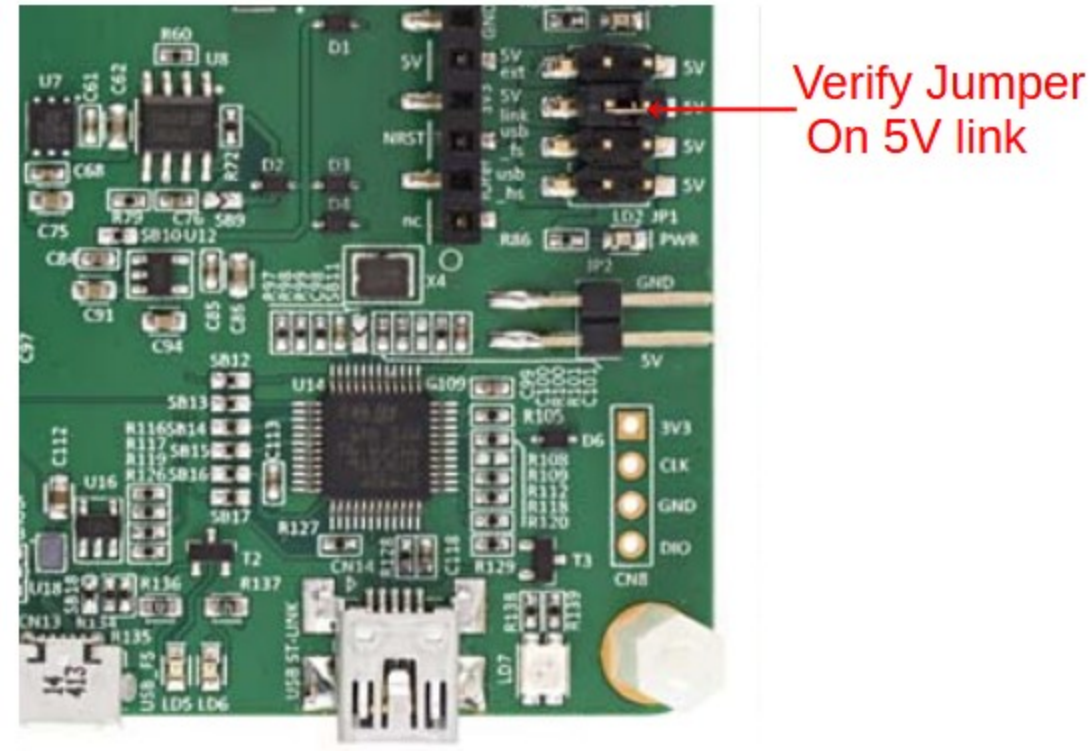
DX FT8 Software Set Up and User Guide for WB2CBA / W5BAA Project

This document is written to guide the user in setting up and using the project firmware.

Step 1:
Download and review the STM32F746 User Guide found here:
https://www.st.com/resource/en/user_manual/um1907-discovery-kit-for-stm32f7-series-with-stm32f746ng-mcu-stmicroelectronics.pdf

Step 2:
Download and install "STM32 ST-Link" utility found here:
https://www.st.com/en/development-tools/stsw-link004.html

Step 3:
Make sure that a jumper is installed on JP1 on the 5V link usb pins as shown below:



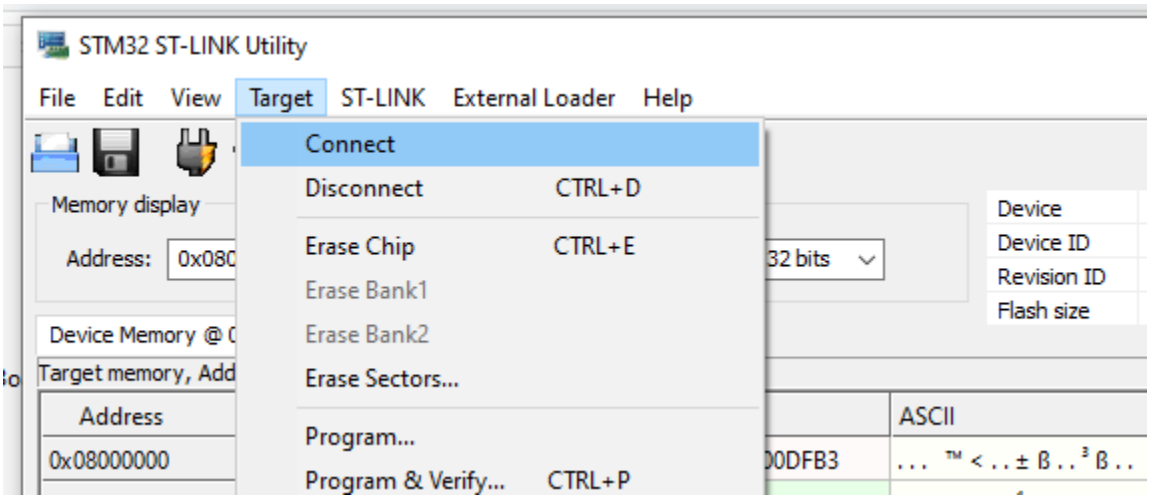
Next connect your computer to the Disco Board via the USB connector shown directly above.

