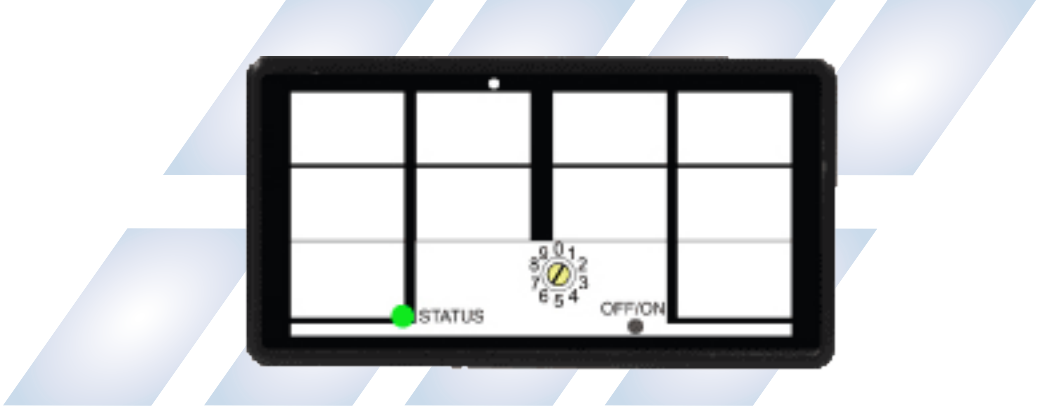
Digital Derringer™

Project 25 Micro Digital & Analog Transmitter/Recorder

T-2500-M



DTC
COMMUNICATIONS

how to contact DTC

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 DTC.

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

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manual conventions

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.

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

TIP: Describes application hints.

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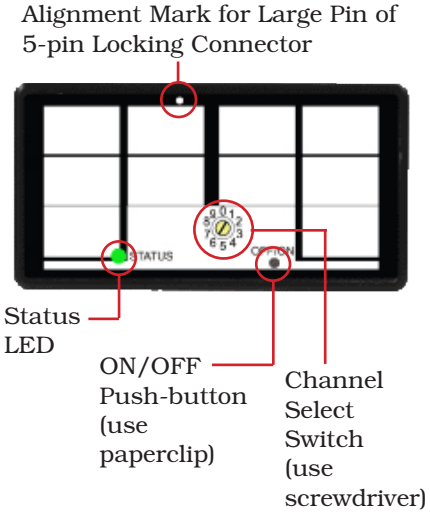
OVERVIEW



Front View

Back View

This manual describes the operation of the Digital Derringer™ T-2500-M. This transmitter operates in the following modes:

- Analog Narrow Clear
- Analog Narrow Scrambled
- Analog Wide Clear
- Analog Wide Scrambled
- Digital Clear
- Digital Encrypted

The T-2500-M is a synthesized VHF, digital and analog audio transmitter with a power output of up to 500 mW. The T-2500-M has built-in recording and memory for up to eight hours of record time.

The T-2500-M has 10 programmable channels. It is designed for personal protection and evidence gathering missions. Its miniature size and rugged design ensures safe concealment and long lasting performance. Battery life is from 2.5 to 10 hours operation depending on the external battery pack used. The transmitter is programmable for digital P25 clear, digital P25 encrypted, analog narrowband, or analog wideband operation. Scrambling is available for analog modes. DES/AES encryption is available for digital modes.

The T-2500-M transmitter has its own internal Tibbets microphone or use the external Tibbets mic.

Concerned with the rapid evolution of digital communication technologies and a need for interoperability, the Association of Public Communications safety Officials (APCO) developed an open architecture, digital standard for public safety and government communications systems. Products compliant with APCO Project 25 standard are interoperable, regardless of the manufacturer. The National Telecommunications and Information Administration (NTIA) has adopted the APCO Project 25 interoperability standard, also known as TIA/EIA-102. The T-2500-M is compliant with this standard.

ANTENNA (Female MMCX Connector)
This RF connector accepts the noodle antenna.

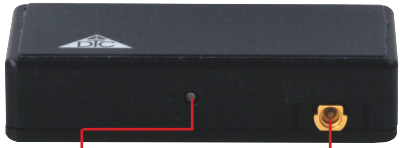
5-PIN LOCKING CONNECTOR
This connector supports the external 36" microphone, DC power input, and external ON/OFF.

USB CONNECTOR
This connector mates with the programming cable during programming.

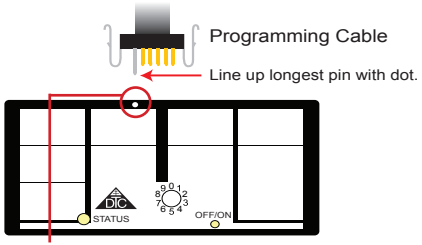
STATUS LED
The unit has a Bi-Color (green/red) LED that is used to give status indication. The LED function is controlled by a global setting to be one of three modes: OFF: Unit gives power ON and OFF status but no other indications, COVERT: Unit indicates state change for approximately 5 seconds every time the state changes, ON: Unit constantly indicates the status using the LED. (See table on page 7.)

ON/OFF SWITCH
The unit will power-ON automatically when the battery is attached; otherwise the ON/OFF push-button switch controls the power to the T-2500-M. The unit *must* be powered-OFF with the push-button (wait for red LED to flash rapidly then turn OFF) if the unit is recording or else the internal memory may become corrupted. Plugging-in the USB cable while recording will cause the recording to stop. Use a paperclip to operate the ON/OFF Switch.

CHANNEL SELECT SWITCH (Rotary)
The channel select switch allows you to change transmit channels and is located on the front of the transmitter. It is a rotary switch which requires the use of the supplied screwdriver to turn the switching mechanism. Select a transmit channel number by turning the rotary switch.



(5-P) Color	Connection
Orange	GND
Red	+6 to 9 V DC
Yellow/Green	Extern. Mic
Brown	Remote OFF



Alignment Mark for Large Pin of 5-pin Locking Connector

Using A Separate Microphone with the Noodle Antenna

NOTE: Do not operate the transmitter without an antenna installed.

NOTE: The channel being used must be programmed to use the internal or 36" external mic by selecting Audio Input in Edit Channel Settings (see page 22).

1. Install the 36" remote microphone into the 5-pin locking connector on the transmitter. Observe the alignment mark for the large pin.
2. Install the noodle antenna into the antenna connector.

NOTE: This is a push-on, push off locking connector. Use extreme caution when connecting or removing the connector. (See illustration, left.)

3. Using a small screwdriver, turn the recessed rotary switch located on the back cover to the desired channel.
4. Attach/install fresh batteries into the battery pack, being careful to observe proper polarity. The unit auto-powers ON.

The Status LED is used to give status indication. The LED function is controlled by a global setting to be one of three modes:

OFF: Unit gives power ON and OFF status but no other indications,

COVERT: Unit indicates state change for approximately 5 seconds every time the state changes,

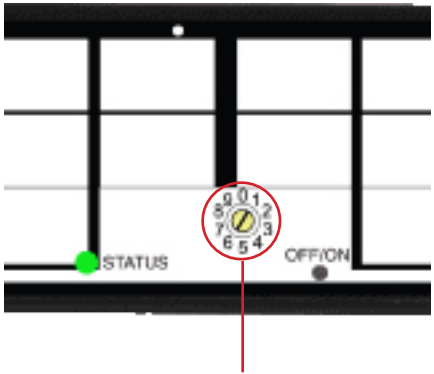
ON: Unit constantly indicates the status using the LED.

LED	Status
Modes	OFF: Configurable LEDs are always OFF Covert: Configurable LEDs show for 5 seconds. Normal: Configurable LEDs are always ON.
Power ON (Always happens)	Bi-color LED green LED lights as soon as possible. Green LED stays lit for a few seconds until another indication happens as shown below. This provides button press feedback.
Power/Channel select button (Always happens)	Once the button press is detected the red LED will come on solid. The LED will then blink until power down is complete. While the red LED is illuminated, the user must *not* disconnect the battery. If the button is released after the LED starts blinking the unit will continue to power down (and blink the LED) until power down is complete.
USB (Always happens)	Bi-color LED, blinking green LED when USB is connected.
TX and record active (Configurable)	Bi-color LED, blinking alternating green and orange (defined as red and green lit).
Record only active (Configurable)	Bi-color LED, both LEDs lit at the same time (orange).
TX only (Configurable)	Bi-color LED, green LED lit.

Accessories

1 T-2500-M Transmitter
1 36” Tibbets External Mic
6 CR2 Batteries
1 CR2 Battery Pack
4 AA Lithium Batteries
1 AA Battery Pack
4 AAA Lithium Batteries (option)
1 AAA Battery Pack (option)
1 Battery Cable
1 Data sheet
1 Noodle Antenna
1 DC Power Cable
1 Operator’s Manual
1 Screwdriver
1 Prog./Watermark Software
1 USB Cable

RECORDING



10 Channel Select Switch

NOTE: Pre-recorded messages are broadcast but not recorded.

