******* Black Pill (STM32F411) Decoder User Guide *****************

draft draft draft you are welcome to add/ correct this draft

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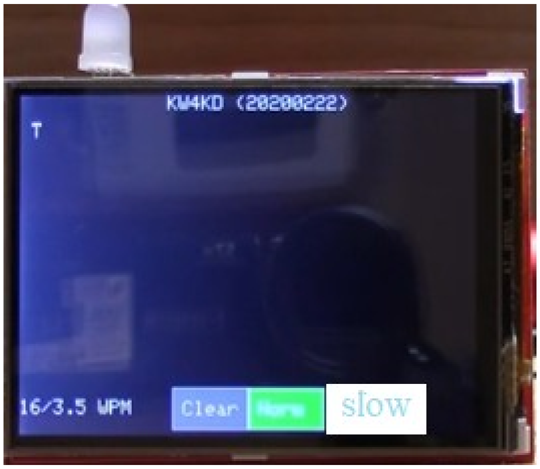
First Time Use Initialization:

After a .bin load or reload, see instructions found on page 2 of this document, for 1st time startup steps.

The Stock Screen and LED:



LED response to variable tone:

initial default center frequency: 750 Hz
green - center frequency+/-25 Hz
red - below center frequency
blue - above center frequency
white - volume is excessive
no light – no usable tone detected
example method(s) to demonstrate LED response:
1. cw pitch of ic 718 was preset to 700 – changed it to 750 hz & the decoder LED goes green, in cadence with the incoming CW signal.
2. a tone generator, or code practice unit, with a known tone, controllable volume and speed can be useful in understanding how the decoder/LED responds.

Display:

top 80% reserved for decoding (9 lines; 40 characters/line)
(no reaction to touch input)
bottom 20% of the screen- information and mode selection
(touch input is active in this region)
Note: the stylus that comes with the screen is recommended for screen picks- if misplaced, a none metal object with a blunt point can be used

lower left information area - 4 modes:

1. 16/3.5 (Speed)/ ("dit" to "dah" ratio)
2. 60/180/60 (time in ms of dit/dah/space)
3. 750hz (incoming tone freq, or locked mode center frequency)
4. 5.0/1 (signal to noise ratio*)

Clear Button - 2 functions

1. quick tap – clear screen & reset WPM to 15wpm
2. press and hold- go to “Setup Screen” screen
   See “Setup Screen” below, for more detail

Center Button – selects 4 decoding modes

1. Norm – good for 95% of senders
2. Bug1- sender style 1
3. Bug2 - sender style 2
4. Bug3 – sender w/ “cootie” style fist

Right Button – (sample interval) 2 modes

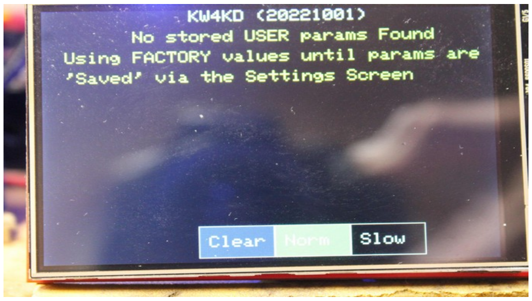
1. Slow – 2x data points taken/sample – repeat tap for fast
   Use this setting for routine decoding
2. Fast – 1x data points taken -
   Disadvantage – Stronger signal needed to detect a valid tone
   Advantage - 2x improvement in timing (Tone vs No Tone)
   Use this setting with high speed code, or Senders using “cootie” keys

*not functional in the current version

First Time Use Initiation:

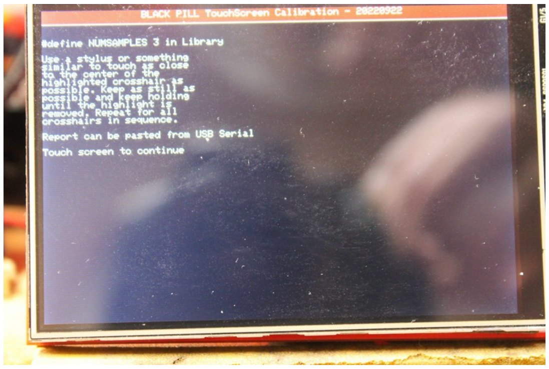
This section describes, what to expect/do, the first time the decoder is started

screens:



```
KW4KD (20221001)
No stored USER params Found
Using FACTORY values until params are
'Saved' via the Settings Screen
```

