README

UPDATED 31/1/2012

This is the 2nd version of the sweep generator software,
(SweepGen v2.00). The software files are available by email only

PLEASE NOTE: That this software does not have a trigger output pulse for locking either an oscilloscope, or display when using the sweep mode. This would be very useful to others, so if anyone is able to do this, then we will supply the software files to you as long as you are willing to pass this on to Mini-Kits so that others can also use it.

The software is compatibile for both the EME85 DDS, & the complete DDS VFO Kit using the EME170 control board. Only a PIC16F648 Microcontroller with the SweepGen software (PIC16F648A SWP) is needed to change the DDS VFO Kit to a Sweep Gen Kit.

The SweepGen software also includes Power Meter software that can be used to read I2C data from the optional RF Power Head Kits PWRHEAD KIT1, & Kit2. The PIC16F648A Microcontroller is used to calibrate & read the power heads & display on a LCD module. The calibration settings for the power heads are saved into a PIC12F675 on the Power head board.

This version v2.00 has been changed to a PIC 16F648A so that there is enough code
space to add the calibration screens for the 7GHz power meter.

When using a 7GHz power meter, the 2 AD8307 power meter calibration screens, (SLOPE and OFFSET) are skipped as they are not used, but a set of claibration screens for the LTC5508 are displayed. see below for a description of how to use the AD8307 or LTC5508 calibration screens.
Also, the power meter memory numbers are changed from P1-8 to 0.5G-5.7G
This change is a simple reminder of the lookup table that is being used to convert the LTC5508 O/P to the correct I/P power.
See the 7GHz_Pwr.txt file for more details of the LTC5508 7GHz power meter.

If you are using the AD8307 power meter the sweepgen software will perform the same as SweepGen v1.00

It provides the following features,

1) SweepGen is only for the PIC 16F648A, PowerMtr is only for the PIC 12F675.
2) The sweep gen software allows 2 modes of operation,
   a) VFO (variable frequency oscillator) mode, where the encoder is used to adjust the frequency, is the default mode.
      While in this mode, VFO is displayed on the top line of the LCD.
   b) MEM (memory) mode, where the encoder is used to select a previously saved start and finish frequency and sweep rate.
3) All settings can be made in the setup screens, except the DDS chip type.
   There are separate hex files for use with the AD9850 and AD9851.

This package should include the following files.

Readme.txt	This file.
SweepGen.asm	The sweep generator program source file.
SWP_9851.hex	Hex file for programming a PIC 16F628. For use with an AD9851.
SWP_9850.hex	Hex file for programming a PIC 16F628. For use with an AD9850.
PowerMtr.asm	The AD8307 power meter program source file.
PowerMtr.hex	AD8307 Hex file for programming a PIC 12F675.
PowerMtr.txt	AD8307 power meter software comments.
7GHz_Pwr.asm	The LTC5508 power meter program source file.
7GHz_Pwr.hex	LTC5508 Hex file for programming a PIC 12F675.
7GHz_Pwr.txt	LTC5508 7GHz power meter software comments.
SWP_3x4.pdf	Circuit diagram of the press button wiring and the wiring between the EME85 DDS board and power meter, using

the 3x4 keypad and switch array as used on 2.XX of DD_SYNTH.

SWP_4x4.pdf Circuit diagram of the 4x4 keypad wiring and the wiring between the EME85 DDS board and power meter.

WARNING:- If using an AD9850 DDS chip, do not to use SWP_9851.hex file as enabling the x6 REFCLK option puts the AD9850 into a factory test mode which may cause the chip to draw more current. If left in this mode for a period of time it may cause the AD9850 chip to over heat.

**** SWEEP GENERATOR DESCRIPTION ****

The 4MHz crystal and the 2 x 22pF capacitors on the EME85 DDS board are not required but may be left on the board as they causes no problems.

The program uses a 4x4 keypad and a mechanical rotory encoder. See SWP_4x4.pdf. The right hand side of the keypad buttons A-D have the following use.

A = Step Size.
B = CAL.
C = MEM.
D = S/F.

It can also use the 3x4 keypad and switch array as used on version 2.XX of DD_SYNTH. But the meaning of the keys has been changed. See SWP_3x4.pdf. The diode between SWITCH A and LCD E on the EME129 DDS control board is not required but may be left on the board as it causes no problems. If using an EME129 DDS Control Board the button layout is.

