Video Microwave Digital
COFDM Transmitter
Model VMD-TX-X

COBHAM

The most important thing we build is trust

VMD

how to contact COBHAM

For operator and troubleshooting information, customers are encouraged to refer to the details in this manual. For additional clarification or instruction, or to order parts, contact COBHAM.

Customer Service is available Monday through Friday between the hours of 9:00 AM and
5:00 PM EST at:

Tel: 603-880-4411

Fax: 603-880-6965

Website: www.cobham.com/dtc

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DTC Communications

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copyright notice

disclaimer

manual conventions

☑ NOTE: Describes special issues you should be aware of while using a particular function.

☀ WARNING: Calls out situations in which equipment could be damaged or a process could be incorrectly implemented, but in which operator safety is not a factor.

✚ TIP: Describes application hints.

RF EXPOSURE STATEMENT

FOR BODY-WORN APPLICATIONS, <u>only</u> the S-Band unit, DTC Part# VMD-TX-S, has been FCC-approved (FCC ID H25VMDTX100S), **AND only** when used in conjunction with DTC's Palladium Digital VidiVest DTC Part# Pd-VidiVest-S(-RC), or Digital Video Jacket DTC Part# Pd-VIDI-DJ-S(-RC).

FOR _ANY_ CONFIGURATION OTHER THAN THAT DESCRIBED ABOVE, a separation distance of at least 20 cm **MUST** be maintained between the antenna and the body of the user or nearby persons.

When the unit is used consistent with the two previous notices, it complies with FCC radiation exposure limits set forth for an uncontrolled environment, per FCC Rules & Regulations, sections 1.1307, 2.1091 & 2.1093, as required by section 90.1217.
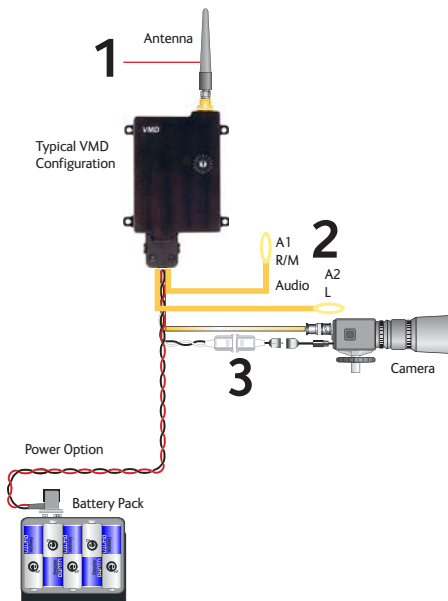
☑ NOTE: Do NOT allow the device to directly contact the skin due to warm operating temperatures.

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1 — Antenna

Typical VMD Configuration

A1
R/M
Audio
A2
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Camera

Power Option

Battery Pack

Typical Wiring Configuration for Analog Video and Audio

Complete these steps:

1 Connect the transmitter antenna to the SMA connector on the top of the transmitter.

2 If you plan to use audio, connect one or two microphones to the Audio 1 (A1) and/or Audio 2 (A2) connectors on the Multi-I/O cable. If using monaural, use Audio 1.

3 Connect power and video input via the Multi I/O cable:

a Attach your camera video input (75 ohm composite video source in PAL or NTSC) to the Multi I/O cable BNC connector.

b Apply the necessary power to your camera (use supplied cable or external source).

WARNING: There is no reverse polarity protection for the camera power connection.

c Attach a 12 VDC power source (such as the supplied battery pack or the AC power adapter) to the Multi I/O cable via the Molex connector. The input voltage range is from 6 to 18 VDC.

d Turn ON your camera.

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4 Set to the required configuration as indicated by the switch position. Refer to the Programming section on page 10 for more information on switch settings. Your Transmitter is now operational. Confirm its signal with your receiver.

