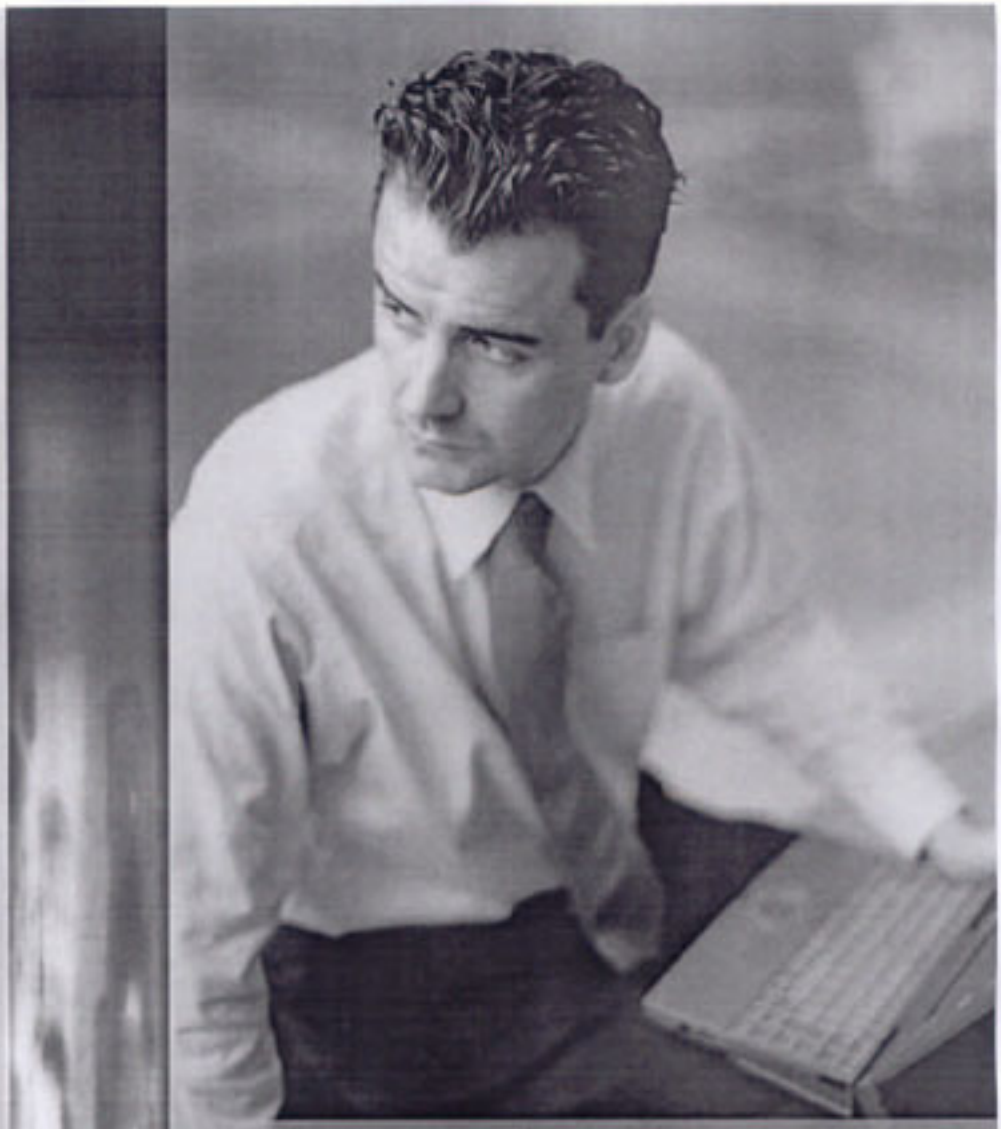


User's Manual

E 1

Spread Spectrum Radios

K-Best technology

www.kbest.com.tw

※ NOTICE ※

The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

※ IMPORTANT NOTE ※

To comply with the FCC RF exposure compliance requirements, no change to the antenna or the device is permitted. Any change to the antenna or the device could result in the device exceeding the RF exposure requirements and void user's authority to operate the device.

To comply with FCC RF exposure requirement, the antenna used for this transmitter must be fixed-mounted on outdoor permanent structures with a separation distance of at least 2 meter from al persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Outdoor units and antennas should be installed ONLY by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities.Failure to do so may void the product warranty and may expose the end user or Service Provider to legal and financial liabilities.K-Best and its resellers or distributors are not liable for injury, damage or regulation violations associated with the installation of Outdoor Units or antennas.

Be sure that the outdoor unit, the antenna and the supporting structure are properly installed to eliminate any physical hazard to either people or property. Verify that the outdoor unit and the antenna mast are grounded so as to provide protection against voltage surges and static charges. Make sure that the installation of the outdoor unit, antenna and cables is performed in accordance with all relevant national and local building and safety codes.

Table of Contents

1. Introduction

PDH, Plesiochronous Digital Hierarchy, has been developed in these recent ten years to a high frequency microwave, digital de/modulation, integrated digital multiplexing, computer control and signal communication technique wholly into a wireless digital signal communication mode.

Relevant products of "PDH equipment" has been extensively use in postal and telecommunication service, power transmission, military affairs, various specialized network especially in the interconnection between base stations of mobile communication, large enterprises, schools and universities network connection. It has been regarded as one of the quickest connection method and has been largely used in provisional and urgent signal communication.

2. System Basic Features

2.1 PDH System

PDH system is different from the traditional microwave equipment in smaller size, lighter weight, easy set up and can be conveniently moved from place to place. The main characteristics lie in its advantageous use of high frequency band microwave transmission (above 5.7GHz frequency), digital transformation, concise structure, quick connection and adapt to complex topographical structure. Extensively use in mobile phone base station's interconnection and signal transmission, short distance local connection, urgent communication, public and specialized network has large application as well. The present wireless low frequency band is jam-packed and with the demand to build a quicker communication network, the use of high frequency band PDH equipment connection is especially meaningful.

2.2 Core Technology

PDH system includes a lot of high technique, which are:

(1) High RF microwave and other related components (amplifier, LNA, MIX, duplexer etc.)

(2) Frequency integrator randomly changes to different frequency band

(3) High amplifier gain control technique（ALC & ATPC）

(4) Advanced QPSK de/modulation

(5) Microwave frame de/multiplexer

(6) Digital band limit

(7) Digital equalizer

(8) Forward Error Correction

(9) Random N*E1 de/multiplexer, where N=1~32

(10) Digital cross-connection

(11) Computer monitoring and signal communication

(12) Network management

(13) Digital service

(14) Digital interface transformation

(15) Highly efficient and improved overall design

※ Audio frequency: Each voice signal needs a 64kbps; made of 8 bits-per-sample code, A/D and D/A conversions.

※ E1 is an European Standard, 1*E1 is 30 voice channels, plus a channel for transmitting and signaling, i.e. 32*64kbps = 2.048Mbps

2.3 Composition and Principle

2.3.1 System Composition

PDH system is composed of ODU and IDU. Other set of equipments include antenna system, end- terminals etc.

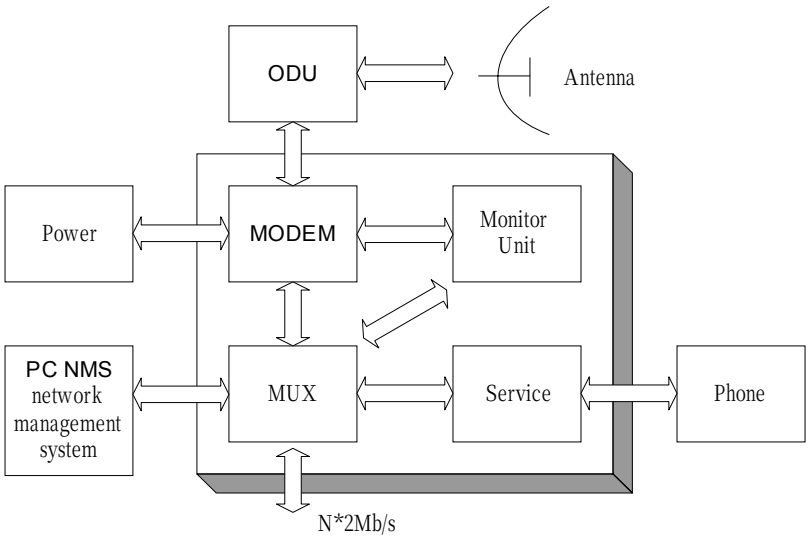
ODU unit is the Rx/Tx unit of microwave signal. It is composed of other microwave units (amplifier, converter, coded integrator etc.), duplexer, IF unit (dual converter, local oscillator, IF processing segment etc.), monitor unit, remote unit, and power board.

IDU unit mainly comprises of QPSK modulator, de/multiplexer, monitor unit, network management system, digital service, power system, other interfaces etc.

Antenna systems include antenna, matching connection, transformation and other installation assembly for fixing on the rooftop.

ODU unit and IDU unit are connected by an IF cable.

PDH System Block Diagram (1+ 0 mode)



2.3.2 System Principle

N number of E1 signals, digital service, 9600b/s system net control and 9600b/s computer data communication etc. multiplexed in a multiplexer to a specific microwave frame code. After QPSK modulation, the system sends the transmission to the ODU through only one IF cable. It enter the ODU upstream IF signal communication through equalized electric circuit interface, higher frequency converter, power amplifier, filter, duplexer and are then transmitted out through the antenna system.

After the opposite terminal's antenna system receives the microwave signals, it is passed on to the duplexer, LNA, low frequency converter, filter, dual frequency converter and then to the IDU. In the IDU, it passes through the QPSK demodulator to recover the microwave frame signal. This frame signal is then processed through de-multiplexer to recover the N number of E1 signal and other service signal.

The monitor unit in the equipment is controlled by the CPU (central processing unit) to function as: monitoring, controlling, dispatching, alarming, processing and indicating signals etc. Based on the statistical result of BER test in de/multiplexer, we have 1E-3BER, 1E-6BER and frame loss signals.

Digital service adopts the Analog rule of 64kbps and PCM (Pulse Code Modulation) decoder method to service communication, complete address selection and full address function. Through simulation transmitting and receiving, to complete the multiple categorized public affairs connection. The dialing mode adopts DTMF system.

System network management uses PC machine of above PII operating system.

Under WINDOW environment's SNMP network management software, it is possible to hold communication through the same equipment, collect all the equipment's status in the network and select records for printing. The introduction of animation design makes the network topology and equipment selection status crystal clear.

3. Technological Characteristics

Traditional digital microwave equipment generally transmits E1 signal only, so there is always the need to apply for frequency channel because of technological limitations.
In recent years, there is a dramatic change in the structure, composition and application of digital microwave communicative equipment. The traditional system of transmission has been changed to the integration of transmitter and receiver as well as from fixed frequency to the possibility of frequency conversion from low to high frequency band. In view of the high frequency digital microwave communication system's new changes and additional newer characteristics, we had already improved the traditional system to a great length.

K-Best's PDH system has the following technological characteristics:

-- high frequency band: 5.8、13、15GHz to 26GHz

-- complete capacity: 2*2Mbps、4*2Mbps、8*2Mbps、16*2 Mbps

-- flexible interface: suitable for multiple network and business connection

-- IDU and ODU unit connected by a single IF cable up to 300m length, thereby, decreasing the RF transmitting loss and increasing the receiving signal-to-noise ratio (S/N)

-- channel conversion, flexible spread network and least backup support

-- digitally advanced QPSK or 16QAM de/modulation

-- powerful monitoring function: simple and easy to operate LCD display. With the overall status display and loopback test function, subscribers can easily maintain the system without the need of special equipment to ascertain where malfunction has occurred

-- improved SNMP network management system suit a lot of different topological structure. It can manage up to 255 number of station equipments and also extend the monitoring support to other microwave equipments

-- quick and easy installation

-- equipment adopt a considerable amount of advanced technology and modularity to design the structure which is highly reliable, small, artistic, quick to produce and easy to maintain.

-- frequency bandwidth and spectrum transmitting RF spurious fits the specifications

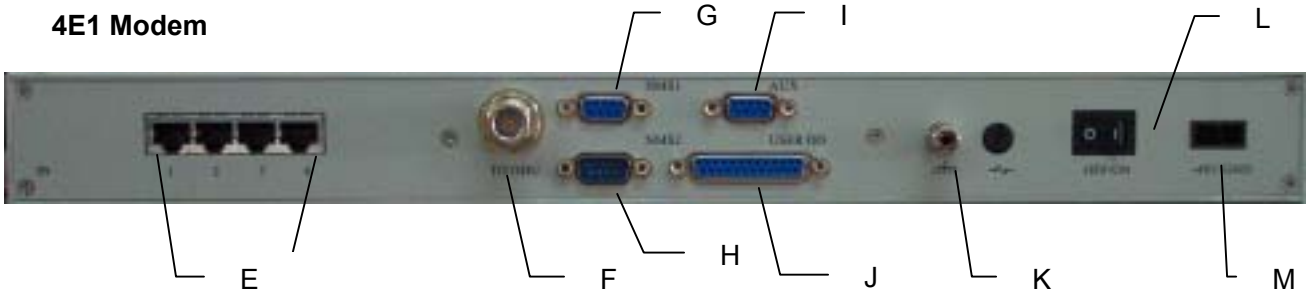
4. Product Overview

4.1 IDU

Front Panel

Rear Panel

4E1 Modem



Transmission Line

Power Cord

4.1.1 Functions

A. LCD Display: Display the normal working temperature, receiving power and BER.

Under normal working condition, display the indoor and outdoor temperature, receiving power and online BER. The display refresh every 1~2secs.

B. LCD Control: LCD glows under normal working condition. If there is an alarm, the LCD back light will automatically glows for 2 minutes and display the alarming status. The buzzer goes off until it is turn off. To shut off the buzzer temporarily, press the monitor control. LCD will display a crossed off speaker sign. Until and unless the alarm is shut off, never switch on the buzzer manually. Alarm display goes off gradually.

ESC	=	exit
ALT	=	switch functions
Left	=	left arrow
Right	=	right arrow
OK	=	confirm

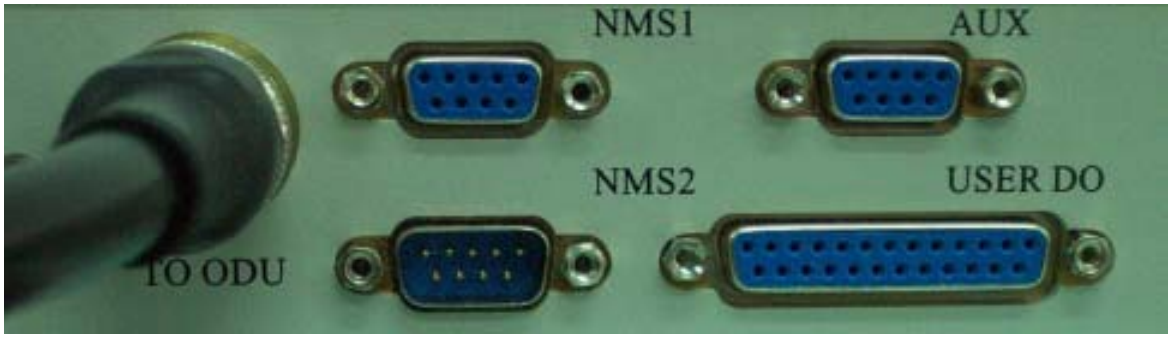
C. LED: LED glows on switching the power ON. LED display green light under normal working condition and red light under critical alarming condition.

D. Service Phone Interface: Service between the stations. Insert RJ-11 into any analog phones and dial the IDU DSC number. If there are more than one equipments in the same network, you may dial "***" and group connection will be connected.

E. Reverse E1 connector (BNC): 2E1 2*Tx/Rx, 4E1 4*Tx/Rx, 8E1 8*Tx/Rx, 16E1 16*Tx/Rx.

F. IF Transmission Port (N-Type 50Ω): Transmission contents include transmitter 310MHz, receiver 70MHz, monitoring signal 11.0592MHz, DC -48V/1A. Maximum transmission 100M when using N-type connector's RG-5 cable. Maximum transmission 200M when using N-type connector's RG-8 cable.

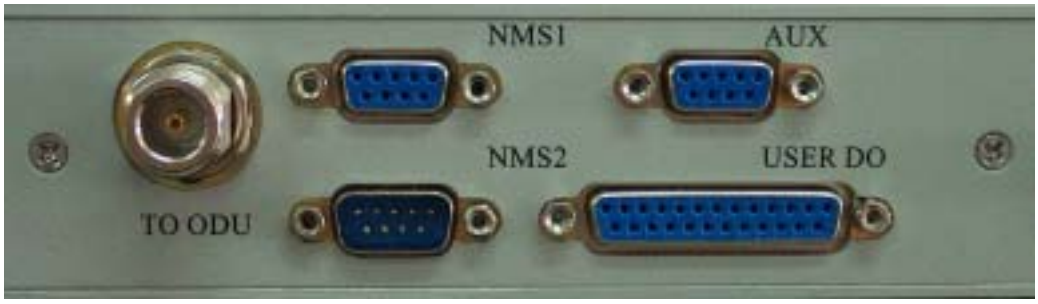
N-type connector's RG-5 cable



E1 modem without IF cable connection

G. Monitor port (NMS1): Connect the COM1 or COM2 (RS-232) of the computer to this port. Open the Arbeit NMS working window to function as the PDH remote terminal display. Other than monitoring the local IDU and ODU, it may also monitor the remote equipments.

Transmission Line (DB9 male + DB9 female)



E1 Modem *without* transmission line

E1 Modem *with* transmission line

H. **String Connection Port (NMS2)**: When there are more than two sets of equipments in the local stations, connect the IDU-NMS2 of this equipment to the IDU-NMS1 of the other equipment. When the NMS2 are connected, the service telephone between these equipments is put into function.

I. **Data Transmission Port (AUX)**: Use the WINDOWS HyperTerminal functions as given in Section 9.2. Connect the COM1 or COM2 (RS-232/DB-9) of the pc's to this port for simple file and data transmission.

J. **Environment Detection Port**: Allows users to fully monitor the central controlling room for the local station. For example: In the absence of human control in the remote stations, the central controlling server is able to receive all fire alarms, power supply etc. information. It can also control the light switches, oil switches etc. It totally realizes the possibility of an intelligent management. All together, there are 8 input ports and 4 output ports.

DB-25 pins for the Environmental Detection Port

DB-25	Description	DB-25	Description
1	Input 1	14	Shield Ground
2	Input 3	15	Input 2
3	Input 5	16	Input 4
4	Input 7	17	Input 6
5	Shield Ground	18	Input 8
6	Shield Ground	19	Shield Ground
7	Output 1 C	20	Output 1 NC
8	Output 1 NO	21	Output 2 C
9	Output 2 NC	22	Output 2 NO
10	Output 3 C	23	Output 3 NC
11	Output 3 NO	24	Output 4 C
12	Output 4 NO	25	Output 4 NC
13	Shield Ground		

K. Grounding connection

L. Safety Wires 250V/2A

M. Power Switch

N. Power Input Port: -48V/1A DC

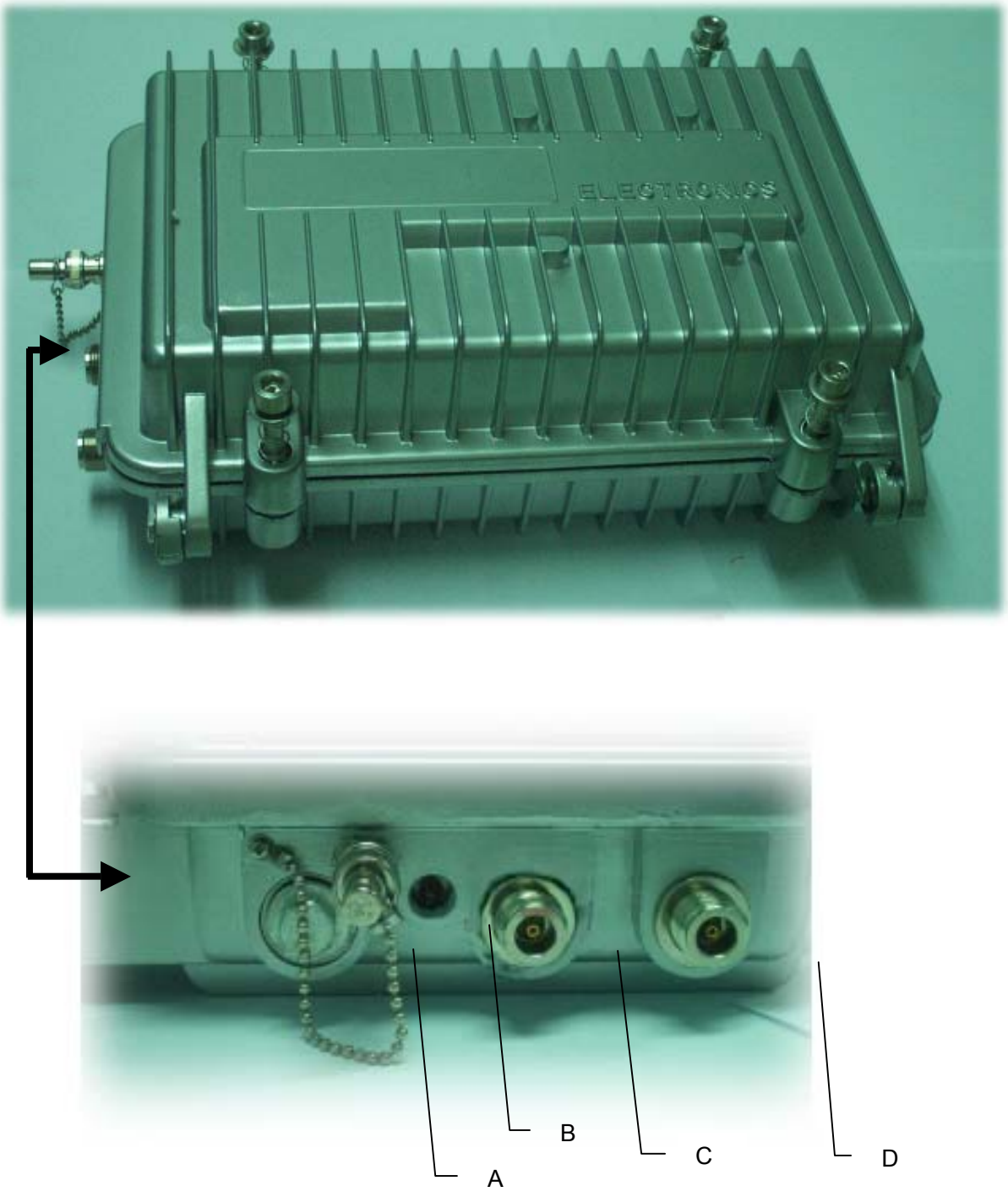
E1 Modem Power Terminal

Connection to Power Terminal

(white black - ; red +)

E1 Modem *with* connection

4.2 ODU



4.2.1 Function

A. **RSSI Status:** while setting up the equipments in longer distance range, in order to conveniently adjust the antenna, we can switch on the BNC 50ohm terminal's resistance rotator. Use a 3in1 use voltmeter to measure the RSSI voltage and potential. Please refer to the table given below. Higher the voltage, better the antenna's elevation.

B. **Power Indicator (LED):** ODU power indicator light. When all the connecting cables are well connected, switch ON the IDU Power. Under normal working conditions, the ODU's LED display green light. LED is red if there is no connection at all.

C. **Antenna Port:** after properly fixing up the Antenna, use a moderate length N-Type connector's cable of 50ohm to connect to this port.

D. **IF Port:** this connection port and IDU-IF are connected by coaxial cable. The maximum length of N-Type connector's RG-5 cable is 100M. The maximum length of N-Type connector's RG-8 cable is 300M. The transmitting contents include transmit 310MHz, receiver 70MHz, monitor signal 11.0592MHz and DC -48V/1A。

※ After cable connection, please entwine waterproof tape at the connection point of the ODU edges at the C and D port. This prevents rain or humidity from the equipment.

4.3 Data Transmission Port Guide

A. Click Start → Programs → Accessories → Communications → HyperTerminal to open the HyperTerminal folder.

B. Enter a name in the Name blank, then press OK or in the HyperTerminal folder, double-click on the HyperTerm icon to display the Connection Description window.

Fig.1

C. In the Connect To window, select the Direct to Com1 option in the Connect Using field. Click on the OK button to open the Connect To window and to display the COM1 Properties window.

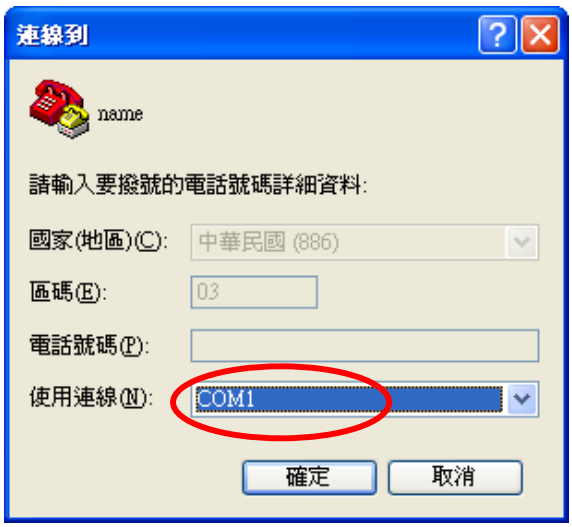


Fig.2

D. In the COM1 Properties window, select the following options:

E. Click on the OK button to open the StandardConfig--HyperTerminal application window.

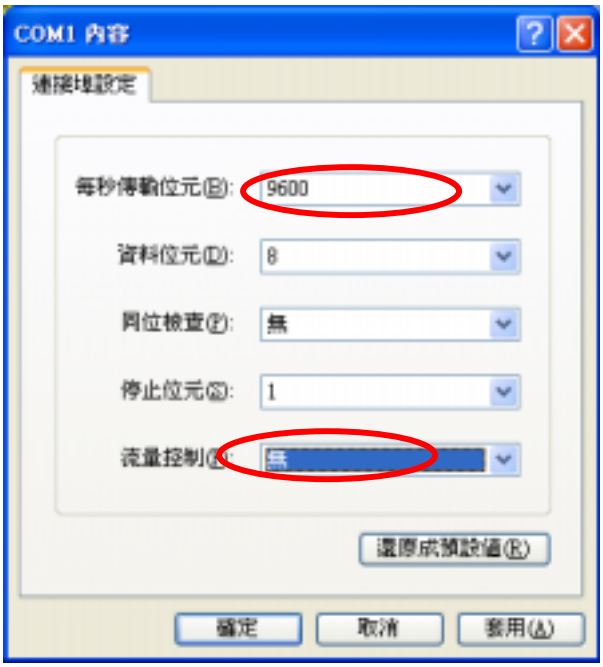
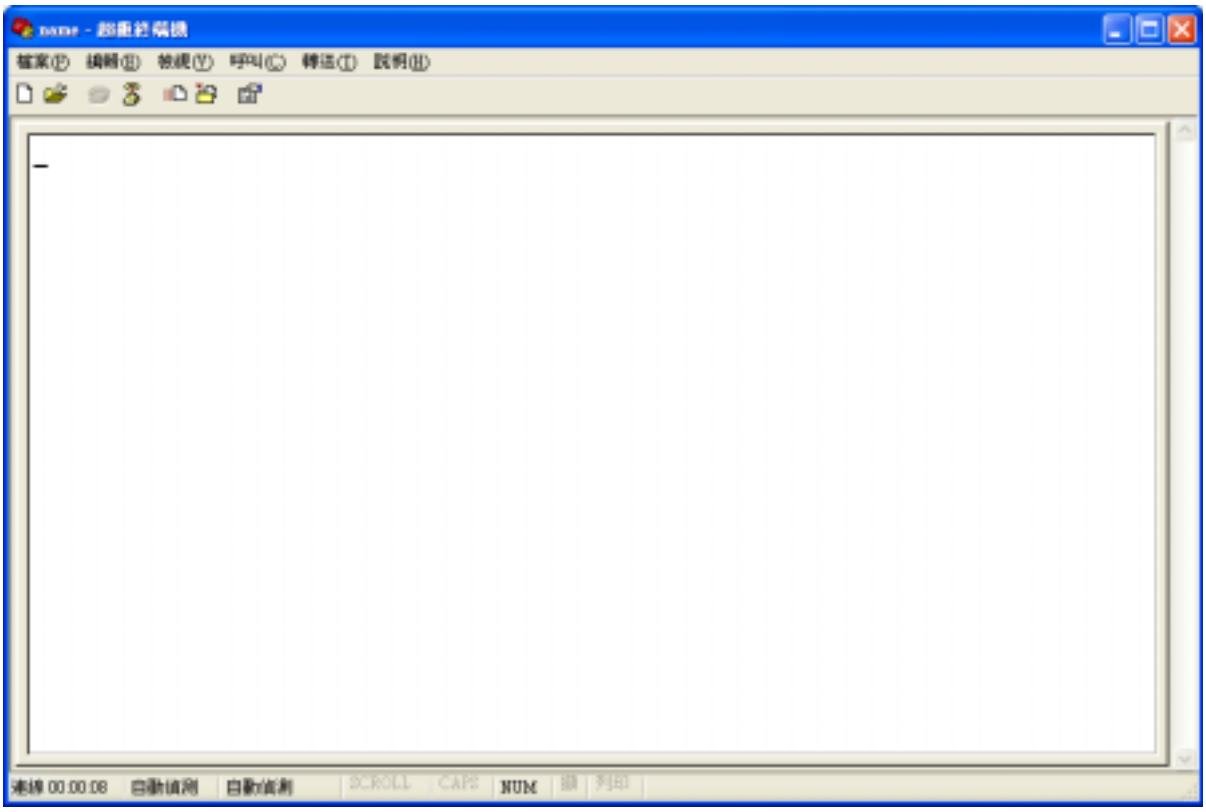


Fig.3

At this point, the HyperTerminal window provides monitor mode access to the terminal concentrator. Please refer to WindowsXX User's Manual.



5. Interface

5.1 Rear panel

E1 interface may be of 75ΩBNC interface or 120ΩRJ-45 interface. User's can flexibly choose between these two.

Beside the standard E1 interface, the equipment also provide V.11, V.28, service, monitor, computer signal communicating data port, loopback test port, etc. This provides the subscribers to conveniently fully monitor the controlling room through this equipment. For instance, from the central controlling room, we can get the information regarding the temperature of the mounting machine, room temperature, fire alarm, power supply, etc. and also from the central computer, we can monitor different functions such as light switches, oil switches etc. This makes the realization of an overall intelligent management of an unguarded station possible. This equipment has 8 input modes that is optically isolated, plus 4 power relay output mode.

5.2 Front panel

5.2.1 Public telephone

Public telephone plays a significant role in this kind of communication or in areas with one and only communication means as in microwave equipment's application in mountainous areas and underdeveloped areas. Other than possessing the function of selective calling, entire calling etc. it also has the following most distinguishing features: whole tone service like dial tone, engage tone, out-of-order tone etc. Users do not feel much difference in using public phone from local call center service because it is very user-friendly and fits all the demands of different users. Network management software is used to set up the public telephone numbers from the local station.

