ANALOG DEVICES

ADP5090-2-EVALZ User Guide
UG-782

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Evaluation Board for the ADP5090 Demonstration Platform for Energy Harvesting

FEATURES

Plug and play energy harvesting platform
Compatible with Analog Devices, Inc., wireless sensor network (WSN) platform
Solar panel harvester included
RoHS compliant

GENERAL DESCRIPTION

The ADP5090 demonstration platform is a plug and play evaluation board (ADP5090-2-EVALZ) for energy harvesting. It includes the photovoltaic (PV) panel and all of the power management to enable devices to be powered using energy harvesting. It is based on the Alta Device PV cell and the ADP5090 energy harvesting power management IC.

The ADP5090 demonstration platform converts light energy to electrical energy. The PV panel converts the light to 0.8 V electrical energy. The ADP5090 boosts the input voltage from 0.8 V to 3.5 V and stores the energy in a supercapacitor.

In addition, there is a low dropout (LDO) regulator on board that powers loads at lower voltage rails than the 3.5 V stored in the supercapacitor. The Alta Device PV cell is a light harvesting, dye sensitized PV cell. It is optimized for indoor environments, where lux levels of 200 lux to 1000 lux are typical.

The ADP5090 is an ultralow power, synchronous, boost dc-to-dc regulator. The ADP5090 runs from input voltages of 0.38 V to 3.3 V and provides a high efficiency solution with integrated power switch, synchronous rectifier, and battery management. The demo platform provides an easy way to evaluate the device.

Full details about the parts are available in the ADP5090 data sheet, which should be consulted when using the ADP5090-2-EVALZ.

The system also plugs directly into the Analog Devices WSN demo platform.

This user guide describes how to set up the board and how to use it for powering loads.

SYSTEM BLOCK DIAGRAM

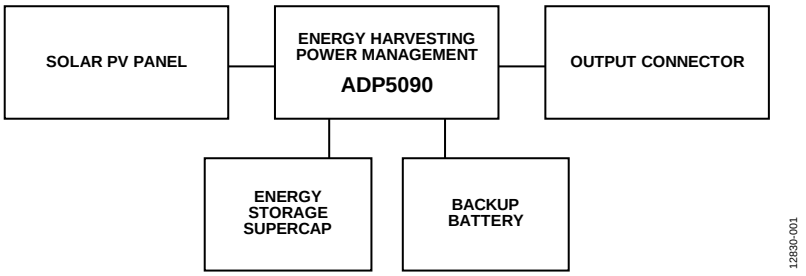

Figure 1.

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REVISION HISTORY

1/15—Revision 0: Initial Version

DEMONSTRATION BOARD QUICK START GUIDE

This section explains how to connect the solar panel to the evaluation board and how to configure the evaluation board to start up and run.

1. Connect the 10-pin connector on the solar panel to the J3 10-pin connector on the ADP5090 as shown in Figure 2.

Figure 2. ADP5090-2-EVALZ Hardware

2. Connect J2_1 and J2_2, J2_9 and J2_10, and J2_11 and J2_12 on the ADP5090, as shown in Figure 3.
3. Place the system in a bright environment. Monitor the voltage on the supercapacitor using the TP3 (BATT) and TP5 (GND) test points.
4. The output is available on J4_1 on the ADP5090.

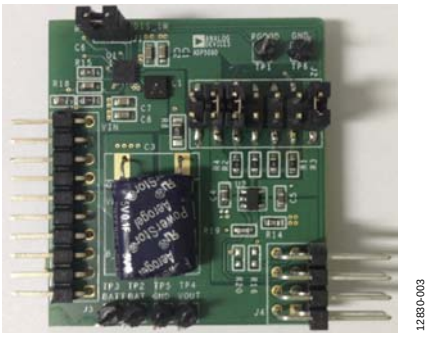

Figure 3. Jumper Setup

EVALUATION BOARD SCHEMATIC

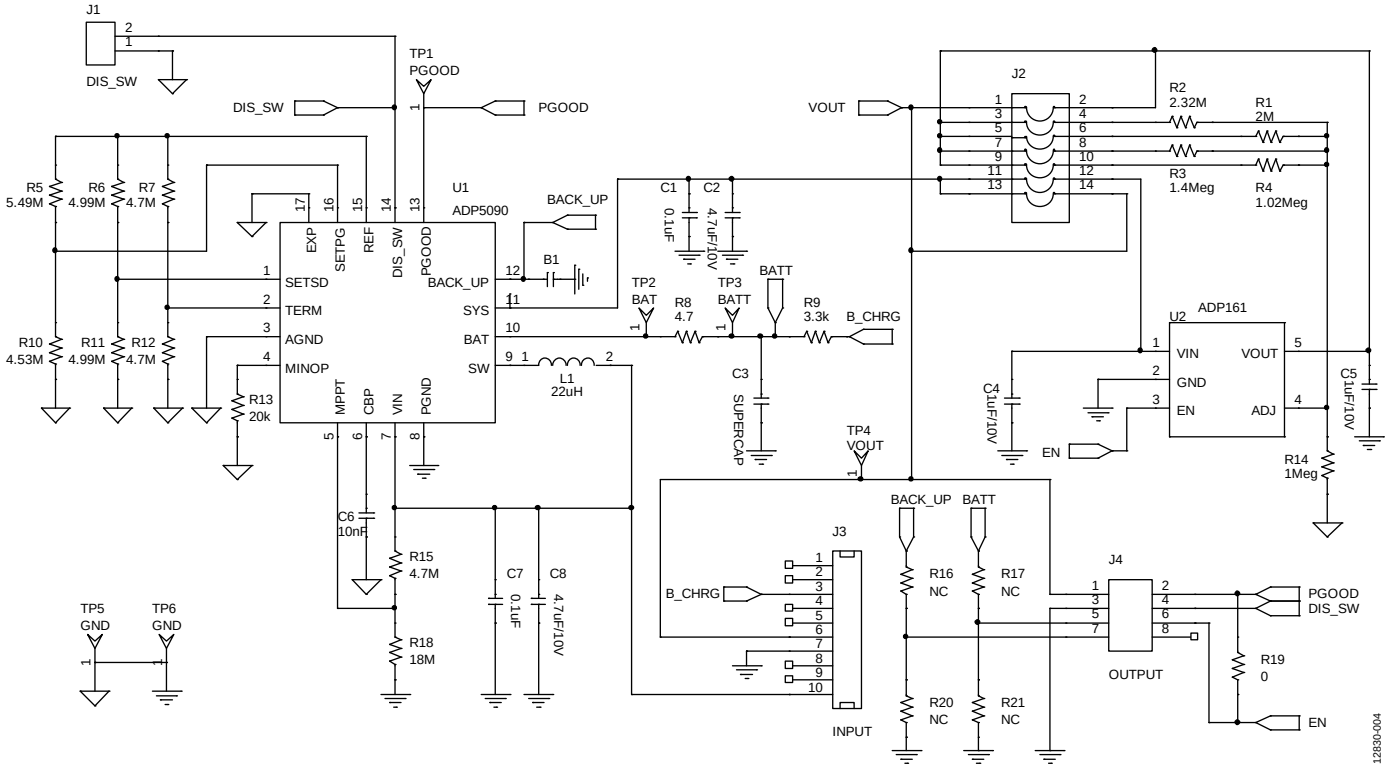

Figure 4. ADP5090 Evaluation Board

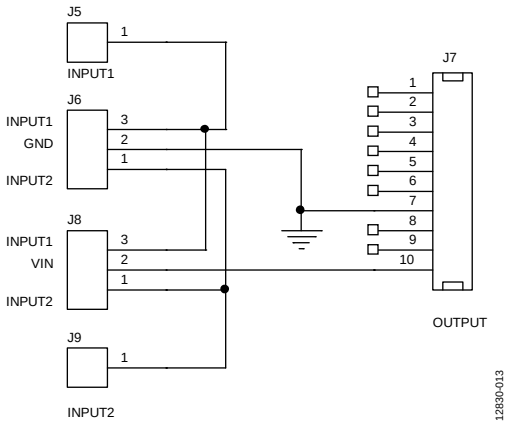

Figure 5. Solar Panel Board

EVALUATION BOARD LAYOUT

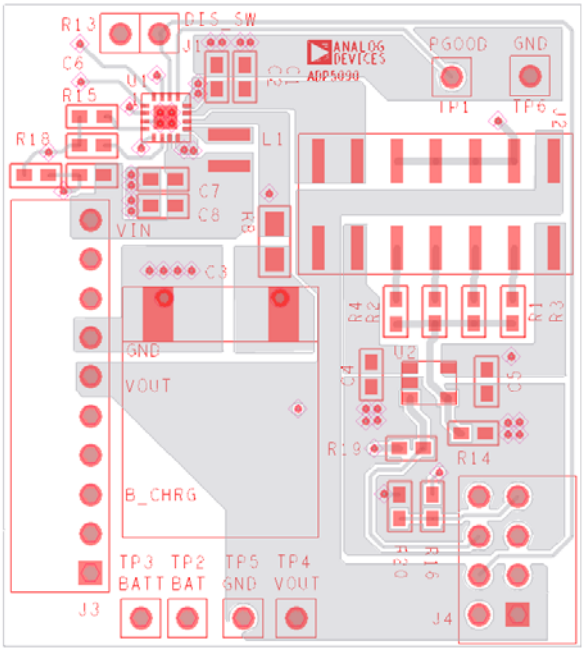

Figure 6. Top Assembly

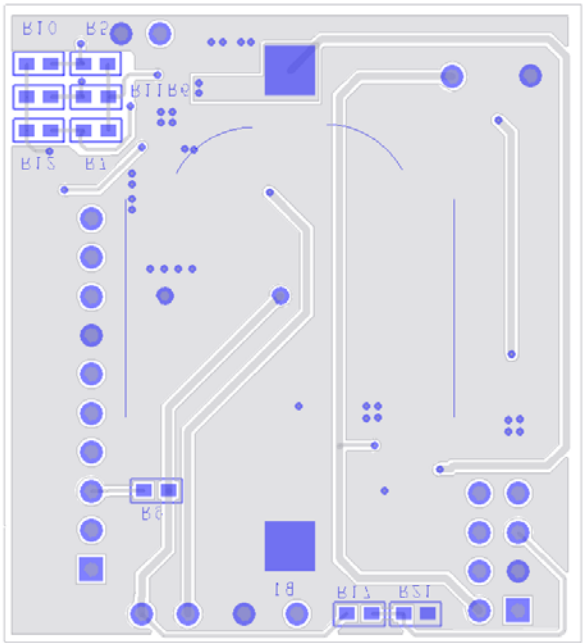

Figure 7. Bottom Assembly

EVALUATION BOARD HARDWARE

POWER MANAGEMENT OF THE OUTPUT (LDO)

A low dropout (ADP161) is included on the demo board. This regulator is used to choose different output voltages. Table 1 shows the jumper connections and the corresponding output voltage on the ADP5090-2-EVALZ. See the Evaluation Board Schematic section for more details.

