# MCRF200

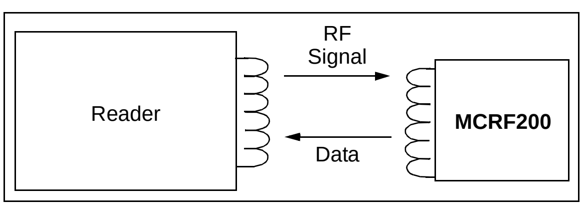
## 125 kHz microID™ Passive RFID Device

### Features

- Factory programming and memory serialization (SQTP℠)
- One-time contactless programmable (developer kit only)
- Read-only data transmission after programming
- 96 or 128 bits of One-Time Programmable (OTP) user memory (also supports 48 and 64-bit protocols)
- Typical operation frequency: 100 kHz-400 kHz
- Ultra low-power operation (5 µA @ $V_{CC}$ = 2V)
- Modulation options:
  - ASK, FSK, PSK
- Data Encoding options:
  - NRZ Direct, Differential Biphase, Manchester Biphase
- Die, wafer, COB, PDIP or SOIC package options
- Factory programming options

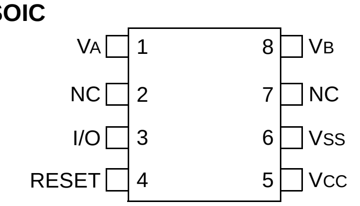
### Application

- Low-cost alternative for existing low-frequency RFID devices
- Access control and time attendance
- Security systems
- Animal tagging
- Product identification
- Industrial tagging
- Inventory control




### Package Type

**PDIP/SOIC**



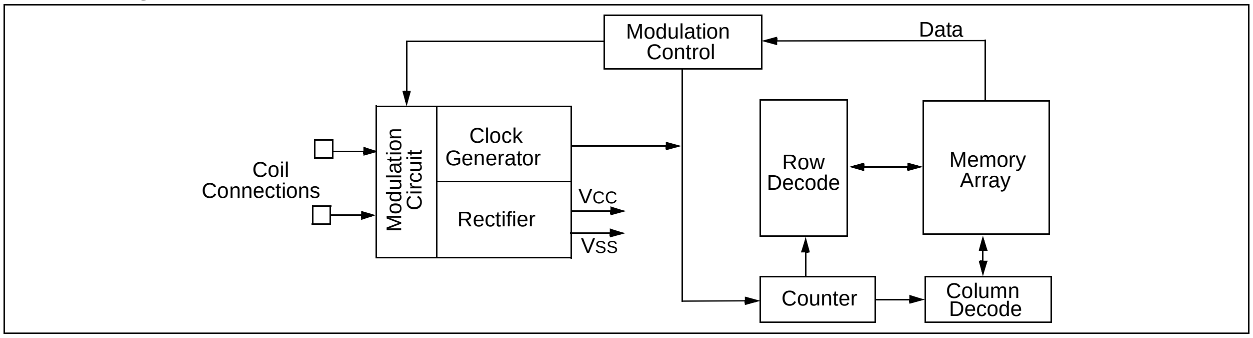

**Note:** Pins 3, 4, 5 and 6 are for device test purposes only. Pins 1 and 8 are for antenna connections. DO NOT ground pin 5.

### Description

The MCRF200 is a passive Radio Frequency Identification (RFID) device for low-frequency applications (100 kHz-400 kHz). The device is powered by rectifying an incoming RF signal from the reader. The device requires an external LC resonant circuit to receive the incoming RF signal and to send data. The device develops a sufficient DC voltage for operation when its external coil voltage reaches approximately 10 $V_{PP}$.

This device has a total of 128 bits of user programmable memory and an additional 12 bits in its configuration register. The user can manually program the 128 bits of user memory by using a contactless programmer in a microID developer kit such as DV103001 or PG103001. However, in production volume the MCRF200 is programmed at the factory (Microchip SQTP – see Technical Bulletin TB023). The device is a One-Time Programmable (OTP) integrated circuit and operates as a read-only device after programming.

## Block Diagram




The configuration register includes options for communication protocol (ASK, FSK, PSK), data encoding method, data rate, and data length.These options are specified by customer and factory programmed during assembly. Because of its many choices of configuration options, the device can be easily used as an alternative or second source for most of the existing low frequency passive RFID devices available today.

The device has a modulation transistor between the two antenna connections ($V_A$ and $V_B$). The modulation transistor damps or undamps the coil voltage when it sends data. The variation of coil voltage controlled by the modulation transistor results in a perturbation of voltage in reader antenna coil. By monitoring the changes in reader coil voltage, the data transmitted from the device can be reconstructed.

The device is available in die, wafer, Chip-on-Board (COB) modules, PDIP, or SOIC packages. Factory programming and memory serialization (SQTP) are also available upon request. See TB023 for more information on contact programming support.

The DV103001 developer's kit includes Contactless Programmer, ASK, FSK, PSK reference readers, and reference design guide. The reference design guide includes schematics for readers and contactless programmer as well as in-depth document for antenna circuit designs.

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings (†)

Storage temperature ............................................ - 65°C to +150°C

Ambient temperature with power applied.......................... -40°C to +125°C

Maximum current into coil pads ................................. 50 mA

† NOTICE: Stresses above those listed under “Absolute 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): $T_A$ = -40°C to +85°C | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sym** | **Min** | **Typ** | **Max** | **Units** | **Conditions** |
| Clock frequency | $F_{CLK}$ | 100 | — | 400 | kHz | |
| Contactless programming time | $T_{WC}$ | — | 2 | — | sec | For all 128-bit array |
| Data retention | | 200 | — | — | Years | at 25°C |
| Coil current (Dynamic) | $I_{CD}$ | — | 50 | | µA | |
| Operating current | $I_{DD}$ | — | 5 | | µA | $V_{CC}$ = 2V |
| Turn-on-voltage (Dynamic) for modulation | $V_AV_B$<br>$V_{CC}$ | 10<br>2 | —<br>— | —<br>— | $V_{PP}$<br>$V_{DC}$ | |
| Input Capacitance | $C_{IN}$ | — | 2 | — | pF | Between $V_A$ and $V_B$ |

## 2.0 FUNCTION DESCRIPTION

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

### 2.1 RF Front-End

The RF front-end of the device includes circuits for rectification of the carrier, $V_{DD}$ (operating voltage) and high-voltage clamping. This section also includes a clock generator and modulation circuit.

#### 2.1.1 RECTIFIER – AC CLAMP

The rectifier circuit rectifies RF voltage on the external LC antenna circuit. 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 POWER-ON RESET

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

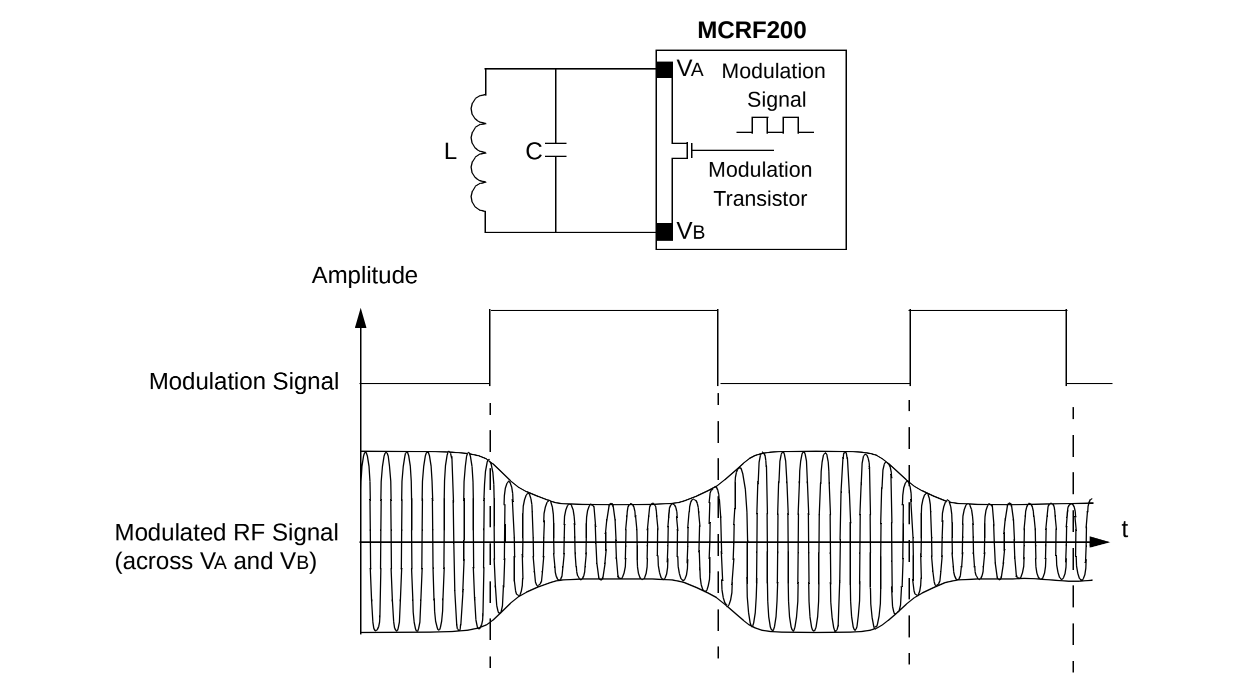
#### 2.1.3 CLOCK GENERATOR

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

#### 2.1.4 MODULATION CIRCUIT

The device 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 two antenna coil pads ($V_A$ and $V_B$). 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.

**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. 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, device programming and erasing is disabled. Table 2-4 contains a description of the bit functions of the control register.

### 2.2.1 BAUD RATE TIMING OPTION

The chip will access data at a baud rate determined by bits CB2, CB3 and CB4 of the configuration register. For example, MOD32 (CB2 = 0, CB3 = 1, CB4 = 1) has 32 RF cycles per bit. This gives the data rate of 4 kHz for the RF carrier frequency of 128 kHz.

The default timing is MOD128 (FCLK/128), and this mode is used for contact and contactless programming. Once the array is successfully programmed, the lock bit CB12 is set. When the lock bit is set, programming and erasing the device becomes permanently disabled. The configuration register has no effect on device timing until the EEPROM data array is programmed (CB12 = 1).

### 2.2.2 DATA ENCODING OPTION

This logic acts upon the serial data being read from the EEPROM. The logic encodes the data according to the configuration bits CB6 and CB7. CB6 and CB7 determine the data encoding method. The available choices are:

- Non-return to zero-level (NRZ_L)
- Biphase Differential, Biphase Manchester
- Inverted Manchester

### 2.2.3 MODULATION OPTION

CB8 and CB9 determine the modulation protocol of the encoded data. The available choices are:

- ASK
- FSK
- PSK_1
- PSK_2

When ASK (direct) option is chosen, the encoded data is fed into the modulation transistor without change.

