

Evaluate: MAX7049

General Description

The MAX7049 evaluation kits (EV kits) provide a proven design to evaluate the MAX7049 frequency-programmable ASK/FSK transmitter in a 28-pin TQFN package with an exposed pad. The EV kits use Windows XP®, Windows Vista®, and Windows® 7-compatible software to provide a simple graphical user interface (GUI). The EV kits enable testing of the device's RF performance and require no additional support circuitry. The RF output uses a 50Ω matching network and an SMA connector for convenient connection to test equipment. The EV kit PCBs come with a MAX7049ATI+ installed.

Features

- ♦ Windows XP-, Windows Vista-, and Windows 7-Compatible Software
- ♦ USB Powered
- ♦ Proven PCB Layout
- ♦ Proven Components List
- ♦ Adjustable Programmable Frequency
- ♦ Fully Assembled and Tested

Ordering Information

PART	TYPE
MAX7049EVKIT-433#	EV Kit (433MHz)
MAX7049EVKIT-868#	EV Kit (868MHz)
MAX7049EVKIT-915#	EV Kit (915MHz)

#Denotes RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
BATT-2032	0	Not installed, battery holder and contact solution
BATT-AAA	0	Not installed, plastic battery holder
C1, C9, C12, C16, C22, C25, C42, C46, C49	9	33pF ±5%, 50V C0G ceramic capacitors (0402) Murata GRM1535C1H330J
C2, C10, C13, C17, C23, C26, C43, C47, C50	9	0.01μF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E103K
C3, C11, C14, C18, C24, C27, C44, C48, C51	9	1μF ±10%, 6.3V X7R ceramic capacitors (0603) Murata GRM188R70J105K
C15	1	10μF ±10%, 6.3V X7R ceramic capacitor (0805) Murata GRM21BR70J106K
C19	1	150pF ±5%, 50V C0G ceramic capacitor (0402) Murata GRM1555C1H151J
C20, C31, C32	3	1500pF ±10%, 50V X7R ceramic capacitors (0402) Murata GRM155R71H152K

DESIGNATION	QTY	DESCRIPTION
C21	1	68pF ±5%, 50V C0G ceramic capacitor (0402) Murata GRM1555C1H680J
C33, C34	2	1.5pF ±0.25pF, 50V C0G ceramic capacitors (0402) Murata GRM1555C1H1R5C
C38, C40, C41	0	Not installed, ceramic capacitors (0402)
C52*	1	433MHz 6.2pF ±0.5pF ceramic capacitor (0402) Murata GRM1555C1H6R2DA01
		868MHz 2.7pF ±0.25pF ceramic capacitor (0402) Murata GRM1555C1H2R7CA01
		915MHz 3.6pF ±0.25pF ceramic capacitor (0402) Murata GRM1555C1H3R6CA01

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

MAX7049 Evaluation Kits

Evaluate: MAX7049

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C53*	0	433MHz Not installed, ceramic capacitor (0402)
		868MHz Not installed, ceramic capacitor (0402)
		915MHz Not installed, ceramic capacitor (0402)
C54*	0	433MHz Not installed, ceramic capacitor (0402)
		868MHz Not installed, ceramic capacitor (0402)
		915MHz Not installed, ceramic capacitor (0402)
C55*	1	433MHz 12pF $\pm 5\%$ ceramic capacitor (0402) Murata GRM1555C1H120JA01
		868MHz 5.6pF ± 0.5 pF ceramic capacitor (0402) Murata GRM1555C1H5R6DA01
		915MHz 2.7pF ± 0.25 pF ceramic capacitor (0402) Murata GRM1555C1H2R7CA01
C56*	1	433MHz 6.2pF ± 0.5 pF ceramic capacitor (0402) Murata GRM1555C1H6R2DA01
		868MHz 3.3pF ± 0.25 pF ceramic capacitor (0402) Murata GRM1555C1H3R3CA01
		915MHz 2.7pF ± 0.25 pF ceramic capacitor (0402) Murata GRM1555C1H2R7CA01

DESIGNATION	QTY	DESCRIPTION
C57*	1	433MHz 6.2pF ± 0.5 pF ceramic capacitor (0402) Murata GRM1555C1H6R2DA01
		868MHz 2.7pF ± 0.25 pF ceramic capacitor (0402) Murata GRM1555C1H2R7CA01
		915MHz 3.0pF ± 0.25 pF ceramic capacitor (0402) Murata GRM1555C1H3R0CA01
CX*	1	433MHz 5.6pF ± 0.25 pF ceramic capacitor (0402) Murata GRM1555C1H3R0CA01
	0	915MHz Not installed, ceramic capacitor (0402)
C100, C102, C104, C106, C109–C113, C117, C122, C125–C132	19	0.1 μ F $\pm 10\%$, 16V X7R ceramic capacitors (0603) Murata GRM188R71C104K
C101, C103, C105, C107	4	10 μ F $\pm 10\%$, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J106M
C114, C115	2	22pF $\pm 5\%$, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J
C116	1	33000pF $\pm 10\%$, 16V X7R ceramic capacitor (0603) Murata GRM188R71C333K
C118, C119	2	10pF $\pm 5\%$, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J
C120, C121	2	100pF $\pm 5\%$, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H101J

MAX7049 Evaluation Kits

Evaluate: MAX7049

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
$\overline{CS}$, DIN, EN, GPO1, GPO2, HOP, LSHDN, SCLK, DI, SDO	10	Red miniature test points
D100–D105	6	Yellow LEDs (1206)
D106–D111	6	Green LEDs (1206)
FB1	1	1k Ω ferrite bead Murata BLM15AG102SN1
GND, TP129, TP131, TP132	4	Black multipurpose test points
GND-A–GND-F, P1.7, SPKEN, TP4, VADJ, VDUT-A, VDUT-B, VEXT, 3V3	14	1-pin headers
J100	1	8-pin (2 x 4) header
J101	1	6-pin (2 x 3) header
J102, J103	0	Not installed, 40-pin (2 x 20) headers
JU1, JU3–JU7, JU12–JU15, JU100, JU101–JU108	19	3-pin headers
JU9, JU10, JU109–JU128	22	2-pin headers
L1	1	433MHz 470nH $\pm 2\%$ inductor (0603) Murata LQW18ANR47G00J
		868MHz 270nH $\pm 2\%$ inductor (0603) Murata LQW18ANR27G00J
		915MHz 270nH $\pm 2\%$ inductor (0603) Murata LQW18ANR27G00J
L2*	1	433MHz 33nH $\pm 2\%$ inductor (0603) Murata LQW18AN33NG00J
		868MHz 12nH $\pm 2\%$ inductor (0603) Murata LQW18AN12NG00J
		915MHz 10nH $\pm 2\%$ inductor (0603) Murata LQW18AN10NG00J

DESIGNATION	QTY	DESCRIPTION
L3*	1	433MHz 15nH $\pm 2\%$ inductor (0603) Murata LQW18AN15NG00J
		868MHz 5.6nH $\pm 2\%$ inductor (0603) Murata LQW18AN5N6C00J
		915MHz 0nH inductor (0603)
L4*	1	433MHz 16nH $\pm 2\%$ inductor (0603) Murata LQW18AN16NG00J
		868MHz 5.6nH $\pm 2\%$ inductor (0603) Murata LQW18AN5N6C00J
		915MHz 8.7nH $\pm 0.5\text{nH}$ inductor (0603) Murata LQW18AN8N7D00J
P100	1	USB type-B right-angle female receptacle
Q100	1	Dual n-channel FET (6 SuperSOT) Fairchild FDC6301N
R1	1	5.11 Ω $\pm 1\%$ resistor (0603)
R2	1	56k Ω $\pm 1\%$ resistor (0603)
R4–R6, R9, R10, R16, R17	7	10 Ω $\pm 1\%$ resistors (0603)
R7	1	2k Ω $\pm 0.5\%$ resistor (0603) Susumu RR0816P-202-D
R8	1	1.5k Ω $\pm 1\%$ resistor (0603)
R12, RB	0	Not installed, resistors (0603)
R13–R15	3	1k Ω $\pm 1\%$ resistors (0603)
R18, R125, R126, RA	4	0 Ω $\pm 5\%$ resistors (0603)
R100	1	50k Ω $\pm 10\%$ potentiometer Vishay TS63Y503k
R101	1	27.4k Ω $\pm 1\%$ resistor (0603)
R102	1	39.2k Ω $\pm 1\%$ resistor (0603)
R103, R105–R107, R127–R130, R133, R134	10	100k Ω $\pm 1\%$ resistors (0603)
R104	1	59k Ω $\pm 1\%$ resistor (0603)
R108	1	158k Ω $\pm 1\%$ resistor (0603)

MAX7049 Evaluation Kits

Evaluate: MAX7049

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R109, R111, R113, R115, R116, R131, R132, R135, R136	9	150Ω ±5% resistors (0603)
R110	1	330Ω ±5% resistor (0603)
R112	1	75Ω ±5% resistor (0603)
R114	1	43Ω ±5% resistor (0603)
R117	1	10kΩ ±5% resistor (0603)
R118	1	2.2kΩ ±5% resistor (0603)
R119	1	1.5kΩ ±5% resistor (0603)
R120, R121	2	27Ω ±5% resistors (0603)
R122	1	470Ω ±1% resistor (0603)
R137, R138, R141–R147, R149	10	100Ω ±5% resistors (0603)
RF, XTAL	2	SMA female vertical connectors
S100, S101	2	Momentary pushbutton switches
S102	1	Quad SPST normally open DIP switch
TP1, TP3, TP5–TP8, TP12–TP14, TP127, VANALOG	11	Red multipurpose test points
U1	1	288MHz to 928MHz frequency-programmable ASK/FSK transmitter (28 TQFN-EP**) Maxim MAX7049ATI+

DESIGNATION	QTY	DESCRIPTION
U100–U103	4	Low noise, LDO linear regulators (5 SC70) Maxim MAX8512EXK+
U104	1	UART-to-USB converter (32 TQFP)
U105	0	Not installed, 93C46 3-wire EEPROM (8 SO)
U106	1	32-bit microcontroller (68 QFN-EP**) Maxim MAXQ2000-RAX+
U107–U110	4	8-channel level translators (20 TSSOP) Maxim MAX3001EEUP+
Y1	1	16MHz crystal, 10pF load C
Y100	1	6MHz crystal (HCM49) Hong Kong X'tals SSL600000018FAF
Y101	0	Not installed, 32.768kHz crystal
Y102	1	16MHz crystal Hong Kong X'tals SSM16000000E18FAF
—	1	USB high-speed A-to-B cables, 6ft
—	41	Shunts
—	1	PCB: MAX7049 EVALUATION KIT

*Indicates matching component.

