TPS61251 Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS61251 evaluation module (EVM). This EVM contains the Texas Instruments 3.25 MHz, up to 6.5 V, step-up DC-DC converter TPS61251 with an adjustable input current limit. The user's guide includes EVM specifications, recommended test setup, the schematic diagram, bill of materials, the board layout, and test data.

CAUTION

Please be aware that the input current is limited to 500 mA on this EVM. For maximum output current operation remove R3 and connect ILIM to VIN.

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1 Introduction

The TPS61251 device provides a power supply solution for products powered by either a three-cell alkaline, NiCd or NiMH battery, or a one-cell Li-Ion or Li-polymer battery. The wide input voltage range is ideal to power portable applications like mobile phones or computer peripherals. The device has a resistor programmable (RILIM) average input current limit and is suitable for a wide variety of applications.

1.1 Requirements

The TPS61251 EVM is designed to operate over the full input voltage range and produces an output voltage of 5.5 V. The output voltage can be adjusted by changing the feedback resistor divider network.

In order to operate this EVM, only a DC power supply capable of delivering between 2.3 V and 6.0 V at up to 500 mA is necessary.

1.2 Applications

- USB Host Supplies from a Single Li-Ion Battery
- Current Limited Applications
- Li-Ion Applications
- Audio Applications
- RF-PA Buffers

1.3 Features

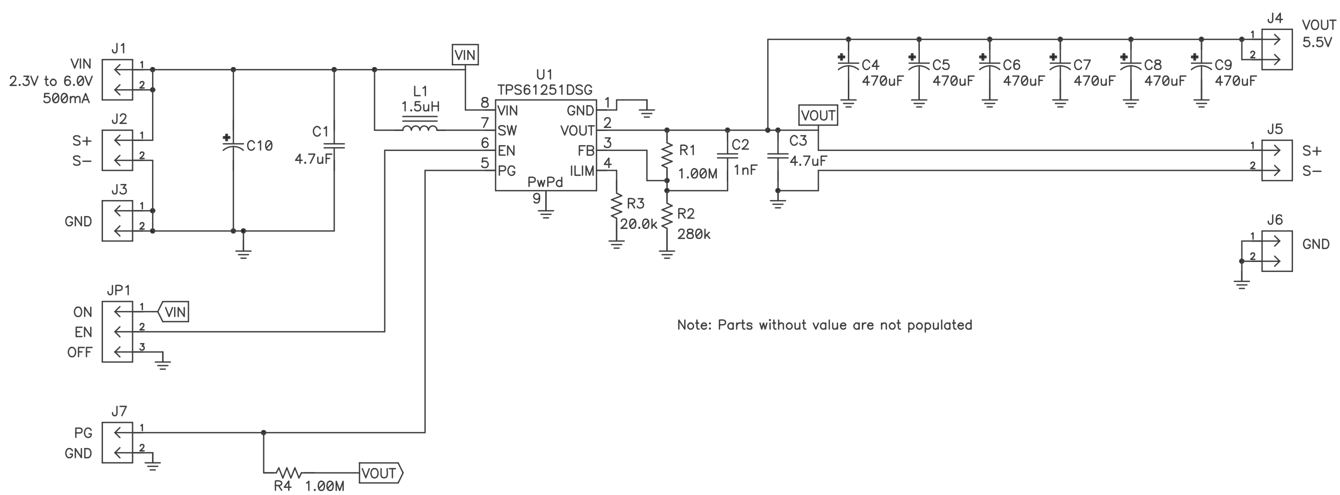
- Resistor Programmable Input Current Limit
  - ±20% Current Accuracy at 500 mA Over Full Temperature Range
  - Programmable from 100 mA up to 1500 mA
- Up to 92% Efficiency
- V_{IN} Range from 2.3 V to 6.0 V
- Power Good Indicates the Appropriate Output Voltage Level
- Adjustable Output Voltage up to 6.5 V
- 100% Duty-Cycle Mode When $V_{IN} > V_{OUT}$
- Load Disconnect and Reverse Current Protection
- Double-sided, two-active-layer PCB with all components on top side
- Active converter area of approximately 60 mm^2

