

## General Description

The MICRF112 is a high-performance, easy to use, true "Data-In, RF-Out," ASK/FSK, phase-locked loop (PLL) based, transmitter IC for applications in the 300MHz to 450MHz frequency range. These applications include remote keyless entry (RKE) and tire pressure monitoring (TPMS). The device needs only a low-cost crystal to precisely set the desired RF frequency, and a few external components for matching the power amplifier output to the antenna.

The MICRF112 operates over the 1.8V to 3.6V operating range and delivers +10dBm (CW) output power into a 50Ω load, while consuming 11.5mA of supply current from a 3.0V power supply. In ASK mode, the device consumes 6.9mA of supply current at a data rate of 1kbps (Manchester 50%). It features a low-power shutdown mode in which the device typically consumes 50nA of supply current. This makes it an ideal solution for battery powered applications.

The MICRF112 is rated for the -40°C to +125°C temperature range, and is available in 10-pin MSOP and 10-pin Ultra-Thin DFN packages. For automotive applications, where AEC-Q100 qualification is required, consider the MAQRF112. For ASK-only applications that do not require shutdown, consider the MICRF113 in SOT23-6.

Datasheets and support documentation can be found on Micrel's website at: [www.micrel.com](http://www.micrel.com).

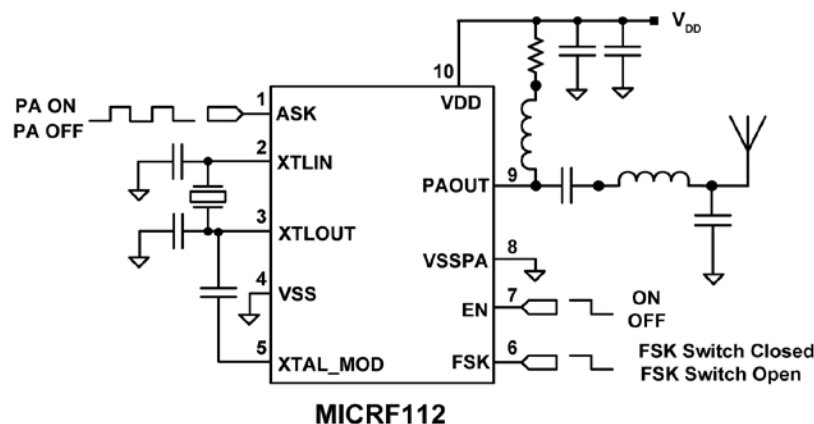
## Features

- 1.8V to 3.6V supply voltage range
- Up to +10dBm output power (CW)
- 6.9mA supply current at 1kbps ASK (50% Manchester)
- 11.5mA supply current at +10dBm (FSK/CW)
- 1μA shutdown supply current
- Data rates up to 50kbps ASK, 10kbps FSK
- Crystal or ceramic resonators sets RF frequency
- -40°C to +125°C temperature range
- 10-pin MSOP (3.0mm x 4.9mm)
- 10-pin Ultra-Thin DFN (2mm x 2mm x 0.4mm)

## Applications

- Remote keyless entry systems (RKE)
- Remote control (STB, HVAC, and appliances)
- Garage door openers (GDO)
- Tire pressure monitor systems (TPMS)
- Outdoor weather stations
- Security/Alarm systems
- Lighting and fan remote controls
- Doorbells
- Irrigation control

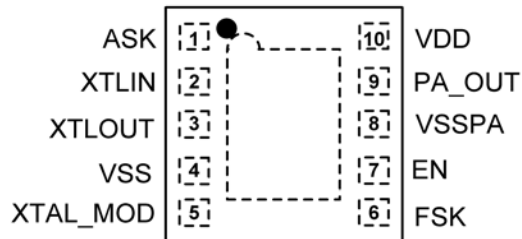
## Typical Application



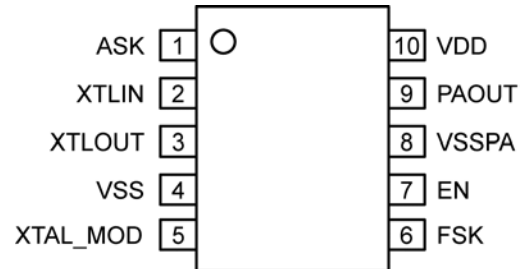
## Ordering Information

| Part Number | Top Mark | Temp. Range     | Package      |
|-------------|----------|-----------------|--------------|
| MICRF112YMM | RF112YMM | -40°C to +125°C | 10-Pin MSOP  |
| MICRF112YMU | 12B      | -40°C to +125°C | 10-Pin UTDFN |

## Pin Configuration



**10-Pin Ultra-Thin DFN (MU)**  
(2mm x 2mm x 0.4mm)  
Top View



**10-Pin MSOP (MM)**  
Top View

**Note:** The Pin1 marking symbol could be a circle, triangle, or other symbol.

## Pin Description

| Pin Number | Pin Name | Pin Function  |
|------------|----------|---|
| 1          | ASK      | ASK Data input  |
| 2          | XT LIN   | Reference oscillator input connection                   |
| 3          | XT LOUT  | Reference oscillator output connection                  |
| 4          | VSS      | Ground  |
| 5          | XTAL_MOD | Reference oscillation modulation port for FSK operation |
| 6          | FSK      | FSK Data input  |
| 7          | EN       | Chip enable, active high                                |
| 8          | VSSPA    | PA ground   |
| 9          | PAOUT    | PA output   |
| 10         | VDD      | Positive power supply                                   |

**Absolute Maximum Ratings<sup>(1)</sup>**

|  |                        |
|--|------------------------|
| Supply Voltage (VDD) .....                 | +4.3V                  |
| Voltage on PAOUT .....                     | +7.2V                  |
| Voltage on I/O Pins .....                  | VSS – 0.3 to VDD + 0.3 |
| Lead Temperature (soldering, 10s).....     | +300°C                 |
| Storage Temperature (T <sub>S</sub> )..... | –65°C to +150°C        |
| ESD Rating.....                            | Note 3                 |

**Operating Ratings<sup>(2)</sup>**

|   |                  |
|---|------------------|
| Supply Voltage (VDD) .....                            | 1.8V to 3.6V     |
| Ambient Operating Temperature (T <sub>A</sub> ) ..... | –40°C to +125°C  |
| Transmitter Frequency Range .....                     | 300MHz to 450MHz |

**Electrical Characteristics<sup>(4)</sup>**

Specifications apply for VDD = 3.0V, T<sub>A</sub> = 25°C, Freq<sub>REFOSC</sub> = 13.560MHz, EN = VDD. 1Kbps data rate, 50% duty cycle. R<sub>L</sub> 50Ω load (matched)

