EVAL-LT8419-AZ

100V Half-Bridge GaN Driver with Single-Pin, Three-State PWM Input, Smart Integrated Bootstrap Switch, and Adjustable Dead Time

General Description

The EVAL-LT8419-AZ evaluation board features the LT8419 driving two 100V enhanced gallium nitride (eGaN) devices in a half-bridge configuration. The circuit is optimized as a buck converter with 48V_{HV} to 24/12V_{LV} at a 1MHz switching frequency, but it can be used as a boost converter or other converter topologies consisting of a half-bridge.

An external PWM signal is required to drive the board. The LT8419 driver has powerful 0.2Ω pull-down and 0.6Ω pull-up drivers to control the gates of the two 100V GaN devices. It also integrates a smart integrated bootstrap switch to generate a balanced bootstrap voltage from V_{CC} with a minimum dropout voltage. The LT8419 provides split gate drivers to adjust the turn-on and turn-off slew rates of the GaN devices to suppress ringing and optimize EMI performance.

Design files for this circuit board are available.

Performance Summary (T_A = +25ºC)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
High-Side Voltage[1]	V_{HV}					80	V
Low-Side Voltage[1]	V_{LV}					80	V
Maximum Load Current[2]		V_{HV} = 48V, V_{LV} = 24V, 1MHz				10	A
Auxiliary Supply Voltage	V_{AUX}			5.5		80	V
Gate Drive Supply Voltage	V_{CC}				5		V
Switching Frequency[3]					1		MHz
Dead Time	DT	P9 header in GND position			2		ns
		P9 header in V_{CC} position			6		ns
		P9 header unconnected			10.5		ns
Efficiency	η	V_{HV} = 48V, I_{LOAD} = 10A, forced airflow	V_{LV} = 24V, 500kHz		98.6		%
			V_{LV} = 24V, 1MHz		98.4		%
			V_{LV} = 12V, 500kHz		97.6		%
			V_{LV} = 12V, 1MHz		97.0		%

[1]The maximum allowable high-side and low-side voltages depend on the inductive loading. Switch-node ringing must be limited to below 100V to ensure safe operation of the EPC2619.

[2]Maximum load current depends on the EPC2619 GaN device temperature, affected by switching frequency, high-side voltage, low-side voltage, and thermal management. Make sure to monitor the die temperature when setting the load current.

[3]At high-switching frequencies, switching losses become dominant. To prevent overheating of the GaN devices, reduce the high-side and low-side voltages, as well as the load current.

Quick Start Procedure

The EVAL-LT8419-AZ evaluation board is a power stage used to evaluate the performance of the LT8419. See *Figure 1* for proper measurement equipment setup and use the following procedure:

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1. With power off, connect the power supply to the board through the V_{HV} and GND terminals. Connect the load to the V_{LV} and GND terminals. Connect the function generator output to the (+) and (-) pins of PWM INPUT, P1 header.
2. Ensure the headers are connected as follows:
   a. Place P5 (VAUX SELECT) in the VHV position.
   b. Place P6 (EN SELECT) in the VCC position.
   c. Place P8 (VCC SELECT) in the LDO position.
   d. Place P9 (DT SELECT) in the VCC position.
3. Set the function generator to output a 5V, 1MHz, 50% duty cycle, high-impedance output pulse waveform.
4. Turn on the power supply at 0V, 7A limit. Increase the voltage slowly to 48V.
5. Verify that the low-side voltage is 24V (±5%).
6. Once the desired low-side voltage is established, adjust the high-side voltage and load current within the operating range, and observe the gate signals, switch-node voltage, voltage ripple, efficiency, and other parameters.
7. When testing finishes, turn off the equipment in the following order: electronic load, power supply, and function generator.

