



WAVE III

10-bit Stereo High Quality Micro-SD Wave Audio Player/Recorder Module with AT-Commands support.

Rev. 1.0 04 May 2019

Product Datasheet and User Manual

1. General Description

Wave III is a two channel Stereo Audio Recorder and Player module with FAT File System support.

The module can record audio on Micro-SD card or play pre-loaded files with high quality from the Micro-SD card.

Recording and Playing is 2 channel Stereo with 10-bits resolution

Wave III supports FAT File System so user can call file names to play or create a file/folder to record using AT-Commands.

Communication is through UART port with Auto-Baud Rate detection system.

Low Latency Commands makes it suitable for applications that multiple audio files need to be played consecutively.

2. Features and Benefits

- NXP ARM Cortex-M0 core.
- UART Port with Auto-Baud Rate detection feature.
- AT-Command Support through serial port.
- High quality Audio.
- Two channel Stereo audio outputs (Left/Right).
- Two channel Stereo audio inputs (Left/Right).
- 10-bit audio resolution for each channel both play and record.
- Standard Wave file support.
- 11 KHz to 48 KHz playing sample rate support
- 32 KHz recording sample rate.
- Single 3.3 V power supply (2.7 V to 3.6 V).
- 5 V tolerant inputs
- On-Board Micro-SD card slot.
- Low power consumption in Sleep mode (0.9 mA – 1.2mA).
- FAT16 / FAT32 support.

3. Applications

- Alarm systems.
- Audio Playing/Recording systems.
- Audio voice announcement systems.

4. Electrical Characteristics

Table 1. Electrical characteristics

Symbol	Parameter	Min	Typ	Max	Unit
Vcc	Power voltage	2.7	3.3	3.6	V
Istb	Standby current	10	12	15	mA
Iwork	Play/Record Current	20	22	26	mA
Isleep	Sleep Current	0.9	1	1.2	mA

5. Pinning Information

Table 2. Pinning Information

Pin	Symbol	Type	Description
1	VCC	I	3.3 V supply voltage
2	#EN	I	UART enable pin. Logic high on this pin will set UART pins to high impedance mode. Should be set Low for normal operation.
3	#RST	I	A LOW-going pulse as short as 50 ns on this pin resets the device. External pullup is required on this pin.
4	RX	I	Serial receive pin
5	TX	O	Serial transmit pin
6	GND	I	Digital Ground (0v Reference)
7	AGND	I	Analog Ground
8	R-OUT	O	Right channel audio output
9	L-OUT	O	Left channel audio output
10	L-IN	I	ADC input for Audio recording (left channel)
11	R-IN	I	ADC input for Audio recording (right channel)
12	#ISP	I	NOT USED. This pin has to be High all the time. Low at reset on this pin will put module in undefined mode.

5.1. VCC

This pin is the 3.3 V supply pin. The voltage on this pin has to be regulated and filtered well to avoid digital noise on the audio.

A 100nf and minimum 10uF capacitor is recommended on this pin as close as possible.

5.2. #EN

Logic Low on this Low active input disables the UART serial port and set the serial pins to High-Impedance mode. This is used when two or more serial devices are in parallel on the same port.

Tie this pin directly to VCC or have an external pullup resistor on this pin if it's not used.

5.3. #RST

Hardware reset pin. A LOW-going pulse as short as 50 ns on this pin resets the device. An external pullup is required on this pin.

5.4. RX

Serial Receive pin. This is Module's UART RX pin. This pin has to be connected to the Controller's TX pin in the design. Fig4

5.5. TX

Serial Transmit pin. This is Module's UART TX pin. This pin has to be connected to the Controller's RX pin in the design. Fig4

5.6. GND

Digital Ground pin. Although Digital and Analog GNDs are tied together internally, but Digital and Analog ground planes have to be isolated in the design to prevent digital noise on audio signals. Fig 1

5.7. AGND

Analog Ground pin. Although Digital and Analog GNDs are tied together internally, but Digital and Analog ground planes have to be isolated in the design to prevent digital noise on audio signals. Fig 1

5.8. R-OUT

Right channel audio output. This pin can go to the Amplifier with a 100nf and a 10k ohm resistor in series. Fig 2

5.9. L-OUT

Left channel audio output. This pin can go to the Amplifier with a 100nf and a 10k ohm resistor in series. Fig 2

5.10. L-IN

Audio signal input for Left channel. This input goes directly to the ADC and Audio can't be connected to this pin directly without the circuitry in Fig 3.

