QAM256

Digital Video Modulator and Upconverter

Installation and Operation Manual

TM077
Revision 4.0

Radyne Corporation • 3138 E. Elwood St. • Phoenix, AZ 85034 • (602) 437-9620 • Fax: (602) 437-4811 • www.radn.com

Warranty Policy

WP

Radyne Corp. (Seller) warrants the items manufactured and sold by Radyne Corp. to be free of defects in material and workmanship for a period of two (2) years from date of shipment Radyne Corp.'s obligation under its warranty is limited in accordance with the periods of time and all other conditions stated in all provisions of this warranty.

This warranty applies only to defects in material and workmanship in products manufactured by Radyne Corp. Radyne Corp. makes no warranty whatsoever concerning products or accessories not of its manufacture. Repair, or at the option of Radyne Corp., replacement of the Radyne Corp. products or defective parts therein shall be the sole and exclusive remedy for all valid warranty claims.

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The applicable warranty period shall commence on the date of shipment from a Radyne Corp. facility to the original purchaser and extend for the stated period following the date of shipment. Upon beginning of the applicable Radyne Corp. warranty period, all customers' remedies shall be governed by the terms stated or referenced in this warranty. In-warranty repaired or replacement products or parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced products or parts. Repair or replacement of products or parts under warranty does not extend the original warranty period.

Warranty Coverage Limitations

The following are expressly ***not covered*** under warranty:

1. Any loss, damage and/or malfunction relating in any way to shipping, storage, accident, abuse, alteration, misuse, neglect, failure to use products under normal operating conditions, failure to use products according to any operating instructions provided by Radyne Corp., lack of routine care and maintenance as indicated in any operating maintenance instructions, or failure to use or take any proper precautions under the circumstances.

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Warranty Replacement and Adjustment

Radyne Corp. will not make warranty adjustments for failures of products or parts, which occur after the specified maximum adjustment period. Unless otherwise agreed, failure shall be deemed to have occurred no more than seven (7) working days before the first date on which Radyne Corp. receives a notice of failure. Under no circumstances shall any warranty exceed the period stated above unless expressly agreed to in writing by Radyne Corp.

Liability Limitations

This warranty is expressly in lieu of and excludes all other express and implied warranties, Including but not limited to warranties of merchantability and of fitness for particular purpose, use, or applications, and all other obligations or liabilities on the part of Radyne Corp., unless such other warranties, obligations, or liabilities are expressly agreed to in writing by Radyne Corp.

All obligations of Radyne Corp. under this warranty shall cease in the event its products or parts thereof have been subjected to accident, abuse, alteration, misuse or neglect, or which have not been operated and maintained in accordance with proper operating instructions.

In no event shall Radyne Corp. be liable for Incidental, consequential, special or resulting loss or damage of any kind howsoever caused. Radyne Corp.'s liability for damages shall not exceed the payment, if any, received by Radyne Corp. for the unit or product or service furnished or to be furnished, as the case may be, which is the subject of claim or dispute.

Statements made by any person, including representatives of Radyne Corp., which are inconsistent or in conflict with the terms of this warranty, shall not be binding upon Radyne Corp. unless reduced to writing and approved by an officer of Radyne Corp.

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Before a warranty repair can be accomplished, a Repair Authorization must be received. It is at this time that Radyne Corp. will authorize the product or part to be returned to the Radyne Corp. facility or if field repair will be accomplished. The Repair Authorization may be requested in writing or by calling:

Radyne Corporation
3138 E. Elwood St.
Phoenix, Arizona 85034 (USA)
ATTN: Customer Support
Phone: (602) 437-9620
Fax: (602) 437-4811

Any product returned to Radyne Corp. for examination must be sent prepaid via the means of transportation indicated as acceptable to Radyne Corp. Return Authorization Number must be clearly marked on the shipping label. Returned products or parts should be carefully packaged in the original container, if possible, and unless otherwise indicated, shipped to the above address.

Non-Warranty Repair

When a product is returned for any reason, Customer and its shipping agency shall be responsible for all damage resulting from improper packing and handling, and for loss in transit, not withstanding any defect or nonconformity in the product. By returning a product, the owner grants Radyne Corp. permission to open and disassemble the product as required for evaluation. In all cases, Radyne Corp. has sole responsibility for determining the cause and nature of failure, and Radyne Corp.'s determination with regard thereto shall be final.

Preface

P

This manual provides installation and operation information for the Radyne QAM256 Digital Video Modulator and Upconverter. This is a technical document intended for use by engineers, technicians, and operators responsible for the operation and maintenance of the QAM256.

Conventions

Whenever the information within this manual instructs the operator to press a pushbutton switch or keypad key on the Front Panel, the pushbutton or key label will be shown enclosed in "less than" (<) and "greater than" (>) brackets. For example, the Reset Alarms Pushbutton will be shown as <RESET ALARMS>, while a command that calls for the entry of a ‘7’ followed by ‘ENTER’ Key will be represented as <7,ENTER>.

Cautions and Warnings

! CAUTION!!

A caution icon indicates a hazardous situation that if not avoided, may result in minor or moderate injury. Caution may also be used to indicate other unsafe practices or risks of property damage.

! WARNING!!

A warning icon indicates a potentially hazardous situation that if not avoided, could result in death or serious injury.

NOTE

A note icon identifies information for the proper operation of your equipment, including helpful hints, shortcuts, or important reminders.

Trademarks

Product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

Copyright

Disclaimer

This manual has been thoroughly reviewed for accuracy. All statements, technical information, and recommendations contained herein and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Radyne Corp. assumes no responsibility for use of any circuitry other than the circuitry employed in Radyne Corp. systems and equipment. Furthermore, since Radyne Corp. is constantly improving its products, reserves the right to make changes in the specifications of products, or in this manual at any time without notice and without obligation to notify any person of such changes.

Record of Revisions

Revision Level	Date	Reason for Change
1.0	1-1-99	New Release
1.1	3-30-99	Clarified DVB ASI information, revised data rates in Specifications section
2.0	4-5-01	Merged TM077 QAM256 Digital Video Modulator with TM084 QAM256 Digital Video Modulator and Upconverter Manuals
3.0	12-3-02	Revised and reformatted Technical Manual. Revised Figure 5-1.
3.1	1-20-04	Revised and reformatted Technical Manual.
3.2	12-29-04	Changed Power Output Accuracy from ± .50 to ± 1.0 dB. Reformatted manual.
4.0	4-29-08	Correct product performance stated.

Comments or Suggestions Concerning this Manual

Comments or suggestions regarding the content and design of this manual are appreciated. To submit comments, please contact the Radyne Corp. Customer Service Department.

Table of Contents

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Introduction

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This chapter provides an overview of the QAM256 Digital Video Modulator and Upconverter. The QAM256 may be referred to in this manual as "the unit", or the modulator".

1.0 Introduction

The Radyne Corporation new DVB-compliant QAM256 Digital Video Modulator and Upconverter meet all DVB requirements for transmission of digital video over broadband coaxial cable and microwave radio. The QAM256 features 4 QAM to 256 QAM modulation, 1 - 52 Mbps data rate, 1 - 8 MHz channel spacing, and Reed-Solomon Forward Error Correction. The QAM256 modulator supports output frequency of 35 to 37 MHz or 43 to 44 MHz or 50 to 862 MHz. The upconverter combines the QAM Modulator and Frequency converter into a 1 Rack Unit (RU) chassis (1.75" high) which eliminates the need for an additional converter unit. The modulator also supports field-changeable RS-422 Parallel, DVB Parallel, M2P Parallel, ASI, and other standard interfaces. Remote Monitor and Control interface is provided through either an RS-485 or Ethernet Remote Port using SNMP protocol.

The QAM256 provides efficient bandwidth utilization for digital video distribution systems. MMDS, LMDS and Cable Television systems all benefit from this innovative modulator. QAM modulation solves the problem of providing multiple video and data channels within bandwidth limitations. The Radyne QAM256 Upconverter has the versatility to adapt to any terrestrial broadband medium and give system operators full management and control of the available bandwidth.

The modulator meets the specifications of the ITU-T Recommendation; J.83 Annex A&B (Telecommunication Standardization of the ITU for Television and Sound Transmission). The microprocessor-based Monitor and Control (M&C) operates from the front panel or the remote port.

The Interface Module is a field-changeable module that contains either RS-422, M2P, DVB, Parallel, ASI, or other standard interface. The interface can accept data in an MPEG-2 transport format, or as random data.

Figure 1-1. QAM256 Digital Video Modulator and Cable Upconverter Front Panel

Installation

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This section provides unpacking and installation instructions, and a description of external connections and backward alarm information.

2.0 Installation Requirements

The QAM256 Modem is designed to be installed within any standard 19-inch wide equipment cabinet or rack, and requires one rack unit (RU) of mounting space (1.75 inches) vertically and 17¾ inches of depth. Including cabling, a minimum of 20 inches of rack depth is required. The rear panel of the modem is designed to have power enter from the left and IF Cabling enter from the right when viewed from the rear of the unit. Data and Control Cabling can enter from either side although they are closer to the center. The unit can be placed on a table or suitable surface if required.

! WARNING!!

There are no user-serviceable parts or configuration settings located inside the QAM256 Chassis. There is a potential shock hazard internally at the Power Supply Module. DO NOT open the QAM256 Chassis under any circumstances. Always disconnect the main plug before servicing of any kind.

! CAUTION!!

Before initially applying power to the unit, it is a good idea to disconnect the transmit output from the operating ground station equipment. This is especially true if the current QAM256 configuration settings are unknown, where incorrect settings could disrupt existing communications traffic.

2.1 Unpacking

The QAM256 Digital Video Modulator and Upconverter was carefully packaged to avoid damage and should arrive complete with the following items for proper installation:

QAM256 Unit
Power Cord, with applicable AC Connector
Installation and Operation Manual

2.2 Removal and Assembly

Carefully unpack the unit and ensure that all of the above items are in the carton. If the Prime AC power available at the installation site requires a different Power Cord/AC Connector, then arrangements to receive the proper device will be necessary before proceeding with the installation.

The QAM256 unit is shipped fully assembled and does not require removal of the covers for any purpose in installation. Should the power cable AC connector be of the wrong type for the installation, either the cable or the power connector end should be replaced. The power supply itself is designed for universal application using from 100 to 240 VAC, 50 to 60 Hz, 1 A.

! CAUTION!!

Always ensure that power is removed from the QAM256 before removing or installing a UIM. Failure to do so may cause damage to the equipment.

2.3 Mounting Considerations

When mounted in an equipment rack, adequate ventilation must be provided. The ambient temperature in the rack should preferably be between 10° and 35°C, and held constant for best equipment operation. The air available to the rack should be clean and relatively dry. The modems may be stacked one on top of the other to a maximum of 10 consecutive units before providing one (1) RU of space for airflow. Modems should not be placed immediately above a high-heat or EMF Generator to ensure the output signal integrity and proper receive operation.

Do not mount the QAM256 in an unprotected outdoor location where there is direct contact with rain, snow, wind or sun. The only tools required for rack mounting the QAM256 are four (4) customer supplied rack-mounting screws and the appropriate screwdriver. Rack mounting brackets are an integral part of the cast front bezel of the unit and are not removable.

Shielded cables with the shield terminated to the conductive backshells are required in order to meet EMC directives. Cables with insulation flammability ratings of 94 VO or better are required in order to meet low voltage directives.

Theory of Operation

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3.0 Theory of Operation

A digital terrestrial interface supplies the modulator with a data stream. The data stream is synchronized if the incoming stream is framed. The data is scrambled, and FEC is added. The data is then convolutionally encoded, punctured, then constellation mapped. The resulting I&Q symbols are digitally filtered. The data is then converted into an analog waveform and is vector modulated onto an RF Carrier produced from the Transmit IF Synthesizer Circuitry.

3.1 QAM256 Operation

A block diagram of the signal flow is shown in Figure 3-1 below.

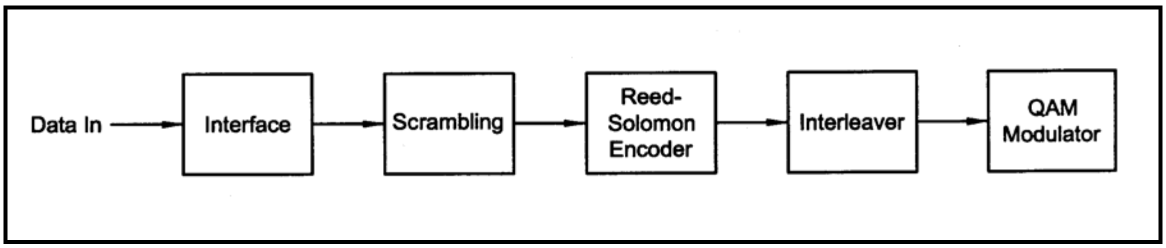

Figure 3-1. Functional Block Diagram

User Interfaces

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4.0 User Interfaces

Operation of the QAM256 consists of controlling the unit operating parameters and monitoring status and responses via one of the control interfaces. The two user interfaces available from the Front Panel are Front Panel Control, and Terminal Mode Control (not currently available). Either of these methods may be used separately or together to monitor and control the QAM256.

4.1 Front Panel User Interface

The Front Panel of the QAM256 allows for complete control and monitor of all QAM256 parameters and functions via the Keypad, LCD Display and Status LEDs.

The front panel layout is shown in Figure 4-1, showing the location and labeling of the front panel. The front panel is divided into four functional areas: the LCD Front Panel Display, the Cursor Control Arrow Keys, the Numeric Keypad, and the Front Panel LED Indicators, each described below in Table 4-1.

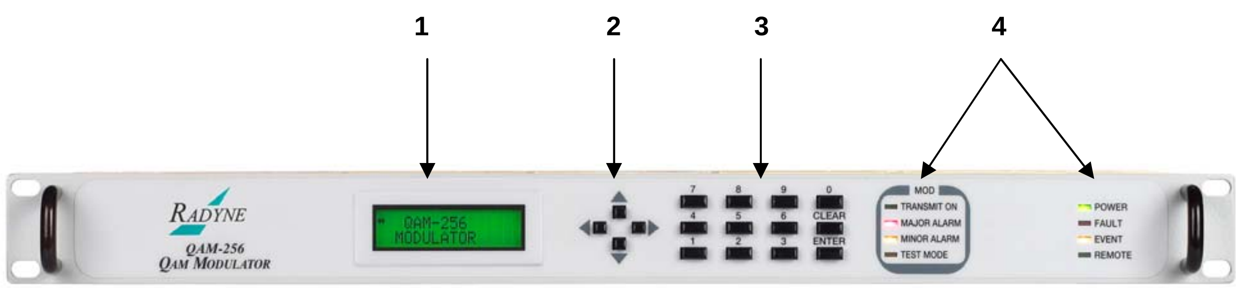


Figure 4-1. QAM256 Front Panel

Table 4-1.		
Item Number	**Description**	**Function**
1	LCD Front Panel Display	Displays QAM256 Operating parameters and Configuration data
2	Cursor Control Arrow Keys	Controls the up, down, right and left motion of the cursor in the LCD Display window
3	Numeric Keypad	Allows entry of numeric data and Clear and Enter function keys
4	Front Panel LED Indicators	See Paragraph 4.1.2 below for an itemized description of these LEDs

4.1.1 LCD Front Panel Display

The front panel display is a 2 line by 16-character LCD display. The display is lighted and the brightness can be set to increase when the front panel is currently in use. The LCD display automatically dims after a period of inactivity. The display has two distinct areas showing current information. The upper area shows the current parameter being monitored, such as ‘Frequency’ or ‘Data Rate’. The lower line shows the current value of that parameter. The LCD display is a single entry window into the large matrix of parameters that can be monitored and set from the Front Panel.

4.1.2 Cursor Control Arrow Keys

A set of ‘Arrow’ or ‘Cursor’ keys (↑), (↓), (→), (←), is used to navigate the parameter currently being monitored or controlled. Table 4-2 describes the functions available at the Front Panel.

4.1.3 Numeric Keypad

A 10 Key Numeric Keypad with 2 additional keys for the ‘Enter’ and ‘Clear’ function allows the entry of data into the system. Table 4-2 describes the functions available at the Front Panel.

Table 4-2.

Edit Mode Key Functions (Front Panel Only)

Parameter Type	0 – 9	↑	↓	←	→	‘Clear’ & ←	‘Clear’ & →
Fixed Point Decimal	Changes Digit	Toggles ± (If Signed)	Toggles ± (If Signed)	Moves Cursor 1 Position Left	Moves Cursor 1 Position Right	N/A	N/A
Unsigned Hexadecimal	Changes Digit	Increments Digit Value	Decrements Digit Value	Moves Cursor 1 Position Left	Moves Cursor 1 Position Right	N/A	N/A
Enumerated	N/A	Previous Value in List	Next Value in List	N/A	N/A	N/A	N/A
Date/ Time	Changes Digit	N/A	N/A	Moves Cursor 1 Position Left	Moves Cursor 1 Position Right	N/A	N/A
IP Address	Changes Digit	Increments Digit Value	Decrements Digit Value	Moves Cursor 1 Position Left	Moves Cursor 1 Position Right	N/A	N/A
Text Strings	Changes Character	Increments Character Value	Decrements Character Value	Moves Cursor 1 Position Left	Moves Cursor 1 Position Right	Clears to Left of Cursor Inclusive	Clears to Right of Cursor Inclusive

4.1.4 Front Panel LED Indicators

Eight LEDs on the QAM256 Front Panel (Refer to Table 4-3) indicate the status of the QAM256's operation. The LED colors maintain a consistent meaning. Green signifies that the indication is appropriate for normal operation, Yellow means that there is a condition not proper for normal operation, and Red indicates a fault condition that will result in lost communications.

