

General Description

The MAX7030 evaluation kit (EV kit) allows for a detailed evaluation of the MAX7030 ASK transceiver. 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 or a 50Ω input impedance spectrum analyzer 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 MAX7030 EV kit comes in two versions: a 315MHz version and a 433.92MHz version. The passive components are optimized for these frequencies. The MAX7030 IC itself is available in three frequencies: 315MHz, 345MHz, and 433.92MHz. The EV kit board components can easily be changed to work at RF frequencies from 300MHz to 450MHz.

For easy implementation into the customer's design, the MAX7030 EV kit also features a proven Printed Circuit Board (PCB) layout, which can be easily duplicated for quicker time-to-market. The PCB gerber files are available for download at www.maximintegrated.com

Features

- Proven PC Board Layout
- Proven Components Parts List
- Multiple Test Points Provided on Board
- Available in 315MHz or 433.92MHz Optimized Versions
- Modification Instructions for 345 MHz Available
- Fully Assembled and Tested
- Can Operate as a Stand-Alone Receiver with a User-Provided Connector and Antenna

Ordering Information appears at end of data sheet.

Quick Start

Required Equipment

- MAX7030 EV kit board
- Regulated power supply
- RF signal generator capable of delivering from -120dBm to 0dBm of output power at the operating frequency (Agilent E4420B or equivalent)
- A means to ASK modulate the RF Generator (may be built-in)
- Optional ammeter for measuring supply current
- Dual-trace oscilloscope
- RF Power Meter (Agilent 436A or equivalent) or spectrum analyzer

Connections and Setup

The MAX7030 EV kit board is fully assembled and tested. Follow the steps below to verify board operation:

- 1) The default power supply range for the instructions that follow is 2.1 to 3.6V. Refer to the [Detailed Description of Hardware](#) section for 5V operation.
- 2) Jumper JU14 can be open or shorted. It is normally used for other Maxim ICs to get DC power through a multipin connector. This multipin connector is not placed on the MAX7030 evaluation board. Short Jumper JU15 and connect a supply to the VDD and GND test points. Connect pins 1-2 on jumpers JU1, JU3, JU9, and JU10 on the MAX7030 EV kit board for 2.1–3.6V operation.
- 3) Connect pins 1-2 on jumper JU7 to keep the ENABLE pin high.
- 4) Connect pins 2-3 on jumper JU6 to set the T/R pin to Receive.
- 5) Connect pins 2-3 on jumper JU5 for conventional data slicing operation (no peak detector outputs)
- 6) Remove the jumper from JU8 to allow the DATA pin to float.
- 7) Connect Pins 1-2 on Jumper JU11. Connect Pins 2-3 on jumpers JU12 and JU13 or leave them open (the pins on the MAX7030 are normally pulled low). These jumpers set the AGC release time to be compatible with the data rate used for this evaluation board.

Receiver Operation

- 1) Connect the RF signal generator to the RFIN SMA connector. Set the power level out of the generator at -100 dBm with no modulation. Connect an oscilloscope probe to test point TP10, which shows the input to the Data Slicer comparator. The DC voltage should be about 0.5 to 0.6V. This voltage will vary from about 0.5 to 1.5V as the input RF power is increased from no power to about -55 dBm, then drop abruptly and increase again as the input RF power is increased. The abrupt drop occurs at the point where the automatic gain control (AGC) of the MAX7030 automatically turns on.

ASK Modulation

- 1) Return the RF power level to -100 dBm and set up ASK modulation on the RF signal generator.
- 2) Use a 4kHz, 50% duty cycle square wave to simulate 4kbps Manchester coded data.
- 3) Set the oscilloscope to AC coupling and set the vertical scale to about 100mV/division. The scope should show a lowpass-filtered square wave (or sine wave, depending on the data filter cutoff frequency) whose amplitude increases with increasing RF power.
- 4) If the RF power is turned off, the scope trace should show a noise voltage with a peak-to-peak value of about 40mV.
- 5) To estimate the sensitivity of the receiver, reduce the RF power to a level where the square wave amplitude on the scope is about 1.5 to 2 times the noise voltage.
- 6) This power level should be somewhere between -111 dBm and -114 dBm if the generator reads the peak power level.
- 7) Move the scope probe to test point TP8 (DATA), change the coupling on the scope back to DC, and set the vertical scale to 1V or 2V/division. You should see a 4kHz square wave going from ground to VDD.
- 8) As you increase the RF power, this square wave will be cleaner.
- 9) 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.
- 10) This power level should be somewhere between -111 dBm and -114 dBm, similar to the level seen in the previous step.

