DCM3717 SM-ChiP Evaluation Board

48V to Point-of-Load Non-Isolated, Regulated DC-DC Converter

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Introduction

The DCM3717 is a non-isolated, regulated DC-DC converter module that operates from a semi-regulated 40 – 60V input to generate a regulated point-of-load output voltage with a range of 10.0 – 12.5V depending on the model. The DCM3717 in the SM-ChiP package configuration utilizes the Vicor patented zero-voltage switching (ZVS) buck-boost regulator stage followed by the Sine Amplitude Converter (SAC™).

The focus of this document is to assist the user in evaluating the DCM3717 SM-ChiP™ family.

The DCM™ evaluation board can be configured for various enabling and fault monitoring schemes, as well as to exercise various loading conditions depending on the application requirements. The evaluation board can be used to evaluate DCMs in stand-alone configuration.

IMPORTANT NOTICE:

Read the precautions below entirely BEFORE using the DCM™ Evaluation Board. Do not operate the evaluation board unless you have the appropriate safety precautions in place on your bench to guarantee safety.

The list below is not comprehensive and is not a substitute for common sense and good practice.

- During operation, the power devices and surrounding structures can be operated safely at high temperatures.
- Remove power and use caution when connecting and disconnecting test probes and interface lines to avoid inadvertent short circuits and contact with hot surfaces.
- When testing electronic products always use approved safety glasses. Follow good laboratory practice and procedures.
- Care should be taken to protect the user from accidental contact when under power.
- Care should be taken to avoid reversing polarities if connecting to the opposite (solder) side of the board.
- The product evaluation boards described in this document are designed for general laboratory evaluation and are not suitable for installation in end-user equipment.
- Refer to the specific DCM module data sheet for electrical, thermal and mechanical product details.

Contents

The evaluation board demo assembly ships with the following contents:

- 1 x DCM evaluation board
- 1 x heat sink and mounting hardware

Features

The DCM evaluation board has the following features:

1. DCM3717 SM-ChiP
2. PMBus interface using a micro USB port.
3. Basic input and output filtering using low ESR ceramic caps and an input LC filter.
4. Test points for DCM signal terminals.
5. Kelvin voltage test points for all power terminals for input and output voltage measurements

Table 1
Evaluation boards

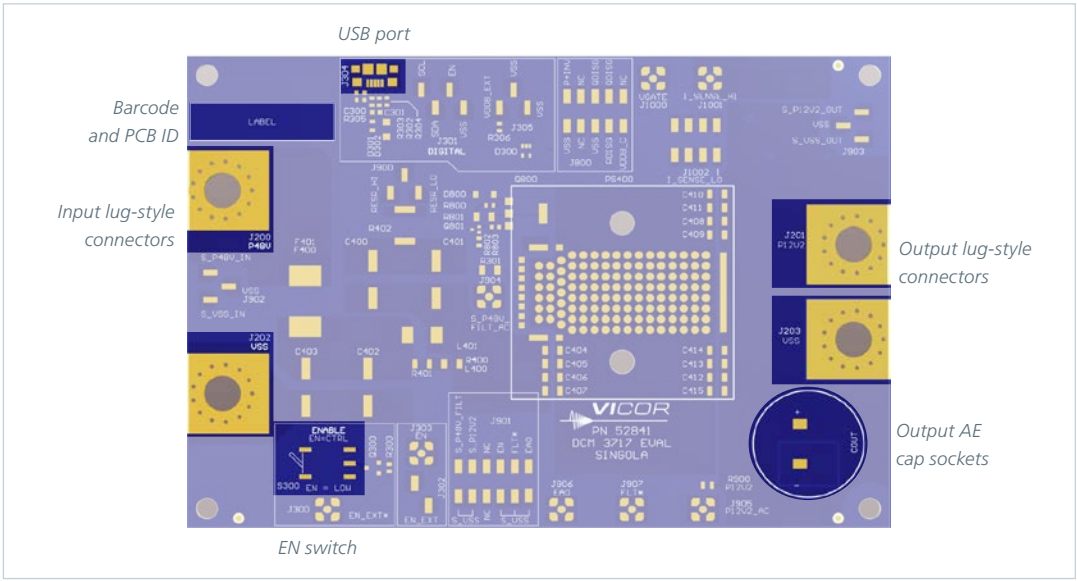
Part Number	Description
DCM3717**E**60E13G5TN1	DCM3717S60E13G5TN1 evaluation board
DCM3717**E**60D13K0TN1	DCM3717S60D13K0TN1 evaluation board

