GSM

CSHP902 Repeater

User, Operation and Maintenance Manual

AVITEC

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1. Document History

Document Number	Document Name	Document Date	Author	Edited by	Approved by	Revision
HP902CDIRUM	CSHP902.DOC	22/10/99		PB	TA	1

Revision	Revised section	Date/Sign
1	First edition	22/10/99
2	Second Edition	26/09/01
3	Third Edition	28/11/01

2. Disclaimer

Every attempt has been made to make this material complete, accurate, and up-to-date. Users are cautioned, however, that Avitec AB reserves the right to make changes without notice and shall not be responsible for any damages, including consequential, caused by reliance on the material presented, including, but not limited to, typographical, arithmetical, or listing errors.

Product names referenced in this document may be trademarks or registered trademarks of their respective companies, and are hereby acknowledged.

Guarantees

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 of +/- 10% from the repeaters rated voltage is acceptable for warranty purposes.

All antennas must be installed with Lightning protection. Damage to power modules as a result of lightning are not covered by the warranty.

3. Safety Instructions and Warnings

3.1. Safety to Personnel

Before installing or replacing any of the 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. Safety to Equipment

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. Avitec AB 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
Calls attention to a procedure or practice,
which, if ignored, may result in personal injury
or may result in damage to the system or system component.
Do not perform any procedure preceded by a
CAUTION until described conditions are fully understood and met.

3.3. Electrostatic Sensitivity

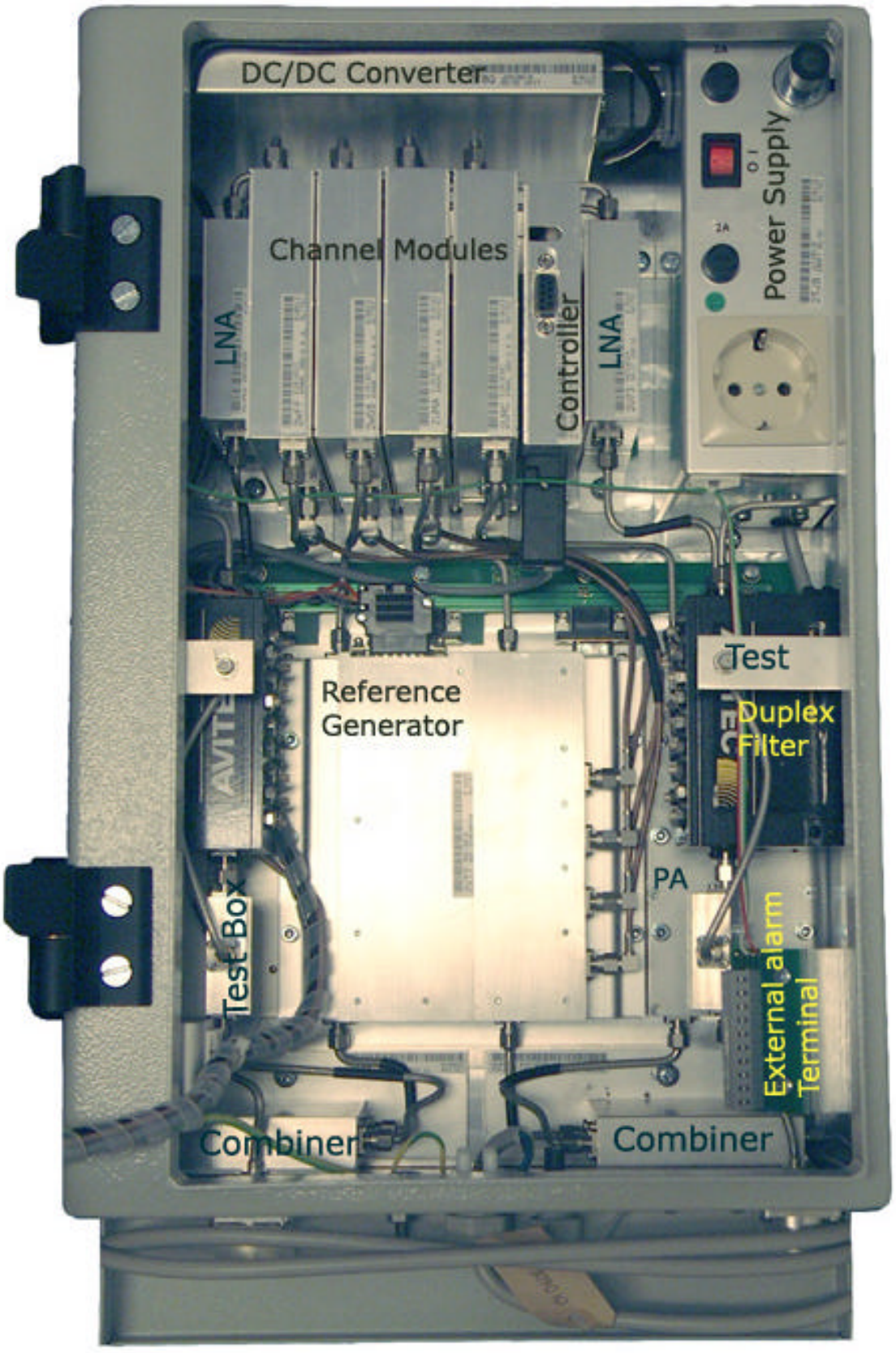
CAUTION
ESD = ELECTROSTATIC DISCHARGE SENSITIVE DEVICE

Observe electrostatic precautionary procedures.

Semiconductor transmitters and receivers provide highly reliable performance when operated in conformity with their intended 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 use of grounded wrist straps, grounded workbench surfaces, and grounded floor mats.

Inside the Repeater



An internal view of the remote unit (CSHP902-IR)

4. Introduction

4.1. Purpose

The purpose of this document is to describe the electrical and mechanical specifications, operation and maintenance of the CSHP 902 Repeater.

4.2. Scope

This document is the product description of the Avitec Repeater CSHP 902.

4.3. Definitions

ALC	Automatic Limit Control
ARFCN	Absolute Radio Frequency Channel
BTS	Base Transceiver Station
BCCH	Broadcast Control Channel
Band Selective Repeater	A repeater which is designed for operation on a combination of channels within a specified band of frequencies, within the operating band of the repeater.
Broadband Repeater	A repeater, which is designed for operation on any combination of, specified maximum number of channels within the operating band of the repeater.
Channel	In this document a channel is the same as a carrier. It also describes one time slot on one carrier in radio terminology.
Channel Selective Repeater	A repeater, which is designed for operation on a specified carrier within the operating band of the repeater. The subset of carriers may be determined during the manufacture of the repeater, or may be programmable.
Downlink (DL)	RF signals that are transmitted from the BTS and relayed to mobile radio equipment.
EMC	Electromagnetic Compatibility
GND	Ground
LED	Light emitting diode
LNA	Low Noise Amplifier
MTBF	Meantime between failures

Definitions Continued

NA	Not Applicable
NC	No Connection
NF	Noise Figure
Repeater	A bi-directional Radio frequency (RF) amplifier that can amplify and transmit a received Mobile Station (MS) signal in the MS transmit band. In addition, simultaneously it can amplify and transmit a received Base Transceiver Station (BTS) RF signal in the BTS transmit band.
RF	Radio Frequency
RS232	Serial Interface Protocol
SN	Serial Number
SDCCH	Stand Alone Control Channel
TCH	Traffic Channel
Uplink (UL)	RF signals that are transmitted from mobile radio equipment to the BTS

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 Communication systems transmit signals in two directions, between base station and mobile radio equipment. If weak radio transmissions occur within the coverage area, and they are due to topological conditions or distance from the transmitter, a repeater system is used to extend the transmission range.
In the downlink path the repeater will pickup the signal from an existing coverage area via a donor antenna, it then amplifies it and re-transmits it into the desired poor coverage area. In the uplink direction the repeater will receive signals from the mobile radios in the covered area and re-transmit them to the corresponding base station.

5. Functional Description of CSHP 902 Repeater

5.1. General Description

The high power repeater is a 2-channel repeater for GSM systems, which has an output power of 38 dBm or 41 dBm per carrier depending on configuration. The CSHP902 consists of a two parts; one remote unit and one donor unit which both can be custom configured due to the modular design. The repeater has a compact design with separate modules for each channel in both UL and DL.

The frequency and amplification can be individually controlled via two alternative methods of communication. The monitoring and control of the system can be conducted either with a direct connection via an RS232 cable to a laptop computer or via the GSM modem (wireless interface) through the network operator.

An aluminium case houses the repeater. Cooling fins for the amplifiers are located on the rear of the unit. Aluminium is chosen as the case material, which gives a lightweight design with good heat conduction and weatherproof protection against the elements. The enclosure conforms to IP65 and NEMA 4 standards.

Connections are made with 7/16” and type-N connectors that are located on the underside of the repeater. The external connections on the bottom are protected from unauthorised access with a cover, which can be opened only from the inside of the repeater.

The repeater units can be divided into the following modules:

- Channel Modules
- Power Amplifier Modules
- Power Supply Module
- Duplex Filter Module
- Control Module
- Reference Generator
- Low Noise Amplifier Module

5.2. Functional Description of Repeater Modules

5.2.1. Channel Modules

Every channel module consists of an IF down-converter with SAW filters, an IF up-converter, and a post amplifier. The module contains a power level control unit. The synthesiser in the module shall be locked to an external reference signal generated.

5.2.2. Power Amplifier Modules

The power amplifiers are made up of temperature-compensated gain blocks. The power transistors are designed for minimum inter-modulation products. The uplink power amplifier has a four watt output power, while the down-link amplifier has an output power of 15 Watts

5.2.3. Power Supply Module

The power supply module is connected to all other electronic modules. The AC input is equipped with a surge, EMI, EMC suppression filter.

5.2.4. Duplex Filter Module

The function of the duplex filter is to isolate the Uplink from the Downlink. The transmit antenna is combined with a duplex filter operating in the appropriate band. The filter consists of band-pass filters that provide isolation against out-of-band signals.

5.2.5. Control Module

The monitor and control of the repeater is made possible with the help of the Control Module. This module determines the status of all channel modules and identifies error conditions. When an error occurs, the control module sends an alarm via DataCall to the Avitec Element Manager(Repeater OMC) at the operator's monitoring centre. The control module sends and receives all channel and amplification data for the addressed channel modules.

5.2.6. Reference Generator

The reference generator module provides the synthesisers in the channel modules with a phase locked reference signal. An oven controlled crystal oscillator is used to generate the 10 MHz reference.

6. To Get Started - Basic Software Control of the Repeater

6.1 General

Both the Donor and the Remote unit are equipped with a control module that allows the monitoring and control of various parameters such as traffic density, channel number, attenuation, temperature, status of door, etc.

The communication interface between the local terminal and the control module is set up as a easy to understand menu for simple manual control and monitoring. This way, the parameters can easily be monitored and set up from the display of the terminal.

This can be performed either via a terminal (PC) locally, or via remote login through the built in GSM modem located on the inside of the repeater door.

To get the repeater operating on-air, you only have to set-up four parameters:

1: ARFCN to be repeated.
2: ARFCN to be used by the link path between Donor and Remote.
3: Desired attenuation (gain) in each signal path.
4: Desired ALC levels in each signal path

NOTE: This procedure is simplified with the built in input and output power monitoring functions of the repeater.

6.2 Terminal Set-up

Connect a straight 9PIN RS232 cable to the 9PIN DSUB female connector located on top of the control module in the repeater. Any VT-100 compatible terminal unit can be used. One example is the "Hyper Terminal" terminal emulation software included in MS Windows operating systems.

The easiest way to perform set-up is to use the user-friendly Repeater Maintenance Console (RMC) software package to configure the repeater.

The terminal parameters should be set as follows:

Baud rate 9600, Parity None, 8 Data bits, 1 Stop bit, and “no flow control”.

When the repeater is switched on, it will start its initialisation procedure, and information will be displayed on the terminal screen. Wait for 10-20 seconds and then press the 'Enter' key. This activates the AVITEC Login screen, which requests the Username and Password. Different user accounts may have different authorities. The default login parameters are

Username	Password	Authority
USERNAM1	PASSWRD1	Read/write
USERNAM2	PASSWRD2	Read/write
USERNAM3	PASSWRD3	Read only
USERNAM4	PASSWRD4	Read only

Type **USERNAM1** followed by Enter. Repeater now prompts for Password.

Type **PASSWRD1** followed by Enter. You are now logged in.

Type **STATUS** followed by Enter. This displays the current repeater settings and status.
(This screen can also be viewed by pressing F3.)

NOTE: Login activation may take several seconds if the control module is busy with a transmission or reception. The username and password should be changed during installation.

The control module logs the number of failed login attempts. If this count exceeds the user defined maximum (default = 8), then future login attempts are no longer allowed. The false login count value is decremented by one every hour. This means that it takes one hour after reaching the maximum number of failed login attempts, before a new attempt can be made.

