Table of Contents

Chapter 1 System Overview

1.1 Introduction

The Mobile Communication System has experienced the first generation (analog system) and the second generation (digital system). As the one of the main development trends of the second generation, cdma2000 1X mobile communication system has been widely used for commercial purpose.

This section first introduces the network solution of Huawei cdma2000 1X mobile communication system, and then the market orientation of Huawei base station ODU3601C.

1.1.1 Network Solution of cdma2000 1X System

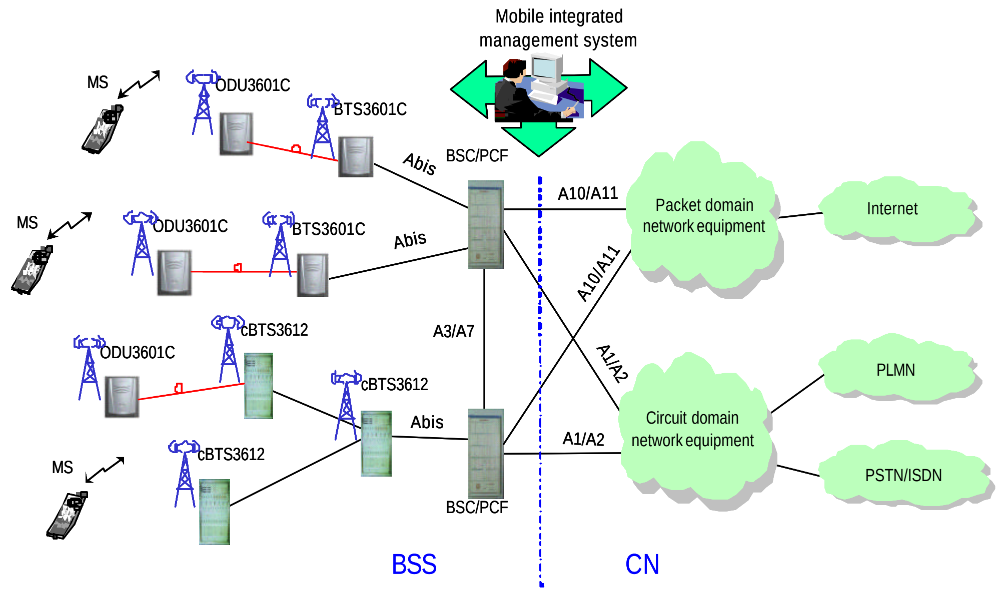
The cdma2000 1X mobile communication system comprises the Base Station Subsystem (BSS) and the Core Network (CN).

The BSS comprises the Base Transceiver Station (including ODU3601), Base Station Controller (BSC), and Packet Control Function (PCF) which is usually integrated with BSC.

The CN comprises the packet domain network and circuit domain network. The equipment of packet domain interworks with Internet, and that of the circuit domain interworks with the conventional PLMN and PSTN/ISDN.

The system's operation and maintenance is implemented via Huawei integrated mobile network management system iManager M2000.

Position of ODU3601C in the network is shown in Figure 1-1.



MS: Mobile Station
ISDN: Integrated Services Digital Network
PSTN: Public Switched Telephone Network
BSS: Base Station Subsystem
BSC: Base Station Controller
PLMN: Public Land Mobile Network
PCF: Packet Control Function
CN: Core Network

Figure 1-1 Network structure of Huawei cdma2000 1X mobile communication system

- ODU3601C

ODU3601C is an outdoor one-carrier soft base station. It shares the baseband processing resource and main control clock resource with its upper-level BTS. It implements radio signal transmission and reception together with the upper-level BTS under the control of BSC.

- BTS3601C

BTS3601C is an outdoor one-carrier BTS. It transmits/receives radio signals so as to realize the communication between the radio system and the Mobile Station (MS).

- cBTS3612

cBTS3612 is a set of indoor BTS equipment. The maximum capacity of single cabinet contains 12 sector carriers. Same with BTS3601C, it also transmits/receives radio signals to accomplish the communication between the radio system and the MS.

- Base Station Controller (BSC)

BSC performs the following functions: BTS control and management, call connection and disconnection, mobility management, power control, and radio resource management. It provides stable and reliable radio connections for the upper-level services through soft/hard handoff.

- Packet Control Function (PCF)

PCF is used for the management of Radio-Packet (R-P) connection. As radio resources are limited, they should be released when subscribers are not sending or receiving information, but the Point-to-Point Protocol (PPP) connection must be maintained. PCF shields the radio mobility against the upper-level services through the handoff function.

- Mobile Station (MS)

MS is a set of mobile subscriber equipment that can originate and receive calls, and can communicate with BTS.

1.1.2 Market Orientation of ODU3601C

Huawei ODU3601C is fully compatible with IS-95A/B and IS-2000 standards.

As illustrated in Figure 1-1, ODU3601C is located between other BTS (such as BTS3601C and cBTS3612) and the MS. It is connected to the upper-level BTS (master BTS) with optical fibers, equivalent to the function of the Radio Frequency (RF) module of the upper-level BTS installed far away.

ODU3601C is an outdoor base station, configured with only one carrier. It features small size, easy installation, flexible networking, less investment and fast network construction. ODU3601C can be used in residential quarters and urban hot spots / blind spots, and provide small-capacity wide-coverage for remote areas (such as rural area, grassland, highway, scenic spots).

ODU3601C shares the clock resource of the upper-level BTS, so no satellite antenna is needed. This feature makes ODU3601C an attractive application in indoor and underground environment where the installation of satellite antenna is difficult.

1.2 System Feature

I. Easy installation

Featuring small size, light weight and mains supply, ODU3601C does not require an equipment room or air conditioner. It neither requires a special tower as it can be easily installed on a metal post, stayed tower or on the wall. All these can reduce the site construction cost without affecting the network quality.

II. Wide application scope

ODU3601C is dust-proof, anti-burglary, water-proof, and damp-proof. With its protection performance in compliance with the IP55 (IEC 60529: Degrees of protection provided by enclosure), it operates normally in different whether conditions.

III. Flexible coverage schemes

ODU3601C shares the baseband subsystem of master BTS for service processing. The I/Q digital modulated signals are transmitted between the ODU3601C and the master BTS through the optical fibers. ODU3601C supports various cascading methods with the master BTS to achieve flexible network coverage.

The cascading distance can be either 10km or 70km, depending on the optical interface module used. For BTS3601C, total two ODU3601Cs can be cascaded, and the second ODU3601C can be placed 60km away. For cBTS3612, total six ODU3601Cs can be cascaded, and the sixth ODU3601C can be placed 90km away.

IV. Synchronization within the whole network

By adopting the automatic delay compensation technique developed by Huawei, the master BTS provides ODU3601C with precise clock synchronization signals via optical fibers. No GPS antenna is needed. This ensures synchronization within the whole network and lowers call drop ratio during handoffs.

V. Unified network planning

Though a logical base station, ODU3601C can be regarded as a normal entity in network planning, as it can be upgraded to be an independent cBTS3601C by adding the Micro-bts Baseband Processing Module (MBPM).

VI. Softer handoff

ODU3601C and the master BTS may cover neighboring cells. As the baseband processing of ODU3601C is implemented by the resource pool of the master BTS, the co-frequency handoff between the ODU3601C and the master BTS is the softer handoff.

VII. Support for multi-bands

ODU3601C supports 450MHz and 800MHz bands, therefore, it can be applied in the 450MHz communication system and the 800MHz communication system.

1.3 Technical Index

The technical indices include engineering, protection and performance indices.

The engineering indices include power supply, power consumption, weight, dimensions and other indices involved in engineering installation.

The protection indices refer to the capabilities of the main external interfaces against surge current.

The performance indices refer to the technical parameters of its receiver/transmitter and the reliability indices of the whole system.

1.3.1 Engineering Index

Power supply	~220V (150~300V AC)
Power consumption	<300W (In normal temperature, while the heating plate is not working) <500W (In low temperature, while the heating plate is working)
Weight	<40kg
Operation environment	Temperature: -40°C~55°C Relative humidity 5%~100%
Cabinet dimensions (height× width×depth)	700mm×450mm×330mm

1.3.2 Protection Index

E1 interface	Differential mode 5kA, or common mode 10kA surge current
RF feeder interface	Differential mode 8kA, or common mode 8kA surge current
AC power supply interface (for connecting AC lightning protection box)	Differential mode 40kA, or common mode 40kA surge current
Satellite feeder interface (for connecting lightning arrestor for satellite feeder)	Differential mode 8kA, or common mode 8kA surge current

1.3.3 Performance Index

I. Transmission

- 450MHz band

Working frequency	460~470MHz
Channel bandwidth	1.23MHz
Channel precision	25kHz
Frequency tolerance	≤±0.05ppm
Transmit power	20W (the maximum value measured at the cabinet-top feeder port)

- 800MHz band

Frequency coverage	869~894MHz
Channel bandwidth	1.23MHz
Channel step length	30kHz
Frequency tolerance	≤±0.05ppm
Transmit power	20W (the maximum value measured at the cabinet-top feeder port)

II. Reception

- 450MHz band

Working frequency	450~460MHz
Channel bandwidth	1.23MHz
Channel precision	25kHz
Signal receiving sensitivity	-127dBm (RC3, and main and diversity reception)

- 800MHz band

Working frequency	824~849MHz
Channel bandwidth	1.23MHz
Channel step length	30kHz
Signal receiving sensitivity	-128dBm (RC3, and main and diversity reception)

III. System reliability

Mean Time Between Failures (MTBF)	≥100,000 hour
Mean Time To Repair (MTTR)	≤1 hour
Availability	≥99.999%

1.4 External Interface

1.4.1 Um Interface

I. Overview

In Public Land Mobile Network (PLMN), MS is connected with the fixed part of the network through the radio channel. The radio channel allows the subscribers to be connected with the network and to enjoy telecommunication services.

To implement interconnection between MS and BSS, systematic rules and standards should be established for signal transmission on radio channels. The standard for regulating radio channel signal transmission is called radio interface, or Um interface.

Um interface is the most important interface among the many interfaces of CDMA system. Firstly, standardized radio interface ensures that MSs of different manufacturers are fully compatible with different networks. This is one of the fundamental conditions for realizing the roaming function of CDMA system. Secondly, radio interface defines the spectrum availability and capacity of CDMA system.

Um interface is defined with the following features:

- Channel structure and access capacity.
- Communication protocol between MS and BSS.
- Maintenance and operation features.
- Performance features.
- Service features.

II. Um interface protocol model

Um interface protocol stack is in 3 layers, as shown in Figure 1-2.

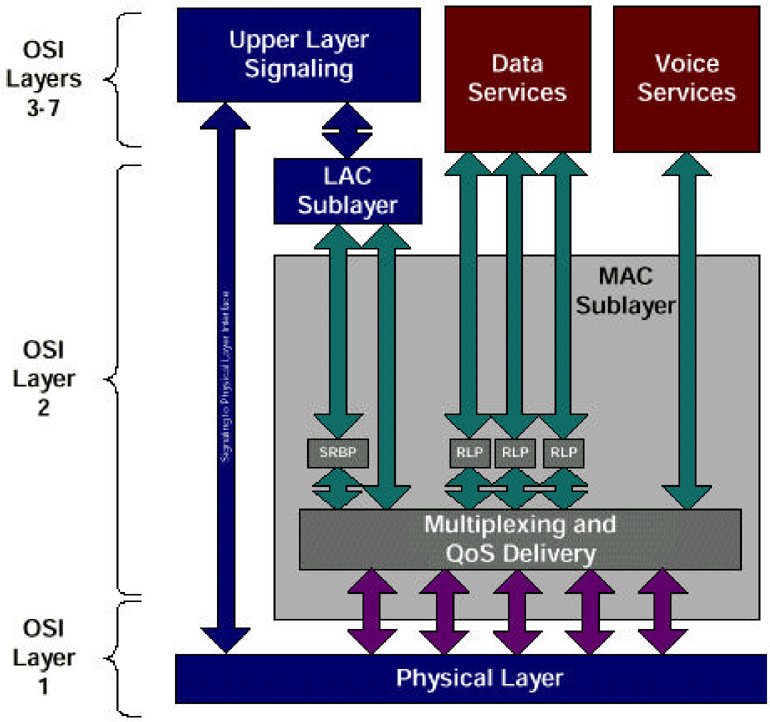


Figure 1-2 Um interface layered structure

Layer 1 is the physical layer, that is, the bottom layer. It includes various physical channels, and provides a basic radio channel for the transmission of higher layer information.

Layer 2 is the data link layer, including Medium Access Control (MAC) sublayer and Link Access Control (LAC) sublayer. The MAC sublayer performs the mapping between logical channels and physical channels, and provides Radio Link Protocol (RLP) function. The LAC sublayer performs such functions as authentication, Automatic Repeat Request (ARQ), addressing and packet organization.

Layer 3 is the top layer. It performs Radio Resource Management (RM), Mobility Management (MM) and Connection Management (CM) through the air interface.

III. Physical layer

1) Working band

Band	Forward band	Reverse band	Duplex spacing	Channel width	Carrier spacing
450MHz	460 - 470MHz	450 - 460MHz	10MHz	1.23 MHz	1.25 MHz
800MHz	869 - 894 MHz	824 - 849 MHz	45MHz	1.23 MHz	1.23 MHz

2) Physical layer function

- Service bearer: the physical channel in the physical layer provides bearer for the logical channel of the higher layer.
- Bit error check: the physical layer provides transmission service with error protection function, including error checking and error correction.
- User identification: the physical layer provides an exclusive ID for every user by code division.

3) Radio configuration

The physical layer supports multiple Radio Configurations (RCs). Different RCs support different traffic channel data rates. For detailed introduction, please refer to Section 3.1.5 Radio Configuration and Channel Support.

IV. Data link layer

Data link layer at Um interface includes two sublayers, MAC and LAC. The purpose of introducing MAC and LAC is to:

- Support higher level services (signaling, voice, packet data and circuit data).
- Support data services of multiple rates.
- Support packet data service and circuit data service of higher quality (QoS).
- Support multi-media service, that is, processing voices, packet data and circuit data of different QoS levels at the same time.

1) MAC sublayer

To support data service and multi-media service, cdma2000 1X provides powerful MAC layer to ensure the reliability of services. MAC layer provides two important functions:

- Radio Link Protocol (RLP), ensuring reliable transmission on the radio link.

- Multiplex function and QoS function, with diversified services and higher service quality.

2) LAC sublayer

LAC layer performs such functions as Automatic Repeat Request (ARQ), authentication and addressing.

V. Layer 3

The higher layer signaling performs the functions such as radio resource management, mobility management and call connection management on air interface.

1) Radio resource management

The radio resource management functions include:

- Radio channel management

It is used to establish, operate and release radio channels, and help to realize soft handoff, softer handoff and hard handoff.

- Power control

Various power control technologies are used on Um interface to reduce the system interference and improve the system capacity.

2) Mobility management

It is used to support the mobility features of the mobile subscriber, performing such functions as registration, authentication and Temporary Mobile Subscriber Identity (TMSI) re-allocation.

3) Connection management

It is used to setup, maintain and terminate calls.

1.4.2 Baseband Data Interface

ODU3601C communicates with the upper-level BTS through the baseband processing interface.

This interface adopts optical fibers to transmit I/Q digital modulated signals, and supports various cascading modes. For details, please refer to Section 1.2 System Feature.

The baseband data interface adopts automatic delay compensation technique. The precise clock synchronization signal is provided by the master BTS through the optical fiber.

1.4.3 Other Interface

I. Test interface

The test interface provides 10MHz and 2s signals through MTRM that may be needed for test instruments.

II. Power supply interface

ODU3601C supports 220V AC power supply. It provides external 220V AC interface and 24V DC battery interface.

1.5 Reliability Design

Reliability design of a system is shown in the stability and reliability of the product during operation.

Huawei ODU3601C is designed based on the following standards:

- *TIA/EIA/IS-95A CDMA Radio Interface Specifications*
- *TIA/EIA/IS-95B CDMA Radio Interface Specifications*
- *TIA/EIA/IS-2000 CDMA Radio Interface Specifications*
- *TIA/EIA/IS-97D CDMA Base Station Minimum Performance Standard*
- *Huawei product reliability design index and related technical specifications*

With various measures taken, the design of boards is in strict accordance with the requirement of above standards pertaining to reliability.

1.5.1 Hardware Reliability Design

I. De-rating design

To improve system reliability and prolong the service life of components, components are carefully selected and strictly tested, and less stress (electrical stress and temperature stress) is to be borne in actual operation than its designed rating.

II. Selection and control of component

The category, specifications and manufacturers of the components are carefully selected and reviewed according to the requirements of the product reliability and maintainability. The replace ability and normalization of components is one of the main factors for the decision, which help to reduce the types of components used and hence improve the availability of the system.

III. Board level reliability design

Many measures have been taken in board design to improve its reliability. Redundancy configuration is applied for key components to improve system reliability.

- Key circuits are designed by Huawei, which lays the foundation of high reliability.
- The hardware WATCHDOG is equipped for the board, and the board can automatically reset in case of fault.
- The board is provided with the functions of over-current and over-voltage protection and the function of temperature detection.
- Strict thermal analysis and simulation tests are conducted during the design of boards for the purpose of ensuring longtime operation.
- The board software and important data is stored in the non-volatile memory, so that the board can be restarted when software upgrading fails.

IV. Fault detection, location and recovery

The BTS system is equipped with the functions of self-detection and fault diagnosis that can record and output various fault information. Common software and hardware faults can be corrected automatically.

The hardware fault detection functions include fault locating, isolating and automatic switchover. The maintenance engineers can identify the faulty boards easily with the help of the maintenance console.

The ODU3601C system also supports the reloading of configuration data files and board execution programs.

V. Fault tolerance and exceptional protection

When faults occur, the system usually will not be blocked.

The system will make a final confirmation on a hardware fault through repeated detection, thus avoiding system reconfiguration or QoS deterioration due to contingent faults.

VI. Thermal design

The influence of temperature on the ODU3601C has been considered in the design.

Thermal design primarily concerns the selection of components, circuit design (including error tolerance, drift design and derating design), structure design and heat dissipation, so that the ODU3601C can work reliably in a wide range of temperatures.

The first consideration in thermal design is to balance the heat distribution of the system. Corresponding measures are taken in the place where heat is more likely to be accumulated.

VII. Maintainability

The purpose of maintainability design is to define the workload and nature of the maintenance, so as to cut the maintenance time. The main approaches adopted include standardization, modularization, error prevention, and testability improvement, which can simplify the maintenance work.

