MDR2400/5800-SR, Orion2410/5810-SRi and Orion5825-SR Digital Radios

User Manual

Document Number: 862-01881

PLESSEY

Issue Status

Issue	Revised Pages/Amendments
1	1
2	31
3	2
4	General – terminology definition PER used instead of BER to remove interpretation ambiguity between Block Error Rate and Bit Error Rate. Note Block (equivalent to packet) concept is still maintained within sections describing G.826 parameters to maintain consistency with G.826 terminology.
5	MIB Description chapter added, RESET Button Additions, chapter on setup of a serial connection between a PC/Laptop and the Element Management Port, IP network address description diagrams.
6	Amendments related to customer furnished equipment, RF Unit temperature range update, Maintenance and Ordering section updates, Appendix added regarding Antennas.
7	Update on RESET Button functionality description, MIB definition additions, product receive sensitivity level adjustment, FCC notice updates (Warning – this page, Antenna Information – Appendix E), NMS picture update. Appendix D Digital Indoor Unit firmware Upgrade Notice added. Appendix B MIB Elements ResetAllRFPerfomanceData and ResetAllG826 deprecated.
8	Added detail for new MDR2400 RF Unit Added detail for new Digital Indoor Unit – balanced and unbalanced connectors
9	Added detail for Orion 5825 – SR radio (16 QAM radio), 1+1 system. Changed to American English. Updated MIB as well as NMS, now JAVA based. Support for Windows XP, 2000 added. Added ftp firmware upload, Appendix G Added text required by the ATCB with regards to the Orion 5825 – SR.
10	Added additional text required by the ATCB to adhere to FCC requirements.
11	Added description of per trib line code selectivity for T1 interfaces. See Section 2.3.1. Added Appendix describing the Orion5810i and Orion2410i Indoor RF units.
12	Add text to describe the Orion5810-SRi and Orion2410-Sri and changes requested by Rheintech.
12c	Add changes requested by ATCB. (Tx power of +25dBm for Orion5810i)

FEDERAL COMMUNICATIONS COMMISSION NOTICE

The equipment has been tested and found to comply with the limits for a Class A digital devices, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

WARNING- To comply with FCC RF exposure limits, the antennas for this transmitter must be fix-mounted to provide a separation distance of 2 meters (6.6 ft) or more from all persons to satisfy RF exposure requirements.

Equipment installation and use
This equipment must be professionally installed. The operator of the spread spectrum or digitally modulated intentional radiator, or the installer if the equipment is professionally installed, is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations.

NOTE 1 The MDR2400 frequency output must be limited to between 2412MHz and 2458MHz and the power to a maximum of +22dBm (2412-2426MHz) and +18dBm (2458MHz) for the required antennas for compliance to FCC standards, U.S. only.
NOTE 2 The center frequencies of the ORION5850 radio is limited by firmware between 5731MHz and 5844MHz as outlined in Sections 2.2.1.4 and 2.2.1.5 and the transmit power is limited to +24dBm. The device must be used with one of the antennas listed below to comply with FCC standards:

1) Gabriel Electronics parabolic antenna, model number SSP2-52B
2) Harris Corporation flat panel antenna, model number MT-20004.

NOTE 3 The center frequencies of the ORION5810i radio is limited by firmware between 5735MHz and 5840MHz as outlined in Section 2.2.1.1 and the transmit power is limited to +25dBm. The device must only be used with the antenna listed below to comply with FCC standards:

1) Gabriel Electronics parabolic antenna, model number SSP2-52B

INDUSTRY CANADA NOTICE

This device has been designed to operate with an antenna having a maximum gain of 33 dBi. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Exposure of Humans to RF Fields

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website: www.hc-sc.gc.ca/rpb

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List of Abbreviations

BIT	Built-in-Test
AIS	Alarm Indication Signal
PER	Packet (or Block) Error Rate
DC	Direct Current
DCE	Data Communications Equipment
DIU	Digital Indoor Unit
DRL	Digital Radio Link
DRS	Digital Radio Station
DTE	Data Terminal Equipment
GUI	Graphical User Interface
ISM	Industrial, Scientific and Medical
LED	Light Emitting Diode
LOS	Loss of signal
Mbps	Megabits per second
N.C	Normally-closed
N.O	Normally-open
NMS	Network Management System
PC	Personal Computer
RF	Radio Frequency
RFU	RF Unit (Prefix I or O for Indoor or Outdoor type)
RSSI	Received Signal Strength Indication
SNMP	Simple Network Management Protocol

1 Introduction

1.1 Radio Description

The MDR2400-SR, MDR5800-SR, Orion2410-SRi and Orion5810-SRi are ISM band digital radio systems that provide short to medium range, point-to-point digital communication with high data security at rates of T1, 2T1 or 4T1. Alternatively, the radio can be software configured to convey E1, 2E1 or 4E1. The radio can also be configured to bridge or route IP via a 10BaseT port. The data rates scale depending on the number of enabled T1/E1 tributaries and whether the data is being bridged or routed. The products make use of spread spectrum technology and may be operated license-free in the 2.4GHz and 5.8GHz ISM bands.

The Orion 5825-SR is a similar radio also operating in the 5.8GHz ISM band. Modulation can be switched between 16 and 32 QAM with digital output scalable up to 8T1/E1.

The radios are ideal for applications such as:

- Cellular/PCS base station interconnects.
- Telecommunications companies, cellular operators and private carriers.
- State Local and Federal Government communication systems.
- Video surveillance data distribution.
- Power utilities.
- Petroleum/gas collection companies.
- Rural communications.
- Emergency/disaster telephone service restoration.
- Internet distribution.

The radio consists of two main parts:

- An RF Unit operating in the 2.4 GHz or 5.8 GHz ISM frequency bands.

  This could be an MDR2400ET, MDR5800, Orion2410i, Orion5810i or an Orion 5850 unit. The units with an “i” suffix is 1U Indoor RFUs.

- An Digital Indoor Unit, available with a Telecommunications (1, 2 or 4T1/E1 and up to 8T1/E1 on the Orion 5825) interface and a Data interface (10BaseT Ethernet).

  This could be an MDRTE, an MDRETU (75 Ohm BNC), Orion10 or an Orion25 unit. All DIUs operate with the MDR2400ET, MDR5800 and Orion10i RFUs. Only the Orion type DIUs operate with the Orion type RFUs.

Interconnection between the RF Unit and Digital Indoor Unit is achieved using a low-cost UV-protected STP (Screened Twisted Pair: 4 pairs) data cable and a UV-protected 2-core power cable. The split Digital Indoor Unit and RF Unit configuration is used for the lowest loss between the antenna and the transceiver, thereby ensuring optimal long-range performance.

The RF Units use a Type-N RF (female) output connector for connection to a coaxial cable jumper when co-located with a 2.4 GHz or a 5.8 GHz antenna for applications where long range is required.

The RF Unit can also be located remote from the antenna (tower base or indoor mounted). The RF connector is then connected to the antenna via a coaxial transmission line. An optional indoor rack mounting adapter is available for mounting the RFU, indoors.

The system is available for use in FCC regulated countries.

Model variants

Table 1. MDR2400-SR- and Orion2410-SRi model variants		
Model Number	**Interfaces**	**Antenna Coupling**
MDR2400-ET*N*or Orion2410-SRi-ET*N*	*N* x T1/E1 10BaseT Ethernet (*N* = 1, 2 or 4)	N-type Female

Table 2. MDR5800-SR and Orion5810-Sri model variants		
Model Number	**Interfaces**	**Antenna Coupling**
MDR5800-ET*N* or Orion5810-SRi-ET*N*	*N* x T1/E1 10BaseT Ethernet (*N* = 1, 2 or 4)	N-type Female

Table 3. Orion 5825-SR model variants		
Model Number	**Interfaces**	**Antenna Coupling**
Orion 5825-ET8	currently only: 8 x T1 / 8 x E1 10BaseT Ethernet	N-type Female

Refer to section 8.6, page 57 for ordering details.

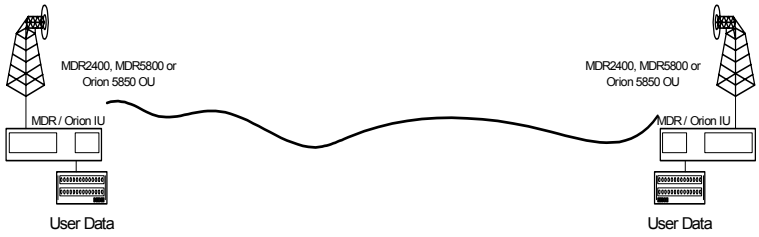
The Network Management System provides control and management of the product. SNMP support via an SNMP agent in the Digital Indoor Unit ensures open network management compatibility.

Comprehensive data and RF loop-back functions ensure that the system is easy to install and maintain.

2 Technical Description

2.1 System Overview

A digital radio link (DRL) consists of a pair of MDR / Orion radio stations.



The radio stations consists of two main parts:

- An RF Unit operating in the 2.4GHz or 5.8 GHz ISM frequency bands. The RF Unit provides the radio transceiver functionality by accepting radio link data from the Digital Indoor Unit and converting it to the 2.4GHz or 5.8 GHz ISM frequency band using spread spectrum or QAM modulation. The received signal is de-modulated and transmitted to the Digital Indoor Unit in a digital format.
- An Digital Indoor Unit, available with 1, 2, 4 or 8 T1 and 1, 2, 4 or 8 E1 data interfaces (choice of T1 or E1 is software selectable). The Digital Indoor Unit combines nT1 or nE1 data with Wayside Service Channel serial data and link IP data to be transmitted across the radio link. The Digital Indoor Unit also provides power to the RF Unit.

Interconnection between RF Unit and Digital Indoor Unit is achieved using low cost data and power cables.

2.2 RF Unit

The MDR2400, MDR5800, Orion2410i and Orion5810i RF Units make use of Spread Spectrum modulation technology for license-free operation in the 2.4GHz and 5.8 GHz ISM bands. The Orion5850 RF Unit uses three software selectable bandwidths for license-free operation in the 5.8 GHz ISM band.

The Orion2410i and Orion5810i RFUs are MDR2400 and MDR5800 RFUs respectively, that have been repackaged into 1U units that should be used in indoor unit applications only. Please refer to Appendix K for more detail.

For operation, the ISM bands are divided into upper and lower frequency sub-bands. A ‘High Band’ RF Unit transmits in the higher frequency sub-band and receives in the lower frequency sub-band, while a ‘Low Band’ RF Unit transmits in the lower sub-band and receives in the higher sub-band. An MDR / Orion radio link will use a ‘Low Band’ RF Unit on one end of the link to communicate with a ‘High Band’ RF Unit on the other end.

The RF Units use a Type-N RF output connector for connection to suitable 2.4GHz and 5.8GHz antennas for applications where long range is required.

The system is available for use in FCC regulated countries.

2.2.1 Frequency plans

The MDR5800, Orion5810i and the Orion 5850 RF Units operate in the 5.725 GHz to 5.850 GHz ISM frequency band with predefined frequency channel plans (termed A, B, C and D). Channel plan D is user selectable / adjustable.

The MDR2400 and Orion2410i RF Units operate in the 2.400 GHz to 2.4835 GHz ISM frequency band with predefined frequency channel plans (termed A, B and D). Channel plan D is user selectable / adjustable.

2.2.1.1 MDR5800 and Orion5810i Frequency Channel Plan A, B and C

The channel spacing is based on the bandwidth occupied by the spread spectrum signal (approximately 17 MHz) and is used to optimise link performance. In the case of plan A, plan B and C, note that both RF Units of a link must be set up to the same frequency channel plan (i.e. A, B or C).

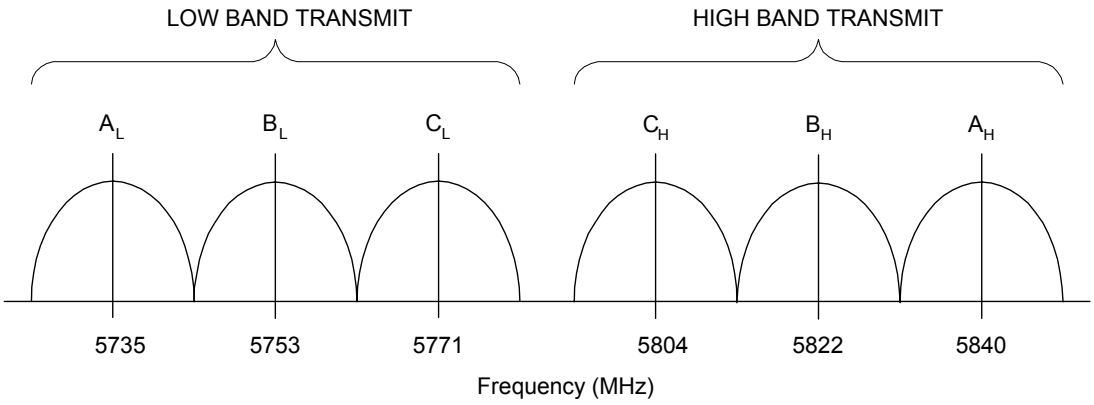


Figure 1. MDR5800 and Orion5810i Frequency channel plans A, B and C

2.2.1.2 MDR2400 and Orion2410i Frequency Channel Plan A, B (non-FCC)

The channel spacing is based on the bandwidth occupied by the spread spectrum signal (approximately 17 MHz) and is used to optimise link performance. In the case of plan A and B, note that both RF Units of a link must be set up to the same frequency channel plan (i.e. A or B).

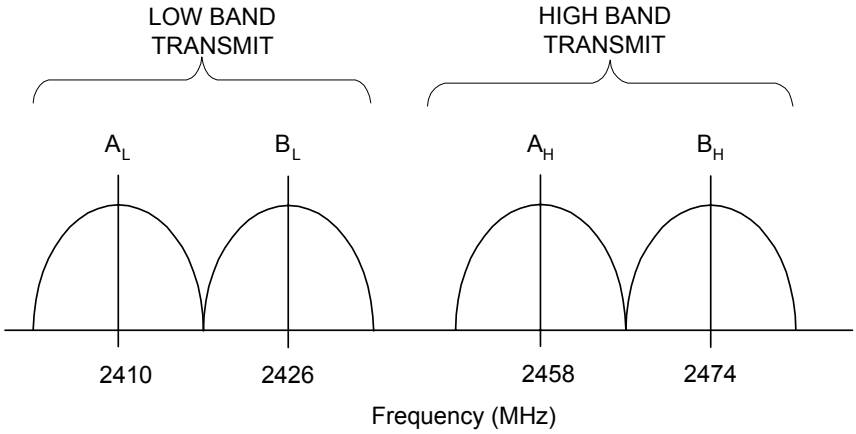


Figure 2. MDR2400 and Orion2410i Frequency channel plans A and B

2.2.1.3 MDR2400 FCC Compliant Frequency Channels for the U.S. only

In countries where FCC compliance is required, only the following frequencies may be used:

Low band RF Unit – 2412MHz to 2426MHz,

High band RF Unit – 2458MHz.

Use frequency plan D (variable frequency) to set the RF Unit.

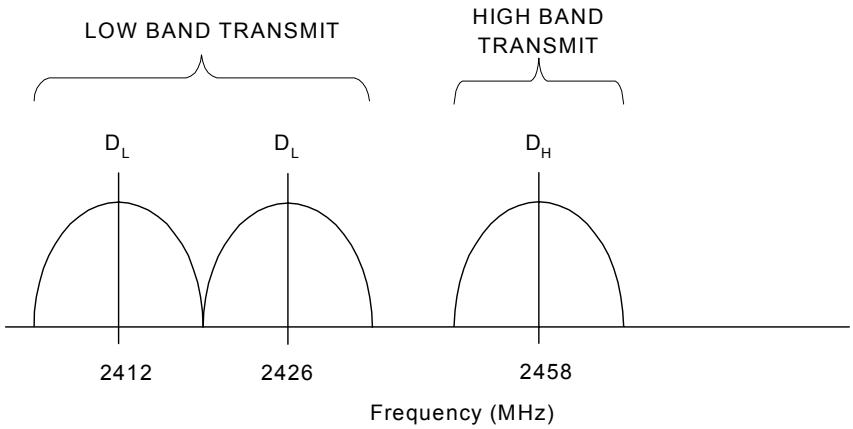


Figure 3. MDR2400 FCC Compliant Frequency Channels for the U.S. only

2.2.1.4 Orion 5850 Frequency Channels Plan A, B and C (FCC Compliant)

The channel spacing is based on the transmit bandwidth, either 3 MHz, 6 MHz, or 10 MHz, software selectable. Different bandwidths can be selected dependent on the optimum link performance; required system sensitivity versus data transfer rate.

Only channel frequencies that are FCC compliant can be selected through the configuration software. The channel frequency ranges are programmed into the radio firmware and cannot be adjusted by the user.

The radios were tested and approved for FCC compliance with the frequency ranges below, see Figure 4.

Low band RF Unit:

Modulation Type	Lowest Center Freq. (MHz)	Highest Center Freq. (MHz)
8464kbps / 16-QAM	5731	5774
16928 kbps / 16-QAM	5732	5773
25392 kbps / 16-QAM	5734	5771

High band RF Unit:

Modulation Type	Lowest Center Freq. (MHz)	Highest Center Freq. (MHz)
8464kbps / 16-QAM	5801	5844
16928 kbps / 16-QAM	5802	5843
25392 kbps / 16-QAM	5804	5841

NOTE 1 Both RF Units in a link must be set to the same frequency channel plan (i.e. A, B, C or D) and modulator type. Also note that the frequencies differ for different transmit bandwidths, i.e. the frequency of channel A changes according to the transmit bandwidth.

NOTE 2 Figure 4 reflects all the frequency bands that could be obtained with the ORION5850 RFU. Pre-programmed frequency ranges in the radio firmware prevent the user from selecting transmission options that will not meet FCC requirements.

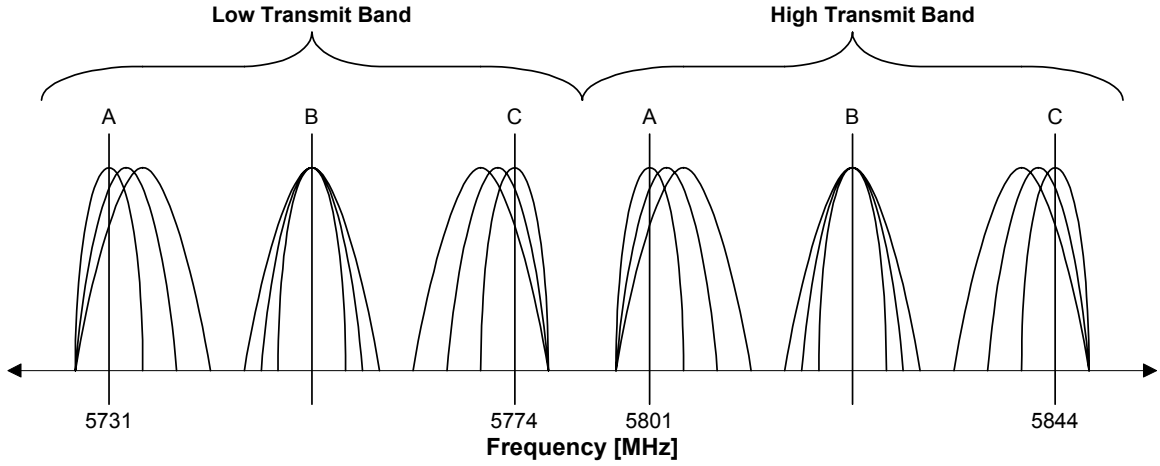


Figure 4. Orion 5850 Frequency channel plans A, B and C. Refer to NOTE 2 above with regards to FCC standards compliance of the different band plans.

2.2.1.5 Frequency Channel Plan D (FCC Compliant)

Frequency plan D allows independent control of transmit and receive frequencies. This allows a flexible frequency plan and can be used to overcome interference in the 2.4GHz and 5.8 GHz ISM bands.

The frequencies that can be used in the lower or upper sub-bands can be selected in 1 MHz increments. Performance degradation can be expected when operating using channel plan D mode with the chosen frequencies close to the sub-band edges i.e. a choice of one of the high frequencies in the lower sub-band and one of the lower frequencies in the upper sub-band.

The allocation of Channel plan D frequencies is shown in Table 4, Table 5 and Table 6.The Orion 5825 has up to three different sets of minimum and maximum frequencies, which are determined by the data rate setting of the RFU.

Only channel frequencies that are FCC compliant can be selected through the configuration software. The channel frequency ranges are programmed into the radio firmware and cannot be adjusted by the user.

The radios ware tested and approved for FCC compliance with the frequency ranges below, see Figure 4.

Table 4. MDR2400 and Orion2410i Channel plan D channel frequencies

Sub-band	Center Frequency (MHz)
L	2410-2426
H	2458-2474

NOTE the allowable operation range in FCC countries, page 14.

Table 5. MDR5800 and Orion5810i Channel plan D channel frequencies	
Sub-band	Center Frequency (MHz)
L	5735-5771
H	5804-5840

Table 6. Orion 5850 Channel plan D channel frequencies		
RF BW [MHz] / Data Rate [kbps]	Center Frequency (MHz)	
	Lower Sub-band	Upper / Higher Sub-band
2.6 / 8464	5731-5774	5801-5844
5.4 / 16928	5732-5773	5802-5843
8.0 / 25392	5734-5771	5804-5841

2.2.1.6 Orion 5850 Modulator Types

The Orion 5850 can operate with different modulator types, the trade-offs being better radio performance versus higher data throughput. The changes can be made via software, using either the Orion NMS / GUI or an SNMP client application.

Modulator types and frequency bands that were tested and approved for compliance with FCC regulations are specified in Sections 2.2.1.4 and 2.2.1.5.

Table 7. Orion 5850 Modulator Types				
Data Rate [kbps]	**Modulation type**	**Raw data throughput [bit/sec]**	**Typical Payload**	**Approx. RFU output spectrum BW**
8464	16-QAM	8 464 052	4T1/E1 + 150kbit Ethernet	2.6 MHz
16928	16-QAM	16 928 105	8T1/E1 + 150kbit Ethernet	5.4 MHz
25392	16-QAM	25 392 157	8T1/E1 + 9.5Mbit Ethernet	8 MHz

NOTE 1: Changing the modulator type of an Orion 5850 RF Unit may take up to 30 seconds. During this period, the link will not be available. Changing the RFU modulator type does not support Auto Recovery thus; the modulator type of the remote station must be changed before the modulator type of the local station is changed.

2.2.2 RF Power Output Options

The RF Unit is designed for use in countries that have adopted FCC standards. It is possible to adjust the output power on the RFU using the supplied NMS software or a

SNMP Management application. The FCC standards for the MDR2400 unit require a limited output power as stated on page 2, U.S. only.

NOTE 1 The firmware on the Orion and MDR type RFUs will not accept power level settings that fall outside the FCC compliant levels.

2.2.3 MDR2400, MDR5800, Orion2410i, Orion5810i and Orion 5850 RF Units

The RF Units transmit and receive RF signals through a diplexer interfaced via an RF cable to an external antenna. The unit has a type-N connector for connection to the RF cable used between the RFU and the antenna.

The RF Unit houses the following main parts:

a. Transmit/Receive Modules
b. Baseband Modulator/Demodulator Circuitry
c. Microcontroller/Framing & Buffering Circuitry
d. Power Amplifier
e. Diplexer

2.3 MDRMTE, MDRMETU, Orion10 and Orion25 Digital Indoor Unit

The Digital Indoor Unit is designed for mounting in a 19" rack, occupying a 1U slot. It can also be used as a table-top system.

The Digital Indoor Unit accepts n x T1/nE1 user payload channels and combines it with Wayside Service Serial Data and IP data to be transmitted across the radio link.

The Digital Indoor Unit is fitted with a DC power supply.

There are four types of Digital Indoor Units:

An MDR 120 Ohm (scalable up to 4 T1/E1),

an MDR 75 / 120 Ohm (scalable up to 4 T1/E1),

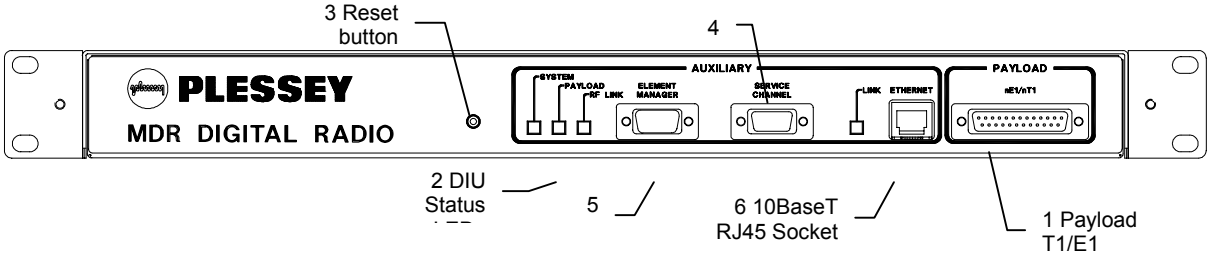
an Orion 10 Digital Indoor Unit (Orion 25 with only up to 4 T1/E1)

and an Orion 25 Digital Indoor Unit (scalable up to 8 T1/E1).

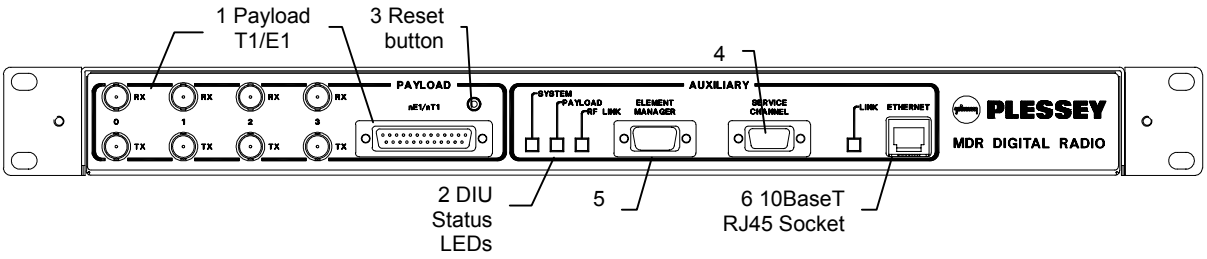
The MDRMTE and MDRMETU Digital Indoor Units can operate with the MDR2400, MDR5800, Orion2410i and Orion5810i RF Units.

The Orion 10 and Orion 25 Digital Indoor Unit is used with the Orion 5850 RF Unit, but can also support the MDR2400, MDR5800, Orion2410i and Orion5810i RFUs if the appropriate firmware version is loaded on the Digital Indoor Unit.

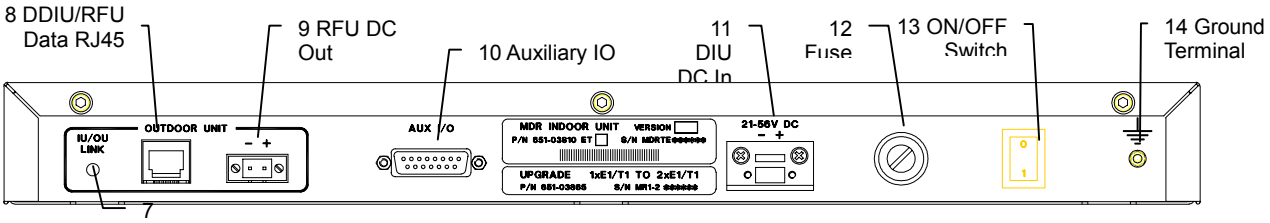
MDR MTE DIGITAL INDOOR UNIT V2, 120 OHM 651-03810-02.1, front panel



MDR MTE 75/120 OHM DIGITAL INDOOR UNIT 651-04008-02, front panel



MDR MTE 120 OHM and 75/120 OHM DIGITAL INDOOR UNIT, rear panel



Orion 25 DIGITAL INDOOR UNIT 651-04189-01 (front panel – no rear panel connectors)

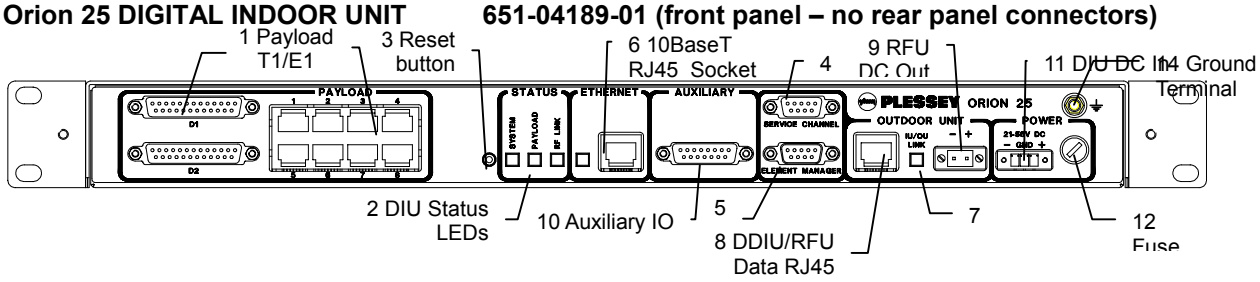


Figure 5. Digital Indoor Unit Connector Panels.

2.3.1 Payload Interface Options

The Digital Indoor Unit can be configured for nT1 or nE1 operation.

- 1, 2, 4 or 8(Orion 25) x T1 (1.544 Mbps)
- 1, 2, 4 or 8(Orion 25) x E1 (2.048 Mbps)

For T1 connectivity, bipolar AMI or B8ZS line coding is software selectable.
For E1 connectivity, bipolar AMI or HDB3 line coding is software selectable.

Line coding on the Orion 25 DIU may be selected separately for tributary channels 1 to 4 and 5 to 8 when used with an Orion 5850 RFU.

The payload can be connected on:

- Unbalanced 75 Ohm BNC connectors, 75/120 Ohm DIU only (RX= In, TX= Out).
- Balanced 120 Ohm, 25 way D-type connectors (refer to paragraph 4.2.4 for the pin outs).
- Balanced RJ48C connectors (refer to paragraph 4.2.5 for the pin outs).

NOTE A special version of the MDR Digital Indoor Unit exists that allows the user to select AMI or B8ZS line encoding on a per-trib basis for T1 connectivity. These Digital Indoor Units are marked as Version 2.1AT and are identified by an "Individual Line Code" label between the ON/OFF switch and the ground terminal on the rear panel of the DIU.

Line codes can be selected on a per-trib basis using the Orion NMS software application. In the **Payload Configuration** window:

1. Set the Digital Indoor Unit Payload interface to T1 mode and Apply.
2. Refresh the information displayed in the window.
3. Select the desired Line Code next to each trib and Apply.

Hardware modified to implement this feature can ONLY work with special DIU firmware – contact the distributor for details.

2.3.2 1+1 Redundancy Protected Payload System

The MDR and Orion radios can be used in a 1+1 redundant mode system to protect the tributary payload data carried over a radio link. This system detects the quality of the link over which it is receiving data and allows switching between two parallel radio links to protect the user data against link failures.

Please refer to Appendix I, or the Protection Kit user manual, doc. no. 862-02236 for detail on the functioning of this system.

2.3.3 Digital Indoor Unit Status LEDs

The Digital Indoor Unit LED functionality is described as follows:

SYSTEM

Green OK, Orange (RFU/DIU Comms Error), Red (RFU/DIU Comms Down)

PAYLOAD

Green OK, Orange (AIS Detected), Red (LOS Detected)

RF LINK

Green OK, Orange (FEC Correcting Errors), Red (FEC unable to correct errors)

In ALL cases flashing red and orange LEDs imply historic alarm conditions (The alarm can be cleared using the front panel button 'position 1' : see next section).

Flashing LED's and yellow indicators (Orion NMS) may also be cleared by clicking on the "Clear Alarms" button in the Orion NMS Main Radio Window.

2.3.4 Reset / Configuration Button

The functionality of the Reset Button is described below. These functions are used to set up the radio. A paper clip or similar "probe" can be used to push the "reset / configuration button". The count value / LED count at which the button is released, will be the "new" configuration / state of the DIU.

The count value is determined by the different LEDs lighting up. 'Position 1' being RF Link LED (Green), 2 being Payload LED (Green), 3 being System LED (Green), 4 being RF Link LED (Orange), 5 being Payload LED (Orange) and 6 being System LED (Orange) etc.

Reset button functions (according to "LED reset" number)

1. Clear Front Panel LEDs (and associated alarms in DIU)
2. Clear Event Log in the Digital Indoor Unit
3. Reset the Digital Indoor Unit (**does not** reset the non-volatile memory storing the DIU's configuration parameters)
4. Routed Configuration: Reset the DIU configuration parameters that are stored in non-volatile memory (BATTERY-BACKED STATIC RAM) and configure as a 'Far Side DIU' : i.e. for a ROUTED IP configuration, set the Ethernet IP address as 10.11.1.2, Element Manager IP address to 10.12.1.2
5. Routed Configuration: Reset the DIU configuration parameters that are stored in non-volatile memory and configure as a 'Near Side DIU' : i.e. for a ROUTED IP configuration set the Ethernet IP address as 10.2.1.2, Element Manager IP address to 10.13.1.2
6. Routed Configuration: If you are not sure how the DIU is configured (NEAR or FAR side DIU), reset it AS IS i.e. reset the 'Near Side DIU' or 'Far Side DIU' configuration parameters depending on how the DIU is currently configured.
7. Bridged Configuration: Reset the DIU configuration parameters that are stored in non-volatile memory (BATTERY-BACKED STATIC RAM) and configure as a 'Far Side DIU' For a BRIDGED IP configuration, see Appendix C of this document for a description of the default IP addresses.
8. Bridged Configuration: Reset the DIU configuration parameters that are stored in non-volatile memory and configure as a 'Near Side DIU'. For a BRIDGED IP configuration, see Appendix C of this document for a description of the default IP addresses.

9, 10, 11 RESERVED

12. Set up Digital Indoor Unit with E1 tributaries.
13. Set up Digital Indoor Unit with T1 tributaries.
14. Deactivate buttons 4 onwards.
15. Toggle SNMP and FTP Servers ON/OFF (V3.00+ firmware)
16. DHCP ON (V3.00+ firmware)
17. DHCP OFF (V3.00+ firmware)
18. Ethernet MAC learning enabled via front panel
19. Transparent ethernet mode enabled via front panel
20. EEprom erased via front panel (MDR Only)
21. RFU back-to-back enable / disabled toggle via front panel

NOTE All buttons can be REACTIVATED (i.e. undoing a 14 'reset') by doing a power-on reset while holding the front-panel Reset Button in for 1 LED count.

NOTE

POSITIONS 4, 5, 6, 7 and 8 RESET THE DIGITAL INDOOR UNIT TO FACTORY DEFAULTS – THESE RESETS ARE TYPICALLY ONLY USED ONCE (THESE CHOICES RESET CERTAIN ADJUSTABLE PARAMETERS IN NON-VOLATILE MEMORY IN THE DIGITAL INDOOR UNITS). IF CHANGES ARE MADE TO THE CONFIGURATION PARAMETERS AND THE USER DOES NOT WANT THESE TO CHANGE WHEN A UNIT IS RESET, THE DIGITAL INDOOR UNIT CAN BE POWER-CYCLED OR POSITION '3' MUST BE USED E.G. THIS TECHNIQUE IS USED IF THE IP ADDRESSES ASSOCIATED WITH THE NETWORK INTERFACES ARE ADJUSTED – THE PROCESSOR NEEDS TO BE RESET TO ALLOW THE CHANGE/S TO BE IMPLEMENTED.

