Standard Operating Procedure:

Use of APRS and GPS Features with Kenwood HAM Radios

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INTRODUCTION:
Common Terms:
• APRS = Automatic Packet/Position Reporting System
• BCON = Beacon packets to be sent at specified intervals
• GPS = Global Positioning System
• NMEA = National Marine Electronics Association
• SSTV = Slow-Scan Television
• TNC = Terminal Node Controller
• TNC PKT = Terminal Node Controller is in Packet mode.

CHAPTER 1: Setting up the KENWOOD TM–D700 “HAM” Radio

The TM-D700 is a mobile FM transceiver with incorporated TNC functions to facilitate and enhance data communication. It has the ability to communicate directly with a computer. The dual bands allow for data to be received in one band while voice can be received in the other, or any combination. Enhanced memory capabilities allow settings, frequencies, functions, and other options to be saved. The “easy-to-read large LCD” offers a user friendly interface while being able to be placed in a convenient location. Figure 1 shows the KENWOOD TM-D700.

Figure 1: (a) KENWOOD TM-D700. (b) TM-D7000 back view.
The TM-D700 is set up with a 12 volt power supply. It can be connected with a cigarette lighter adapter or with a fused direct connection. Figures 2 (a) and (b) show the power supply. The TM-D700 can operate with a range of voltages. Please refer to the instructions manual for usage of other power ratings.

![Image](a) ![Image](b)

**Figure 2:** (a) 12-volt variable power supply. (b) Choice of power outputs; cigarette lighter adapter (top) and direct connection (bottom).

To configure the TM-D700, follow the steps provided in Figure 3. This will allow for the radio to send/receive information packets to/from other HAM radios within range. The APRS method of transmitting data involves each radio sending a package of data

![Image](a) ![Image](b)

**Figure 3:** Taken from page 11; KENWOOD Specialized Communications Instruction Manual, TM-D700.
(coordinates, comments, etc.) in a selected frequency. For stationary radios no GPS is needed since the coordinates are pre-selected. For a mobile radio a GPS unit is very useful. It will transmit new coordinates at a pre-selected rate.

Comments on Operation Flow:

Step 1: The data bands can be programmed to receive/send voice and data transmissions. Simultaneous voice and data transmissions can be sent or received. (Press “MNU”. Turn far left knob from 1-3. Press ok. Turn far left knob again from 1-I. Press ok. Turn far left knob to change A. Press okay. Press Esc.)

Step 2: Hold down [F] for 1 second (until tnc appears)

Step 3: Press in far left knob for faster selection of frequency. (Used 144.410 MHz)

Step 4: Press arrows buttons to go between Call sign digits.

Step 5: NMEA and NMEA96 depend on the output rate of the GPS unit. NMEA outputs at 1200 bps and NMEA96 at 9600 bps. (Used NMEA) See instructions for wiring.

Step 6: Icons are sent with the data APRS transmissions. They help identify the type (or location) of the HAM radio.

Step 7: Coordinates (N: 39° 32. 35’)

(W: 119°48.83’)

Step 8: (in service used)

Step 9: Skipped

Step 10: (Auto used)

Step 11: (Hold [F] for 1 second)

CHAPTER II: Setting up the KENWOOD TH-D7 “HAM” Radio

The TH-D7 (see right) is a handheld radio with similar features to the higher-powered TM-D700. It is powered by a rechargeable battery pack or via an external transformer.

Figure 4 shows the main features of the TH-D7 handheld radio. The TH-D7 has FM dual bands, built-in TNC, supports APRS, total of 200 memory channels, easy to read LCD, large cursor which provides 4 functions, and enhanced qualities (plug-n-play) with the VC-H1 Slow-Scan Television (SSTV).

Configuration of the APRS features of the TH-D7 is done by following the basic procedure in Figure 5. Some useful indicators, abbreviations, and logos are shown in Figures 6-8. After programming, the TH-D7 is capable of using a GPS unit with APRS.
Comments on operation Flow:

Step 1: The data bands can be programmed to receive/send voice and data transmissions. Simultaneous voice and data transmissions can be sent or received. (Press "MNU". Right ok button. Up Down to get "M". Up down to get #. Press ok button and then Esc out.)

Step 2: (none)

Step 3: (none) (144.410 MHz)

Step 4: (none) (Mnu, up down, right, up down, right, put in call sign, right, Esc.)

Step 5: NMEA and NMEA96 depend on the output rate of the GPS unit. NMEA outputs at 1200 bps and NMEA96 at 9600 bps.

Step 6: Icons are sent with the data APRS transmissions. They help identify the type (or location) of the HAM radio.

