



IP•Tube E2 User's Guide

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This equipment has been tested and found to comply with the limits for a 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.

NOTE - Shielded Telecommunication (T1 or E1) and ethernet cables must be used with the Engage IP•Tube to ensure compliance with FCC Part 15 Class A limits.

CAUTION – To reduce the risk of fire, use only No. 26 AWG or larger listed Telecommunication cables.

Equipment Malfunction

If trouble is experienced with an IP•Tube, please contact the Engage Communication Service Center. If the equipment is causing harm to the telephone network, the telecommunications service provider may request that you disconnect the equipment until the problem is resolved.

Engage Communication Service Center:

Phone (U.S.) 831-688-1021
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Email support@engageinc.com
Web www.engageinc.com

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Chapter 1

Introduction

The IP•Tube E² User's Guide provides the information users require to install, configure and operate the IP•Tube E² product developed and manufactured by Engage Communication Inc. This product will enable the user to install the function, across an IP network, to move data in a securely packaged form, to a unit in a remote location. Protocols supported include legacy protocols such as NetBEUI, IPX, AppleTalk and Decnet. Legacy applications that utilize non-routable protocols are able to access services across an IP point to point connection.

Security

The IP•Tube E² provides a high level secure communication by only exchanging packets with the remote network. The Ethernet frames within the IP envelope must be addressed to specific Ethernet MAC addresses.

Network security is established with Full On Source, Destination Address; Port and Flag IP Packet filtering. Interconnectivity is selectively controlled at the interface, network, device and application layers.

Management

Management of the IP•Tube E² is accomplished with a Command Line Interface, (CLI), that is accessed through the console port or a telnet connection. Templates of the most common configurations provide for an Edit and Paste approach.

Unit Ports and Indicators

Console Port

A console port for "Out of Band" management access to the unit with SNMP support. The port indicator shows that the user is connected.

LAN Interface

The IP•Tube E² provides two 10/100 BaseT Full/Half Ethernet LAN interfaces with autonegotiation or configurable speed, and duplex. Management via the LAN ports is enabled when access to the unit is more convenient remotely. LAN1 is a black port and typically receives data from a local network and the LAN2 port, a red port, moves the encapsulated data to a remote network. LAN protocols IP, TCP and ICMP are supported. The LNK indicators show connectivity with a green light.

About this Guide

Organization

Chapter 1 - *Introduction* provides an overview of the *IP•Tube E² User's Guide* as well as feature descriptions.

Chapter 2 - *Installation QuickStart* provides a concise description of the installation and configuration process, plus examples to get the experienced user up and running in a minimum of time.

Chapter 3 - *Installation* of the IP•Tube E² gives a detailed step by step of the installation and initial configuration of the units. It covers the physical environment and connections required to install the units then steps the administrator through the configuration process of the console port and LAN connections.

Chapter 4 - *Command Line Interface* provides a command-by-command description of the upper level interface as well as the interfaces to the various ports.

Chapter 5 - *Configuration and Operation* details the configuration and ongoing operation of the IP•Tube E². Several common configurations are provided as examples.

Chapter 6 - *Troubleshooting* reviews some of the common issues that may occur during installation and normal operation of the units and provides descriptions of causes and solutions to these issues.

Appendices - IP•Tube E² specifications, connector pinouts and crossover wiring details and includes diagrams of the units.

Glossary - Telecommunication and TCP/IP terminology.

Intended Audience

This manual is intended for administrators of telecommunication and network systems. The technical content is written for readers who have basic computer, telecommunication and networking experience.

It is important that any administrator responsible for the installation and operation of Engage IP•Tube products be familiar with IP networking and data communication concepts, such as network addressing and synchronous serial interfaces. These terms are central to an understanding of IP•Tube functionality, and are covered in the Glossary section.

Chapter 2

Installation QuickStart

This QuickStart Chapter is intended for users who understand how they want their IP•Tube E² installed and configured and only require the mechanics of performing that installation.

Communication with the IP•Tube E²

Console Port

Initial communication with the IP•Tube E² unit is made through the Console port, utilizing the Command Line interface, (CLI) detailed in Chapter 4: *Command Line Interface*.

The Console port on the E² uses an RJ45 jack. It is configured as a DTE port. An RJ45/DB9 adapter is provided in the shipment which, in addition to providing a physical interface, performs the null modem operation permitting direct connection to other DTE equipment, such as COM connections of a PC.

Once a serial connection between a workstation and the E² console port is established and a carriage return <CR> is entered, a **Login** prompt will appear.

The default login is: **root**.

No password is needed for first time login.

Telnet

Once an IP address has been assigned and a serial line connected, the user can log into the unit via the network and continue configuration using telnet. Most telnet programs are compatible with the IP•Tube E² console interface.

Editing & Pasting Configurations

Users of either CLI have the option of editing a standard IP•Tube E² configuration in a text editor and pasting that configuration to the IP•Tube E². The examples in this chapter are included in a configuration file found on the shipping disk.

Edit the desired configuration listing using a simple text editor. Connect to the E² unit through Telnet or the Console port, then enter the configuration mode with the command: **config**.

Paste the edited text, comments and all, to the IP•Tube E², then issue the command: **save**. The unit will reset and come up with the new configuration.

To save an IP•Tube E² configuration to a file, issue the command: **show configuration all**, and copy the output of the command to a file with your text editor.

