# SILICONAIR2 USER MANUAL
IEEE802.15.4/ZigBee Module

Overview

Tigo designed SILICONAIR2 is a low power, high performance surface integrated module on board targeted at ZigBee networking applications. RF modules on board use NXP's JN5148 wireless microcontroller to provide comprehensive solution with large memory, high CPU and radio performance and all RF components included.

RF Module on Board
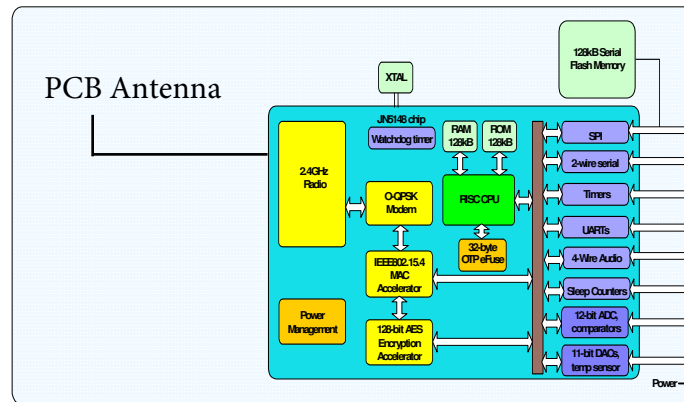
Features: Module

- 2.4GHz IEEE802.15.4 & ZigBee compatible
- Sleep current (with active sleep timer) 2.6µA
- Receiver sensitivity –95dBm
- TX power +3.24dBm max.
- 2.7-3.6V operation
- PCB Antenna Gain +2dBi
- TX current 37mA max.
- RX current 37 mA max.
- Dimension: 18 x 30 x 3.5mm

Industrial temp (-40°C to +85°C)

Lead-free and RoHS compliant

Features: Microcontroller

- 32-bit RISC CPU, up to 32MIPs with low power
- 128kB ROM stores system code
- 128kB RAM stores system data and bootloaded program code
- 4Mbit serial flash for program code and data
- JTAG debug interface
- 4-input 12-bit ADC, 2 12-bit DACs, 2 comparators
- 3 application timer/counters, 3 system timers
- 2 UARTs
- SPI port with 5 selects
- 2-wire serial interface
- 4-wire digital audio interface
- Watchdog timer
- Up to 21 DIO

Declaration

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

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:
1. this device may not cause interference, and
2. this device must accept any interference, including interference that may cause undesired operation of the device.

The radiated output power of this device is below the IC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized. In order to avoid the possibility of exceeding the IC radio frequency exposure limit, human proximity to the antenna should not be less than 20 Cm.

Cet appareil est conforme à Industrie Canada une licence standard RSS exonérés (s). Son fonctionnement est soumis aux deux conditions suivantes:
1. Cet appareil ne doit pas provoquer d'interférences
2. Cet appareil doit accepter toute interférence reçue, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

La puissance de sortie rayonnée de cet appareil est inférieure aux limites d'exposition de radio de fréquence IC. Néanmoins, le dispositif doit être utilisé de telle manière que le potentiel de contact humain pendant l'utilisation normale soit minimisé. Afin d'éviter la possibilité de dépasser la limite d'exposition de fréquence radio de la IC, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm.

1. Introduction

SILICONAIR2 module integrated on board provides Tigo products with communication protocol which allows IEEE802.15.4 [1] wireless applications, using Jennic's JenNet networking protocol or ZigBee PRO, to be quickly and easily included in product designs. RF module on board integrate all of the RF components required, removing the need to have separate RF module and assembly requirement. Products can be designed by simply adding module circuit on board and connecting sensors and switches to the IO pins. RF modules on board use Jennic's single chip IEEE802.15.4 Wireless Microcontroller, allowing Tigo to make use of the extensive chip development support material. Hence, this range of modules design on board allow Tigo to bring wireless applications to product in the minimum time with significantly reduced development effort and cost.