IF YOU OVER-RUN THE SELECTION YOU REQUIRE, CONTINUE UNTIL THE LEDs GO BLANK – THEN, START AGAIN (OPTION AVAILABLE WITH RELEASE 2+ OF DIU FIRMWARE).

2.3.5 Service (Wayside) Serial Data Channel

This port supports asynchronous full duplex, serial data transfer at a speed of 115200 bps.

The interface type is RS-232 configured as DCE (Data Communications Equipment).

Handshaking can be None, Hardware.

2.3.6 Element Manager Port

This port is used for communication with the NMS software or with an SNMP manager to control the MDR system. The port must be connected to a serial port (configured for a speed of 115200 bps) on a personal computer to use the NMS software.

The interface type is RS-232 configured as DTE (Data Terminal Equipment).

Hardware handshaking is used.

2.3.7 10BaseT Ethernet RJ45 Port

This port is used for communications with the NMS / GUI software from a laptop / PC or with an SNMP manger to control the system. It can also be connected to a hub for 10BaseT wayside Ethernet throughput.

The interface type is DTE (Data Terminal Equipment) and can support Full and Half Duplex Ethernet connections. Select the Ethernet Duplex mode from the following MIB element: 1.3.6.1.4.1.1316.1.1.1.4.16 mdrmteEthernetFullDuplex.

Take note that connecting the radio to an Ethernet hub requires the Ethernet interface to operate in Half Duplex mode.

2.3.8 DIU/RFU Link LED

This LED indicates if there is a suitable electrical connection between the Indoor and RF Units[1].

2.3.9 DIU/RFU Data Interconnect RJ45

This receptacle accepts an RJ45 plug that connects to UV-protected STP (Screened twisted pair) cable used between the DIU and the RFU.

2.3.10 DIU/RFU Power Interconnect

This connector (socket) is used for power interconnection between the DIU and the RFU. The connection is made using UV-protected 2-core cable. The cable is connected to a GREEN, two-pin connector, a plug.

CAUTION

The polarity sense (labelled) must be maintained between the DIU and the RFU.

2.3.11 Auxiliary In/Out Port

The auxiliary in/out port is used for remote monitoring and control. The following are provided

- Two inputs (for sensing contact closure or opening) are provided to sense site alarm inputs. The states of these alarm inputs can be monitored with NMS, as well as from an SNMP Management Station.
- Two relay contact outputs, normally-open and normally-closed contacts, are provided as alarm / auxiliary outputs. Output states are software customised and controlled. The outputs are used to indicate alarm or other states selected by the operator via the NMS or a SNMP Management Station.

[1] NOTE that on V1 hardware only the Ethernet Physical interface is checked with this LED, not the RS232/485 interface. The integrity of the RS232/485 interface is checked using the front panel “System LED”. On later versions the RS232/485 interface is no longer used.

2.3.12 DIU DC Power Input

This connector (socket) is used for power input to the DIU. The connection is made using 2 or 3-core cable. The cable is connected to a two pin GREY connector on the MDR radio and a THREE pin GREEN connector on the Orion unit - both are plugs. The polarity-sense (labelled) must be observed and implemented. A ground connection is available on the three-pin connector. This ground connection is not required if the ground terminal is connected (2.3.15).

2.3.13 Fuse Holder

This holder is used to hold a fuse (2A, slow blow fuse).

2.3.14 ON/OFF Switch

This switch is used to control power input to the Digital Indoor Unit (and indirectly the RF Unit). No switch is fitted to the Orion DIU. The unit will start up as soon as the required DC voltage is applied.

2.3.15 Ground Terminal

This is used to accept connection to an earth strap, terminated with a crimped earth lug. Refer to the installation chapter for details on wire/earth lug requirements. A ground connection is also available on the three-pin DIU DC power connector.

3 Planning

This chapter is aimed at management and planning staff to enable them to assess the requirements for installing an MDR / Orion digital radio link.

3.1 System Type Selection

The system uses an RF Unit with a type-N RF output for connection to a range of antennas.

The MDR / Orion is aimed at FCC regulated markets.

Antenna polarization can used to co-locate multiple systems.

Antenna polarization can be used to overcome interference.

3.1.1 Antenna selection

The antenna type must be selected before the system is to be installed. The chosen antenna must enable the system to operate with sufficient link fade margin without excessive cost and allow the user's 'link availability requirements' to be met.

The main consideration when selecting an antenna is antenna gain measured in dBi. A path loss analysis is highly recommended to determine the antenna gain needed for adequate fade margin. The table below shows antenna selection guidelines for some configurations. The distances are calculated for a 20 dB link fade margin.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

Table 8 MDR5800 Antenna Selection

Antenna Type	Gain (dBi)	MDR RFU Typical Distance (Km)	Power level (dBm)
0.15 m Flat panel	18	9	24
0.3 m Flat panel	24	30	24
0.6 m Flat panel	28	80	24

Table 9 Orion5810i Antenna Selection

Antenna Type	Gain (dBi)	MDR RFU Typical Distance (Km)	Power level (dBm)
Gabriel Parabolic Antenna (SSP 52B)	29	80	25

Table 10 Orion5850 Antenna Selection			
Antenna Type	**Gain (dBi)**	**MDR RFU Typical Distance (Km)**	**Power level (dBm)**
0.6 m Flat panel (MT-20004)	28	80	24

Table 11 MDR2400 and Orion2410i Antenna Selection			
Antenna Type	**Gain (dBi)**	**Distance (Km)**	**Power level (dBm)**
1.2 m Parabolic Antenna	27	80	18

3.2 Site Evaluation

When planning a site for a digital radio link, it is of the utmost importance that you take the operational environment of the proposed site into account.

The combined effect of atmospheric environmental factors such as rain and lightning, atmospheric attenuation, signal path obstruction, propagation fading, air temperature gradients, ice build-up, wind and solar radiation can contribute towards reducing the level of performance of the system. The 2.4 GHz and 5.8 GHz bands are not adversely affected by rain, ice or snow. Severely cold and excessively warm climatic conditions outside the scope of the operating temperature range can affect the function of the system, especially the outdoor equipment (see *Environmental Characteristics* on page 50 of this manual).

Also, if masts are not sufficiently rigid, very strong winds can affect the antenna beam alignment and Outdoor equipment reliability due to wind force build-up and/or vibration of the mast-mounted equipment.

3.3 Multipath Effects

The effects of multipath propagation can influence the radio. Understanding these effects will help when installing a radio link and maximise the reliability of the link.

Multipath fading occurs when the receiving antenna receives not only the direct signal from the transmitting antenna but also a signal from the transmitting antenna that has reflected off the ground or nearby obstacles. The reflected signal takes a longer path to reach the receiver and acts as interference since it is not in-phase with the direct path signal. The amplitude of the interference can be almost equal to that of the direct path signal, thus degrading the performance of the link.

Multipath propagation is dependent on transmit frequency and the specific geometry of the link such as antenna heights, distance between the antennas and the local terrain. To counteract multipath propagation, the installer can change the frequency at which the link operates or adjust the height of one or both of the antennas.

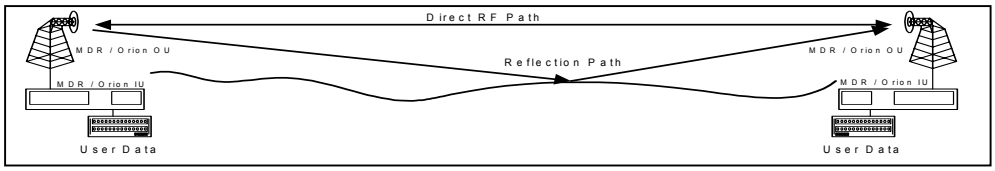


Figure 6. Multipath Effects.

3.4 Interference Considerations

The ISM frequency bands are used by other devices that can cause interference to the MDR / Orion radio systems. Interference can be avoided by careful planning of the system installation. The available methods for providing isolation from interfering radiators are the following:

- Frequency diversity
- Antenna polarization

It is recommended to scan the proposed installation areas with a spectrum analyzer prior to installation to establish the presence of interference. The spectrum analyzer feature available on the NMS / GUI may also be used. If interference is detected on the path, the GUI, via laptop connection, can be used to select a new channel plan (A, B, or C) to “steer around the interferer, or to create a new custom channel plan (Plan D) to avoid the interference. SNMP network architecture, if employed, may also be used to make the frequency plan changes. The frequency spectrum should be scanned over a sufficient time period to ensure that periodic transmissions are recorded.

Interferers will cause problems if their amplitudes are not more than 20 dB below the intended receive power level. A link path loss calculation should be performed to determine the expected receive power level.

The procedure for selecting the optimum antenna polarization and system frequency plan is the following:

- Perform a spectral analysis at each site in the link direction using a high gain antenna.
- Repeat the spectral analysis for vertical and horizontal polarization.
- Select the polarization with the lowest interfering levels as the system antenna polarization.
- Consult the MDR / Orion frequency channel plans as shown in section 2.2.1 and select the frequency plan that would operate in an interference-free band.
- Install the ‘High Band’ and ‘Low Band’ RF Units at the sites where they would experience the lowest interference in their respective *receive* bands.

3.5 Microcell Backhaul Applications of MDR / Orion Digital Radios

In applications where more than one independent and separate links, need to radiate from a central site, a number of parameters can be taken advantage of, to provide isolation and minimise interference between these links:

- Frequency multiplexing
- Antenna polarization
- Choice of High Antenna Gain

It is important to note that these methods only provide isolation between two radio Systems, and that power levels in the separate systems should be balanced to ensure correct operation.

3.5.1 Setting the Transmitted Power Levels

To minimise interference, received power levels should be balanced between separate radio links. This means that transmit power levels should be set to provide similar levels of received power, as indicated by the RSSI values of the adjacent receivers at the central site. Power levels are easily adjusted via point and click selection utilizing the provided NMS / GUI, installed on your laptop or via SNMP network architecture.

3.5.2 Frequency Multiplexing

The MDR2400 and Orion2410i offers three frequency channel plans, the MDR5800 and Orion5810i four and the Orion 5850 also four. Refer to paragraph 2.2.1 for more detail on the frequency channel plans. A radio link requires two channels (one for transmit and one to receive) to provide full duplex operation. Each radio has a high and a low sub-band, one that it uses for transmission and another for reception. Terminology definition: the ‘High-band RF Unit’ of a system transmits on the higher of the two sub-bands. The ‘Low-band RF Unit’ of a system transmits on the lower of the two sub-bands. A system (link) always has one High Band and one Low Band RF Unit. It is important to note that unwanted transmitted signals in adjacent frequency bands can affect other receivers operating in an adjacent band if insufficient antenna isolation is provided. A solution is to group high-band or low-band RF Units at the central site, rather than group high and low-band RF Units together.

3.5.3 Antenna Isolation

Separate links at a central site will have sufficient isolation when radio systems operate outside the radiation beamwidth or side lobes of the system antenna. The achievable isolation can be established by examining the measured radiation patterns of the system antennas. Directional isolation can be used if the antenna radiation is 15 dB or lower relative to the adjacent main beam. Antennas with high directionality will allow reduced angular separation of adjacent systems. Antenna cross-polarization isolation can be used for adjacent radio links, radiating in the same direction. Typical isolation of 30 dB can be achieved using high quality antennas.

4 Installation

This chapter describes a recommended installation procedure for the MDR2400, MDR5800, Orion2410i, Orion5810i and the Orion 5850.

Before installation / departure to site

1. Carefully open all shipping boxes and look for any obvious damage that might have resulted during shipment.
2. Do an operational bench test to verify the functionality of the system.
3. Confirm that both radios have the correct IP configuration (refer to page 108, paragraph C.2) for "local" and "remote" sites. Use the provided NMS / GUI installed on a laptop / PC to configure / analyze the radio via a serial / ethernet connection to the DIU element manager port. Local and remote IP addresses labels may be fitted to the DIU's and can be verified with those listed in the GUI.
4. Both radios should be on the same channel plan (paragraph 2.2.1) and power should be set to an appropriate test level (not muted).
5. **NOTE** Use at least 60dB attenuation when directly connecting two RFU RF ports.
6. After initial power up and a minute or so of "settle time", clear any flashing LEDs via the front panel reset button (paragraph 2.3.4) or the GUI. The DIU status LEDs should be green with no errors indicated and remain green for an appropriate time span (at least 1-2 minutes).
7. After satisfactory results, disconnect the units and transfer to the installation site for permanent installation.

NOTE It is recommended that the installer have previous experience in installing radio communication equipment or has attended a training course from the supplier for the purpose of understanding how to set-up and configure an MDR / Orion radio.

Recommended installation procedure

1. Install the Digital Indoor Unit.
2. Prepare and connect the cables to the Digital Indoor Unit.
3. Install the RF Unit and antenna.
4. Install the Indoor-to-RF Unit interconnection cables (the power and data cables).
5. Turn the Digital Indoor Unit power on.
6. Perform the initial software setup using the supplied NMS application
7. Repeat item 1-5 for the remote site.
8. Align the antennas (use the RSSI voltage on the RFU or the RSSI value from the MIB or the NMS Graphic User Interface to assist with the setup).
9. Perform a functional test and commission the link.
10. Connect to user data.
11. Start the system.

Installation of the MDR / Orion elements are described in the following sections:

- Installing the Digital Indoor Unit
- Installing the RF Unit and Antenna
- Installing the interconnection cables

4.1 Customer Furnished Tools and Equipment

The following table lists tools and equipment required to install the MDR2400-SR, MDR5800-SR, Orion2410-SRi, Orion5810-SRi and the Orion 5825-SR system.

General, DIU-to-RFU Interconnect

- Cable cutting and stripping tools.
- Ground lug crimp tools.
- 3 mm flat screwdriver - DIU to RFU power cable.
- RJ45 crimp tool - DIU to RFU data cable.
- Soldering iron.
- Ground cable or strap rated at 45A with 5 mm ground lug for grounding the Indoor and RF Units.
- Cable ties, used to secure the cables to the mast at regular intervals.

DIU

- Pozi #2 screwdriver - DIU mounting in a 19" rack and the ground lug.
- 7mm Spanner – Attaching the earth cable to the DIU.
- 2.5mm Allen key - To change the position of the DIU mounting brackets.
- DC power supply cable: minimum 2.5 mm square conductor, rated for 10 A. For connection between the power supply and the Digital Indoor Unit DC connector on the rear panel. (The DC connector is on the front panel of the Orion DIU.)
- DIU ground lug: 10-4 (10 square mm for wire and hole big enough for M4 thread)

Outdoor RFU

- 13 mm wrench / spanner – used for attachment of RFU to mounting bracket and mounting bracket to pole. Also used to close RFU with hinge type connection box.
- 2.5 mm Allen key - used to tighten RFU connection box cover fasteners.
- RFU ground lug: 10-8 (10 square mm for wire and hole big enough for M8 thread)
- Multimeter (recommended) to measure RSSI at RFU during antenna panning. The RSSI level may also be read from the NMS / GUI via laptop connection to the DIU, indoors

Indoor RFU

- Pozi #2 screwdriver - DIU mounting in a 19" rack and the ground lug.
- 7mm Spanner – Attaching the earth cable to the DIU.
- 2.5mm Allen key - To change the position of the DIU mounting brackets.
- RFU ground lug: 10-8 (10 square mm for wire and hole big enough for M8 thread)
- Multimeter (recommended) to measure RSSI at RFU during antenna panning. The RSSI level may also be read from the NMS / GUI via laptop connection to the DIU, indoors

Please refer to paragraphs 4.3.1 and 8.5.10 for details on the RF and data cables, which are also customer furnished equipment.

4.2 Digital Indoor Unit

4.2.1 Introduction

This section describes the recommended installation procedure for the Digital Indoor Unit. The Digital Indoor Unit is designed for mounting in the DIN 41494 (19") racking standard and occupies a 1U high slot. Desktop mounting is also possible.

The Digital Indoor Unit's payload (nT1, nE1 and 10BaseT Ethernet) and Service Channel ('Wayside serial') data interfaces and Element Management interface are located on the front panel. Input Power, Auxiliary alarm and 'DIU/RFU Interconnect' interfaces are located on the rear panel for the MDR DIU, suitable for rack installations and on the front panel for the Orion DIU, simplifying accessibility.

The recommended installation procedure for the Digital Indoor Unit is the following:

1. Install the Digital Indoor Unit in the rack.
2. Ground the Digital Indoor Unit. This is required for safety and to minimise radiated emissions.
3. Connect the DC power supply. There is no ON/OFF switch on the Orion DIU, thus connecting the DC power supply will start up the radio.
4. Connect Payload data ports (front panel).
5. Connect Auxiliary In/Out port (optional).
6. Connect Service Channel (Wayside) serial port (optional).
7. Connect the Element Manager port using the supplied cable (front panel).

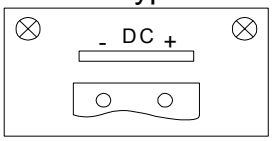
4.2.2 Installing the Digital Indoor Unit in a Rack

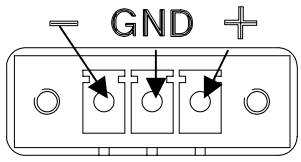
1. Slide the Digital Indoor Unit into the 19" rack and secure to the rack using four (4) APPROPRIATELY sized bolts for size and rack threads provided. M6 x 18 mm screws are recommended.
2. Ground the Digital Indoor Unit by connecting the ground cable or strap between the station ground and the ground terminal on the Digital Indoor Unit rear / front (Orion) panel.

4.2.3 Connecting a DC Power Supply

WARNING – See section 8.4 for specification of the power supply.

1. Observing the polarity of the supply, wire up the supplied power connector cable plug and connect it to the DC supply (Voltage range as indicated on the Digital Indoor Unit) through a minimum 2 A slow blow circuit breaker.
2. Check the supply voltage using a multimeter.
3. Secure the connector screws to the unit.

