WILDCAT REVISION 5.6 / 6.5
PROGRAM BASED ON PMOSS69'S COMMUNITY DEVELOPMENT DSO203 GCC v1.7 APP

SIGNIFICANT REVISIONS OVER ORIGINAL VERSIONS

-SUPPORT FOR 8MB DEVICES AND HARDWARE VERSION 2.81

-RELIABLE TRIGGERING: Efforts have been made to improve triggering performance, something that was notably poor with early programs shipped with the units. Note however that some time base modes have inherent overhead that can cause skipped triggers with random signals. For example, the AUTO mode times out waiting for triggers after a set time so it can auto-scan. While auto-scanning, the frame must finish before any trigger is detected. Most reliable triggering on random or intermittent signals is achieved with the "NORMAL" modes.

-A&B TRIGGER MODE: Trigger on 2 unrelated waveforms simultaneously.

-ACCURATE METERS: The inherent accuracy of an 8 bit sampled signal is rather poor, specially when only a few "steps" are involved with low signal levels. Likewise, the accuracy of time/frequency measurements can be poor when only a few samples are included in the measurement. This revision attempts to improve on this, as much as is possible with accurate calibration, summing ALL frame transfers (rather than just one frame prior to displaying the result), and where possible using quantization error correction.

-LARGE METERS: In addition to the regular types. Fully customizable using same method as the regular meters.

-MULTIPLE CONFIGURATIONS: Different program configurations can be saved and be available for recall. Can also be used to save custom meter settings.

-MENU SHORTCUTS: One button push shortcuts to access V/div, T/div, Trig source and Trig level

-ON SCREEN CHART For quick reference of button functions.

-IMPROVED CALIBRATION: Added functions can help to improve calibration. Master clock compensation (typical units are 60-80 off), the use of 3 digits of precision for voltage calibration, an indicator to precisely set the calibration on the center of a step and compensation for battery/power supply variations. While any of these can be skipped as some tend to be tedious to use, they are available for those who want improved results, and it only needs to be done once.

-IMPROVED X/Y MODE: Ability to adjust buffer size, as well as a persistence mode help "fine tuning" XY mode to properly display moving or complex patterns.

-IMPROVED WAVEFORM GENERATOR: Higher quality waveforms by using up to 10 times greater sampling rates. Also ability to continuously adjust frequency within each range.

-ADVANCED GENERATOR FUNCTIONS: Sweep, burst (adjustable from 1 to 1000 sweeps/bursts per sec), white noise, arbitrary, serial code and precision pulse waveforms. Detector mode to display frequency response. Auto synchronization in detector mode between timebases and frequency sweep to display sweep generator frequency response.

-BMP LOAD: View saved screenshots.

-MAP MODE: displays 200 frames, one per line while modulating color in response to signal amplitude. Useful for example to find missing pulses over an extended amount of time.

-PERSISTENCE MODE: allows comprehensive view of a changing signal. Can be set to continually persist, with manual reset, or to auto reset after an adjustable number of frames.

-FFT/SPECTROGRAPH FUNCTIONS: Increased gain by up to 48 decibels (in log mode) and increased dynamic range by using 32 bit buffers. Auto, log and manual amplitude scaling. Summing function provides flat frequency response. FFT magnification mode expands frequency range by up to 10000x with 7digit meters and 1PPM resolution. Persistence mode provides peak hold. Envelope display available with spectrograph.

-IMPROVED WAVEFORM DISPLAY:
    -DISTORTION Visible under certain conditions as increased noise on CHANNEL B caused by error in FPGA programming on pre-HW 2.81 devices fixed.
    -SWITCHABLE WAVEFORM AMPLITUDE COMPENSATION allows compensation "steps" to be switched off to improve waveform fidelity.
    -WAVEFORM "THICKNESS" ADJUSTMENT
    -EXCESSIVE JITTER on the fastest interpolated time bases has been eliminated.
    -NON LINEARITY at bottom of screen minimized by shifting ADC operation point.
    -AVERAGING and 8x OVERSAMPLING BUFFER MODES can greatly improve display under certain conditions, eliminating jitter for most timebases.
    -FULL SPEED OVERSAMPLING (Available with HW2.81 with included W1.1 FPGA update): 72Ms/sec sampling for ALL TIMEBASES.

-MISC ADDED FUNCTIONS:
    -AUTO-SET adjusts Vranges, Ypositions, timebase, trigger source and meter page automatically.
    -CURSOR METER displays position value of V, T or trigger cursors.
    -CURSOR SELECT METERS allows measurements to be restricted to an area of the waveform defined with cursors.
    -MIN/MAX HOLD functions store peak measured values of a waveform.
    -ALARMS can be set to go off if a value exceeds or goes below a cursor position.
    -STANDBY control: Engage standby mode manually or shut off standby timer.
    -TRIGGER HOLDOFF for the slower time bases.
    -SERIAL, I2C and SPI DECODING, showing individual byte/word positions along the waveform as well as a chart of both HEX and ASCII values
    -CHART MODE (extended time base up to 10 min/div with averaging or oversampling)
    -WAVEFORM INVERT mode for analog channels.
    -AUTO SAVE INCREMENTING BUF AND CSV FILES in chart mode allows recording large amount of data.
    -SAVE BINARY IMAGE OF ENTIRE ROM for device restoration if ever needed.
    -DIRECTORY LIST AND FILENAME EDIT.

BUTTON FUNCTIONS

TOGGLES

				L	R
1	2	3	4	5	6

ONLINE CHART   (Hold button 1 to show on device)

					TOGGLES	
BUTTONS	1	2	3	4	LEFT	RIGHT
PRESS	> double tap for auto-set	[]	O	^	<o> <ADJ>	<o> <MENU>
SHORT>	HOLD reset	AUTO TRIG	METERS sav/ld (config)	SELECT ITEM	SET TRG CHANNEL (XYperst)/ (Raw-Nor) / (Spc Func)	BUFFER (spec/env) (Change) (Spc) (Func)
LONG>	V/DIV short cut	MAN TRIG	STAND BY	T-BASE short cut	MTR PGE (w/mtrs on) WAV CAL (w/mtrs off)	MENU/MTR STDBY TIM
HOLD>	CHART	CAL (offset)	SAVE (config)	METERS CURSOR RSTRCT	TRIGGER HOLDOFF	HOLD MIN/MAX

BUTTON PRESSES: SHORT PRESS = Press button and do not hold for more than 1/2 second

LONG PRESS = Press button and HOLD for more than 1/2 second but NO MORE than 1.5 seconds (buzzer will beep and display flash after 1/2S)

HOLD   = Press and HOLD button until function appears, after about 1.5 seconds (~3 seconds for calibration menu)

1)   BUTTON 1

DOUBLE TAP: ENGAGES AUTO-SET. Press button 1 again to cancel.

SHORT PRESS: TOGGLES HOLD/RUN
RESETS MIN/MAX meters in HOLD MODE
NOTE: that CHANGING SETTINGS SUCH AS BUFFER MODES, V/div AND TIMEBASES while in HOLD MODE can result in
UNINTENDED RESULTS such as incorrect meter readings since updating is suspended. XPOS and CURSOR RESTRICT
METER MODE can be used in regular buffer modes while on hold to scroll through, view and measure buffer contents.

LONG PRESS: SHORTCUT TO ANALOG CHANNELS V/DIV MENU ITEM
If ALREADY on an analog V/DIV item, will TOGGLE THIS CHANNEL ON/OFF
If NO ANALOG channels are on, will TURN ON channel (in FFT mode will only GO to V/DIV. Toggle trace on/off with second press)
If CH-A or CH-B menu is active, will go to V/DIV item of that channel if not already on it
Otherwise will attempt to go to last channel turned on.
If wrong channel is selected when both are on, shift over with right toggle

HOLD BUTTON: DISPLAYS BUTTON FUNCTION REFERENCE CHART
Press BUTTON 1 to exit without doing anything
Press ANY OTHER BUTTON to exit chart and execute it's normal function

2)   BUTTON 2
         SHORT PRESS: Selects AUTO TRIG LEVEL
                         Will default to 1/2 of waveform level from peak to peak.   Press again to select 3/4 and 1/4 of waveform level
                         In GEN TRIG MODE WITH SWEEP OR BURST OUTPUT only 1/4 or 3/4 will be available.

         LONG PRESS: Selects MANUAL TRIG LEVEL MODE
                         Menu will shift over to TRIGGERING MENU and TRIGGERING LEVEL SUB MENU

         HOLD BUTTON: Enters CALIBRATION ROUTINE or ADJUSTS certain MENU DEPENDENT VALUES:
                         With MENU on CH A OR CH B: Enters CALIBRATION MENU
                         With MENU on TIME/DIV SUB MENU WHILE IN FULL SPEED OS MODE (HW2.81-W1.1 FPGA ONLY):
                         adjusts FULL SPEED BUFFER OVERSAMPLING SPEED (Change with left toggle)

                         With MENU on ANY OTHER than FILE: ADJUSTS ADC WINDOW POSITION

3)   BUTTON 3
         SHORT PRESS: METERS OFF > REGULAR METERS > LARGE METERS

         LONG PRESS: ENGAGES STANDBY MODE (If generator is not OFF, disables scope providing better waveform quality)

         HOLD BUTTON: Selects SAVE CONFIGURATION MENU
                         SHORT PRESS BUTTON 3 AGAIN TO SAVE (Menu will return to prior selection)
                         Default displayed after boot will be CONFIG #0 (boot up config)
                         Change config number (0 to 9) if desired before pressing to save (Active config # in use will be displayed in status area)
                         OR if in filename edit mode, will display last loaded/saved config name for editing. Press again to save.

4)   BUTTON 4
         SHORT PRESS: Selects ITEMS (sub-menus) within menus
                         IN METER ITEM SELECTION MODE (Long press right toggle center button to access):   SELECTS METER CHANNEL SOURCE

         LONG PRESS: SHORTCUT TO TIME BASE TIME/DIV

         HOLD BUTTON: Toggles CURSOR RESTRICTED METER FUNCTION   "X" appears in status area when function is ON

5)   LEFT TOGGLE: <LEFT-RIGHT> ADJUSTS SELECTED (FLASHING) MENU ITEMS
                         IN METER ITEM SELECTION MODE (Long press right toggle center button to access):   CHANGES SELECTED
                         (flashing) METER FUNCTION

         LEFT TOGGLE CENTER PRESS:
                SHORT PRESS: SETS TRIGGERING SOURCE CHANNEL
                         If only 2 channels are ON, TOGGLES BETWEEN THE TWO. If Menu is ON a channel, sets triggering to that channel.
                         If more than 2 channels are ON, acts as a SHORTCUT TO TRIGGERING SOURCE MENU (does not change source)
                         If CH-A AND CH-B ONLY are ON, will cycle CH-A > CH-B > CH-A&B

                         ENGAGES SPECIAL CONTROLS IN SELECTED FUNCTIONS (Adjustment items will show in notification area):
                                IN WAVE OUTPUT MENU (FREQ RANGE SUB MENU) Toggles WAVE OUT SPECIAL FUNCTIONS (Sweep/burst adj)
                                IN WAVE OUTPUT MENU (% DUTY PWM SUB MENU) Toggles PULSE MODE/PULSE WIDTH ADJ
                                IN CH 1 MENU (COUPLING SUB MENU) :
                                        In serial decode (RS232/TTL): Toggles SERIAL DECODE DATA/PARITY ADJUST
                                        In SPI decode   : Adjusts SPI parameters (shift between parameters with RIGHT toggle CENTER button
                                IN CH 2 MENU (COUPLING SUB MENU): In SPI decode, toggles decode data display chart
                                IN XY MODE: Toggles PERSISTENCE ON/OFF
                                IN T1-T2 MENUS while in SERIAL DECODE: Toggles AUTO (T2-T1) or MANUAL (T2+T1) MODE
                                IN NORMAL (TIME BASE SELECTED) PERSISTENCE MODE , WHILE ON PERST MENU (flashing): TOGGLES RAW
                                        (non interpolated) MODE   ON > OFF
                                IN FILE MENU: LOADS/SAVES FILE (When loading config, number in use will be displayed in status area, or name at top left of screen)
                                IN CHART MODE (with TIME BASE MENU ON TIME/DIV) Engages BUF or CSV auto incrementing file save select >
                                        AVERAGING or OVERSAMPLING buffer mode select > Back to time base menu (change settings with left toggle < >)
                                WITH MENU ON DISPLAY BRIGHT ADJUST: Engages waveform display fast rise adjust (change with left toggle)
                                WITH TIME BASE MENU MODE and AUTO MODE selected: Accesses untriggered auto mode selection (change with left toggle)

                LONG PRESS: WITH METERS ON > CHANGES METER PAGES   (Note CH-A&B page is NOT CUSTOMIZABLE)
                         CH-A&B > CH-A > CH-B > CH-C > CH-D (Note when changing pages custom selected meter items will revert to defaults.
                         If saving custom meters is desired, save configuration, custom meter settings will be stored along with other parameters)

