



GH-60
Operation Manual

Safety Precautions

The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

WARNING

Keep Away from Live Circuits

Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

WARNING

Shock Hazard

Do not attempt to remove the RF transmission line while RF power is present.

WARNING

Do Not Service or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

WARNING

Safety Earth Ground

An uninterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two-conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

WARNING

Resuscitation

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

WARNING

Remove Power

Observe general safety precautions. Do not open the instrument with the power applied.

Safety Symbols

WARNING

Warning notes call attention to a procedure, which if not correctly performed, could result in personal injury.

CAUTION

Caution notes call attention to a procedure, which if not correctly performed, could result in damage to the instrument.



The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area

Note: *Calls attention to supplemental information.*

Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel, and are repeated here for emphasis.

WARNING

Leaking RF energy is a potential health hazard. Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied.
Severe burns, electrical shock, or death can occur.

Caution Statements

The following equipment cautions appear in the text whenever the equipment is in danger of damage, and are repeated here for emphasis.

CAUTION

Do not exceed maximum input power levels. Exceeding the maximum input will damage the GH-60. If unsure of power levels, measure the test connection with a power sensor before using the GH-60.

CAUTION

Do not block airflow to fan or air vents. Unit will overheat if the fan is not circulating air through the unit.

CAUTION

Replace battery pack with OEM part only, do not use any other battery.

Safety Statements

USAGE

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

SERVICE

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

About this Manual

This manual covers the operating and maintenance instructions for the following models:

GH-60

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our factory. This manual may be periodically updated. When inquiring about updates to this manual refer to the part number and revision on the title page.

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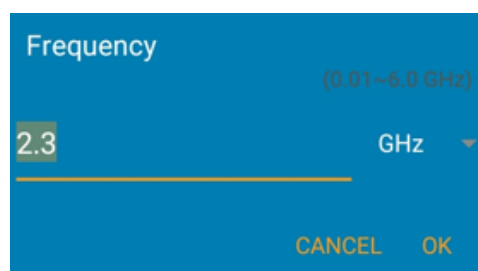
GH-60 Software Operation Instructions

1. Main interface operation instructions

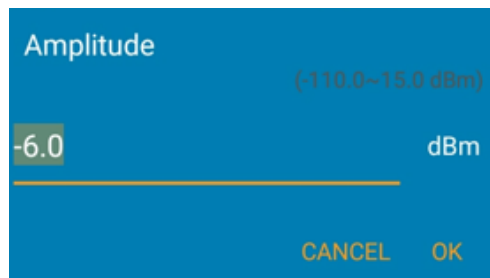
Interface instructions:



- Frequency is the carrier frequency of RF output. The settable range is 10M-6GHz, and the default is 2.3GHz. After setting the value, press OK to take effect. As shown in the picture:



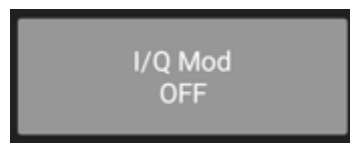
- Amplitude is the power of RF output CW, and the settable range is -110 ~ +15dBm



Select the corresponding standard protocol function item on the screen, and you can freely select the signal standard used. The signal source provides LTE, WCDMA, TD-SCDMA, general digital modulation and other systems for selection.



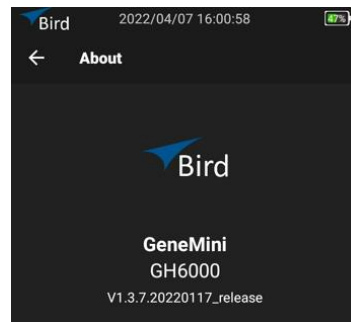
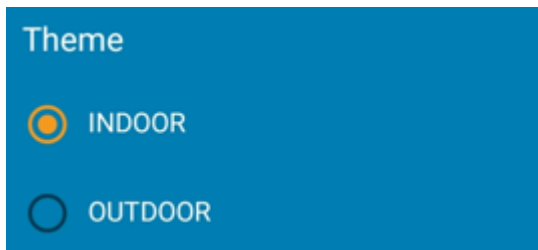
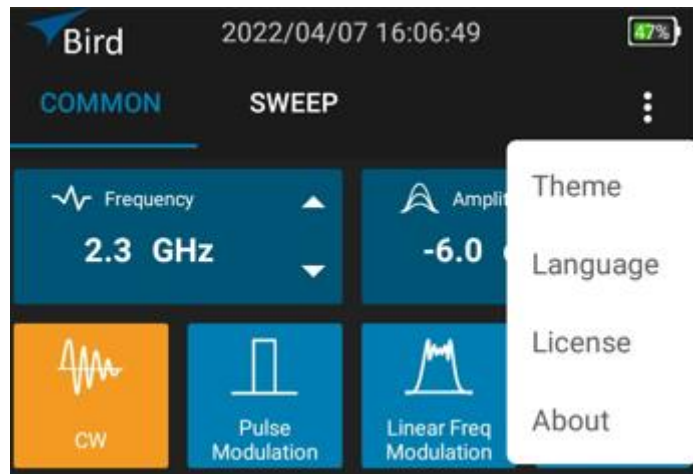
- I / Q mod is the output switch of I / Q baseband output.



- The signal source provides vector signal output, i.e. RF out, which can control the signal output switch.

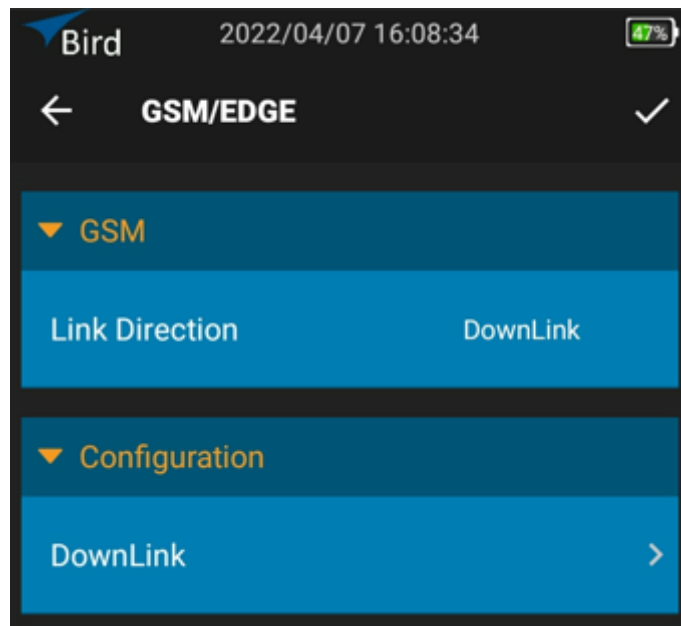


- As shown in the figure below, click the menu button and select “Theme” and “About” version respectively after clicking.



2. GSM test

2.1 GSM main interface parameters instructions



- **Link Direction:** This parameter allows downlink and uplink selection.



- **DownLink:** Click this parameter to enter the downlink parameter configuration interface.
- **UpLink:** Click this parameter to enter the uplink parameter configuration interface.

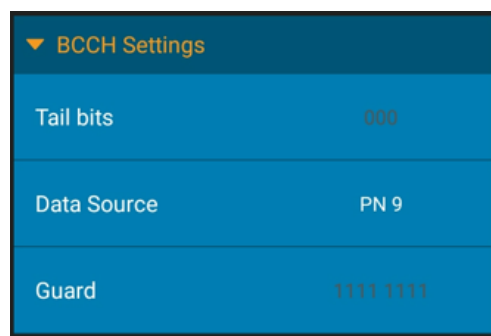
2.2 GSM downlink parameter interface construction

- In the downlink channel, each channel can generate four breakthrough structures mapped to corresponding time slots, and each burst borrow information is 1 bit. In four burst structures, the borrow information field is 4 bit. As shown in the figure below:



BSIC(OCT)	00
hl pattern	1111
hu pattern	1111
Training Sequence TSC	TSC 0

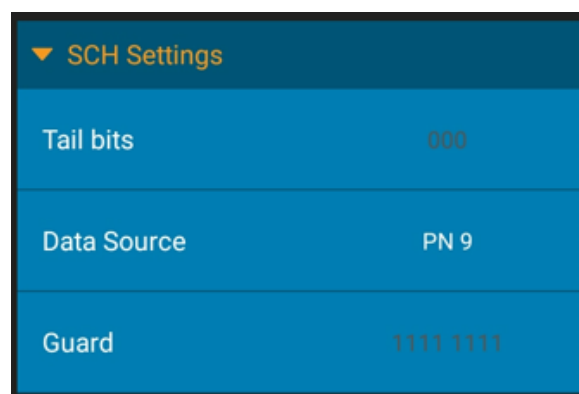
Downlink BCCH channel parameter configuration interface.



▼ BCCH Settings	
Tail bits	000
Data Source	PN 9
Guard	1111 1111

- **Tail bits:** Tail bit, 3bit information, the information values are all 0;
- **Data Source:** Signal input when the information source sequence of BCCH channel is not coded;
- **Guard:** BCCH channel is mapped to the protection bit in slot breakthrough structure, with a length of 8.25 bits.

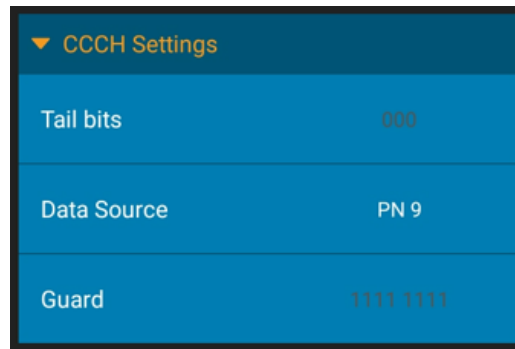
Downlink SCH channel parameter configuration interface.



▼ SCH Settings	
Tail bits	000
Data Source	PN 9
Guard	1111 1111

- **Tail bits:** Tail bit, 3bit information, the information values are all 0;
- **Data Source:** Signal input when the information source sequence of SCH channel is not coded;
- **Guard:** SCH channel is mapped to the protection bit in slot breakthrough structure, with a length of 8.25 bits.

Downlink CCCH channel parameter configuration interface.



- **Tail bits:** Tail bit, 3bit information, the information values are all 0;
- **Data Source:** Signal input when the information source sequence of CCCH channel is not coded;
- **Guard:** CCCH channel is mapped to the protection bit in slot breakthrough structure, with a length of 8.25 bits.

2.3 GSM uplink parameter interface construction

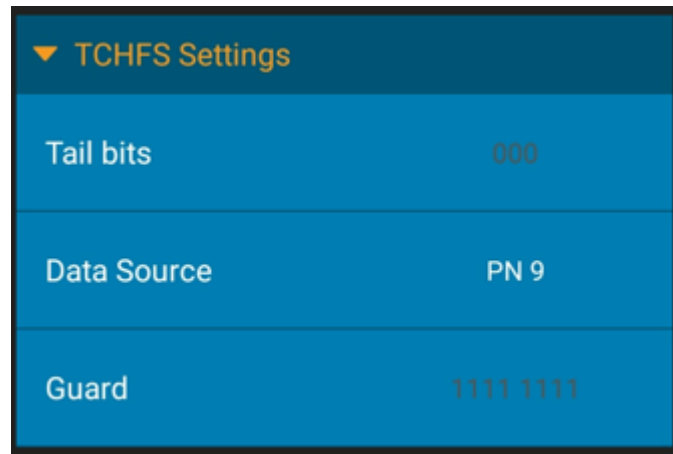
The uplink timeslot is a 26 complex frame structure composed of three channels: TCHFS, FACCH and SACCH.

- In the uplink channel, each channel can generate four breakthrough structures mapped to corresponding time slots, and each burst borrow information is 1 bit. In eight burst structures, the borrow information field is 4 bit.



- **hl pattern:** borrow information, 4 bits long, one bit per burst, information is 1;
- **hu pattern:** borrow bit information, 4 bits in length, one bit in each burst, information is 1;
- **Training Sequence TSC:** Training sequence, value range 0-7.

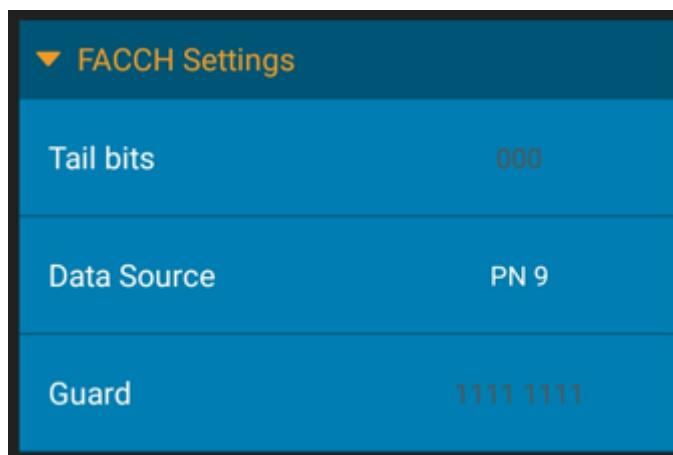
Uplink TCHFS channel parameter configuration interface.



▼ TCHFS Settings	
Tail bits	000
Data Source	PN 9
Guard	1111 1111

- **Tail bits:** Tail bit, 3bit information, the information values are all 0;
- **Data Source:** Signal input when the information source sequence of TCHFS channel is not coded;
- **Guard:** TCHFS channel is mapped to the protection bit in slot breakthrough structure, with a length of 8.25 bits.