VIII. EMC design

The design ensures that ODU3601C will not degrade to an unacceptable level due to the electromagnetic interference from other equipment in the same electromagnetic environment. Neither the ODU3601C will cause other equipment in the same electromagnetic environment to degrade to an unacceptable level.

IX. Lightning protection

To eliminate the probability of lightning damage on the ODU3601C system, proper measures are taken with respect to the lightning protection for DC power supply and antenna & feeder system. For details, please refer to "3.3 Lightning Protection".

1.5.2 Software Reliability Design

Software reliability mainly includes protection performance and fault tolerance capability.

I. Protection performance

The key to improve software reliability is to reduce software defects. Software reliability of ODU3601C is ensured through the quality control in the whole process from system requirement analysis, system design to system test.

Starting from the requirement analysis, software development process follows the regulations such as Capability Mature Mode (CMM), which aim to control faults in the initial stage.

In software design, much attention is devoted to the designing method and implementation: the software is designed in a modular structure, and in a loose coupling mechanism. When a fault occurs to one module, other modules will not be affected. In addition, preventive measures such as fault detection, isolating and clearing are also applied to improve the system reliability. Other effective methods include code read-through, inspection, and unit test.

Various software tests are conducted to improve the software reliability. Test engineers participate the whole software development process, from unit test to system test. They make plans strictly following the demand of the upper-level flow, which ensure the improvement of software reliability. Additionally, test plans are modified and improved with the tests.

II. Fault tolerance capability

Fault tolerance capability of the software system means that the whole system would not collapse when a minor software fault occurs. That is, the system has the self-healing capability. The fault tolerance of BTS3601 software is represented in the following aspects:

- All boards work on a real-time operating system of high reliability.
- If software loading fails, the system can return to the version that was successfully loaded last time.
- Important operations are recorded in log files.
- Different authority levels are provided for operations, so as to prevent users from performing unauthorized operations.
- Warnings are given for the operations that will cause system reboot (such as reset operation). The operator is required to confirm such operations.

Chapter 2 Hardware Architecture

2.1 Overview

2.1.1 Appearance

I. Cabinet appearance

Figure 2-1 shows the appearance of an ODU3601C cabinet. The cabinet dimensions are: 700mm × 450mm × 330mm (height × width × depth).

Figure 2-1 ODU3601C cabinet

II. Cabinet feature

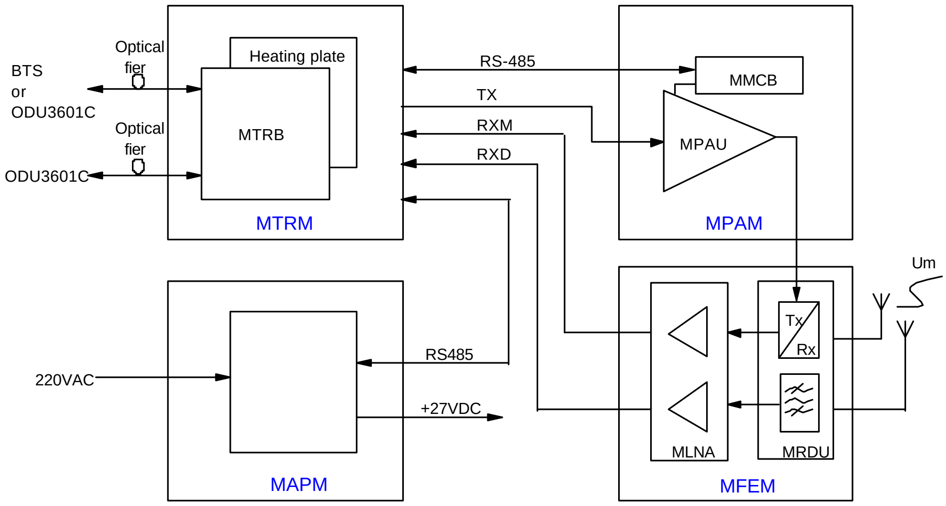
- Excellent electrical conductivity and shielding effect.
- Equipped with thermal tube for heat exhaustion, free of noise
- Water-proof, sun-screening, anti-burglary features make it suitable for outdoor installation.

- Small size, light weight and attractive appearance.
- Modular structure, making installation and maintenance easy.

2.1.2 Functional Structure

The ODU3601C has a compact and highly integrated structure. It consists of Micro-bts Transceiver Module (MTRM), Micro-bts Power Amplifier Module (MPAM), Micro-bts Radio Frequency Front End Module (MFEM), Micro-bts Ac-dc Power supply Module (MAPM), and the antenna & feeder system.

The functional structure is shown in Figure 2-2.



MTRB: Micro-bts Transceiver Board
MPAU: Micro-bts Power Amplifier Unit
MPAM: Micro-bts Power Amplifier Module
MRDU: Micro-bts Divide And Duplexer Receive Filter Unit
MLNA: Micro-bts Low-Noise Amplifier
MTRM : Micro-bts Transceiver Module
MMCB: Micro-bts Monitor & Control Board
MAPM: Micro-bts Ac-dc Power Supply Module
MFEM: Micro-bts Radio Frequency Front End Module

Figure 2-2 Functional structure of ODU3601C

ODU3601C performs the functions of RF signal transceiving and amplification, and the conversion of baseband signals. The functions of various modules are detailed in the following sections.

2.2 MTRM

Micro-bts Transceiver Module (MTRM) consists of MTRB and heating plate.

The heating plate ensures that MTRB can start and operate normally in low temperature.

MTRB modulates/demodulates baseband I/Q signals, performs up/down conversion, and supports the function of cascading via optical fiber.

2.2.1 Structure and Principle

MTRM consists of Micro-bts Intermediate Frequency Unit (MIFU) and Micro-bts Radio up-down Converter Unit (MRCU).

The functional structure is shown in Figure 2-3.

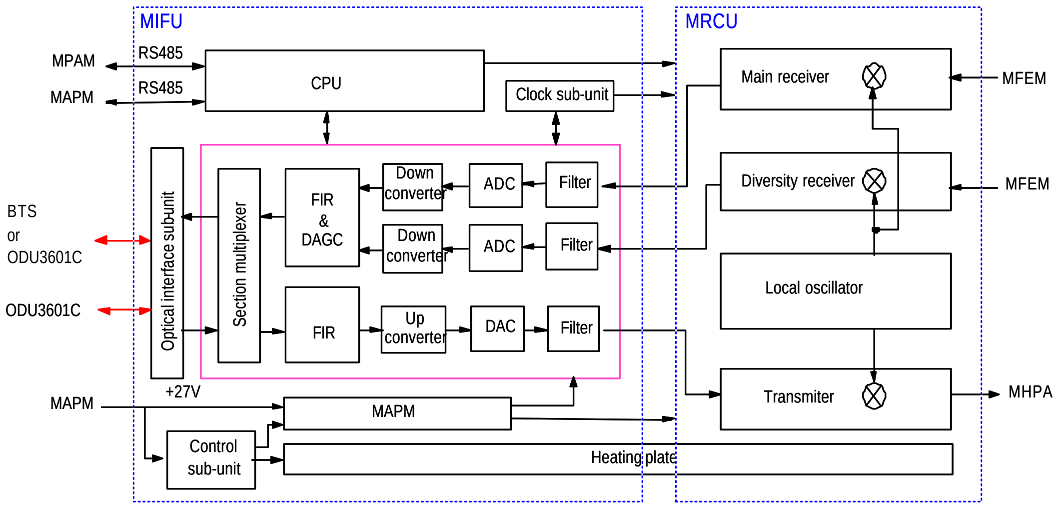


Figure 2-3 Functional structure of MTRM

I. MIFU

MIFU consists of up converter, down converter, multiplexer/demultiplexer, optical interface, clock, CPU, and power supply sub-units. It is in charge of the conversion between analog intermediate frequency signals and digital baseband signals, and the control of MTRB.

- Up converter

The up converter accomplishes wave filtering, digital up conversion and digital-analog conversion of the signals in the transmit path.

On receiving the baseband I/Q signals that have been de-multiplexed, it performs digital up conversion after baseband filtering. Then the digital intermediate frequency signals are converted into analog intermediate frequency signals after digital-analog conversion and wave filtering. At last, the analog intermediate frequency signals are sent to the transmitter in MRCU through Radio Frequency (RF) interface.

- Down converter

The down converter accomplishes the analog-digital conversion, digital down conversion and baseband filtering of the signals in the receive path.

On receiving the analog intermediate frequency signals from the radio interface, it converts them into digital intermediate frequency signals via analog-digital conversion. Then the digital intermediate frequency signals are converted into baseband I/Q signals via digital down conversion and baseband filtering. As last, the I/Q signals are transmitted to the demultiplexer/multiplexer.

- Demultiplexer/multiplexer

Under the control of the CPU, the demultiplexer/multiplexer de-multiplexes the forward I/Q signals, and multiplexes the reverse I/Q signals. At the same time, it multiplexes/de-multiplexes the Operation & Maintenance (O&M) signals of the OML.

- Optical interface sub-unit

This sub-unit consists of two optical interface modules. The optical interface modules perform channel coding/decoding, and accomplish optical-electrical and electrical-optical signal conversion. They are respectively connected with upper-level BTS (or ODU3601C) and the lower-level ODU3601C to realize optical fiber cascading.

If the upper-level BTS is cBTS3612, this optical interface sub-unit is connected to the BTS Resource Distribution Module (BRDM) optical interface of cBTS3612. If the upper-level BTS is BTS3601C or ODU3601C, it is connected to the Micro-bts Transceiver Module (MTRM) optical interface of BTS3601C or ODU3601C.

- Clock sub-unit

The clock sub-unit generates all the clocks needed by MIFU, including the clocks for up/down conversion, analog-digital conversion (ADC), and digital-analog conversion (DAC). At the same time, it also provides the reference clock for the MRCU.

- CPU

The CPU is in charge of the control of MTRB, including the initialization upon power-on, alarm collecting and reporting, and processing related O&M messages. The O&M messages are received from or sent to the upper-level BTS by the multiplex/demultiplex sub-unit of the digital MIFU.

- Control sub-unit and heating plate

The control sub-unit and the heating plate enable MTRM to start and normally operate in low temperature.

When the internal module temperature is lower than -5°C, the heating plate will be first started to heat the module. Other boards of the module will not be powered unless the module temperature rises to the set value.

- Power supply sub-unit

With input voltage of +27V, the power supply sub-unit provides power to MIFU and MRCU.

II. MRCU

MRCU consists of transmitter, main/diversity receiver and local oscillator. It up-converts, amplifies, and performs spurious-suppressive wave filtering for the intermediate frequency signals output by MIFU. It also performs analog down-conversion, amplification, channel-selective wave filtering and receiving noise factor control over the main/diversity receiving signal input from the MFEM.

- Transmitter

On receiving the modulated analog intermediate frequency signals output by MIFU, the transmitter converts them to specified RF band after two times of up conversions. Before and after the up conversion, wave filtering, signal amplification and power control are performed so as to ensure that the output RF signals meet the protocol requirements on power level, Adjacent Channel Power Radio (ACPR) and spuriousness.

- Main/diversity receiver

The main/diversity receiver converts the RF signals output by MFEM to specified intermediate frequency signals via down conversion, and performs wave filtering, signal amplification and power control before and after the down conversion, so as to ensure that the intermediate frequency signals output can be received by MIFU.

- Local oscillator

The local oscillator consists of the intermediate frequency source and transmit/receive RF synthesizer. The intermediate frequency source generates the local frequency signals for intermediate frequency up conversion in transmit path. The RF synthesizer generates the local frequency signals for the up- conversion of the transmit path and the local frequency signals for the down conversion of main/diversity receive path.

2.2.2 External Interface

There are interfaces between MTRM and MPAM/MFEM, upper-level BTS, lower-level ODU3601C and power supply module.

- RF interface to MPAM

The RF transmitting signal is output via this interface to MPAM, where the signal is amplified and then output.

- RF interface to MFEM

The main/diversity RF receiving signal output by MFEM is received via this interface.

- Optical interface to upper-level BTS (or ODU3601C)

Through this interface, the ODU3601C shares the baseband processing resources of upper-level BTS, and performs the functions of receiving configuration messages, reporting alarm information, etc.

And the ODU3601C can also be casecaded to the upper-level ODU3601C through this interface.

- Optical interface to MTRM of lower-level ODU3601C

This interface is used to cascade ODU3601C.

- Alarm interface

MTRM is connected with MBKP through a connector. It collects the alarm information through the RS485 serial bus on MBKP sent by other modules, sends the information through the optical interface to the upper-level BTS.

This interface is also used to transmit control signals and power detection signals for MPAM.

- Power supply interface

This interface is used to supply power to MTRM.

2.2.3 Key Index

- Supported band: 450MHz band and 800MHz band
- Power supply: +27V DC
- Power consumption of MTRB: 40W; Power consumption of heating plate: 110W
- Module size: L × W × T = 430mm × 250mm × 65mm

2.3 MPAM

2.3.1 Structure and Principle

Micro-bts Power Amplifier Module (MPAM) consists of Micro-bts Power Amplifier Unit (MPAU) and Micro-bts Monitor & Control Board (MMCB).

The structure is shown in Figure 2-4.

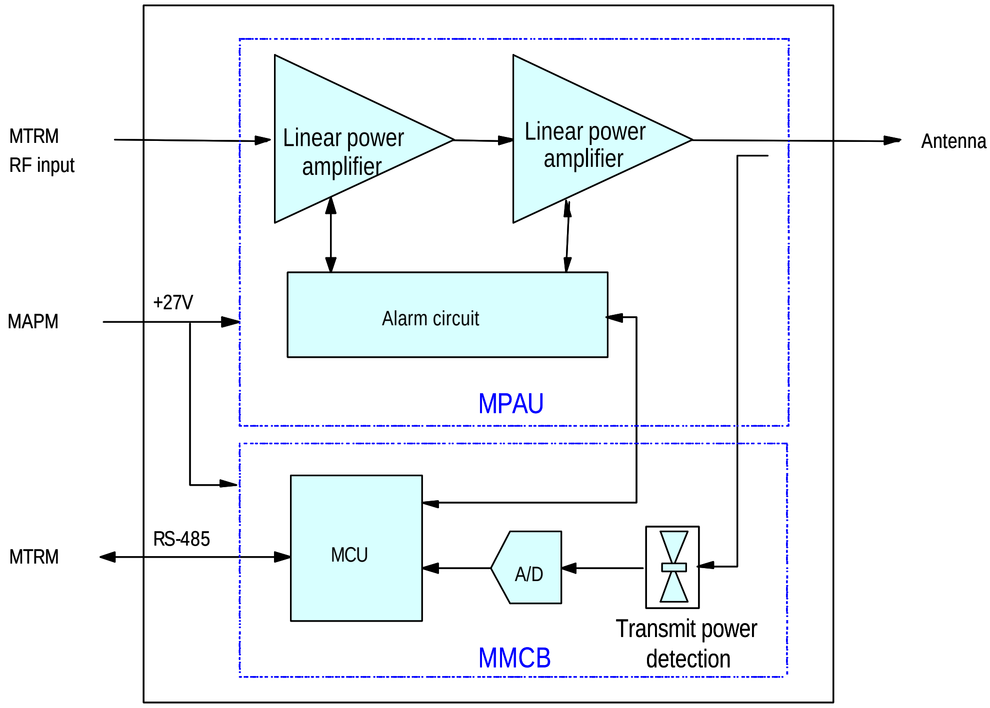


Figure 2-4 Structure of MPAM module

I. MPAU

MPAU consists of two parts: linear power amplifier and alarm circuit.

The power amplifier amplifies the RF signals from MTRM. The amplified RF signals are then sent to MFEM through the backplane.

The alarm circuit monitors the status of power amplifier and generates over-temperature alarm, over-excited alarm and gain decrease alarm signals when conditions satisfied. The alarm signals will be sent to MMCB, where they will be processed and reported to MTRM.

The output power of MPAU can be adjusted by controlling the RF output signal of MTRM.

II. MMCB

MMCB monitors the operation status of MPAU on the real-time basis, reports the detected alarm, measures the transmit power of MPAU, and accomplishes closed-loop power control for the front end RF channel to ensure a constant gain for the whole analog channel. It can also power off the amplifier as instructed.

2.3.2 External Interface

MPAM provides the following external interfaces:

- RF interface to MTRM

MPAM is connected with MTRM through RF cable and receives RF output signals from MTRM.

- RF interface to MFEM

MPAM is connected with MFEM through RF cable. It sends RF signals to MFEM, which will be finally transmitted through the feeder system.

- Alarm interface

MPAM module is connected with MBKP through a connector. It sends alarm signals through the RS485 serial bus on MBKP to MTRM for processing.

- Power supply interface

It supplies power to the module through MBKP.

2.3.3 Key Index

- Supported band: 450MHz band and 800MHz band
- Average output power: ⩾40W (for 450MHz band)

  ⩾28W (for 800MHz band)
- Power supply: +26V~+28V DC
- Power consumption: 230W
- Module size: L × W × T= 430mm × 250mm × 70mm (excluding heat tube radiator)

2.4 MFEM

2.4.1 Structure and Principle

Micro-bts Radio Frequency Front End Module (MFEM) consists of Micro-bts Divide and Duplexer Receive Filter Unit (MRDU) and Micro-bts Low-Noise Amplifier (MLNA).

The functional structure is shown in Figure 2-5.

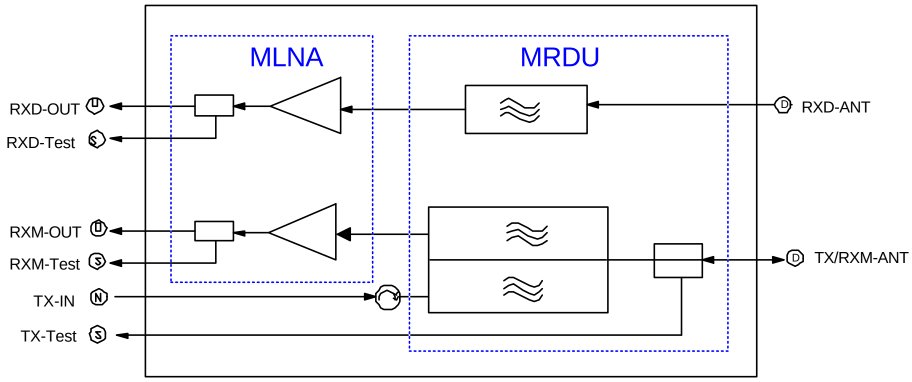


Figure 2-5 Structure of MFEM

I. MRDU

MRDU contains a duplexer and a diversity receive filter.

- Duplexer

The duplexer is used to isolate transmit signals and receive signals, suppress transmission spurious and reduce antenna quantity.

- Diversity receiving filter

Signals received from the diversity antenna are filtered first by the diversity receiving filter in MRDU, then sent to MLNA for low-noise amplification.

II. MLNA unit

This unit contains 2 independent low-noise amplifiers and a MLNA status detection unit.

- Low-noise amplifier

It performs low-noise amplification for main and diversity signals.

- MLNA status detection unit

The status monitoring circuit monitors the working voltage and current of MLNA, and triggers an alarm when fault is detected.

2.4.2 External Interface

MFEM is connected with the feeder and other modules through RF cables. It provides the following external interfaces:

- Interface to MPAM

On the transmit channel, MFEM receives RF signals amplified by MPAM, sends them through the duplexer of MRDU to the antenna system for transmission.

- Interface to MTRM

On the receive channel, MFEM receives main/diversity RF signals from the antenna system, and after low-noise amplification by MLNA, sends them to MTRM for processing.

- Interface to the antenna system
- RF signal monitoring port

On the RF signal monitoring ports, the transmit signal is coupled and output by MRDU, while the main/diversity receive signal is coupled and output by MLNA.

- Power supply interface

It supplies power to the module through MBKP.

2.4.3 Key Index

- Supported band: 450MHz band and 800MHz band
- Power supply: 20V~32V DC
- Power consumption: 11W
- Dimensions: L × W × T = 430mm × 250mm × 60mm

2.5 MAPM

2.5.1 Structure and Principle

The functional structure of MAPM is shown in Figure 2-6. MAPM consists of AC/DC converter, power monitor & control unit, and battery management unit.

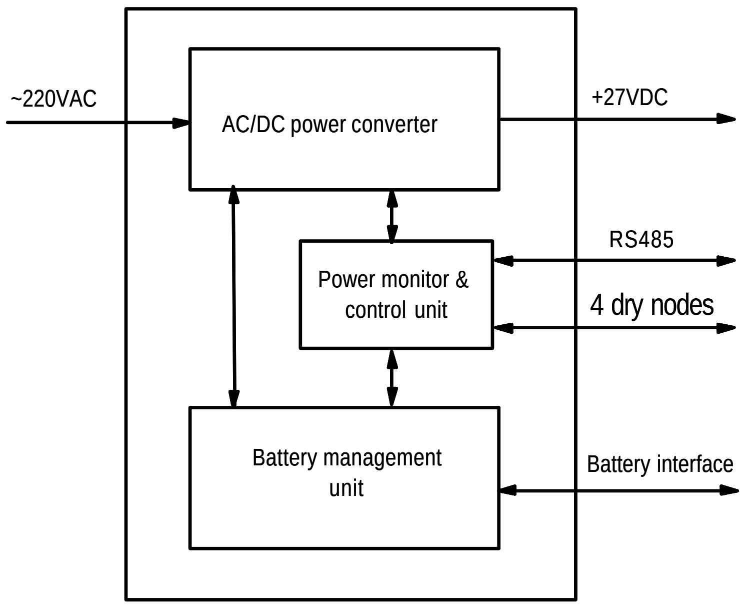


Figure 2-6 Structure of MAPM module

The AC/DC conversion unit converts ~220V AC power (mains) into +27V DC power.

The power monitor & control unit performs status detection and alarm reporting.

The battery management unit performs energy charging and discharging for batteries.

2.5.2 External Interface

The external interfaces of MAPM are shown in Figure 2-6.

- AC input interface

Local mains are input through this interface.

- DC output interface

This interface is connected with the MBKP through which it supplies 27V DC power to other modules.

- Battery interface

The external batteries can be connected with the MAPM through this interface so as to supply power to the ODU3601C in the case of AC power failure.

- Alarm interface

MPAM is connected with MBKP through a connector. It sends alarm signals through the RS485 serial bus on MBKP to MTRM for processing.

- Dry nodes

One of the four dry nodes is used to detect failure alarms of the AC lightning arrester, while the other three are used to monitor the Uninterrupted Power Supply (UPS).

2.5.3 Key Index

- Phases of AC input: Single phase
- Rated voltage of AC input: 220V AC
- Fluctuation range of AC input voltage: 150~300V AC
- Overvoltage protection point of AC input: 310V AC
- Undervoltage protection point of AC input: 140V AC
- Dimensions: L × W × T = 430mm × 250mm × 90mm

2.6 MBKP

The backplane ODU3601C is the same as that of BTS3601C. The only difference is that the slot 1 is not configured (with MBPM) when used for ODU3601C.

ODU3601C consists of four modules: MAPM, MTRM, MFEM, and MPAM. MBKP is used to connect these four modules.

The power supply module supplies +27V DC power to other functional modules through the MBKP.

The alarm signals of MPAM and MAPM are sent to MTRM through the RS485 bus on MBKP. MTRM then transmits the signals through the optical fiber to the upper-level BTS. The OMU of upper-level BTS processes these signals and sends them through OML to BSC.

2.7 Antenna and Feeder Subsystem

The clock synchronization signal of ODU3601C is provided by the upper-level BTS through the optical fiber. So the antenna and feeder system of ODU3601C only has RF antenna and has no dual-satellite synchronization antenna.

The antenna and feeder subsystem transmits the modulated RF signals and receives the signals from MS.

RF antenna & feeder is composed of the antenna, jumper from antenna to feeder, feeder, and the jumper from feeder to cabinet-top, as shown in Figure 2-7.

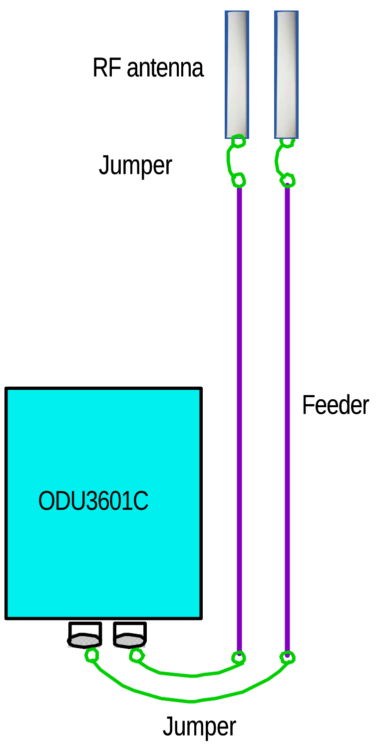


Figure 2-7 Structure of RF antenna & feeder

Note:

If the distance from the antenna to the ODU3601C cabinet is within 15 meters, jumpers can be used directly to connect the antenna and the cabinet. Detailed installation procedures are described in the Installation Manual.

I. Antenna

Antenna is the end point of transmitting and start point of receiving. Antenna type, gain, coverage pattern and front-to-rear ratio may affect the system performance. The network designer should choose antenna properly based on the subscriber number and system coverage.

1) Antenna gain

Antenna gain is the capability of the antenna to radiate the input power in specific directions. Normally, the higher gain, the larger coverage. But there may be blind area in the vicinity.

2) Antenna pattern

Antenna pattern describes the radiation intensity of the antenna in all directions. In the field of telecommunication, it usually means a horizontal pattern. BTS antenna is available in two types: omni antenna and directional antenna. The directional antenna includes the following types: 120°, 90°, 65° and 33°.

3) Polarization

Polarization is used to describe the direction of the electrical field. The mobile communication system often uses uni-polarization antennas. Bi-polarization antennae, with the two polarization directions perpendicular to each other, have been used recently to reduce the quantity of antennae.

4) Diversity technology

Electrical wave propagation in urban area has the following features:

- Field intensity value changes slowly with places and times. It changes in the rule of logarithmic normal distribution, which is called slow attenuation.
- Field intensity transient value attenuates selectively due to multi-path transmission. The attenuation rules falls in Rayleigh distribution, which is called fast attenuation.

Either fast attenuation or slow attenuation impairs the quality of communication or even interrupts the call. Diversity technology is one of the most effective technologies to tackle the problem. Diversity receiving and combining technology can be used to minimize the attenuation when there is little correlation between the two attenuated signals.

There are two types of diversity technologies: polarized diversity and space diversity.

In the present mobile communication system, horizontal space diversity and polarized diversity are both supported. Theoretical conclusion shows that space diversity is effective when the distance between two antennae is over 10 wavelengths.

Polarized diversity facilitates antenna installation and saves space, therefore it is used more and more extensively.

5) Antenna isolation

The receiving/transmitting antenna must be installed with sufficient isolation to minimize the effect on the receiver. The isolation space is subject to the out-band noise of the transmitter and the sensitivity of the receiver.

II. Feeder

Normally, the standard 7/8 inch or 5/4 inch feeders are used to connect the outdoor antenna and indoor cabinet. In the site installation, 7/16 DIN connectors should be prepared based on the actual length of feeders.

Three grounding cable clips for lightning protection should be applied at the tower top (or building roof), feeder middle, and the wall hole through which feeder is led indoor. If the feeder is excessively long, additional cable clips are needed.

Since 7/8 inch feeder should not be bent, the tower top (or building roof) antenna and the feeder, indoor cabinet and the feeder should be connected via jumpers. The jumpers provided by Huawei are 1/2 inch, 3.5m long, and with 7/16DIN connectors.

At the 450MHz band, the loss is about 2.65dB every 100m for 7/8 inch feeder, and about 1.87dB every 100m for 5/4 inch feeder.

At the 800MHz band, the loss is about 3.9dB every 100m for 7/8 inch feeder, and about 2.8dB every 100m for 5/4 inch feeder.

Chapter 3 System Function

3.1 RF Functions

ODU3601C shares the baseband processing resource with the upper-level BTS. Its RF functions are realized by working together with the upper-level BTS and BSC. It complies with the TIA/EIA IS-97-D specifications.

3.1.1 Power Control

CDMA system is a self-jamming system, in which every subscriber is an interference source to other subscribers. If it is possible to ensure that every MS transmits the minimum power it needs, the whole system capacity can be the largest. Therefore, power control directly affects the system capacity and the service quality.

I. Purpose

Power control is to

- Ensure conversation quality, meanwhile restrict the transmitting power on the forward and reverse links, thus minimizing the system interference.
- Overcome the far-near effect caused by the freely distributed mobile stations, so the signals of mobile stations whose distances to the BTS are different can reach the BTS with the same power.
- Realize the system soft capacity control.
- Prolong MS battery life.
- Minimize MS radiation to the human body.

II. Types

Power control can be divided into forward power control and reverse power control. The forward power control is used to control BTS' s transmit power, while the reverse power control aims to control MS' s transmit power.

1) Forward power control

Forward power control can be implemented with various methods, whose applications are subject to the MS protocol version and the system parameters.

- Power control based on Power Measurement Report Message (PMRM)

In PMRM-based power control, the MS determines the method and frequency of reporting PMRM in accordance with the received control message in the system parameter message.

- Power control based on Erasure Indicator Bit (EIB)

In EIB power control, the MS detects the forward frame quality, and feeds back the information to the BTS via EIB. The BTS will adjust the transmit power according to EIB information.

- Quick forward power control

In this mode, the BTS power is adjusted according to power control bit from the MS (the maximum speed can reach 800bit/s). In cdma2000 1X system, large data service is supported. Therefore, the requirement on forward power control is increasingly strict. The forward quick power control method can control forward channel transmit power accurately, so as to reduce the interference and improve the capacity.

2) Reverse power control

Reverse power control includes open-loop power control and closed-loop power control. The closed-loop power control can be sub-divided into inner loop power control and outer loop power control.

- Open-loop power control method

The MS determines the transmit power intensity to access the BTS according to the received pilot signal strength.

- Closed-loop power control method

The BTS issues power control command to the MS, and performs the adjustment according to MS feedback. The principle of closed-loop power control is shown in the following figure.

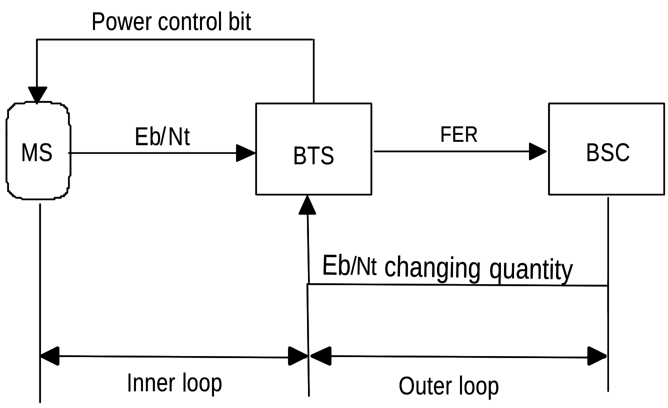


Figure 3-1 Closed-loop power control

Inner loop power control: The BTS issues power control bit according to the received Eb/Nt.

Outer loop power control: The BSC adjusts the Eb/Nt setting value according to the Frame Error Rate (FER) of the received reverse signal. Then the BTS uses the newly set Eb/Nt value to issue power control bit, thus the purpose of indirectly controlling the MS power is achieved.

3.1.2 Handoff

I. Types

The handoff can be divided into the following three types according to the handoff procedures.

- Hard handoff

The MS firstly interrupts the connection with the previous BTS, then sets up the connection with the new BTS.

- Soft handoff

When the MS establishes the communication with a new BTS, it will not release the connection with the previous BTS.

- Softer handoff

It is the soft handoff occurred among different sectors in the same BTS.

II. Purpose

With respect to the purpose, the handoff can be divided into three types: rescue handoff, better cell handoff and traffic handoff.

- Rescue handoff

When the MS is leaving the cell coverage area and the conversation quality is unacceptable, the handoff occurs in order to avoid the interruption of the call.

- Better cell handoff

If the rescue handoff condition is not triggered, this handoff may occur if conversation quality or network performance can be improved. The handoff is called better cell handoff because there is better cell for the call.

- Traffic handoff

This kind of handoff occurs when one cell is congested due to its heavy load and the adjacent cell is relatively idle. This mainly results from traffic peak within short time in a limited area due to some special events (such as sports game, exhibition, etc).

3.1.3 Cell Breath

ODU3601C can control the transmit power so as to adjust the effective coverage of cells and balance the system load. This feature is especially important to CDMA system.

The control range of transmit power provided by ODU3601C for cell breath is 24dB. The transmit power is regulated at a step of 0.5dB.

3.1.4 Diversity Reception

The diversity reception function is realized through two sets of independent receiving devices (including the antenna, feeder, and RF components).

The two sets of receiving devices demodulate the received signals at the same time, and then the baseband processing unit decodes the signals with diversity mergence algorithm to obtain diversity gain.

Diversity reception enhances BTS receivers' capability to resist attenuation, so that the BTS can achieve satisfactory receiving effect even in complicated radio transmission conditions.

3.1.5 Radio Configuration and Channel Support

I. Radio Configuration (RC)

Um interface supports cdma2000 1X, and is compatible with IS-95A/B. The spreading rate is 1.2288Mcps.

The cdma2000 1X physical layer supports multiple radio configurations. Each radio configuration supports the frames of the different rate sets, and possesses different channel configurations and spreading spectrum structures. The supported transmission combinations include:

- Forward RC1, and reverse RC1;
- Forward RC2, and reverse RC2;
- Forward RC3 or RC4, and reverse RC3;
- Forward RC5, and reverse RC4.

With different RCs, cdma2000 1X presents different capabilities. RC1 and RC2 are compatible with IS-95A/B.

Each RC supports certain traffic channel data rate. The specific data rates are listed in Table 3-1 and Table 3-2.

Table 3-1 Forward channel rates

Channel type		Channel rate (bit/s)
F-SYNCH		1200
F-PCH		9600, or 4800
F-QPCH		4800, or 2400
F-DCCH	RC3 or RC4	9600
	RC5	14400 (20ms frame) or 9600 (5ms frame)
F-FCH	RC1	9600, 4800, 2400, or 1200
	RC2	14400, 7200, 3600, or 1800
	RC3 or RC4	9600, 4800, 2700, or 1500 (20ms frame), or 9600 (5ms frame)
	RC5	14400, 7200, 3600, or 1800 (20ms frame), or 9600 (5ms frame)
F-SCCH	RC1	9600
	RC2	14400
F-SCH	RC3	153600, 76800, 38400, 19200, 9600, 4800, 2700,or 1500 (20ms frame)
	RC4	307200, 153600, 76800, 38400, 19200, 9600, 4800, 2700,or 1500 (20ms frame)
	RC5	230400, 115200, 57600, 28800, 14400, 7200,3600, or 1800

Table 3-2 Reverse channel rates

Channel type		Channel rate (bit/s)
R-ACH		4800
R-DCCH	RC3	9600
	RC4	14400 (20ms frame) or 9600 (5ms frame)
R-FCH	RC1	9600, 4800, 2400, or 1200
	RC2	14400, 7200, 3600, or 1800
	RC3	9600, 4800, 2700, or 1500 (20ms frames), or 9600 (5ms frame)
	RC4	14400, 7200, 3600, or 1800 (20ms frames), 9600 (5ms frame)
R-SCCH	RC1	9600
	RC2	14400
R-SCH	RC3	307200,153600, 76800, 38400, 19200, 9600, 4800, 2700, or 1500 (20ms frame)
	RC4	230400, 115200, 57600, 28800, 14400, 7200, 3600, or 1800

II. Physical channel configuration

On Um interface is defined series of physical channels, which are divided into different types according to the channel features. Different RCs support different channels.

1) Forward physical channel

The configuration of forward physical channel is shown in Figure 3-2.