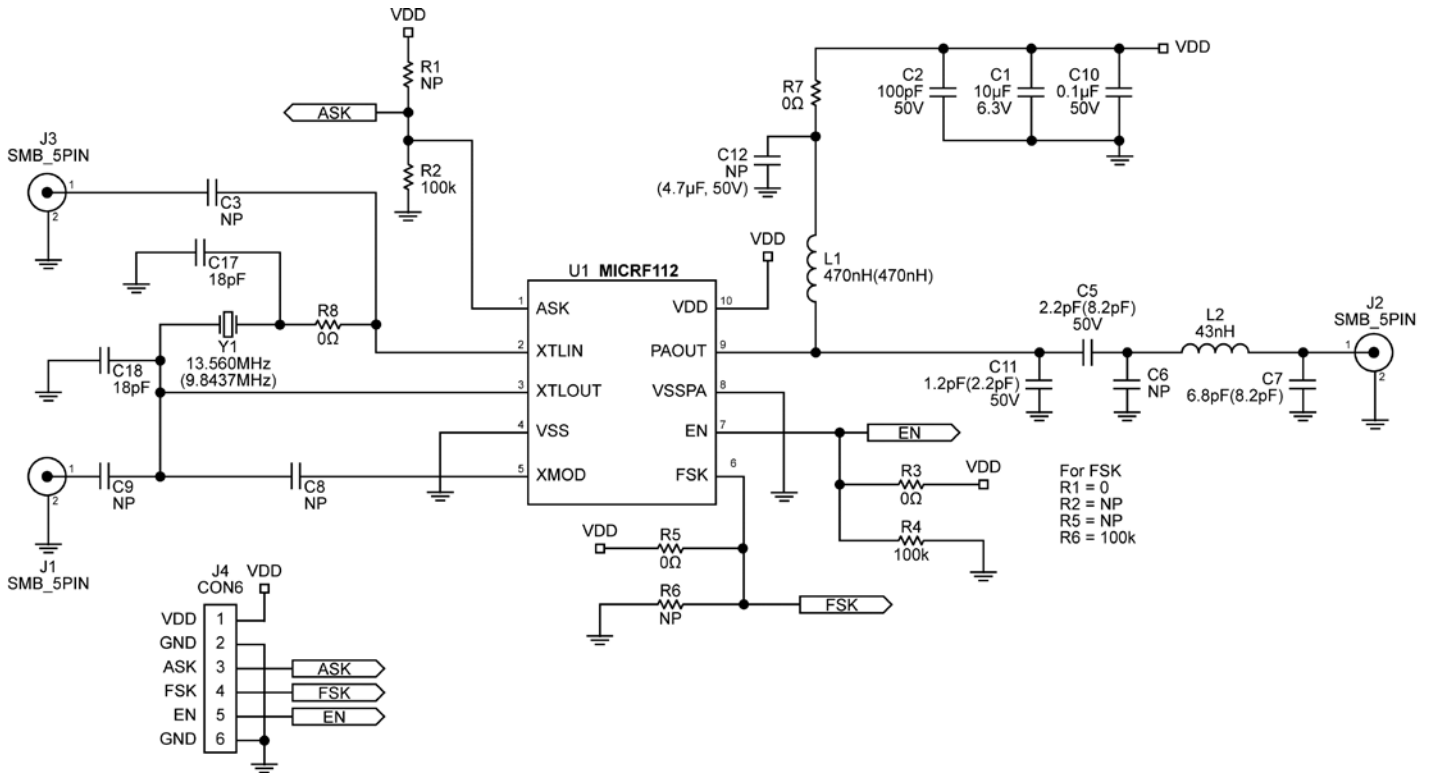
| Parameter   | Condition                                    | Min. | Typ.  | Max. | Units  |
|---|--|------|-------|------|--------|
| <b>Power Supply</b>                                       |  |      |       |      |        |
| Standby Supply Current, I <sub>q</sub>                    | EN = V <sub>SS</sub>                         |      | 0.05  | 1    | μA     |
| Mark Supply Current I <sub>ON</sub>                       | @ 315MHz, P <sub>OUT</sub> = +10dBm          |      | 11.5  |      | mA     |
|   | @ 433.92MHz, P <sub>OUT</sub> = +10dBm       |      | 11.6  |      | mA     |
| SPACE Supply Current, I <sub>OFF</sub>                    | @ 315MHz                                     |      | 2.4   |      | mA     |
|   | @ 433.92MHz                                  |      | 2.7   |      | mA     |
| <b>RF Output Section and Modulation Limits:</b>           |  |      |       |      |        |
| Output Power Level, P <sub>OUT</sub><br>FSK or ASK "Mark" | @ 315MHz <sup>(4)</sup>                      |      | 10    |      | dBm    |
|   | @ 433.92MHz <sup>(4)</sup>                   |      | 10    |      | dBm    |
| Harmonics output for<br>315MHz                            | @ 630MHz <sup>(4)</sup> 2nd harm.            |      | –53   |      | dBc    |
|   | @ 945MHz <sup>(4)</sup> 3rd harm.            |      | –53   |      | dBc    |
| Harmonics Output for<br>433.92MHz                         | @ 867.84MHz <sup>(4)</sup> 2nd harm.         |      | –51   |      | dBc    |
|   | @ 1301.76MHz <sup>(4)</sup> 3rd harm.        |      | –65   |      | dBc    |
| Extinction Ratio for ASK                                  |  |      | 80    |      | dBc    |
| <b>FSK Modulation</b>                                     |  |      |       |      |        |
| Frequency Deviation                                       | Load capacitor = 10pF, crystal type = HC49/U |      | 22    |      | kHz    |
| Data Rate   |  |      |       | 10   | Kbps   |
| <b>ASK Modulation</b>                                     |  |      |       |      |        |
| Data Rate   |  |      |       | 50   | Kbps   |
| Occupied Bandwidth  | @ 315MHz <sup>(5)</sup>                      |      | <700  |      | kHz    |
|   | @ 433.92MHz <sup>(5)</sup>                   |      | <1000 |      | kHz    |
| <b>VCO Section</b>  |  |      |       |      |        |
| 315MHz Single Side Band<br>Phase Noise                    | @ 100kHz from Carrier                        |      | –76   |      | dBc/Hz |
|   | @ 1000kHz from Carrier                       |      | –79   |      | dBc/Hz |
| 433.92MHz Single Side Band<br>Phase Noise                 | @ 100kHz from Carrier                        |      | –72   |      | dBc/Hz |
|   | @ 1000kHz from Carrier                       |      | –81   |      | dBc/Hz |
| <b>Reference Oscillator Section</b>                       |  |      |       |      |        |
| XTLIN, XTLOUT, XTLMOD                                     | Pin capacitance                              |      | 2     |      | pF     |
| External Capacitance                                      | See Schematic C17 & C18                      |      | 18    |      | pF     |
| Oscillator Start-Up Time <sup>(6)</sup>                   | Crystal: HC49S                               |      | 400   |      | μs     |

| Parameter   | Condition                         | Min.                | Typ. | Max.                | Units         |
|---|-----------------------------------|---------------------|------|---------------------|---------------|
| <b>Digital/Control Section</b>                        |                                   |                     |      |                     |               |
| Output Blanking                                       | STDBY transition from low to high |                     | 500  |                     | $\mu\text{s}$ |
| Digital Input (EN, ASK, and FSK)                      | High ( $V_{IH}$ )                 | $0.8 \times V_{DD}$ |      |                     | V             |
|   | Low ( $V_{IL}$ )                  |                     |      | $0.2 \times V_{DD}$ | V             |
| Digital Input Leakage Current (EN, ASK, and FSK Pins) | High ( $V_{IH}$ )                 |                     | 0.05 |                     | $\mu\text{A}$ |
|   | Low ( $V_{IL}$ )                  |                     | 0.05 |                     | $\mu\text{A}$ |
| Undervoltage Lock Out (UVLO)                          |                                   |                     | 1.6  |                     | V             |

**Notes:**

1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating ratings.
3. Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF.
4. Measured using the circuit shown in the "Test Circuit" section.
5. RBW = 100kHz, OBW measured at -20dBc.
6. Dependent on crystal.

# Test Circuit

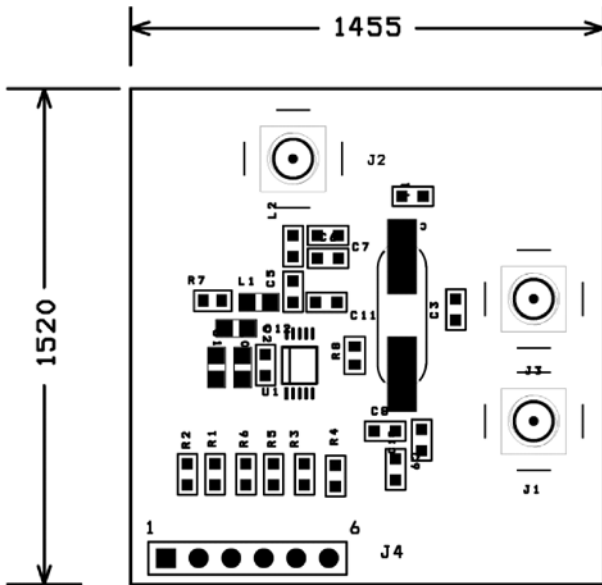


MICRF112 Test Circuit with 50Ω Output (MSOP)

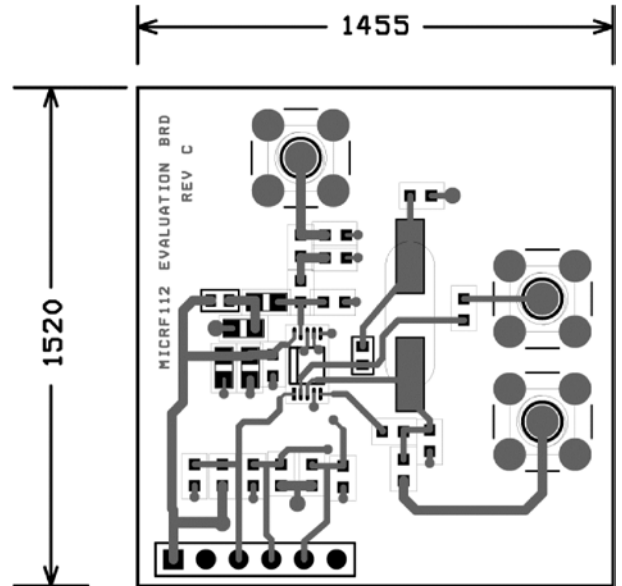
**Notes:**

1. Values without parenthesis are for 433.92MHz and values in parenthesis are for 315MHz.
2. C9 = 100pF for external REF-OSC.
3. For FSK R1 = 0Ω, R2 = NP, R6 = 100k, and R5 = NP.

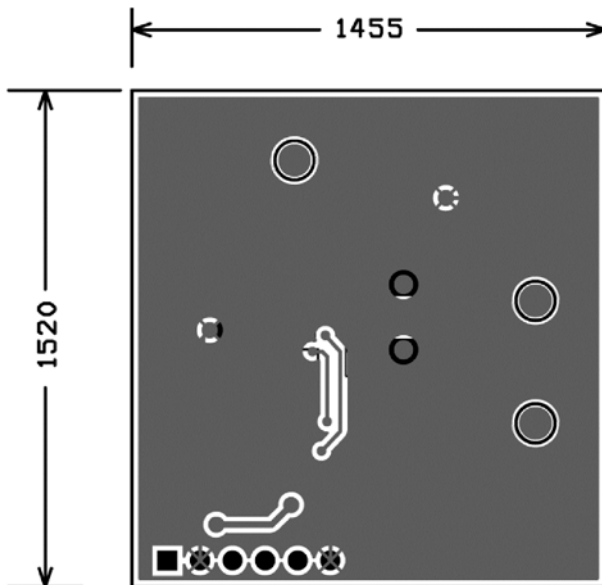
### 50Ω Evaluation Board PCB Layout



**Assembly Drawing**  
MICRF112 50Ω Evaluation Board (MSOP)



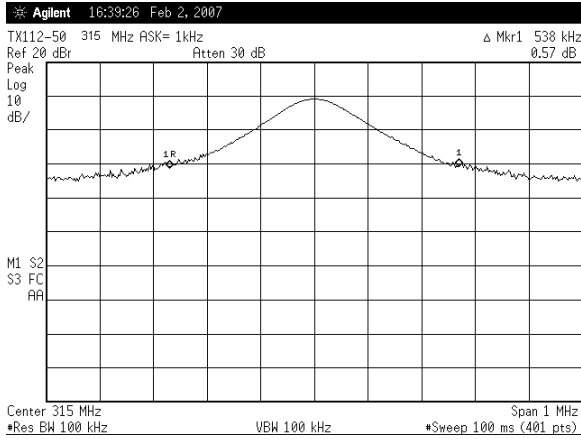
**Top Layer**  
MICRF112 50Ω Evaluation Board (MSOP)



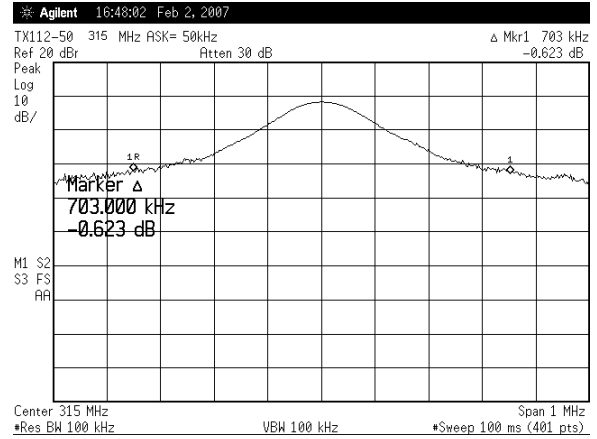
**Bottom Layer**  
MICRF112 50Ω Evaluation Board (MSOP)

# Typical Characteristics Using MICRF112, 50Ω Evaluation Board (MSOP)

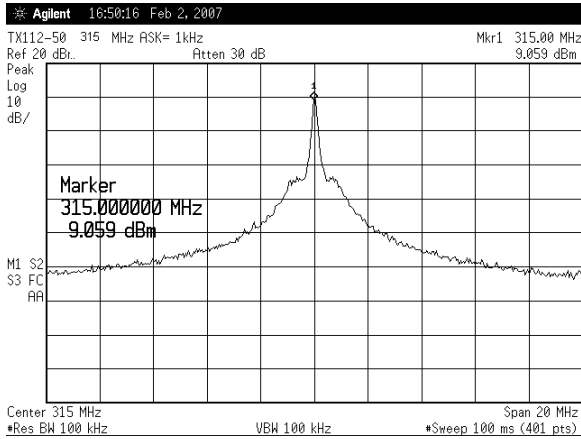
**315MHz OBW, ASK = 1kHz**



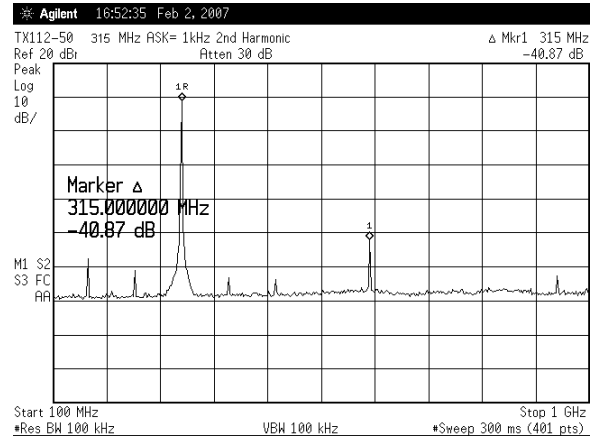
**315MHz OBW, ASK = 50kHz**



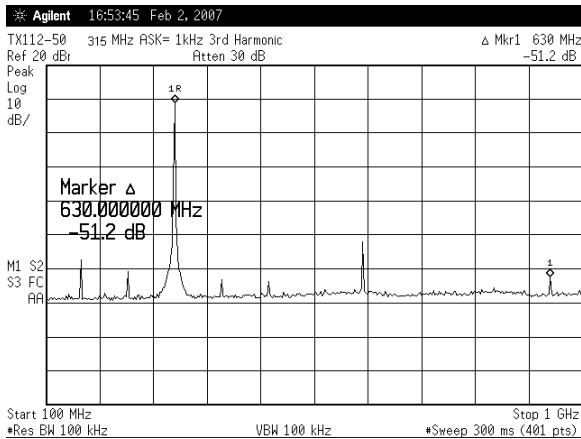
**CW Max Power @ 3V, 315MHz, ASK = 1kHz<sup>(1)</sup>**



**RF Spectrum 2<sup>nd</sup> Harmonic; Fundamental at 315MHz**



**RF Spectrum 3<sup>rd</sup> Harmonic; Fundamental at 315MHz**



**315MHz, Power Level at Space, VDD = 3.0V, ASK = 1kHz**

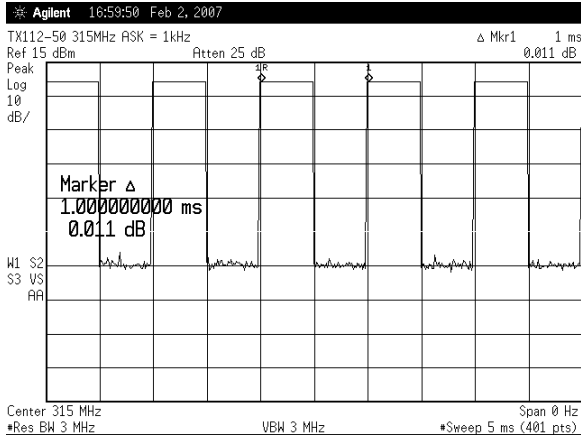


**Note:**

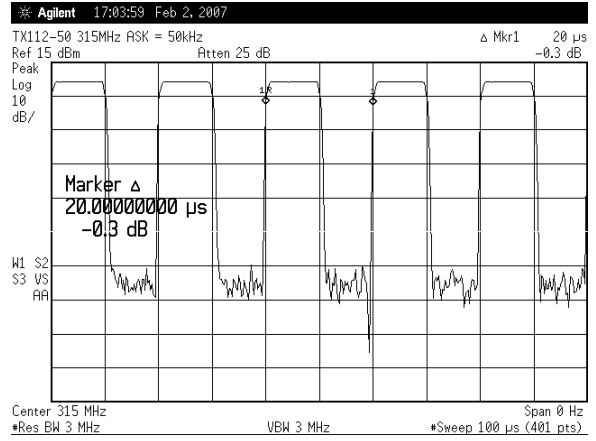
1. 1.2dB cable loss.

Typical Characteristics Using MICRF112, 50Ω Evaluation Board (MSOP) (Continued)

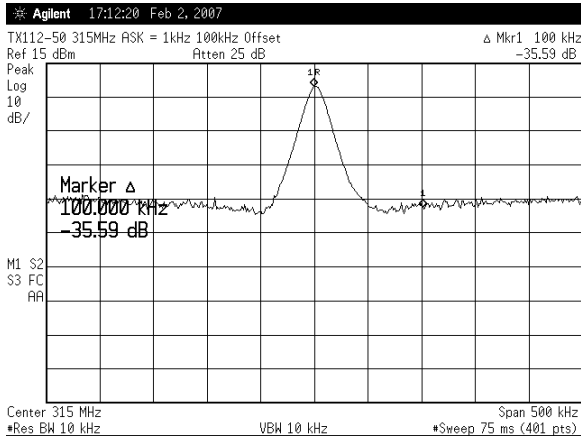
315MHz, Zero Span, ASK = 1kHz



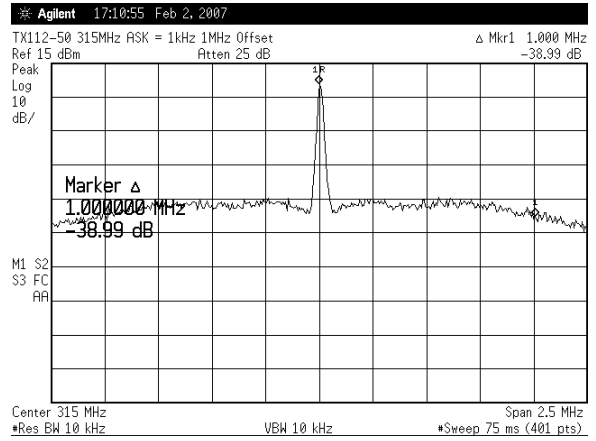
315MHz, Zero Span, ASK = 50kHz



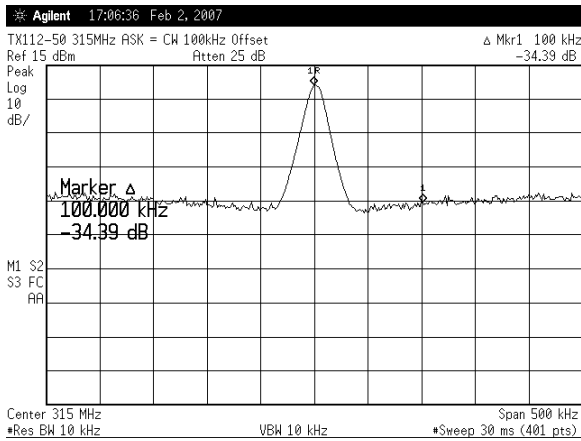
315MHz, Phase Noise, ASK = 1kHz, 100kHz Offset, -75.59dBc/Hz



