

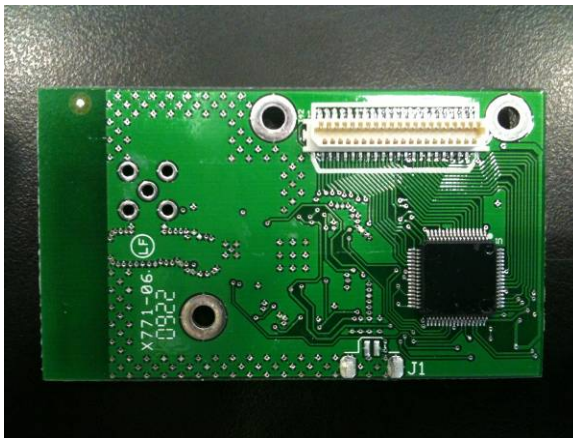
ClimateMinder™ Radio Module Operation Description & User Manual

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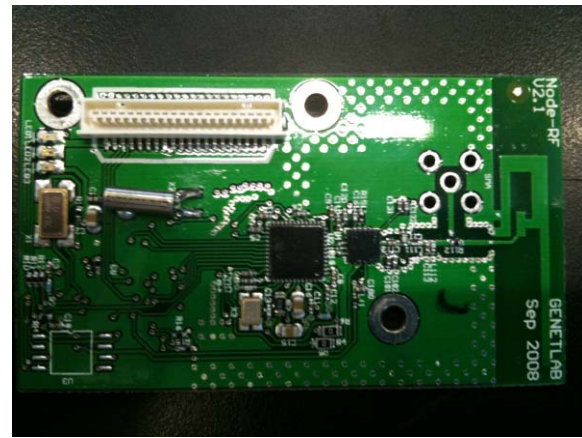
1. Operation Description

ClimateMinder™ is a wireless climate monitoring and control system for agriculture. It uses mobile network technology to transmit key data from the field directly to growers' mobile phones, computers and control systems.

At the core of ClimateMinder™ system field components, there is ClimateMinder's Radio Module. This module includes a microprocessor, RF transceiver and an integrated antenna. The module includes ClimateMinder's firmware to collect and transmit key data such as sensor readings. The module can be attached to interface boards and installed in appropriate enclosures for operation in various environments.



ClimateMinder™ Radio Module Back View



ClimateMinder™ Radio Module Front View

2. Features & Technical Specifications

The radio module has the following features and specifications.

2.1. Key Features

- 250kbps 2.4GHz IEEE 802.15.4 Chipcon(TI) Wireless Transceiver
- TI CC2590 front end amplifier

- 8MHz Texas Instruments MSP430 microcontroller (10k RAM, 48k Flash)
- Integrated ADC, DAC, Supply Voltage Supervisor, and DMA Controller
- PCB type Inverted F antenna with up to 400 m range outdoors,
- Ultra low current consumption
- Fast wakeup from sleep (<6μs)
- Hardware link-layer encryption and authentication
- 41-pin expansion support

Technical Specifications

Processor Specifications		Electromechanical Specifications	
Program Flash Memory	48 kB on chip	Battery	2 × AA or 1 × D-Size 3.6V Lithium Primary Battery
Data RAM	10 kB on chip	External Power	2.4 – 3.6 V
		Human Interface	3 LEDs
Serial Communications	2 × USART	Size	67 × 39 × 42 mm
Analog to Digital Conv	8 channel 12 bit ADC	Expansion Connector	41 pin directional bus
Other Interfaces	I2C / JTAG / 2×DAC		
Current Consumption	Sleep: 0.1 uA Process: 30 mA		
Radio Specifications			
Center Frequency	2.4 GHz		
Data Rate	250 kbps		
Output Power	+ 8 dBm		
Input Power	10 dBm		
Receive Sensitivity	-95 dBm (-101 dBm with AMP)		
Current Consumption	TX 40.4 mA RX 23.1 mA		

3. Components & Operation

3.1. Microprocessor

The low power operation of the ClimateMinder™ Radio Module is due to the ultra low power Texas Instruments MSP430 F1611 microcontroller featuring 10kB of RAM, 48kB of flash, and 128B of information storage. This 16-bit RISC processor features extremely low active and sleep current consumption that permits ClimateMinder™ Radio Module to run for years on a single pair of AA batteries. The MSP430 has an internal digitally controlled oscillator (DCO) that may operate up to 8MHz. ClimateMinder™ Radio Module also has second external crystal (8MHz) for a more stabilized main clock.

The MSP430 has 8 external ADC ports and 8 internal ADC ports. A variety of peripherals are available including SPI, UART, digital I/O ports, Watchdog timer, and Timers with capture and compare functionality. The F1611 also includes a 2-port 12-bit DAC module, Supply Voltage Supervisor, and 3-port DMA controller. The features of the MSP430 F1611 are presented in detail in the Texas Instruments.

