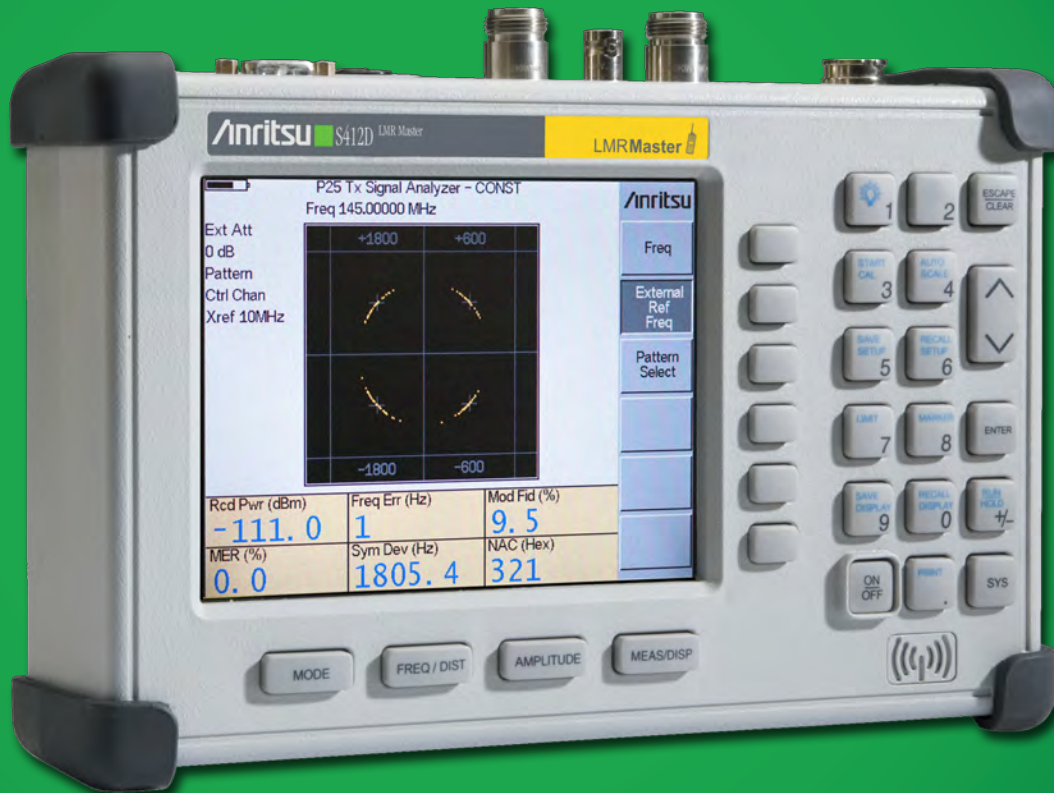


# LMR Master

S412D

An Integrated, Handheld Multi-function Land Mobile Radio Test Tool for Greater Flexibility and Technician Productivity





# **LMR Master S412D Programming Manual**

Remote Mode Command Specification

Part Number: 10580-00261 Revision: C

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# Programming Overview

This programming menu is written exclusively for Anritsu LMR Master model S412D. For information on firmware upgrade, please contact your local Anritsu service center.

## **General Description**

The LMR Master must first be set into “remote” mode for communication with a computer. Remote mode differs from normal repetitive sweep and single-sweep modes. During remote mode, the LMR Master suspends normal operations and attends to the serial port. The front panel display indicates when the LMR Master is in remote mode.

Once in remote mode, you send a series of control bytes and associated data to the LMR Master. These control byte sequences command the LMR Master to perform various functions and activities. The serial port supports virtually all features accessible from the keypad. The only exception is the printer, which requires connection to the same 9 pin connector on the LMR Master rear panel.

To complete the communication session, send the control byte to exit remote mode. LMR Master resumes normal operations. You may also exit the remote mode by using the ESCAPE/CLEAR key.

## **Cabling**

Serial communications take place via the 9 pin connector on the back of the LMR Master. The LMR Master is a DTE-type serial device and therefore requires a “null modem” cable for communication with a computer, which is also a DTE device. We provide a suitable cable with your LMR Master. (Anritsu part number 800-441)

## **Serial Communication Parameters**

The LMR Master communicates at a baud rate of 9600 except when in the “Control Channel” pattern for P25/NXDN measurement modes. The baud rate increases to 115200 when the pattern is “Control Channel” and returns to 9600 when another pattern is selected. It uses no parity bits, 8 data bits, and 1 stop bit (N-8-1). No hardware handshaking is used. The Set Baud Rate serial command Control Byte #197 (C5h) can be used to change the baud rate to other common baud rates.

## **Communications Error Checking**

Since there is no hardware handshaking, byte level error handling must be done by the controlling program. The expected number of response bytes for each control byte (listed in the control byte description section of this manual) works well for responses coming from the LMR Master. For data streams going to the LMR Master, the “watch dog timer” protects against interrupted transmissions by aborting a control byte sequence if the inter-byte time limit is exceeded.

## **Parameter Validation**

The LMR Master validates input parameters for each control byte sequence. If the input parameters are out of range or invalid, the LMR Master notifies the computer by sending Parameter Error Byte #224 (E0h). The LMR Master discards the received data and waits for the next control byte.

## **Entering Remote Mode**

Send the Enter Remote Mode Byte #69 (45h) to the LMR Master to enter remote mode at the end of a sweep Send the Enter Remote Mode Immediately byte #70 (46h) to enter remote mode in the middle of a sweep.

The LMR Master's serial port buffer is one byte wide. No internal buffer exists, so waiting for the unit's response is essential. If the LMR Master is not in remote, sending a second byte overwrites the original byte commanding it to go into remote. If you send control byte #69, you must wait until the end of the sweep. If you send control byte #70, the unit will enter remote mode as soon as it receives the byte. Note that this means that data stored for the current sweep may be incomplete.

Once you receive the response string from LMR Master, you are in remote mode.

### ***Exiting Remote Mode***

Send the Exit Remote control byte #255 (FFh) to the LMR Master. LMR Master sends a response byte of 255 (FFh) then exits remote mode. Remote mode can also be exited by pressing the ESCAPE/CLEAR key.

### ***Lifetime of Changes to LMR Master Operating Parameters***

System parameters changed during remote mode remain changed for normal operation. They are not automatically written to the non-volatile EEPROM. Turning off power erases the changed settings.

If you want the changes saved, you must save the change to one of the setup memories. Use either the run-time setup (location 0, which holds the power-on defaults) or one of the nine saved setups. See control byte #18 (12h) for details.

### ***Write Cycle Limitation of EEPROM***

The EEPROM, used to store calibrations, setups and traces has a guaranteed lifetime of at least 100,000 write cycles and an unlimited number of read cycles. The write cycle limitation is for a specific location. For example, you can store setup #1 100,000 times and setup #2 100,000 times, etc.

It is for this reason we do not automatically store the changed system parameters to EEPROM. Instead, we provide a means of changing the operating parameters independent of this limitation.

Be aware of the EEPROM write cycle limitation when programming the LMR Master. Keep the number of write cycles to a minimum.

### ***Documentation Conventions***

Through this manual the following conventions will be observed:

#### ***Numeric Representation:***

**Hexadecimal** numbers are represented with the suffix h. For example, the decimal number 255 is represented in hexadecimal as FFh.

**Binary** numbers are represented with the suffix b. For example, the decimal number 2 is represented in binary as 10b.

**Decimal** numbers are represented with the prefix # when referring to a control byte (command byte) and without a prefix or suffix in all other cases.

#### ***Bit Positions:***

When enumerating bits in a byte, bit 0 will always be the least significant bit (LSB).

# Control Byte Descriptions

## **Setup System – Control Byte #1 (01h)**

*Description:* Sets system status flags and switches. The current value of the flags can be obtained by executing command #29, Query System Setup, and parsing the values from the appropriate bytes. The LMR Master acts on the entire byte. So, the state of each of the bits must be defined every time the command is issued. See control byte #29 (1Dh) response bytes 170 (VNA modes) and 275 and 276 (Spectrum Analyzer mode) for current LMR Master configuration.

*Bytes to Follow:* 2 bytes

1) Status Byte 1

bit 0: Fixed CW Mode On/Off (1b = On, 0b = Off)

bit 1: Not Used

bit 2: LCD Back Light On/Off (1b = On, 0b = Off)

bit 3: Measurement Unit Metric/English (0b = English, 1b = Metric)<sup>1</sup>

bits 4-7: Not Used

2) Status Byte 2

bit 0: RBW Coupling (to span) (1b = Auto 0b = Manual)

bit 1: VBW Coupling (to RBW) (1b = Auto 0b = Manual)

bit 2: Not Used

bits 3-4: Logarithmic Amplitude Units (00b = dBm 01b = dBV 10b = dBmV 11b = dBuV)

bits 5-6: Detection Algorithm (00b = Positive Peak 01b = RMS Average  
10b = Negative Peak 11b = Sampling Mode)

bit 7: Attenuation Coupling (to ref level) (1b = Auto 0b = Manual)

*LMR Master Returns:* 1 byte

1) 255 (FFh) Operation Complete Byte

238 (EEh) Time-out Error

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<sup>1</sup> Set the Metric/English flag to the proper value before sending distance information.



### **Set LMR Master VNA Frequency – Control Byte #2 (02h)**

*Description:* Sets the LMR Master frequency range. Start and stop frequencies are given in terms of 1 Hz steps. (e.g. 1000.3 MHz would be sent as 1000300000 = 1,000,300,000 Hz.)

Valid range is 25 MHz – 4000 MHz.

See control byte #29 (1Dh) response bytes 28 to 35 for current LMR Master start and stop frequencies.

*Bytes to Follow:* 8 bytes

- 1) Start Frequency (highest byte)
- 2) Start Frequency
- 3) Start Frequency
- 4) Start Frequency (lowest byte)
- 5) Stop Frequency (highest byte)
- 6) Stop Frequency
- 7) Stop Frequency
- 8) Stop Frequency (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Invalid frequency range
  - 238 (EEh) Time-out Error
-

### **Select Measurement Mode – Control Byte #3 (03h)**

*Description:* Sets the measurement mode of the LMR Master. The response byte will not be sent until the mode change is complete.

See control byte #29 (1Dh) response byte 3 for the current LMR Master measurement mode.

*Bytes to Follow:* 1 byte

1) Measurement Mode

- 00h: RL Frequency
- 01h: SWR Frequency
- 02h: Cable Loss Frequency
- 10h: RL Distance
- 11h: SWR Distance
- 12h: Optical DTF
- 30h: Spectrum Analyzer Mode
- 31h: Transmission Mode (Option 21 Only)
- 39h: Channel Scanner Mode (Option 27 Only)
- 3Bh: Interference Analysis Mode (Option 25 Only)
- 40h: Power Meter Mode
- 41h: External Power Monitor Mode (Option 5 Only)
- 93h: iDEN Mode (Option 68 Only)
- 95h: P25 Tx Signal Analyzer Mode (Option 520 Only)
- 96h: P25 Talk-Out Coverage Mode (Option 522 Only)
- 97h: NXDN Tx Signal Analyzer Mode (Option 530 Only)
- 98h: NXDN Talk-Out Coverage Mode (Option 532 Only)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Invalid measurement mode
  - 238 (EEh) Time-out Error
-

### **Set LMR Master VNA Scale – Control Byte #4 (04h)**

*Description:* Sets the top and bottom value of current measurement mode.

Return Loss & Cable Loss:

Unit is dB/1000.

Maximum value sent is 60000 which represents 60.00 dB,

Minimum value sent is 0 which represent 0.00 dB,

Start value < Stop value

SWR:

Unit is 1/1000 (of ratio)

Maximum value sent is 65535 which represents 65.53

Minimum value sent is 1000 which represents 1.00

Start value < Stop value

See control byte #29 (1Dh) response bytes 36 to 43 for current LMR Master scaling.

*Bytes to Follow:* 8 bytes

- 1) Scale Start (highest byte)
- 2) Scale Start
- 3) Scale Start
- 4) Scale Start (lowest byte)
- 5) Scale Stop (highest byte)
- 6) Scale Stop
- 7) Scale Stop
- 8) Scale Stop (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Invalid scale range
  - 238 (EEh) Time-out Error
-

## **Set LMR Master VNA Marker – Control Byte #5 (05h)**

*Description:* Sets an individual marker position and status in the current measurement mode.

The LMR Master sets the position of a marker by its relative position on the graph. The lowest position is 0 at the start frequency (or distance). The highest position is the data point number at the stop frequency (or distance). For example, for a resolution of 130, the first frequency is at position 0. The last frequency is at 129.

To calculate the data point from a frequency (or distance) do the following:

$$\text{point} = (\text{resolution} - 1) * (\text{marker freq} - \text{start freq}) / (\text{stop freq} - \text{start freq})$$

See control byte #29 (1Dh) response bytes 44 to 55 for current frequency markers.

See control byte #29 (1Dh) response bytes 138 to 149 for current distance markers.

See control byte #29 (1Dh) response byte 162 for current marker on/off status.

*Bytes to Follow:* 5 bytes

- 1) Marker Number (01h = marker 1, 02h = marker 2, 03h = marker 3, 04h = marker 4, 05h = marker 5, 06h = marker 6)
- 2) Marker Line On/Off (01h = On, 00h = Off)
- 3) Marker Delta On/Off (01h = On, 00h = Off) <sup>2</sup>
- 4) Marker Value (higher byte)
- 5) Marker Value (lower byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid marker, marker status, or marker position  
238 (EEh) Time-out Error
- 

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<sup>2</sup> This byte is not applicable for markers 5 and 6. It will be ignored by the LMR Master.

## **Set LMR Master VNA Single Limit – Control Byte #6 (06h)**

*Description:* Sets the position and On/Off Status of the Single Limit Line for the VNA modes. See control byte #103 to set the single limit for the spectrum analyzer mode.

The single limit is a single, horizontal line. It can be set to On/Off in any LMR Master mode. If Limit Beep is set to ON, the LMR Master will give an error beep when sweep data appears above the limit line in SWR or Return Loss mode, or when sweep data appears below the limit line in Cable Loss mode.

The single limit and multiple limit types are mutually exclusive. That is, setting the single limit ON automatically turns multiple limit lines OFF. See control byte #112 (70h) for information about multiple limits.

See control byte #29 (1Dh) response bytes 56-59, and byte 164 for current LMR Master configuration.

*Bytes to Follow:* 6 bytes

- 1) Limit Line On/Off (01h = On, 00h = Off)
- 2) Beep at Limit On/Off (01h = On, 00h = Off)
- 3) Limit Value (highest byte)
- 4) Limit Value
- 5) Limit Value
- 6) Limit Value (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid limit status, limit beep status, or limit value  
238 (EEh) Time-out Error

*Notes:*

Return Loss & Cable Loss:

Limit should be sent as ( dB \* 1000 )

Maximum value sent is 60000 which represents 60.00 dB

Minimum value sent is 0 which represents 0.0 dB

SWR:

Limit is in **thousandths** (of ratio), so it should be sent as ( ratio \* 1000 )

Maximum value sent is 65530 which represents 65.53

Minimum value sent is 1000 which represents 1.00

---

## **Set DTF Parameter – Control Byte #7 (07h)**

*Description:* Sets Distance to Fault parameters.

Be aware using this control byte. The distance to fault parameters are all inter-related. Consequently, the control byte must change all of those parameters at the same time to properly set them.

Please refer to the LMR Master User's Guide for a detailed explanation of the factors influencing proper selection of DTF parameters.

Give Start & Stop Distances in hundred-thousandths of meter or foot (12.34 m would be sent as 1234000)

Relative Propagation Velocity is in hundred-thousandths (a Relative Propagation Velocity of 0.850 will be sent as 85000)

Cable Loss is in hundred-thousandths of dB/m or dB/ft (-0.345 dB/m would be sent as 34500)

See control byte #29 (1Dh) response bytes 130-137 (Distance), 150-157 (Propagation Velocity & Cable Loss) for current LMR Master configuration.

*Bytes to Follow:* 16 bytes

- 1) Start Distance (highest byte)
- 2) Start Distance
- 3) Start Distance
- 4) Start Distance (lowest byte)
- 5) Stop Distance (highest byte)
- 6) Stop Distance
- 7) Stop Distance
- 8) Stop Distance (lowest byte)
- 9) Relative Propagation Velocity (highest byte)
- 10) Relative Propagation Velocity
- 11) Relative Propagation Velocity
- 12) Relative Propagation Velocity (lowest byte)
- 13) Cable Loss (highest byte)
- 14) Cable Loss
- 15) Cable Loss
- 16) Cable Loss (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Parameter(s) out of range
  - 238 (EEh) Time-out Error
-

### **Set Time/Date – Control Byte #8 (08h)**

*Description:* Sets the current time and date.

This Time/Date is stamped into all stored sweeps (for users' reference).

The LMR Master stores bytes as ASCII text. Recommended time form is “hh:mm:ss” (hour:minute:sec). Recommended date format is “mm/dd/yyyy” (month/day/year).

The current time setting can be found by using control byte #33 to recall trace 0 and examining response bytes 31-38.

The current date setting can be found by using control byte #33 to recall trace 0 and examining response bytes 21-30.

*Bytes to Follow:* 7 bytes

- 1) Hour
- 2) Minute
- 3) Month
- 4) Day
- 5) Year (Highest byte)
- 6) Year (Lowest byte)
- 7) Daylight Saving (01h = On, 00h = Off)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 238 (EEh) Time-out Error
- 

### **Set Trace Name (Reference Number) – Control Byte #9 (09h)**

*Description:* Stores a Reference Number with the sweep trace.

The reference number is also known as the trace name. It is any combination of 16 letters, numbers and the characters “-“, “;“, “.” and “+”. This command stores a trace name with the sweep trace.

The current reference number is found by recalling trace 0 and examining response bytes 39 to 54.

*Bytes to Follow:* 16 bytes (ASCII text string)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 238 (EEh) Time-out Error
-

### **Serial Port Echo On/Off – Control Byte #10 (0Ah)**

*Description:* Sets the serial port echo mode On/Off.

Serial Port Echo Mode uses the **single sweep** mode (see control byte #11 (0Bh)). At the end of each sweep cycle, the LMR Master sends a Sweep Complete Byte #192 (C0h) to the serial port.

This mode activates once the LMR Master exits from the remote mode. Serial Port Echo status can't be saved to or recalled from saved setups. Cycling power resets the Serial port echo status to Off.

The Serial Port Echo Mode allows run-time handshaking between the LMR Master and computer by doing the following:

- 1) Enter remote mode. Set Serial Port Echo Mode On. Exit remote mode.
- 2) The LMR Master sweeps once and then sends the Sweep Complete Byte.
- 3) After you receive it. Enter remote mode. Recall sweep 0 (last sweep trace in RAM).
- 4) Exit remote mode. Send Sweep Triggering Byte #48 (30h) and wait for the next sweep cycle.
- 5) Repeat steps 2-4

*Bytes to Follow:* 1 byte

- 1) Serial Port Echo Status  
00h : Off  
01h : On

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid serial port echo status  
238 (EEh) Time-out Error
- 

### **LMR Master VNA Single Sweep Mode On/Off – Control Byte #11 (0Bh)**

*Description:* Enables or disables the Single Sweep Mode during LMR Master VNA modes of operation. For Single Sweep Mode during the Spectrum Analyzer mode of operation see control byte #108 (6Ch)

Single Sweep Mode activates once the LMR Master exits from the remote mode.

When the LMR Master returns to local mode, the LMR Master stops sweeping, waits for either the Run/Hold Key of the LMR Master keypad or triggering byte #48 (30h).

LMR Master also checks for the Enter Remote byte #69 (45h) at the end of each sweep. If present in the buffer, LMR Master returns to remote mode.

*Bytes to Follow:* 1 byte

- 1) Single Sweep Mode Status  
00h : Off  
01h : On

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid single sweep mode status  
238 (EEh) Time-out Error
- 

### **Watch-Dog Timer On/Off – Control Byte #12 (0Ch)**

*Description:* Enables or disables the Watch-dog timer. Default is Disabled.

The LMR Master incorporates a watch-dog timer for higher reliability in serial communication. In selected control bytes (see control byte summary), the LMR Master checks for the time interval between each byte received from the



computer. If the time interval exceeds the set time limit (0.5 sec), the LMR Master notifies the computer by sending Time-out Byte #238 (EEh). The LMR Master discards the data it just received and then waits for the next control byte sequence.

*Bytes to Follow:* 1 byte

- 1) Watch-dog timer On/Off  
00h = Off  
01h = On

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid watch-dog timer status
- 

### **Sequence LMR Master Calibration – Control Byte #13 (0Dh)**

*Description:* Initiates a calibration step.

The LMR Master must be calibrated to give accurate measurements.

The command sequence must be sent in correct order. i.e. Open -> Short -> Load. You can also abort the calibration by command – “Abort” before the command - “Load” is sent. Once command - “Load” is sent, calibration is completed, and the old calibration data is lost.

This command is designed to be executed step by step: open, short, load. Issuing any other command during this command sequence will cause undesired results.

*Bytes to Follow:* 1 byte

- 1) Calibration Step to trigger  
01h = Open  
02h = Short  
03h = Load  
04h = Not Used  
05h = Abort

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Error : Invalid Cal operation or Cal Incomplete  
238 (EEh) Time-out Error
- 

### **Set LMR Master VNA Data Points – Control Byte #14 (0Eh)**

*Description:* Set number of measurement data points for LMR Master VNA modes.

*Bytes to Follow:* 1 byte

- 1) Number of Data Points  
00h = 130 Points  
01h = 259 Points  
02h = 517 Points

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid number of data points  
238 (EEh) Time-out Error
-

### **Set LMR Master Calibration Mode – Control Byte #15 (0Fh)**

*Description:* Set the LMR Master calibration mode to OSL Cal (standard) or FlexCal.

*Bytes to Follow:* 1 byte

- 1) Calibration Mode
  - 00h = OSL Calibration (standard)
  - 01h = FlexCal Calibration

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Invalid calibration mode
  - 238 (EEh) Time-out Error
- 

### **Store Sweep Trace – Control Byte #16 (10h)**

*Description:* Saves current trace to the next available memory location. Trace name can be set using control byte #9, “Set Trace Name (Reference Number)” before executing this command.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 5 bytes

- 1-4) Time/Date Stamp (In long integer format)
  - 5) Operation result:
    - 255 (FFh) Operation Complete Byte
    - 224 (E0h) Out of memory (Memory full)
    - 238 (EEh) Time-out Error
- 

### **Save System Setup – Control Byte #18 (12h)**

*Description:* Saves current system setup parameters to a specific setup store location.

The LMR Master saves all parameters described in Query System Status - Control Byte #29 (1Dh), (except Serial Port Echo Status) to the specified store location. Store location 0 is the run-time setup of the LMR Master. It holds the power-on defaults of the LMR Master.

*Bytes to Follow:* 1 byte

- 1) Location to save system setup parameters:
  - 0 – 10 for SWR Mode, Return Loss Mode, Cable Loss Mode and DTF Mode
  - 0 – 5 for Spectrum Analyzer Mode (S412D only)
  - 0 – 5 for Power Meter Mode
  - 0 – 5 for Transmission Mode (with Option 21 Only)
  - 0 – 5 for Interference Analysis Mode (with Option 25 Only)
  - 0 – 5 for Channel Scanner Mode (with Option 27 Only)
  - 0 – 5 for iDEN Mode (with Option 68 Only)
  - 0 – 5 for P25 Tx Signal Analyzer Mode (with Option 520 Only)
  - 0 – 5 for P25 Talk-Out Coverage Mode (with Option 522 Only)
  - 0 – 5 for NXDN Tx Signal Analyzer Mode (with Option 530 Only)
  - 0 – 5 for NXDN Talk-Out Coverage Mode (with Option 532 Only)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Invalid store location
  - 238 (EEh) Time-out Error
-

## **Recall System Setup – Control Byte #19 (13h)**

*Description:* Recalls system setup parameters from a specific store location. Storage locations depend on the measurement mode of the current setup. When the current mode is Spectrum Analyzer, Spectrum Analyzer setups (1-5) can be recalled. When the current mode is one of the LMR Master VNA modes (SWR, RL, CL, DTF), one of the 10 VNA mode setups can be recalled.

The LMR Master recalls all parameters described in Query System Status - Control Byte #29 (1Dh), (except Serial Port Echo Status) from the specified store location. The recalled setup does **not** automatically become the power-on runtime setup when exiting remote. Therefore, a call to #29 will not display the parameters in that setup.

You may want to save the recalled setup as the run-time setup by saving it to setup location 0 (which holds the power-on runtime setup). See control byte #18 (12h) for details.

*Bytes to Follow:* 1 byte

1) Location from which to recall system setup parameters:

- 0 = Run time setup for all measurement modes
- 1 – 10 = Saved setups for LMR Master VNA Modes SWR, RL, CL, DTF
- 1 – 5 = Saved setups for Spectrum Analyzer Mode (S412D Only)
- 1 – 5 = Saved setups for Power Meter Mode
- 1 – 5 = Saved setups for Transmission Mode(with Option 21 Only)
- 1 – 5 = Saved setups for Interference Analysis Mode (with Option 25 Only)
- 1 – 5 = Saved setups for Channel Scanner Mode (with Option 27 Only)
- 1 – 5 = Saved setups for iDEN Mode (with Option 68 Only)
- 1 – 5 = Saved setups for P25 Tx Signal Analyzer Mode (with Option 520 Only)
- 1 – 5 = Saved setups for P25 Talk-Out Coverage Mode (with Option 522 Only)
- 1 – 5 = Saved setups for NXDN Tx Signal Analyzer Mode (with Option 530 Only)
- 1 – 5 = Saved setups for NXDN Talk-Out Coverage Mode (with Option 532 Only)
- 254 = Default setup, current mode
- 255 = Default setup, all modes

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error : Invalid store location or no saved setup
  - 227 (E3h) Frequency Mismatch Error
  - 238 (EEh) Time-out Error
-

### **Trigger Self-Test – Control Byte #21 (15h)**

*Description:* Triggers a self test on the LMR Master.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 12 bytes

- 1) Self-test report: (0b = Fail, 1b = Pass)  
(LSB) bit 0 : Phase Lock Loop  
bit 1 : Integrator  
bit 2 : Battery  
bit 3 : Temperature  
bit 4 : EEPROM read/write  
bit 5 : RTC Battery  
bits 6- 7 : Not Used
- 2) Self-test report: (0b = Fail, 1b = Pass)  
(LSB) bit 0 : Spectrum Analyzer Lock  
bits 1–7 : Not Used
- 3) Battery Voltage (higher byte)
- 4) Battery Voltage (lower byte)
- 5) Temperature (higher byte)
- 6) Temperature (lower byte)
- 7) Lock Fail Counter (higher byte)
- 8) Lock Fail Counter (lower byte)
- 9) Integrator Fail Counter (higher byte)
- 10) Integrator Fail Counter (lower byte)
- 11) Spectrum Analyzer Lock Fail Counter (higher byte)
- 12) Spectrum Analyzer Lock Fail Counter (lower byte)

*Notes:*

Battery Voltage in 1/10th of a Volt (e.g. 124 = 12.4 Volts)

Temperature in 1/10th of degree Celsius (e.g. 362 = 36.2 °C) or degree Fahrenheit (e.g. 934 = 93.4 °F), depending on the current measurement unit (Metric or English) selected

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### **Read Fail Counter – Control Byte #22 (16h)**

*Description:* Reads the Fail Counter. Values are integer numbers of failures.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 8 bytes

- 1) Value of SM Lock Fail Counter (higher byte)
  - 2) Value of SM Lock Fail Counter (lower byte)
  - 3) Value of Integration Fail Counter (higher byte)
  - 4) Value of Integration Fail Counter (lower byte)
  - 5) Value of SA Lock Fail Counter (higher byte)
  - 6) Value of SA Lock Fail Counter (lower byte)
  - 7) Value of SA Fatal Error Counter (higher byte)
  - 8) Value of SA Fatal Error Counter (lower byte)
-

### **Clear Fail Counters – Control Byte #23 (17h)**

*Description:* Resets the Lock Fail Counters, Integrator Fail Counter and spectrum analyzer Fatal Error Counter.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 

### **Query Trace Names – Control Byte #24 (18h)**

*Description:* Returns a list of all saved traces.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 3 + (41 x number of save traces) bytes

- 1-2) # of saved traces

For each trace:

- 1-2) Trace Index
- 3) Measurement Mode (refer to Control Byte #3)
- 4-21) Date/Time in string format (“MM/DD/YYYYHH:MM:SS”)
- 22-25) Date/Time as Unsigned Long Integer (Seconds Since January 1, 1970)
- 26-41) Trace Name (16 bytes)

- 255 (FFh) Operation Complete Byte
- 

### **Delete Sweep Trace – Control Byte #25 (19h)**

*Description:* Delete single trace or all stored sweep traces in LMR Master.

*Bytes to Follow:* 1 byte

- 1) 0 - Delete all traces  
X - Delete single trace #X

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 

### **Query Sweep Memory – Control Byte #27 (1Bh)**

*Description:* Queries LMR Master for percentage of memory that is available for trace storage.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

- 1) % of memory currently available (0 to 100)
- 

### **Query System Status – Control Byte #29 (1Dh)**

*Description:* Queries the LMR Master for current system settings. Unlike Control Byte #20, this command returns only data that is valid for the active mode, plus system settings, such as the defined printer.

The current state of the LMR Master represents the state after the last successful remote control operation.

For example, change the start frequency to another valid frequency while in remote mode, then execute control byte #29. The new start frequency will be returned in the defined bytes, even though no sweep has been performed with that frequency.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:*

For All Modes:

- 1) Number of Following Bytes (higher byte)
- 2) Number of Following Bytes (lower byte)
- 3) Measurement Mode<sup>3</sup>
- 4) Printer Type<sup>4</sup>
- 5) Current Language  
(00h = English, 01h = French, 02h = German, 03h = Spanish, 04h = Chinese, 05h = Japanese)
- 6) LCD Contrast Value (0-255)
- 7) Date Format  
(00h = MM/DD/YYYY, 01h = DD/MM/YYYY, 02h = YYYY/MM/DD)
- 8) RTC battery <sup>5</sup> (higher byte)
- 9) RTC battery (lower byte)
- 10) PC Board Revision <sup>6</sup> (higher byte)
- 11) PC Board Revision (lower byte)
- 12-25) Not Used

For LMR Master VNA Modes:

- 26) LMR Master VNA Mode Data Points (higher byte)
- 27) LMR Master VNA Mode Data Points (lower byte)
- 28) VNA Start Frequency (Frequency in Hz) (highest byte)
- 29) VNA Start Frequency
- 30) VNA Start Frequency
- 31) VNA Start Frequency (lowest byte)
- 32) VNA Stop Frequency (Frequency in Hz) (highest byte)
- 33) VNA Stop Frequency
- 34) VNA Stop Frequency
- 35) VNA Stop Frequency (lowest byte)
- 36) VNA Scale Start (highest byte)<sup>7</sup>
- 37) VNA Scale Start
- 38) VNA Scale Start
- 39) VNA Scale Start (lowest byte)
- 40) VNA Scale Stop (highest byte)
- 41) VNA Scale Stop
- 42) VNA Scale Stop
- 43) VNA Scale Stop (lowest byte)
- 44) VNA Frequency Marker 1 (higher byte)<sup>8</sup>
- 45) VNA Frequency Marker 1 (lower byte)
- 46) VNA Frequency Marker 2 (higher byte)
- 47) VNA Frequency Marker 2 (lower byte)
- 48) VNA Frequency Marker 3 (higher byte)
- 49) VNA Frequency Marker 3 (lower byte)

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<sup>3</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>4</sup> See Control Byte #30 for supported printers.

<sup>5</sup> Value sent as Volts \* 10. For example, 2.7 V = 27.

<sup>6</sup> This value is for internal use only.

<sup>7</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>8</sup> Marker Point = ( # data points – 1 ) \* ( marker freq – start freq ) / ( stop freq – start freq )

Where # of data points can be found in bytes 2-3, start freq is in bytes 4-7, and stop freq is in bytes 8-11.

- 50) VNA Frequency Marker 4 (higher byte)
- 51) VNA Frequency Marker 4 (lower byte)
- 52) VNA Frequency Marker 5 (higher byte)
- 53) VNA Frequency Marker 5 (lower byte)
- 54) VNA Frequency Marker 6 (higher byte)
- 55) VNA Frequency Marker 6 (lower byte)
- 56) LMR Master VNA Single Limit (highest byte)<sup>9</sup>
- 57) LMR Master VNA Single Limit
- 58) LMR Master VNA Single Limit
- 59) LMR Master VNA Single Limit (lowest byte)
- 60) VNA Multiple Limit Segment # (1)
- 61) VNA Multiple Limit Segment Status (0h = Off, 01h = On )
- 62) VNA Multiple Limit Segment Start X (highest byte)<sup>10</sup>
- 63) VNA Multiple Limit Segment Start X
- 64) VNA Multiple Limit Segment Start X
- 65) VNA Multiple Limit Segment Start X (lowest byte)
- 66) VNA Multiple Limit Segment Start Y (higher byte)
- 67) VNA Multiple Limit Segment Start Y (lowest byte)
- 68) VNA Multiple Limit Segment End X (highest byte)
- 69) VNA Multiple Limit Segment End X
- 70) VNA Multiple Limit Segment End X
- 71) VNA Multiple Limit Segment End X (lowest byte)
- 72) VNA Multiple Limit Segment End Y (higher byte)
- 73) VNA Multiple Limit Segment End Y (lowest byte)
- 74-129) Repeat bytes 60 – 73 for segments 2 - 5
- 123) Start Distance (highest byte)<sup>11</sup>
- 124) Start Distance
- 125) Start Distance
- 126) Start Distance (lowest byte)
- 127) Stop Distance (highest byte)
- 128) Stop Distance
- 129) Stop Distance
- 130) Stop Distance (lowest byte)
- 131) Distance Marker 1 (higher byte)<sup>12</sup>
- 132) Distance Marker 1 (lower byte)
- 133) Distance Marker 2 (higher byte)
- 134) Distance Marker 2 (lower byte)
- 135) Distance Marker 3 (higher byte)
- 136) Distance Marker 3 (lower byte)
- 137) Distance Marker 4 (higher byte)
- 138) Distance Marker 4 (lower byte)
- 139) Distance Marker 5 (higher byte)
- 140) Distance Marker 5 (lower byte)
- 141) Distance Marker 6 (higher byte)
- 142) Distance Marker 6 (lower byte)
- 143) Relative Propagation Velocity (highest byte)<sup>13</sup>
- 144) Relative Propagation Velocity
- 145) Relative Propagation Velocity
- 146) Relative Propagation Velocity (lowest byte)

<sup>9</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>10</sup> See Control Byte #112, “Set LMR Master VNA Segmented Limit Lines” for data format.

<sup>11</sup> Distance data uses units 1/100,000m or 1/100,000 ft

<sup>12</sup> Marker Point = ( # data points – 1 ) \* ( marker dist – start dist ) / ( stop dist – start dist )

Where # of data points can be found in bytes 2-3, start dist is in bytes 106-109, and stop dist is in bytes 110-113.

<sup>13</sup> Relative Propagation Velocity uses units 1/100,000.

- 147) Cable Loss (highest byte)<sup>14</sup>
- 148) Cable Loss
- 149) Cable Loss
- 150) Cable Loss (lowest byte)
- 151) Average Cable Loss<sup>15</sup> (highest byte)
- 152) Average Cable Loss
- 153) Average Cable Loss
- 154) Average Cable Loss (lowest byte)
- 155) Status Byte 1: ( 0b = Off , 1b = On)  
 (LSB) bit 0 : LMR Master Marker 1 On/Off  
 bit 1 : LMR Master Marker 2 On/Off  
 bit 2 : LMR Master Marker 3 On/Off  
 bit 3 : LMR Master Marker 4 On/Off  
 bit 4 : LMR Master Marker 5 On/Off  
 bit 5 : LMR Master Marker 6 On/Off  
 bits 6- 7 : Not Used
- 156) Status Byte 2: (0b = Off, 1b = On)  
 (LSB) bit 0 : Not Used  
 bit 1 : LMR Master Marker 2 Delta On/Off  
 bit 2 : LMR Master Marker 3 Delta On/Off  
 bit 3 : LMR Master Marker 4 Delta On/Off  
 bits 4-7: Not Used
- 157) Status Byte 3: ( 0b = Off , 1b = On)  
 (LSB) bit 0 : LMR Master Limit Type (0b = Single, 1b = Multiple)  
 bit 1 : LMR Master Limit Beep On/Off  
 bit 2 : FREQ-SWR Multiple Limit Segment 1 Status On/Off  
 bit 3 : FREQ-SWR Multiple Limit Segment 2 Status On/Off  
 bit 4 : FREQ-SWR Multiple Limit Segment 3 Status On/Off  
 bit 5 : FREQ-SWR Multiple Limit Segment 4 Status On/Off  
 bit 6 : FREQ-SWR Multiple Limit Segment 5 Status On/Off  
 bit 7 : LMR Master Single Limit Status On/Off
- 158) Status Byte 4: (0b = Off, 1b = On)  
 (LSB) bits 0-1: Not Used  
 bit 2: FREQ-RL Multiple Limit Segment 1 Status On/Off  
 bit 3: FREQ-RL Multiple Limit Segment 2 Status On/Off  
 bit 4: FREQ-RL Multiple Limit Segment 3 Status On/Off  
 bit 5: FREQ-RL Multiple Limit Segment 4 Status On/Off  
 bit 6: FREQ-RL Multiple Limit Segment 5 Status On/Off  
 bit 7: Not Used
- 159) Status Byte 5: (0b = Off, 1b = On)  
 (LSB) bits 0-1: Not Used  
 bit 2: FREQ-CL Multiple Limit Segment 1 Status On/Off  
 bit 3: FREQ-CL Multiple Limit Segment 2 Status On/Off  
 bit 4: FREQ-CL Multiple Limit Segment 3 Status On/Off  
 bit 5: FREQ-CL Multiple Limit Segment 4 Status On/Off  
 bit 6: FREQ-CL Multiple Limit Segment 5 Status On/Off  
 bit 7: Not Used
- 160) Status Byte 6: (0b = Off, 1b = On)  
 (LSB) bits 0-1: Not Used  
 bit 2 : DIST-SWR Multiple Limit Segment 1 Status On/Off  
 bit 3 : DIST-SWR Multiple Limit Segment 2 Status On/Off  
 bit 4 : DIST-SWR Multiple Limit Segment 3 Status On/Off  
 bit 5 : DIST-SWR Multiple Limit Segment 4 Status On/Off

<sup>14</sup> Cable loss uses units 1/100,000 dB/m or 1/100,000 dB/ft.

<sup>15</sup> Average Cable Loss is dB \* 1000.



- bit 6: DIST-SWR Multiple Limit Segment 5 Status On/Off
  - bit 7 : Not Used
- 161) Status Byte 7: (0b = Off, 1b = On)
  - (LSB) bits 0-1: Not Used
  - bit 2: DIST-RL Multiple Limit Segment 1 Status On/Off
  - bit 3: DIST-RL Multiple Limit Segment 2 Status On/Off
  - bit 4: DIST-RL Multiple Limit Segment 3 Status On/Off
  - bit 5: DIST-RL Multiple Limit Segment 4 Status On/Off
  - bit 6: DIST-RL Multiple Limit Segment 5 Status On/Off
  - bit 7: Not Used
- 162) Status Byte 8:
  - (LSB) bits 0 - 1 : DTF Windowing Mode
  - bit: 1 0
  - | |
  - 0 0 - Rectangular (No Windowing)
  - 0 1 - Nominal Side Lobe
  - 1 0 - Low Side Lobe
  - 1 1 - Minimum Side Lobe
  - bit 2: Serial Port Echo Status On/Off
  - bits 3 – 7 : Not Used
- 163) Status Byte 9: (0b = Off, 1b = On )
  - (LSB) bit 0 : Fixed CW Mode On/Off
  - bit 1 : LMR Master VNA Cal On/Off
  - bit 2 : LCD Back Light On/Off
  - bit 3 : Measurement Unit Metric/English (0b = English, 1b = Metric)
  - bit 4 : InstaCal On/Off
  - bits 5-6: Not Used
  - bit 7 : Cal Mode (0b = OSL Cal, 1b = FlexCal)
- 164) VNA Signal Standard<sup>16</sup> (higher byte)
- 165) VNA Signal Standard (lower byte)
- 173-300) Not Used

For Spectrum Analyzer Mode/Transmission Mode (Option 21):

- 26) Spectrum Analyzer Mode Data Points (higher byte)
- 27) Spectrum Analyzer Mode Data Points (lower byte)
- 28) Spectrum Analyzer Start Frequency<sup>17</sup> (highest byte)
- 29) Spectrum Analyzer Start Frequency
- 30) Spectrum Analyzer Start Frequency
- 31) Spectrum Analyzer Start Frequency (lowest byte)
- 32) Spectrum Analyzer Stop Frequency<sup>18</sup> (highest byte)
- 33) Spectrum Analyzer Stop Frequency
- 34) Spectrum Analyzer Stop Frequency
- 35) Spectrum Analyzer Stop Frequency (lowest byte)
- 36) Spectrum Analyzer Center Frequency<sup>19</sup> (highest byte)
- 37) Spectrum Analyzer Center Frequency
- 38) Spectrum Analyzer Center Frequency
- 39) Spectrum Analyzer Center Frequency (lowest byte)
- 40) Spectrum Analyzer Frequency Span<sup>20</sup> (highest byte)
- 41) Spectrum Analyzer Frequency Span
- 42) Spectrum Analyzer Frequency Span

<sup>16</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>17</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>18</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>19</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>20</sup> Scaled by Frequency Scale Factor (bytes 321-322)

- 43) Spectrum Analyzer Frequency Span (lowest byte)
- 44) Spectrum Analyzer Minimum Frequency Step Size (highest byte)
- 45) Spectrum Analyzer Minimum Frequency Step Size
- 46) Spectrum Analyzer Minimum Frequency Step Size
- 47) Spectrum Analyzer Minimum Frequency Step Size (lowest byte)
- 48) Ref Level (highest byte)<sup>21</sup>
- 49) Ref Level
- 50) Ref Level
- 51) Ref Level (lowest byte)
- 52) Scale per div (highest byte)<sup>22</sup>
- 53) Scale per div
- 54) Scale per div
- 55) Scale per div (lowest byte)
- 56) Spectrum Analyzer Frequency Marker 1 (higher byte)<sup>23</sup>
- 57) Spectrum Analyzer Frequency Marker 1 (lower byte)
- 58) Spectrum Analyzer Frequency Marker 2 (higher byte)
- 59) Spectrum Analyzer Frequency Marker 2 (lower byte)
- 60) Spectrum Analyzer Frequency Marker 3 (higher byte)
- 61) Spectrum Analyzer Frequency Marker 3 (lower byte)
- 62) Spectrum Analyzer Frequency Marker 4 (higher byte)
- 63) Spectrum Analyzer Frequency Marker 4 (lower byte)
- 64) Spectrum Analyzer Frequency Marker 5 (higher byte)
- 65) Spectrum Analyzer Frequency Marker 5 (lower byte)
- 66) Spectrum Analyzer Frequency Marker 6 (higher byte)
- 67) Spectrum Analyzer Frequency Marker 6 (lower byte)
- 68) Spectrum Analyzer Single Limit (highest byte)<sup>24</sup>
- 69) Spectrum Analyzer Single Limit
- 70) Spectrum Analyzer Single Limit
- 71) Spectrum Analyzer Single Limit (lowest byte)
- 72) SPA Multiple Upper Limit 1 Start X<sup>25</sup> (highest byte)
- 73) SPA Multiple Upper Limit 1 Start X
- 74) SPA Multiple Upper Limit 1 Start X
- 75) SPA Multiple Upper Limit 1 Start X (lowest byte)
- 76) SPA Multiple Upper Limit 1 Start Y (Power Level) (highest byte)<sup>26</sup>
- 77) SPA Multiple Upper Limit 1 Start Y (Power Level)
- 78) SPA Multiple Upper Limit 1 Start Y (Power Level)
- 79) SPA Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 80) SPA Multiple Upper Limit 1 End X<sup>27</sup> (highest byte)
- 81) SPA Multiple Upper Limit 1 End X
- 82) SPA Multiple Upper Limit 1 End X
- 83) SPA Multiple Upper Limit 1 End X (lowest byte)
- 84) SPA Multiple Upper Limit 1 End Y (Power Level) (highest byte)<sup>28</sup>
- 85) SPA Multiple Upper Limit 1 End Y (Power Level)
- 86) SPA Multiple Upper Limit 1 End Y (Power Level)
- 87) SPA Multiple Upper Limit 1 End Y (Power Level) (lowest byte)
- 88-231) SPA Multiple Upper Limits 2-5, SA Multiple Lower Limits 1-5 (see bytes 72-87 for format)

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<sup>21</sup> Value sent as (value in dBm \* 1000) + 270,000)

<sup>22</sup> Value sent as (value \* 1000)

<sup>23</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points – 1 ) ) + start frequency.

<sup>24</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>25</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>26</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>27</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>28</sup> Value sent as ( value in dBm \* 1000 ) + 270000

- 232) RBW Setting (highest byte)<sup>29</sup>
- 233) RBW Setting
- 234) RBW Setting
- 235) RBW Setting (lowest byte)
- 236) VBW Setting (highest byte)<sup>30</sup>
- 237) VBW Setting
- 238) VBW Setting
- 239) VBW Setting (lowest byte)
- 240) OCC BW Method<sup>31</sup>
- 241) OCC BW % Value (highest byte)<sup>32</sup>
- 242) OCC BW % Value
- 243) OCC BW % Value
- 244) OCC BW % Value (lowest byte)
- 245) OCC BW dBc (highest byte)<sup>33</sup>
- 246) OCC BW dBc
- 247) OCC BW dBc
- 248) OCC BW dBc (lowest byte)
- 249) Attenuation (highest byte)
- 250) Attenuation
- 251) Attenuation
- 252) Attenuation (lowest byte)
- 253) Antenna Index(0-14)
- 254-269) Antenna Name (16 bytes in ASCII)
- 270) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Spectrum Analyzer Mode Marker 1 On/Off
  - bit 1 : Spectrum Analyzer Mode Marker 2 On/Off
  - bit 2 : Spectrum Analyzer Mode Marker 3 On/Off
  - bit 3 : Spectrum Analyzer Mode Marker 4 On/Off
  - bit 4 : Spectrum Analyzer Mode Marker 5 On/Off
  - bit 5 : Spectrum Analyzer Mode Marker 6 On/Off
  - bits 6 - 7 : Not Used
- 271) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : Transmission Mode Cal Status On/Off (Option 21)
  - bit 1 : Spectrum Analyzer Mode Marker 2 Delta On/Off
  - bit 2 : Spectrum Analyzer Mode Marker 3 Delta On/Off
  - bit 3 : Spectrum Analyzer Mode Marker 4 Delta On/Off
  - bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)
  - bit 5 : Pre Amp Status On/Off
  - bit 6 : Dynamic Attenuation On/Off
  - bit 7 : Normalization On/Off
- 272) Status Byte 3: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)
  - (LSB) bit 0 : SPA Limit Type (0b = Single, 1b = Multiple)
  - bit 1 : SPA Single Limit Beep On/Off
  - bit 2 : SPA Single Limit Status On/Off
  - bit 3 : SPA Single Limit Beep Level ABOVE/BELOW
  - bit 4 : SPA Multiple Limit Upper Segment 1 Status On/Off
  - bit 5 : SPA Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW<sup>34</sup>

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<sup>29</sup> RBW frequency sent in Hz.

<sup>30</sup> VBW frequency sent in Hz.

<sup>31</sup> 00h = % of power, 01h = dB down

<sup>32</sup> 0 – 99%

<sup>33</sup> 0 – 120 dBc

<sup>34</sup> Beep level is always 1b for upper segmented limit line

- bit 6 : SPA Multiple Limit Upper Segment 2 Status On/Off
- bit 7 : SPA Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW
- 273) Status Byte 4 : ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)
- (LSB) bit 0 : SPA Multiple Limit Upper Segment 3 Status On/Off
- bit 1 : SPA Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW
- bit 2 : SPA Multiple Limit Upper Segment 4 Status On/Off
- bit 3 : SPA Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW
- bit 4 : SPA Multiple Limit Upper Segment 5 Status On/Off
- bit 5 : SPA Multiple Limit Upper Segment 5 Beep Level ABOVE/BELOW
- bit 6 : SPA Multiple Limit Lower Segment 1 Status On/Off
- bit 7 : SPA Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW<sup>35</sup>
- 274) Status Byte 5 : ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)
- (LSB) bit 0 : SPA Multiple Limit Lower Segment 2 Status On/Off
- bit 1 : SPA Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW
- bit 2 : SPA Multiple Limit Lower Segment 3 Status On/Off
- bit 3 : SPA Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW
- bit 4 : SPA Multiple Limit Lower Segment 4 Status On/Off
- bit 5 : SPA Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW
- bit 6 : SPA Multiple Limit Lower Segment 5 Status On/Off
- bit 7 : SPA Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- 275) Status Byte 6: (0b = Off, 1b = On)
- (LSB) bit 0 : Antenna Factors Correction On/Off
- bit 1 : Bias Tee On/Off (Option 10)
- bit 2 : SPA Cal Status On/Off
- bits 3-4 : Amplitude Units (Log) - 00b = dBm 01b = dBV 10b = dBmV 11b = dBuV  
(Linear) – 00b = Watts 01b = Volts
- bits 5-6 : Detection Alg (00b = pos. peak 01b = RMS Averaging 10b = neg. peak 11b =  
Sampling Mode)
- bit 7 : Units Type (0b = Log 1b = Linear)
- 276) Status Byte 7: (0b = Off, 1b = On)
- (LSB) bit 0: Serial Port Echo Status On/Off
- bit 1: Return Sweep Time On/Off
- bit 2: RBW Coupling (1b = Auto, 0b = Manual)
- bit 3: VBW Coupling (1b = Auto, 0b = Manual)
- bit 4: Attenuation Coupling (1b = Auto, 0b = Manual)
- bit 5: Channel Power On/Off
- bit 6: Adjacent Channel Power On/Off
- bit 7: Occupied BW Measurement On/Off
- 277) Reference Level Offset<sup>36</sup> (highest byte)
- 278) Reference Level Offset
- 279) Reference Level Offset
- 280) Reference Level Offset (lowest byte)
- 281) External Reference Frequency<sup>37</sup>
- 282) Signal Standard<sup>38</sup> (higher byte)
- 283) Signal Standard (lower byte)
- 284) Channel Selection<sup>39</sup> (higher byte)
- 285) Channel Selection (lower byte)
- 286) Trigger Type<sup>40</sup>

<sup>35</sup> Beep level is always 0b for lower segmented limit line

<sup>36</sup> Value sent as (value in dBm \* 1000) + 270,000

<sup>37</sup> 1 byte in MHz (i.e. 20 = 20MHz)

<sup>38</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>39</sup> “No Channel” is sent as FFFEh

- 287) Interference Analysis Frequency<sup>41</sup> (highest byte)  
 288) Interference Analysis Frequency  
 289) Interference Analysis Frequency  
 290) Interference Analysis Frequency (lowest byte)  
 291) Trigger Position (0 – 100%)  
 292) Min Sweep Time (in  $\mu$ s) (highest byte)  
 293) Min Sweep Time (in  $\mu$ s)  
 294) Min Sweep Time (in  $\mu$ s)  
 295) Min Sweep Time (in  $\mu$ s) (lowest byte)  
 296) Video Trigger Level<sup>42</sup> (highest byte)  
 297) Video Trigger Level  
 298) Video Trigger Level  
 299) Video Trigger Level (lowest byte)  
 300) Status Byte 8  
 (LSB) bit 0: Input Power Status (1b = Input Power Too High, 0b = Input Power Ok)  
 bit 1: Reserved  
 bits 2-7: Not Used  
 301) Status Byte 9  
 (LSB) bits 0-6: Number of sweeps to average (1-25, 1 implies averaging OFF)  
 bit 7: Not Used  
 302) Status Byte 10: (0b = Off, 1b = On)  
 (LSB) bits 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)  
 bit 2: Max Hold On/Off  
 bit 3: Min Hold On/Off  
 bits 4-7: Not Used  
 303) Impedance (00h = 50 $\Omega$ , 0Ah = 75 $\Omega$  Anritsu Adapter, 0Ch = 75 $\Omega$  Other Adapter)  
 304) Impedance Loss<sup>43</sup> (higher byte)  
 305) Impedance Loss (lower byte)  
 306) AM/FM Demod Type<sup>44</sup>  
 307) AM/FM Demod Status (01h = On, 00h = Off)  
 308) AM/FM Demod Volume (0 to 100)  
 309) AM/FM Demod Frequency<sup>45</sup> (highest byte)  
 310) AM/FM Demod Frequency  
 311) AM/FM Demod Frequency  
 312) AM/FM Demod Frequency (lowest byte)  
 313) AM/FM Demod Time (in ms) (highest byte)  
 314) AM/FM Demod Time (in ms)  
 315) AM/FM Demod Time (in ms)  
 316) AM/FM Demod Time (in ms) (lowest byte)  
 317) SSB BFO Offset<sup>46</sup> (highest byte)  
 318) SSB BFO Offset  
 319) SSB BFO Offset  
 320) SSB BFO Offset (lowest byte)  
 321) Frequency Scale Factor<sup>47</sup> (higher byte)  
 322) Frequency Scale Factor (lower byte)  
 323) Frequency Range Minimum<sup>48</sup> (highest byte)

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<sup>40</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>41</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>42</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>43</sup> Value sent as (value in dB \* 1000), valid values are 0 to 20 dB

<sup>44</sup> AM/FM Demod Type: 00h = FM-Wide Band, 01h = FM-Narrow Band, 02h = AM, 03h = SSB Lower, 04h = SSB

Upper

<sup>45</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>46</sup> Value sent as ((value in Hz) – 10,000)

<sup>47</sup> In number of Hz

- 324) Frequency Range Minimum
- 325) Frequency Range Minimum
- 326) Frequency Range Minimum (lowest byte)
- 327) Frequency Range Maximum<sup>49</sup> (highest byte)
- 328) Frequency Range Maximum
- 329) Frequency Range Maximum
- 330) Frequency Range Maximum (lowest byte)
- 331) Marker Type<sup>50</sup>
- 332-400) Not Used

For Power Meter Mode:

- 26) Power Meter Start Freq<sup>51</sup> (highest byte)
- 27) Power Meter Start Freq
- 28) Power Meter Start Freq
- 29) Power Meter Start Freq (lowest byte)
- 30) Power Meter Stop Freq<sup>52</sup> (highest byte)
- 31) Power Meter Stop Freq
- 32) Power Meter Stop Freq
- 33) Power Meter Stop Freq (lowest byte)
- 34) Power Meter Center Freq<sup>53</sup> (highest byte)
- 35) Power Meter Center Freq
- 36) Power Meter Center Freq
- 37) Power Meter Center Freq (lowest byte)
- 38) Power Meter Span<sup>54</sup> (highest byte)
- 39) Power Meter Span
- 40) Power Meter Span
- 41) Power Meter Span (lowest byte)
- 42) Signal Standard<sup>55</sup> (higher byte)
- 43) Signal Standard (lower byte)
- 44) Channel Selection<sup>56</sup> (higher byte)
- 45) Channel Selection (lower byte)
- 46) Power Meter Offset (highest byte)
- 47) Power Meter Offset
- 48) Power Meter Offset
- 49) Power Meter Offset (lowest byte)
- 50) Power Meter Relative (highest byte)<sup>57</sup>
- 51) Power Meter Relative
- 52) Power Meter Relative
- 53) Power Meter Relative (lowest byte)
- 54) Power Meter Status (00h = Off, 01h = On)
- 55) Power Meter Unit (00h = Watts, 01h = dBm)
- 56) Power Meter Relative Status (00h = Off, 01h = On)
- 57) Power Meter Offset Status (00h = Off, 01h = On)
- 58) Power Meter RMS Averaging Level (00h = Off, 01h = Low, 02h = Medium, 03h = High)
- 59) Frequency Scale Factor<sup>58</sup> (higher byte)

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<sup>48</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>49</sup> Scaled by Frequency Scale Factor (bytes 321-322)

<sup>50</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>51</sup> Scaled by Frequency Scale Factor (bytes 59-60)

<sup>52</sup> Scaled by Frequency Scale Factor (bytes 59-60)

<sup>53</sup> Scaled by Frequency Scale Factor (bytes 59-60)

<sup>54</sup> Scaled by Frequency Scale Factor (bytes 59-60)

<sup>55</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>56</sup> “No Channel” is sent as FFFEh

<sup>57</sup> Value as ((value in dBm \* 1000) + 100)

- 60) Frequency Scale Factor (lower byte)
- 61) Frequency Range Minimum<sup>59</sup> (highest byte)
- 62) Frequency Range Minimum
- 63) Frequency Range Minimum
- 64) Frequency Range Minimum (lowest byte)
- 65) Frequency Range Maximum<sup>60</sup> (highest byte)
- 66) Frequency Range Maximum
- 67) Frequency Range Maximum
- 68) Frequency Range Maximum (lowest byte)
- 69) Zero Status (00h = Off, 01h = On)
- 70) Zero Value<sup>61</sup> (highest byte)
- 71) Zero Value
- 72) Zero Value
- 73) Zero Value (lowest byte)
- 74-120) Not Used

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### **Select Printer Type – Control Byte #30 (1Eh)**

*Description:* Select Printer Type.

*Bytes to Follow:* 1 byte

- 1) Printer ID
  - 0 – Epson Stylus Models
  - 1 – Epson LQ Models
  - 2 – Citizen PN Models
  - 3 – NEC Superscript Models
  - 4 – NEC Silentwriter Models
  - 5 – Seiko DPU 411, 414 Models
  - 6 – Canon BJC 50
  - 7 – Canon BJC 80
  - 8 – Canon BJC 250
  - 9 – Canon BJC 4400
  - 10 – HP DJ 300 Series
  - 11 – HP DJ 400 Series
  - 12 – HP DJ 500 Series
  - 13 – HP DJ 600 Series
  - 14 – HP DJ 800 Series
  - 15 – HP DJ 1120
  - 16 – HP LJ 6L, 6P, 4000
  - 17 – Epson Esc/P Compatible
  - 18 – Epson Esc/P2 Compatible
  - 19 – Epson Esc/P Raster Compatible
  - 20 – HP PCL3 Compatible

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 

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<sup>58</sup> In number of Hz

<sup>59</sup> Scaled by Frequency Scale Factor

<sup>60</sup> Scaled by Frequency Scale Factor

<sup>61</sup> Value sent as ((value in dBm \* 1000) + 100)

### **Select DTF Windowing – Control Byte #31 (1Fh)**

*Description:* Select DTF Windowing Methods.

DTF windowing allows you to make a trade off between side lobe height and resolution.

*Bytes to Follow:* 1 byte

- 1) Windowing Method
  - 00h = Rectangular (finest resolution, highest side lobes)
  - 01h = Nominal Side Lobe (balance between resolution and side lobes)
  - 02h = Low Side Lobe
  - 03h = Minimum Side Lobe

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid DTF Windowing Method
  - 238 (EEh) Time-out Error
- 

### **Set LMR Master VNA Trace Math – Control Byte #32 (20h)**

*Description:* Setup trace math operation and trace for VNA modes.

*Bytes to Follow:* 2 bytes

- 1) Trace Math Operation
  - 00h = Off
  - 01h = Addition
  - 02h = Subtraction
- 2) Trace on which to Perform Math Operation (1 to 200)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid Trace Math Operation
  - 238 (EEh) Time-out Error
- 

### **Recall Sweep Trace – Control Byte #33 (21h)**

*Description:* Queries the LMR Master for sweep trace data.

NOTE: Before you can recall a sweep stored in non-volatile memory (trace numbers 1-200) you must build a trace table in the LMR Master's RAM. Use Control Byte #24 to build the trace table. Since the trace table exists in RAM, Control Byte #24 must be executed every time the LMR Master's power is cycled.

*Bytes to Follow:* 1 byte

- 0 = Last sweep trace before entering remote mode (sweep trace in RAM)
- 1- 200 = Specific saved sweep number (stored sweeps in Flash memory)

*LMR Master Returns:*

- 1-2) # of following bytes (total length - 2)
- 3) Current Instrument Date Format<sup>62</sup>
- 4) Not Used
- 5-11) Model Number (7 bytes in ASCII)
- 12-15) Software Version (4 bytes ASCII)
- 16) Measurement Mode<sup>63</sup>

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<sup>62</sup> 00h = MM/DD/YYYY, 01h = DD/MM/YYYY, 02h = YYYY/MM/DD

<sup>63</sup> Refer to Control Byte #3 "Select Measurement Mode" for detailed value.



- 17-20) Time/Date (in Long Integer<sup>64</sup>)
- 21-30) Date in String Format (mm/dd/yyyy)
- 31-38) Time in String Format (hh:mm:ss)
- 39-54) Reference number stamp (16 bytes in ASCII)
- 55-56) # data points (130, 259 or 517 or 401 or 100)

For all “LMR Master VNA Modes” :

- 57) Start Frequency<sup>65</sup> (highest byte)
- 58) Start Frequency
- 59) Start Frequency
- 60) Start Frequency (lowest byte)
- 61) Stop Frequency (highest byte)
- 62) Stop Frequency
- 63) Stop Frequency
- 64) Stop Frequency (lowest byte)
- 65) Minimum Frequency Step Size (highest byte)
- 66) Minimum Frequency Step Size
- 67) Minimum Frequency Step Size
- 68) Minimum Frequency Step Size (lowest byte)
- 69) Scale Top<sup>66</sup> (highest byte)
- 70) Scale Top
- 71) Scale Top
- 72) Scale Top (lowest byte)
- 73) Scale Bottom (highest byte)
- 74) Scale Bottom
- 75) Scale Bottom
- 76) Scale Bottom (lowest byte)
- 77) Frequency Marker 1<sup>67</sup> (higher byte)
- 78) Frequency Marker 1 (lower byte)
- 79) Frequency Marker 2 (higher byte)
- 80) Frequency Marker 2 (lower byte)
- 81) Frequency Marker 3 (higher byte)
- 82) Frequency Marker 3 (lower byte)
- 83) Frequency Marker 4 (higher byte)
- 84) Frequency Marker 4 (lower byte)
- 85) Frequency Marker 5 (higher byte)
- 86) Frequency Marker 5 (lower byte)
- 87) Frequency Marker 6 (higher byte)
- 88) Frequency Marker 6 (lower byte)
- 89) Single Limit<sup>68</sup> (highest byte)
- 90) Single Limit
- 91) Single Limit
- 92) Single Limit (lowest byte)
- 93) Multiple Limit Segment # (1)
- 94) Multiple Limit Segment Status
- 95) Multiple Limit Start X<sup>69</sup> (highest byte)
- 96) Multiple Limit Start X
- 97) Multiple Limit Start X

---

<sup>64</sup> Time/Date long integer representation is in seconds since January 1, 1970

<sup>65</sup> Frequency units are Hz

<sup>66</sup> See Control Byte #4 “Set LMR Master Scale” for data format

<sup>67</sup> marker point = (# of data points – 1 ) \* ( marker freq – start freq ) / ( stop freq – start freq ) where # of data points can be found in bytes 55-56, start freq is in bytes 57-60, and stop freq is in bytes 61-64.

<sup>68</sup> See Control Byte #6 “Set LMR Master VNA Single Limit” for data format.

<sup>69</sup> See Control Byte #112 “Set LMR Master VNA Segmented Limit Lines” for data format.

- 98) Multiple Limit Start X (lowest byte)
- 99) Multiple Limit Start Y (higher byte)
- 100) Multiple Limit Start Y (lower byte)
- 101) Multiple Limit End X (highest byte)
- 102) Multiple Limit End X
- 103) Multiple Limit End X
- 104) Multiple Limit End X (lowest byte)
- 105) Multiple Limit End Y (higher byte)
- 106) Multiple Limit End Y (lower byte)
- 107–162) Repeat bytes 93-106 for segments 2-5
- 163) Start Distance<sup>70</sup> (highest byte)
- 164) Start Distance
- 165) Start Distance
- 166) Start Distance (lowest byte)
- 167) Stop Distance (highest byte)
- 168) Stop Distance
- 169) Stop Distance
- 170) Stop Distance (lowest byte)
- 171) Distance Marker 1<sup>71</sup> (higher byte)
- 172) Distance Marker 1 (lower byte)
- 173) Distance Marker 2 (higher byte)
- 174) Distance Marker 2 (lower byte)
- 175) Distance Marker 3 (higher byte)
- 176) Distance Marker 3 (lower byte)
- 177) Distance Marker 4 (higher byte)
- 178) Distance Marker 4 (lower byte)
- 179) Distance Marker 5 (higher byte)
- 180) Distance Marker 5 (lower byte)
- 181) Distance Marker 6 (higher byte)
- 182) Distance Marker 6 (lower byte)
- 183) Relative Propagation Velocity<sup>72</sup> (highest byte)
- 184) Relative Propagation Velocity
- 185) Relative Propagation Velocity
- 186) Relative Propagation Velocity (lowest byte)
- 187) Cable Loss<sup>73</sup> (highest byte)
- 188) Cable Loss
- 189) Cable Loss
- 190) Cable Loss (lowest byte)
- 191) Average Cable Loss<sup>74</sup> (highest byte)
- 192) Average Cable Loss
- 193) Average Cable Loss
- 194) Average Cable Loss (lowest byte)
- 195) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Marker 1 On/Off
  - bit 1 : Marker 2 On/Off
  - bit 2 : Marker 3 On/Off
  - bit 3 : Marker 4 On/Off
  - bit 4 : Marker 5 On/Off
  - bit 5 : Marker 6 On/Off

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<sup>70</sup> Distance data uses units 1/100,000m (or feet)

<sup>71</sup> Marker Point = ( # data points – 1 ) \* ( marker dist – start dist ) / ( stop dist – start dist )

Where # of data points can be found in bytes 55-56, start dist is in bytes 163-166, and stop dist is in bytes 167-170.

<sup>72</sup> Relative Propagation Velocity uses units 1/100,000

<sup>73</sup> Cable Loss uses units 1/100,000 dB/m or 1/100,000 dB/ft.

<sup>74</sup> Average Cable Loss is dB \* 1000.

- bits 6-7 : Not Used
- 196) Status Byte 2: (0b = Off, 1b = On)  
 (LSB) bit 0 : Marker 2 Delta On/Off  
 bit 1 : Marker 3 Delta On/Off  
 bit 2 : Marker 4 Delta On/Off  
 bits 3-7 : Not Used
- 197) Status Byte 3: ( 0b = Off , 1b = On)  
 (LSB) bit 0 : Single Limit On/Off  
 bit 1: CW On/Off  
 bit 2: Trace Math On/Off  
 bits 3-5 : Not Used  
 bit 6 : Limit Type ( 0b = Single; 1b = Multiple)  
 bit 7 : Unit of Measurement (1b = Metric, 0b = English)
- 198) Status Byte 4:  
 (LSB) bit 0 - 1 : DTF Windowing Mode  
 bit: 1 0  
 | |  
 0 0 - Rectangular (No Windowing)  
 0 1 - Nominal Side Lobe  
 1 0 - Low Side Lobe  
 1 1 - Minimum Side Lobe  
 bits 2 - 7 : Not Used
- 199) Status Byte 5 (Cal Status):  
 00h : Calibration Off  
 01h : Standard Calibration On  
 02h : InstaCal Calibration On  
 03h : Standard FlexCal On  
 04h : InstaCal FlexCal On
- 200) VNA Signal Standard<sup>75</sup> (higher byte)  
 201) VNA Signal Standard (lower byte)  
 202-324) Not Used
- 325-1364) Sweep Data (130 points \* 8 bytes/point = 1040 bytes)  
 325-2396) Sweep Data (259 points \* 8 bytes/point = 2072 bytes)  
 325-4460) Sweep Data (517 points \* 8 bytes/point = 4136 bytes)
- 8 bytes for each data point
1. gamma<sup>76</sup> (highest byte)
  2. gamma
  3. gamma
  4. gamma (lowest byte)
  5. phase<sup>77</sup> (highest byte)
  6. phase
  7. phase
  8. phase (lowest byte)

*Notes:*

return loss = - 20\* (log(gamma) / log(10))

VSWR = (1+gamma)/(1-gamma)

phase compares the reflected to the incident (reference)

For Spectrum Analyzer Mode/Transmission Mode (Option 21 Only):

57) Start Frequency<sup>78</sup> (highest byte)

<sup>75</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>76</sup> Gamma data uses 1/10,000 units.

<sup>77</sup> Phase data uses 1/10 degree unit.

<sup>78</sup> Scaled by Frequency Scale Factor (bytes 335-336)

- 58) Start Frequency
- 59) Start Frequency
- 60) Start Frequency (lowest byte)
- 61) Stop Frequency<sup>79</sup> (highest byte)
- 62) Stop Frequency
- 63) Stop Frequency
- 64) Stop Frequency (lowest byte)
- 65) Center Frequency<sup>80</sup> (highest byte)
- 66) Center Frequency
- 67) Center Frequency
- 68) Center Frequency (lowest byte)
- 69) Frequency Span<sup>81</sup> (highest byte)
- 70) Frequency Span
- 71) Frequency Span
- 72) Frequency Span (lowest byte)
- 73) Minimum Frequency Step Size (highest byte)
- 74) Minimum Frequency Step Size
- 75) Minimum Frequency Step Size
- 76) Minimum Frequency Step Size (lowest byte)
- 77) Ref Level<sup>82</sup> (highest byte)
- 78) Ref Level
- 79) Ref Level
- 80) Ref Level (lowest byte)
- 81) Scale per div<sup>83</sup> (highest byte)
- 82) Scale per div
- 83) Scale per div
- 84) Scale per div (lowest byte)
- 85) Frequency Marker 1<sup>84</sup> (higher byte)
- 86) Frequency Marker 1 (lower byte)
- 87) Frequency Marker 2 (higher byte)
- 88) Frequency Marker 2 (lower byte)
- 89) Frequency Marker 3 (higher byte)
- 90) Frequency Marker 3 (lower byte)
- 91) Frequency Marker 4 (higher byte)
- 92) Frequency Marker 4 (lower byte)
- 93) Frequency Marker 5 (higher byte)
- 94) Frequency Marker 5 (lower byte)
- 95) Frequency Marker 6 (higher byte)
- 96) Frequency Marker 6 (lower byte)
- 97) Single Limit<sup>85</sup> (highest byte)
- 98) Single Limit
- 99) Single Limit
- 100) Single Limit (lowest byte)
- 101) Multiple Upper Limit 1 Start X<sup>86</sup> (highest byte)
- 102) Multiple Upper Limit 1 Start X
- 103) Multiple Upper Limit 1 Start X
- 104) Multiple Upper Limit 1 Start X (lowest byte)

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<sup>79</sup> Scaled by Frequency Scale Factor (bytes 335-336)

<sup>80</sup> Scaled by Frequency Scale Factor (bytes 335-336)

<sup>81</sup> Scaled by Frequency Scale Factor (bytes 335-336)

<sup>82</sup> Value sent as ( Value in dBm \* 1000 ) + 270,000

<sup>83</sup> Value sent as ( Value \* 1000 )

<sup>84</sup> Value sent as data point on display.  $\text{Freq} = ( \text{Point} * \text{Span} / ( \text{Total Data Points} - 1 ) ) + \text{Start Freq}$

<sup>85</sup> Value sent as ( Value in dBm \* 1000 ) + 270,000

<sup>86</sup> Scaled by Frequency Scale Factor (bytes 335-336)

- 105) Multiple Upper Limit 1 Start Y (Power Level<sup>87</sup>) (highest byte)
- 106) Multiple Upper Limit 1 Start Y (Power Level)
- 107) Multiple Upper Limit 1 Start Y (Power Level)
- 108) Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 109) Multiple Upper Limit 1 End X<sup>88</sup> (highest byte)
- 110) Multiple Upper Limit 1 End X
- 111) Multiple Upper Limit 1 End X
- 112) Multiple Upper Limit 1 End X (lowest byte)
- 113) Multiple Upper Limit 1 End Y (Power Level) (highest byte)
- 114) Multiple Upper Limit 1 End Y (Power Level)
- 115) Multiple Upper Limit 1 End Y (Power Level)
- 116) Multiple Upper Limit 1 End Y (Power Level) (lowest byte)
- 117-260) Multiple Upper Limits 2-5, Multiple Lower Limits 1-5 (see bytes 101-116 for format)
- 261) RBW Setting (Frequency in Hz) (highest byte)
- 262) RBW Setting (Frequency in Hz)
- 263) RBW Setting (Frequency in Hz)
- 264) RBW Setting (Frequency in Hz) (lowest byte)
- 265) VBW Setting (Frequency in Hz) (highest byte)
- 266) VBW Setting (Frequency in Hz)
- 267) VBW Setting (Frequency in Hz)
- 268) VBW Setting (Frequency in Hz) (lowest byte)
- 269) OCC BW Method (0b = % of power, 1b = dB down)
- 270) OCC BW % Value<sup>89</sup>
- 271) OCC BW dBc<sup>90</sup>
- 272) Attenuation<sup>91</sup> (highest byte)
- 273) Attenuation
- 274) Attenuation
- 275) Attenuation (lowest byte)
- 276-291) Antenna Name (16 bytes in ASCII)
- 292) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Marker 1 On/Off
  - bit 1 : Marker 2 On/Off
  - bit 2 : Marker 3 On/Off
  - bit 3 : Marker 4 On/Off
  - bit 4 : Marker 5 On/Off
  - bit 5 : Marker 6 On/Off
  - bits 6-7: Not Used
- 293) Status Byte 2: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Not Used
  - bit 1 : Marker 2 Delta On/Off
  - bit 2 : Marker 3 Delta On/Off
  - bit 3 : Marker 4 Delta On/Off
  - bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)
  - bit 5 : Pre Amp Status On/Off
  - bit 6 : Dynamic Attenuation On/Off
  - bit 7 : Normalization On/Off
- 294) Status Byte 3: (0b = Off, 1b = On)
  - (LSB) bit 0 : Antenna Factor Correction On/Off
  - bits 1-2 : Detection alg (00b = pos. peak 01b = RMS average 10b = neg. peak 11b = sampling mode)

<sup>87</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>88</sup> Scaled by Frequency Scale Factor (bytes 335-336)

<sup>89</sup> % value is 0-99

<sup>90</sup> dBc value 0 – 120 dBc

<sup>91</sup> Value sent as ( value in dB \* 1000 )

- bits 3-4 : Amplitude Units (Log) - (00b = dBm 01b = dBV 10b = dBmV 11b = dBuV)  
(Linear) – (00b = Watts 01b = Volts)
- bit 5 : Channel Power On/Off
- bit 6 : Adjacent Channel Power On/Off
- bit 7 : Units Type (0b = Log 1b = Linear)
- 295) Status Byte 4<sup>92</sup>  
(0b = Off/Beep if data is BELOW line, 1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : Limit Type (0b = Single, 1b = Multiple)  
bit 1 : Not Used  
bit 2 : Single Limit On/Off  
bit 3 : Single Limit Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Upper Segment 1 Status On/Off  
bit 5 : Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW<sup>93</sup>  
bit 6 : Multiple Limit Upper Segment 2 Status On/Off  
bit 7 : Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW
- 296) Status Byte 5  
(0b = Off/Beep if data is below line, 1b = On/Beep if data is above line)  
(LSB) bit 0 : Multiple Limit Upper Segment 3 Status On/Off  
bit 1 : Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW  
bit 2 : Multiple Limit Upper Segment 4 Status On/Off  
bit 3 : Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Upper Segment 5 Status On/Off  
bit 5 : Multiple Limit Upper Segment 5 Beep Level ABOVE/BELOW  
bit 6 : Multiple Limit Lower Segment 1 Status On/Off  
bit 7 : Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW<sup>94</sup>
- 297) Status Byte 6  
(0b = Off/Beep if data is BELOW line, 1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : Multiple Limit Lower Segment 2 Status On/Off  
bit 1 : Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW  
bit 2 : Multiple Limit Lower Segment 3 Status On/Off  
bit 3 : Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Lower Segment 4 Status On/Off  
bit 5 : Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW  
bit 6 : Multiple Limit Lower Segment 5 Status On/Off  
bit 7 : Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- 298) Status Byte 7  
(LSB) bits 0-6: Number of sweeps to average (1-25, 1 implies averaging OFF)  
bit 7: Not Used
- 299) Reference Level Offset <sup>95</sup>(highest byte)
- 300) Reference Level Offset
- 301) Reference Level Offset
- 302) Reference Level Offset (lowest byte)
- 303) External Reference Frequency <sup>96</sup>
- 304) Signal Standard<sup>97</sup> (higher byte)
- 305) Signal Standard (lower byte)
- 306) Channel Selection<sup>98</sup> (higher byte)
- 307) Channel Selection (lower byte)
- 308) Interference Analysis Cellular Standard<sup>99</sup>

<sup>92</sup> For bits 2, 1 and 0 (“X” is “don’t care”): 0X0=no limit, 1X0=single limit, 0X1=multiple limit, 1X1=multiple limit.

<sup>93</sup> Upper limits always trigger an error beep if data is ABOVE the limit segment, for example, this bit is always 1b.

<sup>94</sup> Lower limits always trigger an error beep if data is BELOW the limit segment, for example, this bit is always 0b.

<sup>95</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>96</sup> 1 byte in MHz (i.e. 20 = 20MHz)

<sup>97</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>98</sup> “No Channel” is sent as FFFEh

- 309) Interference Analysis Estimated Bandwidth (highest byte)
- 310) Interference Analysis Estimated Bandwidth
- 311) Interference Analysis Estimated Bandwidth
- 312) Interference Analysis Estimated Bandwidth (lowest byte)
- 313) Interference Analysis Frequency<sup>100</sup> (highest byte)
- 314) Interference Analysis Frequency
- 315) Interference Analysis Frequency
- 316) Interference Analysis Frequency (lowest byte)
- 317-320) Reserved
- 321) Trigger Type<sup>101</sup>
- 322) Trigger Position (0 – 100%)
- 323) Min Sweep Time (in  $\mu$ s) (highest byte)
- 324) Min Sweep Time (in  $\mu$ s)
- 325) Min Sweep Time (in  $\mu$ s)
- 326) Min Sweep Time (in  $\mu$ s) (lowest byte)
- 327) Video Trigger Level<sup>102</sup> (highest byte)
- 328) Video Trigger Level
- 329) Video Trigger Level
- 330) Video Trigger Level (lowest byte)
- 331) Status Byte 8 (0b = Off, 1b = On)
  - (LSB) bit 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)
  - bit 2: Max Hold On/Off
  - bit 3: Min Hold On/Off
  - bit 4: Transmission Calibration On/Off (Option 21 Only)
  - bit 5: Bias Tee On/Off (Option 10 Only)
  - bit 6: Occupied BW Measurement On/Off
  - bit 7: Not Used
- 332) Impedance (00h = 50 $\Omega$ , 0Ah = 75 $\Omega$  Anritsu Adapter, 0Ch = 75 $\Omega$  Other Adapter)
- 333) Impedance Loss<sup>103</sup> (higher byte)
- 334) Impedance Loss (lower byte)
- 335) Frequency Scale Factor<sup>104</sup> (higher byte)
- 336) Frequency Scale Factor (lower byte)
- 337) Frequency Range Minimum<sup>105</sup> (highest byte)
- 338) Frequency Range Minimum
- 339) Frequency Range Minimum
- 340) Frequency Range Minimum (lowest byte)
- 341) Frequency Range Maximum<sup>106</sup> (highest byte)
- 342) Frequency Range Maximum
- 343) Frequency Range Maximum
- 344) Frequency Range Maximum (lowest byte)
- 345) Linked Trace Number (1-200)
- 346) Status Byte 9 (0b = Off, 1b = On)
  - (LSB) bit 0: C/I Measurement On/Off
  - bits 1-3: C/I Carrier Trace/Signal Type<sup>107</sup>
  - bits 4-7: Not Used

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<sup>99</sup> 4 Standards – 00h = 1250kHz CDMA, 01h = GSM, 02h = TDMA, 03h = AMPS, 04h = Unknown, FFh = Interference Analysis Measurement OFF

<sup>100</sup> Scaled by Frequency Scale Factor (bytes 335-336)

<sup>101</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>102</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>103</sup> Value sent as (value in dB \* 1000), valid values are 0 to 20 dB

<sup>104</sup> In number of Hz

<sup>105</sup> Scaled by Frequency Scale Factor

<sup>106</sup> Scaled by Frequency Scale Factor

<sup>107</sup> 000b = Carrier – NB FHSS, 001b = Carrier – WB FHSS, 010b = Carrier – Broadband, 111b = Interference

- 347) C/I Calculated Power<sup>108</sup> (Carrier or Interference – NB FHSS<sup>109</sup>) (highest byte)
- 348) C/I Calculated Power (Carrier or Interference – NB FHSS)
- 349) C/I Calculated Power (Carrier or Interference – NB FHSS)
- 350) C/I Calculated Power (Carrier or Interference – NB FHSS) (lowest byte)
- 351) C/I Calculated Power<sup>110</sup> (Interference – WB FHSS<sup>111</sup>) (highest byte)
- 352) C/I Calculated Power (Interference – WB FHSS)
- 353) C/I Calculated Power (Interference – WB FHSS)
- 354) C/I Calculated Power (Interference – WB FHSS) (lowest byte)
- 355) C/I Calculated Power<sup>112</sup> (Interference – Broadband<sup>113</sup>) (highest byte)
- 356) C/I Calculated Power (Interference – Broadband)
- 357) C/I Calculated Power (Interference – Broadband)
- 358) C/I Calculated Power (Interference – Broadband) (lowest byte)
- 359) Occupied Bandwidth Power (highest byte)<sup>114</sup>
- 360) Occupied Bandwidth Power
- 361) Occupied Bandwidth Power
- 362) Occupied Bandwidth Power (lowest byte)
- 363) Marker Type<sup>115</sup>
- 364-431) Not Used
- 432-2035) Sweep Data (401 points \* 4 bytes/point= 1604 bytes)
  - 4 bytes for each data point
    - 1. dBm<sup>116</sup> (highest byte)
    - 2. dBm
    - 3. dBm
    - 4. dBm (lowest byte)

For Power Meter Mode:

- 57) Power Meter Mode (00h = Off, 01h = On)
- 58) Power Meter Unit (00h = dBm, 01h = Watts)
- 59) Start Frequency<sup>117</sup> (highest byte)
- 60) Start Frequency
- 61) Start Frequency
- 62) Start Frequency (lowest byte)
- 63) Stop Frequency<sup>118</sup> (highest byte)
- 64) Stop Frequency
- 65) Stop Frequency
- 66) Stop Frequency (lowest byte)
- 67) Center Frequency<sup>119</sup> (highest byte)
- 68) Center Frequency
- 69) Center Frequency
- 70) Center Frequency (lowest byte)

<sup>108</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>109</sup> If Status Byte 9, bytes 1-3 equal 111b, then signal will be calculated power for the Interference – NB FHSS trace. Otherwise, these bytes represent the calculated Carrier power.

