

# **D-STAR ONE (iSat) & (Sparrow) Digital Voice (DV) Beacon Tracking: ICOM ID-5100**

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*In my last article published in Break-In's March/April 2019 (pages 4 to 6) iSAT was found to be using a DV beacon announcement along with the Telemetry beacon. Radio tracking the GMSK beacon was discussed in the previous article but I have added additional information regarding the Yaesu FT-817 that might be helpful to some readers to the end of this article.*

Decoding the telemetry beacon using the PSK output from the FT-817 is reasonably straight forward. However, the DV Beacon can only be heard using a D-STAR capable receiver.

To decode the DV Beacon one of the following is required:

- 1) PC sound card and appropriate decoding software.
- 2) Commercially made scanner receiver.
- 3) SDR radio like the Flex 6000 series with DV3000 Dongle from North West Digital radio.
- 4) Genuine ICOM D-STAR radio such as the ID-5100.

As outlined in the previous article on the 27 December 2018 two satellites were successfully launched for D-STAR digital radio [1]. At the time of writing both D-STAR ONE satellites are active with the first to pass over being Sparrow followed by iSAT approximately ten minutes later.

D-STAR ONE is the first private German CubeSat and the first successfully operational D-STAR communication spacecraft worldwide. [2] [3]

To track satellites, I was already using Gpredict software for both Windows 7 and Linux Ubuntu 18. This tracking software also allowed the received Doppler shift (-9 kHz to +9 kHz on 435 MHz) to be compensated for with automatic VFO tuning.

Note: Many radios can be used as detailed on the InterWeb or in the HamLib and Gpredict user manuals.

## **Hardware Set-up**

I used a simple roof mounted 2 dBi ground plane whip antenna feed with low loss coax into a home brew 15 dB 1dB noise figure pre-amp.

Note: The ID-5100 requires a filter between rig and pre-amp due to front end inter-modulation over load when a pre-amp is connected directly.

The reason for such a simple antenna is to achieve a traditional donut shaped omnidirectional pattern. Gain whip antennas have horizontal lobe patterns and although the satellite might be over your house, you will never hear it.

To start with I manually tuned the radio in 5 kHz steps (step size in FM or DV mode) during passes and could hear a couple of DV beacon announcements but was a bit random due to the RX being off frequency at times. The ID-5100 has a recording function to the on-board SD card, so these transmissions can be saved or re-played later, a nice feature.

My idea was to leave the ID-5100 unattended and let it receive the DV announcements automatically during overnight passes. To try this manually here are the frequency steps to program into five consecutive memories.

435.710 (AOS)  
435.705  
435.700 (Mid pass)  
435.695  
435.690 (LOS)

To track the beacon, start at 435.710 then step down following the Doppler during the ten-minute pass. D-STAR ONE (Sparrow) is first in the orbit followed by D-STAR ONE (iSAT) ten minutes later. During the iSAT pass you should hear the voice announcement.

Text and call-sign like this displayed on the ID-5100 radio CD menu:

```
DJ1JBL/E92C>ECMGOS orbitalsystems.  
de  
RPT: DP2GOS
```

My thoughts then went in the direction of making the ID-5100 radio track the satellite so as to take out human error and not having to compensating for Doppler shift. The DV signal requires a narrow receive channel not wider than 5 kHz so I could not afford to be off frequency.

Keeping the receiver centred on the beacon frequency at all times is the goal. Gpredict uses HamLib drivers to control the radio. The information on how to use HamLib is detailed in the Gpredict and HamLib manuals and various InterWeb articles. I downloaded HamLib (hamlib-w32-3.3) <<https://sourceforge.net/projects/hamlib/>> and ran the command lines required and started Gpredict.

For the Linux install use this command line:

```
$ sudo apt-get install libhamlib-utils
```

A nice feature of Gpredict is that it already knows in orbit satellite transponder frequency details.

**Note:** “Update transponder data” has to be downloaded first from the same menu as the “Update TLE data from network” to ensure tracking the correct satellite is achieved.

