



# MAX8753 Evaluation Kit

Evaluates: MAX8753

## General Description

The MAX8753 evaluation kit (EV kit) is a fully assembled and tested surface-mount circuit board that generates the voltages required for active-matrix, thin-film transistor (TFT) liquid-crystal displays (LCDs). The EV kit contains a pulse-width-modulated (PWM) step-up switching regulator (VMAIN), positive and negative charge-pump regulators (OUTP and OUTN) for the TFT gate drive, and a low-voltage linear regulator (OUTL).

The EV kit operates from a +2.6V to +5.5V ( $V_{IN}$ ) DC supply voltage. The step-up regulator switches at 1MHz and is configured for a +9V output capable of providing 160mA with a +3V input. The positive and negative charge pumps are configured for +24V and -11V, respectively, and are both capable of providing 20mA. The linear voltage regulator (LDO) is configured to provide a regulated +2.5V output with a maximum 300mA load.

The MAX8753 EV kit features low quiescent current and high conversion efficiency (90%). Operation at 1MHz allows the use of small surface-mount components. The MAX8753 TQFN package (0.8mm max) with low-profile external components allows the circuit to be less than 1.2mm high.

## Features

- ◆ 90% Efficiency
- ◆ +2.6V to +5.5V Input Range
- ◆ Output Voltages (+3V Input)
  - +9V Output at 160mA (Step-Up Regulator)
  - +24V Output at 20mA (Positive Charge Pump)
  - 11V Output at 20mA (Negative Charge Pump)
  - +2.5V Output at 300mA (Linear Regulator)
- ◆ 1MHz Switching Frequency
- ◆ Low-Profile Design (1.2mm max)
- ◆ Fully Assembled and Tested

## Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX8753EVKIT	0°C to +70°C	28 TQFN (5mm x 5mm)

## Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3	2	10 $\mu$ F $\pm$ 20%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J106M
C2, C4–C7, C15–C18	9	0.1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitors (0603) TDK C1608X7R1H104K Taiyo Yuden UMK107BJ104KA
C8, C9	2	1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitors (1206) Murata GRM31MR71H105KA
C10	1	0.22 $\mu$ F $\pm$ 10%, 16V X7R ceramic capacitor (0603) TDK C1608X7R1C224K
C11	1	1000pF $\pm$ 10%, 100V X7R ceramic capacitor (0603) TDK C1608X7R2A102K
C12	1	10 $\mu$ F $\pm$ 20%, 16V X5R ceramic capacitor (1210) Taiyo Yuden EMK325BJ106KD
C13	0	Not installed, ceramic capacitor (1210)
C14	1	470pF $\pm$ 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H471K
D1	1	1A, 30V Schottky diode (S-flat) Toshiba CRS02

DESIGNATION	QTY	DESCRIPTION
D2, D3	2	250mA, 90V, dual switching diodes (SOT23) Central Semiconductor CMPD1001S (Top mark: L21)
JU1, JU2	2	2-pin headers
L1	1	6.8 $\mu$ H $\pm$ 30%, 1.0A power inductor Sumida CMD6D11B-6R8
R1, R2	2	100k $\Omega$ $\pm$ 5% resistors (0603)
R3	1	20k $\Omega$ $\pm$ 1% resistor (0603)
R4	0	Not installed, resistor (0603)
R5	1	25.5k $\Omega$ $\pm$ 1% resistor (0603)
R6	1	464k $\Omega$ $\pm$ 1% resistor (0603)
R7	1	19.1k $\Omega$ $\pm$ 1% resistor (0603)
R8	1	215k $\Omega$ $\pm$ 1% resistor (0603)
R9	1	28k $\Omega$ $\pm$ 1% resistor (0603)
R10	1	174k $\Omega$ $\pm$ 1% resistor (0603)
R11	1	20k $\Omega$ $\pm$ 5% resistor (0603)
R12	0	Not installed, short by PC trace (0603)
U1	1	MAX8753ETI+ (28-pin TQFN 5mm x 5mm)
—	2	Shunts
—	1	MAX8753 EV kit PC board

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## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor	631-435-1110	www.centrasemi.com
Murata	770-436-1300	www.murata.com
Sumida	847-545-6700	www.sumida.com
Taiyo Yuden	408-573-4150	www.t-yuden.com
TDK	847-803-6100	www.component.tdk.com
Toshiba	949-455-2000	www.toshiba.com/taec