DC Power Connector Pinouts (MDR DIU)		
Digital Indoor Unit connector: GREY	**Pin No**	**Signal**
2-pin Wieland Type 8213 Socket 	+	DC POWER
	-	DC POWER RETURN

DC Power Connector Pinouts (Orion DIU)		
Digital Indoor Unit connector: GREEN	**Pin No**	**Signal**
3-pin Phoenix Type 18.27.87.1 Socket 	+	DC POWER
	GND	GROUND PIN
	-	DC POWER RETURN

4.2.4 Balanced Payload Data : DB25

1. Assemble the (nE1) / (nT1) payload data input and output cable. See the table below for Digital Indoor Unit connector pin assignments.
2. Connect the payload data cable to the DB25 connector on the front panel of the Digital Indoor Unit.

Standard termination of this port is 120 Ohms. On the Orion 25, 75 Ohms termination is available on request (please contact the factory).

NOTE Rx implies IN (signal expected to go INTO the interface), Tx implies RFUT (signal coming out of the interface)

Tribs 1-4 are connected on D1 on the Orion10, Orion25 and MDR DIU. In a similar fashion tribs 5-8 are connected on D2 for the Orion 25 radio, that is pin 2 = RTIP6, pin 10 = RTIP5 and so on.

D-Type Payload Data Connector Pin #	Pin Name	Tributary	Direction
1	GND / Earth		N/A
2	RTIP2	2	RX +
3	RRING2	2	RX -
4	GND / Earth		N/A
5	TTIP2	2	TX -
6	TRING2	2	TX +
7	GND / Earth		N/A
8	GND / Earth		N/A
9	RRING1	1	RX +
10	RTIP1	1	RX -
11	GND / Earth		N/A
12	TRING1	1	TX -
13	TTIP1	1	TX +
14	TRING3	3	TX -
15	TTIP3	3	TX +
16	GND / Earth		N/A
17	RRING3	3	RX+
18	RTIP3	3	RX-
19	GND / Earth		N/A
20	TTIP4	4	TX-
21	TRING4	4	TX+
22	GND / Earth		N/A
23	RTIP4	4	RX+
24	RRING4	4	RX-
25	GND / Earth		N/A

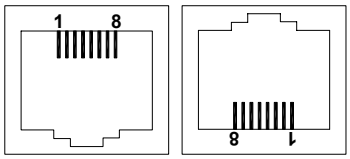
4.2.5 Balanced Payload Data : RJ48

1. Assemble the T1 / E1 payload data input and output cable. See the table below for Digital Indoor Unit connector pin assignments.
2. Connect the payload data cables to the RJ48 connectors (numbered 1-8 for tribs 1-8) on the front panel of the Digital Indoor Unit.

Standard termination of this port is 110 Ohms. On the Orion10 and Orion25, 75 Ohms termination is available on request (please contact the factory).

It is recommended to use a cable that connects to pin 1,2,4, and 5 only since the other pins on the RJ48 are not used to transfer data.

NOTE Rx implies IN (signal expected to go INTO the interface), Tx implies RFUT (signal coming out of the interface)

RJ48C Socket	Pin	Description	Direction
	1	R (Ring 1)	TX
	2	T (Tip 1)	TX
	3,6	50 Ohm terminated	N/A
	4	R1 (Ring)	RX
	5	T1 (Tip)	RX
	7,8	No Connection	N/A

NOTE Use Twisted Pair Cable conductors for pins: 1 & 2, 3 & 6 and 4 & 5.

4.2.6 Unbalanced Payload Data : BNC

One of the variants of the MDR Digital Indoor Unit has a set of 75 Ohm BNC's on the front panel as well as the DB25 connector.

- Rx implies IN (signal expected to go INTO the interface)
- Tx implies RFUT (signal coming RFUT of the interface)

NOTE Tribs are numbered 0-3 on the front panel, but are called 1-4/1-8 in the NMS / GUI.

4.2.7 Connecting Auxiliary In/Out (Optional)

The auxiliary in/out port is used to:

- Monitor switch-closure events using two isolated inputs.
- Control line connections using normally-open and normally-closed relay outputs.

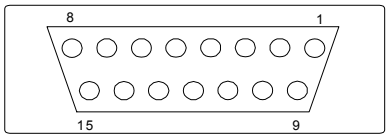
Connect the port:

1. Assemble an auxiliary in/out cable using a 15 way D-type male connector according to connector pin assignments shown in Table 12.

2. Connect to the cable Digital Indoor Unit auxiliary in/out connector.
3. Secure the connector using locking screws.

NOTE The Orion and MDR Digital Indoor Units are equipped with only two relays. The Normally-Open and Normally-Closed output for each of the two relays are however provided on the Auxiliary Connector for convenience.

Table 12. Auxiliary In/Out Connector Pin Outs

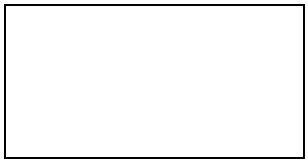
Digital Indoor Unit connector	Pin No	Signal
15-pin D-type female 	1	OUTPUT 1 COMMON
	2	OUTPUT 1 NORMALLY-OPEN
	3	OUTPUT 1 NORMALLY-OPEN
	4	OUTPUT 1 NORMALLY-CLOSED
	5	OUTPUT 1 NORMALLY-CLOSED
	6	OUTPUT 1 COMMON
	7	OUTPUT 2 COMMON
	8	OUTPUT 2 COMMON
	9	OUTPUT 2 NORMALLY-OPEN
	10	OUTPUT 2 NORMALLY-OPEN
	11	OUTPUT 2 NORMALLY-CLOSED
	12	INPUT 1
	13	INPUT 1 RETURN
	14	INPUT 2
	15	INPUT 2 RETURN

4.2.8 Connecting the Service (Wayside) Serial Channel (Optional)

This 'clear' serial channel can transport up to 115,200 bps across the radio link. This channel does not interfere with the payload data channels. The port is configured as DCE.

1. Connect the serial data interface cable to the Service channel connector on the Digital Indoor Unit rear panel. The supplied serial data cable can be used to connect to this port after the software setup is completed.
2. See the table below for Digital Indoor Unit connector pin assignments when a custom cable needs to be assembled.
3. Secure the connector using locking screws.

Service Channel Connector Pinouts

Digital Indoor Unit connector	Pin No	Signal
9-pin D-type Female Connector 	2	TD
	3	RD
	4	DTR
	5	GROUND
	6	DSR
	7	RTS
	8	CTS

4.2.9 Connecting the Element Manager Port

The Element Manager port is used to connect the Digital Indoor Unit to a PC/Laptop serial port. This enables the Digital Indoor Unit to be configured using the supplied NMS / GUI software or controlled via a PPP-dialup connection. The port can be connected to using the supplied serial data cable. The port is configured as DTE.

NOTE The Ethernet 10BaseT port can also be used to control the DIU via the GUI / SNMP software.

4.3 RF Unit

The MDR2400 and MDR5800 outdoor RF Units are also available as 1U indoor RF Units, Orion2410i and Orion5810i, that can be rackmounted in a 1U rack.

Before installing the Orion or MDR RF Unit, ensure that a suitable mast is used for the antenna and that the RF Unit installation is firmly in position. The pole diameter must be between 50 and 102 mm or between 2" and 4½".

The outdoor unit type RF Unit may also be mounted indoors, utilizing an optional rack mount adapter (not included as a standard item) at the base of a tower for convenient access. However, this as not recommended as a long and expensive RF cable would then be required, compromising system sensitivity and increasing link costs.

CAUTION – ENSURE THAT THE POLE IS EARTHED FOR LIGHTNING PROTECTION.

Follow these steps to install the RF Unit:

1. Install the system antenna.
2. Adjust the mounting bracket to be slightly bigger than the pole diameter.
3. Secure the mounting bracket to the pole.
4. Secure the RF Unit to the bracket using the screws on each bracket.
5. Connect the RF Unit to the pole electrically by connecting the earth cable or strap between the pole earth and the RF Unit earth point.
6. Connect the type-N RF output connector to the system antenna through an in-line lightning protection unit in areas with lightning activity.
7. Cover the connectors using an ultra violet protective, self-vulcanising tape.

4.3.1 RF Connection

1. The RF port is an N-type female connector.
2. The N-Type connector is used to connect to the antenna, typically using coaxial transmission line.
3. 1/2" or 5/8” coaxial cables are recommended. Coaxial cable that is 7/8” or larger can exhibit moding at 5.8 GHz and is not recommended for 5.8 GHz radios.

4. Do not use right angle N-type connectors with the radios: they may present high loss.
5. Do not use low quality cables. Some cable types, such as RG-8, may have too high a loss at 5.8 GHz.

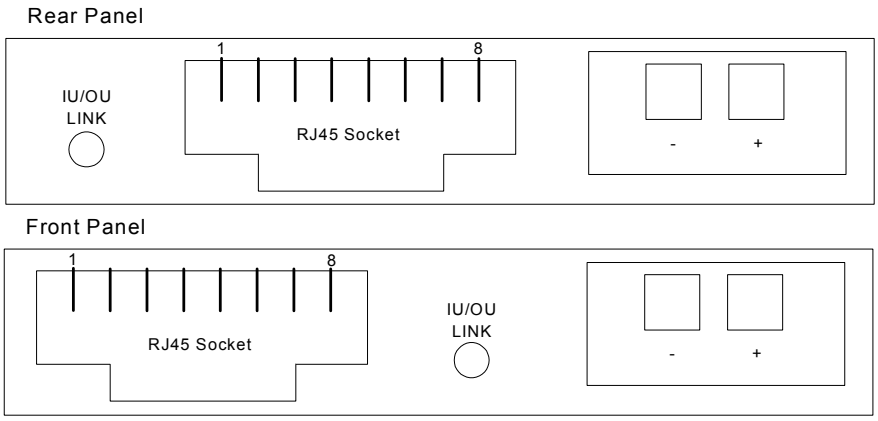
4.4 Interconnection Cable Installation

Follow these steps to install the Digital Indoor Unit to RF Unit interconnection cables.

CAUTION

- **DO NOT OVER TIGHTEN THE CABLE STRAPS ON THE CABLES AND DO NOT FASTEN THE STRAP LOCKING MECHANISM OF THE CABLE STRAP ONTO THE CABLES.**

1. On the RFU side, connect an RJ45 plug to the data cable. Place the RJ45 plug into the RJ45 socket in the RF Unit connection box / Indoor RF Unit front panel.
2. On the RFU side, connect the DC power leads within the RF Unit Connection Box / on the Indoor RF Unit front panel. Use the + and - connections.



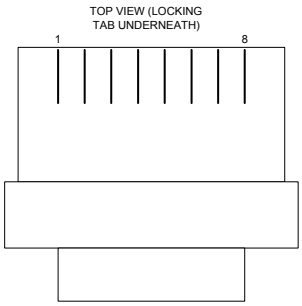
LOOKING AT THE "RF Unit" CONNECTION BOX
(Located on the rear panel of the MDR DIU, front panel of the Orion DIU)

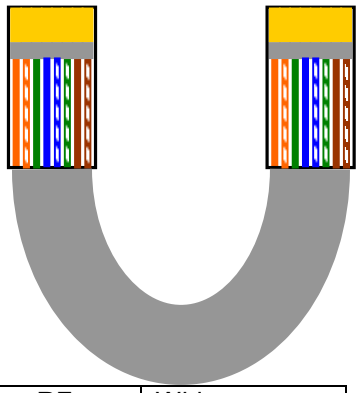
3. If applicable: Close the RF Unit Connection Box Cover using a 2.5mm Allen key. Make sure the rubber gaskets seal correctly over the power and data cables.
4. If applicable: Using cable ties, secure the cable to the pole at regular intervals.
5. On the DIU side, connect an RJ45 plug to the data cable. Place the RJ45 plug into the RJ45 socket in the "RF Unit" connection box.
6. On the DIU side, connect the DC power leads to the supplied GREEN Phoenix plug. Insert this plug into the green socket in the "RF Unit" connection box.
7. The user can see that there is a suitable DIU/RFU data interconnection if the 'DIU/RFU Link' LED of the DIU is lit up green.

CAUTION

- **UNDO THE SCREWS OF THE “CONNECTION BOX” IN A UNIFORM MANNER. THIS ENSURES THAT THE “CONNECTION BOX” GASKET MATERIAL RELEASES STRESS UNIFORMLY AND DOES NOT LEAD TO THE SECURING SCREWS BEING BENT DUE TO THE PRESSURE PLACED ON THE CONNECTION BOX LID.**

4.4.1 INTERCONNECTION CABLE WIRING DESCRIPTION





Pin	DTE (on DIGITAL INDOOR UNIT)	DCE (on RF UNIT)	Wiring
1	TxD+	RxD-	Orange/White
2	TxD-	RxD+	White/Orange
3	RxD+	TxD+	Green/White
4†	TxC+	RxC+	Blue/White
5†	TxC-	RxC-	White/Blue
6	RxD-	TxD-	White/Green
7†	RxC+	TxC+	Brown/White
8†	RxC-	TxC-	White/Brown

NOTE

† VERSION 1 AND 2 RELEASES OF THE HARDWARE (INDOOR AND RF UNITS) CANNOT BE USED INTERCHANGEABLY. FOR VERSION 2 DIU & RFU HARDWARE, USE OF TxC+, TxC-, RxC+, RxC- **FALLS AWAY** AND ONLY TWO (2) TWISTED PAIRS ARE REQUIRED.

5 Antenna Alignment and Software Setup

This chapter describes the procedure for software setup and antenna alignment. The setup is done with a laptop / PC running the supplied NMS Graphical User Interface (GUI) software. See chapter 6 for details on using the NMS / GUI.

5.1 Installation Equipment Required

The following tools and instruments are required for software setup and aligning the antenna:

- RSSI test cable
- Voltmeter
- Wrench / spanner (see appropriate details in installation chapter depending on the antenna being used)
- PC with NMS software and supplied serial data cable.
- Binoculars (optional) used for locating the far end site. This will assist in the antenna alignment operation.
- GPS or Standard Compass (optional) used for locating the far end site. This will assist in the antenna alignment operation.
- Bit Error Rate Tester and connecting leads.

5.2 Information Required

You should know:

- the proposed frequency channel plan for each station.
- the expected receive level based on the chosen system configuration and a path loss analysis.

B.1 Antenna Alignment

5.2.1 Introduction

The RFU should be installed on both sites before alignment starts. Perform the following steps at both stations:

1. Switch the Digital Indoor Unit power ON.
2. Install and run the NMS Software application.
3. Configure the radio channel plan as required.
4. Set the transmitted power to maximum.
5. Perform a RF loopback test at each site before starting the alignment procedure.

5.2.2 Alignment Procedure

1. Locate the far site and point the antenna to the antenna at the far site, as accurately as possible using binoculars or a compass.
2. Connect the multimeter to the RSSI connector on the RFU using the supplied RSSI test cable and set the multimeter to measure volts.
3. Check the RSSI level and refer to the figure below for received power level.
4. Align the antenna until the maximum RSSI is attained.

5. Secure the antenna.
6. Measure the RSSI level and record the value (see section 5.6).
7. Compare with the value with that calculated for the link i.e. using the path loss calculation done when planning the link.

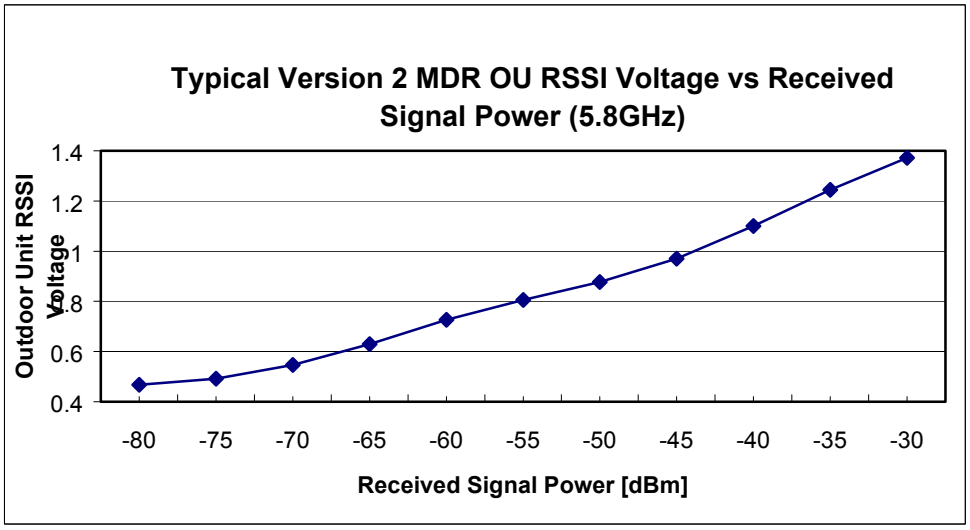


Figure 7. Typical Version 2 MDR5800 and Orion5810i RFU RSSI Voltage as a function of RF input power level

-80 dBm Average 0.436 ± 0.029 V : MIB RSSI 95 ± 1 dBm (see comment below)

-30 dBm Average 1.333 ± 0.047 V : MIB RSSI 54 ± 2 dBm (see comment below)

The front panel RF Link LED, the Received Signal Strength Indicators (RSSI : on NMS, via SNMP or as an Electrical signal on the RF Unit), Carrier-detect (NMS, SNMP) and Frame Lock (NMS, SNMP) indicators are available to assist with link installation and alignment.

NOTE 1 The MIB lists a value representative of the received signal level in [-dBm].

This value corresponds to the signal power measured in a 200 kHz BW centred at the receive frequency of the radio.

When not in spectrum analyser mode, the Orion RFU translates the measured signal power to a value corresponding to the wanted signal power in the receiver bandwidth.

