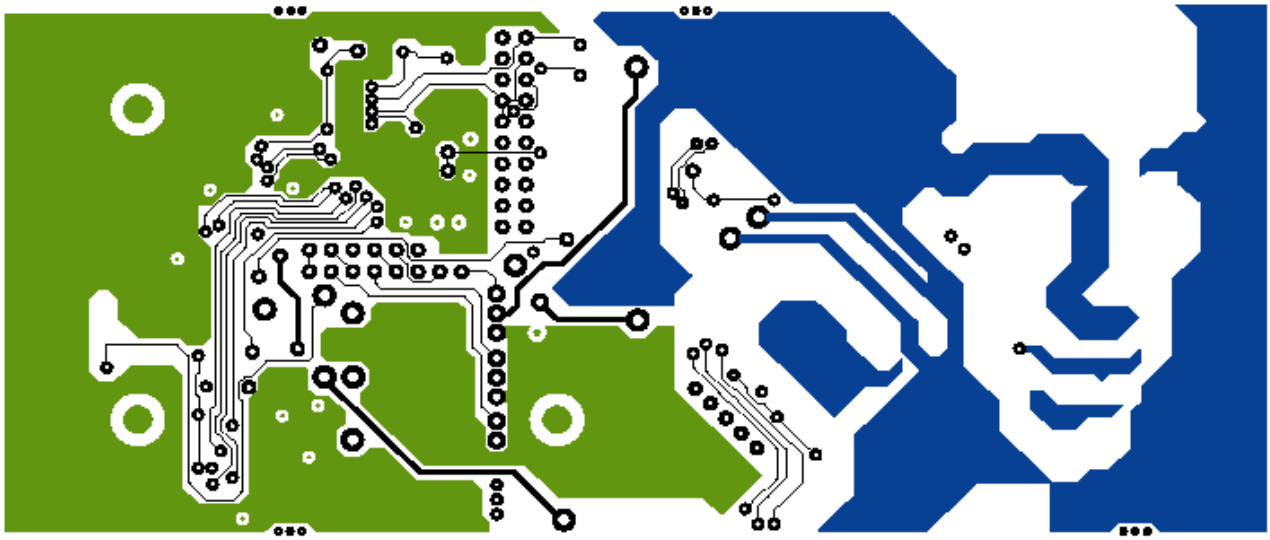
CODAN

Digital Microwave Radio

8800 series

MICROWAVE LINKS



Technical Reference Manual

Technical Reference Manual

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Chapter 1 About this manual

1.1 About this issue

This is the first issue of the technical specifications for the Codan 8800 series DMR.
This manual provides a detailed technical description of the Codan 8800 series DMR ® system components, assemblies software and management topics.

Chapter 1	About this manual – explains terms, abbreviations and standards used in this manual.
Chapter 2	Overview - System building blocks
Chapter 3	System description – Indoor Unit
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1.2 Associated documents

The associated documents are:

Quick Install Guide

Codan 8800 series Reference Manual

MINet Reference Manual

1.3 Standards and icons

The following standards and icons are used in this manual:

This typeface	means
Bold	**the name of a button, knob or LED and a segment of text from the display**
Bold Times	**text that is typed in as a command, or the name of a key on a computer keyboard**
Bold times	**acceptable command abbreviations**
`Courier`	`text that is displayed on a computer screen or in response to a command`
Italic	*a cross-reference or text requiring emphasis*

This icon	Means
	Warning: It is possible that you will seriously damage yourself or the equipment
	Caution: Proceed with caution as your actions may lead to a loss of data, privacy or signal quality
	Note: The text provided next to this icon may be of interest to you

1.4 Definitions

Acronyms and abbreviations

Acronym	Means
AGC	automatic gain control
AIS	alarm indication signal
ANSI	American National Standards Institute
BER	bit error rate
DC	direct current
DIU	data interface unit
DMR	digital microwave radio
DS1	data series 1 (ANSI 1.544 Mbps)
DS3	data series 1 (ANSI 44.736 Mbps)
E1	Electrical data standard 1 (ETSI 2.048 Mbps)
E3	Electrical data standard 3 (ETSI 34.638 Mbps)
EIA	Electronics Industry Alliance
ESR	errored second ratio
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
GUI	graphical user interface
HPA	high power amplifier
I/O	input/output
IDU	indoor unit
IF	intermediate frequency or inter-facility
ISP	Internet service provider
ITU	International Telecommunications Union
LAN	local area network
LEC	local exchange carrier
LED	light emitting diode
LOS	line-of-sight

Acronym	Means
MIB	management information base
MINet	microwave intelligent network
Mux	multiplexer
N/A	not applicable
NMS	network management system
ODU	outdoor unit
OPA	ODU protected assembly
PCN	personal communications network
PCS	personal communications service
ppm	parts per million
RIP	routing information protocol
RU	rack unit
Rx	receive
SAW	surface acoustic wave
SES	severely errored second
SLIP	serial link Internet protocol
SNMP	simple network management protocol
TCP/IP	transport control protocol/Internet protocol
TFTP	trivial file transfer protocol
TTL	transistor-transistor logic
Tx	transmit
UPS	Un-Interruptable power supply
UTP	unshielded twisted pair
WAN	wide area network
10Base-T	10 Mbps Ethernet via twisted pair
100Base-T	100 Mbps Ethernet via twisted pair

1.5 Units of measurement

Measurement	Unit	Abbreviation
Attenuation	decibel	dB
Current	Ampere	A
Data rate	bits per second	bps
Frequency	Hertz	Hz
Impedance	Ohm	Ω
Length	metre	m
Power	decibels relative to 1 mW	dBm
Power	watt	W
Temperature	degrees Celsius	°C
Voltage	Volts	V
Weight	gram	g

Unit Multipliers

Unit	Name	Multiplier
m	milli	10^{-3}
d	deci	10^{-1}
k	kilo	10^{3}
M	Mega	10^{6}
G	Giga	10^{9}

Chapter 2 Overview

2.1 Introduction to the Codan 8800 series series Digital Microwave Radio

The Codan 8800 series is line-of-sight DMR operating in microwave frequency bands between 7 and 38 GHz.

The system supports a wide range of data rates from 3.0 Mbps to 52Mbps.

The modulation format is a form of Continuous Phase Modulation. This modulation provides a high spectrum efficiency of 1.45 b/Hz and is extremely robust in the presence of interference and multi path propagation.

The Codan 8800 series provides interfaces to ETSI standard signalling at 2E1 to 16E1 and E3 or North American digital signalling at 2 DS1 to 16DS1 and DS3. The Codan 8800 series can also provide a wireless connection for Ethernet 10/100Base-T.

The Codan 8800 series product line serves the following communication markets:

- Internet Access Systems: Used by Internet Service Providers (Sips).
- Private Networks: Wireless Bridged LANs.
- PCS/PCN and Cellular Networks: High-speed links between base stations.
- Wireless Local Loop Networks: Fixed wireless systems of Local Exchange Carriers

The Codan 8800 series terminal/network can be managed by a Windows® 98/NT/2000/XP compatible SNMP network management application called thee Microwave Intelligent Network or MINet.

The Codan 8800 series system has a standard MIB interface that can be managed by HP OpenView and other similar management platforms.

The Codan 8800 series network management communications are an open system that uses the TCP/IP protocol to manage all elements of the link

2.2 Basic Structure

The DMR includes two Codan 8800 series terminals. The IDU is installed inside a 19” wiring rack-mount, and the ODU and the antenna are mounted outdoors on a tower or rooftop. A single coaxial cable connects the IDU to the ODU that is directly connected to the antenna.

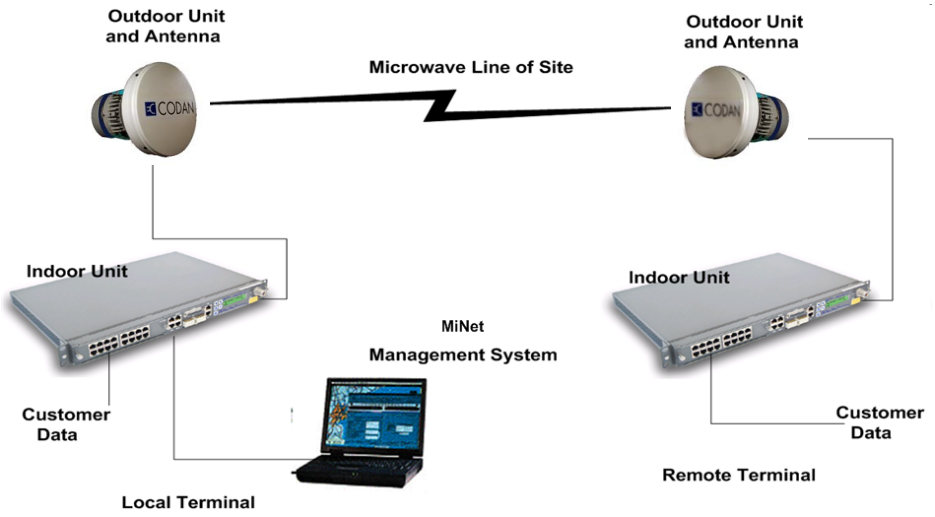

Figure 1- Typical Codan 8800 series radio link

Digital data, service channels, radio overheads and network management information at the local terminal are fed to the IDU. The IDU converts the digital data to TTL level signals and multiplexes them with the service channels onto an aggregate data stream.

The IDU digital modem modulates the aggregate signal to create an Intermediate Frequency (IF) signal. The IF signal is superimposed with DC power and sent to the ODU on a coaxial cable.

The ODU converts the IF signal to a Radio Frequency (RF) signal that is sent to the antenna of the remote terminal.

At the remote terminal ODU, the received signal is converted back to an IF signal. The IF signal is fed through the coaxial cable to the IDU, where it is demodulated and de-multiplexed into digital data and the appropriate service channels.

The link is full duplex (bi-directional), fully symmetrical and transparent to the data stream.

In order to establish a DMR connection, an Codan 8800 series terminal is installed at each site.

These sites designated as the Local site and Remote site as shown in Figure 1, must have a clear line of sight between each other. The achievable maximum range is determined by the availability requirements, operating frequency and antenna size.

Each Codan 8800 series terminal is normally mounted to an appropriate microwave parabolic dish antenna that provides the mounting and alignment devices.

The Link consists of an Indoor Unit (IDU), an Outdoor Unit (ODU) and an antenna as shown in Figure 1. In a typical installation, the IDU is mounted inside a standard 19” rack enclosure and the ODU and the antenna are mounted on a tower, mast or rooftop.

A single coaxial cable connects the IDU to the ODU; the ODU is mounted directly to the antenna.

Note: The terms ‘Local’ and ‘Remote’ are relative, and depend on the location from where the system is operated. The ‘Local’ terminal is at the same location as the operator, The ‘Remote’ terminal becomes ‘Local’ terminal when the operator is at the other site

Chapter 3 Indoor Units

3.1 Indoor Unit Overview

The Indoor Unit (IDU) performs the following functions:

- Multiplexes and de-multiplexes the customer data channels with the service and supervisory channels
- Terminates the coaxial cable from the ODU
- Provides operator control interface
- Provides external alarm interface

The indoor unit is housed in a standard 19” rack and is powered by a DC supply voltage of between ± 22 and 60 Volts.

All interfaces are located on the front panel.

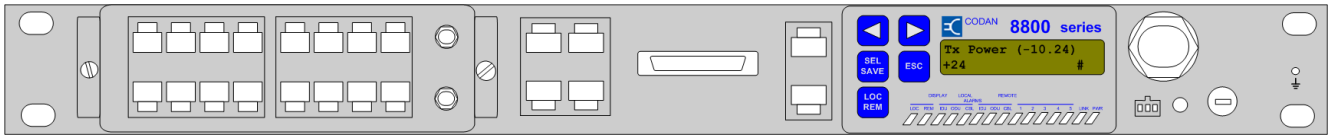

Figure 2 - Indoor Unit

On the front panel, the IDU contains the tributary interfaces, service channels, control panel, DC supply and network management interfaces. The tributaries and service channels are multiplexed, modulated, converted to IF, passed along with the DC voltage and telemetry channel on a single cable to the ODU.

A plug-in Digital Interface Unit, located within the IDU, is used to interface various transmission systems with the IDU. The IDU comprises the modem, tributary multiplexer, power supply and some additional hardware.

The IDU is a software-driven device that operates unattended. The link is configured, operated and monitored through a user interface. The user can access the system locally through the Control Panel, or from a computer with MINet installed which may be directly connected to the IDU or remotely through an Ethernet LAN or via a modem connection.

From the IDU, each segment of the link can be tested, including the tributary, the IDU, the ODU and the telemetry connection. The remote terminal can also be tested using the local IDU front panel control panel.

Two IDU models are available for international data connections:

The ETSI standard, (European Telecommunications Standards Institute) Codan Part Number 08-06305-001.

The FCC standard, (Federal Communications Commission). Codan Part Number 08-06305-002.

3.2 IDU Physical Description

3.2.1 The IDU Front Panel

Serves as an interconnection panel for interfacing to external equipment by providing access to all the physical cable connections.

Provides a user interface to the Network Management System through the Control Panel and via a PC connection with Network Management System software installed

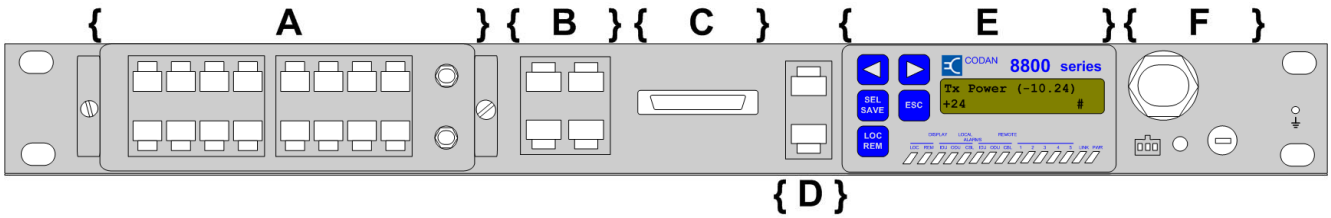

Figure 3 - IDU Front Panel

The IDU contains four functionally distinct areas as follows (from left to right):

{A} Plug-In Unit that contains Tributary interfaces (E1, E3, DS1, DS3, 10/100Base-T, EOW, and Redundancy Information)

{B, C, D} Interface Connections

{B} Service channels, Data, NMS IN/OUT (asynchronous over TCP/IP),

{C} Relays and external input connector

{D} Eth (NMS to LAN) and Test (Factory Use Only)

{E} Control Panel that contains LCD, keypad, and LED's

{F} Power and ODU Connections, DC supply, IDU to ODU connector Grounding Lug, Reset button and fuse

3.2.2 Digital Interface Unit

The following list details the plug-in DIU models that are currently available.

ETSI

- 4E1, BNC type, 75Ω, plus EOW
- 16E1, RJ45, 120 Ω plus E3, BNC. Used as 2E1 to 16E1, or E3 or E3 + 1E1
- 16E1, SCSI, 75Ω/120 Ω. Used for 2E1 to 16E1 protected configurations
- 16E1, SCSI, 75Ω/120 Ω plus E3, BNC plus EOW. Used for 2E1 to 16E1, or E3 for protected configurations
- Four 10/100Base-T plus 4E1

FCC

- 16DS1, RJ45, 100 Ω plus DS3, BNC. Used as 2DS1 to 16DS1, or DS3 or DS3 + 4DS1
- 16DS1, SCSI, 100 Ω. Used for 2DS1 to 16DS1 protected configurations
- 16DS1, SCSI, 100 Ω, plus DS3, BNC plus EOW. Used for 2DS1 to 1DSE1, or DS3 for protected configurations
- Four 10/100Base-T plus 4DS1

3.3 IDU Technical Description – Front Panel

3.3.1 Interface Connections

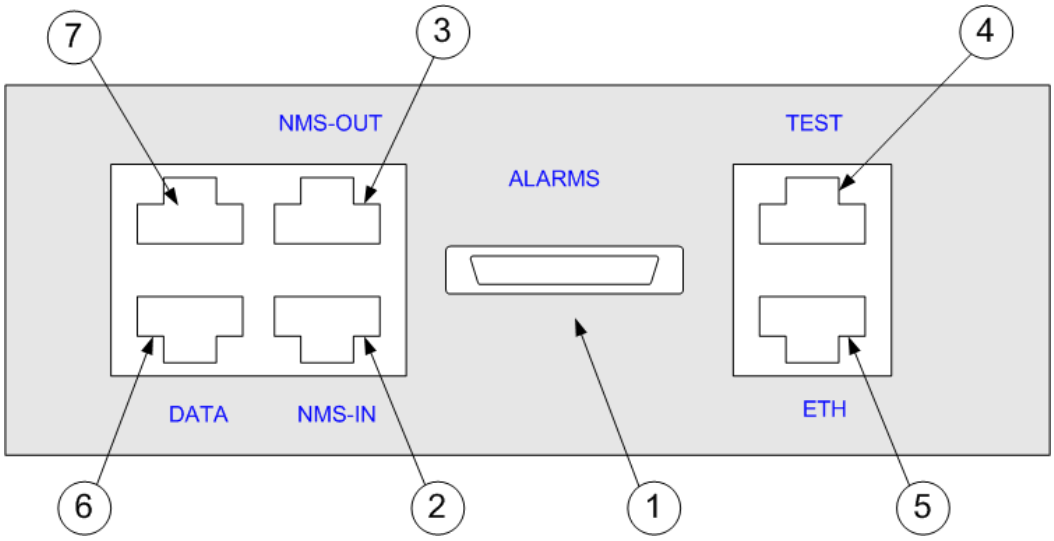

Figure 4 - IDU Interface Connections

The interface connections shown in Figure 4 provide the following:

1. Alarms (DB25 connector - I/O):

Outputs

- Five user-definable change over relays that can be configured using the MINet software.
- Any of the equipment alarms can be mapped to any of the relays.
- Each relay provides normally closed or normally open contacts.
- A configurable internal audible alarm is also available.

Inputs

- Four external optically coupled protected inputs at TTL level signals of 2.4 to 9 VDC.

- With the use of the MINet software:
    - The inputs can be configured to sense low to high level, high to low level or change of state transitions.
    - The severity level can be configured as a warning, error or fatal condition.
    - All external inputs can be mapped to the relays.

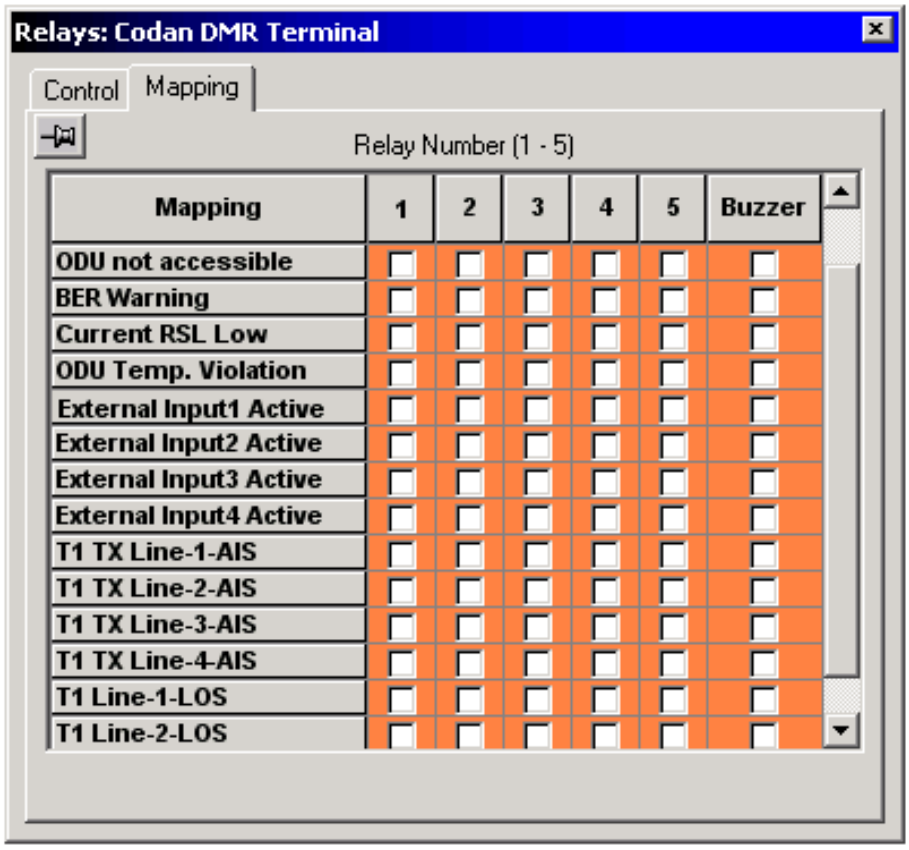

Figure 5 - Relay Mapping

2. NMS IN:

Network Management System RS232 port cabled to the “NMS Out” port on another IDU for “daisy chaining” the links or to connect NMS data of multiple IDUs at a common location to manage the network via the SNMP Protocol.

3. NMS Out:

Network Management System RS232 port cabled to the “NMS In” port on another IDU for “daisy chaining” the links or to connect NMS data of multiple IDUs at a common location to manage the network via the SNMP Protocol.

4. TEST:

Test port for Codan Limited factory personnel only.

5. Eth:

Ethernet port for SNMP management via LAN

6. Data:

RS232 port.

7. Blank:

Not Used.

3.3.2 Control Panel

The Control Panel contains the LCD display, keypad and LED indicators. It serves as both the user interface and Control Panel.

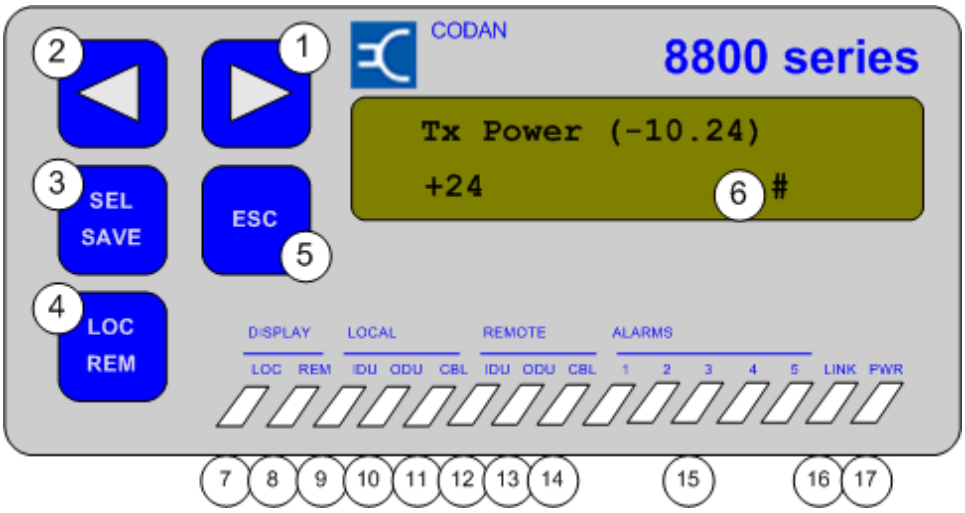

Figure 6 - Control Panel

A stand-alone IDU operating can be configured, monitored, controlled and display system messages and indications on the Control Panel. An NMS application such as MINet integrated into a Network Management Station is another means of communicating with the Codan 8800 series terminal and configuring, monitoring, controlling and displaying system messages.

The Control Panel enables easy system configuration of the local and remote terminals. It also displays the local and remote terminals status and alarms, statistics and test results.

Current/working parameters and system messages are displayed on the 16 character, two-row, LCD display. The menu options are grouped and presented on the LCD in a tree structure. The root of each group leads to the next branch (menu option), descending from top to bottom.

Alarm messages are short messages that are produced by the system and indicate a fault condition. The messages are displayed in the Control Panel's status information window, and can also be read in the Alarms Log tab dialog box.

The Control Panel keys and indications are described in the following table.

Table 3-1 IDU Control Panel Indications

No	Key	Description
1	Forward Arrow	Scroll forward to choose a command parameter at the same level, or to edit a digit
2	Backward Arrow	Scroll backward to choose a command parameter at the same level, or to edit a digit
3	SEL/SAVE	Select or save groups or individual parameters and to enter menus
4	LOC/REM	Select local or remote terminal. LOC/REM LED indicates state
5	ESC	Move upward in the tree
6	LCD Display	Displays LINK status, messages and parameters
7	LOC LED	Green light indicates that the local terminal is selected
8	REM LED	Green light indicates that the remote terminal is selected
9	LOC IDU LED	Yellow indicates malfunction of the local side
10	LOC ODU LED	Yellow indicates malfunction of the local ODU
11	LOC CBL LED	Yellow indicates disconnection or failure of local terminal
12	REM IDU LED	Yellow indicates malfunction of the remote side
13	REM ODU LED	Yellow indicates disconnection or failure of remote terminal connection
14	REM CBL LED	Yellow indicates disconnection or failure of remote terminal connection
15	ALARMS LEDs 1, 2, 3, 4, 5	A yellow alarm LED alerts the operator that the Relay mapped to this LED is active
16	LINK LED	A yellow LED indicates a fault
17	PWR LED	A green LED indicates that the terminal is powered ON

3.3.3 Power and ODU Connections

The IDU can be powered by ±22 - 60 VDC according to the on site services. This can be supplied from either batteries or a safety approved power supply.

An externally located replaceable fuse protects the power input and is located on the front panel.

The ODU is powered from the IDU via the coaxial cable. The power and ODU connections are shown in following:

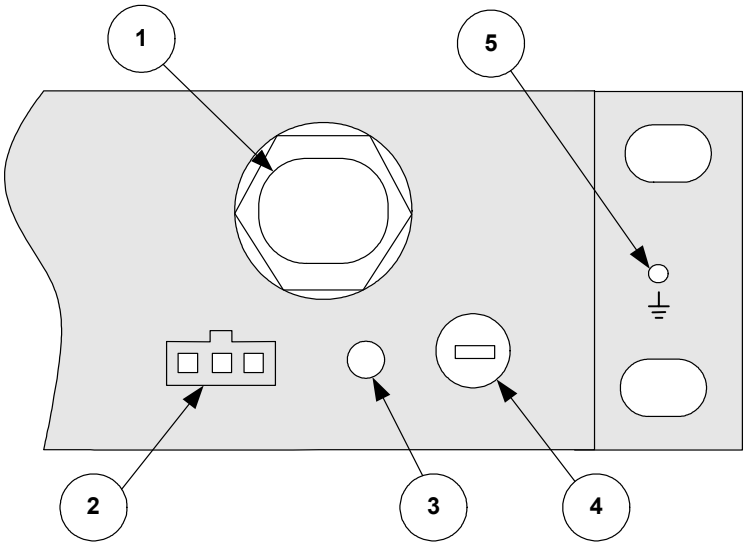

Figure 7 - Front Panel Power and ODU Connections

Warning: Always unplug the power cord from the socket before checking the line fuse to avoid electrical shock.

The IDU power socket has 3 connecting pins. The left connection pin is marked with "V". The centre pin is GND and marked with an earth symbol, and the right side pin is not used.

When the terminal is rack mounted or two terminals are connected to the same power source, the connection to the power source must be as following:

The "V" point can be connected to either the positive pole or the negative pole of the power supply.

In the case of two or more IDUs being connected to the same power source, the polarity of all terminals must be kept the same.

In case of rack mount installation the polarity of the centre or ground point of the terminal must be the same as the GND point of the power supply.

The following table gives a description of the power and ODU connections.

Table 3-2 Power and ODU Connections

No	Designation	Component	Description
1	ODU	Coaxial N-type female connector	Connection to ODU
2	DC PWR	3-pin receptacle	DC Power IN (±22 - 60 VDC) -48V typical
3	RST	Pushbutton	Terminal Reset
4	FUSE	FUSE	Amp for –48 VDC 3 Amp for +24 VDC
5	Earth Symbol	Grounding lug	Ground

Codan provides a power cable (2 metres long) with colour identifiers. The wire with the **RED** sleeve should be connected to the "V" and the plain BLACK wire should be connected to the ground.

As the IDU supports ±22 to 60 VDC, two types of fuses are provided with each IDU to cover the ranges of 22-36 V DC and 36-60 V DC.

When using supply voltage of 22-36 VDC, a 3A fuse should be used. When using supply voltage of 36-60 V DC, a 1.6A fuse should be used in the IDU.

The Codan 8800 series is shipped with a 1.6 Amp fuse installed, to support 36-60 V DC. An additional fuse, to support 22-36 V DC, (3 Amp) is also provided.

3.4 IDU Technical Description – Architecture

The Codan 8800 series Indoor Unit uses a fully digital architecture, which allows advanced features like digital bandwidth selection and dynamic Forward Error Correction, and exceptionally low residual BER.

No calibration of any component is required in any stage of the installation and the operation of the radio. The radio is self-learning based on DSP Processors and programmable logic. In order to maximize performance Strong FEC is implemented.

The Codan 8800 series is modular, in a way that allow various system configurations, by adding or exchanging basic blocks.

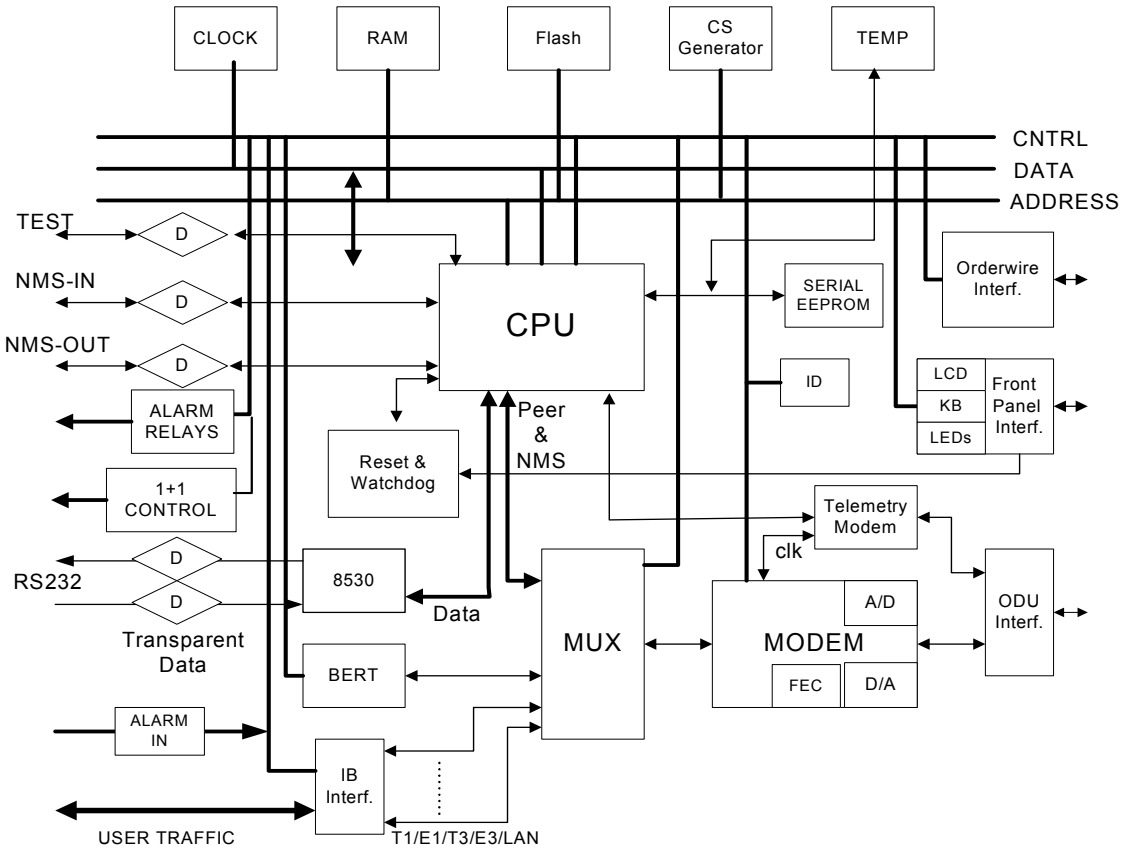

Figure 8 - Digital Portion Block Diagram.

3.4.1 Digital MODEM

The core of the Codan 8800 series is the proprietary Codan ASIC, which is interfaced to the communications processor.

The result is an advanced digital modem.

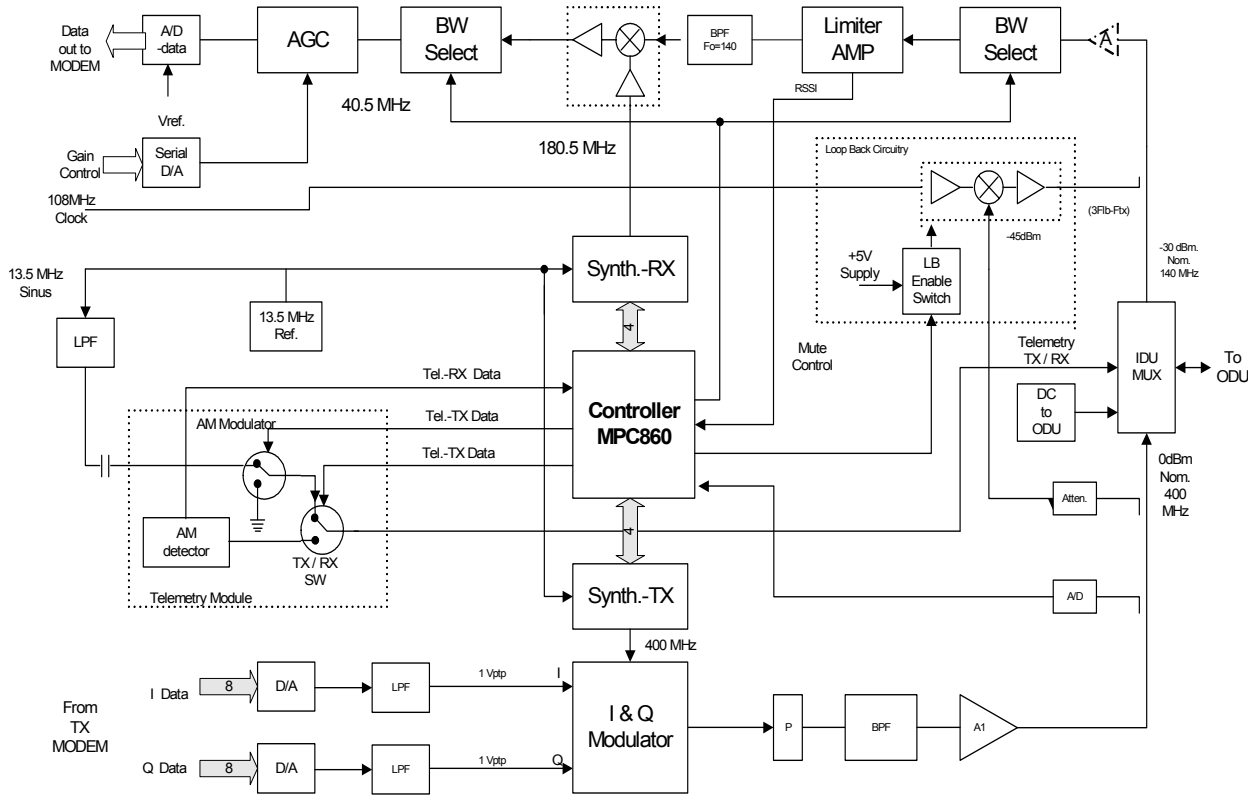

Figure 9 - Digital MODEM Block Diagram.

The digital modem performs the following terminal functions:

Transmit:

- Scrambles the incoming data from the MUX on the Data Interface Unit
- Builds the data frame including the addition of FEC
- Generates the I and Q phases
- Sets the required transmit bandwidth
- Generates the Continuous Phase Modulation on the 400 MHz carrier.

Receive:

- Sets the required receive bandwidth
- Demodulates the incoming Continuous Phase Modulated signal.
- Receives the incoming I and Q phases and converts them to a single serial data stream

- Removes and measures the applied amount of FEC and dismantles the incoming data frame
- Unscrambles the data and sends composite frames to the de-multiplexer on the Data Interface Unit.

3.4.2 Communications Processor

The processor used in the Codan 8800 series is a Motorola 32-bit MPC860 series PowerQUICC™ Integrated Communications Processor which is a versatile one-chip integrated microprocessor and peripheral combination that excels particularly in communications and networking products.

The MPC860 integrates two processing blocks. One block is the embedded MPC8xx core and the second block is a Communication Processor Module (CPM) based on the MC68360 CPM. The CPM supports eight serial channels—four serial communications controllers, two serial management controllers, one serial peripheral interface, and one I^2C interface. This dual-processor architecture provides lower power consumption than traditional architectures because the CPM off-loads peripheral tasks from the embedded MPC8xx core.

The MPC860 is supported by 4 MByte of memory, which is configured as two banks of 2 MByte in each bank. Only one bank of memory is used to support the terminal at any given time.

The Indoor Unit is dispatched from the factory with the most recent version of firmware loaded into each bank of memory. Each bank of memory can be configured with different versions of firmware, which allows a firmware upgrade to be carried out whilst the Indoor Unit continues to function with a previous version of firmware.

3.4.3 Operating System

The operating system chosen for the Codan 8800 series of Digital Microwave Radios is PSOS or Proverbially Secure Operating System.

This system is extremely robust and efficient in network communications devices.

The software supports “Plug and Play” automatic identification and configuration of Data Interface Units and Outdoor Unit frequency bands.

Chapter 4 Data Interface Units

4.1 Data Interface Unit Overview

The architecture of the Codan 8800 series is designed to make the product very flexible.

The personality of the DMR terminal is determined by choosing one, of several Data Interface Units (DIU).

The Data Interface Units available are:

4.1.1 ETSI

- 4E1, BNC type, 75Ω, plus EOW for unprotected configurations– Codan part number 08-06306-001
- 16E1, RJ45, 120 Ω plus E3, BNC. Used as 2E1 to 16E1, or E3 or E3 + 1E1 for unprotected configurations – Codan part number 08-06307-001
- 16E1, SCSI, 75Ω/120 Ω. Used for 2E1 to 16E1 for unprotected or protected configurations – Codan part number 08-06309-001
- 16E1, SCSI, 75Ω/120 Ω plus E3, BNC plus EOW. Used for 2E1 to 16E1, or E3 for unprotected or protected configurations – Codan part number 08-06309-003
- Four 10/100Base-T plus 4E1 – Codan part number 08-06308-001

4.1.2 FCC

- 16DS1, RJ45, 100 Ω plus DS3, BNC. Used as 2DS1 to 16DS1, or DS3 or DS3 + 4DS1 for unprotected configurations – Codan part number 08-06307-002
- 16DS1, SCSI, 100 Ω. Used for 2DS1 to 16DS1 for unprotected or protected configurations – Codan part number 08-06309-002
- 16DS1, SCSI, 100 Ω, plus DS3, BNC plus EOW. Used for 2DS1 to 1DSE1, or DS3 for unprotected or protected configurations – Codan part number 08-06309-004
- Four 10/100Base-T plus 4DS1 – Codan part number 08-06308-002

4.2 DIU Physical Description

Data Interface Units (DIU's) consist of a small front panel mounted on a circuit board and are described in this section. The DIU plugs into the recess on the left side front of the Codan 8800 series Indoor Unit.

