Evaluation Board User Guide
UG-219

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Evaluating the ADP2370/ADP2371 Buck Regulators

FEATURES

Buck regulator input voltage range: 3.2 V to 15 V
Buck regulator output current: 800 mA
Operating temperature range: −40°C to +125°C

EQUIPMENT NEEDED

Voltage meters, current meters, power supply
Resistive or electronic loads

DOCUMENTS NEEDED

ADP2370/ADP2371 data sheet
UG-220 user guide

GENERAL DESCRIPTION

The ADP2370/ADP2371 evaluation boards (ADP2370CP-EVALZ and ADP2371CP-EVALZ) are used to demonstrate the functionality of the ADP2370/ADP2371 buck regulators.

Basic electrical performance measurements, such as line and load regulation, efficiency, and ground current, can be demonstrated with a few voltage supplies, voltage meters, current meters, and load resistors.

Complete information about the ADP2370/ADP2371 buck regulators is available in the ADP2370/ADP2371 data sheet, which should be consulted in conjunction with this user guide when using the evaluation board.

DIGITAL PICTURE OF THE EVALUATION BOARD

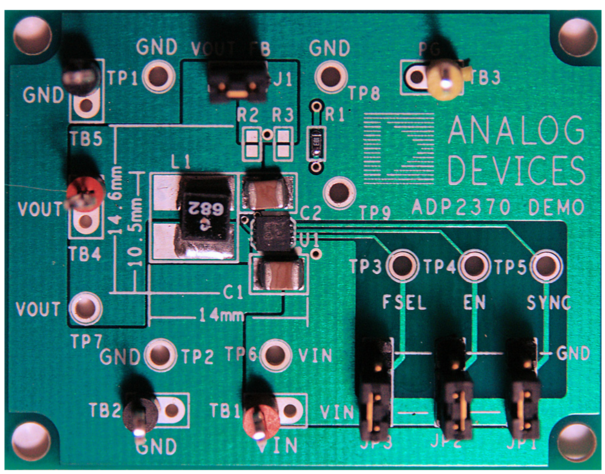

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

4/12—Revision 0: Initial Version

EVALUATION BOARD HARDWARE AND SCHEMATIC

EVALUATION BOARD CONFIGURATION

The ADP2370/ADP2371 evaluation boards ship with all the components necessary to perform basic electrical performance measurements, including the input and output capacitors, buck inductor, and power-good pull-up resistor. The placement of the critical components for the buck regulator (inductor and capacitors) has been optimized for low noise and the smallest possible footprint.

Figure 2 shows the schematic of the evaluation board configuration. Table 1 describes the hardware components.

For complete information about the ADP2370/ADP2371 buck regulators, see the ADP2370/ADP2371 data sheet.