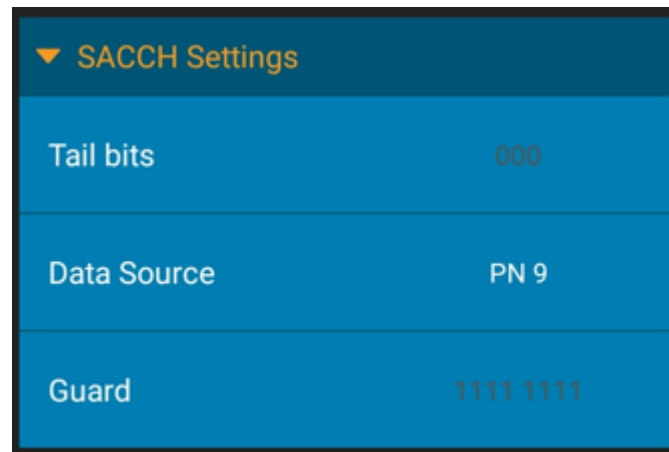
Uplink FACCH channel parameter configuration interface.



▼ FACCH Settings	
Tail bits	000
Data Source	PN 9
Guard	1111 1111

- **Tail bits:** Tail bit, 3bit information, the information values are all 0;
- **Data Source:** Signal input when the information source sequence of FACCH channel is not coded;
- **Guard:** FACCH channel is mapped to the protection bit in slot breakthrough structure, with a length of 8.25 bits.

Uplink SACCH channel parameter configuration interface.



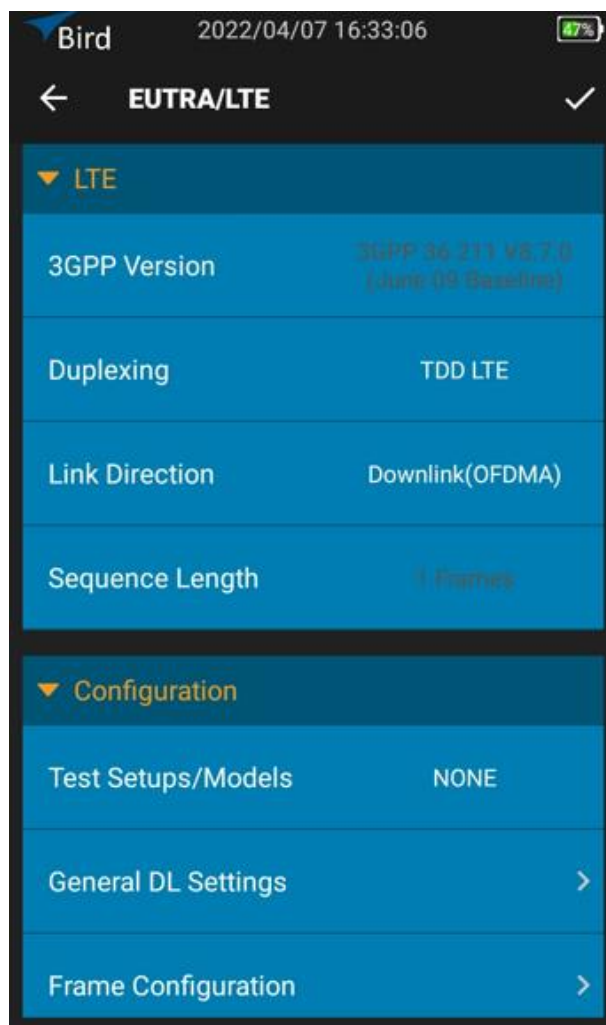
▼ SACCH Settings	
Tail bits	000
Data Source	PN 9
Guard	1111 1111

- **Tail bits:** Tail bit, 3bit information, the information values are all 0;
- **Data Source:** Signal input when the information source sequence of SACCH channel is not coded;
- **Guard:** SACCH channel is mapped to the protection bit in slot breakthrough structure, with a length of 8.25 bits.

3. LTE test

3.1 LTE main interface instruction

LTE module supports TDD-LTE and FDD-LTE. Users can easily switch between the two modes. LTE Uplink and downlink support configuration, and parameter configuration is rich. After selecting LTE mode, the main interface of selecting LTE type and uplink and downlink appears first.



When the configuration information in the interface is completed, click "✓" on the top of the interface to indicate that the signal configuration is completed.

- **3GPP Version** represents the 3GPP protocol version number on which the current LTE format is based.
- **Duplexing** represent LTE mode, choose TDD LTE or FDD LTE.
- **Link Direction** indicates the selected link direction. Uplink is optional. Uplink adopts SC-FDMA (subcarrier frequency division multiple access) technology or downlink.

Downlink adopts OFDM (orthogonal frequency division multiple access) technology.

- **Sequence Length** represents the length of the generated data. The basic unit is 1 frame. The length set by the user should be a positive integer multiple of 1 frame.
- **General UL/DL Settings** button controls the general configuration of the uplink and the partial parameter configuration of each channel;
- **Frame Configuration** button controls the intra frame configuration of the uplink / downlink and the partial parameter configuration of each channel;

3.2 Uplink configuration test

Uplink configurable uplink channels include: PUCCH (physical uplink control channel) / PUSCH (physical uplink shared channel) / PRACH (physical random-access channel). Configurable uplink signals include: RS (reference signal), including DMRS (demodulation reference signal) and SRS (listening reference signal). For which channels the user needs to send, as long as the parameters and general parameters of the required transmission channel are configured, the parameters of the unnecessary transmission channel need not be configured.

For example, if the user chooses to send only the PUCCH channel, only the parameters related to the general parameters and the PUCCH channel need to be configured, and the parameters related to the PUSCH, PRACH and SRS need not be configured. The configurable channel and signal combinations within a frame supported by the current version are:

1. Send PUCCH separately.
2. Send PUSCH separately.
3. Send PRACH separately.
4. Send SRS separately.
5. PUCCH + SRS.
6. PUCCH + PUSCH.

Note: DMRS is divided into PUCCH-DMRS and PUSCH-DMRS. DMRS does not carry high-level information, and DMRS and PUCCH / PUSCH are sent together in the same subframe. When users configure PUCCH / PUSCH, they need to configure DMRS related parameters at the same time. In the same uplink subframe, PUCCH and PUSCH cannot be sent at the same time. PUCCH + PUSCH means that different uplink subframes in a frame can send PUCCH and PUSCH respectively. For SRS signal, SRS + PUCCH can be sent in the same subframe at the same time, but the subframe sent by SRS and PUCCH at the same time is specified by the physical layer protocol, and the user cannot configure it at will.

