

STM32F746_FT8_ADX Project

Project Motivation, Attribution and Other Thoughts, October 2022

For the past ten years after retiring I have had a lot of fun building ham radio projects which utilize microprocessors to perform DSP for SDR radios. Past projects include the SDR2GO, STM32-SDR and STM32F746-SDR. As part of the STM32F746-SDR project I included a Beacons feature that uses a GPS receiver to periodically send a PSK call along with location latitude and longitude. Over time I noticed that the number of stations monitoring PSK traffic using PSK Reporter has significantly dwindled due to rise in popularity of FT8 operation.

So, during the Summer of 2019 I started a quest to do FT8 on a STM746 Disco board.

In one of my restarts of this project I came across the work done by Karlis Goba which you may review on this website: https://github.com/kgoba/ft8_lib. Karlis is a ham, YL3JG.

Sha-Zam I finally got the FT8 stuff to work! Not only does it work, it works well due to the great work done by Karlis. I have had several email exchanges with Karlis and he has been most helpful and supportive in my effort to produce another DSP project.

At present the operating mode of the application is quite limited. However, as I learn more about FT8 operations and experiment with the code I will probably add additional operation modes and features.

Time Synchronization

One of the main items that I learned from Karlis is that it is quite easy to synchronize the application in time without relying upon a GPS clock. To do this, we set up an internal clock in software with millisecond resolution to create what I call FT8 Relative Time. This clock is synchronized by simply watching the waterfall and touching the blue Touch Button entitled "Sync" at the bottom of the display during a lull in FT8 traffic. My experience is that FT8 application will remain synchronized for hours using this method, until you turn off the power.

Simple Operating Modes

The transceiver has three operating modes: Monitoring FT8 Traffic, FT8 QSO and transmitting a Beacon Message.

When the transceiver starts up it is in the Monitoring Mode.

Up to ten decoded FT8 messages and data are displayed in green immediately below the Waterfall. This display is organized as six columns: **FT8 To Call Sign**, **FT8 From Call Sign**, **FT8 Content**, **Received Audio Frequency**, **Received Signal Level**, and **Distance** between your station Maidenhead Locator and the received station Locator in Km.

A blue button is labeled “Mntr”. When this button is touched, it turns red and is labeled “Actv”. This mode allows transmission of FT8 messages.

At this point the unit is in the Reply to CQ mode as indicated by the blue Touch Button which is labeled “QSO”. In this mode up to ten FT8 messages are displayed in the left hand pane. In the right hand pane up to five FT8 CQ messages are displayed as Call Sign and Distance between stations. Touching one of the five messages will generate a message to the selected station. A call will be issued to that station on the next FT8 cycle. This message is displayed at the bottom of the right hand pane. The application will then listen for a reply from this station for two FT8 cycles. If a reply is heard it will be displayed at the bottom of the right hand pane. The application will repeat calling the station up to three times before giving up.

When the QSO Touch Button is touched the button turns red and is labeled “Becn”. In this mode the application monitors the FT8 Relative Time clock and will issue an FT8 CQ that includes Your Call and Maidenhead Locator during the next FT8 cycle. The application then monitors the FT8 traffic and searches for Your Call at the beginning of each FT8 decoded message. When it finds the first decoded message with Your Call, it composes an FT8 reply that includes the Responding Station Call, Your Call and the other stations Received Signal Level. This reply is then transmitted in the next FT8 cycle and is shown as green text at the top of the right hand pane. At the end of this FT8 transmission, the Becn is reset to issue another CQ on after listening to the FT8 traffic for two FT8 cycles.

STM32F746 FT8 Transceiver Project

The F746_FT8 may be used with any SSB transceiver which provides mono audio input, mono audio output and VOX control. I have tested the F746_FT8 with the ADX_UNO transceiver by Barb, WB2CBA.

The Disco Board includes a 4.3 inch color touch display with a resolution of 480X 272 pixels.

The F7_FT8 project uses an SD Card inserted into the SD Card Socket on the F746 board for storage of operating parameters, band frequency data and station data.

ALL control of the transceiver is done thru the touch screen. The secrets of these controls are revealed below.

