GZF9183-V

GSM Frequency Shifting Repeater

User's Manual

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Preface

GZF9183-V Frequency Shifting Repeater of GSM Mobile Communication is an important part for constructing a hybrid GSM mobile communication network. It mainly serves to receive and amplify uplink and downlink radio frequency (RF) signals so as to extend the coverage of BTS.

This Technical Manual deals with the principles, functions, structure, installation, debugging, operation, maintenance, and transport etc of the GZF9183-V Frequency Shifting Repeater and is intended to guide users to properly install, operate and maintain the GZF9183-V Frequency Shifting Repeater.

Statement: The actual product may differ from what is described in this manual due to frequent update of WRI Hongxin products and fast development of technologies in the future. Please contact the local WRI Hongxin office for the latest updating information of the product.

Notice:

1 Based on users' need, the actual working frequency of WRI repeater is to be customized. In this manual, we provide the repeater with frequency 935-960MHz for downlink and 890-915MHz for uplink.

2 Based on users' need, the power supply AC input voltage value provided by WRI is to be customized, either. In this manual, we provide repeater with 220V/50Hz AC or 48V DC power supply; in fact, 110V/60Hz AC power supply is also optional.

3 Based on the users' need, the output power of both downlink and uplink is to be customized, and the output power range is from 0.5W to 10W for uplink and from 2W to 40W for downlink.

4 Based on user's need, the way for band selecting is to be customized, broadband, band selecting or channel selecting is optional. In this manual, we provide repeater with channel selecting.

5 About GZF9183-V, here "900" stands for working frequency, "3" stands for country code named by Hongxin, and "V" stands for repeater type.

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1. System Overview

1.1 Overview

In GSM mobile communication system, limited by the coverage of base station or by geographic environment, the transmission of signals may be influenced by shadow or semi-shadow in some areas, generally referred to as dead zone or semi-dead zone, bringing serious impact on voice quality or even causing failure to normal communication. To solve this problem, apart from adding more base stations, the deployment of mobile communication repeater, characterized by quick expansion of coverage and reduction of cost, shall be an ideal cost-effective choice of high efficiency.

Frequency Shifting Repeater of mobile communications is an important tool to expand network coverage, reduce network cost and realize network optimization. Frequency Shifting Repeater of GSM mobile communications is meant to amplify communication signal, extend network coverage, to improve communication quality by amplifying some weak received signals and expanding the signal coverage and to distribute traffic load in various base stations with efficiency. In the course of network optimization, Frequency Shifting Repeater of GSM mobile communications offers a wide variety of application. In some areas, such as satellite cities of some large cities, remote residential areas, countries and towns or other dead zones or shadow areas formed due to the natural or human obstacles (such as high mountains, large buildings, tunnels or underground stores), Frequency Shifting Repeater of GSM mobile communications shall be the most economical and reasonable solution to the effective coverage

of these networks since these areas are demanding a greater coverage rather than capacity. Frequency Shifting Repeater of GSM mobile communications is cheap with easy installation. It will greatly reduce the investment in equipments and running cost to expand the network by Frequency Shifting Repeater.

GZF9183-V Frequency Shifting Repeater provides operators with multiple solutions that can save the investment in equipments and running maintenance cost without lowering the network quality. As a supplement to GSM base stations, in the areas with some dead zones, the coverage of GSM network can be easily expanded to the dead zones that need covering to solve the problem of coverage.

By using GZF9183-V Frequency Shifting Repeater of mobile communications of excellent performances manufactured by Wuhan Hongxin Telecommunication Technologies Co., Ltd, the surplus capacity of networks can be re-planned or re-arranged so that the resources of networks will be used to their maximum. The application of GZF9183-V repeater shall attract more traffic load with its short cycles, immediate returned profits, easy installation and savings of network resources and expand the network coverage with low cost to make up for the insufficient coverage of system base station. It is a good solution to optimize network with Frequency Shifting Repeater in networks.

In some areas with tough conditions, Frequency Shifting Repeater of mobile communications is characterized by its strong adaptability, quick construction and high sound quality. It can cover the entire coverage area. GZF9183-V Frequency Shifting Repeater of mobile communications can solve the problem remote areas, highways, railways and airport. In the areas where the frequency of the base

station is not used, the extra communication capacity can be transmitted to other areas so that equipment shall be fully used.

1.2 Scope of Application of the Equipment

Applicable to airport, stations, mountain area, railway lines, holiday village, tourist areas, large-scale industry and mining enterprises, remote residential areas, countryside and dead zones and shadow areas of mobile communication. Especially it is important for the area where the wireless signal environment is very complex and putting the optical fiber is very difficult.

1.3 Major Features of the Equipment

1. Use filter with high selectivity and low insertion-loss and multi-grade filter technology to enhance the isolation between uplink and downlink.
2. No interference to the base station and other radio equipments with low noise for the system, proper linearity and high power.
3. Ensure normal working of the repeater under tough environment with automatic level control (ALC) function.
4. Unique wireless digital transmission and remote monitoring system with various ways of monitoring and convenience for network maintenance.
5. Modularized design facilitates assembly and maintenance.
6. Equipped with perfect network management system and friendly operation interface as well highly reliable operation and failure treatment capability.
7. When monitoring center has not been established, technicians can

monitor, set, modify the parameters of all the modules of GSM repeaters and easily collect equipment warning information via local PC. Once the repeater fails, OMC can immediately send warning information to designated mobile stations or phones at will.

8. When monitoring center has been established, technicians can monitor and control repeaters by OMC software in monitoring center for optimize parameters and upgrade software according to the actual situation of network. It will facilitate the monitoring of the working of Frequency Shifting Repeater of GSM mobile communication. See Repeater OMC Operation Instructions of WRI Hongxin Co., Ltd (attached separately) for detailed operation information.

1.4 Basic Principle

GZF9183-V Frequency Shifting Repeater is one of WRI Hongxin series repeaters.

The style of network grouping of GSM Frequency Shifting Repeater is flexible and in variety according to the real situation. The basic ways are as follows:

Using such a repeater, the local repeater will receive the coupled signal by cable or RF signal by air from Base Station service antenna, and the received signal will be sent into filter to clear out the useless signal. Then the signal will be shifted to the other frequency and amplified to the signal with the same frequency and high power, the power range is from

1W to 30W based on the type of High Power Amplifier (HPA). Then the link antenna will send the signal to the remote unit. The remote unit will shift the signal back to the original frequency and amplify it. By the service antenna of remote repeater, the amplified RF signal will be used to covering the dead zones. Just as the figure 1.1 shown.

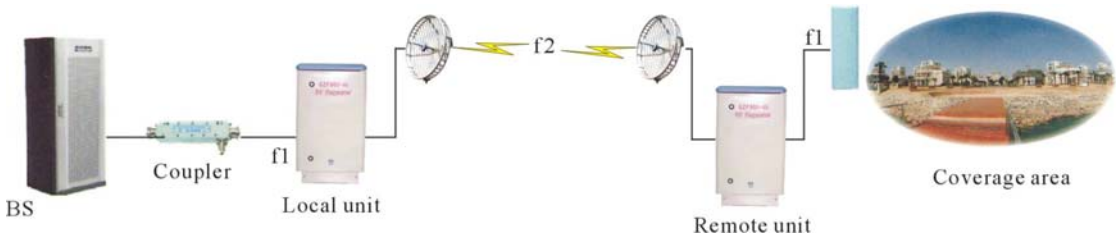
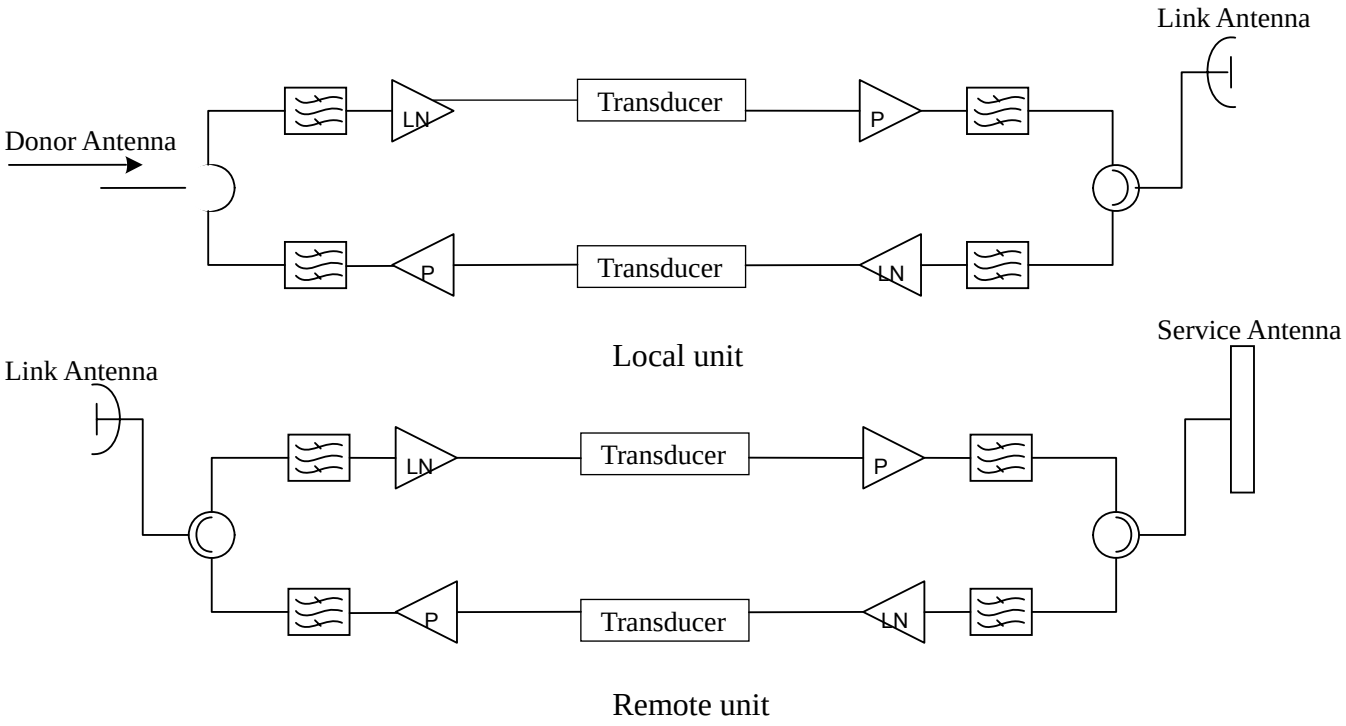


figure 1.1: The basic principle of Frequency Shifting Repeater

2. Working Principle & Technical Indices

2.1 Working Principle

The radio signal is introduced to repeater by its donor antenna from the BTS. In the downlink, the TX signal from BTS is isolated from uplink in the duplexer, and sent to DET. In the duplexer connected with donor antenna, part of signal coupled in 50dB will be used by wireless modem. Then the downlink signal will be sent to the LNA to be amplified, with which the noise figure is still low. After that, the signal will be filtrated by IF filter which has very high Q value. At last, it will be amplified again by the high power amplifier(HPA). After such a progress, the power of the signal will reach 1W to 30W depending on the type of HPA. In the uplink, the progress of amplifying signal is very similar to the downlink, just in different frequency. From the input of donor antenna to the output of service antenna, the gain of repeater system will usually be 90dB. The gain of LNA is about 55-60dB, and the gain of HPA is about 50-55 dB. Total gain of repeater system can be modified by setting the value of the digital attenuators(ATT) located in the LNA and HPA. The dynamic range of ATT is more than 60dB.



2.2 Product Features

1. **Excellent RF indices:** Based on her insight into GSM system, WRI Hongxin has incorporated the GZF9183-V Repeater as a part of the GSM mobile communications system in designing the system indices of the product to make sure that the RF links are transparent and unblocked for adequate absorption of traffic. And ensure the excellent performance of the RF links though proper allocation of the indices of the RF parts and the powerful optimization capability of the RF system. And also make the integrated system have excellent GSM parameter features through analysis, careful designing and strict control of such key parameters as noise characteristics, uplink/downlink transmitting power, coverage range, uplink and downlink balance, out-of-band suppression, and group time delay. What's more, a number of technologies have obtained patents in China.
2. **Module design:** Module design is the development trend of system

design and makes it easier for upgrading and maintenance. To meet market demands, WRI Hongxin has developed a flexible and effective series repeater module system through meticulous system certification, unit analysis, rational division of modules and proper index analysis, thus paving the way for the flexible arrangement of multiple types of machines.

3. **Interior monitor and control (M&C):** The interior M&C module of the GZF9183-V Repeater is the control core of the whole repeater and implements four functions: detection, control, communication, and alarming. The standby battery on the M&C board maintains the normal running of the system in case of power-off and sends a power-off alarm to the OMC center, and supports, monitors or resets wireless Modem; the LED, indicator and MIC switch interface provide onsite maintenance without tools; and the serial interface of the portable computer is connected directly to the system to provide a more convenient local M&C means.

4. **Structure:** The integrated system is made of aluminum alloy and its surface is treated with advanced technique to ensure excellent EMC performance and anti-corrosion performance; the integrated GZF9183-V repeater is tightly sealed so that its anti-rainfall strength is up to 3mm/min (GB4785-84) and its anti-splash strength is up to 3m/s (water speed); water-tight rubber spacers (service life: 10 years) are used between the bottom housing and the top cover, the leakage rate is 1.0Pa cm^2/s (GB2423.23 submersion method), the dust preventing capability is up to $10mg/m^3$ particles (floating) and $3.0mg/m^3$ particles (falling) (GB4795-84). To prevent local temperature rise of the housing resulting from direct sunshine in summer, the repeater is designed with an integrated sun shield and with the latest patent coating technique.

5. **Reliability:** Industrial-level components are used, which can sustain a temperature range of -40°C ~ +85°C so that the product can work reliably in a wide range of environments; the power supply of the integrated system is designed with high redundancy to make sure that the power module can work under normal load in 75°C and start normally in -35°C; the repeater is provided with multi-level lightning protection devices to ensure reliable lightning

protection for the power supply, antenna and feeder. The lightning protection device of the power supply is a combination of a gas discharge tube and a piezo-resistor and is designed with 2-level protection, so that it can absorb very high lightning strike energy as well as remove residual voltage satisfactorily. The MTBF of the integrated system is not shorter than 60000 hours, the MTTR of the integrated system is shorter than 30 minutes, and the maintenance guarantee time is shorter than 24 hours. The service life of the product is at least 10 years.