2 TPS61251 EVM Electrical Performance Specifications

Table 1. TPS61251 EVM Electrical and Performance Specifications

Parameter	Symbol	Notes and Conditions	Min	Typ	Max	Unit
Input Characteristics						
Input Voltage	V_{IN}		2.3		6.0	V
Average Input Current	I_{IN}		400	500	600	mA
No Load Input Current					1	mA
Input UVLO	V_{IN_UVLO}	Falling		2.0	2.1	V
Output Characteristics						
Output Voltage	V_{OUT}	V_{IN} = 3.6 V, I_{OUT} = 300 mA	5.4	5.5	5.6	V
Line Regulation		V_{IN} = 2.3 V to 6.0 V		0.5%		
Load Regulation		I_{OUT} = 0 mA to 300 mA		0.5%		
Output Voltage Ripple	$V_{OUTripple}$	V_{IN} = 3.6 V, I_{OUT} = 300 mA			50	mVpp
Output Current	I_{OUT}	V_{IN} = 3.6 V			300	mA
Systems Characteristics						
Switching Frequency	f			3.25		MHz
Peak Efficiency	ηpk	V_{IN} = 3.6 V		92%		
Full Load Efficiency	η	V_{IN} = 3.6 V, I_{OUT} = 300 mA		90%		

3 TPS61251 EVM Schematic



NOTE: For Reference Only, See Table 2

Figure 1. TPS61251 EVM Schematic

4 Connector and Test Point Descriptions

4.1 Input Connectors

4.1.1 J1 – VIN

This header is the positive connection to the input power supply. The power supply must be connected between these pins and J3 (GND). Twist the leads to the input supply and keep them as short as possible. The input voltage has to be between 2.3 V and 6.0 V.

4.1.2 J2 – Input Sense Connector

This header is intended to measure the input voltage directly on the input capacitor. Therefore, a 4-wire power and sense supply can be connected. Twist the leads to the sensing connector.

4.1.3 J3 – GND

This header is the return connection to the input power supply. Connect the power supply between these pins and J1 (VIN). Twist the leads to the input supply and keep them as short as possible. The input voltage must be between 2.3 V and 6.0 V.

4.2 Output Connectors

4.2.1 J4 – VOUT

This header is the positive connection of the output voltage. Connect the load between these pins and J6 (GND).

4.2.2 J5 – Output Sense Connector

This header is intended to measure the output voltage directly on the output capacitors.

4.2.3 J6 – GND

This header is the return connection of the output voltage. Connect the load between these pins and J4 (VOUT).

4.3 Other Connectors

4.3.1 J7 – Power Good Connector

The Power Good Output (PG) of the IC is an open-drain output and there is a 1 MΩ resistor connected between PG and VOUT. Pin 1 of this connector is connected to PG and Pin2 is connected to GND.

4.4 Jumpers

4.4.1 JP1 – Enable Jumper

Placing a jumper across pins EN and ON ties the EN pin to VIN, thereby enabling the device. Placing a jumper across pins EN and OFF ties the EN pin to GND, which disables the device.

5 TPS61251 EVM Test Data

Figure 5 through Figure 11 present typical performance curves for the TPS61251 EVM. Since actual performance data can be affected by measurement techniques and environmental variables, these curves are presented for reference and may differ from actual field measurements.