Dial tone: When dialing from the local station, you'll hear the same dial tone as any general telephones

Engage tone: The repeating ring tone is 2±0.2s ring and 4±0.4s break

Ring tone: Same as the engage tone

Out-of-order tone: When there is an out-of-order service or lost of signal service, it will ring the out-of-order tone at 500±50ms, 230ms±70ms and then break connection

Busy tone: Continue to redial at an exchange of 500ms±50ms

5.2.2 Definition of the IDU LCD Panel keys

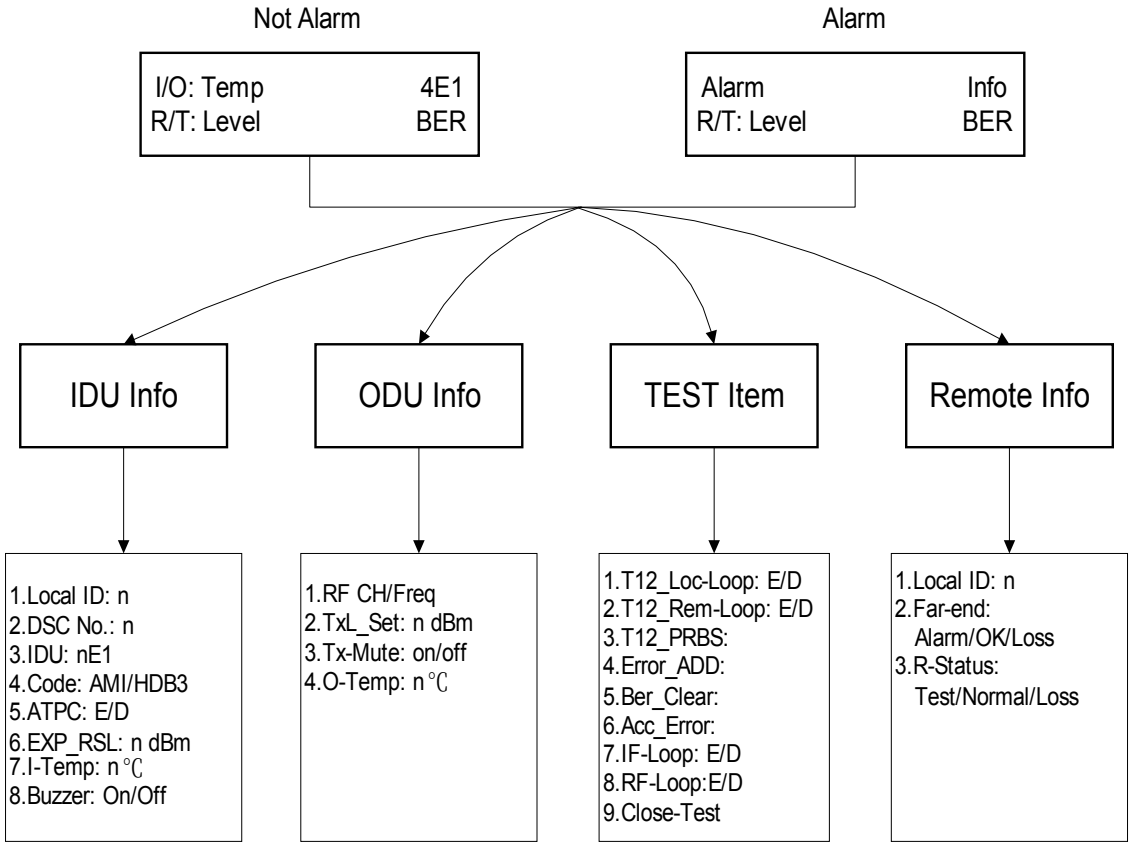
❍ESC ❍ALT
❍Left ❍Right ❍OK

ESC	=	exit
ALT	=	switch functions
Left	=	left arrow
Right	=	right arrow
OK	=	confirm

For the LCD to fully display the system's status and perform those simple set up operations, try to make use of the above-mentioned five function keys to carry out the operations.

LCD displays the contents and different set-up entries. As described below, please apply as mentioned.

IDU LCD Display Status



Under normal condition (no alarm), the LCD displays as below:

1. First line of the LCD display - On the right hand side, in every alternate 1~2 seconds, it displays the I-Temp: xx.x□ stands for IDU temperature. O-Temp: xx.x□ stands for ODU temperature. On the left hand side, 4E1 stands for the activity measure.
2. Second line of the LCD display - On the right hand side, in every alternate 1~2 seconds, it displays the R: xxx stands for the online receiving power in real-time. T: xxx stands for the online transmitting power in real-time. On the right hand side, it displays the bit-error rate (BER).

Bit Error Rate (BER): The conversion formula for accumulated bit errors is

BER = (n/EN*S).

where, n = number of times of bit error;

EN = rate of the equipment, E1's rate is 2.048M；S = working time (in seconds).

For example:

Present bit error times is 3, working time is 2 minutes and system interface is E1

BER = (3 / (2.048 * 10^6 * 2 * 60)) = 1.22 E-8

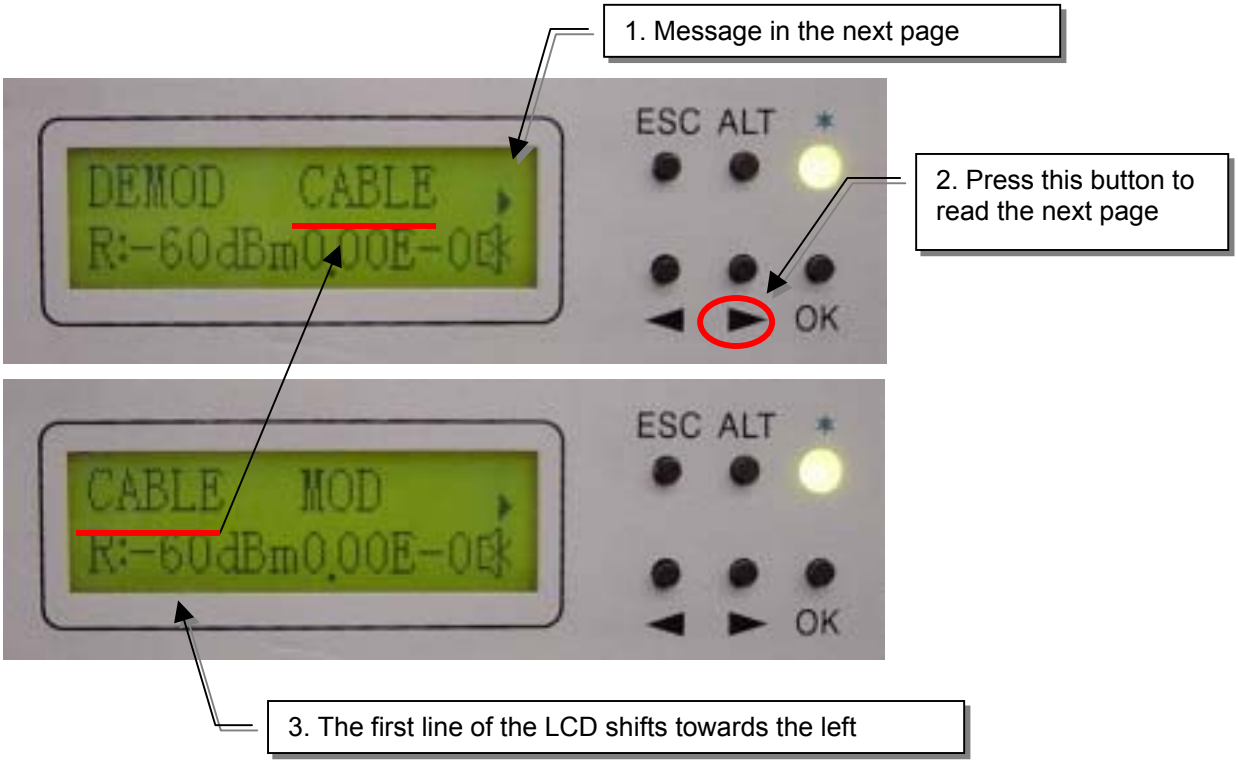
Present bit error times is 1000000, working time is 4 minutes and system interface is E1

BER = (566 / (2.048 * 10^6 * 4 * 60 * 60)) = 3.39 E-5

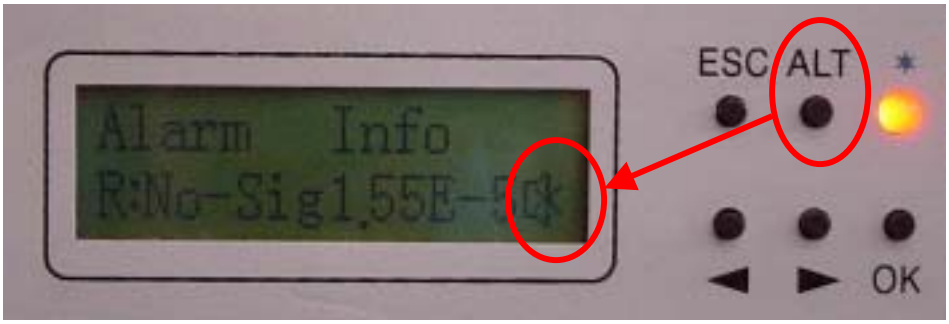
Under warning/alarming condition, the LCD displays as below:

Now press the OK button of the panel. It will display the alarm message. Press the Right/Left button of the panel. The LCD displays the present alarm/warning message.

For example:



Whenever there is an alarm, the LCD back light will light for 2 mins. and the beeper sounds goes off. Other than removing the alarm status or switching off the beeper status, we can also switch off the beeper by pressing the ALT button. To switch on the beeper, please enter the IDU Info/Buzzer: ON/OFF.



5.3 LCD definition & Operation:

IDU Info

A1. Local ID:

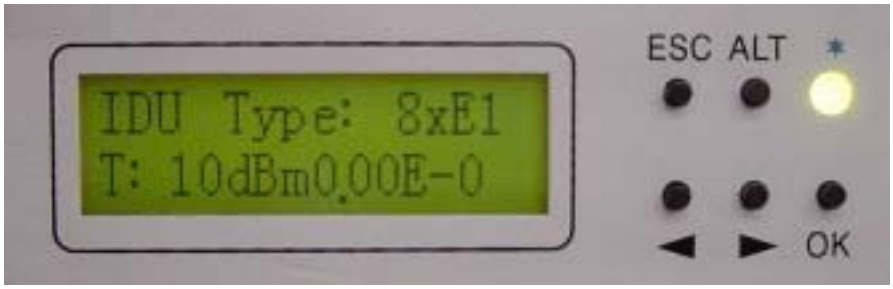
Display the local equipment's address. In the same link route system, there can be a maximum connection of 255 equipments. NMS software is used for the equipment's initial set-up. This function is used for checking the present local end equipment's address.

A2. DSC No.: n

Display the local equipment's service telephone number. In the same link route system, there can be a maximum connection of 255 service telephone. NMS software is used for the service telephone's initial set-up. This function is used for checking the present service telephone number.

A3. IDU: n*E1

Display the number of E1 equipments. If it displays 8*E1, it means that the equipment has eight E1 interface.



A4. Code: AMI/HDB3

Display the local end's IDU dispatch model number. After pressing the OK button, use the Right/Left button to choose the model number. At present, you may select either of the two numbers: AMI or HDB3.

AMI：

AMI (Alternate Mark Inversion) is a synchronous clock encoding technique which uses bipolar pulses to represent logical 1 value. A logical 0 is represented by no symbol and a logical 1 by pulses of alternating polarity.

Example of AMI encoding

The pattern of bits " 1 0 0 0 0 1 1 0 " encodes to "+ 0 0 0 0 - +"

HDB3：

HDB3 (High Density Bipolar Order 3 Encoding) is based on Alternate Mark Inversion (AMI), but extends this by inserting violation codes whenever there is a run of 4 or more 0's. This and similar (more complex) codes have replaced AMI in modern distribution networks. The purpose of this is to prevent long runs of 0's in the data stream, sometimes called a "run length limited" code. Encode any pattern of more than four bits as B00V, where B is a balancing pulse. The value of B is assigned as + or - , so as to make alternate "V"s of opposite polarity. The receiver removes all Violation pulses, but in addition a violation preceded by two zeros and a pulse is treated as the "BOOV" pattern and both the violation and balancing pulse are removed from the received bit stream. This restores the original bit stream.

Summary of HDB3 encoding rules

Transmitted Data	HDB3 Encoded Pattern
0	0
1	Alternate Mark Inversion (AMI)
0000	000V (three 0's and a violation)
0000 0000	B00V B00V

HDB3 is one of CCITT's recommended uses.

Example 1 of HDB3 encoding

The pattern of bits

" 1 0 0 0 0 1 1 0 "

Encoded in HDB3 is

" + 0 0 0 V - + 0 "

(the corresponding encoding using AMI is " + 0 0 0 0 - + ")..

Example 2 of HDB3 encoding

The pattern of bits

" 1 0 1 0 0 0 0 0 1 1 0 0 0 0 1 1 0 0 0 0 0 0 "

Encoded in HDB3 is " + 0 - 0 0 0 V 0 + - B 0 0 V - + B 0 0 V 0 0 " which is:

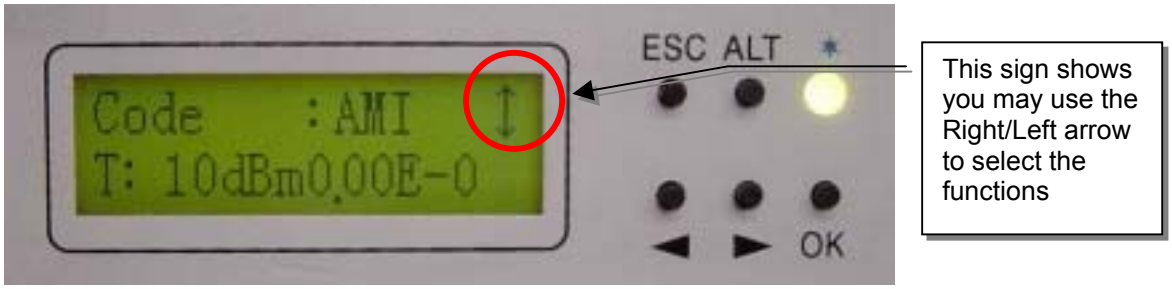
" + 0 - 0 0 0 - 0 + - + 0 0 + - + - 0 0 - 0 0 "

(the corresponding encoding using AMI is " + 0 - 0 0 0 0 0 + - 0 0 0 0- + 0 0 0 0 0 0 ").

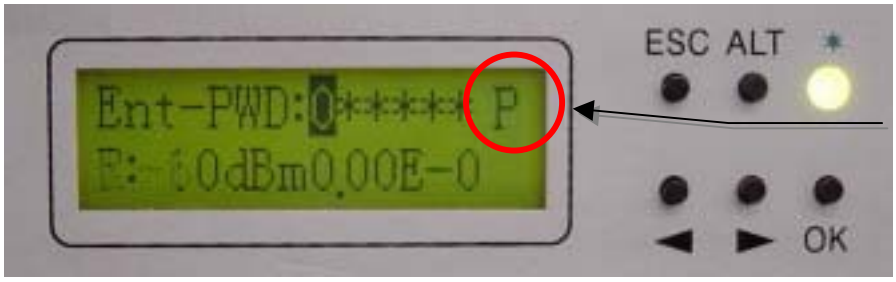
For example: modifying E1 transmitted HDB3 code to AMI code

1. Enter IDU Info/Code: sub-menu. Press OK.

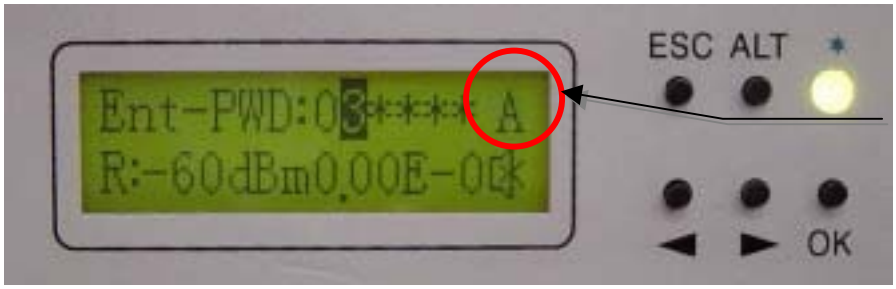
2. Press the Right/Left button to change HDB3 to AMI. Press OK.



3. Enter the password verification. Enter the 6-digits system password. Use ALT to change to different functions.
   P = Place
   A = Adjust
   Press OK.



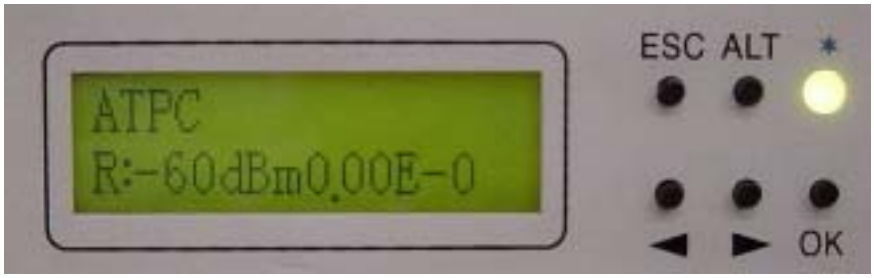
※ For the password, enter as described in NMS guide.



4. Error Password is display on the entering the wrong password. It will not save the wrong password. This will be display for 5~10sec. and then return to the main function display.

※ Use NMS to setup the password. LCD does not allow password correction.

A5. ATPC: En/Dis:（Retain）



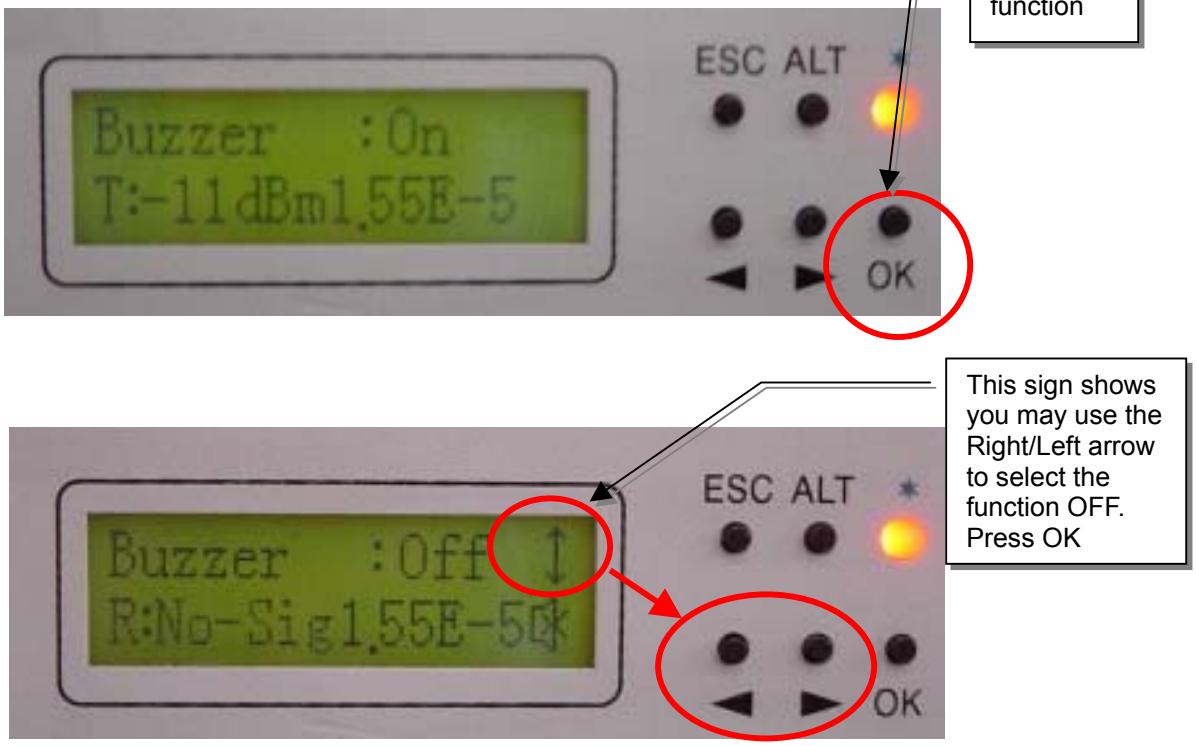
A6. EXP_RSL: - n dBm：（Retain）

A7. I-Temp: n□

Display the local end's ODU working temperature.

A8. Buzzer: ON/OFF

Display the buzzer switch to ON/OFF.



ODU Info

B1. RF CH/Freq

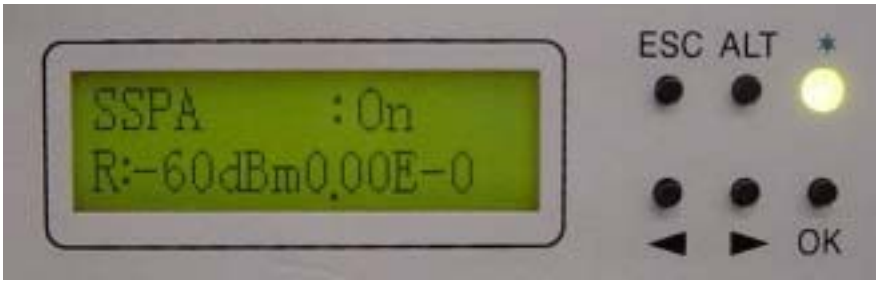
Display the present ODU RF channel and frequency range.

B2. TxL_Set: n dBm

Display the transmit power, n = 5~22dBm.

B3. Tx-Mute: ON/OFF

To set the PA to ON/OFF. Press the OK button after selection. Use the Right/Left button to select ON/OFF, then press OK.



B4. O-Temp: n□

Display the local end's ODU working temperature.

TEST Item

※ Loopback mode. Note: system allows only one kind of loopback at a time

C1. Tn_Loc -Loop: En/Dis

Perform loopback test in the local end for the convenience of testing the local end equipment's stability. Use the Right/Left button to select the local E1 interface of T1~Tn subsidiary route. Press the OK button. The Right/Left button is also used for selecting En/Dis. En = enable the execution of local loopback test. This function can also be used with external connection to E1 transmission for testing any malfunction in the E1 interface.

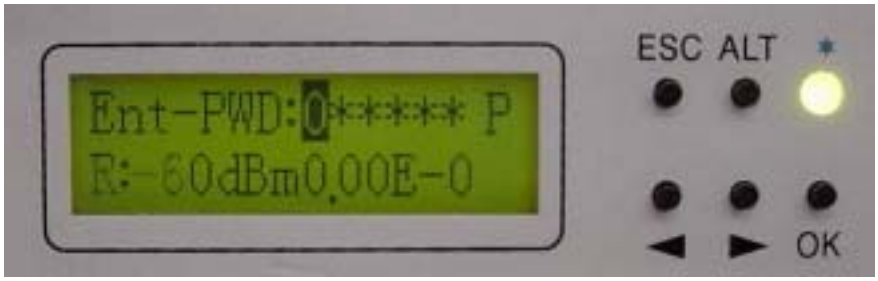
※ Note: This function can not be used with the PRBS provided for testing.

For example:

i) To set up the T2 of E1 to local loopback mode, enter \TEST Item\T2-L-LP, press OK.

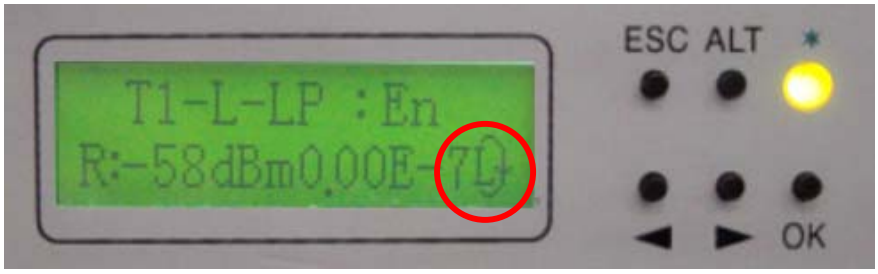
ii) Use the Right/Left button to change Dis (Disable) to En (Enable). Press OK.

iii) It will display the enter password verification. Enter the system 6-digits password. Use ALT to switch between the different functions.
P (Place): shifting/placing the position using the Right/Left arrow
A (Adjust): adjusting the digits from 0~9 using the Right/Left arrow.
Press OK to complete the settings.

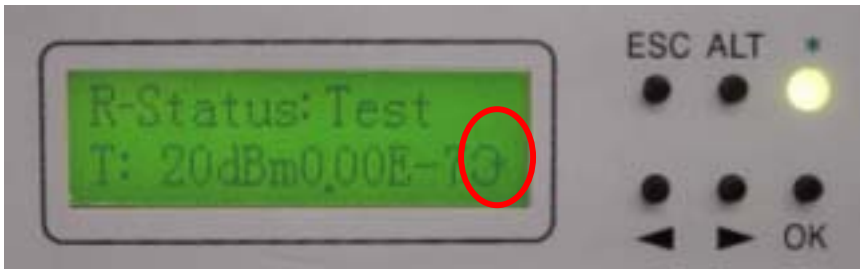


※ For the password, enter as described in NMS guide

Local end: While tributary 1 is in local loopback mode, the right bottom side displays an "L". The LED displays an orange glow.



Remote end: The right bottom side displays a loopback sign.



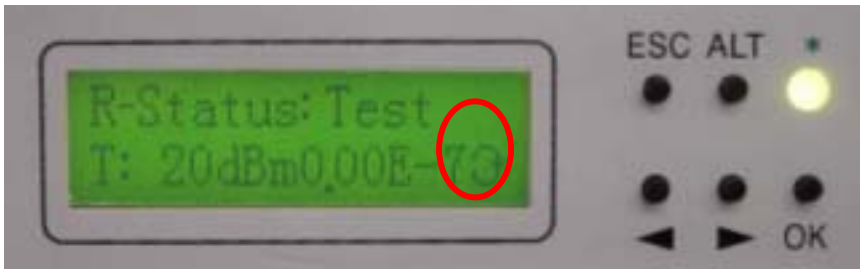
C2. Tn_ Rem -Loop: En/Dis

Perform loopback test in the remote end for the convenience of testing the local end equipment's stability. Use the Right/Left button to select the local E1 interface of T1~Tn subsidiary route. Press the OK button. The Right/Left button is also used for selecting En/Dis. En = enable the execution of local loopback test. This function can be co-operated with the IDU PRBS (C3) function for the loopback test, as well as external connection with E1 equipments for transmission test.

※ Note: while executing PRBS, the local and remote equipment will display both the local and remote's accumulated bit error.

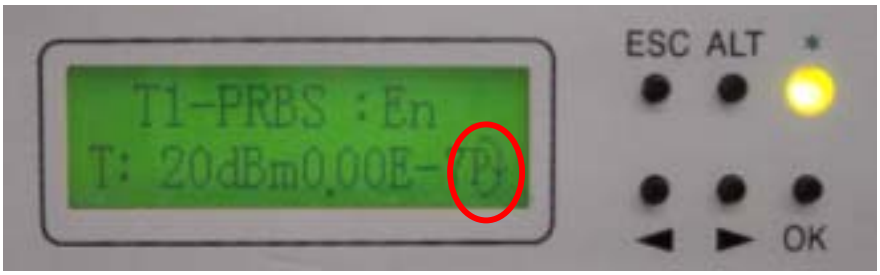
Local end: While tributary 1 is in local loopback mode, the right bottom side displays an "R". The LED displays an orange glow.

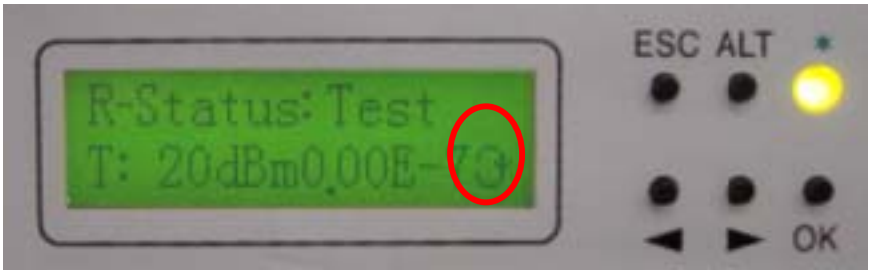
Remote end: The right bottom side displays a loopback sign.



C3. Tn_PRBS12: En/Dis

Use Pseudo Random Code to test the E1 signal transmission. Along with the remote loopback, IF loopback, normal link route equipment and stability of testing equipments, Press the OK button. Use the Right/Left button to select Enable/Disable, and then press OK. On using this function, the LCD will display all the accumulated BER.





Pseudo-Random Bit Sequence (PRBS):

Random noise was first regarded as an element that damages the quality and quantity of communicative signals in communication technology. The random noise in signal channels often distorts the simulated signal produced or bit error to appear upon the demodulation of digital signals. At the same time, it is also one of the elements that limit the channel capacity. Consequently, human's early attempt was to remove or lessen all the pseudo noise in the communication system. Nonetheless, some of them decided to obtain all these pseudo noise. For example, communicative equipments or systems testing in laboratory require an addition of certain noise. So it is necessary to produce/obtain noise here.

In the late 1940s, along with the communication theory, Claude Shannon pointed out that under certain conditions, for the most effective communications, must adopt signals containing the statistical property of white noise. Besides, in order to achieve communications of high reliability and privacy, we must use random noise. However, the biggest difficulty faced in using random noise is that it is not easy to repeatedly produced and processed. Until the 60's, the pseudo random noise came about and solve all these problems.

Pseudo random noise poses statistical property similar to random noise. At the same time, it can be repeatedly produced and processed easily. It has increasingly been extensively use practically because it poses the advantages of random noise and none of its disadvantages. In today's world, it has been extensively used in digital circuit produced periodic series (after filtering). In the future, this shall be called the periodic series or the random series.

Pseudo random sequences are generated using a binary shift register with taps that are modulo-2 added together and fed back to the register's input. The name commonly

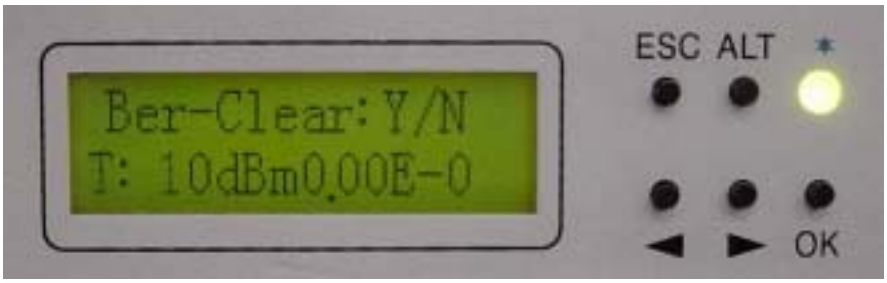
used for this simple circuit is linear feedback shift register, or LFSR. Another type is known as the Non-Linear Feedback Shift Registers. Only certain combinations of feedback taps will result in maximal-length sequences, called m-sequences. These are the longest sequences possible given a specific shift register size, and they have many desirable properties. If the register size is m stages, the length of the m-sequence will be 2m-1. Nowadays, the equipments used are mostly PRBS of m-sequence: $x^{15} + x + 1$, 100003.

C4. Error_ADD: ?

Bit error is produced each time the bit error transmission test is started. This function is for the convenience of online bit error test and for displaying normal loopback test. The bit error can also be added manually. Press the OK button to add one times of bit error.

C5. Ber_Clear: ?

Clear all accumulated bit error on starting the bit error transmission test: Press the OK button.



C6. Acc_Ber: num E -n

Display all the up-to-date accumulated bit error on starting the bit error transmission test.

C7. IF-Loop: En/Dis

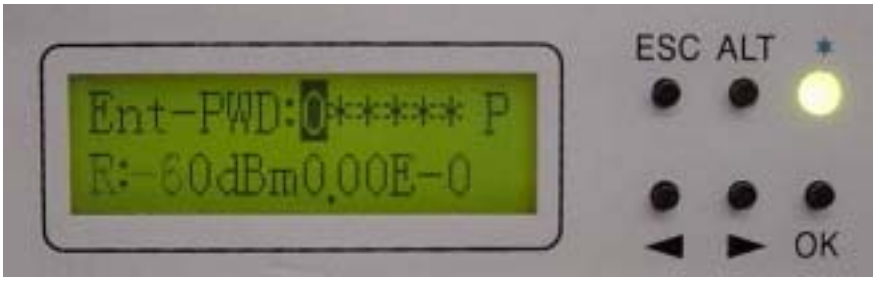
Perform loopback test from IF interface for the convenience of testing the IDU's stability. Press the OK button. Use the Right/Left button for selecting either En/Dis (En: Enable / Dis: Disable). Press the OK button again to start the execution of this function. This function can be co-operated with the IDU PRBS (C3) function for the loopback test, as well as external connection with E1 equipments for transmission test.

For example:

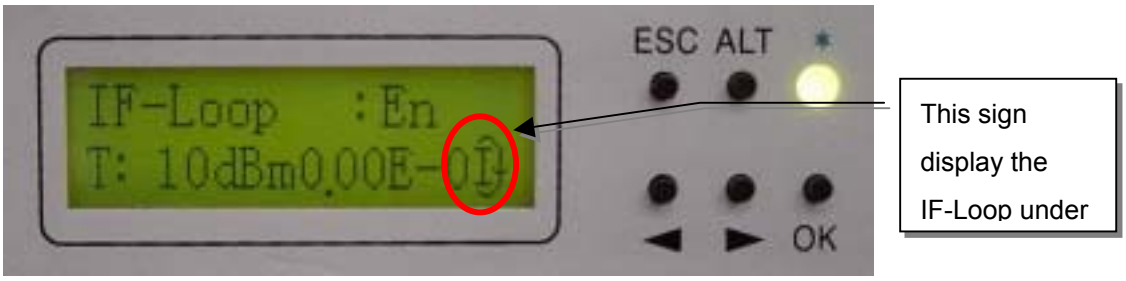
i) Enter \TEST Item\IF-Loop: En/Dis. Press OK.

ii) Use the Right/Left button to switch Dis to En. Press OK.

iii) Enter password using the same method as in C1-Tn_Loc-loop: En/Dis.



While IF-Loop is in execution, the right bottom side will display an "I". The LED display an orange glow.



C8. RF -Loop: En/Dis

Perform loopback test from RF interface for the convenience of testing the IDU and ODU stability. Press the OK button. Use the Right/Left button for selecting

either En/Dis (En: Enable / Dis: Disable). Press the OK button again to start the execution of this function. This function can be co-operated with the IDU PRBS (C3) function for the loopback test, as well as external connection with E1 equipments for transmission test.

For example:

i) Enter \TEST Item\RF-Loop: En/Dis. Press OK.

ii) Use the Right/Left button to switch Dis to En. Press OK.

iii) While RF-Loop is in execution, the right bottom side will display an "H". The LED displays an orange glow.

C9. Close-Test: Y/N

Close all testing procedure.

Remote Info

D1. Local ID: n

Display the address of the remote equipment; n=1~255. It is possible to check the remote end's present ID address.

D2. Far-end: Alarm/OK/Loss

Display the connection status of remote end equipments. It is used as a function of signal monitor for the determination of its source.

Alarm: remote monitor function fails

OK: in connection

Loss: R_MON signal loss

D3. R-Status: Test/Normal/Loss

Display the system present working status. It is possible to check the base station at the opposite end as well as the status of whether there is any online test is carried out upon the execution of this function.

Test: remote end in testing status

Normal: normal working condition

Loss: R-Status signal loss

6. Environmental Condition

6.1 Cable

Intermediate Frequency, IF Cable: RG-8 ≤200m

Radio Frequency, RF Cable: Insertion Loss ≤1dB

6.2 Temperature

Radio Frequency, RF temperature: -30□ to +60□

6.3 Voltage and DC power consumption

Voltage: -36 -78Vdc

DC power consumption: <20W

6.4 Humidity

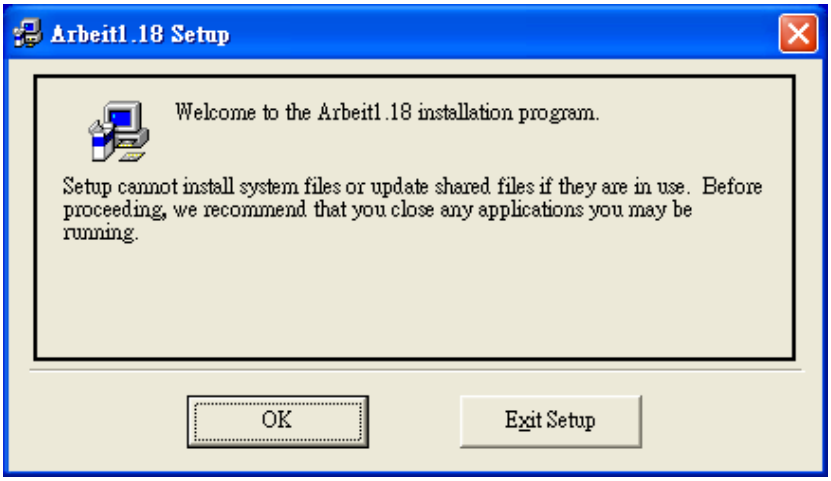
Relative humidity: 10%~95%

7. Software Installation

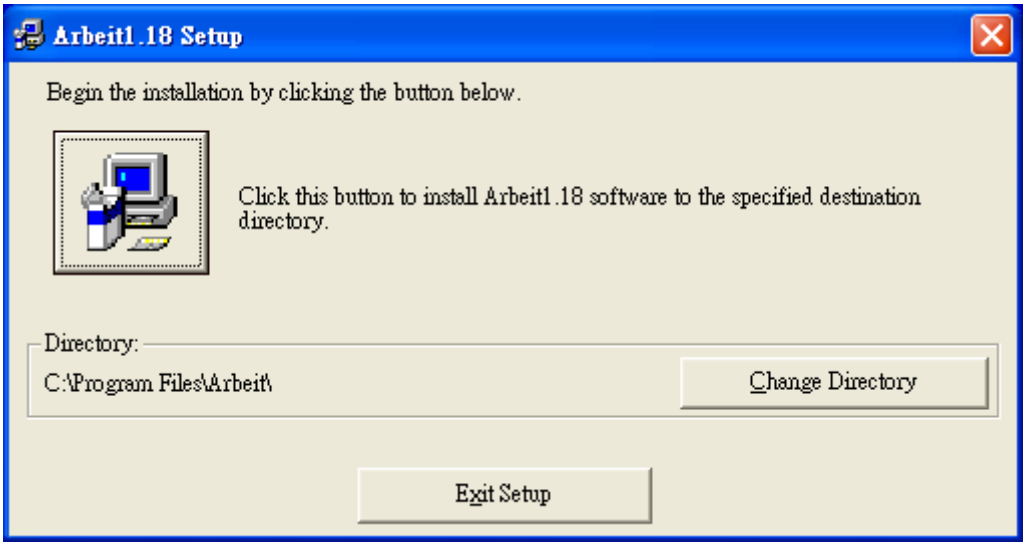
a) Click Open the CD-ROM folder containing the monitor software. The following window appears:

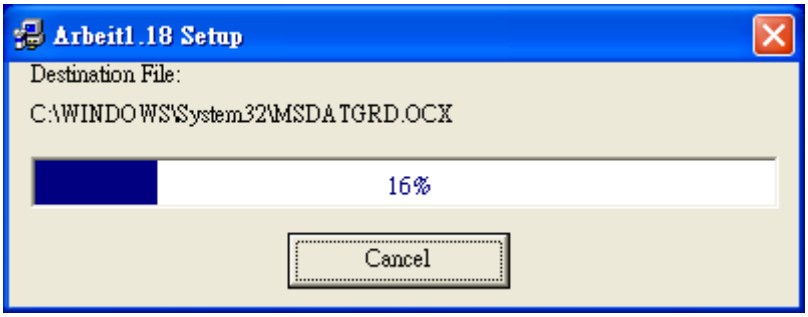
b) Click Open the folder "Arbeit v1.xx". Click twice to execute the "setup.exe" file.

c) The setup welcome window will appear.



d) Click the "OK" button. Install the software to any desired folder by clicking on the "Change Directory" button.





f) Click the button "確定" after the successful completion of software installation.

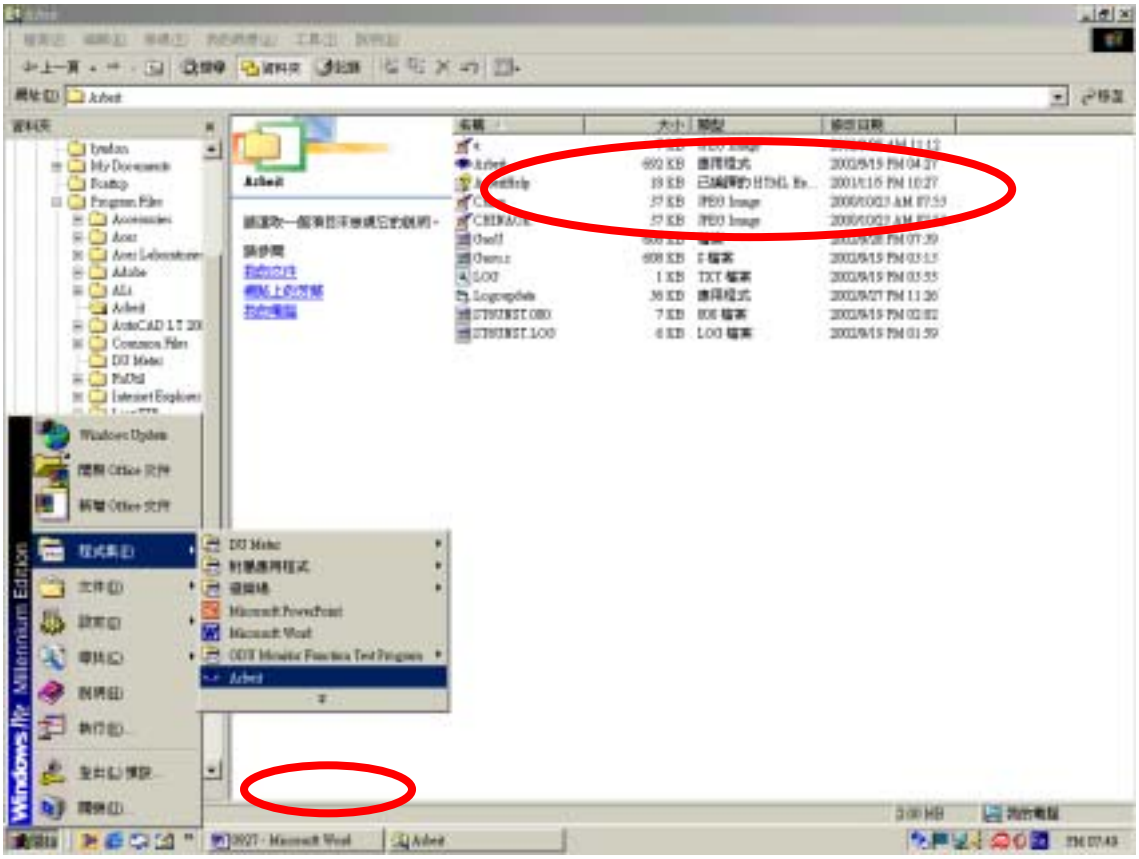
8. Arbeit NMS software

8.1 Open "Arbeit"

There are two ways to open the program Arbeit:

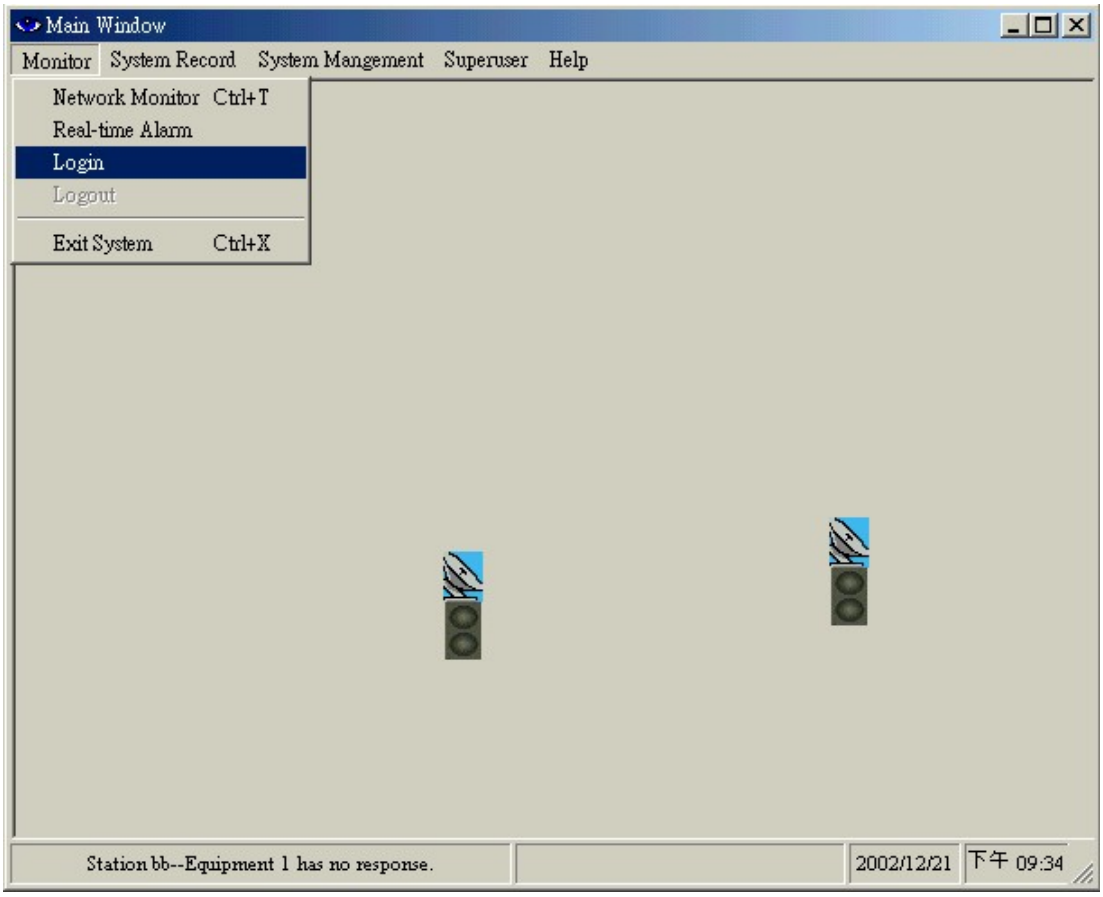
i. Click on the Start→ Programs → Arbeit.

ii. Open File Manager → Program Files → Arbeit → Arbeit.exe.

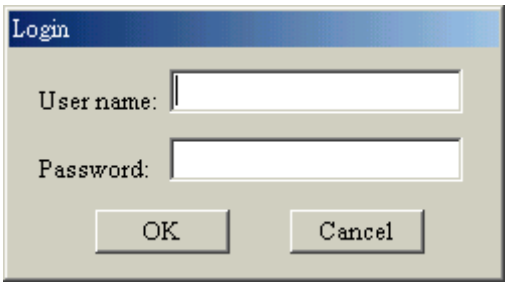


8.2 Login

After executing the program Arbeit, Click on the menu bar "Monitor". Select "Login"



In the Login window, please enter "User name" and "Password".

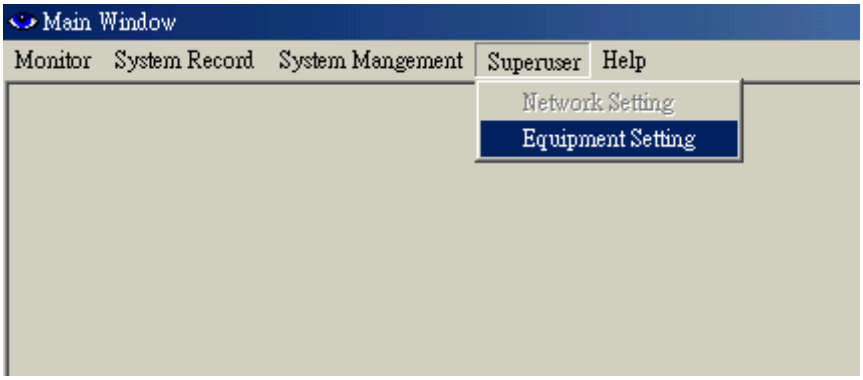


The system already has some pre-set user name and password, which are given below:

#	User name	Password	Function
Configuration	initialize	initialize	Initial setting for single machine
User	dd	2	General users and station maintenance users
Administrator	system	system	Administrator, can add new users
System Test	loopback	loopback	System test
Superuser	andy	andy	Superuser, can use all the functions

8.3 Initialization

Login the local end initialization mode as User Name：initialize　Password：initialize. In the Main Window, select Superuser → Equipment Setting. Another initialization window will appear with five different working mode: IDU Setting 、ODU Setting、Alarm Setting、Cross Connecting、User I/O Setting.



8.3.1 IDU Setting

While setting the below functions, first modify or add any new settings, then press Send Setting to save it in the Status. It is also saved in the IDU equipment. The setting will now be shown on the window Status. Press Check to check any settings made. It will read all the data from the IDU. Exit the window if there are no error settings.

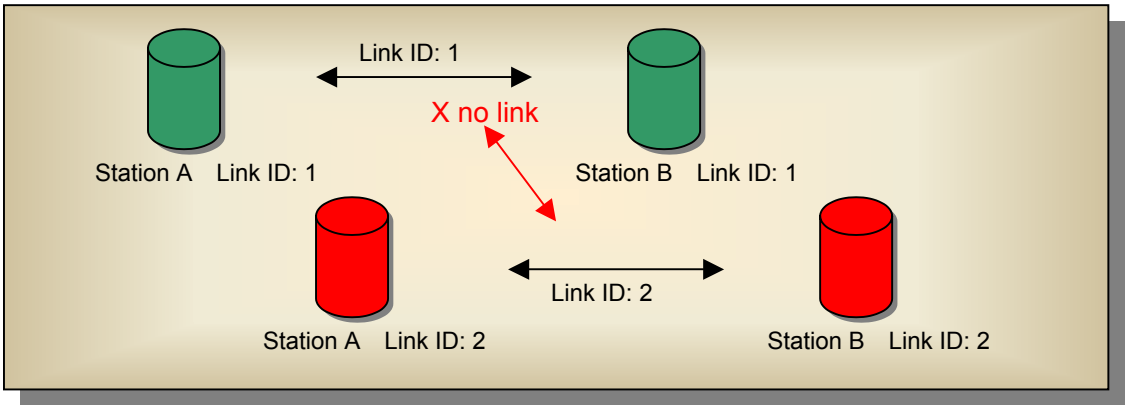
i. **IDU Address:** Each and every E1 modem in the network has its own unique IDU Address for different purpose and ease of setting. While setting up the station, all initialization must be done here first. If initialization is not set accordingly, it will not work properly. As given the figures, we first enter "2" in IDU Address. Press Send Setting to confirm.

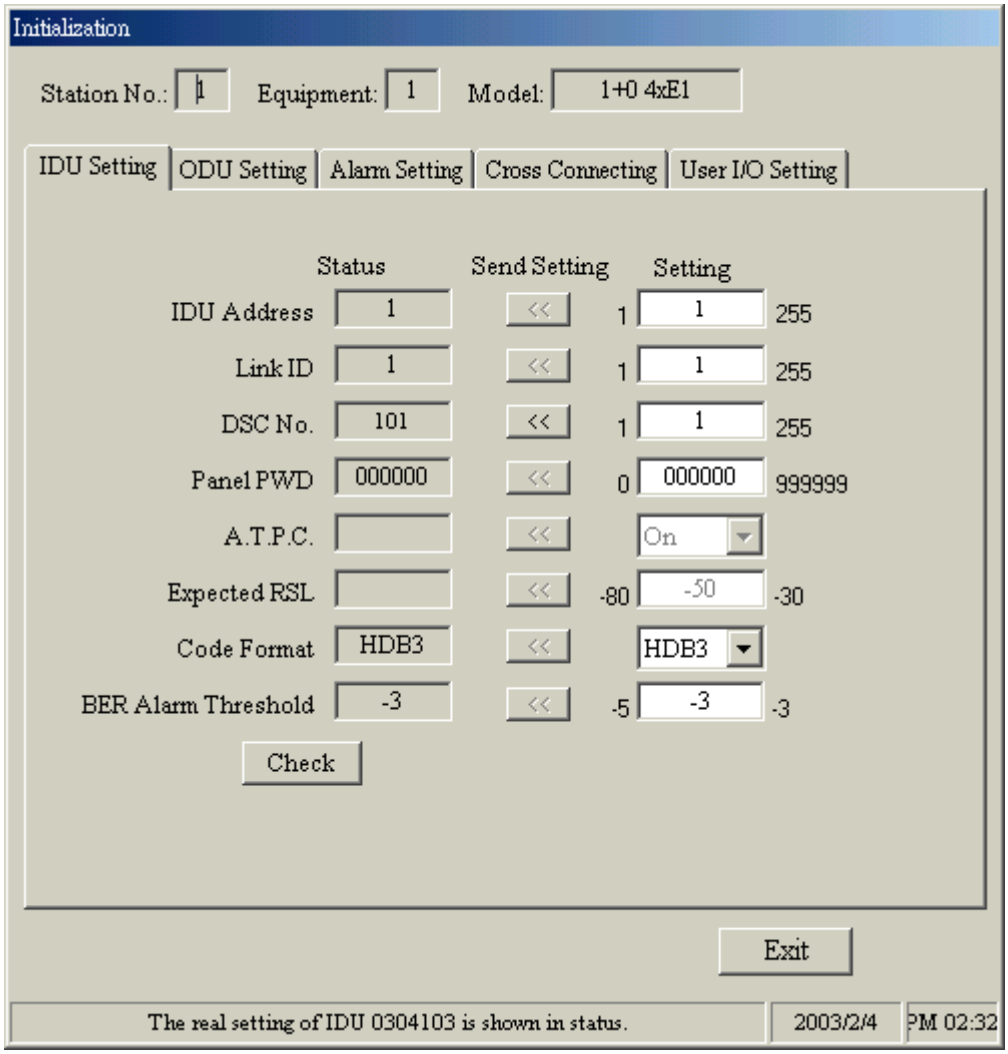
ii. **Link ID:** Link ID might have similar equipment close by if it is kept in the same environment. In order to prevent wrong connection, it is strongly advised to enter a differentiating Link ID.

Check button: Read all the IDU setting and to check whether it has been written in.

Password Change button: Edit initial login and password.

Exit button: Exit and close the initialization mode window.





DSC No：Enter any number between 0~255 for digital service telephone number setting. Note that the DSC number should be different from the Link ID. On the right side of the IDU panel, there is a RJ-11 connector meant for analog telephone, which is used for all phone connection in the route with the base station.

Panel PWD：This function is not open to all users owing to the fact that while setting the IDU in the local end, some of the functions are still in process which will cause the full breakdown of the machine. If necessary, enter the IDU password, which must only be 0~9 digits, ranging from 0~999999.

A.T.P.C：Automatic transmitting power control

Expected RSL：Automatic transmitting power control parameters

Code Format：IDU transmission encoding format AMI or HDB3

BER Alarm Threshold：BER alarm setting: E-5、E-4、E-3 etc.

Check：Check all the IDU setting data

Exit：Exit the initialization mode after all IDU setting.

8.3.2 ODU Setting

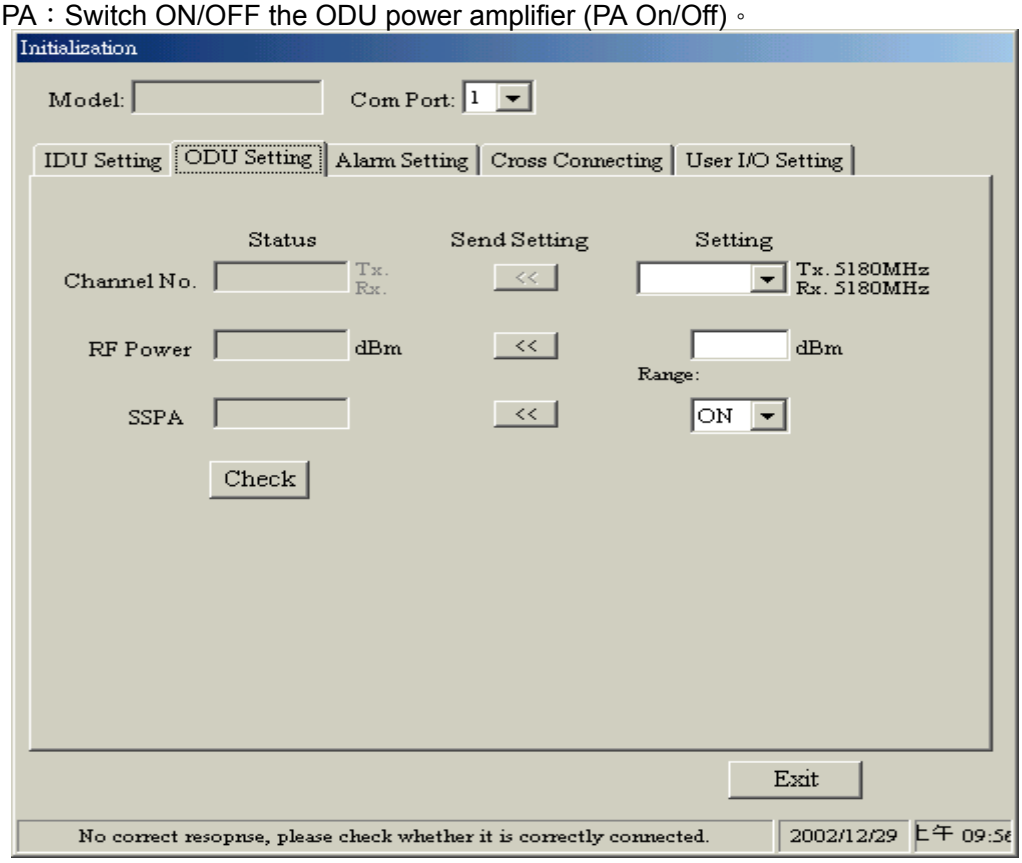
Channel No：Set ODU RF transmitting and receiving power. The frequency channels used are as follows:

4E1				
1	5730.5	5737.5	5822.5	5829.5
2	5738.5	5745.5	5830.5	5837.5
3	5746.5	5753.5	5838.5	5845.5

Unit：MHz

RF Power：Set ODU transmitting power, range 22~5dBm。

SSPA：Switch ON/OFF the ODU power amplifier (PA On/Off)。



8.3.3 Alarm Setting

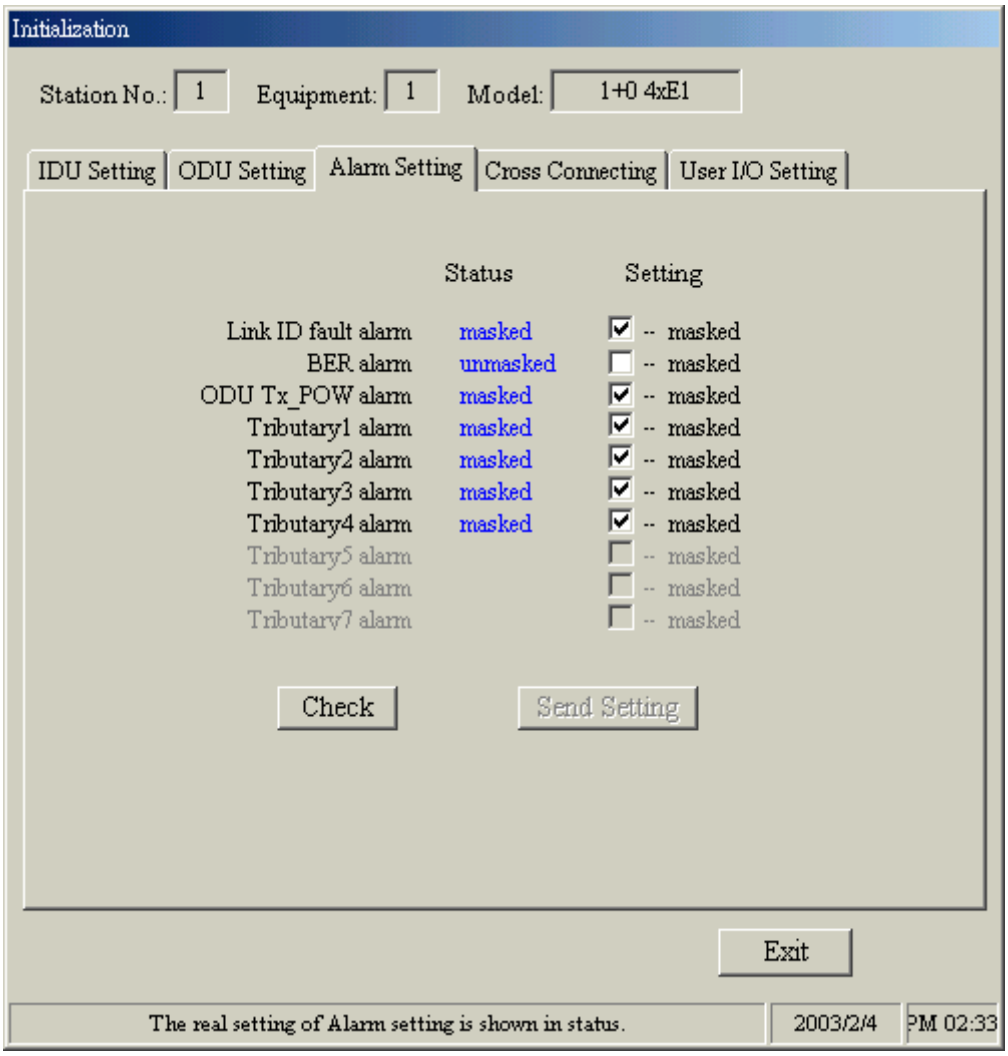
Under normal working condition, if the IDU goes into a critical state, the alarm will start beeping. However, in some cases like if the administrator considers the Link ID unimportant, s/he may tick "masked" and turn off all the alarm functions.

Link ID fault alarm – local station receives the wrong Link ID.

BER alarm – Bit error alarm

ODU Tx_POW alarm – ODU Output Power alarm

Tributary x loss alarm – IDU cannot find the tributary signal.



8.3.4 Cross Connecting

Under normal working condition, with the need of adjusting the controlling room channel, the local and remote end E1 Interface have certain asymmetric variation. The following diagram shows the 4E1 equipment cross connection between local end, IDU A, and remote end, IDU B.

