Pacific Microwave Research, Inc.

DT-200

Digital Microwave Video & Audio Transmitter

USER'S MANUAL

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IMPORTANT WARNING!
THIS EQUIPMENT WILL POSE A RADIATION HAZARD IF IMPROPERLY HANDLED

Pacific Microwave Research, Inc. (PMR), in compliance with RF exposures limits set forth in OET Bulletin 65, Fourth Edition, August, 1999.[1] The following text is intended to notify the user of PMR's transmitter equipment that a radiation hazard could exist if the DT-200S transmitter is improperly operated. The user should carefully read and understand this section before operating equipment.

PMR's DT-200S microwave transmitter is rated at 0.1W (+20 dBm) nominal RF power output and has been designed as an intentional radiator. The device can deliver video and audio signals over short ranges when used with PMR's DR-200S receiver and appropriate antennas in either fixed or mobile applications. When the DT-200S transmitter is operating into an antenna, the system is emitting radio frequency energy!

An internal RF isolator prevents emission of energy at the antenna terminal when no antenna is connected even when the transmitter is powered up. Because the DT-200S is an isolator protected low power device, there is no hazard potential until a proper antenna is connected to the RF output terminal. Safe operating procedures must be observed when the unit is transmitting into an antenna.

Exposure is based upon the average amount of time spent within an electromagnetic field (RF energy) with a given intensity (field intensity in mW/ cm^2). There are two categories of exposure situations; occupational/controlled and general population/uncontrolled.

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. These limits apply in situations when an individual is transient through a location where occupational/controlled limits apply provided the individual is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

Exposure may be controlled by observing the safe distances found in the Table below and remaining beyond those distances from the antenna at all times when the transmitter is operational. At no time should the user remain within a distance less than the indicated safe distance for a period greater than 30 minutes.

[1] The complete text may be found at:
www.fcc.gov/bureaus/engineering_technology/documents/bulletins/oet65/oet65.pdf

The safe distance is based on the MPE exposure limits identified in Table 1. (FCC Limits for Maximum Permissible Exposure) of OST 65. The maximum power density allowed at 2400 MHz is 5 mW/cm^2 for occupational/controlled exposure, and 1 mW/cm^2 for general population/uncontrolled exposure.

For fixed operations, based upon a maximum transmitter power output of 0.1W with an antenna gain of +2 dBi, the safe distance is greater than 4 cm from the antenna for both controlled and uncontrolled exposure.

Exposure level is relative to antenna gain. Gain antennas (parabolic dish, horn, helical, Yagi, etc.) will increase the safe distance required. Table 1 indicates the safe distance for fixed operations, within the main beam of the antenna, based upon a maximum transmitter power output of 0.1W with an antenna gain of +2 dBi.

Frequency – 2400 MHz	**TX Power – 0.1W (+20 dBm)**	**Antenna Gain - +2 dBi**
Safe Distance from Antenna Under Fixed Conditions		
Controlled Exposure (5 mW/cm^2)	**Uncontrolled Exposure (1 mW/cm^2)**	
1.4 cm	**3.2 cm**	

Table 1. FCC limits for MPE based on OST 65 for PMR DT-200S

If the DT-100S is operated at a fixed location and other transmitters are co-located, the user must consider exposure as a result of the aggregate collection of transmitters at the location. Increases of four times in radiated energy level will double the safe distance.

The user must calculate the safe distance for any given case based on the antenna gain required for the application. Pacific Microwave Research can provide such calculations in consultation with the user if required. Contact PMR at 760.295.5416 for additional information.

1.1 Introduction

The DT-200 Digital COFDM Microwave Video and Audio Transmitter from Pacific Microwave Research is a compact transmitter designed for short-range transmission applications. Common uses include remote broadcasting (ENG, EFP), law enforcement surveillance and video collection. The DT-200 is a compact unit designed for portable and fixed applications and transmits remote video to a central receive location. The DT-200 is designed to transmit one NTSC (or PAL) video signal plus two high quality audio signals and an RS-232 data channel. The DT-200 operates from a nominal +12 Vdc power source and is capable of up to 100mW of output power. The DT-200 uses Coded Orthogonal Frequency Division Multiplex (COFDM) modulation to overcome the effects of multipath.

2.0 Operation

The following section describes the proper operating techniques for the DT-200 transmitter including power, antenna, video, and audio connections. The DT-200 generates heat during normal operation. The user should give careful consideration to mounting the transmitter in such a way as to insure heat is directed away from the housing. An external heatsink may be desirable in some operational modes.