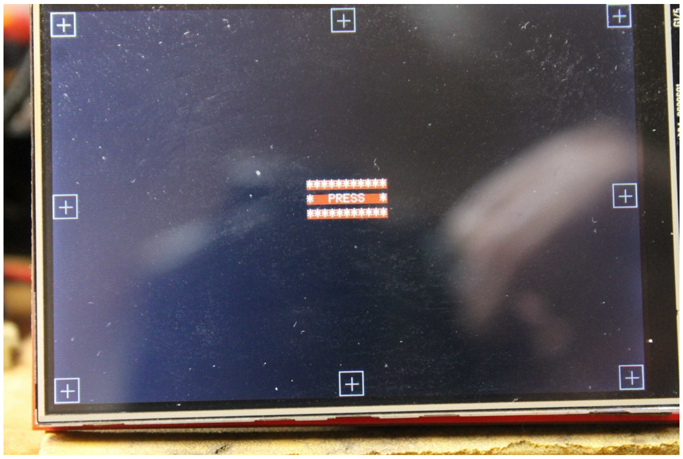
Start Screen: Will automatically advance to the following screen



```
BLACK PILL TouchScreen Calibration - 20220922

#define NUMSAMPLES 3 in Library

Use a stylus or something
similar to touch as close
to the center of the
highlighted crosshair as
possible. Keep as still as
possible and keep holding
until the highlight is
removed. Repeat for all
crosshairs in sequence.

Report can be pasted from USB Serial

Touch screen to continue
```

Screen1: Instructions - very small font; Touch anywhere to advance

Note: Ignore text, “Report can be pasted from USB Serial”



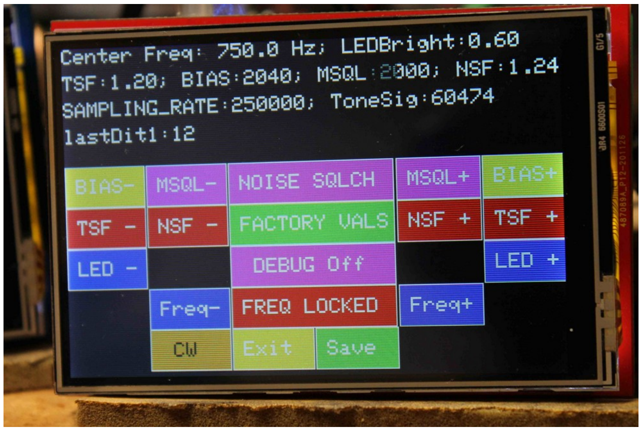
Screen2: Calibration screen; eight touch points [+] to a screen – use stylus to calibrate & advance the active point.

Note: app may have you repeat this process twice

After completion of calibration, the program will return to the normal “decode” screen (shown on 1st page)

Long press the “Clear” button to take you to the “Setup Screen” screen, and then press “Save”, to store your touch screen calibration parameters.

Setup Screen



```
Center Freq: 750.0 Hz; LEDBright:0.60
TSF:1.20; BIAS:2040; MSQL:2000; NSF:1.24
SAMPLING_RATE:250000; ToneSig:60474
lastDit1:12
```

In the setup mode, the user can adjust, & save, the following parameters:

1. Bias (+/-) ; value to subtract from ADC sample to remove the microphone's DC offset
2. MSQL(+/-); Squelch value to use when tone detector is operating in MAN SQLCH mode
3. TSF(+/-); “Tone Scale Factor”; Not Functional in the current version.
4. NSF(+/-); “Noise Scale Factor”; speaker dependent; Adjust for best tone detection.
5. LED(+/-); Sets LED’s maximum brightness.
6. Freq(+/-); Tone detect Frequency; Manually change the tone detect center frequency; Use only when in the "FREQ LOCKED" Tone mode.
7. Squelch Mode (NOISE SQLCH / MAN SQLCH); no explanation needed
8. Factory Vals; return decoder to sketch’s default values.
9. Debug Mode (OFF / Plot / Decode); When not OFF, use the Arduino IDE plot /serial monitor tools, via USB serial connection.
10. Tone mode (AUTO Tune / FREQ LOCKED)

