Appendix B

PSM-2100/512 Remote Control Command Protocol

This Appendix applies to the PSM-2100 and PSM-512 class modems. The only difference is that the upper data rate limit for the PSM-512 is 525 kbps in all modes. The remainder of this document refers only to these modems as the PSM-2100.

The PSM-2100 modem can be controlled by the front panel or from an external device. The use of an external "terminal" for control of the PSM-2100 is covered in the main manual. This Appendix describes the protocol for control of the modem by an external computer or controller. The computer may take many forms ranging from a dedicated stand-alone processor to a personal computer or a larger mini or main-frame computer, and is referred to here simply as a controller. The PSM-2100 contains full software allowing it to be externally controlled. Note however that no software is provided for the external controller, which is the responsibility of the user.

Before the PSM-2100 can be externally controlled it must be set to operate in the proper remote control mode via the front panel. Three parameters must be set as dictated by the control system to be used:

1. Control Interface as either RS-232 or RS-485
2. Packet style as either Binary or ASCII.
3. Modem Address

These parameters may also be set via the remote control port itself, but this is dangerous, as it will probably result in loss of communications. The RS-232 interface is only useful in a point to point control with one controller and one modem. The 485 type interface allows multiple modems and controllers to be tied to the same serial bus. The Binary packet style is more efficient and faster than the ASCII style but can be more difficult to set-up or program within certain controller types. The modem address insures that the modem only responds to messages intended for it.

The RS-485 interface on the modem is configured as a "4 wire" interface. That means that the transmit and receive wire pairs are separate. This allows a controller to both talk and listen at the same time. If a "2 wire" configuration is desired, the transmit and receive pairs may be simply tied together external to the modem. Care should be taken here to insure that the "A" or "-" side of the transmit is tied to the the "A" or "-" of the receive, and the same for the "B" or "+" side.

All remote control communications are formatted as "packets" of information including addresses, commands, responses and data. The modem never initiates transmission of a packet on its own, it only responds to a request or command packet from the controller. The sequence of events in this protocol is for the controller to send a command packet to a particular addressed modem. The addressed modem reads the command packet and if valid executes the command and sends back a response packet. A response is always returned unless:

a) The unit is improperly addressed, which causes the modem to never see the message packet, or
b) The message is globally addressed to all modems, or
c) The message flags or checksum are incorrect causing the modem to reject the message.

If the message packet address is accepted by the modem but the packet format is incorrect then an invalid message response is returned. The response may take one of several formats depending on the command type, but the response format for any particular command is fixed.

Example of Binary Packet Control System

An example Binary control system might consist of a single PC type computer communicating with one to 10 or more modems using an RS-485 interface card installed in the PC as one of the "Com" channels. This setup might be used to monitor and control a small station. The PC could in turn be communicating with a central computer system via a telephone line and modem. A program written in "C" or "BASIC" could periodically request status of each modem to insure that nothing has changed, and upon command from the central computer would change the parameters of any individual modem. For an example of the message format similar to this, see the Binary Packet Command and Response Message sections below.

Example of ASCII Packet Control System

An example ASCII control system might consist of a single PC type computer communicating with a single modem over one of the computer's RS-232 "Com" channels. This setup might be used to test and configure modems before shipment to field locations. A program written in "C" or "BASIC" could request variable information from the user and then output the necessary commands in sequence, and wait for appropriate responses for each command. For example, the standard setup for any station might be to set the transmit and receive data rates to 64 kbps BPSK, with the FEC set to rate ¾, while the parameters that would change might be the transmit and receive frequencies. The program would therefore probably ask the user for the transmit and receive frequencies, and then set those and the other standard parameters, verifying an appropriate response to each command. For an example of the message format similar to this, see the ASCII Packet Command and Response Message sections below.

The remainder of the appendix describes the Binary and ASCII packet formats.

Binary Packet Command Message Format

The Binary Packet from the controller to the PSM-2100 Modem adheres to the following message format.

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag A5 hex	Byte 3 Destination Address 8 bits	Byte 4 Source Address 8 bits	Byte 5 Binary Command 8 bits	Byte 6 Mode Byte 8 bits
Byte 7 Data Byte Count	Byte 8 - (n-3) Data Bytes 16 maximum	Byte n-2 Closing Flag 96 hex	Byte n -1 Checksum	Byte n Pad Byte FF hex	

Address Field

The modem is assigned an address via the front panel control or via the remote control line itself. Modems are normally shipped with the address preset to "1". When multiple modems are connected to the same RS-485 control line each must have an unique address to avoid conflicts. A modem may have the same address as any controller device on a shared bus, but no two controller devices may have the same address. Modems respond only to incoming messages containing their unique address in the destination address position of the control message. A destination address of 255 (0xFF) is a global address received by all modems.

The Source address may be any value from 0 to 254 that is not assigned to a modem and becomes the destination address of the response message. This allows for multiple controllers in one system. The convention of using 255 as the global address is assumed here also for controllers.

Mode Byte Field

The Mode Byte is “00” for read mode, “0F” hex for execute mode, and “FF” hex for execute and write to EEPROM. If data is not written to EEPROM it is lost when power is removed. If the controller is constantly updating every modem there is no need to re-write information to the EEPROM that has not changed. Most EEPROMs have a limited number of times that they are designed to be written to (usually between 100,000 and 1 million), so rewriting the same information every second, for example, to the modem will eventually cause it to fail.

Command Byte Field

The Binary Command Byte is taken from the Command Tables below. Note that there may be multiple command byte tables depending on the modem software version number. The software revision is read from the front panel LCD display.