2.1 Primary Connections

A number of connections must be made in order for the DT-200 to operate properly. These include dc power; transmit antenna, and video input.

WARNING

Prior to transmitting, the user should determine the proper frequency or channel of operation. Operating on the wrong frequency could cause interference to other licensed users. Part 90 users may coordinate frequencies through nationally recognized frequency coordination bodies or through local law enforcement user groups. Part 74 users should contact their local frequency coordinator or check www.sbe.org for additional information. Always verify a frequency is not in use before transmitting.

2.1.1 DC Power Input

The DT-200 is designed to operate from a nominal +12 Vdc power source; however, the transmitter will operate with DC input voltages from +10 - +36 Vdc. DC power is supplied through the front panel PT02E-8-4P (mate supplied) connector (J3) with +12 Vdc on Pin A and Ground on Pin C. This source should be fused at 2.0 A. Power consumption is nominally 0.8 A. The DT-200 transmitter is operating whenever power is applied. See Section 9.0 for J3 connector pin assignments.

2.1.2 Antenna

The antenna is connected to front panel female SMA connector (J1). Any resonant antenna is suitable for connection. Antenna type and gain should be determined based upon the intended application. The DT-200 is protected against opens or shorts at the antenna terminal by an internal isolator. Only high quality coaxial cable should be used to interconnect the transmitter and antenna. All SMA connectors should be tightened with the appropriate 5/16" wrench using approximately 5 in./lbs of torque. MAXIMUM TORQUE IS 8 IN./LBS. DO NOT OVERTIGHTEN. Thumb tight connections are not suitable for reliable operation!

2.1.3 Video Input

Video is input to the DT-200 through the front panel BNC connector (J4). This unbalanced input accepts a nominal 1 Vp/p video input. The transmitter may be configured for the NTSC or PAL standard (See RS-232 control protocol). An isolated video loop output is available to feed to other devices (i.e., monitor video) on the MDM-15 connector (J2) with Pin 4 as video out and Pin 12 as video ground.

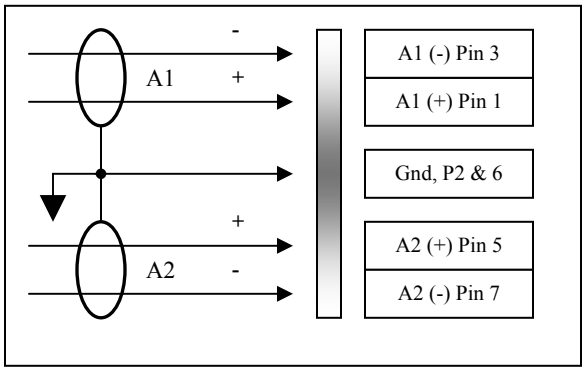
2.1.4 Audio Input

Audio is input to the DT-200 through the front panel MDM-15 connector (J2). The DT-200 is configured for two audio channels. Each audio channel may be used with either balanced or unbalanced sources with a nominal impedance of 600 Ω. When using a balanced source, connect the positive going line to the (+) input and the negative going line to the (-) input. When using an unbalanced source, connect the positive going line to the (-) input and ground the (+) input.

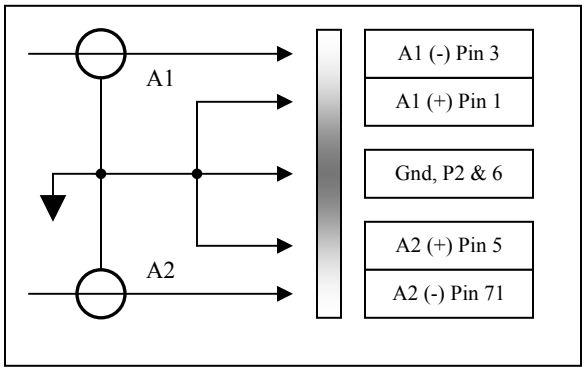
The DT-200 may be configured for line or microphone level inputs (See RS-232 control protocol). Line level audio is typically +9 dBm and microphone level is typically –45 dBm. The input for audio channel 1 is on Pin 1 (+) and Pin 3 (-). The input for audio channel number 2 is on Pin 5 (+) and Pin 7 (-).