The setup screen has three additional buttons:

1. Program Select – 5 choices
2. Exit (leave the Setup mode; return to selected Program choice)
3. Save (Store the current settings to Flash memory)

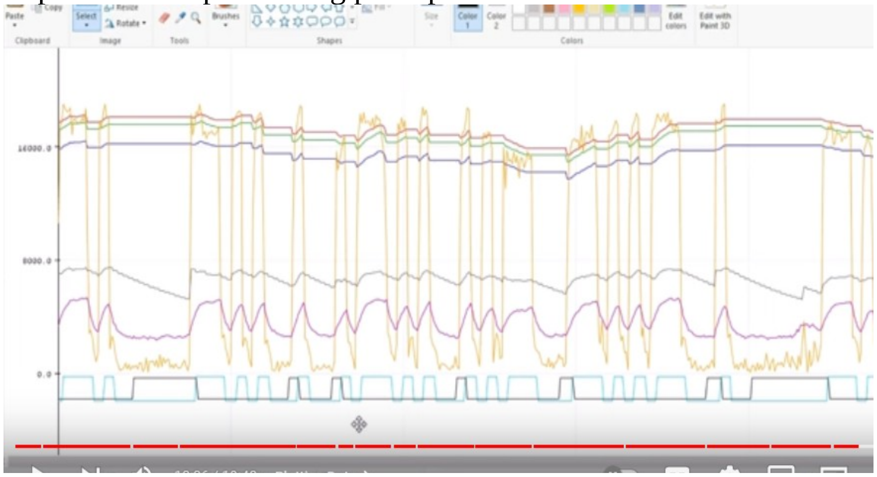
Inside the Decoder- 3 programs running:

1. time based ISR - tone sensing, Goertzel algorithm, and the MPU’s 12 bit ADC to digitize incoming analog signal
2. hardware I/O ISR - logic of how to class low to high transition as a “dit” or “dah”
3. parsing process and screen management loop

Arduino IDE interface:

To access, use Blackpill’s USB C connector, the plot option found under the IDE’s tool menu, & on the decoder’s Setup Screen, set Debug mode to “Plot”

Example screen capture using plot option:



trace description(s);

above zero line:

1- orange- combined magnitude of the Goertzel algorithm
2-3-4- red green blue- low- high center frequency component
5- purple – noise magnitude
6- gray – current squelch value

below zero line:

aqua – key state – high key closed
black – letter break timing group- interpret dits and dahs groups

Supplemental Notes:

Managing response to a CQ while using the decoder:

1. The DX station answers near zero beat to your preferred side-tone - not a special case
2. The DX station answers either high or low to your calling frequency- special case
   - the signal is close enough to your frequency that the decoder follows/locks to the signal without changing your transmit frequency- nothing required
   - the signal is too far off frequency for the decoder capture it

   it’s not good form to move your main VFO A to zero beat his frequency, because the DX station is listening where he last heard you

   solution: change your receive frequency without changing the transmit frequency:

   - Method A - some receivers have a second VFO B that can be used as a RIT function

- Method B - other receivers actually have a dedicated RIT control which changes the receive frequency without effecting the transmit frequency

both of these solutions may require some operator practice to use quickly

If you have concerns about the performance of your tone input method. Go to the decoder’s “Setup Screen” & use the bottom left button (the program select button) to select the "FFT" program. Start it, by touching the "Exit" button. It will take it a few seconds to settle down. But if there is any incoming signal, the FFT view will show it.
If audio presence shows a peak on the FFT graph, and the sound supplied is at a volume and tone you expect to be recognized - then your input circuit is working properly. Generally, all else being good, the decoder needs a signal that’s 1 to 2 S units above the noise floor to decode reliably.

Users of the KW4KD Decoder are encouraged to add their improvements to this document and re-save it in place. Log your change below. Contact the developer if you feel your change needs his attention.

Document Change Log-

Format: call sign, date, brief (25 words max) description of change.
KI4EZC, 10/8/2022 Created Original Document
Kw4kd, 10/9/2022, minor edits & inserted info related to setup/options screen
KI4EZC, 10/9/2022, Added Handling special cases