IP•Tube E² Cabling

The IP•Tube E² uses standard 10/100BaseT Ethernet cabling to connect to an Ethernet switch, router or hub. A crossover 10/100BaseT cable can be used for direct connection to a single router, wireless radio or other Ethernet device.

The cabling used to connect the IP•Tube E² LAN Ports to a switch, router or hub is straight forward Ethernet cabling. Refer to the *Appendices* for the details of the wiring and pinouts of this cable.

IP•Tube E² Configuration Parameters

The setup of the IP•Tube E² involves configuration of the:

- IP•Tube E² Security Parameters
- Interface Specific Parameters
- IP•Tube E² System Parameters

IP•Tube E² Security Parameters

To establish a Full On Source, Destination Address envelopes must be addressed to specific Ethernet MAC addresses. Interconnectivity is selectively controlled at the interface, network, device and application layers.

Interface Specific Parameters

Console Configuration Parameters

The console port is an RJ45 port and uses an RJ45/DB9 adapter, included with the unit, and can be connected directly to a desktop or laptop computer for access to the IP•Tube E². It's configuration is standard:

9600 baud, 1 stop bit, no parity, 8 bit fixed, flow control none

LAN Configuration Parameters

The IP•Tube E² serial interface number 1, "LAN1", is configured for network connectivity. The following parameters must match the configuration of the LAN interface to which it is connected.

Example:

IP•Tube E² System Parameters

System parameters include the IP•Tube E² Host name, the Ethernet IP address and the default router.

Host Name

Provide a unique name for the IP•Tube E².

Example:

HOST NAME AptosTubeE2

Ethernet IP address

The IP address is applied on a per-unit basis. For the Ethernet interface, use LAN1 to access the unit via telnet or both LAN's for connectivity to send data, by UDP, from one location to another. The IP•Tube E² ETHERNET ADDRESS allows the user to specify the Ethernet MAC address for the IP•Tube E² IP packet. The IP•Tube E² Ethernet MAC Address needs to match the MAC address of the destination IP•Tube E² or the Default Router.

Example:

```
IP ADDRESS aaa.bbb.ccc.ddd
```

Note: BroadcastRCV is always on

Default Router

If the remote IP•Tube E², whose IP address is configured with **IP ADDRESS**, resides on a different IP network from the Local IP•Tube E², a default router must be specified. The Default Router is typically the local IP WAN Router.

Example:

```
IP DEFAULT-ROUTER aaa.bbb.ccc.ddd
```

Example 1:***Command Line Listing*****Example 2:*****Command Line Listing***

Chapter 3

Installation of the IP•Tube E²

This chapter provides details on the physical location and connections required for the installation of Engage IP•Tube E² equipment. Also covered is the initial communication with the IP•Tube E².

References are made to the IP•Tube E² *Command Line Interface* as well as *Configuration and Operation*. These topics are covered in detail in later chapters.

The use of Engage IP•Tube E² systems to create a bridge between two Ethernet LANs over an IP network requires one IP•Tube E² unit at each end.

A standard IP•Tube E² package includes:

- IP•Tube E² unit - with installed LAN interface
- Console port adapter and cable
- Power Converter (110 or 220 VAC input/24 VAC or 24 VDC output)
- Documentation Compact Disk with IP•Tube E² User's Guide and configuration examples

Note: power supply not supplied with negative 48 volt models.

Installing the Hardware

Locating the IP•Tube E²

Site consideration is important for proper operation of the IP•Tube E². The user should install the unit in an environment providing:

- A well-ventilated indoor location
- Access within six feet of a power outlet
- Two feet additional clearance around the unit to permit easy cable connection

As an option, the IP•Tube E² can be mounted in a standard 19 inch equipment rack, (rack mounts are available from Engage).

Powering the IP•Tube E²

Engage IP•Tube E² units utilize an external power adapter, available in 110 VAC and 220 VAC versions, providing DC output.

The appropriate power adapter is provided with each unit. Ensure the power adapter is not connected to power then plug the DC adapter into the circular rear panel POWER connector.

Connect the power adapter to an appropriate AC power outlet and check the POWER LED on the front panel of the Engage IP•Tube E². The POWER LED will be GREEN when the internal diagnostics have completed.

Console Port

The IP•Tube E² includes a Console port for initial configuration. It may be used for serial communication from a local workstation or for remote connection via a modem. The Console port utilizes an RJ45/DB9 jack.

IP•Tube E² console port is configured as a DTE (Data Terminal Equipment) port. This allows direct connection to a DCE (Data Communication Equipment) device such as a modem.

An RJ45 to DB9 adapter is provided with the IP•Tube E² which performs the null modem operation permitting direct connection to other DTE equipment, such as the COM1 interface of a PC.

Pinouts for the Console port, as well as Engage supplied adapters, are provided in the *Appendices*.

Communication to the console port should be set for:

9600 baud, 1 stop bit, no parity, 8 bit fixed, flow control none

Once a serial connection between a workstation and the IP•Tube E² console port is established and a carriage return <CR> is entered, a **Login** prompt will appear.

The default login is: **root**.

A password is not needed until it is user set.

