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BG337

433MHZ Module

Specification

Ver:10

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Version Update

Item	Version	Date	Description
1	V01	Dec05,2016	The First Version
2	V02	Sep3,2017	Change Module Size
3	V03	Jan20, 2018	The third Version

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DESCRIPTION

BG337 is a high performance and low cost Sub1GHz ISM band module wireless transceiver. This device integrates high speed pipeline 8051 MCU, 16KBytes In-system programmable flash memory, 4KB SRAM, various powerful functions and excellent performance of Sub1GHz GFSK/FSK transceiver. BG337 has various operating modes, making it highly suited for systems where ultra-low power consumption is required.BG337 has an 8bit ADC for RSSI and 8 channel 12bit ADC for general purpose. Three kinds of serial communication port (SPI, I2C and UART) can interact with other device(s).

BG337 is one of AMICCOM sub1GHz family. It integrates AMICCOM sub1GHz transceiver well and offers a low cost solution with advanced radio features such as high output power amplifier up to 19 dBm (433MHz band, excluding LPF and HPF) and low noise receiver (-110dBm @50Kbps). Therefore, BG337 is very suitable for long LOS (line-of-sight) applications without the need to add an external LNA or PA.

The on-chip data rate divider supports programmable on-air data rates from 2K to 250Kbps to satisfy different systemrequirements. For a battery powered system, BG337 supports fast settling time to reduce average power consumption.

Typical Applications

- Wireless sensor networks
- Industrial monitoring and control
- Wireless alarm and security system
- Wireless ISM band data communication
- Remote control
- Home and building automation

Features

- Small Package size (QFN6 X6, 48 pins).
- High performance pipeline complicated 8051
- Operation clock: 1, 1/2, 1/4, 1/8, 1/16, 1/32 of crystal oscillator.
- 16KB Flash memory, 4KB SRAM
- UART, I^2C, SPI serial communication
- Three 16/8-bit counter/timers
- Two channel PWM
- Watchdog timer
- Sleep timer
- In-Circuit Debugger
- In-System programming/ In-Application programming
- 32 GPIO
- 8 channel 12bit SAR ADC
- One channel 8 bit ADC for RSSI and battery detect
- Programmable threshold of carrier detect.
- Frequency band: 315/433/470/868/915 MHz.

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- FSK and GFSK modulation.
- Programmable data rate from 2Kbps to 250Kbps.
- RX Current consumption (AGC Off) 868MHz: 8.2mA.
- TX Current consumption 868MHz: 80mA @ 18.8dBm.
- PM3 mode without Sleep timer (1.6uA).
- On chip regulator, support input voltage 2.0 ~ 3.6 V.
- High RX sensitivity 868MHz.
  - -109dBm at 50Kbps on-air data rate.
  - -106dBm at 100Kbps on-air data rate.
  - -105dBm at 150Kbps on-air data rate.
  - -102dBm at 250Kbps on-air data rate.
- Support low cost crystal (12.8 MHz /16 MHz).
- Support RTC clock 32.768KHz
- Fast PLL settling time (35 us).
- 9-bits Digital RSSI and Auto RSSI measurement
- Auto Calibrations.
- Auto FCS (CRC) and Filtering.
- HW AES128 to support CCM* security.
- On-chip full range VCO and Fractional-N PLL synthesizer.
- On-chip low power RC oscillator for WOR (Wake on RX) function.
- AFC (Auto Frequency Compensation) for frequency drift due to Xtal aging.
- Separated 64 bytes FIFO for RX and TX.
- Built-in Battery Detect, Thermal Sensor and Crystal load capacitors.

