

RF / DB6M Series**OPERATION & INSTALLATION MANUAL**

DB6M (Dual Band)
6 Sub-Band Repeater for Outdoor Applications
(FCC ID: S3CDB6M33SA and IC:5751A-DB6M33SA
for AWS and 700 LTE Upper C Sub-Bands only)

5920 0030 200

September 2010

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CONTENTS

1. Document History	4
2. Disclaimer	5
3. Safety Instructions and Warnings	6
3.1. Personnel Safety.....	6
3.2. Equipment Safety.....	6
3.3. Electrostatic Sensitivity	6
4. Introduction	7
4.1. Purpose	7
4.2. Scope.....	7
4.3. Definitions	7
4.4. References	8
4.5. General	9
5. Functional Description of DB6M Dual Band Repeater	9
5.1. General Description	9
6. To Get started-Basic Software Control Of the system	11
6.1. General.....	11
6.2. Terminal Set-up	12
6.3. Block Schematic Description	26
7. DB6M Repeater Specifications	28
7.1. Electrical Specifications-RF	1
7.2. Electrical Specification Power Requirement	1
7.3. External Electrical Interface	29
7.4. Mechanical Specification	29
7.5. Environmental Specification.....	29
7.6 Contents of Delivery.....	30
8. Installation	31
8.1. Preparation Sheet- Pre Installation	31
8.2. Engineering Consideration.....	32
8.3. Installation Tools	34
8.4. Installation Procedure	34
8.5. Repeater Gain Settings.....	35
8.6. Commissioning	35
8.7. Dos & Don't Dos	36

8.8. Checklist – Post Installation	37
9. Trouble Shooting	40
10. System Maintenance.....	41
10.1. General.....	41
10.2. Preventive Maintenance	41
11. Shut Down Mechanisms.....	42

1. Document History

Document Number	Document Name	Date	Compiled by	Approved by	Revision
5920 0030 200	DB6M Dual Band Repeater	September 2010	Inderjit	Ramvir Singh	

Revision**Revised Section****Date**

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2. Disclaimer

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In areas with unstable power grids (mains) all repeaters must be installed with a voltage regulator ensuring a constant voltage level at the repeater power input. A maximum voltage deviation should remain within the input range to the repeaters for warranty purposes.

All antennas must be installed with lightning protection. Damage to internal modules, as a result of lightning is not covered by the warranty.

All specifications are subject to change without prior notice.

3. Safety Instructions and Warnings

3.1. Personnel Safety

Before installing or replacing any equipment, the entire manual should be read and understood. The user needs to supply the appropriate AC power to the Repeater. Incorrect AC power settings can damage the repeater and may cause injury to the user.

Throughout this manual, there are "**Caution**" warnings, "**Caution**" calls attention to a procedure or practice, which, if ignored, may result in injury or damage to the system or system component or even the user. Do not perform any procedure preceded by a "Caution" until the described conditions are fully understood and met.

3.2. Equipment Safety

When installing, replacing or using this product, observe all safety precautions during handling and operation. Failure to comply with the following general safety precautions and with specific precautions described elsewhere in this manual violates the safety standards of the design, manufacture, and intended use of this product. **Shyam Telecom Limited** assumes no liability for the customer's failure to comply with these precautions. This entire manual should be read and understood before operating or maintaining the repeater system.

CAUTION

It calls attention to a procedure or practice which, if not followed, may result in personal injury, damage to the system or damage to individual components. Do not perform any procedure preceded by a **CAUTION** until described conditions are fully understood and met.

3.3. Electrostatic Sensitivity

CAUTION

ESD = ELECTROSTATIC DISCHARGE SENSITIVE DEVICE

Observe electrostatic precautionary procedures.

Semiconductor transmitters and receivers provide highly reliable performance when operated in conformity with the intentions of their design. However, a semiconductor may be damaged by an electrostatic charge inadvertently imposed by careless handling.

Static electricity can be conducted to the semiconductor chip from the centre pin of the RF input connector, and through the AC connector pins. When unpacking and otherwise handling the Repeater, follow ESD precautionary procedures including the use of grounded wrist straps, grounded workbench surfaces, and grounded floor mats.

The RF repeater mentioned is tested thoroughly for maximum composite power. There is provision of ALC / APC (automatic level control / automatic power control) which limits the output power in DL path and in UL path beyond the specified limit. It operates in LTS 700 band – upper C sub-band of 10 MHz BW (CF in UL 781 MHz & CF in DL 751 MHz) and AWS band 10 MHz sub-band (UL 1710-1755MHz, DL 2110-2155MHz). Donor antenna and server antenna must be fixed on permanent structure with enough isolation between donor and server antenna to avoid any possible oscillations.

4. Introduction

4.1. Purpose

The purpose of this document is to describe the electrical and mechanical specifications, operation and maintenance of the **DB6M Dual Band Repeater**.

4.2. Scope

This document is the product description of the Shyam **DB6M Dual Band Repeater** for outdoor application.

4.3. Definitions

AGC	Automatic Gain Control
ALC	Automatic Level Control
APC	Automatic Power Control
BCCH	Broadcast Control Channel
BTS	Base Transceiver Station
BSEL	Band Selective

CDMA	Coded Division Multiple Access
CMC	Configuration & Monitoring Console software
CMB	Combiner Unit
CSEL	Channel Selective
DCS	Digital Communication System
DL	Downlink signal (from base station via repeater to mobile station)
EGSM	Extended Global System for Mobile Communication
ETSI	European Telecommunications Standard Institute
GSM	Global System for Mobile communication
GUI	Graphics User Interface
LAC	Location Area Code of the BTS site
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LO	Local Oscillator
MS	Mobile Station
MSC	Mobile Switching Center
NMS	Network Management System
PCN	Personal Communication Network
PCS	Personal Communication System
PSU	Power Supply Unit
RF	Radio Frequency
RMS	Repeater Management System/Remote Monitoring System
RSSI	Received Signal Strength Indication
RTC	Real Time Clock
SMS	Short Message Service
TACS	Total Access Communication System
TDMA	Time Division Multiple Access
VFD	Visual Florescent Display
UL (Uplink)	Uplink signal direction (from mobile station via repeater to base station)

4.4. References

[1] ETS 300 086

Radio Equipment and Systems Land mobile service Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech.

[2] ETS 300 609-4

Digital cellular telecommunications system (phase 2): Base Station

Systems (BSS) equipment specification: Part 4: Repeaters.

[3] ETS 300 342-3

Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC) for European Digital Cellular Telecommunications Systems. Base Station Radio and ancillary equipment and Repeaters meeting phase 2 GSM requirements.

4.5. General

Mobile Communications Systems are planned as cellular systems and each cell of the base station is required to provide RF coverage over a certain geographical area as per defined RF power levels. Due to the RF propagation properties, even using high radiated RF powers or complicated antenna systems, there are zones within the coverage area where the RF signal strength from base station remains inadequate for establishing the desired connectivity to mobile users.

Repeaters traditionally are deployed in the Mobile Communication Network to fill in the “Dead Zones” caused by blocking of signals by geographic topologies such as mountains, valleys, dense foliage, high rising urban landscapes and other man-made structures. The distance from the base station also adversely affects the RF signal strength. The user views repeaters as a means to extend base station coverage so as to reduce the number of base stations and thereby accelerate network availability.

Repeater systems are installed after meticulous planning between BTSs and the mobile users to provide RF coverage in the shadowed regions. Repeater systems are available for different applications and **ultimate choice** shall depend on some of the factors mentioned below:

- Area to be provided with coverage.
- Indoor/outdoor coverage.
- Availability of BTSs in the vicinity.
- Antenna isolation to be achieved.

5. Functional Description of DB6M Dual Band Repeater

5.1. General Description

The **DB6M dual band** modular Repeater System is designed to provide outdoor coverage and can handle signals in up to six sub bands maximum with 3+3 configuration or as per requirement in two of the service bands, used around the World by various service operators. It provides highly selective amplification in the pre-set frequency bands. The details of operating service frequency bands are given below:

SNo	Service Band	DL Frequency (MHz)	UL Frequency (MHz)
-----	--------------	--------------------	--------------------

S.No.	Service Band	DL Frequency (MHz)	UL Frequency (MHz)
1.	SMR 800	851-866	806-821
2.	Cellular	869-894	824-849
3.	SMR 900	935-941	896-902
4.	EGSM	925-960	880-915
5.	GSM 900	935-960	890-915
6.	DCS	1805-1880	1710-1785
7.	PCS	1930-1990	1850-1910
8.	UMTS	2110-2170	1920-1980
9.	AWS	2110 – 2155	1710 - 1755
10.	LTE 700	Upper C, A and B sub-bands are available	

The Customer is requested to refer to the sticker on the repeater unit giving the details of frequency bands set & the bandwidths of different sub bands equipped in the repeater.

