MCRF202

Passive RFID Device with Sensor Input

FEATURES

- Sensor input polarity inverts data stream
- Read only data transmission
- 96- or 128-bits of factory programming user memory (also supports 48 and 64-bit protocols)
- Typical operates at 125 kHz
- On-chip rectifier and voltage regulator
- Low-power operation
- Factory programming and device serialization
- Encoding options:
  - NRZ Direct, Differential Biphase, Manchester Biphase
- Modulation options:
  - Direct, FSK, PSK (change on data change), PSK (change at the beginning of a one)

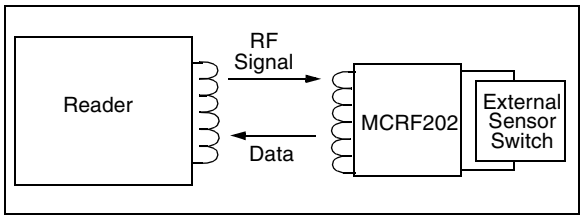
DESCRIPTION

The MCRF202 is a passive Radio Frequency Identification (RFID) device that provides an RF interface for reading the contents of a user memory array. This device is specially designed to detect the logic state of an external sensor, and alter its data transmissions, based on the condition of the sensor input. A logic '1' at the sensor input results in normal operation, a logic '0' at the sensor inputs causes the entire data stream to be inverted. In this way, a reader can simultaneously obtain the tag's ID number and the state of an external switch or other sensor.

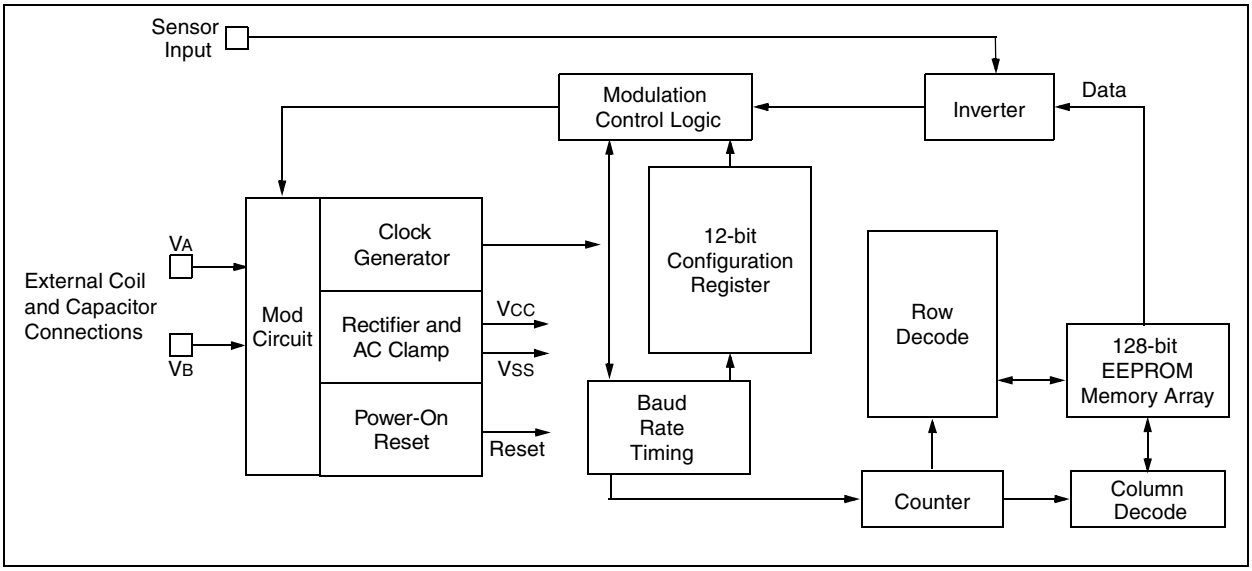
The device is powered by rectifying the incoming RF carrier signal that is transmitted from the reader. When the device develops sufficient DC voltage, it transmits the contents of its memory array by modulating the incoming RF carrier signal. The reader is able to detect the modulation and decodes the data being transmitted. Code length, modulation option, encoding option, and bit rate are set at the factory to fit the needs of particular applications.

