

# MAX7042 Evaluation Kit

## Evaluates: MAX7042

### General Description

The MAX7042 evaluation kit (EV kit) allows for a detailed evaluation of the MAX7042 superheterodyne receiver. It enables testing of the device's RF performance and requires no additional support circuitry. The RF input circuit is designed to work with a 50Ω source impedance RF signal generator and has an SMA connector for convenient connection to test equipment. The EV kit can also directly interface to the user's embedded design for easy data decoding.

The MAX7042 EV kit comes in two versions, a 315MHz version and a 433.92MHz version. The passive components are optimized for these frequencies. These components can be changed to work at 308MHz and 418MHz. In addition, the 4kbps Manchester received data rate can be adjusted from 0kbps to 33kbps by changing two more components.

For easy implementation into the customer's design, the MAX7042 EV kit also features a proven PCB layout that can be duplicated easily for quicker time to market. The EV kit Gerber files are available upon request.

### Features

- ◆ Proven PCB Layout
- ◆ Proven Components Parts List
- ◆ Multiple Test Points Provided On Board
- ◆ Available in 315MHz or 433.92MHz Optimized Versions
- ◆ 308MHz and 418MHz Operation Possible by Changing Components
- ◆ Fully Assembled and Tested
- ◆ Can Operate as a Stand-Alone Receiver with the Addition of an Antenna

### Ordering Information

PART	TYPE
MAX7042EVKIT-315+	EV Kit
MAX7042EVKIT-433+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

### Component List

DESIGNATION	QTY	DESCRIPTION
C1, C20, C21	3	0.01μF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H103K
C2, C22	2	0.1μF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C104K
C3, C4	2	15pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H150J
C5, C6, C13, C19	0	Not installed, ceramic capacitors (0603)
C7, C8, C9	3	100pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H101J
C10	1	<b>315MHz:</b> 1.2pF ±0.1pF, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H1R2B
		<b>433.92MHz:</b> Not installed, ceramic capacitor (0603)

DESIGNATION	QTY	DESCRIPTION
C11, C18	2	220pF ±10%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H221K
C12	1	1500pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H152K
C14, C15, C16	3	0.047μF ±10% 50V X7R ceramic capacitors (0603) Murata GRM188R71H473K
C17	1	470pF ±5% 50V C0G ceramic capacitor (0603) Murata GRM1885C1H471JA01
GND, TP8	2	Black miniature test points
JU1, JU4-JU11	9	3-pin headers
JU2, JU3	0	Not installed, 3-pin headers
JU12	1	2-pin header
L1	1	<b>315MHz:</b> 82nH ±5% inductor (0603) Coilcraft 0603CS-82NXJLU
		<b>433.92MHz:</b> 39nH ± 5% inductor (0603) Coilcraft 0603CS-39NXJLU

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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### Component List (continued)

DESIGNATION	QTY	DESCRIPTION
L2	1	<b>315MHz:</b> 3.9nH $\pm 5\%$ inductor (0603) Coilcraft 0603CS-3N9XJLU
		<b>433.92MHz:</b> 0 $\Omega$ $\pm 5\%$ resistor (0603)
L3	1	<b>315MHz:</b> 30nH $\pm 5\%$ inductor (0603) Murata LQW18AN30NJ00
		<b>433.92MHz:</b> 16nH $\pm 5\%$ inductor (0603) Murata LQW18AN16NJ00
R1, R5	0	Not installed, resistors (0603)
R2, R3, R4	3	100k $\Omega$ $\pm 5\%$ resistors
REF_IN, MIXOUT	0	Not installed, SMA female vertical-mount connectors
RF_IN	1	SMA female vertical-mount connector

DESIGNATION	QTY	DESCRIPTION
TP1-TP7, VDD	8	Red miniature test points
U1	1	Low-power, FSK superheterodyne receiver (32 TQFN-EP*) Maxim MAX7042ATJ+
Y1	1	<b>315MHz:</b> 9.509375MHz crystal Crystek 017034
		<b>433.92MHz:</b> 13.2256MHz crystal Crystek 017035
Y2	1	10.7MHz ceramic filter TOKO #SK107M1N-AO-10
—	9	Shunts
—	1	PCB: MAX7042 EVALUATION KIT+

\*EP = Exposed pad.

### Component Suppliers

SUPPLIER	PHONE	WEBSITE
Coilcraft, Inc.	847-639-6400	www.coilcraft.com
Crystek Corporation	800-237-3061	www.crystek.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
TOKO America, Inc.	847-297-0070	www.tokoam.com

**Note:** Indicate that you are using the MAX7042 when contacting these component suppliers.

### Quick Start

#### Required Equipment

- MAX7042 EV kit
- Regulated power supply capable of providing 3.3V
- RF signal generator capable of delivering -120dBm to 0dBm output power at the operating frequency, in addition to frequency modulation (FM) capabilities (Agilent E4420B or equivalent)
- Optional ammeter for measuring supply current
- Oscilloscope

#### Procedure

The MAX7042 EV kit is fully assembled and tested. Follow the steps below to verify board operation.

**Caution: Do not turn on the DC power supply or RF signal generator until all connections are completed.**

- 1) Verify that the jumpers are in their default position, as shown in Table 1.
- 2) Connect a DC supply set to 3.3V (through an ammeter, if desired) to the VDD and GND terminals on the EV kit. Do not turn on the power supply.
- 3) Connect the RF signal generator to the RF\_IN SMA connector. Do not turn on the generator output. Set the generator for an output carrier frequency of 315MHz (or 433.92MHz) at a power level of -100dBm. Set the modulation of the generator to provide a FSK signal with  $\pm 50$ kHz frequency deviation modulated with a 4kHz square wave.
- 4) Connect the oscilloscope to test point TP6 (DS+ or data slicer positive input). Set the oscilloscope to AC-coupling and set the vertical scale to approximately 100mV/div.

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- 5) Turn on the DC supply. The supply current should read approximately 7.2mA for an EV kit that is set for maximum sensitivity (JU4 pins 1-2 connected). To draw slightly less current, with slightly less sensitivity, connect JU4 pins 2-3.
- 6) Remove the shunt from JU7 momentarily and restore it to the 1-2 position. JU7 is the enable input and toggling it once ensures that the FSK demodulator is calibrated and operational.
- 7) Activate the RF generator's output with modulation and observe TP6 on the scope. Use the RF generator's LF OUTPUT (modulation output) to trigger the oscilloscope. The scope should show a 200mV to 250mV peak-to-peak, lowpass-filtered square wave. If the RF power is turned off, the scope trace shows a noise voltage with high-amplitude and high-frequency characteristics. These are the clicks that characterize the response of an FM demodulator to noise. To estimate the sensitivity, reduce the RF power to a level where the square wave on the scope is noisy but recognizable. This power level

should be below -107dBm. In some cases, the sensitivity can be improved by removing the ammeter.

- 8) Move the scope probe to TP3 (DATA), change the coupling on the scope back to DC, and set the vertical scale to 1V/div or 2V/div. A 4kHz square wave going from ground to VDD (3.3V in this case) should be seen. As the RF power is increased, this square wave becomes cleaner. Another way to estimate sensitivity from this test point is to reduce the RF power until the square wave becomes extremely asymmetric (duty cycle not 50%) and contains short-data transitions (glitches) in the middle of a data interval. This power level should be below -107dBm, similar to the level seen in the previous step.

### Layout Issues

A properly designed PCB is essential for any RF/microwave circuit. Keep high-frequency input and output lines as short as possible to minimize losses and radiation. At high frequencies, trace lengths that are on the order of  $\lambda/10$  or longer can act as antennas.