**EP = Exposed pad.

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
NDK America (Nihon Dempa Kogyo Co., Ltd.)	815-544-7900	www.ndk.com/en
Susumu International USA	203-328-0307	www.susumu-usa.com
Vishay	402-563-6866	www.vishay.com

Note: Indicate that you are using the MAX7049 when contacting these component suppliers.

MAX7049 Evaluation Kits

Evaluate: MAX7049

MAX7049 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX7049.EXE	Application program
CDM20600.EXE	Installs the USB device driver
UNINSTALL.EXE	Uninstalls the EV kit software
USB_Driver_Help_200.PDF	USB driver installation help file

Quick Start

Required Equipment

- MAX7049 EV kit
- Windows XP, Windows Vista, or Windows 7 PC with a spare USB port
- Spectrum analyzer

Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

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

- 1) Visit www.maximintegrated.com/evkitsoftware to download the latest version of the EV kit software, 7049Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.
- 2) Install the EV kit software and USB driver on your computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied to your PC and icons are created in the Windows **Start | Programs** menu. During software installation, some versions of Windows may show a warning message indicating that this software is from an unknown publisher. This is not an error condition and it is safe to proceed with installation. Administrator privileges are required to install the USB device driver on Windows.
- 3) Verify that all jumpers are in their default positions, as shown in Table 1.
- 4) Connect the USB cable from the PC to the EV kit board. A Windows message appears when connecting the EV kit board to the PC for the first time. Each version of Windows has a slightly different message. If you see a Windows message

stating **ready to use**, then proceed to the next step. Otherwise, open the USB_Driver_Help_200.PDF document in the Windows **Start | Programs** menu to verify that the USB driver was installed successfully.

- 5) Start the EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software main window appears, as shown in Figure 1. The EV kit GUI indicates if the USB hardware is connected in the lower-left status bar.
- 6) Enter the frequency of the crystal that is in the EV kit (usually 16MHz) by clicking on the **Options** menu item and selecting the appropriate frequency.
- 7) Connect the RFOUT SMA connector to a power meter to measure transmitted power, or to a spectrum analyzer to see the power level and modulation spectrum. Set the analyzer to a frequency at or near the center frequency of the EV kit and set the frequency span to 4MHz. For example, for an 868MHz EV kit, set the analyzer center frequency near 868MHz.
- 8) The device operates in ASK mode by default. Set the device carrier frequency to the desired frequency by typing the frequency in MHz in the **FTX** edit box, and then pressing Enter.
- 9) Set the Tx power level by entering an integer between 0 and 63 in the **ASK Amplitude** edit box. Each integer represents 0.5mA of DC current in the final power amplifier (PA) stage. A number between 37 and 44 usually produces a transmitted power level near +13dBm, when a +3.0V supply voltage is used. For simple transmission with no data-pulse shaping, leave the **Pulse** radio button selected in the **Common Shaping** group box (the default setting).
- 10) Click on the **MAX7049 Enable** checkbox and verify that the light is green. Verify that the **TX Ready** light is also green. **TX Ready** turns green when the device achieves lock.
- 11) Click on the **TX Data** checkbox and verify that the light is green.
- 12) The spectrum analyzer should display an unmodulated carrier at 868MHz. The power level depends on the **ASK Amplitude** setting entered in Step 9.
- 13) To test FSK, first uncheck the **MAX7049 Enable** checkbox. Click on the **FSK** radio button in the **Modulation** group box for FSK modulation.

MAX7049 Evaluation Kits

Evaluate: MAX7049

- 14) Set the Tx power level for FSK transmission by entering a number between 0 and 63 in the **FSK Amplitude** edit box. A number between 37 and 44 usually produces a transmitted power level near +13dBm, when a +3.0V supply voltage is used.
- 15) Set the PA power-up speed for a FSK transmission by entering a number between 1 and the Tx power setting from the previous step in the **FSK Amplitude Step** edit box. The larger the number, the faster the ramp-up speed.
- 16) Type the two-way frequency deviation in the **FSK FDEV (kHz)** edit box to set the frequency deviation and then press Enter. For example, an entry of 100 creates a ±50kHz deviation. The number in the **FSK FDEV (kHz)** edit box may change slightly after the number is entered because the exact deviation is set by the frequency resolution of the synthesizer. For example, an entry of 100 may return a reading of 99.610895 in the edit box. For simple transmission with no data-pulse shaping, leave the **Pulse** radio button selected in the **Common Shaping** group box (the default setting).
- 17) Click on the **MAX7049 Enable** checkbox and verify that the light is green. Verify that the **TX Ready** light is also green. The spectrum analyzer should display an unmodulated carrier at the logic 0 (Space) frequency, which is about 867.95MHz for the 100kHz deviation example. This frequency may be off by up to a few tens of kHz, depending on the crystal frequency tolerance.
- 18) Toggle the **TX Data** button and observe the frequency shifts on the spectrum analyzer. The logic 1 (Mark) frequency should be near 868.05MHz, or 100kHz higher than the logic 0 frequency.

Additional Evaluation

- 19) For efficiency measurements, take the shunt off of JU115 and connect an ammeter in series.
- 20) Connect a power meter to the RF SMA connector. Measure the output power and supply current.
- 21) The efficiency is calculated by the following equation:

$$\text{Efficiency} = \frac{10 \wedge (P_{\text{OUT}}/10)}{I \cdot V}$$

Table 1. Control-Side Jumper Table (J100, JU100–JU128)

JUMPER	SHUNT POSITION	DESCRIPTION
J100	1-2	VDUT (IC) powered by battery.
	3-4	VDUT powered by USB. Do not use this setting for the IC.
	5-6	VDUT powered by an external supply. Apply the external voltage between the VEXT and GND_ test points.
	7-8*	VDUT powered by an adjustable on-board regulator. Change the resistance of potentiometer R100 to the required DUT supply.
JU100	1-2	Connects the external supply to the REG supply.
	2-3*	Connects the USB supply to the REG supply.
JU101	1-2*	Microcontroller supply comes from the REG supply.
	2-3	Microcontroller supply comes from the battery. Installation of the battery holders is required.
JU102	1-2*	Logic microcontroller supply (VMICROL) is set to 3.3V.
	2-3	Logic microcontroller supply (VMICROL) is set to VMICRO.
JU103	1-2	Core microcontroller supply (VMICRO) is set to VLO.
	2-3*	Core microcontroller supply (VMICRO) is set to 2.5V.
JU104	1-2*	Selects the AAA battery holder for the VBAT supply.
	2-3	Selects the 2032 battery holder for the VBAT supply.

Evaluate: MAX7049

MAX7049 Evaluation Kits

Table 1. Control-Side Jumper Table (J100, JU100–JU128) (continued)

JUMPER	SHUNT POSITION	DESCRIPTION
JU105	1-2	Must supply the microcontroller oscillation frequency externally.
	2-3*	Connects the microcontroller oscillator to the on-board crystal.
JU106	1-2	Must supply the microcontroller oscillation frequency externally.
	2-3*	Connects the microcontroller oscillator to the on-board crystal.
JU107	1-2	Must supply the RTC oscillation frequency externally.
	2-3*	Connects the RTC oscillator to the on-board crystal (not installed).
JU108	1-2	Must supply the RTC oscillation frequency externally.
	2-3*	Connects the RTC oscillator to the on-board crystal (not installed).
JU109	Closed	GPO2 connects to the DUT through level translators.
	Open*	GPO2 does not connect to the DUT.
JU110	Closed*	GPO1 connects to the DUT through level translators.
	Open	GPO1 does not connect to the DUT.
JU111–JU128	Closed*	See Table 2.

*Default position.

Table 2. Jumper Table (JU111–JU128)

JUMPER	SHUNT POSITION	DESCRIPTION
JU111	Closed*	VANALOG supply on the IC side powered by the VDUT supply on the control side.
	Open	Connection point for an ammeter, if supply current measurements are required.**
JU112	Closed*	Don't care.
JU113	Closed*	Don't care.
JU114	Closed*	Don't care.
JU115	Closed	VANALOG supply on the IC side powered by the VDUT supply on the control side.
	Open*	Connection point for an ammeter if supply current measurements are required.**
JU116	Closed*	Connects the GPO1 signal from the IC to the on-board microcontroller. The GPO1 signal can be monitored on the GPO1 test point.
	Open	GPO1 signal is not connected to the on-board microcontroller. The GPO1 signal can be monitored by an external microcontroller on the GPO1 test point without interference loading from the on-board microcontroller.
JU117	Closed*	Connects the enable signal from the on-board microcontroller to the IC. The LSHDN signal can be monitored on the LSHDN test point.
	Open	LSHDN signal is not connected to the on-board microcontroller. When using an external enable signal, remove the jumper and apply the signal on the LSHDN test point.
JU118	Closed*	Don't care.
JU119	Closed*	Don't care.
JU120	Closed*	Connects the hop signal from the on-board microcontroller to the IC. The hop signal can be monitored on the HOP test point.
	Open	Hop signal is not connected to the on-board microcontroller. When using an external hop signal, remove the jumper and apply the signal on the HOP test point.

