FR8016H Datasheet

Bluetooth Low Energy SOC with SIG Mesh integrated

2019.9.1 v0.7

www.freqchip.com

FREQCHIP 富芮坤

Table of Contents

DESCRIPTION 3
FEATURES 3
APPLICATIONS 3
ORDERING INFORMATION 3
1. Hardware Details 4
1.1 Block Diagram 4
1.2 Bluetooth Radio 4
1.3 Bluetooth Controller 5
1.4 Audio Interface 5
1.5 Peripheral Interfaces 5
1.6 Integrated Power Control and Regulation 5
1.7 Battery Charger 5
2. Package and Pin Information 6
2.1 Package 6
2.2 Package Physical Dimensions 6
2.3 Pins Description 7
2.4 Application circuit 9
3. Electrical Characteristics 10
3.1 Absolute Maximum Ratings 10
3.2 Recommended Operating Conditions 10
3.3 Power Consumption 10
3.4 Audio CODEC 11
3.5 Crystal oscillator 11
Contact Information 12

DESCRIPTION

FR8016H is a 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, FR8016H 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
- Internal 4M Flash ROMfor 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
- etc.

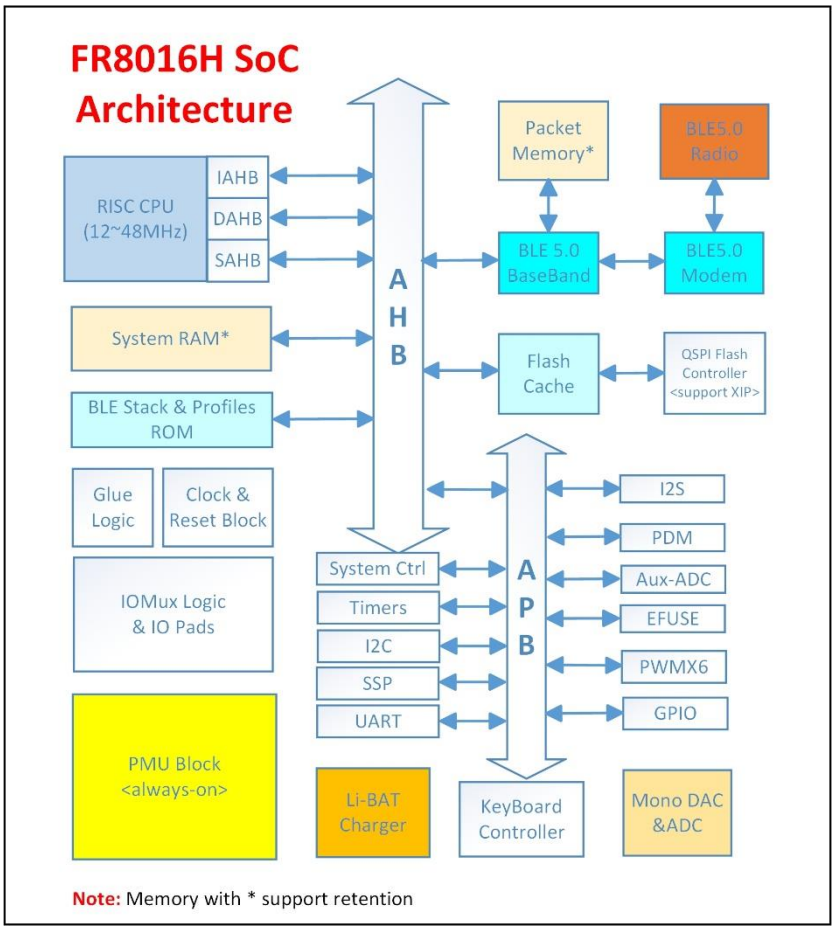
ORDERING INFORMATION

FR8016H -40°C ~ +125°C
QFN32, 4.0*4.0*0.75, 0.4pitch

MODEL	FLASH
FR8016HA	4Mbits
FR8016HB	2Mbits

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（FR8018H 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 Interfaces

- 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)
- Up to 17 general purpose IOs (17 IOs can be set in interrupt mode)
- 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

