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| SUBJECT | SARL/HMO 40m Beacon – INFORMATION PAPER | | |
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| Society | SARL | Country: | South Africa |
| Committee: | C4 | Paper number: | CT08_C4_I_27 |
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The South African Radio League and the Hermanus Magnetic Observatory Beacon project is well on its way with the first six beacons operating. The project will ultimate have 30 beacons around the country operating on 7023 kHz in phase 1 and 60 in phase 2.

According to Dr Lee-Anne McKinnell, ZS2LAW, Ionospheric Research Physicist at the Hermanus Magnetic Observatory, the beacon service will be of great value in confirming actual propagation conditions. This will also be used to confirm the mathematical ionospheric model for the Southern Hemisphere. The results will be used to predict the ionosphere."

The Space Physics Group of the HMO includes an active ionospheric component, and provides ionospheric data for the purpose of Space Weather predictions, which includes HF propagation prediction. The HMO has recently become the Space Weather Regional Warning Centre for Africa, which includes amongst other parameters the provision of HF propagation predictions.

The HMO will collect data from participating Radio Amateurs and Educational Institutions detailing the actual propagation paths between different areas in the country. This information will be correlated with the HF propagation predictions that have been made for the given paths. In this way, a validation procedure can be implemented and confidence levels placed on the predictions provided by the Space Weather Centre.

The 40m beacon system has been modelled on the International Beacon Programme. Volunteer Amateur Stations situated in all areas of South Africa will be provided with a 40 mw automatic beacon that will transmit within a prescribed time slot. This time slot is unique to each transmitter. The transmission period will be 55 seconds.

The 40-mw level has been determined by on the air experiments between a station in Gauteng and a station near East London in the Eastern Cape. This level has found to give the best dynamic range of varying propagation conditions

The beacon transmitter operates in the CW mode on a frequency of 7023 kHz. Each transmitter will be identical and conform to the specification below.

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| Frequency | 7023 kHz |
| Frequency Stability | +/- 20 Hz after 10 minute warm up |
| Antenna Impedance | 50 Ohms |
| Output Power | 40 mW PEP |
| Spurious radiation | less than 65 dB |
| Final Amplifier Efficiency | 62% typical |
| Operating mode | ASK Morse Telegraphy |
| Keying Mechanism | micro controller & gate |
| Keying speed | 8 WPM |

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| Transmission intervals | phase #1 every 30 minutes; phase #2 every 60 minutes<br>Otherwise oscillator off in sleep mode |
| Transmission period | 55 seconds |
| Text capacity | 500 letters |

For timing purposes to keep each beacon within its allocated time slot a Philips PHFPCF8563TF4T3 real time clock chip is used. This unit give the best available stability and give us the facility to correct the time if necessary.

The beacons include a LCD display to show actual real time and buttons to correct the time. The starting time of each beacon has been set in the firmware against the call sign so no settings of these parameters are required except by digital download. All the Host has to do is check the time is right on the clock display.

**Circuit Description**

A separate oscillator and driver from the microprocessor are used to give the best advantage. This has left the microprocessor free to take care of the final amplifier control, time, synchronisation and sending the CW message.

The 16F627 was chosen first for its PWM ability thus allowing the final to be driven at different phase angles providing a digitally controlled class C amplifier

The final amplifier power of 40 mW was decided by practical tests and observation. This was mainly of the 7025 kHz George Beacon, ZS1AGI. The power of 40 mW was chosen so that the greatest change in propagation could be detected.

The final amplifier and its control have made it possible to provide full power with a SWR of 1.6 and an ability to withstand infinite SWR both open- and short circuit.

It was decided to supply the antenna with the beacon to control the lightning protection mechanism. The antenna is a half wave dipole connected by a 300-ohm reactance Balun to 50-ohm coax cable.

The balun provides enough isolation to effect complete independence of the groundside radiator and the detuning effects of the antenna when mounted low to near by objects.

The most important job of the balun is to provide a high impedance function to lightning discharge. The choke effect together with the capacitance of the coax cable, leads to high a voltage rise across the arc gap at the centre connection of the dipole thus discharging a lot of the total energy.

In practice, this has proved a real remedy to the South African prolific lightning conditions. The system has proved itself with five direct strikes on the ZS6SRL beacon without the beacon failing or going off the air.

The beacons transmit CW at around eight words per minutes using the following message format: The example given here is for ZS6SRL

DE ZS6SRL BCN LOC KG33WV QSL BCN.SARL.ORG.ZA (followed by message), this will be followed by the tuning signal consisting of long dashes corresponding to the call sign division.

For example, if the beacon is located in division 6 the beacon will transmit 6 long dashes. Next will be the s-meter signal consisting of 4 dots. The s-meter signal varies with power from 40 mW to 5 mW in four steps. This is to ease reporting by students on receivers not fitted with an “S” meter. If they hear 4 dots, it is 59 if they hear 2 dots it is 52 etc.

“The message” portion of the CW text will be used on some beacons to announce projects or give promotional messages to students. Several message beacons throughout the country will be fitted with SMS download so that Amateur and School Events can be supported.

**Additional Project Items**

A digital receiver has been built that will monitor the beacons continually up to period of a few weeks. The receiver stores the call sign and RST in a data logger within the receiver. After a few weeks or earlier the receiver can be plugged into a USB port and it will download its report into a text file. This file contains Date - Time - Call Sign - RST for all the beacons heard at the Host receiving station.

To accompany this we are placing at the disposal of the receiving stations a computer program called the "Beacon Companion.” This program takes the propagation results from the digital beacon receiver and predicts the propagation to each area of South Africa from the Host base. In addition, you can enter a destination that you wish to communicate with, and the program will tell you what will be the best propagation time for you to do this. This program also helps to see propagation patterns and do detailed analysis from the real data gathered at the Host home base.

This arrangement will also help the beacon project as you can forward your downloaded file to the HMO for addition to the propagation research database.

An MSc student has started her project in January 2008, which will use data already gathered from the beacons currently on the air and the continuously expanding database. There will be a major drive to get more listeners involved and build up the database.

For regular update visit www.sarl.org.za. Reception reports are invited and should be sent to bcn@sarl.org.za