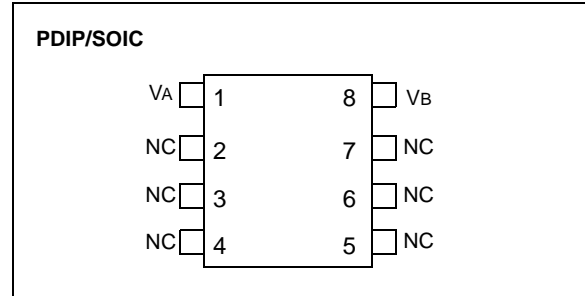


Contactless Programmable Passive RFID Device

FEATURES

- Contactless programmable after encapsulation
- Read only data transmission
- 96 or 128 bits of One-Time Programmable (OTP) user memory (also supports 48 and 64-bit protocols)
- Typical operates at 125 kHz
- On chip rectifier and voltage regulator
- Ultra low power operation
- Factory programming and device serialization available
- 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)

PACKAGE TYPE



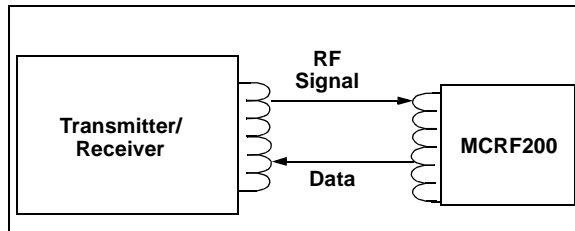
DESCRIPTION

This device is a Radio Frequency Identification (RFID) tag that provides a bidirectional interface for programming and reading the contents of the user array. The device is powered by an external RF transmitter through inductive coupling. When in read mode, the device transmits the contents of its memory array by damping (modulating) the incoming RF signal. The reader is able to detect the damping 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.

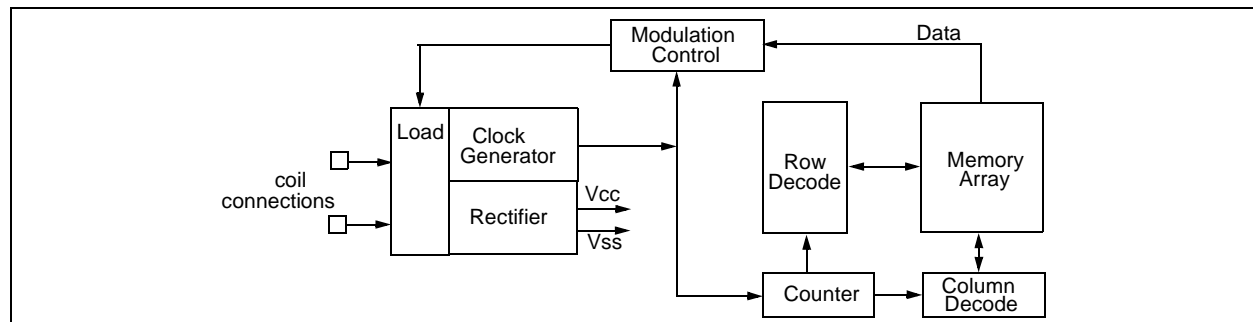
The user memory array of this device can be programmed contactlessly after encapsulation. This allows the user to keep encapsulated blank tags in stock for on-demand personalization. The tags can then be programmed with data as they are needed.

These devices are available in die, wafer, PDIP, SOIC, and COB module form. The encoding, modulation, frequency, and bit rate options are specified by the customer and programmed by Microchip Technology Inc. prior to shipment. Array programming and serialization (SQTP) can also be arranged upon request. See TB023 (page 23) for more information.

APPLICATION



BLOCK DIAGRAM



MCRF200

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: PAD FUNCTION TABLE

| Name | Function |
|-------|-------------------------|
| VA,VB | Coil connection |
| NC | No connection, test pad |

TABLE 1-2: AC AND DC CHARACTERISTICS

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|--|--------|---------------------------------------|------|------|-------|-------------------|
| All parameters apply across the specified operating ranges unless otherwise noted. | | Industrial (I): Tamb = -40°C to +85°C | | | | |
| Clock frequency | FCLK | 100 | — | 150 | kHz | |
| Contactless programming time | TWC | — | 2 | — | s | 128-bit array |
| Data retention | | 200 | — | — | Years | 25°C |
| Coil current (Dynamic) | ICD | — | 50 | | μA | |
| Operating current | IDD | — | 5 | | μA | VCC = 2V |
| Turn-on-voltage (Dynamic) for modulation | VAVB | 10 | — | — | VPP | |
| | VCC | 2 | — | — | VDC | |
| Input Capacitance | CIN | — | 2 | — | pF | Between VA and VB |

FIGURE 1-1: DIE PLOT

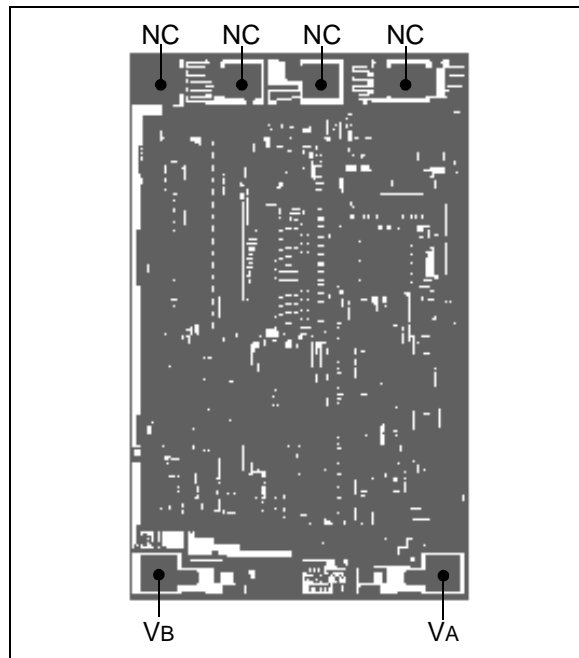


TABLE 1-3 RFID PAD COORDINATES (MICRONS)

| 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 |

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

2.0 FUNCTIONAL DESCRIPTION

The RF section generates all the analog functions needed by the transponder. These include rectification of the carrier, on-chip regulation of VPP (programming voltage), and VDD (operating voltage), as well as high voltage clamping to prevent excessive voltage from being applied to the transponder. This section generates a system clock from the interrogator carrier of the same frequency, detects carrier interrupts, and modulates the tuned LC antenna for transmission to the interrogator. The chip detects a power-up condition and resets the transponder when sufficient voltage develops.

2.1 Rectifier – AC Clamp

The AC voltage generated by the transponder tuned LC circuit is full wave rectified. This unregulated voltage is used as the maximum DC supply voltage for the rest of the chip. The peak voltage on the tuned circuit is clamped by the internal circuitry to a safe level to prevent damage to the IC. This voltage is adjusted during programming to allow sufficient programming voltage to the EEPROM.

2.2 Coil Load Modulation

The MCRF200 communicates to the reader by AM-modulating the coil voltage across the tuned LC circuit.

2.3 VDD Regulator

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

2.4 VPP Regulator

This regulates a programming voltage during the programming mode. The voltage is used for the EEPROM array to perform block erasure of the memory as well as single-bit programming during both contact and contactless programming. During reading, this voltage is level-shifted down and kept below the programming voltages to insure that the part is not inadvertently programmed.

2.5 Clock Generator

This circuit generates a clock based on the interrogator frequency. This clock is used to derive all timing in the tag, including the baud rate, modulation rate, and programming rate.

2.6 IRQ Detector

This circuitry detects an interrupt in the continuous electromagnetic field of the interrogator. An IRQ (interrupt request) is defined as the absence of the electromagnetic field for a specific number of clock cycles. This feature is used during contactless programming.

2.7 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 VDD regulator to allow correct operation. The reset trip points are set such that sufficient voltage across VDD has developed, which allows for correct clocking of the logic for reading of the EEPROM and configuration data, and correct modulation.

2.8 Modulation 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 direct 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, or FSK modulated, or 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 FCLK/2 or FCLK/4.

3.0 CONFIGURATION LOGIC CONTROL BIT REGISTER

The configuration register determines the operational parameters of the device. The configuration register cannot be programmed contactlessly; it is programmed during wafer probe at the Microchip factory. CB11 is always a zero; CB12 is set when successful contact or contactless programming of the data array has been completed. Once CB12 is set, device programming and erasing is disabled. Figure 3-1 contains a description of the control register bit functions.

3.1 Organization

The configuration bit register directly controls logic blocks which generate the baud rate, memory size, encoded data, and modulated data. This register also contains bits which lock the data array.

3.2 Baud Rate Timing

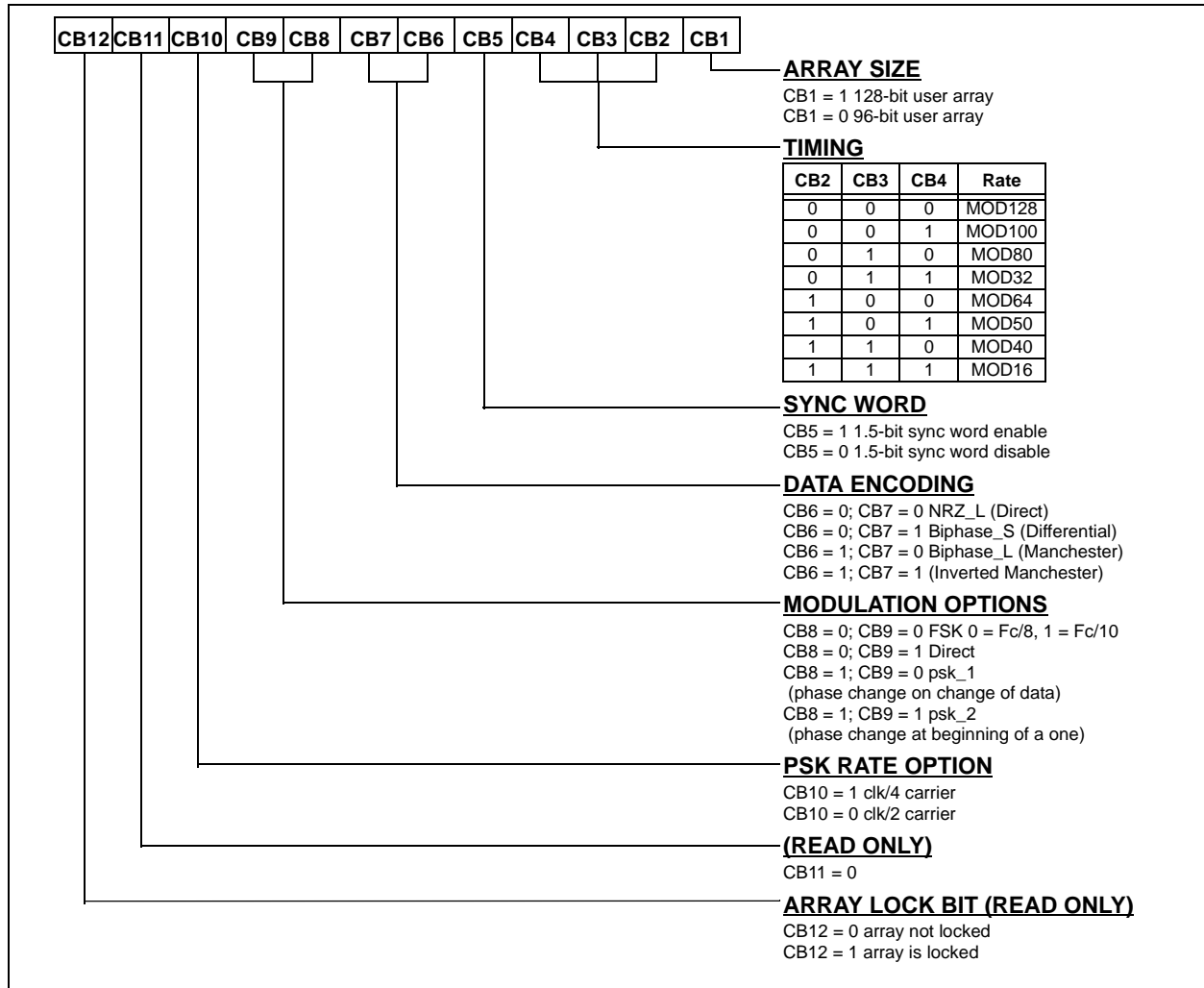
The chip will access data at a baud rate determined by bits CB2, CB3, CB4, and CB5 of the configuration register. CB2, CB3, and CB4 determine the return data rate (CACLK). The default rate of FCLK/128 is used for contact and contactless programming. Once the array is successfully programmed, the lock bit CB12 is set. When the lock bit is cleared, programming and erasing the device becomes permanently disabled. The configuration register has no effect on device timing until after the EEPROM data array is programmed. If CB2 is set to a one and CB5 is set to a one, the 1.5 bit SYNC word option is enabled.

3.3 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 data length during contactless programming is 128 bits.

The column and row decoders route the proper voltage to the array for programming and reading. In the programming modes, each individual bit is addressed serially from bit 1 to bit 128.

FIGURE 3-1: CONFIGURATION REGISTER



4.0 MODES OF OPERATION

The device has two basic modes of operation: Native Mode and Read Mode.

