19-1242; Rev 0; 11/07

MAX17024 Evaluation Kit

Evaluates: MAX17024

General Description

The MAX17024 evaluation kit (EV kit) is a fully assembled and tested printed-circuit board (PCB) that demonstrates the typical 10A application circuit of the MAX17024. The MAX17024 is a DC-DC converter that steps down high-voltage batteries to generate low-voltage core, chipset, or memory bias supplies in notebook computers.

The MAX17024 EV kit provides a dynamically adjustable 1.5V/1.05V output voltage from a 7V to 24V battery input range. It delivers up to 10A output current while achieving greater than 92% efficiency. Programmed by a single resistor, the EV kit operates at 300kHz switching frequency and has superior line- and load-transient response. The EV kit also allows the evaluation of other dynamically adjustable output voltages by varying the external reference input, which can be realized by changing resistors R1, R2, and R3.

Features

- **7V to 24V Input Range**
- **Quick-PWM with Fast Transient Response**
- **Dynamically Selectable 1.5V/1.05V Output Voltage**
- **Dynamically Adjustable Output Voltage (0 to 0.9V_{IN} Range)**
- **10A Output Current**
- **92% Efficiency (V_{IN} = 12V, V_{OUT} = 1.5V at 5A)**
- **300kHz Switching Frequency**
- **Power-Good Output Indicator (PGOOD)**
- **Low-Profile Surface-Mount Components**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX17024EVKIT+	EV Kit

+Denotes lead-free and RoHS-compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	1µF ±10%, 6.3V X5R ceramic capacitors (0402) TDK C1005X5R0J105K KEMET C0402C105K9PAC
C3	1	1000pF ±5%, 50V, C0G ceramic capacitor (0402) Murata GRM1555C1H102J TDK C1005X7R1H102K
C4, C5	2	10µF ±20%, 25V X5R ceramic capacitors (1210) TDK C3225X7R1E106M Taiyo Yuden TMK325BJ106MM
C6, C8, C9, C13, C14	0	Not installed, ceramic capacitors (0603)
C7	1	0.1µF ±10%, 25V X7R ceramic capacitor (0603) TDK C1608X7R1E104K Murata GRM188R71E104K
C10, C11	2	330µF, 2.5V, 6mΩ polymer capacitors (D case) Panasonic EEFSX0D331XR (6mΩ ESR, 1.9mm height) NEC/TOKIN PSGD0E337M7 (7mΩ ESR, 2.8mm height)
C12	1	10µF ±10%, 10V X5R ceramic capacitor (0805) Murata GRM21BR61A106K TDK C2012X5R0J106M
D1	1	30V, 2A Schottky diode (SMA case) Nihon EC21QS03L Central Semiconductor CMSH2-40M, lead free
D2	1	Green surface-mount LED (0805)
JU1	1	3-pin header
JU2	1	2-pin header
L1	1	1µH, 3.25mΩ, 16A power inductor Würth 744 355 2100

MAX17024 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
N1	1	30V, 27A, 9mΩ n-channel MOSFET (SOP Advance) Toshiba TPCA8023-H Fairchild FDMS8690
N2	1	30V, 21A, 3.1mΩ n-channel MOSFET (SOP Advance) Toshiba TPCA8019-H Fairchild FDS8670
N3	1	n-channel logic-level MOSFET (SOT23) Fairchild 2N7002 (Top Mark: 702) Zetex ZVN3306F (Top Mark: MC)
R1	1	49.9kΩ ±1% resistor (0603)
R2	1	54.9kΩ ±1% resistor (0603)
R3	1	97.6kΩ ±1% resistor (0603)
R4	1	1kΩ ±5% resistor (0603)

