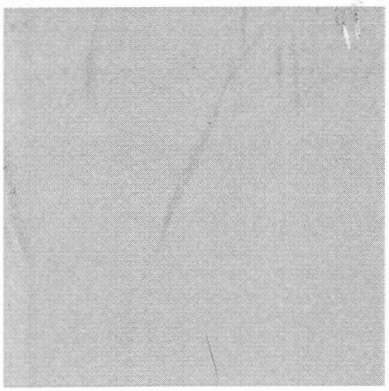
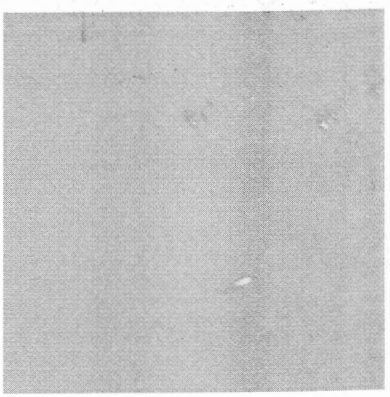
INSTALLATION & OPERATION MANUAL

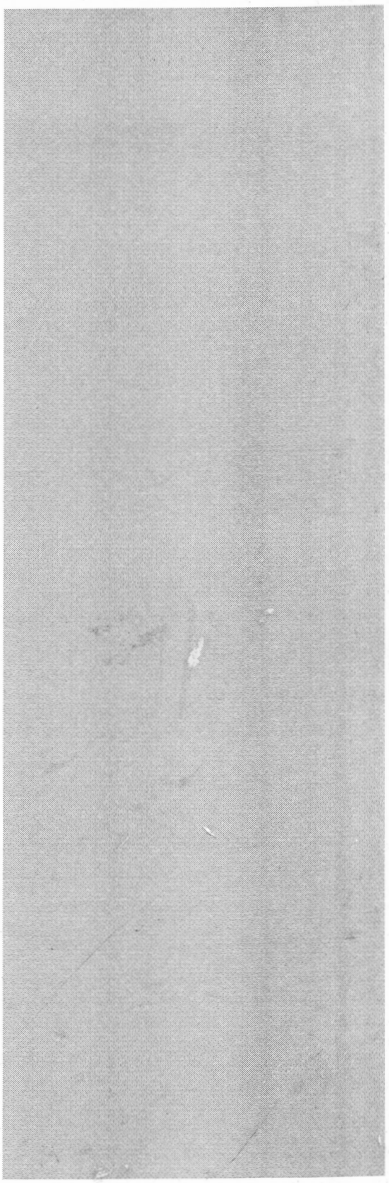
OM 2000

Out of Band Modulator, Software Version 1.0.x

MOTOROLA



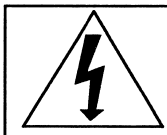




CAUTION

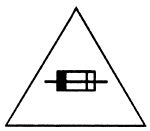
These servicing and installation instructions are for use by qualified personnel only. To reduce the risk of electrical shock, do not perform any servicing other than that contained in the Installation and Troubleshooting Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

SPECIAL SYMBOLS THAT MIGHT APPEAR ON THE EQUIPMENT



This symbol indicates that dangerous voltage levels are present within the equipment. These voltages are not insulated and may be of sufficient strength to cause serious bodily injury when touched. The symbol may also appear on schematics.

The exclamation point, within an equilateral triangle, is intended to alert the user to the presence of important installation, servicing, and operating instructions in the documents accompanying the equipment.



For continued protection against fire, replace all fuses only with fuses having the same electrical ratings marked at the location of the fuse.

Electrostatic discharge (ESD) can damage the OM unit and circuit card asOMblies. Wear an antistatic wrist strap attached to a chassis ground to prevent ESD damage.

This equipment operates over the marked Voltage and Frequency range without requiring manual setting of any selector switches. Different types of line cord sets may be used for connections to the mains supply circuit and should comply with the electrical code requirements of the country of use. This equipment requires a grounding conductor in the line cord.

WARNING: TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE. THE APPARATUS SHALL NOT BE EXPOSED TO DRIPPING OR SPLASHING AND NO OBJECTS FILLED WITH LIQUIDS, SUCH AS VASES, SHALL BE PLACED ON THE APPARATUS.

CAUTION: TO PREVENT ELECTRICAL SHOCK, IF THIS UNIT IS PROVIDED WITH A POLARIZED PLUG, DO NOT CONNECT THE PLUG INTO AN EXTENSION CORD, RECEPTACLE, OR OTHER OUTLET UNLESS THE PLUG CAN BE FULLY INSERTED WITH NO PART OF THE BLADES EXPOSED.

CAUTION: TO ENSURE REGULATORY AND SAFETY COMPLIANCE, USE ONLY THE PROVIDED POWER CABLES.

EQUIPMENT MUST BE CONNECTED TO PROTECTIVE EARTH

THIS EQUIPMENT HAS BEEN DESIGNED FOR CONNECTION TO AN IT POWER DISTRIBUTION SYSTEM WHEN POWERED BY AC.

THIS DEVICE WHEN POWERED BY DC MUST BE PROTECTED BY A LISTED BRANCH CIRCUIT PROTECTER RATED MAXIMUM 25A.

It is recommended that the customer install an AC surge arrestor in the AC outlet to which this device is connected. This is to avoid damaging the equipment by local lightning strikes and other electrical surges.

FCC COMPLIANCE

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 Installation 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/her own expense. Any changes or modifications not expressly approved by Motorola could void the user's authority to operate this equipment under the rules and regulations of the FCC.

CANADIAN COMPLIANCE

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

FDA COMPLIANCE

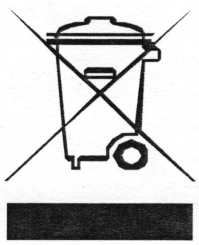
This product meets the requirements of the Code of Federal Regulations, Title 21, Chapter I, Subchapter J, Sections 1010.2, 1010.3, 1040.10, and 1040.11.

IEC COMPLIANCE

This product meets the IEC60825-1 requirements for a CLASS 1 LASER PRODUCT.

International Declaration of Conformity						
We	Motorola, Inc. 101 Tournament Drive Horsham, PA 19044, U.S.A.					
declare under our sole responsibility that the						
Out-of-band Modulator			OM 2000			
to which this declaration relates is in conformity with one or more of the following standards:						
EMC Standards						
EN55022	EN55024	EN55013	EN50083-2	CISPR-22	CISPR-24	CISPR-13
Safety Standards						
EN60065	EN60825	EN50083-1	EN60950	IEC 60950 + A1: 1992 + A2: 1993 + A3: 1995 + A4: 1996		
IEC60065						
following the provisions of the Directive(s) of the Council of the European Union:						
EMC Directive 89/336/EEC		Directive 93/68/EEC		Low Voltage Directive 73/23/EEC		

CARING FOR THE ENVIRONMENT BY RECYCLING



When you see this symbol on a Motorola product, do not dispose of the product with residential or commercial waste.

Recycling your Motorola Equipment

Please do not dispose of this product with your residential or commercial waste. Some countries or regions, such as the European Union, have set up systems to collect and recycle electrical and electronic waste items. Contact your local authorities for information about practices established for your region. If collection systems are not available, call Motorola Customer Service for assistance.

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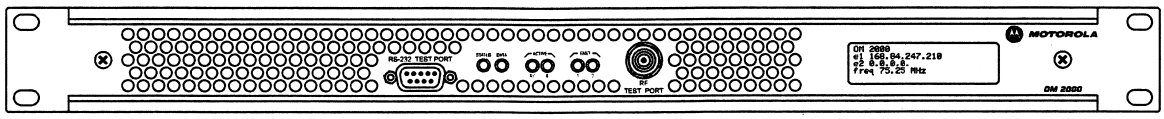
1 INTRODUCTION

The Motorola OM 2000 Out-of-band Modulator links the digital headend equipment with the distribution system by combining the various out-of-band inputs into a quadrature phase shift key (QPSK)-modulated signal. It converts multiple digital input streams into an RF output signal for transmission over the cable system. Figure 1-1 illustrates the OM 2000.

Figure 1-1 — OM 2000 Out-of-band Modulator



The OM 2000:

- Receives Ethernet User Datagram Protocol (UDP) packets from a controlling processor
- Multiplexes downstream data from multiple sources
- Provides forward error correction (FEC) encoding of the bitstream, as well as interleaving and randomization
- Provides downstream QPSK-modulated output within the 71 to 129 MHz range
- Provides industry-standard Ethernet 10Base-T connectivity for operation, administration, maintenance, and provisioning (OAM&P)
- Performs periodic insertion of internally stored messages
- Controls and provides status/alarm reporting using Simple Network Management Protocol (SNMP)

Using This Manual

The following sections provide information and instructions to install, configure, and operate the OM.

Section	Title and Purpose
Section 1	**Introduction** provides a product description, related documentation, the technical helpline, and repair/return information.
Section 2	**Overview** describes functions of the OM 2000.
Section 3	**Installation** provides instructions on how to install the OM 2000.
Section 4	**Setup and Operation** provides instructions on how to set up and operate the OM 2000.
Section 5	**Troubleshooting** provides troubleshooting, testing, and maintenance information.
Appendix A	**Specifications** provides the technical specifications for the OM 2000.
Appendix B	**Cabling Specifications** provides the cabling specifications for the OM 2000.
Appendix C	**Initialization Information** provides special information on the OM 2000 initialization process
Appendix D	**Fan Field Replacement Procedure** provides instructions to replace a malfunctioning OM 2000 fan.
Glossary	The **Glossary** provides the full spelling of the abbreviations and acronyms and definitions of the special terms used in this manual.

Related Documentation

The *System Release Notes* provide information that can be used with the OM 2000.

Although these documents provide information that may be of interest, they are not required to install or operate the OM 2000:

- *SDM User Guide*

Document Conventions

Before you begin, familiarize yourself with the stylistic conventions used in this document:

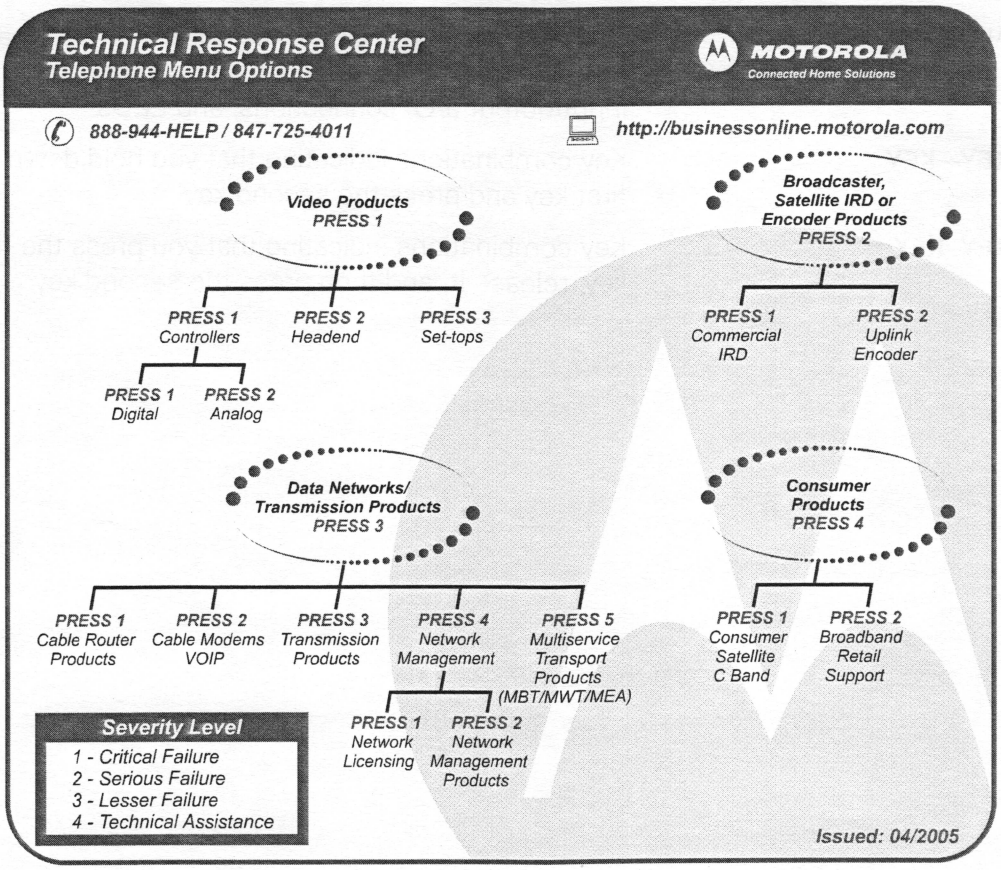
Bold type	Indicates text you must type exactly as it appears, or a default value
Italic type	Denotes a displayed variable or a variable that you must fill in
Condensed type	Indicates a field, menu, or button you must select on a graphical user interface (GUI)
`Courier font`	Indicates text displayed on a GUI, such as system messages
ALL CAPS	Denotes silk screening on the equipment, typically representing front- and rear-panel controls and input/output (I/O) connections, and LEDs
KEY+ KEY	Key combinations indicating that you hold down the first key and press the second key
KEY, KEY	Key combinations indicating that you press the first key, release it, and then press the second key

If You Need Help

If you need assistance with your Motorola product, contact the Motorola Technical Response Center (TRC):

- Toll-free: 1-888-944-HELP (1-888-944-4357)
- Direct: 1-847-725-4011
- Motorola Online: http://businessonline.motorola.com

The TRC is on call 24 hours a day, 7 days a week. In addition, Motorola Online offers a searchable solutions database, technical documentation, and low-priority issue creation and tracking. For specific toll-free numbers when calling from outside the United States, please refer to your product manual or our Web page.



Calling for Repairs

If repair is necessary, call Motorola's Repair Facility at **1-800-227-0450** for a Return for Service Authorization (RSA) number before sending the unit. The RSA number must be prominently displayed on all equipment cartons. The Repair Facility is open from 8:00 AM to 5:00 PM Central Time, Monday through Friday.

When calling from outside the United States, use the appropriate international access code, and then call **956-541-0600** to contact the Repair Facility.

When shipping equipment for repair, follow these steps:

1. Pack the unit securely.
2. Enclose a note describing the exact problem.
3. Enclose a copy of the invoice that verifies the warranty status.
4. Ship the unit **PREPAID** to the address indicated on the RSA form provided by Motorola.

2 OVERVIEW

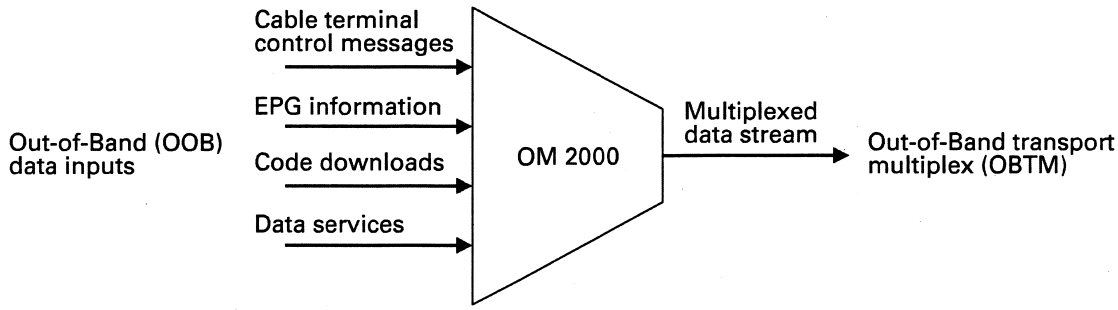
The Motorola OM 2000 creates a QPSK-modulated signal to carry the out-of-band (OOB) datastream of a digital CATV system from the headend to set-top devices (STDs) installed in subscribers' homes. The OOB datastream is the control link through which the headend transmits the commands and authorization messages that control the STDs distributed throughout the CATV system. The headend can also use the OOB datastream to deliver other types of information, including:

- Electronic Program Guide (EPG) information
- Application code downloads
- Control messages for emergency situations
- Data services
- Executable code downloads to fix or upgrade cable terminal operation

Other devices in the headend create the specific commands, messages, and downloadable code that make up the information contained in the OOB datastream. The OM 2000 accepts this information and processes it for delivery on the OOB channel by combining it into an MPEG-2-compliant transport multiplex and outputting that transport multiplex as an RF signal. Other output formats are also available to support specific application requirements.

Figure 2-1 illustrates the operational flow through the OM 2000:

Figure 2-1 — OM 2000 operational flow diagram



Functional Overview

The OM 2000's primary function is to combine multiple OOB data inputs into a single datastream that is transmitted over the OOB channel as an RF signal. The OM 2000 also provides additional signal-processing functionality:

Serial data communications	To support other application requirements, the OM 2000 transmits and receives baseband digital data over various serial data ports.
Emergency alert operation	The OM 2000 can monitor an emergency alert remote control unit and receive and store special cable terminal control messages. When a relay closure is sensed, the special messages are inserted into the OOB data transmission.

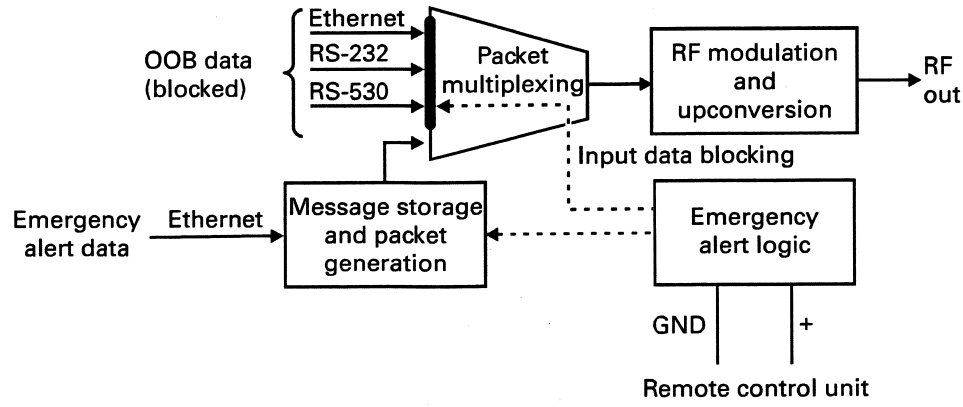
OOB Signal Processing

In converting the OOB data inputs into an RF signal, the OM 2000 performs the following OOB signal processing functions:

- Receives the cable terminal control stream and other OOB data from multiple input sources
- Multiplexes the information into a single, packet-based, MPEG-2-compliant transport stream
- Inserts PID 0 and PID 1 control streams into the transport stream, if necessary
- Modulates the digital transport stream onto a 1.8 MHz-wide RF carrier using QPSK modulation
- Upconverts the resulting signal into an RF output with a center frequency in the 71 through 129 MHz range. (An IF output is available for optional external upconversion to other frequencies.)

Figure 2-2 shows the typical flow of OOB data from the input port(s) through the packet multiplexer to the RF modulator:

Figure 2-2 — OOB data flow through the OM 2000



Receiving OOB Data Inputs

The OM 2000 can receive OOB data through multiple input ports. All data ports are located on the back panel, and each has a unique numeric identifier. Table 2-1 describes the OM 2000 input ports:

Table 2-1 — OM 2000 input ports

Port Type	Port ID	Description
RS-232 DB9 pin serial data (Front)	1	A standard RS-232 serial data port for an external terminal (console) port is used for internal diagnostics.
RS-232 DB9 pin serial data (Rear)	2	A standard RS-232 serial data port (asynchronous only) receives EPG information, code download, and other OOB data types. In some systems, an RS-232 port is configured to receive cable-terminal control-stream information instead of, or in conjunction with, the Ethernet port.
Ethernet 1	3	The standard Ethernet port is the primary input to the OM 2000. Because it is an Ethernet connection, port 3 supports communication with multiple devices over the same physical port.
Generator port	GEN	The MPEG message generator is a virtual input only port that supplies MPEG messages at periodic intervals to the output ports configured by the datapipe. The control interface sets the insertion interval, availability status, and the message data.
RS-530 DB25 serial data	4	The RS-530 serial data port is an expansion port that can be used in the same way as port 2. Like the standard serial data ports, port 4 can be configured for input or output operation.
Ethernet		Not supported in initial release.

In general, OOB data input to the OM 2000 must be in MPEG-2 transport packets. Data sent to configure, control, and boot the OM 2000 need not conform to MPEG-2 format.

Multiplexing the OOB Data

The packet multiplexer combines OOB data from the Ethernet and serial input ports into a single MPEG-2-compliant transport multiplex, and then routes this multiplex to the RF modulator. The multiplexer can also accept input data from special internal sources (for example, the internal generator for emergency alert messages or for PID 0 and PID 1 control data) if necessary.

Caution!

The aggregate input rate of all data to be combined into the RF output must not exceed 2.005 Mbps. If the rate is lower than 2.005 Mbps, the multiplexer will add null packets to achieve the correct data rate. If the aggregate input rate is higher than 2.005 Mbps, the multiplexer will drop packets.

The main destination for most OOB data is the RF modulator; however, the multiplexer can route data to other output destinations. Each input packet stream can be routed to up to three different output destinations. Table 2-2 lists the available destinations.

Table 2-2 — Multiplexer output destinations

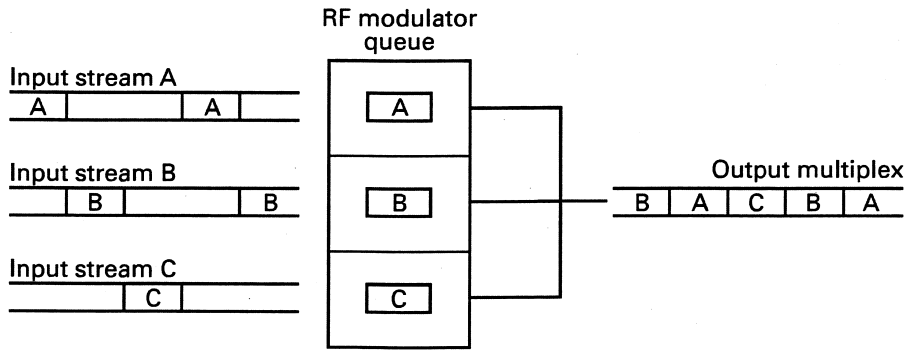
Destination	Description
RF modulator	The RF modulator uses QPSK modulation to convert an MPEG-2-compliant transport multiplex into a 1.8 MHz-wide RF signal with a center frequency between 1 and 129 MHz. Data directed to this destination is output from the RF Out and IF Out connectors on the OM 2000 back panel.
Serial data ports	Data directed to a serial data port is output as a serial datastream. The serial data ports are valid destinations only when configured as output or bi-directional ports.
UDP connections over the Ethernet port	Data directed to a UDP port is output as a serial datastream. The UDP connections are valid destinations only when configured as output ports. A legal UDP port number must be assigned to each connection, and the IP address of the receiving device must be configured.
Null port	The null port is a conceptual destination equivalent to routing a packet to nowhere (that is, discarding the packet).

Because of the number of possible input sources and output destinations, the OM 2000 relies on a collection of data-handling specifications called PID maps to support the proper multiplexing and routing of data through the packet multiplexer. One set of PID maps is defined for each input port to control how the multiplexer handles packets from those streams. Within the set for a port, a single PID map controls the handling of one packet stream, and each set includes a default PID map to control the handling of packet streams having no explicit PID mapping.

The multiplexer uses a queuing scheme to transfer packets from input ports to output buffers. Each destination has a dedicated queue composed of multiple data buffers set up to handle packets from particular input packet streams. As an input packet enters a given input port, the packet multiplexer reads the stream PID map and transfers the packet to the correct output destination queue. To generate the output multiplex for a given destination, the multiplexer extracts packets from the destination's queue by taking one packet from each buffer in a round-robin fashion.

Figure 2-3 illustrates how the packet multiplexer uses a destination queue to create an output multiplex. In this example, the multiplexer routes three different input packet streams labeled A, B, and C to the RF modulator for output. As a packet from stream A enters the queue, the multiplexer transfers it to its associated buffer in the RF modulator destination queue. The multiplexer handles packets from streams B and C are in the same way:

Figure 2-3 — Creating an output multiplex



The multiplexer then builds the output multiplex for the RF modulator by extracting packets from each buffer in the RF modulator queue in sequence (that is, one packet from the A buffer, one from the B buffer, one from the C buffer, and so on).

The input devices supplying the data control the PID numbers assigned to incoming packet streams. As a result, it is possible that packet streams received from two different devices may use the same PID number. To avoid collision of these packets when multiplexed for output, the OM 2000 re-assigns the PID numbers of streams routed to the same destination. PID numbers can be re-assigned to any value or left unchanged, as necessary, to guarantee PID uniqueness in the output. PID number re-assignment for a packet stream is defined in the PID map for that stream.

Inserting PID 0 and PID 1 Control Streams

Depending on your system configuration, the cable-terminal control-stream input to the OM 2000 can include the PID 0 and PID 1 control streams required to define the OOB transport multiplex. If not, these streams are added to the multiplex before it is input to the RF modulator.

The internal MPEG message stores the PID 0 and PID 1 control streams received from the addressable controller and inserts packets containing messages from these streams into the multiplexer at defined intervals. The messages are input to the internal MPEG message generator through the Ethernet and they include data to

PID 0 and PID 1 packets, as well as commands specifying how often the generator should insert the packets into the multiplexer.

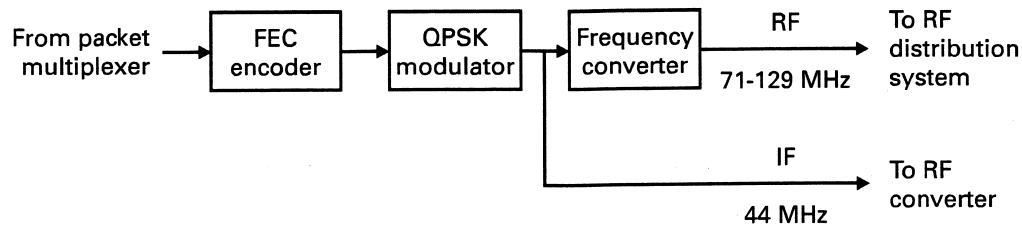
Generating the RF Output

The RF modulator receives the OOB data transport multiplex created by the packet multiplexer and performs the following functions to convert it for RF transmission:

Forward error correction (FEC) encoding	An FEC encoder performs Reed/Solomon encoding, data interleaving, and data randomization to reduce transmission errors.
QPSK modulation	A QPSK modulator converts the digital information in the OOB transport multiplex into a synthesized analog waveform. The waveform is a 1.8 MHz-wide signal with a carrier frequency centered at 44 MHz (IF).
Frequency upconversion	A frequency-agile converter processes the QPSK-modulated 44 MHz IF signal to an RF output frequency configurable from 71 through 129 MHz.

Figure 2-4 shows a block diagram of the RF modulator:

Figure 2-4 — RF modulator block diagram



Generating Serial Data Outputs

Depending on the routing, multiplexing, and PID re-assignment definitions contained in the PID maps, the packet multiplexer directs input packets to serial data port destination queues and multiplexes them into output datastreams in the same way it routes and multiplexes data for the RF modulator.

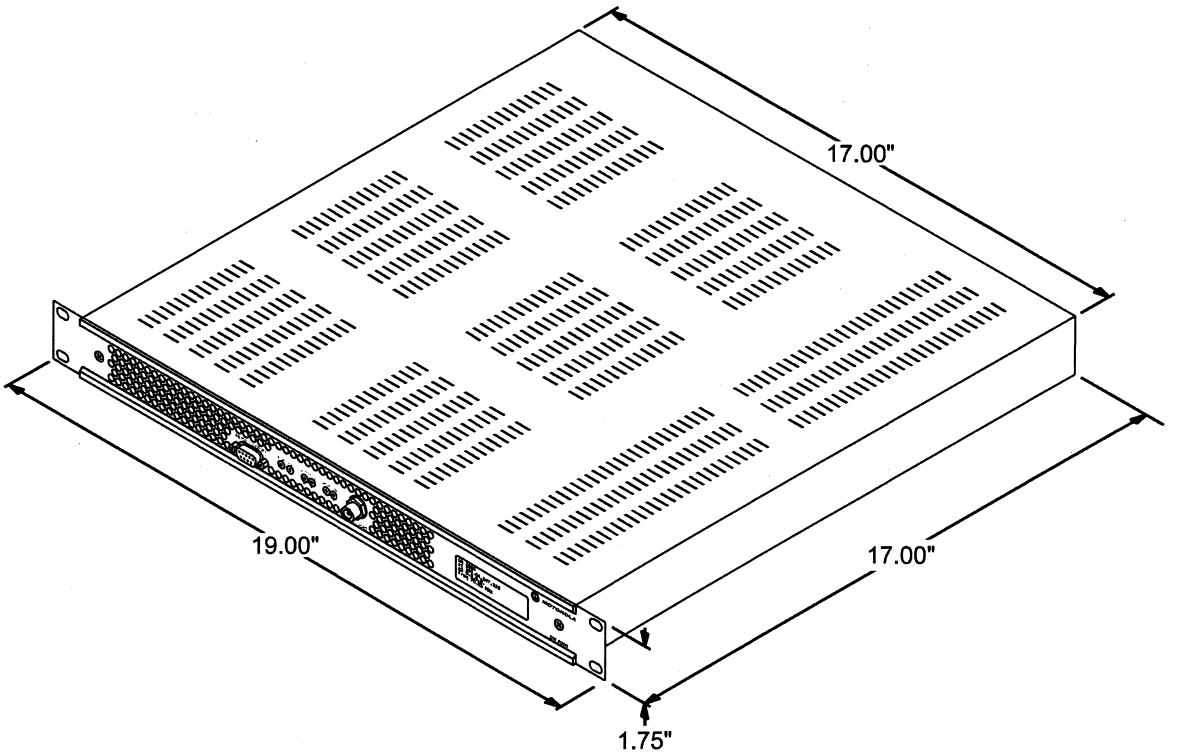
To be valid output destinations, serial data ports must be configured as output ports.

Physical Overview

The OM 2000 chassis mounts in a standard 19-inch equipment rack in a digital headend, network hub office, or network end office. It occupies one rack unit (1.75 vertical inches).

Figure 2-5 illustrates the OM 2000 and its physical dimension:

Figure 2-5 — OM 2000 dimensions



Refer to Appendix A, "Specifications," for complete physical, electrical, and environmental specifications.

Indicators and Connectors

The OM 2000 indicators, as well as the RF monitor jack, are located on the front panel. Figure 2-6 illustrates the front-panel indicators:

Figure 2-6 — OM 2000 front panel

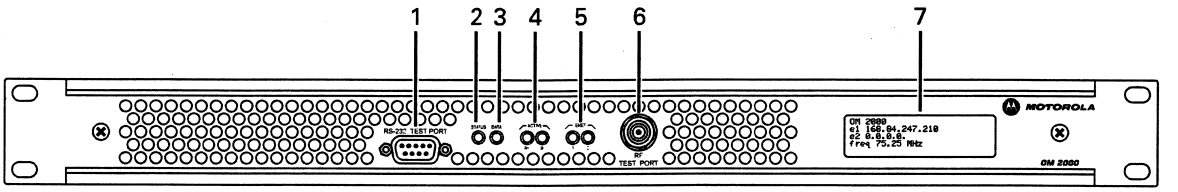
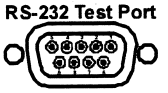
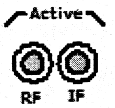
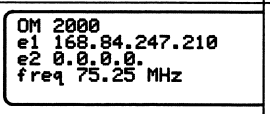


Table 2-3 summarizes the function of the RF monitor jack and each indicator:

Table 2-3 — OM 2000 front panel RF monitor jack and indicators

Key	Connector/Indicator	Description
1	RS-232 Test Port 	Nine-pin RS-232 Test Port (behind front bezel) — an interface used to access internal diagnostics from the operating system command line shell. It also provides an alternate method to configure the OM. • Top row connector pins are: 5, 4, 3, 2, 1 • Bottom row connector pins are: 9, 8, 7, 6
2	Status 	Status/Summary Alarm indicator illuminates during the power-on or reboot cycle for the following conditions: • Blinking Red — powered on and performing initial boot code memory tests. • Blinking Yellow — boot code memory tests have passed. Performing low level initialization. This includes initialization of processor, requesting BOOTP or DHCP, and downloading of OM application files. • Blinking Green — OM has loaded application code and is performing final hardware initialization. This also includes start up of all software tasks. After the OM has completed booting, the Status/Summary Alarm indicator illuminates for the following conditions: • Solid Green — power on and no faults. • Solid Yellow — indicates a minor or warning alarm has occurred. • Solid Red — indicates a critical or major alarm has occurred.
3	Data 	Indicates when data arrives from the cable network.
4	Active  RF IF	RF and IF Output indicators — each illuminates to indicate data activity as follows: • Off — no link or link down (the auto-negotiation failed, no communication to partner, or no link pulse observed). • Solid Green — link up (auto-negotiation link pulse activity, partners agree on capabilities, but no data traffic). • Solid Yellow — Mute. • Solid Red — faulty or failed.
5	Enet 1 2 	10/100Base-T Ethernet indicators 1 and 2 — each illuminates to indicate Ethernet link, data, and collision status as follows: • Off — no link or link down (the auto-negotiation failed, no communication to partner, or no link pulse observed). • Solid Green — link up (auto-negotiation link pulse activity, partners agree on capabilities, but no data traffic). • Alternating Green-Yellow — collision detected (if in half-duplex mode, 10/100Base-T only). Light LED for 100 msec after detection of collision. During high collisions appears as alternating green-yellow.

Key	Connector/Indicator	Description
6		–20 dB test RF monitor jack is an F-type connector that permits convenient monitoring of the RF output at the front panel.
7		The OM 2000 display shows the IP address and RF frequency configured on the device.

Input/Output and Power Connections

Figure 2-7 illustrates the OM 2000 rear panel input/output connectors, power connector, and fans:

Figure 2-7 — Rear panel

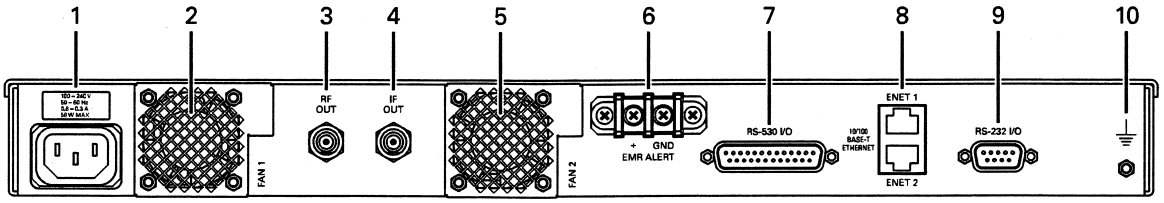
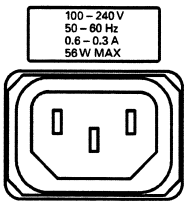
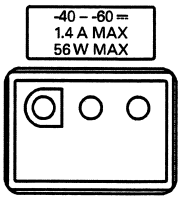
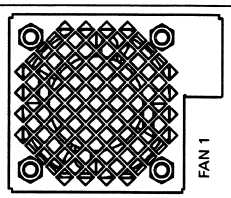
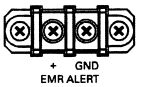
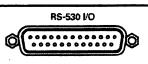
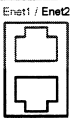


Table 2-4 identifies each connector and describes its function:

Table 2-4 — OM 2000 input/output and power connections

Key	Connector	Description
1		The AC power input connector accepts inputs from 100 through 240 V AC (50 through 60 Hz).
1		The DC power input connector accepts inputs from –40 through –60 V DC.
2, 5		Two field replaceable fans extend from the rear of the OM. To replace a fan, reference Appendix D, "Fan Field Replacement Procedure."

Key	Connector	Description
3	RF OUT 	The RF Modulator port provides RF output in a frequency range from 71 to 129 MHz in 50 KHz steps. The OOB data carried in the RF signal is transmitted at 2.005 Mbps QPSK and are null filled between data packets.
4	IF OUT 	A 44 MHz QPSK modulated IF port provides an IF output which can be used with an external converter to generate any other desired center frequency.
6		The EMR ALRT connectors are of the screw terminal type and part of the emergency alert system circuitry. This circuitry enables civil authorities to deliver emergency warnings to cable subscribers. The screw terminal labeled GND connects to signal ground. The screw terminal labeled + connects to the positive side of an emergency alert remote control unit.
7		DB25 RS530 This port operates in either an asynchronous or synchronous mode and provides higher transparent MPEG data input output capabilities at data rates up to 2.005 Mbps.
8		ENET1 is a 10/100Base-T Ethernet interface (OAM&P) that receives and transmits data to and from external sources. This is a standard RJ-45 connector.
9		DB9 RS-232 communications port used for data input/output.
10		Chassis ground.

3 INSTALLATION

This section provides step-by-step instructions to install the OM 2000 in a digital CATV headend. To complete this process, you must:

- Mount the OM 2000
- Connect the interface cables
- Apply power to the unit
- Confirm that the front-panel LEDs indicate correct installation

Before You Begin

Before you begin the installation, take a few minutes to review the installation information, gather special tools, and complete the tasks listed below to make the installation as quick and easy as possible.

1. Verify that you received the following items with the OM 2000 shipment:

Item	Quantity	Description
OM 2000 chassis	1	Cabinet to house the RF modulator and related equipment.
Mounting screws, 10-32, 0.5 inches long, Phillips, round, with plastic washer	4	Provided to mount front of unit in the rack.
As applicable: • **AC cord, 3 conductor, 7 feet 6 inches, 18AWG** **Or** • **DC cord, 3 conductor, 15 feet, 14 AWG**	1	Power cord for unit.

2. The following items that are not included with the OM 2000, but are necessary to complete the installation:

Item	Description (rear panel connections)
Ethernet cable with RJ-45 connectors	For connection to OAM&P system interface ENET1.
RF coaxial cable with F-type connectors	Required to connect to the RF Out and IF Out connectors.
Serial data cables with female DB-9 connectors	Required to connect to DB-9 port.

Item	Description (rear panel connections)
Serial data cables with female DB-25 connectors	Required to connect to DB-25 port.

Caution!

The power cord must use 18-AWG, stranded-wire cable with a 3-conductor plug appropriate for your ac-power outlet. Using the wrong power cord will damage the OM 2000.

3. Obtain or fabricate any necessary cables. Check the cabling guidelines provided in Appendix B, "Cabling Specifications," for the length restrictions, connector, and cable or wire type for each connection required for your system.

   Note: RS530 serial cables for use with the OM 2000 can be purchased from Motorola. The RS530 cable part numbers are:

   - *RS530 Cable type 1 DSR to OM 2000 for HITSQT+ (PN: 523807-002-00)*
   - *RS530 Cable type 2 Standard RS530 (PN: 471372-003-00)*

4. Brace the unit with optional rear supports for improved stability when mounting the OM 2000 into the equipment rack.

Mounting the OM 2000

Mount the OM 2000 in a standard 19-inch rack. If the equipment operates continuously in a closed cabinet, use forced-air circulation to ensure maximum equipment life and optimum performance.

Caution!

Improper grounding may damage the OM 2000. Refer to the national guidelines or local standards for the OM 2000 proper grounding to equipment racks and to the building grounding system.

To mount the unit in the rack:

1. Insert the four screws with the washers through the four mounting holes in the front panel and into the mounting holes in the rack.
2. Install the optional rear supports, if desired, (part # 213883-000) to improve stability.
3. Tighten all screws.

Connecting the Interface Cables

The following standard cabling is required:

- The Ethernet interface to the headend LAN
- RF or IF output to the distribution system

Depending on your site configuration, you may need additional cabling:

- The RS-232 DB9 interface to the serial data source or destination device
- The DB25 interfaces, either RS-232 or RS-530, to the serial data source or destination device
- Optional ground wire connection; refer to Figure 2-7 for location of grounding stud

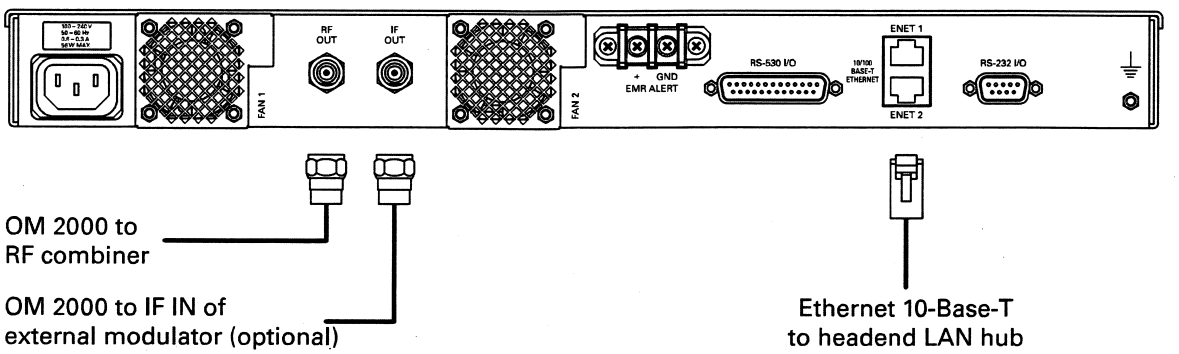
Caution!

> *To avoid possible damage to the OM 2000, ensure that the ac-power cord is disconnected before connecting any I/O cables.*

Connecting Ethernet and Modulator Output Cables

For most applications, the RF modulator must be connected to the distribution system. Figure 3-1 illustrates a typical connection for Ethernet and modulator output. In the illustration, the IF output is connected to a C6U; however, other upconverters can be used:

Figure 3-1 — OM 2000 Ethernet and modulator output connection



To connect the Ethernet and RF-modulator output cables:

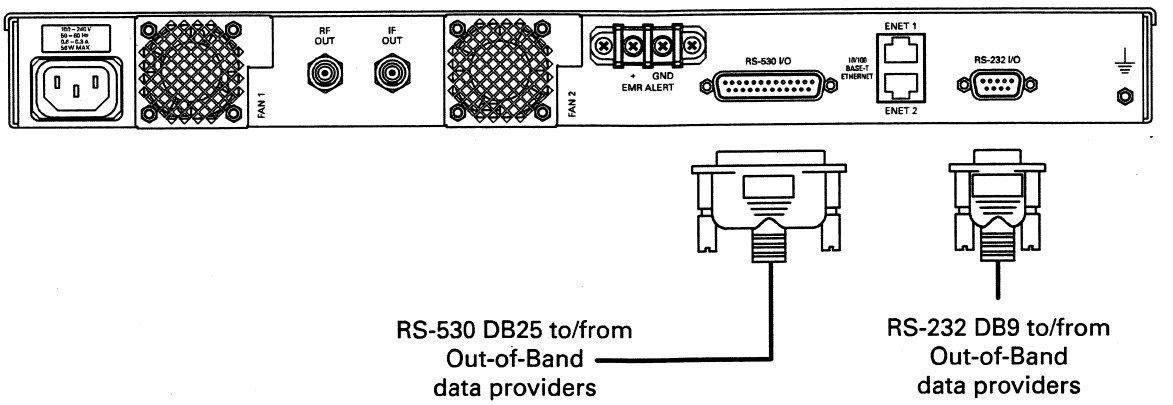
- Connect the Ethernet cable to the rear-panel connector marked ETHERNET.
- Connect the RF combiner to the rear-panel connector marked RF OUT using standard coaxial cable with F-type connectors.
- Connect the upconverter to the IF OUT connector using standard coaxial cable with F-type connectors.

Connecting Optional Serial Port Cables

To connect to a serial port:

1. Align the male pins on the DB9 connector with the female connector marked RS-232 I/O, as illustrated in Figure 3-2:

Figure 3-2 — OM 2000 optional serial and interface output connection



2. Push the cable in until the connector is fully engaged. Do not bend the pins.
3. Align the captive screws on the connector with the threaded standoffs and then tighten the screws.
4. Align the male pins on the DB25 connector with the female connector marked opt1.
5. Push the cable in until the connector is fully engaged. Do not bend the pins.
6. Align the captive screws on the connector with the threaded standoffs on the back of the unit, and then tighten the screws.
7. Repeat steps 4 through 6 for the female connector marked opt2.

Connecting the Optional Ground

Connect a ground wire from the OM 2000 to the rack frame using a #10-32 screw.

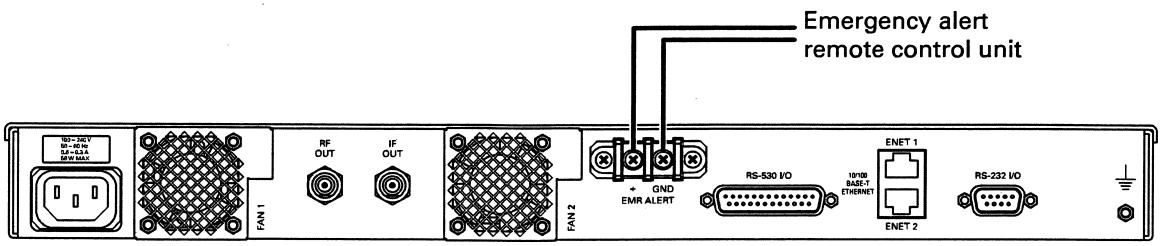
Connecting Emergency Alert Wiring

The OM 2000 emergency alert function may not operate reliably if an excessive voltage differential exists between the remote control unit chassis and the OM 2000 chassis. Both chassis must share a common ground to guarantee less than a 0.5 V differential between the two chassis. You must ensure that the voltage across the emergency alert terminals meets these requirements when including ground and wiring voltage drops. If other units are also connected to the same command contacts, a loss of power or an internal power-supply failure in one of the other units can cause a false alert condition if the unpowered unit reduces the contact voltage to 4 V or less.

To connect the emergency alert unit:

1. Loosen the emergency alert screw connectors on the back of the unit. Refer to Figure 3-3 :

Figure 3-3 — Emergency alert connection



2. Align and then secure the ground wire to the alert connector (labeled ⏚) on the back of the unit.
3. Align and then secure the positive signal wire to the connector labeled "+" on the back of the unit.

OM 2000 Power Connection to AC Power

For AC units, use only an AC power cord that complies with the country's product safety requirements.

For AC units, connect the AC-power cord after all I/O connections are complete. The power supply automatically senses and adapts to any input from 100 through 240 V AC, at 50 through 60 Hz.

Caution!

> ⚠ *To prevent electrical shock, do not use the polarized power cord with an extension cord, receptacle, or other outlet unless all blades can be fully inserted to prevent blade exposure.*

OM 2000 Power Connection to DC Power

For DC units, use the provided DC power cord assembly.

For DC units, connect the DC power cord after all I/O connections are complete. The power supply automatically senses and adapts to any input from –40 through –60 V DC.

Caution!

> ⚠ *The OM 2000 with DC power must be installed in a restricted access area. Do not power this device with less than -40 V DC*

The input of the power supply is isolated from chassis ground. Either the positive or the negative input terminal can be grounded, as determined by the application. See the table below for typical –48 V DC system installation:

Line Cord Wire Color	Description	Typical Connection for –48 V dc System
Red	Hot (–)	Connect to negative terminal of 48 V dc source.
Black	Return (+)	Connect to positive terminal of 48 V dc source. Positive terminal of 48 V dc source may be connected to chassis ground.
Green with yellow stripe	Chassis Ground	Connect to chassis ground.

Confirming Correct Installation

After applying power to the OM 2000, there is short initialization period. If the installation is correct:

- The green POWER indicator is on.
- The RF, IF, and FAULT SUMM LEDs may illuminate red to indicate a configuration error.

When the above sequence is observed, the unit can be configured. Refer to Section 4, "Setup and Operation" for information on preparing the unit for operation. If the above conditions do not occur, refer to Section 5, "Troubleshooting."

4 SETUP AND OPERATION

At power-up, the OM 2000 operating parameters are set either by data stored internally in non-volatile storage (FLASH) or by data downloaded from a Bootstrap Protocol (BOOTP) server on the headend LAN. The method used depends on your system configuration.

After you set the initial operating parameters, you can modify the configuration by:

- Entering new parameter settings at the OM 2000 front panel
- Forcing a reboot to download a new configuration from the BOOTP server
- Sending commands from an SNMP network manager

This section provides information to help you configure the OM 2000 through the graphical user interface (GUI) of the OM Element Manager. For information on downloading data from a BOOTP server, refer to Appendix C, "Initialization Information."

Network Connection

At power-up, the operating configuration of the OM is determined by data stored internally in flash memory, by data that is downloaded from a bootstrap protocol (BOOTP) server. The particular method used to set up initial operation depends on the system configuration.

After setting the initial operating configuration, modify the configuration by:

- Sending commands from an SNMP network manager (such as the OM-EM or SDM)
- Forcing a reboot to download a new configuration to the OM from the BOOTP server. The OM only processes BOOTP responses from the OAM&P interface (ENET1).

  MAC addresses for the two Ethernet ports are included on the serial number label on the bottom of the OM.)

Verifying the Network Connection

Ping the OM OAM&P interface to ensure the IP address was assigned. At bootup, the OAM&P interface, ENET1, should be connected to the local network. The OM will always attempt to auto-negotiate at bootup and will set the duplex and data rate (10 Mbps or 100 Mbps) depending on the results of the auto-negotiation process. If the Data IP interface ENET2 is to be used, it should also be connected to its own network at bootup. ENET1 and ENET2 must be on separate networks.

OM-EM Requirements

The Out-of-band Modulator –Element Manager (OM-EM) standalone application is downloaded from the OM and runs under JRE 1.2.2 and above (up to 1.4.1).

Browsers

Recommended web browsers to run the OM-EM are reasonably current versions of Netscape Navigator® (latest version is 7.1) or Microsoft® Internet Explorer (latest version is 7.0). Browser or proxy settings are not required. The latest versions of these browsers can be downloaded from the following web sites:

- http://www.netscape.com (click on Browser Central)
- http://www.microsoft.com (click on Resources, and then Downloads)
- To view the Java-enabled console, you also must download the Sun® Java Runtime Environment (JRE), version 1.2.2 or higher (up to 1.5.0). The JRE can be downloaded from the Sun Web site at: http://java.sun.com/getjava

Hardware

The OM-EM is like most Windows® applications: the faster the processor and the greater the memory, the faster the OM-EM will respond. Systems with more than 512 MB and/or more memory are highly recommended. Also, the larger the display window and/or the higher the resolution, the better the OM-EM display clarity.

Table 4-1 — Memory Specifications

Item	Minimum Specification	Recommended Specification
PC Processor	300 MHz Pentium® II	P4 1.0 GHz
RAM	128 MB	512 MB
Disk free space	50 MB	50 MB
Display resolution (minimum)	800 x 600	1024 x 768

Operating Systems

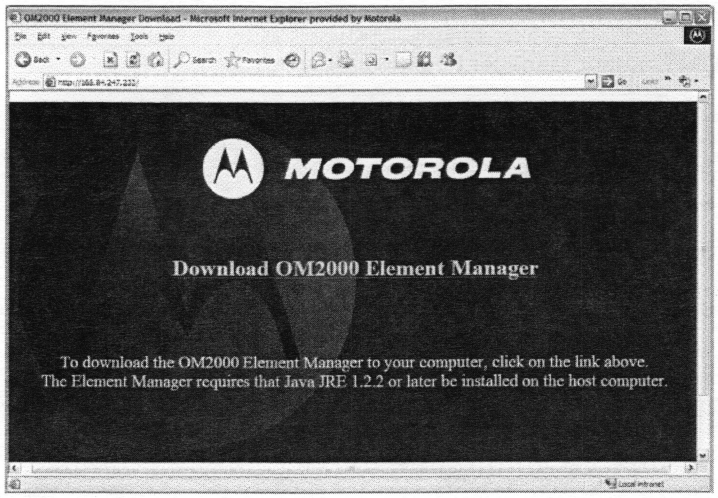
The OM-EM runs under Microsoft Windows NT® version 4.0, Windows® 2000, or Windows XP™.

Initiating an OM-EM Session

To start a session using the OM-EM:

1. Invoke the system browser and enter the OM IP address in the URL address field. Typically, the OAM&P network is used to communicate with the OM via the OM-EM. However, the Data IP network may also be used (after it is properly configured). The addressed OM home page appears, as shown in Figure 4-1:

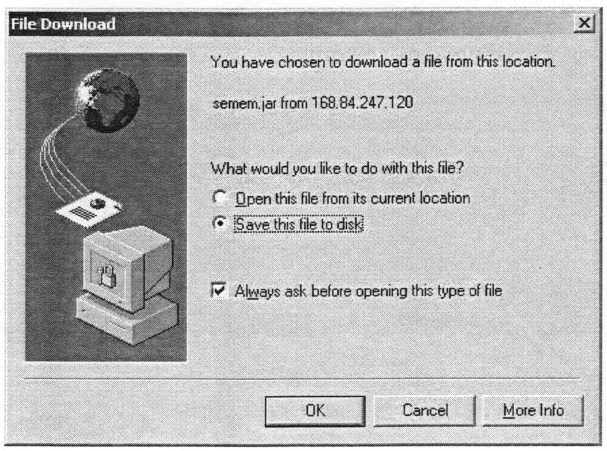
Figure 4-1 — Initiating an OM-EM Session



2. As applicable:
   - Click the hyperlink to download the JRE 1.2.2 from the Sun website (if no connection occurs, you will have to visit the Sun website and search for JRE downloads).
   - Download the OM-EM application.

   The file download pop-up appears, as shown in Figure 4-2:

Figure 4-2 — File download pop-up



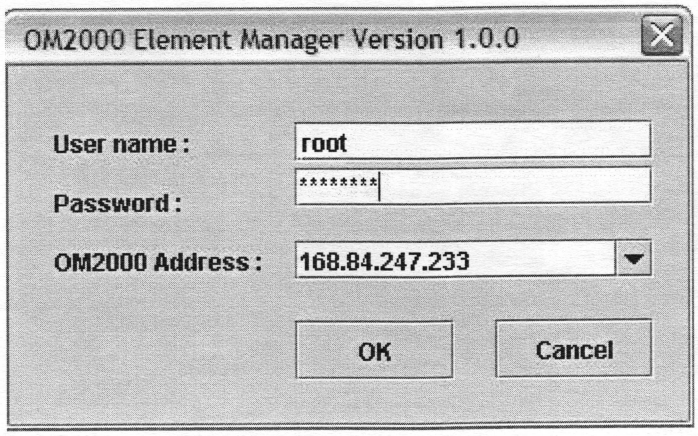
3. Click **Save this file to Disk** and click **OK**. Note that the name of the OM EM file, omem.jar, can be changed to denote a specific OM or OM version (for example, omem10.jar). However, the file extension must be ".jar."
4. To launch the OM-EM, after the application downloads, either double-click the downloaded omem.jar (recommended) or access MS-DOS and, at the command line, type:

   java –jar OMem.jar and press **ENTER**.

   (type **java^-jar^OMem.jar** where ^ means press spacebar)

The OM Element Manager Login window is displayed in Figure 4-3 (a typical IP address is shown):

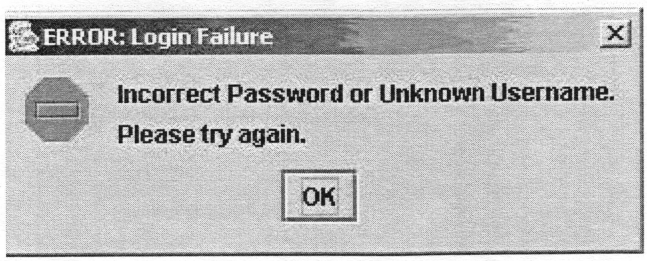
Figure 4-3 — OM Element Manager Login window



5. Type a **<User name>** (root is the default).
6. Type a **<password>** (password is the default).
7. Type the **<OM IP address>** or select an OM from the drop-down list. (The drop-down list contains the most recently accessed OMs.)
8. Click **OK**.

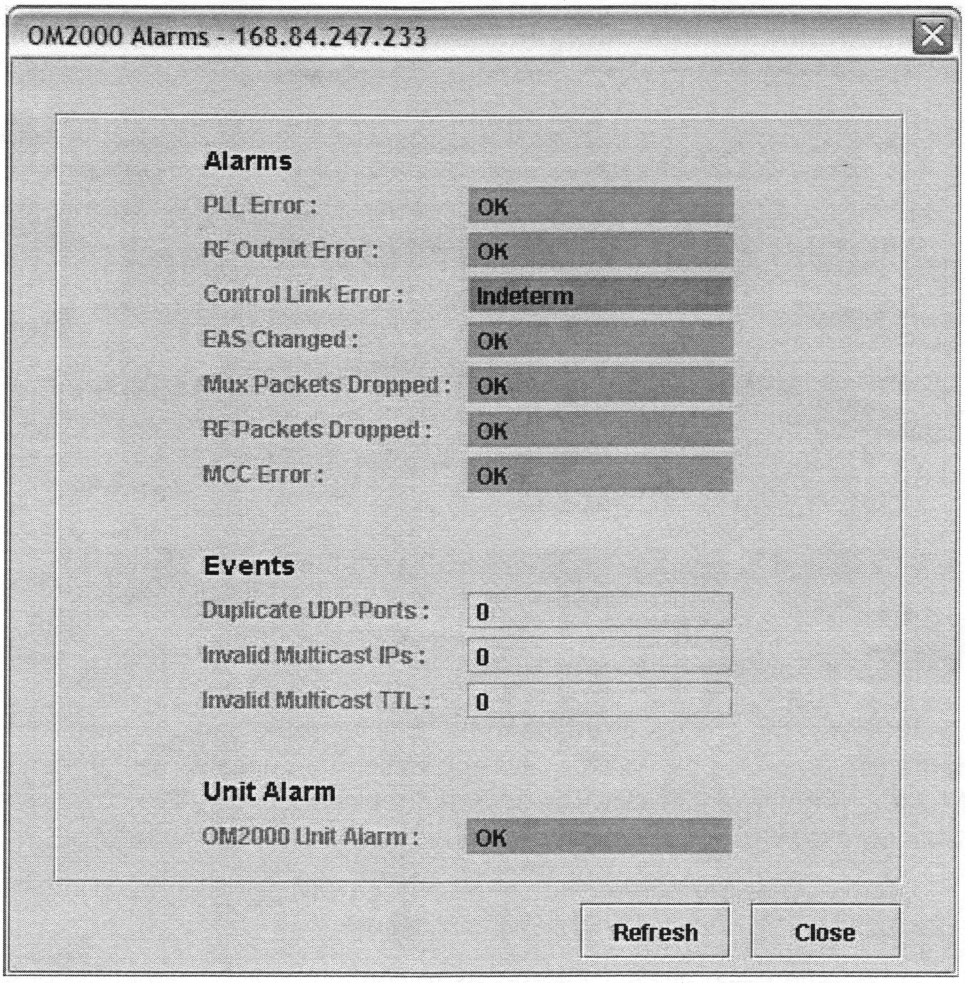
If an incorrect password or user name was entered, an error popup displays, as shown in Figure 4-4:

Figure 4-4 — Incorrect Password error popup



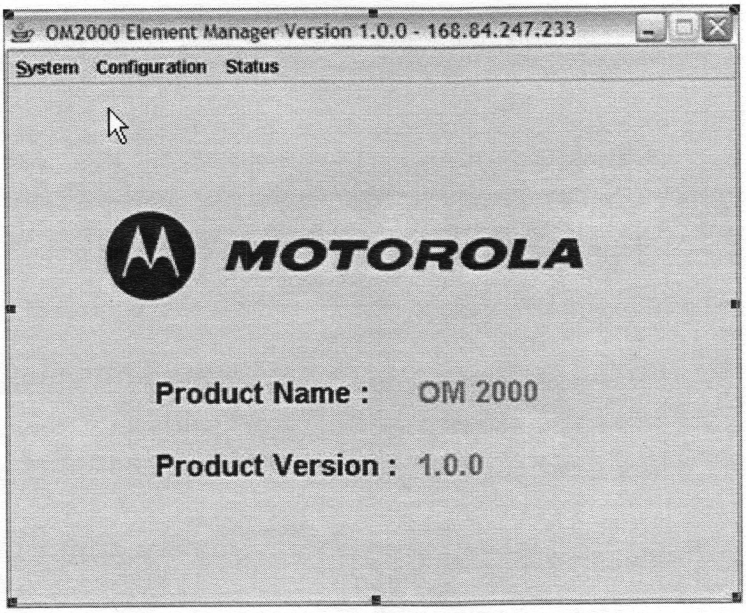
If there is an active warning (yellow), major alarm (magenta), or critical OM Unit Alarm (red), the Alarms window displays, as shown in Figure 4-5.

Figure 4-5 — OM 2000 Alarms window



If the OM does not have an active OM Unit Alarm, the OM-EM Main window is displayed (as shown in Figure 4-6). The drop-down lists for each of the menu bar selections are shown in Figure 4-7, Figure 4-8, Figure 4-14, and Figure 4-19.

Figure 4-6 — OM-EM Main window



OM-EM Software Toolset

The OM-EM is the primary interface to the OM for setup and operation. It is a remote user interface based on a Java application that enables you to monitor an OM 2000 remotely and locally. The software toolset has four drop-down lists that enable access to screen-sets, as follows:

- System — provides screen-sets to reboot the OM, invoke pop-up information about the OM, or exit the OM-EM application.
- Configuration — provides screen-sets to configure OM parameters for the system.
- Status — provides the capability to view any of the status reports and to save all of them to a text file.

Windows within a majority of the screen-sets are tab selected. Each window has operating buttons that appear at the bottom-right.

Table 4-2 — OM-EM Software Toolset Button Functionality

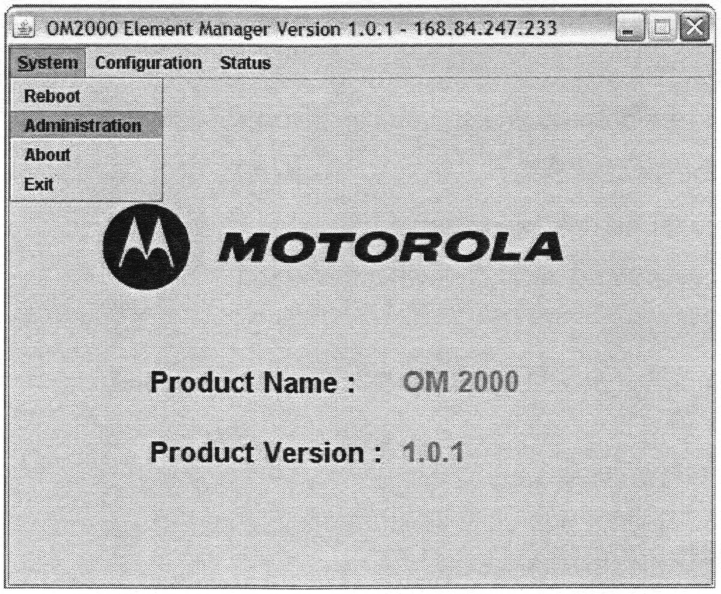
Button	Function	State
Close	Closes the dialogue. All changes not applied are lost.	Always enabled
Apply	Saves (writes) all changes to the OM. For dynamic fields, changes take effect immediately. Changes to fields that are not dynamic require the OM to be rebooted to take effect.	Always enabled

Button	Function	State
Refresh	Loads (reads) values for all fields from the OM. All changes not applied are lost. If you change a field and do not apply it, clicking refresh restores the original value.	Always enabled
Submit	Saves (writes) user name and password changes to the OM.	Always enabled

System

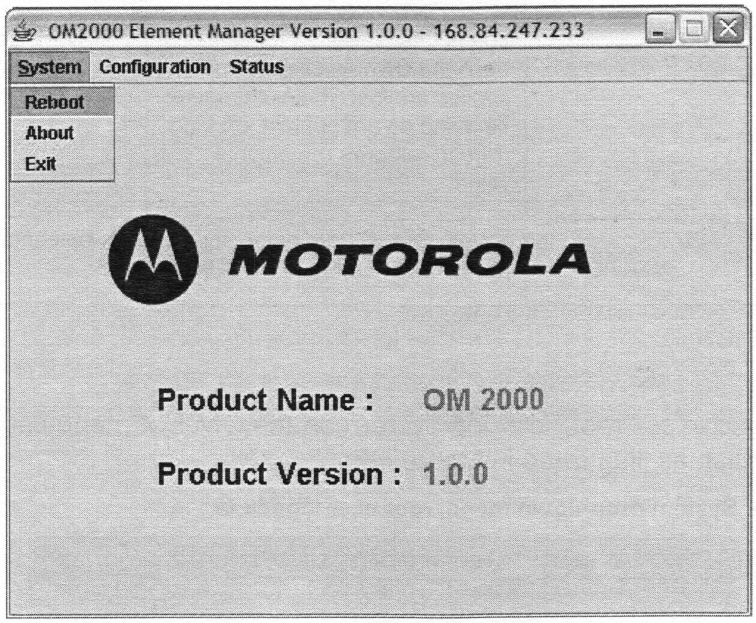
When logged in as "root," clicking System on the OM-EM menu bar displays the drop-down list, as illustrated in Figure 4-7:

Figure 4-7 — System drop-down menu, root user logged in



When logged in as a user other than "root," clicking **System** on the OM-EM menu bar displays the drop-down list, as illustrated in Figure 4-8.

Figure 4-8 — System drop-down menu, non-root user logged in



From the System drop-down list, you can invoke windows to:

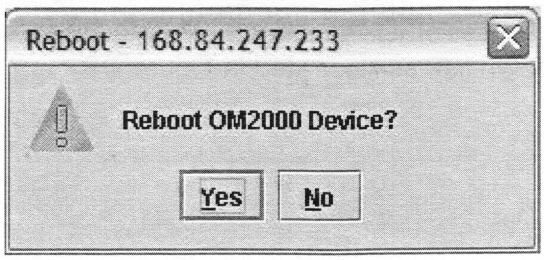
- Reboot the OM
- Manage user names and passwords
- Display current OM revision level information
- Exit the OM-EM

These activities are described in the following subsections.

Reboot

The OM 2000 Reboot pop-up is illustrated in Figure 4-9.

Figure 4-9 — OM 2000 Reboot pop-up



Click **Yes** to reboot the OM 2000.

Administration

The Administration window is only accessible while logged in as "root." The default user name is root, and the default password is password. The Administration window is illustrated in Figure 4-10 and defined in Table 4-3.

Figure 4-10 — Administration window

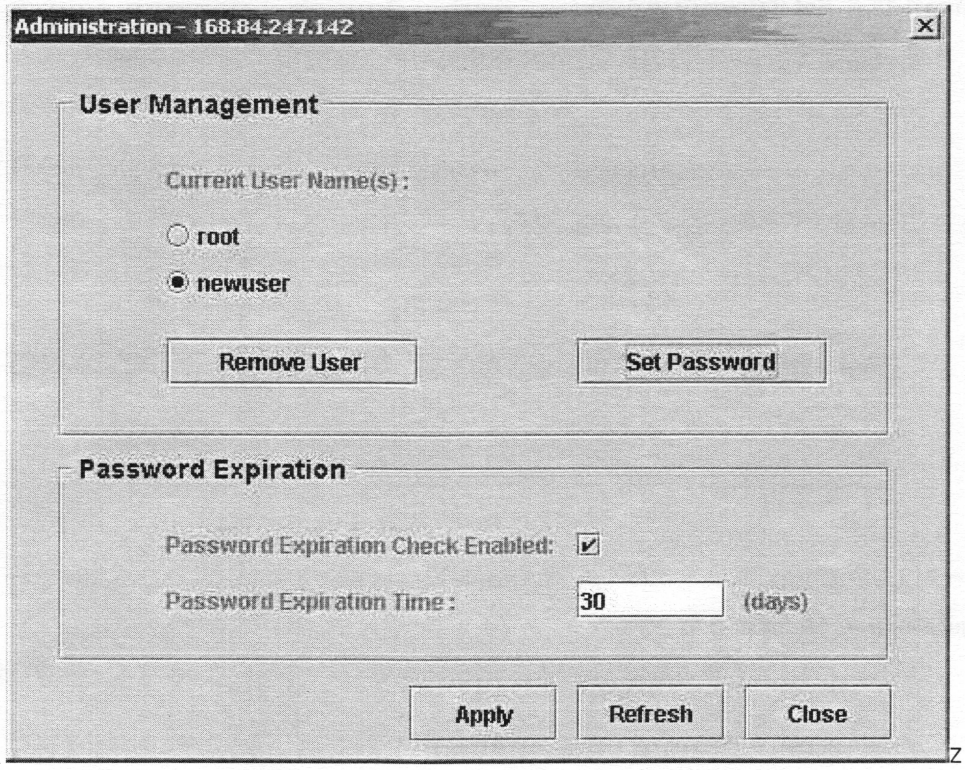


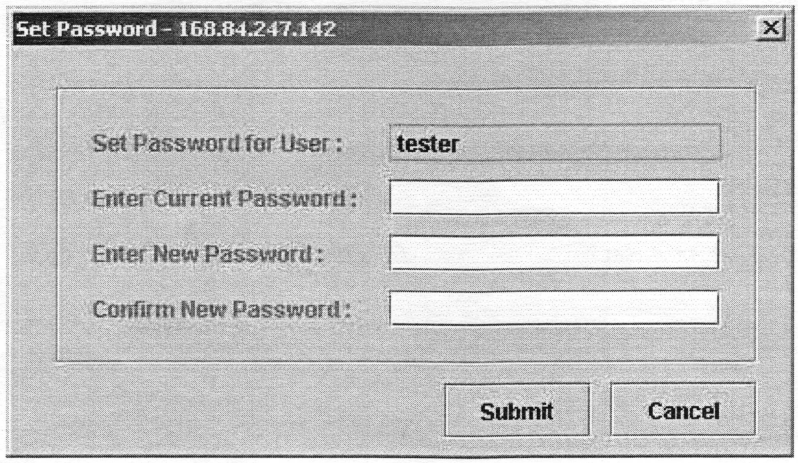
Table 4-3 — Administration window option field definitions

Item	Definition
Current User Names	User "root" is always displayed. If an additional user has been added, this user name will be displayed as well.
Remove User	Deletes the selected user name from the OM-EM. User "root" cannot be removed.
Set Password	Opens the Set Password window, which allows the user to change the current password. The Set Password window is illustrated in Figure 4-11 below.
Password Expiration Check Enabled	If enabled, the OM EM will check for password expiration each time a login occurs or right after a reboot or reprogram. If disabled, the password will never expire.
Password Expiration Time	1 – 999 days; default value = 30 days The number of days a password remains valid after it is created.

Setting the Password

The Setting menu item is only accessible while logged in as a user other than "root." This opens the Set Password Window. It allows the current user's password to be changed. Consistent with standard software procedures, changing requires entering the current user name or password followed by the new one. A password change requires the new password to be entered twice before clicking **Submit**.

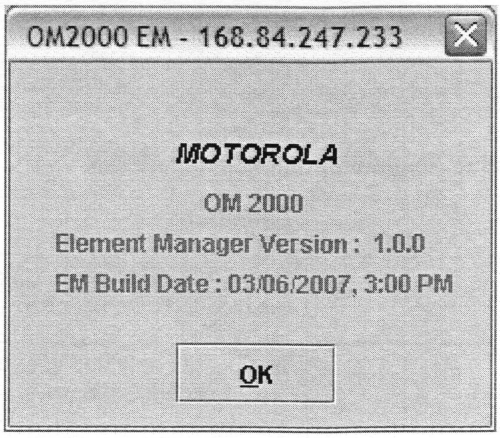
Figure 4-11 — Set Password window



About

The About popup is illustrated in Figure 4-12.

Figure 4-12 — About popup

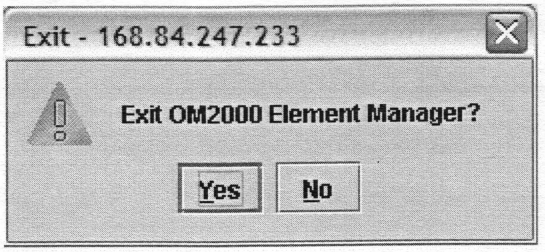


Click **OK** to acknowledge and remove the pop-up.

Exit

The Exit popup is illustrated in Figure 4-13.

Figure 4-13 — Exit popup



Click **Yes** to exit or click **No** to remove the popup.

Configuration

Clicking Configuration on the OM-EM menu bar displays the drop-down list, as illustrated in Figure 4-14.

Figure 4-14 — Configuration drop-down list

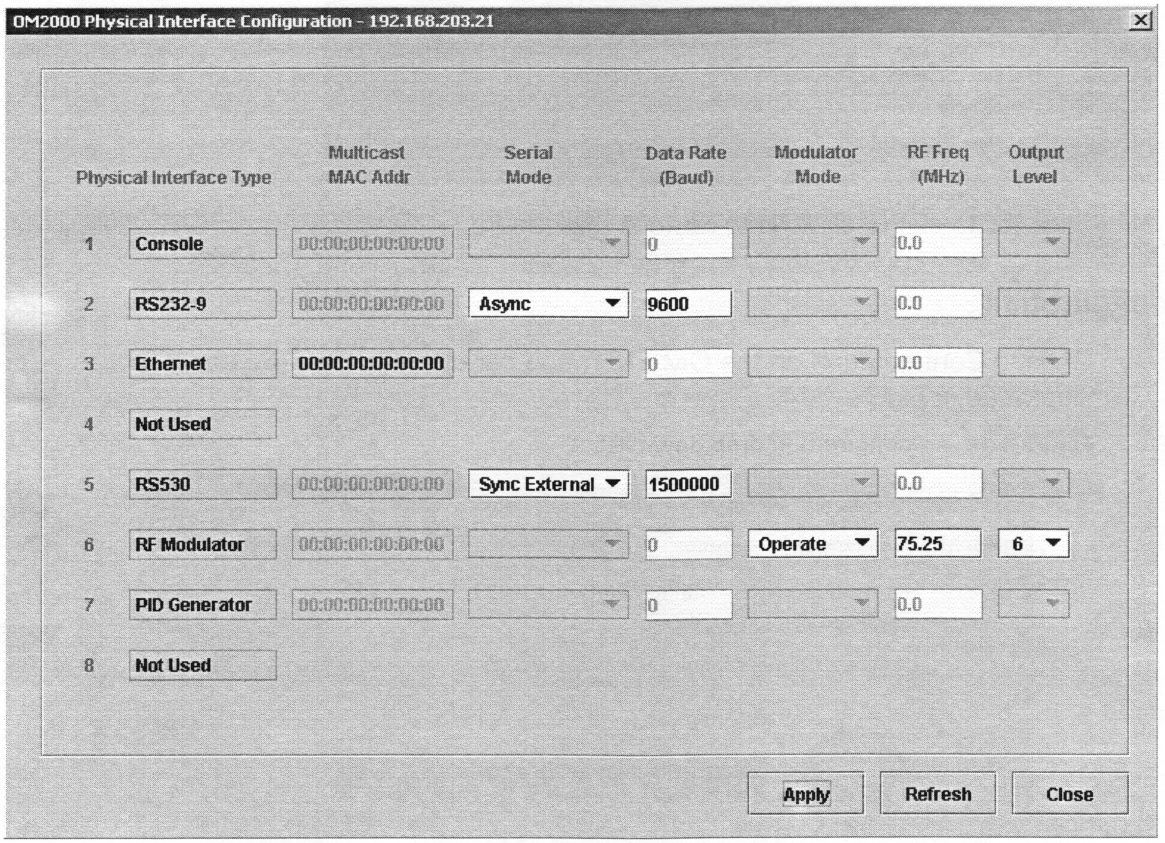
The OM 2000 Configuration screen-sets described below include:

- Physical Interface Configuration
- Logical Ports Configuration
- Network Configuration

Physical Interface Configuration

The OM 2000 supports up to 8 logical ports, physical interface ports 1 through 8. To set up a logical port, you must configure the parameters found in the OM 2000 Physical Interface Configuration window, illustrated in Figure 4-15.

Figure 4-15 — OM 2000 Physical Interface Configuration window



The Physical Interface Configuration screen shows the physical interface type options available on the OM 2000. (Note that Types 4 and 8 on the screen are not used.) These type options are:

1. Console — This option displays the console port settings. The console port provides asynchronous communications at a 9600 baud data rate. It is used only for maintenance.
2. RS232 (DB-9) — This option configures the operating parameters for this physical port. This port is configured for asynchronous communications, and the data rate is configured between 300 and 19.2 Kbps.
3. Ethernet — There are no configurable parameters for this physical port. An information-only label displays the MAC address; this information can also be obtained through the in the Element Manager by selecting **Configuration > Network Configuration**. Other configurable parameters for the Ethernet port are available on the Logical Ports Configuration window (Figure 4-16), available by selecting **Configuration > Logical Ports Configuration** in the Element Manager.
4. Not used.

5. RS-530 (DB-25) — This option configures the operating parameters for this physical port. Select async or sync (internal clock, external clock, or slv on rx clock).
6. RF Modulator — This option configures the operating parameters for this physical port, as well as the IF port. The settings are Operate, Standby, CW Test, Con Test, and Rev Test.
7. Operate causes the RF and IF ports to become active. The selected RF output frequency will be used for the RF port. The RF frequency setting must be between 71 MHz and 129 MHz. The Output Level has settings ranging from 1 to 40. Each increment represents 0.5 dBmV. A value of 1 is 30 dbMv and a value of 40 is 50 dBmV.
8. CW Test and Con Test are test modes. These modes are documented in the section titled Testing the RF Modulator.
9. Rev Test mode causes a spectral inversion of both signals.
10. PID Generator — MPEG Message Generator port option.
11. Not used.

Logical Ports Configuration

The OM 2000 supports up to 16 logical ports, designated ports 1 through 16. At least one logical port must be an input and at least one logical port must be an output.

To set up a logical port, you must:

- Select the port number to configure.
- Select the physical interface associated with the port.
- Select the type of port: input or output. If you select input, you must define the PID map. For Ethernet, you must supply the source (input port) or destination (output port).

The OM 2000 Logical Ports Configuration window is illustrated in Figure 4-16 and defined in Table 4-4.

Figure 4-16 — OM 2000 Logical Ports Configuration window

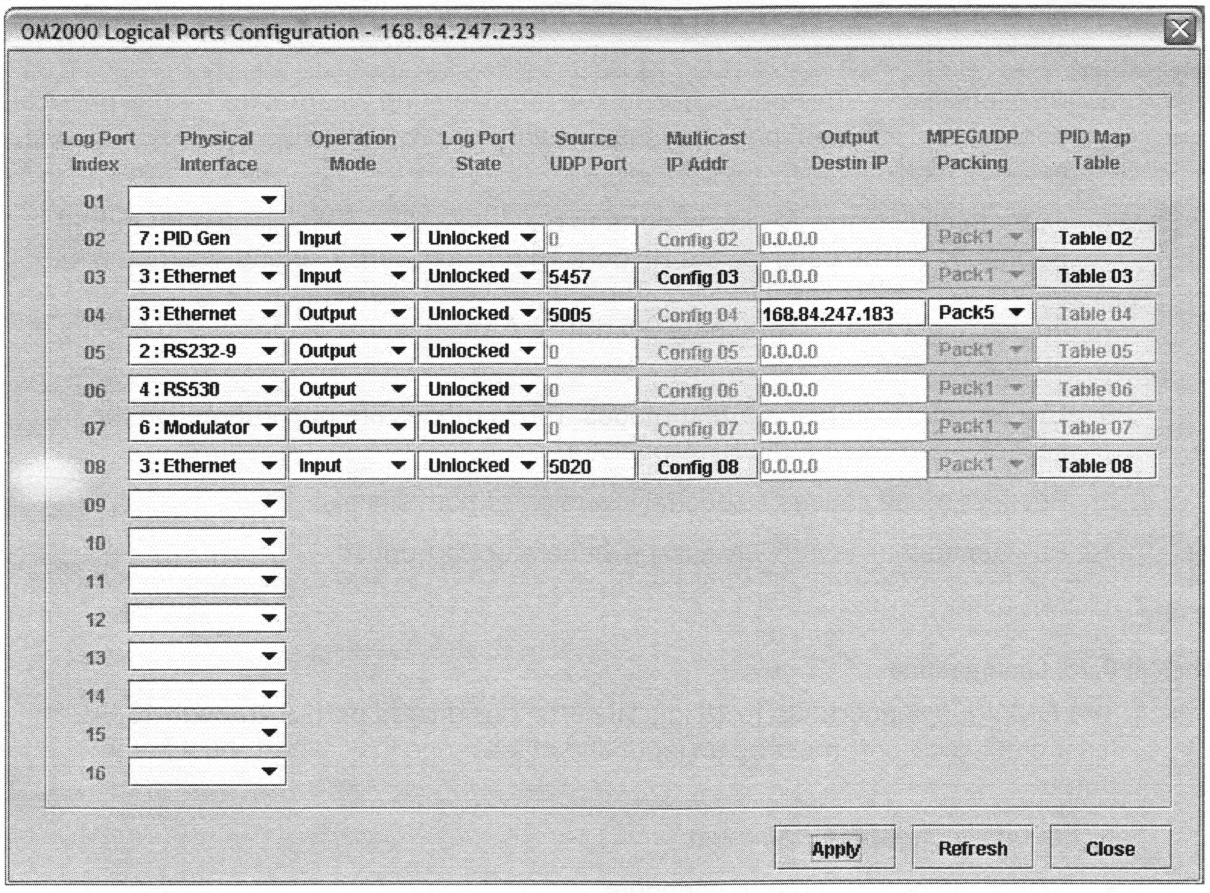


Table 4-4 — System Time window field definitions

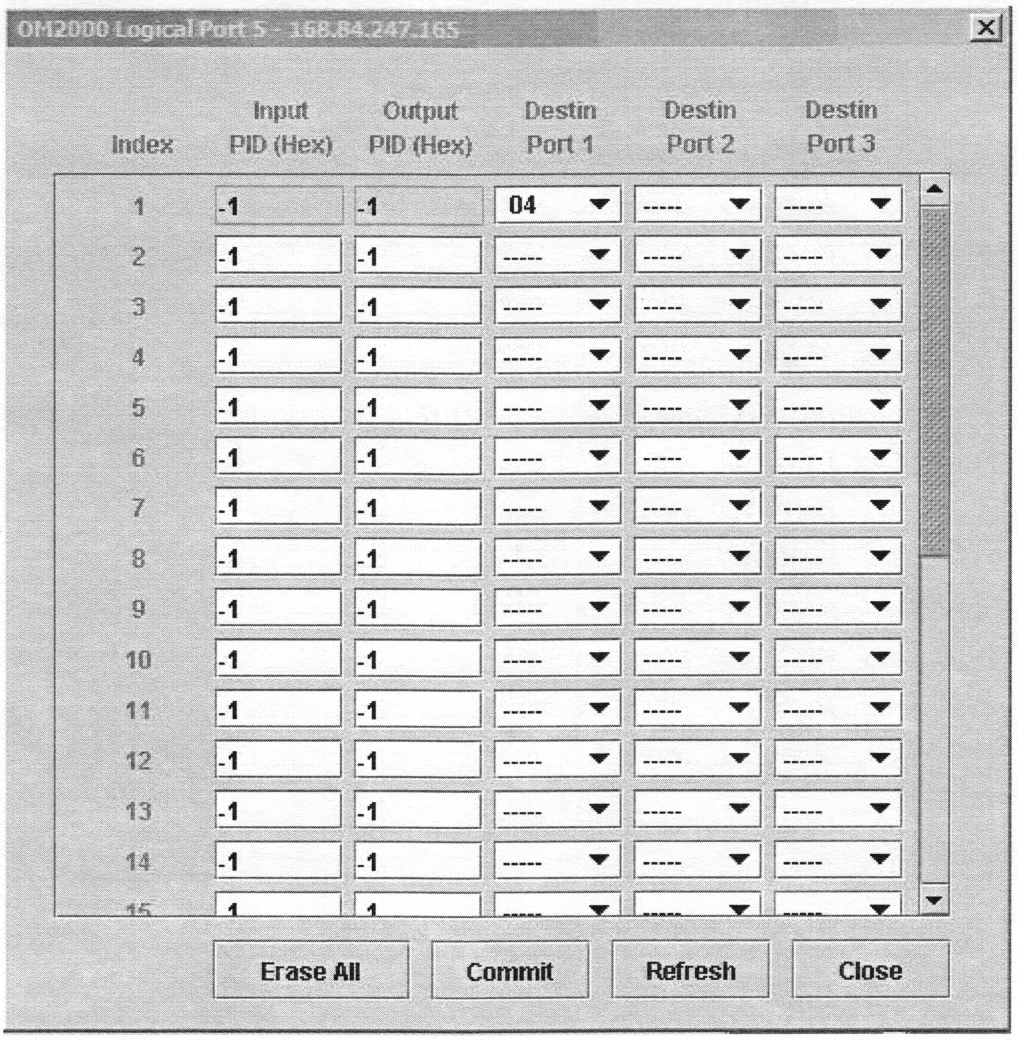
Item	Definition
Logical Port Index	A number between 1 and 16
Physical Interface	Which physical interface is assigned to the logical port
Operation Mode	Input — physical interface is used as an input. Output — physical interface is used as an output.
Log Port State	Use Unlocked only
Source UDP Port	Only used for Ethernet interface
Multicast IP Address	Only used for Ethernet input interface. Up to four Multicast IP addresses can be received per logical port.
Output Destination IP	IP address of where the output stream goes. Can be a singlecast or multicast IP address.
MPEG UDP Packing	Defines the number of MPEG packets per UDP packet transmitted.
PID Map Table	Used to route logical input ports to logical output ports. Also used to drop PIDs and/or remap PIDs.

PID Table Configuration

Each logical input port has an associated PID Table. The first row of the PID Table is used to route the logical input to up to three logical outputs. The second through 28th rows are used to drop PIDs, route PIDs to other logical output ports, and to re-map PIDs to other values.

If a PID value is entered in the Input PID column, and no other columns are filled in, the PID stream will be dropped. If a PID value is entered in the Input PID column and a PID value (potentially a different value) is entered into the Output PID column, the PID stream will be remapped to the Output PID value. In this case, at least one destination port must be filled in. The Logical Port window is illustrated in Figure 4-17.

Figure 4-17 — PID window



Network Configuration

The Ethernet window provides the ability to identify the host default gateway. It provides the ability to view the MAC address of ENET1, as well as the ability to define the IP Address and Subnet Mask (if applicable) for this Ethernet port. The Ethernet window is illustrated in Figure 4-18 and defined in Table 4-5.

Figure 4-18 — Network Configuration window

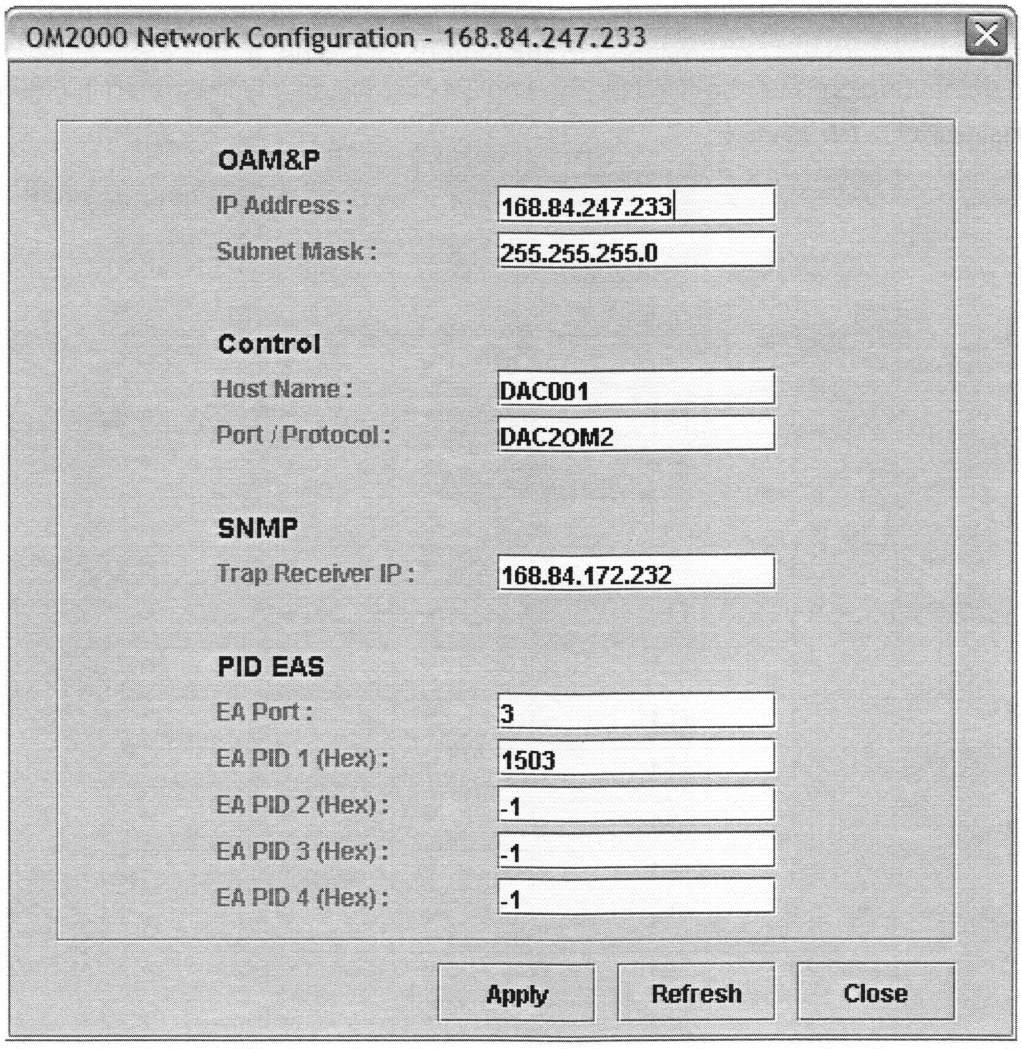


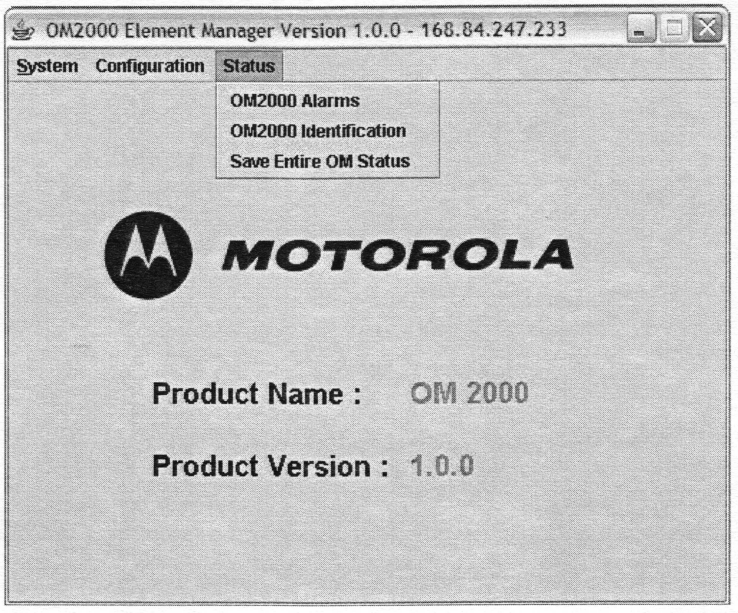
Table 4-5 — Ethernet window field definitions

Item	Definition
IP Address	Used to give the OM-2000 a new IP address
Subnet Mask	Used to give the OM-2000 a new subnet mask
Host Name	Contains the name of the DAC listed in the OM-2000's Host file. Can contain NOHOST if no DAC is present.
Port / Protocol	Contains the name of the service listed in the OM-2000's Service file
Trap Receiver IP	IP Address of where to send SNMP Traps
EA Port	The logical input port number that is used for EAS processing. Incoming PIDs that match the list below will be dropped and EAS information will be inserted.
EA PID 1 (HEX)	PID that is blocked when EAS is activated.
EA PID 2 (Hex)	PID that is blocked when EAS is activated.
EA PID 3 (Hex)	PID that is blocked when EAS is activated.
EA PID 4 (Hex)	PID that is blocked when EAS is activated.

Status

Clicking **Status** on the OM-EM menu bar displays the drop-down list, as illustrated in Figure 4-19.

Figure 4-19 — Status drop-down list



Refer to the applicable subsection for those Status windows that were invoked from button selections of other windows. The subsections that follow describe Status windows that are selected solely from the menu drop-down list.

Table 4-6 — OM Element Manager Status Drop-down List Definitions

Status	
OM Alarms	Window of all OM Alarms
OM Identification	Window with OM version information
Save Entire OM Status	Causes the OM EM to gather and store MIB information

Status—Alarms

This window represents a software panel of monitored conditions in the OM. Although not applicable to all alarm conditions, the six status levels are OK (green), Indeterminate (gray), Warning (yellow), Minor alarm (blue), Major alarm (magenta), and Critical alarm (red). Warning, Minor, and Major alarms do not prevent the OM from performing operational requirements. A Critical alarm prevents the OM from performing operational requirements. The Status—Alarms window is illustrated in Figure 4-20 and defined in Table 4-7.

Figure 4-20 — Alarms window

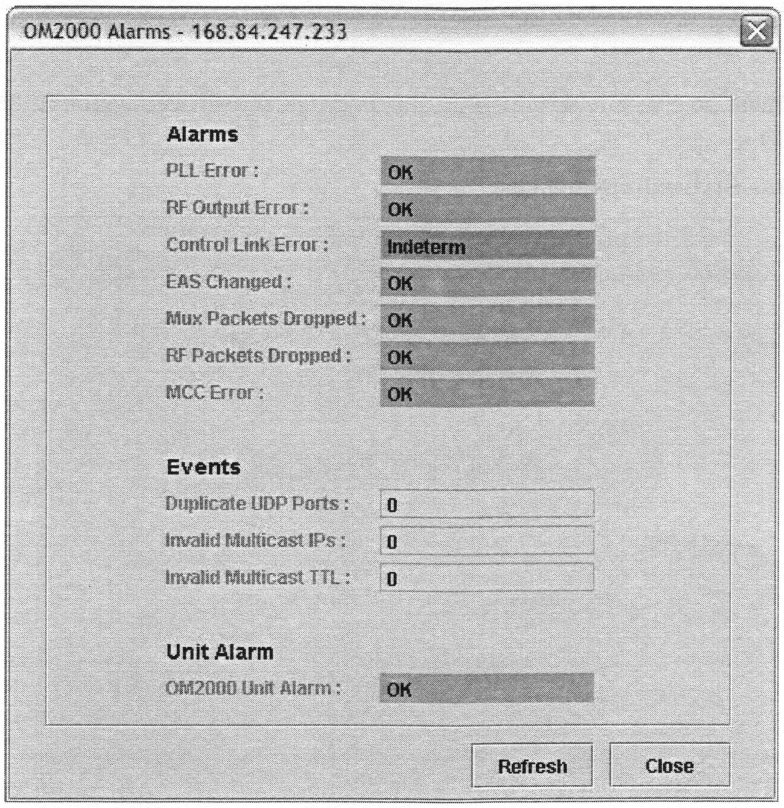


Table 4-7 — Alarms window field definitions

Status	
PLL Error	Indicates the internal PLL is out of lock
RF Output Error	Indicates the internal modulator is experiencing an error
Control Link Error	Indicates that the OM-2000 is not connected to a DAC
EAS Changed	Indicates that EAS is active or inactive
Max Packets Dropped	Indicates that the threshold for Max Packets Dropped has been crossed
MCC Error	Missed Continuity Count error. The MCC Alarm indicates the MCC threshold has been reached. The MCC threshold is the number of occurrences of MPEG messages that came in out of order, or missed all together, per minute. This alarm helps identify the error condition where two RADDs are sending MPEG PID streams to the same OM.
Duplicate UDP Ports	Displays the number of duplicate UDP ports in use. This is an error condition.
Invalid Mulitcast IPs	Displays the number of invalid multicast IP addresses found in the configuration. This is an error condition.
Invalid Multicast TTL	Displays the number of invalid multicast TTL values found in the configuration. This is an error condition.
OM 2000 Unit Alarms	This matches the highest alarm level in all OM 2000 alarms.

OM Identification

This window represents a software panel of monitored events in the OM 2000. The Status — Events window is illustrated in Figure 4-21 and defined in Table 4-8.

Figure 4-21 — Events window

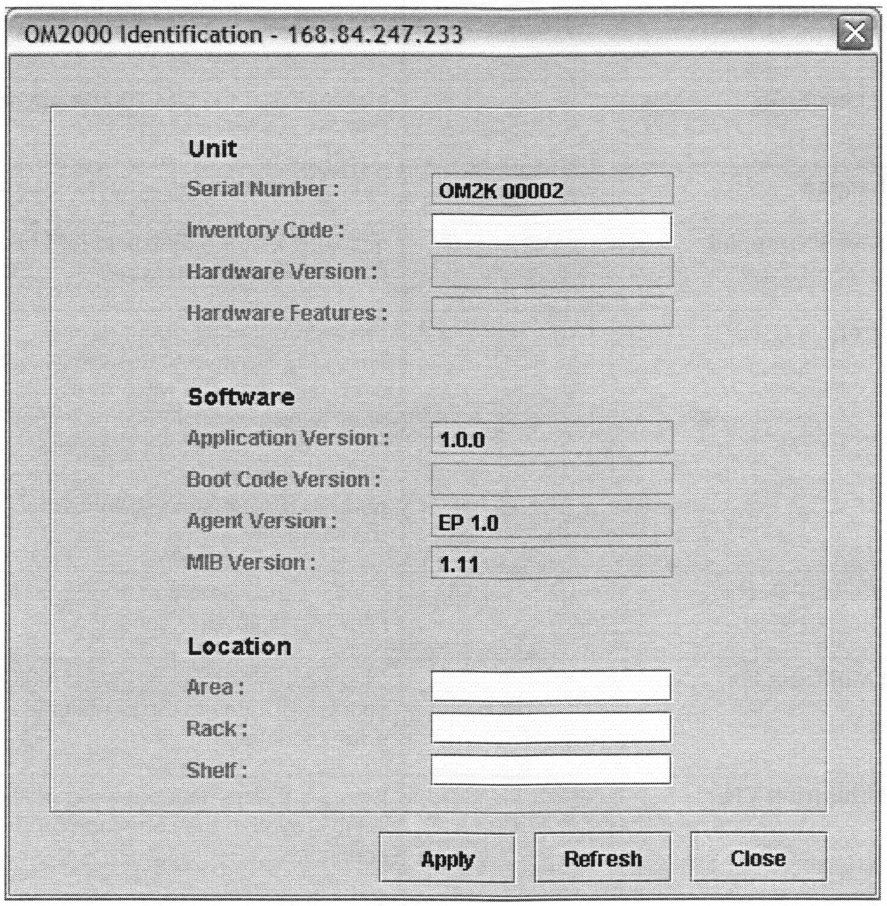


Table 4-8 — Events window field definitions

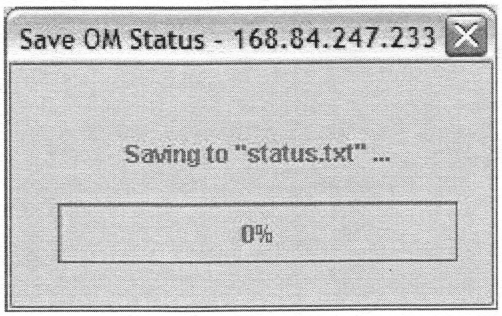
Status	
Serial Number	Display of Serial Number. This is set in the factory.
Inventory Code	User configurable
Hardware Versions	
Hardware Features	
Application Version	Indicates the Application Code version
Boot Code Version	
Agent Version	Displays the SNMP Agent version in the Application Code

Status	
MIB Version	Displays the MIB version used in the Application Code
Area	User configurable
Rack	User configurable
Shelf	User configurable

Status — Save Entire OM Status

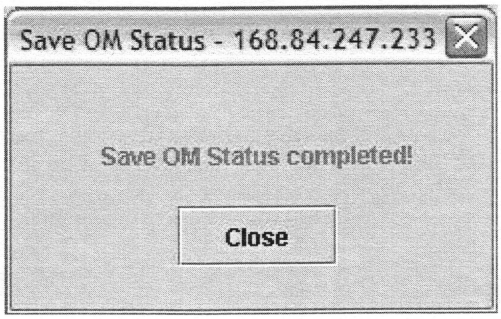
The Save Entire OM Status interface saves all of the status to a status.txt file, which is located in the same directory as the omem.jar file. The Save Entire OM Status window is illustrated in Figure 4-22.

Figure 4-22 — OM Status



Upon successful completion, a pop-up appears, stating "Save OM Status completed"; see Figure 4-23.

Figure 4-23 — Save OM Status window



5 TROUBLESHOOTING

This section provides information to help you isolate and resolve common error conditions reported by the OM 2000. It also provides maintenance recommendations if the unit fails to power up. If you need assistance with your Motorola product, contact the Motorola Technical Response Center (TRC):

- Toll-free: 888-944-HELP (888-944-4357)
- Direct: 1-847-725-4011
- Motorola Online: http://businessonline.motorola.com

The TRC is on call 24 hours a day, 7 days a week. In addition, Motorola Online offers a searchable solutions database, technical documentation, and low-priority issue creation and tracking. For specific toll-free numbers when calling from outside the United States, please refer to your product manual or our Web page.

Table 5-1 through Table 5-3 contain data to aid in quickly resolving problems you may encounter using the OM 2000:

- Table 5-1 describes the operating conditions indicated by the fault LEDs on the front panel.
- Table 5-2 lists common error conditions, symptoms, possible causes, and corrective actions for common OM 2000 error conditions.
- Table 5-3 lists and describes the RF modulator port testing modes.

Table 5-1 — LED status indicators

Indicator	Description
DATA IN	The data in indicator glows green when the unit receives data on one or more of the physical ports or when data is being inserted by the internal PID message generator (PIDGEN).
RF ERROR	The RF ERROR indicator glows red when the RF output level is out of specification or if the detector senses no RF at the output. The indicator is off during normal operation and on during a fault that causes a loss of RF. It is also on when the modulator port is in the STANDBY mode.
STATUS LED	The STATUS LED indicator glows red if any major or critical internal faults are detected.

Table 5-2 — Common fault indications

Problem	Possible Cause	Corrective Action
OM 2000 powers up but fails to initialize	BOOTP/TFTP configuration	Check the BOOTP configuration and all the file paths and names on the server.
	Mechanical error with unit	Repair or replace the unit.
Data in LED indicator fails to light	No input data received	Check the input cables and sources. Check the IP addresses. Enable the input port.
RF / IF LED lights	RF modulator port in Standby mode	Put the modulator in the Operate mode.
Adjusted port settings did not take effect	Changes were not committed or saved through the front-panel display	Commit and then save the changes. Reboot the system.
	Changes are being overwritten by the `OM2000.ini` file	The `OM2000.ini` file is being force downloaded as set within the `OM2000.fof` file. See Section 4, "Setup and Operation" for steps on saving the settings.
No serial port communications available	Port not enabled	Adjust the port settings to match the settings in the headend equipment.
	The data rate, parity, start bit, or stop bit settings are not compatible with the other units in the headend.	Serial port communication parameters are not compatible with other headend units.
Logical Ethernet input port does not receive data (STATUS LED on)	Duplicate UDP port number being used. Two logical Ethernet input ports were configured to use the same UDP port number.	Change the UDP port number to be unique across the entire OM 2000.

Testing the RF Modulator

Although these test modes are mainly intended for factory testing, they can be useful in isolating specific faults. Table 5-3 summarizes the modulator port test modes.

Note: The mode of the RF modulator can be changed on the Physical Interface Configuration screen (Figure 4-15) in the Element Manager.

Table 5-3 — Modulator port testing modes

Mode	Description
CW test	The RF modulator generates a single CW signal. The signal frequency is exactly the same as the center frequency of the QPSK-modulated signal. The signal level is equal to the composite level of the QPSK signal. This mode is useful for exact frequency measurements, but should not be used for power leveling.
CON test	The RF modulator operates the same as in the Operate mode, except that the digital FIR filter coefficients are changed. In the Operate mode, the FIR filter frequency-response shape is rectangular. In the CON Test mode, the FIR filter frequency-response shape is a raised cosine with an alpha value equal to 0.5. This mode is useful for testing using a constellation or vector analyzer.

APPENDIX A — SPECIFICATIONS

RF Output

Modulation	DQPSK
Carrier symbol rate	1.024 Msps
Carrier suppression	50 dB typical
Center frequency	71 through 129 MHz (configurable)
Frequency step size	50 kHz
Level	+30 to +50 dBmV (configurable)
Level step size	0.5 dB
Spurious outputs	-60 dBc minimum

IF Output

Center frequency	44 MHz
Level	+26 dBmV nominal, factory set

AC Electrical Specifications

Voltage, AC	100 through 240 V ac
Line frequency, AC	50 through 60 Hz
Line current, AC	0.6 - 0.3 A, 120 V
Power	56 W maximum
	48 W typical

DC Electrical Specifications

Voltage, DC	-40 - -60 V dc
Nominal	-48 V dc
Power	56 W maximum
	48 W typical

Operating Environment

Ambient temperature	32 °F to 122 °F (0 °C to 50 °C)
Ambient humidity	0 through 90%, non-condensing
Storage temperature	–40 °F to 158 °F (–40 °C to 70 °C)
Cooling	2 Fans

Physical Specifications

Dimensions	1.75 H X 19 W X 18 D inches
Weight	10 lbs
Mounting	Rack mount

Performance Specifications

RF output level stability vs. temperature	± 2 dB
Accuracy of RF center frequency	± 15 ppm
Accuracy of IF center frequency	± 0.005%
Forward error correction	Reed-Solomon (96,94)
FEC interleaving	Convolutional (I=8, I=12)
MER	>30 db Unequalized

Interconnection Specifications

Ethernet port

Network data rate	~100 Mbps maximum
OM 2000 data rate	2.005 Mbps output maximum
Interface	IEEE 802.3
Impedance	120 ohms
Cable	Shielded twisted pair
Connector	RJ-45 (10Base-T)
Messaging	UDP, TCP/IP, SNMP

Data (Bit) Rate

The RS-232 port supports asynchronous communications with the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200. The RS-232 port does not support synchronous communication. There is no flow control with this port.

The RS-530 port supports asynchronous communications with the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, and 57600. There is no flow control with this port.

The RS-530 port also supports synchronous communication with data rates between 50000 bps and 2005000 bps. There is up to 4% of data rate error depending on the rate selected. The data rate is only applicable when in Sync Internal mode. This is when the OM-2000 is transmitting synchronous data and clock.

APPENDIX B — CABLING SPECIFICATIONS

This appendix provides interface-cabling guidelines for the OM 2000.

RS-232 DB9 Interface Cabling

The OM 2000 is configured as a DTE:

Connector type DB9 male shielded connector with screw locks

Cable type Shielded twisted pair

Baud rate Port 1: 9600 bps asynchronous (fixed), 8/N/1

Port 2: 19.2K maximum asynchronous (no sync mode), 8/N/1; Port 2 supports 300, 600, 1200, 2400, 9600, and 19200 bps

Table B-1 — RS-232 DB9 Interface Connector Pinout

Pin Number	Signal	Direction	Description
1	RLSD (DCD)	In	Receive Line Signal Detector (Data Carrier Detect)
2	RX	In	Receive data
3	TX	Out	Transmit data
4	DTR	Out	Data Terminal Ready
5	SG (Shield)		Signal Ground (Shield)
6	DSR	In	Data Set Ready
7	RTS	Out	Request To Send
8	CTS	In	Clear To Send
9	RI	In	Ring Indicator

The OM 2000 can either source or sink the transmit clock. This is a configuration selection. Sinking the clock is needed when sending data through a modem by a network T1 line. In this case, the modem sources a clock that is locked to the network. The OM 2000 sinks the clock and sources data to the modem to be sent to the network.

DB25 RS-530 Interface Cabling

RS530 serial cables for use with the OM 2000 can be purchased from Motorola. The RS530 cable part numbers are:

- RS530 Cable type 1 DSR to OM 2000 PN: 523807-002-00
- RS530 Cable type 2 Standard RS530 PN: 471372-003-00

The OM 2000 is configured as a DTE.

Connector type DB25 male shielded connector with screw locks

Cable type 25 conductor shielded

Bit rate 56 K maximum async/2 Mbps sync

Async: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, or 57600 bps

Sync: 50000 through 2005000 bps (Refer to Appendix A, "Specifications.")

Table B-2 — DB25 RS-530 interface connector pinout

Pin Number	Signal	Direction	Description
1	SHIELD	Shield	Chassis ground
2	BA+	Out	Transmit data +
3	BB+	In	Receive data +
4	CA+	Out	Request to send +
5	CB+	In	Clear to send +
6	CC	In	DCE ready
7	AB	Ground	Chassis ground
8	CF+	In	Receive line signal detect +
9	DD	In	Receiver clock
10	CF	In	Receive line signal detect
11	DA		No connection
12	DB–	In	Transmit clock –
13	CB–	In	Clear to send –
14	BA–	Out	Transmit data –
15	DB	In	Transmit clock

Pin Number	Signal	Direction	Description
16	BB–	In	Receive data –
17	DD	In	Receiver clock
18	LL	Out	Local loopback
19	CA–	Out	Request to send –
20	CD	Out	DTE ready
21	RL	Out	Remote loopback
22	CE	In	Ring indicator
23	AC	Gnd	Chassis
24	DA	Out	Transmit
25	TM	In	Test mode

The OM 2000 can either source or sync the transmit clock; this is determined by a configuration selection. Syncing the clock is needed when sending data through a modem through a network T1 line. In this case, the modem sources a clock that is locked to the network. The OM 2000 syncs the clock and sources data to the modem to be sent to the network.

Ethernet 10/100 Base-T Interface Cabling

Connector type RJ-45 connector

Cable type STP-5 (category 5 shielded twisted pair)

Maximum cable length 150 feet

Table B-3 — Ethernet 10/100Base-T interface connector pinout

Pin Number	Signal	Direction	Description
1	TX+	Out	Transmit data +
2	TX–	Out	Transmit data –
3	RX+	In	Receive data +
4 and 5	n/c		No connect
6	RX–	In	Receive data –
7 and 8	n/c	In	Data set ready

APPENDIX C — INITIALIZATION INFORMATION

The OM undergoes an automatic initialization process on power-up or reset, during which it loads the executable software and parameter settings that control its operation. The OM performs initialization either by self-booting from internal non-volatile memory or externally booting from another device. External initialization is performed by downloading information from a LAN connected BOOTP server. Some initialization information can also be loaded externally from a device connected to the OM front panel RS-232 interface (see Appendix E, "RS-232 Test/Console Port").

Self-boot OM initialization enables the OM to operate:

- Without connecting it to the headend LAN
- In a headend LAN that does not include a BOOTP server

External OM initialization enables the OM to:

- Modify the setup of an installed OM to accommodate system configuration changes
- Load upgraded executable software into an installed OM

Self-Boot Initialization

The OM begins initialization by determining the type of boot operation (BOOTP) and by broadcasting BOOTP requests over its ENET1 Ethernet port. Self-boot initialization occurs when the OM times out waiting for a reply and then initializes itself from the information stored in its non-volatile memory.

External Initialization from a LAN Resident BOOTP Server

For external initialization to occur from a BOOTP server:

- The OM must be connected to the system Ethernet LAN on ENET1
- A BOOTP or DHCP server must be present on the LAN
- The BOOTP or DHCP server must have the OM MAC address

The OM begins initialization by broadcasting BOOTP requests over its ENET1 Ethernet port. The BOOTP server receives the OM BOOTP requests and provides a BOOTP response packet containing the assigned IP addresses and bootfile entries, from which the OM initializes. The response packet may also contain a gateway if the BOOTP server is on a different network segment than the OM Ethernet interface.

On receipt of the BOOTP reply, the OM obtains the FOF filename (OMv12.fof) and path, which it downloads from the BOOTP server. The OM then parses the FOF and compares the listed source files in the FOF with those maintained in the OM local copy of the previously used version. If any listed source filename or path has changed, or if there is a force download flag for any listed files (indicated by an "F" at the end of the line listing the file), the listed file is then downloaded to the OM. If

a downloaded FOF and the OM local copy are the same and a force download flag does not exist in that FOF, the OM does not download any additional files. It continues booting using the values stored in non-volatile memory.

An FOF and other downloaded files are transferred through Trivial File Transfer Protocol (TFTP).

Initialization is complete when the OM finishes loading the executable software and operating parameters, either from a new download or from memory.

The OM is configured to perform a BOOTP request (factory default).

BOOTP Request and Reply Format

BOOTP request and reply messages use the same packet format. The BOOTP packet includes multiple fields divided into the following areas:

Standard Area	Contains fields for specifying basic BOOTP message information, including: • Message type (request or reply) • MAC address of requesting device • IP address assignment of requesting device • Boot file name for the requesting device • Values for some standard fields must be specified and others are optional, depending on whether the BOOTP message is a request or reply
Vendor-Specific Area	Contains fields for use as defined by the vendor: for example, to set values for operating parameters

BOOTP Request

In the BOOTP request, the OM includes:

- A value indicating that the message is a BOOTP request
- A MAC address

The BOOTP request is transferred using UDP.

BOOTP Server Reply

In the BOOTP reply to the OM, the BOOTP server includes:

- A value indicating that the message is a BOOTP reply
- The IP address of the boot server
- The IP address assigned to that OM Ethernet port
- The file-of-files (FOF) name for the OM (OM2000.fof)
- The path for the FOF
- The network mask

The BOOTP reply is transferred using UDP.

Typical OM BOOTP Packet Files

The BOOTP packet file mix is not fixed, as files are added/removed consistent with OM functionality enhancements. A typical list of files is as follows:

Filename	Purpose
OM2000.fof	File of files that contains three field columns: source path, destination path, and force flag. *Do not change the symbolic name of the OM in the second field, as it can cause an initialization failure.*
OM2000.cod	Host application code for main OM processor
OM2000.ini	Contains OM configuration settings for application firmware
Fec_fpga_v01.rbf	Field programming gate array personality file for FEC FPGA
OMem.jar	Executable OM-EM Java based application
OM2000.HST	Example Hosts File
OM2000.SVC	Example Services File
OM2000.GTW	Example Gateways File
OM2000.HTM	HTML File used by internal HTTP Server

Reference Specifications

To support TFTP and BOOTP the OM conforms to the following RFC specifications:

- BOOTP Vendor Extensions, RFC 2132
- Bootstrap Protocol, RFC 951
- The TFTP Protocol, Revision 2, RFC 1350
- Clarifications and Extensions for the Bootstrap Protocol, RFC 1542

Refer to these specifications for complete information on the BOOTP packet format and field descriptions.

HCT 1000 as BOOTP Server

If the HCT1000 is used as the BOOTP server, it must be set up with the OM parameters, as listed in Table C-1.

Table C-1 — HCT 1000 OM parameters

Item	Boot Dir	Boot File	IP	MAC	Subnet	Gateway
Name	BOOTDIR	BOOTFILE	IPADDR	MACADDR	SUB-NET Mask	GATEWAY
Type	FILE	BOOTFILE	IPADDR	MACADDR	IPADDR	IPADDR
Data Source	Local Value	Local Value	Local Value	Local Value	Local Value	Local Value
Value	BOOTDIR/OM2000/01_00.001	OM2000.fof	****	****	****	****
Description	Optional	Optional	Optional	Optional	Optional	Optional
Write to BOOTPVSA	Checked	Checked (graytone)	Checked	Unchecked	Checked	Unchecked
Tag	Hd	N/A (bf)	ip	N/A	sm	N/A
**** is your IP address or value.						

APPENDIX D — FAN FIELD REPLACEMENT PROCEDURE

A fan failure is indicated with a solid red STATUS LED on the OM front panel. When a fan fails, it must be replaced to ensure proper airflow and cooling within the OM. Fan replacement does not require powering down the OM, as each fan plug can be disconnected from its power connector on the OM rear panel.

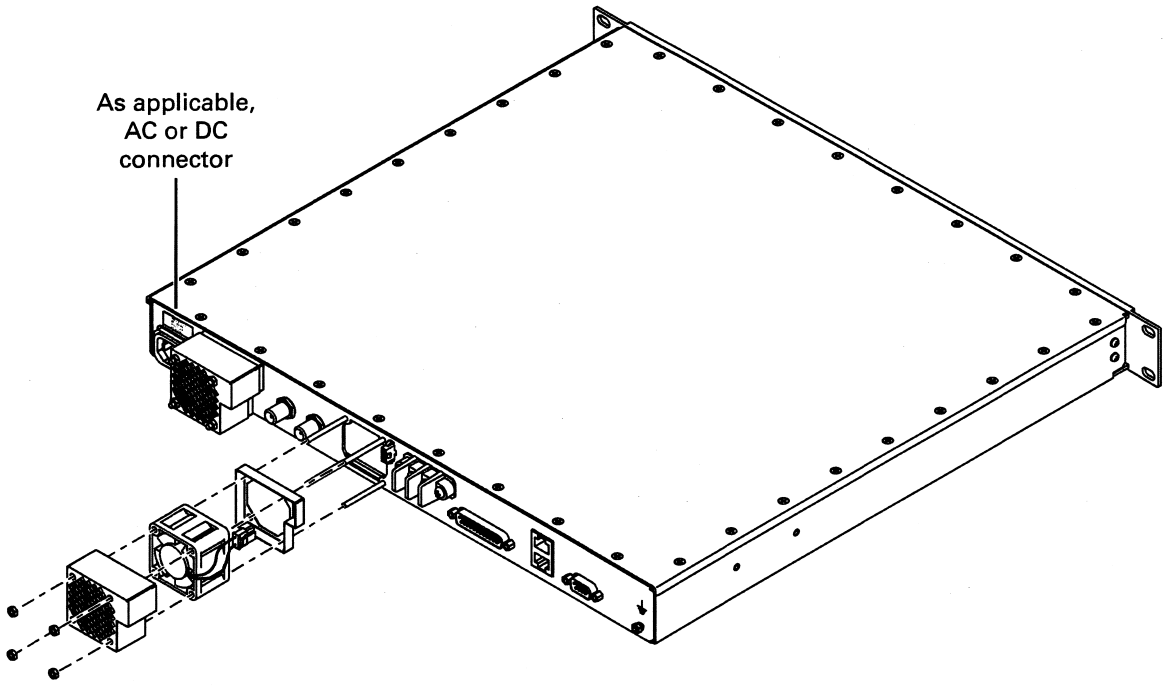
WARNING! Removal and replacement procedures have fan cover removed. Keep hands away from fan blades and do not insert or drop objects into exposed fan blades.

Fan Removal

Refer to Figure D-1 to remove a fan:

1. Identify the failing fan, whose blade is not turning, on the rear panel of the OM. (A failing fan blade does not turn, whereas a marginal fan may have a rasping sound that is definitely a pitch off and also surges in volume from the steady hum of other fans. In a rack of OMs, it is worthwhile identifying any marginal fans to ensure adequate spares are available.)
2. Remove the four hex nuts and washers securing the fan cover to the fan. Save these, as they must be re-installed on the new fan.
3. Slide the fan cover off of the four stand-offs.
4. Unplug the fan power cable from its connector.
5. Note the orientation of the fan cable. The fan blades face toward the OM and the rear of the fan motor faces away from the OM. Slide the fan off of the four stand-offs. Do not slide the base of the fan cover off of the stand-offs.

Figure D-1 — Fan removal/replacement



Replacement Fan Kit Assemblies

The Motorola part number for an OM replacement fan kit assembly (one fan) is 492898-002.

Fan Replacement

To install a fan:

1. Rotate the fan motor so the cable is properly aligned with the connector and slide it onto the four stand-offs. The fan blades should face toward the OM; the rear of the fan motor should face away from the OM.
2. Connect the fan power cable to the connector.
3. Slide the fan cover over the body. The four stand-offs should pass through holes on the fan cover.
4. Secure the fan cover in place with the four washers and hex nuts.
5. Ensure the replacement fan blade is turning. The front panel STATUS LED should not be solid red.

APPENDIX E — RS-232 CONSOLE PORT

The RS-232 Console Port is a command-line interface available using any terminal emulation program. The primary purpose of the interface is to configure the Internet Protocol (IP) address of the Ethernet 1 network interface. Properly setting the IP address is a prerequisite to using the OM-EM. After the IP address has been properly assigned, the OM-EM should be used for all subsequent configuration changes. The user can also view the ENET1 MAC Address.

The RS-232 Test/Console Port is accessed by removing the clip-on bezel on the front panel. It is a standard nine pin connector that accepts a nine pin straight through cable.

Do not use a null-modem cable that swaps transmit and receive.

Establishing Communication with a PC

To initiate a port session with the OM:

1. On the PC connected to the OM, open a terminal emulation program (for example, HyperTerminal).
2. Display the Communications Port window and select the following values:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
3. Click **OK** to close the window.
4. Press **ENTER** and the User Console prompt should be displayed.

General Operations

Getting the Unit's ENET1 MAC Address

Type **getEnet1MacAddr** and the console will display the ENET1 MAC address.

Setting the Unit's ENET1 IP Address

Type **setEnet1IPAddr("168.84.247.89","255.255.255.0"),** where 168.84.247.89 is an example IP Address, and 255.255.255.0 is an example subnet mask.

Type **getEnet1IPAddr** to display the ENET1 IP address. The unit must be power-cycled for the IP address to take effect.

GLOSSARY

Abbreviations and Acronyms

BNC	Bayonet, N-type, C-size connector
BOOTP	Bootstrap Protocol
C6U	Commander 6 Upconverter
CATV	Cable Access Television (originally Community Antenna Television)
CPU	Central Processing Unit
CW	Continuous Wave
DAC 6000	Digital Addressable Controller 6000
DCE	Data Communication Equipment
DCT	Digital Consumer Terminal
DHCP	Dynamic Host Configuration Protocol
DHEI	Digital Headend Expansion Interface
DQPSK	Digital Quadrature Phase Shift Keying
DTE	Data Terminal Equipment
EPG	Electronic Program Guide
ESD	Electrostatic Discharge
FEC	Forward Error Correction
FIR	Finite Impulse Response
FOF	File-Of-Files
HCT 1000	Headend Configuration Tool 1000
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
I/O	Input/Output
IP	Internet Protocol
IPPV	Impulse Pay-Per-View
IRT	Integrated Receiver Transcoder 1000/2000
IRT 1000	Integrated Receiver Transcoder 1000
IRT 2000	Integrated Receiver Transcoder 2000
ISO	International Standards Organization
ITEM 1000	Integrated Transport Encryption Multiplexer 1000

LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
MAC	Media Access Control
MCC	Missed Continuity Count
MER	Modulation Error Ratio
MIB	Management Information Base
MPEG-2	Motion Picture Expert Group–2
MUX	Multiplex
NDTC	National Data Transmission Center
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NVMEM	Non-Volatile Memory
NVRAM	Non-Volatile Random-Access Memory
OAM&P	Operation, Administration, Maintenance, and Provisioning (Ethernet port)
OBTM	Out-of-Band Transport Multiplex (receiver)
OM 2000	Out-of-band Modulator 2000
OOB	Out-Of-Band
PID	Packet Identifier
PLL	Phase-Locked Loop
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RMS (rms)	Root Mean Square
RSA	Return For Service Authorization
SNMP	Simple Network Management Protocol
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TFTP	Trivial File Transfer Protocol
UDP	User Datagram Protocol
UTP	Unshielded Twisted Pair

Definitions of Terms

10/100Base-T

The IEEE standard for twisted pair Ethernet. Uses telephone wiring and standard RJ-45 connectors. It is wired in a star configuration and requires a hub.

BOOTP

Boot protocol. The communication protocol used to transfer initialization information between digital headend network elements and a central server. At power up, network elements issue a BOOTP request. The BOOTP server receives the request and responds with a BOOTP reply that specifies startup information and operating parameters for the requesting device.

BOOTP Reply

Single-packet, multi-field boot protocol message transmitted in UDP by a BOOTP server to provide a boot image to a network device (BOOTP client).

BOOTP Request

Single-packet, multi-field boot protocol message transmitted in UDP by a network device (BOOTP client) to request a boot from a BOOTP server.

Conditional Access Table (CAT)

A table carried in the PID1 stream of a transport multiplex that lists the PID numbers of all EMM streams in a transport multiplex and indexes each EMM stream to an EMM provider ID.

DAC 6000

Motorola Digital Addressable Controller 6000 used for controlling digital cable terminals and digital wireless terminals. The name was changed from ACC 4000D in late 1997.

Forward Error Correction (FEC)

An encoding technique applied to data before transmission to reduce the number of errors introduced by transmission. The receiving device decodes the FEC to recover the original data. Data is formatted with extra error detection and correction bits at the sending end of a transmission. The received bits are used to detect and correct transmission errors.

Headend Configuration Tool (HCT 1000)

A Motorola PC-based tool for provisioning network devices in a digital CATV headend or broadband interactive network. The HCT 1000 helps set up embedded code images, assign IP addresses to network devices, and set up start-up parameters.

Initialization

The process by which digital headend network elements obtain configuration information and operating parameters at power up. This confirms that all indicators and constants are set to prescribed conditions. Data is loaded into a new set-top to

customize its operation for use by a customer in a particular cable system. Typically, during this process the controller sends reset and initialize commands along with configuration and terminal control bytes.

International Electrotechnical Commission

International standards and conformity assessment body for all fields of electrotechnology

Integrated Receiver Transcoder (IRT 1000, IRT 2000)

Motorola digital headend equipment that receives digital satellite signals and remodulates data from QPSK to QAM IF for cable plant transmission.

Internet Protocol (IP) Address

This public standard address is used for packet- and connection-type communications.

IPPV

Impulse Pay-Per-view. An ordering mechanism in which subscribers place orders directly into set-tops by remote control. Events are authorized immediately for viewing.

MAC address

Media Access Control address. A proprietary address used for upstream/downstream communications. This is the lower sub-layer of the Data Link layer in the OSI model and is used to describe the mechanisms used to arbitrate access to a shared medium.

MPEG-2 (MPEG-II)

An international standard (ISO/IEC 13818) for delivering compressed digital video. MPEG-2 broadcast quality is 704x480 pixels at 30 frames per second (fps) in North America and 704x576 pixels at 25 fps in Europe. MPEG-2 is typically compressed at higher than 5 Mbs and intended for higher quality broadcast uses.

OAM&P

A telephone industry acronym referring to operations, administration, maintenance, and provisioning. The term refers to software required to generate the reports and commands needed to control all network equipment. The OAM&P port is a network (Ethernet) port through which a device communicates with the headend network. The OAM&P port is assigned a hardware (MAC) address at the factory; this MAC address is used for communication with the bootp server before the network (IP) address is assigned to the port.

Packet Identifier (PID)

A number assigned to MPEG transport packets to identify the information stream to which they belong. The PID number is assigned in the packet header, and all packets from the same stream have the same PID number. A 13 bit number included in MPEG-2 transport packet headers.

Quadrature Phase Shift Keying (QPSK)

A digital modulation method that combines two carriers that are 90 degrees out of phase (in quadrature), resulting in four possible phase states.

Reed-Solomon encoder

A block-based encoding technique used for forward error correction.

User Datagram Protocol (UDP)

A transmission protocol that uses an IP address to identify the destination host and a port number to identify the destination application.

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