

SI4732 (ESP32) Mini Receiver

Firmware: ATS_MINI

F/W : v0.28

CPU Frequency: 80 MHz (Set during compile)

Date: 27/02/2025

Summary of changes

F/W	Date	Changes
v0.28	27/02/2025	Modified colours for S-Meter and STEREO indicator
v0.26	25/02/2025	Modified battery monitoring thresholds and display voltage resolution Modified stored BFO value to align with stored Frequency value
v0.25	21/02/2025	Modified AGC/ATTN setting to per mode (FM, AM, SSB) Modified SoftMute setting to per mode (AM, SSB) Added AVC setting per mode (AM, SSB) All configuration settings stored in EEPROM Removed BFO setting option. SSB uses combined VFO/BFO tuning Prevent parameter setting if not applicable to current mode
v0.23	12/02/2025	Corrected calibration behaviour Limited (currentBFO + currentCAL) to +/- 16000 Updated LW/MW step limit Added seek stop for AM and FM modes Added REMOTE serial for debug control and monitoring
v0.19	07/02/2025	First release Alternative to standard firmware

Please note installation of this firmware is at risk.

Programming Instructions

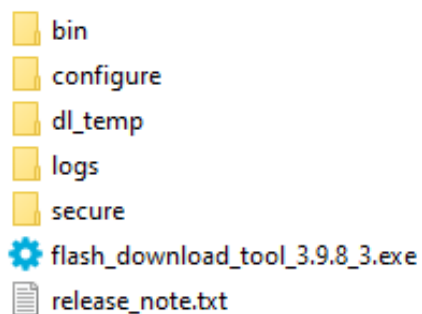
This section covers how to program the device using the bin files.

- Download the Expressif flash download tool.

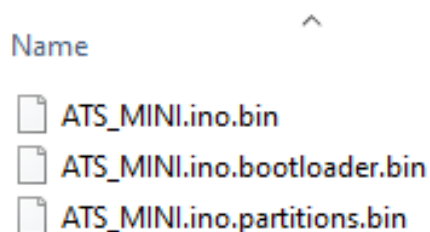
Path: https://docs.espressif.com/projects/esp-test-tools/en/latest/esp32/production_stage/tools/flash_download_tool.html

The filename should be “flash_download_tool.zip”.

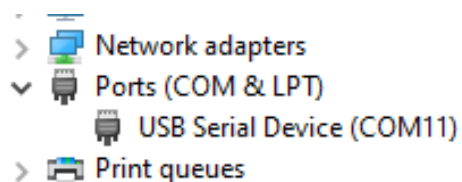
- Extract the zip file.



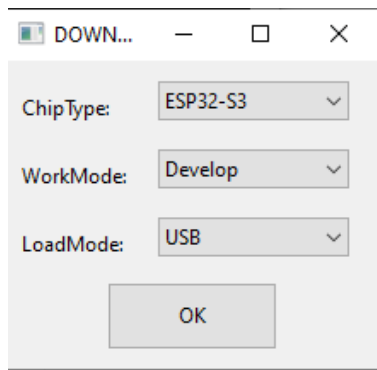
- Extract the ATS_MINI bin files into a folder or desktop.



- With the SI4732 Mini Receiver powered ON, connect to the PC and check the COM port in the Windows Device Manager.



- Run the flash_download_tool and select the options as shown.