4.2.1 Data Interface Unit: 4E1, BNC + EOW

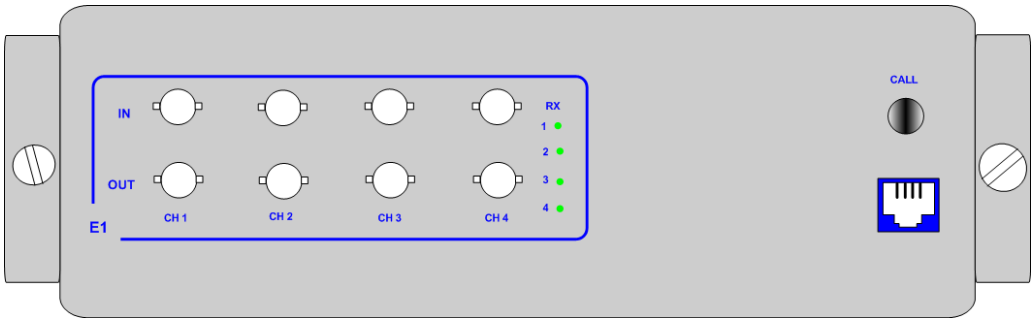

Figure 10 - Data Interface Unit 4 E1 BNC + EOW

The 4 E1 BNC + EOW type DIU can be configured as 2E1 or 4E1.

The inputs support 75 ohm unbalanced. Each channel has a green LED to indicate that the receive path is active. This DIU can only be used in the 1 + 0 configuration.

This DIU also features an RJ-11 connector for a telephone handset and push button to call the remote side. The EOW facility enables telephone communications between two terminals.

The handset is a “k” style unit. It incorporates a low-level electric microphone and a dynamic receiver equipped with a hearing aid coil and a varistor for limiting the receive level.

4.2.2 Data Interface Unit: 16 E1 + E3

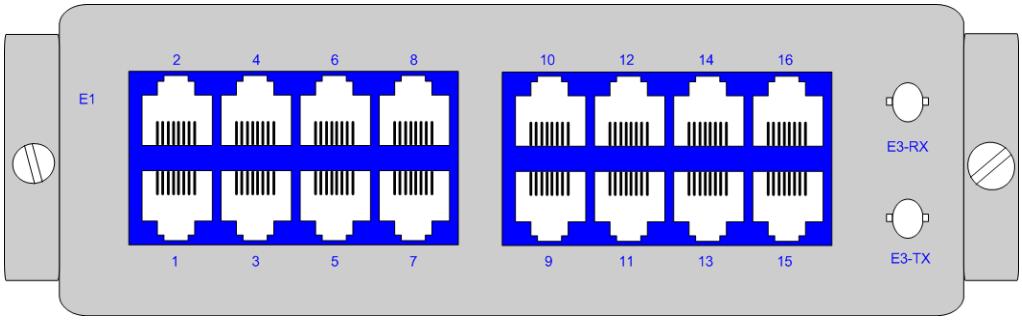

Figure 11 - Data Interface Unit E3 + 16 E1

The 16E1 + E3 DIU unit can be configured as 2E1, 4E1, 8E1, 16E1, E3, and E3+1E1.

Data connections are made via

- E1 – Shielded RJ45 connectors (x 16), 120 Ω
- E3 – Tx / Rx BNC connectors (x 2), 75 Ω unbalanced

This DIU can only be used in the 1 + 0 configuration.

4.2.3 Data Interface Unit: 16 E1, SCSI

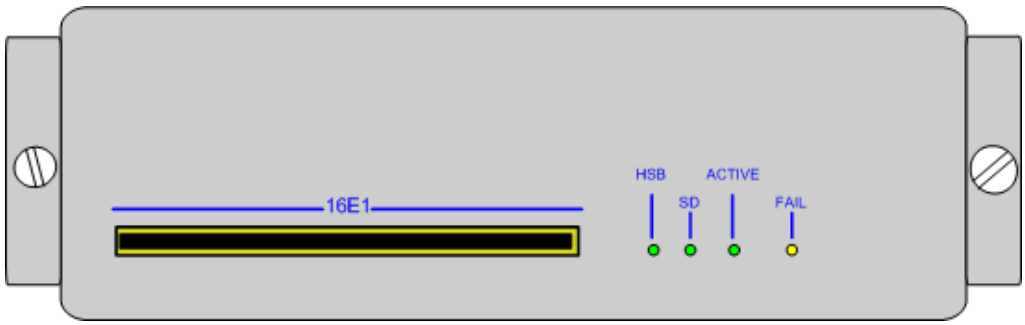

Figure 12 - Data Interface Unit 16 E1, SCSI

The 16E1, SCSI DIU unit can be configured as 2E1, 4E1, 8E1 and 16E1.

This DIU can be used in the 1 + 0, or 1 + 1 configuration.

Data connections are made via:

- E1 – 100-pin SCSI connector and cable at either 75 Ω or 120 Ω, software selectable.
- Cables with a SCSI plug to various cable configurations (Open Tail, DB37, etc) are available and breakout boxes with BNC, DB25, Krone and RJ45 can be supplied.

4.2.4 Data Interface Unit: 16 E1 + E3, SCSI

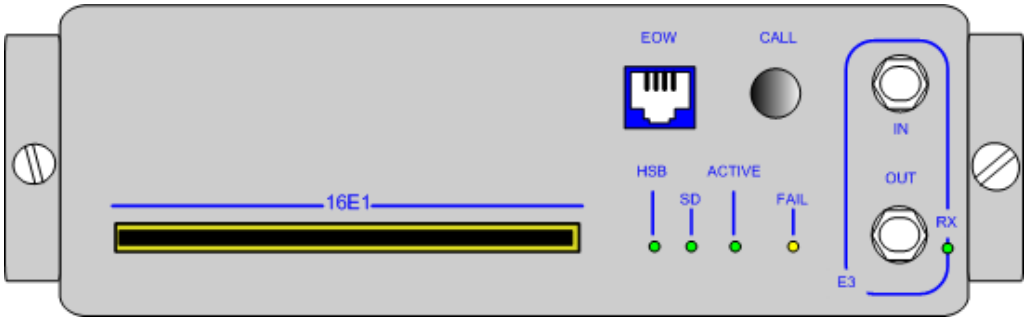

Figure 13 - Data Interface Unit 16 E1 + E3, SCSI

The 16 E1 + E3, SCSI DIU unit can be configured as 2E1, 4E1, 8E1, 16E1, E3 and E3 + 1E1.

This DIU can be used in the 1 + 0, or 1 + 1 configuration.

Data connections are made via:

- E1 – 100-pin SCSI connector and cable at either 75 Ω or 120 Ω, software selectable.
- E3 – BNC at 75 Ω for 1 + 0, 100-pin SCSI connector and cable at 75 Ω for 1 + 1.
- Cables with a SCSI plug to various cable configurations (Open Tail, DB37, etc) are available and breakout boxes with BNC, DB25, Krone and RJ45 can be supplied.

4.2.5 Data Interface Unit: 10/100BaseT + 4 E1

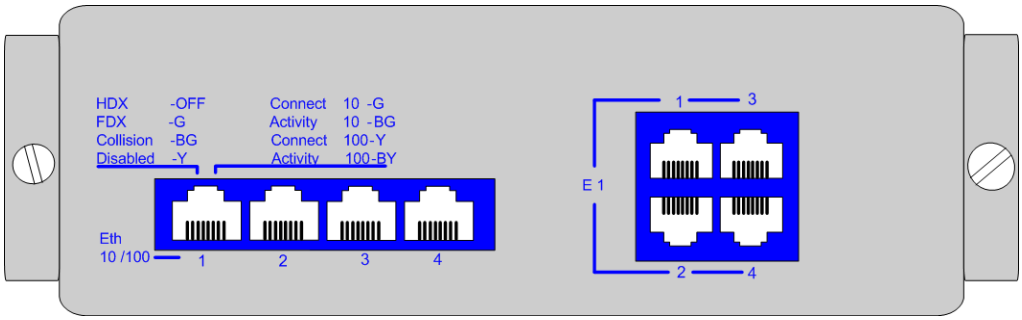

Figure 14 - Data Interface Unit 10/100BaseT + 4E1

The Data Interface Unit 10/100BaseT + 4E1 can be configured as 1, 2, 3 or 4 x LAN plus 0E1, 1E1, 2E1 or 4E1.

The LAN ports can be configured for full or half duplex with auto negotiation.

Each of the 10/100 Base-T ports is fully scalable.

The Ethernet 10/100BaseT connection is equipped with on-line status indications. 2 LED's on each port perform the indication as follows:

Left Side LED:

- HDX Off Half-Duplex while the LED is off
- FDX G Full-Duplex while the LED is green
- Collision BG Collisions while the LED is blinking green
- Disabled Y The Port is disabled while the LED is yellow

Right Side LED:

- Connect 10 G The port is configured to 10Mbps while the LED is green
- Activity 10 BG Throughput is 10Mbps while the LED is blinking green
- Connect 100 Y The port is configured to 100Mbps while the LED is yellow
- Activity 100 BY Throughput is 100Mbps while the LED is blinking yellow

Data connections are made via:

- 10 / 100Base-T – Shielded RJ45 connectors (x2), 100 Ω
- E1 – Shielded RJ45 connectors (x4), 120 Ω balanced

4.2.6 Data Interface Unit: 16 DS1

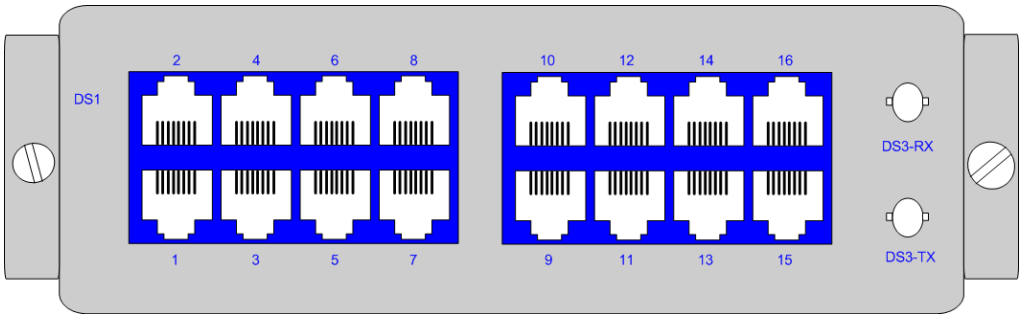

Figure 15 - Data Interface Unit DS3 + 16DS1

The 16DS1 + DS3 DIU unit can be configured to 2DS1, 4DS 1, 8DS 1, 16DS 1, DS3, DS3 +1DS1, DS3 +2DS1and DS3 + 4DS1.

Data connections are made via:

- DS1 – Shielded RJ45 connectors (x 16), 100 Ω
- DS3 – Tx / Rx BNC connectors (x 2), 75 Ω unbalanced

4.2.7 Data Interface Unit: 16 DS1, SCSI

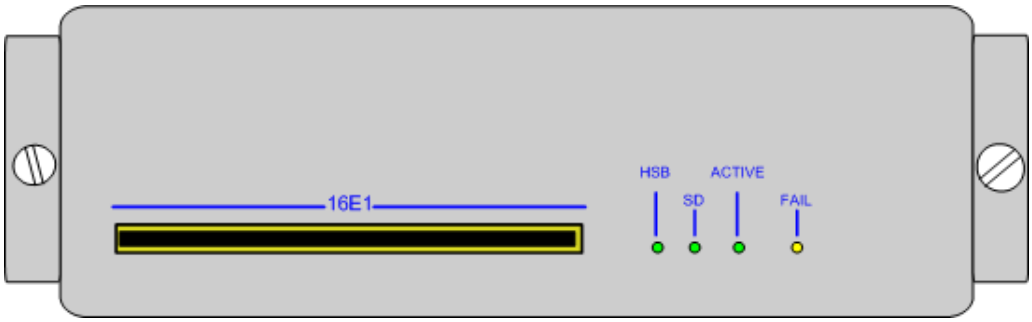

Figure 16 - Data Interface Unit 16 DS1, SCSI

The 16DS1, SCSI DIU unit can be configured as 2DS1, 4DS1, 8DS1 and 16DS1.

This DIU can be used in the 1 + 0, or 1 + 1 configuration.

Data connections are made via:

- E1 – 100-pin SCSI connector and cable at 100 Ω.
- Cables with a SCSI plug to various cable configurations (Open Tail, DB37, etc) are available and breakout boxes with DB25, Krone and RJ45 can be supplied.

4.2.8 Data Interface Unit: 16 DS1 + DS3, SCSI

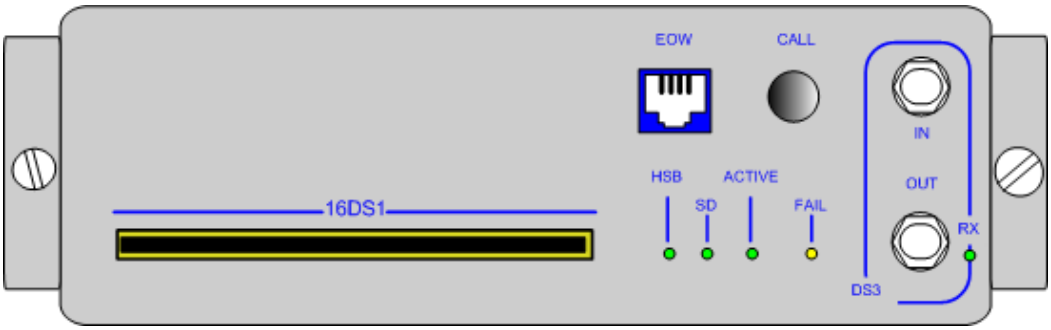

Figure 17 - Data Interface Unit 16 DS1 + DS3, SCSI

The 16DS1 + DS3, SCSI DIU unit can be configured as 2DS1, 4DS1, 8DS1, 16DS1, DS3, DS3 + 1DS1, DS3 + 2DS1 and DS3 + 4DS1.

This DIU can be used in the 1 + 0, or 1 + 1 configuration.

Data connections are made via:

- DS1 – 100-pin SCSI connector and cable at 100 Ω.
- DS3 – BNC at 75 Ω for 1 + 0, 100-pin SCSI connector and cable at 75 Ω for 1 + 1.
- Cables with a SCSI plug to various cable configurations (Open Tail, DB37, etc) are available and breakout boxes with BNC, DB25, Krone and RJ45 can be supplied.

4.2.9 Data Interface Unit: 10/100Base-T + 4 DS1

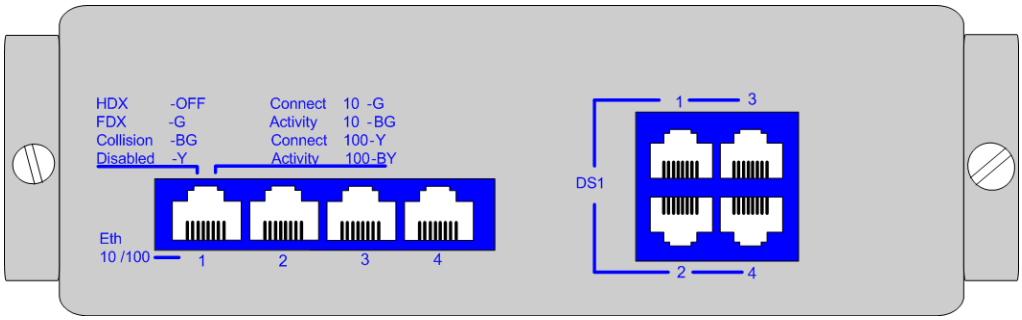

Figure 18 - Data Interface Unit 10/100BaseT + 4DS1

The Data Interface Unit 10/100BaseT + 4DS1 can be configured as 1, 2, 3 or 4 x LAN plus 0DS1, 1DS1, 2DS1 or 4DS1.

The LAN ports can be configured for full or half duplex with auto negotiation.

Each of the 10/100 Base-T ports is fully scalable.

The Ethernet 10/100BaseT connection is equipped with on-line status indications. 2 LED's on each port perform the indication as follows:

Left Side LED:

- HDX Off Half-Duplex while the LED is off
- FDX G Full-Duplex while the LED is green
- Collision BG Collisions while the LED is blinking green
- Disabled Y The Port is disabled while the LED is yellow

Right Side LED:

- Connect 10 G The port is configured to 10Mbps while the LED is green
- Activity 10 BG Throughput is 10Mbps while the LED is blinking green
- Connect 100 Y The port is configured to 100Mbps while the LED is yellow
- Activity 100 BY Throughput is 100Mbps while the LED is blinking yellow

Data connections are made via:

- 10 / 100Base-T – Shielded RJ45 connectors (x2), 100 Ω
- DS1 – Shielded RJ45 connectors (x4), 100 Ω balanced

4.3 DIU Technical Description – Design

The Codan 8800 series of Data Interface Units are based on advanced E1/DS1 or Ethernet chip sets.

These chipsets are the interface between the user traffic and the digital modem.

Irrespective of the type of model of the Data Interface Unit selected the chip sets used are the same across the range for the same functionality.

4.3.1 E1/DS1 Design

The Line Interface of every E1/DS1 port is coupled to the user data by high quality impedance matching transformers. The correct impedance is set in the factory for the Data Interface Units, which use the RJ45 or BNC connectors, whilst the impedance of the Data Interface Units, which use the SCSI connector, can be set via the MINet software, by the end user.

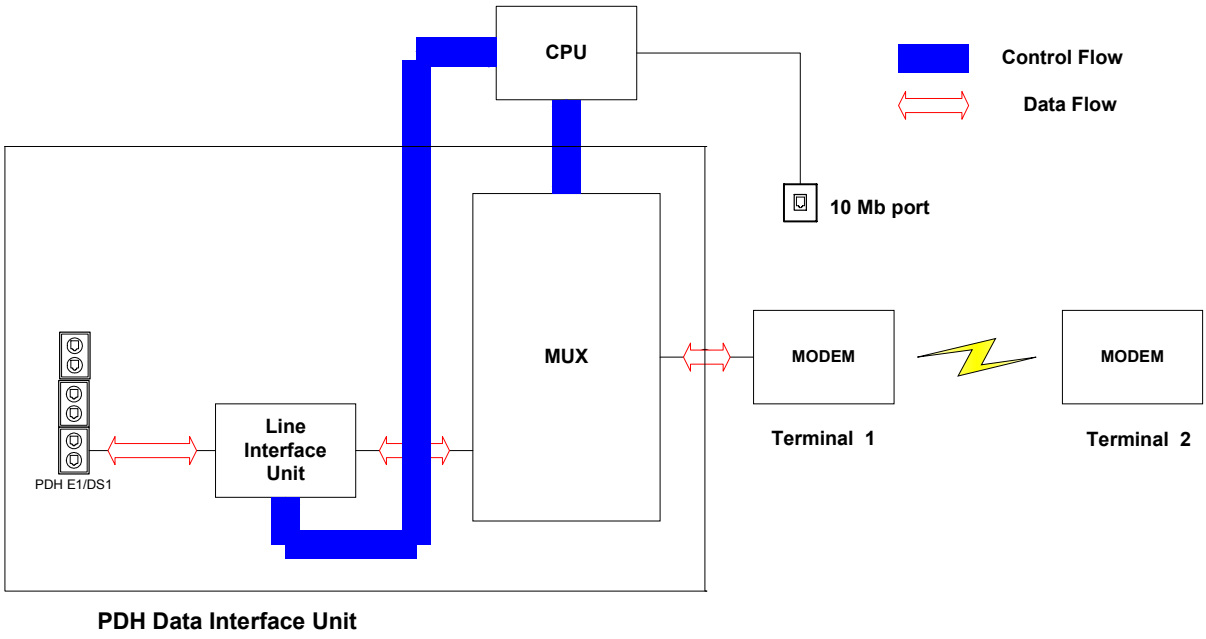

Figure 19 - PDH Interface Block Diagram

The PDH ports of the Data Interface Units are based on the Cirrus Logic CS61884-4 8E1/DS1 framer.

This chip set provide a number of advanced features for the PDH interface:

- Internal AMI, B8ZS, or HDB3 Encoding/Decoding
- LOS Detection per T1.231, ITU G.775, ETSI 300-233
- G.772 Non-Intrusive Monitoring
- G.703 BITS Clock Recovery
- Crystal-less Jitter Attenuation
- Serial/Parallel Microprocessor Control Interfaces
- Transmitter Short Circuit Current Limiter (<50mA)
- TX Drivers with Fast High-Z and Power Down
- JTAG Boundary Scan compliant to IEEE 1149.1

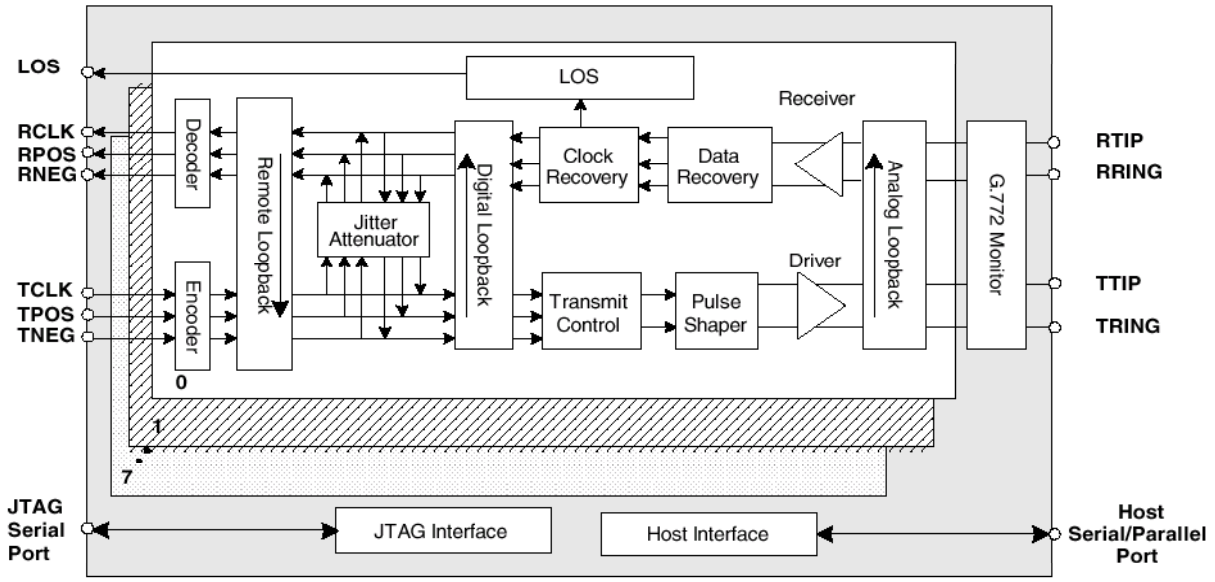

Figure 20 - Block Diagram of the Cirrus Logic CS61884-4 8E1/DS1 framer.

The CS61884 is a full-featured Octal E1/T1/J1 short-haul LIU that supports both 1.544 Mbps and 2.048 Mbps data transmission. Each channel provides crystal-less jitter attenuation that complies with the most stringent standards.

Each channel provides internal AMI/B8ZS/HDB3 encoding/decoding. To support enhanced system diagnostics.

The chipset can be configured for G.772 non-intrusive monitoring of any of the receive or transmit paths.
The chipset makes use of ultra low power matched impedance transmitters and receivers. By achieving a more precise line match, this technique also provides superior return loss characteristics.

All transmitters have controls for independent power down and high impedance.

Each receiver provides reliable data recovery with over 12 dB of cable attenuation.

The receiver also incorporates LOS detection compliant to the most recent specifications.

Both the E1 and DS1 interfaces conform to the standard pulse masks.

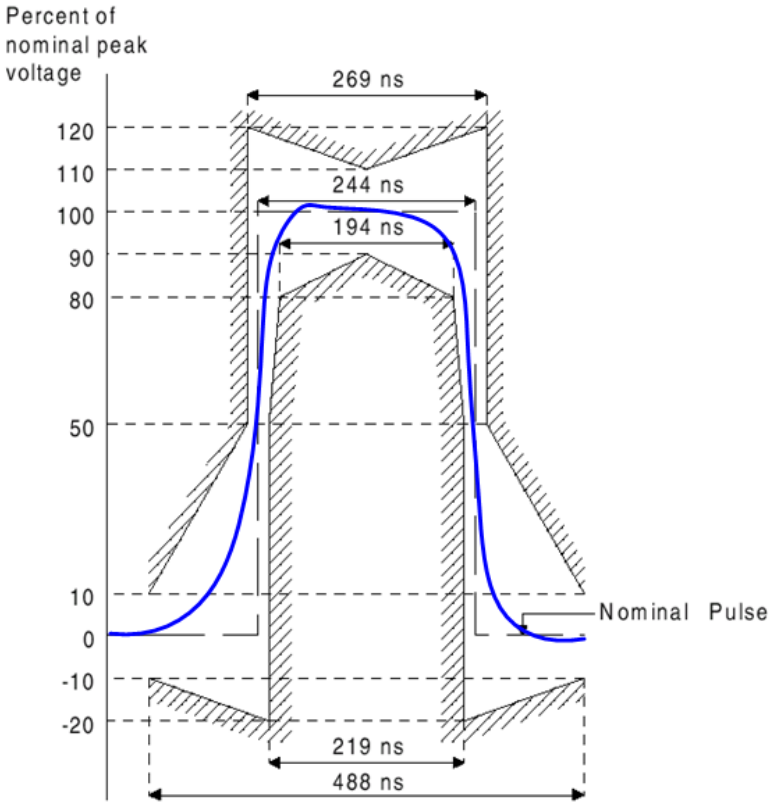

Figure 21 - E1 Pulse Mask

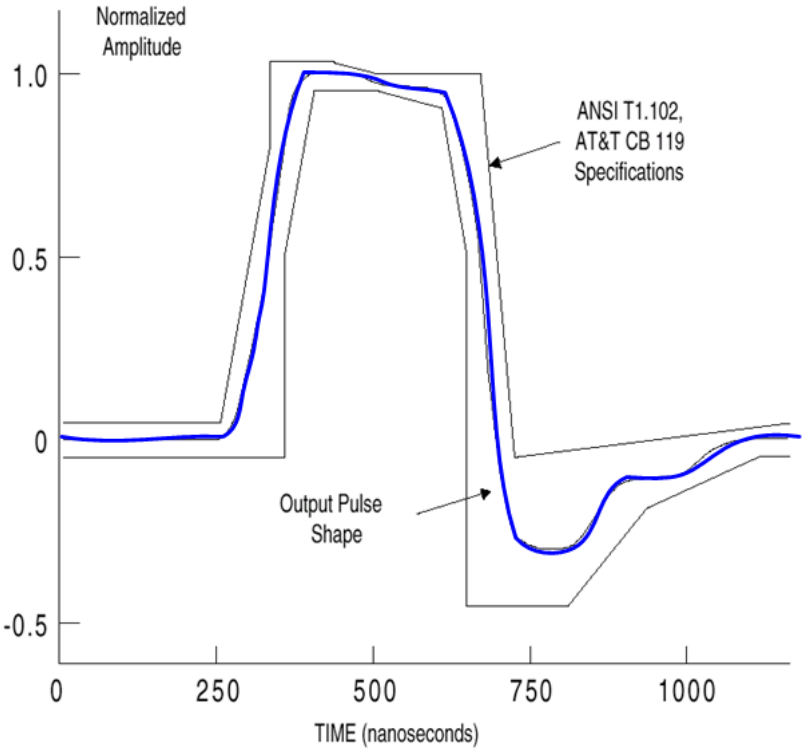

Figure 22 - DS1 Pulse Mask

4.3.2 Ethernet Design

The Line Interface of every Ethernet port is coupled to the user data by high quality impedance matching transformers.

The configuration of the Ethernet port is shown in the following diagram:

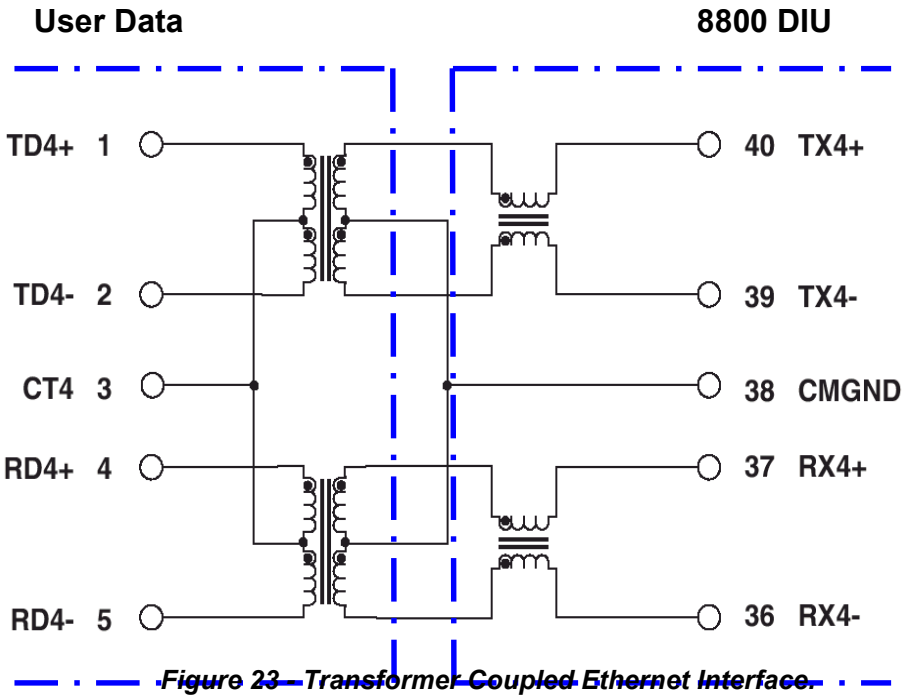

Figure 23 – Transformer Coupled Ethernet Interface.

The following is the basic block diagram of the Ethernet Data Unit Interface:

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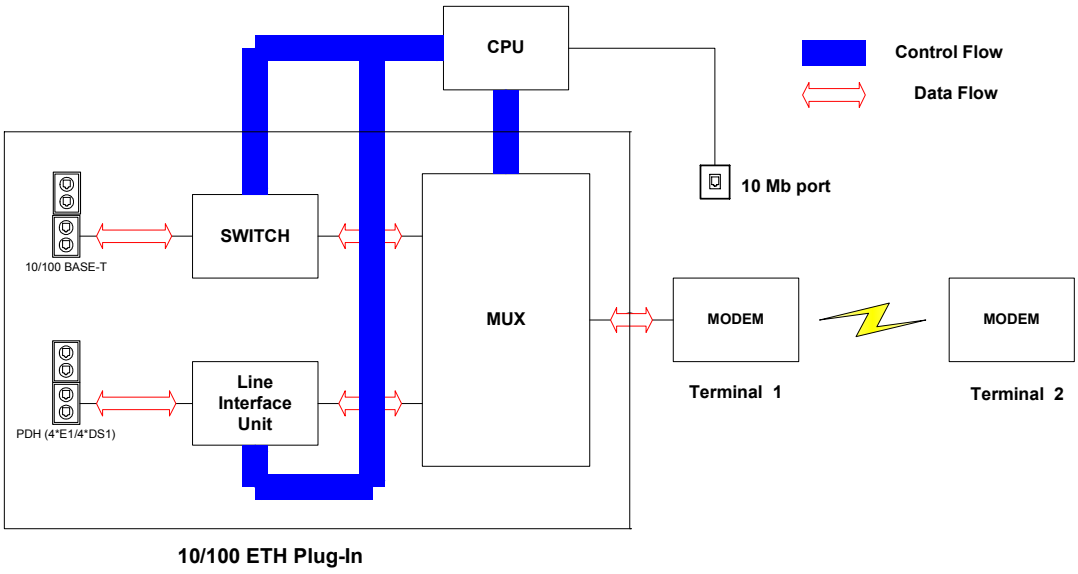


Figure 24 - Ethernet Interface Block Diagram.

The Ethernet ports of the Data Interface Units are based on the Marvell Link Street 88E6063 7-port switch.

This 88E6063 device is a 7-port Quality of Service (QoS) switch integrating a high-performance switching fabric with four priority queues, a high-speed address look-up engine, five 10/100 Ethernet digital PHY ports, two MII ports, seven independent Media Access Controllers (MACs), Virtual Cable Tester (VCT) technology for advanced cable diagnostics, 1Mb of memory.

Other advanced features include 802.1p/IPv4/IPv6 traffic classification, 802.1Q VLAN, extensive RMON counters and special power management techniques for lowest power dissipation.

The 88E6063 switch is optimised for fastest packet routing.

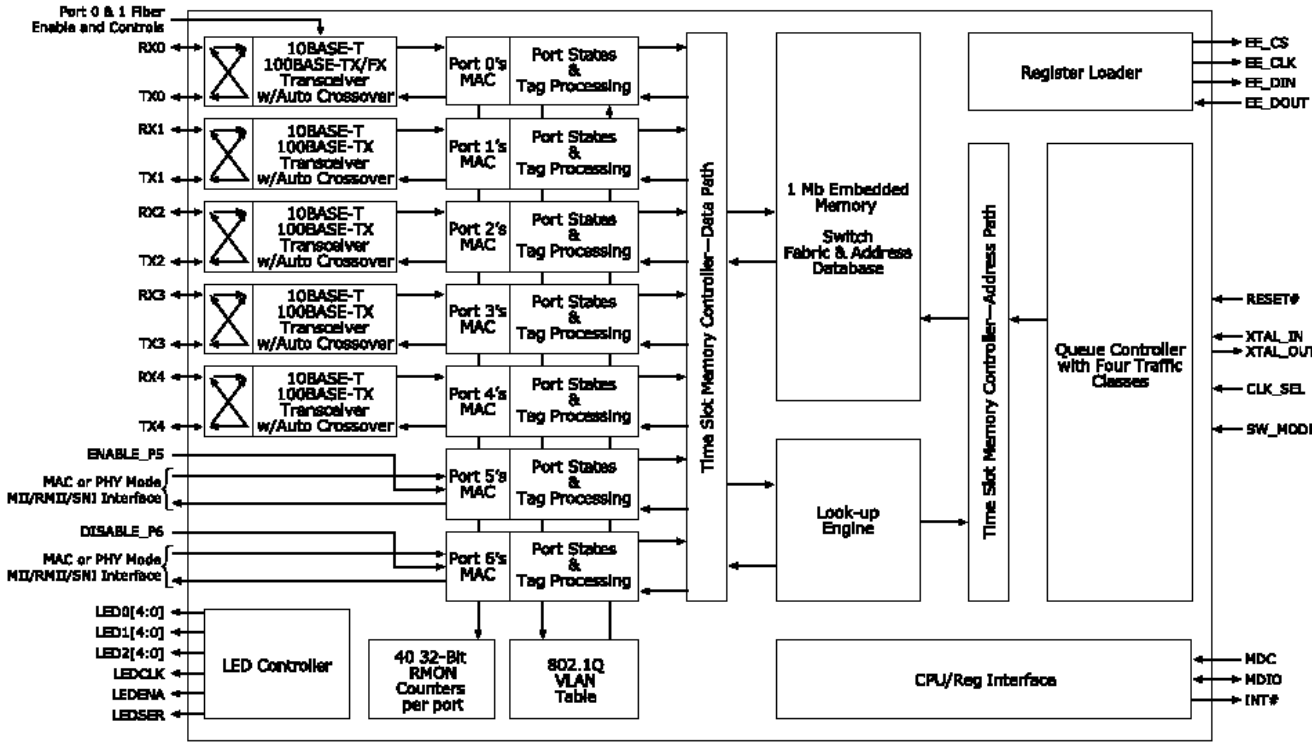


Figure 25 - Block Diagram of the Link Street 88E6063 7-port Ethernet Switch.

The Codan 8800 series Ethernet Data Interface Units support full scalability on each of the Ethernet ports. This is managed via the MINet software.

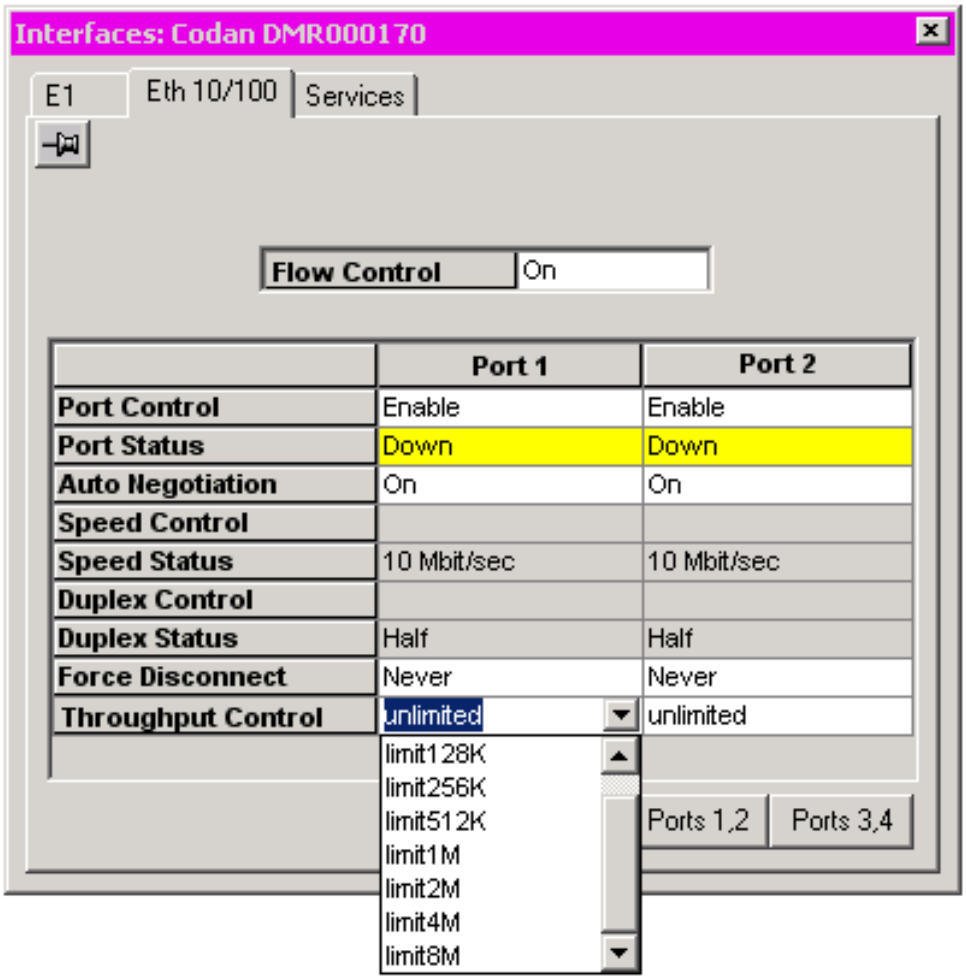


Figure 26 - Ethernet Interface Port Speed Control

Chapter 5 Outdoor Units

5.1 Outdoor Unit (ODU) – Overview

The Outdoor Unit (ODU) is a single compact, lightweight unit containing the transmitter, the receiver and the duplex branching filter.