NOTE 2 For the MDR and Orion10i RFUs, the RSSI values displayed in the MIB are representative of the signal level measured over a 200kHz BW. Add ~20dB to the MIB value for a wanted spread spectrum signal. The NMS / GUI will do this adjustment automatically and will therefore always display the correct RSSI value.

NOTE 3 Due to the technique used to calculate the RSSI level of a wanted signal, the measured RSSI level can differ from the actual value with up to ±3 dB.

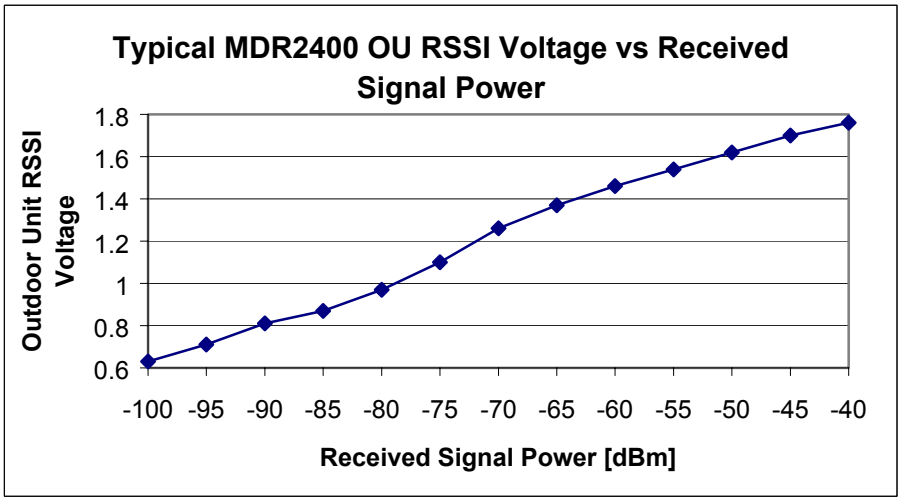


Figure 8. Typical MDR2400 and Orion2410i RFU RSSI Voltage as a function of RF input power level

(See comment above.)

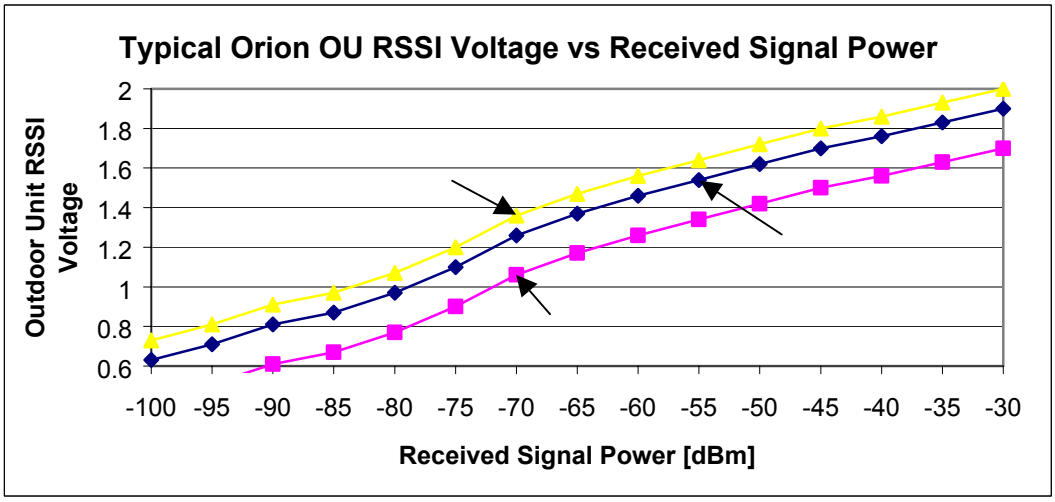


Figure 9. Typical Orion 5850 RFU RSSI Voltage as a function of RF input power level (note the different bandwidths)

5.2.3 Set Transmitted Power Level

It is good practice to match received power levels by adjusting transmitted powers if co-located systems are being installed. This is important to avoid interference between co-located systems. An attenuator can be fitted between the RF Unit and the antenna if the power level cannot be sufficiently reduced. The dBm output at the RFU N-type connector (socket) levels are set via the NMS or using a SNMP Management application.

5.3 Software Setup

Refer to chapter 6, for setting up the following:

- Payload interface.
- Service Channel (Wayside) serial port.
- Auxiliary in/out port.
- General link parameters.

5.4 Functional Test

After completing the physical installation of the Digital Indoor Units, antennas, RF Units and the interconnection cables, you need to commission the system. This procedure describes how to set up the minimum requirements for successful MDR / Orion system operation.

5.4.1 Link Bit Error Rate Performance Test

To start : when the link is setup correctly, the RF Link LEDs on both DIUs on both sides of the RF link should be GREEN.

When the link has been setup and is running error-free:

1. Clear the Digital Indoor Unit Log using Reset Button Position ‘2’
2. Clear the Digital Indoor Unit Errors using Reset Button Position ‘1’

Perform a link bit error rate performance test as follows:

- Connect a bit error rate tester to the payload interface of the link.
- Run data over the link for a period of 24 hours.
- Record the BER.
- Record the LED statuses.

Check the Digital Indoor Unit Packet Error Results via the NMS or via SNMP access to the Digital Indoor Unit MIB – for the NMS, right-click on the antennas in the NMS for either side of the link and select the “Diagnostic/Error Monitor” option. Record the results by saving the data to a file. For SNMP access, use a MIB Browser and check the mdrmteRFLinkPerf and mdrmteG826 Performance groups.

Record all results on a test record. See MDR / Orion Test Record, section 5.6 for an example.

5.5 MDR / Orion Installation Record

Parameter	Unit	Site A	Site B
Site Name			
Antenna Type			
RF cable length	Meters		
Lightening protection unit	Yes/No		
Interconnecting cable length	Meters		
RF Unit serial number			
Digital Indoor Unit serial number			
RF Unit earthed	Yes/No		
Digital Indoor Unit earthed	Yes/No		
Power Supply	Volts DC/AC		

	Date	Name	Signature
Performed by			
Approved by			

5.6 MDR / Orion Test Record

Parameter	Unit	Site A	Site B
Frequency channel plan: Transmit Receive **NOTE 1 :** C is NOT used for the MDR2400. **NOTE 2 :** FCC requirements (U.S. only), page 2.	 A/B/C/D A/B/C/D If D – List Transmit and Receive Frequencies [MHz]		
Transmitter output power (**NOTE 2**)	dBm		
Receiver input level (ON)	Volts		
Receiver input level (ON)	dBm		
Receiver input level (OFF)	Volts		
Receiver input level (OFF)	dBm		
Calculated input level	dBm		
Fade margin	dB		
Frame Lock indicator	Colour		
Fixed attenuator	DB		
BER-test	Hours BER		
Alarm Indicators	Clear (Yes/No)		

	Date	Name	Signature
Performed by			
Approved by			

6 NMS Software

6.1 Scope

This section provides minimal information required to install the Orion NMS. A detailed HTML-based help document can be found on the NMS installation CD supplied with new radios.

6.2 Introduction

The purpose of the Network Management System, hereafter called the NMS, is to allow you to configure, manage or interrogate the following primary functional elements of a Digital Radio Link:

- Digital Indoor Unit
- RF Unit

A Digital Radio Link consists of two Indoor-RF Unit stations connected through a radio link.

The Orion NMS is designed to auto-detect the radio type it is connected to and can support the following radio types:

- Orion XX
- MDR XXXX

Since the firmware and software for the MDR XXXX and the Orion XX10i RFUs are exactly the same, the NMS has no means to detect the difference between these units. The NMS will therefore always display the radio type as MDR XXXX.

The NMS is a PC-based software package that provides you with a graphical interface that is used to perform on-site element management of a digital radio system. It allows you to configure, manage and interrogate the system by selecting various menus and options.

The hardware as well as the software constituting the NMS is collectively called the NMS Terminal.

The NMS Terminal is the principal system support equipment associated with the radio for system installation and commissioning.

The NMS connects to a designated NMS Terminal port (labelled Element Manager) on the front panel of the Digital Indoor Unit, by means of a serial data interface (this cable is supplied in the DIU box). It can also connect to any number of Digital Indoor Units interconnected through an IP network.

The NMS communicates with SNMP agent software that is contained in each Digital Indoor Unit. The NMS communicates with the agent's software: the software enables a unit to interpret MIB (Management Information Base) commands via SNMP (Simple Network Management Protocol).

NOTE The NMS application supplied with older MDR radios have been replaced with the Java-based Orion NMS. The older NMS does not support the Orion series radios and it is highly recommended to replace this NMS with the Orion NMS.

6.3 System requirements

The following PC system requirements apply for the Orion NMS:

- P III 450 MHz or higher CPU
- 128 MB RAM
- 20 MB Free Hard disk space
- CD-ROM Drive
- Win 98, 2000, NT or XP Operating System (Linux optional)

6.4 Installing the NMS

The NMS have been developed on the Java platform from Sun Micro Systems. This requires the installation of a Java Runtime Environment (JRE) on the PC from where the NMS will be used.

The installation files for the NMS and the JRE are provided on the installation CD that is shipped with each radio.

The supplied installation files allows the NMS to be set up on any WIN32 system (Windows 98, NT, 2000, XP). If required, a special installation can also be provided which would allow the NMS to be installed on a system using a Linux operating system.

6.4.1 JRE Installation

Complete the following steps to set up the required JRE on the required PC:

- Browse to the ***//OrionNMS/JRE*** folder in the root of the installation CD
- Execute the ***j2re-1_3_1_02-win.exe*** installation application
- Follow the user prompts in the JRE installation application to set up the JRE in the preferred folder on the PC

6.4.2 NMS Installation

After installing the JRE on the PC, complete the following steps to install the NMS on the PC:

- If a previous version of the Orion NMS have been installed on the target PC, first uninstall the older version
- Browse to the ***//OrionNMS/Setup*** folder in the root of the installation CD
- Execute the ***Plessey_OrionNMS_vXpXX.exe*** installation application
- Follow the user prompts in the NMS installation application to set up the NMS in the preferred folder on the PC

The NMS should now be installed on the target PC and should be available for selection through the Start Programs menu option.

6.4.3 NMS Un-Installation

Select the Uninstall menu item in the Orion NMS menu group from the Start Programs menu to uninstall the NMS form the PC. This action removes all installed files, menu items and register entries from the PC.

6.5 Help documentation

The HTML based help documents for the Orion NMS application is available on the installation CD at the following path: ***//OrionNMS/help/Orion NMS Help.htm***. The help document can be accessed by opening it with an Internet browser of your choice.

The help documents can also be opened from the Windows Start Menu folder created for the Orion NMS or through the ***Help|Contents*** menu in the Orion NMS application.

7 Maintenance Information

1. The user is advised to refer to the Technical Data section (paragraph 8.5.10) for details on DIU/RFU interconnection cables (customer-furnished).
2. The “Ordering Information” paragraph in the Technical Data section (paragraph 8.6) provides details on part numbers for items that can be ordered.
3. Paragraph 4 of this manual lists customer furnished equipment that should be used for installing the MDR / Orion product.
4. There are two options to control the MDR / Orion products via SNMP.
   a. One uses any open-standard-compliant SNMP Management package (HP OpenView, SNMPc etc): in this case, one has access to the full compliment of the product's MIB elements.
   b. The NMS application package supplied with the product accesses a subset of the MIB. It has a graphical user interface carefully designed to assist installation and maintenance staff.

8 Technical Data

8.1 Environmental Requirements

8.1.1 Outdoor Equipment

This specification applies to the outdoor type RFUs only.

Operating temperature:	-30°C to +60°C
Relative humidity:	8-100%
Atmospheric pressure:	0.7 to 1.06 kPa
Lightning protection	ITU-T K.20

8.1.2 Indoor Equipment

This specification applies to all indoor mounted units.

Operating temperature:	0°C to +50°C
Relative humidity:	5-90%
Lightning protection:	ITU-T K.20

8.2 Mechanical Information for Outdoor Equipment

Dimensions (HxWxD):	335mm x 231mm x 124mm
Weight:	~ 5.9 Kg

8.3 Mechanical Information for Indoor Equipment

Dimensions (HxWxD):	45mm x 480 mm x 265mm
Mounting:	19” Rack, 1U high or Table top
Weight:	~ 2.9 Kg

8.4 Power Supply Requirements

DC power supply:	21 to 56 VDC (58 VDC when indicated as such)
DC power supply grounding:	Positively or negatively grounded
Power consumption (MDR2400/5800/ Orion2410i/Orion5810i)	35 W typical, 45 W maximum.
Power consumption (Orion 5825):	35 W typical, 45 W maximum – standard power 42 W typical, 52 W maximum – high power

8.5 Electrical Performance

8.5.1 General Characteristics

MDR2400-SR and Orion2410-SRi

Frequency Range:	2400 to 2483.5 MHz
Payload Data Capacity:	T1 (1.544 Mbps/s) / E1 (2.048 Mbps) 2T1 / 2E1 4T1 / 4E1
RF Channel Bandwidth:	17 MHz
Go/Return spacing:	Can be adjusted as fixed go-return spacing. NOT mandatory in the ISM licence-free bands.
Modulation:	CCK
Processing Gain:	11 dB
Frequency Channel Plan A:	2410 and 2460 MHz
Frequency Channel Plan B:	2426 and 2476 MHz
Transmission Delay:	600 us maximum for radios only (one-way)

MDR5800-SR and Orion5810-SRi

Frequency Range:	5731 to 5844 MHz
Payload Data Capacity:	T1 (1.544 Mbps/s) / E1 (2.048 Mbps) 2T1 / 2E1 4T1 / 4E1
RF Channel Bandwidth:	17 MHz
Go/Return spacing:	Can be adjusted as fixed go-return spacing. NOT mandatory in the ISM licence-free bands.
Modulation:	CCK
Processing Gain:	11 dB
Frequency Channel Plan A:	5735 and 5804 MHz
Frequency Channel Plan B:	5753 and 5822 MHz
Frequency Channel Plan C:	5771 and 5840 MHz
Transmission Delay:	600 us maximum for radios only (one-way)

Orion 5825-SR

Frequency Range:	5731 to 5844 MHz
Payload Data Capacity:	• 1 - 4T1 (1.544 Mbps/s) / 1 - 4E1 (2.048 Mbps) (2.6MHz BW) • 1 - 8T1 (1.544 Mbps/s) / 1 - 8E1 (2.048 Mbps) (5.4MHz, 8.0MHz BW)
RF Channel Bandwidth:	2.6MHz
(Selectable)	5.4MHz
	8.0MHz
Go/Return spacing:	Can be adjusted as fixed go-return spacing. NOT mandatory in the ISM licence-free bands.
Modulation:	16-QAM
Frequency Channel Plan A:	5731 and 5801 MHz (2.6MHz BW) 5732 and 5802 MHz (5.4MHz BW) 5734 and 5804 MHz (8.0MHz BW)
Frequency Channel Plan B:	5752 and 5822 MHz (all bandwidths)
Frequency Channel Plan C:	5774 and 5844 MHz (2.6MHz BW) 5773 and 5843 MHz (5.4MHz BW) 5771 and 5841 MHz (8.0MHz BW)
Transmission Delay:	600 us maximum for radios only (one-way)

8.5.2 Transceiver Characteristics

8.5.2.1 Frequency Band: MDR2400 and Orion2410i Lowband RF Units

Transmit band:	2410 – 2426 MHz (Centre frequency)
Receive band:	2458 – 2474 MHz (Centre frequency)

8.5.2.2 Frequency Band: MDR2400 and Orion2410i Highband RF Units

Transmit band:	2458 – 2474 MHz (Centre frequency)
Receive band:	2410 – 2426 MHz (Centre frequency)

8.5.2.3 Frequency Band: MDR5800 and Orion5810i Lowband RF Units

Transmit band:	5725 – 5787 MHz (Band edge)
Receive band:	5787 – 5850 MHz (Band edge)

8.5.2.4 Frequency Band: MDR5800 and Orion5810i Highband RF Units

Transmit band:	5787 – 5850 MHz (Band edge)
Receive band:	5725 – 5787 MHz (Band edge)

8.5.2.5 Frequency Band: Orion 5850 Lowband RF Units

Transmit band:	5731 – 5774 MHz (Center frequency)
Receive band:	5801 – 5844 MHz (Center frequency)

8.5.2.6 Frequency Band: Orion 5850 Highband RF Units

Transmit band:	5801 – 5844 MHz (Center frequency)
Receive band:	5731 – 5774 MHz (Center frequency)

8.5.3 RF Interface

Transmitted Power	+2 to+24 dBm – MDR2400, MDR5800, Orion2410i +2 to+25 dBm – Orion5810i +2 to +24 dBm – Orion 5850 high output power, software adjustable (incl. mute)
Receiver Sensitivity:	Up to 4T1/4E1 : -88dBm for BER = 10^{-6} (MDR2400) -86dBm for BER = 10^{-6} (MDR5800) Up to 8T1/E1 : Orion 5850, 16 QAM -88dBm for BER = 10^{-6} (2.6 MHz BW) -85dBm for BER = 10^{-6} (5.4 MHz BW) -83dBm for BER = 10^{-6} (8 MHz BW)
Maximum Receive Level:	-30dBm

8.5.4 Payload Data Interfaces

8.5.4.1 1, 2, 4 or 8 (i.e. nE1) Interface

Data Rate:	Full duplex E1 (2.048Mbit/s), 2E1, 4E1 or 8E1
Digital Interface:	ITU-T G.703
Connectors:	Balanced 110 ohm on DB25 Balanced 110 ohm on RJ45 (Orion DIU only) Unbalanced 75 ohm on BNC's (Available on one of the MDR DIU variants)
Line code:	HDB3 or AMI selectable, refer to Section 2.3.1
Jitter and Wander:	ITU-T G.823

8.5.4.2 1, 2, 4 or 8 (i.e. nT1) Interface

Data Rate:	Full duplex T1 (1.544Mbit/s), 2T1, 4T1 or 8T1
Digital Interface:	DSX-1, G.703 compliant
Connectors:	Balanced 110 ohm on DB25 Balanced 110 ohm on RJ45 (Orion DIU only) Unbalanced 75 ohm on BNC's (Available on one of the MDR DIU variants)
Line code:	AMI or B8ZS selectable, refer to Section 2.3.1
Jitter and Wander:	ITU-T G.823

8.5.5 Ethernet Traffic Interface

Data Rate:	< 8 Mbps Half / full duplex software selectable (Refer to Chapter G, page 114)
Digital Interface:	10 BaseT, Half / full duplex, DTE
Connector:	RJ45

8.5.6 Auxiliary Input Interface (CONTACT CLOSURE)

Number of Inputs:	2
Maximum voltage:	12V
Logical zero:	Short from input to return pin
Logical one:	Open input to return pin

8.5.7 Auxiliary Output Interface

Number of outputs:	2
States:	Normally-open and normally-closed
Contact rating:	DC: 220 V, 1 A, 60 W
	AC: 250 V, 1 A, 125 VA

8.5.8 Wayside channel interface

Interface standard:	RS232, DCE
Handshaking:	None, Hardware
Port rate:	115,200 bps

8.5.9 Element Manager Port Interface

Interface standard:	RS232, DTE
Handshaking:	Hardware
Data rate:	115,200 bps

8.5.10 Indoor/RF Unit Interface

The physical interface between the Indoor and RF Unit is IEEE802.3 Ethernet. As such, the same considerations that apply between standard routers/switches/hubs and PC LAN cards should be adhered to when selecting lengths of cables between the RFU and the DIU. Cable lengths of up to 120 meters have been tested in a laboratory environment.

