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MAX16839 Evaluation Kit

Evaluates: MAX16839

General Description

The MAX16839 evaluation kit (EV kit) demonstrates three separate high-voltage, single-channel, linear high-brightness LED (HB LED) drivers using the MAX16839 IC. This EV kit is configured to supply an HB LED current of 100mA per channel and operates from a 5V to 40V rated power supply providing up to 300mA. The EV kit can withstand a 45V automotive load-dump condition. An input switch is included to evaluate pulse-width-modulation (PWM) driving with supply chopping.

The EV kit eases evaluation of the MAX16839 PWM dimming-control feature by providing three independent PWM inputs to all three channels. Each PWM input accepts a digital signal up to 10kHz. Additionally, multiple EV kits can be cascaded by using the MAX16839 FLTS signals. An input common-mode choke is also provided to facilitate EMI immunity testing.

Features

♦ **Three Independent Channels for Driving High-Brightness LEDs**

♦ **100mA LED Current per Channel**

♦ **Three Independent PWM Inputs**

♦ **PWM Dimming Control Up to 10kHz**

♦ **Operates from a 5V to 40V Supply**

♦ **Supply Input Chopper Circuit**

♦ **Capability for Cascading Multiple Kits**

♦ **Proven PCB and Thermal Design**

♦ **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX16839EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	1µF ±10%, 50V X7R ceramic capacitor (0805) Murata GRM21BR71H105K
C2, C3, C4	3	0.022µF ±10%, 50V X7R ceramic capacitors (0805) Murata GRM216R71H223K
C5, C6, C7	3	0.1µF ±10%, 50V X7R ceramic capacitors (0805) Murata GCM21BR71H104K
D1	1	60V, 1A Schottky diode (SMA) Central Semi CMSH1-60M LEAD FREE (Top Mark: CS60M)
D2	1	15V ± 5%, 250mW zener diode (SOD523) Central Semi CMOZ15V LEAD FREE (Top Mark: H0)
JU1, JU2, JU3	3	3-pin headers
JU4–JU11	8	2-pin headers
L1	1	80V, 500mA common-mode choke TDK ZJYS81R5-2P24-G01

DESIGNATION	QTY	DESCRIPTION
P1	1	60V 1.25A p-channel MOSFET (SOT23) Fairchild FDN5618P (Top Mark: 618)
Q1	1	65V 100mA npn transistor (SOT23) Central Semi BC846A TR (Top Mark: 1A) or Fairchild BC846AMTF (Top Mark: 8AA)
R1, R3, R5	3	4.12Ω ±1% resistors (0603)
R2, R4, R6	3	2.05Ω ±1% resistors (0603)
R7, R9, R10	3	10kΩ ±5% resistors (1206)
R8	1	2.2kΩ ±5% resistor (2010)
U1, U2, U3	3	Programmable LED current regulators (6 TDFN-EP*) Maxim MAX16839ATT+ (Pkg. Code: T633+2)
—	11	Shunts (JU1–JU11)
—	1	PCB: MAX16839 EVALUATION KIT+

*EP = Exposed pad.

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Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: *Indicate that you are using the MAX16839 when contacting these component suppliers.*

Quick Start

Required Equipment

- 5V to 40V, 500mA adjustable DC power supply
- Three series-connected HB LED strings rated no less than 100mA and a maximum forward voltage of 39V
- See the *LED Load Configuration* section for more information

Procedure

The MAX16839 EV kit is fully assembled and tested. Follow these steps to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

1) Verify that shunts are installed on pins 1-2 of jumpers JU1, JU2, and JU3 (100mA operation).

2) Verify that shunts are not installed on jumpers JU4–JU10 (independent operation).

3) Verify that a shunt is installed on jumper JU11 (bypass chopper circuit).

4) Set the power-supply output to 12V and disable the output. If the total forward voltage of the HB LED string is > 6.5V, ensure that the input supply rises in less than 14µs, or connect the FLTS output to ground to disable the turn-off in case of fault feature. The IC can otherwise latch in fault condition at startup.

5) Connect the power-supply ground to the PGND PCB pad.

6) Connect the power-supply positive output to the VIN PCB pad.