NOTE: When internal memory begins to fill and available recording time decreases, you should consider downloading the files and removing them from the T-2500-M.

Recording

You can set the recording feature ON or OFF for each of the ten T-2500-M channels. This is accomplished by clicking the *Recording On* or *Recording Off* button for each channel in the DTC Universal Programming Software (see page 22). To make a recording, the desired channel must have the *Recording On* button checked, For the purposes of this tutorial, the *Recording Messages* radio button should be set to ON via the DTC Universal Programmer.

1. Make sure you have fresh batteries and an antenna attached.
2. Set the channel switch to a channel with *Recording Enabled*.
3. Turn on a radio receiver tuned to the same frequency.
4. Turn ON the T-2500-M. First, a message announcing *xxx Hours Of Recording Time* is heard on the receiver.
5. Speak into the enabled microphone, allowing for the recording to progress for a few moments.
6. Turn the T-2500-M power OFF with the ON/OFF push-button.
7. Connect a USB cable to the unit and to your PC.
8. Turn the T-2500-M power ON with the ON/OFF push-button.
9. Using Windows Explorer, open the T-2500-M drive and double click on the newly created .wav file. This should launch your default application for playing audio files.
10. Ensure your PC speakers are turned ON and the Volume is set to a comfortable listening level. The recording just made should now be playing.

NOTE: If the T2500 suddenly loses power during recording or accessing the internal recording storage (during a mission or during file removal via PC connection), it is possible that the internal memory can become corrupted. Care has been taken to make the file storage on the T2500 as reliable as possible; however as with all PC type storage media if power is lost during critical write processes data can be corrupted. In extreme cases of corruption data may be permanently lost. Thus the unit should always be shut down using the power button (not by removing or disconnecting the batteries and it is important to always use fresh batteries at the start of a mission and whenever using a PC to remove recorded audio files.

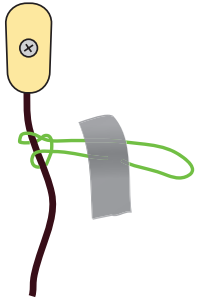
The following messages are transmitted at power-ON or when the channel selector is changed during operation:

Voice Message	Description
More than 4 hours recording time remaining.	More than 4 hours recording time remaining.
More than 3 hours recording time remaining.	More than 3 hours (but less than 4 hours) recording time remaining.
More than 2 hours recording time remaining.	More than 2 hours (but less than 3 hours) recording time remaining.
More than 1 hour recording time remaining.	More than 1 hour (but less than 2 hours) recording time remaining.
More than 30 minutes recording time remaining.	More than 30 minutes (but less than 1 hour) recording time remaining.
Less than 30 minutes recording time remaining.	Less than 30 minutes recording time remaining.

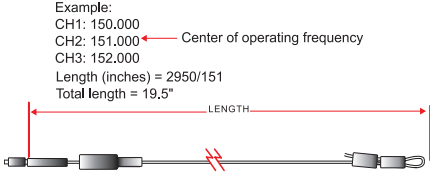
If the memory becomes full during a recording, the message “Memory Full. Recording Stopped,” is transmitted.

NOTE: This device creates audio recordings compatible with Microsoft’s WAV format, including the encryption information contained in the file. However, not all digital audio devices (MP3 players etc.) or audio programs are completely compatible with the Microsoft standard. We recommend using Windows Media Player when working with the digital recordings from this device.

OPERATING TIPS



Microphone mounting technique using rubber band and tape.



Noodle Antenna Adjustment

Audio Circuit and Body Mounting Tips:

All body worn transmitters are susceptible to clothing noise. Reducing this noise is accomplished in a variety of ways. Attach the transmitter to the body with a secure mounting method, such as an ace bandage or a custom harness to reduce rubbing. Then follow these steps:

1. Locate the microphone in the desired location.
2. Always provide a small amount of strain relief on the microphone cable itself. This reduces the noise caused by the microphone cable and element being tugged and prevents cable damage.
3. Secure the microphone cable to the body with medical adhesive tape in at least two spots, the final being about an inch below the element. Remember to leave a strain relief loop!
4. Completely cover the microphone element with an ordinary Band Aid™. This provides a damped baffle for the microphone and a slick surface for clothing to rub on, and actually does not negatively impact the audio pickup level.

The “noodle” antenna may be adjusted over the frequency range of 150 MHz to 174 MHz by adjusting the amount of wire that is folded back along side the end of the antenna. The total length may be calculated by the following formula.

Length (inches) = 2950 / (Freq MHz)

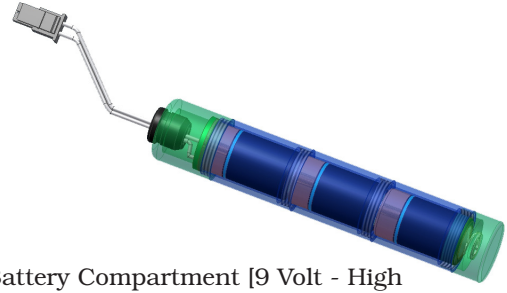
NOTE: When using an external microphone, do NOT connect the Mic GND to the Battery GND or noise may be introduced.

Battery Compartment [6 Volt - Low Power (250 mW) Configuration] (4) AA Batteries) (Use Micro Molex to 9V Snap Cable provided)

Additional Operational Notes:

The T-2500-M operates on two or three CR2 batteries in series (6 or 9 VDC). A fresh set of batteries will operate the unit (transmit mode) for more than 2.5 hours. The four AA battery pack will provide 10 hours of operation time at low power. An optional four AAA battery pack is also available from DTC, which will provide five hours of operation time.

NOTE: Always turn the unit OFF and remove used batteries when not in use. It is imperative to discard partially used batteries, as their remaining life is not predictable. Always start an operation with a fresh set of Lithium batteries.



Battery Compartment [9 Volt - High Power (500 mW) Configuration] (3) CR2 Batteries)

Battery Compartment [6 Volt - Low Power (250 mW) Configuration] (2) CR2 Batteries)

SPECIFICATIONS

Care should be taken when selecting the proper output power for the T-2500-M. Higher power will give the greatest range but will increase the chance of counter detection. DTC recommends using the lowest possible transmit power that can safely do the job.

The output power level is determined by battery selection:
2 CR2 batteries (6 Volts) -- 250 mW,
3 CR2 batteries (9 Volts) -- 500 mW,
4 AA batteries (6 Volts) -- 250 mW,
4 AAA batteries• (6 Volts) -- 250 mW
*optional AAA battery holder

ITEM	SPECIFICATION
Power (RF)	250 mW into 50 Ohm load (6 V) 500 mW into 50 Ohm load (9 V)
Controls and Indicators	10 position rotary channel/select switch Push-button ON/OFF power switch Bi-color Status LED
Connectors	antenna/mic (noodle ant) multi-pin (ext pwr, opt 36" mic) USB (programming, file access/transfer)
Frequency Stability	Within +/- 2.5 ppm over -30° C to +65° C
Channel Capacity	10 User programmable with DTC Universal Software
Frequency Range	150 - 174 MHz (VHF)
Minimum Tuning Step - 250 kHz	Transmitter can be programmed to any channel within specified frequency band.
Deviation	5 kHz (wide) or TIA/EIA-102 compliant 2.5 KHz (narrow) , programmed by channel
Microphone	Tibbets Electret-FET (internal), (external) Tibbets 36" mic
Spurious and Harmonics	50 dBc max
Operating Temp Range	-30° C to + 70° C
Power Sources	2 or 3 CR2 Lithium batteries or 4 AA Lithium batteries. With optional AAA battery holder--4 AAA Lithium batteries.
Battery Life	Two CR2 batteries--2.5 hrs minimum. Three CR2 batteries--2.5 hrs minimum. Four AA Li batteries--10 hrs minimum. Opt. Four AAA Li batteries--5 hrs minimum.
Dimensions	2.10"W x 1.1"H x 0.48"D
Weight	Approx 2 oz. w/o Batteries
NTIA Compliant	TIA/EIA-102 - Analog and Digital mode
NOTE	All specifications at 25° C RF measurements taken into 50 Ohms unless otherwise stated.

Introduction

DTC has built a great deal of flexibility into the programming options you have on the T-2500-M. DTC factory programs your frequencies at time of order at no additional charge to you.

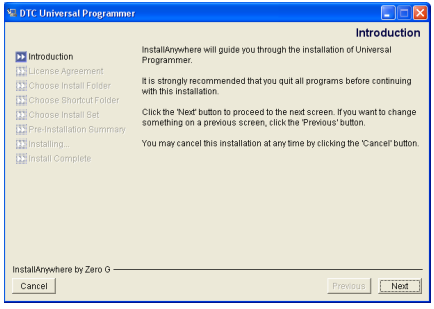
Software and programming cable are included with the kit, enabling you to change your frequencies and other associated features. This is ideal if you work with other agencies, or anticipate the equipment being used by a multi-jurisdictional task force. You can program up to ten channel settings per unit. In general, this allows you to program most variations you might encounter in the field at the depot level.

