ADP2165-EVALZ/ADP2166-EVALZ User Guide

UG-565

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Evaluating the ADP2165/ADP2166 Step-Down Regulator

FEATURES

Full featured evaluation board for the ADP2165/ADP2166
5 A (ADP2165)/6 A (ADP2166) continuous output current
±1% output accuracy over temperature range
Input voltage range: 2.7 V to 5.5 V
Output voltage from 0.6 V to 0.9 × VIN
Precision enable pin with hysteresis
Integrated high-side and low-side MOSFET
ADIsimPower™ design tool

GENERAL DESCRIPTION

The ADP2165/ADP2166 are synchronous, step-down dc-to-dc regulators in a compact 4 mm × 4 mm LFCSP_WQ package. The regulator runs from input voltages of 2.7 V to 5.5 V and requires minimal external components to provide a high efficiency solution with an integrated high-side FET and a synchronous rectified FET.

The ADP2165 evaluation board (ADP2165-EVALZ) and the ADP2166 evaluation board (ADP2166-EVALZ) provide an easy way to evaluate the devices. This user guide describes how to quickly set up the board to collect performance data.

Complete information about the ADP2165/ADP2166 is available in the ADP2165/ADP2166 data sheet, which should be consulted in conjunction with this user guide when using the evaluation board.

EVALUATION BOARDS

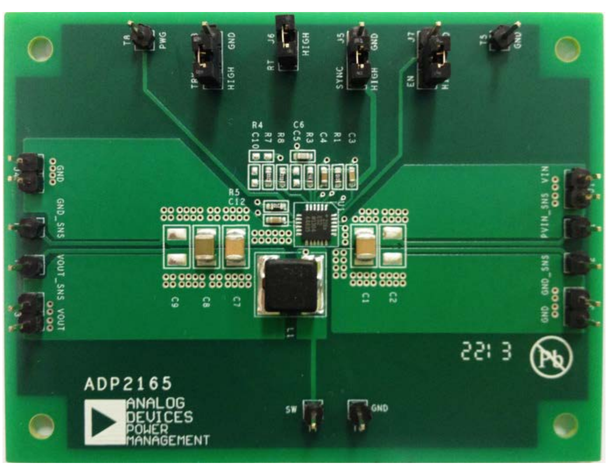

Figure 1. ADP2165-EVALZ

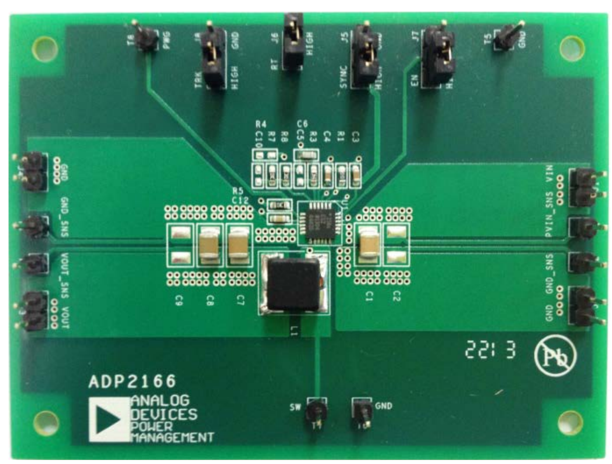

Figure 2. ADP2166-EVALZ

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REVISION HISTORY

10/14—Revision 0: Initial Version

SETTING UP THE EVALUATION BOARD

POWERING UP THE EVALUATION BOARD

The ADP2165-EVALZ and ADP2166-EVALZ evaluation boards are fully assembled and tested. Before applying power to the evaluation board, follow the setup procedures in this section.

Jumper Settings

Table 1 describes the jumper settings. Before selecting the jumper settings, make sure that the enable input, EN, is high.

Table 1. Jumper Settings

Jumper	State or Connection	Function
J5 (SYNC)	High or low	Force PWM (FPWM)
	External clock	Synchronize to the external clock
J6 (RT)	High	Set frequency to 1.2 MHz
	Floating	Set frequency to 620 kHz
	External resistor	Set frequency from 250 kHz to 1.4 MHz
J7 (EN)	High	Enable V_{OUT}
	Low	Disable V_{OUT}
J8 (TRK)	High	Tracking function not used
	External voltage	Tracking with the external voltage

Input Power Source Connection

Before connecting the power source to the evaluation board, make sure that the board is turned off. If the input power source includes a current meter, use the meter to monitor the input current as follows:

1. Connect the positive terminal of the power source to the VIN terminal (J1) on the evaluation board.
2. Connect the negative terminal of the power source to the GND terminal (J2) on the evaluation board.

If the power source does not include a current meter, connect a current meter in series with the input source voltage as follows:

1. Connect the positive terminal of the power source to the positive terminal (+) of the current meter.
2. Connect the negative terminal of the power source to the GND terminal (J2) on the evaluation board.
3. Connect the negative terminal (−) of the current meter to the VIN terminal (J1) on the evaluation board.

Output Load Connection

Before connecting the load to the evaluation board, make sure that the board is turned off. If the load includes a current meter or if the current is not measured, connect the load directly to the evaluation board as follows:

1. Connect the positive load connection (+) to the VOUT terminal (J3) on the evaluation board.
2. Connect the negative load connection (−) to the GND terminal (J4) on the evaluation board.

If a current meter is used, connect it in series with the load as follows:

1. Connect the positive terminal (+) of the current meter to the VOUT terminal (J3) on the evaluation board.
2. Connect the negative terminal (−) of the current meter to the positive terminal (+) of the load.
3. Connect the negative terminal (−) of the load to the GND terminal (J4) on the evaluation board.

Input and Output Voltmeter Connections

Measure the input and output voltages with voltmeters. Make sure that the voltmeters are connected to the appropriate test points on the board. If the voltmeters are not connected to the correct test points, the measured voltages may be incorrect due to the voltage drop across the leads or due to the connections between the board, the power source, and/or the load.

1. Connect the positive terminal (+) of the input voltage measuring voltmeter to Test Point T1 on the evaluation board.
2. Connect the negative terminal (−) of the input voltage measuring voltmeter to Test Point T2 on the board.
3. Connect the positive terminal (+) of the output voltage measuring voltmeter to Test Point T3 on the board.
4. Connect the negative terminal (−) of the output voltage measuring voltmeter to Test Point T4 on the board.

Power On the Evaluation Board

When the power source and load are connected to the evaluation board, the board can be powered on. If the input power source is above 2.7 V, the output voltage rises to 1.2 V by default.

MEASURING EVALUATION BOARD PERFORMANCE

Measuring the Switching Waveform

To observe the switching waveform with an oscilloscope, place the oscilloscope probe tip at Test Point T4 with the probe ground connected to GND. Set the oscilloscope to a dc coupling, 2 V/division, 1 μs/division time base. The switching waveform should alternate between 0 V and the approximate input voltage.

Measuring Load Regulation

Load regulation should be tested by increasing the load at the output and measuring the output voltage between the T3 and T4 test points.

Measuring Line Regulation

Vary the input voltage and measure the output voltage at a fixed output current. The input voltage can be measured between T1 and T2. The output voltage is measured between T3 and T4.

Measuring Efficiency

The efficiency, η, is measured by comparing the input power with the output power.

$$\eta = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times I_{IN}}$$

Measuring Inductor Current

The inductor current can be measured by removing one end of the inductor from the pad on the board and using a wire connected between the pad and the inductor. A current probe can then be used to measure the inductor current.

Measuring Output Voltage Ripple

To observe the output voltage ripple, place an oscilloscope probe across the C8 output capacitor with the probe ground lead placed at the negative capacitor terminal (−) and the probe tip placed at the positive capacitor terminal (+). Set the oscilloscope to an ac coupling, 10 mV/division, 2 μs/division time base and 20 MHz bandwidth.

A standard oscilloscope probe has a long wire ground clip. For high frequency measurements, this ground clip picks up high frequency noise and injects it into the measured output ripple.

Figure 3 shows a simple way to properly measure the output ripple. It requires removing the oscilloscope probe sheath and wrapping a nonshielded wire around the oscilloscope probe. By keeping the ground lengths of the oscilloscope probe as short as possible, true ripple can be measured.

