

FAD1100 Evaluation Board User's Manual

EVBUM2951/D

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 ($\approx 185\text{--}215\text{ mV}$), and a robust input spike filter that rejects pulses shorter than $13\text{ }\mu\text{s}$ 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 $25\text{ }^{\circ}\text{C}$, 400 V breakdown voltage, and reliable conduction characteristics suitable for demanding ignition energy delivery and high-temperature operation. Its low $V_{CE(sat)}$ 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

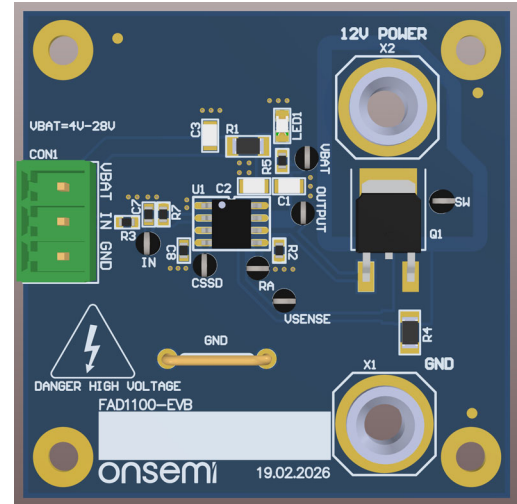


Figure 1. FAD1100EVB Board Picture

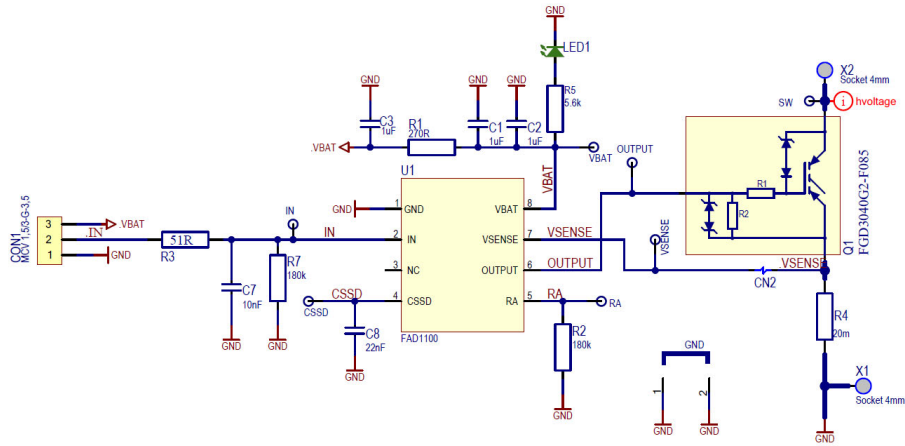


Figure 2. FAD1100 Evaluation Board Schematic

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 μ H to 2 mH**, or a **customer-specific ignition plug (ignition transformer)**, provided its parameters fall within the supported inductance range.

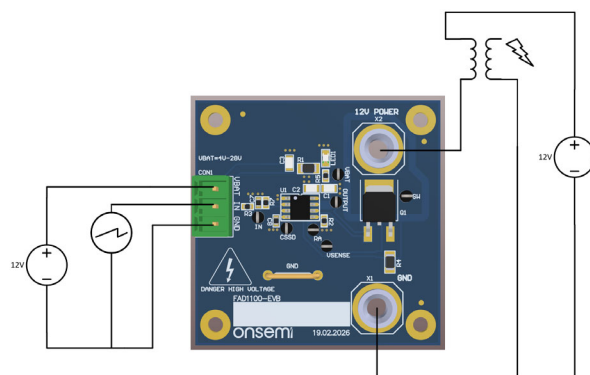


Figure 3. Application Schema for Ignition System

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.

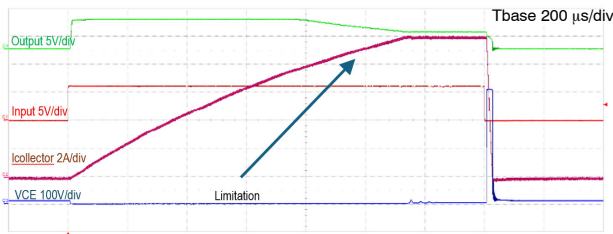


Figure 4. Current Limitation of Induction Load

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.

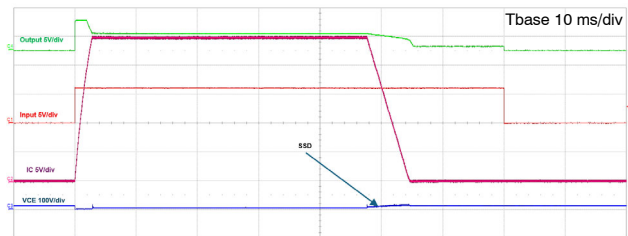


Figure 5. SSD Protection for Switch-off Induction Load

PCB DRAWINGS

Assembly Drawings

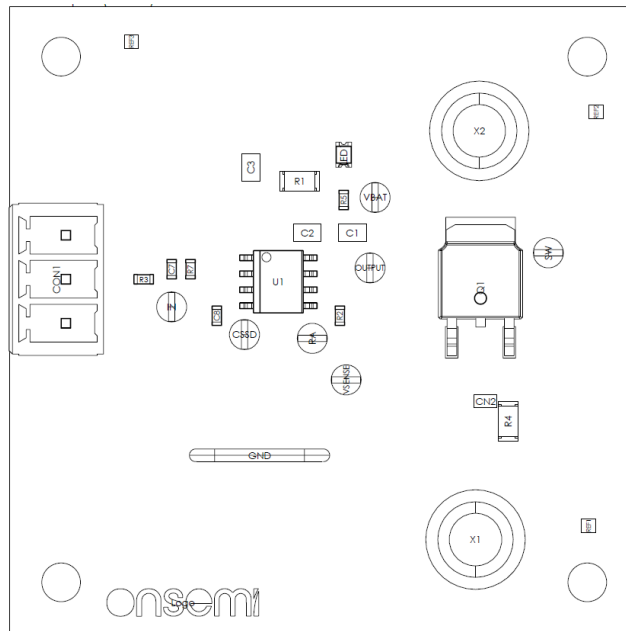


Figure 6. FAD1100EVB PCB Top Assembly Drawing

Composite Drawings

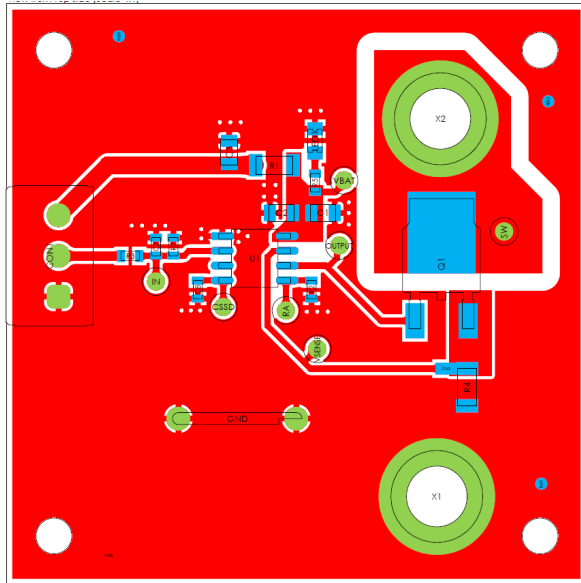


Figure 7. FAD1100EVB PCB Top Composite Drawing

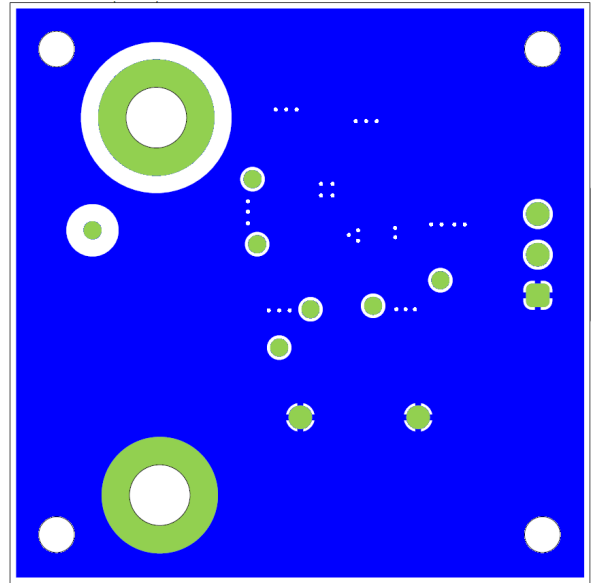


Figure 8. FAD1100EVB PCB Bottom Composite Drawing (bottom view)

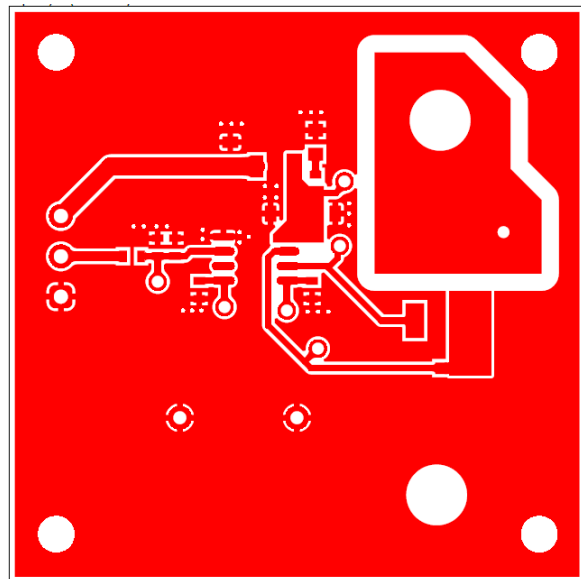


Figure 9. FAD1100EVB PCB Internal Plane 1 Drawing

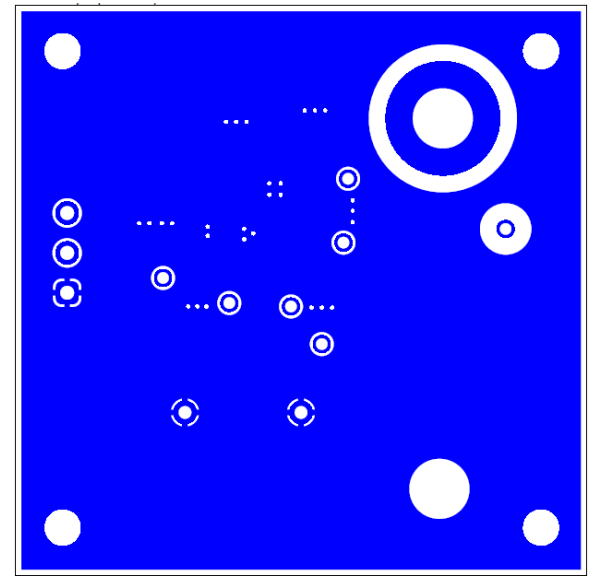


Figure 10. FAD1100EVB PCB Internal Plane 2 Drawing

EVBUM2951/D

REVISION HISTORY

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



onsemi, **onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and will only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

THE BOARD IS PROVIDED BY ONSEMI TO YOU "AS IS" AND WITHOUT ANY REPRESENTATIONS OR WARRANTIES WHATSOEVER. WITHOUT LIMITING THE FOREGOING, ONSEMI (AND ITS LICENSORS/SUPPLIERS) HEREBY DISCLAIMS ANY AND ALL REPRESENTATIONS AND WARRANTIES IN RELATION TO THE BOARD, ANY MODIFICATIONS, OR THIS AGREEMENT, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY AND ALL REPRESENTATIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, AND THOSE ARISING FROM A COURSE OF DEALING, TRADE USAGE, TRADE CUSTOM OR TRADE PRACTICE.

onsemi reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by **onsemi** shall not constitute any representation or warranty by **onsemi**, and no additional obligations or liabilities shall arise from **onsemi** having provided such information or services.

onsemi products including the boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. You agree to indemnify, defend and hold harmless **onsemi**, its directors, officers, employees, representatives, agents, subsidiaries, affiliates, distributors, and assigns, against any and all liabilities, losses, costs, damages, judgments, and expenses, arising out of any claim, demand, investigation, lawsuit, regulatory action or cause of action arising out of or associated with any unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of any products and/or the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by **onsemi** to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

onsemi does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: **onsemi** shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if **onsemi** is advised of the possibility of such damages. In no event shall **onsemi**'s aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

The board is provided to you subject to the license and other terms per **onsemi**'s standard terms and conditions of sale. For more information and documentation, please visit www.onsemi.com.

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