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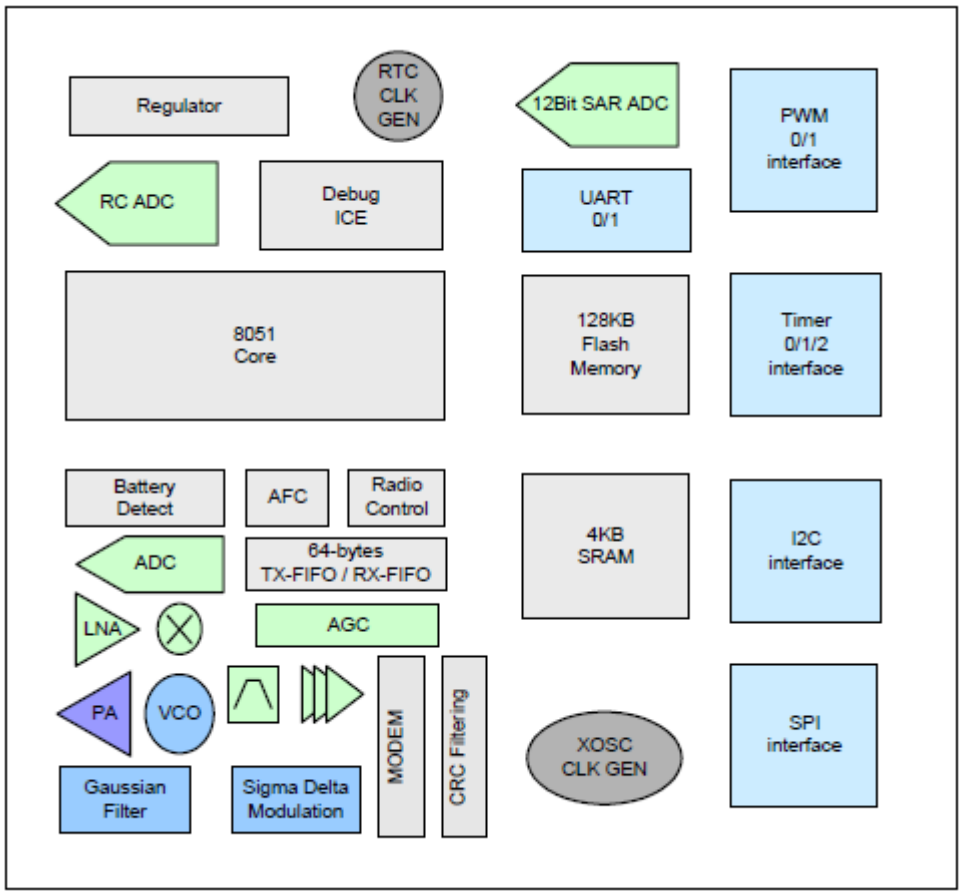
Block Diagram



Absolute Maximum Ratings

Parameter	With respect to	Rating	Unit
Supply voltage range (VDD)	GND	-0.3 ~ 3.6	V
Digital IO pins range	GND	-0.3 ~ VDD+0.3	V
Voltage on the analog pins range	GND	-0.3 ~ 2.1	V
Input RF level		14	dBm
Storage Temperature range		-55 ~ 125	°C
ESD Rating	HBM	± 2K	V
	MM	± 200	V

*Stresses above those listed under “Absolute Maximum Rating” may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Electrical Specification

(Ta=25℃, VDD=3.3V, data rate= 100Kbps, F_{XTAL} =12.8MHz, On Chip Regulator = 1.8V, PN9 pattern, with matching network and low pass filter, unless otherwise noted.)

Parameter	Description	Min.	Typ.	Max.	Unit
General					
Operating Temperature		-40		85	°C
Supply Voltage (VDD)	Regulator supply input	2.0	3.3	3.6	V
Current Consumption (MCU in stop mode and RF in sleep mode)	PM2 mode with Sleep timer		4.2		µA
	PM3 mode with Sleep timer		2.2		µA
	PM3 mode without Sleep timer		1.6		µA
Current Consumption (MCU in normal mode) 433MHz band MCU Clock @ 12.8MHz	Sleep Mode		3.0		mA
	Standby Mode		3.4		mA
	PLL Mode(CG off)		5.0		mA
	RX Mode (AGC Off)		7.15		mA
	RX Mode (AGC ON)		7.35		mA
	TX 18.9dBm (TBG=48, TDC=2, PAC=1)		72		mA
Current Consumption (MCU in normal mode) 868MHz band MCU Clock @ 12.8MHz	PLL Mode(CG off)		5.9		mA
	RX Mode (AGC Off)		8.2		mA
	RX Mode (AGC ON)		8.4		mA
	TX 18.8dBm (TBG=48, TDC=2, PAC=1)		80		mA
Synthesizer block					
Crystal settling time	Idle to standby (XTAL 49US)		0.5		ms
Crystal frequency	General case		12.8/16		MHz
	Data rate = 250Kbps		16		MHz
	Data rate = 32.768K or 16.384Kbps		12.582912		MHz
	Data rate = 38.4Kbps		19.6608		MHz
Crystal tolerance			±20		ppm
Crystal Load Capacitance			20		pF
Crystal ESR				100	ohm
PLL settling time @settle to 25kHz	Standby to PLL		35		µs
Transmitter					
Maximum Output Power	433MHz (excluding LPF and HPF)		19		dBm
	868MHz (excluding LPF and HPF)		18.8		dBm
RF Power Control Range	433MHz (excluding LPF and HPF)		38		dB
	868MHz (excluding LPF and HPF)		43		dB
Out Band Spurious Emission 1. Pout = 12 dBm 2. With LPF and HPF	f < 1GHz (RBW =100kHz)			-36	dBm
	47MHz< f <74MHz 87.5MHz< f <118MHz 174MHz< f <230MHz 470MHz< f <862MHz (RBW =100kHz)			-54	dBm
	Above 1GHz (RBW = 1MHz)			-30	dBm
	2nd Harmonic			-30	dBm
	3rd Harmonic			-30	dBm
TX settling time	PLL to TX		30		µs
Receiver					
433MHz RX Sensitivity	50kbps (Fdev = 18.75KHz)		-110		