Image Rejection

- 1) Keep the scope probe on test point TP8. Change the frequency of the signal generator to 21.4MHz below the normal carrier frequency. This is the image frequency for a super heterodyne receiver with a 10.7MHz IF using low-side injection.
- 2) For 315MHz operation, the image frequency is 293.6MHz. For 433.92MHz operation, the image frequency is 412.52MHz
- 3) Increase the power level of the signal generator until you see a clean square wave form on the scope. Determine the “sensitivity” power level in the same manner as above for ASK sensitivity.
- 4) Subtract the power level at sensitivity from the power level measured at the image frequency to get the image rejection of the mixer.
- 5) For instance, if the sensitivity power level is -114 dBm and the image “sensitivity” power level is -64 dBm, the image rejection is 50dB.

Transmitter Operation

- 1) Disconnect the RFIN SMA connector from the RF Signal Generator and connect it to an RF Power Meter or Spectrum Analyzer.
- 2) Connect pins 1-2 on jumper JU6 to set the T/R pin to Transmit. If you are monitoring the DC current, you should see 3mA to 4mA of current being drawn by the crystal oscillator and PLL.
- 3) Connect pins 1-2 on the jumper JU8. This applies a steady logical 1 (VDD) to the ASK transmitter power amplifier, which causes it to transmit an unmodulated carrier.
- 4) Check the power reading on the RF power meter or spectrum analyzer. It should read about 10mW ($+10$ dBm) for a supply voltage of 2.7V and about 14mW ($+11.5$ dBm) for a supply voltage of 3.3V. If a data source or a function generator is available, you can ASK-modulate the carrier by removing the jumper from JU8 applying a data signal (0 to VDD) to TP8.

Other Information

The capacitors in the Sallen-Key data filters (C25 and C26) can be changed to set the corner frequency of the filter if data rates other than 4kbps are used. The AGC Release time should also be reset using jumpers JU11, JU12, and JU13. See the MAX7030 data sheet for more details.

Detailed Description of Hardware

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.

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 about 19nH/in of inductance and about 1pF/in of capacitance. In the LNA output/mixer input tank circuit, the proximity to the MAX7030 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.

Power Supply

The MAX7030 can operate from 3.3V or 5V supplies. For 5V operation, open jumper JU15 and connect the VDD terminal to 5V. For 3.3V operation, short jumper JU15 and connect the VDD terminal to 3.3V.

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 JU4. Increase the RF signal

generator power to about -70dBm and set the scope amplitude to 20mV or 50mV per division. Decrease the time per division on the horizontal trace to 100ns. The scope trace will show 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 JU4.

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 for such a measurement and install R2 (270 Ω) and C13 (0.01 μ F) to match the 330 Ω Mixer output with the 50 Ω spectrum analyzer. Connect pins 1-2 of jumper JU4 to see the IF output on the spectrum analyzer. Connect pins 2-3 of jumper JU4 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 REFIN SMA connector (not provided). Connect the SMA to a function generator and set the peak-to-peak voltage level from the function generator between 200mV and 600mV. The addition of C19 and C20 (use 0.01 μ F capacitors), plus the removal of C17 and C18, is necessary

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 [Table 2](#) and [Table 3](#) for a description.

