LED Driver for Automotive Exterior/Interior Lamp

40V 150mA 4ch 2 LEDs in series Constant Current LED Driver for Automotive BD18347EFV-M Evaluation Board

Introduction

This user's guide will provide the necessary steps to operate the Evaluation Board of ROHM's BD18347EFV-M LED Driver. This document includes the external parts, operating procedures and application data.

Description

This Evaluation Board was developed for ROHM's LED Driver BD18347EFV-M. BD18347EFV-M is a 40V-withstanding constant current LED driver for automotive applications. It is a 4 channel LED driver with the built-in energy sharing control which can realize to make the board size small. High reliability can be realized with LED Open Detection, the OUTx (all later x=1 to 4) pin Short Circuit Protection, Over Voltage Mute and Thermal Shutdown Function.

Application

Automotive LED Exterior Lamp (Rear Lamp, License Lamp, DRL / Position Lamp, Fog Lamp etc.)

Automotive LED Interior Lamp (Air Conditioner Lamp, Interior Lamp, Cluster Light etc.).

Evaluation board operating condition (default setting)

Table 1. Evaluation board operating condition (default setting)

Parameter	Min	Typ	Max	Unit
Power supply voltage *1	5.5	13	20*1	V
LEDs in series (per channel)	1	-	2	pcs
LEDs in parallel (per IC set)	-	4	-	ch
Number of IC on EVK	-	2	-	units
Output current (per channel)	-	100*2	150	mA
CR Timer Frequency (Global PWM Dimming)	-	300*3	-	Hz

*1 This indicates the voltage near the VIN pin. Be careful of voltage drop by the impedance of power line.

*2 Output current is determined by the RSETx resistors placed on SETx pins and the PWM duty cycle.

*3 Global PWM Dimming CR Timer Frequency is determined by the capacitor C_{CRT} and R_{CRT} placed around CRT pin and DISC pin.

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Evaluation board (BD18347EFV-EVK-101)

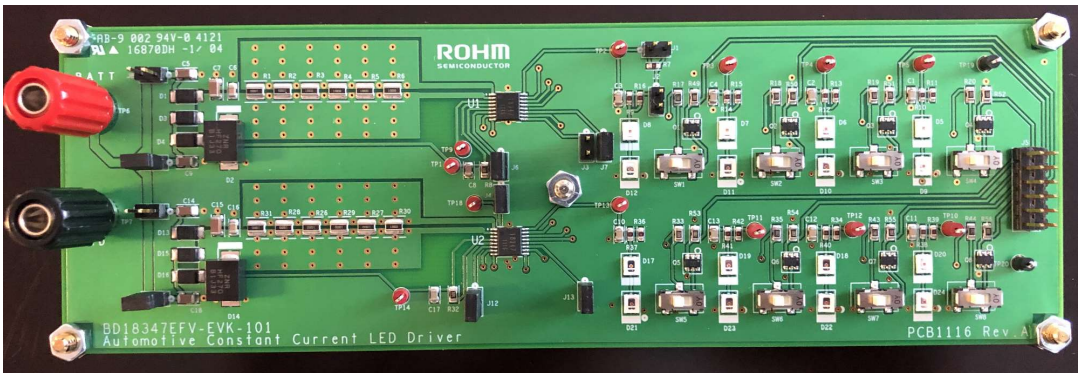

Figure 1. Top view

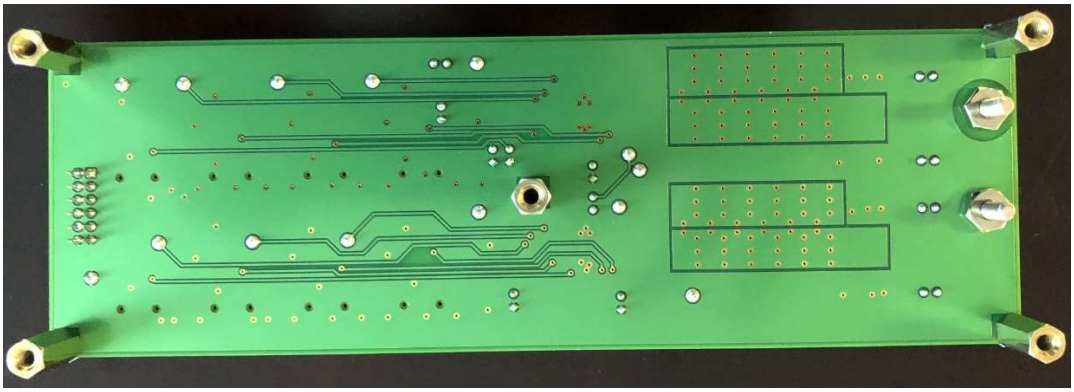

Figure 2. Bottom view

Evaluation board setup

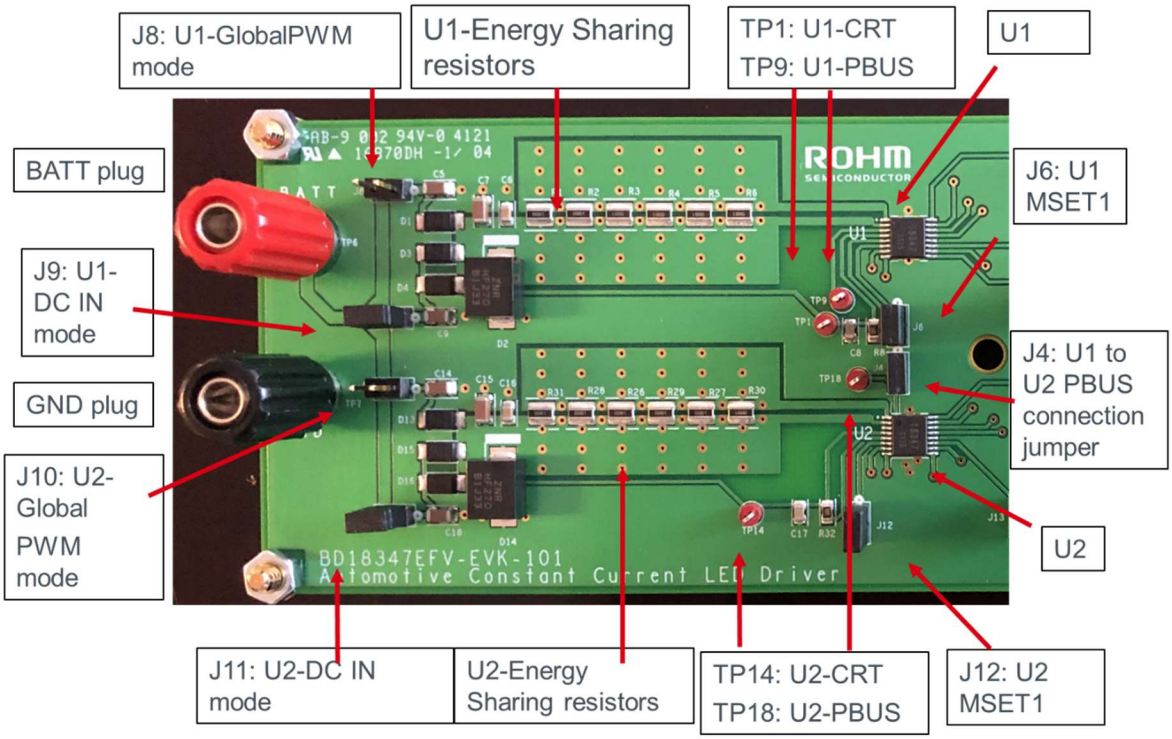

Figure 3. Evaluation board setup – Left Side of EVK: IC, jumpers and test points

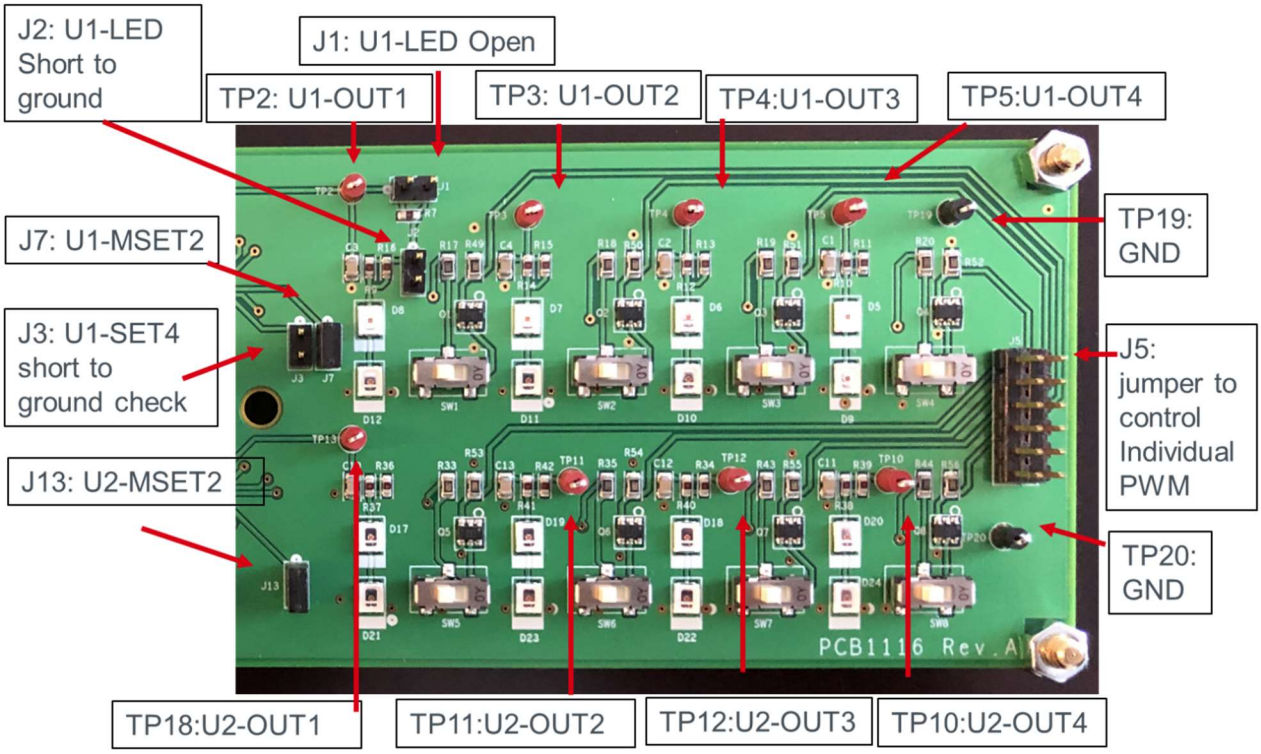

Figure 4. Evaluation board setup – Right Side of EKV: LED driver related jumpers

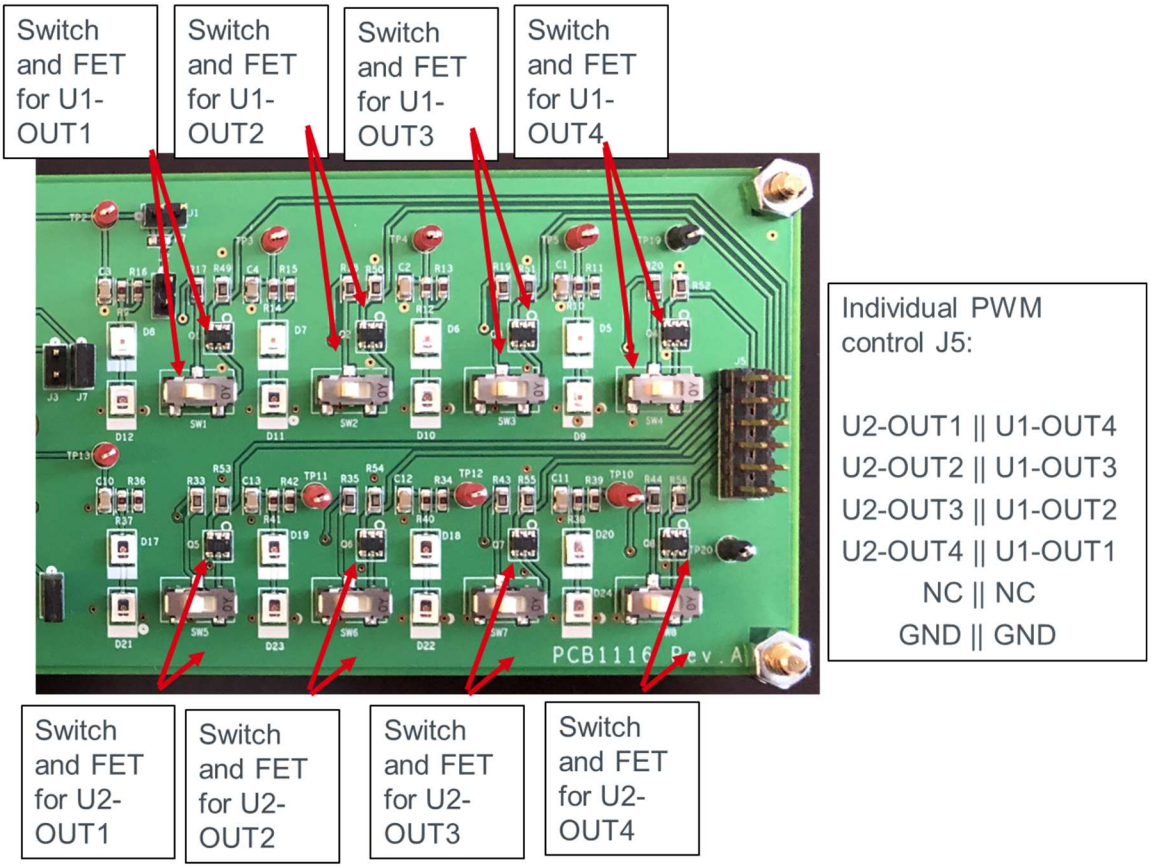

Figure 5. Evaluation board setup – Right Side of EVK: switch, jumpers and FET for individual dimming

Operating procedure: DC Input

1. Connect jumpers J9 and J11 while disconnecting jumpers J8 and J10.