****Only sub bands of AWS and LTE700 Upper C are for FCC and IC approval under FCC ID: S3CDB6M33SA and IC:5751A-DB6M33SA.**

Models: OD6R2-Equipped with 2 sub bands
 OD6R3-Equipped with 3 sub bands
 OD6R4-Equipped with 4 sub bands
 OD6R5-Equipped with 5 sub bands
 OD6R6-Equipped with 6 sub bands

- The DB6M repeater is designed to provide optimal coverage, the area covered shall primarily depend on RF power radiated, manmade structures in the area (high rise buildings), the geographical topologies and availability of reflecting surfaces.
- The ultimate performance & coverage shall depend on the obstructions blocking / absorbing of the RF signals by various objects between the Server antenna of RF repeater and the mobile users.
- The repeater is specifically designed for the Operators who are allocated frequency spectrum in different service bands and non-contiguous sub bands are specified.
- The repeater adopts duplex mode and bi-directional amplification for UL & DL signals between the base station and mobile users.

- It receives signals from the **BTS** through a **DONOR antenna** (highly directional outdoor antenna) and distributes the signals to mobile users after amplification through **SERVER antenna(s)** of directional type in the DL.
- In the UL, the signals from the mobile users are picked up by SERVER antenna and retransmitted to the **BTS** after amplification.
- The repeater finds applications in tunnels, highways, large size airports, and open market areas etc. where traffic requirement is high.
- The system can be incorporated with optional **Remote Management System (RMS)** which can be used for configuration and monitoring the status of the link. It helps not only speedy maintenance but remote configuration also through wireless modem.

The repeater consists of the following modules/units:

- LNA
- Converter modules
- Power amplifiers
- Power supply module
- □Quad-plexer for segregating bands with DL/UL directions
- Supervisory module
- Modem with rechargeable battery & antenna (Optional)
- External modem with power adapter & antenna along with software CD for RMS (optional) application
- A metallic case houses the repeater. Arrangement is made for heat dissipation especially for amplifiers, which generate more heat. The choice of suitable metal as the case material gives a lightweight design with good heat conduction and waterproof protection. The housing conforms to IP65 (NEMA 5) standards.

6. To Get started-Basic Software Control Of the system

6.1. General

The system is equipped with a supervisory module that allows the monitoring and control of various parameters such as RF power, attenuation, temperature, status of door and alarm conditions etc.

The communication interface between the local terminal and the control module can be set up using the **Configuration & Monitoring Console software (CMC)**, which is an easy to use GUI for simple control and monitoring. It enables monitoring of parameters & subsequent adjustment if required.

This function can be performed either using a terminal (PC/laptop) locally, or through remote login using the wireless modem (Optional) located in the repeater. USB port is provisioned in the equipment for connecting PC/laptop.

6.2. Terminal Set-up

The system is delivered with software loaded in order to perform configuration as per requirement. It also enables monitoring the status. Configuration of parameters can be carried out locally with the help of laptop / PC connected to the repeater by means of local USB serial interface or remotely via wireless modem (Optional) mounted inside the repeater. The laptop/PC should be loaded with the CMC software available on the supplied CD along with the USB driver.

I) Login Repeater (Figure 3)

After running the Configuration & Monitoring Console (CMC), user needs to login the repeater, sequence as under, may be followed:

- Click the “LOGIN” on the command bar.
- Select the user type (ADMINISTRATOR or SUPERVISOR).
- Enter the password.
- Finally click the “OK”.

A message “**Logged in successfully**” will appear on the screen after successful login. There are two types of users viz. **ADMINISTRATOR** and **SUPERVISOR**. If user logged in as an **ADMINISTRATOR**, all the functions can be performed through the CMC. By default, the password for both users is “**SHYAM**”.

SUPERVISOR is allowed to perform monitoring of the status & alarms but no change in configuration is permitted. However, the **SUPERVISOR** can change password if so desired.

II) Configuration

Configuring system means setting the system parameters for operation as per the requirement at site.

Click on the command bar to display the configuration window, which allows access to all the configurable repeater parameters. User can login for configuration of parameters.

- **SET** is for updating the repeater parameters.

- **READ** is for confirming the parameters set during the configuration.
Information as detailed below can be incorporated after the “**CONFIGURATION**” window is activated:

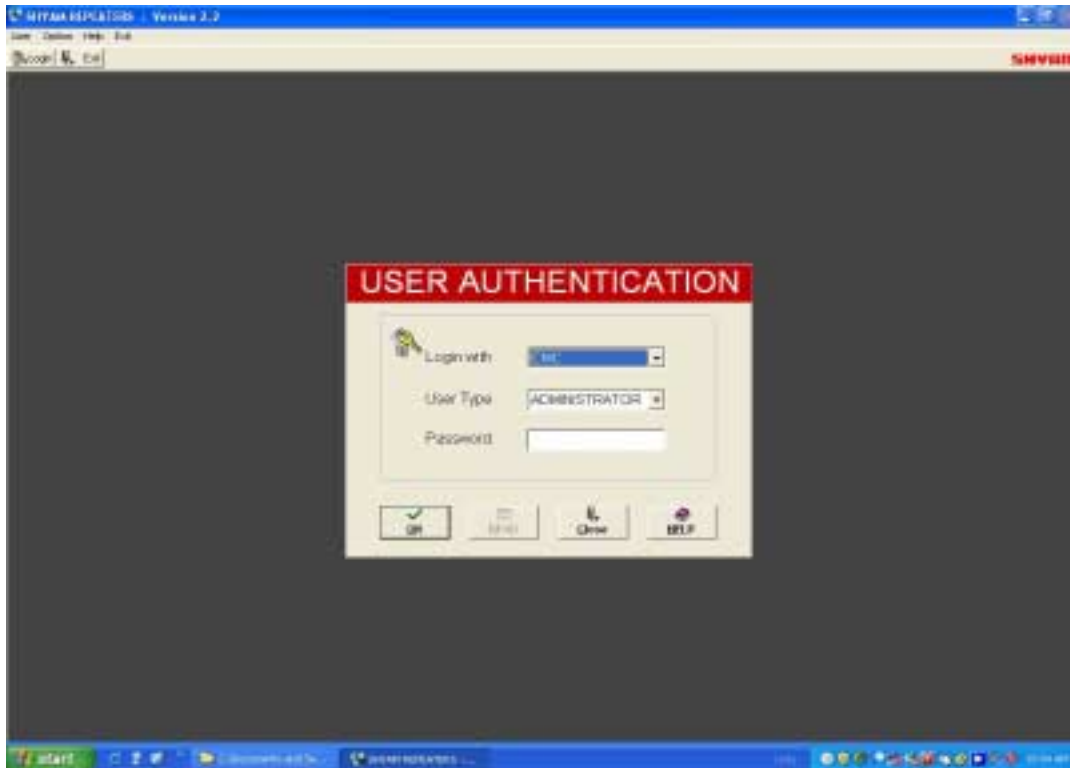


Figure 3: Login Repeater

- Repeater ID:** User can assign a unique repeater ID to each repeater installed. Up to 10 characters are allowed in this field. **(Figure 4)**
- Repeater Location:** User can assign the address of location where repeater is installed. Up to 30 characters are allowed in this field. **(Figure 4)**
- Sub Band ON/OFF Settings:** The system can be equipped up to six sub bands; the sub bands equipped are specified as **ON** in this window while others remain in **OFF** mode. **(Figure 5)**
- Sub Band (UL/DL Frequency Bands) Settings:** The frequency bandwidths of all the 6 sub bands or loaded sub bands in UL & DL are defined. **(Figure 6)**

- e. **Thresholds Output Power:** Maximum Output Power limits in UL & DL for both the bands are set. A “**PA Power high**” alarm will be generated when PA power exceeds the upper limit. **(Figure 7)**