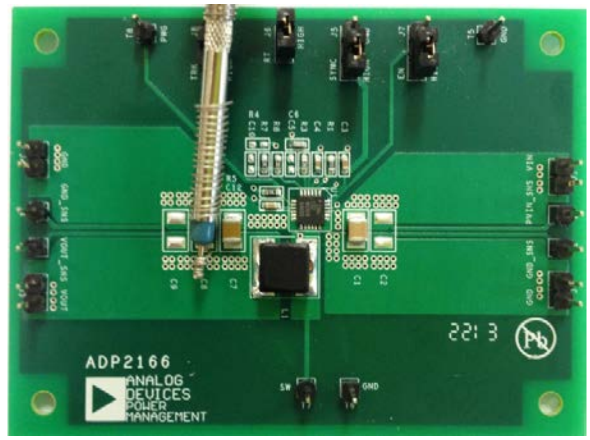

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Figure 3. Output Ripple Measurement

Output Voltage Change

The output voltage of the ADP2165-EVALZ/ADP2166-EVALZ are preset to 1.2 V. However, the output voltage can be adjusted using the following equation:

$$V_{OUT} = 0.6\ \text{V} \times \left(\frac{R7 + R8}{R8}\right)$$

EVALUATION BOARD SCHEMATICS AND ARTWORK

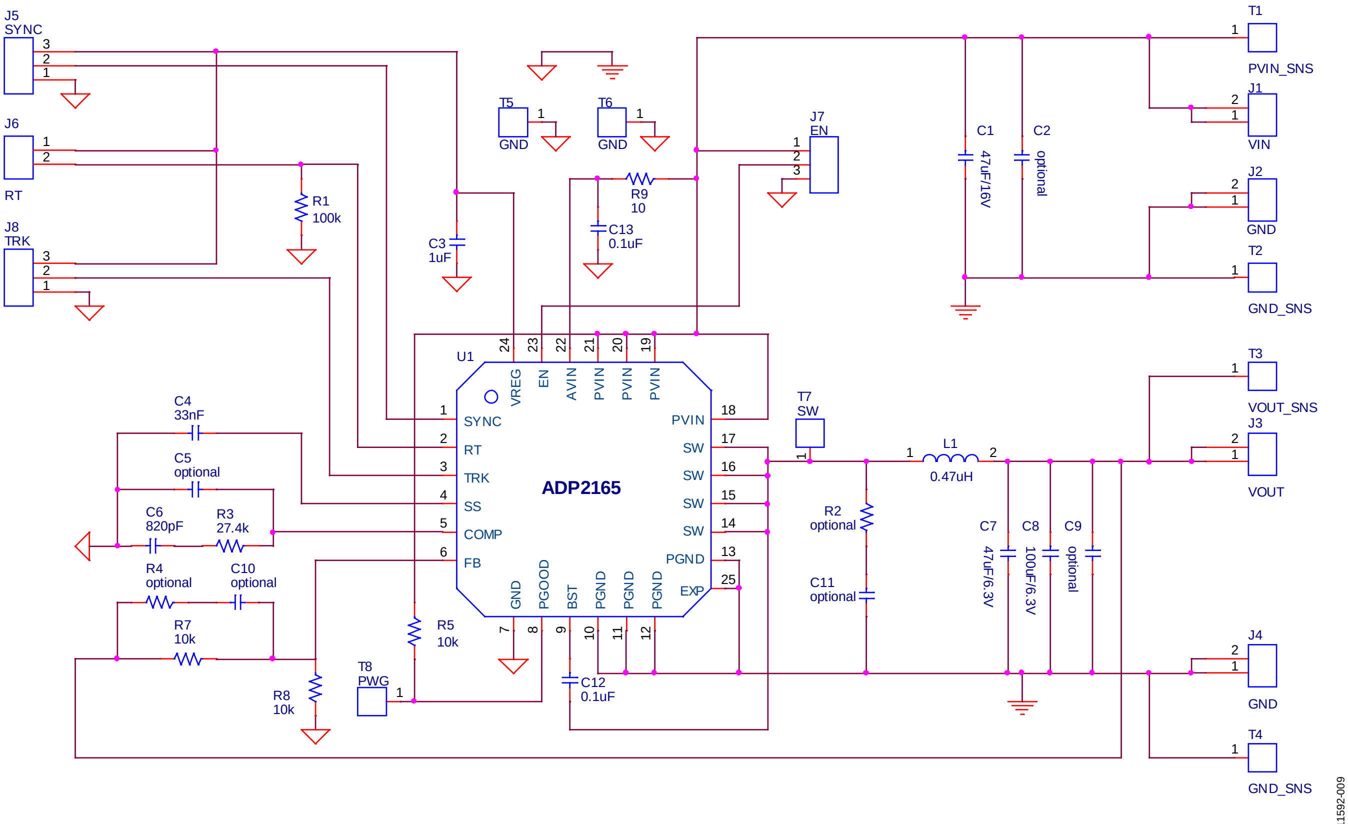

Figure 4. Schematic of the ADP2165-EVALZ

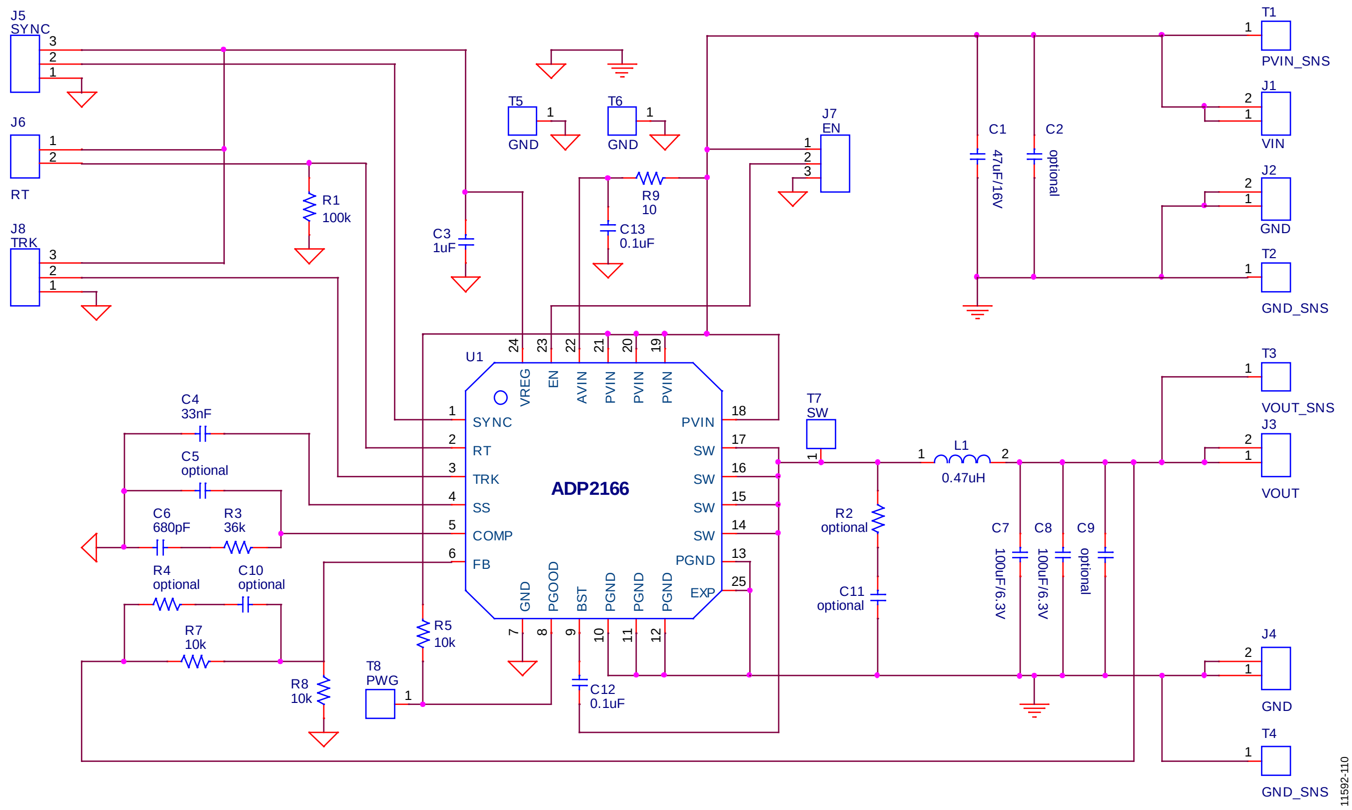

Figure 5. Schematic of the ADP2166-EVALZ

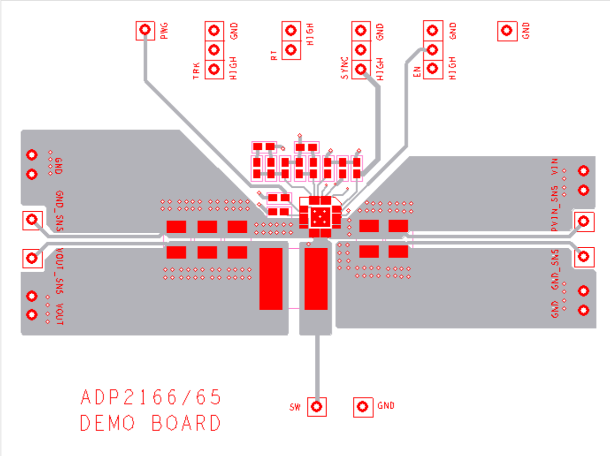