The MCRF202 is available in die, wafer, PDIP and SOIC packages. The encoding, modulation, frequency, bit rate options, and data fields are specified by the customer and programmed by Microchip Technology Inc. prior to shipment. See TB023 for more information on factory serialization (SQTP™).

APPLICATION



BLOCK DIAGRAM



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1.0 ELECTRICAL CHARACTERISTICS

1.1 Maximum Ratings*

Storage temperature .....- 65°C to +150°C
Ambient temp. with power applied .....-40°C to +125°C
Maximum current into coil pads .....50 mA

***Notice:** Stresses above those listed under "Maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

TABLE 1-1: AC AND DC CHARACTERISTICS

All parameters apply across the specified operating ranges unless otherwise noted.	Industrial (I): Tamb = -40°C to +85°C					
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
Clock frequency	F_{CLK}	100	—	150	kHz	
Data retention		200	—	—	Years	25°C
Coil current (Dynamic)	I_{CD}	—	50		µA	
Operating current	I_{DD}	—	5		µA	V_{CC} = 2V (no load to V_{CC} pad)
Operating current	I_{DL}	—	10	—	µA	V_{CC} = 2V (Vcc load through switch to SENSOR)
Turn-on-voltage (Dynamic) for modulation	V_AV_B V_{CC}	10 2	— —	— —	V_{PP} V_{DC}	
Input Capacitance	C_{IN}	—	2	—	pF	Between V_A and V_B
SENSOR pull-down	R_S	400	800	1200	KΩ	
SENSOR trigger threshold	V_S	0.5	1.0	1.5	V	

FIGURE 1-1: DIE PLOT

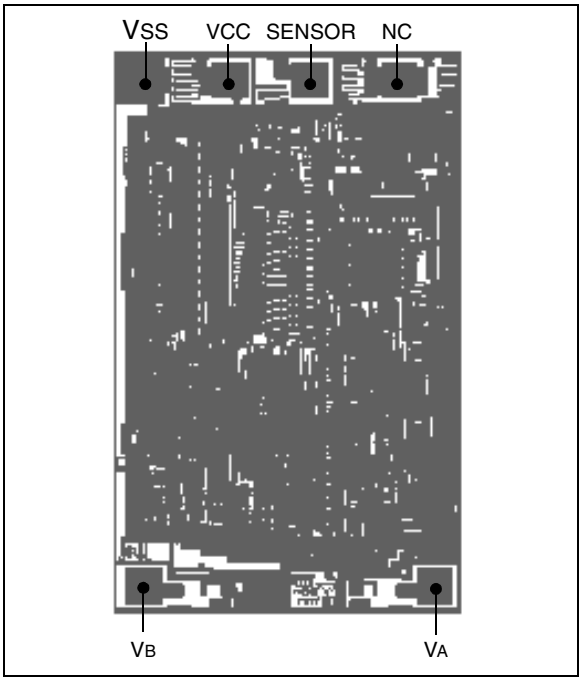


TABLE 1-2 RFID PAD COORDINATES (MICRONS)

Pad Name	Passivation Openings		Pad Center X	Pad Center Y
	Pad Width	Pad Height		
VA	90.0	90.0	427.50	-734.17
VB	90.0	90.0	-408.60	-734.17
VSS	105.3	112.5	-417.60	722.47
VCC	90.0	90.0	-164.70	723.82
SENSOR	90.0	90.0	69.30	723.82

Note 1: All coordinates are referenced from the center of the die.
2: Die size 1.1215 mm x 1.7384 mm.

TABLE 1-3: PAD FUNCTION TABLE

Name	Function
VA,VB	Coil and capacitor connections
NC	No connection, test pad
Vss	Device ground
Vcc	DC supply out from device
SENSOR	Sensor input

2.0 FUNCTIONAL DESCRIPTION

The device contains three major building blocks. They are RF front-end and sensor input, configuration and control logic, and memory sections. The Block Diagram is shown on page 1.

2.1 RF Front-End and Sensor Input

The RF front-end of the device includes circuits for rectification of the carrier, VDD (operating voltage), and high-voltage clamping to prevent excessive voltage from being applied to the device. This section also generates a system clock from the incoming carrier signal and modulates the carrier signal to transmit data to the reader.