Unbalanced audio may be connected to the subcarrier inputs by connecting the high side of the audio source to the (+) terminals and leaving the (-) terminals unconnected. Audio 1 ground is on Pin (2) and Audio 2 ground is on Pin (6). Microphone bias of +2.5 Vdc (nom.) can be found on J3 Pin 8 to supply power to FET microphones. See Section 9.0 for J2 connector pin assignments.

The diagram (Table 1.) below details the proper wiring for both balanced audio and unbalanced audio applications.



Balanced Audio Input Wiring



Unbalanced Audio Input Wiring

Table 1. DT-200 Audio Wiring

2.1.5 Data Channel Input

The DT-200 is capable of transmitting an asynchronous data signal using the RS-232 electrical interface. This is commonly connected to a GPS data stream or other telemetry device. The serial data input connection is found on the front panel MDM-15 connector (J2). Use the supplied MDM-15 mating connector to interface the RS-232 serial data source to the DT-200.

To transmit RS-232 serial data, connect the data source to Pins 9 and 10 on connector J2. Pin 9 is the data signal input to the DT-200 transmitter and Pin 10 is the ground connection. See Section 9.0 for J2 connector pin assignments.

The serial data baud rate must be set using the RS-232 control protocol (Section 13.0). Available baud rates are 1200, 2400, 4800, 9600, 19200, and 38400. The desired baud rate is selected with the RS-232 protocol.

3.0 Power Output

The DT-200 is capable of operating at two power levels to fit a variety of operational scenarios. The nominal power output on high power is 100 mW. The nominal power output on low power is 10 mW. The power level selection is controlled via the RS-232 control protocol (Section 13.0).

4.0 Frequency

Frequency selection of the DT-200 is accomplished by operation of the front panel rotary switch. Up to 10 channels may be programmed into the DT-200 via the RS-232 protocol. Refer to the Data Sheet for the frequencies applicable to this transmitter. Additionally, the frequency of operation of the DT-200 may be set via the RS-232 control protocol (Section 13.0) for remote control applications.

5.0 Modulation Mode

The DT-200 is capable of operation using a variety of COFDM transmission modes. Variables in the modulation mode include constellation format (QPSK or 16QAM), code rate, and guard interval. The modulation modes are selected using the RS-232 control protocol (Section 13.0). The PMR DR-100 or DR-200 receiver will automatically determine the required receive parameters to match the selected transmitted modulation mode. For most applications, QPSK, ½ Code Rate, and ¼ Guard Interval is the best selection (*factory default)*.

6.0 Security Key Code (optional)

The DT-200 may employ the Advanced Encryption Standard (AES) to provide link security. The key code selected using the RS-232 control protocol (Section 13.0) and must match the key code selected on the DR-100 or DR-200 receiver for the link to operate normally. Key code 00 may be selected to transmit a secure signal to any DR-100 or DR-200 receiver regardless of the key code setting of the receiver.

Security key code 00 is used to allow any DT-200 transmitter to communicate with any DR-100 or DR-200 receiver in secure mode. The security key code must be set to key code 00 on the DR-100 or DR-200 under this condition.

7.0 Status LED

The front panel status LED on the DT-200 provides the user with visual feedback on the operating status of the transmitter as noted below. Fault conditions have priority over normal operating conditions.

Normal Operation			
Status	**Color**	**State**	**Priority**
Video Present	Green	Steady	3
No Video	Green	Flashing	
Fault Operation			
Status	**Color**	**State**	**Priority**
Low Voltage	Red	Flashing	2
High Temp	Red	Steady	1

Table 2. DT-200 Status LED Indications

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8.0 Specifications

Electrical:

- Model Number - Frequency Range
  - DT-200P – 340 to 400 MHz
  - DT-200L – 1.7 to 1.9 GHz
  - DT-200S – 1.9 to 2.7 GHz
  - DT-200C1 – 3.1 to 3.5 GHz
  - DT-200C2 – 4.4 to 5.0 GHz
- Modulation – COFDM 2K
- Frequency Stability – ±0.002%
- Spurious/Harmonic Output – > -65 dBc
- Compression – MPEG-2
- Video Input Format – NTSC or PAL
- Video Input Impedance – 75 Ω unbalanced
- Audio –
  - 200 Hz to 15 kHz ±1.5 dB
    - Microphone Level (2x)
- Data – RS-232 interface (standard baud rates to 38.4 kb/s)
- Power Output
  - High Power – 100 mW nominal
- Channels : Up to 10 programmable
- RS232 programming interface