The configuration of each channel is managed with DTC's Universal Programming Software. This software is included with your transmitter and allows you to do all of the following:

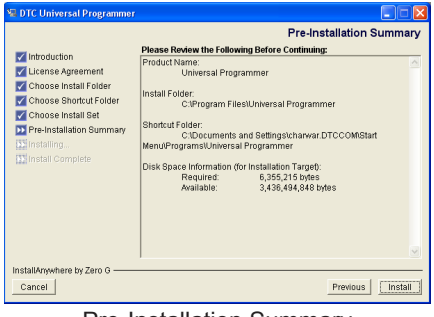
- Assign frequencies to each channel
- Enable/disable recording for each channel
- Select the mode of operation for each channel (digital clear, digital encrypted, analog narrow, or analog wideband, analog scrambled)
- Set internal clock
- Select the DES-OFB and AES encryption keys and 16-bit key ID

Universal Programming Software CD

TIP: Make sure that you program your devices to match frequencies and test the components as a system prior to going into the field!



DTC Software Installation Wizard



Pre-Installation Summary

Installing DTC Universal Programming Software on your PC

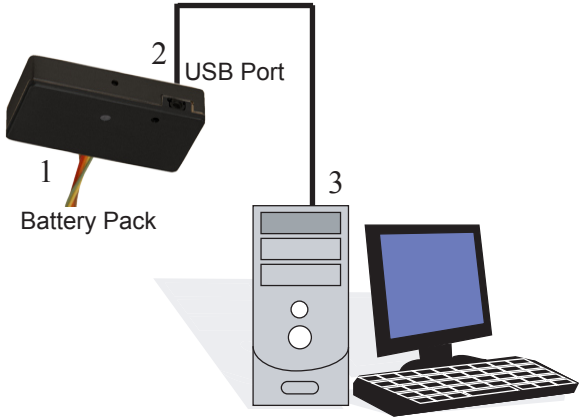
NOTE: Uninstall any previous versions by going to **Add/Remove Programs**, clicking on **Universal Programmer**, and clicking on **uninstall**.

Place the DTC Universal Programming Software CD into your CD drive and complete the following steps:

1. Click on Start, click on Run...
2. Click on the Browse button.
3. In the Browse window, select your CD drive.
4. Double-click `install.exe`.
5. Click OK in the Run... dialog box.
   The DTC Installation Wizard displays (see top right).
6. Read and follow the installation wizard instructions and click Next.
7. Read and accept the license agreement and click Next.
8. Accept the default location or choose a new location and click Next.
9. Accept default icon preferences or customize as desired and click Next.
10. Accept the Typical (DTC branded) installation with Wave Checker, or choose Secure to hide references to DTC (for covert operations). Click Next.
11. Review the Pre-Installation Summary (left) and click Install.
    The progress bar displays during installation.
12. The Install Complete message displays. Click Done.

Your programming software is installed. You do not need to restart your computer.

1. Ensure that your transmitting antenna is connected to the TX.
2. Use fresh batteries or connect a suitable DC power source.
3. Install one end of the USB programming cable to the USB connector on the TX.
4. Connect the other end of the USB programming cable to an available USB port on your computer.
5. Launch the Universal Programmer application. The **Connect Device** Dialog box displays. It will automatically close when the new device is recognized.
6. Windows should automatically detect the new device with removable drive after several seconds. Windows Explorer should display the new removable drive icon.