Use the STM32 ST-Link Utility to install the firmware file entitled "DX_FT8_0.bin" found in this folder on the WB2CBA gitbub Repository for this project:

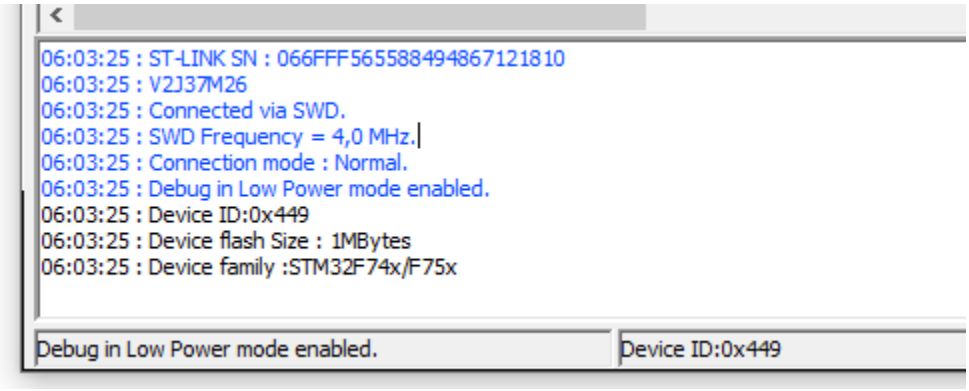
https://github.com/WB2CBA/DX-FT8-FT8-MULTIBAND-TABLET-TRANSCEIVER/tree/main/DX%20FT8%20FIRMWARE

Here is a note on how to use ST-Link Utility to program the firmware om your Disco Board.

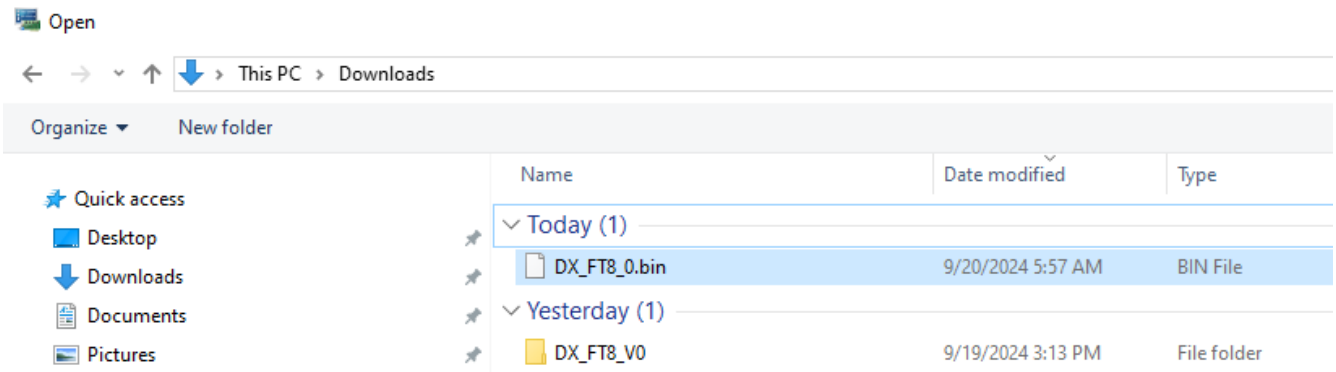
After connecting the Disco Board to your computer start the STM32 ST-Link Utility and then select the Target Tab and then select the Connect Option as shown below:



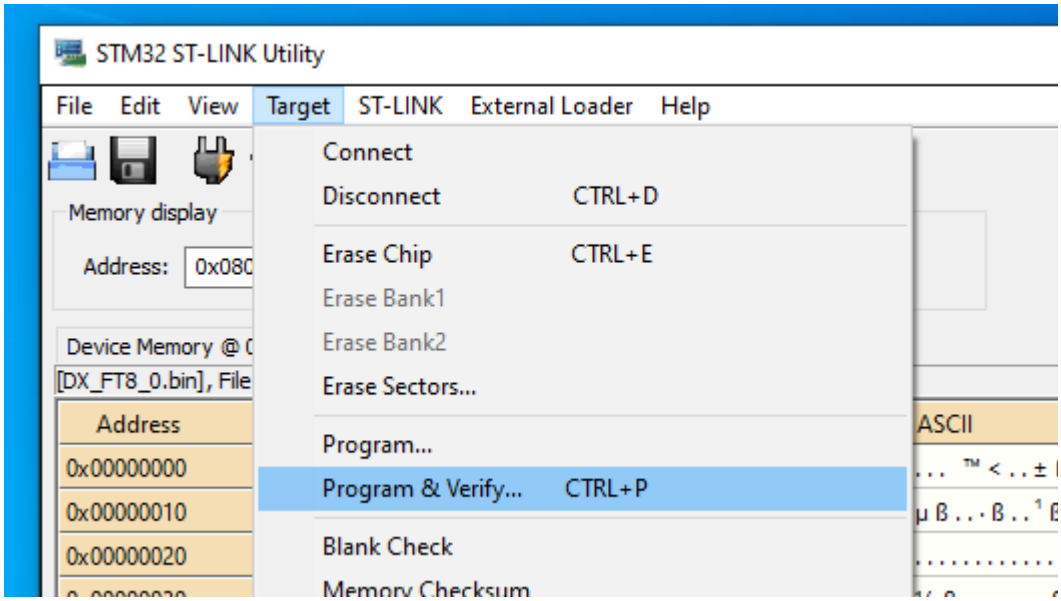
If all goes well you will confirmation of the Disco Board Connection as below:



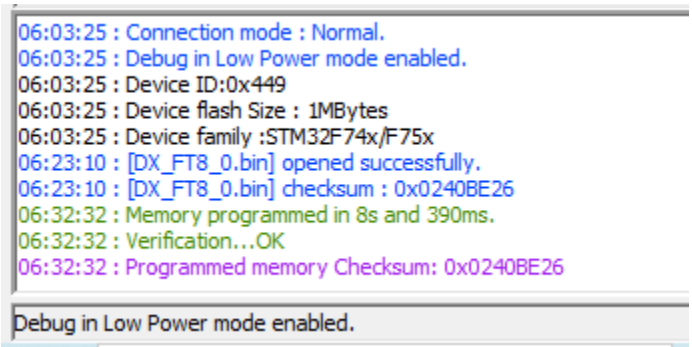
Next, using the File Tab select the Open File Option to select the DX_FT8_0.bin file that you have downloaded to your machine.



Next, using the Target Tab Select the Program & Verify Option.



When the programming is completed you will see the confirmation note shown below:



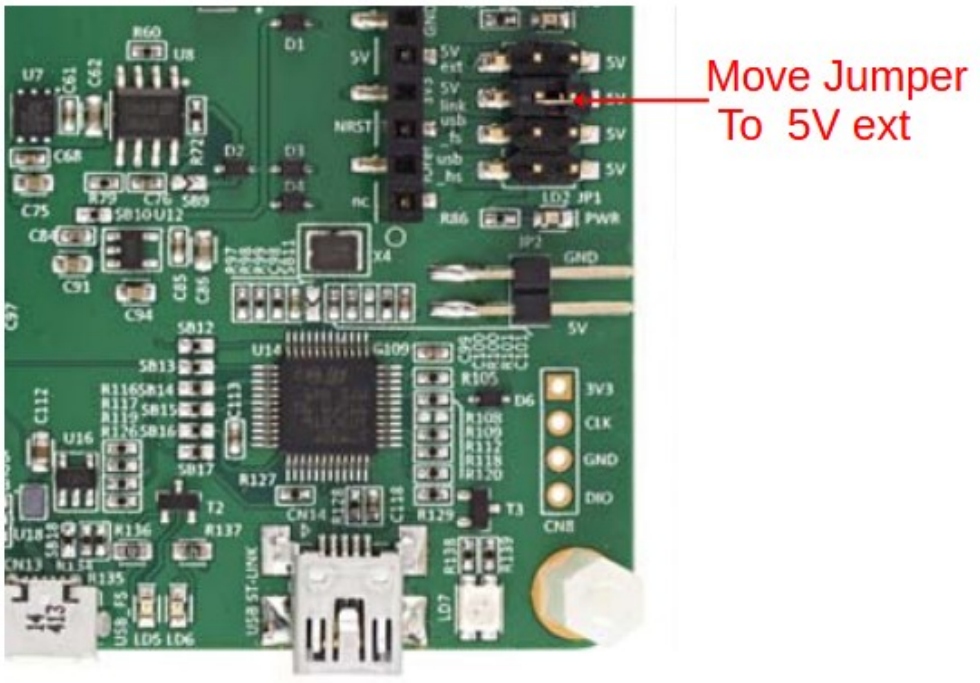
Step 4:
Format an SD Card and then create and save a file labeled “StationData.txt” which includes your Call Sign and Maidenhead Locator. Here is an example of what my station data file contains:

W5BAA:EM00

After creating the file on the SD Card, insert the SD Card in the SD Card Connector as shown below:

Step 5:
After reviewing Barb’s Notes on preparing and connecting the DX_FT8 board to the Disco Board make the required connections between the Audio IQ output of the DX_FT8 board then IQ (Line) Audio input of the Disco board.

