MCRF200

Contactless Programmable Passive RFID Device

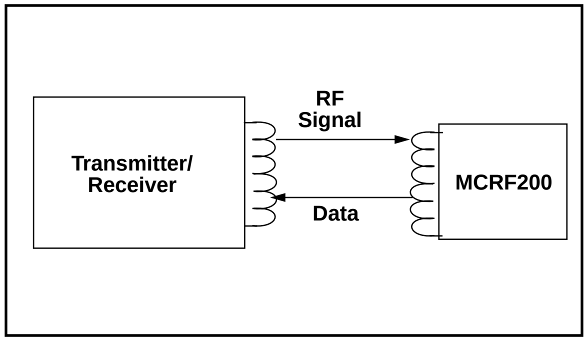
FEATURES

- Contactless programmable after encapsulation
- Read only data transmission
- 96 or 128 bits of OTP user memory
- 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 Bi-Phase, Manchester Bi-Phase, Bi-Phase IDI
- Modulation options:
  - FSK, Direct, PSK (change on data change), PSK (change at the beginning of a one)

DESCRIPTION

This device is a standard 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 the read mode, the device will transmit the contents of its 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.

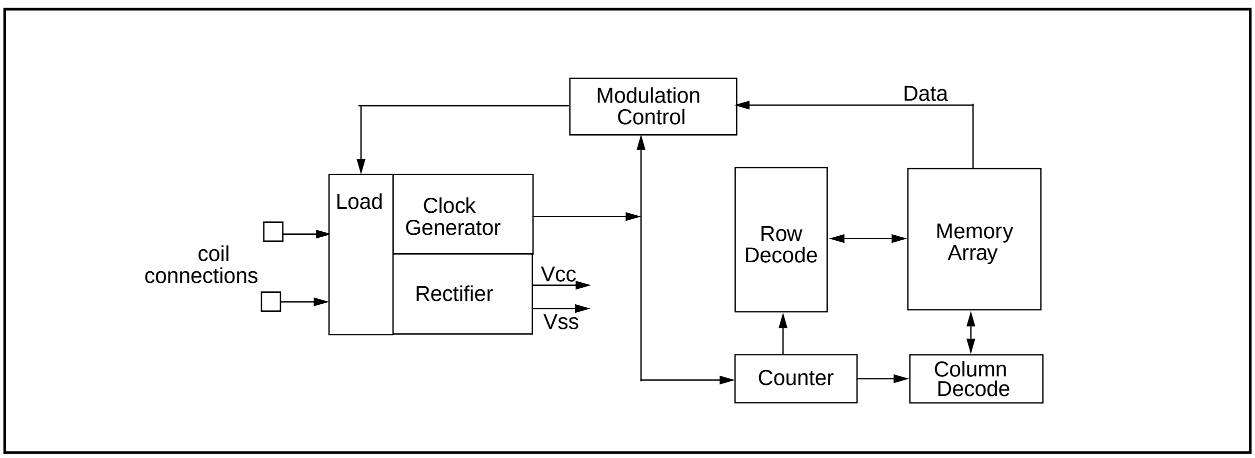
APPLICATION



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 form. The encoding, modulation, frequency, and bit rate options are specified by the customer and programmed by Microchip prior to shipment. Array programming and serialization can also be arranged upon request.

BLOCK DIAGRAM



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

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	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 VCC	10 2	— —	— —	VPP VDC	

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FIGURE 1-1: DIE PLOT

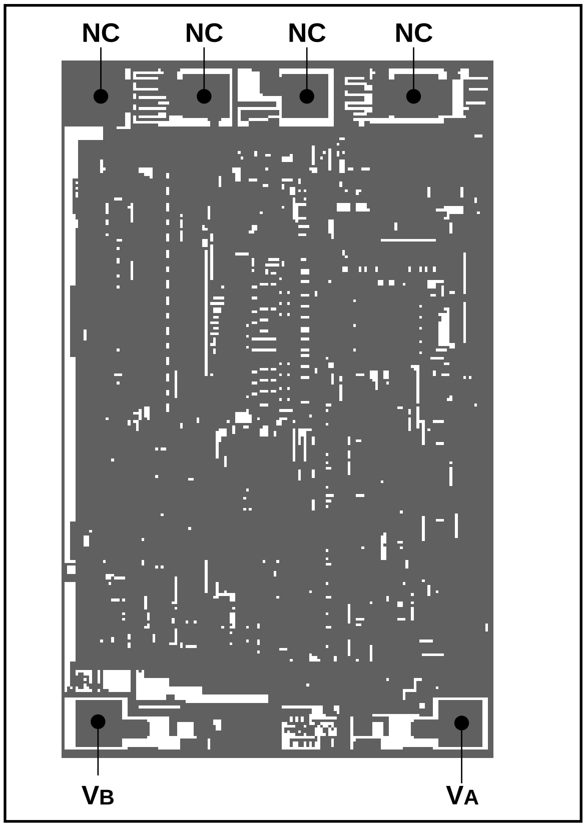


TABLE 1-3: RFID PAD COORDINATES (MICRONS)