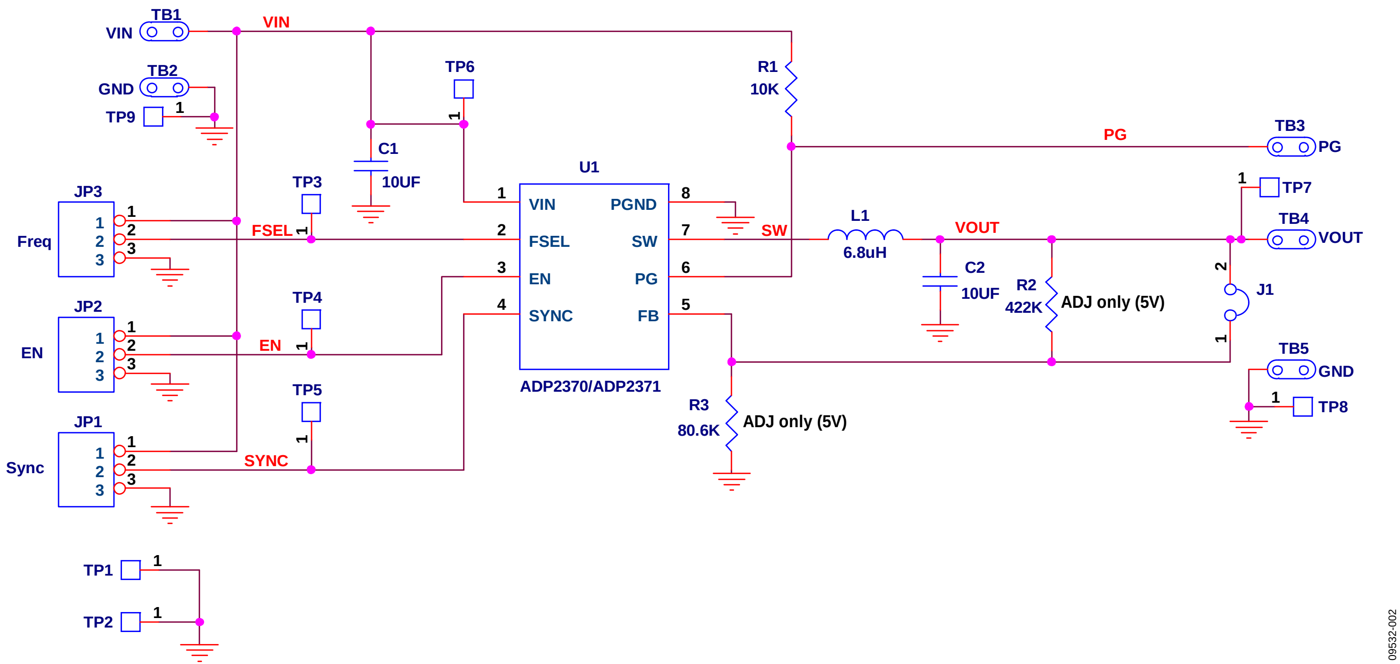

Figure 2. Evaluation Board Schematic

Table 1. Evaluation Board Hardware Components

Component	Function	Description
U1[1]	Buck regulator	ADP2370 or ADP2371 buck regulator.
C1	Input capacitor	10 µF input bypass capacitor required for transient performance.
C2	Output capacitor	10 µF output capacitor required for stability and transient performance.
L1[2]	Inductor	6.8 µH inductor for 3.3 V output at 1.2 MHz.
R1	Pull-up resistor	10 kΩ pull-up resistor for power good (PG).
R2	Resistor	422 kΩ, 1% resistor. With R3, sets the output voltage to 5 V (adjustable version only).
R3	Resistor	80.6 kΩ, 1% resistor. With R2, sets the output voltage to 5 V (adjustable version only).
JP1	Jumper	When JP1 is connected to VIN, forced PWM mode is enabled. When JP1 is connected to GND, auto mode is enabled. When JP1 is connected to SYNC, an external clock can be used to set the operating frequency.
JP2	Jumper	When JP2 is connected to VIN, the output is enabled. When JP2 is connected to GND, the output is disabled.
JP3	Jumper	When JP3 is connected to VIN, 1.2 MHz operation is selected. When JP3 is connected to GND, 600 kHz operation is selected.
J1	Jumper	Connects the FB pin to the buck regulator output (fixed output version only).

[1] Component varies depending on the evaluation board model ordered.
[2] Inductor value varies depending on the output voltage.

OUTPUT VOLTAGE ACCURACY MEASUREMENTS

Figure 3 shows how to connect the evaluation board to a voltage source and a voltage meter (voltmeter) for basic output voltage accuracy measurements. A resistor can be used as the load for the buck regulator. Ensure that the resistor has a power rating adequate to handle the power that is expected to be dissipated across it. An electronic load can be used as an alternative. In addition, ensure that the voltage source can supply enough current for the expected load levels.

Follow these steps to connect the evaluation board to a voltage source and voltage meter:

1. Connect the negative terminal (−) of the voltage source to the GND pad (TB2) on the evaluation board.
2. Connect the positive terminal (+) of the voltage source to the VIN pad (TB1) on the evaluation board.
3. Connect a load between the VOUT pad (TB4) and one of the GND pads on the evaluation board.
4. Connect the negative terminal (−) of the voltmeter to one of the GND pads on the evaluation board.
5. Connect the positive terminal (+) of the voltmeter to the VOUT pad (TP7) on the evaluation board.
6. Connect a jumper between Pin 1 and Pin 2 of JP2 to enable the buck regulator.
7. Connect a jumper between Pin 3 and Pin 2 of JP1 to enable auto mode.
8. Connect a jumper between Pin 1 and Pin 2 of JP3 to enable 1.2 MHz operation.
9. Turn on the voltage source.

If the load current is large, connect the voltage meter as close to TB4 as possible to reduce the effects of IR drops.