5.1 Efficiency

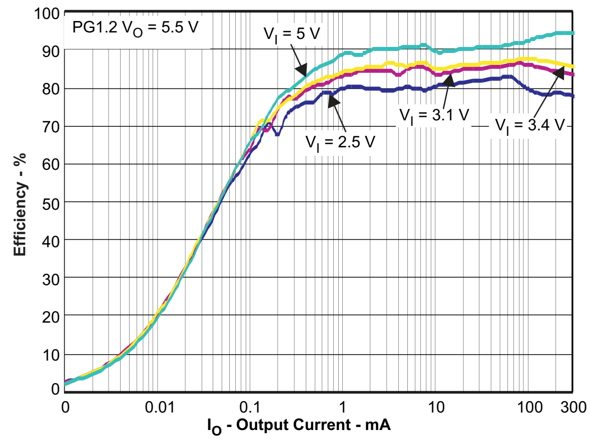


Figure 2. TPS61251 EVM Efficiency vs Load Current

5.2 Load and Line Regulation

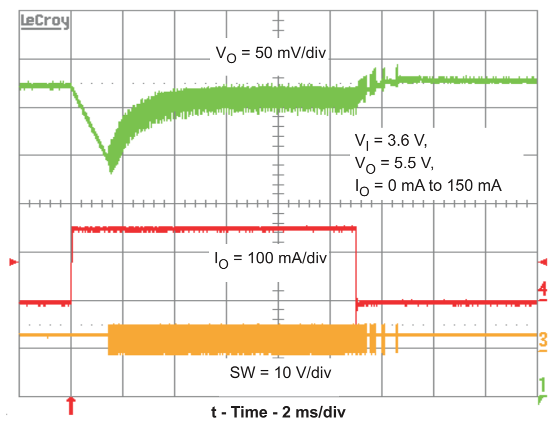


Figure 3. TPS61251 EVM Load Transient Response, Snooze Mode to PFM Mode

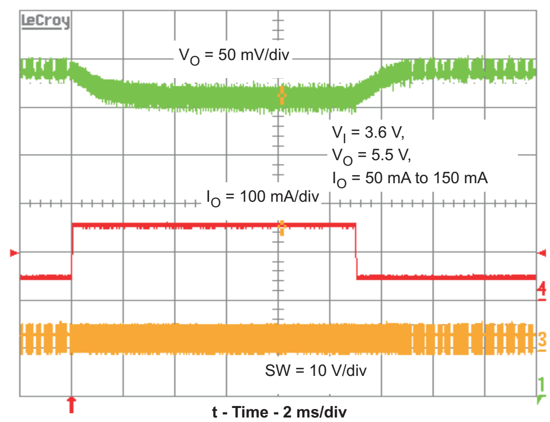


Figure 4. TPS61251 EVM Load Transient Response, PFM Mode

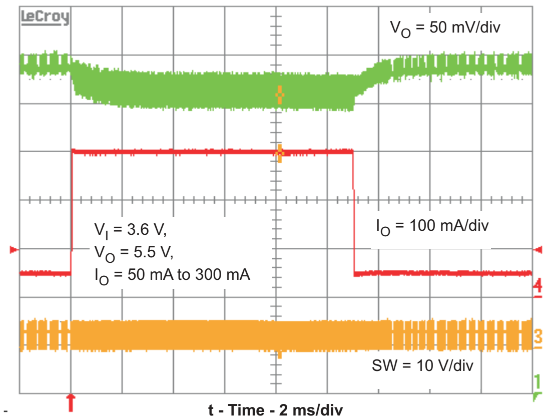


Figure 5. TPS61251 EVM Load Transient Response, PFM Mode to CCM Mode

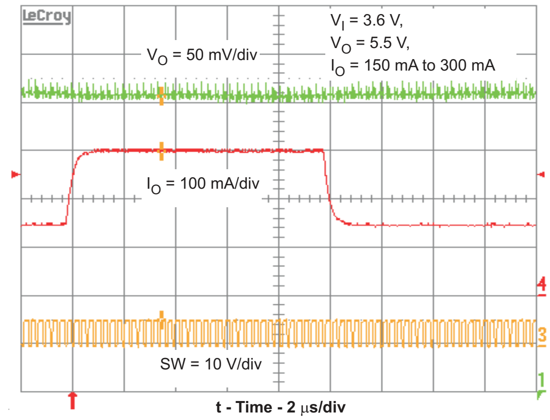


Figure 6. TPS61251 EVM Load Transient Response, CCM Mode

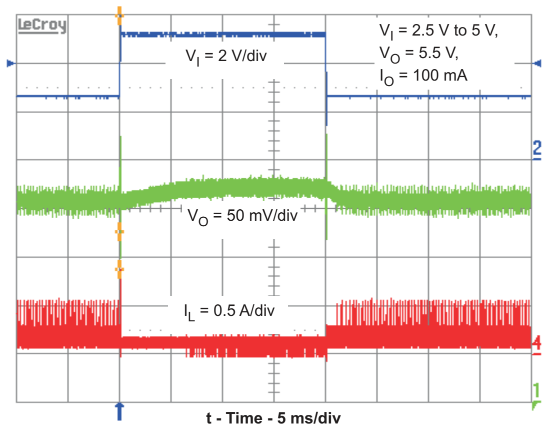


Figure 7. TPS61251 EVM Line Transient Response

5.3 Output Voltage Ripple

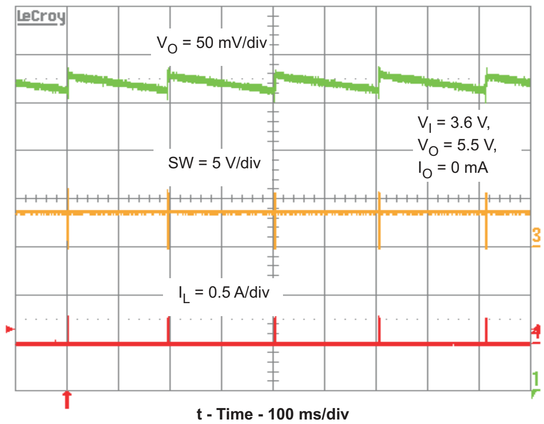


Figure 8. TPS61251 EVM Output Voltage Ripple in Snooze Mode

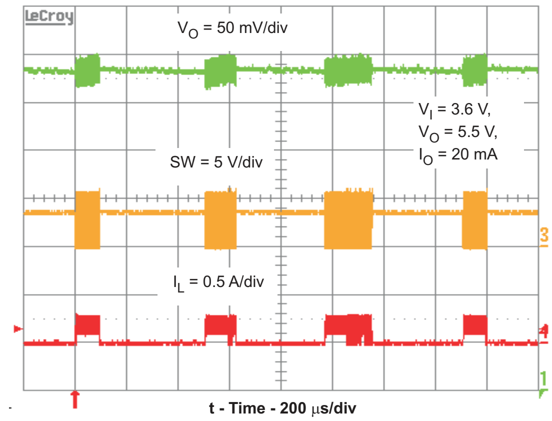


Figure 9. TPS61251 EVM Output Voltage Ripple in PFM Mode

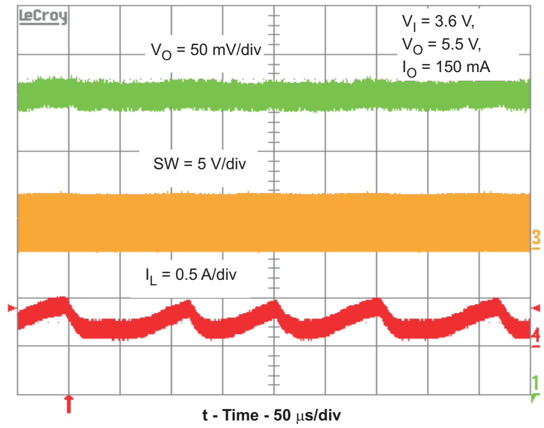


Figure 10. TPS61251 EVM Output Voltage Ripple at 150mA

The current variation on the inductor current is caused by mode changes inside the IC. The IC must ensure accurate output voltage regulation; with very low ESR the regulation loop can switch to a pure comparator regulation scheme. During this operation the output voltage is regulated between two thresholds. The upper threshold is defined by the programmed output voltage and the lower value is about 10 mV lower. If the upper threshold is reached, the off-time is increased to reduce the current in the inductor. Therefore, the output voltage drops slightly until the lower threshold is tripped. Now the off-time is reduced to increase the current in the inductor for charging up the output voltage to the steady-state value. The current swing during this operation mode strongly depends on the current drawn by the load; but, does not exceed the programmed current limit. The output voltage during comparator operation stays within the specified accuracy with minimum voltage ripple.