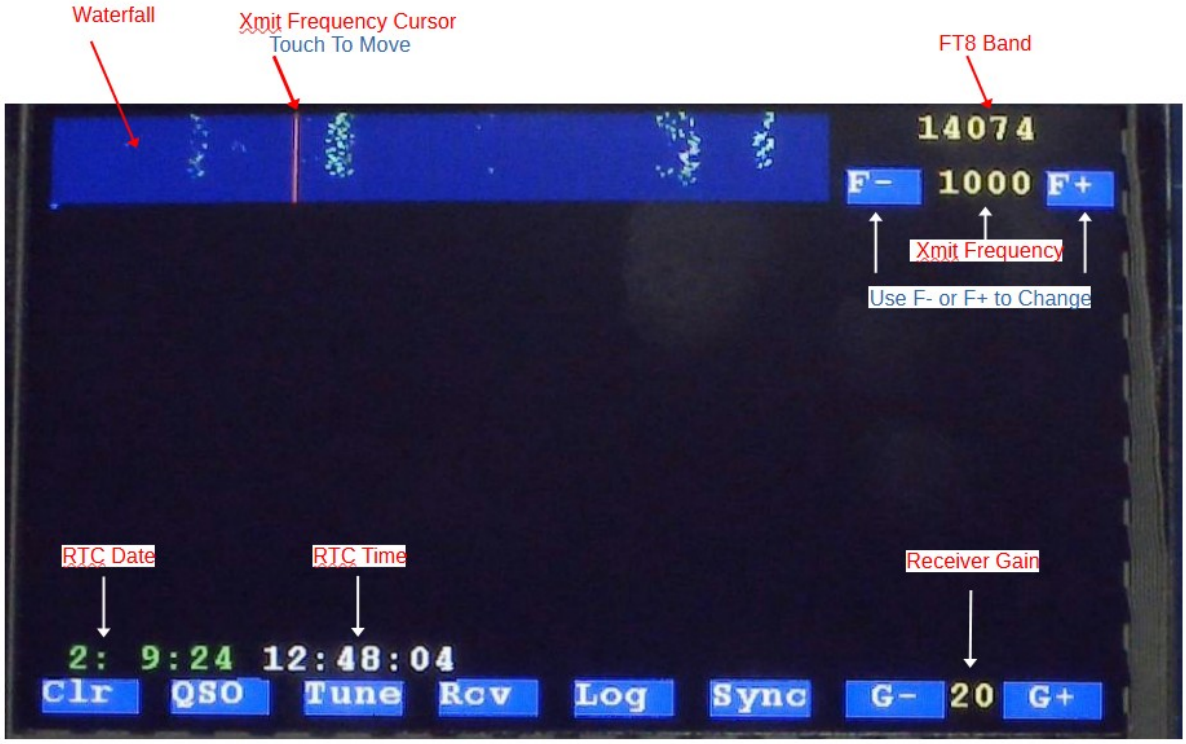
Next, move the jumper on J1 to the 5V ext pins.



Step 6:
Follow Barb's instructions for setting up the input power options for the DX_FT8 board and power up the board and connect an antenna. Here us what you should see.

When you touch the Tune Button you will see the following display.

FT8 Operations Display Legend



When you first set up your unit the Real Time Clock (RTC) Date and Time will probably read as 00:00:00 or be blank. You may set the RTC Date and Time by using the Tune screen.

Clr: Touch to clear FT8 Traffic Display, momentary touch.

QSO: Touch to change FT8 Mode from QSO to Beacon, bi state touch

Tune: Touch to bring up TUNE Screen, bi state touch

Rcv: No Touch, indicates either Receive or Transmit Operation

Log: Touch to turn on Logging, bi state touch

Sync: Touch to Synchronize FT8 Reception With Rest of World, turns from RED to BLUE on Sync

G-: Touch to reduce Receiver Gain by 1 dB.

G+: Touch to increase Receiver Gain by 1 dB.

F-: Touch to reduce transmit audio frequency by 6.25 Hz

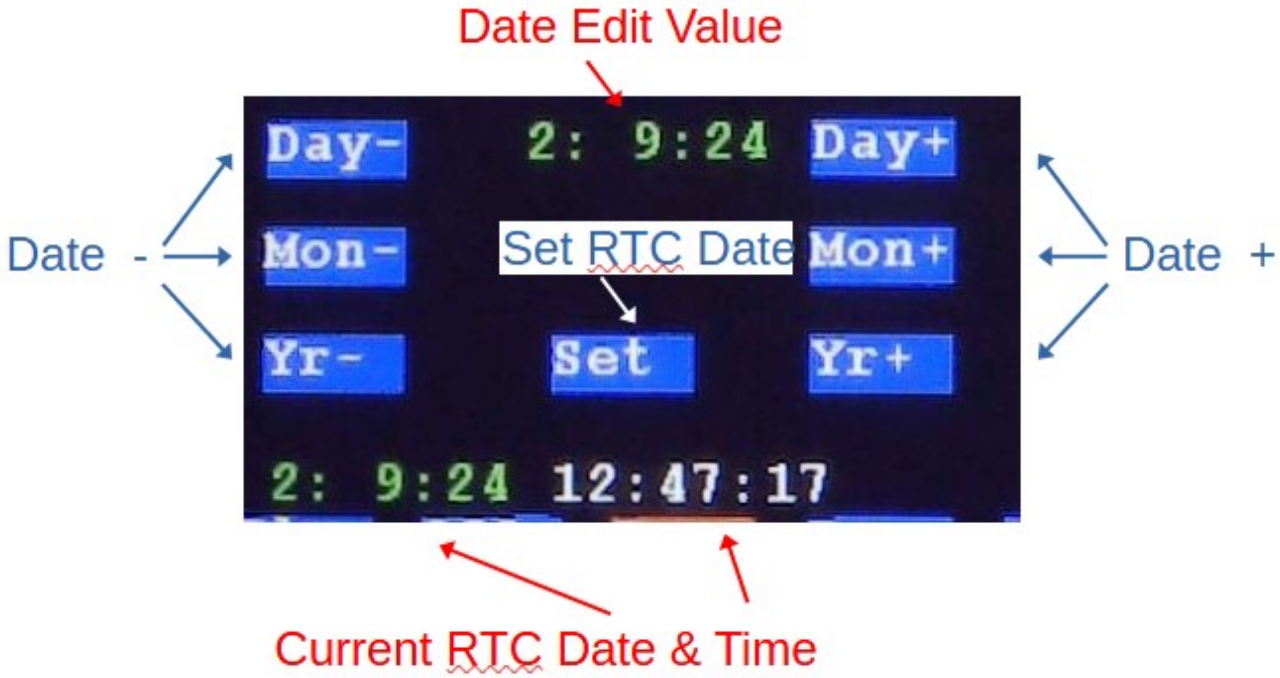
F+: Touch to reduce transmit audio frequency by 6.25 Hz

