G4JNT 500kHz Beacon

This beacon has been running since April 2009, but after a few queries and emails, I realised there was nothing in writing, and all info had been passed on via the LF and UK Beacons Reflectors. So here goes...

After building the 5MHz beacons GB3RAL, WES and 'ORK, (See htt://www.g4jnt.com/http://www.g4jnt.com/5MHzBcnsWeb.pdf) thoughts turned to putting the whole process of CW messages, plain carrier, power steps and a message of some sort (to replace the original pulsed sounder sequence used on the 5MHz beacons) into a single AD9852 PIC as used on my DDS module (See http://www.g4jnt.com/AD9852module.pdf) . A routine for generating a PSK31 message by reprogramming the DDS in real time to generate the phase and amplitude envelope information had already been developed for this DDS chip and it was decided to replace the sounder sequence by a PSK31 message. The final result was first used on air in the hardware for the experimental transatlantic GB3SSS beacon transmission on 1.9MHz from Poldhu, Cornwall, over the winter period of 2006/7... Then again a year later from the same site on 3.6MHz.

The transmission sequence consists of callsign in CW sent at the exact minute interval. Starting at 7 seconds past, the power is reduced in steps of 6dB each second, down to -54dB at the 16 second interval. The power sequence then repeats over the next 9 seconds. For the period 25 to 30 seconds plain carrier is transmitted at full power for automatic monitoring software. The PSK31 message occupies the period from 30 seconds to approximately 48 seconds, with the remainder of the one minute slot plain carrier.

The PA module used for those beacons consists of a Kalmus broadband Class AB MOSFET PA module capable of delivering up to 200 Watts with a flat gain performance over the frequency range 0.5 to 40MHz. The RF source consists of the AD9852 DDS module with the PIC code re-written to accept input from a Motorola Oncore GPS module to provide timing information from the serial data and 1 Pulse per second signal lines. The DDS module, GPS receiver and a small DC-DC converter to provide 5V from a nominal 12V are all built into a tinplate box which directly drives the PA. A keying line was added from the PIC to control the PA output MOSFET bias to enable the power amplifier only during periods of transmission.

After the Poldhu experiment was completed, the hardware was returned to me and sat idle for some time. Then, after a flurry of data mode activity on the new 500kHz band I reprogrammed the PIC, replaced the output low pass filter with a 550kHz cut off one, and set it going as an 'attended' beacon. The antenna consisted of a variometer salvaged from the old Decca beacons and my original 7m high Tee antenna used for 72kHz and 137kHz operation. This was fed against an array of earth spikes and wire buried in my small rear garden. Load resistance measured out at around 20 ohms, which with the estimated radiation resistance of .02 ohms suggested an efficiency in the region of -30dB. So at 100 Watts RF I was putting out around +20dBm.

At Poldhu, the beacon had transmitted for one minute every 15 at 00, 15, 30 and 45 minutes past the hour (the same as GB3RAL on 5.29MHz) However, I run a 24/7 monitor of the 5MHz beacons and transmitting on 500kHz overloaded the Softrock receiver used for this . So the 500kHz transmission timing was altered to transmit at 04, 19, 34 and 49 minutes past the hour to miss the 5MHz monitoring window. Listeners who wanted to use the G3PLX automatic monitoring software

http://www.rsgb.org/spectrumforum/hf/beaconauto.php would need to programme a time offset of 240 seconds into the software so as to fool the software it is looking / plotting GB3RAL.

After several weeks of activity, G3WKL, the RSGB HF manager pointed out to me very politely, that "we weren't licensed for unattended operation on 500khz, and I ought to *be careful*, but he'd see what he could do about licensing it..."

Anyway, about two days later a very nice chap from Ofcom emailed me to say that if I could write down the beacon details and send it in with the right form, an NoV for continuous unattended operation would be forthcoming. I did and it was. Tnx. to John and Ofcom for such efficient prompt service. The beacon operated in this format, transmitting for one minute every 15 for a few months.

G4WGT even set up a grabber for continuous monitoring
http://myweb.tiscali.co.uk/wgtaylor/grabber2.html

The setup is installed in an outside shed and a photo of the setup can be seen. The 100W PA is in the blue rackmount unit with its PSU, and the RF source / GPS are in the tinplate module on the top of the rack. The diecast box mounted on the front of the PA is the 550kHz Low Pass Filter (The small laptop on the top shelf is the 5MHz monitoring system)

Meanwhile I'd been experimenting with generating WSPR on a PIC (http://www.g4jnt.com/wspr_coding_process.pdf) and wanted to add a WSPR beacon in parallel. This would have to be on a slightly different frequency, in the WSPR allocated part of the band from 503.8 to 504kHz, and thoughts initially ran to combining the output from two DDS modules into a single drive waveform for the broadband linear PA This was going to be a bit messy, especially if aiming to avoid both beacons transmitting at the same time to minimise intermods.

Eventually I managed to shoehorn the code for generating both WSPR and the original '5MHz format' + PSK31 signal into a single 16F628 PIC which manages all waveform modulation and frequency switching for the two signals. Instead of a true pseudo random sequence for the WSPR signal as used for the majority of transmissions using this format, a semi-randomised pattern of timeslots repeat ever hour. The ten two-minute slots for a 20% WSPR duty cycle, are interleaved with the four original transmission periods so as to minimise any consecutive sessions to assist in transmitter module cooling in hot weather.

The complete dual function 500kHz beacon has now been running on 503.7kHz and 503.850kHz for several months.