ZES100EVM - Latchup Detection and Protection (LDAP) Evaluation Module User Guide

Abstract

The ZES100EVM User Guide describes the operation of the Latchup-Detection-and-Protection (LDAP) IC ZES100 on the evaluation module. It provides the details on evaluation setup, and to configure the LDAP as designed to protect non-radiation-hardened semiconductor (COTS-Commercial of the Shelf) components from radiation effects, enabling Advanced COTS devices to 'Space-applications' particularly Single-Event-Latchup (SEL) and/or micro-SEL (µ-SEL). This document applies only to the ZES100 EVM.

Contents

1. Introduction

ZES100 LDAP-IC is an integrated solution designed to detect Single-Event Latchup (SEL) in a target device and subsequently provides a power cycling recovery. The ZES100EVM is an evaluation board used to evaluate the LDAP-IC 'ZES100'. The PG output can be used as detection when Latchup occurs, and protect the Commercial-Off-The-Shelf (COTS) devices from anomalous current damage due to SEL/ micro-SEL.

The ZES100EVM is equipped with the following features:

1. Fast response to SEL
2. Detection of the SEL occurrence at on-set
3. Detection of micro-SEL
4. Immune from current drift due to aging and TID
5. Wide-range supply voltage and loading current
6. Overload current short self-protection

Please refer to ZES100 datasheet and application notes for more details.

2. Ordering Information

Part No.	Description	Form Factor	Size
ZES100LDPGEV-EP	ZES100 LDAP Evaluation Board	PCBA	80 mm x 80 mm

For price, delivery, and ordering information please contact info@zero-errorsystems.com

These units ZES100EVM are intended for engineering evaluation only. These units are not suitable for qualification, production, radiation testing or flight use.

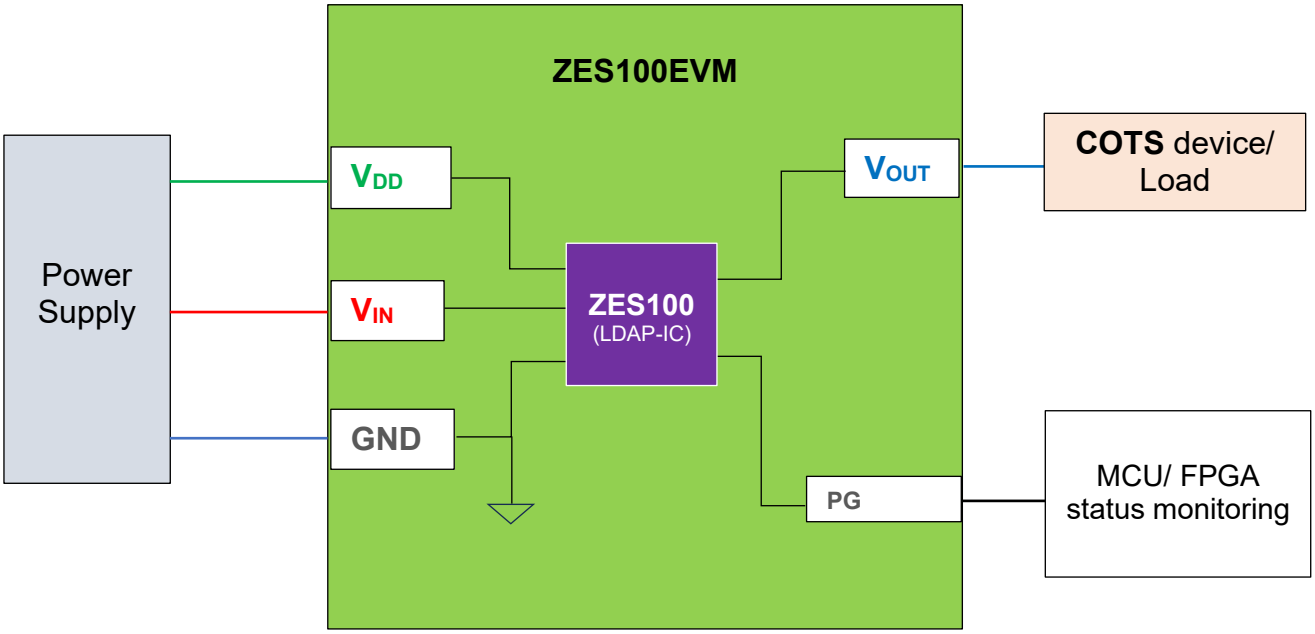
Note: ZES100EVM parts are only tested in room temperature, and hence not warranted for performance over the full specified temperature range of –55°C to 125°C or operating life.

3. ZES100EVM Operational Range

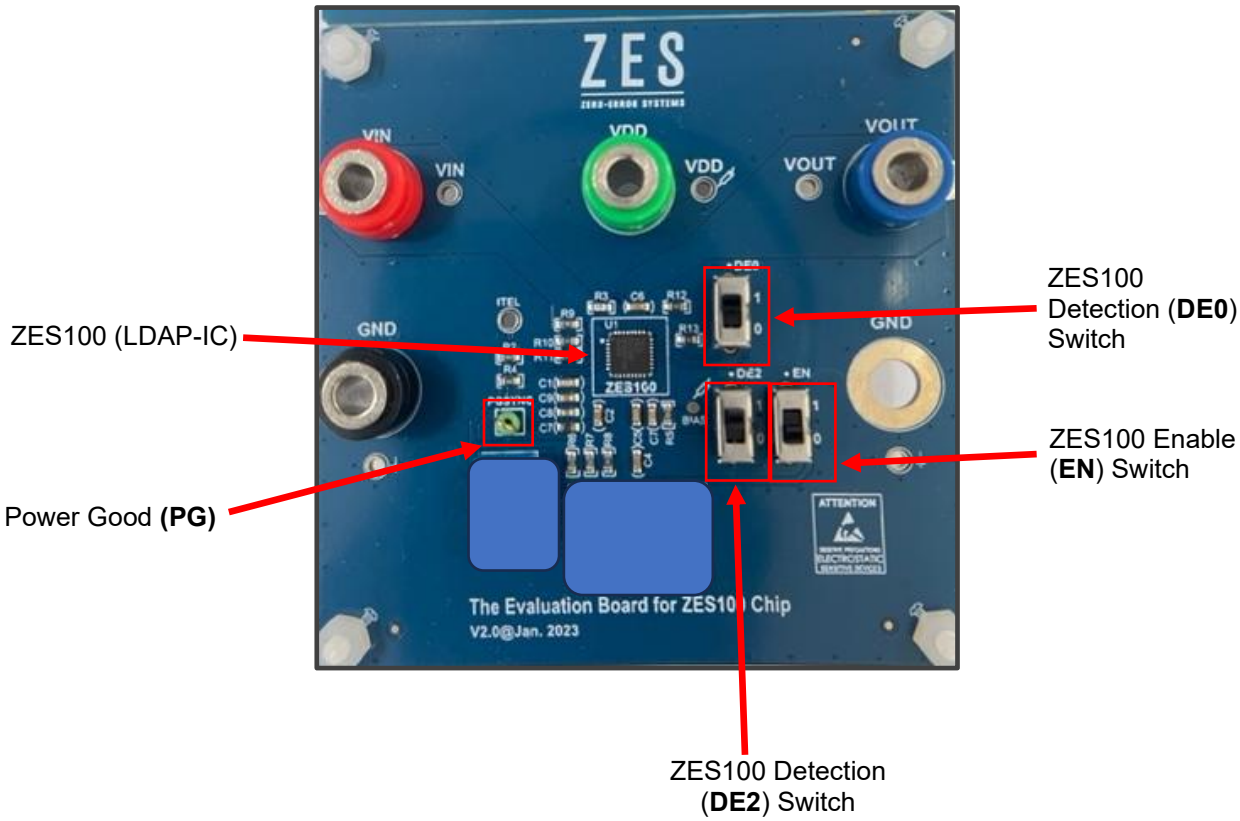
Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage (V_{IN})[1]		1.2	5.0	V_{DD}	V
Input Current (V_{IN})			100	500	mA
Voltage Supply of LDAP (V_{DD})		2.5	5.0	5.5	V
Input Current for LDAP (V_{DD})	V_{DD} = 5V	2.0	3.0	6.0	mA

[1] V_{IN} must be equal to or lower than V_{DD} at any time.

4. ZES100EVM ports connection/ description diagram



5. ZES100EVM Board



6. List of items Required

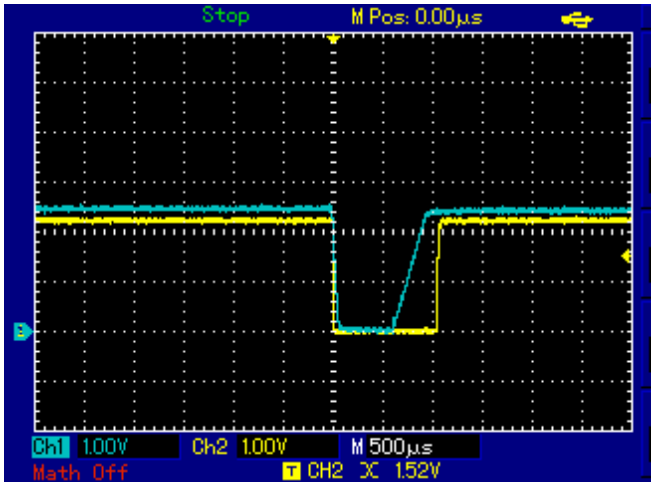
a. DC Power supply – 2 channels (galvanically isolated)
b. COTS device/ Variable resistive load
c. Banana plugs cables
d. MCU/ FPGA (Status monitoring option)

7. Set-up Procedure

a. Ensure both switches **DE0** and **DE2** are at position1. (to activate µ-SEL and Over-current Limit detection)
b. Ensure switch **EN** is at position0. (to enable ZES100)
c. Connect the banana plug cable from Power Supply $\mathbf{V_{DD}}$ Supply to ZES100EVM' $\mathbf{V_{DD}}$ connector.
d. Connect the banana plug cable from Power Supply $\mathbf{V_{IN}}$ Supply to ZES100EVM' $\mathbf{V_{IN}}$ connector.
e. Connect the banana plug cable from ZES100EVM' $\mathbf{V_{OUT}}$ connector to **COTS** device/ load.
f. Connect the Micro-grabber clip from ZES100EVM' Power Good **PG** to MCU/ FPGA status monitoring.

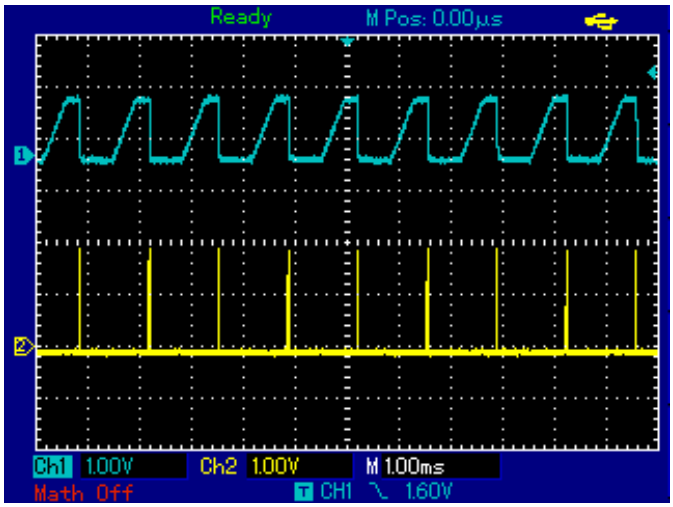
8. SEL/ µ-SEL

ZES100 **PG** will toggle when micro-SEL is detected, induced by Laser at COTS device power switches causing the load current to increase instantaneously.

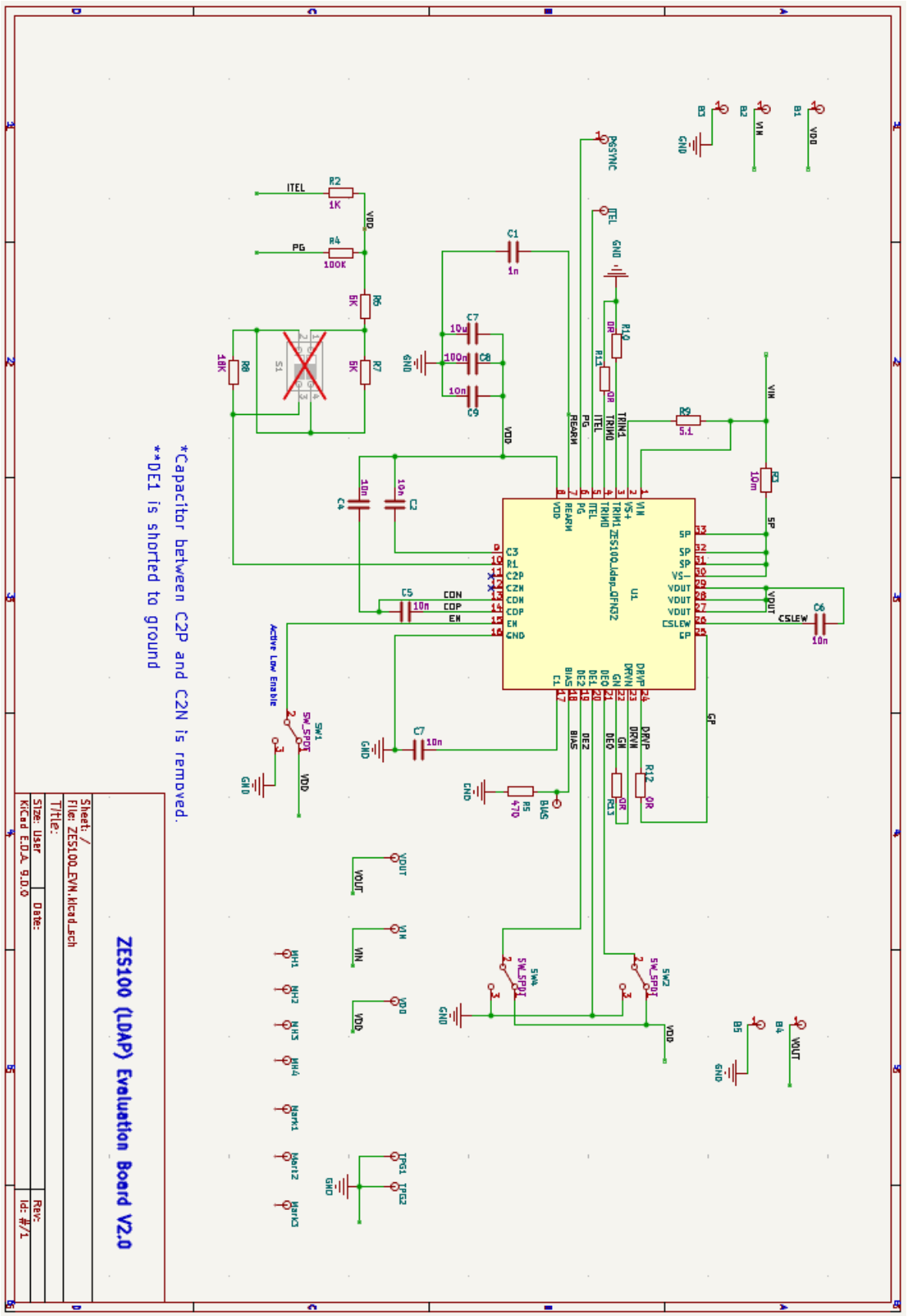


9. Current Limit when overload current

ZES100's self-protection current limit function activated when overload current/ shorted at V_{OUT} occurs.



10. ZES100EVM Schematic



11. Current Sensing

ZES100 has a built-in current sensor to read the current through V_{OUT}, i.e., the output/load current I_{OUT} as the sensed current I_{SEN} with a certain current sensing ratio. The current sensing ratio between I_{OUT} and I_{SEN} can be customized using R_{SEN-} and R_{SEN+} resistors by the following relationship.

$$r = \frac{I_{OUT}}{I_{SEN}} = \frac{I_{OUT,MAX}}{I_{SEN,MAX}} = \frac{R_{SEN+}}{R_{SEN-}}$$

The current sensing ratio depends on the load and the absolute maximum rating ZES100's internal sense current branch (~2mA). For example, a Device Under Protection (DUP) with the requirement of maximum supply current, I_{OUT} of 500mA, we can limit the maximum sensed current $\mathbf{I_{SEN}}$ to 0.98mA (additional derating) to obtain current sensing ratio of 510. If the R_{SEN-} resistance is set to be 10mΩ, then the R_{SEN+} resistance is 5.1Ω. It is recommended to design the minimum voltage drop across R_{SEN-} of 5mV with reference to below **Table**.

Max $I_{OUT(th)}$ (mA)	MOSFET	R_{SEN-} mΩ	R_{SEN+} Ω	Current sensing ratio, **r**	I_{OUT} x R_{SEN-} (**mV** ≥5mV)	(I_{OUT} x R_{SEN-})/ R_{SEN+} (I_{SEN} **mA** <2mA)
1	Internal	5000	5.1	1.02	5	0.98
5	Internal	1000	5.1	5.10	5	0.98
10	Internal	500	5.1	10.20	5	0.98
50	Internal	100	5.1	51.00	5	0.98
100	Internal	50	5.1	102.00	5	0.98
250	Internal	20	5.1	255.00	5	0.98
500	**Internal**	**10**	**5.1**	**510.00**	**5**	**0.98**
1000	External	5	5.1	1020.00	5	0.98
1500	External	3.3	5.1	1545.45	4.95	0.97
2000	External	**2.5**	**5.1**	**2040.00**	**5**	**0.98**
5000	External	1	5.1	5100.00	5	0.98
10000	External	0.5	5.1	10200.00	5	0.98
20000	External	0.25	5.1	20400.00	5	0.98

Note: The above $R_{SEN+/-}$ values are for reference only.

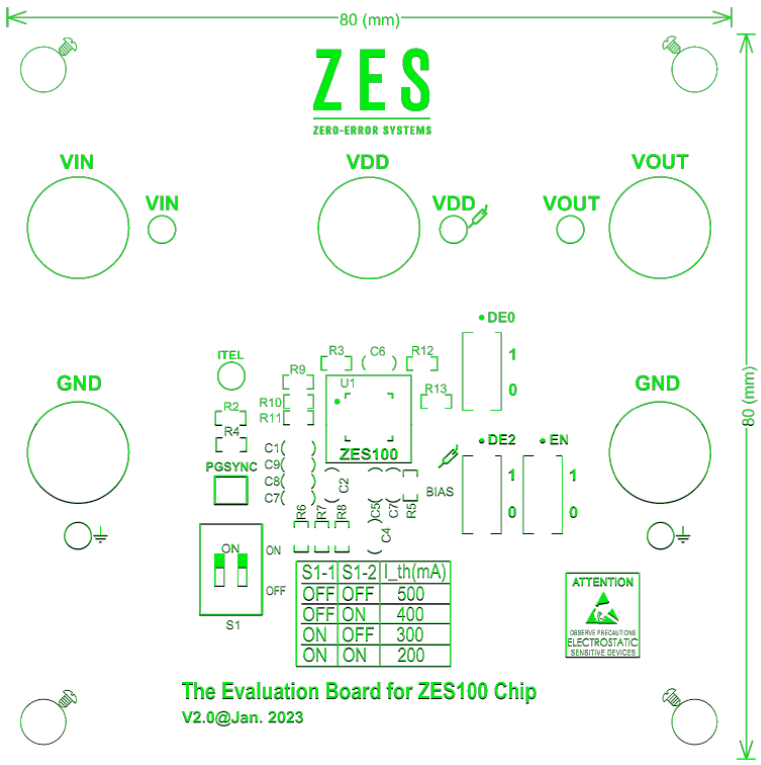
12. External Power Switches (for higher I_{OUT})

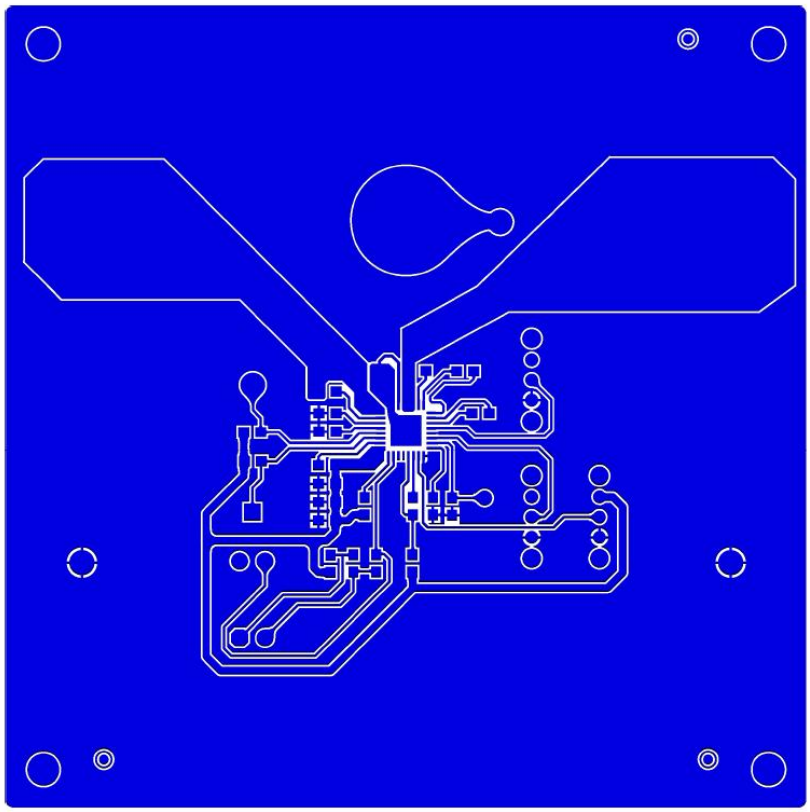
The ZES100 has a built-in power PFET switch, and a pull-down NFET switch (in series with a 50 Ω resistor). Both the built-in switches are de-rated and their gates are accessible through GP and GN, respectively. The max drain-source current of the power PFET is 500mA at 125°C. These power switches can be driven by ZES100's drivers DRVP and DRVN.

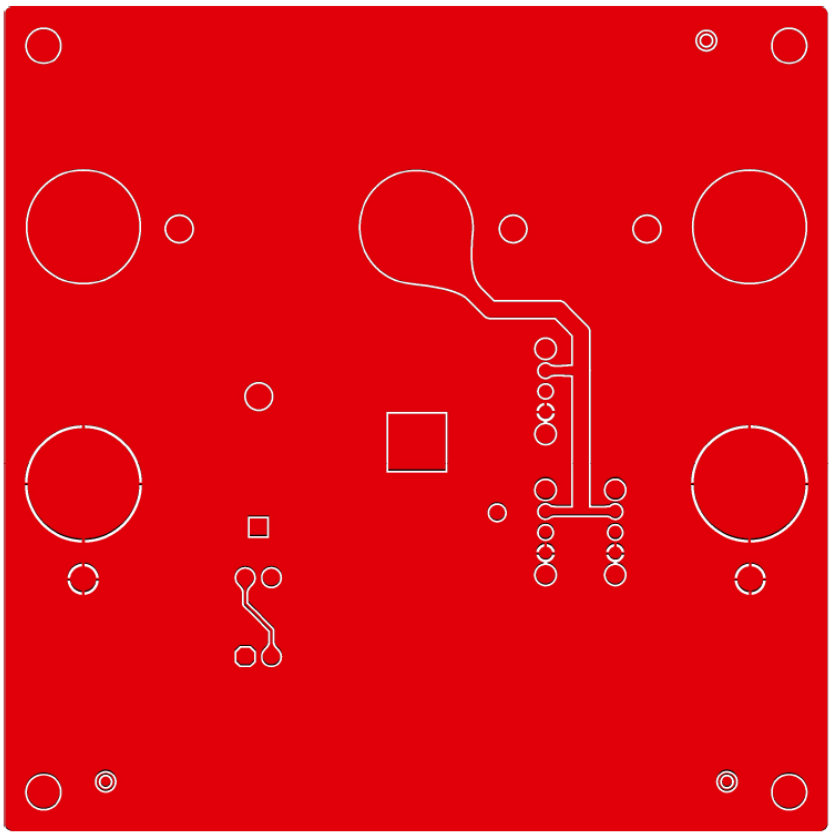
The ZES100 also supports the use of an external power switch (P-channel) to deliver higher $\mathbf{I_{OUT}}$ (>500mA) to load.

*Recommendation for the selection of external switch, the Gate-Source Threshold Voltage $V_{gs(th)} > V_{IN} - 0.2V$.

13. ZES100EVM PCB layout







12. Revision History

Revision No.	Notes	Date
Rev 1.0	Preliminary version	May, 2023
Rev 1.1	Preliminary version	Jan, 2024
Rev 1.2	Official Release	July, 2024
Rev 1.3	Updated with current sensing ratio table	Aug, 2024
Rev 1.4	Increase C_D to 100nF and R_{SEN} table updated	July, 2025
Rev 1.5	PG/Sync pin function revised. Removal of Sync function	Nov, 2025
Rev 1.6	Revert current sensing ratio table	Apr, 2026