Tune Screen Data and Touch Button Legend

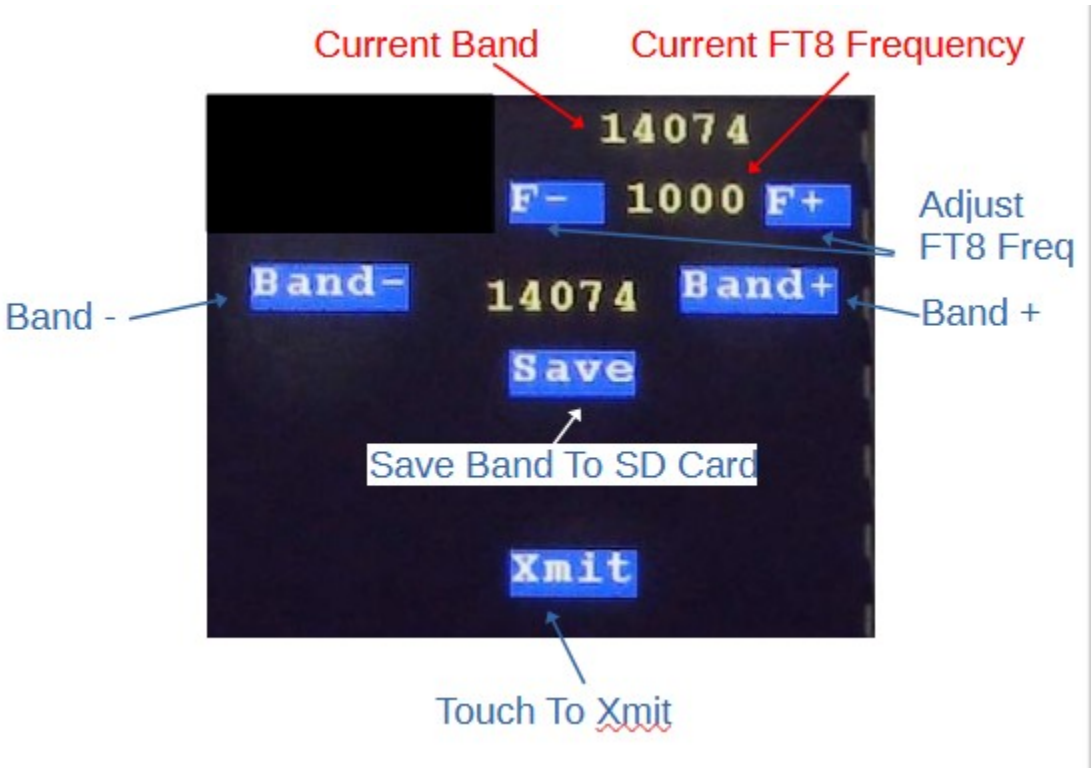
When you touch the **Tune Button** the unit goes into the Tune mode and additional data items and buttons will be presented as shown below:

Time Edit Buttons

Date Edit Buttons



Band & Frequency Buttons



Time Synchronization With the FT8 World

In the world of FT8 time synchronization is vital. After various attempts such using GPS Time or pure manual synchronization a more friendly semi automatic method has been developed.

With this version of hardware the FT8 signals displayed on the waterfall are quite crisp and there is a very distinct band of no received signals at the end of each FT8 slot as shown below:

If you have noisy conditions and there is white snow at the end of the FT8 slot, use the G- button shown above until there is a distinct lull in signals at the end of the FT8 slot. Then, press the Sync button and wait.

The software searches for the lull in FT8 traffic and then sets the synchronization and the Sync Button turns BLUE and FT8 messages are decoded.

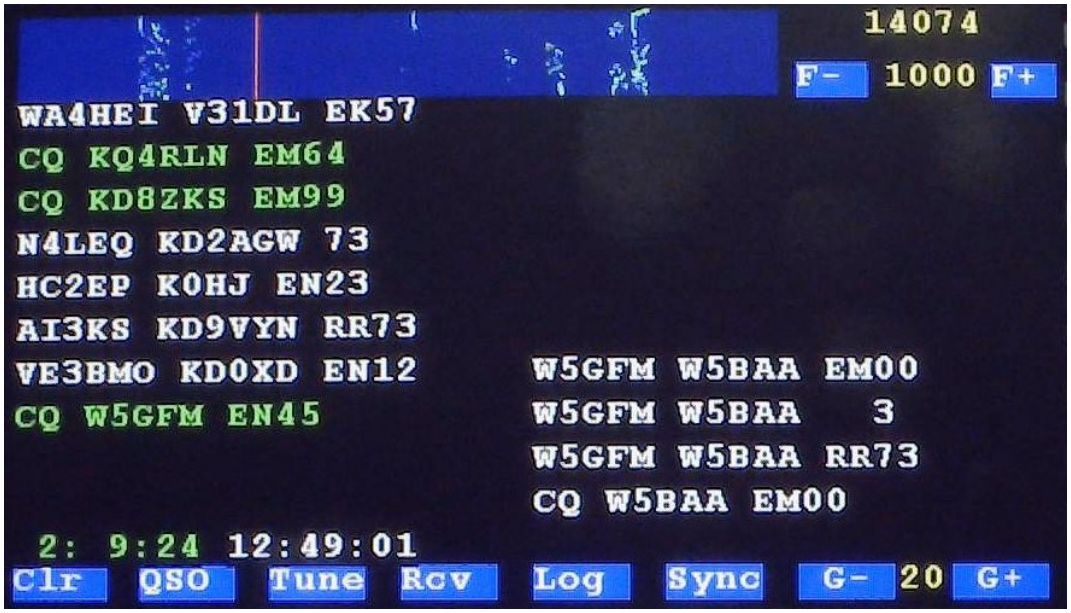
Important Information!!