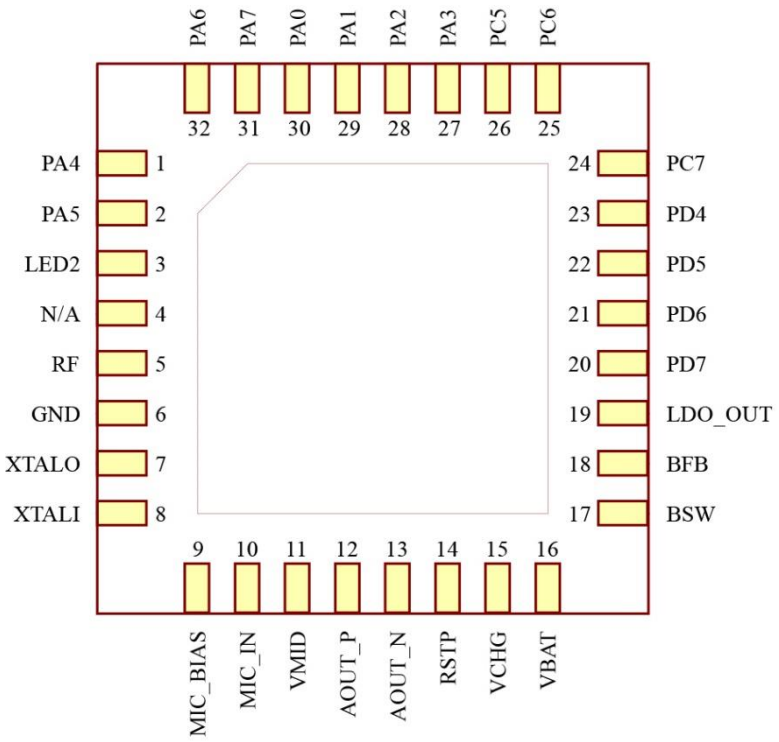
- Embedded Power-On-Reset
- Low power 0.9v core voltage
- On-chip high efficiency switch-mode power supply, 1.8v to 4.3v input direct from battery and programmable output voltage
- On-chip Low Dropout (LDO) Linear Regulator for internal Digital, RF and Analog circuit
- Power management features include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

1.7 Battery Charger

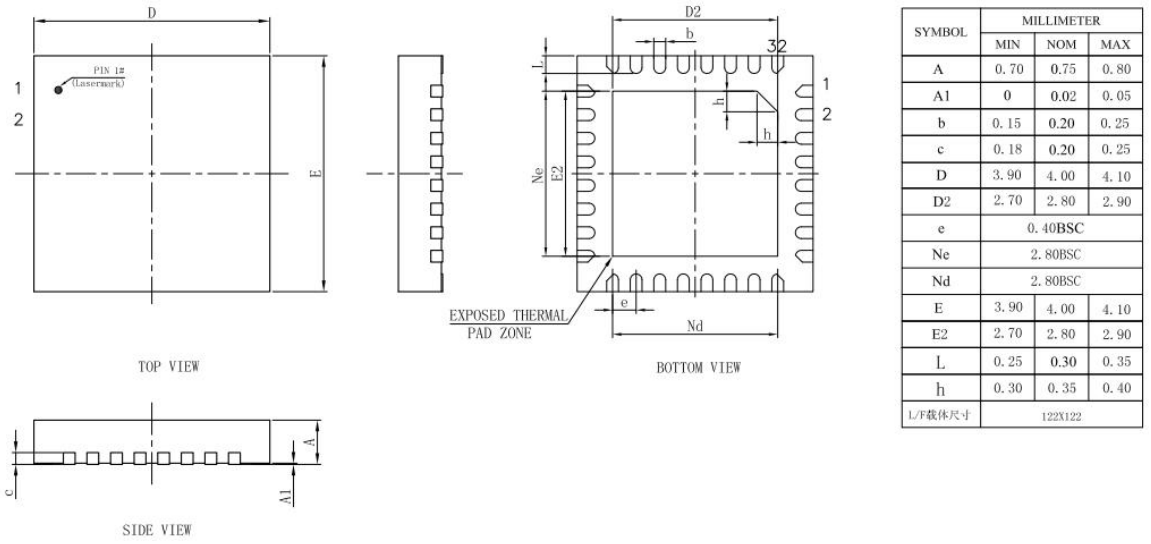
- Lithium ion/Lithium polymer battery charger
- Embedded LVD(low voltage detect)
- Programmable charging current. Fast charging support up to 200mA with no external components

2. Package and Pin Information

2.1 Package



2.2 Package Physical Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	2.70	2.80	2.90
e	0.40BSC		
Ne	2.80BSC		
Nd	2.80BSC		
E	3.90	4.00	4.10
E2	2.70	2.80	2.90
L	0.25	0.30	0.35
h	0.30	0.35	0.40
L/F载体尺寸	122X122		

2.3 Pins Description

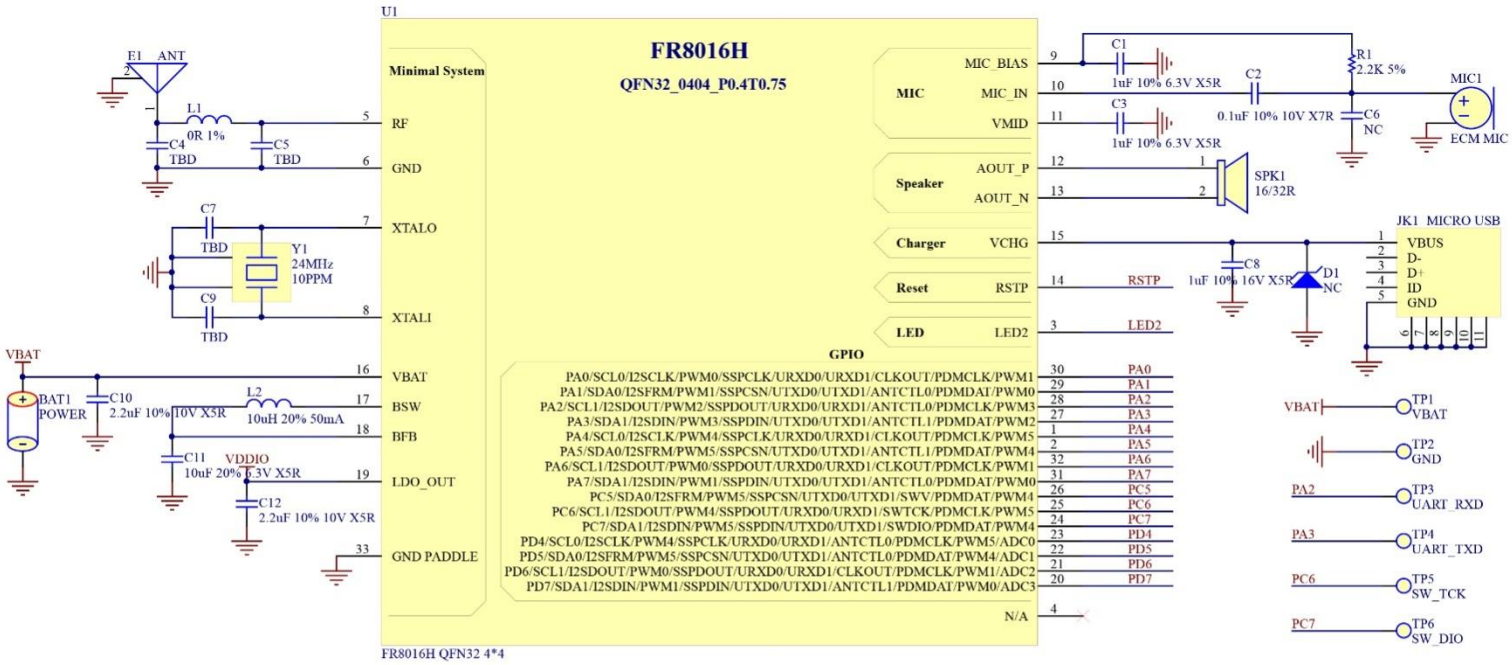
FR8016H is a CMOS device. Floating level on input signals will cause unstable device operation and abnormal current consumption. Pull-up or Pull-down resistors should be used appropriately for input or bidirectional pins.

Notation	Description
I	Digital Input
O	Digital Output
AI	Analog input
AO	Analog output
IO	Bidirectional(digital)
OD	Open Drain
PWR	Power
GND	Ground

Pin name	Pin#	Type	Description
PORTA4	1	I/O	PA4/SCL0/I2SCLK/PWM4/SSPCLK/URXD0/URXD1/CLKOUT/PDMCLK/PWM5
PORTA5	2	I/O	PA5/SDA0/I2SFRM/PWM5/SSPCSN/UTXD0/UTXD1/ANTCTL1/PDMDAT/PWM4
LED2	3	O	LED2 control output
N/A	4		
RF	5	AI/O	RF input and output
GND	6	GND	Ground
XTALO	7	AO	crystal oscillator output
XTALI	8	AI	crystal oscillator input
MIC_BIAS	9	AO	MIC BIAS output
MIC_P	10	AI	Voice positive input
VMID	11	AI	common mode voltage
ROUTP	12	AO	The audio right channel positive output
ROUTN	13	AO	The audio right channel negative output
RSET	14	AI	Reset
VCHG	15	PWR	Power supply for charger
VBAT	16	PWR	Positive power supply for DC/DC
BSW	17	AO	DC/DC output terminal
BFB	18	AI	DC/DC feedback input terminal

LDO_OUT	19	AO	Analog linear regulator output
PORTD7	20	I/O	PD7/SDA1/I2SDIN/PWM1/SSPDIN/UTXD0/UTXD1/ANTCTL1/PDMDAT/PWM0/ADC3
PORTD6	21	I/O	PD6/SCL1/I2SDOUT/PWM0/SSPDOUT/URXD0/URXD1/CLKOUT/PDMCLK/PWM1/ADC2
PORTD5	22	I/O	PD5/SDA0/I2SFRM/PWM5/SSPCSN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM4/ADC1
PORTD4	23	I/O	PD4/SCL0/I2SCLK/PWM4/SSPCLK/URXD0/URXD1/ANTCTL0/PDMCLK/PWM5/ADC0
PORTC7	24	I/O	PC7/SDA1/I2SDIN/PWM5/SSPDIN/UTXD0/UTXD1/SWDIO/PDMDAT/PWM4
PORTC6	25	I/O	PC6/SCL1/I2SDOUT/PWM4/SSPDOUT/URXD0/URXD1/SWTCK/PDMCLK/PWM5
PORTC5	26	I/O	PC5/SDA0/I2SFRM/PWM5/SSPCSN/UTXD0/UTXD1/SWV/PDMDAT/PWM4
PORTA3	27	I/O	PA3/SDA1/I2SDIN/PWM3/SSPDIN/UTXD0/UTXD1/ANTCTL1/PDMDAT/PWM2
PORTA2	28	I/O	PA2/SCL1/I2SDOUT/PWM2/SSPDOUT/URXD0/URXD1/ANTCTL0/PDMCLK/PWM3
PORTA1	29	I/O	PA1/SDA0/I2SFRM/PWM1/SSPCSN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM0
PORTA0	30	I/O	PA0/SCL0/I2SCLK/PWM0/SSPCLK/URXD0/URXD1/CLKOUT/PDMCLK/PWM1
PORTA7	31	I/O	PA7/SDA1/I2SDIN/PWM1/SSPDIN/UTXD0/UTXD1/ANTCTL0/PDMDAT/PWM0
PORTA6	32	I/O	PA6/SCL1/I2SDOUT/PWM0/SSPDOUT/URXD0/URXD1/CLKOUT/PDMCLK/PWM1

2.4 Application circuit



3. Electrical Characteristics

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	ALDO_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	125	℃
Core Supply Voltage		0.9	1.2	1.3	V
I/O Voltage	ALDO_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		7.5		pf
Trim step size		0.1		pf
Tolerance		+-10		ppm
Note: XTAL Load capacitance = 7.5pf				

Contact Information

Website: www.freqchip.com

Sales Email: sales@freqchip.com

Phone: +86-21-5027-0080

Feedback:

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