2.1.1 RECTIFIER – AC CLAMP

The AC voltage generated by the external tuned LC circuit is full wave rectified. This unregulated voltage is used as the maximum DC supply voltage for the rest of the device and for the VCC supply to the external sensor or switch. Any excessive voltage on the tuned circuit is clamped by the internal circuitry to a safe level to prevent damage to the IC.

2.1.2 MODULATION CIRCUIT

The MCRF202 sends the encoded data to the reader by AM-modulating the coil voltage across the tuned LC circuit. A modulation transistor is placed between the antenna coil pads (VA and VB). The transistor turns on and off based on the modulation signal. As a result, the amplitude of the antenna coil voltage varies with the modulation signal. See Figure 2-1 for details.

2.1.3 VCC REGULATOR

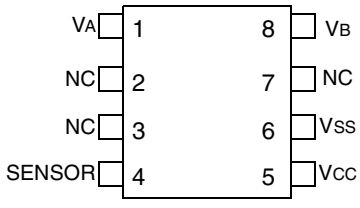
The device generates a DC supply voltage from the unregulated coil voltage.

2.1.4 CLOCK GENERATOR

This circuit generates a clock based on the carrier frequency from the reader. This clock is used to derive all timing in the MCRF202, including the baud rate and modulation rate.

PACKAGE LAYOUT

PDIP/SOIC



2.1.5 POWER-ON RESET

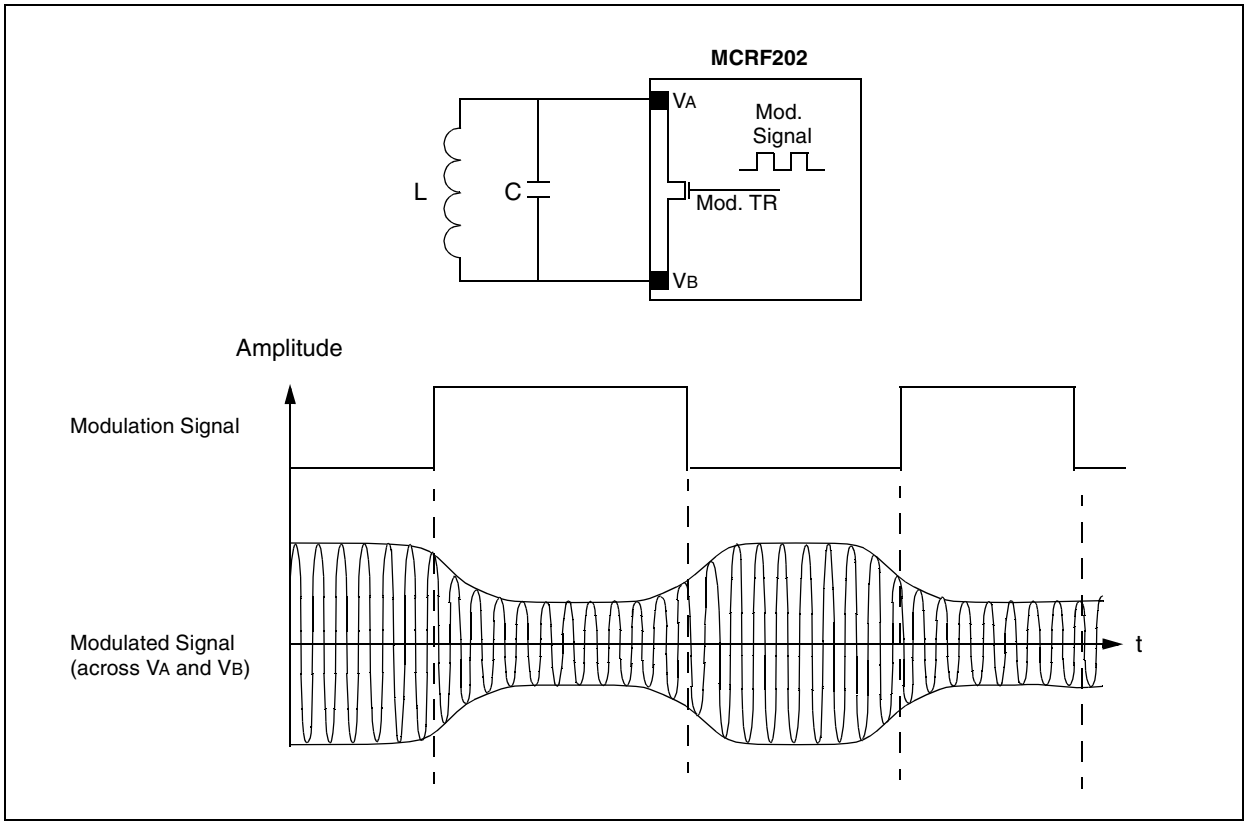
This circuit generates a power-on reset when the tag first enters the interrogator field. The reset releases when sufficient power has developed on the V_{DD} regulator to allow correct operation.

2.1.6 SENSOR INPUT AND DATA INVERTER

The SENSOR input responds to logic high or logic low voltages to drive the internal inverter on or off. A logic high results in normal tag operation; a logic low at SENSOR input activates an inverter, which inverts the entire data stream prior to modulation.

The SENSOR input has an internal pull-down resistor of 800 kΩ (typical). See Figure 2-3 for details.

FIGURE 2-1: MODULATION SIGNAL AND MODULATED SIGNAL



2.2 Configuration Register and Control Logic

The configuration register determines the operational parameters of the device. It directly controls logic blocks which generate the baud rate, memory size, encoded data, modulation protocol, etc. CB11 is always a zero. Once the array is successfully programmed at the factory, the lock bit CB12 is set. When the lock bit is set, programming and erasing the device becomes permanently disabled. Figure 2-2 contains a description of the control register bit functions.

2.2.1 BAUD RATE TIMING

The device will access data at a baud rate determined by bits CB2, CB3, CB4, and CB5 of the configuration register. CB2, CB3, and CB4 determine the data rate (CACLK).

2.2.2 MODULATION CONTROL LOGIC

This logic acts upon the serial data being read from the EEPROM and performs two operations on the data. The logic first encodes the data according to the configuration bits CB6 and CB7. The data can be sent out directly to the modulation logic or encoded Biphase Differential, Biphase Manchester or Manchester with IDI option.

The encoded data is then either passed NRZ Direct out to modulate the coil, FSK modulated, PSK modulated with changes on the change of data, or PSK with changes on the bit edge of a one. Configuration bits CB8 and CB9 determine the modulation option. CB10 is used if the PSK option has been selected, and determines if the return carrier rate is $F_{CLK}/2$ or $F_{CLK}/4$.

2.3 Memory Section

The device has 128 bits of one-time-programmable (OTP) memory. The user can choose 96 or 128 bits by selecting CB1 bit in the configuration register. See Figure 2-2 for more details.

2.3.1 COLUMN AND ROW DECODER LOGIC AND BIT COUNTER

The column and row decoders address the EEPROM array at the clock rate and generate a serial data stream for modulation. This data stream can be up to 128 bits in length. The size of the stream is user programmable with CB1 and can be set to 96 or 128 bits. Data lengths of 48 and 64 bits are available by programming the data twice in the array, end-to-end. The data is then encoded by the modulation logic.

The column and row decoders route the proper voltage to the array for programming and reading.