Table 4-3.

LED	Color	Function
Transmit On	Green	Indicates that the QAM256 Transmitter is turned on.
Major Alarm	Red	Indicates that the transmit direction has failed, losing traffic.
Minor Alarm	Yellow	Indicates that a transmit receive warning condition exists.
Test Mode	Yellow	Indicates that the modulator is involved in a current test mode activity.
Power	Green	Indicates that the unit is turned on.
Fault	Red	Indicates a hardware fault for the unit.
Event	Yellow	Indicates that a condition or event has occurred that the unit has stored in memory.
Remote	Green	Indicates that the unit is set to respond to the remote control or terminal input.

4.2 Parameter Setup

The four Cursor Control Arrow Keys are used to navigate the menu tree and select the parameter to be set. After arriving at a parameter that needs to be modified, depress <ENTER>. The first space of the modifiable parameter highlights (blinks) and is ready for a new parameter to be entered. After entering the new parameter using the keypad (Refer to Figure 4-2), depress <ENTER> to lock in the new parameter. If a change needs to be made prior to pressing <ENTER>, depress <CLEAR> and the display defaults back to the original parameter. Depress <ENTER> again and re-enter the new parameters followed by <ENTER>.

Following a valid input, the QAM256 will place the new setting into the nonvolatile EEPROM making it available immediately and available the next time the unit is powered-up.'

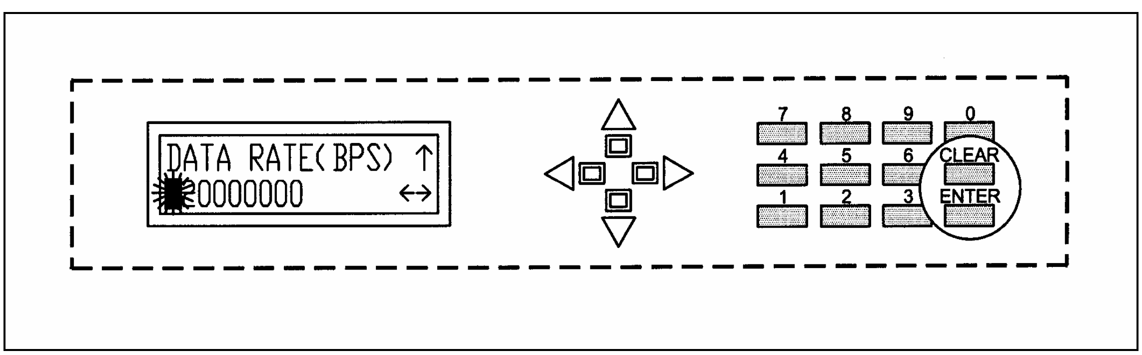


Figure 4-2. Entering New Parameters

4.3 Front Panel Control Screen Menus

The QAM256 Front Panel Control Screens are broken down into sections under several Main Menus.

4.3.1 Main Menus

Modulator
Interface
Monitor
Alarms
System
Test

4.3.2 Modulator Menu Options and Parameters

Frequency:	**{50 MHz – 862 MHz}** Cable Upconverter **{35 MHz – 37 MHz}** Optional **{43 MHz – 44 MHz}** Optional
Encoder Type:	**ITU-T J.83 Annex A {DVB/DAVIC}** **ITU-T J.83 Annex B {DigiCipherII}**
Modulation:	**{4, 16, 32, 64, 128, 256 QAM}**
Data Rate:	**{1 - 52 Mbps}** Refer to Table A-1.
Interleaver:	**DVB {12, 17}** **Trellis {204, 1}**
Spectrum:	**{Normal, Inverted}**
Tx Power:	**{+60 dBmV to +45 dBmV}** With Cable Upconverter **{+0.0dBm to –25.0 dBm}** Without Cable Converter
Tx Enable:	**{On, Off}**
Symbol Rate:	**{7.1 Msps maximum}**
Roll Off:	**{0.12, 0.15, 0.18}**
Framing:	**{MPEG 187, 188, 204}**

4.3.3 Interface Menu Options and Parameters

Interface Type:	**{ PAR M2P, Parallel, ASI, Advanced ASI}**
Clock Polarity:	**{Normal, Inverted}**
Data Invert:	**{Normal, Inverted}**

4.3.4 Monitor Menu Options and Parameters

Event Buff: Displays a history of events recorded in the event buffer. A maximum of 40 events may be stored in the buffer. Upon receipt of the 41st event, the first received event is automatically deleted, and so on, maintaining the maximum 40 events.

Press Clr to Erase Events: Clears the contents of the Event Buffer.

Tx Enabled: **{On, Off}**

4.3.5 Alarms Menu Options and Parameters

Major Tx (menu):

Mod Hardware: **{Pass, Fail}**

Tx Syn Lock: **{Pass, Fail}**

Data PLL Lock: **{Pass, Fail}**

Mod3 Lock: **{Pass, Fail}**

RF SynU Lock: **{Pass, Fail}**

RF SynD Lock: **{Pass, Fail}**

Minor Tx (menu):

Data Actv: **{Pass, Fail}**

Clock Actv: **{Pass, Fail}**

FIFO Fault: **{Pass, Fail}**

Code Clk Active: **{Pass, Fail}**

Common (menu):

M&C Hardware: **{Pass, Fail}**

INT Hardware: **{Pass, Fail}**

4.3.6 System Menu Options and Parameters

Control Mode:	**{Front Panel, Computer}**
Date:	Displays the current date.
Time:	Displays the current time.
Bklt Level:	**{0 – 99 seconds, 0 = No Timeout}**
Key Click:	**{On, Off}**
Emulation:	***TBD***
Firmware Version:	M&C Version
Last Rate:	**{Auto, Symbol, Data}**

4.3.7 Test Menu Options and Parameters

LED Test:	**{Normal}**
Carrier:	**{Normal, CW}**

4.4 Terminal Port User Interface

The Remote Port (J5) of the QAM256 allows for complete control and monitoring of all QAM256 parameters and functions via an RS-232 Serial Interface, or RS-485 for RLLP Protocol. ‘Terminal Mode’ can be entered from the front panel by selecting “System” and then “Control Mode” followed by “Terminal”. The baud rate and evaluation type can be changed at the front panel by using the *System>Baud Rate* Menu.

The Terminal Control Mode is menu-driven and the allowable values for each item number will be shown. To change an item, type in its number followed by <ENTER>. If the parameter to be changed requires a numeric value, enter the number followed by <ENTER> If the parameter is non-numeric, press <SPACE> to cycle through the list of available entries.

NOTE

Items that do not have ID numbers are Status only and cannot be changed.

4.5 Connecting the Terminal

1. Connect the computer to the QAM256 Remote Connector (J5) on the rear of the unit using the RS-232 Cable.

2. Enable the terminal by selecting Terminal Mode (located under the System - Control Mode Menu) from the front panel.

3. Verify that your emulation software is set to the following:

   8 data bits
   no parity
   1 stop bit

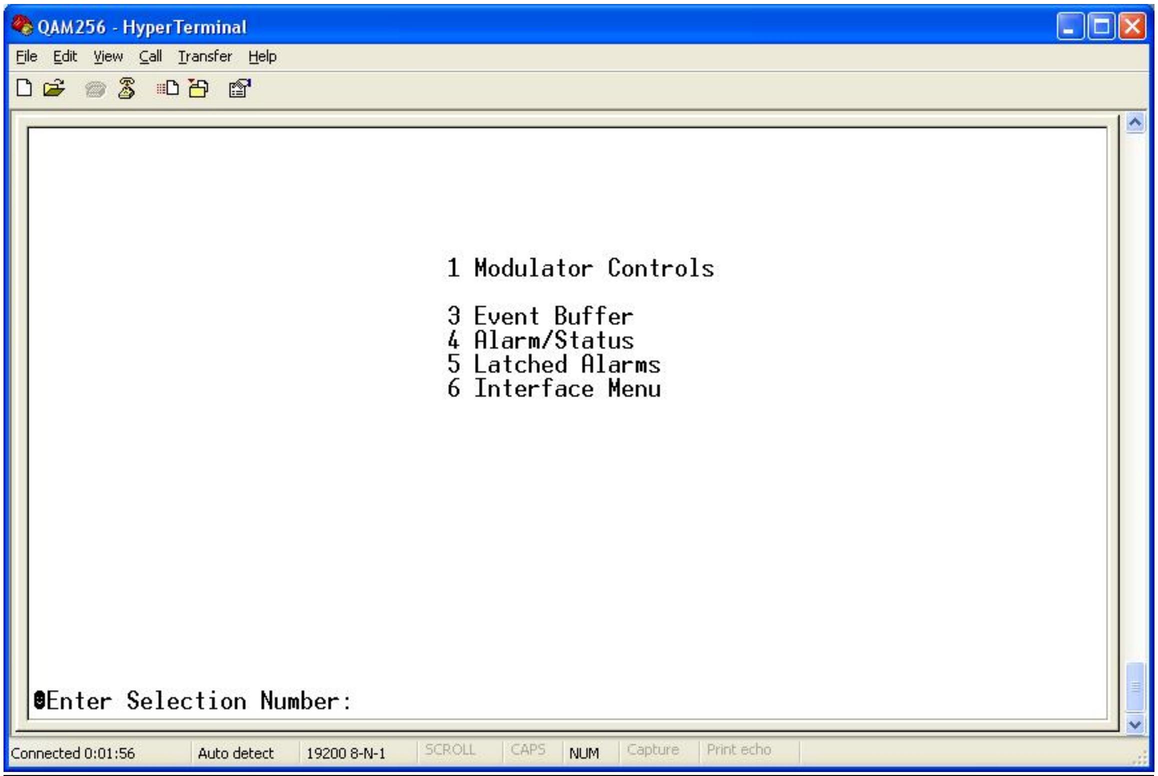
   Modify the QAM256 selection, if necessary, to match the settings (the Front Panel ‘SYSTEM’ Sub-Menu contains all the Terminal Emulation Controls).

4.6 Terminal Screens

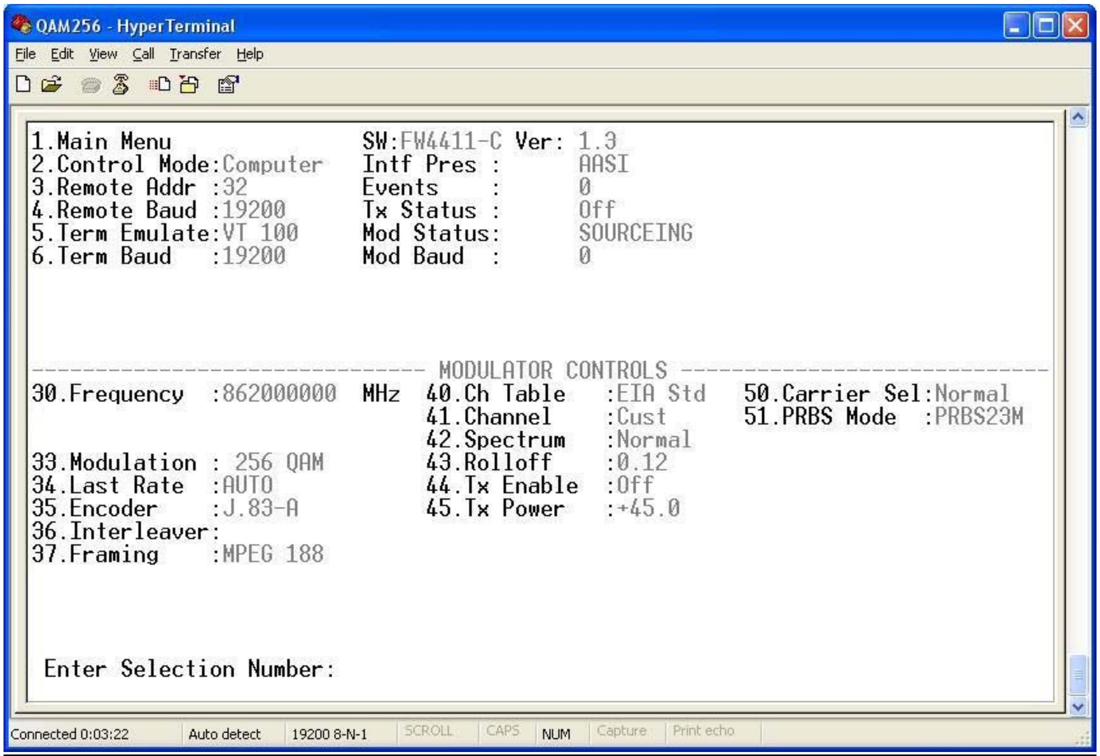
1. Modem configuration can be monitored and controlled via a full screen presentation of current settings and status. The <Esc> Key redraws the entire screen and aborts input any time. The Spacebar refreshes the status area and is used to scroll through selection when in user input mode.

2. To modify an item, the user simply presses its terminal selection followed by <Enter>. The modem responds by presenting the options available and requesting input. If the input is multiple choices, the user is prompted to use the Spacebar to scroll to the desired selection and then press <Enter>. An input can be aborted at any time by pressing <Esc>. Invalid input keys cause an error message to be displayed on the terminal. Some input or display status only appears when the user has the right access levels.

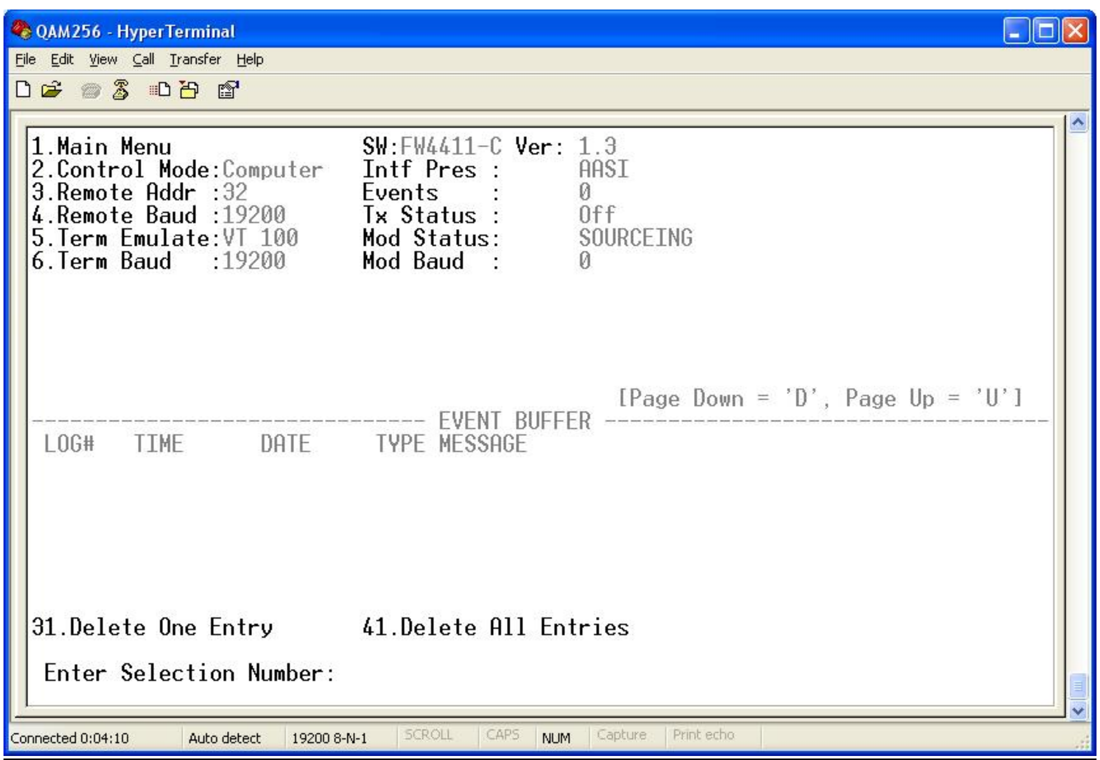
Main Menu Screen:



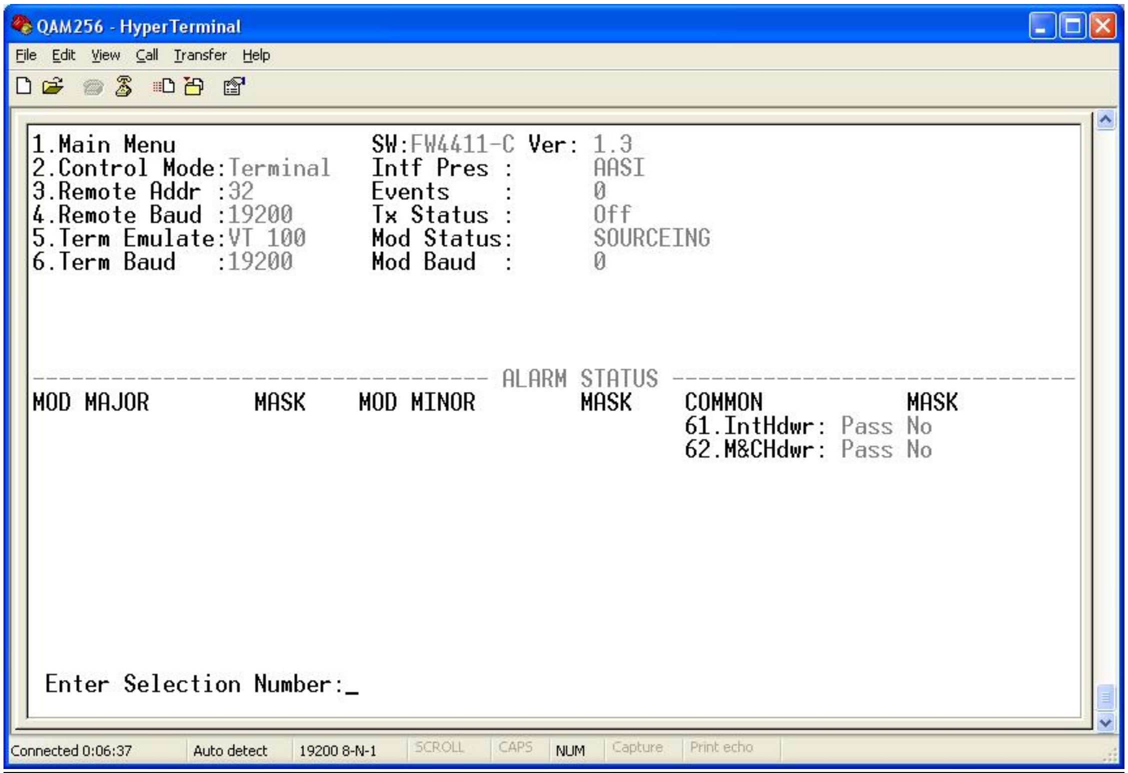
Modulator Control Screen:



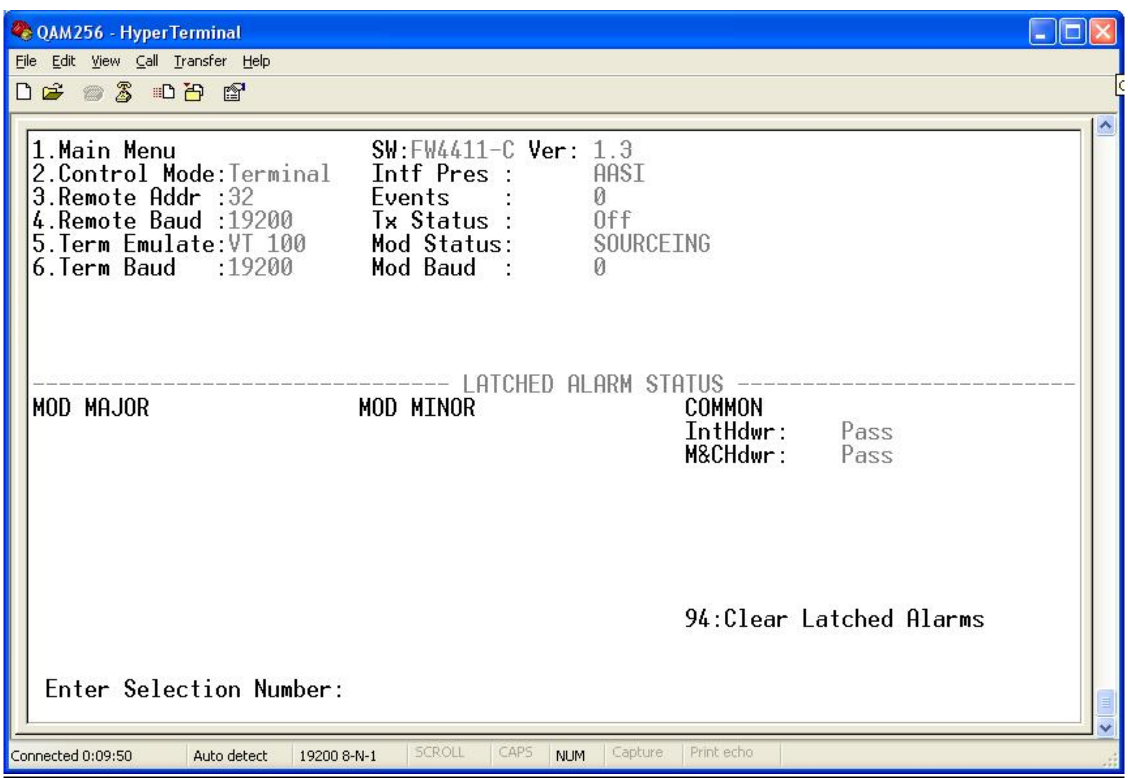
Event Buffer Screen:



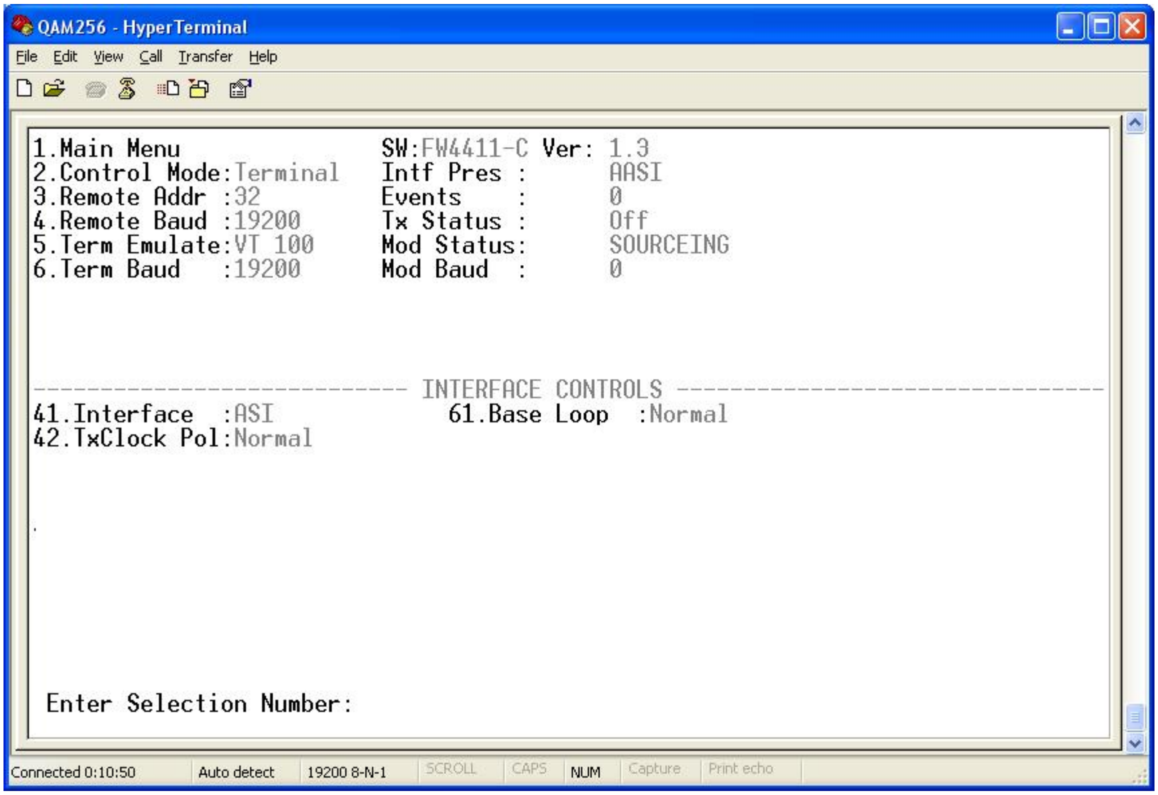
Alarm Status Screen:



Latched Alarm Screen:



Interface Controls Screen:



4.7 QAM256 Terminal Mode Control

'Terminal Mode' can be entered from the front panel by selecting 'System' and then 'Control Mode' followed by 'Terminal.' The default settings for the terminal are as follows:

1. 19,200 Baud;
2. 8 Data bits;
3. 1 stop bit;
4. No parity.

The baud rate can be changed at the front panel by using the System>Baud Rate menu. The new baud rate does not take effect until power to the unit has been recycled.

4.8 Sample Terminal Mode Control Screen Menus

The Terminal Control Mode is menu-driven as shown in the screen captures below. The allowable values for each item number are shown. To change an item, type in its number followed by <ENTER>. If the parameter to be changed requires a numeric value, enter the number followed by <ENTER>. If the parameter is non-numeric, press <SPACE> to cycle through the list of available entries. Note that the items that do not have ID numbers are Status only and cannot be changed.

Note: This feature has not been currently implemented.

4.9 Management Information Base Structure

This section defines the terminology and hierarchy associated with management information base structure at Radyne Corporation.

4.10 Simple Network Management Protocol (SNMP)

Simple Network Management Protocol (SNMP), as its name suggests, is a relatively simple protocol by which management information for a network device may be inspected and/or altered by remote administrators.

4.11 The Management Information Base (MIB)

Management objects are defined in the Management Information Base (MIB), which uses a hierarchical naming scheme. Within this scheme, each object is identified by an Object Identifier (OID), a sequence of non-negative integers that uniquely describes the path taken through the hierarchical structure.

MIB objects may then be specified either from the Root (which has no designator), or alternatively from anywhere within the hierarchical structure.

For example: 1.3.6.1.4.1.2591.4 is equivalent to {iso(1). org(3). dod(6). internet(1). private(4). enterprises(1). Radyne(2591). RCS10L(4)} (See Figure 1).

In general, we are mainly concerned with just two groups that reside in the *internet* subtree, namely the *mgmt*, and *private* groups. For completeness however, the four major groups are discussed below:

4.12 Directory {internet 1} 1.3.6.1.1

This area was reserved to describe how the OSI directory structure may be used in the Internet. To date this has not been implemented and therefore is of little interest to us.

4.13 Mgmt {internet 2} 1.3.6.1.2

This area was reserved to describe objects in the standard MIB. As RFCs defining new groups are ratified, the Internet Assigned Numbers Authority (IANA) assigns new group IDs.

4.14 Experimental {internet 3} 1.3.6.1.3

This subtree provides an area where experimentation is carried out. Only those organizations directly involved in the experiment have any interest in this subtree.

4.15 Private {internet 4} 1.3.6.1.4

This is possible the most important area of the MIB, since it is within this subtree that vendors place objects specific to their particular devices. Beneath the private branch, there is a subtree called enterprises, beneath which each vendor may define its own structure. Vendors are assigned Private Enterprise Numbers (PENs) that uniquely identify them. They may then place all objects specific to their devices in this tree, provided of course that the object conforms to the format defined by SMI. Radyne Corporation's Private Enterprise Number is 2591. Other products are added to Radyne Corporation's subtree as they become remotely manageable through SNMP.

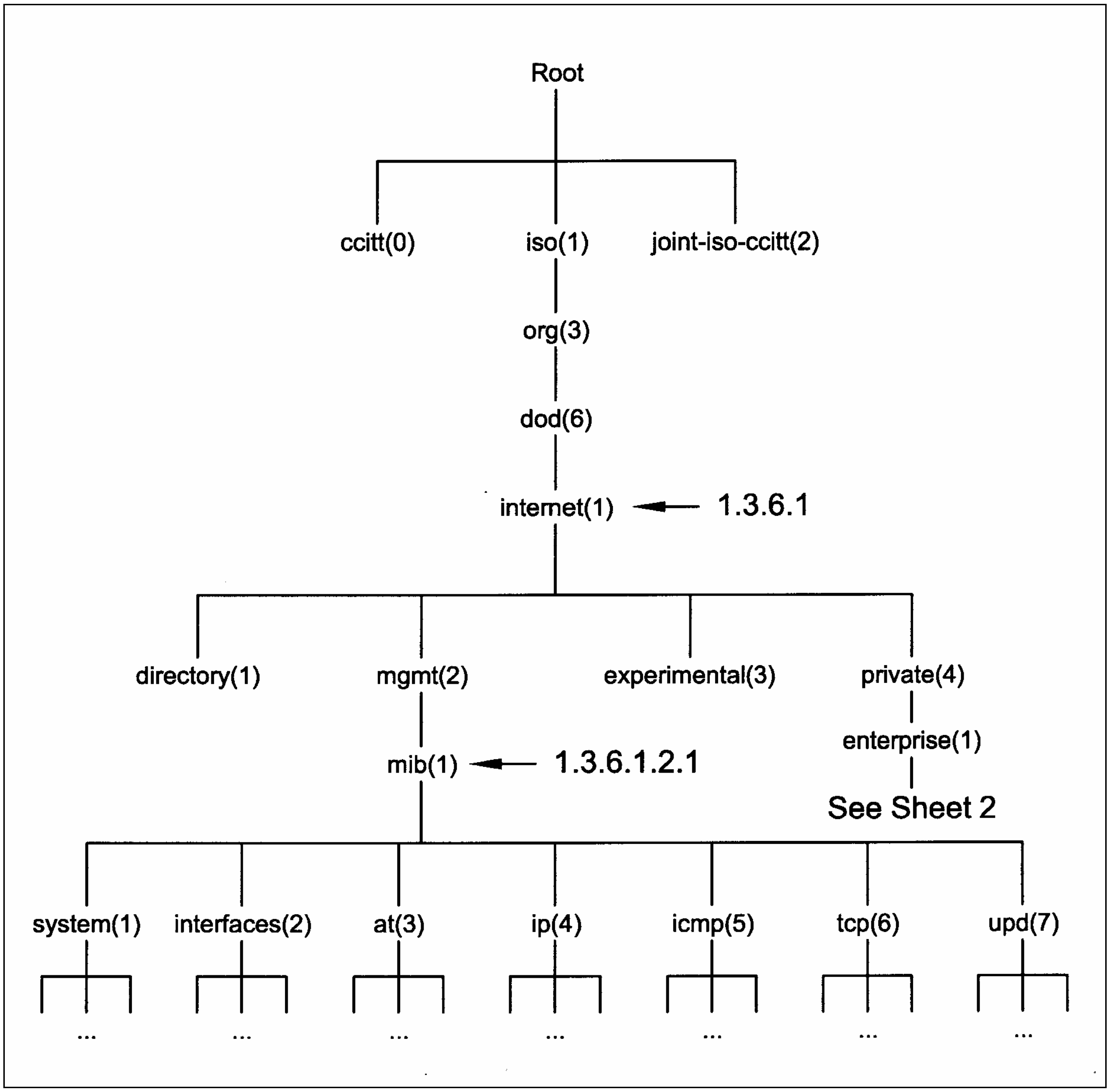


Figure 1. Object Identifiers in the Management Information Base (Sheet 1 of 2)

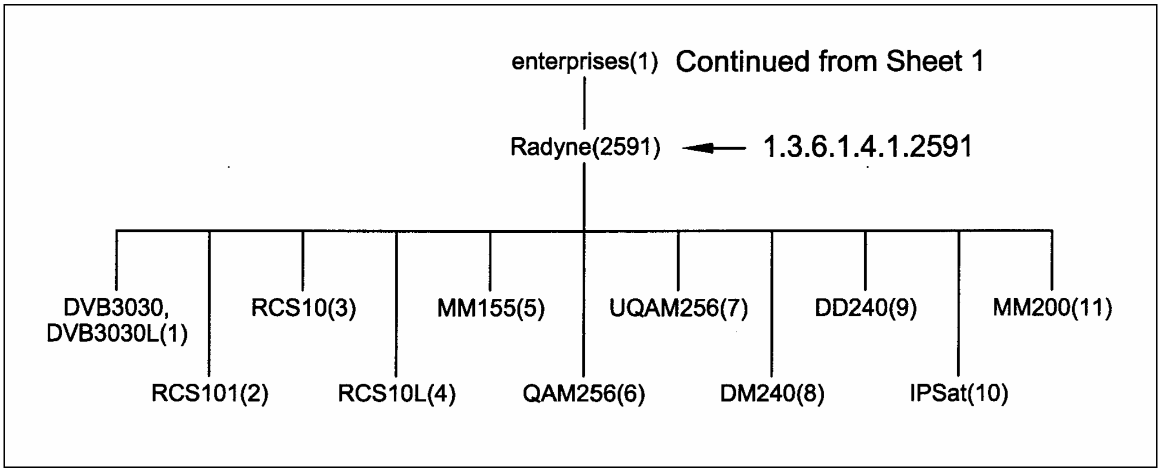


Figure 1. Object Identifiers in the Management Information Base (Sheet 2 of 2)

Refer to Appendix B for the QAM256 MIB.

Rear Panel Interfaces

5

This section discusses the electrical interfaces available from the rear panel. All locations are as viewed from the rear of the unit unless otherwise specified.

5.0 QAM256 Rear Panel Interfaces/Connections

All QAM256 Interfaces/Connections are made to labeled connectors located on the rear of the unit. The connector definitions below are those on the QAM256 unit. Any connection interfacing to the QAM256 must be the appropriate mating connector. Refer to Figure 2-1 for connector locations. All connectors are as viewed from the rear of the unit unless noted.

