泰芯半导体
TaiXin Semiconductor

TaiXin AH Frequency Setting Instructions

珠海泰芯半导体有限公司
TaiXin Semiconductor Co. , Limited
珠海市高新区港湾一号科创园港 11 栋 3 楼

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Zhuhai Taixin Semiconductor Co., Ltd.

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Revision History

Date	Version	Revision Notes	Reviser
2024/03/31	V2.1	Add descriptions of frequencies for Hong Kong and Taiwan.	WY
2023/11/30	V2.0	Synchronize frequency settings for country codes in the code.	WY
2023/07/26	V1.7	Add descriptions for Indonesia, Malaysia, Thailand, and Vietnam; Modify descriptions for Singapore and Australia.	WY
2023/02/01	V1.6.1	Correct typos in the Japan section.	WY
2022/12/01	V1.6	Add notes for EU and Japan.	WY
2022/11/15	V1.5	Revise the frequency usage description for China.	WY
2022/10/20	V1.4	Adjust the frequency settings for Japan.	WY
2022/09/02	V1.3.1	Correct typos in the China section.	WY
2022/07/05	V1.3	Add frequency settings for Japan.	WY
2022/02/18	V1.2	Update the logo.	XYJ
2021/11/29	V1.1	Revise the frequency description for the EU. Add notes for the China frequency band.	WY
2021/08/02	V1.0.5	Correct typos in the Korea section.	WY
2021/03/22	V1.0.4	Correct typos in the 2M frequency section for the US.	WY
2020/12/15	V1.0.3	Add usage notes for the CN/EU frequency bands. Add frequency setting instructions for Korea.	WY
2020/11/3	V1.0.2	Remove 903M and 927M from the US 2M frequency list.	WY
2020/09/20	V1.0.1	Add a description of the channel type.	WY
2020/08/15	V1.0.0	Initial version.	WY

Table of Contents

1. Overview

TaiXin AH chip supports the IEEE802. 11AH protocol standard, operating in the frequency range of 730MHz to 930MHz (refer to the module specification for the specific operating frequency range) .

2. Terminology

- **BSS_BW**:

Bandwidth occupied by the BSS (unit: MHz) , optional 2/4/8 M, set according to the spectrum planning of the country and region, and the characteristics of the specific application.

- **FREQ_START**[1]:

Starting value of the center frequency of the selectable channels (unit: MHz/10, or 100KHz) , set according to the spectrum planning of the country and region.

- **FREQ_END**[1]:

Ending value of the center frequency of the selectable channels (unit: MHz/10, or 100KHz) , set according to the spectrum planning of the country and region.

- **CHAN_LIST**[2]:

List of center frequencies of the selectable channels (unit: MHz/10, or 100KHz) , set according to the spectrum planning of the country and region.

Note 1: If the selectable channels are continuously available, it can be set with FREQ_START and FREQ_END, and the calculated center frequencies of the channels are spaced one BSS_BW apart. For example, with FREQ_START=9080, FREQ_END=9240, and BSS_BW=8, the calculated center frequencies of the channels will be 908M, 916M, and 924M, each occupying 8M bandwidth.

Note 2: If the selectable channels are not continuously available, it can be set with CHAN_LIST. The center frequencies intervals of each channel are not constrained by BSS_BW. CHAN_LIST can contain up to 16 elements, but it is recommended to have no more than 6 elements.

3. Frequency Settings for Different Countries and Regions

Sorted in alphabetical order.

3.1. AU (Australia)

- **Power Limit:**
  30 dBm.

- **Recommended Channels:**

a) BSS_BW=1M
   Total of 13 channels with center frequencies of 916. 5/917. 5/.../927.5 MHz.
   Considering the slow scanning speed due to too many channels, select 6 channels and set by CHAN_LIST: CHAN_LIST=[9165, 9185, 9205, 9225, 9245, 9265];

b) BSS_BW=2M
   Channels for 2M bandwidth are not continuous and must be set using CHAN_LIST: CHAN_LIST=[9160, 9180, 9210, 9230, 9250, 9270], with center frequencies of 916/918/921/923/925/927 MHz;

c) BSS_BW=4M
   Channels for 4M bandwidth are not continuous and must be set using CHAN_LIST: CHAN_LIST=[9170, 9220, 9260], with center frequencies of 917/922/926 MHz;

d) BSS_BW=8M
   Only one channel available: CHAN_LIST=[9240], with the center frequency of 924 MHz.

3.2. CN (China)

Note 1:

Currently, there are no compliant AH frequency bands in China. Please ensure compliance with relevant national spectrum regulations when using them.

Note 2:

The 700 MHz band is occupied by China Broadnet's 5G service, with the specific bands as follows:

- Uplink: 703-743 MHz+Downlink: 758-798 MHz, corresponding to 5G band n28.

- Uplink: 703-733 MHz+Downlink: 758-788 MHz, corresponding to 5G band n28a, also referred to as the "reduced version".

Note 3:

China Unicom's 5G service occupies the 900 MHz band, with the specific bands as follows:

- Uplink: 904-915 MHz, Downlink: 945-960 MHz.

China Mobile's GSM also occupies the 900 MHz band, with the specific bands as follows:

- Uplink: 890-915 MHz, Downlink: 935-960 MHz.

3.3. EU (European Union)

Please note that in the EU, it is necessary to distinguish between audio-visual applications and IoT applications (scenarios with very low duty cycles) .

1) For audio-visual applications, the EU band allows for BSS_BW=2M and BSS_BW=1M (although 1M bandwidth has a lower bit rate, which may not be suitable for audio-visual applications) :
   a) BSS_BW=2M
      Only one channel is available: CHAN_LIST=[8660], with the center frequency of 866 MHz;
   b) BSS_BW=1M
      Three channels are available: CHAN_LIST=[8655, 8665, 8675], with center frequencies of 865.5/866.5/867.5 MHz;

2) For IoT applications, the EU band allows for BSS_BW=2M and BSS_BW=1M
   a) BSS_BW=2M
      Two channels are available: CHAN_LIST=[8640, 8660], with center frequencies of 864 MHz and 866 MHz;
   b) BSS_BW=1M
      Five channels are available: CHAN_LIST=[8635, 8645, 8655, 8665, 8675], with center frequencies of 863.5/864.5/865.5/866.5/867.5 MHz.

Notes:

1) For audiovisual applications, the 863-865 MHz band is restricted to narrowband use with a maximum bandwidth of 300 kHz, making it unsuitable for AH.

2) The EU has strict limitations on the main tone, requiring power restrictions to pass certification.

3.4. ID (Indonesia)

920 – 923 MHz	≤ 400 mW EIRP	Sesuai dengan Tabel 2.9	FCC *Part* 15 §15.249 *and* ANSI C63.10-2013; atau EN 300 220-1 atau EN 302 208	*Radio telemetry, Telecommand*

The power requirement is EIRP not exceeding 400mW, which is 26 dBm.

Available channels are:

a) BSS_BW=2M

Only one channel is available: CHAN_LIST=[9215], with the center frequency of 921.5 MHz;

b) BSS_BW=1M

Two channels are available: CHAN_LIST=[9210, 9220], with center frequencies of 921 M and 922 MHz.

3.5. HK (Hong Kong)

According to Hong Kong's spectrum regulations under the “Telecommunications (Telecommunications Apparatus) (Exemption from Licensing) Order”, the following frequencies can be used with an effective radiated power limit of 2W:

a) BSS_BW=1M

Two recommended channels with center frequencies of 866.1 MHz and 867.1 MHz, i.e., CHAN_LIST=[8661, 8671];

b) BSS_BW=2M

One channel with the center frequency of 866.6 MHz,i.e., CHAN_LIST=[8666].

3.6. JP (Japan)

According to Japan's new spectrum regulations as of September 2022:

a) BSS_BW=1M

Five recommended channels with center frequencies of 918/920/922/924/926 MHz,i.e., CHAN_LIST=[9180, 9200, 9220, 9240, 9260];

b) BSS_BW=2M

Three channels with center frequencies of 922/924/926 MHz,i.e., CHAN_LIST=[9220,

9240, 9260];

c) BSS_BW=4M, one channel with the center frequency of 924 MHz,i.e., CHAN_LIST=[9240].

Notes:

1) Japan's spectrum certification has stringent requirements for spurious emissions, necessitating to reduce the power of the main tone to be very low (near 0 dBm) to pass.

2) The 4M channel requires a duty cycle of less than 10%, making it suitable only for low duty cycle applications. The 920.5-923.5 MHz range has no duty cycle requirements, but only 2M or 1M channels can be used.

3.7. KR (South Korea)

a) BSS_BW=1M

Channels are continuous, with a total of 6 channels and center frequencies of 918/919/920/921/922/923 MHz, i.e., CHAN_LIST=[9180, 9190, 9200, 9210, 9220, 9230];

b) BSS_BW=2M

Channels are continuous, with a total of 3 channels and center frequencies of 918.5/920.5/922.5 MHz, i.e., CHAN_LIST=[9185, 9205, 9225];

c) BSS_BW=4M

Only one channel is available: CHAN_LIST=[9215], with the center frequency of 921.5 MHz.

