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: x15 + x + 1, 100003.

C4. **Ber-Clear**

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

Figure 5-37 Ber-Clear

C5. **Count-Add:**

Display all the current accumulated bit error on starting the BER transmission test.

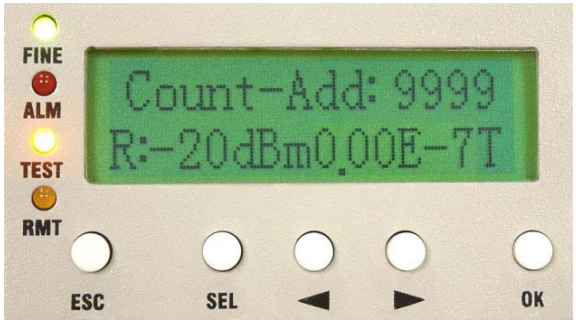


Figure 5-38 Count-Add:n

C6. **P-Acc-T: nS**

Display all accumulated BER time.

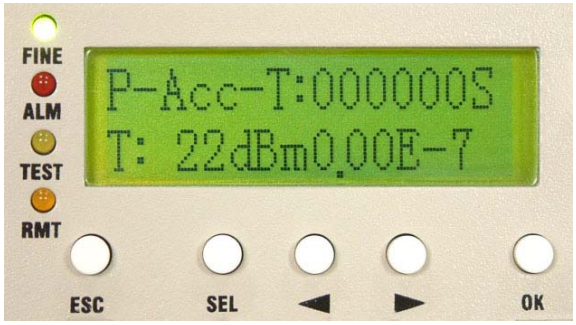


Figure 5-39 P-Acc-T:nS

C7. **IF-Loop: En/Dis**

Perform IF Loopback at the IF interface for the convenience of testing the IDU's stability. Press OK. Use the Right/Left button for selecting either En/Dis (En: Enable/Dis: Disable). Press OK button again to execute the function. This can be used along with E1 transmission tester.

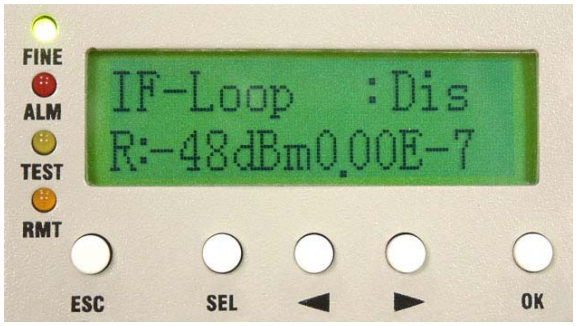


Figure 5-40 IF-Loop:En/Dis (1)

In **IF Loopback**, I appears at the right bottom of the LCD. TEST led gives an orange glow.

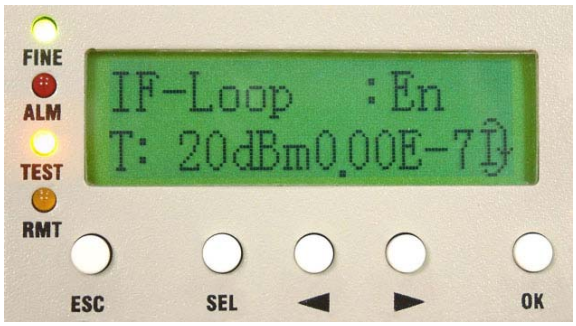


Figure 5-41 IF-Loop:En/Dis (2)

C8. **RF-Loop: En/Dis**

In RF Loopback, H appears at the right bottom of the LCD. The local's and remote's TEST led gives an orange glows.

When the local end is executing RF Loopback, the remote end's connection will be broken. ALM led gives a red warning alarm.

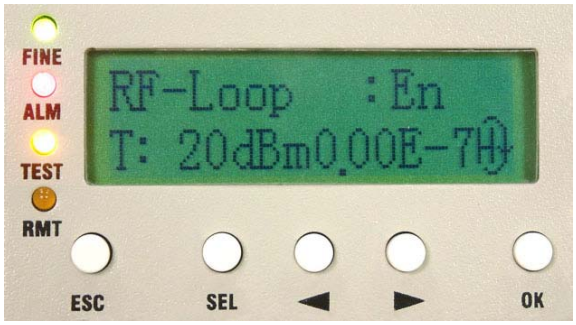


Figure 5-42 RF-Loop:En/Dis

C9. **Close-Test**

Press "OK" to close all tests.

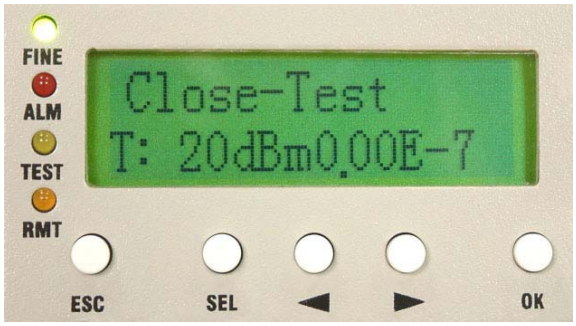


Figure 5-43 Close-Test

5.2.4 Remote Info

Figure 5-44 Remote Info

D1. **Remote ID: n**

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

Figure 5-45 Remote ID:n

D2. **Far-End: OK/Alarm/Loss/Test**

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

OK: active connection

Alarm: remote system alarm occurs

Loss: remote monitor loss

Test: remote system test activated

Figure 5-46 Far-End:OK/Alarm/Loss/Test

D3. **R-Status: Test/Normal**

Display the system current working status. It is possible to check the base station at the remote end as well as the status of any online test.

Test: remote end in test mode.

Normal: normal working condition.

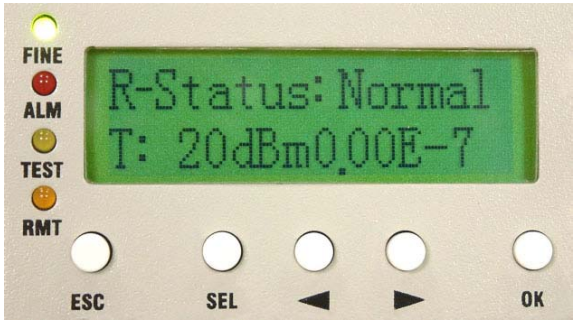


Figure 5-47 R-Status:Test/Normal

D4. **R-AUX2: ASY-CH/SYN-CH**

Display remote AUX2 working status.

Figure 5-48 R-AUX2:ASY-CH/SYN-CH

5.2.5 Config Info

Figure 5-49 Config Info

E1. **MODEM: ON/OFF**

Display the status of external modem at the local end. “ON” implies external modem is connected. “OFF” implies external modem is not connected.

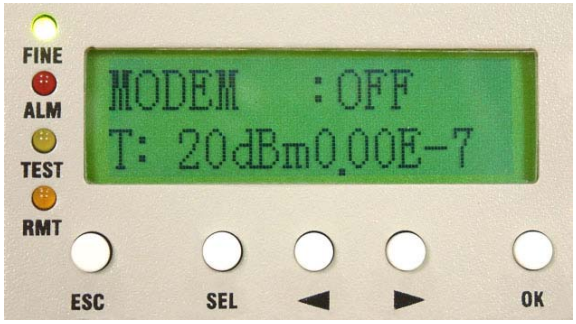


Figure 5-50 MODEM:ON/OFF

E2. **SYS-Conf：1+1/1+0**

Display the IDU system redundant status. 1+1 implies system with redundant. 1+0 implies system without redundant.

Figure 5-51 SYS-Conf:1+1/1+0

E3. **TX：Active/Standby**

Display the transmitter Tx status. Under 1+0 condition, Tx is Active. Under 1+1 condition, Tx is either Active or Standby.

Figure 5-52 Tx:Active/Standby

E4. **RX：Active/Standby**

Display the transmitter Rx status. Under 1+0 condition, Tx is Active. Under 1+1 condition, Tx is either Active or Standby.

Figure 5-53 Rx:Active/Standby

E5. **Power: -36 ~ -72V**

Display the power supply.

Figure 5-54 Power:-36 ~ -72V

E6. **Date: Year/Month/Day**

Display system current date.

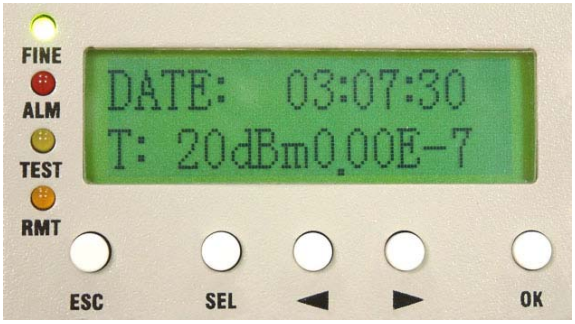


Figure 5-55 Date:Year/Month/Day

E7. **Time: Hour/Min/Sec**

Display system current time.

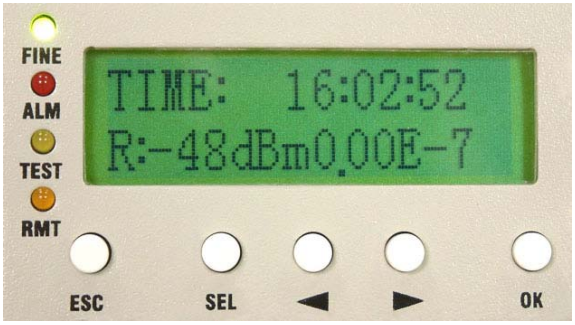


Figure 5-56 Time: Hour/Min/Sec

6 Environmental Condition

6.1 Cable

IF Cable: RG-6 ≤ 100m; RG-8 ≤ 200m

RF Cable: Insertion Loss ≤ 1dB

6.2 Operating Temperature Range

IDU: -5℃ ~ +55℃

ODU: -30℃ ~ +60℃

6.3 DC Input Voltage

DC Input Voltage: -36 ~ -72VDC

6.4 Power Consumption

Power Consumption: <45W

6.5 Humidity

Relative humidity as follows:

IDU: 10% ~ 95%, non-condensed.

ODU: 0% ~ 100%

ODU equipment is water-resistant.

7 Software Installation

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

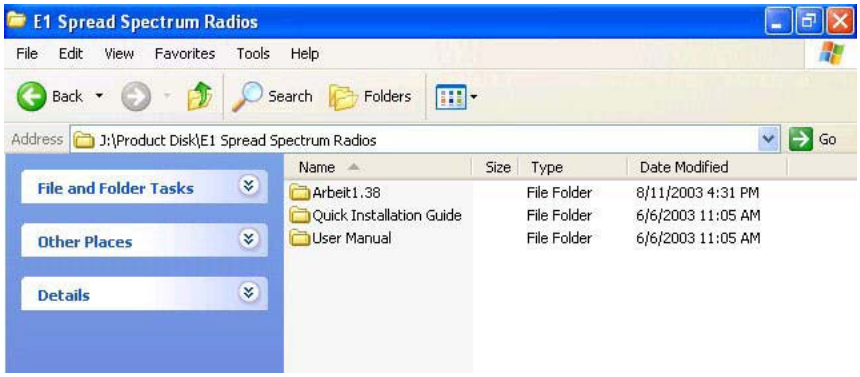


Figure 7-1 Software Installation (1)

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

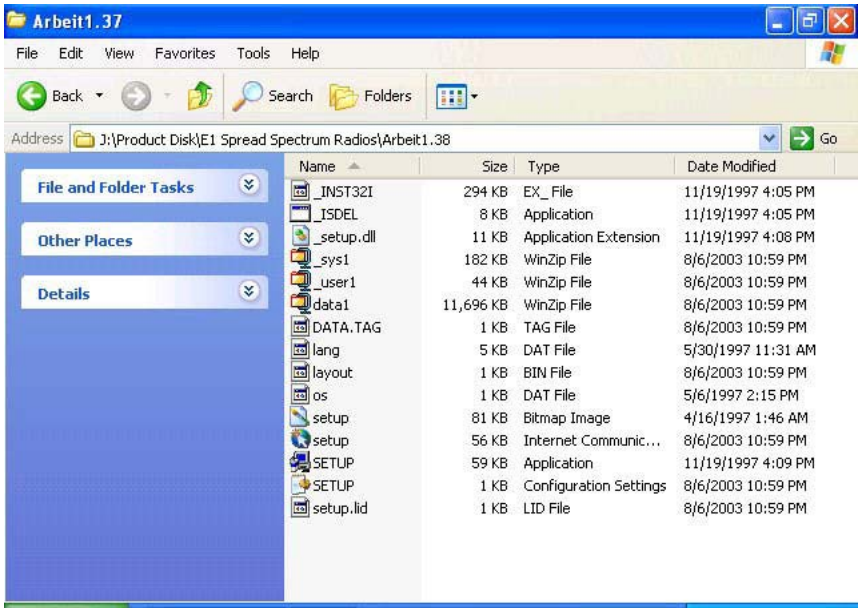


Figure 7-2 Software Installation (2)

c) Click **Next** to start installation.

Figure 7-3 Software Installation (3)

d) Install the software to any desired folder by clicking on **Browse**. Click **Next** to continue.

Figure 7-4 Software Installation (4)

f) Enter the name of the **Program Folders**. Click **Next** to continue.

Figure 7-5 Software Installation (5)

g) Click **Next** to begin copying files.

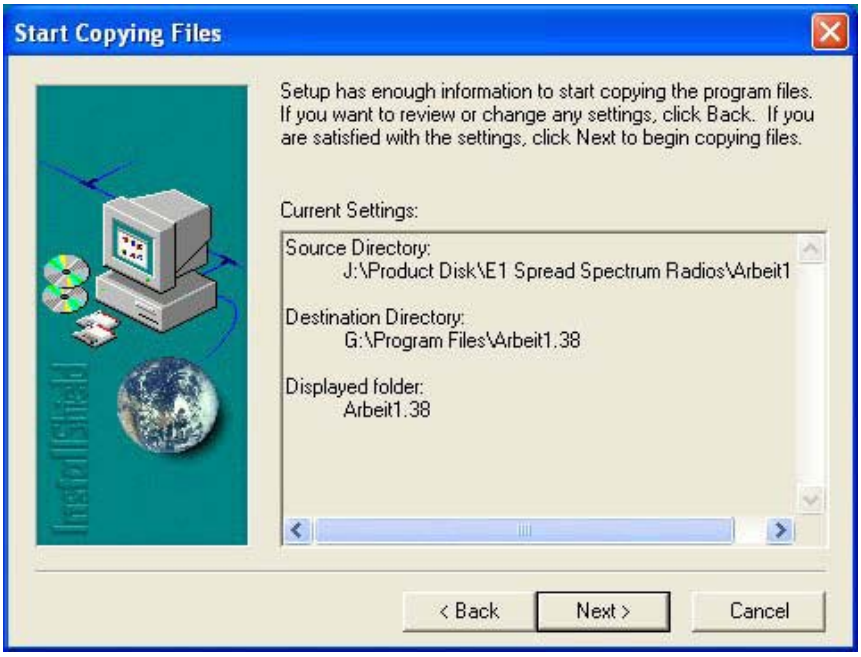


Figure 7-6 Software Installation (6)

8 Arbeit NMS Software

8.1 Open Arbeit NMS

There are two ways to open the program Arbeit:

1. Click on **Start → Program → Arbeit**
2. Open **File Manager → Program Files → Arbeit → Arbeit.exe**

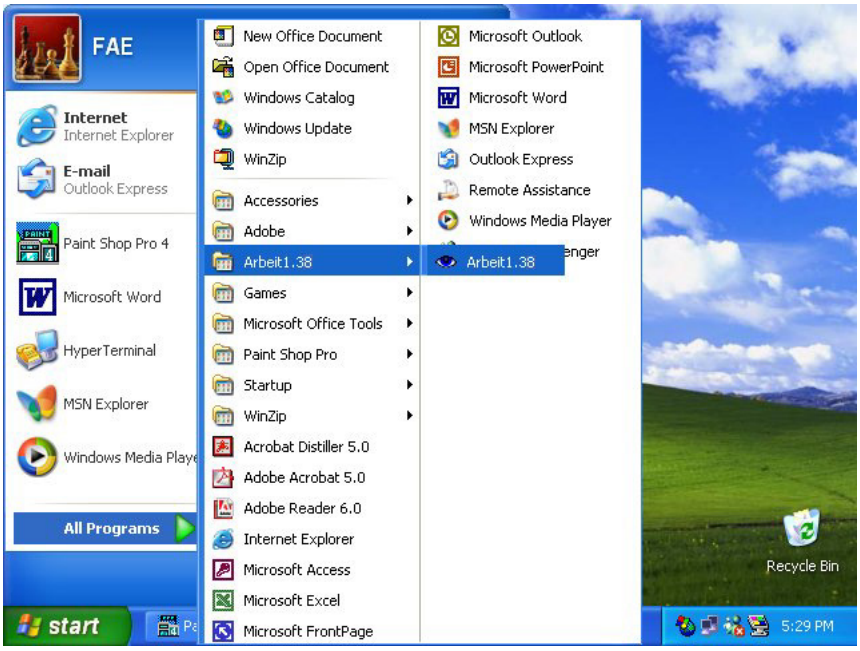


Figure 8-1 Open Arbeit

8.2 Login

After executing the program Arbeit, click the menu bar **Monitor** → select **Login.**

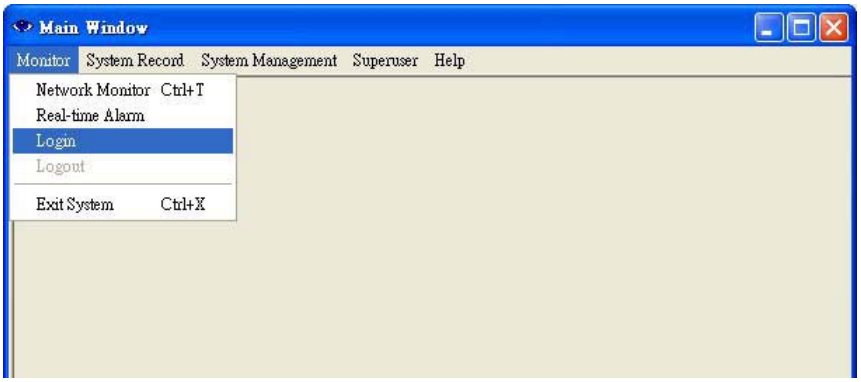


Figure 8-2 Login Arbeit

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

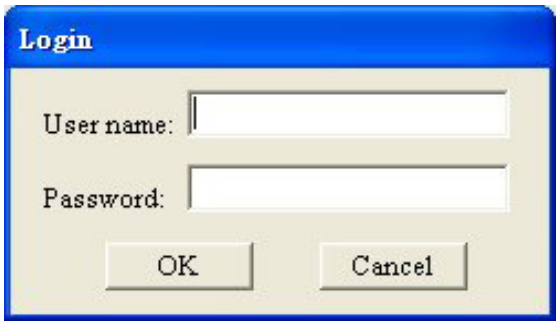


Figure 8-3: Arbeit's User name and Password

The system already has some preset user name and password, which are given below:

Table 8-1: System Preset Password

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

※ *Note*: Remember to Logout after execution or change of user name.

8.3 Initialize

Login the local equipment's initialization mode as **User Name: 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**. We shall explain the different mode in the coming section.

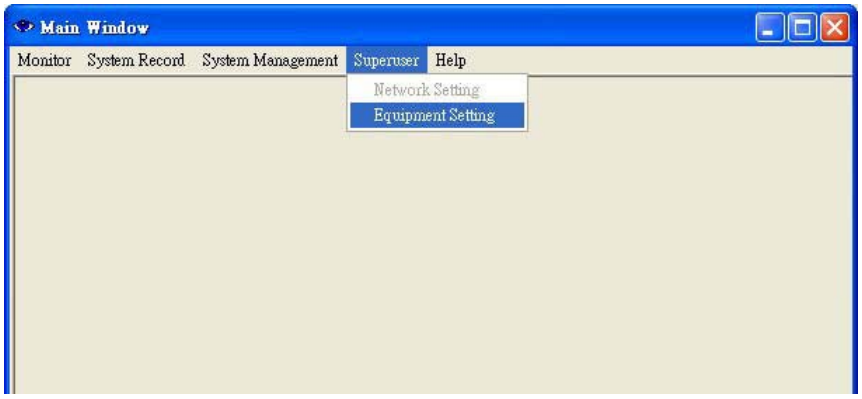


Figure 8-4: Initialize

8.3.1 IDU Setting

While setting the below functions, first modify the parameters in the setting window, then press **Send Setting** to save it in the **Status**. It is also saved in the IDU. 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.

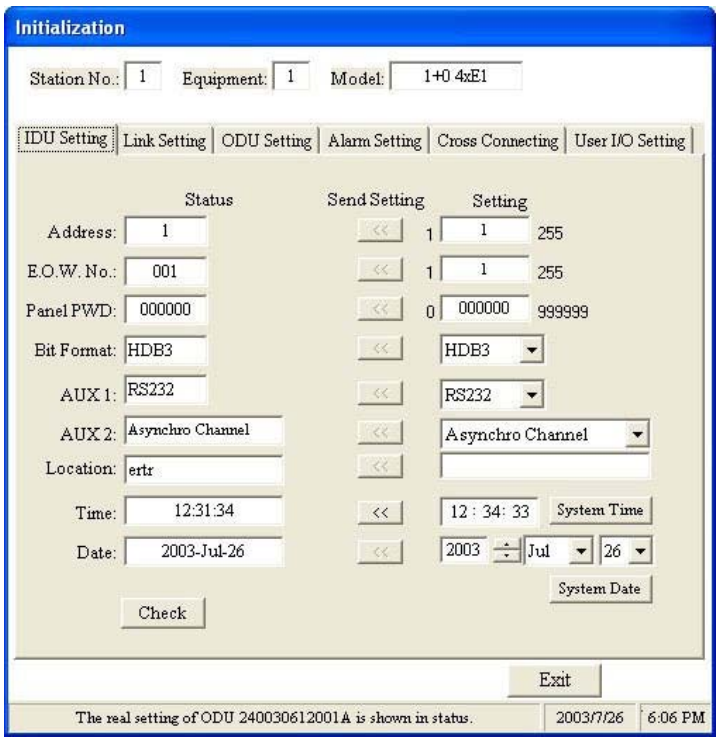


Figure 8-5: IDU Setting

Address: Each and every E1 modem in the network has its own unique **IDU Address** for differentiating and easy setting. While setting up the station, all initialization must be done here first. If initialization is not set accordingly, it will not work properly.

E.O.W No: Enter any number between 0~255 for service number setting. ※ *Note* that the EOW number should be different from the Link ID. On the right side of the IDU panel, there is a RJ-11 connector that is meant for analog telephone. It is used for all phone connection in the link with the base station.

Panel PWD: If necessary, enter the IDU password, which must only be 0~9 digits, ranging from 0~999999.

Bit Format: IDU transmission encoding format AMI or HDB3.

AUX1: Asynchronous data transmission protocol setting for either RS232 or RS422.

AUX2: Asynchronous or Synchronous channel setting.

Location: Equipment's location detail setting.

Time: Set system time. Press System Time for original system time.

Date: Set system date. Press System Date for original system date.

Check: Check all the IDU setting data.

Exit: Exit the initialization mode.

8.3.2 Link Setting

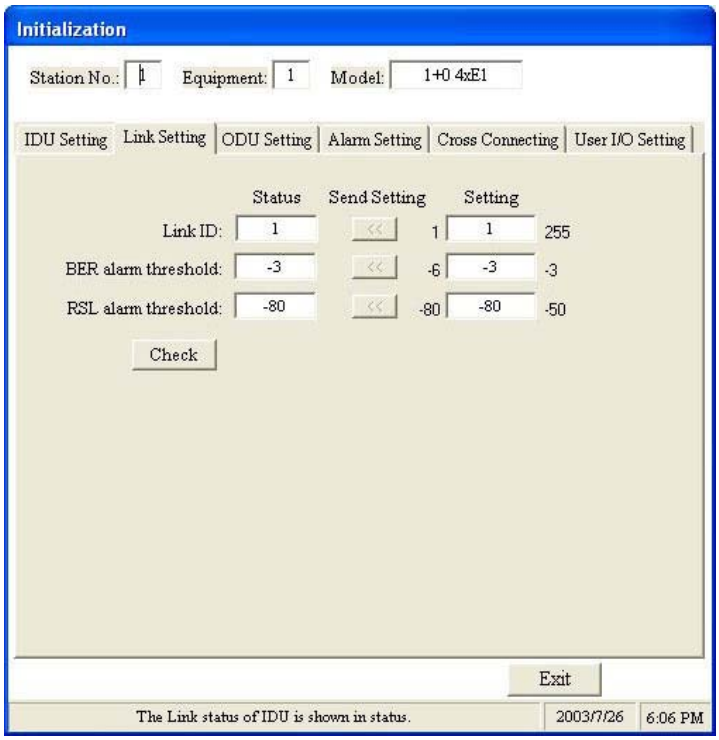


Figure 8-6 Link Setting

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

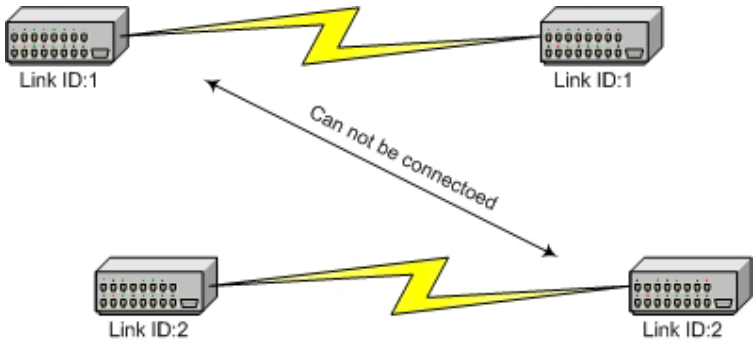


Figure 8-7 Link

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

Expected RSL: Automatic transmitting power control parameters, retain.

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

RSL Alarm Threshold: Receiving power alarm setting.

8.3.3 ODU Setting

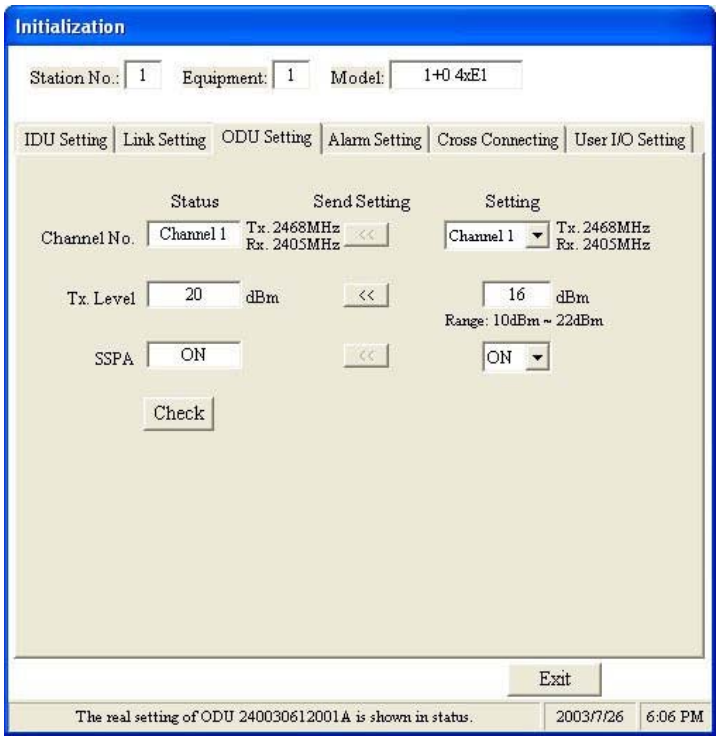


Figure 8-8: ODU Setting

Channel No: Set the ODU's frequency range. 4E1 has four frequency channels to use. Please refer to Appendix 4 for further details.

Tx. Level: IDU transmitting power setting (preset = 22dBm).

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

Check: Check all the IDU setting data.

8.3.4 Alarm Setting

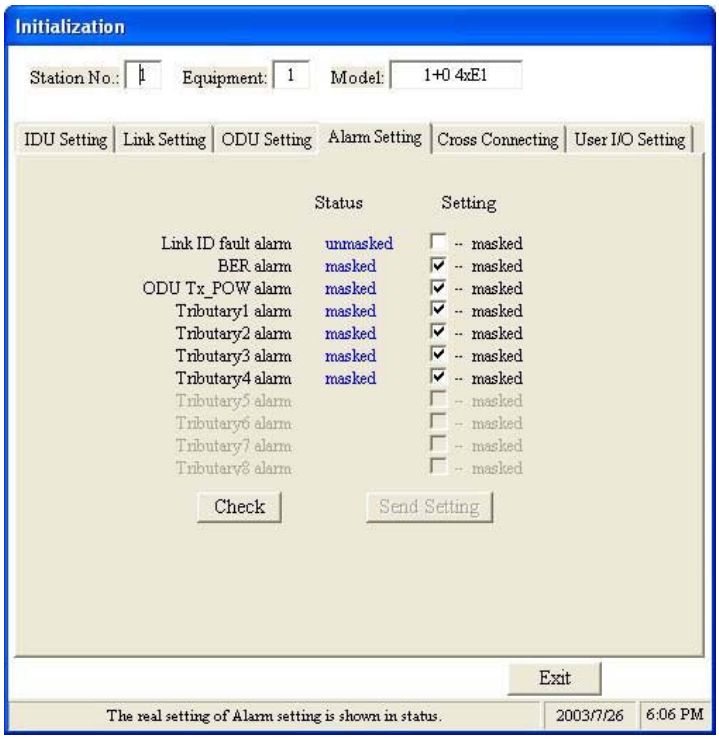


Figure 8-9: Alarm Setting

When 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 turns off all the alarm functions.

Link ID fault alarm: Local equipment receives the wrong **Link ID**.

BER alarm: BER alarm.

ODU Tx_POW alarm: ODU output power alarm.

Tributary n alarm (n=1~4): IDU cannot find the tributary signal.

Send Setting: Modified data are written into the IDU.

Check: Check all the IDU setting data.

8.3.5 Cross Connecting

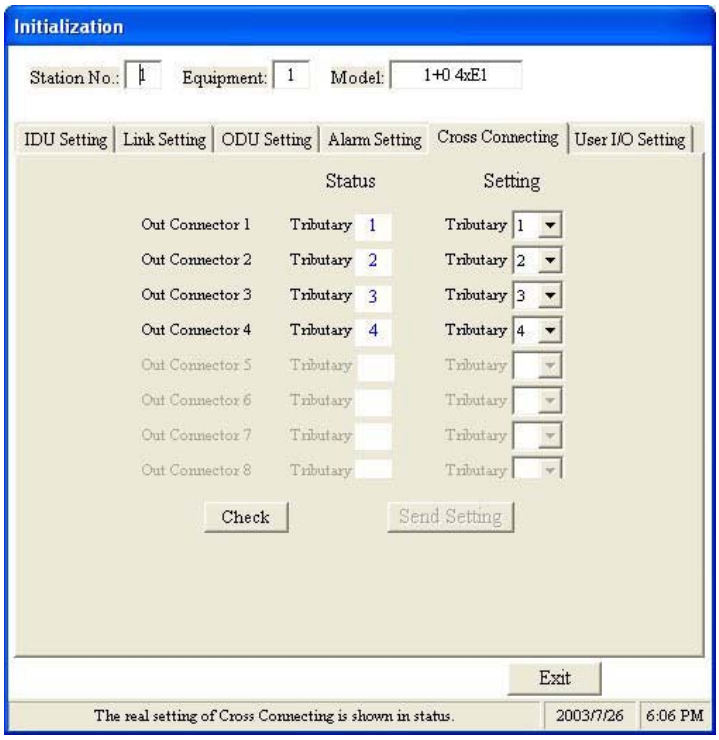
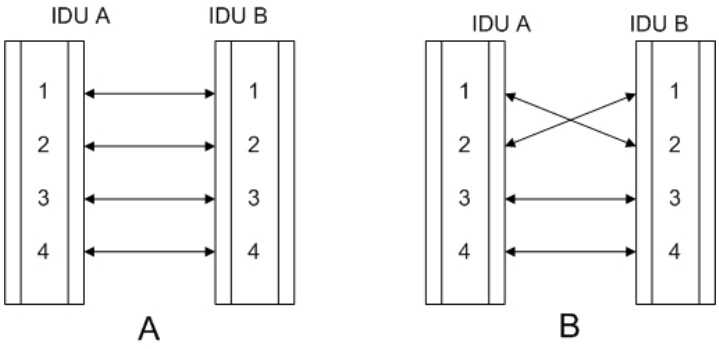


Figure 8-10: Cross Connecting (1)

With the need of adjusting the controlling room channel, the local and remote end E1 Interface have certain asymmetric variation. The system administrator need not have to manually switch the lines. The following diagram shows the 4E1 equipment cross connection between local end, IDU A, and remote end, IDU B.

Send Setting: Modified data are written into the IDU.

Check: Check all the IDU setting data.



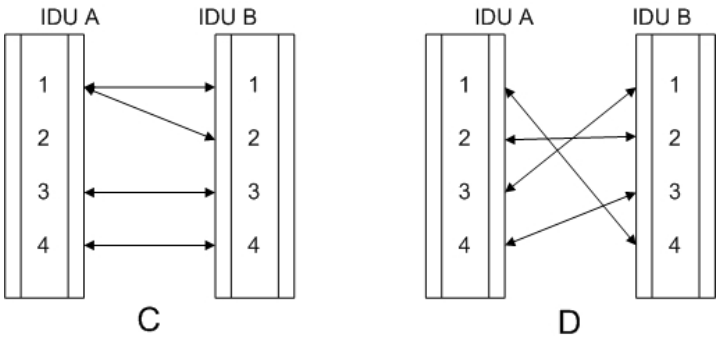


Figure 8-11: Cross Connecting (2)

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 port1 connected to remote port1 & port2. Local and remote port3 & port4 in normal connection mode

Fig. D Local and remote port in cross connection mode between ports 1&4, 2&2, 3&1 and 4&3

8.3.6 User I/O Setting

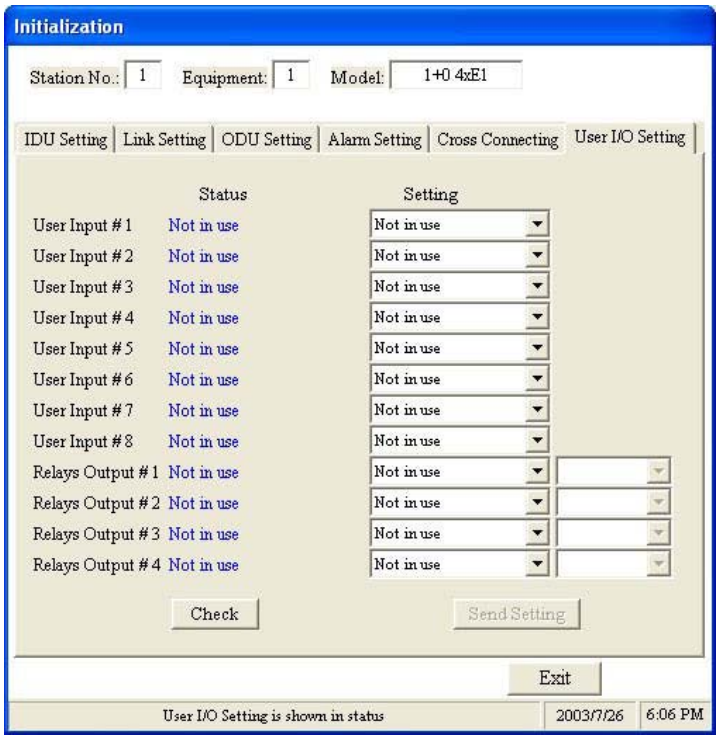


Figure 8-12: User I/O Setting

Besides the standard E1 interface, there are the environment detection and control port. This allows the 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 which makes intelligent management possible. This device has 8 input and 4 relay output ports. 4 relay outputs represent Critical Grade Alarm, Major Grade Alarm, Minor Grade Alarm, and over 1 condition of above-mentioned happened respectively.(See P.64)

Send Setting: Modified data are written into the IDU.

Check: Check all the IDU setting data.

8.4 Superuser

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

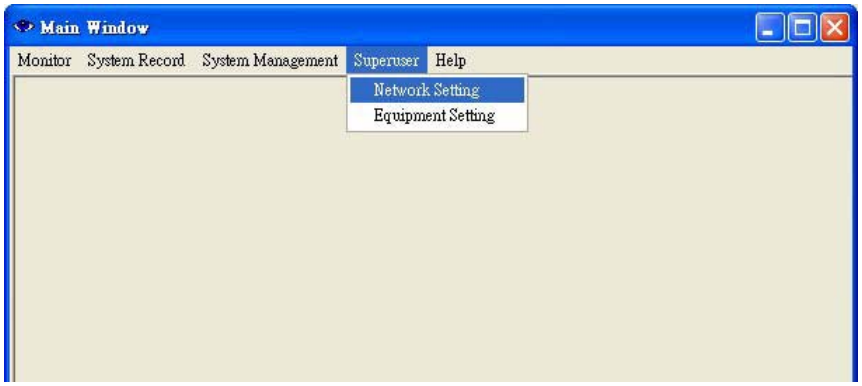


Figure 8-13: Superuser

Add. First select Add. to add new station.

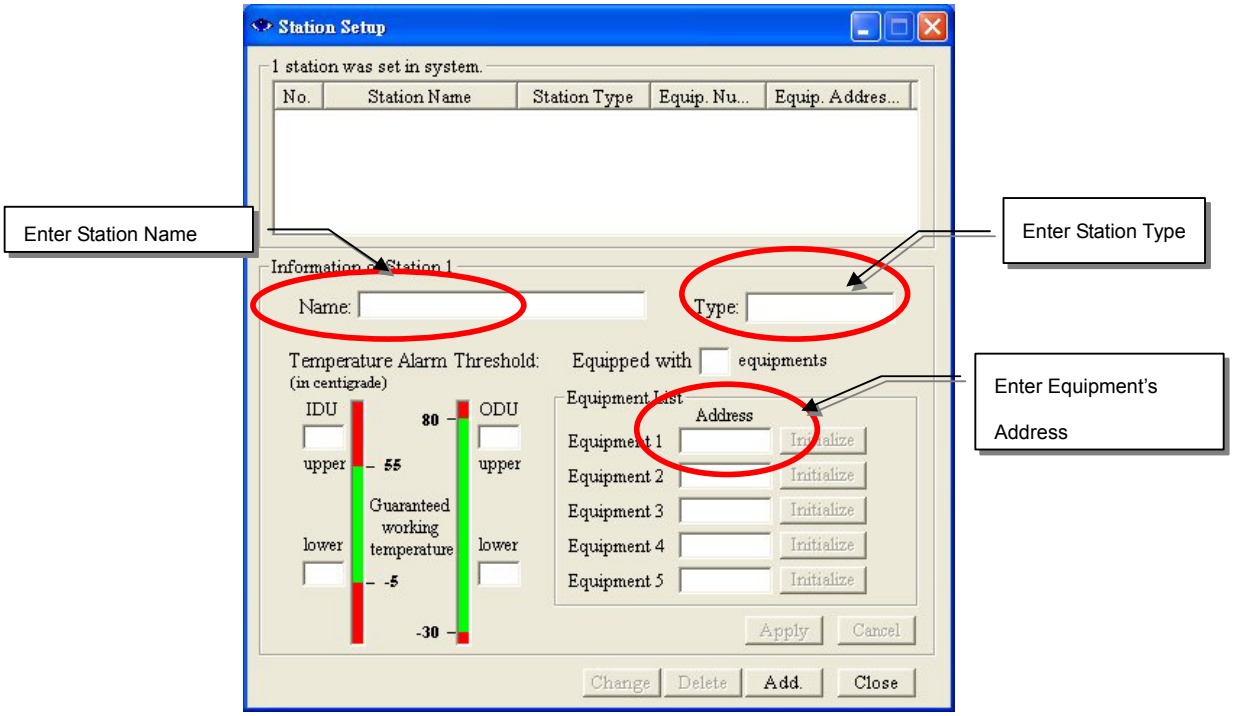


Figure 8-14: Station Setup (1)

Press **Apply** after entering all the data in the red circled blanks.

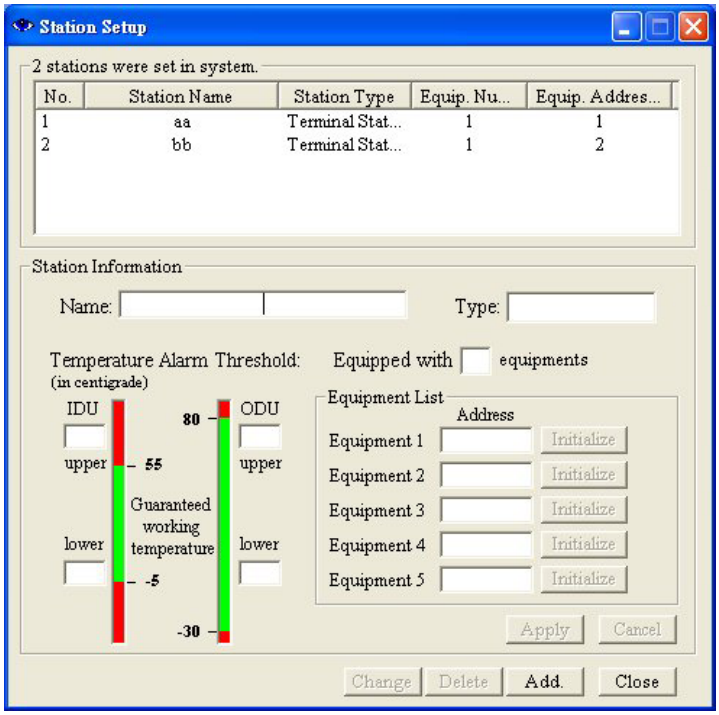


Figure 8-15: Station Setup (2)

Station Setup Example:

1. Enter “aa” in **Name** and “1” in **Address**. Select **Terminal Station** to complete the newly added station’s data.

※ *Note*: Station Name must not exceed 30 characters or numbers.

2. Press **Add.** to enter the second data. Enter “bb” in **Name** and “2” in **Address**.
   Select **Terminal Station** again. Every station has its own address after **Initialize** setting. First, select **Add.**, and 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 Menu, after adding two stations:

Figure 8-16: Station Setup (3)

The stations position in the above diagram is a random result. Point the mouse on the station, right click and move it without releasing by placing it to any desired position.

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

Green glow = normal connection; Red glow = connection, with alarm

Orange glow = test mode; Grey glow = no connection

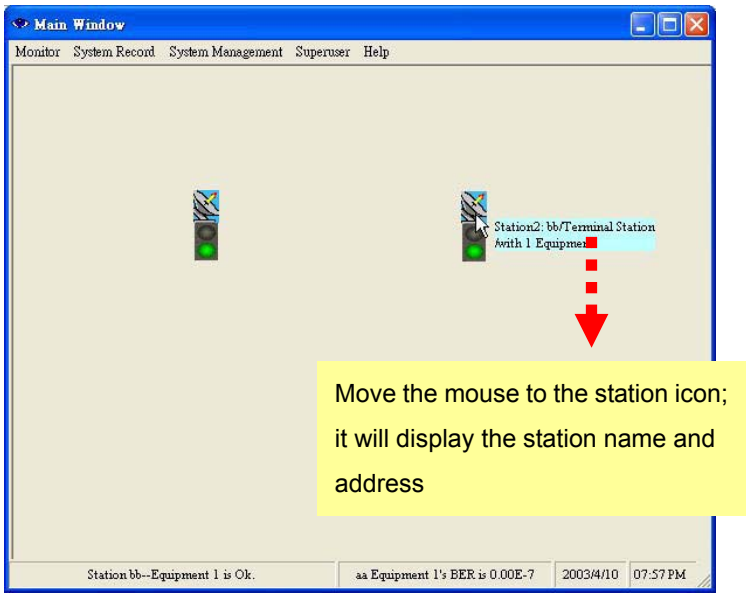


Figure 8-17: Station Setup (4)

Now let us introduce some other functions in the **Station Setup** window:

Temperature Alarm Threshold:

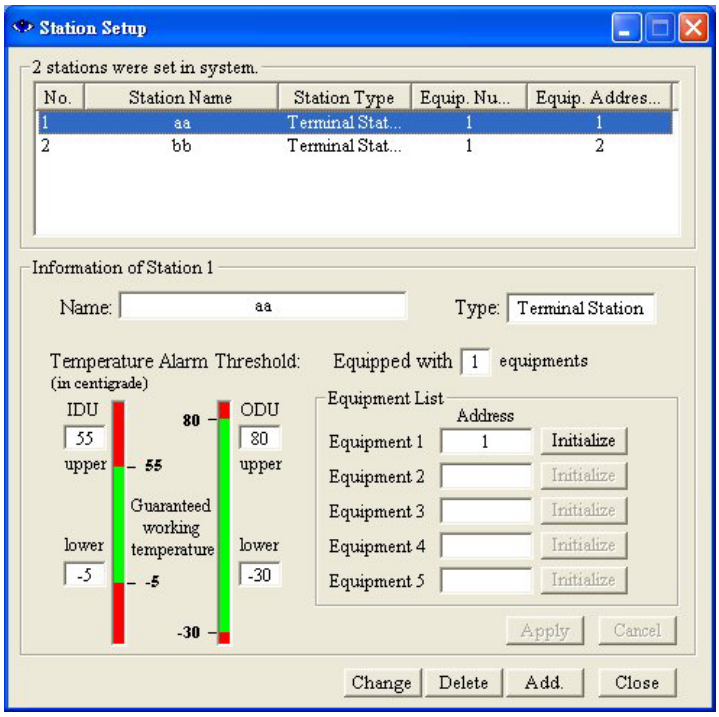


Figure 8-18: Temperature Alarm Threshold

Set the IDU & ODU alarm temperature range. Enter the desired parameters in the **upper** and **lower** IDU & ODU temperature alarm threshold blanks. 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 other settings are correct.

No.

Number of Equipment already set up.

Change

For modifying any stations data, select that particular station and press **Change** to modify its content. Press **Apply** after completing.

Add.

To add new stations.

Delete

To delete unwanted stations.

Terminal Station/Center Station

Base station acts as **Terminal Station**. The stations are in a PTP, point-to-point connection. Base station acts as **Center Station**. When there are more than two equipments in the base station, please select this type of mode. Then only we can use the IDU Net port function. Using Arbeit, it is possible to see all the equipment's link in the station by concatenating all the monitoring information of the station. Each base station can have NOT more than ten **Center Station**. Extended link can have a maximum of 255. This mode is also called the star topology, as illustrated in the following figure:

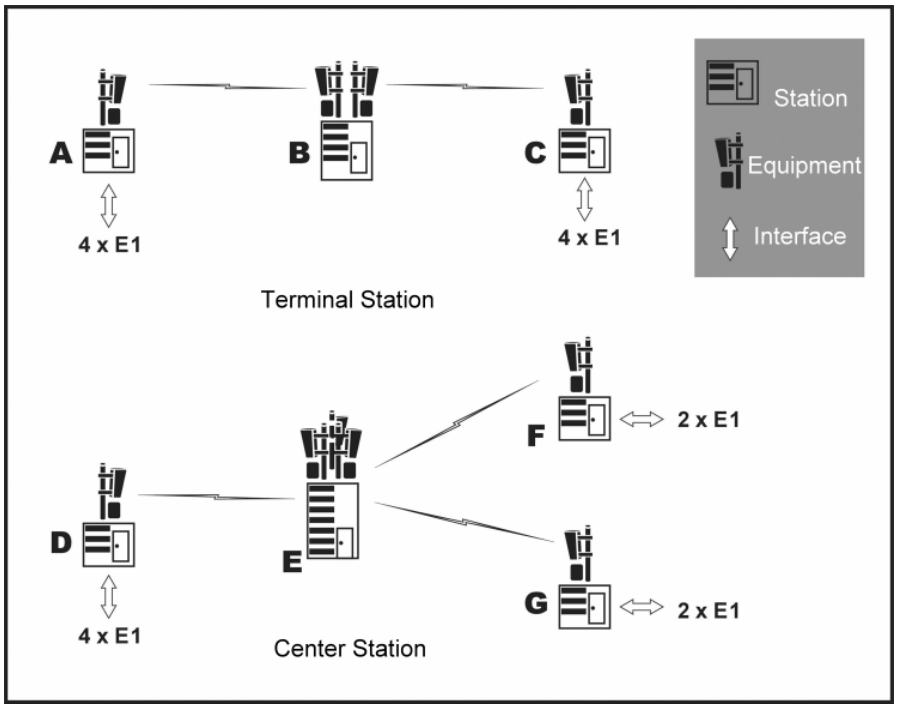


Figure 8-19: Terminal/Center Station

Initialize

This function can randomly change the link of the stations, only provided it is in connection mode. Please refer to the previous chapter on how to initialize.

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**. We shall explain the different mode in the coming section.

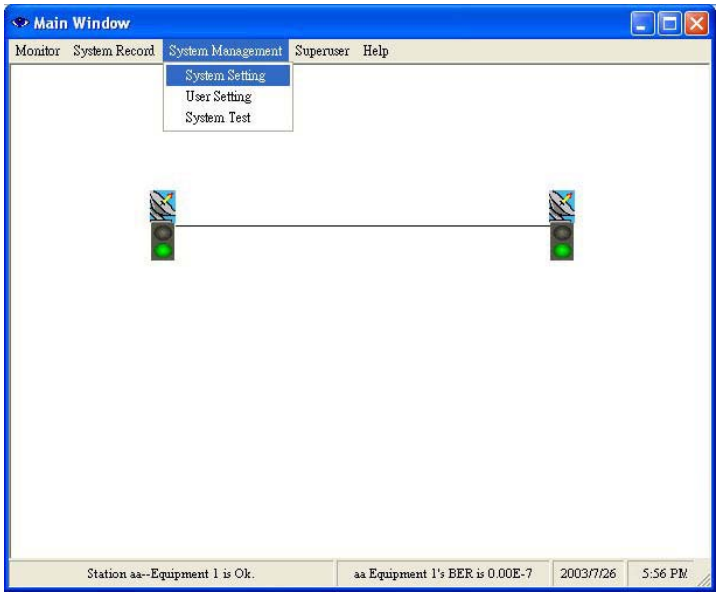


Figure 8-20: System Setting

8.5.1 Background Setting

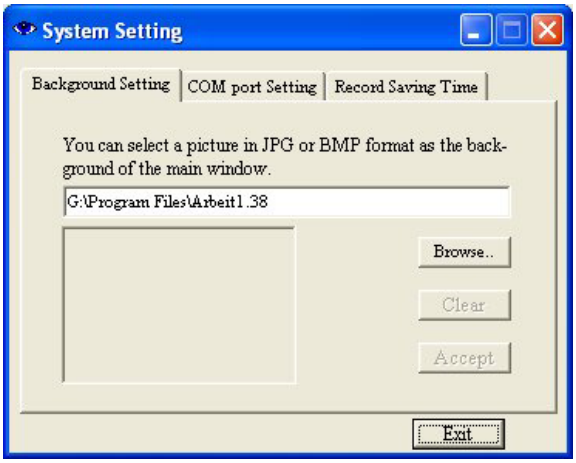


Figure 8-21: Background Setting (1)

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

easy modification. In the following diagram, for example, we open the 03.jpg file, it will show the following:

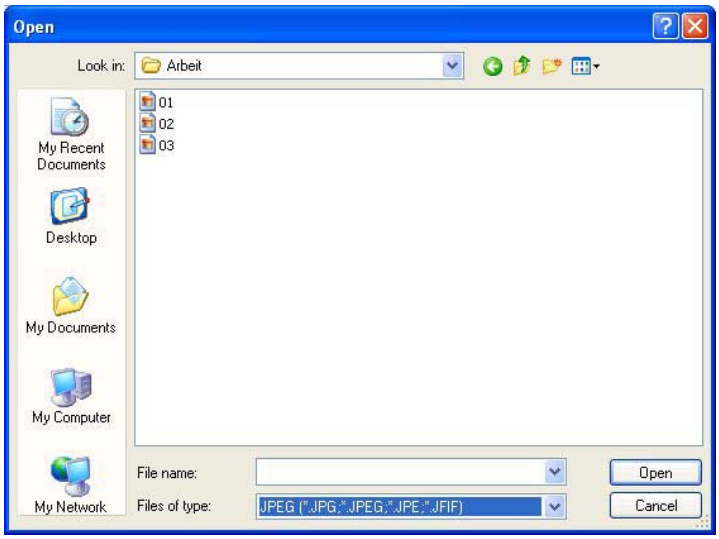


Figure 8-22: Background Setting (2)

After opening the 03.jpg file, we can see a preview of the picture file in the browse section. Press **Accept** to use the picture file as the background setting. Press **Clear** button to remove the background setting.

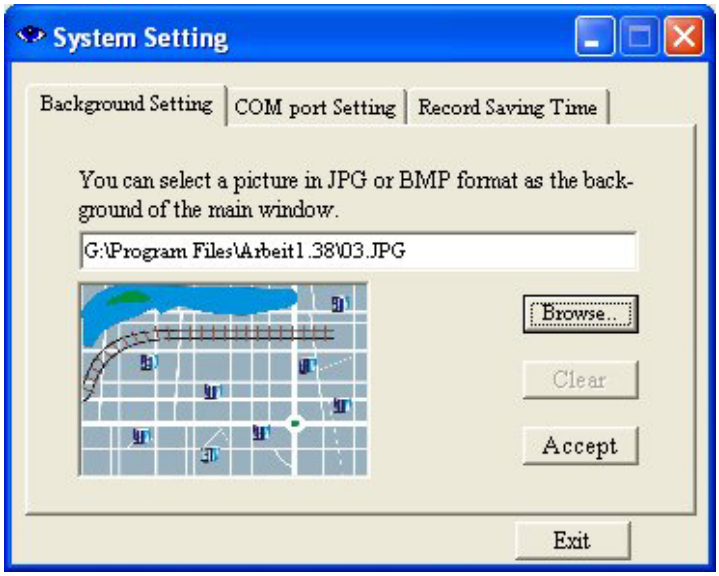


Figure 8-23: Background Setting (3)

Example: Selected background setting

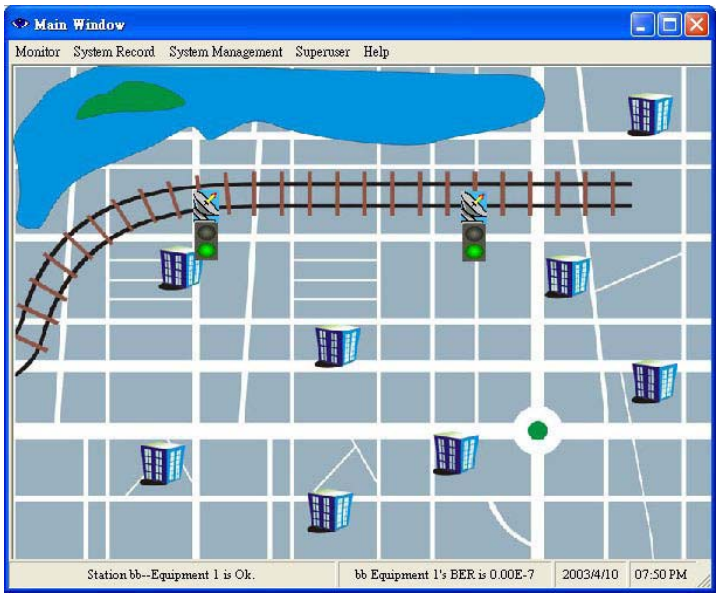


Figure 8-24: Background Setting Complete

8.5.2 COM port Setting

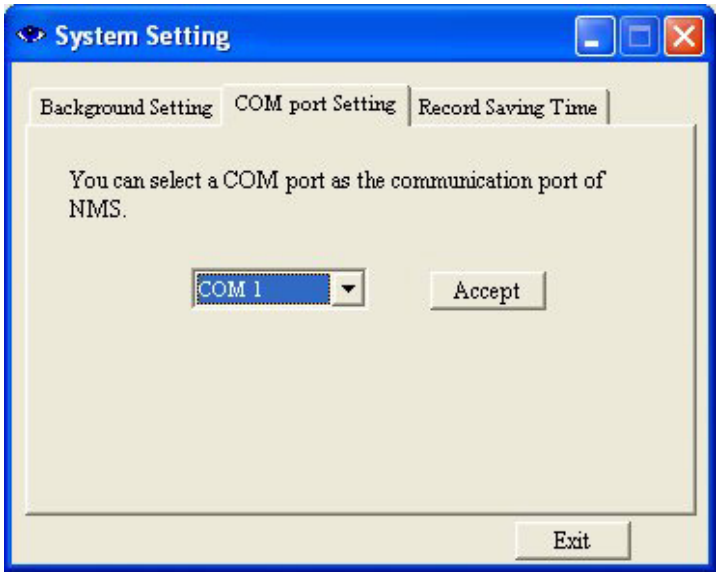


Figure 8-25: COM port Setting

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

8.5.3 Record Saving Time

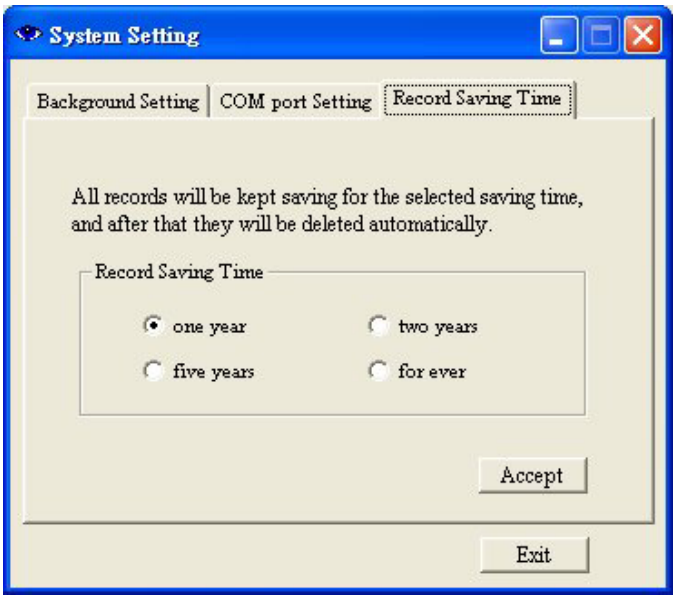


Figure 8-26: Record Saving Time

Select the saving time of all the records: one, two, five or forever years. Press **Accept** after selection.

8.6 User Setting

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

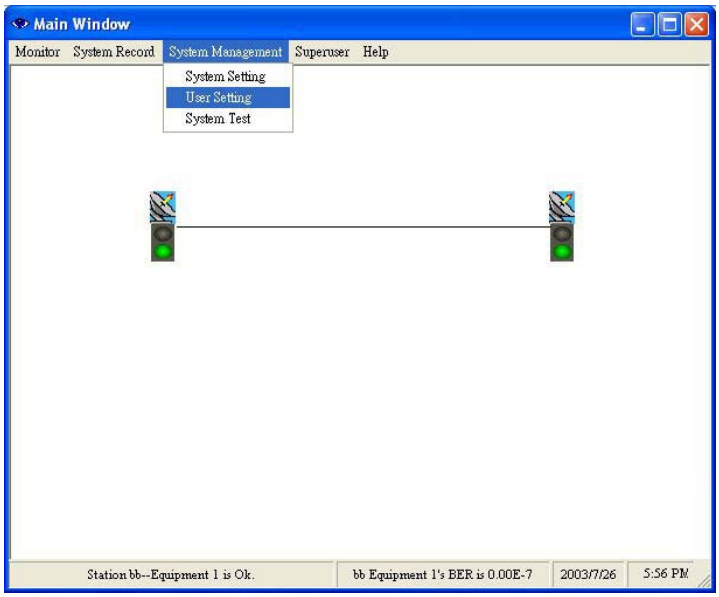


Figure 8-27: User Setting

※ *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 different functions allowed for each grade:

Table 8-2: Function Limits

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

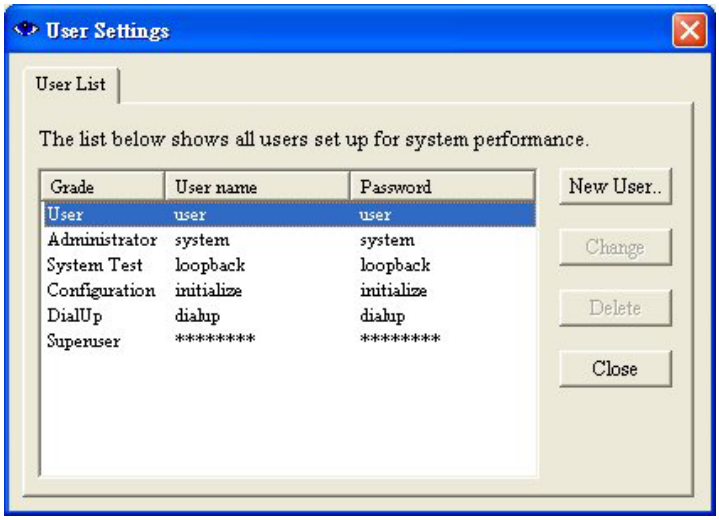


Figure 8-28: User List

Edit **User Name** or **Password**: Click on **User Name "user"**. Press **Change**.

The following dialog box appears.

You may now change the old user name to a new one. Press **Accept**.

If you need to change password, press **Next** to continue.

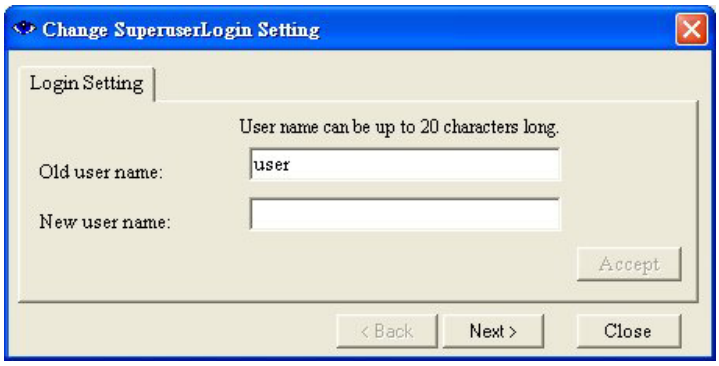


Figure 8-29: Change Superuser Login Setting (1)

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

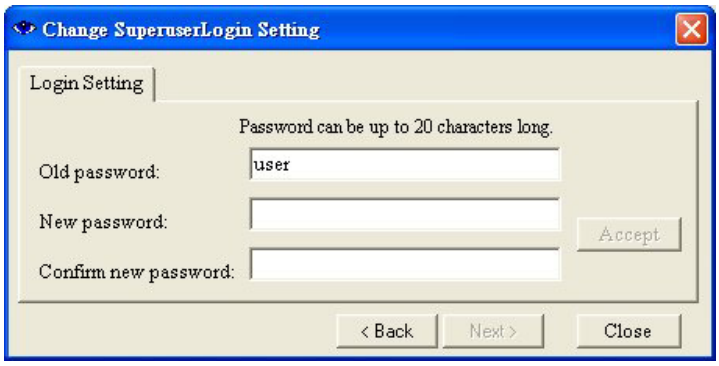


Figure 8-30: Change Superuser Login Setting (2)

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 status while performing any of the loopback functions. Be careful to check if there is any broken link.

Figure 8-31: System Test (1)

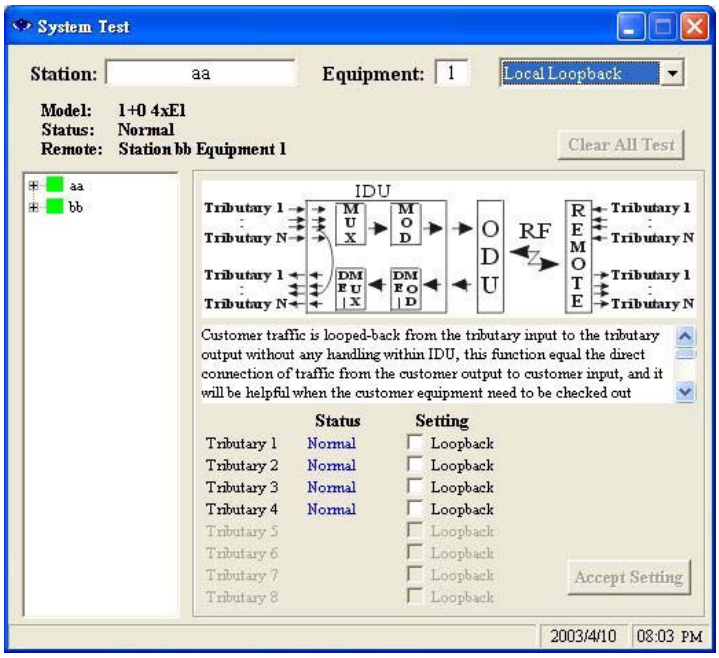


Figure 8-32: System Test (2)

8.7.1 Local Loopback

Under **Local Loopback**, it is easier to detect any malfunction at the E1 interface. E1 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 also done through the NMS or the LCD display button.

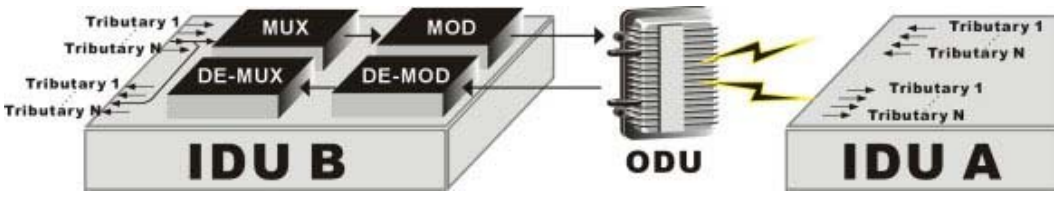


Figure 8-33: Local Loopback

In the **System Test** window, tick the **Setting** column for Tributary 1. Press **Accept Setting**. The IDU's first E1 interface is now performing the **Local Loopback** test. There can be multiple selections for the test. Press **Clear All Test** to stop all tests.

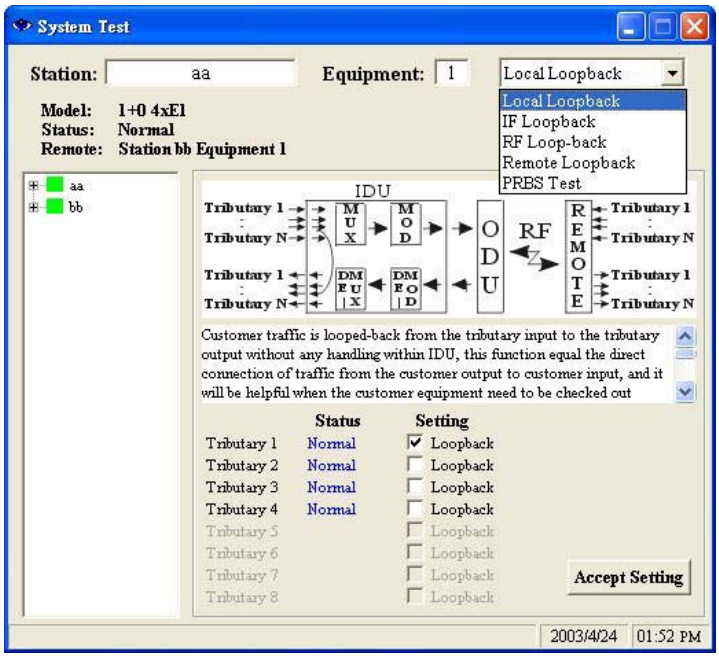


Figure 8-34: Local Loopback Setting

8.7.2 IF Loopback

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

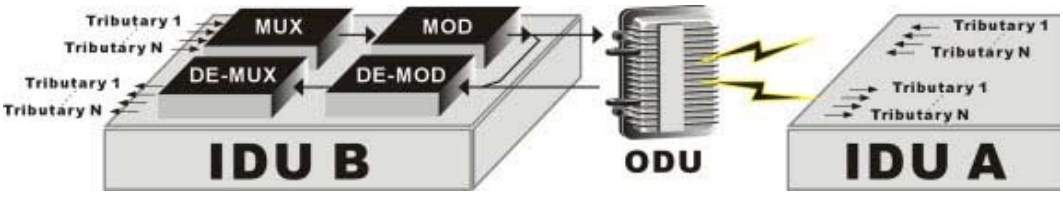


Figure 8-35: IF Loopback

This function is performed only through the IDU's LCD panel.

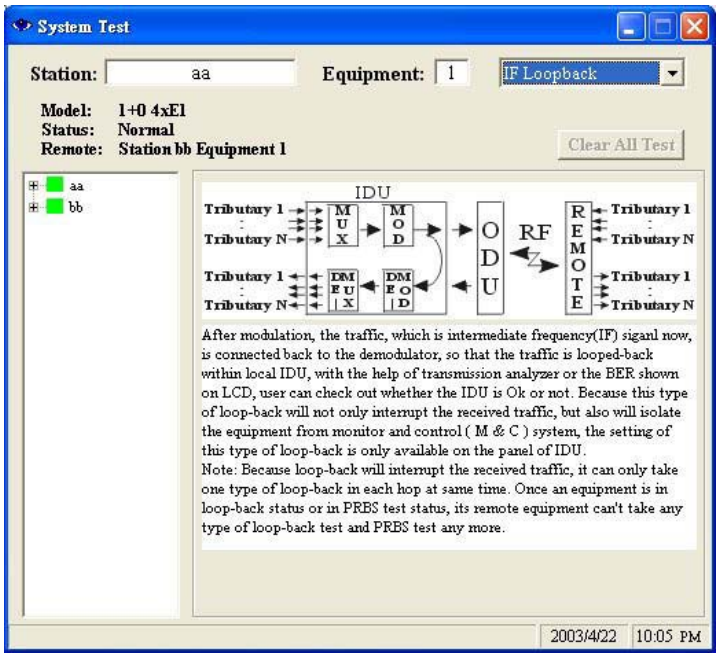


Figure 8-36: IF Loopback Setting

8.7.3 RF Loopback

Under **RF Loopback**, 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.

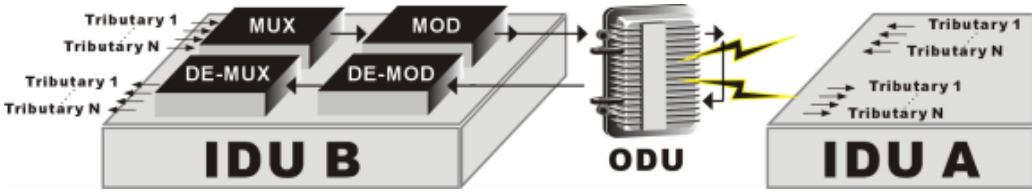


Figure 8-37: RF Loopback

This function is performed only through the IDU's LCD panel.