Top left hand button = Step Size.
Middle left hand button = CAL.
Top right hand button = MEM.
Middle right hand button = S/F.
Other 2 buttons unused.

4 extra wires are connected between the DDS board and the POWER METER PCB. See SWP_3x4.pdf or SWP_4x4.pdf.

The keypad I used, had a contact resistance of 100-150 ohms, but a keypad with a contact resistance as high as 1K ohm should work ok. If your keypad has a higher contact resistance, changing the pullup resistors on SWITCH A, SWITCH B, ENCODER A & ENCODER B on the DDS board to 10K ohms should help.

The keypad keys 1 to 9, # and * are used to control the sweep functions and power meter functions. See below for details.

The keypad can be used to quickly enter any frequency in the setup screens or VFO screen.
Frequencies are entered in MHz, the first digit entered must be a 0.
The * is used to enter a decimal point, and the # is used to ENTER the completed frequency.
As an aid to verifying that keypad entry has been started, the MHz on the second line of the LCD is changed to #, this is also a reminder that # must be used to enter the number after it has been typed in.
ie. to enter a freq of 1.07MHz you would type in 01*07#

The DDS calibration screen sets the DDS to produce produce a 10MHz output.
It displays the DDS SYSTEM CLK frequency.
The DDS SYSTEM CLK should be set to the DDS crystal frequency for the AD9850 and AD9851 (using the x1 REFCLK option), and to 6 times the DDS crystal frequency for the AD9851 (using the x6 REFCLK option).

The meaning of the last digit of the sweep generator version number, displayed at power up indicates which versions is programmed in the 16F628 pic.

ver x.xO for AD9850. (DDS SYSTEM CLK = DDS crystal freq)

ver x.x1 for AD9851, 1x REFCLK. (DDS SYSTEM CLK = DDS crystal freq)
ver x.x2 for AD9851, 6x REFCLK. (DDS SYSTEM CLK = 6 x DDS crystal freq)

A memory function has been included to save and recall 11 sets of start and finish frequencies and sweep rates to EEPROM.

To SAVE the current VFO start and finish frequencies and sweep rate, hold down the MEM button for 1 second, then use the rotary encoder to select one of the 11 memories you want to save to. As an aid to selecting a memory location that is no longer wanted, the bottom line of the LCD displays the start or finish frequency of the selected memory.
Then press the MEM button again for 1 second to complete the SAVE.
A message, "SAVING" will be displayed briefly, before returning you to the VFO display screen.
If you decide that you want to return to the VFO display without proceeding with the SAVE, briefly press the MEM button, or wait for the 10 second timeout.

** Using the saved memories **

To switch from the default VFO (variable frequency oscillator) mode, (where the encoder is used to adjust the frequency) to the MEM mode, where the encoder is used to select a previously saved start and finish frequency and sweep rate, briefly press the MEM button.
"M1" will be displayed on the top line of the LCD, you can use the rotary encoder to select the memory number you want to use. While in the MEM mode the S/F button functions normally, but you can't use the encoder to adjust the frequency.
While in the MEM mode, you cannot use the setup screens, the memory save function or the keypad functions.
There are two ways to exit the MEM mode, and go back to the VFO mode.
1) Briefly pressing the MEM button, ignores the memory you were using and returns the frequency you were using prior to entering the MEM mode.
2) Pressing the MEM button for 1 second, copies the memory you were using into the VFO mode.

When first turned on, the software name and version number is displayed on line 1 of the LCD screen.
If a power meter is fitted its software name and version number is displayed on line 2 of the LCD screen.

After 1 second the VFO screen is displayed.
The frequency displayed is the same as the frequency displayed on the VFO screen before the power was turned off.
Any changes to the frequency are saved to EEPROM 2 seconds after the rotary encoder stops moving.

Pressing the S/F button changes the DDS frequency to the Start or Finish frequency. The current setting is indicated by a S or F on the LCD display before the frequency display.

To enter the calibration screens, press the CAL button, while turning on the power. After the version numbers are displayed the first calibration screen, will be displayed.

If using the AD9851 DDS chip the first screen is a screen for selecting the AD9851 REF CLOCK multiplier. (x1 REFCLK. or x6 REFCLK)
Use the rotary encoder to make the selection, then briefly press the CAL button to step to the next screen.