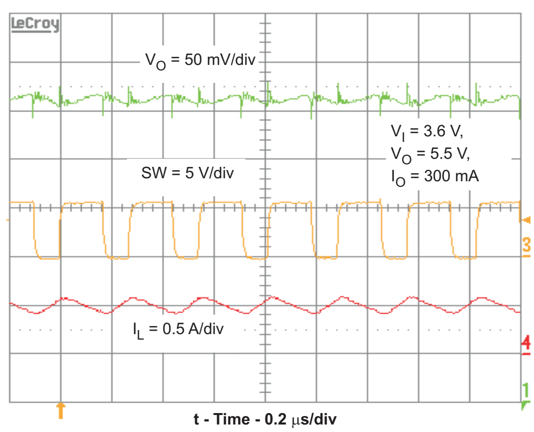


Figure 11. TPS61251 EVM Output Voltage Ripple at Full Load

5.4 Startup

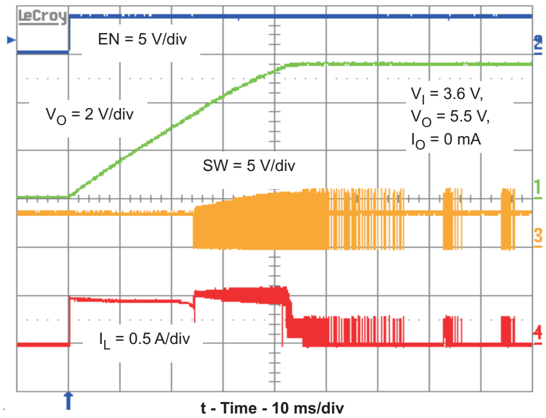


Figure 12. TPS61251 Startup With no Load

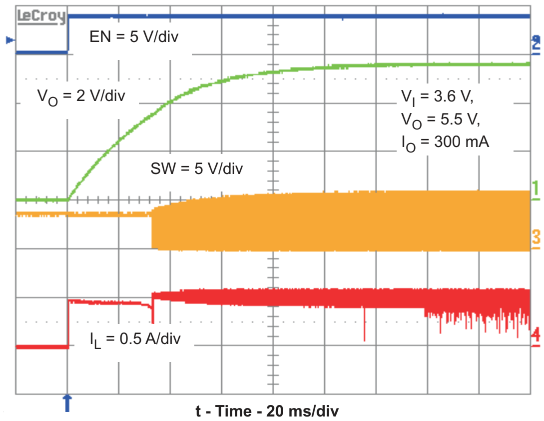


Figure 13. TPS61251 Startup With Full Load

6 TPS61251 EVM Assembly Drawings and Layout

Figure 14 through Figure 16 show the design of the TPS61251 EVM printed circuit board. The EVM uses a 2-Layer, 1-oz copper-clad circuit board 61 mm x 51 mm with all components in a 7 mm × 11 mm active area on the top side. All active top and bottom layer traces allow easy viewing and probing for evaluating the TPS61251 control IC in a practical double-sided application. Moving components to both sides of the PCB, or using additional internal layers, can offer additional size reduction for space-constrained systems.

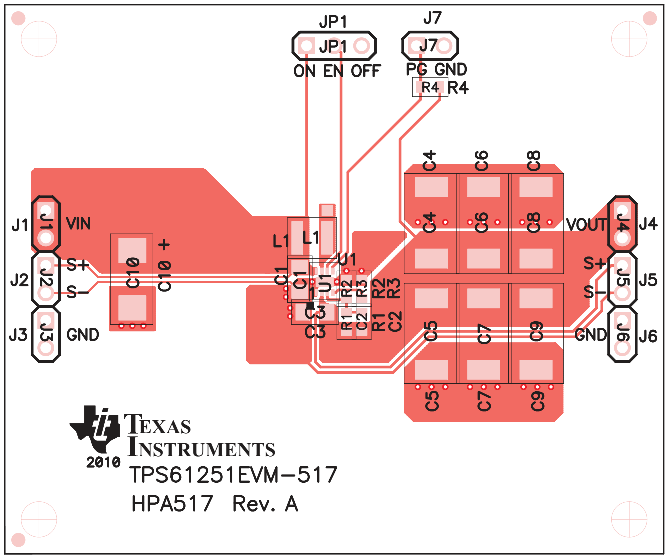


Figure 14. TPS61251 EVM Component Placement (Viewed from Top)