Board Description

This board provides a convenient way to evaluate or demonstrate the performance of the Vicor DCM3717 SM-ChiP™ products. Kelvin connections are provided for accurate voltage measurements on power nodes and signals. The evaluation board also provides lugs for input / output connections and test points for easy connection to standard test equipment.

The following section provides a detailed description of the evaluation board components and test points. The evaluation board includes sockets for adding a bulk capacitor on the output.

Figure 1
Unpopulated evaluation board



General Components

1. ***DCM (PS400):*** DCM3717 SM-ChiP 48V to Point-of-Load Non-Isolated, Regulated DC-DC Converter.
2. ***Fuse (F400 / F401):*** Input Fuse.
3. ***Input lugs (J200 and J202):*** J200 is labeled as P48V and J202 is labeled as VSS. Use these lugs for making connections to the input source. J902 provides kelvin connections to the input lugs. Use this connector to terminate the sense lines from the input source. This will ensure that the full programmed source voltage appears at the input lugs. Check for proper polarity before applying the power.
4. ***Input and output filtering:*** The DCM operates at switching frequencies that can exceed 1MHz. Low ESR ceramic capacitors are included on the board to minimize the switching voltage ripple. The evaluation board contains ceramic capacitors on the output and input. Additionally, an input LC filter is also provided.
5. ***Signal Test points:*** Test points are provided with headers as well as MMCX connectors. Most test points using the headers consist of a signal / VSS pair with S_VSS located on the opposite row of the header. Both the signal and S_VSS are sense lines which are terminated locally at the DCM terminals. J901 is good example of this type of arrangement.
   - ***Positive input power terminal (+IN)*** – Input to the DCM. Use MMCX connector J904.
   - ***Positive output power terminal (+OUT)*** – DCM output sense lines are provided at J903: S_P12V2_OUT and S_VSS_OUT as well as the output lugs – VSS: J203, , P12V2: J201. Additionally, J905 MMCX connector can also be used to monitor the output voltage.
   - ***Intermediate power terminal (+INV)*** – J800: P+INV / VSS
   - ***Transconductance error amplifier output and powertrain modulator control node (EAO)*** – J901: EAO / VSS header and J906 MMCX connector.
   - ***DCM enable control (EN)*** – J901: EN / VSS header and J303 MMCX connector. When driving the EN externally, J300 MMCX connector should be used. Note that the externally applied EN signal at this connector is inverted.
   - ***Digital serial communication clock terminal (SCL)*** – J301: SCL, a local VSS is available on the same connector.
   - ***Fault Flag; pulled low when a fault is detected (FLT)*** – J901: $\overline{\text{FLT}}$ / VSS header and J907 MMCX connector.
   - ***Digital serial communication data terminal (SDA)*** – J301: SDA, a local VSS is available on the same connector.

6. *Enable / Disable Function*: The DCM is shipped from the factory with J302 uninstalled. Without J302, the EN terminal of the DCM is floating and during power up, the DCM is able to pull up the EN terminal to enable itself. For control of the enable / disable function, install one of the jumpers that have been provided on J302. This allows two methods of controlling the enable / disable function:

   - *Using switch S300:* When the switch is in the CTRL position shown on the silk screen, the switch is in the "ON-state" and the DCM will be enabled. Otherwise, the EN terminal will be connected to VSS and the DCM will be disabled.
   - *Using external control:* Switch S300 must be in the "ON-state". Use an external voltage source or function generator to control the EN state though the MMCX connector, J300.

7. *Output lugs (J201 – J203):* J201 is labeled as P12V2. J203 is labeled as VSS. Use these lugs for making connection to the output load. J903 should be used for terminating the kelvin lines from the electronic load. Check for proper polarity before applying the power.