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.
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 V_{PP} (programming voltage), and V_{DD} (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 by modulating the load across the tuned LC circuit, which modulates the received RF field.

2.3 V_{DD} Regulator

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

2.4 V_{PP} Regulator

This regulates a programming voltage during the programming mode. The voltage is switched into 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 with a frequency equal to 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 V_{DD} regulator to allow correct operation. The reset trip points are set such that sufficient voltage across V_{DD} 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 Bi-Phase Differential, Bi-Phase 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 $F_{CLK}/2$ or $F_{CLK}/4$.

3.0 CONFIGURATION LOGIC

3.1 Control Bit Register

The configuration register determines the operational parameters of the device. The configuration register can not 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, programming and erasing of the device is disabled. Figure 3-1 contains a description of the control register bit functions.

3.2 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.

3.3 Baud Rate Timing

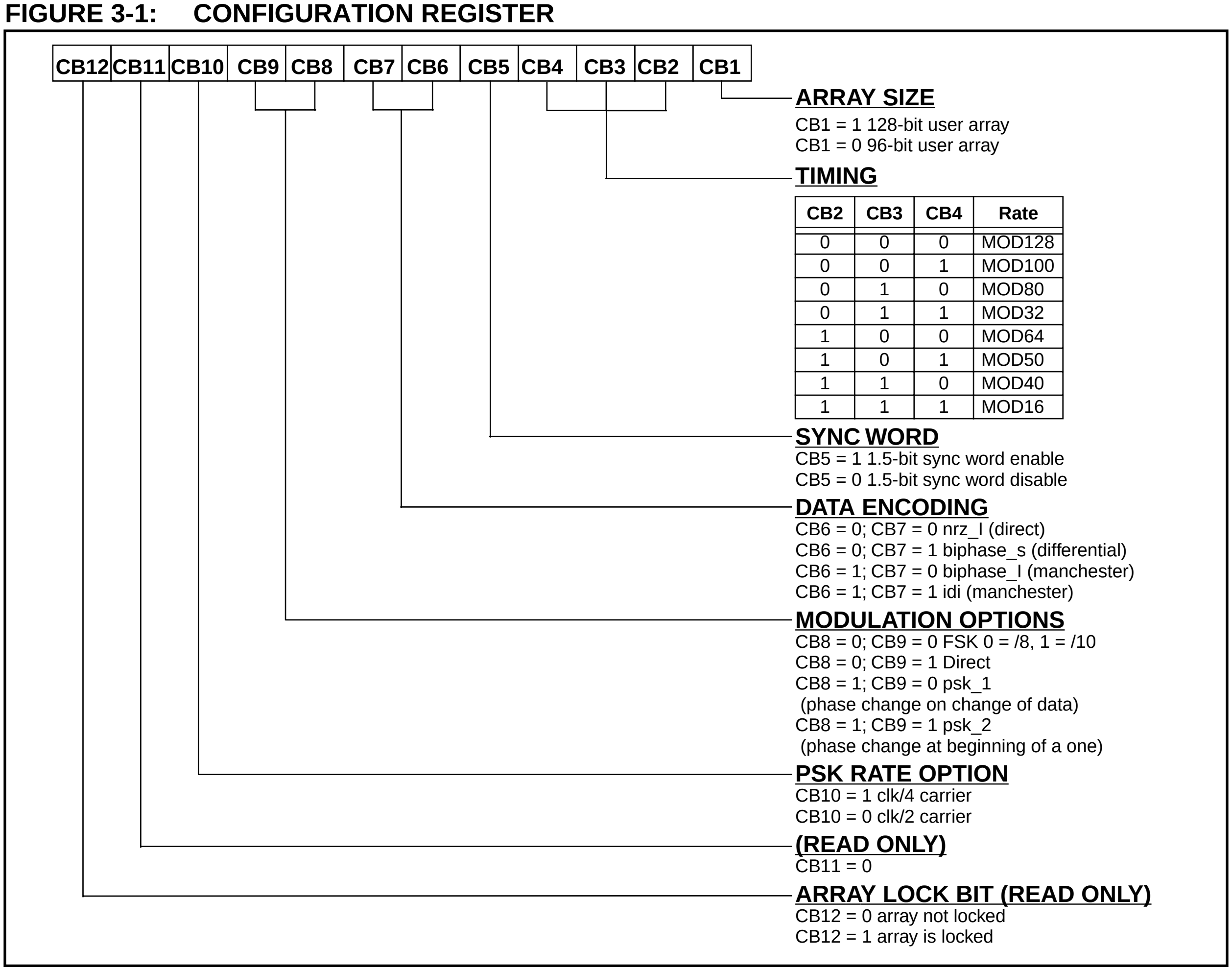
The chip will access data at a baud rate determined by bits CB2, CB3, CB4, and CB5 of the configuration register. CB2, CB3, and CB4 determine the return data rate (CACLK). The default rate of FCLK/128 is used for contact and contactless programming. Once the array is successfully programmed, the lock 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.

3.4 Column and Row Decoder Logic and Bit Counter

The column and row decoders address the EEPROM array at the CACLK 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



CB2	CB3	CB4	Rate
0	0	0	MOD128
0	0	1	MOD100
0	1	0	MOD80
0	1	1	MOD32
1	0	0	MOD64
1	0	1	MOD50
1	1	0	MOD40
1	1	1	MOD16

4.0 MODES OF OPERATION

The device has two basic modes of operation, which are discussed below.

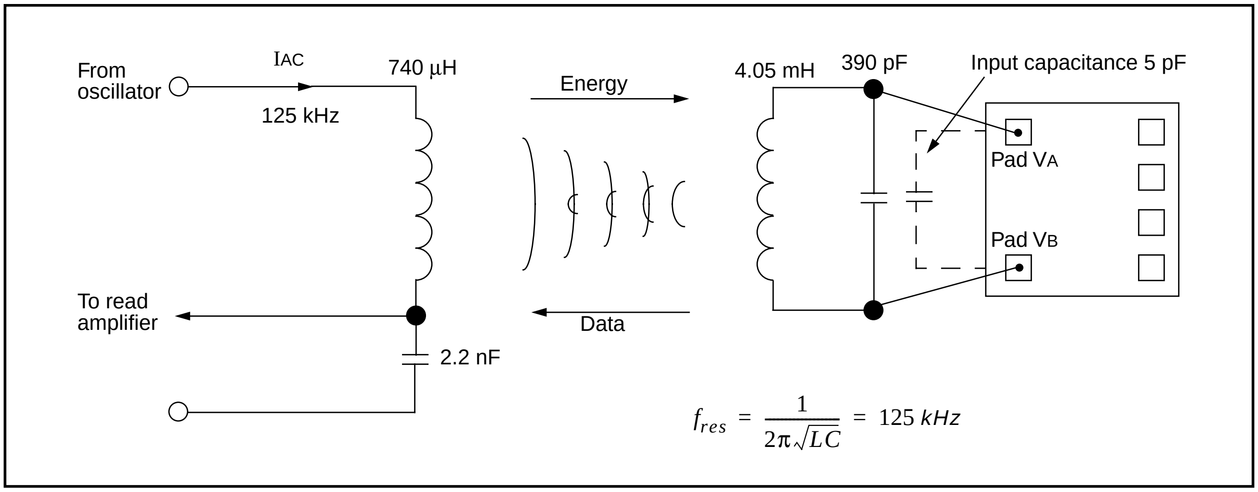
4.1 Native Mode

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



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MCRF200 PRODUCT IDENTIFICATION SYSTEM

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

MCRF 200 – I /WFxxx

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
	S =	Dice in waffle pack
Temperature Range:	I =	-40°C to +85°C
Sample Part Number:		MCRF200-I /W00A
	MCRF200-I/W00A =	125 kHz, industrial temperature, wafer package, contactlessly programmable, 96 bit, FSK /8 /10, direct encoded, F/50 data return rate tag. The configuration register is:

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 (see last page).
2. The Microchip Corporate Literature Center U.S. FAX: (602) 786-7277.
3. The Microchip's Bulletin Board, via your local CompuServe number (CompuServe membership NOT required).

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