

FC-208/D Industrial SCADA Transceiver

USER MANUAL



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I. Summary

FC-208/D Industrial SCADA Transceiver integrates data and voice function. It's designed for electrical power control RTU, feeder FTU, power house TTU, hydrology and irrigation works monitor instrument, water supply management, city street lamp monitor, oil field and oil well monitor and etc. industrial control area. Its technical performance satisfies GB/T16611 'Radio data transceiver general regulations' and the requirements of national standard.

FC-208/D is designed with industrial standard. It adopts high-precision TCXO and 45Mhz IF solution. All components are of industrial standard which is strictly filtrated by aging. It's suitable for various adverse environment. FC-208/D has a built-in MODEM with air data rate of 1200/2400bps. Its interface rate can be set to 1200-9600bps. Odd, even or no check can be optional.

II. Features of FC-208/D

1. Adopting high-precision TCXO with industrial design standard for high reliability and stability.
2. Resistant to 4KV group pulse, 8KV static electricity to stand against bad electromagnetic environment.
3. Multiple safety measures such as large current, over voltage and reverse connection protection.
4. Large channel capacity (16/64). Multi-grade output power can be available.
5. Data transmission is available with built-in MODEM as well as audio transmission.
6. Transparent asynchronous real-time transmission with standard asynchronous communication protocol, no need to configure or program.
7. Data directly drives transmitting, it can transmit large amount of data (>200k bytes) one time.
8. It's easy to connect with various instruments and devices via standard RS-232/485 interface.
9. CTCSS available to avoid irrelevant calls.

III. Technical specifications of FC-208/D

1. General specifications:

- 1) Carrier frequency: VHF/UHF
- 2) Channel spacing: 25kHz
- 3) Modulation mode: MSK
- 4) Air data rate: 1,200/2,400bps
- 5) Channel: 16(64 optional)
- 6) Audio modulation range: 300-3400Hz
- 7) CTCSS: 38
- 8) External Speaker: 2W/8Ω
- 9) Antenna impedance: 50Ω
- 10) Power supply: 13.8VDC typically, ranges from 9V to 15VDC.
- 11) Temperature: -40°C ~ +70°C

2. Specifications of receiver:

- 1) Sensibility: $\leq 0.25 \mu V$ (12dB SINAD)
- 2) 1st IF: 45MHz
- 3) 2nd IF: 455Hz
- 4) Intermodulation rejection: ≥ 75 dB
- 5) Adjacent channel selectivity: ≥ 70 dB
- 6) Audio distortion: $\leq 3\%$
- 7) FSK output Amplitude: 0~450mV

8) AF output Amplitude: 0~5V

3. Specifications of transmitter:

- 1) Frequency stability: $\pm 2.5\text{ppm}$
- 2) Frequency deviation: $\leq \pm 5\text{KHz}$
- 3) Adjacent channel rejection: $\geq 70\text{ dB}$
- 4) Starting time of transmitter: $\leq 50\text{ms}$
- 5) Audio distortion : $\leq 3\%$
- 6) RF output power : 10W

4. Interface RS-232/RS-485

Data rate: 1200~9600bps optional, Format: 8N1/8E1 optional

5. Power Supply:

DC voltage: 9~15V (typically 13.8V)

Standby current of receiver : $\leq 50\text{mA}$ (power-saving status)

Transmitting current: $\leq 2\text{A}$ (13.8V, RF power 10W)

IV. Shape and Interface description

1. The Shape sketch map.

Size : 160mm x 115mm x 45mm

Weight: 900g



Figure 1

2. Panel and Interface Description

1) Front panel and interface description.

The front panel of FC-208/D is shown in figure 2. The front panel includes Microphone port, volume tuner/Squelch level control tuner, power indicator. Local Transmitting /receiving (TX/BUSY) indicator, carrier power (HL/LO) indicator, User's transmitting(TXD) indicator and User's receiving (RXD) indicator. The detailed interface description is shown below:

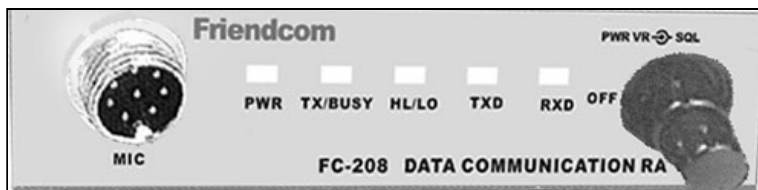


Figure 2

a. MIC jack (MIC): The jack has 8 pins/6 pins for connecting with MIC. The Pins' position shown in figure 3. The definition of the pins shown in table 1:

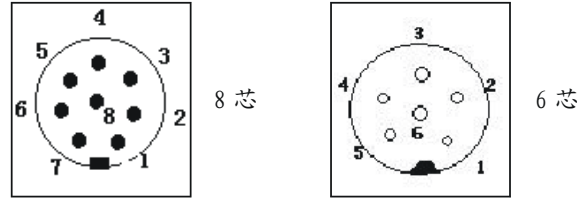


Table 1:

Pin No.	Definition
1	MIC: MIC Signal Input, Level 100mV
2	NC
3	GND: Signal ground, Speaker ground
4	MIC GND: MIC signal input ground
5	SP: Speaker+, connect speaker(2W,8Ω)
6	PTT: Transmit control, Low level valid (0V)
7	NC (8 pins)
8	NC (8 pins)

b. Volume/Squelch tuner (PWR VR/SQL):

The inner knob is for volume control. Turn counterclockwise, the volume is low, otherwise the volume is high. The outer knob is for SQL tuning. Turn counterclockwise, the SQL is low. While the SQL knob is turned to the end counterclockwise, it means in monitor status, i.e. the speaker will send out audio despite the signal is strong or weak. Turn deasil, The SQL is deep. While the SQL knob is turned to the end deasil, it means only about 1μV signal can open SQL. The tuning range is 0-25dB.

c. Power (PWR) indicator: Indicating the status of power on/off.

d. Local transceiver signal transmit/busy Indicator: Red indicates local transmitting status, Green indicates local receiving busy status .

e. RF power (HL/LO) Indicator: Red indicates working in high power(10W),Green indicates working in low power.

f. User device Transmit(TXD)/Receive(RXD)indicator: It indicates the work status of the data terminal. TXD is data transmitting status, RXD is data receiving status.

2) The back panel and port description

The back panel position shown in figure 4. It includes power port(DC/IN), data transmission/frequency-set port(9-pin D socket)、speaker port(SP)and antenna port(ANT).

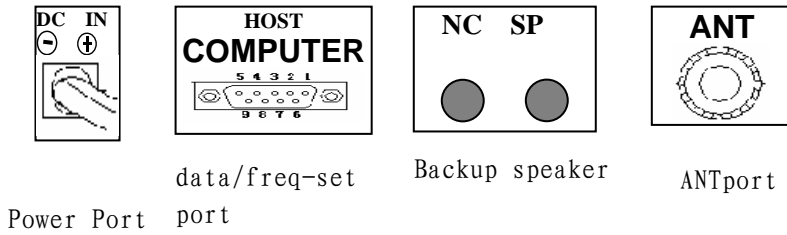


Fig 4

The Port description is listed below:

a. Power Port (DC/IN) : Adopting 9-15VDC power supply, the typical value is 13.8V。 The port is a 2-pin socket. It should be connected correctly according to the sign on the crust (Red for positive and black for negative).

b. Data transmission /Freq-set port(9-pin D socket): It is used to connect with the user’s external devices for data transmission and setting the parameters of the radios. The pin definition is shown in table 2.

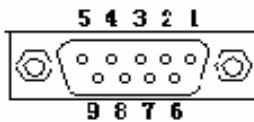


Fig 5

Table 2

	Definition
1	NC
2	MIC: To Connect MIC audio signal. Reserved port, it is same with MIC signal.
3	BUSY: Receiving busy signal, It indicates having received the transmitted carrier signal. Low level (0V) is valid.
4	TXD/RS485 B: Standard RS-232 transmit data signal output or RS485 B.
5	RXD/RS485 A: Standard RS-232 receive data signal input or RS485 A .
6	VDD: Local power supply output +13.8V。
7	NC
8	SP: Audio signal output, directly connect to speaker (2W,8 Ω).
9	GND: Grounding

c. Speaker port (SP): To connect speaker via 2-pin cable. The crust is grounding, the inner pin is signal.

d. Antenna port(ANT): LS16-KF(resistance is 50 Ω).

e. NC: not connected

3 The top panel channel selection button.

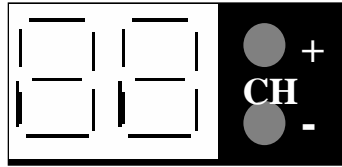


Fig. 6

It is used to select channel. Press '+' or '-' for adding /decreasing channel number. After about 3s of the channel selection, the digital display is off to lower the power consumption.

4. Installation size.

The installation size is shown in figure 7.

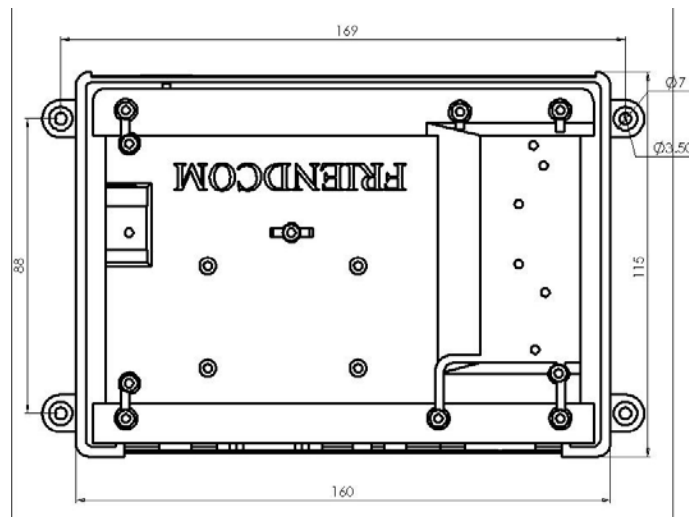


Fig. 7

V. The work principle and the main parts

FC-208/D is mainly composed of transmitter circuit, receiver circuit, digital PLL, CPU, baseband processing unit, built-in MODEM, LED display and interface RS-232/485/UART (shown as fig.8).

The main function of each part is shown below.

(1) Transmitter circuit: To modulate the baseband signal or audio signal to radio frequency and amplify its power.

(2) Receiver circuit: To demodulate the RF signal and amplify it to baseband signal or audio signal.

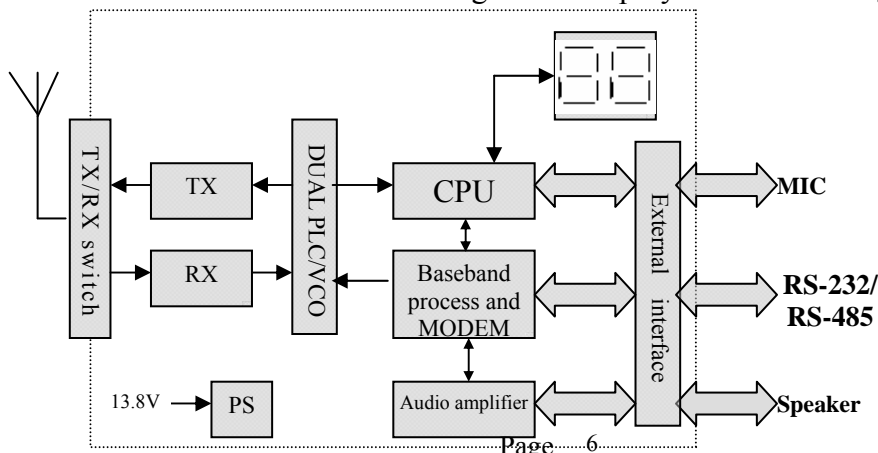


Figure 8

- (3) PLL: Providing standard high-stability RF signal for transmitter and receiver.
- (4) Built-in MODEM: To modulate or demodulate data signal. Air data rate 1200bps/2400bps can be set by software.
- (5) Baseband processing: To filter, amplify and reshape the baseband and audio signal.
- (6) CPU: To carry out running control, interface control, parameter setting and data processing etc.
- (7) LED display: Display the working channel number.
- (8) Power supply: To provide the radio DC power supply.
- (9) External interface: 9-pin D-socket, 8-pin round socket (to be connected with MIC and speaker respectively) and RS-232/RS485 data interface.

VI. Working process

1. Interface mode

RS-232 or RS-485, specified before placing an order.

2. Parameter setting

The following parameters should be determined before using FC-208/D. (The method of setting the parameters is shown in next section.)

Interface rate : 1200bps~9600bps

Check mode: odd, even, none.

Air data rate: 1200bps/2400bps

Channel frequency: It should be set within the work frequency band.

3. E protocol data transmission process

Data receiving flow:

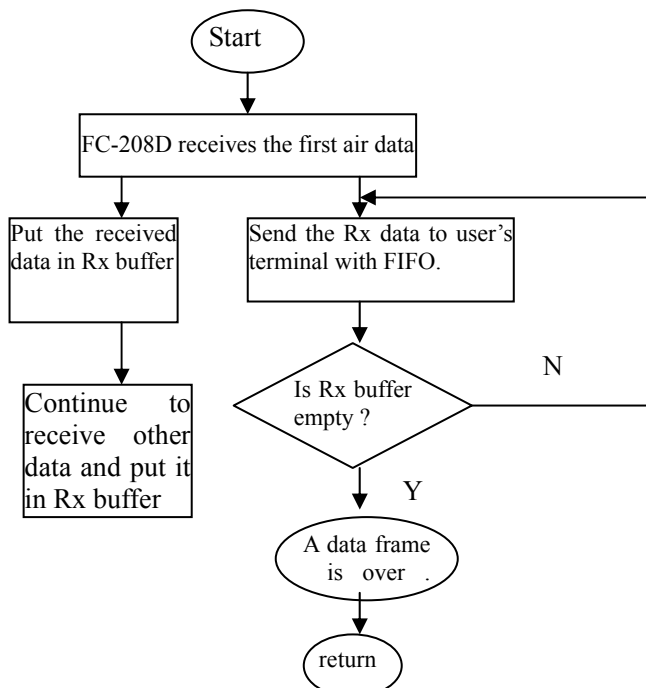


Fig 9

Data transmitting flow is shown in fig 10.

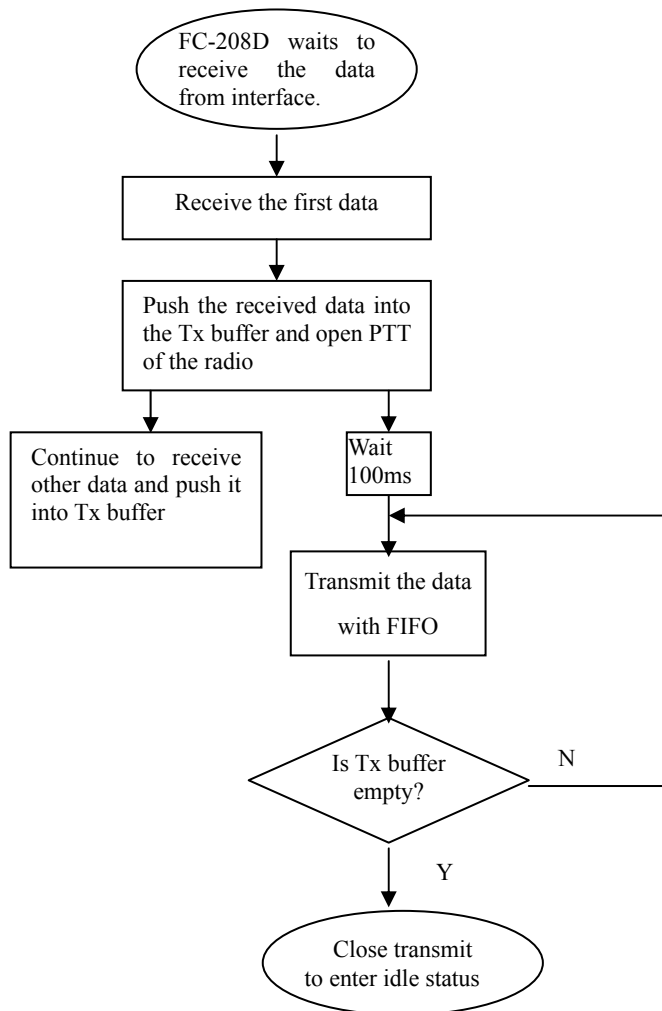


Fig10

4. Data transmission protocol

FC-208/D adopts E-protocol and P-protocol. E-protocol is an all-transparent protocol based on byte. The transmitting radio sends the data from user's terminal by FIFO regardless its format, while the receiving radio just receives the original data from air and sends it to the connected user's device.

The size of FC-208/D's data buffer is 170 bytes, so the transmitted data at one time should be less than 170 bytes. But when the interface rate and the air data rate is 1200bps or 2400bps at the same time, the

transmitted data will be more than 200K bytes at one time by FIFO.

P-protocol has three modes: Addressing mode, General mode and transparent mode. P-protocol is based on frame transmission mode, the transmitted data of each time should be less than 170 bytes because of the limits of 170-byte data buffer.

5. The meaning of three mode of P-protocol and data process flow.

5.1. The meanings of addressing mode

In addressing mode, FC-208/D uses address code to decide whether a data frame is valid and whether to keep or discard the frame. The data is transmitted in a frame. Every data frame has a address code, the transceiver decides whether to send the received data to the terminal according to address code. Some protocols and regulations are available to reduce the complexity of application development, to shorten the development cycle in this mode. It's quite suitable to be used in point to multi-point communication or the circumstance of limited development ability or time.

5.2. The frame format of addressing mode.

a. Setting Command of addressing mode (All the command word expressed in hex).

55	AA	Len(03)	30	00	Check sum(00 33)
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55 AA: Command frame header.

Len: The length of frame = Command word length +1 (The following is the same.)

3000: Indicates addressing mode.

Check sum (2 bytes): The sum (16 bit)of all bytes behind 55AA, the overflow bits are ignored. (The following is the same.)

b. Channel switching command

55	AA	Len(06)	07	XX	00	00	00	Check sum(2 byte)
----	----	---------	----	----	----	----	----	--------------------

XX: The destination channel number (01H-10H)

c. Command to set the address of data transceiver

55	AA	Len(04)	32	Address code(2 byte)	Check sum(2 byte)
----	----	---------	----	----------------------	--------------------

The format of address code(2 byte) is shown below:

b15	b14	b13	b12	b11- b8	b7-bit0
0	0	0	0	System code (4bit)	The transceiver's address code (8bit)

System code:00H-0FH (0-15)

The transceiver's address code:00H-FFH (0-255)

d. The frame format for sending data

7E	Destination address code (2 byte)	Len (1 byte)	Data ≤ 170 byte
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7E: The header of data frame(1 byte)

Len: The length of the frame= the length of data +1

The format of destination address code (2 byte) is shown below:

b15	b14	b13	b12	b11- b8	b7- b0
Communication mode		0	0	System code (4bit)	The transceiver's address code (8bit)

Where bit 14-15 determine the communication mode of the data frame, its meaning shown in the

following table :

b15	b14	Communication mode	description
1	X	Broadcast in all net	System code & address code are invalid, can be set to any value.
0	1	Broadcast in system	A corresponding system code should be set, address code can be set to any value.
0	0	Point to point communication	Both the corresponding system code and address codes should be set.

e. The frame format for receiving data

7E	Len (1 byte)	Source address code (2 byte)	Data ≤ 170 bytes
----	--------------	------------------------------	------------------

7E: The header of data frame(1 byte)

Len: The length of the frame= the length of data +1

The format of source address code (2 byte) is shown below:

b15	b14	b13	b12	b11- b8	b7- b0
Communication mode		0	0	System code (4bit)	The transceiver's address code (8bit)

Where bit 14-15 determine the communication mode of the data frame, its meaning shown in the following table :

bit15	bit14	Communication mode description
1	X	Receiving broadcast in the net.
0	1	Receiving broadcast in the system
0	0	Just receiving the data sent to the local transceiver.

f. The response frame in 1 second after the transceiver receives a setting command from the user's terminal.

Command code	Description
55 AA 02 20 00 22	The setting is correct.
55 AA 02 21 00 23	The setting fails.
No response in 1s	Response is wrong or no response

g. The response frame in 1 second after the transceiver (acting as air data transmitter) receives a data frame from user's terminal.

Command code	Description
55 AA 00	The data frame from RS-232 is correct and has been sent out, the next data frame can be sent.
55 AA EE	The data frame from RS-232 is wrong.

55 AA FF	The data frame from RS-232 is correct, but at present the data cannot be sent out.
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h. The frame structure of feedback to user's terminal while the transceiver (acting as air data receiver) receiving wrong data from air .

Command code	Description
55 AA DD	The received data frame from air is wrong

5.3. The meanings of general mode

General mode is designed for user's self-definition upper communication process. The data is transmitted as a frame without any process. The transceiver sends a data frame from terminal to the air directly while transmitting; and the transceiver sends a data frame from the air to user's terminal directly while receiving. The valid data buffer is 170 bytes, so the valid data for each frame is less than 170 bytes.

5.4. The frame format of general mode.

a. Setting Command of general mode (All the command word expressed in hex).

55	AA	Len(03)	31	00	Check sum(00 34)
----	----	---------	----	----	------------------

55 AA: Command frame header.

Len: The length of frame = Command word length +1

3100: Indicates general mode.

Check sum (2 bytes): The sum (16 bit)of all bytes behind 55AA, the overflow bits are ignored.

b. Channel switching command

55	AA	Len(06)	07	XX	00	00	00	Check sum(2 byte)
----	----	---------	----	----	----	----	----	--------------------

XX: The destination channel number (01H-10H)

c. The frame format for sending data

7E	Len (1 byte)	Data ≤ 170 bytes
----	--------------	------------------

7E: The header of data frame(1 byte)

Len: The length of the frame= the length of data +1

d. The frame format for receiving data

7E	Len (1 byte)	Data ≤ 170 bytes
----	--------------	------------------

7E: The header of data frame(1 byte)

Len: The length of the frame= the length of data +1

e. The response frame in 1 second after the transceiver receives a setting command from user's terminal.

Command code	Description
55 AA 02 20 00 22	The setting is correct.
55 AA 02 21 00 23	The setting fails.
No response in 1s	Response is wrong or no response

f. The response frame in 1 second after the transceiver receives a data frame from user's terminal.

Command code	Description
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55 AA 00	The data frame from RS-232 is correct and has been sent out, the next data frame can be sent .
55 AA EE	The data frame from RS-232 is wrong.

g. The frame structure of feedback to user’s terminal while the transceiver receiving wrong data from air .

Command code	Description
55 AA DD	The received data frame from air is wrong

5.5. The meanings of transparent mode

Transparent mode is designed for user to completely self-definite upper communication process. The data from user’s terminal is sent to air without any process. The data from air is transmitted to user’s terminal without any process. The transceiver just acts as a bridge in data transmission.

6. Audio transmission

Audio communication is available after connecting FC-208/D’s Microphone and speaker. If data transmission and audio is used at the same time, data transmission is preferential. CTCSS can be set to prevent irrelevant call in audio communication. If CTCSS is encoded to zero, CTCSS is forbidden.

VII. FC-208/D EX-works parameter setting

The default parameter setting is shown in the following table while EX-works.

Protocol	E-protocol	P-protocol
Interface rate	1200bps even check	9600bps no check
Air data rate	1200bps	1200bps

VIII. Notes of using the transceiver.

1. Power supply.

1) The supply voltage requirements is shown below according to different power.

When the voltage is 13.8V, the power load capability should be more than 2.5A.

2) If switch power supply is used, it should not be close to FC-208/D. Otherwise it is easy to make the switch power supply self-excited to result in the power supply unstable.

3) Before Power-on, the positive and negative pole of the power should be connected correctly. Antenna port should be connected with dummy loads or antenna to avoid the status of short-circuit or open-circuit.

2. Measures for anti-thunderbolt

If FC-208/D transceiver is used in area of much thunderbolt, Measures of anti-thunderbolt should be considered. The grounding of the transceiver should be good enough.

3. To choose antenna

Generally, the effective bandwidth of antenna is 3-5MHz. We should choose suitable antenna based on the working frequency band. If long distance of transmission is required, the beamed antenna with high gain should be used. The installation of the antenna should be as high as possible and far from the ground. It also should be anti-thunderbolt.

CTCSS NO.	Audio frequency (Hz)	CTCSS NO.	Audio frequency (Hz)
1	67.0	20	131.8
2	71.9	21	136.5
3	74.4	22	141.3
4	77.0	23	146.2
5	79.7	24	151.4
6	82.5	25	156.7
7	85.4	26	162.2
8	88.5	27	167.9
9	91.5	28	173.8
10	94.8	29	179.9
11	97.4	30	186.2
12	100.0	31	192.8
13	103.5	32	203.5
14	107.2	33	210.7
15	110.9	34	218.1
16	114.8	35	225.7
17	118.8	36	233.6
18	123.0	37	241.8
19	127.3	38	250.3

Table 4: Rx/Tx frequency for each Channel

Rx/TxFreq Channel	Tx Freq (MHz)	Rx Freq(MHz)
CH1:	223.125	223.125
CH2:	230.125	230.125
CH3:	235.125	235.125

How to connect the interface:

