Federal Communications Commission
Notice

NOTE

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

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

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

862-01545 µLink System Manual

µLink Digital Radio

System Manual

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Note to Reader

1. Users must be familiar with the Windows 95 operating environment.

List of Abbreviations

AC	Alternate Current
AIS	All Ones ("1's") (detected)
BER	Bit Error Rate
BPSK	Binary encoded Phase Shift Keying
CBIT	Continuous Built in Test
CRC	Cyclic Redundancy Check
DC	Direct Current
DCE	Data Communications Equipment
DRL	Digital Radio Link
DRS	Digital Radio Station
DTE	Data Terminal Equipment
FPGA	Field Programmable Gate Array
IBIT	Initiated Built in Test
IU	Indoor Unit
LAN	Local Area Network
LED	Light Emitting Diode
LRU	Line Replaceable Unit
MDR	Microwave Digital Radio
MIB	Management Information Base
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
N.C	Normally Closed
N.O	Normally Open
NMS	Network Management System
OU	Outdoor Unit
PC	Personal Computer
PCB	Printed Circuit Board
PLL	Phase Locked Loop

QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RF	Radio Frequency
SBIT	Start-up Built in Test
SDC	Serial Data Channel
SNMP	Simple Network Management Protocol
SRD	System Requirements Definition
SRU	Shop Replaceable Unit
TMN	Transmission Management Network
TTL	Transistor-Transistor Logic
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network

Chapter 1: Purpose and Planning

Introduction to Chapter 1

Chapter 1 is aimed at management and planning staff to enable them to assess the suitability and logistic requirements of the µLink Digital Radio, hereafter referred to as the µLink.

µLink Product Family

The µLink design philosophy was to produce a range of products, with the data rate dependent purely on the Indoor Unit (IU) and the frequency band dependent purely on the Outdoor Unit (OU). Thus resulting in a common IU that can operate with different frequency OUs, or alternatively, an OU that remains unchanged while the data rate is altered or upgraded.

Role and Purpose

The µLink operates in the 2.4 GHz ISM frequency band. It provides a full duplex, point-to-point, digital radio link supporting user data rates up to 2048 kbit/s. It is used to transport digital data between two or more sites. Whether the digital information is voice, telephony, cellular, data or video as required by various applications, the µLink can be deployed in urban and rural networks as an interconnect solution. Typical applications for the system include:

- Telecommunications companies, cellular operators and private carriers using low cost spread spectrum E1/T1 links to substitute for conventional copper or licences band microwave links
- Providing last mile leg in urban areas where frequency bands are congested
- Rural communications
- Corporate Networks

System Description

System Overview

A µLink digital radio relay link (DRL) consists of at least one complementary pair of µLink stations that may be extended over longer distances by linking further station pairs in a multiple hop configuration. A single µLink station comprises an Indoor Unit (Figure 1), an Outdoor Unit and Antenna (Figure 2). The Indoor Unit (IU) and Outdoor Unit (OU) are interconnected by a custom cable. Figure 3 is a block diagram of an µLink DRL.

Features

The µLink offers the following key features:

- T1 and E1 payload data interface options.
- IU is independent of OU frequency band and the OU is independent of IU data interfaces.
- Network management features, including remote performance monitoring and configurability. SNMP access to µLink via an SNMP agent will be included in future upgrade products.
- The equipment is compact and versatile, enabling fast deployment.
- The system offers high data link reliability.
- Maintenance requirements are minimal.
- The system provides built-in-diagnostic and test features.
- Co-locate two (2) antennas on a single mast.

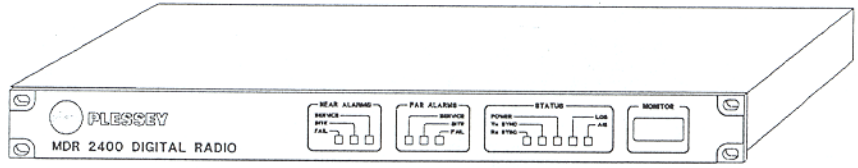

Figure 1. µLink Indoor Unit.

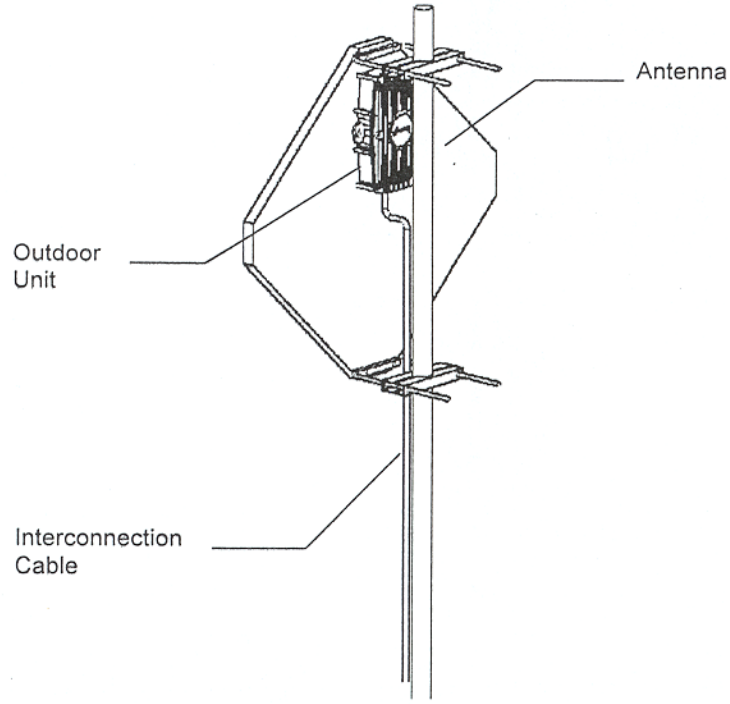

Figure 2. µLink Outdoor Unit and Antenna.

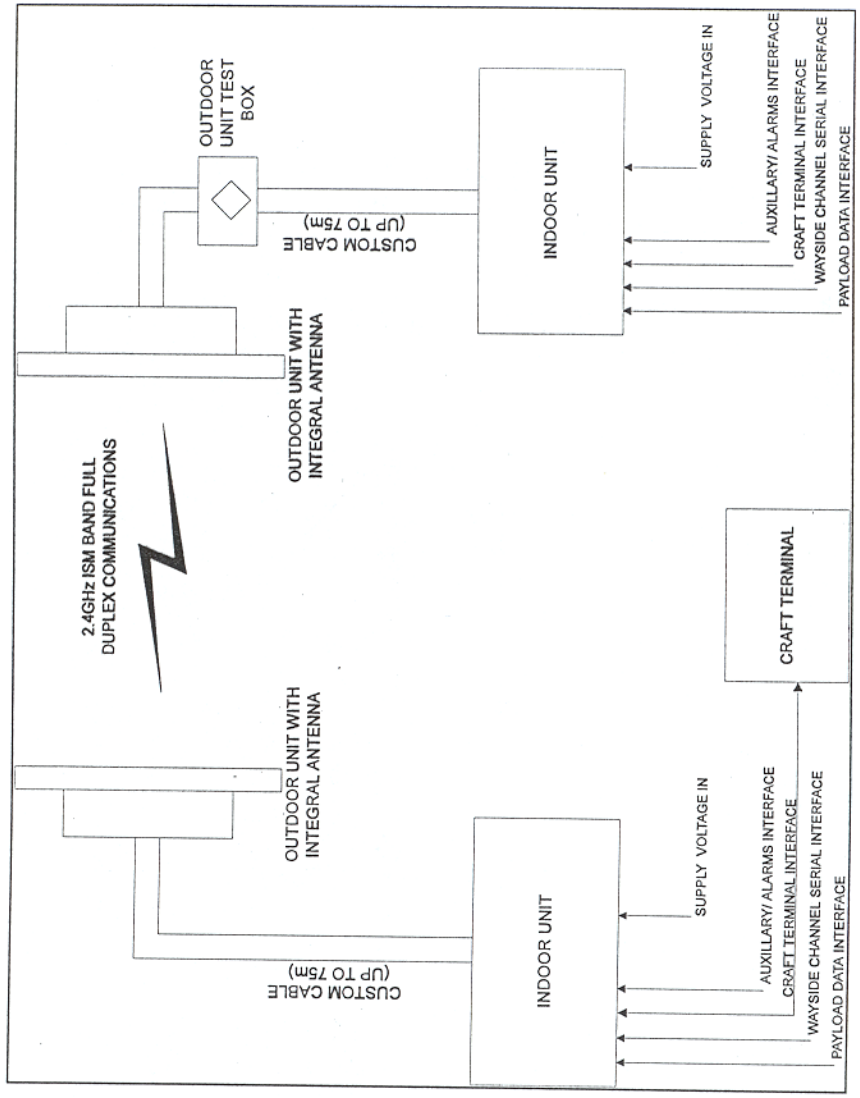

Figure 3. System Overview Block Diagram.

System Configuration Options

Table 1 lists the two model variants of the µLink System, with the input data classification and the radio link data rate. Table 2 lists the possible RF configurations with the output power, coupling type, antenna type and regulations with which the unit complies.

Table 1. µLink System Data Interface Variants

Model Number	Payload Data Type and Rate	Link Rate	PN Code Length
µLink - E	E1, 2048 kbit/s	2412 kbit/s	11
µLink - T	T1, 1544 kbit/s	1692 kbit/s	13

Table 2. µLink System RF Configurations

Option	Output Power	Coupling	Antenna	Regulations
µLink - LP	+2 dBm	Custom Non-ohmic	Flat Panel Tx = 18 dBi	ETSI-300-328
µLink - HP	+12 dBm +26 dBm	Custom Non-ohmic	Flat Panel Tx = 18 dBi	FCC-15.247
µLink - DU	+12 dBm - +30 dBm	N-type Female	Customer Supplied	FCC-15.247

Interface Definitions

The µLink System has the following user services: (see Table 3).

Table 3. µLink System: User Services

Payload Data Interfaces	
E1 Data Interface	120Ω RJ-12/75Ω BNC (factory set). Bipolar AMI or HDB3 software selectable.
T1 Data Interface	100Ω/75Ω (factory set), RJ-12 or BNC Connector. Bipolar AMI or B8ZS software selectable.
Wayside Serial Data Channel	
Provided for user data. Supports asynchronous full duplex serial data transfer (with hardware control). 300 to 19200 baud (software selectable).	
Auxiliary / Alarm Inputs and Outputs	
Inputs	Two (2) switch closure sense inputs are provided.
Outputs	Two (2) isolated relay contact outputs are provided. These are presented to the customer as three output, namely **Common**, **NO** and **NC**.

Planning Information

Site Evaluation

When planning a site for a digital radio relay link, it is of the utmost importance that you take the operational environment of the proposed site into account.
The combined effect of atmospheric environmental factors such as rain and lightning, atmospheric attenuation, signal path obstruction, propagation fading, air temperature gradients, ice build-up, wind and solar radiation can contribute towards reducing the level of performance of the system (as measured in terms of its capability to transfer data without error). In the higher frequency bands, rainfall is the main attenuation mechanism which limits error performance. Ice and snow will obviously have a similar effect. 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 18 of this manual).
Also, if masts are not sufficiently rigid, very strong winds can affect the antenna beam alignment and outdoor equipment reliability due to wind force build-up and/or vibration in the mast mounted equipment.
Non-atmospheric environmental factors such as the electromagnetic interference due to the presence of other antennas, path clutter and terrain topography can also have a detrimental effect on system performance and should be carefully assessed before and during installation.