



## MAX759 LCD Power Supply Evaluation Kit

### General Description

The MAX759 LCD power supply evaluation kit (EV kit) is a special application circuit that uses the MAX759 inverting DC-DC converter to generate the variable negative voltage needed by liquid crystal displays (LCDs). The kit is fully assembled using surface-mounted components. A potentiometer mounted on the board allows adjustment of the output voltage over a -6V to -24V range.

### Features

- ◆ Fully Assembled Surface-Mount EV Kit
- ◆ -6V to -24V Adjustable Output
- ◆ 80% Conversion Efficiency
- ◆ 40mA Output Current

### Ordering Information

PART	TEMP. RANGE	BOARD TYPE
MAX759LCDKIT-SO	0°C to +70°C	Surface-Mount

### Component List

DESIGNATION	QTY	DESCRIPTION	MANUFACTURER
U1	1	MAX759CPD	
None	1	2.0" x 3.0" printed circuit board	
None	1	MAX759 data sheet	
C1	1	150 $\mu$ F low-ESR tantalum capacitor	Sprague 595D157X0016R7
C2, C4	2	0.1 $\mu$ F chip capacitor	
C3, C5	2	0.01 $\mu$ F chip capacitor	
C6, C7	2	33 $\mu$ F low-ESR tantalum capacitor	Sprague 595D336X0035R7
D1	1	1N5819 diode, 40V	NIEC EC10QS04
L1	1	50 $\mu$ H SMT transformer	Coiltronics CTX50-1
R1	1	10k $\Omega$ 5% resistor	
R2	1	6.81k $\Omega$ 1% resistor	
R3	1	100k $\Omega$ single-turn potentiometer	Bourns 3352T-104-ND
R4	1	33.2k $\Omega$ 1% resistor	

Bourns: Phone (714) 781-5500, FAX (714) 781-5273  
Coiltronics: Phone (305) 781-8900  
NIEC (Tokyo): Phone 81-3-3494-7411, FAX 81-3-3494-7414  
Sprague: Phone (516) 746-1385

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### Detailed Description

#### Input Supply Requirements

The MAX759 LCD power supply EV kit has a 4.5V to 6V input range. The lower input limit is due to the minimum operating voltage of the MAX759. The maximum input voltage is limited by the absolute maximum rating of the differential voltage between the V+ and LX pins with some margin for leakage inductance and turns ratio error.

You can determine the maximum input current requirement by calculating the maximum output power levels. Formula 1 shows the relationship between output power and input power with 80% efficiency. Formula 2 is the result of expanding the first equation and solving for I<sub>IN</sub>. Assuming a 5V input and a 24V, 40mA load, the input current can then be calculated.

- (1)  $P_{OUT} / P_{IN} = 80\%$
- (2)  $I_{IN} = (I_{OUT} \times V_{OUT}) / (0.80 \times V_{IN})$

For  $V_{OUT} = -24V$ ,  $I_{OUT} = 40mA$ , and  $V_{IN} = 5.0V$ :  
 $I_{IN} = (40mA \times 24V) / (0.80 \times 5.0V) = 240mA$

Note that the current is an average value. Peak currents are much higher during the inductor charging cycle. The capacitor between V+ and ground should be a low-ESR type, located as close to the MAX759 as possible. Use the EV kit layout as a guide.

#### Output Circuit

The output circuit employs an autotransformer to limit the voltage swing on the MAX759's LX pin while producing the -24V output voltage. The voltage at the center tap of the transformer is one-half of the full output voltage. This keeps the input/output differential voltage below the 22V limit given in the MAX759 data sheet *Absolute Maximum Ratings*.

The Schottky diode must have a breakdown voltage greater than 30V. At the maximum output voltage, the diode will be reversed biased by the combination of the -24V output and the +5V input supply voltage.

The output voltage is determined by the resistors R2, R3, and R4, and the internal VREF voltage. Use Formula 3 to calculate the output voltage. R2 should be a fixed resistor in the 5kΩ to 15kΩ range. R4 sets the minimum output voltage when the potentiometer is adjusted to 0Ω. The maximum output voltage is achieved when R3 is adjusted for maximum resistance.

- (3)  $V_{OUT} = -(V_{REF}/R2) \times (R3 + R4)$

When R3 is adjusted to zero:  
 $V_{OUT} = -(1.23V / 6.81k\Omega) (0\Omega + 33.2k\Omega) = -6.0V$