Data Byte Count Field

The Data Byte Count field includes the total number of Data Bytes only, and should be zero (00) for read mode.

Data Byte Field

Only two data formats are used. 1 byte entries are a single character or unsigned byte type, and 4 byte numbers are in signed format (commonly called “long integer”). No floating point numbers are used, although the incremental value of an entry may allow a decimal point value. For instance the transmit power level is entered as an integer in increments of 0.1 dB, so an entry of -176 represents -17.6 dB. The incremental value (represented by a 1 bit change) is determined from the Write Value column of the Command Tables by ignoring any decimal point and using the number of displayed digits. Thus frequencies are entered in 1 Hz increments, data rates in 1 bps increments, and times in 1 milli-second increments. No offsets are used in any of the number entries.
Special “Multi-Command” packets contain data byte fields consisting of multiple data fields of the types described above arranged consecutively.

Checksum Field

The checksum is (256 minus the sum of all bytes excluding opening and closing pad bytes, and the checksum itself) modulo 256. The checksum never exceeds 255 in value The sum of all bytes (modulo 256) including the checksum itself is always zero.

Pad Bytes

The Pad Bytes are not checked by the processor, and multiple pad bytes may be used. Pad bytes are a all 1’s or “FF” hex. The pad bytes serve several functions in an RS-485 configured system, indicating clean transitions from idle to active states.

Binary Packet Response Message Format

The Binary Response Packet from the PSM-2100 Modem to the controller adheres to the following message format. The response from a modem will occur within approximately ½ second. Note that a modem set to 485 control port mode mutes its receive while sending the response message, so if the 485 bus is configured as 4 wire or 2 wire a modem will not receive a message while responding to a previous message.

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag 5A hex	Byte 3 Destination Address 8 bits	Byte 4 Source Address 8 bits	Byte 5 Binary Command 8 bits	Byte 6 Status Byte 8 bits
Byte 7 Error Byte	Byte 8 Data Byte Count	Byte 9 - (n-3) Data Bytes 16 maximum	Byte n-2 Closing Flag 96 hex	Byte n -1 Checksum	Byte n Pad Byte FF hex

The Destination address is taken from the Source address of the incoming packet to which this is a response. The Status and Error Bytes are defined later in this Appendix. The Data Byte Count field includes the total number of Data Bytes only, and should be zero for read mode. The Pad Bytes are not checked by the processor, and multiple pad bytes may be used. The checksum is 256 minus the sum of all bytes excluding opening and closing pad bytes, and the checksum itself. The sum of all bytes including the checksum itself is always zero.

Example Binary Packet Command and Response Messages

Assume that the controller should check the transmit frequency, and if not set correctly change it to 74.652 MHz. The modem address is set to 12 decimal and the controller is address 200 decimal.

1. Check the transmit frequency:

Command packet from controller to read the transmit frequency

Byte 1 Pad Byte “FF hex”	Byte 2 Opening Flag “A5 hex”	Byte 3 Destination Address- 8 bits “0C hex”	Byte 4 Source Address- 8 bits “C8 hex”	Byte 5 Binary Command 8 bits “01 hex”	Byte 6 Mode Byte 8 bits “00”
Byte 7 Data Byte Count “00 hex”	Byte 8 - (n-3) Data Bytes 16 maximum “Blank”	Byte n-2 Closing Flag “96 hex”	Byte n -1 Checksum “F0 hex”	Byte n Pad Byte “FF hex”	

Response packet from modem

Byte 1 Pad Byte “FF hex”	Byte 2 Opening Flag “5A hex”	Byte 3 Destination Address- 8 bits “C8 hex”	Byte 4 Source Address- 8 bits “0C hex”	Byte 5 Binary Command 8 bits “01 hex”	Byte 6 Status Byte 8 bits “18”
Byte 7 Error Byte “00 hex	Byte 7 Data Byte Count “04 hex”	Byte 8 - (n-3) Data Bytes 16 maximum “80 1D 2C 04”	Byte n-2 Closing Flag “96 hex”	Byte n -1 Checksum “52 hex”	Byte n Pad Byte “FF hex”

This response said that the modem was set to 70.000000 MHz, so the value must be changed. Note that only the packet byte sequence is given below.

2. Program the modem transmit frequency.
   Command packet from controller to set the transmit frequency to 74.652 MHz:
   “FF A5 0C C8 01 FF 04 60 19 73 04 96 FD FF”

Response from modem.

"FF 5A C8 0C 01 1A 00 04 60 19 73 04 96 2D FF"

Notice also that the value was written to EEPROM. The response status byte is shown as "1A" hex, and the error byte was taken as "00". The "1A" status byte means "Alarm B" is active, and the Demod is in alarm. These status bits may change depending on other factors in the modem.

ASCII Packet Command Message Format

The ASCII message format is similar to the Binary format except that the command and data are in ASCII text, and there is no byte count field or checksum field. Three letter Command Codes are followed by ASCII text data necessary to perform the command. Pad Bytes are only used when using the modem RS-485 remote command port, not on the RS-232 port. If the modem address is set to zero, the source and destination fields are not used, resulting in an all text command and response message format.

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag "@"	Byte 3 - 5 Destination Address 3 text digits (000 - 255)	Byte 6 - 8 Source Address 3 text digits (000 - 255)	Byte 9 - 11 Command Code 3 letters	Byte 12 Mode Byte 1 character
Byte 13- (n-2) Data Text	Byte n-1 Closing Flag CR (0D hex)	Byte n Pad Byte FF hex			

Address Field

The modem is assigned an address via the front panel control or via the remote control line itself. Modems are normally shipped with the address preset to "1". When multiple modems are connected to the same RS-485 control line each must have an unique address to avoid conflicts. A modem may have the same address as any controller device on a shared bus, but no two controller devices may have the same address. Modems respond only to messages containing their unique address in the destination address position of the incoming control message. A destination address of 255 (0xFF) is a global address received by all modems. If the modem address is set to zero, the source and destination fields are not used, resulting in an all text command and response message format.

The Source address may be any value from 0 to 254 and becomes the destination address of the response message. This allows for multiple controllers in one system. The convention of using 255 as the global address is assumed here also for controllers.

Mode Byte Field

The Mode Byte character is "?" for read mode, "<" for execute mode, and "=" for execute and write to EEPROM. If data is not written to EEPROM it is lost when power is removed. If the controller is constantly updating every modem there is no need to re-write information to the EEPROM that has not changed. Most EEPROMs have a limited number of times that they are designed to be written to (usually between 100,000 and 1 million), so rewriting the same information every second, for example, to the modem will eventually cause it to fail.

Command Byte Field

The ASCII Command Code is a three letter sequence taken from the Command Tables below. Note that there may be multiple command byte tables depending on the modem software version number. The software revision is read from the front panel LCD display.

Data Text Field

In the ASCII mode data is entered as an ASCII text string and may include decimal points in some entries. For instance the transmit power level is entered as a string and may include a decimal point and 1 decimal position. -17.0 dBm may be entered as "-17" or "-17.0" while -17.6 dBm must be entered as "-17.6". Frequencies are entered in MHz or kHz, as indicated in the command tables, and include a decimal point if entry of digits to the right of the decimal point is desired. Data rates are entered in kHz and also may include a decimal point.
In commands that allow selection of one or more options the option is chosen by inserting the ASCII text for the selection number as listed on the command Table B-1.

The responsefor all parameters is the text string that would be shown on the front panel LCD display. For example, of the modem status is good the response would be "Locked, OK".

Closing Flag Field

The closing flag in an ASCII message is a carriage return or "0D" hex.

ASCII Packet Response Message Format

The response to an ASCII packet message is:

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag "$"	Byte 3 - 5 Destination Address 3 text digits (000 - 255)	Byte 6 - 8 Source Address 3 text digits (000 - 255)	Byte 9 - 11 Command Code 3 letters	Byte 12 - 14 Status - 3 text digits (000 - 255)
Byte 15 - 17 Error - 3 text digits (000 - 255)	Byte 18 Delimiter "="	Byte 19 - (n-2) Data Text	Byte n-2 Closing Flag CR (0D hex)	Byte n Pad Byte FF hex	

The response from a modem will occur within approximately ½ second. Note that a modem set to 485 control port mode mutes its receive while sending the response message, so if the 485 bus is configured as 4 wire or 2 wire a modem will not receive a message while responding to a previous message.
The Destination address is taken from the Source address of the incoming packet to which this is a response. The Status and Error Bytes are defined later in this Appendix. The Pad Bytes are not checked by the processor, and multiple pad bytes may be used.

Example ASCII Packet Command and Response Messages

Assume that the controller should check the transmit frequency, and if not set correctly change it to 74.652 MHz. The modem address is set to 12 decimal and the controller is address 200 decimal. The "CR" in the byte sequence represents a carriage return character which is 0D hex. Note also that the "FF hex" pad bytes are not required if RS-232 is used.

1. Check the transmit frequency:

Command packet from controller to read the transmit frequency

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag "@"	Byte 3 - 5 Destination Address - 3 digits "012"	Byte 6 - 8 Source Address - 3 digits "200"	Byte 9 - 11 Command Code 3 letters "MCF"	Byte 12 Mode Byte 1 character "?"
Byte 13- (n-2) Data Text No characters "Blank"	Byte n-1 Closing Flag Carriage Ret. CR	Byte n Pad Byte FF hex			

Response packet from modem

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag "$"	Byte 3 - 5 Destination Address- - 3 digits "200"	Byte 6 - 8 Source Address- - 3 digits "012"	Byte 9 - 11 Command Code 3 letters "MCF"	Byte 12 - 14 Status - 3 digits "000"
Byte 15 - 17 Error - 3 digits "000"	Byte 18 Delimiter "="	Byte 19 - (n-2) Data Text "70.000000"	Byte n-2 Closing Flag CR	Byte n Pad Byte FF hex	

This response said that the modem was set to 70.000000 MHz, so the value must be changed. Note that only the packet byte sequence is given below with text in quotes and hex bytes un-quoted.

If this same packet was sent in the RS-232 mode and the modem address was set to "0" then the message required could easily be typed from a terminal or computer running communication software and would be:
Command - "@MCF?" and carriage return
Response = "$MCF000000=70.000000" and carriage return

2. Program the modem transmit frequency.
   Command packet from controller to set the transmit frequency to 74.652 MHz:
   FF "@012200MCF=74.562" CR FF
   Response from modem.
   FF "@200012MCF000000=74.562000" CR FF

Notice also that the value was written to EEPROM. The response error and status bytes were taken as "00" which indicate no changes or alarms which is unlikely during changes.

The following table lists the remote control packet commands by binary command number. This table is for PSM-2100 Units with software revisions "1.00" and above. The software version can be viewed at the unit front panel.

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Mod Status	00h	MST	Read Only	See Special Packet Byte Definitions Below
Mod CXR Frequency	01h	MCF	50.000000MHz to 90.000000MHz	50.000000MHz to 90.000000MHz
Mod CXR Offset Frequency	02h	MOF	-1250.000kHz to +1250.000kHz	-1250.000kHz to +1250.000kHz
Mod Output Level	03h	MOL	-5.0dBm to -25.0dBm	-5.0dBm to -25.0dBm
Mod CXR Output	04h	MCO	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Mod Bit Rate	05h	MBR	3.600kbps to 2100.000kbps*	3.600kbps to 2100.000kbps*
Mod Modulation	06h	MMO	(0)BPSK, (1)QPSK	(0)BPSK, (1)QPSK
Mod Code Rate	07h	MCR	(0)R1/2, (1)R3/4, (2)R7/8	(0)R1/2, (1)R3/4, (2)R7/8
Mod RS FEC*	08h	MRS	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Mod Differential Encoder	09h	MDE	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Mod Scrambler	0ah	MSC	(0)Disable, (1)Intelsat, (2)V.35, (3)IBS, (4)IBS RS	(0)Disable, (1)Intelsat, (2)V.35, (3)IBS, (4)IBS RS
Mod Mux*	0bh	MMX	(0)Disable, (1)IBS Standard, (2)IBS Enhanced	(0)Disable, (1)IBS Standard, (2)IBS Enhanced
Mod ES>ES Port*	0ch	MMP	(0)RS-232, (1)RS-485 2 Wire, (2)RS-485 4 Wire	(0)RS-232, (1)RS-485 2 Wire, (2)RS-485 4 Wire
Mod ES>ES Bit Rate*	0dh	MMR	0 to 7 represents standard rates from 150bps to 19.2kbps	150bps to 19.2kbps
Mod ES>ES Data Format*	0eh	MMF	(0)N72, (1)P71, (2)P72, (3)N81, (4)N82, (5)P81	(0)N72, (1)P71, (2)P72, (3)N81, (4)N82, (5)P81
Mod Data Invert	0fh	MDI	(0)Normal, (1)Inverted	(0)Normal, (1)Inverted
Mod Clock Phase	10h	MCP	(0)Normal (1)Inverted	(0)Normal (1)Inverted
Mod Clock Source	11h	MCS	(0)Internal, (1)TT Clk, (2)Demod Clk*	(0)Internal, (1)TT Clk, (2)Demod Clk*
Mod AUPC*	12h	MPC	(0)Disable, (1)Enable	(0)Disable, (1)Enable

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Mod AUPC Eb/No*	13h	MPE	3.0dB to 20.0dB	3.0dB to 20.0dB
Mod AUPC Maximum Level*	14h	MPX	-5.0dBm to Minimum Level	-5.0dBm to Minimum Level
Mod AUPC Minimum Level*	15h	MPN	Maximum Level to -25.0dBm	Maximum Level to -25.0dBm
Mod AUFC*	16h	MFC	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Mod AUFC Freq. Offset Limit*	17h	MFL	0.100kHz to 1250.000kHz	0.100kHz to 1250.000kHz
Mod AUFC Converter Up/Dwn Ratio*	18h	MFR	0.500000000 to 2.000000000	0.500000000 to 2.000000000
Mod AUFC Spectrum*	19h	MFS	(0)Non-Inverted, (1)Inverted	(0)Non-Inverted, (1)Inverted
Mod AUFC Satellite Error Freq.*	1ah	MFF	-1250.000kHz to +1250.000kHz	-1250.000kHz to +1250.000kHz
Mod Mode	1bh	MMD	(0)Continuous, (1)Burst	(0)Continuous, (1)Burst
Mod Preamble Length*	1ch	MPL	(0)32, (1)48, (2)64 Symbols	(0)32, (1)48, (2)64 Symbols
Mod RTS Input	1dh	MRI	(0)Ignore, (1)Control CXR	(0)Ignore, (1)Control CXR
Mod CXR Mute	1eh	MCM	(0)Manual, (1)Automatic	(0)Manual, (1)Automatic
Mod CXR Alarm	1fh	MCA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Mod AUPC Alarm*	20h	MPA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Mod Bit Alarm	21h	MBA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Mod Test Active Alarm	22h	MTA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Mod Hardware Fault Alarm	23h	MHA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Not Used	24h			
Not Used	25h			
Not Used	26h			
Not Used	27h			
Not Used	28h			
Not Used	29h			

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Not Used	2ah			
Not Used	2bh			
Not Used	2ch			
Not Used	2dh			
Not Used	2eh			
Not Used	2fh			
Not Used	30h			
Not Used	31h			
Not Used	32h			
Not Used	33h			
Not Used	34h			
Not Used	35h			
Not Used	36h			
Not Used	37h			
Not Used	38h			
Not Used	39h			
Not Used	3ah			
Not Used	3bh			
Not Used	3ch			
Not Used	3dh			
Not Used	3eh			
Mod Multi-Setting	3fh	MMS	Multiple Field Data Packet	Write Only
Demod Status	40h	DST	If Demod Locked then (0)Abort Lock	See Special Packet Byte Definitions Below
Demod CXR Frequency	41h	DCF	50.000000MHz to 90.000000MHz	50.000000MHz to 90.000000MHz
Demod CXR Offset Frequency	42h	DOF	-Wide Sweep to +Wide Sweep (N/A in Fast Mode)	-Wide Sweep to +Wide Sweep

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Demod Input Level	43h	DIL	Read Only	-20 to -60 dBm in 1 dB increments
Demod Eb/No	44h	DEB	Read Only	0 to 25.5 dB in 0.1 dB increments
Demod Bit Rate	45h	DBR	3.600kbps to 2100.000kbps*	3.600kbps to 2100.000kbps*
Demod Modulation	46h	DMO	(0)BPSK, (1)QPSK	(0)BPSK, (1)QPSK
Demod Code Rate	47h	DCR	(0)R1/2, (1)R3/4, (2)R7/8	(0)R1/2, (1)R3/4, (2)R7/8
Demod RS FEC*	48h	DRS	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Demod Differential Decoder	49h	DDD	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Demod Descrambler	4ah	DDS	(0)Disable, (1)Intelsat, (2)V.35, (3)IBS, (4)IBS RS	(0)Disable, (1)Intelsat, (2)V.35, (3)IBS, (4)IBS RS
Demod Demultiplexer*	4bh	DMX	(0)Disable, (1)IBS Standard, (2)IBS Enhanced	(0)Disable, (1)IBS Standard, (2)IBS Enhanced
Demod ES>ES Port*	4ch	DMP	(0)RS-232, (1)RS-485, (2)RS-485 On	(0)RS-232, (1)RS-485, (2)RS-485 On
Demod ES>ES Bit Rate*	4dh	DMR	150bps to 19.2kbps	150bps to 19.2kbps
Demod ES>ES Data Format*	4eh	DMF	(0)N72, (1)P71, (2)P72, (3)N81, (4)N82, (5)P81	(0)N72, (1)P71, (2)P72, (3)N81, (4)N82, (5)P81
Demod Data Invert	4fh	DDI	(0)Normal, (1)Inverted	(0)Normal, (1)Inverted
Demod Clock Phase	50h	DCP	(0)Normal (1)Inverted	(0)Normal (1)Inverted
Demod Clock Source	51h	DCS	(0)Demod Clk, (1)External FIFO Clk, (2)Mod Clk*	(0)Demod Clk, (1)External FIFO Clk, (2)Mod Clk*
Demod FIFO Status*	52h	DFS	(0)Clear Status, (1)Re-Center FIFO	FIFO Percent fill. 0% to 200%
Demod FIFO Delay*	53h	DFD	0.0025ms to 54612.5000ms*	0.0025ms to 54612.5000ms*
Demod FIFO Size*	54h	DFZ	4 Bits to 131070 Bits	4 Bits to 131070 Bits
Demod Sweep Mode	55h	DSM	(0)Standard, (1)Auto Narrow, (2)Auto Track, (3)Fast	(0)Standard, (1)Auto Narrow, (2)Auto Track, (3)Fast
Demod Wide Sweep Freq.	56h	DWS	0.2kHz to 1250.0kHz	0.2kHz to 1250.0kHz
Demod Narrow Sweep Time*	57h	DNT	10 Sec. to 65535 Sec. (N/A in Fast Mode)	10 Sec. to 65535 Sec.
Demod Lock Qualification Time	58h	DQT	5 Sec. to 65535 Sec.	5 Sec. to 65535 Sec.
Demod SER	59h	DSE	(0/1)Restart SER Count	SER as

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Demod Estimated BER	5ah	DBE	(0/1)Restart BER Count	BER as
Demod Low Eb/No Threshold	5bh	DLE	0.0dB to 25.5dB in 0.1 dB increments	0.0dB to 25.5dB in 0.1 dB increments
Not Used	5ch			
Not Used	5dh			
Demod Backward Alarm	5eh	DBA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Demod Lock Alarm	5fh	DLA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Demod Low Input Alarm	60h	DIA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Demod Eb/No Alarm	61h	DEA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Demod Test Active Alarm	62h	DTA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Demod Hardware Fault Alarm	63h	DHA	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B	(0)Ignore, (1)Alarm A, (2)Alarm B, (3)Alarm A&B
Not Used	64h			
Not Used	65h			
Not Used	66h			
Not Used	67h			
Not Used	68h			
Not Used	69h			
Not Used	6ah			
Not Used	6bh			
Not Used	6ch			
Not Used	6dh			
Not Used	6eh			
Not Used	6fh			
Not Used	70h			

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Not Used	71h			
Not Used	72h			
Not Used	73h			
Not Used	74h			
Not Used	75h			
Not Used	76h			
Not Used	77h			
Not Used	78h			
Not Used	79h			
Not Used	7ah			
Not Used	7bh			
Not Used	7ch			
Not Used	7dh			
Not Used	7eh			
Demod Multi-Setting	7fh	DMS	Multiple Field Data Packet	Write Only
Modem Status	80h	UST	Read Only	See Status Description Below
Modem Configuration Access	81h	UCA	(0)Disable, (1)Local, (2)Remote, (3)Local & Remote	(0)Disable, (1)Local, (2)Remote, (3)Local & Remote
Modem Mode	82h	UMD	(0)Disable, (1)Demod, (2)Mod, (3)Mod & Demod	(0)Disable, (1)Demod, (2)Mod, (3)Mod & Demod
Modem Reference Source	83h	URS	(0)Internal, (1)External	(0)Internal, (1)External
Modem Reference Frequency	84h	URF	(0)2.5MHz, (1)5.0MHz, (2)9.0MHz, (3)10MHz*	(0)2.5MHz, (1)5.0MHz, (2)9.0MHz, (3)10MHz*
Modem Remote Mode	85h	URM	(0)Disable, (1)Binary Pckt, (2)ASCII Pckt, (3)Terminal	(0)Disable, (1)Binary Pckt, (2)ASCII Pckt, (3)Terminal
Modem Remote Port*	86h	URP	(0)RS-232, (1)RS-485	(0)RS-232, (1)RS-485
Modem Remote Address*	87h	URA	0-255, 0=Disable(ASCII Only) 255=Global* 4 byte format in binary	0-255, 0=Disable(ASCII Only) 255=Global*

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Modem Remote Bit Rate*	88h	URB	150bps to 19.2kbps	150bps to 19.2kbps
Modem Remote Data Format*	89h	URD	7 Bit Data*, 8 Bit Data	7 Bit Data*, 8 Bit Data
Modem Remote Parity*	8ah	URY	(0)Space, (1)Mark, (2)Odd, (3)Even, (4)Disabled	(0)Space, (1)Mark, (2)Odd, (3)Even, (4)Disabled
Modem Remote Xon/off*	8bh	URX	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Modem Key Click	8ch	UKC	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Modem LCD Active Backlight	8dh	ULA	(0)Disable, (1)1/3, (2)2/3, (3)Full	(0)Disable, (1)1/3, (2)2/3, (3)Full
Modem LCD Idle Backlight	8eh	ULI	(0)Disable, (1)1/3, (2)2/3, (3)Full	(0)Disable, (1)1/3, (2)2/3, (3)Full
Modem Station ID	8fh	UID	String, 16 characters Maximum	String, 16 characters Maximum
Modem Model	90h	UML	String, Read Only	String, Read Only
Modem Software Version	91h	USV	String, Read Only	String, Read Only
Modem Serial #	92h	USN	Read Only	Serial Number
Modem Interface	93h	UIF	String, Read Only	RS-449, V.35, RS-232, etc.
Modem Interface Option	94h	UIP	String, Read Only	String, Read Only
Modem Interface Maximum Bit Rate	95h	UIX	Read Only	Value in 1 bps increments
Modem Interface Minimum Bit Rate	96h	UIN	Read Only	Value in 1 bps increments
Not Used	97h			
Not Used	98h			
Not Used	99h			
Not Used	9ah			
Not Used	9bh			
Not Used	9ch			
Not Used	9dh			
Not Used	9eh			
Not Used	9fh			
Not Used	a0h			
Not Used	a1h			

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Not Used	a2h			
Not Used	a3h			
Not Used	a4h			
Not Used	a5h			
Not Used	a6h			
Not Used	a7h			
Not Used	a8h			
Not Used	a9h			
Not Used	aah			
Not Used	abh			
Not Used	ach			
Not Used	adh			
Not Used	aeh			
Not Used	afh			
Not Used	b0h			
Not Used	b1h			
Not Used	b2h			
Not Used	b3h			
Not Used	b4h			
Not Used	b5h			
Not Used	b6h			
Not Used	b7h			
Not Used	b8h			
Not Used	b9h			
Not Used	bah			
Not Used	bbh			

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Not Used	bch			
Not Used	bdh			
Not Used	beh			
Not Used	bfh			
Test Status	c0h	TST	(0/1)Disable All Tests	See Special Packet Byte Definitions Below
Test IF Loop*	c1h	TIL	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Test Data Loop*	c2h	TDL	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Test Mod Output*	c3h	TMO	(0)Normal, (1)Pure CXR, (2)Side Band	(0)Normal, (1)Pure CXR, (2)Side Band
Test Demod Step AFC Voltage*	c4h	TDS	Read Only	4
Test Demod LO AFC Voltage*	c5h	TDX	Read Only	4
Test Demod AGC Voltage*	c6h	TDA	Read Only	4
Test Demod IDC Offset Voltage*	c7h	TIO	Read Only	4
Test Demod QDC Offset Voltage*	c8h	TQO	Read Only	4
Test Mod Step AFC Voltage*	c9h	TMS	Read Only	4
Test Mod LO AFC Voltage*	cah	TMX	Read Only	4
Test Reference AFC Voltage*	cbh	TRA	Read Only	4
Test Demod Filter Cal Scale Factor*	cch	TFS	Read Only	4
Test Demod Filter Cal Offset Factor*	cdh	TFO	Read Only	4
Test Demod Filter Calibration*	ceh	TCF	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Test Demod Level Calibration*	cfh	TCD	(0)Disable, (1)Enable, Continue	(0)Disable, (1)Enable, Continue
Test Mod Level Calibration*	d0h	TCM	(0)Disable, (1)Enable, -500 to +500 Cal Offset	(0)Disable, (1)Enable, -500 to +500 Cal Offset
Not Used	d1h			
Test Modem Self Test	d2h	TMT	(0)Disable, (1)Enable	(0)Disable, (1)Enable
Not Used	d3h			

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Not Used	d4h			
Not Used	d5h			
Not Used	d6h			
Not Used	d7h			
Not Used	d8h			
Not Used	d9h			
Not Used	dah			
Not Used	dbh			
Not Used	dch			
Not Used	ddh			
Not Used	deh			
Not Used	dfh			
Not Used	e0h			
Not Used	e1h			
Not Used	e2h			
Not Used	e3h			
Not Used	e4h			
Not Used	e5h			
Not Used	e6h			
Not Used	e7h			
Not Used	e8h			
Not Used	e9h			
Not Used	eah			
Not Used	ebh			
Not Used	ech			
Not Used	edh			

Table B-1
PSM-2100/512 Remote Control Packet Commands for Software Rev "1.00"

Modem Function	Binary Cmd	ASCII Cmd	Write Value	Read Value
Not Used	eeh			
Not Used	efh			
Not Used	f0h			
Not Used	f1h			
Not Used	f2h			
Not Used	f3h			
Not Used	f4h			
Not Used	f5h			
Not Used	f6h			
Not Used	f7h			
Not Used	f8h			
Not Used	f9h			
Not Used	fah			
Not Used	fbh			
Not Used	fch			
Not Used	fdh			
Not Used	feh			
Not Used	ffh			
Notes				
1 byte numbers are unsigned				
4 byte numbers are signed, lsB 1st				
Strings are Standard ASCII				

NOTES:
* Modem Function items with asterisks are optional and not always available from the front panel or remote control. They are valid only if the applicable function is installed or enabled.

PSM-2100 Software Revision 1.00 + Multi-Command Packet Data Fields

Beginning with software revisions 1.00 a new pair of commands has been added to facilitate quick setting in DAMA or other on-the-fly control systems. The most common settings for these type systems have been combined into a single binary command packet for the modulator and another packet for the demodulator. Since the modem requires time to accomplish any setting, a method is provided to allow setting of only selected parameters from the multi-command message while ignoring other settings.
The multi-command message follows the same basic structure as any other message except that the data byte field consists of multiple pre-defined data fields. The response packet from the modem follows the normal binary response except again the data byte field consists of multiple pre-defined data fields

Byte 1 Pad Byte FF hex	Byte 2 Opening Flag A5 hex	Byte 3 Source Address 8 bits	Byte 4 Destination Address 8 bits	Byte 5 Binary Command 8 bits	Byte 6 Mode Byte 8 bits
Byte 7 Data Byte Count = 14 hex	Bytes 8 - 27 Data Bytes 20 Bytes	Byte 28 Closing Flag 96 hex	Byte 29 Checksum	Byte 30 Pad Byte FF hex	

For these special packets the Data Byte Count is 20 (14 hex) and the “Data Bytes” field consists of one option field enable flag followed by 19 parameter bytes as shown below for the modulator and demodulator.

Modulator Multi-Command Packet Data Field

Data Byte 0 Option Field Enable Flags

A one “1” in a bit position of this byte indicates that the modem should read and process that data information bytes corresponding to that bit. All data bytes for each field must be supplied in the message, but those with a 0 in the corresponding flag bit are ignored. If all field enable flags are set to 0 then the response will return the current value for each parameter.

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
CXR Frequency	Offset Frequency	CXR Level	Bit Rate	Code Rate	Mod. Type	CXR Enable	0

Data Bytes 1 - 19 Modulator Parameter Data Fields

Bytes 1-4 CXR Frequency (50000000 to 90000000) in 1 Hz increments, signed number.
Bytes 5-8 CXR Offset Frequency (-1250000 to 1250000) in 1 Hz increments, signed number.
Bytes 9-12 Mod CXR Level (-250 to -50) in 0.1 dB increments, signed number.
Bytes 13-16 Bit Rate (4800 to 2100000) in 1 bps increments, signed number.
Byte 17 Code Rate (0=1/2, 1=3/4, 2=7/8), unsigned number.
Byte 18 Modulation (0=BPSK, 1=QPSK), unsigned number.
Byte 19 Mod CXR Enable (0=Disable, 1=Enable), unsigned number.

Demodulator Multi-Command Packet Data Field

Data Byte 0 Option Field Enable Flags

A one "1" in a bit position of this byte indicates that the modem should read and process that data information bytes corresponding to that bit. All data bytes must be supplied in the message, but those with a 0 in the corresponding flag bit are ignored.

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
CXR Frequency	Sweep Start	Sweep Width	Bit Rate	Code Rate	Mod. Type	Sweep Mode	0

Data Bytes 1 - 19 Demodulator Parameter Data Fields

Bytes 1-4 CXR Frequency (50000000 to 90000000) in 1 Hz increments, signed number.
Bytes 5-8 Sweep Start Frequency (Non-Fast Mode Only, -1250000 to 1250000) in 1 Hz increments, signed number.
Bytes 9-12 Sweep Offset Width (200 to 1250000) in 1 Hz increments, signed number.
Bytes 13-16 Bit Rate (4800 to 2100000) in 1 bps increments, signed number.
Byte 17 Code Rate (0=1/2, 1=3/4, 2=7/8), unsigned number.
Byte 18 Modulation (0=BPSK, 1=QPSK), unsigned number.
Byte 19 Sweep Mode (0=Wide, 1=Auto Narrow, 2=Auto Track, 3=Fast), unsigned number.

Example Use of the Multi Command Packet

An example Multi Command packet and response is shown below to further clarify the use of this special mode.

This example sets the Demodulator as noted by the binary command byte set to 7F hex.
The following command packet from controller will set the Receive frequency to 70.00 MHz, Sweep start 14 Hz above center (not used because this is fast mode), offset +/- 30 kHz acquisition sweep, 256 kbps data rate, Rate ½, QPSK, Fast acquisition mode:

```
FF A5 0C C8 7F FF 14 7F 80 1D 2C 04 0E 00 00 00 30 75 00 00 00 E8 03 00  00   01   03  96 71 FF
Data field values →    | 70.00 MHz |  14 Hz    |  30 kHz   | 256 kbps  |R1/2|QPSK|Fast|
```

The response from modem is.

```
FF 5A C8 0C 7F 1A 00 14 7F 80 1D 2C 04 FE FF FF FF 30 75 00 00 00 E8 03 00  00   01   03  96 B4 FF
Data field values →       | 70.00 MHz |  -2 Hz    |  30 kHz   | 256 kbps  |R1/2|QPSK|Fast|
```

Notice also that the values were written to EEPROM. The response status byte is shown as “1A” hex, and the error byte was taken as “00”. The “1A” status byte means “Alarm B” is active, and the Demod is in alarm. These status bits may change depending on other factors in the modem.

Special Packet Byte Definitions

The modem returns three types of special bytes within the response packet indicating the current modem status, a status byte and an error byte are returned in all response messages, while specific status bytes are returned in response to specific requests for Modulator, Demodulator, Modem and Test status. The meaning of the individual bits in each of these bytes is described below:

Modulator Status Byte (Response to Mod Status Request [00 hex])

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
CXR Syn. Alarm	Bit Timing Alarm	AUFC Alarm	AUPC Alarm	CXR Alarm	CXR Enabled (Config)	RTS Status	CXR Unmod.

CXR Syn. Alarm 1 = Alarm, the modulator synthesizer has failed.
Bit Timing Alarm 1 = Alarm, the modulator bit timing synthesizer is not locked.
AUFC Alarm 1 = Alarm, the AUFC is not within range (settable parameter).
AUPC Alarm 1 = Alarm, the AUPC is not within range (settable parameter).
CXR Alarm 1 = Alarm, the carrier output should be active but is not because of a fault condition.
CXR Enabled (Configurable) 1 = Active, the modulator transmit output is enabled.
RTS Status 1 = Active, the RTS signal is active.
CXR Unmod 1 = Not modulated (pure carrier), 0 = modulated (Normal).

Demodulator Status Byte (Response to Demod Status Request [40 hex])

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
CXR Syn. Alarm	AGC Alarm	Low Eb/No Alarm	Interface Alarm (RS/IBS)	Backward Alarm	Narrow Sweep Active	Lock Qualif. Status	Lock Status

CXR Syn. Alarm 1 = Alarm, the demodulator synthesizer has failed
AGC Alarm 1 = Alarm, the demodulator AGC is out of range
Low Eb/No Alarm 1 = Alarm, the received Eb/No is below the threshold (settable parameter)
Interface Alarm (RS/IBS) 1 = Alarm, the RS/IBS interface card has a failure
Backward Alarm 1 = Alarm, the IBS multiplexer reports a backward alarm from the far end modem
Narrow Sweep Active 1 = Active, the demodulator is currently attempting to acquire in the narrow sweep mode.
Lock Qualif. Status 1 = Active, the lock qualification time (settable parameter) has been met on the current carrier.
Lock Status 1 = Not Locked, 0 = Locked.

Modem Status Byte (Response to Modem Status Request [80 hex])

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Demod Major Alarm	Demod Minor Alarm	Demod Test Active	Mod CXR Enabled (Config)	Mod Major Alarm	Mod Minor Alarm	Mod Test Active	Modem Ref. Alarm

Demod Major Alarm	1 = Alarm, the demodulator has a current major alarm condition
Demod Minor Alarm	1 = Alarm, the demodulator has a current minor alarm condition
Demod Test Active	1 = Test Active
Mod CXR Enabled (Config)	1 = The modulator is configured to the carrier enabled condition.
Mod Major Alarm	1 = Alarm, the modulator has a current major alarm condition
Mod Minor Alarm	1 = Alarm, the modulator has a current minor alarm condition
Mod Test Active	1 = Test Active
Modem Ref. Alarm	1 = Alarm, the modem internal or external reference oscillator has failed.

Test Status Byte (Response to Test Status Request [0C0 hex])

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Side Band Mod. Active	Pure CXR Active	IF Loop Active	Data Loop Active	Mod Lvl Cal Active	Dem Lvl Cal Active	Dem Fltr Cal Active	Modem Self Test Active

Side Band Mod. Active	1 = Special side band transmit output enabled. (used in factory only)
Pure CXR Active	1 = Pure Carrier, the modulation, scrambling and spreading are disabled resulting in a pure carrier.
IF Loop Active	1 = Loop, an IF Loop is currently active
Data Loop Active	1 = Loop, an data Loop is currently active
Mod Lvl Cal Active	1 = Active, the modulator level calibration procedure is currently active (used in factory only)
Dem Lvl Cal Active	1 = Active, the demodulator level calibration procedure is currently active (used in factory only)
Dem Fltr Cal Active	1 = Active, the demodulator filter calibration procedure is currently active (used in factory only)
Modem Self Test Active	1 = Active, the modem self test is currently active

Status Byte (Returned in All Response Packets)

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Status Has Changed	EEPROM Write Enabled	Alarm A Active	Alarm B Active	Demod Alarm	Mod Alarm	0	0

Error Byte (Returned in All Response Packets)

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Warning 0	Warning 1	Warning 2	Warning 3	Error 0	Error 1	Error 2	Error 3

Meaning of Warning and Error Bits

The error byte returned with all response packets contains 4 bits representing warnings and 4 bits representing errors. Warnings concern modem conditions, while errors define reasons why a command or request was denied and not accomplished.

If Bit 3 = 0

```
      Warning bit       x1h             ;warning, bit rate changed
      Warning clock     x2h             ;warning, clock source changed
      Warning fifo      x4h             ;warning, fifo delay changed
Else if Bit 3 = 1
      Warning format    x8h             ;warning, remote data format changed
      Warning ona       x9h             ;warning, option not active
      Warning sub-ch    xah             ;warning, no sub channel
      Warning mod       xbh             ;warning, mod carrier alarm
      Warning dem       xch             ;warning, demod unlocked
```

Where “x” in the above values represents the upper nibble of error bits.

```
err_rdo     1xh             ;error, read only
err_inv     2xh             ;error, invalid request
err_ona     3xh             ;error, option n/a
err_lck     4xh             ;error, option locked
err_bsy     5xh             ;error, option busy
err_mod     6xh             ;error, mod disabled
err_dem     7xh             ;error, demod disabled
```

```
err_lmt     8xh             ;error, request exceeded limit, set to limit
err_cmd     9xh             ;error, invalid command
err_dta     axh             ;error, invalid data
err_pmd     bxh             ;error, invalid packet mode
err_acd     cxh             ;error, access denied, config write protected
```

Where “x” in the above values represents the lower nibble of warning bits.

For example a returned error byte of 0Abh would indicate that the data in the request was invalid and the modem has a carrier alarm.