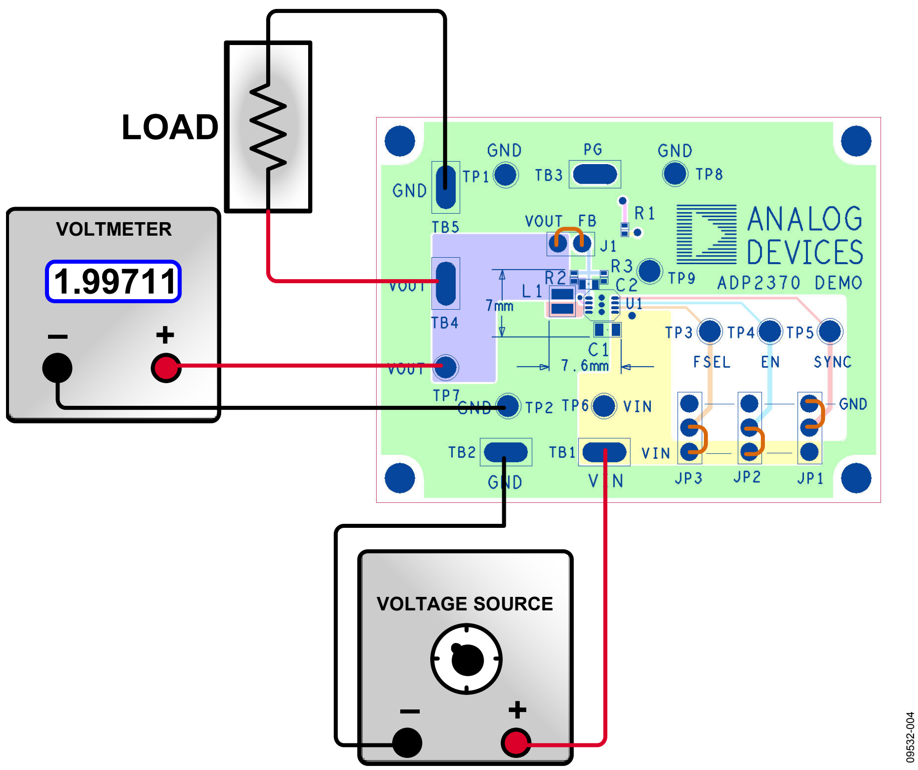

Figure 3. Buck Regulator Output Voltage Regulation Measurement Setup

LINE REGULATION MEASUREMENTS

For line regulation measurements, the output of the buck regulator is monitored while the input is varied. For good line regulation, the output must change as little as possible with varying input levels.

For example, for an ADP2370/ADP2371 with a fixed 3.3 V output, V_{IN} must be varied from 3.8 V to 15 V. This measurement can be repeated under different load conditions. Figure 4 shows the typical line regulation performance of an ADP2370/ADP2371 with a fixed 3.3 V output.

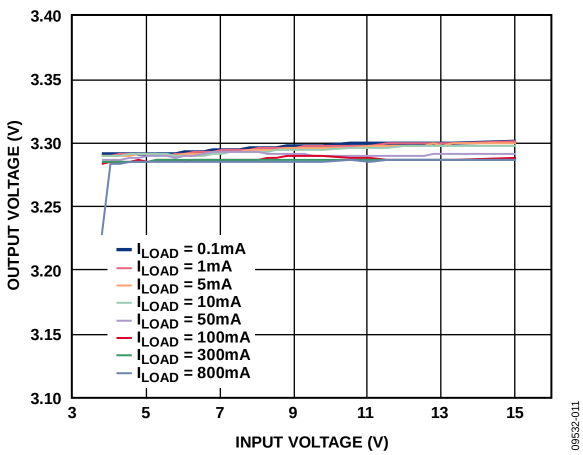

Figure 4. Output Voltage (V_{OUT}) vs. Input Voltage (V_{IN})

LOAD REGULATION MEASUREMENTS

For load regulation measurements, the output of the buck regulator is monitored while the load is varied. For good load regulation, the output must change as little as possible with varying loads.

The input voltage must be held constant during this measurement. The load current can be varied from 0 mA to 800 mA. Figure 5 shows the typical load regulation performance of an ADP2370/ADP2371 with a fixed 3.3 V output for various input voltages.