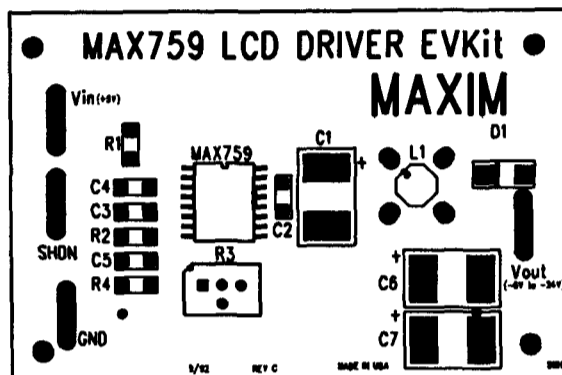


Figure 1. MAX759 LCD Power Supply EV Kit Component Placement Guide

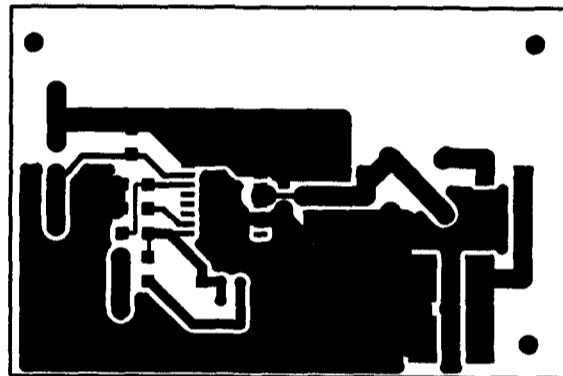


Figure 2. MAX759 LCD Power Supply EV Kit Component-Side Layout

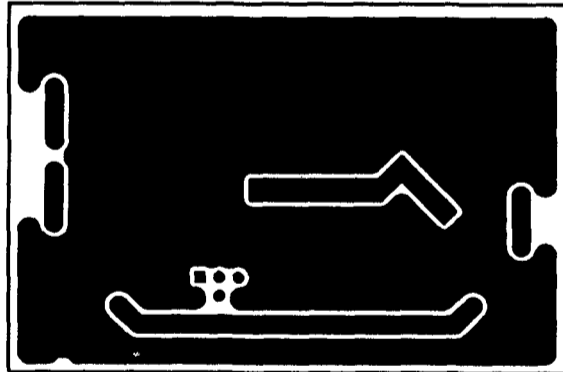


Figure 3. MAX759 LCD Power Supply EV Kit Solder-Side Layout

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When R3 is adjusted to maximum:  
 $V_{OUT} = -(1.23V / 6.81k\Omega) (100k\Omega + 33.2k\Omega) = -24.1V$

Note that there are two 33 $\mu$ F output filter capacitors, which are necessary because of the lack of large-value capacitors with 35V breakdown in surface-mount packages. Radial leaded low-ESR capacitors are preferred for applications built with through-hole component mounting.

### Shutdown Pin

A 10k $\Omega$  resistor pulls the shutdown (SHDN) pin to  $V_{IN}$  for normal operation. The SHDN pin is connected to a pad near the edge of the card so the user may turn off the output voltage with an external signal. Some current will flow through R1 when SHDN is pulled to ground. The resistor is not needed in applications that strap SHDN to  $V_{IN}$  or drive it with CMOS logic.

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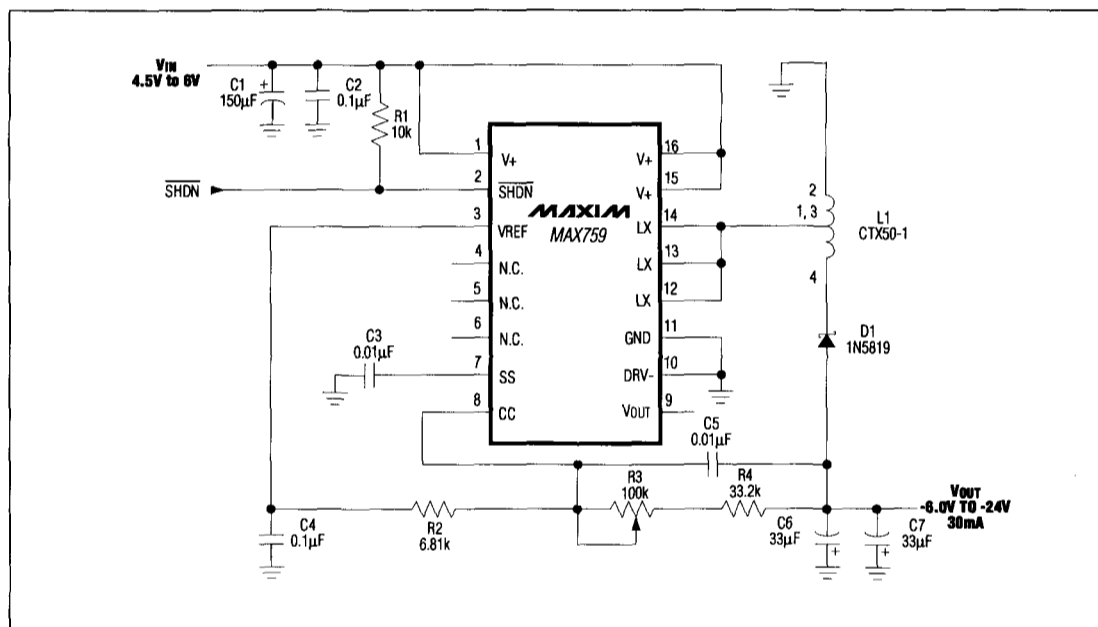


Figure 4. MAX759 LCD EV Kit Schematic