Configuring the Engage IP•Tube E² for the LAN

The IP•Tube E² needs to be configured with a number of parameters for proper operation on the network, including:

- Ethernet IP address and subnet mask
- IP data target unit IP address and subnet mask
- Default gateway if the IP data target is on another IP network

The configuration procedure depends on the network environment in which the IP•Tube E² is to be installed.

Note: It is strongly suggested that you configure the IP•Tube E² with its unique network identity before making any Ethernet or Wide Area connections.

Ethernet Interfaces

Engage IP•Tube E² systems utilize 10/100BaseT Ethernet cable to connect to the Local Area Network. Each system provides a 10/100BaseT interface on the front panel for connection to an Ethernet switch or hub using a straight-thru Ethernet cable. For direct connection to a PC or other LAN device, the user should obtain a 10/100BaseT crossover cable.

10/100BaseT Ethernet cabling and crossover pinouts are provided in the *Appendices*.

Status LEDs

Front panel LEDs provide Power, Console and LAN Interface status.

Power

The Power LED is normally green, although at power-on it will briefly display amber if a firmware upgrade (TFTP upgrade stored in the FLASH ROM) is being loaded.

Ethernet

The IP•Tube E² provides specific information, with RD and TD indicators providing status on packet transmission and receipt, respectively, on the Ethernet interface.

- When receiving, the RD will show a steady or flashing GREEN.
- When transmitting, the TD will show a steady or flashing GREEN.
- If, after power-on, the IP•Tube E² is unable to acquire a unique network address on the LAN the indicator will not go green.

Internal DIP Switches

IP•Tube E² systems contain an internal four position DIP Switch which is accessible by removing the unit rear panel and sliding out the motherboard.

The default setting for all DIP switches is **OFF**.

Switch 1 - Power cycling the unit with DIP Switch 1 **ON** forces the IP•Tube E² to return to factory default settings. Factory settings include operation from Base Flash and deleting any download upgrades. Ensure Switch 1 is returned to the **OFF** position after clearing an upgrade so future upgrades can be performed successfully.

ON also allows a login without a password. This is useful when a password is forgotten. Switch 1 **OFF** retains the previously configured password.

Switch 2 - Must be in the **OFF** position for normal operation.

Switch 3 - Switch 3 is used during manufacturing to test VCXO. The switch must be set to **OFF** for normal operation.

Switch 4 - DIP Switch 4 has two functions. When turned **ON**, it forces the IP•Tube E² into a loop back mode. This is useful for troubleshooting the Serial connections.

Considerations for Network Conditions

If there are asymmetrical conditions on a network, there may be instances where a local IP•Tube E² has failed over to LAN2, but the remote IP•Tube E² has not. If LAN1 and LAN2 have a difference in packet delay, there is a corresponding difference in packet sequence number between LAN1 and LAN2. If the difference in packet sequence number is sufficiently large, when switching to LAN1 or LAN2 there may be a very brief loss of data as the IP•Tube E² must synchronize to the packet sequence of the new data stream.

Chapter 4

Command Line Interface

Command Line access to the IP•Tube E² may be via a serial connection to the Console port or a Telnet connection to the Ethernet interface.

Telnet, part of the TCP/IP Protocol Suite, provides a general communications facility defining a standard method of interfacing terminal devices to each other. Any standard Telnet application can be used to communicate to an Engage IP•Tube E² provided there is IP connectivity between the User Host and the IP•Tube E².

For communication through the Console port, standard terminal communication software is used. The console port may be used to communicate with the IP•TubeE² locally through a terminal, or remotely through a modem.

Console Communication

Serial communication to the console port should be configured for:

9600 baud, 1 stop bit, no parity, 8 bit fixed, flow control none

The console port is an RJ45/DB9 adapter and an appropriate cable and adapter are provided with the IP•Tube E² for use with standard 9 pin COM ports

The RJ45 console port is configured as a DTE (data terminal equipment) port. This allows direct connection to a DCE (data communication equipment) device such as a modem or connection to other DTE, such as a terminal.

The RJ45 to DB9 adapter which is provided with the IP•Tube E² serves the null modem function, permitting direct connection to a COM interface on most PCs.

Logging in to the IP•Tube E²

- A Telnet session is opened by providing the IP address of the IP•Tube E². On opening a Command Line Interface, (CLI) session, via the Console port or Telnet, the **login** prompt requires entry of a login ID.
- The default login ID: **root**.
- The IP•Tube E² is shipped with no password set. Passwords are set or modified with the **passwd** command, detailed below.

Overview of Commands

The Engage CLI supports shorthand character entry. At most 3 characters are required for the parsing of commands. For example: **show configuration** can be entered as: **sh con**. The CLI is not case sensitive. Description of the commands uses both upper and lower case for syntax definitions and examples. A full description of the command line interface follows.

Categories

The command set can be divided into four categories:

- General
- Show
- Config
- Config Interface

Online Help

Included in the General commands is the **HELP** command, providing information on the entire command set.

Configuration Modes

For the **Config** and config **Interface** commands, Engage employs a model approach. The user enters the Config mode, makes changes, then Saves those changes. On Saving the changes the user leaves the Config mode.

The Config interface mode, within the Config mode, is used to set parameters for a specified interface. Once in the Configuration mode, the user enters the **INTERFACE** command. All subsequent commands apply to the specified interface.