1.1. Wireless Transceiver

The Wireless Transceiver comprises a 2.45GHz radio, a modem, a baseband controller and a security coprocessor. The security coprocessor provides hardware-based 128-bit AES-CCM* modes as specified by the IEEE802.15.4 2006 standard. Specifically this includes encryption and authentication covered by the MIC –32/ -64/ -128, ENC and ENC-MIC –32/ -64/ -128 modes of operation.

The transceiver elements (radio, modem and baseband) work together to provide IEEE802.15.4 Medium Access Control (MAC) under the control of a protocol stack. Applications incorporating IEEE802.15.4 functionality can be rapidly developed by combining user-developed application software with a protocol stack library.
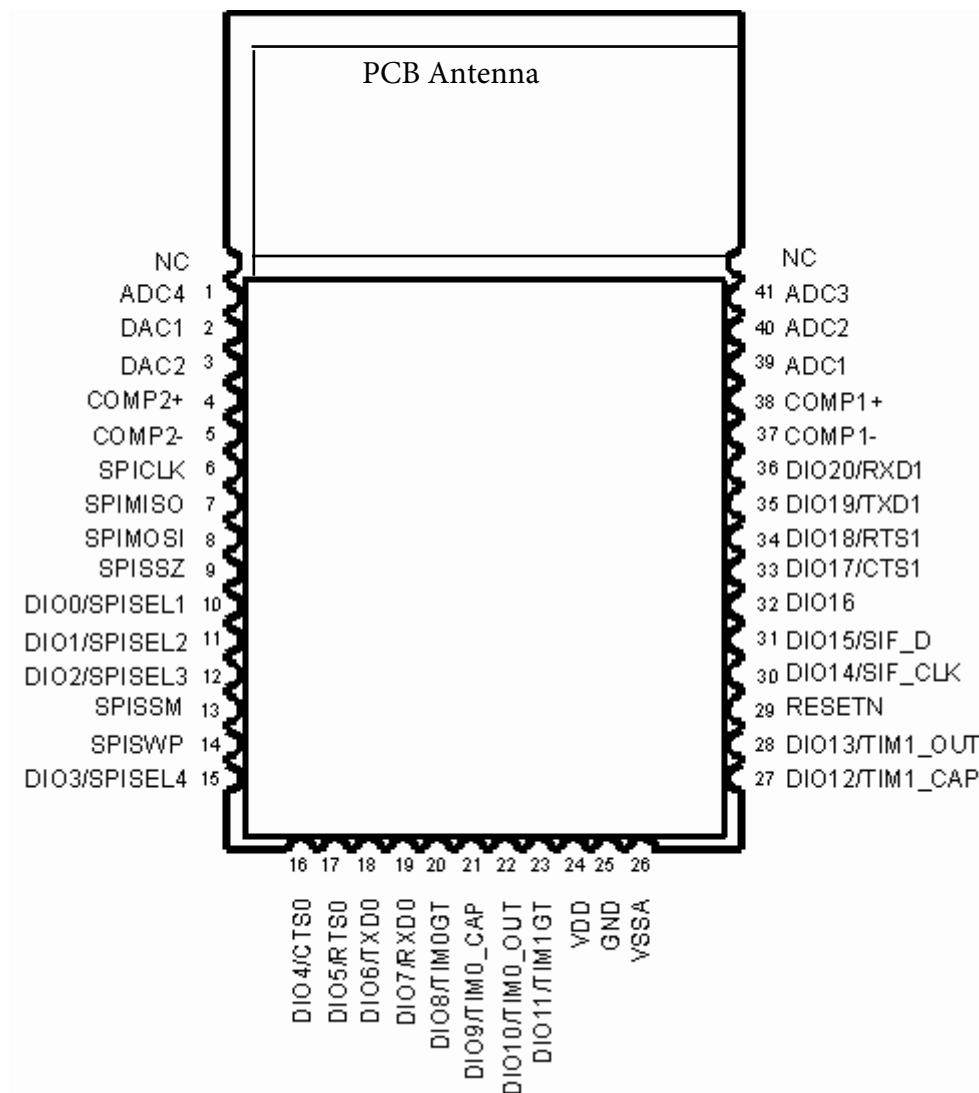
1.2. Feature of SiliconAir2 Module on Board

- 2.4GHz IEEE802.15.4 & ZigBee Compatible
- 2.7-3.6V Operation
- Sleep Current (with Active Sleep Timer) 2.6μA
- Receiver Sensitivity -95dBm
- TX Power +3.24dBm
- Antenna Gain +2dBi
- TX Current 37mA
- RX Current 37mA

2. Specifications

VDD=3.0V @ +25°C

Typical DC Characteristics		Notes
Deep sleep current	1.3uA	
Sleep current	2.6uA	With active sleep timer
Radio transmit current	15mA	CPU in doze, radio transmitting
Radio receive current	18mA	CPU in doze, radio receiving
Centre frequency accuracy	+/-25ppm	Additional +/-15ppm allowance for temperature and ageing
Typical RF Characteristics		**Notes**
Receive sensitivity	-95dBm	Nominal for 1% PER, as per 802.15.4 section 6.5.3.3 (Note 1)
Maximum Transmit power	+3.24dBm	Nominal
Transmit power at 3.6V		With Vdd=3.6V
Maximum input signal	+5dBm	For 1% PER, measured as sensitivity
RSSI range	-95 to -10 dBm	
RF Port impedance – uFl connector	50 ohm	2.4 - 2.5GHz
VSWR (max)	2:1	2.4 - 2.5GHz
Peripherals		**Notes**
Master SPI port	5 selects	250kHz - 16MHz
Slave SPI port	✓	250kHz - 8MHz
Two UARTs	✓	16550 compatible
Two-wire serial I/F (compatible with SMbus & I^{2}C)	✓	Up to 400kHz
Two programmable Timer/Counters with capture/compare facility, Tick timer	✓	16MHz clock
Two programmable Sleep Timers	✓	32kHz clock
Digital IO lines (multiplexed with UARTs, timers and SPI selects)	21	
Four channel Analogue-to-Digital converter	✓	12-bit, up to 100ks/s
Two channel Digital-to-Analogue converter	✓	12-bit, up to 100ks/s
Two programmable analogue comparators	✓	Ultra low power mode for sleep
Internal temperature sensor and battery monitor	✓	

3. I/0 Configuration


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                          PCB Antenna


              NC                                  NC
            ADC4   1                          41  ADC3
            DAC1   2                          40  ADC2
            DAC2   3                          39  ADC1
          COMP2+   4                          38  COMP1+
          COMP2-   5                          37  COMP1-
          SPICLK   6                          36  DIO20/RXD1
         SPIMISO   7                          35  DIO19/TXD1
         SPIMOSI   8                          34  DIO18/RTS1
          SPISSZ   9                          33  DIO17/CTS1
    DIO0/SPISEL1  10                          32  DIO16
    DIO1/SPISEL2  11                          31  DIO15/SIF_D
    DIO2/SPISEL3  12                          30  DIO14/SIF_CLK
          SPISSM  13                          29  RESETN
          SPISWP  14                          28  DIO13/TIM1_OUT
    DIO3/SPISEL4  15                          27  DIO12/TIM1_CAP

                  16 17 18 19 20 21 22 23 24 25 26
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DIO4/CTS0 DIO5/RTS0 DIO6/TXD0 DIO7/RXD0 DIO8/TIM0GT DIO9/TIM0_CAP DIO10/TIM0_OUT DIO11/TIM1GT VDD GND VSSA

4. Assignment

Pin	Signal	Function	Alternative Function
1	ADC4	Analogue to Digital input	
2	DAC1	Digital to Analogue output	
3	DAC2	Digital to Analogue output	
4	COMP2+	Comparator 2 inputs	
5	COMP2-		
6	SPICLK	SPI master clock out	
7	SPIMISO	SPI Master In/Slave Out	
8	SPIMOSI	SPI Master Out/Slave In	
9	SPISSZ	SPI select from module - SS0 (output)	
10	DIO0/SPISEL1	SPI Slave Select1 (output)	General Purpose Digital I/O DIO0
11	DIO1/SPISEL2	SPI Slave Select2 (output)	General Purpose Digital I/O DIO1
12	DIO2/SPISEL3*	SPI Slave Select3 (output)	General Purpose Digital I/O DIO2 *
13	SPISSM	SPI select to FLASH (input)	
14	SPISWP	FLASH write protect (input)	
15	DIO3/SPISEL4*	SPI Slave Select4 (output)	General Purpose Digital I/O DIO3*
16	DIO4/CTS0	UART0 Clear To Send (input) /TCK (JTAG)	General Purpose Digital I/O DIO4
17	DIO5/RTS0	UART0 Request To Send (output) /TMS(JTAG)	General Purpose Digital I/O DIO5
18	DIO6/TXD0	UART0 Transmit Data (output) /TDO(JTAG)	General Purpose Digital I/O DIO6
19	DIO7/RXD0	UART0 Receive Data (input) / TDI(JTAG)	General Purpose Digital I/O DIO7
20	DIO8/TIM0GT	Timer0 clock/gate (input)	General Purpose Digital I/O DIO8
21	DIO9/TIM0_CAP	Timer0 capture (input)	General Purpose Digital I/O DIO9
22	DIO10/TIM0_OUT	Timer0 PWM (output)	General Purpose Digital I/O DIO10
23	DIO11/TIM1GT	Timer1 clock/gate (input)	General Purpose Digital I/O DIO11
24	VDD	3V power	
25	GND	Digital ground	
26	VSSA	Analogue ground	
27	DIO12/TIM1_CAP	Timer1 capture (input)	General Purpose Digital I/O DIO12
28	DIO13/TIM1_OUT	Timer1 PWM (output)	General Purpose Digital I/O DIO13
29	RESETN	Active low reset	

Pin	Signal	Function	Alternative Function
30	DIO14/SIF_CLK	Serial Interface clock / Intelligent peripheral	General Purpose Digital I/O DIO14
31	DIO15/SIF_D	Serial Interface data / Intelligent Peripheral data output	General Purpose Digital I/O DIO15
32	DIO16	Intelligent Peripheral data in	General Purpose Digital I/O
33	DIO17CTS1	UART1 Clear To Send (input)/ Intelligent Peripheral device select	General Purpose Digital I/O DIO17
34	DIO18/RTS1	UART1 Request To Send (output)/ Intelligent Peripheral Interrupt	General Purpose Digital I/O DIO18
35	DIO19/TXD1	UART1 Transmit Data (output)	General Purpose Digital I/O DIO19
36	DIO20/RXD1	UART1 Receive Data (input)	General Purpose Digital I/O DIO20
37	COMP1-	Comparator 1 inputs	
38	COMP1+		
39	ADC1	Analogue to Digital input	
40	ADC2	Analogue to Digital input	
41	ADC3	Analogue to Digital input	

5. Electrical Characteristics

In most cases, the Electrical Characteristics follows JN5148 chip. They are described in detail in the chip datasheet. Where there are differences, they are detailed below.

5.1. Maximum Ratings

Exceeding these conditions will result in damage to the device.

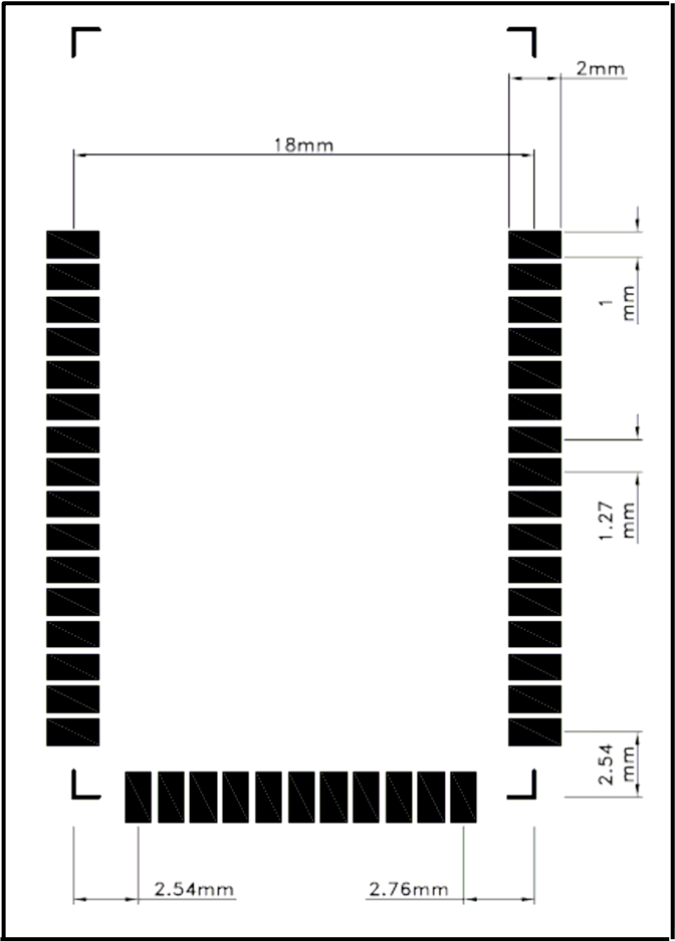| Parameter		Min	Max
Device supply voltage VDD		-0.3V	3.6V
Voltage on analogue pins VREF, ADC1-4, DAC1-2, COMP1M, COMP1P, COMP2M, COMP2P, IBIAS		-0.3V	VDD + 0.3V
Voltage on 5v tolerant digital pins DIO0-DIO8 & DIO11-20, RESETN		-0.3V	Lower of (VDD + 2V) and 5.5V
Voltage on 3v tolerant digital pins DIO9, DIO10, SPISSM, SPISWP, SPICLK, SPIMOSI, SPIMISO, SPISSZ		-0.3V	VDD + 0.3V
Storage temperature		-40ºC	150ºC
ESD rating	Human Body Model [1]		2.0kV
	Machine Model [2]		200V
	Charged Device Model [3]		500V

1) Testing for Human Body Model discharge is performed as specified in JEDEC Standard JESD22-A114.
2) Testing for Machine Model discharge is performed as specified in JEDEC Standard JESD11-A115.
3) Testing for Charged Device Model discharge is performed as specified in JEDEC Standard JESD22-C101.

This device is sensitive to ESD and should only be handled using ESD precautions.

5.2. Operating Conditions

Supply	Min	Max
VDD	2.3V	3.6V
Ambient temperature range	-40˚C	85˚C

6. RF Module PCB Footprint

7. Module Label Description

Dimmensions : 13x16mm
Label material - Polyimide L8001 3M

Tigo energy

FCC ID: XMYSILICONAIR2
IC: 11021A-SILICONAIR2
MODEL: SILICONAIR2

1004414000001
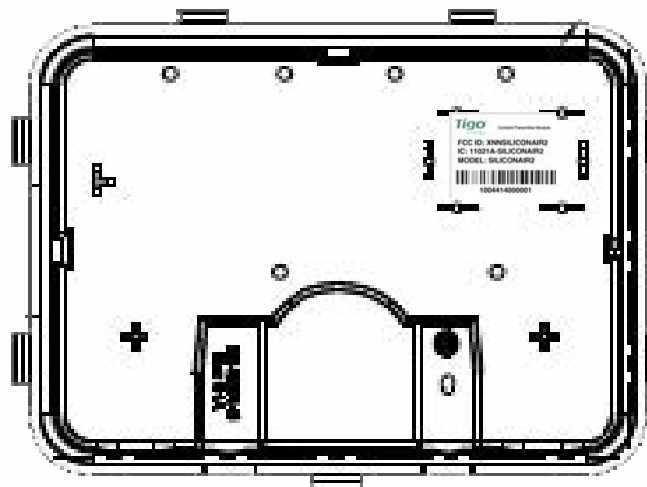
S/N Format :

xxxwwyynnnnnn

xxx – HW Version 1.00

ww- manufactured work week (in the example is 44)

yy – 2 last digits of year (14 for 2014)

nnnnnn – Running number from 000001-999999

8. The label on the host

Module label is placed on TS4 cover after potting and assembly