MSP430x1xx Family User's Guide available at <http://ti.com/msp430>.

	MIN	NOM	MAX	UNIT
Supply voltage during program execution	1.8		3.6	V
Supply voltage during flash memory programming	2.7		3.6	V
Operating free air temperature	-40		85	Degree C
Low frequency crystal frequency		32768		kHz
Active current at Vcc=3V, 1MHz		500	600	μA
Sleep current in LPM3 Vcc=3V, 32.768kHz active		2.6	3.0	μA
Wake up from LPM3 (low power mode)			6	μs

3.2. PC Communication

The ClimateMinder Radio Module communicates with the host PC through USART1 on the TI MSP430.

3.3. Programming

The ClimateMinder Radio Module is programmed through the jtag port of microprocessor. All jtag programmers can be used for programming ClimateMinder Radio Module.

3.4. Radio

ClimateMinder Radio Module features the Chipcon(TI) CC2420 radio for wireless communications. The CC2420 is an IEEE 802.15.4 compliant radio providing the PHY and some MAC functions. With sensitivity exceeding the IEEE 802.15.4 specification and low power operation, the CC2420 provides reliable wireless communication. The CC2420 is highly configurable for many applications with the default radio settings providing IEEE 802.15.4 compliance.

Chipcon(TI) CC2490 Front End Amplifier is also available for use on ClimateMinder Radio Module is an IC designed to work as a PA(Power Amplifier) and LNA(Low Noise

Amplifier) with Chipcon(TI)'s 2.4GHz ICs. This IC supplies high output power for longer range operations

Features and usage of both CC2420 and CC2590 is available in Chipcon(TI)'s datasheet at TI Zigbee RF Solutions 2.4GHz

CC2420 and CC2590 are controlled by the TI MSP430 microcontroller through the SPI port and a series of digital I/O lines and interrupts (see the Schematics on page 7 for more information). The radio may be shut off/down by the microcontroller for low power duty cycled operation. The CC2420 has programmable output power. Common CC2420 register values and their corresponding current consumption and output power are shown in Figure 1. Note that when used, CC2590 will implement a gain of 10dB and current consumption of 22mA.

PA_LEVEL	TXCTRL register	Output Power (dBm)	Current Consumption (mA)
31	0xA0FF	0	17.4
27	0xA0FB	-1	16.5
23	0xA0F7	-3	15.2
19	0xA0F3	-5	13.9
15	0xA0EF	-7	12.5
11	0xA0EB	-10	11.2
7	0xA0E7	-15	9.9
3	0xA0E3	-25	8.5

Figure 1: Output power configuration for the CC2420

	MIN	NOM	MAX	UNIT
Supply voltage during radio operation (Vreg on)	2.1		3.6	V
Operating free air temperature	-40		85	°C
RF frequency range	2400		2483.5	MHz
Transmit bit rate	250		250	Kbps
Nominal output power	-3	0		dBm
Programmable output power range		40		dBm
Receiver sensitivity	-90	-94		dBm
Current consumption: Radio transmitting at 0 dB With CC2590		17.4 50.4		mA mA
Current consumption: Radio receiving With CC2590		19.7		mA
High gain mode		23.1		mA
Low gain mode		21.5		mA
Current consumption: Radio on, Oscillator on		365		µA

Current consumption: Idle mode, Oscillator off		20		μA
Current consumption: Power Down mode, Vreg off			1	μA
Voltage regulator current draw	13	20	29	μA
Radio oscillator startup time		580	860	μs

3.5. Power

ClimateMinder Radio Module can be powered by two AA batteries from J1 input. J1 input is designed to fit the two AA battery form factor and AA cells may be used in the operating range of 2.4 to 3.6V DC, however the voltage must be at least 2.7V when programming the microcontroller flash.

	MIN	MAX	UNIT
Supply voltage J1	2.4	3.6	V
Supply voltage during flash memory programming J1	2.7	3.6	V
Operating free air temperature	-40	+85	°C
Current Consumption: MCU on, Radio RX	21.8	23	mA
Current Consumption: MCU on, Radio TX	19.5	40	mA
Current Consumption: MCU on, Radio off	1800	2400	μA
Current Consumption: MCU idle, Radio off	54.5	1200	μA
Current Consumption: MCU standby	<1		μA

4. Mechanical Characteristics

	Node-RF	UNIT
Width	39	mm
Length	67	mm
Height (without battery pack)	8	mm

5. FCC User's Information

This device has FCC ID: YGHGNTNODERFV2190.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference, and, 2) This device must accept any interference received including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

6. Contact Us

For any additional question please contact us. ClimateMinder's address and other contact information is as follows:

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