The command prompt indicates the mode of operation:

- name# the single “#” indicates standard Telnet mode
- name## indicates the IP•Tube E² is in the Config mode
- name(LAN1)## IP•Tube E² is in Config Interface mode for LAN Port 1

To move up one level, from Interface Config mode to Config mode, enter the **INTERFACE** command with no argument. To change between interfaces when in Interface Config mode, specify the new interface. For example:

- name(s1)## **interface lan1**

Note: The LAN1 port is the public interface, commonly receives data and LAN2 is the private port and generally sends data.

Syntax for Command Parameters

{ } == one of the parameters in set is required

[] == one of the parameters in set is allowed (optional)

System Level or General Commands

PASSWD

Allows setting or modifying the login password. The IP•Tube E² ships with no password set. On entering the **passwd** command, the user is prompted to enter, and confirm, the new password.

BYE | QUIT | LOGOUT

Any of these commands will terminate the Telnet session. If you have unsaved configuration changes, you will be prompted to save or discard the new configuration.

RESET

Resets the IP•Tube E².

HELP [HELP | ALL | CONFIG | SHOW]

Provides Help information on a selected list of topics. Typing **help** with no argument provides the Help summary screen which is the top-level list of commands.

CLEAR {LAN1 | LAN2 | All}

Clears the port statistics on the selected port: LAN1, LAN2 or both.

TERM NN

Allows the user to tailor the number of display lines to their terminal screen size

PING {dest.address} [src.address] [[{number}]]spray]

Sends an ICMP ECHO message to the specified address. Any source address from an interface on the IP•Tube E² can be used. This can be useful to test routes across a LAN or WAN interface.

By default, only 1 message (packet) is sent. A numeric value can be entered to send more than one message. Also, SPRAY can be used to continually send messages until the ESC key is pressed.

UPGRADE {TFTP Server Addr} {Filename}

TFTP (trivial file transfer protocol) provides a means for upgrading IP•Tube E² firmware in a TCP/IP environment. A TFTP upgrade may be accomplished from a CD provided by Engage Communication or the user can configure their own local TFTP server with the appropriate file from the CD or from Engage Tech Support.

Once a connection to a TFTP server site has been established, issue the **upgrade** command.

UPGRADE 157.22.234.129 ML107407.COD

Note that an IP•Tube E² which is running an upgrade must go through a reset when performing an upgrade. This may cause the Telnet connection to drop. If this does occur, simply re-establish the Telnet connection.

SHOW Commands

SHOW INTERFACE [LAN1 | LAN2] {INFO | STATISTICS}

Provides details on either LAN interface. If no interface is specified, either the current interface per "INTERFACE" command will be used, or all interfaces will be shown.

INFO details the port type, port state, etc.

STATISTICS lists the packets transmitted, received, etc.

SHOW ROUTER provides general configuration and status information, including the Ethernet hardware address and the firmware version.

SHOW FILTERS provides a listing of all filters on all interfaces.

SHOW IP STATISTICS provides detailed statistics on IP packets only.

SHOW CONFIG ALL provides a list of all configuration parameters. No argument is the same as **ALL**. This list provides the basis for storing an IP•Tube E² configuration into a local text file. The full configuration can be edited offline.

SHOW CONFIG INTERFACE [LAN1 | LAN2]

If no interface is specified, either the current interface per the **INTERFACE** command will be used, or all interfaces will be shown.

SHOW CONFIG IP [ALL | ROUTES] details the IP configuration. No argument is the same as **ALL**, which provides routes as well as IP configuration items which don't pertain to a specific port, i.e. default router, etc.

SHOW CONFIG ROUTER lists IP•Tube E² Hostname, etc.

CONFIGURATION Commands

Config Commands

Enter the configuration mode, at which point the following commands may be used.

SAVE

Save the changes and exit Configuration mode

END [SAVE]

Exit Configuration mode. The optional **SAVE** instructs the IP•Tube E² to save configuration changes.

RESTORE

Restores the current IP•Tube E² configuration, ignoring any changes which have been made during the current Telnet **CONFIG** session.

HOST NAME {namestring}

Provide a unique name for the IP•Tube E². The new host name does not take effect until a save and reset is performed. For example:

HOST NAME DallasIPTubeE2

Note: Earlier versions of the Engage software use the term ROUTER NAME.

SNMP COMMUNITYNAME

Set or modify Tube SNMP community name. This string is used for authentication for SNMP SetRequests and SNMP traps.

SNMP TRAPS {ON | OFF}

Turns on or off generation of SNMPv1 Traps. The Destination Address for these traps must be configured to be an SNMP management station capable of decoding SNMPv1 traps.

SNMP TRAPS ADDRESS address

Sets the Destination IP Address to which the Tube will send SNMPv1 Traps.

IP DEFAULT-ROUTER address

Enter the IP address of the default router or gateway. This must be an IP address on the same network as the IP•Tube E².

Config Interface Commands

Configuration of the IP•Tube E² involves setting parameters for the LAN interfaces. The user must specify which interface is being configured with the command:

INTERFACE [LAN1 | LAN2]

To move up one level, from **Interface Config** mode to **Config** mode, enter the **interface** command with no argument. To change between interfaces when in **Interface Config** mode, specify the new interface. For example:

```
name(LAN1)## INTERFACE LAN1
```

AUTONEGOTIATION {ON | OFF}

Enable or disable IEEE 802.3 Auto-negotiation on the Ethernet interface. Warning: If the device connected to LAN1 uses Auto Negotiation and LAN1 is configured to use full duplex without Auto-Negotiation, the other device may operate in half duplex mode by default and successful operation cannot be guaranteed.

