Working Digipeaters with the Kenwood TH-D72A and TH-D74A

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The Radios

For satellite operators intending to work packet/APRS mode with a handie-talkie (HT), the Kenwood TH-D72A and newer TH-D74A offer several compelling benefits. Both include built-in TNC and GPS features, and a similar setup. Both the D72 and D74 also allow for five "Status Text" fields that can be transmitted with the operator's position.

In terms of the D74's advantages for working packet/APRS, its color transflective TFT display puts more data on its larger screen, which Patrick prefers. More information on one screen cuts down on the need to page through a series of screens to see information that can't fit on one D72 screen.

The D74 also allows three "other" packet paths (only one in the D72), and up to 20 "phrases" (the D72 permits up to 8); "phrases" are short strings of predefined text that quickly can be pasted into a message to facilitate a QSO, as discussed below. See Figures 2 and 3. The other settings are the same between the two radios. Also, the D74 keypad is softer than the D72, making it easier to use during busy passes when trying to send and receive APRS messages, as well as view screens like the station list.

The one drawback for some packet operators using the D74 may be its inability to access the TNC's "cmd:" prompt, which was available in the D72 and D7. The D74 has a KISS mode, which is compatible with many packet programs that do not need to operate like an old-style terminal program.

Among the differences that do not directly affect packet/APRS operation, only the D74 provides:

- 222 MHz band, in addition to 2 meters and 70 centimeters
- an all-mode receiver
- Bluetooth,
- D-Star compatibility, and
- A MicroSD that allows voice recording.

While the D74 importantly lacks the D72's cross-band full-duplex capability, packet operation is unaffected. A comparison and review of the two models appears in Patrick's post on QRZ.com's Satellite and Space Communication forum.

Digipeating Satellites

Currently, the International Space Station (ISS) and PSAT are the only fully operational and most-used digipeating satellites. A list of currently orbiting packet satellites, as

hannel	Receive (MHz)	Transmit (MHz)	Offset
1	437.560	437.540	-0.02 MHz
2	437.555	437.545	-0.01 MHz
3	437.550	437.550	(no offset, simplex)
4	437.545	437.555	+0.01 MHz
5	437.540	437.560	+0.02 MHz

Table 1 — Necessary Doppler adjustments for 70 cm ARISS digipeater.

Figure 1 — The Kenwood D-710 GA radio is shown on the right side of the Interoperable Radio photo. Also, you can see the AMSAT-built power supply (in white) and the load simulators (to the right of the power supply) and power sources to the left of the power supply. [Courtesy of ARISS.]

Figure 2.

Figure 3.

well as those planned for future launch and deployment, appears on Bob Bruninga's (WB4APR) website at www.aprs.org/astars.html.

ISS

ARISS (Amateur Radio on the International Space Station) has provided a packet/APRS digipeater on the ISS since 2007. That digipeater traditionally has operated on 145.825 MHz, considered the global APRS satellite channel, which obviates the need for Doppler tracking.

Unfortunately, the Ericsson VHF HT that served the ARISS packet operation in the European Columbus Module failed in October 2016. Subsequently, the UHF twin of the failed radio, an Ericsson UHF HT, was put into service in the Russian Service Module using 437.550 MHz. The change to 70 cm now requires users of the packet digipeater to make Doppler adjustments on both the uplink and downlink, as depicted in Table 1.

To program these adjustments on the D72/D74, the operator creates a simplex receive frequency, then uses the VFO to set the transmit frequency and store it to the same memory channel, just as with any other memory. However, for this "odd split," in addition to pressing >OK to store the frequency as the final step, the user must first hold down the PTT button and then press >OK.

To remember these stored channels, the operator might name the saved memory locations for these split frequency pairs something like ARISS U1, ARISS U2, etc., with "U" designating UHF. Saving the original ARISS VHF frequency, which is also the PSAT frequency, as "ARISS V" (for VHF) reinforces the fact that PSAT uses "ARISS" instead of its own name, "PSAT," for the packet path. Additionally, the ARISS V designation may serve as a reminder that the original VHF digipeater frequency will be restored as the ARISS team is planning to deliver a replacement Kenwood D710GA radio to the ISS in late 2017.

PSAT

PSAT (aka NO-84 and PSAT-1) launched in May 2015 and can digipeat packets just like the ISS. One challenge is that NO-84's digipeater is not always on, and operators must watch for its callsign to know the digipeater's status. The "PSAT" callsign means the digipeater is on, and "PSAT-1" means it is off.

Additionally, with only a 350 mW transmitter, the digipeater is fairly weak compared to the ISS. This makes low-elevation passes more difficult to work with the D72/D74, and virtually impossible without an Arrow or Elk antenna.

The ISS and PSAT transponders deliver packets worldwide through the global network of volunteer IGATE ground stations that feed the two downlink capture pages, psat.aprs.org and ariss.net.

Set-up and Operation

Proper radio setup is essential for packet. Although not all that intuitive, at least the same setup applies to operating packet on both the ISS and PSAT. The basic steps for setting up satellite packet/APRS on the Kenwood HTs might look something like this:

1. *Your call sign* — Press the Menu button, select APRS, #300 - BasicSet, then My Callsign. Enter your callsign followed by the SSID number, e.g., KB6IGK-7, where 7 designates an HT or other portable use, or choose any appropriate number for your icon designation.