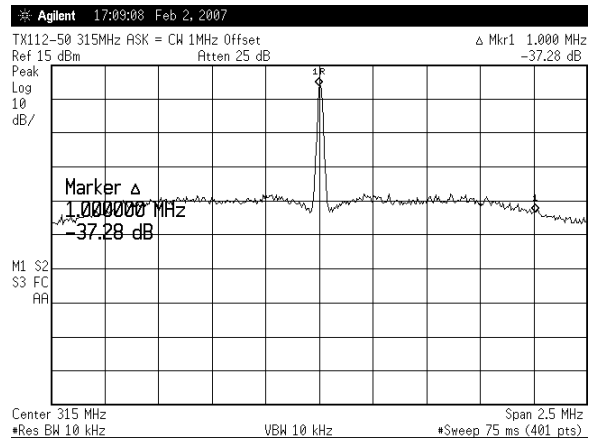
315MHz, Phase Noise, ASK = 1kHz, 1MHz Offset, -78.99dBc/Hz



315MHz, Phase Noise, ASK = CW, 100kHz Offset, -74.39dBc/Hz



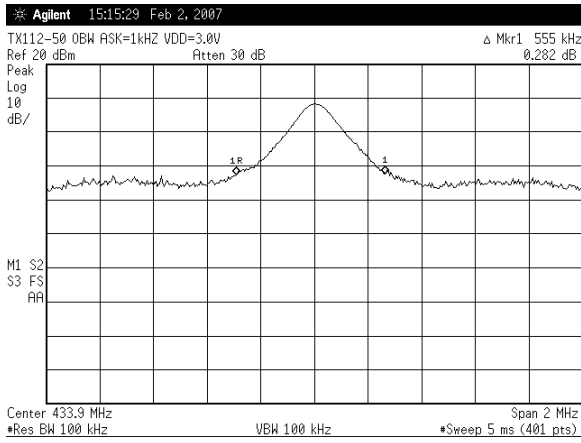
315MHz, Phase Noise, ASK = CW, 1MHz Offset, -77.28dBc/Hz



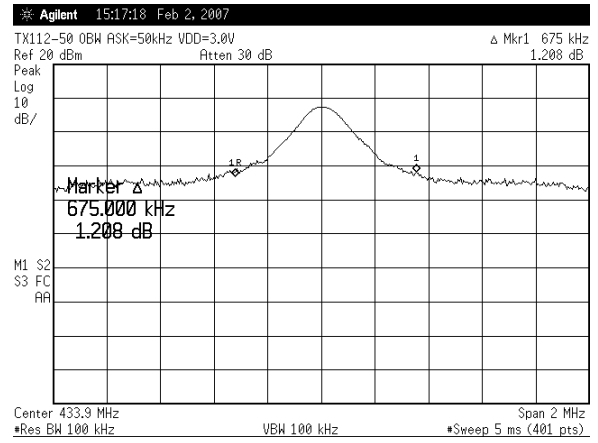


Typical Characteristics Using MICRF112, 50Ω Evaluation Board (MSOP) (Continued)

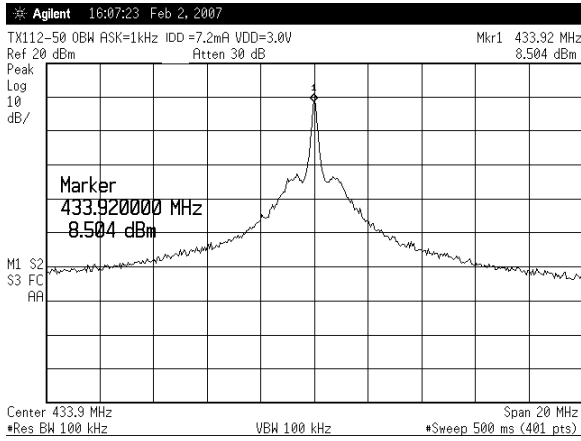
433.92MHz OBW, ASK = 1kHz



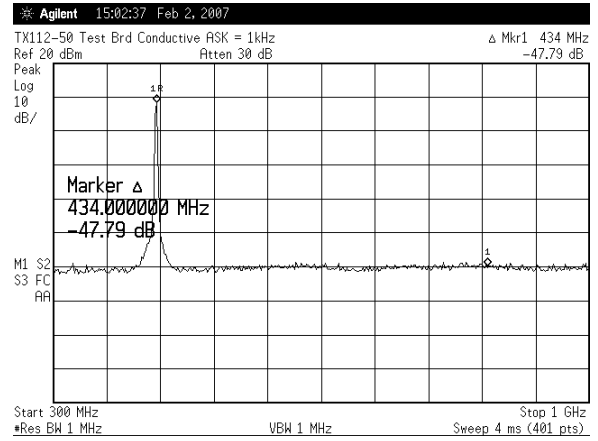
433.92MHz OBW, ASK = 50kHz



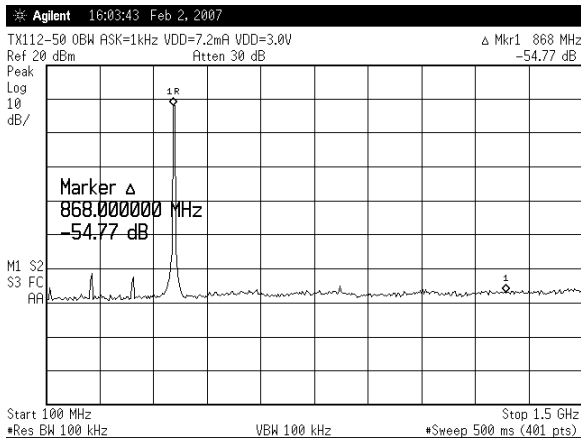
433.92MHz, CW Max Power @ 3V, ASK = 1kHz<sup>(1)</sup>



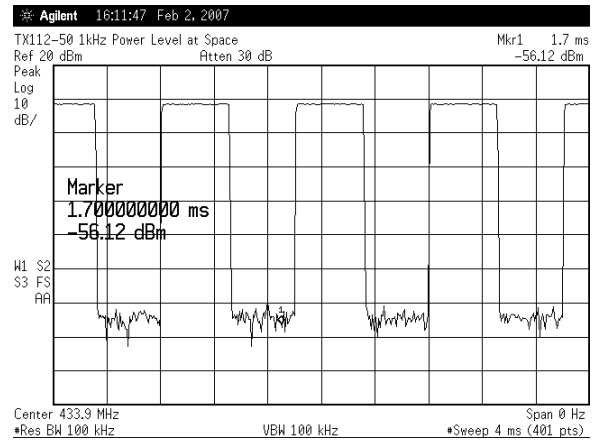
RF Spectrum 2<sup>nd</sup> Harmonic; Fundamental at 433.92MHz



RF Spectrum 3<sup>rd</sup> Harmonic; Fundamental at 433.92MHz



433.92MHz, Power Level at Space, VDD = 3.0V, ASK = 1kHz

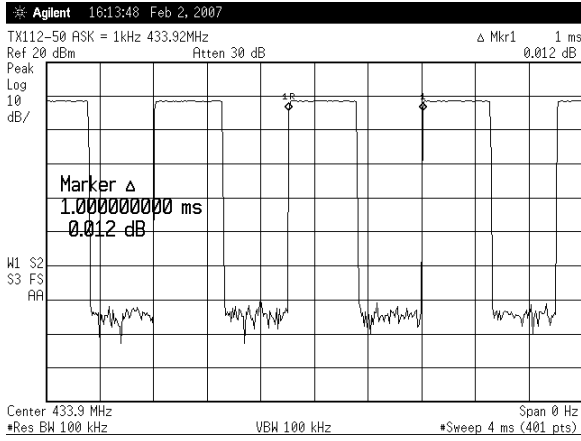


Note:

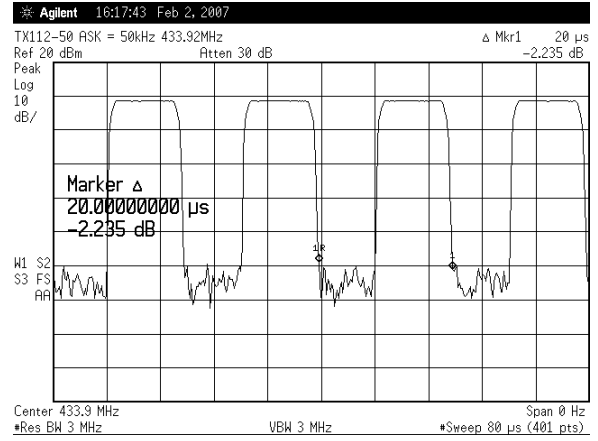
1. 1.3dB cable loss.