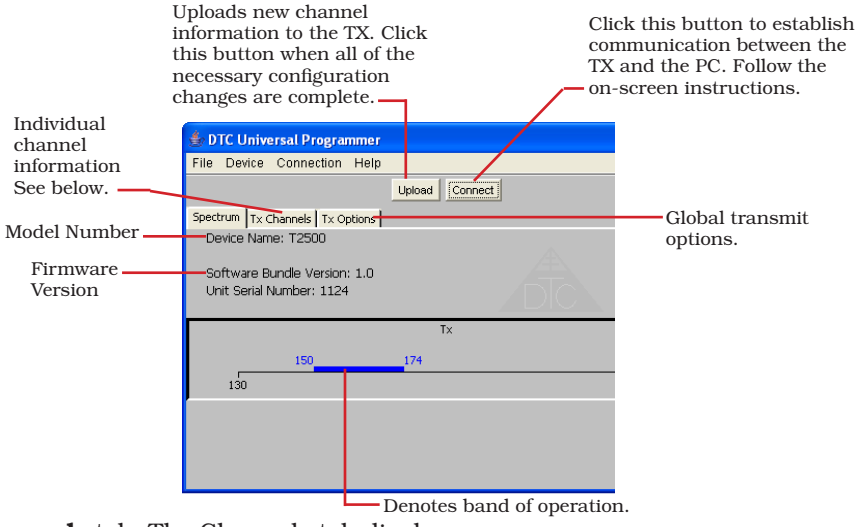


OPEN and SAVE

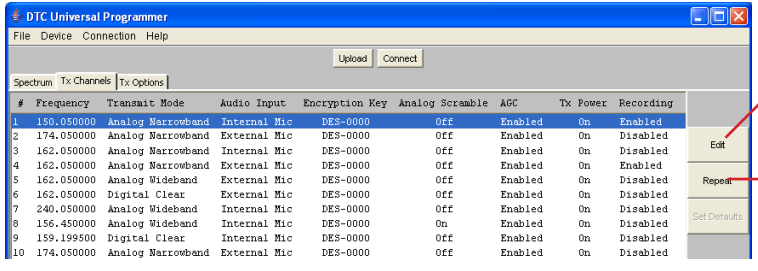
By selecting FILE > SAVE, it is possible to save a particular suite of channel settings to a file for future recall. Similarly, FILE > OPEN can be used to recall a suite of saved channel settings that can then be programmed into the TX.

User Comments are NOT saved when the channel setting information is saved to a file. User Comments are NOT overwritten if the TX is programmed from a file that was recalled.

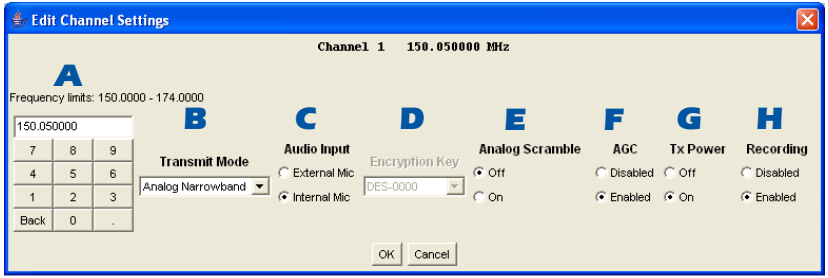
A **downloading** message displays momentarily then the **Universal Programmer Main Screen** displays (below).



6. Select the **TX Channels** tab. The Channels tab displays.



7. In the **TX Channels** tab, select the channel that you want to modify. In the example (page 16), Channel 1 is selected. Press the **Edit Chan** button. The **Edit Channel Settings** dialog box displays.



8. Enter the following configuration parameters for your device:

A Enter frequency in MHz. See note (right).

B Transmit mode. Select Analog Wide, Analog Narrow, Digital Clear, or Digital Encrypted.

C Selects microphone operation.

Internal Mic: the internal microphone is used.

External Mic: the 36" external mic must be connected.

D Sets the encryption key to be associated with this channel (from the key-IDs drop-down menu).

E Enables or Disables the scramble function for each individual channel (analog only).

F Automatic Gain Control mode. Available in analog transmission modes only.

G Selects RF power operation to OFF or ON. Note that input voltage sets output power level.

H Enables or Disables the record function for each individual channel. Recording will occur at all times when this channel is selected.

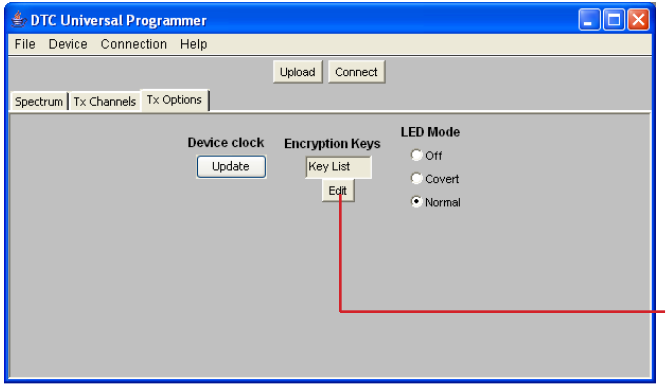
When the settings are complete, click on **OK**.

NOTE: An error condition may occur, causing the LED to alternately blink green, then red, then green, ... etc. There are 2 possible causes for this:

1. A hardware failure, which is preventing the transmitter from locking on the frequency programmed for the selected channel.

2. The user has programmed the selected channel for a frequency which is outside the operational bounds of the unit. (For instance, the selected channel is set for 200 Mhz and the transmitter is designed to go no higher than 174 Mhz.

9 Select the TX Options tab. The TX Options tab displays.

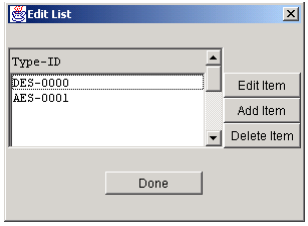


See dialog boxes on page 23.

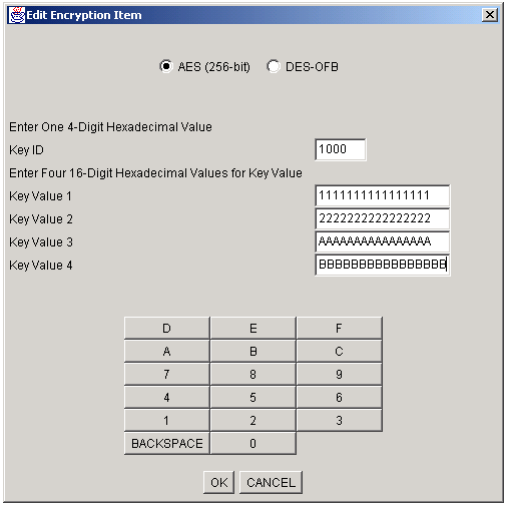
11. From the TX Options tab, select the following configuration parameters:

- **LED Mode** Select Normal to enable full LED operation. Select OFF to disable LED operation. Select Covert to enable LED operation for only a few seconds when performing settings changes.
- **Device Clock** Pressing Update sets the TX internal clock to the PC clock time.
- **Encryption Keys** Click Edit to display the Edit List dialog box.

NOTE: When settings are complete, click **Upload** to make changes to TX.



Edit List Dialog Box



Edit Encryption Item Dialog Box
Edit AES Item

From the **TX Options**, **encryption_Keys** parameter, click **Edit**.

The Edit List dialog box displays.

Select the **Type-ID** in the **Edit List** dialog box. Click the **Add Item** button.

The **Edit Encryption Item** dialog box (bottom) displays.

In *this* example, we have *added* the item **AES-0000**.

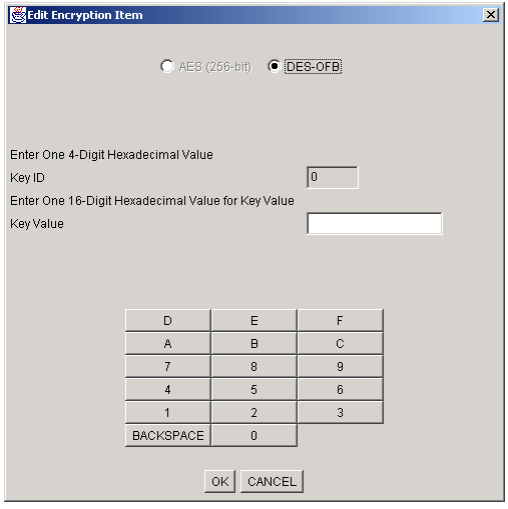
In the *next* example, we have *edited* the item **DES-0000**.)

NOTE: Enter any changes to this dialog box carefully. Double-check and write down the information before clicking the **OK** button.

NOTE: When entering DES-OFB Keys, each pair of hex digits in the string must have odd parity.

For **DES-OFB** encryption, the **Edit Encryption** dialog box displays as shown here (left).

NOTE: Enter any changes to this dialog box carefully. Double-check and write down the information before clicking the **OK** button.



Edit Encryption Item Dialog Box
Add DES Item

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

Table 1

Use Table 1. (left) to convert to hexadecimal numbers.

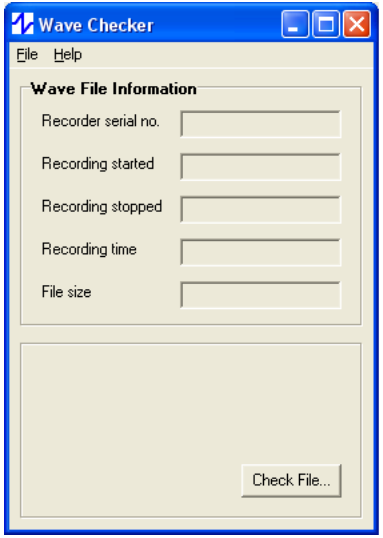


Fig. 1. The Wave Checker dialog box.

Digital Watermark

The digital watermark is a specially encoded header, which is added to the (`.wav`) file. The audio data itself is not changed, and it in no way affects the audio playback.