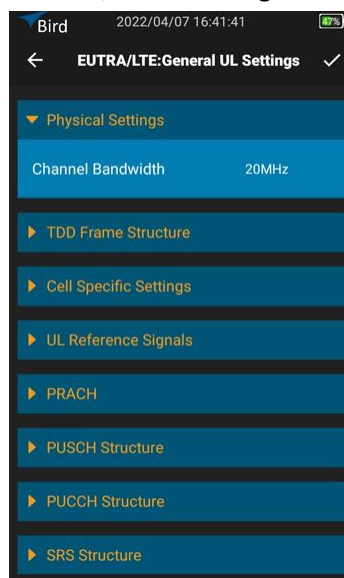
When link direction selects uplink, the interface is as shown in the figure.



The general UL settings button controls the general configuration of the uplink and the partial parameter configuration of each channel;
 Frame Configuration button controls the intra frame configuration of the uplink and the partial parameter configuration of each channel.

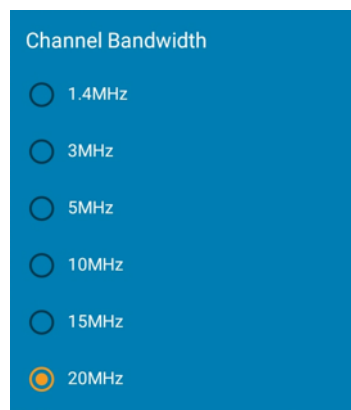
3.2.1 Uplink general parameter configuration

After click General UL Settings button, the following interface will pop out.



Upstream and downstream configuration	Subframe Number									
	0	1	2	3	4	5	6	7	8	9
0	D	S	U	U	U	D	S	U	U	U
1	D	S	U	U	D	D	S	U	U	D
2	D	S	U	D	D	D	S	U	D	D
3	D	S	U	U	U	D	D	D	D	D
4	D	S	U	U	D	D	D	D	D	D
5	D	S	U	D	D	D	D	D	D	D
6	D	S	U	U	U	D	S	U	U	D

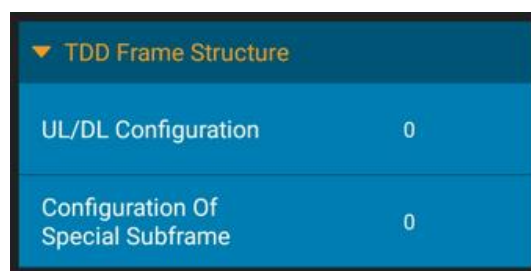
Uplink physical configuration interface



Physical Settings main about LTE bandwidth information.

- In **Channel Bandwidth**, user can choose 1.4MHz/ 3MHz/ 5MHz/ 10MHz/ 15MHz/20MHz

TDD frame structure

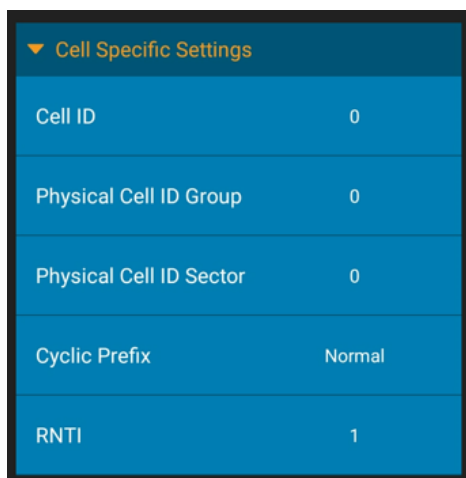


- **UL/DL Configuration** indicates the up and down subframe configuration, and the configurable range is 0-6. The value configuration is different, and the distribution of the up and down frames in a frame is different.
- **Configuration of Special Subframe** indicates special subframe configuration

The distribution of up and down frames in one frame

Note: in FDD mode, all subframes in a frame are uplink subframes (in uplink case), so there is no need to configure the frame structure.

Cell specific settings



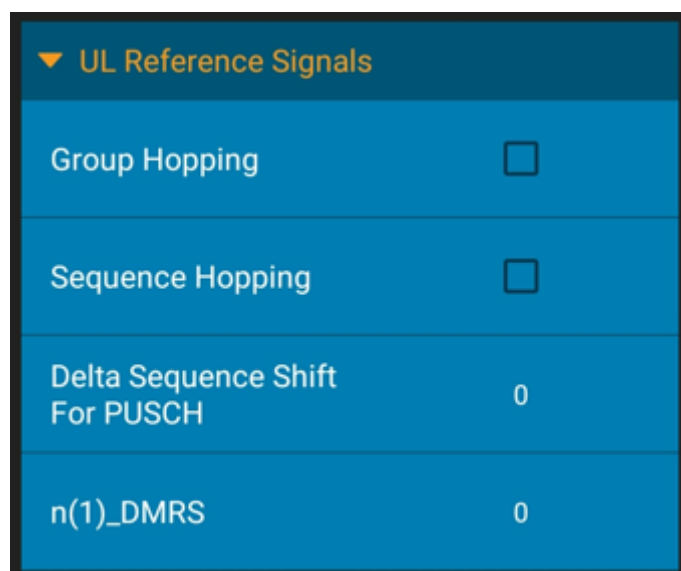
▼ Cell Specific Settings	
Cell ID	0
Physical Cell ID Group	0
Physical Cell ID Sector	0
Cyclic Prefix	Normal
RNTI	1

- **Cell ID** indicates the cell number, and the configurable range is 0 ~ 503.
- **Physical cell ID group** refers to the ID group number of the physical cell. The configurable range is 0-167.
- **Physical layer ID Sector** refers to the internal number of the physical layer cell ID group. The configurable range is 0 ~ 2.

Noted: Cell ID, Cell ID group number and cell ID group internal number meet the mathematical relationship: cell id = cell ID group number * 3 + cell ID group internal number.

- **Cyclic prefix** means cyclic prefix, which can be configured as normal or extended.
- **RNTI** represents the temporary identification of wireless network, and the configurable range is 0-65535.

UL reference signals



▼ UL Reference Signals	
Group Hopping	<input type="checkbox"/>
Sequence Hopping	<input type="checkbox"/>
Delta Sequence Shift For PUSCH	0
n(1)_DMRS	0

UL reference signals configures uplink reference signal (RS) related parameters.

- **Group hopping** refers to group frequency hopping, if checked, it means on, if unchecked, it means off.
- **Sequence hopping** refers to sequence frequency hopping, if checked, it means on, if

unchecked, it means off.

- **Delta sequence shift for PUSCH** is the offset value of PUSCH channel sequence, with the range of 0-29.
- **N (1) - DMRs** is related to the cyclic shift value of PUSCH. The match value should be in the range of set {0,2,3,4,6,8,9,10}.

