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Continuity of ordering part numbers

Infineon continues to support existing part numbers. Please continue to use the ordering part numbers listed in the datasheet for ordering.

MB39C503-EVBSK-01

High Efficiency Single Output Step Down DC/DC Controller Evaluation Board Operation Manual

Doc. No. 002-08718 Rev. *B

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Preface

This manual explains how to use the evaluation board. Be sure to read this manual before using the product. For this product, consult with sales representatives or support representatives.

Handling and use

Handling and use of this product and notes regarding its safe use are described in the manuals.

Follow the instructions in the manuals to use this product.

Keep this manual at hand so that you can refer to it anytime during use of this product.

Notice on this document

All information included in this document is current as of the date it is issued. Such information is subject to change without any prior notice.

Please confirm the latest relevant information with the sales representatives.

Caution of the products described in this document

The following precautions apply to the product described in this manual.

⚠ **WARNING**	Indicates a potentially hazardous situation which could result in death or serious injury and/or a fault in the user's system if the product is not used correctly.

Electric shock, Damage	Before performing any operation described in this manual, turn off all the power supplies to the system. Performing such an operation with the power on may cause an electric shock or device fault.
Electric shock, Damage	Once the product has been turned on, do not touch any metal part of it. Doing so may cause an electric shock or device fault.

⚠ **CAUTION**	Indicates the presence of a hazard that may cause a minor or moderate injury, damages to this product or devices connected to it, or may cause to loose software resources and other properties such as data, if the device is not used appropriately.

Cuts, Damage	Before moving the product, be sure to turn off all the power supplies and unplug the cables. Watch your step when carrying the product. Do not use the product in an unstable location such as a place exposed to strong vibration or a sloping surface. Doing so may cause the product to fall, resulting in an injury or fault.
Cuts	The product contains sharp edges that are left unavoidably exposed, such as jumper plugs. Handle the product with due care not to get injured with such pointed parts.
Damage	Do not place anything on the product or expose the product to physical shocks. Do not carry the product after the power has been turned on. Doing so may cause a malfunction due to overloading or shock.
Damage	Since the product contains many electronic components, keep it away from direct sunlight, high temperature, and high humidity to prevent condensation. Do not use or store the product where it is exposed to much dust or a strong magnetic or electric field for an extended period of time. Inappropriate operating or storage environments may cause a fault.
Damage	Use the product within the ranges given in the specifications. Operation over the specified ranges may cause a fault.

Damage	To prevent electrostatic breakdown, do not let your finger or other object come into contact with the metal parts of any of the connectors. Before handling the product, touch a metal object (such as a door knob) to discharge any static electricity from your body.
Damage	When turning the power on or off, follow the relevant procedure as described in this document. Before turning the power on, in particular, be sure to finish making all the required connections. Furthermore, be sure to configure and use the product by following the instructions given in this document. Using the product incorrectly or inappropriately may cause a fault.
Damage	Always turn the power off before connecting or disconnecting any cables from the product. When unplugging a cable, unplug the cable by holding the connector part without pulling on the cable itself. Pulling the cable itself or bending it may expose or disconnect the cable core, resulting in a fault.
Damage	Because the product has no casing, it is recommended that it be stored in the original packaging. Transporting the product may cause a damage or fault. Therefore, keep the packaging materials and use them when re-shipping the product.

Contents

1. Description

MB39C503 is a single output step down DC/DC controller using external FETs. It achieves the high efficiency with “Enhanced Low Power Mode (LPM) Operation” in light load. In Enhanced LPM, this controller operates that the quiescent current is reduced only 30µA and the switching frequency is fallen by extending on time. These operations enable to improve the efficiency in light load. Internal compensation circuit with current mode architecture and internal boost switch allow reducing the BOM parts and the component area. “Over Current Alerting function” can detect the near over current limitation. The over current alerting level is set 85% for over current limitation level. The function suppresses an excessive margin design through elimination of possibilities of current overflows and enhances the system reliability.

2. Evaluation Board Specification

Table 2-1 Evaluation Board Specification

Component	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	VIN	-	4.0	-	25	V
Output Voltage	VOUT	-	-	3.3	-	V
Output Current	IOUT	SLP_N=H	-	-	10.73	A
Switching Frequency	fSW	-	-	800	-	kHz

3. Pin Description

Table 3-1 Pin Description

Component	Input or Output	Description
VIN	Input	Power supply terminal of DC/DC system.
VOUT	Output	Output of DC/DC system.
VDD	Input	Power supply terminal PWM controller and internal drivers.
EN	Input	Enable input for PWM Controller. When turning on, apply greater than 0.65V and less than 5.5V. When turning off, apply less than 0.25V.
SLP_N	Input	Input terminal transferred to “Enhanced LPM”. Transferred to “Enhanced LPM” by connecting to “L” level.
PWRGD	Output	Open drain output terminal with power good.
ALERT_N_VOUT	Output	Open drain output terminal with over current alerting.
PGND	-	Power Ground Terminal.