Wave Checker is a handy utility that can be used to authenticate the audio wave (`.wav`) files created with the TX by examining the watermark. The application installation is described on page 14.

To use the Wave Checker utility, complete the following steps:

1. Double-click the `Wave Checker.exe` file. The **Wave Checker** dialog box (Fig. 1.) displays.
2. Click the **Check File** button. A Windows **Open** dialog box (Fig.2.) displays.

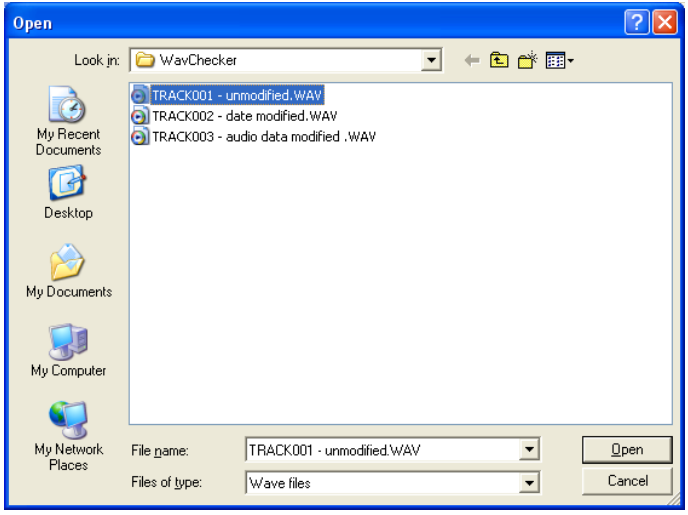


Fig. 2. The Windows Open dialog box.

3. Navigate to the (`.wav`) file that you want to authenticate and select the file. Click the **Open** button (Fig. 2.). One of three results will display: Unmodified (Fig. 3.), Unmodified but date/time not correct (Fig. 4.), or Audio data modified (Fig. 5.).

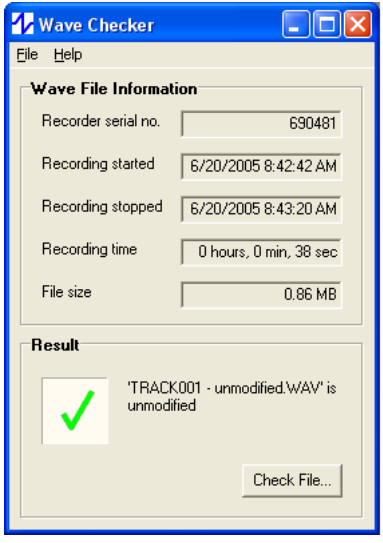


Fig. 3. Result: Unmodified wave file.

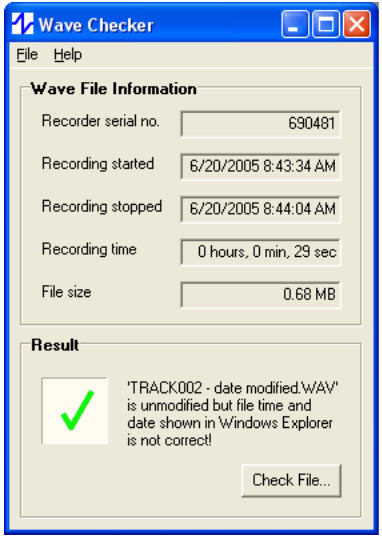


Fig. 4. Result: Unmodified wave file but time/date not correct.

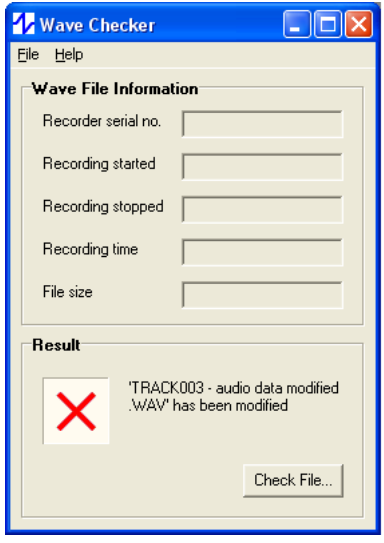


Fig. 5. Result: Wave file audio has been modified.

The result shown in Figure 3 indicates that the file is trustworthy.

In the example in Figure 4, the audio was not modified, but the time and/or date information contained inside the `.wav` file does not agree with the file's date/time stamp, indicating that it may have been tampered with.

In the Figure 5 example, the wave file audio has itself been modified and cannot be trusted.

NOTES

NOTES

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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