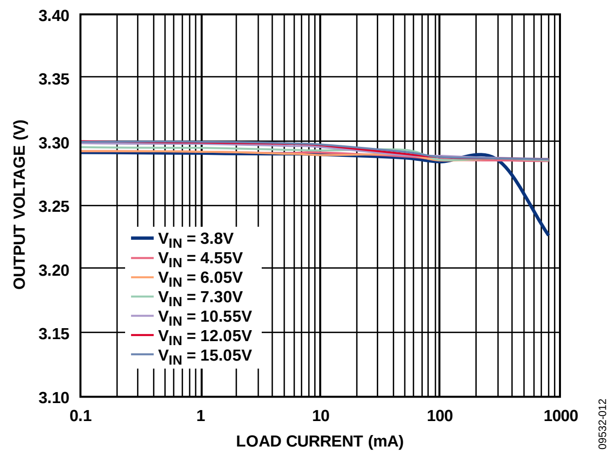

Figure 5. Output Voltage (V_{OUT}) vs. Load Current (I_{OUT})

EFFICIENCY MEASUREMENTS

Figure 6 shows how to connect the evaluation board to a voltage source, two voltage meters, and two current meters (ammeters) for basic efficiency measurements. A resistor can be used as the load for the buck regulator. Ensure that the resistor has a power rating adequate to handle the power that is expected to be dissipated across it. An electronic load can be used as an alternative. In addition, ensure that the voltage source can supply enough current for the expected load levels.

Follow these steps to connect the evaluation board to a voltage source and to the voltage and current meters:

1. Connect a jumper between Pin 1 and Pin 2 of JP2 to enable the buck regulator.
2. Connect a jumper between Pin 3 and Pin 2 of JP1 to enable auto mode.
3. Connect a jumper between Pin 1 and Pin 2 of JP3 to enable 1.2 MHz operation.
4. Connect the negative terminal (–) of the voltage source to the GND pad (TB2) on the evaluation board.
5. Connect the positive terminal (+) of the voltage source to the positive terminal (+) of the input ammeter.
6. Connect the negative terminal (–) of the input ammeter to the VIN pad (TB1) on the evaluation board.
7. Connect the positive terminal (+) of the input voltmeter to the VIN pad (TB1) on the evaluation board.
8. Connect the negative terminal (–) of the input voltmeter to the GND pad (TB2) on the evaluation board.
9. Connect the positive terminal (+) of the output ammeter to the VOUT pad (TB4) on the evaluation board.
10. Connect a load between the negative terminal (–) of the output ammeter and the GND pad (TB5) on the evaluation board.
11. Connect the positive terminal (+) of the output voltmeter to the VOUT pad (TB4) on the evaluation board.
12. Connect the negative terminal (–) of the output voltmeter to the GND pad (TP8) on the evaluation board.
13. Turn on the voltage source.

If the load current is large, connect the voltage meters as close as possible to the VIN and VOUT pads to reduce the effects of IR drops.