**Note that JU111 and JU115 are redundant connections: Place an ammeter on either one while leaving the other open.

MAX7049 Evaluation Kits

Evaluate: MAX7049

Table 2. Jumper Table (JU111–JU128) (continued)

JUMPER	SHUNT POSITION	DESCRIPTION
JU121	Closed*	Connects the GPO2 signal from the IC to the on-board microcontroller. The GPO2 signal can be monitored on the GPO2 test point.
	Open	GPO2 signal is not connected to the on-board microcontroller. The GPO2 signal can be monitored by an external microcontroller on the GPO2 test point without interference loading from the on-board microcontroller.
JU122	Closed*	Connects the on-board $\overline{CS}$ signal to the IC. The $\overline{CS}$ signal can be monitored on the $\overline{CS}$ test point.
	Open	Does not connect the on-board $\overline{CS}$ signal to the IC. When using external SPI, remove this jumper and apply the $\overline{CS}$ signal to the $\overline{CS}$ test point.
JU123	Closed*	Connects the on-board DI signal to the IC. The DI signal can be monitored on the DI test point.
	Open	Does not connect the on-board DI signal to the IC. When using external SPI, remove this jumper and apply the DI signal to the DI test point.
JU124	Closed*	Connects the on-board SCLK signal to the IC. The SCLK signal can be monitored on the SCLK test point.
	Open	Does not connect the on-board SCLK signal to the IC. When using external SPI, remove this jumper and apply the SCLK signal to the SCLK test point.
JU125	Closed*	Connects the on-board enable signal (ENABLE) to the IC. ENABLE can be monitored on the ENABLE test point.
	Open	Does not connect the on-board enable signal to the IC. When using an external signal for enable, remove this jumper and apply the ENABLE signal to the ENABLE test point.
JU126	Closed*	Connects the on-board transmitter data signal (DATAIN) to the IC. DATAIN can be monitored on the DATAIN test point.
	Open	Does not connect the on-board transmitter data signal to the IC. When using an external signal for transmitter data, remove this jumper and apply the DATAIN signal to the DATAIN test point.
JU127	Closed*	Don't care.
JU128	Closed*	Connects the microcontroller to the on-board SDO signal from the IC. The SDO signal can be monitored on the SDO test point.
	Open	Does not connect the microcontroller to the SDO signal from the IC. When using external SPI, remove this jumper and apply the MISO input to the SDO test point.

*Default position.

Table 3. DUT-Side Jumper Table (JU1, JU3–JU7, JU9, JU10, JU12–JU15)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	Connects PAVDD to VANALOG.
	2-3	External PAVDD. Must apply an external voltage on TP1 to power PAVDD.
JU3	1-2*	Connects LOVDD to VANALOG.
	2-3	External LOVDD. Must apply an external voltage on TP3 to power LOVDD.
JU4	1-2*	Connects VCOVDD to VANALOG.
	2-3	External VCOVDD. Must apply an external voltage on TP5 to power VCOVDD.

MAX7049 Evaluation Kits

Evaluate: MAX7049

Table 3. DUT-Side Jumper Table (JU1, JU3–JU7, JU9, JU10, JU12–JU15) (continued)

JUMPER	SHUNT POSITION	DESCRIPTION
JU5	1-2*	Connects CPVDD to VANALOG.
	2-3	External CPVDD. Must apply an external voltage on TP6 to power CPVDD.
JU6	1-2*	Connects PLLVDD to VANALOG.
	2-3	External PLLVDD. Must apply an external voltage on TP7 to power PLLVDD.
JU7	1-2*	Connects XOVD to VANALOG.
	2-3	External XOVD. Must apply an external voltage on TP8 to power XOVD.
JU9	Closed*	Connects the IC ENABLE pin to the ENABLE test point.
	Open	Connects the IC ENABLE pin to a pullup resistor.
JU10	Closed*	Connects the IC DATAIN pin to the DATAIN test point.
	Open	Connects the IC DATAIN pin to a pullup resistor.
JU12	1-2*	Connects DVDD to VANALOG.
	2-3	External DVDD. Must apply an external voltage on TP12 to power DVDD.
JU13	1-2*	Connects AVDD to VANALOG.
	2-3	External AVDD. Must apply an external voltage on TP13 to power XOVD.
JU14	1-2*	Connects PAOUT to VANALOG.
	2-3	External PAOUT. Must apply an external voltage on TP14 to power PAOUT.
JU15	1-2	Connects the IC LSHDN input high.
	2-3*	Connects the IC LSHDN input low.

*Default position.

Layout Issues

A properly designed PCB is essential for any RF/micro-wave 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 matching network, where the inductor is on the order of 12nH and a capacitor is on the order of 5pF, the proximity of the circuit to the 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. Do not share GND vias on decoupling capacitors: Give each capacitor its own via.

Detailed Description of Software

The main window of the MAX7049 EV kit is shown in Figure 1.

The EV kits use Windows XP-, Windows Vista-, and Windows 7-compatible software to provide a simple GUI to demonstrate the MAX7049 IC. Each EV kit GUI has a tab for the transmitter configuration, for the GPO configuration, for controlling individual bits in the registers, and a log page. The **TX Configuration** tab sheet allows the IC to be set up easily without having to focus on programming the registers. The register values can be viewed in the **Register View** tab (Figure 3). This allows easy prototyping with the GUI with different configuration settings.

The **GPO Configuration** tab sheet (Figure 2) displays the various options available at GPO1, GPO2, and SDO. These outputs are available through the TMUX multiplexer. Changing the TMUX value populates the list of outputs available to GPO1, GPO2, and SDO. Many of these outputs can be used for debugging purposes. This tab also displays the temperature. Click on the

MAX7049 Evaluation Kits

Evaluate: MAX7049

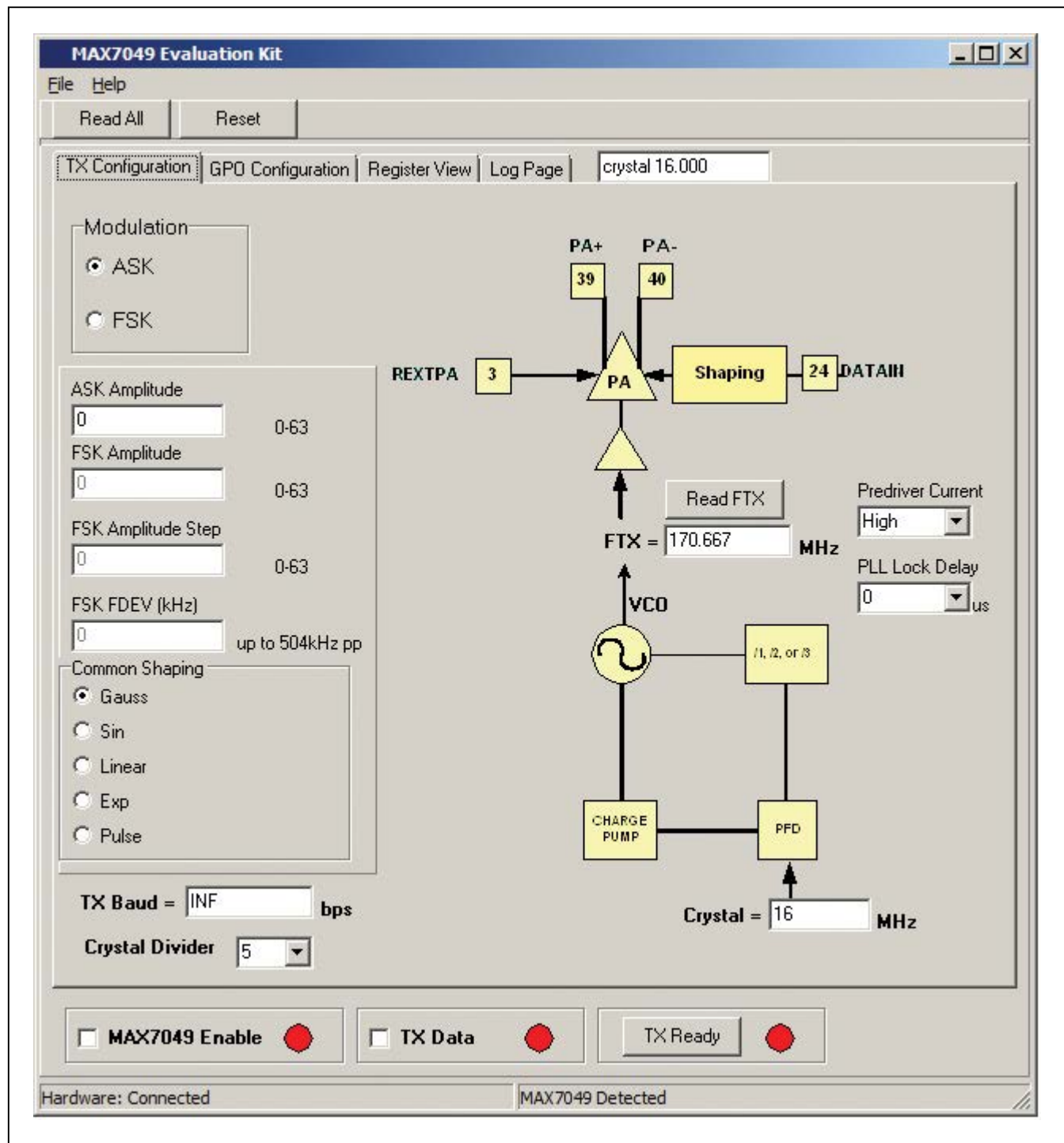


Figure 1. MAX7049 EV Kit Software Main Window (TX Configuration Tab)

MAX7049 Evaluation Kits

Evaluate: MAX7049

thermometer to display the IC temperature code. Various clock output options are also available on this tab sheet. Each EV kit GUI can open a predefined configuration or save a configuration to a file. The file type is unique to the IC and has the extension “.m49”. This file extension is loaded into the registers. Opening the file from **File | Open** loads the file. To save the configuration settings, go to **File | Save**. The file is automatically saved with the correct extension. The enable state is not saved.