This screen is for calibrating the DDS reference frequency.
It sets the DDS to produce 10MHz, and displays the DDS SYSTEM CLOCK frequency.
This should be set to the DDS crystal freq for the AD9850 and AD9851 x1 REFCLK, and to 6 times the DDS crystal frequency for the AD9851 x6 REFCLK.
This can be modified to set the boards O/P frequency to exactly 10 MHz. (using a frequency counter)
This screen will continue to be displayed until the CAL button is pressed briefly.(There is no timeout on this screen)

This screen is for setting the Maximum DDS frequency that can be produced by the DDS circuit board. It is usually set to the DDS LP filter cutoff frequency.
After pressing the CAL button any DDS changes are saved in the 16F648A's EEPROM.

On all setup screens except the DDS SYSTEM CLK screen, if the buttons and rotary encoder are left idle for 10 seconds, any changes made in any of the screens will be ignored and you will be returned to the VFO display.

The power meter calibration screens will be displayed next. If no power meter is fitted you will be returned to the VFO display.

******* If using a AD8307 power meter, the following calibration screens are used. *******

The 1st AD8307 power meter setup screen is for calibrating the power meter SLOPE.
The slope is adjusted so that the power meter correctly measures the difference between two powers about 40db to 50dB apart.
First a level of about -50dBm is connected to the meter,
(the accuracy of this power is not important, but should be at the lower end of the linear range of the AD8307. Above -60dBm) This is best done using a signal generator set to 0dBm and fitting a 50dB attenuator between the sig gen and the power meter board.
Then press button 1 to turn on the dBr mode.
Next the power is increased by a known amount, ie remove the attenuator.
(The input level should be within the linear range of the AD8307. Under +5dBm)
If the dBr reading is incorrect, adjust the slope using the rotary encoder, you will have to repeat this procedure a few times because adjusting the slope will also change the 0dBr reading, so reset the input to the lower level, press button 1 twice to reset the dBr mode. Increase the input level etc.
I found that by changing the slope to give a dBr reading about 50% past the required result, corrected the error the quickest. (50% over correction)

Example using my test board, with a 0dBm sig gen and a 50dB attenuator.
1) 50dB atten fitted, dBr enabled. Then atten removed gave a reading of 51.3dBr.
2) Slope adjusted to give 49.4dBr (50% over correction) SLOPE = -3.74
3) Second pass,
50dB atten fitted, dBr reset. Then atten removed gave a reading of 50.2dBr.
4) Slope adjusted to give 49.9dBr (50% over correction) SLOPE = -4.17
5) Third pass,
50dB atten fitted, dBr reset. Then atten removed gave a reading of 50.0dBr.
6) Slope has been correctly adjusted.

Once the slope is correct, press the CAL button briefly to go to the next screen.

This screen is for calibrating the power meter OFFSET (intercept). The offset is adjusted so that the power meter correctly measures the input power.
The input level should be within the linear range of the AD8307. -60dBm to +5dBm using an accurate signal generator. If the power reading is incorrect, adjust the offset using the rotary encoder, you will NOT have to repeat this procedure as it only adjusts the offset added to the SLOPE set in the previous screen.

After the 2 power meter calibration display screens you will be prompted to save the changes. If you select YES using the rotary encoder, the changes will be saved to EEPROM in the power meter when you press the CAL button. If you select NO the changes will not be saved to EEPROM. You will then be returned to the VFO display.

There is no timeout on any of the power meter screens.

******* If using a LTC5508 power meter, the following calibration screens are used. *******

The 1st LTC5508 power meter setup screen is for selecting one of the 5 power meter
memories to calibrate. The default setting for this screen is EXIT, you can use the
rotary encoder to select a memory (1 to 5). If you leave it on EXIT and press the
CAL button you will be returned to the VFO display, but if you select a memory
before pressing the CAL button you will step to the next setup screen.

This screen is for selecting the frequency text that will be displayed in front of the power display in stead of the memory number. The range is 0.0G to 9.9G, and is set by rotating the encoder.
Again, pressing the CAL button will display the next setup screen.

This is the first of 17 screens used to calibrate the lookup table that is used by the power meter to convert the LTC5508 output to the correct input power at the selected frequency.
The upper right hand corner of the LCD shows the input power level that this point in the lookup table is for (starting at -27.5dBm), the lower right hand corner of the LCD shows the power meter's analog to digital converter result at that input power.
To calibrate the lookup table you feed a signal from an accurate signal generator
at the required frequency. The sig gen level should be set to the level shown on the LCD, then hold down the MEM button for over 2 seconds. (after 1 second the bottom line of the LCD will be cleared, after 2 seconds the current analog to digital converter results from the power meter will be entered onto the display)

Pressing the CAL button will display the next power point in the lookup table. Feed an accurate signal generator set to the level shown on the LCD, (2.5dBm higher than the previous level) then hold down the MEM button for over 2 seconds.
Pressing the CAL button briefly will display the next power point in the lookup table. Repeat the procedure for all 17 power levels. (upto 12.5dBm)

After entering the 17 power levels a display screen will prompt you to save the changes. Select YES using the rotary encoder, and the changes will be saved to EEPROM in the power meter when you press the CAL button. If you select NO the changes will not be saved to EEPROM.

After the save is completed you will be returned to the select memory screen. You can either select another memory to calibrate, or EXIT back to the VFO display.

You can use the power meter calibration screens to view the lookup table calibration values by briefly pressing the CAL button to step through the frequency
text and the 17 lookup table steps.
It is advisable to record all of the calibration results on paper so that they can be re-entered if they are accidentally erased or you make a mistake and over write the values.
To re-enter the results you don't need a sig gen, just step through the lookup table and use the rotary encoder to set the values to the same value as previously
recorded on paper.

There is no timeout on any of the power meter screens.

****
****

If the adjust step size button is pressed, a cursor is displayed under one digit of the frequency display. This can be changed using the rotary encoder. If for example it is under the 1 KHz digit, when the (adjust step size button)

is released, rotating the encoder will change the frequency in 1 KHz steps. There is also a small amount of variable rate tuning. (the faster the encoder is rotated, the greater the step size) Due to 4mS software debouncing, if the encoder is rotated to fast, no change in frequency will occur.
Any changes to the step size, while in the VFO screen, are saved to EEPROM. (changes to the step size, while in the setup screens are not saved)

If the cal button is pressed for 1 second while in the VFO screen, the power meter memory setup screens will be displayed. Adjustments relate to the current power meter memory that is in use. Memory (P1-8 or 2.4G etc) can be selected by keypad function 3 before entering the setup screens. See keypad functions below.

The first screen is for setting the value of an input attenuator or amplifier that
is fitted while using this memory.
  -dB's are used if an attenuator is fitted.
  +dB's are used if an amplifier is fitted.
Pressing the CAL button will display the next setup screen.

The next screen is the MEMORY OFFSET screen and can be used to calibrate the power
meter for this memory. It can be used to correct small offset errors or frequency
dependent errors.

After the 2 power meter display screens you will be prompted to save the changes. If you select YES using the rotary encoder, the changes will be saved to
EEPROM in the power meter when you press the CAL button. If you select NO the changes will not be saved to EEPROM. You will then be returned to the VFO display.

KEYPAD FUNCTIONS.

While in the VFO screen the following functions can be accessed by pressing the correct keypad button.

Button	Function
1	Enable/disable relative dB mode. (dBr)
2	Change the power meter display mode. (dBm, Watts, Volts) Each press of button 2 selects the next display mode for the currently selected power meter memory.
3	Select power meter memory. (P1-8 or 2.4G etc) The P or G on the LCD display will flash. Use the encoder to select the memory then press button 3 again to save the change.
4	Unused.
5	Unused.
6	Unused.
7	Change the sweep direction. Once sweeping has been started by keypad function 8 button 7 can be used to change the sweep direction.
8	Start / Halt / Resume slow sweeping. Start sweeping between the Start frequency (S) and the Finish frequency (F). The encoder can be used to increase or decrease the sweep speed. The sweep rate number is displayed on the left of LCD line 1. Sweeping up is indicated on the LCD by a ^ . Sweeping down is indicated on the LCD by a V .

Another press of button 8 will temporarily halt sweeping.
A halted sweep is indicated on the LCD by a - .
Another press of button 8 will resume sweeping.

9 Start fast sweeping.
Start fast sweeping between the Start frequency (S)
and the Finish frequency (F).
The encoder can be used to increase or decrease the sweep speed.
The sweep rate number is displayed on the left of LCD line 1.
The frequency and power displays are not updated (the pic spends
all its time updating the DDS frequency)

Exit sweep mode.
A quick press of the # button will return to VFO mode.
A 1 second press of the # button will save the current sweep
frequency to the VFO. (Only avaliable if slow sweeping)

* Unused.

There are 2 sweep modes to select from, slow and fast.
In each there are 10 sweep speeds to select from, see below.
Sweeping is performed by stepping the DDS frequency several times a second.

Slow sweep mode.

Sweep Rate Num.	Sweep Rate (approx)	Step size
0	10 Hz per sec	5 Hz per step every 1/2 sec.
1	30 Hz per sec	15 Hz per step every 1/2 sec.
2	100 Hz per sec	25 Hz per step every 1/4 sec.
3	300 Hz per sec	75 Hz per step every 1/4 sec.
4	1 KHz per sec	125 Hz per step every 1/8 sec.
5	3 KHz per sec	375 Hz per step every 1/8 sec.
6	10 KHz per sec	1.25 KHz per step every 1/8 sec.
7	30 KHz per sec	3.75 KHz per step every 1/8 sec.
8	50 KHz per sec	6.25 KHz per step every 1/8 sec.
9	67 KHz per sec	8.20 KHz per step every 1/8 sec.

Fast sweep mode.

Sweep Rate Num.	Sweep Rate (approx)	Step size
0	12 KHz per sec	50 Hz per step every 4.096 mS.
1	37 KHz per sec	150 Hz per "
2	60 KHz per sec	250 Hz per "
3	180 KHz per sec	750 Hz per "
4	300 KHz per sec	1250 Hz per "
5	1 MHz per sec	3750 Hz per "
6	3 MHz per sec	12.5 KHz per "
7	9 MHz per sec	37.5 KHz per "
8	15 MHz per sec	62.5 KHz per "
9	20 MHz per sec	82.0 KHz per "

** If using the AD8307 power meter **

On the power meter the voltage from the AD8307 is a log reading of the
power (dBm). The power meter uses the log reading for all its calculations,
but if required it can convert the log result of the power (dBm)
to a linear result (Watts or Volts) using a lookup table.

The Watts conversion has a .1 dB resolution.
The Volts conversion has a .2 dB resolution.

This means the dBm results are the most accurate, followed by Watts, with Volts

being the least accurate.

** If using the LTC5508 power meter **

On the power meter the voltage from the LTC5508 is a non-linear reading of the power (dBm). The power meter uses the memory number to select a lookup table to convert the LTC5508 O/P to the correct I/P power. The power result is displayed in dBm with a .2 dB resolution.

The Watts conversion has a .2 dB resolution.
The Volts conversion has a .4 dB resolution.

The software is designed to use a 16x2 LCD with or without a R/W pin.
(it uses delays rather than busy checks)
If the LCD has a R/W pin it should be connected to the LCD GND pin.
See SWP_3x4.pdf or SWP_4x4.pdf.

MEMORY CLARIFICATION (P1-8, 0.5G-5.7G and M1-11)

** If using the AD8307 power meter **

The P1-8 are the power meters memories, you can use any memory to save an attenuator
setting and offset and also saved in each memory is the display mode.(dBm,W,V)
You could for example setup P8 for high power use with a 40 dB input attenuator, the offset setup for use at around 500MHz and the display mode to Volts.
These settings and the calibration SLOPE and OFFSET are saved in the power meters
12F675 EEPROM.
This means that you could swap the power meter to a different sweep gen and no recalibration of the power meter is required.

** If using the LTC5508 power meter **

The 0.5G-5.7G are the power meters memories, you can use the memories to save an attenuator setting and offset and also saved in each memory is the display mode.(dBm,W,V)
The memory number is also a reminder of the lookup table that is being used to convert the LTC5508 O/P to the correct I/P power.

The attenuator setting, offset, display mode and calibration data are saved in the
power meters 12F675 EEPROM.
This means that you could swap the power meter to a different sweep gen and no recalibration of the power meter is required.

M1-11 are the sweep generators memories, each memory contains a start and finish frequency and a sweep rate number.
These settings and the DDS calibration info is saved in the DDS boards 16F648A EEPROM.

SWEEP CLARIFICATION (SLOW and FAST)

The slow sweep mode was developed to enable you to sweep between the start and finish
frequency while viewing the frequency and power reading on the LCD display. It could
be used for example to find the 3dB points of a filter, or the frequency of a notch filter.
You can use the halt or change sweep direction to examine any point of interest.

The fast sweep mode is more useful for use with a spectrum analyzer, it does not display
the changing frequency, or the power becuse it would slow down the sweep.
The F or S also does not change to a ^ or v. because the sweep is to fast for them to
mean anything useful. The halt and change sweep direction functions are also disabled.