APPENDIX F: USER MANUAL

Please refer to the following pages.

Velox LE
Installation and Operation Manual

stratex NETWORKS

Velox LE User Manual

862-02411 February 2004

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Federal Communications Commission Notice

The equipment has been tested and found to comply with the limits for Class A, digital device, 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 unauthorised 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 Velox LE 2410 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 centre frequencies of the Velox LE 5850 radio is limited by firmware between 5731MHz and 5844MHz as outlined in Velox LE 5850 and Velox LE 5850i Frequency Channels Plan A, B and C (FCC Compliant) on page 8-6 and Velox LE 2450 and Velox LE 2450i Frequency Channels Plan A, B and C (FCC Compliant) on page 8-7 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:

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

NOTE 3 The centre frequencies of the Velox LE 5810i radio is limited by firmware between 5735MHz and 5840MHz as outlined in Table 2-5 on page 2-3 and the transmit power is limited to +25dBm. The device must only be used with the antenna listed below to comply with FCC standards:

- 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 antenna impedance required 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 web site: www.hc-sc.gc.ca/rpb

ETSI Notice

Transmit power has been limited to +20 dBm EIRP for use in ETSI regulated areas.

Contents

Velox LE Installation and Operation Manual 1

Chapter 1 : About this Manual 1-1

Welcome 1-1
Purpose 1-1
Intended Audience 1-1
What You Need To Know 1-1
Organization 1-2
Associated Documents 1-2
Conventions and Terminology 1-2
Abbreviations 1-3
Support 1-4

Chapter 2 : Planning 2-1

Introduction 2-1
System Type Selection 2-1
Antenna Selection 2-2
General 2-2
Fixed Antennas 2-3
Site Evaluation 2-3
Multipath Effects 2-4
Interference Considerations 2-4
Microcell Backhaul Applications of Velox LE Digital Radios 2-5
General 2-5
Transmitted Power Levels 2-5
Frequency Multiplexing 2-6
Antenna Isolation 2-6

Chapter 3 : Controls, Indicators and Connectors on the DIU and RFU 3-1

Introduction 3-1
Control, Indicators and Connectors on the DIU 3-1
General 3-1
Payload T1/E1 Connectors (1) 3-3
DIU Status Diodes (2) 3-6
Reset/Configuration Button (3) 3-7
Service (Wayside) Serial Data Channel (4) 3-8
Element Manager Port (5) 3-9
10Base-T Ethernet RJ45 Port (10/100Base-T on Velox LE 50 DIU) (6) 3-9
DIU/RFU Link LED (7) 3-9
DIU/RFU Data (8) 3-10
RFU DC Out (9) 3-10
Auxiliary I/O (10) 3-10
DIU DC Power Input (11) 3-11
Fuse Holder (12) 3-12
On/Off Switch (13) 3-12
Ground Terminal (14) 3-12
Indicators and Connectors on the IRFU and ORFU 3-13
General 3-13
Antenna Connector (1) 3-13
RSSI (2) 3-14
DIU COMMS 3-14
DIU/RFU Data (3) 3-14
DIU Power 3-14
DIU DC In (4) 3-14
Ground Terminal (5) 3-15

Chapter 4 : Hardware Installation 4-1

Introduction 4-1
Health and Safety 4-1
Velox LE Health and Safety Requirements 4-1
General Health and Safety 4-1
Operator Health and Safety 4-2
General Hazards 4-2
Hardware Installation Overview 4-5
Pre-Installation 4-6
General 4-6
Installation Tools and Equipment 4-6
Unpacking the Equipment 4-8
Bench Set-up (First time users) 4-10
Getting started (Without a PC) 4-10
Getting Started (with a PC) 4-12
Site Installation 4-15
Installing the Antenna 4-16
Installing the ORFU 4-16
Installing the IRFU 4-19
Installing the DIU 4-19
Installing the DIU to RFU Data and Power Cables 4-21
Commissioning 4-22
General 4-22
Equipment Required for Commissioning 4-22
Information Required 4-22
Antenna Alignment 4-23
Diagnostics (Loopback Modes) 4-26

Chapter 5 : NCT Installation 5-1

Connecting to the Velox LE 5-1
NCT Software Installation 5-1
Scope 5-1
Introduction 5-1
System Requirements 5-2
Installing the NCT 5-2
Configure Radio using NCT 5-3

Chapter 6 : NCT PC Set-up 6-1

Element Manager Point-to-Point Protocol Serial Communications Set-up 6-1
Introduction 6-1
Adding Dial-up Networking : Windows 2000 6-1
Adding Dial-up Networking : Windows XP 6-2
Set-up of Dial-up Connection Properties for Windows 2000/Windows XP 6-2
Adding a Modem for Windows NT 6-3
Adding Dial-up Networking for Windows NT 6-3
Adding a Modem: Windows 95/98 6-4
Adding Dial-up Networking : Windows 95/98 6-5
IP Configuration of the Velox LE 6-7
BRIDGED Configuration: Input Address Assignment 6-7
ROUTED Configuration: Input Address Assignment 6-9

Chapter 7 : Maintenance and Radio Upgrades 7-1

Velox LE FTP Firmware Upload 7-1
Firmware Upload 7-1
Set-up for Full Duplex Mode (at Maximum Transfer Rate) 7-2
Tributary Upgrading 7-3

Chapter 8 : Technical Information 8-1

Radio Description 8-1
Introduction 8-1

Control and Management 8-1
Velox LE Models 8-2
Technical Description 8-4
System Overview 8-4
RFU 8-4
Velox LE, Velox LE 10, Velox LE 25, Velox LE 50 Digital Indoor Unit 8-11
Technical Data 8-13
Environmental 8-13
Physical 8-14
Power Supply 8-14
Electrical Performance 8-14

Chapter 9 : Product Range/Product Matrix 9-1

DIU Variants 9-1
RFU Variants 9-1
System Matrix 9-2
System Variants 9-4

Chapter 10 : Ordering Information 10-1

Velox LE 2400 Digital Radio System 10-1
Velox LE 2410 SR Digital Radio System 10-2
Velox LE 2410 SRi Digital Radio System 10-3
Velox LE 2425 SR Digital Radio System 10-5
Velox LE 2425 SRi Digital Radio System 10-6
Velox LE 2450 IP Digital Radio System 10-7
Velox LE 2450 IPi Digital Radio System 10-7
Velox LE 2450 SR Digital Radio System 10-8
Velox LE 2450 SRi Digital Radio System 10-9
Velox LE 5800 Digital Radio System 10-10
Velox LE 5810 SR Digital Radio System 10-11
Velox LE 5810 SRi Digital Radio System 10-12
Velox LE 5825 SR Digital Radio System 10-14
Velox LE 5825 SRi Digital Radio System 10-15
Velox LE 5850 IP Digital Radio System 10-16
Velox LE 5850 IPi Digital Radio System 10-16
Velox LE 5850 SR Digital Radio System 10-17
Velox LE 5850 SRi Digital Radio System 10-18
Velox LE Accessories, Spares and Upgrades 10-18

Chapter 11 : Domain/Network Management of the Velox LE Product Range... 11-1

Introduction 11-1
SNMP and the Velox LE 11-1
MIB Elements – OID (Object ID) Descriptions 11-2
MIB Elements – Trap Descriptions 11-19

Chapter 12 : 1+1 Protection System Operation 12-1

System Description 12-1
Technical Description 12-1
System Overview 12-1
System Functional Description 12-4
Installation 12-5
Hardware Installation 12-5
Radio Software Configuration 12-6
System Verification 12-7

Chapter 13 : Frequently Asked Questions (FAQ) 13-1

General FAQs 13-1
Support FAQs 13-1

Chapter 1: About this Manual

Welcome

The Velox LE license exempt range (2.4GHz and 5.8GHz) incorporates world leading performance, carrier class reliability and rapid deployment capability. The range is specifically designed to allow network and service providers to minimize time and cost to market while maximizing reach and revenue.

The Velox LE product range is a split-architecture radios system with two installation options.

- All Indoor option consisting of a DIU and IRFU both 1RU high and 19" rack mountable.
- Indoor/Outdoor option consisting of a 1RU high 19" rack mountable DIU and a mast/pole mountable ORFU.

Purpose

This manual provides information on installing, commissioning and troubleshooting a Velox LE Microwave Radio system. Technical descriptions are at module and system level.

Intended Audience

The information in this manual is for use by trained technicians or engineers. It does not provide information or instruction on basic technical procedures. Stratex Networks recommends you read the relevant sections of this manual thoroughly before beginning any installation or operational procedures on a Velox LE.

What You Need To Know

To install and commission a Velox LE, we recommend you have the following knowledge and skills:

- A basic understanding of the principles of microwave transmission
- Installation and maintenance experience on digital and radio frequency systems
- Competent in the use of a PC running a Windows operating system

Organization

Chapter 1 – About this Manual

Chapter 2 – Planning

Chapter 3 – Controls, Indicators and Connectors on DIU

Chapter 4 – Hardware Installation

Chapter 5 – NCT Installation

Chapter 6 – PC Set-up

Chapter 7 – Maintenance and Radio Upgrades

Chapter 8 – Technical Information

Chapter 9 – Product Range/Product Matrix

Chapter 10 – Ordering Information

Chapter 11 – Domain/Network Management

Chapter 12 – 1+1 Protection System Operation

Chapter 13 – FAQ

Index

Associated Documents

The documents identified below contain additional information to assist in installing, commissioning and troubleshooting a Velox LE:

- Stratex Networks Microwave Radio System Standard Practices Guide (PN 260-668029-001).
- Protection Kit User Manual (PN 862-02236). Contains information on the 1+1 Redundancy Protected Payload System.

Conventions and Terminology

Graphical Cues

The following icons function as graphical cues used to characterise particular types of associated supporting information:

This is a caution tip table.
Cautions point out procedures that you must follow precisely to avoid damage to equipment, loss of data, or corruption of files in software applications.

This is a warning tip table.
Warnings point out procedures that you must follow precisely to avoid injury to yourself or others.

This is an idea tip table.
An information icon denotes additional information on a current topic.

This is a note tip table.
A note icon denotes additional information you may require to complete the procedure or understand the function

Abbreviations

Abbreviations used in this manual are listed below.

Assy	Assembly
BW	Bandwidth
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
EIRP	Equivalent Isotropically Radiated Power
GUI	Graphical User Interface
IP	Internet Protocol
IRFU	Indoor Radio Frequency Unit
ISM	Industrial, Scientific and Medical
LED	Light Emitting Diode
LOS	Loss of signal
Mbps	Megabits per second
MIB	Management Information Base
Max	Maximum
Min	Minimum
NC	Normally-closed
NO	Normally-open
NCT	Network Configuration Tool
ORFU	Outdoor Radio Frequency Unit
PC	Personal Computer
PPP	Point-to-Point Protocol
RF	Radio Frequency
RFU	Radio Frequency Unit (Prefix I or O for Indoor or Outdoor type)

RSL	Received Signal Level
RSSI	Received Signal Strength Indication
RU	Rack Unit
SR	Scaleable Radio
SNMP	Simple Network Management Protocol
Trib	Tributary

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Stratex Networks has a global network of support personnel located at our regional offices. The telephone numbers and e-mail addresses of the support personnel concerned are listed below:

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Chapter 2 : Planning

Introduction

This chapter is aimed at management and planning staff to enable them to assess the requirements for installing a Velox LE digital radio link.

System Type Selection

The Velox LE 2400, Velox LE 5800, Velox LE 2410 SR, Velox LE 5810 SR, Velox LE 2410 SRi and Velox LE 5810 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 traffic via a 10Base-T 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 2.4 GHz and 5.8 GHz ISM bands.

The Velox LE 2425 SR, Velox LE 5825 SR, Velox LE 2425 SRi, Velox LE 5825 SRi, Velox LE 2450 IP, Velox LE 5850 IP, Velox LE 2450 IPi, Velox LE 5850 IPi, Velox LE 2450 SR, Velox LE 5850 SR, Velox LE 2450 SRi and Velox LE 5850 SRi are similar radios also operating in the 2.4 and 5.8 GHz ISM bands respectively. Modulation can be switched between 16 and 32 QAM with digital output scalable up to 16 T1/E1 tributaries depending on the specific radio.

The Velox LE digital radio system is aimed at FCC regulated markets. Each radio in the system consists of two main parts:

- A Radio Frequency Unit (RFU) operating in the 2.4 GHz or 5.8 GHz ISM frequency bands. The RFU has an N-type female connector for connection to a range of antennas and can either be and Outdoor RFU (ORFU) or and Indoor RFU (IRFU).
  RFU units available are the Velox LE 2410, Velox LE 5810, Velox LE 2410i, Velox LE 5810i, Velox LE 2450, Velox LE 5850, Velox LE 2450i and Velox LE 5850i units. The models with an "i" suffix are 1RU high IRFUs. See RFU Variants on page 9-1 for further information.
- A Digital Indoor Unit (DIU), available with a Telecommunications interface (0 to 16 T1/E1 tributaries depending on the radio) and a Data interface (10Base-T Ethernet or 10/100Base-T Ethernet, depending on the radio).
  DIU units available are the Velox LE 75/120 Ohm, Velox LE 120 Ohm, Velox LE 10, Velox LE 25 and Velox LE 50 unit. All DIUs operate with the Velox LE 2410/2410i and Velox LE 5810/5810i RFUs. Velox LE 10, 25 and 50 DIUs can operate only with the Velox LE 2450, 5850, 2450i and 5850i RFUs. With the exception of the Velox LE 75/120 Ohm and Velox LE 120 Ohm units the number is a guide to the maximum data capacity of the unit. For example, the maximum data capacity of the Velox LE 25 is 25 Mbps. DIU Variants on page 9-1.

Antenna Selection

General

The antenna type must be selected before the system is 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.

Refer to the Link Planner spreadsheet (LinkPlanner.xls) on the supplied CD for assistance with planning the link and antenna gain selection.

The Table 2-1 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 chosen so that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

Table 2-1. Velox LE 5810 Antenna Selection

Antenna Type	Gain (dBi)	Velox LE 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 2-2. Velox LE 5810i Antenna Selection

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

Table 2-3. Velox LE 5850 and Velox LE 5850i Antenna Selection

Antenna Type	Gain (dBi)	Velox LE RFU Typical Distance (Km)	Power level (dBm)
0.6 m Flat panel (MT - 20004)	28	80	24

Table 2-4. Velox LE 2410, Velox LE 2410i, Velox LE 2450 and Velox LE 2450i Antenna Selection

Antenna Type	Gain (dBi)	Velox LE RFU Typical Distance (Km)	Power level (dBm)
1.2 m Parabolic Antenna	27	80	18

Fixed Antennas

The tables below identify the distances where the 1mW/cm^2 exposure limits may be exceeded during continuous transmission using the proposed fixed antennas.

Table 2-5. Velox LE 5810, Velox LE 5810i, Velox LE 5850 and Velox LE 5850i

Product	Manufacturer	Type	Model	Gain (dBi)	Numeric gain	Peak Power (mW)	Calculated Distance (m)	Minimum RF Exposure Separation Distance (m)
Velox LE 5800 Velox LE 5810i Velox LE 5850	Gabriel	Dish	SSP2 52B	29.0	794.3	239.9	1.2	2
Velox LE 5800	Gabriel	Flat panel	DFPD1-52	23.9	245.5	239.9	0.7	2
Velox LE 5800 Velox LE 5850	MTI	Flat panel	MT-20004	28.0	631.0	239.9	1.1	2

Table 2-6. Velox LE 2410, Velox LE 2410i,Velox LE 2450 and Velox LE 2450i

Product	Manufacturer	Type	Model	Gain (dBi)	Numeric Gain	Peak Power (mW)	Calculated Distance (m)	Minimum RF Exposure Separation Distance (m)
Velox LE 2400 Velox LE 2410i Velox LE 2450	Gabriel	Parabolic	SSG4-23	26.7	467.7	63	0.5	2

WARNING: It is the responsibility of the professional installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), only these antenna configurations shown in the table above are used. The use of any antenna other than those listed is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

The Velox LE System should be installed and operated with fix-mounted antennas that are located with a minimum separation distance of 2 meters (6.6 ft) or more from all persons during normal operation to satisfy RF exposure requirements.

FCC Radiation Exposure Statement
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment when installed as directed.

Site Evaluation

When planning a site for a digital radio link, it is important 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 8-13 of this manual).

Wind force build-up and/or vibration of the mast-mounted equipment can affect the antenna beam alignment and Outdoor equipment reliability. Ensure that mast used is rigid enough to withstand the wind forces expected at the install location.

Multipath Effects

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

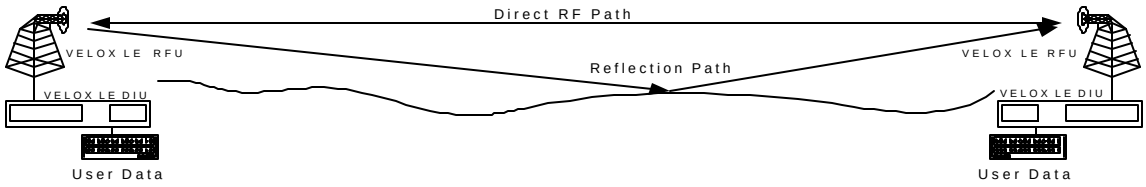


Figure 2-1. Multipath Effects

Interference Considerations

Other devices that can cause interference to the Velox LE radio systems use the ISM frequency bands. 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 analyser feature available on the NCT/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 less 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 antenna polarization.
- Select the polarization with the lowest interfering levels as the system antenna polarization.
- Consult the Velox LE frequency channel plans (see Frequency Plans on page 8-5) and select the frequency plan that would operate in an interference-free band.
- Install the 'High Band' and 'Low Band' RFUs at the sites where they would experience the lowest interference in their respective *receive* bands.

Microcell Backhaul Applications of Velox LE Digital Radios

General

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 minimize 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 (see Transmitted Power Levels below).

Transmitted Power Levels

To minimize 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 utilising the provided NCT / GUI, installed on your laptop or via SNMP network architecture.

Frequency Multiplexing

The Velox LE 2410, Velox LE 2410i, Velox LE 2450 and Velox LE 2450i each offer three frequency channel plans, while the Velox LE 5810, Velox LE 5810i, Velox LE 5850 and the Velox LE 5850i offer four frequency channel plans. Refer to Frequency Plans on page 8-5 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 RFU' of a system transmits on the higher of the two sub-bands. The 'Low-band RFU' of a system transmits on the lower of the two sub-bands. A system (link) always has one High Band and one Low Band RFU. 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 RFUs at the central site, rather than group high and low-band RFUs together.

Antenna Isolation

Separate links at a central site will have sufficient isolation when radio systems operate outside the radiation beam width 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.

Chapter 3 : Controls, Indicators and Connectors on the DIU and RFU

Introduction

This Chapter describes the Controls, Indicators and Connectors available of the various versions of the DIU and RFU (Indoor and Outdoor).

The DIU is designed for mounting in a 19" rack, occupying a 1RU slot. It can also be used as a tabletop system. The DIU 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 ORFU is pole mounted with its antenna whereas the IRFU is designed for 19" rack or table top mounting and is remote from the antenna.

Control, Indicators and Connectors on the DIU

General

The DIUs available are listed below together with cross-references to the applicable front panel and back panel illustrations.

- Velox LE (120 Ohm version) (scalable up to 4 T1/E1), (see Figure 3-1 below and Figure 3-3 on page 3-2).
- Velox LE (75/120 Ohm version) (scalable up to 4 T1/E1), (see Figure 3-2 on page 3-2 and Figure 3-3 on page 3-2).
- Velox LE 10 DIU (scalable up to 4 T1/E1) (see Figure 3-4 on page 3-2. Note that there are no controls, indicators or connectors on the back panel of this DIU).
- Velox LE 25 DIU (scalable up to 8 T1/E1), (see Figure 3-5 on page 3-2.Note that there are no controls, indicators or connectors on the back panel of this DIU).
- Velox LE IP DIU (with optional 16 T1/E1 interface card), (see Figure 3-6. Velox LE IP DIU Front Panel with Payload Interface Panel on page 3-3. Note that there are no controls, indicators or connectors on the back panel of this DIU).
- Velox LE 50 DIU, (see Figure 3-7 on page 3-3. Note that there are no controls, indicators or connectors on the back panel of this DIU).

The number in brackets following each heading is the number identifying the control, indicator or connector on the front/back panel illustration.

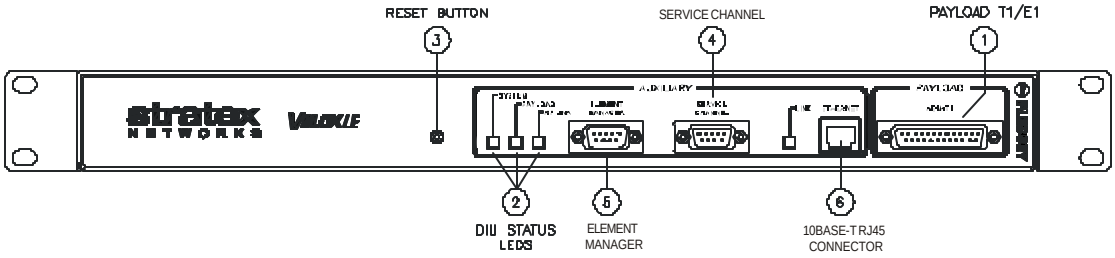


Figure 3-1. Velox LE DIU 120 Ohm Front Panel

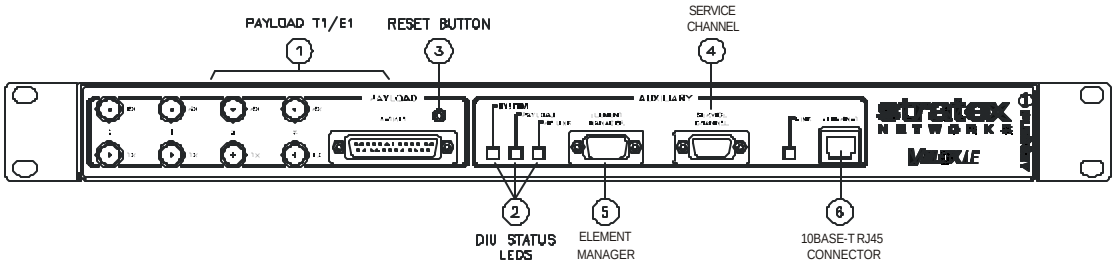


Figure 3-2. Velox LE 75/120 Ohm DIU Front Panel

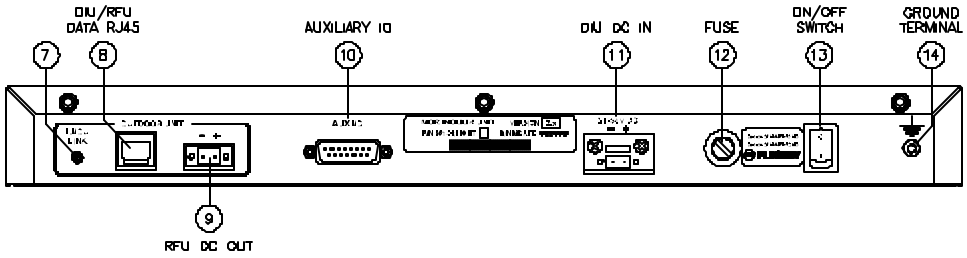


Figure 3-3. Velox LE 75/120 OHM DIU Back Panel

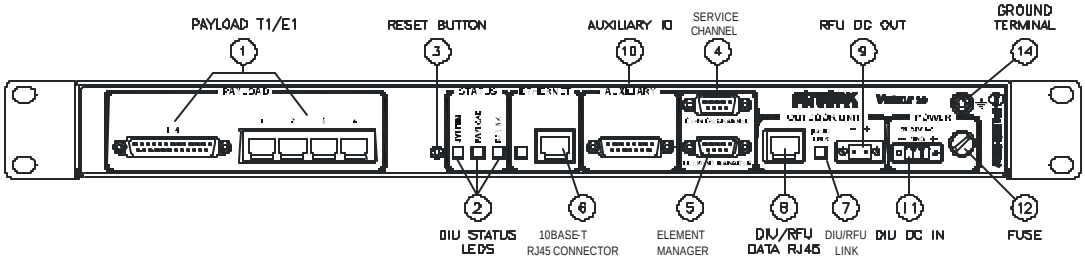


Figure 3-4. Velox LE 10 DIU Front Panel

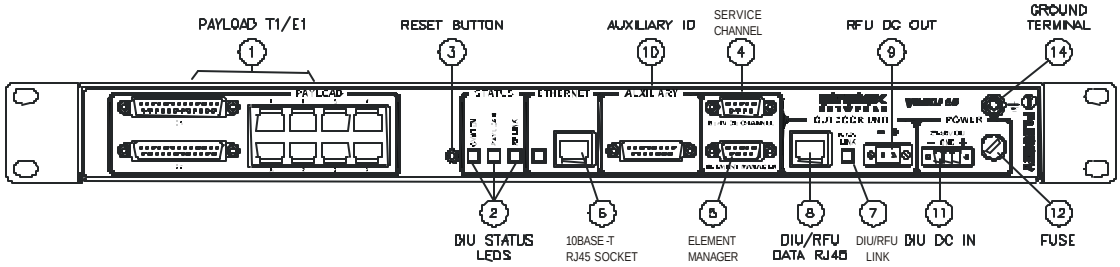


Figure 3-5. Velox LE 25 DIU Front Panel

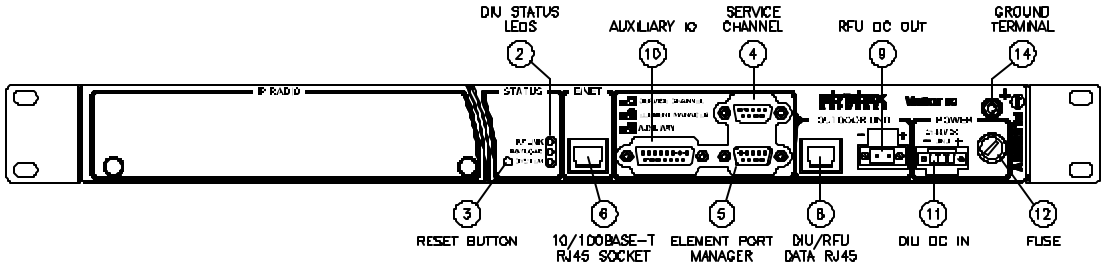


Figure 3-6. Velox LE IP DIU Front Panel with Payload Interface Panel

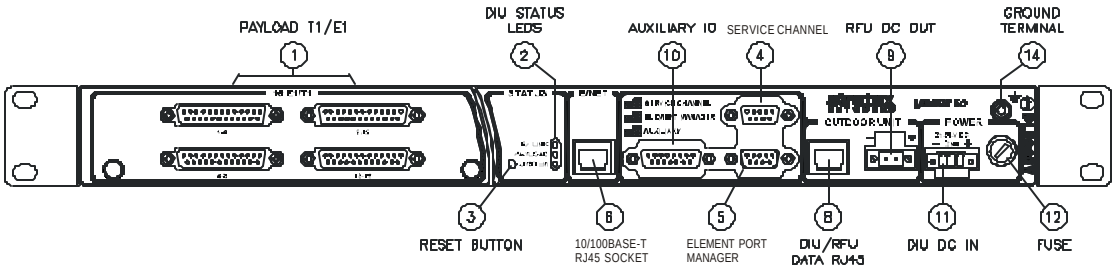


Figure 3-7. Velox LE 50 DIU Front Panel with Payload Interface Panel

Payload T1/E1 Connectors (1)

General

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 (see Table 3-1 on page 3-4 for the pin-outs). Standard termination on the Velox LE 10 and Velox LE 25.
- Unbalanced 75 Ohm, 25 way D-type connectors (see Table 3-2 on page 3-4 for the pin-outs). Optional termination, which on the Velox LE 10 and Velox LE 25 units must be requested from the supplier when ordering the system.
- Balanced 120 Ohm, RJ48C connectors on the Velox LE 10 and Velox LE 25 (see Table 3-3 on page 3-6 for the pin-outs). Standard termination on the Velox LE 10 and Velox LE 25, user configurable on the Velox LE 50.
- Unalanced 75 Ohm, RJ48C connectors on the Velox LE 10 and Velox LE 25 (see Table 3-3 on page 3-6 for the pin-outs). Optional termination, which on the Velox LE 10 and Velox LE 25 units must be requested from the supplier when ordering the system and is user configurable on the Velox LE 50.

25-Way D-type Connections (Balanced 120 Ohm, Unbalanced 75 Ohm)

Balanced 120 Ohm and unbalanced 75 Ohm termination via 25-way D-type connectors are available on all Velox LE DIUs. The standard termination is 120 Ohms on all DIUs. Unbalanced 75 Ohm is an optional termination, which on the Velox LE 10 and Velox LE 25 units must be requested from the supplier when ordering the system and is user configurable on the Velox LE 50.

In Table 3-1 Rx means that signal goes INTO the interface), Tx means that the signal is coming out of the interface.

Tributaries 1-4 are connected on D1 on the Velox LE 120 Ohm, Velox LE 75/120 Ohm, Velox LE 10 and Velox LE 25 DIU. In a similar fashion tributaries 5-8 are connected on D2 for the Velox LE 25 radio, that is pin 2 = RTIP6, pin 10 = RTIP5 and so on. This pattern is repeated for Tributaries 9 – 16 on connectors D3 and D4 for the Velox LE 50 16 E1/T1 payload interface card.

The pin connections are shown in the following tables:

- Table 3-1 on page 3-4 for balanced 120 Ohms termination.
- Table 3-2 on page 3-4 for unbalanced 75 Ohm termination.

Table 3-1. Pin Connections for Balanced 120 Ohm Termination on 25-Way D-Type Connector

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

Table 3-2: Pin Connections for Unbalanced 75 Ohm Termination on 25-Way D-Type Connector

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

RJ48 Connections(Balanced 120 Ohm and Unbalanced 75 Ohm)

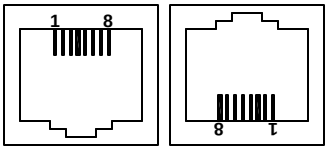
Balanced 120 Ohm and unbalanced 75 Ohm termination via RJ48 connectors are available on the Velox LE 10 and Velox LE 25 DIUs. The standard termination is 120 Ohms on both DIUs. Unbalanced 75 Ohm is an optional termination, which must be requested from the supplier when ordering the system

Although RJ48 Payload connectors are available on only the Velox LE 10 and Velox LE 25 DIUS, RJ48 connections on the Customer interface can be connected to the DB25 payload connector on the Velox LE 120 Ohm and 75/120 Ohm units using the 4 E/T Spider Cable 660-03678, which is supplied as part of the Accessories kit.

The pin connections for balanced 120 Ohms termination Table 3-3 on page 3-6.

For unbalanced 75 Ohm terminations, pins 2 and 5 should be connected to ground. For this connection we recommend using a shielded cable together with RJ-48 shielded connector. If this connector is used, pins 2 and 5 can be connected to the connector body, which is grounded via the connector body of the mating RJ-48 connector on the DIU.

Table 3-3. Pin Connections for Balanced RJ48 Connectors on Velox LE, Velox LE 10 and Velox LE 25 DIUs

RJ48C Socket	Pin	Description	Direction
	1	TRING1	TX+
	2	TTIP1	TX-
	3,6		
	4	RRING1	RX+
	5	RTIP1	RX-
	7,8	No Connection	N/A

Rx means that signal goes INTO the interface, Tx means that the signal is coming out of the interface.

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

Unbalanced Payload Data (BNC) (Velox LE 75/120 Ohm Only)

On the Velox LE 75/120 Ohm there are eight 75 Ohm BNC connectors on the front panel in addition to the DB25 connector, as follows:

- Four Rx connectors - Rx means that the signal goes INTO the interface
- Four Tx connectors - Tx means that the signal is coming OUT of the interface.

Note that Tributaries are numbered 0 to 3 on the front panel of the DIU, but are identified 1-4/1-8 in the NCT Graphical User Interface (GUI).

DIU Status Diodes (2)

There are three LEDs on the front panel all DIU variants. Their purpose is as follows:

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

PAYLOAD - Green OK, Orange (AIS Detected), Red (LOS Detected), Black (No T1/E1, DS3/E2 payload.

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 Reset Button 'position 1' (1-reset).

Clicking on the "Clear Alarms" button in the Velox LE NCT Main Radio Window will clear flashing LED's and yellow indicators (Velox LE NCT).

Steady Orange or Steady Red LEDs indicate a fault condition. The fault condition and the action required are given in Table 3-4 below.

Table 3-4. Interpretation of Status LEDs

LED	Colour	Interpretation	Action
System	RED	There is a problem with the communication to the RFU	*Check cables between DIU and RFU*
RF Link	RED	Continually running bit errors on tributaries	*If System LEDs are green then check RFUs*
Payload	RED	There is no Payload signal present (LOS) on one or more tributaries	*Check connections to the BER Tester*
System	ORANGE	There is a problem with the communication to the RFU	*Check cables between DIU and RFU*
RF Link	ORANGE	FEC is correcting errors – no problem	*No problem unless the LED stays orange*
Payload	ORANGE	The incoming payload signal is AIS	*Check BER tester*

Reset / Configuration Button (3)

You use the Reset button in conjunction with the Status LEDs when configuring the radio. The LED which is ON and its colour when the button is released determines the function. When the Reset Button is pressed, the Status LEDs will light in sequence RF, PAYLOAD and SYSTEM. The LED colour sequence while the button is pressed is GREEN, ORANGE then RED and then GREEN again, i.e. the sequence will repeat. The LED colours and their corresponding functions are listed in Table 3-5 below.

If while pressing the Reset Button you "lose" the count, continue pressing until all the LEDs are out. The sequence is now complete and you can start again from position 1.

Throughout this manual, use of the Reset Button is indicated in text by the LED sequence number followed by the word RESET. For example, LED sequence 1 (RF LED GREEN) is indicated 1-RESET, LED sequence 5 (PAYLOAD LED ORANGE) is indicated 5-RESET, etc.

Table 3-5. Reset Button Functions and Indications

Reset Number	Status LEDs			Function
	RF	PAYLOAD	SYSTEM	
1-RESET	GREEN	OFF	OFF	Clear Front Panel LEDs (and associated alarms in DIU)
2-RESET	OFF	GREEN	OFF	Clear Event Log in the DIU
3-RESET	OFF	OFF	GREEN	Reset the DIU (**does not** reset the non-volatile memory storing the DIUs configuration parameters)
4-RESET	ORANGE	OFF	OFF	Default to Routed Configuration "FAR side" DIU: 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. See Note 1 below.
5-RESET	OFF	ORANGE	OFF	Default to Routed Configuration "NEAR side" DIU: 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. See Note 1 below.
6-RESET	OFF	OFF	ORANGE	Default to Routed Configuration for the side currently configured: If you are not sure how the DIU is configured (NEAR or FAR side

Table 3-5. Reset Button Functions and Indications

Reset Number	Status LEDs			Function
	RF	PAYLOAD	SYSTEM	
				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. See Note 1 below.
7-RESET	RED	OFF	OFF	Default to Bridged Configuration "FAR side" DIU: Reset the DIU configuration parameters that are stored in non-volatile memory (BATTERY-BACKED STATIC RAM) and configure as a 'Far Side DIU'. See Note 1 below.
8-RESET	OFF	RED	OFF	Default to Bridged Configuration "NEAR side" DIU: Reset the DIU configuration parameters that are stored in non-volatile memory and configure as a 'Near Side DIU'. See Note 1 below.
9-RESET	OFF	OFF	RED	RESERVED
10-RESET	GREEN	OFF	OFF	RESERVED
11-RESET	OFF	GREEN	OFF	RESERVED
12-RESET	OFF	OFF	GREEN	Set up DIU with E1 tributaries.
13-RESET	ORANGE	OFF	OFF	Set up DIU with T1 tributaries.
14-RESET	OFF	ORANGE	OFF	Deactivate buttons 4 onwards.
15-RESET	OFF	OFF	ORANGE	Toggle SNMP and FTP Servers ON/OFF (V3.00+ firmware)
16-RESET	RED	OFF	OFF	DHCP ON (V3.00+ firmware)
17-RESET	OFF	RED	OFF	DHCP OFF (V3.00+ firmware)
18-RESET	OFF	OFF	RED	Ethernet MAC learning enabled via front panel
19-RESET	GREEN	OFF	OFF	Transparent Ethernet mode enabled via front panel
20-RESET	OFF	GREEN	OFF	E^2prom erased via front panel (Velox LE Only)
21-RESET	OFF	OFF	GREEN	RFU back-to-back enable / disabled toggle via front panel

NOTE 1: The Bridged Configuration is the default configuration and is the preferred configuration for most networks. For Routed Configuration, the allocation of Ethernet IP Addresses is more complicated and requires specialist network knowledge. For information on the IP Addresses used; refer to:

- BRIDGED Configuration: Input Address Assignment on page 6-7 for Bridged Networks.
- ROUTED Configuration: Input Address Assignment on page 6-9 for Routed Networks.

4-RESET, 5-RESET, 6-RESET, 7-RESET and 8-RESET reset the DIU to factory defaults – these resets are typically **only used once** (these choices reset certain adjustable parameters in non-volatile memory in the DIU). If changes are made to the configuration parameters and the user does not want these to change when a unit is reset, the DIU can be power-cycled or '3-RESET' must be used. For example, 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.

Service (Wayside) Serial Data Channel (4)

This port supports asynchronous full duplex, serial data transfer across the link at a speed of 115200 bps. Data via this channel does not interfere with the payload data channels.

