

FR8016A Datasheet

Bluetooth Low Energy SOC with SIG Mesh integrated

2019.04.16 v1.9

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DESCRIPTION

FR8016A is a SOC (system on chip) for rapid development of Bluetooth Low Energy related products. It contains Bluetooth V4.2 (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, FR8016A integrates RF, CODEC, PMU, Baseband, SPI, IIC, UART, GPIO, ADC, PWM and Keyboard scan train 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 V4.2 LE
- Embedded 32-bits Processor
 - 12~48Mhz speed
- Internal mask ROM, up to 78KB SRAM used for user code and data
- Internal 4M SPI Flash contains 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
- etc.

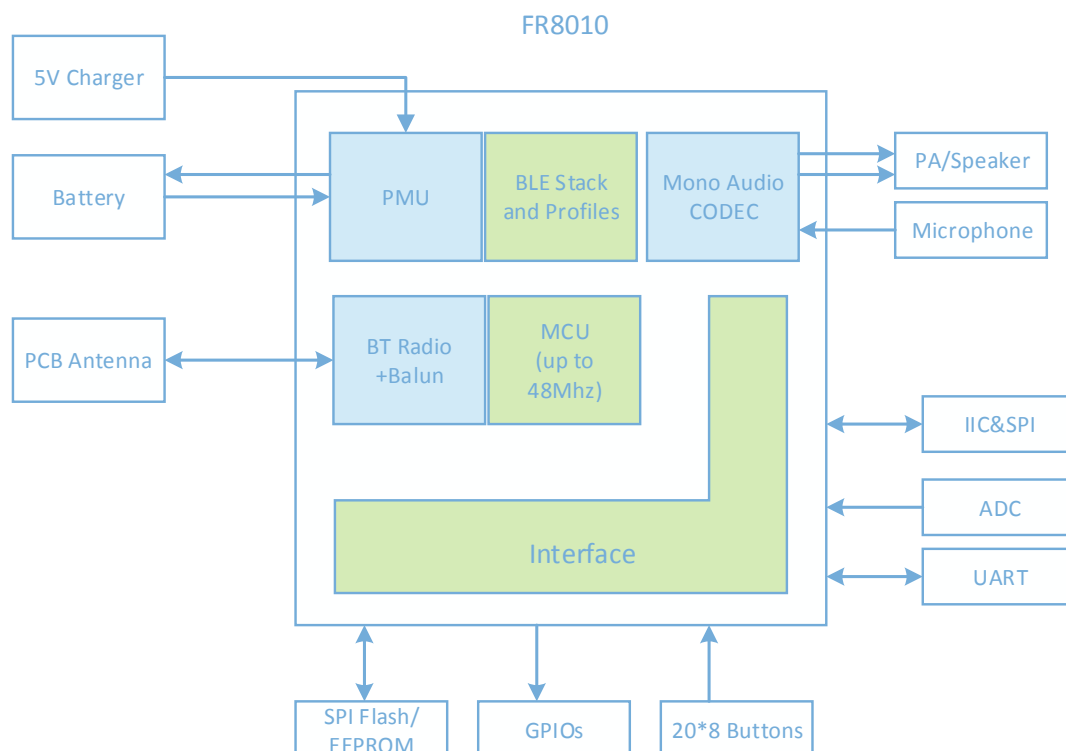
ORDERING INFORMATION

FR8016A -40°C ~ +105°C

QFN32, 4.0*4.0*0.75, 0.4pitch

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 v4.2 LE specification
- Up to 6dBm RF transmit power
- -90dBm receiver sensitivity
- 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 or external 32.768 kHz
- 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 14 general purpose IOs (14 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
- Support ONKEY (switch or long press) power on and power off logic
- Low power 0.9v core voltage
- On-chip high efficiency switch-mode power supply, 2.4v 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

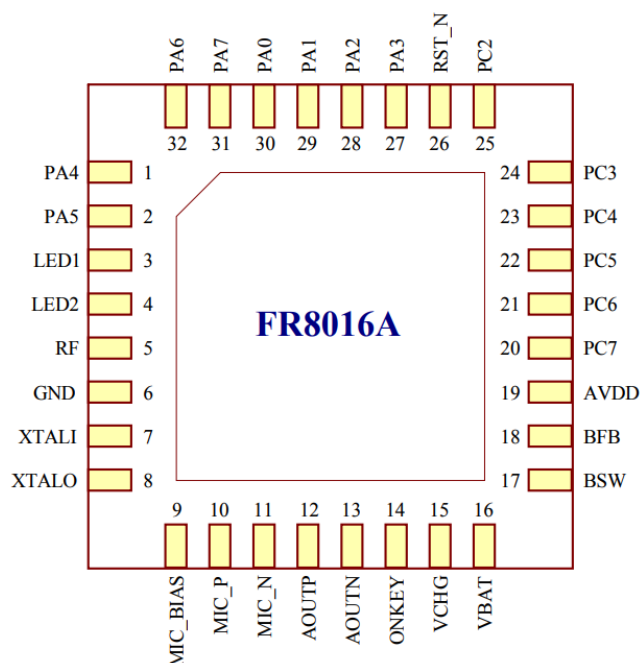
- Power-on-reset cell detects low supply voltage
- Internal voltage level detector