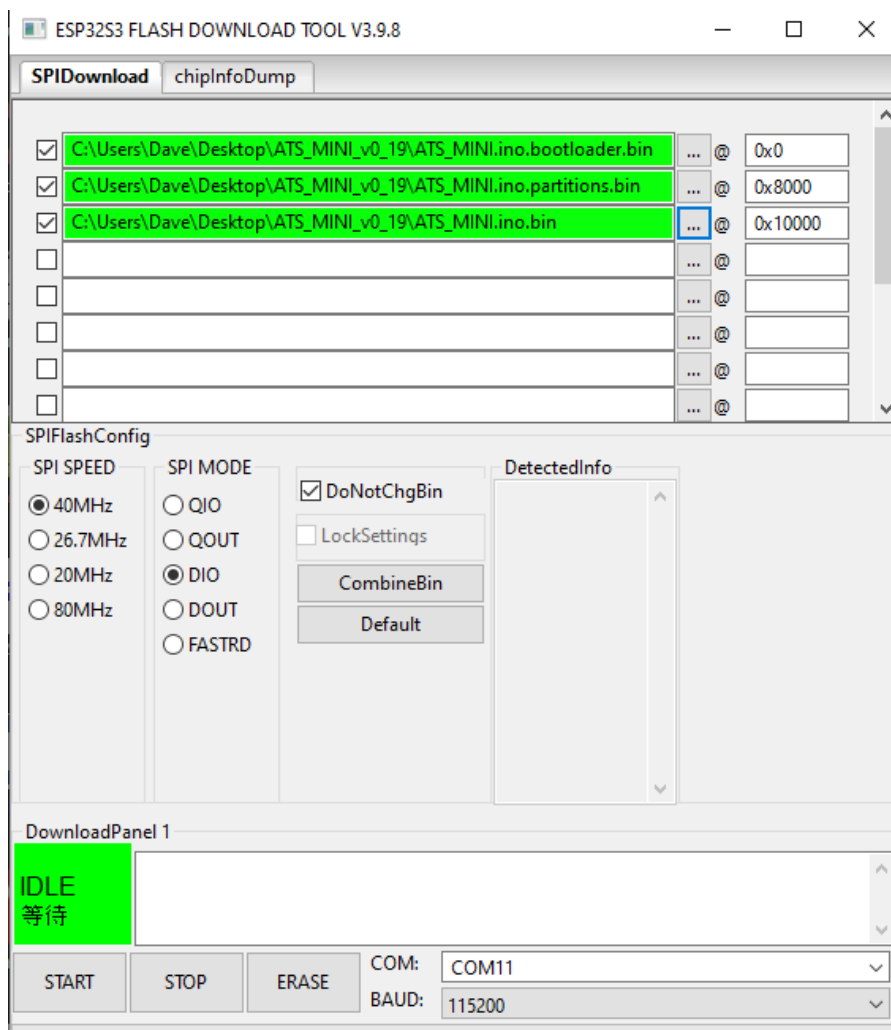


Select "OK",

The required settings are shown below.

Note: The COM port and file paths may be different.

Select the files and enter the addresses values, and enable the check boxes next to the file bars.



After checking all information is correct, press the "START" button.

The transcript should look similar to that shown below. The message "NO XMC flash detected!" is normal and does not indicate a problem.

```
D:\Users\Dave\Documents\Info and Files\Products\RADIO\XHDATA\ATSMI
C:\Users\Dave\Desktop\ATS_MINI_v0_19\ATS_MINI.ino.bootloader.bin
C:\Users\Dave\Desktop\ATS_MINI_v0_19
C:\Users\Dave\Desktop\ATS_MINI_v0_19\ATS_MINI.ino.partitions.bin
C:\Users\Dave\Desktop\ATS_MINI_v0_19
C:\Users\Dave\Desktop\ATS_MINI_v0_19\ATS_MINI.ino.bin
test offset : 0 0x0
case ok
test offset : 32768 0x8000
case ok
test offset : 65536 0x10000
case ok


Uploading stub...
Running stub...
Stub running...
Changing baud rate to 115200
Changed.
NO XMC flash detected!
SPI_BOOT_CRYPT_CNT 0
SECURE_BOOT_EN False
Compressed 15104 bytes to 10429...
Compressed 3072 bytes to 144...
Compressed 382848 bytes to 222812...

is stub and send flash finish
```

- Power cycle the SI4732 Mini Receiver.

A startup screen should be displayed, showing the firmware version.

(Example below for v0.19).



ATS-Mini Receiver
F/W: v0.19
To reset EEPROM
Press+Hold ENC Button

The receiver should then start as shown.



Functional Summary

This section provides a feature summary and highlights the main differences to the standard firmware.