FIGURE 2-2: CONFIGURATION REGISTER

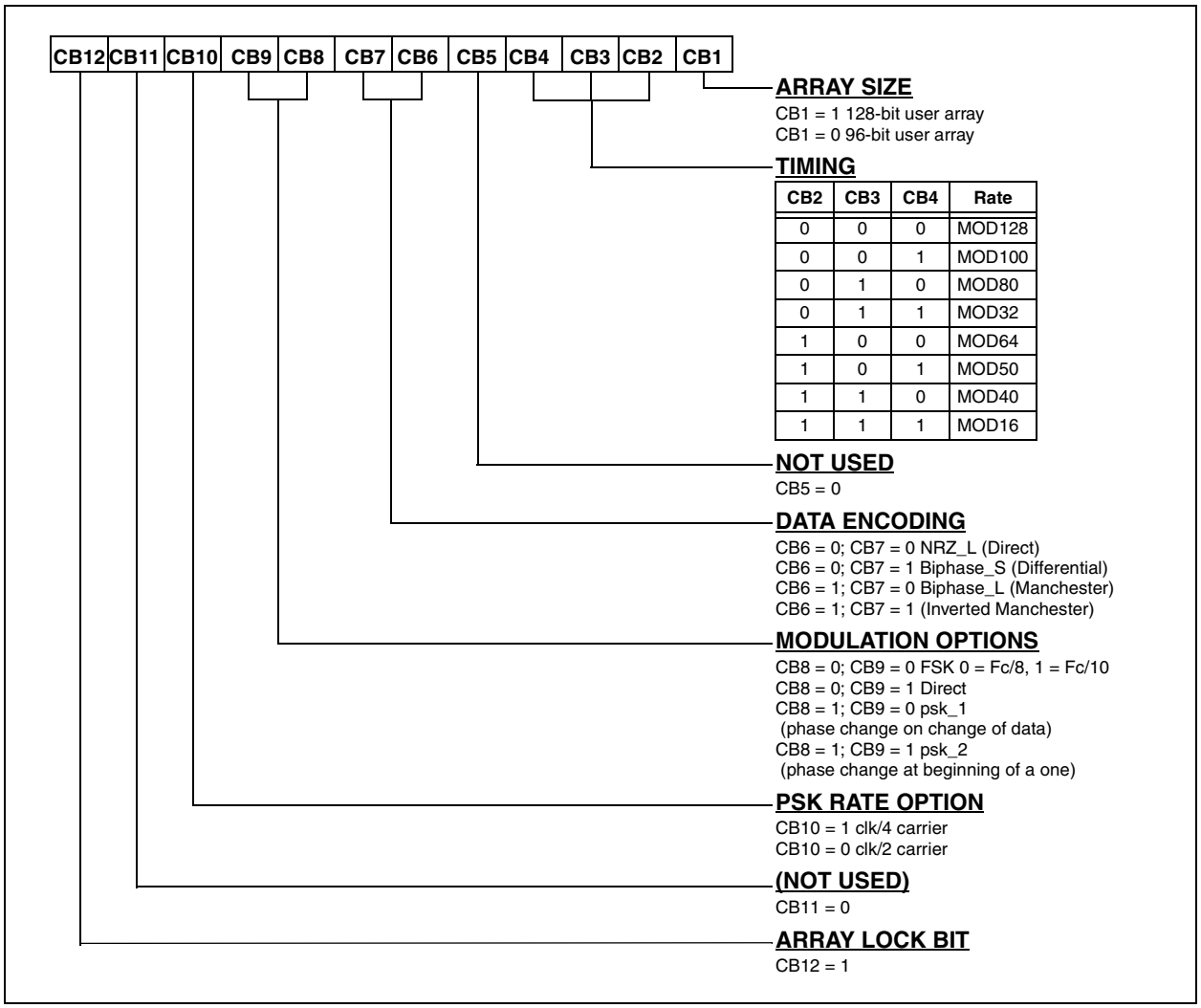
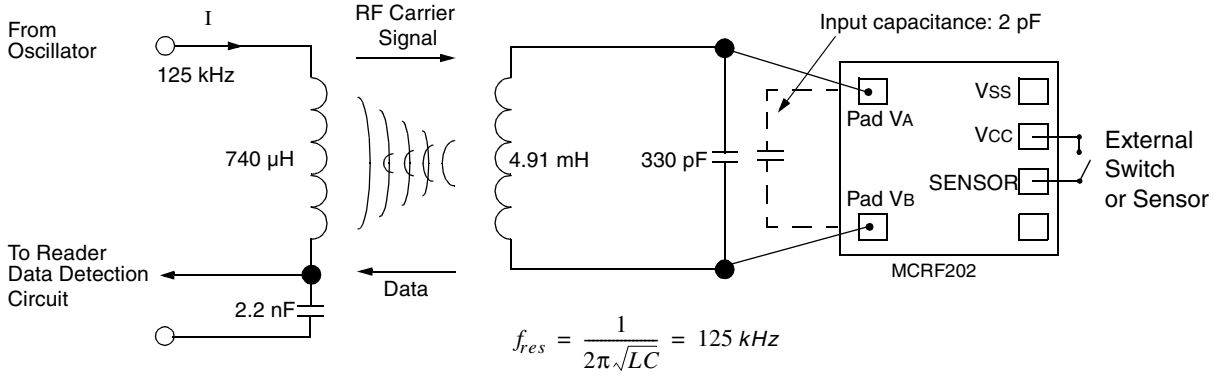


