FAD1100 Evaluation Board User's Manual

EVBUM2951/D

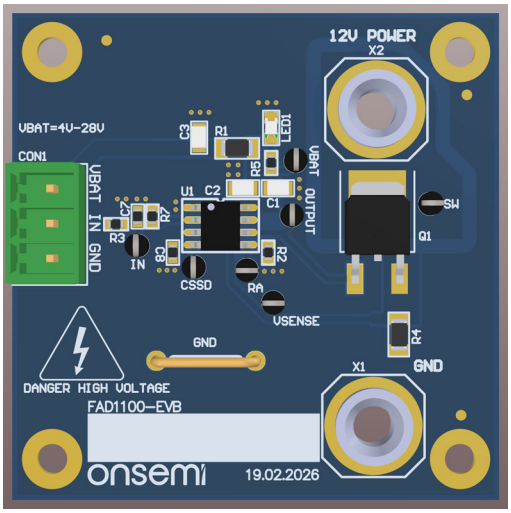

Figure 1. FAD1100EVB Board Picture

Introduction

The FAD1100 Evaluation Board is a compact, ready-to-use platform designed to demonstrate the performance of the FAD1100 automotive ignition driver IC in real ignition-coil applications. The board integrates the FAD1100 driver with an FGD3040G2 400 V / 300 mJ AEC-Q101 qualified ignition IGBT, along with all essential passive and protection components, enabling fast and accurate evaluation of modern coil-on-plug ignition systems.

The FAD1100 incorporates several critical ignition-control functions, including a programmable maximum dwell time, precise current limiting based on the VSENSE threshold (≈185–215 mV), and a robust input spike filter that rejects pulses shorter than 13 µs for reliable operation in harsh automotive electrical environments. Its Soft-Shut-Down (SSD) mechanism gradually reduces the gate drive when the dwell-time limit is exceeded, ensuring spark-free coil discharge even under fault conditions.

The integrated FGD3040G2 ignition IGBT provides 300 mJ inductive switching capability at 25 °C, 400 V breakdown voltage, and reliable conduction characteristics suitable for demanding ignition energy delivery and high-temperature operation. Its low VCE(sat) and fast switching behavior make it ideal for evaluating coil charging, peak-current limiting, and demagnetization dynamics.

To ensure safe evaluation during ignition-level transients, the board features enhanced high-voltage isolation, optimized PCB layout around RA, VSENSE, and CSSD networks, and clearly accessible measurement points. These design elements make the platform an excellent tool for validating dwell-control strategies, energy transfer, protection mechanisms, and SSD-based spark suppression in both bench and system-level automotive environments.

Evaluation Board Features

- 12 V Battery-Level Supply Input
- One Supply Connector for Flexible Powering during Evaluation
- Input Connector for the Trigger (IGT) Signal
- Configurable Current-Limit and Current-Sense Network
- Supports Controlled Soft-Shut-Down (SSD)
- LED Indicator for Presence VBAT Voltage
- Oscilloscope Test Points on Key Signals
- Additional High-Voltage Isolation Spacing Implemented in Accordance with IPC-2221A Guidelines to Ensure Safe Handling of Ignition-level Transients
- Header for Stacking Multiple Boards or Integrating into a Larger Evaluation Setup

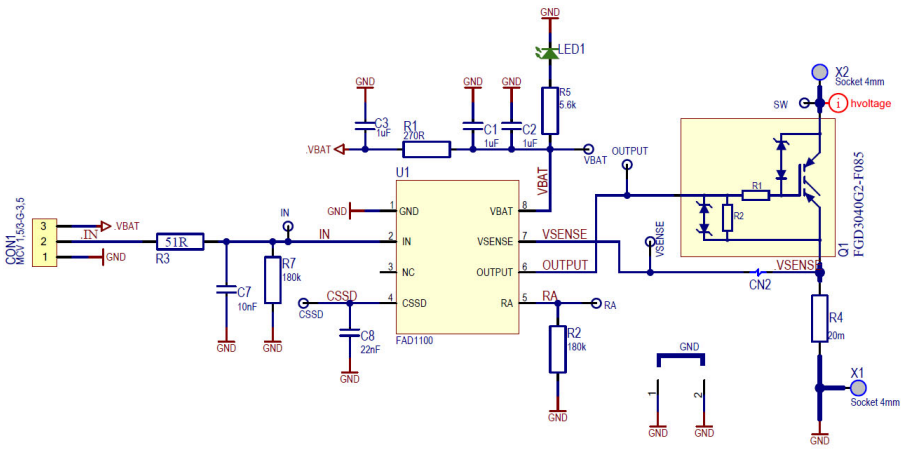

Figure 2. FAD1100 Evaluation Board Schematic

MAXIMUM RATINGS

Rating	External Pin	Min	Max	Unit
VBAT (CON1)	.VBAT	4,5	28	V
IN (CON1)	.IN	−2	18	V
Collector Voltage	X2	−400	400	V
Input Current	X2	0	20	A
VCSSD	VCSSD	−0.3	3.6	V
VOUTPUT	VOUTPUT	−0.3	6.5	V
VSENSE	VSENSE	0	400	mV
FAD1110 junction temperature		−50	+150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