**Table 1. Jumper Table**

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	Connects AVDD to VDD3
	2-3	Connects AVDD to TP1
JU2	—	Not populated, leave open
JU3	—	Not populated, leave open
JU4	1-2*	Selects high sensitivity
	2-3	Selects normal sensitivity
JU5	1-2	Connects FSEL2 to VDD (default for 433.92MHz); see Table 2.
	2-3	Connects FSEL2 to GND (default for 315MHz); see Table 2.
JU6	1-2*	Connects FSEL1 to VDD; see Table 2
	2-3	Connects FSEL1 to GND; see Table 2

JUMPER	SHUNT POSITION	DESCRIPTION
JU7	1-2*	Turns on the MAX7042
	2-3	Puts the MAX7042 in shutdown
JU8	1-2*	Connects HVIN to VDD
	2-3	Connects HVIN to TP4
JU9	1-2*	Connects DVDD to VDD3
	2-3	Connects DVDD to TP5
JU10	1-2*	No peak-detector operation
	2-3	Use peak detector for faster receiver startup
JU11	1-2	Mixer output to MIXOUT
	2-3	External IF input
	Open*	Normal operation, leave open
JU12	1-2*	Connects VDD to +3.3V supply
	Open	Connects VDD to +5V supply

\*Default position.

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Both parasitic inductance and capacitance are influential on circuit layouts and are best avoided by using short trace lengths. Generally, a 10-mil wide PCB trace, 0.0625in above a ground plane, with FR4 dielectric has approximately 19nH/in of inductance and approximately 1pF/in of capacitance. In the LNA output/mixer input tank circuit, the proximity to the MAX7042 IC has a strong influence on the effective component values.

To reduce the parasitic inductance, use a solid ground or power plane below the signal traces. Also, use low-inductance connections to ground on all GND pins, and place decoupling capacitors close to all VDD connections.

The MAX7042 EV kit PCB can serve as a reference design for laying out a board using the MAX7042.

### Detailed Description of Hardware

#### Power Supply

The MAX7042 can operate from 3.3V or 5V supplies. For 5V operation, remove jumper JU12 before connecting the supply to VDD. AVDD is the output of an internal regulator when VDD = 5V. AVDD and DVDD are connected on the EV kit through VDD3. For 3.3V operation, connect JU12.

#### IF Input/Output

The 10.7MHz IF can be monitored with an oscilloscope or a spectrum analyzer. To monitor the IF output with an oscilloscope, connect the scope probe to pin 3 of JU11. Increase the RF signal generator power to approximately -70dBm and set the scope amplitude to 20mV or 50mV per division. Set the time per division on the horizontal trace to 100ns. The scope trace shows the waveform at the output of the external ceramic IF filter.

To monitor the IF output on a spectrum analyzer, use the high-impedance probe attachment from the spectrum analyzer, if one is available, and connect it to pin 3 of JU11.

**Table 2. Frequency Selection Table**

FSEL2 (JU5)	FSEL1 (JU6)	FREQUENCY (MHz)
0	0	308
0	1	315
1	0	418
1	1	433.92

**Note:** 1 = 1-2 position; 0 = 2-3 position.

There is a MIXOUT location on the board that can be populated with a board-mounted SMA connector to monitor the IF output or to inject an IF signal into the IFIN+ pin. Remove the ceramic filter (Y2) for such a measurement and include R1 (270Ω) and C13 (0.01μF) to match the 330Ω mixer output with the 50Ω spectrum analyzer. Connect pins 1-2 of jumper JU11 to see the IF output on the spectrum analyzer. Connect pins 2-3 of jumper JU11 to inject an IF signal into the IFIN+ pin from an external source.

#### REF\_IN External Frequency Input

For applications where the correct frequency crystal is not available, it is possible to directly inject an external frequency through the REF\_IN SMA connector. Connect the SMA to a function generator. The addition of C5 and C6 (use 0.01μF capacitors), plus the removal of C3 and C4 are necessary. The recommended amplitude of the function generator is 500mVp-p.

#### Test Points and I/O Connections

Additional test points and I/O connectors are provided to monitor the various baseband signals and for external connections. See Tables 3 and 4 for a description.

**Table 3. Test Points**

TEST POINT	DESCRIPTION
1	AVDD
2	RSSI
3	FSK data out
4	HVIN
5	DVDD
6	Positive input to data slicer
7	Negative input to data slicer

**Table 4. I/O Connectors**

TEST POINT	DESCRIPTION
RF_IN	RF input
REF_IN	External reference frequency input
MIXOUT	IF input/output
GND	Ground
VDD	Supply input

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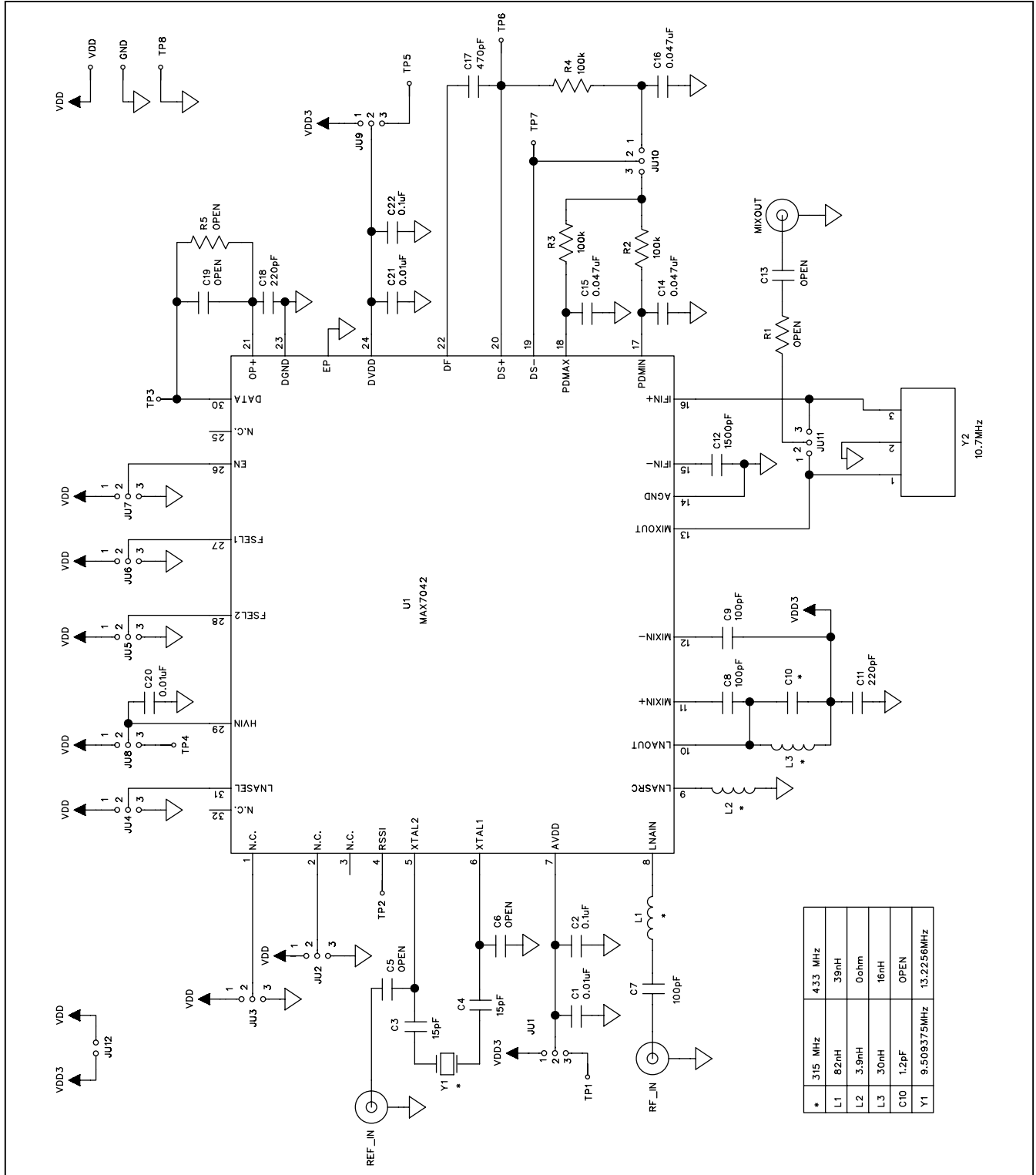


