# New 70MHz Telemetry Beacon G4JNT/P

The old 70MHz Beacon, operating as unattended beacon G4JNT/P on Bell Hill (loc IO80UU) has been replaced. The old one had rather a lot of spurious products that were detectable by locals, and more importantly, only sent old fashioned obsolete Morse code to relay the telemetry information for the site.

The new beacon uses an AD9852 DDS chip controlled by a 16F628 PIC to transmit the telemetry data using PSK31 exactly as supplied from the beacon site's telemetry module . A minimum-content CW ident is included for those who still want to be able to monitor the signal using aural reception.

**Message Content**

The PSK31 message consists of two parts. The first line is constant and sends the callsign, locator and a descriptor. The second line is the telemetry data in the form :

*BHTLM, 230, 1.050, 13.56, +32.1, OIOO*. Which is interpreted as:

Mains voltage 230V (effective RMS), mains current 1.05A, DC battery voltage 13.56V, PSU heat sink temperature 32.1. The OIOO refers to four status switches and will remain unchanged unless we install any more monitoring points.

**Details**

The 70.031MHz output frequency is generated directly by the DDS clocked at 200MHz. The clock comes from a 20MHz TCXO, multiplied by 10 in the chip's onboard PLL clock multiplier and achieves a frequency accuracy of better than 2ppm . A few Hz variation of the output frequency can be expected; at the time of writing / installation it is within 10Hz of nominal. Long term drift characteristic is as yet unknown.

The PSK31 waveform is generated by programming the DDS in real time at a sampling rate of 7812.5Hz using a 250 point lookup table for each instantaneous amplitude point of the waveform. The message data is received by the PIC via an RS232 interface from the TLM module at a rate varying between 2 to 15 seconds between frames. Once a complete frame has been received, as indicated by the terminating [CR] character, it is converted to the varicode alphabet used for PSK31 using a lookup table and the amplitude profile / phase for the resulting 1/0 pattern supplied to the DDS chip at 128us intervals.

When the PSK data is complete, the CW ident is sent using on/off keying. Again, the waveform is generated by reprogramming the PIC at the same rate as used for the PSK31. To keep 'key clicks' to a very low level, the CW element rise and fall edges are shaped using the same amplitude profile and rate as the PSK31 symbols This results in a CW waveform with a bandwidth that can't exceed 31Hz. Note the accurately sine-shaped edges that produce a soft, very pleasant sound. Nicer to listen to than most traditional CW transmissions. A 3 second period of carrier completes the cycle before the PSK31 repeats.

A ping-pong buffer ensures the PSK transmission is not interrupted by a new data frame arriving; the new data is only transmitted after is has been received from the TLM module complete with the terminating [CR].

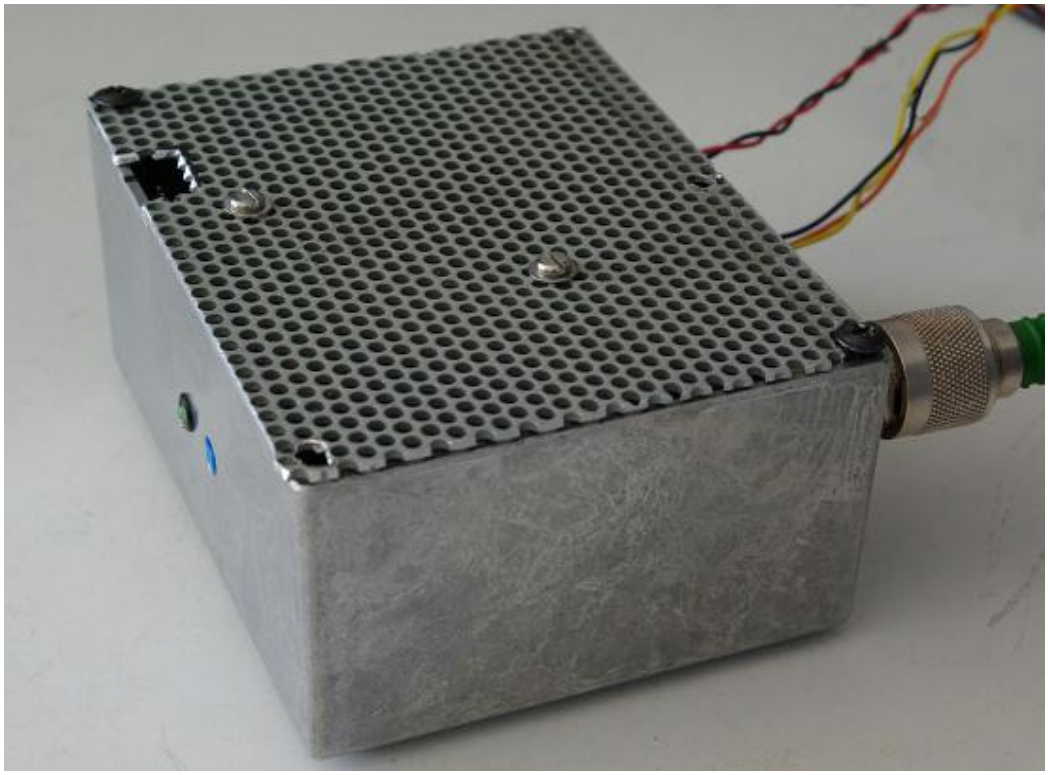
The output from the DDS is raised in level by a MAR-3 modamp driving a 0.5 Watt highly linear PA formed from a push-pull pair of 2N5109 devices operating in class AB. At the waveform peak, the PA is operating with about 0.2dB of gain compression. When running saturated it can give around 1.5 Watts RF output.