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Figure 6. Top Layer

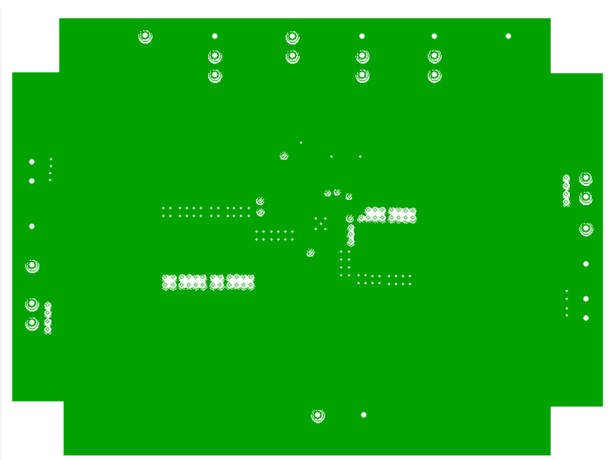
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Figure 7. Second Layer

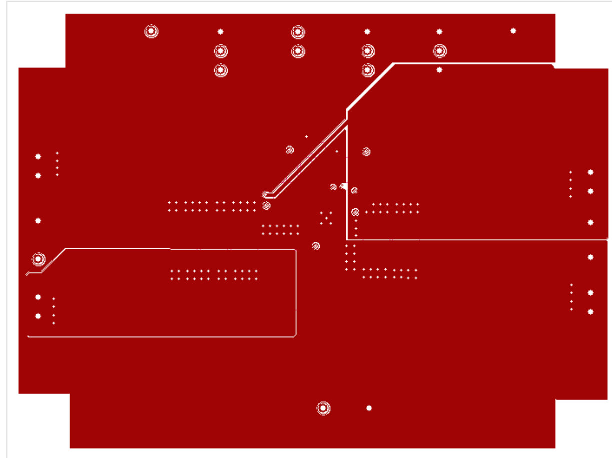
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Figure 8. Third Layer