TX Configuration Tab

The **TX Configuration** tab sheet (Figure 1) highlights the main features for setting the transmitter configuration. The transmitter frequency has three specified ranges through the GUI. The transmit frequency **FTX** ranges are: 287.7MHz to 315MHz, 431.5MHz to 472.5MHz, and 863MHz to 945MHz. The ASK amplitude and FSK frequency deviation both use the internal shaping registers. The GUI provides some common predefined shaping values and automatically programs the shaping registers when selected. The ASK amplitude and FSK frequency deviation share the same shaping registers. The **TX Baud** edit box internally sets the bit step size. When a value is entered, the step size adjusts until it comes closest to the desired baud rate.

GPO Configuration Tab

The **GPO Configuration** tab sheet (Figure 2) simplifies the various GPO output-configuration options. SDO, GPO1, and GPO2 multiplex various signals that can be used for reading the temperature, finding the lock status, outputting a clock, or for debugging purposes. GPO2 is a stronger buffer and designed to drive a clock. It has additional clock options that SDO and GPO1 do not.

Changing the TMUX value changes the outputs available to SDO, GPO1, and GPO2. Each TMUX provides 16 different output options. Many are empty options that do not output anything. The states of those signals are also shown in the **TestBus0** and **TestBus1** registers in the IC and can be viewed in the **Register View** tab.

Register View Tab

The **Register View** tab sheet (Figure 3) displays each register's individual bit logic-level status. A data bit in bold indicates a logic-high, while a data bit that is not bold indicates a logic-low. Clicking on the individual data bit toggles the bit and performs a write and read command. The new command is shown in the edit box at the far right. Write commands can be written to the registers alternatively by typing a hex value in the edit box and pressing the Enter key on the keyboard.

Log Page Tab

The **Log Page** tab sheet can be used to verify that a command was executed. Next to the **Log Page** table is an edit box that displays what was last written to the **Log Page**. It is not necessary to switch to the **Log Page** to verify if a command was sent.

Global Commands

Each EV kit GUI has a few commands that can be viewed in every tab setting. The **MAX7049 Enable** checkbox enables or disables the IC through the register enable bit. The **TX Data** checkbox sets the internal data bit (DATAIN) to logic-high or logic-low. The green color indicates that the bit is set to logic-high and a red color indicates that the bit is set to logic-low. The **TX Ready** flag verifies that the IC transmitter is ready to transmit data when green.

The **Read All** and **Reset** buttons are located near the top left. To reset the IC from the GUI to the default values, press the **Reset** button.

Applying External Signals

To apply an external signal to the ENABLE (enable) and DATAIN (data in) test points, the respective jumper must first be removed and the signal applied to the signal test point. For example, to apply an external signal to DATAIN, uncheck the **TX Data** checkbox and then remove the jumper from JU126 and apply the DATAIN signal to the DATAIN test point. A complex pattern can be sent using the transmitter in this fashion. The enable works similarly. Ensure that the voltage range of the external signals is limited to DVDD before applying the signals.

MAX7049 Evaluation Kits

Evaluate: MAX7049

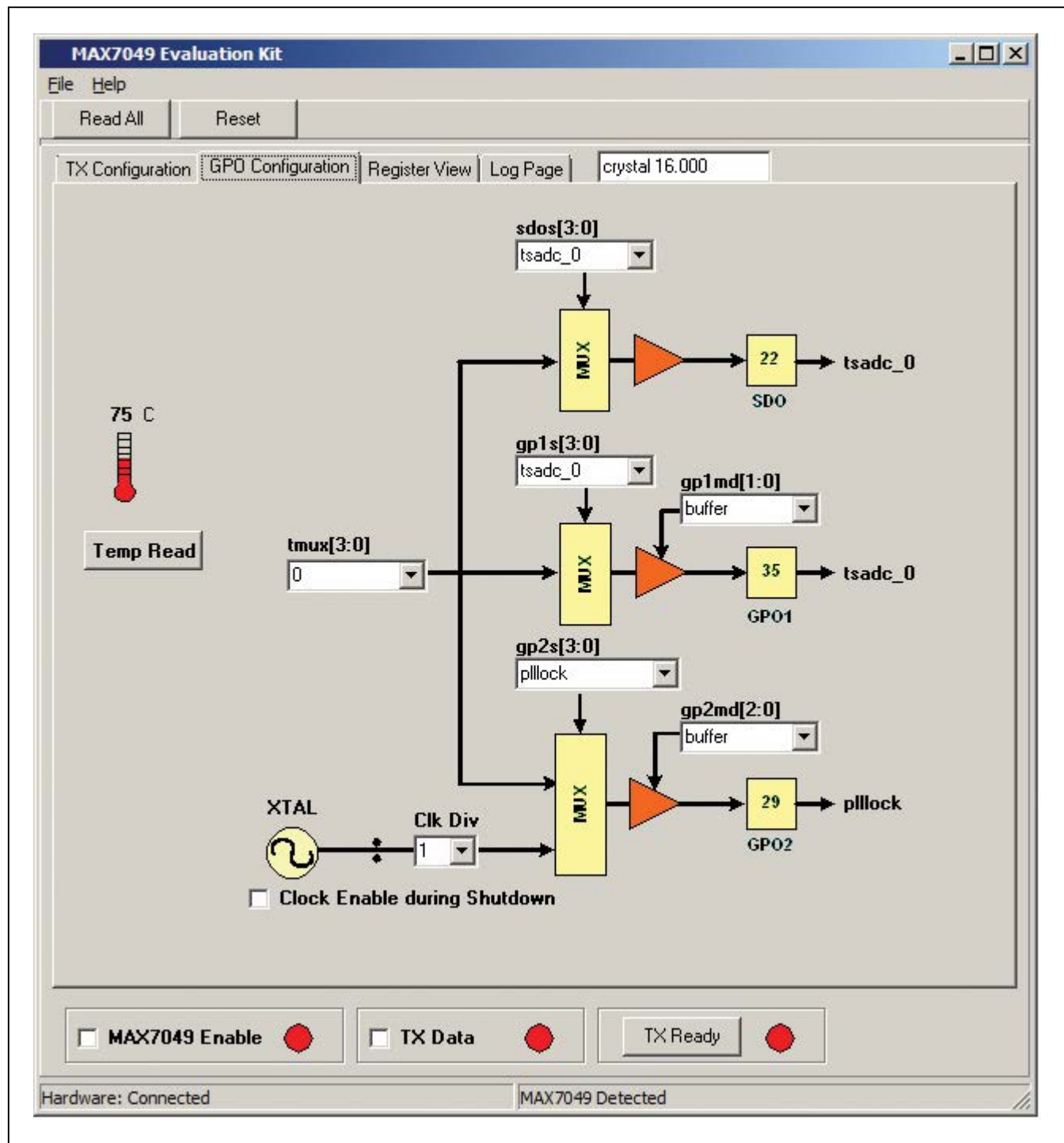


Figure 2. MAX7049 EV Kit Software (GPO Configuration Tab)

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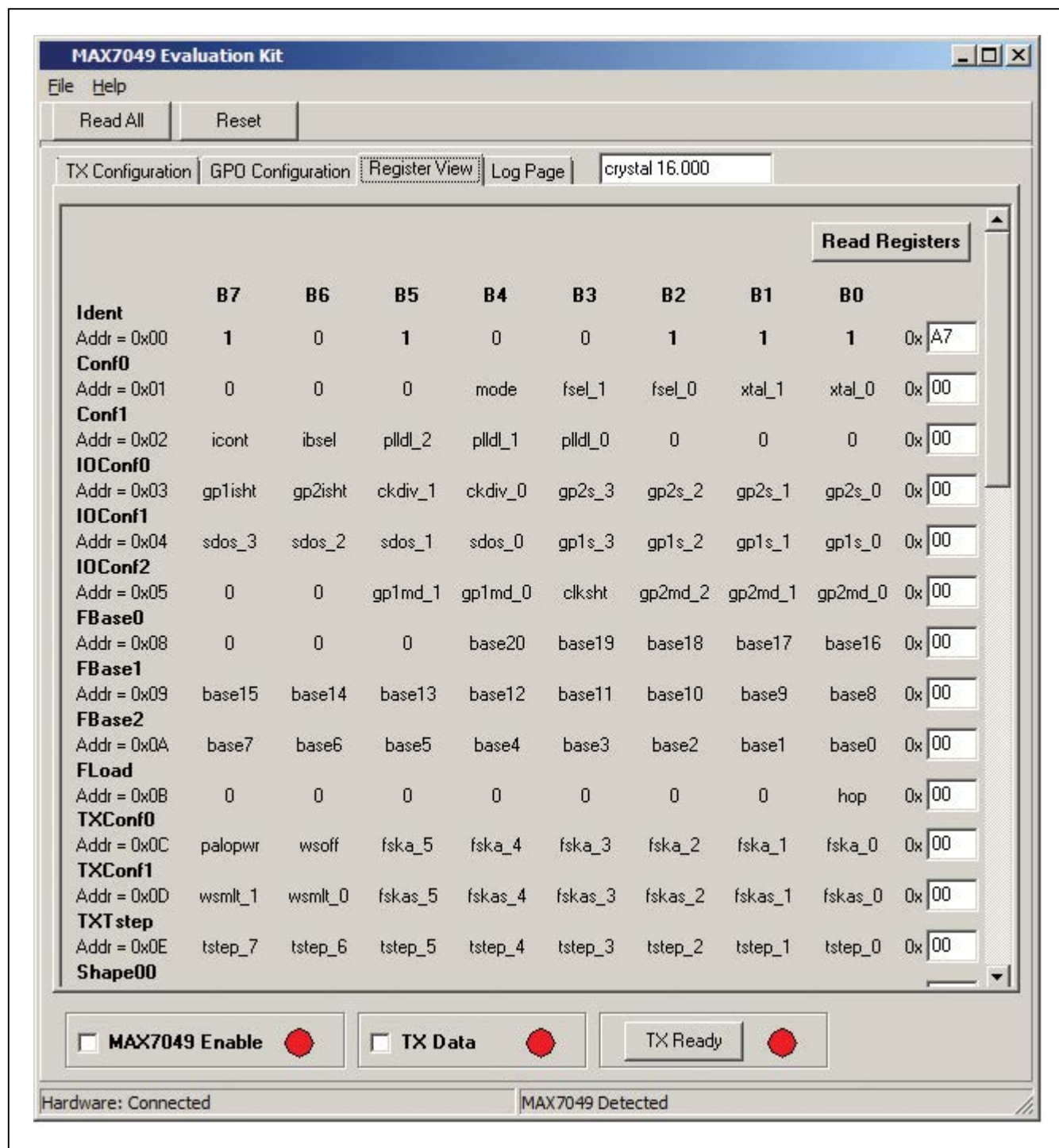


Figure 3. MAX7049 EV Kit Software (Register View Tab)

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ASK Modulation Shaping

For any of the default modulation shapes, set the peak amplitude setting in the **ASK Amplitude** edit box, click on the modulation shape radio button in the **Common Shaping** group box, and set the NRZ data rate in the **TX Baud** edit box. The EV kit software sets the time and amplitude step registers to produce a shaping profile that matches the bit interval as close as possible, given the time and amplitude step resolution.

The amplitude step register settings (there are 19 steps between the 20 amplitude samples, starting at 0 and ending at the final amplitude setting) and the time between amplitude steps is given below for a 20kbps NRZ ASK transmission with Gaussian shaping and an amplitude setting of 40 (20mA PA current).

$$\text{Txtstep} = (0x08) (8 \times 0.3125\mu\text{s} = 2.5\mu\text{s})$$

Arbitrary shaping can be done by going to the **Register View** tab and entering values into the **TXTstep** register and the 19 shape registers individually. Ensure that the sum of the 19 amplitude steps adds up to the desired final amplitude value.

Table 4. ASK Shaping Example

TIME (μs)	AMPLITUDE REGISTER	AMPLITUDE STEPS	CUMULATIVE AMPLITUDE
0.00	Shape00	1	0
2.50	Shape01	1	1
5.00	Shape02	1	2
7.50	Shape03	2	3
10.00	Shape04	2	5
12.50	Shape05	3	7
15.00	Shape06	3	10
17.50	Shape07	3	13
20.00	Shape08	3	16
22.50	Shape09	3	19
25.00	Shape10	3	22
27.50	Shape11	3	25
30.00	Shape12	3	28
32.50	Shape13	3	31
35.00	Shape14	2	34
37.50	Shape15	2	36
40.00	Shape16	1	38
42.50	Shape17	1	39
45.00	Shape18	0	40
47.50	—	0	40
50.00	—	0	40

FSK Modulation Shaping

FSK transmission requires the user to select the data rate, the frequency deviation, the transmitted power (which is constant for the duration of the transmission), and the rise time of the PA at the beginning of the transmission. For any of the default modulation shapes, set the peak-to-peak frequency deviation in the **FSK FDEV (kHz)** edit box, click on the modulation shape radio button in the **Common Shaping** group box, and set the NRZ data rate in the **TX Baud** edit box. The EV kit software sets the time and frequency deviation step registers to produce a frequency-deviation profile that matches the bit interval as close as possible, given the time and frequency step resolution.

Next, select the amplitude of the FSK transmission in the **FSK Amplitude** edit box and the size of the amplitude step for the initial turn-on of the PA in the **FSK Amplitude Step** edit box. The PA amplitude increases by the **FSK Amplitude Step** every Txtstep interval until it reaches the **FSK Amplitude** setting. The Txtstep interval is

Table 5. FSK Shaping Example

TIME (μs)	FREQUENCY REGISTER	STEP	CUMULATIVE COUNT	CUMULATIVE DEVIATION (kHz)
0.00	Shape00	4	0	0
0.94	Shape01	9	4	0.98
1.88	Shape02	15	13	3.17
2.81	Shape03	20	28	6.84
3.75	Shape04	24	48	11.72
4.69	Shape05	27	72	17.58
5.63	Shape06	29	99	24.17
6.56	Shape07	31	128	31.25
7.50	Shape08	30	159	38.82
8.44	Shape09	31	189	46.14
9.38	Shape10	30	220	53.71
10.31	Shape11	31	250	61.04
11.25	Shape12	29	281	68.60
12.19	Shape13	27	310	75.68
13.13	Shape14	24	337	82.28
14.06	Shape15	20	361	88.13
15.00	Shape16	15	381	93.02
15.94	Shape17	9	396	96.68
16.88	Shape18	3	405	98.88
17.81	—	0	408	99.61
18.75	—	0	408	99.61
20.00	—	0	408	99.61

MAX7049 Evaluation Kits

Evaluate: MAX7049

determined by the data-rate entry in the **TX Baud** edit box, and is less than or equal to 1/20 of the data interval (inverse of the data rate). For example, if the **FSK Amplitude** setting is 20 and the **FSK Amplitude Step** setting is 5, then the PA ramps up to its final amplitude in 4 x Txtstep, or approximately 1/5 of a bit interval.

The frequency step register settings (there are 19 steps between the 20 frequency samples, starting at fBASE (FTX - 0.5 x FDEV) and ending at the final frequency setting) and the time between frequency steps is given below for a 50kbps NRZ FSK transmission with Gaussian shaping and a frequency-deviation setting of 100kHz. The FSK deviation vs. time profile starts 50kHz below the transmitted carrier frequency and ends 50kHz above the transmitted carrier frequency. The resolution of each frequency step is equal to the resolution of the fractional-N synthesizer. For a 16MHz crystal, this resolution is slightly less than 250Hz.

$$\text{Txtstep} = (0x03)(3 \times 0.3125\mu\text{s} = 0.9375\mu\text{s})$$

Notice that this shaping profile reaches the total frequency deviation before the end of the bit interval (17.81μs vs. 20μs bit interval) so there is a small portion of the bit interval where the frequency does not change. This is because the resolution of Txtstep is 0.3125μs and this is the closest 20 steps can come to a bit interval.

Arbitrary shaping can be done by going to the **Register View** tab and entering values in the **TXstep** register and the 19 shape registers individually. Ensure that the sum of the 19 frequency steps adds up to the desired final peak-to-peak frequency deviation.

Useful Tips

Each EV kit contains a simple GUI for demonstrating the IC. Some actions do multiple writes and reads in the background. To ensure that the software works correctly, follow the tips below:

- Ensure that the jumpers are installed in their default positions.
- When the program is started, verify that **Hardware: Connected** is displayed in the lower-left side of the status bar and **MAX7049 Detected** is displayed in the lower-right side of the status bar.
- When unplugging the USB cable, wait approximately 5s before plugging it back in. This lets the VANALOG supply drop below the reset threshold.
- After plugging the USB cable from the PC to the EV kit, wait approximately 5s before running the software. The USB driver needs time to be detected before the software can be run.

Detailed Description of Hardware

The MAX7049 EV kits provide a proven layout for the MAX7049 frequency-programmable ASK/FSK transmitter. On-board test points are included to monitor various signals (Table 4).

Power Supply

The device can operate from a 2.1V to 3.6V supply. Each EV kit has several options to power off the USB, or the user can externally supply a voltage to the control side. To power from the USB supply, change the shunt on J100 to the 7-8 position on the control side. The shunt is in the 7-8 position by default. That position makes VDUT equal to VADJ. The user can monitor VADJ with a voltmeter and change the potentiometer resistance to adjust the voltage between 2.1V and 3.6V. **Do not put the shunt on J1 in the 3-4 position because that sets VDUT equal to VBUS (5V), which exceeds the allowable supply voltage.** The 1-2 position on J100 allows the VDUT to be powered from a battery. Battery holders (not populated) are required.

External Supplies

The device has various supply inputs that can all be powered independently. These supplies are on the DUT side and powered by the VANALOG net coming from the control side. All supplies are connected together by default. For current measurements on a specific supply, change the jumper associated with that supply and apply a voltage to the test point to the right of that jumper. It should be noted that DUT current measurements can be influenced by the state of the digital control lines. If a separate external supply is being used for the DUT (with both JU111 and JU115 open), the most accurate current measurement is observed when the control-side circuitry is supplied with the same DC voltage (e.g., the DUT side and control side powered from separate +3.0V supplies).

External SPI

Remove the shunts from the SPI jumpers and apply the signals to the SPI test points. The SPI jumpers are located on JU122, JU123, JU124, and JU128 (Table 7). The external SPI signals need to be limited to the DVDD supply voltage. J101 can be used for observing SPI signals on the control side (Table 8).

External Frequency Input

For applications where an external frequency is desired over the crystal frequency, it is possible to apply an external frequency through the XTAL SMA connector. Resistor R12 is necessary (use 0Ω). The GUI default crystal frequency is 16MHz. To change the frequency, go to **Options | Crystal Frequency** and select one of the three options listed for crystal frequencies.

MAX7049 Evaluation Kits

Evaluate: MAX7049

Table 6. DUT-Side Signal Test Points

NAME	DESCRIPTION
GPO1	GPO1 can output various internal signals dependent on the value of TMUX.
LSHDN	Hardware disable for the IC.
HOP	This signal can optionally be used for frequency hopping.
GPO2	GPO2 can output various internal signals dependent on the value of TMUX. GPO2 is specifically designed to drive a clock output.
$\overline{CS}$	Chip-select for SPI.
DI	Serial data in for SPI.
SCLK	Serial clock for SPI.
ENABLE	Hardware enable for the IC.
DATAIN	Hardware Tx data for the IC.
SDO	Serial data out for SPI.