**Construction**

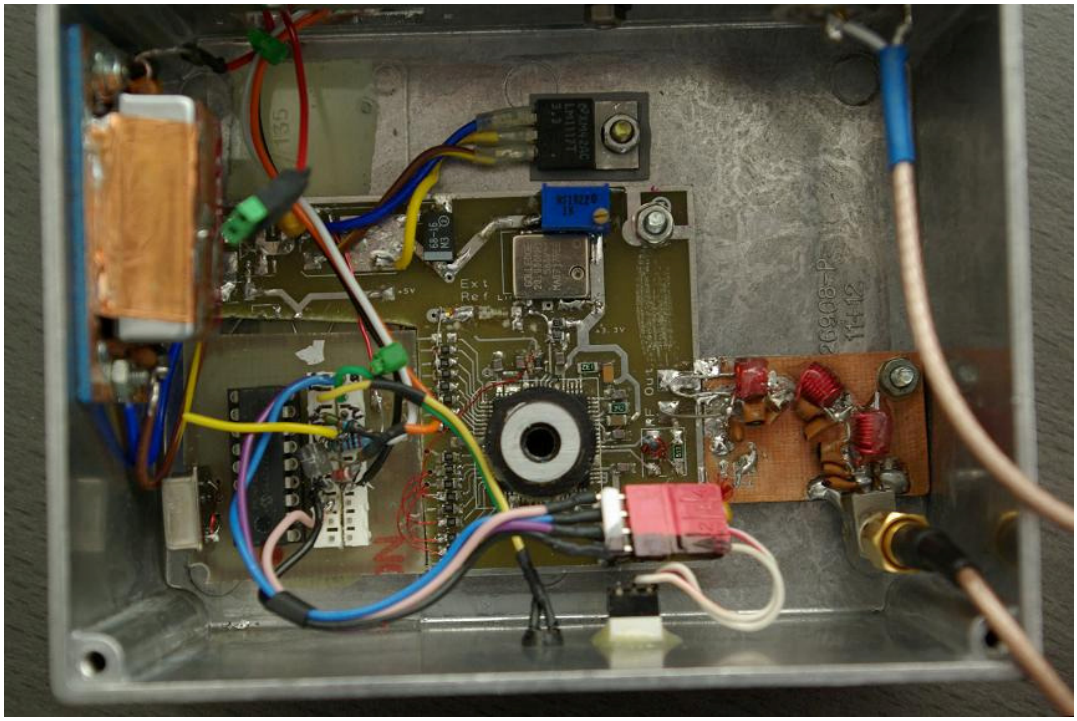
The hardware was all constructed from surplus stock with some PCB modules (literally) hacked from other projects, and other bits built using dead-bug construction. Photographs can be seen below. The large circular blob is a heat sink super-glued onto the DDS chip which consumes 650mA at 3.3V and runs quite hot. This, together with the heat generated from the low efficiency linear PA means that good ventilation is required. A perforated lid for the casing is essential to ensure adequate airflow.