3.8. MY (Malaysia)

No.	Authorised frequency bands/frequencies	Field strength/ RF output power	Transmitter and receiver spurious emissions	Test reference	Applications	Remarks
34.						
35.	916 MHz – 919 MHz	≤ 25 mW (EIRP)	EN 300 220-1/ FCC Part 15	EN 300 220-1/ FCC Part 15	SRC device	Duty cycle < 1% or Frequency Hopping or Listen Before Talk (LBT)
36.	919 MHz - 923 MHz	≤ 500 mW (EIRP)	EN 300 220-1/ FCC Part 15	EN 300 220-1/ FCC Part 15	SRC device	
		≤ 2 W (ERP)	EN 300 220-1/ EN 302 208-1/ FCC Part 15	EN 300 220-1/ EN 302 208-1/ FCC Part 15	RFID	RFID interrogator below 2 W (ERP) is subject to Class Assignment and up to 4 W (ERP) is subject to an Apparatus Assignment as per MCMC SRSP-530 RFID.
		≤ 4 W (ERP)	EN 300 220-1/ EN 302 208-1/ FCC Part 15	EN 300 220-1/ EN 302 208-1/ FCC Part 15		
37.	923 MHz - 924 MHz	≤ 500 mW EIRP	EN 300 220-1/ FCC Part 15	EN 300 220-1/ FCC Part 15	SRC device	≤ 500 mW (EIRP) with duty cycle < 1 % or Frequency Hopping or LBT

1) Effective Radiated Power (ERP) refers to radiation of a half wave tuned dipole. which is used for frequencies below 1 GHz.
2) Equivalent isotropic Radiated Power (EIRP) is a product of the power supplied to the antenna and the maximum antenna gain, relative to an isotropic antenna, and is used for frequencies above 1 GHz. There is a constant difference of 2.15 dB between EIRP and ERP [EIRP (dBm) = ERP (dBm)+2.15].

As shown above, the power limit for 916-919 MHz is 25 mW (approximately 14 dBm) , and for 919-924 MHz the power limit is 500 mW (approximately 27 dBm) , but with a Listen Before Talk (LBT) requirement. Since AH has a CCA mechanism, it meets the LBT requirement.

If only using 919-924 MHz (with higher power) :

a) BSS_BW=1M
   A total of 5 channels with center frequencies of 919.5/920.5/.../923.5 MHz,i.e., CHAN_LIST=[9195, 9205, 9215, 9225, 9235];
b) BSS_BW=2M
   A total of 2 channels with center frequencies of 920.5/922.5 MHz,i.e., CHAN_LIST=[9205, 9225];
c) BSS_BW=4M
   Only one channel is available with the center frequency of 921.5 MHz,i.e., CHAN_LIST=[9215].

3.9. NZ (New Zealand)

Please note that the use of AH spectrum in New Zealand is quite unique. Although AH can be used in the 915-928 MHz range, the power limit for 915-924 MHz is 5 dBm, and for 924-928 MHz it is 36 dBm.

1) When using 915~924 MHz:
   a) BSS_BW=2M
      Channels are continuous for 2M and can be set using FREQ_START/FREQ_END: FREQ_START=9160, FREQ_END=9220, with a total of 4 channels and center frequencies of 916/918/920/922 MHz;
   b) BSS_BW=4M
      Channels are continuous for 4M and can be set using FREQ_START/FREQ_END: FREQ_START=9170, FREQ_END=9210, with a total of 2 channels and center frequencies of 917/921 MHz;
   c) BSS_BW=8M
      Only one channel is available: CHAN_LIST=[9190], with the center frequency of 919 MHz;

2) When using 924-928 MHz:
   a) BSS_BW=1M
      A total of 4 channels with center frequencies of 924.5/925.5/926.5/927.5 MHz,i.e., CHAN_LIST=[9245, 9255, 9265, 9275];
   b) BSS_BW=2M
      A total of 2 channels with center frequencies of 925/927 MHz,i.e., CHAN_LIST=[9250, 9270];
   c) BSS_BW=4M
      Only one channel is available: CHAN_LIST=[9260], with the center frequency of 926 MHz.

3.10. SG (Singapore)

Singapore's power limit is 500 mW (27 dBm) . The available frequency bands are 866-869 MHz and 920-925 MHz.