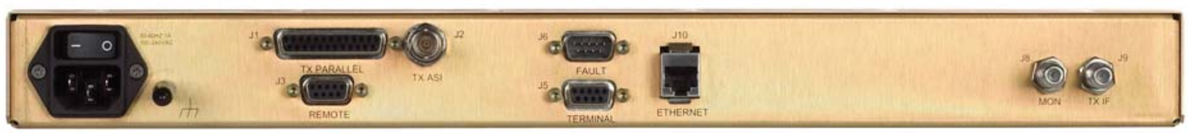


Figure 5-1. QAM256 Back Panel

5.1 AC Power

The unit is powered from a 100 – 240 VAC, 50 – 60 Hz source located on the left side of the unit. Integrated into the power entry module is the Power On/Off Rocker Switch. Power consumption for the unit is 1A. The power cord/connector assembly is a supplied item. A chassis ground connection (#10-32 threaded) stud, is located to the lower right of the AC Power Cord Connection.

5.2 FAULT Connection

The QAM256 has two Form-C dry contact alarm relays onboard and a Fault connector located on the rear panel. The two relays are designated “1” and “2”. The Modem Alarm B Port (J6) can be used for modem fault status. The physical interface is a female 9-Pin D-Sub Connector. This port is an open collector input. The pinouts are listed in Table 5-1.

Table 5-1. FAULT Connection - 9-Pin Female D-Sub - J6

Pin No.	Connection
1	Relay 1 NC
2	Relay 1 C
3	Relay 1 NO (Minor Alarm)
4	Ground
5	NC
6	Mod Fault (Open Collector)
7	Relay 2 NC

8	Relay 2 C
9	Relay 2 NO (Major Alarm)

5.3 TX MON Port

The Transmit Monitor Port (J8) is a Female BNC Connector, -20 dB Monitor Port.

5.4 TX IF Port

The Transmit IF Port (J9) is a Female BNC Connector.

The RS-485 Remote Connector (J3) is a 9-Pin Female D-Sub Connector. The pinouts are listed in Table 5-2.

Table 5-2. REMOTE Connection - 9-Pin Female D-Sub – J3

Pin No.	Signal Name	Description	Direction
1	Tx (B)	Transmit Data (+)	Output
5	GND	Ground	---
6	Tx (A)	Transmit Data (-)	Output
8	Rx (B)	Receive Data (+)	Input
9	Rx (A)	Receive Data (-)	Input

The RS-422 Transmit Parallel Connector (J1) is a 25-Pin Female D-Sub Connector. The pinouts are listed in Table 5-3.

Table 5-3. PARALLEL Connection - 25-Pin Female D-Sub – J3

Pin No.	Signal Name	Direction
1	OUTCLK	Output
14	OUTCLK	Output
2	BCLK+	Input
15	BCLK-	Input
3	SYNC+	Input
16	SYNC-	Input
4	VALID+	Input
17	VALID-	Input
5	D0+	Input
18	D0-	Input
6	D1+	Input

19	D1-	Input
7	D2+	Input
20	D2-	Input
8	D3+	Input
21	D3-	Input
9	D4+	Input
22	D4-	Input
10	D5+	Input
23	D5-	Input
11	D6+	Input
24	D6-	Input
12	D7+	Input
25	D7-	Input
13	GND	---

5.5 ASI/Parallel Interface Connections

5.5.1 TX PARALLEL Connector

The RS-422 Transmit Parallel Connector (J1) is a 25-Pin Female D-Sub Connector. The pinouts are listed in Table 5-3.

5.5.2 REMOTE Connector

The RS-485 Remote Connector (J3) is a 9-Pin Female D-Sub Connector. The pinouts are listed in Table 5-2.

5.5.3 TX ASI Connector

The Transmit ASI Connector (J4) is a Female BNC Connector.

5.6 ASI and Advanced ASI Interfaces

The QAM256 has two ASI options that apply to different uses. The Normal ASI option interfaces to data sources that conform to the DVB ASI Specification. The DVB ASI Specification requires data sources to transmit the ASI/DVB transport stream at a constant data rate and packet gap with no variation in time from one sync byte to the next.

The Advanced ASI Option is designed to interface with data sources that do not conform to the DVB ASI Specification. This card will handle transport streams with inconsistent data rates or packet gaps. The modulator's data rate must be set greater than the fastest data rate that can be expected from the data source. When the data is not available at that data rate, the modulator will output DVB Null Frames (see Table 5-4) until enough data has been received to fill a packet. In this method, the modulator's input buffer will not be overrun and the demodulator will not lose lock due to inconsistent packet delivery.

Table 5-4. DVB Null Packet Description

Null Packet =	Sync Byte	PID	Count	Data
Hex Value	47	IFFF	0000	FF - FF
Byte Number	0	1 - 2	3 - 4	5 - 187

5.7 Framing/Interface Compatibility

Table 5-5 represents the compatibility between the various interfaces and framing types.

Table 5-5. Interface Compatibility

Interface/Framing	187	188	204
Parallel/DVB/M2P	X	X	
Normal ASI	X	X	X
Advanced ASI		X	X
HSSI	X		
T3, E3	X		
STS-1	X		
Serial	X		
ECL	X		

X = Interface Supports This type of Framing
187 = No Framing
188 = DVB Framing
204 = Reed-Solomon DVB Framing

5.8 Optional DVB Interface

The Optional RS-422 DVB Interface Connector (J1) is a 25-Pin Female D-Sub Connector. The pinouts are listed in Table 5-6.

Table 5-6. J1 Optional DVB RS-422 Parallel Connection - 25-Pin Female D-Sub – J3

Pin No.	Signal Name	Direction
1	Clock +	Input
2	System GND	Ground
3	D7 +	Input
4	D6 +	Input
5	D5 +	Input
6	D4 +	Input
7	D3 +	Input
8	D2 +	Input
9	D1 +	Input
10	D0 +	Input
11	DVALID +	Input
12	PSYNC +	Input
13	Cable Shield	Input
14	Clock -	Input
15	System GND	Ground
16	D7 -	Input
17	D6 -	Input
18	D5 -	Input
19	D4 -	Input
20	D3 -	Input
21	D2 -	Input
22	D1 -	Input
23	D0 -	Input
24	DVALID -	Input
25	SYNC -	Input

Maintenance and Troubleshooting

6

6.0 Periodic Maintenance

The QAM256 modulator requires no periodic field maintenance procedures. Should a unit be suspected of a defect in field operations after all interface signals are verified, the correct procedure is to replace the unit with another known working QAM256. If this does not cure the problem, wiring or power should be suspect.

! WARNING!!

There is no external fuse on the QAM256. The fuse is located on the power supply assembly inside the case, and replacement is not intended in the field.

Technical Specifications

7

7.0 Introduction

This section defines the technical performance parameters and specifications for the QAM256 Digital Video Modulator and Upconverter.

7.1 Specifications Without Cable Upconverter

Data Rate:	1 - 55 Mbps
Modulation:	4, 16, 32, 64, 128, and 256 QAM (7 Msps Maximum)
Roll Off:	12, 15, and 18% Selectable
FEC:	204/188 Reed-Solomon with I = 1 - 204 programmable Forney Convolutional Interleaver meets J.83 Annex A, Annex B

7.1.1 IF Interface

Frequency:	43 – 44 MHz, or optional 35 – 37 MHz, 1 Hz Steps
Level:	0 to –25 dBm
Spurious:	-50 dBc
Impedance:	75Ω

7.1.2 Baseband Interface

Format:	MPEG-2 Transport
Physical:	Parallel, ASI, Advanced ASI, DVB Parallel, M2P Parallel

7.1.3 Remote Interface

RS-485, Terminal RS232, Ethernet, 10 Base-T SNMP (Optional)

7.1.4 Physical

Chassis Size:	1.75” H x 19” W x 17.75” D (4.445cm H x 48.26cm W x 48.085cm D)
Power:	100 – 240 VAC, 50/60 Hz or –48 VDC (Optional)
Environmental:	0 - 50°C, < 95% Humidity @ 25°C

7.2 Specifications With Cable Upconverter

Data Rate:	1 - 55 Mbps
Modulation:	4, 16, 32, 64, 128, and 256 QAM (7 Msps Maximum)
Roll Off:	12, 15, and 18% Selectable
FEC:	204/188 Reed-Solomon with I = 1 - 204 programmable Forney Convolutional Interleaver meets J.83 Annex A, Annex B

7.2.1 RF Interface

Frequency:	50 – 862 MHz, 1 Hz Steps
Power Output:	45 – 60 dBmV, 1 dB Steps
Power Output Accuracy:	± 1.0 dB
Power Output Stability:	± 0.5 dB
Power Adjustment:	25 dB
Spurious:	-50 dBc In-Band, 45 dB Out-of-Band
Impedance:	75Ω
Phase Noise:	-88 dBc/Hz, 10 kHz Offset (Single Side-Band)
Return Loss:	16 dB
Carrier Mute:	-55 dB, Automatic on Frequency Change
Output Connector:	F-Type
Output Monitor:	-20 dB, ± 3 dB from RF Output, F-Type

7.2.2 Baseband Interface

Format:	MPEG-2 Transport
Physical:	Parallel, ASI, Advanced ASI, DVB Parallel, M2P Parallel

7.2.3 Remote Interface

RS-485, Terminal RS232, Ethernet, 10 Base-T (Optional)

7.2.4 Physical

Chassis Size:	1.75” H x 19” W x 17.75” D (4.445cm H x 48.26cm W x 48.085cm D)
Power:	100 – 240 VAC, 50/60 Hz or –48 VDC (Optional)
Environmental:	0 - 50°C, < 95% Humidity @ 25°C

RADYNE

Product Options

A

A.0 QAM256 Data Rates

Table A-1. Maximum Symbol Rate = 7.1 Msps

Minimum	Maximum	Modulation Type
1 Mbps	13.086275 Mbps	4 QAM
1 Mbps	26.172549 Mbps	16 QAM
1 Mbps	32.715686 Mbps	32 QAM
1 Mbps	39.258824 Mbps	64 QAM
1 Mbps	45.801961 Mbps	128 QAM
1 Mbps	52.345098 Mbps	256 QAM

SNMP MIB

B

```
QAM256-MIB DEFINITIONS ::= BEGIN

        IMPORTS
                enterprises
                        FROM RFC1155-SMI
                OBJECT-TYPE
                        FROM RFC-1212;

        -- groups in Radyne specific MIB

                radyne OBJECT IDENTIFIER ::= { enterprises 2591 }
                qam256 OBJECT IDENTIFIER ::= { radyne 6 }
                radQAM256ModNVStatus OBJECT IDENTIFIER ::= { qam256 1 }
                radQAM256ModStatus OBJECT IDENTIFIER ::= { qam256 2 }

                radQAM256TxCarrierControl OBJECT-TYPE
                        SYNTAX INTEGER          { off(1), on(2) }
                        ACCESS read-write
                        STATUS current
                        DESCRIPTION
                        "Turns carrier on and off"
                        ::= { radQAM256ModNVStatus 1 }

                radQAM256TxTransmitPower OBJECT-TYPE
                        SYNTAX INTEGER          (-250..0, 450..600)
                        ACCESS read-write
                        STATUS current
                        DESCRIPTION
"Selects the Tx power level in dBm from +0.0 to -25.0 for the QAM25636Mhz and QAM25644Mhz. There is an
implied decimal point. For example a value of -39 represents a transmit power level of -3.9 dBm. Selects the Tx
power level in dBv from +45.0 to +60.0 for the QAM256cable. There is an implied decimal point. For example a
value of 500 represents a transmit power level of 50.0 dBv."
                        ::= { radQAM256ModNVStatus 2 }

                radQAM256TxIFFrequency OBJECT-TYPE
                        SYNTAX INTEGER          (35000000..862000000)
                        ACCESS read-write
                        STATUS current
                        DESCRIPTION
"Selects IF frequency in Hz. The frequency range of the QAM25636Mhz is 35 MHz to 37 MHz, of the
QAM25644Mhz is 43 Mhz to 45 MHz and of the QAM256Cable is 50 Mhz to 862 Mhz."
                        ::= { radQAM256ModNVStatus 3 }

                radQAM256TxDataRate OBJECT-TYPE
                        SYNTAX INTEGER          (1000000..56800000)
                        ACCESS read-write
                        STATUS current
                        DESCRIPTION
                        "Selects the data rate in BPS. The data rate is variable from 1 Mbps to 56.8 Mbps."
                        ::= { radQAM256ModNVStatus 4 }

                radQAM256TxSymbolRate OBJECT-TYPE
                        SYNTAX INTEGER          (1000000..7100000)
                        ACCESS read-write
                        STATUS current
                        DESCRIPTION
                        "Selects the symbol rate in SPS. The symbol rate is variable from 1Msps to 7.1Msps."
                        ::= { radQAM256ModNVStatus 5 }
```

```
radQAM256TxFraming OBJECT-TYPE
        SYNTAX INTEGER          { framing187(1),
                framing188(2),
                framing204(3),
                data(4) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects Unframed, MPEG Sync Byte and MPEG Sync Byte plus Reed-Solomon"
        ::= { radQAM256ModNVStatus 6 }

radQAM256TxModulation OBJECT-TYPE
        SYNTAX INTEGER          { qam4(1),
                qam16(2),
                qam32(3),
                qam64(4),
                qam128(5),
                qam256(6) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects the QAM modulation type."
        ::= { radQAM256ModNVStatus 7 }

radQAM256TxEncoderInterleaver OBJECT-TYPE
        SYNTAX INTEGER          { annexa1204(1), annexa2102(2), annexa368(3),
annexa451(4), annexa634(5), annexa1217(6), annexa1712(7), annexa346(8), annexa514(9), annexa683(10),
annexa1022(11), annexa2041(12), annexb1281(13), annexb1282(14), annexb642(15), annexb1283(16),
annexb324(17), annexb1284(18), annexb168(19), annexb1285(20), annexb816(21), annexb1286(22),
annexb432(23), annexb1287(24), annexb264(25), annexb1288(26), annexb1128(27) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects the interleaver type."
        ::= { radQAM256ModNVStatus 8 }

radQAM256TxRolloff OBJECT-TYPE
        SYNTAX INTEGER          { alpha012(1),
                alpha015(2),
                alpha018(3) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects the alpha factor for the spectrum shape."
        ::= { radQAM256ModNVStatus 9 }

radQAM256TxInterfaceType OBJECT-TYPE
        SYNTAX INTEGER          { g703stsl(1), g703e3(2), g703t3(3), asi(4),
advancedasi(5), paralleldvb(6), parallelm2p(7), ecl(8), hssi(9), smpte(10), g703t3t1(11), g703e3e1(12) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects the interface type.SMPTE, g703t3t1 and g703e3-e1 are not yet
implemented."
        ::= { radQAM256ModNVStatus 10 }

radQAM256TxSpectrum OBJECT-TYPE
        SYNTAX INTEGER          { normal(1),
                inverted(2) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Inverts the direction of rotation for the modulation."
        ::= { radQAM256ModNVStatus 11 }
```

```
radQAM256TxClockPolarity OBJECT-TYPE
        SYNTAX INTEGER          { normal(1),
                inverted(2) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects clock polarity for Tx terrestrial clock relative to Tx data."
        ::= { radQAM256ModNVStatus 12 }

radQAM256TxDataPolarity OBJECT-TYPE
        SYNTAX INTEGER          { normal(1),
                inverted(2) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Selects data polarity"
        ::= { radQAM256ModNVStatus 13 }

radQAM256TxCarrierMode OBJECT-TYPE
        SYNTAX INTEGER          { normal(1),
                cw(2) }
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Normal sets the carrier to normal CW causes the modulator to output pure carrier"
        ::= { radQAM256ModNVStatus 14 }

radQAM256TxMajorAlarm1Mask OBJECT-TYPE
        SYNTAX INTEGER          (0..255)
        ACCESS  read-write
        STATUS current
        DESCRIPTION
        "Major Alarm 1 mask:
                Bit 0=Mod Hardware fault 1=Fault
                Bit 1=Tx Synthesizer fault
                Bit 2=Tx Data PLL lock fault
                Bit 3=Tx Framing Lock (Unused)
                Bit 4=Mod Chip 1 Lock fault (Unused)
                Bit 5=Mod Chip 2 Lock fault (Unused)
                Bit 6=Mod Chip 3 Lock fault (Current chip used)
                Bit 7=Spare
        0 = Mask, 1 = Allow"
        ::= { radQAM256ModNVStatus 15 }

radQAM256TxMajorAlarm2Mask OBJECT-TYPE
        SYNTAX INTEGER          (0..255)
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        "Major alarm 2 mask:
                Bits 0..7 = spares
        0=mask, 1=allow"
        ::= { radQAM256ModNVStatus 16 }

radQAM256TxMinorAlarm1Mask OBJECT-TYPE
        SYNTAX INTEGER          (0..255)
        ACCESS          read-write
        STATUS          current
        DESCRIPTION
        "Minor Alarm 1 mask:
                Bit 0=Clock activity detect fault
                Bit 1=Data activity detect fault
                Bit 2..7=Spares
        0=Mask, 1=Allow"
        ::= { radQAM256ModNVStatus 17 }
```

```
radQAM256TxMinorAlarm2Mask OBJECT-TYPE
        SYNTAX INTEGER          (0..255)
        ACCESS          read-write
        STATUS          current
        DESCRIPTION
        "Minor alarm 2 mask:
                Bits 0..7 = spares
        0=mask, 1=allow"
::= { radQAM256ModNVStatus 18 }

radQAM256CommonAlarm1Mask OBJECT-TYPE
        SYNTAX INTEGER          (0..255)
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        "Common alarm 1 mask:
                Bit 0 = Interface hardware fault mask
                Bit 1 = M&C hardware fault mask
                Bits 2..7 = spares
        0=mask, 1=allow"
        ::= { radQAM256ModNVStatus 19 }

radQAM256CommonAlarm2Mask OBJECT-TYPE
        SYNTAX INTEGER          (0..255)
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        "Common alarm 2 mask:
                Bits 0..7 = spares
        0=mask, 1= allow"
        ::= { radQAM256ModNVStatus 20 }

radQAM256TxControlMode OBJECT-TYPE
        SYNTAX INTEGER          { local(1), terminal(2), computer(3), ethernet(4) }
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        "Selects Tx control mode."
        ::= { radQAM256ModNVStatus 21 }

radQAM256TxTerrestrialLoopback OBJECT-TYPE
        SYNTAX INTEGER          { disable(1), enable(2) }
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        "Enables or disables Tx Terrestrial Loopback."
        ::= { radQAM256ModNVStatus 22 }

radQAM256TxBasebandLoopback OBJECT-TYPE
        SYNTAX INTEGER          { disable(1), enable(2) }
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        " Enables or disables Tx Baseband Loopback."
        ::= { radQAM256ModNVStatus 23 }

radQAM256PRBS OBJECT-TYPE
        SYNTAX INTEGER          { normal(1), prbs23(2), prbs23m(3), prbs15(4),
prbs15m(5) }
        ACCESS  read-write
        STATUS          current
        DESCRIPTION
        "Selects the pseudo-random bit sequence for link testing."
        ::= { radQAM256ModNVStatus 24 }

radQAM256TxLastRateControl OBJECT-TYPE
```

```
                SYNTAX INTEGER        { symbol(1), data(2), auto(3) }
                ACCESS read-write
                STATUS       current
                DESCRIPTION
                "Selects rate control mode."
                ::= { radQAM256ModNVStatus 25 }

        radQAM256TxChannelTable OBJECT-TYPE
                SYNTAX INTEGER        { useiastd(1), useiahrc(2), useiairc(3), ustradstd(4),
ustradhrc(5), ustradirc(6) }
                ACCESS read-write
                STATUS current
                DESCRIPTION
                "Valid for QAM256Cable Modulator Only. Not limited to the above listed tables."
                ::= { radQAM256ModNVStatus 26 }

        radQAM256TxChannelEntry OBJECT-TYPE
                SYNTAX INTEGER        (1..255)
                ACCESS read-write
                STATUS       current
                DESCRIPTION
                "This corresponds to the index entry into a selected
channel table. Maximum entry for EIA tables is 116 where as that for TRAD tables is 67. Valid for QAM256 Cable
Modulator Only."
                ::= { radQAM256ModNVStatus 27 }

-- QAM256 modulator status information.

        radQAM256TxMajorAlarm1Status OBJECT-TYPE
                SYNTAX INTEGER (0..255)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "A bit field. On startup, the agent initializes this to the value '00000000'B
                        Bit 0=Mod Hardware fault
                        Bit 1=Tx Synthesizer fault
                        Bit 2=Tx Data PLL lock fault
                        Bit 3=Tx Framing Lock (Unused)
                        Bit 4=Mod Chip 1 Lock fault (Unused)
                        Bit 5=Mod Chip 2 Lock fault (Unused)
                        Bit 6=Mod Chip 3 Lock fault (Current chip used)
                        Bit 7=Spare
                0 = Pass, 1 = Fail"
                ::= { radQAM256ModStatus 1 }

        radQAM256TxMajorAlarm2Status OBJECT-TYPE
                SYNTAX INTEGER (0..255)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "A bit field. On startup, the agent initializes this to the value '00000000'B
                        Bits 0 ..7 Spares
                0 = Pass, 1 = Fail"
                ::= { radQAM256ModStatus 2 }

        radQAM256TxMinorAlarm1Status OBJECT-TYPE
                SYNTAX INTEGER (0..255)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "A bit field. On startup, the agent initializes this to the value '00000000'B
                        Bit 0=Clock activity detect fault
                        Bit 1=Data activity detect fault
                        Bit 2..7=Spares"
                ::= { radQAM256ModStatus 3 }
```

```
radQAM256TxMinorAlarm2Status OBJECT-TYPE
        SYNTAX INTEGER (0..255)
        ACCESS read-only
        STATUS current
        DESCRIPTION
        "A bit field. On startup, the agent initializes this to the value '00000000'B
                Bits 0..7 Spares
        0 = Pass, 1 = Fail"
        ::= { radQAM256ModStatus 4 }

radQAM256TxCommonAlarm1Status OBJECT-TYPE
        SYNTAX INTEGER (0..255)
        ACCESS read-only
        STATUS current
        DESCRIPTION
        "A bit field. On startup, the agent initializes this to the value '00000000'B
                Bit 0=Interface hardware fault 1=Fault
                Bit 1=M&C Hardware Fault
                Bit 2...7 Spares
        0 = Pass, 1 = Fail"
        ::= { radQAM256ModStatus 5 }

radQAM256TxCommonAlarm2Status OBJECT-TYPE
        SYNTAX INTEGER (0..255)
        ACCESS read-only
        STATUS current
        DESCRIPTION
        "A bit field. On startup, the agent initializes this to
        the value '00000000'B
                Bits 0 ..7 Spares
        0 = Pass, 1 = Fail"
        ::= { radQAM256ModStatus 6 }

radQAM256TxLatchedMajorAlarm1Status OBJECT-TYPE
        SYNTAX INTEGER (0..255)
        ACCESS read-only
        STATUS current
        DESCRIPTION
        "A bit field. On startup, the agent initializes this to the value '00000000'B
                Bit 0=Mod Hardware fault
                Bit 1=Tx Synthesizer fault
                Bit 2=Tx Data PLL lock fault
                Bit 3=Tx Framing Lock (Unused)
                Bit 4=Mod Chip 1 Lock fault (Unused)
                Bit 5=Mod Chip 2 Lock fault (Unused)
                Bit 6=Mod Chip 3 Lock fault (Current chip used)
                Bit 7=Spare
        0 = Pass, 1 = Fail"
        ::= { radQAM256ModStatus 7 }

radQAM256TxLatchedMajorAlarm2Status OBJECT-TYPE
        SYNTAX INTEGER (0..255)
        ACCESS read-only
        STATUS current
        DESCRIPTION
        "Bits 0 ..7 Spares"
        ::= { radQAM256ModStatus 8 }

radQAM256TxLatchedMinorAlarm1Status OBJECT-TYPE
        SYNTAX INTEGER (0..255)
        ACCESS read-only
        STATUS current
        DESCRIPTION
        "A bit field. On startup, the agent initializes this to the value '00000000'B
                Bit 0=Clock activity detect fault
                Bit 1=Data activity detect fault
```

```
                        Bit 2..7=Spares"
                ::= { radQAM256ModStatus 9 }

        radQAM256TxLatchedMinorAlarm2Status OBJECT-TYPE
                SYNTAX INTEGER (0..255)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "Bits 0 ..7 Spares"
                ::= { radQAM256ModStatus 10 }

        radQAM256TxLatchedCommonAlarm1Status OBJECT-TYPE
                SYNTAX INTEGER (0..255)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "Bit 0=Interface hardware fault 1=Fault
                Bit 1=M&C Hardware Fault
                Bit 2..7 Spares"
                ::= { radQAM256ModStatus 11 }

        radQAM256TxLatchedCommonAlarm2Status OBJECT-TYPE
                SYNTAX INTEGER (0..255)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "Bits 0 ..7 Spares"
                ::= { radQAM256ModStatus 12 }

        radQAM256TxCarrierStatus OBJECT-TYPE
                SYNTAX INTEGER { off(1), on(2) }
                ACCESS read-only
                STATUS current
                DESCRIPTION
                        "Shows status of the carrier, on or off"
                ::= { radQAM256ModStatus 13 }

        radQAM256TxInterfaceCardType OBJECT-TYPE
                SYNTAX INTEGER { None(1), g703(2), pasi(3), ecl(4), hssi(5), aasi(6), smpt(7),
t3t1(8) }
                ACCESS read-only
                STATUS current
                DESCRIPTION
"Shows different available interface card types. SMPT and t3t1 interfaces are not yet implemented."
                ::= { radQAM256ModStatus 14 }

        radQAM256TxOptions OBJECT-TYPE
                SYNTAX INTEGER (0..65535)
                ACCESS read-only
                STATUS current
                DESCRIPTION
                "This describes the Tx available options:
                        Bit 0 = Clock polarity
                        Bit 1 = Data polarity
                        Bit 2 = Clock activity
                        Bit 3 = Data activity
                        Bit 4 = Data fifo 1
                        Bit 5 = Data fifo 2
                        Bit 6 = Tx buffer
                        Bit 7 = Internal clock
                        Bits 8..15 = Spares
                0 = unavailable, 1 = available"
                ::= { radQAM256ModStatus 15 }

        radQAM256CommonOptions OBJECT-TYPE
                SYNTAX INTEGER (0..65535)
```

```
                    ACCESS read-only
                    STATUS current
                    DESCRIPTION
                    "This describes the common options:
                           Bit 0 = Baseband loopback
                           Bit 1 = Terrestrial loopback
                           0 = unavailable, 1 = available"
                    ::= { radQAM256ModStatus 16 }

             radQAM256TxModulatorType OBJECT-TYPE
                    SYNTAX INTEGER       { undefined(1), qam256var550(2), qam25636Mhz(3),
qam25644Mhz(4), qam256cable(5) }
                    ACCESS read-only
                    STATUS current
                    DESCRIPTION
"Shows the type of qam256 modulator, QAM256Var550, QAM25636Mhz, QAM25644Mhz or QAM256cable"
                    ::= { radQAM256ModStatus 17 }

END
```

Remote Operations

C

C.0 Remote Operations

CAUTION!!

When new features are added to Radyne Corp. equipment, the control parameters are appended to the end of the Non-Volatile Section of the Remote Communications Specification, and status of the features, if any, are added at the end of the Volatile Section. If a remote M&C queries two pieces of Radyne Corp. equipment with different revision software, they could respond with two different sized packets. The remote M&C MUST make use of the non-volatile count value to index to the start of the Volatile Section. If the remote M&C is not aware of the newly added features to the product, it should disregard the parameters at the end of the Non-Volatile Section and index to the start of the Volatile Section.

Before creating any software based on the information contained in this document, contact the Radyne Corp. Customer Service Department (602-437-9620) to find out if the software revision for that piece of equipment is current and that no new features have been added since the release of this document.

C.1 Host Computer Remote Communications

Control and status messages are conveyed between the QAM256, the subsidiary modems, and the host computer using packetized message blocks in accordance with a proprietary communications specification. This communication is handled by the Radyne Link Level Protocol (RLLP), which serves as a protocol 'wrapper' for the RM&C data.

Complete information on monitor and control software is contained in the Radyne RLLP Protocol Reference Guide.

C.1.1 Protocol Structure

The Communications Specification (COMMSPEC) defines the interaction of computer resident Monitor and Control software used in satellite earth station equipment such as modems, redundancy switches, multiplexers, and other ancillary support gear. Communication is bi-directional, and is normally established on one or more full-duplex 9600-baud multi-drop control buses that conform to EIA Standard RS-485.

Each piece of earth station equipment on a control bus has a unique physical address, which is assigned during station setup/configuration or prior to shipment. Valid decimal addresses on one control bus range from 032 through 255 for up to 224 devices per bus. Address 255 of each control bus is usually reserved for the M&C computer.

C.1.2 Protocol Wrapper

The Radyne COMMSPEC is byte-oriented, with the Least Significant Bit (LSB) issued first. Each data byte is conveyed as mark/space information with two marks comprising the stop data. When the last byte of data is transmitted, a hold comprises one steady mark (the last stop bit). To begin or resume data transfer, a space (00h) substitutes this mark. This handling scheme is controlled by the hardware and is transparent to the user. A basic pictorial representation of the data and its surrounding overhead may be shown as follows:

S1	S2	B0	B1	B2	B3	B4	B5	B6	B7	S1	S2	Etc.

The stop bits, S1 and S2, are each a mark. Data flow remains in a hold mode until S2 is replaced by a space. If S2 is followed by a space, it is considered a start bit for the data byte and not part of the actual data (B0 - B 7).

The COMMSPEC developed for use with the Radyne Link Level Protocol (RLLP) organizes the actual monitor and control data within a shell, or "protocol wrapper" that surrounds the data. The format and structure of the COMMSPEC message exchanges are described herein. Decimal numbers have no suffix; hexadecimal numbers end with a lowercase h suffix and binary values have a lower case b suffix. Thus, 22 = 16h = 000010110b. The principal elements of a data frame, in order of occurrence, are summarized as follows:

<SYN> - the message format header character, or ASCII sync character, that defines the beginning of a message. The <SYN> character value is always 16h.

<BYTE COUNT> - the Byte Count is the number of bytes in the <DATA> field, ranging from zero through TBD. This field is 2 bytes long for the QAM256 protocol.

<SOURCE ID> - the Source Identifier defines the multi-drop address origin. Note that all nodes on a given control bus have a unique address that must be defined.

<DESTINATION ID> - The Destination Identifier serves as a pointer to the multi-drop destination device that indicates where the message is to be sent.

<FRAME SEQUENCE NUMBER> - The FSN is a tag with a value from 0 through 255 that is sent with each message. It assures sequential information framing and correct equipment acknowledgment and data transfers.

<OPCODE> - The Operation Code field contains a number that identifies the message type associated with the data that follows it. Equipment under MCS control recognizes this byte via firmware identification and subsequently steers the DATA accordingly to perform a specific function or series of functions. Acknowledgment and error codes are returned in this field. This field is 2 Bytes for the QAM256 protocol.

<...DATA...> - The Data field contains the binary, bi-directional data bytes associated with the <OPCODE>. The number of data bytes in this field is indicated by the <BYTE COUNT> value.

<CHECKSUM> - The checksum is the modulo 256 sum of all preceding message bytes, excluding the <SYN> character. The checksum determines the presence or absence of errors within the message. In a message block with the following parameters, the checksum is computed as shown below in Table 1.

BYTE FIELD	DATA CONTENT	RUNNING CHECKSUM
<BYTE COUNT> (Byte 1)	00h = 00000000b	00000000b
<BYTE COUNT> (Byte 2)	02h = 00000010b	00000010b
<SOURCEID>	F0h = 11110000b	11110010b
<DESTINATION ID>	2Ah = 00101010b	00011100b
<FSN>	09h = 00001001b	00100101b
<OPCODE> (Byte 1)	00h = 00000000b	00100101b
<OPCODE> (Byte 2)	03h = 00000011b	00101000b
<DATA> (Byte 1)	DFh = 11011111b	00000111b
<DATA> (Byte 2)	FEh = 11111110b	00000101b

Table 1. Checksum Calculation Example

Thus, the checksum is 00000101b, which is 05h or 5 decimal. Alternative methods of calculating the checksum for the same message frame are:

00h + 02h + F0h + 2Ah + 09h + 00h + 03h + DFh + FEh = 305h.

Since the only concern is the modulo 256 (modulo 100h) equivalent (values that can be represented by a single 8-bit byte), the checksum is 05h.

For a decimal checksum calculation, the equivalent values for each information field are:

0 + 2 + 240 + 42 + 9 + 0 + 3 + 223 + 254 = 773;

773/256 = 3 with a remainder of 5. This remainder is the checksum for the frame.
5 (decimal) = 05h = 0101b = <CHECKSUM>

C.1.3 Frame Description and Bus Handshaking

In a Monitor and Control environment, every message frame on a control bus port executes as a packet in a loop beginning with a wait-for-SYN-character mode. The remaining message format header information is then loaded, either by the M&C computer or by a subordinate piece of equipment (such as the QAM256) requesting access to the bus. Data is processed in accordance with the OPCODE, and the checksum for the frame is calculated. If the anticipated checksum does not match then a checksum error response is returned to the message frame originator. The entire message frame is discarded and the wait-for-SYN mode goes back into effect. If the OPCODE resides within a command message, it defines the class of action that denotes an instruction that is specific to the device type, and is a prefix to the DATA field if data is required. If the OPCODE resides within a query message packet, then it defines the query code, and can serve as a prefix to query code DATA.

The Frame Sequence Number (FSN) is included in every message packet and increments sequentially. When the M & C computer or bus-linked equipment initiates a message, it assigns the FSN as a tag for error control and handshaking. A different FSN is produced for each new message from the FSN originator to a specific device on the control bus. If a command packet is sent and not received at its intended destination, then the packet originator does not receive an appropriate response message. The original command packet is then re-transmitted with the same FSN. If the repeated message is received correctly at this point, it is considered a new message and is executed and acknowledged as such.

If the command packet is received at its intended destination but the response message (acknowledgment) is lost, then the message originator (usually the M&C computer) re-transmits the original command packet with the same FSN. The destination device detects the same FSN and recognizes that the message is a duplicate, so the associated commands within the packet are not executed a second time. However, the response packet is again sent back to the source, as an acknowledgment in order to preclude undesired multiple executions of the same command.

To reiterate, valid equipment responses to a message require the FSN tag in the command packet. This serves as part of the handshake/acknowledge routine. If a valid response message is absent, then the command is re-transmitted with the same FSN. For a repeat of the same command involving iterative processes (such as increasing or decreasing transmit power level of a QAM256), the FSN is incremented after each message packet. When the FSN value reaches 255, it overflows and begins again at zero. The FSN tag is a powerful tool that assures sequential information framing, and is especially useful where commands require more than one message packet.

The full handshake/acknowledgment involves a reversal of source and destination ID codes in the next message frame, followed by a response code in the <OPCODE> field of the message packet from the equipment under control.

If a command packet is sent and not received at its intended destination, a timeout condition can occur because the packet originator does not receive a response message. On receiving devices slaved to an M & C computer, the timeout delay parameters may be programmed into the equipment in accordance with site requirements by Radyne Corp. prior to shipment, or altered by qualified personnel. The FSN handshake routines must account for timeout delays and be able to introduce them as well.

C.1.4 Global Response Operational Codes

In acknowledgment (response) packets, the operational code <OPCODE> field of the message packet is set to 0 by the receiving devices when the message intended for the device is evaluated as valid. The device that receives the valid message then exchanges the <SOURCE ID> with the <DESTINATION ID>, sets the <OPCODE> to zero in order to indicate that a good message was received, and returns the packet to the originator. This "GOOD MESSAGE" Opcode is one of nine global responses. Global response Opcodes are common responses, issued to the M&C computer or to another device, which can originate from and are interpreted by all Radyne equipment in the same manner. These are summarized as follows (all Opcode values are expressed in decimal form):

RESPONSE OPCODE DESCRIPTION	OPCODE
Good Message	0000
Invalid Size	0001
Unknown Error	0002
Invalid Control Mode	0003
Invalid Parameter	0004
Invalid Last Rate Mode	0005
Invalid Symbol Rate (Symbol Rate Low)	0006
Invalid Symbol Rate (Symbol Rate High)	0007
Invalid Symbol Rate (Data Rate Low)	0008
Invalid Symbol Rate (Data Rate Low)	0009
Invalid Framing	000A
Invalid Modulation	000B
Invalid Interleaver/Encoder	000D

Table 2. Response OPCODES

C.1.5 Collision Avoidance

When properly implemented, the physical and logical devices and ID addressing scheme of the COMMSPEC normally precludes message packet contention on the control bus. The importance of designating unique IDs for each device during station configuration cannot be overemphasized. One pitfall, which is often overlooked, concerns multi-drop override IDs. All too often, multiple devices of the same type are assigned in a direct-linked ("single-thread") configuration accessible to the M&C computer directly. For example, if two QAM256 Modulators with different addresses (DESTINATION IDs) are linked to the same control bus at the same hierarchical level, both will attempt to respond to the M&C computer when the computer generates a multi-drop override ID of 23. If their actual setup parameters, status, or internal timing differs, they will both attempt to respond to the override simultaneously with different information or asynchronously in their respective message packets and response packets, causing a collision on the serial control bus.

To preclude control bus data contention, different IDs must always be assigned to the equipment. If two or more devices are configured for direct-linked operation, then the M&C computer and all other devices configured in the same manner must be programmed to inhibit broadcast of the corresponding multi-drop override ID.

The multi-drop override ID is always accepted by devices of the same type on a common control bus, independent of the actual DESTINATION ID. These override IDs with the exception of “BROADCAST” are responded to by all directly linked devices of the same type causing contention on the bus. The “BROADCAST” ID, on the other hand, is accepted by all equipment but none of them returns a response packet to the remote M&C.

The following multi-drop override IDs are device-type specific, with the exception of "BROADCAST.” These are summarized below with ID values expressed in decimal notation:

DIRECTLY-ADDRESSED EQUIPMENT	MULTI-DROP OVERRIDE ID
Broadcast (all directly-linked devices)	00
DMD-3000/4000, 4500 or 5000 Mod Section, DMD15	01
DMD-3000/4000, 4500 or 5000 Demod Section, DMD15	02
RCU-340 1:1 Switch	03
RCS-780 1:N Switch	04
RMUX-340 Cross-Connect Multiplexer	05
CDS-780 Clock Distribution System	06
SOM-340 Second Order Multiplexer	07
DMD-4500/5000 Modulator Section	08
DMD-4500/5000 Demodulator Section	09
RCU-5000 M:N Switch	10
DMD15 Modulator	20
DMD15 Demodulator	21
DMD15 Modem	22
DM45 Video Modulator	23
QAM256 Modulator	32
Reserved for future equipment types	24 – 31

Table 3. Broadcast ID’s

Note that multi-drop override ID 01 can be used interchangeably to broadcast a message to a DMD-3000/4000 modem, a DMD-4500/5000, a DMD15 modem, or a DM45. Radyne Corp. recommends that experienced programmers issue the multi-drop override IDs only during system configuration as a bus test tool, and that they not be included in run-time software. It is also *advantageous to consider the use of multiple bus systems where warranted by a moderate to large equipment complement.*

Therefore, if a DMD15 Modulator is queried for its equipment type identifier, it will return a "20" and DMD15 Demodulator will return a "21". A DMD15 Modem will also return a "22". A DM45 Video Modulator will return a "23."

C.1.6 Software Compatibility

The COMMSPEC, operating in conjunction within the RLLP shell, provides for full forward and backward software compatibility independent of the software version in use. New features are appended to the end of the DATA field without OPCODE changes. Older software simply discards the data as extraneous information without functional impairment for backward compatibility.

If new device-resident or M&C software receives a message related to an old software version, new information and processes are not damaged or affected by the omission of data.

The implementation of forward and backward software compatibility often, but not always, requires the addition of new Opcodes. Each new function requires a new Opcode assignment if forward and backward compatibility cannot be attained by other means.

C.1.7 Flow Control and Task Processing

The original packet sender (the M&C computer) relies on accurate timeout information with regard to each piece of equipment under its control. This provides for efficient bus communication without unnecessary handshake overhead timing. One critical value is designated the Inter-Frame Space (FS). The Inter-Frame Space provides a period of time in which the packet receiver and medium (control bus and M&C computer interface) fully recover from the packet transmission/reception process and the receiver is ready to accept a new message. The programmed value of the Inter-Frame Space should be greater than the sum of the "turnaround time" and the round-trip (sender/receiver/bus) propagation time, including handshake overhead. The term "turnaround time" refers to the amount of time required for a receiver to be re-enabled and ready to receive a packet after having just received a packet. In flow control programming, the Inter-Frame Space may be determined empirically in accord with the system configuration or calculated based on established maximum equipment task processing times.

Each piece of supported equipment on the control bus executes a Radyne Link Level Task (RLLT) in accordance with its internal hardware and fixed program structure. In a flow control example, the RLLT issues an internal "message in" system call to invoke an I/O wait condition that persists until the task receives a command from the M & C computer. The RLLT has the option of setting a timeout on the incoming message. Thus, if the equipment does not receive an information/command packet within a given period, the associated RLLT exits the I/O wait state and takes appropriate action.

Radyne equipment is logically linked to the control bus via an Internal Input / Output Processing Task (IOPT) to handle frame sequencing, error checking, and handshaking. The IOPT is essentially a link between the equipment RLLT and the control bus. Each time the M&C computer sends a message packet; the IOPT receives the message and performs error checking. If errors are absent, the IOPT passes the message to the equipment's RLLT. If the IOPT detects errors, it appends error messages to the packet. Whenever an error occurs, the IOPT notes it and discards the message; but it keeps track of the incoming packet. Once the packet is complete, the IOPT conveys the appropriate message to the RLLT and invokes an I/O wait state (wait for next <SYNC> character).

If the RLLT receives the packetized message from the sender before it times out, it checks *for any error messages appended by the IOPT. In the absence of errors, the RLLT processes the received command sent via the transmitted packet and issues a "message out" system call to ultimately acknowledge the received packet. This call generates the response packet conveyed to the sender. If the IOPT sensed errors in the received packet and an RLLT timeout has not occurred, the RLLT causes the equipment to issue the appropriate error message(s) in the pending equipment response frame.*

To maintain frame synchronization, the IOPT keeps track of error-laden packets and packets intended for other equipment for the duration of each received packet. Once the packet is complete, the IOPT invokes an I/O wait state and searches for the next <SYNC> character.

C.1.8 RLLP Summary

The RLLP is a simple send-and-wait protocol that automatically re-transmits a packet whenever an error is detected, or when an acknowledgment (response) packet is absent. During transmission, the protocol wrapper surrounds the actual data to form information packets. Each transmitted packet is subject to time out and frame sequence control parameters, after which the packet sender waits for the receiver to convey its response. Once a receiver verifies that a packet sent to it is in the correct sequence relative to the previously received packet, it computes a local checksum on all information within the packet excluding the <SYN> character and the <CHECKSUM> fields. If this checksum matches the packet <CHECKSUM>, the receiver processes the packet and responds to the packet sender with a valid response (acknowledgment) packet. If the checksum values do not match, the receiver replies with a negative acknowledgment (NAK) in its response frame.

The response packet is therefore either an acknowledgment that the message was received correctly, or some form of a packetized NAK frame. If the sender receives a valid acknowledgment (response) packet from the receiver, the <FSN> increments and the next packet is transmitted as required by the sender. However, if a NAK response packet is returned the sender re-transmits the original information packet with the same embedded <FSN>.

If an acknowledgment (response) packet or a NAK packet is lost, corrupted, or not issued due to an error and is thereby not returned to the sender, the sender re-transmits the original information packet; but with the same <FSN>. When the intended receiver detects a duplicate packet, the packet is acknowledged with a response packet and internally discarded to preclude undesired repetitive executions. If the M&C computer sends a command packet and the corresponding response packet is lost due to a system or internal error, the computer times out and re-transmits the same command packet with the same <FSN> to the same receiver and waits once again for an acknowledgment or a NAK packet.

To reiterate, the format of the message block is shown in Table 4, Link Level Protocol Message Block

Sync	***Count***	***Source Address***	***Destination Address***	***FSN***	***Opcode***	***Data Bytes***	***Checksum***

Table 4. Link Level Protocol Message Block

RLLP Remote Communications Examples

<u>Example #1</u> *Query Common Control Mode*

Example Parameters:

SYNC Byte = 16h (Always.)
Data Count = 00 00h
Source Address = FFh
Destination Address = 20h = 32 decimal
Frame Sequence Number = 01h
Opcode = 20 01h
Checksum = 41h

Transmit Packet:
16 00 00 FF 20 01 20 01 41

Response Packet:
16 00 01 20 FF 01 00 00 02 23

Error Response = 00 00 (Command OK)
Control Mode = 02. (Computer)

<u>*Example #2*</u> *Query Common Control Mode* <u>*with BAD Opcode*</u>

Example Parameters:
SYNC Byte = 16h (Always.)
Data Count = 00 00h
Source Address = FFh
Destination Address = 20h = 32 decimal
Frame Sequence Number = 01h
Opcode = 20 0Fh (BAD Opcode)
Checksum = 4Fh

Transmit Packet:
16 00 00 FF 20 01 20 0F 4F

Response Packet:
16 00 00 20 FF 01 00 02 22

Error Response = 00 02

<u>*Example #3*</u> *Command Mod Data rate*

Example Parameters:
SYNC Byte = 16h (Always.)
Data Count = 00 04h
Source Address = FFh
Destination Address = 2Ch = 44 decimal
Frame Sequence Number = 01h
Opcode = 22 41h
Data = 00 7A 12 00h
Checksum = 1Fh

Transmit Packet:
16 00 04 FF 2C 01 22 41 00 7A 12 00 1F

Response Packet:
16 00 00 2C FF 01 00 00 2C

Error Response = 00 00 (Command OK)

<u>*Example #4*</u> *Command Mod TX Enable. (On)*

Example Parameters:
SYNC Byte = 16h (Always.)
Data Count = 00 01h
Source Address = FFh
Destination Address = 20h = 32 decimal
Frame Sequence Number = 7Fh
Opcode = 22 54h
Data = 01h (01h = On)
Checksum = 16h

Transmit Packet:
16 00 01 FF 20 7F 22 54 01 16

Response Packet:
16 00 00 20 FF 7F 00 00 9E

Error Response = 00 00 (Command OK)

C.2 Remote Port Modes of Operation:

The RLLP Remote Port Packet structure is as follows:

<SYNC>	*= Message format header character that defines the beginning of a message. The <SYNC> character value is always 0x16, (1 byte).*
<BYTE COUNT>	*= Number of bytes in the <DATA> field, (2 bytes).*
<SOURCE ID>	*= Identifies the address of the equipment from where the message*
<DESTINATION ID>	*= Identifies the address of the equipment where the message is to be sent, (1 byte).*
<F.S.N.>	*= Frame sequence number ensures correct packet acknowledgment and data transfers, (1 byte).*
<OPCODE>	*= This byte identifies the message type associated with the information data. The equipment processes the data according to the value in this field. Return error codes and acknowledgment are also included in this field, (2 bytes).*
<…DATA…>	*= Information data. The number of data bytes in this field is indicated by the <BYTE COUNT> value.*
<CHECKSUM>	*= The modulo 256 sum of all preceding message bytes excluding the <SYNC> character, (1 byte).*

QAM256 Common Query Set:

Query	Opcode
Query Common ID	<2000h>
Query Common Control Mode	<2001h>
Query Common Version	<2002h>
Query Common Firmware	<2003h>
Query Common Time	<2004h>
Query Common Date	<2005h>
Query Common Time & Date	<2006h>
Query Common Alarms	<2007h>
Query Common Alarm Mask	<2008h>

Query Common Last Rate Control	<2009h>

QAM256 Common Command Set:

Command	Opcode
Command Common Control Mode	<2201h>
Command Common Time	<2204h>
Command Common Date	<2205h>
Command Common Time & Date	<2206h>
Command Clear Common Alarms	<2207h>
Command Common Alarm Mask	<2208h>
Command Common Last Rate Control	<2209h>

QAM256 Modulator Command Set:

Query	Opcode
Query Modulator Frequency	<2040h>
Query Modulator Data rate	<2041h>
Query Modulator Symbol rate	<2042h>
Query Modulator Last rate control	<2043h>
Query Modulator Modulation	<2044h>
Query Modulator Spectrum	<2045h>
Query Modulator Framing	<2046h>
Query Modulator Interleaver / Encoder	<2047h>
Query Modulator Roll off	<2049h>
Query Modulator Interface Type	<204Ah>
Query Modulator Data Polarity	<204Bh>
Query Modulator Clock Polarity	<204Ch>
Query Modulator Alarms	<204Dh>
Query Modulator Alarm Mask	<204Eh>
Query Modulator PRBS	<204Fh>
Query Modulator BB Loopback	<2051h>
Query Modulator TX Power	<2053h>
Query Modulator TX Enable	<2054h>
Query Modulator TX Carrier	<2055h>
Query Modulator Channel Table	<2060h>
Query Modulator Channel	<2061h>

QAM256 Modulator Command Set:

Command	*Opcode*
Command Modulator Frequency	<2240h>
Command Modulator Data rate	<2241h>
Command Modulator Symbol rate	<2242h>
Command Modulator Modulation	<2244h>
Command Modulator Spectrum	<2245h>

Command Modulator Framing	<2246h>
Command Modulator Interleaver	<2247h>
Command Modulator Roll off	<2249h>
Command Modulator Interface Type	<224Ah>
Command Modulator Data Polarity	<224Bh>
Command Modulator Clock Polarity	<224Ch>
Command Modulator Clear Alarms	<224Dh>
Command Modulator Alarm Mask	<224Eh>
Command Modulator PRBS	<224Fh>
Command Modulator BB Loopback	<2251h>
Command Modulator TX Power	<2253h>
Command Modulator TX Enable	<2254h>
Command Modulator TX Carrier	<2255h>
Command Modulator Channel Table	<2260h>
Command Modulator Channel	<2261h>

Common Query Opcodes

Opcode: <2000h> Query a modulator's identification
Query response:
<1> Modem ID (QAM256 modulator's ID = 32)

Opcode: <2001h> Query a modulator's control mode
Query response:
<1> Modem control mode (0=Front Panel, 1=Terminal, 2=Computer, 3 = Ethernet)

Opcode: <2002h> Query a modulator's Firmware version.
Query response:
<1> Version (implied decimal point)

Opcode: <2003h> Query a modulator's Firmware information.
Query response:
<16> Firmware (8 bytes for firmware part number.)
(8 bytes for release date.)

Opcode: <2004h> Query a modulator's time.
Query response:
<1> Hour (0 through 23)
<1> Minute (0 through 59)
<1> Second (0 through 59)

Opcode: <2005h> Query a modulator's date.
Query response:
<1> Year (0 through 99)
<1> Month (0 through 11)
<1> Day (0 through 30)

Opcode: <2006h> Query a modulator's time and date combined.
Query response:

<1> Year (0 through 99)
<1> Month (0 through 11)
<1> Day (0 through 30)
<1> Hour (0 through 23)
<1> Minute (0 through 59)
<1> Second (0 through 59)

Opcode: <2007h> Query a modulator's common alarms
Query response:
<1> Common Alarm1 (Bit 0 = M&C Hardware Fault)
(Bit 1 = Interface. Hardware Fault)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
<1> Common Alarm2 (Bit 0 = Spare)
(Bit 1 = Spare)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
<1> LatchedComAlarm1 (Bit 0 = M&C Hardware Fault)
(Bit 1 = Interface. Hardware Fault)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
<1> LatchedComAlarm2 (Bit 0 = Spare)
(Bit 1 = Spare)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)

Opcode: <2008h> Query a modulator's common alarms mask
Query response:
<1> Common Alarm1 (Bit 0 = M&C Hardware Fault)
(Bit 1 = Interface. Hardware Fault)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
(0 = mask, 1 = allow)
<1> Common Alarm2 (Bit 0 = Spare)
(Bit 1 = Spare)
(Bit 2 = Spare)

(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
(0 = mask, 1 = allow)

Opcode: <2009h> Query a modulator's Last Rate Control.
Query response:
<1> Last Rate Control (0=Symbol, 1=Data, 2=Auto)

Common Command Opcodes

Opcode: <2201h> Set Common control mode
<1> Modem control mode (0=Front Panel, 1=Terminal, 2=Computer, 3 = Ethernet)

Opcode: <2204h> Set Common time
<1> Hour (0 through 23)
<1> Minute (0 through 59)
<1> Second (0 through 59)

Opcode: <2205h> Set Common date
<1> Year (0 through 99)
<1> Month (0 through 11)
<1> Day (0 through 30)

Opcode: <2206h> Set Common time and date
<1> Year (0 through 99)
<1> Month (0 through 11)
<1> Day (0 through 30)
<1> Hour (0 through 23)
<1> Minute (0 through 59)
<1> Second (0 through 59)

Opcode: <2207h> Clear Common Alarms.
<0> Clear Alarms (no parameters)

Opcode: <2208h> Command Mask Alarms.
<1> Common Alarm1 (Bit 0 = M&C Hardware Fault)
(Bit 1 = Interface. Hardware Fault)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
(0 = mask, 1 = allow)
<1> Common Alarm2 (Bit 0 = Spare)
(Bit 1 = Spare)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
(0 = mask, 1 = allow)

Opcode: <2209h> Set Common Last Rate Control.
<1> Last Rate Control (0=Symbol, 1=Data, 2=Auto)

Modulator Query Opcodes

Opcode: <2040h> Query a modulator's frequency
Query response:
<4> Frequency (Binary value, 1 Hz steps)
(Without cable Upconverter the range = 43 MHz to 44 MHz, or Optional 35 MHz to 37 MHz)
(With cable Upconverter the range = 50 MHz to 862 MHz)

Opcode: <2041h> Query a modulator's data rate
Query response:
<4> Data rate (Binary value, 1bps steps)

Opcode: <2042h> Query a modulator's symbol rate
Query response:
<4> Symbol rate (Binary value, 1sps steps)

Opcode: <2043h> Query a modulator's last rate control.
Query response:
<1> Last Rate Control (0 = Symbol, 1 = Data)

Opcode: <2044h> Query a modulator's modulation.
Query response:
<1> Modulation (0=4 QAM, 1=16 QAM, 2=32 QAM, 3=64 QAM, 4=128 QAM, 5=256 QAM)

Opcode: <2045h> Query a modulator's spectrum.
Query response:
<1> Spectrum (0=Normal, 1=Inverted)

Opcode: <2046h> Query a modulator's framing.
Query response:
<1> Framing (0=MPEG 187, 1=MPEG 188, 2=MPEG 204, 3=Data)

Opcode: <2047h> Query a modulator's interleave and Encoder.
Query response:
<1> Interleaver/Encoder <u>(For Annex-A)</u>
(0 = 1,204, 1 = 2,102, 2 = 3,68, 3 = 4,51, 4 = 6,34, 5 = 12,17, 6 = 17,12, 7 = 34,6, 8 = 51,4, 9 = 68,3, 10 = 102,2, 11 = 204,1)
<u>(For Annex-B)</u>
(12 = 128,1, 13 = 128,2, 14 = 64,2, 15 = 128,3, 16 = 32,4, 17 = 128,4, 18 = 16,8, 19 = 128,5, 20 = 8,16, 21 = 128,6, 22 = 4,32, 23 = 128,7, 24 = 2,64, 25 = 128,8, 26 = 1,128)

Opcode: <2049h> Query a modulator's roll off.
Query response:
<1> Roll off (0=0.12, 1=0.15, 2=0.18)

Opcode: <204Ah> Query a modulator's interface type.
Query response:
<1> Interface Type (0 = STS1, 1 = G.703-E3, 2 = G.703-T3, 3 = Normal ASI, 4 = Advanced ASI, 5 = DVB Parallel, 6 = M2P Parallel, 7 = ECL, 8 =

HSSI)

Opcode: <204Bh>	*Query a modulator's data polarity*	
Query response:		
<1>	*Data Polarity*	*(0=Normal, 1=Inverted)*
Opcode: <204Ch>	*Query a modulator's clock polarity*	
Query response:		
<1>	*Clock Polarity*	*(0=Normal, 1=Inverted)*
Opcode: <204Dh>	*Query a modulator's alarms*	
Query response:		
<1>	*Major Alarm1*	*(Bit 0 = Mod Hardware)*
		(Bit 1 = Tx Synthesizer lock)
		(Bit 2 = Data PLL lock)
		(Bit 3 = Frame lock)
		(Bit 4 = Mod1 lock)
		(Bit 5 = Mod2 lock)
		(Bit 6 = Mod3 lock)
		(Bit 7 = Spare)
<1>	*Major Alarm2*	*(Bit 0 = RX up synthesizer lock)*
		(Bit 1 = RX down synthesizer lock)
		(Bit 2 = RF temperature Detect)
		(Bit 3 = RF CPLD (hardware))
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)
<1>	*Latched Major Alarm1*	*(Bit 0 = Mod Hardware)*
		(Bit 1 = Tx Synthesizer lock)
		(Bit 2 = Data PLL lock)
		(Bit 3 = Frame lock)
		(Bit 4 = Mod1 lock)
		(Bit 5 = Mod2 lock)
		(Bit 6 = Mod3 lock)
		(Bit 7 = Spare)
<1>	*Latched Major Alarm2*	*(Bit 0 = RX up synthesizer lock)*
		(Bit 1 = RX down synthesizer lock)
		(Bit 2 = RF temperature Detect)
		(Bit 3 = RF CPLD (hardware))
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)
<1>	*Minor Alarm1*	*(Bit 0 = Clock Activity Fault)*
		(Bit 1 = Data Activity Fault)
		(Bit 2 = FIFO Fault)
	C	*(Bit 3 = Mod Clock Activity Fault)*
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)
<1>	*Minor Alarm2*	*(Bit 0 = Spare)*
		(Bit 1 = Spare)
		(Bit 2 = Spare)
		(Bit 3 = Spare)

		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
<1>	*Latched Minor Alarm1*	*(Bit 0 = Clock Activity Fault)*
		(Bit 1 = Data Activity Fault)
		(Bit 2 = FIFO Fault)
		(Bit 3 = Mod Clock Activity Fault)
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)
<1>	*Latched Minor Alarm2*	*(Bit 0 = Spare)*
		(Bit 1 = Spare)
		(Bit 2 = Spare)
		(Bit 3 = Spare)
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)

Opcode: <204Eh> *Query a modulator's alarm Mask.*
Query response:

<1>	*Major Alarm1*	*(Bit 0 = Mod Hardware)*
		(Bit 1 = Tx Synthesizer lock)
		(Bit 2 = Data PLL lock)
		(Bit 3 = Frame lock)
		(Bit 4 = Mod1 lock)
		(Bit 5 = Mod2 lock)
		(Bit 6 = Mod3 lock)
		(Bit 7 = Spare)
		(0 = mask, 1 = allow)
<1>	*Major Alarm2*	*(Bit 0 = RX up synthesizer lock)*
		(Bit 1 = RX down synthesizer lock)
		(Bit 2 = RF temperature Detect)
		(Bit 3 = RF CPLD (hardware))
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)
		(0 = mask, 1 = allow)
<1>	*Minor Alarm1*	*(Bit 0 = Clock Activity Fault)*
		(Bit 1 = Data Activity Fault)
		(Bit 2 = FIFO Fault)
		(Bit 3 = Mod Clock Activity Fault)
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)
		(Bit 7 = Spare)
		(0 = mask, 1 = allow)
<1>	*Minor Alarm2*	*(Bit 0 = Spare)*
		(Bit 1 = Spare)
		(Bit 2 = Spare)
		(Bit 3 = Spare)
		(Bit 4 = Spare)
		(Bit 5 = Spare)
		(Bit 6 = Spare)

(0 = mask, 1 = allow)

Opcode: <204Fh> Query a modulator's PRBS (test pattern)
Query response:
<1> PRBS (0 = Normal, 1 = PRBS23, 2 = PRBS23M, 3 = PRBS15, 4 = PRBS15M)

Opcode: <2051h> Query a modulator's Base Band Loopback
Query response:
<1> BB Loopback (0 = Normal, 1 = Loopback)

Opcode: <2053h> Query a modulator's output power level
Query response:
<4> Tx Power Without cable Upconverter, value is in dBm.
(Signed value. +00 to -250 (+0.0 to -25.0 dBm)
(Implied decimal point)
Ex: +0.0dbm, data returned = 00 00 00 00 = 00 decimal = +0.0dbm
Ex: -25.0dbm, data returned = FF FF FF 06 = 100000000 – FFFFFF06 = FAh = 250 = -25.0 dBm

With cable Upconverter, value is in dBv.
(Signed value. +450 to +600 (+45.0 to +60.0 dBv)
(Implied decimal point)

Opcode: <2054h> Query a modulator's carrier control
Query response:
<1> TX Enable (0=Off, 1=On)

Opcode: <2055h> Query a modulator's carrier test
Query response:
<1> TX Carrier (0=Normal, 1=CW)

Opcode: <2060h> Query a modulator's channel table
Query response:
<1> Channel Table (0 = EIA STD, 1 = EIA HRC, 2 =EIA IRC, 3 = Trad STD, 4 = Trad HRC, 5 = Trad IRC)

Opcode: <2061h> Query a modulator's channel
Query response:
<1> Channel (See channel entry tables at end of protocol)

Modulator Command Opcodes

Opcode: <2240h> Command a modulator's frequency
<4> Frequency (Binary value, 1 Hz steps)
(Without cable Upconverter the range = 43 MHz to 44 MHz, or Optional 35 MHz to 37 MHz)
(With cable Upconverter the range = 50 MHz to 862 MHz)
(This command will cause the carrier to turn off)

Opcode: <2241h> Command a modulator's data rate
<4> Data rate (Binary value, 1bps steps)
(This command will cause the carrier to turn off)

Opcode: <2242h> Command a modulator's symbol rate

<4> Symbol rate (Binary value, 1sps steps)
(This command will cause the carrier to turn off)

Opcode: <2244h> Command a modulator's modulation.

<1> Modulation (0=4 QAM, 1=16 QAM, 2=32 QAM, 3=64 QAM, 4=128 QAM, 5=256 QAM)

Opcode: <2245h> Command a modulator's spectrum.
<1> Spectrum (0=Normal, 1=Inverted)

Opcode: <2246h> Command a modulator's framing.
<1> Framing (0=MPEG 187, 1=MPEG 188, 2=MPEG 204, 3=Data)

Opcode: <2247h> Command a modulator's Interleaver and Encoder.
<1> Interleaver/Encoder <u>(For Annex-A)</u>
(0 = 1,204, 1 = 2,102, 2 = 3,68, 3 = 4,51, 4 = 6,34, 5 = 12,17, 6 = 17,12, 7 = 34,6, 8 = 51,4, 9 = 68,3, 10 = 102,2, 11 = 204,1)
<u>(For Annex-B)</u>
(12 = 128,1, 13 = 128,2, 14 = 64,2, 15 = 128,3, 16 = 32,4, 17 = 128,4, 18 = 16,8, 19 = 128,5, 20 = 8,16, 21 = 128,6, 22 = 4,32, 23 = 128,7, 24 = 2,64, 25 = 128,8, 26 = 1,128)

Opcode: <2249h> Command a modulator's roll off.
<1> Roll off (0=0.12, 1=0.15, 2=0.18)

Opcode: <224Ah> Command a modulator's interface type
<1> Interface Type (0 = STS1, 1 = G.703-E3, 2 = G.703-T3, 3 = Normal ASI, 4 = Advanced ASI, 5 = DVB Parallel, 6 = M2P Parallel, 7 = ECL, 8 = HSSI)

Opcode: <224Bh> Command a modulator's data polarity
<1> Data Polarity (0=Normal, 1=Inverted)

Opcode: <224Ch> Command a modulator's clock polarity
<1> Clock Polarity (0=Normal, 1=Inverted)

Opcode: <224Dh> Clear a modulator's Alarms.
<0> Clear Alarms (no parameters

Opcode: <224Eh> Mask a modulators Alarms.
<1> Major Alarm1 (Bit 0 = Mod Hardware)
(Bit 1 = Tx Synthesizer lock)
(Bit 2 = Data PLL lock)
(Bit 3 = Frame lock)
(Bit 4 = Mod1 lock)
(Bit 5 = Mod2 lock)
(Bit 6 = Mod3 lock)
(Bit 7 = Spare)
(0 = mask, 1 = allow)
<1> Major Alarm2 (Bit 0 = RF up synthesizer lock)
(Bit 1 = RF down synthesizer lock)
(Bit 2 = RF temperature Detect)
(Bit 3 = RF CPLD (hardware))
(Bit 4 = Spare)
(Bit 5 = Spare)

(Bit 6 = Spare)
(Bit 7 = Spare)
(0 = mask, 1 = allow)
<1> Minor Alarm1 (Bit 0 = Clock Activity Fault)
(Bit 1 = Data Activity Fault)
(Bit 2 = FIFO Fault)
(Bit 3 = Mod Clock Activity Fault)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(Bit 7 = Spare)
(0 = mask, 1 = allow)
<1> Minor Alarm2 (Bit 0 = Spare)
(Bit 1 = Spare)
(Bit 2 = Spare)
(Bit 3 = Spare)
(Bit 4 = Spare)
(Bit 5 = Spare)
(Bit 6 = Spare)
(0 = mask, 1 = allow)

Opcode: <224Fh> Command a modulator's PRBS (test pattern)
<1> PRBS (0 = Normal, 1 = PRBS23, 2 = PRBS23M, 3 = PRBS15, 4 = PRBS15M)

Opcode: <2251h> Command a modulator's Base Band Loopback
<1> BB Loopback (0 = Normal, 1 = Loopback)

Opcode: <2253h> Command a modulators output power level
<4> Tx Power Without cable Upconverter, value is in dBm.
(Signed value. +00 to -250 (+0.0 to -25.0 dBm)
(Implied decimal point)
Ex: +0.0 dBm, data returned = 00 00 00 00 = 00 decimal = +0.0 dBm
Ex: -25.0 dBm, data returned = FF FF FF 06 = 100000000 – FFFFFF06 = FAh = 250 = -25.0 dBm

With cable Upconverter, value is in dBv.
(Signed value +450 to +600 (+45.0 to +60.0 dBv)
(Implied decimal point)

Opcode: <2254h> Command a modulator's carrier control
<1> TX Enable (0=Off, 1=On)

Opcode: <2255h> Command a modulator's carrier test
<1> TX Carrier (0=Normal, 1=CW)

Opcode: <2260h> Command a modulator's channel table
<1> Channel Table (0 = EIA STD, 1 = EIA HRC, 2 =EIA IRC, 3 = Trad STD, 4 = Trad HRC, 5 = Trad IRC)

Opcode: <2261h> Command a modulator's channel
<1> Channel (See channel entry tables at end of protocol)

The following information is applicable to the QAM256 Cable Upconverter:

Following are the US channel entries:

US EIA STD Entry	Channel	Freq. in MHz		US EIA STD Entry	Channel	Freq. in MHz
0	Custom	Custom		59	"54"	403.25
1	"2"	55.25		60	"55"	409.25
2	"3"	61.25		61	"56"	415.25
3	"4"	67.25		62	"57"	421.25
4	"1"	Custom		63	"58"	427.25
5	"5"	77.25		64	"59"	433.25
6	"6"	83.25		65	"60"	439.25
7	"95"	91.25		66	"61"	445.25
8	"96"	97.25		67	"62"	451.25
9	"97"	103.25		68	"63"	457.25
10	"98"	109.25		69	"64"	463.25
11	"99"	115.25		70	"65"	469.25
12	"14"	121.25		71	"66"	475.25
13	"15"	127.25		72	"67"	481.25
14	"16"	133.25		73	"68"	487.25
15	"17"	139.25		74	"69"	493.25
16	"18"	145.25		75	"70"	499.25
17	"19"	151.25		76	"71"	505.25
18	"20"	157.25		77	"72"	511.25
19	"21"	163.25		78	"73"	517.25
20	"22"	169.25		79	"74"	523.25
21	"7"	175.25		80	"75"	529.25
22	"8"	181.25		81	"76"	535.25
23	"9"	187.25		82	"77"	541.25
24	"10"	193.25		83	"78"	547.25
25	"11"	199.25		84	"79"	553.25
26	"12"	205.25		85	"80"	559.25
27	"13"	211.25		86	"81"	565.25
28	"23"	217.25		87	"82"	571.25
29	"24"	223.25		88	"83"	577.25
30	"25"	229.25		89	"84"	583.25
31	"26"	235.25		90	"85"	589.25
32	"27"	241.25		91	"86"	595.25
33	"28"	247.25		92	"87"	601.25
34	"29"	253.25		93	"88"	607.25
35	"30"	259.25		94	"89"	613.25
36	"31"	265.25		95	"90"	619.25
37	"32"	271.25		96	"91"	625.25
38	"33"	277.25		97	"92"	631.25
39	"34"	283.25		98	"93"	637.25
40	"35"	289.25		99	"94"	643.25
41	"36"	295.25		100	"100"	649.25
42	"37"	301.25		101	"101"	655.25
43	"38"	307.25		102	"102"	661.25
44	"39"	313.25		103	"103"	667.25
45	"40"	319.25		104	"104"	673.25
46	"41"	325.25		105	"105"	679.25
47	"42"	331.25		106	"106"	685.25
48	"43"	337.25		107	"107"	691.25

49	"44"	343.25		108	"108"	697.25
50	"45"	349.25		109	"109"	703.25
51	"46"	355.25		110	"110"	709.25
52	"47"	361.25		111	"111"	715.25
53	"48"	367.25		112	"112"	721.25
54	"49"	373.25		113	"113"	727.25
55	"50"	379.25		114	"114"	733.25
56	"51"	385.25		115	"115"	739.25
57	"52"	391.25		116	"116"	745.25
58	"53"	397.25				

US EIA HRC Entry	Channel	Freq. in MHz		US EIA HRC Entry	Channel	Freq. in MHz
0	Custom	Custom		59	"54"	402.00
1	"2"	54.00		60	"55"	408.00
2	"3"	60.00		61	"56"	414.00
3	"4"	66.00		62	"57"	420.00
4	"1"	72.00		63	"58"	426.00
5	"5"	78.00		64	"59"	432.00
6	"6"	84.00		65	"60"	438.00
7	"95"	90.00		66	"61"	444.00
8	"96"	96.00		67	"62"	450.00
9	"97"	102.00		68	"63"	456.00
10	"98"	108.00		69	"64"	462.00
11	"99"	114.00		70	"65"	468.00
12	"14"	120.00		71	"66"	474.00
13	"15"	126.00		72	"67"	480.00
14	"16"	132.00		73	"68"	486.00
15	"17"	138.00		74	"69"	492.00
16	"18"	144.00		75	"70"	498.00
17	"19"	150.00		76	"71"	504.00
18	"20"	156.00		77	"72"	510.00
19	"21"	162.00		78	"73"	516.00
20	"22"	168.00		79	"74"	522.00
21	"7"	174.00		80	"75"	528.00
22	"8"	180.00		81	"76"	534.00
23	"9"	186.00		82	"77"	540.00
24	"10"	192.00		83	"78"	546.00
25	"11"	198.00		84	"79"	552.00
26	"12"	204.00		85	"80"	558.00
27	"13"	210.00		86	"81"	564.00
28	"23"	216.00		87	"82"	570.00
29	"24"	222.00		88	"83"	576.00
30	"25"	228.00		89	"84"	582.00
31	"26"	234.00		90	"85"	588.00
32	"27"	240.00		91	"86"	594.00
33	"28"	246.00		92	"87"	600.00
34	"29"	252.00		93	"88"	606.00
35	"30"	258.00		94	"89"	612.00
36	"31"	264.00		95	"90"	618.00
37	"32"	270.00		96	"91"	624.00
38	"33"	276.00		97	"92"	630.00

39	"34"	282.00		98	"93"	636.00
40	"35"	288.00		99	"94"	642.00
41	"36"	294.00		100	"100"	648.00
42	"37"	300.00		101	"101"	654.00
43	"38"	306.00		102	"102"	660.00
44	"39"	312.00		103	"103"	666.00
45	"40"	318.00		104	"104"	672.00
46	"41"	324.00		105	"105"	678.00
47	"42"	330.00		106	"106"	684.00
48	"43"	336.00		107	"107"	690.00
49	"44"	342.00		108	"108"	696.00
50	"45"	348.00		109	"109"	702.00
51	"46"	354.00		110	"110"	708.00
52	"47"	360.00		111	"111"	714.00
53	"48"	366.00		112	"112"	720.00
54	"49"	372.00		113	"113"	726.00
55	"50"	378.00		114	"114"	732.00
56	"51"	384.00		115	"115"	738.00
57	"52"	390.00		116	"116"	744.00
58	"53"	396.00				

US EIA IRC Entry	Channel	Freq. in MHz		US EIA IRC Entry	Channel	Freq. in MHz
0	Custom	Custom		59	"54"	403.25
1	"2"	55.25		60	"55"	409.25
2	"3"	61.25		61	"56"	415.25
3	"4"	67.25		62	"57"	421.25
4	"1"	73.25		63	"58"	427.25
5	"5"	79.25		64	"59"	433.25
6	"6"	85.25		65	"60"	439.25
7	"95"	91.25		66	"61"	445.25
8	"96"	97.25		67	"62"	451.25
9	"97"	103.25		68	"63"	457.25
10	"98"	109.25		69	"64"	463.25
11	"99"	121.25		70	"65"	469.25
12	"14"	115.25		71	"66"	475.25
13	"15"	127.25		72	"67"	481.25
14	"16"	133.25		73	"68"	487.25
15	"17"	139.25		74	"69"	493.25
16	"18"	145.25		75	"70"	499.25
17	"19"	151.25		76	"71"	505.25
18	"20"	157.25		77	"72"	511.25
19	"21"	163.25		78	"73"	517.25
20	"22"	169.25		79	"74"	523.25
21	"7"	175.25		80	"75"	529.25
22	"8"	181.25		81	"76"	535.25
23	"9"	187.25		82	"77"	541.25
24	"10"	193.25		83	"78"	547.25
25	"11"	199.25		84	"79"	553.25
26	"12"	205.25		85	"80"	559.25
27	"13"	211.25		86	"81"	565.25
28	"23"	217.25		87	"82"	571.25

29	"24"	223.25		88	"83"	577.25
30	"25"	229.25		89	"84"	583.25
31	"26"	235.25		90	"85"	589.25
32	"27"	241.25		91	"86"	595.25
33	"28"	247.25		92	"87"	601.25
34	"29"	253.25		93	"88"	607.25
35	"30"	259.25		94	"89"	613.25
36	"31"	265.25		95	"90"	619.25
37	"32"	271.25		96	"91"	625.25
38	"33"	277.25		97	"92"	631.25
39	"34"	283.25		98	"93"	637.25
40	"35"	289.25		99	"94"	643.25
41	"36"	295.25		100	"100"	649.25
42	"37"	301.25		101	"101"	655.25
43	"38"	307.25		102	"102"	661.25
44	"39"	313.25		103	"103"	667.25
45	"40"	319.25		104	"104"	673.25
46	"41"	325.25		105	"105"	679.25
47	"42"	331.25		106	"106"	685.25
48	"43"	337.25		107	"107"	691.25
49	"44"	343.25		108	"108"	697.25
50	"45"	349.25		109	"109"	703.25
51	"46"	355.25		110	"110"	709.25
52	"47"	361.25		111	"111"	715.25
53	"48"	367.25		112	"112"	721.25
54	"49"	373.25		113	"113"	727.25
55	"50"	379.25		114	"114"	733.25
56	"51"	385.25		115	"115"	739.25
57	"52"	391.25		116	"116"	745.25
58	"53"	397.25				

US TRAD STD Entry	Channel	Freq. in MHz		US TRAD STD Entry	Channel	Freq. in MHz
0	Custom	Custom		34	"P"	253.25
1	"2"	55.25		35	"Q"	259.25
2	"3"	61.25		36	"R"	265.25
3	"4"	67.25		37	"S"	271.25
4	"A-8"	Custom		38	"T"	277.25
5	"5"	77.25		39	"U"	283.25
6	"6"	83.25		40	"V"	289.25
7	"A-5"	91.25		41	"W"	295.25
8	"A-4"	97.25		42	"AA"	301.25
9	"A-3"	103.25		43	"BB"	307.25
10	"A-2"	109.25		44	"CC"	313.25
11	"A-1"	115.25		45	"DD"	319.25
12	"A"	121.25		46	"EE"	325.25
13	"B"	127.25		47	"FF"	331.25
14	"C"	133.25		48	"GG"	337.25
15	"D"	139.25		49	"HH"	343.25
16	"E"	145.25		50	"II"	349.25
17	"F"	151.25		51	"JJ"	355.25
18	"G"	157.25		52	"KK"	361.25

19	"H"	163.25		53	"LL"	367.25
20	"I"	169.25		54	"MM"	373.25
21	"7"	175.25		55	"NN"	379.25
22	"8"	181.25		56	"OO"	385.25
23	"9"	187.25		57	"PP"	391.25
24	"10"	193.25		58	"QQ"	397.25
25	"11"	199.25		59	"RR"	403.25
26	"12"	205.25		60	"SS"	409.25
27	"13"	211.25		61	"TT"	415.25
28	"J"	217.25		62	"UU"	421.25
29	"K"	223.25		63	"VV"	427.25
30	"L"	229.25		64	"WW"	433.25
31	"M"	235.25		65	"XX"	439.25
32	"N"	241.25		66	"YY"	445.25
33	"O"	247.25		67	"ZZ"	451.25

US TRAD HRC Entry	Channel	Freq. in MHz		US TRAD HRC Entry	Channel	Freq. in MHz
0	Custom	Custom		34	"P"	252.00
1	"2"	54.00		35	"Q"	258.00
2	"3"	60.00		36	"R"	264.00
3	"4"	66.00		37	"S"	270.00
4	"A-8"	72.00		38	"T"	276.00
5	"5"	78.00		39	"U"	282.00
6	"6"	84.00		40	"V"	288.00
7	"A-5"	90.00		41	"W"	294.00
8	"A-4"	96.00		42	"AA"	300.00
9	"A-3"	102.00		43	"BB"	306.00
10	"A-2"	108.00		44	"CC"	312.00
11	"A-1"	114.00		45	"DD"	318.00
12	"A"	120.00		46	"EE"	324.00
13	"B"	126.00		47	"FF"	330.00
14	"C"	132.00		48	"GG"	336.00
15	"D"	138.00		49	"HH"	342.00
16	"E"	144.00		50	"II"	348.00
17	"F"	150.00		51	"JJ"	354.00
18	"G"	156.00		52	"KK"	360.00
19	"H"	162.00		53	"LL"	366.00
20	"I"	168.00		54	"MM"	372.00
21	"7"	174.00		55	"NN"	378.00
22	"8"	180.00		56	"OO"	384.00
23	"9"	186.00		57	"PP"	390.00
24	"10"	192.00		58	"QQ"	396.00
25	"11"	198.00		59	"RR"	402.00
26	"12"	204.00		60	"SS"	408.00
27	"13"	210.00		61	"TT"	414.00
28	"J"	216.00		62	"UU"	420.00
29	"K"	222.00		63	"VV"	426.00
30	"L"	228.00		64	"WW"	432.00
31	"M"	234.00		65	"XX"	438.00
32	"N"	240.00		66	"YY"	444.00
33	"O"	246.00		67	"ZZ"	450.00

US TRAD IRC Entry	Channel	Freq. in MHz		US TRAD IRC Entry	Channel	Freq. in MHz
0	Custom	Custom		34	"P"	253.25
1	"2"	55.25		35	"Q"	259.25
2	"3"	61.25		36	"R"	265.25
3	"4"	67.25		37	"S"	271.25
4	"A-8"	73.25		38	"T"	277.25
5	"5"	79.25		39	"U"	283.25
6	"6"	85.25		40	"V"	289.25
7	"A-5"	91.25		41	"W"	295.25
8	"A-4"	97.25		42	"AA"	301.25
9	"A-3"	103.25		43	"BB"	307.25
10	"A-2"	109.25		44	"CC"	313.25
11	"A-1"	115.25		45	"DD"	319.25
12	"A"	121.25		46	"EE"	325.25
13	"B"	127.25		47	"FF"	331.25
14	"C"	133.25		48	"GG"	337.25
15	"D"	139.25		49	"HH"	343.25
16	"E"	145.25		50	"II"	349.25
17	"F"	151.25		51	"JJ"	355.25
18	"G"	157.25		52	"KK"	361.25
19	"H"	163.25		53	"LL"	367.25
20	"I"	169.25		54	"MM"	373.25
21	"7"	175.25		55	"NN"	379.25
22	"8"	181.25		56	"OO"	385.25
23	"9"	187.25		57	"PP"	391.25
24	"10"	193.25		58	"QQ"	397.25
25	"11"	199.25		59	"RR"	403.25
26	"12"	205.25		60	"SS"	409.25
27	"13"	211.25		61	"TT"	415.25
28	"J"	217.25		62	"UU"	421.25
29	"K"	223.25		63	"VV"	427.25
30	"L"	229.25		64	"WW"	433.25
31	"M"	235.25		65	"XX"	439.25
32	"N"	241.25		66	"YY"	445.25
33	"O"	247.25		67	"ZZ"	451.25

Glossary

G

A	
A	Ampere
AC	Alternating Current
ADC	Analog to Digital Converter
AGC	Automatic Gain Control
AIS	Alarm Indication System. A signal comprised of all binary 1s.
AMSL	Above Mean Sea Level
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
ASIC	Application Specific Integrated Circuit
ATE	Automatic Test Equipment
B	
BER	Bit Error Rate
BERT	Bit Error Rate Test
Bit/BIT	Binary Digit or Built-In Test
BITE	Built-In Test Equipment
bps	Bits Per Second
BPSK	Binary Phase Shift Keying
BUC	Block Upconverter
Byte	8 Binary Digits

C	
C	Celsius
CATS	Computer Aided Test Software
CA/xxxx	Cable Assembly
CD-ROM	Compact Disk – Read Only Memory
CLK	Clock
cm	Centimeter
COM	Common
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check. A system of error checking performed at the transmitting and receiving stations.
CW	Continuous Wave
C/N	Carrier to Noise Ratio
D	
DAC	Digital to Analog Converter
dB	Decibels
dBc	Decibels Referred to Carrier
dBm	Decibels Referred to 1.0 milliwatt
dBmV	Decibel millivolt, The level at any point in a system expressed in dB's above or below a 1 millivolt/75ohm standard.
DC	Direct Current
Demod	Demodulator or Demodulated
DPLL	Digital Phase Locked Loop
DVB	Digital Video Broadcast
D&I	Drop and Insert
E	
E_b/N_0	Ratio of Energy per bit to Noise Power Density in a 1 Hz Bandwidth.
EEPROM	Electrically Erasable Programmable Read Only Memory
EIA	Electronic Industries Association
EMI	Electromagnetic Interference
ESC	Engineering Service Circuits
ES-ES	Earth Station to Earth Station Communication
ET	Earth Terminal

F	
F	Fahrenheit
FAS	Frame Acquisition Sync. A repeating series bits, which allow acquisition of a frame.
FCC	Federal Communications Commission
FEC	Forward Error Correction
FIFO	First In, First Out
FPGA	Field Programmable Gate Arrays
FW	Firmware
G	
g	Force of Gravity
GHz	Gigahertz
GND	Ground
H	
HSSI	High Speed Serial Interface
HW	Hardware
Hz	Hertz (Unit of Frequency)
I	
IBS	Intelsat Business Services
IDR	Intermediate Data Rate
I/O	Input/Output
IEEE	International Electrical and Electronic Engineers
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
INTELSAT	International Telecommunication Satellite Organization
ISO	International Standards Organization
I & Q	Analog In-Phase (I) and Quadrature Signals (Q)
J	
J	Joule

K	
Kbps	Kilobits per Second
Kbps	Kilobytes per Second
kg	Kilogram
kHz	Kilohertz
Ksps	Kilosymbols per Second
L	
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LO	Local Oscillator
M	
mA	Milliampere
Mbps	Megabits per Second
MFAS	Multi-Frame Acquisition Sync. See FAS.
MHz	Megahertz
MIB	Management Information Base
Mod	Modulator or Modulated
ms or msec	Millisecond
M&C	Monitor and Control
N	
NC	Normally Closed
NO	Normally Open
ns	Nanoseconds
NVRAM	Non-Volatile Random Access Memory
N/C	No Connection or Not Connected
O	
OQPSK	Offset Quadrature Phase Shift Keying
P	
PC	Personal Computer
PD Buffer	Plesiochronous/ Doppler Buffer
PLL	Phase Locked Loop
ppb	Parts per Billion
ppm	Parts per Million
P/N	Part Number

Q	
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
R	
RAM	Random Access Memory
RF	Radio Frequency
ROM	Read Only Memory
rms	Root Mean Square
RU	Rack Unit. 1 RU = 1.75"/4.45 cm
Rx	Receive (Receiver)
RxD	Receive Data
R-S	Reed-Solomon Coding. Reed-Solomon codes are block-based error correcting codes with a wide range of applications in digital communications and storage.
S	
SCC	Satellite Control Channel. A Radyne satellite format.
SEQ	Sequential
SYNC	Synchronize
T	
TBD	To Be Designed or To Be Determined
TM	Technical Manual
TPC	Turbo Product Codes
TRE	Trellis
TT	Terminal Timing
Tx	Transmit (Transmitter)
TxD	Transmit Data
U	
UART	Universal Asynchronous Receiver/Transmitter
UUT	Unit Under Test
V	
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage Controlled Oscillator
VDC	Volts, Direct Current
VIT	Viterbi Decoding

W X Y Z	
W	Watt
Misc.	
µs	Microsecond
16QAM	16 Quadrature Amplitude Modulation
8PSK	8 Phase Shift Keying