2. Connect BATT and GND plug to power supply.
3. Observe the LED turn on for all channels at 100% duty cycle.

Operating procedure: Global PWM Dimming

1. Connect jumpers J8 and J10 while disconnecting jumpers J9 and J11.
2. Connect BATT and GND plug to power supply.
3. Observe the LED turn on for all channels at about 10% duty cycle at 300Hz.
4. For more information about Global PWM Dimming please see the datasheet section 4: PWM Dimming Operation.

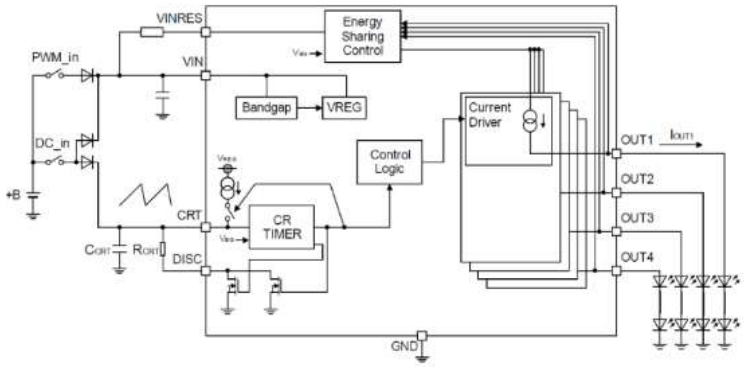

Figure 6. Global PWM Dimming setup

Operating procedure: Individual PWM Dimming

1. Connect jumpers J9 and J11 while disconnecting jumpers J8 and J10.
2. Slide SW1 through SW8 to the right to connect RSETx to the FETs to individually PWM each channel.
3. Connect a function generator to the appropriate J5 pins to control each channel individually (see PCB schematic).
4. Connect BATT and GND plug to power supply.
5. Observe the LED turn on with duty cycle of the function generator for each individual channel.
6. The figure below shows how individual PWM operation works. A signal driving the gate of the FETs will PWM the RSETx resulting in each individual channel following the PWM frequency and duty cycle of the signal.