4. Setup and Checkup

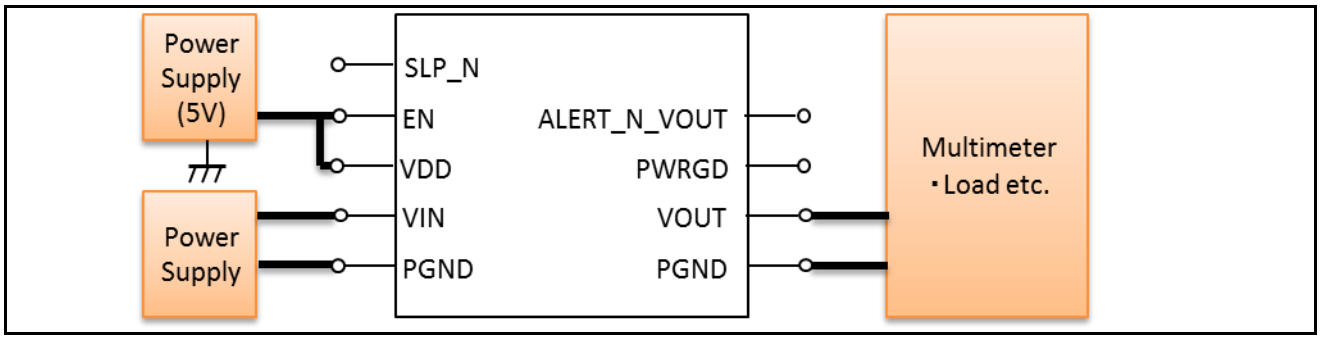
- Supply the DC/DC input power of to the terminal between VIN to PGND.
- Supply the PWM controller input voltage of 5.0V to VDD terminal.
- Connect the VOUT terminal to required loading device or measuring instrument. In this time, connect the EN terminal to “L” state.

Then, turning on the EN input. Confirming the DC/DC output voltage is setting voltage.

Note:

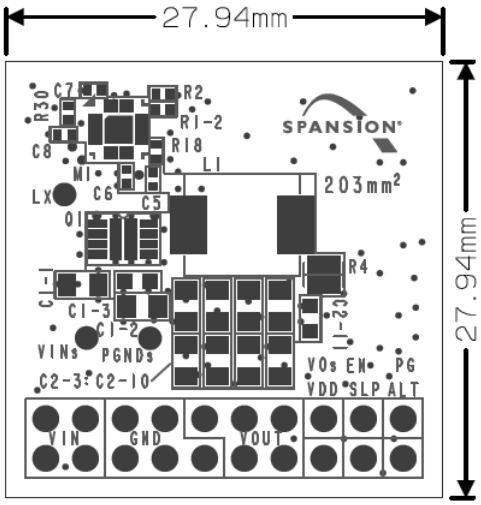
The recommended operating conditions of MB39C503 EN pin is 5.5V maximum. Please don’t connect EN to VIN when VIN voltage is over 5.5V.

Figure 4-1 Image of Connection



5. Component Layout

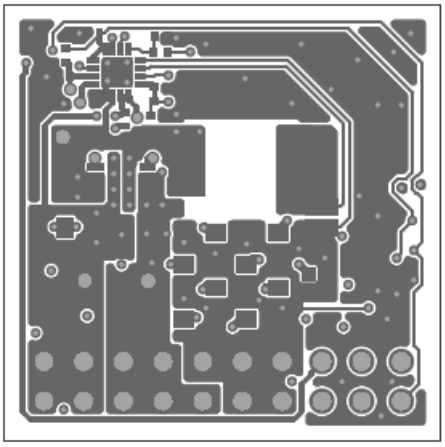
Figure 5-1 Component Layout
Top View



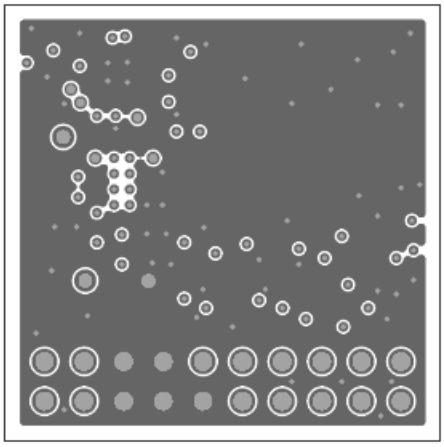
6. Wiring Layout

Figure 6-1 Wiring Layout

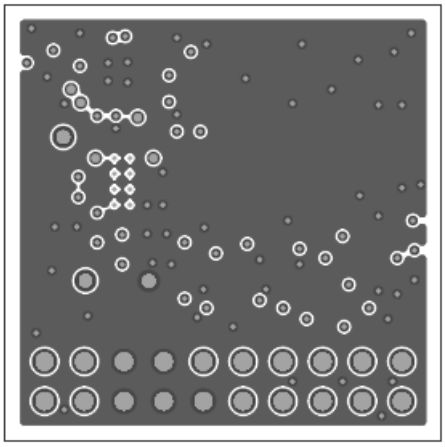
Top Side (Layer 1)