RECOMMENDED OPERATING RANGES

Rating	External Pin	Min	Max	Unit
VBAT (CON1)	.VBAT	6	16	V
IN (CON1)	.IN	0	5	V
Collector Voltage	X2	0	60	V
Input Current	X2	0	pulse operation only	A
VCSSD	VCSSD	−0.3	3.6	V
VOUTPUT	VOUTPUT	−0.3	6.5	V
VSENSE	VSENSE	0	215	mV
FAD1110 junction temperature		−40	+125	°C
PCB temperature		−40	+85	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

FUNCTIONAL DESCRIPTION

The FAD1100 evaluation board provides a compact and complete platform for demonstrating the operation of the FAD1100 ignition driver. It integrates the driver together with an ignition IGBT and the essential application circuitry required to evaluate ignition-coil charging, current-limit behavior, dwell-time management, and the device's diagnostic and protection features. The board allows users to observe the FAD1100's controlled Soft-Shut-Down function, which gradually reduces the IGBT gate drive to discharge an energized ignition coil without producing a spark, ensuring safe behavior during extended dwell or fault conditions. To support reliable operation during ignition-level transient events, the PCB incorporates enhanced high-voltage isolation spacing in accordance with IPC-2221A design guidelines. Overall, the platform enables efficient evaluation of the FAD1100 under realistic automotive ignition conditions while providing safe access to key test points and measurement signals.

Supply Strategy

The power supply architecture is divided into three main paths:

- **VBAT supply (CON1)** – This path provides the primary supply voltage to the FAD1100 device.
  The VBAT pin incorporates internal reverse-battery protection, allowing the evaluation board to withstand accidental reverse-polarity connection during laboratory handling or prototype testing.
- **X2 connector** – This path is connected directly to the primary winding of the ignition coil (or an equivalent inductive load).
  During coil turn-off events, this node can experience overvoltage transients of up to approximately 500 V due to the release of inductive energy. The PCB layout therefore includes extended creepage and clearance distances to safely tolerate these ignition-level voltage spikes.
- **X1 connector** – This path provides the direct connection to the system ground (GND).
  It serves as the common reference point for the power supply and the ignition driver and must be routed with low impedance to ensure stable switching behavior and minimized EMC emissions.

GETTING STARTED

The **CON1** connector serves as the primary supply interface for the ignition driver. The **VBAT** pin must be connected either to an auxiliary DC power source or directly to the high-side end of the ignition transformer's primary winding, depending on the system configuration.

The **IN** pin acts as a pulse-width control input used to trigger the ignition event. The driver reacts to an applied logic-level pulse, where the pulse duration determines the energy delivered into the transformer primary. Typical ignition pulse widths range from **1 ms to 20 ms**, depending on the required arc ignition characteristics.

The **GND** pin provides the common reference potential for both the laboratory DC power supply and the external pulse generator. A low-impedance ground connection is essential to ensure correct switching behavior and to minimize EMC-related issues.

Connector **X2** provides an open-collector (low-side switching) output intended for connecting the low-potential end of the ignition transformer's primary winding. During activation, the driver sinks current through this output to energize the primary winding; when the output is released, the rapid interruption of current generates the high-voltage ignition pulse on the transformer secondary.

The driver can operate with a wide range of inductive loads. The primary load may be **any air-core inductor from 500 µH to 2 mH**, or a **customer-specific ignition plug (ignition transformer)**, provided its parameters fall within the supported inductance range.

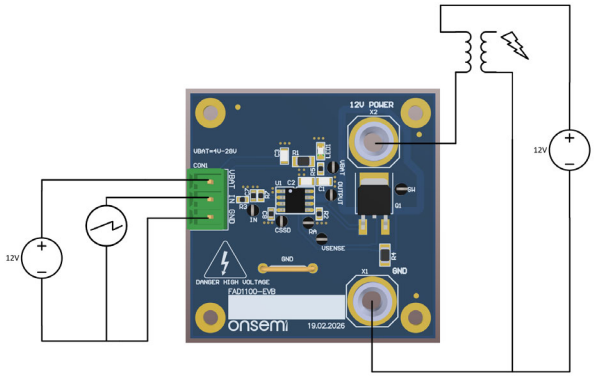

Figure 3. Application Schema for Ignition System

Current Limit

The **FAD1100 driver includes an internal current-limiting mechanism**, which is activated when the voltage on the **Vsense** pin exceeds the specified reference threshold.