8. *Power node test points:* Dedicated test points are provided for making accurate measurements of the input and output voltage and voltage ripple. MMCX connector J904 should be used for measuring the voltage directly at the input to the DCM. It is the best point to measure the input voltage ripple. Likewise, J905 should be used for measuring the output voltage ripple.

9. *Heat sink mounting:* J400 and J401 (see schematic) are the heat sink mounting holes with pre-installed PEM nuts. Use these holes for mounting the heat sink assembly provided in the evaluation board box. For proper installation, see Heat Sink Installation section.

10. *Output bulk capacitance:* The board contains sockets J402, J403 "COUT" for installation of bulk capacitors. Please note polarity indication on silk screen.

Test Point Description

All test nodes are labeled and include a test point for attaching probes, clips or hooks.

Table 2
Test point descriptions

Name	Connector	Description
S_P48V_IN / S_VSS_IN	J902	Source input test points and kelvin connections for the DCM input power terminals
S_P12V2_OUT / S_VSS_OUT	J903	DCM output test points and kelvin connections for the DCM output power terminals
EN / VSS	J303 J901.5 / J901.6 J301	Test points for monitoring the state of EN
P48V_FILT / VSS	J904 J901.11 / J901.12	Test points for monitoring the DCM's input voltage after the LC filter
P12V2 / VSS	J905 J901.9 / J901.10 J903	Test points for monitoring the DCM output voltage
EAO / VSS	J906 J901.1 / J901.2	Test points for monitoring the EAO voltage
$\overline{\text{FLT}}$ / VSS	J907 J901.3 / J901.4	Test points for monitoring the state of $\overline{\text{FLT}}$
P+INV / VSS	J800.2 / J800.1	Test point for monitoring the intermediate power terminal +INV

Bill of Materials

The following table describes the design-specific components of the DCM™ evaluation boards.

Table 3
DCM3717 evaluation board components

Reference Designator	Description	Manufacturer	Manufacturer Part Number	Notes
C300	CAP X7R 0.01µF 10% 100V 0603	Murata Manufacturing	GRM188R72A103KA01J	
C301	CAP X7R 0.10µF 10% 50V 0603 .35 MAX HT	Samsung Electro-Mechanics	CL10B104KB8NNNC	
C400, C401, C402, C403	CAP ALEL POLY 56µF 20% 80V 10X12.7	Panasonic	80SXV56M	
C404, C405, C406, C407	CAP X7S 4.7µF 10% 100V 1206	Murata Manufacturing	GRM31CC72A475KE11K	
C408, C409, C410, C411, C412, C413, C414, C415	CAP X6S 22µF 10% 25V 1206	Samsung Electro-Mechanics	CL31X226KAHN3NE	
C416, C417, C418, C419, C420, C421, D1000, D1001, J1000, J1001, J1002, L400, Q1000, Q1001, R301, R404, R405, R1000, R1001, R1002	NOT APPLIED			
D300	DZEN 5.6V 5% 6Wpk ESD SOD-353	Nexperia	BZA856AVL,115	
D301	DSCH 45V 0.1A SOD523	Diodes Incorporated	SDM10U45-7-F	
D302	DZEN 5.1V 5% 830mW AUTO SOD-123F	Nexperia	BZT52H-C5V1	
D800	ZENER 4.7V 5% 5UA	onsemi	MMSZ4688T1G	
F400	FUSE 30A 125V_{AC} FAST 10.1X3.1 SMD	Littelfuse	0456030.ER	DCM3717E60E13G5TN1
F401	FUSE 40A 60V_{AC} FAST 4.5X12.5 SMD	Littelfuse	0456040.DR	DCM3717E60D13K0TN1
J300, J303, J904, J905, J906, J907	CONN 50Ω MMCX Jack Surface Mount	Samtec	MMCX-J-P-H-ST-SM1-K	
J301	CONN 4 POS SINGLE ROW	Harwin	M20-8770442R	
J302	CONN HDR 2-POS 2.54mm VERT SMT	Harwin	M20-8770242R	
J304	CONN MICRO-B USB SMD	TE Connectivity Ltd	2174507-2	
J305, J900, J902, J903	CONN 3 POS 2.54mm SINGLE ROW	Harwin	M20-877034R	
J400, J401	INSERT BROACHING M3 SS	PennEngineering	KFS2-M3	
J402, J403	CONN 1 POS RT ANGLE SMD 0.79MM LEAD	Mill-Max	8806-0-58-15-47-27-4	
J800	CONN 5 POS DUAL ROW	FCI	95278-101A10LF	
J901	CONN HEADER 12POS DUAL ROW SMT	Amphenol ICC	95278-101A12LF	
L401	IND 72nH 20% 45A 2727	Vishay	IFLR2727EZER72NM01	
PCB	PCB 3717-TC2 DCM Singola 2 (1-UP) EVAL B			
PS400	3717 TC3 5.2MM 40/50/60VIN12.2VO 750W	Vicor	DCM3717S60E13G5TN1	DCM3717S60E13G5TN1
	3717 TC3 5.2MM DCM 40/50/60VIN12.2VO 1kW		DCM3717S60D13K0TN1	DCM3717S60D13K0TN1
Q300	FET 2N7002 SOT-23	onsemi	2N7002LT1G	
Q800	QMOS N 100V 385mR 1.5A SC-73	Nexperia	PMT280ENEA	
Q801	40V 200MA NPN SMALL SWTCHG TRANS SOT-523	Diodes Incorporated	MMBT3904T-7-F	