Antenna Connector

4

- 10 cell AA Lithium Battery Pack
- 12 VDC 2.5A Power Supply & AC Line Cord
- Power, Video, & Audio Cable
- Camera Power Cable (2.1 mm plug)
- Programming Cable
- SDI User Data Cable
- RCA to BNC Adapter
- Antenna
- Configuration Software
- Transport Case
- Microphone, Body-Worn, (2)
- Heatsink

Multi-I/O Connector

VMD Transmitter,
Front View

The VMD (Video Microwave Digital) Series of compact, low power consumption transmitters provide exceptional video quality in high multipath environments. They are ideal for use inside buildings, in urban areas, and in other applications where multipath would normally cause video tearing or breakup.

All VMD Series transmitters offer three bandwidth modes: DVB-T (6, 7, 8 MHz), Narrow (2.5 MHz), and Ultra Narrow (1.25 MHz) channel spacing. All modes transmit video, two channels of voice, and data. VMD transmitters may be located on adjacent channels without a guard band. AES 128-bit (256-bit optional) encryption ensures users of secure communications.

The VMD 100 is a small transmitter with a choice of high or low RF output power level, selectable in software, and each user-selectable up to 100 mW. This unit is ideal for concealments, and shorter range robotic and UAV applications. The package is only 2.50" x 1.88" x 0.44" (approximate dimensions not including connectors).
Power consumption is less than 4.5 Watts (low power setting) or less than 5.0 Watts (high power setting). Operation time on a fresh set of Lithium batteries is more than eight hours*. All connections are conveniently located off the ends of the unit. The VMD can be conveniently powered by standard AA batteries.

*High power setting, Lithium batteries, camera independently powered.

VMD
Digital Transmitter

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Follow the instructions given in the Quick Start section on pages 4-5. When power is first applied to the VMD, the unit reverts to the indicated channel and RF ON state.

VMD Digital Transmitter
w/Optional Heatsink

The VMD Transmitter can store up to 16 different configurations, which can be selected with the Configuration Switch. Each of these configurations can be programmed into the Transmitter with the supplied DTC Programming Software and a Windows PC. Refer to the Programming section on page 10 for more information.

This rotary switch allows the user to select from 16 pre-configured settings.

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OPERATION

(SMA) This connector attaches to the transmitter antenna and carries the RF output signal.

VMD Close-up Front Views

(small locking) This connector provides connections for:

- DC Power Input
- DC Camera Power
- Programming
- Two Microphone Audio Channels
- 75 Ohm Composite Video Signal (Analog)
- Serial Digital Interface (SDI) Input (optional)
- User Data Input


Index Mark
VMD Chassis Rear View

System PC Controller Application Software

Advanced control of the system is available by using the PC control application software. Typically users may want to customize the default configurations to control settings such as frequency, scrambling keys, modulation parameters, and video resolution.

The transmitter is controlled by the application `DigitalVideoProgrammer.exe` located on the CD delivered with the product.

A PC is required with an available RS232 Serial COM port to control the transmitter.

Installation of the control program is as simple as copying the file from the CD to a suitable location on the PC. No install shield routine is launched. Note that the application generates its own log and initialization files, so it is best to create a dedicated directory for these applications, perhaps with links to the applications from the desktop of the PC.
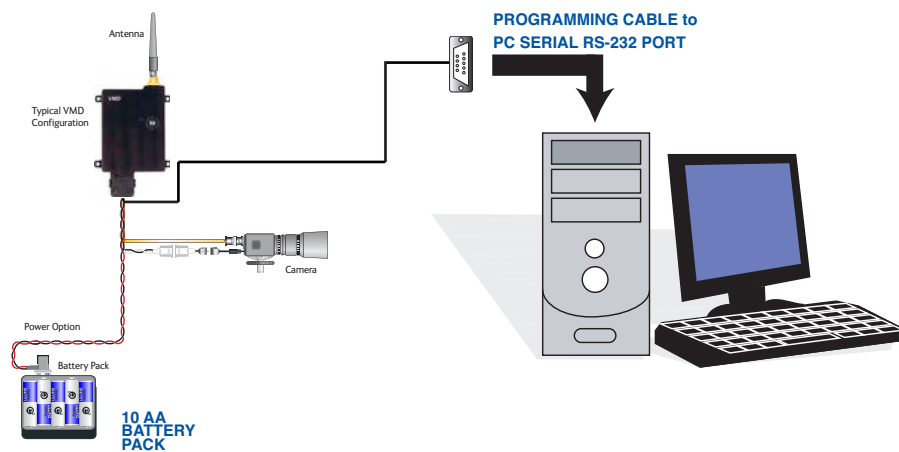
Getting Started

- Use the supplied programming cable to connect the chosen COM port of your PC to the transmitter to be configured.