<sup>110</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>111</sup> If Status Byte 9, bytes 1-3 equal 111b, then signal will be calculated power for the Interference – WB FHSS trace. Otherwise, these bytes should be ignored.

<sup>112</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>113</sup> If Status Byte 9, bytes 1-3 equal 111b, then signal will be calculated power for the Interference – Broadband trace. Otherwise, these bytes should be ignored.

<sup>114</sup> If Method is % of power then the value is db Down \* 1000. If the method is db down, then the value is %

<sup>115</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>116</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>117</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>118</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>119</sup> Scaled by Frequency Scale Factor (bytes 96-97)



- 71) Frequency Span<sup>120</sup> (highest byte)
- 72) Frequency Span
- 73) Frequency Span
- 74) Frequency Span (lowest byte)
- 75) Power Offset Status (00h = Off, 01h = On)
- 76) Power Offset<sup>121</sup> (highest byte)
- 77) Power Offset
- 78) Power Offset
- 79) Power Offset (lowest byte)
- 80) Power Relative Status (00h = Off, 01h = On)
- 81) Power Relative Value<sup>122</sup> (highest byte)
- 82) Power Relative Value
- 83) Power Relative Value
- 84) Power Relative Value (lowest byte)
- 85) RMS Averaging Level (00h = Off, 01h = Low, 02h = Medium, 03h = High)
- 86) Power Zero Status (00h = Off, 01h = On)
- 87) External Reference Status (00h = Off, 01h = On)
- 88) External Reference Frequency (in Hz) (highest byte)
- 89) External Reference Frequency (in Hz)
- 90) External Reference Frequency (in Hz)
- 91) External Reference Frequency (in Hz) (lowest byte)
- 92) Signal Standard<sup>123</sup> (highest byte)
- 93) Signal Standard (lowest byte)
- 94) Channel Selection<sup>124</sup> (highest byte)
- 95) Channel Selection (lowest byte)
- 96) Frequency Scale Factor<sup>125</sup> (higher byte)
- 97) Frequency Scale Factor (lower byte)
- 98) Frequency Range Minimum<sup>126</sup> (highest byte)
- 99) Frequency Range Minimum
- 100) Frequency Range Minimum
- 101) Frequency Range Minimum (lowest byte)
- 102) Frequency Range Maximum<sup>127</sup> (highest byte)
- 103) Frequency Range Maximum
- 104) Frequency Range Maximum
- 105) Frequency Range Maximum (lowest byte)
- 106 – 150) Not Used
- 151) Power Meter Reading<sup>128</sup> (highest byte)
- 152) Power Meter Reading
- 153) Power Meter Reading
- 154) Power Meter Reading (lowest byte)

For P25 Talk-Out Coverage Mode (Option 522 Only):

- 57) Graph Type
- 58) External Reference Status (00h = Off, 01h = On)
- 59) Auto Log (00h = Off, 01h = On)
- 60) External Reference Frequency (in Hz) (highest byte)

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<sup>120</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>121</sup> Value sent as ( value in dB \* 1000 ), valid values are 0 to 60 dB

<sup>122</sup> Value sent as ( value in dBm \* 1000 )

<sup>123</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>124</sup> “No Channel” is sent as FFFEh

<sup>125</sup> In number of Hz

<sup>126</sup> Scaled by Frequency Scale Factor

<sup>127</sup> Scaled by Frequency Scale Factor

<sup>128</sup> Power sent as (power in dBm \* 1000). Use two’s-complement method to decode negative power levels.

- 61) External Reference Frequency (in Hz)
- 62) External Reference Frequency (in Hz)
- 63) External Reference Frequency (in Hz) (lowest byte)
- 64) Center Frequency (in Hz) (highest byte)
- 65) Center Frequency (in Hz)
- 66) Center Frequency (in Hz)
- 67) Center Frequency (in Hz) (lowest byte)
- 68) Reference Level<sup>129</sup> (highest byte)
- 69) Reference Level
- 70) Reference Level
- 71) Reference Level (lowest byte)
- 72) Scale per Division<sup>130</sup> (highest byte)
- 73) Scale per Division
- 74) Scale per Division
- 75) Scale per Division (lowest byte)
- 76) Reference Percentage (highest byte)
- 77) Reference Percentage
- 78) Reference Percentage
- 79) Reference Percentage (lowest byte)
- 80-83) GPS Position – Latitude<sup>131</sup> (long integer)
- 84-87) GPS Position – Longitude<sup>132</sup> (long integer)
- 88-89) GPS Position – Altitude (short integer)
- 90-99) Reserved.
- 100-103) GPS Start Position – Latitude<sup>133</sup> (long integer)
- 104-107) GPS Start Position – Longitude<sup>134</sup> (long integer)
- 108) Received Power (highest byte)
- 109) Received Power
- 110) Received Power
- 111) Received Power (lowest byte)
- 112) Frequency Error (highest byte)
- 113) Frequency Error
- 114) Frequency Error
- 115) Frequency Error (lowest byte)
- 116) BER (highest byte)
- 117) BER
- 118) BER
- 119) BER (lowest byte)
- 120-921) RSSI vs. Time Data. 401 points. Each data point is 2 bytes representing the power in dBm.
- 922-1723) BER vs. Time Data. 401 points. Each data point is 2 bytes representing the percentage.
- 1724-2525) Linked GPS Latitude Data. 401 points. Each point is 2 bytes.
- 2526-3327) Linked GPS Longitude Data. 401 points. Each point is 2 bytes.
- 3328-3819) Reserved.

For P25 Tx Signal Analyzer Mode (Option 520 Only):

- 57) Graph Type
- 58) External Reference Status (00h = Off, 01h = On)
- 59) External Reference Frequency (in Hz) (highest byte)
- 60) External Reference Frequency (in Hz)
- 61) External Reference Frequency (in Hz)

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<sup>129</sup> Value sent as ( Value in dBm \* 1000 ) + 270,000

<sup>130</sup> Value sent as ( Value \* 1000 )

<sup>131</sup> Value sent as ( Degree \* 1000000 ) + ( Minute \* 100000 )

<sup>132</sup> Value sent as ( Degree \* 1000000 ) + ( Minute \* 100000 )

<sup>133</sup> This is the GPS location of the first (oldest) point in the trace.

<sup>134</sup> This is the GPS location of the first (oldest) point in the trace.

- 62) External Reference Frequency (in Hz) (lowest byte)
- 63) Center Frequency (in Hz) (highest byte)
- 64) Center Frequency (in Hz)
- 65) Center Frequency (in Hz)
- 66) Center Frequency (in Hz) (lowest byte)
- 67) External Attenuation (highest byte)
- 68) External Attenuation
- 69) External Attenuation
- 70) External Attenuation (lowest byte)
- 71) Pattern Select<sup>135</sup> (highest byte)
- 72) Pattern Select
- 73) Pattern Select
- 74) Pattern Select (lowest byte)
- 75) Serial Out (00h = Off, 01h = On)
- 76-79) GPS Position – Latitude (long integer)
- 80-83) GPS Position – Longitude (long integer)
- 84-85) GPS Position – Altitude (short integer)
- 86-95) Reserved.
- 96) Received Power (highest byte)
- 97) Received Power
- 98) Received Power
- 99) Received Power (lowest byte)
- 100) Frequency Error (highest byte)
- 101) Frequency Error
- 102) Frequency Error
- 103) Frequency Error (lowest byte)
- 104) BER (highest byte)
- 105) BER
- 106) BER
- 107) BER (lowest byte)
- 108) EVM (highest byte)
- 109) EVM
- 110) EVM
- 111) EVM (lowest byte)
- 112) Symbol Deviation (highest byte)
- 113) Symbol Deviation
- 114) Symbol Deviation
- 115) Symbol Deviation (lowest byte)
- 116) NAC (highest byte)
- 117) NAC (lowest byte)
- 118-597) Constellation Data. 120 Points. Each point is 4 bytes<sup>136</sup>.
- 598-613) Histogram Data. 4 points. Each point is 4 bytes representing the distribution of each symbol.

For NXDN Talk-Out Coverage Mode (Option 532 Only):

- 57) Graph Type
- 58) External Reference Status (00h = Off, 01h = On)
- 59) Auto Log (00h = Off, 01h = On)
- 60) External Reference Frequency (in Hz) (highest byte)
- 61) External Reference Frequency (in Hz)
- 62) External Reference Frequency (in Hz)
- 63) External Reference Frequency (in Hz) (lowest byte)
- 64) Center Frequency (in Hz) (highest byte)
- 65) Center Frequency (in Hz)

<sup>135</sup> Valid value ranges from 0 to 3. See control byte (AD0Ah) for description.

<sup>136</sup> The first 2 bytes represents the X-Coordinate while the second 2 bytes represents the Y-Coordinate.

- 66) Center Frequency (in Hz)
- 67) Center Frequency (in Hz) (lowest byte)
- 68) Reference Level (highest byte)
- 69) Reference Level
- 70) Reference Level
- 71) Reference Level (lowest byte)
- 72) Scale per Division (highest byte)
- 73) Scale per Division
- 74) Scale per Division
- 75) Scale per Division (lowest byte)
- 76) Reference Percentage (highest byte)
- 77) Reference Percentage
- 78) Reference Percentage
- 79) Reference Percentage (lowest byte)
- 80-83) GPS Position – Latitude (long integer)
- 84-87) GPS Position – Longitude (long integer)
- 88-89) GPS Position – Altitude (short integer)
- 90-99) GPS UTC.
- 100-103) GPS Start Position – Latitude (long integer)
- 104-107) GPS Start Position – Longitude (long integer)
- 108) Received Power (highest byte)
- 109) Received Power
- 110) Received Power
- 111) Received Power (lowest byte)
- 112) Frequency Error (highest byte)
- 113) Frequency Error
- 114) Frequency Error
- 115) Frequency Error (lowest byte)
- 116) BER (highest byte)
- 117) BER
- 118) BER
- 119) BER (lowest byte)
- 120-921) RSSI vs. Time Data. 401 points. Each data point is 2 bytes.
- 922-1723) BER vs. Time Data. 401 points. Each data point is 2 bytes.
- 1724-2525) Linked GPS Latitude Data. 401 points. Each point is 2 bytes.
- 2526-3327) Linked GPS Longitude Data. 401 points. Each point is 2 bytes.
- 3328-3737) Linked GPS UTC Time. 41 points. One UTC time for every 10 points. Each point is 1 byte.
- 3738-3820) Point UTC Time Is Linked To. 41 Points. Each point is 1 byte.
- 3821) Pattern (highest byte)
- 3822) Pattern
- 3823) Pattern
- 3824) Pattern (lowest byte)
- 3825-3875) Linked GPS Status. 51 Points. Each Point is 1 byte.
- 3876) Modulation Bandwidth (highest byte)
- 3877) Modulation Bandwidth
- 3878) Modulation Bandwidth
- 3879) Modulation Bandwidth (lowest byte)

For NXDN Tx Signal Analyzer Mode (Option 530 Only):

- 57) Graph Type
- 58) External Reference Status (00h = Off, 01h = On)
- 59) External Reference Frequency (in Hz) (highest byte)
- 60) External Reference Frequency (in Hz)
- 61) External Reference Frequency (in Hz)
- 62) External Reference Frequency (in Hz) (lowest byte)
- 63) Center Frequency (in Hz) (highest byte)

- 64) Center Frequency (in Hz)
- 65) Center Frequency (in Hz)
- 66) Center Frequency (in Hz) (lowest byte)
- 67) External Attenuation (highest byte)
- 68) External Attenuation
- 69) External Attenuation
- 70) External Attenuation (lowest byte)
- 71) Pattern Select<sup>137</sup> (highest byte)
- 72) Pattern Select
- 73) Pattern Select
- 74) Pattern Select (lowest byte)
- 75) Serial Out (00h = Off, 01h = On)
- 76-79) GPS Position – Latitude (long integer)
- 80-83) GPS Position – Longitude (long integer)
- 84-85) GPS Position – Altitude (short integer)
- 86-95) Reserved.
- 96) Received Power (highest byte)
- 97) Received Power
- 98) Received Power
- 99) Received Power (lowest byte)
- 100) Frequency Error (highest byte)
- 101) Frequency Error
- 102) Frequency Error
- 103) Frequency Error (lowest byte)
- 104) BER (highest byte)
- 105) BER
- 106) BER
- 107) BER (lowest byte)
- 108) EVM (highest byte)
- 109) EVM
- 110) EVM
- 111) EVM (lowest byte)
- 112) Symbol Deviation (highest byte)
- 113) Symbol Deviation
- 114) Symbol Deviation
- 115) Symbol Deviation (lowest byte)
- 116) NAC (highest byte)
- 117) NAC (lowest byte)
- 118-597) Constellation Data. 120 Points. Each point is 4 bytes<sup>138</sup>.
- 598-613) Histogram Data. 4 points. Each point is 4 bytes representing the distribution of each symbol.
- 614) Modulation Bandwidth (highest byte)
- 615) Modulation Bandwidth
- 616) Modulation Bandwidth
- 617) Modulation Bandwidth (lowest byte)

*LMR Master Returns* (For invalid sweeps/empty stored sweep locations): 11 bytes

- 1-2) Number of following bytes (9 bytes for invalid sweep recall)
- 3) Current Instrument Date Format<sup>139</sup>
- 4) Model # (unsigned integer, 1Bh for LMR Master model S412D)
- 5-11) Extended Model # (7 bytes in ASCII)

*LMR Master Returns* (Invalid sweep location): 1 byte

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<sup>137</sup> Valid value ranges from 0 to 3. See control byte (AD0Ah) for description.

<sup>138</sup> The first 2 bytes represents the X-Coordinate while the second 2 bytes represents the Y-Coordinate.

<sup>139</sup> 00h = MM/DD/YYYY, 01h = DD/MM/YYYY, 02h = YYYY/MM/DD

- 1) 224 (E0) Parameter Error: Invalid sweep location

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### **Set LMR Master VNA Trace Overlay – Control Byte #34 (22h)**

*Description:* Setup trace overlay operation and trace for VNA modes.

*Bytes to Follow:* 2 bytes

- 1) Trace Overlay Operation (0 or 1)
  - 00h = Off
  - 01h = On
- 2) Trace on which to Perform Overlay Operation (1 to 200)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid Trace Overlay Operation
  - 238 (EEh) Time-out Error
- 

### **Set SPA A/B Trace – Control Byte #35 (23h)**

*Description:* Defines traces “A” and “B” for Spectrum Analyzer mode.

Trace A is always the currently measured data (with or without trace math). It is always visible.

Trace B is always stored data and may come from a saved sweep or a previous “A” trace. There is no default for trace B. Trace B can be ON (visible) or OFF.

*Bytes to Follow:* 3 bytes

- 1) “A” trace display (00h = A only, 01h = A-B, 02h = A+B)
- 2) “B” trace status (00h = Off, 01h = On)
- 3) “B” trace number
  - 0 = save current “A” data into “B” buffer, use that as “B”
  - 1-200 = trace number
  - 255 = no “B” trace defined

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Not enough bytes transferred, “B” trace requested to be used in calculations or displayed, but no trace or invalid trace specified
  - 238 (EEh) Time-out Error
- 

### **Upload Sweep Trace – Control Byte #36 (24h)**

*Description:* Uploads a sweep trace to the LMR Master.

*Bytes to Follow:*

For All Modes:

- 1-2) # of following bytes
- 3) Measurement Mode<sup>140</sup>
- 4-7) Time/Date (in Long Integer)
- 8-17) Date in String Format (MM/DD/YYYY)
- 18-25) Time in String Format (HH:MM:SS)
- 26-41) Reference number stamp (16 ASCII bytes)

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<sup>140</sup> See Control Byte #3 “Set Measurement Mode” for available measurement modes.

42-43) # of data points (130, 259, 517 or 401 or 100)

For VNA Modes:

- 44) Start Frequency (highest byte)<sup>141</sup>
- 45) Start Frequency
- 46) Start Frequency
- 47) Start Frequency (lowest byte)
- 48) Stop Frequency (highest byte)
- 49) Stop Frequency
- 50) Stop Frequency
- 51) Stop Frequency (lowest byte)
- 52) Minimum Frequency Step Size (highest byte)
- 53) Minimum Frequency Step Size
- 54) Minimum Frequency Step Size
- 55) Minimum Frequency Step Size (lowest byte)
- 56) Scale Top (highest byte)<sup>142</sup>
- 57) Scale Top
- 58) Scale Top
- 59) Scale Top (lowest byte)
- 60) Scale Bottom (highest byte)
- 61) Scale Bottom
- 62) Scale Bottom
- 63) Scale Bottom (lowest byte)
- 64) Frequency Marker 1 (higher byte)<sup>143</sup>
- 65) Frequency Marker 1 (lower byte)
- 66) Frequency Marker 2 (higher byte)
- 67) Frequency Marker 2 (lower byte)
- 68) Frequency Marker 3 (higher byte)
- 69) Frequency Marker 3 (lower byte)
- 70) Frequency Marker 4 (higher byte)
- 71) Frequency Marker 4 (lower byte)
- 72) Frequency Marker 5 (higher byte)
- 73) Frequency Marker 5 (lower byte)
- 74) Frequency Marker 6 (higher byte)
- 75) Frequency Marker 6 (lower byte)
- 76) Single Limit Line Value (highest byte)<sup>144</sup>
- 77) Single Limit Line Value
- 78) Single Limit Line Value
- 79) Single Limit Line Value (lowest byte)
- 80) Multiple Limit Segment # (1)
- 81) Multiple Limit Segment Status (00h = Off, 01h = On)
- 82) Multiple Limit Start X (highest byte)<sup>145</sup>
- 83) Multiple Limit Start X
- 84) Multiple Limit Start X
- 85) Multiple Limit Start X (lowest byte)
- 86) Multiple Limit Start Y (higher byte)
- 87) Multiple Limit Start Y (lower byte)
- 88) Multiple Limit End X (highest byte)
- 89) Multiple Limit End X
- 90) Multiple Limit End X

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<sup>141</sup> Frequency in Hz

<sup>142</sup> See Control Byte #4, "Set LMR Master VNA Scale" for data format.

<sup>143</sup> Marker point = (Number of data points – 1) \* (marker freq – start freq) / (stop freq – start freq)

<sup>144</sup> See Control Byte #6, "Set LMR Master VNA Single Limit" for data format

<sup>145</sup> See Control Byte #112, "Set LMR Master VNA Segmented Limit Lines" for data format.

- 91) Multiple Limit End X (lowest byte)
- 92) Multiple Limit End Y (higher byte)
- 93) Multiple Limit End Y (lower byte)
- 94-149) Repeat bytes 80-93 for segments 2-5
- 150) Start Distance (highest byte)<sup>146</sup>
- 151) Start Distance
- 152) Start Distance
- 153) Start Distance (lowest byte)
- 154) Stop Distance (highest byte)
- 155) Stop Distance
- 156) Stop Distance
- 157) Stop Distance (lowest byte)
- 158) Distance Marker 1 (higher byte)<sup>147</sup>
- 159) Distance Marker 1 (lower byte)
- 160) Distance Marker 2 (higher byte)
- 161) Distance Marker 2 (lower byte)
- 162) Distance Marker 3 (higher byte)
- 163) Distance Marker 3 (lower byte)
- 164) Distance Marker 4 (higher byte)
- 165) Distance Marker 4 (lower byte)
- 166) Distance Marker 5 (higher byte)
- 167) Distance Marker 5 (lower byte)
- 168) Distance Marker 6 (higher byte)
- 169) Distance Marker 6 (lower byte)
- 170) Relative Propagation Velocity (highest byte)<sup>148</sup>
- 171) Relative Propagation Velocity
- 172) Relative Propagation Velocity
- 173) Relative Propagation Velocity (lowest byte)
- 174) Cable Loss (highest byte)<sup>149</sup>
- 175) Cable Loss
- 176) Cable Loss
- 177) Cable Loss (lowest byte)
- 178) Average Cable Loss<sup>150</sup> (highest byte)
- 179) Average Cable Loss
- 180) Average Cable Loss
- 181) Average Cable Loss (lowest byte)
- 182) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Marker 1 On/Off
  - bit 1 : Marker 2 On/Off
  - bit 2 : Marker 3 On/Off
  - bit 3 : Marker 4 On/Off
  - bit 4 : Marker 5 On/Off
  - bit 5 : Marker 6 On/Off
  - bits 6-7 : Not Used
- 183) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : Marker 2 Delta On/Off
  - bit 1 : Marker 3 Delta On/Off
  - bit 2 : Marker 4 Delta On/Off
  - bits 3-7: Not Used
- 184) Status Byte 3: (0b = Off , 1b = On)

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<sup>146</sup> Distance data uses units 1/100,000m or 1/100,000 ft

<sup>147</sup> Marker point = ( # of data points – 1 ) \* ( marker dist – start dist ) / ( stop dist – start dist )

<sup>148</sup> Relative Propagation Velocity uses units 1/100,000

<sup>149</sup> Cable Loss uses units 1/100,000 dB/m or 1/100,000 dB/ft

<sup>150</sup> Average Cable Loss is dB \* 1000.



- (LSB) bit 0 : Single Limit On/Off  
bit 1: CW On/Off  
bit 2: Trace Math On/Off  
bits 3-5: Not Used  
bit 6 : Limit Type ( 0b = Single; 1b = Multiple)  
bit 7 : Unit of measurement (1b = Metric, 0b = English)
- 185) Status Byte 4:  
(LSB) bit 0 - 1 : DTF Windowing Mode  
bit: 1 0  
| |  
0 0 - Rectangular (No Windowing)  
0 1 - Nominal Side Lobe  
1 0 - Low Side Lobe  
1 1 - Minimum Side Lobe  
bits 2 – 7 : Not Used
- 186) Status Byte 5 (Cal Status) :  
00h : Calibration Off  
01h : Standard Calibration On  
02h : InstaCal Calibration On  
03h : Standard FlexCal On  
04h : InstaCal FlexCal On
- 187) VNA Signal Standard<sup>151</sup> (higher byte)  
188) VNA Signal Standard (lower byte)  
189-314) Not Used  
315-1354) Sweep Data (130 points \* 8 bytes/point= 1040 bytes)  
315-2386) (259 points \* 8 bytes/point= 2072 bytes)  
315-4450) (517 points \* 8 bytes/point= 4136 bytes)
- 8 bytes for each data point  
1. Gamma<sup>152</sup> (highest byte)  
2. Gamma  
3. Gamma  
4. Gamma (lowest byte)  
5. Phase<sup>153</sup> (highest byte)  
6. Phase  
7. Phase  
8. Phase (lowest byte)

*Notes:*

return loss = - 20\* ( log(Gamma) / log(10) )

VSWR = (1+Gamma)/(1-Gamma)

Phase compares the reflected to the incident (reference)

For Spectrum Analyzer Mode:

- 44) Start Frequency<sup>154</sup> (highest byte)  
45) Start Frequency  
46) Start Frequency  
47) Start Frequency (lowest byte)  
48) Stop Frequency<sup>155</sup> (highest byte)  
49) Stop Frequency  
50) Stop Frequency

<sup>151</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>152</sup> Gamma uses units scaled to 1/10,000

<sup>153</sup> Phase is transmitted in 1/10ths of a degree

<sup>154</sup> Scaled by Frequency Scale Factor (bytes 318-319)

<sup>155</sup> Scaled by Frequency Scale Factor (bytes 318-319)

- 51) Stop Frequency (lowest byte)
- 52) Center Frequency<sup>156</sup> (highest byte)
- 53) Center Frequency
- 54) Center Frequency
- 55) Center Frequency (lowest byte)
- 56) Frequency Span<sup>157</sup> (highest byte)
- 57) Frequency Span
- 58) Frequency Span
- 59) Frequency Span (lowest byte)
- 60) Ref Level<sup>158</sup> (highest byte)
- 61) Ref Level
- 62) Ref Level
- 63) Ref Level (lowest byte)
- 64) Scale per div<sup>159</sup> (highest byte)
- 65) Scale per div
- 66) Scale per div
- 67) Scale per div (lowest byte)
- 68) Marker 1<sup>160</sup> (higher byte)
- 69) Marker 1 (lower byte)
- 70) Marker 2 (higher byte)
- 71) Marker 2 (lower byte)
- 72) Marker 3 (higher byte)
- 73) Marker 3 (lower byte)
- 74) Marker 4 (higher byte)
- 75) Marker 4 (lower byte)
- 76) Marker 5 (higher byte)
- 77) Marker 5 (lower byte)
- 78) Marker 6 (higher byte)
- 79) Marker 6 (lower byte)
- 80) Single Limit<sup>161</sup> (highest byte)
- 81) Single Limit
- 82) Single Limit
- 83) Single Limit (lowest byte)
- 84) Multiple Upper Limit 1 Start X<sup>162</sup> (highest byte)
- 85) Multiple Upper Limit 1 Start X
- 86) Multiple Upper Limit 1 Start X
- 87) Multiple Upper Limit 1 Start X (lowest byte)
- 88) Multiple Upper Limit 1 Start Y (Power Level) (highest byte)
- 89) Multiple Upper Limit 1 Start Y (Power Level)
- 90) Multiple Upper Limit 1 Start Y (Power Level)
- 91) Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 92) Multiple Upper Limit 1 End X<sup>163</sup> (highest byte)
- 93) Multiple Upper Limit 1 End X
- 94) Multiple Upper Limit 1 End X
- 95) Multiple Upper Limit 1 End X (lowest byte)
- 96) Multiple Upper Limit 1 End Y (Power Level) (highest byte)

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<sup>156</sup> Scaled by Frequency Scale Factor (bytes 318-319)

<sup>157</sup> Scaled by Frequency Scale Factor (bytes 318-319)

<sup>158</sup> Value sent as (value in dBm \* 1000) + 270,000

<sup>159</sup> Value sent as (value \* 1000)

<sup>160</sup> Marker values are sent as # of data point on display.

See Control Byte #102, "Set Spectrum Analyzer Marker" for calculation of data point.

<sup>161</sup> All amplitude values are sent as (value in dBm \* 1000) + 270,000

<sup>162</sup> Scaled by Frequency Scale Factor (bytes 318-319)

<sup>163</sup> Scaled by Frequency Scale Factor (bytes 318-319)

- 97) Multiple Upper Limit 1 End Y (Power Level)
- 98) Multiple Upper Limit 1 End Y (Power Level)
- 99) Multiple Upper Limit 1 End Y (Power Level) (lowest byte)
- 100-243) Multiple Upper Limits 2-5, Multiple Lower Limits 1-5 (see bytes 84-99 for format)
- 244) RBW Setting<sup>164</sup> (highest byte)
- 245) RBW Setting
- 246) RBW Setting
- 247) RBW Setting (lowest byte)
- 248) VBW Setting<sup>165</sup> (highest byte)
- 249) VBW Setting
- 250) VBW Setting
- 251) VBW Setting (lowest byte)
- 252) OCC BW Method (00h = % of power, 01h = dB down)
- 253) OCC BW % Value (0-99)
- 254) OCC BW dBc (0-120)
- 255) Attenuation<sup>166</sup> (highest byte)
- 256) Attenuation
- 257) Attenuation
- 258) Attenuation (lowest byte)
- 259-274) Antenna Name (16 bytes in ASCII)
- 275) Status Byte 1: (0b = Off, 1b = On)
  - (LSB) bit 0 : Marker 1 On/Off
  - bit 1 : Marker 2 On/Off
  - bit 2 : Marker 3 On/Off
  - bit 3 : Marker 4 On/Off
  - bit 4 : Marker 5 On/Off
  - bit 5 : Marker 6 On/Off
  - bits 6-7: Not Used
- 276) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : Not Used
  - bit 1 : Marker 2 Delta On/Off
  - bit 2 : Marker 3 Delta On/Off
  - bit 3 : Marker 4 Delta On/Off
  - bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)
  - bit 5 : Pre Amp Status On/Off
  - bit 6 : Dynamic Attenuation On/Off
  - bit 7 : Normalization On/Off
- 277) Status Byte 3: (0b = Off, 1b = On)
  - (LSB) bit 0 : Antenna Factor Correction On/Off
  - bits 1-2 : Detection alg (00b = pos. peak 01b = RMS Averaging 10b = neg. peak, 11 = Sampling Mode)
  - bits 3-4 : Amplitude Units (log) (00b = dBm 01b = dBV 10b = dBmV 11b = dBuV) (Linear) – (00b = Watts 01b = Volts)
  - bit 5 : Channel Power On/Off
  - bit 6 : Adjacent Channel Power Ratio On/Off
  - bit 7 : Units Type (0b = Log 1b = Linear)
- 278) Status Byte 4
  - (0b = Off/Beep if data is BELOW line, 1b = On/Beep if data is ABOVE line)
  - (LSB) bit 0 : Limit Type (0b = Single, 1b = Multiple)
  - bit 1 : Single Limit On/Off
  - bit 2 : Single Limit Beep Level (0b = beep when data is below line 1b = above)

<sup>164</sup> Valid frequencies (in Hz) are 100, 300, 1,000, 3,000, 10,000, 30,000, 100,000, 300,000, 1,000,000

<sup>165</sup> Valid frequencies (in Hz) are 100, 300, 1,000, 3,000, 10,000, 30,000, 100,000, 300,000

<sup>166</sup> Value sent as (value \* 1000)

- bit 3 : Not Used
- bit 4 : Multiple Limit Upper Segment 1 Status On/Off
- bit 5 : Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW
- bit 6 : Multiple Limit Upper Segment 2 Status On/Off
- bit 7 : Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW

279) Status Byte 5

(0b = Off/Beep if data is BELOW line, 1b = On/Beep if data is ABOVE line)

- (LSB) bit 0 : Multiple Limit Upper Segment 3 Status On/Off
- bit 1 : Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW
- bit 2 : Multiple Limit Upper Segment 4 Status On/Off
- bit 3 : Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW
- bit 4 : Multiple Limit Upper Segment 5 Status On/Off
- bit 5 : Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- bit 6 : Multiple Limit Lower Segment 1 Status On/Off
- bit 7 : Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW

280) Status Byte 6

(0b = Off/Beep if data is BELOW line, 1b = On/Beep if data is ABOVE line)

- (LSB) bit 0 : Multiple Limit Lower Segment 2 Status On/Off
- bit 1 : Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW
- bit 2 : Multiple Limit Lower Segment 3 Status On/Off
- bit 3 : Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW
- bit 4 : Multiple Limit Lower Segment 4 Status On/Off
- bit 5 : Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW
- bit 6 : Multiple Limit Lower Segment 5 Status On/Off
- bit 7 : Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW

281) Status Byte 7

(LSB) bits 0-6: Number of Sweeps to Average (1-25, 1 implies averaging OFF)

bit 7 : Not Used

282) Reference Level Offset<sup>167</sup> (highest byte)

283) Reference Level Offset

284) Reference Level Offset

285) Reference Level Offset (lowest byte)

286) External Reference Frequency<sup>168</sup>

287) Signal Standard<sup>169</sup> (higher byte)

288) Signal Standard (lower byte)

289) Channel Selection<sup>170</sup> (higher byte)

290) Channel Selection (lower byte)

291) Interference Analysis Cellular Standard<sup>171</sup>

292) Interference Analysis Estimated Bandwidth (highest byte)

293) Interference Analysis Estimated Bandwidth

294) Interference Analysis Estimated Bandwidth

295) Interference Analysis Estimated Bandwidth (lowest byte)

296) Interference Analysis Frequency<sup>172</sup> (highest byte)

297) Interference Analysis Frequency

298) Interference Analysis Frequency

299) Interference Analysis Frequency (lowest byte)

300-303) Reserved

304) Trigger Type<sup>173</sup>

<sup>167</sup> Value sent as (Value in dBm \* 1000) + 270,000

<sup>168</sup> byte in MHz (i.e. 20 = 20MHz)

<sup>169</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). "No Standard" sent as FFFEh.

<sup>170</sup> "No Channel" is sent as FFFEh.

<sup>171</sup> 4 Standards – 00h = 1250kHz CDMA, 01h = GSM, 02h = TDMA, 03h = AMPS, 04h = Unknown FFh = Interference Analysis Measurement OFF

<sup>172</sup> Scaled by Frequency Scale Factor (bytes 318-319)

- 305) Trigger Position (0 – 100%)  
 306) Min Sweep Time (in  $\mu$ s) (highest byte)  
 307) Min Sweep Time (in  $\mu$ s)  
 308) Min Sweep Time (in  $\mu$ s)  
 309) Min Sweep Time (in  $\mu$ s) (lowest byte)  
 310) Video Trigger Level<sup>174</sup> (highest byte)  
 311) Video Trigger Level  
 312) Video Trigger Level  
 313) Video Trigger Level (lowest byte)  
 314) Status Byte 8 (0b = Off, 1b = On)  
     (LSB)      bit 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)  
                   bit 2: Max Hold On/Off  
                   bit 3: Min Hold On/Off  
                   bit 4: Transmission Calibration Status (Option 21 Only)  
                   bit 5: Bias Tee On/Off (Option 10 Only)  
                   bit 6: Occupied BW Measurement On/Off  
                   bit 7: Not Used
- 315) Impedance (00h = 50 $\Omega$ , 0Ah = 75 $\Omega$  Anritsu Adapter, 0Ch = 75 $\Omega$  Other Adapter)  
 316) Impedance Loss<sup>175</sup> (higher byte)  
 317) Impedance Loss (lower byte)  
 318) Frequency Scale Factor<sup>176</sup> (higher byte)  
 319) Frequency Scale Factor (lower byte)  
 320) Frequency Range Minimum<sup>177</sup> (highest byte)  
 321) Frequency Range Minimum  
 322) Frequency Range Minimum  
 323) Frequency Range Minimum (lowest byte)  
 324) Frequency Range Maximum<sup>178</sup> (highest byte)  
 325) Frequency Range Maximum  
 326) Frequency Range Maximum  
 327) Frequency Range Maximum (lowest byte)  
 328) Linked Trace Number (1-200)  
 329) Status Byte 9 (0b = Off, 1b = On)  
     (LSB)      bit 0: C/I Measurement On/Off  
                   bits 1-3: C/I Carrier Trace/Signal Type<sup>179</sup>  
                   bits 4-7: Not Used
- 330) C/I Calculated Power<sup>180</sup> (Carrier or Interference – NB FHSS<sup>181</sup>) (highest byte)  
 331) C/I Calculated Power (Carrier or Interference – NB FHSS)  
 332) C/I Calculated Power (Carrier or Interference – NB FHSS)  
 333) C/I Calculated Power (Carrier or Interference – NB FHSS) (lowest byte)  
 334) C/I Calculated Power<sup>182</sup> (Interference – WB FHSS<sup>183</sup>) (highest byte)  
 335) C/I Calculated Power (Interference – WB FHSS)  
 336) C/I Calculated Power (Interference – WB FHSS)

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<sup>173</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>174</sup> Value sent as (Value in dBm \* 1000) + 270,000

<sup>175</sup> Value sent as (value in dB \* 1000), valid values are 0 to 20 dB

<sup>176</sup> In number of Hz

<sup>177</sup> Scaled by Frequency Scale Factor

<sup>178</sup> Scaled by Frequency Scale Factor

<sup>179</sup> 000b = Carrier – NB FHSS, 001b = Carrier – WB FHSS, 010b = Carrier – Broadband, 111b = Interference

<sup>180</sup> Value sent as (value in dBm \* 1000) + 270,000

<sup>181</sup> If Status Byte 9, bytes 1-3 equal 111b, then value will be calculated power for the Interference – NB FHSS trace. Otherwise, these bytes represent the calculated Carrier power.

<sup>182</sup> Value sent as (value in dBm \* 1000) + 270,000

<sup>183</sup> If Status Byte 9, bytes 1-3 equal 111b, then value will be calculated power for the Interference – WB FHSS trace. Otherwise, these bytes should be ignored.

- 337) C/I Calculated Power (Interference – WB FHSS) (lowest byte)
- 338) C/I Calculated Power<sup>184</sup> (Interference – Broadband<sup>185</sup>) (highest byte)
- 339) C/I Calculated Power (Interference – Broadband)
- 340) C/I Calculated Power (Interference – Broadband)
- 341) C/I Calculated Power (Interference – Broadband) (lowest byte)
- 342) Marker Type<sup>186</sup>
- 343-400) Not Used
- 401-2004) Sweep Data (401 points \* 4 bytes/point = 1604 bytes)
  - 4 bytes for each data point
    - 1. dBm<sup>187</sup> (highest byte)
    - 2. dBm
    - 3. dBm
    - 4. dBm (lowest byte)

For Power Meter Mode:

- 57) Power Monitor Mode (00h = Off, 01h = On)
- 58) Power Meter Unit (00h = dBm, 01h = Watts)
- 59) Start Frequency<sup>188</sup> (highest byte)
- 60) Start Frequency
- 61) Start Frequency
- 62) Start Frequency (lowest byte)
- 63) Stop Frequency<sup>189</sup> (highest byte)
- 64) Stop Frequency
- 65) Stop Frequency
- 66) Stop Frequency (lowest byte)
- 67) Center Frequency<sup>190</sup> (highest byte)
- 68) Center Frequency
- 69) Center Frequency
- 70) Center Frequency (lowest byte)
- 71) Frequency Span<sup>191</sup> (highest byte)
- 72) Frequency Span
- 73) Frequency Span
- 74) Frequency Span (lowest byte)
- 75) Power Offset Status (00h = Off, 01h = On)
- 76) Power Offset<sup>192</sup> (highest byte)
- 77) Power Offset
- 78) Power Offset
- 79) Power Offset (lowest byte)
- 80) Power Relative Status (00h = Off, 01h = On)
- 81) Power Relative Value<sup>193</sup> (highest byte)
- 82) Power Relative Value
- 83) Power Relative Value
- 84) Power Relative Value (lowest byte)
- 85) RMS Averaging Level (00h = Off, 01h = Low, 02h = Medium, 03h = High)

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<sup>184</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>185</sup> If Status Byte 9, bytes 1-3 equal 111b, then value will be calculated power for the Interference – Broadband trace. Otherwise, these bytes should be ignored.

<sup>186</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>187</sup> Value sent as (Value in dBm \* 1000 ) + 270,000

<sup>188</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>189</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>190</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>191</sup> Scaled by Frequency Scale Factor (bytes 96-97)

<sup>192</sup> Value sent as ( value in dB \* 1000 ), valid values are 0 to 60 dB

<sup>193</sup> Value sent as ( value in dBm \* 1000 )

- 86) Power Zero Status (00h = Off, 01h = On)
- 87) External Reference Status (00h = Off, 01h = On)
- 88) External Reference Frequency (in Hz) (highest byte)
- 89) External Reference Frequency (in Hz)
- 90) External Reference Frequency (in Hz)
- 91) External Reference Frequency (in Hz) (lowest byte)
- 92) Signal Standard<sup>194</sup> (higher byte)
- 93) Signal Standard (lower byte)
- 94) Channel Selection<sup>195</sup> (higher byte)
- 95) Channel Selection (lower byte)
- 96) Frequency Scale Factor<sup>196</sup> (higher byte)
- 97) Frequency Scale Factor (lower byte)
- 98) Frequency Range Minimum<sup>197</sup> (highest byte)
- 99) Frequency Range Minimum
- 100) Frequency Range Minimum
- 101) Frequency Range Minimum (lowest byte)
- 102) Frequency Range Maximum<sup>198</sup> (highest byte)
- 103) Frequency Range Maximum
- 104) Frequency Range Maximum
- 105) Frequency Range Maximum (lowest byte)
- 96 – 150) Not Used
- 151) Power Meter Reading<sup>199</sup> (highest byte)
- 152) Power Meter Reading
- 153) Power Meter Reading
- 154) Power Meter Reading (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Not enough bytes transferred
- 225 (E1h) Memory Error: Not enough memory to store data
- 238 (EEh) Time-out Error

<sup>194</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>195</sup> “No Channel” is sent as FFFEh

<sup>196</sup> In number of Hz

<sup>197</sup> Scaled by Frequency Scale Factor

<sup>198</sup> Scaled by Frequency Scale Factor

<sup>199</sup> Power sent as (power in dBm \* 1000). Use two’s-complement method to decode negative power levels.