7) Connect each HB LED string as follows:

    Channel 1: Connect an HB LED string anode to the LED1+ PCB pad and the cathode to the LED1- PCB pad.

    Channel 2: Connect an HB LED string anode to the LED2+ PCB pad and the cathode to the LED2- PCB pad.

    Channel 3: Connect an HB LED string anode to the LED3+ PCB pad and the cathode to the LED3- PCB pad.

8) Enable the power-supply output.

9) Verify that the attached LEDs are illuminated.

Detailed Description of Hardware

The MAX16839 EV kit demonstrates three separate high-voltage, single-channel, linear HB LED drivers. Each linear current driver circuit uses a MAX16839 IC in a 6-pin TDFN surface-mount package with an exposed pad for enhanced thermal dissipation. On the EV kit, each driver circuit is configured to supply an HB LED current of 100mA per channel at 5% current accuracy. The MAX16839 ICs control the HB LED current by maintaining a 203mV (typ) drop across each channel's external sense resistors (R1 or R2 for channel 1, R3 or R4 for channel 2, and R5 or R6 for channel 3). Additionally, each channel can be reconfigured to provide down to 50mA of current.

The EV kit operates from a 5V to 40V rated power supply providing up to 300mA and the EV kit can withstand a 45V load-dump condition. The input supply is filtered by common-mode choke L1 and capacitor C1, while battery-reverse protection is provided by diode D1. The input supply chopper circuit is comprised of p-channel MOSFET P1, biasing resistor/diode pair R7/D2, and switching transistor Q1. See the *Chopper-Circuit Operation* section for more information on using the chopper circuit.

The MAX16839 PWM dimming-control feature can be evaluated with an independent PWM input on each of the three channels. Each PWM input accepts a digital signal up to 10kHz at the DIM1, DIM2, or DIM3 and GND PCB pads. Additionally, each PWM input functions as an active-high enable for the corresponding channel. Multiple EV kits can be cascaded using the FLTS1, FLTS2, FLTS3, and GND PCB pads and configuring the proper jumpers. Jumpers JU8, JU9, and JU10 disable the MAX16839 fault-detection features.

Each MAX16839 IC features an exposed pad that uses the top-layer and bottom-layer PCB copper as a heat-sink. For a single-layer design, the top-layer copper would only be required from a thermal-design perspective. The EV kit PCB uses 2oz copper for optimum thermal dissipation.

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LED Load Configuration

The EV kit can drive three separate HB LED loads. Each load can consist of multiple HB LEDs in series with a total forward voltage up to 39V. If the HB LED forward voltage is > 6.5V, the input voltage must rise within 14µs to avoid a fault, or the fault feature must be disabled by connecting the FLTS output to ground. The EV kit circuit drives HB LEDs rated for a minimum of 100mA and can be reconfigured to drive up to 50mA. Proper heat-sinking of the LEDs is important for optimum LED performance and durability.

HB LED Current Settings

The EV kit features jumpers to reconfigure each MAX16839 linear current-sink circuit on each channel. When inserted on pins 1-2, jumpers JU1, JU2, and JU3 configure the current sink's limit to 100mA, respectively. Installing the jumpers on pins 2-3 configures the current sink's limit to 50mA. See Table 1 for channel 1, Table 2 for channel 2, and Table 3 for channel 3 jumper settings.

To reconfigure the circuit for another current limit, replace resistor R2, R4, or R6 for channels 1, 2, and 3, respectively, and use the following equation to calculate a new value for the desired current:

$$R_{SENSE} = \frac{203mV}{I_{LED\_}}$$

where $I_{LED\_}$ is the desired HB LED current in amps ((I_{LED1}, I_{LED2}, and I_{LED3}) and R_{SENSE} is the new R2, R4, or R6 resistor value in ohms for obtaining the desired HB LED current. Install the respective jumper (JU1, JU2, or JU3) on pins 1-2 when configuring the channel for another current.

If designing for a higher LED current, verify that the desired current setting does not exceed the power rating of the corresponding resistor (R1–R6) or the LED load. Do not set the LED current above 100mA.

Faults (FLTS1, FLTS2, FLTS3) and Open HB LED Detection

The EV kit features PCB pads for accessing the fault signal (FLTS_) at each IC (U1, U2, and U3). Storage capacitors C5, C6, and C7 are provided at each IC's FLTS pin, respectively, for fault retention/memorization. When the voltage across the capacitor exceeds 1.65V during a fault event, the respective HB LED driver turns off, unless this feature is disabled by connecting the FLTS output of the respective IC to ground. Jumpers JU6 and JU7 are provided to connect all FLTS signals together, which shuts down all channels if a fault is detected at one of them. See Table 4 for configuring the FLTS jumpers. Refer to the *Open-LED Detection and Fault Event Status Memory* section in the MAX16839 IC data sheet for further information on the FLTS signal.

The MAX16839 integrated open HB LED detection feature is enabled when VIN > 7.38V (typ) and the voltage at the DIM pin is high and the IC thermal shutdown is low. When any of these conditions are violated, the fault-detection function is disabled.

Dimming Operation

The EV kit features three independent PWM PCB pads and jumpers for accessing/configuring the current-dimming input (DIM) signal at each IC (U1, U2, and U3). Jumpers JU4 and JU5 are provided to connect all the DIM signals together or to operate independently. Each channel can have a different dimming-signal pattern.

Table 1. Channel 1 HB LED Current (JU1)

SHUNT POSITION	CS PIN	HB LED CURRENT (mA)
1-2*	Connected to R2	100
2-3	Connected to R1	50

*Default position.

Table 2. Channel 2 HB LED Current (JU2)

SHUNT POSITION	CS PIN	HB LED CURRENT (mA)
1-2*	Connected to R4	100
2-3	Connected to R3	50

*Default position.

Table 3. Channel 3 HB LED Current (JU3)

SHUNT POSITION	CS PIN	HB LED CURRENT (mA)
1-2*	Connected to R6	100
2-3	Connected to R5	50

*Default position.

Table 4. Fault FLTS1, FLTS2, FLTS3 (JU6, JU7)

SHUNT POSITION	U1, U2, AND U3 FLTS PINS	FAULT OPERATION
Installed	Connected together	Simultaneous
Not installed*	Independent	Independent

*Default position.

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Use a digital PWM signal with a 5V logic level and a switching frequency between 100Hz and 10kHz. Frequencies lower than 100Hz can introduce flickering in the light output. Vary the duty cycle of the signal to adjust the LED brightness. LED brightness increases as the duty cycle increases and vice versa. When the PWM signal's duty cycle is 100%, the LEDs are continuously on. At 0% duty cycle, the outputs are disabled.

See Table 5 for configuring the DIM_ jumpers. Refer to the *PWM Dimming* section in the MAX16839 IC data sheet for further information on the DIM signal.

Additional Configurations and Features

The EV kit includes several other features to facilitate evaluating the MAX16839 IC. A power-supply chopper-circuit feature, and the ability to cascade multiple kits for operation, are detailed in the following sections.

Chopper-Circuit Operation

The EV kit features a power-supply chopper circuit for the VIN input supply. The input supply chopper circuit is comprised of p-channel MOSFET P1, biasing resistor/diode pair R7/D2, and switching transistor Q1. When installed, jumper JU11 is provided to bypass the chopper circuit.

To use the chopper circuit, connect a function generator with a digital signal to the CHOP and GND PCB pads. Use a 3V to 5V low-frequency pulse-width-modulated (PWM) signal to switch the chopper circuit on/off.

Cascading Multiple Kits

The EV kit features PCB pads and jumpers for cascading multiple kits. To cascade another EV kit, use the following guidelines:

1) Install all DIM_ shunts on jumpers JU4 and JU5.

2) Install all FLTS_ shunts on jumpers JU6 and JU7.

3) Connect the DIM3 PCB pad on kit #1 to the DIM1 PCB pad on kit #2.

4) Connect the FLTS3 pad on kit #1 to the FLTS1 pad on kit #2.

5) Connect the GND PCB pad nearest DIM3 on kit #1 to the GND PCB pad nearest the DIM3 pad on kit #2.

6) Connect a common power supply to both kits' VIN and PGND PCB pads.