- Launch the application by double clicking or using the `Run...` command.

NOTE: Please refer to the Digital Video Programmer Application User Guide for information on connecting the VMD to the host computer and the general programming environment.

NOTE: The application software overrides the Configuration Select Switch. If the controlling PC is disconnected, the unit will stay at the configuration last commanded until the switch position is changed, at which time the switch resumes control.

Digital Video Programmer Software

The opening screen of the **Application Software**, assuming a powered VMD unit is attached to the host computer, looks as shown (right, top).

- The **Unit Address** is a communication parameter and is read-only.

- To view and change individual configuration settings (as permitted by the Administrator) select the desired number from the scroll table on the upper left.

- The drop-down item **Globals** sets two parameters that are common to all 16 configurations (see right, bottom).

Heartbeat provides a beating heart icon on the display, useful when viewing a static scene to confirm active input status

Sleep Mode powers the unit down, while maintaining RS232 communications.
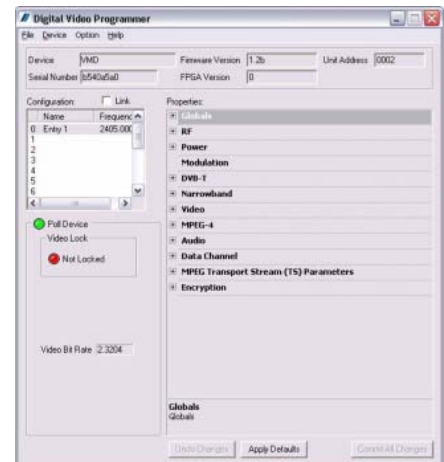
Digital Video Programmer Software
Opening Screen

Globals Drop-down Item

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Transmitter Control Application

RF Output

This control is used to turn the RF output on and off. Turn the transmitter RF power on by selecting **COFDM**.

Output Frequency (MHz)

The Output Frequency setting allows selection of TX output frequency in increments of 0.25 MHz within the allowed tuning range of the unit. If the unit is set to a frequency that is not an integer multiple of 0.25 MHz, the unit will be automatically set to the closest frequency that is an integer multiple of 0.25MHz. An error message will pop-up warning you that the frequency will not be exactly as specified.

RF Bandwidth (MHz)

The actual channel bandwidth that the wireless video link will occupy. The DVB-T compliant mode requires a bandwidth setting of 6, 7 or 8 MHz. The narrowband mode bandwidth is either 1.25 or 2.5 MHz. Narrower bandwidths increase receiver sensitivity and extend the maximum distance of the link, however video quality and latency will suffer. Normal default for good quality video is 2.5MHz. The modulation bandwidth may be set to 1.25, 2.5, 6, 7, or 8 MHz.

RF Output Power

Output power selects one of two output power attenuator settings; low power or high power, typically the low power setting is the larger of the two attenuator settings and is used, for instance, if a power amplifier is added to the transmitter and the output power needs to be lowered substantially to prevent overloading the input of the power amplifier.

Attenuation - High RF pwr (dB)

Output attenuation (dB) is the high power attenuator setting, and is set at the factory for narrowband mask conformance*.

Attenuation Low RF pwr (dB)

Output attenuation low (dB) is the low power attenuator setting, and is set at the factory for DVB-T mask conformance*.

*The value is set at the factory for mask conformance across the full transmitted frequency and ambient temperature ranges (assuming DTC-standard heatsink is attached for ambient temperatures >50 deg.C. This control can be used to make minor adjustments to the output power level, but in normal operation should NOT be changed from factory settings. (0 attenuation = full output power, greater than 0 attenuation = reduced power in 0.25 dB steps.)