Figure 4: Repeater ID/Location Settings

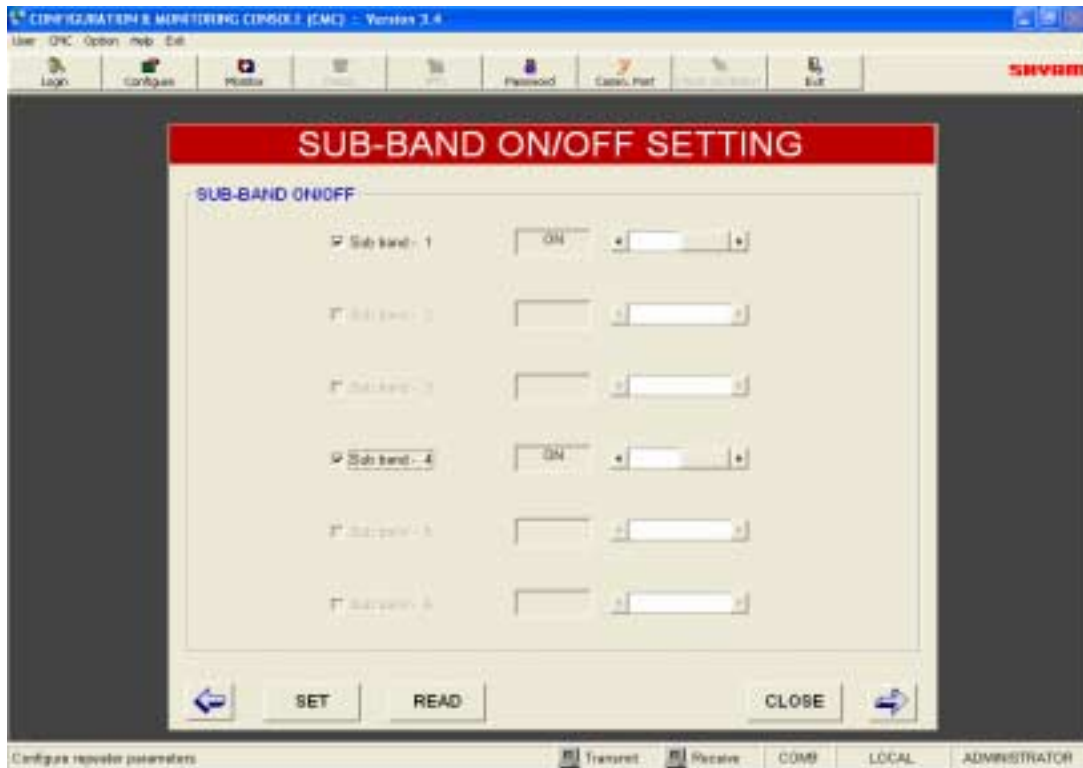


Figure 5: Sub Bands ON/OFF Settings

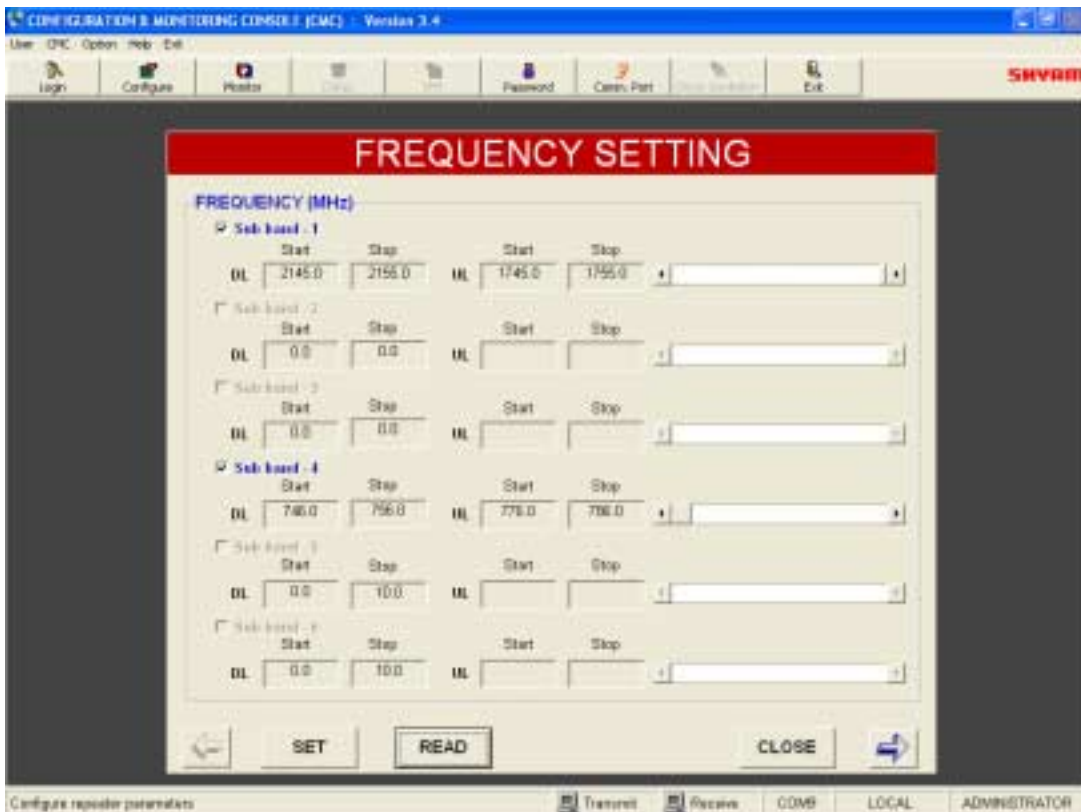


Figure 6: Frequency Settings-Sub bands

- f. **Threshold RSSI Limits:** Lower and Upper RSSI Limits in DL & UL paths for both the bands are set. A RSSI High alarm will be generated when RSSI exceeds the set upper limit, and a RSSI Low alarm will be generated when RSSI goes below the set lower limit set. Upper range that can be set varies from -35 to -55dBm. Lower range that can be set varies from -75 to -95dBm. **(Figure 7)**
- g. **PA ON/OFF:** User can set uplink and/or downlink PA as ON or OFF independently for testing/maintenance purpose at the time of installation for both the bands. **(Figure 8)**

After completing the installation it must be in ON condition only.

After setting parameters in the relevant (configuration) window, it can be closed by clicking at “Close”.



Figure 7: Threshold Settings

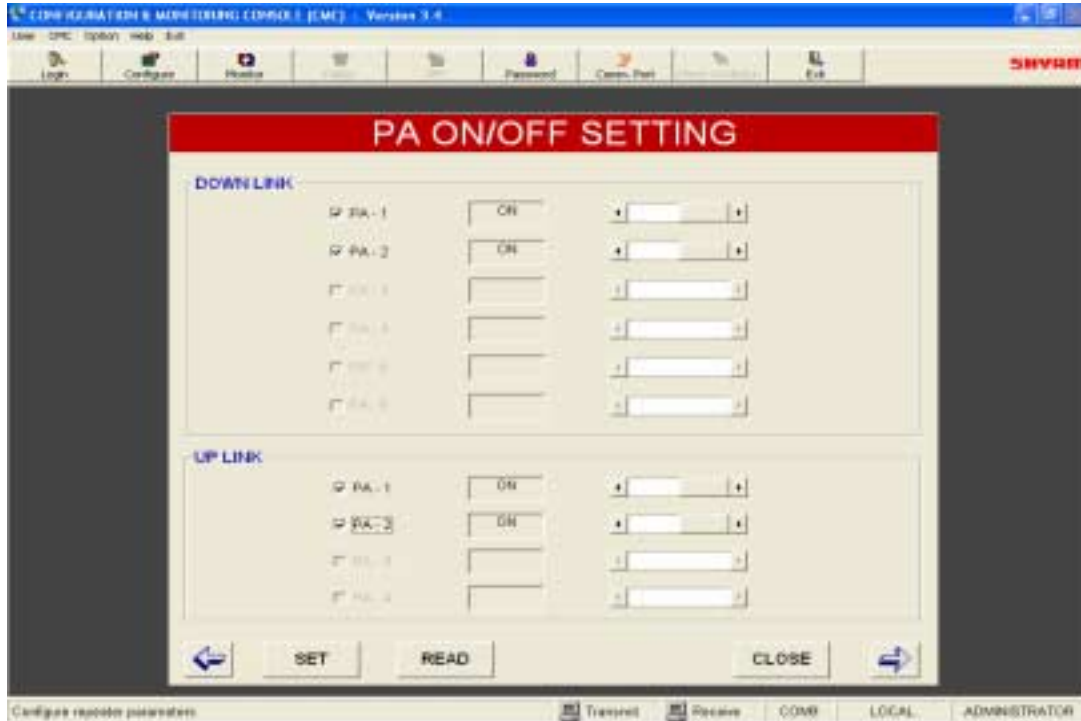


Figure 8: PA ON/OFF Settings

III) Monitoring (Figure 9)