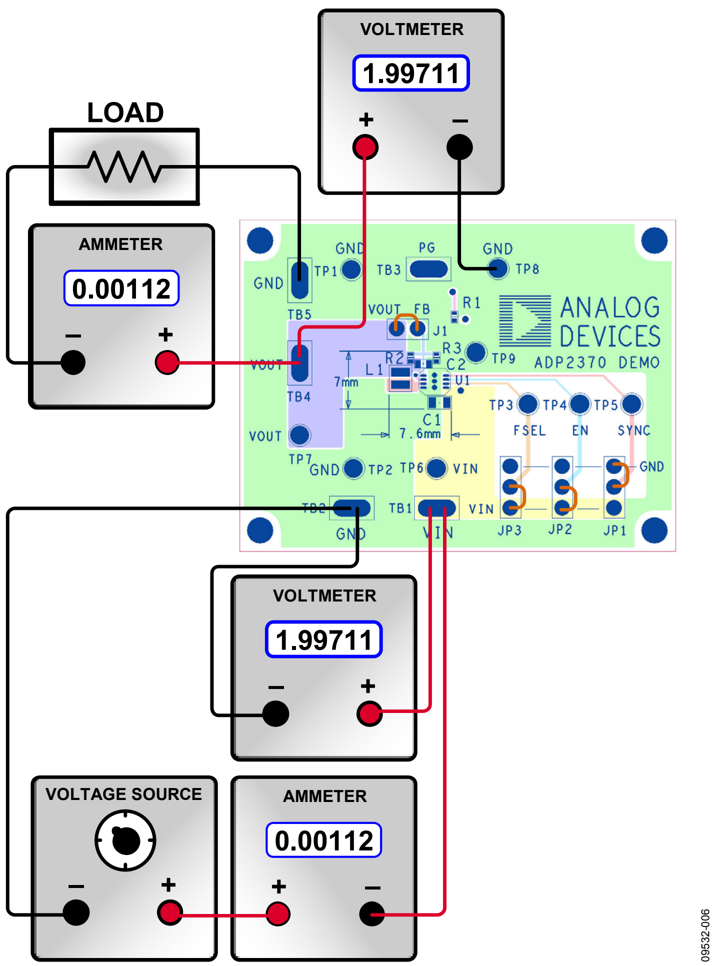

Figure 6. Buck Regulator Efficiency Measurement Setup

CALCULATING THE EFFICIENCY

The efficiency is calculated as follows:

$$Efficiency = 100\% \times (V_{OUT} \times I_{OUT})/(V_{IN} \times I_{IN})$$

The efficiency of the buck regulator can be measured over several combinations of input voltage and load current. Figure 7 shows the efficiency of a 3.3 V output buck regulator over input voltage and load current.

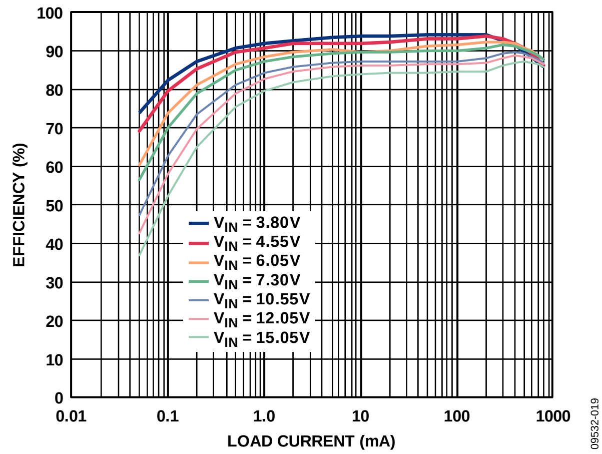

Figure 7. Efficiency vs. Input Voltage and Load Current

QUIESCENT CURRENT MEASUREMENTS

Figure 8 shows how to connect the evaluation board to two voltage sources and a current meter for quiescent current measurements.

Follow these steps to connect the evaluation board to the voltage sources and to the current meter:

1. Connect a jumper between Pin 1 and Pin 2 of JP2 to enable the buck regulator.
2. Connect a jumper between Pin 3 and Pin 2 of JP1 to enable auto mode.
3. Connect a jumper between Pin 1 and Pin 2 of JP3 to enable 1.2 MHz operation.
4. Connect the positive terminal (+) of the input voltage source to the positive terminal (+) of the ammeter.
5. Connect the negative terminal (−) of the ammeter to the VIN pad (TB1) on the evaluation board.
6. Connect the negative terminal (−) of the input voltage source to the GND pad (TB2) on the evaluation board.
7. Remove R1. (R1 can remain in circuit, but it increases the quiescent current by 10 kΩ/V_{IN}.)
8. Connect the positive terminal (+) of the output voltage source to the VOUT pad (TB4) on the evaluation board.
9. Connect the negative terminal (−) of the output voltage source to the GND pad (TB5) on the evaluation board.
10. If the output voltage source has a current limit function, set the current limit to 10 mA or less.
11. Set the output voltage source output voltage to ~500 mV above the normal output voltage of the ADP2370/ADP2371 evaluation board.
12. Turn on the voltage source.

