

## General Description

The MICRF103 is a single chip Transmitter IC for remote wireless applications. The device employs Micrel's latest QwikRadio™ technology. This device is a true "data-in, antenna-out" monolithic device. All antenna tuning is accomplished automatically within the IC which eliminates manual tuning, and reduces production costs. The result is a highly reliable yet extremely low cost solution for high volume wireless applications. Because the MICRF103 is a true single-chip radio transmitter, it is easy to apply, minimizing design and production costs, and improving time to market.

The MICRF103 uses a novel architecture where the external antenna is tuned by the internal UHF synthesizer. This transmitter is designed to comply worldwide UHF unlicensed band international radio regulations. The IC is compatible with virtually all ASK/OOK (Amplitude Shift Keying/On-Off Keyed) UHF receiver types from wide-band super-regenerative radios to narrow-band, high performance super-heterodyne receivers. The transmitter is designed to work with transmitter data rates up to 115k bits per second.

The automatic tuning in conjunction with an external resistor, insures that the transmitter output power stays constant at maximum regulatory transmit power limits for the life of the battery.

When coupled with Micrel's family of QwikRadio™ receivers, the MICRF103 provides the lowest cost and most reliable remote actuator and RF link system available.

## Features

- Complete UHF transmitter on a monolithic chip
- Frequency range 800MHz to 1GHz
- Data rates to 115kbps
- Automatic antenna alignment, no manual adjustment
- Low external part count
- Low standby current <1μA

## Applications

- Remote keyless entry systems (RKE)
- Remote fan/light control
- Garage door opener transmitters
- Remote sensor data links

## Ordering Information

| Part Number | Temperature Range | Package    |
|-------------|-------------------|------------|
| MICRF103BM  | -40°C to +85°C    | 8-Pin SOIC |

## Typical Application

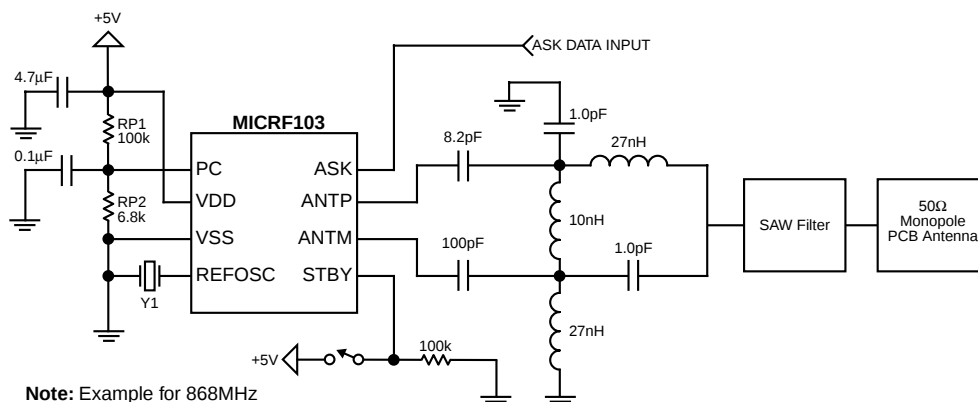
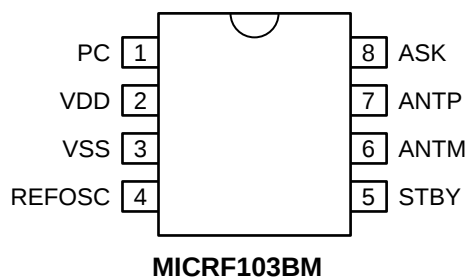


Figure 1

## Pin Configuration



## Pin Description

| Pin Number | Pin Name | Pin Function                                                                                                                                                                                                                                                                                                      |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | PC       | Power Control Input. The voltage at this pin should be set between 0.1V to 0.4V for normal operation.                                                                                                                                                                                                             |
| 2          | VDD      | Positive power supply input for the IC.                                                                                                                                                                                                                                                                           |
| 3          | VSS      | This pin is the ground return for the IC. A power supply bypass capacitor connected from VDD to VSS should have the shortest possible path.                                                                                                                                                                       |
| 4          | REFOSC   | This is the timing reference frequency which is the transmit frequency divided by 64. Connect a crystal (mode dependent) between this pin and VSS, or drive the input with an AC coupled 0.5Vpp input clock. See <i>Reference Oscillator</i> section in this data sheet under <i>Electrical Characteristics</i> . |
| 5          | STBY     | Input for transmitter stand-by control pin is pulled to VDD for transmit operation and VSS for stand-by mode.                                                                                                                                                                                                     |
| 6          | ANTM     | Negative RF power output to drive one side of the transmit antenna.                                                                                                                                                                                                                                               |
| 7          | ANTP     | Positive RF power output to drive the other side of the transmit antenna.                                                                                                                                                                                                                                         |
| 8          | ASK      | Amplitude Shift Key modulation data input pin. For CW operation, connect this pin to VDD.                                                                                                                                                                                                                         |