In this window, the status of the system is monitored for the following parameters/conditions:

SNo	Parameters/Conditions	Remarks
1	RSSI (DL) Band 1	Real time DL signal level is displayed.
2	RSSI (DL) Band 2	Real time DL signal level is displayed.
3	RSSI (UL) Band 1	Real time UL signal level is displayed.
4	RSSI (UL) Band 2	Real time UL signal level is displayed.
5	Attenuation Band 1 (DL)	Indicates attenuation inserted in the system for the band in DL.
6	Attenuation Band 2 (DL)	Indicates attenuation inserted in the system for the band in DL.
7	Attenuation Band 1 (UL)	Indicates attenuation inserted in the system for the band in UL.
8	Attenuation Band 2 (UL)	Indicates attenuation inserted in the system for the band in UL.
9	Output Power Band 1(DL)	PA output power in dBm is displayed.
10	Output Power Band 2(DL)	PA output power in dBm is displayed.
11	Output Power Band 1(UL)	PA output power in dBm is displayed.

12	Output Power Band 2(UL)	PA output power in dBm is displayed.
13	APC for Band 1 (DL)	Real time APC for the band in dB is displayed.
14	APC for Band 2 (DL)	Real time APC for the band in dB is displayed.
15	APC for Band 1 (UL)	Real time APC for the band in dB is displayed.
16	APC for Band 2 (UL)	Real time APC for the band in dB is displayed.
17	Power supply 5.5 V, A & B	Real time value of 5.5V DC derived supply is indicated.
18	Power supply 27 V, A	Real time value of 27V DC derived supply is indicated.
19	Internal Battery voltage	Real time value of internal battery equipped. It is equipped when wireless modem is incorporated.
20	System Temperature	The real time system temperature is displayed.
21	Alarms	Displays if any alarm is present and the category of alarm i.e. critical, major or minor is also shown.

IV) Alarms (Figure 10)

Details of alarms displayed are detailed below:

S.No.	Alarm Indication	Remarks
1	DL RSSI Low (Band 1 & Band 2)	When the RSSI low is detected to be lower than the set limit in any of the two or both bands, alarm is generated.
2	DL RSSI High (Band 1 & Band 2)	When the RSSI high is detected to be higher than the set limit in any of the two or both bands, alarm is generated.
3	DL PA Power High (Band 1 & Band 2)	When PA Power in DL path exceeds the set upper limit in any of the two or both bands, alarm is generated.
4	DL PA Power Low (Band 1 & Band 2)	When PA Power in DL path exceeds the set lower limit in any of the two or both bands, alarm is generated.
5	DL Auto PA OFF (Band 1 & Band 2)	When PA Auto OFF is detected in any of the two or both bands in DL path, alarm is generated.
6	DL Manual PA OFF (Band 1 & Band 2)	When PA Manual OFF is detected in any of the two or both bands in DL path, alarm is generated.
7.	UL Auto PA OFF (Band 1 & Band 2)	When PA Auto OFF is detected in any or the two or both bands in UL path, alarm is generated.

8	UL Manual PA OFF (Band 1 & Band 2)	When PA Manual OFF is detected in any or the two or both bands in UL path, alarm is generated.
9	System Temperature High	When system Temperature exceeds the upper limit, alarm is generated.
10	Synthesizer failure (For equipped sub bands in DL & UL)	When the Synthesizer in any of the equipped Sub bands fails, relevant alarm is displayed.
11	VSWR (DL)	It indicates that the mismatch has occurred in DL due to which VSWR value has exceeded 1.5:1.
12	VSWR (UL)	It indicates that the mismatch has occurred in UL due to which VSWR value has exceeded 1.5:1.

Monitoring interval is 3 seconds i.e. after every 3 seconds data on the monitoring window is refreshed.

■ **Red indication is for Alarm Present.**

■ **Green indication is for No Alarm.**

VFD (Visual Florescent Display): This display facilitates configuration & monitoring of the system without connecting the PC/Laptop at the USB port. Press buttons are provided on the VFD strip with following markings with LEDs to display alarm conditions if any:

- Menu [Status and Configuration captions are visible; either of the two can be selected at a time].
- UP [It facilitates shifting of arrow (marker) up in Menu to select the desired function].
- Down [It facilitates shifting of arrow (marker) down in Menu to select the desired function].
- ENT [It enables to view different parameters/conditions prevailing in the system depending on function selected through MENU viz. configuration or status by pressing].
- ESC [It facilitates restoring the original state].

Different LEDs are provided to show following alarm conditions:

ALARM PANEL DETAILS

S.No.	ALARMS	DL	UL
1	PA OFF MAIN	•	•
2	PA OFF AUTO	•	•
3	PA PWR LOW	•	•
4	PA PWR HIGH	•	•
5	LNA ALARM	•	•
6	VSWR ALARM	•	•
7	SYS TEMP HIGH		•
8	DC FAIL		•
9	DOOR OPEN		•

VFD DISPLAY

FUNCTION
MENU ESC UP DOWN ENT
• • • • •

NOTE: An alarm depends on the Limits set in Threshold Settings as well as Alarm Settings by user.

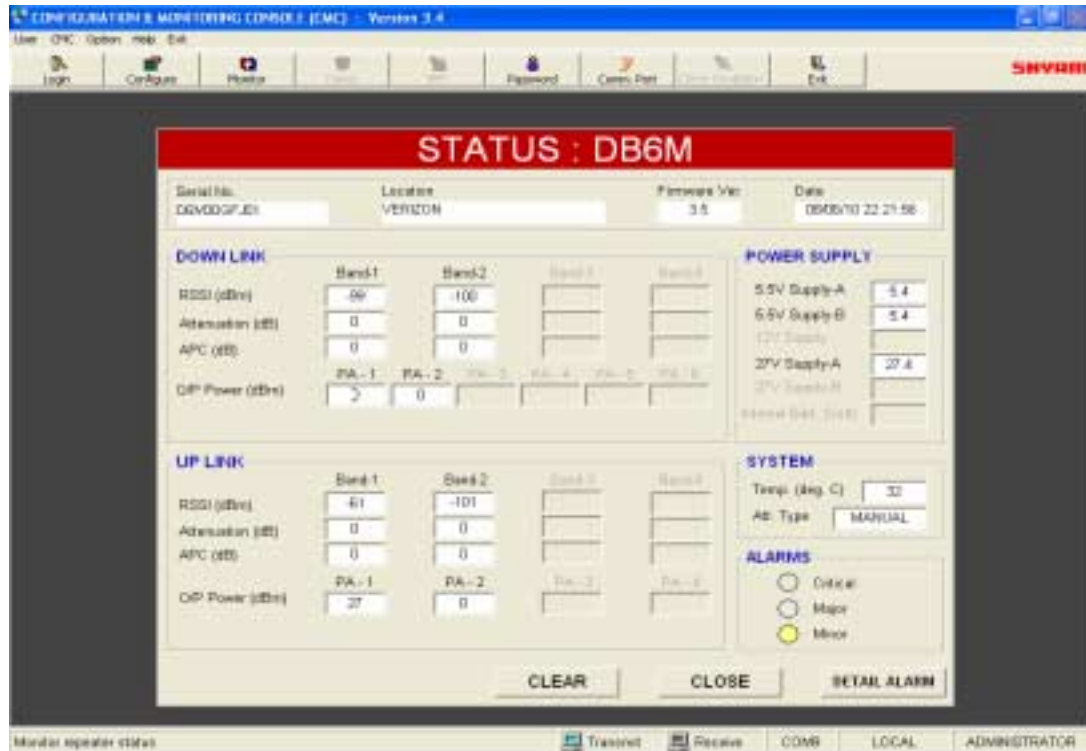


Figure 9: Monitoring (Status)