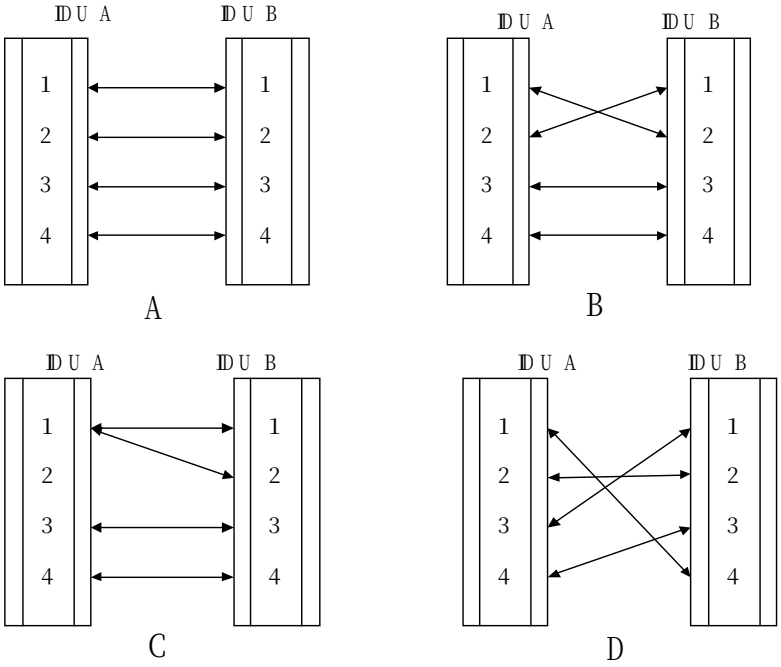
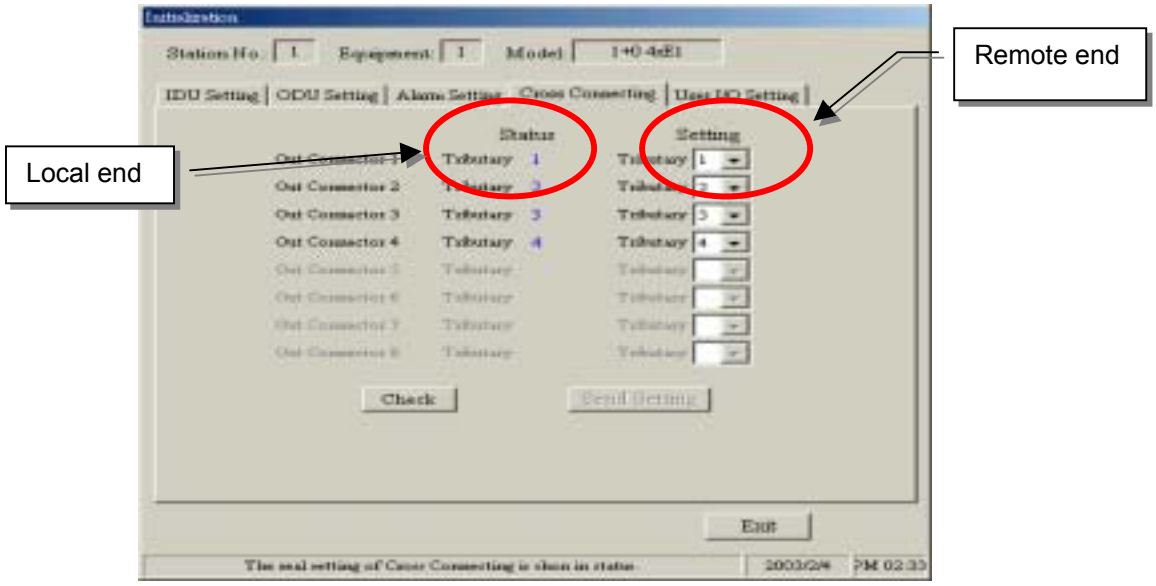


Fig. A Normal connection mode

Fig. B Local and remote port1 & port2 in cross connection mode and port3 & port4 in normal connection mode

Fig. C Local port 1 connected to remote port1 & port 2. Local and remote port3 & port4 in normal connection mode

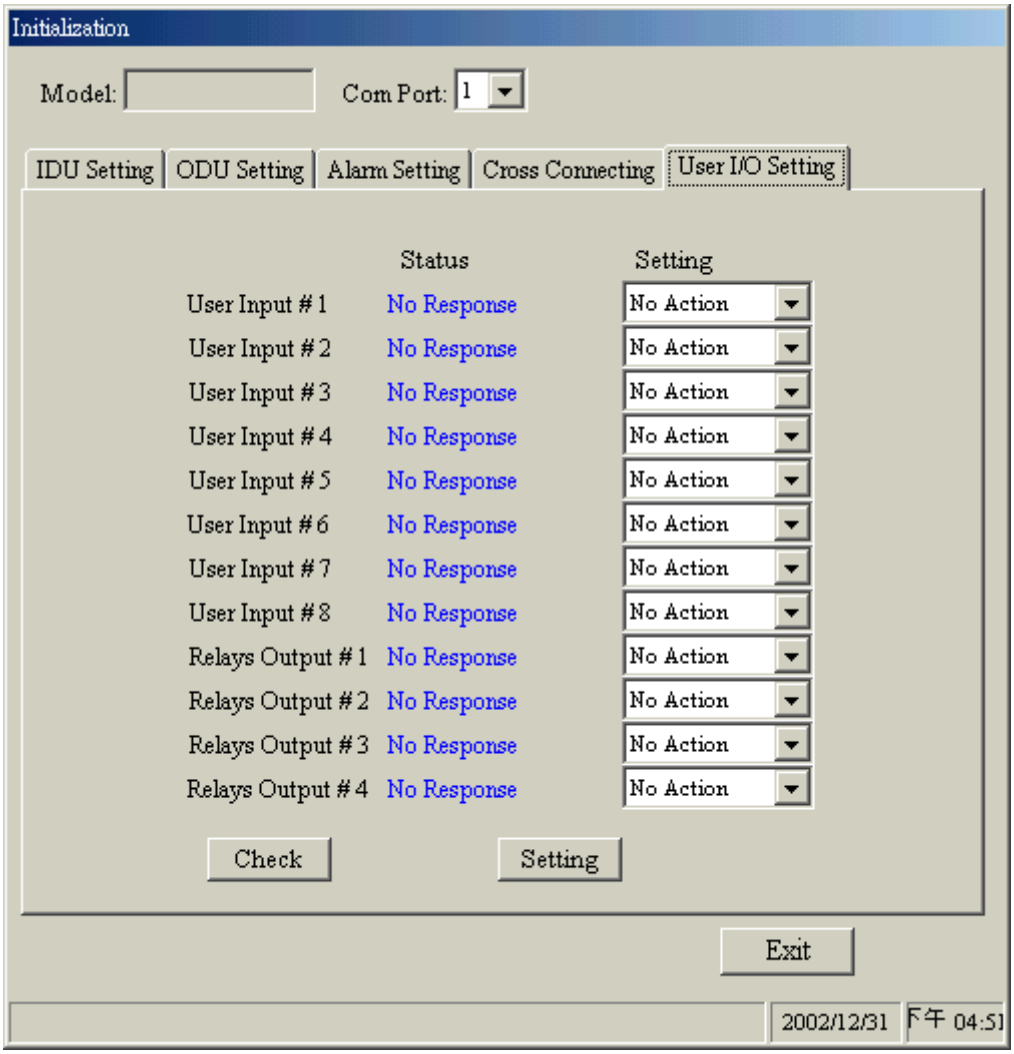
Fig. D Local and remote port in cross connection mode between ports 1&4, 3&1 and 4&3



8.3.5 User I/O Setting

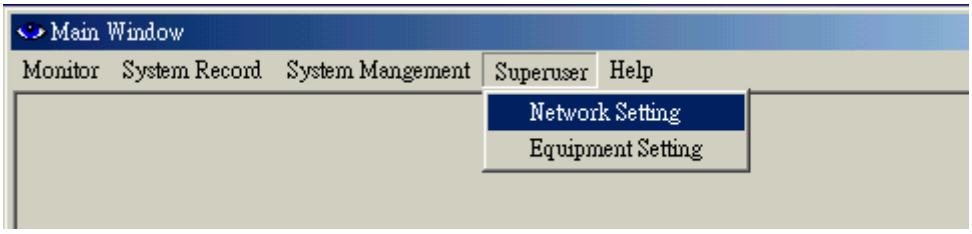
Besides the standard E1 interface, there are the environment monitor and control port. This allows users to fully control the controlling room from the local end. For example: If there is no manual control over the remote end, it is possible to have all the temperature, alarm,

power supply etc. data from the central controlling computer. The central controlling computer controls most of the functions as well which made knowledge management possible. The equipment has 8 User Input and 4 Relay Output.

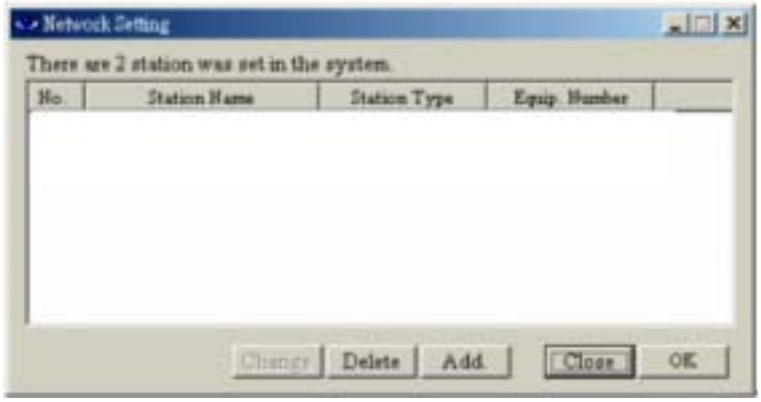


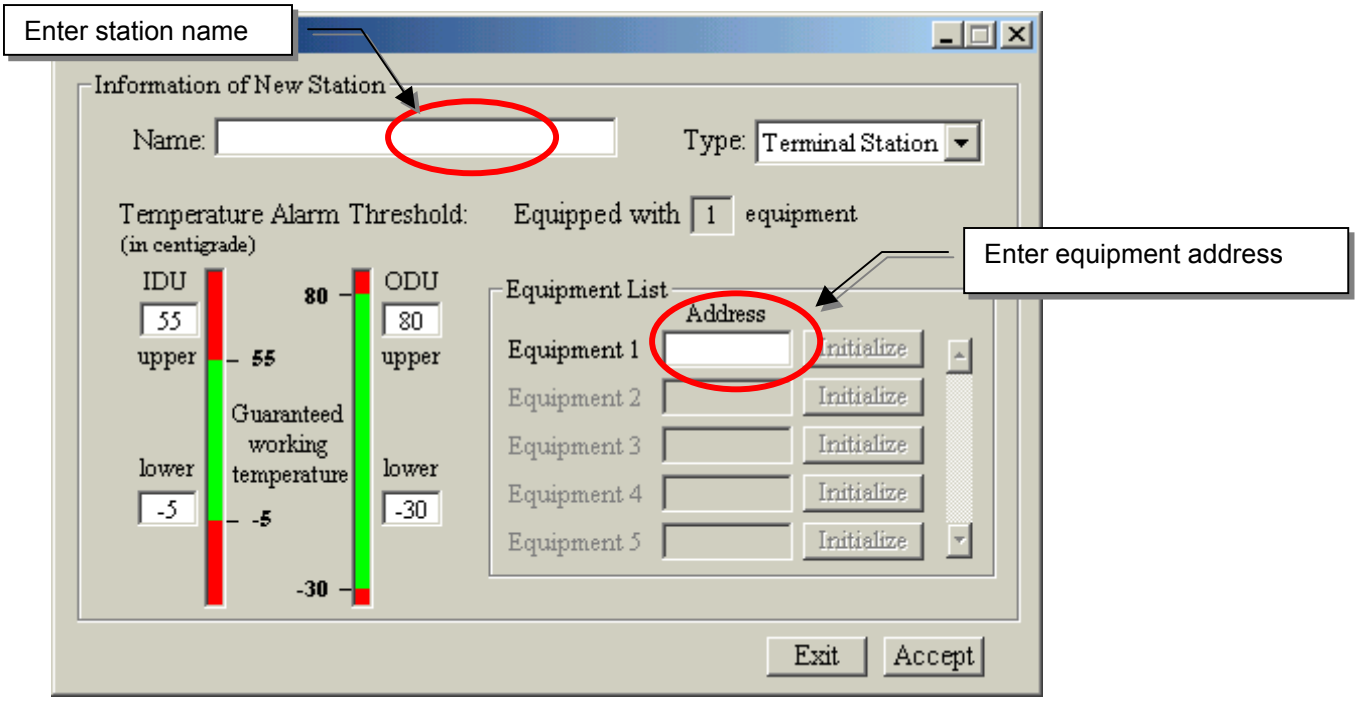
8.4 Superuser

Login the link route setting mode as User Name：superuser Password：8. In the Main Window, select Superuser → Network Setting. Another initialization window will appear with five different working mode: Change、Delete、Add.、Close、OK

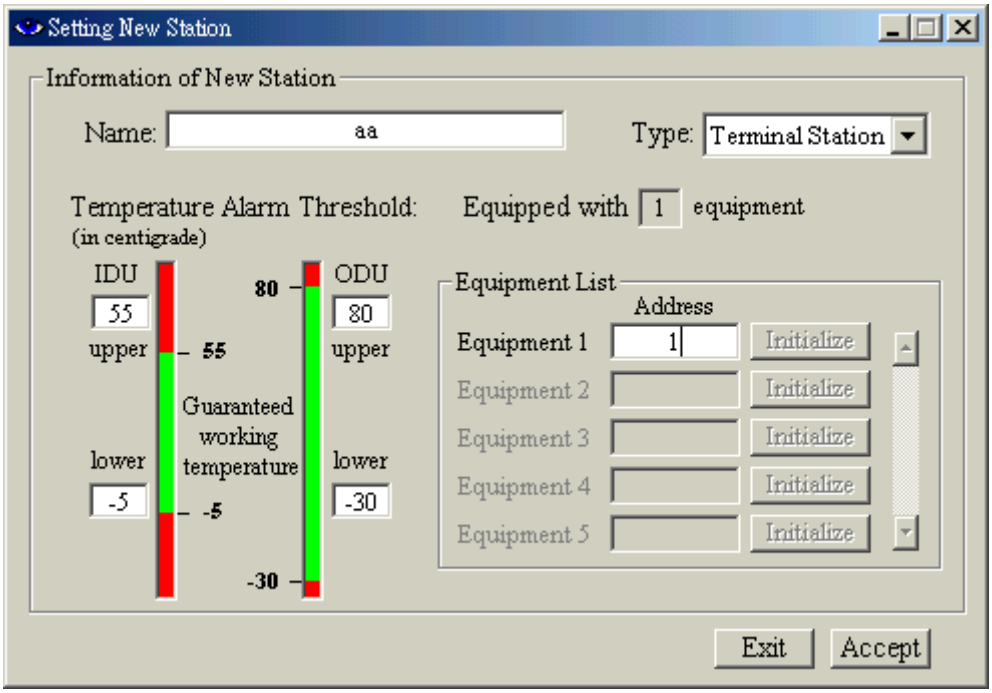


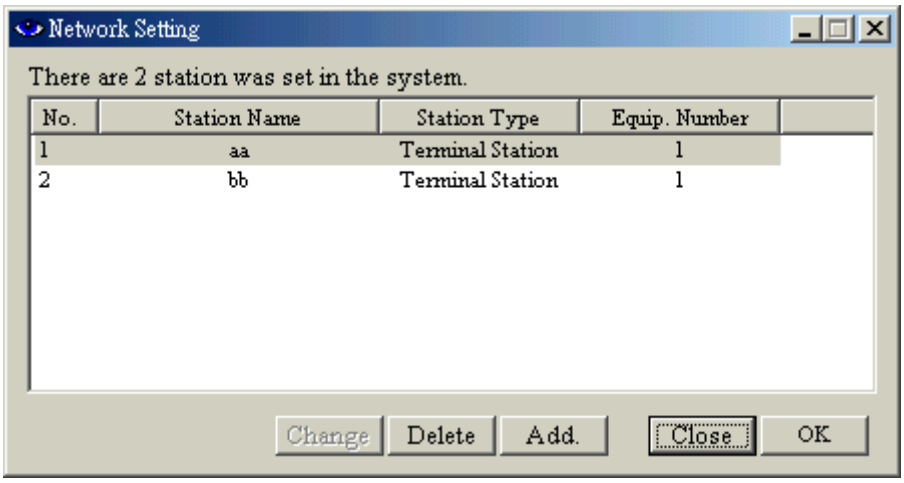
Add. – First select Add. to add new station.





Press Accept after entering all the necessary information.

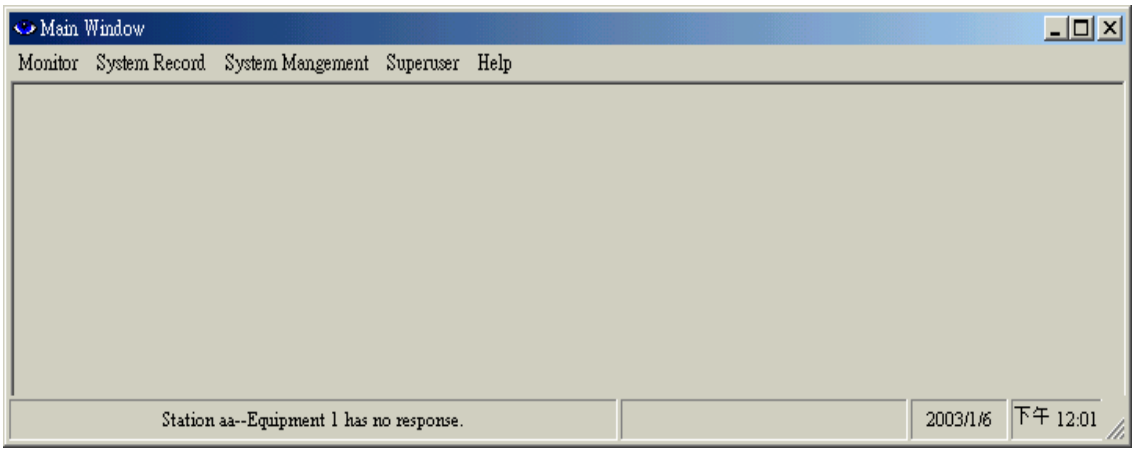




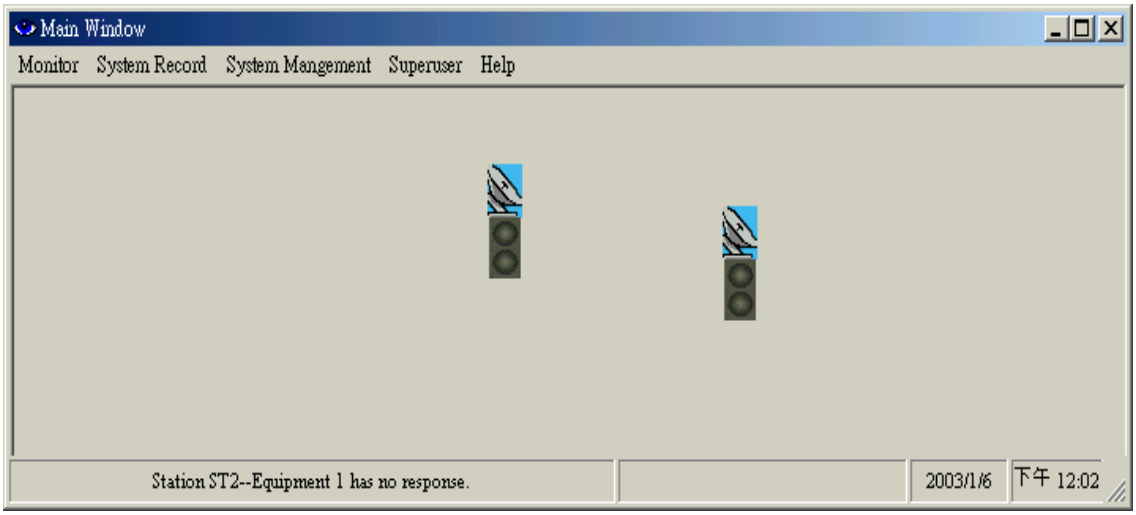
1. Enter "aa" in the Name and "1" in the Address dialog box.
   Note: the station name must not exceed 30 characters or numbers.
2. Press "Add." to enter the second data. Enter "bb" in the Name and "2" in the Address dialog box.

Every station has its own address after the "Initialize" setting. First, select Add. , then choose the corresponding Address. In the Station Name, enter a different name. It will be displayed on the Monitor and on the IDU-LCD.

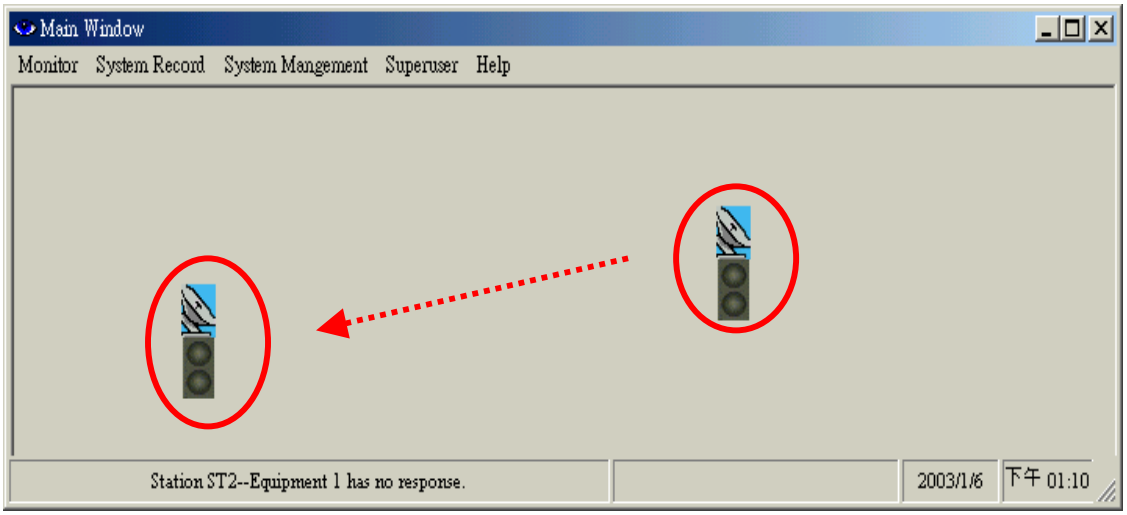
Arbeit Main Window, added 0 station：



Arbeit Main Window, added 2 new stations：



The stations position in the above diagram is a random result. Right click on the station and move it without releasing the mouse and place it to any desired position.



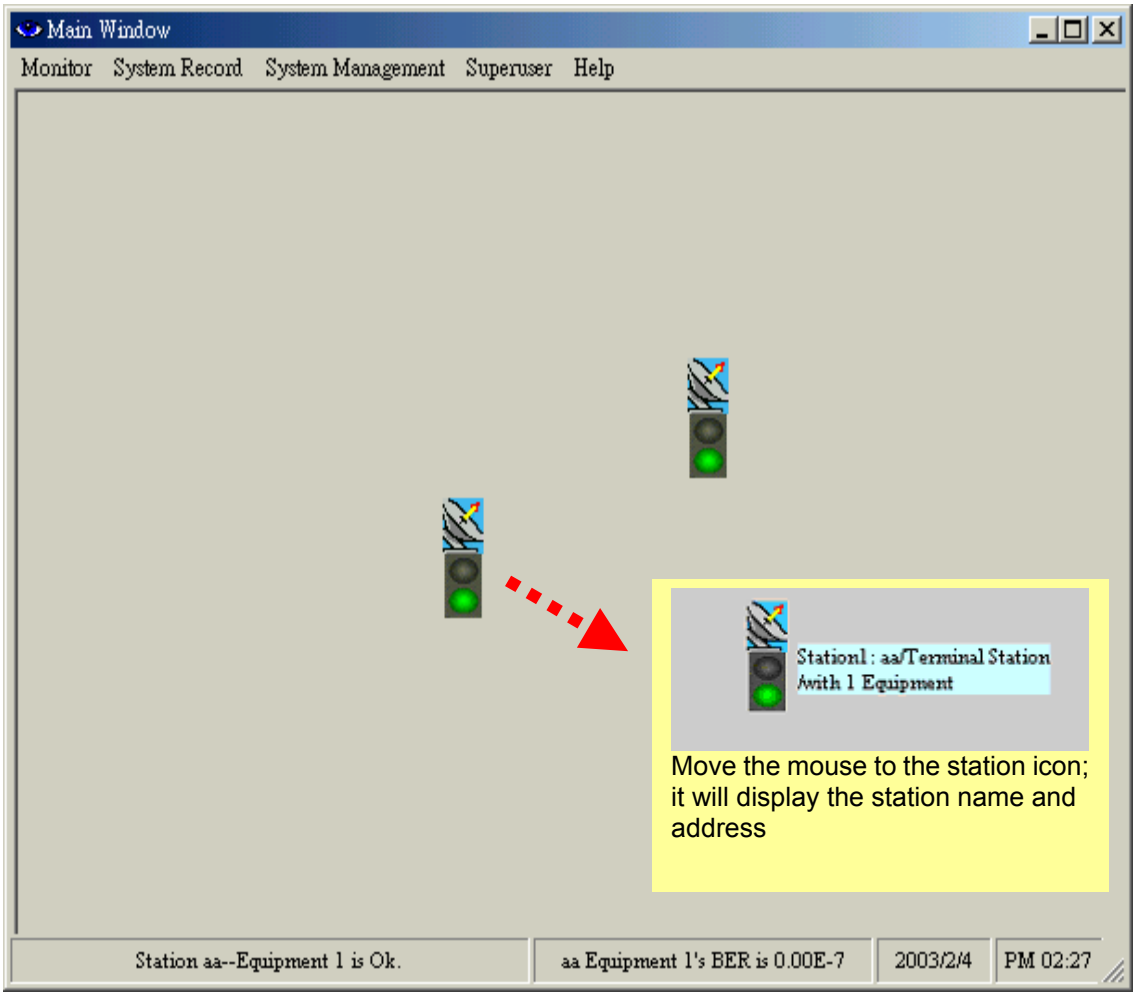
Under normal connection, the station icon will display its working status.

Green glow = normal connection

Red glow = connection, with warning alarm

Orange glow = test state

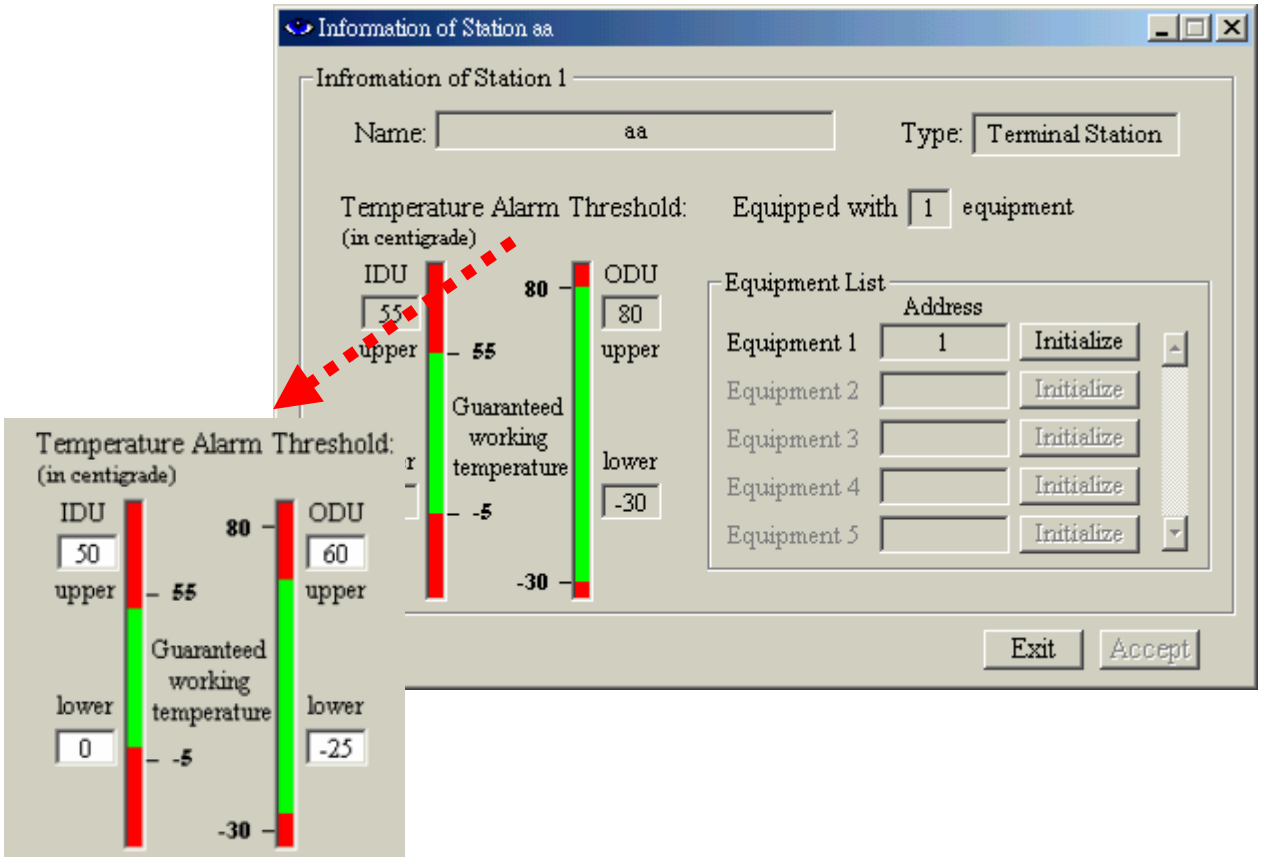
Grey glow = no connection



Now let us introduce some other functions of the link route station setting:

Alarm Temperature Threshold:

Set the IDU&ODU secondary alarm temperature range. Enter the desired parameters in the upper and lower IDU& ODU temperature alarm threshold dialog box. When the temperature is higher than or lower than this threshold, the system alarm will start beeping. The system has its own Operating Temperature threshold as well. As shown in the Station Setup window, the IDU upper and lower Temperature threshold is +50□ and -5□ respectively and the ODU are +60°□ and -30°□ respectively. The threshold can be set between these two upper and lower thresholds. The upper threshold must not be too low and the lower threshold must not be too high, if it is NOT so, the alarm will go off every now and then even if all the setting are correct.



Number

Automatically generate a number from 1~255 for the convenience of calculating the number of stations.

Del.&Add.

The Del.&Add. button is used for adding or deleting any stations.

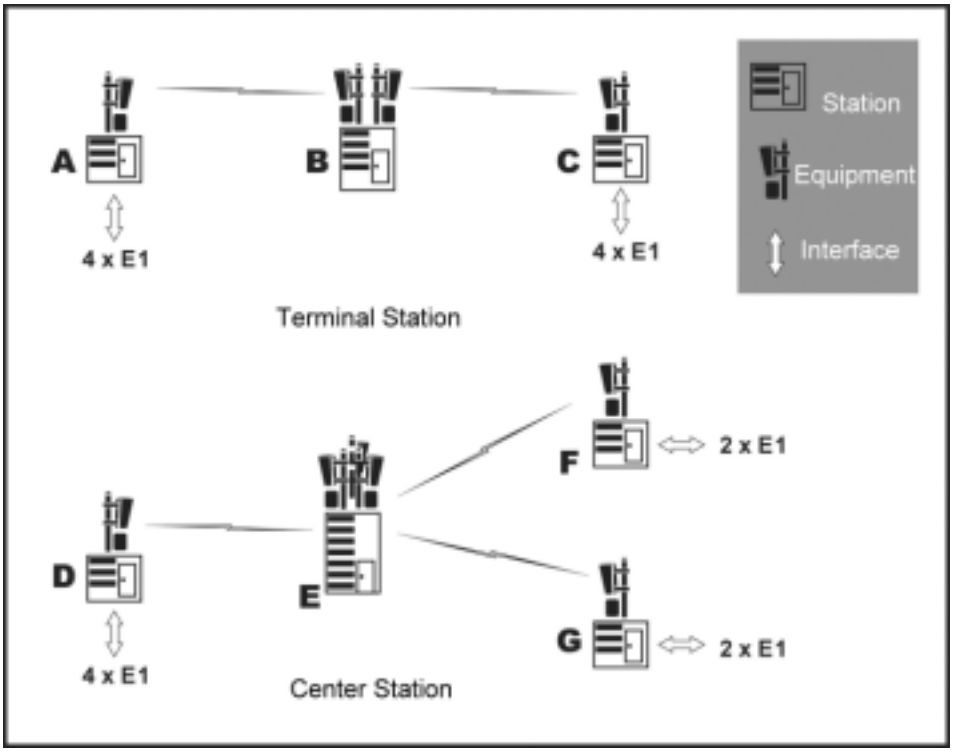
For modifying any stations data, select the particular station and modify its content. Press OK after completing.

Terminal Station

Base station in a terminal end mode. The stations are in a point-to-point connection mode.

Center Station

Base station acts as the Center station. When there are more than two equipments in a base station, please select this type of mode. We can use the IDU Net port function only if we used it in Center Station mode. Using Arbeit, it is possible to see all the equipment's route in the station by concatenating all the monitoring information of the station. 每個 Base station can have NOT more than ten Center. Extended station link route can be a maximum of 255. This mode can also be called the star topology station setting mode, as illustrated in the following diagram:

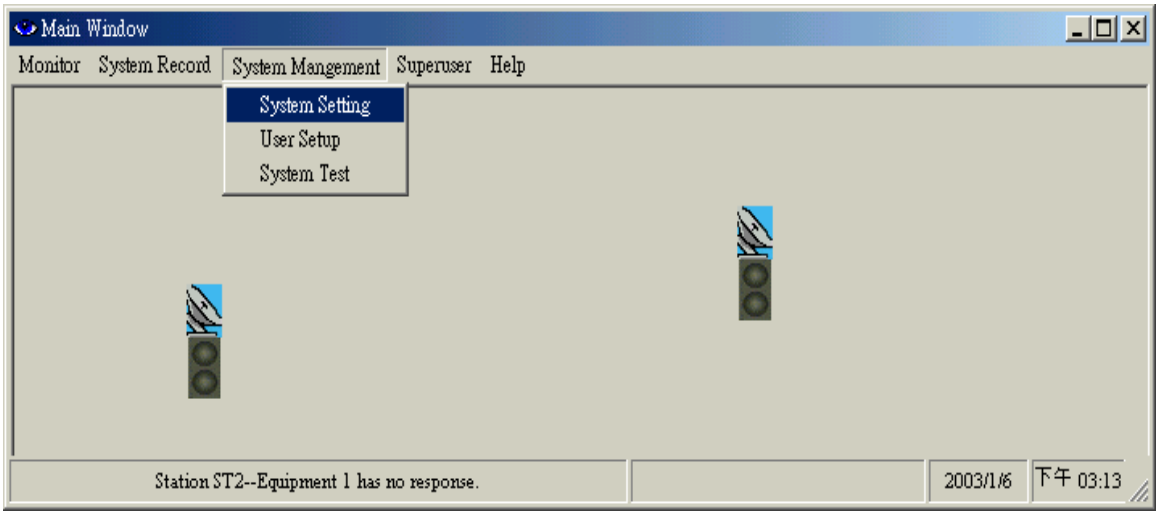


Initialize

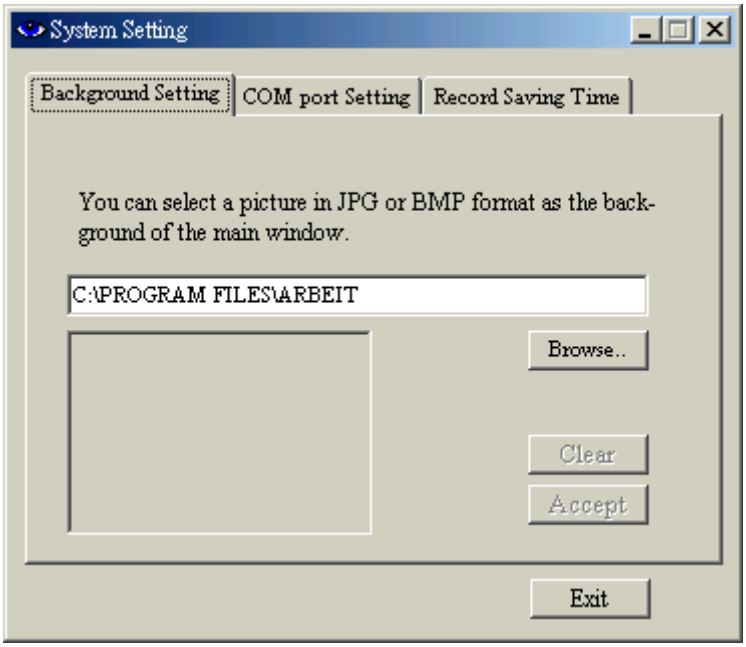
Stations link route initialization mode. This function can randomly change the route of the stations provided it is in connection mode.

8.5 System Setting

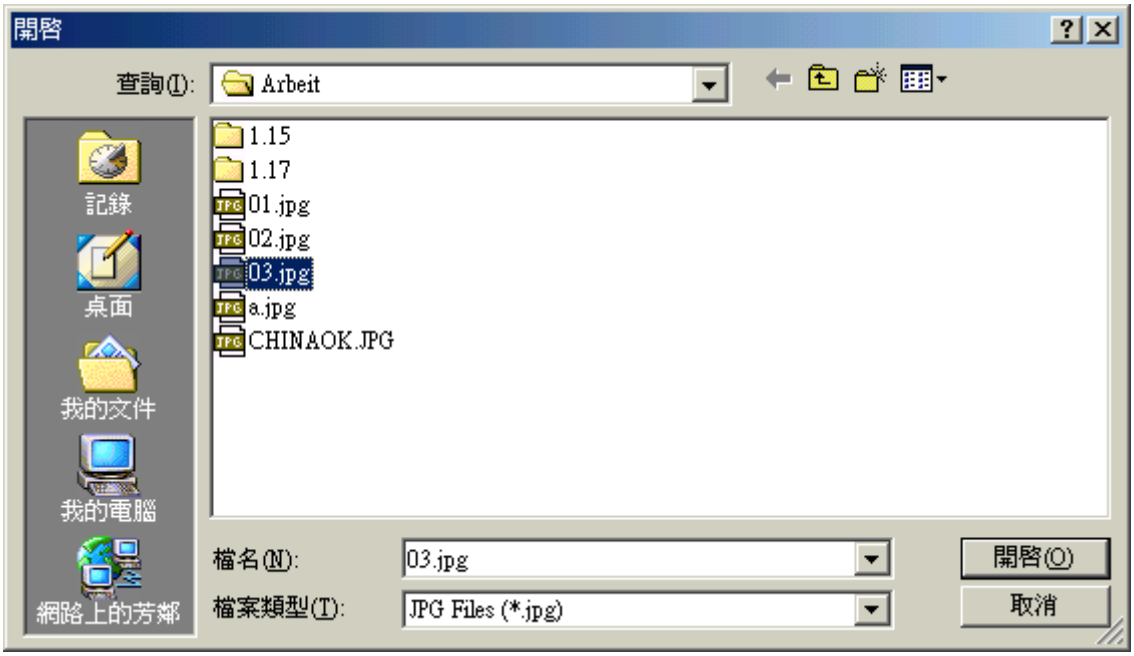
In the Main Window, select System Management → System Setting. Another initialization window will appear with three different working mode: Background Setting、COM Port Setting、Record Saving Time.



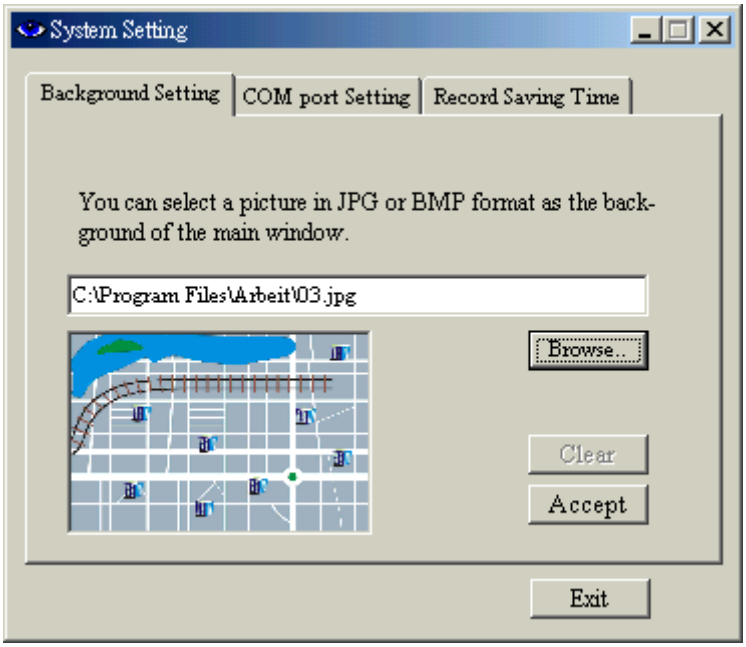
8.5.1 Background Setting



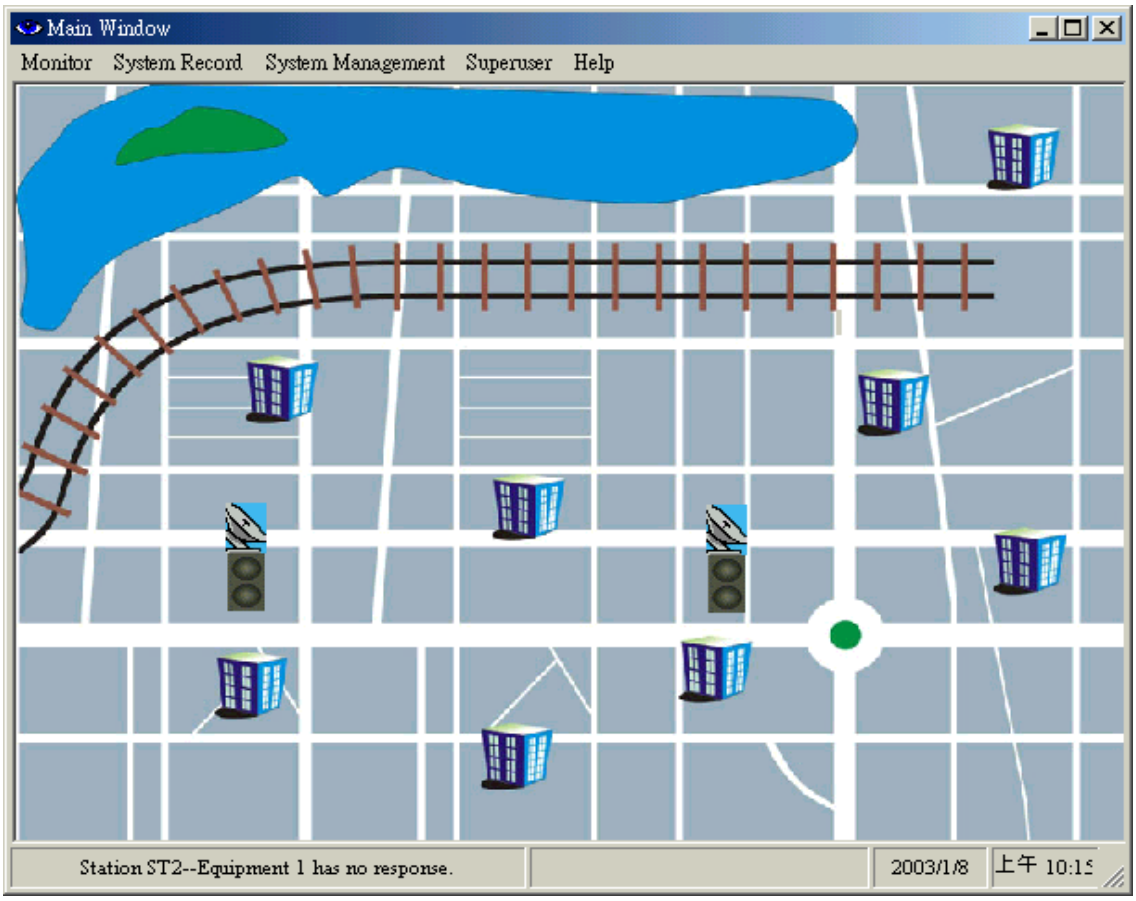
In System Setting, we use the Background Setting tab to edit the router map. For example: street, building, station setting etc. Save the file in *JPEG format after editing. In Arbeit folder, we can open the picture file again for the easy modification. In the following diagram, for example, we open the 03.jpg file, it will show the following:



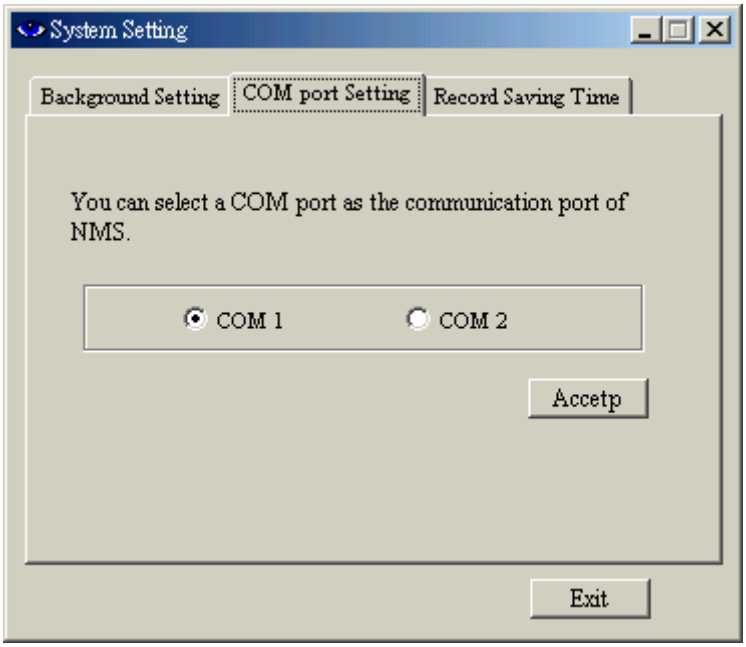
After opening the 03.jpg file, we see a preview of the picture file. Press Accept button to use the picture file as the background setting of your desired route. Press Clear button to remove the background setting.



Example: Selected background setting

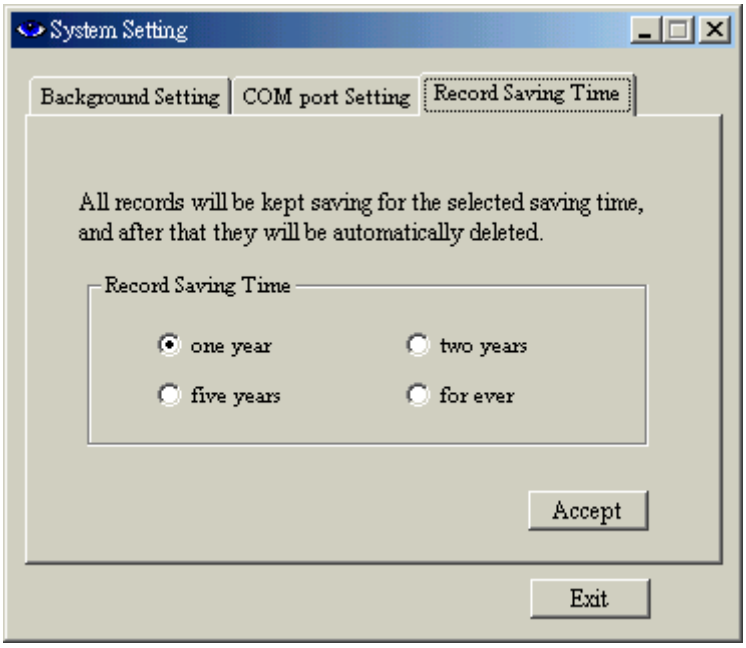


8.5.2 COM port Setting



In the COM port Setting tab, you can select a COM port as the communication port of NMS. Press the Accept button after selection.

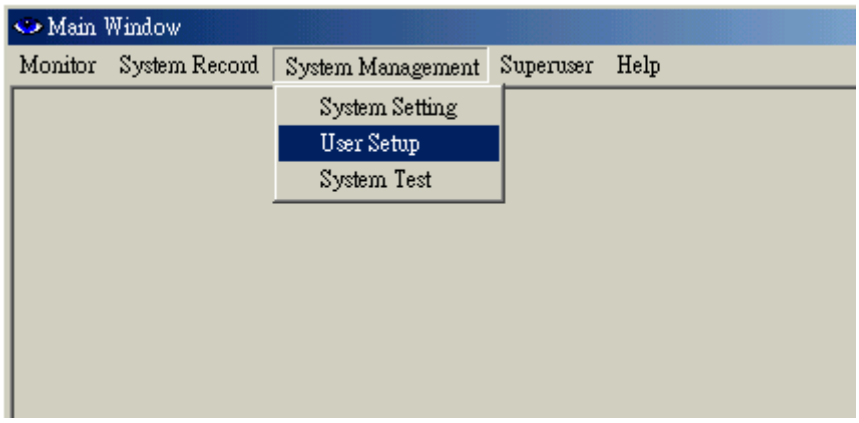
8.5.3 Record Saving Time



Select the saving time of the alarm records: 1/2, 1, 2, 3, or 5 years. Press the Accept button after selection.

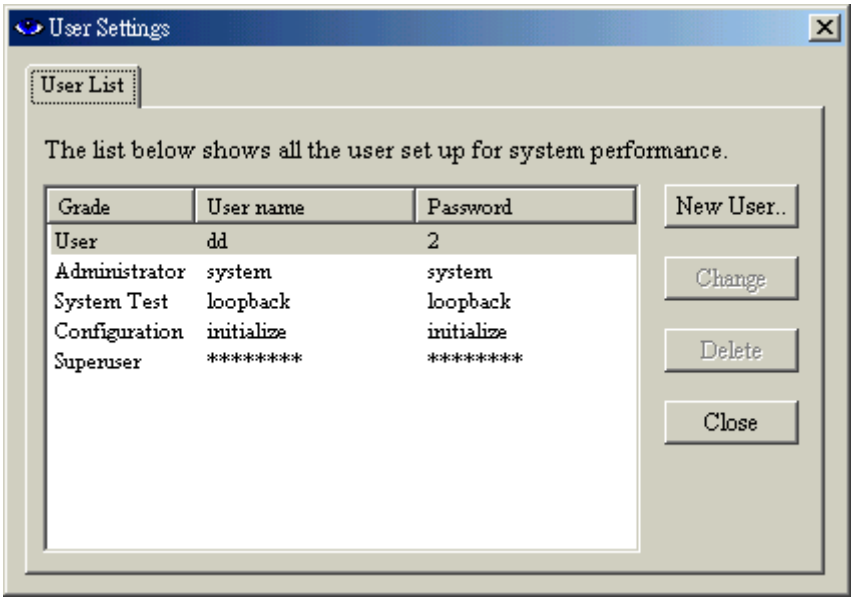
8.6 User Setup

In the Main Window, select System Management → User Setup.

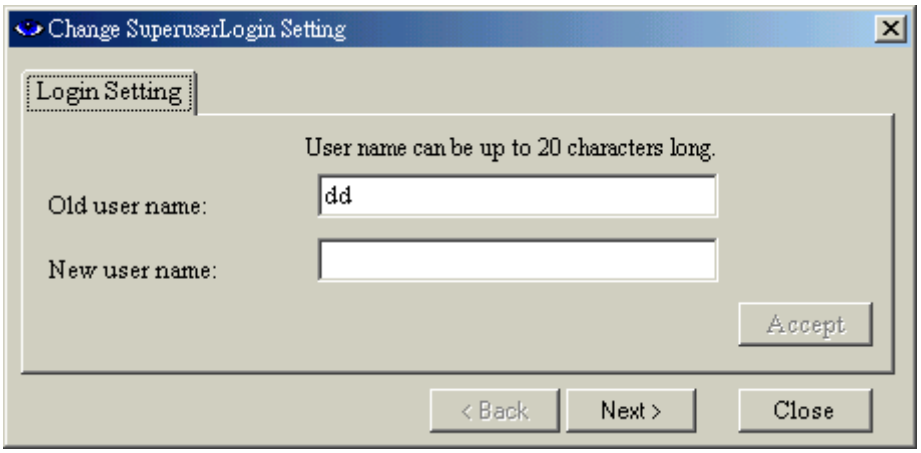


Note: The higher the grade (with different login account), the more the function is allowed. Superuser is the highest grade. The following table shows the function allowed for each grade:

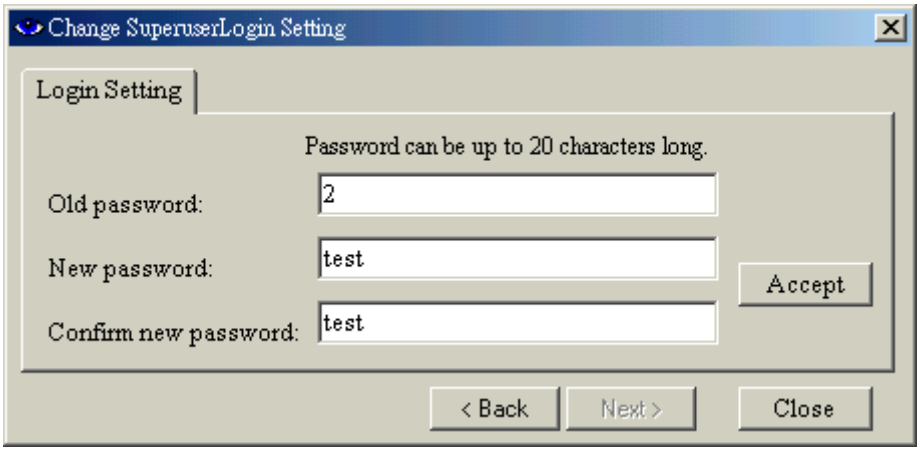
Grade / Login	User	Administrator	System Test	Configuration	Superuser
Superuser	☑	☑	☑	☑	☑
Administrator	☑	☑			
System Test			☑		
Configuration				☑	
User	☑				



Edit User Name or Password: Click on the User Name "dd". Press the Change button. The following dialog box appears. You may now change the old user name to a new one. Press Next to continue.



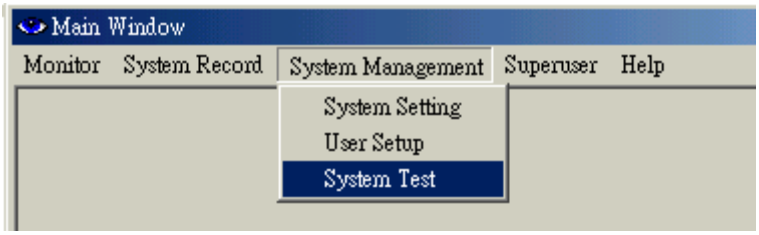
A new dialog box appears to confirm a new password. Press Accept button to write the data.

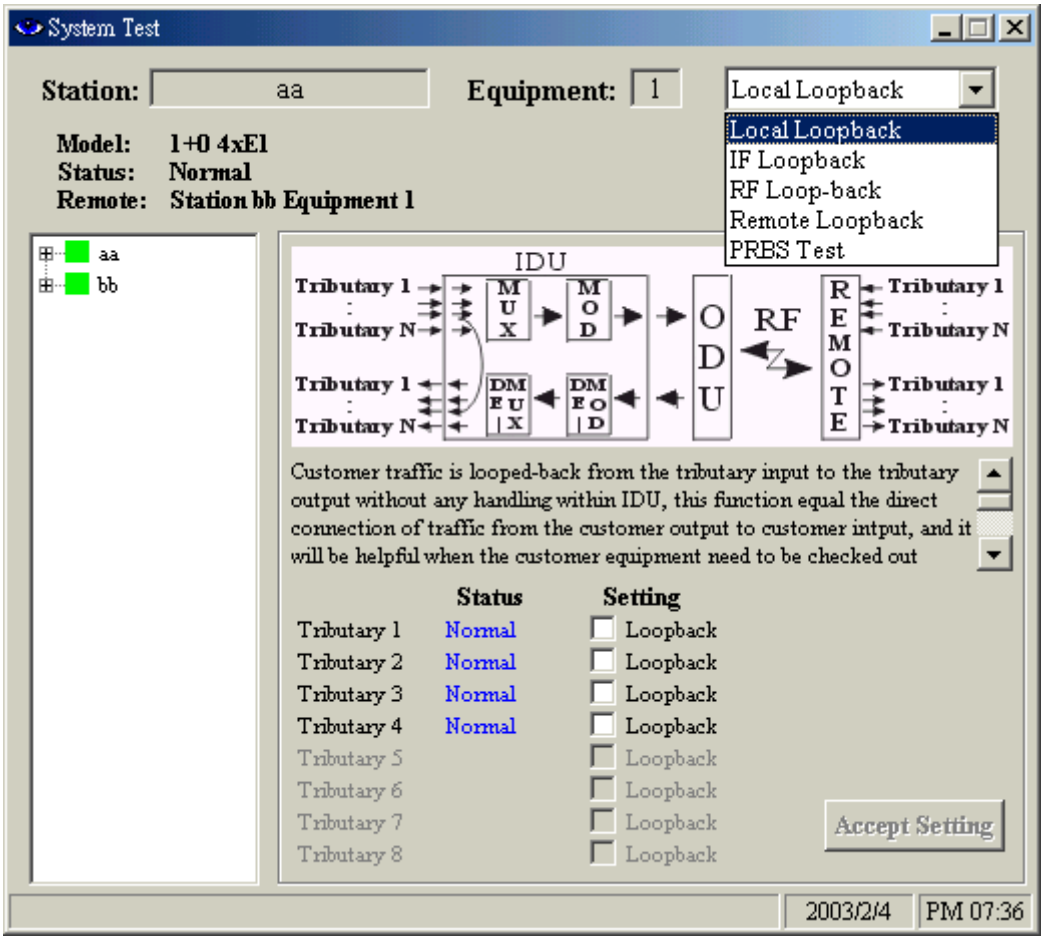


8.7 System Test

In the Main Window, select System Management → System Test. The System Test window has the following functions: Local Loopback、IF Loopback、RF Loopback、Remote Loopback、PRBS Test.

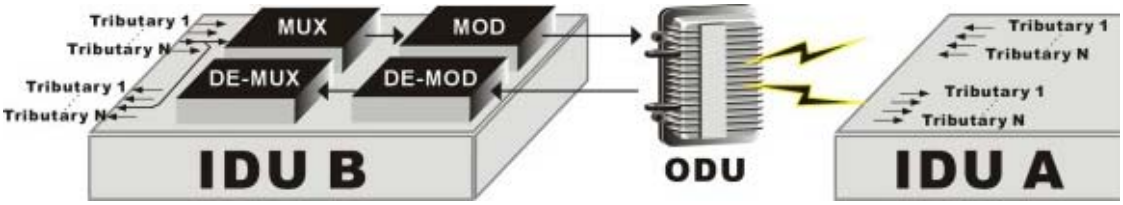
Note: Check all online communication status while performing any of the loopback functions. Be careful to check if there is any broken link.





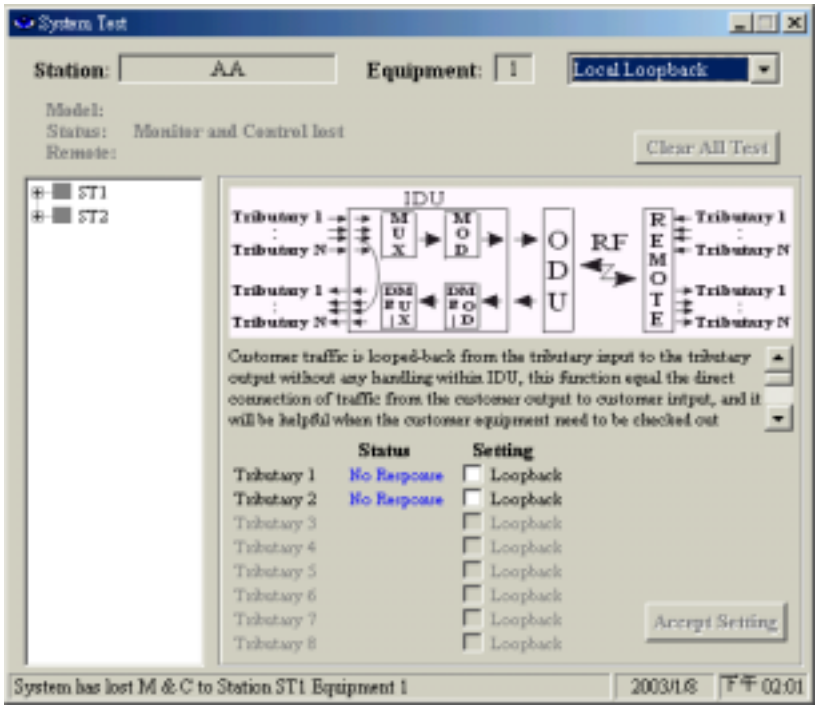
8.7.1 Local Loopback

Local Loopback: Under the local loopback mode, it is easier to detect any malfunction at the E1 interface. Testing equipment is required while detecting because on the execution of this function, the testing signal cannot enter MOD, so it is not possible to use PRBS to detect. This function setting is done through the NMS or the LCD display button.



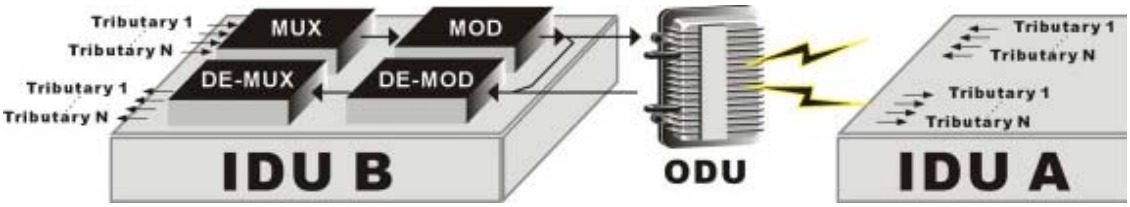
In the System Test window, tick the Setting column for Tributary1. Press Accept Setting. The IDU's first E1 interface is now performing the local loopback test. There can be multiple selection of the test. Press Clear All Test to stop all the settings performing the test.

Local Loopback



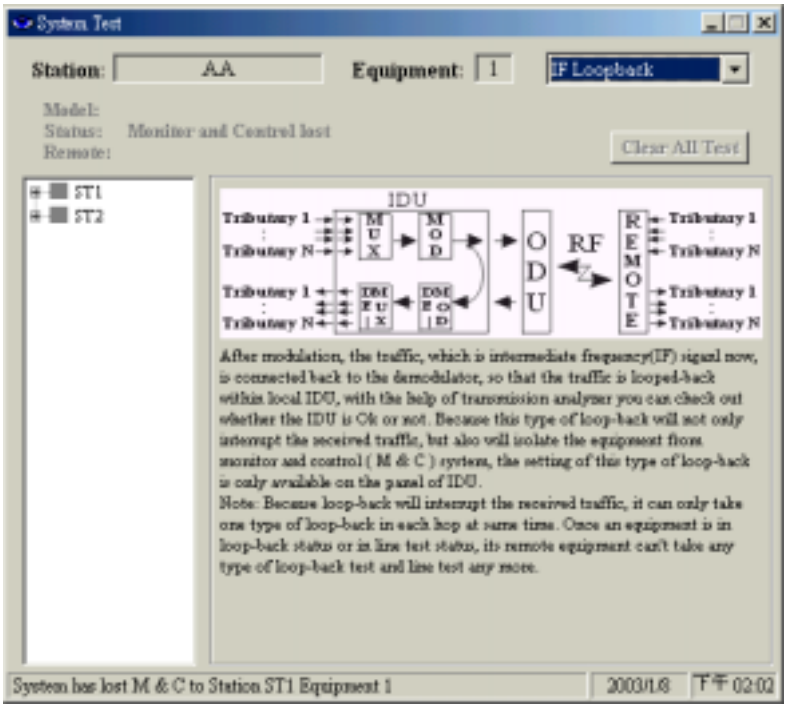
8.7.2 IF Loopback

IF Loopback: Under the IF Loopback mode, a self-detection test on any IDU components malfunction is carried out. This function setting is done through the LCD display button.



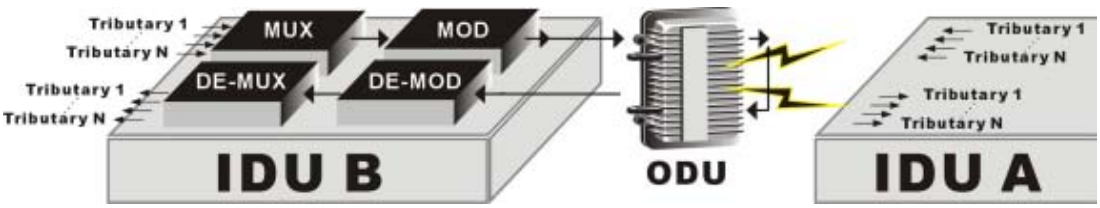
IF Loopback

This function is performed only through the IDU LCD panel.



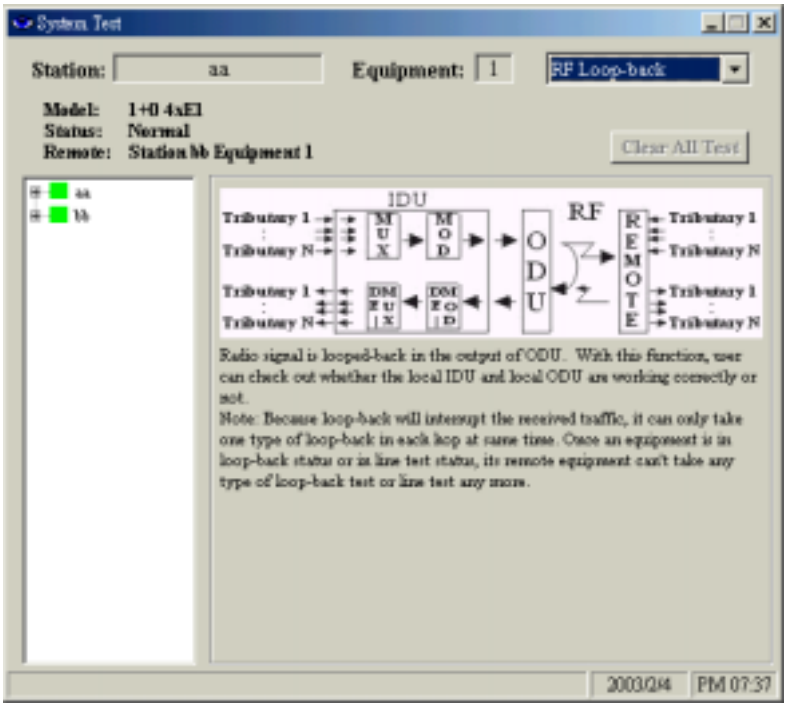
8.7.3 RF Loopback

RF Loopback: Under the RF Loopback mode, a self-detection test on the working conditions of both the IDU and ODU is carried out. This function setting is done through the LCD display button.



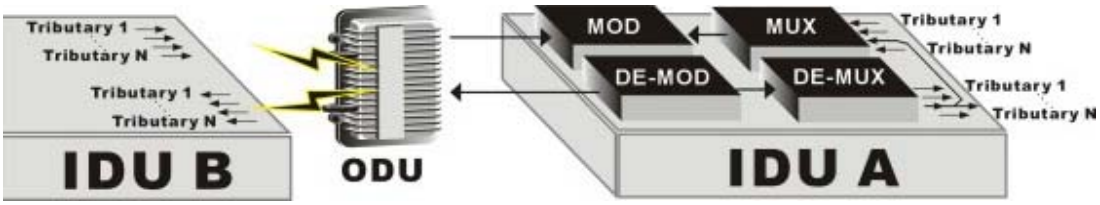
RF Loopback

This function is performed only through the IDU LCD panel.

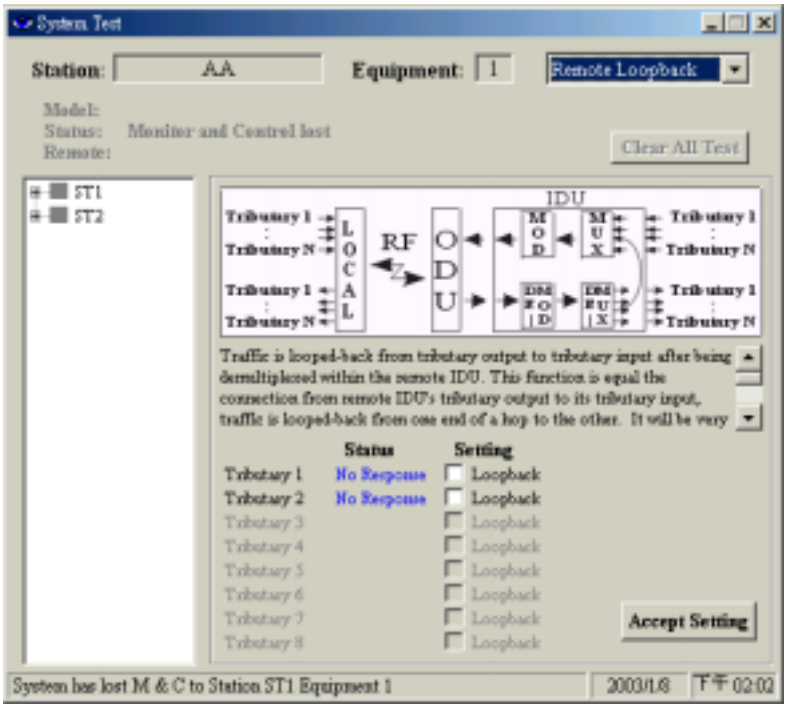


8.7.4 Remote Loopback

Remote Loopback: Under the Remote Loopback mode, a self-detection test on the whole loopback from local to remote is carried out. This function setting is done through the NMS or the LCD display button.



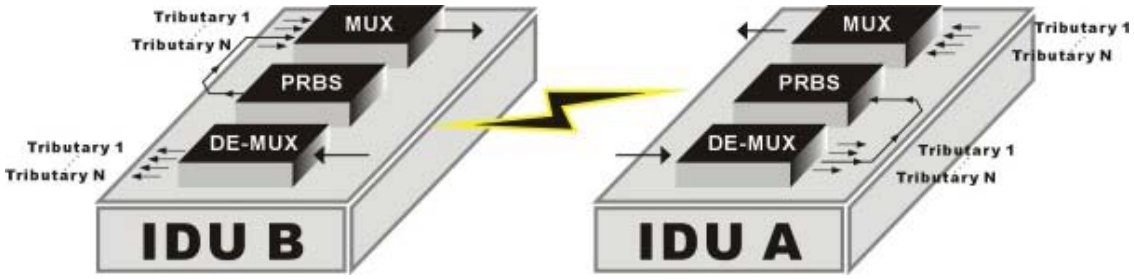
Remote Loopback



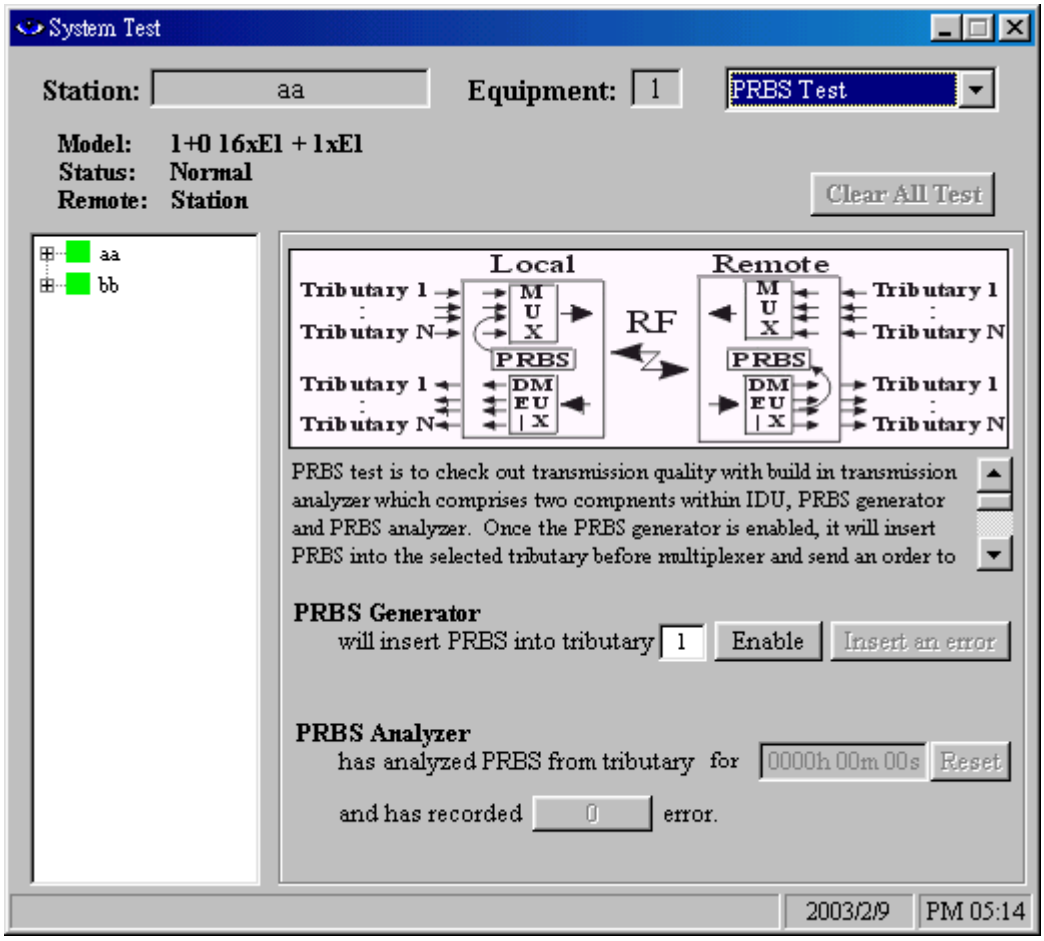
While performing remote loopback function test, first select the testing tributary. Press Accept Setting to execute this function. Press Close All Test to end the test.

8.7.5 PRBS Test

PRBS Test: Under normal working condition, other than the normal BER test, the PRBS function can be used as well to test the mono test accumulated BER and PRBS test stability of the system. While detecting, the PRBS function needs to be started. This function setting is done through the NMS or the LCD display button.



PRBS Test

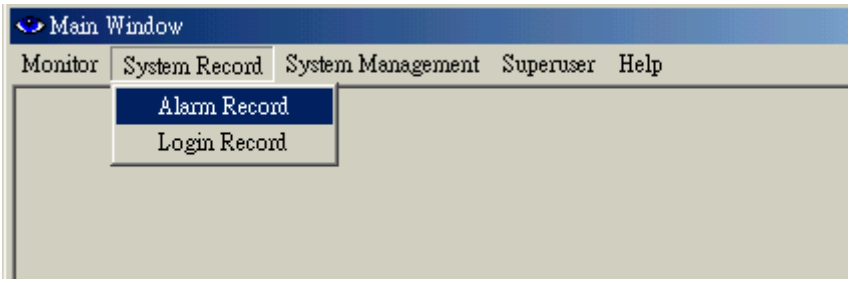


8.8 System Record

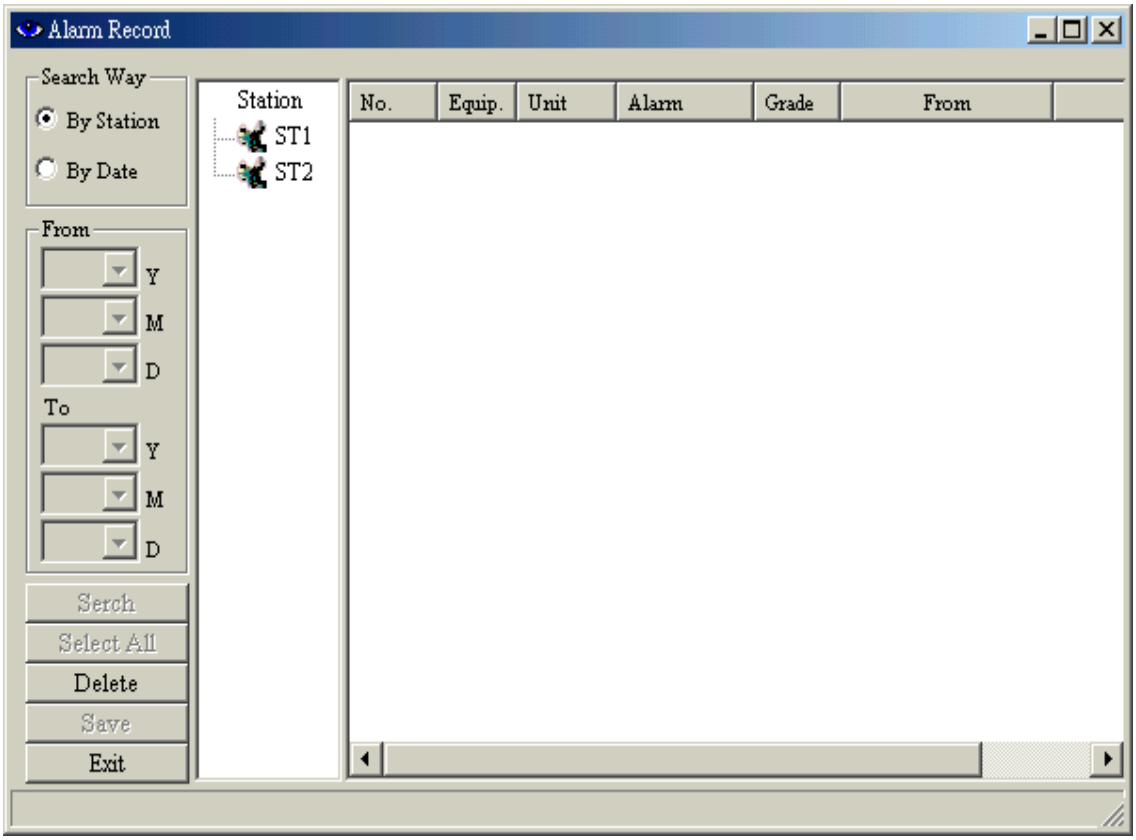
In the Main Window, select System Record. Another initialization window will appear with two different working mode: Alarm Record、Login Record.

8.8.1 Alarm Record

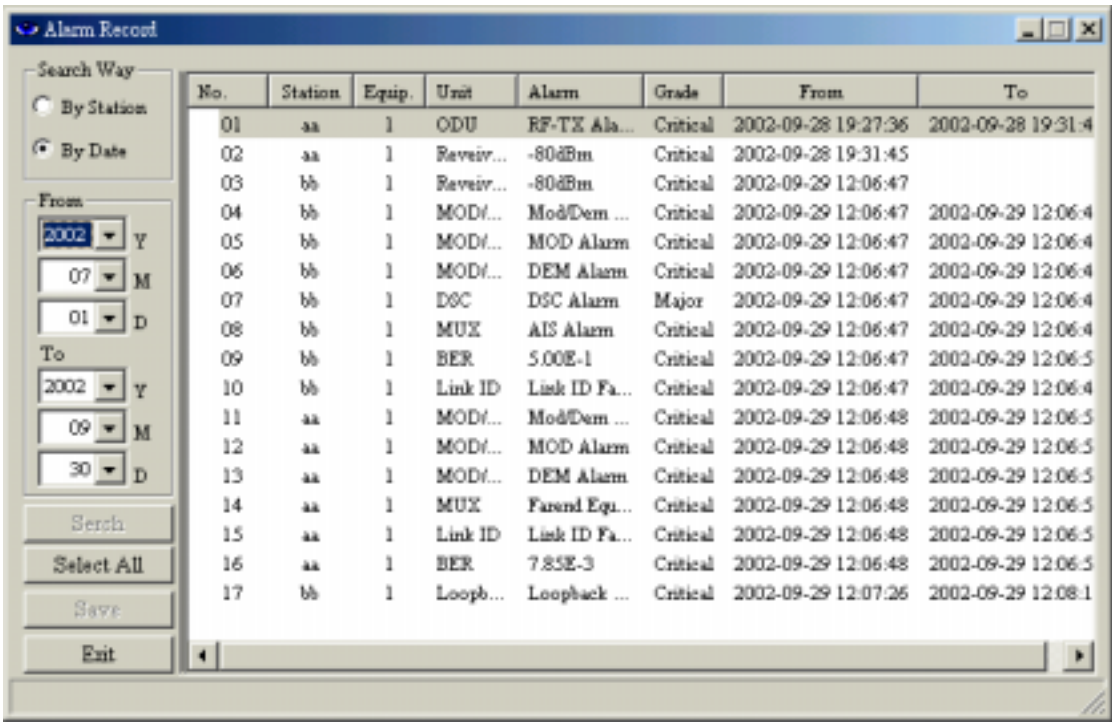
In the Main Window, select System Record → Alarm Record.



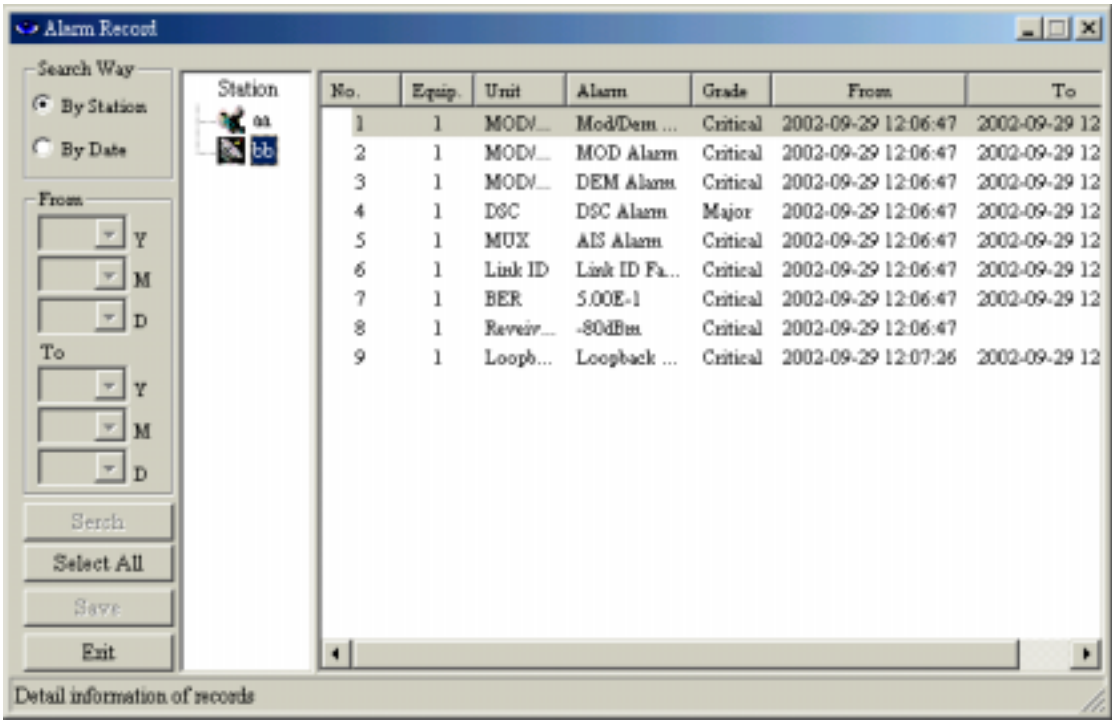
The following window appears: All the alarm record in the network will be recorded in here.


Alarm Record
Search Way
By Station
By Date
From
Y
M
D
To
Y
M
D
Serch
Select All
Delete
Save
Exit
Station
ST1
ST2
No.
Equip.
Unit
Alarm
Grade
From

Alarm record sorted by date: In Search Way, tick By Date.

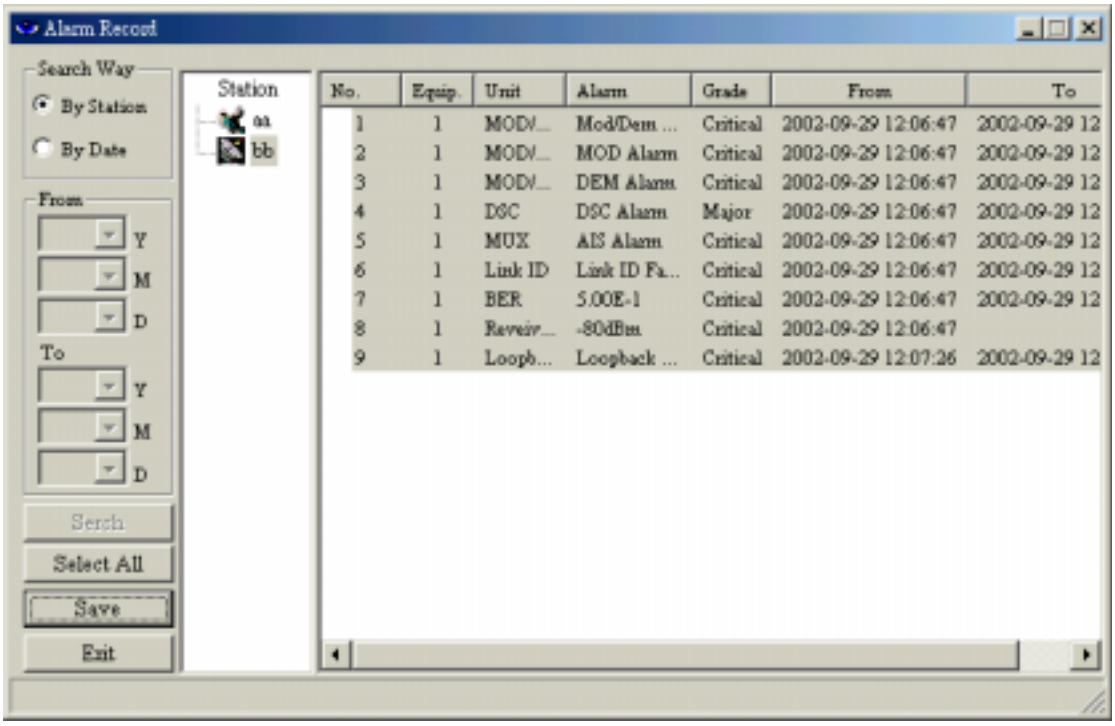


Alarm record sorted by station: In Search Way, tick By Station



Press the Select All button to select all the alarm record. Press the Save button to save the files. The following Save As window will appear. Select the desired folder and file name. Press the Save button.

The file will be saved as *.txt. You may use any word processor to open the file.

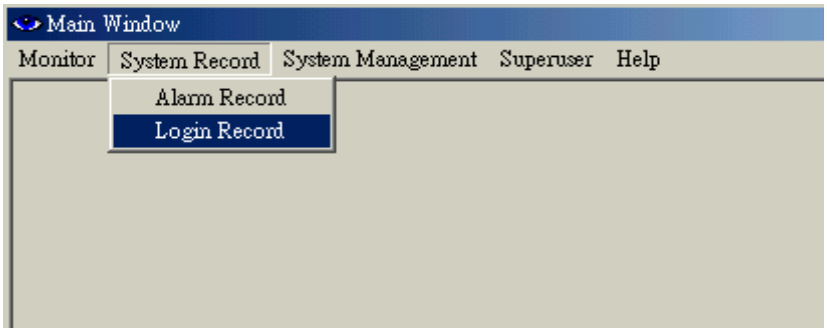


Single Deletion: Select the record you need to delete. Press the Delete button.

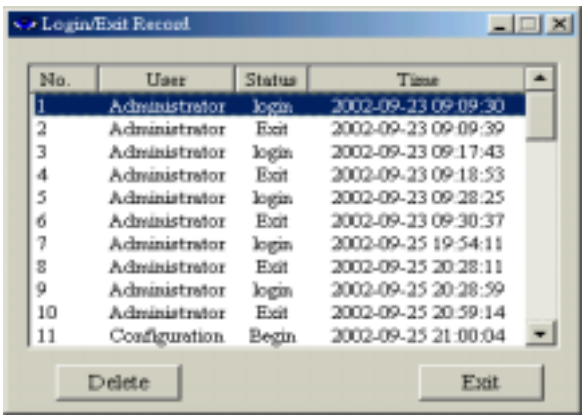
Overall Deletion: Press the Select All button and press the Delete button.

8.8.2 Login Record

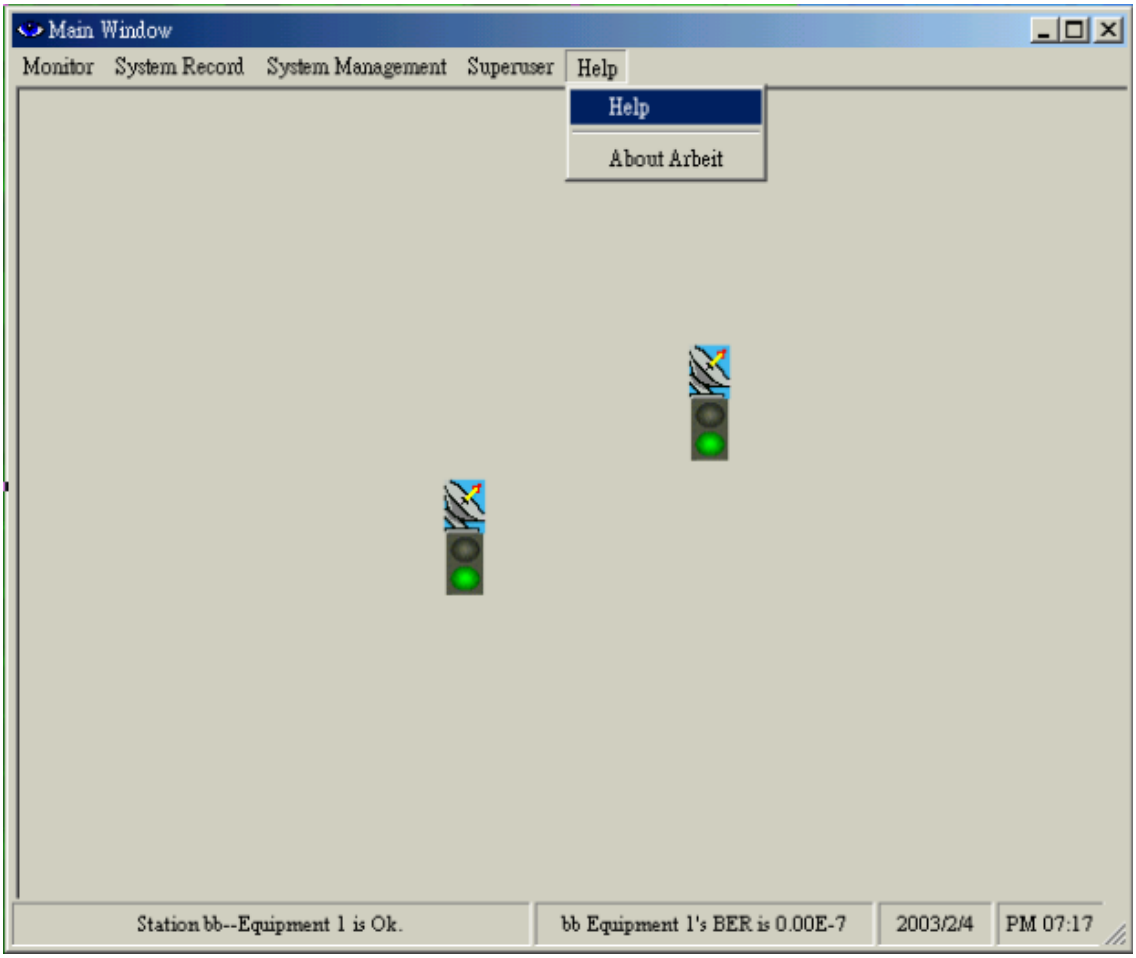
In the Main Window, select System Record → Login Record. Another initialization window will appear.



Select the record you need to delete. Press the Delete button.

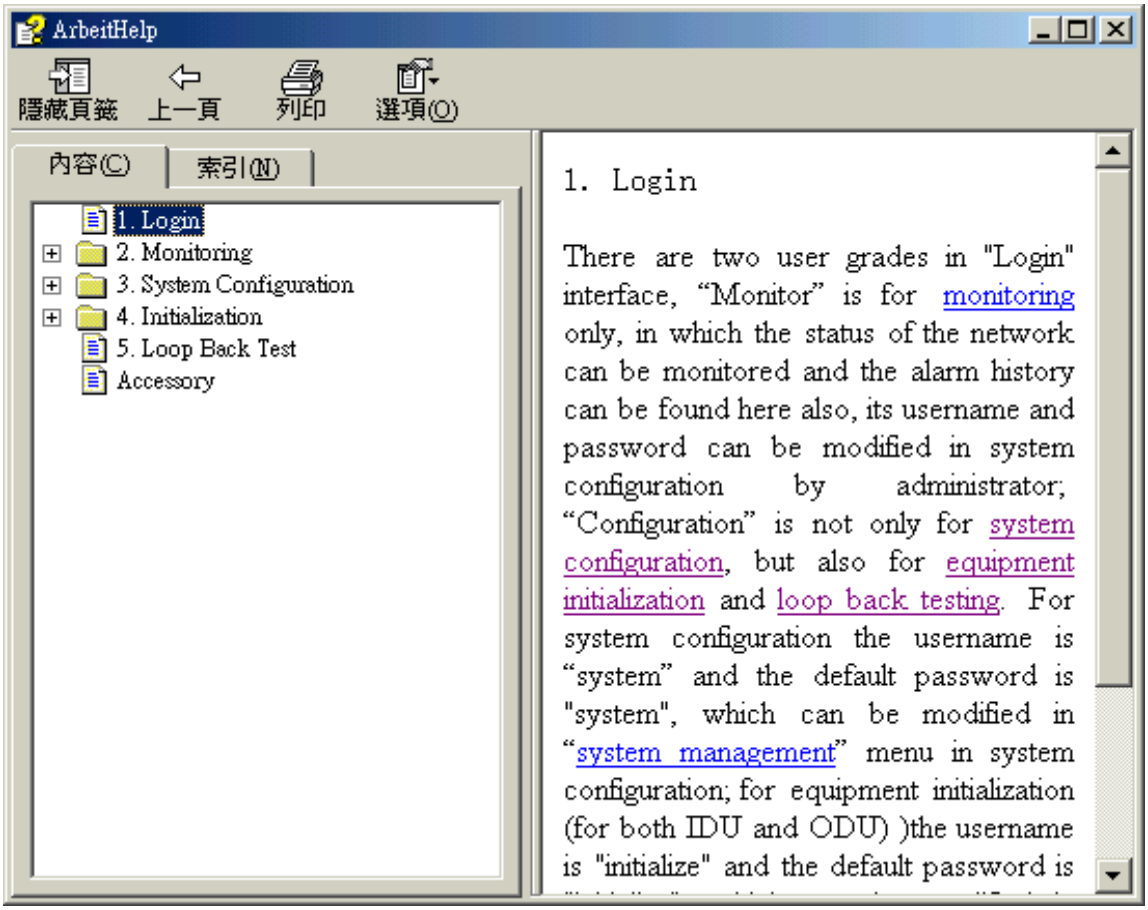


8.9 Help


Main Window
Monitor
System Record
System Management
Superuser
Help
Help
About Arbeit
Station bb--Equipment 1 is Ok.
bb Equipment 1's BER is 0.00E-7
2003/2/4
PM 07:17

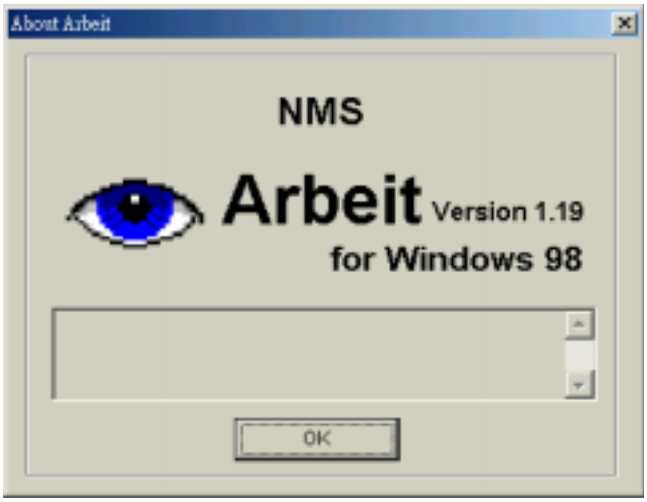
8.9.1 Help Window

You can either select the topics from the Contents or enter keywords to search for specific information.



8.9.2 About Arbeit

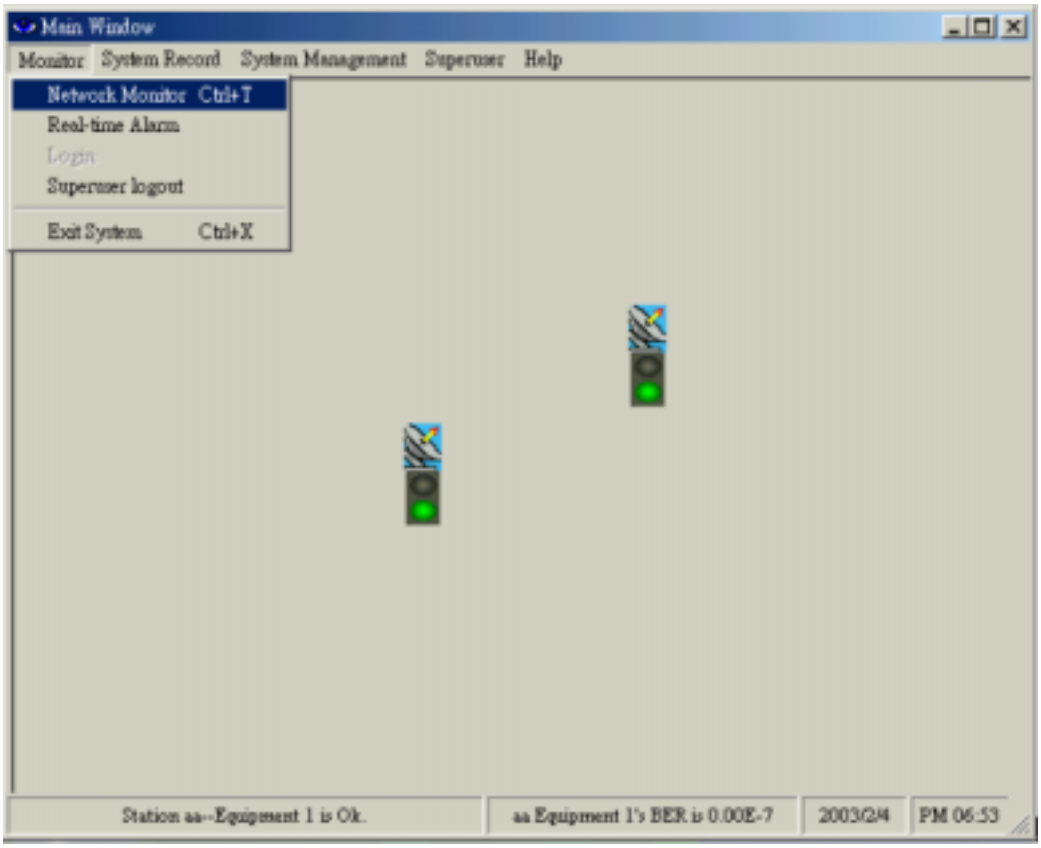
Check Arbeit version.

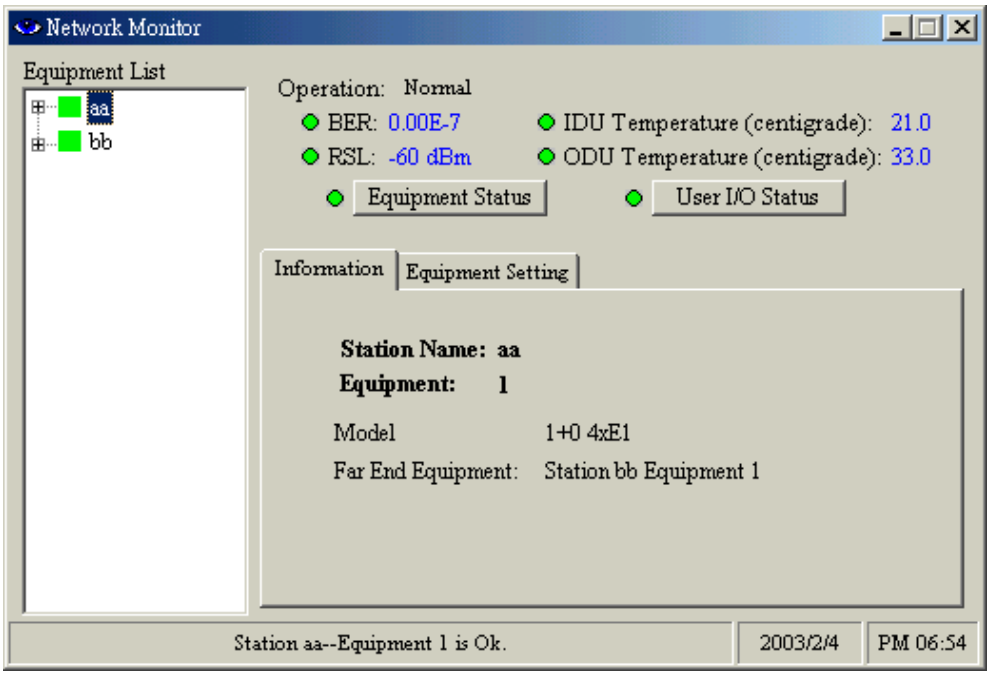


8.10 Monitor

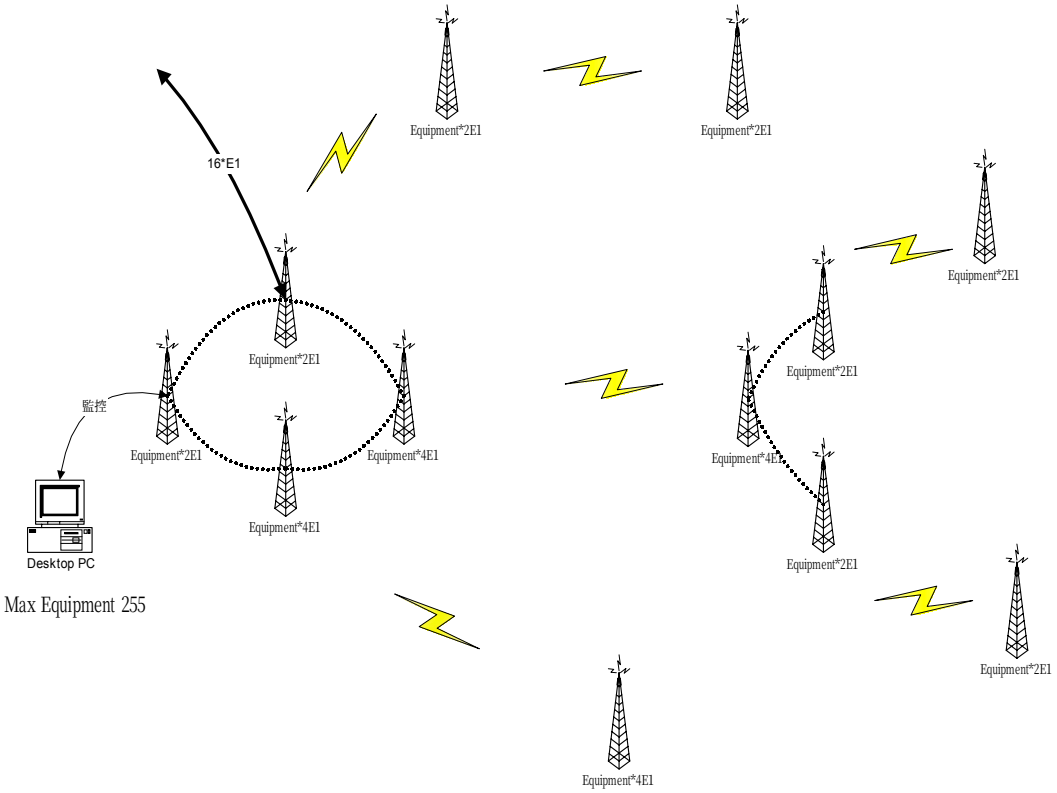
8.10.1 Network Monitor

In the Main Window, select Monitor → Network Monitor.

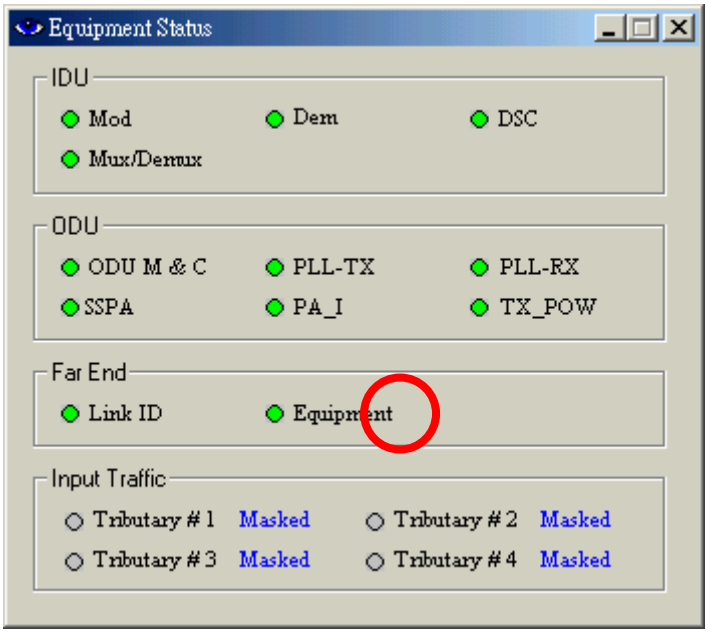




Network Monitor monitors all the station link route information as shown in the following diagram:



In the above Network Monitor window, click on the Equipment Status button. The following dialog box appears:

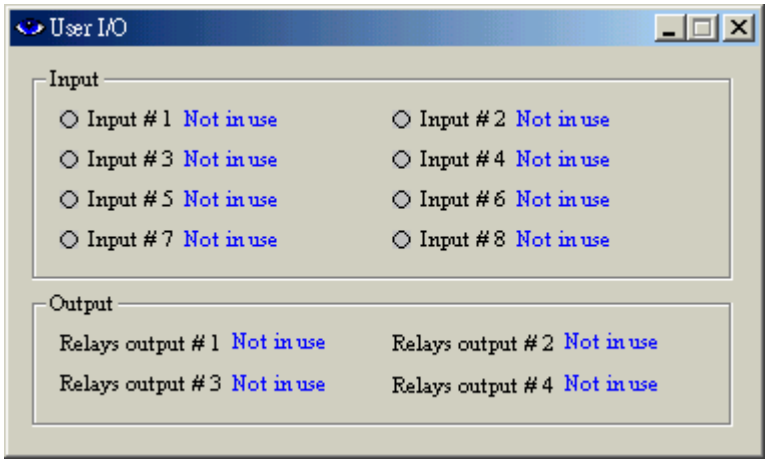


Green = normal; Red = alarm; Grey = lost; Orange = test

Equipment Status

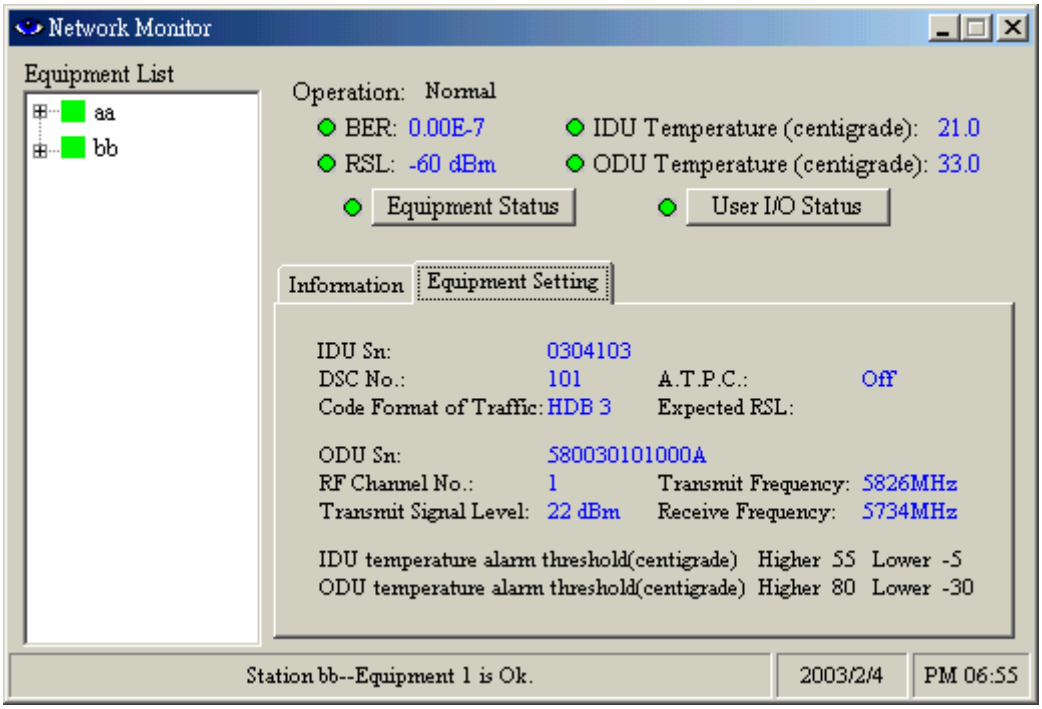
Unit	Status	Description
IDU	Mod	Modulation alarm
	Dem	Demodulation cannot detect the pulse
	DSC	Abnormal service signal
	Mux / Demux	De/modulation alarm
ODU	ODU M & C	ODU control panel signal loss
	PLL-TX	RF TX local oscillator lock malfunction
	PLL-RX	RF RX local oscillator lock malfunction
	SSPA	Transmitting power alarm
	PA_I	PA alarm
	TX_POW	Transmitting power alarm and relay alarm if above ±2dB
Far End	Link ID	Link ID error
	Far End Equipment	Far end equipment alarm
Input Traffic	Tributary #n AIS	IDU detect tributary n with all signal as 1
	Tributary #n LOS	IDU detected tributary n with no signal input
	Tributary #n no response	IDU cannot detect any tributary status

In the above Network Monitor window, click on the User I/O Status button. The following dialog box appears:



Input = Input port status; Output = Relays output port status

Select the Equipment Setting tab beside the Information tab, it will show the following information：

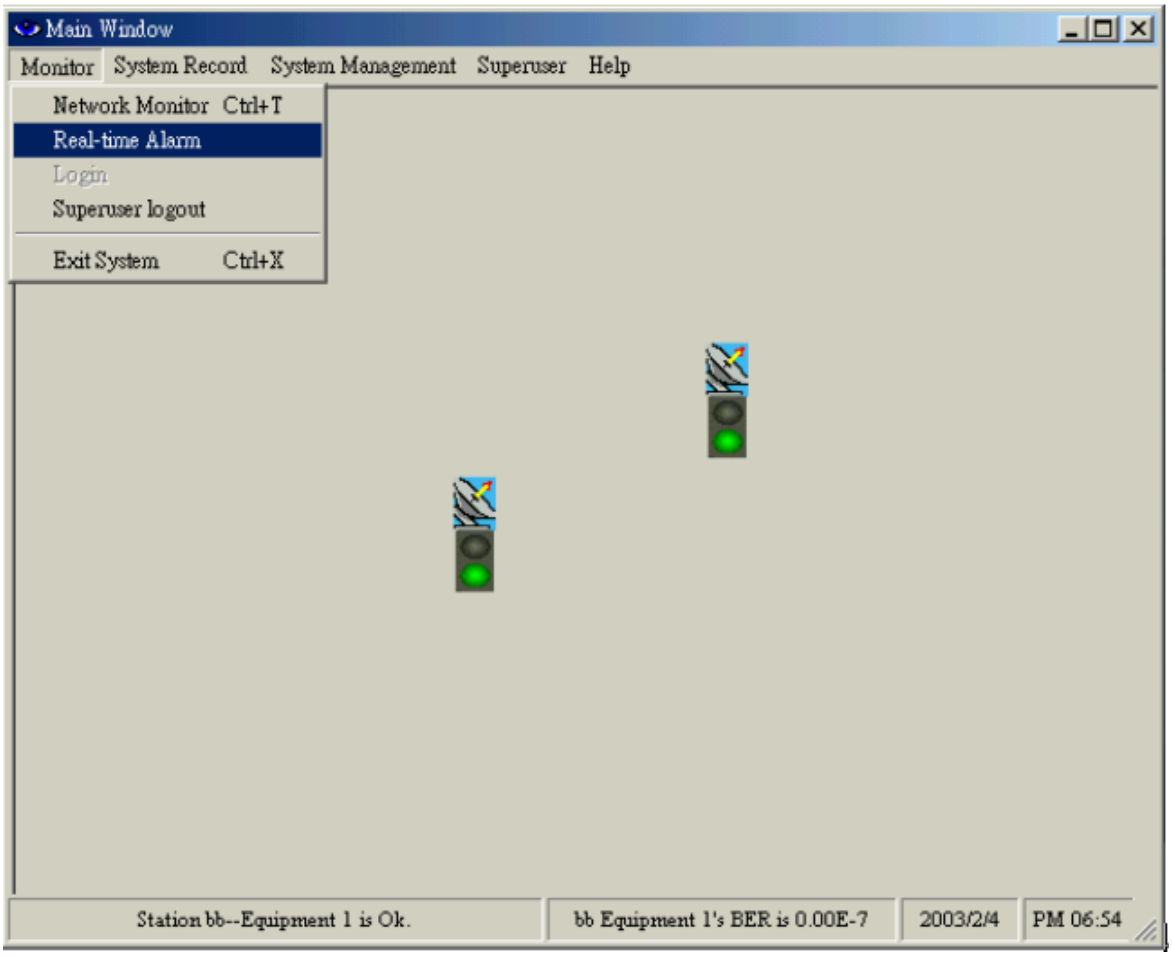


Equipment Setting

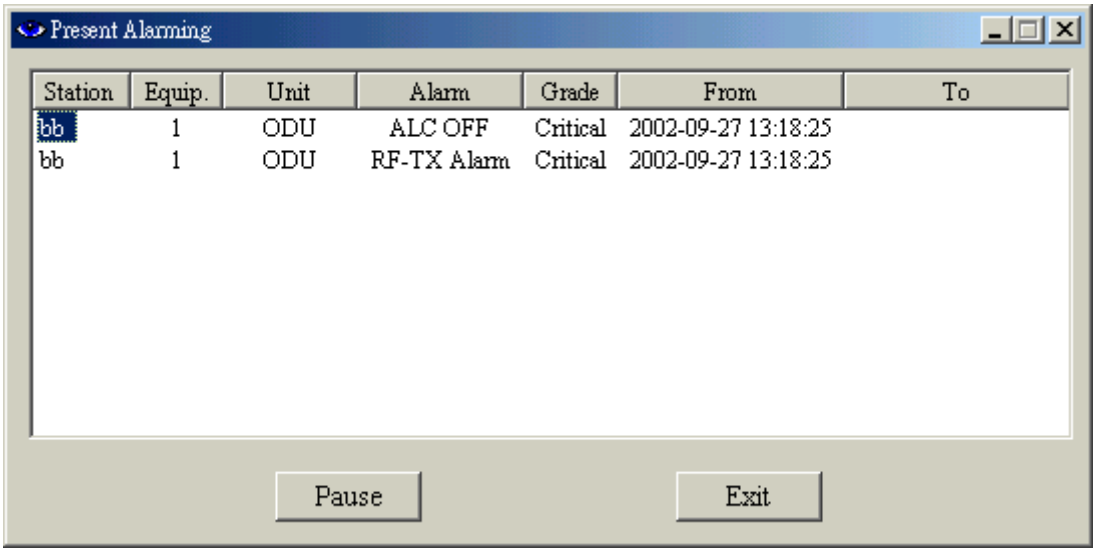
Status	Description
IDU Sn	IDU serial number
DSC No	Digital service telephone number
Code Format of Traffic	E1 encoding type
A.T.P.C.	Automatic power control (retain)
Expected RSL	Automatic power setup parameter (retain)
ODU Sn	ODU serial number
RF Channel No.	RF signal channel
Transmit signal Level	ODU transmitting power setup
Transmit Frequency	ODU transmitting frequency
Receive Frequency	ODU receiving frequency
IDU temperature alarm threshold (℃)	IDU temperature alarm
ODU temperature alarm threshold (℃)	ODU temperature alarm

8.10.2 Real-time Alarm

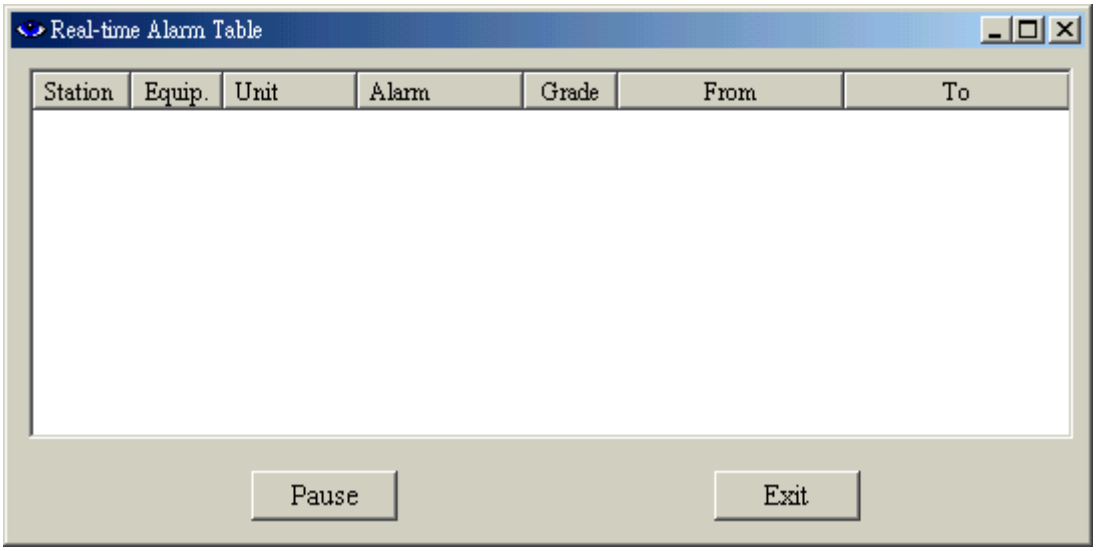
In the Main Window, select Monitor → Real-time Alarm.



Until and unless the problem is removed or if the whole system is switched off, the real-time alarm will still be displayed on the window.



Present Alarming state



No alarm state

Appendix A: Technical Specifications

Transmitter& Receiver

Operation Frequency		5725~5850MHz A: 5817~5847MHz ; B: 5727 ~5757MHz
Communication Mode		Frequency Division Duplex, FDD
Modulation		QPSK
TX Output Power		≤ 22dBm
RX Dynamic Range		-84dBm ~ -15dBm
Sensitivity (10^{-3} BER)	2E1	≤ -89dBm
	4E1	≤ -86dBm
	8E1	≤ -83dBm
	16E1	≤ -80dBm
Sensitivity (10^{-6} BER)	2E1	≤ -87dBm
	4E1	≤ -84dBm
	8E1	≤ -81dBm
	16E1	≤ -77.5dBm
Frequency Selection	2E1	3 Channel
	4E1	3 Channel
	8E1	2 Channel
	16E1	1 Channel
BER During Normal Propagation		≤ 10^{-10}
Receiver Max Input		≤ -10dBm
Receiver Max Input with no BER		≤ -30dBm
Frequency Stability		±10ppm
Gain Flatness (anywhere)		RX: ± 1 dB TX: ± 1dB
TX & RX Isolation		60dB
TVS		> 40 kilovolts
PA Control		10~22dBm (25□) Step 2dB
RSSI (BNC)		for Antenna Alignment

Digital Line interface

Data Rate	2,048 Mbps
E1 Connector (ITU-T G.703)	BNC Unbalanced, 75 ohm OR Balanced, 120 ohm (Optional)
Signal BER	LCD Display on IDU

IDU Structure

IDU LCD		Display of IDU, ODU, Remote, Alarm, Test Item Information
Alarm		Buzzer, LED Indication, LCD Display
LED Indication	Green	Link OK
	Orange	Test
	Red	Alarm

Temperature and Environment

Operating Temperature Range	-30 to 65□
Humidity	10%~95% Non-condensing
Altitude	5,000 meters (maximum)

Network Management System

Operating Computer	PC or Notebook RS232
Operation System	Win98、Win Me、Win2000、Win XP
Interface	RS232
NMS Name	Arbeit
Protocol	NMS or SNMP
Control Client	255
NMS Function	IDU Setup、ODU Setup、Remote Loopback、Local Loopback、PRBS Test、IF Loopback、RF Loopback、BER、Temperature、Alarm、Recorded Alarm、Present Alarm、Router Map、Channel Setup、RSL、Tx Level、Login Record、Display Alarm etc.

IF Cable

Link Cable		≤ 100m RG-5 ≤ 200m RG-8
IDU OUTPUT	Frequency	310MHz ± 50 ppm
	Range	±15MHz
	Power	-30dBm~0dBm
	Return Loss	VSWR 1.3
IDU INPUT	Frequency	70MHz ± 50ppm
	Range	±15MHz
	Power	-20dBm~0dBm
	Return Loss	VSWR 1.3
Monitoring Signal	Frequency	11.0592MHz ± 50ppm
	Range	±0.5MHz
	Power	150~180mVpp
	Return Loss	Input /Output VSWR 1.3

Service Channel

Telephone	Frequency	300-3400Hz
	Impedance	600 ohm balance
	Interface	RJ-11
Monitoring Data (PC)	Bit Rate	9600 baud
	Protocol	RS-232
	Interface	RJ-45
Computer Data (USER)	Bit Rate	9600 baud
	Protocol	RS-232
	Interface	DB-25
User Input	Type	Photo-coupled (TTL)
	Interface	DB-25
	Number	8
	Isolation	3000 VAC (rms)
	LED Power Dissipation	90 mW
User Output	Type	Relay output
	Interface	DB-25
	Number	4
	Max. switching voltage	125 VAC / 60 VDC
	Max. switching current	1 A

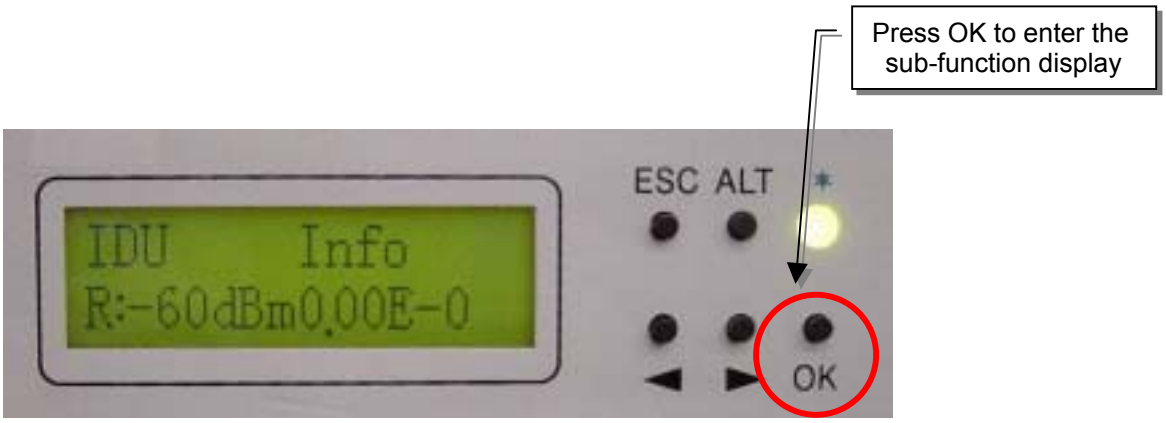
Power

DC Input	DC -48VDC (-36~ -72V)
Power Consumption	< 45 watts
AC Input (optional)	220 VAC (100-250V) 50-60Hz
Connector	Barrier strip, plug-in type

Appendix B: LCD Alarm Description

Alarm		***Status***	***Reason***
MOD	Alarm	Cannot send any correct signal	Asynchronous modulation
DEMOD	Alarm	Cannot receive any correct signal	Asynchronous demodulation
DSC	Alarm	No digital service between the equipments	MUX Unit detecting clock is incorrect
LINK ID	Alarm	LINK ID at the remote end is different from the user's setting	
RAOUT	Alarm	Cannot receive, but can send signal	Remote terminal will notify the local terminal of the alarm
MUX	Alarm	Receiving lock malfunction	Tapping procedure cannot lock the timing
I n-LOS	Loss	IDU cannot detect the input tributary signal	
I1 - AIS	Alarm	Tributary signal input are all 1's	
ODU – M/C	Alarm	IDU cannot monitor ODU	M&C channel between IDU and ODU is down

Alarm Info, IDU Info, ODU Info, TEST Item and Remote Info have the same function precedence. Each function can be mutually switched back and forth using the Right/Left button. For example, if it is now processing the Alarm Info function table. When the Right button is pressed, you'll be directed to the IDU Info menu. Now press the OK button to enter the Menu sub-function table, e.g. Local ID etc.