FIGURE 2-3: TYPICAL APPLICATION CIRCUITS

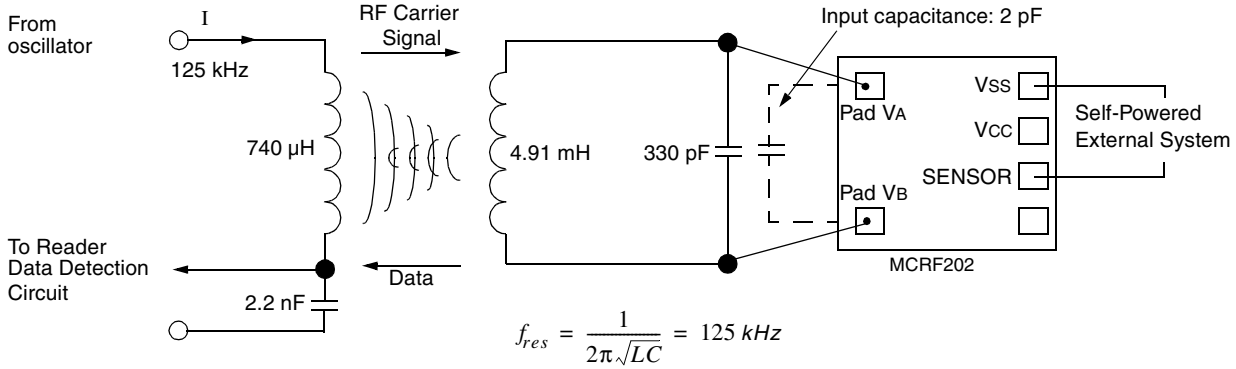
Using MCRF202 with an external passive switch or sensor



$$f_{res} = \frac{1}{2\pi\sqrt{LC}} = 125\ kHz$$

Device Output
External Switch CLOSED: Normal Data Stream
External Switch OPEN: Inverted Data Stream

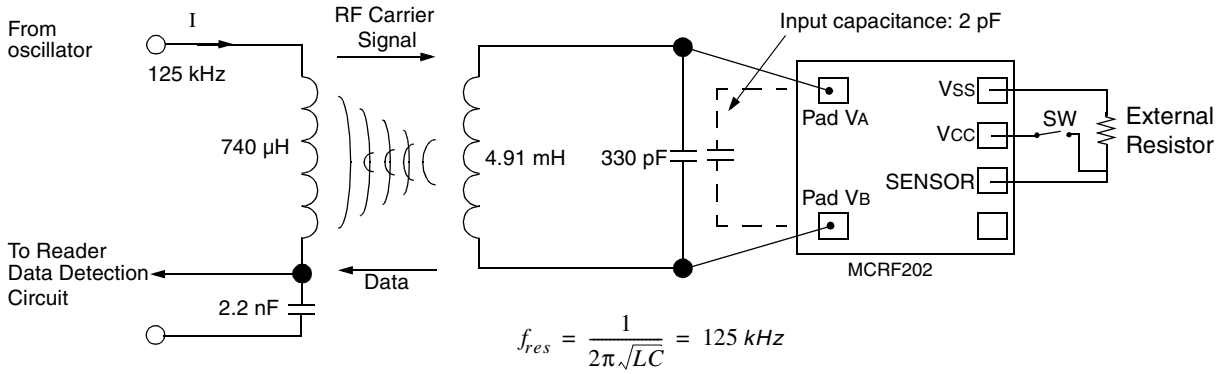
Using MCRF202 with an external, self-powered system



$$f_{res} = \frac{1}{2\pi\sqrt{LC}} = 125\ kHz$$

Device Output
Logic “1” in SENSOR Input: Normal Data Stream
Logic “2” in SENSOR Input: Inverted Data Stream

Using MCRF202 with a low-resistance pull-down



$$f_{res} = \frac{1}{2\pi\sqrt{LC}} = 125\ kHz$$

Device Output
External Switch CLOSED: Normal Data Stream
External Switch OPEN: Inverted Data Stream

MCRF202 PRODUCT IDENTIFICATION GUIDE

To order or obtain information on pricing or delivery, please contact your local Microchip sales office.

