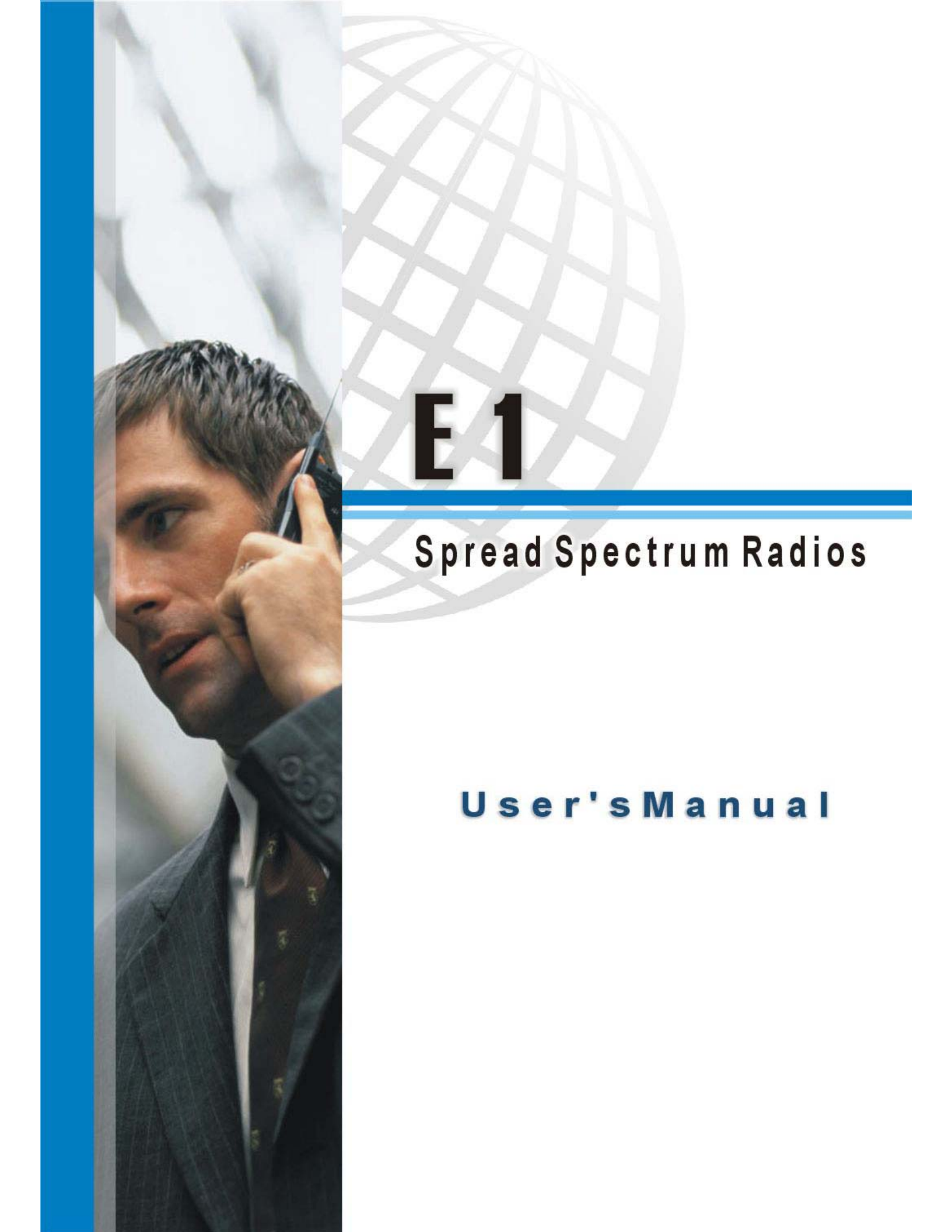




E 1

Spread Spectrum Radios

User's Manual

※Regulatory Notice※

- *To comply with the relevant FCC regulations, changes or modifications are not expressly allowed as it will arbitrarily uses or alters the radio frequency signals in violation, which may void the user's authority to operate this equipment.*
- *Low power radio frequency device must be professionally installed.*
- *For safety reasons, the working condition must not alters the RF signal. When installing this equipment, observe the following precautions to minimize the danger of personnel injury:*
 1. *Antenna used for this device must be fix-mounted on permanent outdoor structures to provide 5 meters or more separation from all persons during device operation to comply with FCC RF exposure requirements.*
 2. *Always disconnect all power connections before installing antenna.*

※Warning※

- *If low power RF devices interference endangers the functioning of a radio navigation service or of other safety maintenance services or seriously degrades, obstructs, or repeatedly interrupts a legitimate radio communication service, it is required to terminate the operation and take steps to improve so as to eliminate future interference.*
- *Low power RF devices MUST tolerate all legitimate ISM band interferences.*
- *The above legal telecommunications are based on the Telecommunications Act of Radio Telecommunication Equipment.*

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1 Introduction

E1 Spread Spectrum Radios 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 Wireless Digital Telecommunication.

E1 Spread Spectrum Radios has been extensively use in post and telecommunication service, electric power, military affairs, various specialized network especially in the interconnection between base stations of mobile communication, large enterprises, schools and universities network connection. It is regarded as one of the quickest linkage method and has been largely used in incidental and urgent telecommunication needs.

2 Features

2.1 E1 Spread Spectrum Radios

E1 Spread Spectrum Radios 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, digital process, concise structure, quick connection and adapt to complex topographical structure. Extensively use in nested mobile phone base station's interconnection and signal transmission, short distance local connection and 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 E1 Spread Spectrum Radios becomes especially meaningful.

2.2 Core Technology

The technologies incorporated in E1 Spread Spectrum Radios include:

- (1) High frequency microwave RF unit and other related RF components design technique (PA, LNA, MIX, DUX etc.)
 - (2) High frequency Synthesizer
 - (3) High amplifier gain control technique
 - (4) Advanced QPSK de/modulation
 - (5) Microwave frame multiplexer
 - (6) Digital equalizer
 - (7) FEC:Forward Error Correction
 - (8) Random N*E1 multiplexer, where N=1~16
 - (9) Digital cross-connection
 - (10) Computer monitors and relays
 - (11) Network management
 - (12) Digital service
 - (13) Highly efficient and improved overall design
- ※ Audio frequency: Each voice signal is 64kbps. It has 8kHz sample, 8bits-per-sample, A/D and D/A conversions.
- ※ E1 is European Standard. 1*E1 is 30 voice channels, plus a frame control and a signaling i.e. $32 \times 64 \text{ kbps} = 2.048 \text{ Mbps}$

2.3 Composition and Principle

2.3.1 System Composition

E1 Spread Spectrum Radios is composed of the Outdoor Unit (ODU) and the Indoor Unit (IDU). Other accessories include the antenna systems and terminals.

ODU is the Rx/Tx unit of microwave signal. It is composed of microwave components (amplifier, LNA, up/downconverter, frequency synthesizer etc.), duplexer, IF unit (include dual converter, local oscillator, IF processing segment etc.), monitor unit, remote unit, and power processing board.

IDU mainly comprised of QPSK modulator, multiplexer, monitor unit, NMS, digital service, power system, other interfaces etc.

Antenna systems include antenna, connectors and other installation accessories for fixing to the pole or stand.

ODU and IDU are connected by an IF cable.

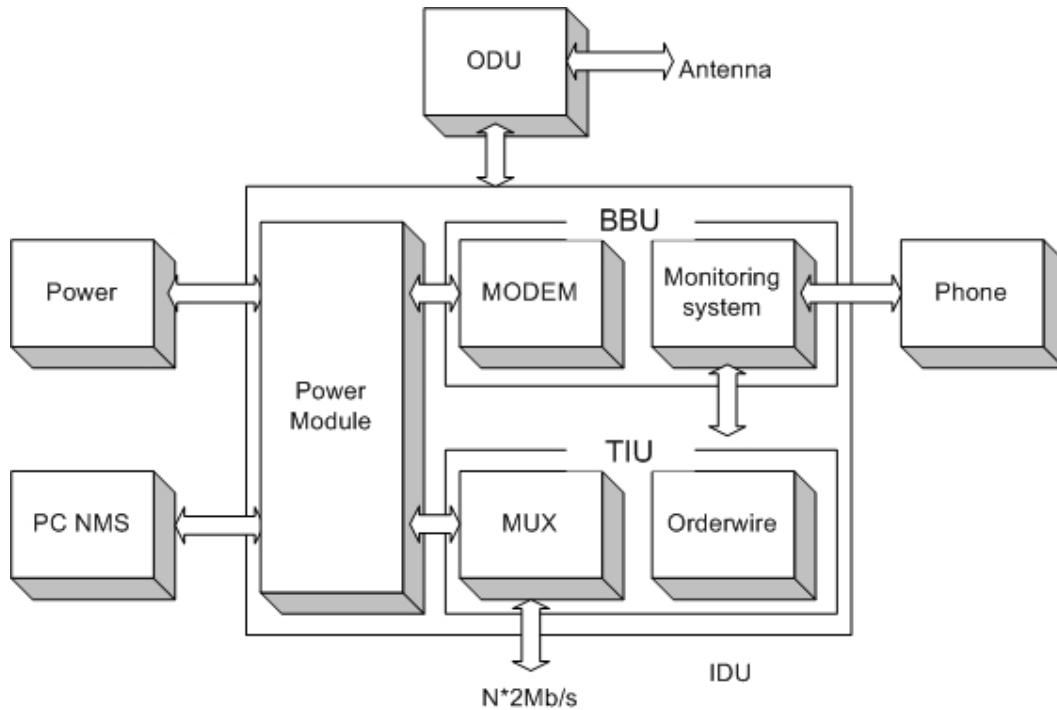


Figure 2-1 E1 IDU Block Diagram

2.3.2 System Principle

N number of E1 signals, digital service, 9600bps system net control and 9600bps data relays multiplexed in a multiplexer to a specific microwave frame code. After QPSK modulation, the system sends the transmission to the ODU through an IF cable. It enters the ODU IF upstream balance circuit, upconverter, power amplifier, filter,

duplexer and are then transmitted out through the antenna system.