When FSK option is chosen, the encoded data is represented by:

a) Sets of 10 RF carrier cycles (first 5 cycles → higher amplitude, the last 5 cycles → lower amplitude) for logic “high” level.

b) Sets of 8 RF carrier cycles (first 4 cycles → higher amplitude, the last 4 cycles → lower amplitude) for logic “low” level.

For example, FSK signal for MOD40 is represented:

a) 4 sets of 10 RF carrier cycles for data ‘1’.

b) 5 sets of 8 RF carrier cycles for data ‘0’.

Refer to Figure 2-2 for the FSK signal with MOD40 option.

The PSK_1 represents change in the phase of the modulation signal at the change of the encoded data. For example, the phase changes when the encoded data is changed from ‘1’ to ‘0’, or from ‘0’ to ‘1’.

The PSK_2 represents change in the phase at the change on ‘1’. For example, the phase changes when the encoded data is changed from ‘0’ to ‘1’, or from ‘1’ to ‘1’.

**FIGURE 2-2: ENCODED DATA AND FSK OUTPUT SIGNAL FOR MOD40 OPTION**

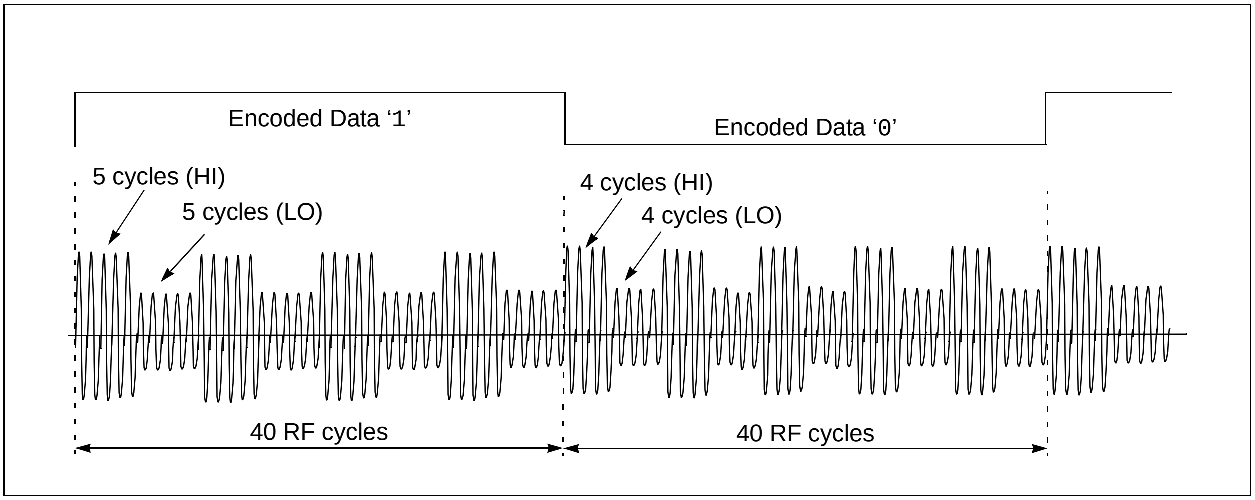
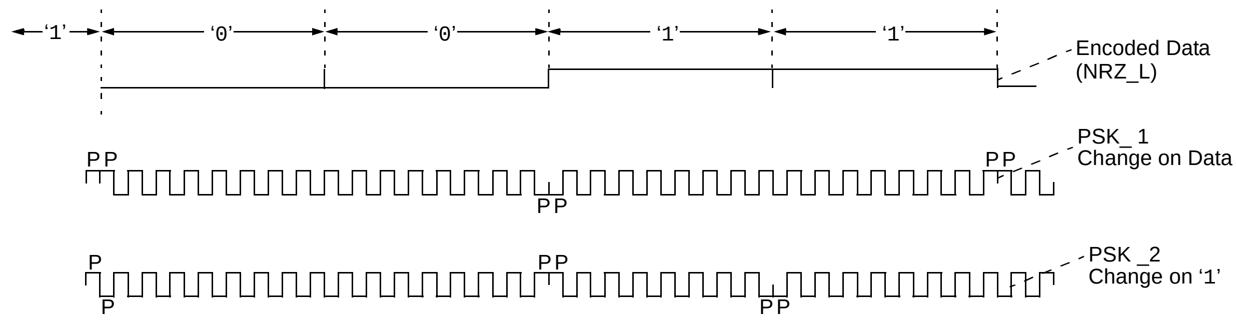


**FIGURE 2-3: PSK DATA MODULATION**




### 2.2.4 MEMORY ARRAY LOCK BIT (CB12)

The CB12 must be ‘0’ for contactless programming (Blank). The bit (CB12) is automatically set to ‘1’ as soon as the device is programmed contactlessly.

## 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 the CB1 bit in the configuration register. See Table 2-4 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 data 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 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.

## 2.4 Examples of Configuration Settings

**EXAMPLE 2-1: “08D” CONFIGURATION**

The “08D” (hex) configuration is interpreted as follows:

CB12 (MSB) … CB1 (LSB)

“08D” → `0000-1000-1101`

Referring to Table 2-4, the “08D” configuration represents:

Modulation = PSK_1
PSK rate = rf/2
Data encoding = NRZ_L (direct)
Baud rate = rf/32 = MOD32
Memory size 128 bits

**EXAMPLE 2-2: “00A” CONFIGURATION**

The “00A” (hex) configuration is interpreted as follows:

CB12 (MSB) … CB1 (LSB)

“00A” → `0000-0000-1010`

The MSB corresponds to CB12 and the LSB corresponds to CB1 of the configuration register. Therefore, we have:

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

Referring to Table 2-4, the “00A” configuration represents:

Not programmed device (blank), anticollision: disabled, FSK protocol, NRZ_L (direct) encoding, MOD50 (baud rate = rf/50), 96 bits.