1) If using an 860M module, the available channels are:
   a) BSS_BW=2M
      Only 1 channel with the center frequency of 867.5 MHz, CHAN_LIST=[8675];

2) If using a 915M module, the available channels are:

a) BSS_BW=1M

A total of 5 channels with center frequencies of 920.5/921.5/922.5/923.5/924.5 MHz, CHAN_LIST=[9205, 9215, 9225, 9235, 9245];

b) BSS_BW=2M

A total of 2 channels with center frequencies of 921.5/923.5 MHz, CHAN_LIST=[9215, 9235];

c) BSS_BW=4M

Only 1 channel with the center frequency of 922.5 MHz, CHAN_LIST=[9225];

3) If using a module that supports both 860M and 915M, the above channels can be combined, but it is recommended to use only one band, such as the 915M band, for antenna efficiency.

3.11. TH (Thailand)

RFID 920-925 MHz <50mW	Sdoc	NBTC TS 1010-2560
RFID 920-925 MHz >50mW	A	NBTC TS 1010-2560

As shown above, the power limit for 920-925 MHz is 50 mW (approximately 17 dBm) . The available channels are:

a) BSS_BW=1M

A total of 5 channels with center frequencies of 920.5/921.5/.../924.5 MHz,i.e., CHAN_LIST=[9205, 9215, 9225, 9235, 9245];

b) BSS_BW=2M

A total of 2 channels with center frequencies of 921.5/923.5 MHz,i.e., CHAN_LIST=[9215, 9235];

c) BSS_BW=4M

Only 1 channel with a center frequency of 922.5 MHz,i.e., CHAN_LIST=[9225].

3.12. TW (Taiwan)

According to Taiwan's spectrum regulations "Low Power Radio Frequency Devices Technical Regulations Amendment", the power limit for 920-925 MHz is: Indoor 1W (30 dBm) , Outdoor 500 mW (approximately 27 dBm) . The available channels are:

a) BSS_BW=1M

A total of 5 channels with center frequencies of 920.5/921.5/.../924.5 MHz,i.e.,

CHAN_LIST=[9205, 9215, 9225, 9235, 9245];

b) BSS_BW=2M

A total of 2 channels with center frequencies of 921.5M/923.5M,i.e., CHAN_LIST=[9215, 9235];

c) BSS_BW=4M

Only 1 channel with the center frequency of 922.5 MHz,i.e., CHAN_LIST=[9225].

3.13. US (United States)

a) BSS_BW=1M

Since there are many available channels (more than 16) , considering scanning speed, it is recommended to use 6 channels, set as follows: CHAN_LIST=[9055, 9095, 9135, 9175, 9215, 9255];

b) BSS_BW=2M

Channels are continuous for 2M, with a total of 13 channels and center frequencies of 903/905/907/909/911/913/915/917/919/921/923/925/927 MHz;

As 2M frequencies are more numerous, it is recommended to select some to avoid slow scanning, such as choosing 6 channels: 905/909/913/917/921/925MHz,i.e., CHAN_LIST=[9050, 9090, 9130, 9170, 9210, 9250];

c) BSS_BW=4M

Channels are continuous for 4M, with a total of 6 channels and center frequencies of 906/910/914/918/922/926 MHz;

Since the upper boundary of the 926 MHz channel reaches 928 MHz, it is likely to exceed power certification standards, so it can be considered to be unused. The actual channels used can be the first 5,i.e., CHAN_LIST=[9060, 9100, 9140, 9180, 9220];

d) BSS_BW=8M

Channels are continuous for 8M, with a total of 3 channels and center frequencies of 908/916/924 MHz;

Although the upper boundary of the 924 MHz channel reaches 928 MHz and may exceed power certification standards, it is recommended to retain the 924 MHz

channel since there are only 3 channels for 8M,i.e., CHAN_LIST=[9080, 9160, 9240].