MCRF202 – I /WF xxx

Configuration:
Hex Code = Three digit hex value to be programmed into the configuration register. Three hex characters correspond to 12 binary bits. These bits are programmed into the configuration register MSB first (CB12, CB11…CB1). See the example below.

Package:
WF = Sawed wafer on frame (7 mil backgrind)
W = Wafer (11 mil backgrind)
S = Dice in waffle pack (11 mil backgrind)
3C = 330pF, 0.45mm COB
WFB = Sawed, Bumped wafer on frame (11 mil backgrind)
WB = Bumped wafer (11 mil backgring)
SB = Bumped die in waffle pack (11 mil backgrind)
SN = 150 mil, 8-lead SOIC
P = 8-lead PDIP

Temperature Range:
I = -40°C to +85°C

Sample Part Number:
MCRF202-I /W80A

MCRF202-I/W80A = 125 kHz, industrial temperature, wafer package, factory programmed, 96 bit, sensor input, FSK Fc/8 Fc/10, direct encoded, Fc/50 data return rate tag. The configuration register is:

CB12	CB11	CB10	CB9	CB8	CB7	CB6	CB5	CB4	CB3	CB2	CB1
1	0	0	0	0	0	0	0	1	0	1	0

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Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:
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2355 West Chandler Blvd.
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Tel: 480-786-7200 Fax: 480-786-7277
Technical Support: 480-786-7627

Atlanta

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Atlanta, GA 30350
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Chicago

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333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

Microchip Technology Inc.
4570 Westgrove Drive, Suite 160
Addison, TX 75248
Tel: 972-818-7423 Fax: 972-818-2924

Dayton

Microchip Technology Inc.
Two Prestige Place, Suite 150
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit

Microchip Technology Inc.
Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Los Angeles

Microchip Technology Inc.
18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York

Microchip Technology Inc.
150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 516-273-5305 Fax: 516-273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

AMERICAS (continued)

Toronto

Microchip Technology Inc.
5925 Airport Road, Suite 200
Mississauga, Ontario L4V 1W1, Canada
Tel: 905-405-6279 Fax: 905-405-6253

ASIA/PACIFIC

Hong Kong

Microchip Asia Pacific
Unit 2101, Tower 2
Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2-401-1200 Fax: 852-2-401-3431

Beijing

Microchip Technology, Beijing
Unit 915, 6 Chaoyangmen Bei Dajie
Dong Erhuan Road, Dongcheng District
New China Hong Kong Manhattan Building
Beijing 100027 PRC
Tel: 86-10-85282100 Fax: 86-10-85282104

India

Microchip Technology Inc.
India Liaison Office
No. 6, Legacy, Convent Road
Bangalore 560 025, India
Tel: 91-80-229-0061 Fax: 91-80-229-0062

Japan

Microchip Technology Intl. Inc.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa 222-0033 Japan
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Shanghai

Microchip Technology
RM 406 Shanghai Golden Bridge Bldg.
2077 Yan'an Road West, Hong Qiao District
Shanghai, PRC 200335
Tel: 86-21-6275-5700 Fax: 86 21-6275-5060

ASIA/PACIFIC (continued)

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan, R.O.C

Microchip Technology Taiwan
10F-1C 207
Tung Hua North Road
Taipei, Taiwan, ROC
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

United Kingdom

Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5858 Fax: 44-118 921-5835

Denmark

Microchip Technology Denmark ApS
Regus Business Centre
Lautrup hoj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Arizona Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - ler Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Arizona Microchip Technology GmbH
Gustav-Heinemann-Ring 125
D-81739 München, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-39-65791-1 Fax: 39-39-6899883

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