# Typical Characteristics Using MICRF112, 50Ω Evaluation Board (MSOP) (Continued)

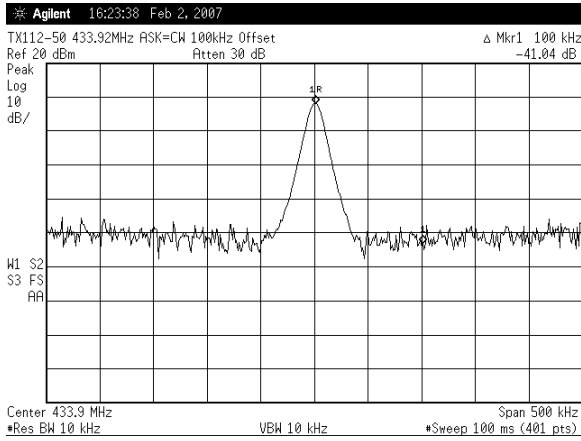
### 433.92MHz Zero Span, 1kHz



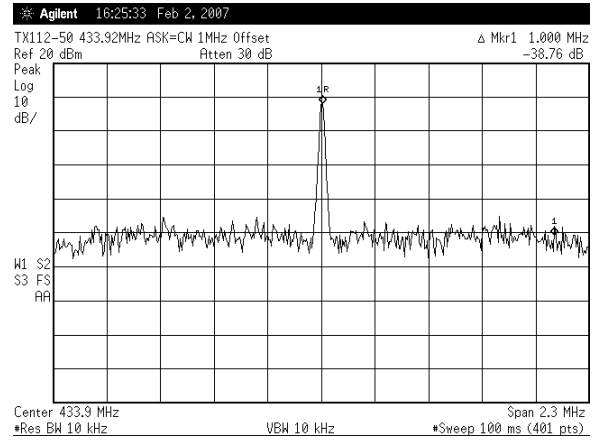
### 433.92ASK Zero Span at 50kHz



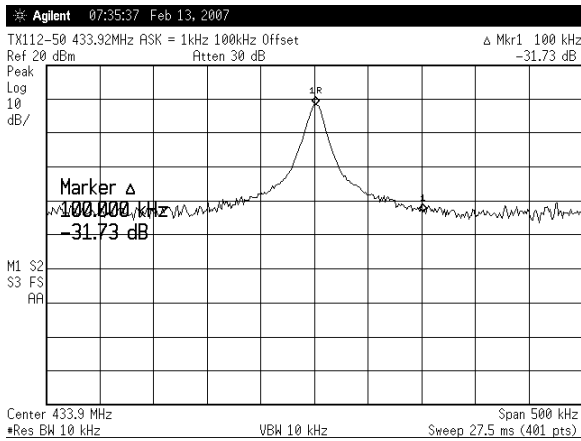
### 433.92MHz Phase Noise, ASK = CW, 100kHz Offset, -81.04dBc/Hz



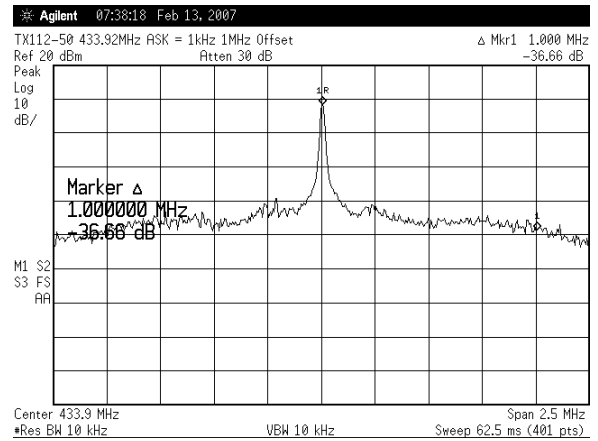
### 433.92MHz Phase Noise, ASK = CW, 1MHz Offset, -78.76dBc/Hz



### 433.92MHz Phase Noise, ASK = 1kHz, 100kHz Offset, -71.73dBc/Hz



### 433.92MHz Phase Noise, ASK = 1kHz, 1MHz Offset, -81.04dBc/H



## Functional Diagram

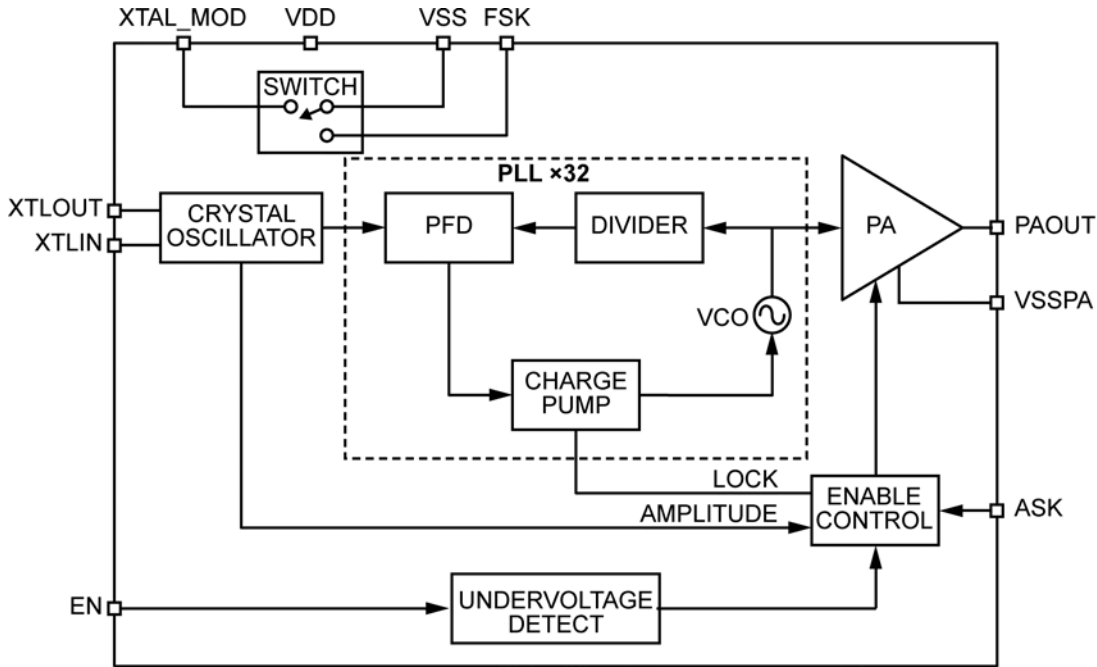


Figure 1. Functional Block Diagram MICRF112 10 Pin ASK/FSK Version

## Functional Description

Figure 1 shows a functional block diagram of the MICRF112 transmitter. The MICRF112 can be best described as a phase-locked transmitter. The system can be partitioned into six functional blocks: crystal oscillator, PLLx32, power amplifier, enable control, undervoltage detect, and open-drain switch for FSK operation.

### Crystal Oscillator

The reference oscillator is a crystal-based Pierce configuration. It is designed to accept crystals with frequencies from 9.375MHz to 14.0625MHz.

### Crystal Oscillator Parameters for ASK Operation

Figure 2 shows a reference oscillator circuit configuration for ASK operation. The reference oscillator can drive crystals with an ESR range from 20Ω to 300Ω.

When the ESR of the crystal is at 20Ω, the crystal parameter limits are:

|                  |            |
|------------------|------------|
| ESR              | 20Ω        |
| C <sub>PAR</sub> | 2 to 10pF  |
| C <sub>MO</sub>  | 10 to 40fF |

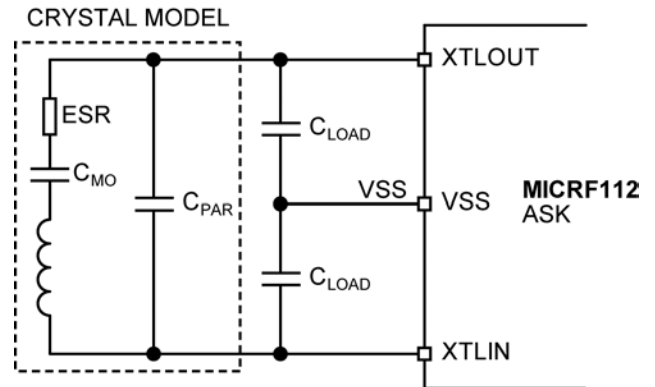


Figure 2. Reference Oscillator ASK Operation

When the ESR of the crystal is at 300Ω, the crystal parameter limits are:

|                   |            |
|-------------------|------------|
| ESR               | 300Ω       |
| C <sub>PAR</sub>  | 2 to 5pF   |
| C <sub>MO</sub>   | 10 to 40fF |
| C <sub>LOAD</sub> | 10 to 30pF |