When FT8 messages and decoded it is important to understand and remember how messages are displayed. There are two panes displayed, one on the left and one on the right. The Left Pane displays Live FT8 Traffic. The Right Pane shows messages you generate or are sent to your Call Sign.

Using The QSO Mode of Operation
When in the QSO Mode all outgoing FT8 Messages are generated by the user using software tools.

To generate an FT8 message select a station that you wish to contact by touching their message in the Right Pane. In the figure below the user sees that W5GFM is calling CQ and wishes to contact this station by touching the message “CQ W5GFM EN45” message.

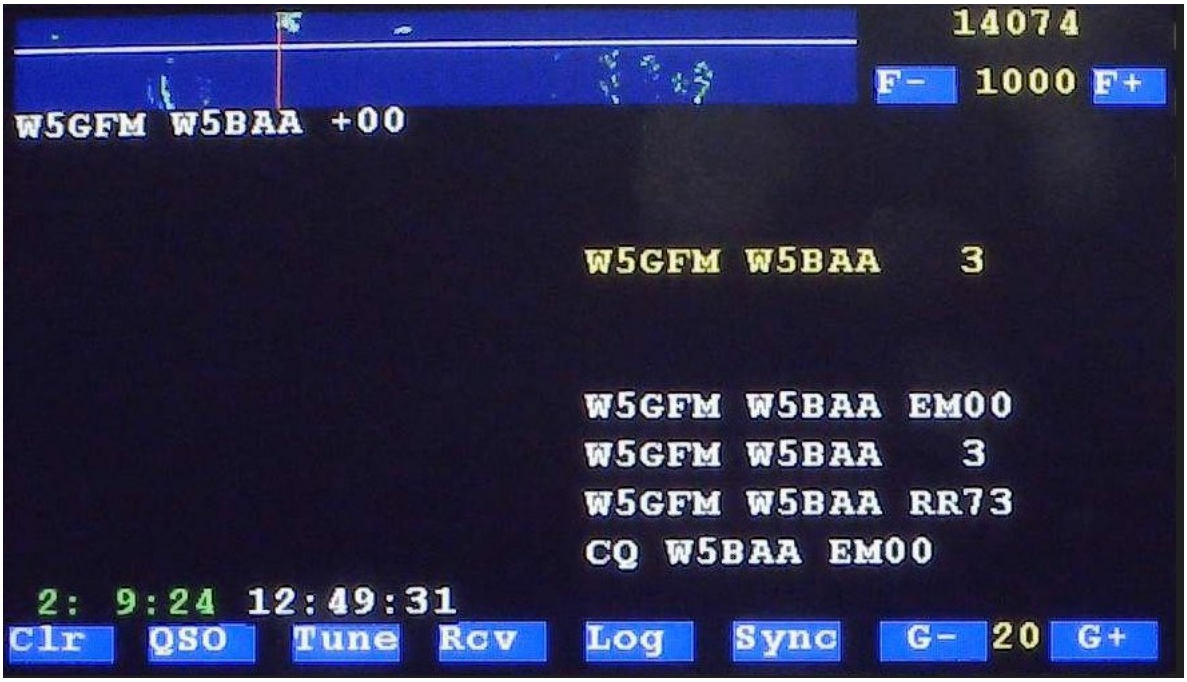
The user is then presented with the messages shown below:



In this example, the user decides to send the “W5GFM W5BAA 3” message by touching the software generated message displayed in the Right Pane.

The selected message is “Qued Up” for transmission and is shown in RED and logged in the short term traffic log shown in YELLOW.

The Qued UP message is then automatically transmitted in the next FT8 Slot. Please see the figure below which shows the “Off The Air” receipt of the message transmitted in the Left Pane and the Qued Up message in RED is erased.



Beacon Mode of Operation

To enter the Beacon Mode of Operation touch the QSO button. You will see that the button turns RED and the button legend says “Becn”. The unit will stay in the Beacon Mode until you touch the QSO / Beacon button again.

The software requires that FT8 messages be decoded before transmitting a CQ message. The software will transmit a CQ then listen for a reply. If no one calls, another CQ message is transmitted.

When a station replies to your CQ, a message giving the calling station a signal report is transmitted.

If the calling station replies again, a RR73 message is transmitted.

When the software no longer sees stations calling your station call, it will then start calling CQ again.

Please see an example of the display of FT8 traffic while in the Beacon Mode. The display is a temporary log of the FT8 messages sent and received. Up to 10 messages are displayed with the oldest message at the top of the list and most recent at the bottom of the list.