1.7 Battery Charger

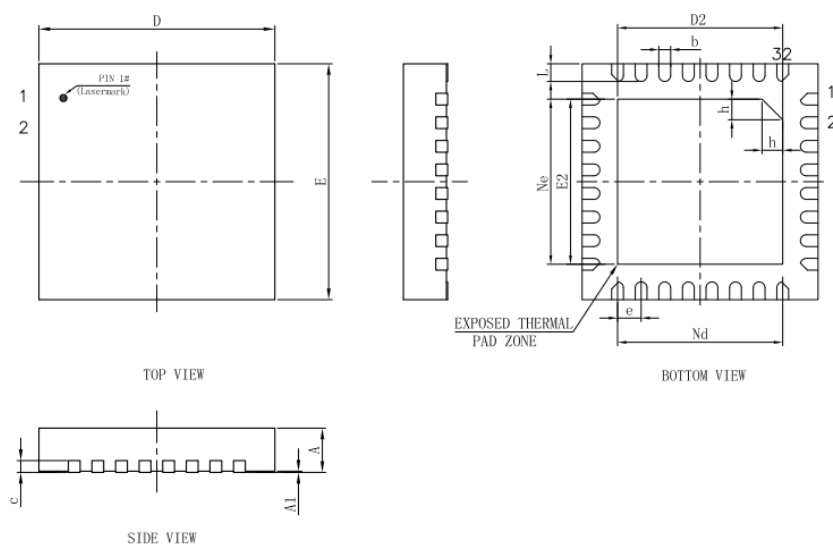
- Lithium ion/Lithium polymer battery charger
- Embedded LVD(low voltage detect)
- Programmable charging current. Fast charging support up to 200mA with no external components

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

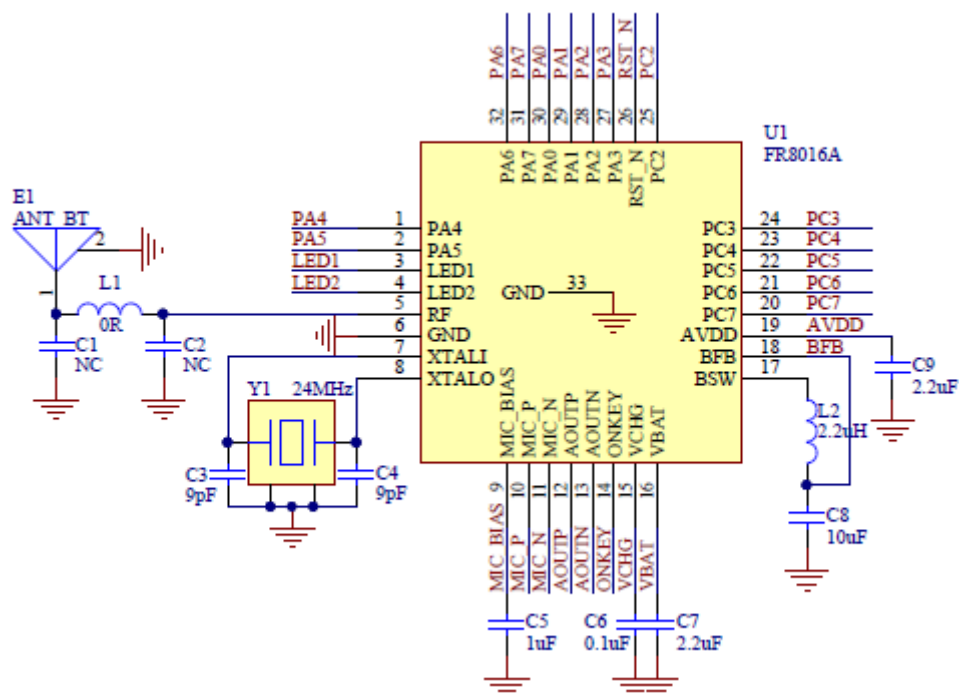
FR8016A is a CMOS device. Floating level on input signals will cause unstable device operation and abnormal current consumption. Pull-up or Pull-down resistors should be used appropriately for input or bidirectional pins.