DESIGNATION	QTY	DESCRIPTION
R5, R9	2	0Ω resistors (0603)
R6	1	200kΩ ±1% resistor (0603)
R7, R8, R10	0	Not installed, resistors (0603) R7 is shorted by PCB trace; R8 and R10 are open
R11	1	0.002Ω ±1%, 1W sense resistor (2512) Panasonic ERJM1WTF2M0U IRC LRF2512LF-01-R002-J
R12	1	100kΩ ±5% resistor (0603), use lead-free only
U1	**1**	**MAX17024ETD+ (14-pin TDFN)**
EN, GATE, PGOOD, REFIN	4	Test points
—	2	Shunts
—	1	PCB: MAX17024 Evaluation Kit+

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	516-435-1110	www.centralsemi.com
Fairchild Semiconductor	408-822-2000	www.fairchildsemi.com
IRC/TT Electronics	361-992-7900	www.irctt.com
KEMET Corp.	864-963-6300	www.kemet.com
Murata Mfg. Co., Ltd.	770-436-1300	www.murata.com
NEC TOKIN Corp.	408-432-8020	www.nec-tokin.com
Nihon Inter Electronics Corp.	661-867-2555	www.niec.co.jp
Panasonic Corp.	714-373-7366	www.panasonic.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-390-4373	www.component.tdk.com
Toshiba America Electronic Components, Inc.	949-623-2900	www.toshiba.com/taec
Würth Electronik GmbH & Co. KG	201-785-8800	www.we-online.com
Zetex	631-360-2222	www.zetex.com

Note: *Indicate that you are using the MAX17024 when contacting these component suppliers.*

Quick Start

Recommended Equipment

Before beginning, the following equipment is needed:

- 7V to 24V power supply, battery, or notebook AC adapter
- DC bias power supply, 5V at 100mA
- Dummy load capable of sinking 10A
- Digital multimeter (DMM)
- 100MHz dual-trace oscilloscope

Procedure

The MAX17024 EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

1) Ensure that the circuit is connected correctly to the supplies and dummy load prior to applying any power.
2) Verify that shunts are across JU1, pins 1-2 (EN high), and JU2 pins are uninstalled (1.5V output).
3) Turn on battery power prior to 5V bias power; otherwise, the output UVLO timer times out and the FAULT latch is set, disabling the regulator until 5V power is cycled below 0.5V, or EN is toggled.
4) Observe the 1.5V output with the DMM and/or oscilloscope. Look at the LX switching node and MOSFET gate-drive signals while varying the load current.

Detailed Description

Jumper Settings

Several jumper settings in the following tables illustrate some of the features of the MAX17024 EV kit.

Shutdown Control Input

The MAX17024 EV kit features a 3-pin jumper (JU1) that selects the shutdown control input. Table 1 lists the selectable jumper options.

External Gate

The MAX17024 EV kit features a 2-pin jumper (JU2) that controls the gate of the external MOSFET (N3). The external MOSFET can be controlled through the gate test point to dynamically adjust the REFIN voltage by forcing N3 to a low- or a high-impedance state. The default configuration has a shunt installed on only one pin of JU2 to provide a 1.5V output. Table 2 lists the selectable jumper options.

Table1. Jumper JU1 Functions

JUMPER POSITION	EN PIN	MAX17024 OUTPUT
1-2*	Connected to VDD.	MAX17024 enabled, V_{OUT} = 1.5V/1.05V.
2-3	Connected to GND.	Shutdown mode, V_{OUT} = 0V.
Not installed	EN must be driven by an external signal connected to the EN test point.	MAX17024 operation depends on the external EN signal levels.

**Default position.*

Table2. Jumper JU2 Functions

JUMPER POSITION	EXTERNAL GATE	MAX17024 OUTPUT
Installed	Connected to VDD	A logic-high on gate turns on the external MOSFET, effectively shorting R3. V_{OUT} = 1.05V through resistor-dividers R1 and R2.
Not installed*	Pulled to ground	A logic-low on gate turns off the external MOSFET. V_{OUT} = 1.5V through resistor-dividers R1 and (R2 + R3).