### **Get Options – Control Byte #37 (25h)**

*Description:* Queries the option(s) installed on the LMR Master, returns a list as an ASCII string.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* Number of bytes depends on the option(s) installed

Option 2:	“2/”
Option 3:	“3/”
Option 5:	“5/”
Option 10:	“10/”
Option 19:	“19/”
Option 21:	“21/”
Option 25:	“25/”
Option 27:	“27/”
Option 31:	“31/”
Option 68:	“68/”
Option 520:	“520/”
Option 522:	“522/”
Option 530:	“530/”
Option 532:	“532/”

If NO options are installed:	“None”
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### **Query Power Level – Control Byte #39 (27h)**

**This command is available with Power Meter and/or Option 5.**

*Description:* Return Power Level at the RF In port. Also returns power meter settings.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 30 bytes

- 1) Status Byte # 1 (0b = Off, 1b = On)  
(LSB) bit 0 : Unit (0b - Watt/%, 1b - dBm/dBr)  
bit 2 : Relative Mode On/Off  
bit 3: Offset Mode On/Off  
bit 4: Zero Mode On/Off  
bits 5-7: Not Used
- 2) RMS Averaging Status<sup>200</sup>
- 3 - 6) Relative Mode Reference Power Level in dBm
- 7 - 10) Offset Mode Power Level
- 11 - 14) Zero Mode Power Level
- 15 - 18) Absolute Power Level
- 19 - 22) Power
- 23 - 26) Center Frequency
- 27 - 30) Span Frequency

*Notes:*

Power is returned as (dBm \* 1000)

Relative power is returned as (dB \* 1000)

Offset is returned as (dB \* 1000)

Frequencies are scaled by the frequency scale factor.

---

### **Set Power Meter Units – Control Byte #40 (28h)**

**This command is available with Power Meter and/or Option 5.**

*Description:* Set Power Meter units to watts or dBm.

*Bytes to Follow:* 1 byte

- 1) Units  
00h = Watt (% if in relative mode)  
01h = dBm (dB if in relative mode)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid Units  
238 (EEh) Time-out Error

---

<sup>200</sup> RMS Averaging – 00h = Off, 01h = Low, 02h = Medium, 03h = High

### **Power Meter Relative Mode On/Off – Control Byte #41 (29h)**

**This command is available with Power Meter and/or Option 5.**

*Description:* Enable or disable Power Meter Relative Mode.

*Bytes to Follow:* 1 byte

- 1) Relative Mode State  
00h = Off  
01h = On w/ trigger (use the current power level as a reference power level)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid parameter  
238 (EEh) Time-out Error
- 

### **Power Meter Offset Mode On/Off – Control Byte #42 (2Ah)**

**This command is available with Power Meter and/or Option 5.**

*Description:* Enable or disable Power Meter Offset Mode.

*Bytes to Follow:* 5 bytes

- 1) On/Off (01h = On, 00h = Off)
- 2 - 5) Offset Power level in dB (Multiplied by 1000)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid parameter  
238 (EEh) Time-out Error

*Note:*

If you turn the Offset mode off, you must still send the other bytes. Bytes 2 - 5 will be ignored.

---

### **Power Meter Zero Mode On/Off – Control Byte #43 (2Bh)**

**This command is available with Power Meter and/or Option 5.**

*Description:* Enable or disable Power Meter Zeroing Mode.

*Bytes to Follow:* 1 byte

- 1) Zero Mode Status  
00h = Off  
01h = On with trigger (current power level is referenced as -80 dBm)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid status  
238 (EEh) Time-out Error
-

### **Power Meter RMS Averaging On/Off – Control Byte #44 (2Ch)**

**This command is available with Power Meter only.**

*Description:* Disable/enable Power Meter RMS Averaging. Enabling can be set to 3 different levels.

*Bytes to Follow:* 1 byte

- 1) RMS Averaging State
  - 00h = Off
  - 01h = On (Low) with trigger (current power level is referenced as -80 dBm)
  - 02h = On (Medium)
  - 03h = On (High)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid state
  - 238 (EEh) Time-out Error
- 

### **Power Meter Center Frequency and Span Setup – Control Byte #45 (2Dh)**

**This command is available with Power Meter only.**

*Description:* Sets the center frequency and span frequency for the Power Meter mode.

*Bytes to Follow:* 8 bytes

- 1) Center Frequency (highest byte)
- 2) Center Frequency
- 3) Center Frequency
- 4) Center Frequency (lowest byte)
- 5) Span (highest byte)
- 6) Span
- 7) Span
- 8) Span (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid frequency range
  - 238 (EEh) Time-out Error
- 

### **Trigger Sweep – Control Byte #48 (30h)**

*Description:* Causes the LMR Master to perform a sweep if it is in single sweep mode.

This command works only when the LMR Master is NOT in remote mode. Send this command, then wait for the "Sweep Complete Byte" to signify the end of the sweep.

Note: The "Sweep Complete Byte" is not returned unless serial echo status is turned on using command #10.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

- 1) 192 (C0h) Sweep Complete Byte (at the end of the sweep)
-

### **Trigger Sweep – Control Word (AA30h)**

*Description:* Causes the LMR Master to perform a sweep if it is in single sweep mode.

This command works only when the LMR Master is NOT in remote mode. Send this command, receive the “Operation Complete Byte” and then wait for the “Sweep Complete Byte” to signify the end of the sweep.

Note: The "Sweep Complete Byte" is not returned unless serial echo status is turned on using command #10.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 2 bytes

- 1) 255 (FFh) Operation Complete Byte (when the command is received)
  - 2) 192 (C0h) Sweep Complete Byte (at the end of the sweep)
- 

### **Sweep Data Echo On/Off – Control Byte #49 (31h)**

*Description:* Sets the sweep data echo mode On/Off.

Sweep Data Echo Mode behaves much like the Serial Port Echo Mode (see Control Byte #10). It automatically puts the unit into single sweep mode. At the end of each sweep cycle, the LMR Master sends a Sweep Complete Byte #192 (C0h) to the serial port. At this time, sweep data can be queried (see Control Byte #33) without having to enter remote mode first or exit remote mode when done. Depending on the value of the second following byte, the next sweep can be automatically triggered after the sweep data has been sent.

This mode activates once the LMR Master exits from the remote mode. Sweep Data Echo status can't be saved to or recalled from saved setups. Cycling power resets the Sweep Data Echo status to Off.

The Sweep Data Echo Mode allows run-time handshaking between the LMR Master and computer by doing the following:

- 1) Enter remote mode. Set Sweep Data Echo Mode On. Exit remote mode.
- 2) The LMR Master sweeps once and then sends the Sweep Complete Byte.
- 3) After you receive it: Recall sweep 0 (last sweep trace in RAM).
- 4) If using auto triggering, repeat steps 2-3. If using manual triggering, go to step 5.
- 5) Send Sweep Triggering Byte #48 (30h) and wait for the next sweep cycle.
- 6) Repeat steps 2-5.

*Note:* To execute commands other than #33, you must use the traditional Enter Remote, Send Commands, Exit Remote communication sequence.

*Bytes to Follow:* 2 bytes

- 1) Sweep Data Echo Status  
00h : Off  
01h : On
- 2) Next Sweep Trigger  
00h : Manual  
01h : Automatic

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error : Invalid sweep data echo status  
238 (EEh) Time-out Error
-

### **Check Battery Status – Control Byte #50 (32h)**

*Description:* Return Smart Battery status.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 17 bytes

- 1-2) Battery Status flags ( Refer to Smart Battery Data Spec 5.1.2.1)
- 3-4) State of Charge (unsigned integer 0 to 100%)Full)
- 5-6) Battery Voltage (unsigned integer 0 to 65535 in mV)
- 7-8) Battery Current (signed integer -32,768 to +32,7687 mA, positive = Charging)
- 9-10) Battery Average current (signed integer -32,768 to +32,7687 mA, positive = Charging)
- 11-12) Average time to empty (unsigned integer 0 to 65535 minute)
- 13-14) Battery Charge Cycle Count (unsigned integer 0 to 65535 cycles)
- 15-16) Battery Capacity at Full Charge in mA Hours (unsigned integer 0 to 65535 cycles)
- 17) Unit under battery power (1 = YES; 0 = NO)

*Note:*

The Smart Battery Data Spec can be found at <http://www.sbs-forum.org/specs/index.html>

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### **Set SPA Minimum Sweep Time – Control Byte #53 (35h)**

*Description:* Sets the minimum sweep time (in  $\mu$ s) for the spectrum analyzer when the span is 0.

Valid range is 50 to 200,000,000.

*Bytes to Follow:* 4 bytes

- 1) Minimum Sweep Time (in  $\mu$ s) (highest byte)
- 2) Minimum Sweep Time (in  $\mu$ s)
- 3) Minimum Sweep Time (in  $\mu$ s)
- 4) Minimum Sweep Time (in  $\mu$ s) (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid sweep time  
238 (EEh) Time-out Error
- 

### **Set Trigger Position – Control Byte #54 (36h)**

*Description:* Sets the trigger position (in percent) for the spectrum analyzer when the span is 0.

*Bytes to Follow:* 1 byte

- 1) Trigger Position (0 – 100%)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid trigger position  
238 (EEh) Time-out Error
-

### **Set Video Trigger Level – Control Byte #55 (37h)**

*Description:* Sets the trigger level (-120 - +20 dBm) for the spectrum analyzer when the span is 0 and trigger mode is video.

The trigger level should be sent as (value in dBm \* 1000) + 120,000.

*Bytes to Follow:* 4 bytes

- 1) Trigger Level (highest byte)
- 2) Trigger Level
- 3) Trigger Level
- 4) Trigger Level (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid trigger level
  - 238 (EEh) Time-out Error
- 

### **Automatically Save Runtime Setup – Control Byte #64 (40h)**

*Description:* Automatically save the runtime setup when exiting remote mode.

This flag must be set once per power cycle of the LMR Master. It returns to its default value when the unit is turned off. The default value is (0), DO NOT automatically save the runtime setup.

*Bytes to Follow:* 1 byte

- 1) Save runtime setup On/Off
  - 00h = Off (default)
  - 01h = On

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 238 (EEh) Time Out Error
- 

### **Download Saved Setup – Control Byte #65 (41h)**

*Description:* Returns parameters associated with the specified setup number. Since different modes have different numbers of setup locations available, the command requires the mode be specified as well as the setup number.

*Bytes to Follow:* 2 bytes

- 1) Measurement Mode<sup>201</sup>
- 2) Setup Number
  - 0 = Run time setup
  - 1 – 10 = Saved setups for Spectrum Analyzer/Transmission Measurement modes
  - 1 – 5 = Saved setups for Power Meter mode
  - 255 = Default setup

*LMR Master Returns:*

For All Modes:

- 1) Number of Following Bytes (higher byte)
- 2) Number of Following Bytes (lower byte)
- 3) Measurement Mode<sup>202</sup>
- 5-20) Not Used

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<sup>201</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>202</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

For LMR Master VNA Modes:

- 21) Number of Data Points (higher byte)
- 22) Number of Data Points (lower byte)
- 23) VNA Start Frequency (in Hz) (highest byte)
- 24) VNA Start Frequency
- 25) VNA Start Frequency
- 26) VNA Start Frequency (lowest byte)
- 27) VNA Stop Frequency (in Hz) (highest byte)
- 28) VNA Stop Frequency
- 29) VNA Stop Frequency
- 30) VNA Stop Frequency (lowest byte)
- 31) Return Loss Scale Start (higher byte)<sup>203</sup>
- 32) Return Loss Scale Start (lower byte)
- 33) Return Loss Scale Stop (higher byte)
- 34) Return Loss Scale Stop (lower byte)
- 35) SWR Scale Start (higher byte)<sup>204</sup>
- 36) SWR Scale Start (lower byte)
- 37) SWR Scale Stop (higher byte)
- 38) SWR Scale Stop (lower byte)
- 39) Cable Loss Scale Start (higher byte)<sup>205</sup>
- 40) Cable Loss Scale Start (lower byte)
- 41) Cable Loss Scale Stop (higher byte)
- 42) Cable Loss Scale Stop (lower byte)
- 43) DTF-RL Scale Start (higher byte)<sup>206</sup>
- 44) DTF-RL Scale Start (lower byte)
- 45) DTF-RL Scale Stop (higher byte)
- 46) DTF-RL Scale Stop (lower byte)
- 47) DTF-SWR Scale Start (higher byte)<sup>207</sup>
- 48) DTF-SWR Scale Start (lower byte)
- 49) DTF-SWR Scale Stop (higher byte)
- 50) DTF-SWR Scale Stop (lower byte)
- 51) VNA Frequency Marker 1 (higher byte)<sup>208</sup>
- 52) VNA Frequency Marker 1 (lower byte)
- 53) VNA Frequency Marker 2 (higher byte)
- 54) VNA Frequency Marker 2 (lower byte)
- 55) VNA Frequency Marker 3 (higher byte)
- 56) VNA Frequency Marker 3 (lower byte)
- 57) VNA Frequency Marker 4 (higher byte)
- 58) VNA Frequency Marker 4 (lower byte)
- 59) VNA Frequency Marker 5 (higher byte)
- 60) VNA Frequency Marker 5 (lower byte)
- 61) VNA Frequency Marker 6 (higher byte)
- 62) VNA Frequency Marker 6 (lower byte)
- 63) Return Loss Single Limit (higher byte)<sup>209</sup>
- 64) Return Loss Single Limit (lower byte)
- 65) SWR Single Limit (higher byte)<sup>210</sup>

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<sup>203</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>204</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>205</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>206</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>207</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>208</sup> Marker Point = ( # data points – 1 ) \* ( marker freq – start freq ) / ( stop freq – start freq )

Where # of data points can be found in bytes 2-3, start freq is in bytes 4-7, and stop freq is in bytes 8-11.

<sup>209</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

- 66) SWR Single Limit (lower byte)
- 67) Cable Loss Single Limit (higher byte)<sup>211</sup>
- 68) Cable Loss Single Limit (lower byte)
- 69) DTF-RL Single Limit (higher byte)<sup>212</sup>
- 70) DTF-RL Single Limit (lower byte)
- 71) DTF-SWR Single Limit (higher byte)<sup>213</sup>
- 72) DTF-SWR Single Limit (lower byte)
- 73) Return Loss Multiple Limit Segment # (1)
- 74) Return Loss Multiple Limit Segment Status (00h = Off, 01h = On )
- 75) Return Loss Multiple Limit Segment Start X (highest byte)<sup>214</sup>
- 76) Return Loss Multiple Limit Segment Start X
- 77) Return Loss Multiple Limit Segment Start X
- 78) Return Loss Multiple Limit Segment Start X (lowest byte)
- 79) Return Loss Multiple Limit Segment Start Y (higher byte)
- 80) Return Loss Multiple Limit Segment Start Y (lowest byte)
- 81) Return Loss Multiple Limit Segment End X (highest byte)
- 82) Return Loss Multiple Limit Segment End X
- 83) Return Loss Multiple Limit Segment End X
- 84) Return Loss Multiple Limit Segment End X (lowest byte)
- 85) Return Loss Multiple Limit Segment End Y (higher byte)
- 86) Return Loss Multiple Limit Segment End Y (lowest byte)
- 87-142) Repeat bytes 63 – 76 for segments 2 – 5
- 143-212) Repeat bytes 63 – 132 for SWR Multiple Limit
- 213-282) Repeat bytes 63 – 132 for Cable Loss Multiple Limit
- 283-352) Repeat bytes 63 – 132 for DTF-RL Multiple Limit
- 353-422) Repeat bytes 63 – 132 for DTF-SWR Multiple Limit
- 423) Start Distance (highest byte)<sup>215</sup>
- 424) Start Distance
- 425) Start Distance
- 426) Start Distance (lowest byte)
- 427) Stop Distance (highest byte)
- 428) Stop Distance
- 429) Stop Distance
- 430) Stop Distance (lowest byte)
- 431) Distance Marker 1 (higher byte)<sup>216</sup>
- 432) Distance Marker 1 (lower byte)
- 433) Distance Marker 2 (higher byte)
- 434) Distance Marker 2 (lower byte)
- 435) Distance Marker 3 (higher byte)
- 436) Distance Marker 3 (lower byte)
- 437) Distance Marker 4 (higher byte)
- 438) Distance Marker 4 (lower byte)
- 439) Distance Marker 5 (higher byte)
- 440) Distance Marker 5 (lower byte)
- 441) Distance Marker 6 (higher byte)
- 442) Distance Marker 6 (lower byte)
- 443) Relative Propagation Velocity (highest byte)<sup>217</sup>

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<sup>210</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>211</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>212</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>213</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>214</sup> See Control Byte #112, “Set LMR Master VNA Segmented Limit Lines” for data format.

<sup>215</sup> Distance data uses units 1/100,000m or 1/100,000 ft

<sup>216</sup> Marker Point = ( # data points – 1 ) \* ( marker dist – start dist ) / ( stop dist – start dist )

Where # of data points can be found in bytes 2-3, start dist is in bytes 106-109, and stop dist is in bytes 110-113.



- 444) Relative Propagation Velocity  
445) Relative Propagation Velocity  
446) Relative Propagation Velocity (lowest byte)  
447) Cable Loss (highest byte)<sup>218</sup>  
448) Cable Loss  
449) Cable Loss  
450) Cable Loss (lowest byte)  
451) Average Cable Loss<sup>219</sup> (highest byte)  
452) Average Cable Loss  
453) Average Cable Loss  
454) Average Cable Loss (lowest byte)  
455) Status Byte 1: (0b = Off, 1b = On)  
(LSB) bit 0 : LMR Master Marker 1 On/Off  
bit 1 : LMR Master Marker 2 On/Off  
bit 2 : LMR Master Marker 3 On/Off  
bit 3 : LMR Master Marker 4 On/Off  
bit 4 : LMR Master Marker 5 On/Off  
bit 5 : LMR Master Marker 6 On/Off  
bits 6- 7 : Not Used  
456) Status Byte 2: (0b = Off, 1b = On)  
(LSB) bit 0 : Not Used  
bit 1 : LMR Master Marker 2 Delta On/Off  
bit 2 : LMR Master Marker 3 Delta On/Off  
bit 3 : LMR Master Marker 4 Delta On/Off  
bits 4-7: Not Used  
457) Status Byte 3: (0b = Off, 1b = On)  
(LSB) bit 0 : LMR Master Limit Type (0b = Single, 1b = Multiple)  
bit 1 : LMR Master Limit Beep On/Off  
bits 2-6 : Not Used  
bit 7 : LMR Master Single Limit Status On/Off  
458) Status Byte 4:  
(LSB) bits 0 - 1 : DTF Windowing Mode  
bit: 1 0  
| |  
0 0 - Rectangular (No Windowing)  
0 1 - Nominal Side Lobe  
1 0 - Low Side Lobe  
1 1 - Minimum Side Lobe  
bits 2 - 7 : Not Used  
459) Status Byte 5: (0b = Off, 1b = On )  
(LSB) bit 0 : Fixed CW Mode On/Off  
bit 1 : Single Sweep On/Off  
bit 2 : Trace Overlay On/Off  
bit 3 : Measurement Unit Metric/English (0b = English, 1b = Metric)  
bits 4-6: Not Used  
bit 7 : Cal Mode (0b = OSL Cal, 1b = FlexCal)  
460) VNA Signal Standard<sup>220</sup> (higher byte)  
461) VNA Signal Standard (lower byte)  
462) Cable Index  
463) Cable Folder<sup>221</sup>

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<sup>217</sup> Relative Propagation Velocity uses units 1/100,000.

<sup>218</sup> Cable loss uses units 1/100,000 dB/m or 1/100,000 dB/ft.

<sup>219</sup> Average Cable Loss is dB \* 1000.

<sup>220</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). "No Standard" sent as FFFEh

<sup>221</sup> 00h=Standard at 1000 MHz, 01h=Standard at 2000 MHz, 02h=Standard at 2500 MHz, 03h=Custom

464) Trace Overlay Index (1-200)  
465-550) Not Used

For Spectrum Analyzer Mode:

- 21) Spectrum Analyzer Start Frequency<sup>222</sup> (highest byte)
- 22) Spectrum Analyzer Start Frequency
- 23) Spectrum Analyzer Start Frequency
- 24) Spectrum Analyzer Start Frequency (lowest byte)
- 25) Spectrum Analyzer Stop Frequency<sup>223</sup> (highest byte)
- 26) Spectrum Analyzer Stop Frequency
- 27) Spectrum Analyzer Stop Frequency
- 28) Spectrum Analyzer Stop Frequency (lowest byte)
- 29) Spectrum Analyzer Center Frequency<sup>224</sup> (highest byte)
- 30) Spectrum Analyzer Center Frequency
- 31) Spectrum Analyzer Center Frequency
- 32) Spectrum Analyzer Center Frequency (lowest byte)
- 33) Spectrum Analyzer Frequency Span<sup>225</sup> (highest byte)
- 34) Spectrum Analyzer Frequency Span
- 35) Spectrum Analyzer Frequency Span
- 36) Spectrum Analyzer Frequency Span (lowest byte)
- 37) Ref Level (highest byte)<sup>226</sup>
- 38) Ref Level
- 39) Ref Level
- 40) Ref Level (lowest byte)
- 41) Scale per div (highest byte)<sup>227</sup>
- 42) Scale per div
- 43) Scale per div
- 44) Scale per div (lowest byte)
- 45) Spectrum Analyzer Frequency Marker 1 (higher byte)<sup>228</sup>
- 46) Spectrum Analyzer Frequency Marker 1 (lower byte)
- 47) Spectrum Analyzer Frequency Marker 2 (higher byte)
- 48) Spectrum Analyzer Frequency Marker 2 (lower byte)
- 49) Spectrum Analyzer Frequency Marker 3 (higher byte)
- 50) Spectrum Analyzer Frequency Marker 3 (lower byte)
- 51) Spectrum Analyzer Frequency Marker 4 (higher byte)
- 52) Spectrum Analyzer Frequency Marker 4 (lower byte)
- 53) Spectrum Analyzer Frequency Marker 5 (higher byte)
- 54) Spectrum Analyzer Frequency Marker 5 (lower byte)
- 55) Spectrum Analyzer Frequency Marker 6 (higher byte)
- 56) Spectrum Analyzer Frequency Marker 6 (lower byte)
- 57) Spectrum Analyzer Single Limit (highest byte)<sup>229</sup>
- 58) Spectrum Analyzer Single Limit
- 59) Spectrum Analyzer Single Limit
- 60) Spectrum Analyzer Single Limit (lowest byte)
- 61) SPA Multiple Upper Limit 1 Start X<sup>230</sup> (highest byte)

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<sup>222</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>223</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>224</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>225</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>226</sup> Value sent as (value in dBm \* 1000) + 270,000)

<sup>227</sup> Value sent as (value \* 1000)

<sup>228</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points - 1 )) + start frequency.

<sup>229</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>230</sup> Scaled by Frequency Scale Factor (bytes 301-302)

- 62) SPA Multiple Upper Limit 1 Start X
- 63) SPA Multiple Upper Limit 1 Start X
- 64) SPA Multiple Upper Limit 1 Start X (lowest byte)
- 65) SPA Multiple Upper Limit 1 Start Y (Power Level) (highest byte)<sup>231</sup>
- 66) SPA Multiple Upper Limit 1 Start Y (Power Level)
- 67) SPA Multiple Upper Limit 1 Start Y (Power Level)
- 68) SPA Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 69) SPA Multiple Upper Limit 1 End X<sup>232</sup> (highest byte)
- 70) SPA Multiple Upper Limit 1 End X
- 71) SPA Multiple Upper Limit 1 End X
- 72) SPA Multiple Upper Limit 1 End X (lowest byte)
- 73) SPA Multiple Upper Limit 1 End Y (Power Level) (highest byte)<sup>233</sup>
- 74) SPA Multiple Upper Limit 1 End Y (Power Level)
- 75) SPA Multiple Upper Limit 1 End Y (Power Level)
- 76) SPA Multiple Upper Limit 1 End Y (Power Level) (lowest byte)
- 77-220) SPA Multiple Upper Limits 2-5, SA Multiple Lower Limits 1-5 (see bytes 61-76 for format)
- 221) RBW Setting (highest byte)<sup>234</sup>
- 222) RBW Setting
- 223) RBW Setting
- 224) RBW Setting (lowest byte)
- 225) VBW Setting (highest byte)<sup>235</sup>
- 226) VBW Setting
- 227) VBW Setting
- 228) VBW Setting (lowest byte)
- 229) OCC BW Method<sup>236</sup>
- 230) OCC BW % Value<sup>237</sup>
- 231) OCC BW dBc<sup>238</sup>
- 232) Attenuation
- 233) Antenna Index (0-14)
- 234-249) Antenna Name (16 bytes in ASCII)
- 250) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Spectrum Analyzer Mode Marker 1 On/Off
  - bit 1 : Spectrum Analyzer Mode Marker 2 On/Off
  - bit 2 : Spectrum Analyzer Mode Marker 3 On/Off
  - bit 3 : Spectrum Analyzer Mode Marker 4 On/Off
  - bit 4 : Spectrum Analyzer Mode Marker 5 On/Off
  - bit 5 : Spectrum Analyzer Mode Marker 6 On/Off
  - bits 6 - 7 : Not Used
- 251) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : Not Used
  - bit 1 : Spectrum Analyzer Mode Marker 2 Delta On/Off
  - bit 2 : Spectrum Analyzer Mode Marker 3 Delta On/Off
  - bit 3 : Spectrum Analyzer Mode Marker 4 Delta On/Off
  - bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)
  - bit 5 : Pre Amp Status On/Off
  - bit 6 : Dynamic Attenuation On/Off
  - bit 7 : Normalization On/Off

<sup>231</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>232</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>233</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>234</sup> RBW frequency sent in Hz.

<sup>235</sup> VBW frequency sent in Hz.

<sup>236</sup> 00h = % of power, 01h = dB down

<sup>237</sup> 0 – 99%

<sup>238</sup> 0 – 120 dBc

- 252) Status Byte 3: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : SPA Limit Type (0b = Single, 1b = Multiple)  
bit 1 : SPA Single Limit Beep On/Off  
bit 2 : SPA Single Limit Status On/Off  
bit 3 : SPA Single Limit Beep Level ABOVE/BELOW  
bit 4 : SPA Multiple Limit Upper Segment 1 Status On/Off  
bit 5 : SPA Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW<sup>239</sup>  
bit 6 : SPA Multiple Limit Upper Segment 2 Status On/Off  
bit 7 : SPA Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW
- 253) Status Byte 4: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : SPA Multiple Limit Upper Segment 3 Status On/Off  
bit 1 : SPA Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW  
bit 2 : SPA Multiple Limit Upper Segment 4 Status On/Off  
bit 3 : SPA Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW  
bit 4 : SPA Multiple Limit Upper Segment 5 Status On/Off  
bit 5 : SPA Multiple Limit Upper Segment 5 Beep Level ABOVE/BELOW  
bit 6 : SPA Multiple Limit Lower Segment 1 Status On/Off  
bit 7 : SPA Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW<sup>240</sup>
- 254) Status Byte 5: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : SPA Multiple Limit Lower Segment 2 Status On/Off  
bit 1 : SPA Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW  
bit 2 : SPA Multiple Limit Lower Segment 3 Status On/Off  
bit 3 : SPA Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW  
bit 4 : SPA Multiple Limit Lower Segment 4 Status On/Off  
bit 5 : SPA Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW  
bit 6 : SPA Multiple Limit Lower Segment 5 Status On/Off  
bit 7 : SPA Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- 255) Status Byte 6: (0b = Off, 1b = On)  
(LSB) bit 0 : Antenna Factors Correction On/Off  
bit 1 : Bias Tee On/Off (Option 10)  
bit 2 : Amplitude Units (Linear) – 00b = Watts 01b = Volts  
bits 3-4 : Amplitude Units (Log) - 00b = dBm 01b = dBV 10b = dBmV 11b = dBuV  
bits 5-6 : Detection Alg (00b = pos. peak 01b = RMS Averaging 10b = neg. peak 11b = Sampling Mode)  
bit 7 : Units Type (0b = Log 1b = Linear)
- 256) Status Byte 7: (0b = Off, 1b = On)  
(LSB) bit 0: Interference Analysis On/Off  
bit 1: C/I Measurement On/Off  
bit 2: RBW Coupling (1b = Auto, 0b = Manual)  
bit 3: VBW Coupling (1b = Auto, 0b = Manual)  
bit 4: Attenuation Coupling (1b = Auto, 0b = Manual)  
bit 5: Channel Power On/Off  
bit 6: Adjacent Channel Power On/Off  
bit 7: Occupied BW Measurement On/Off
- 257) Reference Level Offset<sup>241</sup> (highest byte)  
258) Reference Level Offset  
259) Reference Level Offset  
260) Reference Level Offset (lowest byte)  
261) External Reference Frequency<sup>242</sup>

<sup>239</sup> Beep level is always 1b for upper segmented limit line

<sup>240</sup> Beep level is always 0b for lower segmented limit line

<sup>241</sup> Value sent as (value in dBm \* 1000) + 270,000

- 262) Signal Standard<sup>243</sup> (higher byte)
- 263) Signal Standard (lower byte)
- 264) Channel Selection<sup>244</sup> (higher byte)
- 265) Channel Selection (lower byte)
- 266) Trigger Type<sup>245</sup>
- 267) Interference Analysis Frequency<sup>246</sup> (highest byte)
- 268) Interference Analysis Frequency
- 269) Interference Analysis Frequency
- 270) Interference Analysis Frequency (lowest byte)
- 271) Trigger Position (0 – 100%)
- 272) Min Sweep Time (in  $\mu$ s) (highest byte)
- 273) Min Sweep Time (in  $\mu$ s)
- 274) Min Sweep Time (in  $\mu$ s)
- 275) Min Sweep Time (in  $\mu$ s) (lowest byte)
- 276) Video Trigger Level<sup>247</sup> (highest byte)
- 277) Video Trigger Level
- 278) Video Trigger Level
- 279) Video Trigger Level (lowest byte)
- 280) Status Byte 8  
(LSB) bit 0: Reserved  
bits 1-7: Not Used
- 281) Status Byte 9  
(LSB) bits 0-6: Number of sweeps to average (1-25, 1 implies averaging OFF)  
bit 7: Not Used
- 282) Status Byte 10: (0b = Off, 1b = On)  
(LSB) bits 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)  
bit 2: Max Hold On/Off  
bit 3: Min Hold On/Off  
bit 4: View B On/Off  
bit 5: External Reference Frequency On/Off  
bits 6-7: Not Used
- 283) Impedance (00h = 50 $\Omega$ , 10h = 75 $\Omega$  Anritsu Adapter, 12h = 75 $\Omega$  Other Adapter)
- 284) Impedance Loss<sup>248</sup> (higher byte)
- 285) Impedance Loss (lower byte)
- 286) AM/FM Demod Type<sup>249</sup>
- 287) AM/FM Demod Status (01h = On, 00h = Off)
- 288) AM/FM Demod Volume (0 to 100)
- 289) AM/FM Demod Frequency<sup>250</sup> (highest byte)
- 290) AM/FM Demod Frequency
- 291) AM/FM Demod Frequency
- 292) AM/FM Demod Frequency (lowest byte)
- 293) AM/FM Demod Time (in ms) (highest byte)
- 294) AM/FM Demod Time (in ms)
- 295) AM/FM Demod Time (in ms)
- 296) AM/FM Demod Time (in ms) (lowest byte)

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<sup>242</sup> 1 byte in MHz (i.e. 20 = 20MHz)

<sup>243</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>244</sup> “No Channel” is sent as FFFEh

<sup>245</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>246</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>247</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>248</sup> Value sent as (value in dB \* 1000), valid values are 0 to 20 dB

<sup>249</sup> AM/FM Demod Type: 00h = FM-Wide Band, 01h = FM-Narrow Band, 02h = AM, 03h = SSB Lower, 04h = SSB Upper

<sup>250</sup> Scaled by Frequency Scale Factor (bytes 301-302)

- 297) SSB BFO Offset<sup>251</sup> (highest byte)
- 298) SSB BFO Offset
- 299) SSB BFO Offset
- 300) SSB BFO Offset (lowest byte)
- 301) Frequency Scale Factor<sup>252</sup> (higher byte)
- 302) Frequency Scale Factor (lower byte)
- 303) Frequency Range Minimum<sup>253</sup> (highest byte)
- 304) Frequency Range Minimum
- 305) Frequency Range Minimum
- 306) Frequency Range Minimum (lowest byte)
- 307) Frequency Range Maximum<sup>254</sup> (highest byte)
- 308) Frequency Range Maximum
- 309) Frequency Range Maximum
- 310) Frequency Range Maximum (lowest byte)
- 311) Marker Type<sup>255</sup>
- 312) Channel Power Int BW<sup>256</sup> (highest byte)
- 313) Channel Power Int BW
- 314) Channel Power Int BW
- 315) Channel Power Int BW (lowest byte)
- 316) ACPR Main Channel BW<sup>257</sup> (highest byte)
- 317) ACPR Main Channel BW
- 318) ACPR Main Channel BW
- 319) ACPR Main Channel BW (lowest byte)
- 320) ACPR Adjacent Channel BW<sup>258</sup> (highest byte)
- 321) ACPR Adjacent Channel BW
- 322) ACPR Adjacent Channel BW
- 323) ACPR Adjacent Channel BW (lowest byte)
- 324) ACPR Channel Spacing<sup>259</sup> (highest byte)
- 325) ACPR Channel Spacing
- 326) ACPR Channel Spacing
- 327) ACPR Channel Spacing (lowest byte)
- 328) Interference Analysis Cell Std<sup>260</sup>
- 329) Interference Analysis Est. BW<sup>261</sup> (highest byte)
- 330) Interference Analysis Est. BW
- 331) Interference Analysis Est. BW
- 332) Interference Analysis Est. BW (lowest byte)
- 333) Trace B Trace Id<sup>262</sup>
- 334-500) Not Used

For Transmission Mode (Option 21):

- 21) Start Frequency<sup>263</sup> (highest byte)

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<sup>251</sup> Value sent as ((value in Hz) – 10,000)

<sup>252</sup> In number of Hz

<sup>253</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>254</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>255</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>256</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>257</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>258</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>259</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>260</sup> 4 Standards – 00h = 1250 kHz CDMA, 01h = GSM, 02h = TDMA, 03h = AMPS, 04h = Unknown, FFh =

Interference Analysis Measurement OFF

<sup>261</sup> Frequency in Hz

<sup>262</sup> FFh indicates no trace selected

<sup>263</sup> Scaled by Frequency Scale Factor (bytes 244-245)

- 22) Start Frequency
- 23) Start Frequency
- 24) Start Frequency (lowest byte)
- 25) Stop Frequency<sup>264</sup> (highest byte)
- 26) Stop Frequency
- 27) Stop Frequency
- 28) Stop Frequency (lowest byte)
- 29) Center Frequency<sup>265</sup> (highest byte)
- 30) Center Frequency
- 31) Center Frequency
- 32) Center Frequency (lowest byte)
- 33) Frequency Span<sup>266</sup> (highest byte)
- 34) Frequency Span
- 35) Frequency Span
- 36) Frequency Span (lowest byte)
- 37) Ref Level (highest byte)<sup>267</sup>
- 38) Ref Level
- 39) Ref Level
- 40) Ref Level (lowest byte)
- 41) Scale per div (highest byte)<sup>268</sup>
- 42) Scale per div
- 43) Scale per div
- 44) Scale per div (lowest byte)
- 45) Frequency Marker 1 (higher byte)<sup>269</sup>
- 46) Frequency Marker 1 (lower byte)
- 47) Frequency Marker 2 (higher byte)
- 48) Frequency Marker 2 (lower byte)
- 49) Frequency Marker 3 (higher byte)
- 50) Frequency Marker 3 (lower byte)
- 51) Frequency Marker 4 (higher byte)
- 52) Frequency Marker 4 (lower byte)
- 53) Frequency Marker 5 (higher byte)
- 54) Frequency Marker 5 (lower byte)
- 55) Frequency Marker 6 (higher byte)
- 56) Frequency Marker 6 (lower byte)
- 57) Single Limit (highest byte)<sup>270</sup>
- 58) Single Limit
- 59) Single Limit
- 60) Single Limit (lowest byte)
- 61) Multiple Upper Limit 1 Start X<sup>271</sup> (highest byte)
- 62) Multiple Upper Limit 1 Start X
- 63) Multiple Upper Limit 1 Start X
- 64) Multiple Upper Limit 1 Start X (lowest byte)
- 65) Multiple Upper Limit 1 Start Y (Power Level) (highest byte)<sup>272</sup>
- 66) Multiple Upper Limit 1 Start Y (Power Level)

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<sup>264</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>265</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>266</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>267</sup> Value sent as (value in dBm \* 1000) + 270,000)

<sup>268</sup> Value sent as (value \* 1000)

<sup>269</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points – 1 ) ) + start frequency.

<sup>270</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>271</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>272</sup> Value sent as ( value in dBm \* 1000 ) + 270000

- 67) Multiple Upper Limit 1 Start Y (Power Level)
- 68) Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 69) Multiple Upper Limit 1 End X<sup>273</sup> (highest byte)
- 70) Multiple Upper Limit 1 End X
- 71) Multiple Upper Limit 1 End X
- 72) Multiple Upper Limit 1 End X (lowest byte)
- 73) Multiple Upper Limit 1 End Y (Power Level) (highest byte)<sup>274</sup>
- 74) Multiple Upper Limit 1 End Y (Power Level)
- 75) Multiple Upper Limit 1 End Y (Power Level)
- 76) Multiple Upper Limit 1 End Y (Power Level) (lowest byte)
- 77-220) Multiple Upper Limits 2-5, SA Multiple Lower Limits 1-5 (see bytes 61-76 for format)
- 221) RBW Setting (highest byte)<sup>275</sup>
- 222) RBW Setting
- 223) RBW Setting
- 224) RBW Setting (lowest byte)
- 225) VBW Setting (highest byte)<sup>276</sup>
- 226) VBW Setting
- 227) VBW Setting
- 228) VBW Setting (lowest byte)
- 229) Attenuation
- 230) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Marker 1 On/Off
  - bit 1 : Marker 2 On/Off
  - bit 2 : Marker 3 On/Off
  - bit 3 : Marker 4 On/Off
  - bit 4 : Marker 5 On/Off
  - bit 5 : Marker 6 On/Off
  - bits 6 - 7 : Not Used
- 231) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : S21 Spa Cal Status (0 – Cal OFF, 1 – Cal ON)
  - bit 1 : Marker 2 Delta On/Off
  - bit 2 : Marker 3 Delta On/Off
  - bit 3 : Marker 4 Delta On/Off
  - bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)
  - bit 5 : Pre Amp Status On/Off
  - bit 6 : Dynamic Attenuation On/Off
  - bit 7 : Not Used
- 232) Status Byte 3: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)
  - (LSB) bit 0 : Limit Type (0b = Single, 1b = Multiple)
  - bit 1 : Single Limit Beep On/Off
  - bit 2 : Single Limit Status On/Off
  - bit 3 : Single Limit Beep Level ABOVE/BELOW
  - bit 4 : Multiple Limit Upper Segment 1 Status On/Off
  - bit 5 : Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW<sup>277</sup>
  - bit 6 : Multiple Limit Upper Segment 2 Status On/Off
  - bit 7 : Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW
- 233) Status Byte 4: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)

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<sup>273</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>274</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>275</sup> RBW frequency sent in Hz.

<sup>276</sup> VBW frequency sent in Hz.

<sup>277</sup> Beep level is always 1b for upper segmented limit line



- (LSB) bit 0 : Multiple Limit Upper Segment 3 Status On/Off  
bit 1 : Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW  
bit 2 : Multiple Limit Upper Segment 4 Status On/Off  
bit 3 : Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Upper Segment 5 Status On/Off  
bit 5 : Multiple Limit Upper Segment 5 Beep Level ABOVE/BELOW  
bit 6 : Multiple Limit Lower Segment 1 Status On/Off  
bit 7 : Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW <sup>278</sup>
- 234) Status Byte 5 : ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)
- (LSB) bit 0 : Multiple Limit Lower Segment 2 Status On/Off  
bit 1 : Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW  
bit 2 : Multiple Limit Lower Segment 3 Status On/Off  
bit 3 : Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Lower Segment 4 Status On/Off  
bit 5 : Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW  
bit 6 : Multiple Limit Lower Segment 5 Status On/Off  
bit 7 : Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- 235) Status Byte 6: (0b = Off, 1b = On)
- (LSB) bit 0 : Not Used  
bit 1 : Bias Tee On/Off (Option 10)  
bit 2 : External Reference Freq On/Off  
bits 3-4 : Amplitude Units (Log) - 00b = dBm 01b = dBV 10b = dBmV 11b = dBuV  
(Linear) – 00b = Watts 01b = Volts  
bits 5-6 : Detection Alg (00b = pos. peak 01b = RMS Averaging 10b = neg. peak 11b =  
Sampling Mode)  
bit 7 : Units Type (0b = Log 1b = Linear)
- 236) External Reference Frequency <sup>279</sup>
- 237) Signal Standard<sup>280</sup> (higher byte)
- 238) Signal Standard (lower byte)
- 239) Channel Selection<sup>281</sup> (higher byte)
- 240) Channel Selection (lower byte)
- 241) Trigger Type<sup>282</sup>
- 242) Status Byte 7  
(LSB) bits 0-6: Number of sweeps to average (1-25, 1 implies averaging OFF)  
bit 7: Not Used
- 243) Status Byte 8: (0b = Off, 1b = On)  
(LSB) bits 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)  
bit 2: Max Hold On/Off  
bit 3: Min Hold On/Off  
bit 4: RBW Coupling (1b = Auto, 0b = Manual)  
bit 5: VBW Coupling (1b = Auto, 0b = Manual)  
bit 6: Attenuation Coupling (1b = Auto, 0b = Manual)  
bit 7: View B On/Off
- 244) Frequency Scale Factor<sup>283</sup> (higher byte)
- 245) Frequency Scale Factor (lower byte)
- 246) Frequency Range Minimum<sup>284</sup> (highest byte)
- 247) Frequency Range Minimum

<sup>278</sup> Beep level is always 0b for lower segmented limit line

<sup>279</sup> 1 byte in MHz (i.e. 20 = 20MHz)

<sup>280</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>281</sup> “No Channel” is sent as FFFEh

<sup>282</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>283</sup> In number of Hz

<sup>284</sup> Scaled by Frequency Scale Factor (bytes 244-245)

- 248) Frequency Range Minimum
  - 249) Frequency Range Minimum (lowest byte)
  - 250) Frequency Range Maximum<sup>285</sup> (highest byte)
  - 251) Frequency Range Maximum
  - 252) Frequency Range Maximum
  - 253) Frequency Range Maximum (lowest byte)
  - 254) Marker Type<sup>286</sup>
  - 255) Trace B Trace Id<sup>287</sup>
  - 256) Status Byte 9  
(LSB) bit 0: Reserved  
bits 1-7: Not Used
- 257-400) Not Used

For Power Meter Mode:

- 21) Power Meter Start Freq<sup>288</sup> (highest byte)
- 22) Power Meter Start Freq
- 23) Power Meter Start Freq
- 24) Power Meter Start Freq<sup>289</sup> (lowest byte)
- 25) Power Meter Stop Freq (highest byte)
- 26) Power Meter Stop Freq
- 27) Power Meter Stop Freq
- 28) Power Meter Stop Freq (lowest byte)
- 29) Power Meter Center Freq<sup>290</sup> (highest byte)
- 30) Power Meter Center Freq
- 31) Power Meter Center Freq
- 32) Power Meter Center Freq (lowest byte)
- 33) Power Meter Span<sup>291</sup> (highest byte)
- 34) Power Meter Span
- 35) Power Meter Span
- 36) Power Meter Span (lowest byte)
- 37) Signal Standard<sup>292</sup> (higher byte)
- 38) Signal Standard (lower byte)
- 39) Channel Selection<sup>293</sup> (higher byte)
- 40) Channel Selection (lower byte)
- 41) Power Meter Offset<sup>294</sup> (highest byte)
- 42) Power Meter Offset
- 43) Power Meter Offset
- 44) Power Meter Offset (lowest byte)
- 45) Power Meter Relative (highest byte)<sup>295</sup>
- 46) Power Meter Relative
- 47) Power Meter Relative
- 48) Power Meter Relative (lowest byte)
- 49) Not Used
- 50) Power Meter Unit (00h = Watts, 01h = dBm)

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<sup>285</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>286</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>287</sup> FFh indicates no trace selected

<sup>288</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>289</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>290</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>291</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>292</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>293</sup> “No Channel” is sent as FFFEh

<sup>294</sup> Value sent as (value in dB \* 1000)

<sup>295</sup> Value sent as ((value in dBm \* 1000) + 100)

- 51) Power Meter Relative Status (00h = Off, 01h = On)
- 52) Power Meter Offset Status (00h = Off, 01h = On)
- 53) Power Meter RMS Averaging Level (00h = Off, 01h = Low, 02h = Medium, 03h = High)
- 54) Frequency Scale Factor<sup>296</sup> (higher byte)
- 55) Frequency Scale Factor (lower byte)
- 56) Frequency Range Minimum<sup>297</sup> (highest byte)
- 57) Frequency Range Minimum
- 58) Frequency Range Minimum
- 59) Frequency Range Minimum (lowest byte)
- 60) Frequency Range Maximum<sup>298</sup> (highest byte)
- 61) Frequency Range Maximum
- 62) Frequency Range Maximum
- 63) Frequency Range Maximum (lowest byte)
- 64) Zero Status (00h = Off, 01h = On)
- 65) Zero Value<sup>299</sup> (highest byte)
- 66) Zero Value
- 67) Zero Value
- 68) Zero Value (lowest byte)
- 69-120) Not Used

### **Upload Setup – Control Byte #66 (42h)**

*Description:* Receives parameters defining a setup and saves them in the memory location associated with the specified setup number. Since different modes have different numbers of setup locations available, the command requires the mode be specified as well as the setup number.

Setup numbers as follows:

- 0 = Run time setup
- 1 – 10 = Saved setups for Spectrum Analyzer/Transmission Measurement modes
- 1 – 5 = Saved setups for Power Meter mode

*Bytes to Follow:* 2 bytes

For All Modes:

- 1) Number of Following Bytes (higher byte)
- 2) Number of Following Bytes (lower byte)
- 3) Measurement Mode<sup>300</sup>
- 4) Setup Number in which to store setup
- 5-20) Not Used

For LMR Master VNA Modes:

- 21) Number of Data Points (higher byte)
- 22) Number of Data Points (lower byte)
- 23) VNA Start Frequency (in Hz) (highest byte)
- 24) VNA Start Frequency
- 25) VNA Start Frequency
- 26) VNA Start Frequency (lowest byte)
- 27) VNA Stop Frequency (in Hz) (highest byte)
- 28) VNA Stop Frequency
- 29) VNA Stop Frequency

<sup>296</sup> In number of Hz

<sup>297</sup> Scaled by Frequency Scale Factor

<sup>298</sup> Scaled by Frequency Scale Factor

<sup>299</sup> Value sent as ((value in dBm \* 1000) + 100)

<sup>300</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

- 30) VNA Stop Frequency (lowest byte)
- 31) Return Loss Scale Start (higher byte)<sup>301</sup>
- 32) Return Loss Scale Start (lower byte)
- 33) Return Loss Scale Stop (higher byte)
- 34) Return Loss Scale Stop (lower byte)
- 35) SWR Scale Start (higher byte)<sup>302</sup>
- 36) SWR Scale Start (lower byte)
- 37) SWR Scale Stop (higher byte)
- 38) SWR Scale Stop (lower byte)
- 39) Cable Loss Scale Start (higher byte)<sup>303</sup>
- 40) Cable Loss Scale Start (lower byte)
- 41) Cable Loss Scale Stop (higher byte)
- 42) Cable Loss Scale Stop (lower byte)
- 43) DTF-RL Scale Start (higher byte)<sup>304</sup>
- 44) DTF-RL Scale Start (lower byte)
- 45) DTF-RL Scale Stop (higher byte)
- 46) DTF-RL Scale Stop (lower byte)
- 47) DTF-SWR Scale Start (higher byte)<sup>305</sup>
- 48) DTF-SWR Scale Start (lower byte)
- 49) DTF-SWR Scale Stop (higher byte)
- 50) DTF-SWR Scale Stop (lower byte)
- 51) VNA Frequency Marker 1 (higher byte)<sup>306</sup>
- 52) VNA Frequency Marker 1 (lower byte)
- 53) VNA Frequency Marker 2 (higher byte)
- 54) VNA Frequency Marker 2 (lower byte)
- 55) VNA Frequency Marker 3 (higher byte)
- 56) VNA Frequency Marker 3 (lower byte)
- 57) VNA Frequency Marker 4 (higher byte)
- 58) VNA Frequency Marker 4 (lower byte)
- 59) VNA Frequency Marker 5 (higher byte)
- 60) VNA Frequency Marker 5 (lower byte)
- 61) VNA Frequency Marker 6 (higher byte)
- 62) VNA Frequency Marker 6 (lower byte)
- 63) Return Loss Single Limit (higher byte)<sup>307</sup>
- 64) Return Loss Single Limit (lower byte)
- 65) SWR Single Limit (higher byte)<sup>308</sup>
- 66) SWR Single Limit (lower byte)
- 67) Cable Loss Single Limit (higher byte)<sup>309</sup>
- 68) Cable Loss Single Limit (lower byte)
- 69) DTF-RL Single Limit (higher byte)<sup>310</sup>
- 70) DTF-RL Single Limit (lower byte)
- 71) DTF-SWR Single Limit (higher byte)<sup>311</sup>
- 72) DTF-SWR Single Limit (lower byte)

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<sup>301</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>302</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>303</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>304</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>305</sup> See “Set LMR Master VNA Scale” Control Byte #4 for data format.

<sup>306</sup> Marker Point = ( # data points – 1 ) \* ( marker freq – start freq ) / ( stop freq – start freq )

Where # of data points can be found in bytes 2-3, start freq is in bytes 4-7, and stop freq is in bytes 8-11.

<sup>307</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>308</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>309</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>310</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

<sup>311</sup> See Control Byte #6, “Set LMR Master VNA Single Limit” for data format.

- 73) Return Loss Multiple Limit Segment # (1)
- 74) Return Loss Multiple Limit Segment Status (00h = Off, 01h = On )
- 75) Return Loss Multiple Limit Segment Start X (highest byte)<sup>312</sup>
- 76) Return Loss Multiple Limit Segment Start X
- 77) Return Loss Multiple Limit Segment Start X
- 78) Return Loss Multiple Limit Segment Start X (lowest byte)
- 79) Return Loss Multiple Limit Segment Start Y (higher byte)
- 80) Return Loss Multiple Limit Segment Start Y (lowest byte)
- 81) Return Loss Multiple Limit Segment End X (highest byte)
- 82) Return Loss Multiple Limit Segment End X
- 83) Return Loss Multiple Limit Segment End X
- 84) Return Loss Multiple Limit Segment End X (lowest byte)
- 85) Return Loss Multiple Limit Segment End Y (higher byte)
- 86) Return Loss Multiple Limit Segment End Y (lowest byte)
- 87-142) Repeat bytes 63 – 76 for segments 2 – 5
- 143-212) Repeat bytes 63 – 132 for SWR Multiple Limit
- 213-282) Repeat bytes 63 – 132 for Cable Loss Multiple Limit
- 283-352) Repeat bytes 63 – 132 for DTF-RL Multiple Limit
- 353-422) Repeat bytes 63 – 132 for DTF-SWR Multiple Limit
- 423) Start Distance (highest byte)<sup>313</sup>
- 424) Start Distance
- 425) Start Distance
- 426) Start Distance (lowest byte)
- 427) Stop Distance (highest byte)
- 428) Stop Distance
- 429) Stop Distance
- 430) Stop Distance (lowest byte)
- 431) Distance Marker 1 (higher byte)<sup>314</sup>
- 432) Distance Marker 1 (lower byte)
- 433) Distance Marker 2 (higher byte)
- 434) Distance Marker 2 (lower byte)
- 435) Distance Marker 3 (higher byte)
- 436) Distance Marker 3 (lower byte)
- 437) Distance Marker 4 (higher byte)
- 438) Distance Marker 4 (lower byte)
- 439) Distance Marker 5 (higher byte)
- 440) Distance Marker 5 (lower byte)
- 441) Distance Marker 6 (higher byte)
- 442) Distance Marker 6 (lower byte)
- 443) Relative Propagation Velocity (highest byte)<sup>315</sup>
- 444) Relative Propagation Velocity
- 445) Relative Propagation Velocity
- 446) Relative Propagation Velocity (lowest byte)
- 447) Cable Loss (highest byte)<sup>316</sup>
- 448) Cable Loss
- 449) Cable Loss
- 450) Cable Loss (lowest byte)
- 451) Average Cable Loss<sup>317</sup> (highest byte)

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<sup>312</sup> See Control Byte #112, “Set LMR Master VNA Segmented Limit Lines” for data format.

<sup>313</sup> Distance data uses units 1/100,000m or 1/100,000 ft

<sup>314</sup> Marker Point = ( # data points – 1 ) \* ( marker dist – start dist ) / ( stop dist – start dist )

Where # of data points can be found in bytes 2-3, start dist is in bytes 106-109, and stop dist is in bytes 110-113.

<sup>315</sup> Relative Propagation Velocity uses units 1/100,000.

<sup>316</sup> Cable loss uses units 1/100,000 dB/m or 1/100,000 dB/ft.

<sup>317</sup> Average Cable Loss is dB \* 1000.

- 452) Average Cable Loss
- 453) Average Cable Loss
- 454) Average Cable Loss (lowest byte)
- 455) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : LMR Master Marker 1 On/Off
  - bit 1 : LMR Master Marker 2 On/Off
  - bit 2 : LMR Master Marker 3 On/Off
  - bit 3 : LMR Master Marker 4 On/Off
  - bit 4 : LMR Master Marker 5 On/Off
  - bit 5 : LMR Master Marker 6 On/Off
  - bits 6- 7 : Not Used
- 456) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : Not Used
  - bit 1 : LMR Master Marker 2 Delta On/Off
  - bit 2 : LMR Master Marker 3 Delta On/Off
  - bit 3 : LMR Master Marker 4 Delta On/Off
  - bits 4-7: Not Used
- 457) Status Byte 3: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : LMR Master Limit Type (0b = Single, 1b = Multiple)
  - bit 1 : LMR Master Limit Beep On/Off
  - bits 2-6 : Not Used
  - bit 7 : LMR Master Single Limit Status On/Off
- 458) Status Byte 4:
  - (LSB) bits 0 - 1 : DTF Windowing Mode
  - bit:     1 0
  - | |
  - 0 0 - Rectangular (No Windowing)
  - 0 1 - Nominal Side Lobe
  - 1 0 - Low Side Lobe
  - 1 1 - Minimum Side Lobe
  - bits 2 – 7 : Not Used
- 459) Status Byte 5: (0b = Off, 1b = On )
  - (LSB) bit 0 : Fixed CW Mode On/Off
  - bit 1 : Single Sweep On/Off
  - bit 2 : Trace Overlay On/Off
  - bit 3 : Measurement Unit Metric/English (0b = English, 1b = Metric)
  - bits 4-6: Not Used
  - bit 7 : Cal Mode (0b = OSL Cal, 1b = FlexCal)
- 460) VNA Signal Standard<sup>318</sup> (higher byte)
- 461) VNA Signal Standard (lower byte)
- 462) Cable Index
- 463) Cable Folder<sup>319</sup>
- 464) Trace Overlay Index (1-200)
- 465-550) Not Used

For Spectrum Analyzer Mode:

- 21) Spectrum Analyzer Start Frequency<sup>320</sup> (highest byte)
- 22) Spectrum Analyzer Start Frequency
- 23) Spectrum Analyzer Start Frequency
- 24) Spectrum Analyzer Start Frequency (lowest byte)
- 25) Spectrum Analyzer Stop Frequency<sup>321</sup> (highest byte)

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<sup>318</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>319</sup> 00h=Standard at 1000 MHz, 01h=Standard at 2000 MHz, 02h=Standard at 2500 MHz, 03h=Custom

<sup>320</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>321</sup> Scaled by Frequency Scale Factor (bytes 301-302)

- 26) Spectrum Analyzer Stop Frequency
- 27) Spectrum Analyzer Stop Frequency
- 28) Spectrum Analyzer Stop Frequency (lowest byte)
- 29) Spectrum Analyzer Center Frequency<sup>322</sup> (highest byte)
- 30) Spectrum Analyzer Center Frequency
- 31) Spectrum Analyzer Center Frequency
- 32) Spectrum Analyzer Center Frequency (lowest byte)
- 33) Spectrum Analyzer Frequency Span<sup>323</sup> (highest byte)
- 34) Spectrum Analyzer Frequency Span
- 35) Spectrum Analyzer Frequency Span
- 36) Spectrum Analyzer Frequency Span (lowest byte)
- 37) Ref Level (highest byte)<sup>324</sup>
- 38) Ref Level
- 39) Ref Level
- 40) Ref Level (lowest byte)
- 41) Scale per div (highest byte)<sup>325</sup>
- 42) Scale per div
- 43) Scale per div
- 44) Scale per div (lowest byte)
- 45) Spectrum Analyzer Frequency Marker 1 (higher byte)<sup>326</sup>
- 46) Spectrum Analyzer Frequency Marker 1 (lower byte)
- 47) Spectrum Analyzer Frequency Marker 2 (higher byte)
- 48) Spectrum Analyzer Frequency Marker 2 (lower byte)
- 49) Spectrum Analyzer Frequency Marker 3 (higher byte)
- 50) Spectrum Analyzer Frequency Marker 3 (lower byte)
- 51) Spectrum Analyzer Frequency Marker 4 (higher byte)
- 52) Spectrum Analyzer Frequency Marker 4 (lower byte)
- 53) Spectrum Analyzer Frequency Marker 5 (higher byte)
- 54) Spectrum Analyzer Frequency Marker 5 (lower byte)
- 55) Spectrum Analyzer Frequency Marker 6 (higher byte)
- 56) Spectrum Analyzer Frequency Marker 6 (lower byte)
- 57) Spectrum Analyzer Single Limit (highest byte)<sup>327</sup>
- 58) Spectrum Analyzer Single Limit
- 59) Spectrum Analyzer Single Limit
- 60) Spectrum Analyzer Single Limit (lowest byte)
- 61) SPA Multiple Upper Limit 1 Start X<sup>328</sup> (highest byte)
- 62) SPA Multiple Upper Limit 1 Start X
- 63) SPA Multiple Upper Limit 1 Start X
- 64) SPA Multiple Upper Limit 1 Start X (lowest byte)
- 65) SPA Multiple Upper Limit 1 Start Y (Power Level) (highest byte)<sup>329</sup>
- 66) SPA Multiple Upper Limit 1 Start Y (Power Level)
- 67) SPA Multiple Upper Limit 1 Start Y (Power Level)
- 68) SPA Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 69) SPA Multiple Upper Limit 1 End X<sup>330</sup> (highest byte)
- 70) SPA Multiple Upper Limit 1 End X

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<sup>322</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>323</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>324</sup> Value sent as (value in dBm \* 1000) + 270,000)

<sup>325</sup> Value sent as (value \* 1000)

<sup>326</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points – 1 ) ) + start frequency.

<sup>327</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>328</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>329</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>330</sup> Scaled by Frequency Scale Factor (bytes 301-302)

- 71) SPA Multiple Upper Limit 1 End X
- 72) SPA Multiple Upper Limit 1 End X (lowest byte)
- 73) SPA Multiple Upper Limit 1 End Y (Power Level) (highest byte)<sup>331</sup>
- 74) SPA Multiple Upper Limit 1 End Y (Power Level)
- 75) SPA Multiple Upper Limit 1 End Y (Power Level)
- 76) SPA Multiple Upper Limit 1 End Y (Power Level) (lowest byte)
- 77-220) SPA Multiple Upper Limits 2-5, SA Multiple Lower Limits 1-5 (see bytes 61-76 for format)
- 221) RBW Setting (highest byte)<sup>332</sup>
- 222) RBW Setting
- 223) RBW Setting
- 224) RBW Setting (lowest byte)
- 225) VBW Setting (highest byte)<sup>333</sup>
- 226) VBW Setting
- 227) VBW Setting
- 228) VBW Setting (lowest byte)
- 229) OCC BW Method<sup>334</sup>
- 230) OCC BW % Value<sup>335</sup>
- 231) OCC BW dBc<sup>336</sup>
- 232) Attenuation
- 233) Antenna Index (0-14)
- 234-249) Antenna Name (16 bytes in ASCII)
- 250) Status Byte 1: ( 0b = Off , 1b = On)
  - (LSB) bit 0 : Spectrum Analyzer Mode Marker 1 On/Off
  - bit 1 : Spectrum Analyzer Mode Marker 2 On/Off
  - bit 2 : Spectrum Analyzer Mode Marker 3 On/Off
  - bit 3 : Spectrum Analyzer Mode Marker 4 On/Off
  - bit 4 : Spectrum Analyzer Mode Marker 5 On/Off
  - bit 5 : Spectrum Analyzer Mode Marker 6 On/Off
  - bits 6 - 7 : Not Used
- 251) Status Byte 2: (0b = Off, 1b = On)
  - (LSB) bit 0 : Not Used
  - bit 1 : Spectrum Analyzer Mode Marker 2 Delta On/Off
  - bit 2 : Spectrum Analyzer Mode Marker 3 Delta On/Off
  - bit 3 : Spectrum Analyzer Mode Marker 4 Delta On/Off
  - bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)
  - bit 5 : Pre Amp Status On/Off
  - bit 6 : Dynamic Attenuation On/Off
  - bit 7 : Normalization On/Off
- 252) Status Byte 3: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)
  - (LSB) bit 0 : SPA Limit Type (0b = Single, 1b = Multiple)
  - bit 1 : SPA Single Limit Beep On/Off
  - bit 2 : SPA Single Limit Status On/Off
  - bit 3 : SPA Single Limit Beep Level ABOVE/BELOW
  - bit 4 : SPA Multiple Limit Upper Segment 1 Status On/Off
  - bit 5 : SPA Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW<sup>337</sup>
  - bit 6 : SPA Multiple Limit Upper Segment 2 Status On/Off
  - bit 7 : SPA Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW

<sup>331</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>332</sup> RBW frequency sent in Hz.

<sup>333</sup> VBW frequency sent in Hz.

<sup>334</sup> 00h = % of power, 01h = dB down

<sup>335</sup> 0 – 99%

<sup>336</sup> 0 – 120 dBc

<sup>337</sup> Beep level is always 1b for upper segmented limit line



- 253) Status Byte 4 : ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : SPA Multiple Limit Upper Segment 3 Status On/Off  
bit 1 : SPA Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW  
bit 2 : SPA Multiple Limit Upper Segment 4 Status On/Off  
bit 3 : SPA Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW  
bit 4 : SPA Multiple Limit Upper Segment 5 Status On/Off  
bit 5 : SPA Multiple Limit Upper Segment 5 Beep Level ABOVE/BELOW  
bit 6 : SPA Multiple Limit Lower Segment 1 Status On/Off  
bit 7 : SPA Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW<sup>338</sup>
- 254) Status Byte 5 : ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : SPA Multiple Limit Lower Segment 2 Status On/Off  
bit 1 : SPA Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW  
bit 2 : SPA Multiple Limit Lower Segment 3 Status On/Off  
bit 3 : SPA Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW  
bit 4 : SPA Multiple Limit Lower Segment 4 Status On/Off  
bit 5 : SPA Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW  
bit 6 : SPA Multiple Limit Lower Segment 5 Status On/Off  
bit 7 : SPA Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- 255) Status Byte 6: (0b = Off, 1b = On)  
(LSB) bit 0 : Antenna Factors Correction On/Off  
bit 1 : Bias Tee On/Off (Option 10)  
bit 2 : Amplitude Units (Linear) – 00b = Watts 01b = Volts  
bits 3-4 : Amplitude Units (Log) - 00b = dBm 01b = dBV 10b = dBmV 11b = dBuV  
bits 5-6 : Detection Alg (00b = pos. peak 01b = RMS Averaging 10b = neg. peak 11b = Sampling Mode)  
bit 7 : Units Type (0b = Log 1b = Linear)
- 256) Status Byte 7: (0b = Off, 1b = On)  
(LSB) bit 0: Interference Analysis On/Off  
bit 1: C/I Measurement On/Off  
bit 2: RBW Coupling (1b = Auto, 0b = Manual)  
bit 3: VBW Coupling (1b = Auto, 0b = Manual)  
bit 4: Attenuation Coupling (1b = Auto, 0b = Manual)  
bit 5: Channel Power On/Off  
bit 6: Adjacent Channel Power On/Off  
bit 7: Occupied BW Measurement On/Off
- 257) Reference Level Offset<sup>339</sup> (highest byte)  
258) Reference Level Offset  
259) Reference Level Offset  
260) Reference Level Offset (lowest byte)  
261) External Reference Frequency<sup>340</sup>  
262) Signal Standard<sup>341</sup> (higher byte)  
263) Signal Standard (lower byte)  
264) Channel Selection<sup>342</sup> (higher byte)  
265) Channel Selection (lower byte)  
266) Trigger Type<sup>343</sup>  
267) Interference Analysis Frequency<sup>344</sup> (highest byte)

<sup>338</sup> Beep level is always 0b for lower segmented limit line

<sup>339</sup> Value sent as (value in dBm \* 1000) + 270,000

<sup>340</sup> 1 byte in MHz (i.e. 20 = 20MHz)

<sup>341</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>342</sup> “No Channel” is sent as FFFEh

<sup>343</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>344</sup> Scaled by Frequency Scale Factor (bytes 301-302)

- 268) Interference Analysis Frequency
- 269) Interference Analysis Frequency
- 270) Interference Analysis Frequency (lowest byte)
- 271) Trigger Position (0 – 100%)
- 272) Min Sweep Time (in  $\mu$ s) (highest byte)
- 273) Min Sweep Time (in  $\mu$ s)
- 274) Min Sweep Time (in  $\mu$ s)
- 275) Min Sweep Time (in  $\mu$ s) (lowest byte)
- 276) Video Trigger Level<sup>345</sup> (highest byte)
- 277) Video Trigger Level
- 278) Video Trigger Level
- 279) Video Trigger Level (lowest byte)
- 280) Status Byte 8  
(LSB) bit 0: Reserved  
bits 1-7: Not Used
- 281) Status Byte 9  
(LSB) bits 0-6: Number of sweeps to average (1-25, 1 implies averaging OFF)  
bit 7: Not Used
- 282) Status Byte 10: (0b = Off, 1b = On)  
(LSB) bits 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)  
bit 2: Max Hold On/Off  
bit 3: Min Hold On/Off  
bit 4: View B On/Off  
bit 5: External Reference Frequency On/Off  
bits 6-7: Not Used
- 283) Impedance (00h = 50 $\Omega$ , 10h = 75 $\Omega$  Anritsu Adapter, 12h = 75 $\Omega$  Other Adapter)
- 284) Impedance Loss<sup>346</sup> (higher byte)
- 285) Impedance Loss (lower byte)
- 286) AM/FM Demod Type<sup>347</sup>
- 287) AM/FM Demod Status (01h = On, 00h = Off)
- 288) AM/FM Demod Volume (0 to 100)
- 289) AM/FM Demod Frequency<sup>348</sup> (highest byte)
- 290) AM/FM Demod Frequency
- 291) AM/FM Demod Frequency
- 292) AM/FM Demod Frequency (lowest byte)
- 293) AM/FM Demod Time (in ms) (highest byte)
- 294) AM/FM Demod Time (in ms)
- 295) AM/FM Demod Time (in ms)
- 296) AM/FM Demod Time (in ms) (lowest byte)
- 297) SSB BFO Offset<sup>349</sup> (highest byte)
- 298) SSB BFO Offset
- 299) SSB BFO Offset
- 300) SSB BFO Offset (lowest byte)
- 301) Frequency Scale Factor<sup>350</sup> (higher byte)
- 302) Frequency Scale Factor (lower byte)
- 303) Frequency Range Minimum<sup>351</sup> (highest byte)
- 304) Frequency Range Minimum

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<sup>345</sup> Value sent as ( value in dBm \* 1000 ) + 270,000

<sup>346</sup> Value sent as (value in dB \* 1000), valid values are 0 to 20 dB

<sup>347</sup> AM/FM Demod Type: 00h = FM-Wide Band, 01h = FM-Narrow Band, 02h = AM, 03h = SSB Lower, 04h = SSB Upper

<sup>348</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>349</sup> Value sent as ((value in Hz) – 10,000)

<sup>350</sup> In number of Hz

<sup>351</sup> Scaled by Frequency Scale Factor (bytes 301-302)

- 305) Frequency Range Minimum
- 306) Frequency Range Minimum (lowest byte)
- 307) Frequency Range Maximum<sup>352</sup> (highest byte)
- 308) Frequency Range Maximum
- 309) Frequency Range Maximum
- 310) Frequency Range Maximum (lowest byte)
- 311) Marker Type<sup>353</sup>
- 312) Channel Power Int BW<sup>354</sup> (highest byte)
- 313) Channel Power Int BW
- 314) Channel Power Int BW
- 315) Channel Power Int BW (lowest byte)
- 316) ACPR Main Channel BW<sup>355</sup> (highest byte)
- 317) ACPR Main Channel BW
- 318) ACPR Main Channel BW
- 319) ACPR Main Channel BW (lowest byte)
- 320) ACPR Adjacent Channel BW<sup>356</sup> (highest byte)
- 321) ACPR Adjacent Channel BW
- 322) ACPR Adjacent Channel BW
- 323) ACPR Adjacent Channel BW (lowest byte)
- 324) ACPR Channel Spacing<sup>357</sup> (highest byte)
- 325) ACPR Channel Spacing
- 326) ACPR Channel Spacing
- 327) ACPR Channel Spacing (lowest byte)
- 328) Interference Analysis Cell Std<sup>358</sup>
- 329) Interference Analysis Est. BW<sup>359</sup> (highest byte)
- 330) Interference Analysis Est. BW
- 331) Interference Analysis Est. BW
- 332) Interference Analysis Est. BW (lowest byte)
- 333) Trace B Trace Id<sup>360</sup>
- 334-500) Not Used

For Transmission Mode (Option 21 Only):

- 21) Start Frequency<sup>361</sup> (highest byte)
- 22) Start Frequency
- 23) Start Frequency
- 24) Start Frequency (lowest byte)
- 25) Stop Frequency<sup>362</sup> (highest byte)
- 26) Stop Frequency
- 27) Stop Frequency
- 28) Stop Frequency (lowest byte)
- 29) Center Frequency<sup>363</sup> (highest byte)
- 30) Center Frequency

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<sup>352</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>353</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>354</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>355</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>356</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>357</sup> Scaled by Frequency Scale Factor (bytes 301-302)

<sup>358</sup> 4 Standards – 00h = 1250 KHZ CDMA, 01h = GSM, 02h = TDMA, 03h = AMPS, 04h = Unknown, FFh =

Interference Analysis Measurement OFF

<sup>359</sup> Frequency in Hz

<sup>360</sup> FFh indicates to trace selected

<sup>361</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>362</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>363</sup> Scaled by Frequency Scale Factor (bytes 244-245)

- 31) Center Frequency
- 32) Center Frequency (lowest byte)
- 33) Frequency Span<sup>364</sup> (highest byte)
- 34) Frequency Span
- 35) Frequency Span
- 36) Frequency Span (lowest byte)
- 37) Ref Level (highest byte)<sup>365</sup>
- 38) Ref Level
- 39) Ref Level
- 40) Ref Level (lowest byte)
- 41) Scale per div (highest byte)<sup>366</sup>
- 42) Scale per div
- 43) Scale per div
- 44) Scale per div (lowest byte)
- 45) Frequency Marker 1 (higher byte)<sup>367</sup>
- 46) Frequency Marker 1 (lower byte)
- 47) Frequency Marker 2 (higher byte)
- 48) Frequency Marker 2 (lower byte)
- 49) Frequency Marker 3 (higher byte)
- 50) Frequency Marker 3 (lower byte)
- 51) Frequency Marker 4 (higher byte)
- 52) Frequency Marker 4 (lower byte)
- 53) Frequency Marker 5 (higher byte)
- 54) Frequency Marker 5 (lower byte)
- 55) Frequency Marker 6 (higher byte)
- 56) Frequency Marker 6 (lower byte)
- 57) Single Limit (highest byte)<sup>368</sup>
- 58) Single Limit
- 59) Single Limit
- 60) Single Limit (lowest byte)
- 61) Multiple Upper Limit 1 Start X<sup>369</sup> (highest byte)
- 62) Multiple Upper Limit 1 Start X
- 63) Multiple Upper Limit 1 Start X
- 64) Multiple Upper Limit 1 Start X (lowest byte)
- 65) Multiple Upper Limit 1 Start Y (Power Level) (highest byte)<sup>370</sup>
- 66) Multiple Upper Limit 1 Start Y (Power Level)
- 67) Multiple Upper Limit 1 Start Y (Power Level)
- 68) Multiple Upper Limit 1 Start Y (Power Level) (lowest byte)
- 69) Multiple Upper Limit 1 End X<sup>371</sup> (highest byte)
- 70) Multiple Upper Limit 1 End X
- 71) Multiple Upper Limit 1 End X
- 72) Multiple Upper Limit 1 End X (lowest byte)
- 73) Multiple Upper Limit 1 End Y (Power Level) (highest byte)<sup>372</sup>
- 74) Multiple Upper Limit 1 End Y (Power Level)
- 75) Multiple Upper Limit 1 End Y (Power Level)

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<sup>364</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>365</sup> Value sent as (value in dBm \* 1000) + 270,000)

<sup>366</sup> Value sent as (value \* 1000)

<sup>367</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points – 1 ) ) + start frequency.

<sup>368</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>369</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>370</sup> Value sent as ( value in dBm \* 1000 ) + 270000

<sup>371</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>372</sup> Value sent as ( value in dBm \* 1000 ) + 270000

- 76) Multiple Upper Limit 1 End Y (Power Level) (lowest byte)  
77-220) Multiple Upper Limits 2-5, SA Multiple Lower Limits 1-5 (see bytes 67-82 for format)
- 221) RBW Setting (highest byte)<sup>373</sup>  
222) RBW Setting  
223) RBW Setting  
224) RBW Setting (lowest byte)  
225) VBW Setting (highest byte)<sup>374</sup>  
226) VBW Setting  
227) VBW Setting  
228) VBW Setting (lowest byte)  
229) Attenuation  
230) Status Byte 1: ( 0b = Off , 1b = On)  
(LSB) bit 0 : Marker 1 On/Off  
bit 1 : Marker 2 On/Off  
bit 2 : Marker 3 On/Off  
bit 3 : Marker 4 On/Off  
bit 4 : Marker 5 On/Off  
bit 5 : Marker 6 On/Off  
bits 6 - 7 : Not Used
- 231) Status Byte 2: (0b = Off, 1b = On)  
(LSB) bit 0 : S21 Spa Cal Status (0 – Cal OFF, 1 – Cal ON)  
bit 1 : Marker 2 Delta On/Off  
bit 2 : Marker 3 Delta On/Off  
bit 3 : Marker 4 Delta On/Off  
bit 4 : Pre Amp Mode (0b = Manual, 1b = Auto)  
bit 5 : Pre Amp Status On/Off  
bit 6 : Dynamic Attenuation On/Off  
bit 7 : Not Used
- 232) Status Byte 3: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : Limit Type (0b = Single, 1b = Multiple)  
bit 1 : Single Limit Beep On/Off  
bit 2 : Single Limit Status On/Off  
bit 3 : Single Limit Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Upper Segment 1 Status On/Off  
bit 5 : Multiple Limit Upper Segment 1 Beep Level ABOVE/BELOW<sup>375</sup>  
bit 6 : Multiple Limit Upper Segment 2 Status On/Off  
bit 7 : Multiple Limit Upper Segment 2 Beep Level ABOVE/BELOW
- 233) Status Byte 4: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)  
(LSB) bit 0 : Multiple Limit Upper Segment 3 Status On/Off  
bit 1 : Multiple Limit Upper Segment 3 Beep Level ABOVE/BELOW  
bit 2 : Multiple Limit Upper Segment 4 Status On/Off  
bit 3 : Multiple Limit Upper Segment 4 Beep Level ABOVE/BELOW  
bit 4 : Multiple Limit Upper Segment 5 Status On/Off  
bit 5 : Multiple Limit Upper Segment 5 Beep Level ABOVE/BELOW  
bit 6 : Multiple Limit Lower Segment 1 Status On/Off  
bit 7 : Multiple Limit Lower Segment 1 Beep Level ABOVE/BELOW<sup>376</sup>
- 234) Status Byte 5: ( 0b = Off/Beep if data is BELOW line ,  
1b = On/Beep if data is ABOVE line)

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<sup>373</sup> RBW frequency sent in Hz.

<sup>374</sup> VBW frequency sent in Hz.

<sup>375</sup> Beep level is always 1b for upper segmented limit line

<sup>376</sup> Beep level is always 0b for lower segmented limit line

- (LSB) bit 0 : Multiple Limit Lower Segment 2 Status On/Off
- bit 1 : Multiple Limit Lower Segment 2 Beep Level ABOVE/BELOW
- bit 2 : Multiple Limit Lower Segment 3 Status On/Off
- bit 3 : Multiple Limit Lower Segment 3 Beep Level ABOVE/BELOW
- bit 4 : Multiple Limit Lower Segment 4 Status On/Off
- bit 5 : Multiple Limit Lower Segment 4 Beep Level ABOVE/BELOW
- bit 6 : Multiple Limit Lower Segment 5 Status On/Off
- bit 7 : Multiple Limit Lower Segment 5 Beep Level ABOVE/BELOW
- 235) Status Byte 6: (0b = Off, 1b = On)
  - (LSB) bit 0 : External Reference Frequency On/Off
  - bit 1 : Bias Tee On/Off (Option 10)
  - bit 2 : Amplitude Units (Linear) – 00b = Watts 01b = Volts
  - bits 3-4 : Amplitude Units (Log) - 00b = dBm 01b = dBV 10b = dBmV 11b = dBuV
  - bits 5-6 : Detection Alg (00b = pos. peak 01b = RMS Averaging 10b = neg. peak 11b = Sampling Mode)
  - bit 7 : Units Type (0b = Log 1b = Linear)
- 236) External Reference Frequency<sup>377</sup>
- 237) Signal Standard<sup>378</sup> (higher byte)
- 238) Signal Standard (lower byte)
- 239) Channel Selection<sup>379</sup> (higher byte)
- 240) Channel Selection (lower byte)
- 241) Trigger Type<sup>380</sup>
- 242) Status Byte 7
  - (LSB) bits 0-6: Number of sweeps to average (1-25, 1 implies averaging OFF)
  - bit 7: Not Used
- 243) Status Byte 8: (0b = Off, 1b = On)
  - (LSB) bits 0-1: Trace Math Operation (00b = A only, 01b = A-B, 10b = A+B)
  - bit 2: Max Hold On/Off
  - bit 3: Min Hold On/Off
  - bit 4: RBW Coupling (1b = Auto, 0b = Manual)
  - bit 5: VBW Coupling (1b = Auto, 0b = Manual)
  - bit 6: Attenuation Coupling (1b = Auto, 0b = Manual)
  - bit 7: View B On/Off
- 244) Frequency Scale Factor<sup>381</sup> (higher byte)
- 245) Frequency Scale Factor (lower byte)
- 246) Frequency Range Minimum<sup>382</sup> (highest byte)
- 247) Frequency Range Minimum
- 248) Frequency Range Minimum
- 249) Frequency Range Minimum (lowest byte)
- 250) Frequency Range Maximum<sup>383</sup> (highest byte)
- 251) Frequency Range Maximum
- 252) Frequency Range Maximum
- 253) Frequency Range Maximum (lowest byte)
- 254) Marker Type<sup>384</sup>
- 255) Trace B Trace Id<sup>385</sup>
- 256) Status Byte 9

<sup>377</sup> 1 byte in MHz (i.e. 20 = 20MHz)

<sup>378</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>379</sup> “No Channel” is sent as FFFEh

<sup>380</sup> Trigger Type – 00h = Single, 01h = Free Run, 02h = Video, 03h = External

<sup>381</sup> In number of Hz

<sup>382</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>383</sup> Scaled by Frequency Scale Factor (bytes 244-245)

<sup>384</sup> 00h = Regular Marker, 01h = Noise Marker

<sup>385</sup> FFh indicates no trace selected

(LSB) bit 0: Reserved  
bits 1-7: Not Used  
257-400) Not Used

For Power Meter Mode:

- 21) Power Meter Start Freq<sup>386</sup> (highest byte)
- 22) Power Meter Start Freq
- 23) Power Meter Start Freq
- 24) Power Meter Start Freq<sup>387</sup> (lowest byte)
- 25) Power Meter Stop Freq (highest byte)
- 26) Power Meter Stop Freq
- 27) Power Meter Stop Freq
- 28) Power Meter Stop Freq (lowest byte)
- 29) Power Meter Center Freq<sup>388</sup> (highest byte)
- 30) Power Meter Center Freq
- 31) Power Meter Center Freq
- 32) Power Meter Center Freq (lowest byte)
- 33) Power Meter Span<sup>389</sup> (highest byte)
- 34) Power Meter Span
- 35) Power Meter Span
- 36) Power Meter Span (lowest byte)
- 37) Signal Standard<sup>390</sup> (higher byte)
- 38) Signal Standard (lower byte)
- 39) Channel Selection<sup>391</sup> (higher byte)
- 40) Channel Selection (lower byte)
- 41) Power Meter Offset<sup>392</sup> (highest byte)
- 42) Power Meter Offset
- 43) Power Meter Offset
- 44) Power Meter Offset (lowest byte)
- 45) Power Meter Relative (highest byte)<sup>393</sup>
- 46) Power Meter Relative
- 47) Power Meter Relative
- 48) Power Meter Relative (lowest byte)
- 49) Not Used
- 50) Power Meter Unit (00h = Watts, 01h = dBm)
- 51) Power Meter Relative Status (00h = Off, 01h = On)
- 52) Power Meter Offset Status (00h = Off, 01h = On)
- 53) Power Meter RMS Averaging Level (00h = Off, 01h = Low, 02h = Medium, 03h = High)
- 54) Frequency Scale Factor<sup>394</sup> (higher byte)
- 55) Frequency Scale Factor (lower byte)
- 56) Frequency Range Minimum<sup>395</sup> (highest byte)
- 57) Frequency Range Minimum
- 58) Frequency Range Minimum
- 59) Frequency Range Minimum (lowest byte)
- 60) Frequency Range Maximum<sup>396</sup> (highest byte)

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<sup>386</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>387</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>388</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>389</sup> Scaled by Frequency Scale Factor (bytes 54-55)

<sup>390</sup> Index into Standard List (use control byte #89 to retrieve the ASCII string name). “No Standard” sent as FFFEh

<sup>391</sup> “No Channel” is sent as FFFEh

<sup>392</sup> Value sent as (value in dB \* 1000)

<sup>393</sup> Value sent as ((value in dBm \* 1000) + 100)

<sup>394</sup> In number of Hz

<sup>395</sup> Scaled by Frequency Scale Factor

- 61) Frequency Range Maximum
- 62) Frequency Range Maximum
- 63) Frequency Range Maximum (lowest byte)
- 64) Zero Status (00h = Off, 01h = On)
- 65) Zero Value<sup>397</sup> (highest byte)
- 66) Zero Value
- 67) Zero Value
- 68) Zero Value (lowest byte)
- 69-120) Not Used

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error
- 238 (EEh) Time Out Error

### **Read Parameter Limits – Control Byte #67 (43h)**

*Description:* Returns limits (minimum and maximum values) associated with each parameter defined for the specified measurement mode.

