2	957.2
90	908.0	953.0	112	912.4	957.4
91	908.2	953.2	113	912.6	957.6
92	908.4	953.4	114	912.8	957.8
93	908.6	953.6	115	913.0	958.0
94	908.8	953.8	116	913.2	958.2
95	909.0	954.0	117	913.4	958.4
96	909.2	954.2	118	913.6	958.6
97	909.4	954.4	119	913.8	958.8
98	909.6	954.6	120	914.0	959.0
99	909.8	954.8	121	914.2	959.2
100	910.0	955.0	122	914.4	959.4
101	910.2	955.2	123	914.6	959.6
102	910.4	955.4	124	914.8	959.8

The following table provides all information about ARFCN and its corresponding frequencies for the **MR341 EGSM** for UL and DL.

ARFCN number	Frequency MHz	Frequency MHz	ARFCN number	Frequency MHz	Frequency MHz
	UL	DL		UL	DL
975	880,2	925,2	1000	885,2	930,2
976	880,4	925,4	1001	885,4	930,4
977	880,6	925,6	1002	885,6	930,6
978	880,8	925,8	1003	885,8	930,8
979	881,0	926,0	1004	886,0	931,0
980	881,2	926,2	1005	886,2	931,2
981	881,4	926,4	1006	886,4	931,4
982	881,6	926,6	1007	886,6	931,6
983	881,8	926,8	1008	886,8	931,8
984	882,0	927,0	1009	887,0	932,0
985	882,2	927,2	1010	887,2	932,2
986	882,4	927,4	1011	887,4	932,4
987	882,6	927,6	1012	887,6	932,6
988	882,8	927,8	1013	887,8	932,8
989	883,0	928,0	1014	888,0	933,0
990	883,2	928,2	1015	888,2	933,2
991	883,4	928,4	1016	888,4	933,4
992	883,6	928,6	1017	888,6	933,6
993	883,8	928,8	1018	888,8	933,8
994	884,0	929,0	1019	889,0	934,0
995	884,2	929,2	1020	889,2	934,2
996	884,4	929,4	1021	889,4	934,4
997	884,6	929,6	1022	889,6	934,6
998	884,8	929,8	1023	889,8	934,8
999	885,0	930,0			

The following table provides all information about ARFCN and its corresponding frequencies for the **MR441** for UL and DL.

ARFCN number	Frequency MHz	Frequency MHz	ARFCN number	Frequency MHz	Frequency MHz
	UL	DL		UL	DL
			550	1717.8	1812.8
512	1710.2	1805.2	551	1718.0	1813.0
513	1710.4	1805.4	552	1718.2	1813.2
514	1710.6	1805.6	553	1718.4	1813.4
515	1710.8	1805.8	554	1718.6	1813.6
516	1711.0	1806.0	555	1718.8	1813.8
517	1711.2	1806.2	556	1719.0	1814.0
518	1711.4	1806.4	557	1719.2	1814.2
519	1711.6	1806.6	558	1719.4	1814.4
520	1711.8	1806.8	559	1719.6	1814.6
521	1712.0	1807.0	560	1719.8	1814.8
522	1712.2	1807.2	561	1720.0	1815.0
523	1712.4	1807.4	562	1720.2	1815.2
524	1712.6	1807.6	563	1720.4	1815.4
525	1712.8	1807.8	564	1720.6	1815.6
526	1713.0	1808.0	565	1720.8	1815.8
527	1713.2	1808.2	566	1721.0	1816.0
528	1713.4	1808.4	567	1721.2	1816.2
529	1713.6	1808.6	568	1721.4	1816.4
530	1713.8	1808.8	569	1721.6	1816.6
531	1714.0	1809.0	570	1721.8	1816.8
532	1714.2	1809.2	571	1722.0	1817.0
533	1714.4	1809.4	572	1722.2	1817.2
534	1714.6	1809.6	573	1722.4	1817.4
535	1714.8	1809.8	574	1722.6	1817.6
536	1715.0	1810.0	575	1722.8	1817.8
537	1715.2	1810.2	576	1723.0	1818.0
538	1715.4	1810.4	577	1723.2	1818.2
539	1715.6	1810.6	578	1723.4	1818.4
540	1715.8	1810.8	579	1723.6	1818.6
541	1716.0	1811.0	580	1723.8	1818.8
542	1716.2	1811.2	581	1724.0	1819.0
543	1716.4	1811.4	582	1724.2	1819.2
544	1716.6	1811.6	583	1724.4	1819.4
545	1716.8	1811.8	584	1724.6	1819.6
546	1717.0	1812.0	585	1724.8	1819.8
547	1717.2	1812.2	586	1725.0	1820.0
548	1717.4	1812.4	587	1725.2	1820.2
549	1717.6	1812.6	588	1725.4	1820.4