**Note:** Indicate that you are using the MAX8753 when contacting these component suppliers.

## Recommended Equipment

- +2.6V to +5.5V, 2A DC power supply
- Voltmeter

## Quick Start

The MAX8753 EV kit is fully assembled and tested. Follow these steps to verify board operation. **Do not turn on the power supply until all connections are completed.**

- 1) Connect the positive terminal of the DC power supply to the VIN pad. Connect the negative terminal of the DC power supply to the PGND pad.
- 2) Verify that there are no shunts placed across jumpers JU1 and JU2 to enable the MAX8753 and all of the outputs.
- 3) Turn on the +2.6V to +5.5V DC power supply and verify that VMAIN is +9V.
- 4) Verify that OUTN is -11V.
- 5) Verify that OUTP is +24V.
- 6) Verify that OUTL is +2.5V.

## Detailed Description

The MAX8753 EV kit operates from a +2.6V to +5.5V input power supply. The EV kit contains a high-efficiency, pulse-width-modulated (PWM) step-up switching regulator, positive and negative charge-pump regulators, and a low-voltage LDO. The MAX8753 provides output control through the  $\overline{\text{SHDN}}$  and LCDON configuration jumpers,

JU1 and JU2. See the *Output Control* ( $\overline{\text{SHDN}}$  and LCDON) section.

As configured, the step-up switching regulator generates a +9V output (VMAIN) and provides 160mA from a +3V input when the regulated charge pumps are providing 20mA each. In the event that the charge pumps are unloaded, the VMAIN output is capable of providing 240mA from a +3V input. The step-up switching regulator output voltage can be adjusted from VIN to +13V by changing the values of feedback resistors R9 and R10.

The positive charge pump provides a regulated +24V output at load currents up to 20mA. The positive charge pump can be configured for output voltages up to three times VMAIN (minus dropout) by changing the values of feedback resistors R5 and R6. The negative charge pump provides a regulated -11V output at up to 20mA. The negative charge pump can be configured for output voltages from 0 to -12V by changing the values of feedback resistors R7 and R8.

The linear regulator supplies a regulated +2.5V output at load currents up to 300mA. The LDO output can be configured for voltages up to VIN (minus dropout) by changing the values of feedback resistors R3 and R4.

For details on changing the feedback resistors associated with each of the MAX8753 EV kit outputs, see the *Evaluating Other Output Voltages* section. **Operation at a different input voltage, output voltages, or load currents may require a different inductor, output capacitors, and feedback components.** Refer to the MAX8753 data sheet for detailed information on component selection.

## Jumper Selection

### Output Control ( $\overline{\text{SHDN}}$ and LCDON)

The MAX8753 IC provides two enable inputs, LCDON and  $\overline{\text{SHDN}}$ , to enable/disable the LCD supply outputs (VMAIN, OUTN, and OUTP), linear regulator (OUTL), and internal reference supply (REF). The  $\overline{\text{SHDN}}$  input has precedence over the LCDON input. When  $\overline{\text{SHDN}}$  is pulled low, all outputs are disabled, reducing the IC quiescent current to less than 1 $\mu$ A (typ). The  $\overline{\text{SHDN}}$  input is set through jumper JU1 and the LCDON input is set through jumper JU2. See Table 1 for output configuration.

**Table 1. Jumper JU1 and JU2 Functions**

SHUNT LOCATION				INTERNAL REFERENCE	LINEAR REGULATOR	LCD SUPPLIES
JU1	$\overline{\text{SHDN}}$ PIN	JU2	LCDON PIN	REF	OUTL	VMAIN, OUTN, OUTP
Installed	GND	Installed	GND	Disabled		Disabled
Installed	GND	Not installed	VIN	Disabled		Disabled
Not installed	VIN	Installed	GND	Enabled		Disabled
Not installed	VIN	Not installed	VIN	Enabled		Enabled

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## Evaluating Other Output Voltages

The MAX8753 EV kit outputs (VMAIN, OUTP, OUTN, and OUTL) can be configured for different voltage levels by adjusting their respective feedback resistors. Table 2 lists each of the MAX8753 outputs and their associated feedback resistors. To configure the feedback network, plug the desired output voltage and appropriate constants into the listed equation.

Operation at a different input voltage, output voltages, or load currents may require a different inductor, output capacitors, and feedback components. Refer to the MAX8753 data sheet for detailed information on component selection.