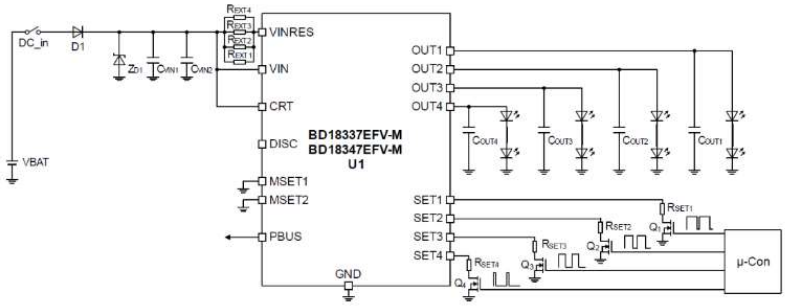

Figure 7. Individual PWM Dimming setup

Functionality: Lamp Control Modes

1. Use the jumpers J6, J7, J12 and J13 to control the MSET1 and MSET2 of the two IC U1 and U2.

By connecting the MSET1 pin to ground or open, it is possible to change output channel operation mode on detecting an LED error. The MSET2 pin can also be used to control CH4 operation.

MSET1=L (GND short) : If SCP or LED Open is detected in any one of 4 channels, all the channels are OFF.

MSET1=H (Pin open) : Remaining channels continue to operate even if one channel detects SCP or LED Open.

MSET2=L (GND short) : CH4 operates in the same way as CH1 to CH3

MSET2=H (Pin open) : CH4 ignores the PWM signal generated by CRTIMER and are always in DC mode. When CH4 detects SCP or LED Open, PBUS : H is maintained and CH1 to CH3 continue to operate (License Lamp Mode).

Table 2. Lamp Control Modes

Normal Mode (MSET2=L)

MSET1	MSET2	OUT1 to OUT3 OPEN Detect	OUT1 to OUT3 SCP	OUT4 OPEN Detect	OUT4 SCP	LED Error CH Output	Remaining CH1 to CH3 Output	CH4 Output	PBUS
L All CH OFF	L Normal Mode	Detect	-	-	-	ON	OFF	OFF	L
		-	Detect	-	-	OFF	OFF	OFF	
		-	-	Detect	-	ON	OFF	ON	
		-	-	-	Detect	OFF	OFF	OFF	
H IndividualCH OFF		Detect	-	-	-	ON	ON	ON	L
		-	Detect	-	-	OFF	ON	ON	
		-	-	Detect	-	ON	ON	ON	
		-	-	-	Detect	OFF	ON	OFF	

License Mode (MSET2=H)

MSET1	MSET2	OUT1 to OUT3 OPEN Detect	OUT1 to OUT3 SCP	OUT4 OPEN Detect	OUT4 SCP	LED Error CH Output	Remaining CH1 to CH3 Output	CH4 Output	PBUS
L All CH OFF	H License Mode	Detect	-	-	-	ON	OFF	ON	L
		-	Detect	-	-	OFF	OFF	ON	
		-	-	Detect	-	ON	ON	ON	H
		-	-	-	Detect	OFF	ON	OFF	
H IndividualCH OFF		Detect	-	-	-	ON	ON	ON	L
		-	Detect	-	-	OFF	ON	ON	
		-	-	Detect	-	ON	ON	ON	H
		-	-	-	Detect	OFF	ON	OFF	

Functionality: OUTx short to ground

1. Use the jumper J2 to short IC U1 OUT1 pin to ground..

If the OUTx pin is shorted to GND, the OUTx voltage goes low. When the OUTx pin voltage $V_{OUTx} \leq 0.6$ V (Typ), then SCP mechanism is enabled after a delay of t_{SCPD2} (20 µs (Typ)). In case of SCP, output current I_{OUT} is turned off to prevent thermal damage of the IC. Fault is indicated by pulling the PBUS pin low after a delay open t_{SCPD1} (60 µs (Typ)). To prevent false SCP at power supply startup, the output SCP is disabled until $V_{CRT} > 2.0$ V (Typ) once UVLO is released. In case of power supply ramping up with the OUTx pin short circuit condition (V_{OUTx} <0.6 V (Typ)), SCP mechanism is enabled after t_{SCPPON} (140 µs (Typ)), only if UVLO is released and $V_{CRT} > 2.0$ V (Typ).

