**DDS Sweep generator – description & operation.**

This unit is intended to provide either a single frequency within the range of 1c/s – 60 Mc/s, or a selected sweep from within the same range.

The unit comprises a CPU (Raspberry PI/3), an interface board and a DDS module using the AD9850 generator chip. Also included is an attenuator for -10 dB steps into 50 Ohms. Control (local or remote) is provided by USB or Ethernet ports. There is a small built-in HDMI display board.

It is intended later, to provide graphical plotting of sweep results on the internal screen, but currently an external oscilloscope is required for output viewing. The unit provides 100 microsecond pulses – one to trigger the scan start and two to provide frequency spot markers. These pulses are 5V in amplitude.

Operation:

Initially, a keyboard and mouse are connected and the unit booted up. From the RPi menu at the top of the display, a console window is selected which is then expanded fully (This is necessary to ensure that text at the bottom of the display is visible.). The programme called “curse” is then run. This should result in a display (based upon the NCurses library) which displays boxes for the various parameters, plus help or error messages at the bottom of the display.

The oscilloscope for viewing the results is connected with the trigger output BNC fed to ‘ext. trigger’ on the scope. The markers BNC is connected to one ‘Y’ amplifier and the amplitude obtained from the test piece is fed to the other ‘Y’ amplifier. The Y settings should be set to ‘chop’ mode.

On the generator, when the ‘U’ key is pressed, the user may tab to the various parameter windows on the display and enter the required data. Note the parameter labeled ‘INCREMENT’. This is the increment within the pass-band which when detected causes the output of the AD9850 to update it’s frequency output. Note that for *any* range of frequencies, the scan goes through the entire range at 1 cycle intervals. This is necessary to produce accurate markers at the chosen frequencies. If a wide bandwidth is being swept, this could result in a very slow display if the AD9850 was commanded on each cycle. Making the increment sufficiently large whilst retaining a smooth output curve will minimise the scan delay. If the increment is too large however, the oscilloscope signal reading will become stepped in appearance, which may result in poor amplitude measurement.

When all required data is entered, the RETURN key is pressed. If the numbers entered pass a ‘sanity’ check, a scan may be initiated by pressing ‘R’. This key may then be repeatedly pressed to toggle between run & stop.

If the mode is changed to ‘SINGLE’ by pressing the ‘M’ key, the mode may be toggled between SINGLE or SWEEP. Performing a mode change will stop the generator. In SINGLE mode, the only parameter which has an effect is the start frequency, which will provide a constant output at the selected frequency. No marker or trigger is produced. After mode is changed, the return key must also be pressed, to update the parameter storage.

Oscilloscope requirements:

* The scope should have sufficient bandwidth for the frequencies involved.
* It should be a dual-trace device.
* Trigger output to ext. trigger on scope.
* Markers to one ‘Y’ channel
* Other channel to display either the RF envelope, or probe output.
* Timebase switched to external trigger and ‘normal’
* ‘Y’ amplifiers switched to ‘chop’ mode.

The oscilloscope is set by first running a sweep (with two markers selected WITHIN the sweep range).

The timebase is set as required, to trigger correctly and at any convenient speed. In normal use, only two markers should be visible on the marker input. If these are duplicated, the timebase speed should be increased. The two channels are positioned for easy reading, in terms of positioning the output signal against the markers for easy identification. The signal may be read as a raw RF envelope, or via a diode detector if a single line amplitude trace is preferred. The timebase speed is adjusted simply for ease of reading – it has no bearing on result accuracy, which is determined solely by the measurement of the amplitude from the test piece, with frequency accuracy being determined by the markers.

Shutting down:

The RPi is essentially a Linux computer and should be shut down correctly. Fist the curse programme is ended with the ESC key, when a command prompt will re-appear. The command “sudo halt” is then entered, followed by the return key, after which the shutdown sequence take place. At least ten seconds should then elapse before power-down, to permit a safe and complete shut down.

Note that the ‘sudo’ prefix determines that the following command will be executed as a super-user, so should not be used unless required, as severe damage to the operating system may result from a mis-type!

Default settings:

The parameters are stored in static memory after an update (in a file named ‘data’) and these will be presented in the window boxes when the unit is next operated, even after power-down. It may be immediately re-run using those stored parameters.

Software:

There are two processes involved. The ‘curse’ programme is responsible for all parameter display, storage and operator commands. When a run command is entered, a second process is spawned named ‘dds’. This reads the stored parameters and runs continuously until a stop command or exit command is received. The dds process is responsible for converting the parameter strings to numbers, performing the required computations and loading the result to the AD9850 chip.

Compile notes:

It is necessary to install the software library known as ‘WiringP’. This is no longer included in the Raspberry sources and must be obtained from a repository such as Github. The NCURSES library is also required, which can be currently obtained via the RPi sources.