Screen Layout

A real time Waterfall display of received audio is displayed at the top. The Waterfall covers the range of 300 to 2168 Hz. A red cursor is shown which shows the base frequency chosen for transmission in the QSO, Beacon, and Tune modes. The location of the cursor may be set by touching the Waterfall or by touching the -F or +F buttons placed immediately to the right of the Waterfall. The transmit frequency is displayed in yellow between the -F and + F buttons.

The decoded FT8 messages and data are displayed immediately below the Waterfall. The format and content of the message display have already been described in the previous sections.

A line of eight Touch Buttons is shown below the FT8 message area.

Touch Buttons

There are ten touch buttons on the user screen which are shown as **blue** with text labels in white upon boot up and will change to **red** background when touched. The operation of each button is described below:

Mntr: When this button is **blue** the received FT8 traffic messages along with other data will be displayed. The unit will not transmit when in the monitor mode. When this button is **red** the unit may be used to do an FT8 QSO or to issue FT8 beacon messages.

QSO: When this button is **blue** the unit is in the QSO mode. When it is **red** the unit is in the Beacon mode.

Tune: When this button is blue, the unit is in the receive mode. When it is **red** a continuous tone is transmitted at the audio frequency indicated by the red cursor line displayed in the waterfall. You may use this to tune your antenna or amplifier.

Rcv / Xmit: This button does not respond to your touch. However, it is linked to the QSO and Tune buttons so that when it is **blue** the unit is in the receive mode. When it is **red** the unit is transmitting in the QSO, Beacon or Tune mode.

Log: When this button is **red** each FT8 QSO conducted by your unit will be saved to a log file on the SD card.

Sync: This button is at the bottom of the Disco board and is used to time synchronize the FT8 coding and decoding algorithms.

-G : +G These buttons are at the far right hand side. They are used to adjust the input audio gain of the unit so that different types of transceivers may be used. The current input gain is displayed at the very top of the display in yellow. The audio input gain may be set between 10 to 32 dB.

-F : +F These buttons are at the top right hand side. They are used to adjust the transmit base audio frequency. They may be used to provide fine adjustment of the displayed cursor and audio frequency. The transmit frequency is shown in yellow between the two buttons. The frequency may be set between 300 and 2168 Hz.

SD Card Installation

The application utilizes a micro SD card. A micro SD must be installed in the micro SD slot. The system displays an error message if no micro SD disk is found.

For proper operation, one file must exist on the SD at initial boot up: StationData.txt

However, you must create and install the StationData.txt file manually. Notepad is a good Windows application for creating this simple file. The file requires a single line of data as shown below:

W5BAA:EM00

Replace my call with your call and the EM00 with your Maidenhead Locator.

Logging QSOs

When you use the application you may log your FT8 transactions by using the Log Touch Button. The log is saved to the SD Card.

The log file will be automatically generated and it will have the file name described above,

An example of the contents of a log file are shown below:

Open Log File

1:16:29 W5BAA K6AGA DM04 746 -4 1924

1:16:29

K6AGA W5BAA -4

1:17:14 W5BAA KC3FOI FN20 746 -9 2430

1:17:14

KC3FOI W5BAA -9

1:31:29 W5BAA N8FRJ EN91 621 -11 2022

1:31:29

N8FRJ W5BAA -11

1:35:44 W5BAA WB2TQE EL96 1115 -9 1812

1:35:44

WB2TQE W5BAA -9

1:39:14 W5BAA W8BF EM75 746 -10 1417

1:39:14

W8BF W5BAA -10

2:25:44 W5BAA N6MFT CM97 746 -7 2166

2:25:44

N6MFT W5BAA -7

Installing Firmware on F746 Disco Board

The firmware is supplied as a STM32f binary file labeled “STM32F746_FT8_ADX.bin”.

This file is installed on the STM32F746 board using the STM Utility called ST Link which may be obtained at this link: <https://www.st.com/en/development-tools/stsw-link004.html> .

ST Link is free and only requires an USB cable for connection between your PC and the F746 Disco board.

Powering the F746 Disco Board

It is recommended that the F746 be powered at the 5 volt level. The board may be powered at the 12 volt level using the Vin pin on CN6 but this results in a waste of battery capacity.

The board may be powered using one of three USB connectors at the bottom of the board or an external power connector, JP2.

Selection of the 5 volt power source is done by moving the jumper on JP1.