



MB39A135EVB-01 1CH Buck DC/DC Converter IC

Evaluation Kit User Guide

Doc. No. 002-18071 Rev. **

Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709
Phone (USA): 800.858.1810
Phone (Intl): +1.408.943.2600
www.cypress.com

Copyrights

© Cypress Semiconductor Corporation, 2016. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit cypress.com. Other names and brands may be claimed as property of their respective owners.

Contents



Safety Information	4
Regulatory Compliance	4
General Safety Instructions	4
1. Introduction	5
1.1 Kit Contents	5
2. Kit Overview	6
2.1 Terminal Information	6
2.2 Specification	6
2.3 Hardware	7
3. Set Up and Check	8
3.1 Set Up and Check	8
4. Initial Settings	9
4.1 Initial Settings	9
5. Reference Data	11
5.1 Reference Data	11
Appendix	13
A.1 Schematic	13
A.2 Bill of Materials (BOM)	14
A.3 Image	15
A.4 Silk Screen	15
A.5 Layout	16
Revision History	17

Safety Information



Regulatory Compliance

This Evaluation Kit is intended for use as a development platform for hardware in a laboratory environment. The board is an open system design, which does not include a shielded enclosure. This may cause interference to other electrical or electronic devices in close proximity.

In a domestic environment, this product may cause radio interference. The user may then be required to take adequate prevention measures. Also, the board should not be used near any medical equipment or RF devices.

Attaching additional wiring to this product or modifying the product operation from the factory default may affect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.



This Evaluation Kit contains electrostatic discharge (ESD) sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused this board in the protective shipping package.

General Safety Instructions

ESD Protection

ESD can damage boards and associated components. Cypress recommends that you perform procedures only at an ESD workstation. If an ESD workstation is not available, use appropriate ESD protection by wearing an antistatic wrist strap attached to chassis ground (any unpainted metal surface) on your board when handling parts.

Handling Boards

This board is sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide board over any surface.

1. Introduction



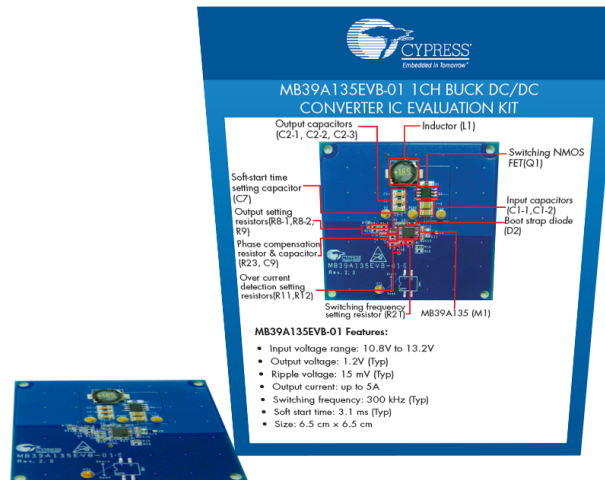
Thank you for your interest in the MB39A135EVB-01 1CH Buck DC/DC Converter IC Evaluation Kit (EVK). The kit is designed as an easy-to-use evaluation kit, showcasing the features of the Cypress MB39A135EVB-01 1CH Buck DC/DC Converter IC that has synchronous rectification. For more information, see [the MB39A135 datasheet](#).

1.1 Kit Contents

This evaluation kit includes the following items as shown in [Figure 1-1](#):

- MB39A135EVB-01 evaluation board
- Quick start guide (www.cypress.com/MB39A135EVB-01)

Figure 1-1. MB39A135EVB-01 Evaluation Kit Contents



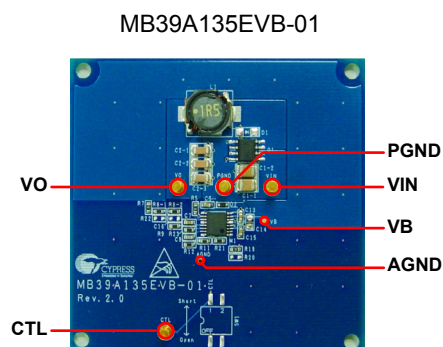
Visit www.cypress.com/shop for more information. Inspect the contents of the kit; if any parts are missing, contact your nearest Cypress sales office.

2. Kit Overview



2.1 Terminal Information

Terminal Name	I/O	Descriptions
VIN	I	Input power supply terminal
VO	O	DC/DC converter output terminal
CTL	O	DC/DC converter status control terminal CTL = 0 V to 0.8 V: Standby mode CTL = 2.0 V to VIN: Operation mode
VB	O	Bias voltage output terminal
PGND	–	Ground terminal
GND	–	Ground terminal



2.2 Specification

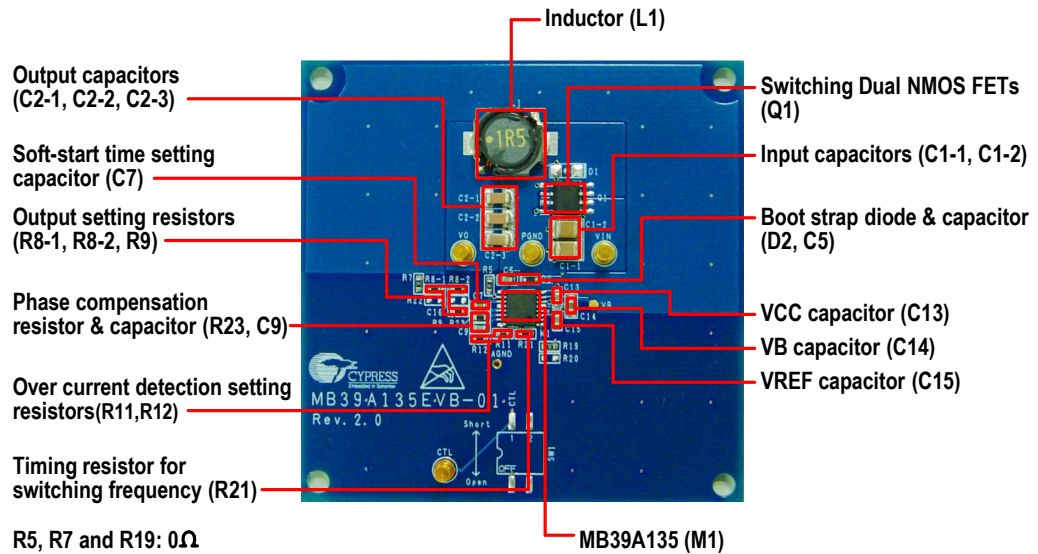
Parameter		Value			Unit
		Min	Typ	Max	
Input voltage	VIN	10.8	12	13.2	V
Output voltage	VO	–	1.2	–	V
Ripple voltage	VO	–	15	–	mV
Output current	I _O	–	–	5	A
Oscillation frequency		–	300	–	kHz
Soft-start time	VO	–	3.1	–	ms

2.3 Hardware

The kit consists of the following components as shown in [Figure 2-1](#):

- Output capacitors (C2-1, C2-2, C2-3)
- Soft-start time setting capacitor (C7)
- Output setting resistors (R8-1, R8-2, R9)
- Phase compensation resistor and capacitor (R23, C9)
- Over-current detection setting resistors(R11,R12)
- Timing resistor for switching frequency (R21)
- Inductor (L1)
- MB39A135 (M1)
- Switching Dual NMOS FETs (Q1)
- Input capacitors (C1-1, C1-2)
- Boot strap diode and capacitor (D2, C5)
- VCC capacitor (C13)
- VB capacitor (C14)
- VREF capacitor (C15)
- R5, R7 and R19: 0-ohm

Figure 2-1. Kit Components

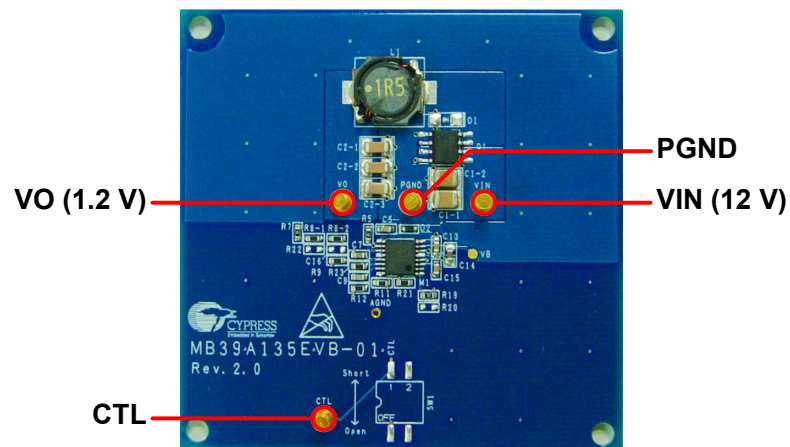


3. Set Up and Check



3.1 Set Up and Check

Figure 3-1. Kit Components



Setup*

1. Connect VIN to a power supply and PGND to the ground.
2. Connect CTL to VIN.
3. Connect VO to a voltmeter.

Check*

1. Apply 12 V to VIN.
2. VO voltage should be 1.2 V (typ).

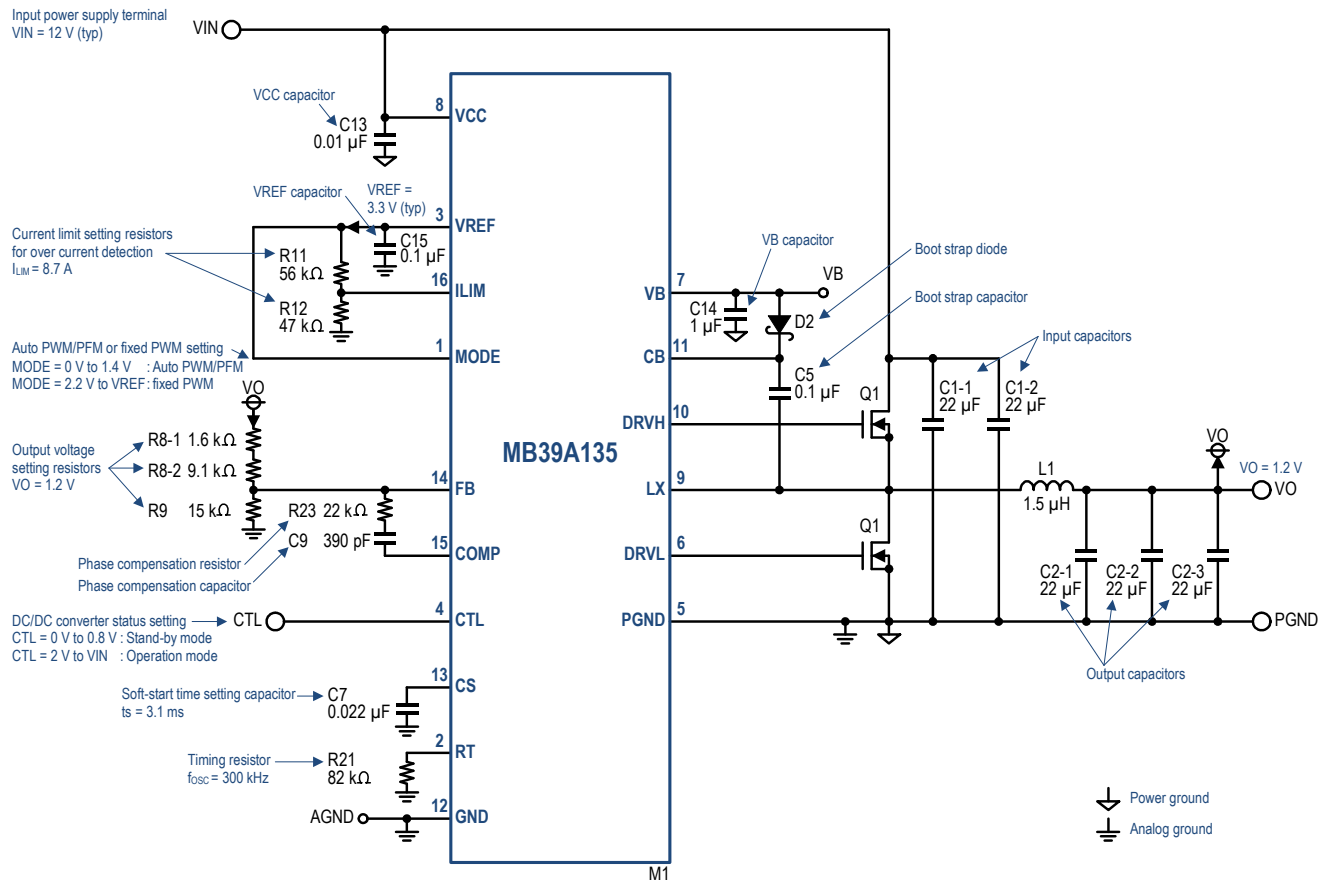
*Do not supply power to VIN until settings are completed.

4. Initial Settings



4.1 Initial Settings

Figure 4-1. Schematic



For more the detailed schematic and the bill of materials (BOM), see [Appendix](#).

1. Output voltage

$$V_O = \frac{(R8-1 + R8-2) + R9}{R9} \times 0.7 = \frac{(1.6k + 9.1k) + 15k}{15k} \times 0.7 = 1.20 \text{ [V]}$$

2. Oscillation frequency

$$f_{osc} = \frac{1.09}{R21 \times (40 \times 10^{-12}) + (300 \times 10^{-9})} = \frac{1.09}{82k \times (40 \times 10^{-12}) + (300 \times 10^{-9})} = 304469 \text{ [Hz]} \approx 300 \text{ [kHz]}$$


3. Soft-start time

$$t_s = \frac{0.7 \text{ [V]}}{I_{cs} \text{ [A]}} \times C7 = \frac{0.7 \text{ [V]}}{(5 \times 10^{-6})} \times C7 = (1.4 \times 10^5) \times (0.022 \times 10^{-6}) = 0.00308 \text{ [s]} \approx 3.1 \text{ [ms]}$$

4. Current limit for over current detection

$$I_{LIM} = \frac{\frac{R12}{R11 + R12} \times VREF - 0.3 \text{ [V]}}{6.8 \text{ [V/V]} \times (R_{ON_H})} + \frac{V_{IN} - V_O}{L1} \times (200 \times 10^{-9} - \frac{V_O}{2 \times f_{osc} \times V_{IN}})$$

$$= \frac{\frac{47k}{56k + 47k} \times 3.3 - 0.3}{6.8 \times (21 \times 10^{-3})} + \frac{12 - 1.2}{1.5 \times 10^{-6}} \times (200 \times 10^{-9} - \frac{1.2}{2 \times 300k \times 12})$$

 See the datasheet of Q1

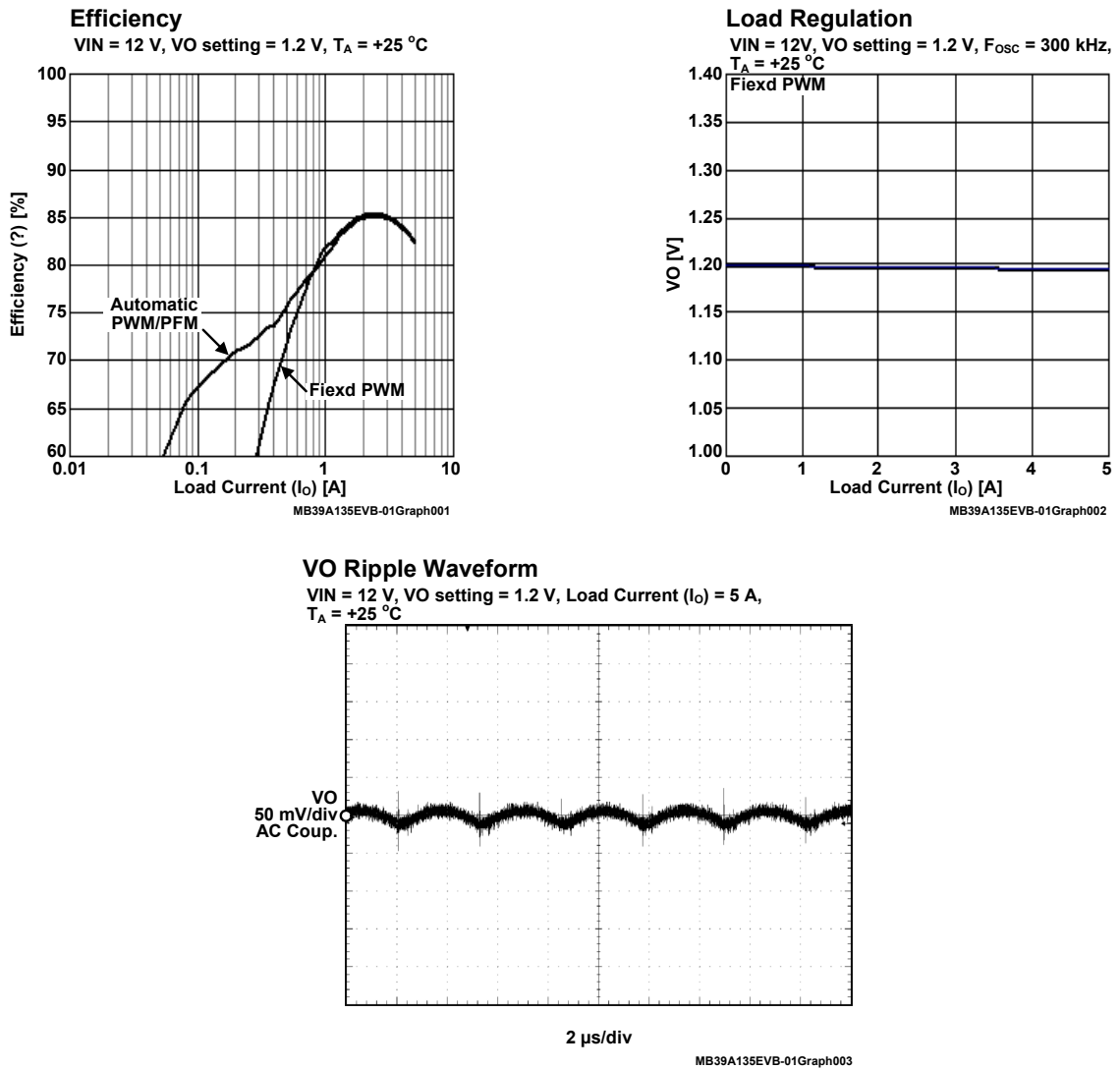
$$\approx 8.68 \text{ [A]}$$

5. Reference Data



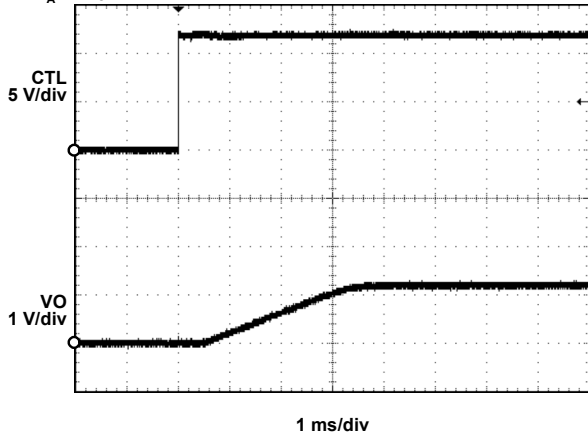
5.1 Reference Data

Figure 5-1. Reference Data



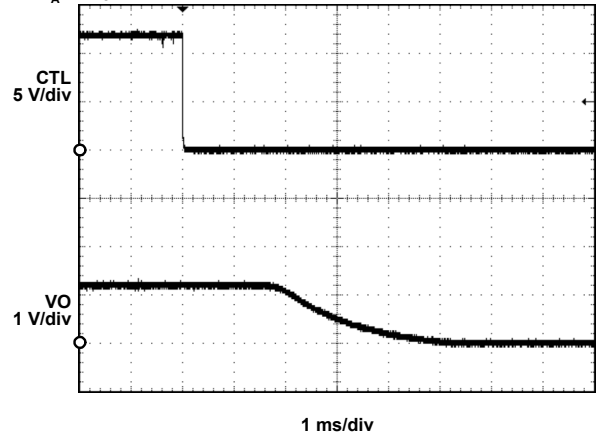
Turn On Response

VIN = 12 V, VO setting = 1.2 V, Load Current (I_o) = 5 A,
T_A = +25 °C



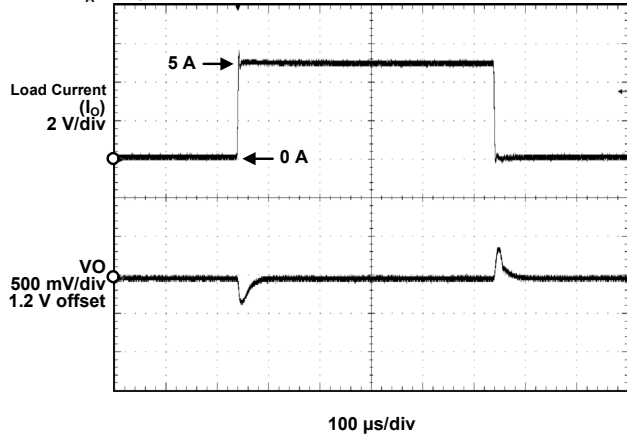
Turn Off Response

VIN = 12 V, VO setting = 1.2 V, Load Current (I_o) = 5 A,
T_A = +25 °C



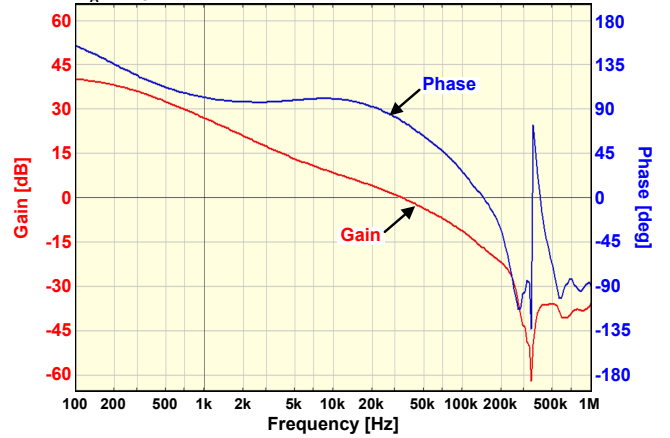
Load Transient Response

VIN = 12 V, VO setting = 1.2 V, Load Current (I_o) = 5 A,
T_A = +25 °C



Gain & Phase Characteristics

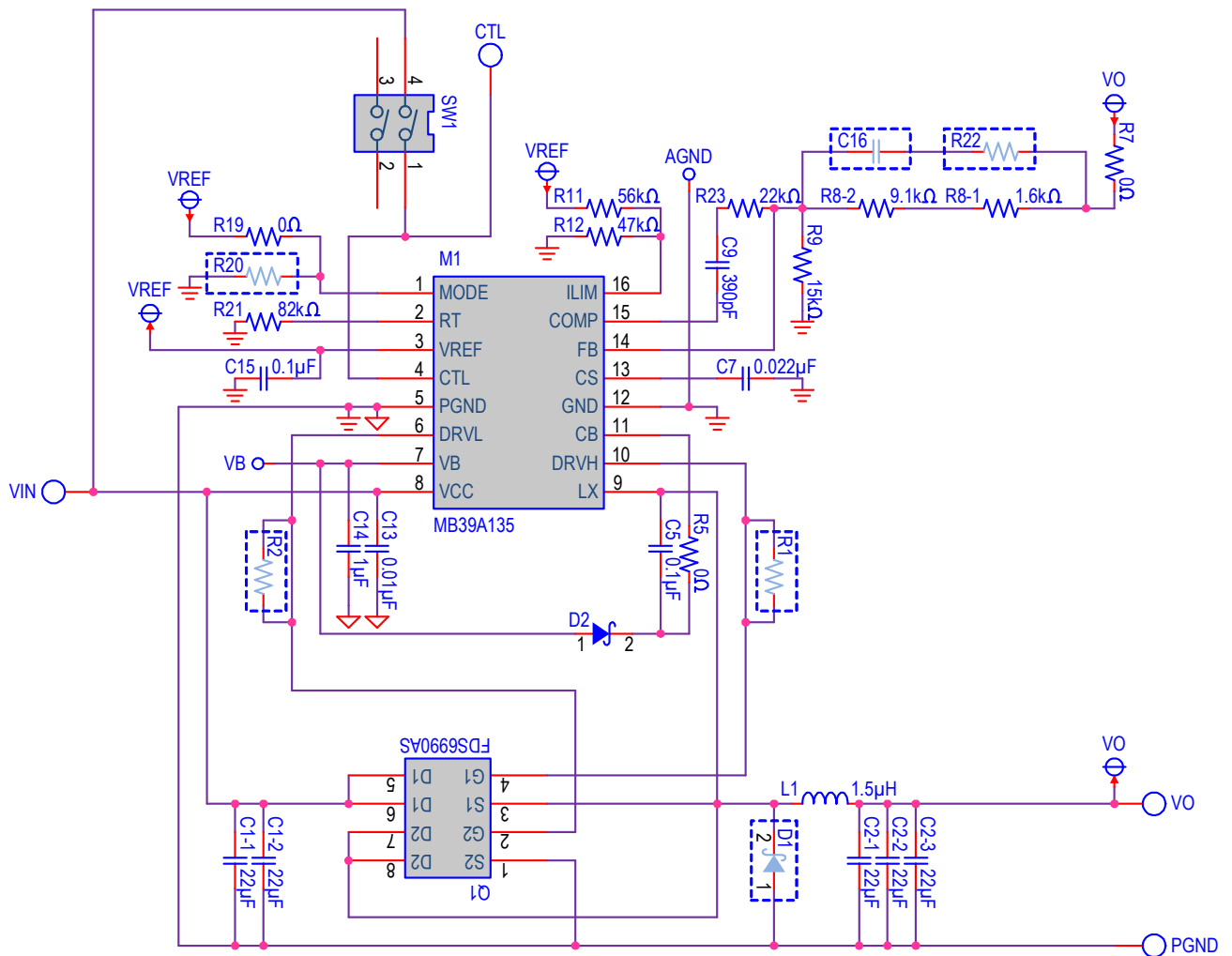
VIN = 12 V, VO setting = 1.2 V, Load Current (I_o) = 5 A,
T_A = +25 °C



Appendix



A.1 Schematic

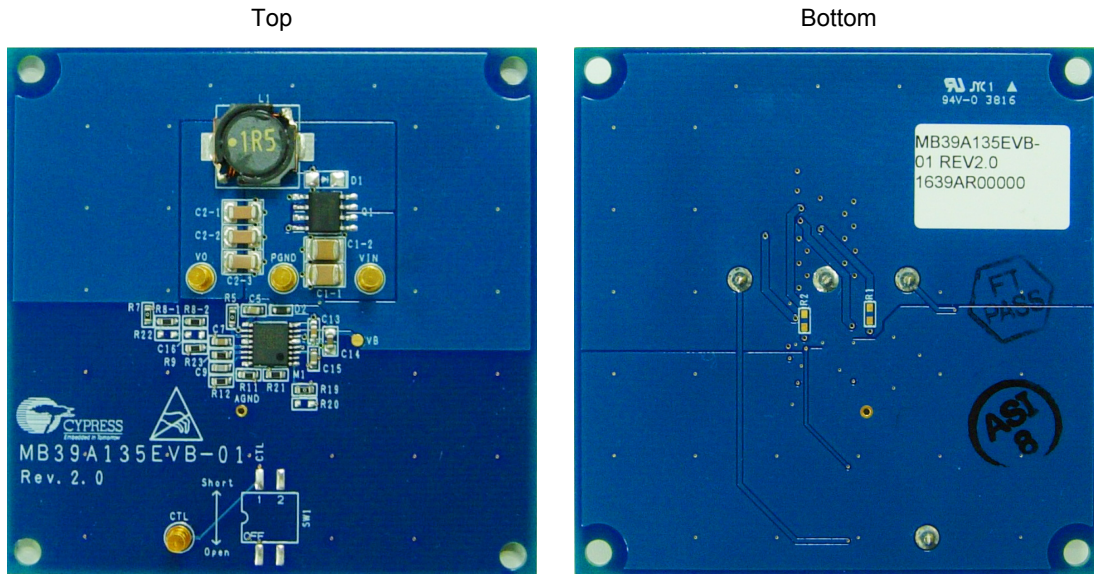


A.2. Bill of Materials (BOM)

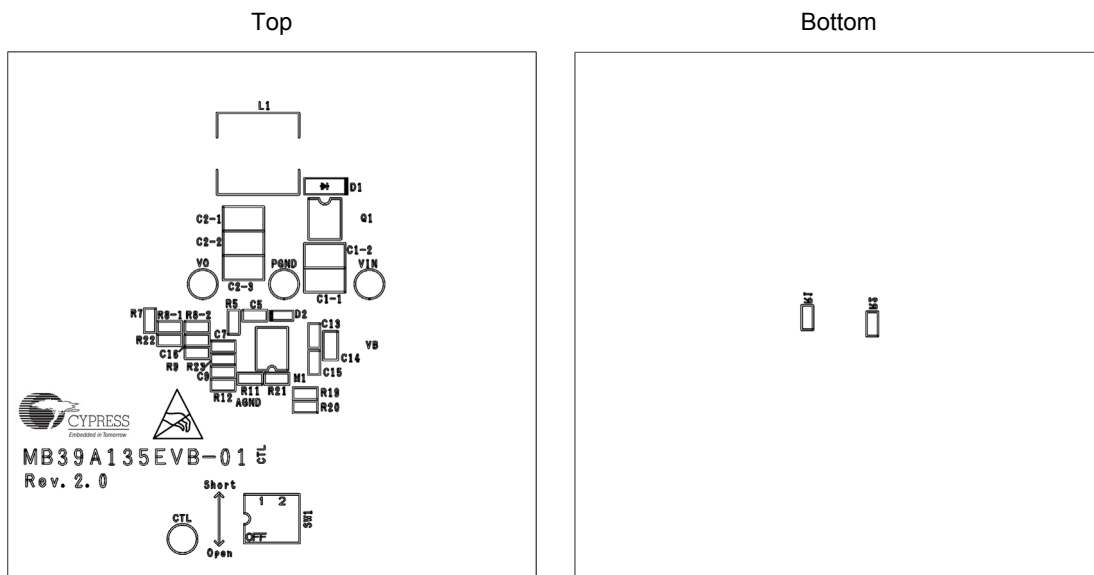
No	Symbol	Item	Value / Description	Part Number	Vendor	PKG / Size	Remark
1	M1	IC	Buck controller	MB39A135PFT-G-JN-ERE1	Cypress	STB016	--
2	Q1	Dual NMOS FETs	$V_{DS} = 30\text{ V}$, $I_D = 8\text{ A}$, $R_{ON} = 21\text{ m}\Omega$	FDS6990AS	Fairchild	SO8	--
3	D1	--	--	--	--	--	No mount
4	D2	Schottky Diode	$V_F = 0.4\text{ V}$ (Max) at $I_F = 0.2\text{ A}$	BAT54XV2T1G	On semi	SOD-523	--
5	L1	Inductor	1.5 μH (6.2 $\text{m}\Omega$, 8.9 A, 30 %)	VL10040T-1R5N8R9	TDK	10 \times 9.7 \times 4 (mm)	--
6	C1-1, C1-2	Capacitor	22 μF (25 V, X5R, 10 %)	GRM32ER61E226KE15K	Murata	1210	--
7	C2-1, C2-2, C2-3	Capacitor	22 μF (10 V, JB)	C3216JB1A226M160AC	TDK	1206	--
8	C5	Capacitor	0.1 μF (50 V, JB)	C1608JB1H104K080AA	TDK	0603	--
9	C7	Capacitor	0.022 μF (50 V, JB)	C1608JB1H223K080AA	TDK	0603	--
10	C9	Capacitor	390 pF (50 V, JB)	C1608CH1H391J080AA	TDK	0603	--
11	C13	Capacitor	0.01 μF (50 V, JB)	C1608JB1H103K080AA	TDK	0603	--
12	C14	Capacitor	1 μF (16 V, JB)	C1608JB1C105K080AA	TDK	0603	--
13	C15	Capacitor	0.1 μF (50 V, JB)	C1608JB1H104K080AA	TDK	0603	--
14	C16	--	--	--	--	--	No mount
15	R1	--	--	--	--	--	No mount
16	R2	--	--	--	--	--	No mount
17	R5, R7, R19	Resistor	0 Ω	RK73Z1JTDD	KOA	0603	--
18	R8-1	Resistor	1.6 k Ω (1/16 W, 0.5 %)	RR0816P-162-D	SSM	0603	--
19	R8-2	Resistor	9.1 k Ω (1/16 W, 0.5 %)	RR0816P-912-D	SSM	0603	--
20	R9	Resistor	15 k Ω (1/16 W, 0.5 %)	RR0816P-153-D	SSM	0603	--
21	R11	Resistor	56 k Ω (1/16 W, 0.5 %)	RR0816P-563-D	SSM	0603	--
22	R12	Resistor	68 k Ω (1/16 W, 0.5 %)	RR0816P-683-D	SSM	0603	--
23	R20	--	--	--	--	--	No mount
24	R21	Resistor	82 k Ω (1/16 W, 0.5 %)	RR0816P-823-D	SSM	0603	--
25	R22	--	--	--	--	--	No mount
26	R23	Resistor	22 k Ω (1/16 W, 0.5 %)	RR0816P-223-D	SSM	0603	--
27	SW1	--	--	--	--	--	No mount
28	PIN	Terminal	Wire wrap	WT-2-1	Mac-Eight	--	--

A.3 Image

Figure 6-1. Image

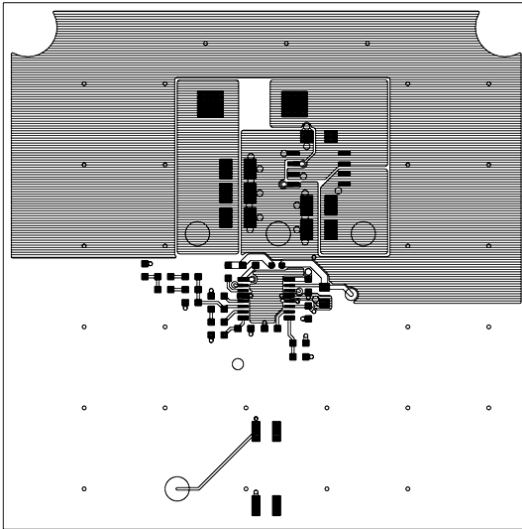


A.4 Silk Screen

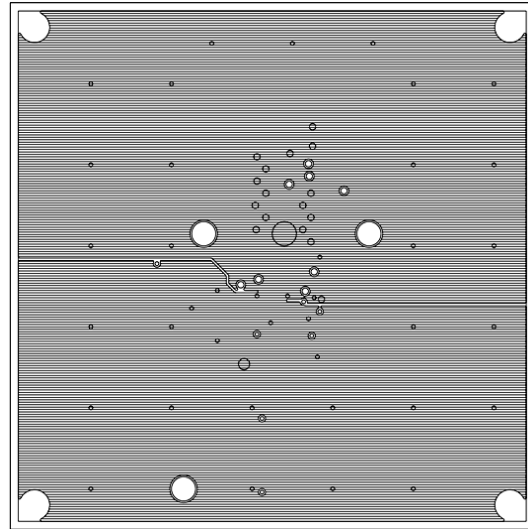


A.5 Layout

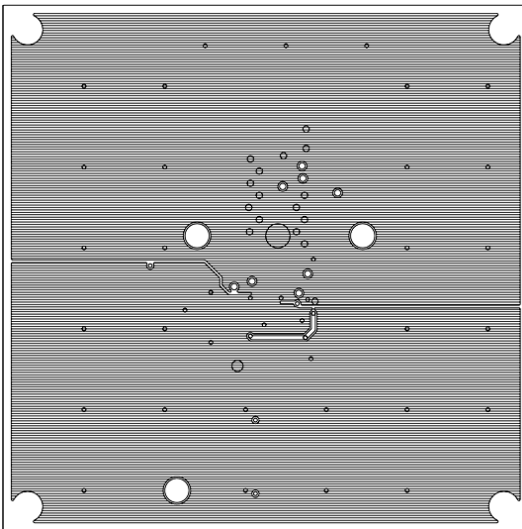
Top



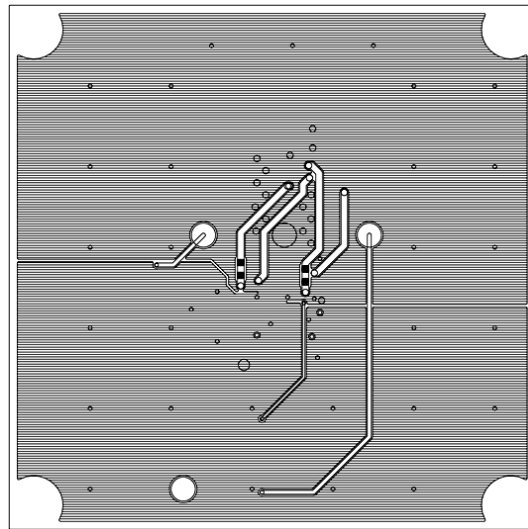
Layer 2



Layer 3



Bottom



Revision History



Document Revision History

Document Title: MB39A135EVB-01 1CH Buck DC/DC Converter IC Evaluation Kit User Guide				
Document Number: 002-18071				
Revision	ECN#	Issue Date	Origin of Change	Description of Change
**	5553029	12/14/2016	HIXT	New user guide