Note: The peak-peak voltage of audio signal can't exceed VCC, Otherwise there will be distortion on recorded audio.

5.11. R-IN

Audio signal input for Right channel. This input goes directly to the ADC and Audio can't be connected to this pin directly without the circuitry in Fig 3.

Note: The peak-peak voltage of audio signal can't exceed VCC, Otherwise there will be distortion on recorded audio.

5.12. #ISP

This pin has to be tied to VCC all the time. Low at reset on this pin will put module in undefined mode.

6. File Format

This module supports FAT16 and FAT32 only.

SD-Card has to be formatted with FAT16 or FAT32.

Wave III module only supports standard wave audio format.

Playing file could be stereo or mono, 8 or 16 bit. And supported sample rate is from 11 KHz to 48 KHz.

Recording is also in standard wave format. Stereo, 16-bit, 32 KHz.

Recorded file can be played in any standard wave player software or device.

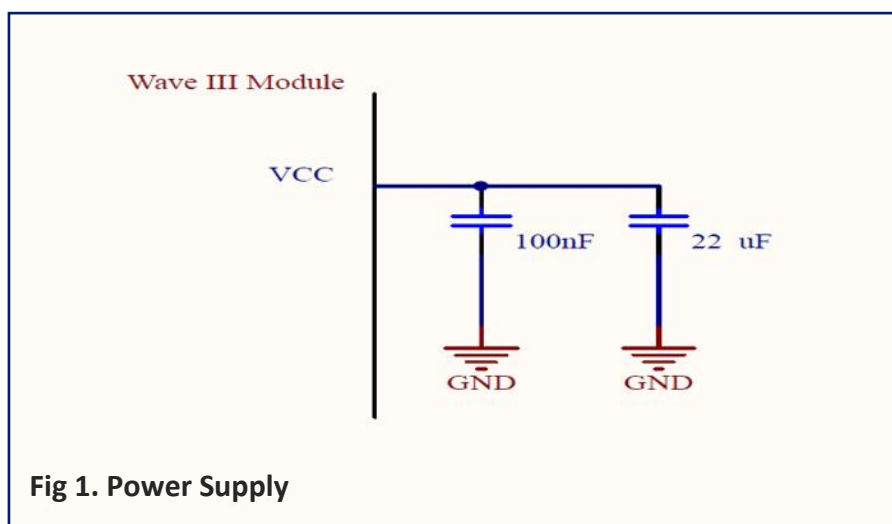
7. Power Supply

Power supply has to be well-regulated and filtered with decoupling capacitors with the capacity big enough to kill all digital noise and ripples on the VCC line.

100nF and 22uF capacitors are recommended for decoupling.

Decoupling Capacitors should be installed as close as possible to the VCC pin.

Note: Digital Ground and Analog Ground has to be separated and connected together right at the GND pin on the WAVE III module.

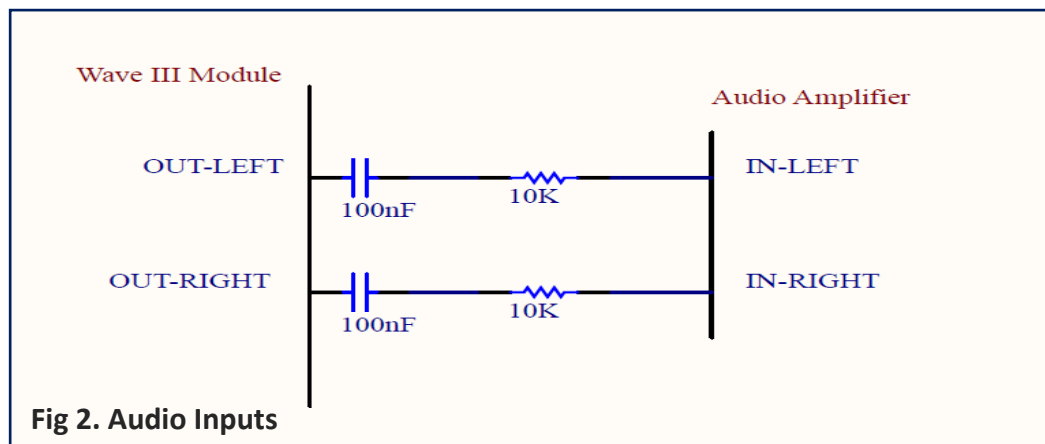


8. Audio Outputs

Audio Outputs need to be isolated DC-wise and at least have 10k ohm impedance. The circuit below is recommended for getting Audio signal from Outputs.