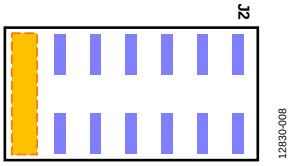

Figure 8. Jumper Position on Demonstration Board for Setting 1

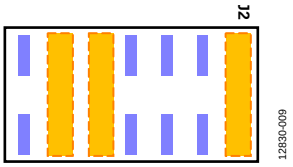

Figure 9. Jumper Position on Demonstration Board for Setting 2

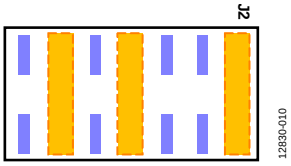

Figure 10. Jumper Position on Demonstration Board for Setting 3

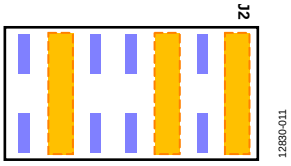

Figure 11. Jumper Position on Demonstration Board for Setting 4

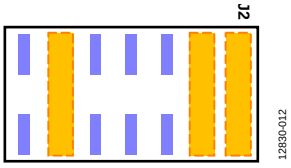

Figure 12. Jumper Position on Demonstration Board for Setting 5

Table 1. Power Management of Sensor Nodes

Setting	V_{OUT} (V)	Jumper Position
1	3.5 V (LDO bypassed)	J2_13 and J2_14 (see Figure 8)
2	2 V	J2_1 and J2_2, J2_9 and J2_10, and J2_11 and J2_12 (see Figure 9)
3	2.4 V	J2_1 and J2_2, J2_7 and J2_8, and J2_11 and J2_12 (see Figure 10)
4	3 V	J2_1 and J2_2, J2_5 and J2_6, and J2_11 and J2_12 (see Figure 11)
5	3.3 V	J2_1 and J2_2, J2_3 and J2_4, and J2_11 and J2_12 (see Figure 12)

J4 OUTPUT CONNECTOR

The J4 output connector (see Figure 13) connects the demo board to the load. As well as providing power, it also has some other interface connections that allow more interaction between the demo board and the host microcontroller unit (MCU) on the load. It is directly compatible with the Analog Devices WSN demo boards. Table 2 shows the pinout of the J4 output connector and a brief description of the pin functions.

Table 2. J4 Output Connector

Pin No.	Mnemonic	Description
1	VOUT	Output voltage supply from the demo board to the load
2	PGOOD	PGOOD output signal from the ADP5090
3	GND	Ground
4	DIS_SW	DIS_SW input signal to the ADP5090
5	BATT	Supercapacitor voltage (for battery monitoring)
6	EN	Enable LDO
7	BACK_UP	Backup voltage (for battery monitoring)
8	NC	No connect

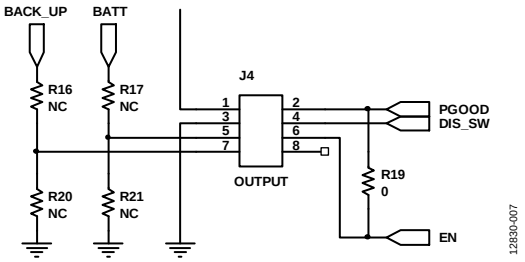

Figure 13. J4 Output Connector

A detailed description of each J4 output connector pin follows:

- The VOUT pin (Pin 1) is the output voltage that the demonstration board delivers to the load.
- The ADP5090 has a programmable PGOOD signal. When the PGOOD threshold is reached, the ADP5090 sets the PGOOD pin (Pin 2) high. It is connected to the host MCU GPIO input. See the ADP5090 data sheet for more detailed information on this function.
- The GND pin (Pin 3) is the ground connection for the ADP5090.
- Connect the DIS_SW pin (Pin 4) to the host MCU GPIO output. If the host MCU requires the ADP5090 to temporarily halt the switching regulator function, set this pin high. See the ADP5090 data sheet for more detailed information on this function.
- Connect the BATT pin (Pin 5) to the analog input of the host MCU to monitor the voltage on the supercapacitor of the ADP5090 demo board. Populating R17 and R21 creates a resistor divider for cases where the MCU analog input range is lower than the supercapacitor voltage.
- The EN pin (Pin 6) is the enable control signal for the ADP161 LDO regulator on the ADP5090 demonstration board. Connect this pin to the host MCU GPIO output to enable or disable the ADP161.
- Connect the BACK_UP pin (Pin 7) to the analog input of the host MCU to monitor the voltage on the supercapacitor of the ADP5090 demonstration board. Populating R16 and R20 creates a resistor divider for cases where the MCU analog input range is lower than the supercapacitor voltage.
- The NC pin (Pin 8) is the no connect pin. Do not use this pin.

