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QAM256

Digital Video Modulator and Upconverter

Installation and Operation Manual

TM077 - Rev. 3.1

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

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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 ComStream, Inc. permission to open and disassemble the product as required for evaluation. In all cases, Radyne ComStream, Inc. has sole responsibility for determining the cause and nature of failure, and Radyne ComStream, Inc.'s determination with regard thereto shall be final.

Preface

This manual provides installation and operation information for the Radyne ComStream, Inc. DMD20 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 DMD20.

Conventions

Whenever the information within this manual instructs the operator to press a pushbutton switch or keypad key on the MMS11 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



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.



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

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Record of Revisions

Revision Level	Date	Reason for Change
1	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	10-9-03	Revised Appendix A, Table A-1, Minimum Data Rate.

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 ComStream, Inc. Customer Service Department.

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A.0 QAM256 Data Rates 1


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Section 1 - Introduction

1.0 Introduction

The Radyne ComStream, Inc. new DVB-compliant QAM 256 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 upconverter features an output frequency range of 50 – 862 MHz. This 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, T3, E3 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, T3, E3 or other standard interface. The interface can accept data in an MPEG-2 transport format, or as random data.

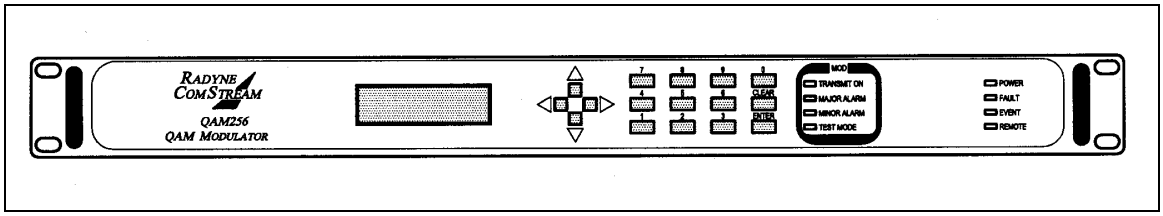


Figure 1-1. QAM256 Digital Video Modulator and Cable Upconverter Front Panel


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Section 2 - Installation

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.



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.



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.



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 94VO or better are required in order to meet low voltage directives.

Section 3 - Operation

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.

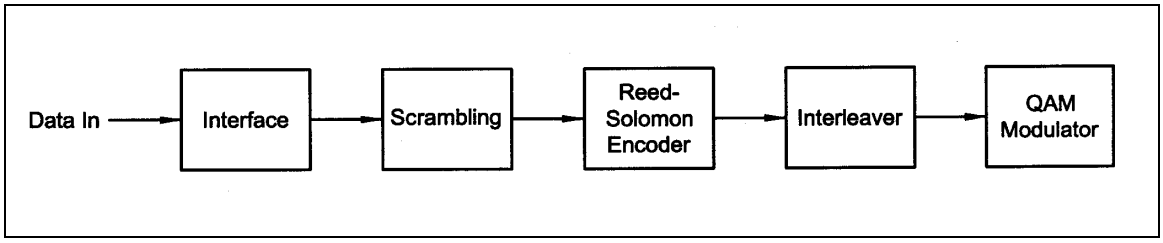


Figure 3-1. Functional Block Diagram


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Section 4 – User Interfaces

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.

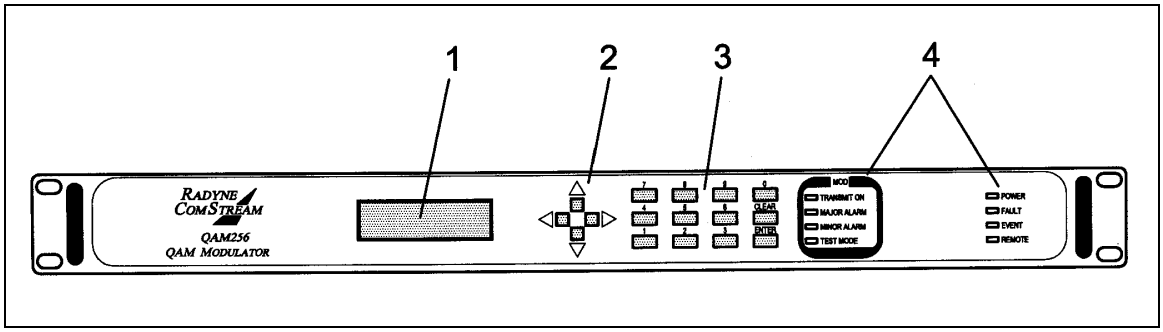


Figure 4-1. QAM256 Front Panel

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.'

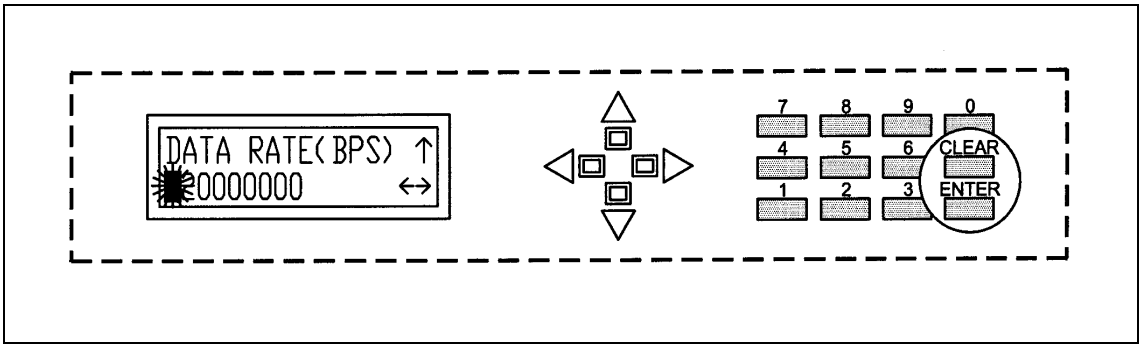


Figure 4-2. Entering New Parameters

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}** IF Carrier Frequency
Encoder Type:	**ITU-T J.83 Annex A {DVB/DAVIC}** **ITU-T J.83 Annex B {DigiCipher I I}**
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}**
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, T3, E3, STS-1, Serial, Parallel, HSSI, ECL, 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 QAM256 Terminal Mode Control (TBD)

'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.

4.5 Sample Terminal Mode Control Screen Menus (TBD)

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.***

4.6 Management Information Base Structure

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

4.7 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.

4.8 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:

4.9 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.

4.10 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.

4.11 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.

4.12 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 ComStream, Inc.'s Private Enterprise Number is 2591. Other products are added to Radyne ComStream, Inc.'s subtree as they become remotely manageable through SNMP.

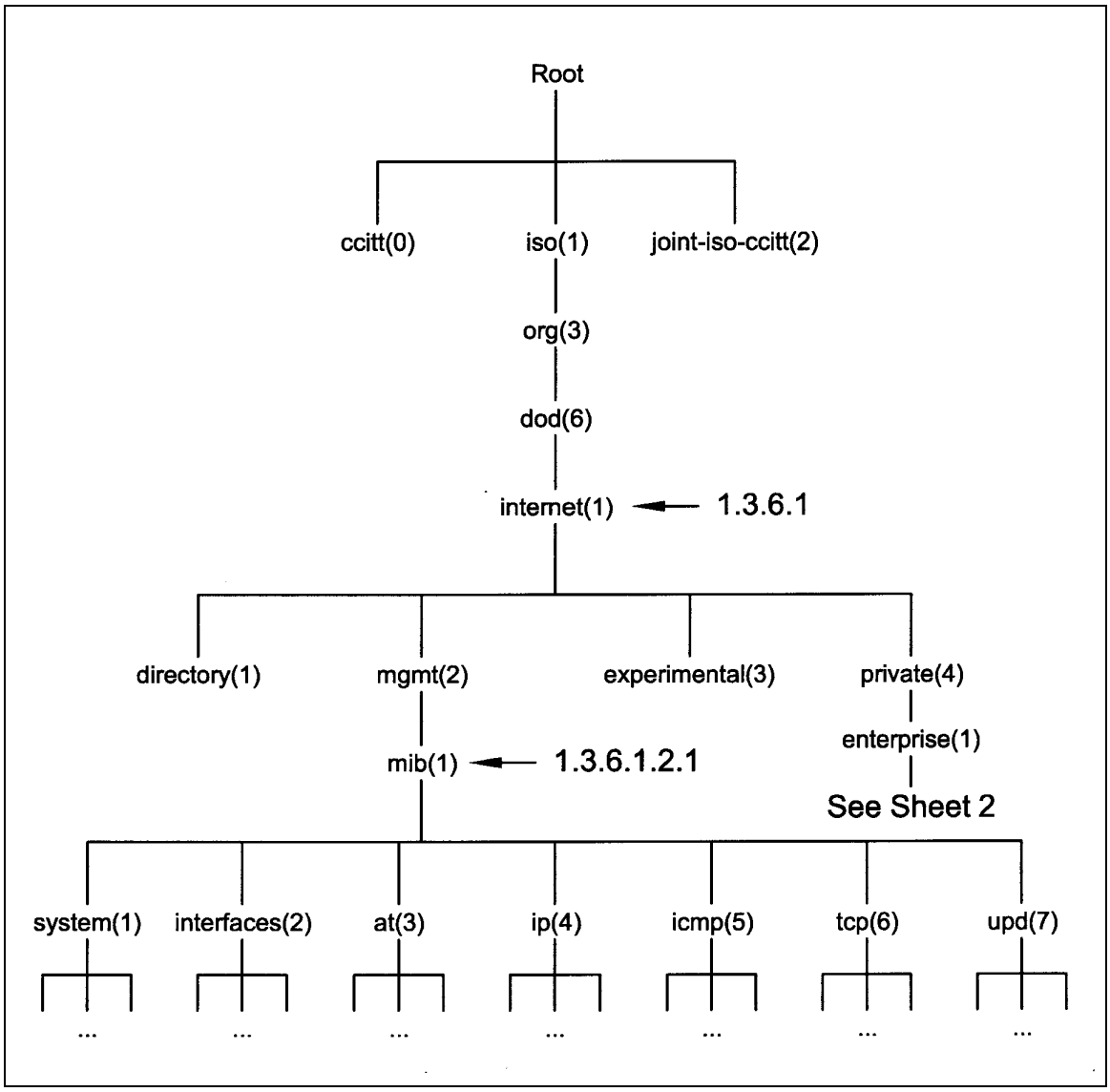


Figure 1. Object Identifiers in the Management Information Base (Sheet 1 of 2)

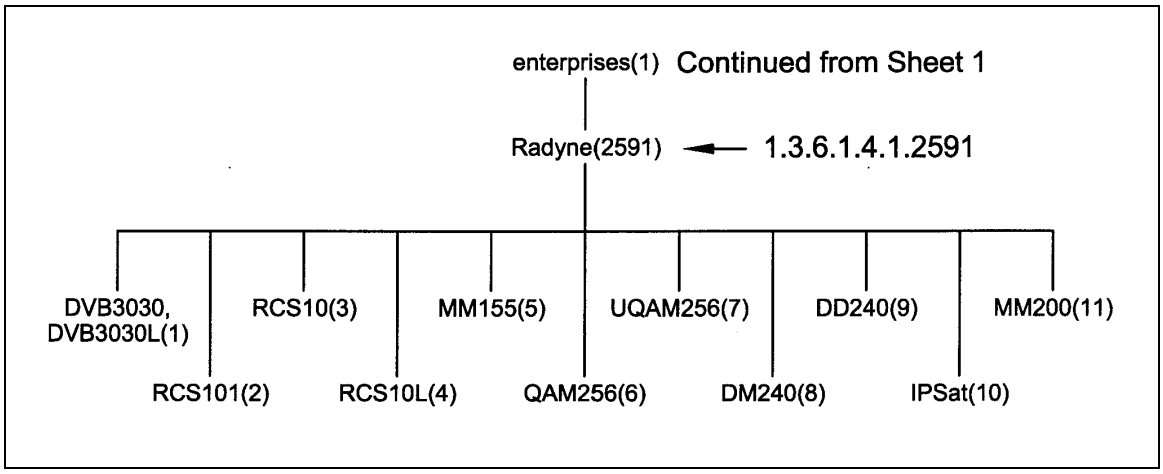


Figure 1. Object Identifiers in the Management Information Base (Sheet 2 of 2)

```
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
```


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Section 5 – Electrical Interfaces

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.

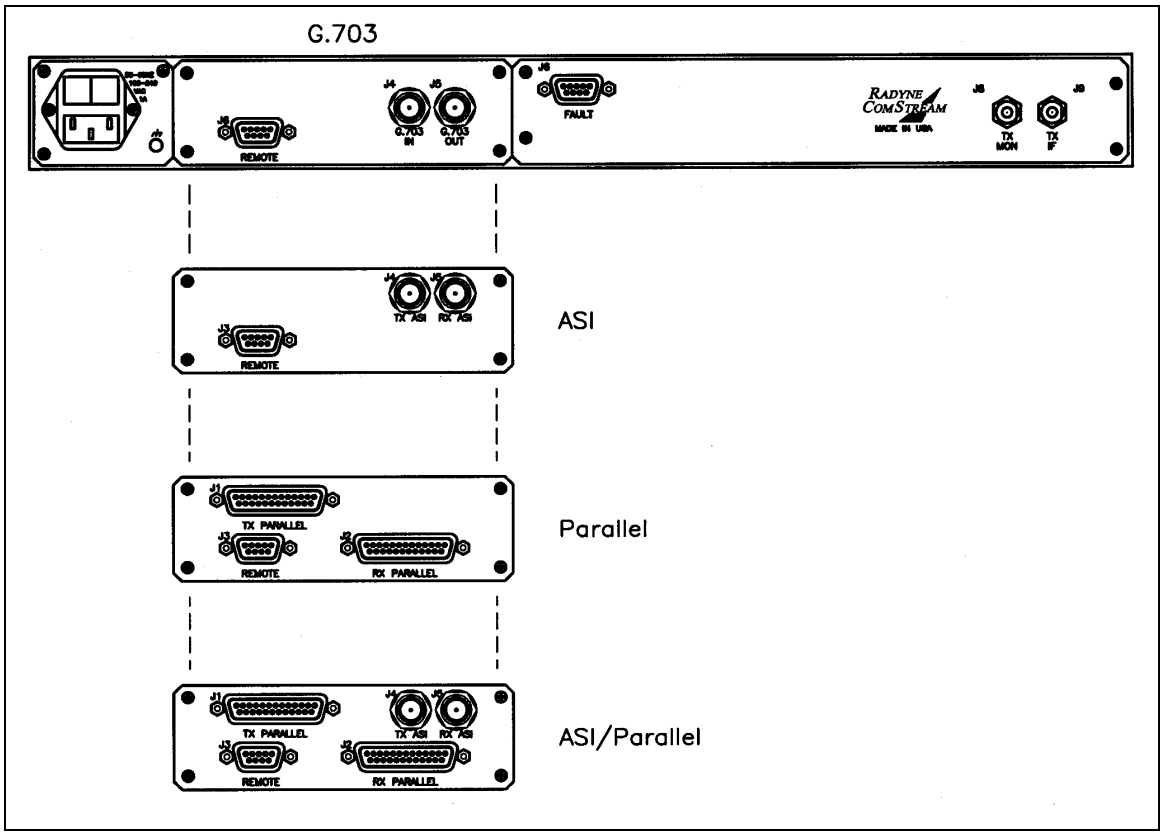


Figure 5-1. QAM256 Back Panel

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.

5.5 G.703 Interface Connections

5.5.1 REMOTE 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
2	GND	Ground	---
3	Tx (A)	Transmit Data (-)	Output
4	Rx (B)	Receive Data (+)	Input
9	Rx (A)	Receive Data (-)	Input

5.5.3 G.703 IN Connector

The G.703 IN Connector (J4) is a Female BNC Connector.

5.5.2 G.703 OUT Connector

The G.703 OUT Connector (J5) is a Female BNC Connector.

5.6 ASI Interface Connections

5.6.1 REMOTE Connector

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

5.6.2 TX ASI Connector

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

5.6.3 RX ASI Connector

The Receive ASI Connector (J5) is a Female BNC Connector.

5.7 Parallel Interface Connections

5.7.1 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.

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	---

5.7.2 RX PARALLEL Connector

The RS-422 Receive Parallel Connector (J2) is a 25-Pin Female D-Sub Connector. The pinouts are listed in Table 5-3.

5.7.3 REMOTE Connector

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

5.8 ASI/Parallel Interface Connections

5.8.1 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.

5.8.2 RX PARALLEL Connector

The RS-422 Receive Parallel Connector (J2) is a 25-Pin Female D-Sub Connector. The pinouts are listed in Table 5-3.

5.8.3 REMOTE Connector

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

5.8.4 TX ASI Connector

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

5.8.5 RX ASI Connector

The Receive ASI Connector (J5) is a Female BNC Connector.

5.9 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

5.10 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

5.11 Optional DVB Interface

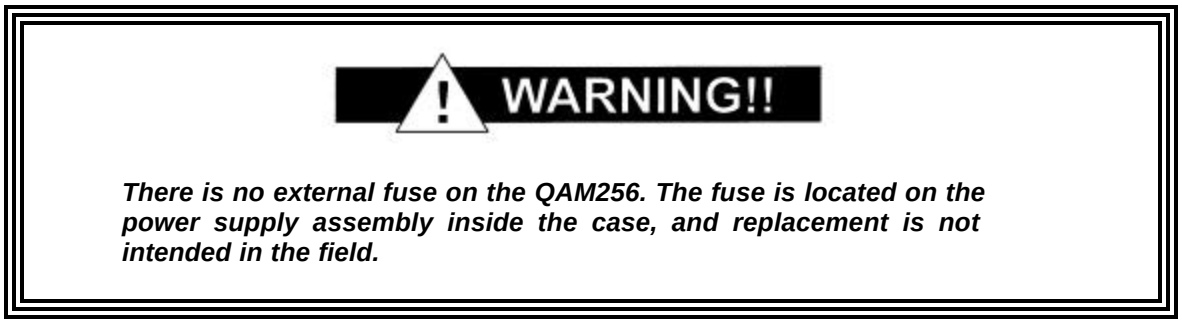
The Optional RS-422 DVB Interface Connector (J1) is a 25-Pin Female D-Sub Connector. The pinouts are listed in Table 5-6.

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

Section 6 – Maintenance

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.




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Section 7 – Technical Specifications

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:	-5 to –25 dBm
Spurious:	-50 dBc
Impedance:	75O

7.1.2 Baseband Interface

Format:	MPEG-2 Transport
Physical:	Parallel, ASI, Advanced ASI, DVB Parallel, M2P Parallel, T3, E3, STS-1, HSSI, ECL

7.1.3 Remote Interface

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

7.1.4 Physical

Chassis Size:	1.75” H x 19” W x 17.75” 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:	35 – 60 dBmV, 1 dB Steps
Power Output Accuracy:	± 0.5 dB
Power Output Stability:	± 0.5 dB
Power Adjustment:	25 dB
Spurious:	-50 dBc In-Band, 45 dB Out-of-Band
Impedance:	75O
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, T3, E3, STS-1, HSSI, ECL

7.2.3 Remote Interface

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

7.2.4 Physical

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

Appendix A

A.0 QAM256 Data Rates

Table A-1.		
Maximum Symbol Rate = 7.1 Msps		
Minimum	Maximum	Modulation Type
1.843137 Mbps	13.086275 Mbps	4 QAM
3.686274 Mbps	26.172549 Mbps	16 QAM
4.607843 Mbps	32.715686 Mbps	32 QAM
5.529411 Mbps	39.258824 Mbps	64 QAM
6.450980 Mbps	45.801961 Mbps	128 QAM
7.372549 Mbps	52.345098 Mbps	256 QAM


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