Figure 1. MAX7042 EV Kit Schematic

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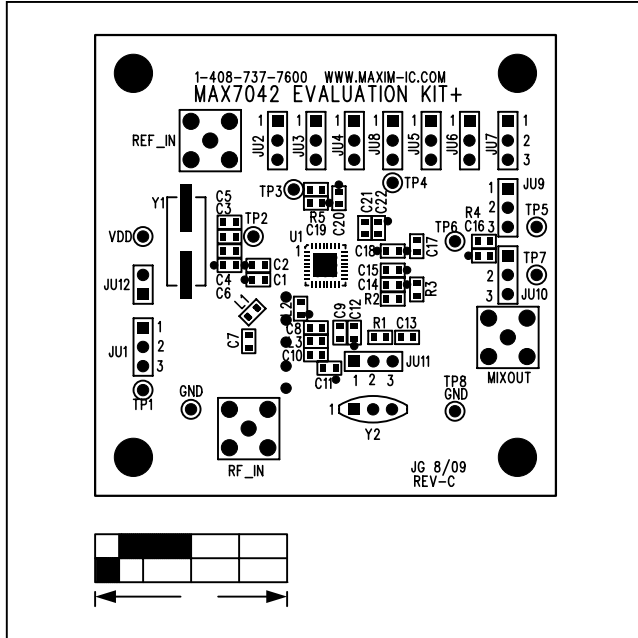


Figure 2. MAX7042 EV Kit Component Placement Guide—Component Side

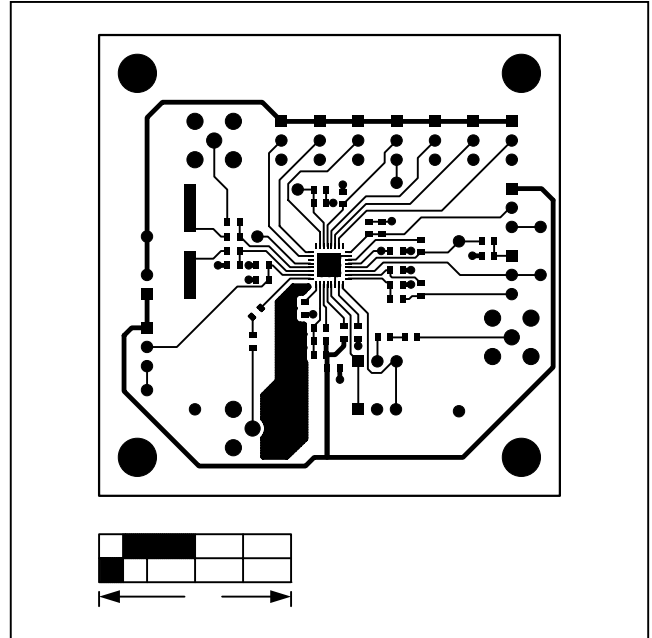


Figure 3. MAX7042 EV Kit PCB Layout—Component Side

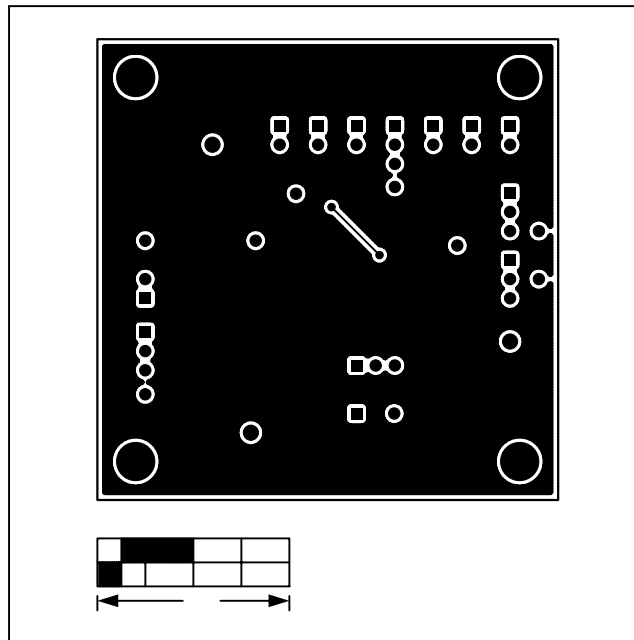


Figure 4. MAX7042 EV Kit PCB Layout—Solder Side

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