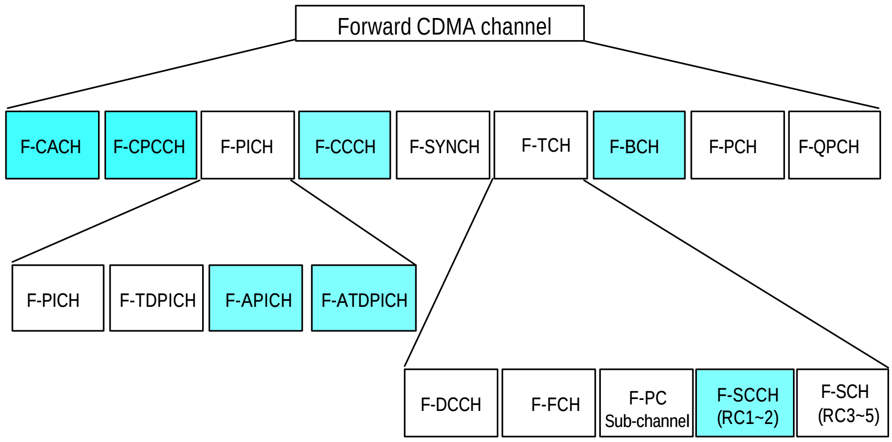


Figure 3-2 Forward physical channels

- Forward Common Assignment Channel (F-CACH)

F-CACH is used for transmitting the assignment information in quick response to the reversed channel, and provides the support for random access packet transmission in the reversed link. F-CACH controls Reverse Common Control Channel (R-CCCH) and Forward Common Power Control Channel (F-CPCCH) in Reservation Access Mode, and provides the quick acknowledgement in power-controlled access mode. In addition, it also provides congestion control function.

- Forward Common Power Control Channel (F-CPCCH)

F-CPCCH is used in the system to support multiple R-CCCHs and Reverse Enhanced Access Channels (R-EACHs) to perform power control.

- Forward Pilot Channel (F-PICH)

Signals are transmitted on F-PICH all the time. The BTS transmits a fixed signal in the pilot channel. This signal serves to provide phase reference for the coherent demodulation of MS receiver to ensure coherent detection, and facilitates MS to acquire synchronization signals from the synchronization channel and sector identification information.

If the sector supports transmit diversity, it is necessary to configure Forward Transmit Diversity Pilot Channel (F-TDPICH).

If smart antenna or beam shaping formation technology is adopted, the BTS will provide one or more Forward Auxiliary Pilot Channels (F-APICHs) on the forward channel to improve the system capacity and coverage.

When diversity transmit method is used in CDMA channel with F-APICH, BTS will provide corresponding Forward Transmit Diversity Auxiliary Pilot Channel (F-ATDPICH).

- Forward Common Control Channel (F-CCCH)

F-CCCH are a series of coding & interleaving spreading and modulation spread spectrum signals, used by the MSs in the BTS coverage area. BTS transmits the system information and the designated MS information on this channel.

- Forward Sync. Channel (F-SYNCH)

The MSs in the coverage of BTS get initial synchronization information from F-SYNCH. The rate of synchronization channel is 1,200bit/s and the frame length is 26.667ms. The PN of pilot signal in I channel and Q channel of synchronization channel is the same as the PN in the pilot channel of the same BTS.

- Forward Traffic Channel (F-TCH)

F-TCH is used to send the user information and signaling information to an MS during the call. F-TCH can be sub-divided into:

Forward Dedicated Control Channel (F-DCCH), which bears traffic information and signaling information,

Forward Fundamental Channel (F-FCH), which bears traffic information,

Forward Power Control sub-channel (F-PC sub-channel): which are the signals sent only in forward fundamental channel or forward dedicated control channel,

Forward Supplemental Code Channel (F-SCCH): which bears traffic information, and is applicable to RC1 and RC2, and

Forward Supplemental Channel (F-SCH), which bears traffic information and is applicable to RC3, RC4 and RC5.

- Forward Broadcast Channel (F-BCH)

F-BCH is used by BTS to send the system information and broadcast messages (such as short messages). F-BCH operates in discontinuous mode.

- Forward Paging Channel (F-PCH)

F-PCH is used by BTS to send the system information and MS-specific information to MS.

Paging channel can be used to send the information with the fixed data rate of 9,600bit/s or 4,800bit/s. In a certain system (with the same system identification number), all paging channels send the information with the same data rate.

The frame length of paging channel is 20ms. Each frequency of the sector can support seven paging channels at most.

- Forward Quick Paging Channel (F-QPCH)

This is used to send paging order and the system configuration changing order to MSs operating in sub-timeslot mode, instructing them to receive the paging messages. Thus the MS battery energy can be saved.

Quick paging channel can be divided into some 80ms timeslots. Each timeslot can be divided into paging order and configuration changing order. The data rate that can be supported is 2,400bit/s or 4,800bit/s.

Note:

In Figure 3-2, the channel in shadow will be supported in the subsequent version.

2) Reverse physical channel configuration

The configuration of reverse physical channel is shown in Figure 3-3.

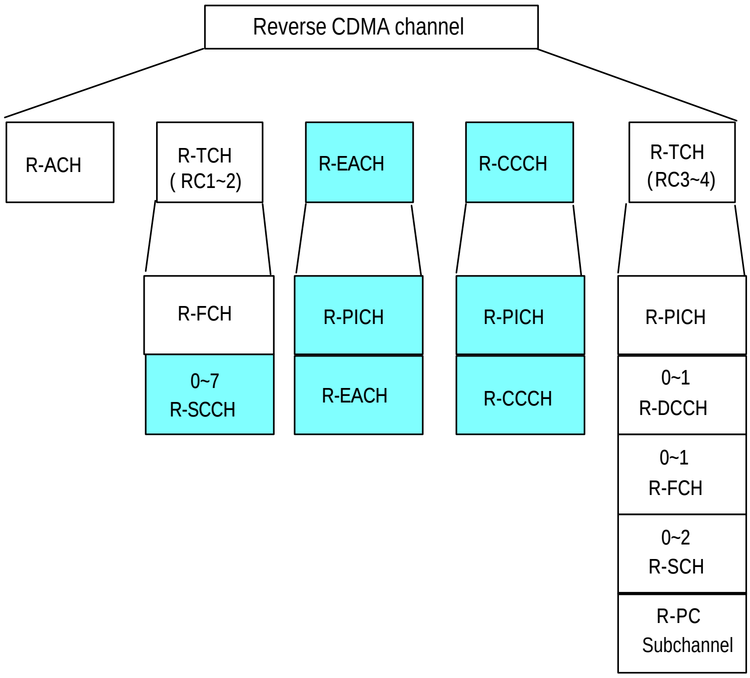


Figure 3-3 Configuration of reverse physical channel

- Reverse Access Channel (R-ACH)

R-ACH is used by MS to originate the communication with BTS, and respond to paging channel message. MS uses random access protocol to initiate access procedure. Regarding each of the supported paging channel, Maximum 32 access channels can be supported.

- Reverse Traffic Channel (R-TCH)

R-TCH is used by MS to send the user information and signaling information during the call.

In the configuration of RC1~RC2, R-TCH can be sub-divided into:

Reverse Fundamental Channel (R-FCH), and

Reverse Supplemental Code Channel (R-SCCH).

In the configuration of RC3~RC4, R-TCH can be sub-divided into:

Reverse Pilot Channel (R-PICH), which assists BTS to capture MS and improves receiving performance,

Reverse Dedicated Control Channel (R-DCCH) used to bear traffic information and signaling information,

Reverse Fundamental Channel (R-FCH) used to bear traffic information,

Reverse Supplemental Channel (R-SCH) used to bear the traffic information, and

Reverse Power Control sub-channel (R-PC subchannel), which is only used in RC3 and RC4 (The MS supports inner loop power control and outer loop power control on this channel).

- Reverse Enhanced Access Channel (R-EACH)

R-EACH is used by MS to originate the communication with BTS, or respond to the message that is specially sent to MS. R-EACH adopts random access protocol and supports two types of access modes: Basic Access Mode and Reservation Access Mode.

- Reverse Common Control Channel (R-CCCH)

R-CCCH is used to send the user and signaling information to BTS in case of not using reverse traffic channel. Two access modes are supported: Reservation Access Mode and Designated Access Mode.

Note:

In Figure 3-3, the channels in shadow will be supported in the subsequent version.

3.2 Maintenance Function

ODU3601C maintenance can be implemented through the following methods:

- Near maintenance

ODU3601C near maintenance operations include routine inspection, fault locating and hardware troubleshooting.

- Mainenance from upper-level BTS

ODU3601C can be regarded as the RF module installed far away from the upper-level BTS. Maintenance over the ODU3601C can be implemented through the local maintenance console of the upper-level BTS.

- OMC remote maintenance

OMC remote maintenance operations include software downloading, interface management, test management, status management, event report processing, equipment management, site configuration, and so on.

For detailed information abound ODU3601C maintenance, please refer to the "BTS Maintenance" module of upper-level BTS User Manual.

3.3 Lightning Protection

3.3.1 Lightning Protection for Power Supply

As an outdoor soft base station, ODU3601C features strong protection capability against extreme temperature, rain, dust and lightning, and is adaptive to the power supply of unstable voltage.

ODU3601C MAPM is designed to be lightning proof. However, when operating together with the lightning protection box for power supply, the lightning proof effect will be even more satisfactory.

ODU3601C must be installed together with the lightning protection box for power supply to protect it from lightning strike when: (1) There are only AC interfaces (outdoor environment); or (2) The power distribution system does not have all-round protection mechanism (indoor environment).

ODU3601C uses the single phase lightning protection box SPD211SZ of AC power supply. It is connected between the mains cable and the ODU3601C input cable, and can resist the surge current over 40kA. The phase voltage of local mains shall be 220VAC, and working frequency 50Hz. The connection is shown in Figure 3-4.

The AC lightning protection box should be selected according to the actual situation from the three types: 20kA, 40kA and 100kA.

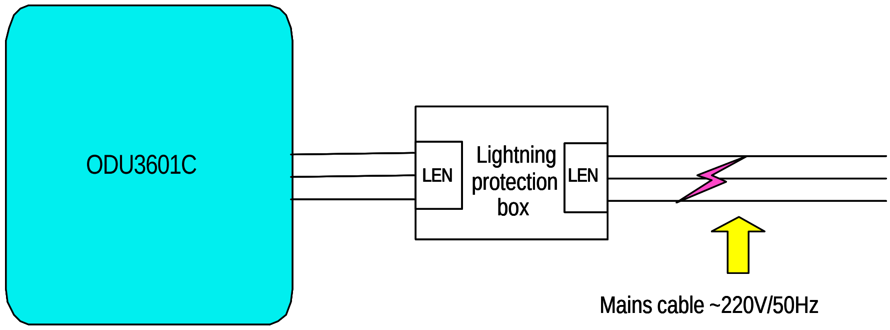


Figure 3-4 ODU3601C AC power supply

The AC lightning protection box is a cube independent of the BTS equipment. This feature makes it applicable to other BTS. The holes for cables are covered by water-proof plastic, making installation convenient.

3.3.2 Lightning Protection for Antenna and Feeder System

The RF equipment of the ODU3601C shall be placed within the protection range of the lightning rod, which is the precondition to ensure the normal performance of ODU3601C lightning protection system.

Antenna & feeder lightning protection function is to protect against secondary lightning attack, i.e. the inductive lightning. Inductive lightning means that the feeder receives inductive current at the moment of lightning attack, which may cause damage to the equipment.

Inductive lightning can be prevented effectively in three ways:

- The feeder is grounded at least at three points. In actual implementation, the number of grounding points depends on the length of the feeder.
- The RF antenna & feeder part and MFEM are grounded through an internal path. The lightning current induced by the antenna and feeder can be directly discharged to the ground through the grounded point. Besides, the MFEM itself features strong protection capability against lightning current, and can satisfy the normal protection requirements without adding lightning protector.
- Lightning rod protection. The lightning rod must be installed within the effective range for the BTS when BTS is installed on the tower, in the open, or at a high place. The protective range of the lightning arrester is shown in Figure 3-5.

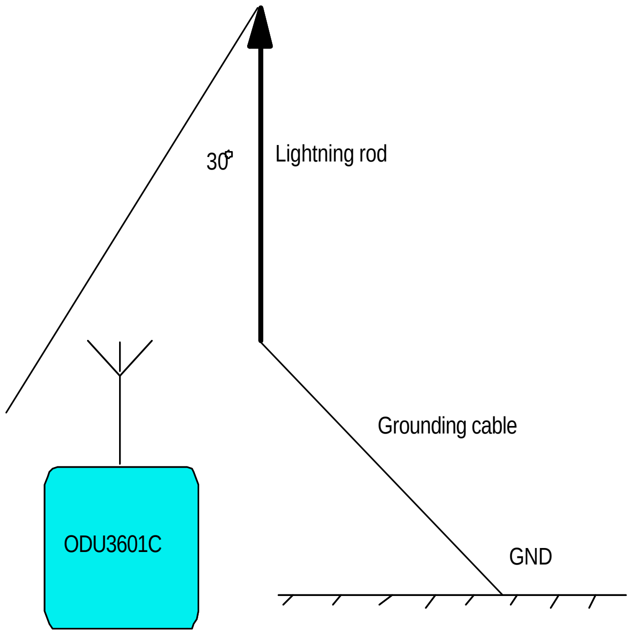


Figure 3-5 Lightning protection of RF antenna & feeder

3.4 Configuration and Networking

3.4.1 Cabinet Configuration

The ODU3601C is of one-carrier configuration. Its main parts include MAPM, MTRM, MFEM and MPAM.

Configuration of the ODU3601C cabinet is shown in Figure 3-6.

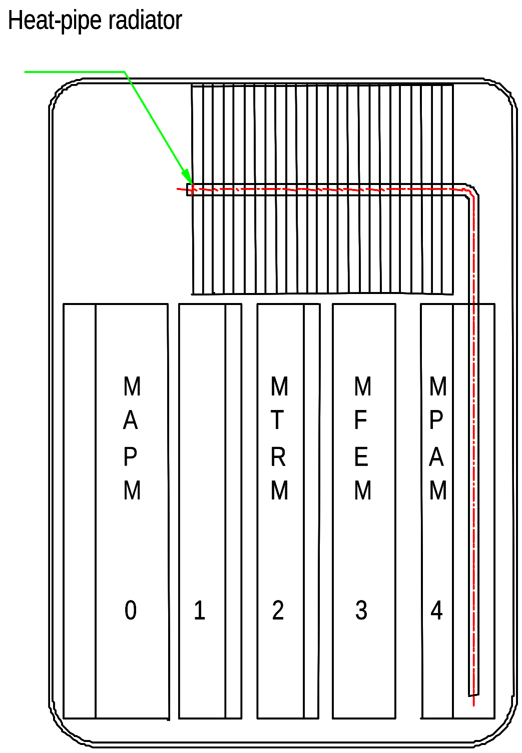


Figure 3-6 ODU3601C configuration

As shown in the above configuration, slots 0, 2, 3 and 4 are configured with MAPM, MTRM, MFEM and MPAM respectively. Slot 1 is not configured with any module, but waterproof treatment should be performed.

When the transmission conditions are met, the ODU3601C can be upgraded to cBTS3601C by adding MBPM in slot 1 and satellite antenna and feeder.

3.4.2 Site Configuration

- Basic configuration

The basic configuration is one carrier for omni cell.

- Cascading configuration

Cascaded with BTS3601C, ODU3601C supports S(1/1) configuration. With two ODU3601Cs cascaded with BTS3601C, it supports S(1/1/1) configuration.

3.4.3 ODU3601C Networking

I. Networking of ODU3601C

The ODU3601C is cascaded with the up-level BTS (such as BTS3601C and cBTS3612) to form network topology. For the information of cascading distance and levels, please refer to Section 1.2 System Feature.

The network topology of ODU3601C cascaded with BTS is shown in Figure 3-7.

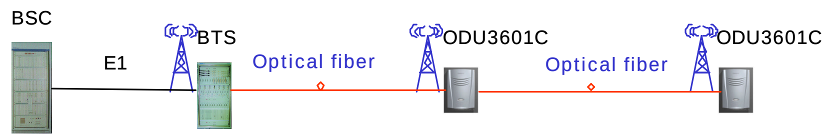


Figure 3-7 Networking of ODU3601C

II. Combined networking

The combined networking of Huawei cdma2000 1X BTS series is shown in Figure 3-8.

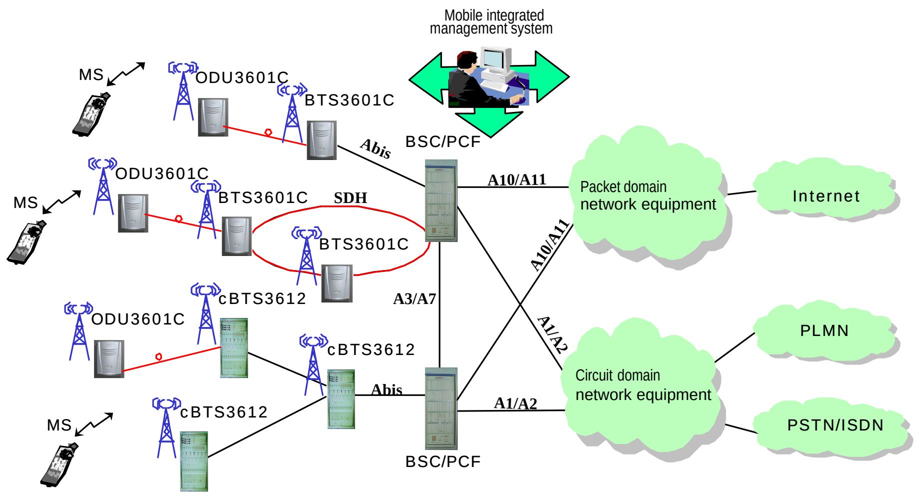


Figure 3-8 Combined networking of Huawei cdma2000 1X BTS series

Appendix A Performance of Receiver and Transmitter

The performances of BTS receivers and transmitters comply with or surpass all the specifications defined in the IS-97-D Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations.

A.1 Performance of Receiver

A.1.1 Frequency Coverage

450MHz band: 450 - 460MHz

800MHz band: 824 - 849MHz

A.1.2 Access Probe Acquisition

The access probe failure rates under the reliability of 90% is below the maximum values listed in Table A-1:

Table A-1 Access probe failure rates

Eb/N0 Per RF input point (dB)	Maximum failure rate
5.5	50%
6.5	10%

A.1.3 R-TCH Demodulation Performance

I. Performance of R-TCH in Additive White Gaussian Noise (AWGN)

The demodulation performance of the Reverse Traffic Channel in AWGN (no fading or multipath) environment is determined by the frame error rate (FER) at specified Eb/N0 value. FER of 4 possible data rates should be calculated respectively. With 95% confidence, the FER for each data rate does not exceed the two given FERs in Table A-2 to Table A-9, which adopt the linear interpolation in the form of Log_{10}(FER). Eb/N0 measurement value is decided by whichever is bigger of the Eb/N0 values in two RF input ports.