2. *The beacon* — Using the initial steps in 1 above, under menu #3D0 - TX Beacon Method, for the Initial Interval, select Manual.

3. *Baud rate* — Menu #311 – Int.TNC, for Data Band select A-Band; for Data Speed, select 1200 bps.

4. *Position comment* — Menu #380 – PositionComment, select In Service or Special or Custom #; just don't select Emergency.

5. *Status Text* — Menu #390 StatusText, user entry area for up to 42 alphanumeric characters, along with the number of times it is sent.

Patrick uses the Status Text field with a 1/1 TX rate, where it is sent every time his position is transmitted, so there is some readable text besides his callsign. For text, the operator can enter a "CQ" call, or his callsign with some other information (e.g., location), or a line of text explaining his activity (hamfest, rare location, NPOTA, etc.).

When working stations through the ISS or NO-84 digipeaters, the

StatusText field can be used either to identify the operator and the digipeater or to show the operating location. For example, for NPOTA activations in 2016, Patrick used the NPOTA site number and grid locator in this field. Stations would then note that he was doing a NPOTA activation, and see his location.

6. *Packet/APRS path* — Menu #3H0 – PacketPath, for Type, select *Others; for Path, enter ARISS, which should work for both the ISS and PSAT as described above.

7. *Message* — Press MSG button twice to bring up MSG Input, enter the callsign of the target station and a text message.

8. *Phrases* — This allows the operator to create short predefined phrases that can be copied and pasted into the MSG Input text field.

9. *TNC* — The TNC button will activate the internal TNC in either of two modes, APRS 12 or Packet 12. Pressing the button toggles between those modes and off. Select APRS 12 for satellite operation.

10. *Antennas* — Arrow and Elk work best for both satellites. A long duckie like the Diamond SRH77CA or telescoping whip also can work for ISS digipeating. The ISS has a stronger downlink than NO-84, which makes a big difference when trying antennas like the long duckies or telescoping whips.

Two-way messages are needed to complete a QSO via APRS. To avoid having to enter messages manually, Patrick uses the predefined "phrases." He uses a minimum of 3 "phrases" to make exchanges via APRS messages:

1. "Hi from [grid/grids] in [state]"
2. "TNX for call. [grid/grids] in [state]"
3. "TNX/73"

To automate the process of entering a callsign, Patrick uses the heard stations list to start sending messages. If a station isn't sending APRS-formatted packets, the operator will not be able to see it in the station list. An APRS message to that station will require manually entering the callsign and the message (or using a a predefined phrase).

After sending the first message to start a potential QSO, Patrick looks for a response from the other station, which would be followed by sending the third message. This is similar to the rapid-fire exchanges of grid locatorson the FM and SSB/CW satellites. If a station calls via APRS message, Patrick will reply with the second message. He then should see something from the other station like his third message to confirm that his reply was heard. If he sees a signoff message from the other station, he may send his third message to wrap up the QSO.

He usually keeps a couple of additional messages stored in his radios. One has a brief description of his station. Another says "Please use APRS msgs for QSOs," as the APRS-ready radios will not display freeform text typed into a terminal program. The APRS-ready radios expect APRS-formatted packets — positions, messages, or beacons — and may only show a call sign without the rest of the packet when a non-APRS packet is received.

When sending APRS messages, an operator will sometimes see an "ack" come from the other station. This confirms that the other station received the operator's messages. Patrick does not use "ack" responses to decide if a QSO was made because those are automatically generated by the radio or software used by the other stations. Some stations will use automatic responses, which are normally prefixed by "AA:" followed by text. He doesn't log these as QSOs because he cannot determine if there is an operator on the other end. This is like working the old ROBOT on the RS satellites, where the satellite was capable of making a basic CW QSO.

Figure 4 — KB6IGK using TH-D72A, tuning to second frequency (U2) in early part of ISS pass. [All photos Joe Kornowski, KB6IGK, unless otherwise noted.]

Figure 5 — Station list showing a received position beacon from WD9EWK-9.

Figure 6 — Position Comment from WD9EWK-9.

Figure 7 — Status Text from WD9EWK-9, p. 1.

Figure 8 — Status Text from WD9EWK-9, p. 2.

Figure 9 — APRS grid location and distance/ direction from WD9EWK-9.

Figure 10 — APRS moving direction and speed of WD9EWK-9.

Figure 11 — APRS altitude of WD9EWK-9.

Figure 12 — APRS position data from WD9EWK-9.

Figure 13 — First digipeater (F) showing ISS callsign.

Figure 14 — WD9EWK's initial message to KB6IGK.

Figure 15 — Reply message sent to WD9EWK.

Figure 16 — WD9EWK QSL to KB6IGK.

Figure 17 — WD9EWK's TH-D74 showing message from KB6IGK. [Patrick Stoddard, WD9EWK, photo.]

Figure 18 — KB6IGK shown in WD9EWK's TH-D74 station list. [Patrick Stoddard, WD9EWK, photo.]

Figure 19 — TH-D72 with Diamond