**Table 2. Output Voltage Configuration**

OUTPUT	AS CONFIGURED	MAX VOLTAGE	FEEDBACK RESISTORS	CONSTANTS
VMAIN	+9V	+13V	$R_{10} = R_9 \times \left[ \left( \frac{V_{MAIN}}{V_{FB}} \right) - 1 \right]$	$V_{FB} = 1.245V$ $R_9 = 10k\Omega \text{ to } 50k\Omega$
OUTP	+24V	+28V	$R_6 = R_5 \times \left[ \left( \frac{OUTP}{V_{FBP}} \right) - 1 \right]$	$V_{FBP} = 1.25V$ $R_5 = 10k\Omega \text{ to } 50k\Omega$
OUTN	-11V	-12V	$R_8 = R_7 \times \left[ \left( \frac{OUTN - V_{FBN}}{V_{FBN} - V_{REF}} \right) \right]$	$V_{FBN} = 250mV$ $V_{REF} = 1.25V$ $R_7 = 10k\Omega \text{ to } 50k\Omega$
OUTL	+2.5V	+V <sub>IN</sub>	$R_4 = R_3 \times \left[ \left( \frac{OUTL}{V_{FBL}} \right) - 1 \right]$	$V_{FBL} = 1.25V$ $R_3 = 10k\Omega \text{ to } 50k\Omega$

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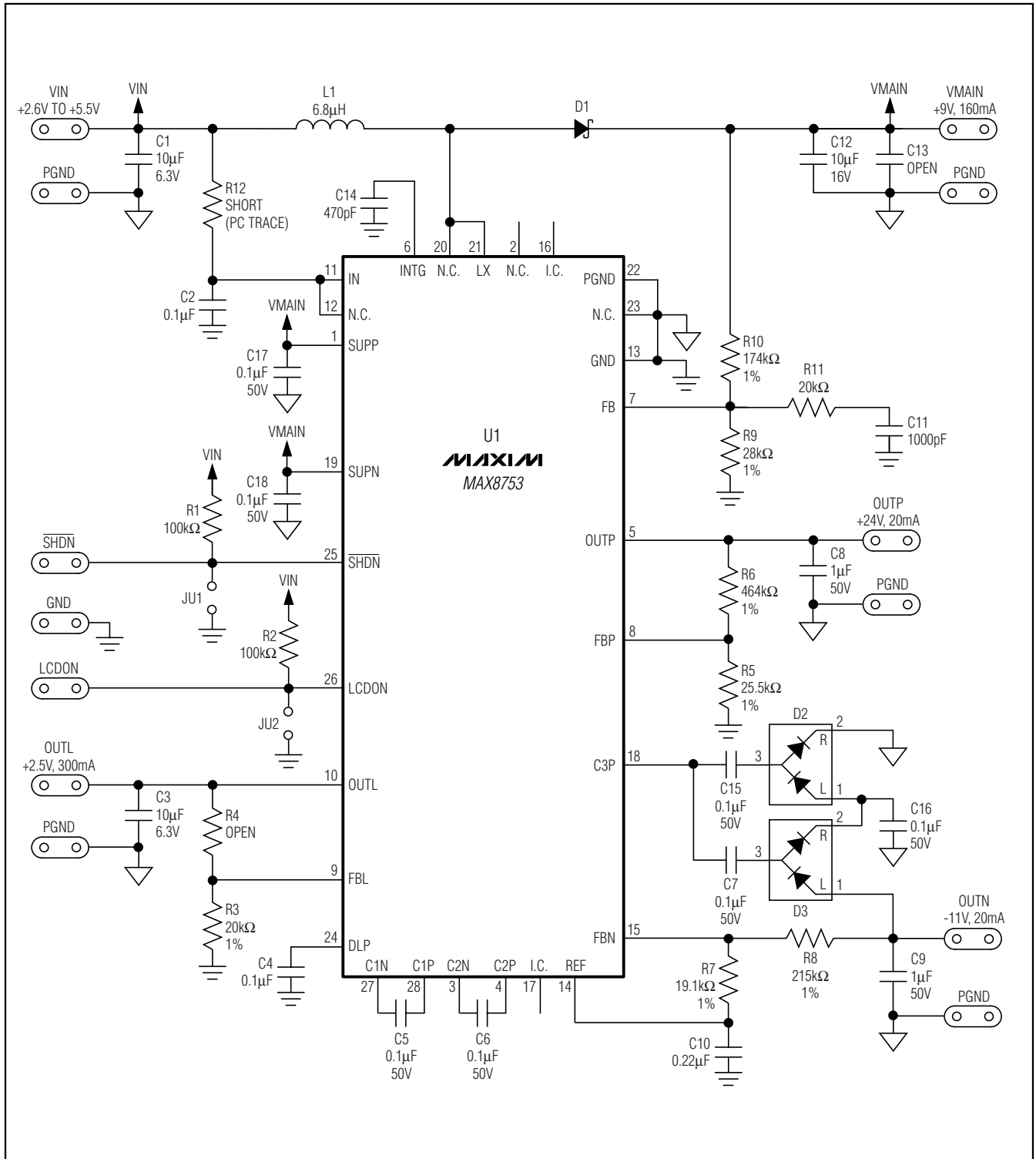