DUPLEX {HALF | FULL}

Sets the duplex mode for the Ethernet interface. This command only takes effect when Auto-negotiation is configured to **OFF**. Warning: If the device connected to LAN1 uses Auto-Negotiation and LAN1 is configured to use full duplex without Auto-Negotiation, the other device may operate in half duplex mode by default and successful operation cannot be guaranteed.

SPEED {10 | 100}

Sets the line rate in Mbps for the Ethernet interface. This command only takes effect when Auto-negotiation is configured to **OFF**.

IP ADDRESS address[/mask]

The interface IP address and subnet mask are required for configuration with telnet or connectivity tests with ping. The subnet mask can be entered in long or short form. This configuration parameter applies to LAN1 only. Examples:

```
IP ADDRESS 192.168.1.1/255.255.255.0
```

```
IP ADDRESS 192.168.1.1/24
```

IP DEFAULT-ROUTER address

Configures the IP address of the default router or gateway for this Ethernet interface. This must be an IP address on the same network as the IP•Tube E² Ethernet interface. This default router takes precedence over the system's default router.

BROADCASTRCV {OFF | ON}

The Ethernet interface can be configured to disable the reception of Broadcast and Multicast packets. The IP protocol uses broadcast packets to resolve the Ethernet MAC Address of the destination IP.

BROADCASTRCV OFF requires that the Destination IP•Tube E² or the Default Router and any local device that wants to communicate with the IP•Tube E² needs to be configured with the MAC address of the IP•Tube E² in its ARP table. Due to the complexity involved in setting up the IP Address to Ethernet MAC addresses manually it is recommended that BroadcastRCV is set to **ON** unless broadcast storms are expected on the network where the IP•Tubes E² reside. BroadcastRCV turned OFF will however reduce incoming traffic. For the Ethernet interface, first specify **INT LAN1**. Typically if BroadcastRCV is set to **OFF** the Tube Ethernet ARP and Tube Ethernet Address need to be configured with the MAC address of the IP•Tube E² packet's Ethernet destination, refer to Interface LAN1. Since the destination for the IP•Tube E² packet will have its broadcast receive turned **OFF** also. LAN2 is configured at the factory with BroadcastRCV permanently ON.

TUBE UDPPORT value

TUBE UDPPORT specifies the UDP port source and destination address. The IP•Tube E² only accepts packets that match its UDP Port configuration. This port number is typically 3175 but can be

any available port on the router.

TUBE TOS value

Sets the Type of Service Byte of the IP packets in which frames are encapsulated. The setting of the TOS byte can be used to ensure that the real time TDM data from the IP•Tube E² is ensured high priority, assuming Quality of Service support is provided by each router or switch in the IP path between the Tubes. Alternatively the IP destination address can be used to ensure that the IP•Tube E² packets receive the required priority and bandwidth. IP TOS is defined in the IETF RFC 1349, accessible online at www.ietf.org. A TOS setting of 0x08 maximizes throughput.

TUBE TOS is displayed in hex, with values ranging from 0x00 to 0x08. Preceding the entry with "0x" results in a direct Hexidecimal input. Example:

TUBE TOS 0x06

TUBE ETHERNET ARP {ON | OFF}

TUBE Ethernet **ARP OFF** uses the Ethernet MAC address specified by the IP•TUBE E² Ethernet Address.

TUBE Ethernet **ARP ON** uses the Ethernet MAC address obtained automatically by the IP•Tube's IP to Ethernet MAC Address Resolution Protocol. Note: Default Configuration. **TUBE ON | OFF** is only applicable when BROADCASTRCV is OFF.

TUBE 1 ETHERNET ARP {ON | OFF}

TUBE Ethernet **ARP OFF** uses the Ethernet MAC address specified by the TUBE Ethernet Address. TUBE Ethernet ARP ON uses the Ethernet MAC address obtained automatically by the IP•Tube's IP to Ethernet MAC Address Resolution Protocol. The "1" specifier selects the LAN1 interface for TUBE ETHERNET ARP. If not specified, TUBE ETHERNET ARP is automatically configured for LAN1.

TUBE ETHERNET ADDRESS abcdef

TUBE ETHERNET ADDRESS specifies the Ethernet MAC address for the IP•Tube E² IP packet. The TUBE Ethernet MAC Address needs to match the MAC address of the destination IP•Tube E² unit or the Default Router. Only enter the 6 bytes of MAC address, i.e. 001122334455.

NOTE: Unless Broadcast storms are suspected it is highly recommended that the automatic resolution of the IP address to Ethernet MAC address is utilized, with BROADCASTRCV ON.

Chapter 5

IP•Tube E² Configuration & Operation

This chapter provides operational theory and configuration details specific to the IP•Tube E². The IPTube E² has unique requirements regarding its interface to other equipment.

The 10/100BaseT interface introduces new configuration parameters for interface LAN1.

Autonegotiate ON - Interface determines speed and duplex mode.

Autonegotiate OFF - Speed and duplex are set manually.

Speed {10 | 100} - 10Mbps or 100Mbps

Duplex - {HALF | FULL}.

These parameters are set automatically by turning **Autonegotiate ON**.