## Application Information

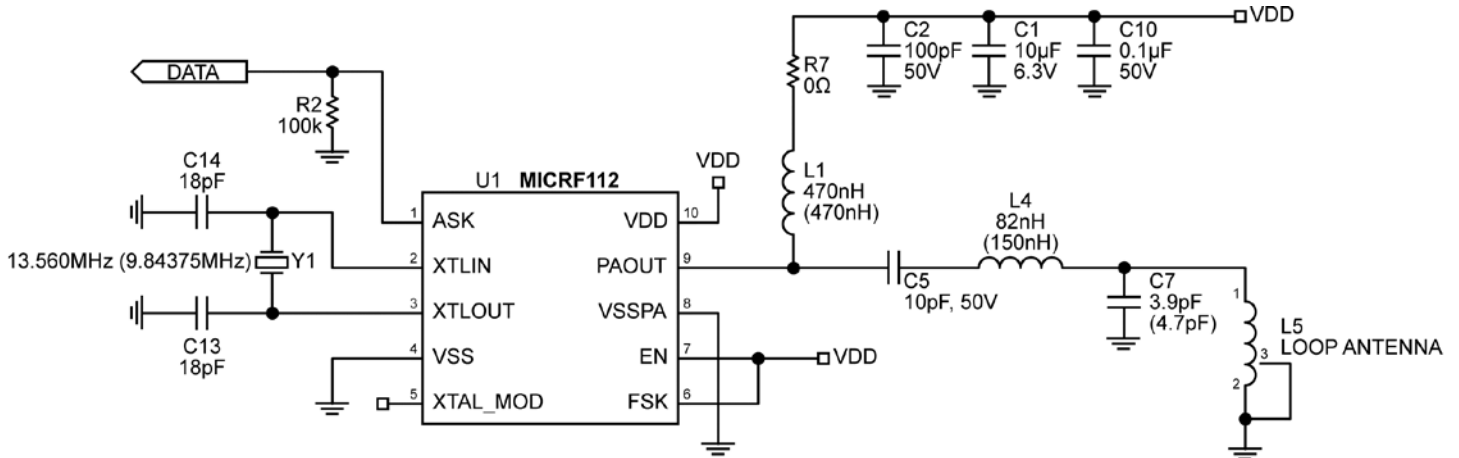


Figure 4. ASK 433.92MHz and 315MHz (MSOP)

Note: Values in parenthesis are for 315MHz.

The MICRF112 is ideal for driving a 50Ω source monopole or a loop antenna. Figure 4 is an example of a loop antenna configuration. Figure 4 also shows both 315MHz and 433.92MHz ASK configurations for a loop antenna. In addition to using a different crystal, modified values are needed for certain frequencies. These are listed in Table 1.

| Frequency (MHz) | L1 (nH) | C5 (pF) | L4 (nH) | C7 (pF) | Y1 (MHz) |
|-----------------|---------|---------|---------|---------|----------|
| 315.0           | 470     | 10      | 150     | 6.8     | 9.84375  |
| 433.92          | 680     | 10      | 82      | 4.7     | 13.5600  |

Table 1. Modified Frequency Values

The reference design shown in Figure 4 has an antenna optimized for using the matching network, as described in Table 1.

### Power Control Using an External Resistor

R7 is used to adjust the RF output levels that may be needed to meet compliance. As an example, Tables 2 and 3 list typical values of conducted RF output levels and corresponding R7 resistor values for the 50Ω test board shown in the Test Circuit.

| R7, Ω | Output Power, dBm | IDD, mA |
|-------|-------------------|---------|
| 0     | 10                | 6.7     |
| 75    | 8.5               | 6.3     |
| 100   | 8.0               | 6.2     |
| 500   | 1.6               | 4.13    |
| 1000  | -3.8              | 4.87    |

Table 2. ASK Output Power at 1Kbps (Manchester) vs. External Resistor at 315MHz

| R7, Ω | Output Power, dBm | IDD, mA |
|-------|-------------------|---------|
| 0     | 8.68              | 7.5     |
| 75    | 8.34              | 7.33    |
| 100   | 8.02              | 7.3     |
| 500   | 4.34              | 6.3     |
| 1000  | 0.42              | 5.5     |

Table 3. ASK Output Power at 1Kbps (Manchester) vs. External Resistor at 433.92MHz

**Output Matching Network**

Part of the function of the output network is to attenuate the second and third harmonics. When matching to a transmit frequency, be sure not only to optimize for maximum output power but to attenuate unwanted harmonics.

**Layout Issues**

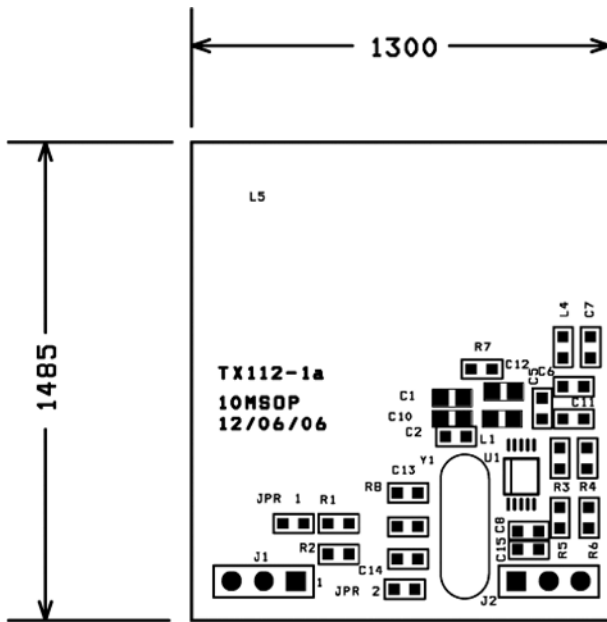
PCB layout is extremely important to achieve optimum performance and consistent manufacturing results. Be careful with the orientation of the components to ensure that they do not couple or decouple the RF signal. PCB trace length should be short, to minimize parasitic inductance (1in ~ 20nH). For example, depending on inductance values, a 0.5in trace can change the

inductance by as much as 10%. To reduce parasitic inductance, the use of wide traces and a ground plane under signal traces is recommended. Use vias with low value inductance for components requiring a connection to ground.

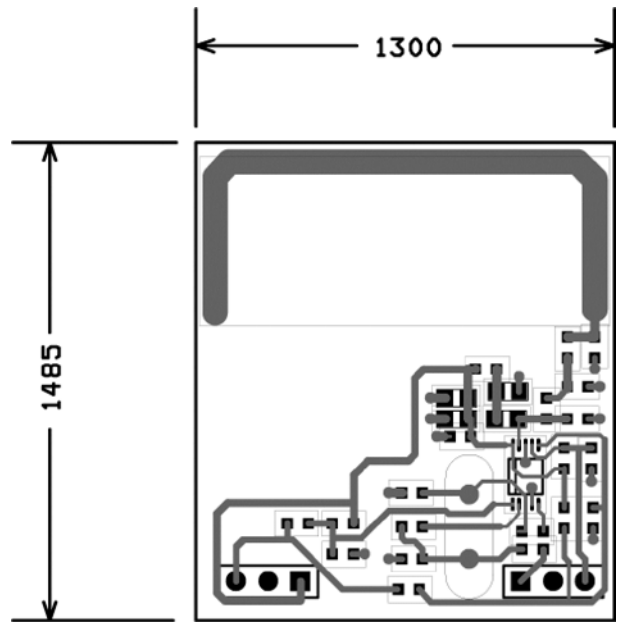
**Antenna Layout**

The antenna trace layout affects directivity. No ground plane should be under the antenna trace. For consistent performance, do not place components inside the loop of the antenna. Gerbers for the Evaluation Board PCB, with a suggested layout are available on the Micrel web site at: [www.micrel.com](http://www.micrel.com).