@BER=0.1% high gain mode	100kbps (Fdev = 37.5KHz)		-107		dBm
	150kbps (Fdev = 56.25KHz)		-105		
	250kbps (Fdev = 93.75KHz) ,16MHz Xtal		-102		
868MHz RX Sensitivity @BER=0.1% high gain mode	50kbps (Fdev = 18.75KHz)		-109		dBm
	100kbps (Fdev = 37.5KHz)		-106		
	150kbps (Fdev = 56.25KHz)		-105		
	250kbps (Fdev = 93.75KHz),16MHz Xtal		-102		
915MHz RX Sensitivity @BER=0.1% high gain mode	50kbps (Fdev = 18.75KHz)		TBD		dBm
	100kbps (Fdev = 37.5KHz)		TBD		
	150kbps (Fdev = 56.25KHz)		TBD		
	250kbps (Fdev = 93.75KHz),16MHz Xtal		TBD		
IF Filter bandwidth	50K Mode (10 ppm Xtal needed)		50		KHz
	100K Mode		100		
	150K Mode		150		
	250K Mode		250		
IF center frequency	50K Mode		100		KHz
	100K Mode		200		
	150K Mode		300		
	250K Mode		500		
Interference (915MHz, 100Kbps)	Co-channel (C/I)		14		dB
	ACR1 (C/I_{ch1})		-21		dB
	ACR2 (C/I_{ch2})		-37		dB
	Offset ± 10MHz		-50		dB
Maximum Operating Input Power	@ RF input (BER = 0.1%)			10	dBm
RX Spurious Emission	25MHz ~ 1GHz			-57	dBm
	Above 1GHz			-47	dBm
RSSI Range	AGC on	-110		-30	dBm
RX Settling Time	PLL to RX		30		µs
	Standby to RX		250		µs

Digital IO DC characteristics					
High Level Input Voltage (V_{IH})		0.8*VDD		VDD	V
Low Level Input Voltage (V_{IL})		0		0.2*VDD	V
High Level Output Voltage (V_{OH})	@I_{OH}= -0.5mA	VDD-0.4		VDD	V
Low Level Output Voltage (V_{OL})	@I_{OL}= 0.5mA	0		0.4	V

12Bit SAR ADC					
Input voltage range		0		1.8	V
External reference voltage			1.8		V
Input capacitor			25		pF
Bandwidth			200		KHz
EOB, effective number of bits			10		Bit
INL			-/+ 2		LSB
DNL			-/+ 1		LSB
Conversion time		8		128	µs
Current consumption			0.4		mA
Regulator					
Regulator settling time	Pin 7 connected to 1nF		350		µs
Band-gap reference voltage			0.6		V
Regulator output voltage(VDDA)		1.8	1.8	2.1	V

Power on Reset Electrical Characteristics

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		REGI	Condition				
V_{POR}	REGI Start Voltage to ensure Power-on Reset	—	—	—	—	100	mV
$R_{POR\ AC}$	REGI Raising Rate to ensure Power-on Reset	—	—	0.04	—	—	V/ms
t_{POR}	Minimum Time for REGI to remain at V_{POR} to ensure Power-on Reset	—	—	3	—	—	ms

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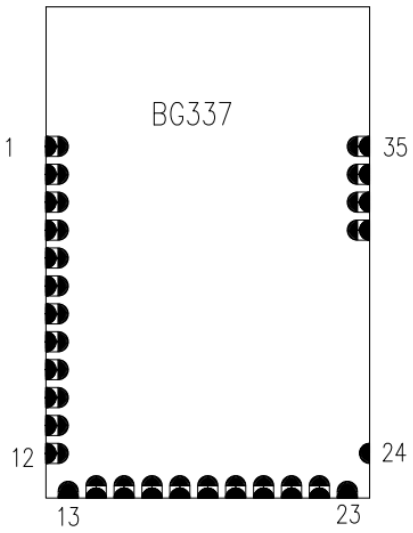
PIN Define