**EXAMPLE 2-3: MCRF200 CONFIGURATION FOR FDX-B ISO ANIMAL STANDARD PROTOCOL (ASP)**

The FDX-B ISO Specification is:

Modulation = ASK
Data encoding = Differential biphase
Baud rate = rf/32 = 4 Kbits/sec for 128 kHz
Memory size = 128 bits

Referring to Table 2-4, the equivalent MCRF200 configuration is: “14D”.

**TABLE 2-4: CONFIGURATION REGISTER**

| CB12 | CB11 | CB10 | CB9 | CB8 | CB7 | CB6 | CB5 | CB4 | CB3 | CB2 | CB1 |
|---|---|---|---|---|---|---|---|---|---|---|---|

**MEMORY SIZE**

CB1 = 1 128-bit user memory array
CB1 = 0 96-bit user memory array

**BAUD RATE**

| 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 |

**SYNC WORD**

CB5 = 0 (Always)

**DATA ENCODING**

CB6 = 0; CB7 = 0 NRZ_L (Direct)
CB6 = 0; CB7 = 1 Biphase_S (Differential)
CB6 = 1; CB7 = 0 Biphase_L (Manchester)
CB6 = 1; CB7 = 1 (Inverted Manchester)

**MODULATION OPTIONS**

CB8 = 0; CB9 = 0 FSK 0 = Fc/8, 1 = Fc/10
CB8 = 0; CB9 = 1 Direct (ASK)
CB8 = 1; CB9 = 0 PSK_1
(phase change on change of data)
CB8 = 1; CB9 = 1 PSK_2
(phase change at beginning of a one)

**PSK RATE OPTION**

CB10 = 1 Carrier/4
CB10 = 0 Carrier/2

**(ANTICOLLISION OPTION (Read-only)**

CB11 = 0 Disabled (Always)

**MEMORY ARRAY LOCK BIT (Read-only)**

CB12 = 0 User memory array not locked (Blank)
CB12 = 1 User memory array is locked
(Programmed)

## 3.0 MODES OF OPERATION

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

### 3.1 Native Mode

Every unprogrammed blank device (CB12=0) operates in Native mode, regardless of configuration register settings:

FCLK/128, FSK, NRZ_L (direct)

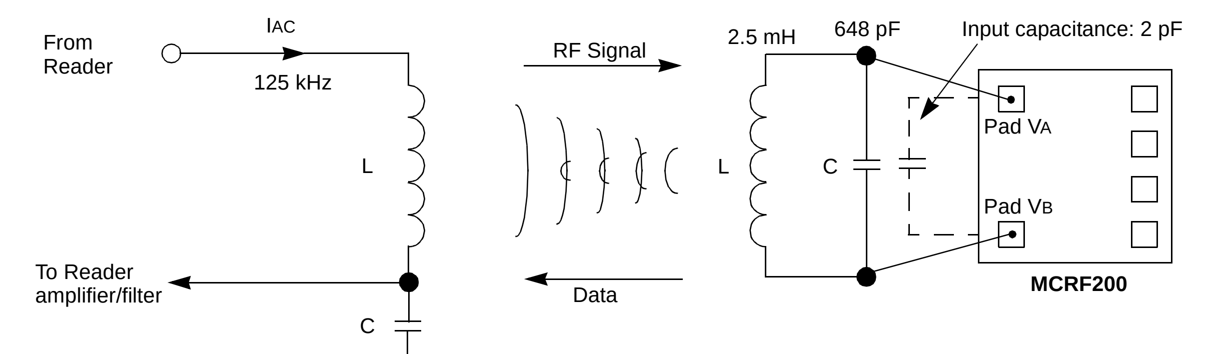
Once the user memory is programmed, the lock bit is set (CB12=1) which causes the MCRF200 to switch from Native mode to the Communication mode defined by the configuration register.

Refer to Figure 4-1 for contactless programming sequence. Also see the *microID™ 125 kHz RFID System Design Guide* (DS51115) for more information.

### 3.2 Read Mode

After the device is programmed (CB12=1), the device is operated in the Read-only mode. The device transmits its data according to the protocol in the configuration register.

**FIGURE 3-1: TYPICAL APPLICATION CIRCUIT**




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

## 4.0 CONTACTLESS PROGRAMMING

The contactless programming of the device is possible for blank devices (CB12=0) only and is recommended for only low-volume, manual operation during development. In volume production, the MCRF200 is normally used as a factory programmed device only. The contactless programming timing sequence consists of:

a) RF power-up signal.
b) Short gap (absence of RF field).
c) Verify signal (continuous RF signal).
d) Programming signal.
e) Device response with programmed data.

The blank device (CB12=0) understands the RF power-up followed by a gap as a blank checking command, and outputs 128 bits of FSK data with all '1's after the short gap. To see this blank data (verify), the reader/programmer must provide a continuous RF signal for 128 bit-time. (The blank (unprogrammed) device has all 'F's in its memory array. Therefore, the blank data should be all '1's in FSK format). Since the blank device operates at Default mode (MOD128), there are 128 RF cycles for each bit. Therefore, the time requirement to complete this verify is 128 bits x 128 RF cycles/bit x 8 use/cycles = 131.1 msec for 125 kHz signal.

As soon as the device completes the verify, it enters the programming mode. The reader/programmer must provide RF programming data right after the verify. In this programming mode, each bit lasts for 128 RF cycles. Refer to Figure 4-1 for the contactless programming sequence.

Customer must provide the following specific voltage for the programming:

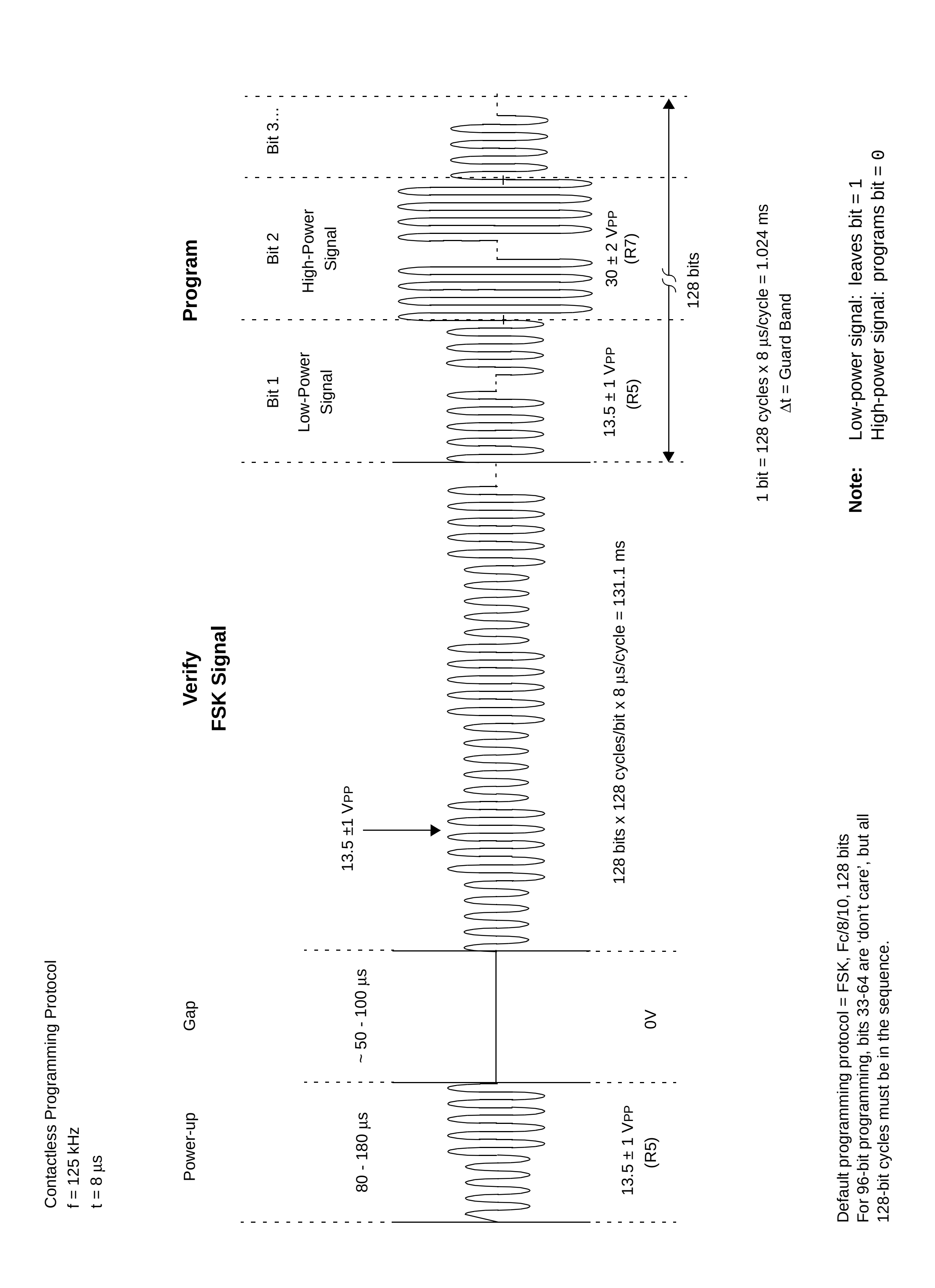
1. Power-up and verify signal = 13.5V ±1 $V_{PP}$
2. Programming voltage:
   - To program bit to '1': 13.5V ±1 $V_{PP}$
   - To program bit to '0': 30V ±2 $V_{PP}$

After the programming cycle, the device outputs programmed data (response). The reader/programmer can send the programming data repeatedly after the device response until the programming is successfully completed. The device locks the CB12 as soon as the programming mode (out of field) is exited and becomes a read-only device.

Once the device is programmed (CB12=1), the device outputs its data according to the configuration register.

The PG103001 (Contactless Programmer) is used for the programming of the device. The voltage level shown in Figure 4-1 is adjusted by R5 and R7 in the contactless programmer. Refer to the *MicroID™ 125 kHz RFID System Design Guide* (DS51115) for more information.

**FIGURE 4-1: CONTACTLESS PROGRAMMING SEQUENCE**



## 5.0 MECHANICAL SPECIFICATIONS FOR DIE AND WAFER

**FIGURE 5-1: DIE PLOT**

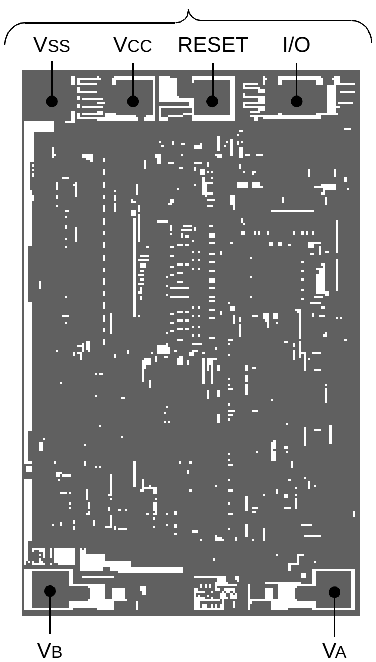



**TABLE 5-1: PAD COORDINATES (μm)**

| 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
44.15 mils x 68.44 mils

**TABLE 5-2: PAD FUNCTION TABLE**

| Name | Function |
|---|---|
| VA | Antenna Coil connection |
| VB | |
| VSS | For device test only<br>Do Not Connect to Antenna |
| VCC | |
| RESET | |
| I/O | |

**TABLE 5-3: DIE MECHANICAL DIMENSIONS**

| Specifications | Min | Typ | Max | Unit | Comments |
|---|---|---|---|---|---|
| Bond pad opening | —<br>— | 3.5 x 3.5<br>89 x 89 | —<br>— | mil<br>µm | **Note 1, Note 2** |
| Die backgrind thickness | —<br>— | 7<br>177.8 | —<br>— | mil<br>µm | Sawed 6” wafer on frame (option = WF) **Note 3** |
| | —<br>— | 11<br>279.4 | —<br>— | mil<br>µm | Unsawed wafer (option = W) **Note 3** |
| Die backgrind thickness tolerance | —<br>— | —<br>— | ±1<br>±25.4 | mil<br>µm | |
| Die passivation thickness (multilayer) | — | 0.9050 | — | µm | **Note 4** |
| Die Size:<br>Die size X*Y before saw (step size)<br>Die size X*Y after saw | <br>—<br>— | <br>44.15 x 68.44<br>42.58 x 66.87 | <br>—<br>— | <br>mil<br>mil | <br>—<br>— |

**Note 1:** The bond pad size is that of the passivation opening. The metal overlaps the bond pad passivation by at least 0.1 mil.

**2:** Metal Pad Composition is 98.5% Aluminum with 1% Si and 0.5% Cu.

**3:** As the die thickness decreases, susceptibility to cracking increases. It is recommended that the die be as thick as the application will allow.

**4:** The Die Passivation thickness (0.905 µm) can vary by device depending on the mask set used. The passivation is formed by:

-Layer 1: Oxide (undoped oxide 0.135 µm)

-Layer 2: PSG (doped oxide, 0.43 µm)

-Layer 3: Oxynitride (top layer, 0.34 µm)

**5:** The conversion rate is 25.4 µm/mil.

**Notice:** Extreme care is urged in the handling and assembly of die products since they are susceptible to mechanical and electrostatic damage.

**TABLE 5-4: WAFER MECHANICAL SPECIFICATIONS**

| Specifications | Min | Typ | Max | Unit | Comments |
|---|---|---|---|---|---|
| Wafer Diameter | — | 8 | — | inch | 150 mm |
| Die separation line width | — | 80 | — | µm | |
| Dice per wafer | — | 14,000 | — | die | |
| Batch size | — | 24 | — | wafer | |

## 6.0 FAILED DIE IDENTIFICATION

Every die on the wafer is electrically tested according to the data sheet specifications and visually inspected to detect any mechanical damage such as mechanical cracks and scratches.

Any failed die in the test or visual inspection is identified by black colored ink. Therefore, any die covered with black ink should not be used.

The ink dot specification:

- Ink dot size: minimum 20 µm x 20 µm
- Position: central third of die
- Color: black

## 7.0 WAFER DELIVERY DOCUMENTATION

Each wafer container is marked with the following information:

- Microchip Technology Inc. MP Code
- Lot Number
- Total number of wafers in the container
- Total number of good dice in the container
- Average die per wafer (DPW)
- Scribe number of wafers with number of good dice

## 8.0 NOTICE ON DIE AND WAFER HANDLING

The device is very susceptible to Electrostatic Discharge (ESD). ESD can cause critical damage to the device. Special attention is needed during the handling process.

Any untraviolet (UV) light can erase the memory cell contents of an unpackaged device. Flourescent lights and sun light can also erase the memory cell although it takes more time than UV lamps. Therefore, keep any unpackaged devices out of UV light and also avoid direct exposure from strong flourescent lights and sun light.

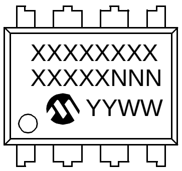
Certain integrated circuit (IC) manufacturing, chip-on-board (COB) and tag assembly operations may use UV light. Operations such as backgrind, de-tape, certain cleaning operations, epoxy or glue cure should be done without exposing the die surface to UV light.

Using x-ray for die inspection will not harm the die, nor erase memory cell contents.