The load current is monitored through the **R4 sense resistor**, whose voltage drop is fed into the Vsense input.

As shown in the figure, once the sensed current reaches the limit threshold, the driver begins to regulate the current by **reducing the voltage level at the OUTPUT pin**. This gradual decrease in OUTPUT voltage prevents any further rise in primary-side current. The device therefore operates in a controlled current-limiting mode, ensuring safe operation of the ignition transformer and avoiding overstress of the switching stage.

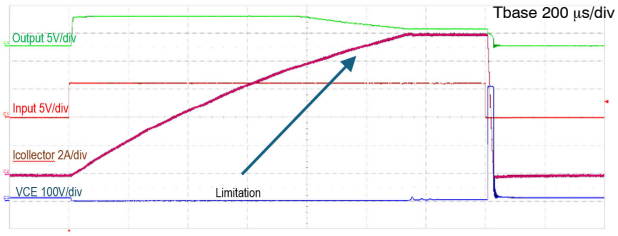

Figure 4. Current Limitation of Induction Load

Maximum Dwell Time and Soft-Shutdown (SSD)

During the Soft-Shutdown (SSD) operation of the ignition driver, the inductive load (coil) is not switched off abruptly. Instead, the current is reduced in a controlled manner, typically by driving the IGBT into the **controlled resistive region** of its collector-emitter characteristic.

This means that:

- the IGBT does not transition immediately into the blocking state,
- but is actively controlled so that its collector-emitter voltage-current characteristic enters a resistive mode,
- where a portion of the energy stored in the inductance is dissipated as heat directly in the IGBT (within the resistive part of its V-A characteristic).

This method effectively prevents:

- a steep di/dt during turn-off,
- excessive voltage overshoots across the coil,
- and the generation of an unintended spark.

As indicated in the figure, this behavior is typically illustrated by a linear decrease of the coil current accompanied by a controlled rise of the collector-emitter voltage (U_{CE}) across the IGBT, while the dissipation occurs inside the device.