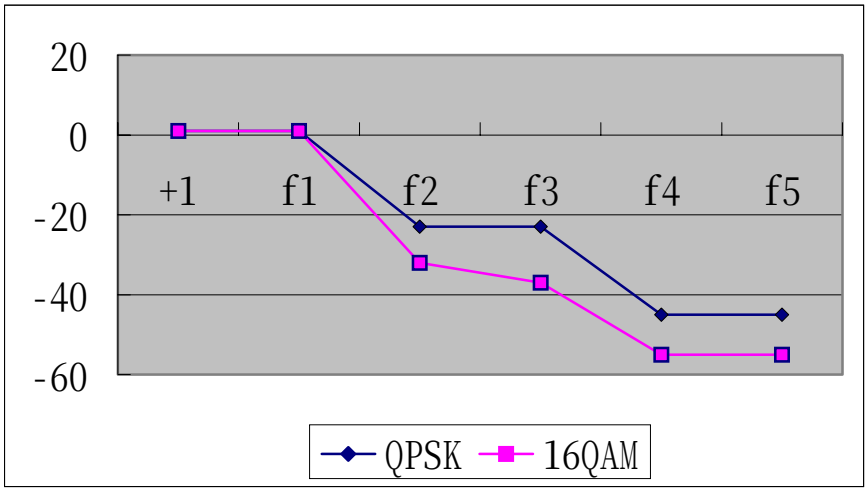


Appendix C: LCD Display＆Function Table

Status	LCD Display		Function	Description
IDU Info (A)	1	Local ID: n	Display the local address	Display the local equipment's address
	2	DSC No.: n	Display the service number	Display the local equipment's service telephone number
	3	IDU: n x E1	Display the activity measure	Display the number of E1 equipments
	4	Code: AMI/HDB3	Display or set-up the model number	Display or set-up the E1 equipments model number
	5	ATPC: En/Dis	Automatic Transmit Power Control	Retain
	6	EXP_RSL: - n dBm	Automatic Transmit Power Control parameters	Retain
	7	I-Temp: n□	IDU working temperature	
	8	Buzzer: ON/OFF	Buzzer switch	
ODU Info (B)	1	RF CH/Freq.	Display RF channel and frequency limit	Display the present ODU RF channel and frequency range
	2	TxL_Set: n dBm	Display the transmit power	Display the transmit power, n = 5~22dBm
	3	Tx-Mute: ON/OFF	To set the PA to ON/OFF	
	4	O-Temp: n□	ODU working temperature	
TEST Item (C)	1	Tn_Loc -Loop: En/Dis	Set-up local loopback function	Perform loopback test in the local end for the convenience of testing the local end equipment's stability
	2	Tn_ Rem -Loop: En/Dis	Set-up remote end loopback function	Perform loopback test in the remote end for the convenience of testing the local end equipment's stability
	3	Tn_PRBS12: En/Dis	Bit error transmission test	Use Pseudo Random Code to test the E1 signal transmission
	4	Error_ADD: ?	Manual addition of bit error	Bit error is produced each time the bit error transmission test is started
	5	Ber_Clear: ?	Clear all accumulated bit error	Clear all accumulated bit error on starting the bit error transmission test
	6	Acc_Ber: num E -n	Accumulated bit error display status	Display all the up-to-date accumulated bit error on starting the bit error transmission test
	7	IF-Loop: En/Dis	Set-up IF loopback function	Perform loopback test from IF interface for the convenience of testing the IDU's stability
	8	Close-Test: Y/N	Close all test	Y: close N: cancel
Remote Info	1	Local ID: n	Display the remote end address	Display the address of the remote equipment; n=1~255
	2	Far-end: Alarm/OK/Loss	Display the connection status of remote end equipments	Alarm: remote monitor function fails OK: in connection Loss: R_MON signal loss

(D)	3	R-Status: Test/Normal/Loss	Display the system present working status	Test: remote end in testing status Normal: normal working condition Loss: R-Status signal loss

Appendix D: Frequency Spread Spectrum

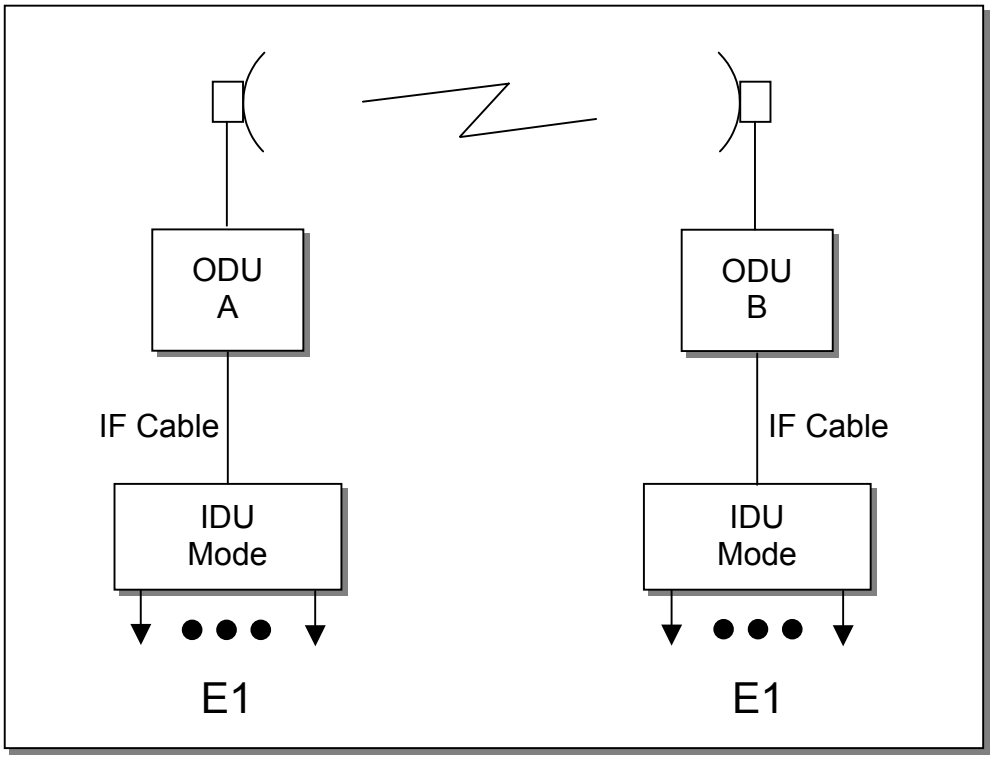


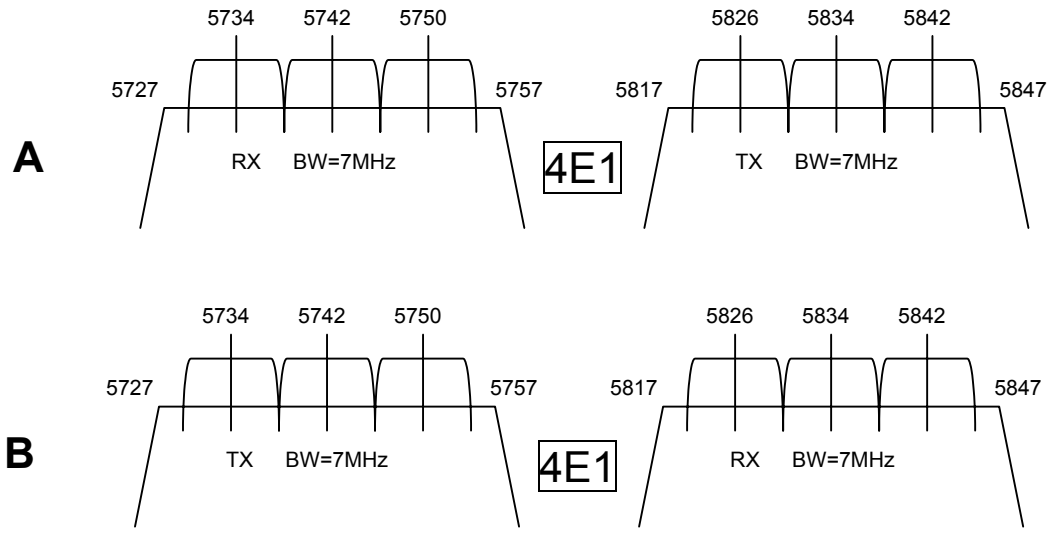
Example of the transmitting spectrum

Bit Rate (Mbit/S)		Channel Spacing (MHz)	F1 (MHz)	F2 (MHz)	F3 (MHz)	F4 (MHz)	F5 (MHz)
1	4*E1	7	2.7	5.6	6.5	13	17.5
2	4*E1	7	2.8	5.6	7	14	17.5

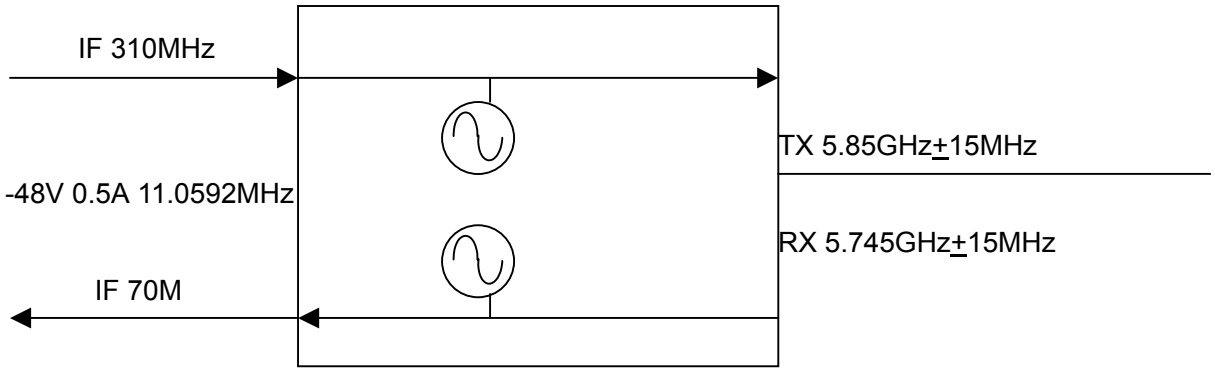
	TX			RX		
7MHz	4E1					
channel	Left	Middle	Right	Left	Middle	Right
1	5730.5	5734	5737.5	5822.5	5826	5829.5
2	5738.5	5742	5745.5	5830.5	5834	5837.5
3	5746.5	5750	5753.5	5838.5	5842	5845.5

(Frequency Unit: MHz / QPSK)

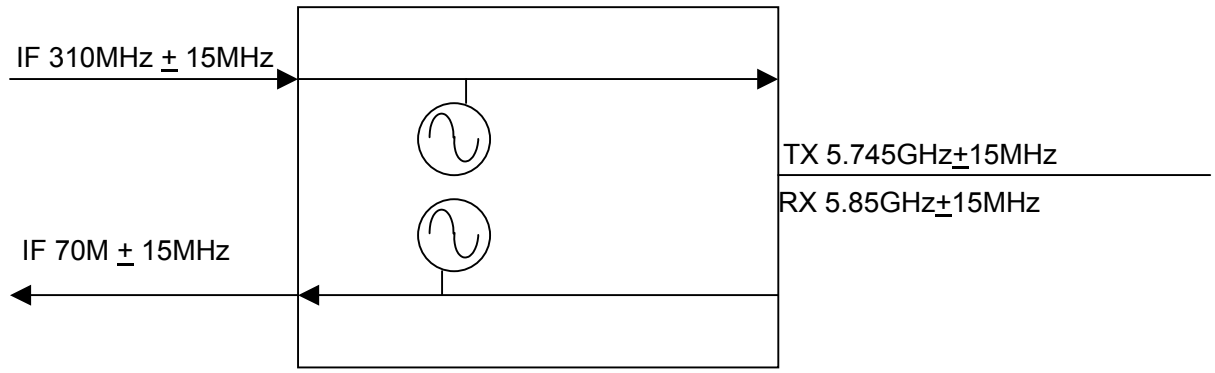

ODU
A
ODU
B
IF Cable
IF Cable
IDU
Mode
IDU
Mode
E1
E1


A
5734
5742
5750
5727
5757
RX BW=7MHz
4E1
5826
5834
5842
5817
5847
TX BW=7MHz
B
5734
5742
5750
5727
5757
TX BW=7MHz
4E1
5826
5834
5842
5817
5847
RX BW=7MHz

Appendix E: 5.8GHz ODU Block Diagram

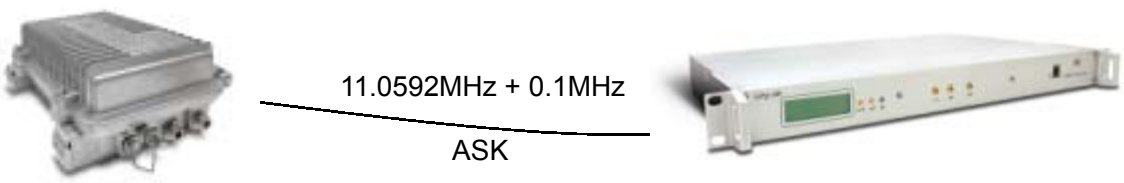


ODU *A* receiving unit



ODU *B* receiving unit

5.8GHz Point-to-Point Monitoring System



Appendix F: ODU Installation Guide

Parts of ODU assembly

Nut[1] **Washer[2]** **Washer[3]**

ODU Fastening Assembly

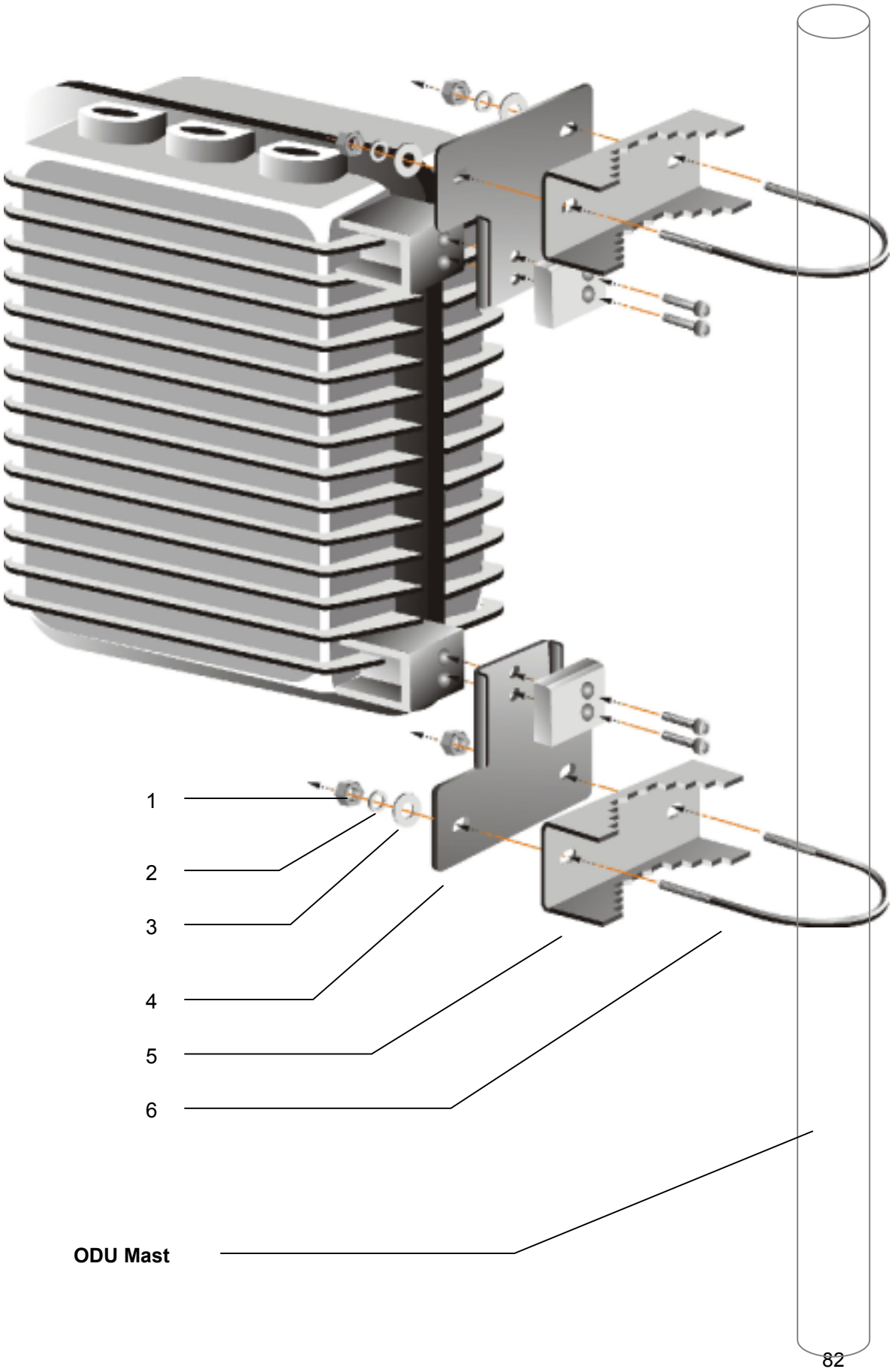
Name	Quantity
Screw[1]	4
Washer[2]	4
Washer [3]	4
Retaining Ring[4]	2
Vee Block[5]	2
U-Bracket[6]	2

Retaining Ring[4]

Vee Block[5]

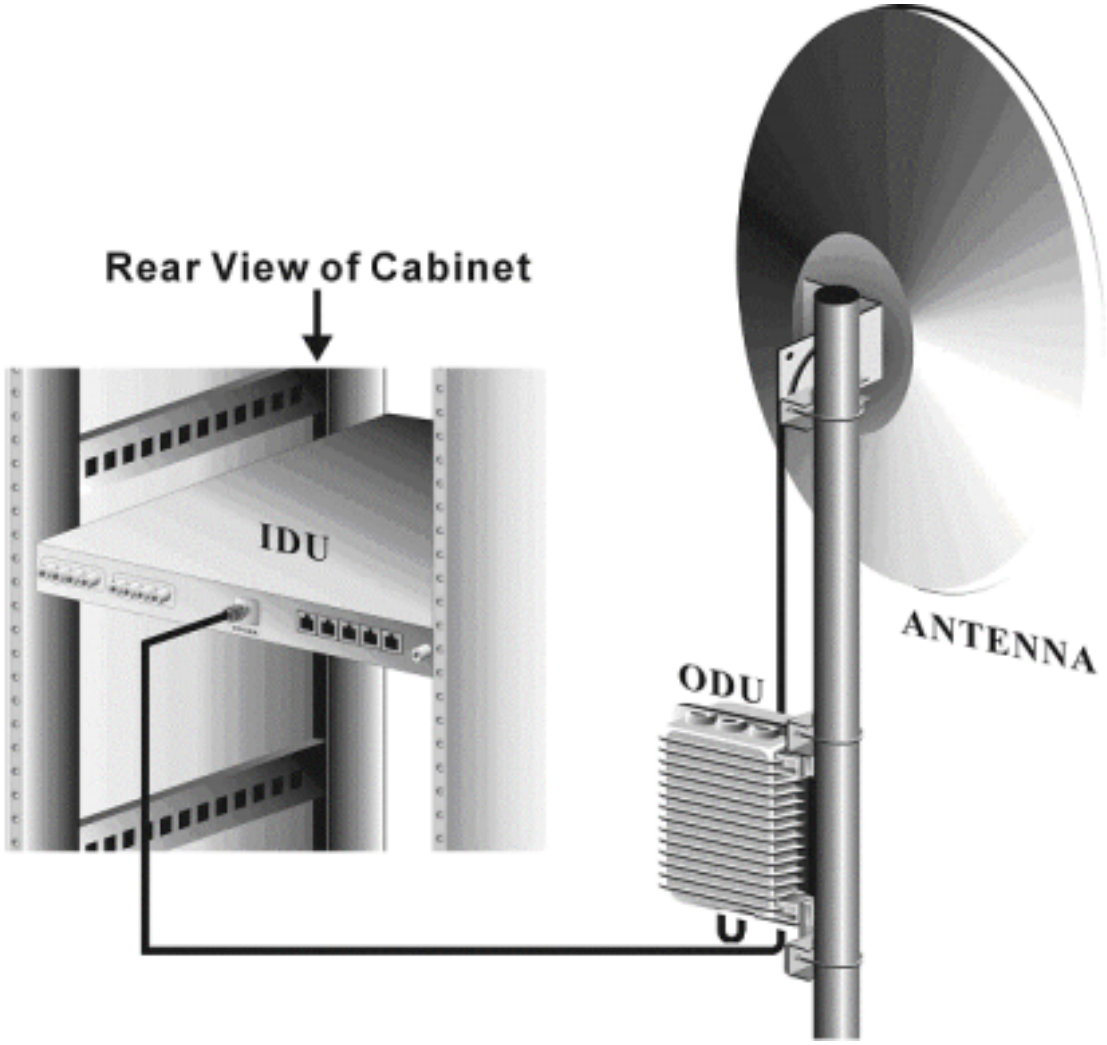
U-Bracket[6]

ODU Quick Installation Diagram



IDU + ODU Quick Installation Guide

※Note: Experts guidance is a must for the installation of this particular equipments



Appendix G: RSL Calculation and Link Budget

The received signal level (RSL) can be estimated using the following formula:

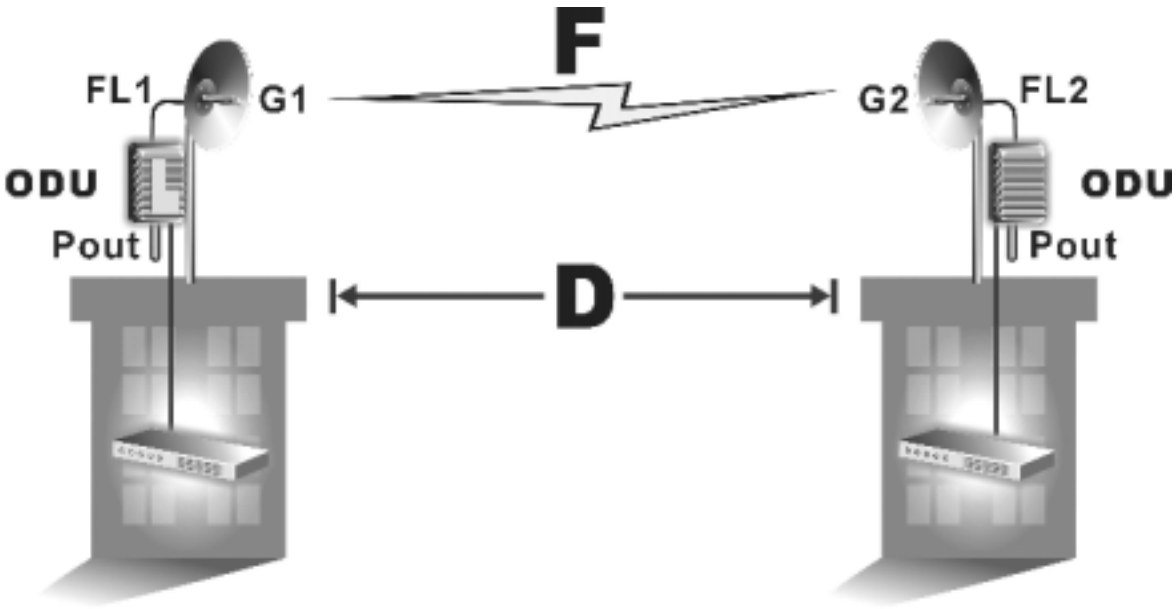
RSL (dBm) = $P_{out} – FL_1 + G_1 + G_2 – FL_2 – L_P$

where: P_{out} is the transmitter output power (in dBm)

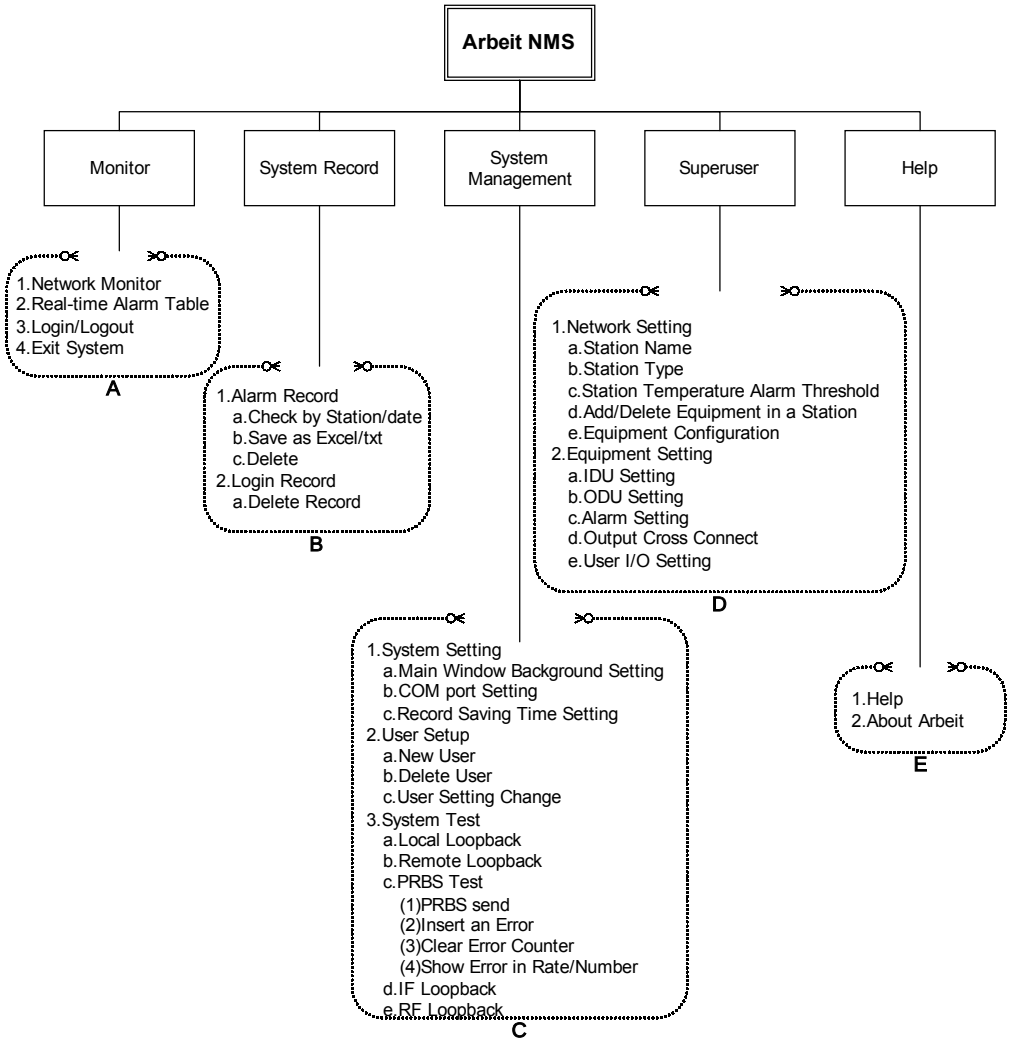
FL_1 is the feeder loss of the transmit side (in dBm)
G_1 is the gain of the transmit antenna (in dB)
G_2 is the gain of the receive antenna (in dB)
FL_2 is the feeder loss of the receive side (in dB)
L_P is the Path loss, defined by:
L_P (dB) = $96.6 + 20 \log_{10}F + 20 \log_{10}D$

where: F = Frequency in GHz (1.5, 2.4 or 5.8)
D = Distance of path in miles

This link budget is very important for determining any potential problems during installation. If you have calculated the expected RSL, you can see if it has been achieved during installation, and troubleshoot if necessary.



Appendix H: Arbeit Network Management System Tree



Appendix I: Arbeit NMS Alarm

Alarm		*Grade*	*Status*	*Unit*	*Reason*
MOD/DEM Unit	Fault	Critical	No signal in both directions	MOD/DEM	Hardware troubleshoot
MOD	Alarm	Critical	Can't send any correct signal	MOD/DEM	
DEM	Alarm	Critical	Can't receive any correct signal	MOD/DEM	
DSC Unit	Fault	Major	No digital service between the equipments	DSC	Hardware troubleshoot, but main network still exist
DSC	Alarm	Major	No digital service between the equipments	DSC	MUX Unit detecting clock is incorrect
LINK ID	Fault	Critical	LINK ID at the remote end is different from the user's setting	LINK ID	
Loopback	Test	Critical	IDU is in Loopback Testing state	Loopback	
Far-end Equipment	Alarm	Critical	Far-end equipment can't receive correct signal, but can send correct signal	MUX	Far-end equipment notifies the other end of the alarming condition
MUX	Fault	Critical	No signal in both directions	MUX	Hardware troubleshoot
AIS	Alarm	Critical	Equipment can't receive any correct signal	MUX	If DEM alarms, MUX Unit will send an AIS to indicate that the MUX Unit is OK
Loss of Frame	Loss	Critical	Equipment can't receive any correct signal	MUX	If BER is too high, MUX Unit can't detect any correct signal
Group	Loss	Critical	Equipment can't receive any correct signal	MUX	MUX Unit can't detect the MOD/DEM Unit's clock.
TRIB X	Loss	Critical	IDU can't detect any signal from this tributary	MUX	
CABLE	Fault	Critical	IDU loses M&C to the ODU	Cable	M&C channel between IDU and ODU is down
TX FIX Lock	Fault	Critical	TX lock malfunction	ODU	Transmitting lock malfunction
RX FIX Lock	Fault	Critical	RX receives	ODU	Receiving lock malfunction
Agile Lo.	Fault	Critical		ODU	
AGC	Off	Critical		ODU	
ALC	Off	Critical		ODU	
RF-TX	Alarm	Critical	TX transmitting power	ODU	
RF-RX	Alarm	Critical	RX receiving power	ODU	
SSPA	Off	Critical	Transmitting power status	ODU	
ODU M&C	Alarm	Critical	No link between IDU and ODU	ODU/IDU	Cable not connected
PLL-TX	Alarm	Critical		ODU	
PLL-RX	Alarm	Critical		ODU	
PA-A	Alarm	Critical		ODU	
SSPA	Alarm	Critical	PA switched OFF	ODU	
TX-POW	Alarm	Critical			
Link ID	Alarm	Critical		ODU/IDU	
Eqijpment	Alarm	Critical		ODU/IDU	
Tributary #n loss	Alarm	Critical		IDU	
Tributary #n AIS	Alarm	Critical		IDU	
IDU Temperature	Alarm	Major	Below IDU temperature threshold	IDU	
BER	Alarm	Critical	Bit Error Rate		

ODU Temperature		Major	Below receiving power range		
RSL		Critical	Below ODU temperature threshold		

Appendix J: ODU Troubleshooting Guide

If the equipment is NOT functioning properly after installation, please check the following conditions:

I. Local end Equipment *not found* in Arbeit.

A. IDU - Is the red or green indicator light ON?

1. Check if the DC connector is loose.
2. If NOT, use a voltmeter to check if the DC output is -48V.
3. If there is no problem as define above, please contact us.

B. ODU interface connection.

The ODU has two N-type connectors: Antenna IF Port and IF Port.

Check if all the connections are properly connected.

C. ODU power indicator.

When the ODU is properly connected to the IDU, the IDU's IF cable transmit three IF signal and DC -48V. If the light is not glowing, use a voltmeter to check if the coaxial cable connection is working normally.

Red light indicates NO CONNECTION to PDH.

Green light indicates CONNECTION to PDH.

II. Other equipments *not found* in Arbeit.

1. Check if the other equipments' Channel that need to be linked have the same setting.
2. Check if any critical alarm has occurred.
3. The frequency band may be occupied by other user. Try to change for free Channel.
4. Check if Arbeit's IDU ID conflict with the other equipments' similar setting.
5. Check if Arbeit's IDU Link ID is same as that of the other equipments that need linking.

III. Unable to simultaneously monitor multiple set of equipments from the same PC.

Check if the NMS1 & NMS2 transmission line's connection mode is correct.

IV. Cannot execute Loopback test.

1. Check if the IDU LED is OK. Green glow indicates normal.

2. Far-end equipment performing local, IF or RF loopback simultaneously.

Appendix K: Antenna

For Point to Point Operation Only

5.8GHz Directional Antenna

Dimensions-mm	200 x 200 x 30 mm^3
Gain-dBi	19 dBi
Half-Power Beam width	H-plane 14 E-plane 13
F/B Ratio	30 dB
VSWR	≤ 1.4
Maximum Input Power-W	50
Mounting hardware-mm	30~70 mm
Tiltable Range	Hor. 360 Ver. 0~15
Weight-Kg	0.4 kg