6.3. Commands Necessary to Set up Remote Access

When the repeater is delivered, the back-up battery will be disconnected. The battery cable connector is found next to the GSM modem on the inside of the repeater door. Before starting with the set-up of the telephone, please connect the cables together. In the event of a power disruption this battery will supply the wireless interface and the control module with power. The battery is fully charged after the repeater has been connected to external power for 24 hours.

Configuring for DATACALL: Insert the SIM-card into the Wireless interface (Wavecom module) and enter the following four commands:

SET PIN xxxx	Where xxxx is the PIN code of the SIM card. NOTE: ensure the SIM card has a DATACALL number and is activated. If PIN-code is disabled, leave XXXX blank.
SET MTP Wavecom	Sets the modem type: Wavecom
SET ASC **SET MIS AT+CBST=0,0,3** **or** **SET MIS AT+CBST=7,0,3**	Clears any old telephone number the repeater calls on alarm Sets the modem initialisation string. Note! These strings work in most networks, but might have to be adjusted from network to network.
SET DEV DTC **ACT RCD** **LOGOUT**	Set up for datacall (modem) communication. Resets the communications device after next logout Exits the terminal mode

After entering the commands, logout by using the command **LOGOUT.** Make sure the modem has been successfully initialised by checking the display.

During this procedure the wireless interface will try to access the GSM network, which will only be possible if the repeater is connected to antennas. For lab tests with 50 Ω attenuators on repeater ports, it is possible to temporarily disconnect the wireless interface antenna cable SMA connector from the box and connect it to a small whip antenna.

It is now possible to log in to the repeater by dialling the DATA CALL number of the SIM card.

NOTE:

Do not try to enable the wireless interface for DATA CALL traffic if it has not registered any GSM radio signal. If an attempt to enable the wireless interface is done when a very weak GSM radio signal is detected, the communication between the repeater and the terminal will be extremely slow.

6.4. Commands used to set Parameters

The best method of adjusting RF parameters is by using the 'user-friendly' Repeater Maintenance Console software. One can also set RF parameters when in Terminal mode by using the following commands followed by the 'enter' key:

SET CHA 1 xxx 2 yyy	Sets repeater channel 1 to ARFCN xxx and channel 2 to ARFCN yyy
SET LNK 1 zzz 2 www	Sets channel 1 link ARFCN to zzz and channel 2 ARFCN www

It is also possible to set only one channel at a time, for example:

SET CHA 1 30
SET LNK 2 14

NOTE: Setting input frequency = output frequency is not recommended!
There should always be 3 guard channels or 800kHz from centre frequency to centre frequency.

SET ATD 1 xx 2 yy	Sets attenuation to xx in downlink channel 1 and yy in channel 2.
SET ATU 1 xx 2 yy	Sets attenuation to xx in uplink channel 1 and yy in channel 2

NOTE: Gain = Full gain - attenuation.

To shorten the command to only control one channel, see above.

SET LVU 1 xx 2 yy	Sets ALC Uplink to xx for channel 1 and yy for channel 2
SET LVD 1 xx 2 yy	Sets ALC Downlink to xx for channel 1 and yy for channel 2.

7. CSHP 902 Useful Information

7.1. Are calls possible on link frequencies?

Calls cannot be connected via the link frequencies for the following reasons.

The mobile station (MS) searches for the Broadcast Control Channel (BCCH) beamed from the Base Transceiver Station (BTS) Even though the MS may find the frequency shifted link signal BCCH transmission, it will not be possible to initiate a call through it.

When a call is initiated, the BTS switches from BCCH to the Stand Alone Control Channel (SDCCH), which (apart from other information) instructs the MS which frequency (ARFCN) to use during the call. This makes the MS switch back to the non-frequency shifted ARFCN (BTS frequency), where it will find no BTS signal and the call is aborted. The same is true when logging into the network.

NOTE: The BCCH, SDCCH, and TCH channels are logical GSM channels, not to be confused with Absolute Radio Frequency Channels (ARFCN). Only the latter are associated with specific frequencies.

7.2. Frequency Hopping and Repeaters

The CSHP902 repeater with two channels is fully compatible with base band frequency hopping, as long as only two frequencies are being used for hopping by the BTS, and the repeater is configured for exactly those two frequencies.

7.3. Coupler

The Donor unit must be connected to the BTS main antenna feed line through a -30 dB coupler. The coupler taps a tiny portion of the power from the BTS antenna cable and reduces it to a level compatible with the repeater input. This means that 30 dB has to be subtracted from Donor gain.

7.4. Antenna Isolation

Because the CSHP902 converts the carrier frequency used in the link, antenna isolation requirements are far less stringent than is the case with other kinds of repeaters. Avitec recommends a minimum of 75dB of isolation between the link and server antenna. When maximum output power levels are used this isolation requirement will mainly help to prevent blocking of the input stages.
When using the CSHP902 ER-R at least 10dB of isolation is recommended between the two serving antennas.

7.5. Minimum Channel Spacing

Avitec recommends a spacing of **four GSM channels** (0.8MHz) between the carriers in the two amplifier chains. Decreasing the spacing may lead to degraded performance.

7.6. Minimum Link Channel Spacing

Avitec recommends a spacing of **four GSM channels** (0.8MHz) between the centre frequencies in the two amplifier chains. Decreasing the spacing may lead to degraded performance.

7.7. Environmental Specification

Operating Temp. Range	-25 to + 55 ^{O}C
Storage Temp. Range	-30 to + 75 ^{O}C
Enclosure	Weather Resistance – IP 65

7.8. Other Specifications

MTBF	>50,000hrs
EMC	ETS 300 342-3
Electrical Safety	EN 60 950

8. Attenuation Control

8.1. Attenuation Control of the Donor Unit

Attenuation control tables for the different repeater models are found in **Section 12** of this manual. The attenuation can be adjusted in 2 dB steps on all models of the CSHP 902.

8.2. Attenuation Control of the Remote Unit

Attenuation control tables for the different repeater models are found in **Section 12** of this manual. The attenuation can be adjusted in 2 dB steps on all models of the CSHP 902.

9. Control Module

9.1. General

Both the Donor and the Remote units are equipped with a control module that allows the monitoring and control of various parameters such as channel number, attenuation, temperature, status of door, etc. The communication interface between the local terminal and the control module is set up as a self-explanatory menu for simple manual control and monitoring. This way, the parameters can be observed and changed from the display of the terminal.

This can be performed either via a terminal (PC) locally, or via remote login through the built in wireless interface located on the inside of the repeater door.

9.2. Commands

A complete set of commands can be found in the Command and Attribute Summary for the CSHP902 Repeater.

9.3. Command log

A command log, kept in the control module, stores the last ten commands entered. Use the up and down arrow keys to read off these stored commands. The right and left arrow keys may then be used, along with the backspace and clear buttons, to edit the command.

9.4. Quick commands

Four quick commands are available with the function keys when using the Terminal Mode:

F1:	help menu
F2:	shows a list with the last ten entered commands
F3:	status screen
F4:	traffic data.

9.5. Configuring the external alarms

The external alarms can be configured active-low or active-high.
Active high means that an applied voltage of between 12 and 24 Volts will cause the external alarm indicator to turn red.
Active low means that when there is no voltage the alarm indicator turns red.

Examples of Software Commands for the external alarms are shown below:
`SET EXT X Y Z W` (X is configuration of alarm 1 and Y of alarm 2 etc…)
If X is set to 1 and Y to 0 then alarm 1 is active low and alarm 2 is active high.

To set the delay before the alarm is activated the following command is used:
`SET ALA EX1 X Y Z LLL UUU TTT`
The letters represent digits. The delay in seconds takes the place of `TTT`.
e.g. `SET ALA EX1 0 1 0 030 030 002`. This indicates a delay of 2 seconds.
All software commands are described in the Command and Attribute Summary.

Further information on external alarms can be found in **section 13.2** of this document.

9.6. LED indicators

The multicoloured LED on the controller module indicates the following conditions.

Green	Repeater is functioning properly
Red	Repeater is not functioning properly
Amber	User logged in to control module.

NOTE: Depending on alarm configuration, the door alarm may go off a few seconds after the door has been opened; in this case, the LED will turn red.

10. System Maintenance

10.1. General

The system normally operates without any operator intervention or maintenance. In the unlikely event of a unit failure, the field replaceable components (antenna unit, cables, etc.) should be checked and replaced if faulty and the system restored. A failed unit can be removed and replaced with a spare while the rest of the system (other repeaters) is operating. However, the power supply of the failed repeater should be isolated from AC mains and DC power before any module is replaced. Should the system malfunction, the condition of the antenna systems as well as the continuity of the cabling should be checked before replacing any of the repeater modules.

10.2. Preventative Maintenance

The CSHP 902 repeater does not require any preventative maintenance.

11. Frequency and Channel List

GSM Ch	Uplink MHz	Downlink MHz	GSM Ch	Uplink MHz	Downlink MHz	GSM Ch	Uplink MHz	Downlink MHz	GSM Ch	Uplink MHz	Downlink MHz
1	890,20	935,20	32	896,40	941,40	63	902,60	947,60	94	908,80	953,80
2	890,40	935,40	33	896,60	941,60	64	902,80	947,80	95	909,00	954,00
3	890,60	935,60	34	896,80	941,80	65	903,00	948,00	96	909,20	954,20
4	890,80	935,80	35	897,00	942,00	66	903,20	948,20	97	909,40	954,40
5	891,00	936,00	36	897,20	942,20	67	903,40	948,40	98	909,60	954,60
6	891,20	936,20	37	897,40	942,40	68	903,60	948,60	99	909,80	954,80
7	891,40	936,40	38	897,60	942,60	69	903,80	948,80	100	910,00	955,00
8	891,60	936,60	39	897,80	942,80	70	904,00	949,00	101	910,20	955,20
9	891,80	936,80	40	898,00	943,00	71	904,20	949,20	102	910,40	955,40
10	892,00	937,00	41	898,20	943,20	72	904,40	949,40	103	910,60	955,60
11	892,20	937,20	42	898,40	943,40	73	904,60	949,60	104	910,80	955,80
12	892,40	937,40	43	898,60	943,60	74	904,80	949,80	105	911,00	956,00
13	892,60	937,60	44	898,80	943,80	75	905,00	950,00	106	911,20	956,20
14	892,80	937,80	45	899,00	944,00	76	905,20	950,20	107	911,40	956,40
15	893,00	938,00	46	899,20	944,20	77	905,40	950,40	108	911,60	956,60
16	893,20	938,20	47	899,40	944,40	78	905,60	950,60	109	911,80	956,80
17	893,40	938,40	48	899,60	944,60	79	905,80	950,80	110	912,00	957,00
18	893,60	938,60	49	899,80	944,80	80	906,00	951,00	111	912,20	957,20
19	893,80	938,80	50	900,00	945,00	81	906,20	951,20	112	912,40	957,40
20	894,00	939,00	51	900,20	945,20	82	906,40	951,40	113	912,60	957,60
21	894,20	939,20	52	900,40	945,40	83	906,60	951,60	114	912,80	957,80
22	894,40	939,40	53	900,60	945,60	84	906,80	951,80	115	913,00	958,00
23	894,60	939,60	54	900,80	945,80	85	907,00	952,00	116	913,20	958,20
24	894,80	939,80	55	901,00	946,00	86	907,20	952,20	117	913,40	958,40
25	895,00	940,00	56	901,20	946,20	87	907,40	952,40	118	913,60	958,60
26	895,20	940,20	57	901,40	946,40	88	907,60	952,60	119	913,80	958,80
27	895,40	940,40	58	901,60	946,60	89	907,80	952,80	120	914,00	959,00
28	895,60	940,60	59	901,80	946,80	90	908,00	953,00	121	914,20	959,20
29	895,80	940,80	60	902,00	947,00	91	908,20	953,20	122	914,40	959,40
30	896,00	941,00	61	902,20	947,20	92	908,40	953,40	123	914,60	959,60
31	896,20	941,20	62	902,40	947,40	93	908,60	953,60	124	914,80	959,80

12. Repeater Specifications:

The CSHP902 consists of two units. There are four different units available and these can be combined in

12.1. CSHP 902 SD

Electrical Specification - DONOR (SD)