Figure 1. MAX8753 EV Kit Schematic

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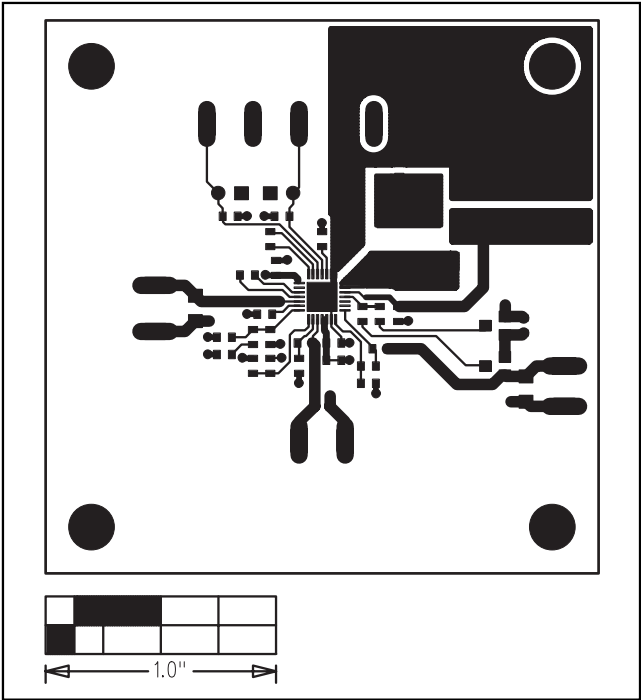
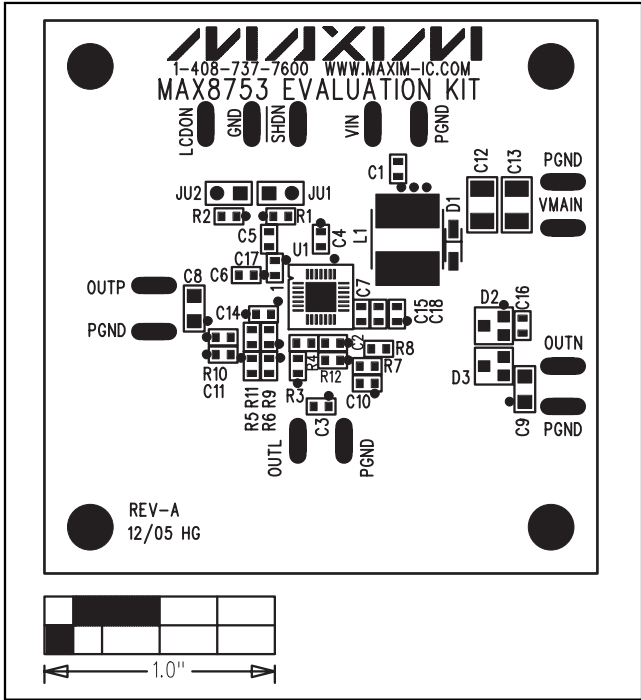