“Frequency Parameters (for SPA, TM and PM)” are start, stop, and center frequencies, multiple limit “x” parameters and AM/FM demod frequency parameters.

“Frequency Parameters (for VNA modes)” are start and stop frequencies and multiple limit “x” parameters.

“Distance Parameters” are start and stop distances, multiple limit “x” parameters and cable loss.

*Bytes to Follow:* 2 bytes

- 1) Measurement Mode<sup>398</sup>
- 2) Limits to Read (00h = Frequency Parameter Limits (Spectrum Analyzer, Transmission Mode, Power Meter), 01h = Available RBWs, 02h = Available VBWs, 03h = Distance Parameter Limits (Metric Units, VNA DTF Modes) 04h = Distance Parameter Limits (English Units, VNA DTF Modes), FFh = All Other Parameter Limits)

*LMR Master Returns:*

For All Modes:

- 1) Number of Following Bytes (higher byte)
- 2) Number of Following Bytes (lower byte)
- 3) Measurement Mode<sup>399</sup>
- 5-20) Not Used

For Spectrum Analyzer, Transmission (Option 21) and Power Meter Modes, Frequency Parameter Limits:

- 21) Number of Valid Frequency Ranges

For each range:

- 1) Range Scale Factor<sup>400</sup> (higher byte)
- 2) Range Scale Factor (lower byte)
- 3) Range Start Frequency<sup>401</sup> (highest byte)
- 4) Range Start Frequency

<sup>396</sup> Scaled by Frequency Scale Factor

<sup>397</sup> Value sent as ((value in dBm \* 1000) + 100)

<sup>398</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>399</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>400</sup> Scale Factor in number of Hz

<sup>401</sup> Scaled by Span Scale Factor



- 5) Range Start Frequency
- 6) Range Start Frequency (lowest byte)
- 7) Range Stop Frequency<sup>402</sup> (highest byte)
- 8) Range Stop Frequency
- 9) Range Stop Frequency
- 10) Range Stop Frequency (lowest byte)

For Spectrum Analyzer, Transmission (Option 21) Modes, Available RBWS:  
 21) Number of Valid RBWs

For each RBW:

- 1) RBW Frequency (in Hz) (highest byte)
- 2) RBW Frequency (in Hz)
- 3) RBW Frequency (in Hz)
- 4) RBW Frequency (in Hz) (lowest byte)

For Spectrum Analyzer, Transmission (Option 21) Modes, Available VBWS:  
 21) Number of Valid VBWs

For each VBW:

- 1) VBW Frequency (in Hz) (highest byte)
- 2) VBW Frequency (in Hz)
- 3) VBW Frequency (in Hz)
- 4) VBW Frequency (in Hz) (lowest byte)

For VNA Modes, Distance Parameter Limits, in Metric Units:

- 21) Distance Minimum<sup>403</sup> (highest byte)
- 22) Distance Minimum
- 23) Distance Minimum
- 24) Distance Minimum (lowest byte)
- 25) Distance Maximum<sup>404</sup> (highest byte)
- 26) Distance Maximum
- 27) Distance Maximum
- 28) Distance Maximum (lowest byte)
- 29) Cable Loss Minimum<sup>405</sup> (highest byte)
- 30) Cable Loss Minimum
- 31) Cable Loss Minimum
- 32) Cable Loss Minimum (lowest byte)
- 33) Cable Loss Maximum<sup>406</sup> (highest byte)
- 34) Cable Loss Maximum
- 35) Cable Loss Maximum
- 36) Cable Loss Maximum (lowest byte)

For VNA Modes, Distance Parameter Limits, in English Units:

- 21) Distance Minimum<sup>407</sup> (highest byte)
- 22) Distance Minimum
- 23) Distance Minimum
- 24) Distance Minimum (lowest byte)
- 25) Distance Maximum<sup>408</sup> (highest byte)

---

<sup>402</sup> Scaled by Span Scale Factor

<sup>403</sup> Distance sent as (distance in meters \* 100,000)

<sup>404</sup> Distance sent as (distance in meters \* 100,000)

<sup>405</sup> Cable loss sent as (loss in dB/m \* 100,000)

<sup>406</sup> Cable loss sent as (loss in dB/m \* 100,000)

<sup>407</sup> Distance sent as (distance in feet \* 100,000)

- 26) Distance Maximum
- 27) Distance Maximum
- 28) Distance Maximum (lowest byte)
- 29) Cable Loss Minimum<sup>409</sup> (highest byte)
- 30) Cable Loss Minimum
- 31) Cable Loss Minimum
- 32) Cable Loss Minimum (lowest byte)
- 33) Cable Loss Maximum<sup>410</sup> (highest byte)
- 34) Cable Loss Maximum
- 35) Cable Loss Maximum
- 36) Cable Loss Maximum (lowest byte)

For VNA Modes, All Other Parameter Limits:

- 21) Frequency Minimum<sup>411</sup> (highest byte)
- 22) Frequency Minimum
- 23) Frequency Minimum
- 24) Frequency Minimum (lowest byte)
- 25) Frequency Maximum<sup>412</sup> (highest byte)
- 26) Frequency Maximum
- 27) Frequency Maximum
- 28) Frequency Maximum (lowest byte)
- 29) Return Loss Scale/Limit Y Minimum<sup>413</sup> (highest byte)
- 30) Return Loss Scale/Limit Y Minimum
- 31) Return Loss Scale/Limit Y Minimum
- 32) Return Loss Scale/Limit Y Minimum (lowest byte)
- 33) Return Loss Scale/Limit Y Maximum<sup>414</sup> (highest byte)
- 34) Return Loss Scale/Limit Y Maximum
- 35) Return Loss Scale/Limit Y Maximum
- 36) Return Loss Scale/Limit Y Maximum (lowest byte)
- 37) Cable Loss Scale/Limit Y Minimum<sup>415</sup> (highest byte)
- 38) Cable Loss Scale/Limit Y Minimum
- 39) Cable Loss Scale/Limit Y Minimum
- 40) Cable Loss Scale/Limit Y Minimum (lowest byte)
- 41) Cable Loss Scale/Limit Y Maximum<sup>416</sup> (highest byte)
- 42) Cable Loss Scale/Limit Y Maximum
- 43) Cable Loss Scale/Limit Y Maximum
- 44) Cable Loss Scale/Limit Y Maximum (lowest byte)
- 45) SWR Scale/Limit Y Minimum<sup>417</sup> (highest byte)
- 46) SWR Scale/Limit Y Minimum
- 47) SWR Scale/Limit Y Minimum
- 48) SWR Scale/Limit Y Minimum (lowest byte)
- 49) SWR Scale/Limit Y Maximum<sup>418</sup> (highest byte)
- 50) SWR Scale/Limit Y Maximum
- 51) SWR Scale/Limit Y Maximum

---

<sup>408</sup> Distance sent as (distance in feet \* 100,000)

<sup>409</sup> Cable loss sent as (loss in dB/ft \* 100,000)

<sup>410</sup> Cable loss sent as (loss in dB/ft \* 100,000)

<sup>411</sup> Frequencies sent in Hz

<sup>412</sup> Frequencies sent in Hz

<sup>413</sup> Scale sent in (dB \* 1000)

<sup>414</sup> Scale sent in (dB \* 1000)

<sup>415</sup> Scale sent in (dB \* 1000)

<sup>416</sup> Scale sent in (dB \* 1000)

<sup>417</sup> Scale sent in (ratio \* 1000)

<sup>418</sup> Scale sent in (ratio \* 1000)

- 52) SWR Scale/Limit Y Maximum (lowest byte)
- 53) Marker Minimum<sup>419</sup> (higher byte)
- 54) Marker Minimum (lower byte)
- 55) Marker Maximum<sup>420</sup> (higher byte)
- 56) Marker Minimum (lower byte)
- 57) Propagation Velocity Minimum (highest byte)
- 58) Propagation Velocity Minimum
- 59) Propagation Velocity Minimum
- 60) Propagation Velocity Minimum (lowest byte)
- 61) Propagation Velocity Maximum<sup>421</sup> (highest byte)
- 62) Propagation Velocity Maximum
- 63) Propagation Velocity Maximum
- 64) Propagation Velocity Maximum (lowest byte)
- 65) Cable Folder Minimum
- 66) Cable Folder Maximum
- 67) Trace Overlay Index Minimum
- 68) Trace Overlay Index Maximum
- 69-200) Not Used

For Spectrum Analyzer Mode, All Other Parameter Limits:

- 21) Frequency Scale Factor Minimum<sup>422</sup> (higher byte)
- 22) Frequency Scale Factor Minimum (lower byte)
- 23) Frequency Scale Factor Maximum<sup>423</sup> (higher byte)
- 24) Frequency Scale Factor Maximum (lower byte)
- 25) Span Minimum<sup>424</sup> (highest byte)
- 26) Span Minimum
- 27) Span Minimum
- 28) Span Minimum (lowest byte)
- 29) Span Maximum<sup>425</sup> (highest byte)
- 30) Span Maximum
- 31) Span Maximum
- 32) Span Maximum (lowest byte)
- 33) Reference Level Minimum<sup>426</sup> (highest byte)
- 34) Reference Level Minimum
- 35) Reference Level Minimum
- 36) Reference Level Minimum (lowest byte)
- 37) Reference Level Maximum<sup>427</sup> (highest byte)
- 38) Reference Level Maximum
- 39) Reference Level Maximum
- 40) Reference Level Maximum (lowest byte)
- 41) Scale Minimum<sup>428</sup> (highest byte)
- 42) Scale Minimum
- 43) Scale Minimum

---

<sup>419</sup> Value sent as data point on the display. Equivalent frequency (or distance) = ( # data points – 1) \* (marker X – start X) / (stop X – start X)

<sup>420</sup> Value sent as data point on the display. Equivalent frequency (or distance) = ( # data points – 1) \* (marker X – start X) / (stop X – start X)

<sup>421</sup> Propagation velocity sent as (velocity \* 100,000)

<sup>422</sup> Scale Factor in number of Hz

<sup>423</sup> Scale Factor in number of Hz

<sup>424</sup> Scaled by Span Scale Factor

<sup>425</sup> Scaled by Span Scale Factor

<sup>426</sup> Value sent as (value \* 1000) + 270,000

<sup>427</sup> Value sent as (value \* 1000) + 270,000

<sup>428</sup> Value sent as (value \* 1000)

- 44) Scale Minimum (lowest byte)
- 45) Scale Maximum<sup>429</sup> (highest byte)
- 46) Scale Maximum
- 47) Scale Maximum
- 48) Scale Maximum (lowest byte)
- 49) Marker Minimum<sup>430</sup> (higher byte)
- 50) Marker Minimum (lower byte)
- 51) Marker Maximum<sup>431</sup> (higher byte)
- 52) Marker Maximum (lower byte)
- 53) Limit Y Minimum<sup>432</sup> (highest byte)
- 54) Limit Y Minimum
- 55) Limit Y Minimum
- 56) Limit Y Minimum (lowest byte)
- 57) Limit Y Maximum<sup>433</sup> (highest byte)
- 58) Limit Y Maximum
- 59) Limit Y Maximum
- 60) Limit Y Maximum (lowest byte)
- 61) OBW Method Minimum
- 62) OBW Method Maximum
- 63) OBW % of Power Minimum
- 64) OBW % of Power Maximum
- 65) OBW dBc Minimum
- 66) OBW dBc Maximum
- 67) Attenuation Minimum
- 68) Attenuation Maximum
- 69) Amplitude Units Minimum
- 70) Amplitude Units Maximum
- 71) Detection Algorithm Minimum
- 72) Detection Algorithm Maximum
- 73) RL Offset Minimum<sup>434</sup> (highest byte)
- 74) RL Offset Minimum
- 75) RL Offset Minimum
- 76) RL Offset Minimum (lowest byte)
- 77) RL Offset Maximum<sup>435</sup> (highest byte)
- 78) RL Offset Maximum
- 79) RL Offset Maximum
- 80) RL Offset Maximum (lowest byte)
- 81) External Reference Frequency Minimum<sup>436</sup> (highest byte)
- 82) External Reference Frequency Minimum
- 83) External Reference Frequency Minimum
- 84) External Reference Frequency Minimum (lowest byte)
- 85) External Reference Frequency Maximum<sup>437</sup> (highest byte)
- 86) External Reference Frequency Maximum
- 87) External Reference Frequency Maximum

---

<sup>429</sup> Value sent as (value \* 1000)

<sup>430</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points - 1 )) + start frequency.

<sup>431</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points - 1 )) + start frequency.

<sup>432</sup> Value sent as (value \* 1000) + 270,000

<sup>433</sup> Value sent as (value \* 1000) + 270,000

<sup>434</sup> Value sent as (value \* 1000) + 270,000

<sup>435</sup> Value sent as (value \* 1000) + 270,000

<sup>436</sup> Reference frequency in Hz

<sup>437</sup> Reference frequency in Hz

- 88) External Reference Frequency Maximum (lowest byte)
- 89) Trigger Type Minimum
- 90) Trigger Type Maximum
- 91) Minimum Sweep Type (in  $\mu$ s) Minimum (highest byte)
- 92) Minimum Sweep Type (in  $\mu$ s) Minimum
- 93) Minimum Sweep Type (in  $\mu$ s) Minimum
- 94) Minimum Sweep Type (in  $\mu$ s) Minimum (lowest byte)
- 95) Minimum Sweep Type (in  $\mu$ s) Maximum (highest byte)
- 96) Minimum Sweep Type (in  $\mu$ s) Maximum
- 97) Minimum Sweep Type (in  $\mu$ s) Maximum
- 98) Minimum Sweep Type (in  $\mu$ s) Maximum (lowest byte)
- 99) Video Trigger Level Minimum<sup>438</sup> (highest byte)
- 100) Video Trigger Level Minimum
- 101) Video Trigger Level Minimum
- 102) Video Trigger Level Minimum (lowest byte)
- 103) Video Trigger Level Maximum<sup>439</sup> (highest byte)
- 104) Video Trigger Level Maximum
- 105) Video Trigger Level Maximum
- 106) Video Trigger Level Maximum (lowest byte)
- 107) Sweep Average Minimum
- 108) Sweep Average Maximum
- 109) Trace Math Minimum
- 110) Trace Math Maximum
- 111) Impedance Loss Minimum<sup>440</sup> (highest byte)
- 112) Impedance Loss Minimum
- 113) Impedance Loss Minimum
- 114) Impedance Loss Minimum (lowest byte)
- 115) Impedance Loss Maximum<sup>441</sup> (highest byte)
- 116) Impedance Loss Maximum
- 117) Impedance Loss Maximum
- 118) Impedance Loss Maximum (lowest byte)
- 119) Demod Type Minimum
- 120) Demod Type Maximum
- 121) Demod Volume Minimum
- 122) Demod Volume Maximum
- 123) Demod Time Minimum (in ms) (highest byte)
- 124) Demod Time Minimum (in ms)
- 125) Demod Time Minimum (in ms)
- 126) Demod Time Minimum (in ms) (lowest byte)
- 127) Demod Time Maximum (in ms) (highest byte)
- 128) Demod Time Maximum (in ms)
- 129) Demod Time Maximum (in ms)
- 130) Demod Time Maximum (in ms) (lowest byte)
- 131) SSB BFO Offset Minimum<sup>442</sup> (highest byte)
- 132) SSB BFO Offset Minimum
- 133) SSB BFO Offset Minimum
- 134) SSB BFO Offset Minimum (lowest byte)
- 135) SSB BFO Offset Maximum<sup>443</sup> (highest byte)
- 136) SSB BFO Offset Maximum

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<sup>438</sup> Value sent as  $(\text{value} * 1000) + 270,000$

<sup>439</sup> Value sent as  $(\text{value} * 1000) + 270,000$

<sup>440</sup> Value sent as  $(\text{value in dB} * 1000)$

<sup>441</sup> Value sent as  $(\text{value in dB} * 1000)$

<sup>442</sup> Value sent as  $((\text{value in Hz}) - 10,000)$

<sup>443</sup> Value sent as  $((\text{value in Hz}) - 10,000)$

- 137) SSB BFO Offset Maximum
- 138) SSB BFO Offset Maximum (lowest byte)
- 139) ACPR Main Channel BW Minimum (in Hz) (highest byte)
- 140) ACPR Main Channel BW Minimum (in Hz)
- 141) ACPR Main Channel BW Minimum (in Hz)
- 142) ACPR Main Channel BW Minimum (in Hz) (lowest byte)
- 143) ACPR Main Channel BW Maximum (in Hz) (highest byte)
- 144) ACPR Main Channel BW Maximum (in Hz)
- 145) ACPR Main Channel BW Maximum (in Hz)
- 146) ACPR Main Channel BW Maximum (in Hz) (lowest byte)
- 147) ACPR Adjacent Channel BW Minimum (in Hz) (highest byte)
- 148) ACPR Adjacent Channel BW Minimum (in Hz)
- 149) ACPR Adjacent Channel BW Minimum (in Hz)
- 150) ACPR Adjacent Channel BW Minimum (in Hz) (lowest byte)
- 151) ACPR Adjacent Channel BW Maximum (in Hz) (highest byte)
- 152) ACPR Adjacent Channel BW Maximum (in Hz)
- 153) ACPR Adjacent Channel BW Maximum (in Hz)
- 154) ACPR Adjacent Channel BW Maximum (in Hz) (lowest byte)
- 155) ACPR Channel Spacing Minimum (in Hz) (highest byte)
- 156) ACPR Channel Spacing Minimum (in Hz)
- 157) ACPR Channel Spacing Minimum (in Hz)
- 158) ACPR Channel Spacing Minimum (in Hz) (lowest byte)
- 159) ACPR Channel Spacing Maximum (in Hz) (highest byte)
- 160) ACPR Channel Spacing Maximum (in Hz)
- 161) ACPR Channel Spacing Maximum (in Hz)
- 162) ACPR Channel Spacing Maximum (in Hz) (lowest byte)
- 163) Channel Power Integration BW Minimum (in Hz) (highest byte)
- 164) Channel Power Integration BW Minimum (in Hz)
- 165) Channel Power Integration BW Minimum (in Hz)
- 166) Channel Power Integration BW Minimum (in Hz) (lowest byte)
- 167) Channel Power Integration BW Maximum (in Hz) (highest byte)
- 168) Channel Power Integration BW Maximum (in Hz)
- 169) Channel Power Integration BW Maximum (in Hz)
- 170) Channel Power Integration BW Maximum (in Hz) (lowest byte)
- 171-300) Not Used

For Transmission Measurement Mode (Option 21 Only), All Other Parameter Limits:

- 21) Span Scale Factor Minimum<sup>444</sup> (higher byte)
- 22) Span Scale Factor Minimum (lower byte)
- 23) Span Scale Factor Maximum<sup>445</sup> (higher byte)
- 24) Span Scale Factor Maximum (lower byte)
- 25) Span Minimum<sup>446</sup> (highest byte)
- 26) Span Minimum
- 27) Span Minimum
- 28) Span Minimum (lowest byte)
- 29) Span Maximum<sup>447</sup> (highest byte)
- 30) Span Maximum
- 31) Span Maximum
- 32) Span Maximum (lowest byte)
- 33) Reference Level Minimum<sup>448</sup> (highest byte)

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<sup>444</sup> Scale Factor in number of Hz

<sup>445</sup> Scale Factor in number of Hz

<sup>446</sup> Scaled by Span Scale Factor

<sup>447</sup> Scaled by Span Scale Factor

<sup>448</sup> Value sent as (value \* 1000) + 270,000

- 34) Reference Level Minimum
- 35) Reference Level Minimum
- 36) Reference Level Minimum (lowest byte)
- 37) Reference Level Maximum<sup>449</sup> (highest byte)
- 38) Reference Level Maximum
- 39) Reference Level Maximum
- 40) Reference Level Maximum (lowest byte)
- 41) Scale Minimum<sup>450</sup> (highest byte)
- 42) Scale Minimum
- 43) Scale Minimum
- 44) Scale Minimum (lowest byte)
- 45) Scale Maximum<sup>451</sup> (highest byte)
- 46) Scale Maximum
- 47) Scale Maximum
- 48) Scale Maximum (lowest byte)
- 49) Marker Minimum<sup>452</sup> (higher byte)
- 50) Marker Minimum (lower byte)
- 51) Marker Maximum<sup>453</sup> (higher byte)
- 52) Marker Maximum (lower byte)
- 53) Limit Y Minimum<sup>454</sup> (highest byte)
- 54) Limit Y Minimum
- 55) Limit Y Minimum
- 56) Limit Y Minimum (lowest byte)
- 57) Limit Y Maximum<sup>455</sup> (highest byte)
- 58) Limit Y Maximum
- 59) Limit Y Maximum
- 60) Limit Y Maximum (lowest byte)
- 61) Attenuation Minimum
- 62) Attenuation Maximum
- 63) Amplitude Units Minimum
- 64) Amplitude Units Maximum
- 65) Detection Algorithm Minimum
- 66) Detection Algorithm Maximum
- 67) External Reference Frequency Minimum<sup>456</sup> (highest byte)
- 68) External Reference Frequency Minimum
- 69) External Reference Frequency Minimum
- 70) External Reference Frequency Minimum (lowest byte)
- 71) External Reference Frequency Maximum<sup>457</sup> (highest byte)
- 72) External Reference Frequency Maximum
- 73) External Reference Frequency Maximum
- 74) External Reference Frequency Maximum (lowest byte)
- 75) Trigger Type Minimum
- 76) Trigger Type Maximum
- 77) Sweep Average Minimum

---

<sup>449</sup> Value sent as (value \* 1000) + 270,000

<sup>450</sup> Value sent as (value \* 1000)

<sup>451</sup> Value sent as (value \* 1000)

<sup>452</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points - 1 )) + start frequency.

<sup>453</sup> Value sent as data point on the display. Equivalent frequency = (point \* span / ( # data points - 1 )) + start frequency.

<sup>454</sup> Value sent as (value \* 1000) + 270,000

<sup>455</sup> Value sent as (value \* 1000) + 270,000

<sup>456</sup> Reference frequency in MHz

<sup>457</sup> Reference frequency in MHz

- 78) Sweep Average Maximum
- 79) Trace Math Minimum
- 80) Trace Math Maximum
- 81-200) Not Used

For Power Meter Mode, All Other Parameter Limits:

- 21) Span Scale Factor Minimum<sup>458</sup> (higher byte)
- 22) Span Scale Factor Minimum (lower byte)
- 23) Span Scale Factor Maximum<sup>459</sup> (higher byte)
- 24) Span Scale Factor Maximum (lower byte)
- 25) Span Minimum<sup>460</sup> (highest byte)
- 26) Span Minimum
- 27) Span Minimum
- 28) Span Minimum (lowest byte)
- 29) Span Maximum<sup>461</sup> (highest byte)
- 30) Span Maximum
- 31) Span Maximum
- 32) Span Maximum (lowest byte)
- 33) Power Meter Offset Minimum (highest byte)
- 34) Power Meter Offset Minimum
- 35) Power Meter Offset Minimum
- 36) Power Meter Offset Minimum (lowest byte)
- 37) Power Meter Offset Maximum (highest byte)
- 38) Power Meter Offset Maximum
- 39) Power Meter Offset Maximum
- 40) Power Meter Offset Maximum (lowest byte)
- 41) Power Meter Relative Minimum<sup>462</sup> (highest byte)
- 42) Power Meter Relative Minimum
- 43) Power Meter Relative Minimum
- 44) Power Meter Relative Minimum (lowest byte)
- 45) Power Meter Relative Maximum<sup>463</sup> (highest byte)
- 46) Power Meter Relative Maximum
- 47) Power Meter Relative Maximum
- 48) Power Meter Relative Maximum (lowest byte)
- 49-150) Not Used

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### **Query Saved Setups – Control Byte #68 (44h)**

*Description:* Returns a list of setups saved for the specified measurement mode. Modes that are stored in the same table (i.e. Spectrum Analyzer and Transmission Measurement modes or RL, CL and SWR modes) will be returned by this command when any of the modes in that list are specified.

*Bytes to Follow:* 1 byte

- 1) Measurement Mode<sup>464</sup>

*LMR Master Returns:*

For All Modes:

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<sup>458</sup> Scale Factor in number of Hz

<sup>459</sup> Scale Factor in number of Hz

<sup>460</sup> Scaled by Span Scale Factor

<sup>461</sup> Scaled by Span Scale Factor

<sup>462</sup> Value sent as ((value in dBm + 100) \* 1000)

<sup>463</sup> Value sent as ((value in dBm + 100) \* 1000)

<sup>464</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.



- 1) Number of Following Bytes (higher byte)
- 2) Number of Following Bytes (lower byte)
- 3) Number of Setups

For Each Setup, VNA Modes – Frequency Domain:

- 1) Setup Number
- 2) Attributes  
bit 0: Read Only Status (00h = Write-able, 01h = Read Only)  
bits 1-7: Not Used
- 3) Measurement Mode<sup>465</sup>
- 4) Cal Status<sup>466</sup>
- 5) Frequency Scale Factor<sup>467</sup> (higher byte)
- 6) Frequency Scale Factor (lower byte)
- 7) Start Frequency<sup>468</sup> (highest byte)
- 8) Start Frequency
- 9) Start Frequency
- 10) Start Frequency (lowest byte)
- 11) Stop Frequency<sup>469</sup> (highest byte)
- 12) Stop Frequency
- 13) Stop Frequency
- 14) Stop Frequency (lowest byte)
- 15-20) Not Used

For Each Setup, VNA Modes – Time Domain (i.e. DTF):

- 1) Setup Number
- 2) Attributes  
bit 0: Read Only Status (00h = Write-able, 01h = Read Only)  
bits 1-7: Not Used
- 3) Measurement Mode<sup>470</sup>
- 4) Cal Status<sup>471</sup>
- 5) Not Used
- 6) Measurement Units (00h = Feet, 01h = Meters)
- 7) Start Distance<sup>472</sup> (highest byte)
- 8) Start Distance
- 9) Start Distance
- 10) Start Distance (lowest byte)
- 11) Stop Distance<sup>473</sup> (highest byte)
- 12) Stop Distance
- 13) Stop Distance
- 14) Stop Distance (lowest byte)
- 15-20) Not Used

For Each Setup, Spectrum Analyzer, Transmission Mode, Power Meter Modes:

- 1) Setup Number

---

<sup>465</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>466</sup> 00h = Cal Off, 01h = OSL Cal On, 02h = OSL InstaCal On, 03h = FlexCal On, 04h = FlexCal InstaCal On

<sup>467</sup> Frequency Scale Factor is in number of Hz

<sup>468</sup> Frequency is scaled by the frequency scale factor specified in bytes 5-6.

<sup>469</sup> Frequency is scaled by the frequency scale factor specified in bytes 5-6.

<sup>470</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>471</sup> 00h = Cal Off, 01h = OSL Cal On, 02h = OSL InstaCal On, 03h = FlexCal On, 04h = FlexCal InstaCal On

<sup>472</sup> Distance sent as (distance \* 100,000) where “distance” is in the units specified in byte 6.

<sup>473</sup> Distance sent as (distance \* 100,000) where “distance” is in the units specified in byte 6.

- 2) Attributes  
bit 0: Read Only Status (00h = Write-able, 01h = Read Only)  
bits 1-7: Not Used
- 3) Measurement Mode<sup>474</sup>
- 4) Cal Status (Transmission Mode Setup Only, 00h = Off, 01h = On)
- 5) Frequency Scale Factor<sup>475</sup> (higher byte)
- 6) Frequency Scale Factor (lower byte)
- 7) Start Frequency<sup>476</sup> (highest byte)
- 8) Start Frequency
- 9) Start Frequency
- 10) Start Frequency (lowest byte)
- 11) Stop Frequency<sup>477</sup> (highest byte)
- 12) Stop Frequency
- 13) Stop Frequency
- 14) Stop Frequency (lowest byte)
- 15-20) Not Used

### **Enter Remote Mode – Control Byte #69 (45h)**

*Description:* Enter remote mode at the end of a sweep then send model number and firmware version to the computer.

The computer sends Enter Remote mode byte #69 (45h) to the LMR Master and waits for response.

Since the LMR Master polls its serial port buffer at the end of each sweep, the computer must wait until the LMR Master sends the return bytes before sending a new control byte. Otherwise, the new control byte overwrites the old one (saying enter remote) and the LMR Master does not respond as expected.

Once in remote mode, the LMR Master stops sweeping. A Remote Mode Indicator appears on the LCD.

The LMR Master sends its model and software version numbers to the computer. The LMR Master is now able to take multiple control bytes. It waits for the next control byte.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 13 bytes

- 1-2) Model # (unsigned integer, 1Bh for LMR Master S412D)
- 3-9) Extended Model # (7 bytes in ASCII)
- 10-13) Software Version - 4 bytes (ASCII)

<sup>474</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>475</sup> Frequency Scale Factor is in number of Hz

<sup>476</sup> Frequency is scaled by the frequency scale factor specified in bytes 5-6.

<sup>477</sup> Frequency is scaled by the frequency scale factor specified in bytes 5-6.

### **Enter Remote Mode Immediately – Control Byte #70 (46h)**

*Description:* Enter remote mode in the middle of a sweep, then send the model number and firmware version to the computer.

The computer sends Enter Remote Mode Immediately byte #70 (46h) to the LMR Master and waits for a response. This control byte causes the unit to enter remote mode immediately. Note that this could result in incomplete sweep data. Use control byte #69 if complete data is required.

Once in remote mode, the LMR Master stops sweeping. A Remote Mode Indicator appears on the LCD.

The LMR Master sends its model and software version numbers to the computer. The LMR Master is now able to take multiple control bytes. It waits for the next control byte.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 13 bytes

- 1-2) Model # (unsigned integer, 1Bh for LMR Master S412D)
  - 3-9) Extended Model # (7 bytes in ASCII)
  - 10-13) Software Version (4 bytes in ASCII)
- 

### **Write Protect Setup – Control Byte #71 (47h)**

*Description:* Makes a saved setup either read-only or write-able.

Setup numbers as follows:

- 255 = All Setups in the Specified Mode
- 1 – 5 = Saved setups for Spectrum Analyzer/Transmission Measurement modes
- 1 – 5 = Saved setups for Power Meter mode
- 1 – 5 = Saved Setups for VNA modes

*Bytes to Follow:* 3 bytes

- 1) Measurement Mode<sup>478</sup>
- 2) Setup Number
- 3) Write-Protect Status (00h = Allow Writes (default), 01h = Lock Setup (i.e. “read only”))

*Spectrum Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

<sup>478</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

### **Clear Setup Memory Location – Control Byte #72 (48h)**

*Description:* Clears a setup memory location such that it appears as “<EMPTY>” in the Recall Setup list.

Setup numbers as follows:

- 255 = All Setups in the Specified Mode
- 1 – 5 = Saved setups for Spectrum Analyzer/Transmission Measurement modes
- 1 – 5 = Saved setups for Power Meter mode
- 1 – 5 = Saved Setups for P25 Talk-Out/P25 Tx Signal Analyzer modes
- 1 – 5 = Saved Setups for NXDN Talk-Out/NXDN Tx Signal Analyzer modes
- 1 – 5 = Saved Setups for VNA modes

*Bytes to Follow:* 2 bytes

- 1) Measurement Mode<sup>479</sup>
- 2) Setup Number

*Spectrum Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

### **Write Custom Cable – Control Byte #80 (50h)**

*Description:* Write a cable parameter in the custom cable list.

*Bytes to Follow:* 25 bytes

- 1) Not Used
- 2) Cable List index (0 - 49)
- 3 – 17) Cable Description (string)
- 18) Propagation Velocity (highest byte)<sup>480</sup>
- 19) Propagation Velocity
- 20) Propagation Velocity
- 21) Propagation Velocity (lowest byte)
- 22) Insertion Loss (highest byte)<sup>481</sup>
- 23) Insertion Loss
- 24) Insertion Loss
- 25) Insertion Loss (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

<sup>479</sup> Refer to Control Byte #3 “Select Measurement Mode” for valid measurement modes.

<sup>480</sup> Propagation Velocity in units 1/100,000

<sup>481</sup> Insertion Loss in units 1/100,000 dB/m or 1/100,000 dB/ft

## **Recall Custom Cable – Control Byte #81 (51h)**

*Description:* Query a cable in the custom cable list.

*Bytes to Follow:* 2 bytes

- 1) Not Used
- 2) Cable list index (0-49)

*LMR Master Returns:* 24 bytes

- 1) Upper bound of Custom Cable Index
  - 2 – 16) Cable Description (string)
  - 17) Propagation Velocity (highest byte)<sup>482</sup>
  - 18) Propagation Velocity
  - 19) Propagation Velocity
  - 20) Propagation Velocity (lowest byte)
  - 21) Insertion Loss (highest byte)<sup>483</sup>
  - 22) Insertion Loss
  - 23) Insertion Loss
  - 24) Insertion Loss (lowest byte)
- 

## **Write Antenna – Control Byte #82 (52h)**

*Description:* Receives an antenna to the LMR Master via the serial port.

An antenna is described with an index into the list (1-10) and an ASCII name that appears in the list on the LMR Master. Each antenna can have up to 60 antenna factors. Each antenna factor has an associated frequency and value. These are specified one at a time.

Frequencies are sent in Hz scaled by the Scale Factor.

The value of the antenna factor should be sent as (value \* 100).

*Bytes to Follow:* 26 – 380, depending on the number of antenna factors

- 1) Antenna List Index (1-10)
  - 2-17) Antenna Name (in ASCII)
  - 18) Number of Antenna Factors (max = 60)
  - 19-20) Frequency Scale Factor (in Hz)
- For each antenna factor:
- 1) Frequency (scaled by Scale Factor) (highest byte)
  - 2) Frequency (scaled by Scale Factor)
  - 3) Frequency (scaled by Scale Factor)
  - 4) Frequency (scaled by Scale Factor) (lowest byte)
  - 5) Antenna Factor (higher byte)
  - 6) Antenna Factor (lower byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

<sup>482</sup> Propagation Velocity in units 1/100,000

<sup>483</sup> Insertion Loss in units 1/100,000 dB/m or 1/100,000 dB/ft

### **Recall Antenna – Control Byte #83 (53h)**

*Description:* Sends an antenna from the LMR Master via the serial port.

An antenna is described with an index into the list (1-10) and an ASCII name that appears in the list on the LMR Master. Each antenna can have up to 60 antenna factors. The number of antenna factors will be sent before the actual values are sent. Each antenna factor has an associated frequency and value. These are specified one at a time.

Frequencies are sent in Hz scaled by the Scale Factor.

The value of the antenna factor should be sent as (value \* 100).

*Bytes to Follow:* 1 byte

- 1) Antenna List index (1-10)

*LMR Master Returns:* (28-382 bytes, depending on the number of antenna factors)

- 1) Maximum Antenna Number (10)
- 2-17) Antenna Name (in ASCII)
- 18) Number of Antenna Factors (max = 60)
- 19-20) Frequency Scale Factor (in Hz)
- 21-22) Number of Following Bytes

For each antenna factor:

- 1) Frequency (scaled by Scale Factor) (highest byte)
  - 2) Frequency (scaled by Scale Factor)
  - 3) Frequency (scaled by Scale Factor)
  - 4) Frequency (scaled by Scale Factor) (lowest byte)
  - 5) Antenna Factor (higher byte)
  - 6) Antenna Factor (lower byte)
- 

### **Set Field Strength Measurement – Control Byte #84 (54h)**

*Description:* Sets the state of the measurement (ON or OFF) and the antenna index for the field strength measurement. Antennas 1-10 are custom antennas. Antennas 11-15 are the standard antennas. The standard antennas are as follows:

11. Anritsu #2000-1030 (MAXRAD MPA1750) – 1710-1880 MHz
12. Anritsu #2000-1031 (MAXRAD MPA1850) – 1850-1990 MHz
13. Anritsu #2000-1032 (MAXRAD MPA2450) – 2400-2483.5 MHz
14. Anritsu #2000-1200 (Centurion EXCSM806) – 806-899 MHz
15. Anritsu #2000-1035 (Centurion EXE-902-SM) – 896-941 MHz

Note that if the field strength measurement is turned ON, all other measurements (channel power, adjacent channel power) are turned OFF.

*Bytes to Follow:* 2 bytes

- 1) Field Strength Measurement State (On/Off)
- 2) Antenna List index (1-15)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid state or index  
238 (EEh) Time Out Error
-

### **Set Channel Power – Control Byte #85 (55h)**

*Description:* Sets the state of the measurement (ON or OFF), and the setup parameters to perform the channel power measurement.

Send a 0 (zero) following the command to set the channel power measurement in the current setup.

Send a 1 (one) to set the channel power associated with the trace that was most recently uploaded by command #36, Upload Sweep Trace.

Note that if the channel power measurement is turned ON, all other measurements (field strength, adjacent channel power) are turned OFF.

*Bytes to Follow:* 14 bytes

- 1) Channel Power Location (0 = current setup, 1 = last uploaded trace)
- 2) Channel Power Measurement State (On/Off)
- 3-6) Center Frequency
- 7-10) Integration Bandwidth
- 11-14) Span Frequency

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

### **Read Channel Power – Control Byte #86 (56h)**

*Description:* Read the current channel power or the channel power of a stored trace.

Send a 0 (zero) following the command to read the current channel power measurement (i.e. the one that is updated as the unit is sweeping).

Send 1-200 to read the channel power associated with a stored trace (use Query Trace Names, #24, to obtain trace numbers).

*Bytes to Follow:* 1 byte

- 1) Channel Power Location (0 = current measured value, 1-200 = value in stored trace)

*LMR Master Returns:* 21 bytes

- 1) Channel Power On/Off
  - 2-5) Channel Center Frequency
  - 6-9) Integration Bandwidth
  - 10-13) Channel Span Frequency
  - 14-17) Channel Power (= (power in  $dBm$  \* 100) + 270000)
  - 18-21) Channel Power Density (= (density in  $dBm/Hz$  \* 100) + 270000)
-

### **Set Adjacent Channel Power Ratio (ACPR) – Control Byte #87 (57h)**

*Description:* Sets the state of the measurement (ON or OFF), the center frequency, the main channel bandwidth, the adjacent channel bandwidth and the channel spacing.