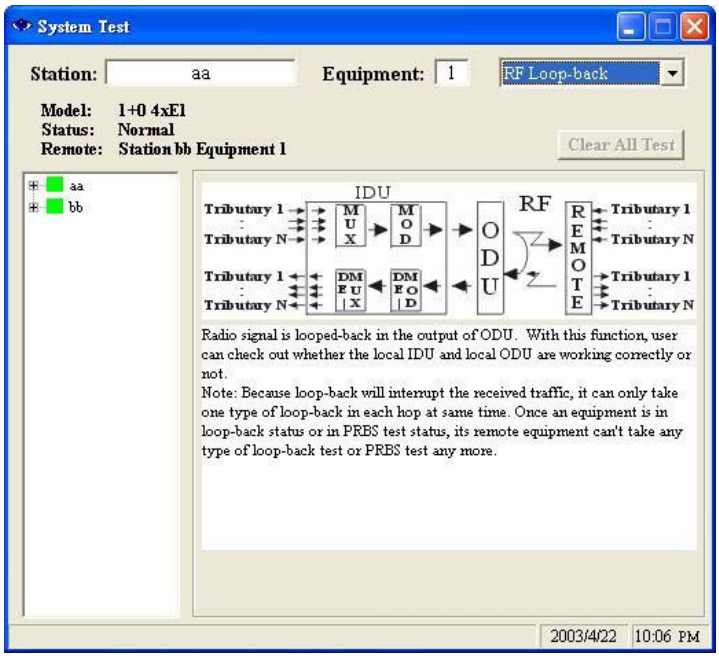


Figure 8-38: RF Loopback Setting

8.7.4 Remote Loopback

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

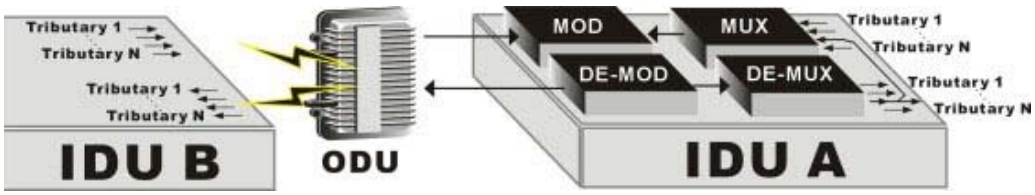


Figure 8-39: Remote Loopback

In the **System Test** window, tick the **Setting** column for Tributary 1. Press **Accept Setting**. The IDU's first E1 interface is now performing the **Remote Loopback** test. There can be multiple selections for the test. Press **Clear All Test** to stop all tests.

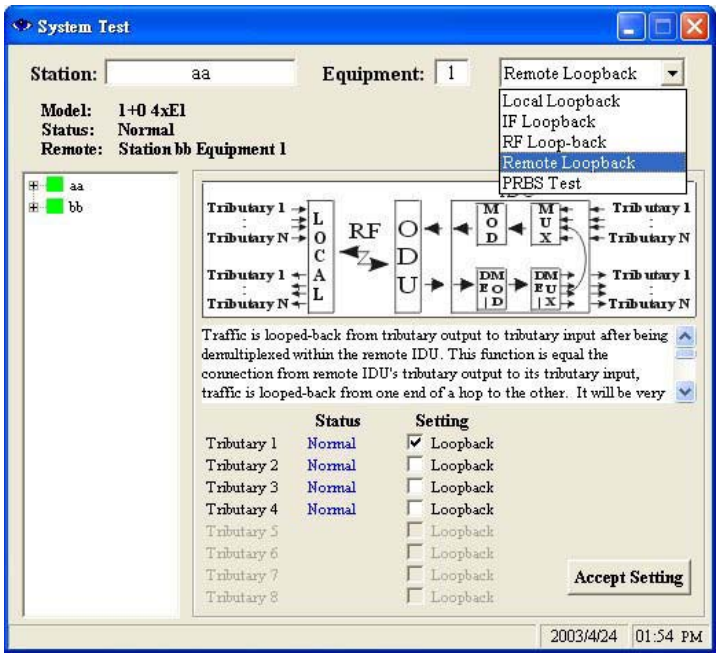


Figure 8-40: Remote Loopback Setting

8.7.5 PRBS Test

Under normal working condition, other than the normal BER test, the PRBS function can be used as well to test the individual link accumulated BER and stability of the system. While detecting, it is required to start the PRBS function. This function setting is done through the NMS or the LCD display button.

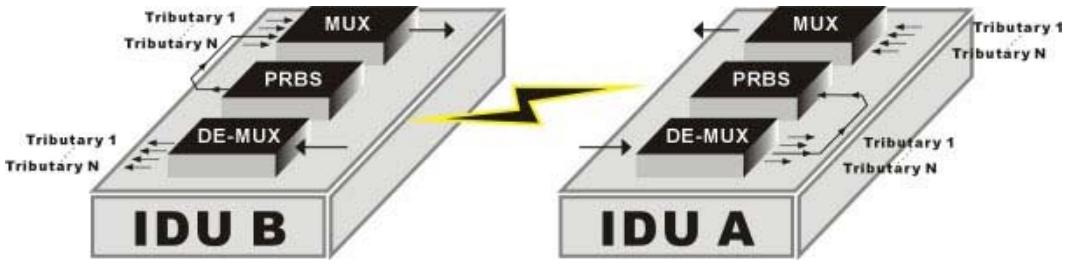


Figure 8-41: PRBS Test

In the **System Test** window, enter "1" for PRBS Generator. Press **Enable**. The IDU's first E1 interface is now performing the PRBS test. Press **Clear All Test** to stop all tests or press **Disable** to stop this test.

Insert an error: Once the PRBS generator is enabled, it will insert PRBS into the selected tributary in order to test the quality of signal.

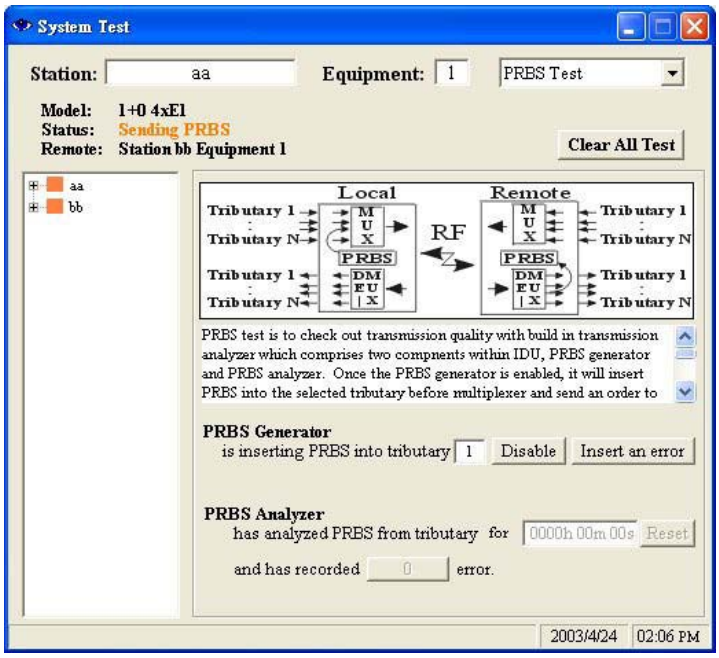


Figure 8-42: PRBS Test Setting

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** and **Report Export**. We shall explain the different mode in the coming section.

8.8.1 Alarm Record

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

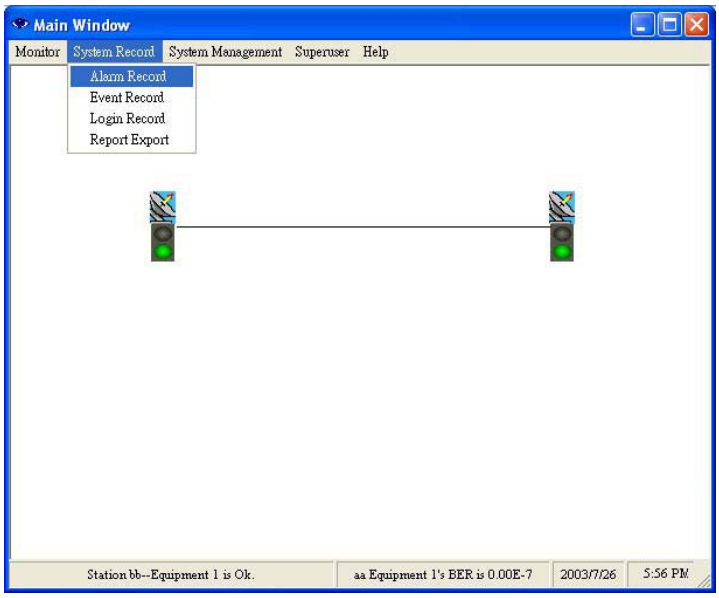


Figure 8-43: Alarm Record (1)

The following window appears: All the alarm record in the network will be recorded here. The levels of alarm are classified into 3 levels: Critical Grade, Major Grade, and Minor Grade. The following states the detail items in every level:

Critical Grade:ODU M/C,Cable,Mod,Demod,Link ID,Mux,PLL-Tx,PLL-Rx and SSPA.

Major Grade:T# LOS 及 T# AIS.

Minor Grade:DSC,Far end,PA-I,-5V and Tx-POW.

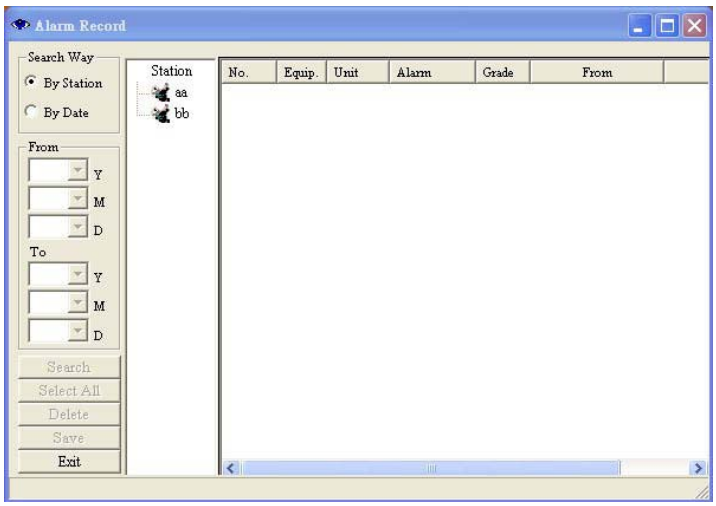


Figure 8-44: Alarm Record (2)