Table 7. SPI Jumpers and Test Points

JUMPER	NAME
JU122	$\overline{CS}$
JU123	DI
JU124	SCLK
JU128	SDO

Table 8. SPI Header (J101)

JUMPER POSITION	NAME	DESCRIPTION
1	VMICROL	SPI I/O logic voltage
2	MAXQ_SS	SPI chip-select
3	MAXQ_SCLK	SPI clock
4	MAXQ_MOSI	SPI data out (goes to DI)
5	MAXQ_MISO	SPI data in (goes to SDO)
6	GND	GND

MAX7049 Evaluation Kits

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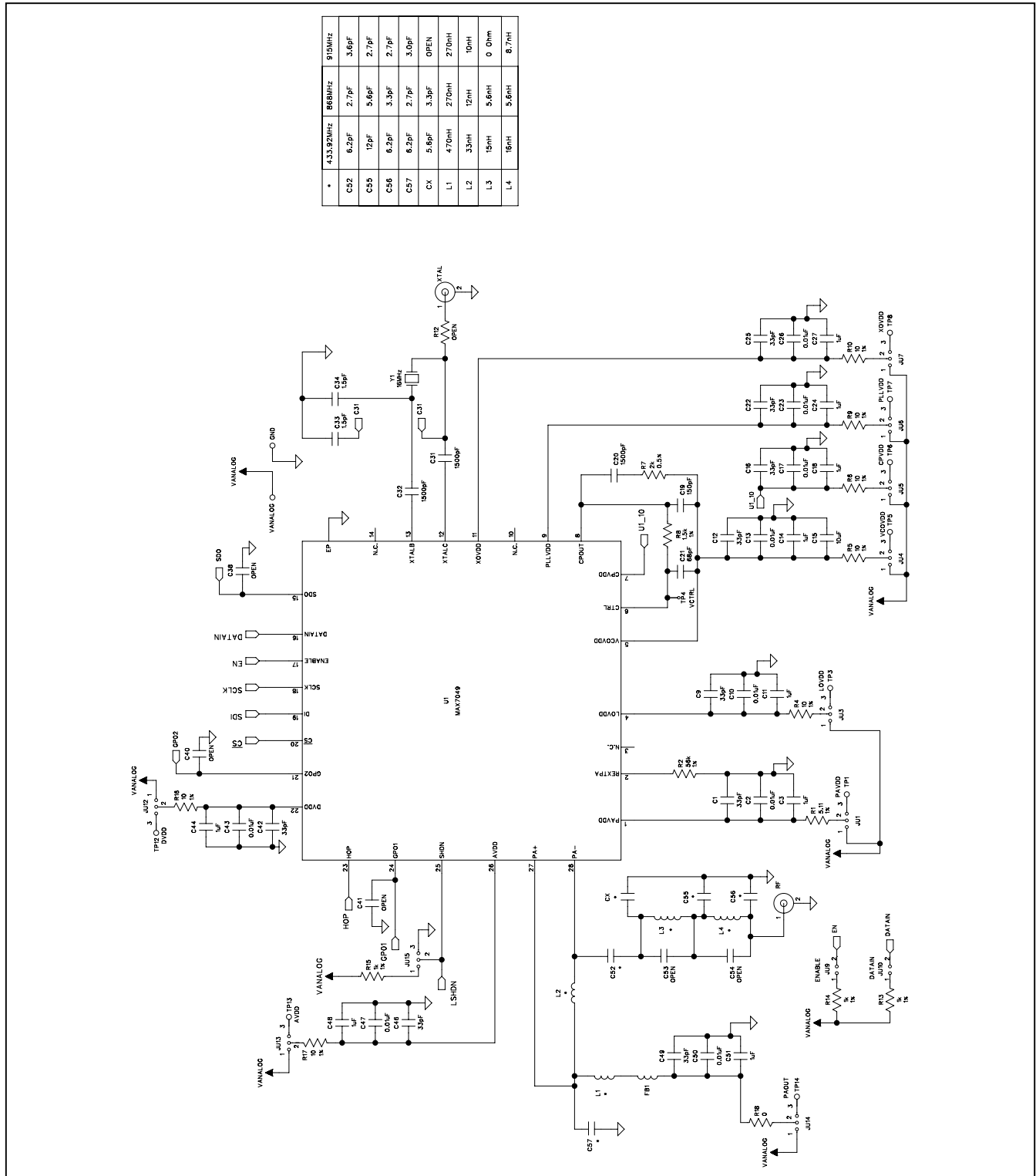


Figure 4a. MAX7049 EV Kits Schematic (Sheet 1 of 5)

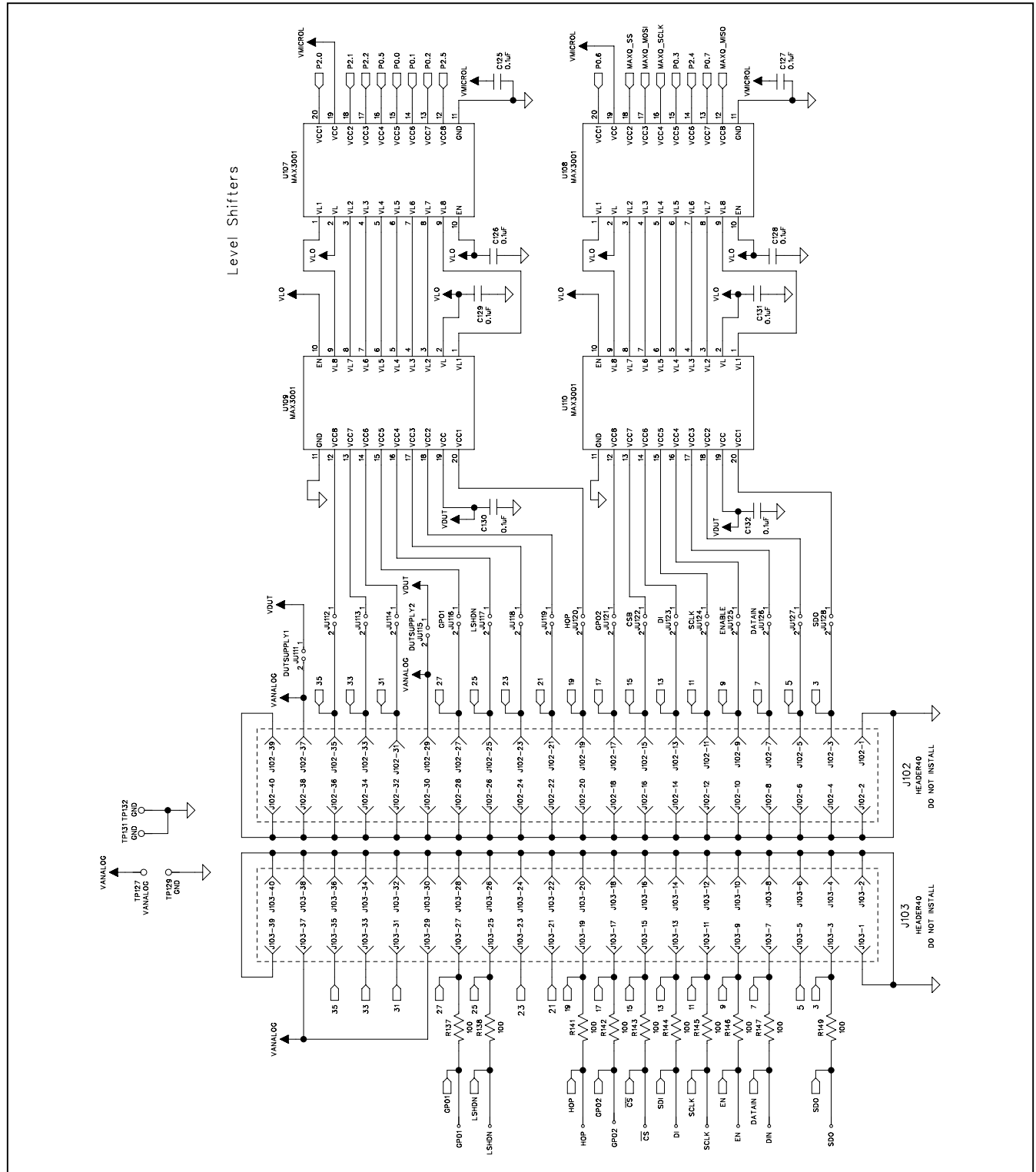


Figure 4b. MAX7049 EV Kits Schematic (Sheet 2 of 5)