IP•Tube E² Installation Steps

The process of installing an IP•Tube E² involves the following steps:

- Planning for IP•Tube E² interconnect
- Installing the IP•Tube E² hardware
- Configuring System and Ethernet parameters
- Configuring the IP•Tube E² interface parameters
- Making Ethernet cabling connections
- Verifying the IP•Tube E² connection

System and Ethernet Parameters

Initial configuration items include the hostname for the specific IP•Tube E², as well as a login and password. See *Chapter 4: Command Line Interface* for specific syntax requirements.

Examples:

HOST NAME AptosTubeE2

PASSWD <cr>

An IP default router should be defined if the IP•Tube E² being configured is on a different IP network than the remote IP•Tube E²:

Example:

IP DEFAULT-ROUTER 172.16.1.254

The IP•Tube E² IP address is configured by first entering the interface:

INTERFACE {LAN1 | LAN2}

Then entering the address.

Example:

IP ADDR 172.16.1.222/24

The IP•Tube E² encapsulation is enabled and disabled with the command:

TUBE {ON | OFF}

IP•Tube E² destination address, called "**TUBE ADDR**" is set to the IP address of the receiving unit.

Example:

TUBE ADDR 172.16.0.222

TOS, QoS and UDP Port Number

The IP•Tube E² TOS command is used to control the Type of Service Byte in the IP packets containing the encapsulated data. The setting of the TOS byte can be used to ensure that the real time data from the IP•Tube E² is accorded high priority as it traverses the IP network. Support for the TOS byte is required within each router or switch making up the interconnect between the IP•Tube E² units. A TOS setting of 0x08 maximizes throughput. Note: **TUBE TOS** is displayed in hex. Preceding the entry with 0x results in a direct hexadecimal input.

Example:

TUBE TOS 0x08

Additionally, intermediary routers and switches can be configured for Quality of Service (QoS) prioritization to ensure that IP•Tube E² packets receive highest priority as they are routed through the IP interconnect. This QoS could be configured based on the IP•Tube E² Ethernet IP addresses, but a more straightforward method makes use of the unique UDP port number used by the IP•Tube E².

Communication between IP•Tube E² systems uses packets destined for UDP port number 3175. This registered port assignment, (reference www.iana.org/assignments/port-numbers), allows QoS configuration to prioritize UDP packets destined for port 3175.

This prioritization is essential for voice and other traffic which is sensitive to latency and delay on the LAN/WAN interconnection.

IP Packet Encapsulation Overhead

The encapsulation of data into IP/UDP packets for transmission over Ethernet adds overhead due to the Ethernet, IP, and UDP headers - a total of 44 bytes. This 44 byte overhead should be taken into account when considering Ethernet bandwidth utilization.

The encapsulation overhead can be expressed as a ratio of (Data + Overhead)/(Data) and can be used to calculate the Ethernet bandwidth utilization.

IP•Tube Cabling

The IP•Tube E² uses standard 10/100BaseT Ethernet cabling to connect to an Ethernet switch or hub. Refer to the *Appendices* for the details of the wiring of this cable.

SNMP Support

All Engage products support SNMP (Simple Network Management Protocol) version 1. SNMP support provides access via IP to groups of administrative, configuration-related, and statistical information objects about the Engage device. An IP network connection to the device and a PC with an

application which provides an SNMP version 1 client are required.

An SNMP client will query the device and display the information objects and their values to the user. Groups of SNMP information objects are referred to as MIBs (Management Information Base). All Engage products support most of MIB-II (MIB-2). The subgroups of information in MIB-II are as follows:

- System group: contains system information such as a designated system identifier, location, and vendor ID (Engage).
- Interface group: contains information about the network connections on the device including interface type, link status, packets transmitted and received.
- AT group: contains information about the ARP entries on the device including the values for MAC Address and IP Address for each entry.
- IP group: contains IP statistics and configuration on the device including IP packets received, packets discarded, and IP address and subnet mask.
- ICMP group: contains statistics for ICMP statistics including packets sent for redirect, port unreachable, or echo requests (Ping).
- UDP group: contains statistics for UDP including packets received and transmitted, and packets sent to a UDP port with no listener.
- SNMP group: contains statistics for the SNMP protocol including packets received and transmitted, error packets, and number of set requests.

For more detail, MIB-II is fully specified in RFC1213, available at <http://www.faqs.org/rfc/rfc1213.html>.

SNMPv1 Traps

The IP•Tube E² supports generation of SNMPv1 Traps. Traps are messages sent from the device's LAN port when specific events occur.

The following traps may be generated:

- coldStart: this trap is generated if the Tube reinitializes itself after a configuration change.
- warmStart: this trap is generated if the Tube reinitializes itself after a reset which does not involve a configuration change.
- linkUp: this trap is generated when a physical interface transitions from being disconnected to connected.
- linkDown: this trap is generated when a physical interface transitions from being connected to disconnected.
- authenticationFailure: this trap is generated when a login to the user interface or an SNMPv1 SetRequest failed because an incorrect password was given.
- enterprisespecific: these are Engage proprietary traps.

We define the following subcategories:

- engageTrapRxOverrun: this trap is generated when excessive receiver overruns are happening on an interface.
- engageTrapTxUnderrun: this trap is generated when excessive transmitter underruns are happening on an interface.
- engageTrapBufferExhaustion: this trap is generated when the device runs out of free buffers for packet processing.
- engageTrapDeafness: this trap is generated when an interface on the box has

not received packets for a long period of time.