The housing is common to all frequency bands and is designed to mount directly to antennas up to 1800 mm in diameter.

The ODU is pressure tested in the factory and then a small plug seals the pressure gland.

The conical profile of the heat sink elements means that high passive cooling efficiency is achieved. An internal temperature rise of only 8º C with maximum transmit power is noted.

Figure 27 - Outdoor Unit

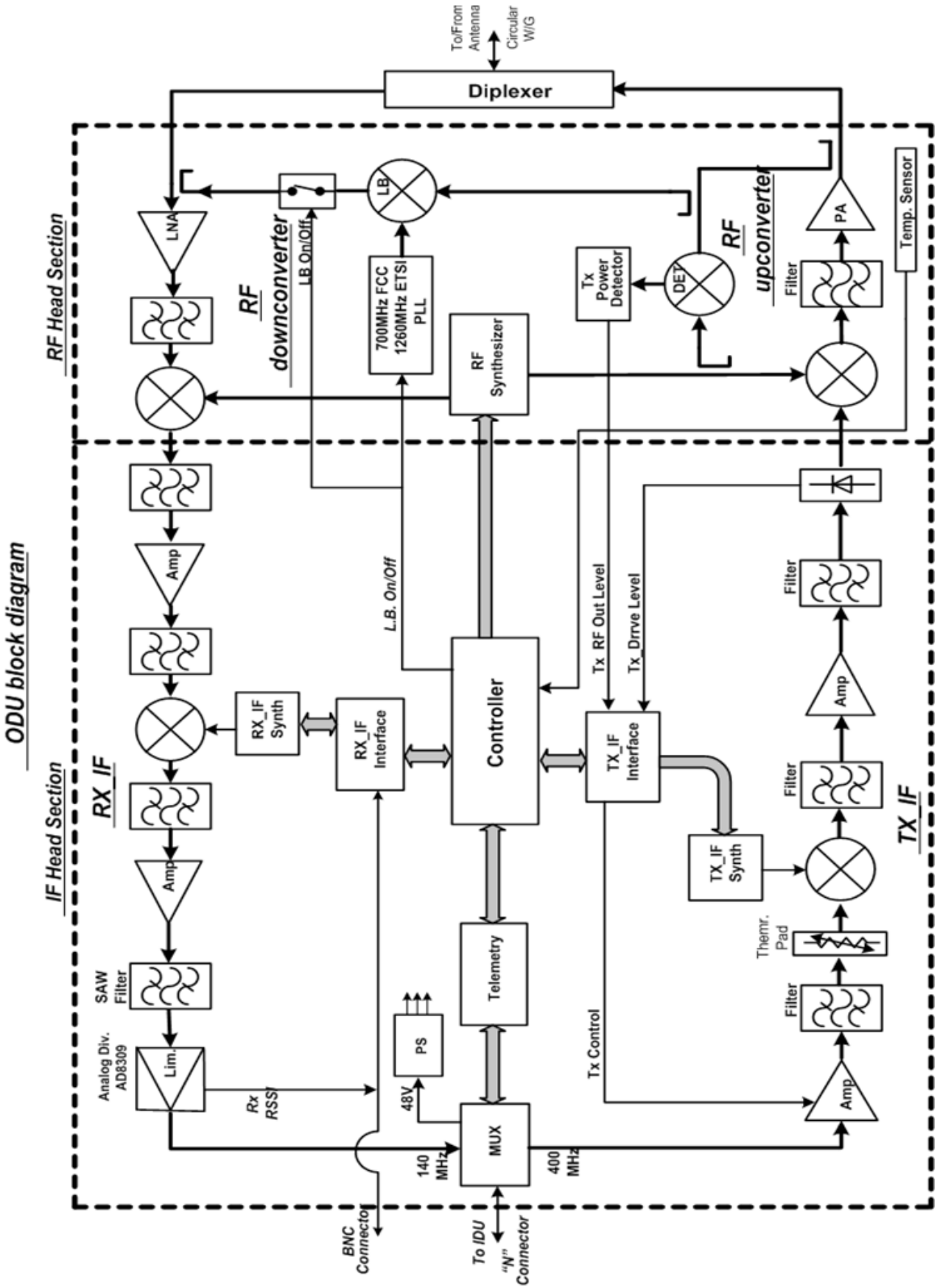


Figure 28 - Block Diagram of the ODU

The ODU contains the RF section of the link and generates all of the RF signals.

Monitoring and RF status is conveyed between the IDU and ODU via half duplex telemetry.

The ODU can be mounted on a mast, tower or rooftop, and it can be removed from the antenna without affecting antenna alignment.

The ODU is installed in with the “N” Type connector towards the down position, 45º from vertical. The ODU can be rotated 90º thus both horizontal polarisation and vertical polarisation are supported.

A BNC connector is provided to monitor the receiver level during antenna alignment. The voltage provided is linearised such that each 10 dB of receive signal is approximately 600 mV DC. Refer to the following table:

Table 5-1 RSL Volts at BNC connector

RSL	-10	-20	-30	-40	-50	-60	-70	-80	-85
Volts DC	4.9	4.3	3.8	3.2	2.7	2.1	1.6	1.1	0.8

A single low cost coaxial cable is used to communicate between the IDU and the ODU This cable carries the transmit IF signal from the IDU to the ODU, the receive IF signal back from the ODU to the IDU and the telemetry signals being passed in both directions.

Power for the ODU is derived from the IDU and is the same supply voltage and polarity as feeds the IDU. A power supply in the ODU generates the appropriate voltages required. The IF cable also provides DC power to the ODU from the IDU.

5.2 Frequency Band Theory

Both ETSI and FCC radio standards define Transmit (Tx), and Receive (Rx) frequencies. The spacing between the Tx and Rx frequencies is fixed, and varies depending on the frequency band in use and the applicable local standards.

The Codan 8800 series divides most frequency bands into four sub bands, or one ODU per sub band. In some instances, where the band plan allows a large duplex frequency separation (15 GHz with a 720 MHz split), then a single pair of Codan 8800 series ODU’s will manage the whole band.

An Codan 8800 series local terminal that transmits on sub-band 1 receives a signal transmitted in sub-band 3 from the remote terminal and vice versa. By the same token, an Codan 8800 series terminal that transmits in sub-band 4 receives a signal transmitted in sub-band 2 and vice versa.

Shown below is an example of the 15 GHz band with a 420 MHz Duplex Frequency.

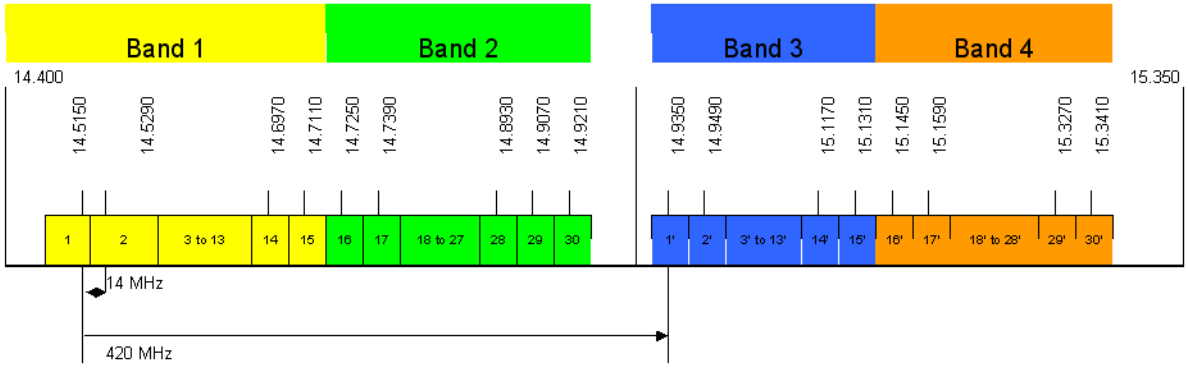


Figure 29 -15 GHz Band ODU Relationships

5.2.1 Frequency Bands and ODU Relationships

The Codan 8800 series complies with the following communications/radio standards:

- CEPT/ERC/REC 12-08E,
- REC ITU-R F.386-6,
- ETSI EN 301 Z16
- REC ITU-R F.747,
- ETSI EN 301 128
- CEPT/ERC/REC 12-02E,
- REC ITU-R F497-5
- Mexico / ETSI EN 301 128
- ACA RALI – FX3:
- REC ITU-R F.636-3,
- CEPT/ERC/REC/12-07E,
- FCC Part 101 & Part 15/B & Part 2
- CEPT/REC/ 12-03E,
- REC ITU-R F.595-6,
- ETSI T/R 13-02E,
- ITU-R F.637-3,
- ETSI T/R 13-02E,
- T/R 12-01/ITU-R F.749-1,

To achieve full duplex communications, ODU's are supplied in partner pairs.

The Codan 8800 series will require an ODU partnership of sub bands 1 and 3 or sub bands 2 and 4.

A 1 + 0 link will always have a matched pair of ODU's, with one of each sub bands 1 and 3 or 2 and 4. These will always have an odd and even part number. The lowest part number will always be odd**.**

A 1 + 1 link will always have a two matched pairs of ODU's, with two sub bands 1 and 3 or 2 and 4.

The following tables show this relationship for the various frequency bands, and the coverage of the respective ODU combinations.

Terminal "A"

Sub-Bands 1 or 2

Terminal "B"

Sub-Bands 3 or 4

Table 5-2 ITU – 7 GHz – Standard Power

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
154 MHz	1	ODU, ITU, Tx 7.128 - 7.212 GHz	08-06310-001	3	ODU, ITU, Tx 7.282 - 7.366 GHz	08-06310-002
	2	ODU, ITU, Tx 7.212 - 7.268 GHz	08-06310-003	4	ODU, ITU, Tx 7.366 - 7.422 GHz	08-06310-004
	1	ODU, ITU, Tx 7.428 - 7.512 GHz	08-06310-009	3	ODU, ITU, Tx 7.582 - 7.666 GHz	08-06310-010
	2	ODU, ITU, Tx 7.512 - 7.568 GHz	08-06310-011	4	ODU, ITU, Tx 7.666 - 7.722 GHz	08-06310-012
161 MHz	1	ODU, ITU, Tx 7.1245 - 7.2085 GHz	08-06310-005	3	ODU, ITU, Tx 7.2855 - 7.3695 GHz	08-06310-006
	2	ODU, ITU, Tx 7.2085 - 7.265 GHz	08-06310-007	4	ODU, ITU, Tx 7.3695 - 7.4255 GHz	08-06310-008
	1	ODU, ITU, Tx 7.253 - 7.358 GHz	08-06310-021	3	ODU, ITU, Tx 7.414 - 7.519 GHz	08-06310-022
	2	ODU, ITU, Tx 7.358 - 7.477 GHz	08-06310-023	4	ODU, ITU, Tx 7.519 - 7.631 GHz	08-06310-024
	1	ODU, ITU, Tx 7.4245 - 7.4945 GHz	08-06310-013	3	ODU, ITU, Tx 7.5855 - 7.6555 GHz	08-06310-014
	2	ODU, ITU, Tx 7.4945 - 7.5645 GHz	08-06310-015	4	ODU, ITU, Tx 7.6555 - 7.7255 GHz	08-06310-016
245 MHz	1	ODU, ITU, Tx 7.428 - 7.540 GHz	08-06310-017	3	ODU, ITU, Tx 7.673 - 7.785 GHz	08-06310-018
	2	ODU, ITU, Tx 7.540 - 7.7652 GHz	08-06310-019	4	ODU, ITU, Tx 7.785 - 7.897 GHz	08-06310-020

Table 5-3 ITU – 7 GHz – High Power

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band	ODU, ITU, Tx 7.6555 - 7.7255 GHz	Part No
154 MHz	1	ODU, ITU, Tx 7.128 - 7.212 GHz	08-06311-001	3	ODU, ITU, Tx 7.282 - 7.366 GHz	08-06311-002
	2	ODU, ITU, Tx 7.212 - 7.268 GHz	08-06311-003	4	ODU, ITU, Tx 7.366 - 7.422 GHz	08-06311-004
	1	ODU, ITU, Tx 7.428 - 7.512 GHz	08-06311-009	3	ODU, ITU, Tx 7.582 - 7.666 GHz	08-06311-010
	2	ODU, ITU, Tx 7.512 - 7.568 GHz	08-06311-011	4	ODU, ITU, Tx 7.666 - 7.722 GHz	08-06311-012
161 MHz	1	ODU, ITU, Tx 7.1245 - 7.2085 GHz	08-06311-005	3	ODU, ITU, Tx 7.2855 - 7.3695 GHz	08-06311-006
	2	ODU, ITU, Tx 7.2085 - 7.265 GHz	08-06311-007	4	ODU, ITU, Tx 7.3695 - 7.4255 GHz	08-06311-008
	1	ODU, ITU, Tx 7.253 - 7.358 GHz	08-06311-021	3	ODU, ITU, Tx 7.414 - 7.519 GHz	08-06311-022
	2	ODU, ITU, Tx 7.358 - 7.477 GHz	08-06311-023	4	ODU, ITU, Tx 7.519 - 7.631 GHz	08-06311-024
	1	ODU, ITU, Tx 7.4245 - 7.4945 GHz	08-06311-013	3	ODU, ITU, Tx 7.5855 - 7.6555 GHz	08-06311-014
	2	ODU, ITU, Tx 7.4945 - 7.5645 GHz	08-06311-015	4	ODU, ITU, Tx 7.6555 - 7.7255 GHz	08-06311-016

Table 5-4 ITU – 8 GHz – Standard Power

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
119 MHz	1	ODU, ITU, Tx 8.279 - 8.335 GHz	**08-06312-005**	3	ODU, ITU, Tx 8.398 - 8.454 GHz	**08-06312-006**
	2	ODU, ITU, Tx 8.321 - 8.377 GHz	**08-06312-007**	4	ODU, ITU, Tx 8.440 - 8.496 GHz	**08-06312-008**
126 MHz	1	ODU, ITU, Tx 8.279 - 8.328 GHz	**08-06312-009**	3	ODU, ITU, Tx 8.405 - 8.454 GHz	**08-06312-010**
	2	ODU, ITU, Tx 8.321 - 8.370 GHz	**08-06312-011**	4	ODU, ITU, Tx 8.447 - 8.496 GHz	**08-06312-012**
311.32 MHz	1	ODU, ITU, Tx 7.725 - 7.852 GHz	**08-06312-001**	3	ODU, ITU, Tx 8.036 - 8.164 GHz	**08-06312-002**
	2	ODU, ITU, Tx 7.844 - 7.971 GHz	**08-06312-003**	4	ODU, ITU, Tx 8.155 - 8.283 GHz	**08-06312-004**

Table 5-5 ITU – 8 GHz – High Power

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
119 MHz	1	ODU, ITU, Tx 8.279 - 8.335 GHz	**08-06313-005**	3	ODU, ITU, Tx 8.398 - 8.454 GHz	**08-06313-006**
	2	ODU, ITU, Tx 8.321 - 8.377 GHz	**08-06313-007**	4	ODU, ITU, Tx 8.440 - 8.496 GHz	**08-06313-008**
126 MHz	1	ODU, ITU, Tx 8.279 - 8.328 GHz	**08-06313-009**	3	ODU, ITU, Tx 8.405 - 8.454 GHz	**08-06313-010**
	2	ODU, ITU, Tx 8.321 - 8.370 GHz	**08-06313-011**	4	ODU, ITU, Tx 8.447 - 8.496 GHz	**08-06313-012**
311.32 MHz	1	ODU, ITU, Tx 7.725 - 7.852 GHz	**08-06313-001**	3	ODU, ITU, Tx 8.036 - 8.164 GHz	**08-06313-002**
	2	ODU, ITU, Tx 7.844 - 7.971 GHz	**08-06313-003**	4	ODU, ITU, Tx 8.155 - 8.283 GHz	**08-06313-004**

Table 5-6 ITU – 10.5 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
91 MHz	1	ODU, ITU, Tx 10.504 – 10.548 GHz	**08-06443-001**	3	ODU, ITU, Tx 10.592 – 10.636 GHz	**08-06443-002**
	2	ODU, ITU, Tx 10.548 – 10.592 GHz	**08-06443-003**	4	ODU, ITU, 10.636 –10.680 GHz	**08-06443-004**

Table 5-7 ACA, FCC – 10.5 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
65 MHz	1	ODU, ACA, Tx 10.550 – 10.583 GHz	**08-06442-001**	3	ODU, ACA, Tx 10.615 – 10.648 GHz	**08-06442-002**
	2	ODU, ACA, Tx 10.582 – 10.615 GHz	**08-06442-003**	4	ODU, ACA, 10.647 –10.680 GHz	**08-06442-004**

Table 5-8 ITU – 13 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
266 MHz	1	ODU, ITU, Tx 12.751 - 12.863 GHz	**08-06433-001**	3	ODU, ITU, Tx 13.017 - 13.129 GHz	**08-06433-002**
	2	ODU, ITU, Tx 12.863 - 12.975 GHz	**08-06433-003**	4	ODU, ITU, Tx 13.129 - 13.241 GHz	**08-06433-004**

Table 5-9 ITU, ACA – 15 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
315 MHz	1	ODU, ITU, Tx 14.628 - 14.767 GHz	**08-06315-001**	3	ODU, ITU, Tx 14.943 - 15.082 GHz	**08-06315-002**
	2	ODU, ITU, Tx 14.760 - 14.911 GHz	**08-06315-003**	4	ODU, ITU, Tx 15.075 - 15.226 GHz	**08-06315-004**
420 MHz	1	ODU, ITU, Tx 14.501 - 14.725 GHz	**08-06315-005**	3	ODU, ITU, Tx 14.921 - 15.145 GHz	**08-06315-006**
	2	ODU, ITU, Tx 14.718 - 14.928 GHz	**08-06315-007**	4	ODU, ITU, Tx 15.138 - 15.348 GHz	**08-06315-008**
490 MHz	1	ODU, ITU, Tx 14.403 - 14.634 GHz	**08-06315-013**	3	ODU, ITU, Tx 14.893 - 15.124 GHz	**08-06315-014**
	2	ODU, ITU, Tx 14.627 - 14.858 GHz	**08-06315-015**	4	ODU, ITU, Tx 15.117 - 15.348 GHz	**08-06315-016**
644 MHz	1	ODU, ACA, Tx 14.500 - 14.7125 GHz	**08-06315-009**	3	ODU, ACA, Tx 14.925 - 15.1375 GHz	**08-06315-010**
	2	ODU, ACA, Tx 14.7125 - 14.925 GHz	**08-06315-011**	4	ODU, ACA, Tx 15.1375 - 15.350 GHz	**08-06315-012**

Table 5-10 ITU – 18 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
1010 MHz	1	ODU, ITU, Tx 17.714 – 18.190 GHz	**08-06316-001**	3	ODU, ITU, Tx 18.724 – 19.200 GHz	**08-06316-002**
	2	ODU, ITU, Tx 18.190 – 18.666 GHz	**08-06316-003**	4	ODU, ITU, Tx 19.200 – 19.626 GHz	**08-06316-004**

Table 5-11 FCC – 18 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
1560 MHz	1	ODU, FCC, Tx 17.700 – 18.140 GHz	**08-06316-005**	3	ODU, FCC, Tx 19.260 – 19.700 GHz	**08-06316-006**

Table 5-12 ITU – 23 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
1008 MHz	1	ODU, ITU, Tx 22.000-22.592	**08-06317-001**	3	ODU, ITU, Tx 23.008-23.600	**08-06317-002**
1200 MHz	1	ODU, ITU, Tx 21.20-21.80	**08-06317-003**	3	ODU, ITU, Tx 22.40-23.00	**08-06317-004**
	2	ODU, ITU, Tx 21.80-22.40	**08-06317-005**	4	ODU, ITU, Tx 23.00-23.60	**08-06317-006**
1232 MHz	1	ODU, ITU, Tx 21.224-21.784	**08-06317-007**	3	ODU, ITU, Tx 22.456-23.016	**08-06317-008**
	2	ODU, ITU, Tx 21.784-22.344	**08-06317-009**	4	ODU, ITU, Tx 23.016-23.576	**08-06317-010**

Table 5-13 FCC – 23 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
1200 MHz	1	ODU, FCC, Tx 21.20-21.80	**08-06317-011**	3	ODU, FCC, Tx 22.40-23.00	**08-06317-012**
	2	ODU, FCC, Tx 21.80-22.40	**08-06317-013**	4	ODU, FCC, Tx 23.00-23.60	**08-06317-014**

Table 5-14 ITU – 26 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
1008 MHz	1	ODU, ITU, Tx 24.549 - 24.997 GHz	**08-06318-001**	3	ODU, ITU, Tx 25.557 - 26.005 GHz	**08-06318-002**
	2	ODU, ITU, Tx 24.997 - 25.445 GHz	**08-06318-003**	4	ODU, ITU, Tx 26.005 - 26.453 GHz	**08-06318-004**

Table 5-15 ITU – 38 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
1260 MHz	1	ODU, ITU, Tx 37.506 - 37.842 GHz	**08-06319-001**	3	ODU, ITU, Tx 38.766 – 39.102 GHz	**08-06319-002**
	2	ODU, ITU, Tx 37.842 - 38.178 GHz	**08-06319-003**	4	ODU, ITU, Tx 39.102 – 39.438 GHz	**08-06319-004**

Table 5-16 FCC – 38 GHz

Frequency Separation	Terminal A			Terminal B		
	Sub Band		Part No	Sub Band		Part No
700 MHz	1	ODU, FCC, Tx 38.600 - 38.950 GHz	**08-06319-005**	3	ODU, FCC, Tx 39.300 - 39.650 GHz	**08-06319-006**
	2	ODU, FCC, Tx 38.950 - 39.300 GHz	**08-06319-007**	4	ODU, FCC, Tx 39.650 - 40.000 GHz	**08-06319-008**

5.3 Outdoor Unit (ODU) – Technical Description

The ODU consists of the following functions:

- Transmit IF
- Receive IF
- RF Head Up/Down Converter
- RF Duplexer
- RF Local Oscillator
- The Cable Multiplexer
- ODU Controller
- Power Supply
- Telemetry
- IF Cable

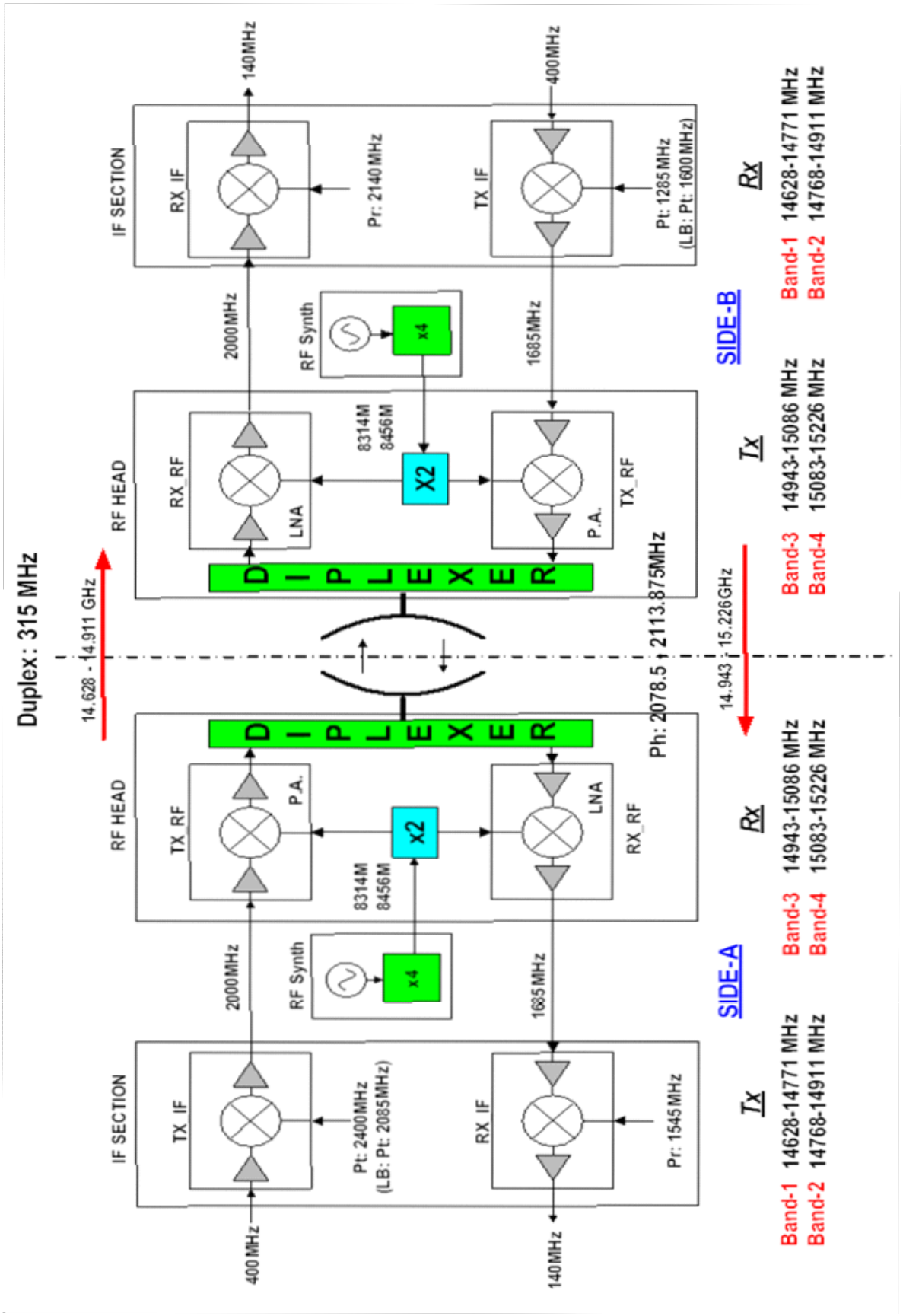


Figure 30 - 15 GHz ODU Example of Signal Flow

5.3.1 Transmit IF

The transmit IF module converts the 400 MHz input signal received from the Indoor Unit (IDU) to a conditioned IF signal in 1.0 to 3.0 GHz frequency range. This IF signal is then transferred to the RF Head up converter.

The transmit IF consists of an input buffer amplifier, a monolithic limiter, a low pass filter, a 30dB variable attenuator to control the output power (P/C), an up-converter mixer driven by its transmit IF LO synthesiser and finally an output stage.

The transmit IF output stage consists of two serial band pass filters and a switched bypass utilised during ODU Loop-Back.

5.3.2 Receive IF

The receive IF module converts the IF input signal coming from the RF Head to a frequency in the 1.5 to 3.0 GHz range down to a nominal 140 MHz output to be transferred to the IDU.

It consists of an input stage, down-converter including receive IF synthesiser, low pass filter, limiter and buffer amplifier. The limiter also provides the RSSI information required to display Received Signal Level (RSL) during service and antenna alignment.
The input stage consists of variable Attenuator, an amplifier and two serial band pass filters for image rejection.

5.3.3 RF Up / Down Converter

This microwave module includes both transmit and receiver sections.

The transmit section consists of an up-converter from S band to the microwave band with an incorporated LO frequency multiplier, a power amplifier (PA), a power detector with a closed loop level control.

The receiver down converter section consists of a low noise amplifier (LNA) and a down-converter IRM mixer from the microwave band to S band. The receiver has its own LO frequency multiplier.

5.3.4 RF Diplexer

The diplexer consists of two band pass filters. One band pass filter for the receiver band and the other for the transmit band.

Both filters have a common port, which is connected to the antenna.

An additional band pass filter covering the same band as the transmitter is incorporated in the same enclosure. This filter is connected between the mixer output in RF Head up converter, and the PA input to reduce local oscillator leakage.

5.3.5 RF Local Oscillator

The RF local oscillator includes an S band synthesiser (~2 GHz) followed by an x2, ×3 or x4 frequency multiplier (depending on the required RF frequency and the choice of IF).

The multiplied output is typically in the range of 7 to 11 GHz.

5.3.6 Cable Multiplexer

The cable multiplexer is a passive device which separates or combines all to signals on the IF cable and handles the IF to and from the IDU, DC power supply and telemetry signals.

5.3.7 ODU Controller

The ODU Controller includes the digital circuitry and micro controller and performs the task of interfacing to the IDU commands and controls and monitors the functions of the ODU hardware –(Synthesisers, Attenuators, Telemetry, Mute … etc.).

5.3.8 Power Supply

The Power supply consists of a DC/DC converter and some additional voltage regulators.

The IDU supply voltage of +/- 22 to +/- 62 Volts to the DC/DC input is converted to the following output voltages:

- +15 Volts,
- +8 Volts and
- +3.3 Volts

Voltage regulators following the DC/ DC converter produce the following additional output voltages:

- +5 Volts,
- -5 Volts and
- +6 Volt

These voltages are used for common digital circuitry and the RF Head up/down converter.

The overall power handling of the power supply is 30Watts.

5.3.9 Telemetry

The ODU communicates with the IDU via a telemetry modem. Control signals are sent up from the IDU and status reports are sent down from the ODU. The control signals are sent on a 13.5 MHz Amplitude Modulated carrier, and the status reports are sent on a 10 MHz Amplitude Modulated carrier.

The ODU is an RFI shielded enclosure having one functional “N” type interface connector for the signals between the IDU and the ODU and one BNC connector that is used during the antenna alignment procedure.

The ODU can be mounted directly to antennas up to 1800 mm in diameter or remotely mounted using a remote mount kit and flexible waveguide.

5.3.10 IF Cable

The design of the Outdoor Unit allows low cost coaxial cable to be used to interconnect the IDU to the ODU.

Note: Codan recommends the use of low loss, 100% shield coaxial cable with an Ultra Violet stabilised outer jacket.

The following table indicates the maximum lengths for various types of Times Microwave® coaxial cable, when using a –48 VDC power supply.

Table 5-17 IF Cable Types Vs. Length Chart

K1	0.24788		0.40123		0.79426		1.17086	
K2	0.00085		0.00085		0.00108		0.00154	
Cable	LMR-600		LMR-400		LMR-240		LMR-200	
Diameter	15 mm		10.3 mm		6.1 mm		4.95 m	
Distance (m)	Loss @ 140 MHz in dB	Loss @ 400 MHz in dB	Loss @ 140 MHz in dB	Loss @ 400 MHz in dB	Loss @ 140 MHz in dB	Loss @ 400 MHz in dB	Loss @ 140 MHz in dB	Loss @ 400 MHz in dB
10	0.31	0.53	0.49	0.84	0.95	1.63	1.41	2.4
20	0.61	1.06	0.97	1.67	1.91	3.26	2.81	4.81
30	0.92	1.59	1.46	2.51	2.86	4.9	4.22	7.21
40	1.22	2.12	1.95	3.35	3.82	6.53	5.63	9.61
50	1.53	2.65	2.43	4.18	4.77	8.16	7.03	12.02
60	1.83	3.18	2.92	5.02	5.73	9.79	8.44	14.42
70	2.14	3.71	3.41	5.86	6.68	11.42	9.85	16.82
80	2.44	4.24	3.89	6.69	7.64	13.05	11.26	19.23
90	2.75	4.77	4.38	7.53	8.59	14.69	12.66	21.63
100	3.05	5.3	4.87	8.36	9.55	16.32	14.07	24.03
110	3.36	5.83	5.35	9.2	10.5	17.95	15.48	26.44
120	3.66	6.36	5.84	10.04	11.46	19.58	16.88	28.84
130	3.97	6.89	6.33	10.87	12.41	21.21	18.29	31.24
140	4.27	7.42	6.81	11.71	13.37	22.84	19.7	33.65
150	4.58	7.95	7.3	12.55	14.32	24.48	21.1	36.05
160	4.88	8.48	7.79	13.38	15.28	26.11	22.51	38.45
170	5.19	9.01	8.27	14.22	16.23	27.74	23.92	40.86
180	5.49	9.54	8.76	15.06	17.19	29.37	25.32	43.26
190	5.8	10.07	9.25	15.89	18.14	31	26.73	45.66
200	6.1	10.6	9.73	16.73	19.1	32.63	28.14	48.07
210	6.41	11.12	10.22	17.57	20.05	34.27	29.55	50.47
220	6.71	11.65	10.71	18.4	21.01	35.9	30.95	52.87
230	7.02	12.18	11.19	19.24	21.96	37.53	32.36	55.28
240	7.32	12.71	11.68	20.08	22.92	39.16	33.77	57.68
250	7.63	13.24	12.17	20.91	23.87	40.79	35.17	60.08
260	7.94	13.77	12.65	21.75	24.83	42.42	36.58	62.49
270	8.24	14.3	13.14	22.58	25.78	44.06	37.99	64.89
280	8.55	14.83	13.63	23.42	26.74	45.69	39.39	67.29
290	8.85	15.36	14.11	24.26	27.69	47.32	40.8	69.7
300	9.16	15.89	14.6	25.09	28.65	48.95	42.21	72.1
310	9.46	16.42	15.09	25.93	29.6	50.58	43.62	74.5
320	9.77	16.95	15.57	26.77	30.56	52.22	45.02	76.91
330	10.07	17.48	16.06	27.6	31.51	53.85	46.43	79.31
340	10.38	18.01	16.55	28.44	32.47	55.48	47.84	81.71
350	10.68	18.54	17.03	29.28	33.42	57.11	49.24	84.12
360	10.99	19.07	17.52	30.11	34.38	58.74	50.65	86.52
370	11.29	19.6	18.01	30.95	35.33	60.37	52.06	88.92
380	11.6	20.13	18.49	31.79	36.29	62.01	53.46	91.33
390	11.9	20.66	18.98	32.62	37.24	63.64	54.87	93.73
400	12.21	21.19	19.47	33.46	38.2	65.27	56.28	96.13
410	12.51	21.72	19.95	34.29	39.15	66.9	57.68	98.54
420	12.82	22.25	20.44	35.13	40.11	68.53	59.09	100.94
430	13.12	22.78	20.93	35.97	41.06	70.16	60.5	103.34
440	13.43	23.31	21.41	36.8	42.02	71.8	61.91	105.75
450	13.73	23.84	21.9	37.64	42.97	73.43	63.31	108.15
460	14.04	24.37	22.39	38.48	43.93	75.06	64.72	110.55
470	14.34	24.9	22.87	39.31	44.88	76.69	66.13	112.96
480	14.65	25.43	23.36	40.15	45.84	78.32	67.53	115.36
490	14.95	25.96	23.85	40.99	46.79	79.95	68.94	117.76
500	15.26	26.49	24.33	41.82	47.75	81.59	70.35	120.17
Green – Length is acceptable			**Red – Length is unacceptable**					

Chapter 6 Software

The software architecture consists of four elements:

1 The operating system,

2 Features not accessible to the end user

3 The configurable parameters, accessible to the end user,

4 The Control Panel,

6.1 The Operating System

6.1.1 PSOS

The operating system used in the Codan 8800 series is the Proverbially Secure Operating System or PSOS.

The capabilities of PSOS provide a flexible naming and protection mechanism, and are used to implement arbitrarily complex subsystems efficiently fulfilling the wide variety of requirements of the Codan 8800 series

The properties of PSOS that make this possible are summarised as follows.

1. The capability mechanism is extremely simple, with only two operations involving the creation of capabilities, and none permitting the alteration of capabilities.

2. The operations on capabilities can be completely controlled at the most primitive conceptual level of the system design and implemented in hardware, and the protection provided is not by passable.

3. Capabilities and other PSOS facilities encourage strong modularity via the creation of data and procedure abstractions.

4. No special protection mechanisms are necessary to protect system programs.

5. Mechanisms for initialization, backup and recovery, and auditing for both PSOS and its subsystems can be constructed without subverting the protection mechanism.

6. The access rights of the given capability limit the operations permitted upon the particular object designated by a given capability.

7. The proper hardware support for PSOS can be implemented using established techniques. The formal techniques used to design PSOS make implementation straightforward and make formal verification of correct operation possible.

All of the advantages summarised here makes PSOS and subsystems implemented on PSOS far more secure and reliable than contemporary operating systems.

6.1.2 Plug and Play

Only one version of the operating system is released from the factory at any time with the software supporting the "plug and play" approach, automatically recognising the installed DIU and the band plan of the connected ODU.

The factory releases updated software revisions when new frequency bands are introduced or now software features are released. Provided the features of the updated software are supported by the hardware, the firmware in the terminal can be easily upgraded by a Trivial File Transfer Protocol (TFTP) session.

6.1.3 Link Supervisory

Communication between each end of a link is via an overhead 64 kbps peer-to-peer channel using the TCP/IP protocol.

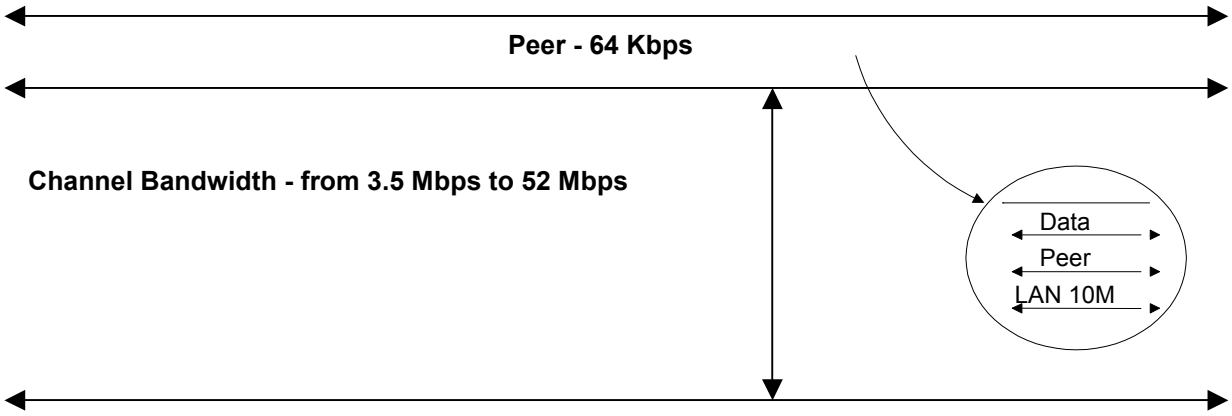


Figure 31 **- End-to-End Peer Communications**

6.2 Features not Accessible to the End User

6.2.1 Adaptive Receiver Intermediate Frequency.

The Codan 8800 series Digital Microwave Radio ODU may use either a 28 MHz or 44 MHz SAW filter.

To overcome the problems of Adjacent Channel rejection, an algorithm in the software determines which side of the required channel is the adjacent channel or interference signal.