The opposite terminal's antenna system receives the microwave signals and passed on to the multiplexer, LNA, downconverter, filter, dual conversion and the IDU. In the IDU, it passes through the QPSK demodulator to recover the microwave frame signal. This frame signal is then processed through demultiplexer to recover the N number of E1 signal and other service signal.

The monitor unit of the equipment is controlled by the CPU (central processing unit) to function as: monitoring, controlling, dispatching, alarming, processing and signaling etc. Based on the statistical result of BER test in the multiplexer, we have 10^{-3} BER, 10^{-6} BER and frame loss signals.

Digital service adopts the Analog rule of 64kbps and PCM (Pulse Code Modulation) for service relay, complete address selection and full address function. Simulating transfer completes the multiple categorized public affairs connection. The dialing mode adopts DTMF system.

System network management uses PC machine of Intel Pentium II and above operating system.

Under Microsoft Windows environment's using Telnet software, it is possible to relay between equipment, collect all the equipment's status in the network and select records for printing.

3 Technological Characteristics

Traditional digital microwave equipment generally transmits E1 signal only, so there is always the need to apply for frequency channel use 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

E1 Spread Spectrum Radios has the following technological characteristics:

- Complete capacity: 2*E1 、 4*E1s 、 8*E1 、 16*E1
- Simplified set up: The ODU's Signal Indicator indicates the correct angle adjustment of the antenna
- Flexible interface: suitable for multiple network and service links
- IDU and ODU unit connected by a single IF cable up to 200m length, thereby, decreasing the RF transmission loss and increasing the receiving signal-to-noise ratio (S/N)
- Channel conversion function reduce the cost of large and flexible network deployment
- Digitally advanced QPSK de/modulation
- Powerful monitoring function: simple and easy to operate LCD display. With the overall status display and loopback test function, users can easily maintain the system without the need of special equipment to ascertain any malfunction
- Improved network management system suit a lot of different network topological structure. It can manage up to 255 station equipments and also extend the monitoring support to other microwave equipments
- Quick and easy installation

4 Product Description

4.1 Indoor(IDU)/Modem

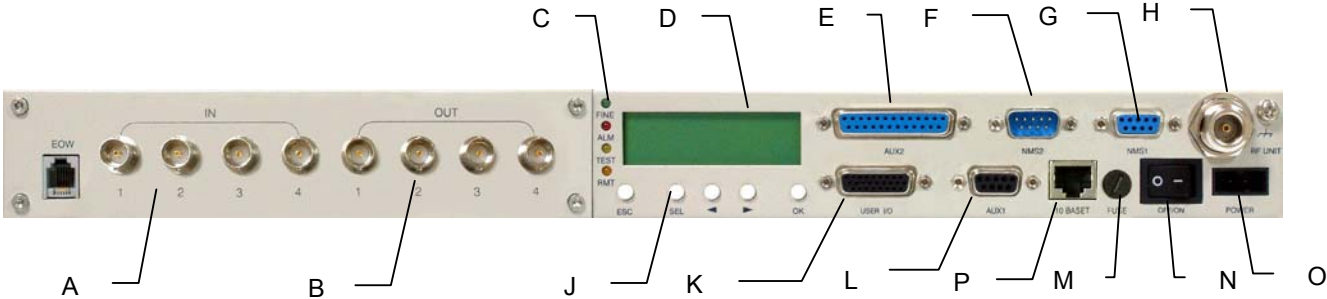


Figure 4-1 Front Panel (4E1,BNC)



Figure 4-2 Front Panel (4E1,RJ-48)

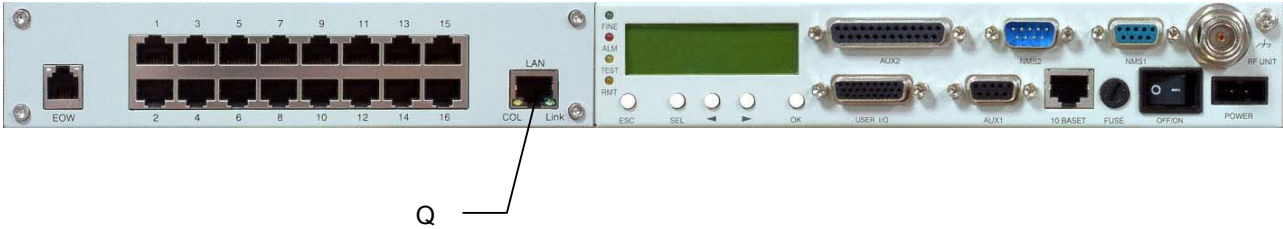


Figure 4-3 Front Panel (16E1+LAN,RJ-48)

Table 4-1 Accessories List

No.	Item	Qty
1	RS-232 Cable	1
2	Cross-over Cat.5 Cable	1
3	-48V Power Cord	1
4	Grounding Cable	1
5	Fuse	1

4.1.1 General Description

- A. **Service Phone Interface(EOW):** Service phone between the stations. Insert the RJ-11 of any general phones and dial the IDU EOW number. If there are more than one equipments in the same network, you may dial “***” for group connection. All the phones in the network will ring.
- B. **Symmetric E1 connector (RJ-48):** 2E1: 2*RJ-48 、 4E1: 4* RJ-48 、 8E1: 8* RJ-48 、 16E1: 16* DB-25 (asymmetric). In this manual, we have taken 4E1 equipment as an example for easy explanation.
- C. **LED:** FINE indicates normal working condition. ALM indicates critical alarming condition. RMT indicates remote unstable condition. TEST indicates system undergoing loopback test.

Table 4-2 Definition of LED

Item	Definition	
FINE(green)	Flashes @ 4Hz	System is initializing
	ON	System is initializing or system is working well
	OFF	Severe alarm happens (which affects normal communication)
ALM(red)	Flashes @ 4Hz	Minor alarm happens(which doesn't affect normal communication)
	ON	On when alarm happens(which affects normal communication)
	OFF	No alarm
TEST(yellow)	System is testing itself	
RMT(brown)	Flashes @ 4Hz	Can't connect with remote equipment
	ON	MUX alarm happens on remote equipment
	OFF	Remote equipment is working well

- D. **LCD Display:** LCD display is a standard LCD panel with 16 characters in a line, 2 lines in the panel. Display the normal working temperature; transmit/receive power, capacity, frequency, BER and system time.