Open an Admin Windows (or Linux) command prompt window and enter the following command line string:

```
rigctld -c 07 -m 371 -r COM6 -T 127.0.0.1 -t 4532
```

**Note:** The COM port number must match that used by the USB modem or serial converter.

Then open Radio Control from the Gpredict top right drop down menu and select the satellite you want to track.

**Note:** This has been previously set up in Gpredict Edit>Preferences>Interfaces>Radios

With the radio device selected as ID-5100 move to the left and select iSAT/TLM Beacon. 435.700 MHz should then display in the down link radio section of the window. I clicked the “Track” button and immediately the radio tuned off centre frequency to match the Doppler shift expected on the next pass.

With the radio tuning taken care of, pre-amp and antenna already connected I started the record function on the ID-5100 and waited for the next pass. DV announcements were heard four times during the tracked pass and I could play each one back. Slow speed data text message was also displayed.

### **ID-5100 set-up from Gpredict (Windows PC)**

ICOM recommend using the CT-17 CI-V remote level convertor (see Figure 1) that is then connected to the SP2 speaker socket on the rear of the radio. This part was off the shelf at RWB Communications at a reasonable price.

A custom-made audio cable was needed to connect the CT-17.



*Figure 1. ID-5100 Icom CT-17 CI-V remote level convertor.*

I also found an alternative from ZLP Electronics UK in the CT17 but also required a custom Mono to Stereo cable. (See Figure 2). The great thing about the ZLP CT17 is that it already has a USB modem attached, is smaller and a lower price delivered. The ICOM CT-17 required a USB to serial converter for the RS-232 connection to work. The CT-17 is now running on the ID-5100. (ICOM ID-4100 not tested yet)



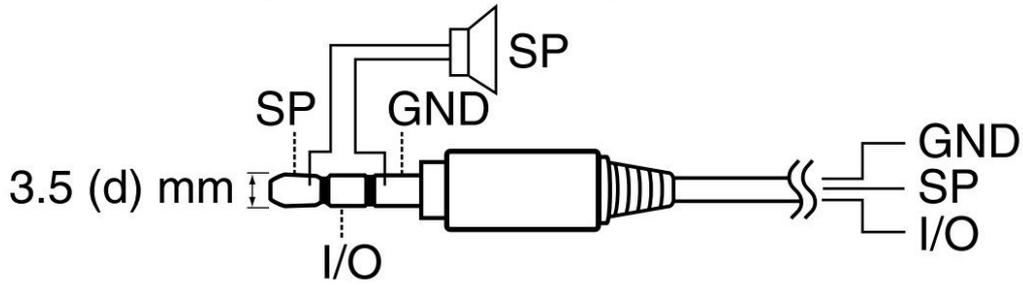
*Figure 2. ID-5100 USB CT17 CI-V modem from ZLP Electronics.*

It steps the radio at 1.25, 2.5, 3.75 or 5 kHz which is perfect to track fast moving low earth orbit satellites.

(Default for FM is 5 kHz so it overrides standard stepping using a direct data entry –see Figure 4) Step change depends on rate of Doppler shift determined by the Gpredict tracking program. This method cannot only be used for DV but FM satellites such as AO-91 and AO-92.

ICOM advised how to make the CT-17 work. The remote connection 3.5 mm Mono has to convert to 3.5 mm Stereo. The Icom CT-17 is only supplied with Mono cables. ID-5100 uses tip and common for the speaker and common and ring for data [I/O]. Converted CT-17 data cable plugs into SP2 on the rear of the ID-5100. (See Figure 3).

- Connections (ID-5100A/E side)



\*No speaker is necessary for the CT-17 side.

Figure 3. ID-5100 Remote Control SP2 Plug wiring.

For the RS-232 PC communication to the CT-17 I use a 25-way to 9-way gender bender to serial cable and USB to serial converter. Perfect operation however cumbersome. I used a laptop PC plus USB as above and a desktop PC with COM1 serial output directly to the CT-17. Both working perfectly as expected.