The interface type is RS-232 configured as DCE (Data Communications Equipment). Note that Handshaking can be "None."

Pin-outs for the Service Channel connector are given in Table 3-6 below.

Table 3-6. Service Channel Connector Pin-outs

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

Element Manager Port (5)

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

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

Hardware handshaking is used.

10Base-T Ethernet RJ45 Port (10/100Base-T on Velox LE 50 DIU) (6)

This port is used for communications with the NCT/GUI software from a laptop/PC or with an SNMP manger to control the system. It can also be connected to a hub for 10Base-T or 10/100Base-T 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.

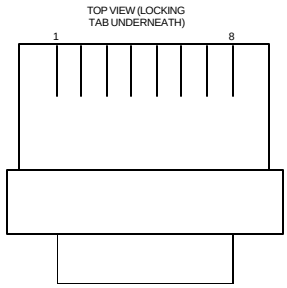
DIU/RFU Link LED (7)

Normal condition ON indicating that there is communication between the DIU and the RFU. If it is OFF, check the Data Cable between the DIU and RFU.

DIU/RFU Data (8)

This receptacle accepts an RJ45 plug that connects to UV-protected STP (Screened twisted pair) cable used between the DIU and the RFU. Pin-outs for the DIU/RFU Data cable are given in Table 3-7 below.

Table 3-7. Pin-outs for DIU to RFU Data Cable

RJ45	Pin	DTE (on DIU)	DCE (on RFU)	Wiring
	1	TxD+	RxD-	Orange/White
	2	TxD-	RxD+	White/Orange
	3	RxD+	TxD+	Green/White
	4	NC	NC	
	5	NC	NC	
	6	RxD-	TxD-	White/Green
	7	NC	NC	
	8	NC	NC	

RFU DC Out (9)

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 plug.

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

Auxiliary I/O (10)

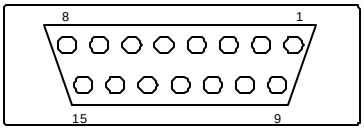
The auxiliary in/out port is used for remote monitoring and control. The following are provided

- 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 NCT, as well as from an SNMP Management Station.
- Two relays each with two outputs (one output with the contacts normally open and the other with the contacts normally closed), 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 NCT or a SNMP Management Station.

Pin-outs for the Auxiliary I/O connector are given in Table 3-8 below.

Table 3-8. Auxiliary In/Out Connector Pin-outs

DIU connector	Pin No	Signal
15-pin D-type female	1	OUTPUT 1 COMMON
	2	OUTPUT 1 NORMALLY -OPEN

Table 3-8. Auxiliary In/Out Connector Pin-outs		
DIU connector	Pin No	Signal
	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

DIU DC Power Input (11)

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 Velox LE 120 Ohm and Velox LE 75/120 Ohm units and a THREE pin GREEN connector on the Velox LE 10, Velox LE 25 and Velox LE 50 units - 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 (see page 3-12).

Power Supply and consumption is as follows:

DC power supply:	21 to 56 Vdc or 21 to 58 Vdc dependent on the version and variant
DC power supply grounding:	Positively or negatively grounded
Power consumption: (Velox LE 2400/5800 120 Ohm & 75/120 Ohm Units and 2410i/5810i)	35 W typical, 45 W maximum
Power consumption: (all other Velox LE systems)	40 W typical, 45 W maximum

The power supply specification for the current Velox LE 10, Velox LE 25 and all Velox LE 50 DIUs is 21 to 58 Vdc whereas older Velox LE 10, Velox LE 25 DIUs and all other older DIUs require 21 to 56 Vdc.
Please ensure that you comply with the power supply specification printed above the POWER connector on the DIU.

Wiring data are given in Table 3-9 and Table 3-10 below.

Table 3-9. Pin-outs for DC Power Connector (Velox LE DIU 120 Ohm & 75/120 Ohm)

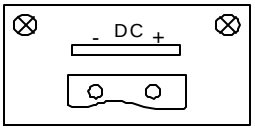
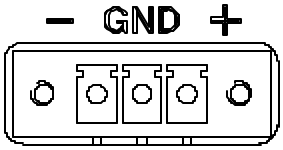
DIU connector: GREY	Pin No	Signal
2-pin Wieland Type 8213 Socket 	+	DC POWER
	-	DC POWER RETURN

Table 3-10. Pin-outs for DC Power Connector (Velox LE 10, Velox LE 25, Velox LE 50 DIU)

DIU connector: GREEN	Pin No	Signal
3-pin Phoenix Type 18.27.87.1 Socket 	+	DC POWER
	GND	GROUND PIN
	-	DC POWER RETURN

Fuse Holder (12)

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

On/Off Switch (13)

This switch is used to control power input to the DIU (and indirectly the RFU). Note that the ON/OFF switch is **NOT** fitted to the Velox LE 10, Velox 25 and Velox 50 DIUs. These DIUs will start up as soon as the required DC voltage is applied.

Ground Terminal (14)

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.

Indicators and Connectors on the IRFU and ORFU

General

The Velox LE 2410i, Velox LE 2450i, Velox LE 5810i and Velox LE 5850i ORFUs have the same indicators and connectors on their front panels.Thus, only one example the Velox LE 2410i is shown (see Figure 3-8 below.

There are no indicators on the ORFU. The connectors are shown in Figure 3-9 below.

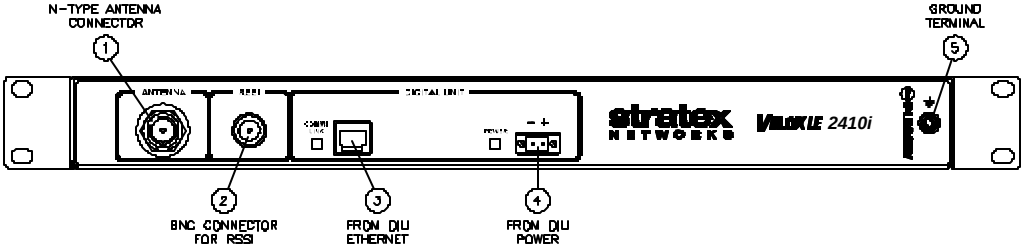


Figure 3-8. Connectors and Indicators on the Velox LE IRFU Front Panel

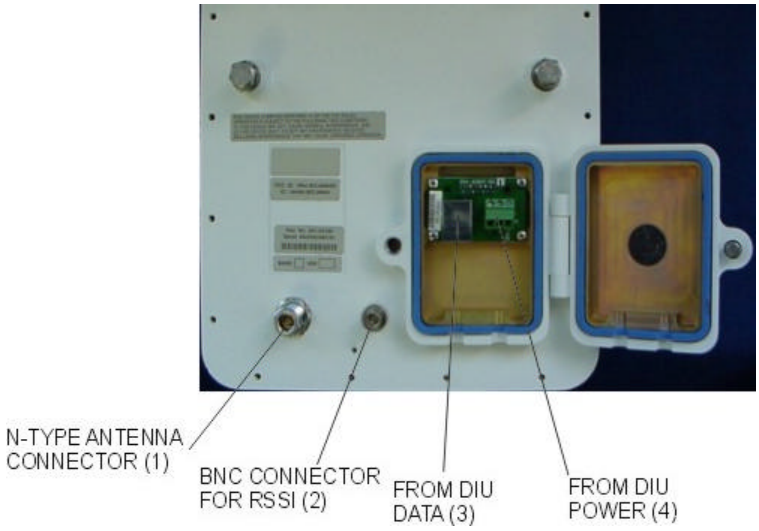


Figure 3-9. Connectors and Indicators on the Velox LE ORFU

Antenna Connector (1)

The RFU connects to the antenna using a 50 ohm co-axial cable or flexible waveguide via a launch/N-type adaptor terminated with male Type N connectors on each end. The female N-type Antenna connector on the RFU provides termination for this line on the RFU.

Flexible waveguide connected via a launch/N-type adaptor is recommended for longer feeder runs to minimize losses.

Table 3-11. RFU Antenna Connector Pin-outs	
Pin	**Description**
Centre	Transmitter and Receiver RF
Outer	Common Signal/Chassis Ground

RSSI (2)

The RSSI connector is a BNC connector that provides DC voltage level corresponding with the RSL (Received Signal Level) for use in antenna installation and alignment. A standard DVM (Digital Volt Meter) is used for this purpose.

Table 3-12. RFU RSSI Connector Pin-outs	
Pin	**Description**
Centre	Transmitter and Receiver RF
Outer	Common Signal/Chassis Ground

DIU COMMS

LED on the IRFU only whose normal condition is ON indicating that there is communication between the DIU and the RFU. If it is OFF, check the Data Cable between the DIU and RFU.

DIU/RFU Data (3)

This receptacle accepts an RJ45 plug that connects to UV-protected STP (Screened twisted pair) cable used between the DIU and the RFU. Pin-outs for the DIU/RFU Data cable are given in Table 3-7 on page 3-10.

DIU Power

LED on the IRFU only whose normal condition is ON indicating that power is being received from the DIU. If it is OFF, check the DIU is ON and that the Power Cable between the DIU and RFU is serviceable.

DIU DC In (4)

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 connector depends on the unit as follows:

- IRFU - GREEN, two-pin plug.

- ORFU – GREEN, three-pin plug.

Ground Terminal (5)

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.

Chapter 4: Hardware Installation

Introduction

This chapter covers installation procedures for all the Velox LE split-architecture radio systems. All steps, from unpacking and checking the equipment, through to completion of the physical installation and antenna alignment are addressed.

For a full description of the Velox LE systems, refer to the System Overview on page 8-4.

Health and Safety

Velox LE Health and Safety Requirements

Ensure relevant health and safety practices are adhered to at all times, when working on or around the Velox LE radio equipment. Table 4-1 on page 4-1 details the recommended general health and safety practices. Table 4-2 on page 4-2 details recommended operator health and safety practices.

Ensure the general hazards in Table 4-3 on page 4-2 are fully addressed at the planning and installation stages.

General Health and Safety

Table 4-1. General Health and Safety Practices

Hazardous Materials	No hazardous materials are used in the construction of the equipment and, therefore, no special handling/disposal procedures are required.
Hazardous Voltages	The Velox LE 10 and Velox LE 25 takes up to 56/58V input to the DIU and convert it to 64V nominal or up to 80V OC for RFU power feed. The Velox LE 50 DIU meets SELV standards and the RFU power feed is always be low 60V with a nominal/average of 53V.
Safety Signs	It is not necessary to place external warning signs or other indications on the equipment.
Surface Temperatures	While external surfaces of the equipment do become warm during operation due to normal heat dissipation, the temperatures reached are not considered hazardous.
Flammability	The equipment is designed and constructed to minimize the risk of smoke and fumes under fire conditions.

Operator Health and Safety

Table 4-2. Operator Health and Safety Practices

Protection from RF Burns: **Velox LE Radios**	While the Velox LE radio does not generate RF fields of intensity sufficient to cause RF burns, it is hazardous to look into or stand in front of an active antenna aperture while the radio is active.
	Do not stand in front of or look into an antenna without first ensuring the associated transmitter or transmitters are switched off.
Protection from RF Burns: **General**	When any of the Velox LE ORFU is to be installed on a structure or rooftop that has existing antennas fitted, avoid exposure to potentially harmful levels of RF radiation from these antennas.
	Do not proceed with an installation without first determining the RF exposure risk. If necessary ask the structure/rooftop owner or operator. Where necessary, wear a protective suit or have the required transmitter(s) switched off for the duration of the installation.
	Even where the perceived risk is low, do not stand in front of or look into other antennas.
Lifting Equipment	Care must be taken when hoisting or lifting the RFU or its antenna during installation or maintenance. The RFU is nominally 6kg (13.2lbs), but dependent on size, associated antennas with their mounting hardware can weigh in excess of 100kg (220 lbs.), which will require specialised lifting equipment and an operator trained and certified in its use.
Equipment Protrusions	While the equipment has been ergonomically designed to be free from unnecessary protrusions or sharp surfaces that may catch or otherwise cause injury during handling, always take care when working on or around the equipment.
Safety Warnings	When a particular practice or procedure poses implied or potential harm to the user or to the radio equipment, a warning is included in this manual.

General Hazards

The General hazards to be addressed when planning and installing a Velox LE system are detailed in Table 4-3.

Table 4-3. General Hazards

Maximum ambient temperature	The maximum ambient temperature (Tmra) for the Velox LE DIU is +50° Celsius.
	The maximum ambient temperature (Tmra) for the Velox LE ORFU is +60° Celsius and for the Velox LE IRFU is +50° Celsius. Compliance to the operational specification is not guaranteed for higher ambient temperatures. To ensure correct operation and to maximize long term component reliability, ambient temperatures must not exceed this figure.
Rack mount temperature considerations	If the Velox LE type DIU and IRFU are installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. The maximum ambient temperature (Tmra) of +50° Celsius applies to the immediate operating environment of the Velox LE DIU and IRFU, which if installed in a rack, is the ambient applying within the rack.
Airflow requirements	Rack installations must be made so the airflowrequired for safe and correct operation of the Velox LE is not compromised. For the Velox LE, unobstructed air passage must be maintained to

	each side of the indoor units, which requires a minimum of 50 mm (2 inches) of side spacing to any rack panels, cable bundles or similar.
Circuit overloading	Consideration must be given to the connection of a Velox LE to existing dc supply circuits and the effect that overloading of circuits might have on the power supply, circuit protection devices and supply wiring. Check the Velox LE power consumption specifications and the supply capability of the power supply system when addressing this concern. This check of capacity must extend right to the dc power supply and not just to an intermediate connection point.
Power supply connection	The Velox LE radio must be used with correct power supply (21-56 Vdc power supply or 21 – 58 Vdc power supply as indicated). The power supply must be located in the same premises as the Velox LE system.
Earth connection	Reliable earthing of the Velox LE system must be maintained. Refer to instructions in the manual for earthing of the ODU, ODU cable, lightning surge suppressor and indoor unit.
Lightning surge suppressor	All Velox LE RFU cables must be fitted with a lightning surge suppressor. Refer to instructions in the suppressor supplier's documentation for suppressor installation information.
Mechanical loading	When installing the DIU and IRFU in a rack, ensure the rack is securely anchored. Check to ensure that the additional loading of a Velox LE DIU or units will not cause any reduction in mechanical stability of the rack.
Restricted access	The Velox LE system must be installed in restricted access sites. The DIU and associated power supply must be installed in restricted areas, such as dedicated equipment rooms, closets, cabinets or the like. Similarly, access must be restricted to the RFU/antenna location.

In particular, install and operate a Velox LE system in accordance with the following statements and warnings:

An appropriate power supply disconnect device should be provided as part of the building installation.

The Velox LE system has been evaluated for safety with the maximum allowed for the system, i.e. 56 Vdc or 58 Vdc depending on the system.

The Velox LE type DIU earth must be connected directly to the dc supply system earthing conductor, or to a bonding jumper from an earthing terminal bar, or bus to which the dc supply system earthing is connected.

The Velox LE type system must be located in the immediate area, such as in the same or adjacent cabinets, of any other equipment that has a connection to the same earthed conductor of the same dc supply circuit. The Velox LE dc system must not be earthed elsewhere.

The dc supply source must be located within the same premises as the Velox LE system.

There must be no switching or disconnecting devices in the earthed circuit and the point of connection to a Velox LE system.

Do not look into or stand immediately in front of an active antenna.

Never install an ORFU on a structure, rooftop or the like where there are existing antennas without first ascertaining the RF exposure risk from the existing antennas, and where necessary taking appropriate risk avoidance action.

Refer to Stratex Network's *Microwave Radio Systems Standard Practices Guide* for more information on health and safety when using Stratex Networks products.

Hardware Installation Overview

An Overview of the hardware installation is shown in Figure 4-1.

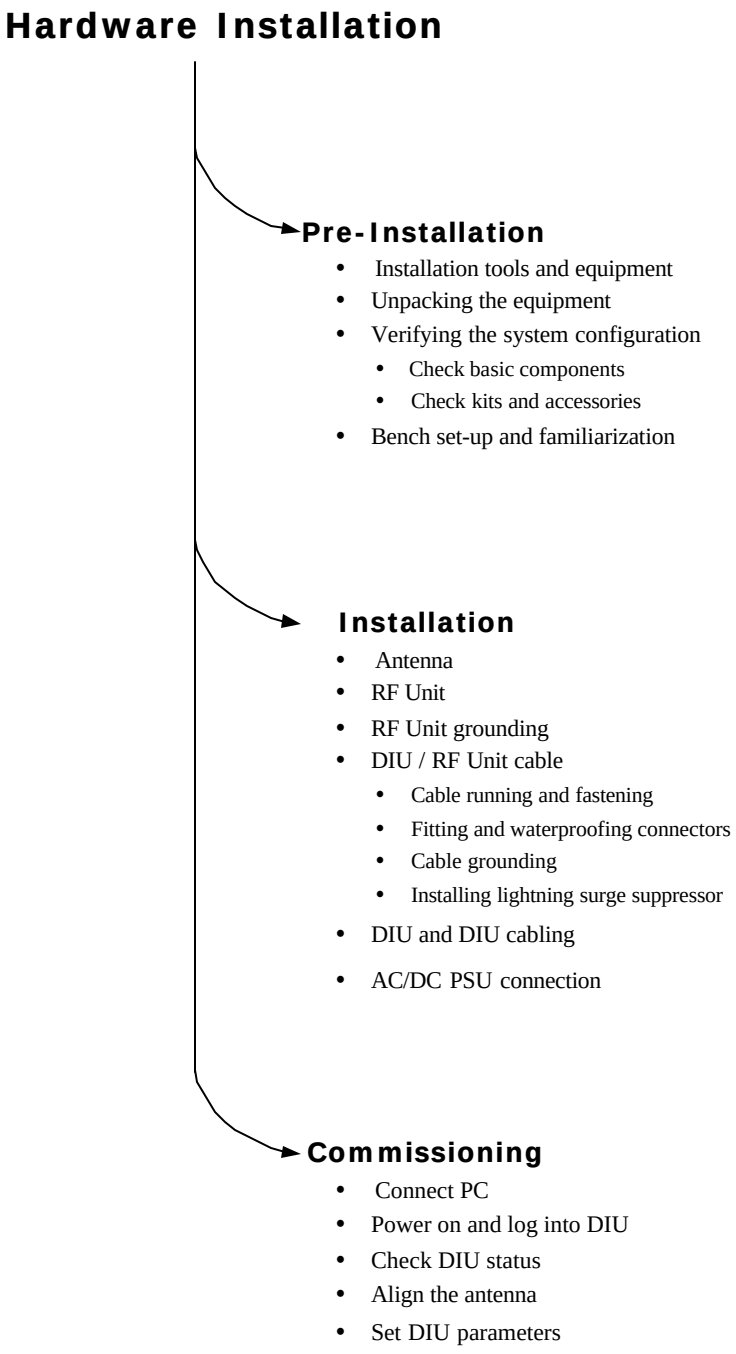


Figure 4-1. Hardware Installation – Overview

CAUTION

Failure to check the configuration may result in interference to other links if frequency and power settings are incorrect for the site.

Pre-Installation

General

This section details the following:

- Tools and equipment to be supplied or manufactured by the installer (see Installation Tools and Equipment below).
- Unpacking of shipping boxes and verification of contents to ensure that what has been delivered is what is required (see Unpacking the Equipment on page 4-8).
- Bench set-up to verify the equipment and carry out initial configuration (see Bench Set-up (First time users) on page 4-10).

All the above should be carried out before going to the installation site.

Installation Tools and Equipment

Before going to site check that you have the recommended tools, materials and equipment for each equipment as listed in Table 4-4 below, Table 4-5 on page 4-7 and Table 4-6 on page 4-8.

Table 4-4. Tools and Material for Installation

Antennas	Refer to the antenna manufacturer's data for required and recommended installation tools and equipment. This data will be included with every antenna.	
VeloxLE (General)	The following tools and material are not included in the standard Velox LE installation kits and must be separately sourced or supplied by the installer.	
	Basic electrician's toolkit.	The kit must include cable cutting and crimp tool for attaching lugs to stranded copper cable, a multimeter, RJ45 crimp tool, soldering iron and a set of Allen keys.
	Ground cable or strap	Ground cable or strap rated at 45A with 5 mm ground lug for grounding the Indoor and RFUs.
	Adjustable wrench	(5-25mm)
	Hot-air gun	For use on the heat-shrink tubing supplied with the Andrew N-type connectors.
	Protective grease and zinc-rich paint	For weather-protecting grounding attachment points on towers and grounding bars.
	Tape	UV Protective, self-vulcanising tape for the protection of connectors.
	Cable ties	Used to secure the cables to the mast at regular intervals.
	Binoculars or GPS or Compass	Bearing of other station during antenna alignment
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.

Table 4-4. Tools and Material for Installation		
	DC power supply cable	Minimum 2.5 mm square conductor, rated for 10 A. For connection between the power supply and the DIU DC connector on the rear panel. (The DC connector is on the front panel of the Velox LE DIU.)
	DIU ground lug	10-4 (10 square mm for wire and hole big enough for M4 thread)
ORFU	**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	10-4 (10 square mm for wire and hole big enough for M4 thread)
	Multimeter (recommended)	Measure RSSI at RFU during antenna panning. The RSSI level may also be read from the NCT / GUI via laptop connection to the DIU, indoors
IRFU	**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	10-4 (10 square mm for wire and hole big enough for M4 thread)
	Multimeter (recommended)	Measure RSSI at RFU during antenna panning. The RSSI level may also be read from the NCT / GUI via laptop connection to the DIU, indoors

Table 4-5. Cables Assemblies to be Manufactured		
Cable Assy Name	**Connector Type**	**Remarks**
DIU Power Input Cable		Input connector supplied
	2-Pin Wieland Type 8213 Socket	Velox LE 120 Ohm, Velox 75/120 Ohm
	3-Pin Phoenix Type 18.27.87.1	Velox LE 10, Velox LE 25, Velox LE 50
DIU to ORFU Power Cable		Recommended Cable: 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. Suggested cable types are: 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) Note that for IRFU systems DIU to IRFU power cable is supplied.
DIU to ORFU Data Cable		Recommended Cable: 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 a standard FTP Cat 5 cable that is 'upjacketed' with suitable plastic for FR/UV (Flame retardant/Ultra Violet) protection. Suggested cable types are: Superior Essex BBDN CAT 5 cable P/N 04-0010-34 (7.8mm) Superior Essex CAT 5 P/N 18-241-31 18-241-11 (5.1mm) General Cable CAT 5 P/N 2137113 2137114 (5.6mm) Belden CAT 5 P/N BC1002 (6.0mm) Note that for IRFU systems DIU to IRFU data cable is supplied.
IRFU to Antenna RF Cable	N-type Male Connector	High quality ½ or 5/8" coaxial cable or elliptical wave guide for longer runs to minimize losses.
Balanced Payload Data Cable	DB25	
Balanced Payload Data Cable	RJ48	Velox LE 10 and Velox LE 25
Unbalanced Payload Data Cable	BNC	Velox LE 75/120 Ohm Only
Auxiliary I/O Cable	15-Way D-type	
Service Cable	9-Way D-type	

Table 4-5. Cables Assemblies to be Manufactured		
Cable Assy Name	**Connector Type**	**Remarks**
Loop Back Connector		Required for back-to-back testing. Rx connections wired to Tx connections on the payload connector.

Apart from the Cable Assem blies listed in Table 4-5 the Customer must supply the installation and test equipment listed in Table 4-6.

Table 4-6. Additional Equipment to be Supplied by the User	
Equipment Required	**Remarks**
Inline Lightning Protection Unit	A lightning protection unit must be installed at the RFU Antenna connection.
Antenna	Refer to Antenna Selection on page 2-2. Note that Stratex Networks can supply antennas if required.
Power Supply	Supply of DC supply to DIU
T1 or E1 BER Tester	Required for back-to-back testing. If BER is not connected during back-to-back testing, then the Payload LED will be Red, i.e. no payload signal.

Unpacking the Equipment

One RFU and one DIU are shipped per packing box. DIUs are shipped with configuration as ordered. Standard installation items are included and any optional accessories will also be included, subject to the available space. Additional RFUs and DIUs are shipped in dedicated 'satellite' boxes. The contents of the Accessories Box are listed in Table 4-7 on page 4-9.

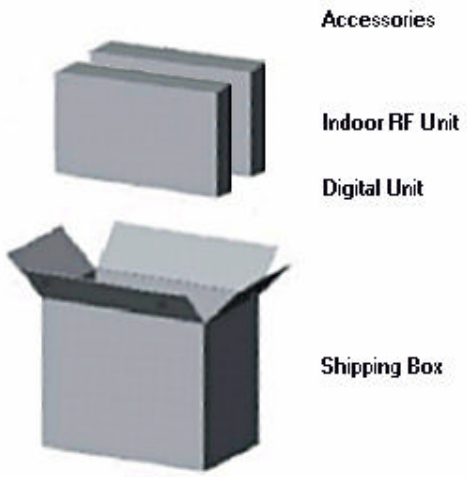


Figure 4-2. All Indoor Radio Packing Configuration

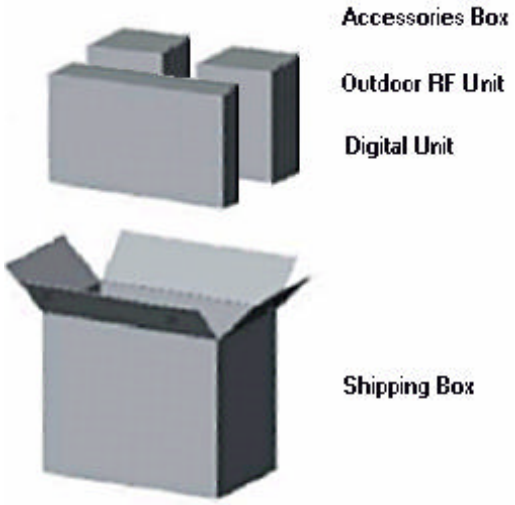


Figure 4-3. Indoor/Outdoor Radio packing configuration.

Open the shipping containers using a utility knife carefully remove the equipment and place it on a clean flat working surface. Save the shipping and packing material in case the equipment has to be returned.

Table 4-7. Contents of Accessories Box

Description	Part Number	Qty	Remarks
ORFU Pole Mounting Kit	651-03809	1	Comprises: Mounting Bracket Mounting Bracket Clamp 2 x Mounting U-Bolts 4 x Nut M8 Hex Stainless Steel ISO/C 4 x Washer M8 Plain Flat Stainless Steel 4 x Washer M8 Spring Single Coil Type A Stainless Steel
4 E/T Spider Cable	660-03678	1	For interconnectin g between the DB25 Payload Connector and 4 x RJ48 lines. Supplied with units with DB25 Payload connectors only.
RSSI Cable	660-03405	1	BNC Plug to 2 x 4mm Plugs (one black plug & one red Plug)
Ring Terminal M8	388-00585-N	1	Ring Tongue Lug Crimp 001 10 mm sq Conductor supplied with ORFUs only. For connecting RFU to ground.
Connector 002 Block Plug Single Row Straight Free 5,08mm (Grey)	368-02744-Q	1	DC input connector for Velox LE 120 Ohm and Velox LE 75/120 Ohm DIUs.
3-pin Phoenix Type 18.27.87.1 Socket		1	DC input connector for Velox LE 10, Velox LE 25, Velox LE 50 DIU
Connector 002 Block Plug Screw flange 5.08mm (Green)	368-03614	2	Connectors for DIU to RFU Power Cable
Lap Link cable: Dual Header Serial	660-03349	1	(25 & 9 way both ends). For progamming the system via the Element Manager connector.
Software CD	651-04252-02	1	Contains NCT and other system software
Installation and Operations Manual	862-02411	1	This Manual
Combined DIU to IRFU Power/Data Cable	660-03770-01	1	Cable one metre long, which is supplied with IRFU systems only
DIU/IRFU Rack Mounting Hardware	Various	A/R	4 x M16 x 18 mm and washers are supplied for each unit.

Bench Set-up (First time users)

Getting started (Without a PC)

This section describes the suggested steps to follow to successfully set-up a Velox LE link without using a PC.

This section applies to all Velox LE radios with the only difference being the location of the interface connectors on the various DIUs.

Complete the checklist to ensure that you have the required equipment and information to continue.

Do not continue until you have read and completed the checklist!

	Steps to follow:	Check	Additional Information
1.	Velox LE Installation & Operation Manual (This Manual)		Ensure that you understand: The use of the Reset Button when configuring the Velox LE (see Reset/Configuration Button (3) on page 3-7. How to interpret the DIU front panel LEDs (see DIU Status Diodes (2) on page 3-6 and DIU/RFU Link LED (7) on page 3-9).
2.	Connect the Velox LE System as shown in Figure 4-4 on page 4-12 noting the following (the numbers in brackets following each note correspond to the numbers given on Figure 4-4):		
	2 x DIU		
	2 x RFU		1 low and 1 high band - see L/H stamp near serial number.
	2 x Power supplies (1)		21 to 58 Vdc, 35 W typical (40 W, 45 W max).
	Make 2 x PSU to DIU power cable (2)		For wiring data, see Table 3-9 on page 3-12 or Table 3-10 on page 3-12 depending on the version.
	Ground both DIU and RFUs (3)		Connect ground cable between ground terminal on units and ground.
	Make 2 x DIU to RFU power cables (4)		For wiring data, see RFU DC Out (9) on page 3-10.
	Make 2 x DIU to RFU Data cables (5)		For wiring data, see Table 3-7 on page 3-10.
	N-type male to N-type male (6 GHz) RF cable to connect RFU (6)		Use between 60 dB (min) and 90 dB (max) attenuation and a short low-loss RF transmission line to connect the two radios.
	Connect BER Tester to Payload Connector (9) (10)		The BER Test must be connected for this test.
	60 – 90 dB of N-type attenuators (7)		Note Max input is –30 dBm, default output power is +24 dBm
3.	Connect attenuator(s) to RFUs		
4.	Interconnect the two RFUs with N-Type RF cable		
5.	Connect DIU to RFU x 2		Power and Data. Ensure that DIUs are not powered-up when connecting.
6.	Connect PSU to DIU x 2		Note that Velox LE 10, Velox LE 25 and Velox LE 50 DO NOT have Power ON/OFF switches, i.e. if PSU is on and connected to the source supply, the systems will power-up.
7.	Power-up both DIUs		ON/OFF Switch on back panel of Velox LE 120 Ohm & Velox LE 75/120 Ohm Versions. No switch on other versions.
8.	For each system, allow about one minutes settle time and clear any Alarm Conditions present		Using front panel Reset Button, carry out a 1-RESET to clear front panel LEDs and associated alarms in DIU.

Refer to Table 3-5 on page 3-7 for information on using the Reset Button to configure the Velox LE.

9.	Set one DIU to a NEAR Bridge configuration		Using front panel Reset Button, carry out an 8-RESET (Bridged Configuration) to set DIU to NEAR Bridge Configuration. Note that if a Routed configuration is being used a 5-RESET should be carried out.
10.	Set the other DIU to a FAR Bridge configuration		Using front panel Reset Button, carry out a 7-RESET (Bridged Configuration) to set DIU to FAR Bridge Configuration. Note that if a Routed configuration is being used, a 4-RESET should be carried out.
11.	Set the NEAR DIU to the required data rate (T1 or E1)		Using front panel Reset Button, carry out a 12-RESET (E1 Tributaries) or 13-RESET (T1 Tributaries)
12.	Set the FAR DIU to the same data rate as NEAR DIU (point 11 above) (T1 or E1) (use front panel Reset button)		
13.	Check the "RF Link" LED status		LED Green for working link

Refer to Table 3-4 on page 3-7 for information on Status LED interpretation. Note that if BER Tester is NOT connected, the Payload LED will be RED indicating No Payload signal.

14.	Clear DIU errors		Using front panel Reset Button, carry out a 1-RESET to clear front panel LEDs and associated alarms in DIU. If required the EVENT LOG can be cleared by using 2-RESET (only necessary if viewing the EVENT LOG on a PC. Reset BER Tester.
15.	Monitor Status		BER Tester should run with no errors All 3 Front Panel LEDs should be green. Note that "RF Link" LED may flash orange from time-to-time. See Note below for "Payload" LED indication.

Unless all tributaries are in use the "Payload" LED will be RED. For example, if only two tributaries are in use, but all four are active, the "Payload" LED will be RED, as the two unused tributaries have no signal. This is not important, as the main purpose of this test is to test the link, i.e. "RF Link" LED GREEN.

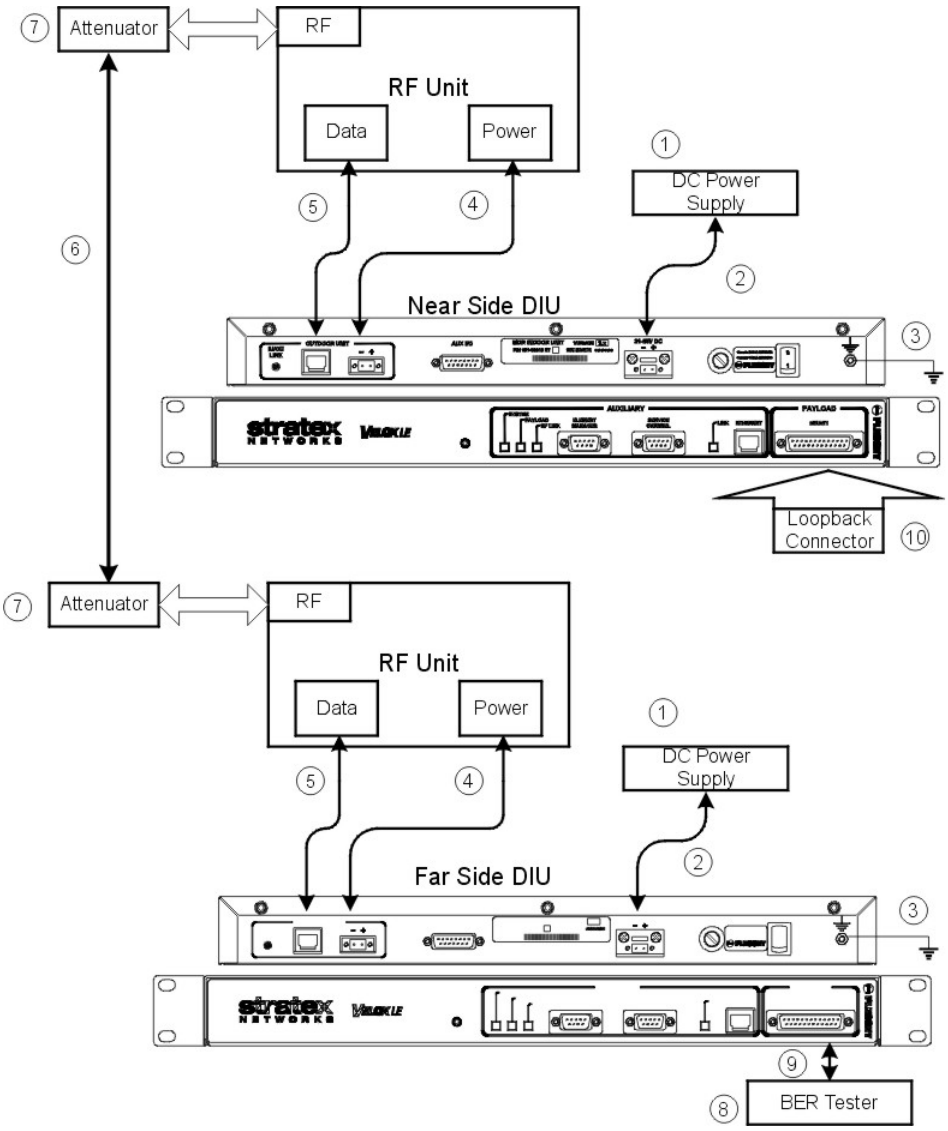


Figure 4-4. Velox LE System Connection for T1/E1 Bench Test (without PC)

Getting Started (with a PC)

This section describes the suggested steps to follow to successfully set-up a Velox LE link using a PC with NCT installed (see Chapter 5: NCT Installation).

This section applies to ALL Velox LE radio series with the only difference being the location of the interface connectors on the various DIUs.

Complete the checklist to ensure that you have the required equipment and information to continue.

Do not continue until you have read and completed the checklist!