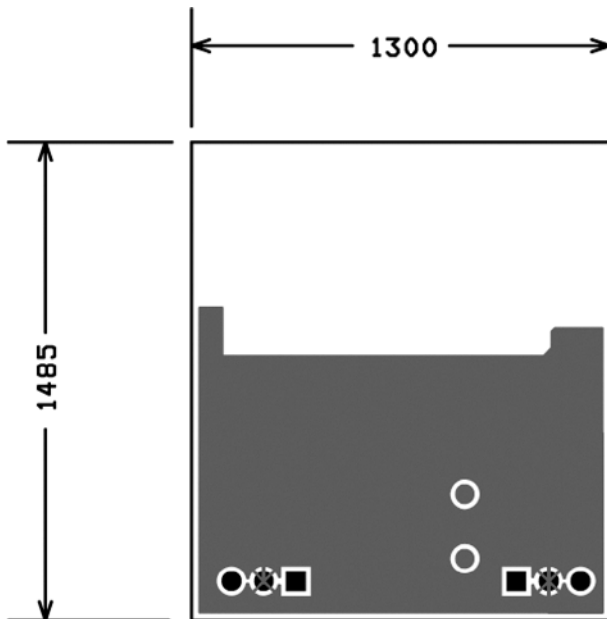
### Demo Board PCB Layout



**Assembly Drawing**  
MICRF112 Evaluation Board (MSOP)



**Top Layer**  
MICRF112 Evaluation Board (MSOP)



**Bottom Layer**  
MICRF112 Evaluation Board (MSOP)

### Evaluation Board Schematic

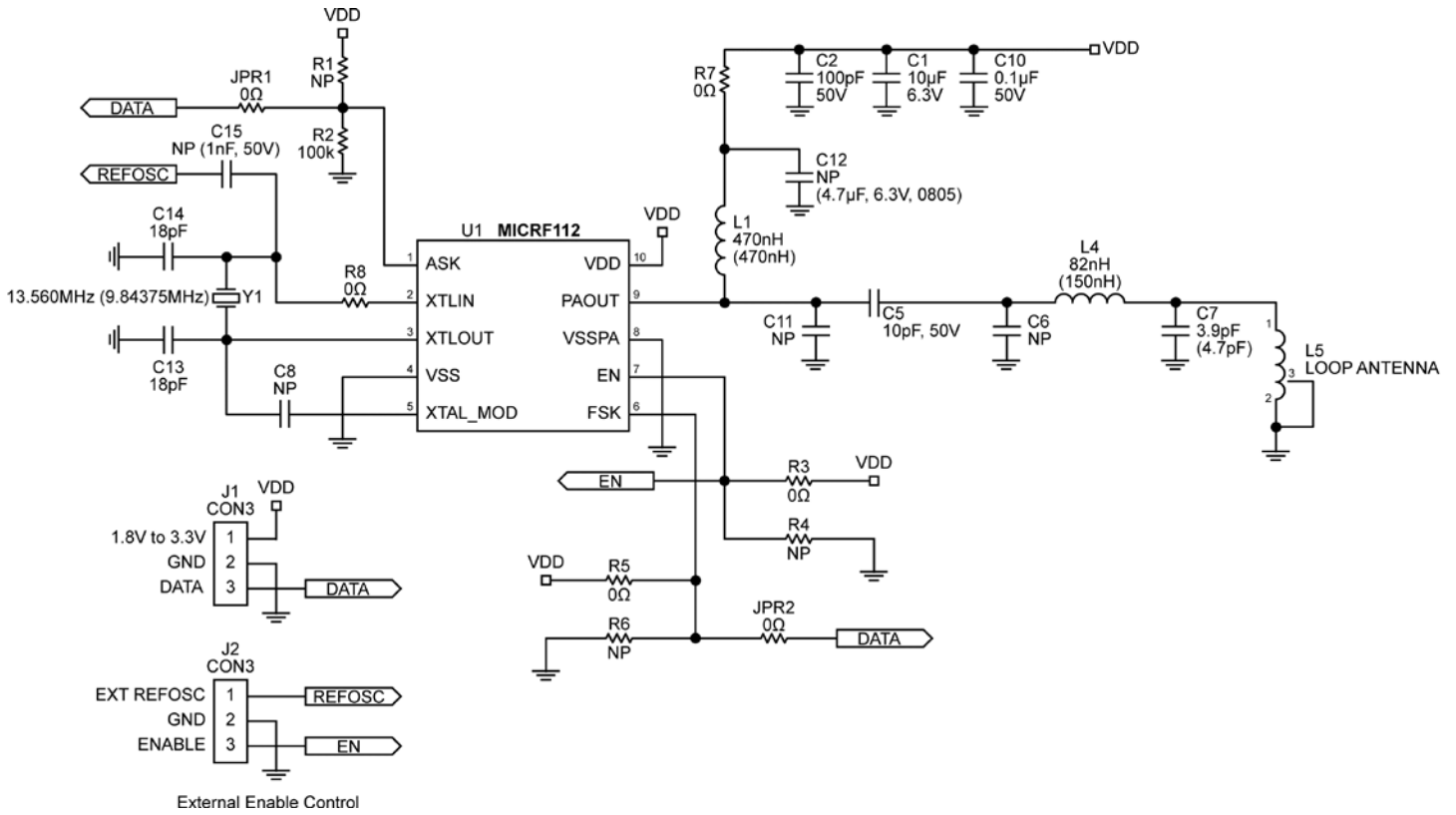


Figure 5. TX112-1 Evaluation Board Schematic (MSOP)

Note: Configuration is for ASK operation. Values in parenthesis are for 315MHz.

### Functional Description of the TX112-1 Evaluation Board

The layout of the TX112-1 Evaluation Board PCB is shown on page 15. Figure 5 is a detailed schematic of the TX112-1. Components labeled “NP” use different configurations for FSK operation. Table 2 describes each header pin connector used in the evaluation board.

| Pin  | Function Name | Functional Description            |
|------|---------------|-----------------------------------|
| J1-1 | VDD           | 1.8V to 3.6V                      |
| J1-2 | Ground        | VSS                               |
| J1-3 | ASK INPUT     | Modulating Data Input, ASK or FSK |
| J2-1 | REF-OSC       | External Reference Input          |
| J2-2 | GROUND        | VSS                               |
| J2-3 | ENABLE        | Enable Input, Active High         |

Table 4. Header Pin Connectors



**TX112-1-433.92 ASK Bill of Materials**

| Item                     | Part Number               | Manufacturer                | Description   | Qty.     |
|--------------------------|---------------------------|-----------------------------|---|----------|
| C1                       | GRM21BR60J106KE01L        | Murata <sup>(1)</sup>       | 10µF Capacitor, 0805  | 1        |
| C2                       | GRM1885C1H101JA01D        | Murata                      | 100pF Capacitor, 0603   | 1        |
| C5                       | GRM1885C1H100JA01D        | Murata                      | 10pF Capacitor, 0603  | 1        |
| R1,R4,R6                 |                           |                             |   | 3        |
| C6,C8,C11,C12,C15        |                           |                             |   | 5        |
| C7                       | GRM1885C1H4R7JA01D        | Murata                      | 4.7pF Capacitor, 0603   | 1        |
| C10                      | GRM188F51H104ZA01D        | Murata                      | 0.1µF Capacitor, 0603   | 1        |
| C13,C14                  | GRM1885C1H180JA01D        | Murata                      | 18pF Capacitor, 0603  | 2        |
| J1,J2                    | TSHR-114-S-02-A-GT        |                             | CON3  | 2        |
| L1                       | 0805CS-680XJB             | Coilcraft <sup>(2)</sup>    | 470nH Inductor, 0805  | 1        |
| L4                       | 0603CS-082NXJB            | Coilcraft                   | 150nH Inductor, 0603  | 1        |
| L5                       | ANTENNA LOOP, Part of PCB |                             | Antenna   | 1        |
| R2                       | CRCW0603100KFKEA          | Vishay <sup>(3)</sup>       | 100kΩ Resistor, 0603  | 1        |
| R3,R5,R7<br>R8,JPR1,JPR2 | CRC06030000Z0EA           | Vishay                      | 0Ω Resistor, 0603   | 6        |
| <b>U1</b>                | <b>MICRF112YMM</b>        | <b>Micrel<sup>(4)</sup></b> | <b>300MHz to 450MHz, +10dBm<br/>ASK/FSK Transmitter with<br/>Shutdown</b> | <b>1</b> |
| Y1                       | SA-13.5600-F-10-C-3-3     | HIB <sup>(5)</sup>          | 13.560MHz XTAL  | 1        |

**Notes:**

1. Murata Tel: [www.murata.com](http://www.murata.com).
2. Coilcraft: [www.coilcraft.com](http://www.coilcraft.com).
3. Vishay Tel: [www.vishay.com](http://www.vishay.com)
4. **Micrel, Inc.:** [www.micrel.com](http://www.micrel.com).
5. HIB: [www.hib.com.br](http://www.hib.com.br).

**Tx112-1-315MHz ASK Bill of Materials**

| Item                     | Part Number               | Manufacturer                | Description   | Qty.     |
|--------------------------|---------------------------|-----------------------------|---|----------|
| C1                       | GRM21BR60J106KE01L        | Murata <sup>(1)</sup>       | 10 $\mu$ F Capacitor, 0805  | 1        |
| C2                       | GRM1885C1H101JA01D        | Murata                      | 100pF Capacitor, 0603   | 1        |
| C5                       | GRM1885C1H1000JA01D       | Murata                      | 10pF Capacitor, 0603  | 1        |
| R1,R4,R6                 |                           |                             |   | 3        |
| C6,C8,C11,C12,C15        |                           |                             |   | 5        |
| C7                       | GRM1885C1H6R8JA01D        | Murata                      | 4.7pF Capacitor, 0603   | 1        |
| C10                      | GRM188F51H104ZA01D        | Murata                      | 0.1 $\mu$ F Capacitor, 0603   | 1        |
| C13,C14                  | GRM1885C1H180JA01D        | Murata                      | 18pF Capacitor, 0603  | 2        |
| J1,J2                    | TSHR-114-S-02-A-GT        |                             | CON3  | 2        |
| L1                       | 0805CS-470XJB             | Coilcraft <sup>(2)</sup>    | 470nH Inductor, 0805  | 1        |
| L4                       | 0603CS-R15XJB             | Coilcraft                   | 150nH Inductor, 0603  | 1        |
| L5                       | ANTENNA LOOP, Part of PCB |                             | Antenna   | 1        |
| R2                       | CRCW0603100KFKEA          | Vishay <sup>(3)</sup>       | 100k $\Omega$ Resistor, 0603  | 1        |
| R3,R5,R7<br>R8,JPR1,JPR2 | CRC06030000Z0EA           | Vishay                      | 0 $\Omega$ Resistor, 0603   | 6        |
| <b>U1</b>                | <b>MICRF112YMM</b>        | <b>Micrel<sup>(4)</sup></b> | <b>300MHz to 450MHz, +10dBm<br/>ASK/FSK Transmitter with<br/>Shutdown</b> | <b>1</b> |
| Y1                       | SA-9.84375-F-10-C-3-3     | HIB <sup>(5)</sup>          | 9.84375MHz XTAL   | 1        |

**Notes:**

1. Murata Tel: [www.murata.com](http://www.murata.com).
2. Coilcraft: [www.coilcraft.com](http://www.coilcraft.com).
3. Vishay Tel: [www.vishay.com](http://www.vishay.com).
4. Micrel, Inc.: [www.micrel.com](http://www.micrel.com).
5. HIB: [www.hib.com.br](http://www.hib.com.br).