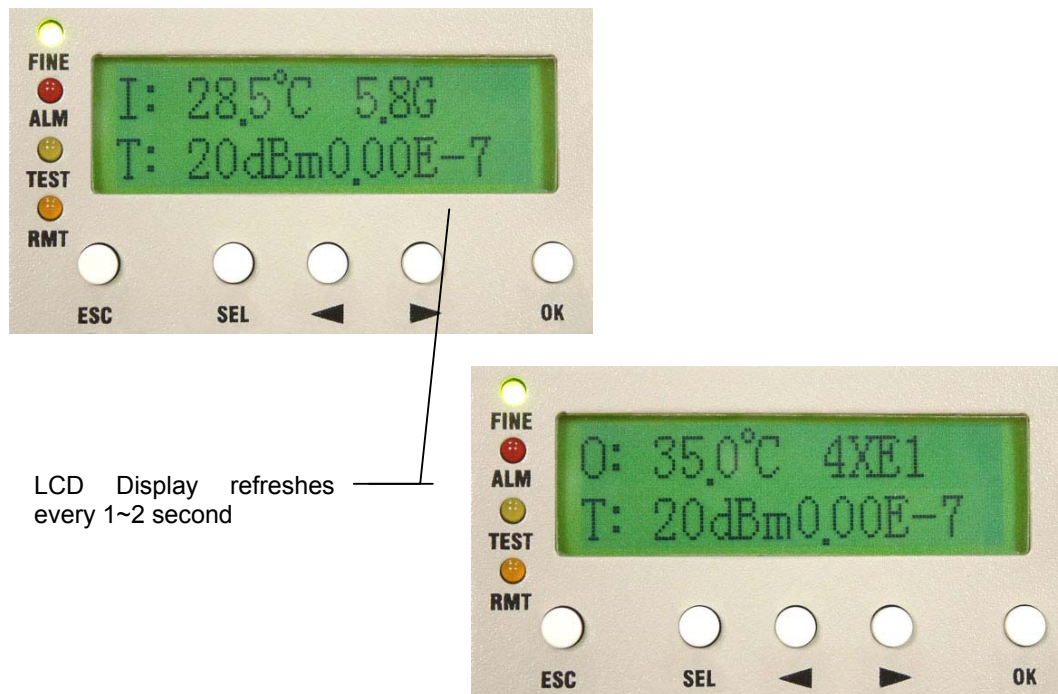


Figure 4-4 LCD Display

- E. **Data Port 2 (AUX2):** Synchronous/asynchronous data port. In asynchronous communication, you could implement asynchronous data transmission which data rate is smaller than or equal to 19.2Kbps via this port. In synchronous data transmission, this port would be a 64Kbps channel which customer could implement RS-422 data transmission via this port. This RS-422 is a contradirection channel which input/output clock both comes from IDU. When local equipment should communicate with remote site equipment for simple data file transmission or online text communication, this port could be used.
- F. **String Port (NMS2):** This port is for interconnection of NMS1 & NMS2 port between two equipments, or between computer & NMS2 port. It also could be used as a connection port for modem which allows customer to implement remote access. 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, only one of the service phones is working.
- G. **Monitor port (NMS1):** This port is for cascading connection between two equipments, or PPP network connection between computer & NMS1 port. Connect the COM1 or COM2 (RS-232) of the computer to this port or act as a connection between more stations.
- H. **IF Port (N-Type 50Ω):** Transmission includes transmitter 310MHz, receiver 70MHz, monitor 11.0592MHz, DC -48V/0.5A. Maximum transmission of 100m possible when using RG-6 cable. Maximum transmission 200m possible when using RG-8 cable.
- I. **Grounding**
- J. **LCD Function Keys:** Under normal working condition, LCD back light will glow if any button is pressed,

If there is any alarm, the LCD backlight will automatically glow for 2 minutes and display the alarming status. The buzzer goes off until it is turned off. To shut off the buzzer temporarily, press **SEL**.



Figure 4-5 LCD Function Key

Table 4-3 Function Key Modes

Item	Display Mode	Edit Mode
ESC	Escape from current screen.	Stop edit mode.
SEL	Turn off buzzer on alarm condition.	● Switch between Adjust and Position mode. ● Select digit number on Adjust mode. Mainly for enter of password.
► (Right)	Switch to next-level screen .	● Move to next position on Position Mode. ● Increase the value of current digit on Adjust Mode.
◄ (Left)	Switch to last-level screen .	● Move to last position on Position Mode. ● Decrease the values of current digit on Adjust Mode.
OK	● Choose a sub-function. ● Activate edit mode for a function .	● Set up or stop edit mode. ● Finishing the enter process of password.

K. **User I/O Port:** Allows users to fully monitor the central controlling room from the local station. For example: In the absence of human control in the remote stations, the central controlling server is able to receive all the data like fire alarms, power supply etc. It can also control the light switches, oil switches etc. This function totally realizes the possibility of intelligent management. Altogether, there are 8 input ports and 4 output ports.

- **User Input Pots:** IDU has been equipped with 8 inputs which are used for monitoring the environment. 4 of them have only 1 input and the rest 4 of them have 2 inputs. User could monitor conditions such as temperature alarm, invasion alarm, and fire alarm of base station via these ports. The isolation voltage of Input optocoupler is 2500Vr.m.s and forward current of input is $I_F=50\text{mA}$ and forward voltage is 1.2-1.4V. As for the input voltage which has 1 input is more than 2.5V, the level is high. When input voltage is less than 2 V, the level is low. As for the input voltage of A-K

which has 2 inputs is less than 1.2V, the level is high. When voltage is more than 1.5V, the level is low.

- **USER Output Ports:** IDU has 4 user output ports which is type C relay output. The trigger current of relays are 1A 30VDC, 0.3A 60VDC, and 0.5A 125VAC.

The type of output ports could be configured via textmenu or SNMP software. It has following 3 types:

- (1) **Forcible Output:** There are three options, Not in use, Always open, and Always close. It is used for remote access such as remote control over air conditioning of base station. When you choose “Not in use”, the relay stays in “NC”.

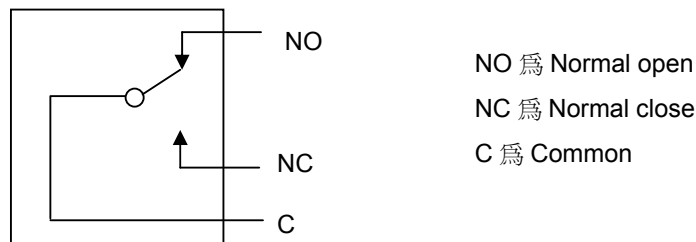


Figure 4-6 Type C Relay Output Diagram

- (2) **Alarm Relay Output:** You could choose following alarm types for output: Tx(when alarm happens concerning Tx), Rx(when alarm happens concerning Rx), and Tx 及 Rx(when alarm happens concerning both Tx & Rx). The chosen alarm level is low. These alarms are important alarms and would influence normal transmission. When alarm happens, the relay stays in “NO”.

RX alarm = PLL_RX + DEM + MUX
TX alarm=PLL_TX MOD

- (3) **User Input – Relay Output:** User could choose user input as relay output via textmenu or SNMP software. It could be used for automatic monitoring of base station. When user input detects voltage to be low, the relay stays in “NO”. When it detects to be high, the relay stays in “NC”.

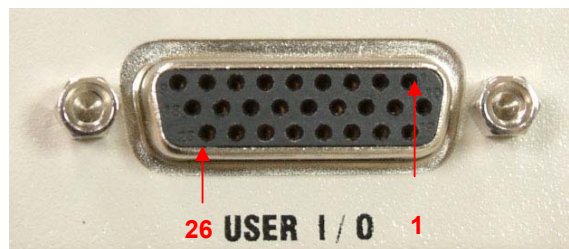


Figure 4-7 User I/O Port DB-26 pin

- Data Port 1 (AUX1):** Use the Windows OS's HyperTerminal function (9.6K). User could implement

asynchronous data transmission which the maximum data rate is 9.6Kbps. Connect the COM1 or COM2 (RS-232/DB-9) of two-end computers to this port for simple file and data transmission.

M. **Fuse: 250V/2A**

N. **Power switch**

O. **Input power port: -48V/1A DC**

P. **ETH LAN port:** This port can be connected to the existing network to manage the system. You should use a cross-over cable to connect with your computer.

Q. **Ethernet Transmission Port:** You could implement 10/100BaseT Ethernet transmission via this port.

✓ ETH LAN port and Ethernet Transmission port are independent and can't communicate with each other.

Table 4-4 The Definition of LED in Ethernet Transmission Port

Item	Mark	Definition	
1	COL(Orange)	On	Collision happens to Ethernet.
2	Link(Green)	On	Activate Ethernet port, and connect with proper equipment.
		Flashing	Active Ethernet port, but connect improperly.