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MAX7049 Evaluation Kits

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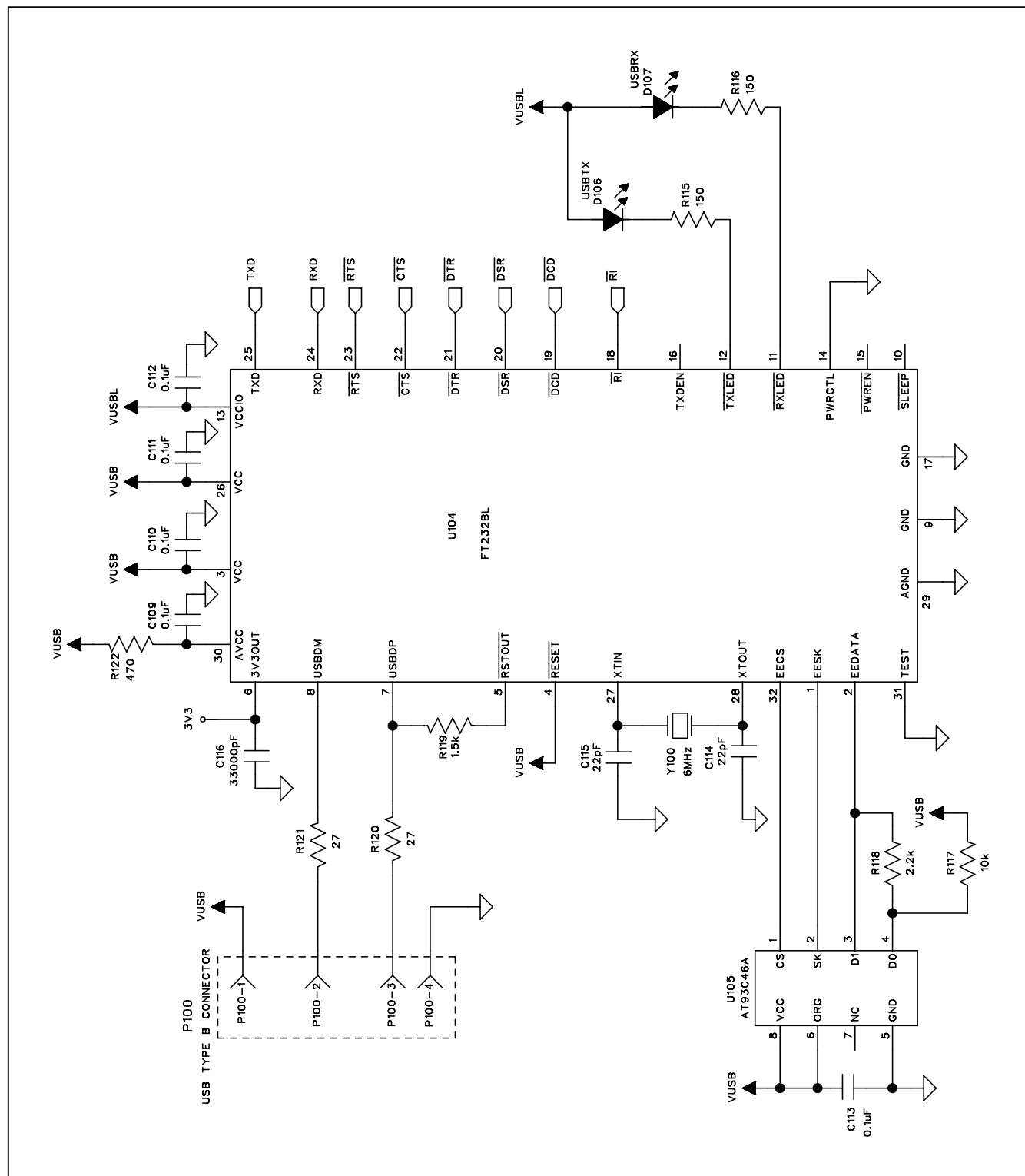


Figure 4d. MAX7049 EV Kits Schematic (Sheet 4 of 5)

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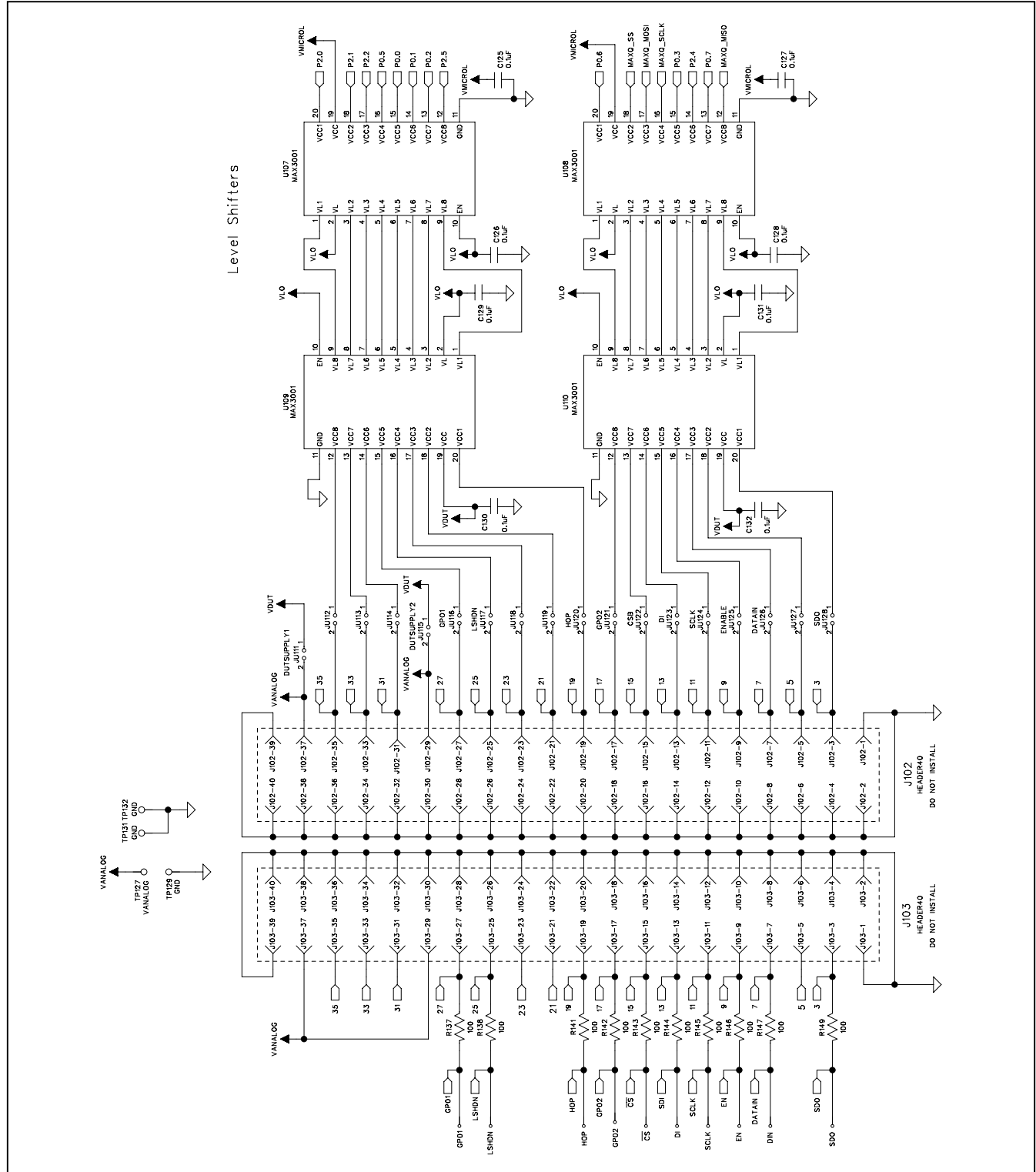


Figure 4b. MAX7049 EV Kits Schematic (Sheet 2 of 5)

MAX7049 Evaluation Kits

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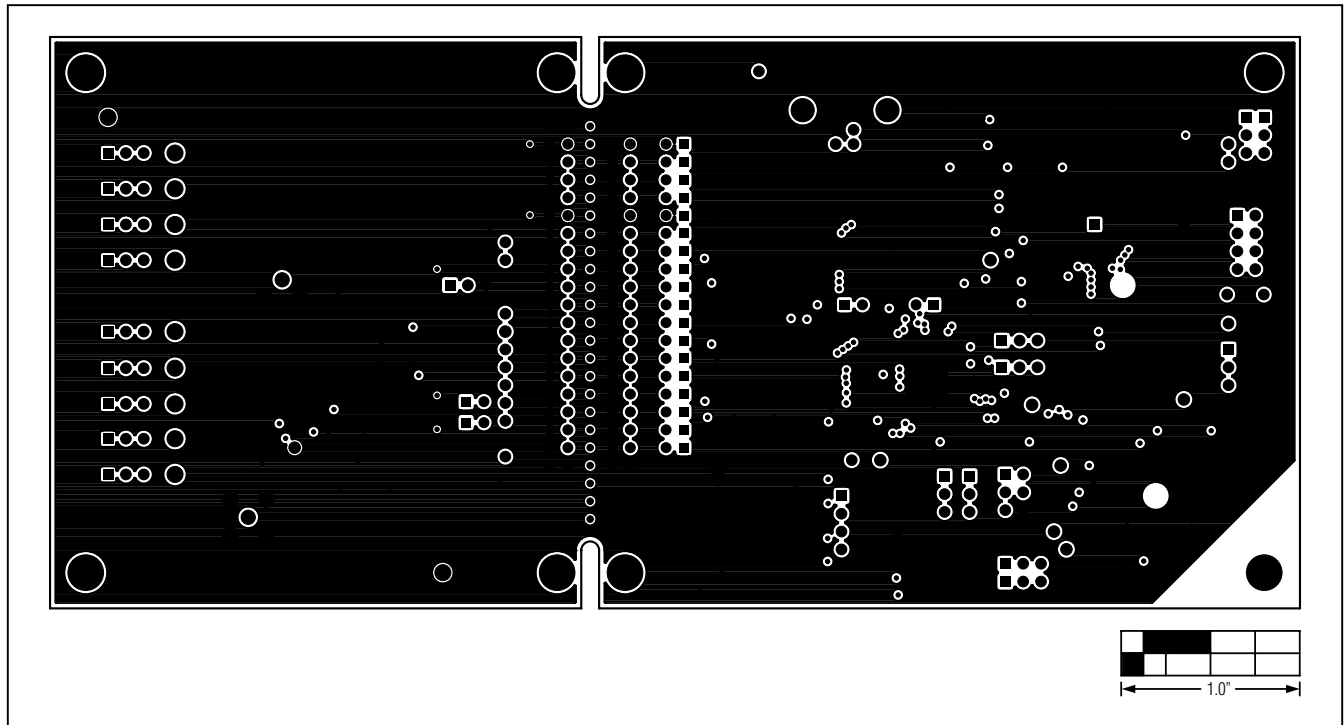