**Default position.*

Evaluating Other Dynamic Output Voltages

The EV kit output is preset to 1.05V/1.5V. However, the output voltage can also be adjusted between 0 and 2V (FB = OUT) by selecting R1, R2, and R3 values. The MAX17024 regulates FB to the voltage set at REFIN. By changing the voltage at REFIN, the MAX17024 can be used in applications that require dynamic output voltage changes between two set points. Using the external gate signal, a resistor can be switched in and out of the REFIN resistor-divider, changing the voltage at REFIN. A logic-high on gate turns on the external n-channel MOSFET, forcing N3's drain to a low-impedance state. A logic-low on gate disables the n-channel MOSFET, so N3's drain is high impedance. The two output voltages (FB = OUT) are determined by the following equations:

$$V_{OUT(LOW)} = \left(\frac{R2}{R1+R2}\right)V_{REF}$$

$$V_{OUT(HIGH)} = \left(\frac{R2+R3}{R1+R2+R3}\right)V_{REF}$$

where V_{REF} = 2V.

Setting the Switching Frequency (fSW)

The switching-frequency setting input is adjusted by replacing external resistor R6 (R_{TON}) according to the following equations:

$$T_{SW} = C_{TON}\left(R_{TON} + 6.5k\Omega\right)\left(\frac{V_{FB}}{V_{OUT}}\right)$$

$$f_{SW} = \frac{1}{T_{SW}}$$

where C_{TON} = 16.26pF and $V_{FB} = V_{REFIN}$ under normal operating conditions.

Setting VOUT with a Resistive Voltage-Divider at FB

Connecting FB to a resistive divider allows for output voltages above the reference voltage (0 to 0.9V_{IN} range). To obtain an output above 2V, replace R9 and install resistor R10 with values according to the following equation:

$$V_{OUT} = V_{FB}\left(1+\frac{R9}{R10}\right)$$

where $V_{FB} = V_{REFIN}$. Calculate R9 using a recommended value of 10kΩ for R10.

The switching-frequency setting should be adjusted accordingly. Also, refer to the MAX17024 IC data sheet for selection of output capacitor and inductor values for output voltages greater than 2V.