The following table lists information to assist the user to select cables to be used between the Indoor and RF Units.

Interconnecting cable Data	
South Africa STP (FTP) 4 Pairs Solid Cat 5, PVC FR UV protected Polifin H2/J263/904 Outer Black. Outer diameter of cable : 7.3mm ± 0.5mm. (this is an "upjacketed" STP 4 Pair cable).	This is a standard FTP Cat 5 cable that is 'upjacketed' with suitable plastic for FR/UV (Flame retardant/Ultra Violet) protection.
Other cables: 1. Superior Essex BBDN CAT 5 cable P/N 04-0010-34 (7.8mm) 2. Superior Essex CAT 5 P/N 18-241-31 18-241-11 (5.1mm) 3. General Cable CAT 5 P/N 2137113 2137114 (5.6mm) 4. Belden CAT 5 P/N BC1002 (6.0mm) Option 1 is the preferred choice. For the cables that have diameters less the required OD, one can use one or two pieces of heatshrink on the cable where it passes through the gasket.	
Interconnecting cable Power	
South Africa Power 1.5mm sq stranded PVC Insulated, PVC FR UV protected Polifin H2/J263/904 Outer Black 300/500V Temp -20°C to +85°C. Cable outer diameter: between 7.4mm and 9mm i.e. 8.2mm ± 0.8mm.	
Other cables: Superior Essex type SJOOW flexible cable P/N 441821* (7.4mm) Carol Cable (General Cable) SJOW/SJO P/N 02001 18 gauge 2 conductor (7.8mm)	

8.6 Ordering Information

To confirm the correct order numbers, please visit www.plesseybbw.com/download.htm to download an "Order Number Generator" utility.

Part No	Model Number	Description
651-03994-01-H1 or **651-03994-01-L1**	**MDR2400-ET1**	MDR2400 Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low Band RF Unit, Type-N RF output, high power output, Full T1/E1, 2Mbps or 1.5Mbps data interface
651-04106-01-H1 or **651-04106-01-L1**		As above with 75 Ohm, BNC unbalanced payload also available.
651-03994-01-H2 or **651-03994-01-L2**	**MDR2400-ET2**	MDR2400 Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 2xT1/2xE1, 2x2Mbps or 2x1.5Mbps data interface
651-04106-01-H2 or **651-04106-01-L2**		As above with 75 Ohm, BNC unbalanced payload also available.
651-03994-01-H4 or **651-03994-01-L4**	**MDR2400-ET4**	MDR2400 Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 4xT1/4xE1, 4x2Mbps or 4x1.5Mbps data interface
651-04106-01-H4 or **651-04106-01-L4**		As above with 75 Ohm, BNC unbalanced payload also available.

The MDR2400 operates from 21-56VDC (58VDC if indicated as such), optional 110-220VAC power supply available below.
A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB).

Part No	Model Number	Description
651-04318-02-H1 or **651-04318-02-L1**	**Orion5810-SRi ET1**	Orion5810-SRi Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 1xT1/4xE1, 1x2Mbps or 1x1.5Mbps data interface
651-04318-02-H2 or **651-04318-02-L2**	**Orion5810-SRi ET2**	Orion5810-SRi Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 2xT1/4xE1, 2x2Mbps or 2x1.5Mbps data interface
651-04318-02-H4 or **651-04318-02-L4**	**Orion5810-SRi ET4**	Orion5810-SRi Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 4xT1/4xE1, 4x2Mbps or 4x1.5Mbps data interface

The Orion5810-SRi operates from 21-56VDC (58VDC if indicated as such), optional 110-220VAC power supply available below.
A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB).

Part No	Model Number	Description
651-04317-01-H1 or **651-04317-01-L1**	**Orion2410-SRi ET1**	Orion2410-SRi Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 1xT1/4xE1, 1x2Mbps or 1x1.5Mbps data interface

651-04317-01-H2 or **651-04317-01-L2**	**Orion2410-SRi ET2**	Orion2410-SRi Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 2xT1/4xE1, 2x2Mbps or 2x1.5Mbps data interface
651-04317-01-H4 or **651-04317-01-L4**	**Orion2410-SRi ET4**	Orion2410-SRi Radio: Digital Indoor Unit (DB25 balanced payload) and High or Low band RF Unit, Type-N RF output, high power output, Full 4xT1/4xE1, 4x2Mbps or 4x1.5Mbps data interface

The Orion2410-SRi operates from 21-56VDC (58VDC if indicated as such), optional 110-220VAC power supply available below.
A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB).

Part No	Model Number	Description
651-04253-01-H08 or **651-04253-01-L08**	**Orion5825-ET8**	High Power (24 dBM) Orion5825 Radio: Digital Indoor Unit and High or Low Band RF Unit, Type-N RF output, Full 8xT1/8xE1, 8x2Mbps or 8x1.5Mbps data interface

The Orion 5825 operates from 21-56VDC (58VDC if indicated as such), optional 110-220VAC power supply available below.

A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB).

Accessories & Upgrades

Part Number	Description
651-04226	MDR2400SR, MDR5800SR, Orion2410SRi and Orion5810SRi 1+1 hot standby combiner/splitter (4-tribs)
651-04227	ORION 5825 1+1 hot standby combiner/splitter (8-tribs)
651-03864	Bench Power Supply 110-220VAC to 24VDC
651-07865	19" Rack Mount for Outdoor RF Unit (4u high)
651-03865	MDR Digital Indoor Unit Upgrade 1xT1/E1 to 2xT1/E1
651-03866	MDR Digital Indoor Unit Upgrade 2xT1/E1 to 4xT1/E1
651-03867	MDR Digital Indoor Unit Upgrade 1xT1/E1 to 4xT1/E1
651-04251	MDR / Orion NMS Software CD - Spare Part
651-03809	RFU Pole Mounting Kit - Spare Part
862-01881	MDR / Orion Digital Radio System User Manual - Spare Part
660-03405	MDR / Orion Cable Assembly: RSSI Test Loom - Spare Part
660-03770	Digital Indoor Unit to Indoor RF Unit power and data cable – Spare Part

The MDR and Orion systems use standard CAT5 Ethernet cable and RJ-45 connectors for connecting the Digital Indoor Unit to the RF Unit. A two-wire power cable is also required between the Digital Indoor Unit and the RF Unit.

NOTE Screened CAT-5 cable (for noise immunity) and UV resistant cables (for long-term outdoor use) are required to meet FCC EMC emission standards for this type of product.

Spare Parts for MDR2400, MDR5800, Orion2410i, Orion5810i and Orion 5825 radios

Part Number	Description
651-04104-02-1	MDR MTE Digital Indoor Unit 1xT1/E1 - Spare Part
651-04104-02-2	MDR MTE Digital Indoor Unit 2xT1/E1 - Spare Part
651-04104-02-4	MDR MTE Digital Indoor Unit 4xT1/E1 - Spare Part
651-04105-02-1	MDR MTE 75/120 OHM Digital Indoor Unit (BNC) 1xT1/E1 - Spare Part
651-04105-02-2	MDR MTE 75/120 OHM Digital Indoor Unit (BNC) 2xT1/E1 - Spare Part
651-04105-02-4	MDR MTE 75/120 OHM Digital Indoor Unit (BNC) 4xT1/E1 - Spare Part
651-04316-01-1	Orion 10 Digital Indoor Unit 1xT1/E1
651-04316-01-2	Orion 10 Digital Indoor Unit 2xT1/E1
651-04316-01-4	Orion 10 Digital Indoor Unit 4xT1/E1
651-04231-01-08	Orion 25 Digital Indoor Unit 8xT1/E1
651-03806-02L	MDR5800 Low Band Outdoor RF Unit - Spare Part
651-03806-02H	MDR5800 High Band Outdoor RF Unit - Spare Part
651-03905-01L	MDR2400 Low Band Outdoor RF Unit - Spare Part
651-03905-01H	MDR2400 High Band Outdoor RF Unit - Spare Part
651-04299-02.1L	Orion5810i Low Band Indoor RF Unit - Spare Part
651-04299-02.1H	Orion5810i High Band Indoor RF Unit - Spare Part
651-04307-01.1L	Orion2410i Low Band Indoor RF Unit - Spare Part
651-04307-01.1H	Orion2410i High Band Indoor RF Unit - Spare Part
651-04255-01L	Orion 5850 Low Band RF Unit - Spare Part
651-04255-01H	Orion 5850 High Band RF Unit - Spare Part

MDR2400 Ordering Information:

Part no's:
1T1/E1 Radio: 651-03994-01-H1 or 651-03994-01-L1
2T1/E1 Radio: 651-03994-01-H2 or 651-03994-01-L2
4T1/E1 Radio: 651-03994-01-H4 or 651-03994-01-L4

Each **MDR2400** radio includes the following:

Part No	Description	QTY
651-04104-02-1 or 651-04104-02-2 or 651-04104-02-4	MDR Digital Indoor Unit: 1xT1/E1or 2xT1/E1 or 4xT1/E1, 120 Ohm	1
651-03905-01H or 651-03905-01L	MDR2400 ET4 RF Unit	1
651-03809	MDR 5800 RFU Pole Mounting Kit	1
862-01881	MDR / Orion Digital Radio System User Manual	1
651-04252	NMS Software CD	1
660-03405	RSSI Cable	1

It is possible to purchase upgrades for T1/E1 Digital Indoor Units (upgrades to 2T1/E1 or 4T1/E1). The user contacts the factory or distributor and provides the Digital Indoor Unit Bar Code number details. The factory then supplies a "Tributary Code", unique to the Digital Indoor Unit, which is entered using the MIB (MDR v.1 & 2+ and Orion products) or using the NMS (v. 2+ and Orion products).

MDR5800 Ordering Information:

Part no's:
1T1/E1 Radio: 651-03853-02-H1 or 651-03853-02-L1
2T1/E1 Radio: 651-03853-02-H2 or 651-03853-02-L2
4T1/E1 Radio: 651-03853-02-H4 or 651-03853-02-L4

Each **MDR5800** radio includes the following:

Part No	Description	QTY
651-04104-02-1 or 651-04104-02-2 or 651-04104-02-4	MDR Digital Indoor Unit: 1xT1/E1or 2xT1/E1 or 4xT1/E1, 120 Ohm	1
651-03806-02H or 651-03806-02L	MDR5800 RF Unit	1
651-03809	MDR 5800 RFU Pole Mounting Kit	1
862-01881	MDR / Orion Digital Radio System User Manual	1
651-04252	NMS Software CD	1
660-03405	RSSI Cable	1

It is possible to purchase upgrades for T1/E1 Digital Indoor Units (upgrades to 2T1/E1 or 4T1/E1). The user contacts the factory or distributor and provides the Digital Indoor Unit Bar Code number details. The factory then supplies a "Tributary Code", unique to the Digital Indoor Unit, which is entered using the MIB (MDR v.1 & 2+ and Orion products) or using the NMS (v. 2+ and Orion products).

ORION5810-SRi Ordering Information:

Part no's:
1T1/E1 Radio: 651-04318-02-H1 or 651-04318-02-L1
2T1/E1 Radio: 651-04318-02-H2 or 651-04318-02-L2
4T1/E1 Radio: 651-04318-02-H4 or 651-04318-02-L4

Each **Orion5810-SRi** radio includes the following:

Part No	Description	QTY
651-04104-02-1 or 651-04104-02-2 or 651-04104-02-4	MDR Digital Indoor Unit: 1xT1/E1or 2xT1/E1 or 4xT1/E1, 120 Ohm	1
651-04299-02H or 651-04299-02L	Orion5810i Indoor RF Unit	1
862-01881	MDR / Orion Digital Radio System User Manual	1
651-04252	NMS Software CD	1
660-03405	RSSI Cable	1
660-03770	Digital Indoor Unit to Indoor RF Unit power and data cable	1

It is possible to purchase upgrades for T1/E1 Digital Indoor Units (upgrades to 2T1/E1 or 4T1/E1). The user contacts the factory or distributor and provides the Digital Indoor Unit Bar Code number details. The factory then supplies a "Tributary Code", unique to the Digital Indoor Unit, which is entered using the MIB (MDR v.1 & 2+ and Orion products) or using the NMS (v. 2+ and Orion products).

ORION2410-SRi Ordering Information:

Part no's:
1T1/E1 Radio: 651-04317-01-H1 or 651-04317-01-L1
2T1/E1 Radio: 651-04317-01-H2 or 651-04317-01-L2
4T1/E1 Radio: 651-04317-01-H4 or 651-04317-01-L4

Each **Orion2410-SRi** radio includes the following:

Part No	Description	QTY
651-04104-02-1 or 651-04104-02-2 or 651-04104-02-4	MDR Digital Indoor Unit: 1xT1/E1or 2xT1/E1 or 4xT1/E1, 120 Ohm	1
651-04307-01H or 651-04307-01L	Orion2410i Indoor RF Unit	1
862-01881	MDR / Orion Digital Radio System User Manual	1
651-04252	NMS Software CD	1
660-03405	RSSI Cable	1
660-03770	Digital Indoor Unit to Indoor RF Unit power and data cable	1

It is possible to purchase upgrades for T1/E1 Digital Indoor Units (upgrades to 2T1/E1 or 4T1/E1). The user contacts the factory or distributor and provides the Digital Indoor Unit Bar Code number details. The factory then supplies a "Tributary Code", unique to the Digital Indoor Unit, which is entered using the MIB (MDR v.1 & 2+ and Orion products) or using the NMS (v. 2+ and Orion products).

Orion 5825-SR Ordering Information:

Part no's:
8T1/E1 Radio: 651-04253-01-H08 or 651-04253-01-L08

Each **Orion 5825** radio includes the following:

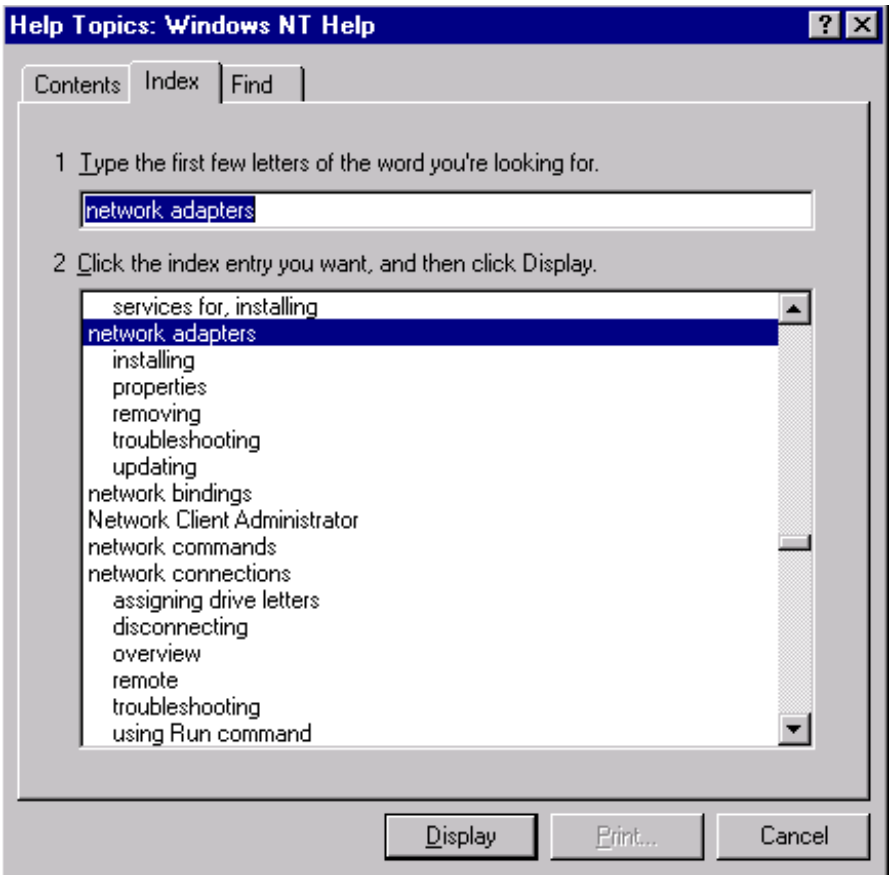
Part No	Description	QTY
651-04231-01-08	Orion 25 Digital Indoor Unit: 8xT1/E1	1
651-04255-01H or 651-04255-01L	Orion 5850 RF Unit	1
651-03809	MDR / Orion RFU Pole Mounting Kit	1
862-01881	MDR / Orion Digital Radio System User Manual	1
651-04252	NMS Software CD	1
660-03405	RSSI Cable	1

A Appendix: Element Manager Port Point-to-Point Serial Communications Setup

This appendix summarises how to set up a network connection (using PPP) between a computer and the MDR / Orion DIU's Element Manager port. It lists how the connection can be setup and configured to allow data transfer and SNMP-based control of the MDR / Orion DIU.

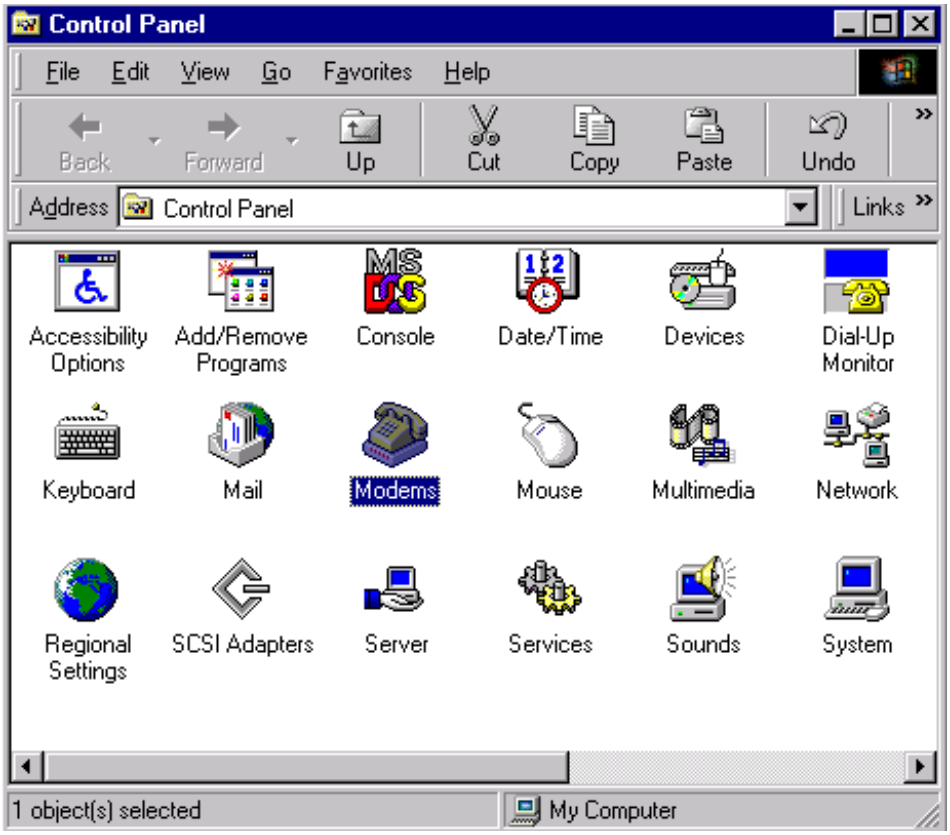
Note : For both NT and Win 95 or 98 machines, check that a Network Adapter is installed.

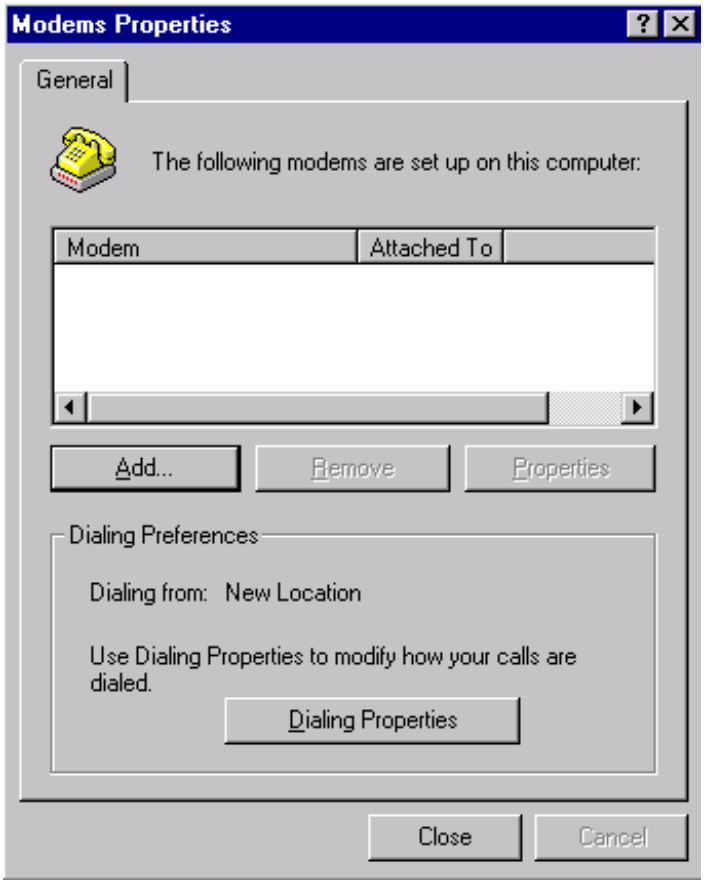
The following screen capture shows the Windows help available to assist setting up a serial comms network adapter.

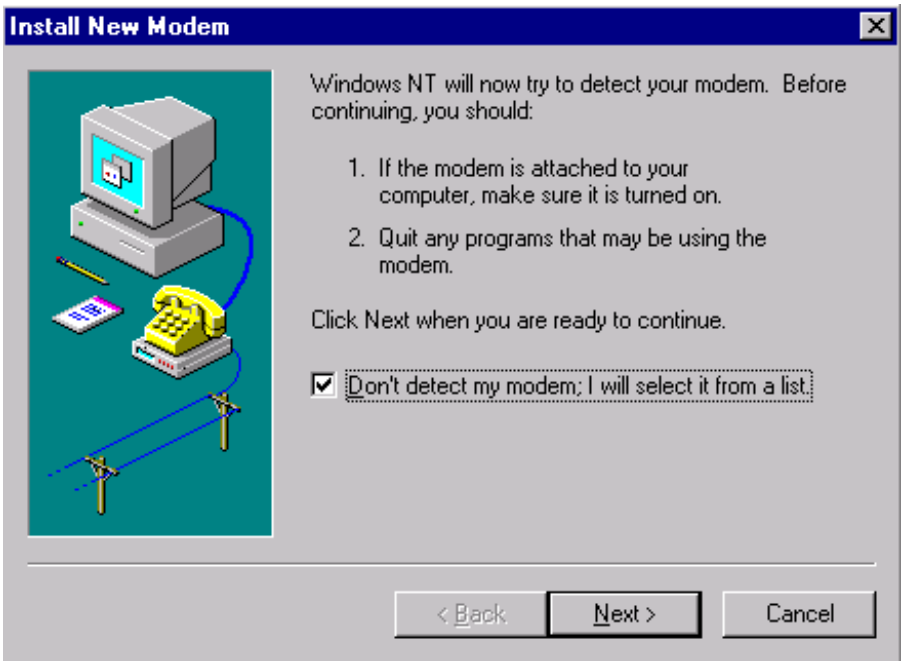


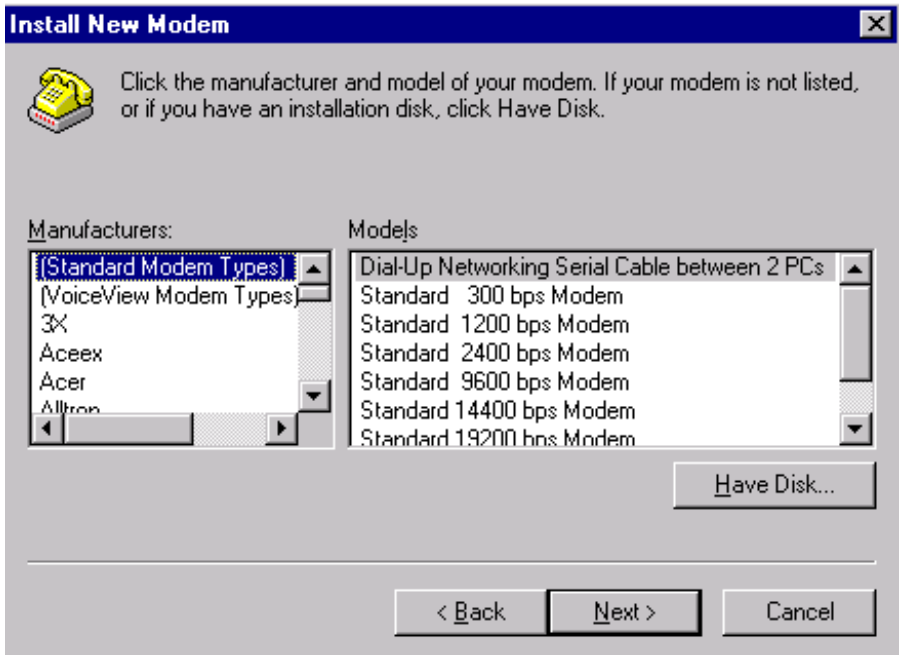
A.1 Adding a Modem : Windows NT

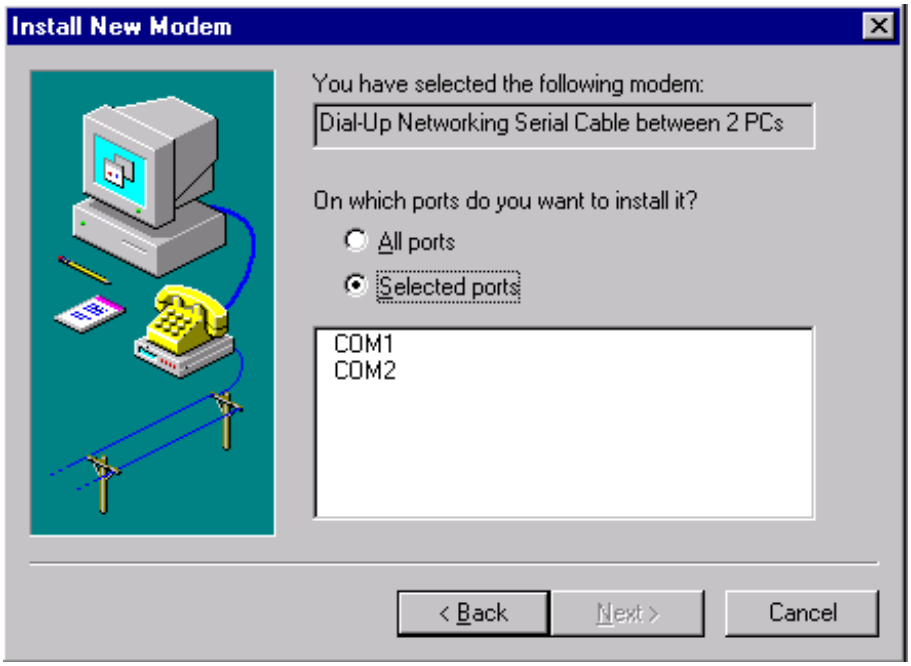
1. When working with a PC running a Windows NT, add a modem using the following screen as a guideline.


Control Panel
File Edit View Go Favorites Help
Back Forward Up Cut Copy Paste Undo
Address Control Panel
Links
Accessibility Options
Add/Remove Programs
Console
Date/Time
Devices
Dial-Up Monitor
Keyboard
Mail
Modems
Mouse
Multimedia
Network
Regional Settings
SCSI Adapters
Server
Services
Sounds
System
1 object(s) selected
My Computer

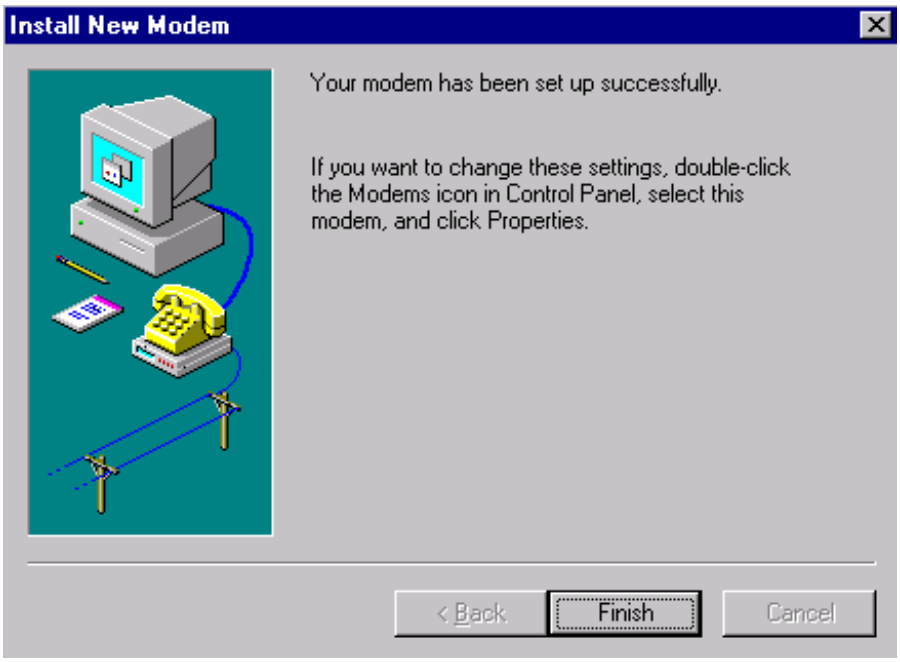

Modems Properties
General
The following modems are set up on this computer:
Modem
Attached To
Add...
Remove
Properties
Dialing Preferences
Dialing from: New Location
Use Dialing Properties to modify how your calls are dialed.
Dialing Properties
Close
Cancel


Install New Modem
Windows NT will now try to detect your modem. Before continuing, you should:
1. If the modem is attached to your computer, make sure it is turned on.
2. Quit any programs that may be using the modem.
Click Next when you are ready to continue.
Don't detect my modem; I will select it from a list.
< Back
Next >
Cancel





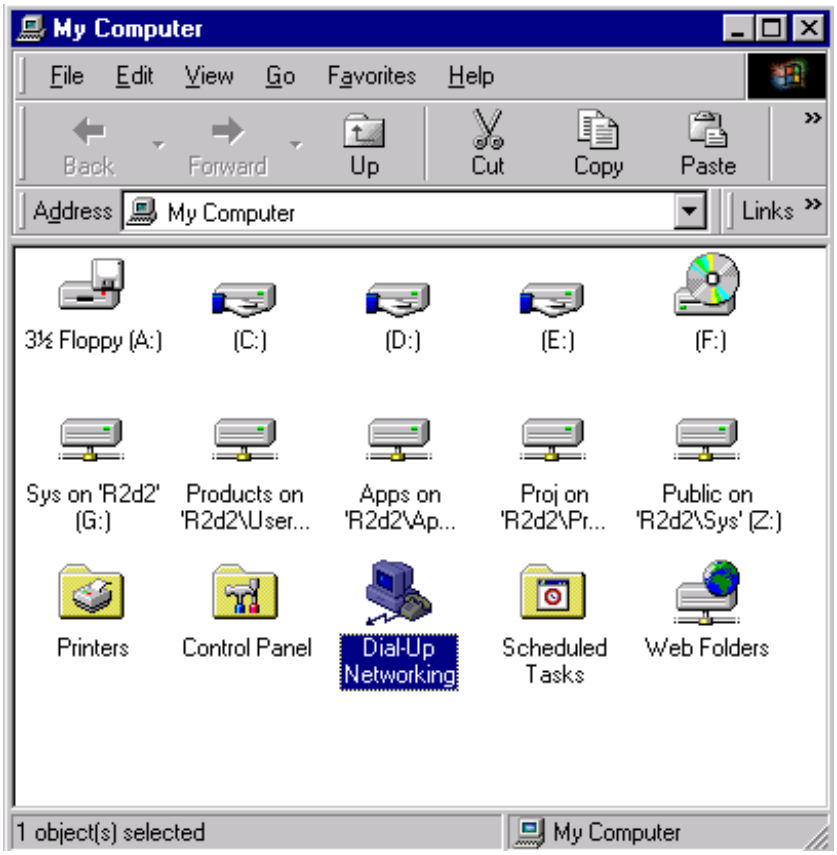
2. Select the COM port to use – push the Next when the COM port has been selected.


Install New Modem
Your modem has been set up successfully.
If you want to change these settings, double-click the Modems icon in Control Panel, select this modem, and click Properties.
< Back
Finish
Cancel

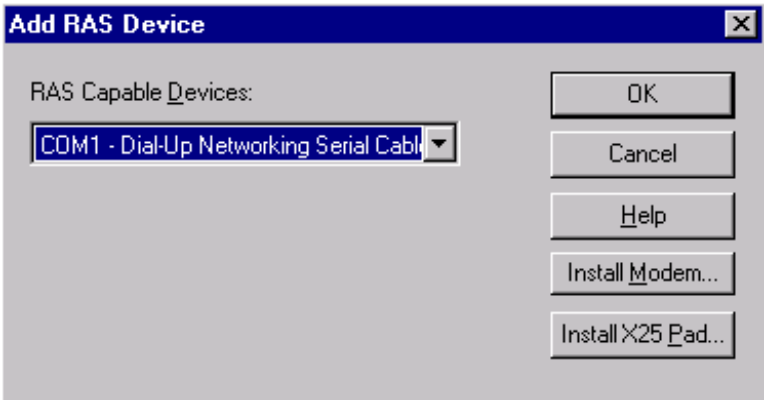
A.2 Adding Dial-up Networking : Windows NT

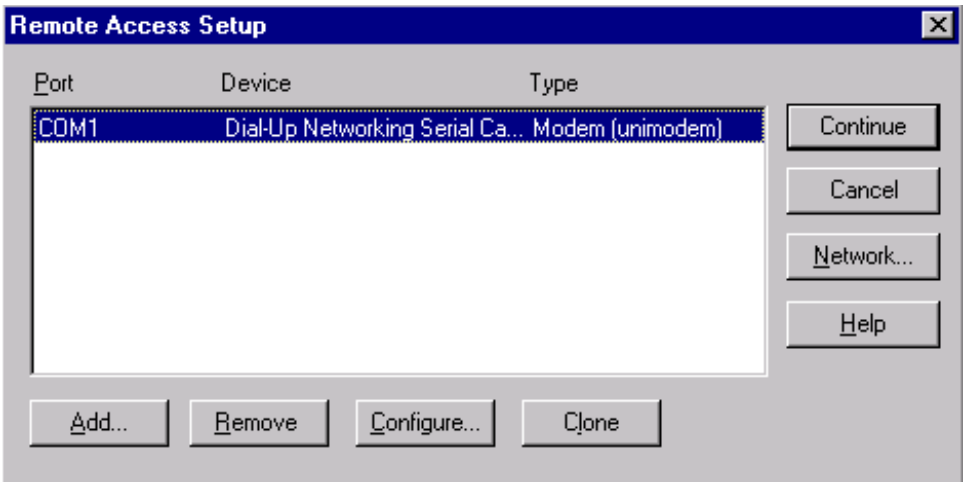
A.2.1 To add dial-up networking

1. From the desktop, open the My Computer icon and double-click the **Dial-up Networking** icon.

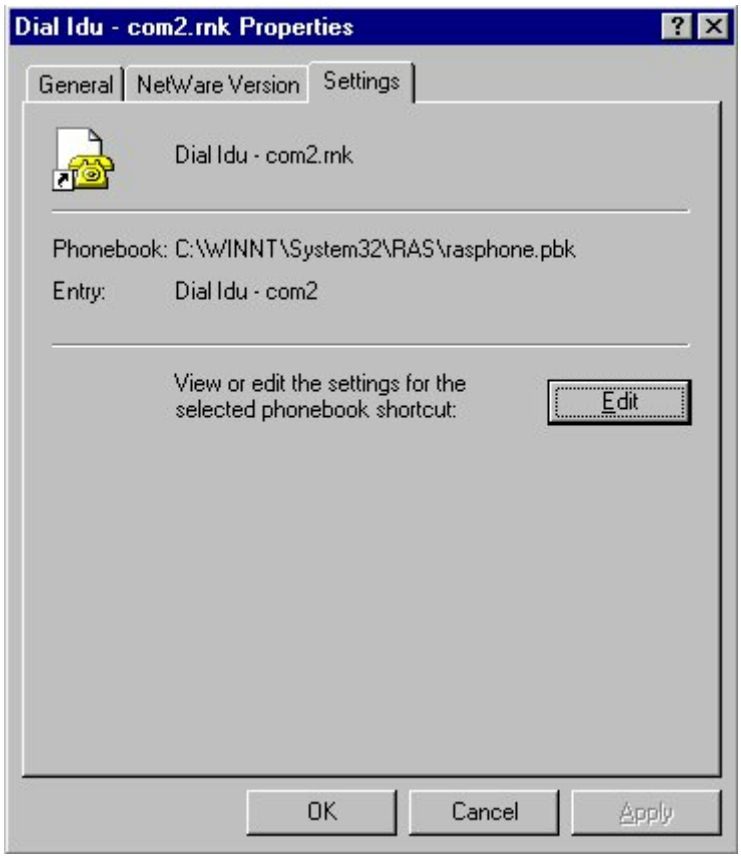


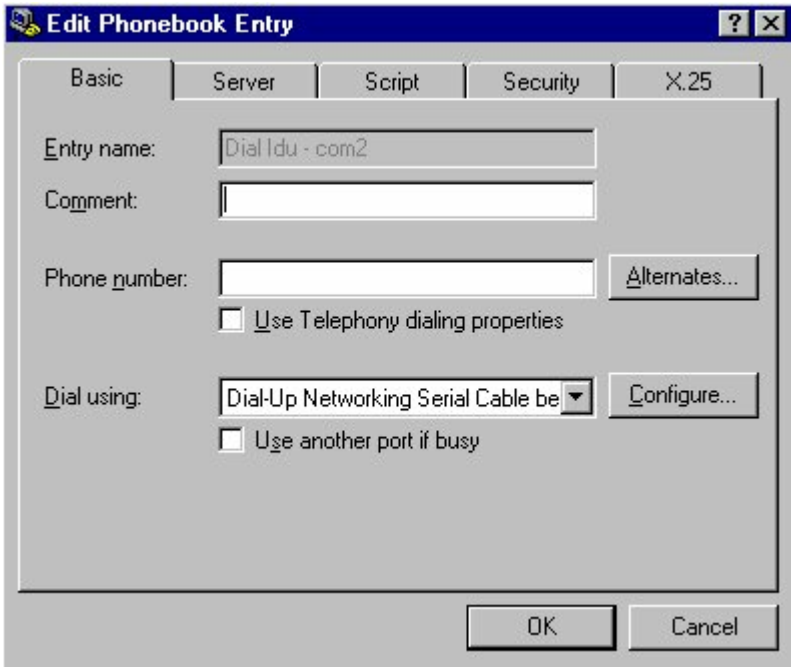
2. The following windows are displayed:

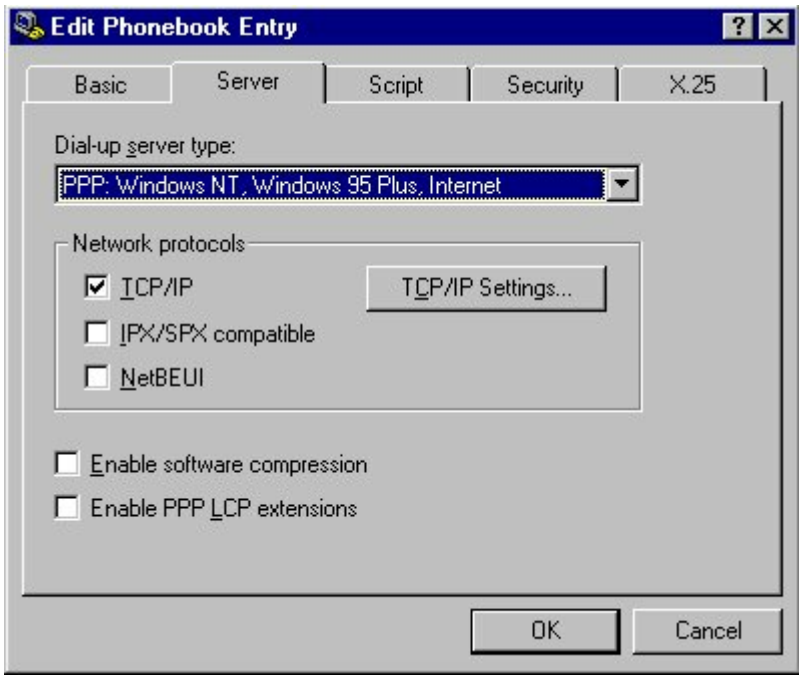


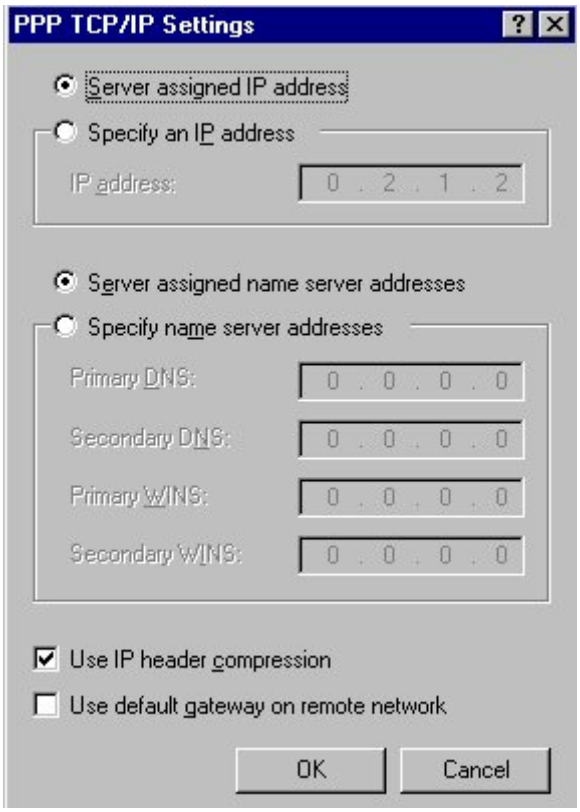


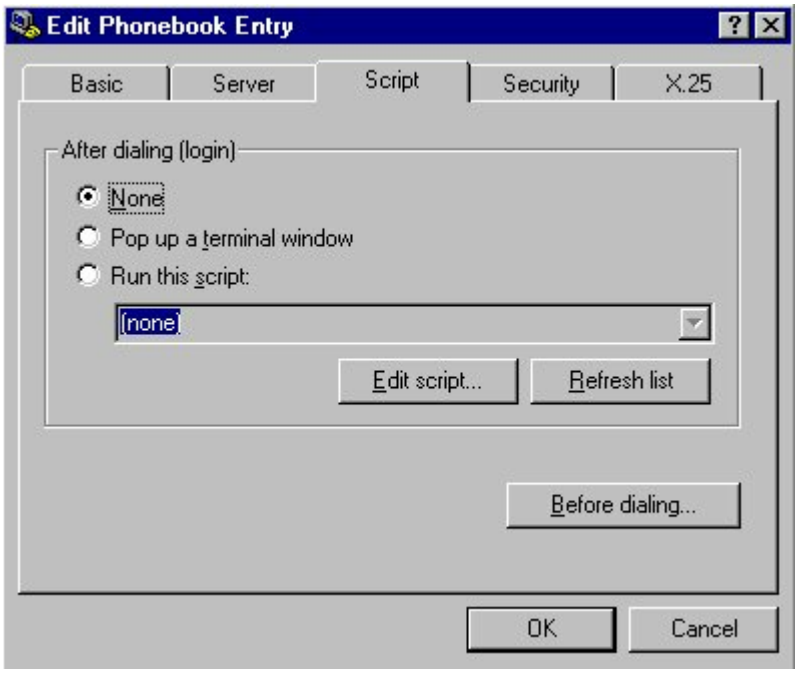
3. Whether COM1 or COM2 is selected, setup the connection using the following screens as a guideline. This allows establishment of a PPP connection between the computer and the DIU's Element Manager port.

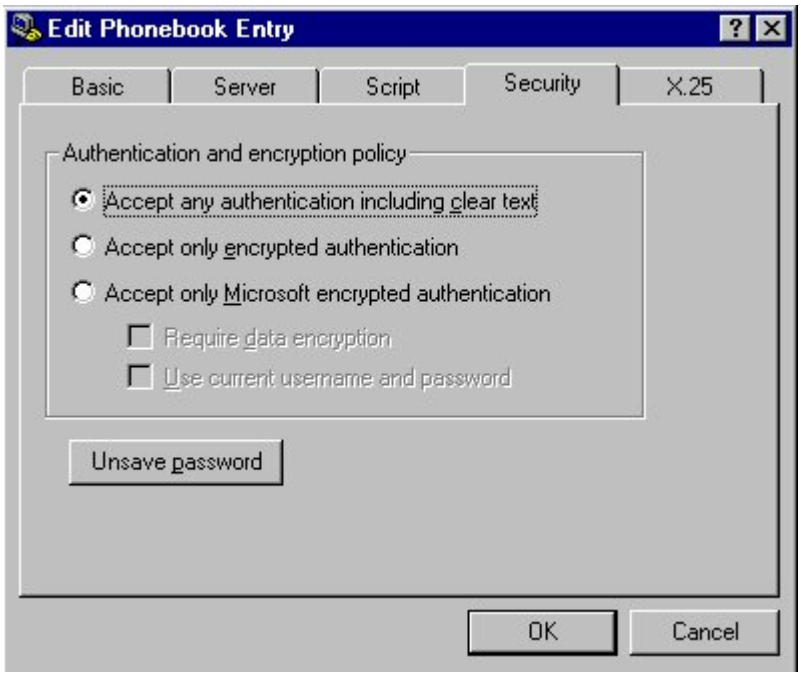



Edit Phonebook Entry
Basic
Server
Script
Security
X.25
Entry name:
Dial Idu - com2
Comment:
Phone number:
Alternates...
Use Telephony dialing properties
Dial using:
Dial-Up Networking Serial Cable be
Configure...
Use another port if busy
OK
Cancel


Edit Phonebook Entry
Basic
Server
Script
Security
X.25
Dial-up server type:
PPP: Windows NT, Windows 95 Plus, Internet
Network protocols
TCP/IP
TCP/IP Settings...
IPX/SPX compatible
NetBEUI
Enable software compression
Enable PPP LCP extensions
OK
Cancel

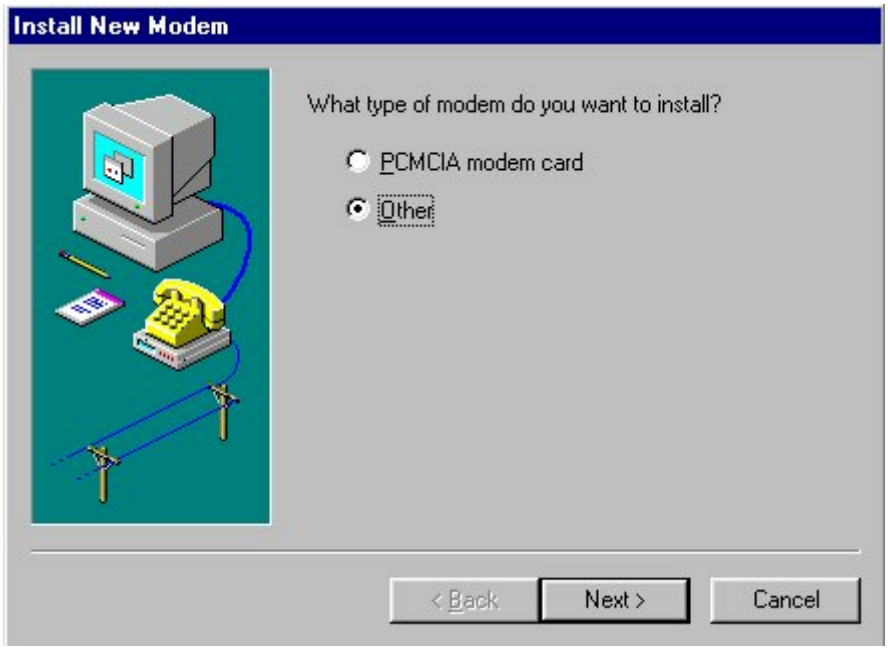

PPP TCP/IP Settings
Server assigned IP address
Specify an IP address
IP address:
0 . 2 . 1 . 2
Server assigned name server addresses
Specify name server addresses
Primary DNS:
0 . 0 . 0 . 0
Secondary DNS:
0 . 0 . 0 . 0
Primary WINS:
0 . 0 . 0 . 0
Secondary WINS:
0 . 0 . 0 . 0
Use IP header compression
Use default gateway on remote network
OK
Cancel

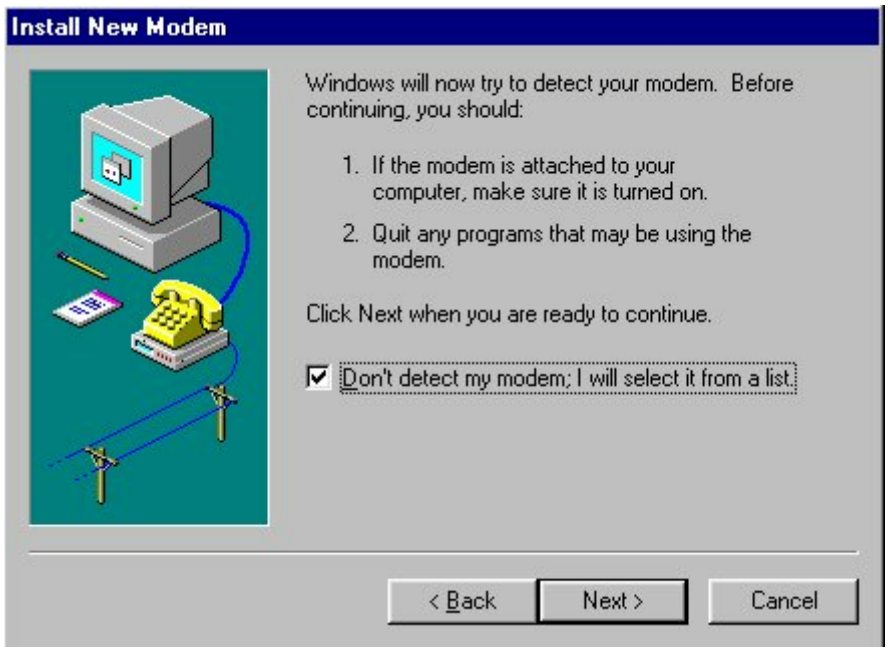

Edit Phonebook Entry
Basic
Server
Script
Security
X.25
After dialing (login)
None
Pop up a terminal window
Run this script:
(none)
Edit script...
Refresh list
Before dialing...
OK
Cancel


Edit Phonebook Entry
Basic
Server
Script
Security
X.25
Authentication and encryption policy
Accept any authentication including clear text
Accept only encrypted authentication
Accept only Microsoft encrypted authentication
Require data encryption
Use current username and password
Unsave password
OK
Cancel

A.3 Adding a Modem : Windows 95/98

1. When working with a PC running a Windows 95/98, add a modem using the following screen as a guideline.





3. Use the mdrnull.inf to add a serial cable modem connection capability to the PC or laptop.