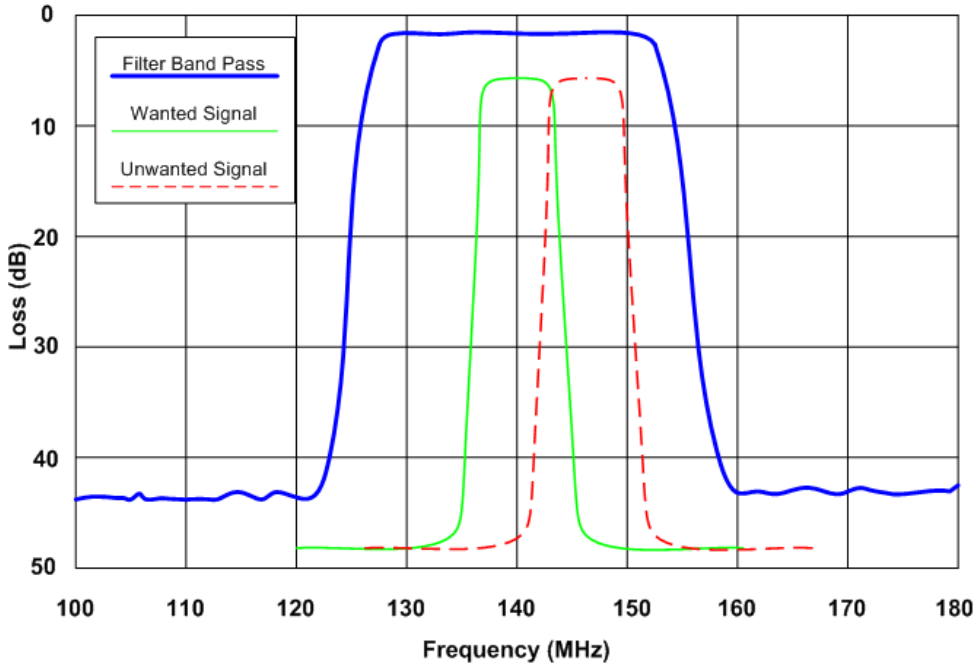


Figure 32 - Required Signal plus Adjacent Channel

The software modifies the receiver IF frequency to move the adjacent channel to outside the pass band of the filter.

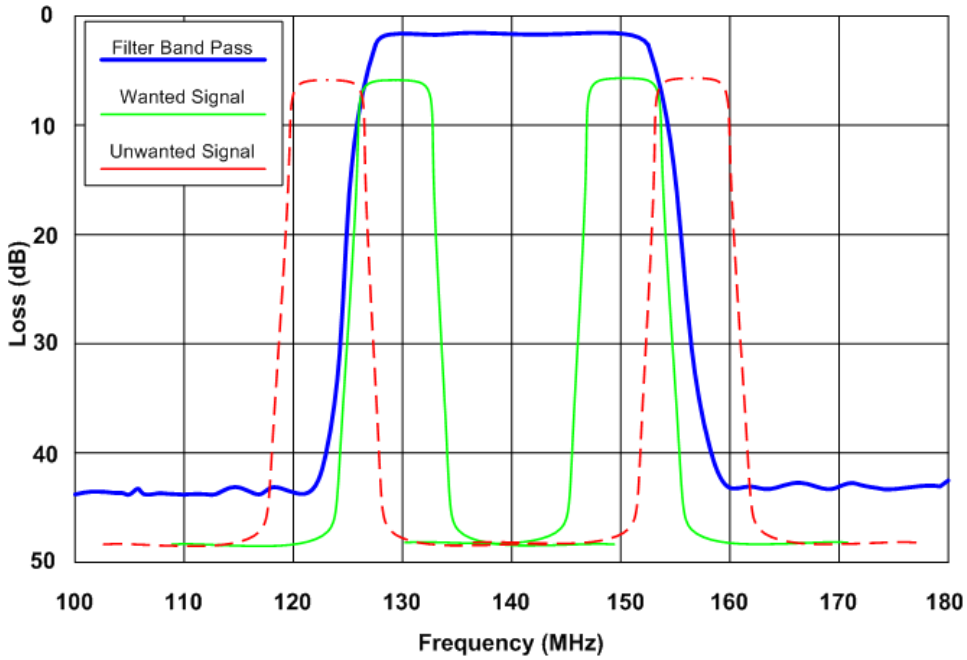


Figure 33 - Adaptive IF Filtering Adjacent Channel

6.2.2 Adaptive Reed-Solomon Forward Error Correction

The Codan implementation of Reed-Solomon FEC is different to the standard implementation in that the FEC is adaptive. The terminal sets the maximum available bandwidth, and as conditions worsen, the terminal applies a greater amount of FEC up to the limit of the bandwidth.

Conversely as conditions improve, the amount of FEC required is reduced. Thus the amount of FEC required is automatically and dynamically applied. This sustains bandwidth for the user data.

The maximum amount of FEC applied will correct up to 20 errored bytes in a 255-byte frame.

This dynamic FEC is available for the entire range plug in Data Interface Units with the exception of the Ethernet plug in module.

Table 6-1 Table of Maximum FEC Performance

Capacity	Bandwidth	Maximum Errored Bytes corrected
2E1	3.5 MHz	20 bytes
4E1	7 MHz	20 bytes
8E1	14 MHz	16 bytes
16E1	28 MHz	12 bytes

Ethernet traffic, by nature is bandwidth variable, so the requirement to sustain bandwidth for the user data is not necessary. In this case for the 4 x LAN + 4E1/DS1 DIU, the degree of FEC available in the Codan 8800 series DMR is selectable by the end user. The end user can define a fixed level of FEC of either 10 bytes or 20 bytes.

6.2.3 The Configurable Parameters

The basic configuration is done using the IDU Control Panel. The user is guided through the main system parameters with the assistance of the Quick Configuration menu.

The configuration involves navigation through the IDU Control Panel menus and setting the various parameters.

6.2.4 Initial Power Up.

Initially configure the Codan 8800 series system using the IDU Control Panel.

- Configuring Link Capacity
- Setting Tx Frequency (Channel #)
- Setting Channel Spacing
- Setting Tx Power

6.2.5 Power Up

When the IDU is connected to power, the unit performs a self-test.

Initialisation messages appear on the Control Panel LCD.

At the end a of the sequence, a “Self Test Passed Successfully” message will be displayed and then, the following information will be displayed.

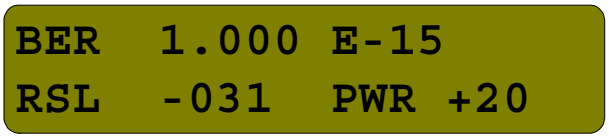


Figure 34 - Main LCD Screen example

The screen described in the above is an example only. The actual values may be different from those displayed above.

The main menu is a display of information on:

- Current Bit Error Rate (BER) 1.0 E-15 value means: No errors.
- Receive Signal Level (RSL) in dBm, and
- Transmit Power Level (PWR) in dBm. The displayed power level presents the actual working terminal power level.

An alarm screen, over-riding the main LCD screen, may also appear. Since the terminal is not yet configured, the performance and alarm messages described above may be ignored.

6.3 LCD Display

The Liquid Crystal Display (LCD) has a sixteen character, two-row display on which all messages appear (one at a time).

The LCD is used to show the following types of messages:

- Current Operation
- Alarm
- Self-test
- Configuration
- Communication
- Flags
- Parameters
- Values
- Reset

6.3.1 Alarm Messages

Alarm messages take priority over all other LCD screens. If an alarm message has been received, it will override the main LCD screen and will always relate to the most recent alarm detected.

The Codan 8800 series is capable of accumulating up to the last 15 alarm events.

To view the alarms, the user must enter the alarm log branch:

- Pressing on the **SEL/SAVE** key will start an editing session by entering the menu tree.
- Pressing the ◄ and ► keys will navigate to the alarm log.
- Pressing on the **ESC** key will return to the Main LCD Screen.

6.3.2 Self-Test Messages

After a power-on, hard reset, or self-test activation, the **"SELF-TEST"** running message will appear on the LCD. If a specific test has failed, the system will display a **"SELF-TEST failed"** message and wait for the operator's confirmation.

If the **"SELF-TEST"** passed successfully, an appropriate message will be displayed for a few seconds, and then the Main LCD Screen will automatically open.

6.3.3 Configuration Messages

Configuration involves parameters that apply to an individual terminal and parameters that pertain to both terminals (local and remote terminals).

During configuration, if the user has changed a parameter that pertains to both terminals of the link, he is prompted to apply configuration modifications to the other terminal as well.

6.3.4 Communication Messages

When communication problems occur with the remote link terminal, or with the Outdoor Unit over the coax cable, remote parameters may be unavailable and a **"Communication Timeout"** message is displayed.

If the Remote Side becomes unavailable during an editing session, the current session must be terminated and a new editing session attempted later.

6.3.5 Flags

When using the Control Panel, the user must distinguish between the symbols that are displayed as flags to indicate various parameter conditions.

*	Active Values of parameters – those with which the Terminal is currently working – are indicated by the asterisk symbol.
#	Parameters that have been saved but which have not yet been activated as current are indicated by the hash symbol. These parameters are stored in a temporary memory. The user will be asked to confirm the activation of these parameters in a later stage of the editing session.

6.3.6 Types of Parameters

There are several types of parameters: read/write, read only or operation parameters.

The Read/Write parameters type are classified to:

- Action parameters type
- Static parameters type

Action Parameters are configurable values that are instantaneously effective on the operating Codan 8800 series terminal and not updated and saved in the system configuration. A typical example for this type of parameter is the **"System Reset"** under the sub menu **"Configuration - Operation".**

Static Parameters are saved in the temporary IDU memory until the Update Configuration operation occurs, after which the updated configuration becomes active.

A typical example for this type of parameter is the Tx Power under the sub menu **"Configuration – Link".**

Read/write parameters can either be selected from a pre-defined system list or a parameter that can be edited character-by-character. An example of a list-type of parameter is the **"Link Capacity"**. An example of a character-by-character edited parameter is the **"IP Address"**.

6.3.7 Types of Values

Parameter fields require entering different types of values, depending on the parameter. These values may be integer or IP-type characters.

Integer Values

Integer values are generally displayed in decimal format (some may be hexadecimal).

Numbers may be positive or negative. The **+/-** sign can also be modified when necessary (Tx Power in dBm values). The number of digits displayed is automatically determined to enable setting the parameter to values within the Min-Max value range defined for that parameter.

For a read/write leaf, the number is modified by successively editing each digit of the number.
(IP Addresses).

When the on-the-fly parameters are modified, the system prompts the user to activate the modification immediately. IP Addresses are an example of such a parameter. IP addresses and IP Subnet Mask definitions are always displayed in the following standard format (four bytes in decimal format, separated by a stop):

- 000.000.000.000 and where each byte value is in the range of 0 to 255.

These parameters are edited by successively editing each of the digits. The IP's can be on-line modified without any effect on the Link operation.

6.3.8 Reset Operations

The Terminal can be manually reset by either software or hardware. Software reset is performed via the IDU control panel **System Reset** (Cold reset), or by pressing the IDU **RESET** pushbutton (Hardware reset). Some of the parameters like link capacity will automatically perform a reset after modification.

The Factory Default configuration via the IDU control panel is a fixed manufacturer setting of parameters and values that can be useful for initial operation of a virgin terminal. This Codan 8800 series option might be useful in faultfinding or when the Link is down due to the mismatch of the configuration programming.

Generally, a new 8800 system is supplied with its virgin '*Factory Default'* parameters set.

6.4 The Control Panel

For security, access to the terminal is limited by password. Any attempt to read or change parameters from the Control Panel will activate a screen requesting the appropriate password. There are three types of access privileges:

- **User** (read only)
- **Administrator** (read and write access, but no functions that may affect traffic over the Link)
- **Supervisor** (full read/write privileges).

The following table shows the factory set passwords for accessing the Control Panel:

Table 6-2 Default Authorisations

Authorisation Level	Touch keys				
User	ESC	ESC	ESC	ESC	ESC
Administrator	ESC	ESC	SEL/SAVE	SEL/SAVE	SEL/SAVE
Supervisor	ESC	ESC	►	►	►

- User level authorisation provides read only access.
- Administrator level authorisation provides read/wrote access to configuration options that can not stop the link from operating
- Supervisor level authorisation provides full read/wrote access to all configuration options

6.4.1 Control Panel Operation

Configuration Editing Session Overview

After the Codan 8800 series system has been powered **ON** and completed its initialisation process, the Control Panel shows the Main Menu Screen.

Before starting an editing session, press the **LOC/REM** Control Panel key, while the main menu screen is displayed. This selects the local or remote terminal whose configuration is to be viewed/edited.

Start the editing session by pressing the **SEL/SAVE** key. The system copies the Active Configuration of the currently selected terminal to the Image Configuration Area (RAM) of the Front Panel, enabling the user to browse the Configuration.

Scrolling horizontally through tree branches at the same level is done using the forward and backward arrows. **SEL/SAVE** is used to select a branch and or choose a sub-branch from within a branch. Clicking **SEL/SAVE** on any sub-branch will open the parameters of that sub-branch.

When a parameter is displayed, clicking **SEL/SAVE** will activate the “edit” mode for that parameter. **ESC** is used to exit the “edit” mode and move up the tree up to the highest level.

To end a Control Panel editing session and return to the main branch of the configuration tree, successively press the **ESC** key. If at least one parameter value has been modified, the user is prompted to activate the new configuration, with the update confirmation message.
If the user selects **YES** with the arrow keys and confirms with the **SEL/SAVE** key, then the new configuration that includes all the modifications that has been saved in temporary image memory of the Front Panel, is immediately activated.

If the user selects **NO** then the system allows the user to either continue the editing session or exit. If the user exits at this point then all previously made changes are erased.

Some parameters apply to both terminals. If the parameter is link specific, the user is prompted to save the changes to both terminals and the update 2 sides message appears.

- Some parameter changes may cause system reset when activated. Modification will cause reset of the tributary lines.
- The user is prompted to activate on-the-fly parameters immediately upon exiting the editing parameter screen.

To save the configuration, the user is required to return to the main branch of the Configuration tree by successively pressing the **ESC** key.

How to Select Values from a List

Values for some parameters can be selected from a predefined list. The Link Capacity parameter is an example.

From the Configuration branch, press **SEL/SAVE** and scroll to the **LINK** sub branch using the forward and backward arrow keys. Press **SEL/SAVE** again, and scroll to the Link Capacity parameter. Press **SEL/SAVE**, the first digit in the second row will be underlined. Using the forward and backward arrow keys scroll until you arrive at the desired value.

Press **ESC** to go up the configuration tree.

How to edit character by character

Some of the parameters can be edited on a character-by-character basis. The Link ID parameter is an example.

To access the **Link ID** parameter, press **SEL/SAVE** from the Configuration branch. Press **SEL/SAVE** again for the **LINK** sub-branch.

Press **SEL/SAVE**, and scroll to the **Link ID** parameter. Press **SEL/SAVE** again to enter the editing mode. The first character in the second row will be underlined. Use the forward and backward arrow keys to scroll from **0** to **9**. Press **SEL/SAVE**, and the underline will move to the second character. Edit this parameter in the same manner. Continue with the same for all next characters.

When finished, press **ESC** to go up the Configuration tree.

6.4.2 ATPC, Tx Mute and Switch Over features

ATPC

Each terminal of a link controls the transmit level of the other terminal to ensure the receive signal stays within its own preset limits.

The purpose of Automatic Transmitter Power Control (ATPC) is to make the transmit power more efficient relative to specific site conditions. The concept is based on obtaining the measured Tx and the RSL values of both terminals and calculating the differences between the measured powers of each. The algorithm then decides whether to increase or decrease the Tx value of the other terminal to comply with the preset RSL value of the first terminal.

The Control Panel parameters that deal with the ATPC are:

- ATPC Control
- RSL Optimal
- RSL Upper Threshold

- RSL Lower Threshold
- ATPC Timer
- ATPC Alarm

It is recommended to allow at least 5dB difference between the Upper, Optimal and Lower RSL parameters.

Main Benefits/Features

- Reduced frequency “reuse distance” for digital-to-digital and digital-to-analogue links based on propagation protection models.
- Reduced interference between hops, for hops that re-use the same frequencies;
- Improved compatibility with analogue and digital systems at nodal stations;
- Reduced interference between neighbouring systems or adjacent channels of the same system;
- Reduced up-fading problems;
- Reduced terminal power consumption;
- Extended equipment MTBF due to lower thermal dissipation
- Dynamically increase system gain as a countermeasure against rainfall attenuation.
- Maximum power disabled after a user definable “time out” timer
- Definable window between lower and upper thresholds.

RSL Optimal Value - the local receive power level that the remote radio’s internal ATPC system will attempt to maintain over the link. This value is the calculated receive signal level, based on a nominal Tx power output at the remote end, path loss, and antenna gains.

The other two settings define the range in which the receive level can vary before the remote radio’s internal ATPC system attempts to take corrective action to bring the signal back to the calculated receive power level.

RSL Upper Threshold - the highest receive power value before the radio attempts corrective action. The received level must exceed this value for more than 10 seconds before the ATPC action commences.

RSL Lower Threshold - the lowest receive power value before the radio attempts corrective action. The received level must be lower than this value for more than 10 seconds before the ATPC action commences.

Example, for a -45 dBm normal RSL, the low RSL limit is set at -50 and the high is set at -40.

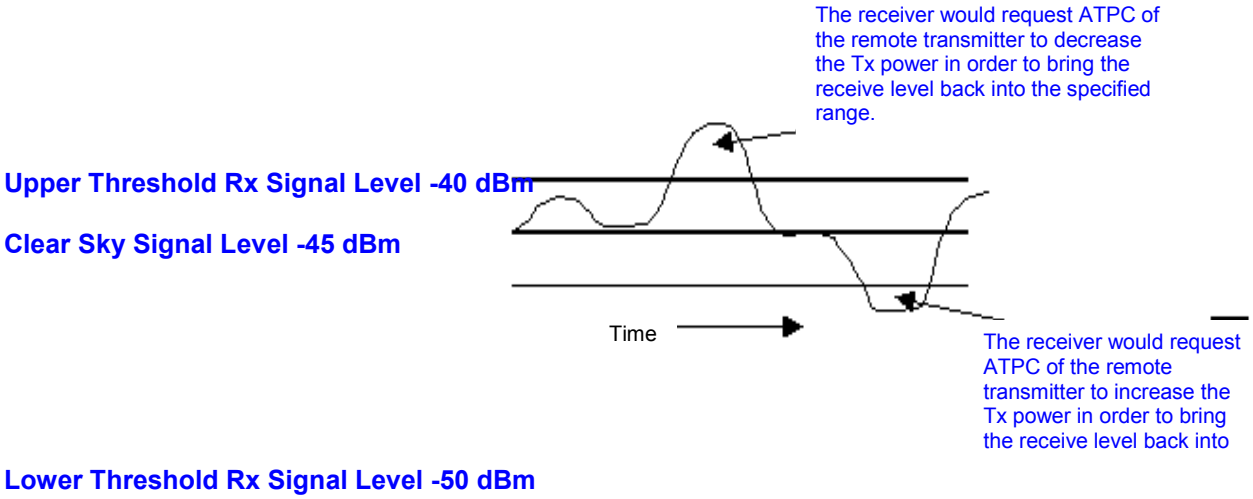


Figure 35 - Receive Signal Level Fluctuations vs. Time

Maximum Power Time Out – As ATPC is used to give protection against path fading, and path fading is a propagation property, which changes in both time and geographic location, the Codan 8800 series has the ability to disable ATPC after maximum power has been applied for a user definable amount of time.

The Tx power will default back to the clear sky level. This gives added protection to the network, when abnormalities may cause Tx power to go to, and remain at maximum.

A user definable alarm can also be generated when maximum power has been applied for the defined time.

Software

The ATPC parameters are configured in software and can be set either via the front panel keypad or via the MINet Element Manager or the SNMPc based NMS.

The algorithm used to determine when to apply ATPC is based on a perceived fade condition. High BER is only considered if it occurs simultaneously with a fade condition.

User configurable parameters are defined in the following table:

Table 6-3 Table of ATPC definable parameters

Parameter	Description	Range	Default
Tx Power	Set Tx power to maximum allowable to meet License conditions.	-10 dBm to maximum up to 35 dB in 1 dB increments.	Maximum
ATPC?	Enable/disable ATPC	Yes/No	No
RSL Optimal Value	RSL value calculated for clear sky conditions	-15 dBm to –90 dBm in 1 dB increments.	-45 dBm

RSL Upper Threshold	RSL maximum level. Must be at least 1 dB above optimum value. This value must be exceeded for more than 10 seconds to activate ATPC	-15 dBm to –90 dBm in 1 dB increments.	-40 dBm
RSL Lower Threshold	RSL minimum level. Must be at least 1 dB below optimum value. This value must be exceeded for more than 10 seconds to activate ATPC	-15 dBm to –90 dBm in 1 dB increments.	-50 dBm
ATPC Time Out?	Enable/disable ATPC time out	Yes/No	No
Timer	Set time out timer	1 minute to 60 minutes in 1-minute increments.	5 minutes
Time out timer Alarm?	Enable/disable ATPC time out timer alarm	Yes/No	No
Alarm Level	Define the level of alarm for NMS	Low, Medium, High	High

6.4.3 Tx Mute

The purpose of Tx Mute is for Link diagnostics and testing verification. The Control Panel parameters are:

- Tx Mute
- Pause Tx control
- Pause Tx period

The pause Tx mechanism activates the Tx Mute for a predefined time, which is set using the **Pause Tx** period parameter (up to 36000 sec with a default time of 60 sec.).

6.4.4 Alarm browsing using the touch keys

In the **ALARM LOG** menu, the touch keys function somewhat differently than in other Control Panel menus because of the added capability to erase alarms from the queue. Figure 39 shows a description of touch key operation in the Alarms Menu.

Table 6-4 Table of Alarm key functions

Key	Function
►	Browse to next alarm. This key does not erase the alarm from the **ALARM LOG** queue
◄	Browse to previous alarm. This key does not erase the alarm from the **ALARM LOG** queue
SEL/SAVE	Erases the alarm from the **ALARM LOG** queue. The message, **"Alarm Log Empty**" appears when all of the alarms have been erased.
ESC	Exits alarm browsing

For all alarms, a time stamp (in minutes) is displayed on the second row of the LCD.

Viewing the Alarm log in the remote terminal is not possible since each of the terminals reports the Local and the Remote end problems, and these can be viewed only from the Local terminal.

Each Alarm massage contains its **REM** or **LOC** prefix.

6.4.5 Changing IDU port capability

Note: Only a Supervisor with full read/write privileges is authorised to modify port capacity.

To update the IDU capabilities, the Supervisor must perform the following sequence of tasks:

1. In the Control Panel, scroll using ◄ or ► until **Configuration** is displayed.
2. Press **SEL/SAVE** to select **Configuration**.
3. Scroll using ◄ or ► until **Operations** is displayed.
4. Press **SEL/SAVE** to select **Operation**.
5. Scroll using ◄ or ► until **Link Capacity** is displayed.
6. Press **SEL/SAVE** to select **Link Capacity**
7. Scroll using ◄ or ► until the required **Link Capacity** is displayed.
8. Press **SEL/SAVE** to save the new capacity displayed in the LCD. (If an error occurred, Invalid Value will appear. Press **ESC** to continue.).
9. Press **ESC** until **Update Changes** are displayed.
10. Press **Y** (Yes). The display will show **Changes Updated OK**.
11. Continue to press **ESC** to exit from menu.

Chapter 7 Element Management

7.1 MINet Overview

MINet is an element manager or network management system (NMS) that monitors the status of elements within a given network. It adjusts their parameters as necessary to ensure proper communications and displays network elements and their attributes.

Using MINet, operators can configure an Codan 8800 series system, monitor and analyse events, make adjustments and report network events based on displayed information.

MINet uses the familiar Microsoft Windows environment and the Simple Network Management Protocol (SNMP) to communicate and manage links having management platforms based on TCP/IP.

7.1.1 "Left" and "Right" Terminal Convention

A few conventions are used in MINet to describe the terminals of a link. In this manual, reference is often made to the "left terminal" and "right terminal." Both terminals of a link are symmetrical.

"Left" is the convention used for the terminal whose parameters are displayed on the left hand panel of the main window. The "left" terminal will have a pink-coloured title bar and a pink-coloured button on the left side of the IDU image.

"Right" is the convention used for the terminal whose parameters are displayed on the right hand panel of the main window The "right" terminal will have a blue coloured title bar and a blue coloured button on the left side of the IDU image. "Right" is the convention used for the terminal displayed in the right panel, which is coloured blue and has a blue button.

Another convention is "Peer Terminal". When working with one terminal, "peer" refers to the other terminal of the same link. For instance, the user can get IP information of the "peer" terminal, by viewing its parameters in the Peer IP.

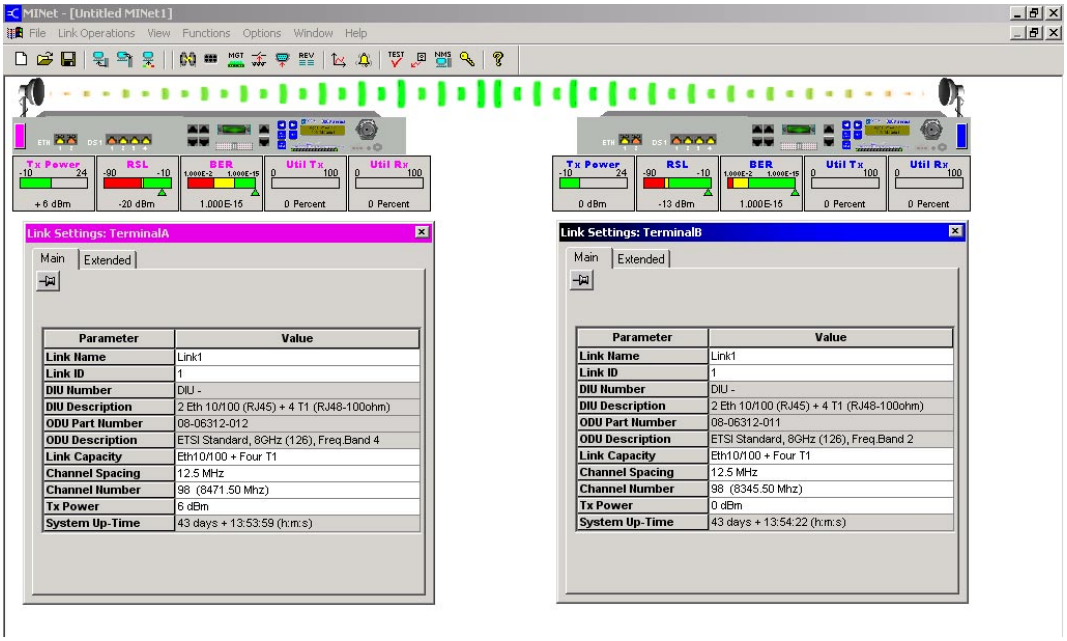


Figure 36 - Link Settings Screen in MINet

7.1.2 MINet Element Manager

The Codan 8800 series is equipped with a network management system (NMS).

The Codan 8800 series NMS contains two components:

- An SNMP-based management system called MINet that is installed on a PC
- An SNMP agent that is physically embedded in the IDU.

The element manager and agent communicate with one another using the SNMP protocol over TCP/IP. The SNMP agent contains a database of standard and private SNMP Management Information databases (MIBs). To acquire information, the management communicates with the agent's database. Thus, the management system generally functions as a master and the agent as a slave.

An exception to this master-slave relationship is the handling of important alarm notifications. These agent-initiated messages or alarms, which are sent to the management system, are called traps.

Note that MINet does not have a capability to receive the traps itself directly but rather re-directs the traps to specific user-determined trap recipient IP addresses. HP OpenView and some Windows Operating Systems, for example, have in-built trap manager capabilities.

7.1.3 MINet Features

MINet, provides the following features:

- A Graphical User Interface (GUI) based windows environment
- Ability to configure and set a terminal's properties
- Ability to view all data port information
- Remote access over the Internet
- Traffic monitoring
- Alarm, status, security, performance, test and configuration management
- Ability to up load firmware upgrades to local, remote and network terminals

7.1.4 MINet Functions

This section covers the following topics:

- Defines basic MINet concepts
- Describes the menu bar.
- Describes the tollbar and status bar
- Presents the zoom function of the IDU image

7.2 Application Concepts

MINet enables interrogation of several links, however, only a single link can be active and polled at a time from a single PC unless MINet integrated into HP OpenView or similar Network Management package is being used.

The parameters of the two terminals of a link are visually represented on screen by left and right panels. MINet displays a variety of link parameters for purposes of monitoring, configuration and control.

A visual representation of both IDUs of a link can be displayed to show the status of IDU tributary ports and the IDU's Front Panel LEDs.

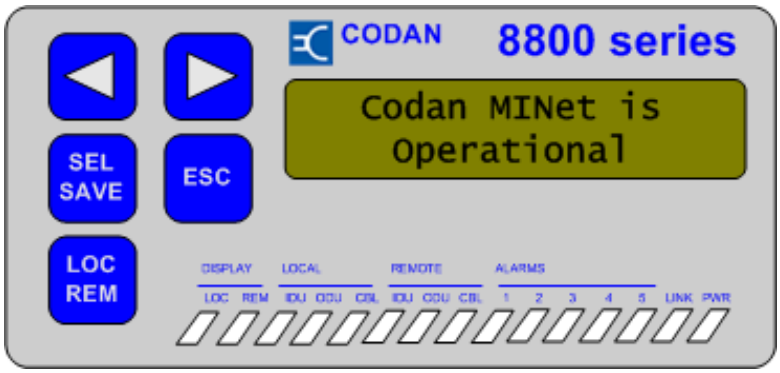


Figure 37 - MINet Zoom of LCD showing LED Status

The parameter windows as well as the Codan 8800 series IDU image are colour coded to display their status at a glance: green for OK, yellow for warnings, orange for user control, red for fatal errors.

7.2.1 System Security and Password Protection

MINet provides three levels of system access:

- User *(Factory Default Password User)*
- Administrator *(Factory Default Password Admin)*
- Supervisor. *(Factory Default Password Super)*

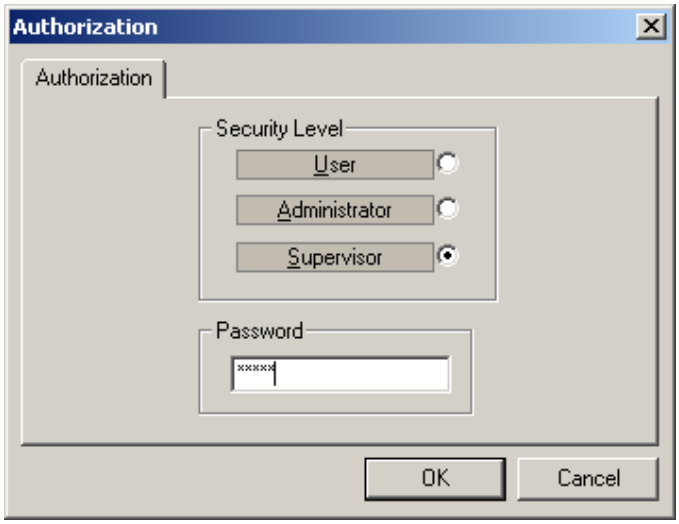


Figure 38 - MINet Initial Authorisations

System security is automatically activated when there is any unauthorised attempt to modify system parameters. An authorised user's attempt to access a function that is not included in the access level for that user is considered an unauthorised activity. A further level of protection is SNMP Community, which determines the user's read/write or read only authorisation.

7.2.2 Active Configurations

Each terminal contains a factory default setting (that cannot be changed by the user), and the factory default is stored in memory.

When a new terminal is initially booted, the factory settings are loaded as the **Active Configuration**.

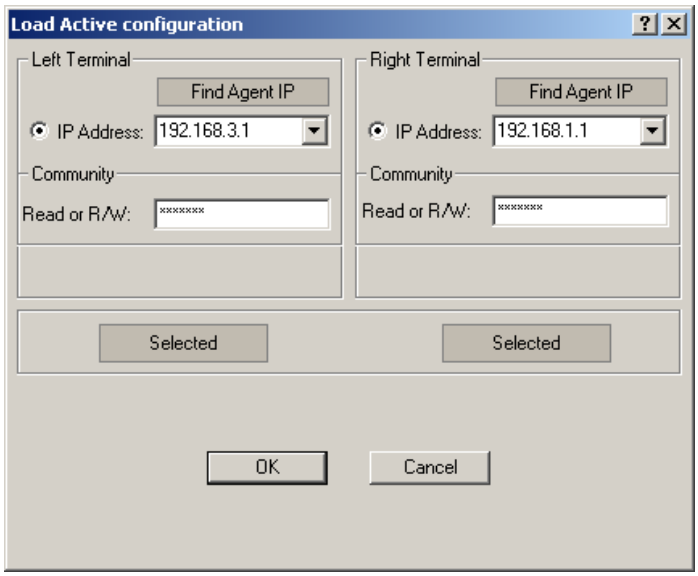


Figure 39 - MINet Load Active Configurations

When a link is initially accessed the parameters of the factory setting can be modified, and this new configuration becomes the IDU's **Active Configuration**.

Each IDU contains an **Active Configuration** in dedicated non-volatile memory, and this is the actual configuration that operates the terminal. It is this configuration that is loaded when the user performs **Load Active Configuration**. This **Active Configuration** is also used by the IDU when it is necessary to re-boot the terminal.

7.2.3 Configuration Files

MINet can work in three modes:

- **OFFLINE mode**.

  In off line mode, configuration files or parameters are set and stored in a PC memory as the default. The basic practical use of off line mode is to set and save a backup of a configuration for future use

- **ONLINE mode**.

  On line mode is used when MINet communicates with the terminal for up-loading files from a PC or downloading the Active Configuration that is stored in the Codan 8800 series terminal.

- **File Mode**.

File Mode is used to save an Active Configuration file from the Codan 8800 series terminal to a PC for backup purposes or to make changes updating the radio. A configuration file can be transmitted to Codan for technical support. To save .cfg files to a PC file, select Save As from the File menu.

7.2.4 Modifying an Active Configuration

User capability to modify link parameters depends on the level of access authorisation. This section assumes that the user has logged on with supervisor authorisation and can change all system parameters.

In MINet, parameters can be changed by entering values or text in fields or by selection from a pull-down menu, depending on the parameter type. After a selection is made, the modified field will be coloured blue. The blue colour signifies that the parameter value in the field has been changed on screen. These changes have not yet been updated to the **Active Configuration**.

Most parameters have black writing on a white background, ie. these fields can be modified. Other parameters are displayed for information purposes only and are greyed out.

Some parameters have pull-down list to open, from which the user can select the appropriate value.

7.2.5 Updating the Active Configuration

This section assumes that the **Active Configuration** has been modified. To update the active configuration click on **Link Operations**, **Update Active Configuration** on the menu bar.

When the **Update Active Configuration** screen appears select **Update First** option for the remote terminal. This is an important precautionary measure. If the remote terminal has been set to update first and it cannot be updated for some reason, troubleshooting can be done from the local terminal, which is operating. Click **OK**.

Note: From a Network Management perspective, the Remote Terminal is the one furthermost down the network. It is not necessarily a geographical location.

After the link is updated, navigate to the window where the changes have been made, and verify that the changes are no longer blue. This means that they have been included in the **Active Configuration**.

7.2.6 On-screen Save

MINet provides a mechanism to ensure that parameter changes are not inadvertently lost. If the user makes changes in one window (remember, the changes are coloured blue) and opens another window without updating the **Active Configuration** or saving to file, then a confirmation message will appear to prompt the operator to save the changes that have been made.

Click **Yes** to save these changes temporarily before updating the **Active Configuration** or saving to a file. If this is done, the changes will be saved on-screen and other changes can also be made.

7.2.7 System Messages

MINet has a system of messages that prompts the user if parameter changes need further attention. The user is prompted to confirm the changes and/or perform the designated activity.

Action Messages

Some incorrectly modified parameters can be corrected automatically by the system. If an automatic change is suggested, a message similar to the following will appear.

Figure 40 - System Action Message

Illegal Action Message

If an attempt is made to save or update an illegal modification, a message similar to the following will appear:

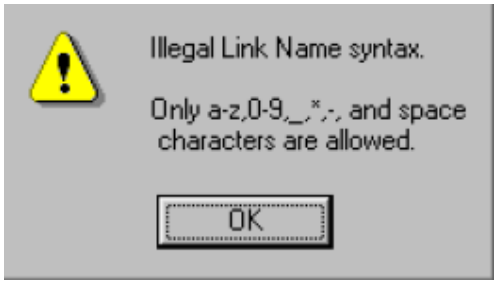


Figure 41 - Illegal Action Message

Non-Critical Parameters Message

If non-critical parameters are changed, and it is recommended that the other terminal should be changed as well, a message similar to following will appear.

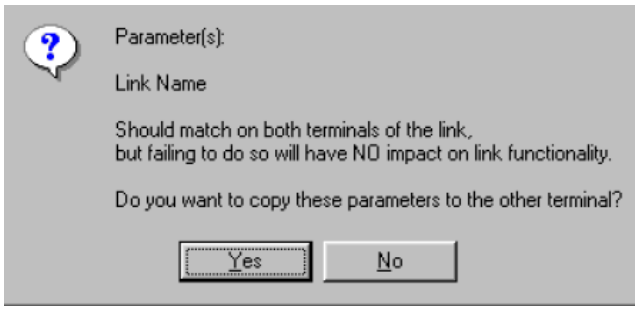


Figure 42 - Non-Critical Parameters Message

Critical Parameters Message

If the user has changed critical parameters that could cause the link to fail, a message similar to the following will appear.

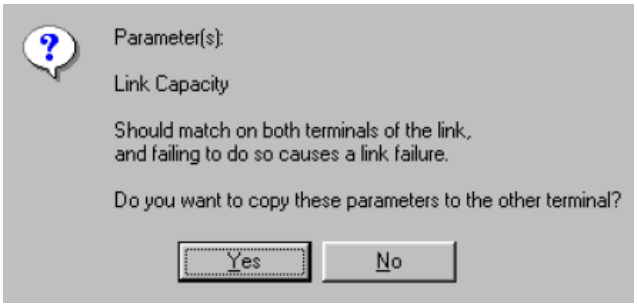


Figure 43 - Critical Parameters Message

Changes made to certain parameters on one terminal but not the other can cause the link to fail. It is recommended that the operator should click on the Yes button.

7.2.8 OFFLINE / ONLINE and NORMAL/CONFIG Modes

MINet enables **OFFLINE** and **ONLINE** operations.

After the system is powered on and communication between the PC and the Codan 8800 series terminal has been established, **ONLINE** is displayed on the status bar. **Active Configuration** parameters can be updated, and status and performance can be polled only in the **ONLINE** mode.

When a parameter is modified in **ONLINE** mode, the status bar automatically switches from **NORMAL** to **CONFIG** mode. After updating the **Active Configuration**, the status bar switches back from **CONFIG** to **NORMAL** mode.

In **FILE** mode, the user can work only with configuration files (.cfg) that have been previously saved from the terminal while **ONLINE** mode was active. If a configuration file is saved when the system is on-line, three files are created. These are:

- ***.cfg** (Link configuration file)
- ***LU.cfs** (Left Terminal status file)
- ***RU.cfs** (Right Terminal status file)

*** = Link Name.**

In **OFFLINE** mode, configurations can only be saved as *.cfg and *LU.cfs and *RU.cfs files.

To update an **Active Configuration** with a configuration file, the system must be in **ONLINE** mode.