                         WITH METERS OFF > Toggles WAVE CALIBRATION ON/OFF ("C" or "U" is displayed in status area)

HOLD BUTTON: TOGGLES TRIGGER HOLDOFF ("T" will show in notification area, position indicating relative delay. Color will be of channel color if in supported mode/timebase, greyed out if not)

6)   RIGHT TOGGLE: <LEFT-RIGHT>   SELECTS MENUS   (HOLD LEFT to go to CH-A, HOLD RIGHT to go to FILE MENU)
                     IN METER ITEM SELECTION MODE: SELECTS METER FOR CUSTOM SETTINGS

     RIGHT TOGGLE CENTER PRESS:
     SHORT PRESS: SELECTS BUFFER SIZE/MODE:
                    SHORT (1 screen wide) > SHORT AVERAGING > 8x OVERSAMPLING > FULL SPEED OVERSAMPLING > LONG (Approx 10 screens wide)
                    IN SPECTROGRAPH MODE SELECTS (IF CH4 MENU BLINKING):   SPEC > SPEC + ENVELOPE > ENVELOPE
                    IN WAVE OUT SPECIAL FUNCTIONS MODE (IN NOTIFICATION AREA):   CHANGES SPECIAL FUNCTION SELECTION
                    IN SERIAL DECODE AND SPI MODES (IN NOTIFICATION AREA):   SHIFT ACCESS TO NEXT PARAMETER
                    WITH MENU ON DISPLAY BRIGHT ADJUST: ADJUSTS WAVEFORM HORIZONTAL THICKNESS
                    WITH MENU IN FILENAME EDIT: RESETS SELECTED CHARACTER TO SPACE
                    WITH MENU ON FFT/MAGNIFY (IN NOTIFICATION AREA):   TOGGLES BETWEEN AUTO AND T1 MODE

     LONG PRESS: WITH METERS ON : TOGGLES   NORMAL MENU SELECTION > METER ITEM SELECTION (For custom meter settings)
                    WITH METERS OFF: TOGGLES STANDBY TIMER ON > OFF
                    WITH MENU IN FILENAME EDIT: RESETS ALL CHARACTERS TO SPACES
                    WITH FILE LIST DISPLAYING FOR LOADING: DELETE SELECTED FILE (press again to confirm)

     HOLD BUTTON: TOGGLES MIN/MAX HOLD FUNCTION ON > OFF (Meter MIN/MAX titles will show in WHITE when hold is on, values will show
                    in selected channel color, "H" will also show in status area)

MENUS
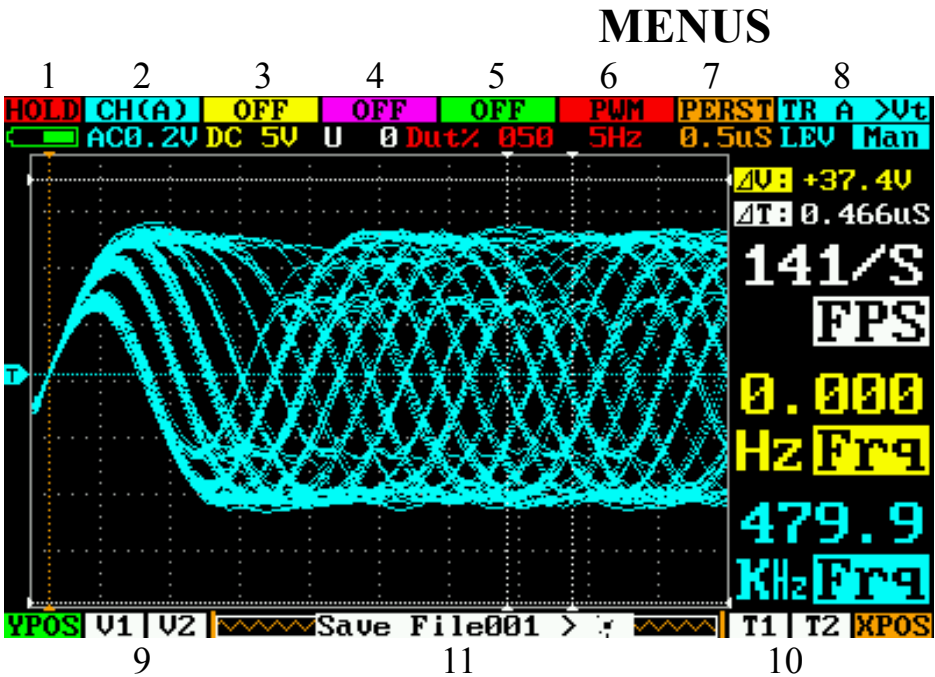
STATUS AREA: BELOW CH C (4) IN WHITE
     U or C - Wave calibration on (C) or uncalibrated (U)
     H   - Hold mode ON for Vmax and Vmin
     X   - Cursor selected meters ON
     0-9   - Active config file in present use (0 is boot up config)

1)   RUN/HOLD (display only) Displays RUN/HOLD status

<ADJUST ITEMS WITH LEFT TOGGLE>   <CHANGE MENUS WITH RIGHT TOGGLE>
                   <CHANGE SUB MENUS WITH SHORT PRESS BUTTON 4>

>>NOTE that once a sub menu ITEM has been selected, it will STAY when leaving and coming back to the menu. This is handy as it allows a quick selection between the items in different menus, however it may be confusing to first time users as the focus may seem to be flinging around randomly from place to place on the screen.

     MENUS   SUB MENUS   ITEMS

2-3) ANALOG CH A AND B
           CH source: OFF > CH(A) > CH A(inv) > CH(A)x10 > CH Ax10(inv)   (Displays CH-A=X or x10A=X, CH-B=Y or x10B=Y in XY mode)

           COUPLING   AC > DC > DT > TL > RS > I2 > SP   (AC > DC > Detector mode > TTL serial decode > RS-232 serial decode >
                                                                      I2C decode > SPI decode)   NOTE: TL and RS only available with CH-A

           VERT RANGE   50MV / DIV TO 10V/DIV in 1-2-5 steps

           Y POSITION   (Bottom left of screen)

4) **DIGITAL CH 3**
   CH source   OFF > CH(C)   (NOTE THAT CH 3 IS DISABLED if trig source is A&B)

   Y POSITION   (Bottom left of screen)

5) **DIGITAL CH 4**
   CH source   OFF > CH(D) > (A+B) > (A-B) > (C&D) > (C or D) > DAT_A > DAT_B > DAT_C > DAT_D > MAP > SPEC > hFFT_B (Hann window) > sFFT_B (Summing) > hFFT_A (Hann window) > s (Summing) FFT CH-A   (NOTE THAT CH 4 IS DISABLED if trig source is A&B)

   FFT GAIN   (In notification area, only in FFT/SPEC Modes) LOG>AUTO > 0db > +6db >.......> +36db > +42db

   Y POSITION   (In all other Modes, selection blinks at bottom left of screen)

6) **GENERATOR OUTPUT**
   WAVE TYPE   OFF > ARBTR > UART > SINE > TRIANGLE > SAWTOOTH > SQUARE > PWM > NOISE

   FREQUENCY   (RANGE)   PWM= 1HZ TO 8MHZ   NOISE= 1HZ to 1MHZ   ALL OTHERS= 1HZ TO 200KHZ

   LEVEL/DUT%   PWM= DUTY 1% TO 99%   ALL OTHERS= LEVEL 0 TO 2.6V P-P

7) **TIME BASE**
   SCAN MODE   TRIGGERING OFF > AUTO > NORMAL > NORMAL W/CLEAR > PERSISTENCE > SINGLE > XY
                            (NOTE that only NORM will show with A&B source)
   TIME/DIVISION   1SEC TO .1uS In 1-2-5 steps (10 MINS to 100 mS / DIV in CHART MODE)

   X POSITION   (Selection blinks at right bottom of screen) Shifts hor position of triggered waveform (In LARGE BUFFER MODE, notification area shows window POSITION within buffer)   WHEN PAUSED IN AVERAGING OR OVERSAMPLING BUFFER MODE only moves TRIG CURSOR

   PERS FRAMES   (In notification area, only in PERSISTENCE MODE) PERSISTENCE FRAMES: CONTINUOUS > VARIABLE FROM 1 TO 256 FRAMES

   XY SAMPLES   (In notification area, only in XY MODE)   BUFFER SIZE FOR XY MODE= VARIABLE FROM 256 TO 4096 SAMPLES

8) **TRIGGERING MODE**
   TRIG SOURCE   CH-A > CH B > CH C > CH D > CH-A&B   (Selecting CH-A&B as SOURCE disables digital channels)

   TRIG TYPE   + TRANSITIONS > - TRANSITIONS > LEVEL GREATER THAN CURSOR > LEVEL LESS THAN CURSOR > LOW LESS THAN DELTA T1-T2 > LOW GREATER THAN DELTA T1-T2 > HIGH LESS THAN DELTA T1-T2 > HIGH GREATER THAN DELTA T1-T2 > GEN

   TRIG LEVEL   Adjusts triggering cursor level (NOT AVAILABLE IN AUTO TRIG MODE)

   TRIG DELAY   (In notification area, if delay is enabled, only in NORMAL MODES, 1mS and slower and in single frame buffer mode only) Adjust trigger delay in steps of 1 major div. Shifts "T" indicator.

9) **VOLTAGE CURSORS**
   V1   Adjust top VOLTAGE CURSOR (Can be used to adjust parts of waveform to be included in meters in CURSOR SELECT METER MODE)
   V2   Adjust lower VOLTAGE CURSOR (Can be used to adjust parts of waveform to be included in meters in CURSOR SELECT METER MODE) In FFT mode, shows reference db LEVEL.

   V SOURCE   Selects CH-A or CH-B as SOURCE to display in DELTA V display at top right of screen.

10) **TIME CURSORS**
    T1   Adjust left TIME CURSOR position (Can be used to select parts of waveform to be displayed in meters in CURSOR SELECT METER MODE, also adjusts START POSITION in SERIAL DECODE MANUAL MODE) In FFT mode, shows FREQUENCY at position of cursor.
    T2   Adjust right TIME CURSOR position (Can be used to select parts of waveform to be displayed in meters in CURSOR SELECT METER MODE, also adjusts BAUD RATE in SERIAL DECODE MODE)

11) **NOTIFICATION AREA/FILE MENU**
    LOAD/SAVE   LOAD FILE > SAVE FILE
    FILE #   CHANGE FILE NUMBER (same number unit used for all types)
    FILE TYPE   CONFIGURATION FILE > ARB > UAR > ROM (BIN) > BMP > DAT > BUF > CSV (CSV and ROM cannot be loaded), ARB and UAR only in LOAD MODE)
    LIST/EDIT   If LOAD FILE IS SELECTED, FILE LIST IS DISPLAYED.   IF SAVE FILE IS SELECTED, FILENAME EDIT FUNCTION IS DISPLAYED.

OPERATION

AUTO-SET: Double tap BUTTON 1 QUICKLY (< ½ sec). Program will turn on any channel with a signal, set V ranges, Y positions, timebase, trigger source and meter page for a usable display. If no signal is present, autoset will pause and wait for a signal, notification will show status. If only DC is present, function will display it, look for a trigger for a few seconds, then terminate with a default timebase of 5mS/div. Press button 1 again at any time while function is active to cancel and revert to prior configuration.
  Autoset will use the following settings upon completion:
   -AC or DC coupling, any other selection will default to DC
   -Trig type >Vt.
    -Menu will be preset to Time/Div.
  Other settings will persist when using autoset and can be used to modify results, for example:
  -A&B trig mode will persist if both channels have signals.
  -Buffer mode and any triggered timebase mode active before autoset will be restored upon completion.

CH A, B, C, D:
VOLTS/DIV SHORTCUT: LONG PRESS BUTTON 1 to access either CH A or CH B VOLTS/DIV sub menus. Also can be used to
TOGGLE CHANNEL ON/OFF. See BUTTON FUNCTIONS section for more info.
Channels A and B are analog channels and have coupling and Y (vert) sensitivity range sub menus. Change SUB MENUS with BUTTON 4. ALL have Y position sub menus.
CHANNEL C is a simple digital channel. CHANNEL D has MULTIPLE FUNCTIONS. In addition to selecting the channel D input, it can display the sum and difference of CH A and CH B, AND and OR LOGIC between CH C and CH D, traces saved in DAT file formats (after loading the DAT file, select REC_A, B, C or D), and selects FFT, SPECTROGRAPH and MAP displays. NOTE that SPECTROGRAPH and MAP displays WILL NOT SHOW ANYTHING unless either CH A or CH B are ON (CH A has precedence if both are on)

OUTPUT GENERATOR :
ADJUST WAVE TYPE by shifting output menu. OFF > ARBT > UART > SINE > TRIANGLE > SAWTOOTH > SQUARE > PWM > NOISE.
Sine, triangle, sawtooth and square range is from 1hz to 200khz and can be ADJUSTED FOR AMPLITUDE by shifting sub menu to Vo (volts output). Best quality will be at maximum amplitude as internal digital background noise will become noticeable at the lowest settings. PWM (pulse width modulation) can be adjusted for DUTY% (Vo menu changes over to duty%) but cannot be adjusted for amplitude. Frequency for this wave type ranges from 1hz to 8Mhz. ARBT (arbitrary) wave range depends on number of samples, see "USING ADVANCED GENERATOR FUNCTIONS". SHIFT FREQUENCIES (RANGES with variable control) with FREQUENCY SUB MENU. Shift to OFF when not using generator, some of the advanced functions take a considerable amount of processor resources and can slow down main scope operation.

VARIABLE:
  CONTINUOUSLY SHIFT FREQUENCIES within each range by PRESSING LEFT TOGGLE CENTER BUTTON while FREQ RANGE MENU IS FLASHING. Frequency is displayed in notification area. (Shift back by pressing again) Adjust with LEFT TOGGLE STEPS of approx +/- 0.7%, increasing at the higher frequency ranges due to the limitations of the scaling dividers in the system. RANGE of approx +/- 1 octave above and below the selected range (4:1 ratio overall), the higher frequency ranges having lower high frequency limits due to sampling rate limitations of the internal DAC. Selected frequencies will be RESET to the range default when changing ranges. NOTE THAT FREQ ADJ CAN BE CHANGED TO SWEEP OR BURST ADJ (see "advanced gen functions").

SAMPLES PER PERIOD is 720 samples for frequencies of 2.5Khz and below, 360 for 5khz range, 180 for 10khz and 72 for the 20khz range, due to limitations of the internal DAC. Frequencies of up to 200Khz can be selected with reduced quality but can still be useful. NOTE that a DC OFFSET is present at the wave out connector, regardless of the wave type or level. This may be desirable in some cases such as driving logic circuits but in other cases may need to be filtered out externally.

TIME BASE MODES:
TIME/DIV SHORTCUT: LONG PRESS BUTTON 4 at any time to access TIME/DIV sub menu.
NOTE that in A&B TRIGGER MODE, mode will be LOCKED in NORML. Previous selection will be restored upon exiting A&B source.

<TrOFF> Triggering and synchronization completely disabled, device will start new scan as soon as it reaches the right side of the screen.
   NOTE that in TrOFF mode ONLY, extended time base is available (1 sec/div to 10 min/div, see CHART MODE).

<AUTO> Scans in normal triggered way. If triggering is lost, after an appropriate delay, will auto scan. Note that at low scan speeds, If monitoring relatively low frequencies, triggering may be lost as it may enter auto scan before being triggered again. If this happens, switch to <NORMAL> mode.
     WHILE IN AUTO trig mode, with MENU SELECTION ON AUTO (AUTO blinking):
      Press LEFT TOGGLE CENTER BUTTON to toggle UNTRIGGERED AUTO MODE SELECTION Change with LEFT TOGGLE.
      Setting is saved with config save. (Only available with HW2.81 and FPGA W1-W1.1)

UNTRIGGERED AUTO MODE SELECTIONS:
      AUTO trig CONT WAVE= Pauses each frame before displaying while not triggered so waveforms can be represented correctly.
      Data is not saved while paused for displaying so at first trigger, pre-trigger data is lost.

      AUTO trig FAST RELEASE= Lets data continuously overwrite even if display can't keep up so at first trigger event while untriggered, pre-trigger data can be displayed. However, continuous overwriting can result in broken waveform display while not triggered at faster timebases.

      NOTE that with either setting, some trigger events that occur while in untriggered display may be properly captured, so these may be missed. Use NORMAL modes to properly capture slow or occasional events if necessary.

-NORMAL MODES: <NORML> Provides best triggering as after scan is complete, the device just waits for another trigger. <NorCl> NORMAL WITH CLEAR: <NORML> mode leaves last scanned frame visible on screen while waiting for another trigger. <NorCL> clears last displayed frame after a short delay. This can be useful for example to monitor a series of identical pulses. In normal mode, new pulses would just overwrite the old one and it may not be apparent a new event has occurred.

-PERSISTENCE MODE

   SELECT <PERS> IN TIME BASE MODE: All traces will stay displayed on screen until manually reset if in CONTINUOUS MODE.
   SELECT CONTINUOUS OR AUTO RESET NUMBER OF FRAMES: With menu in TIME BASE, cycle items with BUTTON 4 to
      how FRAMES= in notification area. Change with LEFT TOGGLE. At extreme left will be CONT (continuous). Shift to right to select:
   AUTO and NUMBER OF FRAMES to show until auto resetting.
      RESET (if in continuous mode) by engaging ANY button or toggle. Freeze display with HOLD, then press again to reset.
      PERSISTENCE MODE acts as a NORMAL mode, so will not show any display (or change) until triggered.
      TOGGLE RAW MODE by SHORT pressing LEFT TOGGLE CENTER BUTTON. Raw mode turns off all interpolation, so that only data POINTS are displayed, with no lines
      connecting them. This can be useful in improving resolution when many waveforms are close to each other, since interpolation lines have a tendency to quickly cover everything
      up if too close. The first frame in RAW mode will nevertheless be displayed with interpolation to improve graphics, only subsequent frames will be displayed as data points.

-SINGLE

      SELECT <SINGL> Display pauses after capturing a single frame. Reset with SHORT PRESS BUTTON 1   NOTE that single mode will
   default to large buffer mode except in averaging and oversampling buffer mode where it will capture only 1 frozen frame (XPOS will shift trig point, not window)

-XY MODE

      SELECT <XY> IN TIME BASE MODE: Channel A is displayed along X axis, and channel B along the Y axis.
      While in TIME BASE MENU, change items (BUTTON 4) to show SAMPLES= in notification area. Change number of samples with
      LEFT TOGGLE.
      Range includes from 256 to 4096 samples, which corresponds to a frame rate of around 50 to 6 or so FPS. Faster frame rates (fewer samples) will result in a more "fluid" display
      with moving patterns, the faster a pattern is moving the faster is the frame rate necessary to follow it correctly. However, more samples improves the graphics, and if there are not
      enough samples the pattern may not be complete, showing a gap. If there are too many samples, the pattern may fold upon itself, showing multiple traces. In such a case shifting
      to a faster time base will correct this. A bit of experimentation with TIME BASE SETTINGS and SAMPLE NUMBERS will quickly show optimum settings for each display.
         For STATIONARY PATTERNS, PERSISTENCE MODE can be used. SHORT press LEFT TOGGLE CENTER BUTTON to
      toggle mode. This will improve graphics as dots will quickly populate the display to form lines.
         To SHIFT PATTERN POSITION use CHA XPOS to shift HORIZONTALLY and CHB XPOS to shift VERTICALLY

BUFFER SIZE, AVERAGING AND OVERSAMPLING MODES:
 Short press RIGHT TOGGLE CENTER BUTTON to cycle between 4 buffer modes: Color of zigzag in notification area will change with mode
      Regular single window buffer (orange) > Averaging single window buffer (green) > 8x Oversampling single window buffer (red) >
      Full speed oversampling buffer (blue)> Large buffer mode (orange) Rectangle will be orange in OS modes, white in non-OS modes.
 In any of the single frame buffer modes, notification area rectangle will occupy the whole section, while in large buffer mode an appropriate
sized rectangle will show the present position of the visible frame within the buffer. XPOS (sub menu of the time base menu) will shift the
visible frame position within the buffer.

   REGULAR SINGLE WINDOW BUFFER is used to get the fastest frame refresh rates. Scan ends at the end of the screen and the program
waits for another trigger. Single window modes are specially useful at the slower time bases, where filling the entire buffer would take a
considerable amount of time, slowing refresh rates to an unacceptable level.

   AVERAGING SINGLE WINDOW BUFFER ends scan after screen is displayed like the regular mode but accumulates multiple additional
samples and averages the result before displaying, effectively producing a low pass filter with a cut off point just above each timebase's
bandwidth. Produces very clean, jitter free waveforms with minimal noise at the expense of a somewhat slower frame refresh rate. Using this buffer
mode (as well as oversampling buffer mode, since FFT defaults to averaging in that case) with FFT functions will help reduce aliasing when out
of band high frequency components are present.

 OVERSAMPLING SINGLE WINDOW BUFFER accumulates multiple samples before displaying and records positive and negative peaks
in the waveform before displaying them as a vertical bar, effectively extending the frequency response to above the timebase's bandwidth.
Reduces aliasing artifacts and eliminates jitter in the displayed waveform. Use this to display high frequency waves or HF wave components
well above the sampling rate, when low frequency components need to be observed, such as monitoring modulation on an RF carrier.
NOTE that in this mode FFT FUNCTIONS use AVERAGING, as in the averaging buffer mode since oversampling is not suitable.

 XPOS in AVERAGING AND OVERSAMPLING MODE works a bit differently than in regular buffer modes. Instead of shifting window
position and/or adjusting the size of the buffer, buffer size is fixed, and XPOS in these two modes shifts the triggering position. When paused,
changing XPOS will only change the trigger vernier and not shift the window.

FULL SPEED OVERSAMPLING MODE: (Only available with HARDWARE V2.81 when used with included FPGA V1.1 update)
 A single window buffer mode which sets the sampling speed at a default of 72M samples/second for ALL TIMEBASES, except for very lowest
of 50Ms/div and lower for which the speed is gradually reduced to maintain a 60,000 x oversampling ratio with the timebase. Actual speed can
be adjusted gradually in steps down to 2Ms/sec by holding down BUTTON 2 for MORE THAN 3 SECONDS while menu is on TIME/DIV.
Save with config 0. Reducing speed can be useful in some cases for example to reduce noise.

How this mode works:
Incoming waveforms are sampled at a continuous 72Mhz rate, regardless of timebase. Different timebases are then generated by dividing the samples, and storing the most positive and most negative point within each of these divided periods, and representing these as one single sample on screen, which results in a vertical bar between these minimum and maximum points, the only way complete waveforms can be represented within one sample. This provides a display much like an analog scope, and extends the bandwidth to the full capability of the hardware without aliasing, regardless of timebase. Will give much better display of RF modulation envelopes and other high frequency events when viewed at slow timebases, without aliasing.

Unlike the averaged and regular (8x) OS mode, which sample triggering at 8x and store the oversampled synchronized waveform in memory, data is oversampled on the fly in this mode, as there is not enough memory to store the waveforms at these sampling speeds, so no memory exists of the triggered and synchronized OS waveforms other than the max and min values. Therefore, triggering only occurs at each display sample point as in regular modes so this mode does not benefit from the jitter stabilizing effect of the stored OS modes. METERS and FFT FUNCTIONS get an averaged or peak "screen derived" value in this mode as oversampling is processed in the FPGA and is happening at too fast a rate for the program to access and process, so these may not be as accurate as with other buffer modes, particularly when displaying a large amount of waves (or when an FFT display peak is towards the right of the screen).

NOTE: OVERSAMPLING and AVERAGING MODES from 100x to 600x are available for all hardware versions for CHART MODE (see chart mode for more info)

 LARGE BUFFER MODE records all 4096 samples and stores them in a buffer. Use XPOS sub menu of TIME BASE MODE to shift the window view along the buffer. Since all 4096 samples need to be obtained before the display refreshes, this can take a considerable amount of time, specially in the slower timebases. Gives a record of approx 10 windows width. METER ACCURACY, particularly time based meters, will benefit from using this mode, since many more samples are available for calculations.

NOTE that in SPECTROGRAPH MODE, GEN OUTPUT FREQ, BACKLIGHT BRIGHTNESS ADJUST AND SERIAL DECODE MODES where items need to be selected in the notification area, right toggle center press has a different function.

TRIGGERING SOURCE:
 TRIGGERING SOURCE SHORTCUT: SHORT PRESS LEFT TOGGLE CENTER BUTTON when NOTIFICATIONS ARE NOT DISPLAYED, to set triggering source. An attempt will be made to set source to a relevant channel. See BUTTON FUNCTIONS for more info. NOTE that this button has several ALTERNATE FUNCTIONS depending on the menu selected.
 In TRIGG MENU select TR A, B, C, D or A&B for triggering source channel. Selecting A&B will lock time base mode in NORML. Previously selected time base mode will return upon exiting A&B mode.

TRIGGERING LEVEL:
 MANUAL TRIGGERING LEVEL SHORTCUT: LONG PRESS BUTTON 2 to put trigger level mode in MANUAL. Menu will shift to LEVEL and will change to MANUAL. Adjust trigger point with LEFT TOGGLE. As long as mode is in MANUAL, item can be selected to manually set trigger level.

 AUTO TRIGGER LEVEL: SHORT PRESS BUTTON 2.   MAN in trig sub menu will change to 1/2 (sets level to the middle of the waveform) SHORT PRESS AGAIN to set to 3/4, then 1/4 of wave level.