Environmental:

- Operating temperature: -10 to +55 °C
- Relative Humidity: 0 to 95%, non-condensing

Mechanical:

- PTO 4-pin power
- Housing – milled aluminum
- MDM-15 pin audio/data
- Weight – 15 oz.
- Dimensions – 5.3" L x 3.5" W x 1.125" H
- RF Output Connector – SMA female
- Video Input Connector – BNC female
- Channel Select Switch - 10 position

Power:

- Operating voltage: +10 to +36 Vdc
- Current: 0.75 A @ 13.8 Vdc

Options:

Belt Clip
Mounting interface for tactical robots

Accessories:

Antennas: Helmet mounted antenna systems.
Battery: Rechargeable belt mounted battery.
Camera: Helmet mounted color video camera (NTSC or PAL)

9.0 Connector Pin-out

The following table applies to the MDM-15 (J2) located on the front panel of the DT-200 transmitter. The DT-200 is supplied with the mating connector.

PIN #	MDM-15 Function (J2)
1	Audio 1 (+)
2	Audio 1 Ground
3	Audio 1 (-)
4	Monitor Video Output
5	Audio 2 (+)
6	Audio 2 Ground
7	Audio 2 (-)
8	Microphone Bias
9	Data Channel Input (+)
10	Data Channel Input (-)
11	RESERVED
12	Video Ground
13	RS-232 Control Input (+)
14	RS-232 Control Common (-)
15	RS-232 Control Output (+)

Table 3. DT-200 MDM-15 Wiring

The following table applies to the PT02E-8-4P (J3) located on the front panel of the DT-200 transmitter. The DT-200 is supplied with the mating connector.

PIN #	PT02E-8-4P Function (J3)
A	+10 - +36 Vdc Input
B	N/C
C	Ground
D	N/C

Table 4. DT-200 DC Connector Wiring

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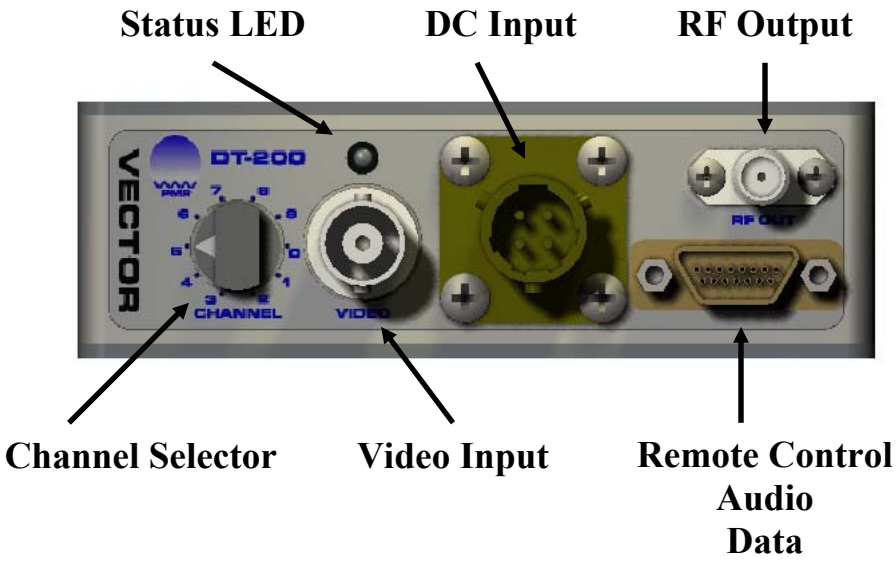
10.0 Front Panel Controls