		***Donor Unit (SD)**
Frequency range		UL 890.2 – 914.8 MHz DL 935.2 – 959.8 MHz
Impedance		50 Ω
Number of channels		2
Channel bandwidth		200 kHz
Output power UL		-10 dBm ± 1 dB
Output power DL		+ 33 dBm ± 1 dB
Maximum Input Level (no damage)		UL + 10 dBm DL + 23 dBm
Gain at Max. Setting		42 ± 1.5 dB
Gain Steps		2 ± 0.5 dB
Attenuation Range		30 ± 1 dB
Gain Variation Over Temp.		± 3 dB
Selectivity		> 35 dB @ 400 kHz > 70 dB @ 600 kHz
Flatness (200 kHz BW)		± 1 dB
Flatness (15 MHz BW)		± 1 dB
Oscillator Lock		1×10^{-9}
Noise Figure at Max Gain		DL N/A ,UL < 4 dB
Signal Delay		7.0 µs max
IM Products UL IM Products DL		< -70 dBm < -36 dBm
Spurious Emissions from RF Ports UL		< -70 dBm (< 1GHz) < -70 dBm (> 1GHz)
Spurious Emissions from RF Ports DL Return loss at RF ports		< -36 dBm (< 1GHz) < -30 dBm (> 1GHz) > 14dB

***NOTE:** All specifications are made without coupler connection.

Attenuation Control - DONOR (SD)

*Nominal Gain Setting (dB)	Attenuation (dB)
42	0
40	2
38	4
36	6
34	8
32	10
30	12
28	14
26	16
24	18
22	20
20	22
18	24
16	26
14	28
12	30

Electrical Specification Power Requirements – DONOR (SD)

	Donor Unit
Power Requirements	• standard voltage option, 230VAC ± 20% • low voltage option;-48 VDC
Power Cons. Idle mode	< 50 W
Power Con. Typical	80 W
Power Cons. Maximum	< 120 W

External Electrical Interfaces-DONOR (SD)

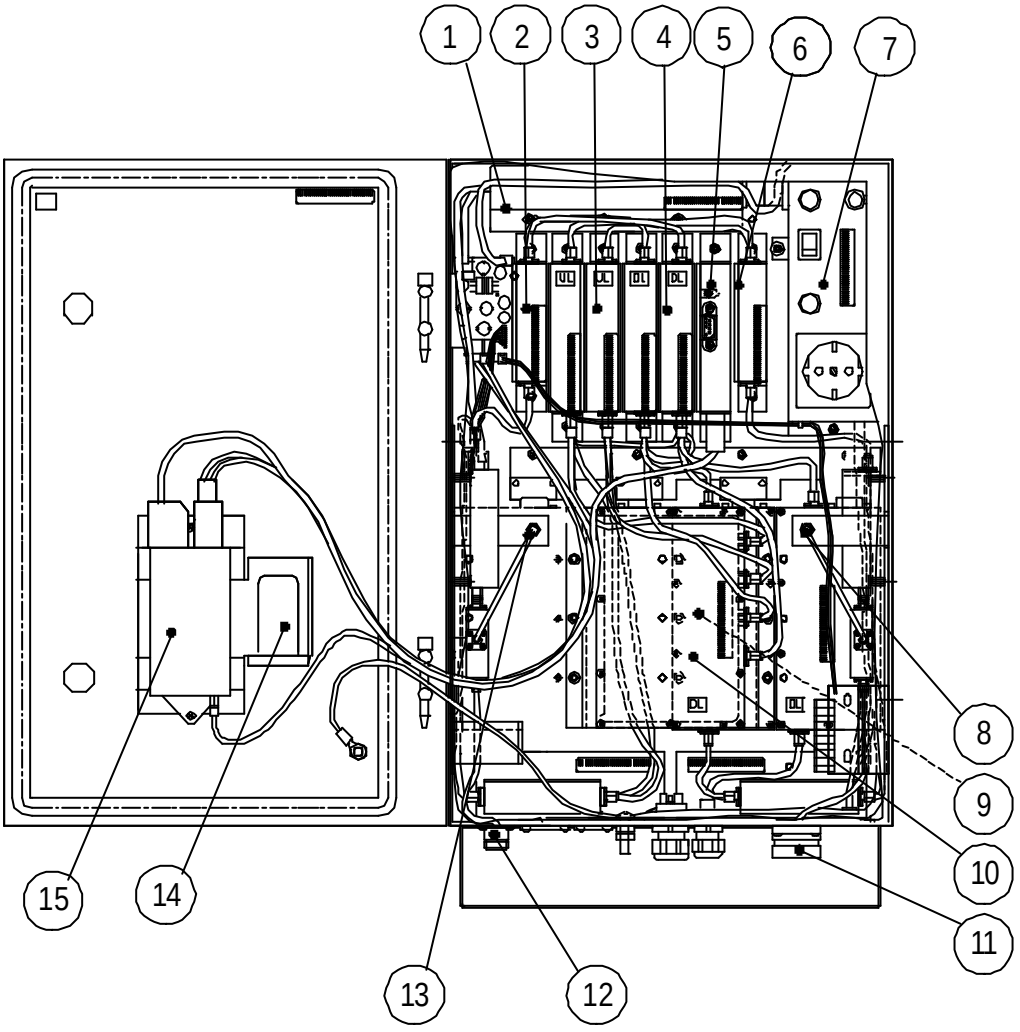
		Donor Unit (SD)
RF ports UL		N-type Female
RF ports DL		7/16 Female

Mechanical Specification-DONOR (SD)

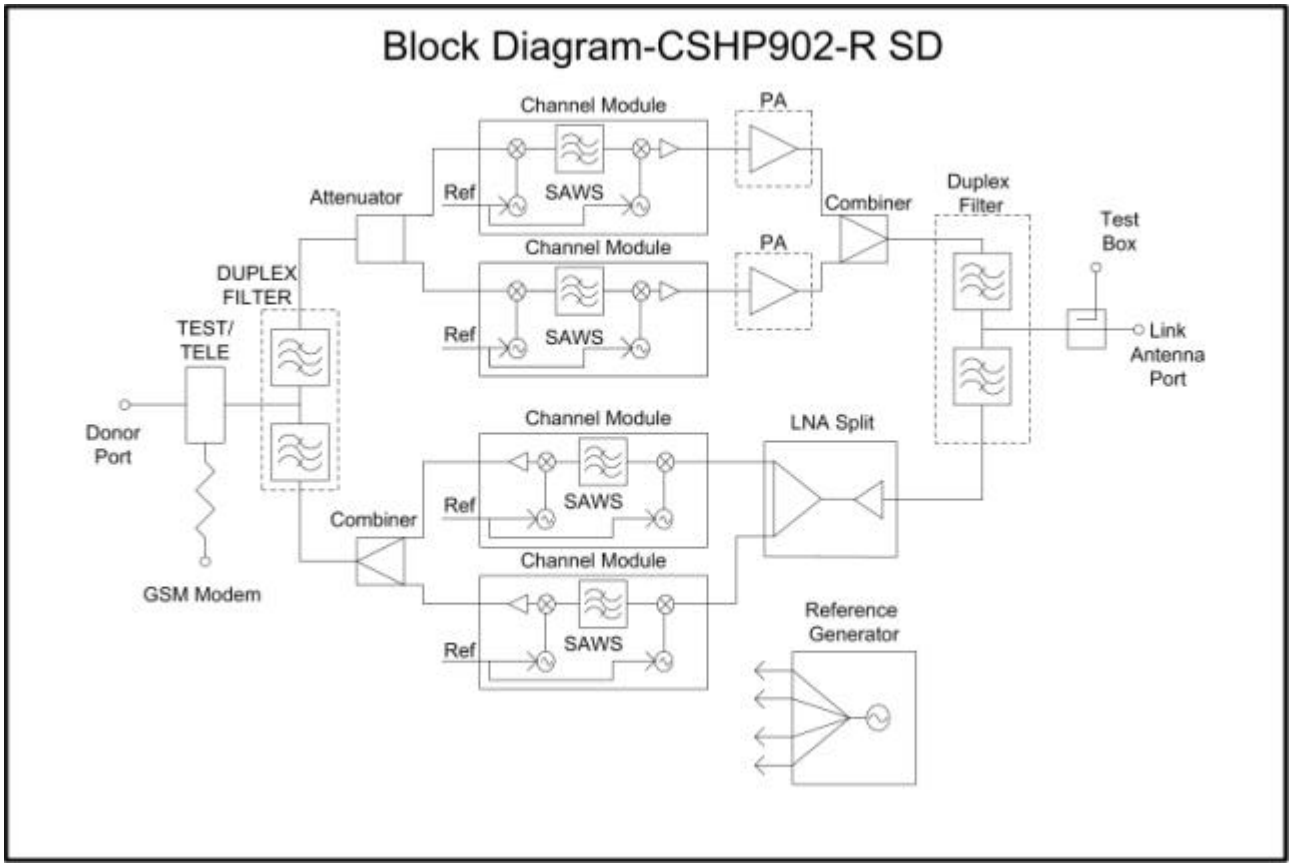
		Donor Unit
Dimensions (w x h x d)		12” x 18” x 9.5” 305 x 455 x 240 mm
Weight		22 kg max
Housing Material		Aluminium
Grounding Connection		Bolt
Housing Colour		Grey
Cooling		External Fins

Mechanical Drawing - DONOR (SD)

1)	DC/DC Power Supply	2)	Low Noise Amplifier DL
3)	UL Channelizer	4)	DL Channelizer
5)	Control Module	6)	Low Noise Amplifier UL
7)	AC/DC Power Supply	8)	RF test port
9)	Power Amplifiers	10)	Reference Generator
11)	7/16 Link antenna port	12)	TX 1&2 N-type female
13)	Tele box	14)	Battery Pack
15)	Wavecom Modem	16)	RX 1&2 N-type female



Repeater Block Diagram - DONOR (SD)



12.2. CSHP 902 DD

Electrical Specification RF – DONOR (DD)

		*Donor Unit (DD)
Frequency range		UL 890.2 – 914.8 MHz DL 935.2 – 959.8 MHz
Impedance		50 Ω
Number of channels		2
Channel bandwidth		200 kHz
Output power UL		-7 dBm ± 1 dB
Output power DL		+ 33 dBm ± 1 dB
Maximum Input Level (no damage)		UL + 10 dBm DL + 23 dBm
Gain at Max. Setting		45 ± 1.5 dB
Gain Steps		2 ± 0.5 dB
Attenuation Range		30 ± 1 dB
Gain Variation Over Temp.		± 3 dB
Selectivity		> 35 dB @ 400 kHz > 70 dB @ 600 kHz
Flatness (200 kHz BW)		± 1 dB
Flatness (15 MHz BW)		± 1 dB
Oscillator Lock		1×10^{-9}
Noise Figure at Max Gain		DL N/A ,UL < 4 dB
Signal Delay		7.0 µs max
IM Products UL IM Products DL		< -70 dBm < -36 dBm
Spurious Emissions from RF Ports UL		< -70 dBm (< 1GHz) < -70 dBm (> 1GHz)
Spurious Emissions from RF Ports DL Return loss at RF ports		< -36 dBm (< 1GHz) < -30 dBm (> 1GHz) > 14dB

***NOTE:** All specifications are made without coupler connection.

Attenuation Control - DONOR (DD)

*Nominal Gain Setting (dB)	Attenuation (dB)
42	0
40	2
38	4
36	6
34	8
32	10
30	12
28	14
26	16
24	18
22	20
20	22
18	24
16	26
14	28
12	30

Electrical Specification Power Requirements – DONOR (DD)

	Donor Unit
Power Requirements	• standard voltage option, 230VAC ± 20% • low voltage option;-48 VDC
Power Cons. Idle mode	< 50 W
Power Con. Typical	80 W
Power Cons. Maximum	< 120 W