Figure 2. MAX8753 EV Kit Component Placement Guide—Component Side

Figure 3. MAX8753 EV Kit PC Board Layout—Component Side

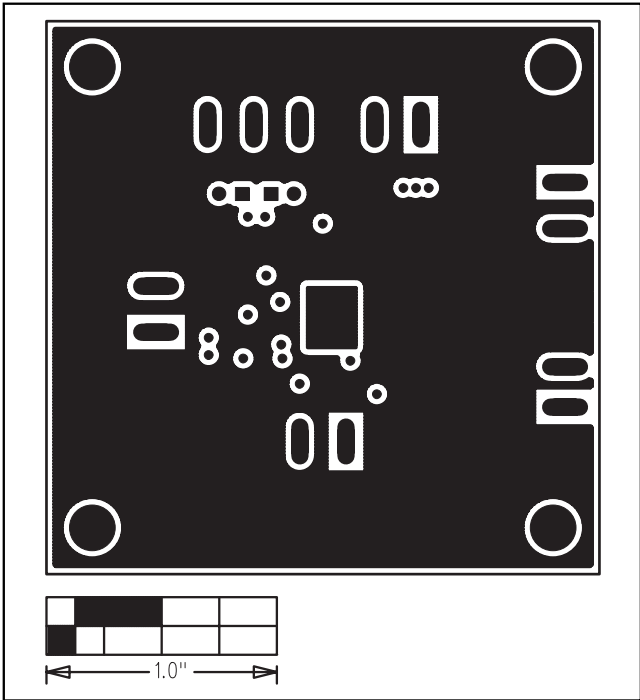


Figure 4. MAX8753 EV Kit PC Board Layout—Internal Layer 2—GND Plane

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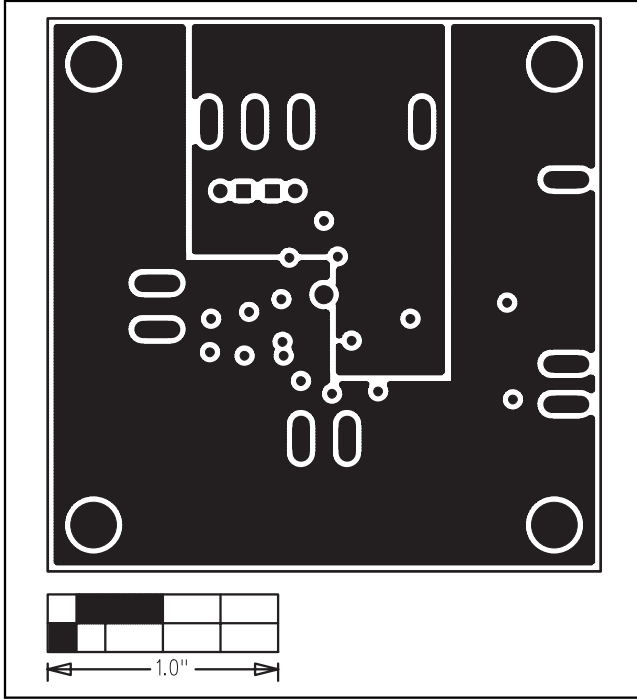


Figure 5. MAX8753 EV Kit PC Board Layout—Internal Layer 3—Power Plane

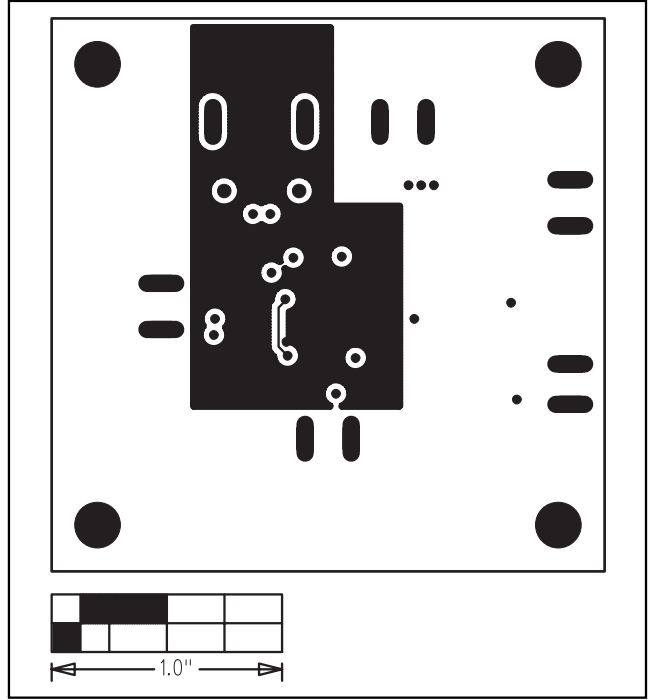


Figure 6. MAX8753 EV Kit PC Board Layout—Solder Side

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