**Results.**

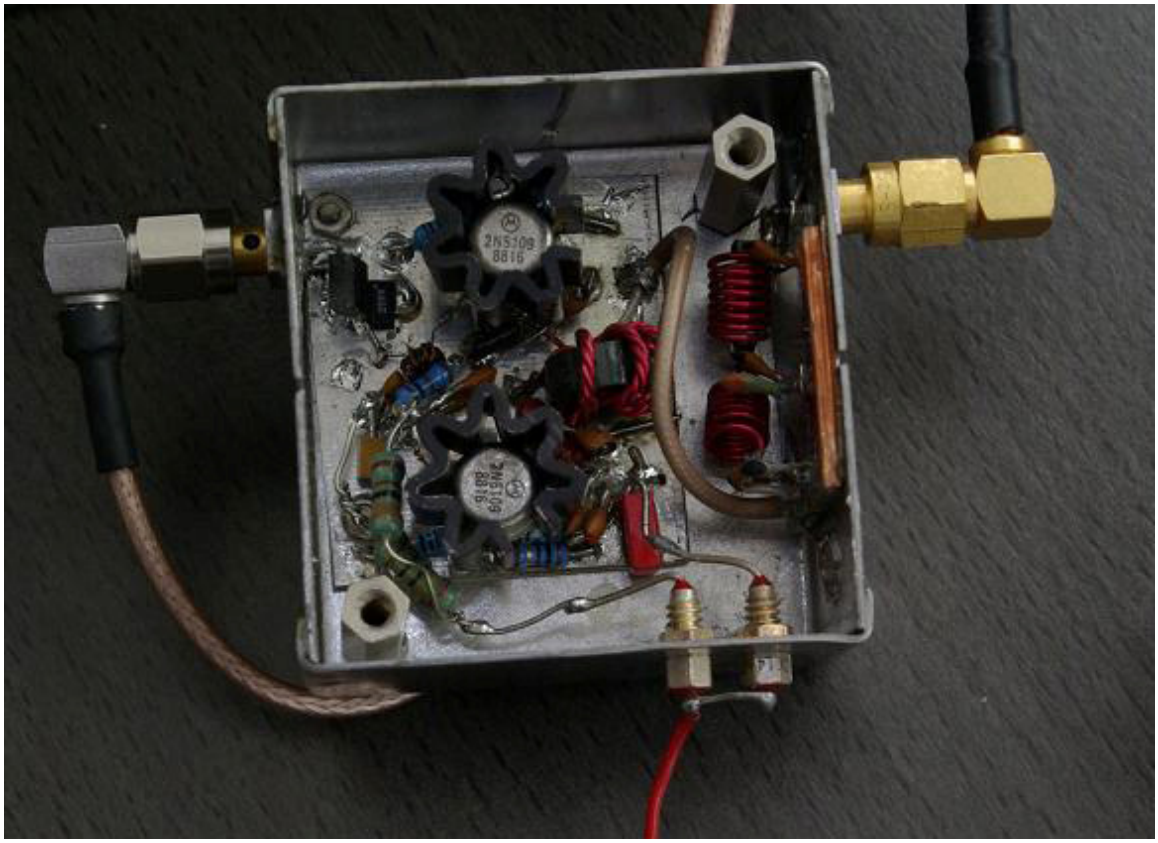
Theoretically, the 250 point sampling of the PSK31 envelope and CW symbols ought to result in sidebands either side of the transmission spaced at the 7.8125kHz sampling rate. Theory suggests these should be at a level of about -50 to -60dBc, but in practice were undetectable, being at least -70dBc. This lower-than-expected result has been seen before for this method of direct PSK31 generation and remains still to be explained. No other spurious outputs can be seen other than harmonics, which are better than -50dBc



**70MHz Beacon / Telemetry transmitter, external view**



**Driver Unit Internal view.** *Top left 5V SMPSU, bottom left PIC controller. DDS and TCXO reference centre, low pass filter for the DDS on the right. Top 3.3V regulator for the AD9852.*



**PA Module, mounted on underside of perforated lid.**