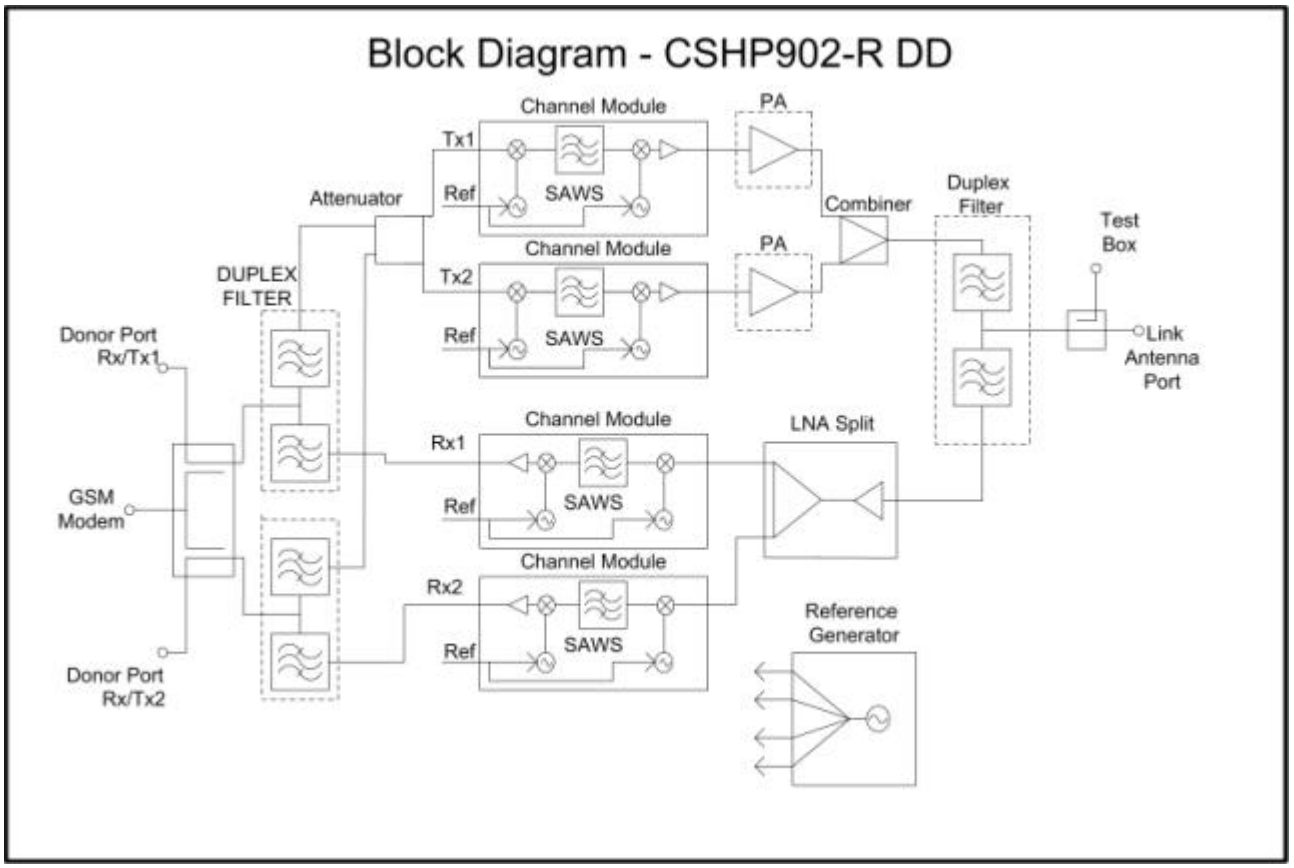
External Electrical Interfaces-DONOR (DD)

		Donor Unit (DD)
RF ports UL		(2x) N-type Female
RF ports DL		7/16 Female

Mechanical Specification –DONOR (DD)

		Donor Unit
Dimensions (w x h x d)		12” x 18” x 9.5” 305 x 455 x 240 mm
Weight		22 kg max
Housing Material		Aluminium
Grounding Connection		Bolt
Housing Colour		Grey
Cooling		External Fins

Repeater Block Diagram - DONOR (DD)



12.3. CSHP 902 IR

Electrical Specification - REMOTE (IR)

		Remote Unit (IR)
Frequency range		UL 890.2 – 914.8 MHz DL 935.2 – 959.8 MHz
Impedance		50 Ω
Number of channels		2
Channel bandwidth		200 kHz
Output power UL		+ 33 dBm ± 1 dB
Output power DL		+ 38 dBm ± 1 dB
Maximum Input Level (no damage)		+ 10 dBm
Gain at Max. Setting		102 ± 1.5 dB
Gain Steps		2 ± 0.5 dB
Attenuation Range		30 ± 1 dB
Gain Variation Over Temp.		± 3 dB
Selectivity		> 35 dB @ 400 kHz > 70 dB @ 600 kHz
Flatness (200 kHz BW)		± 1 dB
Flatness (15 MHz BW)		± 1 dB
Oscillator Lock		1×10^{-9}
Noise Figure at Max Gain		< 4 dB
Signal Delay		7.0 µs max
IM Products UL IM Products DL		< -36 dBm < -36 dBm
Spurious Emissions from RF Ports UL		< -36 dBm (< 1GHz) < -30 dBm (> 1GHz)
Spurious Emissions from RF Ports DL Return loss at RF ports		< -36 dBm (< 1GHz) < -30 dBm (> 1GHz) > 14dB

Attenuation Control - REMOTE (IR)

*Nominal Gain Setting (dB)	Attenuation (dB)
102	0
100	2
98	4
96	6
94	8
92	10
90	12
88	14
86	16
84	18
82	20
80	22
78	24
76	26
74	28
72	30

Electrical Specification Power Requirements – REMOTE (IR)

Power Requirements	**Remote Unit** • Standard voltage option, 230VAC ± 20% • low voltage option, -48 VDC
Power Cons. Idle mode	< 60 W
Power Con. Typical	110 W
Power Cons. Maximum	< 230 W

External Electrical Interfaces-REMOTE (IR)

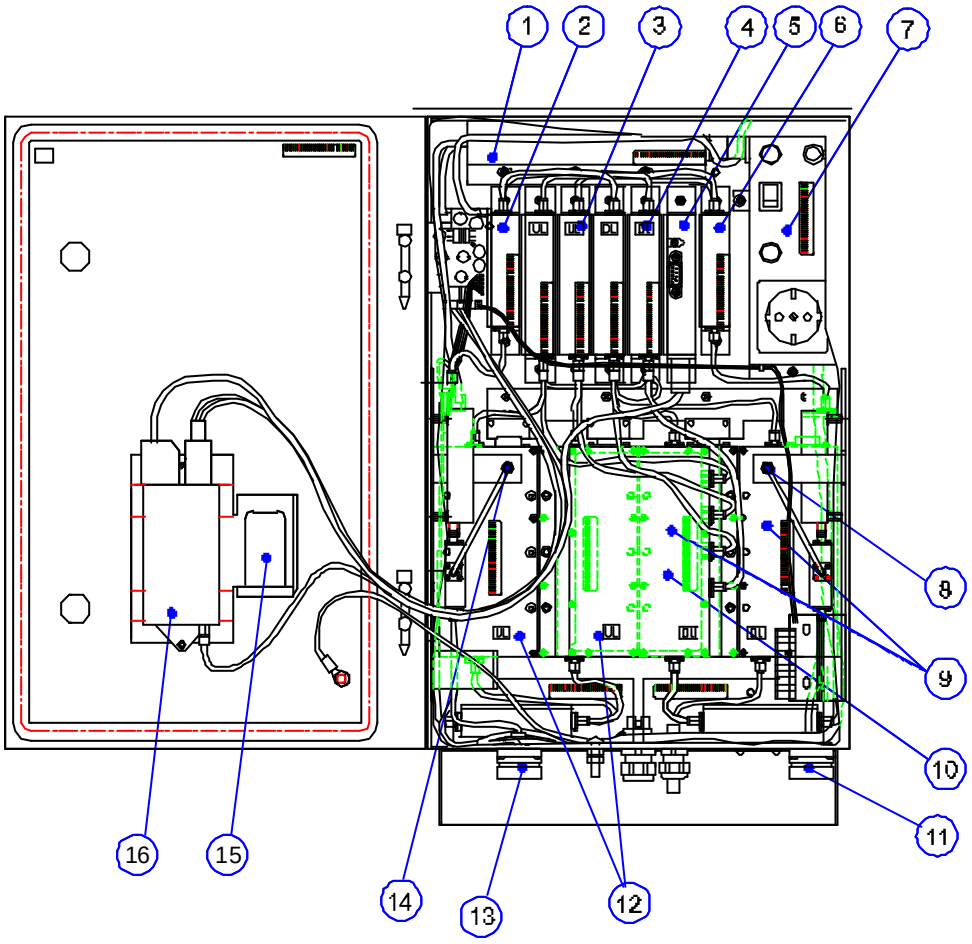
		Remote Unit (IR)
RF ports UL		7/16 Female
RF ports DL		7/16 Female

Mechanical Specification-REMOTE (IR)

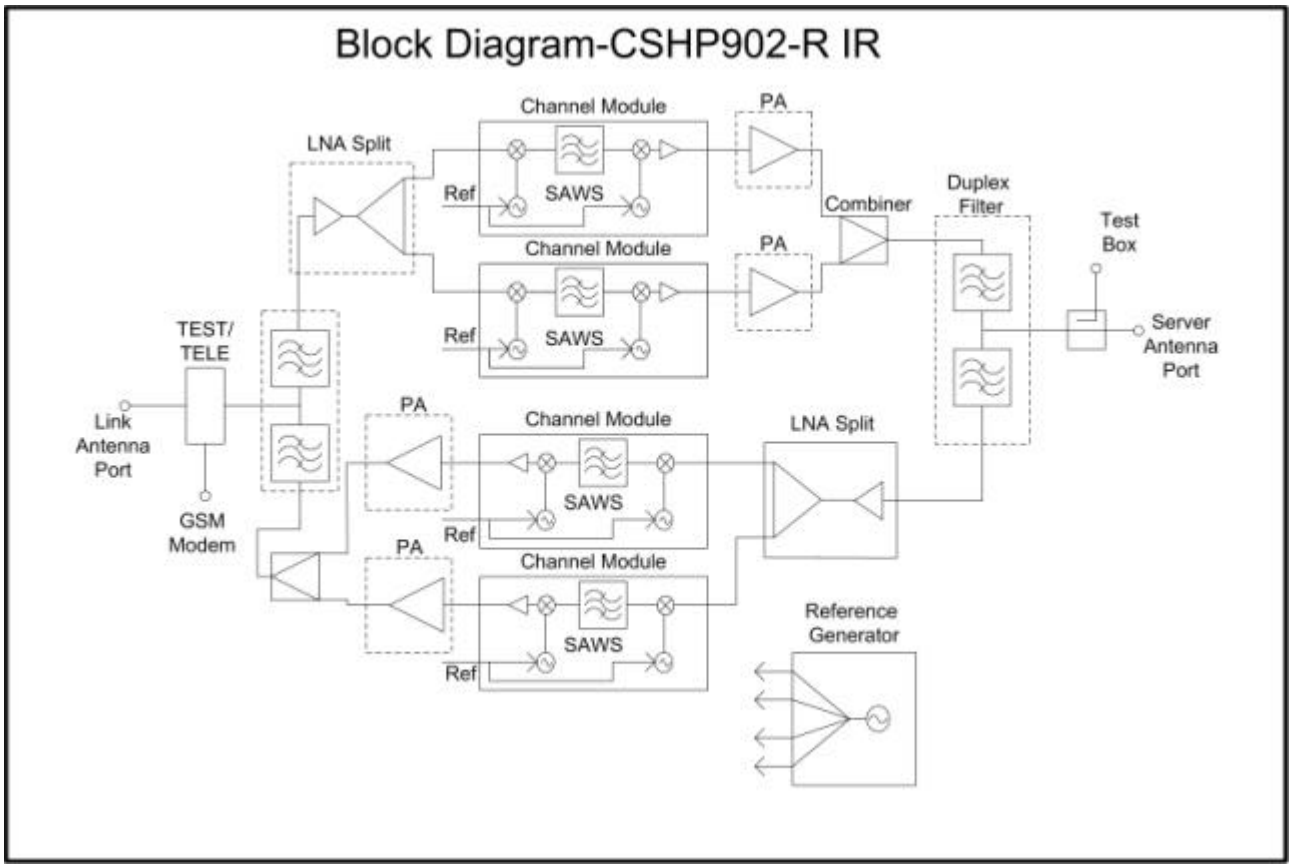
		Remote Unit
Dimensions (w x h x d)		12” x 18” x 9.5” 305 x 455 x 240 mm
Weight		25 kg max
Housing Material		Aluminium
Grounding Connection		Bolt
Housing Colour		Grey
Cooling		External Fins

Repeater Mechanical Drawing – REMOTE (IR)

1)	DC/DC Power Supply	2)	Low Noise Amplifier DL
3)	UL Channelizer	4)	DL Channelizer
5)	Control Module	6)	Low Noise Amplifier UL
7)	AC/DC Power Supply	8)	RF test port
9)	Power Amplifiers	10)	Reference Generator
11)	7/16 Serving antenna port	12)	Power Amplifiers
13)	7/16 Link antenna port	14)	RF test port
15)	Battery Pack	16)	Wavecom Modem



Repeater Block Diagram - REMOTE (IR)



12.4. CSHP 902 ER

Electrical Specification RF – REMOTE (ER)

		Remote Unit (ER)
Frequency range		UL 890.2 – 914.8 MHz DL 935.2 – 959.8 MHz
Impedance		50 Ω
Number of channels		2
Channel bandwidth		200 kHz
Output power UL		+ 33 dBm ± 1 dB
Output power DL		+ 41 dBm ± 1 dB
Maximum Input Level (no damage)		+ 10 dBm
Gain at Max. Setting		105 ± 1.5 dB
Gain Steps		2 ± 0.5 dB
Attenuation Range		30 ± 1 dB
Gain Variation Over Temp.		± 3 dB
Selectivity		> 35 dB @ 400 kHz > 70 dB @ 600 kHz
Flatness (200 kHz BW)		± 1 dB
Flatness (15 MHz BW)		± 1 dB
Oscillator Lock		1×10^{-9}
Noise Figure at Max Gain		< 4 dB
Signal Delay		7.0 µs max
IM Products UL IM Products DL		< -36 dBm < -36 dBm
Spurious Emissions from RF Ports UL		< -36 dBm (< 1GHz) < -30 dBm (> 1GHz)
Spurious Emissions from RF Ports DL Return loss at RF ports		< -36 dBm (< 1GHz) < -30 dBm (> 1GHz) > 14dB