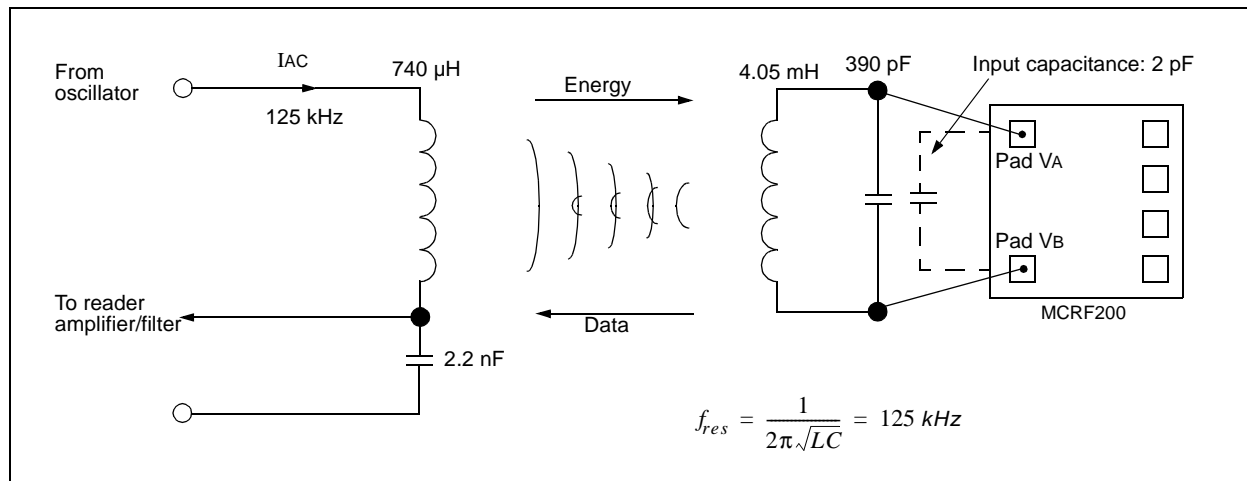
4.1 Native Mode

In native mode, a transponder will have an unprogrammed array and will be in the default mode for contactless programming (default baud rate FCLK/128, FSK, NRZ_direct).

4.2 Read Mode

The second mode is a read mode after the contactless or contact programming has been completed and for the rest of the lifetime of the device. The lock bit CB12 will be set, and when the transponder is powered, it will have the ability to transmit according to the protocol in the configuration register.

FIGURE 4-1: TYPICAL APPLICATION CIRCUIT



MCRF200 GUIDE PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------------------|--|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|
| <p>MCRF 200 - I /WFxxx</p> | <p>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.</p> <p>Package:</p> <p>WF = Sawed wafer on frame (7 mil backgrind) W = Wafer (11 mil backgrind) S = Dice in waffle pack SN = 150 mil SOIC P = PDIP 1C = 0.45 mm COB module with 1000 pF capacitor 3C = 0.70 mm COB module with 330 pF capacitor</p> <p>Temperature Range:</p> <p>I = -40°C to +85°C</p> <p>Sample Part Number:</p> <p>MCRF200-I /W00A</p> <p>MCRF200-I/W00A = 125 kHz, industrial temperature, wafer package, contactlessly programmable, 96 bit, FSK Fc/8 Fc/10, direct encoded, Fc/50 data return rate tag. The configuration register is:</p> <table border="0"> <tr> <td>CB12</td><td>CB11</td><td>CB10</td><td>CB9</td><td>CB8</td><td>CB7</td><td>CB6</td><td>CB5</td><td>CB4</td><td>CB3</td><td>CB2</td><td>CB1</td> </tr> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td> </tr> </table> | CB12 | CB11 | CB10 | CB9 | CB8 | CB7 | CB6 | CB5 | CB4 | CB3 | CB2 | CB1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| CB12 | CB11 | CB10 | CB9 | CB8 | CB7 | CB6 | CB5 | CB4 | CB3 | CB2 | CB1 | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | | | | | | | | | | | | | | |

Sales and Support

Data Sheets

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:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site (www.microchip.com)

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

New Customer Notification System

Register on our web site (www.microchip.com/cn) to receive the most current information on our products.



WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-692-7966 Fax: 480-792-7456

Atlanta

500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Chicago

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

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Dayton

Two Prestige Place, Suite 130
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit

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

Los Angeles

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

New York

150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose

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

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

China - Beijing

Microchip Technology Beijing Office
Unit 915
New China Hong Kong Manhattan Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Shanghai

Microchip Technology Shanghai Office
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

Hong Kong

Microchip Asia Pacific
RM 2101, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaughnessy Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

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

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

Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark

Microchip Technology Denmark ApS
Regus Business Centre
Lautrup hofj 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 - 1er 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 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

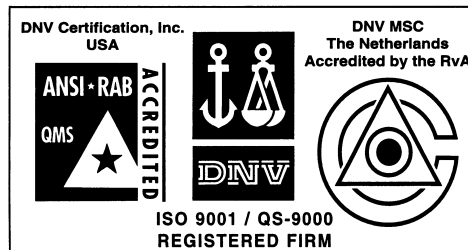
Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

10/01/00



Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELoc® code hopping devices, Serial EEPROMs and microperipheral products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.

All rights reserved. © 2001 Microchip Technology Incorporated. Printed in the USA. 2/01 Printed on recycled paper.

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, except as maybe explicitly expressed herein, under any intellectual property rights. The Microchip logo and name are registered trademarks of Microchip Technology Inc. in the U.S.A. and other countries. All rights reserved. All other trademarks mentioned herein are the property of their respective companies.