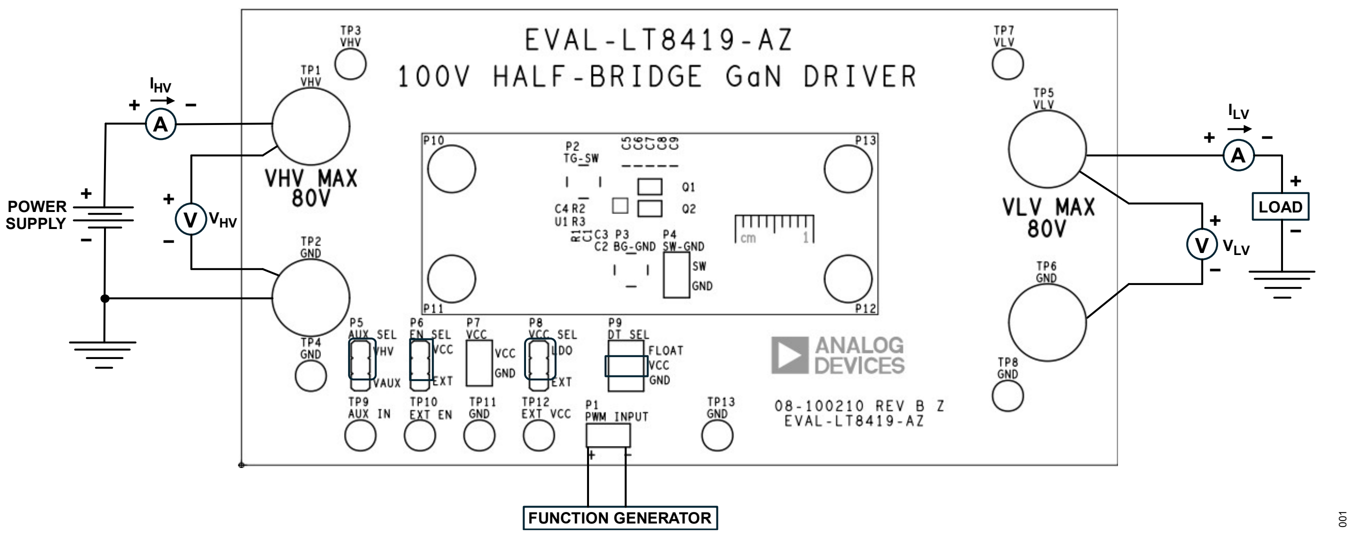


Figure 1. EVAL-LT8419-AZ Board Connections

Output Voltage and Power

The EVAL-LT8419-AZ can be configured as either a buck or a boost converter, or other converter topologies consisting of a half-bridge with maximum input and output voltages of 80V. At full load with forced airflow, the board can deliver 240W, but the top GaN heats up significantly. Therefore, a heat sink is recommended if this operating condition is expected over an extended period. See the *Thermal Considerations* section for more details on using a heat sink.

The conversion ratio can be adjusted by changing the duty cycle of the PWM input signal(s), while the switching frequency is set by the PWM input signal frequency. To optimize the converter efficiency at a different power specification, appropriately resize passive power component inductors and input/output capacitors. The dead times must also be adjusted to minimize the loss during the dead time. [Figure 3](#) and [Figure 4](#) show the converter efficiency versus the load current at different operating conditions.

LDO Setting

An LDO (U2) supplies power to the LT8419. The output voltage of this LDO is set to 5V in the default configuration, but it can be adjusted by changing the R4 and R5 values. The input power of U2 comes from either a default auxiliary power supply, AUX INPUT, ranging from 5.5V to 80V, or directly from the board's VHV power supply, which can be selected by changing the position of jumper P5.

EN Select

The enable (EN) signal for the LT8419 circuit on the EVAL-LT8419-AZ can be sourced either from V_{CC} or from an external signal. This is configured by adjusting the jumper position on the P6 header. To use an external enable signal, set the P6 jumper to the EXT position and apply the external signal to the EXT EN (TP10).

DT Select and Control Mode

The EVAL-LT8419-AZ is an open-loop half-bridge converter without a feedback network or control loop. Therefore, the board requires an external PWM signal to drive the LT8419 PWM pin.

The EVAL-LT8419-AZ also provides an option to configure the LT8419 dead-time through header P9. Leaving the P9 jumper unconnected selects a 10.5ns dead time, connecting it to VCC selects a 6ns dead time, and connecting it to GND selects a 2ns dead time.

For header P1 (PWM INPUT), connect the positive terminal to the pin labeled (+), and connect the negative terminal to the pin labeled (-).

Ripple Voltage Measurement

When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See *Figure 2* for the recommended measurement technique. Solder short, stiff leads to the (+) and (-) terminals of an output or input capacitor. The probe's ground ring needs to touch the (-) lead, and the probe tip needs to touch the (+) lead.

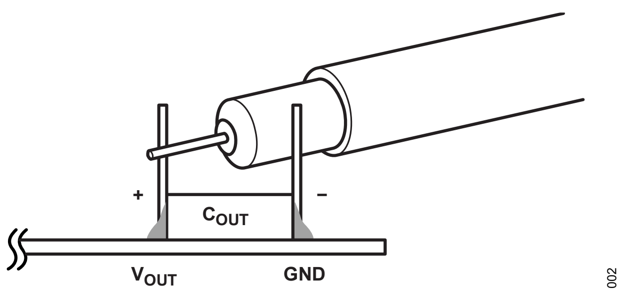


Figure 2. Measuring Ripple Voltage

Thermal Considerations

At high-switching frequencies and high-output power, take care to prevent overheating on the GaN devices. For better thermal management, the EVAL-LT8419-AZ is equipped with four mechanical spacers that can be used to attach a heat sink (567-45AB) to the top layer. Since all the high-profile components are placed on the bottom layer, the heat sink is easily placed on the top layer against the surface of GaN devices and the LT8419. Insert a thermal pad under the heat sink to ensure good contact to improve thermal dissipation.

Measurement Considerations

A high-speed differential probe, such as the Firefly or IsoVu, is recommended for measuring the high-side and low-side gate voltages at headers P2 and P3. Its low parasitic elements make it suitable for measuring high-frequency waveforms. Low parasitic capacitance passive probes with ground springs are recommended for measuring voltage at other nodes.

Performance

(V_{HV} = 48V, T_A = +25°C, unless otherwise noted.)

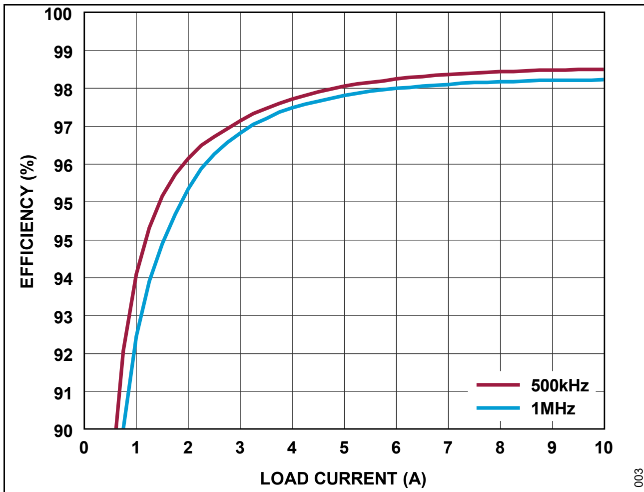


Figure 3. Efficiency vs. Load Current at 24V_{LV} (Forced Airflow)

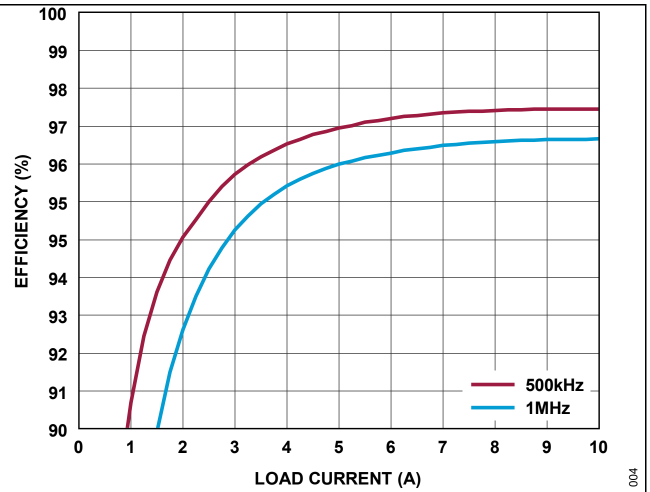


Figure 4. Efficiency vs. Load Current at 12V_{LV} (Forced Airflow)