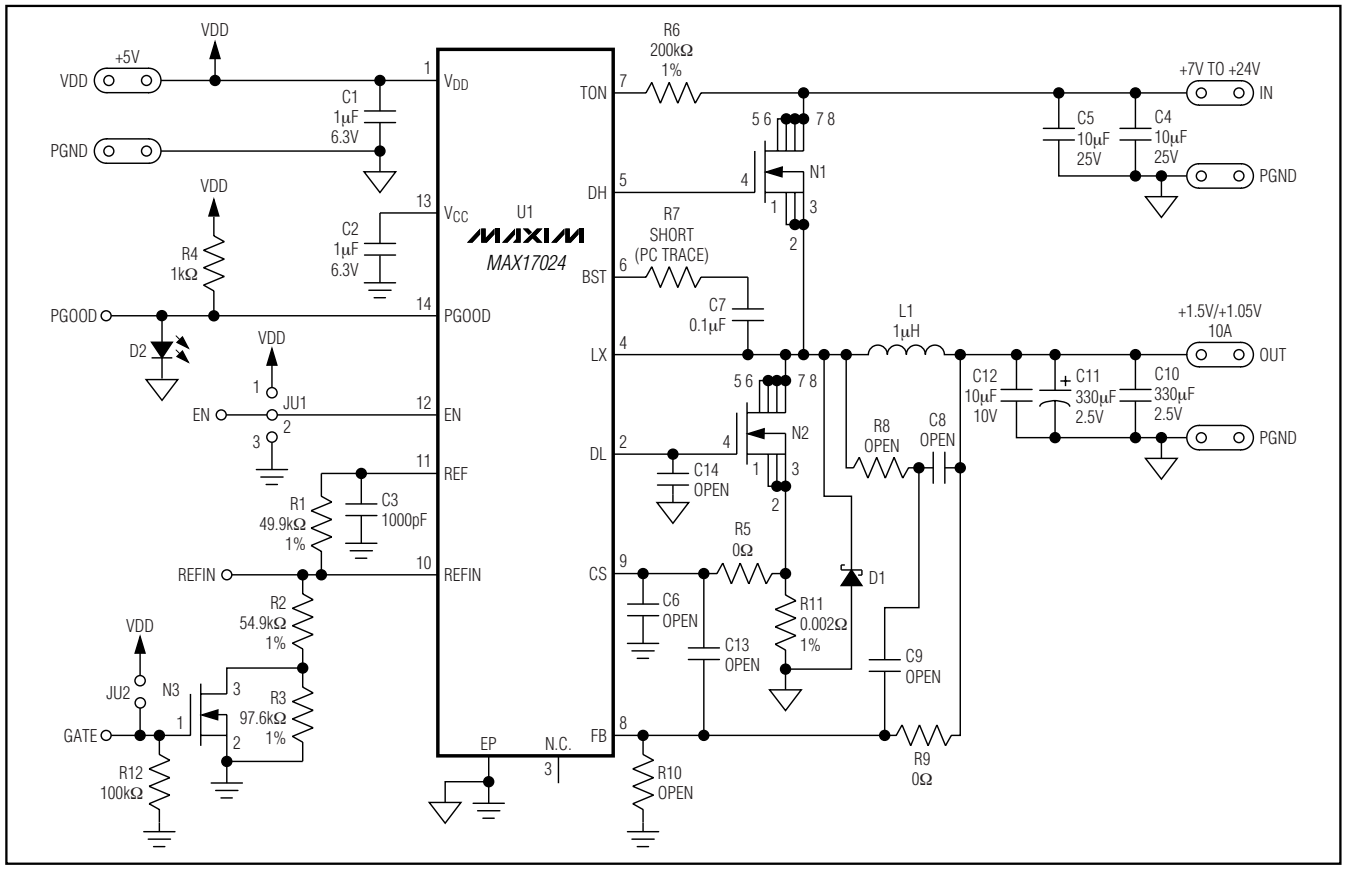

Figure 1. MAX17024 EV Kit Schematic

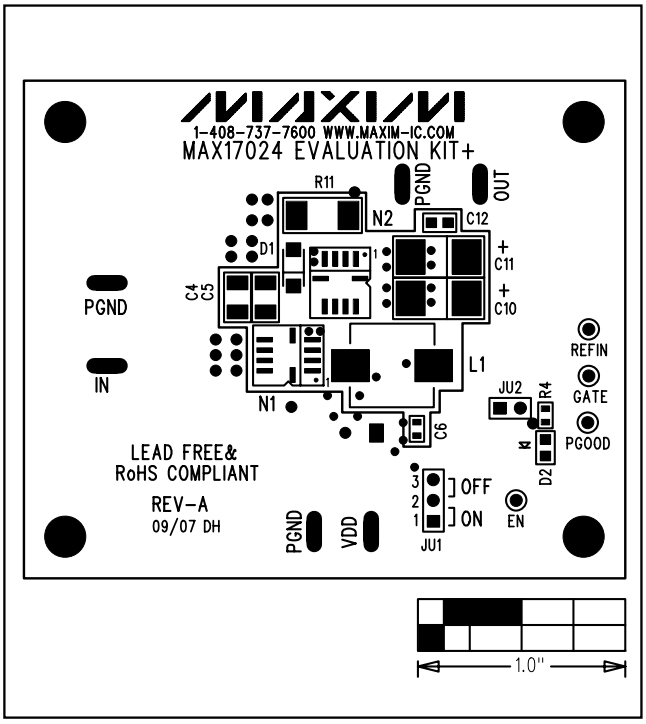

Figure 2. MAX17024 EV Kit Component Placement Guide—Component Side

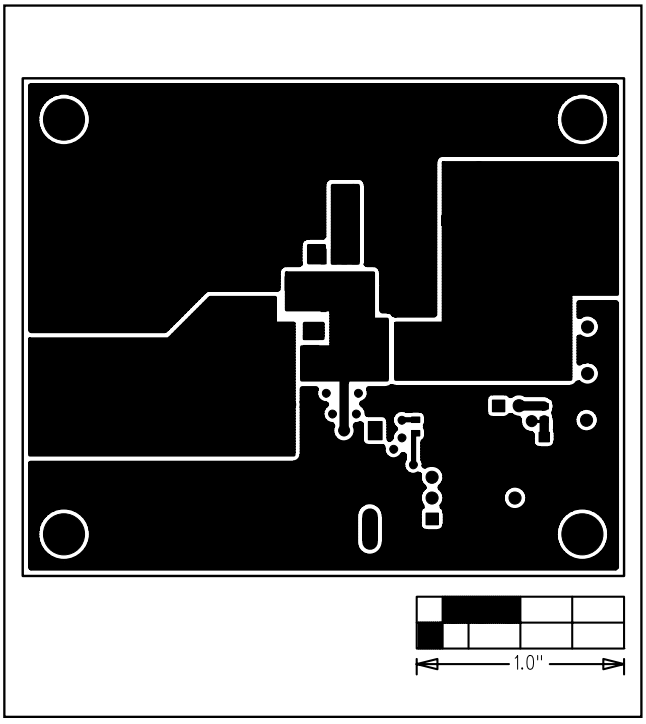

Figure 3. MAX17024 EV Kit PCB Layout—Component Side

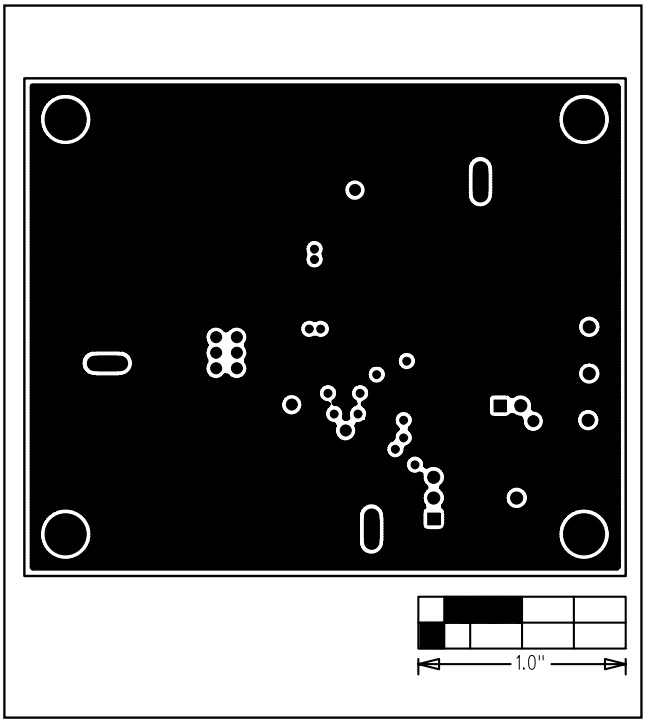

Figure 4. MAX17024 EV Kit PCB Layout—GND Layer 2

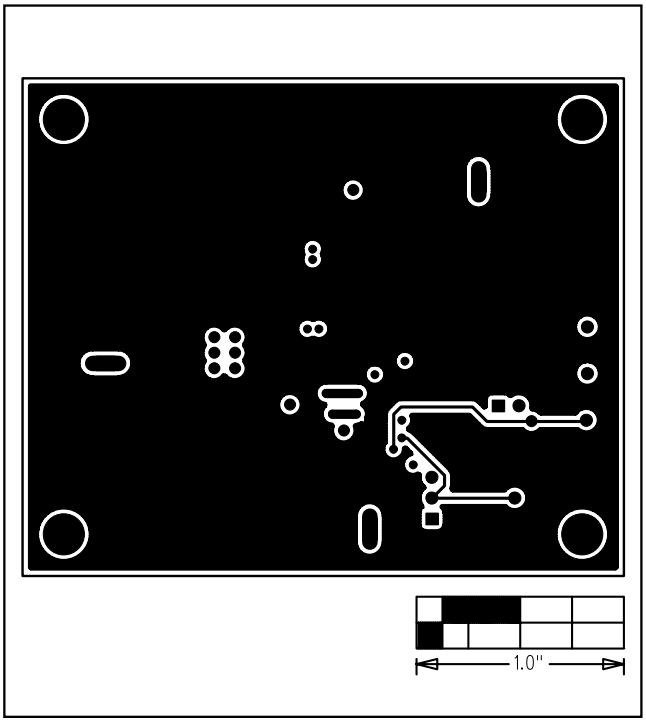

Figure 5. MAX17024 EV Kit PCB Layout—GND Layer 3

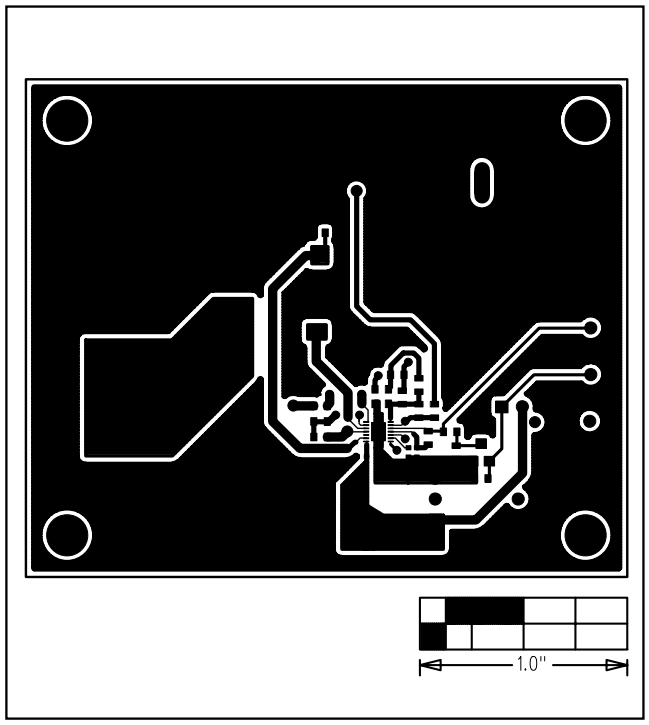

Figure 6. MAX17024 EV Kit PCB Layout—Solder Side

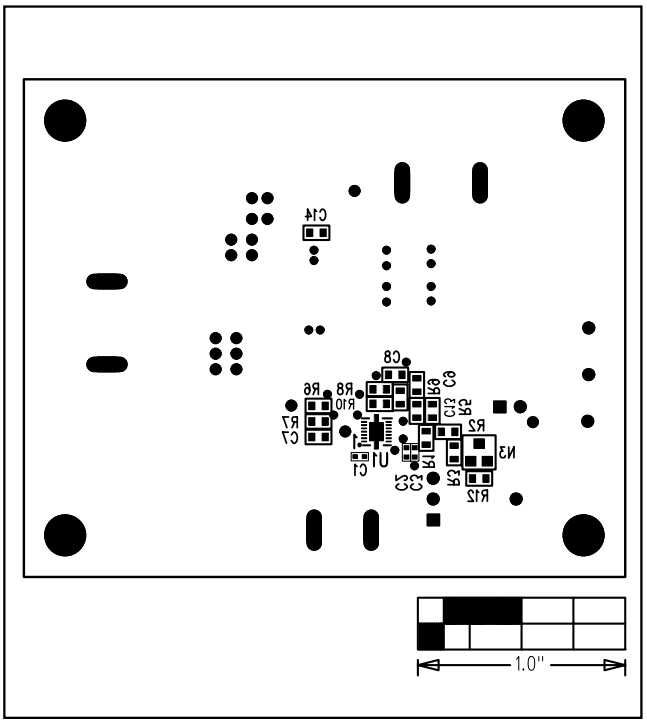

Figure 7. MAX17024 EV Kit Component Placement Guide—Solder Side