TRIGGERING TYPES
   Change TRIGG MENU TYPE ITEM:
      LEVEL BASED: >Vt <Vt Triggers when wave crosses over the TRIGGER CURSOR to above or below.
      EDGE BASED: POS EDGE, NEG EDGE Triggers when wave crosses over the TRIGGER CURSOR on positive or negative edges
      TIME BASED: LOW LESS THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor DOWN to
               the time it crosses the cursor BACK UP is SHORTER than the DIFFERENCE BETWEEN THE T1 AND T2
               CURSORS ON SCREEN, the device will trigger when COMING BACK UP.

               LOW GREATER THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor DOWN to
               the time it crosses the cursor BACK UP is LONGER than the DIFFERENCE BETWEEN THE T1 AND T2
               CURSORS ON SCREEN, the device will trigger when COMING BACK UP.

               HIGH LESS THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor UP to
               the time it crosses the cursor BACK DOWN is SHORTER than the DIFFERENCE BETWEEN THE T1 AND T2
               CURSORS ON SCREEN, the device will trigger when GOING BACK DOWN.

               HIGH GREATER THAN DELTA T1-T2: When the period of the waveform as it crosses the trigger cursor UP to
               the time it crosses the cursor BACK DOWN is LONGER than the DIFFERENCE BETWEEN THE T1 AND T2
               CURSORS ON SCREEN, the device will trigger when GOING BACK DOWN.

     GEN: Triggers after space between sweeps or bursts from generator, on first pos transition if above wave center or neg
               transition if below. If generator is set to a continuous wave type, triggering in this mode is set to > VT.

     Note that it makes NO DIFFERENCE WHERE THE T1 AND T2 CURSORS ARE ON SCREEN, only the SPACING BETWEEN THEM. They can be positioned
        wherever it can be useful to gauge waveform width. Also note that if the time base is changed, the cursors will remain in the same relative spacing, while the
        "LOW/HIGH TIME" will change, potentially disabling triggering.

-A&B TRIGGER SOURCE

Selecting A&B as a trigger source will allow triggering on two completely different (frequency unrelated) signals simultaneously.
ONLY NORMAL TRIGGERING MODE is compatible with A&B source: Selecting A&B source will LOCK the device in NORMAL
mode. DIGITAL CHANNELS also will be DISABLED. Previous settings will be restored when exiting mode.
CHANGING TRIGGERING LEVEL either in AUTO or MANUAL mode will affect both A and B trigger cursors equally. To change each independently
shift SOURCE TO EITHER A OR B, change the level for that channel then return to A&B mode. Trig cursors will remain where set relative to each other.
NOTE that selecting A&B trigger source will DISABLE AVERAGING and OVERSAMPLING modes.

-DELAYED TRIGGER MODE:

ONLY AVAILABLE IN NORMAL MODES AT TIME BASES OF 1mS/DIV AND LOWER IN SINGLE FRAME BUFFER MODE
HOLD LEFT TOGGLE CENTER BUTTON to toggle mode. "T" shows in notification area on buffer display at approximate position
of delay. If in supported mode/time base, indicator will show in color of triggering channel, otherwise will be grayed out.
TO CHANGE DELAY: From TRIGG menu change items to select blinking "T" indicator. Move LEFT TOGGLE right to increase
delay or left to decrease in steps of 1 (major) screen division.
NOTE that at faster time bases or different triggering modes, much of the functionality of a delayed trigger can be had using the time based trigger types.
At time bases faster than 1mS/div timing integrity is lost, as frame rates cannot keep up with incoming signal, so adding extra delay becomes meaningless.
At the very fastest time bases, for example, only a very small portion of the incoming data stream is captured. The lost data period is known as "Dead Time"
and is inherent in all but the most expensive instruments available, with more expensive devices offering faster display frame rates and less dead time.

-**CHART MODE:**

For extended time base of 100mS/div to 10min/div, SELECT <TrOFF>, then shift time base to greater than 1S. This ENGAGES CHART MODE.
Time/div display turns WHITE as an indicator. Mode is NOT TRIGGERED and will CONTINUOUSLY RUN until PAUSED. RESET recording
position to extreme left of screen by pressing <PAUSE> then <RUN>. Yellow cursor at top of screen indicates present recording position.
NOTE that when sampling reaches extreme right of screen (or end of buffer in full buffer mode) recording will then start over and overwrite continuously.

In FULL SIZE BUFFER, window will scroll when sampling reaches to the right. Shifting XPOS back to view buffer will stop the window
scrolling, shifting it forward to the advancing sampling position will allow it to resume. XPOS can be used to move down the buffer
whether in RUN, HOLD or SAVED BUF FILE DISPLAY. Also note TIME BASED METERS ARE DISABLED IN CHART MODE.

The very start of the trace can be immediately observed since this mode is not triggered, unlike triggered modes where the pre-trigger 5 screen
divisions have to be captured before new data is displayed.

AUTO SAVE INCREMENTING BUF OR CSV FILES: For saving to disk continuously, new incrementing BUF or CSV files can be automatically
saved at end of each acquired buffer while in full buffer chart mode. With menu on TIME BASE TIME/DIV press LEFT TOGGLE CENTER BUTTON
to access auto file save select. Change with LEFT TOGGLE. Files will start with present # in file menu and will overwrite without notification.
IN THE EVENT OF A WRITE FAILURE WHILE AUTO SAVING (eg: drive is full) Auto save will be disabled.

CHART mode is OVERSAMPLED at ratios ranging from 100x at 0.1S/div to 600x at 10Min/div. Access AVERAGING or OVERSAMPLING (peak hold)
select menu with LEFT TOGGLE CENTER BUTTON while on TIME BASE TIME/DIV > AUTO FILE SAVE > AVERAGING/OVERSAMPLING select.
Change with LEFT TOGGLE. Selection is saved in config files.

-**METERS:**

Select meter mode by SHORT PRESSING BUTTON 3. Cycles   NO METERS > SMALL METERS > LARGE METERS. In all meters
the color displayed is the color of the source channel. Meters displaying in WHITE are either GLOBAL, not relating to any particular
channel (display brightness, battery voltage, etc) . HOLD MODE for V MAX AND V MIN meters also show in WHITE.
TIME BASED METERS ARE DISABLED IN CHART MODE.

In SMALL METER MODE:
The 5 top meters will always be, from the top:
-DELTA-V: Shows the difference in voltage, relating to the present selected range, between the V1 and V2 cursors. Change the
SOURCE CHANNEL for this while in the V cursor menu (shift RIGHT TOGGLE until V1 or V2 at the bottom of screen flashes)
Then use BUTTON 4 to cycle V1 > V2 > DELTA V. When DELTA V FLASHES, you can use the LEFT TOGGLE to select
either CH A OR CH B. The display will change to the source color for the selected channel.
-DELTA-T: Shows the difference in time, relating to the present time base, between the T1 and T2 cursors.
-FREQ: (Alternate to DELTA-T, change with left toggle after selecting with button 4) Shows frequency when T cursors span one wavelength.
-BACKLIGHT: Shows the display brightness level. Select this using the RIGHT TOGGLE. When this meter flashes, backlight
can be adjusted with the LEFT TOGGLE.
-VOLUME: Shows the level of the buzzer. Select this using the RIGHT TOGGLE. When this meter flashes, buzzer volume level
can be adjusted with the LEFT TOGGLE.
-BATTERY VOLTAGE: For display only,

In LARGE METER MODE:
-Only DELTA-V and DELTA-T will persist on all meter pages, except for the preset page showing only 2 large meters which will
also show the same small 5 meters as described above.

METER PAGES:
 Change between the 5 meter "pages" by LONG PRESSING LEFT TOGGLE CENTER BUTTON. One page is preset and cannot be
 changed and will show only 2 meters in large meter mode. LONG PRESS again to access 4 customizable pages, each preset to
 favor one of the channels.

CUSTOMIZABLE METERS:
  BOTTOM 9 REMAINING METERS (top 3 in large meter mode) can have their items and source changed.
  LONG PRESS RIGHT TOGGLE CENTER BUTTON to change focus from the regular menus to the meters. Use RIGHT TOGGLE
 to select meter to customize. LEFT TOGGLE will CHANGE METER ITEMS. SHORT PRESS BUTTON 4 to change METER ITEM
 SOURCE (meter color will change to the channel's color).
   LONG PRESS RIGHT TOGGLE AGAIN to revert to regular menus.

NOTE that depending on the source, some items may not be available (eg: DC volts from digital CH C or D)
>> ALSO NOTE that while you can change from large to small to no meters without affecting custom meter settings, CHANGING
 METER PAGES will RESET custom settings. IF IT IS DESIRED TO SAVE CUSTOM METER SETTINGS, save the settings to one of
 the additional CONFIG FILES. Meter settings of the displayed page will be restored upon reload, along with all other settings.

-METER ITEMS:
 Customizable items that meters can be set to display: (color indicates source channel selected)
 NOTE that only time based items can be displayed with digital channels.

 Voltage ranges displayed: mV, V
 Frequency ranges displayed: mH, Hz, Khz, Mhz
 Time ranges displayed: nS, uS, mS, S

 Vbt = Battery voltage
 FPS = Frames per second. Display refresh rate (note that at the slower time bases, frame rates will be faster than data refresh rates)
 Vdc = Average voltage of the displayed waveform
 RMS= Effective DC equivalent of an AC waveform (note that this includes any DC offset present with the waveform)
 Frq =   Frequency of displayed wave (Needs to have at least one complete period within display, starting with a positive alternation)
 Max = Maximum voltage attained by waveform from entire buffer.
 Min = Minimum voltage attained by waveform from entire buffer.
 Vpp = Maximum peak to peak waveform voltage
 Per =   Time span of one complete measured waveform, averaged from all waves in entire buffer
 Dut =   % duty cycle, time waveform was above mid point in relation to when it was below
 TH =   Time waveform was above mid point within one complete measured waveform, averaged from all waves in entire buffer.
 TL =   Time waveform was below mid point within one complete measured waveform, averaged from all waves in entire buffer.

-CURSOR SELECT METERS
 To toggle mode HOLD BUTTON 4 until notification appears. An "X" will be displayed in status area with mode active. All meter readings
  will be restricted to between the time cursors T1 and T2. For frequency and time meters, at least one positive alternation followed by
  a negative alternation must be enclosed for the time meters to register. The "trigger point" in calculating time measurements will
  be half way of the peak to peak value of the enclosed signal. This can be changed by using the V1 and V2 cursors. The V1
  cursor, if brought down below the middle of the signal, will lower the trigger point as it goes down below it. Similarly, the V2
  cursor if brought up above the trigger point, will raise it. The V2 cursor has precedence over V1, so if V1 is brought down below
  V2, V2 if brought up, will define the trigger point for measurements.

   T1 and T2 can independently be disabled while in this mode by bringing T1 all the way to the left of the screen, or T2 all
  the way to the right of the screen. With T2 all the way right, all data to the end of the buffer is included, if T1 is all the way left
  all data from the start of the pre-trigger section (150 samples before the trigger point indicator vernier) will be included.
  Works whether in RUN or HOLD, and at all Xposition settings in both buffer modes (long or single frame).
   In DETECTOR mode, cursor select mode will show a frequency display at the bottom of the screen (see using advanced gen functions)

-MIN/MAX METER HOLD MODE, ALARMS
    HOLD MODE allows the HIGHEST/LOWEST displayed values to be recorded and saved. To toggle, HOLD RIGHT TOGGLE
  CENTER BUTTON until notification appears. "H" will be displayed in the status area when mode is active. MIN and MAX items in
  meters will show in WHITE. Values will show in SOURCE COLOR. Press HOLD, then RUN to RESET. Changing any parameter which
  is related to Y display will also reset function (eg: Y range, Y pos, etc). Changing buffer size will also reset function.
  ALARMS are also ENABLED in this mode. When waveform either goes ABOVE V1 or BELOW V2, buzzer will sound as long as
   the waveform is either above or below, and for approx 1 second after.
  DISABLE ALARMS: Move V1 cursor to the very top of the screen to disable it, and disable V2 by moving it to the very bottom of the screen.

CURSORS:
 Shift menu selection with RIGHT TOGGLE until V1/V2/DELTA-V or T1/T2 are selected. Change items with BUTTON 4. Shift cursor positions with LEFT TOGGLE.
 With DELTA-V selected, SOURCE CHANNEL of the display can be changed with LEFT TOGGLE.

NOTE THAT CURSORS HAVE ADDITIONAL FUNCTIONS:
   -IN TIME BASED TRIGGERING TYPES: The difference in position between T1 and T2 determine the reference to whether a low/high
    pulse is either shorter or longer than to trigger on.
   -IN FFT MODE: T1 can be used to indicate frequency. V2 can be used to indicate level in decibels.
   -IN CURSOR SELECT METER MODE: T1 and T2 can select which part of the waveform to measure. V1 and V2 can be used to select
    which part of a waveform the frequency and time meters respond to.
   -IN SERIAL DECODE MODE: The difference between T1 and T2 sets the baud rate. In manual mode shifting either will shift both together
    so start position can be changed without changing baud rate.