**Absolute Maximum Ratings (Note 1)**

Supply Voltage ( $V_{DD}$ ) ..... +6V  
 Voltage on I/O Pins .....  $V_{SS}-0.3$  to  $V_{DD}+0.3$   
 Storage Temperature Range .....  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$   
 Lead Temperature (soldering, 10 seconds) .....  $+300^{\circ}\text{C}$   
 ESD Rating, **Note 3**

**Operating Ratings (Note 2)**

Supply Voltage ( $V_{DD}$ ) ..... 4.75V to 5.5V  
 Maximum Supply Ripple Voltage ..... 10mV  
 PC Input Range .....  $0.1\text{V} < V_{PC} < 0.4\text{V}$   
 Ambient Operating Temperature ( $T_A$ ) .....  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$   
 Programmable Transmitter Frequency Range:  
 ..... 800MHz to 1GHz

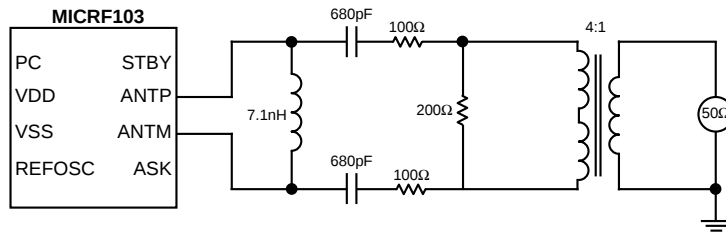
**Electrical Characteristics**

Specifications apply for  $4.75\text{V} < V_{DD} < 5.5\text{V}$ ,  $V_{PC} = 0.35\text{V}$ ,  $T_A = 25^{\circ}\text{C}$ ,  $\text{freq}_{\text{REFOSC}} = 13.5625\text{MHz}$ ,  $\text{STBY} = V_{DD}$ . **Bold** values indicate  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$  unless otherwise noted.