Table 1. Jumper Function Table

JUMPER	STATE	FUNCTION
JU1	1-2*	VDD3 to AVDD
JU1	2-3	AVDD to TP1
JU2	1-2*	PAVDD directly to PAOUT
JU2	2-3	PAVDD to PAOUT through ROUT for pulse shaping
JU3	1-2*	VDD3 to PAVDD
JU3	2-3	PAVDD to TP2
JU4	1-2	Mixer output to MIX_OUT SMA Connector
JU4	2-3	External IF input
JU4	NC*	Normal operation
JU5	1-2	Use Peak Detector for faster receiver startup
JU5	2-3*	No Peak Detector Operation
JU6	1-2	Set device to Transmit
JU6	2-3	Set device to Receive
JU6	NC	Set device to Receive
JU7	1-2*	Device enabled
JU7	2-3	Device asleep
JU7	NC	Enable controlled by SPI
JU8	1-2	Input data pulled high
JU8	2-3	Input data pulled low
JU8	NC	Data in/out controlled by SPI
JU9	1-2*	HVIN tied to VDD
JU9	2-3	HVIN tied to TP4
JU10	1-2*	DVDD tied to VDD3
JU10	2-3	DVDD tied to TP3
JU11	1-2*	AGC1 pulled high
JU11	2-3	AGC1 pulled low
JU11	NC	AGC1 pulled low
JU12	1-2	AGC0 pulled high
JU12	2-3	AGC0 pulled low
JU12	NC*	AGC0 pulled low
JU13	1-2	AGC2 pulled high
JU13	2-3	AGC2 pulled low
JU13	NC*	AGC2 pulled low
JU14	NC*	Not Used
JU15	1-2*	Connect VDD to +3.3V supply
JU15	NC	Connect VDD to +5.0V supply

*Default setting

Table 2. Test Points

TP	DESCRIPTION
1	AVDD
2	PAVDD
3	DVDD
4	HVIN
5	CLKOUT
6	ENABLE
7	T/R
8	DATA
9	RSSI
10	DS+
11	DS-
12	PAVDD/ESOUT

Table 3. I/O Connectors

SIGNAL	DESCRIPTION
RFIN	RF input/output
REF_IN	External reference frequency input
MIXOUT	IF input/output
GND	Ground
VDD	Supply input

Component Suppliers

SUPPLIER	WEBSITE
Murata	http://www.murata.com
Crystek	http://www.crystek.com
Coilcraft	http://www.coilcraft.com

Note: Indicate that you are using MAX7030EVKIT when contacting these component suppliers.

Ordering Information

PART	TEMP. RANGE	IC PACKAGE
MAX7030EVKIT-315	-40°C to +85°C	32-TQFN
MAX7030EVKIT-433	-40°C to +85°C	32-TQFN

MAX7030 EV Kit Bill of Materials

PART	QTY	DESCRIPTION
C1, C21, C22, C27	4	0.01uF 10% 50V X7R CER CAP (0603) Murata: GRM188R71H103K
C2	1	0.1uF 10% 50V X7R Cer Cap (0603) Murata: GRM188R71C104K
C3	1	680pF 10% 50V CER CAP (0603) MURATA GRM1885C1H681K
C4, C25, C28, C29	4	220pF 10% 50V CER CAP (0603) MURATA GRM1885C1H221K
C5, C7, C8, C17, C18	5	100pF 5% 50V CER CAP (0603) MURATA GRM1885C1H101J
C6 (315MHz)	1	2.7pF +/-0.1pF 50V C0G CER CAP (0603) MURATA: GRM1885C1H2R7B
C6 (433MHz)	1	1.8pF +/-0.1pF 50V C0G CER CAP (0603) MURATA: GRM1885C1H1R8B
C9	1	1500pF 10% 50V X7R CER CAP (0603) Murata GRM188R71H152K
C10, C11, C12	3	0.047uF 10% 50V X7R CER CAP (0603) Murata: GRM188R71H473K
C13, C19, C20, C23, C24	0	0603 Capacitor NOT INSTALLED
C14 (315MHz)	1	12pF 5% 50V C0G CER CAP (0603) Murata: GRM1885C1H120J
C14, C16 (433MHz)	2	6.8pF 5% 50V C0G CER CAP (0603) Murata: GRM1885C1H6R8J