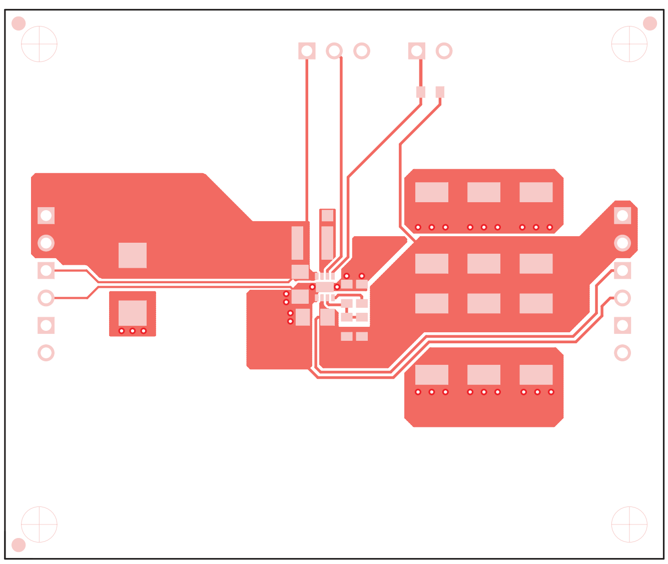


Figure 15. TPS61251 EVM Top Copper (Viewed from Top)

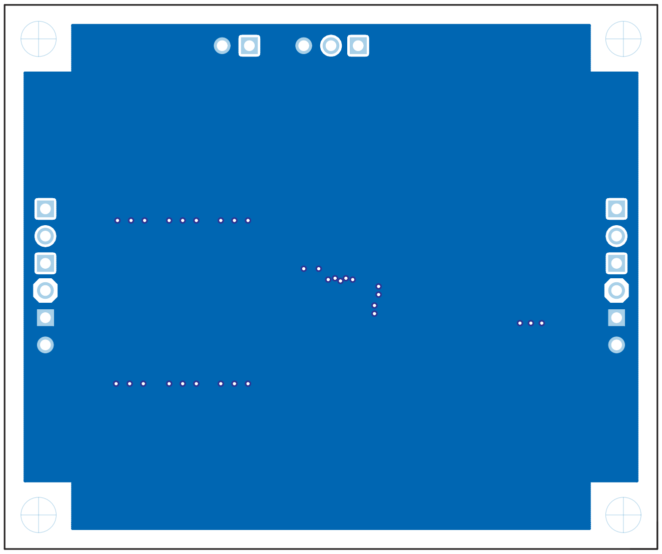


Figure 16. TPS61251 EVM Bottom Copper (Viewed from Bottom)

7 List of Materials

Table 2 lists the EVM components as configured according to the schematic shown in Figure 1.

Table 2. HPA517A Bill of Material

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C1, C3	4.7 µF	Capacitor, Ceramic, 10V, X7R, 10%	0805	GRM21BR71A475KA73	Murata
0	C10	open	Capacitor, Aluminum	6032 (C)	Std	Sanyo
1	C2	1nF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
6	C4, C5, C6, C7, C8, C9	470 µF	Capacitor, Polymer SMT, 6.3V, –25 to +105°C, ±20%	7343(D)	T520W477M006ATE055	Kemet
1	L1	1.5 µH	Inductor, SMT, 2.2A, 72mΩ	0.118 X 0.118 inch	XFL3012-152ME	Coilcraft
2	R1, R4	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	280k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	20.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	TPS61251DSG	IC, High Frequency Step-Up Converter, Fixed V_O	QFN	TPS61251DSG	TI

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 2.3 V to 6 V and the output voltage range of 3 V to 6.5 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 60° C. The EVM is designed to operate properly with certain components above 60° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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