Send a 0 (zero) following the command to set the channel power measurement in the current setup.

Send a 1 (one) to set the adjacent channel power associated with the trace that was most recently uploaded by command #36, Upload Sweep Trace.

Note that if the ACPR measurement is turned ON, all other measurements (field strength, channel power) are turned OFF.

*Bytes to Follow:* 18 bytes

- 1) Adjacent Channel Power Location (0 = current setup, 1 = last uploaded trace)
- 2) Adjacent Channel Power Measurement State (On/Off)
- 3-6) Center Frequency
- 7-10) Main Channel Bandwidth
- 11-14) Adjacent Channel Bandwidth
- 15-18) Channel Spacing

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

### **Read Adjacent Channel Power (ACPR) – Control Byte #88 (58h)**

*Description:* Read the current adjacent channel power or the adjacent channel power of a stored trace.

Send a 0 (zero) following the command to read the current adjacent channel power measurement (i.e. the one that is updated as the unit is sweeping).

Send 1-200 to read the channel power associated with a stored trace (use Query Trace Names, #24, to obtain trace numbers).

*Bytes to Follow:* 1 byte

- 1) Adjacent Channel Power Ratio Location (0 = current measured value, 1-200 = value in stored trace)

*LMR Master Returns:* 29 bytes

- 1) ACPR On/Off
  - 2-5) Main Channel Center Frequency
  - 6-9) Main Channel Bandwidth
  - 10-13) Adjacent Channel Bandwidth
  - 14-17) Channel Spacing
  - 18-21) Main Channel Power (= (power in *dBm* \* 100) + 270000)
  - 22-25) Lower Adjacent Channel Power (= (power in *dBm* \* 100) + 270000)
  - 26-29) Upper Adjacent Channel Power (= (power in *dBm* \* 100) + 270000)
-



### **Read Signal Standard Name – Control Byte #89 (59h)**

*Description:* Returns the name corresponding to the desired signal standard index as an ASCII string in English.

*Bytes to Follow:* 3 bytes

- 1) Mode (00h = VNA, 01h = Spectrum Analyzer)
- 2) Signal Standard Index (higher byte)
- 3) Signal Standard Index (lower byte)

*LMR Master Returns:* 2 bytes + number of bytes in string (or 1 byte on error)

- 1) String length (in number of bytes – referred to as “X” on the next line)
- 2-(X+1)) Standard Name in ASCII
- X+2) 255 (FFh) Operation Complete Byte

OR

- 1) 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
- 

### **Measure OCC BW % of Power – Control Byte #96 (60h)**

*Description:* Measure OCC BW with % of Power method.

*Bytes to Follow:* 4 bytes

- 1) % of Power (highest byte)
- 2) % of Power
- 3) % of Power
- 4) % of Power (lowest byte) (in 100<sup>th</sup> of %, 9123 = 91.23% )

*LMR Master Returns:* 16 bytes

- 1-4) Occupied Bandwidth (in Hz)
  - 5-8) Measure dB down (dB \* 100,000)
  - 9-12) Low Frequency OCC BW
  - 13-16) High Frequency OCC BW
- 

### **Measure OCC BW dB Down – Control Byte #97 (61h)**

*Description:* Measure OCC BW with dB down method.

*Bytes to Follow:* 4 bytes

- 1-4) dB down (in 100<sup>th</sup> of dB, 1234 = 12.34dB)

*LMR Master Returns:* 16 bytes

- 1-4) Occupied Bandwidth (in Hz)
  - 5-8) Measure % of Power (% of power \* 100)
  - 9-12) Low Frequency OCC BW
  - 13-16) High Frequency OCC BW
- 

### **Set Bias Tee Function - Control Byte #98 (62h)**

**This command is available only with Option 10.**

*Description:* Set the Bias Tee function On/Off. If the Bias Tee is turned on, the Spectrum Master returns the results of Bias Tee.

*Bytes to Follow:* 1 byte

- 00h – Turns the Bias Tee Off
- 01h – Turns the Bias Tee On

*LMR Master Returns:*

If bias tee is turned Off (1 byte)

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Invalid state
- 238 (EEh) Time-out Error

If bias tee is turned On (10 bytes)

- 1) Bias Tee Board Indicator (00h = No Hardware Installed, 01h = Hardware Installed)
- 2) Bias Tee Current (highest byte)
- 3) Bias Tee Current
- 4) Bias Tee Current
- 5) Bias Tee Current (lowest byte)
- 6) 10 \* Bias Tee Voltage (highest byte) : voltage value is in volt/10
- 7) 10 \* Bias Tee Voltage
- 8) 10 \* Bias Tee Voltage
- 9) 10 \* Bias Tee Voltage (lowest byte)
- 10) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error
- 238 (EEh) Time-out Error

Note: Due to the hardware delay, the LMR Master does not return the results of the Bias Tee until approximately 3 seconds after the Bias Tee is turned on.

---

### **Set Spectrum Analyzer Start/Stop Frequency – Control Byte #99 (63h)**

*Description:* Sets the spectrum analyzer start and stop frequencies.

*Bytes to Follow:* 8 bytes

- 1) Start Frequency (highest byte)
- 2) Start Frequency
- 3) Start Frequency
- 4) Start Frequency (lowest byte)
- 5) Stop Frequency (highest byte)
- 6) Stop Frequency
- 7) Stop Frequency
- 8) Stop Frequency (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid frequency range
  - 238 (EEh) Time Out Error
-

### **Set Spectrum Analyzer Center Freq./Span – Control Byte #100 (64h)**

*Description:* Sets the spectrum analyzer center frequency and span.

*Bytes to Follow:* 8 bytes

- 1) Center Frequency (highest byte)
- 2) Center Frequency
- 3) Center Frequency
- 4) Center Frequency (lowest byte)
- 5) Frequency Span (highest byte)
- 6) Frequency Span
- 7) Frequency Span
- 8) Frequency Span (lowest byte)

*Spectrum Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid frequency range
  - 238 (EEh) Time Out Error
- 

### **Set Spectrum Analyzer Scale – Control Byte #101 (65h)**

*Description:* Sets the reference level and the number of dB represented by each graph division.

Ref Level will be the “top” scale of the graph, and there are total of 10 division, so bottom scale can be determined by : Ref level + 10 x dB/div.

*Bytes to Follow:* 8 bytes

- 1) Ref Level (highest byte)
- 2) Ref Level
- 3) Ref Level
- 4) Ref Level (lowest byte)
- 5) dB/div (highest byte)
- 6) dB/div
- 7) dB/div
- 8) dB/div (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Invalid scale
- 238 (EEh) Time Out Error

*Notes:*

Ref Level is sent as the (Ref Level \* 1000) + 270,000 (0 dBm = 270,000, 20 dBm = 290000, -120 dBm = 150,000)  
Scale should be sent as (dBm \* 1000) (e.g. -12.34 dBm = -12340)

---

### **Set Spectrum Analyzer Marker – Control Byte #102 (66h)**

*Description:* Sets an individual Spectrum Analyzer marker.

*Bytes to Follow:* 5 bytes

- 1) Marker Number (01h = marker 1, 02h = marker 2, 03h = marker 3, 04h = marker 4, 05h = marker 5, 06h = marker 6)
- 2) Marker Line On/Off (01h = On, 00h = Off)
- 3) Marker Delta Status On/Off (01h = On, 00h = Off)
- 4) Marker Value (higher byte)
- 5) Marker Value (lower byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid marker number, status or position  
238 (EEh) Time Out Error

*Note:*

Marker Value is between 0 and 400, inclusive:  $\text{Point} = (400 * (\text{marker freq} - \text{start freq})) / \text{span}$

---

### **Set Spectrum Analyzer Single Limit – Control Byte #103 (67h)**

*Description:* Sets the position and On/Off Status of the Limit Line.

*Bytes to Follow:* 6 bytes

- 1) Limit Number (1 for LMR Master)
- 2) Limit Line On/Off (01h = On, 00h = Off)
- 3) Beep at Limit On/Off (01h = On, 00h = Off)
- 4) Limit Value (highest byte)
- 5) Limit Value
- 6) Limit Value
- 7) Limit Value (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid limit number, status or value  
238 (EEh) Time Out Error

*Note:*

Limit Value is sent as the  $(\text{Limit Value} * 1000) + 270,000$  (0 dBm=270,000, 20 dBm=290000, -120 dBm=150,000)

---

### **Set Spectrum Analyzer Peak Hold – Control Byte #105 (69h)**

*Description:* Sets the max hold and min hold settings on the Spectrum Analyzer.

*Bytes to Follow:* 1 byte

- 1) Peak Hold State
  - 00h – Peak Hold Off
  - 01h – Max Hold On
  - 02h – Min Hold On

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid state
  - 238 (EEh) Time Out Error
- 

### **Set Spectrum Analyzer Sweep Mode – Control Byte #108 (6Ch)**

*Description:* Enables or disables the Single Sweep Mode during Spectrum Analyzer mode of operation.

Single Sweep Mode activates once the LMR Master exits from the remote mode.

For Single Sweep Mode during LMR Master VNA modes of operation see control byte #11 (0Bh).

*Bytes to Follow:* 1 byte

- 1) Sweep Mode
  - 00h – Single Sweep
  - 01h – Continuous Sweep
  - 02h – Video Trigger (span must be 0)
  - 03h – External Trigger (span must be 0)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid Mode
  - 238 (EEh) Time Out Error
- 

### **Set Spectrum Analyzer Marker to Peak – Control Byte #109 (6Dh)**

*Description:* Sets the specified marker to the peak value of the sweep.

*Bytes to Follow:* 1 byte

- 1) Marker Number (1-6)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid Marker Number
  - 238 (EEh) Time Out Error
-

## **Set Spectrum Analyzer Marker to Center – Control Byte #110 (6Eh)**

*Description:* Sets the center frequency equal to the frequency of the specified marker.

*Bytes to Follow:* 1 byte

- 1) Marker Number (1-4)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid Marker Number  
238 (EEh) Time Out Error

---

## **Set LMR Master VNA Segmented Limit Lines – Control Byte #112 (70h)**

*Description:* Sets the position and On/Off status of the limit lines.

LMR Master VNA modes support 5 limit segments. Each segment may have any finite slope and can be enabled and disabled independently of every other segment. The limit beep is enabled for all segments or no segments.

Limit segments are specified by their end points (starting and ending “x” and “y” values).

See control byte #29 (1Dh) response bytes 60 to 129 for the current LMR Master configuration.

*Bytes to Follow:* 14 bytes

- 1) Limit Number
- 2) Limit Line On/Off (01h = On, 00h = Off)
- 3) Starting X (highest byte)<sup>484</sup>
- 4) Starting X
- 5) Starting X
- 6) Starting X (lowest byte)
- 7) Starting Y (higher byte)
- 8) Starting Y (lower byte)
- 9) Ending X (highest byte)<sup>485</sup>
- 10) Ending X
- 11) Ending X
- 12) Ending X (lowest byte)
- 13) Ending Y (higher byte)
- 14) Ending Y (lower byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid limit segment, status or value  
238 (EEh) Time Out Error

*Notes:*

Limit Value depends on the current display mode selected.

Return Loss &: Limit should be sent as ( dB \* 1000 )

Cable Loss      Maximum value sent is 60000 which represents 60.00 dB  
Minimum value sent is 0 which represents 0.0 dB

SWR:              Limit is in thousandths (of ratio), so it should be sent as ( ratio \* 1000 )  
Maximum value sent is 65530 which represents 65.53  
Minimum value sent is 1000 which represents 1.00

---

<sup>484</sup> Frequency in Hz or Distance in 1/100,000 ft (or meters)

<sup>485</sup> Frequency in Hz or Distance in 1/100,000 ft (or meters)

## **Set Spectrum Analyzer Multiple Limit – Control Byte #113 (71h)**

*Description:* Sets the position and On/Off Status of a limit segment.

Multiple limits are defined by multiple limit segments, each with a different finite slope. The single limit is a single, horizontal line that can be defined to act as an upper limit or as a lower limit. See control byte #103 for information about the single limit.

The limit types are mutually exclusive. That is, you cannot have both single and multiple limits at the same time. Note that setting a limit segment ON automatically makes the limit type “MULTIPLE”.

One segment is defined each time this command is sent to the Spectrum Master. The first two bytes of the command specify which segment is being defined. There are 5 upper limits and 5 lower limits available in Spectrum Analyzer mode. Byte 1 selects the segment number. Byte 2 specifies whether it is an upper limit or a lower limit. Byte 3 turns the segment ON or OFF. Byte 4 specifies whether the error beep sounds when the bound set by the segment is exceeded by the measured data.

The segment location is defined by its endpoints. The “Start” endpoint must appear to the left of the “End” endpoint on the graph. That is, Start X < End X. If Start X = End X then Start Y must equal End Y. Vertical segments are not allowed.

*Bytes to Follow:* 20 bytes

- 1) Segment number (1-5)
- 2) Segment type (00h = LOWER limit, 01h = UPPER limit)
- 3) Limit Line On/Off (01h = On, 00h = Off)
- 4) Limit Beep On/Off (01h = On, 00h = Off)
- 5) Limit Value Start X (highest byte)
- 6) Limit Value Start X
- 7) Limit Value Start X
- 8) Limit Value Start X (lowest byte)
- 9) Limit Value Start Y <sup>486</sup>(highest byte)
- 10) Limit Value Start Y
- 11) Limit Value Start Y
- 12) Limit Value Start Y (lowest byte)
- 13) Limit Value End X (highest byte)
- 14) Limit Value End X
- 15) Limit Value End X
- 16) Limit Value End X (lowest byte)
- 17) Limit Value End Y <sup>487</sup>(highest byte)
- 18) Limit Value End Y
- 19) Limit Value End Y
- 20) Limit Value End Y (lowest byte)

*Spectrum Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid limit segment, status or value
  - 238 (EEh) Time Out Error
- 

<sup>486</sup> ( Value in dBm \* 1000 ) + 270,000

<sup>487</sup> ( Value in dBm \* 1000 ) + 270,000

### **Set Return Spectrum Analyzer Sweep Time – Control Byte #114 (72h)**

*Description:* If this is enabled, the duration of the current sweep (in milliseconds) will be returned as 4 bytes via the serial port at the end of the sweep. If Serial Echo Status is enabled, the 4 bytes will be returned AFTER the sweep complete byte.

*Bytes to Follow:* 1 byte

- 1) Return SPA Sweep Time flag state  
00h = Don't Return Sweep Time  
01h = Return Sweep Time

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid state  
238 (EEh) Time Out Error
- 

### **Set Reference Level Offset – Control Byte #115 (73h)**

*Description:* Set the value of the reference level offset.

The reference level offset allows the user to view the result of trace math (A+B, A-B) even if it is greater than +20 dBm or less than -120 dBm. The offset is a constant that is subtracted from the reference level.

Note that the valid range is -100 to +100 dB.

Send the value as (value in dB \* 1000) + 270,000.

For example, to compensate for a 30 dB attenuator, the reference level offset should be -30 dB. That value would be sent over the serial port as (-30 \* 1000) + 270,000 = 240,000.

*Bytes to Follow:* 4 bytes

- 1) Reference Level Offset (highest byte)
- 2) Reference Level Offset
- 3) Reference Level Offset
- 4) Reference Level Offset (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error
- 

### **Set Spectrum Analyzer Impedance – Control Byte #116 (74h)**

*Description:* Set the impedance and the loss value due to an adapter.

The LMR Master can automatically compensate for the effects of impedance adapters. The impedance of the LMR Master is 50Ω, so there is no need for an adapter in this case. The loss for the Anritsu 75Ω adapter 12N50-75B is known by the LMR Master.



This control byte also allows for the specification of the impedance and the loss due to an adapter the system does not know. In either case, 5 bytes must be sent to the unit. If the impedance is 50Ω or one of the known adapters is specified, bytes 2-5 are ignored. If an unknown adapter is specified, the unit uses bytes 2-5 to correct for the adapter.

*Bytes to Follow:* 5 bytes

- 1) Impedance Adapter<sup>488</sup>
- 2) Impedance Loss<sup>489</sup> (highest byte)
- 3) Impedance Loss
- 4) Impedance Loss
- 5) Impedance Loss (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error
- 238 (EEh) Time Out Error

---

### **Read Marker Value – Control Byte #117 (75h)**

*Description:* Returns the frequency location of the specified marker, and the value at that location.

*Bytes to Follow:* 1 byte

- 1) Marker number (1-6)

*Spectrum Master Returns:* 8 bytes (1 byte if an error occurs)

- 1) Frequency (highest byte)
- 2) Frequency
- 3) Frequency
- 4) Frequency (lowest byte)
- 5) Value at Marker (highest byte)
- 6) Value at Marker
- 7) Value at Marker
- 8) Value at Marker (lowest byte)

**OR**

- 1) 224 (E0h) Parameter Error: Invalid marker number
- 238 (EEh) Time-out Error

*Note:*

Marker value sent as (value in dBm \* 1,000) +270,000

If markers are set to be noise markers, convert the returned dBm value to dBm/Hz using this formula (only if detection method is RMS Average):

$$\text{marker (in dBm/Hz)} = \text{marker value (in dBm)} - 10 * \log_{10}(\text{RBW}) - 0.13$$

---

<sup>488</sup> Impedance Adapter: 00h = 50 Ω 0Ah = 75Ω, adapter 12N50-75B 0Ch = 75Ω, other adapter offset

<sup>489</sup> Send the loss value as value in dB\* 1,000

### **Set Sweep Averaging – Control Byte #118 (76h)**

*Description:* Sets the number of sweeps to average. The maximum number is 25. Sending a 1 turns averaging off.

*Bytes to Follow:* 1 byte

- 1) Number of sweeps to average (1-25, 1 turns averaging OFF)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error
- 

### **Field InstaCal – Control Byte #120 (78h)**

*Description:* This command is used by the customer in the field to start an InstaCal sequence.

Prior to sending this command to the LMR Master, the InstaCal module should be connected to the R/F Out port. To execute this command, exit remote mode after sending this command.

*Byte to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Communication Error : LMR Master was unable to communicate with InstaCal module  
238 (EEh) Time Out Error : Field InstaCal sequence was unable to complete
- 

### **Read InstaCal Module ASCII Serial Number – Control Byte #124 (7Ch)**

*Description:* Returns the InstaCal Module serial number in ASCII.

*Bytes to Follow:* 1 byte

- 1) Serial number storage location (01h=main serial, 02h=secondary)

*LMR Master Returns:* 8 bytes

- 1-8) Serial Number, in ASCII
-

### **Set LMR Master Marker (Peak/Valley) – Control Byte #129 (81h)**

*Description:* Sets an individual marker in current measurement mode to either peak (maximum) signal or valley (minimum) signal.

*Bytes to Follow:* 2 bytes

- 1) Marker Number (01h = marker 1, 02h = marker 2, 03h = marker 3, 04h = marker 4, 05h = marker 5, 06h = marker 6)
- 2) Marker Line Search Status (01h = Peak , 00h = Valley )

*LMR Master Returns:* 3 bytes (1 byte if an error occurs)

- 1) Marker Position (higher byte)<sup>490</sup>
- 2) Marker Position (lower byte)
- 3) 255 (FFh) Operation Complete Byte

**OR**

- 1) 224 (E0h) Parameter Error : Invalid marker or marker search status  
238 (EEh) Time Out Error
- 

---

<sup>490</sup> The marker position is sent as a data point on the display. Equivalent Frequency = (position \* span / (# data points – 1) ) + start frequency

### **Set / Reset Spectrum Analyzer External Reference – Control Byte #133 (85h)**

*Description:* Sets the external reference frequency for the spectrum analyzer in increments of 1 MHz from 2 – 20 MHz. The frequencies are sent in Hz.

*Bytes to Follow:* 1 byte if turning the reference OFF, 5 bytes if turning the reference ON

Turn OFF the external reference:

- 1) 00h - Turn OFF the frequency reference

**OR**

Turn ON the external reference (the reference frequency is also sent):

- 1) 01h - Turn ON the frequency reference
- 2) External Reference Frequency (in Hz) (highest byte)
- 3) External Reference Frequency (in Hz)
- 4) External Reference Frequency (in Hz)
- 5) External Reference Frequency (in Hz) (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error

---

### **Check Spectrum Analyzer External Reference – Control Byte #134 (86h)**

*Description:* Checks to see if Spectrum Analyzer external reference is present. If it is, it then checks to see if it is at the correct frequency for PLL locking.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

On Success:

- 1) 00h – Reference present and at the correct frequency (PLL functioning)  
01h – Reference is not present  
02h – Reference is present, but internal PLL and external frequency do not match up.

**OR**

On Error:

- 1) 224 (E0h) Parameter Error – Not in External reference mode  
238 (EEh) Time-out Error.
-

### **Set SA Preamp State (On/Off/Auto) – Control Byte #136 (88h)**

*Description:* Sets the state of Spectrum Analyzer preamplifier.

Setting the preamp state to ON or OFF sets the preamp coupling to manual. That is, the preamplifier state is controlled independently of all other parameters.

Setting the preamp state to AUTO couples the preamp state to the reference level and the attenuation. If the attenuation is automatically coupled to the reference level, the preamp will turn on when the reference level is set less than -26 dBm. If the attenuation is manually coupled to the reference level, the preamp will turn on when the value of (attenuation – reference level)  $\geq$  51.

*Bytes to Follow:* 1 byte

- 1) Mode (00h = Off, 01h = On, 02h = Auto)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid state  
238 (EEh) Time Out Error

---

### **Set Spectrum Analyzer Units – Control Byte #140 (8Ch)**

*Description:* Sets the scale type (logarithmic or linear) and the units.

Linear units can be:

- 01h = Volts
- 02h = Watts

Logarithmic units can be:

- 03h = dBm
- 04h = dBV
- 05h = dBmV
- 06h = dB $\mu$ V

*Bytes to Follow:* 2 bytes

- 1) Scale Type (00h = Linear, 01h = Logarithmic)
- 2) Units

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time-out Error
-

### **Set Spectrum Analyzer Resolution Bandwidth – Control Byte #141 (8Dh)**

*Description:* Sets the resolution BW frequency for the Spectrum Analyzer.

*Bytes to Follow:* 4 bytes

- 1) Resolution Bandwidth (frequency in Hz) (highest byte)
- 2) Resolution Bandwidth (frequency in Hz)
- 3) Resolution Bandwidth (frequency in Hz)
- 4) Resolution Bandwidth (frequency in Hz) (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid RBW
  - 238 (EEh) Time Out Error
- 

### **Set Spectrum Analyzer Video Bandwidth – Control Byte #142 (8Eh)**

*Description:* Sets the video BW frequency for the Spectrum Analyzer.

*Bytes to Follow:* 4 bytes

- 1) Video Bandwidth (frequency in Hz) (highest byte)
- 2) Video Bandwidth (frequency in Hz)
- 3) Video Bandwidth (frequency in Hz)
- 4) Video Bandwidth (frequency in Hz) (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid VBW
  - 238 (EEh) Time Out Error
- 

### **Set Spectrum Analyzer Attenuation – Control Byte #143 (8Fh)**

*Description:* Sets the attenuation of the Spectrum Analyzer. Send a value of 255 (FFh) to enable dynamic attenuation.

Automatic control couples the attenuation to the reference level. Note that setting the attenuation using this command automatically sets the attenuation coupling to “MANUAL”, thereby allowing it to be defined independently of the reference level.

*Bytes to Follow:* 1 byte

- 1) Attenuation (0 – 51)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid attenuation
  - 238 (EEh) Time Out Error
-

### **Set AM/FM Demodulation – Control Byte #145 (91h)**

*Description:* Sets the AM/FM/SSB Demodulation state. This command is also used to set the type of Modulation, volume, Demodulation Frequency, BFO Adjust (SSB only) and the Demodulation time. On turning demodulation ON, after exiting remote, at the end of every sweep, demodulation is performed at the Demodulation frequency for a period of time specified in the Demod Time.

*Bytes to Follow:* 16 bytes

- 1) Set AM/FM/SSB Demod On/Off<sup>491</sup>
- 2) Demodulation Type<sup>492</sup>
- 3) Speaker Volume (higher byte)<sup>493</sup>
- 4) Speaker Volume (lower byte)
- 5) Demodulation Time<sup>494</sup> (highest byte)
- 6) Demodulation Time
- 7) Demodulation Time
- 8) Demodulation Time (lowest byte)
- 9) Demodulation Frequency (highest byte)
- 10) Demodulation Frequency
- 11) Demodulation Frequency
- 12) Demodulation Frequency (lowest byte)
- 13) SSB BFO Adjust<sup>495</sup> (highest byte)
- 14) SSB BFO Adjust
- 15) SSB BFO Adjust
- 16) SSB BFO Adjust (lowest byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error

---

### **Set Baud Rate – Control Byte #197 (C5h)**

*Description:* Set baud rate for this session. An invalid setting returns the baud rate to 9600.

*Bytes to Follow:* 1 byte

- 1) Baud Rate Index  
00h = 9600 baud  
01h = 19200 baud  
02h = 38400 baud  
03h = 56000 baud  
04h = 115200 baud

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error: Invalid baud rate index  
238 (EEh) Time Out Error

---

<sup>491</sup> 00h = Off, 01h = On

<sup>492</sup> 00h = FM Wideband, 01h = FM Narrowband, 02h = AM, 03h = SSB Lower, 04h = SSB Upper

<sup>493</sup> Speaker Volume is from 0 to 100 in steps of 10

<sup>494</sup> Demodulation time in milliseconds from 100 millisecond to 500 seconds

<sup>495</sup> BFO Valid Values are -10 kHz to +10 kHz. Send value as BFO(in Hz) + 10,000. For Example -10 kHz would be sent as 0, 0 would be sent as 10000 and +10 kHz would be 20000

### **Set Language – Control Byte #198 (C6h)**

*Description:* Set the LMR Master display language.

*Bytes to Follow:* 1 byte

- 1) Language Index
  - 00h = English
  - 01h = French
  - 02h = German
  - 03h = Spanish
  - 04h = Chinese
  - 05h = Japanese

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid language index
  - 238 (EEh) Time Out Error
- 

### **Query Time – Control Byte #208 (D0h)**

*Description:* Queries the LMR Master for the current time in ASCII format.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 8 bytes (HH:MM:SS)

- 1) Hour (higher byte)
  - 2) Hour (lower byte)
  - 3) :
  - 4) Minute (higher byte)
  - 5) Minute (lower byte)
  - 6) :
  - 7) Second (higher byte)
  - 8) Second (lower byte)
- 

### **Read Main Serial Number – Control Byte #221 (DDh)**

*Description:* Returns the Main (External) Serial Number as four bytes. This command remains for backward compatibility.

A better command to use would be “Read ASCII Serial Number” #225 (E1h) which returns the serial number in ASCII format.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 4 bytes

- 1) Main Serial Number (highest byte)
  - 2) Main Serial Number
  - 3) Main Serial Number
  - 4) Main Serial Number (lowest byte)
-



### **Read ASCII Serial Number – Control Byte #225 (E1h)**

*Description:* Reads and returns the LMR Master serial number as 8 ASCII bytes.

*Bytes to Follow:* 1 byte

- 1) Serial number storage location
  - 01h = Main (External) Serial Number
  - 02h = Secondary (Motherboard) Serial Number

*LMR Master Returns:* 8 bytes

- 1-8) Serial Number (in ASCII)
- 

### **Exit Remote Mode – Control Byte #255 (FFh)**

*Description:* LMR Master exits remote mode.

The computer sends the Exit Remote command #255 (FFh) to the LMR Master. LMR Master returns a confirm flag (FFh). The LMR Master resumes sweeping, either continuously or singly.

You may also press the “ESCAPE” key on the LMR Master key pad to exit from remote mode (given that the serial communication is still in sync). In this case, the LMR Master does not return a confirm byte to the serial port.

When exiting remote mode, system parameters changed during remote mode are used immediately.

System parameters changed during remote mode are not written to the non-volatile EEPROM.

You may want to save the change to the run-time setup (saved setup location 0, which holds the power-on setup) or one of the saved setups for the current measurement mode. See control byte #18 (12h) for details.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete
- 

### **Select SPA/Power Meter Signal Standard – Control Word (A103h)**

*Description:* Selects a Signal Standard. Use this command for both Spectrum Analyzer and Power Meter modes.

*Bytes to Follow:* 1 byte

- 1) Signal Standard – See the section “Signal Standards” for a list of standards and their indices.

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid signal standard
  - 238 (EEh) Time Out Error
- 

### **Select SPA/Power Meter Channel – Control Word (A104h)**

*Description:* Selects a channel within the range of the currently selected signal standard. Use this command for both Spectrum Analyzer and Power Meter modes.

See the section “Signal Standards” for a list of valid channels for the selected channel.

*Bytes to Follow:* 2 bytes

- 1) Channel (higher byte)
- 2) Channel (lower byte)

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Invalid channel
- 238 (EEh) Time Out Error

---

### **Perform Transmission Mode Calibration – Control Word (A301h)**

**This command is available only with option 21.**

*Description:* Perform Transmission Mode Calibration.

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Invalid channel
- 238 (EEh) Time Out Error

---

### **Turn OFF Transmission Mode Calibration – Control Word (A302h)**

**This command is available only with option 21.**

*Description:* Turn OFF Transmission Mode Calibration

*Bytes to Follow:* 0 bytes

*LMR Master Returns:* 1 byte

---

### **Automatic Cal Disable – Control Byte #240 (F1h)**

*Description:* Disable automatic calibration.

*Bytes to Follow:* 1 byte

- 1: to disable automatic calibration
- 0: to enable automatic calibration

*Cell Master Returns:* 1 byte

- 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error : Invalid Parameter
- 238 (Eeh) Time-out Error

---

### **Set/Query P25 Center Frequency – Control Byte (AD01h)**

**This command is available only with option 520 and option 522.**

*Description:* Sets or queries the center frequency for Talk-Out Coverage or Tx Signal Analyzer Mode

*Bytes to Follow:* 1 byte for query, 5 bytes for set

- 1) Set/query center frequency (00h = query, 01h = set)

For set ONLY:

- 2) Center Frequency (Highest Byte)
- 3) Center Frequency

- 4) Center Frequency
- 5) Center Frequency (Lowest Byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

- 1) Center Frequency (Highest Byte)
- 2) Center Frequency
- 3) Center Frequency
- 4) Center Frequency (Lowest Byte)
- 5) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error

---

### **Set/Query P25 External Reference – Control Byte (AD02h)**

**This command is available only with option 520 and option 522.**

*Description:* Sets or queries the external reference for the P25 Talk-Out Coverage or P25 Tx Signal Analyzer.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

- 1) Set/query external reference (00h = query, 01h = set)

For set ONLY:

- 2) External reference (00h = Off, 01h = On)

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

- 1) External reference (00h = Off, 01h = On)
- 2) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte  
224 (E0h) Parameter Error  
238 (EEh) Time Out Error

---

### **Set/Query P25 External Reference Frequency – Control Byte (AD03h)**

**This command is available only with options 520 and option 522.**

*Description:* Sets or queries the external reference frequency for the P25 in increments of 1 MHz from 2 – 20 MHz. The frequencies are sent in Hz.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

- 1) Set/query external reference frequency (00h for query, 01h for set)

For set ONLY:

- 2) External reference frequency (in Hz) (highest byte)
- 3) External reference frequency (in Hz)
- 4) External reference frequency (in Hz)
- 5) External reference frequency (in Hz) (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set  
 For query:

- 1) External reference frequency (in Hz) (highest byte)
- 2) External reference frequency (in Hz)
- 3) External reference frequency (in Hz)
- 4) External reference frequency (in Hz) (lowest byte)
- 5) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error

### **Set/Query P25 Measurement Function – Control Byte (AD04h)**

**This command is available only with option 520 and option 522.**

*Description:* Selects or queries measurement function in P25 Talk-Out Coverage or P25 Tx Signal Analyzer mode. Please note that certain measurement functions are only available in the measurement mode that they belong to. The pattern must be set to “Control Channel” before entering control channel measurement function. Please use control word “AD0Ah” to set the pattern.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

- 1) Set/query measurement function (00h for query, 01h for set)

For set ONLY

- 2) Function ID

Talk-Out Coverage ONLY

0	1
RSSI vs. Time	BER vs. Time

Tx Signal Analyzer ONLY

2	3	4
Constellation	Histogram	Control Channel

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

- 1) Function ID

Talk-Out Coverage ONLY

0	1
RSSI vs. Time	BER vs. Time

Tx Signal Analyzer ONLY

2	3	4
Constellation	Histogram	Control Channel

- 2) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Module not attached
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error: Module not attached  
238 (EEh) Time Out Error

---

### **Set/Query P25 Reference Level – Control Byte (AD05h)**

**This command is available only with option 522.**

*Description:* Set or queries the value of the reference level for the RSSI vs. Time measurement function in P25 Talk-Out Coverage mode.

Note that the valid range is –120 dBm to +20 dBm.  
Send the value as (value in dBm \* 1000) + 270,000.

*Bytes to Follow:* 1 byte for query, 5 bytes for set  
1) Set/query reference level (00h for query, 01h for set)  
For set ONLY:  
2) Reference Level (highest byte)  
3) Reference Level  
4) Reference Level  
5) Reference Level (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set  
For query:

1) Reference Level (highest byte)  
2) Reference Level  
3) Reference Level  
4) Reference Level (lowest byte)  
5) 255 (FFh) Operation Complete Byte  
    224 (E0h) Parameter Error  
    238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte  
    224 (E0h) Parameter Error  
    238 (EEh) Time Out Error

---

### **Set/Query P25 Scale Division – Control Byte (AD06h)**

**This command is available only with option 522.**

*Description:* Sets or queries the number of dB represented by each graph division for the RSSI vs. Time measurement function in P25 Talk-Out Coverage mode.

Note that the valid range is 1 to 15.  
Send the value as (value \* 1000).

*Bytes to Follow:* 1 byte for query, 5 bytes for set  
1) Set/query scale division (00h for query, 01h for set)  
For set ONLY:  
2) Scale Division (highest byte)  
3) Scale Division  
4) Scale Division  
5) Scale Division (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set  
For query:

1) Scale Division (highest byte)

- 2) Scale Division
- 3) Scale Division
- 4) Scale Division (lowest byte)
- 5) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid scale
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid scale
  - 238 (EEh) Time Out Error

### **Set/Query P25 Reference Percentage – Control Byte (AD07h)**

**This command is available only with option 522.**

*Description:* Sets or queries the reference percentage for the BER vs. Time measurement function in P25 Talk-Out Coverage mode.

Note that the valid range is 1 to 100.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

- 1) Set/query reference percentage (00h for query, 01h for set)

For set ONLY:

- 2) Reference Percentage (highest byte)
- 3) Reference Percentage
- 4) Reference Percentage
- 5) Reference Percentage (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

- 1) Reference Percentage (highest byte)
- 2) Reference Percentage
- 3) Reference Percentage
- 4) Reference Percentage (lowest byte)
- 5) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid scale
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid scale
  - 238 (EEh) Time Out Error

### **Set/Query P25 External Attenuation – Control Byte (AD08h)**

**This command is available only with option 520.**

*Description:* Sets or queries the external attenuation in P25 Tx Signal Analyzer mode.

Note that the valid range is 0 dB to 51 dB.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

- 1) Set/query reference percentage (00h for query, 01h for set)

For set ONLY:

- 2) External Attenuation (highest byte)
- 3) External Attenuation
- 4) External Attenuation
- 5) External Attenuation (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

- 1) External Attenuation (highest byte)
- 2) External Attenuation
- 3) External Attenuation
- 4) External Attenuation (lowest byte)
- 5) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid scale
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Invalid scale
  - 238 (EEh) Time Out Error

---

### **Set/Query P25 Auto Logging – Control Byte (AD09h)**

**This command is available only with option 522.**

*Description:* Sets or queries auto log status in P25 Talk-Out Coverage mode.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

- 1) Set/query auto logging (00h = query, 01h = set)

For set ONLY:

- 2) Auto Logging (00h = Off, 01h = On)

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

- 1) Auto Logging (00h = Off, 01h = On)
- 2) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error

---

### **Set/Query Pattern in P25 Measurement Modes – Control Byte (AD0Ah)**

**This command is available only with option 520 and option 522.**

*Description:* Selects or queries the pattern in P25 Talk-Out Coverage or P25 Tx Signal Analyzer mode.

Please note that the “None” pattern is only available in Talk-Out coverage mode.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

- 1) Set/query measurement function (00h for query, 01h for set)

For set ONLY

- 2) Pattern (highest byte)
- 3) Pattern
- 4) Pattern
- 5) Pattern (lowest byte)
  - Tx Signal Analyzer

0	1	2	3
---	---	---	---

1011 Hz	O.153	Voice	Control Channel
---------	-------	-------	-----------------

Talk-Out Coverage

0	1	2	3	4
1011 Hz	O.153	Voice	Control Channel	None

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

- 1) Pattern (highest byte)
- 2) Pattern
- 3) Pattern
- 4) Pattern (lowest byte)

Tx Signal Analyzer

0	1	2	3
1011 Hz	O.153	Voice	Control Channel

Talk-Out Coverage

0	1	2	3	4
1011 Hz	O.153	Voice	Control Channel	None

- 2) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Module not attached
- 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error: Module not attached
- 238 (EEh) Time Out Error

### **Query Talk-Out Coverage Measurement Data in P25 Measurement Modes – Control Byte (AD0Dh)**

**This command is available only with option 530.**

*Description:* Queries the most recent measurement data for Talk-Out Coverage. The command returns an ASCII string with the following format:

“<RSSI Value>,<BER Value>,<GPS Latitude>,<GPS Longitude>,<UTC Time>,<FFh>”

Please note that the length of the string may vary.

*LMR Master Returns:* Variable number of bytes

For query:

- 1-Length of String) Talk-Out Coverage Measurement Data  
 Last Byte) 255 (FFh) Operation Complete Byte  
 224 (E0h) Parameter Error  
 238 (EEh) Time Out Error



---

### **Set/Query NXDN Center Frequency – Control Byte (AE01h)**

**This command is available only with option 530 and option 532.**

*Description:* Sets or queries the center frequency for Talk-Out Coverage or Tx Signal Analyzer Mode

*Bytes to Follow:* 1 byte for query, 5 bytes for set

1) Set/query center frequency (00h = query, 01h = set)

For set ONLY:

2) Center Frequency (Highest Byte)

3) Center Frequency

4) Center Frequency

5) Center Frequency (Lowest Byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

1) Center Frequency (Highest Byte)

2) Center Frequency

3) Center Frequency

4) Center Frequency (Lowest Byte)

5) 255 (FFh) Operation Complete Byte

    224 (E0h) Parameter Error

    238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte

    224 (E0h) Parameter Error

    238 (EEh) Time Out Error

---

### **Set/Query NXDN External Reference – Control Byte (AE02h)**

**This command is available only with option 530 and option 532.**

*Description:* Sets or queries the external reference for the Talk-Out Coverage or Tx Signal Analyzer.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

1) Set/query external reference (00h = query, 01h = set)

For set ONLY:

2) External reference (00h = Off, 01h = On)

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

1) External reference (00h = Off, 01h = On)

2) 255 (FFh) Operation Complete Byte

    224 (E0h) Parameter Error

    238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte

    224 (E0h) Parameter Error

    238 (EEh) Time Out Error

### **Set/Query NXDN External Reference Frequency – Control Byte (AE03h)**

**This command is available only with options 530 and option 532.**

*Description:* Sets or queries the external reference frequency in increments of 1 MHz from 2 – 20 MHz. The frequencies are sent in Hz.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

1) Set/query external reference frequency (00h for query, 01h for set)

For set ONLY:

2) External reference frequency (in Hz) (highest byte)

3) External reference frequency (in Hz)

4) External reference frequency (in Hz)

5) External reference frequency (in Hz) (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

1) External reference frequency (in Hz) (highest byte)

2) External reference frequency (in Hz)

3) External reference frequency (in Hz)

4) External reference frequency (in Hz) (lowest byte)

5) 255 (FFh) Operation Complete Byte

    224 (E0h) Parameter Error

    238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte

    224 (E0h) Parameter Error

    238 (EEh) Time Out Error

---

### **Set/Query NXDN Measurement Function – Control Byte (AE04h)**

**This command is available only with option 530 and option 532.**

*Description:* Selects or queries measurement function in Talk-Out Coverage or Tx Signal Analyzer mode. Please note that certain measurement functions are only available in the measurement mode that they belong to. The pattern must be set to “Control Channel” before entering control channel measurement function. Please use control word “AE0Ah” to set the pattern.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

1) Set/query measurement function (00h for query, 01h for set)

For set ONLY

2) Function ID

    Talk-Out Coverage ONLY

0	1
RSSI vs. Time	BER vs. Time

Tx Signal Analyzer ONLY

2	3	4
Constellation	Histogram	Control Channel

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

1) Function ID

    Talk-Out Coverage ONLY

0	1
RSSI vs. Time	BER vs. Time

Tx Signal Analyzer ONLY

2	3	4
Constellation	Histogram	Control Channel

- 2) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Module not attached
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error: Module not attached
  - 238 (EEh) Time Out Error

### **Set/Query NXDN Reference Level – Control Byte (AE05h)**

**This command is available only with option 532.**

*Description:* Set or queries the value of the reference level for the RSSI vs. Time measurement function in Talk-Out Coverage mode.

Note that the valid range is –120 dBm to +20 dBm.  
Send the value as (value in dBm \* 1000) + 270,000.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

- 1) Set/query reference level (00h for query, 01h for set)

For set ONLY:

- 2) Reference Level (highest byte)
- 3) Reference Level
- 4) Reference Level
- 5) Reference Level (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

- 1) Reference Level (highest byte)
- 2) Reference Level
- 3) Reference Level
- 4) Reference Level (lowest byte)
- 5) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error

### **Set/Query NXDN Scale Division – Control Byte (AE06h)**

**This command is available only with option 532.**

*Description:* Sets or queries the number of dB represented by each graph division for the RSSI vs. Time measurement function in Talk-Out Coverage mode.

Note that the valid range is 1 to 15.  
Send the value as (value \* 1000).

*Bytes to Follow:* 1 byte for query, 5 bytes for set  
1) Set/query scale division (00h for query, 01h for set)  
For set ONLY:  
2) Scale Division (highest byte)  
3) Scale Division  
4) Scale Division  
5) Scale Division (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set  
For query:  
1) Scale Division (highest byte)  
2) Scale Division  
3) Scale Division  
4) Scale Division (lowest byte)  
5) 255 (FFh) Operation Complete Byte  
    224 (E0h) Parameter Error: Invalid scale  
    238 (EEh) Time Out Error  
For set:  
1) 255 (FFh) Operation Complete Byte  
    224 (E0h) Parameter Error: Invalid scale  
    238 (EEh) Time Out Error

---

### **Set/Query NXDN Reference Percentage – Control Byte (AE07h)**

**This command is available only with option 532.**

*Description:* Sets or queries the reference percentage for the BER vs. Time measurement function in Talk-Out Coverage mode.

Note that the valid range is 1 to 100.

*Bytes to Follow:* 1 byte for query, 5 bytes for set  
1) Set/query reference percentage (00h for query, 01h for set)  
For set ONLY:  
2) Reference Percentage (highest byte)  
3) Reference Percentage  
4) Reference Percentage  
5) Reference Percentage (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set  
For query:  
1) Reference Percentage (highest byte)  
2) Reference Percentage  
3) Reference Percentage  
4) Reference Percentage (lowest byte)  
5) 255 (FFh) Operation Complete Byte  
    224 (E0h) Parameter Error: Invalid scale  
    238 (EEh) Time Out Error  
For set:  
1) 255 (FFh) Operation Complete Byte  
    224 (E0h) Parameter Error: Invalid scale  
    238 (EEh) Time Out Error

---

### **Set/Query NXDN External Attenuation – Control Byte (AE08h)**

**This command is available only with option 530.**

*Description:* Sets or queries the external attenuation in Tx Signal Analyzer mode.  
Note that the valid range is 0 dB to 51 dB.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

1) Set/query reference percentage (00h for query, 01h for set)

For set ONLY:

2) External Attenuation (highest byte)

3) External Attenuation

4) External Attenuation

5) External Attenuation (lowest byte)

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

1) External Attenuation (highest byte)

2) External Attenuation

3) External Attenuation

4) External Attenuation (lowest byte)

5) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error: Invalid scale

238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error: Invalid scale

238 (EEh) Time Out Error

---

### **Set/Query NXDN Auto Logging – Control Byte (AE09h)**

**This command is available only with option 532.**

*Description:* Sets or queries auto log status in Talk-Out Coverage mode.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

1) Set/query auto logging (00h = query, 01h = set)

For set ONLY:

2) Auto Logging (00h = Off, 01h = On)

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

1) Auto Logging (00h = Off, 01h = On)

2) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error

238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error

238 (EEh) Time Out Error

## **Set/Query Pattern in NXDN Measurement Modes – Control Byte (AE0Ah)**

**This command is available only with option 530 and option 532.**

*Description:* Selects or queries the pattern in Talk-Out Coverage or Tx Signal Analyzer mode.  
Please note that the “None” pattern is only available in Talk-Out coverage mode.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

1) Set/query measurement function (00h for query, 01h for set)

For set ONLY

2) Pattern (highest byte)

3) Pattern

4) Pattern

5) Pattern (lowest byte)

Tx Signal Analyzer

0	1	2	3
Tone	O.153	Voice	Control Channel

Talk-Out Coverage

0	1	2	3	4
Tone	O.153	Voice	Control Channel	None

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

1) Pattern (highest byte)

2) Pattern

3) Pattern

4) Pattern (lowest byte)

Tx Signal Analyzer

0	1	2	3
Tone	O.153	Voice	Control Channel

Talk-Out Coverage

0	1	2	3	4
Tone	O.153	Voice	Control Channel	None

2) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error: Module not attached

238 (EEh) Time Out Error

For set:

1) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error: Module not attached

238 (EEh) Time Out Error

---

## **Set/Query NXDN Serial Output – Control Byte (AE0Bh)**

**This command is available only with option 530.**

*Description:* Sets or queries serial output status for the Control Channel function in Tx Signal Analyzer.

*Bytes to Follow:* 1 byte for query, 2 bytes for set

1) Set/query serial output (00h = query, 01h = set)

For set ONLY:

- 2) Serial Output(00h = Off, 01h = On)

*LMR Master Returns:* 2 bytes for query, 1 byte for set

For query:

- 1) Serial Output (00h = Off, 01h = On)
- 2) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error
- 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error
- 238 (EEh) Time Out Error

---

### **Set/Query Modulation Bandwidth in NXDN Measurement Modes – Control Byte (AE0Ch)**

**This command is available only with option 530 and option 532.**

*Description:* Selects or queries the modulation bandwidth in Talk-Out Coverage or Tx Signal Analyzer modes.

*Bytes to Follow:* 1 byte for query, 5 bytes for set

- 1) Set/query serial output (00h = query, 01h = set)

For set ONLY:

- 2) Modulation Bandwidth (highest byte)
- 3) Modulation Bandwidth
- 4) Modulation Bandwidth
- 5) Modulation Bandwidth (lowest byte)

0	1
6.25 kHz	12.5 kHz

*LMR Master Returns:* 5 bytes for query, 1 byte for set

For query:

- 1) Modulation Bandwidth (highest byte)
- 2) Modulation Bandwidth
- 3) Modulation Bandwidth
- 4) Modulation Bandwidth (lowest byte)

0	1
6.25 kHz	12.5 kHz

- 5) 255 (FFh) Operation Complete Byte
- 224 (E0h) Parameter Error
- 238 (EEh) Time Out Error

For set:

- 1) 255 (FFh) Operation Complete Byte
  - 224 (E0h) Parameter Error
  - 238 (EEh) Time Out Error
-

### **Query Talk-Out Coverage Measurement Data in NXDN Measurement Modes – Control Byte (AE0Dh)**

**This command is available only with option 532.**

*Description:* Queries the most recent measurement data for Talk-Out Coverage. The command returns an ASCII string with the following format:

“<RSSI Value>,<BER Value>,<GPS Latitude>,<GPS Longitude>,<UTC Time>,FFh”

Please note that the length of the string may vary.

*LMR Master Returns:* Variable number of bytes

For query:

1-Length of String) Talk-Out Coverage Measurement Data

Last Byte) 255 (FFh) Operation Complete Byte

224 (E0h) Parameter Error

238 (EEh) Time Out Error

---

### **P25/NXDN Talk-Out Coverage Data Ready Query – Control Byte #56 (38h)**

**This command is available only with option 520, option 522, option 530 and option 532.**

*Description:* Queries whether there is new data in Talk-Out Coverage. Returns one byte when new data is available for query with control word AD0Dh (for P25) or AE0Dh (for NXDN).

*LMR Master Returns:* 1 byte

1) 192(C0h) New data is available.



## Parameter Definitions

Parameter	# of bytes	Step	Example / Description
Frequency	<b>4 bytes unsigned</b>	<b>1 Hz</b>	<b>1000.3 MHz = 1000300000</b>
Scale (RL, CL)	<b>2 bytes unsigned</b>	<b>1 / 1000 dB</b>	<b>51.3 dB = 51300</b>
(SWR)	<b>2 bytes unsigned</b>	<b>1 / 1000 (ratio)</b>	<b>65.53 = 65530</b>
Limit (RL, CL)	<b>2 bytes unsigned</b>	<b>1 / 1000 dB</b>	<b>51.3 dB = 51300</b>
(SWR)	<b>2 bytes unsigned</b>	<b>1 / 1000 (ratio)</b>	<b>65.53 = 65530</b>
Markers (Frequency & distance marker)	<b>2 bytes unsigned</b>	<b>1 sweep point</b>	<b>Marker Values are given in relative position of the graph. The lowest value is 0, while the highest is (# of data points - 1).</b>
Distance	<b>4 bytes unsigned</b>	<b>1/100,000 m/ft</b>	<b>12.34 m = 1234000</b>
Relative Propagation Velocity	<b>4 bytes unsigned</b>	<b>1 / 100,000</b>	<b>0.837 = 83700</b>
Cable Loss	<b>4 bytes unsigned</b>	<b>1 / 100,000 dB</b>	<b>-0.345 dB/m = 34500</b>
Gamma	<b>4 bytes signed</b>	<b>1 / 10,000 (ratio)</b>	<b>Gamma value is the ratio of magnitude of reflected signal over the magnitude of incident signal.</b>
Phase	<b>4 bytes signed</b>	<b>1 / 10 degree</b>	<b>Phase value is the difference in phase between the incident and reflected signal.</b>
Power: dBm/dB	<b>4 bytes signed</b>	<b>1 / 1000 dBm</b> <b>1 / 1000 dB</b>	<b>51.3 dBm = 51300</b> <b>10.4 dB = 10400</b>
Lock Fail Counter	<b>2 bytes unsigned</b>	<b>1 error count</b>	<b>234 fails = 234</b>
Integrator Fail Counter	<b>2 bytes unsigned</b>	<b>1 error count</b>	<b>123 fails = 123</b>

# Signal Standards

## **Spectrum Analyzer Mode**

<b>Index</b>	<b>Standard</b>	<b>Center (Hz)</b>	<b>Span (Hz)</b>	<b>Valid Channels</b>
00h	AMPS / EIA 553 - Uplink	859000000	70000000	1-799, 990-1023
01h	AMPS / EIA 553 - Downlink	859000000	70000000	1-799, 990-1023
02h	C-450 (P) - Uplink	463500000	21000000	1-800
03h	C-450 (P) - Downlink	463500000	21000000	1-800
04h	C-450 (SA) - Uplink	462500000	15000000	1-247
05h	C-450 (SA) - Downlink	462500000	15000000	1-247
06h	CDMA US Cellular - Uplink	859000000	70000000	1-799, 990-1023
07h	CDMA US Cellular - Downlink	859000000	70000000	1-799, 990-1023
08h	CDMA US PCS - Uplink	1920000000	140000000	1-1199
09h	CDMA US PCS - Downlink	1920000000	140000000	1-1199
0Ah	CDMA Korea PCS - Uplink	1810000000	120000000	1-599
0Bh	CDMA Korea PCS - Downlink	1810000000	120000000	1-599
0Ch	CDMA Japan / ARIB - Uplink	878500000	93000000	1-799, 801-1039, 1041-1199
0Dh	CDMA Japan / ARIB - Downlink	878500000	93000000	1-799, 801-1039, 1041-1199
0Eh	CDMA China - 1 - Uplink	916000000	88000000	0-1000, 1329-2047
0Fh	CDMA China - 1 - Downlink	916000000	88000000	0-1000, 1329-2047
10h	CDMA China - 2 - Uplink	910000000	76000000	0-1000
11h	CDMA China - 2 - Downlink	910000000	76000000	0-1000
12h	CDMA2000 Class 0, Korea Cellular - Uplink	859000000	70000000	1-799, 990-1023
13h	CDMA2000 Class 0, Korea Cellular - Downlink	859000000	70000000	1-799, 990-1023
14h	CDMA2000 Class 0, N.A. Cellular - Uplink	859000000	70000000	1-799, 990-1023
15h	CDMA2000 Class 0, N.A. Cellular - Downlink	859000000	70000000	1-799, 990-1023
16h	CDMA2000 Class 1, N.A. PCS - Uplink	1920000000	140000000	0-1199
17h	CDMA2000 Class 1, N.A. PCS - Downlink	1920000000	140000000	0-1199
18h	CDMA2000 Class 2, (TACS Band) - Uplink	916000000	88000000	0-1100, 1329-2047
19h	CDMA2000 Class 2, (TACS Band) - Downlink	916000000	88000000	0-1100, 1329-2047
1Ah	CDMA2000 Class 3, (JTACS Band) - Uplink	878500000	93000000	1-799, 801-1039, 1041-1199
1Bh	CDMA2000 Class 3, (JTACS Band) - Downlink	878500000	93000000	1-799, 801-1039, 1041-1199
1Ch	CDMA2000 Class 4, Korea PCS - Uplink	1810000000	120000000	0-599
1Dh	CDMA2000 Class 4, Korea PCS - Downlink	1810000000	120000000	0-599
1Eh	CDMA2000 Class 5, (NMT-450-20 kHz) - Uplink	472500000	43000000	1039-1473, 1792-2016
1Fh	CDMA2000 Class 5, (NMT-450-20 kHz) - Downlink	472500000	43000000	1039-1473, 1792-2016

20h	CDMA2000 Class 5, (NMT-450-25 kHz) - Uplink	439500000	57000000	1-300, 539-871
21h	CDMA2000 Class 5, (NMT-450-25 kHz) - Downlink	439500000	57000000	1-300, 539-871
22h	CDMA2000 Class 6, IMT-2000 - Uplink	2045000000	250000000	0-1199
23h	CDMA2000 Class 6, IMT-2000 - Downlink	2045000000	250000000	0-1199
24h	CDMA2000 Class 7, N.A. 700 MHz Cellular - Uplink	770000000	48000000	0-359
25h	CDMA2000 Class 7, N.A. 700 MHz Cellular - Downlink	770000000	48000000	0-359
26h	Digital Multimedia Broadcasting (DMB)	2642500000	50000000	0
27h	ETACS - Uplink	916000000	88000000	0-1000, 1329-2047
28h	ETACS - Downlink	916000000	88000000	0-1000, 1329-2047
29h	GSM 900 - Uplink	897400000	40000000	1-124, 975-1023
2Ah	GSM 900 - Downlink	942400000	40000000	1-124, 975-1023
2Bh	GSM 1800 - Uplink	1747400000	80000000	512-885
2Ch	GSM 1800 - Downlink	1842400000	80000000	512-885
2Dh	GSM 1900 - Uplink	1879800000	80000000	512-810
2Eh	GSM 1900 - Downlink	1959800000	80000000	512-810
2Fh	JTACS - Uplink	878500000	93000000	0-1198 (even numbers only)
30h	JTACS - Downlink	878500000	93000000	0-1198 (even numbers only)
31h	MATS-E - Uplink	925000000	70000000	1-1000
32h	MATS-E - Downlink	925000000	70000000	1-1000
33h	N-AMPS / IS-88L - Uplink	859000000	70000000	1-799, 990-1023
34h	N-AMPS / IS-88L - Downlink	859000000	70000000	1-799, 990-1023
35h	N-AMPS / IS-88M - Uplink	859000000	70000000	1-799, 990-1023
36h	N-AMPS / IS-88M - Downlink	859000000	70000000	1-799, 990-1023
37h	N-AMPS / IS-88U - Uplink	897500000	147000000	1-799, 990-1023
38h	N-AMPS / IS-88U - Downlink	897500000	147000000	1-799, 990-1023
39h	NADC IS136 Cellular - Uplink	859000000	70000000	1-799, 990-1023
3Ah	NADC IS136 Cellular - Downlink	859000000	70000000	1-799, 990-1023
3Bh	NADC IS136 PCS - Uplink	1920000000	140000000	1-1199
3Ch	NADC IS136 PCS - Downlink	1920000000	140000000	1-1199
3Dh	NMT-411-25 kHz - Uplink	420500000	19000000	539-871
3Eh	NMT-411-25 kHz - Downlink	420500000	19000000	539-871
3Fh	NMT-450-20 kHz - Uplink	460500000	19000000	1039-1473
40h	NMT-450-20 kHz - Downlink	460500000	19000000	1039-1473
41h	NMT-450-25 kHz - Uplink	459000000	18000000	1-300
42h	NMT-450-25 kHz - Downlink	459000000	18000000	1-300
43h	NMT-470-20 kHz - Uplink	486500000	15000000	1972-2016
44h	NMT-470-20 kHz - Downlink	486500000	15000000	1972-2016
45h	NMT-900 - Uplink	925000000	70000000	1-1000
46h	NMT-900 - Downlink	925000000	70000000	1-1000
47h	NMT-900 (Offset) - Uplink	925000000	70000000	1025-2023
48h	NMT-900 (Offset) - Downlink	925000000	70000000	1025-2023
49h	NTACS - Uplink	878500000	93000000	1-1199
4Ah	NTACS - Downlink	878500000	93000000	1-1199
4Bh	PDC 800 Analog - Uplink	891500000	97000000	0-1680
4Ch	PDC 800 Analog - Downlink	891500000	97000000	0-1680

4Dh	PDC 1500 (JDC) - Uplink	1513000000	72000000	0-960
4Eh	PDC 1500 (JDC) - Downlink	1513000000	72000000	0-960
4Fh	PHS - Uplink	1906500000	23000000	1-77
50h	PHS - Downlink	1906500000	23000000	1-77
51h	SMR 800 - 12.5 kHz - Uplink	836000000	60000000	1-1199
52h	SMR 800 - 12.5 kHz - Downlink	836000000	60000000	1-1199
53h	SMR 800 - 25 kHz - Uplink	836000000	60000000	1-600
54h	SMR 800 - 25 kHz - Downlink	836000000	60000000	1-600
55h	SMR 1500 - Uplink	1483000000	60000000	1-479
56h	SMR 1500 - Downlink	1483000000	60000000	1-479
57h	TACS - Uplink	925000000	70000000	1-1000
58h	TACS - Downlink	925000000	70000000	1-1000
59h	UMTS/WCDMA - Uplink	1920000000	70000000	9600-9900
5Ah	UMTS/WCDMA - Downlink	2110000000	70000000	10550-10850
5Bh	UMTS/Region 2 - Uplink	1850000000	70000000	9250-9550
5Ch	UMTS/Region 2 - Downlink	1930000000	70000000	9650-9950
5Dh	802.11a	5170000000	84000000	34-161 (See Below)
5Eh	802.11b	2442000000	84000000	1-14
5Fh	802.11 DS	2448000000	72000000	1-14
60h	802.11 FH	2448500000	93000000	2-95
61h	802.11g	2442000000	84000000	1-14

### VNA Modes

Index	Standard	Start Frequency (Hz)	Stop Frequency (Hz)
00h	Bluetooth US & Europe Uplink	2400000000	2484000000
01h	Bluetooth US & Europe Downlink	2400000000	2484000000
02h	Bluetooth US & Europe Fullband	2400000000	2484000000
03h	Bluetooth Japan Uplink	2472000000	2497000000
04h	Bluetooth Japan Downlink	2472000000	2497000000
05h	Bluetooth Japan Fullband	2472000000	2497000000
06h	C 450 P Uplink	453000000	464000000
07h	C 450 P Downlink	463000000	474000000
08h	C 450 P Fullband	453000000	474000000
09h	C 450 SA Uplink	465000000	470000000
0Ah	C 450 SA Downlink	455000000	460000000
0Bh	C 450 SA Fullband	455000000	470000000
0Ch	CDMA China 1 2 Uplink	872000000	915000000
0Dh	CDMA China 1 2 Downlink	917000000	960000000
0Eh	CDMA China 1 2 Fullband	872000000	960000000
0Fh	Cellular Uplink	824000000	849000000
10h	Cellular Downlink	869000000	894000000
11h	Cellular Fullband	824000000	894000000
12h	Cellular 700 MHZ Uplink	776000000	794000000
13h	Cellular 700 MHZ Downlink	746000000	764000000
14h	Cellular 700 MHZ Fullband	746000000	794000000
15h	DCS GSM 1800 Uplink	1710000000	1785000000
16h	DCS GSM 1800 Downlink	1805000000	1880000000
17h	DCS GSM 1800 Fullband	1710000000	1880000000
18h	GSM 900 Uplink	880000000	915000000
19h	GSM 900 Downlink	925000000	960000000

1Ah	GSM 900 Fullband	880000000	960000000
1Bh	IEEE 802 11 FH Uplink	2402000000	2495000000
1Ch	IEEE 802 11 FH Downlink	2402000000	2495000000
1Dh	IEEE 802 11 FH Fullband	2402000000	2495000000
1Eh	IEEE 802 11 DS Uplink	2412000000	2484000000
1Fh	IEEE 802 11 DS Downlink	2412000000	2484000000
20h	IEEE 802 11 DS Fullband	2412000000	2484000000
21h	IEEE 802 11 B G Uplink	2400000000	2484000000
22h	IEEE 802 11 B G Downlink	2400000000	2484000000
23h	IEEE 802 11 B G Fullband	2400000000	2484000000
24h	IMT 2000 UMTS WCDMA Uplink	1920000000	1980000000
25h	IMT 2000 UMTS WCDMA Downlink	2110000000	2170000000
26h	IMT 2000 UMTS WCDMA Fullband	1920000000	2170000000
27h	ISM 2 4 GHZ Uplink	2400000000	2484000000
28h	ISM 2 4 GHZ Downlink	2400000000	2484000000
29h	ISM 2 4 GHZ Fullband	2400000000	2484000000
2Ah	JTACS/NTAC Japan ARIB Uplink	887000000	925000000
2Bh	JTACS/NTAC Japan ARIB Downlink	832000000	870000000
2Ch	JTACS/NTAC Japan ARIB Fullband	832000000	925000000
2Dh	NMT 411 Uplink	411000000	420000000
2Eh	NMT 411 Downlink	421000000	430000000
2Fh	NMT 411 Fullband	411000000	430000000
30h	NMT 450 Uplink	450000000	460000000
31h	NMT 450 Downlink	460000000	470000000
32h	NMT 450 Fullband	450000000	470000000
33h	NMT 450 20 kHz CDMA2000 Uplink	451000000	484000000
34h	NMT 450 20 kHz CDMA2000 Downlink	461000000	494000000
35h	NMT 450 20 kHz CDMA2000 Fullband	451000000	494000000
36h	NMT 450 25 kHz CDMA2000 Uplink	411000000	458000000
37h	NMT 450 25 kHz CDMA2000 Downlink	421000000	468000000
38h	NMT 450 25 kHz CDMA2000 Fullband	411000000	468000000
39h	NMT 900 MATS E Uplink	890000000	915000000
3Ah	NMT 900 MATS E Downlink	935000000	960000000
3Bh	NMT 900 MATS E Fullband	890000000	960000000
3Ch	PCS GSM 1900 Uplink	1850000000	1910000000
3Dh	PCS GSM 1900 Downlink	1930000000	1990000000
3Eh	PCS GSM 1900 Fullband	1850000000	1990000000
3Fh	PCS Korea Uplink	1750000000	1780000000
40h	PCS Korea Downlink	1840000000	1870000000
41h	PCS Korea Fullband	1750000000	1870000000
42h	PDC 800 Uplink	898000000	940000000
43h	PDC 800 Downlink	843000000	885000000
44h	PDC 800 Fullband	843000000	940000000
45h	PDC 1500 Uplink	1525000000	1549000000
46h	PDC 1500 Downlink	1477000000	1501000000
47h	PDC 1500 Fullband	1477000000	1549000000
48h	PHS Uplink	1895000000	1918000000
49h	PHS Downlink	1895000000	1918000000
4Ah	PHS Fullband	1895000000	1918000000
4Bh	SMR 800 Uplink	806000000	821000000
4Ch	SMR 800 Downlink	851000000	866000000
4Dh	SMR 800 Fullband	806000000	866000000
4Eh	SMR 1500 Uplink	1453000000	1465000000

4Fh	SMR 1500 Downlink	1501000000	1513000000
50h	SMR 1500 Fullband	1453000000	1513000000
51h	TACS/ETACS Uplink	872000000	915000000
52h	TACS ETACS Downlink	917000000	960000000
53h	TACS ETACS Fullband	872000000	960000000
54h	Tetra Uplink	380000000	430000000
55h	Tetra Downlink	380000000	430000000
56h	Tetra Fullband	380000000	430000000

# Programming Examples

This section contains several sample functions written in C, (and one in Visual Basic) that can be used as references when programming the Anritsu Handheld Products. These include functions to set up the comm Port, enter and exit remote mode and set the reference level of the spectrum analyzer.

## Examples in C:

```

/*****
/*   unsigned char EnterRemote(BYTE *ResponseBytes)           */
/*   Description: This function implements control byte #69, Enter */
/*               Remote Mode.  If successful, the unit will be in */
/*               remote mode, waiting to accept additional serial */
/*               commands.                                         */
/*   Inputs  :   ResponseBytes = pointer to an array of bytes at */
/*               least 13 elements long (13 bytes are expected in */
/*               response to the Enter Remote command).           */
/*   Returns:   SUCCESS if the unit is in remote mode             */
/*               FAILURE if the command fails                     */
/*               Response bytes are returned in the variable     */
/*               ResponseBytes.                                    */
*****/
unsigned char EnterRemote(BYTE *ResponseBytes)
{
    BYTE *SendEnterRemoteCharPointer; // Data to send
    BYTE SerialCommand;

    SendEnterRemoteCharPointer = &SerialCommand;
    SerialCommand = 69; // 69 is the Enter Remote Mode serial command

    // Write 1 byte of data from SendEnterRemoteCharPointer to the //
COM Port
    WriteToPort (SendEnterRemoteCharPointer, 1);

    // Read the data returned by the LMR Master - expecting 13 bytes,
    // give the unit 30 seconds to respond before timing out.
    if(!ReadFromPort(13, ResponseBytes, 30))
    {
        return FAILURE;
    }
    else
    {
        return SUCCESS;
    }
} /* EnterRemote */

```

```

/*****
/*   unsigned char SetSPAScale(unsigned long ReferenceLevel,   */
/*                           unsigned long dBScale, BYTE *ResponseBytes) */
/*   Description: This function implements control byte #101, Set */
/*               Spectrum Analyzer Scale.  It sets the spectrum */
/*               analyzer reference level and scale (dB/div).     */
/*   Inputs  :   RefLevel = reference level value               */
/*               dBScale = scale value                           */
*****/

```

```

/*          NOTE: This function assumes the values have          */
/*          already been checked to fall in the valid range      */
/*          and scaled according to the formulas in the          */
/*          Programming Manual.                                   */
/*          ResponseBytes = pointer to an array of bytes at      */
/*          least 1 element long (1 byte is expected in         */
/*          response to the Set Spectrum Analyzer Scale         */
/*          command).                                           */
/* Returns:  SUCCESS if the values are set                       */
/*          FAILURE if the command fails                         */
/*          Response bytes are returned in the variable         */
/*          ResponseBytes.                                       */
/*****/
unsigned char SetSPAScale(unsigned long RefLevel,
                          unsigned long dBScale, BYTE *ResponseBytes)
{
    BYTE *SendScalePointer;    // Data to send
    BYTE SendBytes[9];
    BYTE SerialCommand;

    // Serial Command to Set Scale on the SPA.
    SerialCommand = 101;

    // Data pointer.
    SendScalePointer = &SendByte[0];

    // First byte to send is the serial command, #101.
    SendBytes[0] = SerialCommand;

    // Convert the reference level and scale into 8 bytes
    // (4 bytes each) for the SPA. Put the bytes in the
    // SendBytes variable, starting with byte 1 (leave byte 0
    // as the command byte).
    Get8Bytes(RefLevel, Scale, &SendBytes[1]);

    // Write 9 bytes of data in SendScalePointer to the port.
    WriteToPort (SendScalePointer, 9);

    // Expecting 1 byte back (give the unit 5 seconds to respond):
    // 0xFF = success
    // 0xE0 = parameter failure (invalid value)
    // 0xEE = time-out (insufficient # of bytes received by SPA)
    if(!ReadFromPort(1, ResponseBytes, 5))
    {
        return FAILURE;
    }
    else
    {
        if ( *ResponseBytes != 0xFF )
        {
            return FAILURE;
        }
        else
        {
            return SUCCESS;
        }
    }
}

```



```

    }
} /* SetSPAScale */

/*****
/*   unsigned char ExitRemote(BYTE *ResponseBytes)           */
/*   Description: This function implements control byte #255, Exit */
/*               Remote Mode.  If successful, the unit will leave */
/*               remote mode and resume sweeping.              */
/*   Inputs  :   ResponseBytes = pointer to an array of bytes at */
/*               least 1 element long (1 byte is expected in    */
/*               response to the Exit Remote command).          */
/*   Returns:   SUCCESS if the unit exits remote mode          */
/*               FAILURE if the command fails                   */
/*               Response bytes are returned in the variable   */
/*               ResponseBytes.                                 */
*****/
unsigned char ExitRemote(BYTE *ResponseBytes)
{
    BYTE *SendExitRemoteCharPointer;    // Data to send
    BYTE SerialCommand;

    SendExitRemoteCharPointer = &SerialCommand;
    SerialCommand = 255; // 255 is the Exit Remote Serial Command

    // Write 1 byte of data from SendExitRemoteCharPointer to the //
COM Port
    WriteToPort (SendExitRemoteCharPointer, 1);

    // Expecting 1 byte back (give the unit 5 seconds to respond):
    // 0xFF = success
    if(!ReadFromPort(1, ResponseBytes, 1))
    {
        return FAILURE;
    }
    else
    {
        if ( *ResponseBytes != 0xFF )
        {
            return FAILURE;
        }
        else
        {
            return SUCCESS;
        }
    }
} /* ExitRemote */

/*****
/*   void Get8Bytes(unsigned long parm1, unsigned long parm2,   */
/*                 BYTE* ByteData )                             */
/*   Description: This function converts the 2 four byte values to */
/*               8 bytes for transmission to the LMR Master.  parm1 occupies */
/*               the first four bytes, parm2 occupies the second 4 bytes.    */
/*   Inputs:      parm1 - 4 byte unsigned long integer          */
*****/

```

```

/*          parm2 - 4 byte unsigned long integer          */
/* Returns:  SUCCESS if the unit is in remote mode      */
/*          FAILURE if the command fails                */
/*          The resulting bytes are returned in the     */
/*          memory location pointed to by ByteData. This */
/*          location must have at least 8 empty bytes.  */
/*****
void Get8Bytes(unsigned long parm1, unsigned long parm2,
               BYTE* ByteData)
{
    // MSB of 1st parameter
    *ByteData = (BYTE)((parm1 & 0xFF000000)>>24);
    *(ByteData+1) = (BYTE)((parm1 & 0x00FF0000)>>16);
    *(ByteData+2) = (BYTE)((parm1 & 0x0000FF00)>>8);
    // LSB of 1st parameter
    *(ByteData+3) = (BYTE)(parm1 & 0x000000FF);

    // MSB of 2nd parameter
    *(ByteData+4) = (BYTE)((parm2 & 0xFF000000)>>24);
    *(ByteData+5) = (BYTE)((parm2 & 0x00FF0000)>>16);
    *(ByteData+6) = (BYTE)((parm2 & 0x0000FF00)>>8);
    // LSB of 2nd parameter
    *(ByteData+7) = (BYTE)(parm2 & 0x000000FF);
} /* Get8Bytes */

/*****
BOOL OpenCommunications(int ComPort, int ComBaud)
/* Description : This function is to Open the communication port
/* and set the port settings
/* Inputs :    int - ComPort entered as a command line argument
/*            int - ComBaud The Baud rate for Communication
/* Returns:    SUCCESS - If the Communication link was established
/*            FAIL - IF there was an error opening the COM Port
/*****
BOOL OpenCommunications(int ComPort, int ComBaud)
{
    DCB      CommSettings; // Structure with COM Port settings
    LPCTSTR ComPortNumber; // Pointer to the COM port number
    BOOL PortReady;       // Return val after setting the COM Port
    COMMTIMEOUTS timeout; // Structure with Time out values

    switch (ComPort)
    {
    case '1':
        ComPortNumber = "COM1";
        break;
    case '2':
        ComPortNumber = "COM2";
        break;
    case '3':
        ComPortNumber = "COM3";
        break;
    case '4':
        ComPortNumber = "COM4";
        break;
    }
}

```

```

default:
    CloseHandle(ComHandle);
    fclose(fp);
    exit(0);
    break;
}

/* Creating a File to Open a COM Port*/
ComHandle = CreateFile( ComPortNumber,
                        GENERIC_READ | GENERIC_WRITE,
                        0, // exclusive access
                        NULL, // no security
                        OPEN_EXISTING,
                        0, // no overlapped I/O
                        NULL); // null template

/* Set up the COM Ports Input and Output Buffer
Syntax -
BOOL SetupComm(
HANDLE hFile,      // handle to communications device
DWORD dwInQueue,  // size of input buffer
DWORD dwOutQueue  // size of output buffer
);
*/
PortReady = SetupComm(ComHandle, 5000, 5000);

/* Open the existing COM Settings
Syntax -
BOOL GetCommState(
HANDLE hFile,      // handle to communications device
LPDCB lpDCB       // pointer to device-control block
                  // structure
);
*/
PortReady = GetCommState(ComHandle, &CommSettings);

/*Check to see if it was successful*/
if(!PortReady)
{
    CloseHandle(ComHandle);
    fclose(fp);
    exit(0);
}

/* This is Used to Update the CommSettings Structure Variables*/
// Setting the Baud Rate
switch (ComBaud)
{
    case '1':
        CommSettings.BaudRate = CBR_9600;    // rate - 9600
        break;
    case '2':
        CommSettings.BaudRate = CBR_19200;   // rate - 19200
        break;
    case '3':
        CommSettings.BaudRate = CBR_38400;   // rate - 38400
        break;
}

```

```

        case '4':
            CommSettings.BaudRate = CBR_56000; // rate - 56000
            break;
        case '5':
            CommSettings.BaudRate = CBR_115200; // rate - 115200
            break;
        default:
            CommSettings.BaudRate = CBR_9600; //Default - 9600
            break;
    }

    // disable null stripping
    CommSettings.fNull = FALSE;
    // RTS flow control
    CommSettings.fRtsControl = RTS_CONTROL_ENABLE;
    // XON/XOFF in flow control
    CommSettings.fInX = FALSE;
    // XON/XOFF out flow control
    CommSettings.fOutX = FALSE;
    // DTR flow control type
    CommSettings.fDtrControl = DTR_CONTROL_ENABLE;
    // number of bits/byte, 4-8
    CommSettings.ByteSize = 8;
    // 0-4=no,odd,even,mark,space
    CommSettings.Parity = NOPARITY;
    // 0,1,2 = 1, 1.5, 2
    CommSettings.StopBits = ONESTOPBIT;

    /* Setting the COM State with the changed parameters
    Syntax -
        BOOL SetCommState(
            HANDLE hFile, // handle to communications device
            LPDCB lpDCB // pointer to device-control block structure
        );
    */

    PortReady = SetCommState (ComHandle, &CommSettings);

    /* Setting the parameters for the timeouts.
    NOTE: Without Timeout Settings, Reading the COM Port will not work
    properly*/

    // This gives the Timeout value for each bytes received
    timeout.ReadIntervalTimeout = MAXDWORD;
    timeout.ReadTotalTimeoutConstant = 0;
    timeout.ReadTotalTimeoutMultiplier = 0;

    /* Sets the communication timeouts
    Syntax -
        BOOL SetCommTimeouts(
            HANDLE hFile, // handle to comm device
            LPCOMMTIMEOUTS lpCommTimeouts /* pointer to comm time-out
    structure */
        );
    */
    SetCommTimeouts(ComHandle, &timeout);

```

```

    if(PortReady)
    {
        return SUCCESS;
    }
    else
    {
        CloseHandle(ComHandle);
        fclose(fp);
        return FAIL;
        exit(0);
    }
}

```

### **Example in Visual Basic**

```

Private Sub cmdSetBaudRateSM_Click()
    Dim ChangeBaudSerialCmd As Integer
    Dim BaudRate As Integer
    Dim strInputBuf As Variant
    Dim PreviousSettings As String

    PreviousSettings = commCtrl.Settings

    'Check that we're in remote and have selected a baud rate
    If CheckInitialConditions(True, False, True) = False Then
        GoTo SetSMBaud_err_handler
    End If

    ChangeBaudSerialCmd = 197      'Setting Baud rate Serial Command
    BaudRate = GetBaudSerialCmd    'Get the Serial cmd for the specific baud
rate
    commCtrl.Output = Chr$(ChangeBaudSerialCmd) + Chr$(BaudRate)    'Sending
the data

    Delay (300)

    'Change the Baud setting for the application also
    If BaudRate = 0 Then
        commCtrl.Settings = "9600,n,8,1"
    ElseIf BaudRate = 1 Then
        commCtrl.Settings = "19200,n,8,1"
    ElseIf BaudRate = 2 Then
        commCtrl.Settings = "38400,n,8,1"
    ElseIf BaudRate = 3 Then
        commCtrl.Settings = "56000,n,8,1"
    ElseIf BaudRate = 4 Then
        commCtrl.Settings = "115200,n,8,1"
    Else
        'Box will fail, set back to 9600.
        commCtrl.Settings = "9600,n,8,1"
    End If

    Delay (1000)
    strInputBuf = CStr(commCtrl.Input)
    strInputBuf = Mid(strInputBuf, 1, 1)

```

```
If strInputBuf = "" Then
    MsgBox "Invalid Baud Rate - NO STRING"
    GoTo SetSMBaud_err_handler
End If

If Asc(strInputBuf) = 255 Then
    MsgBox "Set Baud Rate Succesfully"
ElseIf Asc(strInputBuf) = 238 Then
    MsgBox "LMR Master Timed out"
    GoTo SetSMBaud_err_handler

ElseIf Asc(strInputBuf) = 224 Then
    MsgBox "Invalid Baud Rate - ERR 224"
    GoTo SetSMBaud_err_handler
Else
    MsgBox "Invalid Baud Rate - ERR " + CStr(Asc(strInputBuf))
    GoTo SetSMBaud_err_handler

End If

Exit Sub
SetSMBaud_err_handler:
    commCtrl.Settings = PreviousSettings
End Sub
```

---

# Revision History

Date	Revision Name	Change Description
11/20/2008	10580-00261 A	Initial Release
05/15/2008	10580-00261 B	Included P25 mode information in Select Measurement Mode – Control Byte #3 (03h) Corrected the setups in Write Protect Setup – Control Byte #71 (47h) Included P25 mode information in Recall Sweep Trace – Control Byte #33 (21h) <b>Added Commands</b> Set/Query P25 Center Frequency – Control Byte (AD01h) Set/Query P25 External Reference Frequency – Control Byte (AD03h) Set/Query P25 External Reference – Control Byte (AD02h) Set/Query P25 Measurement Function – Control Byte (AD04h) Set/Query P25 Reference Level – Control Byte (AD05h) Set/Query P25 Scale Division – Control Byte (AD06h) Set/Query P25 Reference Percentage – Control Byte (AD07h) Set/Query P25 External Attenuation – Control Byte (AD08h) Set/Query P25 Auto Logging – Control Byte (AD09h) Set/Query Pattern in P25 Measurement Modes – Control Byte (AD0Ah)
12/4/2009	10580-00261 C	Included NXDN mode information in Select Measurement Mode – Control Byte #3 (03h) Included NXDN mode information in Recall Sweep Trace – Control Byte #33 (21h) <b>Added Commands</b> Query Talk-Out Coverage Measurement Data in P25 Measurement Modes – Control Byte (AD0Dh) Set/Query NXDN Center Frequency – Control Byte (AE01h) Set/Query NXDN External Reference – Control Byte (AE02h) Set/Query NXDN External Reference Frequency – Control Byte (AE03h) Set/Query NXDN Measurement Function – Control Byte (AE04h) Set/Query NXDN Reference Level – Control Byte (AE05h) Set/Query NXDN Scale Division – Control Byte (AE06h) Set/Query NXDN Reference Percentage – Control Byte (AE07h) Set/Query NXDN External Attenuation – Control Byte (Ae08h) Set/Query NXDN Auto Logging – Control Byte (AE09h) Set/Query Pattern in NXDN Measurement Modes – Control Byte (AE0Ah) Set/Query NXDN Serial Output – Control Byte (AE0Bh) Set/Query Modulation Bandwidth in NXDN Measurement Modes – Control Byte (AE0Ch) Query Talk-Out Coverage Measurement Data in NXDN Measurement Modes – Control Byte (AE0Dh) P25/NXDN Talk-Out Coverage Data Ready Query – Control Byte #56 (38h)