Maximum amplitude of the output signals is same as VCC. For example if the VCC is 3.3v, the amplitude of output signal will be 3.3v peak-peak max.

Note: All the analog signals are in respect to AGND

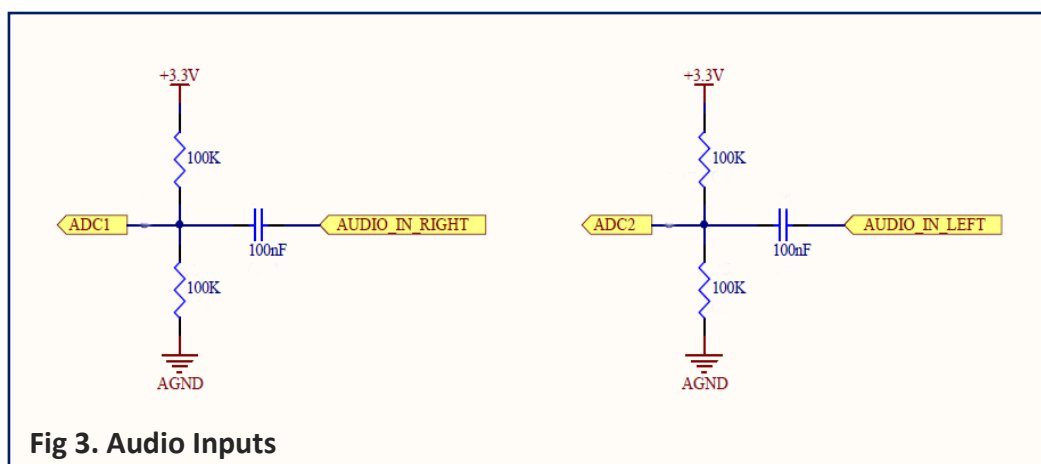


9. Audio Inputs

This is the recommended circuitry for the Audio inputs. The components listed in Fig3 has to be mounted externally in the design.

Maximum allowed amplitude for the input signals is $VCC/2$ peak-peak. For example if the VCC is 3.3 V, the input signal amplitude cannot exceed 1.65 v peak-peak.

Note: All the analog signals are in respect to AGND



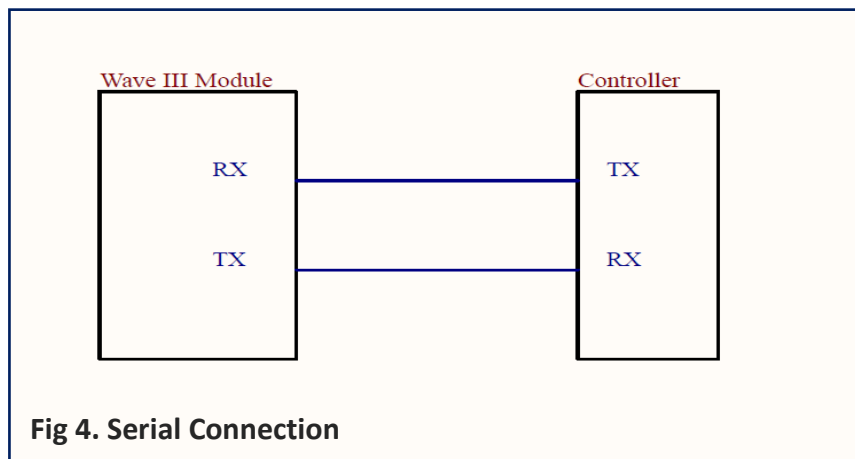
10. Serial Communication

Communication with WAVE III module is through UART port. UART port is standard serial port, 8bit data, no parity and 1 stop bit.

Baud rate is set automatically however, default baud-rate is set to 115200 at startup, and master controller must send "A" or "a" character first thing after startup (with the desired baud-rate) to set the baud-rate.

RX on the module pin connects to TX on the controller and vice versa.

Note: RX pin on WAVE III module is 5v tolerated.



11. Startup

Once module powers up or resets, the baud rate will be set to 115200 by default, runs the SD card initialization and returns the result through the serial port.

If SD card is present and mounted successfully, response would be "READY#"

If SD Card is present but has issues, module will respond "SD NOT MOUNTED#"

If there is no SD card present, response will be "SD NOT FOUND#"

It's recommended to wait for this response with default baud rate first thing after module start up to get the module status.

After this response module will go to Auto baud-rate setting mode.

At this point controller must send "A" or "a" character with the desired baud-rate (even if the desired baud-rate is same as default) to set the baud-rate. After baud-rate setup the module will be ready to receive commands.

Note: Echo is on by default after startup so one way to make sure the baud-rate is set successfully, is to 'A' or 'a', once same character received, baud-rate is set.

12.AT-Commands

Communication with the module is through serial port using AT-Commands.

Note: before sending commands make sure the baud-rate setup described in section 11. Startup is done.

AT-Commands have three parts; Header, Command and Data. Header is always "AT" and the string format is:

AT+Command=Data 0x0d 0x0a (0x0d 0x0a is Carriage Return + Line Feed ASCII standard codes at the end of the command string)

Module also sends responses through the serial port. Responses could be in reaction to a command or just a notification of a process or status change.

The response format is:

RESPONSE# 0x0d 0x0a (0x0d 0x0a is Carriage Return + Line Feed ASCII standard codes at the end of the command string)

Note: the whole command string is followed by 0X0D 0X0A (Carriage Return + Line Feed ASCII standard codes)

Note: all the responses coming from the module are also followed with 0x0D and 0x0A (Carriage Return + Line Feed ASCII standard codes).

Table 3. Commands

Header		Command		Data	Description
AT	+	TST			Communication Test
AT	+	ECO	=	0/1	Turn UART echo Off/On
AT	+	RST			Module Soft-Reset
AT	+	REV			Get revision info
AT	+	SDP	=	0/1	SD Card Off/On
AT	+	SLP			Put module in sleep mode
AT	+	PLY	=	FILENAME.WAV	Play file name
AT	+	RCA	=	FILENAME.WAV	Record to file name with audio loop back
AT	+	RCB	=	FILENAME.WAV	Record to file name without audio loop back
AT	+	STP			Stop Playing/Recording
AT	+	BEP	=	FREQUENCY	Make beep sound
AT	+	MKD	=	FOLDER NAME	Make Directory
AT	+	DLT	=	PATH	Delete file or Directory

Table 4. Responses

Response		Description
SD READY	#	SD Card is read and mounted. Module is ready to use.
SD NOT FOUND	#	SD Card in not inserted.
SD NOT MOUNTED	#	SD Card has format issue or is corrupted.
FILE ENDED	#	Playing or Recording is stopped manually or playing file is ended.
FILE READ ERROR	#	Error reading file contents.
FILE WRITE ERROR	#	Error writing to file.
DISK ERROR	#	SD card fat file system error.
FILE NOT FOUND	#	Addressed file is not found.
PCM ERROR	#	Audio format is not supported
PLAYING	#	Playing audio file.
RECORDING	#	Recording audio to file.
COMMAND ERROR	#	Wrong command.
OK	#	Command received successfully.
WAVE OUT OF RANGE	#	Wave sample rate is out of range (<11000 or >48000)
SD EJECTED	#	SD Card turned off.
DIRECTORY ERROR	#	Error making directory
DELETE ERROR	#	Error deleting file or folder
RECORD ERROR	#	Error making file
OUT OF RANGE	#	Beep frequency out of range (>30000)

12.1. Test Command

AT+TST

This command will test the serial communication and returns "OK#" if the module is on and connection is good.

It's highly recommended to send this command after reset and after adjusting baud rate and wait for "OK#" to make sure the baud-rate is set successfully.

Example:

Send: "AT+TST" 0x0d 0x0a

Receive: "OK#" 0x0d 0x0a

12.2. ECHO Command

AT+ECO=0/1

This command will turn the serial echo on/off and returns "OK#".

Example:

Send: "AT+ECO=0" 0x0d 0x0a (Turn Echo off)

Receive: "OK#" 0x0d 0x0a

Send: "AT+ECO=1" 0x0d 0x0a (Turn Echo on)

Receive: "OK#" 0x0d 0x0a

Note: Echo is on by default after reset.

12.3. Reset Command

AT+RST

This command will soft-reset the module. This will act like Low pulse on #Reset pin with one difference that soft-reset will take at least one second to reset the module.

This command also returns "OK#" and then goes through the startup process and will return "READY#" if the card is present and format is supported.

Example:

Send: "AT+RST" 0x0d 0x0a

Receive: "OK#" 0x0d 0x0a

"READY#" 0x0d 0x0a (after approximately 1 second)

It's helpful when #Reset pin is not used or the controller has no access to it.

Note: Module will go through the whole startup process after this command like the Hard-Rest and the baud-rate needs to be adjusted after reset again.

Note: Soft-Reset cannot wake the module up from sleep mode. Wakeup is done with Hard-rest only.

12.4. Firmware Info Command

AT+REV

This command will get the module's firmware revision info.

The response to this command will be the firmware info followed by # and 0x0d 0x0a

Example:

Send: "AT+REV" 0x0d 0x0a

Receive: "REV 1.0#" 0x0d 0x0a

12.5. SD card Power On/Off

AT+SDP=0/1

This command will power the SD card ON or OFF.

AT+SDP=0 will cut the power going to the SD card and return "SD EJECTED#"

AT+SDP=1 will power up the SD again and prepare the module to normal standby mode. This command will return "READY#" if the SD card is present otherwise will return "SD NOT FOUND#" or "SD NOT MOUNTED#" if there is something wrong with the SD card.

Example:

SD is present

Send: "AT+SDP=1" 0x0d 0x0a

Receive: "READY#" 0x0d 0x0a

SD is not present

Send: "AT+SDP=1" 0x0d 0x0a

Receive: "SD NOT FOUND#" 0x0d 0x0a

SD is present but has issues

Send: "AT+SDP=1" 0x0d 0x0a

Receive: "SD NOT MOUNTED#" 0x0d 0x0a

Send: "AT+SDP=0" 0x0d 0x0a

Receive: "SD EJECTED#" 0x0d 0x0a

12.6. Sleep Command

AT+SLP

This command will put the module in Sleep mode to lower the power consumption.

UART pins in sleep mode will go to high impedance mode and SD card power will be shut down. Current draw on this mode will be around 1mA.

Note: The only way to wake the module up from sleep mode is to reset the module using #Reset pin. (Soft-Reset won't work in sleep mode).

The response to this command will be "OK"

Example:

Send: "AT+SLP" 0x0d 0x0a

Receive: "OK#" 0x0d 0x0a

12.7. Play Command

AT+PLY=FILENAME.WAV

This command will start playing the addressed wave file.

The file has to have standard Wave format 8 or 16 bit 11 KHz to 48 KHz sample rate.
File name can be up to 16 characters and file extension is always .wav

Example:

Send: "AT+PLY=MUSIC.WAV" 0x0d 0x0a

If the file is in folder "FOLDERA" (file path: FOLDERA\MUSIC.WAV)

Send: "AT+PLY=FOLDERA/MUSIC.WAV" 0x0d 0x0a

If the file is in folder "FOLDERA\FOLDERB" (file path: FOLDERA\FOLDERB\MUSIC.WAV)

Send: "AT+PLY=FOLDERA/FOLDERB/MUSIC.WAV" 0x0d 0x0a

Receive:

"PLAYING#" 0x0d 0x0a (If the file gets played with no issues)

"SD NOT FOUND#" 0x0d 0x0a (If SD is not present)

"FILE NOT FOUND#" 0x0d 0x0a (If File doesn't exist)

"DISK ERROR#" 0x0d 0x0a (If There is something wrong with the SD card or its format)

"FILE READ ERROR#" 0x0d 0x0a (If There is error reading the file content)

"PCM ERROR#" 0x0d 0x0a (If Audio file's format is not supported)

"WAVE OUT OF RANGE#" 0x0d 0x0a (If Audio sample rate is out of range)

"FILE ENDED#" 0x0d 0x0a (This response comes when the audio file ends or stops manually with stop command)

Note: length of the whole path string (folder name + file name + extension cannot exceed 60 characters).

12.8. Record Command (Record with audio loop back)

AT+RCA=FILENAME.WAV

This command will start recording to the addressed file. And the recorded audio will be also played back on the Audio output pins while recording. If that's not desired, use the RCB command which doesn't have loop back.

If the addressed file exists, it will overwrite it, if doesn't exist, it'll create a new file.