3.14. VN (Vietnam)

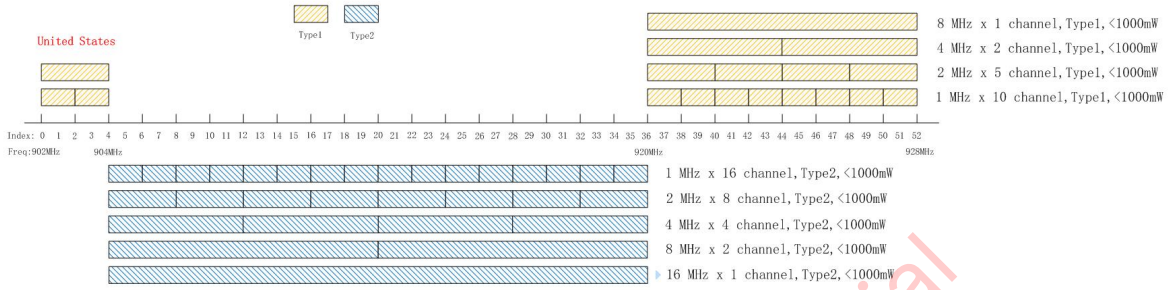
918.4 ÷ 923 MHz	≤ 500 mW ERP	According to spurious emission limit 8	- The maximum allowed bandwidth of the hopping channel at 20 dbdepletion is 500 kHz. - Equipment must use techniques to reduce harmful interference such as frequency-hopping spread spectrum (FHSS) modulation, listening before transmitting, duty cycle

As shown above, Vietnam requires a bandwidth of 500 kHz, making AH non-compliant with Vietnamese regulations.

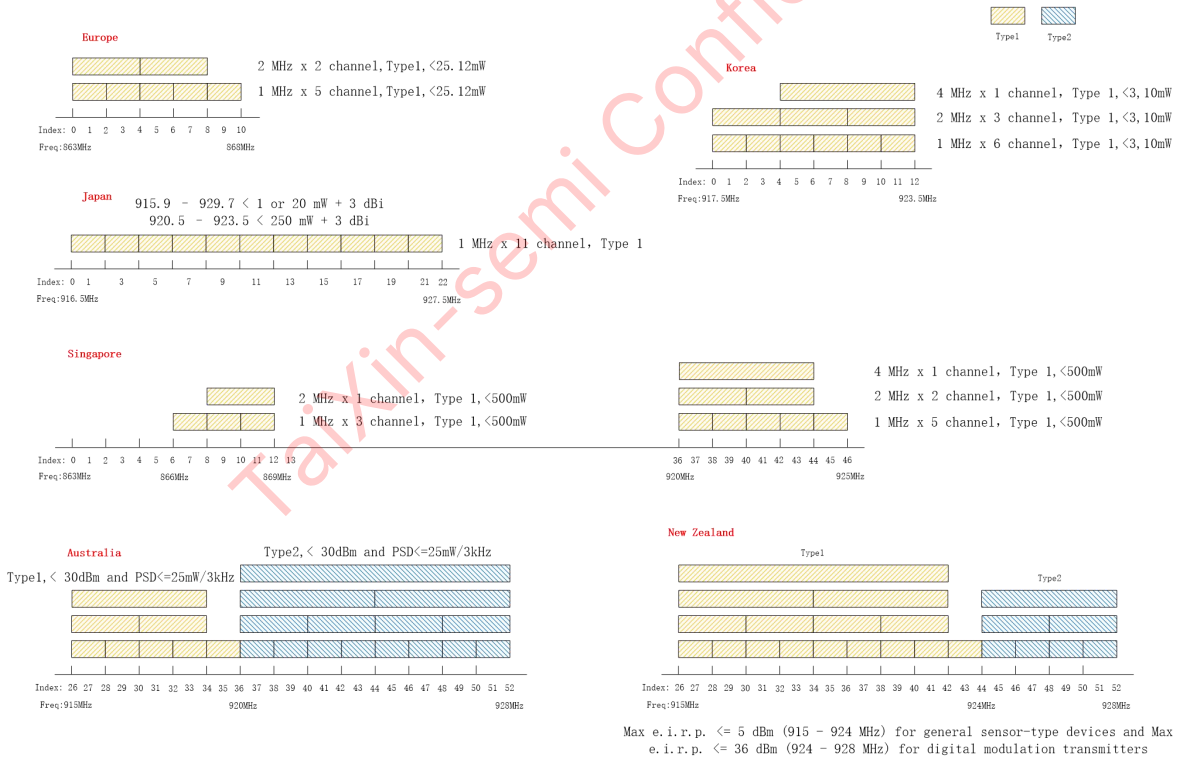
Appendix A

Global AH Spectrum Allocation

1) United States



2) Other Countries and Regions



Note: Type 1 and Type 2 refer to two channel types defined by the AH protocol, with different CCA thresholds. Type 1 has a lower CCA threshold and is mainly used for sensor nodes, while Type 2 is used for high data flow nodes. For practical purposes, the distinction between Type 1 and Type 2 can be ignored for now.