FR8018H Datasheet

Bluetooth Low Energy SOC with SIG Mesh integrated

Version: V1.2
Release Date: 2022.04

Contents

DESCRIPTION

FR8018H is a family of SOC (system on chip) for rapid development of Bluetooth Low Energy related products. It contains Bluetooth V5.0 (LE Mode) fully compliant system with Freqchip designed firmware and software stack. Users can develop various applications based on embedded 32-bits high performance MCU.

With Freqchip's innovational technology, FR8018H integrates Audio CODEC, PMU (Li-battery charger + LDO) , SPI flashROM with XIP mode, IIC, UART, GPIO, ADC, PWM all in a single chip, which provides customer with:

1. competitive power consumption
2. stable connection
3. low-cost BOM

The Bluetooth Smart firmware includes the L2CAP service layer protocols, Security Manager (SM), Attribute Protocol (ATT), the Generic Attribute Profile (GATT) and the Generic Access Profile (GAP). Furthermore, application profiles such as Proximity, Health Thermometer, Heart Rate, Blood Pressure, Glucose, Human Interface Device (HID) and SDK (include drivers, OS API, etc.) are supported. The SDK has integrated SIG Mesh for networking application.

FEATURES

- Compliant with Bluetooth Specification V5.0 LE, support 2M, 1M, 500K and 125K data rate
- Embedded 32-bitsProcessor
  - 12~48Mhz speed
- Internal mask150KBROM, up to 48KB SRAM
- FR8018H uses external SPI flash to store user programs, and supports up to 128Mb memory capacity theoretically.
- FR8018HA Internal 4Mb Flash ROM for user space software and data
- FR8018HD Internal 8Mb Flash ROM for user space software and data
- Integrated Battery Charger
- Integrated DC-DC Regulator
- Mono Audio CODEC
- Interface:
  - GPIO
  - UART
  - SPI
  - I2C
  - PWM
  - I2S
  - LED
- ROM Software:
  - BLE Profile & Protocol: GATT, LM, LC, etc.
  - Driver API
  - SIG Mesh

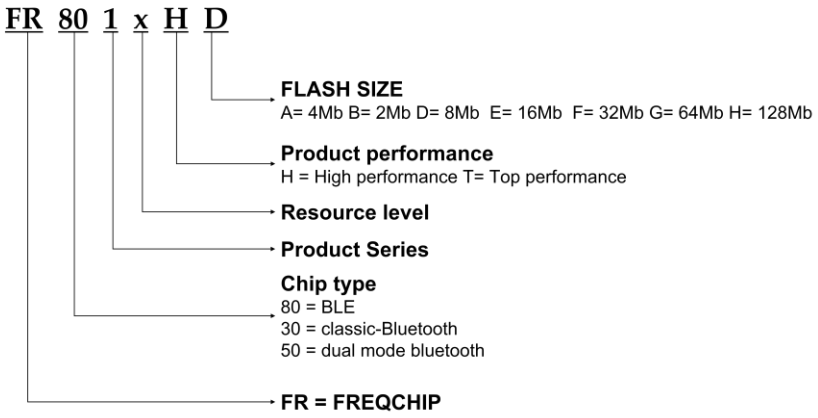
APPLICATIONS

- voice remote control
- smart toy
- led control
- SIG Mesh application
- smart locks

ORDERING INFORMATION

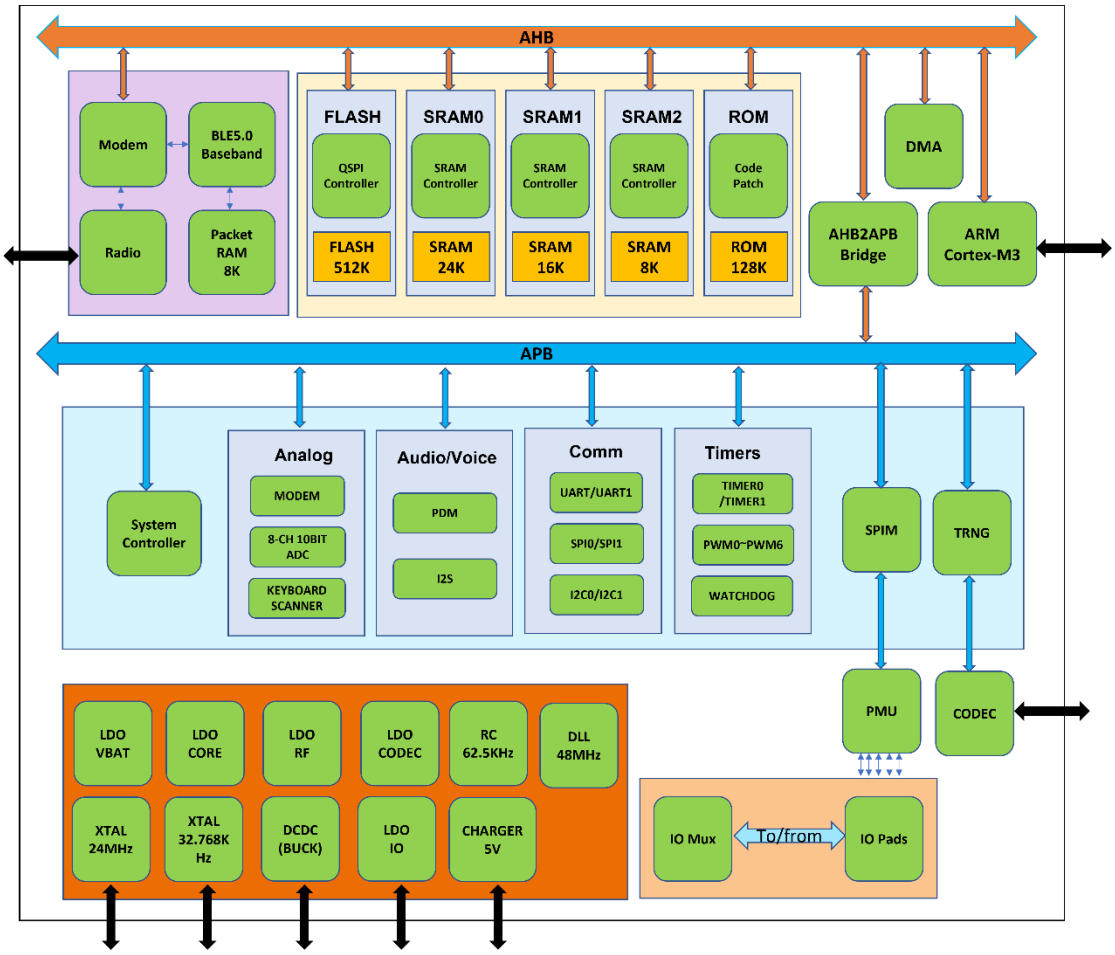
Part No.	Flash Size	Temperature rang	Package	Packing
FR8018H	External SPI flash	-40°C ~ +105°C	QFN48 6*6(P0.4 T0.75)	Tape and reel
FR8018HA	4Mbits	-40°C ~ +105°C	QFN48 6*6(P0.4 T0.75)	Tape and reel
FR8018HD	8Mbits	-40°C ~ +105°C	QFN48 6*6(P0.4 T0.75)	Tape and reel

命名规则：



1. Hardware Details

1.1 Block Diagram



1.2 Bluetooth Radio

- On-chip balun (50Ω impedance in TX and RX modes)
- No external trimming is required in production
- Qualified to Bluetooth v5.0 LE specification
- Up to 10dBm RF transmit power
- -94dBm (1M) receiver sensitivity in LDO mode
- Integrated channel filters
- Digital demodulator for improved sensitivity and co-channel rejection
- Real time digitized RSSI
- Fast AGC for enhanced dynamic range

1.3 Bluetooth Controller

- All device classes support (Broadcaster, Central, Observer, Peripheral)
- All packet types (Advertising / Data / Control)
- Encryption (AES / CCM)
- Bit stream processing (CRC, Whitening)
- Frequency hopping calculation
- Low power modes supporting internal 32.0 kHz RC oscillator or external 32.768 kHz crystal（FR8018HA only）
- Supports power down of the baseband during the protocol's idle periods

1.4 Audio Interface

- Embedded 16-bit Mono Audio CODEC
- DAC SNR 96dB, THD -86dB
- ADC SNR 84dB, THD -83dB
- DAC/ADC Support 8k/16k/44.1k/48kHz sample rate

1.5 Peripheral Interface

- UART port for Debugging and AT Commands
- IIC interface to support external EEPROM or other devices (like G-SENSOR)
- One more SPI interface to support other device (like OLED controller)
- General purpose 10-bits ADC used for ADKey and other analog input
- PWM controller
- Hardware LED controller
- General purpose programmable timer for various task
- Watchdog used for tracking unexpected exception

1.6 Integrated Power Control and Regulation

- Embedded Power-On-Reset
- Low power 0.9v core voltage
- On-chip high efficiency switch-mode power supply, 1.8v to 4.3v input direct from battery and programmable output voltage
- On-chip Low Dropout (LDO) Linear Regulator for internal Digital, RF and Analog circuit
- Power management features include software shutdown and hardware wake-up
- Power-on-reset cell detects low supply voltage
- Internal voltage level detector

1.7 Battery Charger

- Lithium ion/Lithium polymer battery charger
- Embedded LVD(low voltage detect)
- Programmable charging current. Fast charging support up to 200mA with no external components

2. Package and Pin Information

2.1 Package

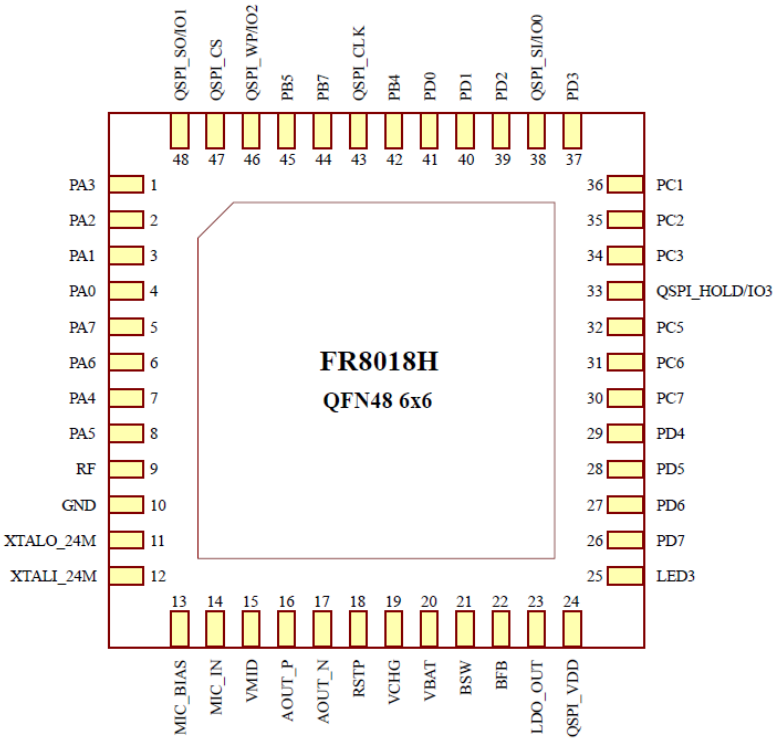


Figure 2-1 FR8018H pins information

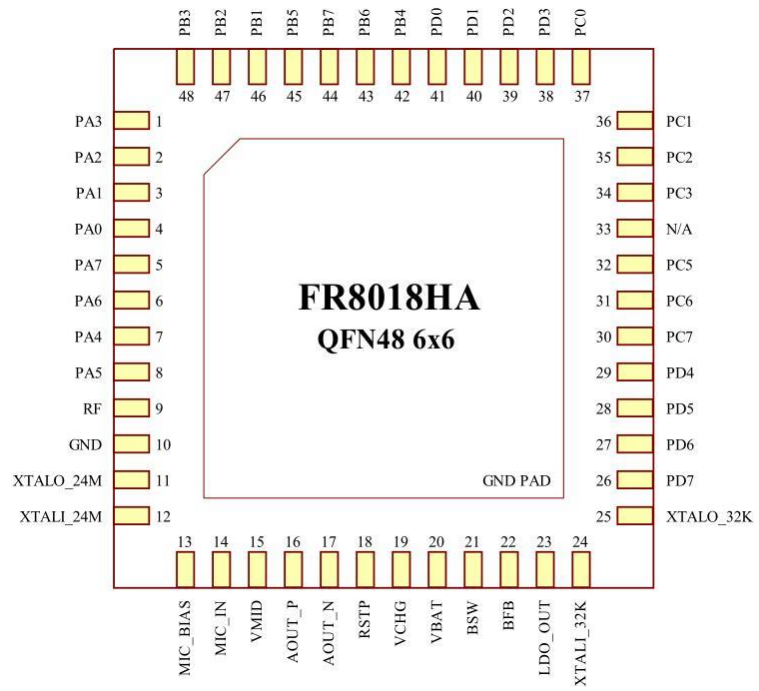
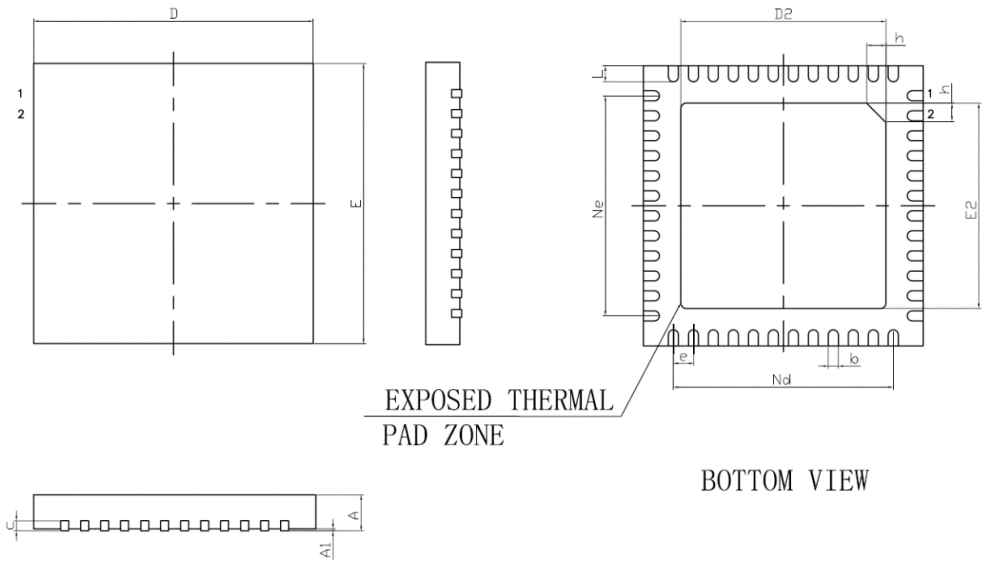


Figure 2-2 FR8018HA/FR8018HD pins information

2.2 Package Physical Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.23
D	5.90	6.00	6.10
D2	4.10	4.20	4.30
e	0.40BSC		
Ne	4.40BSC		
Nd	4.40BSC		
E	5.90	6.00	6.10
E2	4.10	4.20	4.30
L	0.35	0.40	0.45
h	0.30	0.35	0.40
L/F载体尺寸 (MIL)	177*177		

Figure 2-3 package outline information

2.3 Pins Description

FR8018H is a CMOS device. Floating level on input signals will cause unstable device operation and abnormal current consumption. Pull-up or Pull-down resistors should be used appropriately for input or bidirectional pins.

Notation	Description
DI	Digital Input
DO	Digital Output
DIO	Bidirectional (digital)
AI	Analog input
AO	Analog output
AIO	Bidirectional (analog)
PWR	Power
GND	Ground

Pin number			Pin name	Type	Description
FR8018H	FR8018HA	FR8018HD			

1	1	PORTA3	DIO	SDA1/I2SDIN/PWM3_P/SSPDIN/UTXD0/UTXD1/ANTCTL1/PDMDAT/PWM2_N
2	2	PORTA2	DIO	SCL1/I2SDOUT/PWM2_P/SSPDOUT/URXD0/URXD1/ANTCTL0/PDMCLK/PWM3_N
3	3	PORTA1	DIO	SDA0/I2SFRM/PWM1_P/SSPCSN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM0_N
4	4	PORTA0	DIO	SCL0/I2SCLK/PWM0_P/SSPCLK/URXD0/URXD1/CLKOUT/PDMCLK/PWM1_N
5	5	PORTA7	DIO	SDA1/I2SDIN/PWM1_P/SSPDIN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM0_N
6	6	PORTA6	DIO	SCL1/I2SDOUT/PWM0_P/SSPDOUT/URXD0/URXD1/CLKOUT/PDMCLK/PWM1_N
7	7	PORTA4	DIO	SCL0/I2SCLK/PWM4_P/SSPCLK/URXD0/URXD1/CLKOUT/PDMCLK/PWM5_N
8	8	PORTA5	DIO	SDA0/I2SFRM/PWM5_P/SSPCSN/UTXD0/UTXD1/ANTCTL1/PDMDAT/PWM4_N
9	9	RF	AIO	RF input and output
10	10	GND	GND	Ground
11	11	XTALO_24M	AO	24MHz Crystal oscillator output
12	12	XTALI_24M	AI	24MHz Crystal oscillator input
13	13	MIC_BIAS	AO	Microphone bias output
14	14	MIC_IN	AI	Microphone input
15	15	VMID	AI	common mode voltage
16	16	AOUT_P	AO	Speaker output positive
17	17	AOUT_N	AO	Speaker output negative
18	18	RSTP	AI	Global reset (high active)
19	19	VCHG	PWR	Charger supply input
20	20	VBAT	PWR	Battery positive supply input
21	21	BSW	AO	DC/DC output terminal
22	22	BFB	AI	DC/DC feedback input terminal
23	23	LDO_OUT	AO	Analog linear regulator output
24	-	QSPI_VDD	AO	Connect to External SPI flash VCC pin
-	24	XTALI_32K	AI	32KHz Crystal oscillator input
25	-	LED3	DO	LED3 control output
-	25	XTALO_32K	AO	32KHz Crystal oscillator output

26	26	PORTD7	DIO	SDA1/I2SDIN/PWM1_P/SSPDIN/UTXD0/UTXD1/ANTCTL1/PDMDAT/PWM0_N/ADC3
27	27	PORTD6	DIO	SCL1/I2SDOUT/PWM0_P/SSPDOUT/URXD0/URXD1/CLKOUT/PDMCLK/PWM1_N/ADC2
28	28	PORTD5	DIO	SDA0/I2SFRM/PWM5_P/SSPCSN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM4_N/ADC1
29	29	PORTD4	DIO	SCL0/I2SCLK/PWM4_P/SSPCLK/URXD0/URXD1/ANTCTL0/PDMCLK/PWM5_N/ADC0
30	30	PORTC7	DIO	SDA1/I2SDIN/PWM5_P/SSPDIN/UTXD0/UTXD1/SWDIO/PDMDAT/PWM4_N
31	31	PORTC6	DIO	SCL1/I2SDOUT/PWM4_P/SSPDOUT/URXD0/URXD1/SWTCK/PDMCLK/PWM5_N
32	32	PORTC5	DIO	SDA0/I2SFRM/PWM5_P/SSPCSN/UTXD0/UTXD1/SWV/PDMDAT/PWM4_N
33	-	QSPI_HOLD/IO3	DIO	Connect to External SPI flash HOLD/IO3 pin
-	33	N/A	N/A	N/A
34	34	PORTC3	DIO	SDA1/I2SDIN/PWM3_P/SSPDIN/UTXD0/UTXD1/SWV/PDMDAT/PWM2_N
35	35	PORTC2	DIO	SCL1/I2SDOUT/PWM2_P/SSPDOUT/URXD0/URXD1/SWV/PDMCLK/PWM3_N
36	36	PORTC1	DIO	SDA0/I2SFRM/PWM1_P/SSPCSN/UTXD0/UTXD1/SWV/PDMDAT/PWM0_N
37	38	PORTD3	DIO	SDA1/I2SDIN/PWM3_P/SSPDIN/UTXD0/UTXD1/WLANRX/PDMDAT/PWM2_N
-	37	PORTC0	DIO	SCL0/I2SCLK/PWM0_P/SSPCLK/URXD0/URXD1/SWV/PDMCLK/PWM1_N
38	-	QSPI_SI/IO0	DIO	Connect to External SPI flash SI/IO0 pin
39	39	PORTD2	DIO	SCL1/I2SDOUT/PWM2_P/SSPDOUT/URXD0/URXD1/WLANTX/PDMCLK/PWM3_N
40	40	PORTD1	DIO	SDA0/I2SFRM/PWM1_P/SSPCSN/UTXD0/UTXD1/BLERX/PDMDAT/PWM0_N
41	41	PORTD0	DIO	SCL0/I2SCLK/PWM0_P/SSPCLK/URXD0/URXD1/BLETX/PDMCLK/PWM1_N
42	42	PORTB4	DIO	SCL0/I2SCLK/PWM4_P/SSPCLK/URXD0/URXD1/CLKOUT/PDMCLK/PWM5_N
43	-	QSPI_CLK	DI	Connect to External SPI flash CLK pin

-	43	PORTB6	DIO	SCL1/I2SDOUT/PWM2_P/SSPDOUT/URXD0/URXD1/ANTCTL1/PDMCLK/PWM3_N
44	44	PORTB7	DIO	SDA1/I2SDIN/PWM3_P/SSPDIN/UTXD0/UTXD1/CLKOUT/PDMDAT/PWM2_N
45	45	PORTB5	DIO	SDA0/I2SFRM/PWM5_P/SSPCSN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM4_N
46	-	QSPI_WP/IO2	DIO	Connect to External SPI flash WP/IO2 pin
-	46	PORTB1	DIO	SDA0/I2SFRM/PWM1_P/SSPCSN/UTXD0/UTXD1/BLERX/PDMDAT/PWM0_N
47	-	QSPI_CS	DI	Connect to External SPI flash CS pin
-	47	PORTB2	DIO	SCL1/I2SDOUT/PWM2_P/SSPDOUT/URXD0/URXD1/WLANTX/PDMCLK/PWM3_N
48	-	QSPI_SO/IO1	DIO	Connect to External SPI flash SO/IO1 pin
-	48	PORTB3	DIO	SDA1/I2SDIN/PWM3_P/SSPDIN/UTXD0/UTXD1/WLANRX/PDMDAT/PWM2_N

2.4 Application Circuit

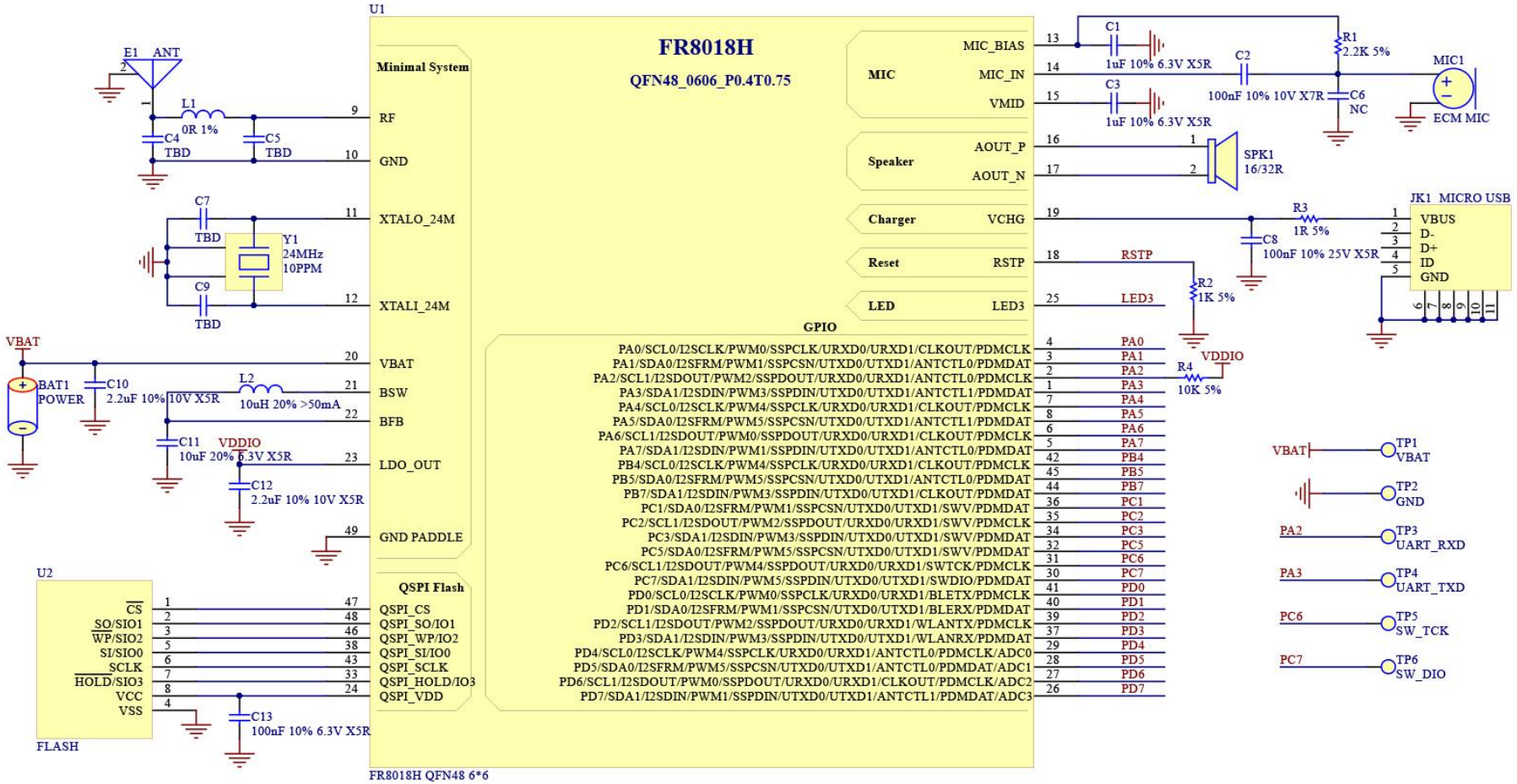


Figure 2-4 FR8018H application circuit

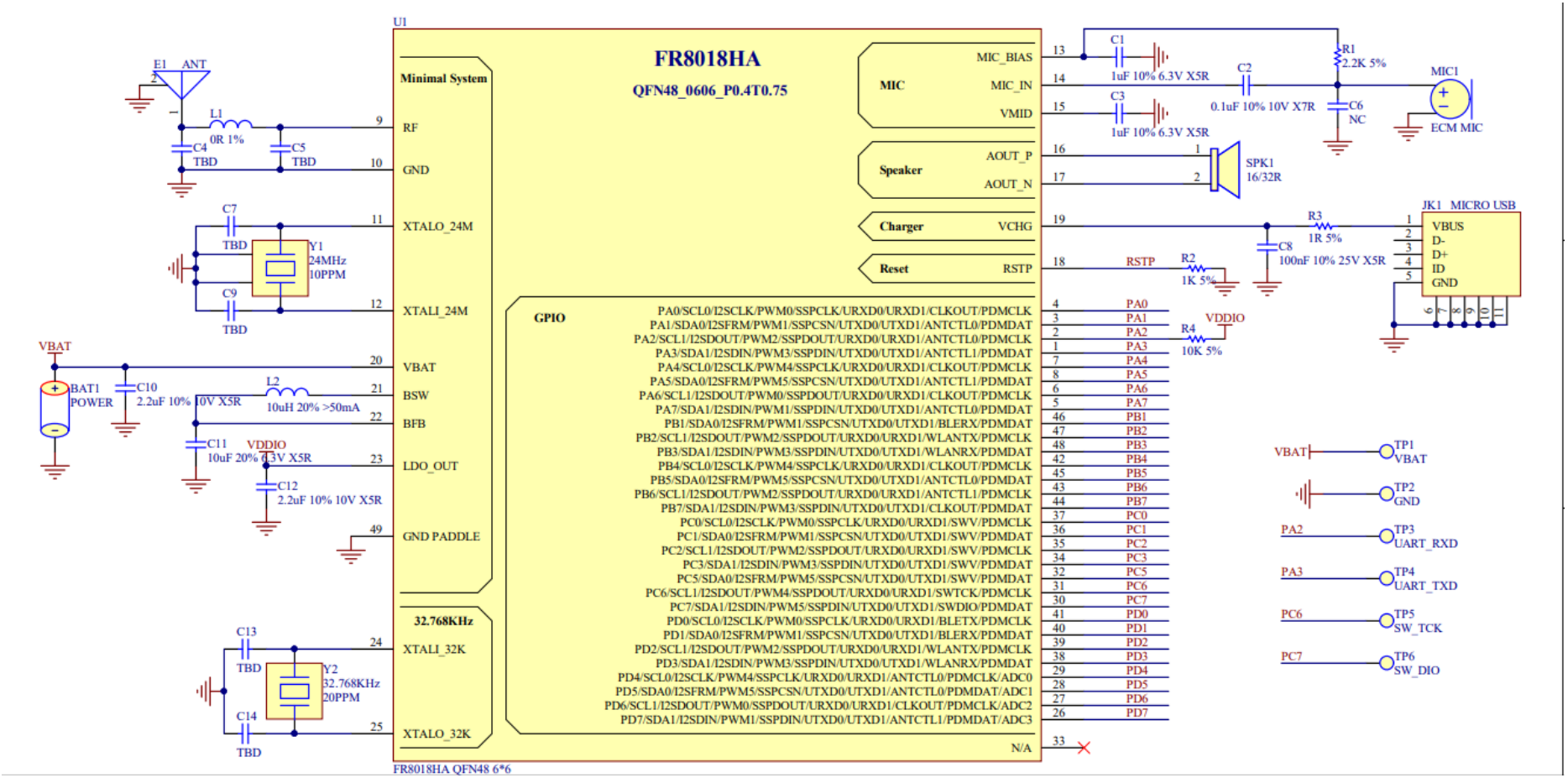


Figure 2-5 FR8018HA/FR8018HD application circuit

3. Electrical Characteristic

3.1 Absolute Maximum Ratings

Continuous operation at or beyond these conditions may permanently damage the device.

Rating		Min	Max	Unit
Storage Temperature		-40	125	℃
Core Supply Voltage		0.9	1.3	V
I/O Voltage	LDO_OUT	1.6	3.3	V
Supply Voltage	VBAT	1.8	4.3	V
	VCHG	4.75	5.25	V

3.2 Recommended Operating Conditions

Operating Condition		**Min**	**Typ**	**Max**	**Unit**
Operating Temperature Range		-40	20	105	℃
Core Supply Voltage		0.9	1.2	1.3	V
I/O Voltage	LDO_OUT	1.6	2.9	3.3	V
Supply Voltage	VBAT	1.8	3.3	4.3	V
Charge input voltage	VCHG	4.75	5	5.25	V

3.3 Power Consumption

Operation Mode	Average	Maximum	Unit
TX peek current (0dB)		8	mA
RX peek current		9.7	mA
Deep sleep current (include 48K retention RAM)	6.1		μA
Power off	2.7		μA

3.4 Audio CODEC

Digital to Analogue Converter(Mono)					
PARAMETER	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNIT**
Resolution	-	-	-	20	Bits
Sampling frequency (Fs)*	The synchronized clock signal	8		48	kHz
SNR (Signal to Noise Ratio)	Fin=1kHz B/W=20Hz—20KHz A-Weighted THD_N<0.01% Fs(8K,16K,32K,44.1K,48K)		92		dB
Digital Gain	Digital Gain Resolution=1/48dB	-48		32	dB
Analogue Gain	Analog Gain Resolution = 3dB	0		-30	dB
Output voltage fulls-cale	VDDA=2.9V		1500		mV
Stopband attenuation		65			dB
Analog to Digital Converter(Mono)					
PARAMETER	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNIT**
Resolution	-	-	-	16	Bits
Sampling frequency (Fs)*	The synchronized clock signal	8		48	kHz
Signal to Noise Ratio	A-weighted		79		dBFS
	W/O weighting		79		dBFS
Digital Gain	Digital Gain Resolution=1/48dB	-48		32	dB
Analogue Gain	Analog Gain Resolution = 3dB	0		30	dB

3.5 Crystal Oscillator

CLOCK SOURCE	**Min**	**Typ**	**Max**	**Unit**
Main Crystal OSC(12M/24Mhz) for Bluetooth RF application				
Clock Frequency	24	24	24	MHz
Digital rim range		9		pf
Trim step size		0.1		pf
Tolerance		+-10		ppm
Note: XTAL Load capacitance = 9pf				

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Feedback:

Freqchip welcomes feedback on this product and this document. If you have comments or suggestions, please send an email to doc@freqchip.com.

Revision History

Reversion Number	Reversion Date	Description
V1.2	2022.4.11	**draft**