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	I2S_CLK/I2C0_CLK/PWM4/SSP1_CLK/SSP0_CLK/UART0_RX D/UART1_RXD/UART0_CTS/CLK_OUT/SSP0_RXD
PORTA5	2	I/O	I2S_FRM/I2C0_DAT//PWM5/SSP1_CSN/SSP0_CSN/UART0_TX D/UART1_TXD/UART0_RTS/
LED1	3	O	LED1 control output
LED2	4	O	LED2 control output
RF	5	AI/O	RF input and output
GND	6	GND	Ground
XTALI	7	AI	crystal oscillator input
XTALO	8	AO	crystal oscillator output
MIC_BIAS	9	AO	MIC BIAS output
MIC_P	10	AI	Voice positive input
MIC_N	11	AI	Voice negative input
ROUTP	12	AO	The audio right channel positive output
ROUTN	13	AO	The audio right channel negative output
ONKEY	14	AI	Chip soft power on/off terminal
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

AVDD	19	AO	Analog linear regulator output
PORTC7	20	I/O	I2S_DIN/I2C1_DAT/PWM7/SPI1_DIN/ SPI0_DIN/ UART1_TX/UART0_TX/ADC7*/SW_DIO
PORTC6	21	I/O	I2S_DOUT/I2C1_CLK/ PWM6/ SPI1_DOUT/ SPI0_DOUT/UART1_RX/UART0_RX/ADC6*/SW_TCK
PORTC5	22	I/O	I2S_FRM/I2C0_DAT/ PWM5/ SPI1_CSN/ SPI0_CSN/ UART0_TX/UART1_TX/ADC5*/SWV
PORTC4	23	I/O	I2S_CLK/I2C0_CLK/ PWM4/ SPI1_CLK/ SPI0_CLK/ UART0_RX/UART1_RX/ADC4*
PORTC3	24	I/O	I2C1_DAT/I2S_DIN/PWM3/SSP0_DIN/SSP1_DIN/UART1_TXD /UART0_TXD/ADC3*
PORTC2	25	I/O	I2C1_CLK/I2S_DOUT/PWM2/SSP0_DOUT/SSP1_DOUT/UART 1_RXD/UART0_RXD/ADC2*
RST_N	26	AI	Reset
PORTA3	27	I/O	I2S_DIN/I2C1_DAT/ PWM3/ SPI0_DIN/ SPI1_DIN/ UART1_TX/UART0_TX/UART1_RTS/
PORTA2	28	I/O	I2S_DOUT/I2C1_CLK/ PWM2/ SPI0_DOUT/ SPI1_DOUT/ UART1_RX/UART0_RX/UART1_CTS/
PORTA1	29	I/O	I2S_FRM/I2C0_DAT/ PWM1/ SPI0_CSN/ SPI1_CSN/ UART0_TX/UART1_TX/UART0_RTS/
PORTA0	30	I/O	I2S_CLK/I2C0_CLK/ PWM0/ SPI0_CLK/ SPI1_CLK/ UART0_RX/UART1_RX/UART0_CTS/CLK_OUT/
PORTA7	31	I/O	I2S_DIN/PWM7/SSP1_DIN/SSP0_DIN/UART1_TXD/UART0_T XD/UART1_RTS/
PORTA6	32	I/O	I2S_DOUT/PWM6/SSP1_DOUT/SSP0_DOUT/UART1_RXD/UA RT0_RXD/UART1_CTS/CLK_OUT

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	105	°C
Core Supply Voltage		0.9	1.3	V
I/O Voltage	ALDO_OUT	2.1	3.3	V
Supply Voltage	VBAT	2.5	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	°C
Core Supply Voltage		0.9	1.2	1.3	V
I/O Voltage	ALDO_OUT	2.1	2.9	3.3	V
Supply Voltage	VBAT	2.5	3.7	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 80K retention RAM)	16.7		μA
Deep sleep current (include 8K retention RAM)	7.2		μA
Power off	5.1		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-scale	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

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Revision History

Feedback:

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

Reversion Number	Reversion Date	Description
V1.0	2017.12.24	Initial Version
V1.1	2018.02.24	Modify Several Parameter
V1.2	2018.05.24	Modify Several Parameter
V1.3	2018.06.24	Modify Several Parameter
V1.4	2018.08.20	Modify Several Parameter
V1.5	2018.09.20	Add SIG Mesh support
V1.6	2018.12.01	Modify Several Parameter
V1.7	2019.03.08	Update Pins Description
V1.8	2019.04.10	Modify Several Parameter
V1.9	2019.04.16	Update Pins Description