	Steps to follow:	Check	Additional Information
1.	Velox LE Installation & Operation Manual (This Manual)		Ensure that you understand: The use of the Reset Button when configuring the Velox LE (see Reset/Configuration Button (3) on page 3-7. How to interpret the DIU front panel LEDs (see DIU Status Diodes (2) on page 3-6 and DIU/RFU Link LED (7) on page 3-9).
2.	NCT Program		NCT Program installed on the PC to be used together with an understanding of how to use NCT to configure the System (refer to NCT Program integrated software help).
3.	Connect the Velox LE System as shown in Figure 4-5 on page 4-15 noting the following (the numbers in brackets following each note correspond to the numbers given on Figure 4-5):		
	2 x DIU		
	2 x RFU		1 low and 1 high band - see L/H stamp near serial number
	2 x Power supplies (1)		21 to 58 Vdc, 35 W typical, 45 W maximum.
	Make 2 x PSU to DIU power cable (2)		For wiring data, see Table 3-9 on page 3-12 or Table 3-10 on page 3-12 depending on the version.
	Ground both DIU and RFUs (3)		Connect ground cable between ground terminal on units and ground.
	Make 2 x DIU to RFU power cables (4)		For wiring data, see RFU DC Out (9) on page 3-10.
	Make 2 x DIU to RFU Data cables (5)		For wiring data, see Table 3-7 on page 3-10.
	N-type male to N-type male (6 GHz) RF cable to connect RFU (6)		Use between 60 dB (min) and 90 dB (max) attenuation and a short low-loss RF transmission line to connect the two radios.
	60 – 90 dB of N-type attenuators (7)		Note Max input is –30 dBm, default output power is +24 dBm
	Connect BER Tester to Payload Connector (9) (10)		
	Connect PC (11) to Near Side DIU to Element Manager Port via serial cable (12) or to Ethernet connection (13)		PC must have NCT loaded and either: ▪ If using Ethernet – Ethernet channel set-up. ▪ If using Element Manager Port, serial connection configured. Note the configuration required is dependent on the version of Microsoft Windows installed on the PC (see Element Manager Point-to-Point Protocol Serial Communications Set-up on page 6-1 for further information).
4.	Connect attenuator (s) to RFUs		
5.	Interconnect the two RFUs with N-Type RF cable		
6.	Connect DIU to RFU x 2		Power and Data. Ensure that DIUs are not powered-up when connecting.
7.	Connect PSU to DIU x 2		Note that Velox LE 10, Velox LE 25 and Velox LE 50 DO NOT have Power ON/OFF switches, i.e. if PSU is on and connected to the source supply, the systems will power-up.
8.	Power-up both DIUs		ON/OFF Switch on back panel of Velox LE 120 Ohm & Velox LE 75/120 Ohm Versions. No switch on other versions.
9.	For each system, allow about one minutes settle time and clear any Alarm Conditions present.		Using front panel Reset Button, carry out a 1-RESET to clear front panel LEDs and associated alarms in DIU.

Refer to Table 3-5 on page 3-7 for information on using the Reset Button to configure the Velox LE.

10.	Set DIU with PC connected to a NEAR Bridge configuration. Default IP address: Ethernet option: 192.168.1.2 Modem option: 192.168.2.2		Using front panel Reset Button, carry out an 8-RESET (Bridged Configuration) to set DIU to NEAR Bridge Configuration. Note that if a Routed configuration is being used, a 5-RESET should be carried out.
11.	Set the NEAR DIU to the required data rate (T1 or E1)		Using front panel Reset Button. carry out a 12-RESET (E1 Tributaries) or 13-RESET (T1 Tributaries)
12.	At the NCT, connect to NEAR side DIU		If Serial Cable Connection is being used.
13.	Ping NEAR side DIU Default IP address: Ethernet option: 192.168.1.2 Serial Cable option: 192.168.2.2		See BRIDGED Configuration: Input Address Assignment on page 6-7 for further information.
14.	Set the other DIU to a FAR Bridge configuration. Default IP address: Ethernet option: 192.168.1.2 Modem option: 192.168.2.2		Using front panel Reset Button, carry out a 7-RESET (Bridged Configuration) to set DIU to FAR Bridge Configuration. Note that if a Routed configuration is being used, a 4-RESET should be carried out.
15.	Set the FAR DIU to the same data rate as point 19 (T1 or E1) (use front panel Reset button)		Using front panel Reset Button. carry out a 12-RESET (E1 Tributaries) or 13-RESET (T1 Tributaries)
16.	Ping FAR side DIU Default IP address: Ethernet option: 192.168.1.3 Serial Cable option: 192.168.2.3		See BRIDGED Configuration: Input Address Assignment on page 6-7 for further information.
17.	Check the “RF Link” LED status		LED Green for working link

Refer to Table 3-4 on page 3-7 for information on Status LED interpretation. Note that if BER Tester is NOT connected, the “Payload LED” will be RED indicating No Payload signal.

18.	Clear DIU errors		Using front panel Reset Button, carry out a 1-RESET to clear front panel LEDs and associated alarms in DIU. If required the EVENT LOG can be cleared by using 2-RESET (only necessary if viewing the EVENT LOG on a PC). Reset BER Tester.
19.	Monitor Status		BER Tester should run with no errors All 3 Front Panel LEDs should be green. Note that “RF Link” LED may flash orange from time-to-time. See Note below for “Payload” LED indications.

Deactivate all *unused* tributaries to ensure that the “Payload” LED stays GREEN for the tributaries *used*, i.e. if only two tributaries are in use, but all four are active, the “Payload” LED will be RED as the two unused tributaries have no signal. Deactivating the two unused tributaries via the NCT/GUI will result in the “Payload” LED only indicating information for two active tributaries only.

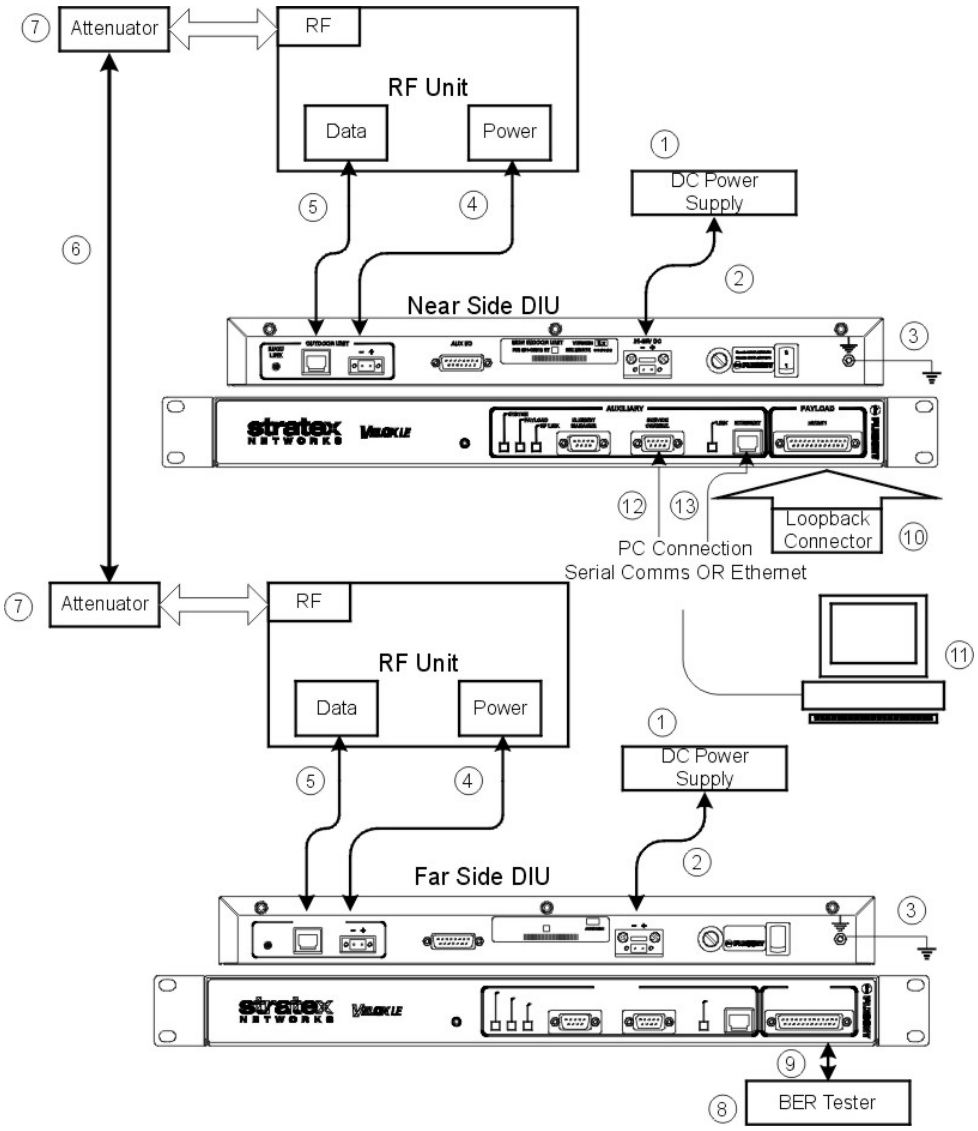


Figure 4-5. Velox LE System Connection for T1/E1 Bench Test (with PC)

Site Installation

This section assumes that pre-planning of the link has been completed to ensure correct location and orientation of antennas and that the antenna support structure (tower/mast/building) has appropriate cable attachment and grounding connection points. For more information on pre-planning, refer to the Stratex Networks' *Microwave Radio Systems Standard Practices Guide*.

It is suggested that a record of the equipment installed and other installation information is made. A typical installation record is shown in Table 4-8 on page 4-27.

Installation procedures are listed in the following order:

1. Installing the antenna.
2. Installing the RFU, which includes:
   - Grounding.
   - Fitting lightning surge suppressor between the RFU and the antenna.
   - Making up the RF Cable between the RFU and the antenna.
3. Installing the DIU, which includes:
   - Grounding.
   - Making-up and fitting the power supply cables.
4. Making-up and installing the cables between the DIU and the RFU, i.e.:
   - DIU/RFU Data Cable.
   - DIU/RFU Power Cable.
5. Making-up and installing optional cables, as follows:
   - Payload Cables.
   - Auxiliary I/O.
   - Service Wayside Channel.
   - Element Manager.
   - RFU RSSI cable.
6. Commissioning, which includes:
   - Software set-up.
   - Antenna alignment.

Before proceeding with an installation review the health, safety and hazard information given in Table 4-1 on page 4-1, Table 4-2 on page 4-2 and Table 4-3 on page 4-2.

Installing the Antenna

Stratex Networks offers antennas from several major manufacturers.

Antennas must be installed in accordance with the manufacturer's instructions, a copy of which is included with every antenna.

Before going to site, check that you have all the required installation tools as recommended by the antenna manufacturer, and that you have the antenna orientation and initial pointing data.

Installing the ORFU

The ORFU installation comprises the following:

- Install the RFU mounting bracket onto the antenna mast. Note that the mast diameter must be between 50 mm (2”) and 102 mm (4½).
- Mount and secure the RFU on the mounting plate.

The ORFU may be mounted indoors, utilising an optional rack mount adapter (not included as a standard item) at the base of a tower for convenient access. However, before using this method consideration must be given to the distance between the RFU and the antenna as long lengths of RF cable could have a compromising affect on system sensitivity. In addition, link costs would increase due to the high cost of such cable.

CAUTION

Ensure that the Antenna Mast is adequately grounded for Lightning Protection.

Follow these steps to install the RFU:

1. Install the system antenna in accordance with the manufacturer’s instructions.
2. Unpack the RFU mounting bracket assembly from the accessories box:
   - Remove the nuts, spring washers and flat washers from the Mount U-bolts.
   - Assemble the Mounting U-bolts to the the Mounting Bracket Clamp.
3. Referring to Figure 4-6:
   - Slide the U-bolts around the mast/pole and fit the Mounting Bracket Clamps.
   - Fit the 4 x M8 flat washers, spring washers and nuts onto U-bolt threads and finger tighten.
   - Using a 13 mm AF wrench, tighten the M8 nuts until the bracket is secure.

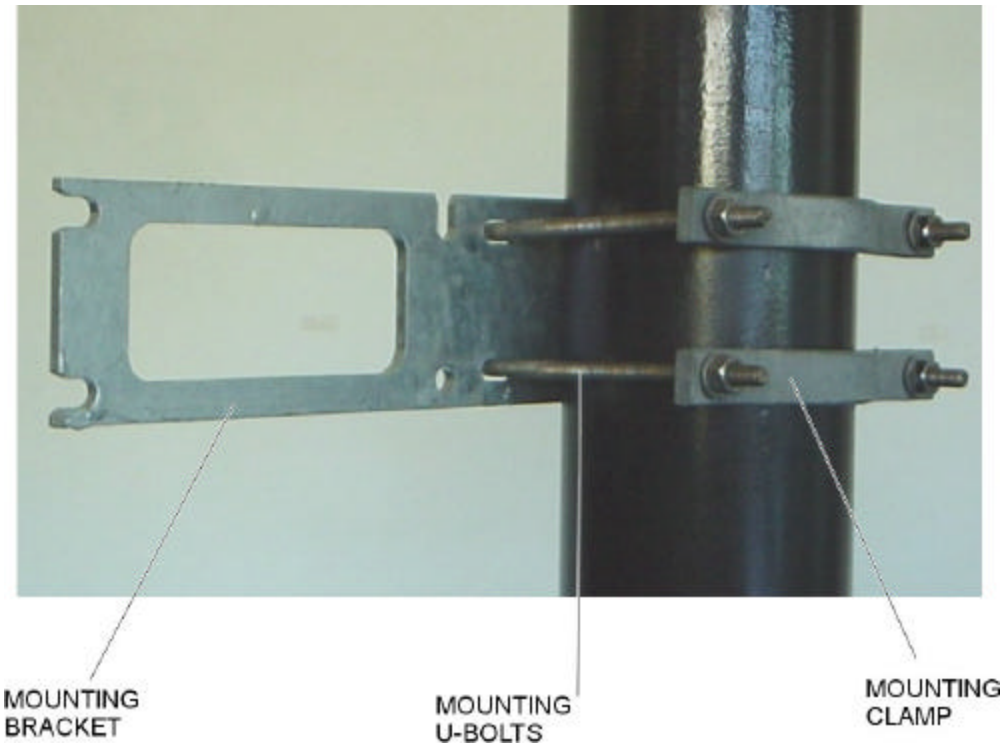


Figure 4-6. Installing the RFU (1)

4. Refer to Figure 4-7:
   - Loosen Mounting Bolts (1), (2) and (3) on the back of the RFU.
   - Remove Mounting Bolt (4).
   - Slide the RFU onto the Mounting Bracket so that the threads of the loosened bolts engage in the slotted holes in the Mounting Bracket.
   - Replace Mounting Bolt (4).
   - Secure the RFU by tightening Mounting Bolts (1), (2), (3) and (4).

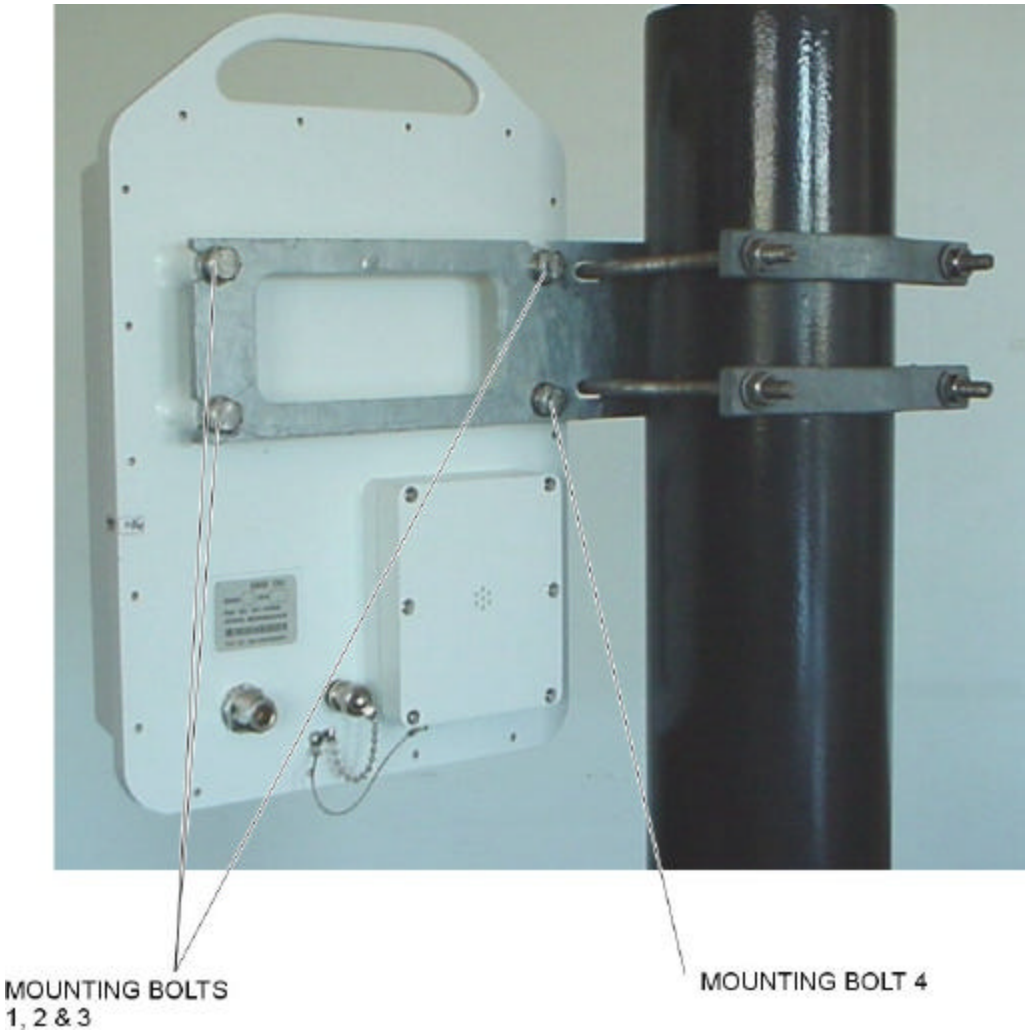


Figure 4-7. RFU Installation (2)

5. Ground the RFU as follows:
   - Connect the RFU to the pole electrically by connecting the earth cable or strap between the pole earth and the RFU Ground Terminal.
   - OU ground lug: 10-8 (10 square mm for wire and hole big enough for M8 thread).
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. Weatherproof connectors using an ultra violet protective, self-vulcanising tape.

Installing the IRFU

The Velox LE 2410, Velox LE 2450, Velox LE 5810 and Velox LE 5850 outdoor RFUs are also available as 1RU high IRFUs, Velox LE 2410i, Velox LE 2450i, Velox LE 5810i and Velox LE 5850i, that can be rack mounted in a 19" rack.

Note that when installing an IRFU consideration must be given to the distance between the IRFU and the antenna as long lengths of RF cable could have a compromising affect on system sensitivity. In addition, link costs would increase due to the high cost of such cable.

1. Install the IRFU as follows:
   - Slide the IRFU into the 19" rack and secure to the rack using four (4) M6 x 18 mm screws and washers provided.
   - Ground the IRFU by connecting the ground cable or strap between the station ground and the ground terminal on the IRFU front panel.
2. Install the system antenna (see Installing the Antenna on page 4-16). Note that the RSSI BNC connector is on the front panel of the IRFU.
3. Connect IRFU to antenna noting the following:
   - Connect the RF cable or waveguide outer conductor to the pole lightning earth electrically before it enters the building in which the equipment is housed.
   - Connect the type-N RF output connector on the front panel to the system antenna through an inline lightning protection unit.
   - The N-Type connector is used to connect to the antenna, typically using coaxial transmission line or flexible waveguide via a launch/N-type adaptor.
   - 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.
   - Do not use right angle N-type connectors with the radios: they may present high loss.
   - Do not use low quality cables. Some cable types, such as RG-8, may have too high a loss at 5.8 GHz.
   - Elliptical waveguide is recommended for longer feeder runs to minimize losses.
4. Weatherproof the connectors using an ultra violet protective, self-vulcanising tape.

Ensure that the Antenna Mast is adequately grounded for Lightning Protection.

Installing the DIU

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

The DIUs payload (nT1, nE1 and 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 Velox LE DIU, suitable for rack installations and on the front panel for the rest of the Velox LE 10, Velox LE 25 and Velox LE 50 DIUs, simplifying accessibility.

Install DIU as follows:

1. Install the DIU in the rack:
   - Slide the DIU into the 19" rack.
   - Secure to the rack using four (4) M6 x 18 mm screws and washers provided.
2. Ground the DIU by connecting the ground strap between the station ground and the Ground Terminal on the DIU rear/front panel (depending on product variant). This is required for safety and to minimize radiated emissions.
3. DC power connection:

The power supply specification for the current Velox LE 10, Velox LE 25 and all Velox LE 50 DIUs is 21 to 58 Vdc whereas older Velox LE 10, Velox LE 25 DIUs and all other DIUs require 21 to 56 Vdc.
ENSURE that you comply with the power supply specification printed above the POWER connector on the DIU.
DC power supply grounding: Positively or negatively grounded
Power consumption 40 W typical (35 W Velox LE 2400/5800), 45 W maximum.

   - Prepare DC power supply cable.
     Table 3-9 on page 3-12 (Velox LE 120 Ohm and Velox LE 75/120 Ohm).
     Table 3-10 on page 3-12 (Velox LE 10, Velox LE 25 and Velox LE 50).
   - Connect cable to the DC supply (Voltage range as indicated on the DIU) through a minimum 2 A slow blow circuit breaker. Check the supply voltage using a multimeter.
   - On Velox LE 120 Ohm and Velox LE 75/120 Ohm ensure ON/OFF switch on rear panel is set to 0 and connect DC power cable to 21-58 Vdc connector on rear panel. Tighten connector screws.
   - Do NOT connect DC power cable to Velox LE 10, Velox LE 25 and Velox LE 50 as these units DO NOT have an ON/OFF switch, i.e. connecting the DC power supply will power-up the radio.
4. Payload Data Ports:

Balanced 120 Ohm (DB25) – Prepare cable (refer 25-Way D-type Connections (Balanced 120 Ohm, Unbalanced 75 Ohm)

Balanced 120 Ohm and unbalanced 75 Ohm termination via 25-way D-type connectors are available on all Velox LE DIUs. The standard termination is 120 Ohms on all DIUs. Unbalanced 75 Ohm is an optional termination, which on the Velox LE 10 and Velox LE 25 units must be requested from the supplier when ordering the system and is user configurable on the Velox LE 50.

- on page 3-3) and connect to front panel connector(s).

Balanced 110 Ohm (RJ48) – Prepare cables (refer

Table 3-2: Pin Connections for Unbalanced 75 Ohm Termination on 25-Way D-Type Connector

D-Type Payload Connector Pin #	Pin Name	Tributary	Direction	Remarks
1	Rx GND/Earth		N/A	
2	RTIP2	2	RX +	

Table 3-2: Pin Connections for Unbalanced 75 Ohm Termination on 25-Way D-Type Connector

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

- RJ48 Connections(Balanced 120 Ohm and Unbalanced 75 Ohm) on page 3-4 and connect to front panel connectors.
- Unbalanced 75 Ohm (BNC) – Prepare cables (refer Unbalanced Payload Data (BNC) (Velox LE 75/120 Ohm Only) on page 3-6 and connect to front panel connectors.

5. Auxiliary In/Out port (optional). If required prepare cable and connect to DIU front panel (refer Auxiliary I/O (10) on page 3-10 for cable preparation information).
6. Service Channel (Wayside) Serial Port (optional).). If required prepare cable and connect to DIU front panel (refer Service (Wayside) Serial Data Channel (4) on page 3-8 for cable preparation information).
7. Connect the Element Manager port using the supplied Lap Link Cable (660-03349).
8. Ensure that all connector locking screws are secured

Installing the DIU to RFU Data and Power Cables

1. Using a 10 mm Allen key open the lid on the RFU connection box (ORFU only).
2. Prepare and install DIU to RFU Data Cable (refer to Table 3-7 on page 3-10 for wiring data and Table 4-5 on page 4-7 for recommended cables).

3. Using the two supplied connectors blocks (Green), prepare DIU to RFU Power Cable refer to Table 4-5 on page 4-7 for recommended cables).

DO NOT CONNECT the DIU to RFU Power Cable while power is applied to the IDU. The DIU can be powered without the RFU connected; however, power should be removed before the RFU is connected and reapplied only after the Power Cable is connected and the RFU is properly terminated at the RF port, i.e. antenna connected.

4. Connect the Power Cable to the DIU and RFU connectors.
5. Use cable ties at regular intervals to secure the Data and Power cables to the mast.
6. Close and secure the RFU connection box lid using a 10 mm AF Allen key.

Commissioning

General

This section describes the procedure for software set-up and antenna alignment. The set-up is done using a laptop/PC running the supplied NCTGraphical User Interface (GUI) software. See Chapter 5: NCT Installation for details on installing the NCT/GUI. Use of the NCT/GUI is described in the Online Help file supplied with the software.

Equipment Required for Commissioning

The following tools and instruments are required for software set-up and aligning the antenna:

- RSSI cable (supplied part number 660-03405)
- Multimeter (measurement of RSSI)
- Wrench/spanner (see appropriate details in installation chapter depending on the antenna being used)
- PC with NCT software and Lap Link cable (supplied part number 660-03349). PC should be configured for applicable connection to DIU (serial cable or Ethernet).
- 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.
- Cellular phone or two-way radios (for talking too far-end crew and tower crew).
- Loop Back connector.

Information Required

You should know:

- The proposed frequency channel plan for each station. Also see section Frequency Plans on page 8-5.
- The expected receive signal level based on the chosen system configuration and a path loss analysis.

Antenna Alignment

Introduction

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

1. Switch the DIU power ON.
2. Run the NCT Software application.
3. Configure the radio channel plan as required.
4. Set the transmitted power to maximum.
5. Perform a RF loop back test at each site before starting the alignment procedure.

Alignment Procedure

1. Locate the far site and point the antenna to the antenna at the far site, as accurately as possible using selected method (binoculars, compass, GPS).
2. Connect the Multimeter to the RSSI connector on the RFU using the supplied RSSI cable and set the Multimeter to measure volts.
3. Note the RSSI level and refer to Figure 4-8, Figure 4-9 and Figure 4-10 below for received power level.
4. Loosen the antenna and align the antenna until the maximum RSSI is attained.
5. Secure the antenna.
6. Measure the RSSI level and record the value.
7. Compare with the value with that calculated for the link, i.e. using the path loss calculation done when planning the link.

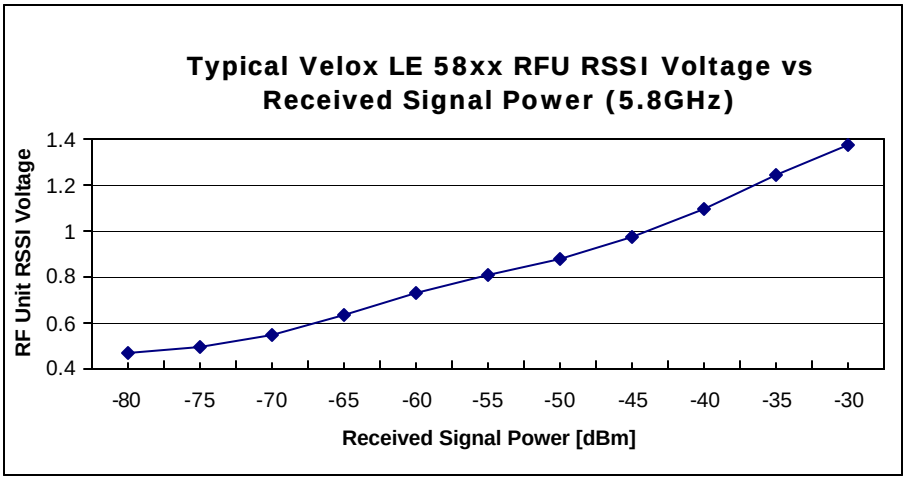


Figure 4-8. Typical Velox LE 5810 and Velox LE 5810i RSSI Voltage versus Received Signal Power

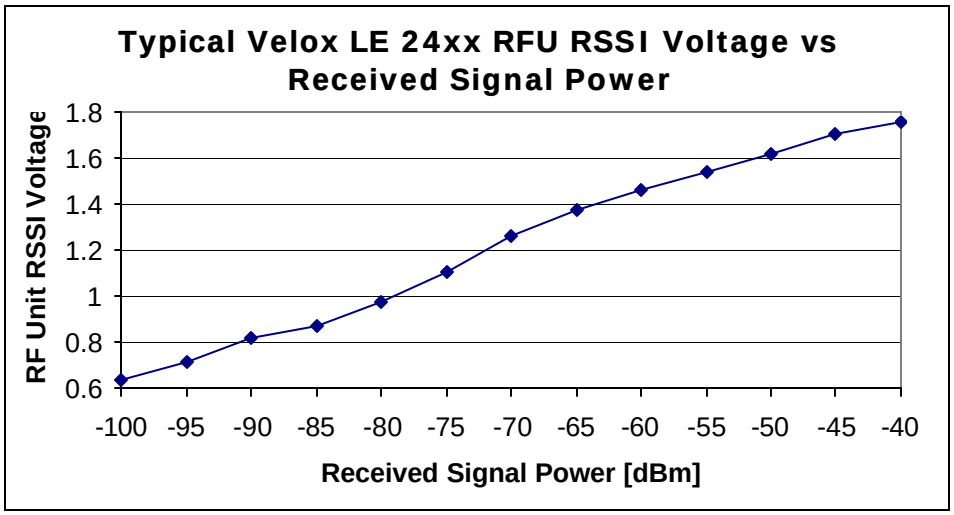


Figure 4-9. Typical Velox LE 2410 and Velox LE 2410i RFU RSSI Voltage as a function of RF input power level

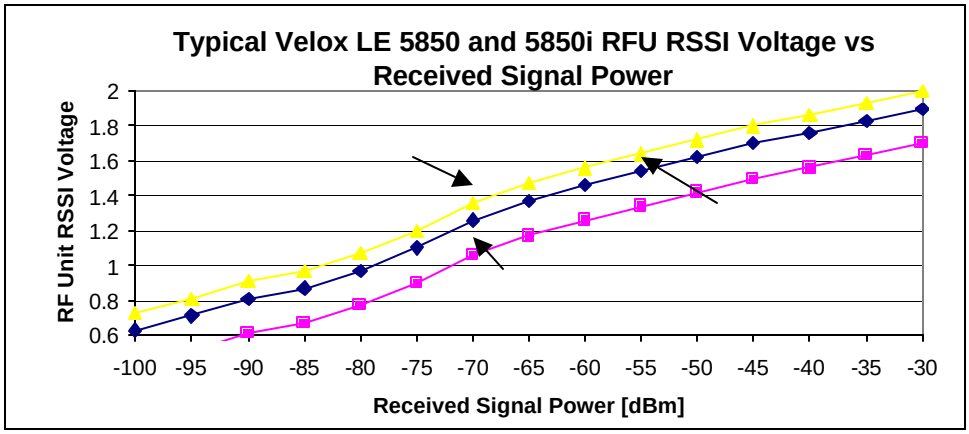


Figure 4-10. Typical Velox LE 5850 and 5850i RFU RSSI Voltage as a Function of RF Input Power Level (note the different bandwidths)

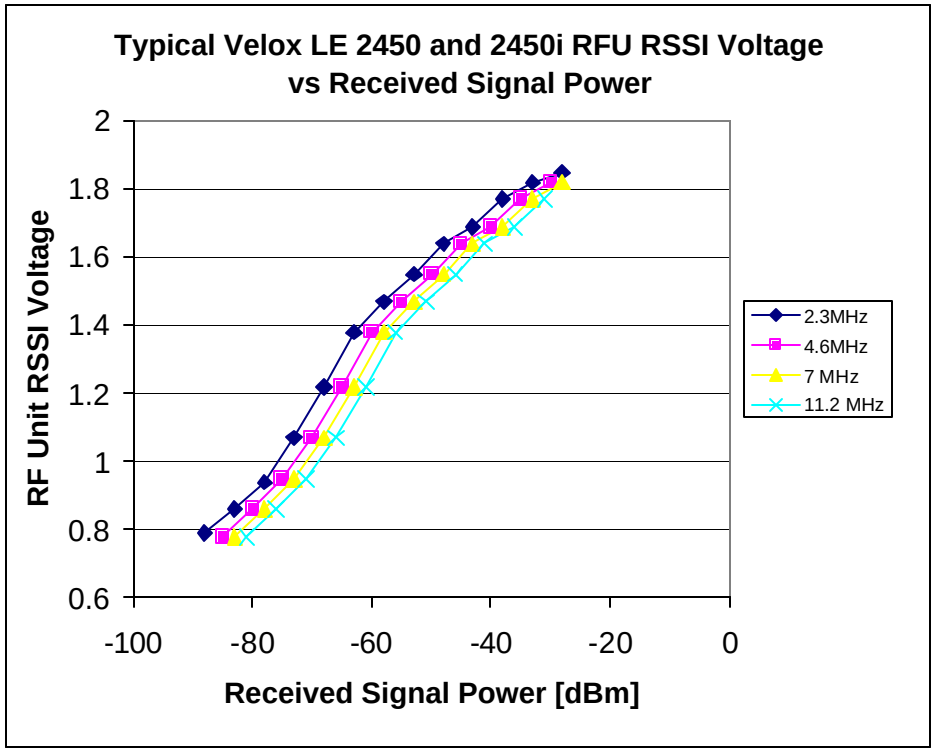


Figure 4-11. Typical Velox LE 2450 and 2450i RFU RSSI Voltage as a Function of RF Input Power Level (note the different bandwidths)

From the Figure 4-8 to Figure 4-11:

- -80 dBm Average 0.436 ± 0.029 V, which relates to a MIB (Management Information Base) RSSI of 95 ± 1 dBm (see Notes below)
- -30 dBm Average 1.333 ± 0.047 V, which relates to a MIB RSSI of 54 ± 2 dBm (see Notes below).

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

NOTE 1 For the Velox LE 2400, Velox LE 5800, Velox LE 2410i and Velox LE 5810i 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 NCT / GUI will do this adjustment automatically and will therefore always display the correct RSSI value.

NOTE 2 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.

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 RFU and the antenna if the power level cannot be sufficiently reduced. The dBm output at the RFU N-type connector (socket) levels are set-up via the NCT or using a SNMP Management application.

Diagnostics (Loopback Modes)

This section describes the usage of the loop back modes.The purpose of loop back is to return the payload data to its sender, thus *looping it back*. The payload data is never sent to the other radio in the link. This can be done at two stages in the Velox LE products;

Baseband / IF Loopback

BaseBand loopback *loops* the payload data *back* to the sender just before it reaches the radio's RF-modem. BaseBand loopback can be used to verify all the data cables and connectors and the radio's interface circuitry.

RF Loopback

RF loopback *loops* the final transmitted microwave signal *back* to the radio's microwave receiver. RF loopback verifies the RF-modem and the transceiver line-ups.

The RF loop back works best in Band Plan B; using it in other band plans is not guaranteed to work.

CAUTION

The signal does reach the antenna connector and is thus still transmitted if an antenna is connected.

Loopback Procedure

- Connect DIU to PC via the Element Manager Port or Ethernet port. Also see : NCT Installation on page 5-1 and Element Manager Point-to-Point Protocol Serial Communications Set-up on page 6-1
- Open the NCT application.
- Go to the “Diagnostics” dropdown list and click on the “Loopback Window”.
- Choose the required option from the dropdown list.

eg. Baseband Loopback window.

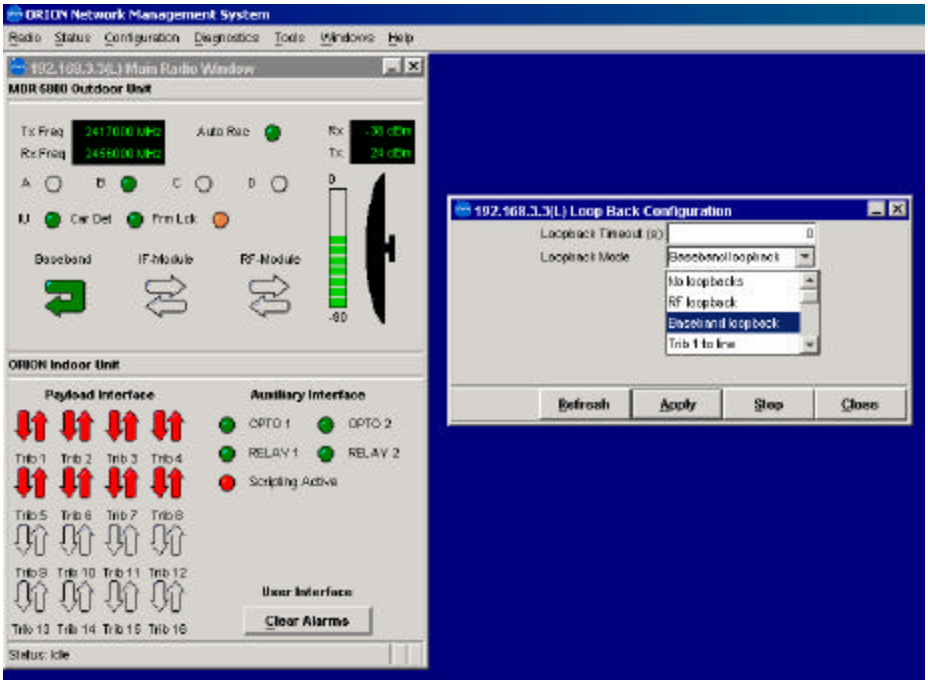


Figure 4-12. Baseband Loopback window

Velox LE Installation Record

A typical Installation Record is shown below in Table 4-8.

Table 4-8. Velox LE 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		
RFU serial number	NA		

DIU serial number	NA		
RFU grounded	Yes/No		
DIU grounded	Yes/No		
Power Supply	Volts DC/AC		

	Date	Name	Signature
Installed by			
Approved by			

Velox LE Test Record

A suggested Test Record sheet is shown in Table 4-9 below.

Table 4-9. Velox LE Test Record Sheet

Parameter	Unit	Site A	Site B
Frequency channel plan: Transmit Receive NOTE 1: C is NOT applicable for the Velox LE 2400. 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)		

Chapter 5 : NCT Installation

Connecting to the Velox LE

This can be done by two methods:

- By means of the Ethernet port.
- Serial Cable Connection. See Element Manager Point-to-Point Protocol Serial Communications Set-up on page 6-1.

NCT Software Installation

Scope

This section provides brief instructions on how to install the Velox LE NCT. A detailed HTML-based help document can be found on the NCT installation CD supplied with new radios.

Introduction

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

- DIU
- RFU

The NCT 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 NCT comprises hardware and software, whichis known as the NCT Terminal.

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

The NCT connects to a designated NCT Terminal port (ELEMENT MANAGER) on the front panel of the DIU, by means of a serial data interface (supplied Lap Link Cable). It can also connect to any number of DIUs interconnected through an IP network.

The NCT communicates with SNMP agent software that is contained in each DIU. The NCT communicates with the agent's software: the software enables a unit to interpret

MIB (Management Information Base) commands via SNMP (Simple Network Management Protocol).

The NCT application supplied with older Velox LE radios have been replaced with the Java-based Velox LE NCT. The older NCT does not support the new Velox LE series radios and it is highly recommended to replace the old NCT with the new NCT version.

System Requirements

The system requirements for the Velox LE NCT PC are as follows:

- 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)

Installing the NCT

General

The NCT has 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 NCT will be used.

The installation files for the NCT and the JRE are provided on the installation CD that is shipped with the Accessories that accompany each Velox LE Radio (DIU and RFU).

The supplied installation files allow the NCT 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 NCT to be installed on a system using a Linux operating system.

Note that the NCT updates are available from the following Web Site:

- www.stratexnet.co.za/updates

JRE Installation

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

1. Browse to the ***//Velox LE NCT/JRE*** folder in the root of the installation CD
2. Run the ***j2re-1_3_1_02-win.exe*** installation application
3. Follow the user prompts in the JRE installation application to set up the JRE in the preferred folder on the PC

NCT Installation

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

1. If a previous version of the Velox LE NCT have been installed on the target PC, first uninstall the previous version
2. Browse to the ***//Velox LE NCT/Setup*** folder in the root of the installation CD
3. Execute the ***Stratex_Velox LE NCT_vXpXX.exe*** installation application
4. Follow the user prompts in the NCT installation application to set up the NCT in the preferred folder on the PC

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

NCT Uninstall

Access Start/Velox LE NCT and select the Uninstall option to uninstall the NCT from the PC. This action removes all installed files, menu items and registry entries from the PC.

Help documentation

The HTML based help documents for the Velox LE NCT application are available on the installation CD at the following path: **//Velox LE NCT/help/Velox LE NCT Help.htm**. Open the Help using an Internet browser, e.g. MS Internet Explorer.

The Help can also be opened from the Windows Start folder created for the Velox LE NCT or through the **Help/Contents** menu in the Velox LE NCT application.

Configure Radio using NCT

Use the NCT help files for information on how to set-up the Velox LE system. Follow *"Getting Started"* in the dropdown menu *Help/Contents* of the Velox LE NCT.

Chapter 6 : NCT PC Set-up

Element Manager Point-to-Point Protocol Serial Communications Set-up

Introduction

This section summarises how to set up a network connection using Point-to-Point Protocol (PPP) between a PC and the Element Manager port on the Velox LE DIU. It lists how the connection can be set-up and configured to allow data transfer and SNMP-based control of the Velox LE DIU.

The procedures given act as guidelines only and may differ from one version of Windows to the next. If further assistance is required, consult Help for your particular MS Version.

Adding Dial-up Networking : Windows 2000

The installation procedure documented here is based on the procedure that should be followed for Windows 2000.

1. Click on “Start” on the desktop “Start bar”.
2. Select “Settings” menu item.
3. Select “Network and Dial-up Connections” menu item.
4. Select “Make New Connection” menu item.
5. The “Network Connection Wizard” window will open.
6. Click “Next” button.
7. Select “Connect directly to another computer” and press the “Next” button.
8. Set the dialup connection to connect as “Guest” and click the “Next” button.
9. Select the COM port that you intend to use to connect to the radio from the “Select a Device” dropdown box and click the “Next” button.
10. Select the users that must be able to use this dialup connection and click the “Next” button.

Enter the name of this dialup connection and click the “Finish” button. This name may be any name of your choice. The connection is now installed, but its properties must still be configured.

Adding Dial-up Networking : Windows XP

The installation procedure documented here is based on the procedure that should be followed for Windows XP.

1. Click “Start” on the desktop “Start bar”.
2. Select “Connect to” menu item.
3. Select “Show all connections” menu item.
4. Select “Create a new connection” menu item in the “Network Tasks” section.
5. The “New Connection Wizard” window will open.
6. Click “Next” button.
7. Select “Set up an advanced connection” and press the “Next” button.
8. Select “Connect directly to another computer” and press the “Next” button.
9. Set the dialup connection to connect as “Guest” and click the “Next” button.
10. Enter the name of this dialup connection and click the “Next” button. This name may be any name of your choice.
11. Select the COM port that you intend to use to connect to the radio from the “Select a Device” dropdown box and click the “Next” button.
12. Select the users that must be able to use this dialup connection and click the “Next” button.
13. Click the “Finish” button. The connection is now installed, but its properties must still be configured.

Set-up of Dial-up Connection Properties for Windows 2000/Windows XP

1. Click on “Start” on the desktop “Start bar”.
2. Select “Settings” menu item.
3. Browse to the newly added connection under the “Network and Dial-up Connections” menu item and right click on the connection with your mouse.
4. Select the “Properties” item from the pop-up menu to bring up the properties window.
5. Click on the “Configure” button below the “Select a Device” combo box in the “General” properties tab window to bring up the “Modem Configuration” box.
6. Select “115200” form the “Maximum speed (bps):” drop down box and click “Enabled hardware flow control” option. All other options must be deselected. Click the “OK” button.
7. Click on the “Options” properties tab, select “Redial if line is dropped” and press the “OK” button.
8. Browse to the newly added connection under the “Network and Dial-Up connections”, and click on the connection with your mouse. This will bring up the connection window. The values of the “Username” and “Password” fields does not matter, press “Connect” to dial into the radio once the dialup cable has been plugged into the DIU and the PC.

For PCs with Windows NT, 95 or 98, check that a Network Adapter is installed.

9. Consult the Windows Help for assistance on setting up a serial comms network adapter.
10. Double click “My Computer” icon.
11. Click on the “Help” dropdown box in “My Computer” window and choose the “Help Topics” option.
12. Click the “Index” tab.
13. Enter “network adapters” in the search field box.
14. Follow the instructions to set up the adapter.

Adding a Modem for Windows NT

When working with a PC running a Windows NT, add a modem using the following procedure:

1. On the desktop, double click “My Computer” icon.
2. Double click the “Modems” icon in the “My Computer” window.
3. The “Modems Properties” window will open.
4. Click the “Add.” button in the “Modem Properties” window.
5. The “Install New Modem” window will open.
6. Click the checkbox labelled “Don’t detect my modem; I will select it from a list.”
7. Click the “Next” button.
8. Select the “(Standard Modem Types)” option in the “Manufacturers:” selection box.
9. Select the “Dial-Up Networking Serial Cable between 2 PCs” option in the “Models” selection box.
10. Select the COM port to use – click the “Next” button when the COM port has been selected.
11. Click the “Finish” button to complete the installation.

Adding Dial-up Networking for Windows NT

1. On the desktop, double click “My Computer” icon.
2. Double click the “Dial-up Networking” icon in the “My Computer” window.
3. The “Add RAS Devices:” window will open.
4. Select the “COM1 – Dial-Up Networking Serial Cable” or “COM2 – Dial-Up Networking Serial Cable” option in the “RAS Capable Devices:” selection box.
5. Click “OK” button.
6. The “Remote Access Setup” window will open.
7. Click on the “Continue” button.

8. Whether COM1 or COM2 is selected, the window “Dial Idu – comX.rnk Properties” will open. The set-up from here allows establishment of a PPP connection between the computer and the DIUs Element Manager port.
9. Select the “Settings” tab and click the “Edit” button.
10. The “Edit Phonebook Entry” window will open.
11. Select the “Basic” tab in the “Edit Phonebook Entry” window.
12. Clear all fields and select “Dial-Up Networking Serial Cable be….” in the “Dial using:” edit box.
13. Select the “Server” tab and “Edit Phonebook Entry” window.
14. Select “PPP: Windows NT, Windows 95 Plus, Internet” option in the “Dial-up server type:” edit box. Select TCP/IP option in the “Networks protocols” group box. All other fields should be clear.
15. Click the “TCP/IP Settings…” button.
16. The “PPP TCP/IP Settings” window will open.
17. Select “Server assigned IP address”, “Server assigned name server address” and “Use IP header compression”.
18. Click the “OK” button.
19. The “Edit Phonebook Entry” window will be displayed.
20. Select the “Script” tab.
21. Select the “None” option in the “After dialling (login)” group box.
22. Select the “Security” tab.
23. Select “Accept any authentication including clear text” option.
24. Click the “OK” button.

Adding a Modem: Windows 95/98

1. When working with a PC running Windows 95/98, add a modem using the following procedure:
2. On the desktop, double click “My Computer” icon.
3. Double click the “Modems” icon in the “My Computer” window.
4. The “Modems Properties” window will open.
5. Click the “Add.” button in the “Modem Properties” window.
6. The “Install New Modem” window will open.
7. Select “Other” option.
8. Click the “Next” button.
9. Click the checkbox labelled “Don’t detect my modem; I will select it from a list.”
10. Click the “Next” button.
11. Use the mdrnull.inf to add a serial cable modem connection capability to the PC or laptop.

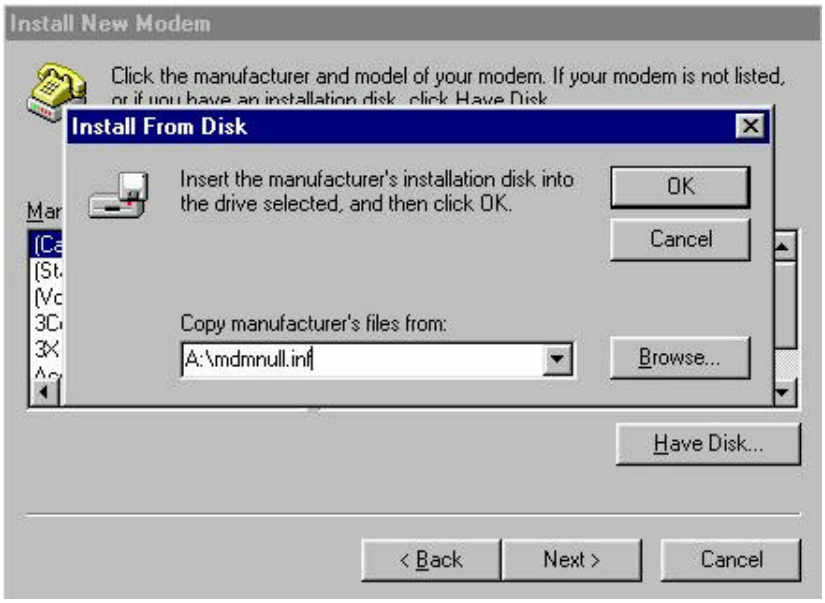


Figure 6-1. Selecting the Modem (Windows 95/98)

1. Once set-up, use the “Direct Connection Properties” window to set up the COM port’s parameters.
2. Select the required COM port in the “Port” edit box.
3. Select “115200” and “Only connect at this speed” in the “Maximum speed” group box.
4. Click the “OK” button.
5. The “Direct Connection Properties” window will open.
6. In the “Connection preferences” group box, select:
   Data bits = 8
   Parity = None
   Stop bits = 1
   All other option should be de-selected.
7. Click the “OK” button to finish.

Adding Dial-up Networking : Windows 95/98

After adding the modem, set up the connection properties using the following steps as a guideline. This will allow establishment of a PPP connection between the computer and the DIU s Element Manager port.

1. A Null_Modem connection should be available. If one doesn’t exist, double click on the “Make New Connection” icon.
2. The “Null_Modem” window will open.
3. Select the “General” tab.
4. Select “Use country code and area code” and enter telephone number information.
5. Select “Direct Connection” option in the “Connect using:” group box.
6. Select “Server Types” tab.

7. Select “PPP: Windows 95, Windows NT 3.5, Internet” option in the “Type of Dial-up Server” edit box. Select TCP/IP option in the “Allowed networks protocols” group box. All other fields should be clear.
8. Click the “TCP/IP Settings…” button.
9. The “PPP TCP/IP Settings” window will open.
10. Select “Server assigned IP address”, “Server assigned name server address”, “Use IP header compression” and “Use default gateway on remote network”.
11. Click the “OK” button.

IP Configuration of the Velox LE

BRIDGED Configuration: Input Address Assignment

Figure 6-2 shows the default (factory) network IP addresses assigned to the various network ports on the Velox LE System: BRIDGED CONFIGURATION.

For most networks, the Bridged Configuration is the preferred IP configuration.

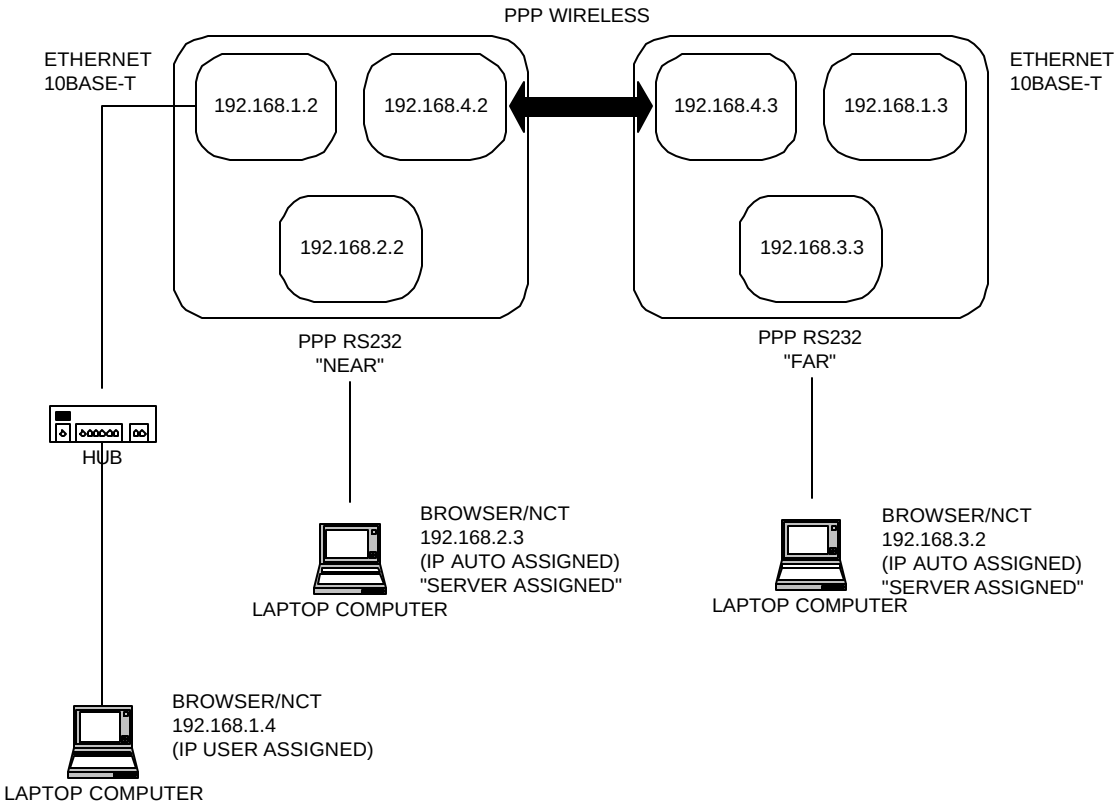


Figure 6-2. Velox LE Bridging Configuration

Note that the netmask for all the 192.168.x.x addresses is 255.255.255.0.

Carrying out a Ping on a Bridged Network

To carry out a Ping, connect to DIU by using the modem dial-up connection. Once a connection is established, open a Dos window and type ping 192.168.x.x. Where x.x is

the last two digits of the Ethernet IP Address of the equipment you want to ping. For example in Figure 6-3 there are two Ping commands as follows:

- Ping 192.168.2.2, which is the Ethernet IP Address of the Element Manager in "NEAR" system.
- Ping 192.168. 3.3, which is the Ethernet IP Address of the Element Manager in "FAR" system.

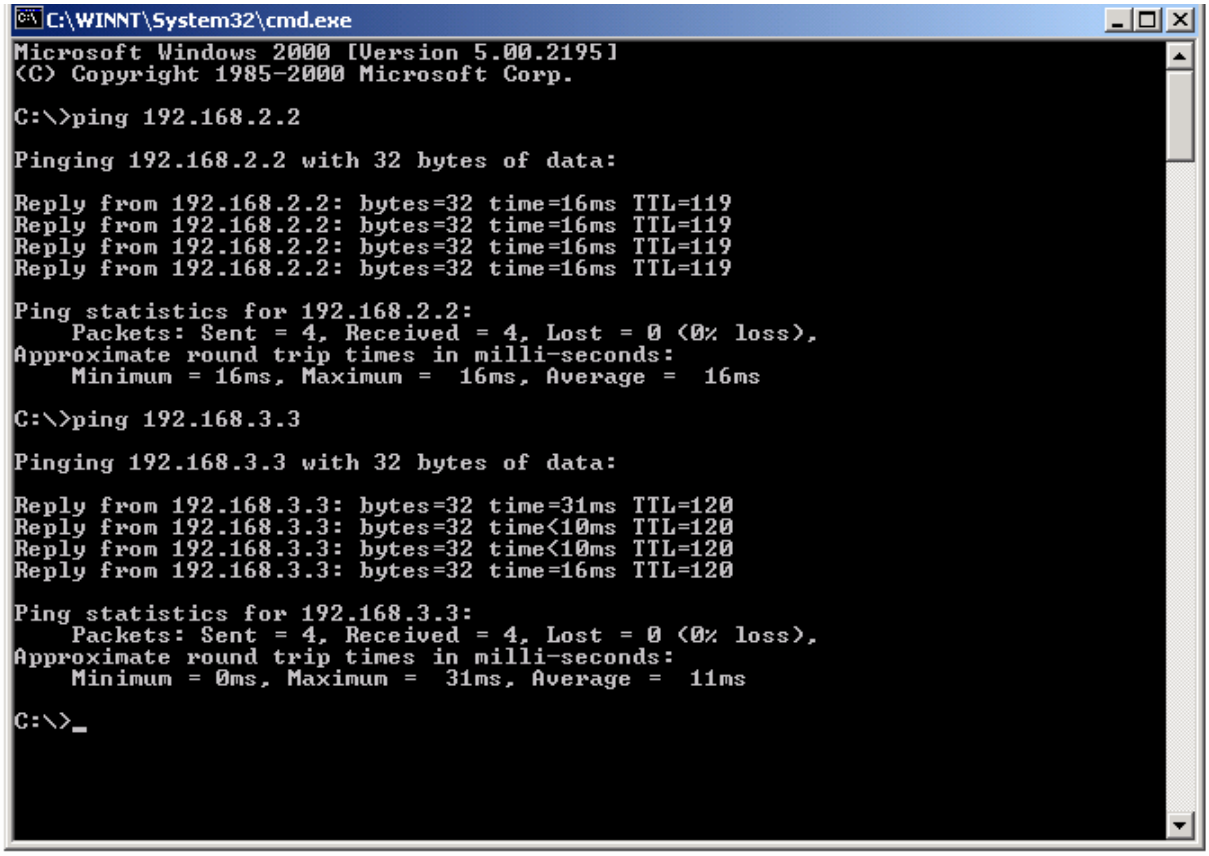


Figure 6-3. Screen showing Example Pings

ROUTED Configuration: Input Address Assignment

Figure 6-4 shows the default (factory) network IP addresses assigned to the various network ports on the Velox LE System: ROUTED CONFIGURATION.

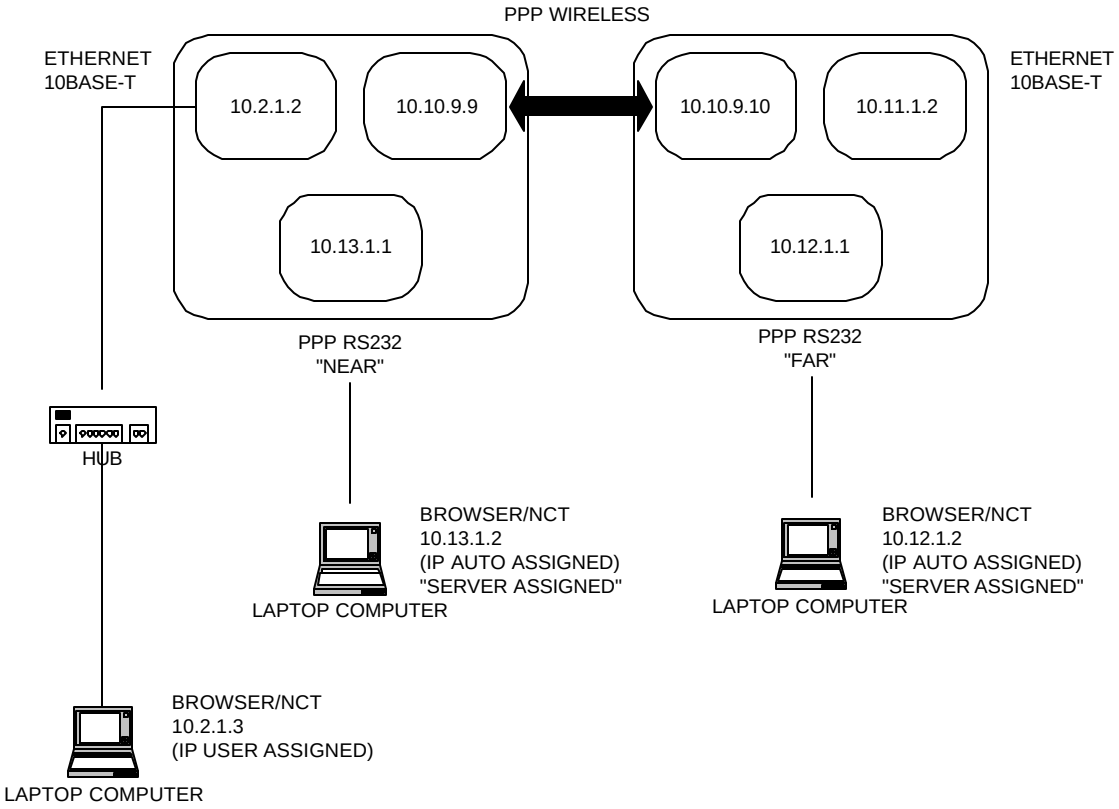


Figure 6-4. Velox LE Routed Configuration

Chapter 7 : Maintenance and Radio Upgrades

Velox LE FTP Firmware Upload

Firmware Upload

Firmware can be uploaded to Velox LE DIUs using FTP uploads as well as by using the "CVF Loader" or NCT software, available on the software CD or from the distributor.

Note the following:

- Username : anonymous
- Password : guest

The relevant MIB info is in the "mdrmteConfiguration" GROUP

- 1.3.6.1.4.1.1316.1.1.1.2.5 mdrmteFirmware.
- 1.3.6.1.4.1.1316.1.1.1.2.5.1 mdrmteFTPServerStatus. By default the DIU FTP server is active.
- 1.3.6.1.4.1.1316.1.1.1.2.5.2 mdrmteFlashNewFirmware. By default the upgrade is immediate (it can also be timed).

We recommend that the user ALWAYS verifies that the new version has been uploaded and is being used by the DIU. To do this verification, check the following element:

- 1.3.6.1.4.1.1316.1.1.1.2.4.3 mdrmteIUFirmwareVersion

This OID (object ID) is part of:

- 1.3.6.1.4.1.1316.1.1.1.2.4 mdrmteGeneral, part of the "mdrmteConfiguration" GROUP

When updating the DIU firmware by means of FTP, note that the choice of IP address is very important. You must always choose the IP address of the interface "closest" to you. In other words if you are using Ethernet to connect, then use the IP address of the Ethernet Interface, e.g. 192.168.1.2 for NEAR DIU in a Bridged configuration. See

IP Configuration of the Velox LE on page 6-7 for information on IP addresses.

If you are updating the firmware on the FAR unit, use the IP address of the "overhead" PPP link - **NOT** the Ethernet interface of the FAR unit. For example, use 192.168.4.3 when uploading to the FAR side and using the Bridged configuration. If by mistake you use the wrong address, you will create a "half-established" FTP session, and NO FURTHER SESSIONS will be permitted until the session times out after some minutes.

Set-up for Full Duplex Mode (at Maximum Transfer Rate)

Set-up the Velox LE radio in Full Duplex mode as follows:

1. Upload the radio Firmware by following the aforementioned procedure. Full duplex Ethernet operation is supported from version 2 of the firmware.
2. Using the Rest Button set the required default configuration. 7-RESET and 8-RESET for Bridged Configuration and 4-RESET, 5-RESET and 6-RESET for Routed Configuration (see Table 3-5 on page 3-7 for full details of default configurations).
3. Ensure that the PCB revision of the DIU is issue_2_mod_a(3) by reading the following MIB element: 1.3.6.1.4.1.1316.1.1.1.2.4.15 mdrmteIndoorUnitPCBrevision. If the PCB revision is issue_2(2) the radio hardware does not support Full Duplex Ethernet mode.
4. Disable all tributary channels to make the maximum user bandwidth available for Ethernet traffic.
5. Enable Full Duplex mode via the MIB using element: 1.3.6.1.4.1.1316.1.1.1.4.16 mdrmteEthernetFullDuplex.
6. Set the data rate to T1 if required using MIB element: 1.3.6.1.4.1.1316.1.1.1.2.1.1 mdrmteDataRate.

Tributary Upgrading

The tributary configuration code determines the software capabilities of the radio and is unique to every radio. This code has a very specific structure and must be entered exactly the same as was provided by the manufacturer. The preferred way to enter this tributary configuration code is to copy and paste it from the document in which it was provided, by using the Ctrl-C and Ctrl-V shortcut keys for copy and paste. A tributary configuration code may be entered only once. If an invalid code is entered, and the Apply button is pressed, the radio will appear to accept the code. The code will however, not take effect and will be replaced by the previous valid code when the radio is reset.

Install a new tributary configuration code as follows:

1. Open the document that contains the tributary configuration code and copy the code.
2. From NCT, access the NCT drop-down menu and select the Configuration/Station Properties option.
3. Paste the tributary code in the Configuration Code box.
4. Click Apply.

Chapter 8: Technical Information

Radio Description

Introduction

The Velox LE 24/5800, Velox LE24/5810 SR and Velox LE24/5810 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 10Base-T 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 2.4 GHz and 5.8 GHz ISM bands.

The Velox LE 24/5825 SR, Velox LE 24/5825 SRi, Velox LE 24/5850 IP, Velox LE 24/5850 IPi, Velox LE 24/5850 SR and Velox LE 24/5850 SRi are similar radios also operating in the 2.4 and 5.8 GHz ISM bands respectively. Modulation can be switched between 16 and 32 QAM with digital output scalable up to 16 T1/E1 tributaries depending on the specific radio.

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.

Control and Management

There are two options to control the Velox LE products via SNMP:

- Using any open-standard-compliant SNMP Management package, e.g. HP OpenView, SNMPc etc. Using a MIB Browser provides access to the full compliment of the MIB elements of the Velox LE.
- Using the Network Configuration Tool (NCT) application package supplied. The NCT provides control and management of the product although not to the full complement of the MIB element. SNMP support via an SNMP agent in the DIU

ensures open network management compatibility. The NCT has a Graphical User Interface (GUI) carefully designed to assist installation and maintenance staff.

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

Velox LE Models

Each radio in the system consists of two main parts:

- A Radio Frequency Unit (RFU) operating in the 2.4 GHz or 5.8 GHz ISM frequency bands. The RFU has an N-type female connector for connection to a range of antennas and can either be and Outdoor RFU (ORFU) or and Indoor RFU (IRFU).
  RFU units available are the Velox LE 2410, Velox LE 5810, Velox LE 2410i, Velox LE 5810i, Velox LE 2450, Velox LE 5850, Velox LE 2450i and Velox 5850i units. The models with an "i" suffix are 1RU high IRFUs. See RFU Variants on page 9-1 for further information.
- A Digital Indoor Unit (DIU), available with a Telecommunications interface (0 to 16 T1/E1 tributaries depending on the radio) and a Data interface (10Base-T Ethernet or 10/100Base-T Ethernet, depending on the radio).
  DIU units available are the Velox LE 75/120 Ohm, a Velox LE 120 Ohm, Velox LE 10, Velox LE 25 or a Velox LE 50 unit. All DIUs operate with the Velox LE 2410/2410i and Velox LE 5810/5810i RFUs. Velox LE 10, 25 and 50 DIUs can operate only with the Velox LE type 2450 and 5850 RFUs. With the exception of the Velox LE 75/120 Ohm and Velox LE 120 Ohm units the number is a guide to the maximum data capacity of the unit. For example, the maximum data capacity of the Velox LE 25 is 25 Mbps. DIU Variants on page 9-1.

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

The RFUs 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 RFU can also be located remote from the antenna (tower base or indoor mounted). The RF connector is then connected to the antenna via either a coaxial transmission line or a flexible waveguide.

The system is available for use in FCC regulated countries.

For more detailed information on models available see System Variants on page 9-4. For Ordering Information refer to Chapter 10.

Table 8-1. Velox LE Models

Model Number	Interfaces	Antenna Coupling
Velox LE 24/5800, Velox LE24/5810 SR and Velox LE24/5810 SRi Model Variants		
Velox LE 2400 Velox LE 2410 SR Velox LE 2410 SRi	*N* x T1/E1 10Base-T Ethernet (*N* = 1, 2 or 4)	N-type Female

Table 8-1. Velox LE Models		
Model Number	**Interfaces**	**Antenna Coupling**
Velox LE 5800 Velox LE 5810 SR Velox LE 5810 SRi	*N* x T1/E1 10Base-T Ethernet (*N* = 1, 2 or 4)	N-type Female
Velox LE 24/5825 SR Model Variants		
Velox LE 2425 SR Velox LE 2425 SRi	8 x T1/8 x E1 and 10Base-T Ethernet	N-type Female
Velox LE 5825 SR Velox LE 5825 SRi	8 x T1/8 x E1 and 10Base-T Ethernet	N-type Female
Velox LE 24/5850 IP Model Variants		
Velox LE 2450 IP Velox LE 2450 IPi	10/100Base-T Ethernet only	N-type Female
Velox LE 5850 IP Velox LE 5850 IPi	10/100Base-T Ethernet only	N-type Female
Velox LE 24/5850 SR model variants		
Velox LE 2450 SR Velox LE 2450 SRi	10/100Base-T Ethernet and 1 - 16 E1/T1	N-type Female
Velox LE 5850 SR Velox LE 5850 SRi	10/100Base-T Ethernet and 1 - 16 E1/T1	N-type Female

The abbreviation SR indicate that the model is a scaleable radio, which means that to increase the number of tributaries, e.g. from 1 to 4 requires only a software upgrade.
The abbreviation IP indicates that the system is suitable for IP data only.

Velox LE SR 8 x T1/8 x E1 and 10Base-T Ethernet functionality:
Depending on the radio model and RFU configuration, the Velox LE radio can simultaneously support 1 to 8 E1 or T1 tributary channels, with the balance of the available user BW made up by Ethernet packet data, up to a maximum aggregate Ethernet throughput no greater than 9.5 Mbps (Combined up - and downstream throughput). The unidirectional Ethernet throughput of the radios is limited to a maximum of 8 Mbps, which decreases as more tributary channels are activated.

Technical Description

System Overview

A digital radio link (DRL) consists of a pair of Velox LE radio stations as shown in Figure 8-1 below.

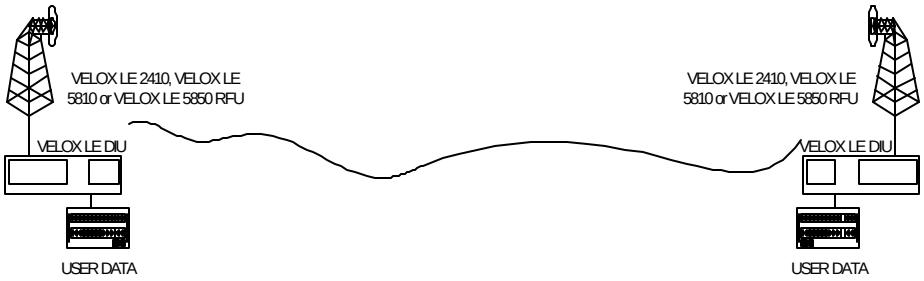


Figure 8-1. Velox LE Digital Radio Link

The radio station consists of two main parts:

- An RFU operating in the 2.4GHz or 5.8 GHz ISM frequency bands. The RFU provides the radio transceiver functionality by accepting radio link data from the DIU 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 DIU in a digital format.
- A DIU, available with 0, 1, 2, 4, 8 or 16 T1 or E1 data interfaces (choice of T1 or E1 is software selectable). The DIU combines nT1 or nE1 data with Wayside Service Channel serial data and link IP data to be transmitted across the radio link. The DIU also provides power to the RFU. In the Velox LE 50, the E1/T1 data interface is provided through an optional Interface Card.

Interconnection between RFU and DIU is achieved using low cost data and power cables.

RFU

The Velox LE 2410, Velox LE 5810, Velox LE 2410i and Velox LE 5810i RFUs make use of Spread Spectrum modulation technology for license-free operation in the 2.4GHz and 5.8 GHz ISM bands.

The Velox LE 2450 RFU uses three software selectable bandwidths for license-free operation in the 2.4 GHz ISM band. The Velox LE 5850 RFU uses three software selectable bandwidths for license-free operation in the 5.8 GHz ISM band.

All the RFUs with the postfix “i” (e.g. Velox LE 2410i and Velox LE 5810i) have been repackaged into 1RU units that should be used in indoor unit applications only. Please refer to Installing the IRFU on page 4-19 for more detail.

For operation, the ISM bands are divided into upper and lower frequency sub-bands. A ‘High Band’ RFU transmits in the higher frequency sub-band and receives in the lower frequency sub-band, while a ‘Low Band’ RFU transmits in the lower sub-band and

receives in the higher sub-band. A Velox LE radio link will use a 'Low Band' RFU on one end of the link to communicate with a 'High Band' RFU on the other end.

The RFUs 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.

Frequency Plans

General

The Velox LE 5810, Velox LE 5810i, Velox LE 5850 and the Velox LE 5850i RFUs 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 Velox LE 2410, Velox LE 2410i Velox LE 2450 and the Velox LE 2450i RFUs operate in the 2.400 GHz to 2.4835 GHz ISM frequency band with p redefined frequency channel plans (termed A, B and D). Channel plan D is user selectable/adjustable.

Velox LE 5810 and Velox LE 5810i Frequency Channel Plan A, B and C

Refer to Figure 8-2 below. The channel spacing is based on the bandwidth occupied by the spread spectrum signal (approximately 17 MHz) and is used to optimize link performance. Note that for plan A, plan B and C, both RFUs in a link must be set-up to the same frequency channel plan (i.e. A, B or C).

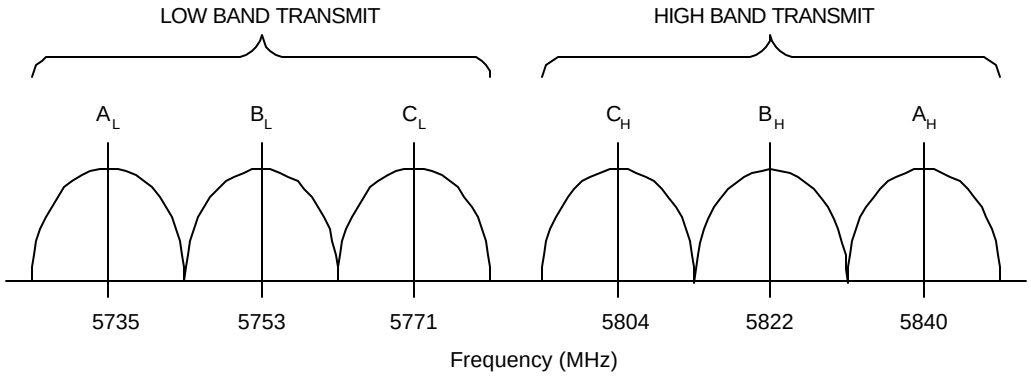


Figure 8-2. Velox LE 5810 and Velox LE 5810i Frequency channel plans A, B and C

Velox LE 2410 and Velox LE 2410i FCC Compliant Frequency Channels for the USA only

In countries where FCC compliance is required, only the following frequencies may be used (see Figure 8-3 below):

- Low band RFU – 2412MHz to 2426MHz,
- High band RFU – 2458MHz.

Use frequency plan D (variable frequency) to set the RFU.

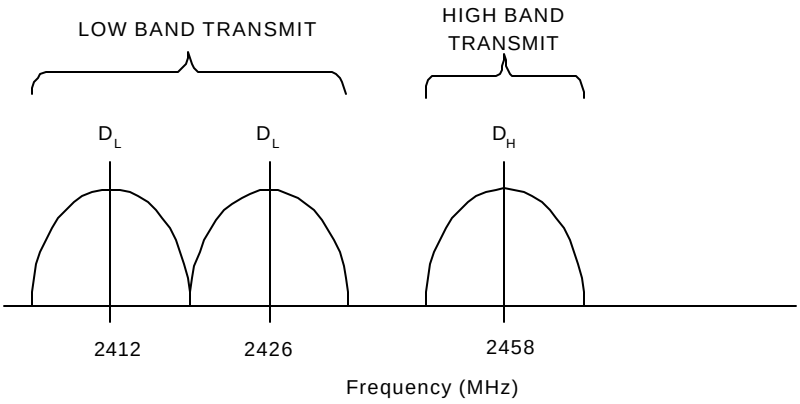


Figure 8-3. Velox LE 2410 and Velox LE 2410i FCC Compliant Frequency Channels for the USA only

Velox LE 2410 and Velox LE 2410i Frequency Channel Plan A, B (non-FCC)

Refer to Figure 8-4 below. The channel spacing is based on the bandwidth occupied by the spread spectrum signal (approximately 17 MHz) and is used to optimize link performance. In the case of plan A and B, note that both RFUs of a link must be set up to the same frequency channel plan (i.e. A or B).

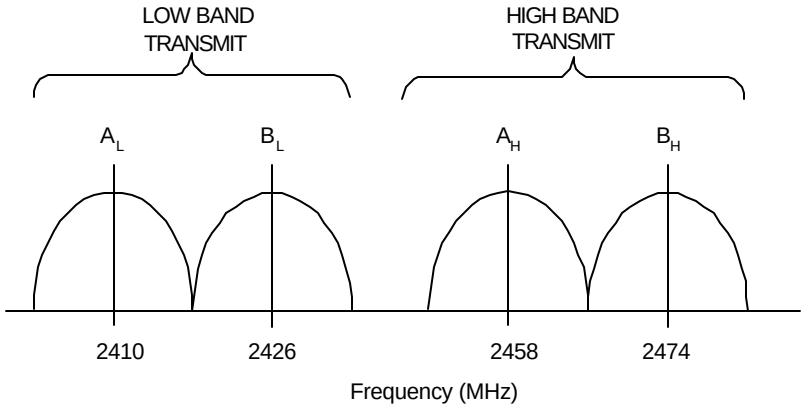


Figure 8-4. Velox LE 2410 and Velox LE 2410i Frequency channel plans A and B

Velox LE 5850 and Velox LE 5850i Frequency Channels Plan A, B and C (FCC Compliant)

The channel spacing is based on the transmit bandwidth and can be either 3 MHz, 6 MHz, 10 MHz or 14 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 as listed in Table 8-2 below, (see also Figure 8-5 on page 8-7).

Table 8-2. Frequency Ranges for Velox LE 5850 and Velox LE 5850i		
Modulation Type	**Lowest Centre Freq. (MHz)**	**Highest Centre Freq. (MHz)**
Low band RFU:		
8.46Mbps / 16-QAM	5731	5774
16.93 Mbps / 16-QAM	5732	5773
25.39 Mbps / 16-QAM	5734	5771
50.78 Mbps / 32-QAM	5736	5769
High band RFU:		
8.46Mbps / 16-QAM	5801	5844
16.93 Mbps / 16-QAM	5802	5843
25.39 Mbps / 16-QAM	5804	5841
50.78 Mbps / 32-QAM	5806	5839

NOTE 1: Both RFUs 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 8-5 below reflects all the frequency bands that could be obtained with the Velox LE 5850 and Velox LE 5850i RFU. Pre-programmed frequency ranges in the radio firmware prevent the user from selecting transmission options that will not meet FCC requirements.

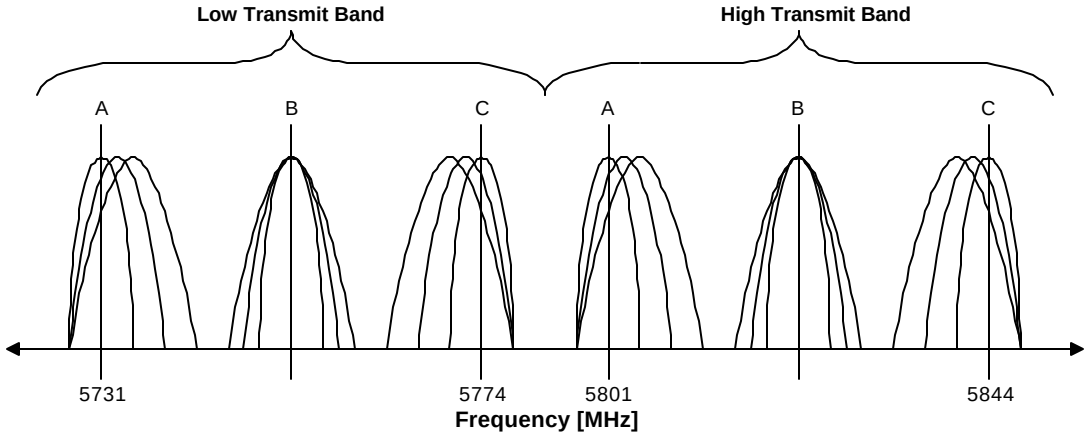


Figure 8-5. Velox LE 5850 and Velox LE 5850i Frequency channel plans A, B and C.

Refer to **NOTE 2** above with regards to FCC standards compliance of the different band plans.

Velox LE 2450 and Velox LE 2450i Frequency Channels Plan A, B and C (FCC Compliant)

The channel spacing is based on the transmit bandwidth and can be either 3 MHz, 6 MHz, 10 MHz or 14 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 Table 8-3 below (see also Figure 8-6 on page 8-8).

Table 8-3. Frequency Ranges for Velox LE 2450 and Velox LE 2450i

Modulation Type	Lowest Centre Freq. (MHz)	Highest Centre Freq. (MHz)
Low band RFU:		
8.46Mbps / 16-QAM	2405	2429
16.93 Mbps / 16-QAM	2406	2428
25.39 Mbps / 16-QAM	2408	2426
50.78 Mbps / 32-QAM	2410	2424
High band RFU:		
8.46Mbps / 16-QAM	2444	2469
16.93 Mbps / 16-QAM	2445	2468
25.39 Mbps / 16-QAM	2447	2466
50.78 Mbps / 32-QAM	2451	2463

NOTE 1: Both RFUs 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 8-6 below reflects all the frequency bands that could be obtained with the Velox LE 2450 RFU. Pre-programmed frequency ranges in the radio firmware prevent the user from selecting transmission options that will not meet FCC requirements.

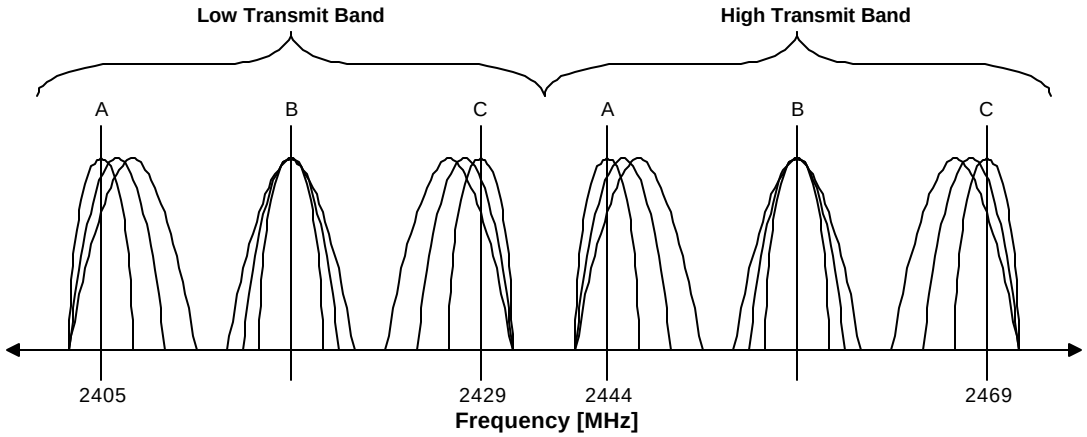


Figure 8-6. Velox LE 2450 and Velox LE 2450i Frequency channel plans A, B and C

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 8-4, Table 8-5, Table 8-6 and Table 8-7 below. The Velox LE 24/5850 RFUs have up to four 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 were tested and approved for FCC compliance with the frequency ranges in Table 8-4 below.

Table 8-4. Velox LE 2410 and Velox LE 2410i Channel plan D channel frequencies

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

NOTE: See Velox LE 2410 and Velox LE 2410i FCC Compliant Frequency Channels for the USA only on page 8-5 for the allowable operation range in FCC countries.

Table 8-5. Velox LE 5810 and Velox LE 5810i Channel plan D channel frequencies

Sub-band	Centre Frequency (MHz)
L	5735-5771
H	5804-5840

Table 8-6. Velox LE 5850 Velox LE 5850i and Channel plan D channel frequencies

RF BW [MHz] / Data Rate [kbps]	Centre 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
14.0 / 50784314	5769-5769	5806-5839

Table 8-7. Velox LE 2450 and Velox LE 2450i Channel plan D channel frequencies		
RF BW [MHz] / Data Rate [kbps]	Centre Frequency (MHz)	
	Lower Sub-band	Upper / Higher Sub-band
2.6 / 8464	2405-2429	2444-2469
5.4 / 16928	2406-2428	2445-2468
8.0 / 25392	2408-2426	2447-2466
14.0 / 50784314	2410-2424	2451-2463

Velox LE 2450 and Velox LE 5850 Modulator Types

The Velox LE 2450 and Velox LE 5850 can operate with different modulator types (see Table 8-8 below), the trade-off being better radio performance versus higher data throughput. The changes can be made via software using the Velox LE NCT/GUI or an SNMP client application.

Modulator types and frequency bands that were tested and approved for compliance with FCC regulations (see Velox LE 5850 and Velox LE 5850i Frequency Channels Plan A, B and C (FCC Compliant) on page 8-6 and Velox LE 2450 and Velox LE 2450i Frequency Channels Plan A, B and C (FCC Compliant) on page 8-7.

Table 8-8. Velox LE 24/5850 Modulator Types				
Data Rate [kbps]	Modulation Type	Raw data Throughput (bps)	Typical Payload	Approx. RFU output spectrum BW
8464	16-QAM	8 464 052	4T1/E1 + 150 kbit Ethernet	2.6 MHz
16928	16-QAM	16 928 105	8T1/E1 + 150 kbit Ethernet	5.4 MHz
25392	16-QAM	25 392 157	8T1/E1 + 9.5 Mbit Ethernet	8 MHz
50784	32-QAM	50 784 314	46 Mbit/s Ethernet or 16 T1/E1 + 14 Mbit/s Ethernet	14 MHz

NOTE: Changing the modulator type of a Velox LE 24/5850 RFU 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.

RF Power Output Options

The RFU 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 NCT software or a SNMP Management application. The FCC standards for the Velox LE 2410 unit require a limited output power as stated in the FCC Notice (USA only) in the front matter of the manual.

NOTE: The Velox LE type RFU firmware will not accept power level settings that fall outside the FCC compliant levels.

Velox LE 24/5810, Velox LE 24/5810i, Velox LE 24/5850 and Velox LE 24/5850i RFUs

The RFUs transmit and receive RF signals through a diplexer interfaced via a 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 RFU houses the following main parts:

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

Velox LE, Velox LE 10, Velox LE 25, Velox LE 50 Digital Indoor Unit

General

The Digital Indoor Unit (DIU) is designed for mounting in a 19" rack, occupying a 1RU slot. It can also be used as a tabletop system.

The DIU 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 DIU is fitted with a DC power supply.

There are five types of DIUs:

- Velox LE (120 Ohm) (scaleable up to 4 T1/E1) (see Figure 8-8 below).
- Velox LE (75 / 120 Ohm) (scaleable up to 4 T1/ E1) (see Figure 8-7 below).
- Velox LE 10 (scaleable up to 4 T1/E1) (see Figure 8-9 below).
- Velox LE 25 (scaleable up to 8 T1/E1) (see Figure 8-10 below).
- Velox LE 50 (with optional 16 T1/E1 interface card) (see Figure 8-11 below).

The Velox LE DIUs can operate with the Velox LE 2400, Velox LE 5800, Velox LE 2410i and Velox LE 5810i RFUs.

The Velox LE 10 / 25 and 50 DIU is used with the Velox LE 24/5850 RFU, but can also support the Velox LE 24/5800, and Velox LE 24/5810i RFUs if the appropriate firmware version is loaded on the DIU.

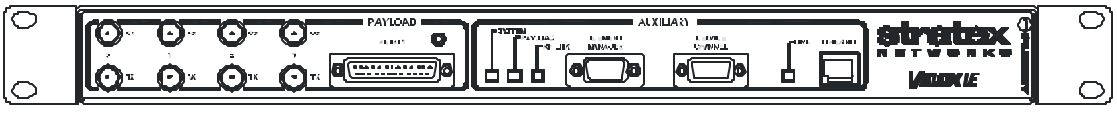


Figure 8-7. Velox LE (75 Ohm) DIU

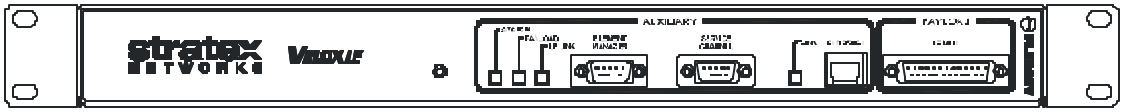


Figure 8-8. Velox LE (120 Ohm) DIU

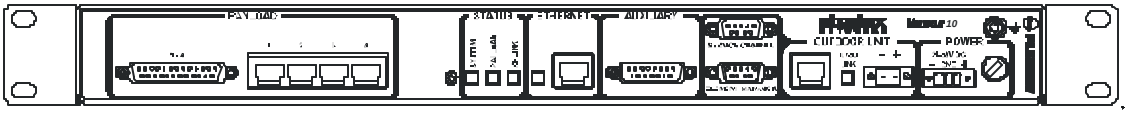


Figure 8-9. Velox LE 10 DIU

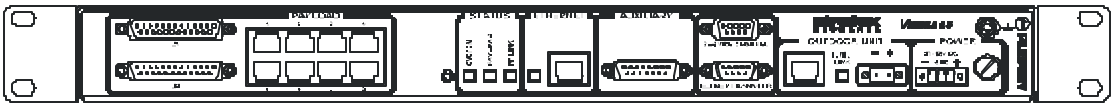


Figure 8-10. Velox LE 25 DIU

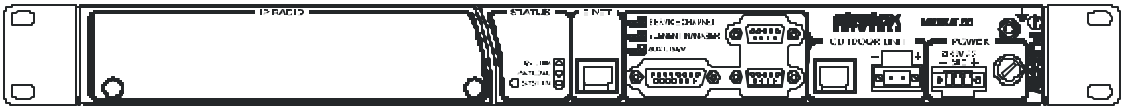


Figure 8-11. Velox LE IP DIU

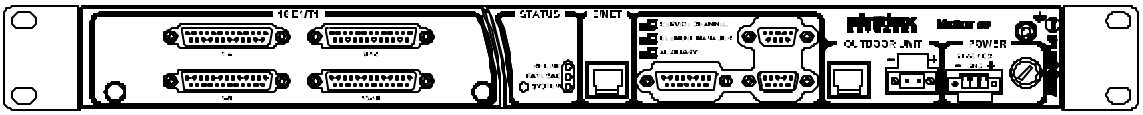


Figure 8-12. Velox LE 50 DIU

Payload Interface Options

Tributary Payload

The DIU can be configured for T1 or E1 operation, as follows:

- Velox LE-Type and Velox LE 10 type DIU:
  1, 2, or 4 x T1 (1.544 Mbps) or E1 (2.048 Mbps).
- Velox LE 25 type DIU:
  1, 2, 4 or 8 x T1 (1.544 Mbps) or E1 (2.048 Mbps).
- Velox LE 50 type DIU:
  None (10Base-T/100Base-T Ethernet only).
  1 - 16 x T1 (1.544 Mbps) or 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 Velox LE 25 DIU may be selected separately for tributary channels 1 to 4 and 5 to 8 when used with a Velox LE 24/5850 RFU.

Line coding and impedance may be selected on a per tributary basis for the Velox LE 50 DIU with a tributary data interface.

The payload can be connected on:

- Unbalanced 75 Ohm BNC connectors, 75/120 Ohm DIU only (RX= In, TX= Out).
- Balanced 120 Ohm or unbalanced 75 Ohm, 25 way D-type connectors.
- Balanced 120 Ohm or unbalanced 75 Ohm, RJ48C connectors on the Velox LE 10 and Velox LE 25.

NOTE A special version of the Velox LE DIU exists that allows the user to select AMI or B8ZS line encoding on a per-tributary basis for T1 connectivity. These DIUs are indentified by the letters AT following the version number.
Line codes can be selected on a per-tributary basis using the Velox LE NCT software application. In the **Payload Configuration** window:

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

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

Ethernet Payload

Velox LE-Type and Velox LE 10 type DIU:

- 10Base-T RJ45

Velox LE 25 type DIU:

- 10Base-T RJ45

Velox LE 50 type DIU:

- 10/100Base-T RJ45

1+1 Redundancy Protected Payload System

The Velox LE 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 Chapter 12: 1+1 Protection System Operation, or the Protection Kit user manual, publication number 862-02236 for functional information.

Technical Data

Environmental

RFU

Operating temperature:	-33°C to +60°C
Relative humidity:	8-100%
Atmospheric pressure:	0.7 to 1.06 kPa
Lightning protection	ITU-T K.20

DIU and IRFU

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

Physical

RFU

Dimensions (H x W x D):	335mm x 231mm x 124mm
Weight:	~ 5.9 Kg

DIU and IRFU

Dimensions (H x W x D):	45mm x 480 mm x 265mm
Mounting:	19" Rack, 1RU high or Table top
Weight:	~ 2.9 Kg

Power Supply

DC power supply:	21 to 56 Vdc or 21 to 58 Vdc dependent on the version and variant
DC power supply grounding:	Positively or negatively grounded
Power consumption (Velox LE 2400/5800 and 2410i/5810i)	35 W typical, 45 W maximum.
Power consumption (All other Velox LE radios)	40 W typical, 45 W maximum.

The power supply specification for the current Velox LE 10, Velox LE 25 and all Velox LE 50 DIUs is 21 to 58 Vdc whereas older Velox LE 10, Velox LE 25 DIUs and all other DIUs require 21 to 56 Vdc.
Please ensure that you comply with the power supply specification printed above the POWER connector on the DIU.

Electrical Performance

General Characteristics

Velox LE 2400, Velox LE 2410 SR and Velox LE 2410 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)

Velox LE 2425 SR and Velox LE 2425 SRi

Frequency Range:	2405 to 2469 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:	2405 and 2444 MHz (2.6MHz BW)
	2406 and 2445 MHz (5.4MHz BW)
	2408 and 2447 MHz (8.0MHz BW)
Frequency Channel Plan B:	2417 and 2456 MHz (all bandwidths)
Frequency Channel Plan C:	2429 and 2469 MHz (2.6MHz BW)
	2428 and 2468 MHz (5.4MHz BW)
	2426 and 2466 MHz (8.0MHz BW)
Transmission Delay:	600 us maximum for radios only (one-way)

Velox LE 2450 SR, Velox LE 2450 SRi, Velox LE 2450 IP and Velox LE 2450 IPi

Frequency Range:	2405 to 2469 MHz
Payload Data Capacity:	Ethernet Only (Max 46 Mb/s bi-directional)
	Optional through interface card:
	1 - 16T1/E1 (1.544 Mbps/s) / (2.048 Mbps)
RF Channel Bandwidth:	2.6MHz
(Selectable)	5.4MHz
	8.0MHz
	14.0 MHz
Go/Return spacing:	Can be adjusted as fixed go-return spacing.
	NOT mandatory in the ISM licence-free bands.
Modulation:	16-QAM / 32-QAM
Frequency Channel Plan A:	2405 and 2444 MHz (2.6MHz BW)
	2406 and 2445 MHz (5.4MHz BW)
	2408 and 2447 MHz (8.0MHz BW)
	2410 and 2451 MHz (14.0MHz BW)
Frequency Channel Plan B:	2417 and 2457 MHz (all bandwidths except 14 MHz)
Frequency Channel Plan C:	2429 and 2469 MHz (2.6MHz BW)
	2428 and 2468 MHz (5.4MHz BW)
	2426 and 2466 MHz (8.0MHz BW)
	2424 and 2463 MHz (14.0MHz BW)
Transmission Delay:	600 us maximum for radios only (one-way)

Velox LE 5800, Velox LE 5810 SR and Velox LE 5810 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)

Velox LE 5825 SR and Velox LE 5825 SRi

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)

Velox LE 5850 SR, Velox LE 5850 SRi, Velox LE 5850 IP and Velox LE 5850 IPi

Frequency Range:	5731 to 5844 MHz
Payload Data Capacity:	Ethernet Only (Max 46 Mb/s bi-directional)
	Optional through interface card:
	1 - 16T1/E1 (1.544 Mbps/s) / (2.048 Mbps)
RF Channel Bandwidth:	2.6MHz
(Selectable)	5.4MHz
	8.0MHz
	14MHz
Go/Return spacing:	Can be adjusted as fixed go-return spacing.
	NOT mandatory in the ISM licence-free bands.
Modulation:	16-QAM / 32-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)
	5736 and 5806 MHz (14.0MHz 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)
	5769 and 5839 MHz (14.0MHz BW)
Transmission Delay:	600 us maximum for radios only (one-way)

Transceiver Characteristics

Frequency Band: Velox LE 2410 and Velox LE 2410i Low Band RFUs

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

Frequency Band: Velox LE 2410 and Velox LE 2410i High Band RFUs

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

Frequency Band: Velox LE 2450 and Velox LE 2450i Low Band RFUs

Transmit band:	2405 – 2429 MHz (Centre frequency)
Receive band:	2444 – 2469 MHz (Centre frequency)

Frequency Band: Velox LE 2450 and Velox LE 2450i High Band RFUs

Transmit band:	2444 – 2469 MHz (Centre frequency)
Receive band:	2405 – 2429 MHz (Centre frequency)

Frequency Band: Velox LE 5810 and Velox LE 5810i Low Band RFUs

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

Frequency Band: Velox LE 5810 and V elox LE 5810i High Band RFUs

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

Frequency Band: Velox LE 5850 and Velox LE 5850i Low Band RFUs

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

Frequency Band: Velox LE 5850 and Velox LE 5850i High Band RFUs

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

RF Interface

Transmitted Power	+2 to+24 dBm – Velox LE 2410, Velox LE 5810, Velox LE 2410i +2 to+25 dBm – Velox LE 5810i +2 to +24 dBm – Velox LE 5850 high output power, software adjustable (incl. mute)
Receiver Sensitivity:	Up to 4T1/4E1 : -88dBm for BER = 10^{-6} (Velox LE 2400) -86dBm for BER = 10^{-6} (Velox LE 5800) Up to 16T1/E1: Velox LE 5850, 16/32 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) -78dBm for BER = 10^{-6} (14 MHz BW)
Maximum Receive Level:	-30dBm

Payload Data Interfaces

1, 2, 4 or 8 (i.e. n x E1) Interface (Velox LE 10, Velox LE 25)

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 (Velox LE 10/25 DIU only) Unbalanced 75 ohm on BNC connectors (Available on one of the Velox LE 2400/5800 DIU variants)
Line code:	HDB3 or AMI selectable, refer to Payload Interface Options on page 8-12.
Jitter and Wander:	ITU-T G.823

1, 2, 4 or 8 (i.e. n x T1) Interface (Velox LE 10, Velox LE 25)

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 (Velox LE 10/25 DIU only)

	Unbalanced 75 ohm on BNC connectors (Available on one of the Velox LE 2400/5800 DIU variants)
Line code:	AMI or B8ZS selectable, refer to Payload Interface Options on p age 8-12.
Jitter and Wander:	ITU-T G.823

1-16 (i.e. nT1) Interface Card (Available on Velox LE 50 as optional I/F card)

Data Rate:	Full duplex T1 (1.544Mbit/s) up to 16T1
Digital Interface:	DSX-1, G.703 compliant
Connectors:	Balanced on DB25, Termination impedance selectable per tributary channel through software (75, 100, 110, 120 Ohm)
Line code:	AMI or B8ZS selectable per tributary channel through software
Jitter and Wander:	ITU-T G.823

1-16 (i.e. nE1) Interface Card (Available on Velox LE 50 as optional I/F card)

Data Rate:	Full duplex E1 (2.048Mbit/s) up to 16E1
Digital Interface:	ITU-T G.703
Connectors:	Balanced on DB25, Termination impedance selectable per tributary channel through software (75, 100, 110, 120 Ohm)
Line code:	AMI or B8ZS selectable per tributary channel through software
Jitter and Wander:	ITU-T G.823

Ethernet Traffic Interface

All DIU except Velox LE 50 DIU:

Data Rate:	< 8 Mbps Half / full duplex software selectable (Refer to note on Velox LE Scaleable 1-to-4/8 E/T1/10Base-T Ethernet functionality on page 8-3.
Digital Interface:	10Base-T, Half / full duplex, DTE
Connector:	RJ45

Velox LE 50 DIU:

Data Rate:	< 46 Mbps Half / full duplex software selectable limited by RF data capacity
Digital Interface:	10/100Base-T, Half / full duplex, DTE
Connector:	RJ45

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

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

Wayside Channel Interface

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

Element Manager Port Interface

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

Indoor/RFU Interface

The physical interface between the Indoor and RFU 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.

Chapter 9 : Product Range / Product Matrix

DIU Variants

The available DIU variants are listed in Table 9-1 below.

Table 9-1. DIU Variants

Variant Name	Description
Velox LE	DIU only - no RF circuitry 9.5Mbps data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 10	DIU only - no RF circuitry 9.5Mbps data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 25	DIU only - no RF circuitry 25Mbps data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE IP	DIU only - no RF circuitry Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 50	DIU only - no RF circuitry 46Mbps data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface

RFU Variants

The available RFU variants are listed in Table 9-2. RFU Variants below.

Table 9-2. RFU Variants

Variant Name	Description
2.4 GHz RF Variants	
Velox LE 2410	High or Low band ORFU, mast mountable, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps data capacity
Velox LE 2410i	High or Low bandIRFU, 1 RU 19" rack mountable, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps data capacity
Velox LE 2450	High or Low band ORFU, mast mountable, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex data capacity
Velox LE 2450i	High or Low band ORFU, 1 RU 19" rack mountable, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex data capacity

Table 9-2. RFU Variants	
Variant Name	**Description**
5.8 GHz Variants	
Velox LE 5810	High or Low band ORFU, mast mountable, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps data capacity
Velox LE 5810i	High or Low band IRFU, 1 RU 19" rack mountable, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps data capacity
Velox LE 5850	High or Low band ORFU, mast mountable, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex data capacity
Velox LE 5850i	High or Low band ORFU, 1 RU 19" rack mountable, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex data capacity

System Matrix

The system matrix is shown Figure 9-1 below. The combination of the selected DIU and the selected RFU gives the system name. For example, using a Velox LE 10 DIU together with Velox LE 5810 RFU forms a Velox LE 5810 SR System.

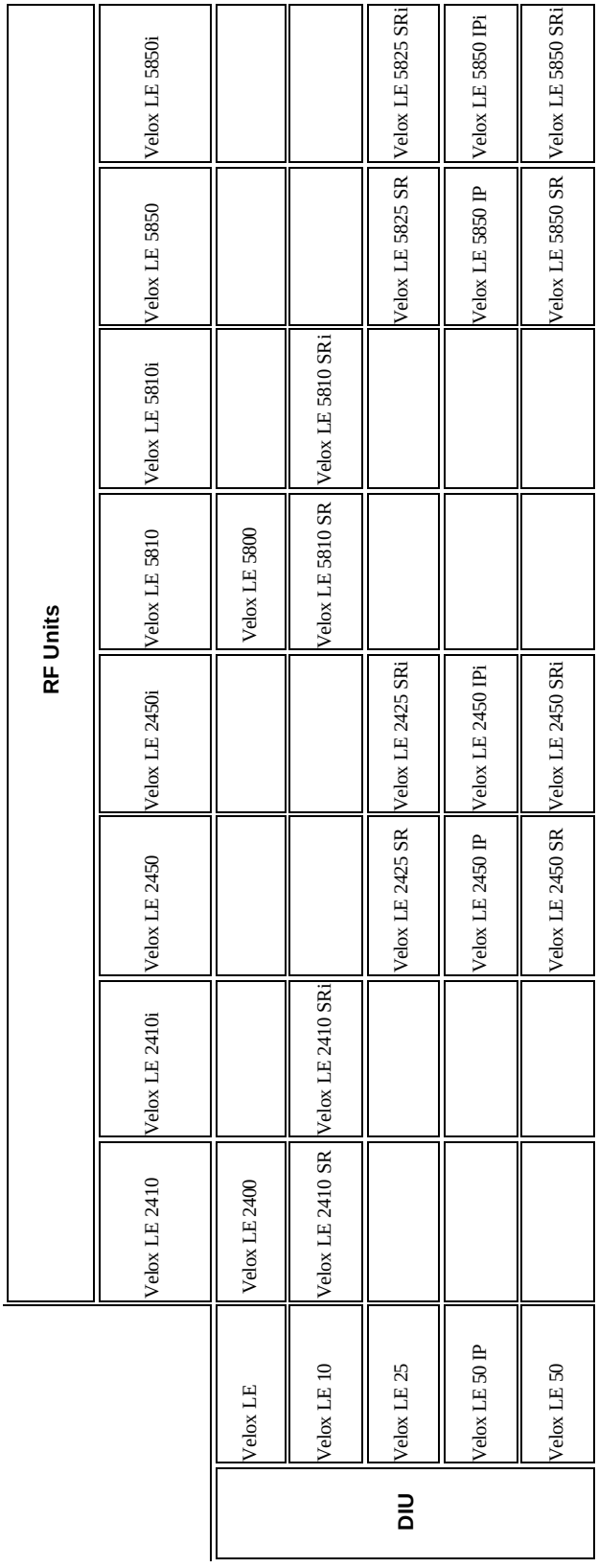


Figure 9-1. System Matrix

System Variants

The system variants are listed in Table 9-3 below.

Table 9-3. System Variants

System Name	Description
Velox LE 2400	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 2410 SR	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 2410 SRi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 2425 SR	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 2425 SRi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 2450 IP	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 2450 IPi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 2450 SR	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
Velox LE 2450 SRi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
Velox LE 5800	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 5810 SR	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface

Velox LE 5810 SRi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 5825 SR	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 5825 SRi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 5850 IP	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 5850 IPi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 5850 SR	One DIU and One High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
Velox LE 5850 SRi	One DIU and One High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface

Chapter 10 : Ordering Information

Velox LE 2400 Digital Radio System

The Part Numbers for Velox LE 2400 Systems and Spare Parts available for these systems are given in Table 10-1 below.

Table 10-1. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum

Ordering Code	Description
	Velox LE 2400 Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 2400 Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-03994-01-H1-PT	Velox LE 2400 Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-03994-01-L1-PT	Velox LE 2400 Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-03994-01-H2-PT	Velox LE 2400 Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-03994-01-L2-PT	Velox LE 2400 Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-03994-01-H4-PT	Velox LE 2400 Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-03994-01-L4-PT	Velox LE 2400 Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Unbalanced Interface - BNC (specify - E1 or T1, Bridge or Router)	
651-04106-01-H1-PT	Velox LE 2400 Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-04106-01-L1-PT	Velox LE 2400 Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-04106-01-H2-PT	Velox LE 2400 Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-04106-01-L2-PT	Velox LE 2400 Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-04106-01-H4-PT	Velox LE 2400 Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-04106-01-L4-PT	Velox LE 2400 Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Velox LE 2400 operates from 21-56Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band(LB)	
Spares Package for Velox LE 2400 Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2400 Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-03994-01-S1-PT	Velox LE 2400 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-03994-01-S2-PT	Velox LE 2400 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-03994-01-S4-PT	Velox LE 2400 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1

Unbalanced Interface - BNC (specify - E1 or T1, Bridge or Router)	
651-04106-01-S1-PT	Velox LE 2400 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-04106-01-S2-PT	Velox LE 2400 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-04106-01-S4-PT	Velox LE 2400 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
RFU Spare Parts	
651-03905-01L-PT	Velox LE 2410 Low Band ORFU - Spare Part
651-03905-01H-PT	Velox LE 2410 High Band ORFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04104-02-1-PT	Velox LE DIU 1xE1/T1 - Spare Part
651-04104-02-2-PT	Velox LE DIU 2xE1/T1 - Spare Part
651-04104-02-4-PT	Velox LE DIU 4xE1/T1 - Spare Part
Unbalanced Interface - BNC (specify - E1 or T1)	
651-04105-02-1-PT	Velox LE DIU 1xE1/T1 - Spare Part
651-04105-02-2-PT	Velox LE DIU 2xE1/T1 - Spare Part
651-04105-02-4-PT	Velox LE DIU 4xE1/T1 - Spare Part
The Velox LE 2400 uses standard CAT5 Ethernet cable and RJ-45 connectors for connecting the DIU to the ORFU. A two-wire power cable is also required between the DIU and the ORFU. Note Screened Cat5 cable, and UV resistant cables are recommended for long term outdoor use.	

Velox LE 2410 SR Digital Radio System

The Part Numbers for Velox LE 2410 SR Systems and Spare Parts available for these systems are given in Table 10-2 below.

Table 10-2. Microwave Digital Radio System, 2.4 GHz ISM Frequency Band, Spread Spectrum

Ordering Code	Description
	Velox LE 2410 SR Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 2410 SR Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04373-01-H1-PT	Velox LE 2410 SR Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-04373-01-L1-PT	Velox LE 2410 SR Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-04373-01-H2-PT	Velox LE 2410 SR Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-04373-01-L2-PT	Velox LE 2410 SR Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-04373-01-H4-PT	Velox LE 2410 SR Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-04373-01-L4-PT	Velox LE 2410 SR Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04376-01-H1-PT	Velox LE 2410 SR Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-04376-01-L1-PT	Velox LE 2410 SR Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1

651-04376-01-H2-PT	Velox LE 2410 SR Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-04376-01-L2-PT	Velox LE 2410 SR Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-04376-01-H4-PT	Velox LE 2410 SR Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-04376-01-L4-PT	Velox LE 2410 SR Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Velox LE 2410 SR operates from 21-58 Vdc (21-56Vdc where indicated), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2410 SR Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2410 SR Sp-Pkg: DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04373-01-S1-PT	Velox LE 2410 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-04373-01-S2-PT	Velox LE 2410 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-04373-01-S4-PT	Velox LE 2410 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04376-01-S1-PT	Velox LE 2410 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-04376-01-S2-PT	Velox LE 2410 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-04376-01-S4-PT	Velox LE 2410 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
RFU Spare Part	
651-03905-01L-PT	Velox LE 2410 SR Low Band ORFU - Spare Part
651-03905-01H-PT	Velox LE 2410 SR High Band ORFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04316-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04316-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04316-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04378-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04378-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04378-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
The Velox LE 2410 SR uses standard CAT5 Ethernet cable and RJ-45 connectors for connecting the DIU to the ORFU. A two-wire power cable is also required between the DIU and the ORFU. Note Screened Cat5 cable, and UV resistant cables are recommended for long term outdoor use.	

Velox LE 2410 SRi Digital Radio System

The Part Numbers for Velox LE 2410 SRi Systems and Spare Parts available for these systems are given in Table 10-3 below.

Table 10-3. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum - All indoor radio	
Ordering Code	**Description**
	Velox LE 2410 SRi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 2410 SRi Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04317-01-H1-PT	Velox LE 2410 SRi Radio:1 DIU and 1 High Band IRFU - 1E1 /1T1
651-04317-01-L1-PT	Velox LE 2410 SRi Radio:1 DIU and 1 Low Band IRFU - 1E1 /1T1
651-04317-01-H2-PT	Velox LE 2410 SRi Radio:1 DIU and 1 High Band IRFU - 2E1 /2T1
651-04317-01-L2-PT	Velox LE 2410 SRi Radio:1 DIU and 1 Low Band IRFU - 2E1 /2T1
651-04317-01-H4-PT	Velox LE 2410 SRi Radio:1 DIU and 1 High Band IRFU - 4E1 /4T1
651-04317-01-L4-PT	Velox LE 2410 SRi Radio:1 DIU and 1 Low Band IRFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04381-01-H1-PT	Velox LE 2410 SRi Radio:1 DIU and 1 High Band IRFU - 1E1 /1T1
651-04381-01-L1-PT	Velox LE 2410 SRi Radio:1 DIU and 1 Low Band IRFU - 1E1 /1T1
651-04381-01-H2-PT	Velox LE 2410 SRi Radio:1 DIU and 1 High Band IRFU - 2E1 /2T1
651-04381-01-L2-PT	Velox LE 2410 SRi Radio:1 DIU and 1 Low Band IRFU - 2E1 /2T1
651-04381-01-H4-PT	Velox LE 2410 SRi Radio:1 DIU and 1 High Band IRFU - 4E1 /4T1
651-04381-01-L4-PT	Velox LE 2410 SRi Radio:1 DIU and 1 Low Band IRFU - 4E1 /4T1
Velox LE 2410 SRi operates from 21-58 Vdc (21-56Vdc where indicated), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2410 SRi Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2410 SRi Sp-Pkg: DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04317-01-S1-PT	Velox LE 2410 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 1E1 /1T1
651-04317-01-S2-PT	Velox LE 2410 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 2E1 /2T1
651-04317-01-S4-PT	Velox LE 2410 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04381-01-S1-PT	Velox LE 2410 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 1E1 /1T1
651-04381-01-S2-PT	Velox LE 2410 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 2E1 /2T1
651-04381-01-S4-PT	Velox LE 2410 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 4E1 /4T1
RFU Spare Part	
651-04353-01L-P	Velox LE 2410 SRi Low Band IRFU - Spare Part
651-04353-01H-P	Velox LE 2410 SRi High Band IRFU - Spare Part
DIU Spare Part	

Balanced Interface - DB25 (specify - E1 or T1)	
651-04316-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04316-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04316-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04378-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04378-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04378-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare P art
The Velox LE 2410 SRi uses standard CAT5 Ethernet cable and RJ-45 connectors for connecting the DIU to the IRFU. A two-wire power cable is also required between the DIU and the IRFU. Note Screened Cat5 cable, and UV resistant cables are recommended for long term outdoor use.	

Velox LE 2425 SR Digital Radio System

The Part Numbers for Velox LE 2425 SR Systems and Spare Parts available for these systems are given in Table 10-4 below.

Table 10-4. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum

Ordering Code	Description
	Velox LE 2425 SR Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 2425 Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04367-01-H08-P	Velox LE 2425 SR Radio:1 DIU and 1 High Band ORFU - 8E1 /8T1
651-04367-01-L08-P	Velox LE 2425 SR Radio:1 DIU and 1 Low Band ORFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04390-01-H08-P	Velox LE 2425 SR Radio:1 DIU and 1 High Band ORFU - 8E1 /8T1
651-04390-01-L08-P	Velox LE 2425 SR Radio:1 DIU and 1 Low Band ORFU - 8E1 /8T1
Velox LE 2425 SR Radio operates from 21-58 Vdc (21-56Vdc where indicated), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2425 SR Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2425 SR Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04367-01-S08-P	Velox LE 2425 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04390-01-S08-P	Velox LE 2425 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 8E1 /8T1

RFU Spare Part	
651-04368-01L-P	Velox LE 2450 Low Band ORFU - Spare Part
651-04368-01H-P	Velox LE 2450 High Band ORFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04313-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04386-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part

Velox LE 2425 SRi Digital Radio System

The Part Numbers for Velox LE 2425 SRi Systems and Spare Parts available for these systems are given in Table 10-5 below.

Table 10-5. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum - All indoor radio

Ordering Code	Description
	Velox LE 2425 SRi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 2425 SRi Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04369-01-H08-P	Velox LE 2425 SRi Radio:1 DIU and 1 High Band IRFU - 8E1 /8T1
651-04369-01-L08-P	Velox LE 2425 SRi Radio:1 DIU and 1 Low Band IRFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04403-01-H08-P	Velox LE 2425 SRi Radio:1 DIU and 1 High Band IRFU - 8E1 /8T1
651-04403-01-L08-P	Velox LE 2425 SRi Radio:1 DIU and 1 Low Band IRFU - 8E1 /8T1
Velox LE 2425 SRi Radio operates from 21-58 Vdc (21-56Vdc where indicated), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2425 SRi Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2425 SRi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04369-01-S08-P	Velox LE 2425 SRi Sp-Pkg:1 DIU and 1 HBand 1 LB IRFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04403-01-S08-P	Velox LE 2425 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 8E1 /8T1
RFU Spare Part	

651-04370-01L-P	Velox LE 2450i Low Band IRFU - Spare Part
651-04370-01H-P	Velox LE 2450i High Band IRFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04313-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04386-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part

Velox LE 2450 IP Digital Radio System

The Part Numbers for Velox LE 2450 IP Systems and Spare Parts available for these systems are given in Table 10-6 below.

Table 10-6. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum

Ordering Code	Description
Velox LE 2450 IP Microwave Digital Radios Complete	
	Velox LE 2450 IP Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
651-04371-01-HE-P	Velox LE 2450 IP Radio:1 DIU and 1 High Band ORFU - IP only
651-04371-01-LE-P	Velox LE 2450 IP Radio:1 DIU and 1 Low Band ORFU - IP only
Velox LE 2450 IP Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2450 IP Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2450 IP Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
651-04371-01-SE-P	Velox LE 2450 IP Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - IP only
RFU Spare Part	
651-04368-01L-P	Velox LE 2450 Low Band ORFU - Spare Part
651-04368-01H-P	Velox LE 2450 High Band ORFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04322-01-E-P	Velox LE IP DIU IP only - Spare Part

Velox LE 2450 IPi Digital Radio System

The Part Numbers for Velox LE 2450 IPi Systems and Spare Parts available for these systems are given in Table 10-7 below.

Table 10-7. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum - All indoor radio	
Ordering Code	**Description**
	Velox LE 2450 IPi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 2450 IPi Microwave Digital Radios Complete	
651-04374-01-HE-P	Velox LE 2450 IPi Radio:1 DIU and 1 High Band IRFU - IP only
651-04374-01-LE-P	Velox LE 2450 IPi Radio:1 DIU and 1 Low Band IRFU - IP only
Velox LE 2450 IPi Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2450 IPi Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2450 IPi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex Ethernet 10/100Base-T data interface
651-04374-01-SE-P	Velox LE 2450 IPi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - IP only
RFU Spare Part	
651-04370-01L-P	Velox LE 2450i Low Band IRFU - Spare Part
651-04370-01H-P	Velox LE 2450i High Band IRFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04322-01-E-P	Velox LE IP DIU IP only - Spare Part

Velox LE 2450 SR Digital Radio System

The Part Numbers for Velox LE 2450 SR Systems and Spare Parts available for these systems are given in Table 10-8 below.

Table 10-8. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum	
Velox LE 2450 SR Microwave Digital Radios Complete	
Ordering Code	**Description**
	Velox LE 2450 SR Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
651-04377-01-H16-P	Velox LE 2450 SR Radio:1 DIU and 1 High Band ORFU - 16E1 /16T1
651-04377-01-L16-P	Velox LE 2450 SR Radio:1 DIU and 1 Low Band ORFU - 16E1 /16T1
Velox LE 2450 SR Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Microwave Digital Radio System Spare Parts for Velox LE 2450 SR	
Ordering Code	**Description**

	Velox LE 2450 SR Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 46Mbp s link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
651-04377-01-S16-P	Velox LE 2450 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 16E1 /16T1
RFU Spare Part	
651-04368-01L-P	Velox LE 2450 Low Band ORFU - Spare Part
651-04368-01H-P	Velox LE 2450 High Band ORFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04379-01-16-P	Velox LE 50 DIU 16xE1/T1 - Spare Part

Velox LE 2450 SRi Digital Radio System

The Part Numbers for Velox LE 2450 Sri Systems and Spare Parts available for these systems are given in Table 10-9 below.

Table 10-9. Microwave Digital Radio System, 2.4GHz ISM Frequency Band, Spread Spectrum - All indoor radio

Ordering Code	Description
	Velox LE 2450 SRi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
Velox LE 2450 SRi Microwave Digital Radios Complete	
651-04380-01-H16-P	Velox LE 2450 SRi Radio:1 DIU and 1 High Band IRFU - 16E1 /16T1
651-04380-01-L16-P	Velox LE 2450 SRi Radio:1 DIU and 1 Low Band IRFU - 16E1 /16T1
Velox LE 2450 SRi Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 2450 SRi Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 2450 SRi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
651-04380-01-S16-P	Velox LE 2450 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 16E1 /16T1
RFU Spare Part	
651-04370-01L-P	Velox LE 2450i Low Band IRFU - Spare Part
651-04370-01H-P	Velox LE 2450i High Band IRFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04379-01-16-P	Velox LE 50 DIU 16xE1/T1 - Spare Part

Velox LE 5800 Digital Radio System

The Part Numbers for Velox LE 5800 Systems and Spare Parts available for these systems are given in Table 10-10 below.

Table 10-10. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum	
Ordering Code	**Description**
	Velox LE 5800 Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 5800 Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-03853-02-H1-PT	Velox LE 5800 Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-03853-02-L1-PT	Velox LE 5800 Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-03853-02-H2-PT	Velox LE 5800 Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-03853-02-L2-PT	Velox LE 5800 Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-03853-02-H4-PT	Velox LE 5800 Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-03853-02-L4-PT	Velox LE 5800 Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Unbalanced Interface - BNC (specify - E1 or T1, Bridge or Router)	
651-04055-02-H1-PT	Velox LE 5800 Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-04055-02-L1-PT	Velox LE 5800 Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-04055-02-H2-PT	Velox LE 5800 Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-04055-02-L2-PT	Velox LE 5800 Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-04055-02-H4-PT	Velox LE 5800 Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-04055-02-L4-PT	Velox LE 5800 Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Velox LE 5800 operates from 21-56 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5800 Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 5800 Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-03853-02-S1-PT	Velox LE 5800 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-03853-02-S2-PT	Velox LE 5800 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-03853-02-S4-PT	Velox LE 5800 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
Unbalanced Interface - BNC (specify - E1 or T1, Bridge or Router)	
651-04055-02-S1-PT	Velox LE 5800 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-04055-02-S2-PT	Velox LE 5800 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-04055-02-S4-PT	Velox LE 5800 Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
RFU Spare Part	
651-03806-02L-PT	Velox LE 5810 Low Band ORFU - Spare Part
651-03806-02H-PT	Velox LE 5810 High Band ORFU - Spare Part

DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04104-02-1-PT	Velox LE DIU 1xE1/T1 - Spare Part
651-04104-02-2-PT	Velox LE DIU 2xE1/T1 - Spare Part
651-04104-02-4-PT	Velox LE DIU 4xE1/T1 - Spare Part
Unbalanced Interface - BNC (specify - E1 or T1)	
651-04105-02-1-PT	Velox LE DIU 1xE1/T1 - Spare Part
651-04105-02-2-PT	Velox LE DIU 2xE1/T1 - Spare Part
651-04105-02-4-PT	Velox LE DIU 4xE1/T1 - Spare Part
The Velox LE 5800 uses standard CAT5 Ethernet cable and RJ-45 connectors for connecting the DIU to the ORFU. A two-wire power cable is also required between the DIU and the ORFU. Note Screened Cat5 cable, and UV resistant cables are recommended for long term outdoor use.	

Velox LE 5810 SR Digital Radio System

The Part Numbers for Velox LE 5810 SR Systems and Spare Parts available for these systems are given in Table 10-11 below.

Table 10-11. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum

Ordering Code	Description
	Velox LE 5810 SR Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 5810 SR Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04375-02-H1-PT	Velox LE 5810 SR Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-04375-02-L1-PT	Velox LE 5810 SR Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-04375-02-H2-PT	Velox LE 5810 SR Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-04375-02-L2-PT	Velox LE 5810 SR Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-04375-02-H4-PT	Velox LE 5810 SR Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-04375-02-L4-PT	Velox LE 5810 SR Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04382-02-H1-PT	Velox LE 5810 SR Radio:1 DIU and 1 High Band ORFU - 1E1 /1T1
651-04382-02-L1-PT	Velox LE 5810 SR Radio:1 DIU and 1 Low Band ORFU - 1E1 /1T1
651-04382-02-H2-PT	Velox LE 5810 SR Radio:1 DIU and 1 High Band ORFU - 2E1 /2T1
651-04382-02-L2-PT	Velox LE 5810 SR Radio:1 DIU and 1 Low Band ORFU - 2E1 /2T1
651-04382-02-H4-PT	Velox LE 5810 SR Radio:1 DIU and 1 High Band ORFU - 4E1 /4T1
651-04382-02-L4-PT	Velox LE 5810 SR Radio:1 DIU and 1 Low Band ORFU - 4E1 /4T1
Velox LE 5810 SR operates from 21-58 Vdc (21-56Vdc where indicated), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5810 SR Microwave Digital Radio System	

Ordering Code	Description
	Velox LE 5810 SR Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04375-02-S1-PT	Velox LE 5810 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-04375-02-S2-PT	Velox LE 5810 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-04375-02-S4-PT	Velox LE 5810 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04382-02-S1-PT	Velox LE 5810 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 1E1 /1T1
651-04382-02-S2-PT	Velox LE 5810 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 2E1 /2T1
651-04382-02-S4-PT	Velox LE 5810 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 4E1 /4T1
RFU Spare Part	
651-03806-02L-PT	Velox LE 5810 SR Low Band ORFU - Spare Part
651-03806-02H-PT	Velox LE 5810 SR High Band ORFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04316-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04316-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04316-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04378-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04378-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04378-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
The Velox LE 5810 SR uses standard CAT5 Ethernet cable and RJ-45 connectors for connecting the DIU to the ORFU. A two-wire power cable is also required between the DIU and the ORFU. Note Screened Cat5 cable, and UV resistant cables are recommended for long term outdoor use.	

Velox LE 5810 SRi Digital Radio System

The Part Numbers for Velox LE 5810 SRi Systems and Spare Parts available for these systems are given in Table 10-12 below.

Table 10-12. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum - All indoor radio

Ordering Code	Description
	Velox LE 5810 SRi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Velox LE 5810 SRI Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	

651-04318-02-H1-PT	Velox LE 5810 SRi Radio:1 DIU and 1 High Band IRFU - 1E1 /1T1
651-04318-02-L1-PT	Velox LE 5810 SRi Radio:1 DIU and 1 Low Band IRFU - 1E1 /1T1
651-04318-02-H2-PT	Velox LE 5810 SRi Radio:1 DIU and 1 High Band IRFU - 2E1 /2T1
651-04318-02-L2-PT	Velox LE 5810 SRi Radio:1 DIU and 1 Low Band IRFU - 2E1 /2T1
651-04318-02-H4-PT	Velox LE 5810 SRi Radio:1 DIU and 1 High Band IRFU - 4E1 /4T1
651-04318-02-L4-PT	Velox LE 5810 SRi Radio:1 DIU and 1 Low Band IRFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04383-02-H1-PT	Velox LE 5810 SRi Radio:1 DIU and 1 High Band IRFU - 1E1 /1T1
651-04383-02-L1-PT	Velox LE 5810 SRi Radio:1 DIU and 1 Low Band IRFU - 1E1 /1T1
651-04383-02-H2-PT	Velox LE 5810 SRi Radio:1 DIU and 1 High Band IRFU - 2E1 /2T1
651-04383-02-L2-PT	Velox LE 5810 SRi Radio:1 DIU and 1 Low Band IRFU - 2E1 /2T1
651-04383-02-H4-PT	Velox LE 5810 SRi Radio:1 DIU and 1 High Band IRFU - 4E1 /4T1
651-04383-02-L4-PT	Velox LE 5810 SRi Radio:1 DIU and 1 Low Band IRFU - 4E1 /4T1
Velox LE 5810 SRi operates from 21-58 Vdc (21-56Vdc where indicted), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5810 SRi Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 5810 SRi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 9.5Mbps link data capacity, fully scalable between 10Base-T Ethernet and up to 4xE1(4x2Mbps) or 4xT1(4x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04318-02-S1-PT	Velox LE 5810 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 1E1 /1T1
651-04318-02-S2-PT	Velox LE 5810 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 2E1 /2T1
651-04318-02-S4-PT	Velox LE 5810 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 4E1 /4T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04383-02-S1-PT	Velox LE 5810 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 1E1 /1T1
651-04383-02-S2-PT	Velox LE 5810 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 2E1 /2T1
651-04383-02-S4-PT	Velox LE 5810 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 4E1 /4T1
RFU Spare Part	
651-04354-01L-PT	Velox LE 5810 SRi Low Band IRFU - Spare Part
651-04354-01H-PT	Velox LE 5810 SRi High Band IRFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04316-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04316-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04316-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04378-01-01-P	Velox LE 10 DIU 1xE1/T1 - Spare Part
651-04378-01-02-P	Velox LE 10 DIU 2xE1/T1 - Spare Part
651-04378-01-04-P	Velox LE 10 DIU 4xE1/T1 - Spare Part
The Velox LE 5810 SRi uses standard CAT5 Ethernet cable and RJ-45 connectors for connecting the DIU to the IRFU.	

A two-wire power cable is also required between the DIU and the IRFU.

Note Screened Cat5 cable, and UV resistant cables are recommended for long term outdoor use.

Velox LE 5825 SR Digital Radio System

The Part Numbers for Velox LE 5825 SR Systems and Spare Parts available for these systems are given in Table 10-13 below.

Table 10-13. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum

Ordering Code	Description
	Velox LE 5825 SR Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 5825 SR Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04253-01-H08-P	Velox LE 5825 SR Radio:1 DIU and 1 High Band ORFU - 8E1 /8T1
651-04253-01-L08-P	Velox LE 5825 SR Radio:1 DIU and 1 Low Band ORFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04384-01-H08-P	Velox LE 5825 SR Radio:1 DIU and 1 High Band ORFU - 8E1 /8T1
651-04384-01-L08-P	Velox LE 5825 SR Radio:1 DIU and 1 Low Band ORFU - 8E1 /8T1
Velox LE 5825 SR Radio operates from 21-58 Vdc (21-56Vdc where indicted), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5825 SR Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 5825 SR Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04253-01-S08-P	Velox LE 5825 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU- 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04384-01-S08-P	Velox LE 5825 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU- 8E1 /8T1
RFU Spare Part	
651-04254-01L-P	Velox LE 5850 Low Band ORFU - Spare Part
651-04254-01H-P	Velox LE 5850 High Band ORFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04313-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04386-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part

Velox LE 5825 SRi Digital Radio System

The Part Numbers for Velox LE 5825 SRi Systems and Spare Parts available for these systems are given in Table 10-14 below.

Table 10-14. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum - All indoor radio

Ordering Code	Description
	Velox LE 5825 SRi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Velox LE 5825 SRi Microwave Digital Radios Complete	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04342-01-H08-P	Velox LE 5825 SRi Radio:1 DIU and 1 High Band IRFU - 8E1 /8T1
651-04342-01-L08-P	Velox LE 5825 SRi Radio:1 DIU and 1 Low Band IRFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04388-01-H08-P	Velox LE 5825 SRi Radio:1 DIU and 1 High Band IRFU - 8E1 /8T1
651-04388-01-L08-P	Velox LE 5825 SRi Radio:1 DIU and 1 Low Band IRFU - 8E1 /8T1
Velox LE 5825 SRi Radio operates from 21-58 Vdc (21-56Vdc where indicted), optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Ordering Code	**Description**
	Velox LE 5825 SRi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 25Mbps link data capacity, 10Base-T Ethernet and up to 8xE1(8x2Mbps) or 8xT1(8x1.5Mbps) data interface
Spares Package for Velox LE 5825 SRi Microwave Digital Radio System	
Balanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04342-01-S08-P	Velox LE 5825 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 8E1 /8T1
Unbalanced Interface - DB25 (specify - E1 or T1, Bridge or Router)	
651-04388-01-S08-P	Velox LE 5825 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 8E1 /8T1
RFU Spare Part	
651-04358-01L-P	Velox LE 5850i Low Band IRFU - Spare Part
651-04358-01H-P	Velox LE 5850i High Band IRFU - Spare Part
DIU Spare Part	
Balanced Interface - DB25 (specify - E1 or T1)	
651-04313-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part
Unbalanced Interface - DB25 (specify - E1 or T1)	
651-04386-01-08-P	Velox LE 25 DIU 8xE1/T1 - Spare Part

Velox LE 5850 IP Digital Radio System

The Part Numbers for Velox LE 5850 IP Systems and Spare Parts available for these systems are given in Table 10-15 below.

Table 10-15. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum	
Ordering Code	**Description**
	Velox LE 5850 IP Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
Velox LE 5850 IP Microwave Digital Radios Complete	
651-04305-01-HE-P	Velox LE 5850 IP Radio:1 DIU and 1 High Band ORFU - IP only
651-04305-01-LE-P	Velox LE 5850 IP Radio:1 DIU and 1 Low Band ORFU - IP only
Velox LE 5850 IP Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5850 IP Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 5850 IP Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, Up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
651-04305-01-SE-P	Velox LE 5850 IP Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - IP only
RFU Spare Part	
651-04254-01L-P	Velox LE 5850 Low Band ORFU - Spare Part
651-04254-01H-P	Velox LE 5850 High Band ORFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04322-01-E-P	Velox LE IP DIU IP only - Spare Part

Velox LE 5850 IPi Digital Radio System

The Part Numbers for Velox LE 5850 IPi Systems and Spare Parts available for these systems are given in Table 10-16 below.

Table 10-16. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum - All indoor radio	
Velox LE 5850 IPi Microwave Digital Radios Complete	
Ordering Code	**Description**
	Velox LE 5850 IPi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
651-04385-01-HE-P	Velox LE 5850 IPi Radio:1 DIU and 1 High Band IRFU - IP only
651-04385-01-LE-P	Velox LE 5850 IPi Radio:1 DIU and 1 Low Band IRFU - IP only
Velox LE 5850 IPi Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5850 IPi Microwave Digital Radio System	

Ordering Code	Description
	Velox LE 5850 IPi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, up to 46 Mbps full duplex 10/100Base-T Ethernet data interface
651-04385-01-SE-P	Velox LE 5850 IPi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - IP only
RFU Spare Part	
651-04358-01L-P	Velox LE 5850i Low Band IRFU - Spare Part
651-04358-01H-P	Velox LE 5850i High Band IRFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04322-01-E-P	Velox LE IP DIU IP only - Spare Part

Velox LE 5850 SR Digital Radio System

The Part Numbers for Velox LE 5850 SR Systems and Spare Parts available for these systems are given in Table 10-17 below.

Table 10-17. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum	
Ordering Code	**Description**
	Velox LE 5850 SR Radio: 1 DIU and 1 High or Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
Velox LE 5850 SR Microwave Digital Radios Complete	
651-04387-01-H16-P	Velox LE 5850 SR Radio:1 DIU and 1 High Band ORFU - 16E1 /16T1
651-04387-01-L16-P	Velox LE 5850 SR Radio:1 DIU and 1 Low Band ORFU - 16E1 /16T1
Velox LE 5850 SR Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5850 SR Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 5850 SR Sp-Pkg: 1 DIU and 1 High and 1 Low band ORFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
651-04387-01-S16-P	Velox LE 5850 SR Sp-Pkg:1 DIU and 1 HB and 1 LB ORFU - 16E1 /16T1
RFU Spare Part	
651-04254-01L-P	Velox LE 5850 Low Band ORFU - Spare Part
651-04254-01H-P	Velox LE 5850 High Band ORFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04379-01-16-P	Velox LE 50 DIU 16xE1/T1 only - Spare Part

Velox LE 5850 SRi Digital Radio System

The Part Numbers for Velox LE 5850 SRi Systems and Sp are Parts available for these systems are given in Table 10-18 below.

Table 10-18. Microwave Digital Radio System, 5.8GHz ISM Frequency Band, Spread Spectrum - All indoor radio

Ordering Code	Description
	Velox LE 5850 SRi Radio: 1 DIU and 1 High or Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
Velox LE 5850 SRi Microwave Digital Radios Complete	
651-04389-01-H16-P	Velox LE 5850 SRi Radio:1 DIU and 1 High Band IRFU - 16E1 /16T1
651-04389-01-L16-P	Velox LE 5850 SRi Radio:1 DIU and 1 Low Band IRFU - 16E1 /16T1
Velox LE 5850 SRi Radio operates from 21-58 Vdc, optional 110-220 Vac power supply available below. A complete link requires two radios, one must be High Band (HB) and the other a Low Band (LB)	
Spares Package for Velox LE 5850 SRi Microwave Digital Radio System	
Ordering Code	**Description**
	Velox LE 5850 SRi Sp-Pkg: 1 DIU and 1 High and 1 Low band IRFU, Type-N RF output, high power output for FCC and unregulated, 46Mbps link data capacity, fully scalable between 10/100Base-T Ethernet and up to 16xE1(16x2Mbps) or 16xT1(16x1.5Mbps) data interface
651-04389-01-S16-P	Velox LE 5850 SRi Sp-Pkg:1 DIU and 1 HB and 1 LB IRFU - 16E1 /16T1
RFU Spare Part	
651-04358-01L-P	Velox LE 5850i Low Band IRFU - Spare Part
651-04358-01H-P	Velox LE 5850i High Band IRFU - Spare Part
DIU (specify - E1 or T1) Spare Part	
651-04379-01-16-P	Velox LE 50 DIU 16xE1/T1 only - Spare Part

Velox LE Accessories, Spares and Upgrades

Table 10-19. Velox LE Accessories & Upgrades

Ordering Code	Description
651-04226	Velox LE 4B 1+1 hot standby combiner/splitter (4 tribs - Balanced)
651-04227	Velox LE 8B 1+1 hot standby combiner/splitter (8 tribs - Balanced)
651-04347	Velox LE 8U 1+1 hot standby combiner/splitter (8 tribs - Unbalanced)
651-03987	75/120 Ohm Patch Panel Assembly
478-07865	19" Rack Mount for Outdoor Unit (4u high)
651-03864	Bench Power Supply 110-220VAC to 24VDC
651-03868-02	Velox LE 2400 & Velox LE 5800 NMS Software Disk - Spare Part
651-04252-02	Velox LE NMS Software CD - Spare Part
651-03809	ODU Pole Mounting Kit - Spare Part
862-01881	Velox LE User Manual - Spare Part
660-03405	Cable Assembly: RSSI Test Loom - Spare Part
651-03865	Velox LE Upgrade 1xE1/T1 to 2xE1/T1

651-03866	Velox LE Upgrade 2xE1/T1 to 4xE1/T1
651-03867	Velox LE Upgrade 1xE1/T1 to 4xE1/T1

Chapter 11 : Domain / Network Management of the Velox LE Product Range

Introduction

All management of the Velox LE products are implemented using SNMP (Simple Network Management Protocol), an open standard. The products can be managed by:

a. Standard SNMP managers such as HP OpenView or SNMPc, i.e. there is Open Network Management compatibility.

For rapid product installation, the NCT GUI Application (hereafter referred to as the NCT-GA) provides extensive management functions on site and, via the microwave radio link, can be used to access the Velox LE station on the opposite side of the link. The NCT-GA is a software application that runs on a PC workstation such as a laptop or notebook computer that is connected to a Velox LE DIU serial port (DB9 DTE) or an Ethernet connection (10Base-T DTE), both accessed via the DIU front-panel.

NOTE: The lates NCT can be downloaded from www.stratexnet.co.za/updates

SNMP and the Velox LE

Use of SNMP within the product allows remote: configuration, monitoring of performance, notification of alarms and firmware upgrades via an IP-network. Within an IP network supporting routing of IP data, the radios can be supported from any remote location. The product can be accessed via the Internet if the necessary gateways are provided. A GSM/PCS modem dial-up capability provides another remote management option.

The DIUs have built-in SNMP agents and an extensive MIB (Management Information Base). The Velox LE product uses SNMP V1 (RFC1155, 1157). The user has access to an Enterprise MIB (obtainable Stratex Support – see Support on page 1-4 for details) and MIB II (RFC 1213).

Access to the MIB via the DIU SNMP agent is via Ethernet (10Base-T interface on the product's front panel) or PPP (RFC 1661) via the product's serial channel Element Manager Port. The use of SNMP provides flexibility for operators with central equipment monitoring. It provides management access to radio configuration (all data interfaces), interface status and statistics, fault and maintenance information.

Using a login and password to give the user “administrator” or “standard user” rights (if enabled) ensures SNMP security. The "standard user rights" option limits the ability to SET MIB variables.

NOTE: Secure SNMP is not supported.

The product has threshold-based alarm generation (there is an extensive SNMP trap list with a trap filter that is adjustable via SNMP). Network access (wired or wireless i.e. GSM/PCS Modem) allows over-the-air remote firmware uploading (FTP) with a load verification (and reversion) capability.

There are three principle requirements to use SNMP with the Velox LE Radio Stations:

a. A Management Station that runs a SNMP Management Software package that is installed on a networked or stand-alone PC that can be connected to a DIU either using a serial connection or an Ethernet connection. From the Management station, the agents within the DIUs can be configured or polled for information.
b. Agent: The agent accepts SNMP GET, SET or GET-NEXT commands from the Management Application software and collects or adjusts information from the DIUs MIB.
c. Management Information Base (MIB): the MIB is a database that is accessed based on the OID (object ID) the SNMP Manager has chosen. The DIU uses an Enterprise MIB and a standard MIB (MIB II) to store or allow access to information relevant to the Velox LE link.

MIB Elements – OID (Object ID) Descriptions

NOTE: The MIB database is updated on a regular basis. Information on the latest additions can be obtained from www.stratexnet.co.za/firmware.

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316	Stratex			
.1316.1	products			
.1316.1.1	digitalradio			
.1316.1.1.1	Mdrmte			
.1316.1.1.1.1	MdrmtePerformance			
.1316.1.1.1.2	MdrmteConfiguration			
.1316.1.1.1.3	MdrmteFault			
.1316.1.1.1.4	MdrmteAccess			
.1316.1.1.1.5	MdrmteRelayOutputs			
.1316.1.1.1.6	MdrmteOptoInputs			
.1316.1.1.1.1.1 .1316.1.1.1.1.1.1	MdrmtePayloadPerf MdrmtePpTable	 SEQUENCE	 not-accessible	
.1316.1.1.1.1.1.1.1	MdrmtePpEntry	MdrmtePpEntry	not-accessible	
.1316.1.1.1.1.1.1.1.1	MdrmtePpIndex	INTEGER	read-only	

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.1.1.1.1.2	MdrmtePpLOS	INTEGER	read-only	A Loss of Signal has been detected on the input to a tributary - there is one for each tributary (0, 1, 2, 3, ...).
.1316.1.1.1.1.1.1.1.3	MdrmtePpAIS	INTEGER	read-only	An Alarm Indication Signal has been detected on the input to a tributary - there is one for each tributary (0, 1, 2, 3, ...).
.1316.1.1.1.1.1.2	MdrmteCrcErrors	INTEGER	read-only	The number of CRC4 or CRC6 errors seen on the selected tributary since the last time errors were cleared.
.1316.1.1.1.1.1.3	MdrmteCrcTribSelect	INTEGER	read-write	The tributary selected for CRC checking.
.1316.1.1.1.1.1.4	MdrmteCrcLock	INTEGER	read-only	Indication of whether the CRC checking algorithm has locked onto a CRC frame signature in the payload data.
.1316.1.1.1.1.1.5	MdrmteCrcEbitCnt	INTEGER	read-only	Reflects the number of assertions of the 'E' bits in selected tributary.
.1316.1.1.1.1.2	MdrmteRFLinkPerf			
.1316.1.1.1.1.2.1	MdrmteCarrierDetect	INTEGER	read-only	Indicates if a RF Carrier has been detected by the RFU - if so, the header in the RF Packet has been identified as a potential valid packet - note however, that it could be received from another transmitter that uses the same header format.
.1316.1.1.1.1.2.2	MdrmteRSSI	Gauge	read-only	A dBm value representative of the received signal level. The value detected is representative of the level that would be measured should a spread spectrum signal be input at the RFUs Diplexer RF Port - a CW (Continuous Wave) signal will appear to be 20 dB higher.
.1316.1.1.1.1.2.3	MdrmteCurrentPER	DisplayString	read-only	This is the current Packet Error Rate and is based on the number of “uncorrectable” packets/blocks being detected by the FEC (Forward Error Correction) circuitry within the DIU (based of the number of errored packets divided by the total number of packets transmitted in a measurement period of 250msec).
.1316.1.1.1.1.2.4	MdrmteMaximizedPER	DisplayString	read-only	This is the maximum Packet Error Rate detected during the last measurement period, based number of maximum number.
.1316.1.1.1.1.2.5	MdrmteLinkUnavailable	INTEGER	read-only	Based on G.826 criteria, this MIB element indicates RF Link Availability/Non-availability

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.1.2.6	MdrmteFrameUnlock	INTEGER	read-only	The data that is transmitted across the RF Link is conveyed in a frame, compiled within.
.1316.1.1.1.1.2.7	MdrmteRemoteFrameUnlock	INTEGER	read-only	Frame-lock (MdrmteFrameUnlock) as seen by the other end of the link is fed back here.
.1316.1.1.1.1.2.8	MdrmteErrSecRatioExceeded	INTEGER	read-only	The ESR is a ratio of the number of Errored seconds (one second periods within.
.1316.1.1.1.1.2.9	MdrmteSevErrSecRatioExceeded	INTEGER	read-only	The SESR is a ratio of the number of Severely Errored seconds (one second periods within.
.1316.1.1.1.1.2.10	MdrmteBkgrndBlkErrRatioExceeded	INTEGER	read-only	The BBER is a ratio of the number of uncorrectable blocks/packets received.
.1316.1.1.1.1.2.11	MdrmteMinorPERExceede d	INTEGER	read-only	This parameter indicates if the minor packet (uncorrectable by FEC) error rate has been exceeded based on the defined.
.1316.1.1.1.1.2.12	MdrmteMajorPERExceeded	INTEGER	read-only	This parameter indicates if the major packet (uncorrectable by FEC) error rate has been exceeded based on the defined.
.1316.1.1.1.1.2.13	MdrmteCriticalPERExceeded	INTEGER	read-only	This parameter indicates if the critical packet (uncorrectable by FEC) error rate has been exceeded based on the defined.
.1316.1.1.1.1.2.14	MdrmtePrevParamsRestored	INTEGER	read-only	Indicates if autorecovery for the RFU settings had to be invoked.
.1316.1.1.1.1.2.15	MdrmteAveragePER	DisplayString	read-only	This is the current Average Packet Error Rate and is based on the number of.
.1316.1.1.1.1.2.16	MdrmteStartSweep	INTEGER	read-write	This is used to start the spectral RSSI sweep.
.1316.1.1.1.1.2.17	MdrmteRssiSpectrum	DisplayString	read-only	This contains the results of the sweep through the spectrum of.
.1316.1.1.1.1.3	MdrmteG826			
.1316.1.1.1.1.3.1	MdrmteStatus	INTEGER	read-only	Indicates if 'G.826-like' errored, severely errored and unavailable.
.1316.1.1.1.1.3.2	MdrmteTotalSeconds	Counter	read-only	Indicates the total number of seconds, both available and unavailable.
.1316.1.1.1.1.3.3	MdrmteAvailableSeconds	Counter	read-only	A period of unavailable time begins at the onset of ten consecutive SES events.
.1316.1.1.1.1.3.4	MdrmteUnavailableSeconds	Counter	read-only	A period of unavailable time begins at the onset of ten consecutive SES events.
.1316.1.1.1.1.3.5	MdrmteErroredSeconds	Counter	read-only	A one second period with one or more errored packets(not correctable packets) or at least one defect.

Table 11-1. OID Descriptions for the MIB Elements				
Object ID	**Object name**	**Object Type**	**Access Rights**	**Description**
.1316.1.1.1.1.3.6	MdrmteSeverelyErroredSeconds	Counter	read-only	A one-second period which contains > 30% errored blocks or at least one defect. SES is a subset of ES.
.1316.1.1.1.1.3.7	MdrmteErroredBlocks	Counter	read-only	A packet which has been identified as containing not correctable bits by the FEC circuitry
.1316.1.1.1.1.3.8	MdrmteBackgroundBlockErrors	Counter	read-only	An errored block not occurring as part of a SES.
.1316.1.1.1.1.3.9	MdrmteErroredSecondsRatio	DisplayString	read-only	The ratio of ES to total seconds in available time during a fixed measurement interval.
.1316.1.1.1.1.3.10	MdrmteSeverelyErroredSecondsRatio	DisplayString	read-only	The ratio of SES to total seconds in available time during a fixed measurement interval.
.1316.1.1.1.1.3.11	MdrmteBackgroundBlockErrorRatio	DisplayString	read-only	The ratio of Background Block Errors (BBE) to total blocks in available time
.1316.1.1.1.1.3.12	MdrmteDeprecated2	INTEGER	write-only	Deprecated
.1316.1.1.1.1.3.13	MdrmteCorrectedSymbols	INTEGER	read-only	This parameter lists the number of corrected symbols i.e. those corrected by the FEC
.1316.1.1.1.1.4	MdrmteCounters			
.1316.1.1.1.1.4.1	MdrmteLostEthRxPkts	Counter	read-only	Indicates the total number of times an Ethernet packet could not be buffered
.1316.1.1.1.1.4.2	MdrmteLostLinkRxPkts	Counter	read-only	Indicates the total number of times a link packet could not be buffered
.1316.1.1.1.1.4.3	MdrmteLostWaySideTxPkts	Counter	read-only	Indicates the total number of times a wayside packet could not be buffered
.1316.1.1.1.1.4.4	MdrmteScc1FullCnt	Counter	read-only	Indicates the total number of times SCC1 was full to capacity
.1316.1.1.1.1.4.5	MdrmteScc2FullCnt	Counter	read-only	Indicates the total number of times SCC2 was full to capacity
.1316.1.1.1.1.4.6	MdrmteScc1UnderrunCnt	Counter	read-only	Indicates the total number of times SCC1 ran out of BDs
.1316.1.1.1.1.4.7	MdrmteScc2UnderrunCnt	Counter	read-only	Indicates the total number of times SCC2 ran out of BDs
.1316.1.1.1.1.4.8	MdrmteScc2RxBdAbortCnt	Counter	read-only	Indicates the total number of times SCC2 received an aborted frame
.1316.1.1.1.1.4.9	MdrmteScc2RxBdNonOctCnt	Counter	read-only	Indicates the total number of times SCC2 received a Non octet aligned frame
.1316.1.1.1.1.4.10	MdrmteScc2RxBdCrcCnt	Counter	read-only	Indicates the total number of times SCC2 received a frame with a CRC error
.1316.1.1.1.1.4.11	MdrmteEtherTxRetries	Counter	read-only	Indicates the total number of (collisions) packets that were retransmitted on Ethernet

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.1.4.12	MdrmteEtherTxDeferCnt	Counter	read-only	Indicates the total number of frames deferred due to early collisions on Ethernet
.1316.1.1.1.1.4.13	MdrmteEtherTxHeartBeatCnt	Counter	read-only	Indicates the total number of times the collision inup was not asserted on Ethernet
.1316.1.1.1.1.4.14	MdrmteEtherTxLateCollisions	Counter	read-only	Indicates the total number of late collisions on Ethernet
.1316.1.1.1.1.4.15	MdrmteEtherReTxLimit	Counter	read-only	Indicates the total number of times the retransmission limit was reached on Ethernet
.1316.1.1.1.1.4.16	MdrmteEtherTxUnderrun	Counter	read-only	Indicates the total number of buffer under runs on Ethernet
.1316.1.1.1.1.4.17	MdrmteEtherTxCarrierLost	Counter	read-only	Indicates the total number of times carrier was lost on Ethernet
.1316.1.1.1.1.4.18	MdrmteEtherRxLenErr	Counter	read-only	Indicates the total number of frame length violations received on Ethernet
.1316.1.1.1.1.4.19	MdrmteEtherRxNonOctet	Counter	read-only	Indicates the total number of non-octet aligned frames received on Ethernet
.1316.1.1.1.1.4.20	MdrmteEtherRxShort	Counter	read-only	Indicates the total number of (too) short frames received on Ethernet
.1316.1.1.1.1.4.21	MdrmteEtherRxCRCerr	Counter	read-only	Indicates the total number of CRC errored frames received on Ethernet
.1316.1.1.1.1.4.22	MdrmteEtherRxOverrun	Counter	read-only	Indicates the total number of receiver overruns received on Ethernet
.1316.1.1.1.1.4.23	MdrmteEtherRxCollision	Counter	read-only	Indicates the total number of "collision" frames received on Ethernet
.1316.1.1.1.1.4.24	MdrmteEtherJunkFrames	Counter	read-only	Indicates the total number of invalid frames received on Ethernet
.1316.1.1.1.1.4.25	MdrmteEtherShortFrames	Counter	read-only	Indicates the total number of times the Ethernet frame received was too short .
.1316.1.1.1.1.4.26	MdrmteEtherTxBdsFull	Counter	read-only	Indicates the total number of times the Ethernet Tx BD queue was too full to insert data
.1316.1.1.1.1.4.27	MdrmteEtherRxPauseCnt	Counter	read-only	Indicates the total number of times the Ethernet receiver was disabled due to lack of buffers.
.1316.1.1.1.1.4.28	MdrmteIdma1InUse	Counter	read-only	Indicates the total number of times IDMA controller 1 was already in use. memcpy() was used instead.
.1316.1.1.1.1.4.29	MdrmteIdma2InUse	Counter	read-only	Indicates the total number of times IDMA controller 2 was already in use. memcpy() was used instead.

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.1.4.30	MdrmteLinkKnQueueFull	Counter	read-only	Indicates the total number of times a Kwiknet frame was deferred due to a lack of space in the AMX link queue.
.1316.1.1.1.1.4.31	MdrmteLinkTxBdsFull	Counter	read-only	Indicates the total number of times the RF Link Tx BD queue was too full to insert data
.1316.1.1.1.1.4.32	MdrmteKnEtherFramesLost	Counter	read-only	Indicates the total number of times the Kwiknet queue was too full to insert Ethernet data
.1316.1.1.1.1.4.33	MdrmteKnCraftFramesLost	Counter	read-only	Indicates the total number of times the Kwiknet queue was too full to insert SCC4 data
.1316.1.1.1.1.4.34	MdrmteKnLinkFramesLost	Counter	read-only	Indicates the total number of times the Kwiknet queue was too full to insert SCC2 data
.1316.1.1.1.1.4.35	MdrmteKnFramesTooShort	Counter	read-only	Indicates the total number of times the Kwiknet buffer allocated was too short.
.1316.1.1.1.1.4.36	MdrmteLinkVoidFrames	Counter	read-only	Indicates the total number of overwritten frames received on the wireless PPP link
.1316.1.1.1.1.4.37	MdrmteLinkRxPauseCnt	Counter	read-only	Indicates the total number of times the link receiver was disabled due to lack of buffers.
.1316.1.1.1.1.4.38	MdrmteRelayServerRestarts	Counter	read-only	Indicates the total number of times the Relay scripting server restarted.
.1316.1.1.1.1.4.39	MdrmteRelayClientRestarts	Counter	read-only	Indicates the total number of times the Relay scripting client restarted.
.1316.1.1.1.1.4.40	MdrmteMuxEtherErrors	Counter	read-only	The number of Ethernet errors reported by the FPGA
.1316.1.1.1.1.4.41	MdrmteMuxBlockErrors	Counter	read-only	The number of Block errors reported by the FPGA
.1316.1.1.1.1.4.42	MdrmteOuRxEtherCRCerrors	Counter	read-only	The number of Ethernet errors reported by the FPGA on the RFU
.1316.1.1.1.1.5	MdrmteResetAllPerfData	INTEGER	write-only	Reset all parameters associated with Packet Error and G.826 measurements for the RF Link
.1316.1.1.1.2.1	MdrmtePayloadConf			
.1316.1.1.1.2.1.1	MdrmteDataRate	INTEGER	read-write	Configure the tributary data interface rate - either E1 or T1
.1316.1.1.1.2.1.2	MdrmteLineCodeType	INTEGER	read-only	Deprecated
.1316.1.1.1.2.1.3	MdrmtePcTable	SEQUENCE	not-accessible	
.1316.1.1.1.2.1.3.1	MdrmtePcEntry	MdrmtePcEntry	not-accessible	
.1316.1.1.1.2.1.3.1.1	MdrmtePcIndex	INTEGER	read-only	
.1316.1.1.1.2.1.3.1.2	MdrmtePcLabel	DisplayString	read-write	E1/T1 Payload configuration tributary label

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.2.1.3.1.3	MdrmtePcActive	INTEGER	read-write	Defines whether tributaries are active or inactive
.1316.1.1.1.2.1.4	MdrmteLineEncodingTable	SEQUENCE	not-accessible	
.1316.1.1.1.2.1.4.1	MdrmteLineEncodingEntry	MdrmteLineEncodingEntry	not-accessible	
.1316.1.1.1.2.1.4.1.1	MdrmteLineEncodingIndex	INTEGER	read-only	
.1316.1.1.1.2.1.4.1.2	MdrmteLineEncodingTribSelect	INTEGER	read-only	Selects the tributary, or group of tributaries to which encoding applies
.1316.1.1.1.2.1.4.1.3	MdrmteLineEncoding	INTEGER	read-write	Defines the line code types for the tributaries, either HDB3 or AMI for E1
.1316.1.1.1.2.2 .1316.1.1.1.2.2.1	MdrmteRFLinkConf MdrmteTxPower	INTEGER	read-write	Allows set-up of the output power available at the diplexer port of the RFU
.1316.1.1.1.2.2.2	MdrmteBandPlan	INTEGER	read-write	The Velox LE5800 RFUs operate in the 5.725 GHz to 5.850 GHz ISM frequency band.
.1316.1.1.1.2.2.3	MdrmteTxFrequencyPlanD	INTEGER	read-write	Frequency plan D allows independent control of transmit and receive frequencies.
.1316.1.1.1.2.2.4	MdrmteRxFrequencyPlanD	INTEGER	read-write	Refer to the MdrmteTxFrequencyPlanD description
.1316.1.1.1.2.2.5	MdrmteTransmitBand	INTEGER	read-only	This value is read from the RFU via the DIU and defines whether it transmits in the
.1316.1.1.1.2.2.6	MdrmteReserved2	INTEGER	read-write	
.1316.1.1.1.2.2.7 .1316.1.1.1.2.2.8	MdrmteRegulations MdrmteAutoRecovery	INTEGER	read-only read-write	This parameter is read from the RFU via the DIU and defines regulatory compliance of the RFU This feature is used if the user is installing a link from one side and there is no assistance on the opposite side of the link. It mitigates against the link failing and not being able to be
.1316.1.1.1.2.2.9	MdrmteOURateOverride	INTEGER	read-write	Deprecated
.1316.1.1.1.2.2.10	MdrmteOUDataRate	INTEGER	read-write	A setable rate that allows a reduced transfer data rate over the RF Link
.1316.1.1.1.2.2.11	MdrmteTxFrequencyCurrent	INTEGER	read-only	This value [MHz] is read back from the RFU and defines the transmit frequency of the RFU
.1316.1.1.1.2.2.12	MdrmteRxFrequencyCurrent	INTEGER	read-only	This value [MHz] is read back from the RFU and defines the receive frequency of the RFU

Table 11-1. OID Descriptions for the MIB Elements				
Object ID	**Object name**	**Object Type**	**Access Rights**	**Description**
.1316.1.1.1.2.2.13	MdrmteNonAutoBandPlan	INTEGER	read-write	Same as MdrmteBandPlan setting in this MIB group except Autorecovery is not enabled - this allows control of the Outdoor
.1316.1.1.1.2.2.14	MdrmteNonAutoTxFreqPlanD	INTEGER	read-write	Same as Velox LETxFrequencyPlanD setting in this MIB group except autorecovery is not enabled - this allows control of the Outdoor
.1316.1.1.1.2.2.15	MdrmteNonAutoRxFreqPlanD	INTEGER	read-write	Same as Velox LERxFrequencyPlanD setting in this MIB group except autorecovery is not enabled - this allows control of the Outdoor
.1316.1.1.1.2.2.16	MdrmteNonAutoTxPower	INTEGER	read-write	Same as Velox LETxPower setting in this MIB group except autorecovery is not enabled - this allows control of the Outdoor
.1316.1.1.1.2.2.17	MdrmteRadioType	INTEGER	read-only	This value is read from the RFU via the DIU and defines
.1316.1.1.1.2.2.18	MdrmteSevereErrorMargin	INTEGER	read-write	Defines the percentage threshold (1-99) used when calculating in a one second period
.1316.1.1.1.2.2.19	MdrmteTimedMute	INTEGER	write-only	Initiates muting of transmitted signal for a short period to facilitate spectral analysis.
.1316.1.1.1.2.3	MdrmteServiceChannel			
.1316.1.1.1.2.3.1	MdrmteScDataRate	INTEGER	read-write	Bit rate used across the wayside service channel link
.1316.1.1.1.2.3.2	MdrmteScDataBits	INTEGER	read-write	The data width - can be 7 or 8 bits
.1316.1.1.1.2.3.3	MdrmteScParity	INTEGER	read-write	Serial channel - set to none, odd or even
.1316.1.1.1.2.3.4	MdrmteScStopBits	INTEGER	read-write	The number of stop bits can be set to 1 or 2
.1316.1.1.1.2.3.5	MdrmteScFlowControl	INTEGER	read-write	Either hardware or no flow control is used
.1316.1.1.1.2.3.6	MdrmteScStatusDump	INTEGER	read-write	Allows the wayside service (serial) channel to be used as a diagnostics port
.1316.1.1.1.2.4	MdrmteGeneral			
.1316.1.1.1.2.4.1	MdrmteStationName	DisplayString	read-write	The station name is stored in the DIU in non-volatile memory
.1316.1.1.1.2.4.2	MdrmteIUSerialNumber	DisplayString	read-only	An electronic serial number is read from the DIU - this number is unique
.1316.1.1.1.2.4.3	MdrmteIUFirmwareVersion	DisplayString	read-only	The DIU firmware number is the version of application firmware that is loaded into
.1316.1.1.1.2.4.4	MdrmteIUBootkernelVersion	DisplayString	read-only	The DIU boot kernel version is the version of boot firmware that is loaded into

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.2.4.5	MdrmteOUBarCode	INTEGER	read-only	The RFU bar-code number is programmed into the RFU at time of manufacture and is read via the
.1316.1.1.1.2.4.6	MdrmteOUPICFirmwareVersion	DisplayString	read-only	The RFU PIC firmware number is programmed into the RFU at time of manufacture and is read via the
.1316.1.1.1.2.4.7	MdrmteOUPayloadSupport	INTEGER	read-only	Deprecated
.1316.1.1.1.2.4.8	MdrmteDate	DisplayString	read-write	This is a date record that is recovered from the DIUs Real T ime Clock
.1316.1.1.1.2.4.9	MdrmteTime	DisplayString	read-write	This is a time record that is recovered from the DIUs Real T ime Clock
.1316.1.1.1.2.4.10	MdrmteNOVRAMInit	INTEGER	read-write	If activated, the Non-volatile memory is initialised to a set of default parameters
.1316.1.1.1.2.4.11	MdrmteFECBypass	INTEGER	read-write	This is primarily a laboratory test entry used to control whether the FEC circuitry within the
.1316.1.1.1.2.4.12	MdrmteFECCorrectableSymbols	INTEGER	read-write	This is primarily a laboratory test entry used to control the FEC correction power - 20 parity symbols
.1316.1.1.1.2.4.13	MdrmteTribCode	DisplayString	read-write	This is a text entry code (80 characters i.e. 40 bytes) used to allow activation of tributaries on the DIUs.
.1316.1.1.1.2.4.14	MdrmteIndoorUnitBarCodeNumber	DisplayString	read-write	This is a text entry code used to allow storage of the DIUs bar code serial number (as seen on the outside of the
.1316.1.1.1.2.4.15	MdrmteIndoorUnitPCBrevision	INTEGER	read-write	This is a numeric entry code used to reflect the PCB revision number and modification status.
.1316.1.1.1.2.4.16	MdrmteLocation	DisplayString	read-write	The station location is stored in the DIU in non-volatile memory
.1316.1.1.1.2.4.17	MdrmteOnePlusOne	INTEGER	read-write	Enables 'one-plus-one' dual-redundant (non-hitless) operation
.1316.1.1.1.2.4.18	MdrmteMaxTribs	INTEGER	read-only	The number of tributaries that can be used with the current tributary code.
.1316.1.1.1.2.4.19	MdrmteDefaultConfig	INTEGER	write-only	Allows one to set one of four default-configurations.
.1316.1.1.1.2.4.20	MdrmteTotalTribs	INTEGER	read-only	How many Tribs in total on this version of IDU motherboard.
.1316.1.1.1.2.4.21	MdrmteCustomConfigSet	INTEGER	read-write	Changes the way in which the default configurations work by pre-loading
.1316.1.1.1.2.4.22	MdrmteFpgaVersion	INTEGER	read-only	Firmware version of the FPGA.
.1316.1.1.1.2.4.23	MdrmteOuCommsRate	INTEGER	read-write	Data-rate of the Ethernet link between the DIU and the RFU.

Table 11-1. OID Descriptions for the MIB Elements				
Object ID	**Object name**	**Object Type**	**Access Rights**	**Description**
.1316.1.1.1.2.4.24	MdrmteHdlcRateCap	INTEGER	read-write	Maximum Data-rate of the HDLC link between the DIUs (Mbit/sec + 1)
.1316.1.1.1.2.4.25	MdrmteOUSerialNo	DisplayString	read-only	The RFU serial number is programmed into the RFU at time of manufacture and is read via the
.1316.1.1.1.2.4.26	MdrmteApVersion	DisplayString	read-only	The Firmware version number of the Atmel processor
.1316.1.1.1.2.5	MdrmteFirmware			
.1316.1.1.1.2.5.1	MdrmteFTPServerStatus	INTEGER	read-write	This allows activation/deactivation of the FTP server that runs in the DIU and is
.1316.1.1.1.2.5.2	MdrmteFlashNewFirmware	INTEGER	read-write	This entry determines the time when the new version of firmware will be activated
.1316.1.1.1.2.5.3	MdrmtePlatformSupport	DisplayString	read-only	This indicates the hardware types supported by the firmware:
.1316.1.1.1.2.6	MdrmteOutdoorUnit			
.1316.1.1.1.2.6.1	MdrmteOuPersonalityTable	SEQUENCE	not-accessible	
.1316.1.1.1.2.6.1.1	MdrmteOuPersonalityEntry	MdrmteOuPersonalityEntry	not-accessible	
.1316.1.1.1.2.6.1.1.1	MdrmteOuPersonalityIndex	INTEGER	read-only	
.1316.1.1.1.2.6.1.1.2	MdrmteOuPersonalityActive	INTEGER	read-write	Indicates whether this particular RFU personality is selected.
.1316.1.1.1.2.6.1.1.3	MdrmteOuPersonalityDataRate	INTEGER	read-only	Maximum raw data rate of the personality.
.1316.1.1.1.2.6.1.1.4	MdrmteOuPersonalityModulation	INTEGER	read-only	Modulation type.
.1316.1.1.1.2.6.1.1.5	MdrmteOuPersonalityFpgaVersion	INTEGER	read-only	FPGA version.
.1316.1.1.1.2.6.1.1.6	MdrmteOuPersonalityRssiComp	INTEGER	read-only	RSSI compensation factor used by the RFU
.1316.1.1.1.2.6.1.1.7	MdrmteOuPersonalityMinTxFreq	INTEGER	read-only	Lowest allo wed Tx frequency
.1316.1.1.1.2.6.1.1.8	MdrmteOuPersonalityMaxTxFreq	INTEGER	read-only	Highest allowed Tx frequency
.1316.1.1.1.2.6.1.1.9	MdrmteOuPersonalityMinRxFreq	INTEGER	read-only	Lowest allowed Rx frequency
.1316.1.1.1.2.6.1.1.10	MdrmteOuPersonalityMaxRxFreq	INTEGER	read-only	Highest allowed Rx frequency
.1316.1.1.1.2.6.1.1.11	MdrmteOuPersonalityPlanATxFreq	INTEGER	read-only	Band plan A Tx frequency
.1316.1.1.1.2.6.1.1.12	MdrmteOuPersonalityPlanARxFreq	INTEGER	read-only	Band plan A Tx frequency
.1316.1.1.1.2.6.1.1.13	MdrmteOuPersonalityPlanBTxFreq	INTEGER	read-only	Band plan B Tx frequency
.1316.1.1.1.2.6.1.1.14	MdrmteOuPersonalityPlanBRxFreq	INTEGER	read-only	Band plan B Rx frequency
.1316.1.1.1.2.6.1.1.15	MdrmteOuPersonalityPlanCTxFreq	INTEGER	read-only	Band plan C Rx frequency
.1316.1.1.1.2.6.1.1.16	MdrmteOuPersonalityPlanCRxFreq	INTEGER	read-only	Band plan C Rx frequency
.1316.1.1.1.2.6.1.1.17	MdrmteOuPersonalityMaxTxPower	INTEGER	read-only	Maximum allowed Transmit Power
.1316.1.1.1.2.6.1.1.18	MdrmteOuPersonalityMinTxPower	INTEGER	read-only	Minimum allowed Transmit Power
.1316.1.1.1.2.6.1.1.19	MdrmteOuPersonalityDefTxPower	INTEGER	read-only	Default Transmit Power

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.2.6.1.1.20	MdrmteOuPersonalityDescription	DisplayString	read-only	Verbal description of this personality
.1316.1.1.1.2.6.2	MdrmteOuPersonalities	INTEGER	read-only	The number of FPGA personalities that the RFU has programmed
.1316.1.1.1.2.6.3	MdrmteOuActivePersonality	INTEGER	read-write	The currently active FPGA personality
.1316.1.1.1.3.1	MdrmteInfo			
.1316.1.1.1.3.1.1	MdrmteLEDTable	SEQUENCE	not-accessible	A group of LEDs on the front panel of the DIU.
.1316.1.1.1.3.1.1.1	MdrmteLEDEntry	MdrmteLED Entry	not-accessible	An LED entry containing objects describing a particular LED.
.1316.1.1.1.3.1.1.1.1	MdrmteLEDIndex	INTEGER	read-only	A unique value for each LED in the DIU. Its value
.1316.1.1.1.3.1.1.1.2	MdrmteLEDLabel	DisplayString	read-only	SYSTEM Green OK, Orange (RFU/DIU Comms Error), Red (RFU/DIU Comms Down).
.1316.1.1.1.3.1.1.1.3	MdrmteLEDState	INTEGER	read-only	The current state of the LED - for a detailed description of functionality, see the MdrmteLEDLabel entry
.1316.1.1.1.3.1.1.1.4	MdrmteLEDColour	INTEGER	read-only	The current colour of the LED - for a detailed description of functionality, see the MdrmteLEDLabel entry
.1316.1.1.1.3.1.1.1.5	MdrmteLEDHistoricAmberWarning	INTEGER	read-only	The number of Amber 'blips' that the LED is flashing
.1316.1.1.1.3.1.1.1.6	MdrmteLEDHistoricRedError	INTEGER	read-only	The number of Red 'blips' that the LED is flashing
.1316.1.1.1.3.1.2	MdrmteOutdoorUnitComms	INTEGER	read-only	Describes the state of DIU communication with the RFU.
.1316.1.1.1.3.1.3	MdrmteOutdoorUnitResetType	INTEGER	read-only	This message is read from the RFU and identifies the last reason for a reset within the
.1316.1.1.1.3.1.4	MdrmteOutdoorUnitLockDetect	INTEGER	read-only	The transmit RF synthesiser, receive RF synthesiser and IF phased locked loop lock detect signals
.1316.1.1.1.3.1.5	MdrmtePayloadDrive	INTEGER	read-only	In a One-Plus-One configuration, this tells you if this DIU is driving the
.1316.1.1.1.3.1.6	MdrmteLock	INTEGER	read-only	In a One-Plus-One configuration, this tells you if this DIU is driving the
.1316.1.1.1.3.1.7	MdrmtePeerPayloadDrive	INTEGER	read-only	In a One-Plus-One configuration, this tells you if the peer (standby) is driving the
.1316.1.1.1.3.1.8	MdrmtePeerLock	INTEGER	read-only	In a One-Plus-One configuration, this tells you if the peer (standby) is driving the
.1316.1.1.1.3.1.9	MdrmteOuEtherRate	INTEGER	read-only	The current (actual) Data-rate of the Ethernet link between the DIU and the RFU.

Table 11-1. OID Descriptions for the MIB Elements				
Object ID	**Object name**	**Object Type**	**Access Rights**	**Description**
.1316.1.1.1.3.2	MdrmteSelfTest			
.1316.1.1.1.3.2.1	MdrmteFlash	INTEGER	read-only	Identifies pass/fail status of the DIUs application flash
.1316.1.1.1.3.2.2	MdrmteDRAM	INTEGER	read-only	Identifies pass/fail status of the DIUs Dynamic RAM
.1316.1.1.1.3.2.3	MdrmteSRAM	INTEGER	read-only	Identifies pass/fail status of the DIUs Static RAM
.1316.1.1.1.3.2.4	MdrmteLineInterface	INTEGER	read-only	Identifies pass/fail status of the DIUs Line Interface IC
.1316.1.1.1.3.2.5	MdrmteFPGA	INTEGER	read-only	Identifies pass/fail status of the DIUs FPGA interface registers to the microprocessor
.1316.1.1.1.3.2.6	MdrmteFEC	INTEGER	read-only	Identifies pass/fail status of the DIUs FEC IC electrical interface
.1316.1.1.1.3.2.7	MdrmteRealTimeClock	INTEGER	read-only	Identifies pass/fail status of the DIUs Real Time Clock
.1316.1.1.1.3.2.8	MdrmteIndoorUnitResetType	INTEGER	read-only	This message is read from the DIU and identifies the last reason for a reset within the
.1316.1.1.1.3.2.9	MdrmteLoopbackMode	INTEGER	read-write	Entry defines the loopback mode of a radio station in terms of loopback at either
.1316.1.1.1.3.2.10	MdrmteLoopbackTimeOut	INTEGER	read-write	This is the number of seconds the loopback will run for until it times out
.1316.1.1.1.3.2.11	MdrmteOuTemperature	DisplayString	read-only	This is the measured temperature in the Out-door unit (if supported) in degrees Celsius
.1316.1.1.1.3.2.12	MdrmteOuEtherPhy	INTEGER	read-only	Identifies pass/fail status of the Ethernet phy to the RFU
.1316.1.1.1.3.2.13	MdrmteEEprom	INTEGER	read-only	Identifies pass/fail status of the DIUs EEPROM
.1316.1.1.1.3.3	MdrmteTrapManagement			
.1316.1.1.1.3.3.1	MdrmteTrapFilter	INTEGER	read-write	Alarms within the Velox LE product are classified as critical, major, minor or informational. The trap
.1316.1.1.1.3.3.2	MdrmteNumberTrapManagers	INTEGER	read-only	This entry shows the number of trap managers allowed
.1316.1.1.1.3.3.3	MdrmteTrapManagerTable	SEQUENCE	not-accessible	
.1316.1.1.1.3.3.3.1	MdrmteTrapManagerEntry	MdrmteTrapManagerEntry	not-accessible	
.1316.1.1.1.3.3.3.1.1	MdrmteTrapManagerIndex	INTEGER	read-only	
.1316.1.1.1.3.3.3.1.2	MdrmteTrapManagerIP	IPAddress	read-write	This is the IP address of the management station that is set up to detect and act upon
.1316.1.1.1.3.3.3.1.3	MdrmteTrapManagerComm	DisplayString	read-write	This is the 'SNMP community name' used for dispatch of traps

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.3.3.3.1.4	MdrmteTrapManagerActive	INTEGER	read-write	Defines whether a particular Trap Manager is active or inactive
.1316.1.1.1.3.4	MdrmtePerfTrapThreshold			
.1316.1.1.1.3.4.1	MdrmteMinorPERThreshold	DisplayString	read-write	Defines the threshold used as a checking criterion for the Minor PER (Packet Error Rate)
.1316.1.1.1.3.4.2	MdrmteMajorPERThreshold	DisplayString	read-write	Defines the threshold used as a checking criterion for the Major PER (Packet Error Rate)
.1316.1.1.1.3.4.3	MdrmteCriticalPERThreshold	DisplayString	read-write	Defines the threshold used as a checking criterion for the Critical PER (Packet Error Rate)
.1316.1.1.1.3.4.4	MdrmteErrSecRatioThreshold	DisplayString	read-write	Defines the threshold used as a checking criterion for the Errored Second Ratio
.1316.1.1.1.3.4.5	MdrmteSevErrSecRatioThreshold	DisplayString	read-write	Defines the threshold used as a checking criterion for the Severely Errored Second Ratio
.1316.1.1.1.3.4.6	MdrmteBkgrndBlkErrRatioThreshold	DisplayString	read-write	Defines the threshold used as a checking criterion for the Background Block Error Ratio
.1316.1.1.1.3.5	MdrmteEventLogTable	SEQUENCE	not-accessible	
.1316.1.1.1.3.5.1	MdrmteEventLogEntry	MdrmteEventLogEntry	not-accessible	
.1316.1.1.1.3.5.1.1	MdrmteEventIndex	INTEGER	read-only	
.1316.1.1.1.3.5.1.2	MdrmteEventDate	DisplayString	read-only	Lists the date on which the event occurred
.1316.1.1.1.3.5.1.3	MdrmteEventTime	DisplayString	read-only	Lists the time when the event occurred
.1316.1.1.1.3.5.1.4	MdrmteEventType	INTEGER	read-only	Lists the type of event - informational, minor, major or critical
.1316.1.1.1.3.5.1.5	MdrmteEventDescription	DisplayString	read-only	Textual description of the logged event
.1316.1.1.1.3.6	MdrmteClearEventLog	INTEGER	write-only	This entry is used to clear the Event Log
.1316.1.1.1.3.7	MdrmteResetAllFaults	INTEGER	write-only	This entry is used to
.1316.1.1.1.3.8	MdrmteEnableDebug	INTEGER	read-write	This entry is used to enable test and debugging features
.1316.1.1.1.3.9	MdrmteErrorWindow	INTEGER	read-write	This entry is used to set the time period in minutes during
.1316.1.1.1.3.10	MdrmteTrapData	DisplayString	read-only	Textual description or data relating to a trap
.1316.1.1.1.3.11	MdrmteLogCorrectedSymbols	INTEGER	read-write	Enable or disable periodic logging of corrected symbols
.1316.1.1.1.3.13	MdrmteHideHistoricLeds	INTEGER	read-write	Enable or disable the 'historic' flashing on the LEDs
.1316.1.1.1.3.12	MdrmteEngineering			
.1316.1.1.1.3.12.1	MdrmteDataStreamStatus	INTEGER	read-only	Status bits for the RFU and Tribs during production tests.

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.3.12.2	MdrmteFramingSchedule	INTEGER	read-only	The current framing schedule selected on the FPGA
.1316.1.1.1.3.12.3	MdrmteFrameTribCnt	INTEGER	read-only	The number of Tribs supported by the framing structure in use
.1316.1.1.1.3.12.4	MdrmteIuBackToBack	INTEGER	read-write	Loop one DIU to another without RFUs for production tests
.1316.1.1.1.3.12.5	MdrmteWaysideFeedsOu	INTEGER	read-write	Feed the Wayside channel to the RFU for production tests
.1316.1.1.1.4.1	MdrmteEthernetIPAddress	IpAddress	read-write	The IP address associated with product's Ethernet port.
.1316.1.1.1.4.2	MdrmteEthernetNetMask	IpAddress	read-write	The netmask associated with the Ethernet port
.1316.1.1.1.4.3	MdrmteMaxNumUsers	INTEGER	read-only	If the firmware is compiled with the security feature
.1316.1.1.1.4.4	MdrmteMaxNumActiveUsers	INTEGER	read-only	If the firmware is built with the security feature switched on, users
.1316.1.1.1.4.5	MdrmteNumActiveUsers	Gauge	read-only	If the firmware is built with the security feature switched on, users
.1316.1.1.1.4.6	MdrmteUserTable	SEQUENCE	not-accessible	Deprecated
.1316.1.1.1.4.6.1	MdrmteUserEntry	MdrmteUser Entry	not-accessible	Deprecated
.1316.1.1.1.4.6.1.1	MdrmteUserIndex	INTEGER	read-only	Deprecated
.1316.1.1.1.4.6.1.2	MdrmteUserName	DisplayString	read-write	If the firmware is built with the security feature switched on, users
.1316.1.1.1.4.6.1.3	MdrmteUserPassword	DisplayString	write-only	If the firmware is built with the security feature switched on, users
.1316.1.1.1.4.6.1.4	MdrmteUserAccessLevel	INTEGER	read-write	If the firmware is built with the security feature switched on, users
.1316.1.1.1.4.6.1.5	MdrmteUserActive	INTEGER	read-write	Indicates if a user is active or not based on password entry
.1316.1.1.1.4.6.1.6	MdrmteUserAdd	INTEGER	write-only	In security-enabled mode, allows an administrator to add users
.1316.1.1.1.4.6.1.7	MdrmteUserDelete	INTEGER	write-only	In security-enabled mode, allows an administrator to delete users
.1316.1.1.1.4.7	MdrmteRFLinkIPAddress	IpAddress	read-write	PPP IP address for the RF Link. The user need not adjust this parameter
.1316.1.1.1.4.8	MdrmteRFLinkNetMask	IpAddress	read-write	PPP IP netmask for the RF Link. The user need not adjust this parameter
.1316.1.1.1.4.9	MdrmteRemoteIPAddress	IpAddress	read-write	Default PPP IP address for the other end of the link. The user need not adjust this parameter
.1316.1.1.1.4.10	MdrmteElementManagerIPAddress	IpAddress	read-write	Default PPP IP address for the element manager port - 10.13.1.1

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.4.11	MdrmteElementManagerNetMask	IpAddress	read-write	IP netmask for the Element Manager PPP port
.1316.1.1.1.4.12	MdrmteIPNegotiable	INTEGER	read-write	Determines if the local PPP IP address is negotiable or not - does not need to be adjusted by
.1316.1.1.1.4.13	MdrmtePPPisDefaultRoute	INTEGER	read-write	Determines if PPP interface is the default route - does not need to be adjusted by
.1316.1.1.1.4.14	MdrmteStaticRouteTable	SEQUENCE	not-accessible	Manually added static routes. (Only activated after system reset)
.1316.1.1.1.4.14.1	MdrmteStaticRouteEntry	MdrmteStaticRouteEntry	not-accessible	
.1316.1.1.1.4.14.1.1	MdrmteStaticRouteIndex	INTEGER	read-only	
.1316.1.1.1.4.14.1.2	MdrmteStaticRouteIPAddressDestination	IpAddress	read-write	Ultimate destination
.1316.1.1.1.4.14.1.3	MdrmteStaticRouteIPAddressMask	IpAddress	read-write	net mask, 255.255.255.255 if destination is host address
.1316.1.1.1.4.14.1.4	MdrmteStaticRouteIPAddressNextHop	IpAddress	read-write	Where to forward to
.1316.1.1.1.4.14.1.5	MdrmteStaticRouteInterfaceForNextHop	INTEGER	read-write	Interface (net) for next hop
.1316.1.1.1.4.15	MdrmteBridgeEnable	INTEGER	read-write	Determines if the system is to act as a transparent bridge for all Ethernet packets received.
.1316.1.1.1.4.16	MdrmteEthernetFullDuplex	INTEGER	read-write	Determines if the Ethernet interface is full or half-duplex.
.1316.1.1.1.4.17	MdrmteDefaultGateway	IpAddress	read-write	Default Gateway (Only activated after system reset)
.1316.1.1.1.4.18	MdrmteDefaultGWInterface	INTEGER	read-write	Default Gateway interface
.1316.1.1.1.4.19	MdrmteElementManagerPeerIP	IpAddress	read-write	Default PPP IP address for the PC connected to the element manager serial port.
.1316.1.1.1.4.20	MdrmteMacLearning	INTEGER	read-write	Enable or disable the ability to learn what MAC addresses are present locally.
.1316.1.1.1.4.21	MdrmteEnableDHCP	INTEGER	read-write	Enable or disable the DHCP client on Ethernet. If enabled, the locally stored IP
.1316.1.1.1.4.22	MdrmteClearArpCache	INTEGER	read-write	Delete all cached MAC addresses in the ARP table
.1316.1.1.1.4.23	MdrmteMacAddress	DisplayString	read-write	3-octet sub-string of the Ethernet MAC address excluding the Plessey RFUI.
.1316.1.1.1.4.24	MdrmteSnmpSetCommunity	DisplayString	write-only	Up to 31 octets defining the SNMP Write community string for READ/WRITE access.
.1316.1.1.1.4.25	MdrmteSnmpGetCommunity	DisplayString	write-only	Up to 31 octets defining the SNMP Read community string for READ access.
.1316.1.1.1.5.1	MdrmteRelay1			

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.5.1.1	MdrmteRelay1Label	DisplayString	read-write	A short, descriptive name indicating the primary function of the relay,
.1316.1.1.1.5.1.2	MdrmteRelay1OpenStateLabel	DisplayString	read-write	A short, descriptive name indicating the primary function of the relay
.1316.1.1.1.5.1.3	MdrmteRelay1ClosedStateLabel	DisplayString	read-write	A short, descriptive name indicating the primary function of the relay
.1316.1.1.1.5.1.4	MdrmteRelay1Reserved	INTEGER	read-write	Reserved.
.1316.1.1.1.5.1.5	MdrmteRelay1CurrentState	INTEGER	read-write	The current state of the relay. Used to activate/deactivate a relay.
.1316.1.1.1.5.1.7	MdrmteRelay1Latching	INTEGER	read-write	Indicates whether the relay will be latched by Scripting events, or will follow the state.
.1316.1.1.1.5.1.6	MdrmteRelay1ScriptTable	SEQUENCE	not-accessible	
.1316.1.1.1.5.1.6.1	MdrmteRelay1ScriptEntry	MdrmteRelay1ScriptEntry	not-accessible	
.1316.1.1.1.5.1.6.1.1	MdrmteRelay1ScriptIndex	INTEGER	read-only	
.1316.1.1.1.5.1.6.1.2	MdrmteRelay1ScriptID	INTEGER	read-only	Defines which of the listed alarms can cause a relay to activate
.1316.1.1.1.5.1.6.1.3	MdrmteRelay1ScriptActiveLocal	INTEGER	read-write	Defines if the script is active or not for local relay activation
.1316.1.1.1.5.1.6.1.4	MdrmteRelay1ScriptActiveRemote	INTEGER	read-write	Defines if the script is active or not for remote relay activation
.1316.1.1.1.5.2	MdrmteRelay2			
.1316.1.1.1.5.2.1	MdrmteRelay2Label	DisplayString	read-write	A short, descriptive name indicating the primary function of the relay.
.1316.1.1.1.5.2.2	MdrmteRelay2OpenStateLabel	DisplayString	read-write	A short, descriptive name indicating the primary function of the relay
.1316.1.1.1.5.2.3	MdrmteRelay2ClosedStateLabel	DisplayString	read-write	A short, descriptive name indicating the primary function of the relay
.1316.1.1.1.5.2.4	MdrmteRelay2Reserved	INTEGER	read-write	Reserved.
.1316.1.1.1.5.2.5	MdrmteRelay2CurrentState	INTEGER	read-write	The current state of the relay. Used to activate/deactivate a relay.
.1316.1.1.1.5.2.7	MdrmteRelay2Latching	INTEGER	read-write	Indicates whether the relay will be latched by Scripting events, or will follow the state.
.1316.1.1.1.5.2.6	MdrmteRelay2ScriptTable	SEQUENCE	not-accessible	
.1316.1.1.1.5.2.6.1	MdrmteRelay2ScriptEntry	MdrmteRelay2ScriptEntry	not-accessible	
.1316.1.1.1.5.2.6.1.1	MdrmteRelay2ScriptIndex	INTEGER	read-only	

Table 11-1. OID Descriptions for the MIB Elements

Object ID	Object name	Object Type	Access Rights	Description
.1316.1.1.1.5.2.6.1.2	MdrmteRelay2ScriptID	INTEGER	read-only	Defines which of the listed alarms can cause a relay to activate
.1316.1.1.1.5.2.6.1.3	MdrmteRelay2ScriptActiveLocal	INTEGER	read-write	Defines if the script is active or not for local relay activation
.1316.1.1.1.5.2.6.1.4	MdrmteRelay2ScriptActiveRemote	INTEGER	read-write	Defines if the script is active or not for remote relay activation
.1316.1.1.1.5.3	MdrmteRelayScriptServerPort	INTEGER	read-write	This specifies the IP port number to be used by the Relay scripting server
.1316.1.1.1.5.4	MdrmteRelayClientComms	INTEGER	read-only	This indicates the state of the Relay Scripting client-server socket.
.1316.1.1.1.5.5	MdrmteRelayScriptRemotePollTime	INTEGER	read-write	This specifies the poll interval for remote scripting updates in seconds.
.1316.1.1.1.5.6	MdrmteActiveEventsTable	SEQUENCE	not-accessible	Show all the currently active events (even if scripting on the event is disabled.)
.1316.1.1.1.5.6.1	MdrmteActiveEventsEntry	MdrmteActiveEventsEntry	not-accessible	
.1316.1.1.1.5.6.1.1	MdrmteActiveEventsIndex	INTEGER	read-only	Index
.1316.1.1.1.5.6.1.2	MdrmteActiveEventsLabel	INTEGER	read-only	Name of the event
.1316.1.1.1.5.6.1.3	MdrmteActiveEvents	INTEGER	read-only	Defines whether events are active or inactive
.1316.1.1.1.5.6.1.4	MdrmteActiveRemoteEvents	INTEGER	read-only	Defines whether remote events are active or inactive
.1316.1.1.1.5.7	MdrmteRelayScriptingEnable	INTEGER	read-write	This enables or disables relay scripting. Both near and far units must have the same setting.
.1316.1.1.1.6.1	MdrmteOptoInput1			
.1316.1.1.1.6.1.1	MdrmteOptoInput1Label	DisplayString	read-write	A short, descriptive name indicating the primary function of the contact-closure input
.1316.1.1.1.6.1.2	MdrmteOptoInput1State	INTEGER	read-only	Indicates if the opto input contact-closure input is active (on) or not (off)
.1316.1.1.1.6.2	MdrmteOptoInput2			
.1316.1.1.1.6.2.1	MdrmteOptoInput2Label	DisplayString	read-write	A short, descriptive name indicating the primary function of the contact-closure input
.1316.1.1.1.6.2.2	MdrmteOptoInput2State	INTEGER	read-only	Indicates if the opto input contact-closure input is active (on) or not (off)

MIB Elements – Trap Descriptions

Table 11-2. Trap Descriptions for MIB Elements

No	Trap	Description
1	MdrmteTrapUndefined : Informational	
2	MdrmteTrapPayloadLOS : Critical	Indicates a Loss of Signal identified on the INPUT TO a tributary
3	MdrmteTrapPayloadAIS : Critical	Indicates an Alarm Indication Signal ' all 1's ' identified/sensed on the INPUT TO a tributary
4	MdrmteTrapLinkUnavailable : Critical	Indicates, based on G.826 criteria if the RF Link has become unavailable
5	MdrmteTrapLinkFrameUnlock : Critical	Indicates a Frame Unlock condition associated with the DIU
6	MdrmteTrapLinkOuSynthUnlock : Critical	Indicates if a synthesiser unlock condition was identified in the RFU
7	MdrmteTrapLinkMinorPERExceeded : Minor	Indicates the minor packet error rate threshold was exceeded
8	MdrmteTrapLinkMajorPERExceeded : Major	Indicates the major packet error rate threshold was exceeded
9	MdrmteTrapLinkCriticalPERExceeded : Critical	Indicates the critical packet error rate threshold was exceeded
10	MdrmteTrapLinkESR Exceeded : Minor	Indicates the Link Error Second Ratio Threshold limit was exceeded
11	MdrmteTrapLinkSESRExceeded : Critical	Indicates the Link Severely Error Second Ratio threshold limit was exceeded
12	MdrmteTrapLinkBBERExceeded : Minor	Indicates the Link Background Block Error Rate threshold limit was exceeded
13	MdrmteTrapFTPUploadDone : Informational	Indicates FTP Upload done
14	MdrmteTrapFlashEraseFail : Informational	Indicates failure to erase Application flash
15	MdrmteTrapFirmwareUpgradePass : Informational	Indicates that firmware was uploaded successfully
16	MdrmteTrapFirmwareUpgradeFail : Informational	Indicates that there was a firmware upload failure
17	MdrmteTrapInterstationCommsTimeOut : Major	Indicates an inter-station communications timeout
18	MdrmteTrapInterstationCommsInvalid Response : Minor	Indicates a communications error on the inter-station overhead link
19	MdrmteTrapOUCommsTimeOut : Major	Indicates an RFU communications timeout
20	MdrmteTrapOUCommsInvalidResponse : Minor	Indicates an RFU communications error - an invalid response was received
21	MdrmteTrapOUCommsTxFail	Indicates RFU communications transmit failure
22	MdrmteTrapSSPCRCError : Minor	Simple Serial Protocol CRC error identified
23	MdrmteTrapSSPLengthError : Minor	Simple Serial Protocol Length error identified
24	MdrmteTrapOptoInput1Off : Major	Contact closure input off state detected - Opto 1
25	MdrmteTrapOptoInput1On : Major	Contact closure input off state detected- Opto 1
26	MdrmteTrapOptoInput2Off : Major	Contact closure input off state detected - Opto 2
27	MdrmteTrapOptoInput2On : Major	Contact closure input on state detected - Opto 2
28	MdrmteTrapUserLoginFailed : Informational	With security MODE ON - indicates a user attempted to log on and the attempt failed
29	MdrmteTrapUserLogoutFailed : Informational	With security MODE ON - indicates a user attempted to log out and the attempt failed
30	MdrmteTrapUserAddFailed : Informational	With security MODE ON - indicates there was an attempt to add a user, but the attempt failed.

Table 11-2. Trap Descriptions for MIB Elements		
No	**Trap**	**Description**
31	MdrmteTrapUserDeleteFailed : Informational	With security MODE ON - indicates there was an attempt to remove/delete a user, but the attempt failed.
32	MdrmteTrapUserLogIn : Informational	With security MODE ON - indicates a user logged in.
33	MdrmteTrapUserLogOut : Informational	With security MODE ON - indicates a user logged out.
34	MdrmteTrapUserAdd : Informational	With security MODE ON - indicates a user was added successfully.
35	MdrmteTrapUserDelete : Informational	With security MODE ON - indicates a user was deleted successfully.
36	MdrmteTrapOUSetBandPlan : Informational	Indicates the RFU channel/band plan was changed.
37	MdrmteTrapOUSetTxChannel : Informational	Indicates the RFU transmit frequency was changed.
38	MdrmteTrapOUSetRxChannel : Informational	Indicates the RFU receive frequency was changed.
39	MdrmteTrapOUEepromWrite : Minor	Indicates there was an attempt to write to the RFU EEPROM.
40	MdrmteTrapOUSetTxPower : Informational	Indicates there was an attempt to change the transmit power.
41	MdrmteTrapOUSetPNCode	Deprecated
42	MdrmteTrapOUSetAutoRecovery	Indicates there was an attempt to change the 'auto recovery' setting.
43	MdrmteTrapOUProgramConfig	Deprecated
44	MdrmteTrapOUChangeRFLoopback : Informational	Indicates a change the RFU RF Loopback setting was implemented.
45	MdrmteTrapOUChangeBBPLoopback : Informational	Indicates a change the Baseband Processor Loopback setting was implemented.
46	MdrmteTrapOUWriteBBP : Minor	Indicates there was an attempt to write to the Baseband Processor.
47	MdrmteTrapSetDate : Informational	Indicates the DIU date was adjusted.
48	MdrmteTrapSetTime : Informational	Indicates the DIU time was adjusted.
49	MdrmteTrapSynchronizeSwRTC : Informational	Indicates the DIUs time was synchronised with its real-time clock.
50	MdrmteTrapSetRelayLabel	A relay label was changed.
51	MdrmteTrapSetRelayOpenStateLabel	A relay open-state label was changed.
52	MdrmteTrapSetRelayClosedStateLabel	A relay closed-state label was changed.
53	MdrmteTrapSetRelayDefaultState : NA	Deprecated
54	MdrmteTrapSetRelayCurrentState : Informational	Relay's current state has changed
55	MdrmteTrapRelayScriptEnable	Relay scripting is enabled.
56	MdrmteTrapRelayScriptDisable	Relay scripting is disabled.
57	MdrmteTrapGetEventLog : Informational	DIUs event log is being accessed.
58	MdrmteTrapClearEventLog : Informational	DIUs event log is being cleared.
59	MdrmteTrapSelfTestFailure : Major	DIUs self test failed.
60	MdrmteTrapProcessorReset : Critical	There was a DIU processor reset.
61	MdrmteTrapEtherRx	There was a DIU Receive Ethernet buffer error.
62	MdrmteTrapTest : Informational	Test trap
63	MdrmteTrapGenericText	Test trap
64	MdrmteTrapGenericText_Data	Test trap
65	MdrmteTrapGenericText_DecData	Test trap
66	MdrmteTrapSocket_Error	Test trap
67	MdrmteLog_Link_Status : Informational	The Event Log was cleared, so a summary of the status has been logged.

Table 11-2. Trap Descriptions for MIB Elements		
No	**Trap**	**Description**
68	MdrmteLog_Link_Errors : Informational	One or more packet errors occurred in the last error window.
69	MdrmteLog_Link_Corrections : Informational	One or more corrected symbols occurred in the last error window.
70	MdrmteLocRelayScriptOpen : Minor	A relay opened as a result of a local relay-scripting event.
71	MdrmteLocRelayScriptClose : Minor	A relay closed as a result of a local relay-scripting event.
72	MdrmteRemRelayScriptOpen : Minor	A relay opened as a result of a remote relay-scripting event.
73	MdrmteRemRelayScriptClose : Minor	A relay closed as a result of a remote relay-scripting event.
74	MdrmteRemScriptEvent : Minor	A remote event occurred which will be processed by relay scripting.
75	MdrmteTrapLinkFrameUnlockAgain	Indicates a Frame Unlock condition associated with the DIU
76	MdrmteTrapOUSetFrequencies	Indicates the RFU receive frequencies were changed.
77	MdrmteTrapOUSetPersonality	Indicates the RFU FPGA personality was changed.

Chapter 12 : 1+1 Protection System Operation

System Description

When a single radio link is used to convey user data, any number of unexpected events may cause the link to fail resulting in user data being lost. This would require immediate corrective actions from the network operator responsible for maintaining the radio link. Since such a failure may occur at any time and possibly at a remote location, corrective actions may be very costly, both in terms of downtime and human resources. Common reasons for radio links to fail are:

- Signal fading on the radio link
- The presence of strong in-band interference
- Equipment failure

One possible solution to this problem is to install a second redundant radio link that can automatically take over the function of the primary radio link. This not only reduces the downtime of the link, but also provides the network operator with the opportunity to repair the faulty link at a convenient time.

This document describes the one-plus-one redundancy system that can be used with the radio products of Stratex Networks. Radio systems that are currently supported by the system are:

- Velox LE 2400, Velox LE 2410 SR, Velox LE 2410 SRi
- Velox LE 5800, Velox LE 5810 SR, Velox LE 5810 SRi
- Velox LE 2425 SR, Velox LE 2425 SRi
- Velox LE 5825 SR, Velox LE 5825 SRi

This document includes a detailed technical description of the redundancy system and contains information on its installation.

Technical Description

System Overview

General

The functionality required to provide a protected radio link is built into the Velox LE-type Software Radios. This implies that the user can set up a protected radio link by interconnecting the equipment for two parallel radio links through a 1RU-protection panel and a dedicated communications cable.

Each DIU in a protected radio system continuously monitors the status of the radio link it uses, as well as the radio link provided through the redundant system running in parallel. DIUs forming part of a redundant link at each end of the radio link share status information through a cable connecting the two Auxiliary ports of the DIUs.

Only the tributary payload data channels are protected by the redundant link i.e. there is no protection for Ethernet data. Tributary payload data is split and combined between links through a 1RU-protection panel that connects to the user network equipment as well as the two DIUs used at each end of the redundant link. Although both radio links are functioning continuously, only one of the DIUs is actively driving the tributary channels of the user network at any given time.

Each DIU continuously monitors the level of the Packet Error Ratio (PER) for the radio link on which it is receiving user data. When the PER exceeds a predefined ratio of 10 consecutive seconds, the DIU driving the tributary channels of the user network will signal the redundant DIU to take over processing the data it receives over the radio link.

The value of the PER threshold is configurable and can be changed through the Velox LE NCT if required. The default value is set at 30%.

There is no notion of a primary and secondary link in this redundancy system. The first link to be configured successfully will start driving the tributary payload channels. Switch over will only take place when the aforementioned condition occurs. In the event where the link to which the data was switched over fails at a later stage, the system will attempt to switch the data back to the original link.

NOTE 1: A situation can arise where the up - and downstream user tributary data is carried by separate radio links, i.e. link A carries the upstream data, and link B carries the downstream data.

NOTE 2: Due to the architecture of the redundancy system, the process of switching over from one link to another is not hitless and user tributary data will be lost for a few seconds (< 10).

System Configuration

The block diagram in Figure 12-1 on page 12-3 illustrates a typical redundancy system configuration. Note that this system is managed over an Ethernet LAN, where the two local DIUs are connected to the LAN using a hub. It is important to note that the IP addresses for each DIU should be unique. It is however possible to configure each link in the redundant system separately through the Element-Manager port of each local DIU, in which case it is not necessary to assign unique IP addresses to the DIUs.

The block diagram in Figure 12-1 also illustrates the following interfaces:

- DIU A to DIU B connection through the respective Auxiliary ports of the four DIUs
- The Protection Panel interfaces on each side of the link that combines and splits the tributary payload channels between the two radio links
- The single user network interfaces provided by the Protection Panel
- The two radio links that provide the redundancy required for user data protection

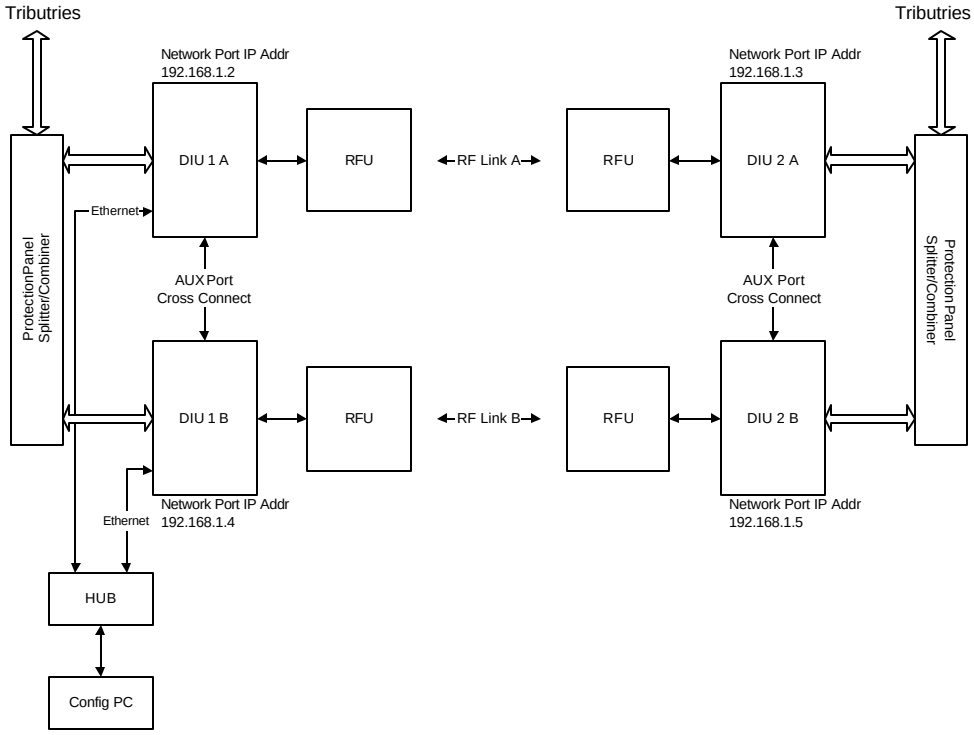


Figure 12-1. Block Diagram of a Typical Redundancy Protected System where the Radio Links are Managed through an Ethernet Network

1RU Protection Panel

There are two types of protection panels: a four and an eight tributary channel panel. They operate in the same way and perform the signal splitting and combination functions for the tributary channels taking part in the redundancy protected radio system. Note from Table 12-1 that the Protection Kit is currently only provided in 110-ohm as a compromise to make provision for E1 and T1 mode.

Table 12-1: Protection Kit Connector Interfaces

Description	Connector	Impedance
Velox LE Protection Panel		
Payload Network Interface	2xDB-25 or 8xRJ-48	110 ohm
DIU Interface	2x2xDB-25	110 ohm
Velox LE Protection Panel		
Payload Network Interface	DB-25 or 4xRJ-48	110 ohm
DIU Interface	2xDB-25	110 ohm

The cables required to connect the Patch Panel to the two DIUs are provided with the Patch Panel. The DB-25 pin-outs used for each DB-25 connector on the patch panel are exactly the same as that of the Velox LE DIUs respectively.

Auxiliary Port Communication

The two DIUs on each side of the radio link share status information through the two relay outputs and OPTO inputs on the Auxiliary (AUX) port of each DIU. Information shared by each of these:

- Indication if the DIU is currently driving the tributary channels on the user network
- The current Frame Lock status detected by the DIU for the radio link it is using

System Functional Description

Each DIU taking part in a protected radio link continuously monitors the PER of the radio link it is receiving tributary data over. If the PER for the link increases above the Sever Error Margin for more than 10 consecutive seconds, the DIU will request the second DIU to take over the driving of the tributary channels if the second DIU sees a frame lock.

Once the second DIU has started driving the tributary channels, the first DIU becomes the redundant link.

The flow diagram for the algorithm that governs the protection switchover process in each DIU is illustrated in Figure 12-2 below.

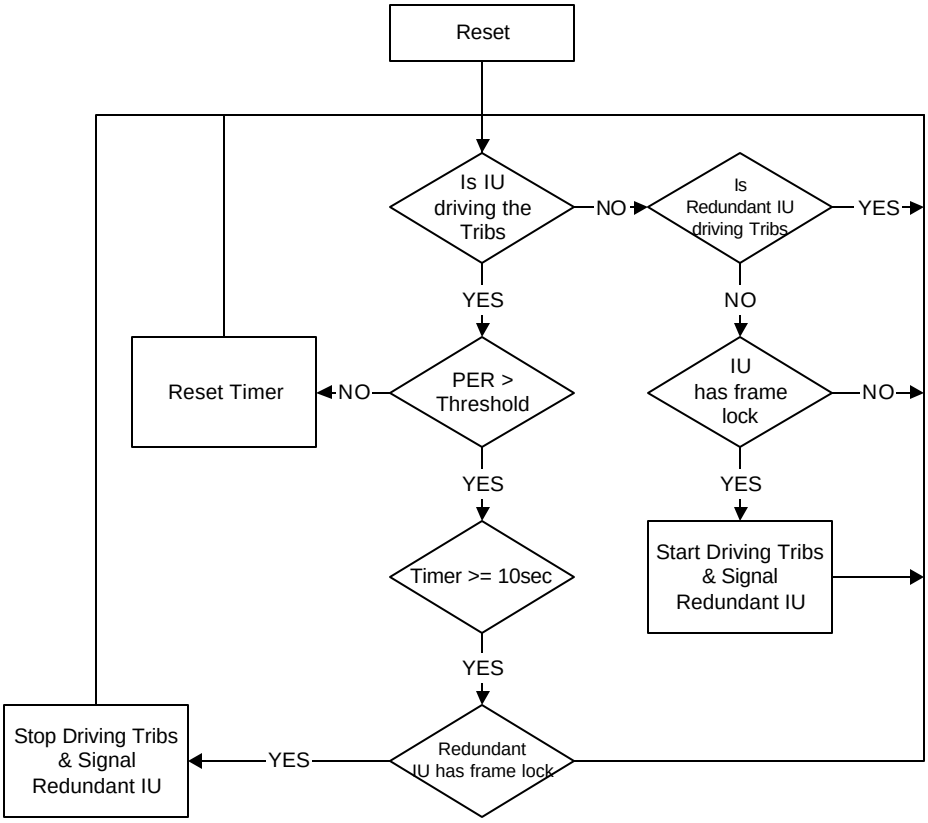


Figure 12-2. Redundant System Switch-over Algorithm

Installation

Hardware Installation

The following list of equipment is required to set up a protected radio link:

- Four Velox LE DIUs
- Four Velox LE RFUs
- Two Velox LE Protection Kit 1RU panels (Supplied with protection kit)
- Four / Eight DIU interface loom cables (Supplied with protection kit)
- Tributary channel interface cables to connect to the user network
- Two DIU auxiliary communications cables (Supplied with protection kit)
- Standard tools and cabling required to set up a Velox LE radio link

Illustrations of the Protection Kits front panels can be seen in Figure 12-3 and Figure 12-4 below. Note from the drawings that the Velox LE Protection Kit offers the ability to protect eight E1/T1 tributary channels.

Follow the steps below at each site to interconnect and set up the protected radio systems:

1. Install each DIU-RFU system as described in the Velox LE User Manual
2. Install the four / eight tributary channel Protection Kit panel in the rack mount
3. Connect tributary paths A and B on the Protection Kit panel to the two installed DIUs using the provided DB-25 interface cables
4. Link the two DIU auxiliary ports of the DIUs through the DIU auxiliary communications cable
5. Switch on the two units and configure the radios as explained in Radio Software Configuration on page 12-6.
6. Connect the tributary interface of the Protection Kit panel to the user network through the preferred interface (DB-25 / RJ48)

NOTE: Ensure that you acquire the correct protection kit, i.e. the one that matches the DIU type you intend to use.

Figure 12-3. Velox LE 8U Protection Kit Front Panel (Unbalanced)

Figure 12-4. Velox LE 8B Protection Kit Front Panel (Balanced)

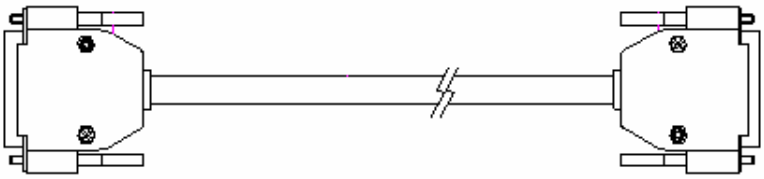


Figure 12-5. Tributary Channel Interface Cable used to connect Protection Kit Paths A & B to the two DIUs

DIU auxiliary communications cables are supplied with the Protection Kit and are used to connect the auxiliary ports of the two DIUs in accordance with Table 12-2 below. The system diagram when using the two radio pairs in bridging mode is shown in Figure 12-1 on page 12-3.

Table 12-2. Auxiliary Port Cross-connection	
Radio 1A Pin No	**Radio 1B Pin No**
1	12
2	13
8	14
9	15
12	1
13	2
14	8
15	9

Table 12-3. Auxiliary Port Cross-connection

Radio Software Configuration

Two MIB elements are used to configure the radios taking part in the protected radio link. These MIB elements can be set using any SNMP element manager application, or through the Velox LE NCT application. Please refer to the following for details on using the above applications:

- Velox LE NCT HTML help file.
- 3rd party user manual (If a 3rd party SNMP element manager / MIB browser is used.

Set the following MIB element in all DIUs taking part in the protected radio link to 1 (Yes). **MdrmteOnePlusOne (OID: 1.3.6.1.4.1.1316.1.1.1.2.4.17, Parent: MdrmteGeneral)**

The MIB element controlling the switch-over threshold, **MdrmteSevereErrorMargin (OID: 1.3.6.1.4.1.1316.1.1.1.2.2.18, Parent: MdrmteRFLinkConf),** is set to 30% by default. This value is a percentage and represents the switchover threshold for the Packet Error Ratio (PER). When the PER exceeds 30%, the switchover will occur. The value of this MIB element can be adjusted to meet the exact user requirements. It is advisable to set the switchover threshold on all DIUs to the same value.

System Verification

Since most of the functionality of the protected system is hidden from the user, it may be difficult to monitor the status at times. It can however be determined by monitoring the MIB elements listed below.

The status of the protected link can also be monitored through the Velox LE NCT. Please refer to the Velox LE NCT user manual for more information on this option.

- Name: MdrmteOnePlusOne – shows if the protected mode is active (OID: 1.3.6.1.4.1.1316.1.1.1.2.4.17, Parent: MdrmteGeneral)
- Name: MdrmtePayloadDrive – shows if the DIU is driving the tributary channels of the user network (OID: 1.3.6.1.4.1.1316.1.1.1.3.1.5, Parent: MdrmteInfo)
- Name: MdrmteLock – shows if frame lock is present (OID: 1.3.6.1.4.1.1316.1.1.1.3.1.6, Parent: MdrmteInfo)
- Name: MdrmtePeerPayloadDrive – shows if the Auxiliary port connected DIU (Peer) is driving the tributary channels. This element is the inverse (opposite) of MdrmtePayloadDrive (OID: 1.3.6.1.4.1.1316.1.1.1.3.1.7, Parent: MdrmteInfo)
- Name: MdrmtePeerLock - shows if the Auxiliary port connected DIU (Peer) has frame lock (OID: 1.3.6.1.4.1.1316.1.1.1.3.1.8, Parent: MdrmteInfo)
- Name: MdrmteSevereErrorMargin – the threshold percentage value for link unavailable to switch over (OID: 1.3.6.1.4.1.1316.1.1.1.2.2.18, Parent: MdrmteRFLinkConf)
- Name: MdrmteAveragePER – average Packet Error Ratio (OID: 1.3.6.1.4.1.1316.1.1.1.1.2.15, Parent: MdrmteRFLinkPerf)
- Name: MdrmteCurrentPER – real time Packet Error Ratio. For example a PER of 1e-1 (10%) corresponds to a SevereErrorMargin value of 10. The Current PER has to exceed the Severe Error Margin for 10 seconds continuously for the link to become unavailable and switch over to its peer DIU. (OID: 1.3.6.1.4.1.1316.1.1.1.1.2.3, Parent: MdrmteRFLinkPerf)

Chapter 13 : Frequently Asked Questions (FAQ)

General FAQs

Q **Can I operate several Velox LE radios in the same location?**

A Yes. Up to 6 links (hops) have been operated from a single location. Please be advised that inter-radio isolation considerations must be adhered to. This includes considerations related to antenna transmission characteristics.

Q **Can I use back-to-back RFs to make a straight repeater?**

A Yes. Make sure to use either 2 high band or 2 low band radios at the same location.

Q **Does the Velox LE provide channel banks or multiplex to "break down" T1's to DSO's?**

A No

Q **Has the Velox LE been connected to a PBX with E1 interface?**

A Yes. A Velox LE link conveys Primary Rate data transparently.

Q **How does the Velox LE series equipment deal with interference?**

A The Velox LE incorporates processing gain (through use of a spread spectrum technique). This provides interference immunity.

Q **What is the weight and dimensions of a packed Velox LE product?**

A Velox LE 5800 and Velox 2400: 17.5 Kg (38.5 lb.) 57cm x 32cm x 42cm (weight includes mounting brackets and manual).

Support FAQs

Q **Do you have 24 hour 7 day technical support if I have a radio failure?**

A Technical support queries should be routed to the supplier from whom the equipment was purchased. As accredited distribution/sales channels, they are trained to deal with the majority of technical support issues. Should it be required, they will escalate the issue to Stratex Networks that has a worldwide support network. For information on Stratex Networks support facilities refer to Support on page 1-4.

Q Where do I call for technical support?

A Your first call should be to the supplier from whom the equipment was purchased. As accredited distribution/sales channels they have been trained to deal with the majority of technical support issues which may arise. Should it be required, they will escalate the issue to Stratex Networks itself. For information on Stratex Networks support facilities refer to Support on page 1-4.

Q For protected systems, can I use a double feeder antenna?

A Yes, two independent links are used for a protection system. Stratex Networks suggest using two different Tx frequencies. Essentially providing polarization diversity.

Q How do I upgrade my Velox LE 2400 or Velox LE 5800 radio from 1E1/T1 to 2 and 4 E1/T1?

A A tributary code must be purchased. You use the NCT, a graphical utility to "load" the tributary code into the DIU. Thereafter, extra tributaries can be activated. See Chapter 5: NCT Installation for information on the NCT and Chapter 7:Tributary Upgrading.

Q What T1/E1 configuration do I order if I only want to use radio for maximum capacity (10 Mbit) Ethernet?

A Radios with a single T1/E1 active are all that are required to provide this capacity. You then deactivate the tributary using the graphical software utility supplied with the Velox LE radios.

Index

1

1+1 Protection System
  Overview, 12-1

A

Abbreviations, 1-3
About
  1+1 Protection System, 12-1
  1+1 Redundancy Protected Payload System, 8-14
  DIU, 8-11
  Frequency Plans, 8-5
  RFU, 8-4
  Velox LE Digital Radio Systems, 8-1
Accessories Supplied, 4-9
Adding a Modem for Windows NT, 6-3
Adding Dial-up Networking for Windows NT, 6-3
Antenna Alignment, 4-23
Antenna Connector, 3-13
Antenna Installation, 4-16
Antenna Isolation, 2-6
Antenna Selection, 2-2
Associated Documents, 1-2
Auxiliary I/O, 3-10
Auxiliary Input Interface, 8-19
Auxiliary Output Interface, 8-19

B

Back Panel
  Velox LE 75/120 Ohm DIU, 3-2
Back-to-Back test
  With PC, 4-12
  Without PC, 4-10
Balanced 120 Ohm
  Pin Connections, 3-4, 3-6
BaseBand Loopback, 4-26
Bridged Configuration
  IP Address Assignment, 6-7

C

Cables
  DIU to RFU (RJ45 + power)
    Cable type, 8-2
Cables Assemblies to be Manufactured, 4-7
Commissioning, 4-22
  Information required, 4-22
  Set Transmitted Power Level, 4-26
Commisssioning
  Equipment required, 4-22
Configuring a 1+1 Protection System, 12-2
Control, Indicators and Connectors on the DIU, 3-1
Customer Supplied Equipment, 4-8

D

Diagnostics, 4-26
Dial-up networking
  Add
    Windows 95/98, 6-5
DIU
  Installation, 4-19
  Payload Interface Options, 8-13
  Variants, 9-1
DIU Comms LED, 3-14
DIU DC In Connector, 3-14
DIU DC Power Input, 3-11
DIU description, 8-11
DIU Power LED , 3-14
DIU Status Diodes, 3-6
DIU to RFU Data cables
  Installation, 4-21
DIU/RFU Data, 3-10
DIU/RFU Data Connector, 3-14
DIU/RFU Link LED, 3-9

E

Electrical Performance data, 8-15
Element Manager Port, 3-9
Element Manager Port Interface, 8-19
Environmental data, 8-14
Equipment Required for Commissioning, 4-22
Ethernet Traffic Interface, 8-18
ETSI Notice, 3

F

FAQs
  General, 13-1
  Support, 13-1
FCC Notice, 3
Firmware
  Upload
    FTP, 7-1
Firmware upgrades, 7-1
Fixed Antennas, 2-3
Frequency Multiplexing 2-6
Frequency Plans, 8-5
  Frequency Channel Plan D (FCC Compliant), 8-9
  Velox LE 2410 and Velox LE 2410i, 8-6
  Velox LE 2410 and Velox LE 2410i (USA Only), 8-5
  Velox LE 2450 and Velox LE 2450i (FCC Compliant), 8-8
  Velox LE 5810 and Velox LE 5810i, 8-5
  Velox LE 5850 and Velox LE 5850i, 8-6
Front Panel
  Velox LE 10 DIU, 3-2
  Velox LE 25 DIU, 3-2
  Velox LE 50 DIU, 3-3
  Velox LE 75/120 Ohm DIU, 3-2
  Velox LE DIU 120 Ohm, 3-2
  Velox LE IP DIU, 3-3
Front Panels
  Velox LE IRFU, 3-13
Full duplex mode at max transfer rate, 7-2
Fuse Holder, 3-12

G

General Hazards, 4-2
Graphical Cues, 1-2
Ground Terminal, 3-12
Ground Terminal (RFU), 3-15

H

Hardware Installation Overview, 4-5
Health and Safety
  General, 4-1
  General Hazards, 4-2
  Operator, 4-2
  Requirements, 4-1
Health and Safety Requirements, 4-1

I

IF Loopback, 4-26
Indoor/RFU Interface, 8-19
INDUSTRY CANA DA Notice, 3
Installation
  Antenna, 4-16
  Antenna Alignment, 4-23
  Back-to-Back test (without PC), 4-10
  Cables Assemblies to be Manufactured, 4-7
  Commissioning, 4-22
  Contents of Accessories Box, 4-9
  DIU, 4-19
  DIU to RFU Data cables, 4-21
  IRFU, 4-19
  Knowledge required, 1-1
  ORFU, 4-16
  Overview, 4-5
  Power Cables, 4-21
  Pre-Installation Checks, 4-6
  RFU Mechanical, 4-17
  Tools and Equipment, 4-6
  Unpacking the Equipment, 4-8
  User Supplied Equipment, 4-8
Installation Planning
  Antenna Isolation, 2-6
  Antenna Selection, 2-2
  Fixed Antennas, 2-3
  Frequency Multiplexing, 2-6
  Interference, 2-4
  Multipath Effects, 2-4
  Site Evaluation, 2-3
  System Type Selection, 2-1
  Transmitted Power Levels, 2-5
Installation Record, 4-27
Installing a 1+1 Protection System, 12-5
Interfaces
  Auxiliary Input, 8-19
  Auxiliary Output, 8-19
  Element Manager Port, 8-19
  Ethernet Traffic, 8-18
  Indoor/RFU, 8-19
  Wayside Channel, 8-19
Interference considerations, 2-4
IP Address Assignment
  Bridged configuration, 6-7
  Routed Configuration, 6-9
IP configuration of the Velox LE, 6-7
IRFU
  Installation, 4-19

L

Loopback Procedure, 4-27

M

Manual contents, 1-2
MIB Elements – OID (Object ID) Descriptions, 11-2
MIB Elements – Trap Descriptions, 11-19
Microcell Backhaul, 2-5
Modem
  Add
    Windows 95/98, 6-4
Modulation
  Different types
    Velox LE 2400, 8-15
    Velox LE 5800, 8-16
    Velox LE 5850, 8-10
Multipath Effects, 2-4

N

NCT
  Installation, 5-2
  JRE Installation, 5-2
  PC requirements, 5-2
  PC Set-up, 6-1
  Using to configure a Radio, 5-3
NCT PC Set-up
  Adding a Modem for Windows NT, 6-3
  Adding Dial-up Networking for Windows NT, 6-3
  Adding Dial-up Networking for Windows XP, 6-2
  Dial-up Connection Properties for Windows 2000/Windows XP, 6-2
  Dial-up Networking
    Windows 2000, 6-1
  PPP Serial Communications, 6-1
NCT Software Installation, 5-1

O

On/Off Switch, 3-12
ORFU
  Installation, 4-16
Overview of the system, 8-4

P

Payload Data Interfaces specification, 8-18
Payload Interface Options, 8-13
  Ethernet Payload, 8-13
  Tributary Payload, 8-13
Payload T1/E1 Connectors, 3-3
  Balanced/Unbalanced 25-Way DiType, 3-3, 4-20
  Balanced/Unbalanced RJ48, 3-5
  Unbalanced Payload Data (BNC), 3-6
Physical data, 8-14
Pin Connections for Balanced 120 Ohm Termination on 25-Way D-Type Connector, 3-4
Pin Connections for Balanced RJ48 Connectors on Velox LE 10 and Velox LE 25 DIUs, 3-6
Pin Connections for Unbalanced 75 Ohm Termination on 25-Way D-Type Connector, 3-4, 4-20
Pinging on a Bridged Network, 6-7
Pin-outs
  Auxiliary In/Out Connector, 3-10

DC Power Connector (Velox LE 10, Velox LE 25, Velox LE 50 DIU), 3-12
DC Power Connector (Velox LE DIU 120 Ohm & 75/120 Ohm), 3-12
RFU Antenna Connector, 3-14
RFU RSSI Connector, 3-14
Service Channel Connector, 3-9
Power
DIU DC requirement, 8-14
Power Cables
Installation, 4-21
Pre-Installation Checks, 4-6

R

Reset/Configuration Button, 3-7
RF Interface specification, 8-17
RF Loopback, 4-26
RF Power Output Options, 8-11
RFU
Variants, 9-1
RFU DC Out, 3-10
RFU description, 8-4
Routed Configuration
IP Address Assignment, 3-8, 6-9
RSSI Connector, 3-14

S

Service (Wayside) Serial Data Channel, 3-8
Set Transmitted Power Level, 4-26
Site Evaluation, 2-3
Site Installation, 4-15
Software configuration of a 1+1 Protection System, 12-6
Stratex Networks
Contacting, 1-4
Support, 1-4
System Matrix, 9-2
System Type Selection, 2-1
System Variants, 9-4

T

Test Record, 4-28
Tools and Equipment for Installation, 4-6
Transceiver Characteristics, 8-17
Transmitted Power Levels, 2-5
Tributary Upgrading, 7-3

U

Unbalanced 75 Ohm
Pin Connections, 3-4, 4-20
Unpacking the Equipment, 4-8
Upgrading
Firmware, 7-1
Tributaries, 7-3

V

Velox LE
Models available, 8-2
Verifying a 1+1 Protection System, 12-7

W

Wayside Channel Interface, 8-19