## FSK Operation

The Bill of Materials tables describe the components needed for ASK operation for 433.92MHz and 315MHz.

Table 5 lists the component values that change between ASK and FSK operation. Note that use of a high FSK data rate may excite parasitic resonant modes with some crystal types. Recommended crystals from the Bill of Materials tables are good for both ASK and FSK.

| Mode | R1         | R2            | R5         | R6            | JPR1       | JPR2       | C8  |
|------|------------|---------------|------------|---------------|------------|------------|---|
| ASK  | NP         | 100k $\Omega$ | 0 $\Omega$ | NP            | 0 $\Omega$ | NP         | NP  |
| FSK  | 0 $\Omega$ | NP            | NP         | 100k $\Omega$ | NP         | 0 $\Omega$ | 3.3pF <sup>(1)</sup><br>10pF <sup>(2)</sup> |

**Notes:**

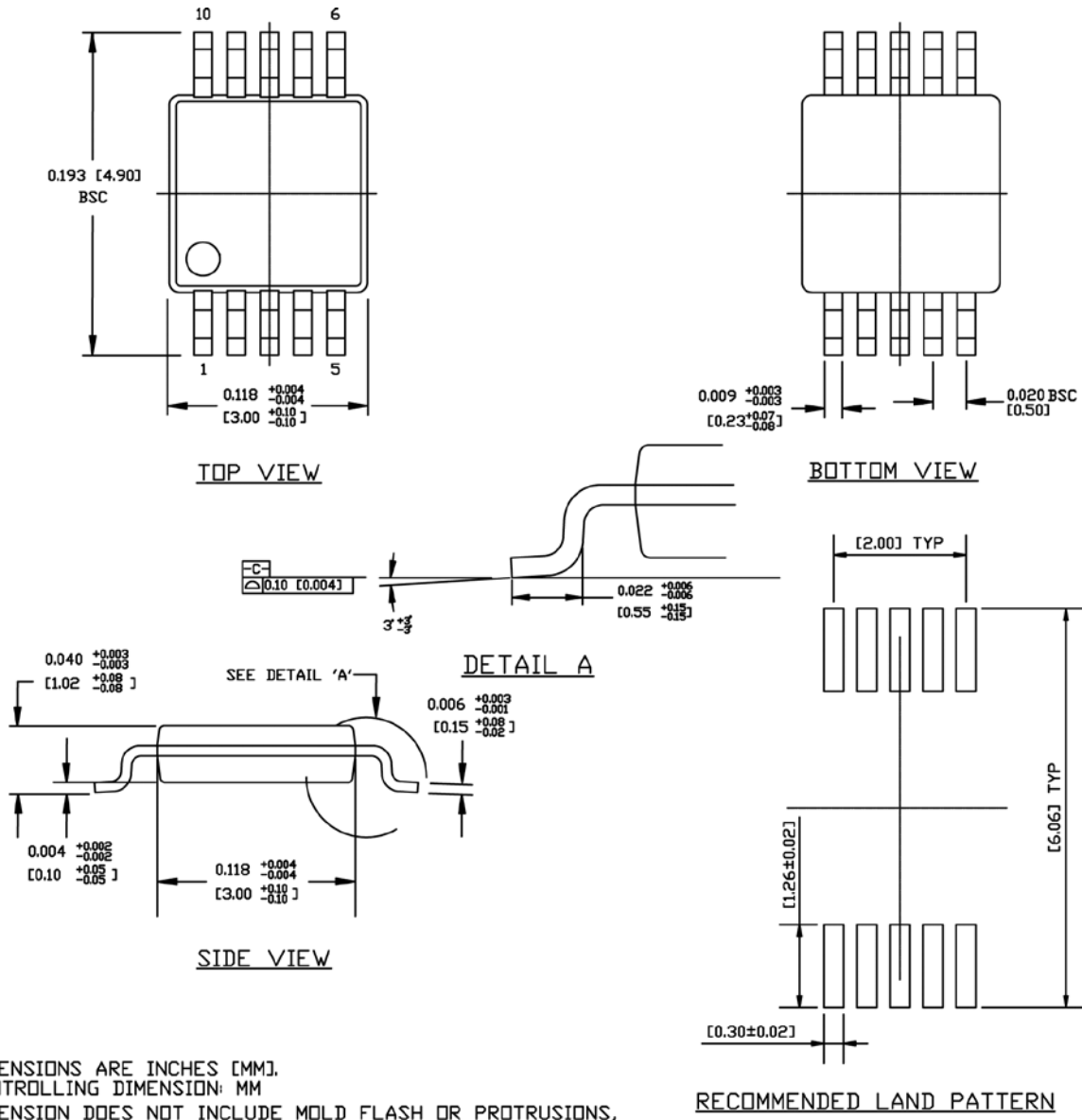
1. C8 = 3.3pF for 1kHz using HC49/U or HC49US type crystals.
2. C8= 10pF for 10kHz using HC49/U, (high profile) only.

**Table 5. ASK and FSK Settings**

|                          | R3         | R4            |
|--------------------------|------------|---------------|
| Constant ON              | 0 $\Omega$ | NP            |
| External Standby Control | NP         | 100k $\Omega$ |

**Table 6. Enable Control (Shutdown)**

# Package Information<sup>(1)</sup>

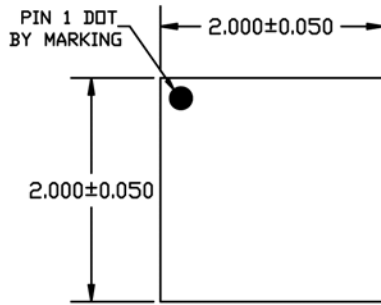


- NOTES:**
1. DIMENSIONS ARE INCHES [MM].
  2. CONTROLLING DIMENSION: MM
  3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.008 [0.20] PER SIDE.

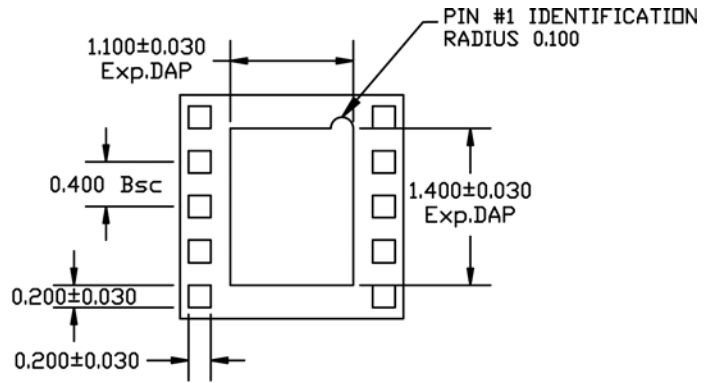
## 10-Pin MSOP Package Type (YMM)

**Note:** The Pin1 marking symbol could be a circle, triangle, or other symbol. Package information is correct as of the publication date. For updates and most current information, go to [www.micrel.com](http://www.micrel.com).

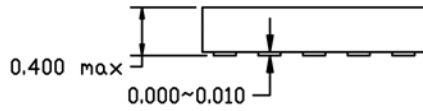
Package Information<sup>(1)</sup> (Continued)



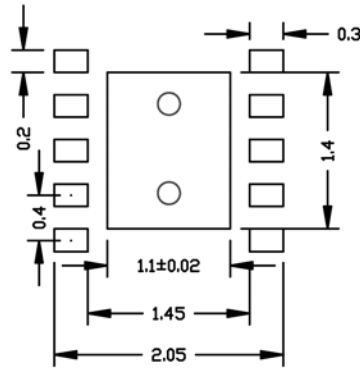
TOP VIEW  
NOTE: 1,2,3,4



BOTTOM VIEW  
NOTE: 1,2,3,4



SIDE VIEW  
NOTE: 1,2,3,4



RECOMMENDED LAND PATTERN  
NOTE: 5

- NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
  2. MAX. PACKAGE WARPAGE IS 0.08 mm.
  3. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
  4. PIN #1 ID ON TOP WILL BE LASER MARKED.
  5. Red Circle Indicates Thermal Via. Size should be 0.200mm to 0.0350mm in diameter, 0.80mm pitch, and should be connected to ground plane for maximum thermal performance.

10-Pin Ultra-Thin DFN 2mm x 2mm x 0.4mm (MU)

**Note:** The Pin1 marking symbol could be a circle, triangle, or other symbol. Package information is correct as of the publication date. For updates and most current information, go to [www.micrel.com](http://www.micrel.com).

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