

EPC Space EPCSC401 Demonstration board user guide

20V to 50V Input, 12V 5A Output DC-DC converter featuring EPC7011L7 Rad-Hard power stage and EPCS4001 Rad-Hard Control IC

EPCSC401 is a Rad-Hard DC-DC converter demonstration system, meant to generate a regulated output from a wide input range voltage source, when no isolation is necessary.

The power conversion topology consists of a buck regulator, implemented with EPC7011L7 rad-hard, hermetic GaN power stage. The converter control is provided by the EPCS4001, a Si-based rad-hard control IC designed and manufactured by CERN. Figure 1 shows the top side of the PCB, while Figure 2 shows the schematic.



Figure 1: top side view of EPCSC401 demo board

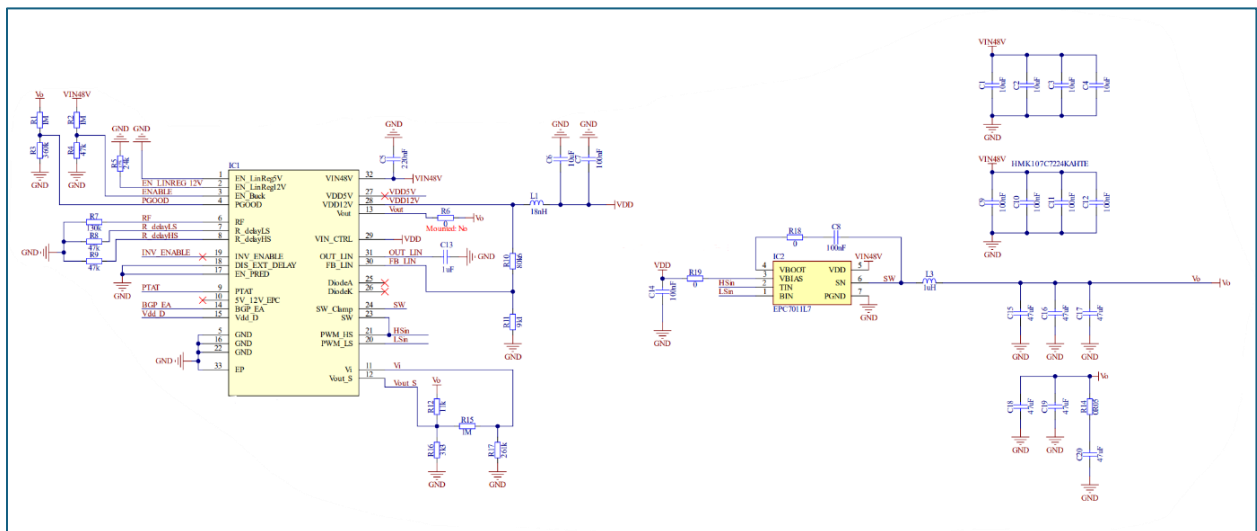


Figure 2: EPCSC401 schematic

Datasheets for both EPC Space products (Control IC and Power Stage) are available on epc.space website for download.

PCB Assembly and Thermal Considerations

Figure 3 shows the main elements of the system.

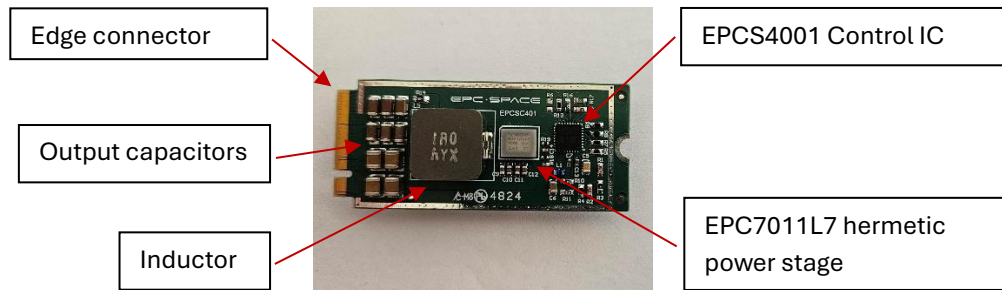


Figure 3: EPCSC401 Main Elements

The bottom of the PCB includes a minimalistic heatsink (shown in Figure 4), which is necessary to operate the converter with full output power in normal Lab settings.

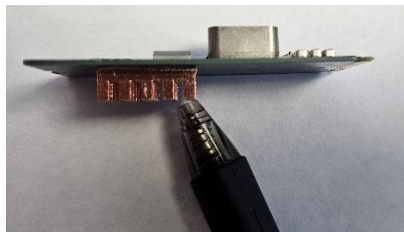


Figure 4: bottom side heatsink (parts are conduction-cooled only through the PCB)

Both the IC and the power stage are designed to be cooled through the PCB, by a combination of copper pours (min Cu 1.5oz recommended) and thermal vias. In Space applications, the PCB is mechanically and thermally coupled to larger mechanical structures, which are normally able to dissipate single-digit Watt levels of thermal power. For the sake of the demonstration board, the provided heatsink will enable the same capability, with a minimal airflow (~400CFM) at room temperature. It is important to notice that

coupling the two devices through the PCB bottom layer enables the thermal protection in the IC to act on the power stage temperature as well.