RF	
RF Output	Off
Output Frequency (MHz)	2405.0000
RF Bandwidth (MHz)	2.5
Power	
RF Output Power	High
Attenuation – High RF pwr (dB)	0.00
Attenuation – Low RF pwr (dB)	32.00

PROGRAMMING

Properties:	
DVB-T	
Provider Name	**Anything**
Service Name	**Unit 1**
FEC Rate	**1/2**
Guard Interval	**1/32**
Modulation	**QPSK**
Spectrum Inversion	**Normal**
4kHz Offset	**None**

DVBT Provider Name

DVB-T provider name is a place to assign a Provider name for the DVB-T configuration.

DVBT Service Name

DVB-T service name is a place to assign a Service name for the DVB-T configuration.

DVBT FEC Rate

DVB-T FEC rate selects forward error correction rates in the wideband DVB-T modes. Options are 1/2, 2/3, 3/4, 5/6, and 7/8 with 1/2 giving best range and 3/4 possibly giving better video quality under certain conditions. Recommended default is 1/2.

DVBT Guard Interval

DVB-T guard interval selects guard intervals in the wideband DVB-T modes or 1/32, 1/16, 1/8, 1/4. Use the smallest guard interval that will allow reliable low error rate communications, this parameter may need to be adjusted when the link is relocated; the recommended default is 1/16.

DVBT Modulation

DVB-T modulation selects the modulation used in the wideband DVB-T mode. Modulations QPSK, 16QAM, or 64QAM can be selected. QPSK will give best distance and in most cases very good video quality and low latency.

DVBT Spectrum Inversion

DVB-T spectrum inversion allows flipping the modulated spectrum to compensate for spectrum inversion that may take place on the receiver side due to high side LO injection.

DVBT 4 kHz Offset

DVB-T 4 kHz offset is not normally used but might improve BER in cases where the TX upconverter I/Q balance is poor.

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Narrowband FEC

Narrowband FEC sets the forward error correction rate in the narrow bandwidth modes of 1.25 or 2.5 MHz. The two rates available are 1/3 and 2/3; the normal default setting for good quality video is 2/3. Changing the FEC rate to 1/3 will extend the receiver sensitivity by 2 to 3 dB at the expense of degraded video quality and longer latency.

Narrowband Guard Interval

Narrowband guard interval is used in the narrowband modes of 1.25 and 2.5MHz to adjust for varying multi-path delay conditions. The default is 1/16 however 1/8 can be selected if necessary to deal with extreme multi-path delays on long links. Selecting 1/8 guard interval could cause a degradation in video quality and latency.

Narrowband Modulation

Narrowband modulation is used in the narrowband modes to select between QPSK and 16QAM modulation. For best range with good video quality, QPSK is used; 16QAM will give better video quality but will cut down the link range by approximately 50%.

Unit Name

The Unit Name is the index for each configuration. It is only transmitted, however, for Narrowband and Ultra-Narrowband modulations. (In DVB-T, Provider Name or Service Name can be used to uniquely identify the device.)

Narrowband	
FEC Rate	2/3
Guard Interval	1/16
Modulation	QPSK
Unit Name	Entry 1

PROGRAMMING

Video	
Video Input	**PAL**
Horizontal Resolution	**528**
Video Sharpness	**Normal**
MPEG Mode	**MPEG2**
Video Profile	**4:2:0**
MPEG-4	
Encoding Mode	**low delay interlaced**
Frame Rate	**full**

Video Input

Video input selects the video format going into the MPEG video compressor. Options are: OFF (no video input typically used when link is used for data or audio only), PAL, NTSC, NTSC no pedestal, SDI PAL, SDI NTSC.

Horizontal Resolution

Horizontal resolution determines the maximum number of horizontal Pixels that can be sampled by the video encoder. For optimal performance this setting should be set to the first value that exceeds the horizontal resolution of the camera in use. Options are: 352, 480, 528, 720 pixels.

Video Sharpness

Video sharpness is a filter that may be switched in to smooth out blockiness in the video.

MPEG Mode

MPEG mode selects the MPEG compression being used, options are: MPEG2 or MPEG-4 (Part 2 ASP). MPEG-4 mode has to be used when in the 1.25 MHz bandwidth mode since this mode can use a nonstandard frame rate that is not supported by MPEG-2. MPEG-4 is not available in DVB-T mode.

Video Profile

Selects the chroma format; 4:2:0 or 4:2:2. Note that 4:2:2 is not useful in narrowband modulations due to the degree of compression used.

GOP Length

Selects the Group Of Pictures (GOP) size; min. 0, max. 100. Note that system latency increases with GOP length, while reducing the video bit rate. The specified latency of 54 ms for this product applies only for a GOP length of 0. A GOP length of 15 for NTSC video (12 for PAL) will result in a latency of approximately 1/2 a second.

Video Bitrate (status only)

Video bitrate is a status window that will display the video transport data rate. This varies with bandwidth, modulation, FEC rate and guard interval. The rate will increase with bandwidth and higher levels of modulation, it will go down as the FEC rate and guard interval are increased and other services are active such as data and audio. The video bit rate will also decrease as other service options are activated such as audio and data channels. As a rule video quality and latency improve as the bit rate is increased.

MPEG-4 Encoding Mode

MPEG4 encoding mode selects the characteristics of the MPEG4 compression. Options are: low delay interlaced, standard delay interlaced, low delay progressive, and standard delay progressive. Interlaced scanning is what is used in conventional over-the-air video. Progressive scan is available on some cameras and involves scanning an entire frame in one pass rather than two in interlaced scanning.

MPEG-4 Frame Rate

MPEG-4 frame rate selects the frame rate used in the MPEG-4 mode, full frame rate is 30 fps for NTSC and 25 fps for PAL a frame rate of 1/2 or less has to be used in 1.25 MHz bandwidth mode. Options are: Full, 1/2, 1/4, 1/8. or 1/24.

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Audio Encoder

Audio encoder selects quantity of active audio channels (2 maximum), sampling rate (8, 16 or 32 kHz) which determines upper frequency response, and sampling bits (8 or 12) which determines audio signal to noise. (Options are listed on right.)

NOTE: The higher the sampling rate, the more bandwidth required, which can increase video latency.

Audio Source

If the SDI option has been purchased for the unit, the audio can be sourced from either the microphone inputs (Analog) or embedded audio present in an SDI input stream. Note that if an SDI video input has been selected the microphone input can still be used as the audio source if desired. If Embedded Audio is selected, the Audio Encoder must be set to one of the 48kHz MPEG options.

Audio Input Level

Audio input level selects the audio preamp gain level. Options are:
0 dB, 12 dB, 24 dB, 36 dB, 48 dB. Use 24 dB for DTC supplied microphones. Note: 3.5 VDC phantom power is at the microphone input for powering electret condenser microphones.

MPEG Layer Audio (kbps)

The user can select the MPEG audio bit rate.

Higher bit rates result in better audio quality at the receiver. For narrowband modulations, note that selecting higher bit rates will result in restricted data capacity for the video link and will require slow frame rates.

MPEG Audio Offset

MPEG Audio Offset is a tool to manually synchronize audio to the video, should it be necessary. The user enters an integer value that offsets the PTS (Presentation Time Stamp) in the MPEG-2 transport stream.

Audio DID (SDI data ID)

SD-SDI (Standard Definition) can carry up to 16 embedded stereo audio streams, The VMD can extract one of these streams for transmission with video. If SDI embedded audio is selected as the audio source, the hexadecimal DID (Data Identifier) identifies the stream number.