Figure 4. ID-5100 Display 1.25kHz step at AOS tuned to Sparrow DV repeater output.

**ID-5100 setup:**

- 1) DV mode tuned to 435.700 MHz. (ID-4100 not tested yet but expected to work the same)
- 2) rigctlD -c 07 -m 371 -r COM6 -T 127.0.0.1 -t 4532
- 3) -c 07 is ID-5100 CI-V Hex address.

- 4) -m 371 is the HamLib rig type ID-5100.
- 5) -T 127.0.0.1 is host address.
- 6) -t 4532 is the port number.
- 7) Gpredict satellite tracking software driving HamLib rig control software. (runs on both Windows 7 SP1-64bit and Ubuntu 18 - 64bit)

**FT-817 additional notes for set-up to track the GMSK beacon:**

- 1) PKT 9k6 mode tuned to 435.700 MHz. (FT-857 and other rigs can also be used)
- 2) Command prompt string: rigctld -m 120 -r COM6 -T 127.0.0.1 -t 4532
- 3) -m 120 is the HamLib rig type FT-817. -r COM6 is the COM port number.
- 4) -T 127.0.0.1 is host address. -t 4532 is the port number.
- 5) Gpredict satellite tracking software driving Hamlib rig control software. (runs on both Windows 7 SP1 – 64bit and Ubuntu 18 - 64bit)
- 6) See Figure 5 of FT-817 tuning in 10 Hz steps with FM / PKT mode selected.
- 7) See Figure 6 of Gpredict FT-817 radio selected tracking iSAT GMSK beacon Gpredict steps the radio continuously and seen on the ID-5100/FT-817 displays as 1.25 kHz and 10 Hz steps even in FM or PKT mode.



*Figure 5. FT-817 Tracking 10 Hz.*

Enjoy the challenge of decoding D-STAR ONE and other satellites using similar techniques.

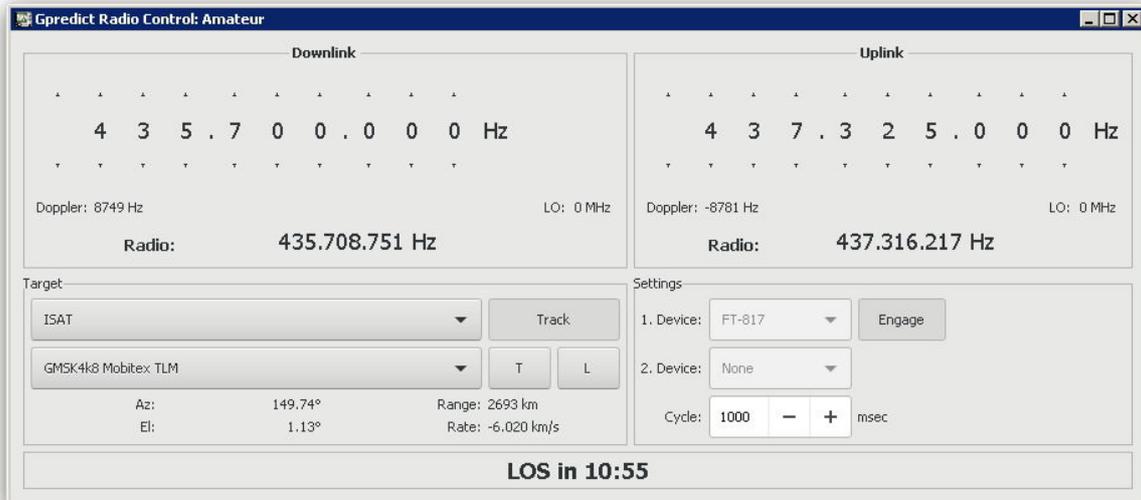


Figure 6. FT-817-HamLib-Command-iSAT

## References:

- [1] <<http://www.d-star.one/>>
- [2] <<http://www.dk3wn.info/p/?cat=525>>
- [3] <<http://www.dk3wn.info/p/?cat=526>>