Figure 7. MAX7049 EV Kits PCB Layout—Inner Layer 2

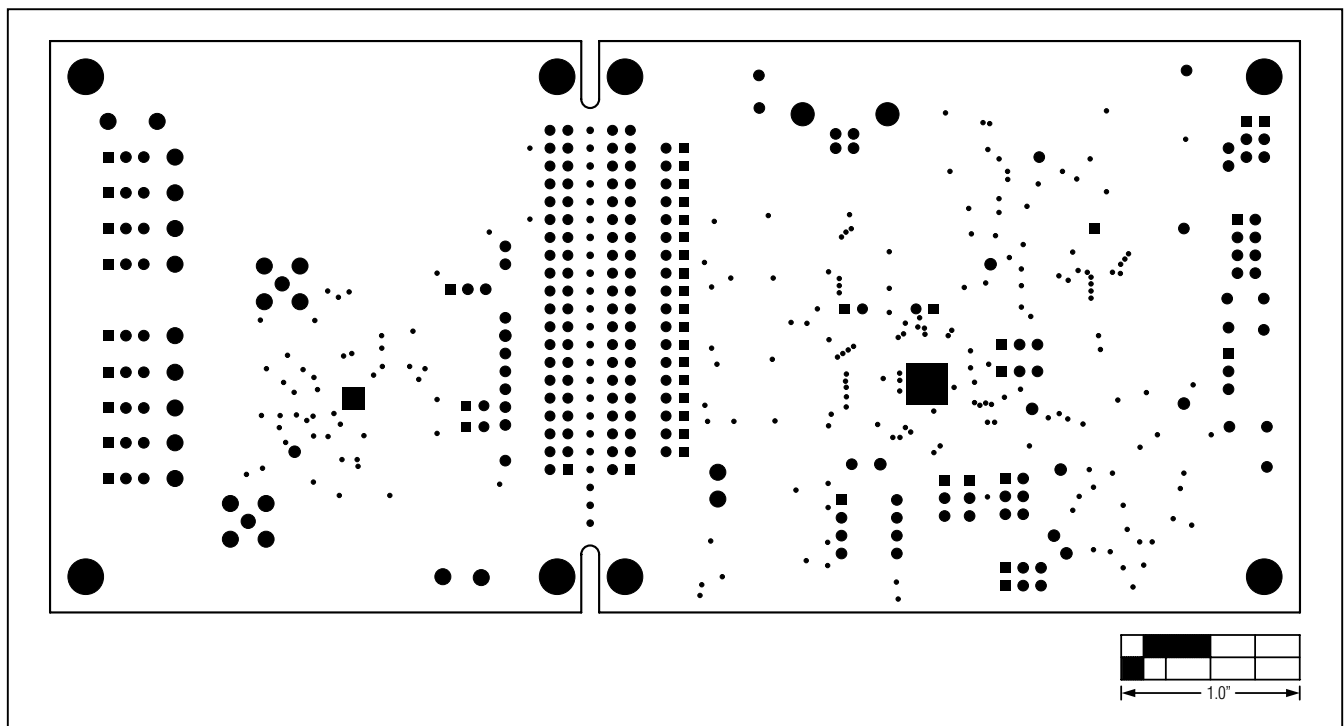


Figure 8. MAX7049 EV Kits PCB Layout—Inner Layer 3

MAX7049 Evaluation Kits

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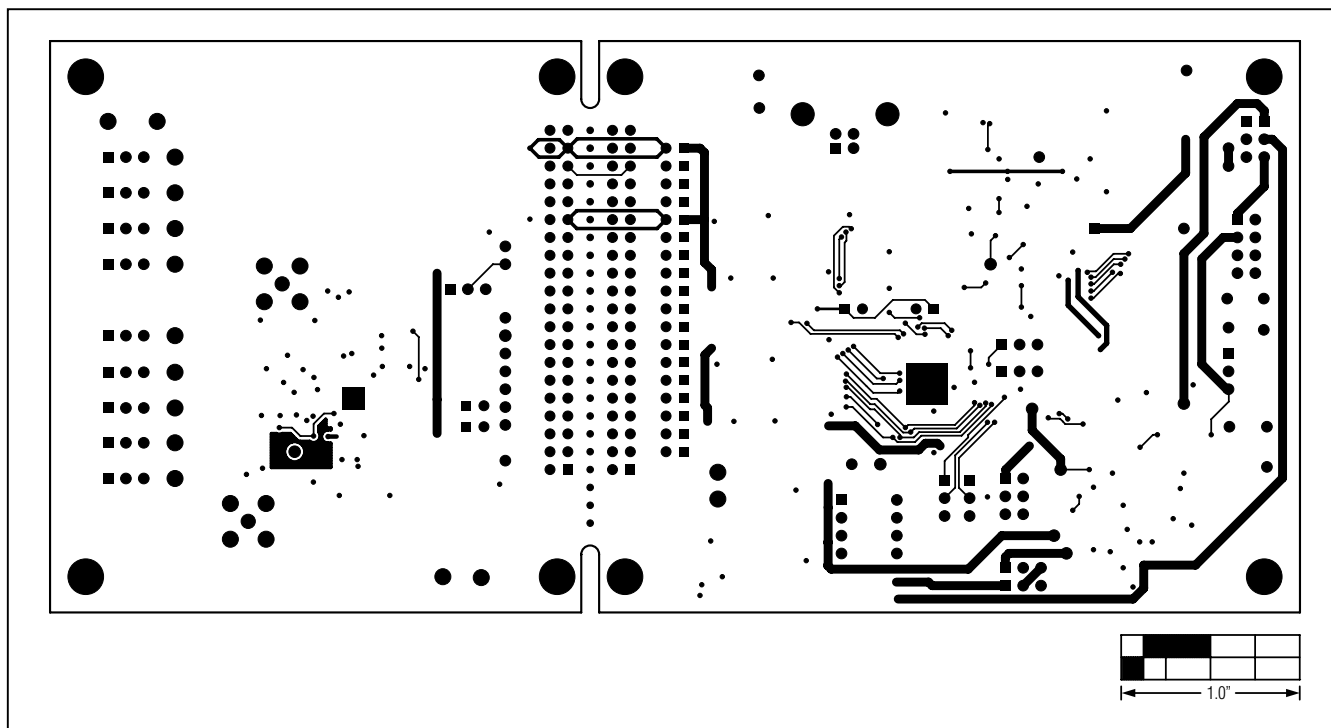


Figure 9. MAX7049 EV Kits PCB Layout—Solder Side

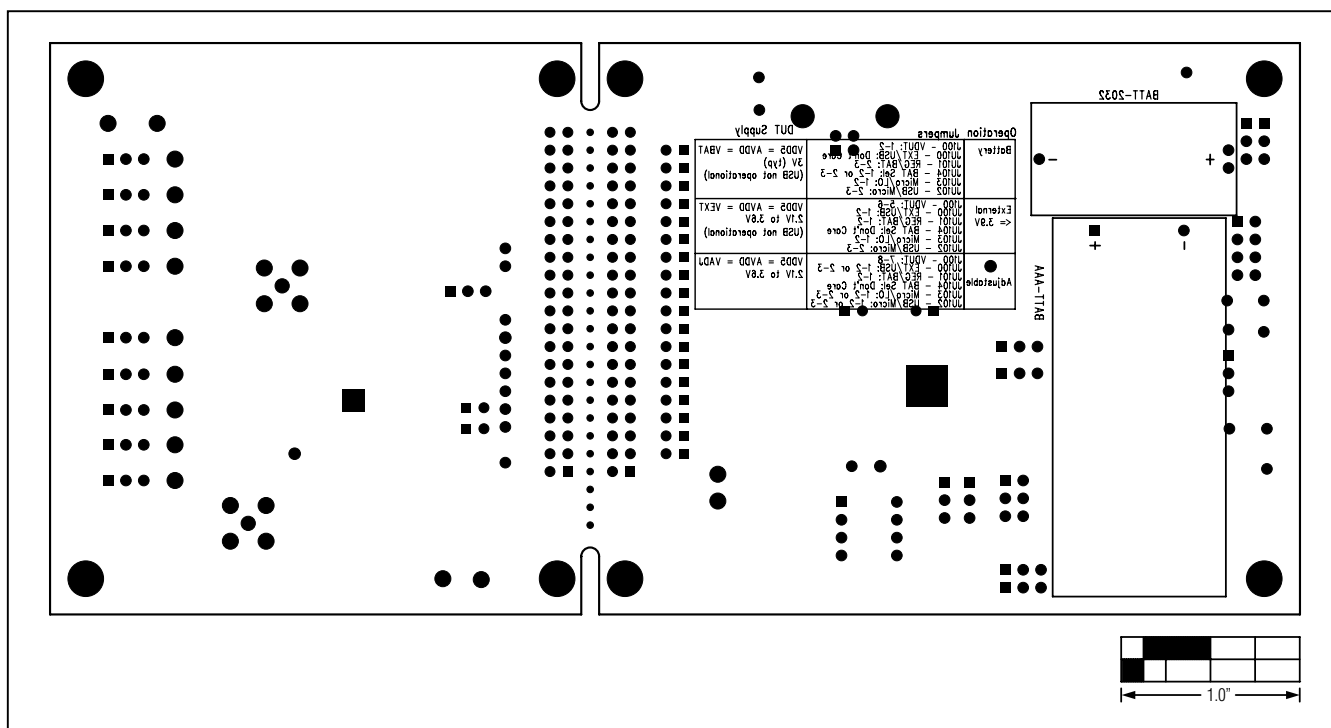


Figure 10. MAX7049 EV Kits Component Placement Guide—Solder Side

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/12	Initial release	—



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25