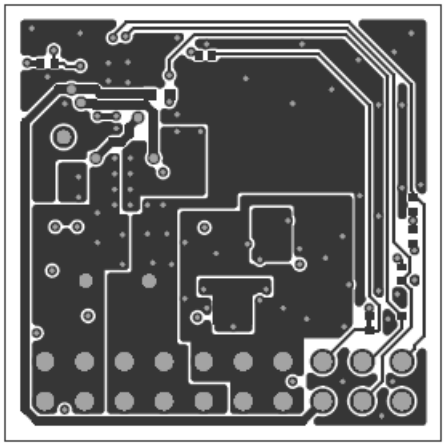
Inside (Layer 2)



Inside (Layer 3)

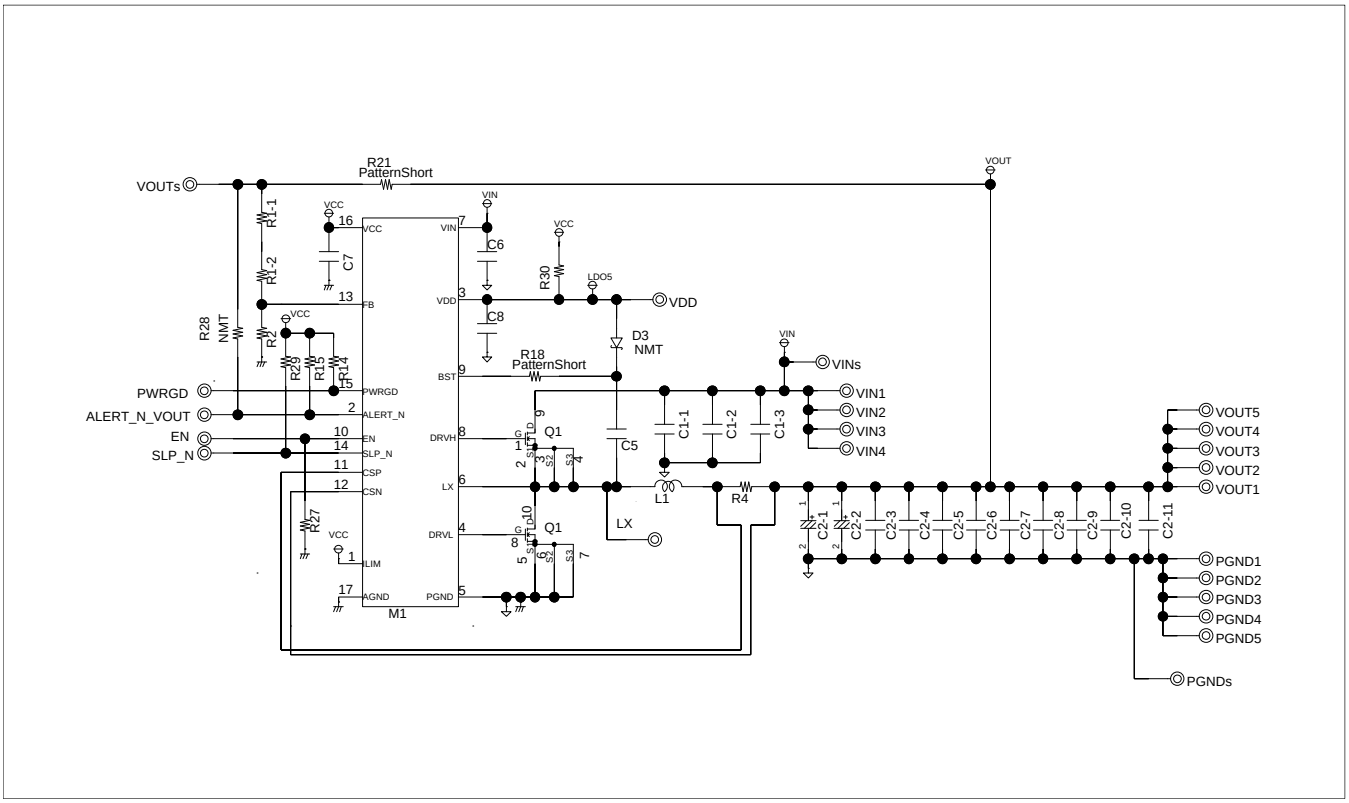


Bottom Side (Layer 4)