7.3 Polling

Polling status and configuration are activities that are performed when MINet is running and the system is online. Three different types of polling can be performed:

- **Status polling** – polls asynchronous events such as alarms, counters and status. When status polling is in process, a message will appear on the left-hand side of the status bar.
- **Configuration polling** – polls all user-changeable configuration parameters.
- **Performance polling** – polls the results of performance indicators such as BER RSL, Unavailable Time, etc.

The polling intervals can be modified in the **NMS Management** window by selecting **Options**, **NMS Management** on the menu bar. The initial polling interval in seconds is the default value. Once updated, polling is executed according to the user's requirements.

The polling engine is enabled only in online mode and runs automatically according to the defined parameters.

To poll the status manually, select **Link Operations** on the menu bar and select **Poll Status Now**.

7.4 Resetting the Link and Individual Terminals

MINet enables resetting the entire link or resetting either the right or left terminal separately.

A reset will shut down and restart the link or the terminal.

7.4.1 Reset Link

To reset the entire link, select **Link Operations** on the menu bar and then select **Reset Link**.

The following confirmation screen will appear.

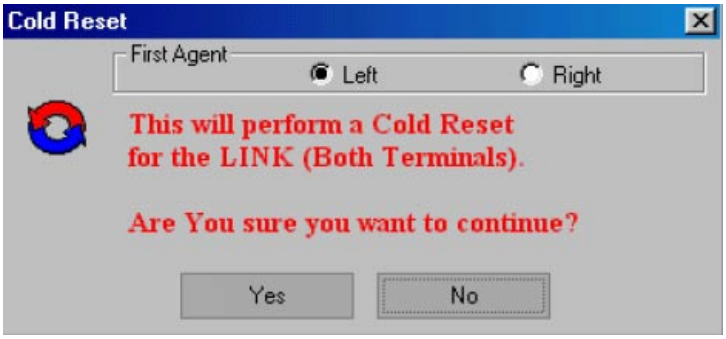


Figure 44 - Reset Confirmation

Mark the remote terminal to perform **Cold Reset** first. If **Cold Reset** cannot be completed for the remote terminal for some reason then troubleshooting can be done from the local terminal.

Optionally, each terminal may be reset individually.

7.5 Bank Switchover

Two memory areas are available for storing firmware in the IDU and the ODU. These memory areas or banks are called Bank 1 and Bank 2. One is the active bank and the other is used to store a backup version of the firmware. When bank switchover is performed, the system switches to the alternate stand-by firmware bank and resets the hardware and software.

Generally, bank switchover is performed after a TFTP software up-load or after a system irregularity when the backup firmware is needed.

For the IDU, the current firmware revisions present in the active and alternate banks are displayed in the **Components Revisions** window. For the ODU, only the active firmware version is displayed in the **Components Revisions** window.

Performing bank switchover will cause the link to reset. Mark the remote terminal to perform bank switchover first.

7.6 Setting the Factory Default

A factory default configuration is stored in the IDU memory and enables returning the **Active Configuration** to its factory default configuration.

Setting the link to return to factory default configuration will cause the link to reset and the configured IP addresses and link parameters will be lost. This activity should be performed only after all precautionary measures have been taken. It is recommended that all current configurations be saved before implementing the factory default configuration. This is done to prevent the loss of complex configurations.

To set the link to factory default configuration

- Select **Link Operations**,
- **Set Factory Default** on the menu bar.

Verify that the **REMOTE** terminal is selected to be activated first.

7.7 Functions Menu

This menu includes all the fields necessary to perform configuration and evaluate status as well as system testing and up-loading upgrades of system firmware.

The following topics are covered:

- Performing configuration of the following: link settings, interfaces, agent management relays and external inputs
- Evaluating status – examining component revisions, evaluating performance parameters and viewing system alarms
- Performing operations such as system testing, TFTP software up-load and bank switchover

7.8 Configuration

7.8.1 Link Settings

The Link Settings window is the initial parameters window that opens when MINet is started. It can also be accessed from Functions, Configuration on the menu bar by choosing Link Settings. The window contains 2 tabs.

- Link Settings – Main Tab
- Link Settings – Extended tab

Link Settings – Main Tab.

This window contains the basic link data. Some parameters are derived from the hardware and will be read only as shown by a grey background. Other parameters, which are more performance-oriented, can be modified from the windows and have a white background. If crucial parameters such as link capacity or channel number are modified, it is recommended to set the remote terminal to **Update First**.
The following parameters appear in this tab:

- **Link Name.** Text field for the user to enter relevant information.

- **Link IP.** Text field for the user to enter relevant information.
- **Plug-in Part Number.** Read only field with information read from the IDU. Can be changed in offline mode.
- **Plug-in Description.** Read only field with information read from the IDU.
- **ODU Part Number.** Read only field with information read from the ODU. Can be changed in offline mode.
- **ODU Description.** Read only field with information read from the ODU.
- **Link Capacity.** Current link capacity. Clicking on the field opens a pull-down list from which the user can select the relevant link capacity.
- **Channel Spacing.** Enables setting the bandwidth for systems that have an Eth 10/100 plug-in. For PDH, channel spacing is automatically determined by link capacity and therefore does not display on screen.
- **Channel Number.** Clicking on the field opens a pull-down list from which the user can select the appropriate frequency. These channels are listed by an internal Codan index number with the frequency for the indexed channel indicated in parenthesis (MHz).

  Both terminals must operate on the same channel. If a channel is being modified, then it is important to update the remote terminal first. Frequency synthesiser steps for all Codan 8800 series radios are 0.25 MHz except, when the T/R spacing is 311.32 MHz, which has a step size of 0.1186 MHz.
- **Tx Power Transmission Power**. Enables the user to set the transmit power of the specific ODU. Clicking on the field opens a pull-down list from which the user can select the relevant transmission power (dBm).
- **System Up-Time.** Time that elapsed since the system was last reset.

Link Settings – Extended Tab.

- **Terminal Name.** Text field for the user to enter relevant information.
- **Terminal Location.** Text field for the user to enter relevant information.
- **Contact Details.** Text field for the user to enter relevant information.
- **Force AIS on all E1s.** This parameter enables the transmission of AIS as follows:

  - Never,
  - On BER warning,
  - On BER error,
  - Always

- **FEC Correctable Bytes**. The level of FEC for PDH DIU's is automatically calculated. For PDH, this is determined automatically according to link capacity. For PDH DIU's, the capacity is known and identical capacities always occupy

the same bandwidth. The rest of the bytes of the link are used to carry the FEC information.

For a LAN DIU, the capacity is variable. Forward Error Correction Adjustment is available only with the Ethernet LAN DIU. FEC of 10 or 20 bytes of a 255 bytes frame can be selected. Therefore, 10 bytes of FEC or 20 bytes of FEC, which occupy about 3 Mbps and are subtracted from Ethernet throughput, can be used to improve system gain by approximately 1.6 dB. Modifying this parameter requires resetting the link.

- **ODU Temperature.** A built-in feature read from a sensor physically located on the ODU.
- **Tx Power Level.** Actual transmission level as read from the RF head. The user can compare actual power level with the configured power to which the ODU was set in the Main tab.
- **ATPC Control Automatic Transmit Power Control**. Enables controlling the transmit power of the terminal according to the remote terminal RSL. It can be enabled or disabled by clicking on the field. If ATPC is enabled three parameters can be set:
  - RSL upper threshold,
  - RSL optimal threshold,
  - RSL lower threshold.

7.8.2 Interfaces

Interfaces are hardware with which the system operates and include the service channels and data tributaries. The Interfaces window is accessed from **Functions, Configuration, and Interface** on the menu bar.

Interfaces – E1/E3

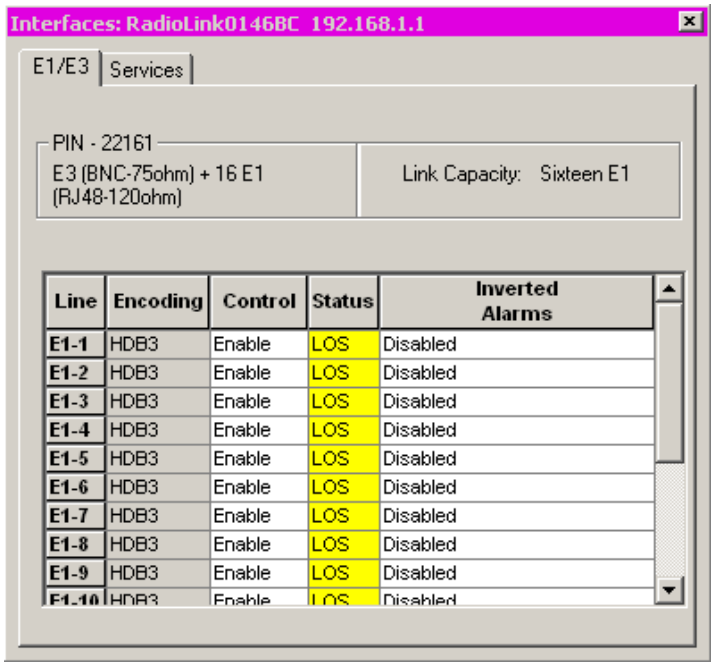


Figure 45 - Interfaces - E1/E3 Tab

For each E1/DS1 line (up to 16, depending on the type of IDU plug-in) and one E3, the following tributary parameters are available:

- **Encoding**. HDB3 only is available for the E1 ports. If DS1 ports are being implemented, B3ZS or AMI encoding can be selected by clicking on the desired cell.
- **Control.** Port Control can be enabled or disabled by clicking on the desired cell. Generally, this is done individually on a port-by-port basis for administrative purposes.
- **Status** Read only. This field is colour coded and provides port status. If alarms such as Loss of Signal (LOS) are active, they will be shown in this field.
- **Inv Alarms.** Alarms can be enabled or disabled by clicking on the desired cell.

Interfaces – Eth 10/100

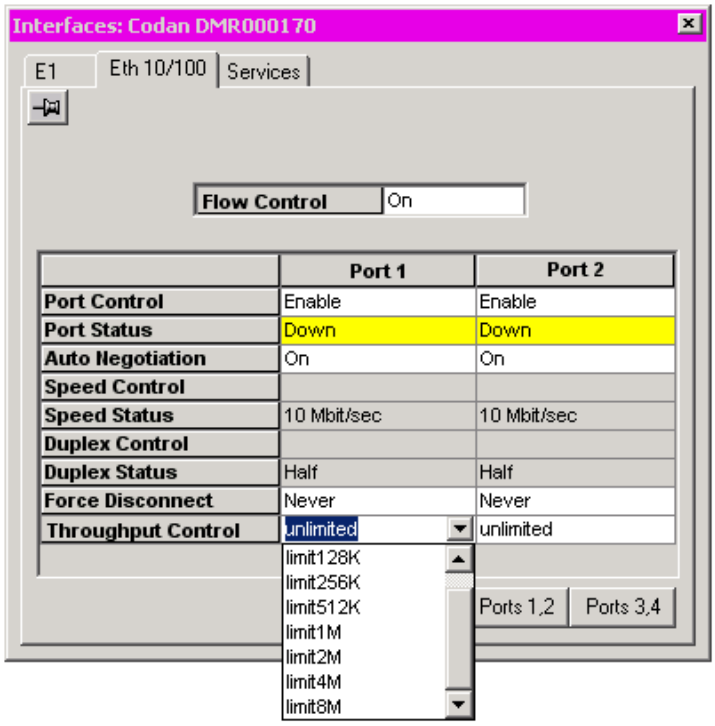


Figure 46 - Interfaces - Eth 10/100Base-T

If an Ethernet 10/100Base-T Data Interface Unit is installed, an Ethernet tab will be available. This tab controls Ethernet the port parameters of flow control, port control, auto negotiation, port throughput and force disconnect and provides Ethernet status information on port status, speed status and duplex status.

- **Flow Control** can be set to **On** or **Off** by clicking on the field. This parameter must be set to **On** in order to prevent frames loss. The external port that is connected to the Eth 10/100 DIU port should also be set to Flow Control On as the link cannot transmit a full 100 Mbps.
- **Port Control** can be set to Enable or Disable by clicking on the field.

- **Port Status** is a read only field. If port control is set to enable, alarm status will be colour coded to indicate actual status.
- **Auto Negotiation.** When auto negotiation is set to **Off**, the user can manually configure the Speed Control and Duplex Control fields.
- **Speed Control.** When auto negotiation is set to **Off**, Speed Control can be set to 10 Mbit/s or 100 Mbit/s.
- **Speed Status** displays the actual speed that the port detected.
- **Duplex Control.** When auto negotiation is set to **Off**, Duplex Control can be set to full duplex or half duplex.
- **Duplex Status** displays the actual duplex that the port detected.
- **Force Disconnect** can be set to **Never** or **On Link Down** by clicking on the field. This will connect or disconnect the port accordingly.
- **Port Throughput** can be set to **128 kbps**, **256 kbps**, **512 kbps**, **1 Mbps**, **2 Mbps**, **4 Mbps**, **8 Mbps** or **unlimited**.

Interfaces - Services

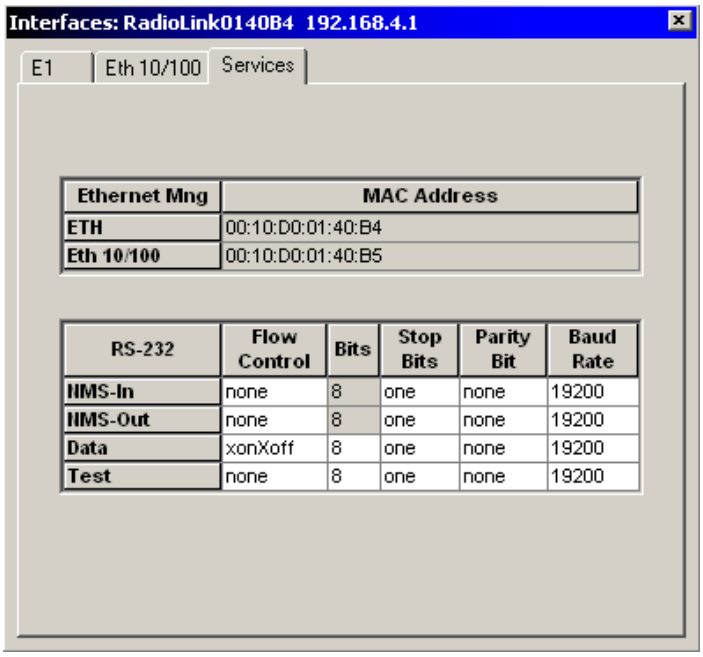


Figure 47 - Interfaces - Services

Configuring Services

The Services tab provides access to service channels. Service channels refer to parameters governing the NMS, Ethernet and Data (serial) ports of the IDU.

The **Services** tab contains two panels. The upper panel is always read only and shows the **Ethernet** port MAC address for IP address management purposes The **Eth** 10/100 MAC address appears only when using the **4 x LAN + 4E1/DS1** Data Interface Unit.

The lower panel contains parameters for **RS-232** communication: **NMS-In**, **NMS-Out**, **Data**, and **Test**. It is here that the user determines the serial communication parameters and whether these ports are enabled or disabled.

7.8.3 Management

The Management window is accessed from **Functions, Configuration, and Management** on the menu bar. From this window the Left and Right Terminal IP addresses are defined as well as the routing table. Other features in this window are definitions of SNMP Community and Traps, as well as software access to the IDU Front Panel Password Function.

Management Window - IP

The IP tab contains all the terminal's IP addresses. This tab lists IP and local Subnet Mask addresses for **NMS In (SLIP), NMS Out (SLIP), Link** and **ETH** connection, **NMS In (SLIP) Dest, NMS Out (SLIP) Dest**.

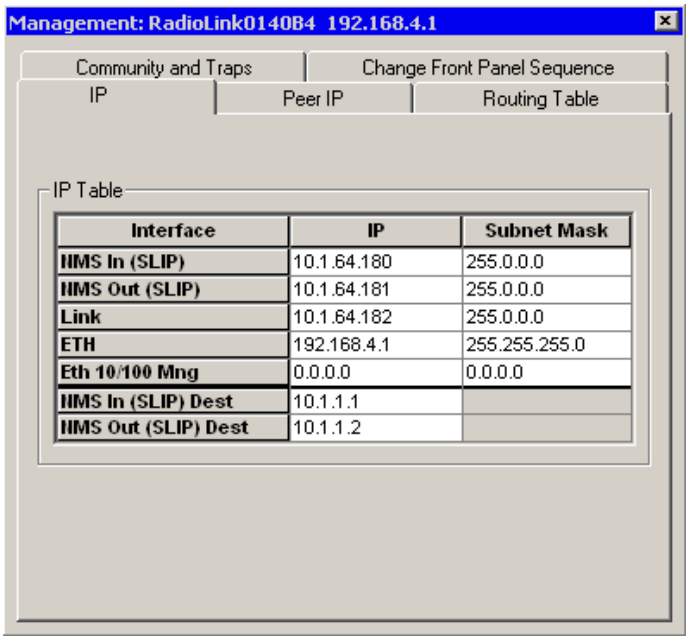


Figure 48 - Management – IP Tab

Management Window - Peer IP Tab

This option displays the IP address table of the "other" terminal of the link. These are read-only parameters and cannot be modified from this tab. "Peer" indicates that this information is received by the internal proprietary peer protocol.

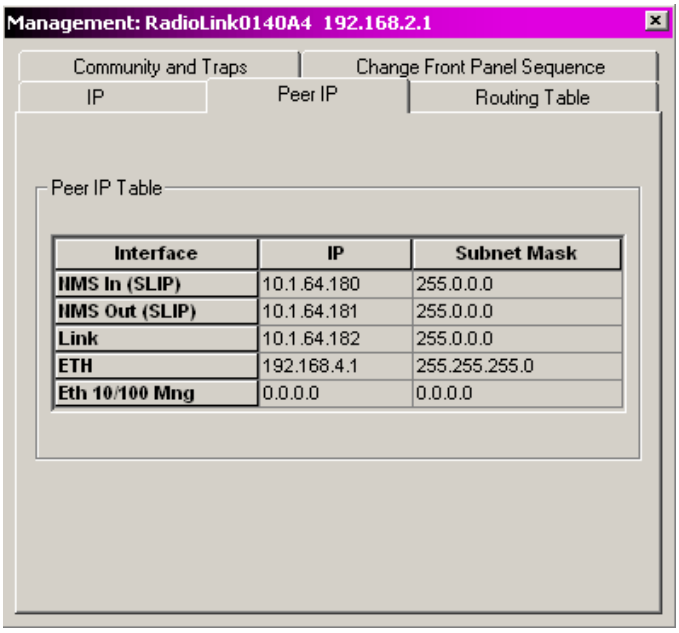


Figure 49 - Management – Peer IP

The Peer IP tab is useful when the user knows the IP addresses of one terminal but wants to know the IP addresses of the other terminal. By connecting to the known terminal, the user can discover the remote terminal's IP addresses.

Management Window - Routing Table

The Routing Table is used to route data among Codan 8800 series terminals and to the outside world. The Routing Table contains the parameters of Destination IP address (**Dest IP Addr**), **Next Hop**, **Route Mask** (Subnet Mask number) and **Interface**.

An example of adding a route command is to add a default gateway (eg. Destination IP is 0.0.0.0 and Route Mask is 0.0.0.0). The default gateway address determines the destination address for all frames leaving the terminals to the outside world. When the Dest IP Addr is 0.0.0.0, the address entered in the Next Hop field is the Default Gateway address.

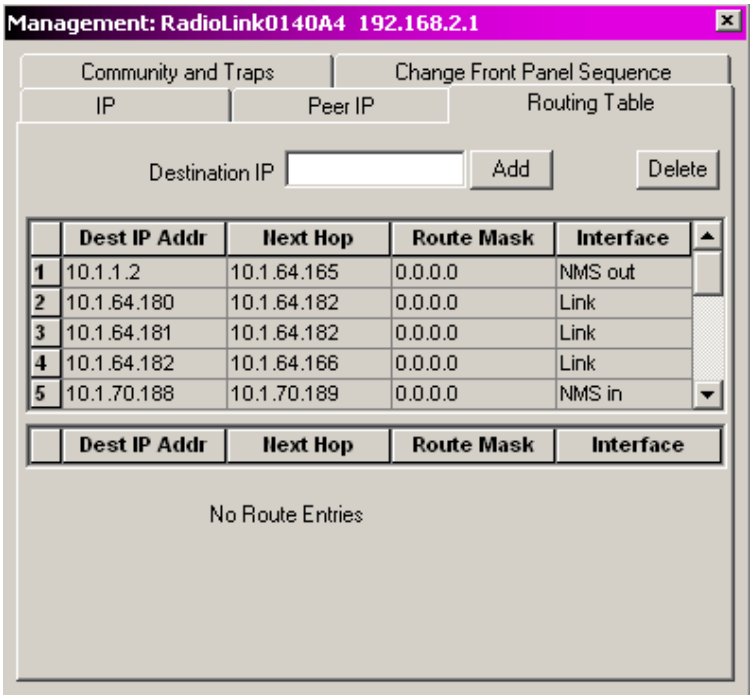


Figure 50 - Management – Routing Table

Management Window - Community and Traps

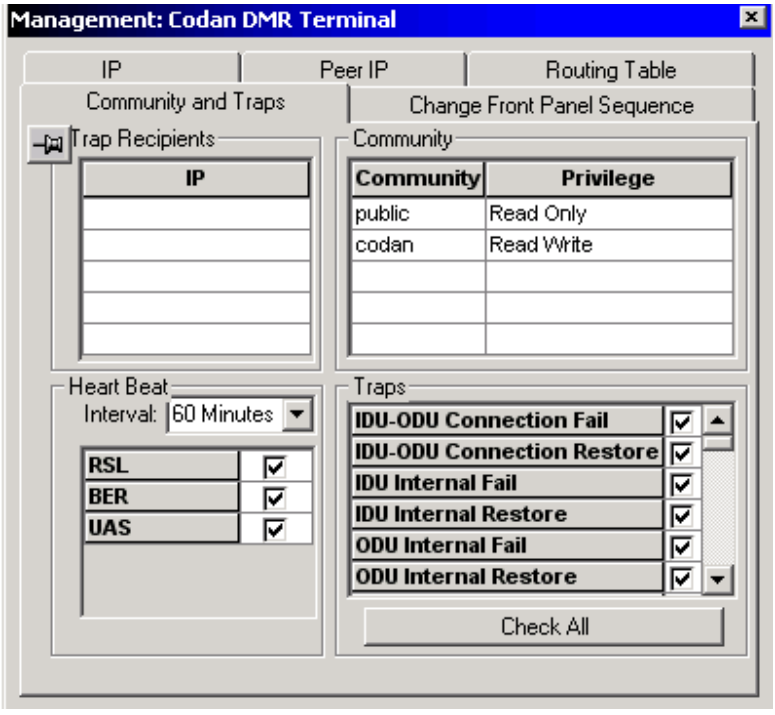


Figure 51 - Management – Community and Traps Tab

- **Trap Recipients.** The Trap IP recipient address is important for accumulating system messages that can be utilised for performance analysis. All IP addresses listed in the table will receive trap messages.

- **Community.** Community is a basic SNMP convention and is generally implemented in a manner that provides system security. The community designation can be any alphanumeric string. In addition, the privilege type can also be determined.

- **Privilege types** may be set to **Read/Write** or **Read Only**.

- **Heart Beat.** Heart Beat is a "keep alive" signal plus an optional **RSL**, **BER** and **UAS** status report that is generated at predefined intervals. The status report can be generated at 1,10, 30, 60, or 120 minute intervals. The data is then sent to the trap IP addresses listed in Trap Recipients.

- **Traps.** Traps are sent when specific events occur on the network. SNMP traps are sent to IP addresses that are designated as trap recipients. A specific SNMP trap can be enabled/disabled by marking the appropriate check box from the scroll-down list. MINet currently supports approximately 50 types of traps.

Management Window - Change Front Panel Sequence

In order to gain access to the Front Panel, a five-key **PASSWORD** must be pressed.

The Front Panel password sequence can be set through MINet as follows.

- From the **Change Front Panel Sequence** tab, select the **Security Level** to be modified, **User**, **Administrator** or **Supervisor**.

- Click **New**

- In the **Change Front Panel Sequence** tab, click in a sequence of exactly five of the following buttons: **<**, **>**, **SEL/SAVE**, **ESC**, **LOC/REM**. If you make a mistake, use **Clear** to start over.

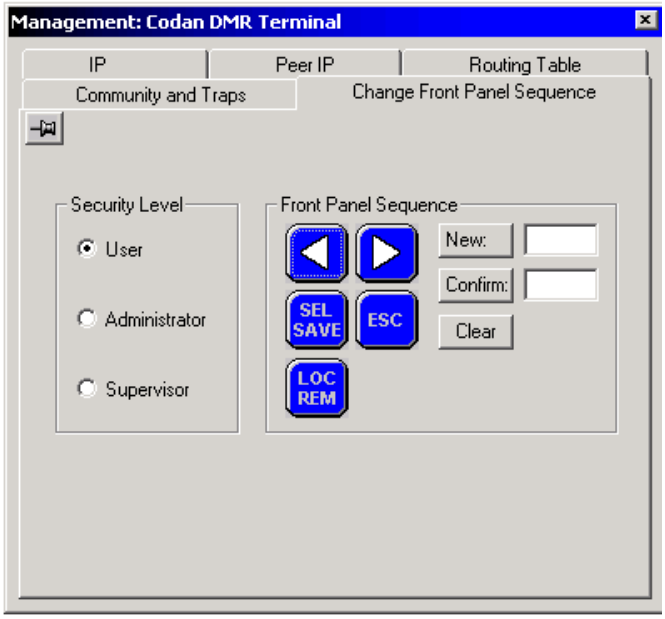


Figure 52 - NMS Management – Change Front Panel Sequence Tab

NOTE: Take care to press the buttons slowly. When clicking quickly, some buttons may not register.

- Click **Confirm**
- Enter the exact sequence again in the same way.
- Perform **Update Active Configuration**.

NOTE: Setting the factory default will reload the default Front Panel sequence.

7.8.4 Relays

Relays are used to control external equipment connected to the 8800 terminals, which are generally not directly related to communications. Such equipment could be a UPS (Un-Interruptable Power Supply), air conditioning system, buzzer, lights, etc. Relays enable the IDU to respond to defined sets of conditions.

When relays are used, a cable is connected to the Alarms port on the IDU. Wiring can enable up to 5 relays to be connected plus an additional relay internally connected to a buzzer inside the IDU. The Relays window is accessed from **Functions, Configuration, and Relays** on the menu bar. Alarms are generated for the equipment in accordance with the parameters in the Control and Mapping tabs of the Relays window.

Relays Window - Control

The Control tab contains parameters that determine whether the accessory equipment is enabled, and if so, when and how it should be activated. The following parameters are available for relays:

- **Enable/Disable**: Enables the relays/buzzer.
- **Normal State**: Defines the normal state of the output (open or closed).
- **Forced Activation**: When turned to ON, the relay/buzzer will become active (ie. will change from the normal state).
- **Status**: Provides a report of the current state of each output. Status is colour-coded. Depending on the output, status could be Open/Closed (for relays), and Off/On (for buzzer).

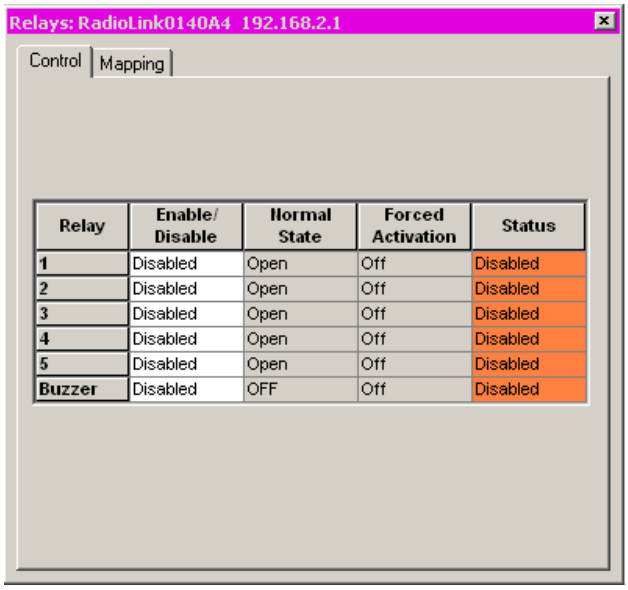


Figure 53 - Configuration, Relays - Control Tab

Relays Window - Mapping

The Mapping tab enables setting the mapping of alarms that will apply to a maximum of five relays and one buzzer. The actual number of events depends on the IDU configuration and the number of supported tributary lines.

If check boxes are marked, they define the events or alarms for which the relay and buzzer outputs will be activated. For any output, mark the check box for the appropriate event. After marking the desired check boxes, perform **Update Active Configuration**.

For example, after the **RSL Low** alarm is marked for relay #1, this relay can be configured and connected to an external bell. In addition, Alarm LED #1 on the IDU Front Panel will light when activated.

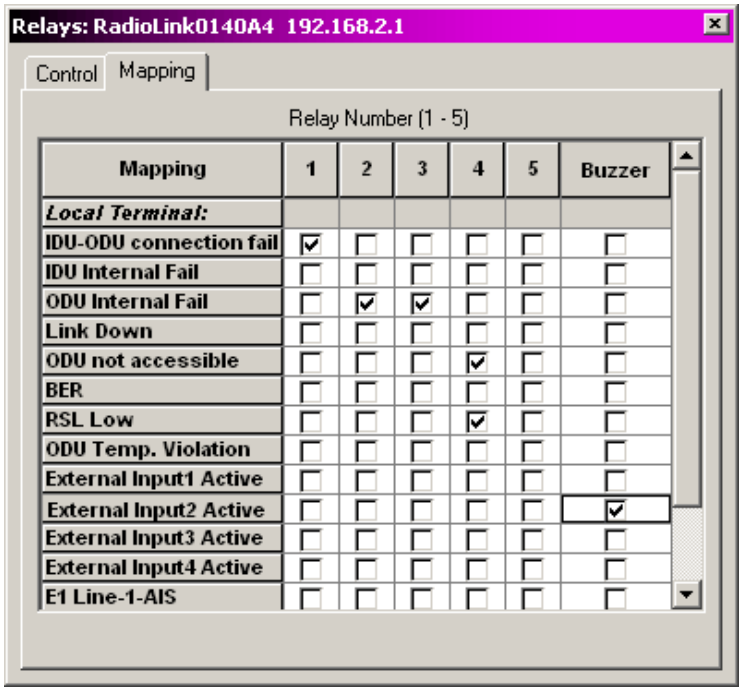


Figure 54 - Configuration, Relays – Mapping Tab

7.8.5 External Inputs

This section describes configuring external sensors. External inputs in an analogue signal range of 2.5V to 9V are used to alert the Codan 8800 series terminal of events occurring outside the terminal. MINet enables activating external inputs and viewing their status in the External Inputs window.

For example, a door can be connected to an external input so that when it is opened, an alarm is generated and appears on screen with a user-defined severity indication.

The External Inputs window is accessed from **Functions, Configuration, and External Inputs** on the menu bar.

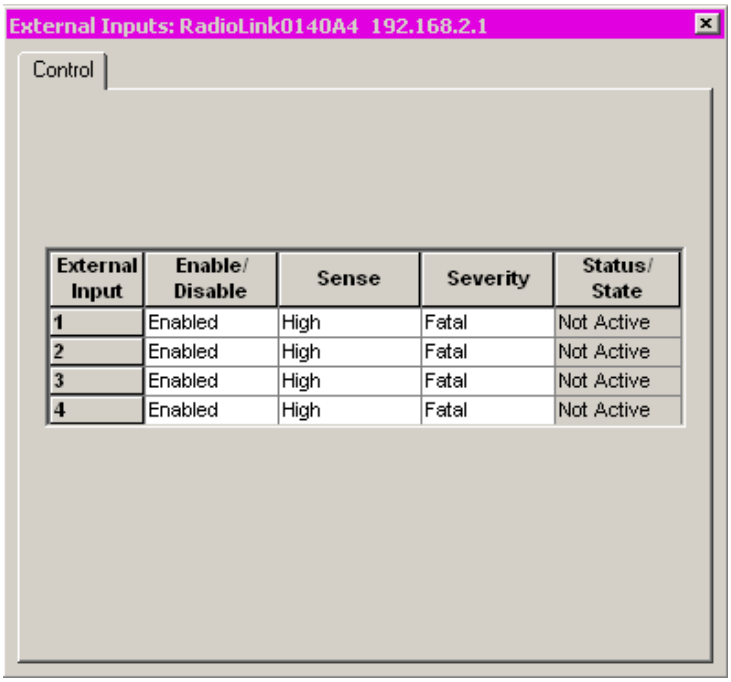


Figure 55 - External Inputs Window

When external inputs are used, a cable is connected to the Alarms port on the IDU. A **DB-25** connector includes both relays and external input DIU connections.

The External Inputs window displays parameters for up to 4 inputs. For each external input, the following parameters can be defined:

- **Enable/Disable**: Enables/disables the input.
- **Sense**: The input can sense Low, High or Any Change to user-defined settings.
- **Severity**: The user can set the severity level of the activated input to either Warning or Fatal. Active inputs can be filtered and sorted by levels of severity. In this manner, for example, inputs whose voltage level has a severity level of "Warning" can be ignored, even when active.
- **The status** of each external input is colour coded for user convenience as follows: green (OK – input not activated), yellow (warning), orange (user control), red (fatal). Otherwise, it will be greyed out.

7.9.6 Status

This menu includes the following system status options:

- Components revisions
- Performance
- Alarms

Components Revisions Status

This option displays information about the hardware and software of system components. For each main system component (IDU, ODU, DIU), the following information is displayed:

- Part number
- Serial number
- Hardware revision
- Software revision
- Alternate software revision, and
- Boot revision.

The information is especially important for maintenance purposes. The Components Revisions window is accessed from **Functions, Status, and Components Revisions** on the menu bar.

7.9.7 Performance

The Performance window contains a large number of performance parameters in three tabbed windows: **Link**, **Link Thresholds** and **RSL** (Receive Signal Level). If an Ethernet Data Interface Unit is being used, then two additional tabs are displayed: **Eth10/100 Statistics** and **Eth100 Utilisation**.

The user sets some parameters, others are calculated by the system on the basis of user settings, and still others are calculated by the system independent of user settings.

The Performance window is accessed from **Functions, Status, and Performance** on the menu bar.

Performance – Link

The Link Tab displays major link statistics for performance indicators and is a performance results window. A performance value is displayed for each parameter, as well as its percentage relative to the elapsed time. By using the Period Mode field, the user can choose to sample data in a 24-hour period, since the last reset or for the current 15-minute period.
By default, MINet colour codes major parameters.

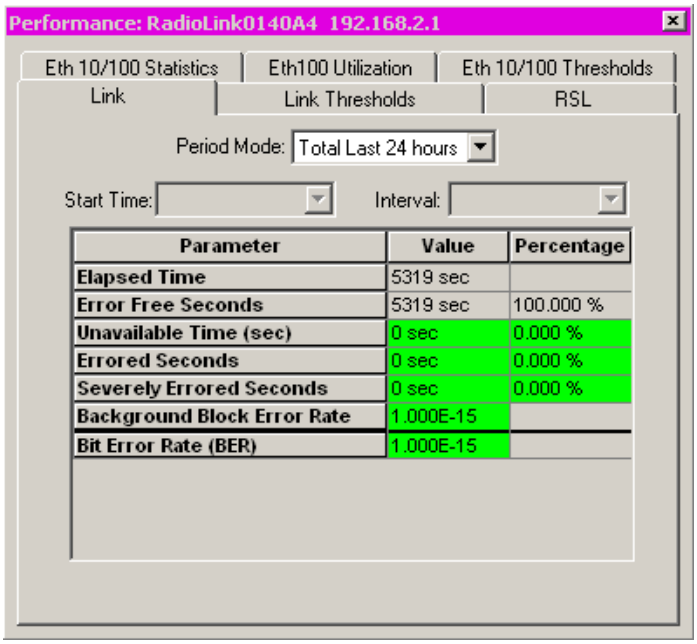
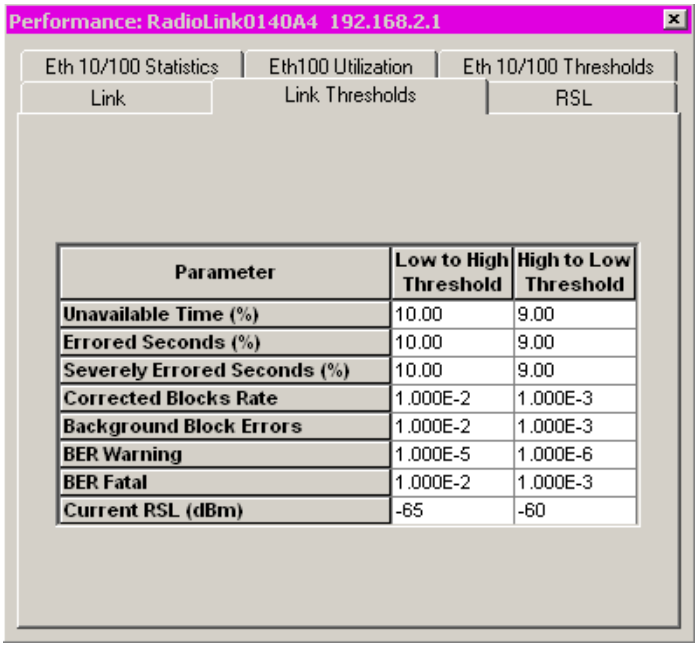


Figure 56 - Performance – Link

Performance - Link Thresholds

This window enables setting the thresholds for link performance parameters. The operator is able to define the performance parameter when the link switches bot into and out of alarm for4 the following parameters:

- Unavailable time
- Errored seconds
- Severely errored seconds
- Corrected block rate
- Background block errors
- BER warning
- BER fatal, and
- Current RSL



Parameter	Low to High Threshold	High to Low Threshold
Unavailable Time (%)	10.00	9.00
Errored Seconds (%)	10.00	9.00
Severely Errored Seconds (%)	10.00	9.00
Corrected Blocks Rate	1.000E-2	1.000E-3
Background Block Errors	1.000E-2	1.000E-3
BER Warning	1.000E-5	1.000E-6
BER Fatal	1.000E-2	1.000E-3
Current RSL (dBm)	-65	-60

Figure 57 - Performance – Link Thresholds

Performance – RSL

This window shows read only RSL performance statistics. The Current dBm Receive Signal Level is colour coded according to the defined Current RSL threshold setting. The Average, Maximum and Minimum RSL are also calculated by the system and cannot be changed. The Elapsed Time shows the amount of time that has elapsed since the last radio restart.

Performance – Eth 10/100 Statistics

This window shows statistics for various Ethernet parameters. This tab is available only if an Ethernet 10/100Base-T DIU is used in the system.

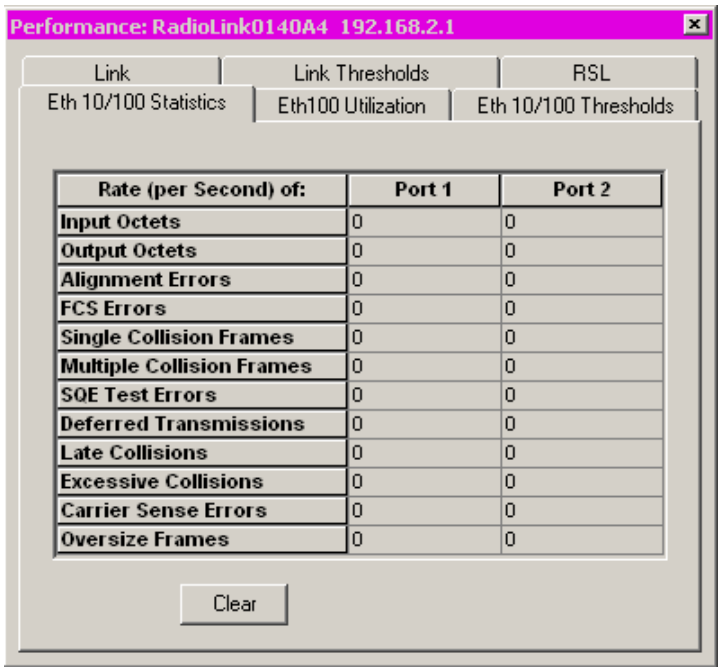


Figure 58 - Performance – Eth 10/100 Statistics

Performance – Eth 10/100 Utilisation

This window shows figures for Ethernet port usage. It will be available only if a **4 x LAN + 4E1/DS1** Data Interface Unit is used in the system. The displayed parameters comply with the Ethernet MIB standard.

Utilisation is based on the current link throughput available as 100%. For example, if link capacity is Ethernet only and channel spacing is 28 MHz, then 100% represents 36 Mbps, which is the maximum available throughput for this configuration.

7.9.8 Alarms Status

MINet enables monitoring the alarm status for all the major components of the Codan 8800 series system being, **Link**, **ODU**, **IDU**, **E1/DS1** (tributaries), (and Eth 10/100). The **Alarm Log** tab provides a full list of accumulated alarm messages.

The alarm status of each parameter in each tab is colour coded for user convenience as follows:

- Green (OK),
- Yellow (warning),
- Orange (user control),
- Red (fatal).

The Alarm Status tabs are accessible from **Functions, Status, and Alarms** on the menu bar.

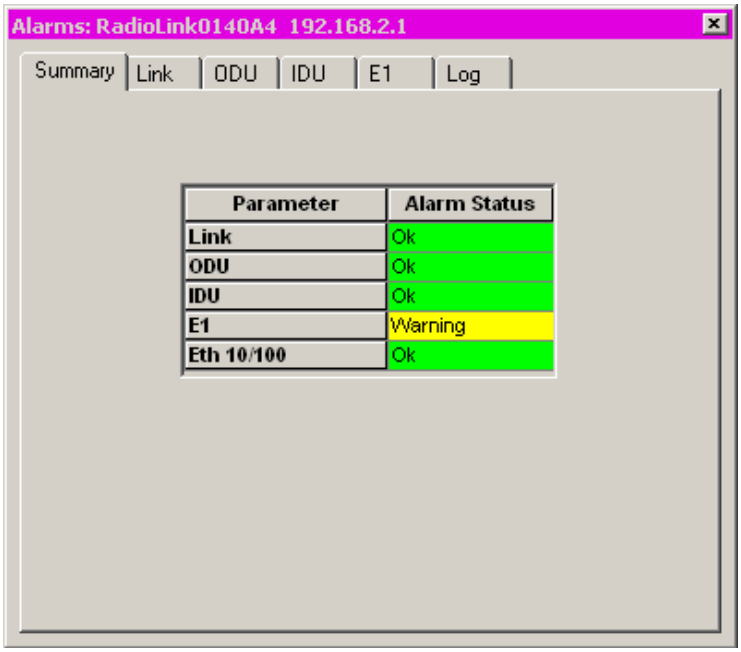


Figure 59 - Alarm Status Opening Window – Summary Tab

Clicking on the **Save File** icon can save the log file. The **Save As** window will appear and normal windows conventions apply to save the file to the PC. This function saves the log file as a text file.

7.9.9 Operations

Tests

For link maintenance, several tests have been provided.

To access MINet link tests, select **Functions, Tests** on the menu bar. The parameters of each test appear in the test's tabbed window.

Loopback

Loop back tests can be performed for the local IDU port and the remote IDU port. Although the individual tributaries of the local IDU port may be looped back, the loop back function does not affect traffic on other ports. This feature is used to verify whether the designated port is operating correctly.

In this window, the user designates the location of the loop back and the desired tributary or tributaries. Attaching standard test equipment to one of the IDUs performs the testing. Test results are received at the test equipment.

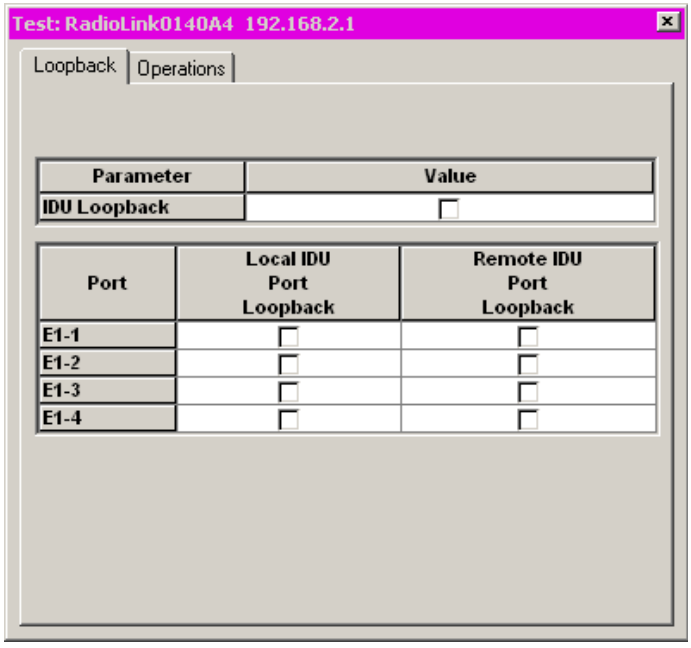


Figure 60 - Loop back test Window

Operations

Operations tests enable turning **Tx Mute** on/off, with or without a timeout period. This feature is used to block transmission during installation or when interference is being checked on site.

In normal **Tx Mute**, the user initiates on/off by changing the Value field. **Pause Tx** functions like normal **Tx Mute** except that a timeout period (**Pause Tx Period**) is set by the user. **Pause Tx** is typically intended for use with a remote terminal that is being set to mute, so that a remote terminal will automatically become active again after the designated time period has elapsed.

7.9.10 TFTP Download

Introduction

The IDU as well as the ODU includes two memory banks to hold the Codan 8800 series firmware. Each bank can hold identical or different versions of firmware. Typically these versions are the latest up-loaded revision and the previously up-loaded revision

Either memory bank can be switched to be the active, running a version of firmware.

TFTP (Trivial File Transfer Protocol) is used to upgrade the Codan 8800 series firmware revision. Any TFTP server can be used for this purpose. The TFTP client/server Codan suggests a freeware program called **Pumpkin** from Klever Group, Inc., which can be downloaded from the Internet at the following URL:

http://www.klever.net/kin/index.html

Main Procedural Steps

1. Establishing an Ethernet connection.
2. Performing the TFTP process.

Step 1: Establishing an Ethernet Connection

- Ensure that the terminal is powered-up and working properly.
- Configure **ETH IP** on the IDU to be on the same Subnet as the PC.

  Example:

PC ETH Mask IP:	255.255.255.000
PC ETH IP:	192.168.1.10
Terminal ETH Mask IP:	255.255.255.000
Terminal ETH IP:	192.168.1.1

- Connect a crossover cable from the **PC ETH** port to the **IDU ETH** port.
- Ping the IDU from the PC in order to verify communication.

Step 2. TFTP Procedure

- Start MINet with Supervisor access authorisation
- It is possible to perform TFTP for one terminal only. When downloading only to the local terminal clicking the Display button can hide the remote terminal. This is also true when performing a TFTP download for only the remote terminal. When a terminal is hidden, polling is turned off for that terminal, thus the procedure is performed faster
- Click the **Display** button to turn off the terminal
- Click the **Load Active Configuration** button from the toolbar
- Enter the **IDU IP** address, and load the configuration
- Click **OK**, and wait until it has loaded
- Select the **TFTP (S/W Download)** from the toolbar or from the menu bar
- Enter the Server IP Address by typing the Server IP Address in the field provided. The entered IP address is the same PC ETH IP address that was previously set in step 1.
- Type the **File Name** in the appropriate field. (Record either the **ODU*.bin** file name or the **IDU*.bin** file name. Only one is downloaded at a time.)
- Click **Apply Now**.

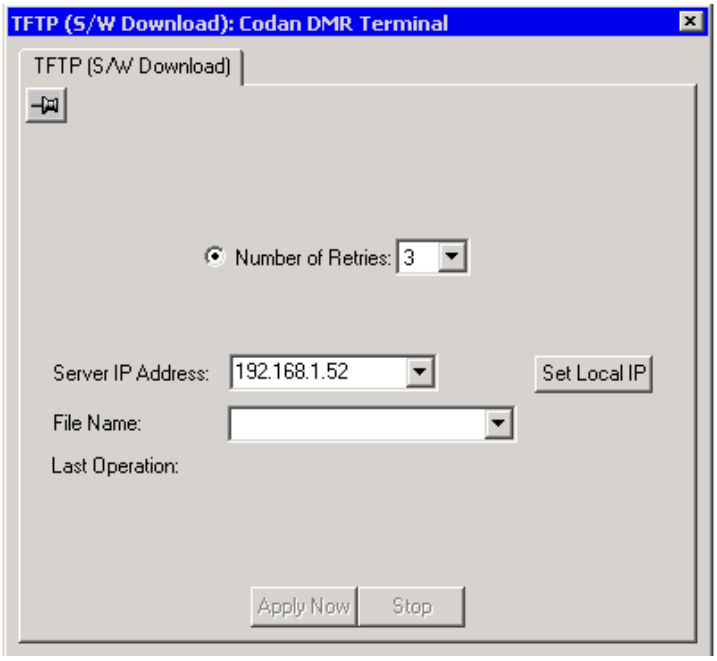


Figure 61 - TFTP Screen

- While the TFTP client/server data transfer is in progress, observe that the firmware file is being transferred to the Codan 8800 series terminal. The PC screen will display **Last Operation: In Process**
- The **In Process** message is displayed as for long as the procedure takes to complete. An up-load to the IDU usually takes only a few seconds. . An up-load to the ODU can last about 5 minutes.
- On completion of the data transfer The TFTP window message shows **Last Operation: Success.**
- The time to wait for the appearance of the **Success** message depends on the current polling interval. If the polling interval had been set to a relatively long time, polling can be immediately activated by pressing **Poll Status Now** from the toolbar or from **Link Operations** on the menu bar.

Step 3: **Complete the TFTP process as follows.**

- Wait until the **Last Operation** message shows: **Success**
- Proceed with up-loading the **IDU*.bin** or **ODU*.bin** file depending on which was already up-loaded.

After up-loading both the **IDU*.bin** or **ODU*.bin** files, a bank switchover may be performed.

Bank Switchover

To perform bank switchover, carry out the following procedure:

- From Link Operations on the menu bar, select Bank Switchover.
- Mark the **IDU** and/or the **ODU** check boxes, and indicate which terminal, left or right to switch first.

- Click OK to finish.

Performing bank switchover will cause the link to reset.

Mark the remote terminal to perform Bank Switchover first. If Bank Switchover cannot be performed for the remote terminal for some reason, troubleshooting can be done from the local terminal, which is still operating.

Do not power down the IDU or the ODU during a firmware up-grade.

Chapter 8 Network Management

This section is intended to convey the basic principles involved in implementing link management using the different options available for all Codan 8800 series configurations.

Dependant upon which Data Interface Unit is used, link management is performed by assigning IP addresses to the IDU plug-in ports or by using built-in ports on the standard IDU itself. Typically, a PC with MINet is connected to one of the terminals. MINet is capable of managing both terminals even if one or both terminals are remotely installed.

Actual networks may be quite complex. A LAN or the Internet may separate the management PC on which MINet is installed from the local IDU.

Configurations that have either E1 or DS1 type Data Interface Units use out of band management only. 4 x LAN + 4E1/DS1 Data Interface Units have the option to use either in band or out of band management.

8.1 IDU Ports and IP Addresses

The Codan 8800 series architecture provides for the two basic types of management implementations of **In Band** and **Out Of Band**.

An **Out Of Band** network refers to a link management system in which a dedicated network for link management purposes connects the terminals.

An **In Band** network refers to a link management system in which some of the link's bandwidth used for customer traffic is allocated for management purposes.

The Codan 8800 series reserves a 64K bandwidth slice for management and other proprietary purposes.

The user can implement **In Band** or **Out Of Band** management depending on the link hardware that is used.

The ports of a link are assigned IP addresses, which enable them to find and communicate with one another.

The following ports are available for assigning IP addresses for management purposes.

ETH port.	**Out Of Band**. This Ethernet 10 Mbit port is the IDU's main management port. If the ETH port is implemented as the management port, it has to be configured for every managed terminal. Each IP address will have a different Subnet for each terminal.
Ethernet 10/100.	**In Band**. Available only on terminals where a 4 x LAN + 4E1/DS1 DIU is installed. Implemented with different IP addresses on the same Subnet.
NMS-IN (Out Of Band)	Used to manage remote links via modem and telephone or to cascade terminals at a site.
NMS-OUT (Out Of Band)	Used to cascade terminals at a site.

8.1.1 Out Of Band Management

The **ETH** port is a 10 Mbit Ethernet port intended for management purposes. It is located on front panel of the **IDU**. In some cases, the **ETH** port would be the only one available for management purposes. The only constraint is that the input to the **ETH** port is via an Ethernet protocol and that the **ETH** port has a designated IP address.

In cases where management is performed via the link, a 64K bandwidth segment known as a peer channel, is used for management purposes. The information that enters the local terminal at the **IDU ETH** port is also used to manage the remote terminal via the peer channel.

Example

The **ETH** port behaves like a router in that it enables terminals with two different subnets to communicate with one another.

The example assumes that a PC is connected to an IDU at one terminal and the PC and the local IDU are on the same Subnet with different IP addresses. Since the IDU is connected to a remote IDU with another Subnet, the local **ETH** port must be informed of the destination to which it should direct remote traffic. Use of a routing table embedded in the smart IDU **ETH** port achieves this.

The routing information, which is input from the MINet workstation into the local **ETH** port, instructs it to direct all remote traffic that it receives to the remote terminal.

In live implementations, access to the **ETH** port may be through a LAN, and the addressing scheme is likely to be more complicated than that presented here.

To be able to manage both terminals, a static route on the management PC must be added. A static route is a path in a PC's routing table that is manually configured by a network administrator.

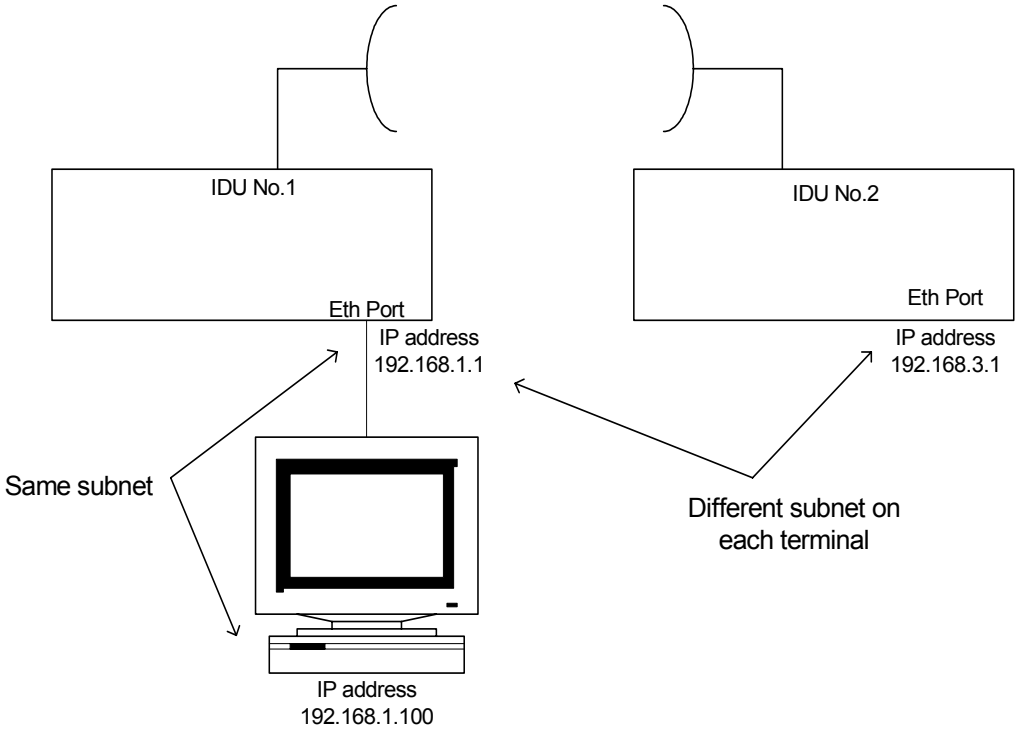


Figure 62 - Out of Band Management via the Eth Port

To add a static route, perform the following:

- Open a **DOS** session on the management PC.
- At the command line, use the following syntax to add a static route for the remote terminal.

```
route add <remote network address>  <local network address>
```

For example, to add a route for the remote terminal with the address of **192.168.3.1** through local Ethernet IP address at **192.168.1.1**, the following line should be entered:

```
route add 192.168.3.1 192.168.1.1
```

This command informs the PC that communication with **192.168.3.1** should be established through **192.168.1.1.** All frames sent to the remote terminal, **192.168.3.1** would be directed to the local terminal.

Use the <**route print>** command to verify that the route was properly added to the routing table.

8.1.2 In-band Management

In-band management refers to link management that is performed within the customer's bandwidth range in a dynamic manner. It can only be used when 4 x LAN + 4E1/DS1 DIU is installed.

The bandwidth for link management purposes expands and contracts depending on the volume of management traffic involved. This is called **In Band** because management it is performed using the customer's traffic channel. Link management is performed inside of the customer's traffic. In this case, 64K is still set aside for Codan 8800 series proprietary use.

Example

In-band management is one option to manage a link. The intention of the 4 x LAN + 4E1/DS1 DIU is to emulate a simple switching device in which one terminal is connected to the other by an Ethernet cable.

In band management is done as part of the main payload. This means the management PC is part of the same global network and Ethernet traffic between the two terminals.

According to the standards set for switching, such a network requires that both terminals belong to the same IP.

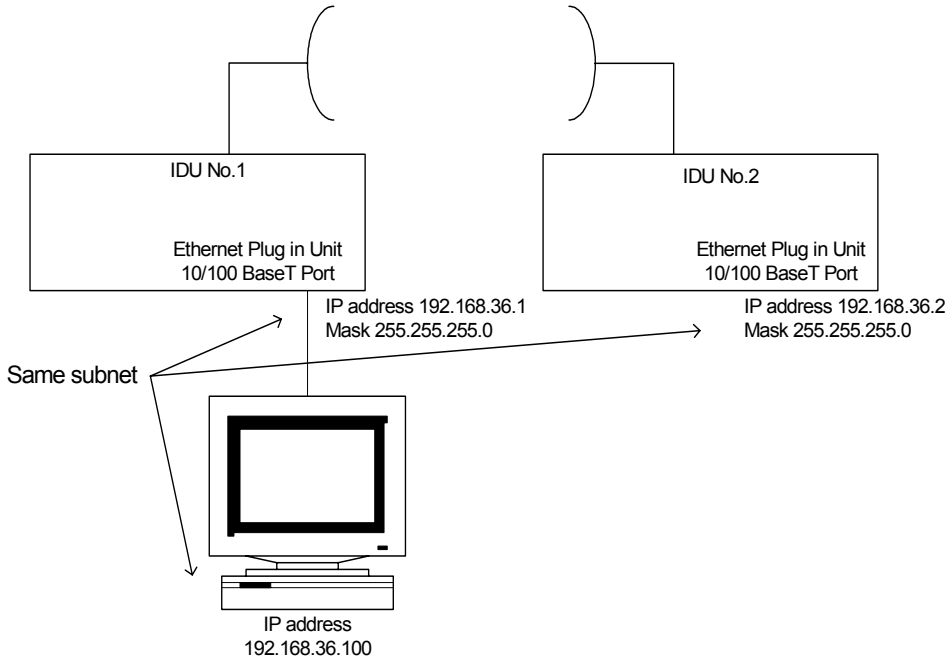


Figure 63 - In Band Management via 4 x LAN + 4E1/DS1 DIU

In this case, adding a static route is unnecessary.

8.2 Using NMS-IN and NMS-OUT Ports

8.2.1 NMS-IN

The **NMS-IN** port is located on the IDU and is allocated an IP address for the purpose of managing the link and remote terminals via a modem and standard dial-up telephone line. In this case, management is performed **Out Of Band**.

This port is also used for cascading terminals via **SLIP** (Serial Link IP), the protocol that runs on the **NMS-IN** port.

8.2.2 NMS- OUT

The **NMS-OUT** port connects to an **NMS-IN** port and is intended only for cascading IDU units.

8.3 RIP (Routing Internet Protocol)

8.3.1 The Advantages of RIP

In large and complicated networks, dynamic routing is used instead of static routing.

When several links are cascaded, or configured in a 1+1 System, additional IP and routing tables needs to be configured. By using a dynamic routing table, which is supported by the RIP protocol, the routing configuration process is simplified.

With the **RIP** implementation, all the internal interfaces (**NMS-IN, NMS-OUT, Link**) are automatically assigned with an IP address. Only the external **Ethernet interface** has to be manually assigned an IP address.

A routing statement is added in the management PC for the first remote network. The dynamic RIP table controls and updates the all network IP addresses. This enables the network to be dynamically adjusted to changing conditions otherwise all routing decisions have to be predetermined and remain static.

8.3.2 RIP in a cascading configuration

Cascading several links using **RIP** saves time for the operator by eliminating the need to manually configure the routing statements and enter all of the network IP addresses.

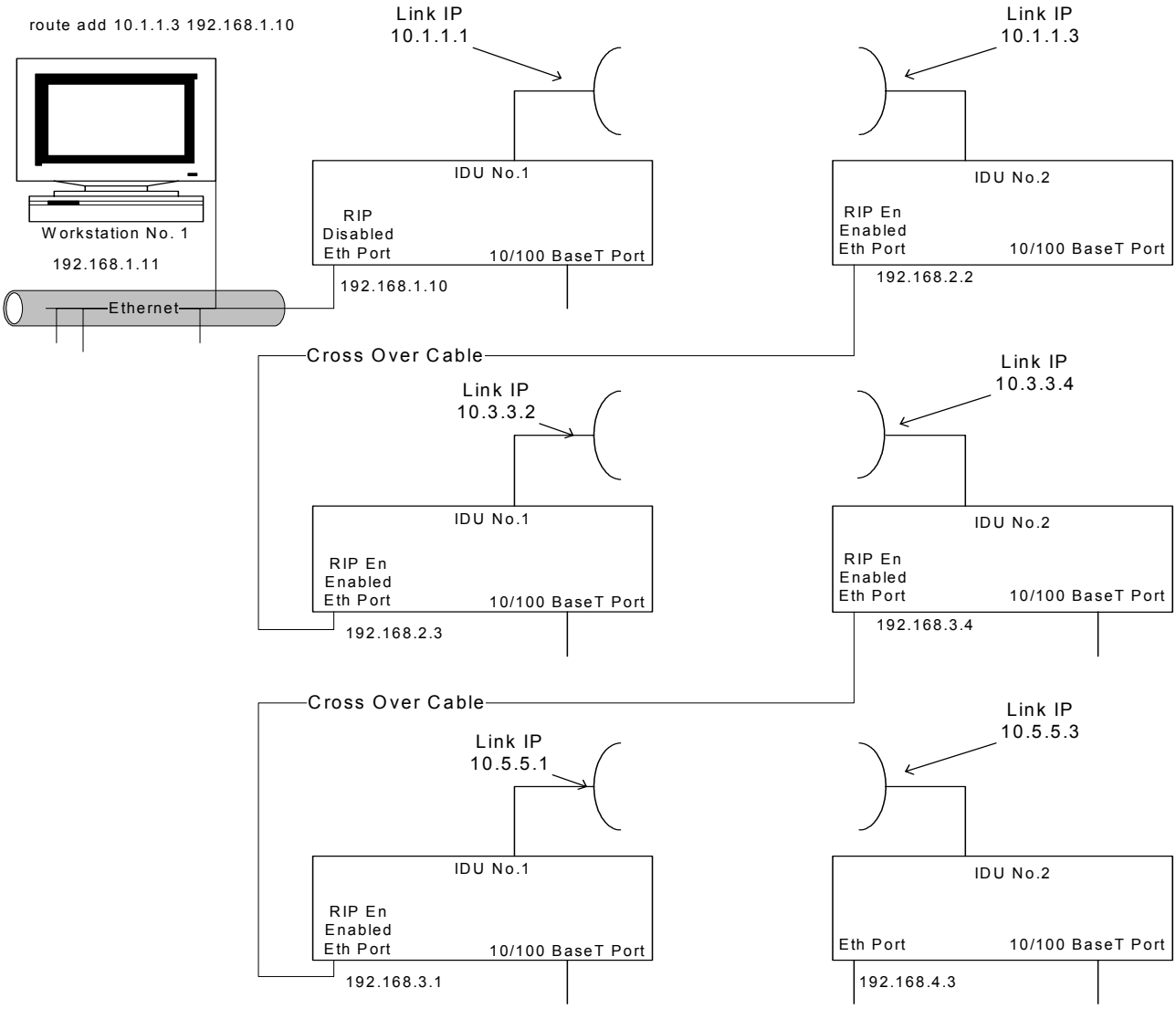


Figure 64 - Cascaded management using RIP

The above figure describes the cascading configuration for three links using RIP.

The connections between links use the Ethernet ports with a crossover cable. Only one static routing statement needs to be added to the management PC.

The example configuration relates to a private network management configuration. All IP subnet masks used in this example are 255.255.255.0 (class C).

The Codan 8800 series default is to have **RIP** disabled on all the **Ethernet Ports**. This is done to prevent **RIP** information from being propagating back to the local public Ethernet network.

When using cascading or with a 1+1 System, the **RIP** should be enabled for **Ethernet** ports as shown.

NOTE: When managing links over the Internet, public IP addresses must be used. To access the remote links in the cascading configuration (as shown above), a public IP address has to be assigned to ALL **Ethernet** interfaces on those links that need to be accessed.

8.3.3 Using RIP with protected system

A protected link in a Hot-stand-by configuration system includes four terminals. The system is configured with two active and two non-active terminals. The system will switch automatically in case of failure by link or by a single terminal.

For management purposes all four terminals are assigned with IP addresses. There are issues that need to be emphasized when configuring the IP addresses of the system:

1. Each pair of terminals (i.e., local or remote) should be assigned with an IP address of the same subnet.
2. Each side of the link should be assigned with an IP address of a different subnet.
3. **RIP** has to be enabled on the **Ethernet** interfaces to exchange information **only** when not connected to the local public Ethernet network.
4. If RIP is disabled between a pair of terminals, backup IP addresses need to be assigned for both terminals.

In a four terminal system routing must be assigned between terminals for management purposes. It can be done by using either static routing or with dynamic routing (RIP).

Communication between the protected terminals uses an Ethernet connection. When using an Ethernet connection, the two terminals can be connected via HUB \ Switch, using a straight through **CAT 5** cable or a direct connection between the terminals using a crossover UTP cable.

The following figure describes the IP configuration of the 1+1 System when one side is connected via a hub and the other side with a crossover cable. All IP masks are class C masks (255.255.255.0)

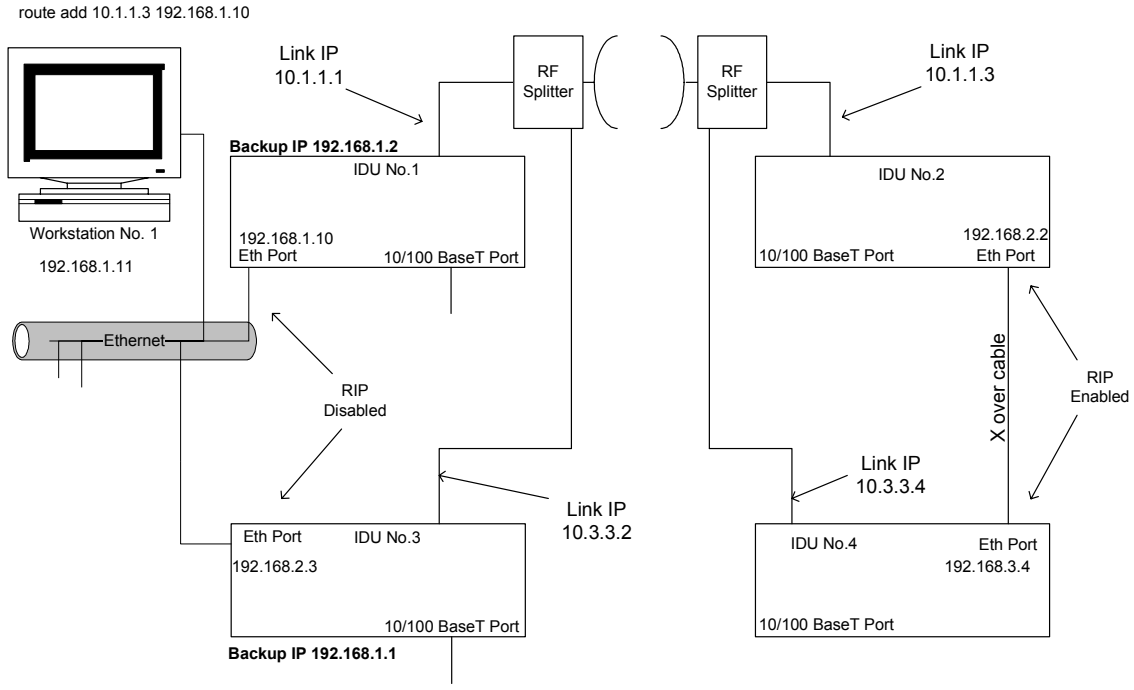


Figure 65 - IP Configuration for protected system

Since the RIP is disabled for IDUs 1 & 3 as shown above, information regarding the protected terminal must be exchanged between the two terminals on each side. This information is needed for management purposes in case one of the terminals fails. This information is called a Backup IP address and it has to be manually assigned to each terminal with the IP address of the protected terminal.

Using the configuration above as an example, IDU 1 will receive the IP address of 192.168.1.2 as a backup IP address and IDU 3 will receive the IP address of 192.168.1.1 as a backup IP address. This way, if one of the terminals fails to communicate because of hardware or software failure, the IP address of the other IDU will be available for the host PC.

When the RIP is enabled (in IDUs 2 & 4), the RIP exchanges information regarding the IP addresses of the primary and the secondary (upper and lower) units.

8.3.4 Enabling RIP on an Ethernet interface

The **RIP** on the Ethernet interfaces of the Codan 8800 series is disabled by default. Enabling the **RIP** is done via the Control Panel.

The following procedure describes the steps to enable **RIP** on an Ethernet interface from the Front Panel:

1. Press **SEL/SAVE**, the '**Please Wait…**' message will be displayed.
2. When '**Quick Config'** is displayed, press **SEL/ SAVE** to enter password.
3. The '**Enter password'** message will be displayed.
4. Enter the supervisor password (**ESC, ESC ►►►**).
5. Scroll with the '**ESC**' and arrows ◄► until '**ETH IP RIP'** is displayed.
6. Using **SEL/SAVE** and the ◄►, change the displayed value from 'Disabled' to 'Enabled'.
7. Press **SEL/SAVE** and the **#** sign will be displayed on the LCD.
8. Press '**ESC**' to update and save changes.
9. Follow instructions on the LCD to save changes.

8.3.5 Configuring 1+1 management system

When using the 1+1 System, The Management System needs to be configured with all of the IP addresses of the four terminals. This process is done in two steps. In the first step, the active pair is loaded to the MINet software. In the second step, the protected pair is loaded.

Step 1. Load the configuration of the first set of terminals as if it is a single link

Step 2. The MINet detects a 1+1 System and loads the system screen. MINet prompts to load the 1+1 link.

Step 3. Enter the IP address of the protected link. Click OK and MINet will load the system configuration of the second link.

Final Status: Link configuration has been loaded and displayed by MINet.

8.4 HP OpenView Support

MINet-OV enables the use of MINet's Graphical interface with HP OpenView to monitor more than one link at a time.

This section contains the following:

- Introduction to MINet-OV
- MINet-OV installation procedure
- MINet-OV features

8.4.1 Introduction to MINet-OV

MINet OpenView is Codan's premiere network management system and is designed to provide open standard management capabilities for large Codan 8800 series radio networks.

MINet-OV can manage multi-regional networks containing Codan 8800 series point-to-point radios.

MINet-OV is based on the industry's leading network management platform of HP® OpenView Professional Suite, Version D.01.02 or Network Node Manager 7.5, running on a **Windows 2000, NT** or later version server.

The **MINet-OV** system uses the industry standard Simple Network Management Protocol (SNMP) to manage Codan equipment furnished with an integrated SNMP agent.

8.4.2 MINet-OV Installation

Please verify that **MINet-OV** support has been purchased by your organisation. Otherwise, you will not be able to install this application.

To install **MINet-OV**, carry out the following steps:

Step 1. Place the CDROM in the PC CDROM drive

Step 2. Access the CD, and open the Install folder

Step 3. Click the Setup.exe icon

After a moment, the **Setup** window opens.

Note the MINet version number that appears in the upper left-hand corner of the window. A reminder message is displayed to exit any active HP OpenView and/or MINet sessions.

Step 4. Click **OK**. The **Install Shield Wizard Setup** window opens.

Step 5. Click **Next** to open a window in which all customer information must be entered. The serial number is located on the CD cover. It must be copied precisely as it appears.

Step 6. Click **Next** to continue and enter the desired location for the program to be stored on your PC The default installation directory can be accepted, or use the **Browse** button to choose another directory.

Step 7. Click **Next** to continue. A window appears asking you to select the required components. All components available for installation will be shown in the **Select Components** window. Select the installation components by marking the check box. Note that a description of each component is given in the Description box. Verify that there is enough space available on the installation disk drive. Click Next to continue.

Step 8. A progress bar appears indicating that all programs required for **MINet-OV** are being registered for proper application operation.

Step 9. After registration, a window will appear requesting installation of public and private MIBs on the computer.

Step 10. Click **Yes** to install the MIBs

Step 11. After MIB installation, click **Finish** to complete installation and exit the installation wizard.

8.4.3 MINet-OV Features

The HP OpenView user manual should be consulted for a full description of HP OpenView functions. This section is intended to describe features available when working with MINet-OV and HP OpenView.

When HP OpenView is opened after **MINet-OV** installation, HP OpenView builds a network map that includes the Codan 8800 series as an SNMP object. This building process can take a long time for large networks. The map displays Codan icons to show Codan 8800 series radios in their relative position according to network subnets.

By navigating down to a sub-map, an individual segment and its networked elements can be viewed. Right clicking on a Codan icon activates a pop-up window. This window enables running **MINet-OV** and performing other functions such as making an RSL query, power query, etc

To activate **MINet**, select a radio link icon by left clicking, Open the sub-menu by right clicking and then choose **Run EM Configuration** from the pop-up menu.
To activate **MINet-OV** with both terminals of a link, select the two terminals using **Ctrl + Shift** key combination, and choose **Run EM Configuration** from the pop-up menu.

The actual operation of **MINet-OV** is similar to that of **MINet** as explained earlier in this manual.

Every alarm implemented by either a public or private MIB is sent to and is displayed in the HP OpenView alarm log according to its alarm category. With regard to traps, the Codan 8800 series can be configured using **MINet-OV** to send traps to the HP OpenView trap manager. In this case, the trap message will appear in HP OpenView Alarm Browser window.

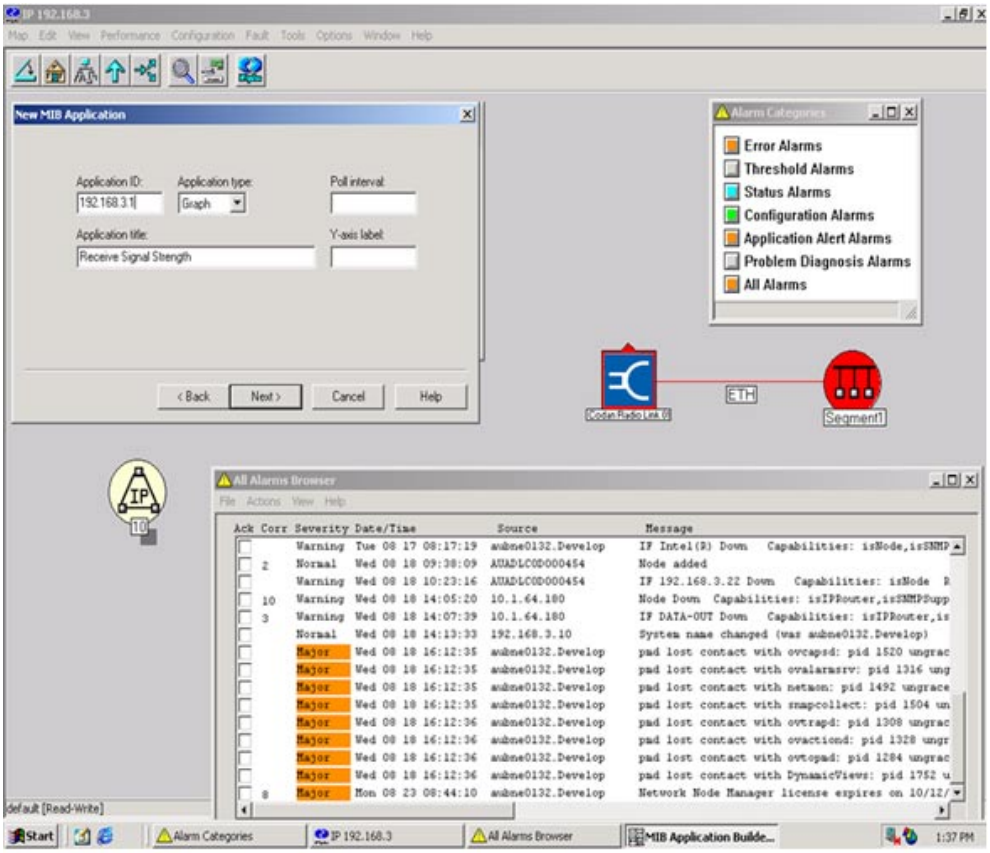


Figure 66 - MINet – OV Screen

8.4.4 Supported SNMP MIBs

Recommended public MIBs:

- RFC 1213.MIB
- RFC 1253.MIB
- RFC 1406.MIB
- RFC1407.MIB
- RFC 1643.MIB
- RFC 1659.MIB

Recommended private MIBs

- Codan-SMI.MY
- Codan_8800.MIB

Chapter 9 1+1 protected configuration

Protected systems are used to improve link reliability and availability.