2.3 Technical Indices

2.3.1 Major Technical Indexes

Item	Standard value	
	Uplink	Downlink
Work frequency band	890~915MHz	935~960MHz
Maximum output power (to be customized)	36 dBm	43 dBm
Duplex spacing	45MHz	45MHz
Channel spacing	200KHz	200KHz
Number of channels	4	4
Gain (max variation -25 to +55C)	<5db	<5db
Group time delay	≤ 6 μs	≤ 6 μs
Group delay variation within any ± 100KHz	<200ns	<200ns
Noise Figure	≤ 4 dB	≤ 4 dB
VSWR	≤ 1.5	≤ 1.5
Gain adjustment range	45 dB ~ 105 dB	45 dB ~ 105 dB
Gain adjustment step	1dB	1dB

Table 2-3-1 Major technical indices of the GZF9183-V Repeater

2.3.2 Ambient Environment Condition

Ambient temperature: -25°C ~ +55°C
Storage temperature: -40°C ~ +85°C
Relative humidity: ≤ 95%
Air Pressure: 70 106kPa

2.3.3 Power Supply Requirements

Power Supply: 220V AC/50Hz or 48V DC
Allowed fluctuation range of voltage: 180 260VAC, 44~54VDC
Allowed variation range of frequency: 45Hz ~ 65Hz
Power Consumption: ≤300Watt

2.3.4 Mechanical Characteristics

The GZF9183-V meets IP65 standard and can be fixed to the wall or the installation pole with installation accessories.

The physical appearance of GZF9183-V Repeater is shown in Fig. 2-3-4.

GZF9183-V

Fig.2-3-4

2.3.5 Interfaces

Antenna interface: N-type connector

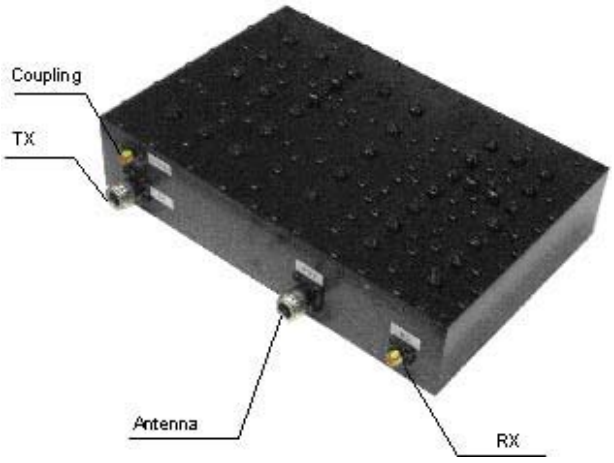
Portable computer and wireless modem interface: RS232

3. System Composition

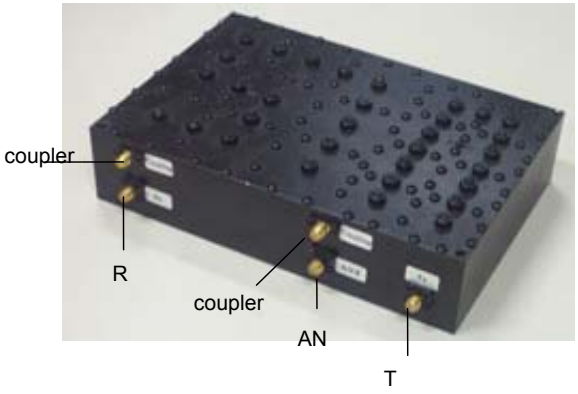
3.1 RF Unit

The RF unit, the main functional module of the GZF9183-V Repeater, serves to bi-directionally receive and transfer the radio signals transmitted by the BTS and the mobile phone. It consists of LNA and HPA in the uplink, so It does in the downlink.

3.1.1 Duplexer



Duplexer connected with service antenna



Duplexer connected with donor antenna

Configuration

Link Duplexer in the GZF9183-V plays several roles in the repeater system. First, duplexers connected with donor antenna and service antenna contain filters in the downlink and uplink. The filters in uplink reject the downlink band just as the downlink ones reject the uplink band. So the uplink and downlink are isolated into independent channels. There are two duplexers for one GZF9183-V repeater, one is connected with donor antenna, the other is connected with service antenna. For the duplexer connected with donor antenna, two coupler ports will be provided, but the two ports have different coupled values, are 50dB, the port for uplink power detection has a coupled value of 50dB, the other port for wireless modem has a coupled value of 20dB. For the duplexer near the service antenna, only one 50dB coupler port will be provided for downlink signal power detection.

Donor Duplexer

ANT: Donor Antenna

RX: Uplink PA RF OUT

TX: Downlink LNA RF IN

Wireless Modem Coupling: Wireless Modem
Coupling (RX-50dB): DET RF2
Service Duplexer
ANT: Antenna
RX: Uplink LNA RF IN
TX: PA RF OUT
Coupling (TX –50dB): DET RF1

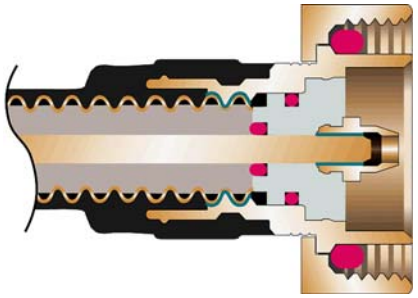
1. Frequency Range Downlink 890MHz~915MHz Uplink 935MHz~960MHz
2. Power Capacity ≥100W
3. Out-band suppression @935MHz>70 dB @915MHz>70 dB
   @925MHz>30 dB @980MHz>30 dB
   @880MHz>30 dB
4. Group Time Delay 150ns Max in-band
5. Ambient Temperature -40 70
6. Connector Type SMA Female
7. Ambient Humidity ≤95 Non-condensing

3.1.2 PA

Downlink PA

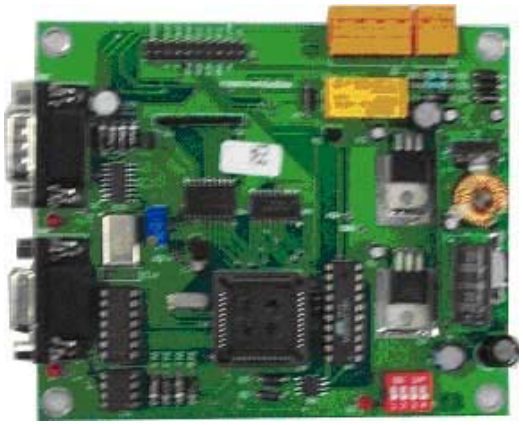
930MHz 960MHz ALC Auto Level Control 40W Output Power Amplifier
Label "HXPA945-30-40m01a", "945" means downlink module,"40" means max output power is 40 watt.
PA module in GZF9183-V is equipped in the downlink.
+27V DC power connects to the relevant outlet of power supply module.

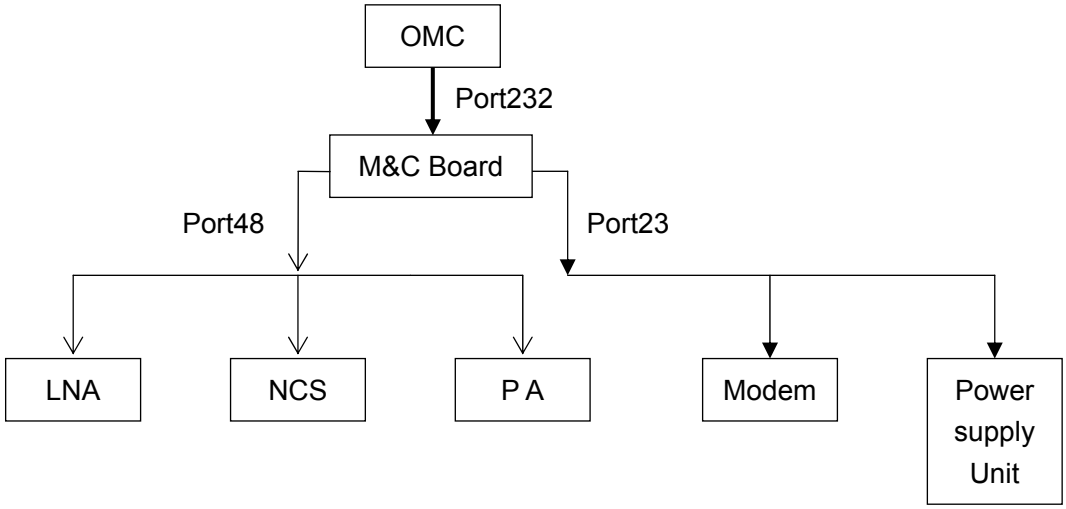
3.1.3 RFF1/2``-50 Cable



Electrical Specifications			
Impedance（Ω）		50±1	
Max Work Frequency（MHz）		3000	
RF Peak Voltage（kV）		1.39	
Peak Rating Power（kW）		19	
IMD3	800~1000MHz	≤-160dBc	
	1600~2000MHz	≤-160dBc	
Echo Ullage（dB）	0~1000MHz	JB	JBW
		28	26
	1000~2000MHz	JB	JBW
		26	24
Attenuation （dB/m）	1000MHz	11/100	
	2000MHz	17/100	
Average Rating Power（kW）	1000Hz	0.71	
	2000Hz	0.48	
Mechanical Specifications			
Max Pull(N)		500	
Min..Incurvated Semidiameter)(mm)	Single Flection	15	
	Many Flection	30	
Working Temperature Range (□)	-40~+70		
Watertightness Rate	IP 68		

3.2 M&C





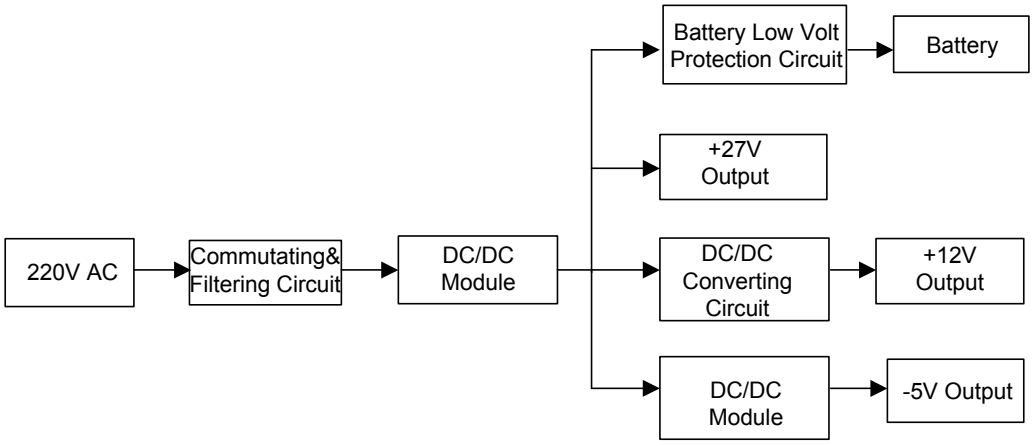
In the repeater, the working flow procedure is shown above. All the active modules are connected in serial line to M&C board.

3.3 Power Supply Unit

300W 48V DC / 220 AC Power Supply

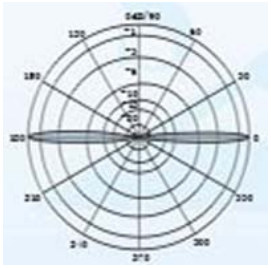
Rating Output Power: 300W
Input Voltage Range: 48V DC / 220V AC input
Output Voltage Type: +27V(10A),+9V(3A)
Features: 1 Modularized and small-sized design,
2 High power consistency,
3 DC\DC converting technology,
4 Own interface to backup battery, can control charge and discharge of backup battery,
5 Over Voltage Protection, Over Current Protection, Over Temperature Protection, Backup Battery Low Voltage Protection.

Structural Figure: (the input DC voltage is to be customized)



3.4 Accessories

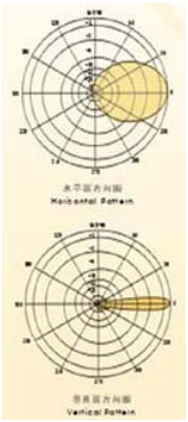
3.4.1 Outdoor Omni Directional Antenna



Outdoor omni-directional antenna usually works as service antenna to offer omni-directional coverage to appointed area.

Electrical Specifications	
Frequency Range	870-960MHz
VSWR	≤1.5
Input Impedance	50Ω
Gain	11.5dBi
Polarization Type	Horizontal or Vertical
Beam width 1/2 Power Points	8°
Max.Power	500W
Connector Type	N Female
IMP3	≤ -107dBm
Lightning Protection	DC ground
Mechanical Specifications	
Height	3m
Weight	10kg
Rated Wind Velocity	60m/s
Maximum Diameter	φ52mm
Diameter of installation pole	Φ60(mm)

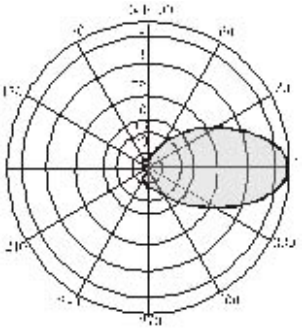
3.4.2 Directional Panel Antenna



Directional panel antenna usually works as service antenna to offer directional coverage to appointed area.