In this case the logging function was turned on. When logging is on, each time an RR73 message is sent by W5BAA a log entry is made.

Logging Function

To turn on the logging function touch the Log button which will turn RED.

Logging works while operating in the QSO Mode or Beacon mode. A log entry is made each time a RR73 message is sent: For example “KB4UHK W5BAA RR73”

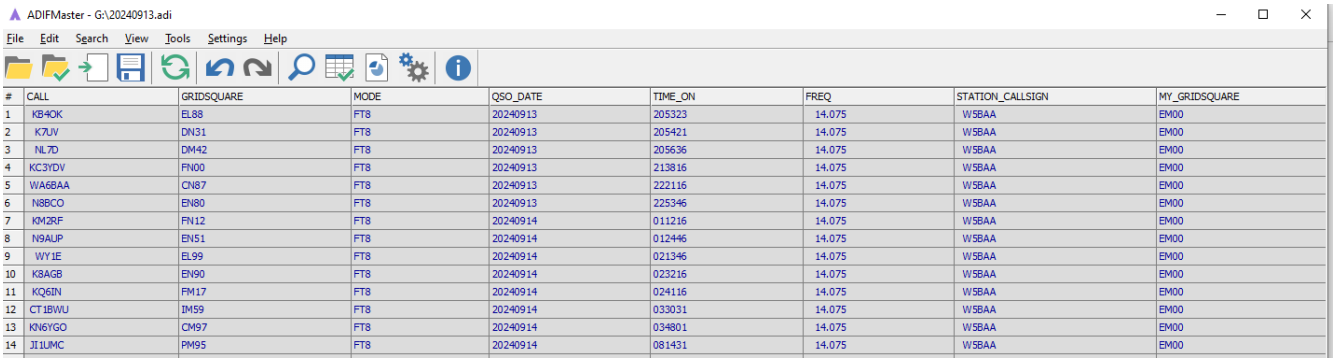
The name of the log file will be the current RTC date. The log data is stored in an ADIF format and given the extension “.adi”. An example filename is “20200902.adi.

The filename is made using the current Date.

On a given day, the same filename will used for all log entries until the date is changed by the RTC.

An ADIF file may be displayed and edited by the ADIF viewer ADIFMaster which may found at this location: https://www.dxshell.com/

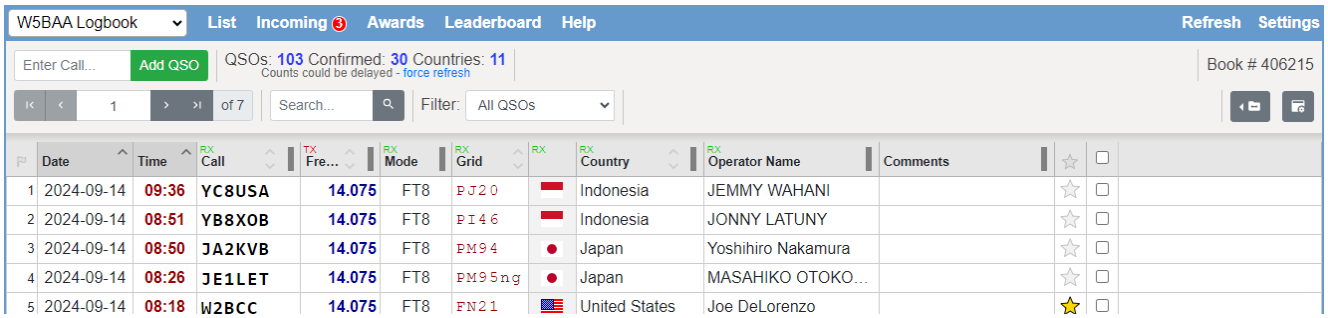
Please see an example of a log file’s contents below:



#	CALL	GRIDSQUARE	MODE	QSO_DATE	TIME_ON	FREQ	STATION_CALLSIGN	MY_GRIDSQUARE
1	KB4OK	EL88	FT8	20240913	205323	14.075	W5BAA	EM00
2	K7UV	DN31	FT8	20240913	205421	14.075	W5BAA	EM00
3	NL7D	DM42	FT8	20240913	205636	14.075	W5BAA	EM00
4	KC3YDV	FN00	FT8	20240913	213816	14.075	W5BAA	EM00
5	WA6BAA	CN87	FT8	20240913	222116	14.075	W5BAA	EM00
6	N8BCO	EN80	FT8	20240913	225346	14.075	W5BAA	EM00
7	KM2RF	FN12	FT8	20240914	011216	14.075	W5BAA	EM00
8	N9AUP	EN51	FT8	20240914	012446	14.075	W5BAA	EM00
9	WY1E	EL99	FT8	20240914	021346	14.075	W5BAA	EM00
10	K8AGB	EN90	FT8	20240914	023216	14.075	W5BAA	EM00
11	KQ6IN	FM17	FT8	20240914	024116	14.075	W5BAA	EM00
12	CT1BWU	IM59	FT8	20240914	033031	14.075	W5BAA	EM00
13	KN6YGO	CM97	FT8	20240914	034801	14.075	W5BAA	EM00
14	JI1UMC	PM95	FT8	20240914	081431	14.075	W5BAA	EM00

Further, the log file may be uploaded to your QRZ Logbook found here: https://logbook.qrz.com/logbook.