ATS_MINI

This firmware is for use on the SI4732 (ESP32-S3) Mini/Pocket Receiver

Based on the following sources:

Ralph Xavier: <https://github.com/ralphxavier/SI4735>
PU2CLR, Ricardo: <https://github.com/pu2clr/SI4735>
Goshante: https://github.com/goshante/ats20_ats_ex

G8PTN, Dave (2025)

NOTES

- Special instructions for the TFT-eSPI library
Ref: <https://github.com/Xinyuan-LilyGO/T-Display-S3#quick-start>
- The code for this sketch was developed using Arduino IDE 1.8.19
- The main changes from the Ralph Xavier firmware are as follows
 - User interface modified
 - Removed the frequency scale
 - Set "Volume" as the default adjustment parameter
 - Modified the S-Meter size and added labels
 - All actions now use a single press of the rotary encoder button, with a 10s timeout
 - Added status bar with indicators for Display and EEPROM write activity
 - Added unit labels for "Step" and "BW"
 - Added SSB tuning step options 10Hz, 25Hz, 50Hz, 0.1k and 0.5k
 - Added background refresh of main screen
 - VFO/BFO tuning mechanism added based on Goshante ATS_EX firmware
This provides "chuff" free tuning over a 30kHz span (+/- 15kHz)
Compile option "BFO_MENU_EN" for debug purposes, manual BFO is not required
 - Modified the audio mute behaviour
Previously the rx.setAudioMute() appeared to unmute when changing band
The "Mute" option now toggles the volume level between 0 and previous value
 - Modified the battery monitoring function
Uses set voltages for 25%, 50% and 75% with a configurable hysteresis voltage
Added voltage reading to status bar
 - Added "Brightness" menu option
This controls the PWM from 32 to 255 (full on) in steps of steps of 32
When the brightness is set lower than 255, PSU or RFI noise may be present
 - Added "Calibration" menu option
This allows the SI4732 reference clock offset to be compensated
 - Added Automatic Volume Control (AVC) menu option
This allows the maximum audio gain to be adjusted
 - Settings for AGC/ATTN, SoftMute and AVC stored in EEPROM per mode
AGC/ATTN (FM, AM, SSB), SoftMute (AM, SSB), AVC (AM, SSB)
 - Added a REMOTE serial interface for debug control and monitoring

Notes

- All selections are now done on a single press of the rotary encoder. The menu pages will automatically time out after 10 seconds. The default option is "Volume". There are three additional menu options, display "Brightness", frequency "Calibration" and Automatic Volume Control "AVC". The redundant "BFO" setting option has been removed. Please refer to the Appendix section "MENU PARAMETERS" for a summary of the available parameter settings.
- In SSB mode, additional step options are now possible (10Hz, 25Hz, 0.1k, 0.5k) as well as 1k, 5k, 9k and 10k. In SSB mode it should be "chuff" free over a span of 30kHz.
- The "Time" on the status bar is reset to 00:00 at boot and can be used as a run time indicator. For future updates, It should be possible to get the time from RDS or from NTP if the WIFI is enabled.
- The two indicators on the top status bar provide feedback for Screen updates (GREEN) and EEPROM write (RED).

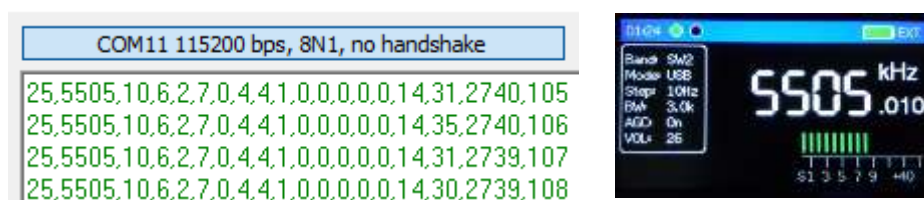
If there is no screen activity, the screen status indicator may remain ON/OFF for a while. There is a background refresh of the main screen every 5 seconds, or it will occur more often during tuning, RSSI and RDS Station changes.

The screen status indicator will remain ON/OFF whilst the menu window is open, but it will change state when moving between options or changing a parameter value.

- The battery meter shows the state of charge (SOC) with fixed steps. When the SOC drops below 25% the indicator will turn "RED". Hysteresis is applied to prevent chattering between levels.

A measured voltage level is also reported. The battery voltage is meaningless when the USB (5V) port is connected and therefore the voltage will be replaced with an "EXT" label to indicate external power is connected.

- During testing and to reduce wear on the rotary encoder, a REMOTE serial interface has been added. This serial interface is 115200 bps, 8N1. Example output to a serial terminal below.



For further details on the command and information structure, please refer to the Appendix section "REMOTE SERIAL".

Note: If the receiver is placed into SEEK mode, the serial interface will be halted until the SEEK mode is completed or exited manually via the hardware rotary encoder Up/Down.

Appendix

MENU PARAMETERS

The table below shows a summary of the “Menu” options.

Menu #	Parameter	Function	Default	Comments
1	Band	Select band data from the internal band table	VHF	
2	Mode	Select Mode (FM, AM, LSB, USB)	FM	
3	Volume	Adjust volume level	35	
4	Step	Adjust frequency step	100 kHz	Mode and Band specific
5	Bandwidth	Adjust filter bandwidth	Auto	Mode specific
6	Mute	Mute/Unmute the volume	Off	
7	AGC/ATTN	Adjust AGC and Attenuation FM AM SSB	AGC ON AGC ON AGC ON	Mode specific
8	SoftMute	Adjust Softmute (Max Attn) AM SSB	4 dB 4 dB	Mode specific
9	AVC	Adjust AVC (Max Gain) AM SSB	48 dB 48 dB	Mode specific
10	Spare 1	Spare	N/A	
11	Seek Up	FM, AM seek up	N/A	Exit using rotary encoder Up/Dn
12	Seek Dn	FM, AM seek down	N/A	Exit using rotary encoder Up/Dn
13	Calibration	Adjust calibration offset	0 Hz	Applicable for SSB only
14	Brightness	Adjust display brightness level	128	
15	Spare 2	Spare	N/A	

Notes

- The default values are those following an EEPROM reset. The option to reset the EEPROM is available during boot up.

Changed values are automatically stored to EEPROM approximately 10 seconds after the current adjustments have been completed.

- Modifications of parameters are only possible if they are applicable for the current selected mode.

Example 1: “SoftMute” and “AVC” only applies for AM and SSB.

Example 2: “Calibration” only applies for SSB.

ATS-MINI BAND TABLE									
				Frequency VHF (FM): x10kHz AM/SSB: x 1kHz					
Index	bandName	bandType	minimumFreq	maximumFreq	currentFreq	currentStepIdx	bandwidthIdx	Step (kHz)	BW (kHz)
0	VHF	FM_BAND_TYPE	6400	10800	10390	1	0	100	Auto
1	MW1	MW_BAND_TYPE	150	1720	810	3	4	10	3
2	MW2	MW_BAND_TYPE	531	1701	783	2	4	9	3
3	MW2	MW_BAND_TYPE	1700	3500	2500	1	4	5	3
4	80M	MW_BAND_TYPE	3500	4000	3700	0	4	1	3
5	SW1	SW_BAND_TYPE	4000	5500	4885	1	4	5	3
6	SW2	SW_BAND_TYPE	5500	6500	6000	1	4	5	3
7	40M	SW_BAND_TYPE	6500	7300	7100	0	4	1	3
8	SW3	SW_BAND_TYPE	7200	8000	7200	1	4	5	3
9	SW4	SW_BAND_TYPE	9000	11000	9500	1	4	5	3
10	SW5	SW_BAND_TYPE	11100	13000	11900	1	4	5	3
11	SW6	SW_BAND_TYPE	13000	14000	13500	1	4	5	3
12	20M	SW_BAND_TYPE	14000	15000	14200	0	4	1	3
13	SW7	SW_BAND_TYPE	15000	17000	15300	1	4	5	3
14	SW8	SW_BAND_TYPE	17000	18000	17500	1	4	5	3
15	15M	SW_BAND_TYPE	20000	21400	21100	0	4	1	3
16	SW9	SW_BAND_TYPE	21400	22800	21500	1	4	5	3
17	CB	SW_BAND_TYPE	26000	28000	27500	0	4	1	3
18	10M	SW_BAND_TYPE	28000	30000	28400	0	4	1	3
19	All	SW_BAND_TYPE	150	30000	15000	0	4	1	3

REMOTE SERIAL

The USB port can be used for debug control and monitoring.