Electrical Specifications	
Frequency Range	790-960MHz
VSWR	≤1.5
Input Impedance	50Ω
Gain	18dBi
Polarization Type	Vertical
(3dB) Horizontal Beam width	65°
(3dB) Vertical Beam width	30°
First Upper Side Lobe Suppression	-16dB
First Down Null-Fill	-20dB
Front to Back Ratio	≥25dB
Max.Power	500W
Connector Type	N Female
IMD3	-107dBm
Lightning	DC Ground
Mechanical Specifications	
Dimension (LXWH)	260×250×40 mm
Weight	0.5kg
Wind Loading Area	0.09 m^2
Rated Wind Velocity	210km/h
Radiating Element Material	Aluminum Alloy
Radome Material	UV Protected ABS
Diameter of Installation Pole	φ50-φ114 mm

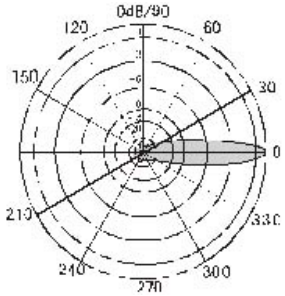
3.4.3 Yagi Antenna



Directional Yagi antenna usually works as service antenna to offer directional coverage to appointed area.

Electrical Specifications	
Frequency Range	890-960MHz
Band width	70 MHz
VSWR	≤1.5
Input Impedance	50Ω
Gain	17dBi
Front to Back Ratio	14.5dB
Polarization Type	Vertical or Horizontal
Beam width	49°
Max.Power	150W
Lightning Protection	DC Ground
Connector Type	N Female
Mechanical Specifications	
Number of Element	9 Element
Length	908mm
Weight	647g
Rated Wind Velocity	210km/h
Diameter of Installation Pole	φ45-φ50（ mm）

3.4.4 Short Backfire Antenna



For its high gain, short backfire antenna is usually used as the donor antenna of Frequency Shifting Repeater.

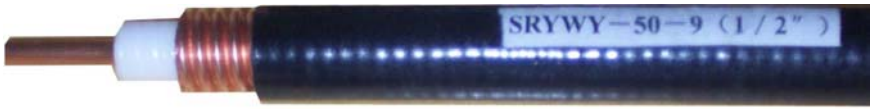
Electrical Specifications	
Frequency Range(MHz)	824-896/870-960
VSWR	≤1.35
Input Impedance(Ω)	50
Gain(dBi)	17
Polarization	Vertical or Horizontal
Half Power Horizontal Beamwidth	25°
Vertical Horizontal Beamwidth(3dB)	17°
First Upper Side Lobe Suppression(dB)	≤ -17
Front to Back Ratio(dB)	30
Max.power(W)	200
Lightning Protection	DC Earthing
Connector	N-type(Female)
Mechanical Specifications	
Diameter(m)	0.9
Weight(kg)	10
Rated Wind Velocity(km/h)	126
Reflector Material	Aluminum Alloy Pipe
Radiator Material	Copper
Diameter of installation pole（mm）	Φ48-φ90

3.4.5 Arrestor

Arrestors are usually equipped between the cables joining the equipment and antenna to protect the equipment against lightening surge electricity.

Parameters				
	SL-35R	SL-35P	SL-23R	SL-23P
Frequency Range	DC~2500MHz		DC~1500MHz	
Impedance	50Ω			
Insertion Loss	0.2dB			
VSWR	≤1.2			
Power Capacity	200W			
Discharge Voltage	DC230V±15			
Insulated Resistance	≥10000MΩ(DC100V)			
Connector Type	N-J/N-K	N-K/N-K	N-J/N-K	N-K/N-K
Dimension	58*25*35mm		75*20*45mm	
Weight	140g		110g	

3.4.6 1/2 Inch Super Suppleness Cable



The cable often works as a part of antenna feeder for joining master and BTS, slave unit and antenna.

Mechanical Specifications		
Run Temperature Range（℃）		-40~+70
Min Setting Temperature（℃）		-20
Max.Pull（N）		500
Weight（kg/km）		190
Min..Incurvated Semidiameter	Single Flection	15
	Many Flection	30
Electrical Specifications		
Impedance（Ω）		50±1
Attenuation（dB/m）		10.9/100 (950M)
Transmit Speed Coefficient		0.82
Max Rating Power（kW）		0.34 (950MHz)
Echo Ullage		customized
Capacitance（pF/m）		82

4. Equipment Test & Debugging

4.1. Test Condition, Instruments, Meters & Relevant Accessories

4.1.1 Test Condition

1. Temperature: -25□~+55□
2. Relative humidity: 35□ 95%

4.1.2 Instruments, Meters & Relevant Accessories

1. Signal generator, one set
2. Spectrum analyzer, one set
3. Vector network analyzer, one set
4. Noise Figure analyzer, one set
5. 30dB electric attenuator and 50Ω standard load (both of 50W), one set respectively
6. Some coaxial cables

4.2. Testing Frequency Band(To be customized)

Downlink: 935□ 960MHz

Uplink: 890□ 915MHz

4.3. Testing Method & Procedure

4.3.1 Maximum Output Power

1. Connect testing system according to figure 4.3.1(make the calibration according to the dotted line before test);

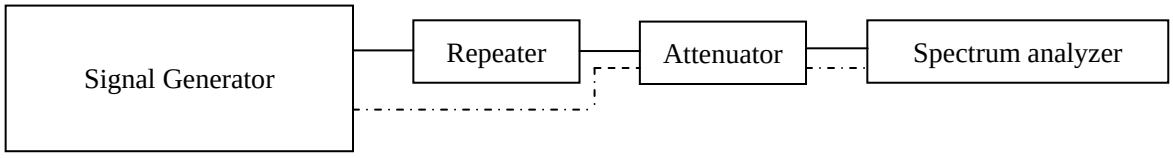


figure 4.3.1

2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set the output frequency of signal generator as the central working frequency of repeater;
4. Set repeater gain to its maximum;
5. Adjust the output level of signal generator until the output of repeater reaches the required index value.

4.3.2 Maximum Gain

1. Connect testing system according to the real line in figure 4.3.1;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set the output frequency of signal generator as the central working frequency of repeater;
4. Set repeater gain to its maximum;
5. Adjust the output level of signal generator until the output of repeater reaches its maximum. The maximum gain of repeater is the difference between the output power of repeater and the output power of signal generator.

4.3.3 Auto Level Control (ALC)

1. Connect testing system according to the real line in figure 4.3.1;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;

3. Set the output frequency of signal generator as the central working frequency of repeater;
4. Set repeater gain to its maximum;
5. Adjust the output level of signal generator until the output of repeater reaches its maximum;
6. Increase the output level of signal generator by 10dB, measure the output power of repeater with spectrum analyzer. ALC value is the difference between this value and maximum output power.

4.3.4 Gain Adjustment Range

1. Connect testing system according to the real line in fig4.3.1;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set repeater gain to its minimum;
4. Adjust the output of signal generator until the output of repeater reaches its maximum.
5. Measure the output level of repeater with spectrum analyzer. Minimum gain is the difference between this value and the output of signal generator. The difference between maximum gain and minimum gain is Gain adjustment range.

4.3.5 Gain Adjustment Step Length & Error

1. Connect testing system according to the real line in figure 4.3.1;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set the output frequency of signal generator as the central working frequency of repeater;
4. Set repeater gain to its maximum;

5. Adjust the output of signal generator until the output of repeater reaches its maximum;
6. Measure the output power of repeater with spectrum analyzer;
7. Decrease repeater gain by step. Use spectrum analyzer to measure the output power for every step length decrease of repeater and record it, until repeater gain reaches the minimum.

4.3.6 Ripple In Band

1. Connect testing system according to the real line in figure 4.3.1;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set the output frequency of signal generator as the central working frequency of repeater;
4. Set repeater gain to its maximum;
5. Adjust the output level of signal generator until the output of repeater reaches its maximum; i.e. the output of signal generator is $L_{in\ max}$;
6. Connect testing system according to the real line in figure 4.3.1 (the dotted line is a figure showing the connection in calibrated testing system);
7. Set the output level of vector network analyzer as $L_{in\ max}$;
8. Use vector network analyzer to measure in band ripple.

4.3.7 Voltage Standing-Wave Ratio

1. Connect testing system according to the real line in figure 4.3.2;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;

3. Set the output level of vector network analyzer as the maximum input level of repeater;
4. Set repeater gain to its maximum;
5. Use network analyzer to measure VSWR of the operating band at the connected port.
6. Other ports shall be tested in the same method.

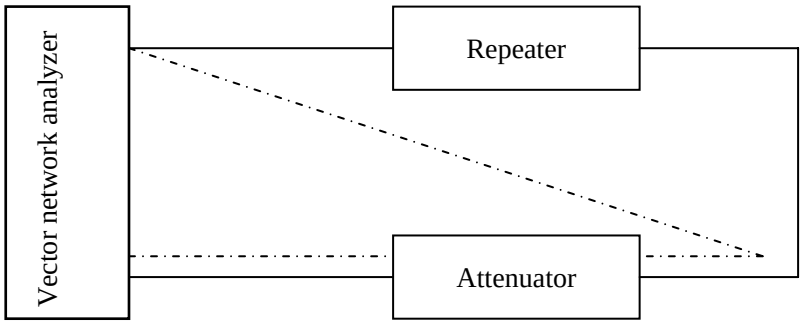


figure 4.3.2

4.3.8 Spurious Emission

1. Connect the testing system according to the figure 4.3.1;
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set repeater gain to its maximum;
4. Set the start frequency, stop frequency and corresponding RBW value as required in the test;
5. Measure the spurious emission of this frequency band with spectrum analyzer.

4.3.9 Uplink SNR

1. Connect the testing system according to the real line 1n figure 4.3.1;
2. Shut down the forward link;
3. Set repeater gain to its maximum;
4. Set the frequency of the two signal generators as that of f1 and f2 in the reverse operating band. Output power f1: -85dBm, f2: -45dBm. The difference between the peak power amplified at f1 and bottom peak noise power is uplink SNR(the following is the setting of spectrum analyzer : the central frequency is f1, band width 200kHz, RBW automatic, Referenced level proper, average value chosen).

4.3.10 Group Time Delay

1. Connect the testing system according to the real line in figure 4.3.2;
2. Set the central frequency of network analyzer as the central frequency of repeater, frequency span as the operating band width of repeater, and the output level as the maximum input level of repeater. Calibrate delay in transmission measurement method according to the dotted line in the figure 4.3.2;
3. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
4. Set repeat gain to its maximum;
5. Measure group delay with network analyzer.

4.3.11 Noise Figure

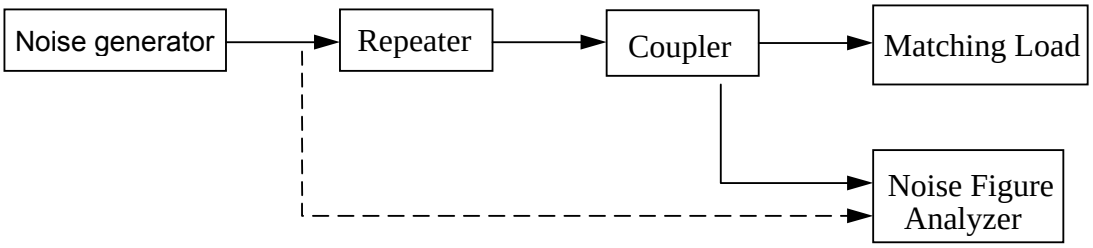


figure 4.3.3

1. Connect testing system according to figure 4.3.3 (make the calibration according to the dotted line before test)
2. Shut down reverse link while measuring forward link, and shut down forward link while measuring reverse link;
3. Set repeater gain to its maximum; Measure NF with noise figure analyzer.

5. Construction Process

5.1 Construction Flow

In light of the status of the construction at the early stage and current new requirements on the construction from the operators, the following specifications for the organization and execution of the project construction are formulated to ensure the quality of the construction and to establish a reputable image of WRI Hongxin Corp. all over the country while all the standards set by the operators are under simultaneous execution.

The following organization flow must be observed for the execution of a single respective construction works. The general working flow of the GZF9183-V Repeater is shown in figure. 5.1.

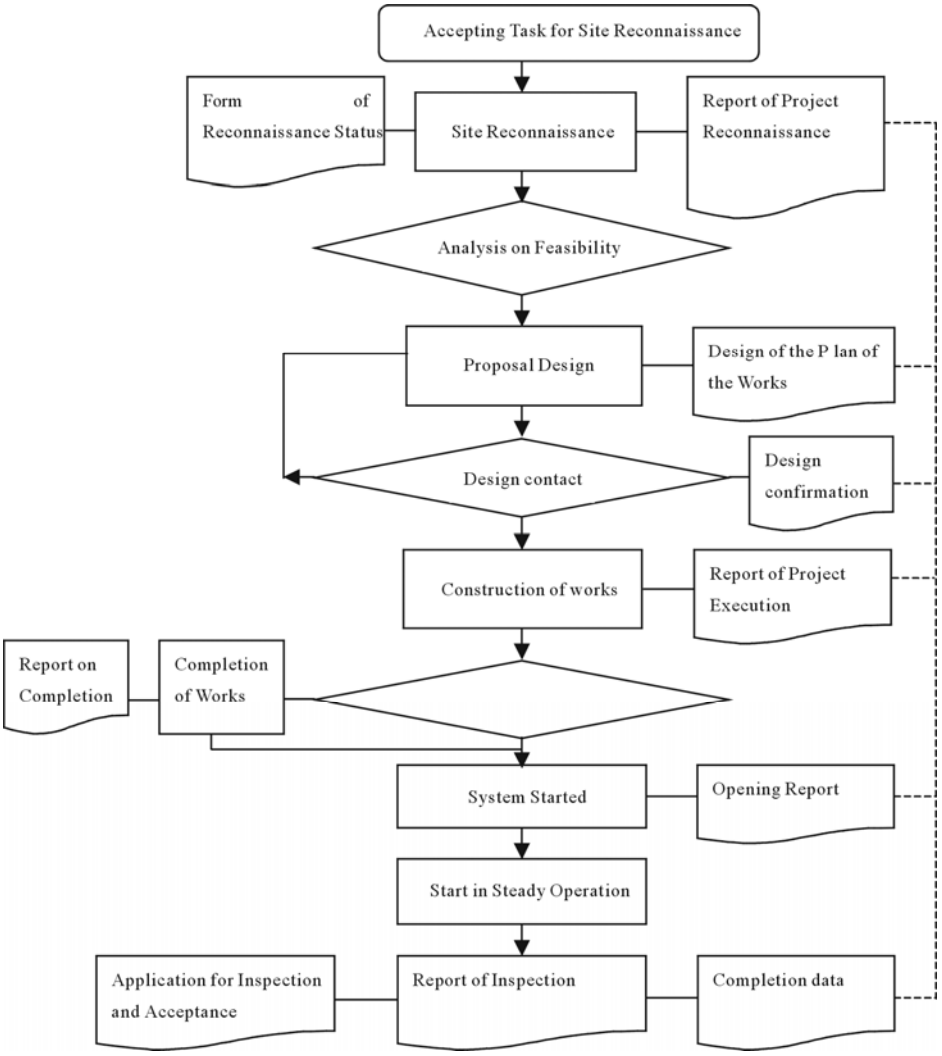


figure 5.1 The general working flow of the GZF9183-V Repeater

Based on the above figure, the organization flow of respective works can be generally classified into: reconnaissance, design, construction, self-inspection, start, inspection and acceptance as well file re-arrangement.

5.1.1 Reconnaissance of Works

Purpose: detailed reconnaissance of works can bring the design plan closer to real works and can endow the design with more rationality and technical feasibility to generate convenience for the construction at middle phase and the start and inspection and acceptance in the later phase.

Organization flow:

1 Collection of data

The data collected during reconnaissance are classified into natural environment data and mobile signal data based on the characteristics of the coverage of mobile communication.

1.1 Natural environment data:

General environment: including the general environment in the coverage area such as height of buildings, geographic location, flow of people (good for analyzing call numbers inside the buildings), structure of the buildings and other information,

Local environment: service area of each building (length and width), layout of each floor, local characteristics, positions of passages and so on.

1.2 Environment for wireless signal:

The detailed data collection on the wireless environment in the coverage area shall bring convenience for design plan making to rationally control the position of antenna and output power of the antenna and also control switching during design to avoid any modification after the start of the construction due to the defective coverage.

During reconnaissance, each works must contain the following wireless information: information on the nearby base station (position, frequency, sub-area code), signal coverage of each floor.

1.3 Testing methods

Digital camera: can take the pictures of the panorama and local view of the typical position in coverage area;

GPS locator: collect the longitude and latitude of the coverage area and station;

Ruler: measure the acreage, length, distances between the emitting

suppliers.

Panorama Testing: by panorama testing and scientific method, collect the accurate wireless signal in the coverage area to provide detailed and authentic data for design of the works.

2 Location of stations: determine the location of the equipment station after the coordination with construction units or realty owners according to the types of repeaters. The location of the stations must be fixed in view of convenience for construction and meeting the conditions of the works.

3 Introduction of power: sites with proper AC power supply shall be chosen with priority according to the site environment (the length of power introduction cable should not exceed 1000m considering the attenuation), and solar power shall be chosen if there is no AC power available near the coverage station.

4 Choice of fundamental construction (mainly for outdoor works): determine the model and length for the type of the holding pole for the donor and service antennae, determine the types (metal sheet room and house of bricks) of the equipment (solar) protection as well as the sizes: Determine if there are any special requirements for the main equipment or feed line of antenna (such as the area with frequent lightening) based on the local climate.

5 Re-arrangement of data

Standardized reconnaissance data shall be good for formulating design plan and good for filing and checking of the files of works. Therefore, all the testing data must be filed after the collection and testing. As for the panorama testing data, it must be analyzed and corresponding reconnaissance report shall be filled in after their re-management.

5.1.2 Engineering Design

Purpose: to provide detailed, reasonable and feasible solutions for the works so that a complete plan shall be readily available for construction.

The reasonableness of the design plan shall decide the control on progress of the works and quality control of the works. The defective design plan shall delay the progress of works, harm the quality, lead to the increase in cost and potential danger for construction. Therefore, considering the actual situation of construction in various places, we require that when formulating and verifying a design plan of works, we must make full analysis in the aspects of technique, organization, management and economy comprehensively to assure the technical

feasibility and economic rationality for better quality construction.

Design flow:

1 Determine design purpose and design plan: determine the requirements and coverage target of a respective works based on the technical bidding documents of construction unit. Plan the scale of current works and design, determine the design contents and estimation plan after careful study of the reconnaissance and technical bidding documents.

2 Formulate general frame of the plan: formulate general frame for design plan and determine the design direction based on the design plan and requirements for current works.

3 Perfect designing contents; complete all the contents of the plan, such as design basis, panorama data analysis based on reconnaissance report.

4 Analysis on feasibility and rationality of the plan: all plans must be analyzed in terms of technical feasibility and rationality such as prediction on the border magnetic field, switch analysis, interference analysis, balance analysis and so on.

5 Quotation; rationally quote on the plan according to the market requirements after repeated examination of the feasibility of technical plan and verify the pricing of the plan after comparison.

Key requirements for design:

1 Reinforce the analysis on the rationality of the plan

2 Decide reasonable editing format and corresponding fonts according to the template of the design.

3 Reinforce the analysis on pilot panorama testing.

4 Use special drawing tools (Microsoft Visio) to draw the point location drawings and system frame.

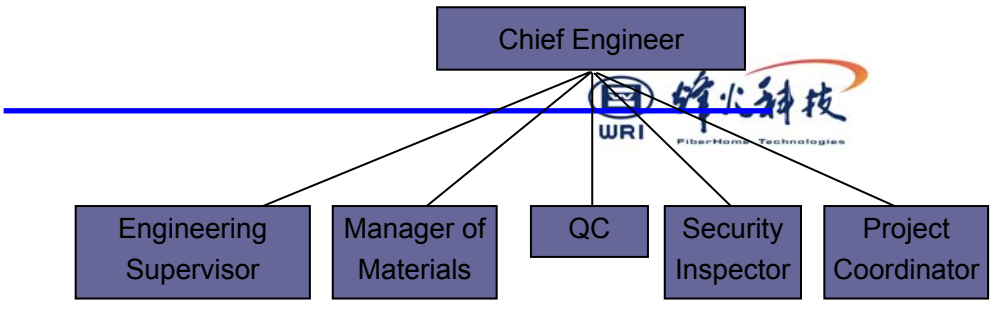
5 Hand signature shall be requested for places of signature.

5.1.3 Organization of Construction

Purpose: according to statistics, the start or poor effect at the start of system after the completion of construction is usually caused by disorder in construction and management. Therefore, apart from strict execution according to the process provided in relevant documents, specific plan for construction of works must be formulated in light specific construction to strictly provide all flows, reinforce the management of site construction and practice liability system of each work for each individual.

Organization structure

1 The following structure can be adopted for organization to assure the



orderly operation and to eliminate troubles.

Chief Engineer: formulate and arrange the feasibility plan according to the Rules of Management for Engineering Start, Specifications for Construction and Service Specifications for the Construction of the company, regularly or irregularly check the construction and is responsible for the quality of the engineering, progress, cost control, security and all affairs of the construction and shall order the construction team to re-manage when he finds disqualification during the construction of the works.

Engineering Supervisor: responsible for the progress and technique of the construction. Organize and arrange the construction by all units according to the Engineering Design, Specifications for Construction and Service Specifications for Construction. Formulate the schedules for construction, guide and standardize the execution of the engineering by the construction units, solve problOMC at the site, ask construction units to assist quality control engineers and debugging engineers to conduct quality control and debugging, control and check daily progress. Engineering supervisor is responsible for chief engineer. He must report construction schedule to chief engineer and is not allowed to execute the schedule until it is approved. Engineering supervisor must report progress of the construction to chief engineer every day.

Security Inspector: responsible for the security of the constructions, including checking of the certificate for operation at high places and electrician's certificate, all problOMC in operation at high places, construction of the works with potential danger and safe lighting.

QC: responsible for quality control of the construction. Inform Party A and the owners of the requirements for system inspection and acceptance, control the process for the whole construction, strictly check the operation and construction of the works according to the cable laying standard and construction specifications of Party A or Supervisor. Inform Engineering Supervisor in written forms of the disqualification in the engineering or potential trouble and ask him to revise. All the written notice for modification must be handed in to chief engineer after the construction is finished as a basis for evaluation of the construction units.

Project Coordinator: responsible for the coordination of everything at the construction site, such as taking the equipment

and arranging the entrance of the transportation equipment, entrance permits of all persons, water and power for construction, communication with Party A concerning the arrangement for construction, also responsible for logistics. He is responsible for chief engineer.

Material Manager: keep and control the material during the construction. Coordinate, control and distribute all materials for construction. Buy the material and solve the problem of urgent needs of the materials. He must manage the material in good order.

2. Progress of Construction

   To assure the progress of construction, a reasonable arrangement for progress of construction must be made to ensure an orderly construction. In the course of construction, it is required that progress of construction must be controlled with good follow-up in addition to strict and reasonable arrangement of the progress of construction.

3. Predict, analysis and solutions on key and difficult issues in various phases of construction

   Predict and analyze possible key and difficult issues in various phases of construction before start of construction and provide solutions.

   In case of any alterations in the construction, they must be analyzed for feasibility under the supervision of engineering supervisor based on the " Sheet for Alteration of Engineering Design" formulated by the company. Then fill in "Sheet for Alteration of Engineering Design" after confirmation that the alteration shall not affect the system in technique and report to chief engineer.

   QC and security inspector shall strictly control quality: when QC and security inspector find any potential danger after their examination of the total construction according to the relevant security regulations and quality standard, they must inform engineering supervisor and order them to re-manage. Meanwhile, ask the party to fill in " Report on Construction Quality Accident" and Table of Construction security Accident according to the real situation and hand them in to chief engineer and construction unit for examination and file.

   Chief engineer must formulate plan for construction, plan for progress of construction according to the actual situation at site and submit them to the owner for approval. To assure smooth construction, a chief engineer must consult the owners

concerning all the issues and verify them before the start of construction, then formulate scientific, reasonable, standard, secure, economical and operative construction organization plan. Chief engineer must explain some issues in the construction plan that may bring some impact on owner and will not start construction until he gets the consent of the owner. Civilized and secure construction must be conducted.

ProblOMC for balance, interference and indoor/outdoor switch may appear due to the unpredictable factors in the optimization even though the feasibility of the plan has been studied in the plan in the optimization of the system. The above problOMC must be removed in time and persons in charge in relevant departments should exchange and consult with each other at proper time to perfect the optimization of the whole system.

4. Key Requirements

Quality must be strictly controlled in the construction in various places of the country based on the construction at the early phase so as to eliminate the following:

- Construct without familiarization of the drawings or the construct while drawings have not been check jointly; alter design without the approval of the design department.
- Fail to construct according to drawings.
- Fail to construct according to the standard for inspection and acceptance of the construction.
- Fail to construct according to relevant operation process.
- Construct blindly without basic knowledge of structure.
- Management for construct is in disorder. Construction plan is improper. Construction order is wrong. Technical organization is poor. Technical explanation is not enough. Construct against regulations. Neglect quality control and inspection and acceptance. All these will lead to quality problOMC.

5.1.4 Opening & Self-Examination of the Construction

Purpose: formulate flow for opening and improve on the quality of the construction.

Preparation before opening

- Check the route of feed lines of antenna to determine if the facilities are constructed according to drawings or if they are fastened.
- Check the output power of signal source to see if it agrees with the

plan.

- Check the power supply to see if they meet the requirements for equipment.

Opening and self-examination of the construction: test and analyze by testing tools (testing mobile phone, panorama software) to see if the index for coverage meet the requirements.

The checking and analyzing include: coverage, switch, signal quality, re-choice in local area and other relevant standards for inspection and acceptance.

5.1.5 Organization for Construction, Inspection & Acceptance

Purpose: formulate rational process for construction inspection and acceptance, re-arrange report of inspection and acceptance, coordinate with construction unit for inspection and acceptance so the construction can be smoothly inspected and accepted.

Process for Completion Inspection and Acceptance

After the opening of the construction, when the construction is found to have met the requirements after self-examination with the presentation of report of completion, drawings of completion, final account of completion, construction summary and other necessary documents, it will be proper to submit application for inspection and acceptance to the construction unit to perform inspection and acceptance according to process. The process is:

- Re-arrange various reports and files.
- Organize inspection and acceptance authorities (organize inspection and acceptance committee or team in accordance with the construction scale and relation)
- Re-arrange all kinds of technical documents.
- Perform self-evaluation of the construction quality.
- Submit completion report to construction unit for inspection and acceptance.

Preparations for completion inspection and acceptance

Completion and acceptance process is a key to on-time completion, qualification and acceptance by the construction unit. To assure the smooth inspection and acceptance of the construction, it is required that construction must be performed step by step according to the general requirements of the plan. The following preparations are included before inspection and acceptance:

Continue to perfect self-examination and properly handle the ending work. Ending work shall appear at the period close to completion of

construction while some sporadic unfinished work will come out. Ending work is sporadic, spattered, small in scale and widely spread. If they are not finished in time, they can influence the completion inspection and acceptance of the construction. According to our experience for completion of construction, we must properly handle the ending work in view of the new projects and sort out the ending work to eliminate them.

Operation of self-examination of construction: at opening of the construction, all that are related to the coverage of the construction must be checked. Usually the following index and data must be understood: coverage rate, call quality, drop-off rate, switch and requirements from the construction unit. It is requested that all the construction processes must be thoroughly checked one by one according to the processes and drawings. Once any omissions are found and need making up, operation plan must be made right on spot to arrange rational construction for modification. The system shall be opened once it is confirmed to be qualified and shall start pilot operation for a period of time (depending on actual situation in various places).

Preparations for data of construction completion

The data and documents for construction completion are the major files that display the overall information on the construction and will be helpful for the future maintenance and repair.

The data and documents for construction completion include the following:

Reconnaissance report, design plan, plan design evaluation sheet, bill of materials, record of equipment installation and debugging, record of inspection and acceptance of dead zone construction (See relevant report specimen for various specimen).

Inspection and acceptance

Inspection and acceptance is the evaluation of the construction quality. The persons in charge of the construction (chief engineer) must submit inspection and acceptance report to construction unit to assure the smooth inspection and hand-over to avoid any delay during the inspection and acceptance of the construction. It must be emphasized here that the application for inspection and acceptance of construction can not be made to the construction unit until it is confirmed that the construction is found reliable in compliance with the acceptance standard after rational way of testing so as to ensure the rate of passing in inspection and acceptance to improve the reputation of the company.

5.2 System Installation

Work flow of outdoor construction shown as the figure 5.2:

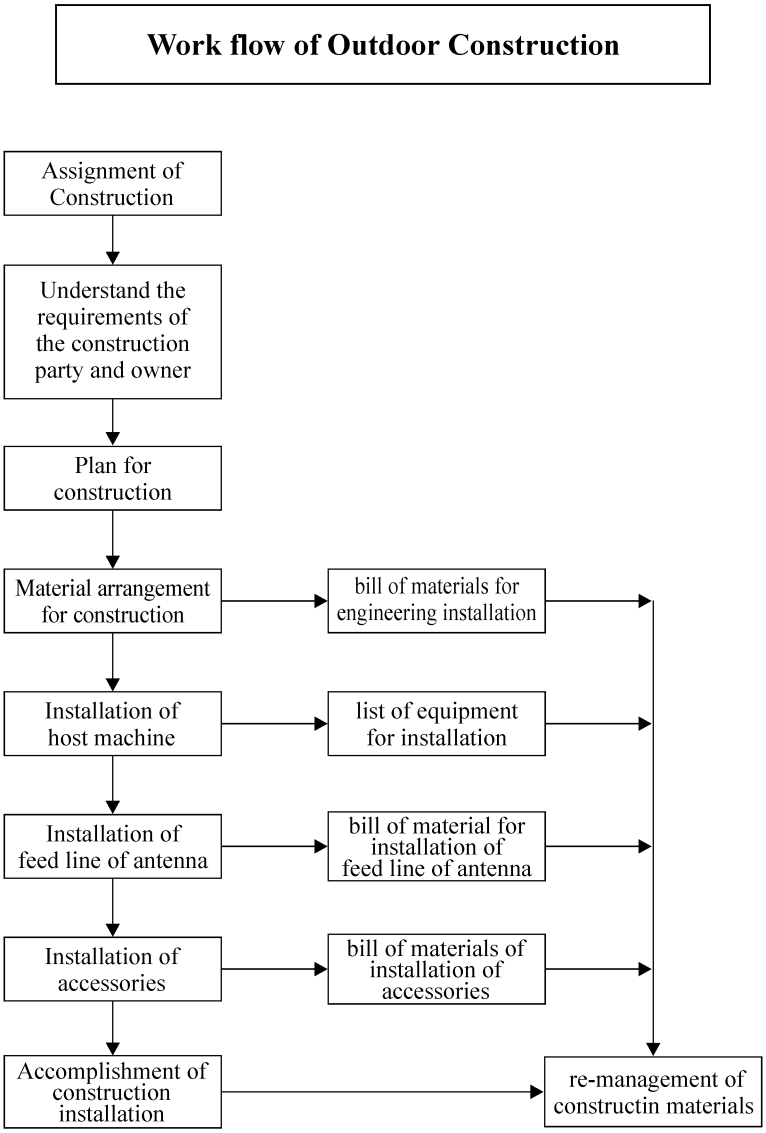


figure 5.2

5.2.1 Installation Flow

The general working flow of the GZF9183-V Repeater is shown in figure 5.2.1.

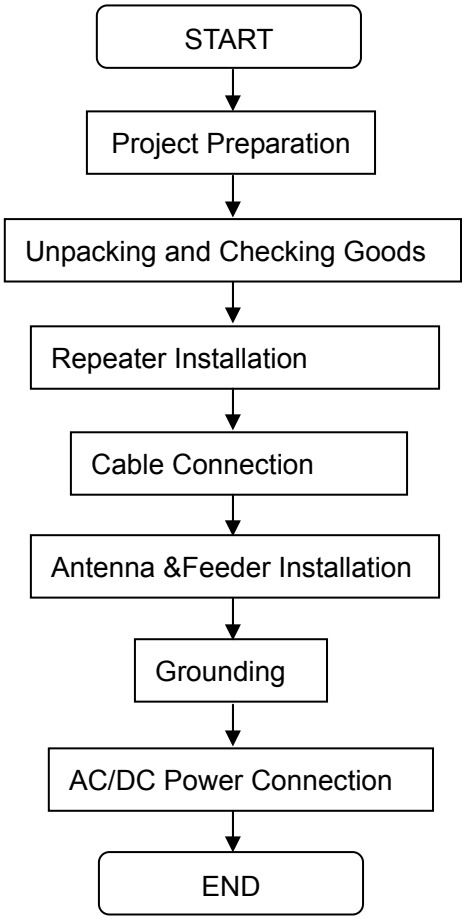


figure 5.2.1 The general working flow of the GZF9183-V Repeater

To ensure safety during the installation, make sure to wear safety belt for overhead operations and wear safety hats for on-the-ground operations, and take care never working in rainstorms.

5.2.2 User's Cooperation

WRI Hongxin's technicians will take charge of the equipment installation and the user's technicians should provide help if necessary. To ensure the normal running and maintenance of the equipment, the user's technicians should proactively work together with WRI Hongxin's engineers and technicians and get familiar with the installation, structure,

cabling, debugging procedure, etc.

5.2.3 On-site Survey

Before installation, the installation technicians should consult with the project manager of the user and learn whether the installation site is ready for equipment installation. Specifically, they should survey such it OMC as the installation site, iron tower or high pole, surrounding environment (temperature and humidity) and power supply. Where conditions permit, they should make an on-site survey together with the relevant persons of the user.

5.2.4 Installation Tools

Installation tools include: electric percussion drill, iron hammer, pulley, rope, safety belt, safety hat, ladder, screwdriver, hacksaw, knife, pliers, spanner, compass, tape, tweezers, electric iron, etc.

5.2.5 Technical Documentation

The installation technicians should keep on hand, and read in advance, such documents as *Project Design Document, Equipment Installation Specifications,* and *User's Manual* for the GZF9183-V Frequency Shifting Repeater.

5.3 Installation Conditions

5.3.1 Basic Installation Conditions

The GZF9183-V Repeater is designed to work outdoors under the temperature -25°C ~ +55°C and relative humidity ≤95%, so it can work in the outdoor natural environments at most areas. The following basic conditions should be ready before installation:

1. 220V AC or 48V DC power is available. (According to user's requirement)

2. A grounding bar is available nearby.

3. There are appropriate buildings, iron towers or high poles to service antenna.

5.3.2 Recommended Environment Requirements

1. The first choice is wall mounting in a room that is cool, dry, well ventilated, provided with fire control facilities, free from corrosive gases or smoke, and water-tight on the roof, with the electromagnetic interference field intensity less than 140dB μv/m (0.01 MHz ~ 110000 MHz).
2. The second choice is a shady and well-ventilated outdoor wall without direct sunshine or rain drenching.
3. The third choice is a common wall, iron tower or high pole.
4. The installation height should be such as to facilitate RF cabling, heat radiation, safety protection and maintenance.
5. Independent and stable 150VAC～260V AC（nominal 220V/50Hz）or 44VDC~54VDC power should be provided (based on different need, the value of AC power is to be customized, for example, 110V/60Hz AC power will be provided in some country), which mustn't be shared with other large-power communication equipment and electric appliances.
6. The installation building, iron tower or high pole should be provided with lightning protection facilities and should be strong and stable enough.
7. The antenna backstay or roof should be provided with a pole to help mount the antenna. The diameter of the pole may be 50mm ~ 80mm, depending on the antenna to be mounted. A ladder should also be available to help mount the antenna. All metal parts should be properly grounded and provided with lightning protection facilities.

5.4 Equipment Check

5.4.1 Counting the Goods

Check whether the packing box is intact in appearance. If any goods are wrong or missing or if the outer package is damaged seriously, stop

unpacking immediately and find out the cause, and report to the relevant department.

5.4.2 Unpacking Inspection

Open the packing box if it is intact. Handle with care to avoid damaging anything.

After the packing box is opened, check whether the goods inside match the packing list and whether the packing list matches the inspection list in the Unpacking Inspection Report. If any goods are wrong or missing or if the outer package is damaged seriously, find out the cause, and report to the relevant department.

After unpacking inspection, fill out the Unpacking Inspection Report. Both parties shall sign the Report, and then the goods shall be handed over to the user. Each party shall hold one copy of the Unpacking Inspection Report, and the project supervisor should feed back the "Inspection Conclusion" within seven days to the vendor for documentation.

5.5 Installation of the Main Chassis of the GZF9183-V Repeater

Mounting on an embracing pole or wall

The GZF9183-V Repeater is attached with such installation fittings as installation board and fixing pieces. The chassis of the GZF9183-V Repeater can be mounted either on the wall or on a high pole.

The bottom of the equipment is usually about 1.2 m above the ground.

I. Repeater Installation Mode of Bracket on Embracing Pole

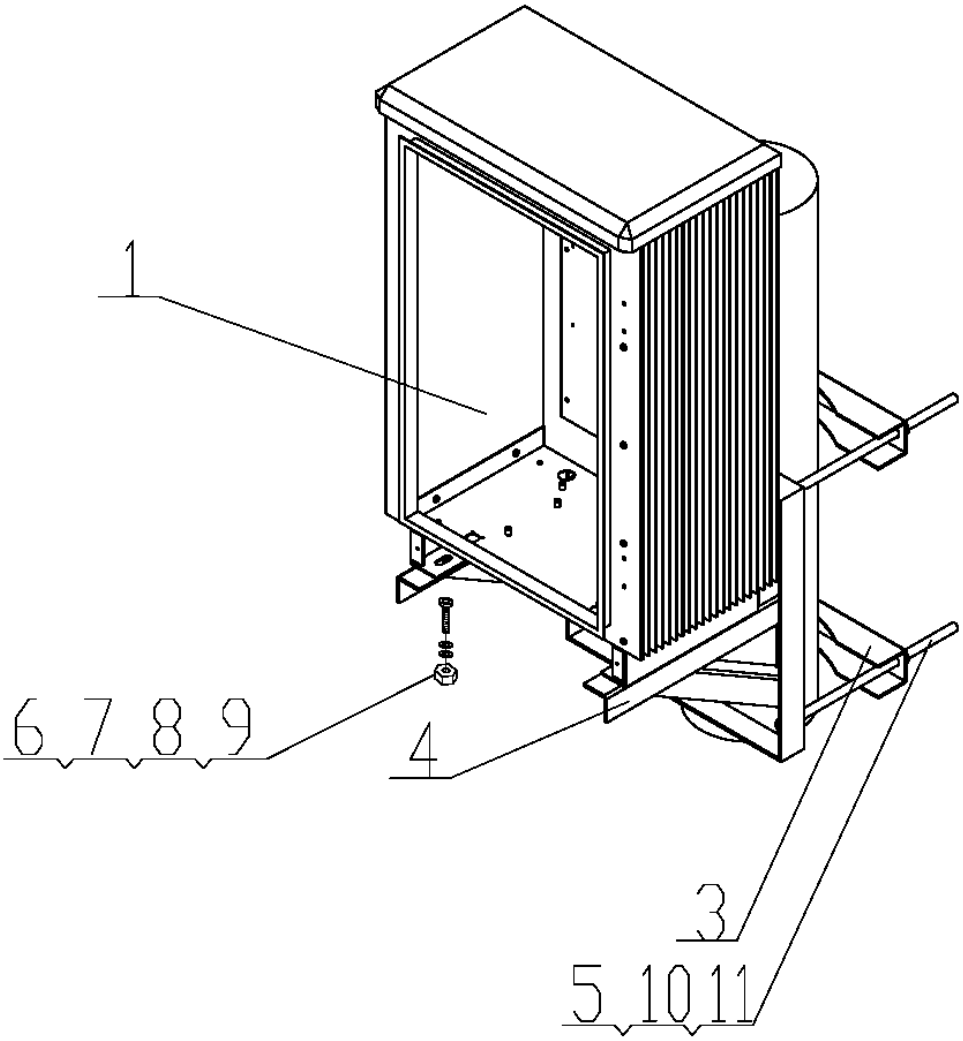


figure 5.5.1 Scheme of installation

S/N	Coding	Name	Quantity	Remark
1		Protective casing	1	
3	8.038.023R1A	Staple bolt	2	
4	8.038. ZJ	Bracket	1	
5	8.309.044R1A	M12 lengthened bolt	4	
6	GB5870-86	Screw bolt M8X25	4	
7	GB6170-86	Nut M8	4	
8	GB97.1-85	Flat washer 8	4	
9	GB93-87	Spring washer 8	4	
10	GB6170-86	Nut M12	4	
11	GB847-85	Flat washer 12	4	

table 5.5.1 Details for installation scheme

Installation Instruction:

Step 1:
As shown in figure 5.5.1, fasten the bracket and staple bolt on embracing pole with M12 lengthened bolt, flat washer 8 (GB97.1-85) and spring washer 8 (GB93-87).

Step 2:
As shown in figure 5.5.1, remove down panel of main casing for Repeater, fit four M8X25 bolts (GB5870-86) over the installation hole of equipment, the installation hole of frame, flat washer 8 (GB97.1-85) and spring washer 8 (GB93-87) in turn, and fasten them with Nut M8 (GB6170-86) for connection.

Step 3:
As shown in figure 5.5.1, install the down panel, and connect earth wire for equipment with ground reliably.