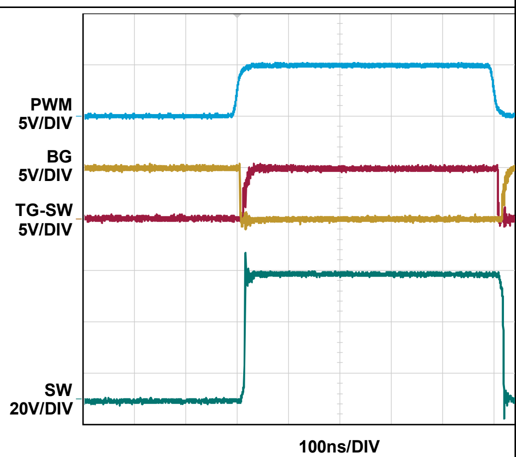


Figure 5. Steady-State Waveform at 24 V_{LV}, 0A Load, 1MHz

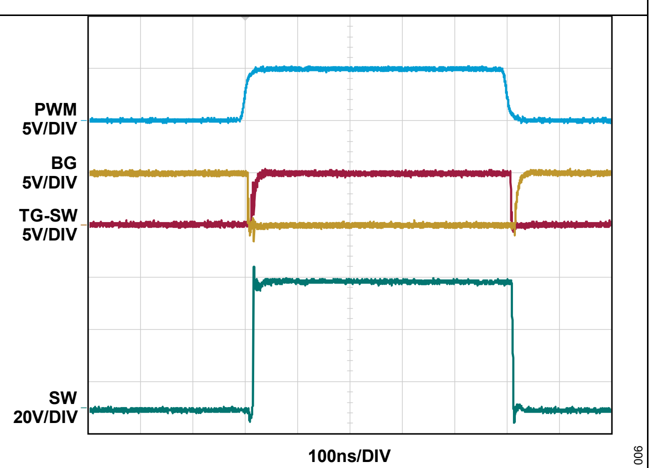


Figure 6. Steady-State Waveform at 24 V_{LV}, 10A Load, 1MHz

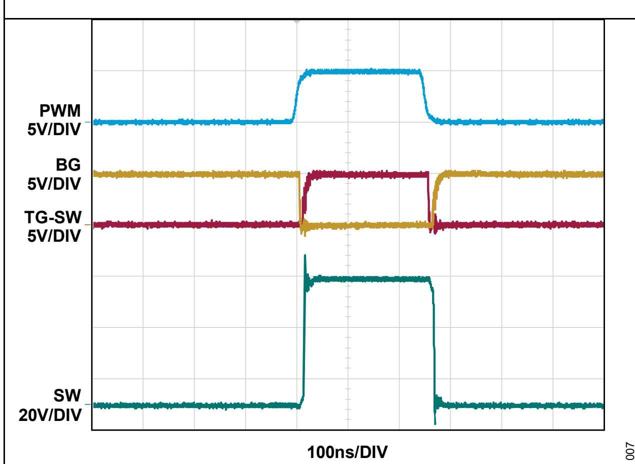


Figure 7. Steady-State Waveform at 12V_{LV}, 0A Load, 1MHz

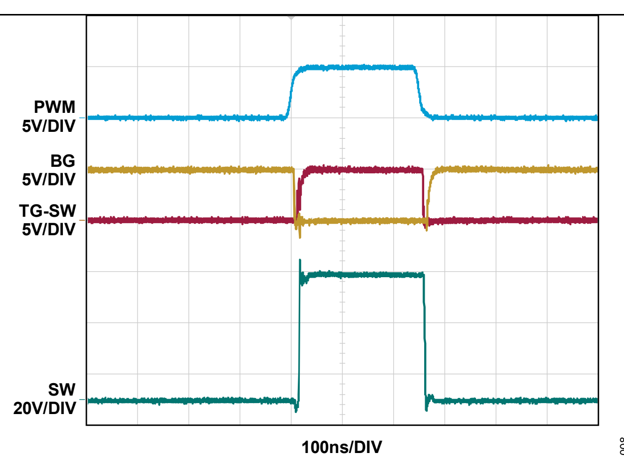