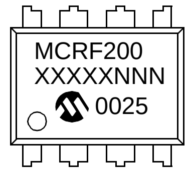
## 9.0 PACKAGING INFORMATION

### 9.1 Package Marking Information

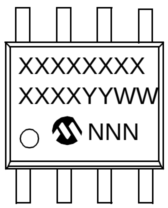
8-Lead PDIP (300 mil)



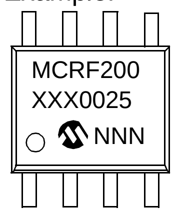

Example:




8-Lead SOIC (150 mil)




Example:

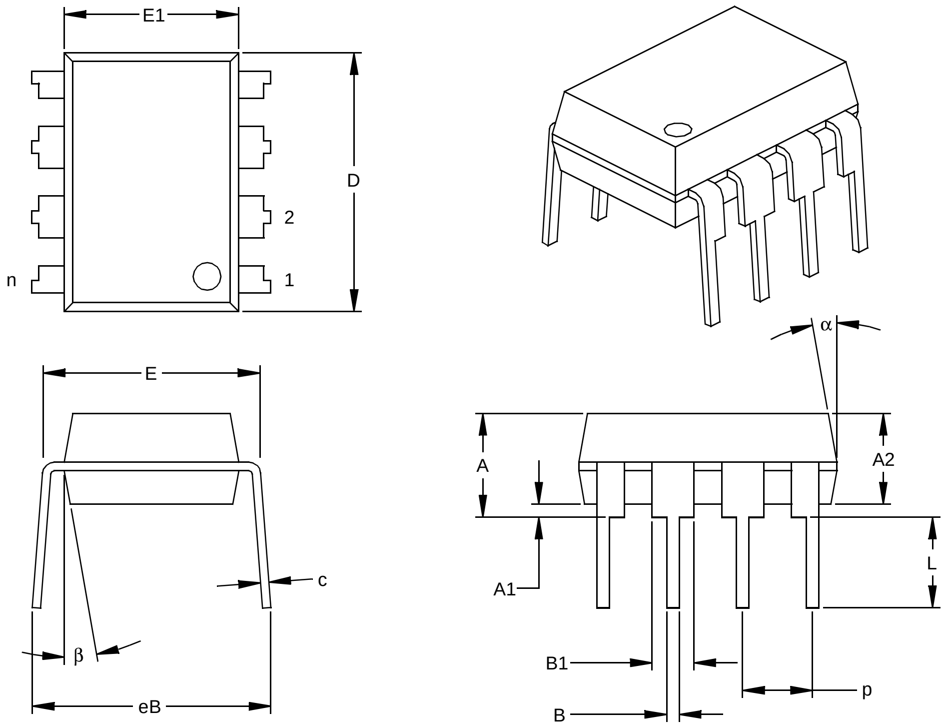



| | | |
|---|---|---|
| **Legend:** | XX...X | Customer specific information* |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week ‘01’) |
| | NNN | Alphanumeric traceability code |

**Note**: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line thus limiting the number of available characters for customer specific information.

* Standard device marking consists of Microchip part number, year code, week code, and traceability code.

