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Switching Regulator Series

Buck Converter with Integrated FET BD9E304FP4-LBZ EVK

BD9E304FP4-EVK-003 (12V→5V, 3.0A)

Introduction

This user's guide provides the necessary steps to operate the EVK of ROHM's BD9E304FP4-LBZ 1-channel Buck DC/DC converter. This includes the external parts, operating procedures, and application data.

Description

This EVK has been developed for ROHM's synchronous buck DC/DC converter customers evaluating BD9E304FP4-LBZ and outputs 5V from 24V or 12V input voltage. The BD9E304FP4-LBZ accepts a power supply input range of 4.5V to 36V and generates an output voltage ranging from (0.1 x V_{IN} or 0.7V) to 0.8 x V_{IN} using external resistors. The operating frequency is fixed at 300 kHz. The Light Load Mode control provides good efficiency characteristics in light load conditions, which is ideal for applications that needs to lessen the standby power. The current mode control DC/DC converter provides high-speed transient response performance. Additional protection functions include a built-in soft start function to prevent inrush current at startup, UVLO (Under Voltage Lock Out), TSD (Thermal Shutdown Detection), SCP (Short Current Protection), OCP (Over Current Protection), and OVP (Over Voltage Protection).

Application

Industrial Products as Factory Automation

Secondary power supply and adapter equipment

Telecommunication Devices

Operating Limits

Parameter	Min	Typ	Max	Units	Conditions
Input Voltage	10.0	12.0	36.0	V	
Output Voltage		5.0		V	
Output Current Range			3.0	A	
Operating Frequency		300		kHz	
Maximum Efficiency		95.0		%	Vin=12V, Iout=0.6A
UVLO Detect Voltage		3.9		V	Vin sweep down
UVLO Hysteresis Width		350		mV	

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EVK



Figure 1. BD9E304FP4-EVK-003(Top View)

EVK Schematic

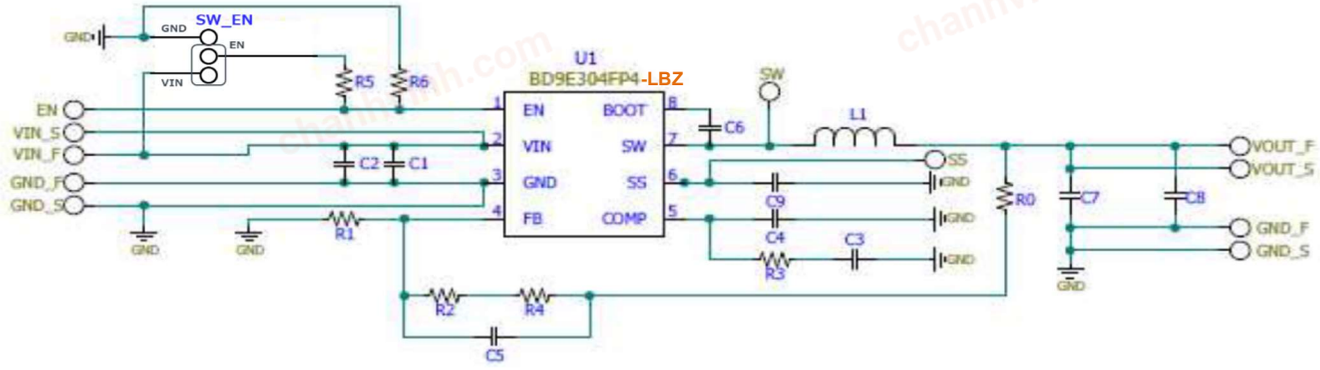


Figure 2. BD9E304FP4-EVK-003 Circuit Diagram

Operating Procedure

1. Turn off the DC power supply and connect the GND terminal of the power supply to the GND_F terminal (left side in EVK) of the EVK.
2. Connect the VCC pin of the DC power supply to the VIN_F pin of the EVK.
3. Connect the load to the VOUT_F and GND_F (right side in EVK) terminal of EVK. When using an electronic load, connect with the load turned off.
4. Connect a voltmeter to the VOUT_S terminal and the GND_S terminal (right side in EVK) of EVK.
5. Connect the jumper of SW_EN to VIN (ON) side.
6. Turn on the DC power supply. Make sure the voltmeter shows 5V.
7. Turn on the electronic load.

(Caution) This EVK does not support hot plug. Do not perform hot plug test.

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Operation State Settings

Below is a table of BD9E304FP4-LBZ condition selectable using SW_EN.

Table 1. SW_EN Settings

SW_EN state	BD9E304FP4-LBZ Condition
ON (short to VIN)	Enable
OFF (short to GND)	Shutdown

Parts list

Table 2. Parts list

Parts Number	Type	Value	Size/ Size Code [Unit:mm(inch)]	Power Rating	Voltage/ Current Rating	Temp. Coefficient/ DCR	Tolerance	Parts Name	Manufacturer	Quantity
C1,C6	Capacitor	0.1μF	1005(0402)	-	50V	X5R	±10%	GRM155R61H104KE14	Murata	2
C2	Capacitor	10μF	3225(1210)	-	100V	X7S	±10%	GRM32EC72A106KE05	Murata	1
C7,C8	Capacitor	47μF	3216(1206)	-	16V	X5R	±10%	GRM32EB31C476KE15L	Murata	2
C5	Capacitor	120pF	0603(0201)	-	50V	C0G	±5%	GRM0335C1H121JA01	Murata	1
C3	Capacitor	680pF	0603(0201)	-	25V	C0G	±5%	GRM0335C1E681JA01	Murata	1
R3	Resistor	33k	1005(0402)	1/16W	-	-	±1%	MCR01MZPF3302	ROHM	1
R4	Resistor	15k	1005(0402)	1/16W	-	-	±1%	TRR01MZPF1502	ROHM	1
R2	Resistor	300k	1005(0402)	1/16W	-	-	±1%	TRR01MZPF3003	ROHM	1
R1	Resistor	43k	1005(0402)	1/16W	-	-	±1%	TRR01MZPF4302	ROHM	1
L1	Inductor	15μH	100100(4040)	-	Ist=5.1A	DCR=35.2mΩ±20%	±20%	1274AS-H-150M#	Murata	1
U1	IC	-	2.80x2.92	-	-	-	-	BD9E304FP4-LBZ	ROHM	1
R5	-	Short	Soldering	-	-	-	-	Shorted by Solder	-	0
R6	-	Open		-	-	-	-	-	-	0
R0	-	Short	Soldering	-	-	-	-	Shorted by Solder	-	0
EN, VIN_S,VIN_F, GND_Fx2, GND_Sx2, SS, VOUT_S, VOUT_F	Test Pin	-	1mm Hole	-	10A	-	-	ST-2-2	Mac8	10
SW_EN	Header	-	-	-	-	-	-	68000-103HLF	Amphenol FCi	1
SW_EN	Jumper	-	-	-	-	-	-	QPC02SXGN-RC	SULLINS	1

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Board Layout

EVK PCB information

Number of Layers	Material	Board Size	Copper Thickness
4	FR-4	67.5mm x 67.5mm x 1.6mmt	1oz (35μm)

The layout of BD9E304FP4-EVK-003 is shown below.

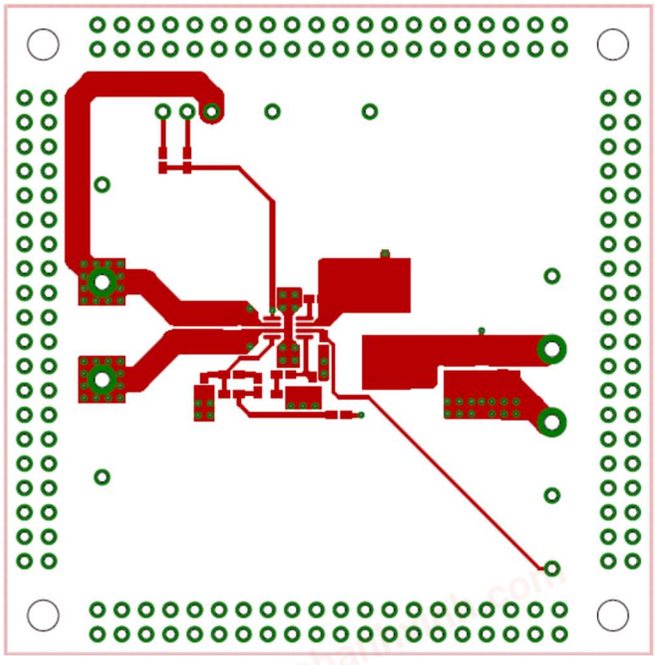


Figure 3. Top Layer Layout
(Top View)

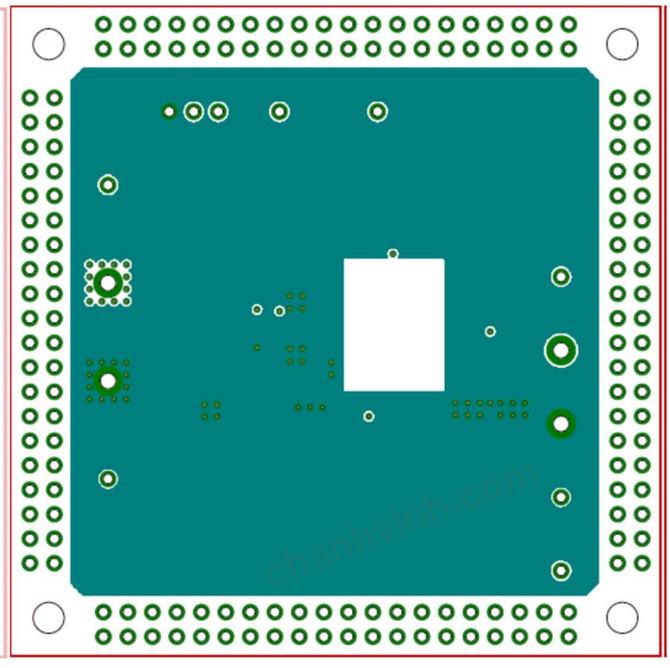


Figure 4. Middle1 Layer Layout
(Top View)

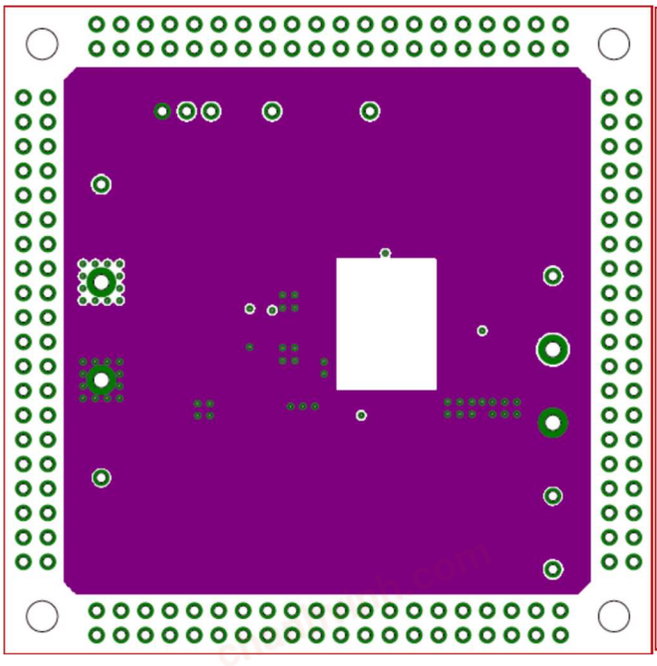


Figure 5. Middle2 Layer Layout
(Top View)

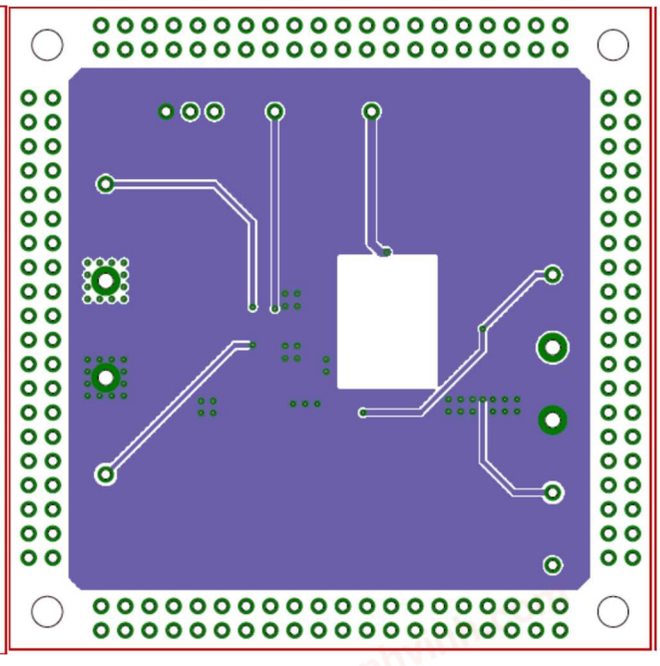


Figure 6. Bottom Layer Layout
(Top View)

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Reference application data

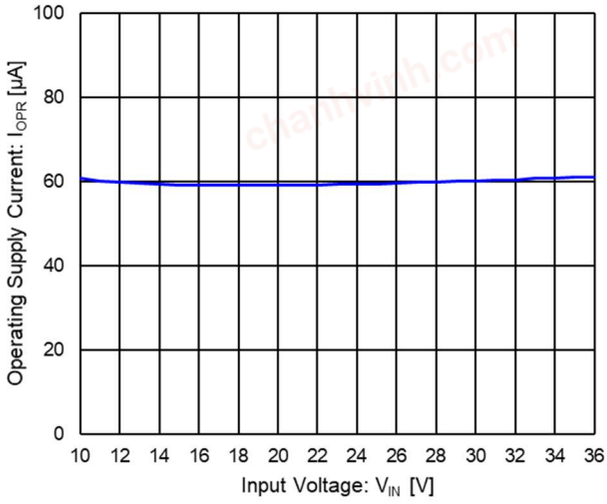


Figure 7. Operating Quiescent Current vs Input Voltage
(VIN=12V, VOUT=5V, IOUT=0A)

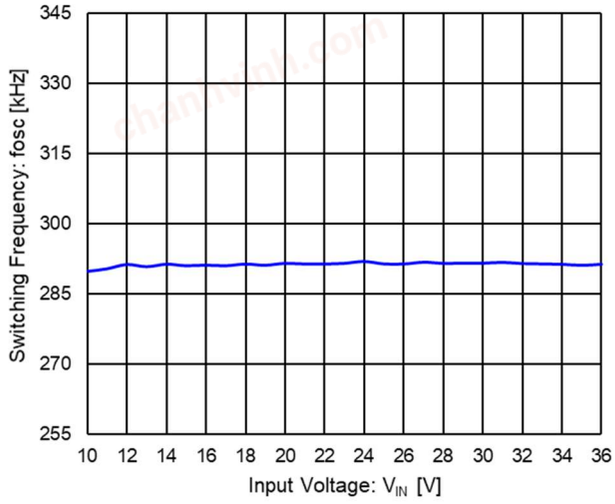


Figure 8. Switching Frequency vs Input Voltage
(VOUT=5V, IOUT=3A)

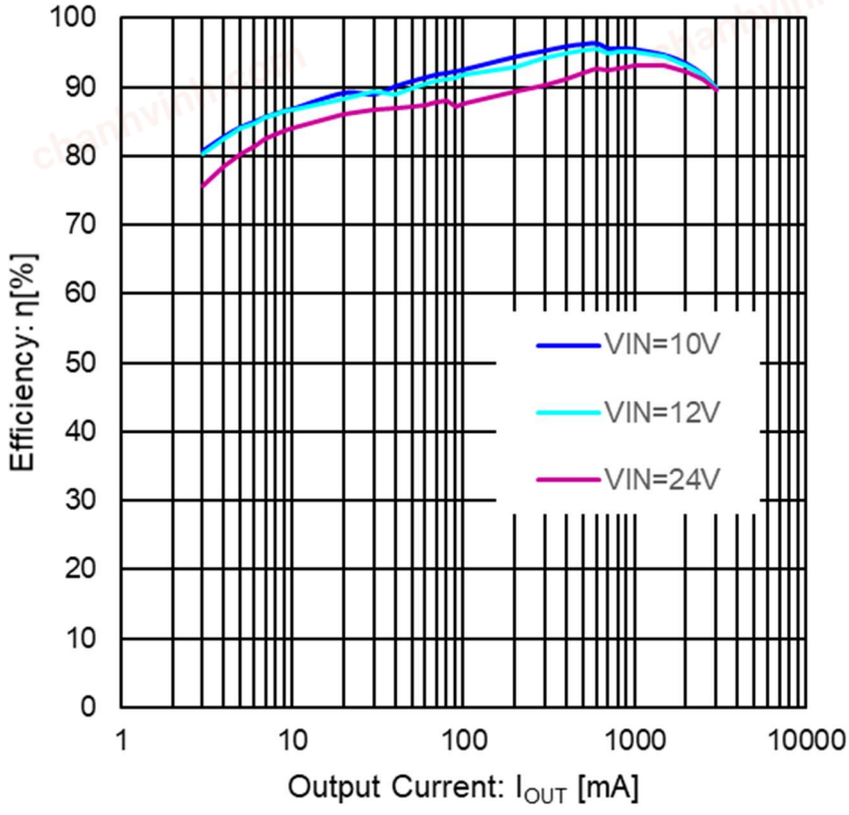


Figure 9. Efficiency vs Output Current (VOUT=5V)

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Reference application data - continued

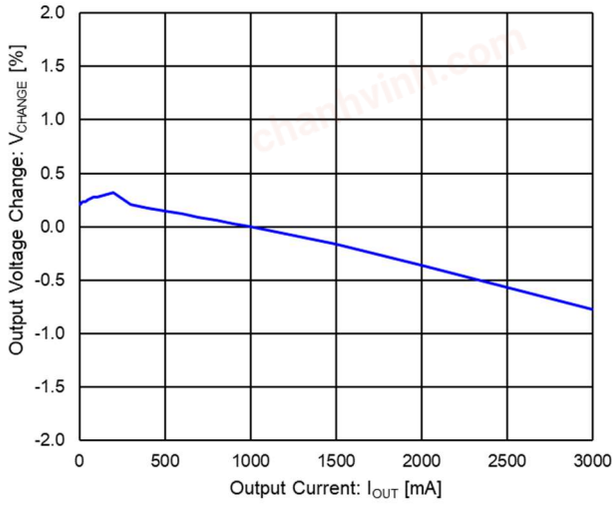


Figure 10. VOUT Load Regulation
(VIN=12V, VOUT=5V)

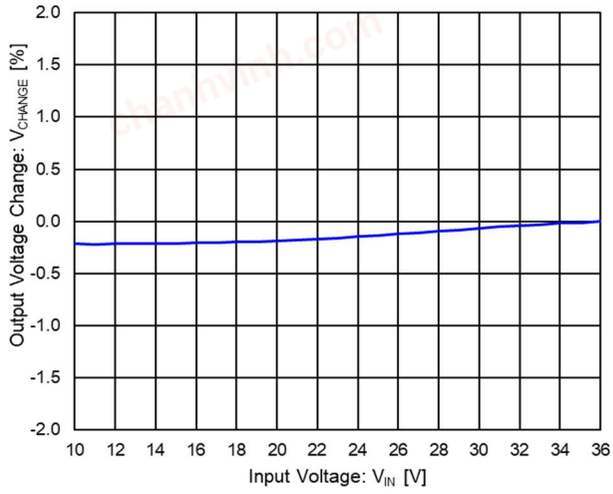


Figure 11. VOUT Line Regulation
(VOUT=5V, IOUT=3A)

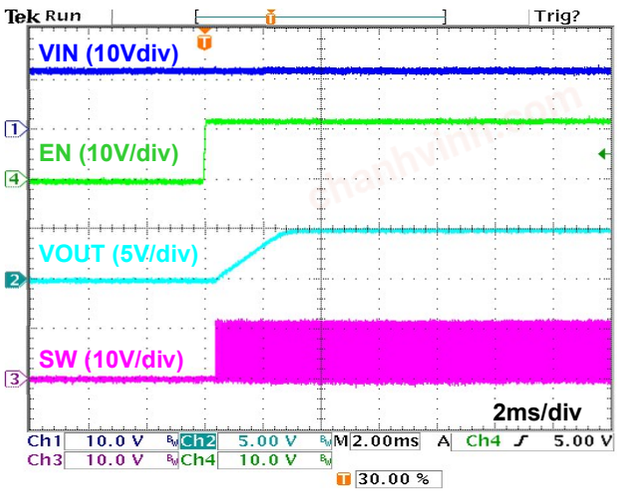


Figure 12. Rise-up Waveform
(VEN=0V→12V, IOUT=3A)

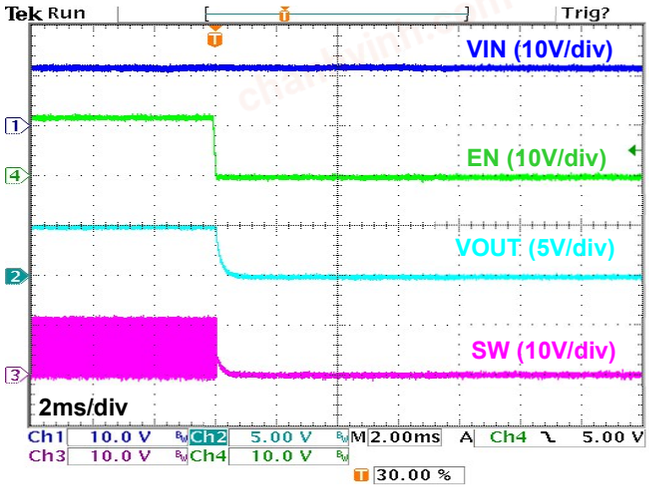


Figure 13. Shut-down Waveform
(VEN=12V→0V, IOUT=3A)

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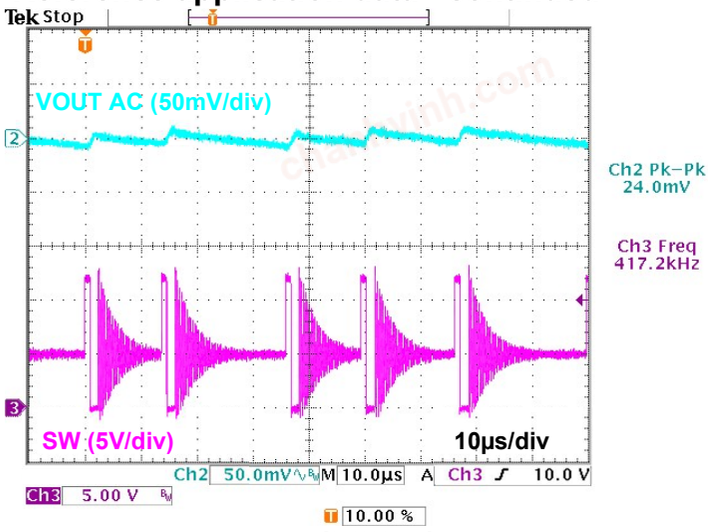


Figure 14. SW Waveform
(VIN=12V, VOUT=5V, IOUT=30mA)

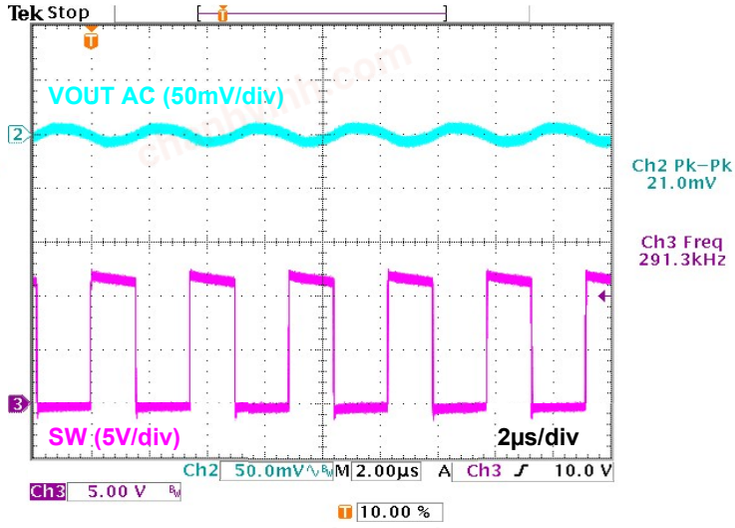


Figure 15. SW Waveform
(VIN=12V, VOUT=5V, IOUT=3A)

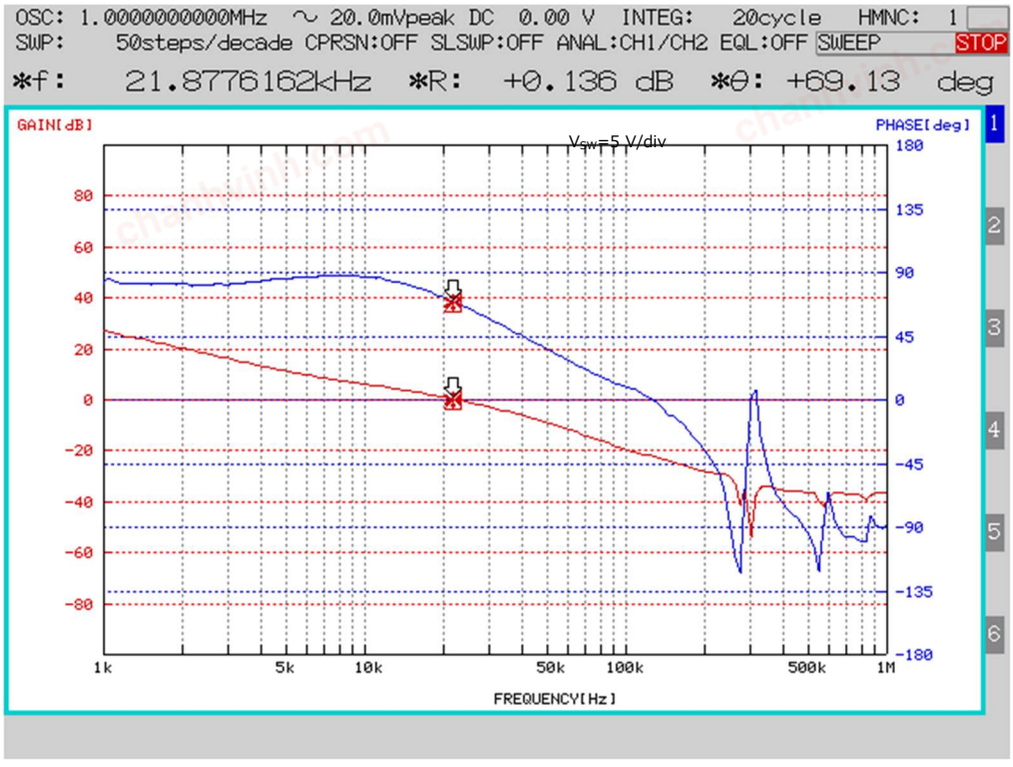


Figure 16. Frequency Response
(VIN=12V, VOUT=5V, IOUT=3A)

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Products lists in the Parts list

The product names listed in the parts list are available during the time of creating this user's guide. In case some parts are no longer available in the future, select the equivalent products.

Selection of Ceramic Capacitors

In selecting the ceramic capacitors, consider the DC bias characteristics and select the parts with equivalent actual capacitance of capacitors in the Parts List (Table 2). For reference, Figure 17 shows the DC bias characteristics of GRM32EC72A106KE05 (Murata) listed as C2 in the Parts list (Table 2). Actual capacitance degrades to 8.1µF under the condition of 12V output (DC bias voltage is 12V). When selecting an alternative component, select the product that has same capacitance under 12V of DC bias voltage. (The data shown in Figure 17 is for reference only. Please check with the capacitor manufacturer for the DC bias characteristics of ceramic capacitors.)

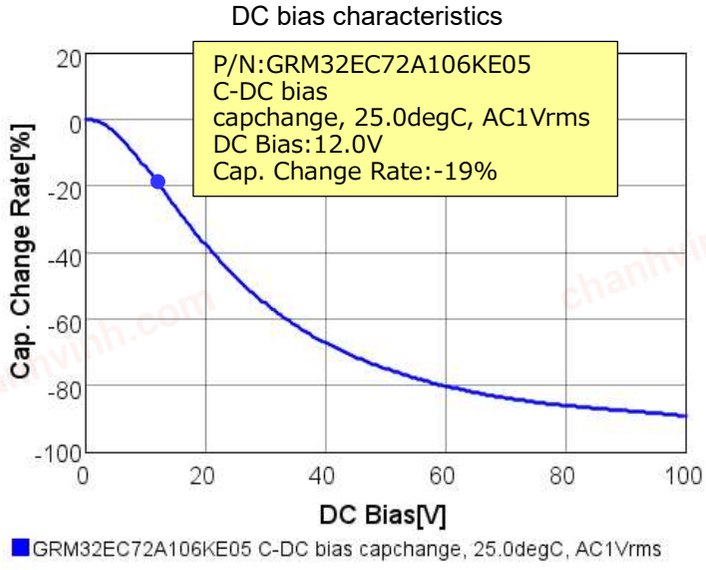


Figure 17. GRM32EC72A106KE05 (Murata) DC bias characteristics

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Revision History

Date	Revision Number	Description
21.Feb.2022	001	Initial release

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Notes

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