II Repeater Installation Mode of Bracket on Wall

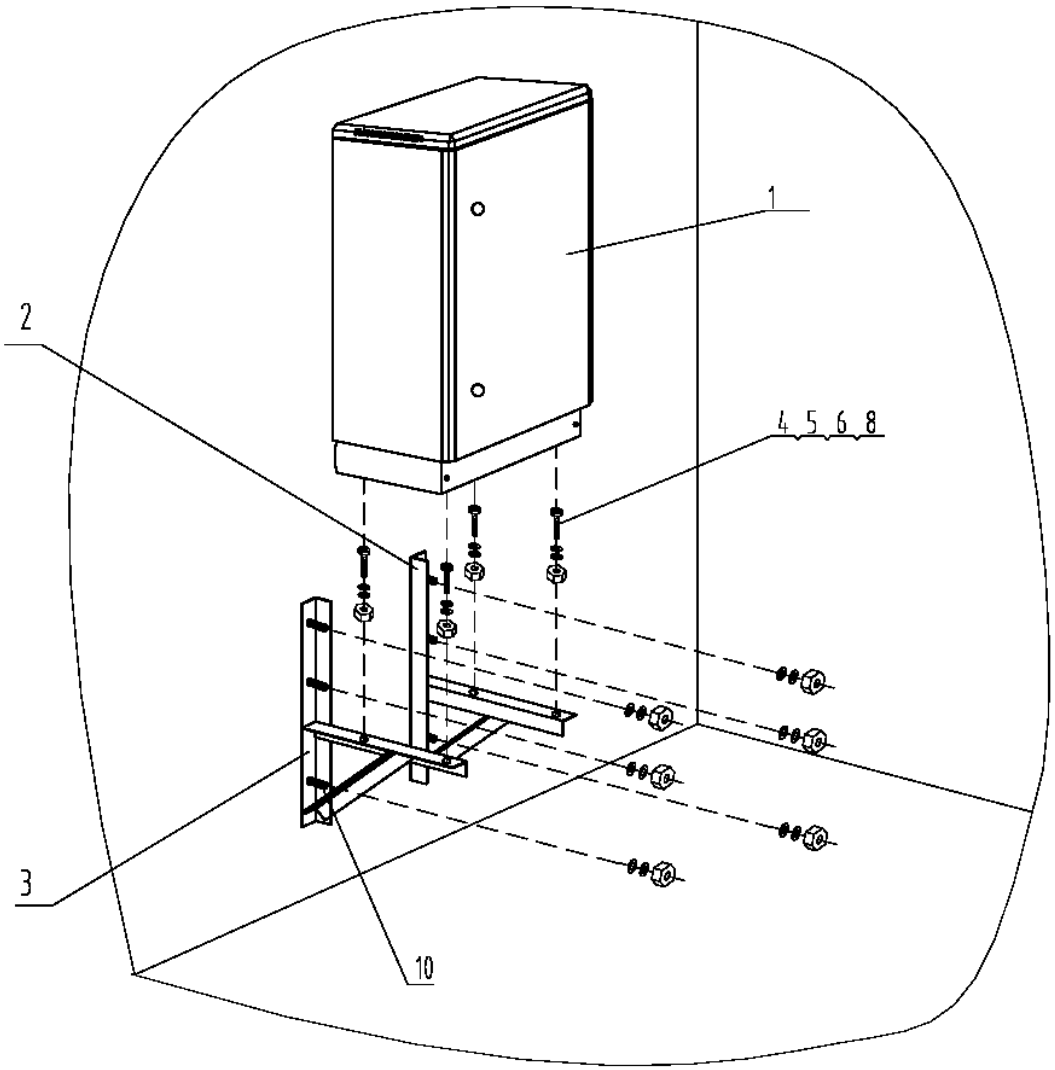


figure 5.5.2 Scheme of installation

S/N	Coding	Name	Quantity	Remark
1		Protective casing	1	
2	8.038.009R1A	Bracket (1)	1	
3	8.038.010R1A	Bracket (2)	1	
4	GB5870-86	Screw bolt M8 X 25	4	
5	GB6170-86	Nut M8	4	
6	GB97.1-85	Flat washer 8	4	
7	GB97.1-85	Flat washer 12	6	
8	GB93-87	Spring washer 8	4	
9	GB93-87	Spring washer 12	6	
10		Steel expansion bolt M12X110	6	

table 5.5.2 Details for installation scheme

Installation Instruction:

Step 1:
As shown in figure 5.5.2 firstly bore six holes on wall for installation with Churn Drill (hammer), the size of which is the same as that of installation hole for bracket.

Step 2:
As shown in figure 5.5.2 put six steel expansion bolts and expanding pipes into bored holes, then fit bolts over the installation hole on bracket as well as flat washer and spring washer, at last put nuts onto bolts and screw them down tightly.

Step 3:
As shown in figure 5.5.2 remove down panel of equipment, fit four M8X25 bolts (GB5780-86) over the installation hole of equipment, the installation hole of bracket, flat washer and spring washer in turn, and fasten them with nuts for connection.

Step 4:
As shown in figure 5.5.2 install up and down panels and connect earth wire for equipment with ground reliably.

III Installation Mode for Repeater Canopy on Embracing Pole

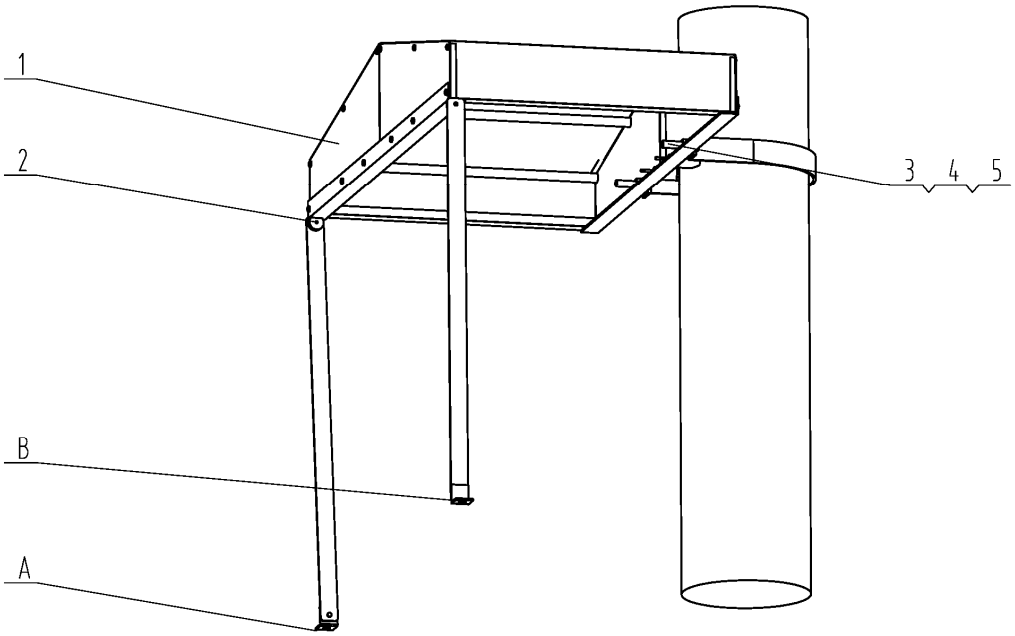


figure 5.5.3 Scheme of installation

S/N	Coding	Name	Quantity	Remark
1		Canopy (including accessories)	1	
2	GB817-85	Panhead bolt M5 X 10	2	
3	GB5870-86	Screw bolt M12 X 60	2	
4	GB97.1-85	Flat washer 12	2	
5	GB93-87	Spring washer 12	2	

table 5.5.3 Details for installation scheme

Installation Instruction:

Step 1:
As shown in figure 5.5.3 fasten canopy and attached staple bolt on embracing pole with bolt M12X60 (GB5870-86), flat washer 12 (GB97.1-85) and spring washer12 (GB93-87);

Step 2:
As shown in figure 5.5.3 fasten bracket A and B of canopy on installation platform based on actual conditions of project.

IV. Installation Mode for Canopy on Wall

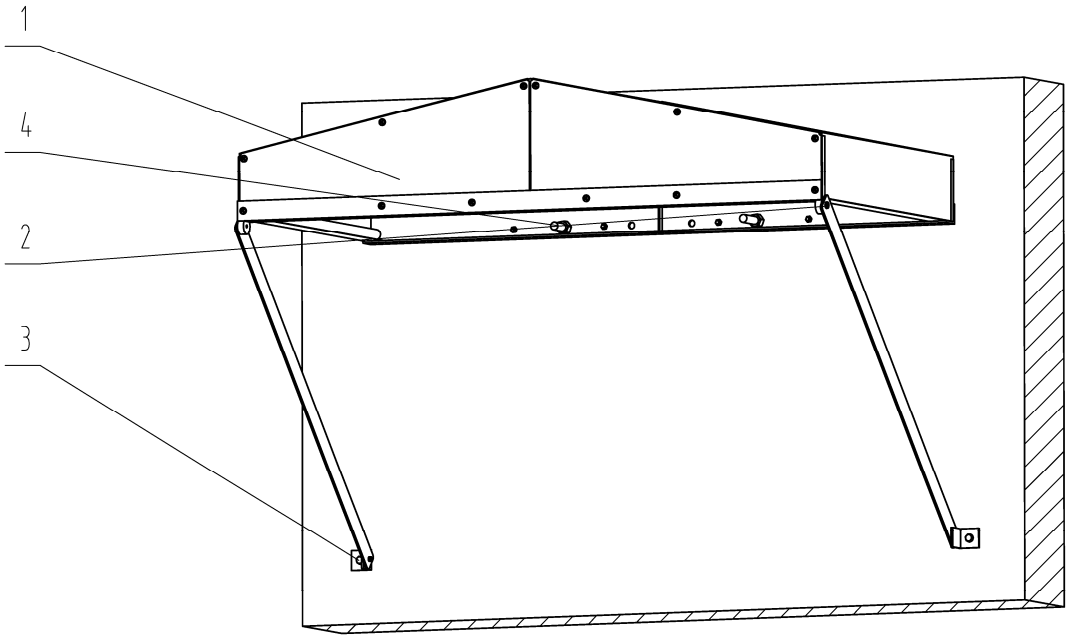


figure 5.5.4 Scheme of installation

S/N	Coding	Name	Quantity	Remark
1		Canopy (including accessories)	1	
2	GB817-85	Panhead bolt M5 X 10	2	
3		Steel expansion bolt M5 X 60	2	
4		Steel expansion bolt M12 X 110	2	

table 5.5.4 Details for installation scheme

Installation Instruction:

Step 1:
As shown in figure 5.5.4 firstly bore four holes on wall for installation with Churn Drill (hammer), size of which is the same as that of installation hole for canopy;

Step 2:
Remove staple bolt and Pedestal (I) from the canopy;

Step 3:
As shown in figure 5.5.4 put four steel expansion bolts and expanding pipes into bored holes, then put nuts onto steel expansion bolts and screw them down tightly.

5.6 Antenna Feeder Installation

The GZF9183-V Repeater should be connected to the set of antenna feeder system, it is the service antenna connected to the service interface. The requirements for the installation of the antenna feeder system of the GZF9183-V Repeater are the similar to those for the BTS, with the differences described below. For more information, please read the requirements for the installation of the BTS antenna feeder system (refer to *Installation Manual for GZF9183-V GSM Frequency Shifting Repeater)*

5.6.1 Laying Cables

- The models, specifications, direction and positions of the laying of the cables of the equipment must comply with the requirements. It is prohibited to unroll the cable at random from the center. No twist, knotting or winding are allowed.

- When laying the cable, the cable must be unrolled from the cable reel radially step by step in relaxed way. It is prohibited to unroll the cable at random from the center. It is prohibited to unroll the cable at random from the center. No twist, knotting or winding are allowed. No surge or dog leg are accepted
- Cables must be lined in good order to reduce curves. If they must be bent, the bending radius must meet the following requirements:

Linear diameter	Second time bending radius	First time bending radius
10DFB	150mm	60mm
1/2''common	210mm	70mm
1/2'' super soft	120mm	40mm
7/8''	360mm	120mm

- Feed line must fix with laces, L-type base of feed line, and wave-guide card with single/double hole, partition code and PVC tube. The table for the fixed distance is as follows:

	<1/2" feed line	>1/2'' feed line
When placed horizontally	1.0m	1.5m
When placed vertically	0.8m	1.0m

- In the areas like a machine room and passages where cables are exposed, cables must be protected with sleeves (PVC or silver plated tube). Cables must be cased in soft sleeves at bending points and fixed with pipe clamps. Check 2.3.1.4 for the distances. The following is the table for the diameter of PVC tube:

	<1/2'' feed line	>1/2'' feed line

Diameter of the PVC tube	25mm or 32mm	50mm

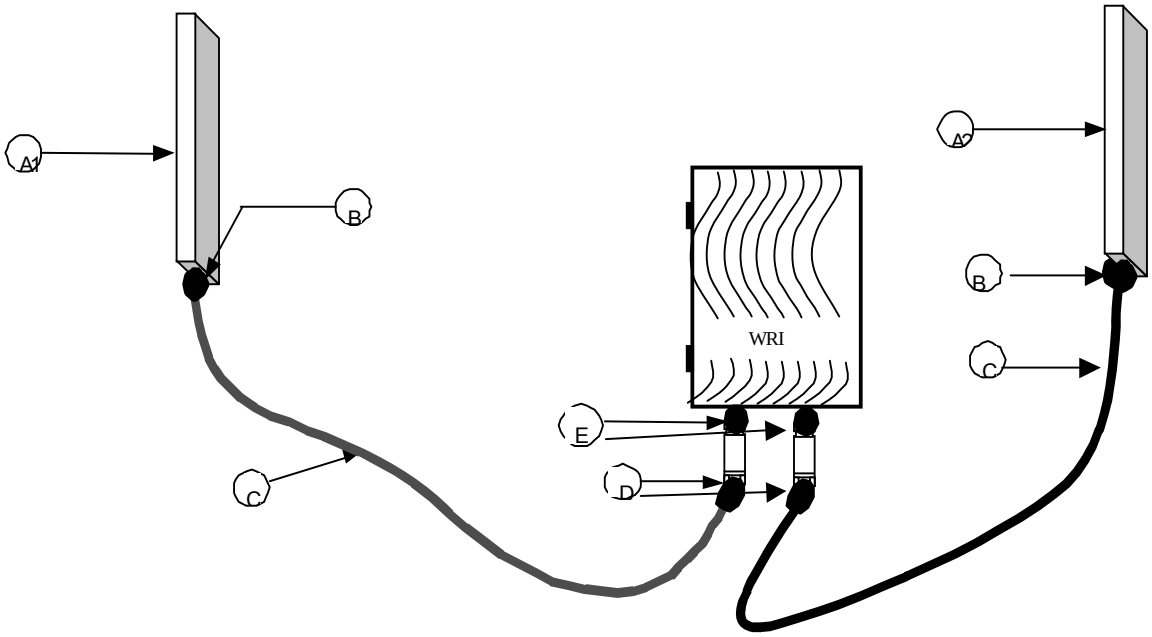
- Cables have to be recalled and re-installed when trouble appears in construction. It is prohibited to pull the cable by force.
- When cables vertically pass through machine rooms, the holes must be reinforced according to design with measures against rain. When cables horizontally pass the rooms, the holes must be reinforced with protective frames and sealed after the cables are fixed. Cables must not be hurt when they are being sealed. The protective frames should have colors harmonious with the color of the wall.
- RF cables and AC cables must be laid separately. Proper measures must be taken to separate them when they have to be placed together.
- It is prohibited to enlace the cables along with the lightning cables.
- When the cable is laid in frames or casing, the laying must be flat and even. Feed line must be enlaced evenly along the frame. See 2.3.1.4 for fixed distances for feed lines. Cables must be lined closely in order after being enlaced. Extra part of laces must be cut off.
- When cables are laid in suspense, they must be fixed with cable hooks along the suspended cables. The size of the hooks: 250mm for 1/2'' cable radius and 350mm for 7/8'' cable radius. See 2.3.1.4 for requirement for fixed distances.
- When the cables are laid along walls, laying must be flat and even. Feed lines must be fixed with cable clamps. Cables must be protected in sleeves (PVC tube or zinc plated sleeves). The bending part of the feed line must be enlaced with soft tube.
- Cables must be fixed with special cable fixer according to the

requirements when they are laid along the steel towers.