Recommended Lab Setup

The demo system includes a motherboard that routes power and probing signals out of the demo board edge connector. Simply insert the connector and secure the converter with a bolt at the top. Figure 5 shows the motherboard and its schematic.

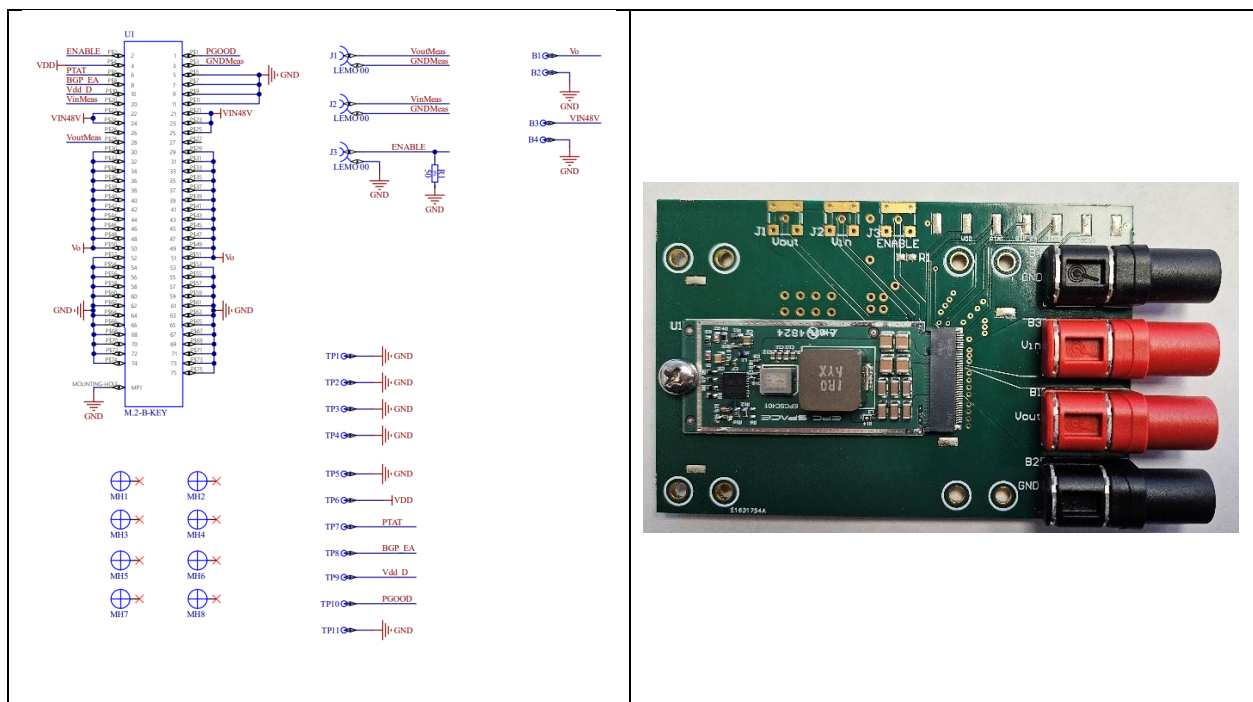


Figure 5: Motherboard schematic and board with the DC-DC converter installed

Banana jacks on the motherboard are clearly labeled and color coded, to interconnect an external power supply and a load. A variety of test points are available; J1, J2 and J3 are configured for “tip-and-barrell” oscilloscope probes, as shown in Figure 6 on a typical benchtop setup.

