MAXIM

MAX739 Evaluation Kit

MAX739 EV Kit

EV Kit General Description

The MAX739 evaluation kit (EV kit) permits evaluation of Maxim's current-mode, pulse-width modulating (PWM), inverting DC-DC converters. This EV kit has an easy-to-assemble DIP layout.

The EV kit contains a printed circuit board and all components needed to evaluate an application circuit. The PC board is common to the MAX736/MAX737/MAX739/MAX759. The MAX736/MAX737/MAX739 have fixed outputs of -12V, -15V, and -5V, respectively. The MAX759 is adjustable from 0V to -15V. Output voltages beyond -15V require a transformer.

When assembled, the EV kit is a working, inverting DC-DC converter with the following characteristics:

In Bootstrapped Mode
(DRV- = -5.6V for the MAX736/MAX737)
(DRV- = V_{OUT} for MAX739/MAX759)

IC	Input Voltage (V)		Output Voltage (V)	Typical Output Current Capability (mA) V_{IN} = 5.0V
	Min	Max		
MAX736	4	8.6	-12	140
MAX737	4	5.5	-15	110
MAX739	4	11.0	-5	300
MAX759			Adj*	

In Non-Bootstrapped Mode (DRV- = 0V for all parts)

IC	Input Voltage (V)		Output Voltage (V)	Typical Output Current Capability (mA) V_{IN} = 5.0V
	Min	Max		
MAX736	4	8.6	-12	70
MAX737	4	5.5	-15	50
MAX739	4	15.0	-5	250
MAX759			Adj*	

*Adjustable output.

Features

- ♦ **Output Voltage:**
  -12V (MAX736)
  -15V (MAX737)
  -5V (MAX739)
  Adjustable, 0V to -15V (MAX759)
- ♦ **80% Typical Efficiencies at Full Load**
- ♦ **Soft-Start Protection**
- ♦ **Inverts from a 4V Minimum Input Voltage**
- ♦ **On-Chip Power MOSFET**
- ♦ **Shutdown Capability**
- ♦ **All Components and PC Board Included in Kit**

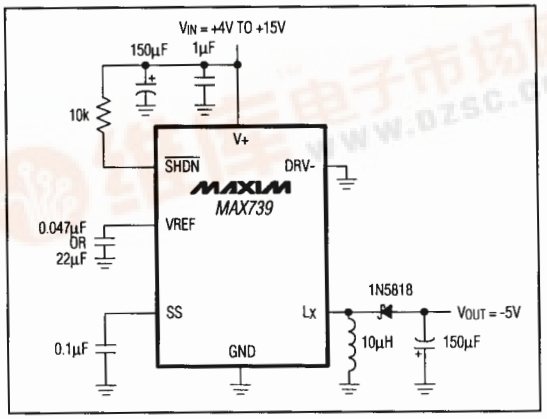
Ordering Information

PART	TEMP. RANGE	BOARD TYPE
MAX739EVKIT-DIP	0°C to +70°C	Through-Hole

The MAX739 EV kit can be used to evaluate the MAX736/MAX737/MAX759. To order a free sample of the appropriate part from Maxim, call toll free 1-800-998-8800, FAX 408-737-7194, or return one of the sample request cards found inside every *Power-Supply Design Guide* brochure.

Part No.	Description
MAX736CPD	-12V Inverting Current-Mode PWM Regulator
MAX737CPD	-15V Inverting Current-Mode PWM Regulator
MAX759CPD	Adjustable Inverting Current-Mode PWM Regulator

Typical Operating Circuit



MAX739 Evaluation Kit

Component List

DESIGNATION	QTY.	DESCRIPTION
IC1	1	MAX739CPD
None	1	Printed circuit board
L1A	1	33µH inductor
L1B	1	10µH inductor
C1	1	1.0µF ceramic capacitor
C2, C5	2	150µF low-ESR electrolytic capacitors
C3A	1	0.047µF ceramic capacitor
C3B	1	22µF tantalum capacitor
C4	1	0.1µF ceramic capacitor
D1	1	1N5818 Schottky diode
D2	1	1N4690 5.6V zener diode
R1, R2	2	10kΩ 5% resistors

Table 1. Operating Modes

MODE	VOLTAGE REQUIREMENTS	REQUIRED CONNECTIONS
Non-Bootstrapped Mode (DRV- connected to GND, all parts)	V_{IN} < 15V, V_{IN} - V_{OUT} < 21V	Connect wire jumper across J3
Bootstrapped Mode (DRV- connected to V_{OUT}, MAX739/ MAX759 only)	V_{IN} < 11V, V_{IN} - V_{OUT} < 17V	Connect wire jumper across J1
Bootstrapped Mode (DRV- clamped to -5.6V, MAX736/ MAX737/MAX759)	V_{IN} < 11V, V_{IN} - V_{OUT} < 21V, V_{IN} - DRV- < 17V	Connect wire jumper across J2. Solder R2 and D2 in the places provided.

Table 2. EV Kit Component Selection

MAX739/MAX759	
COMPONENT	**VALUE**
C3A (V_{IN} > 11V)	0.047µF
C3B (V_{IN} < 11V)	22µF
L1A	33µH
L1B	10µH

MAX736/MAX737	
COMPONENT	**VALUE**
C3B	22µF
L1B	10µH

Note: When evaluating the MAX739 or MAX759, either inductor can be used. Use the 33µH inductor to maximize available output power. When evaluating the MAX736 or MAX737, use only the 10µH inductor. See the *Component Selection Guide* section in the data sheet for additional component information.

EV Kit Assembly

The kit may be assembled for operation in bootstrapped or non-bootstrapped mode. Bootstrapping provides increased switch-gate drive, which allows higher output currents. See the *Typical Operating Characteristics* section of the MAX736/MAX737/MAX739/MAX759 data sheet.

When operating the device in the bootstrapped or non-bootstrapped mode, stay within the maximum operating limits. See the *Absolute Maximum Ratings* table in the MAX736/MAX737/MAX739/MAX759 data sheet.

In bootstrapped mode, a zener diode can be used to clamp the DRV- pin to an acceptable level. For example, when using the MAX736 (-12V output) with a 9V input voltage, DRV- cannot be connected to V_{OUT} because V_{IN} - DRV- is greater than 17V. Use the 1N4690 zener diode provided with the kit to clamp the DRV- voltage to -5.6V so that the V_{IN} - DRV- voltage differential falls within the permissible range.

Refer to the Operating Modes table (Table 1) and the EV Kit Component Selection table (Table 2) to assemble the EV kit.

Assembly List

C1 . . . . .1.0µF monolithic capacitor
C2 . . . . .150µF electrolytic capacitor
C3A . . .0.047µF monolithic capacitor (see Table 2)
C3B . . . .22µF tantalum capacitor (see Table 2)
C4 . . . . .0.1µF monolithic capacitor
C5 . . . . .150µF electrolytic capacitor
L1A . . . .33µH inductor (see Table 2)
L1B . . . .10µH inductor (see Table 2)
D1 . . . . .1N5818 Schottky diode
R1 . . . . .10kΩ 5% resistor
Install R2 and D2 only if the evaluation board is to be used in bootstrapped mode with DRV- clamped to -5.6V.

R2 . . . . .10kΩ 5% resistor
D2 . . . . .1N4690 5.6V zener diode
Jumper . .The jumper must be installed across J1,
. . . . . .J2 or J3 for proper operation (see Table 1).
J1 . Bootstrapped to V_{OUT}
J2 . Bootstrapped to D2
. . (requires R2 and D2)
J3 . Non-bootstrapped mode.
. . Use non-bootstrapped mode for
. . widest operating voltage range.
For the MAX759, R3 and R4 are selected by the user.