Audio	
Audio Encoder	**Off**
Audio Source	**Analog**
Audio Input Level	**0dB (line level)**
MPEG Layer Audio (kbps)	**256 (I)/128 (II)**
MPEG Audio Offset	**0**
Audio DID (SDI Data ID)	**0**

Audio Encoder Options are:
- Off
- 8 kHz 8 bit mono
- 8 kHz 8 bit stereo
- 16 kHz 8 bit mono
- 16 kHz 8 bit stereo
- 32 kHz 8 bit mono
- 32 kHz 8 bit stereo
- 32 kHz 12 bit mono
- 32 kHz 12 bit stereo
- 32 kHz MPEG L1 stereo
- 32 kHz MPEG L1 mono
- 48 kHz MPEG L1 stereo
- 48 kHz MPEG L1 mono
- 32 kHz MPEG L2 stereo
- 32 kHz MPEG L2 mono
- 48 kHz MPEG L2 stereo
- 48 kHz MPEG L2 mono

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PROGRAMMING

Data Channel	
Serial Data	Off
Serial Data Baud Rate	1200

Serial Data (On/Off)

Allows activation of the RS232 half-duplex serial data channel and selection of parity (none, even, or odd).

Serial Data Baud Rate

Data baud rate selects data channel baud rate, standard rates between 1200 and 115,200 baud are available. Default is 1200. Note that 57600 is not available for DVB-T modes.

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MPEG Transport Stream (TS) Parameters	
TS ID	0
TS Version Number	0
PMT PID	0
TS Program Number	0
PCR PID	8190
Video PID	300
Video Stream ID	0
Audio PID 1	200
Audio Stream ID	0
Data PID	100
Encryption	
Data Scrambling	Off

TS ID

Transport Stream Identifier.

TS Version Number

Transport Stream Version Number.

PMT PID

Program Map Table Packet Identifier.

TS Program Number

Transport Stream Program Number.

PCR PID

Program Clock Reference Packet Identifier.

Video PID

Video Packet Identifier.

Video Stream ID

Video Stream ID.

Audio PID 1

Audio Packet Identifier

Audio Stream ID

Audio Stream ID.

Data PID

Data Packet Identifier.

Encryption

This selects from 4 different encryption options; Off (no encryption); ABS, AES128, or AES 256 (optional).
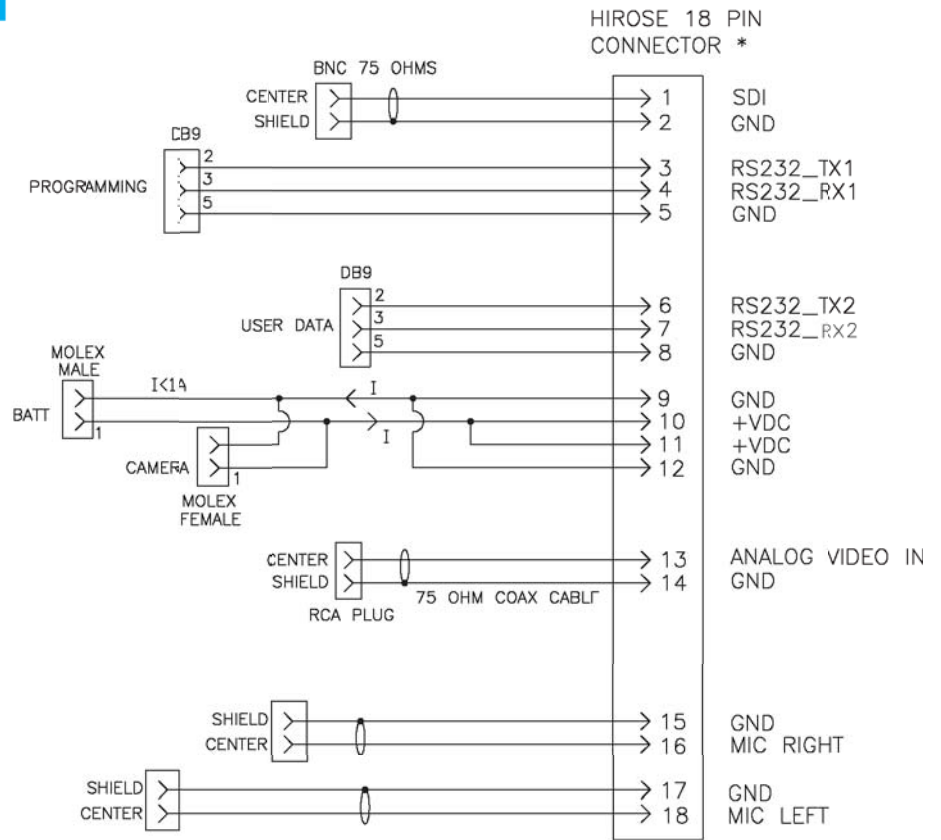
SPECIFICATIONS