Bill of Materials (Cont.)

Table 3 (Cont.)
DCM3717E60E13G5TN1 evaluation board components

The following table describes the design-specific components of the DCM™ evaluation boards.

Reference Designator	Description	Manufacturer	Manufacturer Part Number	Notes
R300	RES 10kΩ 1/10W 1% 0603	KOA Speer Electronics	RK73H1JTTD1002F	
R302, R303	RES 2.05kΩ 1/10W 1% 0603	KOA Speer Electronics	RK73H1JTTD2051F	
R304, R306	RES 200Ω 1/10W 1% 0603	KOA Speer Electronics	RK73H1JTTD2000F	
R305, R800	RES 100kΩ 1/10W 1% 0603	KOA Speer Electronics	RK73H1JTTD1003F	
R400	RES ZERO OHM JUMPER 2A 1206	Vishay	CRCW12060000Z0EC	
R401	RES 0.51Ω 1/4W 5% 1206	KOA Speer Electronics	SR732BTTDR51J	
R402	RES 47mR 5% 1W 100PPM 2512	Panasonic	ERJL1WKJ47MU	
R801	RES 4.32kΩ 1/4W 1% SMD 1206	KOA Speer Electronics	RK73H2BTTD4321F	
R802	RES 140K OHM 1/10W 1% 0603	KOA Speer Electronics	RK73H1JTTD1403F	
R803	RES 432Ω 1/10W 1% 0603	KOA Speer Electronics	RK73H1JTTD4320F	
R900	RES 49.9Ω 1/8W 1% 0805	KOA Speer Electronics	RK73H2ATTE49R9F	
S300	SW Horizontal SPDT 1 POS SMD	C&K Components	GT11MSABETR	

Recommended Test Equipment

The following is a list of recommended test equipment:

1. Safety glasses
2. DC power supply: Refer to the specific DCM™ model data sheet to ensure the supply has sufficient power and current capability.
3. Electronic load: Refer to the specific DCM model data sheet to ensure the load has sufficient power handling and current capability for testing
4. Fans with placement as shown in Figure 2
5. Digital multi-meters (DMMs)
6. Oscilloscope and probes
7. Interconnect wires, cables and fastening hardware

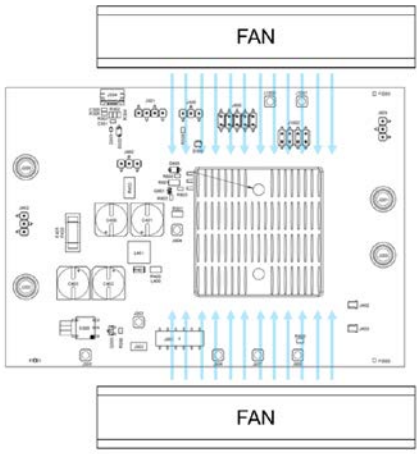
PCB Set Up

1. Install the two jumpers provided at the following locations:
   - J302, if external control of the EN terminal is desired.
   - J800.8 to J800.7, to enable the discharge function. ("QDISG to "RDISG") J800.6 to J800.5, to disable the discharge function. ("QDISG to "VSS").
2. Install the heat sink provided as per instructions in section "Heat Sink Installation".

Basic Connections and Operation

1. Confirm bench equipment is powered off.
2. Connect the input DC power supply positive lead to the positive input lug of the evaluation board: J200 – P48V. Connect the input power supply negative lead to J202 – VSS input lug of the evaluation board. Sense lines from the DC power supply should be terminated at J902.
   The power supply's positive sense line should be tied to S_P48V_IN and the negative sense line should be tied to S_VSS_IN.
3. Use of twisted pair cables of a suitable wire gauge is recommended to minimize the inductance of the cables to the power source.
4. Verify proper polarity of the connections.
5. Connect the positive output lug J201 of the evaluation board to the electronic-load's positive input. Connect the VSS output lug J203 of the evaluation board to the electronic-load's negative input. Sense lines from the electronic load should be terminated at J903. The electronic load's positive sense line should be tied to S_P12V2_OUT and the negative sense line should be tied to S_VSS_OUT.
6. Verify proper polarity of the connections.
7. Verify all electrical termination fasteners are securely tightened to ensure a proper, low-impedance connection is made between the DCM evaluation board and the external power source and load. The connectors and fasteners should be kept within the exposed copper.
8. Direct airflow from the cooling fans across the DCM. The airflow should be in the same direction as the fins on the heat sink as shown in Figure 2.
9. Have the latest DCM data sheet on hand for reference.

Figure 2
Fan location with respect to heat sink



Power Up

Start up From V_{IN}:

1. Select an Enable Option:

- Switch Control: Set S300 in the ON-state as described in "Board Description, 6 - Enable / Disable Function"
- External Drive: Set S300 in the ON-state then externally drive EN through J303.

2. Set state of EN = 1 using one of the options above.

3. V_{IN} is ramped past the V_{IN} UV rising threshold. The DCM will pull up the voltage on its EN terminal with an internal current source and start up itself.

Start up from EN:

1. Set state of EN = 0 using one of the options above

2. V_{IN} is ramped up past the UV rising threshold with the EN signal driven low.

3. Once V_{IN} is at the desired steady state voltage, set state of EN = 1.

Note: When ramping up VIN, the user must limit the slew rate of VIN as specified in the product data sheet.

Power Down

The DCM may be powered down by ramping V_{IN} to 0V or setting the state of EN = 0.

Heat Sink Installation

The evaluation boards, DCM3717E60E13G5TN1, DCM3717E60D13K0TN1, come with heat sink mounting holes and preinstalled PEM nuts, which makes the heat sink installation easy.

Utilize the hardware components provided in the heat sink assembly kit, Vicor part number 51430.

Table 4
Vicor p/n 51430 component list

Item Reference	Name	Description	Manufacturer	Part Number	Qty
A	Screw	M3 x 0.50mm thread, 22mm long, button head hex drive, passivated 18-8 stainless steel	McMaster-Carr	50326-22 / 92095A473	2
B	Spring	Standard compression series, passivated stainless steel	Lee Spring	54261 / LC 029BB 03M	2
C	Heat Sink	HS 40 x 40 x 25 26CTC TRANSVERSE MNT HOLE	Vicor	51455	1
D	Thermal Interface Material (TIM)	TIM PAD 38.5 x 20.0 x 0.5THK	TIMTEL	51051 / SG 0.5-TL6.0	1

Figure 3 depicts the exploded view of the heat sink and hardware components along with the product evaluation board.

Step 1: Place the TIM on the top surface of the SM-ChiP™ DCM3717.

- Remove the thin protective plastic sheets from both sides of the TIM before installing TIM on the top surface of the SM-ChiP.
- Cover the entire top surface of the SM-ChiP with the TIM to avoid short circuit of the power/signal castellations of the DCM with the heat sink. TIM provides electrical isolation between the DCM surface and the heat sink surface.

Step 2: Place the heat sink on top of the TIM material.

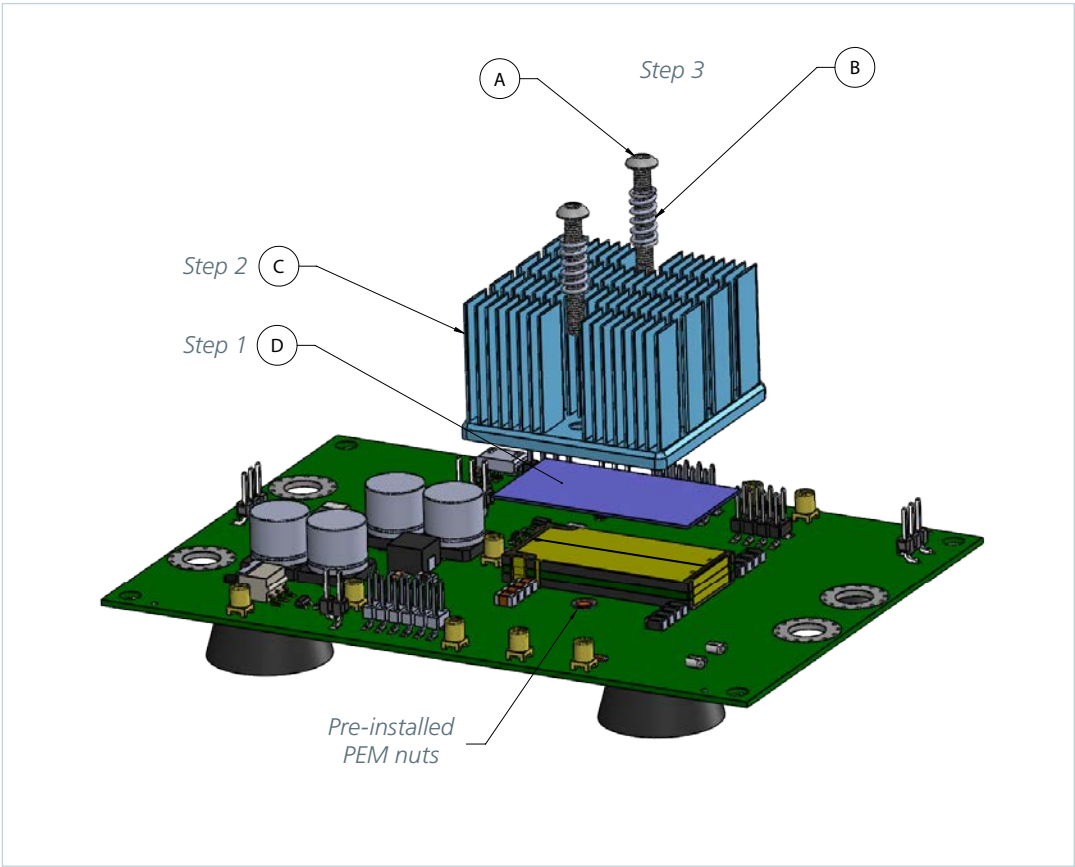
- Heat sink is machined with the mounting holes that match with the mounting holes on the evaluation board. Align the mounting holes on the heat sink with the mounting holes on the evaluation board.

Step 3: Place a set of screw and a spring in each mounting hole as shown in the figure.

Step 4: Fasten the screws.

- Deflect the spring ~3.8 mm using 7 or 8 turns of M3 x 0.5 screw. That will result in ~20psi of pressure applied to the DCM3717.

Figure 3
Vicor p/n 51430 exploded view



Revision History

Revision	Date	Description	Page Number(s)
1.0	01/16/25	Initial release	n/a
1.1	03/21/25	Cosmetic update	9

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