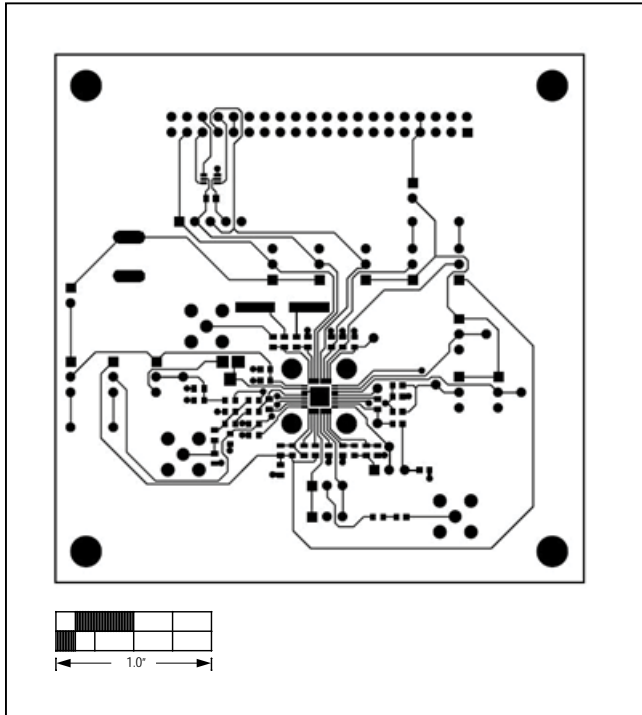
PART	QTY	DESCRIPTION
C15 (315MHz)	1	22pF 5% 50V C0G CER CAP (0603) Murata: GRM1885C1H220J
C15 (433MHz)	1	10pF 5% 50V C0G CER CAP (0603) Murata: GRM1885C1H100J
C16 (315MHz)	1	10pF 5% 50V C0G CER CAP (0603) Murata: GRM1885C1H100J
C26	1	470pF 5% 50V C0G CER CAP (0603) MURATA GRM1885C1H471JA01
L1, L2 (315MHz)	2	30nH 5% (0603) Coilcraft: 0603CS-30NXJBC
L1, L2, L5 (433MHz)	3	22nH 5% (0603) Coilcraft: 0603CS-22NXJBC
L3 (315MHz)	1	12nH 5% (0603) Coilcraft: 0603CS-12NXJBC
L3 (433MHz)	1	10nH 5% (0603) Coilcraft: 0603CS-10NXJBC
L4 (315MHz)	1	30nH 5% (0603) Murata: LQW18AN30NJ00
L4 (433MHz)	1	16nH 5% (0603) Murata: LQW18AN16NJ00
L5 (315MHz)	1	27nH 5% (0603) Coilcraft: 0603CS-27NXJBC
L6 (315MHz)	1	100nH 5% (0603) Coilcraft: 0603CS-R10XJBC
L6 (433MHz)	1	68nH 5% (0603) Coilcraft: 0603CS-R68XJBC
R1	1	5K POTENTIOMETER BC COMPONENTS: SM4W502

MAX7030 EV Kit Bill of Materials (continued)