Figure 10: Alarms Window

Summary of Alarms

S.No	Alarms	Status-VFD	Status-CMC	Status-SMS	Status-RMS
1.	PA Power High DL	●	●	●	●
2.	PA Power High UL	●	-	-	-
3.	PA Power Low DL	●	●	●	●
4.	PA Power Low UL	●	-	-	-
5.	VSWR DL	●	●	●	●
6.	VSWR UL	●	●	●	●
7.	AC fail	-	-	●	-
8.	DC fail	●	-	●	-
9.	RSSI Low	-	●	●	●
10.	RSSI High	-	●	●	●
11.	System Temperature High	●	●	●	●
12.	Door open	●	●	●	●
13.	Synthesizer fail – DL	-	●	●	●
14.	Synthesizer fail – UL	-	●	●	●
15.	PA OFF auto – DL	●	●	-	●

16.	PA OFF auto – UL	●	●	-	●
17.	PA OFF manual-DL	●	●	-	●
18.	PA OFF manual-UL	●	●	-	●
19.	5.5 V- A	-	●	-	●
20.	5.5V- B	-	●	-	●
21.	27.0 V-A	-	●	-	●
22.	27.0 V-B	-	●	-	●
23.	LNA Alarm-DL	●	-	-	-
24.	LNA Alarm-UL	●	-	-	-

- Available
- Not Available

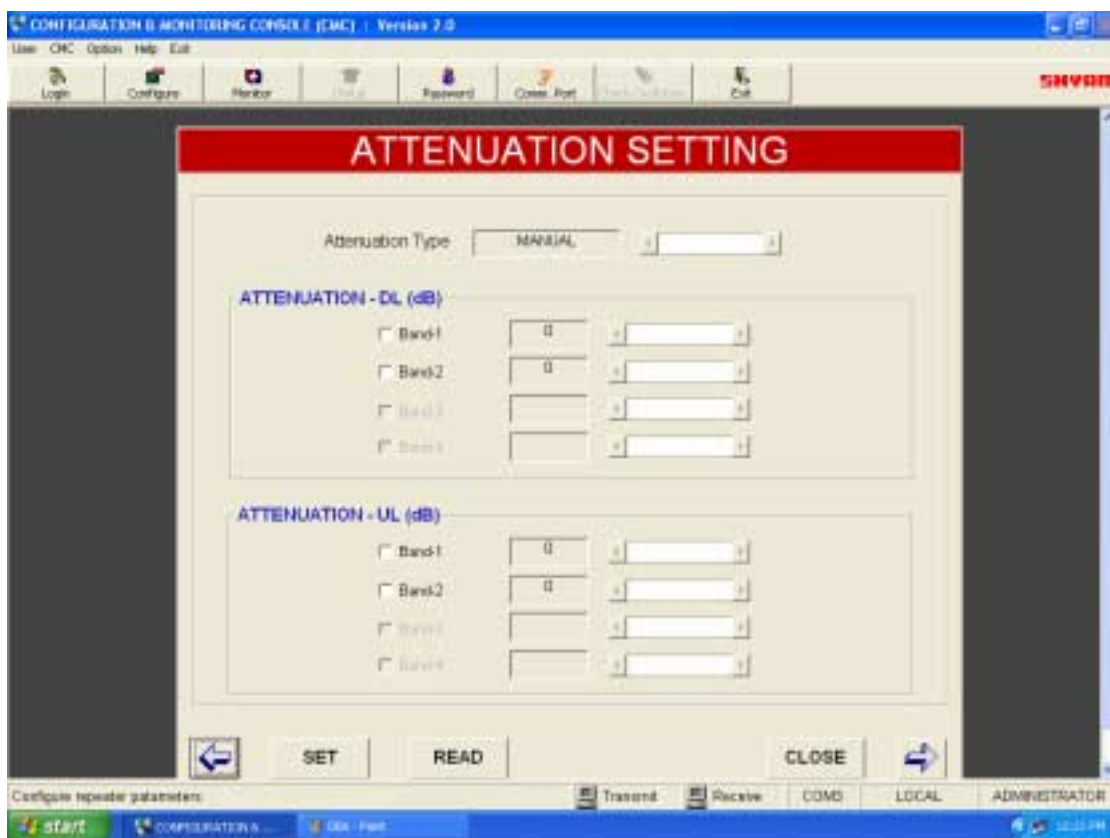


Figure 11: Attenuation Setting Window

As per requirement, a variable attenuator up to 31dB can be inserted manually through software in UL & DL as shown in figure 11 above.

V) Communication Window (Figure 12)

In COMMUNICATION window, user can select serial communication port of the computer and type of connection between repeater and computer. There are two types of connections viz. Local and Remote

Local Connection: In this type of connection, User computer COM Port and repeater's USB Port are connected directly using cable. Sequence is given below:

- Click the "COMM." on the command bar to display the COMMUNICATION window.
- Select the Connection Type as "LOCAL"
- Select the computer's Comm. Port where the repeater is connected.
- Click "OK".

Remote Connection: This connection is established through Wireless Modem. Remote facility is to be clicked and finally click at "OK".

Wireless Modem (Optional) is equipped inside the housing of the repeater and it can be easily located through a sticker provided on the same. It has a groove with SIM cardholder in which the SIM card can be inserted for remote communication.

CAUTION

When the communication between repeater & PC/Laptop is in progress through USB:

1. Do not remove cable from the USB port.
2. Do not switch off the repeater.

In case the communication is not required any more, click at **EXIT** before removing cable from USB port to avoid *hanging* of the PC/Laptop. In case the PC/Laptop goes in to *hanging* mode, it has to be re-started after closing / switching OFF & ON the repeater.

VI) Instant Alarms by SMS

The provision exists in the system for getting the alarm information through "**Instant Alarms by SMS**" which is carried out by Wireless Modem. Following information is desired to be fed for enabling this facility:

- SMS Service Center Number
- RMS Phone Number
- Maintenance Phone Number
- Alarms to be activated

VII) Security Settings (Figure 13)

The system has two levels of permitting Log in to the repeater to avoid unauthorized operation. The levels are: **ADMINISTRATOR & SUPERVISOR.**

Each level has a specific password. The password for each level can be changed at intervals. **ADMINISTRATOR** has rights to perform all functions Viz. Configuration, Monitoring etc. Whereas the **SUPERVISOR** is allowed to perform limited functions like monitoring of alarms, establishing communication etc

VIII) Repeater Management System (RMS): A set of repeaters in an area can be configured for monitoring from a centralized place. It can be accomplished through a external modem & PC which sequentially accesses all the pre defined repeaters with location, ID & mobile numbers at a set time interval & keeps the events of alarms in its memory. There is no limitation on managing number of repeaters but the time interval between successive polling from each repeater shall keep on increasing as the numbers of repeaters are increased. Further, the data storage shall depend on the PC which is used with external modem.

IX) Real Time Clock: The software incorporated in the repeater is envisaged with a real time clock which is set on real time basis.



Figure 12: Communication Window



Figure 13: Password Settings

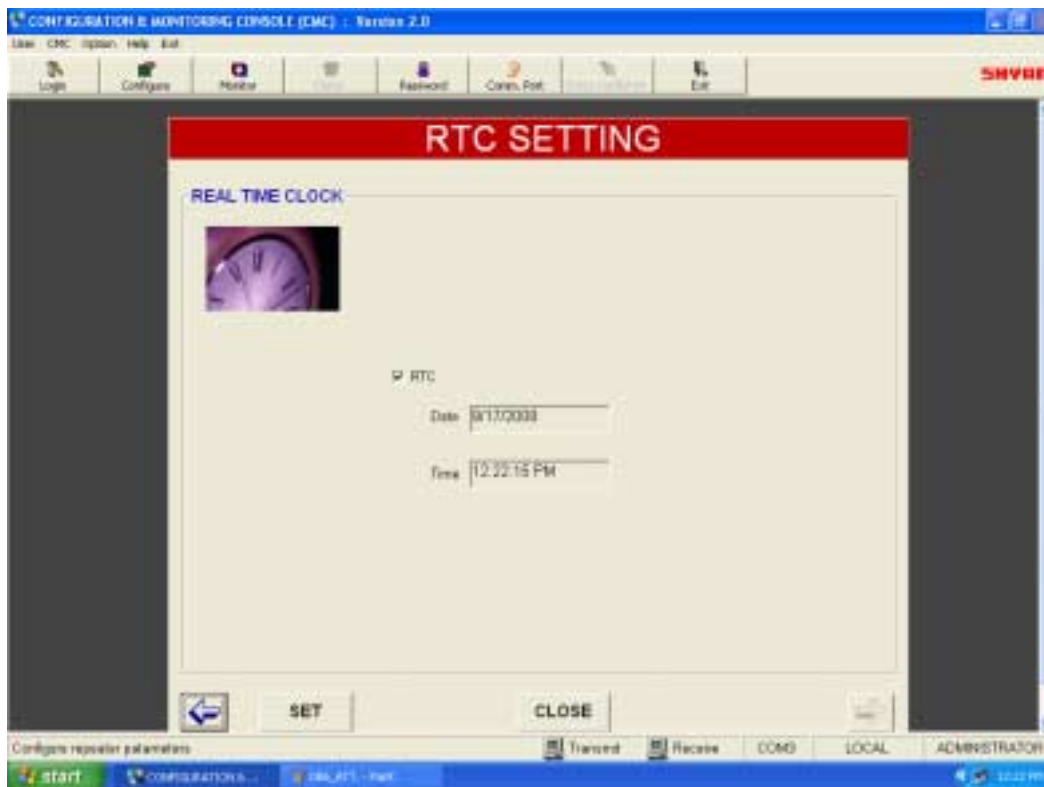


Figure 14: Real Time Clock Setting Window

6.3. Block Schematic Description

The signals intercepted through the Donor antenna in the DL pass through different modules/units for further signal processing; the detail explanation is given upon request.