7. Circuit Diagram

Figure 7-1 Circuit Diagram



8. Parts List

Table 8-1 Parts List

Component	Item	Specification	Vender	Package	Parts Name	Remark
M1	IC	-	Cypress	QFN-16	MB39C503	Controller
Q1	Nch FET	VDS=30V, ID=11A RON=8.8mΩ, QG=6.7nC VDS=30V, ID=13.5A RON=5.3mΩ, QG=14nC	Fairchild	Power33	FDMC7208S	High/Low Side FET
D3	-	-	-	-	-	No mount
L1	Inductor	0.68μH(14A)	ALPS	7.4 x 6.5mm	GLMCR6803A	LX
C1-1	Capacitor	10μF(35V)	TDK	2012	C2012X5R1V106K	VIN
C1-2	Capacitor	10μF(35V)	TDK	2012	C2012X5R1V106K	VIN
C1-3	Capacitor	1.0μF(50V)	TDK	1608	C1608X5R1H105K	VIN
C2-1 *	- *	- *	- *	- *	- *	No mount *
C2-2 *	- *	- *	- *	- *	- *	No mount *
C2-3	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-4	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-5	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-6	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-7	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-8	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-9	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-10	Capacitor	47μF(10V)	TDK	2012	C2012X5R1A476M	VOUT
C2-11	Capacitor	10μF(10V)	TDK	1608	C1608X5R1A106K	VOUT
C5	Capacitor	0.47μF(35V)	TDK	1005	C1005X5R1V474K	BST
C6	Capacitor	1.0μF(35V)	TDK	1005	C1005X5R1V105K	VIN
C7	Capacitor	1.0μF(35V)	TDK	1005	C1005X5R1V105K	VCC
C8	Capacitor	4.7μF(10V)	TDK	1005	C1005X5R1A475K	VDD
R1-1	Resistor	8.2kΩ	SSM	1005	RG1005PD822	FB
R1-2	Resistor	47kΩ	SSM	1005	RG1005PD473	FB
R2	Resistor	24kΩ	SSM	1005	RG1005PD243	FB
R4	Resistor	2mΩ	SSM	2012	KRL2012-M-R002-G	RSENSE
R14 *	Resistor *	330kΩ *	KOA *	1005 *	RK73B1ETTP334J *	PWRGD *
R15 *	Resistor *	330kΩ *	KOA *	1005 *	RK73B1ETTP334J *	ALERT_N *
R18	-	-	-	-	-	No mount

Component	Item	Specification	Vender	Package	Parts Name	Remark
R21 *	- *	- *	- *	- *	- *	No mount *
R27 *	Resistor *	220kΩ *	KOA *	1005 *	RK73B1ETTP224J *	EN *
R28 *	- *	- *	- *	- *	- *	No mount *
R29 *	Resistor *	330kΩ *	KOA *	1005 *	RK73B1ETTP334J *	SLP_N *
R30	Resistor	10Ω	TE Connectivity	1005	CPF0402B10RE1	VDD
-	Pin	3A	HIROSE	2.54	HIF3H-20PB-2.54DSA	-

***** : parts on buck side

9. Reference Data

Figure 9-1 Efficiency vs Output Current, VOUT ;3.3V-Setting

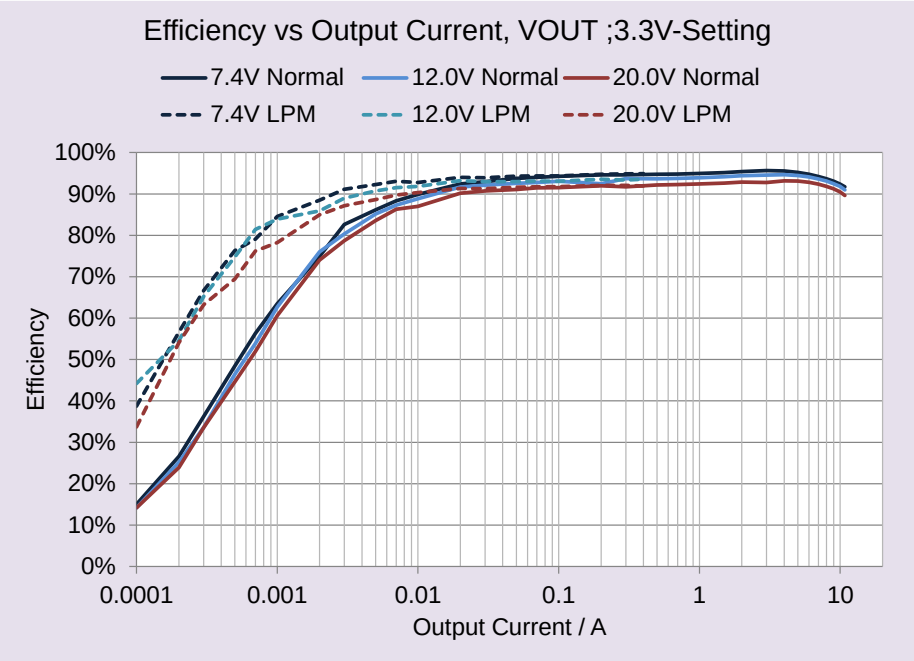


Figure 9-2 Load regulation Output Voltage vs Output Current, OUT ;3.3V-Setting

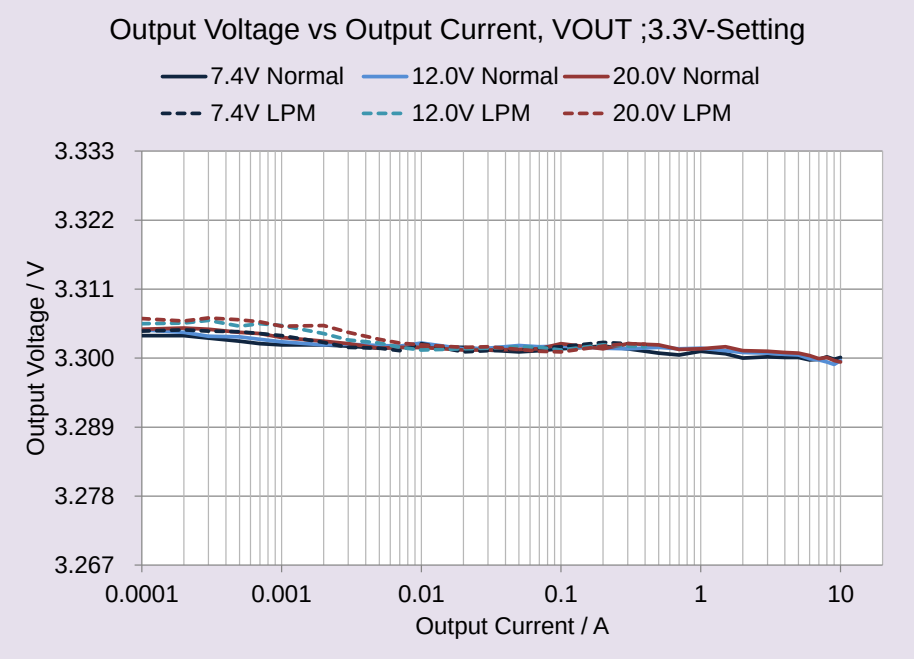


Figure 9-3 Start-up (EN=0V to 5V) VIN=7.4V, VOUT=3.3V, IOUT=0.05A, SLP_N=H

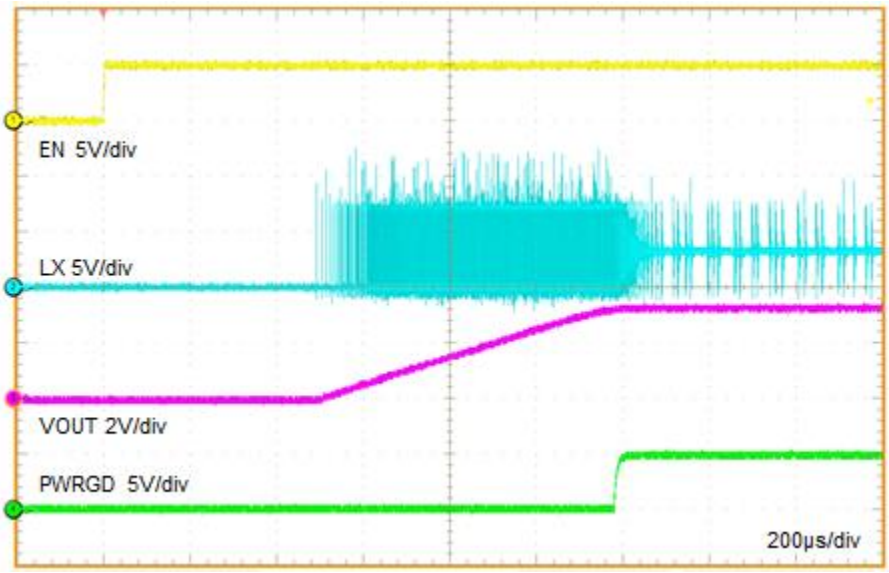


Figure 9-4 Shut-down (EN=5V=>0V)VIN=7.4V, VOUT=3.3V,IOUT=0.05A , SLP_N=H

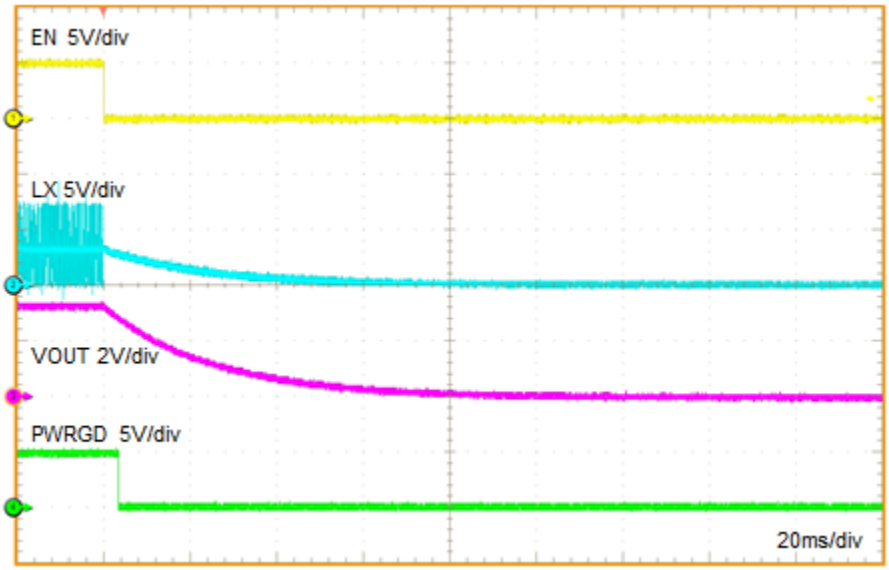


Figure 9-5 Load step response (VIN=7.4V,VOUT=3.3V) IOUT=0.05A to 9.72A, SLP_N=H

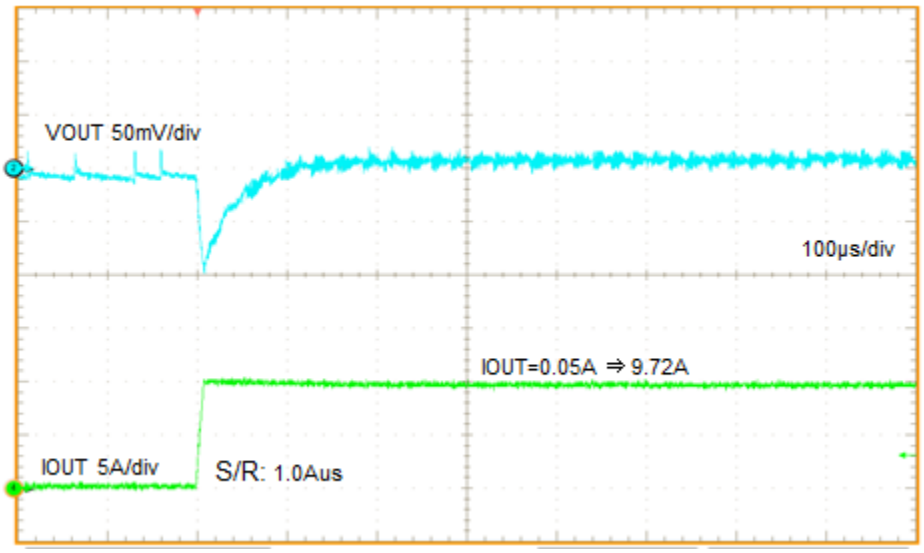


Figure 9-6 Load step response (VIN=7.4V,VOUT=3.3V) IOUT=9.72A to 0.05A, SLP_N=H

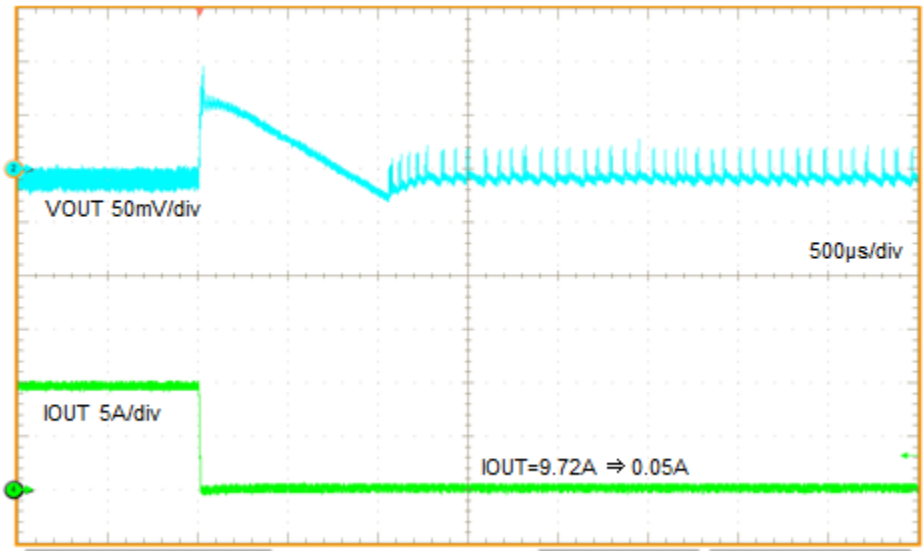


Figure 9-7 Switching waveform (VIN=7.4V,Iout=10.8A) , SLP_N=H

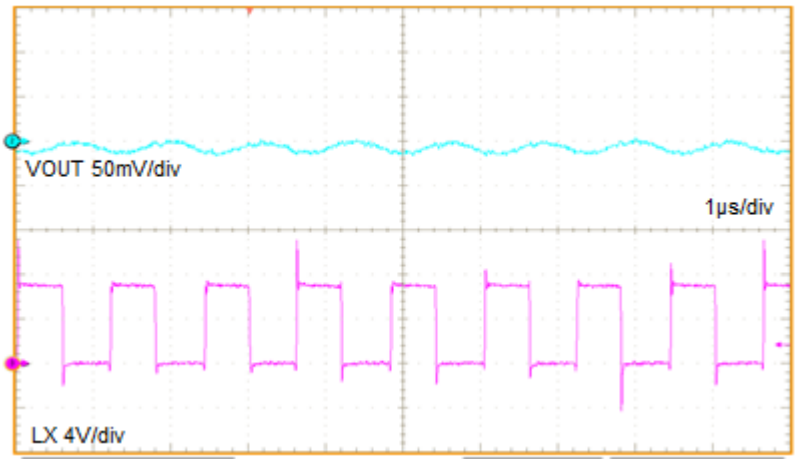


Figure 9-8 Switching waveform (VIN=7.4V,Iout=0.05A) , SLP_N=H

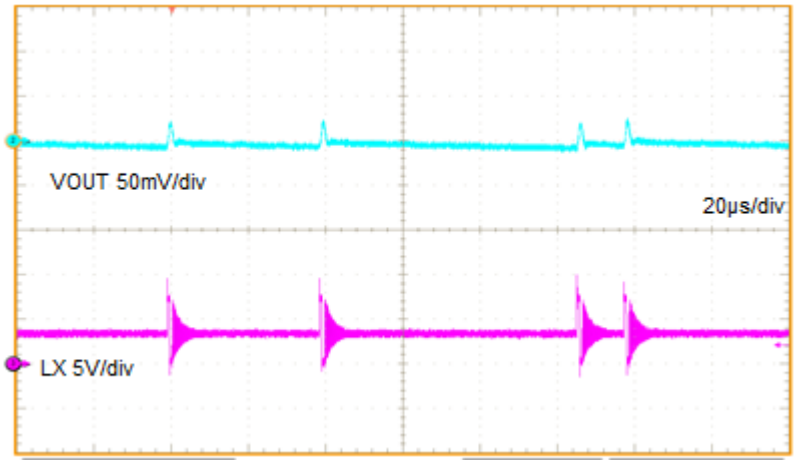


Figure 9-9 Switching waveform (VIN=7.4V,Iout=0.3A), LPM at SLP_N=L

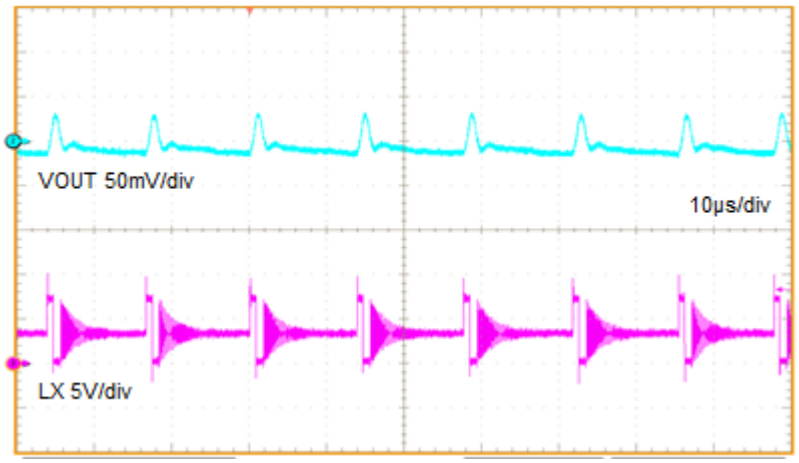
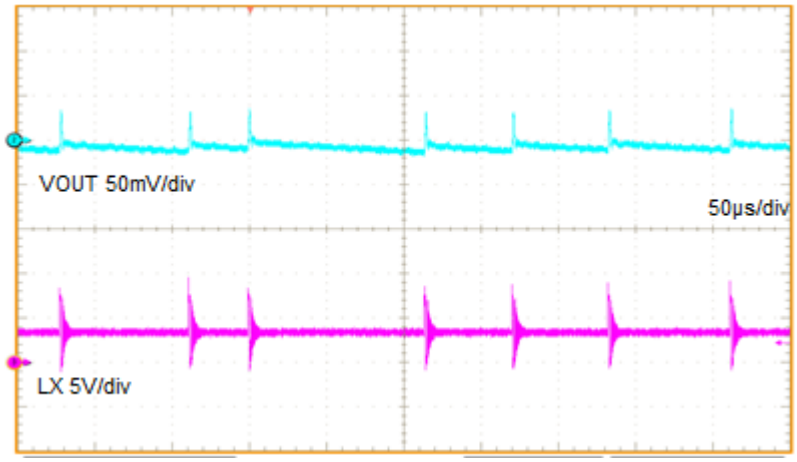


Figure 9-10 Switching waveform (VIN=7.4V,Iout=0.05A) , LPM at SLP_N=L



10. Initial Settings

- Output Voltage

$$V_{OUT} = \frac{R1[\Omega] + R2[\Omega]}{R2[\Omega]} \times V_{REF}[V] = \frac{55.2 \times 10^3 + 24 \times 10^3}{24 \times 10^3} \times 1.0 = 3.3[V]$$

- Current Limit at VIN=7.4V

$$I_{LIMIT} = \frac{0.026[V]}{R4[\Omega]} + \frac{\Delta I_L[A]}{2} - \frac{V_{OUT}[V] \times 300 \times 10^{-9}}{2 \times L[H]} = \frac{0.026}{2 \times 10^{-3}} + \frac{3.36}{2} - \frac{3.3 \times 300 \times 10^{-9}}{2 \times 0.68 \times 10^{-6}} = 13.95[A]$$

$$\Delta I_L = \frac{V_{IN}[V] - V_{OUT}[V]}{L[H]} \times \frac{V_{OUT}[V]}{V_{IN}[V] \times f_{SW}[Hz]} = 3.36[A]$$

- Over Current Alerting Threshold Level at VIN=7.4V

$$I_{ALERT} = \left(\frac{0.026[V]}{R4[\Omega]} - \frac{V_{OUT}[V] \times 300 \times 10^{-9}}{2 \times L[H]} \right) \times 0.85 + \frac{\Delta I_L[A]}{2}$$

$$= \left(\frac{0.026}{2 \times 10^{-3}} - \frac{3.3 \times 300 \times 10^{-9}}{2 \times 0.68 \times 10^{-6}} \right) \times 0.85 + \frac{3.36}{2} = 12.26[A]$$

11. Evaluation board picture

Figure 11-1 Evaluation board Picture (top)

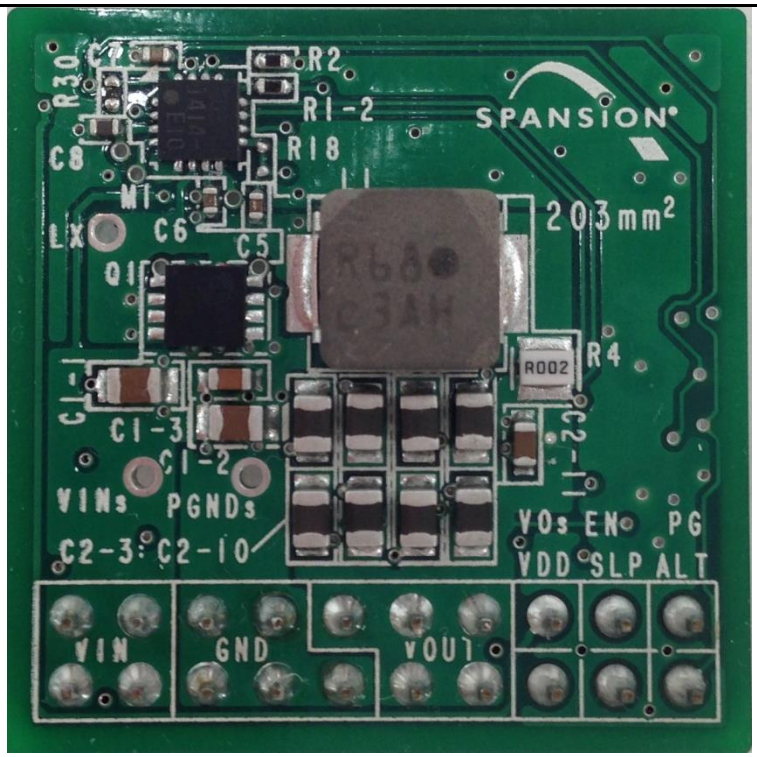
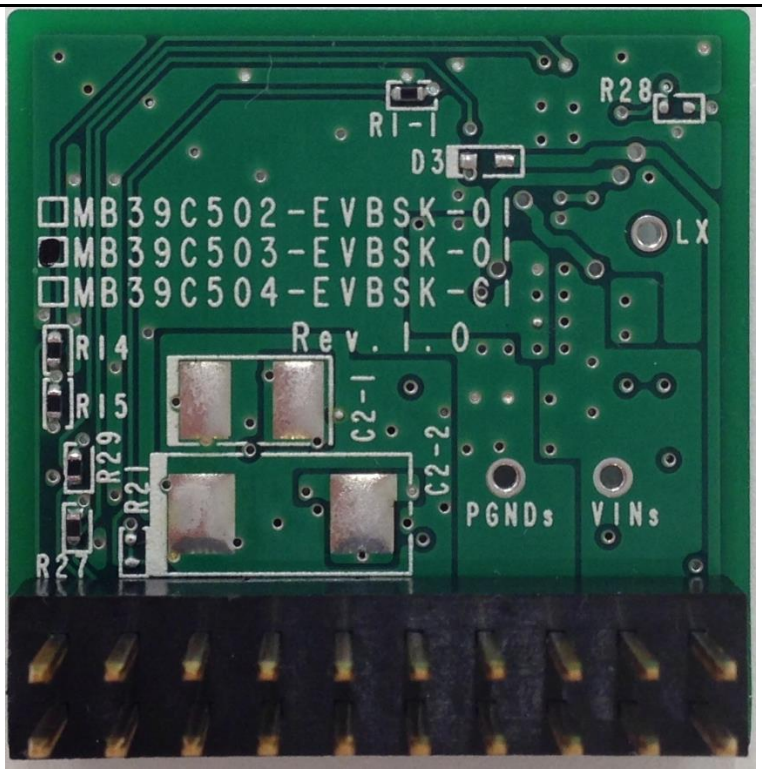


Figure 11-2 Evaluation board Picture (back)



12. Ordering Information

Table 12-1 Ordering Information

Part number	EVB revision	Note
MB39C503-EVBSK-01	Rev 1.0	---

Revision History

Document Revision History

Document Title: MB39C503-EVBSK-01 High Efficiency Single Output Step Down DC/DC Controller Evaluation Board Operation Manual Document Number: 002-08718			
Revision	**ECN Number**	**Issue Date**	**Description of Change**
**	-	11/19/2014	Initial release.
*A	5248029	04/29/2016	Updated to Cypress template.
*B	6744382	12/04/2019	Updated to new template. Completing Sunset Review.