***NOTE:** All specifications are made without coupler connection.

Attenuation Control - REMOTE (ER)*

*Nominal Gain Setting (dB)	Attenuation (dB)
105	0
103	2
101	4
99	6
97	8
95	10
93	12
91	14
89	16
87	18
85	20
83	22
81	24
79	26
77	28
75	30

Electrical Specification Power Requirements – REMOTE (ER)

Power Requirements	**Remote Unit** • Standard voltage option, 230VAC ± 20% • low voltage option;-48 VDC
Power Cons. Idle mode	< 60 W
Power Con. Typical	110 W
Power Cons. Maximum	< 230 W

External Electrical Interfaces –REMOTE (ER)

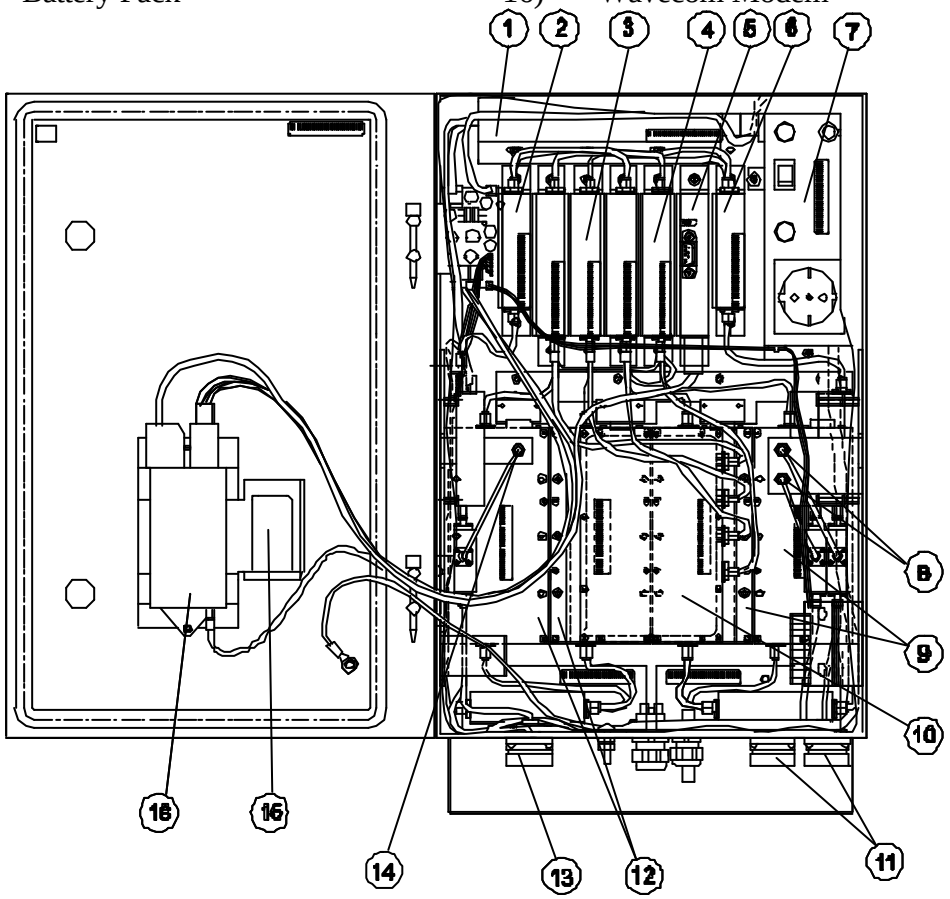
		Remote Unit (ER)
RF ports UL		7/16 Female
RF ports DL		7/16 Female

Mechanical Specification –REMOTE (ER)

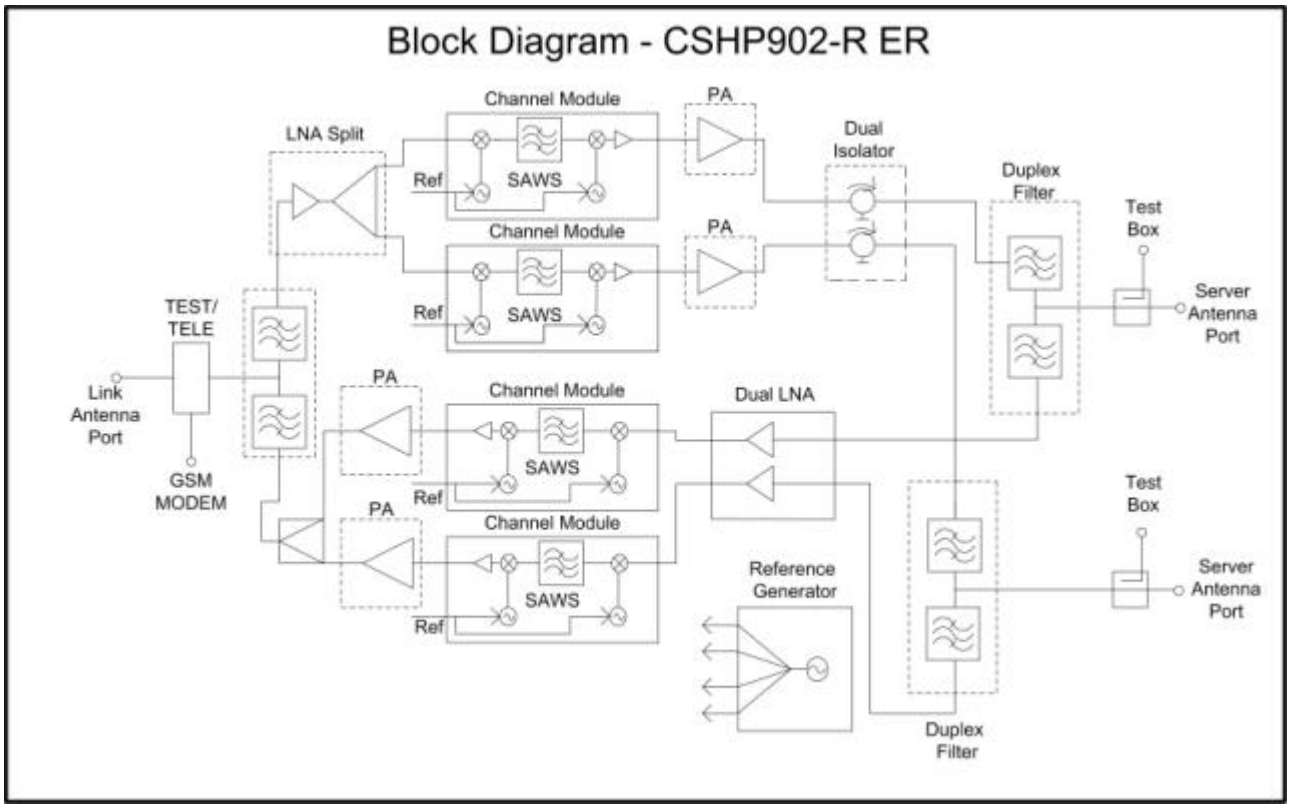
		Remote Unit
Dimensions (w x h x d)		12” x 18” x 9.5” 305 x 455 x 240 mm
Weight		25 kg max
Housing Material		Aluminium
Grounding Connection		Bolt
Housing Colour		Grey
Cooling		External Fins

Repeater Mechanical Drawing – REMOTE (ER)

1) DC/DC Power Supply
2) Low Noise Amplifier DL
3) UL Channelizer
4) DL Channelizer
5) Control Module
6) Low Noise Amplifier UL
7) AC/DC Power Supply
8) RF test port
9) Power Amplifiers
10) Reference Generator
11) 7/16 Serving antenna ports 12) Power Amplifiers
13) 7/16 Link antenna port
14) RF test port
15) Battery Pack
16) Wavecom Modem



Repeater Block Diagram - REMOTE (ER)



13. Installation Guide-CSHP902-SD/IR/DD/ER

A basic knowledge of repeater systems is recommended before starting an installation. We will therefore begin with a brief description of the products covered in this guide and explain in general terms how a frequency translating repeater system works.

Figure 1 illustrates a typical frequency translating repeater system.

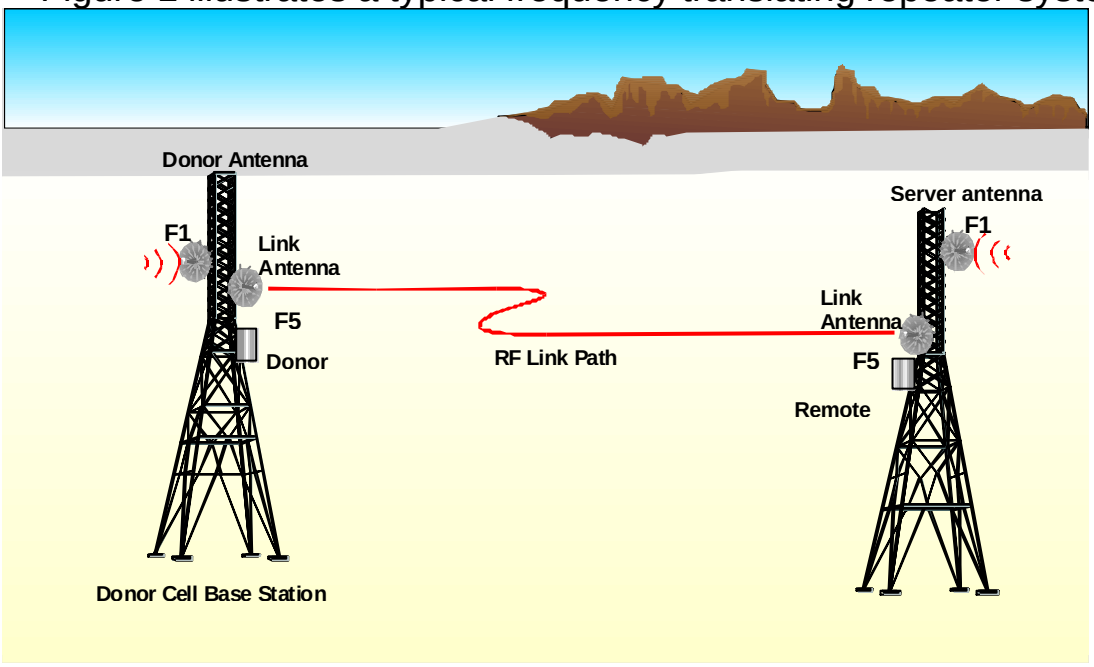


Figure 1.

The Frequency Translating Repeater

The frequency translating repeater system consists of two units, the donor unit and the remote unit. The donor unit is mounted at the BTS site and the remote unit is mounted at the remote site.
A bi-directional coupler is mounted in the main antenna feeder cable where the signal is tapped into the donor unit. This unit converts the applicable carrier frequencies into other designated carrier frequencies that are chosen in such a way that they will not interfere with the carrier frequencies used in nearby sectors. In the GSM system adjacent carriers should have a centre to centre 800kHz separation (3 guard channels). The donor unit is connected to a link antenna facing in the direction of the remote site.

The remote unit has a link antenna facing in the direction of the donor unit's link antenna.
This picks up the signal from the donor unit. The Remote unit converts the carrier frequency back to the original carrier frequency, amplifies and retransmits it to the mobile station. The same applies in the uplink direction.

The frequency translating repeater systems manufactured by Avitec have been designed for flexibility and ease of installation.

The various units can be combined in different ways depending on the goal to be achieved.

Avitec has four basic units available for the GSM 900 system. A system always consists of one donor unit and one remote unit.

- Single Donor (CSHP902-SD)
- Double Donor (CSHP902-DD)

- Internal Remote (CSHP902-IR)
- External Remote (CSHP902-ER)

The choice of donor and remote is application specific.

The most commonly used Donor is the CSHP902-SD. This is used when the signal is tapped from one antenna.
The CSHP902-DD is used in cases where signals from different source antennas are desired.

The remote unit CSHP902-IR has one server antenna and an internal combiner.

The remote unit CSHP902-ER has two server antenna outputs and no internal combiner.

Installation

To consider before installation

- What type of power does the repeater require?
    - Mains AC (230V) or –48VDC
- Is there adequate grounding and lightning protection (EMP)?
    - Earth cable should be Min. 16mm″
- Is there adequate antenna isolation?
- What kind of repeater system is being installed?
- Is there a clear line of sight between the Donor Unit's Link antenna and the Remote Repeater's Link antenna?
- Try to mount the repeater unit where it is easily accessible.
- It is important that the link antennas are aligned face to face.
- Make sure that cables and connectors are compatible. Using cables and connectors from the same manufacturer is one way of doing this.
- If the BTS has different sectors always choose to use the carriers used in the sector facing away from the remote site in order to avoid inter symbol interference. (ISI)
- A sealing compound such as silicone or vulcanizable tape should be used to waterproof all joins as moisture and dust can impair RF characteristics.