Operating Principle

The MAX736/MAX737/MAX739/MAX759 inverting switching regulators use a current-mode pulse-width modulation (PWM) controller to convert an unregulated DC voltage (≥4V) to a negative output voltage. PWM controllers provide precise output regulation, low subharmonic noise, cycle-by-cycle current limiting, overcurrent limiting, and programmable soft-start protection. Typical full-load efficiencies are 83%, and no-load supply current is typically 1.7mA.

Assembly Instructions

CAUTION: Observe the following safety measures.

- Do not apply power until all components are installed.
- Do not solder or work on the circuit while power is applied.
- Never apply more than the maximum supply voltage to V_{IN}.

The EV kits are shipped unassembled. You will need the following assembly tools:

1. Long-nose pliers
2. Wire cutters
3. 30W soldering iron and rosin-core solder
4. Hook-up wire (#18-22AWG) for the input and output connections.

Install the components as shown in Figure 2 and solder them in place. Observe polarity on the capacitors, diode, and IC. Keep all leads short. Inspect the completed board for cleanliness, shorts, and solder splashes.

Operation

Continuous-/Discontinuous-Conduction Modes

The input voltage, output voltage, load current, and inductor value determine whether the IC operates in continuous or discontinuous mode. Operating in continuous mode maximizes available output power. As the inductor value or load current decreases, or the input voltage increases, the EV kit tends to operate in discontinuous mode. Refer to the MAX736/MAX737/MAX739/MAX759 data sheet for more detailed information.

Bootstrapped/Non-Bootstrapped Modes

The voltage at DRV- determines the amount of gate drive applied to the internal power MOSFET. The more negative the voltage at DRV-, the higher the gate drive, which translates into more available output power. A jumper is provided so the DRV- pin can be connected to GND (J3) or V_{OUT} (J1) when using the MAX739/MAX759, and GND (J3) or an intermediate voltage of -5.6V (J2) set by the 1N4690 zener diode for the MAX736/MAX737/MAX759. Refer to the MAX736/MAX737/MAX739/MAX759 data sheet for additional information. **Do not exceed the maximum input/output differential voltage as stated in the *Absolute Maximum Ratings*.**

Shutdown Control

A 10kΩ resistor is provided between V+ and $\overline{SHDN}$ to simplify entering and exiting shutdown. For normal operation, $\overline{SHDN}$ (a high-impedance input) is pulled up through the 10kΩ resistor. To enter shutdown mode, $\overline{SHDN}$ must be pulled to GND. **NOTE: In shutdown mode, the actual shutdown current measured will exceed the specified limit due to the current through the 10kΩ resistor.** To measure the true shutdown current, lift one side of the $\overline{SHDN}$ 10kΩ pull-up resistor and tie $\overline{SHDN}$ to GND.

MAX759 Adjustable Output

The EV kit output voltage is set by resistors R3 and R4, which form a voltage divider between the output and the error-amplifier input (CC) pin. The voltage at the junction of R3 and R4 is 0.0V. Since CC is a high-impedance CMOS input, it will not significantly load the voltage divider. To set the output voltage, let R4 be any value between 5kΩ and 15kΩ. R3 is given by the formula:

$$R3 = (-V_{OUT})(R4) / 1.23V$$

WARNING: When adjusting the output voltage, do not exceed the maximum differential input/output voltage stated in the *Absolute Maximum Ratings*.

Testing

Test the assembled EV kit with an adjustable bench power supply as a source. Under no-load conditions, apply power to the EV kit by first setting the bench supply output voltage to 0V and then slowly increasing the bench supply voltage. Be sure V+ falls within the stated power-supply limits.

Before connecting the EV kit to the actual circuit that the EV kit will energize, use a resistive load to verify operation. This minimizes the chance of damaging EV kit components and the circuit to which it will provide power.

The bench supply should have a 1A to 3A capability and its current limiting should be set to prevent interaction with the EV kit's peak currents.