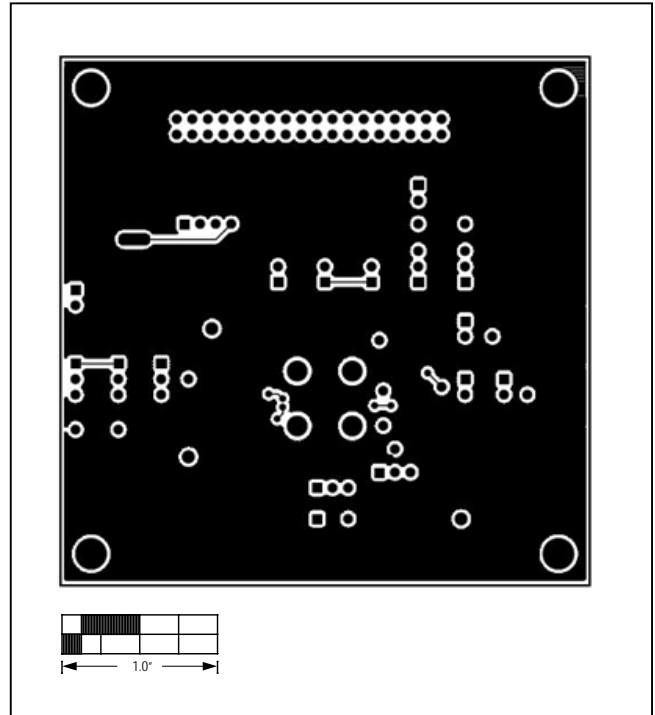
PART	QTY	DESCRIPTION
R2, R6, R7	0	RESISTOR (0603) NOT INSTALLED
R3, R4, R5	3	100 KΩ RESISTOR 5% (0603) Any
RF IN	1	SMA CONNECTOR TOP-MOUNT DIGI-KEY: J500-ND JOHNSON: 142-0701-201
MIXOUT	0	SMA CONNECTOR TOP-MOUNT NOT INSTALLED
REFIN	0	SMA CONNECTOR TOP-MOUNT Not Installed
JU1, JU2, JU3, JU4, JU5, JU6, JU7, JU8, JU9, JU10, JU11, JU12, JU13	13	3 PIN HEADER Digi-Key S1012-36-ND or Equivalent
JU14, JU15	2	2-PIN HEADER DIGIKEY: S1012-36-ND
J1	0	5 PIN HEADER Digi-Key S1012-36-ND or Equivalent Not Installed

PART	QTY	DESCRIPTION
J2	0	2X20 RIGHT ANGLE RECEPTACLE SAMTEC SSW-120-02-S-D-RA Methode Electronics RS2R-40-G Not installed
See table for Jumper Settings	9	SHUNT Digi-Key S9000-ND or Equivalent Quantity does not match
VDD, GND, TP5, TP6, TP7, TP9, TP10, TP11, TP8	9	Test Point Mouser: 151-203 or Equivalent
TP1, TP2, TP3, TP4, TP12	0	Test Point Not installed
Y1 (315MHz)	1	Crystal 12.67917MHz Crystek 017299
Y1 (433MHz)	1	Crystal 17.63417MHz Crystek 017301
Y2	1	10.7MHz CER FILTER Murata: SFTLA10M7FA00-B0
U1	1	MAX7030LATJ TQFN-32
U2	0	MAX4729EXT SC70-6 Not Installed

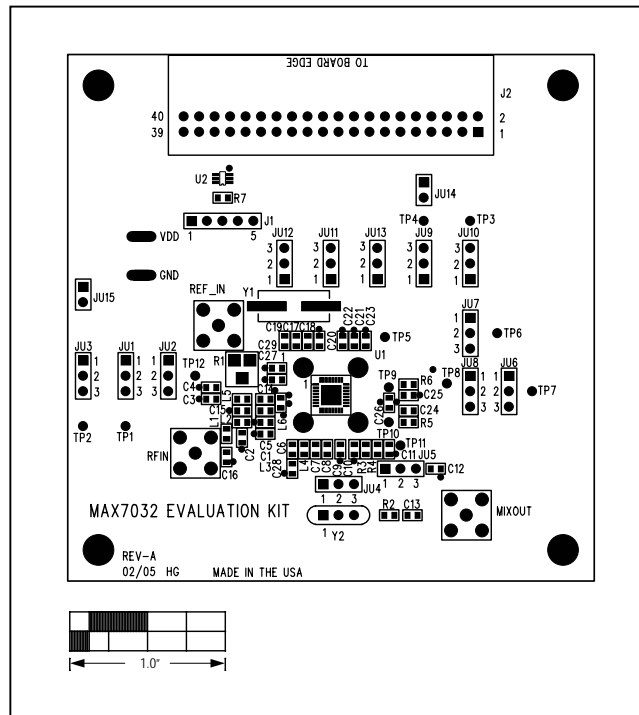
MAX7030 EV Kit PCB Layout Diagrams



MAX7030 EV Kit Board Layout—Component Side



MAX7030 EV Kit Board Layout—Solder Side



MAX7030 EV Kit Board Layout—Component Placement

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/18	Initial release	—

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

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