Pin No	PIN Name	PIN Type	Description	PIN Name	PIN Type	Description
1	P0_0	Digital I/O	SPI_SCLK	19	Reset	System reset
2	P0_1	Digital I/O	SPI_MOSI	20	P2_0	Digital I/O	ADC4
3	P0_2	Digital I/O	SPI_MISO	21	P2_1	Digital I/O	ADC5
4	P0_3	Digital I/O	SPI_SSEL	22	P2_2	Digital I/O	ADC6
5	P0_4	Digital I/O	GPIO/ICE MODE	23	P2_3	Digital I/O	ADC7
6	P0_5	Digital I/O	I2C_SCL	24	P2_4	Digital I/O	
7	P0_6	Digital I/O	I2C_SDA	25	P2_5	Digital I/O	
8	P0_7	Digital I/O	GPIO1/INT2	26	P2_6	Digital I/O	
9	P1_0	Digital I/O	TIMER2_T2/IN1	27	P2_7	Digital I/O	
10	P1_1	Digital I/O	TIMER2_T2EX/CS1	28	P3_0	Digital I/O	UART0_RX
11	P1_2	Digital I/O	GPIO2/INT3/RS1	29	P3_1	Digital I/O	UART0_TX
12	P1_3	Digital I/O	INT4/CKO/RT1	30	P3_2	Digital I/O	INT0/ADC0
13	P1_4	Digital I/O	TTAG_TTDIO	31	P3_3	Digital I/O	INT1/ADC1
14	P1_5	Digital I/O	TTAG_TTCK	32	P3_4	Digital I/O	TIMER0_T0/ADC2
15	P1_6	Digital I/O	PWM0	33	P3_5	Digital I/O	TIMER0_T0/ADC3
16	P1_7	Digital I/O	PWM1	34		NC	
17	GND	Ground	Digital Ground	35		NC	
18	VCC		Supply voltage output				

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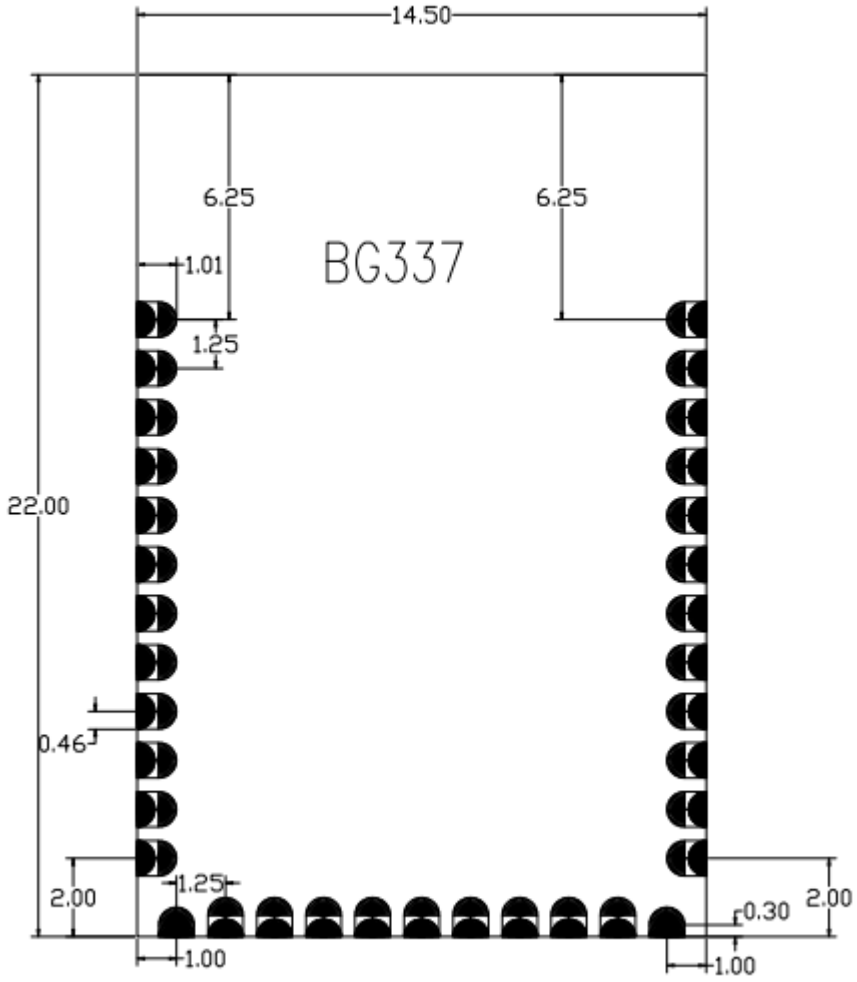
Module Size