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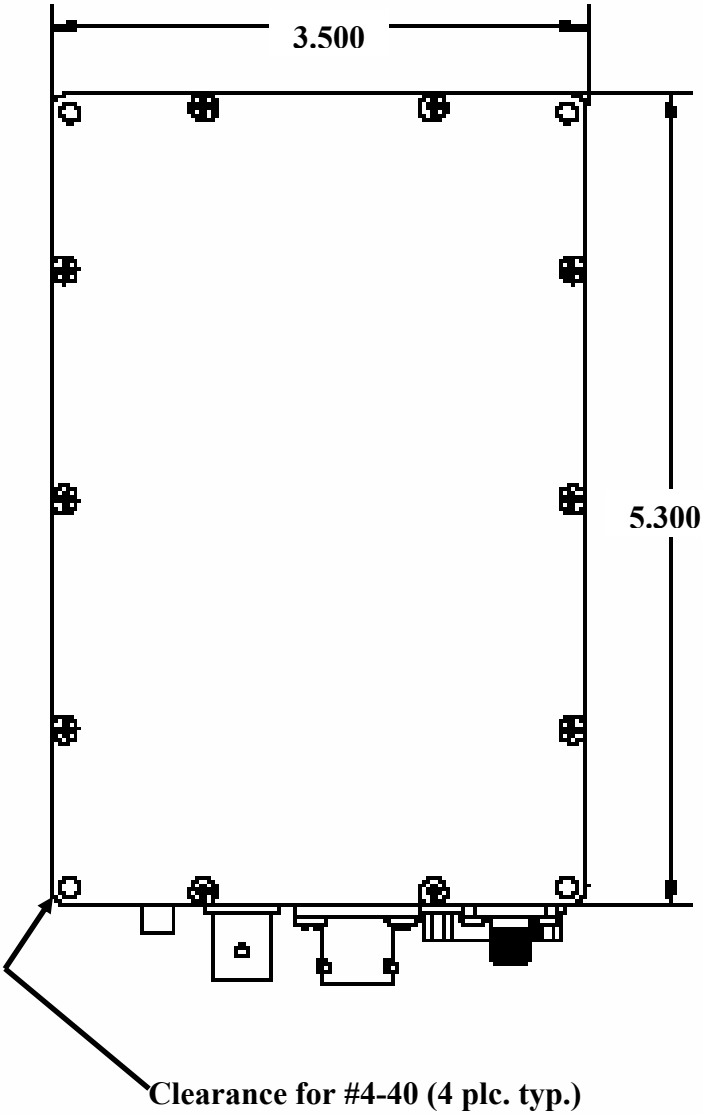
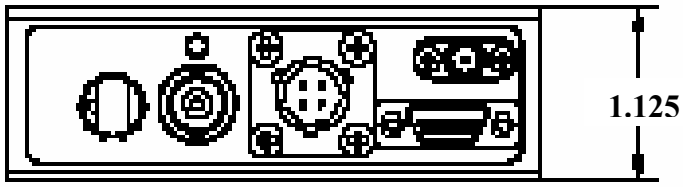
11.0 Mechanical



All Dimensions in Inches



12.0 Repair

There are no user serviceable parts inside the DT-200. Damage to the QC seals on the transmitter voids the warranty. Should your unit require service, contact Pacific Microwave Research, Inc. at 760.295.5416 or www.pmicrowave.com to request an RMA number.

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13.0 RS-232 Control Protocol

1.0.0 General Characteristics

1. Processor type = PIC18F6620
2. Processor Osc. = 16.0 MHz
3. RS232 Communications, Baud Rate 9600, N, 8, 1

2.0.0 RS-232 Control Commands

All commands are case sensitive.
The response to any syntactically VALID command is "$V#".
The response to any syntactically INVALID command is '$I#'.
The response to any syntactically VALID, but incorrect command is "$E#".

Valid ("V") or invalid ("I") responses refer to command syntax and are only an indication the command was entered correctly. They are not an indication of command success. Responses are prefixed with a $ and suffixed with a #.

1. Change Communications Mode

This command defines the operation mode of the DT200. The Mode is defined as "Local" when the unit is controlled via front panel selection. The Mode is defined as "Remote" when the unit is controlled via RS232 serial commands.
When in local mode the response to all commands except $MR# will be 'I'.

Command Syntax: **$M*a*#**
where:
a = L Local mode
a = R Remote mode

Example:

	Command	Response
Select Local operation	$ML#	$V#
Select Remote operation	$MR#	$V#

2. Change RF Channel

This command selects the operating RF channel of the unit. The frequency value for each channel is programmed using the "Channel Frequency Programming Command". There are 10 channels available numbered 01 through 10.
If the selected channel is outside the range of previously programmed channels, no change in channel will occur. The unit response will be "I".

Command Syntax: **$N*nn*#**
where:
nn = channel number 01 through 10

Example:

	Command	Response
Change to channel five	$N05#	$V#
Change to channel 27 (invalid)	$N27#	$I#

3. Change RF Frequency in MHz

This command selects the RF operating frequency of the unit. The frequency is defined as any four digit number.