PRACH parameter configuration

▼ PRACH	
Enable PRACH	<input type="checkbox"/>
Restricted Set(High Speed Mode)	<input type="checkbox"/>
PRACH Frequency Offset	0
PRACH Configuration Index	0
PRACH Configuration Subindex	0
Zero Correlation Zone Configuration	0
PRACH Logical Root Sequence Configuration	0
PRACH Preamble Sequences Configuration	0
PRACH Time Offset	0

- **Enable PRACH** indicates whether to send reach, check indicates to send PRACH, and uncheck indicates not to send.
- **Restricted set (high speed mode)** indicates whether to use restriction set (high-speed mode), check indicates to use restriction set (high-speed mode), and uncheck indicates to unused.
- **PRACH frequency offset**, the configurable range changes with the channel bandwidth. The relationship between the reach frequency and the bandwidth is as follows:

Channel bandwidth/MHz	1.4	3	5	10	15	20
PRACH frequency offset	0	0~9	0~19	0~44	0~69	0~94

- **PRACH Configuration Index** indicates the configuration serial number of PRACH, with the range of 0-63. For TDD mode, the physical layer protocol reserves 58-63, for FDD mode, the physical layer protocol reserves 30, 46, 60, 61, 62, so the actual configurable range should exclude the reserved value.
- **PRACH Configuration Sub index** indicates the sub serial number of RPACH configuration, which needs to be configured only in TDD mode. The configurable range is related to PRACH configuration index. When the configuration is unreasonable, the software will forcibly convert to the maximum configurable value. This parameter does not need user configuration in FDD mode.
- **Zero Correlation Zone Configuration** indicates zero correlation domain configuration index. The configurable range is 0-15 when restricted set is off (non restricted set), and 0-14 when restricted set is on (restricted set).
- **PRACH Logical Root Sequence Configuration** indicates the configuration index of the preach logical root sequence. The configuration range in FDD mode is 0-837. The configurable range in TDD mode is related to the preach configuration index. When the PRACH configuration index ≥ 48 , the configurable range is 0-135. In other cases, the configurable range is 0-837. When the current configurable range is exceeded, the software will forcibly convert to the maximum configurable value.
- **PRACH Preamble Sequences Configuration** range is 0~63.
- **PRACH Time Offset** indicates the time offset of the transmit RPACH in TDD mode. The optional value is 0 / 624. This parameter cannot be configured in FDD mode.

PUSCH parameter configuration

PUSCH Structure configuration PUSCH channel parameter, as shown in the photo.

PUSCH Structure	
Frequency Hopping Mode	inter-subframe
PUSCH Hopping Offset	0
Number Of Sub-bands	1

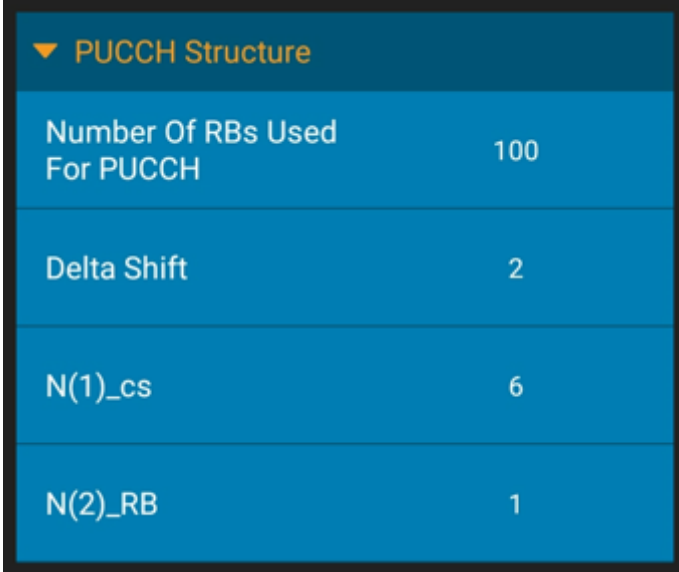
- **Frequency Hopping Mode** have inter-subframe or intra-subframe two options.
- **PUSCH Hopping Offset** value range is related to the channel bandwidth. See the following table for the specific range.

Channel BW/MHz	1.4	3	5	10	15	20
Frq. hopping offset	0~4	0~12	0~22	0~48	0~72	0~98

- **Number of Sub-bands** value range is related to the PUSCH hopping offset configuration. The minimum value is 1 and the maximum value is 4. When the value exceeds the current actual configurable value, the software will perform a forced conversion.

PUCCH parameter configuration

PUCCH Structure configuration PUCCH channel parameter, as shown in the photo.



▼ PUCCH Structure	
Number Of RBs Used For PUCCH	100
Delta Shift	2
N(1)_cs	6
N(2)_RB	1

- **Number of RBs used for PUCCH** indicates the number of resource blocks that can be occupied by PUCCH. The minimum value is 0 and the maximum value is no more than number of resource blocks per slot.
- **Delta Shift** related to cyclic shift value, value range 1-3.
- **N (1) _cs** Indicates the number of cyclic shift bits available in PUCCH format 1 / 1A / 1b, with a value range of 0-7, and its value must be an integer multiple of Delta Shift. See table for specific relationship.

Delta Shift	1	2	3
N(1)_cs	0/1/2/3/4/5/6/7	0/2/4/6	0/3/6

- **N(2)_RB** indicates the number of PUCCH2 / 2A / 2B resource blocks that can be used for transmission. The minimum value is 0 and the maximum value is no more than number of RBs used for PUCCH - 1.

SRS parameter configuration

- SRS Structure configuration SRS signal parameter, as shown in the photo.



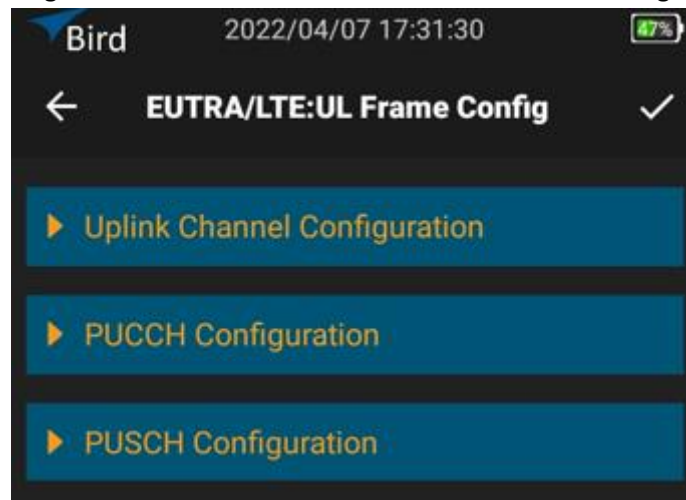
The image shows a screenshot of a configuration menu for SRS Structure. The menu is titled 'SRS Structure' and contains several parameters with their current values:

Parameter	Value
SRS Configuration Paras	<input type="checkbox"/>
SRS Cyclic Shift	0
SRS Bandwidth Configuration C_SRS	5
SRS Bandwidth B_SRS	1
SRS Configuration Index I_SRS	0
SRS Subframe Configuration	0
SRS Transmission Comb k_TC	0
SRS Hopping Bandwidth	0
SRS Freq Domain Position (nRRC)	0

- SRS Cyclic Shift value range 0~7
- SRS Bandwidth Configuration C_SRS value range 0~7
- SRS Bandwidth B_SRS value range 0~3
- SRS Configuration Index I_SRS value range 0~644
- SRS Subframe Configuration value range 0~15, 14 and 15 are reserved for physical layer protocol of TDD mode and 15 are reserved for FDD mode, and the reserved value should be removed from the actual configurable range.
- SRS TransmissionComb k_TC is related to SRS position in frequency domain, value range 0/1
- SRS Hopping Bandwidth value range 0~3
- SRS Freq Domain Position (nRRC) value range 0~23

3.2.2 Uplink frame configuration and channel option

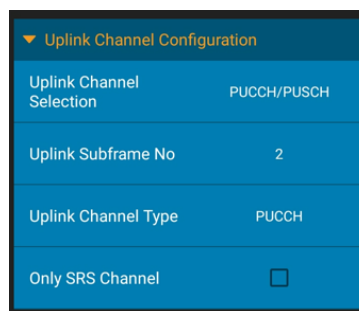
Click the frame configuration button and the interface as shown in the figure will pop up.



In the interface, configure the channel type of each subframe in the uplink frame.

Uplink Channel Selection can choose PUCCH/PUSCH and PRACH。

When Uplink Channel Selection configure to PUCCH/PUSCH, as shown in the photo.



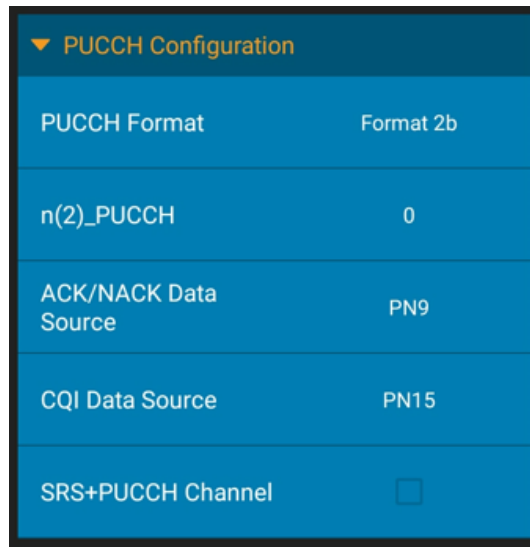
At this time, the uplink subframe no and the uplink channel type are jointly configured

- **Uplink Subframe No** value range 0~9
- **Uplink Channel Type** option NULL/PUCCH/PUSCH

Only SRS Channel control whether to send SRS channel separately. If it is checked, it means to send SRS separately. If it is not checked, it means not to send SRS.

PUCCH format and carried data configuration

PUCCH Configuration control part of PUCCH channel parameter



▼ PUCCH Configuration	
PUCCH Format	Format 2b
n(2)_PUCCH	0
ACK/NACK Data Source	PN9
CQI Data Source	PN15
SRS+PUCCH Channel	<input type="checkbox"/>

- **PUCCH Format** configurable PUCCH format is related to the parameter cyclic prefix. When the parameter cyclic prefix is configured as normal, the push format can be format 1 / 1A / 1B / 2 / 2A / 2B; when the parameter cyclic prefix is configured as extended, the push format can be format 1 / 1A / 1B / 2.
- **n(1)_PUCCH/n(2)_PUCCH** correspond to PUCCH Format. When 1 / 1A / 1b is selected for PUCCH format, the parameter to be configured is n (1) PUCCH, and its configurable range is given by the previous parameter range n (1) PUCCH (normal CP) or range n (1) PUCCH (extended CP); when 2 / 2A / 2b is selected for PUCCH format, the parameter to be configured is n (2) PUCCH, and its configurable range is given by the previous parameter range n (2) PUCCH.
- **ACK/NACK Data Source** indicates the ACK / NACK (confirm / deny) information in the control information carried by PUCCH, which can be configured with full 0 / full 1 / 10 repeat / 01 repeat / pn9 / pn15.
- **CQI data source** refers to CQI (channel quality indication) information in control information carried by PUCCH, which can be configured with full 0 / full 1 / 10 repetition / 01 repetition / pn9 / pn15.
- **SRS + PUCCH Channel** controls whether SRS and PUCCH are sent at the same time in a subframe. If it is checked, it means they are sent together, if not, it means they are not sent together. When 2 / 2A / 2b is selected for the PUCCH format, the physical layer protocol does not support simultaneous sending of SRS and PUCCH. In this case, SRS is not sent, so it is not configurable.

PUSCH configuration

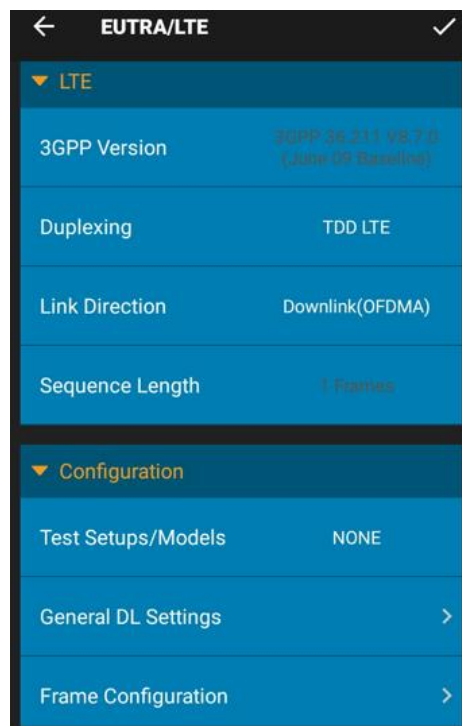
▼ PUSCH Configuration	
n(2)_DMRS	0
Number Of RBs For PUSCH	10
MCS	0
Frequency Hopping	<input type="checkbox"/>
Frequency Hopping Type	Type1
Information In Hopping Bits	0
RB Offset	0
RV Index	0

- **N (2)_DMRs** is related to the cyclic shift value of PUSCH. The match value should be in the range of set {0,2,3,4,6,8,9,10}.
- **Number of RBs for PUSCH** represents the number of RBs assigned to the PUSCH channel, value range 1~parameter Number Of Resource Blocks Per Slot.
- **MCS** represents modulation coding scheme, value range 0-28.
- **Frequency Hopping**, check means frequency hopping is on, and uncheck means frequency hopping is off.
- **Information in Hopping Bits**, when Number Of Resource Blocks Per Slot<50, value range is 0~1; when Number of Resource Blocks Per Slot>=50, values range is 0~3.
- **Frequency Hopping Type** value is determined by Number Of Resource Blocks Per Slot and Information in Hopping Bit, users don't need to configure.
- **RB Offset** represents the sequence number of the first resource unit assigned to PUSCH, value range 0~ (Number Of Resource Blocks Per Slot - Number of RBs for PUSCH), the software will force conversion when the user configuration is unreasonable.
- **RV Index** indicates the redundant version number, value range 0~3.