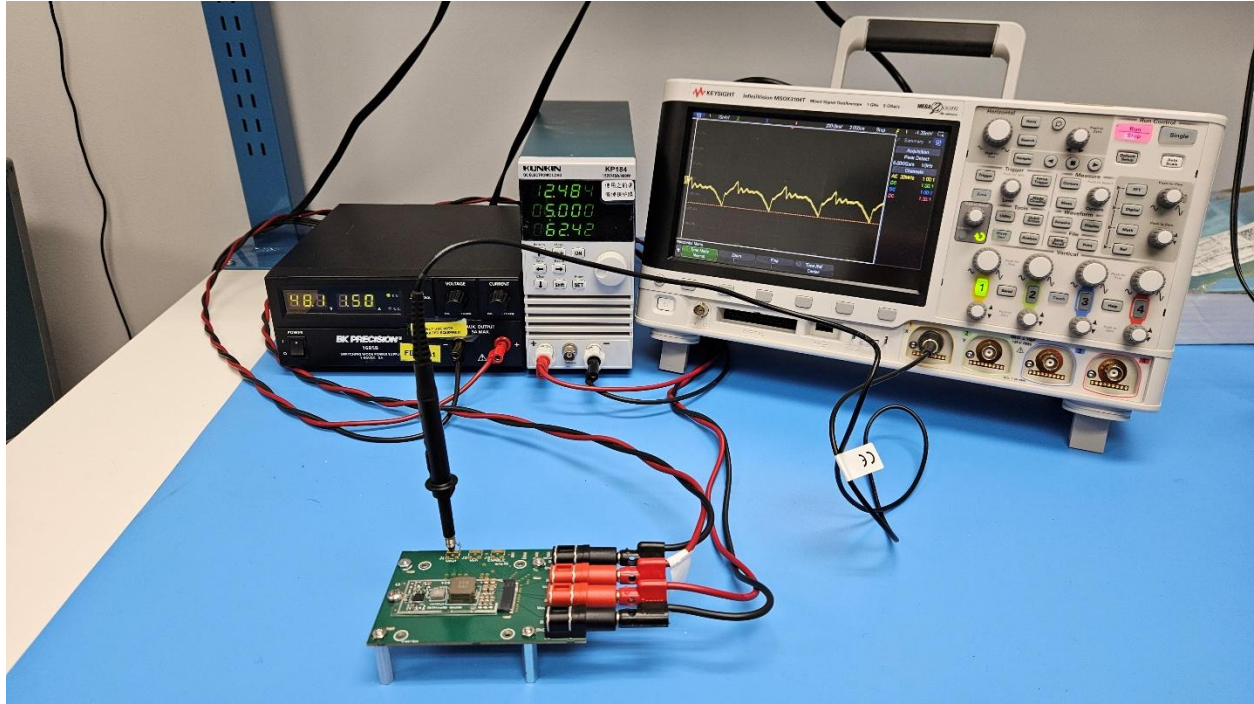


Figure 6: typical benchtop setup

Notes on demo board configuration

- Power good signal: configurable through divider R1, R3; as shipped, 3.2V for a nominal 12V output.
- Enable: configurable through divider R2, R4; as shipped, it enables switching when V_{in} exceeds $\sim 18V$. Absolute maximum rating is 3.3V, which has to be maintained when V_{in} reaches max.
- V_{out} can be supplied to the power stage through R6 if in the 12V range. As shipped, R6 is not populated, and the controller always uses the internal linear regulator to generate the 12V rail for the power stage. If populated, the internal LDO will be OR-ed with the output voltage.
- If more than 2A load is applied, please apply some airflow.

Bill of Materials

Designator	Value	Description	Manufacturer	Quantity	Manufacturer Info
C1, C2, C3, C4	10uF 1210 100V	Non-polarised capacitor		4	CC1210_10UF_100V_10%_X7S
C5	220nF 0805 100V	Non-polarised capacitor		1	CC0805_220NF_100V_10%_X7R
C6	10uF 0805 25V	Non-polarised capacitor		1	CC0805_10UF_25V_10%_X5R
C7, C8, C14	100nF 0402 50V	Non-polarised capacitor		3	CC0402_100NF_50V_10%_X7R
C9, C10, C11, C12	100nF 0603 100V	Non-polarised capacitor		4	CC0603_100NF_100V_10%_X7R
C13	1uF 0402 25V	Non-polarised capacitor		1	CC0402_1UF_25V_10%_X5R
C14	100nF 0402 50V	Non-polarised capacitor			CC0402_100NF_50V_10%_X7R
C15, C16, C17, C18, C19, C20	47uF 1206 25V	Non-polarised capacitor		6	CC1206_47UF_25V_20%_X5R
FTG1, FTG2, FTG3		Fiducial Target		3	FIDUCIAL_TARGET_C100-200
IC1	EPCS4001	EPC Space IC REG CTRLR BUCK	EPC Space	1	EPCS4001
IC2	EPC7011L7C	EPC Space power stage	EPC Space	1	EPC7011L7C
L1	18nH	Power Inductor	KEMET	1	SDWL1608CP18NGSTF
L3	1uH	Inductor	Coilcraft	1	MPX1D1264L1R0
R1, R2, R15	1M	Resistor - 1%		3	R0603_1M_1%_0.1W_100PPM
R3	360k	Resistor - 1%		1	R0603_360K_1%_0.1W_100PPM
R4, R8, R9	47k	Resistor - 1%		3	R0603_47K_1%_0.1W_100PPM
R5	24k	Resistor - 1%		1	R0603_24K_1%_0.1W_100PPM
R6	0	Resistor		1	R0603_0R_JUMPER
R7	130k	Resistor - 1%		1	R0603_130K_1%_0.1W_100PPM
R10	80k6	Resistor - 0.1%		1	R0603_80K6_0.1%_0.063W_10PPM
R11	9k1	Resistor - 0.1%		1	R0603_9K1_0.1%_0.1W_25PPM
R12	11k	Resistor - 1%		1	R0603_11K_1%_0.1W_100PPM
R14	0R05	Resistor - 1%		1	R0805_0R05_1%_0.25W_300PPM
R16	3k3	Resistor - 0.1%		1	R0603_3K3_0.1%_0.1W_25PPM
R17	261k	Resistor - 0.1%		1	R0603_261K_0.1%_0.063W_10PPM
R18, R19	0	Resistor		2	R0402_0R_JUMPER
U1	M.2-B-KEY	M2 connector		1	