Command Syntax: **$F*nnnn*#**

where:

nnnn = RF frequency (MHz). Frequency must be within selected band and conform to licensed parameters.

Example:

	Command	Response
Change RF to 2459 MHz	$F2459#	$V#
Change RF to invalid channel	$FJUNK#	$I#

4. Change Audio 1 Level

This command selects the allowable audio input level for Audio 1 channel. The available input levels may be selected as Microphone Input or Line Input. Nominal microphone input level is –45 dBm. Nominal line input level is +9 dBm.

Command Syntax: **$A*a*#**

where:

a = M Selects mic level

a = L Selects line level

Example:

	Command	Response
Change Aud1 to Mic Level	$AM#	$V#
Change Aud1 to Line Level	$AL#	$V#

5. Change Audio 2 Level

This command selects the allowable audio input level for Audio 2 channel. The available input levels may be selected as Microphone Input or Line Input. Nominal microphone input level is –45 dBm. Nominal line input level is +9 dBm.

Command Syntax: **$B*a*#**

where:

a = M Selects mic level

a = L Selects line level

Example:

	Command	Response
Change Aud2 to Mic Level	$BM#	$V#
Change Aud2 to Line Level	$BL#	$V#

6. Change Key Select

This command selects the number of the encryption key that is operational. The encryption key value for each key number is programmed using the "Encryption Key Programming Command". There are 16 available key numbers.

Command Syntax: **$K*nn*#**

where:

nn = Desired key, 00 through 15

Example:

	Command	Response
Change to Key 3	$K03#	$V#

7. Change Input Video Standard

This command selects the input video standard. The two available standards are PAL and NTSC.

Command Syntax: **$V*a*#**

where:

a = P	Selects PAL video standard
a = N	Selects NTSC video standard

Example:

	Command	Response
Change video to PAL	$VP#	$V#
Change video to NTSC	$VN#	$V#

8. Change Modulation Constellation

This command selects the modulation constellation type.

Command Syntax: **$L*n*#**

where:

n = 0	Selects QPSK
n = 1	Selects 16QAM

Example:

	Command	Response
Change Constellation to QPSK	$L0#	$V#
Change Constellation to 16QAM	$L1#	$V#

9. Change COFDM Guard Interval

This command selects the COFDM guard interval.

Command Syntax: **$G*n*#**

where:

n = 0	Selects 1/4 guard interval
n = 1	Selects 1/8 guard interval
n = 2	Selects 1/16 guard interval
n = 3	Selects 1/32 guard interval

Example:

	Command	Response
Change Guard to ¼	$G0#	$V#
Change Guard to 1/8	$G1#	$V#
Change Guard to 1/16	$G2#	$V#
Change Guard to 1/32	$G3#	$V#

10. Change COFDM Forward Error Correction

This command selects the COFDM FEC value.

Command Syntax: **$E*n*#**

The available FEC values are:

n = 1	FEC of 1/2
n = 2	FEC of 2/3
n = 3	FEC of 3/4
n = 4	FEC of 5/6
n = 4	FEC of 7/8

Example:

	Command	Response
Change FEC to ½	$E0#	$V#
Change FEC to 2/3	$E1#	$V#
Change FEC to ¾	$E2#	$V#
Change FEC to 5/6	$E3#	$V#
Change FEC to 7/8	$E4#	$V#

11. Change RF Power Output mode

This command selects the transmitter RF power output mode. The attenuator will be set according to corresponding variable values.

Command Syntax: **$Pn#**

The available output levels are:

n = 0 Selects standby mode
n = 1 Selects low power mode
n = 2 Selects high power mode

Example:

	Command	Response
Change Power to standby	$P0#	$V#
Change Power to low	$P1#	$V#
Change Power to high	$P2#	$V#

12. Change Data Channel RS232 Baud Rate

This command selects the available asynchronous data transmission rate of the data channel.

Command Syntax: $T*n*#

The available rates are:

n = 0 Selects 1200 bps
n = 1 Selects 2400 bps
n = 2 Selects 4800 bps
n = 3 Selects 9600 bps
n = 4 Selects 19200 bps
n = 5 Selects 38400 bps

Example:

	Command	Response
Change Rate to 1200 baud	$T0#	$V#
Change Rate to 2400 baud	$T1#	$V#
Change Rate to 4800 baud	$T2#	$V#
Change Rate to 9600 baud	$T3#	$V#
Change Rate to 19200 baud	$T4#	$V#
Change Rate to 38400 baud	$T5#	$V#

13. Change Frequency Band

This command selects the RF operating band of the unit.

Command Syntax: **$Q*a*#**

The allowable bands are as follows:

a = P Selects P Band (300 MHz to 500 MHz)
a = T Selects T Band (800 MHz to 1000 MHz)

a = L	Selects L Band (1200 MHz to 1900 MHz)
a = S	Selects S Band (2000 MHz to 2700 MHz)
a = 3	Selects 3G Band (3000 MHz to 3900 MHz)
a = C	Selects C Band (4000 MHz to 5000 MHz)

Example:

	Command	Response
Change Band to P Band	$QP#	$V#

3.0.0 RS-232 Verification Commands (Must be in Remote Mode)

1. Read Local/Remote Mode condition

This command returns the current communications mode.

Command Syntax: $M?#

Example:

	Command	Response
Check communications mode (currently in Local mode)	$M?#	$?ML#

2. Read RF Channel

This command returns the current RF output channel.

Command Syntax: $N?#

Example:

	Command	Response
Check RF Channel (currently 01)	$N?#	$?N01#

3. Read RF Frequency

This command returns the current operational RF output frequency.

Command Syntax: $F?#

Example:

	Command	Response
Check RF Frequency	$F?#	$?F1234#

4. Read Audio 1 Level

This command returns the current operational status of Audio 1 Input level.

Command Syntax: $A?#

where the response is:

L	Line level
M	Microphone level

Example:

	Command	Response
Check Audio 1 level	$A?#	$?AL# (line)
	$A?#	$?AM# (mic)

5. Read Audio 2 Level

This command returns the current operational status of Audio 2 Input level.

Command Syntax: **$B?#**

where the response is:

L	Selects Line level
M	Selects Microphone level

Example:

	Command	Response
Check Audio 2 level	$B?#	$?BL# (line)
	$B?#	$?BM# (mic)

6. Read channel information

This command returns the current number and frequency of operational RF channels programmed into the unit.

Command Syntax: **$N*?#**

where the response is of the format:
$?N*aa,xxxx,xxxx,xxxx…xxx#

Example:

	Command	Response
Read Channel Freq's	$N*?#	$?N*02,1700,1720# (Currently two chan.:1700 and 1720)

7. Read Status of Video, Temperature, and Voltage

This command returns the current fault status.

Command Syntax: **$S?#**

Example:

	Command	Response
Read Status	$S?#	$?S,OK-VID,TEMP-075,VDC-1353# (Current Status: 75 ˚C, 13.53 Vdc)

8. Read Input Video Standard

This command returns the current operational video input standard.

Command Syntax: **$V?#**

Valid responses would include:
N = NTSC
P = PAL

Example:

	Command	Response
Read input standard	$V?#	$?VN# (NTSC)
	$V?#	$?VP# (PAL)

9. Read Modulation constellation mode

This command returns the current modulation constellation.

Command Syntax: **$L?#**

Valid responses would include:
0 = QPSK
1 = 16QAM

Example:

	Command	Response
Read modulation mode	$L?#	$?L0# (QPSK)
	$L?#	$?L1# (16QAM)

10. Read COFDM Guard Interval

This command returns the current guard interval.

Command Syntax: **$G?#**

Valid responses would include:
0 = 1/4 guard interval
1 = 1/8 guard interval
2 = 1/16 guard interval
3 = 1/32 guard interval

Example:

	Command	Response
Read Guard Interval	$G?#	$?G0# (1/4)

11. Read COFDM Forward Error Correction

This command returns the current forward error correction setting.

Command Syntax: **$E?#**

Valid responses would include:
1 = FEC of 1/2
2 = FEC of 2/3
3 = FEC of 3/4
4 = FEC of 5/6
4 = FEC of 7/8

Example:

	Command	Response
Read forward error correction	$E?#	$?E1# (1/2)

12. Read Complete Modulation Mode

This command returns the current operational COFDM modulation parameters. Modulation MODE consists of FEC, Guard, Constellation.

Command Syntax: **$D?#**

Example:

	Command	Response
Check Modulation MODE	$D?#	$?D1/2,1/16,QPSK#

13. Read RF Output Power mode

This command returns the current RF power output mode.

Command Syntax: **$P?#**

Valid responses include:
0 = Standby
1 = Low Power
2 = High Power

Example:

	Command	Response
Check RF Output	$P?#	$?P1# (low)

14. Read Data Channel RS232 Baud Rate

This command returns the current asynchronous data transmission rate of the data channel.

Command Syntax: **$T?#**

Valid responses include:
0 = 1200 bps
1 = 2400 bps
2 = 4800 bps
3 = 9600 bps
4 = 19200 bps
5 = 38400 bps

Example:

	Command	Response
Check RS232 Baud rate	$T?#	$?T2# (2400)

15. Read Frequency Band

This command returns the current RF operating band.

Command Syntax: **$Q?#**

Valid responses include:
P = P Band (300 MHz to 500 MHz)
T = T Band (800 MHz to 1000 MHz)
L = L Band (1200 MHz to 1900 MHz)
S = S Band (2000 MHz to 2700 MHz)
3 = 3G Band (3000 MHz to 3900 MHz)
C = C Band (4000 MHz to 5000 MHz)

Example:

	Command	Response
Check RF operating band	$Q?#	$?QC# (C-band)

16. Read Encryption Key Number

This command returns the current operational encryption key number.

Command Syntax: **$K?#**

Valid responses are of the format:
$?K*nns*#
where:
nn = Current encryption key
s = D Default (hardcoded) Encryption key source
s = none User (EEPROM) Encryption key source

Example:

	Command	Response
Check Key Number	$K?#	$?K1#

17. Read Motherboard Firmware Part number and Version

This command returns, as a string, the motherboard firmware part number and version number.

Command Syntax: **$MF?#**

Valid responses include:
0 = Automatic Power Level control OFF
1 = Automatic Power Level control ON

Example:

	Command	Response
Check motherboard firmware p/n and version	$MF?#	$?MF101683,01.01.01# (Currently p/n:101683 and version 01.01.01)

18. Read Serial Number

This command returns the DT-200 Serial number. The serial number is stored as a four digit number.

Command Syntax: **$SN?#**

Valid responses are four digits long

Example:

	Command	Response
Read DT200 serial number	$SN?#	$?SN:1526# (S/N:1526)

4.0.0 RS-232 Programming Commands (Must be in Remote Mode)

1. Program Channel Frequencies

Program RF Channels with new frequency values by using a string command separated by commas.
The number of channels must be defined.
A maximum of 16 channels may be defined with designators 01 through 10.
Channel frequencies are in MHz.
All channel frequencies must be included.

Command Syntax: **$N*nn*,*xxxx*,*xxxx*,*xxxx*…*xxxx*#**

nn = Number of channels, 01 through 10
xxxx = Channel frequencies in MHz

Examples:	Command	Response
Program 1 channel	$N01,4410#	V
Program 6 channels	$N06,4590,4870,4910,4950,5000,5000#	V

2. Write User Encryption Key

This command defines the user portion (suffix) of the encryption key.
There are a maximum of 16 user keys (nn), numbered 00 through 15.
Changes can be made to only one user key at a time.
Each user key (xxx) consists of eight numbers, ranging from 0 – 255.

Command Syntax: $KUnn,xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx#

Example:	Command	Response
To create user key 01 (consisting of numbers 125,200, 84, 15,254, 106, 219, 3)	$KU01,125,200,84,15,254,106,219,3#	V

5.0.0 Complete Command List

1. Program Channel Frequencies

COMMAND TYPE	WRITE/MODE	CHANGE	QUERY
Communications mode		$M*a*#	$M?#
Serial Number			$SN?
#Channel (current)	$N*nn,xxxx,xxxx…xxxx*#	$N*nn*#	*$N?*#
Channels (All)			$N*?#
Status (Video, Temp., Voltage)			$S?#
Frequency		$F*nnnn*#	$F?#
Audio 1		$A*a*#	$A?#
Audio 2		$B*a*#	$B?#
Current Key number		$K*nn*#	$K?#
User Encryption key	$KUnn,xxx,xxx…,xxx#		
Video standard		$V*a*#	$V?#
Read Motherboard Firmware P/N and Version			$MF?#
Modulation mode (Complete)			$D?#
Modulation Constellation		$L*n*#	$L?#
COFDM Guard Interval		$G*n*#	$G?#

COFDM FEC	$E*n*#	$E?#
Output Power Mode	$P*n*#	$P?#
RS232 Baud Rate	$T*n*#	$T?#
Frequency Band	$Q*a*#	$Q?#