Control

Function	Up	Down	Push Button	Comments
Rotary Encoder	"U"	"D"	"P"	The "P" emulates a single push and can not be used for EEPROM reset.
Band	"B"	"b"		See Note
Mode	"M"	"m"		See Note
Step	"S"	"s"		See Note
BandWidth	"W"	"w"		See Note
AGC/ATTN	"A"	"a"		See Note
Volume	"V"	"v"		See Note
BackLight	"L"	"l"		See Note

Note: To trigger an EEPROM write, issue a "U" and "D" command whilst in VFO mode. The write occurs after 10 seconds.

Monitor

The following comma separated information is sent out on the serial interface.

Position	Parameter	Function	Comments
1	app_ver	F/W version	Example 23, F/W = v0.23
2	currentFrequency	Frequency	FM = 10 kHz, AM/SSB = 1 kHz
3	currentBFO	BFO	SSB = Hz
4	bandIdx	Band	See tables
5	currentMode	Mode	See tables
6	currentStepIdx	Step	See tables
7	bwIdxFM	Bandwidth FM	See tables
8	bwIdxAM	Bandwidth AM	See tables
9	bwIdxSSB	Bandwidth SSB	See tables
10	agcIdx	AGC/ATTN	See tables
11	cmdBand	Menu Band	1 = Active
12	cmdMode	Menu Mode	1 = Active
13	cmdStep	Menu Step	1 = Active
14	cmdBandwidth	Menu Bandwidth	1 = Active
15	cmdAgc	Menu AGC/ATTN	1 = Active
16	remote_volume	Volume	0 to 63 (0 = Mute)
17	remote_rssi	RSSI	0 to 127 dBuV
18	adc_read_avr	ADC average value	Voltage = Value x 1.702 / 1000
19	g_remote_seqnum	Sequence number	0 to 255 repeating sequence

In SSB mode, the "Display" frequency (Hz) = (currentFrequency x 1000) + currentBFO

Tables

bandIdx: The index references the to the band table. Examples shown below.

Note: The band table does not currently differentiate between AM and SSB, switching mode with an out-of-range step size will cause the step to be defaulted to 1kHz.

Index	Name	Band Type	Min Freq	Max Freq	Current Freq	Current Step	Bandwidth
0	"VHF"	FM_BAND_TYPE	6400	10800	10390	1	0
1	"MW1"	MW_BAND_TYPE	150	1720	810	3	4
19	"ALL"	SW_BAND_TYPE	150	30000	15000	0	4

currentMode:

Index	Mode
0	FM
1	LSB
2	USB
3	AM

currentStepIdx:

FM:

Index	FM
0	50 kHz
1	100 kHz
2	200 kHz

AM/SSB:

Index	AM (LW/MW)	AM	SSB
0	1 kHz	1 kHz	1 kHz
1	5 kHz	5 kHz	5 kHz
2	9 kHz	9 kHz	9 kHz
3	10 kHz	10 kHz	10 kHz
4	50 kHz	50 kHz	
5		100 kHz	
6		1 MHz	
7			10 Hz
8			25 Hz
9			50 Hz
10			100 Hz
11			500 Hz

Note: "LW/MW" is the "Band Type" used from the band table.

bwIdxFM:

Index	Bandwidth
0	Auto
1	110 kHz
2	84 kHz
3	60 kHz
4	40 kHz

bwIdxAM:

Index	Bandwidth
0	1.0 kHz
1	1.8 kHz
2	2.0 kHz
3	2.5 kHz
4	3.0 kHz
5	4.0 kHz
6	6.0 kHz

bwIdxSSB:

Index	Bandwidth
0	0.5 kHz
1	1.0 kHz
2	1.2 kHz
3	2.2 kHz
4	3.0 kHz
5	4.0 kHz

agcIdx:

Index	FM	AM	SSB
0	AGC ON	AGC ON	AGC ON
1	ATTN = 0	ATTN = 0	ATTN = 0
2 - 26	ATTN = 1 - 25	ATTN = 1 - 25	
27	ATTN = 26	ATTN = 26	
28		ATTN = 27	
29 - 36		ATTN = 28 - 35	
37		ATTN = 36	

Notes

ATTN = 0 is “ACG OFF” with no attenuation.

The SI4732/5 SSB patch effectively only supports “AGC ON” and “AGC OFF”.