589	1725.6	1820.6	633	1734.4	1829.4
590	1725.8	1820.8	634	1734.6	1829.6
591	1726.0	1821.0	635	1734.8	1829.8
592	1726.2	1821.2	636	1735.0	1830.0
593	1726.4	1821.4	637	1735.2	1830.2
594	1726.6	1821.6	638	1735.4	1830.4
595	1726.8	1821.8	639	1735.6	1830.6
596	1727.0	1822.0	640	1735.8	1830.8
597	1727.2	1822.2	641	1736.0	1831.0
598	1727.4	1822.4	642	1736.2	1831.2
599	1727.6	1822.6	643	1736.4	1831.4
600	1727.8	1822.8	644	1736.6	1831.6
601	1728.0	1823.0	645	1736.8	1831.8
602	1728.2	1823.2	646	1737.0	1832.0
603	1728.4	1823.4	647	1737.2	1832.2
604	1728.6	1823.6	648	1737.4	1832.4
605	1728.8	1823.8	649	1737.6	1832.6
606	1729.0	1824.0	650	1737.8	1832.8
607	1729.2	1824.2	651	1738.0	1833.0
608	1729.4	1824.4	652	1738.2	1833.2
609	1729.6	1824.6	653	1738.4	1833.4
610	1729.8	1824.8	654	1738.6	1833.6
611	1730.0	1825.0	655	1738.8	1833.8
612	1730.2	1825.2	656	1739.0	1834.0
613	1730.4	1825.4	657	1739.2	1834.2
614	1730.6	1825.6	658	1739.4	1834.4
615	1730.8	1825.8	659	1739.6	1834.6
616	1731.0	1826.0	660	1739.8	1834.8
617	1731.2	1826.2	661	1740.0	1835.0
618	1731.4	1826.4	662	1740.2	1835.2
619	1731.6	1826.6	663	1740.4	1835.4
620	1731.8	1826.8	664	1740.6	1835.6
621	1732.0	1827.0	665	1740.8	1835.8
622	1732.2	1827.2	666	1741.0	1836.0
623	1732.4	1827.4	667	1741.2	1836.2
624	1732.6	1827.6	668	1741.4	1836.4
625	1732.8	1827.8	669	1741.6	1836.6
626	1733.0	1828.0	670	1741.8	1836.8
627	1733.2	1828.2	671	1742.0	1837.0
628	1733.4	1828.4	672	1742.2	1837.2
629	1733.6	1828.6	673	1742.4	1837.4
630	1733.8	1828.8	674	1742.6	1837.6
631	1734.0	1829.0	675	1742.8	1837.8
632	1734.2	1829.2	676	1743.0	1838.0

677	1743.2	1838.2	721	1752.0	1847.0
678	1743.4	1838.4	722	1752.2	1847.2
679	1743.6	1838.6	723	1752.4	1847.4
680	1743.8	1838.8	724	1752.6	1847.6
681	1744.0	1839.0	725	1752.8	1847.8
682	1744.2	1839.2	726	1753.0	1848.0
683	1744.4	1839.4	727	1753.2	1848.2
684	1744.6	1839.6	728	1753.4	1848.4
685	1744.8	1839.8	729	1753.6	1848.6
686	1745.0	1840.0	730	1753.8	1848.8
687	1745.2	1840.2	731	1754.0	1849.0
688	1745.4	1840.4	732	1754.2	1849.2
689	1745.6	1840.6	733	1754.4	1849.4
690	1745.8	1840.8	734	1754.6	1849.6
691	1746.0	1841.0	735	1754.8	1849.8
692	1746.2	1841.2	736	1755.0	1850.0
693	1746.4	1841.4	737	1755.2	1850.2
694	1746.6	1841.6	738	1755.4	1850.4
695	1746.8	1841.8	739	1755.6	1850.6
696	1747.0	1842.0	740	1755.8	1850.8
697	1747.2	1842.2	741	1756.0	1851.0
698	1747.4	1842.4	742	1756.2	1851.2
699	1747.6	1842.6	743	1756.4	1851.4
700	1747.8	1842.8	744	1756.6	1851.6
701	1748.0	1843.0	745	1756.8	1851.8
702	1748.2	1843.2	746	1757.0	1852.0
703	1748.4	1843.4	747	1757.2	1852.2
704	1748.6	1843.6	748	1757.4	1852.4
705	1748.8	1843.8	749	1757.6	1852.6
706	1749.0	1844.0	750	1757.8	1852.8
707	1749.2	1844.2	751	1758.0	1853.0
708	1749.4	1844.4	752	1758.2	1853.2
709	1749.6	1844.6	753	1758.4	1853.4
710	1749.8	1844.8	754	1758.6	1853.6
711	1750.0	1845.0	755	1758.8	1853.8
712	1750.2	1845.2	756	1759.0	1854.0
713	1750.4	1845.4	757	1759.2	1854.2
714	1750.6	1845.6	758	1759.4	1854.4
715	1750.8	1845.8	759	1759.6	1854.6
716	1751.0	1846.0	760	1759.8	1854.8
717	1751.2	1846.2	761	1760.0	1855.0
718	1751.4	1846.4	762	1760.2	1855.2
719	1751.6	1846.6	763	1760.4	1855.4
720	1751.8	1846.8	764	1760.6	1855.6

765	1760.8	1855.8	809	1769.6	1864.6
766	1761.0	1856.0	810	1769.8	1864.8
767	1761.2	1856.2	811	1770.0	1865.0
768	1761.4	1856.4	812	1770.2	1865.2
769	1761.6	1856.6	813	1770.4	1865.4
770	1761.8	1856.8	814	1770.6	1865.6
771	1762.0	1857.0	815	1770.8	1865.8
772	1762.2	1857.2	816	1771.0	1866.0
773	1762.4	1857.4	817	1771.2	1866.2
774	1762.6	1857.6	818	1771.4	1866.4
775	1762.8	1857.8	819	1771.6	1866.6
776	1763.0	1858.0	820	1771.8	1866.8
777	1763.2	1858.2	821	1772.0	1867.0
778	1763.4	1858.4	822	1772.2	1867.2
779	1763.6	1858.6	823	1772.4	1867.4
780	1763.8	1858.8	824	1772.6	1867.6
781	1764.0	1859.0	825	1772.8	1867.8
782	1764.2	1859.2	826	1773.0	1868.0
783	1764.4	1859.4	827	1773.2	1868.2
784	1764.6	1859.6	828	1773.4	1868.4
785	1764.8	1859.8	829	1773.6	1868.6
786	1765.0	1860.0	830	1773.8	1868.8
787	1765.2	1860.2	831	1774.0	1869.0
788	1765.4	1860.4	832	1774.2	1869.2
789	1765.6	1860.6	833	1774.4	1869.4
790	1765.8	1860.8	834	1774.6	1869.6
791	1766.0	1861.0	835	1774.8	1869.8
792	1766.2	1861.2	836	1775.0	1870.0
793	1766.4	1861.4	837	1775.2	1870.2
794	1766.6	1861.6	838	1775.4	1870.4
795	1766.8	1861.8	839	1775.6	1870.6
796	1767.0	1862.0	840	1775.8	1870.8
797	1767.2	1862.2	841	1776.0	1871.0
798	1767.4	1862.4	842	1776.2	1871.2
799	1767.6	1862.6	843	1776.4	1871.4
800	1767.8	1862.8	844	1776.6	1871.6
801	1768.0	1863.0	845	1776.8	1871.8
802	1768.2	1863.2	846	1777.0	1872.0
803	1768.4	1863.4	847	1777.2	1872.2
804	1768.6	1863.6	848	1777.4	1872.4
805	1768.8	1863.8	849	1777.6	1872.6
806	1769.0	1864.0	850	1777.8	1872.8
807	1769.2	1864.2	851	1778.0	1873.0
808	1769.4	1864.4	852	1778.2	1873.2

853	1778.4	1873.4	870	1781.8	1876.8
854	1778.6	1873.6	871	1782.0	1877.0
855	1778.8	1873.8	872	1782.2	1877.2
856	1779.0	1874.0	873	1782.4	1877.4
857	1779.2	1874.2	874	1782.6	1877.6
858	1779.4	1874.4	875	1782.8	1877.8
859	1779.6	1874.6	876	1783.0	1878.0
860	1779.8	1874.8	877	1783.2	1878.2
861	1780.0	1875.0	878	1783.4	1878.4
862	1780.2	1875.2	879	1783.6	1878.6
863	1780.4	1875.4	880	1783.8	1878.8
864	1780.6	1875.6	881	1784.0	1879.0
865	1780.8	1875.8	882	1784.2	1879.2
866	1781.0	1876.0	883	1784.4	1879.4
867	1781.2	1876.2	884	1784.6	1879.6
868	1781.4	1876.4	885	1784.8	1879.8
869	1781.6	1876.6			

The following table provides all information about ARFCN and its corresponding frequencies for the **MR741** for UL and DL.

ARFCN number	Frequency MHz	Frequency MHz	ARFCN number	Frequency MHz	Frequency MHz
	UL	DL		UL	DL
512	1850.2	1930.2	551	1858.0	1938.0
513	1850.4	1930.4	552	1858.2	1938.2
514	1850.6	1930.6	553	1858.4	1938.4
515	1850.8	1930.8	554	1858.6	1938.6
516	1851.0	1931.0	555	1858.8	1938.8
517	1851.2	1931.2	556	1859.0	1939.0
518	1851.4	1931.4	557	1859.2	1939.2
519	1851.6	1931.6	558	1859.4	1939.4
520	1851.8	1931.8	559	1859.6	1939.6
521	1852.0	1932.0	560	1859.8	1939.8
522	1852.2	1932.2	561	1860.0	1940.0
523	1852.4	1932.4	562	1860.2	1940.2
524	1852.6	1932.6	563	1860.4	1940.4
525	1852.8	1932.8	564	1860.6	1940.6
526	1853.0	1933.0	565	1860.8	1940.8
527	1853.2	1933.2	566	1861.0	1941.0
528	1853.4	1933.4	567	1861.2	1941.2
529	1853.6	1933.6	568	1861.4	1941.4
530	1853.8	1933.8	569	1861.6	1941.6
531	1854.0	1934.0	570	1861.8	1941.8
532	1854.2	1934.2	571	1862.0	1942.0
533	1854.4	1934.4	572	1862.2	1942.2
534	1854.6	1934.6	573	1862.4	1942.4
535	1854.8	1934.8	574	1862.6	1942.6
536	1855.0	1935.0	575	1862.8	1942.8
537	1855.2	1935.2	576	1863.0	1943.0
538	1855.4	1935.4	577	1863.2	1943.2
539	1855.6	1935.6	578	1863.4	1943.4
540	1855.8	1935.8	579	1863.6	1943.6
541	1856.0	1936.0	580	1863.8	1943.8
542	1856.2	1936.2	581	1864.0	1944.0
543	1856.4	1936.4	582	1864.2	1944.2
544	1856.6	1936.6	583	1864.4	1944.4
545	1856.8	1936.8	584	1864.6	1944.6
546	1857.0	1937.0	585	1864.8	1944.8
547	1857.2	1937.2	586	1865.0	1945.0
548	1857.4	1937.4	587	1865.2	1945.2
549	1857.6	1937.6	588	1865.4	1945.4
550	1857.8	1937.8	589	1865.6	1945.6

590	1865.8	1945.8	634	1874.6	1954.6
591	1866.0	1946.0	635	1874.8	1954.8
592	1866.2	1946.2	636	1875.0	1955.0
593	1866.4	1946.4	637	1875.2	1955.2
594	1866.6	1946.6	638	1875.4	1955.4
595	1866.8	1946.8	639	1875.6	1955.6
596	1867.0	1947.0	640	1875.8	1955.8
597	1867.2	1947.2	641	1876.0	1956.0
598	1867.4	1947.4	642	1876.2	1956.2
599	1867.6	1947.6	643	1876.4	1956.4
600	1867.8	1947.8	644	1876.6	1956.6
601	1868.0	1948.0	645	1876.8	1956.8
602	1868.2	1948.2	646	1877.0	1957.0
603	1868.4	1948.4	647	1877.2	1957.2
604	1868.6	1948.6	648	1877.4	1957.4
605	1868.8	1948.8	649	1877.6	1957.6
606	1869.0	1949.0	650	1877.8	1957.8
607	1869.2	1949.2	651	1878.0	1958.0
608	1869.4	1949.4	652	1878.2	1958.2
609	1869.6	1949.6	653	1878.4	1958.4
610	1869.8	1949.8	654	1878.6	1958.6
611	1870.0	1950.0	655	1878.8	1958.8
612	1870.2	1950.2	656	1879.0	1959.0
613	1870.4	1950.4	657	1879.2	1959.2
614	1870.6	1950.6	658	1879.4	1959.4
615	1870.8	1950.8	659	1879.6	1959.6
616	1871.0	1951.0	660	1879.8	1959.8
617	1871.2	1951.2	661	1880.0	1960.0
618	1871.4	1951.4	662	1880.2	1960.2
619	1871.6	1951.6	663	1880.4	1960.4
620	1871.8	1951.8	664	1880.6	1960.6
621	1872.0	1952.0	665	1880.8	1960.8
622	1872.2	1952.2	666	1881.0	1961.0
623	1872.4	1952.4	667	1881.2	1961.2
624	1872.6	1952.6	668	1881.4	1961.4
625	1872.8	1952.8	669	1881.6	1961.6
626	1873.0	1953.0	670	1881.8	1961.8
627	1873.2	1953.2	671	1882.0	1962.0
628	1873.4	1953.4	672	1882.2	1962.2
629	1873.6	1953.6	673	1882.4	1962.4
630	1873.8	1953.8	674	1882.6	1962.6
631	1874.0	1954.0	675	1882.8	1962.8
632	1874.2	1954.2	676	1883.0	1963.0
633	1874.4	1954.4	677	1883.2	1963.2

678	1883.4	1963.4	722	1892.2	1972.2
679	1883.6	1963.6	723	1892.4	1972.4
680	1883.8	1963.8	724	1892.6	1972.6
681	1884.0	1964.0	725	1892.8	1972.8
682	1884.2	1964.2	726	1893.0	1973.0
683	1884.4	1964.4	727	1893.2	1973.2
684	1884.6	1964.6	728	1893.4	1973.4
685	1884.8	1964.8	729	1893.6	1973.6
686	1885.0	1965.0	730	1893.8	1973.8
687	1885.2	1965.2	731	1894.0	1974.0
688	1885.4	1965.4	732	1894.2	1974.2
689	1885.6	1965.6	733	1894.4	1974.4
690	1885.8	1965.8	734	1894.6	1974.6
691	1886.0	1966.0	735	1894.8	1974.8
692	1886.2	1966.2	736	1895.0	1975.0
693	1886.4	1966.4	737	1895.2	1975.2
694	1886.6	1966.6	738	1895.4	1975.4
695	1886.8	1966.8	739	1895.6	1975.6
696	1887.0	1967.0	740	1895.8	1975.8
697	1887.2	1967.2	741	1896.0	1976.0
698	1887.4	1967.4	742	1896.2	1976.2
699	1887.6	1967.6	743	1896.4	1976.4
700	1887.8	1967.8	744	1896.6	1976.6
701	1888.0	1968.0	745	1896.8	1976.8
702	1888.2	1968.2	746	1897.0	1977.0
703	1888.4	1968.4	747	1897.2	1977.2
704	1888.6	1968.6	748	1897.4	1977.4
705	1888.8	1968.8	749	1897.6	1977.6
706	1889.0	1969.0	750	1897.8	1977.8
707	1889.2	1969.2	751	1898.0	1978.0
708	1889.4	1969.4	752	1898.2	1978.2
709	1889.6	1969.6	753	1898.4	1978.4
710	1889.8	1969.8	754	1898.6	1978.6
711	1890.0	1970.0	755	1898.8	1978.8
712	1890.2	1970.2	756	1899.0	1979.0
713	1890.4	1970.4	757	1899.2	1979.2
714	1890.6	1970.6	758	1899.4	1979.4
715	1890.8	1970.8	759	1899.6	1979.6
716	1891.0	1971.0	760	1899.8	1979.8
717	1891.2	1971.2	761	1900.0	1980.0
718	1891.4	1971.4	762	1900.2	1980.2
719	1891.6	1971.6	763	1900.4	1980.4
720	1891.8	1971.8	764	1900.6	1980.6
721	1892.0	1972.0	765	1900.8	1980.8

766	1901.0	1981.0	789	1905.6	1985.6
767	1901.2	1981.2	790	1905.8	1985.8
768	1901.4	1981.4	791	1906.0	1986.0
769	1901.6	1981.6	792	1906.2	1986.2
770	1901.8	1981.8	793	1906.4	1986.4
771	1902.0	1982.0	794	1906.6	1986.6
772	1902.2	1982.2	795	1906.8	1986.8
773	1902.4	1982.4	796	1907.0	1987.0
774	1902.6	1982.6	797	1907.2	1987.2
775	1902.8	1982.8	798	1907.4	1987.4
776	1903.0	1983.0	799	1907.6	1987.6
777	1903.2	1983.2	800	1907.8	1987.8
778	1903.4	1983.4	801	1908.0	1988.0
779	1903.6	1983.6	802	1908.2	1988.2
780	1903.8	1983.8	803	1908.4	1988.4
781	1904.0	1984.0	804	1908.6	1988.6
782	1904.2	1984.2	805	1908.8	1988.8
783	1904.4	1984.4	806	1909.0	1989.0
784	1904.6	1984.6	807	1909.2	1989.2
785	1904.8	1984.8	808	1909.4	1989.4
786	1905.0	1985.0	809	1909.6	1989.6
787	1905.2	1985.2	810	1909.8	1989.8
788	1905.4	1985.4			

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