Physical
Unit Dimensions (approx.)	2.50" x 1.85" x 0.44" (not including connectors) 64 mm x 48 mm x 11 mm
Chassis Connector - RF	SMA female

Environmental
Operational Temp	-10 degrees C to 65 degrees C
Operational Relative Humidity	up to 95%

Power
Input Voltage	6.0 to 18.0 VDC (reverse-polarity protected)
Power Consumption	~ 5 W for RF Out 100 mW, ~ 4.5 W for RF Out 50 mW, Sleep Mode < 0.5 W

Operating Time
	8 hours+ (10 New Lithium AA Batteries)

Control
PC Control Interface	RS-232
Memory	16 user-programmable configurations

Video Encoding
Compression Standard	MPEG-2 (ISO/IEC 13818-2), MPEG-4 Part 2 (ASP) DVB-T Compliant
Line Standard	NTSC 525 or PAL 625
Profile	SP@ML
GOP Length	1 to 100, selectable
Chroma Formats	4:2:0, 4:2:2 (DVB-T only)
Video Bitrates	1Mbps to 10 Mbps
Video Latency	End to end delay of 54 milliseconds (for GOP length = 0)

Audio Encoding
Input	Stereo or Dual Mono pair
Encoding Modes:	32 kHz/12bit, 16 kHz/8bit, 8kHz/8bit (all Stereo or Mono)/MPEG Layer I, 32 kHz or 48kHz, MPEG Layer II, 32 kHz or 48kHz
Bitrates	64 kbps to 448 kbps depending on configuration
THD	< 0.1% max
Response	20Hz to 15kHz, +/- 0.25dB depending on configuration
Crosstalk	> 55 dB min
S/N	60 dB RMS

Data Encoding
Ancillary data format	FBI standard ancillary data format

Composite Video Input
Standards	NTSC or PAL
Specification Rec.	ITU-R BT.470-4, SMPTE 170M
Horizontal Resolution	720, 528, 480, 352 pixels
Vertical Resolution	480 (525 lines) or 576 (625 lines)
Connector	Multi-I/O
Composite PAL and NTSC decoding	Eight-bit comb filtering composite decoder

SDI Input
Standards	Per SMPTE 259M

Transmitter Identification (user-defined)
	DVB-T	Provider Name, Service Name
	Narrow- & Ultra-Narrow Band Modulations	Unit Name

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Analog Audio

2 x Microphone inputs	compatible with Tibbets 251 microphone. Electret Mic bias provided by phantom power.
Nominal Level	+0 dBu @1kHz
Analog Audio Input Clip Level	+12 dBu
Connector	JT4MB02 (Telocate Systems, BC)

Encryption

Encryption type	Fixed key scrambling system. Algorithms offered: ABS (32bit proprietary), AES128, AES256 (option)

COFDM RF output

RF Output Power	> 20 mW in nominal 50Ω impedance with VSWR < 1.5:1
Harmonics & Spurious	< -25dBm in any 1MHz b/w over 10MHz – 20GHz, outside spectral mask limits
RF Load Mismatch Tolerance	No damage for infinite VSWR, any phase angle for indefinite time Output Frequency Bands (options, one of) 1700 – 1850 MHz, 2200 – 2400 MHz, 4400 – 5000 MHz
Frequency Step Size	250kHz
Frequency Accuracy	±10ppm
COFDM Standard	Proprietary 1.25 or 2.5 MHz channel bandwidth, DVB-T.
Occupied Bandwidth	1.22/2.44/6/7/8 MHz

DVB-T modulation

Available Modulations	QPSK, 16-QAM, 64-QAM
FEC	1/2,2/3,3/4,5/6,7/8
Guard Intervals	1/32, 1/16, 1/8, 1/4
COFDM Carriers	2k
Phase Noise of DVB-T OFDM carriers:	-65dBc/Hz @ 1kHz offset -75dBc/Hz @ 10kHz offset -86dBc/Hz @ 100kHz offset -105dBc/Hz @ 1MHz offset

Spectral Mask of DVB-T OFDM carriers:

	b/w MHz		dBc	
	6	7	8	Rel Lvl dBc
	3.6	4.2	4.8	-28
Freq offset from Cntr (MHz) ±	6.0	7.0	8.0	-35
	8.0	9.3	10.7	-45
	12.0	14.0	16.0	-50

Modulation Error Ratio	≥ 22dB
Spectrum Inversion Capability	Yes

Narrowband modulation

Available Modulations	QPSK, 16-QAM
FEC	1/3,2/3
Guard Intervals	1/16, 1/8
COFDM Carriers	400
Spectral Mask of OFDM Carriers	2.5 MHz (narrowband) 25 dBc @ +/-1.22MHz from cntr. 1.25 MHz (ultra narrowband) 25 dBc @ +/-0.625MHz
Spectrum Inversion capability	Yes
Digital Transport requirement	MPEG Transport Stream (ISO/IEC 13818-1)
Transport Stream Parameters (user defined)	TS: ID, Vers# & Prog#; PIDs PCR, PMT, Video, Audio, Ancillary Data IDs Video Stream, Audio Stream

CONNECTOR PIN-OUT

Hirose connector: Manufacturer's
Part Number ST40X-18S-CV(80).

HIROSE 18 PIN
CONNECTOR *

BNC 75 OHMS

CENTER → 1 SDI
SHIELD → 2 GND

DB9

PROGRAMMING
2
3 → 3 RS232_TX1
5 → 4 RS232_RX1
→ 5 GND

DB9

USER DATA
2
3 → 6 RS232_TX2
5 → 7 RS232_RX2
→ 8 GND

MOLEX
MALE

BATT
I<14
1
→ 9 GND
→ 10 +VDC
→ 11 +VDC
→ 12 GND

CAMERA
1

MOLEX
FEMALE

CENTER → 13 ANALOG VIDEO IN
SHIELD → 14 GND
75 OHM COAX CABLE
RCA PLUG

SHIELD → 15 GND
CENTER → 16 MIC RIGHT

SHIELD → 17 GND
CENTER → 18 MIC LEFT

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TWO YEAR WARRANTY

DTC Communications, Inc. (DTC) warrants its RF transmitting and receiving products to be free from defects in workmanship or material for a period of two (2) years from the date of shipment unless otherwise stated.

The liability of DTC, Inc. under this warranty is limited to replacing, repairing, or issuing credit, at option, for any products, which are returned by the purchaser during such warranty period, provided:

DTC is notified and a Repair Authorization Number is issued by DTC Customer Service within 30 days after discovery of such defects by Customer.

The defective units are returned to DTC with transportation charged Prepaid by the Customer.

Product damaged in shipment must be reported to and claim forms filed with the Carrier by the Customer. In shipments to the factory, notice and claim procedures will be initiated by DTC.

DTC's examination of such products shall disclose to its satisfaction that such defects exist and have not been caused by misuse, misapplication, neglect, improper installation, improper storage, alteration, physical damage or accidents.

The warranty shall not apply to material or accessories ordinarily susceptible to field damage or of a disposable nature. Examples include batteries, antennas, microphones, headsets, cases, accessory bags, etc. The warranty shall not apply to Engineering Prototypes or Customer requested modifications to electronic circuits.

This warranty does not apply to and DTC does not independently warrant items or systems sold by DTC which are produced by other manufacturers. With respect to such items, the Customer shall look to the warranty of the original manufacturer and DTC disclaims all warranty, expressed or implied.

Nothing in this warranty, or any statement, brochure, bulletin, or advertisement is to be interpreted as establishing the suitability of any product for particular application or use. Applications of the product and the determination of suitability for any application, is the sole responsibility of the Customer.

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