Table 5. DIM1, DIM2, DIM3 (JU4, JU5)

| SHUNT POSITION	U1, U2, AND U3 DIM PINS	DIM OPERATION
Installed	Connected together	Synchronous
Not installed*	Independent	Independent

*Default position.

Table 6. Chopper-Circuit Operation (JU11)

SHUNT POSITION	MOSFET P1/ BIASING RESISTOR R8	CHOPPER-CIRCUIT OPERATION
Installed	Connected to ground	Bypassed
Not installed*	Connected to Q1	Running

*Default position.

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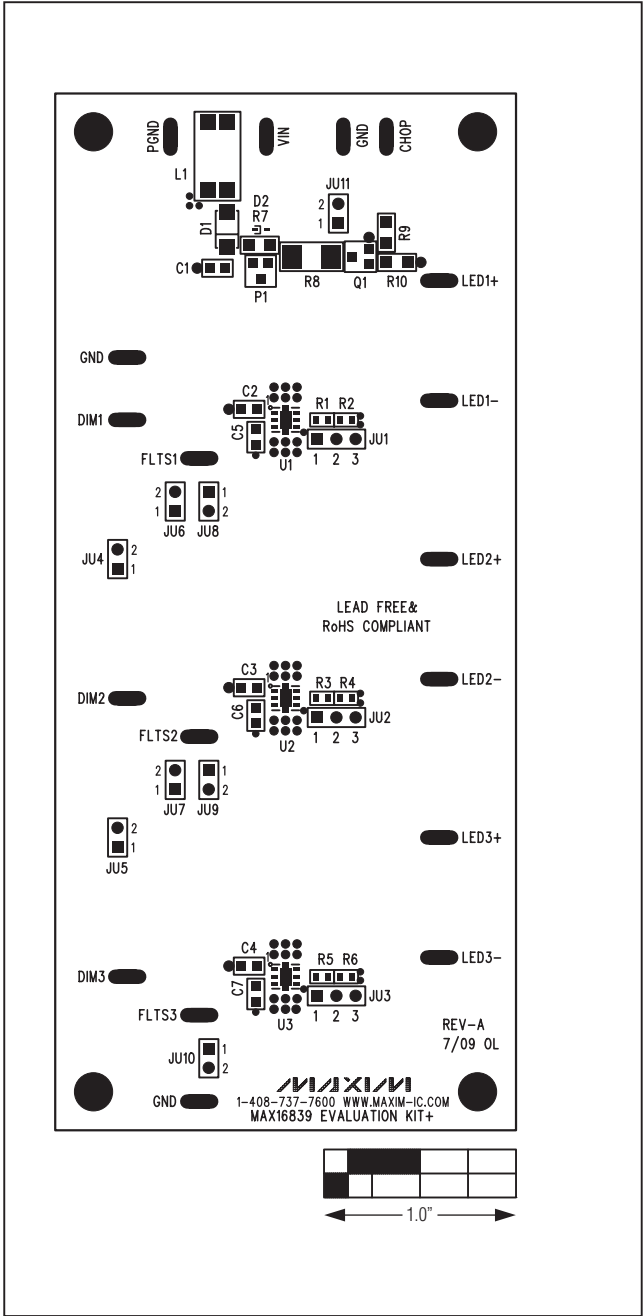Figure 1. MAX16839 EV Kit Schematic
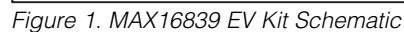