- When cables are buried for laying, feed line must be buried at depth of 0.8m and must be protected with zinc plated steel tube or PVC tube. A warning sign must be set up in every 5 – 10m along the route of the feed lines.
- See figures for illustration of cable installation

5.6.2 Installation of the Service Antenna & Feeder

The installation of the service antenna and the connected feeder is shown in figure 5.6.2.



A1: Donor antenna/Link antenna A2: Link antenna/Service antenna B: Antenna connector C: Antenna feeder

D & E: (RF) lightning arrestor connectors

figure 5.6.2 Connection of the service antenna and feeder

The service antenna of the GZF9183-V Repeater is usually plate antenna (45°, 60°, 90° and 120°).

5.6.3 Making Joint

- Making of RF co-axial cable joint should be in accordance with the

requirements in the drawing of the making of cable joint;

- The redundant length of cable should be unified. The size of peeling of each layer should be suitable with the corresponding part of cable plug;
- When cutting and peeling with knife the cable jacket and insulation, force shall be properly used not to damage woven screen and cable core;
- Cable core should be soldered correctly and firmly with proper quantity of soldering tin. Soldered dot should be smooth without spines and not be in a shape of knurl. Co-axial cable plug must be firmly assembled strictly according to its installation instruction by use of complete fittings, and assembly position must be correct;
- If at the cutting point a pyrocondensation sleeve is required, the pyrocondensation sleeve shall have identical and proper length, providing even pyrocondensation;
- For construction of cable, protect terminals from water and humidity. A terminal exposed outdoors must be made waterproof handling with waterproof adhesive tape. Terminals must be sawn off if they are affected with damp or if water enters into them.

5.6.4 Precautions for Antenna Feeder Installation

1. The donor, link and service antenna shouldn't be too near vertically, otherwise self-excited reception and transmission may result.
2. The antenna feeder system must be installed by experienced professionals.
3. Do not install the antenna near any power line so as to ensure personal safety.
4. All exposed connectors must be sealed with self-adhesive waterproof

tape and electric isolating tape.

5.7 Grounding & Power Supply Connection

5.7.1 Equipment Grounding

The GZF9183-V Repeater must be grounded properly. On the sides of the main chassis of the GZF9183-V Repeater are grounding bolts , which are connected to the ground with 2mm^2 or thicker copper wire. The grounding cable should be as short as possible.

1. For installation on an iron pole, the grounding cable of the equipment is usually connected to the iron pole (iron tower). The grounding resistance (R) of the iron pole should be less than 10 Ω and the grounding junction pieces should be protected from corrosion.

2. For installation on the wall, the grounding cable of the equipment is connected to the integrated grounding bar. The grounding resistance (R) of the grounding bar should be less than 5 Ω and the grounding junction pieces should be protected from corrosion.

5.7.1.1 Cable Laying of Ground Wires

- Bus ground wires should be of 35mm^2 guide line, and sub-ground wire of 16mm^2 guide line.
- Ground wires must be protected in PVC pipe or placed in wire casing, straight / vertical with decoration concerned.
- If ground wires go through the wall, the part in the wall must be put into PVC pipe or corrugated pipe for protection, and the hole on the wall must be sealed with fireproofing clay.
- Ground wires should not go in a 90^o right angle. The curvature radius should be more than 130mm.
- If ground wires of antenna bracket and ground wires of feeder line

are connected with the lightning conductor on the roof, inversed funnel (that is, distiller) should not be shaped, and the direction of the funnel must be downward.

- The terminal grounding points of ground wires of antenna bracket fall in the ground net or the lightning net nearest to the antenna bracket. They should not be connected into houses.
- Indoor ground wires should not be connected with the lightning net on high positions such as the outdoor roof.
- Ground wires put in PVC pipe should be fixed in the same principle with that of radio frequency cable laying. When they are placed in wire casing, the fastening interval for wire casing is 0.3M.

5.7.1.2 Connection of Ground Wires

- Ground wires between equipment and users feeder lines, user antenna brackets and grounding row are sub-ground wire, connected with 16mm2 copper cored rubber cable.
- Ground wires between grounding row and ground net or outdoor antenna bracket and ground net are bus ground wires, connected with 35mm2 guide lines.
- Sub-ground wires should be connected with grounding pole of the equipment case using 60Alug.
- Sub-ground wires should be connected with supplier/user antenna bracket and grounding row using 200Alug.
- Bus ground wires should be connected with grounding row and ground net using 300A lug.
- Grounding point on feeder lines should be directly sealed with waterproof clay and then packed in electric adhesive plaster.

Grounding points on grounding row or ground net must be sealed with lubricant to avoid water and rust.

5.7.1.3 Handling of Lightning System

- All the input and output terminals of outdoor equipment must be connected with lightning conductor.
- For all the outdoor repeaters, it must be ensured that three points be connected with ground.
- When connecting the lightning conductor with ground wires, the direction of the wires should be downward, but not upward, which helps instantaneous current to be rapidly guided into the ground.
- In order to decrease inductance when the lightning conductor is connected with ground wires, the curving angle of ground wires should be above 90^{o}, and the curvature radius above 130mm.
- The grounding points of equipment protection zone, feeder lines, outdoor antenna backstop should be apart from each other. Every grounding points require to have a fine connection without any loose and be made anti-oxidation handling (to be covered with rust-resisting lacquer or silver powder) and waterproof and antisepsis handling.
- Lightning rod: hold pole lightning should have a diameter of 12-15mm and a length of 1500mm. Outdoor antenna should be within the 45o protection angle of the lightning rod.
- The grounding earth resistance of all the grounding nets should be less than 5Ω. For places where the thunderstorm days per year is less than 20 days, their grounding earth resistance may be less than 10Ω.
- For details, refer to the grounding criteria of repeater system.

5.7.2 Power Supply Connection

For the GZF9183-V Repeater not requiring standby power supply, the 48V DC or 220V/50Hz AC power can be led in directly from the power outlet. The power inlead should be 2mm^2 conductor shorter than 30 m.

Note: To ensure personal safety, make sure to disconnect the external contactor before connecting 220VAC power supply to the equipment and take care never to work in rainstorms.

5.7.2.1 Power Cable Laying and Installation of Power Supply

- Power supply without stable voltage of its transmission-line system is required to have a mainstay;
- For input power supply of equipment, live wire, zero line and ground wire must be correspondingly connected. Dielectric resistance between cable cores and between cable cores and ground should not be less than 1M Ohm;
- Alternating current 220V power supply wires adopt 2.5mm2×3 rubber kicking;
- Power supply wire should not be tied together with other cables;
- Cable laying of Power supply should be put in PVC pipe, straight and vertical;
- If power supply wire needs to go through wall, the parts in the wall must be added with PVC pipe or corrugated pipe for protection, and the hole on the wall must be sealed with fireproofing clay;
- The fixed interval of horizontal / vertical wiring of power supply wire in PVC pipe is 1 meter, and the interval of wiring in 100×40 wire casing is 0.3 meter;
- Power supply wire between equipment and distribution case can be cut off. No plug needs to be used. The terminal can be directly

connected to creepage prevention switch. For example, if power supply wire is not long enough, more wires can be connected with it; but live wire,zero line and ground wire must be connected in separate points, and soldered with soldering tin. The section to be soldered should first be packed with electric adhesive plaster, and be closed in pyrocondensation pipe;

- When connecting power supply, full preparation for safety should be made to ensure absolute body safety.

5.7.2.2 Installation of Power Supply

- Requirements for power supply connection of solar repeater: First connect the charging controller with circuit of accumulator, then connect solar plate with the circuit of the charging controller;
- Power supply in solar repeater requires to be installed in places with long-time and sufficient sunlight.
- Whether power supply in solar repeater should be installed in the south facing the north or in the north facing the south depends on local conditions.

5.8 Installation of Embracing Pole & Antenna Bracket (for tower)

- When embracing pole is buried in the earth, the depth of its burying can be determined according to soil texture and the height of the hold pole. A depth of 0.8～1.2m shall apply for a 6mhold pole, 1.2～1.6m for a 8m hold pole, 1.6～1.8m for a 10m hold pole and 2.0～2.2m for a 12m hold pole.
- The lightning mark, paint mark and the installation of lantern (if required) of antenna tower should be in accordance with the

design requirements;

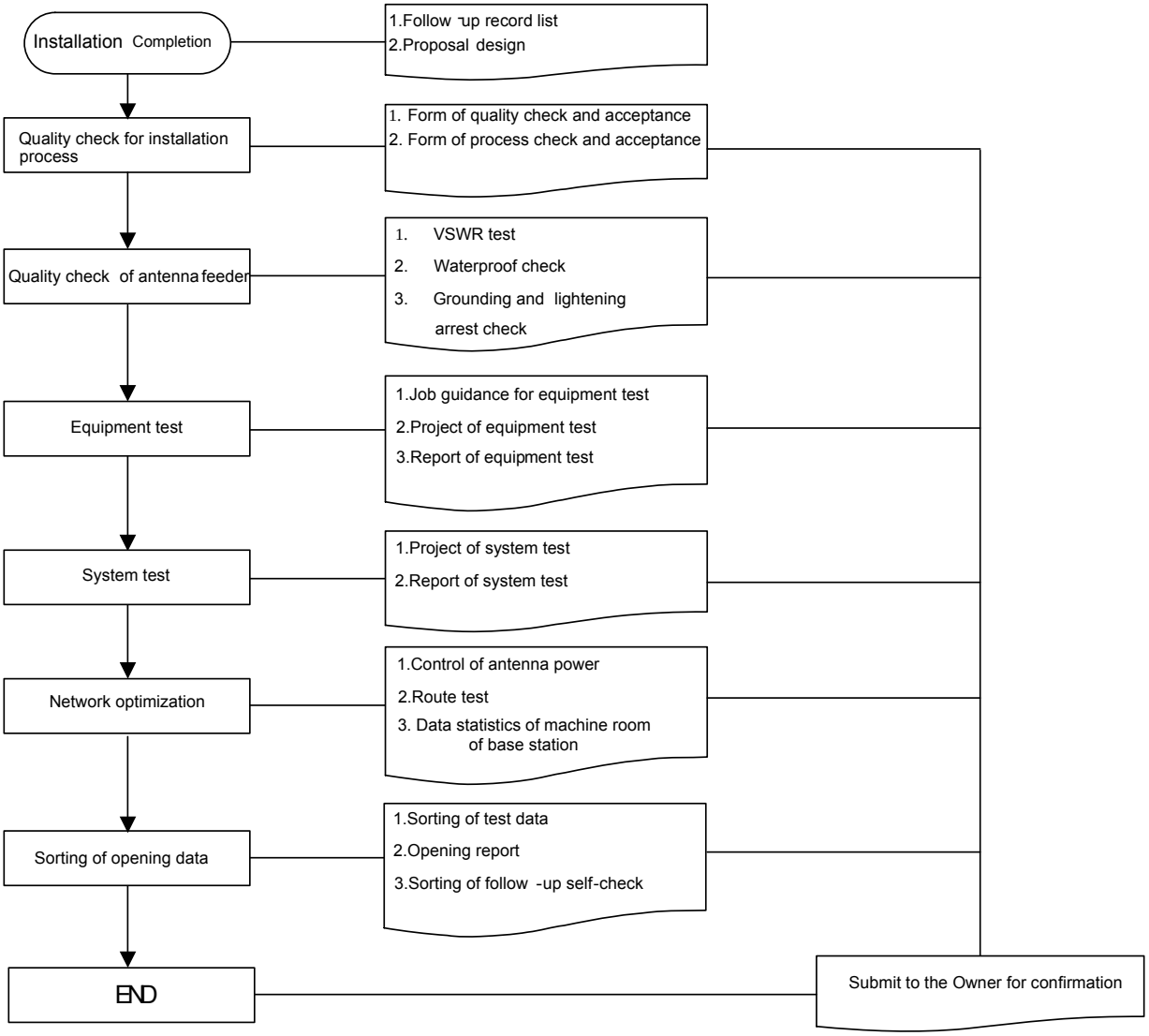
- Grounding of antenna bracket (for tower) should be in accordance with the design requirements;
- For installation of antenna bracket (for tower) on roof, full consideration should be given to the carrying capacity of the roof structure;
- Antenna bracket (tower) installed on roof should not damage the original waterproof layer of the building. If damaged, waterproof handling should be made;
- Stay wire rope used for fastening of antenna bracket (for tower) should satisfy requirement of pulling force and be adjusted with the degree of its tightness;
- The depth of stay wire should accord with requirement, and the deviation should not exceed 5cm. The deviation of pull distance should not exceed 10cm;
- Antenna bracket (for tower) must be of certain strength and stableness, and satisfy the wind resistance requirement after installation of equipment and safety requirement of operation on the tower.
- Basic abutment plate should be installed according to designed elevation and be adjusted well with its level. Fill the cement under the plate.
- There should be no oil paint on the flange plate to maintain good electric contact;
- The connection bolts should be all fastened. Sufficient measures should be taken to avoid looseness. Stay wire should be adjusted to reach the vertical degree specified in the design;
- Tower shoe should be installed at the position required in the

design;

- Pilot assembly must be made before the installation of tower combined in separate parts. The deviation of screw aperture position must be less than 2mm;
- Effective lightning conductor must be installed in iron tower.