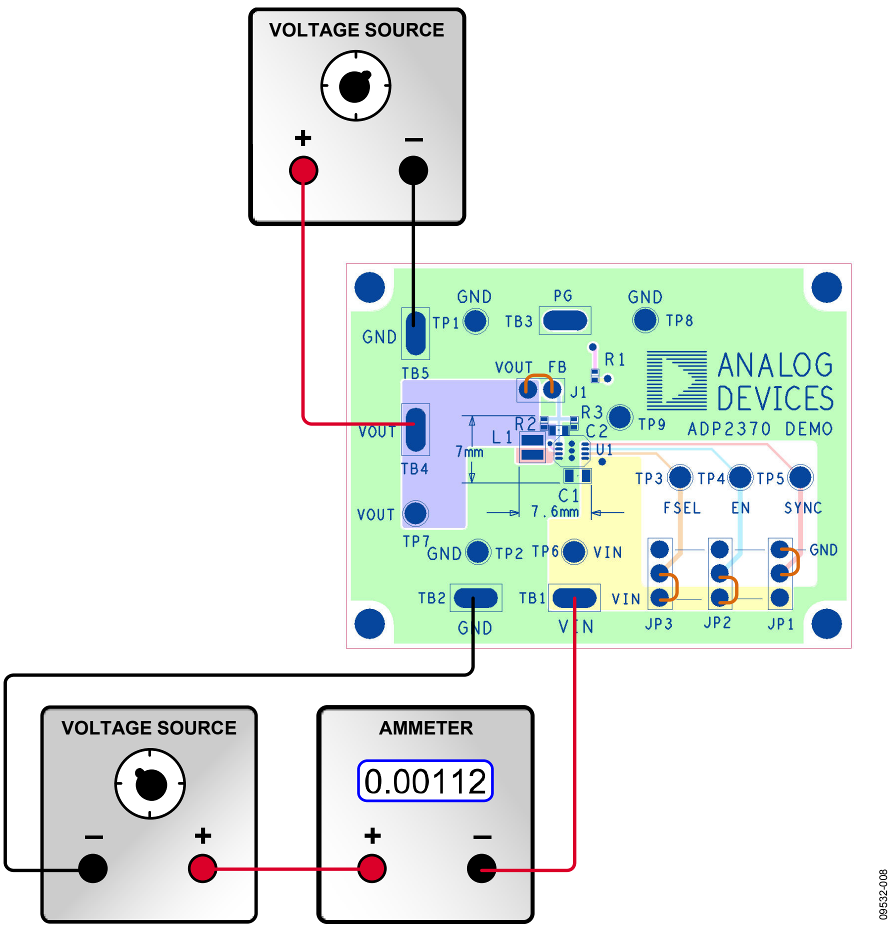

Figure 8. Quiescent Current Measurement Setup

QUIESCENT CURRENT CONSUMPTION

Quiescent current measurements can determine how much current the internal circuits of the buck regulator consume under no load conditions. To be efficient, the regulator must consume as little current as possible. Figure 9 shows the typical quiescent current consumption at no load for various input voltages. When the device is disabled (EN = PGND), quiescent current drops to less than 2 μA.

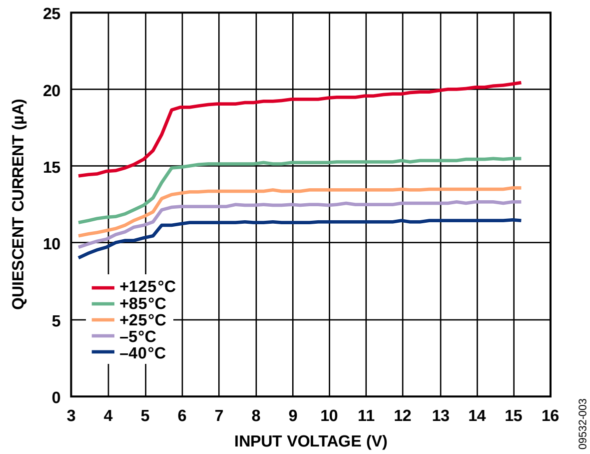

Figure 9. Quiescent Current vs. Input Voltage, No Load

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Qty	Reference Designator	Description	Manufacturer/Vendor	Vendor Part No.
2	C1, C2	Capacitor, MLCC, 10 µF, 25 V, 1210, X5R	Murata or equivalent	
3	JP1, JP2, JP3	Header, single, STR, three pins	Digi-Key Corp.	S1012E-03-ND
1	J1	Header, single, STR, two pins	Digi-Key Corp.	S1012E-02-ND
1	L1	Inductor, 6.8 µH, 4 mm × 4 mm × 3 mm	Coilcraft	XAL4030-682ME
1	R1	Resistor, 10 kΩ, 0.10 W, 0603	Vishay or equivalent	
1	U1	IC, ADP2370/ADP2371 buck regulator	Analog Devices, Inc.	ADP2370ACPZ-3.3-R7 ADP2371ACPZ-3.3-R7

RELATED LINKS

Resource	Description
ADP2370/ADP2371	Product Page
UG-220	ADP2370/ADP2371 RedyKit™ User Guide

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