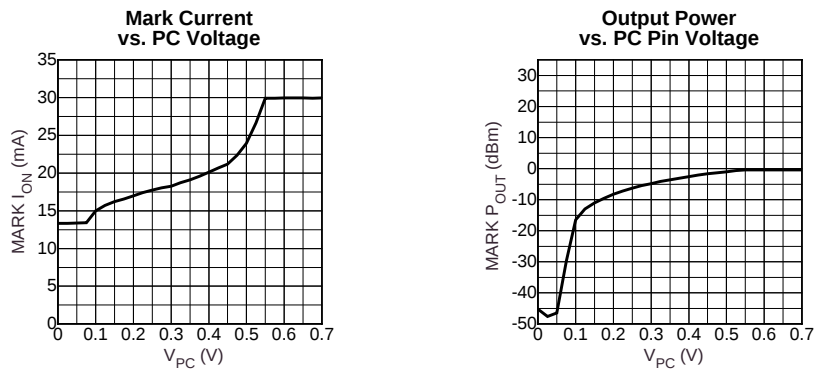
| Parameter                                         | Condition                                                            | Min                 | Typ     | Max                 | Units           |
|---------------------------------------------------|----------------------------------------------------------------------|---------------------|---------|---------------------|-----------------|
| <b>Power Supply</b>                               |                                                                      |                     |         |                     |                 |
| Standby Supply Current, $I_Q$                     | $V_{\text{STBY}} < 0.5\text{V}$                                      |                     | 0.10    |                     | $\mu\text{A}$   |
| MARK Supply Current, $I_{\text{ON}}$              | @868MHz                                                              |                     | 19      | <b>26.5</b>         | mA              |
|                                                   | @915MHz                                                              |                     | 20      | <b>27.5</b>         | mA              |
| SPACE Supply Current, $I_{\text{OFF}}$            | @868MHz                                                              |                     | 14      | <b>18</b>           | mA              |
|                                                   | @915MHz                                                              |                     | 15      | <b>21</b>           | mA              |
| MARK/SPACE Ratio                                  | 33%@868MHz                                                           |                     | 16      |                     | mA              |
|                                                   | 33%@915MHz                                                           |                     | 17      |                     | mA              |
| <b>RF Output Section and Modulation Limits:</b>   |                                                                      |                     |         |                     |                 |
| Maximum Power Level, $P_{\text{OUT}}$             | @868MHz (EIRP)                                                       |                     | -3      |                     | dBm             |
|                                                   | @915MHz (EIRP)                                                       |                     | -3      |                     | dBm             |
| Output Power Variation                            | over supply and temperature                                          |                     | $\pm 2$ |                     | dBm             |
| Extinction ratio for ASK                          |                                                                      | 38                  | 45      |                     | dBc             |
| Varactor tuning range                             | <b>Note 5</b>                                                        | <b>2.6</b>          | 3.0     | 3.3                 | pF              |
| <b>Reference Oscillator Section</b>               |                                                                      |                     |         |                     |                 |
| Reference Oscillator Input Impedance              |                                                                      |                     | 300     |                     | k $\Omega$      |
| Reference Oscillator Source Current               |                                                                      |                     | 5.0     |                     | $\mu\text{A}$   |
| Reference Oscillator Input Voltage (peak-to-peak) |                                                                      | 0.2                 |         | 1.0                 | $V_{\text{PP}}$ |
| <b>Digital / Control Section</b>                  |                                                                      |                     |         |                     |                 |
| Calibration Time                                  | note 7, ASK=HIGH                                                     |                     | 20      |                     | ms              |
| Power Amplifier Output Hold-off Time from STBY    | note 4, STDBY transition from LOW to HIGH crystal, ESR < 20 $\Omega$ |                     | 5       |                     | ms              |
| Transmitter Stabilization Time From STBY          | from external reference (500mVpp)                                    |                     | 9       |                     | ms              |
|                                                   | crystal, ESR < 20 $\Omega$                                           |                     | 12      |                     | ms              |
| Maximum Data rate<br>- ASK modulation             | duty cycle of the modulating signal = 50%                            | <b>115</b>          |         |                     | kbits/s         |
| STBY HIGH $V_{\text{IH}}$                         | enable voltage                                                       | 0.8 $V_{\text{DD}}$ |         |                     | V               |
| STBY LOW $V_{\text{IL}}$                          |                                                                      |                     |         | 0.1 $V_{\text{DD}}$ |                 |
| ASK Pin                                           | $V_{\text{IH}}$ , input high voltage                                 | 0.8 $V_{\text{DD}}$ |         |                     | V               |
|                                                   | $V_{\text{IL}}$ , input low voltage                                  |                     |         | 0.1 $V_{\text{DD}}$ | V               |
| ASK Input Current                                 | ASK = 0V, 5.0V input current                                         | -10                 | 0.1     | 10                  | $\mu\text{A}$   |

- Note 1.** Exceeding the absolute maximum rating may damage the device.
- Note 2.** The device is not guaranteed to function outside its operating rating.
- Note 3.** Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF.
- Note 4.** After the release of the STDBY, the device requires an initialization time to settle the REFOSC and the internal PLL. The first MARK state (ASK HIGH) after exit from STDBY needs to be longer than the initialization time. The subsequent low to high transitions will be treated as data modulation whereby the envelope transition time will apply.
- Note 5.** The varactor capacitance tuning range indicates the allowable external antenna component variation to maintain tune over normal production tolerances of external components. Guaranteed by design not tested in production.
- Note 6.** For the ASK modulation scheme, the part will accept ASK (digital ON/OFF) input and will transmit the data with a finite extinction ratio and the pin will set the MARK power level.
- Note 7.** When the device is first powered up or it loses power momentarily, it goes into the calibration mode to tune up the transmit antenna.