The BTS site

How the CSHP902-SD should be connected.(Donor Unit)

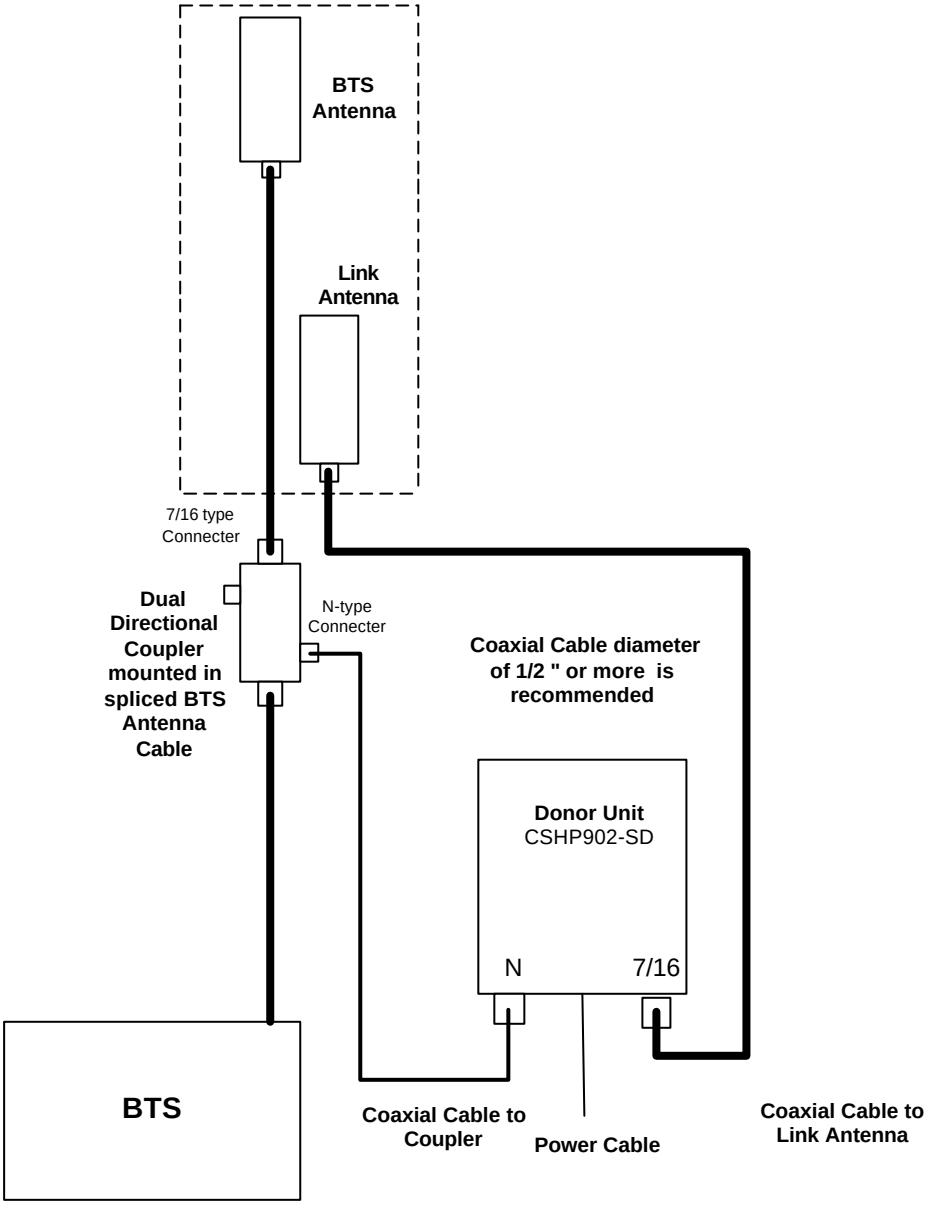


Figure 2

The Remote site

How the CSHP902-IR should be connected. (Remote Unit with internal combiner))

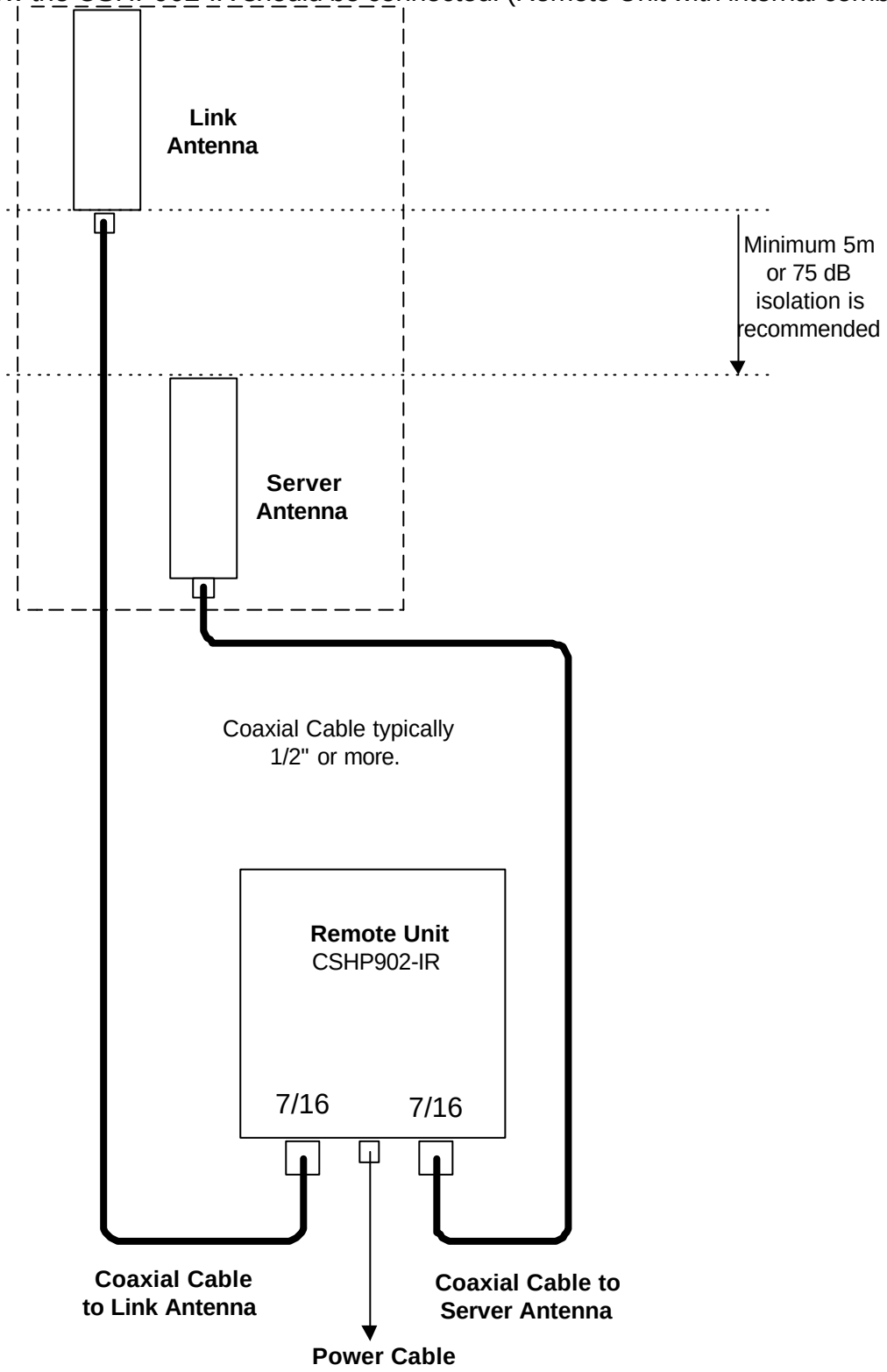


Figure 3.

The Frequency Translating Repeater System

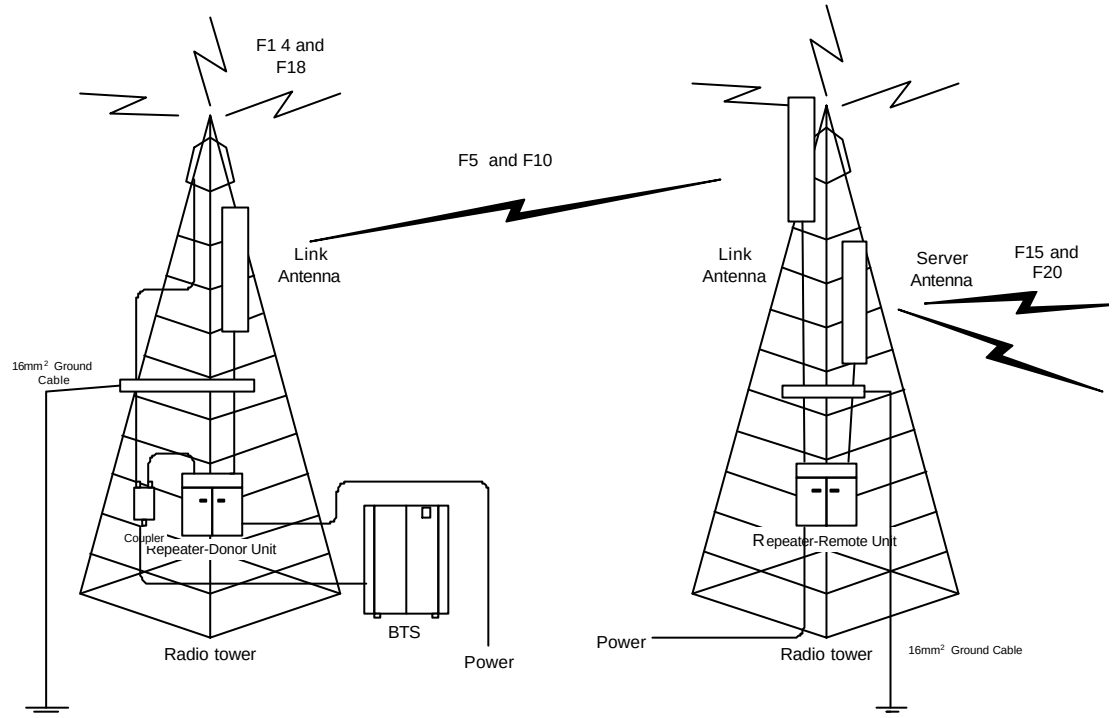


Figure 4

Figure 4 illustrates a basic frequency translating system. Channel separation, lightning protection and grounding are essentials in any reliable radio system.

- There should be a separation of at least 4carrier bands (800kHz) between the Link frequencies and the Broadcast Frequencies. In the Illustration Above the link carriers are F5 and F10 and the Broadcast Carrier Frequencies are F15 and F20
- Even though the Frequency Translating system reduces the need for Antenna separation it does not eliminate it. For this reason a vertical isolation of 75dB is recommended.
- It is important to remember that a whole sector must be used when installing a frequency translating repeater. EX. The base station sector using F15 and F20 is transmitted to the repeater. The base station sector used must have the same number of carriers as the repeater.
- Grounding and lightning Protection measures are also essential ingredients in the construction of a reliable repeater site. All cables should be fitted with suitable Lightning protection devices that should in turn be connected to an adequately dimensioned grounding cable. The minimum recommended conductive area for such a Cable is 16mm″.

How to connect the coupler at the donor/BTS site in a Frequency translating system

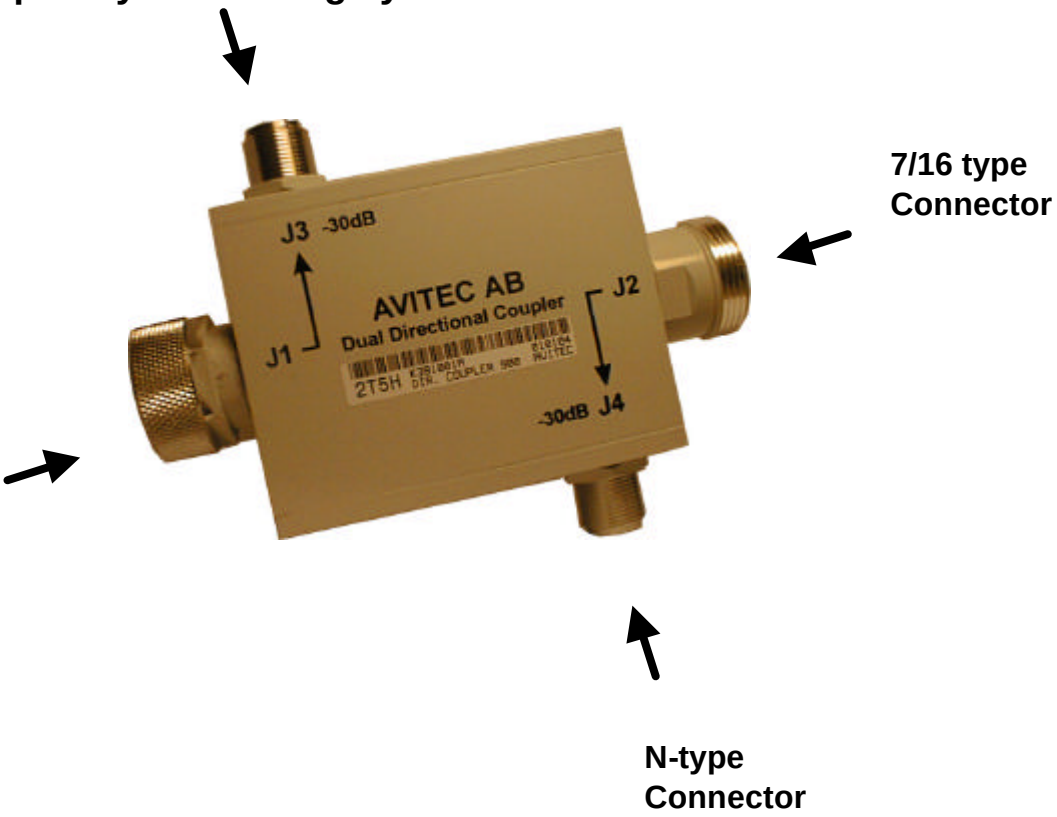


Figure 6.

Connectors **1** and **2** are for the cable from the BTS to the BTS antenna.
Connectors 3 or 4 are for the cable to the donor.

The donor must be connected to 3 if 1 is connected to the BTS and to 4 if 2 is connected to the BTS.

The N-Type connector not used shall be capped to prevent the ingression of dust and water.

3 and 4 are N-type connectors.
1 and 2 are 7/16 connectors.

All connections shall be waterproofed using silicone or other suitable substance.

It makes no difference which side is connected to the cable from the BTS as long as the cable feeding the donor unit is connected to the N-type connector closest to the BTS as described above.

The BTS site

How to connect the CSHP902-DD (Double Donor)

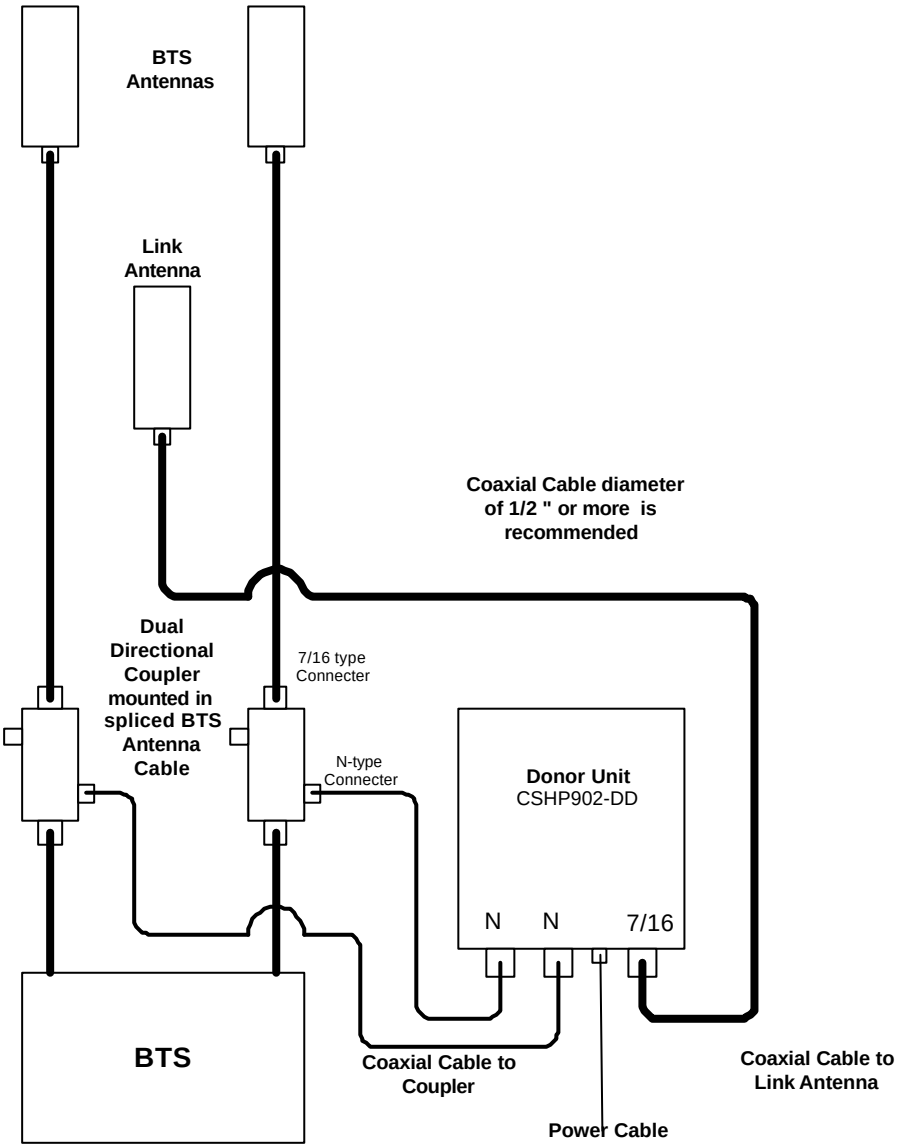


Figure 7.

The double donor configuration described in figure 7 can be wired in other ways depending on how the BTS is configured.

The Remote Site

Connecting the CSHP902-ER. This is a remote Unit with one antenna per channel. (A cross polarized antenna can also be used however maximum output power is achieved using two separate antennas.)

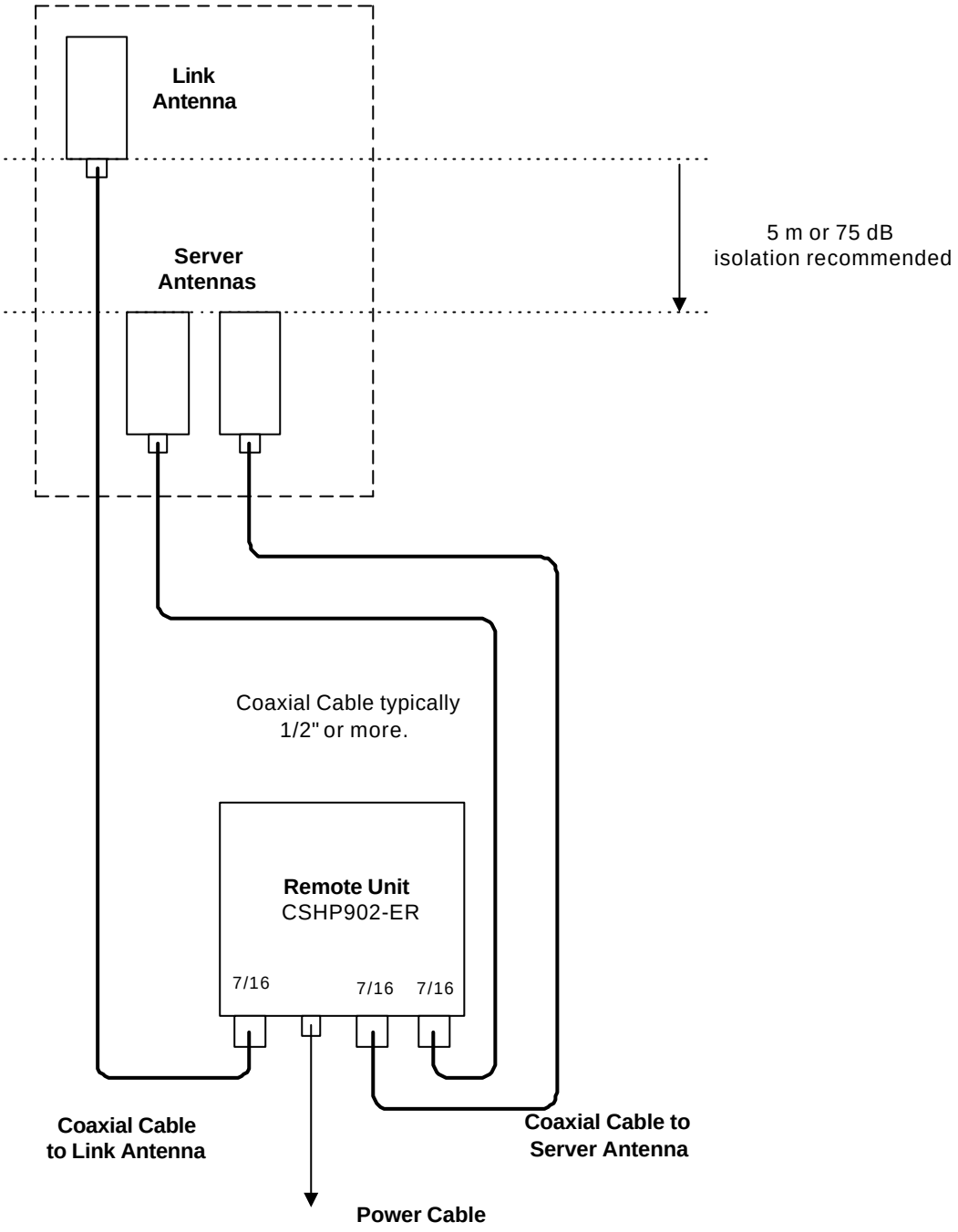
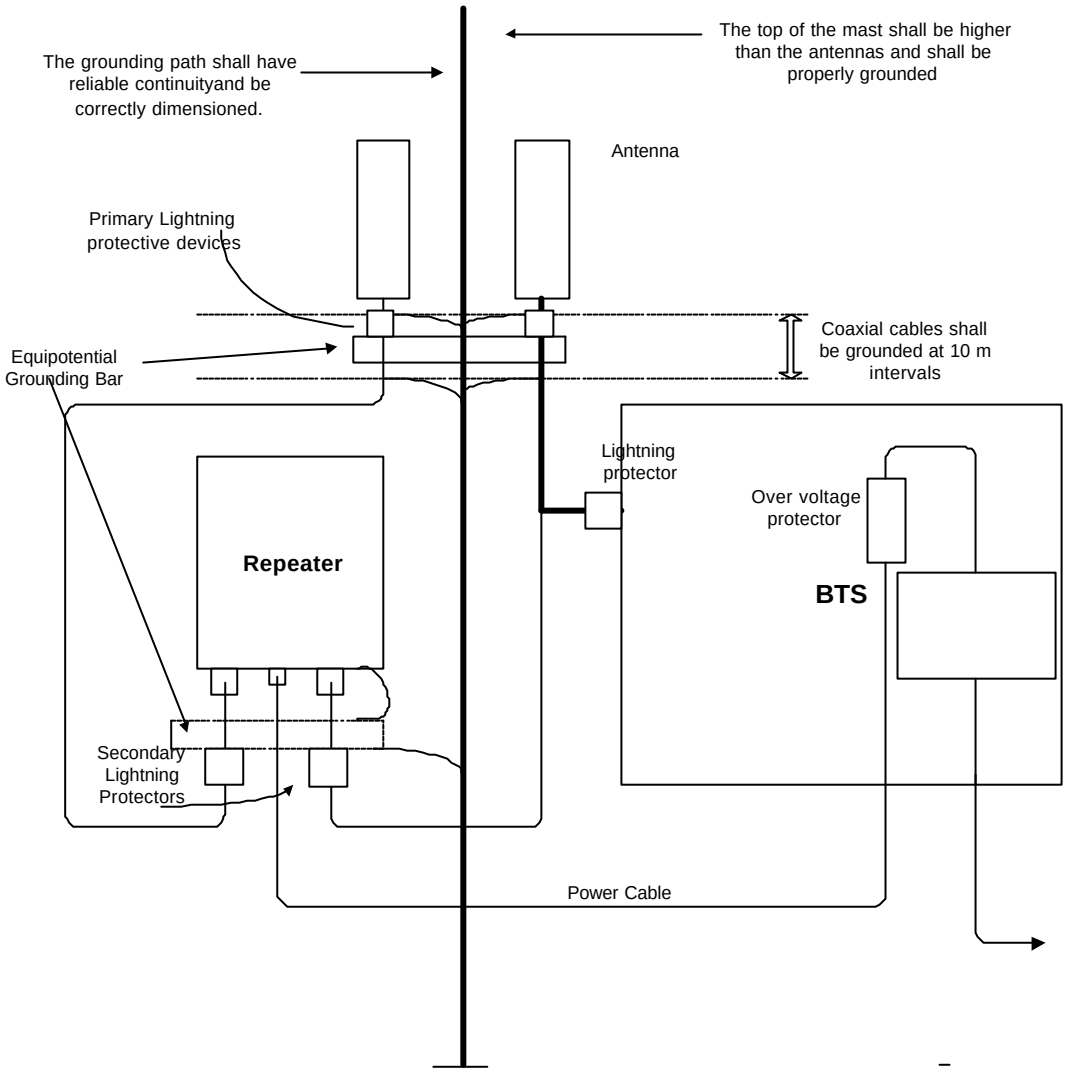


Figure 8.

13.1. Lightning Protection (EMP)



All coaxial cables and power cables need to be protected from the transients that lightning can cause.
If all the paths into the repeater and base station are protected with protective devices the chances of damage by lightning are reduced. Sometimes several lightning protection devices are used in series with declining threshold voltages. This helps attenuate the pulse component that makes it through the first layer of protection

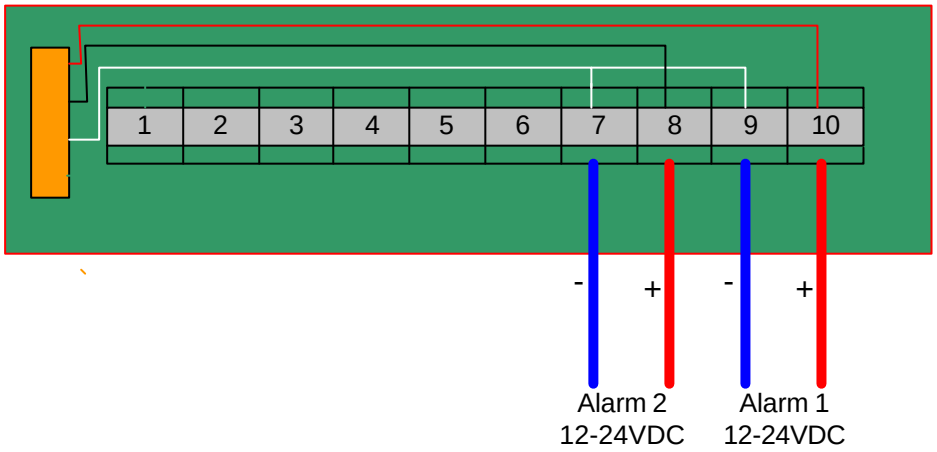
Note: If insufficient Electro Magnetic Protection is provided or if EMP measures are not taken warranties issued by Avitec are not valid.

13.2. Connecting the External Alarms

The alarm board is found in the bottom right hand corner of the repeater.
There is a pillar terminal mounted on a printed circuit board with wiring joining the circuit board to the distribution board.

The can be connected to two external alarm sources. These must have a voltage between 12 and 24VDC.
The presence or absence of this voltage will trigger the alarm depending on how alarm thresholds have been configured in the RMC or AEM.

Alarm 1 is connected to pillar terminals 9 and 10.
Alarm 2 is connected to pillar terminals 7 and 8.



Please refer to section 9.5 on how to configure the external alarms.

13.3. Getting the Repeater started

Once the repeaters, their antennas and cables have all been mounted and connected it is time to start testing the system. Avitec's Remote Maintenance Console (RMC) is an essential tool in this process.

In order to use the RMC you will need the following:

- A PC with operating system Windows 95/98, NT or better.
- The program in the form of diskettes or CD.
- A modem and telephone line or a suitable cable if direct connection to the repeater is desired.
- The Data Call number to the repeater.(Looks like a telephone number but is for data transfer only)

How the RMC is installed is explained in a separate instruction sheet available from Avitec.
Before the RMC can establish contact with the repeater the power must be switched on.
The default window in the RMC is BASICS. From this window most of the parameters can be set.

Measuring Antenna Isolation using the RMC

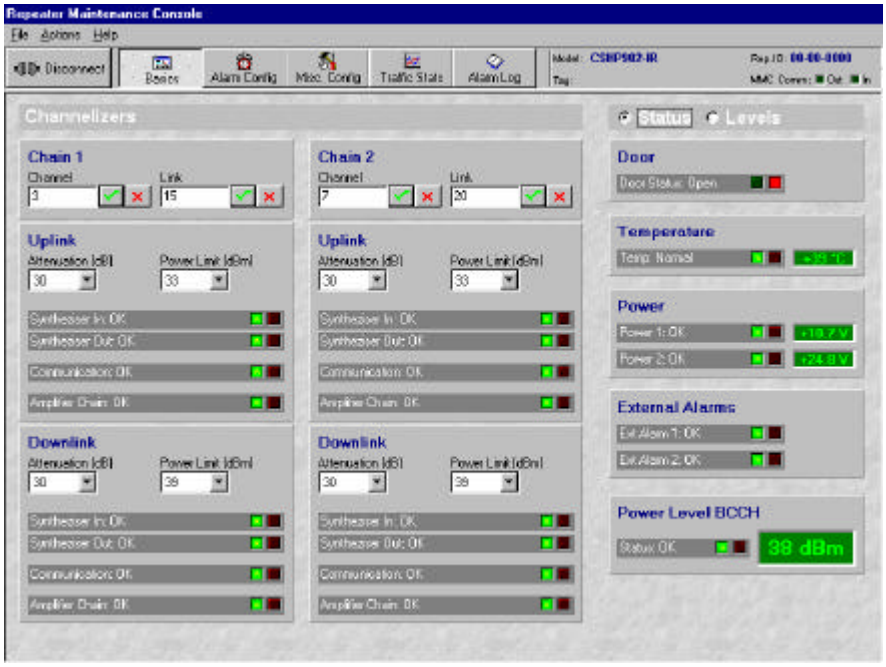
One of the unique features of the RMC is it's ability to measure the antenna isolation at the remote site.(Requires that the repeater has at least two channels)

In the example below we assume that the link carriers have been assigned frequencies F3 and F7. The broadcast carriers are for the purposes of this example F15 and F20.

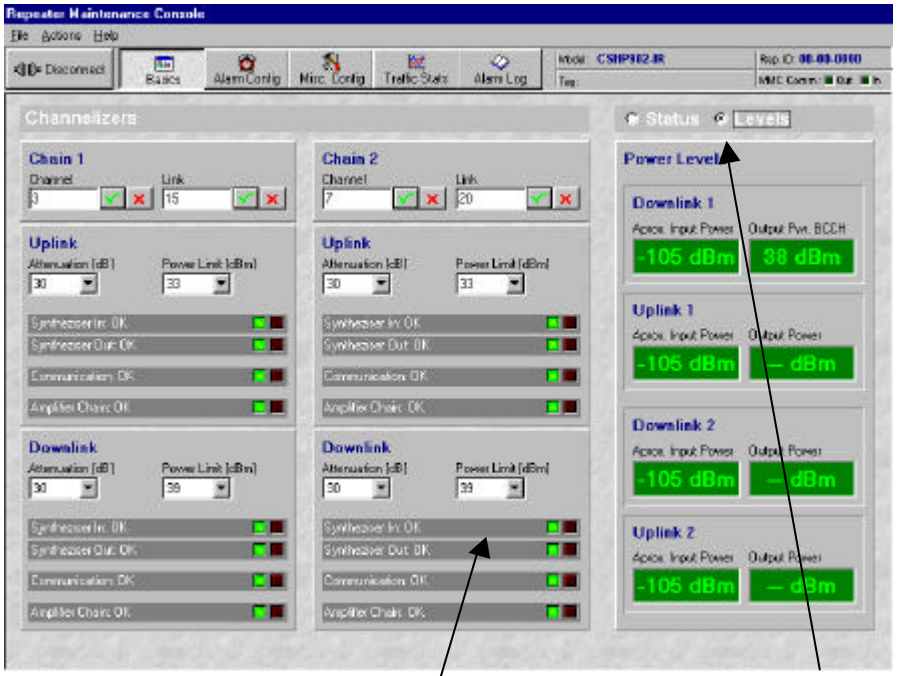
This is what you do:

- Make sure that the 'levels' frame on the right hand side of the basics window is displayed.
- The channel in chain 1 must always contain the BCCH.
- The link signal gain should not be set higher than necessary.
- Set the parameters for the channel in chain 1 to F15 and in the link field to F3.
- Before setting chain 2 set the Power Limit in chain 2 to **' OFF '.**
- In Chain 2 set the link field to F15 (This means that the frequency transmitted by the server antenna is the same as the frequency being picked up by the link antenna)
- Look at the power levels on the right side of your screen. Note the Downlink 1 output power and Downlink 2 input power. The antenna isolation can now be calculated using the following formula:
  Output Power BCCH – (Input Power(Downlink 2))=Isolation

Screen Dumps from the RMC

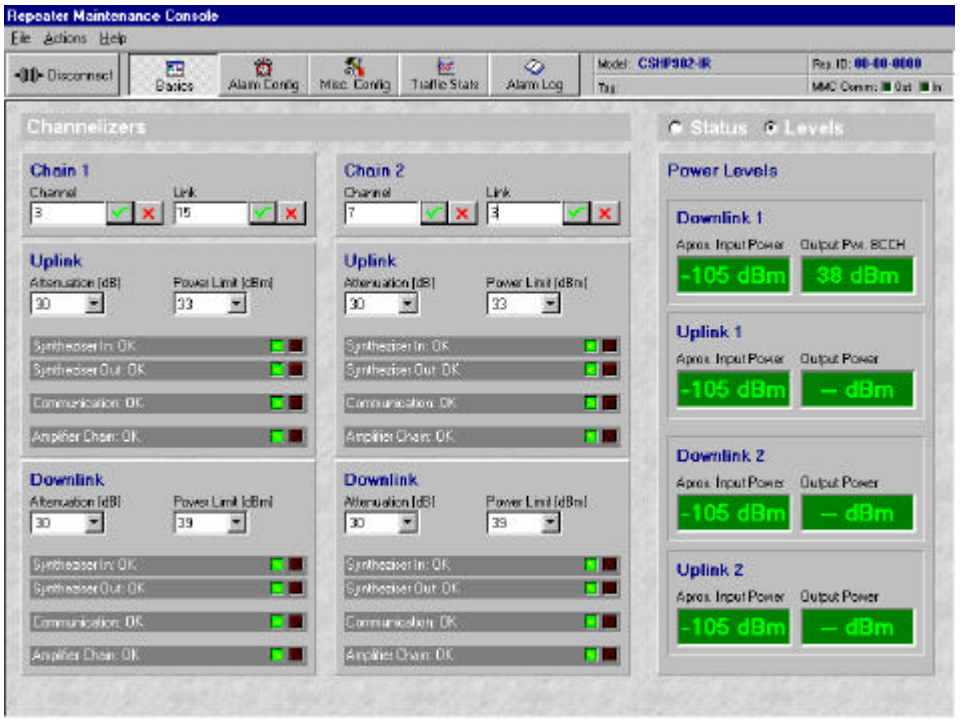


The channel and link fields have been filled in with carrier numbers 3, 15 (chain 1) and 7, 20 (chain 2)

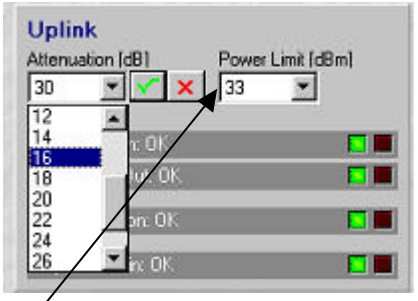


In order to view power levels it is necessary to click on ‘levels’

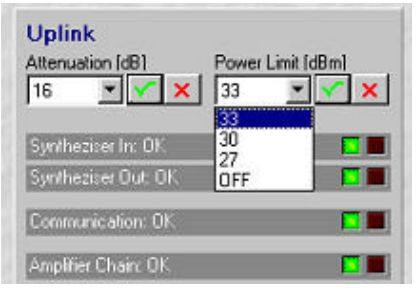
Choose **OFF** when measuring antenna isolation.



In the screen dump above the link carrier number in Chain 2 has been changed to carrier 3. The repeater will pick up the server antenna signal via the link antenna. The antenna isolation is the difference between 1 and 2. In this case 38-(-105) = 143dB (This is far more than the required 75dB which means that the antenna isolation is good)



Attenuation menu



Power Limit menu

Be sure to click on the tick once a change has been made! This is to confirm the change.

When commissioning a repeater for the first time it is important to set the attenuation levels at a maximum and then slowly reduce them until the desired signal strength is reached (start with 30 and lower this figure to raise the output power).
Zero attenuation is the same as maximum amplification.
Attenuation tables are available in the manual supplied with the product.

The power limit menu limits the output power to the figure chosen or the channel can be switched off completely by clicking on **off.** The downlink Power Limit in chain 2 shall always be switched off when measuring antenna isolation.