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Figure 2. MAX16839 EV Kit Component Placement Guide—
Component Side
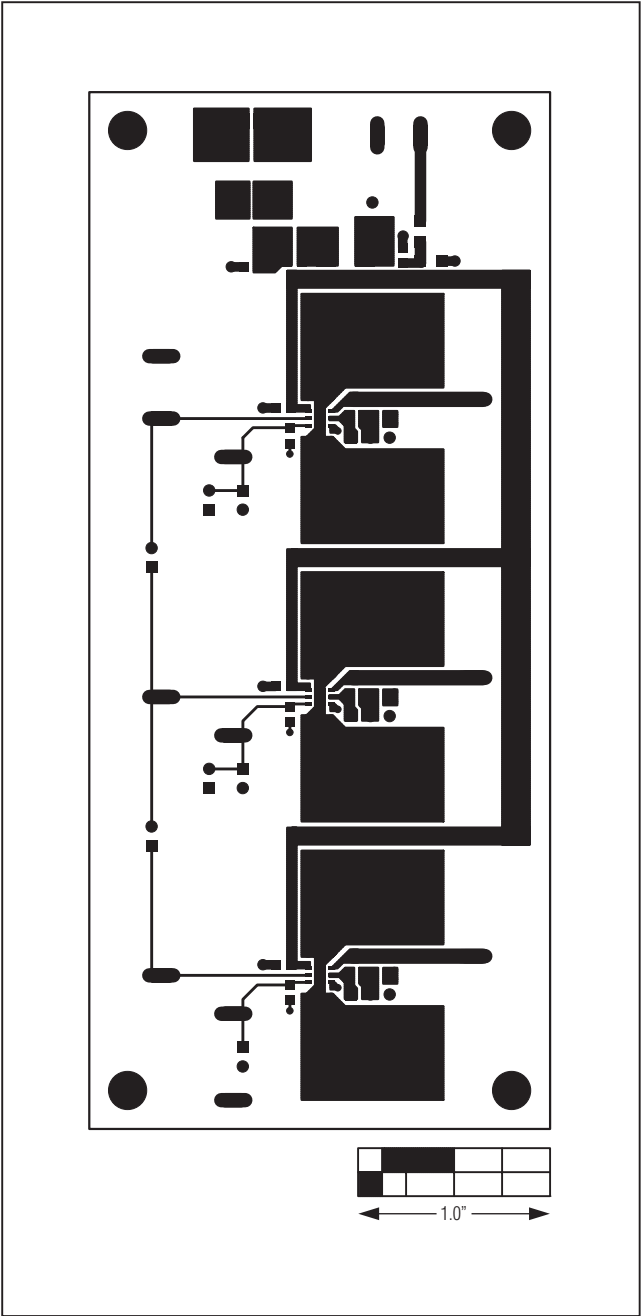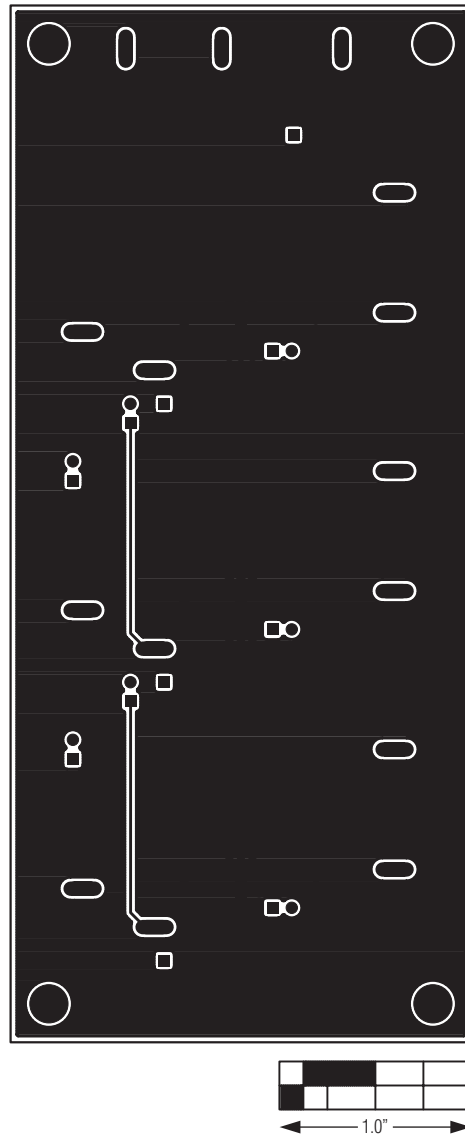

Figure 3. MAX16839 EV Kit PCB Layout—Component Side

Figure 4. MAX16839 EV Kit PCB Layout—Solder Side

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REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/09	Initial release	—
1	5/10	Updated data sheet based on new revision of the IC	2, 3

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