

**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.

**μLink Digital Radio
System Manual**

Publication Number: 862-01545

**Issue 1
February 1999**



Tellumat (Pty) Limited
Reg. No. 96/000957/07
64/74 White Road, Retreat, 7945
P.O. Box 30451, Tokai, 7966
Telephone: +27 21 710-2911
Fax No. +27 21 710-2333

| | |
|------------------------------------------------------------|----|
| Chapter 2: Installation | 21 |
| Introduction to Chapter 2 | 21 |
| Site Requirements | 21 |
| Parts and Accessories Supplied for Installation | 22 |
| Customer Furnished Tools and Equipment | 23 |
| Installation Overview | 24 |
| Antenna Installation | 24 |
| Outdoor Unit Installation | 26 |
| Indoor Unit Installation | 27 |
| Interconnection Cable Installation | 29 |
| System Commissioning | 31 |
| Information Required | 31 |
| Commissioning Procedure | 31 |
| Setting-up Procedure | 31 |
| Beaming-up | 31 |
| Set Critical Parameters | 31 |
| Link Error Performance Test | 32 |
| Appendix A to Chapter 2: | 33 |
| µLink External Connector Pin Details | 33 |
| Indoor Unit Connector Pin Details | 33 |
| Outdoor Unit Connector Pin Details | 36 |
| Chapter 3: Operational Information | 37 |
| Introduction to Chapter 3 | 37 |
| Indoor Unit (IU) Controls, Indicators and Connectors | 37 |
| Front Panel | 37 |
| Indoor Unit (IU) Controls, Indicators and Connectors | 41 |
| Rear Panel | 41 |
| Chapter 4: µLink Management System | 43 |
| General Information | 43 |
| Hardware (supplied by Customer) | 43 |
| Software and Hardware (supplied by Tellumat) | 44 |
| Setting-up | 44 |
| Accessing the Software Program | 45 |
| Menu Structure | 45 |
| Main Screen | 46 |
| Short-cut Buttons Area | 47 |

| | |
|-----------------------------------------------------|----|
| Station Control Screen | 49 |
| Indoor Unit: Configuration | 50 |
| Indoor Unit: Build State | 51 |
| Indoor Unit: Status | 52 |
| Indoor Unit: Loopback Control | 56 |
| Outdoor Unit: Configuration | 57 |
| Outdoor Unit: Build State | 59 |
| Outdoor Unit: Status | 60 |
| Outdoor Unit: Loopback Control | 61 |
| Chapter 5: Maintenance Information | 63 |
| Introduction to Chapter 5 | 63 |
| Fault Diagnosis | 63 |
| Chapter 6: Functional Description | 65 |
| Introduction to Chapter 6 | 65 |
| µLink System Description | 65 |
| Indoor Unit | 66 |
| Chapter 7: Parts List | 67 |
| Introduction to Chapter 7 | 67 |
| Parts Lists | 67 |

List of Illustrations

| Figure | Page |
|---------------------------------------------------------------------|-------------|
| Figure 1. µLink Indoor Unit | 3 |
| Figure 2. µLink Outdoor Unit and Antenna | 3 |
| Figure 3. System Overview Block Diagram | 4 |
| Figure 4. Multipath Effects. | 8 |
| Figure 5. Frequency Band Plan. | 19 |
| Figure 6. µLink Antenna. | 25 |
| Figure 7. µLink Outdoor Unit. | 26 |
| Figure 8. Indoor Unit Rear Panel. | 28 |
| Figure 9. Outdoor Unit Mounted on Antenna. | 30 |
| Figure 10. IU Front Panel Controls, Indicators and Connectors. | 38 |

Figure 11. IU Rear Panel Controls, Indicators and Connectors..... 41
 Figure 12. µLink Management Software: Typical Main Screen. 46
 Figure 13. Typical Station Control Screen. 48
 Figure 14. Indoor Unit: Typical E1 Configuration Screen..... 50
 Figure 15. Indoor Unit: Typical Build State Screen..... 51
 Figure 16. Indoor Unit: Typical Status Screen. 52
 Figure 17. Indoor Unit: Typical Failure Alarm Details Screen. 53
 Figure 18. Indoor Unit: Typical Site Alarms and Control Screen..... 54
 Figure 19. Indoor Unit: Typical Service Alarm Details Screen. 55
 Figure 20. Local Indoor Loopback Control Screen..... 56
 Figure 21. Outdoor Unit: Typical Configuration Screen..... 57
 Figure 22. Outdoor Unit: Typical Build State Screen. 59
 Figure 23. Outdoor Unit: Typical Status Screen. 60
 Figure 24. Local Outdoor Loopback Control Screen. 61
 Figure 25. µLink System..... 68

List of Tables

| Table | Page |
|-------------------------------------------------------------------|-------------|
| Table 1. µLink System Data Interface Variants | 5 |
| Table 2. µLink System RF Configurations..... | 5 |
| Table 3. µLink System: User Services | 6 |
| Table 4. Link Error Performance Check List | 32 |
| Table 5. IU Front Panel: Controls, Indicators and Connectors..... | 39 |
| Table 6. Status LEDs:..... | 40 |
| Table 7. IU Rear Panel: Controls, Indicators and Connectors..... | 42 |
| Table 8. µLink System Level Parts List | 69 |

Note to Reader

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

© 1999 Tellumat (Pty) Limited

The information contained herein is the property of Tellumat (Pty) Limited and is supplied without liability for errors or omissions. No part may be reproduced, used or disclosed except as authorised by contract or other written permission. The copyright and the foregoing restriction on reproduction, use and disclosure extend to all media in which this information may be embodied, including magnetic or electronic storage etc.