File name can have up to 16 characters length and the extension has to be .wav.

The file won't be playable on standard players if different extension is used.

Recorded file will have standard wave format (stereo 16bit 32 KHz) playable in any wave player software or device.

Example:

Send: "AT+RCA=TEST.WAV" 0x0d 0x0a

If the file is in folder "FOLDERA" (file path: FOLDERA\TEST.WAV)

Send: "AT+RCA=FOLDERA/test.WAV" 0x0d 0x0a

If the file is in folder "FOLDERA\FOLDERB" (file path: FOLDERA\FOLDERB\TEST.WAV)

Send: "AT+RCA=FOLDERA/FOLDERB/TEST.WAV" 0x0d 0x0a

Receive:

"RECORDING#" 0x0d 0x0a (If starts recording with no issues)

"SD NOT FOUND#" 0x0d 0x0a (If SD is not present)

"RECORD ERROR#" 0x0d 0x0a (If there is issue with creating file)

"DISK ERROR#" 0x0d 0x0a (If There is something wrong with the SD card or its format)

"FILE WRITE ERROR#" 0x0d 0x0a (If there is error with writing into file)

"FILE ENDED#" 0x0d 0x0a (This response comes when the audio recording stops with stop command)

Note: length of the whole path string (folder name + file name + extension cannot exceed 60 characters).

12.9. Record Command (Record without audio loop back)

AT+RCB=FILENAME.WAV

This command will start recording to the addressed file. And the recorder audio will not be played back on the Audio output pins during the recording process. If that's not desired, use the RCA command that has loop back.

This command acts same as RCA. Refer to RCA for Command description.

12.10.Stop Command (Stop Playing/Recording)

AT+STP

This command stops Recording or playing.

Note: Send stop command before new play/record if the module is already playing or recording.

Example:

Send: "AT+STP" 0x0d 0x0a

Receive: "FILE ENDED#" 0x0d 0x0a

12.11.Make Beep Sound Command

AT+BEP=FREQUENCY

This command will generate beep audio sound with desired frequency on both Left and Right channels.

Frequency can be from 1 to 30000 (1Hz to 30 KHz). Frequency 0 will stop the beep generator.

Note: If module is playing or recording, stop it using AT+STP before using this command.

Example:

Send: "AT+BEP=2000" 0x0d 0x0a (Make a 2 KHz audio sound)

Receive: "OK#" 0x0d 0x0a

Example:

Send: "AT+BEP=18000" 0x0d 0x0a (Make a 18 KHz audio sound)

Receive: "OK#" 0x0d 0x0a

Example:

Send: "AT+BEP=0" 0x0d 0x0a (Stop audio sound)

Receive: "OK#" 0x0d 0x0a

12.12.Make Directory Command

AT+MKD=NAME

This command will make a new directory with the desired name in desired path.

NAME is a string including the path and directory name. Name can be up to 16 characters and the whole string length cannot exceed 60 characters

Example:

Send: "AT+MKD=FOLDER1" 0x0d 0x0a (Make a folder named "FOLDER1" in root)

Example:

Send: "AT+MKD=FOLDER1/FOLDER2" 0x0d 0x0a (Make a subfolder named "FOLDER2" in FOLDER1)

Receive:

"OK#" 0x0d 0x0a (If folder is created successfully)

"SD NOT FOUND#" 0x0d 0x0a (If SD is not present)

"DIRECTORY ERROR#" 0x0d 0x0a (If there is error with creating directory)

"DISK ERROR#" 0x0d 0x0a (If There is something wrong with the SD card or its format)

12.13.Delete File/Directory Command

AT+DLT=NAME

This command will delete the file or directory.

NAME is a string including the path and directory name and cannot exceed 60 characters.