Figure 8. Steady-State Waveform at 12V_{LV}, 10A Load, 1MHz

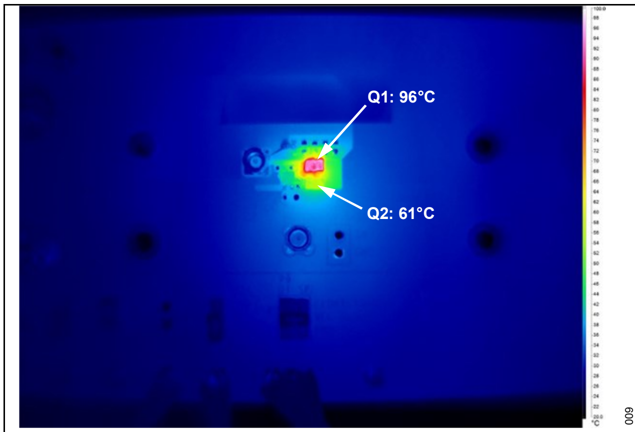


Figure 9. Thermal Image, 24V_{LV}, 10A Load, 1MHz, Top

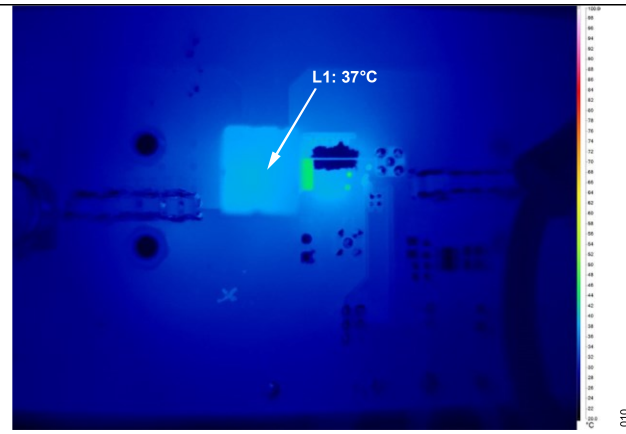


Figure 10. Thermal Image, 24V_{LV}, 10A Load, 1MHz, Bottom

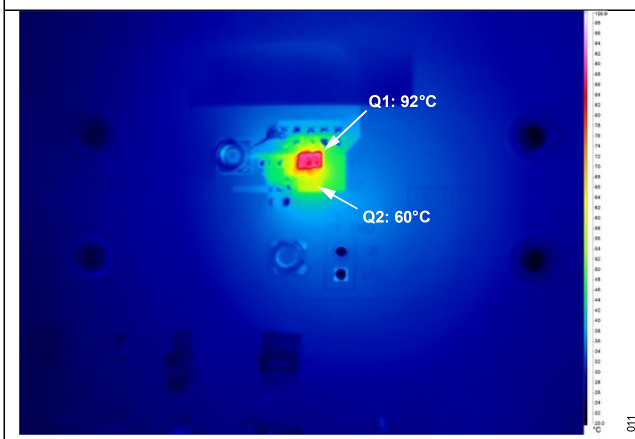


Figure 11. Thermal Image, 12V_{LV}, 10A Load, 1MHz, Top

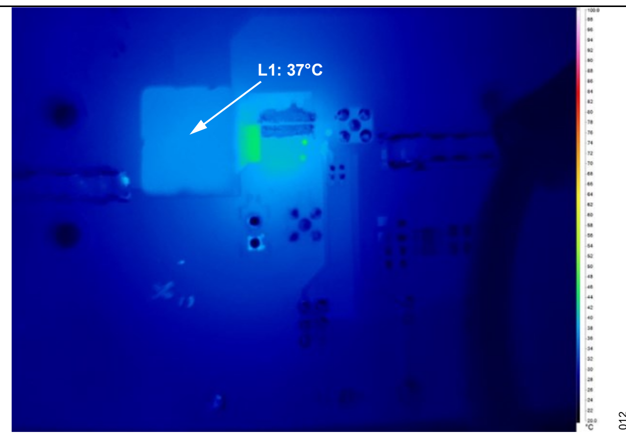
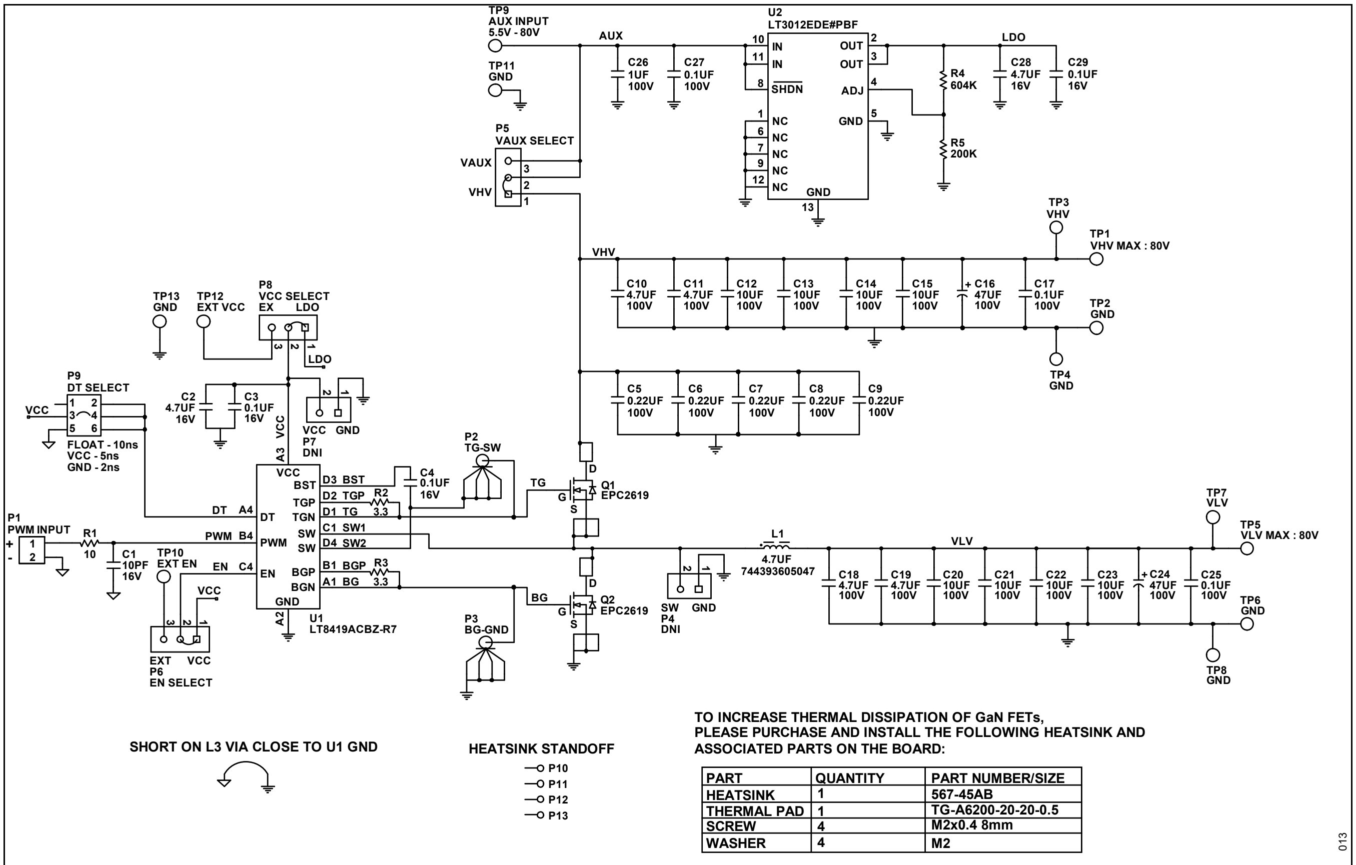


Figure 12. Thermal Image, 12V_{LV}, 10A Load, 1MHz, Bottom

Schematic



PART	QUANTITY	PART NUMBER/SIZE
HEATSINK	1	567-45AB
THERMAL PAD	1	TG-A6200-20-20-0.5
SCREW	4	M2x0.4 8mm
WASHER	4	M2

Figure 13. EVAL-LT8419-AZ Schematic

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/26	Initial release	—

Notes