

## Evaluating the ADP195 High-Side Power Switch

### FEATURES

**Ultrasmall 1 mm × 1 mm, 4-ball, 0.5 mm pitch WLCSP**

**Small 2 mm × 2 mm, 6-lead, 0.5 mm pitch LFCSP**

**Low  $R_{DS(on)}$  of 65 mΩ at 1.8 V**

**Low input voltage range of 1.1 V to 3.6 V**

**1 amp continuous operating current**

**Operating temperature range:  $T_J = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$**

### GENERAL DESCRIPTION

The ADP195-EVALZ and ACP195CP-EVALZ are used to demonstrate the functionality of the ADP195 power switch.

Simple device measurements such as VIN to VOUT resistance ( $R_{DS(on)}$ ), ground current, and off state current can be demonstrated with just a single voltage supply, a voltmeter, a current meter, and load resistors.

Full details about the [ADP195](#) high side power switches are available in the ADP195 data sheet, which should be consulted when using the ADP195-EVALZ or ADP195CP-EVALZ.

### EVALUATION BOARDS

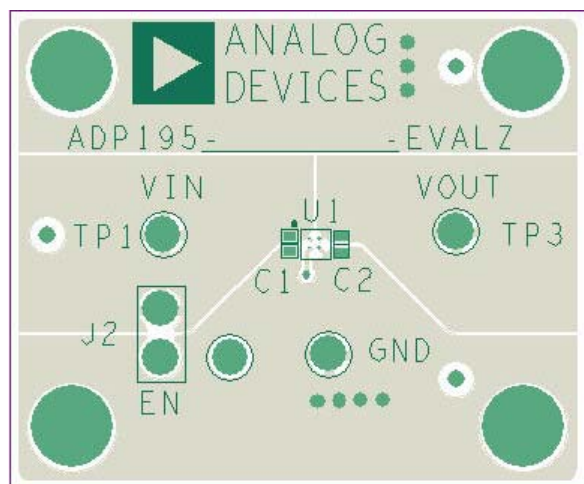


Figure 1. 4-Ball WLCSP Demonstration Evaluation Board

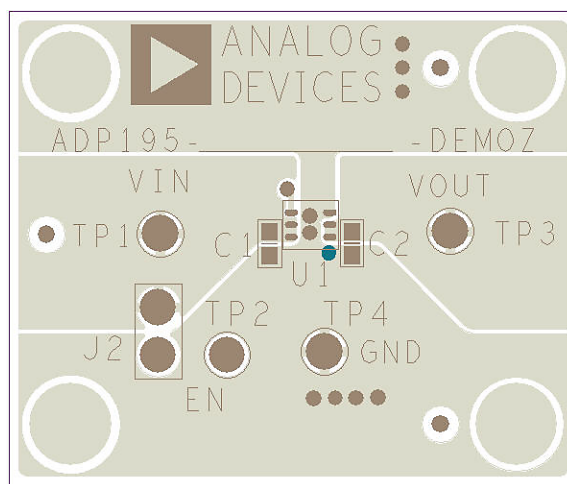


Figure 2. 6-Lead LFCSP Evaluation Board

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## REVISION HISTORY

### 1/11—Rev. 0 to Rev. A

Changes to Features Section and General Description Section .	1
Added Figure 2; Renumbered Sequentially .....	1
Added Figure 4.....	3
Changes to $V_{IN}$ and $V_{OUT}$ Resistance ( $R_{DS(on)}$ ) Section .....	4
Added Figure 6.....	4
Added Figure 8.....	5
Changes to Ground Current Measurement Section .....	6
Added Figure 10.....	6
Changes to Shutdown Current Measurement Section .....	8
Added Figure 14.....	9
Changes to Table 2.....	10

### 4/10—Revision 0: Initial Version

## EVALUATION BOARD SCHEMATIC AND HARDWARE

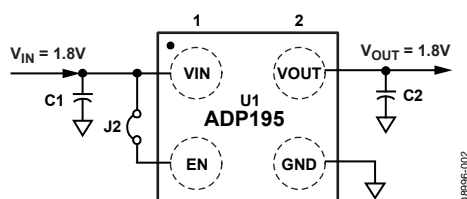


Figure 3. 4-Ball WLCSP Evaluation Board Schematic

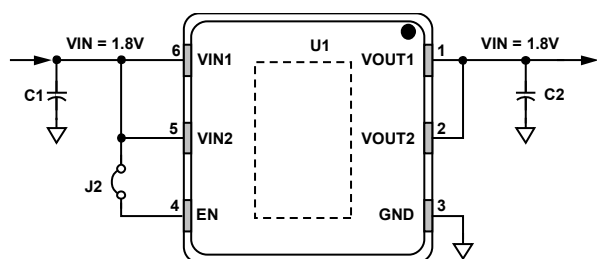


Figure 4. 6-Lead LFCSP Evaluation Board Schematic

Table 1. Evaluation Board Hardware Components

Component	Function	Description
U1	Power switch	High-side power switch.
C1	Input capacitor	0.1 $\mu$ F input bypass capacitor. Optional to improve transient performance. Connect C1 from VIN to GND for the WLCSP, and VIN1 and VIN2 to GND for the LFCSP
C2	Output capacitor	0.1 $\mu$ F output capacitor. Optional to improve transient performance. Connect C2 from VOUT to GND for the WLCSP, and VOUT1 and VOUT2 to GND for the LFCSP.
J2	Jumper	Jumper. Connects EN to VIN for the WLCSP, or VIN1 and VIN2 for the LFCSP to enable automatic startup.

## $V_{IN}$ TO $V_{OUT}$ RESISTANCE ( $R_{DS_{ON}}$ )

$R_{DS_{ON}}$  can be measured using the configurations shown in Figure 7 and Figure 8.  $R_{DS_{ON}}$  is defined as the input-to-output voltage differential divided by the load current.

The voltmeter reading divided by the load current value gives the equivalent  $R_{DS_{ON}}$  value. For more accurate measurements, a second voltmeter can be used to monitor the input voltage across the input capacitor. The input supply voltage may need to be adjusted to account for IR drops, especially if large load currents are used. Figure 5 shows a typical curve of  $R_{DS_{ON}}$  measurements with different load currents for the 4-ball WLCSP package and Figure 6 shows a typical curve of  $R_{DS_{ON}}$  measurements with different load currents for the 6-lead LFCSP.

Use the following steps to connect to a voltage source and voltmeter:

1. Connect the negative terminal (–) of the voltage source to one of the GND pads on the evaluation board.
2. Connect the positive terminal (+) of the voltage source to the VIN pad of the evaluation board.
3. Connect a load between the VOUT pad and one of the GND pads.
4. Connect the negative terminal (–) of the voltmeter to the VOUT pad.
5. Connect the positive terminal (+) of the voltmeter to the VIN pad.

When these steps are completed, the voltage source can be turned on. If J1 is inserted (connecting EN to VIN for automatic startup), the switch powers up.

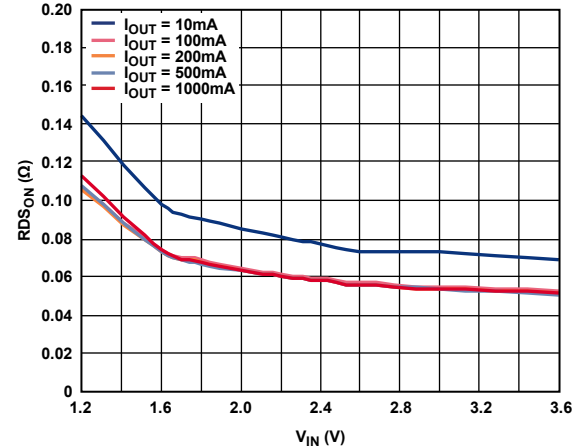


Figure 5. 4-Ball WLCSP  $R_{DS_{ON}}$  vs. Input Voltage,  $V_{IN}$

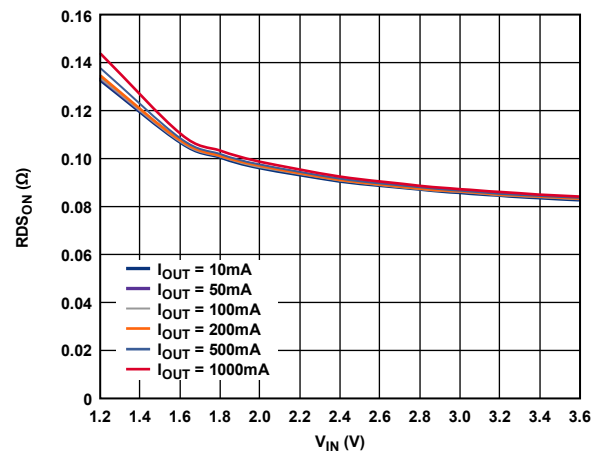
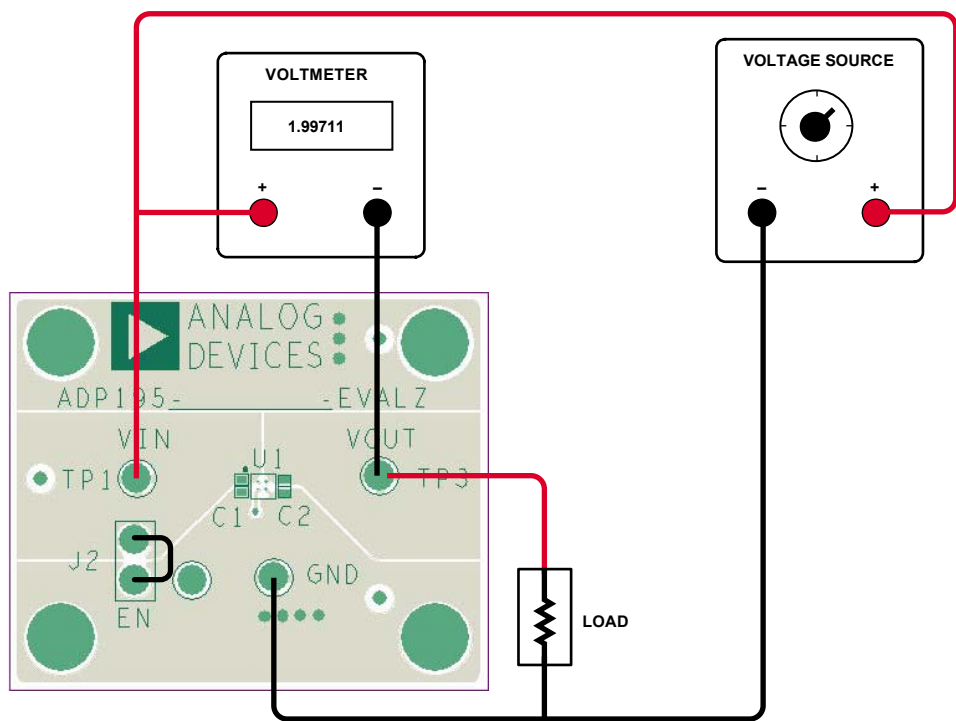
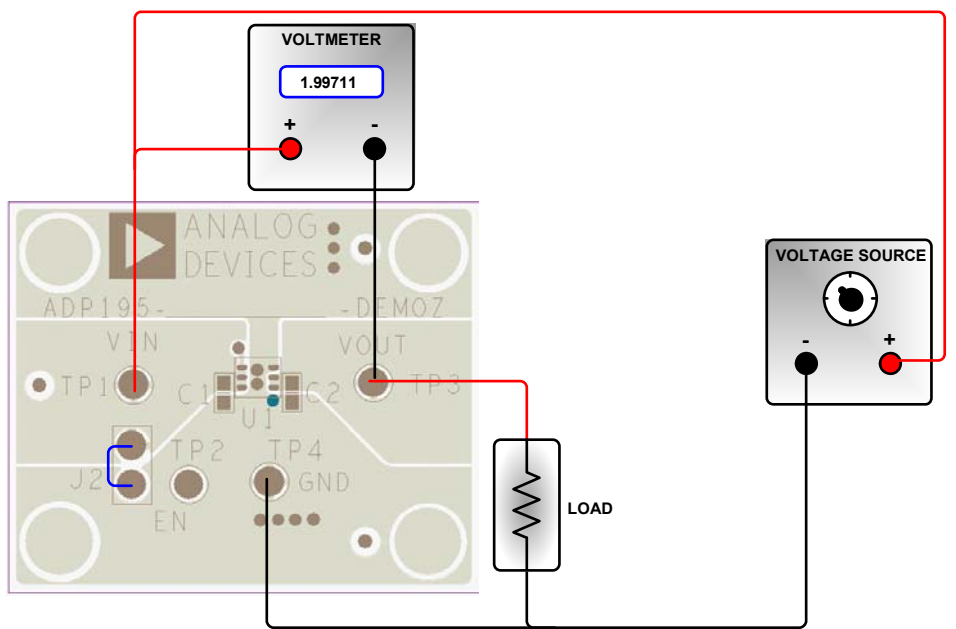


Figure 6. 6-Lead LFCSP  $R_{DS_{ON}}$  vs. Input Voltage,  $V_{IN}$

Figure 7. WLCSP  $R_{DS(on)}$  MeasurementFigure 8. LFCSP  $R_{DS(on)}$  Measurement

## GROUND CURRENT MEASUREMENT

Figure 9 and Figure 10 show how the evaluation boards can be connected to a voltage source and an ammeter for ground current measurements. A resistor can be used as the load for the regulator. Ensure that the resistor has a power rating adequate to handle the power expected to be dissipated across it. An electronic load can be used as an alternative. Ensure that the voltage source used can supply enough current for the expected load levels. If voltmeters are connected at the input or output terminals, subtract the current resulting from the shunt resistance of the voltmeter for accurate ground current measurement.

Follow these steps to connect to a voltage source and ammeter:

1. Connect the positive terminal (+) of the voltage source to the VIN pad on the evaluation board.
2. Connect the positive terminal (+) of the ammeter to the GND pad of the evaluation board.
3. Connect the negative terminal (–) of the ammeter to the negative (–) terminal of the voltage source.
4. Connect a load between the VOUT pad of the evaluation board and the negative (–) terminal of the voltage source.

The voltage source can now be turned on. If J2 is inserted (connecting EN to VIN for automatic startup), the switch powers up.

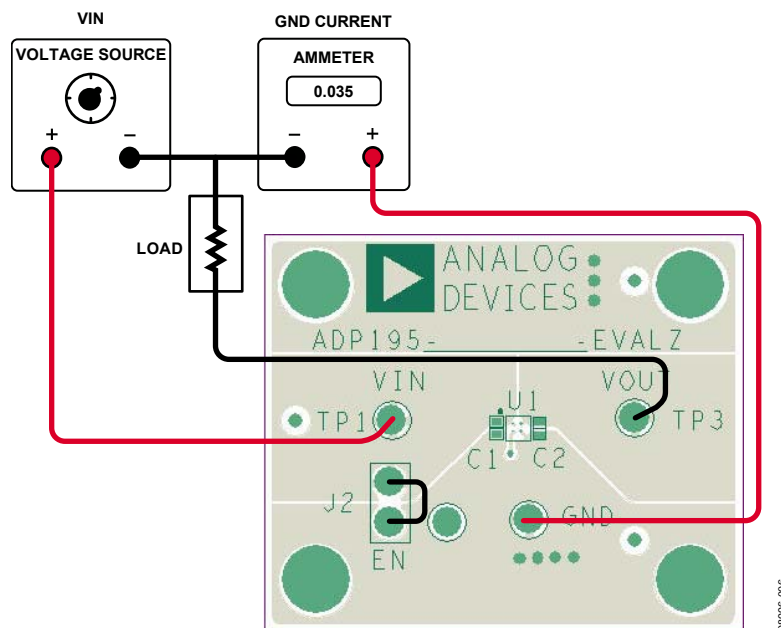


Figure 9. 4-Ball WLCSP Ground Current Measurement

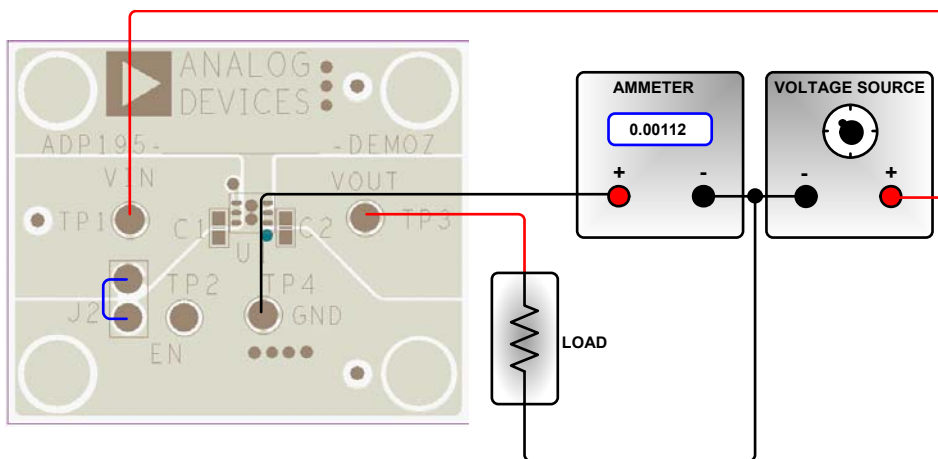


Figure 10. 6-Lead LFCSP Ground Current Measurement

## GROUND CURRENT CONSUMPTION

Ground current measurement is a way of determining how much current the internal circuits of the regulator are consuming while performing the power switch function. To be efficient, the power switch must consume as little current as possible. Figure 11 shows the typical ground current consumption for various load levels.

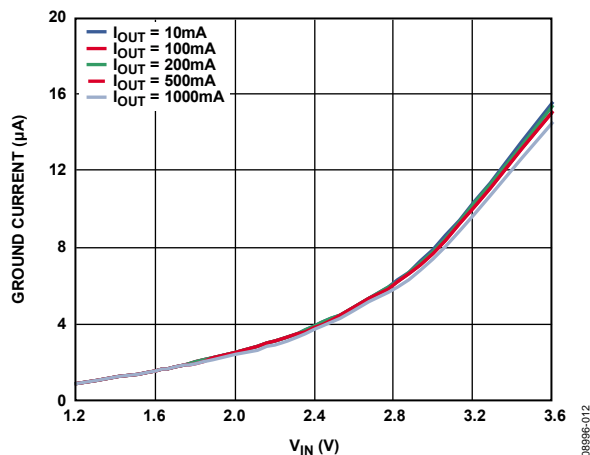


Figure 11. Ground Current vs. Input Voltage,  $V_{IN}$

## SHUTDOWN CURRENT MEASUREMENT

Figure 13 and Figure 14 show how the evaluation boards can be connected to a voltage source and an ammeter for shutdown current measurements. The ammeter can also be connected to the GND terminal to measure the ground current, which is equal to the shutdown current when EN is tied to ground. Figure 12 shows the typical shutdown current consumption for various input voltages.

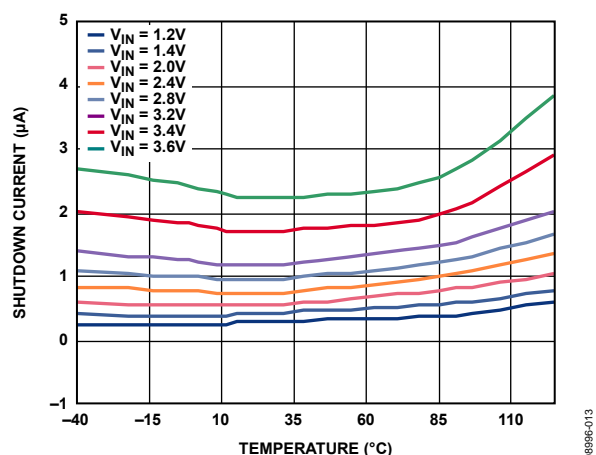


Figure 12. Shutdown Current vs. Temperature and Input Voltage,  $V_{IN}$

Follow these steps to connect to a voltage source and ammeter:

1. Connect the positive terminal (+) of the voltage source to the (+) of the ammeter.
2. Connect the negative terminal (-) of the voltage source to GND pad and EN pin on the evaluation board.
3. Connect the negative terminal (-) of the ammeter to the VIN pad on the evaluation board.

The voltage source can now be turned on.

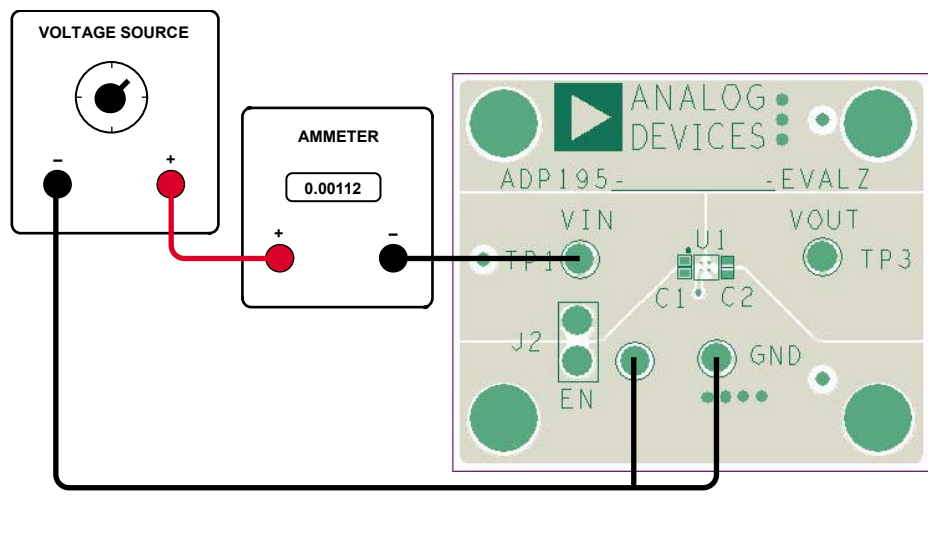


Figure 13. 4-Ball WLCSP Shutdown Current Measurement



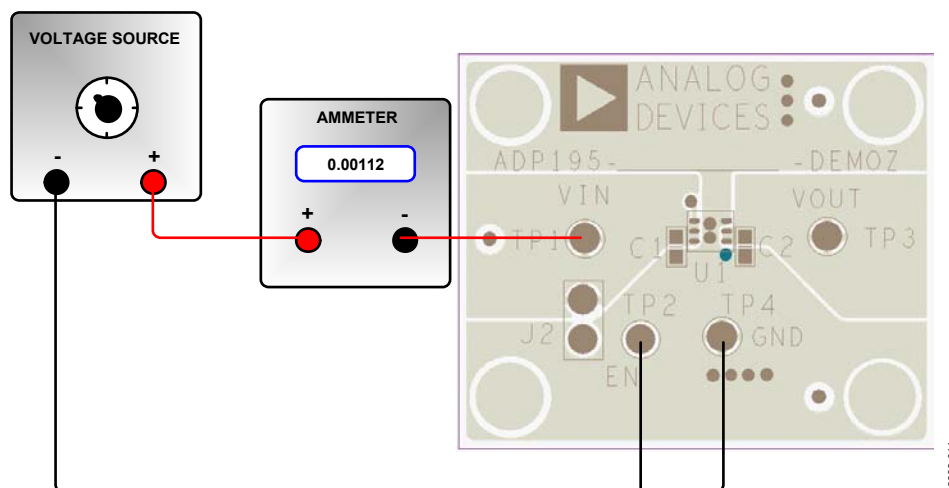


Figure 14. 6-Lead LFCSP Shutdown Current Measurement

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ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Qty	Reference Designator	Description	Manufacturer/Vendor	Vendor Part No.
2	C1, C2	Capacitor, MLCC, 0.1 μF, 10 V, 0402, X5R	Murata or equivalent	GRM155R61A104KA01D
1	J2	Header, single, STR, two pins	Digi-Key Corp.	S1012E-36-ND
1	U1	IC, power switch	Analog Devices, Inc.	ADP195ACBZ, ADP195ACPZ

## NOTES

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**ESD Caution**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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