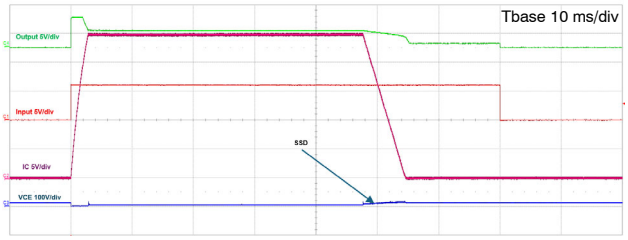

Figure 5. SSD Protection for Switch-off Induction Load

PCB DRAWINGS

Assembly Drawings

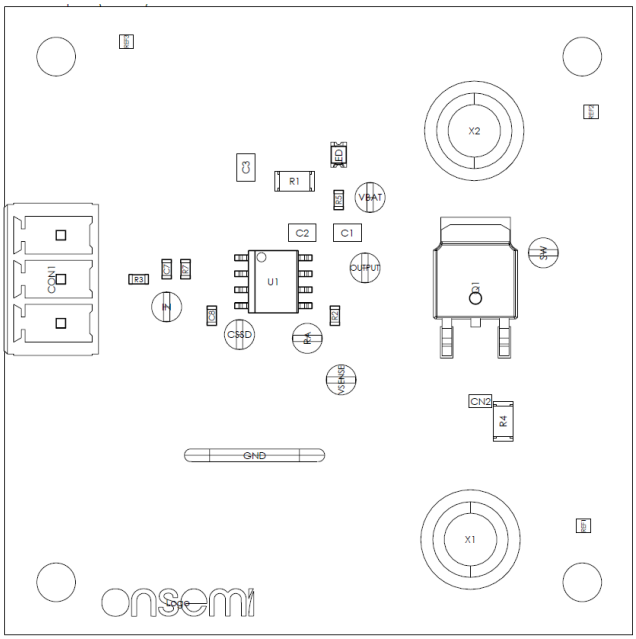

Figure 6. FAD1100EVB PCB Top Assembly Drawing

Composite Drawings

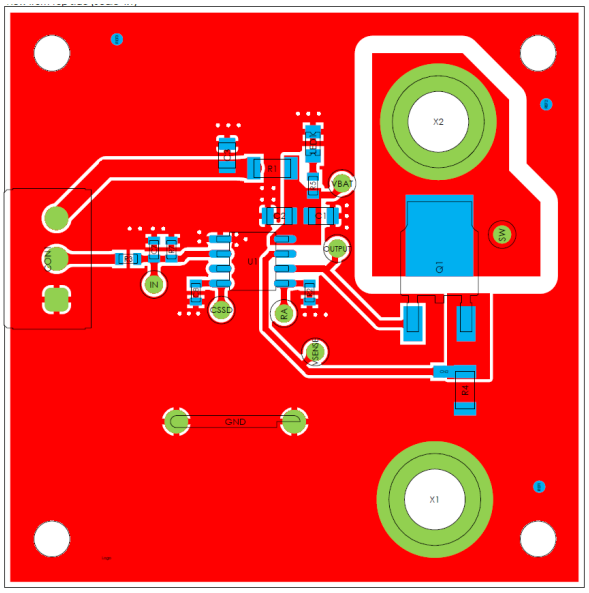

Figure 7. FAD1100EVB PCB Top Composite Drawing

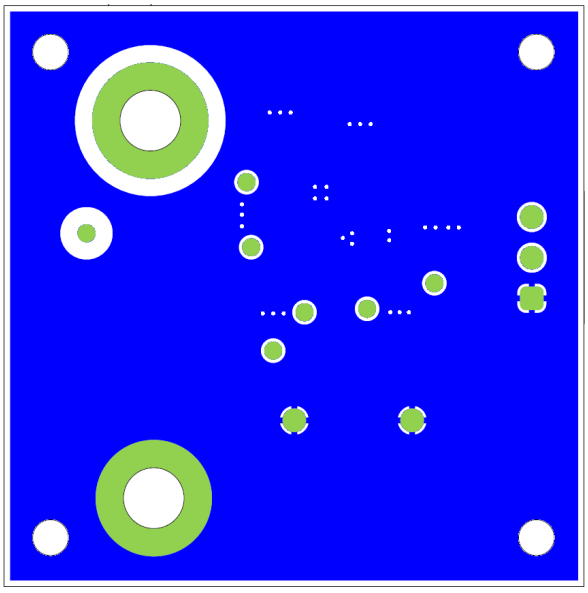

Figure 8. FAD1100EVB PCB Bottom Composite Drawing (bottom view)

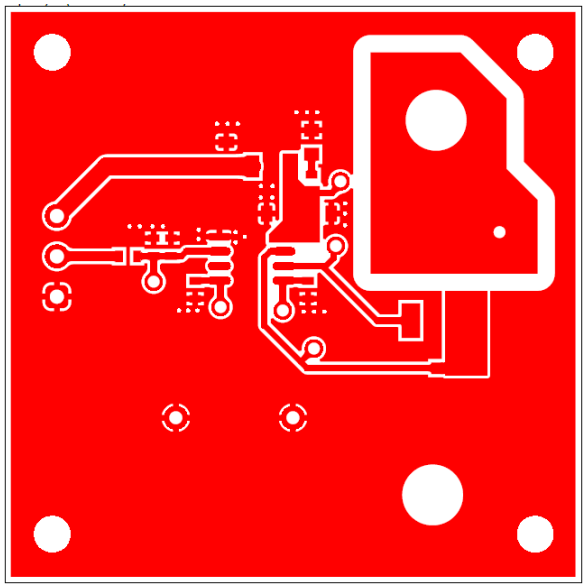

Figure 9. FAD1100EVB PCB Internal Plane 1 Drawing

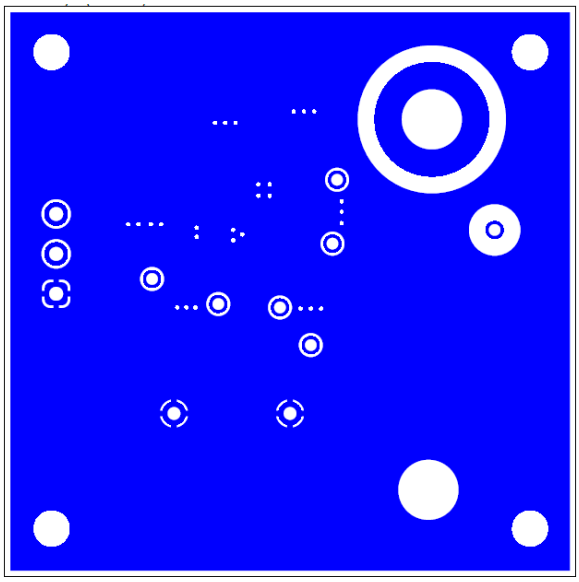

Figure 10. FAD1100EVB PCB Internal Plane 2 Drawing

REVISION HISTORY

Revision	Description of Changes	Date
0	Initial document release.	4/8/2026

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales