

APPLICATION NOTE

Using Gate Driver Transformers for Effective Isolated Power in Switching Devices



Bourns® Model HVMA03F4A-LP8S
Transformer

Introduction

Gate driver transformers are excellent choices to provide necessary isolated power to gate drivers of switching devices such as SiC MOSFETs and IGBTs. Common applications that require this capability include switched-mode power supplies, motor drives, renewable energy, and automotive traction inverters. This application note describes how to implement the Bourns® Model HVMA03F4A-LP8S transformer for isolated power in these types of applications.

Generally, IGBT/SiC gate drivers require a gate voltage in the range of 15 V to 20 V and 0 V to -5 V for reliable turn-off. The advantages of negative gate voltage are that it increases noise immunity, enables faster extraction of charge from the gate, and helps to avoid false turn-on in a half bridge configuration. As a general rule, a gate driver transformer capable of delivering 2 W or more is required to handle modern switching devices. Presented in this application note are the Bourns tests to determine the power handling capability of the Bourns® Model HVMA03F4A-LP8S transformer while providing suitably regulated voltage levels.

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Test Setup

For this test, the Model HVMA03F4A-LP8S transformer is driven by a Texas Instruments IC (TI UCC25800), which is a low-EMI transformer driver for isolated bias power supplies. Since this is an open loop system, the transformer is supplied with a regulated voltage. A dual output of +16 V/-4 V is generated to enable bipolar driving of the switch. For convenience, the TI evaluation board for the UCC25800 IC was used with some modifications to change the operating frequency to 1 MHz, as well as the regulated output voltage levels. A schematic of the circuit used for this application note is shown below.

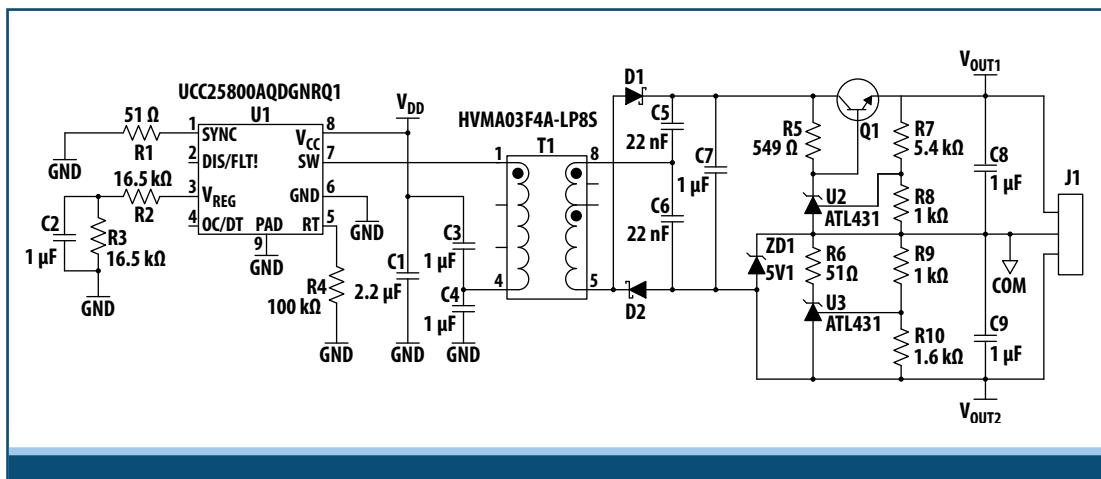


Figure 1. | Schematic of test circuit

Figure 2 shows the actual board used with the mounted Model HVMA03F4A-LP8S transformer. Figure 3 illustrates the setup showing how the transformer delivers 4.4 W into an electronic load.



Figure 2. | Transformer mounted on driver board



Figure 3. | Transformer delivering over 4 W into the electronic load

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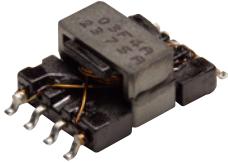
Sample Results

When delivering around 4.4 W, the temperature rise of the transformer surface is approximately 45 °C, per the test setup in Figure 3.

Input Voltage (V)	Input Current (C)	Input Power (W)	Output Voltage V1 (V)	Output Voltage V2 (V)	Output Voltage V1 - V2 (V)	Output Current (A)	Output Power (W)	Temp. Rise (°C)
24	0.037	0.89	15.9	-4.0	19.9	0	0	30.1
24	0.054	1.30	15.9	-4.0	19.9	0.02	0.40	30.3
24	0.073	1.75	15.9	-4.0	19.9	0.04	0.80	30.6
24	0.092	2.21	15.9	-4.0	19.9	0.06	1.20	31.2
24	0.110	2.64	15.9	-4.0	19.9	0.08	1.59	33.4
24	0.130	3.12	15.9	-4.0	19.9	0.10	1.99	34.7
24	0.149	3.58	15.9	-4.0	19.9	0.12	2.39	36.1
24	0.168	4.03	15.9	-4.0	19.9	0.14	2.79	37.4
24	0.188	4.51	15.9	-4.0	19.9	0.16	3.19	39.7
24	0.206	4.94	15.9	-4.0	19.9	0.18	3.59	41.8
24	0.226	5.42	15.9	-4.0	19.9	0.20	3.99	42.4
24	0.244	5.86	15.9	-4.0	19.9	0.22	4.39	45.2

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Conclusion

With its high creepage of greater than 8 mm and very low profile, the automotive grade, AEC-Q200 compliant Bourns® Model HVMA03F4A-LP8S transformer is especially suited to help designers meet automotive application specifications. A significant design benefit is its small size with the capability to deliver more than 4 W of power in an ambient temperature of up to 80 °C. The results of the Bourns tests shown are at an operating frequency of 1 MHz, but similar outcomes may be obtained at lower frequencies, for example in the 700 kHz region.

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