Example:

Send: "AT+DLT=MUSIC.WAV" 0x0d 0x0a (Delete file named "MUSIC.WAV" in root directory)

Example:

Send: "AT+DLT=FOLDER1/MUSIC.WAV" 0x0d 0x0a (Delete file named "MUSIC.WAV" in folder "FOLDER1")

Example:

Send: "AT+DLT=FOLDER1/FOLDER2" 0x0d 0x0a (Delete folder named "FOLDER2" in folder "FOLDER1")

Example:

Send: "AT+DLT=FOLDER3" 0x0d 0x0a (Delete "FOLDER3" in root directory)

Receive:

"OK#" 0x0d 0x0a (Delete was successful)

"SD NOT FOUND#" 0x0d 0x0a (If SD is not present)

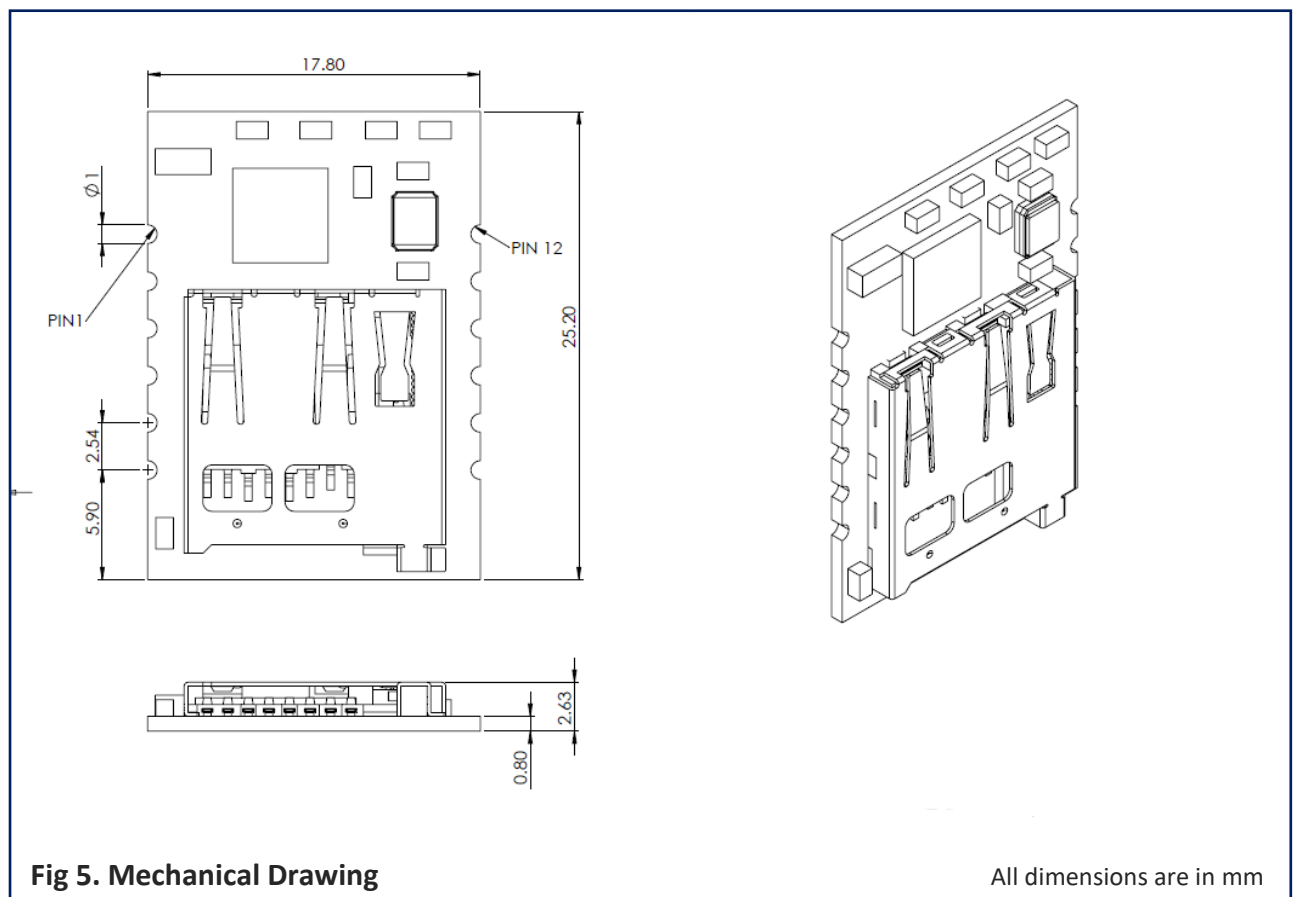
"DELETE ERROR#" 0x0d 0x0a (Error while deleting, could be because the directory is not empty or the file/folder not found)

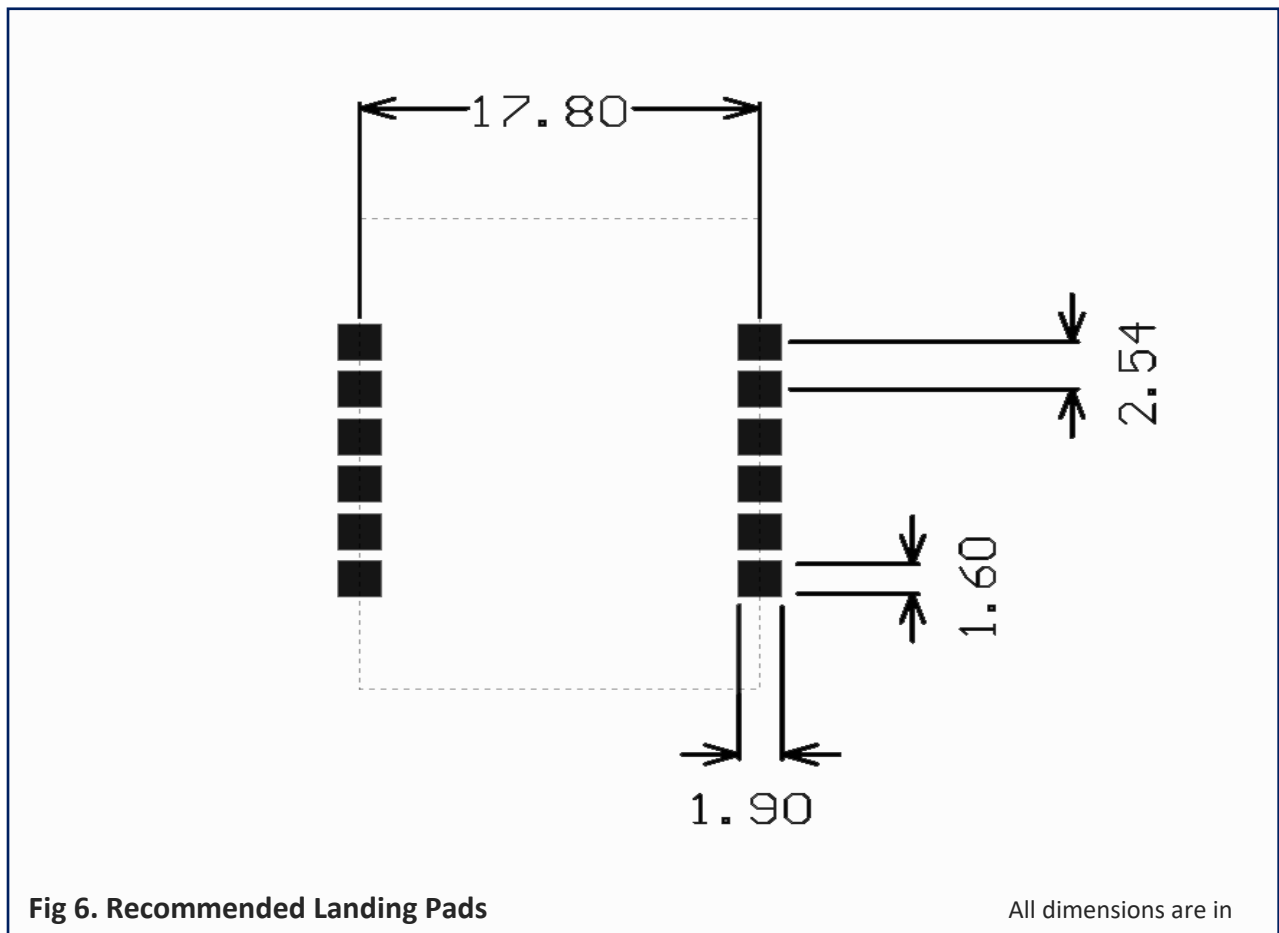
"DISK ERROR#" 0x0d 0x0a (If There is something wrong with the SD card or its format)

Note: Delete cannot be performed on non-empty directory. If need to delete a non-empty folder, the contents inside need to be deleted first.

Note: File name has to always have extension. Name without extension is considered as a folder

13.Mechanical Drawing





Note: it's highly recommended to avoid any plane and routing on the top layer underneath the module to prevent any possible short circuit.

14.References

- Visit www.seniorelectron.com for more information and libraries
- Dev kit for the module is also available at www.seniorelectron.com