Step 7: Position data is not needed when the radio is hooked-up to a GPS unit. Coordinates are sent with data APRS transmissions. (Lab coordinates: N:39° 32.31’ W:119°48.76’)

Step 8: Positions comments are very important. They can report an emergency situation. Please see Figure 2.
Step 9: (none)

Step 10: The options are MANUAL, PTT, or AUTO. Descriptions are shown in Figure 3.

Step 11: (none)
Chapter III: Setting up the GARMIN GPS V unit.

To begin the initializing of the GPS V unit (Figure 9), follow the directions in the quick start guide. It is good to notice that this unit is extremely portable and can be mounted in your vehicle. MAPSOURCE, a routing information program, is included with the unit.
You will need to get the “Unlock Code” from the GARMIN website. The unit is self-initiated and is user friendly. (Our Unlock Code: ZBKZUSYCFDWSNWZT829PPT4DA)

To hook up to the GPS-V to the TM-D700 ham radio, first a cable must be made to allow the two units to hook up (Figure 10).

![Connecting with a GPS Receiver](image)

*Figure 10: Taken form page 10; KENWOOD Specialized Communication Instruction Manual, TM-D700.*

Once the cable is made, connect the wires to the back of the GARMIN GPS and plug the standard SMAS into the TM-D700 (in the front GPS port located between the com port and the data port).

When using a GARMIN GPS V, you will use the parameters described in Figure 10. This will allow APRS data to be transmitted. To program the “interface” menu on the GPS V, Find the Menu, by turning on the GPS (hold down the ‘red light’ button). The unit will acquire necessary satellite information on its own. Once this is complete, press menu and then menu again to get into the main menu. Enter the setup menu and press left once. This will bring you to the interface sub-menu where you will enter the format and baud rate as discussed in Figure 10.

When setting up the GARMIN GPS V with the TH-D7, one must modify the GPS unit power/data port connector with a 2.5 mm (1/10") 3 conductor plug. This is the exact same modification that you need to do in order to use the GPS with the TM-D700. To turn off the GPS unit, hold down the ‘red light’ button.
Chapter 4: Setting up the GARMIN GPS 25-LVC with the ham radios.

The GARMIN GPS 25-LVC (Figure 11) is a small sensor board capable of transmitting vital information and is a necessary component for this experiment. Its size and low energy consumption makes it a practical unit. This board is at the core of the above-described Garmin GPS-V, except without all the controls and display.

Before handling the sensor board, remember to ground yourself by touching a metal object, or (better yet) use a grounding strap.

To start, the unit must be interfaced with a computer to run its self initialization.

With one of the rainbow 12 wire cables, connect the sensor board to the pc interface port head. Only three of the colored wire will be used to make the connection. The number four wire (White) is the serial data output and is soldered into the serial port hole number 2. The number five wire (Blue) is the serial data input and is going to be soldered into hole number 3. And the last wire to connect is the number eight wire (Black) and is the ground. This is soldered into the number five hole on the serial port head. (Note: the rainbow colored wires are plugged into the sensor boarding in a very specific way. Hold the wires, with the port in view and count the eighth wire from the left. If it is black, you are holding it the correct way.)

The antenna connection is rather simple. Plug the antenna into the sensor board as shown in Figure 11.
Once all connections have been made, the configuration program located under GARMN GPS on the computer that is titled GPS cfg must be entered. Once the program runs, get into the comm toolbar and hit ‘setup’. A pop-up will appear on the screen where the serial port and baud rate need to be set. The settings are serial port 3 and baud rate auto.

Once the settings program is completed, the rest of the sensor board must be configured. Under the Config toolbar, go into the sensor configuration prompt or hit F7. This will result in the screen where the rest of the commands must be entered. The Earth Datum should be set to WGS 84. Fix mode should be Automatic. Differential and Velocity filter should also be set to automatic. The baud rate will be set to 1200. Once all these have been changed, click ok and enter the connect command on the original screen. The message should say “connection success at 1200 baud”. The latitude and longitude with the altitude should appear. Confirm that they are correct and save the changes. This will store that information on the sensor board. This can be referred to as “home base coordinates”.

![Figure 13: (a) The connection points for the rainbow wire and the SMA plug (b).](image)

To connect the sensor board to the TH-D7, make another connection with the other rainbow wire provided. Simply solder and heat shrink wires four, five, eight, and ten to corresponding wires on the SMA plug. (White, Blue, Black, and Red) This will allow the sensor board and the radio to communicate. The 2.5 mm (1/10”) conductor plug fits directly into the side of the TH-D7 in the GPS port. Once the batteries are hooked up to the wire and the wire is hooked up to the radio, simply turn on the radio to begin receiving information. Make sure the frequencies between the radios are the same. Roughly one minute after, the first information is sent, the TM-D700 will show a small screen that will flash the call sign of the person transmitting. By hitting “detail”, the latitude, longitude, distance, and time that is being transmitted will be shown.