     TRIGGER LEVEL CURSORS will show with a "T" on left side of screen in color of the selected channel. Adjust while in manual mode with
 trigg menu item LEV with LEFT TOGGLE.
     TRIGGER POINT CURSOR is an orange vertical cursor that shows the exact point when the device triggers on the signal. It's position can
 be shifted from the center of the screen towards the left with the LEFT TOGGLE while XPOS is selected.

CURSOR METER:
 Position values of various cursors can be displayed at left top of screen. Display will show when menu is on either V vernier, T vernier, Xpos (will show T verniers) or trigger level
  if in manual trigger mode.
  When menu is on T cursor adjust or Xpos, display will show T1 or T2 time from trigger point.
  With untriggered modes display will show T1 or T2 time from start at left of screen (mainly useful in chart mode). Chart mode timebases slower than 1S/div will display in (hours)
  (minutes) Seconds.
  Display will show a negative number if T1 or T2 is positioned to the left of the trigger point, indicating time before trigger.
  V cursors will show position of cursor from Ypos waveform centerline for selected channel.
  If meters are on, display will stay on, otherwise display will show for a few seconds after selecting or adjusting and then shut off.
  Cursor display is disabled if FFT is engaged to prevent overwriting FFT values. Also, in persistence mode display will "persist" along with waveform until updated or reset.
  Display can be disabled, with menu on T vernier or V vernier, select delta time/freq with button 4 (T1 > T2 > delta time/freq) for T cursors or channel select for V cursors (V1 > V2 >
  chan select). Press center left toggle to toggle display enable/disable. T and V displays can be enabled/disabled independently. Notification will show status when toggling. Save with
  boot config if desired, otherwise default will be both enabled. Trigger cursor will be enabled/disabled along with V cursors.

FILE FUNCTIONS:
 SHIFT MENU ALL THE WAY TO THE RIGHT using RIGHT TOGGLE to access the file menu. Toggle can be just held right until it stops.
 With BUTTON 4 select   LOAD/SAVE >   FILE# >   FILE TYPE (BMP, DAT, BUF, CSV, CFG, ARB, UAR, ROM) > FILE EDIT or FILE LIST
 CHANGE ITEMS with LEFT TOGGLE. EXECUTE file operation by PRESSING LEFT TOGGLE CENTER BUTTON

 Select FILE TYPE first before engaging FILE EDIT or FILE LIST. If file LOAD is selected, file LIST will be displayed. If file SAVE is selected,
 EDIT BOX will be displayed. Default numbered files can be alternatively be saved/recalled using numbers selected in FILE# sub-menu.

 With LIST displayed, use LEFT TOGGLE to move blinking selection up down list of filenames. Use RIGHT TOGGLE to move selection one page
 up/down at a time if there are a large number of entries. SHORT PRESS LEFT TOGGLE CENTER BUTTON to load selected file. Last loaded file
 will remain highlighted as a reference until file type is changed. Button 3 can be used to load config files and exit file menu. Config files loaded from
 list will have name displayed on left side of screen. Characters not in the Quad's character table (if renamed externally) will be displayed as a dot (eg: tidle "~"
 used by Windows to truncate long file names, followed by a number). BOOT CONFIG 0 will NOT be displayed in list, as this is a WPT file with a unique name.

 DELETE FILE: With LIST displayed, delete selected (blinking) file by LONG pressing RIGHT TOGGLE CENTER. Press again to confirm delete, any other button to cancel.

 With EDIT BOX displayed, change selected character with LEFT TOGGLE. Available characters are, in sequence: MISC SYMBOLS > 9-0 > SPACE > A-Z
 Filenames of previously loaded BMP and BUF files will show as default in edit box if file type has not been changed, otherwise, spaces will show as default.
 LAST LOADED CONFIG FILE FROM LIST or LAST EDITED & SAVED CONFIG will remain as default when engaging edit CFG, even if file type has been changed.
 RESET selected character to space with SHORT press RIGHT TOGGLE CENTER BUTTON, reset ALL characters with LONG press RIGHT TOGGLE CENTER BUTTON.
 SPACES can be left in filename. MID-NAME spaces will be replaced with underscores, all other spaces will be removed.

 RIGHT TOGGLE can escape from both edit box and file list. To keep selected position on either edit or file list after leaving functions, first shift over to another sub-item
 with button 4. When re-engaging editing or list, previous selection will be restored, unless file type has been changed.

 FILE TYPES:
   -SAVE BMP for a screenshot of the device. Can be exported via USB or loaded back into the device to display.
   -LOAD BMP to view saved screenshots.
   -SAVE DAT files save the screen trace buffer from all 4 channels. Only what is visible on the screen is saved.
   -LOAD DAT loads saved screen buffer traces into CHANNEL D   <REC_A> <REC_B> <REC_C> <REC_D> buffers. Selecting
    these from the CHANNEL D MENU SOURCE will display one of the 4 channels.

-SAVE BUF saves the entire buffer (1 screen in single screen buffer mode or ~10 screens in large buffer mode) for all 4 channels along with the relevant
 time base, channel range, and buffer type information.
-LOAD BUF loads a saved buffer file and puts the device in HOLD for displaying. If saved from a large buffer, XPOS can be used to scroll the window through the
 buffer. Engaging RUN will exit display and return to previous settings. Serial, SPI and I2C modes can be used with BUF file loads but the timebase should not be changed.

 -SAVE CSV saves an exportable file to load in external spreadsheets and waveform display utilities. The first field contains a time reference for each sample, starting
 from the trigger point. Samples before the trigger point with show as negative numbers, indicating the time before trigger. In untriggered modes (eg: chart mode), start
 point will be at first sample.
 If digital channels are OFF, channels A & B will be in the next 2 fields with a scaled voltage value referenced to the 0 baseline. If an OS buffer mode is active, 2 sets
 or fields will be present for each analog channel, the first representing the high values and the second the low values. Both can be superimposed to represent the
 oversampling display. NOTE that at 2uS/div and faster for 8x oversampling (red buffer indicator) the buffer mode reverts to a NON oversampling mode because of buffer
 size limitation. With FULL SPEED oversampling (blue buffer indicator, available only with HW2.81 and V1.1 FPGA) the buffer reverts to a NON oversampling mode
 at timebases of 0.2uS and 0.1uS/div, since sampling is already at full speed for each sample.
 If any digital channel is ON, all 4 channels are represented as they appear on the device to display timing relationships, with numbers representing ADC steps or vert pixels.

 -LOAD ARB loads a comma delimited text file with a sequence of numbers defining output of the arbitrary wave generator function.
 Output type selected must be ARBTR before loading the file for this to have any effect.

 -LOAD UAR loads a file of any format for generator serial transmission. File can be of any length, but only the first 4096 bytes will be
 transmitted. Output type selected must be UART for this to have any effect. Transmission starts after this file is loaded.

 -SAVE CFG saves an alternate config file that can be recalled later to restore the saved settings. Up to 9 of these can be saved if using the default numbering method,
 in addition to the default boot-up config. A number in the status area shows the presently loaded config. #0 will always be the default boot config (XXXX.WPT) while
 the additional files have a CFG extension. Any number of additional config files can be saved if edited with the filename edit function. When these are loaded after
 selecting from the filename list, the name will show at the top left of the screen, just below the RUN/HOLD display.
 HOLD BUTTON 3 for a shortcut to SAVE CONFIG, then press BUTTON 3 AGAIN to save. Default will save file #0; change number with
 left toggle to save to an alternate file or edit filename before pressing button 3 again if desired.

 -LOAD CFG will restore previously saved settings. LOAD CFG#0 with the file# flashing will be the default file menu setting after boot-up.
 This makes it easy to select alternate configs: just hold RIGHT TOGGLE right until menus stop, CHANGE CONFIG NUMBER with LEFT TOGGLE.
 OR engage file list to load highlighted blinking file, then press LEFT TOGGLE CENTER BUTTON to load. File menu will stay with numbers or
 file highlighted, making it easy to "browse" though other configs. OR press BUTTON 3 to load and restore menu selection saved with config.

 -SAVE ROM: This saves a 512KB binary image of the complete ROM, including bootloader, licence, SYS, all apps, FPGA and logo in .BIN format
 for restoring device via internal header if ever necessary. Filename is set to ROM_IMG.BIN and cannot be changed. Make sure enough space is
 available on drive before using this, or saving ANY TYPE OF FILE if the drive is ALMOST FULL, specially on 2MB devices. If there isn't, the
 system's file access functions leave the failed entry behind and uses up the remaining space. Deleting the entry may not restore the lost space,
 only after repairing the volume with a utility such as CHKDSK (from the command line in Windows) or reformatting can the lost space be recovered.

FFT MODE
   FFT mode is part of CHANNEL D. It can quickly be accessed by moving left toggle left while in CH D menu, if set to OFF.
 You can scroll backwards: hFFT channel B < sFFTchannel B < hFFTchannel A < sFFTchannel A < OFF
 2 window modes are available: Hann (h) or Summing (s).
   The SUMMING MODE is not actually a window, but a function that sums any detected peak with it's neighbors. This provides an absolutely flat
 frequency response, at the expense of the two frequencies above and below the peak. For most measurements this won't be noticed, and is the
 preferable mode to use. When displaying signals of constantly varying frequency (such as music), the "every other frequency missing" notches may
 be apparent. In such cases it may be preferable to use the Hann window. It should be noted that in this mode, ALL frequencies CAN be displayed.
 Only where there is a peak are the neighboring frequencies restricted.
   TO MINIMIZE ALIASING buffer mode can be set to either AVERAGING or 8x OVERSAMPLING. In either case, AVERAGING WILL BE USED. There is no
 advantage to using the full or large buffer mode, this will only slow the frame rate down. FULL SPEED OS MODE (available only with 2.81 and up devices) can give
 poor results, particularly towards the right half of the screen where the waves are clustered close together: other buffer modes are generally cleaner and more accurate.

   MAGNIFICATION MODES: in CH D menu, while in one of the 4 FFT sources, press BUTTON 4 to display MAG modes in notification area. 2 modes are
 available: AUTO and T1 mode. Toggle between the two with RIGHT TOGGLE CENTER BUTTON. Engage either mode by pressing LEFT TOGGLE CENTER
 BUTTON. Press again to leave mode. When this is engaged, waveform trace and regular meters will be disabled, as their display would be irrelevant. Higher resolution
 frequency meters will be displayed instead. Wave trace can be turned back on manually while in this mode but regular meters will be locked out.
     AUTO MODE: Used to lock on to and display a triggered signal. Adjust for a stable waveform display with a readable frequency with the spectrum peak near center. If 2 or
 more frequencies are interfering with each other preventing a stable waveform and frequency display, use T1 mode instead. An unstable display before engaging will result in
 inaccurate readings in auto mode when magnified. With "AUTO MAG: 0x" displaying in notification area, press left toggle center button. This engages the MAG mode, centers
 the peak and engages higher resolution meters. Notification area will show MAG: 1x. This "base level" represents an approx 5 fold expansion over the regular display, depending
 on where the peak was positioned in the regular display before engaging. An additional 2000x is available in 2-5-10x steps by using the LEFT TOGGLE. The program will
 attempt to re-center the peak when magnifications levels are changed. Use the RIGHT TOGGLE to SHIFT the WINDOW left or right to position peak if necessary: If the
 window is shifted so far with the right toggle that the peak goes beyond the right or left side, reading will be lost: shift the window back to restore. NOTE that if the waveform
 peak itself however drifts beyond the sides, it will "fold back" with an incorrect reading, keeping the peak within the window with the right toggle will prevent this.

At right/bottom of the display, start and end meters will show the frequency at the left and the right side of the spectrum window. At higher magnifications, meters will show greater resolution and accuracy, however, the screen refresh rate will slow down, limited to about 3 - 4 or so seconds per frame as the slowest for lower frequencies. If for any reason the display is suspected to have shifted beyond the window limit, because the frequency has drifted or the window has been shifted too far, press LEFT TOGGLE CENTER BUTTON TWICE TO RE-ALIGN. The second press will return to the previous magnification level. Shift window back to center if necessary with the right toggle. Magnification level with mode engaged will remain until changed, T1 mode is engaged, FFT is disabled or the device is restarted. It is not saved in configs.