Table A-2 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC1

Data rate (bit/s)	FER limits (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
9,600	3.0 @ 4.1dB	0.2 @ 4.7dB
4,800	8.0 @ 4.1dB	1.0 @ 4.7dB
2,400	23.0 @ 4.1dB	5.0 @ 4.7dB
1,200	22.0 @ 4.1dB	6.0 @ 4.7dB

Table A-3 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC2

Data rate (bit/s)	FER limits (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
14,400	5.0 @ 3.2dB	0.2 @ 3.8dB
7,200	6.3 @ 3.2dB	0.7 @ 3.2dB
3,600	5.8 @ 3.2dB	1.0 @ 3.2dB
1,800	3.5 @ 3.2dB	1.0 @ 3.2dB

Table A-4 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC3

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
9,600	2.3% @ 2.4 dB	0.3% @ 3.0 dB
4,800	2.3% @ 3.8 dB	0.4% @ 4.4 dB
2,700	2.5% @ 5.0 dB	0.5% @ 5.6 dB
1,500	1.7% @ 7.0 dB	0.4% @ 7.6 dB

Table A-5 Maximum FER of R-SCH receiver in demodulation performance test under RC3

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
19,200	9% @ 1.7 dB	1.7% @ 2.3 dB
38,400	13% @ 1.4 dB	2.1% @ 2.0 dB
76,800	14% @ 1.3 dB	2.4% @ 1.9 dB
153,600	14% @ 1.3 dB	2.4% @ 1.9 dB
307,200	14% @ 1.8 dB	2.0% @ 2.4 dB

Table A-6 Maximum FER of R-SCH (Turbo Code) receiver in demodulation performance test under RC3

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
19,200	20% @ 0.6 dB	0.9% @ 1.2 dB
38,400	24% @ -0.1 dB	0.3% @ 0.5 dB
76,800	30% @ -0.5 dB	0.2% @ 0.1 dB
153,600	60% @ -0.9 dB	0.1% @ -0.3 dB
307,200	90% @ -0.3 dB	0.1% @ 0.3 dB

Table A-7 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC4

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
14,400	2.4% @ 0.8 dB	0.3% @ 1.4 dB
7,200	2.4% @ 3.1 dB	0.4% @ 3.7 dB
3,600	1.7% @ 4.6 dB	0.3% @ 5.2 dB
1,800	1.6% @ 6.6 dB	0.5% @ 7.2 dB

Table A-8 Maximum FER of R-SCH receiver of demodulation performance test under RC4

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
28,800	10% @ 1.7 dB	1.9% @ 2.3 dB
57,600	12% @ 1.6 dB	1.7% @ 2.2 dB
115,200	14% @ 1.6 dB	2.0% @ 2.2 dB
230,400	12% @ 1.7 dB	1.7% @ 2.3 dB

Table A-9 Maximum FER of R-SCH (Turbo Code) receiver of demodulation performance test under RC4

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
28,800	27% @ 0.7 dB	0.5% @ 1.3 dB
57,600	28% @ 0.2 dB	0.2% @ 0.8 dB
115,200	60% @ -0.2 dB	0.1% @ 0.4 dB
230,400	33% @ -0.5 dB	0.1% @ 0.1 dB

II. R-TCH performance in multipath fading without closed-loop power control

The performance of the demodulation of the Reverse Traffic Channel in a multipath fading environment is determined by the frame error rate (FER) at specified Eb/N0 value. FER of 4 possible data rates should be calculated respectively. With 95% confidence, the FER for each data rate shall not exceed that given by linear interpolation on a log10 (FER) scale between the two values given in Table A-13 and Table A-14. And the test value of Eb/N0 assumes the average value of Eb/N0 in two RF input ports. During the test, the reverse service channel Eb/N0 of each RF input port adopted is within the limits specified in Table A-12.

The configurations of standard channel simulator are given in Table A-10; and the channel models of the R-TCH receiving performance test in multipath environment are listed in Table A-11.

Table A-10 Standard channel simulator configuration

Standard channel Simulator configuration	Speed	Number of Paths	Path 2 power (corresponds to path 1)	Path 3 power (corresponds to path 1)	Deferring path 1 input	Deferring path 2 input	Deferring path 3 input
B	8km/h	2	0dB	N/A	0μs	2.0μs	N/A
C	25km/h	1	N/A	N/A	0μs	N/A	N/A
D	100km/h	3	0dB	-3dB	0μs	2.0μs	14.5μs

Table A-11 Channel models for the R-TCH receiving performance test

Case	Channel Simulator configurations
B	2 (8 km/h, 2 paths)
C	3 (30 km/h, 1 path)
D	4 (100 km/h, 3 paths)
D2	4 (100 km/h, 3 paths)

Table A-12 Eb/N0 limits of R-TCH without closed-loop power control

Rate configuration	Condition	Eb/N0 Limits (dB)	
		Lower limit	Upper limit
RC1	B	11.1	11.7
	C	11.2	11.8
	D	8.8	9.4
	D2	9.2	9.8
RC2	B	10.7	11.3
	D	8.5	9.1
	D2	8.9	9.5

Table A-13 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC1

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	9,600	1.3	0.8
	4,800	1.4	0.9
	2,400	1.6	1.2
	1,200	1.3	0.9
C	9,600	1.2	0.7
	4,800	1.4	0.9
	2,400	2.5	1.7
	1,200	2.0	1.4
D	9,600	1.6	0.6
	4,800	2.6	1.2
	2,400	6.4	3.4
	1,200	5.6	3.5
D2	9,600	0.9	0.3
	4,800	1.6	0.7
	2,400	4.2	2.3
	1,200	4.1	2.6

Table A-14 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC2

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	14,400	1.3	0.8
	7,200	1.0	0.5
	3,600	0.7	0.4
	1,800	0.6	0.5
D	14,400	1.7	0.6
	7,200	1.6	0.6
	3,600	1.5	0.9
	1,800	2.2	1.2
D2	14,400	0.9	0.3
	7,200	0.9	0.4
	3,600	1.1	0.6
	1,800	1.5	0.9

III. Performance in multipath fading with closed-loop power control

The performance of the demodulation of the Reverse Traffic Channel in a multipath fading environment is determined by the frame error rate (FER) at specified Eb/N0 value. FER of 4 possible data rates needs to be calculated respectively. With 95% confidence, the FER for each data rate shall not exceed that given by linear interpolation on a $\log_{10}$ scale between the two values given in Table A-16 and Table A-23. And the test value of Eb/N0 assumes the average value of Eb/N0 tested on the two RF input ports.

Table A-15 Channel models for the R-TCH receiving performance test

Condition	Number of Channel Simulator configurations
A	1 (3 km/h, 1 path)
B	2 (8 km/h, 2 paths)
C	3 (30 km/h, 1 path)
D	4 (100 km/h, 3 path)

Table A-16 Maximum FER of demodulation performance test of R-FCH receiver under RC1

Condition	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	9,600	2.8% @ 5.9 dB	0.3 @ 6.5 dB
	4,800	7.6 @ 5.9 dB	2.2 @ 6.5 dB
	2,400	23.0 @ 5.9 dB	12.0 @ 6.5 dB
	1,200	22.0 @ 5.9 dB	14.0 @ 6.5 dB
C	9,600	1.5 @ 7.1 dB	0.7 @ 7.7 dB
	4,800	8.0 @ 7.1 dB	4.8 @ 7.7 dB
	2,400	18.0 @ 7.1 dB	13.0 @ 7.7 dB
	1,200	16.0 @ 7.1 dB	12.0 @ 7.7 dB

Table A-17 Maximum FER of demodulation performance test of R-FCH receiver under RC2

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	14,400	2.8 @ 5.2 dB	0.4 @ 5.8 dB
	7,200	4.7 @ 5.2 dB	1.3 @ 5.8 dB
	3,600	8.7 @ 5.2 dB	4.6 @ 5.8 dB
	1,800	15.0 @ 5.2 dB	9.8 @ 5.8 dB
C	14,400	1.3 @ 7.7 dB	0.7 @ 8.3 dB
	7,200	3.2 @ 7.7 dB	1.8 @ 8.3 dB
	3,600	4.7 @ 7.7 dB	3.5 @ 8.3 dB
	1,800	5.2 @ 7.7 dB	3.9 @ 8.3 dB

Table A-18 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC3

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
A	9,600 (20 ms)	2.4% @ 3.4 dB	0.5% @ 4.0 dB
	4,800	2.0% @ 4.4 dB	0.5% @ 5.0 dB
	2,700	1.8% @ 5.6 dB	0.5% @ 6.2 dB
	1,500	1.8% @ 7.2 dB	0.6% @ 7.8 dB
B	9,600 (20 ms)	2.0% @ 3.9 dB	0.5% @ 4.5 dB
	4,800	2.0% @ 4.9 dB	0.5% @ 5.5 dB
	2,700	1.8% @ 6.1 dB	0.5% @ 6.7 dB
	1,500	1.7% @ 7.8 dB	0.5% @ 8.4 dB
C	9,600 (20 ms)	1.5% @ 5.2 dB	0.6% @ 5.8 dB
	4,800	1.5% @ 6.1 dB	0.6% @ 6.7 dB
	2,700	1.4% @ 7.2 dB	0.6% @ 7.8 dB
	1,500	1.4% @ 8.8 dB	0.6% @ 9.4 dB
D	9,600 (20 ms)	2.0% @ 4.7 dB	0.5% @ 5.3 dB
	4,800	2.0% @ 5.7 dB	0.5% @ 6.3 dB
	2,700	1.8% @ 6.9 dB	0.5% @ 7.5 dB
	1,500	1.7% @ 8.5 dB	0.5% @ 9.1 dB

Table A-19 Maximum FER of demodulation performance test of R-SCH (Turbo Code) receiver under RC3

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	307,200	10% @ 2.6 dB	2.0% @ 3.2 dB
	153,600	10% @ 2.6 dB	2.0% @ 3.2 dB
	76,800	10% @ 2.1 dB	2.4% @ 2.7 dB
	38,400	9.0% @ 2.4 dB	2.4% @ 3.0 dB
	19,200	9.0% @ 2.8 dB	2.5% @ 3.4 dB

Table A-20 Maximum FER of demodulation performance test of R-SCH (Turbo Code) receiver under RC3

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	307,200	15% @ 0.8 dB	1.8% @ 1.4 dB
	153,600	12% @ 0.2 dB	2.0% @ 0.8 dB
	76,800	10% @ 0.7 dB	2.0% @ 1.3 dB
	38,400	10% @ 1.3 dB	2.0% @ 1.9 dB
	19,200	10% @ 2.1 dB	2.5% @ 2.7 dB

Table A-21 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC4

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
A	14,400	2.2% @ 3.2 dB	0.4% @ 3.8 dB
	7,200	1.9% @ 3.9 dB	0.4% @ 4.5 dB
	3,600	1.9% @ 5.1 dB	0.5% @ 5.7 dB
	1,800	1.8% @ 7.0 dB	0.5% @ 7.6 dB
B	14,400	2.0% @ 3.8 dB	0.4% @ 4.4 dB
	7,200	2.0% @ 4.3 dB	0.5% @ 4.9 dB
	3,600	1.8% @ 5.6 dB	0.5% @ 6.2 dB
	1,800	1.8% @ 7.5 dB	0.5% @ 8.1 dB
C	14,400	1.6% @ 5.1 dB	0.6% @ 5.7 dB
	7,200	1.7% @ 5.6 dB	0.7% @ 6.2 dB
	3,600	1.5% @ 6.7 dB	0.6% @ 7.3 dB
	1,800	1.6% @ 8.4 dB	0.7% @ 9 dB
D	14,400	2.0% @ 4.6 dB	0.5% @ 5.2 dB
	7,200	2.0% @ 5.1 dB	0.5% @ 5.7 dB
	3600	1.9% @ 6.3 dB	0.5% @ 6.9 dB
	1,800	1.8% @ 8.1 dB	0.6% @ 8.7 dB

Table A-22 Maximum FER of demodulation performance test of R-SCH(Turbo Code) receiver under RC4

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	230,400	10% @ 2.4 dB	1.4% @ 3.0 dB
	115,200	9.0% @ 2.5 dB	2.3% @ 3.1 dB
	57,600	9.0% @ 2.6 dB	2.2% @ 3.2 dB
	28,800	7.5% @ 2.8 dB	2.5% @ 3.4 dB

Table A-23 Maximum FER of demodulation performance test of R-SCH (Turbo Code) receiver under RC4

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	230,400	10% @ 1.1 dB	2.0% @ 1.7 dB
	115,200	10% @ 1.0 dB	1.5% @ 1.7 dB
	57,600	11% @ 1.5 dB	1.8% @ 2.1 dB
	28,800	10% @ 2.1 dB	2.0% @ 2.7 dB

A.1.4 Receiving Performance

I. Sensitivity

450MHz band:

The R-TCH FER shall be <1.0% with 95% confidence when -127dBm/1.23MHz CDMA RC3 signal level is inputted at BTS RF main and diversity input ports.

800MHz band:

The R-TCH FER shall be <1.0% with 95% confidence when -128dBm/1.23MHz CDMA RC3 signal level is inputted at BTS RF main and diversity input ports.

II. Receiver dynamic range

450MHz band:

The R-TCH FER shall be 1.0% or less with 95% confidence when -127dBm/1.23MHz~-65dBm/1.23MHz CDMA signal level is inputted at BTS RF main and diversity input ports.

800MHz band:

The R-TCH FER shall be 1.0% or less with 95% confidence when -128dBm/1.23MHz~-65dBm/1.23MHz CDMA signal level is inputted at BTS RF main and diversity input ports.

III. Single-tone desensitization

450MHz band:

Input the single-tone interference deviated from the center frequency at the BTS RF input port: when the single-tone interference deviates from the center frequency +900kHz and -900kHz, the input single-tone interference power is 87dB higher than the output power of the mobile station simulator. When R-TCH FER maintains <1.5%, the output power of mobile station simulator changes less than 3dB whether there is single-tone interference or not.

800MHz band:

Input the single-tone interference deviated from the center frequency at the BTS RF input port: when the single-tone interference deviates from the center frequency about +750kHz and -750kHz, the input single-tone interference power is 50dB higher than the output power of the mobile station simulator; when the single-tone interference deviates from the center frequency +900kHz and -900kHz, the input single-tone interference power is 87dB higher than the output power of the mobile station simulator.

When R-TCH FER maintains <1.5%, the output power of mobile station simulator changes less than 3dB whether there is single-tone interference or not.

IV. Intermodulation spurious response attenuation

Input two single-tone interference of center frequency at the BTS RF input port: both deviate from the center frequency +900kHz and +1700kHz respectively, and -900kHz and -1700kHz respectively, the input single-tone interference power is 72dB higher than the output power of the mobile station simulator. When R-TCH FER keeps <1.5%, the output power of the mobile station simulator changes less than 3dB whether there are two single-tone interference or no interference.

V. Adjacent channel selectivity

The output power of the mobile station simulator shall increase by no more than 3 dB and the FER shall be less than 1.5% with 95% confidence.

A.1.5 Limitation on Emission

I. Conducted spurious emission

At BTS RF input port, the conducted spurious emissions within the BTS receiving frequency range is <-80dBm/30kHz.

At BTS RF input port, the conducted spurious emissions within the transmitting frequency range is <-60dBm/30kHz.

At BTS RF input port, the conducted spurious emissions within other frequency range of 0~6GHz is <-47dBm/30kHz.

II. Radiated spurious emission

The radiated spurious emission is in compliant with local radio specifications.

A.1.6 RSQI

Received Signal Quality Indicator (RSQI) is defined as the signal-to-noise ratio Eb/N0, where Eb is the energy per bit including the pilot and power control overhead and N0 is the total received noise-pulse-interference power in the CDMA bandwidth including the interference from other subscribers. The RSQI report values are list in Table A-24.

Table A-24 RSQI range

Eb/N0 (dB) per input port	Minimum acceptable report value	Maximum acceptable report value
4	10	18
5	12	20
6	14	22
7	16	24
8	18	26
9	20	28
10	22	30
11	24	32
12	26	34
13	28	36
14	30	38

A.2 Performance of Transmitter

A.2.1 Frequency Requirement

I. Frequency coverage

450MHz band: 460 - 470MHz

800MHz band: 869 - 894MHz

II. Frequency tolerance

Within the working temperature range, the average difference between the actual carrier frequency of CDMA transmit sector and the carrier frequency of the dedicated transmit sector is less than $\pm 5\times 10^{-8}$($\pm$0.05ppm) of the designated frequency.

A.2.2 Modulation Requirement

I. Synchronization and timing

Time tolerance for pilot frequency: The pilot time alignment error should be less than 3 μs and shall be less than 10 μs. For base stations supporting multiple simultaneous CDMA Channels, the pilot time tolerance of all CDMA Channels radiated by a base station shall be within ±1 μs of each other.

Time tolerance of pilot channel and other code-division channels: in the same CDMA channel, time error between the pilot channel and other forwarding code-division channels is $<\pm$50ns.

The phase differences between the Pilot Channel and all other code channels sharing the same Forward CDMA Channel should not exceed 0.05 radians and shall not exceed 0.15 radians.

II. Waveform quality

The normalized cross correlation coefficient, ρ, shall be greater than 0.912 (excess power < 0.4 dB).

A.2.3 RF Output Power Requirement

I. Total power

Total power is the mean power delivered to a load with resistance equal to the nominal load impedance of the transmitter. The total power of this system is +43dBm (20W), the deviation in all kinds of environmental conditions shall not exceed +2dB and -4dB.

II. Pilot power

The Pilot Channel power to total power ratio shall be within ±0.5 dB of the configured value.

III. Code domain power

For RC1and RC2, the code domain power in each inactive W_n^{64} channel shall be 27 dB or more below the total output power.

For RC3 and RC4, the code domain power in each inactive W_n^{128} channel shall be 30 dB or more below the total output power. .

For RC1 and RC2, the code domain power in each inactive W_n^{256} channel shall be 33 dB or more below the total output power of each carrier.

A.2.4 Limitation on Emission

I. Conducted spurious emission

The requirements on Conducted Spurious Emissions vary with frequency bands, as shown in Table A-25. Local radio requirements should also be observed.

Table A-25 Conducted Spurious Emissions Performance

Offset from carrier central frequency	Spurious requirement	
750 kHz~1.98 MHz	-45 dBc / 30 kHz	
1.98 MHz~4.00 MHz	-60 dBc / 30 kHz; Pout ≥ 33 dBm -27 dBm / 30 kHz; 28 dBm ≤ Pout < 33 dBm -55 dBc / 30 kHz; Pout < 28 dBm	
> 4.00 MHz (ITU Class A Requirement)	-13 dBm / 1 kHz; -13 dBm / 10 kHz; -13 dBm/100 kHz; -13 dBm / 1 MHz;	9 kHz < f < 150 kHz 150 kHz < f < 30 MHz 30 MHz < f < 1 GHz 1 GHz < f < 5 GHz
> 4.00 MHz (ITU Class B Requirement)	-36 dBm / 1 kHz; -36 dBm / 10 kHz; -36 dBm/100 kHz; -30 dBm / 1 MHz;	9 kHz < f < 150 kHz 150 kHz < f < 30 MHz 30 MHz < f < 1 GHz 1 GHz < f < 12.5 GHz

II. Radiated spurious emission

The radiated spurious emission complies with local radio specifications.

Appendix B EMC Performance

ETSI EN 300 386 Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Telecommunication network Equipment. ElectroMagnetic Compatibility (EMC) Requirements are the EMC standards of telecommunication equipment globally applicable. EMC Performance of BTS complies with ETSI EN 300 386 V1.2.1 (2000-03). They are described in two aspects: EMI (EelectroMagnetic Interference) and EMS (ElectroMagnetic Sensitivity).

B.1 EMI Performance

I. Conductive Emission (CE) at DC input/output port

CE performance indices are listed in Table B-1.

Table B-1 CE index at -48V port

Frequency range	Threshold (dBμV)	
	Average	Quasi-peak
0.15 ~ 0.5MHz	56~46	66~56
0.5 ~ 5MHz	46	56
5 ~ 30MHz	50	60

II. Radiated Emission (RE)

RE performance indices are listed in Table B-2.

Table B-2 RE performance requirement

Band (MHz)	Threshold of quasi-peak (dBμV/m)
30 ~ 1,000	61.5
1,000 ~ 12,700	67.5

Note:

Test place is arranged according to ITU-R 329-7 [1].

B.2 EMS Performance

I. R-F anti-electromagnetic interference (80MHz~1000MHz)

Values of RF anti-EMI test are listed in Table B-3.

Table B-3 Values of RF anti-EMI test

Test port	Test level	Performance class
Whole cabinet	3V/m	A

📖 **Note:**

Test method is the same as IEC1000-4-3 [9].

II. Voltage drop anti-interference

Among all test items of EMS, the requirement for resisting continuous interference test is class A and the requirement for resisting transient interference test is class B. Requirement for power drop and level interruption is shown in Table B-4.

Table B-4 Requirement for power drop and level interruption

Test port	Test level	Performance class
AC port	Drop 30% Last for 10ms	A
	Drop 60% Last for 100ms	When there is backup power, A When there is no backup power, the communication link need not be maintained. It can be re-created and the user data can be lost.
	Drop over95% Last for 5000ms	When there is backup power, A When there is no backup power, the communication link need not be maintained. It can be re-created and the user data can be lost.

📖 **Note:**

Test method is the same as IEC61000-4-11 [13].

III. Electrostatic Discharge (ESD)

Requirement for ESD test level is shown in Table B-5.

Table B-5 Requirement for ESD test level

Discharge mode	Test level	Performance class
Contact	2kV, 4kV	B
Air	2kV, 4kV, 8kV	B

Note:

1. Test method is the same as IEC 61000-4-2 [5].
2. ESD should be performed to all exposed surface of equipment to be tested except those to be protected as required by the user's document.

IV. RF conductive anti-interference

In CDMA equipment, the port where a cable of more than 1 meter may be connected to, including control port, DC input/output port and the input/output port of the connection line when cabinets are combined, should satisfy the requirement for RF conductive anti-interference. Voltage level is shown in Table B-6.

Table B-6 Voltage level

Test port	Voltage level	Performance class
DC line port	3V	A
AC line port		
Signal line port and control line port		

Note:

Test method is the same as IEC61000-4-6 [9].

V. Surge

For CDMA equipment, the DC power input port, indoor signal line of more than 3 m, control line (such as E1 trunk line, serial port line) and the cable that may be led out to the outdoor should all satisfy the requirement for surge interference level. The test level is shown in Table B-7.

Table B-7 Test level

Test port	Test level	Performance class
AC port	Line~line, 2kV Line~ground, 4kV	B
Control line, signal line	Line~line, 0.5kV Line~ground, 1kV	B
Control line, signal line (outdoor)	Line~line, 1kV Line~ground, 2kV	B

Note:

The test method is the same as IEC61000-4-5 [11].

VI. Common-mode fast transient pulse

The signal and data lines between CDMA cabinets and that connected with other systems (such as E1 trunk line), control line and cable connected to DC input/output port, should be the requirement for fast transient pulse anti-interference level. The threshold value is shown in Table B-8.

Table B-8 Threshold value

Test port	Test level	Performance class
Signal control line port	0.5kV	B
DC line input/output port	1kV	B
AC line input port	2kV	B

Note:

Performance class A: it means that BTS can withstand the test without any damage and it can run normally in the specified range. There is not any change in the software or data (all data in the storage or the data being processed) related to the tested switching equipment. Equipment performance is not lowered.

Performance class B: it means that BTS can withstand the test without any damage. There is no change in the software or the data in storage. Communication performance is lowered a little, but in the tolerance (as defined for differet products). The existing communication link is not interrupted. After the test, the equipment can recover to the normal status before the test automatically without any interference of the operator.

Performance class C: some functions of BTS are lost temporarily during the test, but they will recover to normal performance in a specific period after the test (normally the shortest time needed for system reboot). There is no physical damage or system software deterioration.

Performance class R: after the test, there is no physical damage or fault (including software corruption) with BTS. Protection equipment damage caused by external interference signal is acceptable. When the protection equipment is replaced and the running parameters are re-configured, the equipment can operate normally.

Appendix C Environment Requirement

BTS3601C environment requirements involve storage, transportation, and operation environments. These requirements are specified based on the following standards:

- ETS 300019 Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment
- IEC 60721 Classification of environmental conditions

C.1 Storage Environment

I. Climate environment

Table C-1 Requirements on climate environment

Item	Range
Altitude	⩽5000m
Air pressure	70kPa~106kPa
Temperature	-40~+70 Celsius degree
Temperature change rate	⩽1 Celsius degree/min
Relative humidity	10%~100%
Solar radiation	⩽1120W/s²
Thermal radiation	⩽600W/s²
Wind speed	⩽30m/s
Rain	Drippling

II. Biotic environment

- No microorganism like fungal or mould multiplied around or inside.
- Free from the attack of rodential animals (such as rats).

III. Air cleanness

- No explosive, electrically/magnetically conductive, or corrosive particles around.
- The density of physical active substances shall meet the requirements listed in Table C-2.

Table C-2 Requirements on the density of physical active substances

Physical active substance	Unit	Content
Suspending dust	mg/m³	⩽5.00
Falling dust	mg/m² h	⩽20.0
Sands	mg/m³	⩽300
Note: Suspending dust: diameter ⩽75μm Falling dust: 75μm⩽diameter⩽150μm Sands: 150μm⩽diameter⩽1,000μm		

- The density of chemical active substances shall meet the requirements listed in Table C-3.

Table C-3 Requirements on the density of chemical active substances

Chemical active substance	Unit	Content
SO_2	mg/m³	⩽0.30
H_2S	mg/m³	⩽0.10
NO_2	mg/m³	⩽0.50
NH_3	mg/m³	⩽1.00
Cl_2	mg/m³	⩽0.10
HCl	mg/m³	⩽0.10
HF	mg/m³	⩽0.01
O_3	mg/m³	⩽0.05

IV. Mechanical stress

Table C-4 Requirements on mechanical stress

Item	Sub-item	Range	
Sinusoidal vibration	Displacement	⩽7.0mm	-
	Acceleration	-	⩽20.0m/s²
	Frequency range	2~9Hz	9~200Hz
Unsteady impact	Impact response spectrum II	⩽250m/s²	
	Static load capability	⩽5kPa	
Note: Impact response spectrum: The max. acceleration response curve generated by the equipment under the specified impact excitation. Impact response spectrum II indicates that the duration of semisinusoidal impact response spectrum is 6ms. Static load capability: The capability of the equipment in package to bear the pressure from the top in normal pile-up method.			

C.2 Transportation Environment

I. Climate environment

Table C-5 Requirements on climate environment

Item	Range
Altitude	⩽5,000m
Air pressure	70kPa~106kPa
Temperature	-40~+70 Celsius degree
Temperature change rate	⩽3 Celsius degree/min
Relative humidity	10%~100%
Solar radiation	⩽1,120W/s²
Thermal radiation	⩽600W/s²
Wind speed	⩽30m/s

II. Biotic environment

- No microorganism like fungal or mould multiplied around or inside.
- Free from the attack of rodential animals (such as rats).

III. Air cleanness

- No explosive, electrically/magnetically conductive, or corrosive particles around.
- The density of physical active substances shall meet the requirements listed in Table C-6.

Table C-6 Requirements on the density of physical active substances

Physical active substance	Unit	Content
Suspending dust	mg/m^3	No requirement
Falling dust	$mg/m^2 h$	⩽3.0
Sands	mg/m^3	⩽100
Note: Suspending dust: diameter ⩽75μm Falling dust: 75μm⩽diameter⩽150μm Sands: 150μm⩽diameter⩽1,000μm		

- The density of chemical active substances shall meet the requirements listed in Table C-7.

Table C-7 Requirements on the density of chemical active substances

Chemical active substance	Unit	Content
SO_2	mg/m^3	⩽0.30
H_2S	mg/m^3	⩽0.10
NO_2	mg/m^3	⩽0.50
NH_3	mg/m^3	⩽1.00
Cl_2	mg/m^3	⩽0.10
HCl	mg/m^3	⩽0.10
HF	mg/m^3	⩽0.01
O_3	mg/m^3	⩽0.05

IV. Mechanical stress

Table C-8 Requirements on mechanical stress

Item	Sub-item	Range		
Sinusoidal vibration	Displacement	⩽7.5mm	-	-
	Acceleration	-	⩽20.0m/s²	⩽40.0m/s²
	Frequency range	2~9Hz	9~200Hz	200~500Hz
Random vibration	Acceleration spectrum density	10m²/s³	3m²/s³	1m²/s³
	Frequency range	2~9Hz	9~200Hz	200~500Hz
Unsteady impact	Impact response spectrum II	⩽300m/s²		
	Static load capability	⩽10kPa		
Note: Impact response spectrum: The max. acceleration response curve generated by the equipment under the specified impact excitation. Impact response spectrum II indicates that the duration of semisinusoidal impact response spectrum is 6ms.				

Item	Sub-item	Range
Static load capability: The capability of the equipment in package to bear the pressure from the top in normal pile-up method.		

C.3 Operation Environment

I. Climate environment

Table C-9 Requirements on temperature and humidity

Product	Temperature	Relative humidity
BTS3601C	-40~+55 Celsius degree	5%~100%
Note: The measurement point of temperature and humidity is 2 m above the floor and 0.4 m in front of the equipment, when there is no protective panels in front of and behind the cabinet.		

Table C-10 Requirements on other climate environment

Item	Range
Altitude	⩽4000m
Air pressure	70kPa~106kPa
Temperature change rate	⩽5 Celsius degree/min
Solar radiation	⩽1120W/m²
Rain	⩽12.5L/min±0.625 L/min (IPX5)
Wind speed	⩽50m/s

II. Biotic environment

- No microorganism like fungal or mould multiplied around or inside.
- Free from the attack of rodential animals (such as rats).

III. Air cleanness

- No explosive, electrically/magnetically conductive, or corrosive particles around.
- The density of physical active substances shall meet the requirements listed in Table C-11.

Table C-11 Requirements on the density of physical active substances

Physical active substance	Unit	Content
Suspending dust	mg/m^3	≤5
Falling dust	$mg/m^2 h$	≤20
Sands	mg/m^3	≤300
Note: Suspending dust: diameter ≤75μm Falling dust: 75μm≤diameter≤150μm Sands: 150μm≤diameter≤1,000μm		

- The density of chemical active substances shall meet the requirements listed in Table C-12.

Table C-12 Requirements on the density of chemical active substances

Chemical active substance	Unit	Content
SO_2	mg/m^3	≤0.30
H_2S	mg/m^3	≤0.10
NH_3	mg/m^3	≤1.00
Cl_2	mg/m^3	≤0.10
HCl	mg/m^3	≤0.10
HF	mg/m^3	≤0.01
O_3	mg/m^3	≤0.05
NO_x	mg/m^3	≤0.05
Soft mist	-	Yes

IV. Mechanical stress

Table C-13 Requirements on mechanical stress

Item	Sub-item	Range	
Sinusoidal vibration	Displacement	≤3.5mm	-
	Acceleration	-	$≤10.0m/s^2$
	Frequency range	2~9Hz	9~200Hz
Unsteady impact	Impact response spectrum II	$≤100m/s^2$	
	Static load capability	0	
Note: Impact response spectrum: The max. acceleration response curve generated by the equipment under the specified impact excitation. Impact response spectrum II indicates that the duration of semisinusoidal impact response spectrum is 6ms. Static load capability: The capability of the equipment in package to bear the pressure from the top in normal pile-up method.			

Appendix E Standard Compliance

E.1 General Technical Specification

TIA/EIA-97-D: Recommended Minimum Performance Standards for Base Stations Supporting Dual-mode Spread Spectrum Mobile Stations

General Technical Requirements: FEDERAL IMT-MC (CDMA 2000) CELLULAR MOBILE SYSTEM OPERATING IN BAND 450 MHZ

E.2 Um Interface

I. Physical layer

TIA/EIA IS-2000-2-A: Physical Layer Standard for cdma2000 Spread Spectrum Systems

II. MAC layer

TIA/EIA IS-2000-3-A: Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems

III. Service capability

TSB2000: Capabilities Requirements Mapping for cdma2000 standards

E.3 Abis Interface

I. Physical layer

- E1 interface

E1 Physical Interface Specification, September 1996

- SDH STM-1

ANSI T1.101: Synchronization Interface Standard

ITU-T G.707: (3/96) Network node interface for the synchronous digital hierarchy (SDH)

ITU-T G.703: (10/98) Physical/electrical characteristics of hierarchical digital interfaces

ITU-T G.957: Optical interface for equipment and systems relating to the synchronous digital hierarchy

ITU-T G.958: Digital line systems based on the synchronous digital hierarchy for use on optical fiber cables

- ATM

AF-PHY-0086.001: Inverse Multiplexing for ATM(IMA) Specification Version 1.1

ATM Forum af-phy-0064.000

ATM Forum af-phy-0130.000

ATM on Fractional E1/T1, October 1999

II. ATM layer

ANSI T1.627-1993: Telecommunications broadband ISDN-ATM Layer Functionality and specification

III. ATM adaptation layer

ITU-T recommendation I.366.2: B-ISDN ATM Adaptation Layer Type 2 Specification

ITU-T I.363.5: B-ISDN ATM Adaptation Layer 5 Specification: Type 5 AAL

IV. TCP/IP

RFC791: Internet Protocol

RFC793: Transport Control Protocol

V. Abis interface high layer protocol

3GPP2 A.R0003: Abis interface technical report for cdma2000 1X Spread Spectrum System

VI. Self-defined standard

cdma2000 1X Abis Interface High Layer Protocol

E.4 Lightning Protection

IEC 61312-1(1995) Protection Against Lightning Electromagnetic Impulse Part I: General Principles

IEC 61643-1(1998) Surge Protective devices connected to low-voltage power distribution systems

ITU-T K.11 (1993) Principles of Protection Against Over-voltage and Over-current.

ITU-T K.27 (1996) Bonding Configurations and Earthing Inside a Telecommunication Building

ETS 300 253(1995) Equipment Engineering; Earthing and bonding of telecommunication equipment in telecommunication centers

E.5 Safety

IEC60950 Safety of information technology equipment Including Electrical Business Equipment

IEC60215 Safety requirement for radio transmitting equipment

CAN/CSA-C22.2 No 1-M94 Audio, Video and Similar Electronic Equipment

CAN/CSA-C22.2 No 950-95 Safety of Information Technology Equipment Including Electrical Business Equipment.

UL 1419 Standard for Professional Video and Audio Equipment

73/23/EEC Low Voltage Directive

UL 1950 Safety of information technology equipment Including Electrical Business Equipment

IEC60529 Classification of degrees of protection provided by enclosure (IP Code).

GOST 30631-99. General Requirements to machines, instruments and other industrial articles on stability to external mechanical impacts while operating;

GOST R 50829-95. Safety of radio stations, radio electronic equipment using transceivers and their components. The general requirements and test methods;

GOST 12.2.007.0-75. Electrotechnical devices. The general safety requirements.

E.6 EMC

TS 25.105; 3rd Generation Partnership Project; TSG RAN WG4; UTRA (BS) TDD; Radio transmission and reception89/336/EEC EMC directive Council directive of 3 May 1989 on approximation of laws of the Member States relating to electromagnetic compatibility;

CISPR 22 (1997): "Limits and methods of measurement of radio disturbance characteristics of information technology equipment";

Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current = 16 A"

IEC 61000-4-2 (1995): " Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 2: Electrostatic discharge immunity test";

IEC 61000-4-3 (1995): " Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 3: Radiated, radio-frequency electromagnetic field immunity test";

IEC 61000-4-4 (1995): " Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 4: Electrical fast transient/burst immunity test";

IEC 61000-4-5 (1995): " Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 5: Surge immunity test";

IEC 61000-4-6 (1996): " Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 6: Immunity to contacted disturbances, induced by radio frequency fields";

IEC 61000-4-11 (1994): " Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 11: Voltage dips, short interruptions and voltage variations. Immunity tests";

ITU-T Recommendation K.20, Resistibility of Telecommunication Switching Equipment to Overvoltages and Overcurrents;

CFR 47,FCC Part 15- Radio Frequency Device;

TS 25.113v3.1.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; Base station EMC;

ITU-R Rec. SM.329-7: "Spurious emissions";

GOST R 51318.22-99: Electromagnetic compatibility of technical equipment. Man-made noise from informational equipment. Limits and test methods;

GOST 30429-96. "Electromagnetic compatibility of technical equipment. Man-made noise from equipment and apparatus used together with service receiver systems of civil application. Limits and Test methods.

E.7 Environment

IEC 60721-3-1"Classification of environmental conditions- Part3: Classification of groups of environmental parameters and their severities-Section 1: Storage";

IEC 60721-3-2"Classification of environmental conditions- Part3: Classification of groups of environmental parameters and their severities-Section 2: Transportation";

IEC 60721-3-3 (1994) "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations";

IEC 60721-3-4 (1995): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weather protected locations";

ETS 300 019-2-1 "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part2-1, Specification of environmental tests Storage";

ETS 300 019-2-2 "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part2-2, Specification of environmental tests Transportation";

ETS 300 019-2-3 "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part2-3, Specification of environmental tests Transportation Stationary use at weather-protected locations";

ETS 300 019-2-3 "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part2-3, Specification of environmental tests Transportation Stationary use at non-weather-protected locations";

IEC 60068-2-1 (1990): "Environmental testing - Part 2: Tests. Tests A: Cold";

IEC 60068-2-2 (1974): "Environmental testing - Part 2: Tests. Tests B: Dry heat";

IEC 60068-2-6 (1995): "Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal)".

GOST 15150-69: Machines, instruments and other industrial articles. Applications for different climatic regions. Categories, operating, storage and transportation conditions in compliance with the environmental factors";

GOST 23088-80. "Electronic equipment. Requirements to packing and transportation and test methods".

Appendix F Abbreviation

F.1 Abbreviation of Modules

MAPM	Micro-bts Ac-dc Power supply Module
MBKP	Micro-bts Backplane
MBPB	Micro-bts Base-band Processing Board
MBPM	Micro-bts Base-band Processing Module
MDPM	Micro-bts Dc-dc Power supply Module
MFEM	Micro-bts Radio Frequency Front End Module
MLNA	Micro-bts Low-Noise Amplifier
MMCB	Micro-bts Monitor & Control Board
MPAU	Micro-bts Power Amplifier Unit
MPAM	Micro-bts Power Amplifier Module
MRDU	Micro-bts Divide And Duplexer Receive Filter Unit
MTRB	Micro-bts Transceiver Board
MTRM	Micro-bts Transceiver Module

F.2 Glossary

3GPP2	3rd Generation Partnership Project 2
A	Availability
A1/A2/A5	
A3/A7	
A8/A9	
A10/A11	
AAA	Authorization, Authentication and Accounting
AAL2	ATM Adaptation Layer 2
AAL5	ATM Adaptation Layer 5
Abis	
AC	Authentication Center
A/D	Analog/Digit
ADC	Analog Digit Converter
ANSI	American National Standards Institute
ARQ	Automatic Repeat Request
ATM	Asynchronous Transfer Mode
AUC	Authentication
BAM	Back Administration Module
BPSK	Binary Phase Shift Keying
BS	Base Station
BSC	Base Station Controller
BSS	Base Station Subsystem
BTS	Base Transceiver Station
CCITT	International Telegraph and Telephone Consultative Committee
CDMA	Code Division Multiple Access
CEs	Channel Elements
CLI	Command Line Interpreter
CLK	Clock
CM	Connection Management
CN	Core Network
CTC	Common Transmit Clock

D/A	Digit/Analog
DAC	Digit Analog Converter
DAGC	Digit Automatic Gain Control
DC	Direct Current
DCE	Data Communications Equipment
EIA	Electronics Industry Association
EIB	Erasure Indicator Bit
EIR	Equipment Identity Register
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
FA	Foreign Agent
F-APICH	Forward Assistant Pilot Channel
F-ATDPICH	Forward Transmit Diversity Assistant Pilot Channel
F-BCH	Forward Broadcast Channel
FCACH	Forward Common Assignment Channel
F-CCCH	Forward Common Control Channel
F-CPCCH	Forward Common Power Control Channel
F-DCCH	Forward Dedicated Control Channel
FER	Frame Error Rate
F-FCH	Forward Fundamental Channel
F-PCH	Forward Paging Channel
F-PICH	Forward Pilot Channel
F-QPCH	Forward Quick Paging Channel
F-SCCH	Forward Supplemental Code Channel
F-SCH	Forward Supplemental Channel
F-SYNCH	Forward Sync Channel
F-TCH	Forward Traffic Channel
F-TDPICH	Forward Transmit Diversity Pilot Channel
FTP	File Transfer Protocol
GLONASS	Global Navigation Satellite System
GMSC	Gateway Mobile-services Switching Centre
GPS	Global Positioning System
GRIL	GPS/GLONASS Receiver Interface Language
GUI	Graphics User Interface
HA	Home Agent
HDLC	High level Data Link Control
HLR	Home Location Register
HPAU	High Power Amplifier Unit
HPSK	Hybrid Phase Shift Keying
ICP	IMA Control Protocol
IF	Intermediate Frequency
IMA	Inverse Multiplexing for ATM
IP	Internet Protocol
IPOA	IP over ATM
ISDN	Integrated Services Digital Network
ITC	Independent Transmit Clock
ITU	International Telecommunications Union
ITU-T	ITU Telecommunication Standardization Sector
IWF	Interworking Function
JTAG	Joint Test Action Group
LAC	Link Access Control
LMF	Local Maintenance Function
LNA	Low-Noise Amplifier
MAC	Medium Access Control
MML	Man-Machine Language
Modem	Modulator-Demodulator
MPU	Micro Process Unit

MS	Mobile Station
MSC	Mobile Switching Center
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NID	Network Identification
OAM	Operation, Administration and Maintenance
OCXO	Oven voltage Control Oscillator
OEM	Original Equipment Manufacturer
OMC	Operation & Maintenance Center
OML	Operation & Maintenance Link
OMU	Operation & Maintenance Unit
OQPSK	Offset Quadrature Phase Shift Keying
OTD	Orthogonal Transmit Diversity
PCF	Packet Control Function
PDSN	Packet Data Service Node
PGND	Protection Ground
PLMN	Public Land Mobile Network
PN	Pseudo Noise
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit
PVC	Permanent Virtual Channel
PVP	Permanent Virtual Path
PWM	Pulse-Width Modulation
QIB	Quality Identification Bit
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
R-ACH	Reverse Access Channel
RC	Radio Configuration
RC1	Radio Configuration 1
RC2	Radio Configuration 2
RC3	Radio Configuration 3
RC4	Radio Configuration 4
R-CCCH	Reverse Common Control Channel
R-DCCH	Reverse Dedicated Control Channel
R-EACH	Reverse Enhanced Access Channel
RF	Radio Frequency
R-FCH	Reverse Fundamental Channel
RLP	Radio Link Protocol
RM	Radio Management
R-PICH	Reverse Pilot Channel
R-SCCH	Reverse Supplemental Code Channel
R-SCH	Reverse Supplemental Channel
RSQI	Receive Signal Quality Indicator
R-TCH	Reverse Traffic Channel
SDH	Synchronous Digital Hierarchy
SDU	Selection/Distribution Unit
SID	System Identification
SME	Signaling Message Encryption
SPU	Signaling Process Unit
SRBP	Signaling Radio Burst Protocol
SSSAR	Special Service Segmentation and Reassemble
STM-1	Synchronization Transfer Mode 1
STS	Space Time Spreading
TA	Timing Advance
TA	Terminal Adapter
TAm	Mobile Terminal Adapter

TCP	Transport Control Protocol
TDMA	Time Division Multiple Access
TE1	Terminal Equipment 1
TE2	Terminal Equipment 2
TIA	Telecommunications Industry Association
TMSI	Temp Mobile Subscriber Identifier
TRX	Transceiver
UART	Universal Asynchronous Receiver/Transmitter
Um	
UTC	Universal Coordinated Time
VCI	Virtual Channel Identifier
VLR	Visitor Location Register
VPI	Virtual Path Identifier

Table of Contents

Chapter 1 Routine Maintenance Instructions

1.1 Overview

ODU3601C Routine Maintenance Instructions describes in details the contents and methods of ODU3601C routine maintenance operations. It serves as a reference in determining the routine maintenance schedule of a particular site.

1.1.1 Purposes of Routine Maintenance

Normal system operation of ODU3601C in different running environment depends on effective routine maintenance. ODU3601C routine maintenance is intended to detect and solve problems in due time to prevent trouble.

1.1.2 Classification of Routine Maintenance Operations

I. Classification by implementing methods

- Conventional maintenance

This method is applied on regular basis to observe the operation of the system, test and analyze equipment performance.

- Unconventional maintenance

The unconventional method is to test whether the system performance has degraded by artificially creating some faults. For example, maintenance engineers may artificially create some faults and test if the alarm system reports alarm correctly.

II. Classification by period length

- Unscheduled maintenance

This includes the maintenance operations performed at equipment fault or network adjustment. For example, maintenance tasks performed due to by user complaint, damage of equipment and line fault. Solving of problems left over by daily maintenance operations is also regarded as unscheduled maintenance operation.

- Daily maintenance

It refers to the maintenance tasks conducted each day. ODU3601C daily maintenance helps maintenance engineers keep track of the operating conditions of the equipment at any moment so that problems can be solved in time. When a problem is detected in daily maintenance, record it in detail to help eliminate it in time.

- Periodical maintenance

Periodical maintenance refers to the maintenance tasks conducted regularly. Periodical maintenance helps maintenance engineers keep track of the long-term performance of the equipment.

Periodical maintenance includes: monthly maintenance, quarterly maintenance and yearly maintenance.

1.1.3 Usage of Routine Maintenance Records

As a maintenance engineer, you are required to fill in the following tables when you conduct the daily, monthly, quarterly and yearly maintenance for your ODU3601C. And specific instructions have been given after those tables.

I. Daily unexpected fault handling record

Note down in details the unexpected faults occurred in ODU3601C daily maintenance operations in the table for future reference. The user may modify the record according to the actual needs, or compile the records into manuals.

II. Monthly maintenance record

Note down in details the actual maintenance operations carried out during ODU3601C monthly maintenance in the table. For details, see ODU3601C Monthly Maintenance Operation Instruction.

III. Quarterly maintenance record

Note down in details the actual maintenance operations carried out during ODU3601C quarterly maintenance in the table. For details, see ODU3601C Quarterly Maintenance Operation Instruction.

IV. Yearly maintenance record

Note down in details the actual maintenance operations carried out during ODU3601C yearly maintenance in the table. For details, see ODU3601C Yearly Maintenance Operation Instruction.

Table 1-1 Daily Unexpected Fault Handling Record

<table>
<tr><td>Site</td><td></td><td>Belong-to BSC</td><td></td></tr>
<tr><td>Time when fault occurred:</td><td></td><td>Time when fault is solved:</td><td></td></tr>
<tr><td>Person on duty:</td><td></td><td>Handled by:</td><td></td></tr>
<tr><td colspan="4">Classification of fault:
☐ Micro-bts Ac-dc Power supply Module (MAPM) ☐ Micro-bts Transceiver Module (MTRM)
☐ Micro-bts Radio Frequency Front End Module (MFEM) ☐ Micro-bts Power Amplifier Module (MPAM)
☐ Antenna and feeder system ☐ Others</td></tr>
<tr><td colspan="4">Fault detected:
☐ With user complaint ☐ From the alarm system
☐ In Daily maintenance ☐ From other sources</td></tr>
<tr><td colspan="4">Description of fault:</td></tr>
<tr><td colspan="4">Alarm handling & result:</td></tr>
</table>

Table 1-2 Monthly Maintenance Record

Site: _______________

<table>
<tr><td>Time of maintenance:____(MM)_____(DD)_____(YY)
____(MM)____(DD)____(YY)</td><td colspan="3">Maintainer:</td></tr>
<tr><th>Items</th><th>Status</th><th>Remarks</th><th>Maintenance engineers</th></tr>
<tr><td>Environment</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>Temperature</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>Humidity</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>Indoor air-conditioner</td><td>☐Normal, ☐Abnormal</td><td>Upon indoor installation for ODU3601C</td><td></td></tr>
<tr><td>Call test</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>Battery group</td><td>☐Normal, ☐Abnormal</td><td>When a battery group is used</td><td></td></tr>
<tr><td>Grounding, lightening protection and power supply system</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>RF antenna and feeder part</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>Power supply module</td><td>☐Normal, ☐Abnormal</td><td></td><td></td></tr>
<tr><td>Description of fault and handling measures taken</td><td colspan="3"></td></tr>
<tr><td>Problems remained</td><td colspan="3"></td></tr>
<tr><td>Shift leader check</td><td colspan="3"></td></tr>
</table>

Caution:

Avoid short circuit upon battery check!

Table 1-3 Quarterly Maintenance Record

Site: _______________

Time of maintenance:____(MM)_____(DD)____(YY) ____(MM)____(DD)____(YY)	Maintainer:		
Items	Status	Remarks	Maintenance engineers
Power supply	☐Normal, ☐Abnormal		
Road test	☐Normal, ☐Abnormal		
Accessories check	☐Normal, ☐Abnormal		
Description of fault and handling measures taken			
Problems remained			
Shift leader check			

Table 1-4 Yearly Maintenance Record

Site: _______________

Time of maintenance:____(MM)_____(DD)_____(YY) ____(MM)____(DD)____(YY)	Maintainer:		
Items	**Status**	**Remarks**	**Maintenance engineers**
Call test	☐Normal, ☐Abnormal		
Cabinet sanitation	☐Normal, ☐Abnormal		
BTS power output	☐Normal, ☐Abnormal		
Grounding resistance and grounding wires	☐Normal, ☐Abnormal		
Water-proof performance of antenna and feeder connector and lightening protection grounding clip	☐Normal, ☐Abnormal		
Firmness and angle of antenna	☐Normal, ☐Abnormal		

Description of fault and handling measures taken	
Problems remained	
Shift leader check	

1.2 Monthly Maintenance Instructions

Items	Instructions	Note
Call test	Make calls with a Mobile Station (MS). Collect information at both the MS and the Base Station Controller (BSC) to see if all calls are normal for all sector carriers.	There should be no noise, no call dropping, nor cross talking.
Grounding, lightening protection systems and power supply system	1) Check the connections in the grounding system and the lightening protection system. 2) Check if the power supply system is normal. 3) Check if any part of the lightening protector is burnt.	Keep the lightening protector in good status.
Antenna and feeder part	1) Check if the support of the antenna is set to the correct direction; 2) Check if the water-proof performance of the feeder is normal.	Query at the maintenance console.
Power supply module	Check if there is any alarm on the power supply module.	

1.3 Quarterly Maintenance Instructions

Items	Instructions	Note
Check 220V AC supply	Measure whether input voltage and frequency are in the specified range.	Range of normal input voltage: Rated frequency:
Road test	Test on the handoff and coverage area of the cells with a test MS.	
Accessories check	Check the auxiliary facility box and UPS, etc.	

1.4 Yearly Maintenance Instructions

Items	Instructions	Note
Call test	Make calls with an MS. Collect information at both the MS and the BSC to see if all calls are normal for all sector carriers.	There should be no noise, no call dropping, nor cross talking.
Cabinet sanitation	Tools required: Vacuum cleaner, alcohol and towel.	Impose strict operation regulations to prevent mis- operation on the power supply system.
BTS power output	Test the transmit power of the carriers.	Check if the output is the same as designed in the BSC.
Grounding resistance and grounding wires	1) Measure the grounding resistance with proper test instruments. 2) Check for lose grounding wire connectors and their aging status	
Water-proof performance of antenna and feeder connector and lightening protection grounding clip	1) Check the external parts; 2) Unwrap them and check.	Wrap up the checked parts with the same material used before the check.
Firmness and angle of antenna	1) Tighten the bolts with the wrench. 2) Check if the angle are correctly set.	Do not apply too much torque on the bolts

Chapter 2 Fault Analysis and Locating

2.1 Conventional Fault Handling Process and Method

2.1.1 Classification of Faults

Faults can be classified into three categories according to their sources:

- Faults with BTS equipment
- Faults with data configuration
- Faults with other Network Elements (NE) like MS, BSC, or cells of other BTSs.

Generally, faults can be reported by:

- The alarm system. The alarm system will send out signal whenever it detects a fault, and recommend relevant resolution.
- MS Subscribers. Sometimes, poor service or performance is also a form of fault. For instance, poor conversation quality, MS access failure.
- Maintenance & Operation Engineer. In some case, fault might happen while loading data or sending commands.

2.1.2 General Handling Procedure

The fault handling process involves four stages: Information collection, fault judgment, fault location, and troubleshooting.

- Information collection: Collect all available original information
- Fault judgment: Specify the fault range
- Fault location: Locate the specific fault cause
- Troubleshooting: Eliminate faults and restore the system through proper measures or steps

2.1.3 Conventional Methods for Fault Judgment and Location

I. Original information analysis

The original information includes abnormal phenomenon reported by Maintenance & Operation Engineers, users or offices. It provides first-hand materials for fault judgment and analysis. Thus it helps engineers minimize the fault range and locate fault type.

II. Alarm information analysis

The alarm system of the BTS will send out signals in the form of sound, light, LED and screen output. This information, shown in the Alarm Maintenance Console, includes detailed description for fault, possible cause and recommended solution. The faults identified by alarm system range from hardware, link and trunk to CPU load. Hence, the alarm system is a very useful tool for engineers to locate and solve faults.

Alarm information analysis can help locate the specific location and cause of the fault. The rich and complete alarm information from the BSS alarm console can be used to locate a fault directly or in cooperation with other methods. It is the major method for fault analyzing.

III. Indicator status analysis

On the maintenance window of BTS modules, there are indicators to reflect statuses of boards, circuits, links and nodes. Hints given by indicators often help engineer to locate faults quickly. Generally, this method is applied together with alarm information.

IV. MS dialing test

In most cases, BTS functions affect the quality of voice and data services. It is a straightforward method to verify calling function and BTS modules via MS dialing test. This method is frequently used to verify signaling system, voice and data transmission.

V. Instruments and meters

It is a conventional technical method for BTS fault handling to analyze fault through instruments and meters. Instruments and meters can provide visualized and quantized data to directly reflect the fault nature. This method is widely applied in signaling analysis, wave shape analysis, BER detection and feeder fault detection

VI. Traffic measurement

Call completion rate, a key indicator for measuring capability of telecom operators, directly relates to profits of operators and their customer satisfaction. Therefore, it is critically important for operators to increase call completion rate and minimize call loss.

Traffic measurement is a powerful tool to enhance call completion rate by detecting cause for call loss. Faults with BTS are also direct causes that affect call completion rate.

VII. Interface tracing

The BSS O&M system can trace messages of Abis interface, OML interface, Um interface and A interface on the real-time basis.

This function provides a very efficient approach for identifying faults occurred in call connection or BTS-BSC signaling interworking. Given this information, engineers can easily locate root cause and figure out follow-up actions.

VIII. Loopback test

Loopback test is a common approach to verify normal functioning of transmission equipment and trunk parameter setting. Loopback test is a kind of self-sending and self-receiving method. By performing this test, engineers are able to check transmission equipment, channel, service status, and signaling interworking.

Two loopback modes are available: Software loopback and hardware loopback. The former is easier to perform and more flexible but less reliable than the latter.

Conventional loopback tests are E1 loopback test and optical fiber loopback test.

Note:

When E1 outloop test is activated on the BSC side, the time parameter is mandatory. Otherwise the BTS will be kept in the disconnected status all the time unless the BTS is reset on the site.

IX. Contrast/Conversion

In the contrast mode, the user can compare the faulty part or phenomenon with the normal part or phenomenon so as to detect the dissimilarity and locate the fault. This method can be used in simple fault cases.

After spare parts are used, the fault range or location still cannot be specified. In this case, the user can interchange the normal parts like boards or fiber with the possible faulty parts, and then detect the change on operation status. In this way, the fault range or fault location can be detected. This method can be used in cases with complex fault ranges.

Note:

Interchanging is a risky operation. For example: A board in short-circuit status, if interchanged to a normal subrack, may damage the normal subrack. Therefore, the use of this method is requires great care. Do not use it unless you are sure that it will not cause new faults

X. Getting help on Huawei technical support website

Users can login Huawei's technical support website support@huawei.com for help. This website collects a large number of cases for all product lines, and shares our experience in specific fault location and solving.

Registration is needed before you can use these information. After login with your user name and password, you can search the information of your interest. For example, input [Maintenance experience], [Mobile Telecommunication] and [CDMA] to search the related fault cases.

In addition, you can enter the [Technical Forum] of support@huawei.com to search related problems or post your questions for solution.

XI. Contacting Huawei local office

If you cannot locate or solve the fault, you can contact Huawei local office or contact Huawei headquarters.

Within the warranty period, Huawei provides the following services: Telephone consultation, telephone instruction, remote dial-up diagnosis, on-the-site support, hardware maintenance, complaint handling, on-the-site training and regional manager service.

Contact information of Huawei Customer Service Center

Hotline: 86-755-28560000 8008302118

Fax: 86-755-28560111

E-mail: support@huawei.com

E-mail of technical support network administrator: supportmaster@huawei.com

2.2 Typical Case Analysis

This part shares with you some typical cases our customer met, together with relevant resolution, in their maintenance and operation process. It is expected to give you some hint in solving the problem you encounter. Four cases are presented hereinafter: software download fault, initialization failure, coverage fault and module fault.

2.2.1 Software Download Fault

I. Fault Description

Software download faults include software download failure, maintenance console prompting failure or the failure of generating correct prompt information. For ODU3601C, the software to be downloaded is the software of Micro-bts transceiver Module (MTRM).

II. Troubleshooting

Software download failure may be caused by the following two factors: The failure of downloading software to the upper-level BTS and the file loading operation abnormally terminated by the board

- Failure of downloading software to upper-level BTS

1) Check whether the OMU BOOTP of the upper-level BTS is normal

The BOOTP failure may be caused by a blocked link, incorrect route or configuration errors, etc. These causes should be analyzed one by one to eliminate the faults.

2) Check whether the FTP server in BAM is configured correctly.

The FTP server configuration includes the following four items: user name, password, user access path and access authority. Incorrect configuration of any of these four items may lead to user login failure and software loading failure.

Related details are available in the "BTS Maintenance" module of the user manual of the upper-level BTS.

- File loading terminated abnormally by board

All files should carry a correct file header in the specific format as required. The file ID and file version in the header should match that in the activation commands released by the OMC, otherwise the board may consider the software to be downloaded is not what is expected and thus prompt exceptional errors.

2.2.2 Initialization Failure

I. Fault Description

When the ODU3601C is powered on, the system initialization aborts, which leads to the BTS start-up failure.

Upon this failure, the ACT indicator of MTRM keeps flashing fast.

II. Troubleshooting

The ODU3601C initialization faults can be located through the following methods. Otherwise, please refer to the "BTS Maintenance" module of the user manual of the upper-level BTS.

- Incorrect BTRM data configuration

BTRM data configuration error may also lead to the BTS initialization failure, thus we need to carefully check all the parameters, such as the board ID, cell ID, cell resource pool ID and optical interface ID, etc. Reconfigure those parameters if necessary.

- Incorrect physical board connection

Eliminate the fault according to the following two cases:

- The boards or modules are not installed properly and need to be corrected;

- Fiber connection fault exists between the upper-level BTS and the MTRM of ODU3601C. Please refer to the "BTS Maintenance" module of the user manual of the upper-level BTS.

2.2.3 Coverage Fault

I. Fault Description

The downlink coverage scope decreases while the receiving signal fluctuation of the mobile station increases.

II. Troubleshooting

In the case of coverage fault, please eliminate the system's antenna feeder fault and RF module fault first, and then eliminate the effect from external interference sources.

1) Check antenna & feeder system

Check with sitemaster whether the Voltage Standing Wave Ratio (VSWR) is normal (VSWR should be less than 1.5 for BTS installation). If abnormal, check VSWR (less than 1.5) step by step from the antenna port of MFEM to the antenna of BTS, and check the transmit power (including testing the transmit power at the coupling-output port of MFEM). Check whether the connectors are installed correctly and tightly and check the seals. Check the following cases to eliminate faults

- Water infiltration in the antenna feeder system;
- Antenna, feeder and jumper damaged;
- BTS antenna and jumper disconnected or in poor contact;
- The feeder and jumper are disconnected or in poor contact;
- The jumper and MFEM are disconnected or in poor contact;
- The feeder and jumper connector are not installed correctly.

2) Check RF channel

Test the output downlink power at the feeder port of ODU3601C. If the difference between the down link power and the nominal power of BTS is too large, the fault should exist with the RF downlink channel. In this case, please check the following items in sequence: MTRM, MPAM, MFEM. Then check whether the inter-module RF jumpers are normal, and whether water infiltrates into the connectors.

2.2.4 Module Fault

I. Fault Description

ODU3601C has four modules: MAPM, MTRM, MFEM and MPAM. Module faults include:

- Alarm module fault;
- Fault of the upper-level board or module of the alarm module;
- Poor contact of the module and slot;
- Backplane fault.

II. Troubleshooting

- Eliminate MAPM Fault

Follow the handling process below. Go to next step if the problem cannot be solved with the current one:

1) When the external power supply fault is eliminated, MAPM input becomes abnormal.
2) Reset this MAPM.
3) Replace the MAPM.

- Eliminate MTRM Fault

Follow the handling process below. Go to next step if the problem cannot be solved with the current one:

1) If the problem is caused by the external interference, nothing needs to be done to the BTS, but try to reduce the external interference.
2) Check whether MTRM is in poor contact with the slot;
3) Eliminate antenna feeder system fault.
4) Eliminate the corresponding upper-level BTS fault.
5) Eliminate the fiber fault between BTS and the upper-level BTS.
6) Reset this MTRM.
7) Replace this BTRM.

- Eliminate Fault of Other Module

Check whether poor contact exists between other modules and slots. Replace MFEM and MPAM directly if it is faulty.

Chapter 3 Part Replacement

3.1 General Replacement Procedure

3.1.1 Note

I. Influence on service

Upon replacement of ODU3601C parts, please monitor the influence this replacement brings to the BTS service (including the cascaded ODU3601C).

II. Alarm query

Prior to replacement, query the alarms from the remote maintenance console and make a record. After replacement, query the alarms again and check whether the corresponding alarm is cleared and whether a recovery alarm is generated.

III. Version check

Prior to replacement, please confirm the version of the new module, and make a record. After MTRM is replaced, please query the software version to check whether the version is correct.

IV. Tools required

A Phillips screwdriver and a socket spanner matching M4 bolts.

V. Anti-static requirement

Modules are sensitive to electrostatic. Therefore, your operation must be in strict compliance with the procedures: Wear anti-static gloves or wrist strap and make sure the part is properly grounded so as to avoid preventable damages to the module. .

3.1.2 Module Removal

I. Remove plastic shell

Unlock the anti-burglary lock on the cabinet bottom, screw off the two fixing bolts on the sides of the shell and then remove the shell.

II. Switch off power

Switch off the power of MAPM. To replace MAPM, please switch off the external power first.

III. Remove wire on the module bottom

Remove the water-resistant tape and the wire on the module bottom. Make sure not to damage the fiber or the fiber connector.

IV. Remove bolts on module top and those on module bottom

V. Remove module

Remove the module along the slot, put it into an antistatic bag, then into a damp-proof bag. Finally, put the wrapped module into a packing box with foam cushion.

MPAM is equipped with a set of thermal tube and heavy. Upon replacement, make sure to keep the module undamaged.

3.1.3 Module Installation

I. Check module

Prior to module installation, take out the module from the packing box, remove the anti-static bag and damp-proof bag, and then check whether the module is damaged.

II. Check board nameplate

Locate the slot for the board from the nameplate.

III. Insert module

Push the module along the slot with both hands until you feel the module engage the backplane connector. Make sure that the panel and subrack surface are on the same surface.

IV. Tighten bolts on module top and those on module bottom

V. Connect cables on module bottom

Please refer to the installation manual for details. Make sure to keep the module away from water.

VI. Switch on

Resume the power supply after replacement and check the relevant indicator (after opening the cover of the maintenance window) to judge whether the module is running normally.

If MAPM is replaced, switch on the external power first.

3.1.4 Replacement Completed

After replacement, check the result in the following three aspects:

- Check whether the relevant indicator status is normal. Please refer to Chapter 4 Module Maintenance Window.
- Check from the remote maintenance console of OMC whether the corresponding alarm has disappeared and whether any recovery alarm has been generated at the same time.
- Make calls with MS on the site to check whether the BTS is working normally.

3.2 Part Replacement

3.2.1 Module Replacement

This section contains the items for special attention during module replacement based on the Section 3.1 General Replacement Procedure

I. Replace MAPM.

Prior to replacement, switch off the 220V AC power.

If batteries are connected on the +24V battery interface of MAPM, disconnected the batteries (Make sure to avoid short circuit) and avoid short circuit to the power supply

II. Replace MTRM

After replacement, query the module version through the local maintenance console or the OMC maintenance console so as to check whether the version is correct.

III. Replace MFEM

MFEM is connected with MTRM, MPAM and the antenna feeder system through RF cable. After replacement, make sure to resume the connections, otherwise the RF index will be affected.

IV. Replace MPAM

MPAM is equipped with a set of thermal tube and thus heavy. Upon replacement, make sure to keep the module undamaged.

3.2.2 Optical Fiber Replacement

I. Check optical fiber

Prior to replacement, carefully check the new fiber.

Make clear marks for fiber correspondence to avoid any mis-operation.

Note:

The MTRM module of ODU3601C has two external optical interfaces, one used for connection with the cascaded ODU3601C while the other for connection with the upper-level BTS (If the upper-level BTS is BTS3612, it is connected with BRDM; If the upper-level BTS is BTS3601C or ODU3601C, it is connected with the corresponding MTRM).

II. Insert/remove fiber connector

This operation should be conducted very carefully. Make sure to avoid breaking the internal cores of the fiber connector.

Before inserting the connector, align the fiber connector (of MTRM) with the fiber interface and align its spacing arm with the fixing slot of the interface. Then carefully plug the connector into the fiber interface until you feel the connector well engage the interface. This indicates that the connector has been plugged in position. Then turn the spacing arm into the corresponding fixing slot and tighten the nut. Now the fiber connector is installed.

Prior to fiber replacement, make clear marks for fiber connection relation so that the proper fibers are plugged in.

III. Excessive optical fiber

Put the excessive optical fibers into bellow and store them in the specified place.

Appendix A Module Maintenance Window

For the water-proof purpose, each module maintenance window is installed with a seal cover. Indicators and interfaces inside are invisible unless this cover is opened.

A.1 MTRM

I. Indicators in the maintenance window

Table A-1 Indicators in the maintenance window of MTRM

Indicator	Color	Meaning	Description	Normal status
RUN	Green	Status indicator	Fast flash (4Hz): MTRM is started or software downloading is in progress Slow flash (0.5Hz): BTRM is working normally. Other: Board error	Slow flash (0.5Hz)
ALM	Red	Alarm indicator	Fast flash (4Hz): Critical alarm Slow flash (0.5Hz): Major alarm Slow flash (0.25Hz): Minor alarm Off: No alarm	Off
ACT	Green	Operation indicator	On: BTRM is working normally and the clock is locked. Slow flash (0.25Hz): Alarm on monitor link Slow flash (0. 5Hz): The clock has not been locked yet or can not be locked.	On

II. Interfaces in the maintenance window

Table A-2 Interfaces in the maintenance window

Interface	Function
10M	10MHz signal interface
COM	Serial communication interface for internal test
RST	Reset button
TRX_ID	An 4-digit DIP switch
PP2S	2-second signal interface
HPA_TEST	Test button used for forward local RF transmission
LOAD	Jumper used for internal test

Table A-3 TRX_ID DIP switch

DIP switch No.				MTRM No.
4	3	2	1	
This bit is invalid, and the default status is off	ON (0)	ON (0)	ON (0)	0
	ON (0)	ON (0)	OFF (1)	1
	ON (0)	OFF (1)	ON (0)	2
	ON (0)	OFF (1)	OFF (1)	3
	OFF (1)	ON (0)	ON (0)	4
	OFF (1)	ON (0)	OFF (1)	5
	OFF (1)	OFF (1)	ON (0)	6

Note:

When the ODU3601C is cascaded to the BTS3601C, the. MTRM No. of ODU3601C of level 1 is 1, and the. MTRM No. of ODU3601C of level 2 is 2, and the rest may be deduced by analogy.

When the ODU3601C is cascaded to the cBTS3612, the. MTRM No. of ODU3601C of level 1 is 0, and the. MTRM No. of ODU3601C of level 2 is 1, and the rest may be deduced by analogy.

A.2 MPAM

No maintenance window installed.

A.3 MFEM

No indicators are installed for MFEM. The interfaces in the window are described in the following table.

Table A-4 Interfaces in the maintenance window of MFEM

Interface	Function
TX_TST	Used for coupling test of output power (degree of coupling: -30±1dB)
RXM_TST	Used for coupling test of main received signals
RXD_TST	Used for coupling test of diversity received signals

A.4 MAPM

The maintenance window of MAPM is shown in Figure A-1.

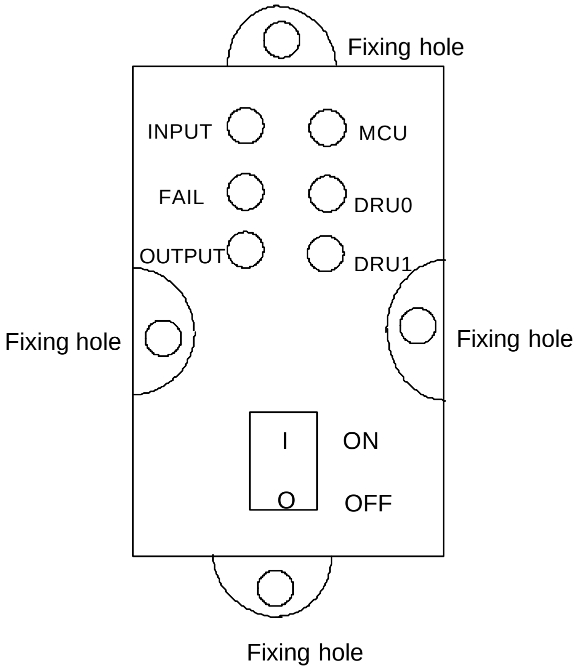


Figure A-1 Maintenance window of MAPM

The indicators in the maintenance window are described in the following table.

Table A-5 Indicators of MAPM

Indicator	Color	Meaning	Description	Normal Status
INPUT	Green	Power input	On: Normal Off: Abnormal	On
FAIL	Red	Module alarm	On: Alarm Off: Normal	Off
OUTPUT	Green	Power output	On: Normal Off: Abnormal	On
MCU	Green	These three indicators are reserved in ODU3601C.		
DRU0	Green			
DRU1	Green			

Appendix B Return Loss, VSWR and Reflection Coefficient

Return loss (dB)	Voltage Standing Wave Ratio (VSWR)	Reflection coefficient G
4	4.41943	0.63096
5	3.56977	0.56234
6	3.00952	0.50119
7	2.61457	0.44668
8	2.32285	0.39811
9	2.09988	0.35481
10	1.92495	0.31623
11	1.78489	0.28184
12	1.6709	0.25119
13	1.57689	0.22387
14	1.49852	0.19953
15	1.43258	0.17783
16	1.37668	0.15849
17	1.32898	0.14125
18	1.28805	0.12589
19	1.25276	0.1122
20	1.22222	0.1
21	1.19569	0.08913
22	1.17257	0.07943
23	1.15238	0.07079
24	1.13469	0.0631
25	1.11917	0.05623
26	1.10553	0.05012
27	1.09351	0.04467
28	1.08292	0.03981
29	1.07357	0.03548
30	1.06531	0.03162
31	1.058	0.02818
32	1.05153	0.02512
33	1.0458	0.02239
34	1.04072	0.01995
35	1.03621	0.01778
36	1.03221	0.01585
37	1.02866	0.01413
38	1.0255	0.01259
39	1.0227	0.01122
40	1.0202	0.01
41	1.01799	0.00891
42	1.01601	0.00794
43	1.01426	0.00708
44	1.0127	0.00631
45	1.01131	0.00562
46	1.01007	0.00501
47	1.00897	0.00447
48	1.00799	0.00398
49	1.00712	0.00355
50	1.00634	0.00316

The calculation formulas for reflection coefficient Γ, return Loss (RL), and VSWR are displayed in the following table:

Reflection coefficient G	VSWR	Return loss (dB)
$\Gamma = \frac{Ureflected}{Uforward}$	$VSWR = \frac{Uforward + Ureflected}{Uforward - Ureflected}$	$RL = 20\lg \frac{Uforward}{Ureflected}$
$\Gamma = \frac{1}{alg(\frac{RL}{20})}$	$VSWR = \frac{1+\Gamma}{1-\Gamma}$	$RL = 20\lg \frac{1}{\Gamma}$
$\Gamma = \frac{VSWR-1}{VSWR+1}$	$VSWR = \frac{alg(\frac{RL}{20})+1}{alg(\frac{RL}{20})-1}$	$RL = 20\lg \frac{VSWR+1}{VSWR-1}$

In the above formulas, *Uforward* stands for forward voltage and *Urelected* for reverse voltage.