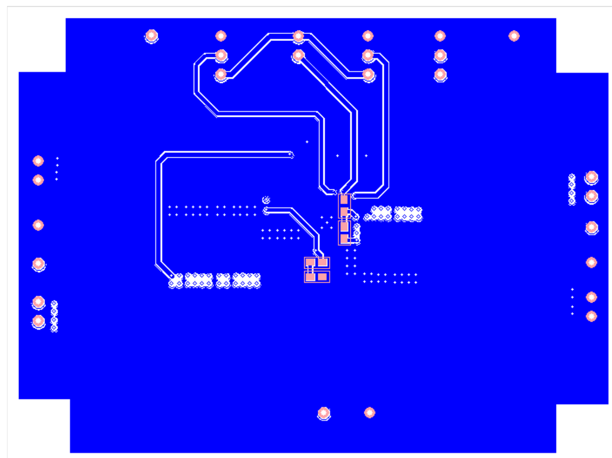
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Figure 9. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Qty	Reference Designator	Description	PCB Footprint	Vendor	Part No.
1	C1	Capacitor, 47 µF, 16 V	C1210	Murata	GRM32ER61C476KE15
1	C2, C9	Capacitor, optional	C1210		
1	C3	Capacitor, 1 µF	C0603	Murata	GRM188R71E105KA12
1	C4	Capacitor, 33 nF	C0603	Murata	GRM188R71E333KA01
1	C5	Capacitor, optional	C0603	Murata	
1	C6	Capacitor, 820 pF	C0603	Murata	GRM1885C1H821JA01
1	C7	Capacitor, 47 µF, 6.3 V	C1210	Murata	GRM32ER60J476ME20
1	C8	Capacitor, 100 µF, 6.3 V	C1210	Murata	GRM32ER60J107ME20
2	C10, C11	Capacitor, optional	C0603		
2	C12, C13	Capacitor, 0.1 µF	C0603	Murata	GRM188R71E104KA01
1	L1	Inductor, 0.47 µH	Inductor, 7 × 7	Würth Elektronik	744314047
1	R1	Resistor, 100 kΩ	R0603	Vishay	CRCW0603100KFKTA
2	R2, R4	Resistor, optional	R0603		
1	R3	Resistor, 27.4 kΩ	R0603	Vishay	CRCW060327K4FKTA
3	R5, R7, R8	Resistor, 10 kΩ	R0603	Vishay	CRCW060310KFKTA
1	R9	Resistor, 10 kΩ	R0603	Vishay	CRCW060310RFKTA
1	U1	IC	24-lead LFCSP_WQ	Analog Devices, Inc.	ADP2165
4	J1, J2, J3, J4	Connector	SIP2	Harwin	M20-9990245
3	J5, J7, J8	Jumper	SIP3	Harwin	M20-9990246
1	J6	Jumper	SIP2	Harwin	M20-9990245
8	T1, T2, T3, T4, T5, T6, T7, T8	Test point	SIP1	Harwin	M20-9990245

Table 3.

Qty	Reference Designator	Description	PCB Footprint	Vendor	Part No.
1	C1	Capacitor, 47 µF, 16 V	C1210	Murata	GRM32ER61C476KE15
1	C2, C9	Capacitor, optional	C1210		
1	C3	Capacitor, 1 µF	C0603	Murata	GRM188R71E105KA12
1	C4	Capacitor, 33 nF	C0603	Murata	GRM188R71E333KA01
1	C5	Capacitor, optional	C0603	Murata	
1	C6	Capacitor, 680 pF	C0603	Murata	GRM1885C1H681JA01
2	C7, C8	Capacitor, 100 µF, 6.3 V	C1210	Murata	GRM32ER60J107ME20
2	C10, C11	Capacitor, optional	C0603		
2	C12, C13	Capacitor, 0.1 µF	C0603	Murata	GRM188R71E104KA01
1	L1	Inductor, 0.47 µH	Inductor, 7 × 7	Würth Elektronik	744314047
1	R1	Resistor, 100 kΩ	R0603	Vishay	CRCW0603100KFKTA
2	R2, R4	Resistor, optional	R0603		
1	R3	Resistor, 36 kΩ	R0603	Vishay	CRCW060336KFKTA
3	R5, R7, R8	Resistor, 10 kΩ	R0603	Vishay	CRCW060310KFKTA
1	R9	Resistor, 10 kΩ	R0603	Vishay	CRCW060310RFKTA
1	U1	IC	24-lead LFCSP_WQ	Analog Devices	ADP2166
4	J1, J2, J3, J4	Connector	SIP2	Harwin	M20-9990245
3	J5, J7, J8	Jumper	SIP3	Harwin	M20-9990246
1	J6	Jumper	SIP2	Harwin	M20-9990245
8	T1, T2, T3, T4, T5, T6, T7, T8	Test point	SIP1	Harwin	M20-9990245

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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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