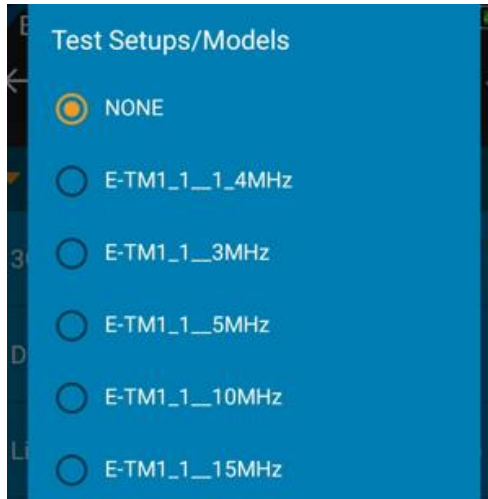
3.3 Downlink configuration

Downlink configurable downlink channels include: PBCH (physical broadcast channel) / PCFICH (physical control format indication channel) / PHICH (physical HARQ indication channel) / PDCCH (physical downlink control channel) / PDSCH (physical downlink shared channel). Configurable downlink signals include: SS (synchronous signal), including PSS (main synchronous channel) and SSS (auxiliary synchronous signal) / RS (reference signal). CRS (cell specific reference signal) is supported in the current version. Unlike uplink, a downlink wireless frame generally contains all the above downlink channels and signals, so all the related parameter users need to configure. This version provides some switches for channel and signal transmission. For example, PSS / SSS, PBCH, etc. can be sent or not controlled by the user. If you choose not to send a channel / signal, the parameters related to this channel / signal alone do not need to be configured. In general, it is recommended that the user send all channels and signals.

When link direction selects downlink, the interface as shown in the figure below will appear.



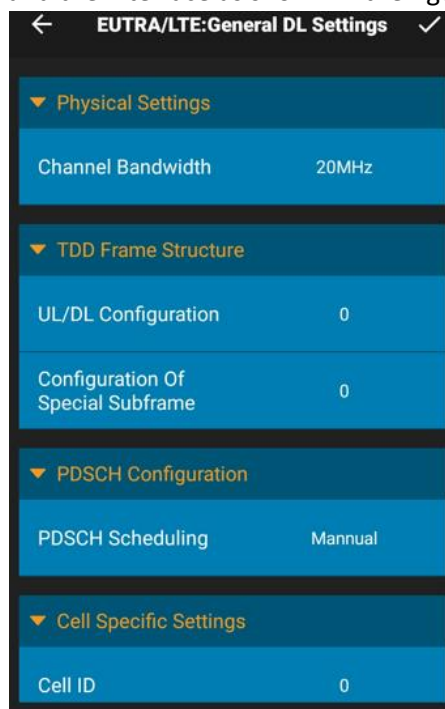
- **Test Setups/Models** button control ETM mode. ETM mode means that all downlink parameters have been set with one click. After selecting an ETM mode, there is no need to configure the parameters in general DL settings and frame configuration. Therefore, ETM mode is convenient for testing.



- **General DL Setting buttons** control the general configuration of downlink and the parameter configuration of some channels and signals.
- **Frame Configuration button** controls the intra frame configuration of the downlink and the parameter configuration of each channel part.

3.3.1 Downlink general parameter configuration

General DL settings button and the interface as shown in the figure will pop up.

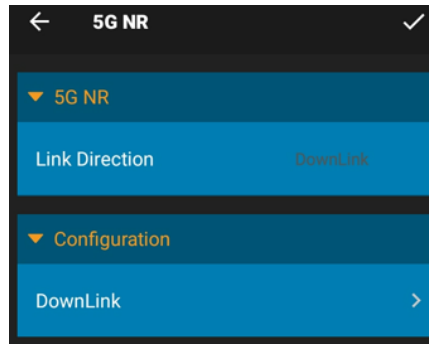


Physical Settings change LTE bandwidth. The same as uplink, **channel bandwidth** represents the channel bandwidth. The user can select 1.4mhz/3mhz/5mhz/10mhz/15mhz/20mhz.

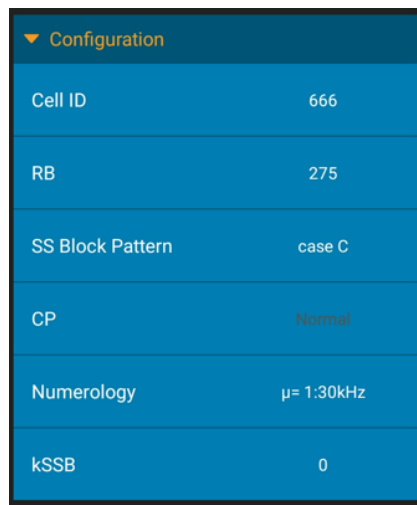
4. 5G NR Test

4.1 Description of 5G NR main interface

Select 5G NR in the main interface of baseband, then enter 5G NR main interface, as shown in Figure 1



Link Direction is the selected link direction, and Downlink can be configured. At present, GH-60 5G NR has only downlink setting. Select downlink to enter the configuration interface, as shown in the figure below.



4.2 5G NR downlink parameter configuration test

- **Cell ID:** Set cells ID;
- **RB:** Resources blocks
- **SS Block Pattern:** There are three modes, case A, case B and case C, which represent synchronization signal block. In fact, they refer to synchronization / PBCH block, because synchronization signal and PBCH channel are packed into a block that is always transmitted together. The components of the block are as follows: synchronization signal: PSS (primary synchronization signal), SSS (secondary

synchronization signal) PBCH: PBCH DMRS and PBCH (data)

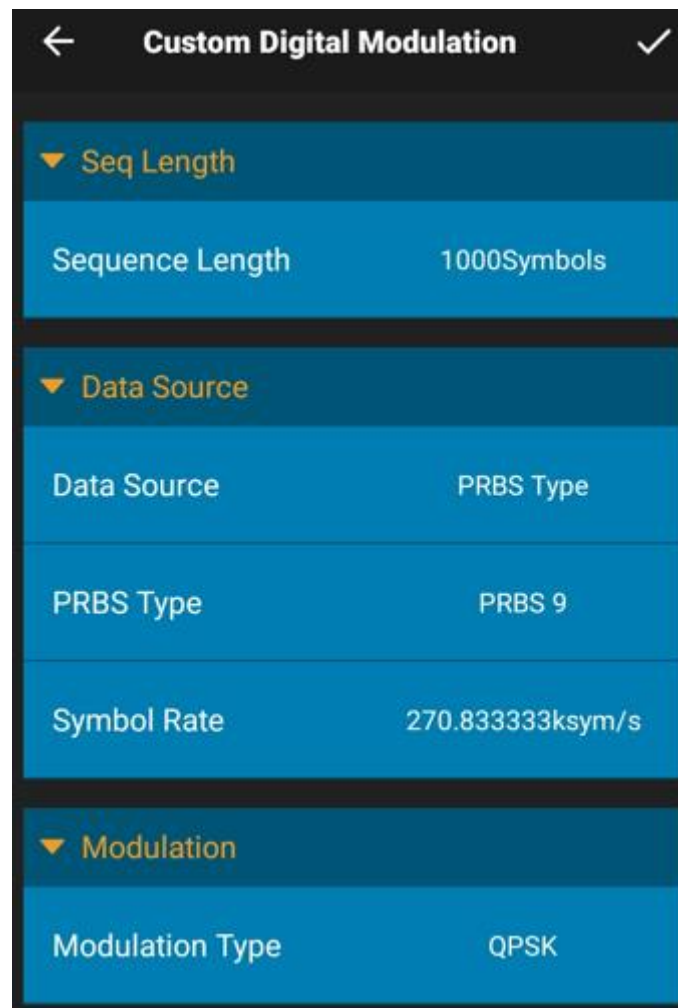
- **CP:** Cyclic prefix
- **Numerology** is used to configure subcarriers, when $u = 1:15\text{kHz}$, SSB can only configure case A mode. When $u = 1:30\text{kHz}$, SSB can configure case B and case C mode;
- **KSSB:** Subcarrier offset (0 ~ 23)

5. Custom Digital Modulation

Custom digital modulation provides ASK, PSK, FSK, QAM and other digital modulation modes, and can set symbol rate and symbol length by itself.

In the Baseband A or Baseband B option box of the main interface, select custom digital modulation to enter the general digital modulation setting interface.

Main interface of general digital modulation interface:



Interface parameter meaning:

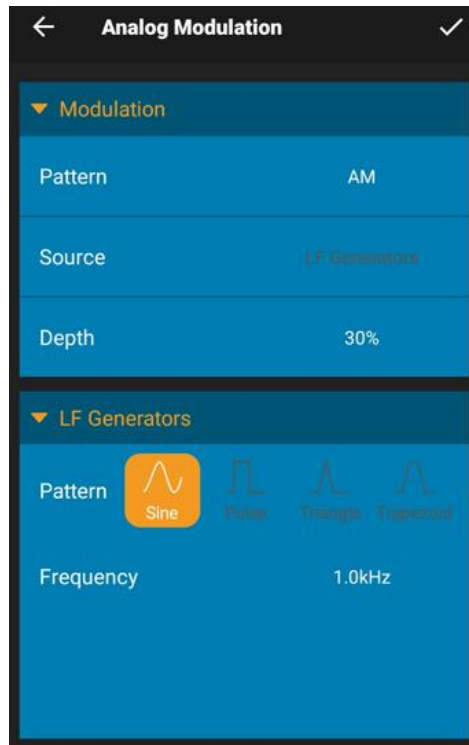
- **Sequence Length:** the symbol length after mapping, value range 1-220000 Symbols
- **Data Source:** can select all 0 sequence, all 1 sequence, PRBS type and pattern manually
- **PRBS Type:** random sequence format, options PN9, PN11, PN15, PN16, PN20, PN21, PN23
- **Symbol Rate:** value range 22K—22M Sym/s
- **Modulation Type :** choose modulation type

Software provide modulation type as below:

- **ASK modulation:** ASK
- **PSK modulation:** BPSK,QPSK,QPSK 45, QPSK EDGE,OQPSK, $\pi/4$ QPSK, $\pi/2$ DBPSK, $\pi/4$ DQPSK, $\pi/8$ D8PSK,8PSK,8PSK EDGE
- **QAM modulation:** 16QAM,16QAM EDGE,32QAM,32QAM, EDGE, 64QAM, 128QAM, 256QAM
- **FSK:** MSK, 2FSK, 4FSK, Variable FSK(vary 4FSK; vary 8FSK; vary 16FSK)
- When selecting ASK, you need to set the ASK depth parameter in the range of 0% - 100%.When selecting FSK, FSK deviation (frequency deviation constant) is needed, and the range is 27.0833khz-4.0625mhz.
- **Filter:** Select the shaping filter used for baseband data. Support the selection of multiple filters.
- **Impulse Length:** The length parameter of the filter, ranging from 1 to 128, is 10 by default.
- **Oversampling:** Interpolation multiple before filtering, value range is 1-32, default is 16. The interpolation value is 0.
It is worth noting that the sampling rate of the output signal = symbol rate * oversampling, and the number of bits of the output signal = sequence Length * oversampling. If the sampling rate is not within the sampling range of the hardware (22m-130m), the software will automatically up sampling (using CIC filter) or down sampling (sampling at intervals), so that the actually used interpolation multiple is no longer the value set on the boundary.
- **Roll Off Factor:** The roll off coefficient of the root raised cosine filter is 0.05-0.99, and the default value is 0.35. The receiver should use the root raised cosine filter with the same roll term coefficient for matched filtering.

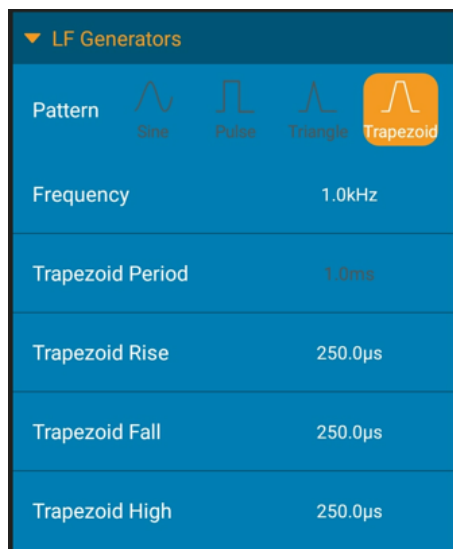
6. Analog Modulation

In the baseband A option, find the option of analog modulation, as shown in the figure after opening.



- **Pattern** indicates modulation mode, optional AM, FM, PM modulation. Each modulation mode has its own parameters. Am is depth, FM is deviation and PM is deviation. Option have Sine, Pulse, Triangle, Trapezoid.
- **Frequency** represents the frequency of the waveform to be modulated.

In addition, pulse, triangle and trapezoid also have corresponding period parameter settings.



- **I/Q Mod Switch**, when using mode modulation, make sure that the switch is on.



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