The Codan 8800 series provides 100% redundancy and hitless switching in a protected system and may operate with one antenna in the Hot Standby mode, or two antennas in the Space Diversity mode, depending on the customer's requirements.

9.1 1 + 1 Common Features

The configuration requires two Indoor Units, with SCSI Data Interface Units. Each Indoor Unit connects to an ODU.

To achieve 100% redundancy and hitless switching with no single point of failure, the Indoor Units are interconnected to provide intra IDU communication. This communication is provided on a number of pins on the 100-pin SCSI connector.

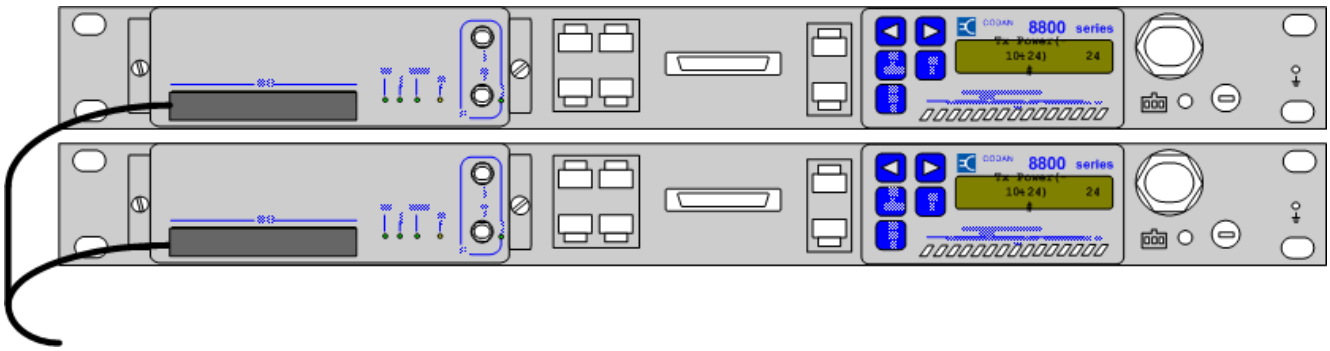


Figure 67 - IDU Redundancy

The tributary inputs and outputs of each Indoor Unit are connected together in a "Y" configuration. Only one IDU is on line at any given time, and the input and output impedances are automatically adjusted by software.

This inter-IDU communication, the "Y" cable configuration which is typically terminated in a pair of "D37 female connectors" and the advanced software algorithm used to support redundancy, means that the objectives of full redundancy and no single point of failure are achieved.

The output of each ODU can be connected to distribution equipment e.g. a Krone Block or a break out panel.

The Codan 8800 series supports a number of breakout panels. These are:

- SCSI to RJ45 (16E1/DS1)
- SCSI to Krone (16E1/DS1)
- SCSI to BNC (16E1/DS1)
- SCSI to DB25 (16E1/DS1)

Figure 68 - SCSI to RJ45 Breakout Panel.

The “Y” configuration is in built in the breakout panel.

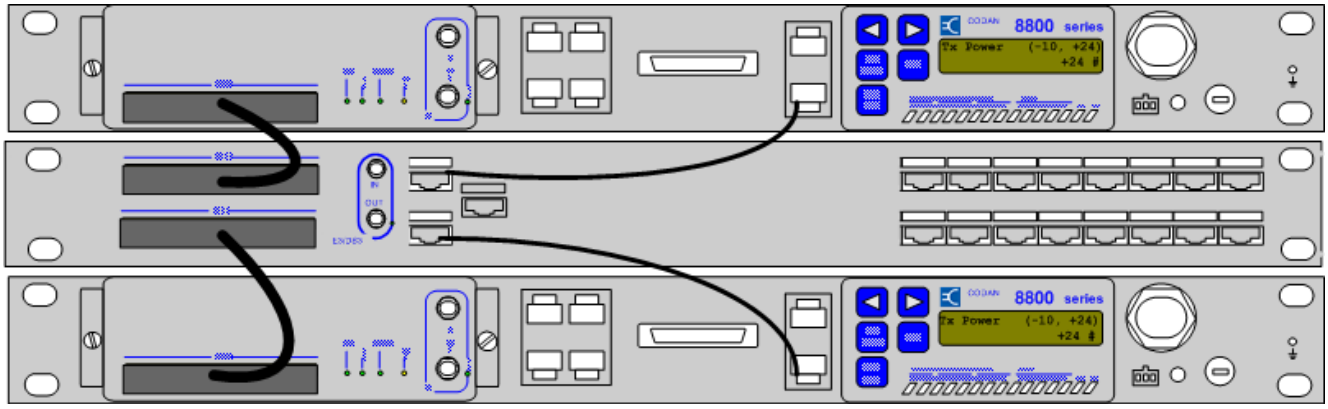


Figure 69 - 16E1/E3, 1 + 1 with RJ45 Breakout Panel and Management Redundnacy

9.2 Hot Standby Mode

Hot Standby is used to provide protection to the service in case of a hardware failure.

9.2.1 Configuration - Hot Standby

In the hot standby mode, both terminals are set to the same frequency. One terminal’s transmitter is muted to prevent interference.

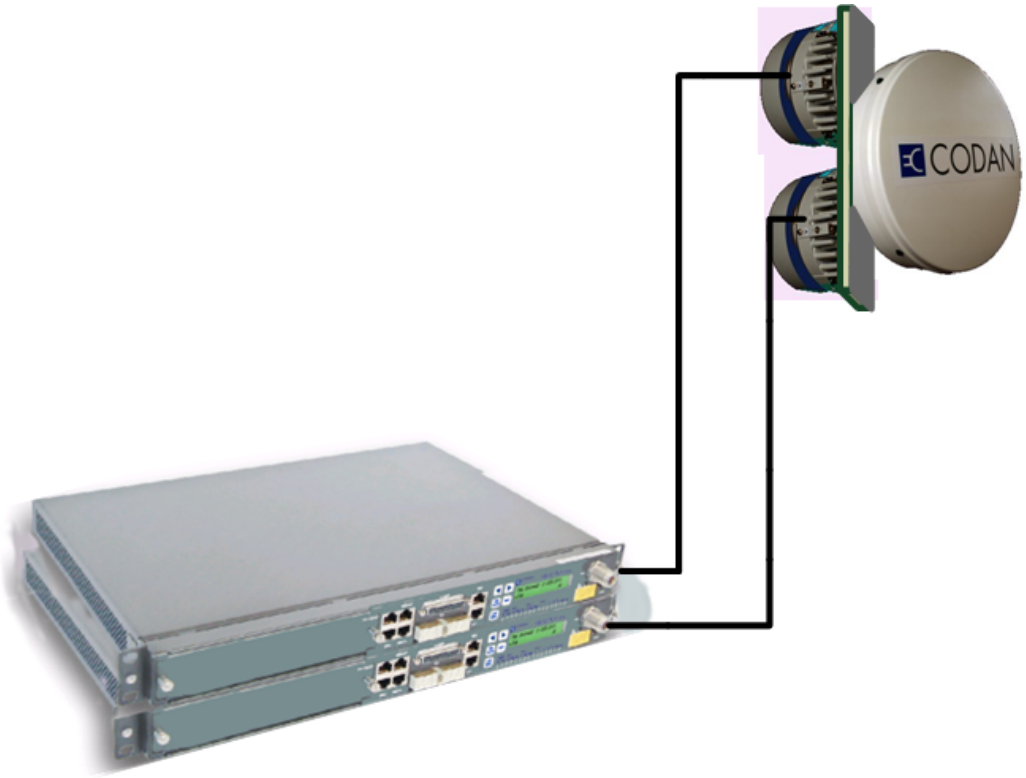


Figure 70 - Hot Stand-by configuration.

The ODU's connect to the antenna via a three port Redundancy Splitter with one ODU attached to the **MAIN** port and one ODU attached to the **STBY** port. The third port of the Redundancy Splitter connects to the antenna.

The Redundancy Splitter is of the unequal split type with a loss of 1.5 dB from the Main ODU to antenna and a loss of 6 dB from the Stand-by ODU to antenna. The isolation from the **MAIN** port and the **STBY** port is greater than 20 dB.

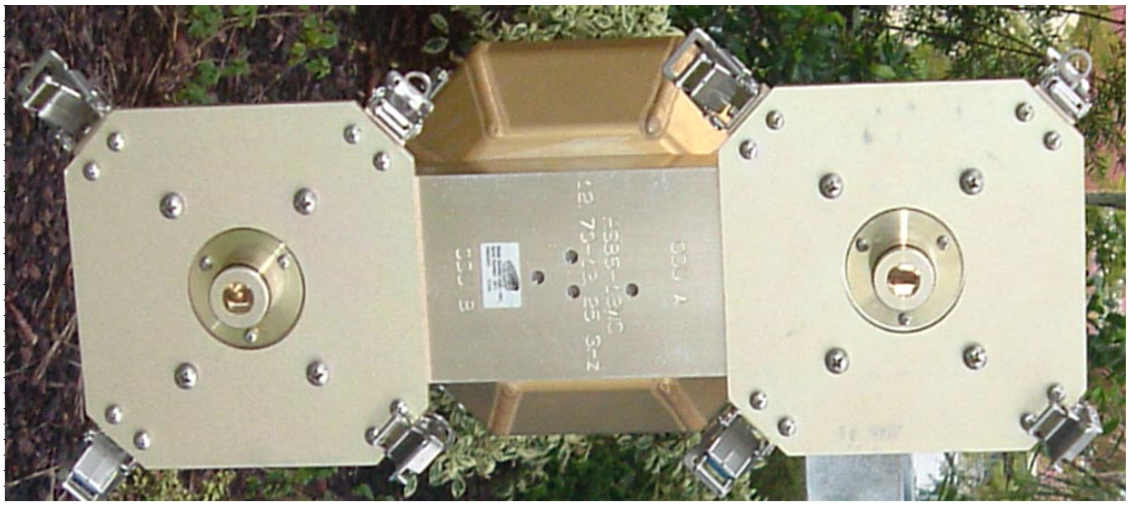


Figure 71 - Unequal Redundancy Splitter

9.2.2 Operation - Hot Standby Mode

In the Hot Standby mode, each ODU transmits and receives. One ODU is active (transmits and receives). The other ODU has its transmitter muted, and only its receiver is active.

When there is a problem with the active (Main) terminal, the ODU's transmitter is muted and the stand by terminal begins to transmit. In the hot standby configuration, both transmitters operate on the same frequency,

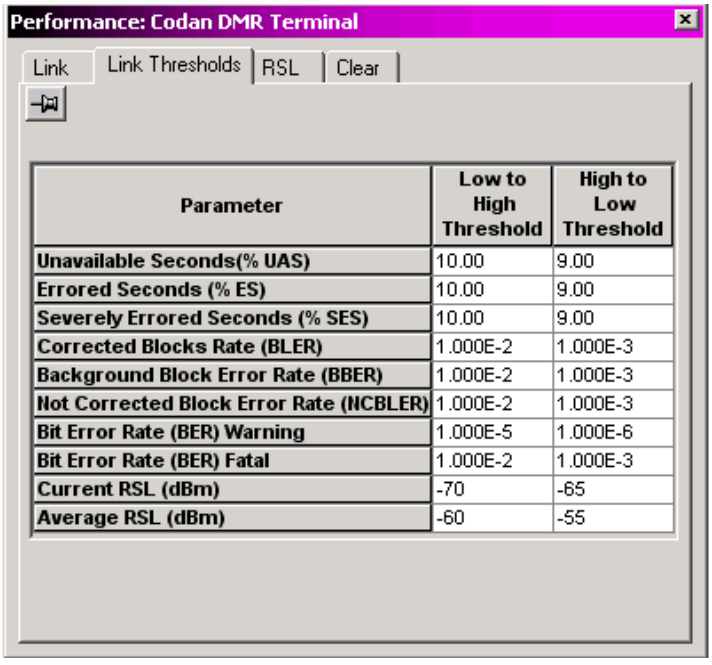
9.2.3 Switching Conditions – Hot Standby Mode

The Hot Standby protected system provides link continuity in the event that a fault occurs in the primary link.

The switch over to the Standby terminal is activated by an alarm condition in a terminal of the primary link. The terminal with the alarm condition signals the alternate terminal that it has a problem. The alternate terminal decides (using a software algorithm) whether to take control. Taking control involves signaling between the Indoor Units to switch the traffic from the previously active IDU to the inactive IDU, which then delivers the traffic. The switching is hitless and transparent.

The following alarm conditions will automatically trigger a switch from the primary to the alternate terminal:

- DC power loss
- Modem/Mux or any other link failure alarm
- Receive Frame loss
- Loss of lock on transmit signal
- Loss of transmit power
- RSL alarm bypassing the RSL lower threshold level
- BER alarm bypassing the BER upper threshold level
- Telemetry fail between IDU and ODU



Parameter	Low to High Threshold	High to Low Threshold
Unavailable Seconds(% UAS)	10.00	9.00
Errored Seconds (% ES)	10.00	9.00
Severely Errored Seconds (% SES)	10.00	9.00
Corrected Blocks Rate (BLER)	1.000E-2	1.000E-3
Background Block Error Rate (BBER)	1.000E-2	1.000E-3
Not Corrected Block Error Rate (NCBLER)	1.000E-2	1.000E-3
Bit Error Rate (BER) Warning	1.000E-5	1.000E-6
Bit Error Rate (BER) Fatal	1.000E-2	1.000E-3
Current RSL (dBm)	-70	-65
Average RSL (dBm)	-60	-55

Figure 72 - The RSL Threshold and BER Alarm are configurable items.

9.3 Space Diversity Mode

Space Diversity is used to provide path protection in the event of path or propagation problems. It also behaves in a manner similar to Hot Standby in that the service is protected in case of a hardware failure.

9.3.1 Configuration – Space Diversity

In the Space Diversity mode, both terminals are set to the same frequency. One terminal's transmitter is muted to prevent interference.

Figure 73 - Space Diversity configuration.

Each ODU is connected to individual antennas. A pre-calculated distance separates the antennas vertically.

9.3.2 Operation – Space Diversity Mode

In the Space Diversity mode, each ODU transmits and receives. One ODU is active (transmits and receives). The other ODU has its transmitter muted, and only its receiver is active.

The incoming receive signal includes Forward Error Correction (FEC) in the Data frames.

As each receiver is active, and the receive signals are originating from the same transmitter, any difference in the receive signals can be attributed to propagation or path anomalies. The algorithm in the software in each IDU, determines which of the IDU receive frames has the least amount of FEC applied, or which frame most closely resembles the frame originally sent by the remote transmitter.

The frame with the least amount of FEC applied is the frame, which is sent to the external equipment.

This frame-by-frame voting gives a System Gain increase of 4 dB over an unprotected system.

When there are hardware problems, the Space Diversity mode also behaves link a Hot Standby installation in that if a problem with the active (Main) terminal is detected, the ODU's transmitter is muted and the stand by terminal begins to transmit. In the hot standby configuration, both transmitters operate on the same frequency,

9.3.3 Switching Conditions – Space Diversity Mode

The Space Diversity protected system provides link continuity in the event that either a path problem is encountered or a fault occurs in the primary link equipment.

The voting between the IDU's is activated by the amount of FEC applied in each incoming data frame.

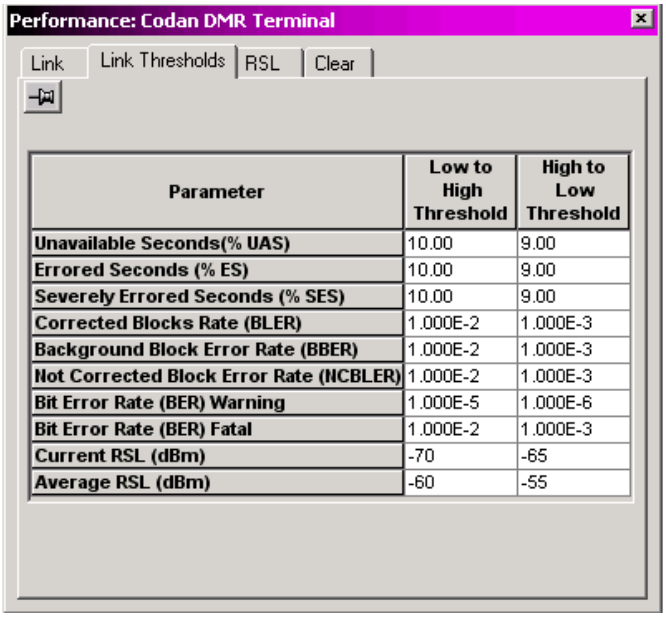
The switch over to the Standby terminal in the event of a hardware problem is activated by an alarm condition in a terminal of the primary link. The terminal with the alarm condition signals the alternate terminal that it has a problem. The alternate terminal decides (using a software algorithm) whether to take control. Taking control involves signaling between the Indoor Units to switch the traffic from the previously active IDU to the inactive IDU, which then delivers the traffic. The switching is hitless and transparent.

The following condition will automatically toggle the IDU's:

- The amount of applied FEC is lower in one IDU when compared to the other IDU.

The following alarm conditions will automatically trigger a switch from the primary to the alternate terminal:

- DC power loss
- Modem/Mux or any other link failure alarm
- Receive Frame loss
- Loss of lock on transmit signal
- Loss of transmit power
- RSL alarm bypassing the RSL lower threshold level
- BER alarm bypassing the BER upper threshold level
- Telemetry fail between IDU and ODU



Parameter	Low to High Threshold	High to Low Threshold
Unavailable Seconds(% UAS)	10.00	9.00
Errored Seconds (% ES)	10.00	9.00
Severely Errored Seconds (% SES)	10.00	9.00
Corrected Blocks Rate (BLER)	1.000E-2	1.000E-3
Background Block Error Rate (BBER)	1.000E-2	1.000E-3
Not Corrected Block Error Rate (NCBLER)	1.000E-2	1.000E-3
Bit Error Rate (BER) Warning	1.000E-5	1.000E-6
Bit Error Rate (BER) Fatal	1.000E-2	1.000E-3
Current RSL (dBm)	-70	-65
Average RSL (dBm)	-60	-55

Figure 74 - The RSL Threshold and BER Alarm are configurable items.

9.4 Protected system commissioning

Before applying power to the system, verify that all cables are properly connected and that a “Y” configuration exists in the cabling or the breakout panel.

9.4.1 Protection Mode

The following specific instructions apply and should be read in full before commencing commissioning:

Step 1. Verify that all interconnect cables are installed.

Step 2. Power up both IDUs.

Step 3. Access the Upper IDU LCD Front Panel and configure the basic parameters using the **Quick Config**.

Step 4. Access the Lower IDU LCD Front Panel and configure the basic parameters using the **Quick Config**.

Step 5. Without logging out from the LCD password protected menu, choose the primary terminal and the Hot Standby mode or the Space Diversity mode.

Step 6. Align the antenna using the guidelines given in Codan 8800 series Reference Manual.

Step 7. Assure proper operation of both links (primary and secondary), by individually failing the upper and lower IDU’s. Removing DC power will achieve this.

Step 8. The link and power LEDs for the upper and lower IDU should be solid green.

Step 9. Repeat steps 1 to 8 in order to configure the other terminal.

Step 10. The Protected System is now ready to carry traffic.

9.5 Configuration Rules for 1 + 1 mode

Setting the protected terminal parameters requires the user to follow some basic rules.

Setting configuration parameters requires the configuration indicated in the following table.

Identical indicates that both IDUs of the same protected terminal should be configured identically for the specific parameters.

In addition to the requirements stated in the table, it is necessary to verify that the link terminals' (Remote and Local) parameters comply with the Codan 8800 series parameters requirement. Link ID, Link Capacity, and Frequency and Channel should be identical on both sides of the Link.

Table 9-1 Protected Terminal Requirements

Parameter	**Hot Standby Mode**
Link ID	Identical
Link Capacity	Identical
Frequency (Ch #)	Identical
Tx Power	Installation requirements
ETH IP Address & Mask	Different
NMS IN IP Address & Mask	Identical
NMS IN Dest IP Address & Mask	Identical
NMS OUT IP Address & Mask	Identical
NMS OUT Dest IP Address & Mask	Identical
LINK IP Address & Mask	Identical

9.6 NMS Configuration for 1 + 1 mode

Configuring and managing the Codan 8800 series Protected links can be performed using the LCD Front Panel or the MINet software. Using the MINet software requires the following:

- IP Connection to the two IDUs.
- **SLIP** connection to one of the Protected Terminals from the **NMS-IN** input
- IDUs' IP address setting.
- IP routing tables setting.

9.6.1 Hardware Connections

Two methods to access and manage the protected terminals are available:

- **Ethernet** – Using the 10M Base-T ports for fast and efficient management with Ethernet segment as Switch and HUB.
- **SLIP** – Connecting Laptop or Desktop PC serial port to the **NMS-In** port for direct or remote out-of-band management.

Ethernet Connection

Step 1. At the remote side, connect between the two **Ethernet** 10Mbps ports of the two IDUs, with a crossover Ethernet cable

Step 2. At the local side, connect the two **Etherne**t 10Mbps ports of the two IDUs, to an Ethernet segment (via Hub or Switch).

Step 3. At the local side, (to the same Ethernet segment) connect the management PC equipped with MINet software.

SLIP Connection

Step 1. At the remote side, connect between the two **Ethernet** 10Mbps ports of the two IDUs, with a crossover Ethernet cable

Step 2. At the local side, connect between the two **Ethernet** 10Mbps ports of the two IDUs, with a crossover Ethernet cable

Step 3. At the local side, connect the **NMS-IN** port directly to the PC serial connection using an RS232 cable. An External Modem connection is also available via this port.

9.6.2 IDU IP address setting

Each Protected Terminal (2 IDU's) has the following IP interfaces, which need to be initially configured using the LCD Panel:

- Ethernet IP Upper Link – This is the Upper Link Access IP address. The network system administrator should assign this IP address.
- Ethernet IP Lower Link – This is the Lower Link Access IP address. The network system administrator should assign this IP address.
- NMS IN/OUT IP address – This is the **SLIP** IP address, which is required for daisy-chain configuration or for modem connection. This type of connection requires configuring the **NMS IN** destination IP (the SLIP target IP address).

9.7 Management for the 1 + 1 mode

9.7.1 Loading a 1+1 Active Configuration

To load a 1+1 Protected System Active configuration carry out the following steps:

Step 1. Select Link Operations on the menu bar, and choose **Load Active Configuration**

Step 2. Fill in the IP addresses as you would for a standard link. Click **OK**.

Step 3. The link will begin to load. After the loading of one pair of terminals a message will appear prompting the operator to "**Load Alternate 1+1 Link**"

Step 4. Click **YES** and the load active configuration appears again

Step 5. Fill in the IP addresses for the other pair of IDUs. Click **OK** to continue.

Step 6. Select either the **Hot Stand-by** or **Space Diversity**

MINet loads each pair of IDUs consecutively and finishes with the second pair not with the first. The (1+1) screen will appear when the load process completes.

9.7.2 Updating a 1+1 Active Configuration

The windows of a 1+1 system are identical to those of a single IDU-to-IDU link. Navigation is by the menu bar or by activating toolbar functions. However, it is possible to navigate only through the displayed menus of an IDU. Switching between the display of “upper” and “lower” IDU of a terminal can be done by clicking on the buttons right and left sides of the IDU picture.

In this manner, each individual IDU of a terminal can be separately configured as necessary. Obviously, key communications parameters like frequency and capacity must be identical to both sides of the link and between the IDUs of a terminal for the redundancy function to operate effectively.

The configuration windows operate in the same way as in a single IDU-to-IDU terminal, and appropriate messages prompt the user as necessary.

After changes are made in the configuration, moving to another window will generate a **Save** confirmation message. In this case, if **Yes** is chosen, then the configuration will be saved “on screen” for the first “pair” of IDUs. After the process finishes, a confirmation message will appear for changing the second pair of IDUs.

In order to update the configuration to the Active Configuration, select **Link Operations** on the menu bar and choose **Update Active Configuration**.

9.7.3 1+1 Hot Stand-by Switch Over

This function enables manual switching from the currently active IDU of one terminal to the other IDU at the same terminal. In other words, if the “top” terminal was the active terminal before Switch Over, then the “bottom” terminal will be the active terminal after Switch Out and vice versa.

To perform 1+1 Switch Out, Carry out the following steps:

Step 1. If performing Switch Out for the entire link, select **Link Operations** on the menu bar and click **1+1 Switch Out Link**.

i. A confirmation screen will appear.

ii. Select the remote terminal to switch first. Click **OK**

Step 2. If performing Switch Over for one terminal only, select **Link Operations** on the menu bar. For purposes of this example, we assume that Switch Over is being performed for the left terminal only.

i. Click **1+1 Switch Over Terminal** and choose **Left**.

ii. A confirmation screen will appear. Click **Yes** to continue.

After the Switch Over process has been completed for the left terminal, the configuration window appears.

9.8 Ethernet Redundancy via the Codan 8800 series Digital Microwave Radio

Achieving Ethernet redundancy will require two Codan 8800 series links, four LAN + 4E1/DS1 Data Interface Units, two high performance cross polar antennas and two low cost routers, which support the spanning, tree protocol.

Alternatively, two ports of the prime router could be used if available and if spanning tree is supported, with only a single low cost router used at one end.

The two Codan 8800 series Ethernet Links are actually configured as 1+ 0 links but used in parallel.

The links use the same frequencies and the Outdoor Units are connected to cross-polar antennas. This means that one link path has horizontal polarisation and the other path has vertical polarisation. The use of high performance cross-polar antennas gives at least 30 dB of isolation between the paths.

Each terminal is assigned its own unique IP address via MINet or the front panel keypad prior to connection to the LAN and the Ethernet ports required are connected to the routers.

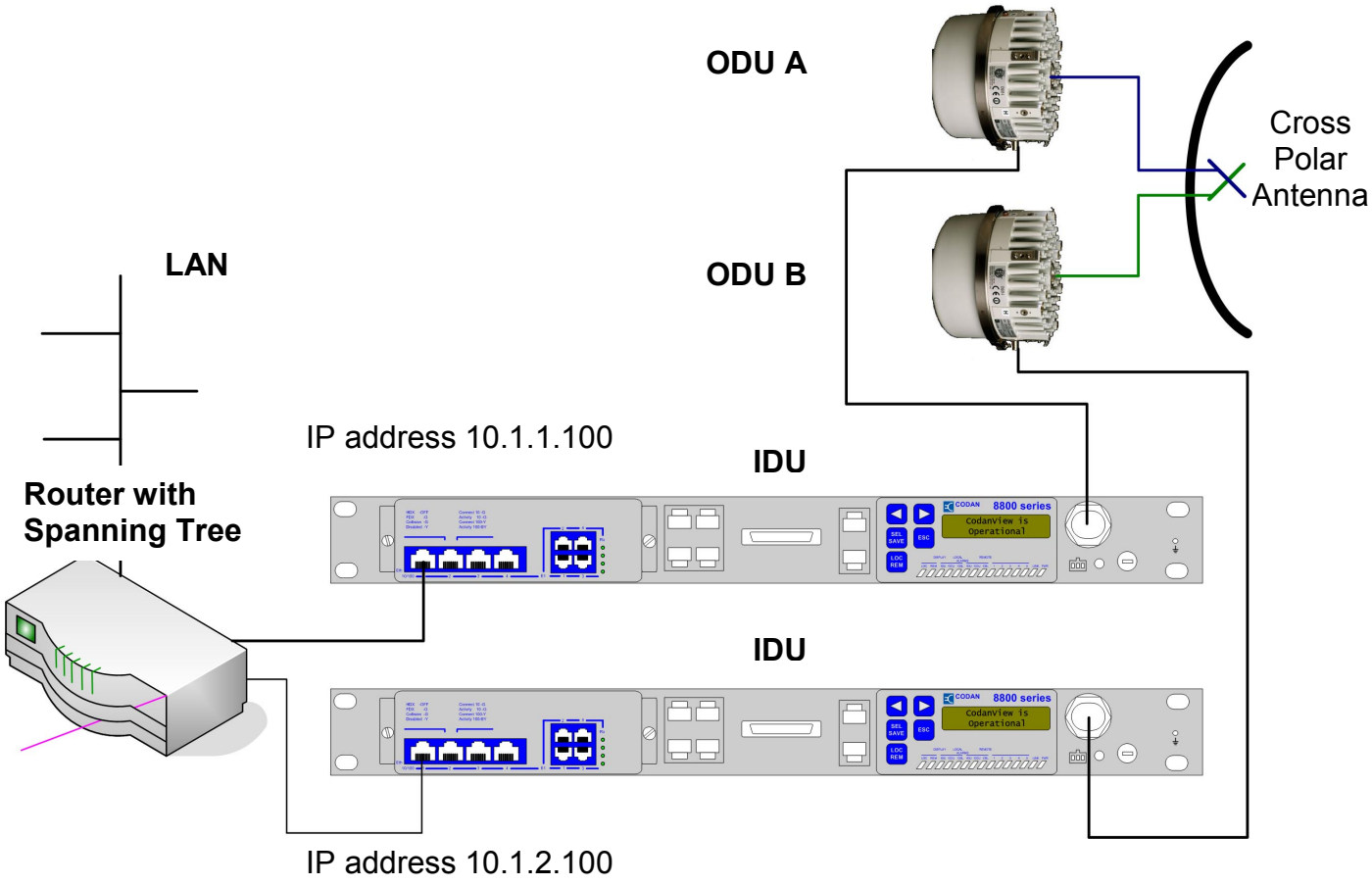


Figure 75 - Left Hand Terminal IP addressing example

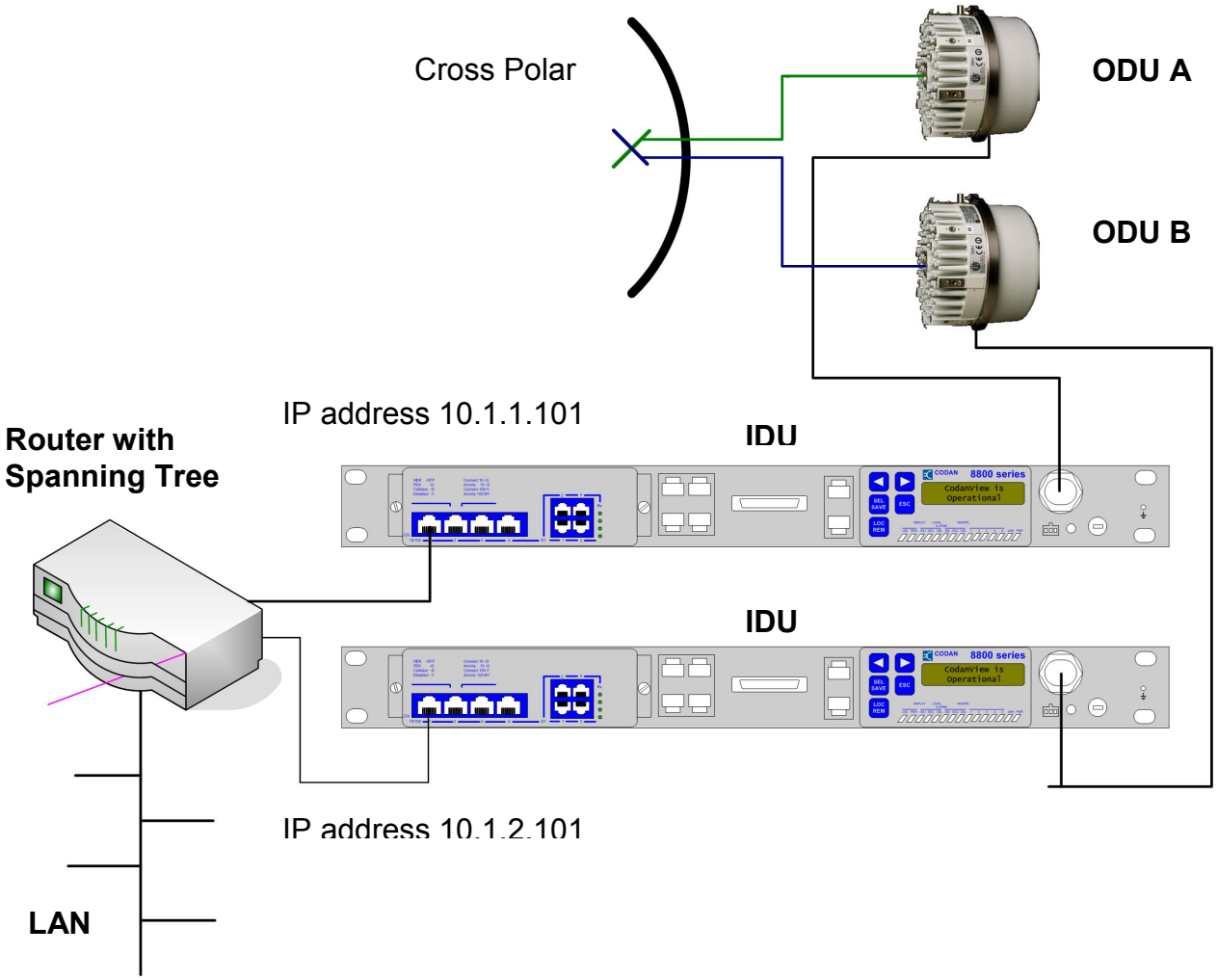


Figure 76

- Right Hand Terminal IP addressing example

These routers are then connected to the LANs.

The routing tables in the routers then learn the various paths to the remote end.

9.7.1 Minimising Spanning Tree settling time

To minimise the amount of time taken to recalculate the port paths, in the event of hardware or path failure, the Ethernet ports on the Data Interface Units should be configured to "**Force Disconnect on Link Down".**

This is achieved via the "**Interfaces**" button on the MINet tool bar.

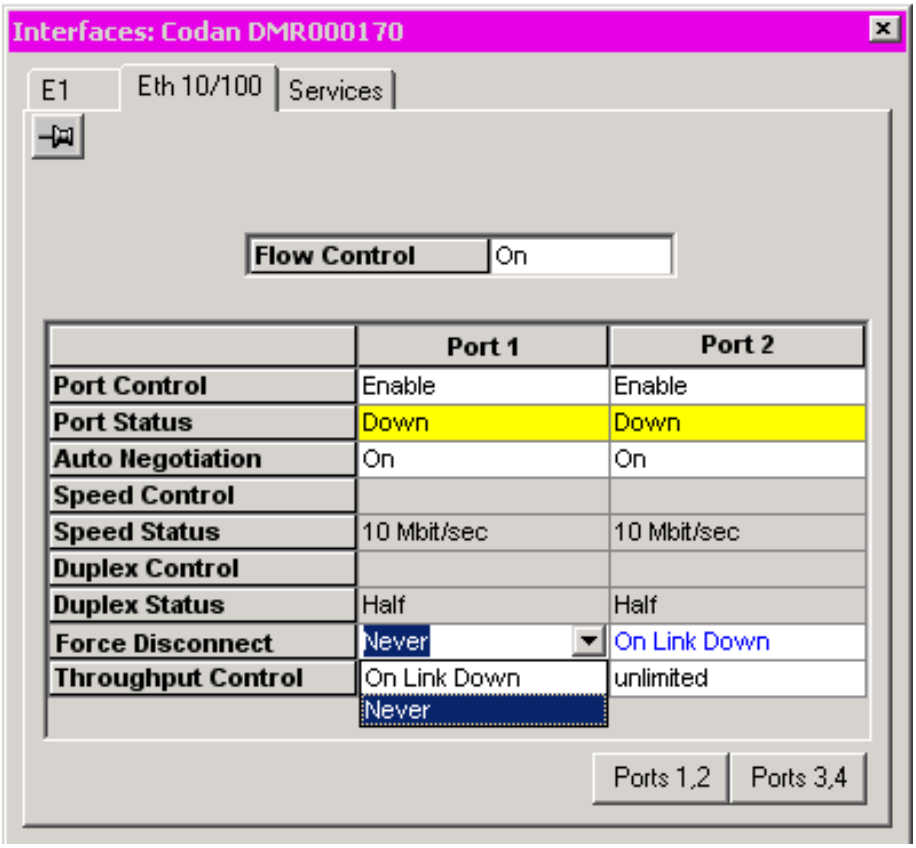


Figure 77 - Ethernet Interfaces Port Configuration

Finally the Spanning Tree “default time” of 30 seconds to recalculate the spanning tree decision should be adjusted to the shortest time possible, which will allow reliable performance.

Chapter 10 Fault Finding

10.1 SNMP Traps

SNMP Traps are messages sent by the agent to a number of IP Addresses. The messages include information about alarms, system status, and information in general.

The Codan 8800 series includes a number of defined trap parameters in the MIB, which the user can configure such as the IP, Alarm selection, condition for activation, and content.

The Codan 8800 series does not include a default IP Address configuration.

Alarms can be mapped to external relays or selected to send SNMP Traps.

NOTE: Traps are asynchronous generated Alarms. Alarms can also be polled by means of the Network Management System (NMS).

10.2 External relays

External relays are used to control additional equipment connected to the Codan 8800 series terminal, which are generally not directly related to communications.

Such equipment could be a UPS (Un-interruptible Power Supply), buzzer, lights, etc. Relays enable the IDU to respond to defined internal conditions within the network.

10.3 Troubleshooting

The following table describes how to interpret messages, LED indicators, and Severity levels in order to help isolate fault conditions and the steps required to correct them.

The indications are shown on the Control Panel, Element Manager, and included in MIBs.

Table 10-1 Codan 8800 series Fault Conditions

Event	Indication	Severity	Possible Cause	Corrective Action
IDU – ODU communication failure	**LINK LED** plus **SNMP** message	Fatal	**IDU - ODU** Connection fault Link down Remote not accessible **RSL** low level	Check to make sure that the **IDU-ODU** cable is properly connected and up to standard. If lightening protection is installed, disconnect it, and connect the cable directly between the IDU and the ODU
IDU internal failure	**IDU LED** plus **SNMP*** message	Fatal	**IDU Rx** or **Tx** synthesizer out of lock Power supply failure	Check **DC** power Set factory defaults Re-initialize the system before setting all the correct parameters
ODU Internal Failure	**ODU LED** plus **SNMP*** message	Fatal	**ODU Rx** or **Tx** synthesizer out of lock **ODU** power supply failure	Reboot the **ODU** Replace the **ODU**
Link Down	**LED** plus **SNMP*** message **LCD** displays a pulsating 'X'	Fatal	**MUX** or **MODEM** not synchronized Power failure Frequency interference	Check weather conditions such as snow, rain, fog etc. Check for obstacles blocking the line of sight. Verify that the remote terminal is functioning. If possible, try another frequency. Check the link's ID Verify that both terminals have the same parameters set
Remote terminal not accessible	Warning message	Warning	Peer management problem Remote link failed	Verify that the remote terminal is operating properly Verify IP connection
Security violation	SNMP* message	Message	Invalid password entered	Re-enter password
Local ODU not accessible	Warning message No RSL indication	Fatal	Telemetry failure ODU doesn't respond after timeout Cable is disconnected	Check that the IDU is connected to the ODU
Local RSL out of range	Warning message Low RSL is displayed on the LCD	Warning	RSL is below the initial predefined threshold	Check the weather conditions such as snow, rain, fog etc Check for obstacles blocking the line of sight Increase the remote Tx power to the maximum permitted, or enable the ATPC function Check the antenna's alignment

Event	Indication	Severity	Possible Cause	Corrective Action
Tributary port	SNMP*	Warning	Indicates that there is an AIS on the specified line	Perform a signal check to see if the line is working Use an external testing device
Data Interface Unit LOS detection (local).	SNMP*	Warning	A warning message indicates that there is a LOS on the specified line Data transfer is blocked	Check the line for proper connections Check another port
Local BER out of range	Warning message	Warning	BER is below the initial predefined threshold Internal data transfer problem between the Rx and the Tx	Check the weather conditions such as snow, rain, fog etc Check for obstacles blocking the line-of-sight Check to see if the RSL is low
External input doesn't function	No input signal SNMP message	Message	Incorrectly defined user definition Faulty connection External connection signal is not at the correct level	Check user definitions Check connections Check specifications
TFTP failure	SNMP*	Message	TFTP failed: **Connectivity –** Physical indication or logical – TCP/IP connectivity between TFTP server and client Operational – Incorrect TFTP process **Hardware –** flash, checksum, or corrupt file	Verify IP connection between the terminal and the TFTP server Check the TFTP procedure
Local ODU temperature out of range	Warning message SNMP* message	Warning	The local ODU temperature is outside the acceptable temperature range	Check that the outside temperature is within the ODU operational range as defined in the technical specification
MUTE transmitter	Warning message SNMP* message	Warning	The ODU transmitter is in the mute mode User initiated IDU sends a mute command	If a user command is the cause, check the IDU-ODU connectivity (physical, logical, or loop back). **NOTE:** The 1+1 Hot Standby mode requires one transmitter to be muted to prevent frequency interference
Temporary communicatio n break	Severe Errored Seconds SNMP* LCD message	Error SNMP* message	Severe Error Seconds are below the initial predefined threshold	Check weather conditions such as snow, rain, fog etc Check if the RSL is close to the lower limit

10.4 Isolating problems

10.4.1 Basics

Narrowing down, or identifying the possible sources of a problem is the most efficient way to fix a fault.

Getting answers to questions you ask yourself and from the Codan 8800 series terminal achieves this.

Identifying a problem can be difficult and time consuming. Therefore, it advisable to proceed logically and gradually narrow down all the possible sources until at last there is only one source left to examine.

Many times it helps to determine what a problem isn't rather than what it is. Performing and verifying tests on specific parts of the system to make sure they are function properly is a step towards narrowing down the possible sources.

Take notes during every phase of your testing including the results. This is to prevent re-testing the same component.

Hints for Questions:

- Failure description at the time the problem first appeared.
- Terminal configuration and status at the time the problem was detected.
- Firmware version. Newer versions of software may change alarm status
- Commands or memory location.
- Corrective action that has already been carried out.
- The period between the last time the system worked normally and the time the fault occurred.
- The operation of the Codan 8800 series broadly consists of three stages being startup, operation, and shutdown. The stage during which the fault occurs may help isolate it.
- Is the fault repeatable, consistent or random Try to simulate it.

10.5 Repairing the Fault

Once the fault has been identified, repairing it should be fairly straightforward. There are some additional considerations such as backing up configurations and equipment safety.

10.5.1 Make Backups

Backup all critical data, including configuration files if it's a software fault.

Have both a copy of the software version of the program being checked, and the latest version of the program on site. Sometimes the latest version corrects a bug that was within the previous version.

If there is a requirement to upgrade to a newer version of the firmware, ensure that the latest version is compatible with the hardware before installation.

10.5.2 Safety

Avoid connecting and disconnecting cables while the power is on.

Avoid all short circuits on the coaxial cable between the ODU and the IDU.

10.5.3 Verify the Repair

Repairing a fault doesn't necessarily mean that the system is functional.

After fixing the specific fault, test the system to make sure that full functionality has been restored.

Test a range of functionality to be sure that:

- The entire problem has been solved.
- No new problems have been introduced.

Chapter 11 Alarm List

11.1 Fatal Alarms

Table 11-1 Fatal Alarms

Alarm Definition	Severity	SNMP Traps Sent for event ON	SNMP Traps Sent for event OFF
IDU Not Operational	Fatal	IDU Internal Fail	ODU Internal Restore
IDU ODU Cable Fault	Fatal	IDU-ODU Connection Fail	IDU-ODU Connection Restore
IDU Power Supply Low Value	Fatal	IDU Internal Fail	IDU Internal Restore
IDU Rx Synthesiser Out of Lock	Fatal	IDU Internal Fail	IDU Internal Restore
IDU Tx Synthesiser Out of Lock	Fatal	IDU Internal Fail	IDU Internal Restore
Link Down	Fatal	Link Down	Link Up
ODU Power Supply Out of Range	Fatal	ODU Internal Fail	ODU Internal Restore
ODU RF Synthesiser Out of Lock	Fatal	ODU Internal Fail	ODU Internal Restore
ODU Rx Synthesiser Out of Lock	Fatal	ODU Internal Fail	ODU Internal Restore
ODU Tx Synthesiser Out of Lock	Fatal	ODU Internal Fail	ODU Internal Restore
Operating System Failure	Fatal	IDU Internal Fail	IDU Internal Restore
Remote Terminal Not Responding	Fatal	Remote Not Accessible	Remote Accessible
Telemetry Not Operational	Fatal	ODU Not Accessible	ODU Accessible
Tx Failure	Fatal	ODU Internal Fail	ODU Internal Restore

13.2 Error Alarms

Table 11-2 Error Alarms

Alarm Definition	Severity	SNMP Traps Sent for event ON	SNMP Traps Sent for event OFF
Link BBER Alarm	Error	BER Warning Start	BER Warning Restored
Link BER Failure Alarm	Error	BER Warning Start	BER Warning Restored
Link BLER Alarm	Error	BER Warning Start	BER Warning Restored
Link Degraded Minutes (DM) Alarm	Error	BER Warning Start	BER Warning Restored
Link Errored Seconds (ES) Alarm	Error	BER Warning Start	BER Warning Restored
Link ID Violation	Error	Link ID Violation	Link ID Validation
Link NCBLER Alarm (Not Corrected)	Error	BER Warning Start	BER Warning Restored
Link Severely Errored Seconds (SES) Alarm	Error	BER Warning Start	BER Warning Restored
Link Unavailable Seconds (UAS) Alarm	Error	BER Fatal Start	BER Fatal Restored
ODU Not Responding	Error	ODU Not Accessible	ODU Accessible
ODU Temperature Violation	Error	ODU Temperature High	ODU Temperature Restored
Remote Terminal Failure	Error	Remote Not Accessible	Remote Accessible
Rx Failure	Error	ODU Internal Fail	ODU Internal Restore
Self Test Fault	Error	IDU Internal Fail	IDU Internal Restore
Slip Modem Failure	Error	IDU Internal Fail	IDU Internal Restore
Telemetry Failure	Error	ODU Not Accessible	ODU Accessible
TFTP Download Access Violation	Error	TFTP Failed	Nil
TFTP Download Checksum Error	Error	TFTP Failed	Nil
TFTP Download Configuration Incompatible Image	Error	Configuration Mismatch	Nil
TFTP Download Failure	Error	TFTP Failed	Nil
TFTP Download File Not Found	Error	TFTP Failed	Nil
TFTP Download General Error	Error	TFTP Failed	Nil
TFTP Download No Response From Server	Error	TFTP Failed	Nil
TFTP Download Software Incompatible Image	Error	Configuration Mismatch	Nil

11.3 Warning Alarms

Table 11-3 Warning Alarms

Alarm Definition	Severity	SNMP Traps Sent for event ON	SNMP Traps Sent for event OFF
E3 Line-01-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E3 Line-01-LOS	Warning	LOS Start	LOS Stop
E3 Line-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-01-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-01-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-01-LOS	Warning	LOS Start	LOS Stop
E1 Line-02-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-02-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-02-LOS	Warning	LOS Start	LOS Stop
E1 Line-03-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-03-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-03-LOS	Warning	LOS Start	LOS Stop
E1 Line-04-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-04-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-04-LOS	Warning	LOS Start	LOS Stop
E1 Line-05-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-05-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-05-LOS	Warning	LOS Start	LOS Stop
E1 Line-06-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-06-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-06-LOS	Warning	LOS Start	LOS Stop
E1 Line-07-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-07-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-07-LOS	Warning	LOS Start	LOS Stop

Alarm Definition	Severity	SNMP Traps Sent for event ON	SNMP Traps Sent for event OFF
E1 Line-08-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-08-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-08-LOS	Warning	LOS Start	LOS Stop
E1 Line-09-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-09-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-09-LOS	Warning	LOS Start	LOS Stop
E1 Line-10-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-10-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-10-LOS	Warning	LOS Start	LOS Stop
E1 Line-11-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-11-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-11-LOS	Warning	LOS Start	LOS Stop
E1 Line-12-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-12-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-12-LOS	Warning	LOS Start	LOS Stop
E1 Line-13-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-13-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-13-LOS	Warning	LOS Start	LOS Stop
E1 Line-14-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-14-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-14-LOS	Warning	LOS Start	LOS Stop
E1 Line-15-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-15-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-15-LOS	Warning	LOS Start	LOS Stop
E1 Line-16-AIS	Warning	Tx or Rx AIS Start	Tx or Rx AIS Stop
E1 Line-16-LOOP	Warning	Port Loop Back On	Port Loop Back Off
E1 Line-16-LOS	Warning	LOS Start	LOS Stop

11.2 User Defined Alarms

Table 11-4 User Defined Alarms

Alarm Definition	Severity	SNMP Traps Sent for event ON	SNMP Traps Sent for event OFF
Eth 10-100 Rx Link Usage High	User Defined	Eth Rx Usage High Start	Eth Rx Usage High Stop
Eth 10-100 Rx Link Usage Low	User Defined	Eth Rx Usage Low Start	Eth Rx Usage Low Stop
Eth 10-100 Tx Link Usage High	User Defined	Eth Tx Usage High Start	Eth Tx Usage High Stop
Eth 10-100 Tx Link Usage Low	User Defined	Eth Tx Usage Low Start	Eth Tx Usage Low Stop
External Input 1 Active	User Defined	External Input On	External Input Off
External Input 2 Active	User Defined	External Input On	External Input Off
External Input 3 Active	User Defined	External Input On	External Input Off
External Input 4 Active	User Defined	External Input On	External Input Off

11.3 Additional SNMP Traps Sent

- Heart Beat (Interval period is user defined)
- Relay On
- Relay Off
- Configuration Bank Switch

Chapter 12 Factory Defaults

12.1 Factory Default Setting

Factory default settings are provided to ensure communications between both sides of a link.

These settings are especially useful when local adjustments are made that do not provide the desired communication result. The technician can always rely on the default settings for communications and check it with local customised settings for debugging purposes.

Default settings are general and provide the basic parameters to ensure proper functionality.

When a link is in the field and there is a need to implement a factory default setting it will normally be for one of the following reasons:

1. Link is not operating.

   Manually perform the factory default on each terminal. Either the local or the remote terminal may be the first to apply defaults.

2. Link is operating.

   Even though communication exists between two terminals implementing factory default may still be required when a management mismatch situation occurs and you have to reset the IP addresses

When a link is operating, and you need to implement a default for any reason, first perform the action on the remote terminal, and then on the local terminal.

12.2 Factory default parameters

The following tables list the factory default parameters for the Data Interface Units and the 8800 IDU and ODU.

Table 12-1 Data Interface Unit factory default

Data Interface Unit Type	Default Link Capacity	Default Channel Spacing
4E1 BNC	4E1	7 MHz
E3 + 16E1	E3+1E1	28 MHz
4 x LAN + 4 E1	10/100 BaseT + 4 E1	28 MHz
DS3 + 16DS1	DS3 + 4DS1	24 MHz
10/100 BaseT + 4 DS1	10/100 BaseT + 4 DS1	50 MHz

Table 12-2 Codan 8800 series Terminal Factory Default

Control Panel parameter	Default Parameter
Frequency (Ch#)	Middle frequency (Depends on the ODU type)
Tx Power	Max power and Tx range (Depends on the ODU maximum power)
Link ID	1
ATPC Control	Disabled
RSL Optimal Val	-45
RSL Upper Thr	-40
RSL Lower Thr.	-50
ETH IP Mask	255.255.255.0
ETH IP	192.168.X.1
ETH IP RIP	Disabled
NMS-In IP	Determined by the system
NMS-In Dest IP	10.1.1.1
NMS-Out IP	NMS-In IP + 1
NMS-Out Dest IP	NMS-In Dest IP + 1
LINK IP	NMS-Out IP + 1 (or NMS-In + 2)
NMS-IN & OUT Baud Rate Flow Control Data Bits Stop Bits Parity	19200 NONE 8 Bits 1 Stop Bit None

Table 12-3 Codan 8800 series Software Factory Defaults

Control Panel parameter	***Default Parameter***
Tx Mute	Off
Pause TX control	Disabled
Pause TX period	600 (Sec)
System	None
Load Config	Factory Default
Mode CW	Off
ODU Serial Num	ODU serial number
ODU Type	ETSI
ODU Frequency	Operating frequency (GHz)
ODU Band	Bands from 1 to 4
ODU Duplex	According to frequency standard type
ODU Temperature	Internal ODU temperature (C° and F°)
IDU Serial Num	IDU's serial number
IDU Type	ETSI
ETH MAC Address	IDU's ETH MAC Address
Sys Up Time	HH:MM:SS (Operational System Time)
Port State	Active data ports
IDU HW Revisions	Rev x.x / x.x
IDU Software	Rev xx.xx
IDU Alternate SW	Rev xx.xx
ODU Hardware	Rev xx.xx
ODU Software	Rev xx.xx
Plug-In Hardware	*Rev x.xx*
Boot Software	*Rev xx.xx*

Chapter 13 Specifications

13.1 IDU Specifications

13.1.1 Physical

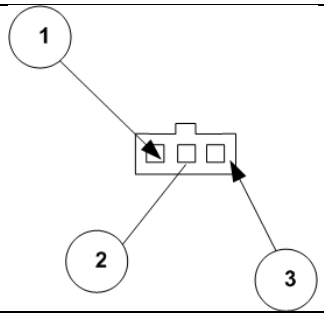
Dimensions	44.5 mm (1RU) x 430 mm x 305 mm 1.75" (1RU) x 19 " x 12 "
Weight	4.6 kg 10 lbs.

13.1.2 Electrical

Power Supply	+/- 22 VDC to +/- 62 VDC
Fuse – 22 to 36 VDC	3.0 Amp
Fuse – 36 to 62 VDC	1.6 Amp
Power Consumption	11.5 Watts

13.1.3 Power Port Definition

Pin Number	Pin name
1	+/- 22 VDC to +/- 62 VDC DC Power
2	NOT USED
3	Earth (0 Volts)



13.1.4 Environmental

Temperature - Operation	-10 °C to + 45 °C
Temperature - Storage	-40 °C to +55 °C
Humidity	Up to 95% @ 40° C
Altitude	5,000 metres Above Sea Level

13.1.5 Platform Architecture

Processor	Motorola MPC860 – 32 bit Integrated Communications Processor
Clock Speed	143 MHz
Memory	2 Banks x 2 Mb each
Operating System	PSOS

13.1.6 "N" Type Connector - Frequencies and Levels

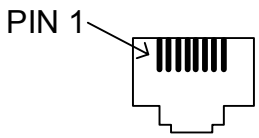
Tx IF	400 MHz @ 0 dBm ±3 dBm
Rx IF	140 MHz @ -10 dBm ±3 dBm
Modulation	Continuous Phase Frequency Shift
Up-link Telemetry – Half Duplex	13.5 MHz, AM, -15 dBm ±3 dBm
Down-link Telemetry – Half Duplex	10 MHz, AM, -15 dBm ±3 dBm
DC Voltage	Supply voltage and Polarity

13.1.7 NMS IN - Port Definition

Bits	8
Stop Bits	1,2
Parity	none, odd, even
Data (Baud) Rate	1200 to 38,400
Flow Control	none, X-On/X-Off

13.1.8 NMS IN – Pin Configuration

Pin Number	Pin name
1	NOT USED
2	NOT USED
3	NOT USED
4	GND
5	RS-232 TXD
6	RS-232 RXD
7	NOT USED
8	RS 232 RTS

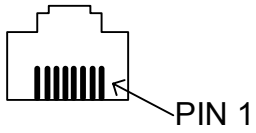


13.1.9 NMS Out - Port Definition

Bits	8
Stop Bits	1,2
Parity	none, odd, even
Data (Baud) Rate	1200 to 38,400
Flow Control	none, X-On/X-Off

13.1.10 NMS Out – Pin Configuration

Pin Number	Pin name
1	NOT USED
2	NOT USED
3	NOT USED
4	GND
5	RS-232 TXD
6	RS-232 RXD
7	NOT USED
8	RS 232 CTS

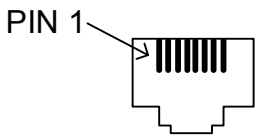


13.1.11 Eth - Port Definition

Port: 10 Base-T (10Mbps), 100 Ω

13.1.12 Eth - Port Definition

Pin Number	Pin name
1	TX+
2	TX-
3	RX+
6	RX-

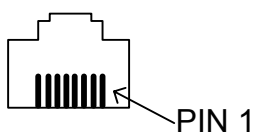


13.1.13 Data (RS232) - Port Definition

Bits	8
Stop Bits	1,2
Parity	none, odd, even
Data (Baud) Rate	1200 to 38,400
Flow Control	none, X-On/X-Off

13.1.14 Data (RS232) – Pin Configuration

Pin Number	Pin name
1	RXRING
2	RXTIP
4	TXRING
5	TXTIP



13.1.15 DB25 - Output Relay Specifications

Maximum Switching Voltage	220VDC, 250VAC
Maximum Switching Power	30W/62.5VA
Maximum Switching Current	1A
Maximum Carrying Current	2A
Maximum Break-down Voltage Between open contacts	1000VAC

13.1.16 DB25 – Input Specifications

Voltage Range - TTL	2.4 to 9 VDC
Current Range - TTL	1 mA to 10 mA

13.1.17 DB25 – Pin Out

Pin Number	Pin name
1	EXT INPUT 1A
2	EXT INPUT 1B
3	EXT INPUT 2A
4	EXT INPUT 2B
5	RELAY 2 – N/O
6	RELAY 2 – C
7	RELAY 1 – N/C
8	RELAY 5 – C
9	RELAY 5 – N/O
10	RELAY 4 – N/C
11	RELAY 3 – N/O
12	NOT USED
13	GND
14	EXT INPUT 3A
15	EXT INPUT 3B
16	EXT INPUT 4A
17	EXT INPUT 4B
18	RELAY 2 – N/C
19	RELAY 1 – N/O
20	RELAY 1 – C
21	RELAY 5 – N/C
22	RELAY 4 – N/O
23	RELAY 4 – C
24	RELAY 3 – N/C
25	RELAY 3 – C

13.2 DIU Specifications

13.2.1 Physical

Dimensions	38 mm x 180 mm x 130 mm 1.5" x 7 " x 5 "
Weight	250 g 10 oz.

13.2.2 Electrical

Power Supply	Required voltages supplied by DIU
Power Consumption	2 Watts maximum

13.2.3 Environmental

Temperature - Operation	-10 °C to + 45 °C
Temperature - Storage	-40 °C to +55 °C
Humidity	Up to 95% @ 40° C
Altitude	5,000 metres Above Sea Level

13.24 Platform Architecture - E1, E3, DS1 and DS3

Interface Processor	Cirrus Logic CS61884
Clock Speed	1.544 MHz (FCC) or 2.048 MHz (ETSI)
MUX	Altera MAX II CPLD
Operating System	PSOS (from IDU)
Features supported	Internal AMI, B8ZS, or HDB3 Encoding/Decoding LOS Detection per T1.231, ITU G.775, ETSI 300-233 AIS Detection per T1.231, ITU G.775, ETSI 300-233 G.772 Non-Intrusive Monitoring G.703 BITS Clock Recovery Crystal-less Jitter Attenuation compliant with G.735, G.742 and G.783 Transmitter Short Circuit Current Limited (<50mA) JTAG Boundary Scan compliant to IEEE 1149.1 Digital Loop – back Remote Loop – back.
Allowable E1/DS1 cable attenuation	12 dB
Input Common Mode Rejection Ratio	> 50 dB @ 1 MHz
Cross Talk between adjacent connectors	> 65 dB @ 1 MHz
Return Loss - Transmit	15 dB for E1 and DS1
Return Loss - Receive	18 dB for E1 and DS1
Surge Capability – Metallic Voltage	800 V peak, 10/560 µsec
Surge Capability – Longitudinal Voltage	2400 V peak, 10/700 µsec

13.2.5 E1 - Port Definition

BNC	75 Ω - Unbalanced
RJ45	120 Ω - Balanced
Encoding	HDB3

13.2.6 DS1 - Port Definition

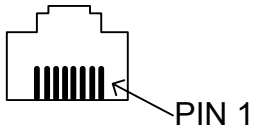
RJ45	100 Ω - Balanced
Encoding	B3ZS AMI

13.2.7 E3/DS3 - Port Definition

BNC	75 Ω - Unbalanced
Maximum DS3 Cable Length	68 metres

13.2.8 E1/DS1 – RJ45 Pin Out

Pin Number	Pin name
1	RXRING
2	RXTIP
4	TXRING
5	TXTIP



13.2.9 E1/DS1 – SCSI Pin Out

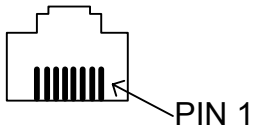
SCSI100	Pin Name		SCSI100	Pin Name
Pin 1	L_TEST16 (1+1 only)		Pin 51 (1+1 only)	L_ONE4
Pin 2	L_TEST18 (1+1 only)		Pin 52 (1+1 only)	L_ONE0
Pin 3	L_TEST17 (1+1 only)		Pin 53 (1+1 only)	L_ONE5
Pin 4	L_TEST19 (1+1 only)		Pin 54 (1+1 only)	L_ONE1
Pin 5	L_TEST22 (1+1 only)		Pin 55 (1+1 only)	L_ONE6
Pin 6	E3/T3_TXTIP		Pin 56 (1+1 only)	L_ONE2
Pin 7	E3/T3_TXRING (1+1 only)		Pin 57 (1+1 only)	L_ONE7
Pin 8	GND (1+1 only)		Pin 58 (1+1 only)	L_ONE3
Pin 9	RXTIP16		Pin 59 (1+1 only)	E3/T3_RXTIP
Pin 10	RXRING16		Pin 60 (1+1 only)	E3/T3_RXRING
Pin 11	TXTIP16		Pin 61	GND
Pin 12	TXRING16		Pin 62	RXTIP15
Pin 13	(1+1 only)		Pin 63	RXRING15
Pin 14	RXTIP14		Pin 64	TXTIP15
Pin 15	RXRING14		Pin 65	TXRING15
Pin 16	TXTIP14		Pin 66	(1+1 only)
Pin 17	TXRING14		Pin 67	RXTIP13
Pin 18	(1+1 only)		Pin 68	RXRING13
Pin 19	RXTIP12		Pin 69	TXTIP13

Pin 20	RXRING12		Pin 70	TXRING13
Pin 21	TXTIP12		Pin 71	(1+1 only)
Pin 22	TXRING12		Pin 72	RXTIP11
Pin 23	(1+1 only)		Pin 73	RXRING11
Pin 24	RXTIP10		Pin 74	TXTIP11
Pin 25	RXRING10		Pin 75	TXRING11
Pin 26	TXTIP10		Pin 76	GND
Pin 27	TXRING10		Pin 77	RXTIP9
Pin 28	GND		Pin 78	RXRING9
Pin 29	RXTIP8		Pin 79	TXTIP9
Pin 30	RXRING8		Pin 80	TXRING9
Pin 31	TXTIP8		Pin 81	GND
Pin 32	TXRING8		Pin 82	RXTIP7
Pin 33	GND		Pin 83	RXRING7
Pin 34	RXTIP6		Pin 84	TXTIP7
Pin 35	RXRING6		Pin 85	TXRING7
Pin 36	TXTIP6		Pin 86	GND
Pin 37	TXRING6		Pin 87	RXTIP5
Pin 38	GND		Pin 88	RXRING5
Pin 39	RXTIP4		Pin 89	TXTIP5
Pin 40	RXRING4		Pin 90	TXRING5
Pin 41	TXTIP4		Pin 91	GND
Pin 42	TXRING4		Pin 92	RXTIP3
Pin 43	GND		Pin 93	RXRING3
Pin 44	RXTIP2		Pin 94	TXTIP3
Pin 45	RXRING2		Pin 95	TXRING3
Pin 46	TXTIP2		Pin 96	GND
Pin 47	TXRING2		Pin 97	RXTIP1
Pin 48	VCC (1+1 only)		Pin 98	RXRING1
Pin 49	VCC (1+1 only)		Pin 99	TXTIP1
Pin 50	VCC (1+1 only)		Pin 100	TXRING1

13.2.10 Platform Architecture - Ethernet

Interface Processor	Link Street 88E6063 7-Port Ethernet Switch
Clock Speed	25 MHz
MUX	Altera MAX II CPLD
Operating System	PSOS (from IDU)
Features Supported	Integrated 1 Mb on-chip memory Support for up to 2,048 MAC address entries with automatic learning and aging QoS determined by • Destination MAC address, • Port ID, • IEEE 802.1p, • IPv4 Type of Service (TOS), • Differentiated Services 802.1Q VLAN support for up to 64 VLANs Extensive RMON statistics counters IGMP snooping (IPv4) and MLD snooping (IPv6)
Throughput per Port (one port enabled)	128 Kbps to 16 Mbps – scalable Up to 48 Mbps - unlimited
Differential to Common Mode Rejection Ratio – 1 to 60 MHz	<- 37 dB
Differential to Common Mode Rejection Ratio – 60 to 200 MHz	<- 25 dB
Cross Talk between adjacent connectors – 10 MHz	> 60 dB
Cross Talk between adjacent connectors – 100 MHz	> 35 dB
Return Loss – 2 to 30 MHz	> 18 dB
Return Loss – 60 to 100 MHz	> 12 dB
Surge Capability – Metallic Voltage	800 V peak, 10/560 µsec
Surge Capability – Longitudinal Voltage	2400 V peak, 10/700 µsec

13.2.11 Ethernet 10/100 Base-T – Pin out

Pin Number	Pin name	
1	RX+	
2	RX-	
3	TX+	
6	TX-	

13.2.12 Latency Delay for PDH systems:

Mode	Delay (msec)
4E1	1.2
8E1	1.0
16E1 / E3 / E3+1E1	0.9
4DS1	1.2
8DS1	1.0
16DS1	0.8
DS3 / DS3+2DS1 / DS3+4DS1	0.6

13.3 ODU Specifications

13.3.1 Physical

Dimensions	44.5 mm (1RU) x 430 mm x 305 mm - 1.75" (1RU) x 19 " x 12 "
Weight	4.6 kg - 10 lbs.

13.3.2 Environmental

Temperature Range	-33º C to + 55º C
Humidity	100% condensing
Altitude	5,000 metres above sea level

13.3.3 "N" Type Connector - Frequencies and Levels

Tx IF	400 MHz @ -35 dBm ±3 dB (@ ODU Input)
Rx IF	140 MHz @ -10dBm ± 3 dB (@ODU output)
Information Bandwidth (-3db)	54 MHz
Up-link Telemetry – Half Duplex	13.5 MHz, AM, -15 dBm ±3 dBm
Down-link Telemetry – Half Duplex	10 MHz, AM, -15 dBm ±3 dBm
DC Voltage	Supply Voltage and Polarity
Power Consumption- Standard Power	22 Watts
Power Consumption - High Power	27 Watts

13.3.4 Telemetry

Initialisation	ODU initiated by IDU during start-up / reset
Control	Full control of ODU from IDU LCD/Keypad or via MINet (NMS applications)
Protocol	Proprietary including check sum. 19200 baud, 8 bits, 1 stop bit, no parity (RS232 on AM modulated carrier)
Telemetry Commands	1. TX Power Mute 2. TX Power level 3. TX-IF Attenuation 4. TX-IF frequency 5. TX-IF LO Frequency 6. RX-IF Attenuation 7. RX-IF frequency 8. RX-IF LO Frequency 9. RX-IF LO Frequency 10. Mode of operation: Normal/Loop-Back
Telemetry Status Displays	1. TX Power level 2. RX Power level 3. Synthesisers Freq. Lock Indications 4. BITE Indications
Configuration	IDU is Master, ODU is slave
Hardware	CPU, 128k RAM (code/data), 500 K Flash (Boot, Bank A/B code for downland, non-volatile memory for parameters)
Telemetry Hand-shaking	Acknowledge every IDU request after maximum 30 msec

13.4 Transmitters

	7 GHz	8 GHz	10.5 GHz	13 GHz	15 GHz	18 GHz	23 GHz	26 GHz	38 GHz
Frequency Range (GHz)	7.1 – 7.9	7.7 – 8.5	10.5 – 10.7	12.7 – 13.3	14.5 – 15.4	17.7 – 19.7	21.2 – 23.6	24.5 – 26.5	37.5 – 40.0
Tx/Rx Spacing (MHz)	154 161 245	116 126 311.32	65 91	266	315 420 490 644	1010 1560	1008 1200 1232	1008	700 1260
Tx Output Power – Std Power (dBm) (-0 / + 2 dB over temperature)	+24	+24	+25	+27	+27	+22	+22	+22	+19
Tx Output Power – High Power (dBm) (-0 / + 2 dB over temperature)	+28	+28	N/A						
Tx Output Power Control Range	-10 dBm to Maximum Power								
Tx Output Power Step Size	1 dB								
Tx Output Mute Level	<-45 dBm								
Tx Output Mute Activation Time	<1 msec								
Flatness: Entire band	± 2 dB								
Flatness: Over 65 MHz	± 0.5 dB								
Flatness: Over 20 MHz	± 0.2 dB								
Frequency Stability	± 5 parts per million including aging								
Spectral Purity (spurii): - 1 GHz	< -50 dBm								
Spectral Purity (spurii): + 1 GHz	< -30 dBm								
SSB Phase Noise @ ΔF=10 kHz	-70 dBc/Hz								
SSB Phase Noise @ ΔF=100 kHz	-85 dBc/Hz								
SSB Phase Noise @ ΔF=1 MHz	-100 dBc/Hz								

13.5 Receiver

	7 GHz	8 GHz	10.5 GHz	13 GHz	15 GHz	18 GHz	23 GHz	26 GHz	38 GHz
Frequency Range (GHz)	7.1 – 7.9	7.7 – 8.5	10.5 – 10.7	12.7 – 13.3	14.5 – 15.4	17.7 – 19.7	21.2 – 23.6	24.5 – 26.5	37.5 – 40.0
Tx/Rx Spacing (MHz)	154 161 245	116 126 311.32	65 91	266	315 420 490 644	1010 1560	1008 1200 1232	1008	700 1260
Receiver Threshold @ BER 10^{-3} – 7 MHz Channel (± 2 dB over temperature)	-87 dBm	-86 dBm	-86 dBm	-86 dBm	-86 dBm	-85 dBm	-87 dBm	-85.5 dBm	-82 dBm
Receiver Threshold @ BER 10^{-3} – 14 MHz Channel (± 2 dB over temperature)	-84 dBm	-83 dBm	-83 dBm	-83 dBm	-83 dBm	-82 dBm	-82.5 dBm	-82.5 dBm	-80 dBm
Receiver Threshold @ BER 10^{-3} – 28 MHz Channel (± 2 dB over temperature)	-81 dBm	-80 dBm	-80 dBm	-80 dBm	-80 dBm	-79 dBm	-79.5 dBm	-79.5 dBm	-77 dBm
Receiver Threshold @ BER 10^{-6} – 7 MHz Channel (± 2 dB over temperature)	-84 dBm	-83 dBm	-83 dBm	-83 dBm	-83 dBm	-82 dBm	-82.5 dBm	-82.5 dBm	-80 dBm
Receiver Threshold @ BER 10^{-6} – 14 MHz Channel (± 2 dB over temperature)	-81 dBm	-80 dBm	-80 dBm	-80 dBm	-80 dBm	-79 dBm	-79.5 dBm	-79.5 dBm	-77 dBm
Receiver Threshold @ BER 10^{-6} – 28 MHz Channel (± 2 dB over temperature)	-78 dBm	-77 dBm	-77 dBm	-77 dBm	-77 dBm	-77 dBm	-76.5 dBm	-76.5 dBm	-74 dBm
Noise Figure (Maximum Over Temp.)	<4.2 dB	<4.2 dB	<4.5 dB	<4.5 dB	<4.8 dB	<5.0 dB	<5.3 dB	<5.7 dB	<6.2 dB
Input Power Range	-90 dBm to 0 dBm								
Information Bandwidth (-3dB)	54 MHz								
IF Centre Frequency	140 MHz								
IF Bandwidth (-1 dB)	100 MHz								
IF Output Power	0 dBm ± 3 dB								
Power Flatness over IF band	± 1 dB								
Receive Power Resolution	1dB								
Receive Power Accuracy	± 2 dB								
Spectral Purity: Harmonics Of The Input Freq.	< -15 dB								
Spectral purity: Spurious, $\|\Delta F\|$<0.5 MHz	< -40 dBc								
Spectral purity: Spurious, $\|\Delta F\|$>0.5 MHz	< -60 dBc								
SSB Phase Noise @ ΔF=10 kHz	-70 dBc/Hz								
SSB Phase Noise @ ΔF=100 kHz	-85 dBc/Hz								

13.5.1 Adjacent Channel Interference

Channel Spacing = 7 MHz.

Adjacent Channel Frequency Difference	Receiver BER Threshold, dBm	Carrier Signal Level, dBm	Interference Signal Level, dBm	C/I ratio, dBm		BER at required C/I ratio
				Measured for BER=10^{-6}	Limit	
+7 MHz	-81	-80	-80	0	-	No Errors
		-80	-75.6	-4.4	+1	10^{-6}
		-78	-74	-4.0	-	No Errors
		-78	-72.8	-5.2	-3	10^{-6}
- 7 MHz	-81	-80	-80	0	-	No Errors
		-80	-77.1	-2.9	+1	10^{-6}
		-78	-74	-4.0	-	10^{-7}
		-78	-73.8	-4.2	-3	10^{-6}

Channel Spacing = 14 MHz.

Adjacent Channel Frequency Difference	Receiver BER Threshold, dBm	Carrier Signal Level, dBm	Interference Signal Level, dBm	C/I ratio, dBm		BER at required C/I ratio
				Measured for BER=10^{-6}	Limit	
+14 MHz	-78	-77	-77	0	-	No Errors
		-77	-72	-5	+1	10^{-6}
		-75	-71	-4.0	-	No Errors
		-75	-69.1	-5.9	-3	10^{-6}
- 14 MHz	-78	-77	-77	0	-	No Errors
		-77	-72.4	-4.6	+1	10^{-6}
		-75	-71	-4.0	-	No Errors
		-75	-69	-6.0	-3	10^{-6}

Channel Spacing = 28 MHz.

Adjacent Channel Frequency Difference	Receiver BER Threshold, dBm	Carrier Signal Level, dBm	Interference Signal Level, dBm	C/I ratio, dBm		BER at required C/I ratio
				Measured for BER=10^{-6}	Limit	
+28 MHz	-75	-74	-74	0	-	No Errors
		-74	-65.7	-8.3	+1	10^{-6}
		-72	-68	-4.0	-	No Errors
		-72	-631	-9.0	-3	10^{-6}
- 28 MHz	-75	-74	-74	0	-	No Errors
		-74	-65.7	-8.3	+1	10^{-6}
		-72	-68	-4.0	-	No Errors
		-72	-62.5	-9.5	-3	10^{-6}

Chapter 14 Compliance and Standards

14.1 Compliance

The Codan 8800 series of Digital Microwave Radio products are fully compliant with the following international standards and recommendations:

ITU-R Recommendation F.746-4: "Radio-frequency channel arrangements for radio-relay systems".

ITU-R Recommendation F.1092-1: "Error performance objectives for constant bit rate digital path at or above the primary rate carried by digital radio-relay systems which may form part of the international portion of a 27 500 km hypothetical reference path".

ITU-R Recommendation F.1189-1: "Error performance objectives for constant bit rate digital paths at or above the primary rate carried by digital radio-relay systems which may form part or all of the national portion of a 27 500 km hypothetical reference path".

ITU-R Recommendation F.557-4: "Availability objective for radio-relay systems over a hypothetical reference circuit and a hypothetical reference digital path".

ITU-T Recommendation G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

ITU-T Recommendation G.827: "Availability parameters and objectives for path elements of international constant bit-rate digital paths at or above the primary rate".

ITU-R Recommendation F.752-1: "Diversity techniques for radio-relay systems".

ITU-R Recommendation F.1093-1: "Effects of multi-path propagation on the design and operation of line-of-sight digital radio-relay systems".

ITU-R Recommendation F.385-6: “Radio Frequency Channel Arrangements for Radio Relay Systems operating in the 7 GHz Band”.

ITU-R Recommendation F.386-4: “Radio Frequency Channel Arrangements for Radio Relay Systems operating in the 8 GHz Band”.

ETSI EN 301 216: “Fixed Radio Systems; Point-to-point equipment; Pleisiochronous Digital Hierarchy (PDH); Low and medium capacity digital radio systems operating in the frequency bands between 3 GHz and 11 GHz.

ETSI EN 301 128: “Fixed Radio Systems; Point-to-point equipment; Pleisiochronous Digital Hierarchy (PDH); Low and medium capacity digital radio systems operating in the 13 GHz, 15 GHz and 18 GHz frequency bands”

ETSI EN 300 198: “Fixed Radio Systems; Point-to-point equipment; Parameters for radio systems for the transmission digital signals operating at 23 GHz”

ITU-R Recommendation F.1101: "Characteristics of digital radio-relay systems below about 17 GHz".

ETSI ETS 300 019 (Parts 1 and 2): "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1: Classification of environmental conditions; Part 2: Specification of environmental tests".

ETSI ETS 300 132 (Part 2): "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
ETSI EN 300 385: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Electro-Magnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment".

ITU-T Recommendation G.773: "Protocol suites for Q-interfaces for management of transmission systems".

IEC 60154: "Flanges for waveguides".

ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".

ITU-T Recommendation G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8488 and 44736 Kbit/s hierarchical levels".

ITU-R Recommendation F.1191-1: "Bandwidth and unwanted emissions of digital radio-relay systems"

ETSI ETS 300 119: "Equipment Engineering (EE); European telecommunication standard for equipment practice".

ETSI TR 101 036-1: "Fixed Radio Systems; Point-to-point equipment; Generic wordings for standards on digital radio systems characteristics; Part 1: General aspects and point-to-point equipment parameters".

CEPT/ERC Recommendation 74-01: "Spurious emissions".
ETSI EN 301 489-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Electro-Magnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services".

EEU R&TTE Directive 1999

EN60950: "ETSI CE".

NTRL ANSI/UL 1950: FCC

FCC Part 15

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