## 8-Lead Plastic Dual In-line (P) – 300 mil (PDIP)

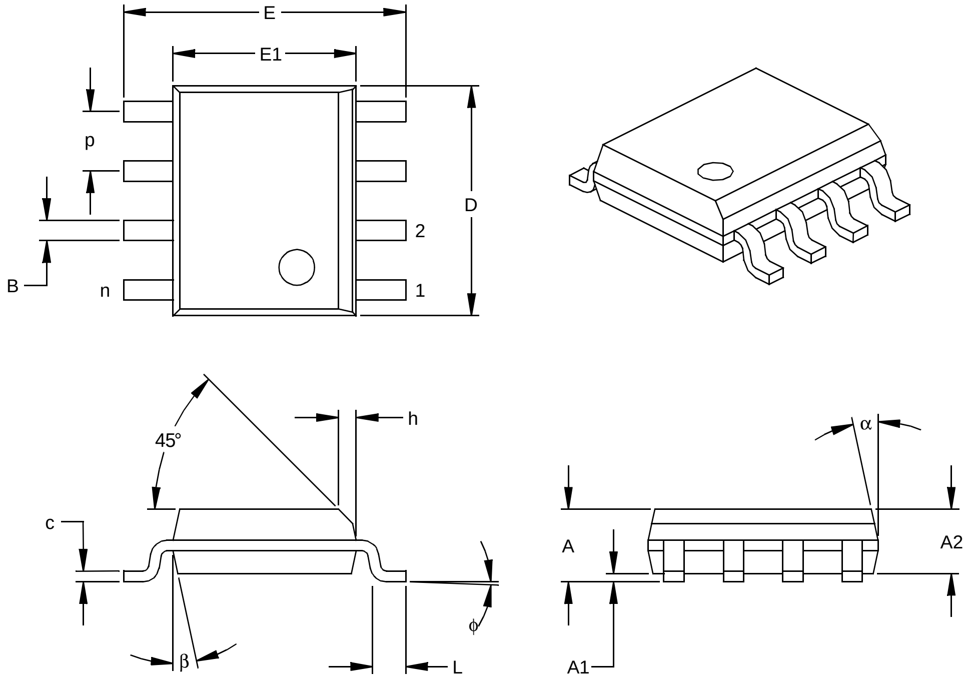



| UNITS | | INCHES* | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|---|
| DIMENSION LIMITS | | MIN | NOM | MAX | MIN | NOM | MAX |
| Number of Pins | n | | 8 | | | 8 | |
| Pitch | p | | .100 | | | 2.54 | |
| Top to Seating Plane | A | .140 | .155 | .170 | 3.56 | 3.94 | 4.32 |
| Molded Package Thickness | A2 | .115 | .130 | .145 | 2.92 | 3.30 | 3.68 |
| Base to Seating Plane | A1 | .015 | | | 0.38 | | |
| Shoulder to Shoulder Width | E | .300 | .313 | .325 | 7.62 | 7.94 | 8.26 |
| Molded Package Width | E1 | .240 | .250 | .260 | 6.10 | 6.35 | 6.60 |
| Overall Length | D | .360 | .373 | .385 | 9.14 | 9.46 | 9.78 |
| Tip to Seating Plane | L | .125 | .130 | .135 | 3.18 | 3.30 | 3.43 |
| Lead Thickness | c | .008 | .012 | .015 | 0.20 | 0.29 | 0.38 |
| Upper Lead Width | B1 | .045 | .058 | .070 | 1.14 | 1.46 | 1.78 |
| Lower Lead Width | B | .014 | .018 | .022 | 0.36 | 0.46 | 0.56 |
| Overall Row Spacing § | eB | .310 | .370 | .430 | 7.87 | 9.40 | 10.92 |
| Mold Draft Angle Top | α | 5 | 10 | 15 | 5 | 10 | 15 |
| Mold Draft Angle Bottom | β | 5 | 10 | 15 | 5 | 10 | 15 |

* Controlling Parameter
§ Significant Characteristic

**Notes:**
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.
JEDEC Equivalent: MS-001
Drawing No. C04-018

## 8-Lead Plastic Small Outline (SN) – Narrow, 150 mil (SOIC)

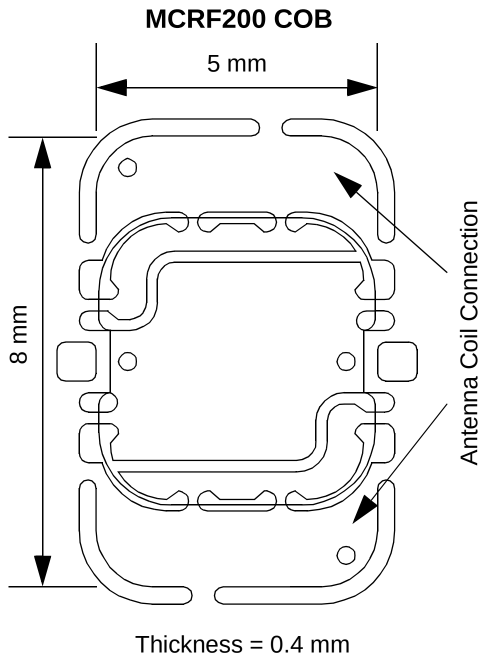



| UNITS | | INCHES* | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|---|
| DIMENSION LIMITS | | MIN | NOM | MAX | MIN | NOM | MAX |
| Number of Pins | n | | 8 | | | 8 | |
| Pitch | p | | .050 | | | 1.27 | |
| Overall Height | A | .053 | .061 | .069 | 1.35 | 1.55 | 1.75 |
| Molded Package Thickness | A2 | .052 | .056 | .061 | 1.32 | 1.42 | 1.55 |
| Standoff § | A1 | .004 | .007 | .010 | .10 | .18 | .25 |
| Overall Width | E | .228 | .237 | .244 | 5.79 | 6.02 | 6.20 |
| Molded Package Width | E1 | .146 | .154 | .157 | 3.71 | 3.91 | 3.99 |
| Overall Length | D | .189 | .193 | .197 | 4.80 | 4.90 | 5.00 |
| Chamfer Distance | h | .010 | .015 | .020 | .25 | .38 | .51 |
| Foot Length | L | .019 | .025 | .030 | .48 | .62 | .76 |
| Foot Angle | φ | 0 | 4 | 8 | 0 | 4 | 8 |
| Lead Thickness | c | .008 | .009 | .010 | .20 | .23 | .25 |
| Lead Width | B | .013 | .017 | .020 | .33 | .42 | .51 |
| Mold Draft Angle Top | α | 0 | 12 | 15 | 0 | 12 | 15 |
| Mold Draft Angle Bottom | β | 0 | 12 | 15 | 0 | 12 | 15 |

* Controlling Parameter
§ Significant Characteristic

**Notes:**
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.
JEDEC Equivalent: MS-012
Drawing No. C04-057

### 1M/3M COB (IOA2)



**NOTES:**

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| PART NO. | X | /XX | XXX |
|---|---|---|---|
| Device | Temperature Range | Package | Configuration/SQTP code |

| | |
|---|---|
| Device | MCRF200 = 125 kHz Contactless Programmable MicroID™ tag, 96/128-bit |
| Temperature Range | I = -40°C to +85°C (Industrial) |
| Package | WF = Sawed wafer on frame (7 mil backgrind)<br>W = Wafer (11 mil backgrind)<br>S = Dice in waffle pack<br>P = Plastic PDIP (300 mil Body) 8-lead<br>SN = Plastic SOIC (150 mil Body) 8-lead<br>1M = 0.40 mm (I0A2 package) COB Module w/1000 pF capacitor<br>3M = 0.40 mm (I0A2 package) COB Module with 330 pF capacitor |
| Configuration | 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). Refer to example. |
| SQTP Code | An assigned custom, 3-digit code used for tracking and controlling production and customer data files for factory programming. In this case the configuration code is not shown in the part number, but is captured in the SQTP documentation. |

**Examples:**

a) 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.

b) MCRF200-I/WFQ23 = 125 kHz, industrial temperature, wafer sawn and mounted on frame, factory programmed.

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 |

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