a. DONOR Antenna

Donor antenna of appropriate bandwidth & gain interfaces the BTS on one side and repeater system on other side through RF cable. It is used to intercept signals from the base station and switch electromagnetic waves into RF signals in the DL and vice versa in the UL.



Figure 16: A Typical Donor Antenna

The antenna with 10dBi gain transfers the intercepted signals to the repeater and transmits uplink signals amplified by the repeater.

b. Quad-plexer**c. Low Noise Amplifier (LNA)****d. Converter Module****e. Power Amplifier****f. Supervisory Module****g. POWER SUPPLY****h. SERVER Antenna**

2dBi gain server antenna transmits signals from the repeater station to mobile users and transport received uplink signals from the mobile users to the base station. Based on the coverage area, directional antenna having proper gain with connectors is installed at pre-planned spots as per the coverage area requirements.



Figure 17: Typical Server Antennas

7. DB6M Repeater Specifications

7.1. Electrical Specifications-RF

S.No.	Parameters	Specified Limits/Remarks
1.	Number of Bands	Two, one each in 700/900 MHz & 1800/1900/2100/AWS MHz frequency bands or as per requirement of the user.
2.	Frequency band in DL path.	Customized as per requirement of the user.
3.	Frequency band in UL path.	Incorporated as per requirement of the customer in accordance with frequency set for downlink.
4.	Number of RF Sub bands	Up to six with 3 sub bands maximum in each band in 3+3 configuration. Bandwidth of each sub band is set as per requirement.
5.	RF power options & associated P1 (DL)	+33dBm (+40dBm), +37dBm (+44dBm) & +40dBm (+47dBm)
6.	Automatic Power Control	25 dB
7.	Repeater Gain	95 dB \pm 3dB for +37dBm RF power 83 dB \pm 3dB for +33dBm RF power
8.	Attenuation range for gain adjustment in DL & UL	31 dB in 1 dB step (Software control)
9.	Gain flatness over band	Within 4dB

10.	Gain variation with temperature	± 1.5 dB
11.	Total delay in the signal path/direction	5.5 microseconds.
12.	Noise figure	5 dB Max.
13.	Impedance	50 Ohms
14.	Return loss	16 dB
15.	Power supply	100 to 240 V AC, 47/63 Hz
16.	GUI Interface	Wireless modem (optional), USB port

7.2. Electrical Specification Power Requirement

Parameters	Specified/Limits
Input AC Voltage Range	100-240 V, 47/63 Hz
Power Consumption +33dBm RF output Power +37dBm RF output Power	150 watts 300 watts Power Consumption shall vary in accordance with sub-bands equipped & RF power configured

7.3. External Electrical Interface

Parameters	Specified/Limits
RF port UL	N-type (F)
RF port DL	N-type (F)

7.4. Mechanical Specification

Dimensions (w x h x d)	560x445x200 mm (22x17x8 inches) for +33dBm 850x515x240 mm (33x20x9 inches) for +37dBm
Weight	30 Kg. (66 lbs.) for +33dBm 41 Kg. (90 lbs.) for +37dBm
Housing	Outdoor application
Grounding Connection	Bolt
Housing Color	Grey
Cooling	Convection

7.5. Environmental Specification

Conditions	Specified/Limits
------------	------------------

Operating Temperature	-35°C to +55°C
Storage Temperature	-30°C to +85°C
Enclosure	IP-65

7.6 Contents of Delivery

ITEMS	QUANTITY
Repeater DB6M unit-Model as per requirement	1
PC interface cable for USB port	1
Power cable with 3 pin plug	1
Operation & Installation manual	1
CD containing the application software	1
Wireless Modem (Optional) with antenna	1 set
Repeater Door Key	Two nos.
Screws, Nuts & Bolts for mounting	1 set

8. Installation

8.1. Preparation Sheet- Pre Installation

Before the installation commences, a preparation sheet to examine the various requirements is to be compiled as per detail given below:

1. General

Application: Outdoor

Service Band 1: Frequency Band DL- Frequency Band UL-
Service Band 2: Frequency Band DL- Frequency Band UL-

Number Of Sub Bands: six

Sub Band 1: Frequency Band DL- UL-
Sub Band 2: Frequency Band DL- UL-
Sub Band 3: Frequency Band DL- UL-
Sub Band 4: Frequency Band DL- UL-
Sub Band 5: Frequency Band DL- UL-
Sub Band 6: Frequency Band DL- UL-

2. Technical requirements

S.No.	Requirement	Remarks
1.	Estimated received signal strength available at site where donor antenna is to be installed	
2.	Estimated cable loss from donor antenna to the repeater unit	
3.	Estimated DL RF power to the input to the repeater	
4.	Desired RF Power in DL	
5.	Proposed gain settings in DL path	
6.	Attenuator to be inserted in DL path	
7.	Estimated cable loss from repeater unit to server antenna port	
8.	ERP at server antenna	
9.	Desired RF Power in UL	
10.	Proposed gain settings in UL path	
11.	Attenuator to be inserted in UL path	

3. Proposed site Address: -----

4. User's Address & other particulars: -----

Date:

Prepared by: -----

8.2. Engineering Consideration

a. Site Selection

Site selection is one of the most critical decisions affecting the overall performance of the system. A repeater must be located where it can receive the maximum signal from the donor site in order to maximize the repeater's output and performance, signal strength greater than or equal to -75dBm is desired.

Examples of donor antenna locations include (but are not limited to): the roof of a building adjacent to the affected area, with the antennas mounted on the highest possible point on the structure; the top of the hill that is obstructing the donor site's coverage, with the antennas mounted on poles at ground level; an existing utility pole with equipment or as the situation permits.

Distance from both the donor site as well as from the new area to be covered must be taken into consideration. The repeater unit should be located close to the donor site to receive maximum signal strength and at the same time is located from where the area proposed for coverage can be reached. In addition, the donor antenna associated should have line of sight with BTS site to reduce the effects of fading.

Another important issue when choosing a repeater location is the availability of AC mains for operating the system. Sites where repeater unit is installed should be easily accessible for the maintenance team.

b. Antenna Selection and Placement

Proper selection of the repeater's donor and server antennas is crucial in designing the repeater system. Appropriate antenna characteristics help to provide proper isolation between the server (coverage) and donor antennas, which helps to prevent feedback.

Specific ways to achieve proper isolation include: using high gain, directional antennas with good Front to Back ratios (25dB or better); physical separation of the repeater's donor and server antennas; and external shielding between antennas. A high gain antenna will help minimize overall path loss to achieve the desired output power. Donor antenna gains are typically 10 to 12dBi, while server antennas can be installed as per requirement.

- The antennas should have proper frequency band of operation.

- Adequate separation is to be ensured from the power lines to avoid damage to the equipment and humans.
- Antenna with proper characteristics to maintain adequate isolation to avoid oscillations. Normally, isolation should be 15 dB more than the gain set for the repeater. It should have good front to back ratio.
- The beam width for the DONOR antenna should be as small as possible.
- The SERVER antenna with proper gain required, is installed.
- There should be adequate vertical & horizontal separation between the DONOR & SERVER antennas to avoid interference and noise.

Separation can be determined by the mathematical formulas:

Vertical Separation:

$$\text{Isolation (dB)} = 28 + 40 \log (D/\lambda \text{ in meters})$$

Horizontal Separation:

$$\text{Isolation (dB)} = 22 + 20 \log (D/ \lambda \text{ in meters}) - (\text{Gain of donor antenna} + \text{gain of server antenna})$$

D-Distance between donor & server antennas in meters

λ – Wave length in meters

c) Overlapping Coverage

Ideally, the repeater system will be engineered with minimal overlapping coverage between the donor base station and the repeater. However, the mobile users will occasionally receive signals from both the donor and the repeater at similar levels. This situation is comparable to a mobile receiving multiple signals at varying times due to multi-path propagation.

The repeater contributes a maximum signal delay of 5.5 microseconds in one direction.

d) Call Processing

The mobile communication system perceives calls handled by the repeater as actually being handled by the donor site (BTS); the repeater is just an extension of the base station's coverage. Therefore, the donor handles call initiation, power control messages, hand-over requests, etc., for mobiles in the repeater area. When the base station assigns a channel to the mobile, that channel is sent through the repeater and then re-radiated under the same frequency. Since the repeater is technically part of the base station, no hand-over takes place when a mobile moves from the repeater's coverage area to that of the base station. When the mobile moves from the

repeater's area to a neighboring site, the base station handles the hand-off in the same way as for a mobile in the base station area.

8.3. Installation Tools

You will need the following basic tools for installation:

- a. Standard wrenches/screwdrivers/cable stripper/cable cutter/pliers set for installing the **DB6M** Unit and antennas. (Refer to the manufacturer's recommendations for installing the antennas).
- b. RF cable connection tool for installing connectors.
- c. Multi-meter.
- d. Mobile handset loaded with Net engineering software to be used for signal level measurement.
- e. Magnetic compass for measuring the azimuth of the BTS and repeater site.

8.4. Installation Procedure

The **DB6M Modular** repeater should be installed at an outdoor location depending on the survey report. The repeater unit shall be mounted vertically to a mast, which means the RF connectors will be at the bottom side.

In case of wall mounting, minimum physical separation between the repeater housing & the wall should be 50 mm.

Furthermore, the repeater shall be mounted in a way so that there is free access to the individual units, while the door of the repeater is open. Therefore, enough clearance has to be provided for comfortable reach.

The repeater is mounted at the pre-selected site firmly placed with clamps and other mechanical accessories. Connections as detailed below are carried out:

- RF cable routed from DONOR antenna is connected at the BTS port as indicated.
- RF cable routed to SERVER antenna is connected at TX/RX port for signal distribution.
- For energizing the system, the cable from AC mains is connected at AC mains port, range 100-240 V.
- USB port is provided for carrying out configuration and monitoring.

Important: Grounding of the unit has to be ensured before extending the power to the repeater system.

Following points need considerations for laying of RF cable:

1. RF cable installation must comply with local or National Electrical Codes. The cable shall have nominal 50-Ohm impedance. Routing of the RF cables is to be as per the site installation plan.
2. Fix the supplied connectors to the RF cable and verify the following:
 - The center conductor to outer shield of RF coaxial cable indicates “Open Circuit” condition.
 - Check for any short circuit between center conductor and outer shield.
 - Place short between the center conductor and outer shield using a piece of wire temporarily and check the other end of conductor for any break in the RF cable.

8.5. Repeater Gain Settings

The **repeater gain** is one of the vital parameters since it also decides the area required to be provided with RF coverage. The noise contribution has to be minimum while setting the gain which should be set with utmost care. The variation in gain up to 31 dB in steps 1 dB is possible to be achieved with the help of software control attenuator, provided in the system. The gain setting for Uplink and Downlink path is independent of each other.

a. Forward Gain Setting

The process of setting the forward gain is very simple. Forward signal level strength can be measured with a mobile hand set loaded with NET engineering software.

Alternatively, RF output power of repeater can be measured using the visual indication shown on the display panel of the repeater.

Once the RF output power has been determined, the attenuation will have to be modified to reach the desired output signal level.

The gain of repeater can be set using any of the following methods:

- a. Local USB serial interface mode (GUI based)
- b. Through (optional) wireless modem.

b. Reverse Gain Setting

For reverse gain setting, a 31 dB variable attenuator is provided; the required value can be inserted for the desired gain. The gain is set to such a value so as to cause minimum interference at the base station but high enough to ensure a strong signal.

8.6. Commissioning

Important:-Repeater should not be connected to Power without termination at the antenna ports. The termination can be carried out either by the antenna connection as well as a dummy load or the 50 Ω

terminated connection of a measuring instrument (Power Meter, Spectrum analyzer with appropriate PAD)

After setting the gain, verify the parameters:

1. DL RF power radiated in the set frequency band.
2. Received RF power in the DL.
3. UL RF power radiated in the set frequency band.
4. Received RF power in the UL.
5. Record the value of attenuation introduced for setting the gain.

8.7. Dos & Don't Dos

1. The site should be accessible for maintenance purposes.
2. Arrangement is to be made to avoid unauthorized access to the repeater.
3. Proper grounding of the repeater housing is done to avoid damage to the system.
4. For outdoor applications, the housing must be waterproof.
5. Stable power supply for repeater unit should be ensured.
6. The route of Cables to/from antennas should be short to minimize the cable losses and should be free from sharp bends & kinks.
7. Local standard of cabling should be followed.
8. The donor antenna should have proper line of sight with the BTS from where the signals are to be intercepted for maximum signal strength and to reduce the effect of fading.
9. There should be adequate separation between the cables (antenna system) and the power lines to avoid damage to the equipment & injury to humans.
10. The selection of BTS should be made taking other BTSs in the same vicinity in to consideration to avoid interference.
11. Gain of the repeater should be set after taking antenna isolation in to consideration.
12. The estimation of coverage area should be confirmed.
13. The system should be configured for normal traffic after actual measurement of:
 - a) RF power in the DL
 - b) RF power in the UL
 - c) Antenna Isolation
 - d) Gain settings in DL & UL
14. Feedback regarding performance of the system may be sent to Shyam Telecom by the user.

8.8. Checklist – Post Installation

After the installation of the system is accomplished, points as indicated in the checklist are verified.

Service Bands Particulars:

Frequency Band for Band 1 DL	
Frequency Band for Band 1 UL	
Frequency Band for Band 2 DL	
Frequency Band for Band 2 UL	

A. Repeater Installation

S. No.	Point(s) to be Verified	Remarks
1.	Ensure isolation between server and donor antennas, it has to be 15 dB + Gain set of the repeater.	
2.	Actual isolation measured	
3.	Ensure proper grounding of the unit	
4.	Cable from donor antenna connected to donor antenna port	
5.	Cable from server antenna connected to the relevant port in the unit	
6.	Mains cable connected to the repeater unit	
7.	Cable protection ensured and outdoor connections are waterproof	

B. Repeater Set Up

S.No.	Point(s) to be Verified	Remarks
1.	Number of sub bands equipped	
2.	Number of Sub band(s) in Band 1 with frequency bandwidth of each.	
3.	Number of Sub band(s) in Band 2 with frequency bandwidth of each.	
4.	Repeater switched ON	
5.	Any error (alarms) observed	
6.	Gain set	
7.	Power level in DL	
8.	Attenuation in DL	
9.	Power level in UL	
10.	Attenuation in UL	
11.	Observation on CMC software & GUI	
12.	Repeater secured & locked	

Any Other Remark/Comment:

Date of Installation: -----

Repeater ID & Site Address: -----

Name of the Installer: -----

9. Trouble Shooting

The repeater is provided for different alarm conditions through LEDs on VFD & further details of alarms are available on GUI. The display of different alarm conditions on GUI is a guiding tool for locating the faulty module.

