
KANGLONG®
Two-Way Radio Manufacturer

Auto Network Models
Instruction Manual

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Keywords: Auto network two-way radio
summary :

List of abbreviations:

abbreviation	Full English name	Chinese explanation
LRAN	Long Range Automatic Networking	远距离自动组网

1. Range

This product is based on SX1278 as a radio frequency transceiver. The main control is STM32F4 for the platform design and belongs to LRAN. The general product line is a customer-customized mass production project.

The product adopts LRA, an independently developed universal self-organizing network protocol, a walkie-talkie product that uses the SX1278 chip for radio frequency transceiver.

2. Overview

This product is based on the casing selected by the customer, using STM32F4+SX1278 to design a digital self-organizing network walkie-talkie, completing the software and hardware design of the digital walkie-talkie product, and completing small batch trial production.

2.1. Product Business Brief

This product is an ad hoc network digital walkie-talkie, digital mode LRAN 1.0 networking protocol, and voice transmission; not compatible with FM analog format. The application is a voice intercom with no data communication service.

2.2. Networking and device independence

This product is a walkie-talkie mobile phone product, which can carry out 1-to-1 and 1-to-many voice and data communication between mobile phones. The mobile phone can also be used as a relay for voice and data communications. Data communication functions are limited by the customer's structure, user interface, supporting accessories and software, and APP design.

3. Overall system design

3.1. System functionenergy, performance

3.1.1. Features

digital mode	Products comply with LARN Standards and specifications related to self-organizing network walkie-talkies	
Simulation mode	Not supported	
Adoption standards:	Refer to the relevant digital walkie-talkie standards	
Product main features:	Remark:	
No screen		
16 channels	The full call, group call, and individual call modes of each channel can be set individually.	
2 definable function keys	Set through software programming, with long press/short press function (CPS configuration is not supported yet)	
LED	Transceiver indication, two-color or LEDx2	
Power-on indicator light and beep	The LED indicator light turns green and then goes out, accompanied by a prompt channel beep to indicate power on.	
Battery display/low voltage alarm	Sound reminder: battery is extremely low	
Factory reset	none	
Online upgrade	Software and firmware can be upgraded through factory programming tools	
Power saving function	Generally, there is no dedicated low-power processing	
High/low power switching	The current model does not support	
Transmission time limit (TOT)	60 seconds	
emergency call	support	
Squelch level setting	automatic	
Scan/Area Scan (Mixed Mode)	none	
monitor	Current channel reception	
Signal strength indicator	When there is a signal, the indicator light will prompt	
Voice broadcast	Can broadcast channel number, battery level, prompt tone, relay switch, etc.	
UART writing frequency	Supported, completed through frequency writing software	
Digital mode features	Group call/all call/individual call	CPS programming
	local identity code	Support ID writing

	voice encryption	universal digital scrambling
	Remote stun/remote kill/activate	Customized functions are not supported by the general version.
	Caller/Called Detection	_____
	call alert	Indicator light prompt
	Remote monitoring	Repeater function.
	Support relay	Universal LRAM 1.0 protocol
Simulation mode features	CTCSS/DSC	No simulation support
	Tail tone detection	No simulation support

3.1.2. Overall machine performance indicators

1) digital mode

index	Indicator requirements	Remark
Working frequency band	UHF: 400-510MHz	
Frequency interval	250kHz (25kHz x 10)	
working temperature	-20~60℃	
standby		
Standby current of the whole machine	<60mA	
take over		
Receiver spurious emissions	9kHz ~ 1GHz ≤ -57dBm	Antenna port
Sensitivity	-120dBm	BER<5%
	-117dBm	BER<1%
Strong signal bit error rate	≤1×10 ⁻⁴	
co-channel suppression	-12dB	
ACS	Upper	_____
	Lower	_____
Intermodulation	_____	
block	_____	
Spurious response immunity		
Receiver spurious emissions	Antenna port	_____
	Chassis port	_____
emission		
Transmit power	High power: 4W/5W	According to customer's hardware configuration
Power variation tolerance	±1.5dB	
Transmission frequency error	≤1.5×10 ⁻⁶	200~500MHz
Transmitter spurious emissions	9kHz~1GHz ≤ -36dBm	Antenna port
FSK Error	<5%	
Emission current consumption		
Launch rise and fall times	<1.5ms	

2) moldSimulation mode (neither supported)

index		Indicator requirements	Remark
Working frequency band		UHF: 400-470MHz	
Frequency interval		12.5kHz/25kHz	
working temperature		-20~60℃	
standby			
Standby current of the whole machine		<80mA	
take over			
Receiver spurious emissions		9kHz ~ 1GHz ≤ -57dBm	Antenna port
Sensitivity		-122dBm	SINAD = 12dB
co-channel suppression		-12dB	
audio distortion		<3%	
Audio signal-to-noise ratio		≥40dB	12.5kHz
		≥45dB	25kHz
Modulation characteristics		-6dB/oct	The change does not exceed +1dB~ -3dB
ACS	Upper	64dB@12.5kHz 70dB@25kHz	
	Lower	64dB@12.5kHz 70dB@25kHz	
Intermodulation		62dB	
block		84dB	
Spurious response immunity			
emission			
Transmit power		High power: 4W/5W Low power: 1W	
Power variation tolerance		±1.5dB	
Transmission frequency error		≤1.5 × 10 ⁻⁶	200~500MHz
Transmitter spurious emissions		9kHz~1GHz ≤ -36dBm	Antenna port
Emission current consumption			
audio distortion		<3%	
Audio signal-to-noise ratio		≥40dB	12.5kHz
		≥45dB	25kHz
Modulation limits		2.5kHz	
Modulation characteristics		6dB/oct	The change does not exceed +1dB~ -3dB
ACPR(dB)	Upper	-60dB@12.5kHz -68dB@25kHz	TIA603
	Lower	-60dB@12.5kHz -68dB@25kHz	

3.1.3. Machine technical parameters

index	Technical parameters
powered by	7.2V
Standby current	<60mA
Working current	<1.8A

3.1.4. standards to follow

- L-RAN Custom digital networking protocol.

3.2. System configuration

Configuration items	describe
Walkie-talkie motherboard	The main hardware of the walkie-talkie, including the main control and radio frequency circuit
Intercom IAP software	The walkie-talkie boot program, used for upgrades, supports frequency writing.
Walkie-talkie software	Walkie-talkie embedded software, including main control software, host computer interface software, vocoder soft core, etc.
Frequency writing software	PC software, used to program information such as walkie-talkie numbers, frequencies, etc.
Factory programming tool software	PC-side software, used for writing and authorizing official software for walkie-talkies
Test program programming tool	PC-side software, used for writing walkie-talkie test software, debugging frequency offset, and transmit power usage
Burning program programming tool	PC-side software, used for writing automatic aging test programs for walkie-talkies, needs to be customized

3.3. System upgrade and expandability design

3.3.1. Functionality of the new system is lost
none

3.3.2. Version upgrade specifications

The whole machine software can be upgraded through IAP.

3.3.3. System scalability design
none.

3.4. Other design decisions

none.

4. General overview of the software

4.1. Software configuration

Software name	describe
Intercom IAP software	The walkie-talkie boot program, used for upgrades, supports frequency writing.
Walkie-talkie software	Walkie-talkie embedded software, including main control software, host computer interface software, vocoder soft core, etc.
Frequency writing software	PC software, used to program information such as walkie-talkie numbers, frequencies, etc.
Factory programming tool	PC-side software, used for writing and authorizing official software for walkie-talkies

software	
Test program programming tool	PC-side software, used for writing walkie-talkie test software, debugging frequency offset, and transmit power usage

4.2. Package description

Software name	describe
Intercom IAP software	Publish as compiled .hex file
Walkie-talkie software	Publish to the authorization server and write in IAP mode through the factory programming tool.
Frequency writing software	Published as .exe installation file, can be run on PC
Factory programming tool software	Published as .exe installation file, can be run on PC
Test program programming tool	Published as .exe installation file, can be run on PC

4.3. Software running platform

Software name	Operating environment
Walkie-talkie software	Walkie-talkie motherboard
Frequency writing software	Windows 7 or above, XP version needs to be customized
Factory programming tool software	Windows 7 or above, XP version needs to be customized
Test program programming tool	Windows 7 or above, XP version needs to be customized

5. General overview of hardware

5.1. Hardware configuration

Software name	describe
Walkie-talkie motherboard	The main hardware of the walkie-talkie, including main control and radio frequency circuit

5.2. Design/Construction Selection of Hardware/Firmware

Design according to customer's shell and aluminum shell.

6. System design specifications

6.1. System architecture

This solution is designed based on STM32F4+SX1278, with an external WT2031 vocoder.

7. System design specifications (functions)

7.1. 16 channels

Supports 16 channels, each channel can be set individually for full call, group call, and individual call.

7.2. 2 definable function keys

Supports two custom function keys. The supported functions are as follows:

Function	Function description	Remark
KEY-A short press	Voice Battery power broadcast	Prompt battery level.
KEY-A long press	Relay on/off/auto	Relay function on/off/automatic
KEY-B short press	Voice current channel	Prompt current channel.
KEY-B long press	Beep open/close	Beep open/close

7.3. Bi-color LED

The two-color LED light can indicate the sending, receiving, reporting, power-on and other status indications of the walkie-talkie.

Indicator status

7.4. Power-on indicator light and beep

The LED indicator light turns green and then goes out, accompanied by a channel signal tone, indicating power-on.

7.5. Battery display/low voltage alarm

Low voltage alarm, sound prompt: "Battery is extremely low".

7.6. Factory reset

Restore all configuration parameters to factory default values

7.7. Online upgrade

The main control software and vocoder software of the whole machine can be upgraded through the frequency writing line, which requires the CPU program to have the IAP upgrade function. After the upgrade is successful, the radio automatically restarts.

7.8. Power saving function

None yet.

7.9. High/low power switching

This model is not supported.

7.10. Launch limited-time TOT

Fixed to 60s.

7.11. area

The current version is not supported.

7.12. emergency call

- Normal mode: Press and hold the SOS button for more than 3 seconds to send the SOS alarm signal to the group. The machine will start playing the alarm signal when it is received, and the transmitter will also play the alarm at the same time.
- Silent mode: Press and hold the SOS button for more than 3 seconds to send an SOS alarm signal to the group. The machine will start playing the alarm signal when it is received, but the transmitter will not broadcast.
- Off mode: Button function is disabled.

7.13. Squelch level setting

Automatic processing.

7.14. Signal strength indicator

Screenless machines do not have this feature.

7.15. LRANDigital functions

- Support relay/non-relay modes
- Support group call, all call, individual call
- Support voice and SMS communication (not supported by screenless machines)
- Supports remote stun/remote killing/activation (customized function, not supported by the normal version)
- call alert
- Beep switch
- Channel busy alarm detection
- Prompt tone switching between Chinese and English (CPS)

7.16. Analog function

none.

7.17. Function settings supported by each digital channel

Refer to the frequency writing software instructions.

8. Subsystem design specifications (hardware type)

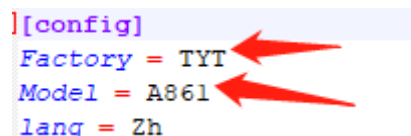
- Powered by 7.2V lithium battery;
- With a battery power detection function.
- Support the frequency writing function.
- Supports internal and external MICs and speakers, and can be switched;
- The CPU uses STM32F401/402RCT6 to run the main control program of the whole machine.
- Support volume, channel knob, etc.;
- The number is reported by software, no external reporting chip is needed.
- The vocoder uses an external WT2031.
- The radio frequency uses the SX1278 chip as the radio frequency channel for sending and receiving.

9. Frequency writing software function

9.1. Personalization of software (header, etc.)

Users can modify the name of the heads-up display in the upper left corner of the software. The configuration file is the "baseconfig.ini" file in the decompression directory of the frequency writing software. After opening, the line "Factory = JingWei" represents the manufacturer's name, and "Model = A511" represents the model. If modifications are needed, just modify "JingWei" or "A511", as shown in the figure below:

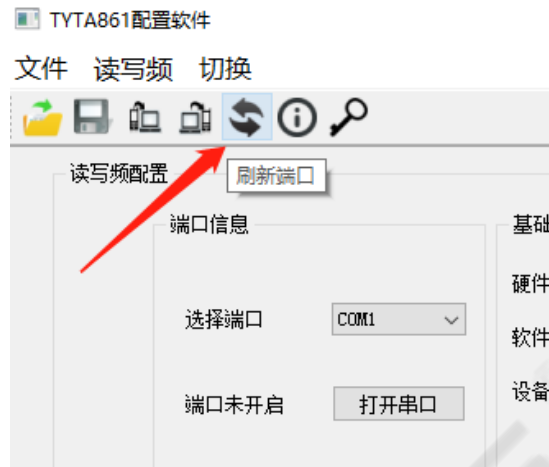
```
[config]
Factory = TYT
Model = A861
lang = Zh
```

A screenshot of a text-based configuration file. The file content is: [config], Factory = TYT, Model = A861, lang = Zh. Two red arrows point to the values 'TYT' and 'A861' respectively.

9.2. Port selection

The upper left area of the frequency writing software contains port information. You can select the corresponding serial port and click the "Open Serial Port" button to connect. If there is no corresponding

serial port in the serial port selection list, you can click the Refresh Port button in the toolbar to refresh the serial port selection list. As shown below:



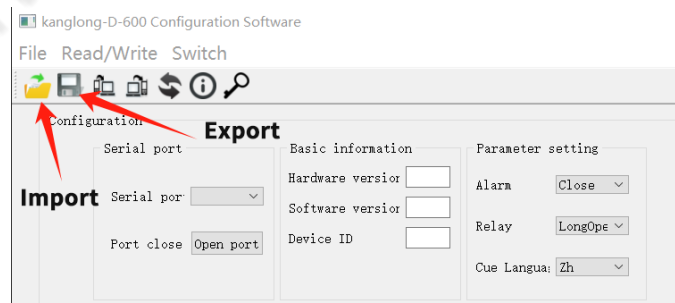
9.3. Read and write frequency operations

The frequency reading operation can be performed through the "Read Frequency" button on the toolbar or "Read and Write Frequency" -> "Read Frequency" in the menu bar; the frequency writing operation can be performed through the "Write Frequency" button on the toolbar or "Read and Write Frequency" -> "Write Frequency" in the menu bar. As shown below:



9.4. Parameter import and export

Parameter import and export To facilitate the migration of frequency writing parameters or save the design, save it locally in the form of Excel and click the "Import Excel" and "Export Excel" buttons in the toolbar to execute, as shown in the following figure:



9.5. Alarm settings

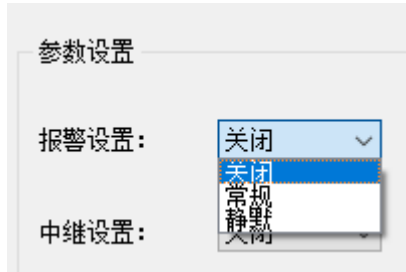
The alarm setting is in the parameter setting area of the frequency writing interface. There are 3 modes:
Off: The alarm key does not respond.

General: Press the alarm button, and the alarm will sound for itself and the intercom in the same

frequency band.

Silent: Press the alarm button, the intercom in the same frequency band will sound the alarm, but the intercom itself will not sound the alarm.

As shown below:



9.6. Relay settings (add description for parameters)

Relay settings can be set in three modes:

Off: Turn off the relay function.

Always On: The radio will forward all received packets.

Custom: The radio only forwards data packets that meet the relay conditions. If you choose custom mode, you need to set relay conditions.

Among them, the default RSSI=70 and SNR=-20 are the experience values with better effect.

As shown below:



Relay condition setting parameter description:

When the relay setting (i.e., the relay switch) is turned on and the "custom" mode is selected, when the signal-to-noise ratio SNR is greater than or equal to the snr threshold, and rssi is greater than or equal to the rssi threshold, no relay will be performed. The default signal-to-noise ratio threshold is 20, and the rssi threshold is -70.

The larger the values of Rssi and snr are, the better the signal quality is.

Snr setting range is 0 to 30.

Rssi setting range is -120 to -1.

For example, the signal-to-noise ratio threshold snr_limit is 20, and the rssi threshold rssi_limit is -70.

The snr of the currently received data is 23 and the rssi is -55. Since $snr \geq snr_limit$ and $rssi \geq rssi_limit$, it is not relayed.

The snr of the currently received data is 19 and the rssi is -55. Since $snr < snr_limit$, the data is relayed and forwarded.

The snr of the currently received data is 23, and the rssi is -85. Since $snr \geq snr_limit$, but $rssi < rssi_limit$, the data is relayed and forwarded.

9.7. frequency calibration

The manufacturer's version of the frequency writing software includes a frequency calibration function, which is used to adjust the channel frequency offset. In the frequency calibration setting area of the frequency writing interface, turn on the frequency calibration switch and fill in the correct value. If the switch is not selected "On", frequency calibration will not take effect. The frequency calibration value can be filled in the range of -500000~500000Hz. As shown below:



9.8. Channel parameter configuration

- Frequency: refers to the frequency of the current channel, an integer or decimal ranging from 400 to 510, with 3 integer digits and 3 decimal digits, the unit is MHz
- Channel type: Channel type can choose three modes: "all call", "group call", and "individual call"
 - All call: Send to everyone in the same frequency band.
 - Group call: send only to a specific group;
 - Personal call: sent to a specified user.
- Sending group/ID: When the channel type is group call, this is the sending group number; when the channel type is individual call, this is the user ID.
 - Send group: The channel type is group call, fill in the group call ID here, the range is 1~254
 - ID: The channel type is a personal call; fill in the target user device ID here. The tentative range is six digits from 000000 to FFFFFFFF, which will be changed to a decimal ID later.
- Receiving group: The receiving group is the group number for receiving messages on the current channel, ranging from 1 to 254

10. Industrial & Structural Design

none

11. Process outline design

none

12. cost analysis

12.1 Cost structure under typical configuration (decomposed into key devices/components)

serial number	device	Price(RMB)	Cost reduction plan
1	STM32F401(2)RCT6	——	
2	SX1278	——	SX1268/LLCC68 (not compatible)
3	WT2031	——	
4	Licensing fee	——	
5	other	——	——

13. Specification list

14. appendix