## Test Circuit



Typical Characteristics



## Functional Diagram

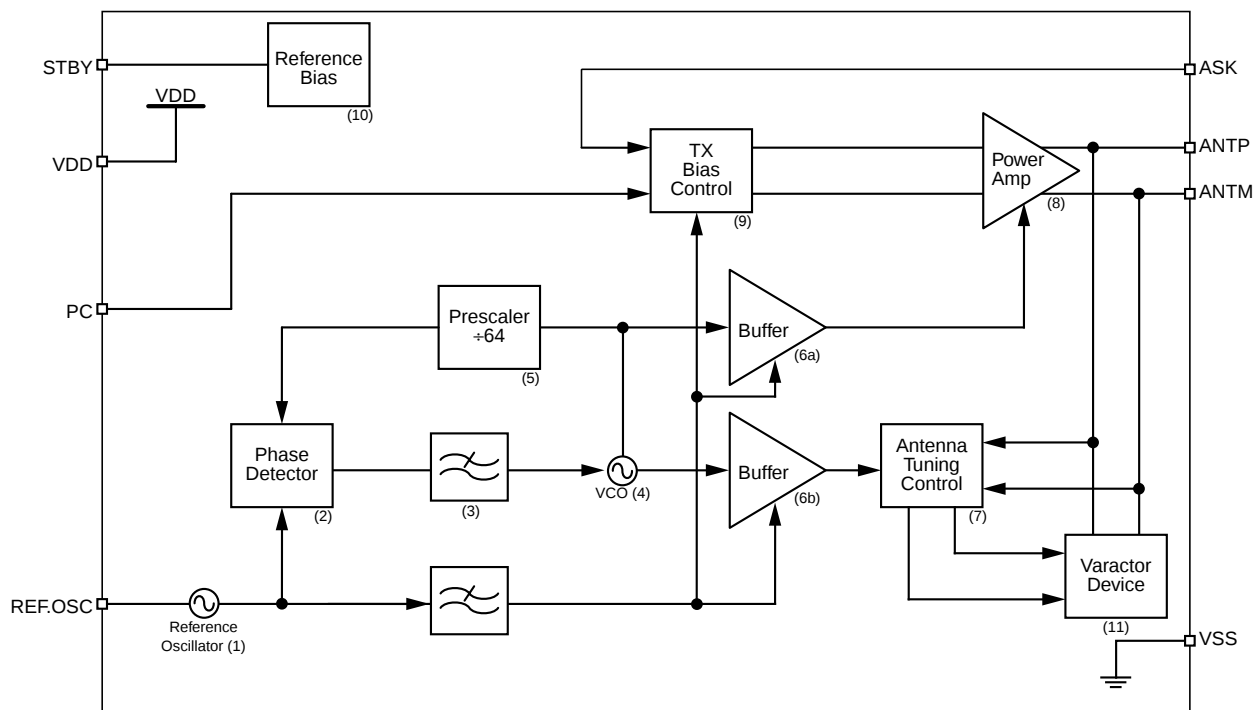


Figure 2. MICRF103 Block Diagram

## Functional Description

The block diagram illustrates the basic structure of the MICRF103. Identified in the figure are the principal functional blocks of the IC, namely the (1, 2, 3, 4, 5) UHF synthesizer, (6a/b) Buffer, (7) Antenna tuner, (8) Power amplifier, (9) TX bias control, (10) Reference bias and (11) Process tuner.

The UHF synthesizer generates the carrier frequency with quadrature outputs. The in-phase signal (I) is used to drive the PA and the quadrature signal (Q) is used to compare the antenna signal phase for antenna tuning purpose.

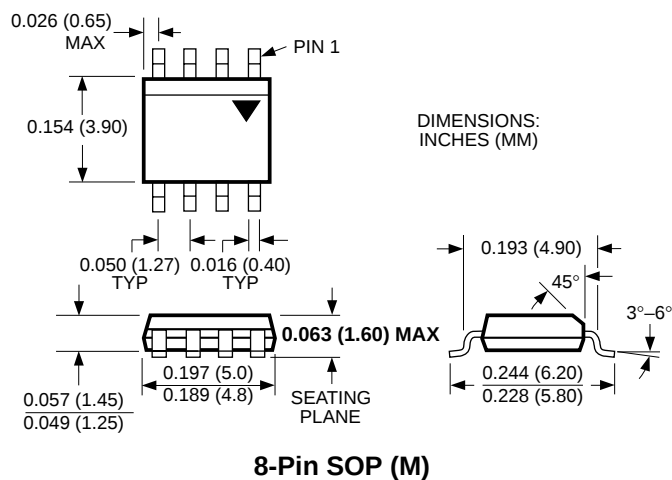
The antenna tuner block senses the phase of the transmit signal at the antenna port and controls the varactor capacitor to tune the antenna.

The power control unit senses the antenna signal and controls the PA bias current to regulate the antenna signal to the transmit power.

The process tune circuit generates process independent bias currents for different blocks.

Included within the IC is a differential varactor that serves as the tuning element to insure that the transmit frequency and antenna are aligned with the receiver over all supply and temperature variations.

## Package Information



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