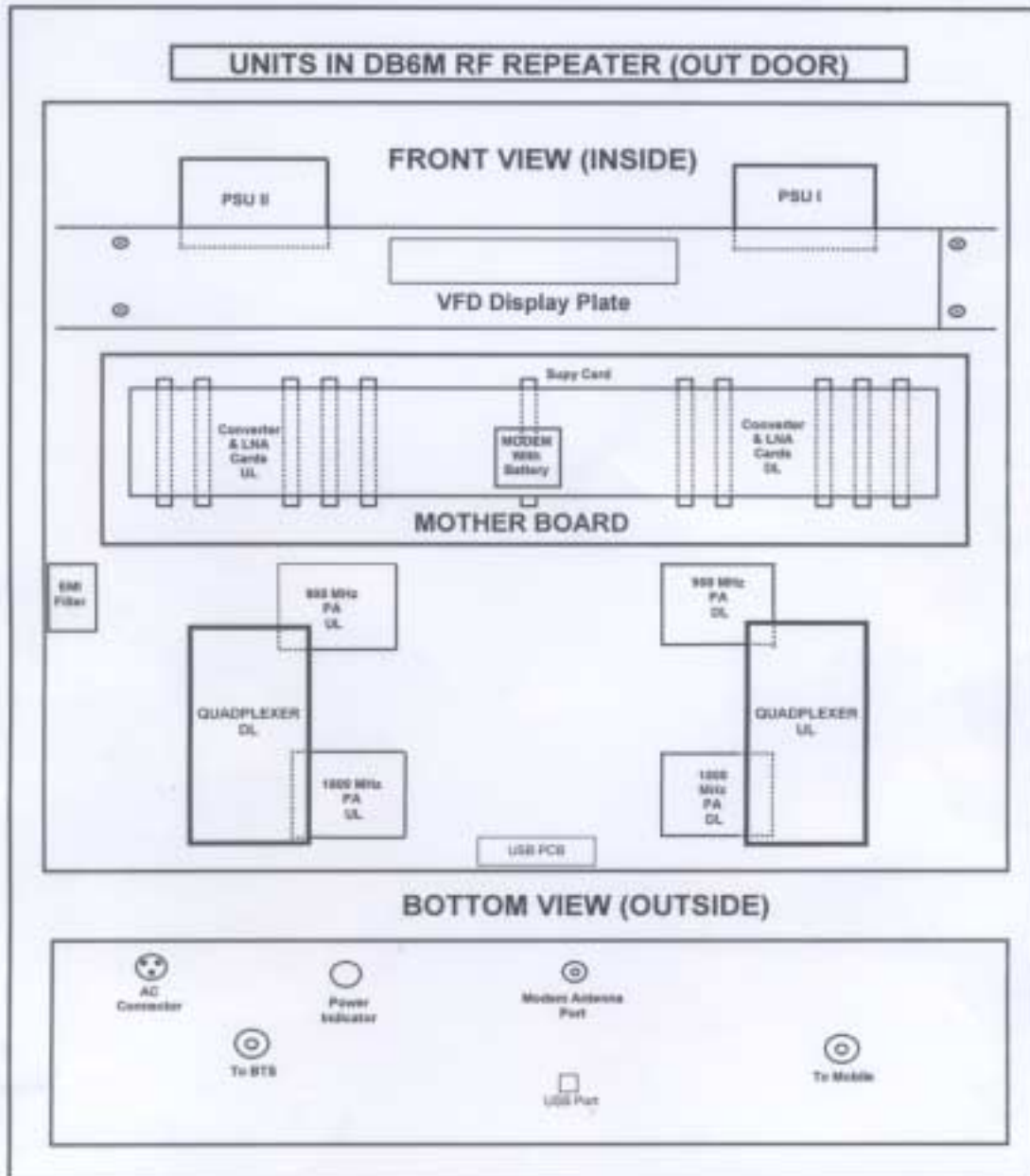
The details of alarms in the system is given in clause 6.2 with reference to figure 10 & the associated table which is self explanatory and it shall guide the maintenance team to detect the faulty unit.

Some of the conditions, which may be observed in field after installation, are tabulated below:

SNo	Observation	Possible reasons & solutions
1.	The repeater does not turn ON.	<ul style="list-style-type: none"> Check the AC mains availability at plug. Check the continuity of power cable. Check the voltage at the input to PSU. Check the voltage at the output of PSU.
2.	Signals are not available at the desired power after completing the installation.	<ul style="list-style-type: none"> Check the AC power cord and make sure the power switch is on. Check all the connectors of the repeater system for proper connections. <ul style="list-style-type: none"> The "BTS" port has to be connected to donor antenna. The "MS" port has to be connected to server antenna. Check the continuity of RF cables going to antennas. Check for any alarm on GUI/VFD relating power low. Check the RSSI at the in put. Check the configuration & set limits.
3.	Speech quality is observed to be low/unclear/with echo.	<ul style="list-style-type: none"> Vertical & horizontal separation between the donor & server antennas should be adequate for proper isolation. Gain of the repeater may be high, it may have to be reduced.
4.	The system performed well in the beginning but after few days, the performance has degraded.	<ul style="list-style-type: none"> Check the RSSI at the in put. Check the line of sight of donor antenna with the BTS. Observe if any new building has come up which might be obstructing the signals. Verify the net gain of repeater in DL & UL paths if required the gain may be adjusted. Relocate the donor antenna to solve the problem if necessary. Check the RF cable for physical damage if any. Also check

		for sharp bends or RF cable pressed. Under these conditions, RF signal losses increase. If so, replace RF cable.
5.	There is no communication in one of the sub bands	<ul style="list-style-type: none"> Go to the GUI & observe for the alarm for synthesizer failure. Replace the converter unit, signals shall come up.

The layout of modules in the repeater is shown below



ALARM PANEL DETAILS

S.No	ALARMS	DL	UL
1	PA OFF MAN	•	•
2	PA OFF AUTO	•	•
3	PA PWR LOW	•	•
4	PA PWR HIGH	•	•
5	LNA ALARM	•	•
6	VSWR ALARM	•	•
7	PA TEMP HIGH		•

32 DIGIT LCD DISPLAY

FUNCTION
 MENU ESC UP DOWN ENT
 ○ ○ ○ ○ ○

10. System Maintenance

10.1. General

The system normally operates without any operator intervention or maintenance. In the event of fault, the field replaceable units (antenna & cables) should be checked for faults and the system restored. A faulty unit can be removed and replaced with a spare while the rest of the system is still operating. Soldering or local repair of the modules should be avoided. Faulty module/unit should be replaced with genuine spares from **Shyam Telecom Limited** only.

The power supply of the faulty repeater should be isolated from AC mains and DC power before any module is replaced. In the event of a system malfunction, the status of the antenna systems should be checked as well as the continuity of the cabling before replacing any modules within the repeater.

10.2. Preventive Maintenance

The **DB6M Modular** repeater does not require any preventive maintenance.

11. Shut Down Mechanisms

The repeater has an automatic shutdown mechanism to protect the repeater itself, and also to eliminate any degradation to VZW network, when the normal operational conditions cannot be maintained.

The repeater shuts down automatically when the composite uplink or downlink output powers are above the values defined as peak for the device for a period not to exceed 5 seconds.

After automatic shutdown, the repeater automatically turns-on in order to assess whether the temporary condition has changed. If the condition is still detected, the repeater shuts down again.

And it takes 3 to 15 minutes (user configurable) to ON again after automatic shut down.

For Technical Support, please contact at any of the following addresses:

Asia Pacific

HEADQUARTER

Shyam Telecom Ltd.

246 UDYOG VIHAR, Phase IV,
GURGAON – 122015 (INDIA)

Tel: +91-124-4311600 FAX: +91-124-4018116

Americas

Shyam Telecom Inc.

6, KILMER ROAD, SUIT D,
EDISON, New Jersey-08817 (USA)

Tel: + 1-732-985-1324 Fax: + 1-732-907-1023

Europe

Shyam Telecom GmbH.

Frohsinnstrasse 16,
63739 Aschaffenburg, (GERMANY)

Tel: + 49-6021-45901-0 Fax: + 49-6021-45901-29

Email: contact@shyamtelecom.com

FCC Statement:

FCC ID:S3CDB6M33SA

This device complies with Part 2, 27 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

IC Statement:

Trade Name: SHYAM DB6M Dual Band Repeater

Model No.: DB6M33-700UC+AWS

IC: 5751A-DB6M33SA

This device complies with RSS-131, RSS-102 of the IC Rules.

Warning

Changes of modifications not expressly approved by the manufacturer could void the user's authority to operate the equipments.

Antenna Information:

This device has been designed to operate with the antennas listed below, and having a maximum gain of 10dB. Antennas not included in this list or having a gain greater than 10dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Antenna (or equivalent) list:

- 1) Yagi Antenna 10 dbi for outdoor installation
- 2) Omni Antenna 2 dbi for indoor installation

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

WARNING! This equipment complies with FCC & IC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. For mobile or fixed location transmitters, the minimum separation distance is greater than 25 cm (indoor server antenna) and 55cm (outdoor Donor antenna), even if calculations that the MPE distance would be less.