6. Site Opening & Debugging

Site opening work flow chart:



6.1 Tools for Opening

- One spectrum analyzer or spectrometer;
- One signal source;
- One set of special tool;
- One VSWR tester;
- Alcohol and absorbent cotton;

- Several jumpers and adapters;
- Several attenuators;
- One set of route tester

6.2 Details for Opening

6.2.1 Check on Process

Quality check shall be carried out based on quality standards of Hongxin while completing check on technical index of the project.

- VSWR test: VSWR test shall be implemented by means of trouble positioning and test results shall be recorded in details. Requirements: VSWR of antenna feeder system tested by equipment ports≤1.4.
- Process of antenna installation: installation shall be implemented correctly and securely and ensure the position and direction for installation are correct and azimuth angle of antenna shall be recorded (azimuth with true north as 0^{o})
- Process of equipment installation: ensure the equipment is installed securely, height and location of installation are exact without causing damage to cabinet appearance; equipment be installed within cabinet with power clamper fastened within equipment; connected with feeder line and marks be correct; correct connection with power supply to provide safety and reliability.
- Cable laying: ensure cables are laid smartly, waterproof treatment of connecter is sound and lightening arresting measures are adopted.
- Marks: Correct and easy for examining;

- Connection: Correct and secure;
- Wiring: Secure connection, sound fastening, straight, smart and reasonable wiring to which big elbows shall not be allowed, wiring shall be fastened with clips or bandage.
- Grounding: Sound grounding of antenna, feeder and mainframe, which complies with three points grounding;
- It OMC mentioned above shall conform to construction process hereto. Rectification and improvement shall be made if requirements above are not satisfied till improvements conform to construction specifications and requirements presented by the owner.

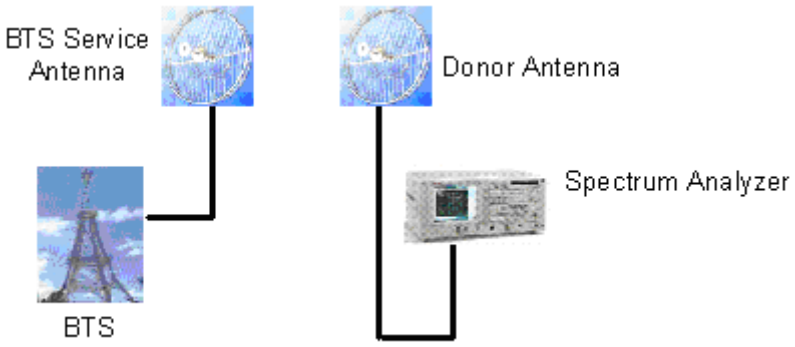
6.2.2 Implementation of Equipment Test

Efforts shall be made to ensure whether performance index of equipment is affected or not in process of transportation and installation and signal source is checked. Check shall be conducted on signal source (donor antenna or wired coupling) to see whether it works normally or the transmission hits targets.

Equipment test: main equipment shall be powered on for line up, through which, Owner's requirements on various index shall be satisfied to ensure minimum interference to the system from the main equipment, meanwhile, records shall be done.

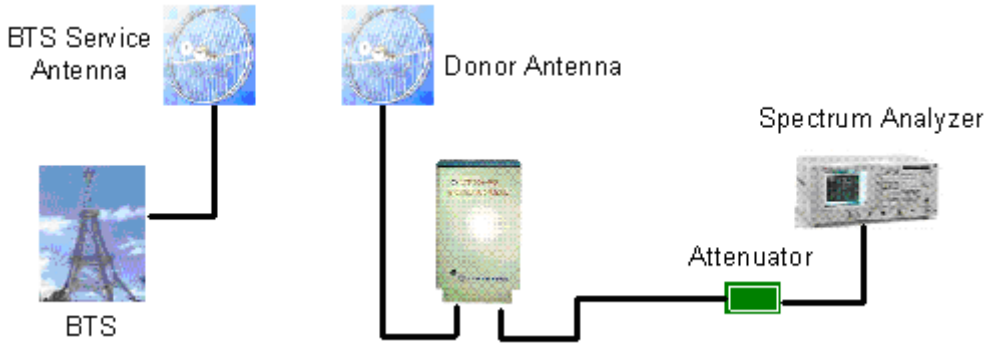
a. Input power of local equipment;

Receiving power from BTS;

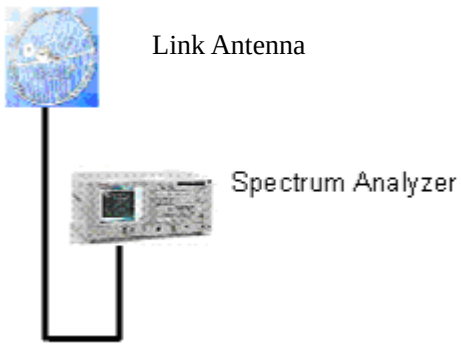


Index: receiving power of donor antenna shall be higher than –75dBm.

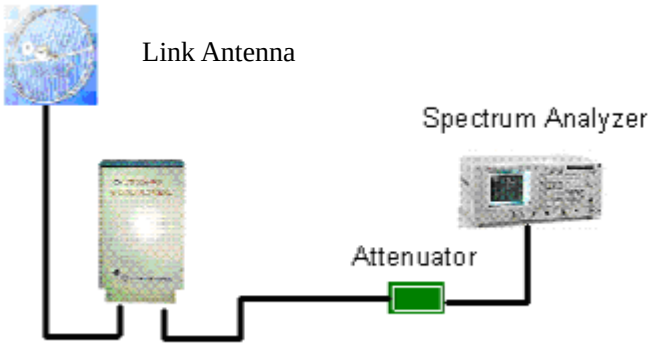
b. Diagram of output power test of local equipment downlink;



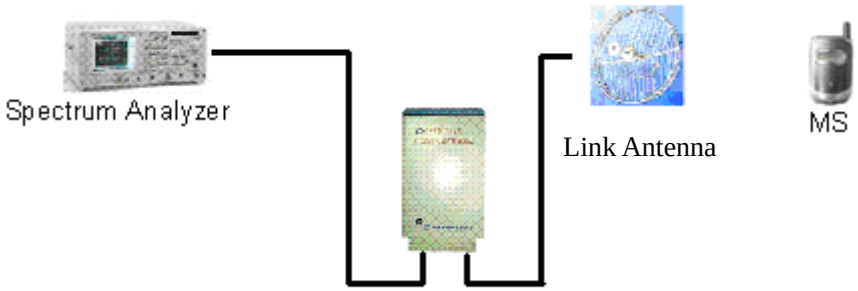
c. Input power of remote equipment;



d. Diagram of output power test of remote equipment downlink;



e. Noise figure test of the system;



6.2.3 Implementation of System Test

GZF9183-V debugging (GSM)

- Signals received within outdoor coverage system by donor antenna shall be tested with spectrometer to ensure quality of signals received and that strength of signals meets requirements of index, reaching -85~-55dBm;
- Downlink Signal which is amplified in the repeater should be measured at the antenna port which is connected with service antenna, the signal power shall be 33~45dBm based on the type of downlink PA;

- Uplink signal received by service antenna shall be measured by spectrometer after it pass the service antenna to ensure whether it is good enough to be amplified, the power value shall between -85~-55dBm;
- Uplink signal which is amplified in the repeater shall be measured by spectrometer in the antenna port which is connected with donor antenna. The value shall be 27~33dBm based on the type of uplink PA;
- Downlink output shall be measured by spectrometer and downlink gain shall be adjusted to ensure strength of output signals reaches 43dBm—the nominal value of the equipment;
- The isolation between uplink and downlink shall be measured, the value shall be at lest 120dB;
- VSWR of antenna feeder system within working frequency shall be measured by means of length measuring methods with VSWR tester (typically <1.4) to ensure the antenna feeder system works normally;
- Input power of antenna shall be measured with spectrometer to ensure it meets design requirements.

Test of monitoring system

Mainly perform tests on reliability and accuracy of monitoring system as well as integrity of function, meantime, make detailed record about them.

6.2.4 Implementation of Network optimization

a. Test of antenna power

Input power of each antenna port shall be tested prior to formal opening and test results recoded in detail shall be taken along with design plan as basis for evaluation on check and acceptance of construction quality and the owner.

b. Route test

- Coverage situation after completion of the project shall be tested and analysed through testing software. Effects upon completion shall be described in terms of coverage and quality and at the same time switching between area covered and those uncovered shall be tested to ensure the system exerts no effects on targets to be covered. Test data cleared up shall be compared with those prior to coverage, results of which shall be adopted as evaluation basis for check and acceptance to be conducted by the owner.
- Test instrument: spectrometer, Pilot premier test software, Notepad, Mobile phone to be tested, GPS and digital camera;

c. Content for test

 Location and panorama of project: Data shall be collected by means of GPS and digital camera.

 Test of coverage quality within coverage area

Premier software for dialling test shall be used to test route coverage and coverage peripheries shall be tested.

- Field strength of coverage: Premier for data test shall be adopted to test field strength within area tested, basis of which shall be plan design standard or standards set by the owner. As for outdoor coverage design, signal strength received by mobile phone tested is normally no less than –70dBm within 85% of area coverage and no less than –80dBm within 90% of area coverage

any spots in coverage in principle and field strength of coverage shall meet standards specified in design plan and set by the owner;

- Speech quality: ≤4 grade within 95% of the total;
- Access success ratio within wireless coverage: it is required that mobile station may be switched to network in 95% of the positions of cover area and 99% of time-limit;

 Data collection of equipment room of base station

It is necessary to understand and make statistics on data of signal source base station of equipment upon opening of the system and effects on base station from data shall be observed. Parameters shall be readjusted timely when abnormal circumstance occurs.

6.2.5 Collection of Opening Data

a. Sorting of test data

Data to be cleared up include at least the following:

- Data for equipment test
- Data for system test
- Data for route test
- Statistics data for equipment room

Data above shall be submitted to the Owner as evaluation basis.

b. Opening report

All documentation shall be cleared up and summarized as opening report for the project when each index is confirmed to meet requirements presented by the Owner or included in *Construction Specifications of Outdoor Repeater* and *Opening Specifications of Outdoor Repeater* prepared by WRI Hongxin.

Opening reports include:

- Implementation scheme of the Project;
- List of equipment, main materials and assisting materials;

- Amendments and causes of plan: describe it OMC to be changed and causes for such changes in construction in detail;
- Working index of main equipment: including all index of main equipment to be tested as required by opening specifications.
- Test data includes VSWR test data, output power of equipment, input power of donor antenna and test data for uplink noise floor of equipment. Premier test software is recommended for DT dialling test, which includes RxLevsub of coverage area and route map and statistic report list of such data as RxQualSub, Handover and Cell Reselect data.
- Issues in suspension in project: it is required to clarify in detail issues unspecified in the project.

7. System Maintenance

It is unnecessary to shut down the equipment without special need once the equipment is put to use. Therefore, equipment must be used in ventilated and clean environment, avoiding dust from entering the equipment, consequently causing damage.

The equipment must be shut down immediately for maintenance once abnormities incur (such as noise from module increases or odor appears). Check if the antenna fails to receive signal due to the change of angle when the signals can no be received or received poorly while the equipment is found to work with normality. Adjust antenna and re-fix it when it is found with changed angle.

When the equipment is working normally, do not touch the joints between equipment if not necessary so as to prevent joints from getting loosened and improperly contacted. When equipment fails, user must turn it off and notify our company. It is not allowed to take apart the joints between the equipment or to turn on the equipment, to avoid accident. Please contact WRI Hongxin Co. if you have any questions.

8. Precautions

- The products of our company have been tested and aged before delivery so as to ensure quality.
- The products are sealed upon delivery and no units or individuals are allowed to unseal them without the authorization of our company. Our company shall not be liable for any consequences caused due to the unauthorized start of the product.
- Check all the attached accessories by packing list upon reception of the equipment of our company. Contact the supplier in time for any shortage.
- Our company owns the property right of our products which is protected by State law. No units or individuals are allowed to copy them. Our company shall investigate any of these actions for their legal responsibilities and reserves the right to claim for economic losses duly suffered.

9. Transportation & Storage

9.1 Transportation

The GZF9183-V Repeater is encased in three layers in delivery. The inlayer is a moisture-proof/water-proof plastic bag, the middle layer is a shockproof plastic foam card, and the outer layer is an aluminium-mould box. The GZF9183-V Repeater can be transported via the truck or train, avoiding rough loading/unloading, case upside-down, severe squeezing, direct exposure to the rain or snow, and mechanical damage.

9.2 Storage

The GZF9183-V Repeater should be placed in the original packing box before it is used. The storage environment requires that the temperature should be 25°C ~+65°C and the relative humidity should not be greater than 95%. There should be free of harmful gas or combustible, explosive and corrosive chemical materials, and there is no violent mechanical vibration or shock, and no strong magnetic field exists. The storehouse should be kept in good ventilation.

10. Appendix Terms & Abbreviations

Abbreviation	Full-name
AGC	Automatic Gain Control
ALC	Automatic Level Control
ATT	Attenuator
BSC	Base Station Controller
BTS	Base Transceiver Station
COVERAGE ANT	Coverage Antenna or Service Antenna
DONOR ANT	Donor Antenna
DLX	Duplexer
FLT	Filter
GSM	Global System for Mobile
HPA	High Power Amplifier
IMD3	3 rd order Intermodulation Distortion
LNA	Low Noise Amplifier
MSC	Mobile Switching Center
Min Rx Lev	Minimum Receive Level
HPA	High Power Amplifier
REPEATER	Repeater
SNR	Signal Noise Ratio
VSWR	Voltage Standing Wave Ratio