- engageTrapTubeEnetRxAbsent: this trap is generated when an IP•Tube E² does not receive IPTube-encapsulated IP packets on its LAN interface when it expects.

For more detail on the industry standard traps, please see <http://www.faqs.org/rfc/rfc1157.html>.

Chapter 6

Troubleshooting

Communication and Network systems are subject to problems from a variety of sources. Fortunately, an organized troubleshooting approach usually leads to the area of the problem in short order. It is essential to distinguish between problems caused by the LAN (network system), the WAN equipment (communication equipment) and the IP•Tube E² configuration.

This troubleshooting chapter is structured with symptoms in the order the user might encounter them.

Unable to Communicate with the IP•Tube E²

Installations first require communication with the IP•Tube E² through console access or from the network, usually the same network as the IP•Tube E² itself. Proceed through the following symptoms if you are unable to communicate with the local IP•Tube E² using Telnet, Ping, etc. IP Addressing should be double checked if accessing the unit via the network.

Ethernet/General

Cause: Network Cabling is faulty

Solution: Verify cabling is good by swapping IP•Tube E² cabling with a known good cable and connection. Check the status LEDs on the 10/100BaseT switch to confirm a good connection. If necessary, create a stand-alone LAN with just the workstation and the IP•Tube E².

High Ethernet Error Count

Cause: Bad cabling or building wiring

Solution: Check all cabling. Swap to known good port on 10/100BaseT switch or hub to troubleshoot, (testing with large Ping Packets to ascertain quality of Ethernet Connection). To eliminate issues with building wiring connect the IP•Tube E² with a known good Ethernet cable in the same room as the Ethernet hub.

Cause: Can not connect to a hub at 100 Mbps with autonegotiate turned on. Connection drops to 10 Mbps at half duplex.

Solution: Change LAN1 interface to match what the hub is configured for, by first turning **Autonegotiate OFF**.

Can't Communicate using Telnet with the IP•Tube E²

Cause: IP address is not set properly on the IP•Tube E²

Solution: The Console Port, which requires an RJ45 to DB9 adapter, (included with the product), provides direct access to the command line interface of the IP•Tube E². The Console port utilizes the CLI, detailed in Chapter 4: *Command Line Interface*. Details of the connector pins are in the *Appendices*. Here the IP address can be double checked for accuracy.

Cause: Workstation not on the same subnet as the IP•Tube E²

Solution: During an initial configuration of an IP•Tube E², communication should come from within the same net/subnet. With no default router, the IP•Tube E² will not be able to reply to communication off its own subnet.

Cause: IP stack on the workstation not configured

Solution: Ensure that other devices on the same LAN can be pinged, or otherwise 'seen'.

Can't communicate to the IP•Tube E² - Console Port

Cause: Baud Rate, Stop Bits, etc. set wrong on communication application

Solution: Ensure the communication software is configured for a fixed, asynchronous data rate of 9600 bps, 1 stop bit, no parity, 8 bit fixed and that the Flow control is set to none.

Cause: Transmit and Receive Data swapped

Solution: The console port is configured as a DTE port. For connection to a DCE device, such as a modem, a Null Modem adapter is required.

IP•Tube E² Off Net IP Interconnect Verification

In most applications the IP•Tube E² will be located on different IP networks and the interconnection is through a routed connection. At each end of the routed connection the Tube's default router IP address needs to be pointed to the first router in the path to that remote IP subnet. Through a Telnet connection to an IP•Tube E² it is possible to verify the ability of the unit to ping its local default router and to ping the remote IP•Tube E². Note: the console port does not support the Ping Command as it does not have an IP Address.

TCP/IP Connection

An IP Ping program is the best tool for troubleshooting TCP/IP connectivity. As a sanity check, first ensure you can ping the local router. If unsuccessful, go back to "Can't Communicate using telnet with the IP•Tube E²"

Can't IP Ping Remote IP•Tube E²

Cause: Ping workstation does not have Default Gateway (or Router) set. In the workstation's IP configuration, alongside workstation's own IP address and subnet mask, you must provide the IP address of the device (a router) to which all packets destined off the local net should be sent.

Cause: default router on the net, serving as Default Gateway for all net workstations, does not know about the remote IP net where the remote IP•Tube E² is located.

Solution: Under these circumstances, the two IP•Tube E² units are on different networks or subnets, the **DEFAULT ROUTER** address must be configured.

Appendix A

IP•Tube E2 Specifications

Ethernet Port

- 10/100 Base T Full/Half Ethernet

LAN Protocol

- IP, TCP, UDP, ICMP
- Assured Delivery Protocol

Quality of Service Support

- IP Type of Service (TOS) CLI configurable
- IANA Registered UDP Port 3175

TFTP Online Upgrade Capable (FLASH ROMs)

- IP•Tube E² is fully operational during upgrade

Management

- Telnet support with Edit and Paste Template Files
- Console Port for Out of Band Management
- SNMP support (MIB I, MIB II)
- Remote configuration & monitoring

Power Supply

- External 24 Volts AC, 1Amp, with standard AC plug. International power supplies available.