Trouble-Shooting

The following chart is a trouble-shooting guide for a malfunctioning board.

Output voltage negative and not regulated	1. Load current is too high 2. Output filter capactitor inserted backwards
Output voltage positive and not regulated	1. 1N5818 Schottky diode inserted backwards
No output voltage	1. DRV- pin floating. Tie DRV- to GND, V_{OUT} or an intermediate voltage. 2. V+ less than 4V. 3. V+ supply filter capacitor not connected.

MAX739 Evaluation Kit

Available Terminals

Terminal Name	Function
V+	Positive Supply Voltage Input. Do not exceed the maximum allowable input/output differential voltage specified in the *Absolute Maximum Ratings*.
V_{OUT}	Negative Output Voltage
GND	Ground
$\overline{SHDN}$	Shutdown Control pulled up to V+ for normal operation. Tie to GND for shutdown. See *Shutdown Control* section.

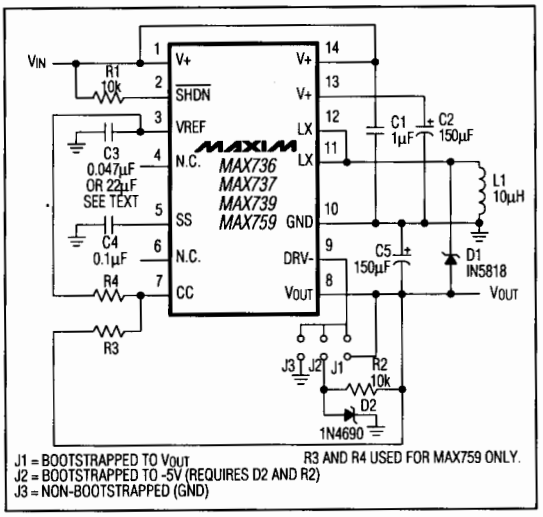


Figure 1. EV Kit Schematic Diagram

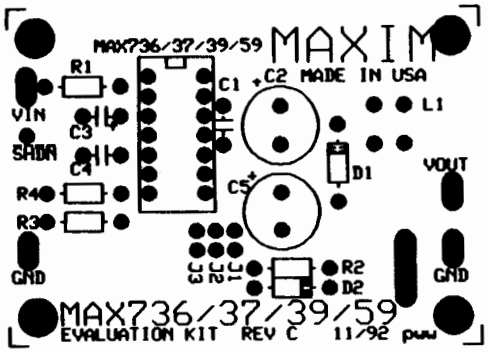


Figure 2. DIP Component Placement (1x Scale)

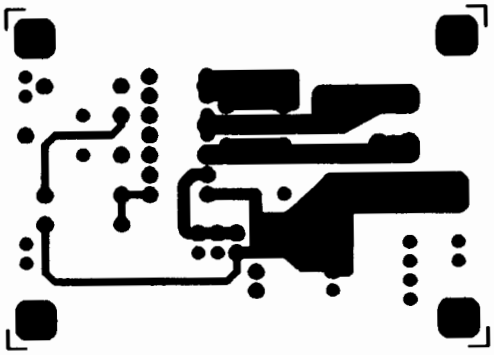


Figure 3. DIP PC Layout, Solder Side (Viewed from Component Side, 1x Scale)

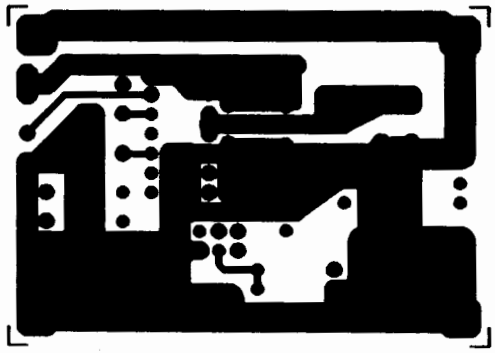


Figure 4. DIP PC Layout, Component Side (1x Scale)