T1 MODE: Used to lock on to the frequency indicated by the T1 cursor BEFORE engaging mode. First adjust for the desired frequency with the timebase and T1 cursor. The T1 CURSOR can be SHIFTED with the LEFT TOGGLE - BEFORE engaging mode. Then with T1 MODE MAG= 0 displayed, press LEFT TOGGLE CENTER BUTTON. Default magnification is x1, since as magnification is increased with the LEFT TOGGLE, the frequency likely will have to be SHIFTED MANUALLY with the RIGHT TOGGLE, to stay aligned with the T1 cursor by moving the window. Shifting the window to the LEFT will INCREASE the frequency at the T1 cursor, shifting it to the RIGHT will DECREASE it. The T1 cursor can be used to adjust to the exact frequency, but it will be reset if the window is shifted in the highest magnification level selected. For example: If magnification is increased all the way to x2000 and the T1 cursor is shifted over to some peak to determine it's exact frequency, shifting the window to move the display will reset the cursor to it's mid-screen position. However, backing off to x1000, x500, etc, everything will remain in place, and shifting the window at these lower magnification levels will not affect the T1 position, only if magnification is brought back again to x2000 (or any other max level attained) will shifting the window reset the cursor. Resetting by pressing the left toggle center button twice while the notification is showing T1 MODE will reset display to x1.

IN BOTH MAGNIFICATION MODES: LONG PRESS BUTTON 4 shortcut to time/div is changed to a SHORTCUT to TOGGLE BETWEEN MAG MODE AND T1 ADJUST WHILE THE MODES ARE ENGAGED, OR T1 MODE SELECTED, otherwise, if the MAG sub menu is NOT selected, the shortcut works normally. This makes it easy to adjust the cursor in T1 mode. Settings such as timebase, meters and cursor position changed while in these modes will be restored upon leaving. ALSO NOTE that FREQUENCY ACCURACY will depend on properly compensating the CPU clock with an external standard with the PPM clock adjust function. PPM adjust can now also be accessed without entering calibration, while displaying the ADCoffset control, use the left toggle center button to toggle between the two. >> To determine whether additional waveform peaks are sidebands associated with a frequency, shift the window with the right toggle. If peaks are part of the main waveform, they will shift with it. If they are just background peaks not part of the window's range, they will move away to random positions. Often, background harmonics of the main signal can be hidden this way, either pushed over to the sides or behind the main peak.

FFT GAIN can be adjusted by a factor of 42db. Dynamic range is such that even with +42db gain setting, a full scale waveform will not overload. TO ADJUST FFT GAIN, while in the CH D menu, and in any FFT/SPECTROGRAPH mode, press BUTTON 4 (source > magnification mode > gain adjust): A gain display will show in the notification area. Use left toggle to change. Selecting towards the left will show AUTO. In this position, gain setting will automatically change in relation to the signal level. For constantly changing waveforms (music for example) or to gain extra resolution with large amplitude signals, switch over to manual settings, (0 to +42db in 6db steps). LOG AMPLITUDE SCALING can be selected in notification area gain menu   LOG > AUTO > 0db > +6db > .... > +42db In FFT mode, V2 CURSOR functions as a level reference (shown at top of screen). Value for this as well as the db scale on the right will change with different gain settings. In a similar way, T1 cursor can be shifted to indicate frequency. NOTE that the frequency displayed on peaks is not the frequency of the signal but the "bin" center frequency. Bins at the far left carry a RELATIVELY wide range of frequencies and may not show the exact frequency of the signal. Accuracy will improve for peaks away from the left edge. PERSISTENCE MODE: If this is engaged while in FFT mode, will act as a "peak hold", as all display frames will stay on screen. Reset with any button, or freeze with HOLD and press again to reset. Note that in this mode, the "floating" peak frequency display and red indicators will be disabled, as any reference to the actual peak will be lost. TO DISABLE PEAK FREQUENCY READOUT AND INDICATORS: Shut meters off. Readout will only show with meters on. This may be desirable for example when displaying music, as the indicator will be doing much flinging around.

SPECTROGRAPH

THIS IS ALSO PART OF CH D: In DIGITAL CHANNEL D MENU, select SPEC. Either channel A or channel B MUST be turned on, and selects the input for this mode. If BOTH are ON, CH A has precedence and will be displayed. SPEC MODE displays the FFT frequency spectrum on vertical rising lines, one for each frame. The COLOR at any given point defines the LEVEL, from dark blue > cyan > white > red as the amplitude rises, and the HEIGHT defines the FREQUENCY. TO DISPLAY ENVELOPE: SHORT press RIGHT TOGGLE CENTER BUTTON to cycle SPEC > SPEC WITH ENVELOPE > ENVELOPE ONLY. A MOVING CURSOR (short yellow line) will display at top of screen to show scan position, frequency scale at the left and seconds "ticks" will be displayed in all but the slowest time bases. ADJUST GAIN and scaling in the same way as with FFT GAIN adjust. Does not affect envelope level.

MAP MODE

CHANGE CHANNEL D MENU TO MAP. Either channel A or channel B must be turned on, and selects the input for this mode. If both are ON CH A has precedence and will be displayed. MAP MODE displays normal oscilloscope waveform level as a changing COLOR, each frame on a single horizontal line, so therefore has the ability to display 200 simultaneous frames. COLOR varies according to signal position on screen, with bottom of screen showing as black or dark blue, middle as cyan, and top as white or red. Note that adjusting Y POSITION CHANGES THE BACKGROUND, if no signal is displayed or changes the signal mid-point color if a signal is displayed.

WAVE CALIBRATION ENABLE/DISABLE

Toggle WAVE CALIBRATION ON > OFF with LONG PRESS LEFT TOGGLE CENTER BUTTON   WHILE METERS ARE OFF. "C" for calibrated or "U" for uncalibrated will display in the status area. Turning calibration OFF can be useful to preserve waveform quality. Calibration compensation is accomplished by introducing "steps" along the waveform, increasing or decreasing amplitude. Under some conditions these can be visible and detract from showing an accurate display of the monitored waveform. Has NO EFFECT on METERS, these show calibrated values at all times.

STANDBY CONTROLS

Device will by default engage standby mode whenever no buttons have been pressed/toggled for 10 minutes. Press any key to resume from standby, key will not perform any other function. When engaging STANDBY with GENERATOR ON device will only DISABLE the scope, minimizing jitter caused by scope operation when the device is used only for it's generator functions. When powering/charging device from an AC adapter/USB standby is disabled. MANUALLY ENGAGE STANDBY (or disable scope if generator is on) with LONG PRESS BUTTON 3. TOGGLE STANDBY TIMER ON/OFF with LONG PRESS RIGHT TOGGLE CENTER BUTTON while meters are NOT SHOWING. This setting is NOT saved when saving config, will reset to default standby enabled after reboot.

USING ADVANCED GENERATOR FUNCTIONS

-Sweep and burst modes are available for all wave types except noise and arbitrary.

-SWEEP AND TONE BURST GENERATOR: While in OUTPUT MENU, FREQ sub menu, SHORT press LEFT TOGGLE CENTER BUTTON to display special generator functions. SHORT press RIGHT TOGGLE CENTER BUTTON is then used to cycle through FREQ ADJUST > FREQUENCY SWEEP PERIOD > TONE BURST RATE > TONE BURST DURATION > TONE BURST FREQUENCY > back again to FREQ ADJUST. Relevant value will be displayed in notification area. Change values with LEFT TOGGLE.

TONE BURST RATE and TONE BURST DURATION are shown in same display, use LONG press RIGHT TOGGLE CENTER BUTTON to go backwards from BURST FREQ to BURST DURATION to TONE BURST RATE if necessary.

While in sweep mode or burst mode, output display will show in WHITE. In continuous, arbitrary or OFF mode, display will show in RED.

All modes will remain AS SET if menu is shifted away and will be saved with configuration. When not using generator, shifting wave type to OFF will allow all resources to be available to scope function and provide best performance.

-TRIGGERING on sweep and bursts can be facilitated by selecting "GEN" mode in triggering type menu. In this mode, triggering is set to trigger after the time span between sweeps or bursts, on the first positive transition if the trigger cursor is above the wave center, or the first negative transition if it's below. NORMAL SWEEP MODES should be used, as auto mode can time out between sweeps/bursts and cause instability. AC COUPLING should also be used if DC from the generator is present at the input, as it will prevent the program to find the wave center. ALSO, in this mode, auto trig is restricted to 1/4 and 3/4 level of wave as a transition may not be detected at the half way point. MAN trig level gives best results since spaces between sweeps/bursts can cause auto trigger instability.

GEN menu selection COLOR will change from channel color to GRAY if the combinations of settings (most likely timebase) or hardware limitations (eg: max time between sweeps > 4096 samples, limited by 12 bit variable in FPGA) can't guaranty triggering even if trigger level is properly set. In such a case, triggering may work ok but may not as certain settings are changed. In such a case, change timebase until GEN changes back to channel color.

-RANDOM NOISE MODE: Shift wave type to NOISE. Change bandwidth with FREQ sub menu. Noise mode is not adjustable as to output level. At 20Khz and below, noise is filtered with a 10X oversampling filter, below 1Khz with a 100X oversampling filter. Above 20Khz no filter is used and the generator will output raw digital samples.

-PULSE MODE: Shift mode to PWM continuous (shift output function using left/right toggle center buttons if necessary to move out of sweep or burst modes). While in OUTPUT MENU change sub menu to %DUTY using BUTTON 4. Adjust %DUTY with LEFT TOGGLE to the approximate value desired (for very short pulses this can be set to either 0% for positive pulses or 100% for negative pulses). While in %DUTY sub menu SHORT press LEFT TOGGLE CENTER BUTTON to access PULSE LENGTH display in notification area. This also engages pulse mode. Note that engagement of this mode is NOT saved with config files. Adjust pulse length with LEFT TOGGLE. For large changes, shift back to %DUTY with LEFT TOGGLE CENTER BUTTON, then back again to set to desired length. If %duty is less than 50%, pulse length will show as +value, if more than 50% length will show as a negative pulse length value, decreasing as the setting approaches 100%.
-While in PULSE MODE, repetition rate (frequency) can be adjusted by shifting sub menu to FREQ and changing range or by engaging the VARIABLE FREQUENCY DISPLAY in the notification area. Pulse length will not be affected by changing frequency. If very small values are used and the frequency is shifted to lower values, length might then increase if the set values are less than the minimum values supported. Also, while shifting ranges, some set length values may shift very slightly longer/shorter as different available division ratios are engaged.

-ARBITRARY WAVE MODE: First shift wave type to "ARBT". Then access file menu, select LOAD, ARB type and load desired file. Change frequency range and adjust frequency in the normal way. ONLY FREQ sub menu and FREQ ADJUST mode with display in the notification area are supported in this function. Wave will stay in memory until a different wave type is selected. Maximum frequency range available will depend on the number of samples used.
-GENERATING ARBITRARY WAVE FILES: This is a plain text file with a sequence of numbers ranging from 0 (max neg value) to 4095 (max pos value). Commas are used to separate the numbers as in a CSV (comma separated values) file. They can be generated manually or with any program that can create these type of files. Compilers and interpreters for example can easily write a math formula or algorithm as a sequence of numbers to a file. The program will ignore any whitespace or other characters other than numerals or commas. 3 simple rules apply: 1) First value MUST define how many samples are used. This can be anything from 2 to 720 samples. 2) There MUST be at least as many following numbers describing the wave as the first sample number indicates. If there are not, the program will generate an error upon loading. If more are present the program will simply ignore the surplus. 3) The last value MUST be followed by a comma. Programs that generate these types of files typically do NOT add a comma after the last field, so this may have to be added manually with a text editor. Alternatively, an extra value could just be added.

FOR EXAMPLE: The simplest waveform would be a square wave and could written like this: 2,0,4095,   and would be a full amplitude square wave with a frequency adjustable from 1Hz to 900Khz.
SAVE or RENAME the file with a filename in the format of DATAxxx.ARB where xxx can be anything from 000 to 255.

-SERIAL CODE GENERATOR: Shift wave type to "UART". Change menu item to "FREQ". Notification area will show parameters
to adjust. Use SHORT PRESS RIGHT TOGGLE to change blinking cursor to select BAUD RATE, FORMAT, STOP BITS and
CONTINUOUS modes.
Adjust BAUD RATE from ~1100 to 4,500,000 with LEFT TOGGLE. Use SHORT PRESS LEFT TOGGLE to change between
FAST and FINE adjust rates.
Change FORMAT   7Pe > 7Po > 8N > 8Pe > 8Po > 9N with LEFT TOGGLE, where 7/8/9= Number of bits (including parity),
 Pe= Even Parity, Po= Odd Parity and N= No parity.
Select STOP BITS: 1 or 2 bits (1S or 2S) with LEFT TOGGLE.
Select SINGLE TRANSMISSION or CONTINUOUS (1 or C): In SINGLE mode data is output once after a file is loaded, then the line
is idled (high logic). In CONTINUOUS mode, data from the file is continuously resent, without any pauses, breaks or other interruptions.

INITIATE SERIAL TRANSMISSION by LOADING a DATAxxx.UAR file from the FILE MENU while the generator is in UART mode.
UAR file can be of any format. The program will parse it out and transmit it as a sequence of single bytes. File size is limited to 4096 BYTES,
if the file is longer only the first 4096 bytes will be transmitted.

STOP TRANSMISSION (if in continuous mode) by changing ANY of the adjustment parameters (eg: change "C" to "1")

MODE/FUNCTION LOCKOUTS
 -Some functions or modes have been disabled under certain settings, either because the combination made no sense, the hardware did not support them
or because of programming issues. Some examples are: Invert modes while in any of the 3 serial decode functions; averaging and oversampling buffers
while in TrOFF, XY, detector or A & B trigger modes; digital channels with averaging or oversampling buffers or A & B trigger modes; SPEC, MAP
or any of the SERIAL, SPI or I2C decode functions while in CHART mode and any but NORML time base mode with A & B trigger source.

-If any function seems disabled, check settings carefully to make sure they support it.

 DETECTOR MODE
  USING DETECTOR MODE TO DISPLAY FREQUENCY RESPONSE:
   1)   Engage sine sweep mode: Shift generator menu to SINE, then with sub menu on FREQ short press left toggle center button
to turn on special functions. Short press right toggle center button to shift to sweep mode (notification area will show sweep period adj).
   2)   Set scope sweep to NORMAL (auto mode can time out between sweeps and cause instability)
   3)   Set triggering to GEN
   4)   Set chA or chB coupling mode to DT and turn on channel.
   5)   Set buffer to single frame at first: Quickly scan all frequencies by shifting generator freq range. Entire sweep for range will be contained
within window. Xpos may need to be shifted to the extreme left on some of the ranges to show entire sweep.
   6)   With a signal from the generator fed back into chA or B, freq response curve should be visible. Adjust vert range, Y pos,
and trig level if necessary. Note that AUTO trig level in GEN mode with sweep on is restricted to 3/4 and 1/4 only. MAN works best for
this function and can be used to "lock" 3/4 level after selecting it by engaging MAN with button 2 long press. 1/2 level or close to
wave center should be avoided as scope needs to trigger going either above or below this point, so if trig level is too close to the center
line triggering will not know which way to go.

  -To allow program to auto set, change frequency RANGE with output menu on FREQ. Make sure to adjust freq and not special function parameters (eg:
sweep period). In other words, ADJ parameters should NOT be displayed in notification area, if necessary, short press left toggle center button to go back to FREQ.

  -When changing frequency range in this manner (with at least one channel on in detector mode and sweep mode with one of the analog
waveforms selected) the program will automatically adjust SWEEP PERIOD and SCOPE TIMEBASE to properly display response curve.
Entire frequency range can be quickly scanned this way to find relevant area of response curve.

  -To get BETTER RESOLUTION, shift buffer to FULL. In the same way as with single frame buffer, changing frequency range will adjust
sweep period and timebase automatically for a wider displayed sweep appropriate for a full buffer. Xpos will be now be necessary to be
used to view entire sweep. Note that more than 1 sweep or a partial 2nd sweep may now be visible at the right after shifting Xpos.

  -SWEEP PERIOD and TIME BASE can be manually adjusted, if desired, keeping in mind the program first adjusts the sweep period, then
timebase to match. Therefore, sweep period can be manually adjusted without changing frequency range, but timebase will be readjusted.
Finally, timebase can be then adjusted without anything else changing.

  -To display FREQUENCY SCALE, move T1 and T2 to center, or somewhat a bit right of center with distance between the two at something
like 1 to 2 divisions, wide enough to display at least on complete wave. Readings will be displayed no matter where the cursors are but
accuracy will be best if they are close to the middle. THEN HOLD BUTTON 4 DOWN to engage CURSOR RESTRICT FREQ METER.
Note that meters do not have to be showing but it may be useful to have meters on for monitoring. Once freq readout is gained, the program
will extrapolate a frequency scale at the bottom with a readout at each division. ALSO NOTE that scale is estimated, particularly in single
frame buffer mode, with accuracy typically within +/- 2 to 3%. For best accuracy, shift to full buffer mode and a properly expanded sweep,
or position cursors around position of interest and read FREQ meter. The distance between the two T cursors must be wide enough to contain
at least one complete wave or a reading will not be obtained.

  -It may be advantageous to save such a configuration to one of the extra available positions to quickly recall if desired.

-PWM wave type CAN be used in detector mode, but noise and aliasing artifacts will become significant at the higher frequencies. PWM inter sweep level will be shifted from 0 (as is normal for this mode) to ½ of the wave amplitude and duty set to 50%; however auto setting of sweep period and timebase will NOT work using PWM waveforms. Settings will have to be made manually.

SERIAL DECODE

-This is only available using analog channel A: With menu on CHA, change item to COUPLING, then using LEFT TOGGLE cycle AC > DC > DET > TL > RS and select either TL (TTL, for positive logic) or RS (RS232 for inverted logic). Coupling will be set to DC in both modes. Notification area will show BAUD RATE, DATA LENGTH AND PARITY (N for none or P for any type). While in CHA MENU, and COUPLING blinking, short press LEFT TOGGLE CENTER BUTTON and adjust DATA size with LEFT TOGGLE: change from 5bits >>> 8bits with no parity > 5bits>>> 8bits with parity. To return to coupling press LEFT TOGGLE CENTER BUTTON again. FFT, spectrograph and MAP modes must be OFF.
   Set timebase mode to NORMAL or SINGLE, buffer to FULL if more than just a few bytes are expected and other parameters to properly display waveform in top half of screen (bottom half is used to display characters/hex data). BAUD rate RANGE is changed along with the normal scope timebase: select timebase to properly display signal, then shift menu to T1-T2 ADJUST. Baud rate is set by changing distance between T1 and T2. Cursors can be anywhere, only the distance between the two is relevant. It can be useful though to set T1 at start of wave: for example, if baud rate is unknown, T1 can be positioned at start of waveform (start bit) and T2 moved to approximate character frame length, defined as number of data bits + 2 (start and stop bits) + 1 parity bit if present. Extra stop bits are ignored. Once rate is within approx +/- 5% of correct value the decoder should synchronize and show a valid display.
   Timebase used in relation to baud rate will determine how many characters are displayed: selecting slowest time base possible while retaining a clearly defined waveform (with T1 and T2 around 1 division apart) will allow the maximum number of characters to be displayed (max is 96). Conversely, speeding up timebase will allow for a clearer waveform but will restrict the size of data displayed.

SYNCHRONIZING ON CONTINUOUS STREAM:
   The decoder should synchronize on a continuous stream, provided enough characters are decoded. A "continuous stream" meaning a stream interrupted at some mid-point, where the start character/byte is unknown. This will also depend on the type of data captured; if a continuous stream of a same particular byte value is sent, for example, depending on the value, the program could confuse data bits for stop bits and improperly decode them. In such a case, first set data size, parity and baud rate. Then manually define the first start bit: With menu on T1-T2, short press LEFT TOGGLE CENTER BUTTON to engage manual mode (notification display will change from T2-1=BAUD to T2+1) and shifting left toggle will move BOTH T1 and T2 together, keeping the baud rate as set. T1 will now define the first decoded start bit, shifting it along the data stream should show a point, along a decoded byte where synchronization is correct. The "T2+1" display color will change to help identify when in sync, but in some conditions, such as when very few or many of the same characters are displayed causing the decoder to sync on the data rather than on start/stop bits it may be necessary to observe the data itself.

DECODING PAST 96 BYTES:
   It is possible for the buffer under some conditions to hold up to 150 bytes of data. These can be decoded by advancing XPOS to the end of the 96 byte decoded portion, engaging manual mode and shifting the T cursors. Decoding will then start at this position and display the rest of the data.

   Captured data can be quickly saved in "BUF" format: The menu can be kept on file and consecutive captures written to file with one button push. Reloading each buffer file will decode the data. Alternatively, BMP screenshots can be saved, and will show decoded data but these take longer to write.

NOTES:
   When selecting 9 bits for decoding, then 9th (MSB) is simply discarded. The 9 bit selection is included only to allow proper synchronization. The status of this bit can be observed from the waveform, if necessary and will be located to the left of the stop bit, which is above the right byte location arrow ">". The same holds true for the Parity bit.
   In the latest versions (4.4 and up), serial decoding has been extended to the fastest timebases.

USING I2C DECODE:
   Connect the DATA line to CH A and the CLOCK line to CH B. Set CH A COUPLING sub menu to I2, and ALSO CH B COUPLING sub menu to I2. Time base mode works best set to NORMAL or SINGLE. AUTO can be temporarily used to view signal if not triggered in normal mode. Setup triggering and time base to properly display CH B clock signal. Level triggering set to neg transition usually works well, time based triggering on inter-packet spaces can also be used to advantage. Manual trig level works best as these signals tend to come in bursts. Move both channels up into the top half of the screen as bottom half is used to display buffer data.

   NOTE that the triggering level must ALSO BE PROPERLY SET FOR THE DATA CHANNEL. As a reminder, the trig level arrow at the left of the screen for Ch A will remain while triggering is set to the Ch B clock. To adjust this, the trigger source needs to be set to CH A and adjusted in the normal manner. This sets the point at which the data is sensed changing HI/LOW and can be fine tuned to eliminate the effect of noise, ringing or other waveform distortions if necessary (for example a drooping positive transition on the signal lines from weak pull-up resistors can be compensated for by bringing the trig levels down towards the base line).

   Bytes displayed with first clock sequence or restart sequence will be the SLAVE ADDRESS and are displayed in PURPLE, with the associated ASCII display showing "ad". 10 bit addresses occupy 2 bytes: the first will be the 2 most significant bits of the address in byte "XX" format (0 to 3) while the second contains the remaining 8 bits. Bytes not colored purple are data. The byte location frame indicators "<   >" show the direction of data flow, with the right arrow highlighted indicating master to slave transfers and a left highlighted arrow indicating a slave to master transfer. The color of the highlighted arrow further signifies the ACK (GREEN) or NACK (RED) bit associated with each byte.

   Bottom of screen displays the content of the buffer in ASCII and HEX format.

USING SPI DECODE: *NOTE that to if using Ch C as clock, devices prior to HW V2.72 should have protection diodes at the digital inputs removed as these severely limit the bandwidth and timing, and will cause decoding to fail at all but the lowest frequencies.*

Connect the 2 data lines (MOSI and MISO) to CH A and CH B. The clock signal is normally connected to CH C, but can also be connected to CH B, in which case only one of the two data channels will be displayed. If CH C is turned OFF, the program will use CH B as a clock. In SPI mode, the word and ASCII waveform location indicators sit just below the 0 baseline of the channel, and move up/down with the waveform as the Y position is changed. CH D can also be connected to the relevant slave select line. Triggering can be set to either clock (Ch C or Ch B) or slave select, if connected. The BUFFER CHART displays both data channels and can overwrite the entire display, depending on the amount of data, and is toggled ON/OFF from the CH B COUPLING ITEM with the LEFT TOGGLE CENTER button. If word length has been set MANUALLY to either 7 or 8 bits, ASCII data will be displayed on the chart in addition to HEX, otherwise only HEX data will show. Data is displayed in relation to the waveform positions, if Ch B waveform is above the Ch A waveform, top display is of Ch B, bottom Ch A. If Ch A was above Ch B then Ch A data will be above.

NOTE THAT TRIGGERING LEVELS MUST BE PROPERLY SET ON BOTH ANALOG CHANNELS.
Trig level arrows at the left of the display will be displayed as a reminder. Change by selecting with trig source and adjusting in the normal way. Trig level defines the HI/LOW change point for the clock/data pulses and can be moved up/down the waveform to eliminate noise, ringing, etc.

Set BOTH CH A AND CH B COUPLING MODES TO SP.
Set trig mode on MANUAL and time base/trig controls to properly display the clock signal. The SPI SETUP MENU is accessed by selecting the CH A COUPLING sub menu. Relevant parameters to be adjusted will be displayed in the notification area. Press LEFT TOGGLE center button to shift cursor to the notification area. Change items to be adjusted by pressing the RIGHT TOGGLE center button. The CHART DISPLAY is toggled by shifting to CH B COUPLING menu while set to SP and pressing LEFT TOGGLE button. Note that the chart display text overwrites the waveform and will not show unless data is captured.

INFORMATION ABOUT AN SPI TRANSMISSION MUST BE KNOWN AND ENTERED INTO THE DEVICE IN ORDER TO PROPERLY DECODE.
NOTE that any of these parameters can be adjusted AFTER a properly synchronized signal is displayed or paused, if necessary, while observing the waveform and decoded data. All settings except for the chart enable toggle are saved in a configuration file.

Adjust MODE: Clock polarity and phase are indicated with a pair of binary digits, the first digit indicates polarity, with "0" having a low base, with clock pulses going positive, while "1" indicates a high base or rest position with clock pulses going negative. The second binary digit adjusts whether data is read from the leading clock edge "0" or trailing clock edge "1". Select the 4 possible combinations with the left toggle.

Adjust DATA BIT DIRECTION: Press CENTER RIGHT TOGGLE to shift cursor to ">" just to the right of the mode indicator bits. Change with left toggle. ">" indicates a MSB or most significant bit first transmission while "<" indicates a LSB or least significant bit first type.

WORD LENGTH can be specified in one of 3 ways: 1) Manually 2) AUTO or 3) Reset after space, meaning a space of a certain length between clock word bursts. Change with LEFT TOGGLE: display will change from extreme left: 145 ... 3 > AUTO > 2 ... 192 with numbers to the left of AUTO denoting "RESET AFTER SPACE" or ") < xxx > (" mode and the number of samples to reset word length upon, and numbers to the right "MANUAL mode" or "BITS=XXX" and the number of bits to reset on.

The first type ("BITS=XXX) sets the word length manually and will not reset on spaces after the trigger point but simply continuously counts bits, resetting on the selected word size. Use for example with a continuous stream of clock pulses without spaces between words. Bit numbering will simply jump across spaces if the setting does not correspond to the number of clock pulses in a burst and continue increasing. Also use this mode with bits set at 7 or 8 bits to display ASCII characters in chart.

"AUTO" resets word size on any space between bursts that is greater than 2 clock pulses. Can be used for virtually all transmissions, specially useful when word size varies.

The last case ") < xxx > (" manually sets the length of a space, in samples, that the word length will reset upon. There are 30 samples to a screen division, 6 to a minor division. This needs to be set to a value greater than the distance between clock pulses, but less than the space between the word clock bursts. Useful when the word length changes during a transmission. It can also be used to manually synchronize the decoder to a continuous data stream that lacks the necessary space before the waveform trigger point to reset the word size, provided SOME space greater than a clock space (1/2 period) is available. Default space before triggering is 60 samples or 2 divisions, regardless of the X position. Anything prior or to the left of this is disregarded.

CALIBRATION PROCEDURE

 Proper calibration minimizes DC offsets of the analog channel traces, provides proper DC tracking as Y position is moved up/down, amplitude calibration of the displayed waveforms and meter readings, compensation for the CPU clock frequency as it affects the frequency/time meters and minimizes offset variations and gain changes as the battery and/or power supply voltage changes.

If calibration menu (HOLD BUTTON 2) is done while the menu is NOT on either CHANNEL A OR CHANNEL B (OR ONE OF THEIR SUB MENUS) and NOT on TIME/DIV(this will access OS mode speed) or FILE MENU, the ADC OFFSET adjustment will be accessed instead, with a value appearing in the NOTIFICATION AREA from 0 to 54. Default is 54. Adjust with LEFT TOGGLE then save in boot up config #0.
WHAT THIS CONTROL CHANGES:
 While the ADC provides 256 "steps" (8 bits), only 200 are used for the display. The original programs used steps 0 to 200, discarding the top 56 at the top of the screen. Unfortunately, there is quite a bit of non-linearity (compression) in the bottom 50 or so steps, causing distortion of the waveform. This is a well know hardware issue for these devices. In order to compensate for this, the operating point was shifted up by 54 steps, moving the entire range into a more linear area towards the top of the screen. In addition to minimizing the distortion at the bottom, this also helped the calibration procedure achieve better results, as it assumes linear ADC operation. However there have been instances where, perhaps in some ranges and not in others, the preamp failed to fully swing the signal to the top of the ADC range, resulting in visible clipping below the top to the screen. This control can be used if desired to bring the operation point down below the point where clipping occurs by shifting it down from a value of 54, albeit at the expense of engaging down more into the non-linear area at the bottom of the range.

To ENTER CALIBRATION, the menu MUST BE EITHER ON CHANNEL A OR CHANNEL B (blinking). Does not matter which sub-menu, as long as it's of either chA or chB.
 To enter the calibration process HOLD BUTTON 2 (about 3 seconds).
 THE FOLLOWING SEQUENCE OF FUNCTIONS WILL BE DISPLAYED: (Instructions will be shown on screen)

>NOTE that any of these can be skipped, as some are tedious, but they are available for those who want the best results. At the MINIMUM
 AUTO CALIBRATION of DC offsets is easy and should be done. If 2 sets are saved as described below, effects from variations of battery voltage/
 power supply will be compensated for.

1) MASTER CLOCK FREQUENCY OFFSET: at this point, the built-in generator will be set to a 1Mhz square wave. To calibrate, connect a frequency counter to the WAVE OUT and measure the frequency. Enter any discrepancy from 1.000000 Mhz by using left toggle: + values if counter frequency is high, - if it's low. For example, if the counter reads 1.000085 Mhz, enter +85. If it reads 0.999965 Mhz, enter -35. If no counter is available, just leave it at zero. Press button 2 to go to next screen.
   FREQUENCY OFFSET CAN ALSO BE ADJUSTED WITHOUT ENTERING CALIBRATION: With menu NOT on CHA or CHB (and not on time/div if in full speed buffer mode) HOLD BUTTON 2, notification area will show ADC offset adjustment. Use left toggle center button to toggle to frequency compensation. Increase this value to increase the displayed frequency on the meters, decrease to lower. Save value by saving boot config 0.

2) AUTO CALIBRATION: You will be prompted to ground the relevant channel's probe and press button 2. This minimizes DC offsets of the 2 analog channels, as well as offset tracking as Y position is changed. For the next few screens, follow on screen instructions to go to the next function, other channel, to abort or load default settings.

3) VOLTAGE GAIN CALIBRATION: After auto calibration of offsets, selecting the next operation will bring up gain calibration. In this section, you will be prompted to connect a reference DC voltage to the channel you are currently calibrating, for each of the 8 ranges starting with the 50mv/div range. Applied voltage must be within the range displayed at the top of the screen, so a stable source adjustable over a wide range with low noise will be needed. An indicator is provided to show if the voltage is exactly on one of the ADC's "steps". This helps accuracy, however if there is much noise superimposed on the input (from nearby switched mode power supplies or from the DC source itself) or if the source is not finely adjustable, it may be hard to center the indicator, specially at the lower ranges; in such a case just disregard it. The reading (flashing) on the menu for the range selected is then adjusted with the LEFT TOGGLE to EXACTLY MATCH THE APPLIED VOLTAGE. Follow direction on screen to select the other ranges.

   AT THE END you will be prompted to enter this either as a LOW BATTERY CALIBRATION with BUTTON 2 or HIGH BATTERY CALIBRATION with BUTTON 3: If calibration (auto calibration of DC offsets as well as voltage gain) is done with a relatively low battery (~1/4 to 1/2 charge) and saved with button 2, then done again with a charger connected and saved with button 3, two extra sets of data will be saved and the program will interpolate between the two as battery/power supply changes, minimizing the effects on offsets and gain. These devices are notorious for poor regulation affecting these. If a second calibration is NOT DONE, the program will simply just use the first one.

IF IT IS DESIRED TO SKIP GAIN CALIBRATION: Just keep the input grounded and leave whatever residual readings are in the different range fields, move down through the fields with right toggle and go on to the next step. Follow on screen directions to either save and exit, or go on to calibrate the other channel.

CALIBRATION DATA is SAVED on the config file 0 (XXXX.WPT), along with any other settings present at the time. NOTE that although calibration data is also saved to any of the additional config files (CONF00X.CFG) along with the settings when saving to these, it is NOT READ when LOADING these to restore the settings. Calibration is only read from the boot-up file (WPT) to prevent possible interference from older saved data after a subsequent calibration is performed.

MISC SETTINGS

FAST RISE BRIGHTNESS ADJUST: Wave trace is dimmed on vertical transitions (bars) of more than 5 pixels. This is done to simulate the "thinning" of a CRT scope trace on fast rise signals. On some displays, notably on earlier devices, this effect is a bit exaggerated, and can produce a VERY NOTICEABLE "FLICKERING" of short vertical segments in SOME waveforms, and/or an OVER EXAGGERATION OF BRIGHTENING OF WAVE TOPS/BOTTOMS. On other displays, it may only be noticeable when viewing the screen to the left at an angle. To reduce the amount of dimming to fix this, select the the BACKLIGHT (B.L.) menu and press LEFT TOGGLE CENTER BUTTON. Adjust value in notification area from 0 (default, max dimming) to 3 (max brightness) as required with LEFT TOGGLE. SAVE setting by saving boot up config #0.   > A test pattern for this can be made by displaying 4 complete sine waves of about 3/4 screen height with meters on.

WAVEFORM HORIZONTAL THICKNESS ADJUST: Select the BACKLIGHT (B.L.) menu and press RIGHT TOGGLE CENTER BUTTON. This allows changing the width of any straight horizontal section of waveforms from the original of 3 pixels thick to 1, 2 or 3 pixels thick for user preference. Default is the original of 3 pixels. Change with LEFT TOGGLE. After changing, save with config file 0. While it is saved in other configs, it will only recall from config 0. Note that full speed oversampling mode will revert to a 1 pixel thick display regardless of this setting to prevent noise normally found in this mode from overly thickening trace.

KEYPRESS CONTINUOUS BEEPING LEVEL SETTING:
With menu on volume adjustment, press LEFT TOGGLE CENTER BUTTON to enable adjustment. Change with left toggle. Value (0-9) represents a percentage of main key beeper volume. Save with boot config to make permanent. Note that only the "fast" auto repeat continuous beeping if affected by this (such as changing cursor positions), slow repeat rate beeper volume is not changed (such as holding right toggle to rapidly change menus), since this provides useful feedback for quickly selecting menus.

HARDWARE AND COMPATIBILITY ISSUES

COMPATIBILITY   >> MAKE SURE THE CORRECT VERSION IS USED FOR THE HARDWARE<<
   VERSIONS 6.5 is COMPATIBLE WITH:
     Hardware V2.81 and later ONLY   (WARNING: LOADING V6.5 ON PRE-HW 2.81 DEVICES WILL OVERWRITE THE FPGA CODE!)
     Sys V1.64
     FPGA 2.81 or W1.0 - 1.1   (FPGA W1.1 update is needed for full speed oversampling mode to work)

   VERSION 5.6 IS COMPATIBLE WITH:
     Hardware V2.6 to V2.72 but NOT including V2.81 (WARNING: LOADING V5.6 ON V2.81 AND LATER DEVICES WILL FAIL, OR POSSIBLY OVERWRITE
                                              PART OF THE SYSTEM. There appears to be some safeguard against this, but possibly not on all DFU versions)
     Sys V 1.51 and later
     FPGA V2.61
     ALTERBIOS V 0.4   Needs to be installed on 2Mb devices to fix file corruption issues. Developed by Petteri Aimonen, available at
                      http://koti.kapsi.fi/jpa/dsoquad/ (along with a variety of other interesting software for the Quad)

   VERSIONS 6.5 AND 5.6 leave both "slot 3" and "slot 4" available for other programs to use. Previous versions only left slot 4 open.

HARDWARE ISSUES
   For SPI decoding, the clock can be either on Ch B or Ch C. Prior to hardware V2.72, these devices had protection diodes that severely limited
   the bandwidth and timing of the digital channels. Unless these are removed, at the speeds SPI typically uses, using Ch C the waveform
   will be so far out of sync (if it triggers at all), that the function will be useless. For these devices, Ch B can be used for the clock but decoding
   will then be restricted to Ch A only.

   V4.x and later will detect HW version 2.81 and adjust the correction for the CH B 2 least significant bits issue of the earlier
   versions. The problem does not exist in HW2.81 and so correction will be disabled.

   The programs and system versions used with these devices make use of undocumented hardware resources. Specifically:
      -Units come with an ADC rated for 40MS/sec which is overclocked to 72MS/sec
      -The wave out generator in the community versions (including this one) overclock the uP DAC, which is rated for 1Mhz, to 1.8Mhz
       at the highest analog range.
      -Some versions (including this one) make use of a larger amount or RAM than is documented for the uP version installed.
      -Some programs (including this one) make use of undocumented areas of ROM to store themselves on.

   While most devices seem take these in stride, some samples have been found that had issues with overclocking the ADC. One device produced nothing
   but garbage at the fastest time bases, while at lower speeds with lower sampling rates worked OK. This unit was found to have an ADC NOT from
   Analog Devices, like the originals, but a clone. The device also showed premature clipping of waveforms at the top of the screen, indicating an issue with
   the preamp/ADC analog "window" interface. After this was replaced with an Analog Devices chip everything worked fine.

   Some ADC ic's used with later versions have displayed intermittent parasitic noise bursts on channel A. This is particularly evident when used with full
   speed sampling and the updated FPGA code for HW versions 2.81 and later. Otherwise, without oversampling, the random noise, which increases as the
   sampling rate is increased is rarely captured and not noticed. Replacing the ADC ic in such a case has been shown to fix the problem.

CREDITS

I wish to extend appreciation to the SEEED forum developers of the program this version is based on:
  marcosin
  pmoss69
  JackTheVendicator
As well as to the original authors for making the source available

And also to
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  JPA   for the Alterbios patch.
  Jerson   for suggesting a beep to indicate long button press. (V4 includes a visual indicator for this as well)

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