Physical

- Standard 19 inch rack mount kit available
- Dimensions: 9.0 x 7.3 x 1.63 inches
- Weight: approximately 2 lbs., excluding external power adapter.

IP•Tube E2 Switch Settings

BlackBond systems contain a four position DIP Switch which is accessible by removing the unit rear panel and sliding out the motherboard.

The default setting for all DIP switches is **OFF**.

Switch 1

Powering cycling the unit with DIP Switch 1 **ON** forces the IP•Tube E² to return to factory default settings. Factory settings include operation from Base Flash and deleting any download upgrades. Ensure Switch 1 is returned to the **OFF** position after clearing an upgrade so future upgrades can be performed successfully.

Switch 2

Applies only to BlackBond units.

Switch 3

Used during manufacturing to test VCXO. The switch must be set to **OFF** for normal operation.

Switch 4

Switch 4 is used to clear IP filters. When the unit is powered up with DIP Switch 4 set **ON**, all TCP/IP filters will be deleted. This is a good method for recovering from improperly configured filters.

Console Port Information

RJ45 Console Port Pinout

RJ45 pin	Signal Name
3	TxData
6	RxData
1	RTS
8	CTS
4	Gnd
2	DTR

RJ45/db9F Null Modem Adapter

RJ45 pin	db9pin
3	2
6	3
1	8
4	5
2	6

Glossary

Terms and Concepts

Before using the Engage IP•Tube E², you should be familiar with the terms and concepts that describe TCP/IP. If you are experienced with internet routers, these terms may already be familiar to you.

General Networking Terms

Network

A network is a collection of computers, server devices, and communication devices connected together and capable of communication with one another through a transmission medium.

Internet

An internet is any grouping of two or more networks connected by one or more internet routers.

Network Services

Network services are the capabilities that the network system delivers to users, such as print servers, file servers, and electronic mail.

Addresses

Transmitting information in a network system is made possible by an addressing scheme that identifies the sender and destination of the transmission, using network and node addresses. Data is transmitted to and from these addresses in the form of packets.

Routing Table

A routing table is maintained in each router. This table lists all networks and routers in the internet and enables routers to determine the most efficient route for each packet. The routing table serves as a logical map of the internet, specifying the address of the next router in the path to a given destination network and the distance in hops. The router uses the routing table to determine where and whether to forward a packet.

Each router periodically broadcasts its routing table to other routers on each of its directly connected networks, enabling them to compare and update their own tables with the most recent record of connected networks and routes. In this way, routing tables are kept current as changes are made on the internet.

Hop

A hop is a unit count between networks on the internet. A hop signifies “one router away.”

Node

Device on the network.

TCP/IP Networking Terms

FTP

File Transfer Protocol gives users the ability to transfer files between IP hosts. It uses TCP to provide connection initiation and reliable data transfer.

Host

A computer with one or more uses that can act as an endpoint of communication if it has TCP/IP.

ICMP

Internet Control Message Protocol provides a means for intermediate gateways and hosts to communicate. There are several types of ICMP messages and they are used for several purposes including IP flow control, routing table correction and host availability.

IP

Internet Protocol which routes the data.

IP Datagram

The basic unit of information passed across an IP Internet. It contains address information and data.

PING

Packet InterNet Groper is a program which uses an ICMP echo request message to check if the specified IP address is accessible from the current host.

Port

A destination point used by transport level protocols to distinguish among multiple destinations within a given host computer.

SubNet Address

An extension of the IP addressing scheme which enables an IP site to use a single IP address for multiple physical networks. Subnetting is applicable when a network grows beyond the number of hosts allowed for the IP address class of the site.

TCP

Transmission Control Protocol ensures reliable, sequential, delivery of data. TCP at each end of the connection ensures that the data is delivered to the application accurately, sequential, completely and free of duplicates. The application passes a stream of bytes to TCP which breaks it into pieces, adds a header, forming a segment, and then passes each segment to IP for transmission.

Telnet

The TCP/IP standard protocol for remote terminal connection service. A user can Telnet from the local host to a host at a remote site.

UDP

User Datagram Protocol provides a simple, efficient protocol which is connectionless and thus unreliable. The IP address contained in the UDP header is used to direct the datagram to a specific destination host.

Well-Known Port

Any set of port numbers reserved for specific uses, with transport level protocols (TCP & UDP). Well-known ports exist for echo servers, time servers, telnet and FTP servers.

Communication Link Definitions

Synchronous Serial Interfaces

A serial interface between two devices which provides for bi-directional data transfer as well as clocking. One device, the DCE, provides the transmit and the receive timing to the second device, the DTE.

Data Communication Equipment (DCE)

This interfaces to the communication service's transmission/reception medium, and includes T1 Voice/Data Multiplexors, 64/56 Kilobit DSU/CSU's, and Fiber Optic Modems. The DCE provides the transmit and receive data pathways, along with their synchronous clocking signals, that are used by the Engage Router's DTE interface for full duplex communication between the remotely interconnected networks.

Data Terminal Equipment (DTE)

This equipment, such as an Engage Router, attaches to the terminal side of Data Communication Equipment.

Data Carrier Detect (DCD)

A signal that indicates to the DTE that the DCE is receiving a signal from a remote DCE.

Data Terminal Ready (DTR)

Prepares the DCE to be connected to the phone line, then the connection can be established by dialing. Enables the DCE to answer an incoming call on a switched line.