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.

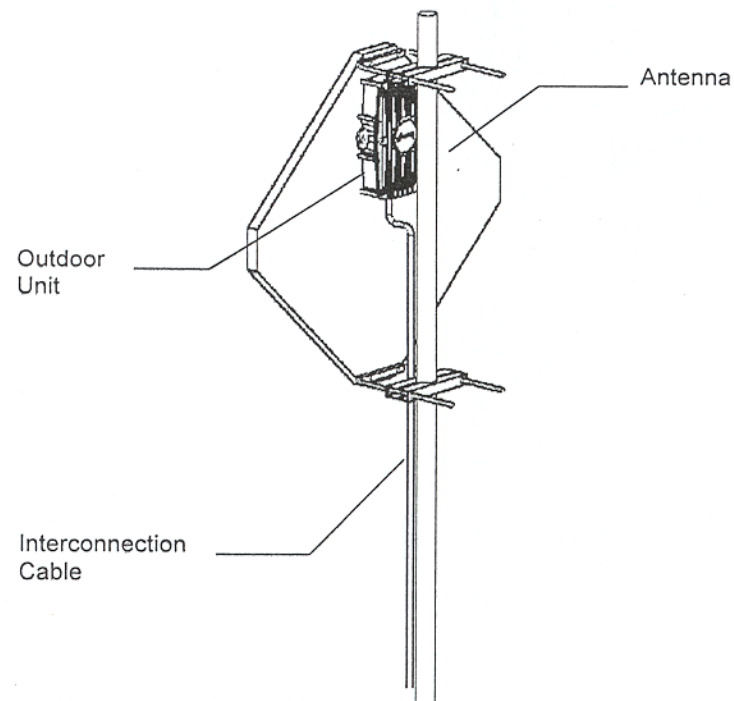


Figure 2. μLink Outdoor Unit and Antenna.

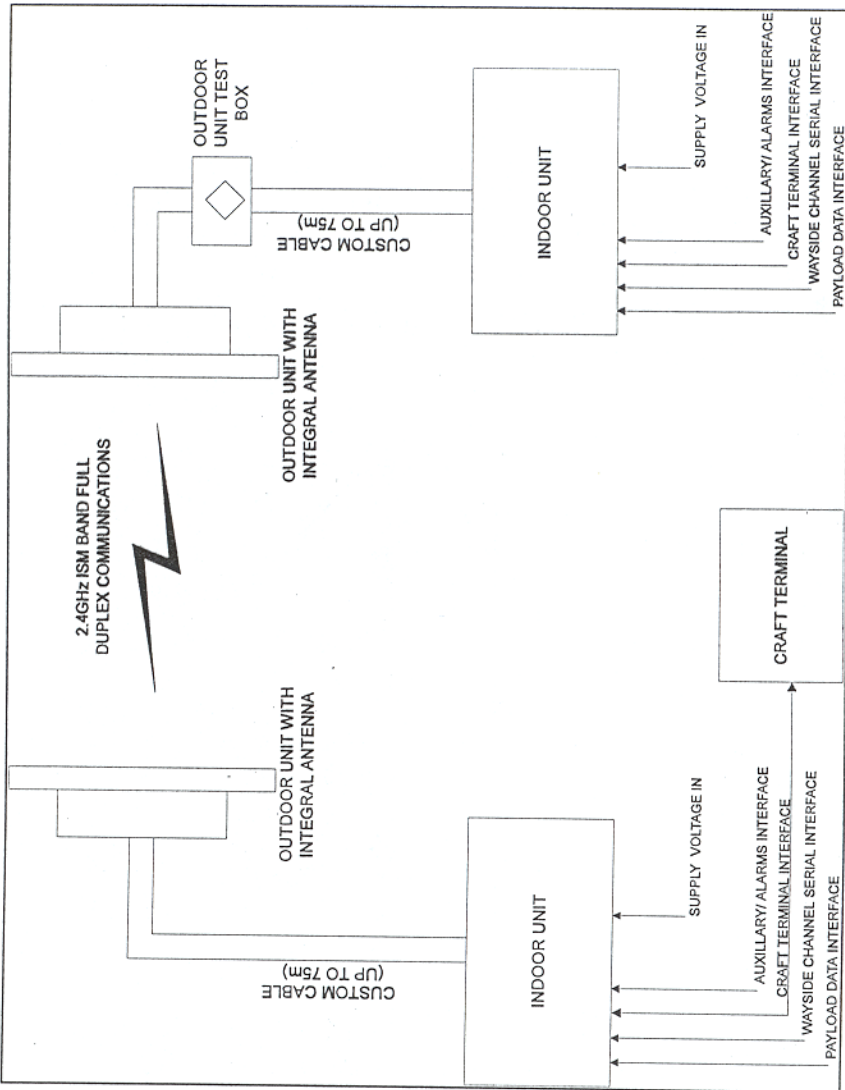


Figure 3. System Overview Block Diagram.

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.

| 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 |

| 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.