BILL OF MATERIALS

Table 3. Bill of Materials

Quantity	Reference	Description	Part Number	Vendor
1	B1	CR2032 holder	BC2032-F1	Memory Protection Devices
2	C1, C7	0.1 µF capacitors, C0603	GRM188R71H104KA93	Murata
2	C2, C8	4.7 µF, 10 V capacitors, C0603	GRM21BR61A475KA73	Murata
1	C3	Supercapacitor, 12 × 12	PB-5R0H104-R	Cooper Bussmann
2	C4, C5	1 µF,10 V capacitors, C0603	GRM185R61A105KE36	Murata
1	C6	10 nF capacitor, C0603	GRM188R71H103KA01	Murata
1	J1	DIS_SW jumper, SIP2	61304011121	Würth Elektronik
1	J2	VOUT jumper, SIP14_dual	61001421121	Würth Elektronik
1	J3	INPUT jumper, SIP10_BtoB	61301011021	Würth Elektronik
1	J4	OUTPUT jumper, SIP8_2rows	61300821021	Würth Elektronik
1	J5	INPUT1 jumper, PV_INPUT	Not applicable	Alta Device
1	J6	GND jumper, SIP3	61304011121	Würth Elektronik
1	J7	OUTPUT jumper, SIP10	613010143121	Würth Elektronik
1	J8	VIN jumper, SIP3	61304011121	Würth Elektronik
1	J9	INPUT2 jumper, PV_INPUT	Not Applicable	Alta Device
1	L1	22 µH inductor, 3 × 3	EPL3015-223ML, 744025220	Coilcraft®, Würth Elektronik
1	R1	2 MΩ resistor, R0603	CRCW06032M00FKEA	Vishay Dale
1	R2	2.32 MΩ resistor, R0603	CRCW06032M320FKEA	Vishay Dale
1	R3	1.4 MΩ resistor, R0603	CRCW06031M40FKEA	Vishay Dale
1	R4	1.02 MΩ resistor, R0603	CRCW06031M02FKEA	Vishay Dale
1	R5	5.49 MΩ resistor, R0603	CRCW06035M49FKEA	Vishay Dale
2	R6, R11	4.99 MΩ resistors, R0603	CRCW06034M99FKEA	Vishay Dale
3	R7, R12, R15	4.7 MΩ resistors, R0603	CRCW06034M70FKEA	Vishay Dale
1	R8	4.7 Ω resistor, R0805	CRCW08054R70JNEAIF	Vishay Dale
1	R9	3.3 kΩ resistor, R0603	CRCW06033K3FKEA	Vishay Dale
1	R10	4.53 MΩ resistor, R0603	CRCW06034M53FKEA	Vishay Dale
1	R13	20 kΩ resistor, R0603	CRCW060320K0FKEA	Vishay Dale
1	R14	1 MΩ resistor, R0603	CRCW06031M00FKEA	Vishay Dale
4	R16, R17, R20, R21	NC (no connect) resistors, R0603	Not Applicable	Not Applicable
1	R18	18 MΩ resistor, R0603	RK73B1JTTD186J	KOA
1	R19	0 Ω resistor, R0603	CRCW06030000FKEA	Vishay Dale
1	TP1	PGOOD test point, SIP1	61304011121	Würth Elektronik
1	TP2	BAT test point, SIP1	61304011121	Würth Elektronik
1	TP3	BATT test point, SIP1	61304011121	Würth Elektronik
1	TP4	VOUT test points, SIP1	61304011121	Würth Elektronik
2	TP5, TP6	GND test points, SIP1	61304011121	Würth Elektronik
1	U1	ADP5090 16-lead LFCSP	ADP5090ACPZ-1-R7	Analog Devices
1	U2	ADP161 5-lead SOT-23	ADP161AUJZ-R7	Analog Devices

NOTES

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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