4.2 Outdoor(ODU)/RF Unit

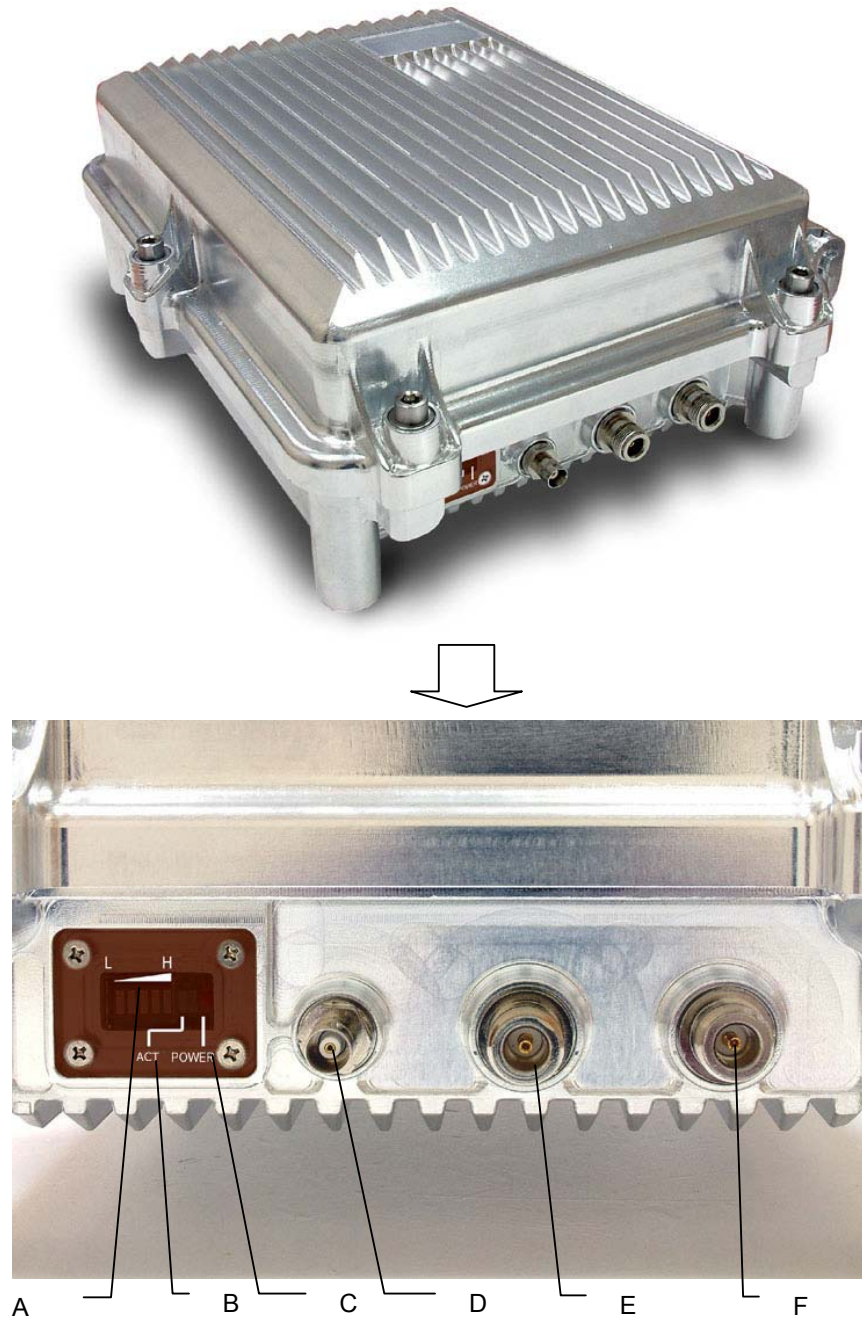


Figure 4-8 ODU Display

4.2.1 General Description

- A. **Antenna Alignment Indicator:** If there is no electric meter during set up, this indicator helps to define the antenna alignment. Higher the signal strength indicates better antenna alignment.

- B. **ACT Indicator (ACT):** This indicator lights up on receiving signal from the opposite device.
 - C. **Power Indicator:** ODU's power indicator light. When all the connecting cables are well connected, switch ON the IDU's power. The ODU will provide a power of -48V/0.5A through the IF cable of the IDU.
 - D. **Receive Signal Strength Indicator (RSSI):** For better antenna alignment between two terminals at a longer distance, please rotate and open the BNC 50Ω. Use an electric meter to measure the RSSI voltage. Weak voltage indicates weak signal received, strong signal indicates the most accurate angle position.
 - E. **Antenna Interface (TO ANT):** Use N-type coaxial cable to connect to the Antenna.
- ✓ At the ODU's E and F interface, please entwine waterproof tape at the connection point so as to prevent rainwater or moisture from the device. Natural damage is not warranted.
- F. **IF Port (N-Type 50Ω):** Transmission includes transmitter 310MHz, receiver 70MHz, monitor 11.0592MHz, DC -48V/0.5A. Maximum transmission of 100m possible when using RG-6 cable. Maximum transmission 200m possible when using RG-8 cable.

4.3 Date Port Guide

- The given example uses Microsoft Windows XP. For other OS, please assess accordingly.
- STEP 1: Click **Start** → **Programs** → **Accessories** → **Communications** → **HyperTerminal**. In the **Connection Description** window enter name in the **Name:** window and click **OK** to continue.



Figure 4-9 Data Port Settings (1)

- STEP 2: In the **Connect To** window click on the down arrow for the **Connect using:** drop down menu selections and select the **COM Port** where the modem is connected. In this example, the modem is connected to **COM1**. The other fields in the window will gray out and the **COM1** is now set. Click **OK** to

continue.



Figure 4-10 Data Port Settings (2)

- STEP 3: The **COM1 Properties** window will appear. Set the **Bits per second** to 9600; **Data Bits** to 8; **Parity** to **None**; **Stop Bits** to 1; **Flow Control** to **None**; and click **OK** to continue.

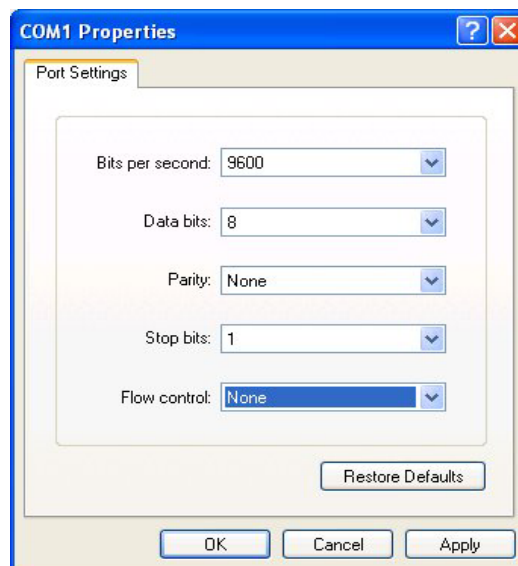


Figure 4-11 Data Port Settings (3)

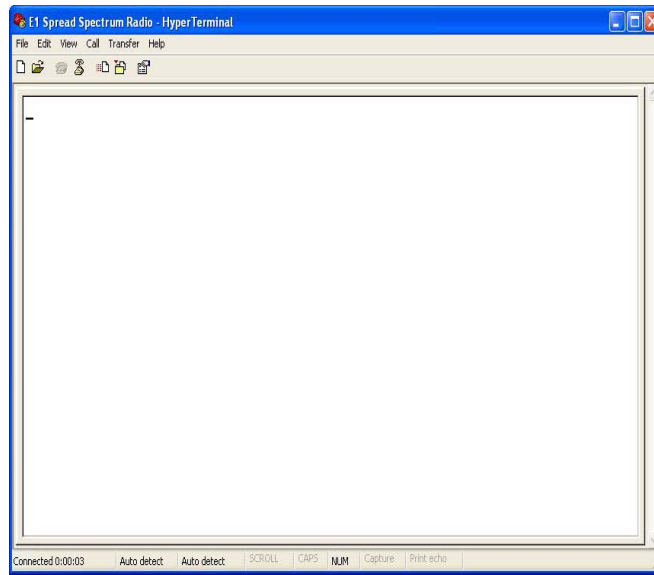


Figure 4-12 Data Port Settings (4)

5 Interface

5.1 Front Panel

E1 interface can be of unbalanced 75Ω BNC or balanced 120Ω RJ-48. User's can flexibly choose either of these two interface equipment.

Besides the standard E1 interface, the equipment also provides service, monitor, data, User I/O and control port. This allows the user to conveniently fully monitor the control room through this equipment. This equipment has 8 input ports, plus 4 output ports.

5.1.1 Engineering Order Wire(EOW)

Service phone plays a significant role in underdeveloped and mountainous areas. Other than possessing the function of selective and entire calling, 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 service phone from general phone service because it is very user-friendly and fits all the demands of users. We can also use textmenu to set up the service phone numbers.

- ✓ 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 $2 \pm 0.2s$ ring and $4 \pm 0.4s$ 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 $500 \pm 50ms$, $230ms \pm 70ms$ and then break connection
- Busy tone: Continue to redial at an exchange of $500ms \pm 50ms$

5.1.2 LCD Description

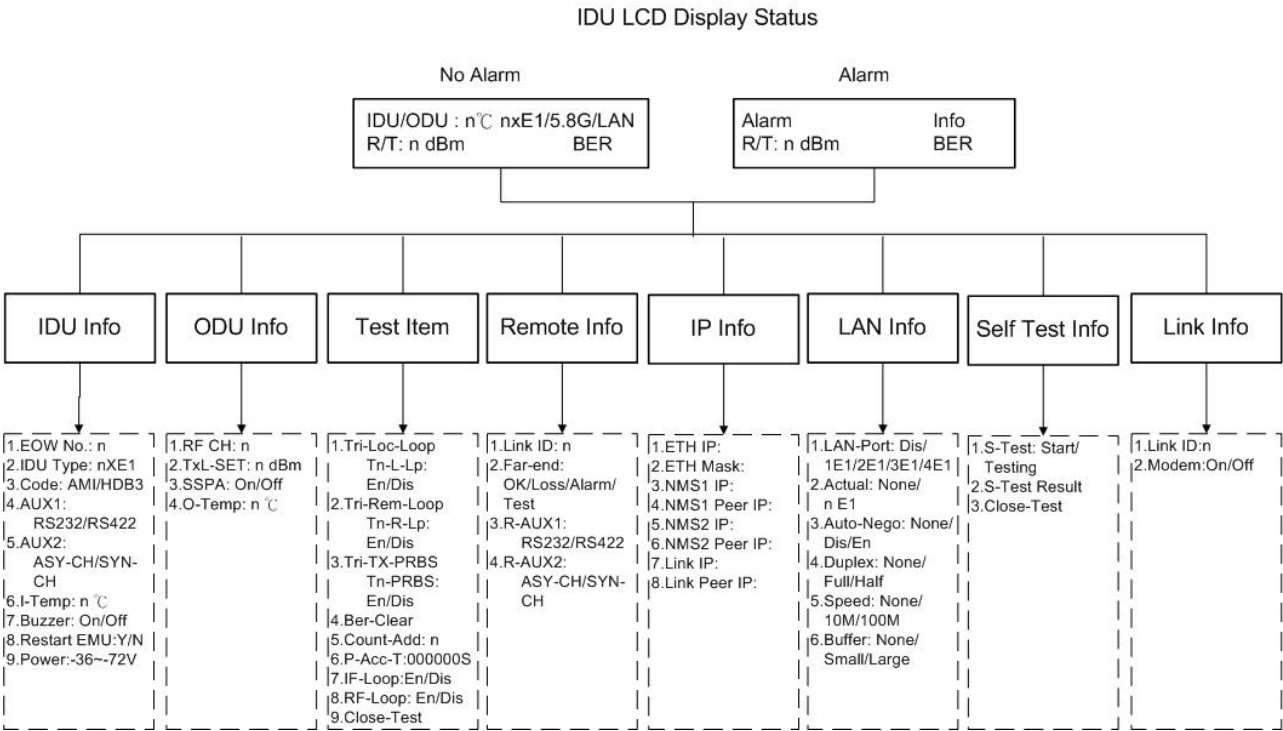


Figure 5-1 IDU Function Tree

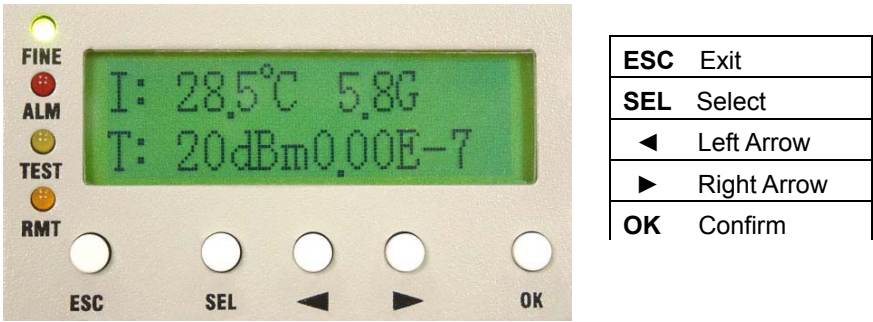


Figure 5-2 LCD Function Keys (1)

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.

Under normal condition, the LCD displays as below:

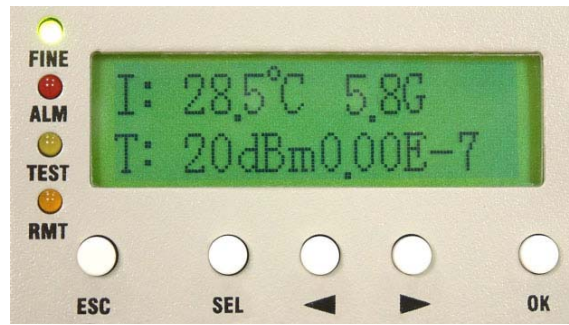


Figure 5-3 LCD Function Keys (2)

1st line of the LCD display – refreshes every alternate 1~2 seconds.

Left hand side: IDU temperature. O-Temp: xx.x°C stands for ODU temperature.

Right hand side: 4XE1 stands for the system capacity. LAN stands for the system support Ethernet transmission function. 2.4/5.8G stands for the operating frequency.

2nd line of the LCD display – refreshes every alternate 1~2 seconds.

Left hand side: R: xxxdBm stands for the real-time online receiving power. T: xxxdBm stands for the real-time online transmitting power.

Right hand side: On the right hand side, it displays the bit-error rate (BER).

■ **Note:** 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 = running time (in seconds).

For example:

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

$$\therefore BER = (3 / (2.048 * 106 * 2 * 60)) = 1.22 * 10^{-8}$$

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

$$\therefore BER = (566 / (2.048 * 106 * 4 * 60 * 60)) = 3.39 * 10^{-5}$$

Under alarm condition, the LCD displays as below:



Figure 5-4 Alarm Status

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 current alarm message. Please refer to section 9.2. For example:

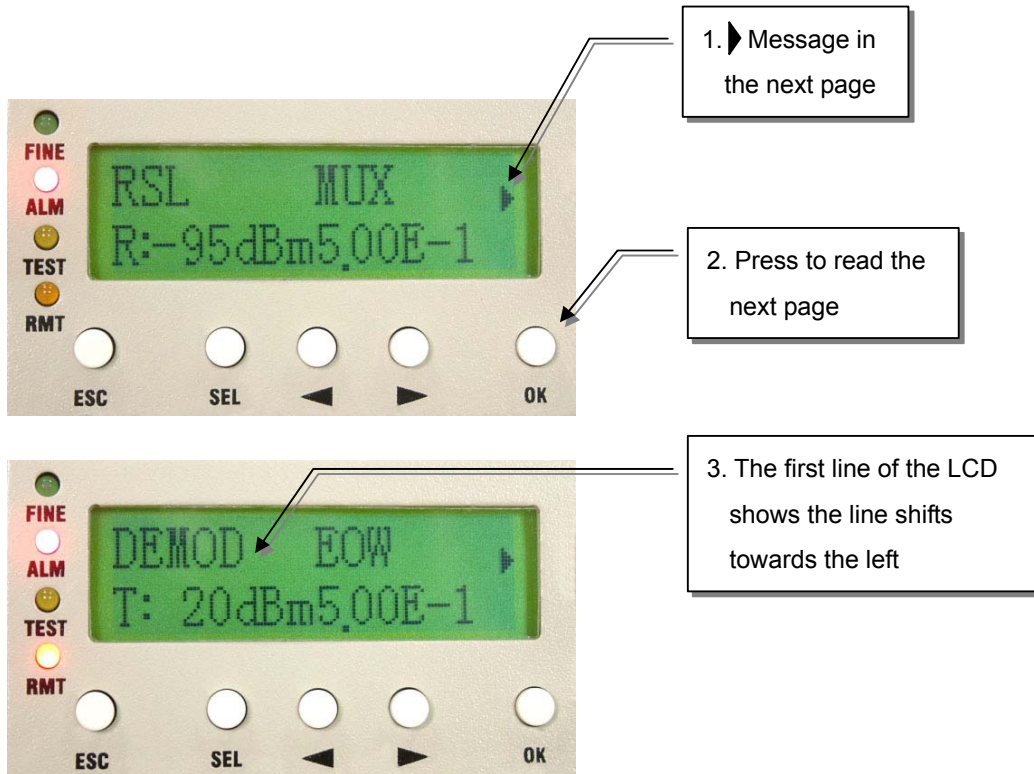


Figure 5-5 Alarm Function

Whenever there is an alarm, the LCD back light will light for 2 minutes and the buzzer sounds goes off. Other than removing the alarm status or switching off the buzzer status, we can switch off the buzzer by pressing the **SEL** button. To switch on the buzzer, please enter the **IDU Info/Buzzer: On/Off**.



Figure 5-6 Buzzer OFF

5.2 LCD Operation

5.2.1 IDU Info



Figure 5-7 IDU Info

A1. **EOW No.: n** (as in A1 display, press ►)

Display the local equipment's service phone number EOW, Engineering Order Wire. In the same link route system, there can be a maximum series connection of 255 service phone. NMS software is used for the service phone's initial set-up.



Figure 5-8 EOW No:n

A2. **IDU Type: nXE1** (as in A2 display, press ►)

Display the number of E1 capacity. If it displays 4XE1, it means that the equipment has four E1 interface. In this manual, we have taken 4E1 equipment as an example for easy explanation.



Figure 5-9 IDU Type: nXE1

A3. **Code: AMI/HDB3** (as in A3 display, press ►)

Display the code used. After pressing the **OK** button, use the **Right/Left** button to choose either of the two codes: AMI or HDB3.

■ **Note:** AMI Code→

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 - +

■ **Note:** 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.

HDB3 is one of CCITT's recommended uses.

For example: switching E1 transmitted HDB3 code to AMI code

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



Figure 5-10 Code:HDB3/AMI

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

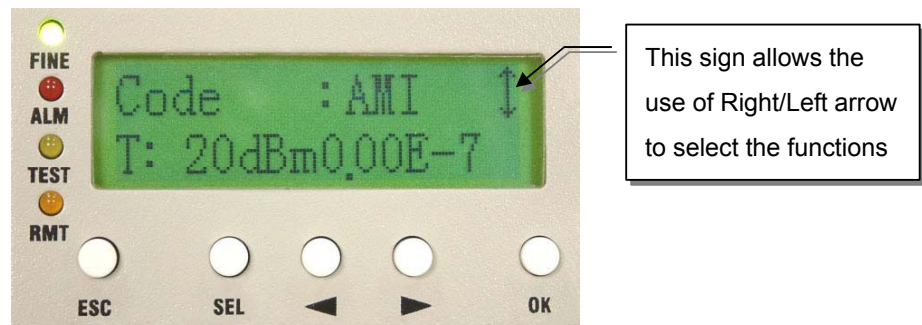


Figure 5-11 Code Switch (1)

3. Enter the password verification. Enter the 6-digits system password (preset password is 000000). Use **SEL** to change between different functions. Press **OK**.

✓ **P** = Place; **A** = Adjust

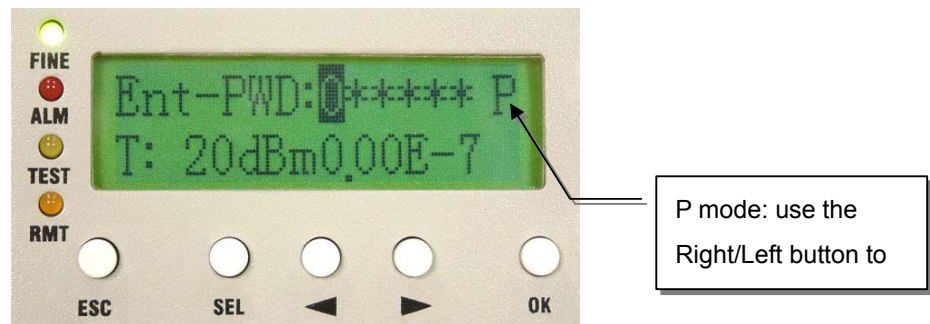


Figure 5-12 Code Switch (2)

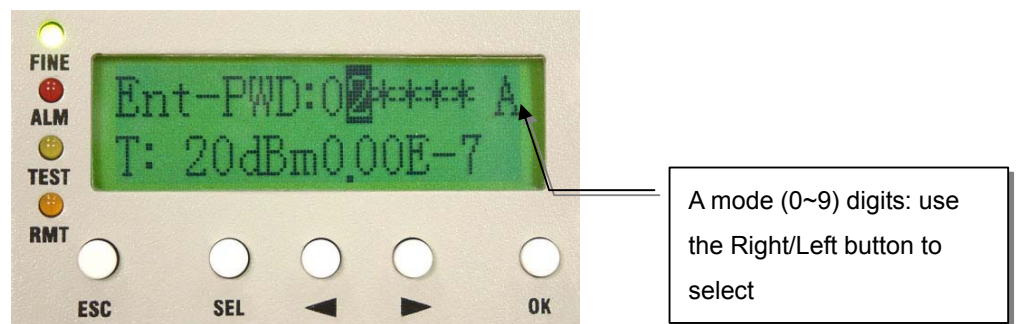


Figure 5-13 Code Switch (3)

4. Error Password is displayed on 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.



Figure 5-14 Code Switch (4)

A4. AUX1: RS232/RS422

This protocol is used to transfer simple file and data transmission between local and remote equipment through RS232 or RS422.



Figure 5-15 AUX1:RS232/RS422

A5. AUX2: ASY-CH/SYN-CH

Select either ASY-CH for asynchronous channel or SYN-CH for synchronous channel.



Figure 5-16 AUX2:ASY-CH/SYN-CH

A6. I-Temp: n°C

Display the local ODU's working temperature.

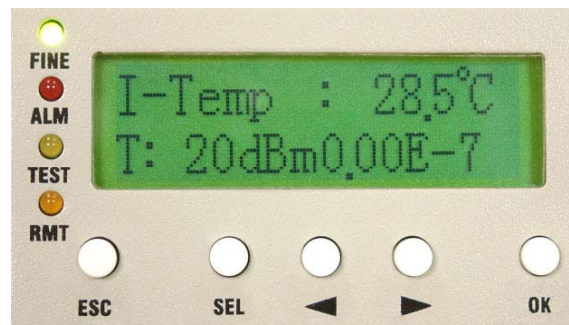


Figure 5-17 I-Temp:n°C

A7. Buzzer: On/Off

Display the buzzer On/Off switch.

- ✓ In any other screens, you could press “SEL” to close the buzzer when it beeps.

Ex:

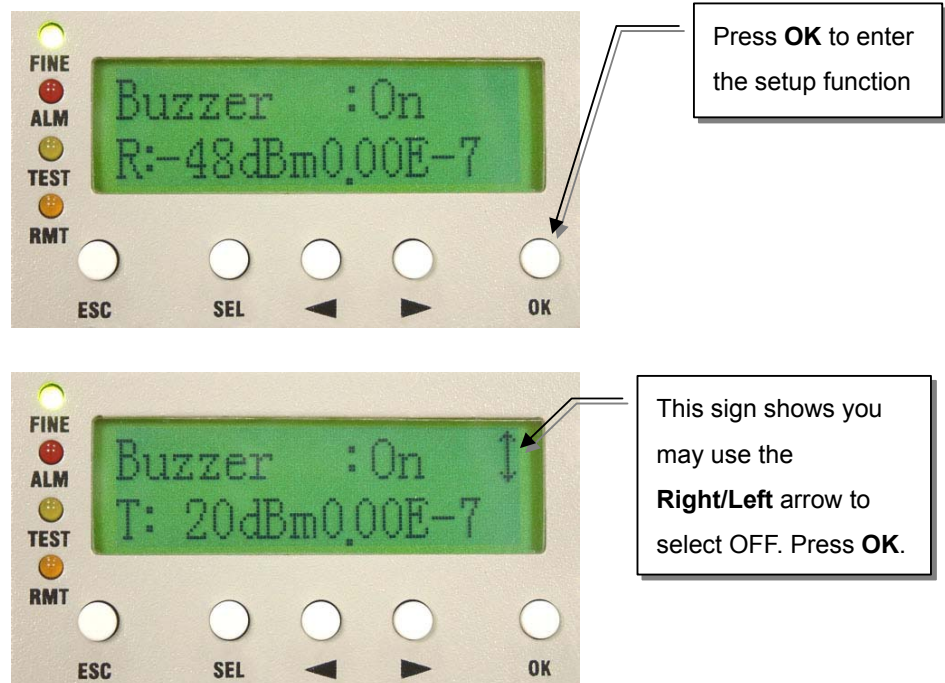


Figure 5-18 Buzzer:On/Off

A8. Restart EMU: Y/N

Restart the E1 Radios system. EMU stands for Embedded Unit.



Figure 5-19 Restart EMU:Y/N

A9. Power: -36~-72V

Display the power supply.



Figure 5-20 Power:-36~-72V

5.2.2 ODU Info



Figure 5-21 ODU Info

B1. RF-CH: n

Display the ODU's current RF channel.



Figure 5-22 RF-CH:n

B2. TxL-SET: ndBm

Display the transmitting power level.



Figure 5-23 TxL-SET:ndBm

B3. SSPA: 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.



Figure 5-24 SSPA:On/Off

B4. O-Temp: n°C

Display the local ODU's current working temperature.

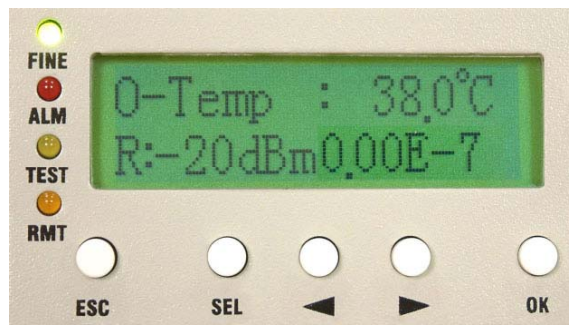


Figure 5-25 O-Temp:n°C

5.2.3 Test Item

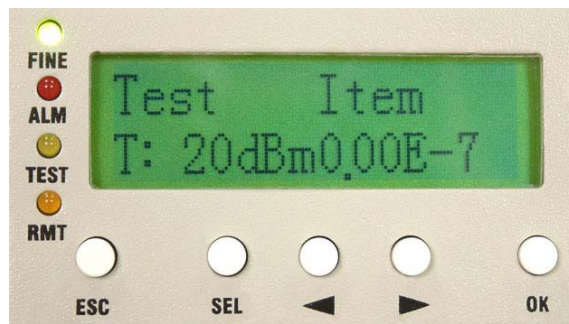


Figure 5-26 Test Item

This item allows you to enter Loopback mode.

- ✓ System allows only one kind of loopback at a time except for PRBS test.

Enter Test Item. Press **OK**. Enter the password verification. Enter the 6-digits system password. Use **SEL** to change between different functions.

- ✓ **P** = Position; **A** = Adjust; Press **OK**.



Figure 5-27 Enter Password

- ✓ The default password is "000000".

C1. Tri-Loc-Loop\Tn-L-LP: En/Dis

Local Loopback mainly conduct loopback test for E1 interface. It loops input signal of E1 interface out to the output of the same E1 interface. This function is testing whether external equipment such as DLC is working well or not. Perform Local Loopback test in the local end for the convenience of testing the equipment's stability. Use the Right/Left button to select the T1~Tn tributary of the local E1 interface. Press OK. The Right/Left button is also used for selecting En/Dis (En=Enable/Dis=Disable). This is used along with E1 transmission tester for E1 interface test.

- ✓ This function can not be used with its own PRBS function for testing.

For example:

1. To set the tributary 1 of E1 to Local Loopback. Enter \TEST Item\ Tri-Loc-Loop \T1-L-LP. Press OK.



Figure 5-28 Tn-L-LP:En/Dis (1)

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



Figure 5-29 Tn-L-LP:En/Dis (2)

Local End: Tributary 2 in Local Loopback. $\downarrow$ appears at the right bottom of the LCD. TEST led gives an orange

glow.

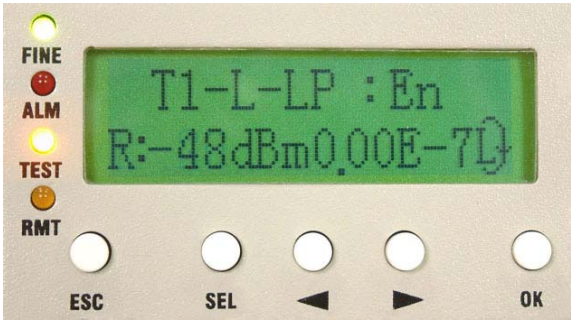


Figure 5-30 Tn-L-LP:En/Dis (3)

Remote End:  appears at the right bottom of the LCD.



Figure 5-31 Tn-L-LP:En/Dis (4)

Table 5-1 Loopback Test Lists

Item	Symbol	Content
		It means under condition of IF loopback. IF loopback could be activated by LCD panel. You could cancel it in LCD panel, textmenu, and SNMP software.
		It means under condition of RF loopback. RF loopback could be activated by LCD panel. You could cancel it in LCD panel, textmenu, and SNMP software.
		It means under condition of local loopback. Local loopback could be activated by LCD panel. You could cancel it in LCD panel, textmenu, and SNMP software.
		It means under condition of remote loopback. Remote loopback could be activated by LCD panel. You could cancel it in LCD panel, textmenu, and SNMP software.
	P	It means one of local tributaries is under condition of sending PRBS. It could be activated and cancelled in LCD panel, textmenu, and SNMP software. In this mean time, the corresponding tributary of remote station is receiving PRBS. You could read accumulated error numbers in LCD panel of remote station.

	T	It means local equipment is receiving PRBS.
		It means one of local tributaries is under condition of sending PRBS and conducting PRBS test. It could be activated and cancelled in LCD panel, textmenu, and SNMP software. In this mean time, the corresponding tributary of remote station is receiving PRBS. You could read accumulated error numbers in LCD panel of remote station.
		It means loopback test of remote stations.
		It means local equipment is under condition of sending IF and PRBS tests.
		It means local equipment is under condition of sending RF and PRBS tests.

C2. Tri-Rem-LP\Tn-R-LP: En/Dis

Remote Loopback test mainly conducts tests for working condition of whole tributary. You could choose external E1 tester or internal PRBS to verify condition. Perform Remote Loopback in the remote end for the convenience of testing the link's stability. Use the Right/Left button to select the T1~Tn tributary of the remote E1 interface. Press OK. The Right/Left button is also used for selecting En/Dis (En=Enable/Dis=Disable). This is used along with IDU PRBS (given in C3) for BER test as well as with E1 transmission tester for E1 interface test.

- ✓ While executing PRBS, the local and remote equipment will display the accumulated bit error.

For example:

Local End:  appears at the right bottom of the LCD means in Remote Loopback. TEST led gives an orange glow.



Figure 5-32 Tn-R-LP:En/Dis (1)

Remote End:  appears at the right bottom of the LCD. TEST led gives an orange glow.

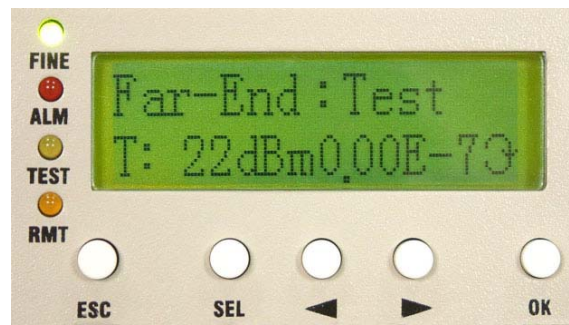


Figure 5-33 Tn-R-LP:En/Dis (2)

C3. Tri-TX-PRBS\Tn-PRBS: En/Dis

Press the Right/Left button to enter PRBS tributary test. Use Pseudo Random Code for E1 signal transmission test along with the Remote Loopback, normal link equipment and the testing equipments to test the stability. Press OK. Use the Right/Left button to select Enable/Disable. Press OK. On using this function, the LCD will display the accumulated BER.

When Tributary 3 is in Remote Loopback (TEST led is orange). Open tributary 3 PRBS test. Now **P** will appear at the right bottom of the LCD. Remote end's TEST led will turn orange too with "T" display on the front panel LCD.



Remote End:



Figure 5-34 Tn-PRBS:En/Dis

- **Note:** 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 $2^m - 1$. Nowadays, the equipments used are mostly PRBS of m-sequence: $x^{15} + x + 1$, 100003.

C4. Ber-Clear

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



Figure 5-35 Ber-Clear

C5. Count-Add:

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



Figure 5-36 Count-Add:n

C6. P-Acc-T: nS

Display all accumulated BER time.

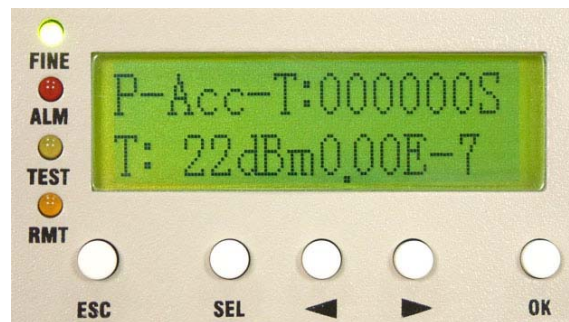


Figure 5-37 P-Acc-T:nS

C7. IF-Loop: En/Dis

IF Loopback test mainly conducts tests for condition of local IDU. When IF loopback test has been performed, the transmission between stations is interrupted. There are 3 methods to verify the conditions:

- (a) To verify thru external E1 tester
- (b) To verify thru real-time BER display in LCD panel. When it displays 0.00E-7, the system is working well.
- (c) To verify thru internal PRBS function.

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 5-38 IF-Loop:En/Dis (1)

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

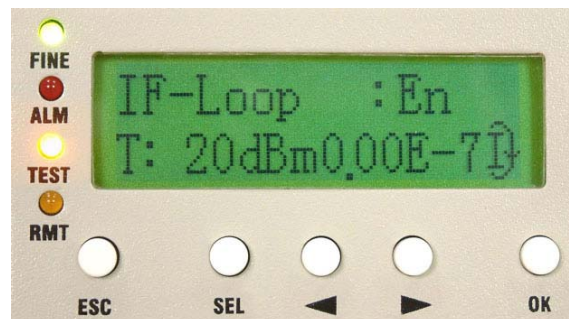


Figure 5-39 IF-Loop:En/Dis (2)

C8. RF-Loop: En/Dis

RF Loopback test mainly conducts tests for condition between IDU and ODU. When RF loopback test has been performed, the transmission between stations is interrupted. There are 3 methods to verify the conditions:

- (a) To verify thru external E1 tester
- (b) To verify thru real-time BER display in LCD panel. When it displays 0.00E-7, the system is working well.
- (c) To verify thru internal PRBS function.

In RF Loopback,  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.

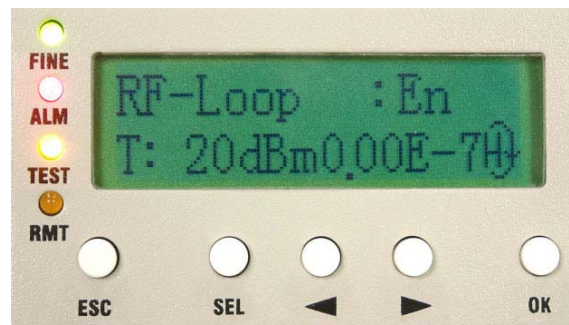


Figure 5-40 RF-Loop:En/Dis

C9. Close-Test

Press “OK” to close all tests.



Figure 5-41 Close-Test

5.2.4 Remote Info



Figure 5-42 Remote Info

D1. Link ID: n

Display the ID of the current remote link, n=1~255.



Figure 5-43 Link 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 5-44 Far-End:OK/Alarm/Loss/Test

D3. R-AUX1: RS-232/RS-422

Display remote AUX1 working status.



Figure 5-45 R-AUX1:RS-232/RS-422

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

Display remote AUX2 working status.



Figure 5-46 R-AUX2:ASY-CH/SYN-CH

5.2.5 IP Info

E1. ETH IP:

Display ETH port IP address.

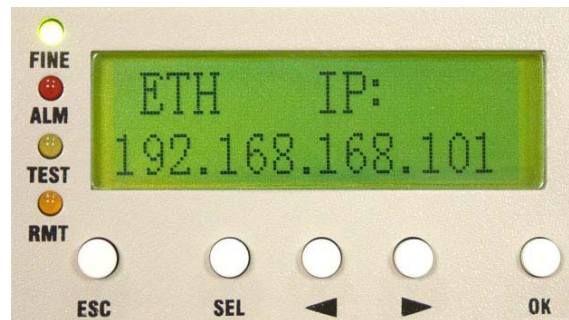


Figure 5-47 ETH IP:

- ✓ The default IP is 192.168.168.1.

E2. ETH Mask:

Display ETH subnet mask.



Figure 5-48 ETH Mask:

E3. NMS1 IP:

Display NMS1 port IP address.

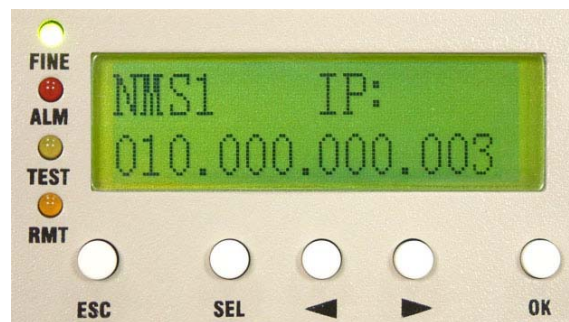


Figure 5-49 NMS1 IP:

E4. NMS1 Peer IP:

Display peer NMS1 port IP address when more than two equipments are connected in the local station.

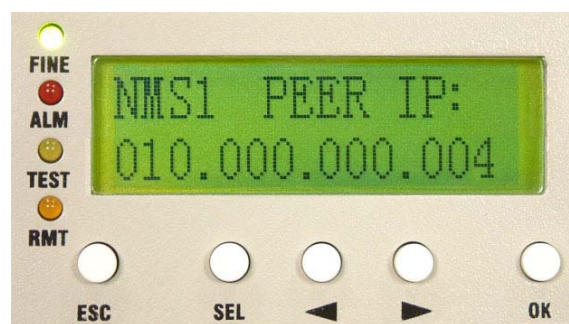


Figure 5-50 NMS1 Peer IP:

E5. NMS2 IP:

Display NMS2 port IP address.

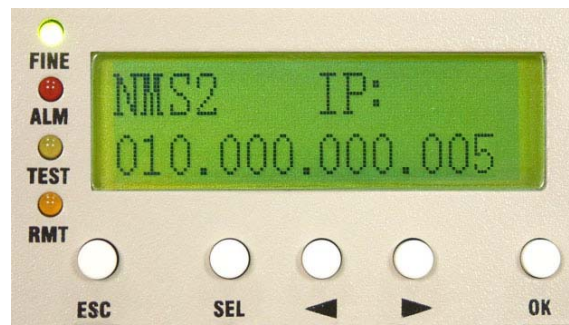


Figure 5-51 NMS2 IP:

E6. NMS2 Peer IP:

Display peer NMS2 port IP address when more than two equipments are connected in the local station.

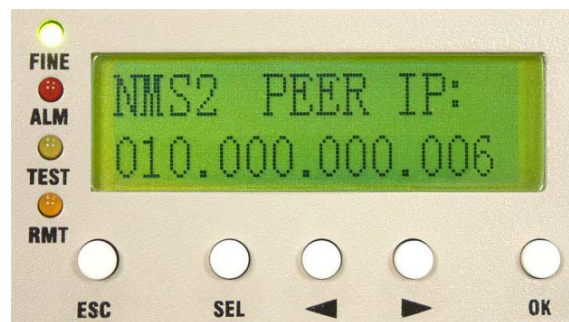


Figure 5-52 NMS2 Peer IP:

E7. Link IP:

Display Link port IP address. Link means RF connection between two stations.

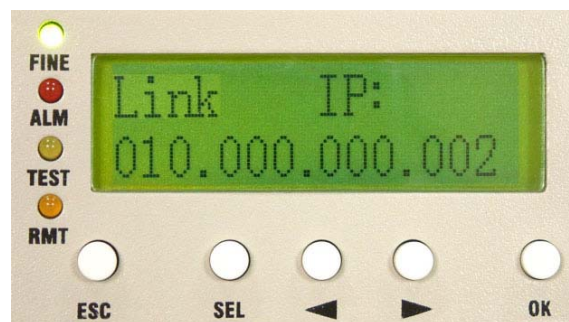


Figure 5-53 Link IP:

E8. Link Peer IP:

Display peer Link port IP address.

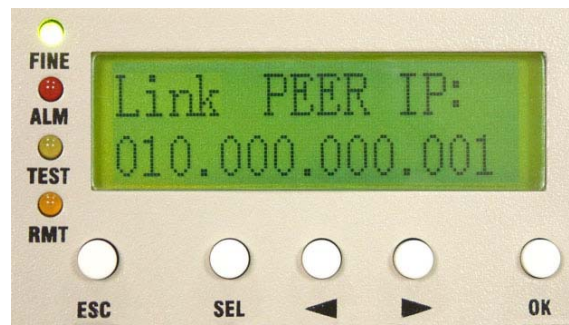


Figure 5-54 Link Peer IP:

5.2.6 LAN Info



Figure 5-55 LAN Info

This subpage displays with only E1+LAN product.

F1. LAN-Port: Dis/1E1/2E1/3E1/4E1

Activate E1 interface number which should be used for Ethernet transmission. Take following figure as example, it setup 4E1 as Ethernet transmission.



Figure 5-56 LAN-Port:Dis/1E1/2E1/3E1/4E1

F2. Actual: None/1E1/2E1/3E1/4E1

Display actual E1 interface number which has been transferred to Ethernet transmission.



Figure 5-57 Actual:None/1E1/2E1/3E1/4E1

F3. Auto-Nego: None/Dis/En

Activate/close Ethernet auto-negotiation function.



Figure 5-58 Auto-Nego:None/Dis/En

F4. Duplex: None/Full/Half

The configuration of Ethernet interface duplex.



Figure 5-59 Duplex:None/Full/Half

F5. Speed: None/10M/100M

The configuration of Ethernet interface speed.



Figure 5-60 Speed:None/10M/100M

F6. Buffer: None/Small/Large

The configuration of Ethernet interface buffer.



Figure 5-61 Buffer:None/Small/Large

5.2.7 Self Test Info



Figure 5-62 Self Test Info

G1. S-Test: Start/Testing

Activate Self Test function/Self Test status display. After activating this function, system will automatically perform IF-Loopback, RF-Loopback and RMT-Loopback tests and display test results in "S-Test Result" menu.

- ✓ The test procedure explains as following: the system would perform IF loopback test first and choose the first tributary to send PRBS. If error number within 30 seconds is 0, then it will display "IF-LP:OK".

Otherwise, It will show "IF-LP: NG". If system passes the IF loopback test, it will judge the monitor channel between IDU & ODU is working normal which is the same as whether ODU M/C alarm happens. If system passes IF loopback test, the system will perform RF and PRBS tests. If error number within 30 seconds is 0, then it will display "RF-LP:OK". Otherwise, It will show "RF-LP: NG". If the system passes RF loopback test, the system continues to perform remote loopback test. Before performing remote loopback test, system would verify the condition between local and remote is normal. If normal, system would perform remote loopback & PRBS tests for each tributary in turn. If the error number is 0, then the tributary is viewed to pass the test. If tributary doesn't pass the test, it will show "RMT-LP: NG Trib n" which means tributary n doesn't pass remote loopback test. Under the process of testing, any one of the test fails will end the self test procedure.



Figure 5-63 S-Test:Start/Testing

G2. S-Test Result

Self Test result displays.



Figure 5-64 S-Test Result

G3. Close-Test

Close Self Test function.



Figure 5-65 Clost-Test

5.2.8 Link Info



Figure 5-66 Link Info

G1. Link ID: n

Display the ID of the Link; n=1~255. Link ID indicates that current receiving signals is coming from correct remote station. In network, there is possibility to receive same-frequency signal not belonging to the same link. In this situation, the signal should be viewed as interference. For avoiding the situation, the two stations of the same link should be set to be the same Link ID. When local equipment receives signals, system would compare Link ID. If it is identical, it means system is receiving correct signals. If not, it would cause Link ID alarm and output E1 signals with all "1".



Figure 5-67 Link ID:n

G2. 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.

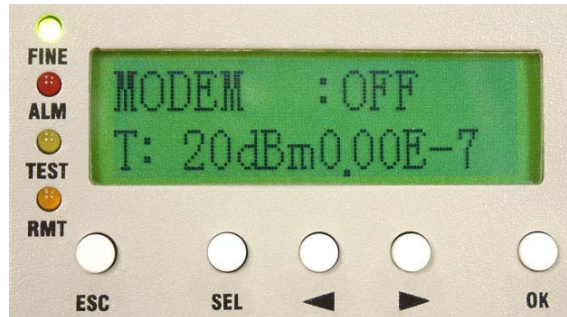


Figure 5-68 MODEM:ON/OFF

6 Environmental Condition

6.1 Cable

IF Cable: RG-6 $\leq$ 100m; RG-8 $\leq$ 200m

RF Cable: Insertion Loss $\leq$ 1dB

6.2 Operating Temperature Range

IDU: -5°C ~ +55°C

ODU: -30°C ~ +60°C

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.