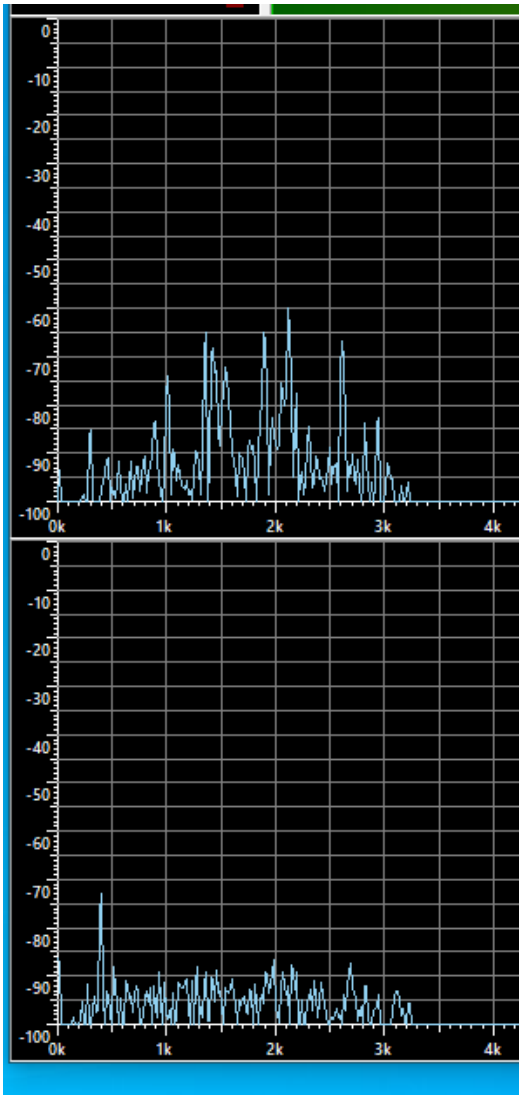
For example:



	Date	Time	RX Call	TX Fre...	RX Mode	RX Grid	RX	RX Country	RX Operator Name	Comments
1	2024-09-14	09:36	YC8USA	14.075	FT8	PJ20		Indonesia	JEMMY WAHANI	
2	2024-09-14	08:51	YB8XOB	14.075	FT8	PI46		Indonesia	JONNY LATUNY	
3	2024-09-14	08:50	JA2KVB	14.075	FT8	PM94		Japan	Yoshihiro Nakamura	
4	2024-09-14	08:26	JE1LET	14.075	FT8	PM95ng		Japan	MASAHIKO OTOKO...	
5	2024-09-14	08:18	W2BCC	14.075	FT8	FN21		United States	Joe DeLorenzo	

Monitoring Receiver Audio Output

The demodulated signal audio output may be observed via the Green 3.5 mm stereo audio jack, CN10. The top audio spectrum is the received Upper Sideband audio and the bottom spectrum is the Lower Sideband audio. Please note the excellent unwanted sideband suppression from DX FT8 board.



A nice tool for observing the audio output is an application called “Goldwave” which may be found here: https://goldwave.com/

Extra Benefits

One of the key benefits of the STM32F746 board that has significantly contributed to the success of the DX FT8 project are the ARDUINO connectors shown below. All signals except for the IQ Audio signals required for this project are made thru these connectors. Also the required power connections are made thru these connectors.

Table 5. ARDUINO® connectors (CN4, CN5, CN6 and CN7)

Left connectors						Right connectors				
CN No.	Pin No.	Pin name	STM32 pin	Function		Function	STM32 pin	Pin name	Pin No.	CN No.
						I2C1_SCL	PB8	D15	10	CN7 digital
						I2C1_SDA	PB9	D14	9	
						AVDD	-	AREF	8	
						Ground	-	GND	7	
CN6 power	1	NC	-	-		SPI2_SCK	PI1	D13	6	
	2	IOREF	-	3.3V Ref		SPI2_MISO	PB14	D12	5	
	3	RESET	NRST	RESET		TIM12_CH2, SPI2_MOSI	PB15	D11	4	
	4	+3V3	-	3.3V input/output		TIM1_CH1	PA8	D10	3	
	5	+5V	-	5V output		TIM2_CH1	PA15	D9	2	
	6	GND	-	Ground		-	PI2	D8	1	
	7	GND	-	Ground		-				
	8	VIN	-	Power input		-	PI3	D7	8	CN4 digital
-						TIM12_CH1	PH6	D6	7	
CN5 analog	1	A0	PA0	ADC3_IN0		TIM5_CH4,SPI2_NSS	PI0	D5	6	
	2	A1	PF10	ADC3_IN8		-	PG7	D4	5	
	3	A2	PF9	ADC3_IN7		TIM3_CH1	PB4	D3	4	
	4	A3	PF8	ADC3_IN6		-	PG6	D2	3	
	5	A4	PF7 or PB(1)	ADC3_IN5 (PF7) or I2C1_SDA (PB9)		USART6_TX	PC6	D1	2	
	6	A5	PF6 or PB8(1)	ADC3_IN4 (PC0) or I2C1_SCL (PB8)		USART6_RX	PC7	D0	1	

1. Refer to *Table 12* for details.