Functionality: LED open

1. Remove resistor R7 and use jumper J1 to simulate an open LED condition.

When one of the LEDs is in the open state, the OUTx pin voltage rises. At $V_{OUTx} \geq V_{INRES}$ - 0.05 V (Typ), LED Open Detection operation is performed. In case of LED Open Detection, fault is indicated by pulling the PBUS pin low.

Functionality: SETx short to ground

1. Use jumper J3 to short IC U1 SET4 resistor to ground.

When the SETx pin is shorted to GND, the IC detects that the SETx pin current has increased and turns off the output current. The maximum resistance on the SETx pin short detection is $R_{SETx} \leq 5.0$ kΩ (Max). Fault is indicated by pulling the PBUS pin low.

Note that the SETx pin short detection resistance value R_{SETx} is 5 kΩ or less when the over voltage mute function is active.

Functionality: PBUS

1. Use jumper J4 to short IC U1 and IC U2 PBUS pins together.

The PBUS pin is the pin to input and output an error signal.

When abnormality such as LED Open or the OUTx pin short circuit occurs, it can notify the abnormality to the outside by changing the PBUS pin output from high to low. In addition, by externally controlling the PBUS pin from high to low, the output current is turned off. When using multiple LSIs to drive multiple LEDs, it is possible to turn off all LED lines at once by connecting the PBUS pins of each CH as shown in the figure below, even if LED Open or the OUTx pin short circuit occurs.

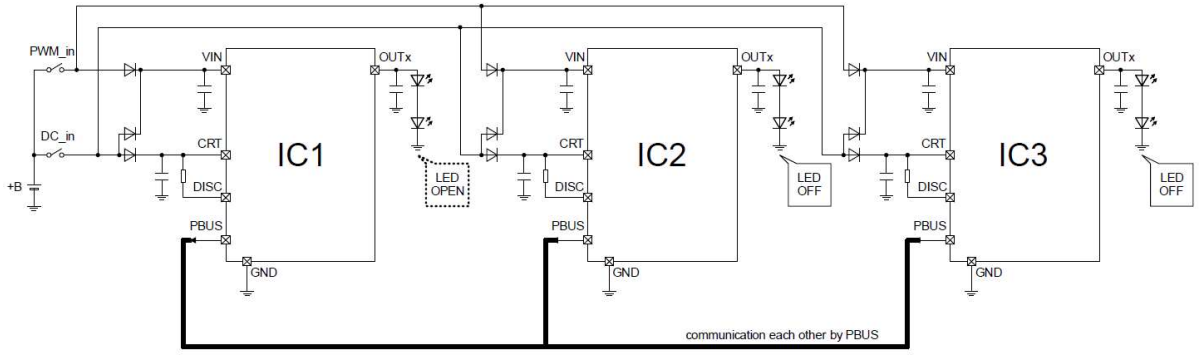

Figure 8. PBUS Function

Pin configuration

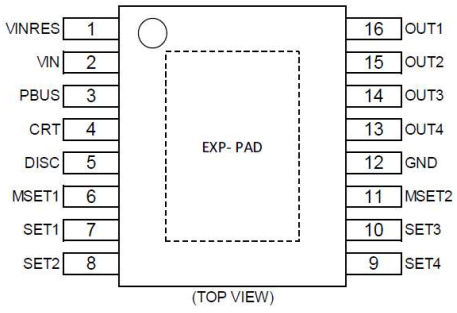

Figure 9. Pin configuration

Evaluation board schematic

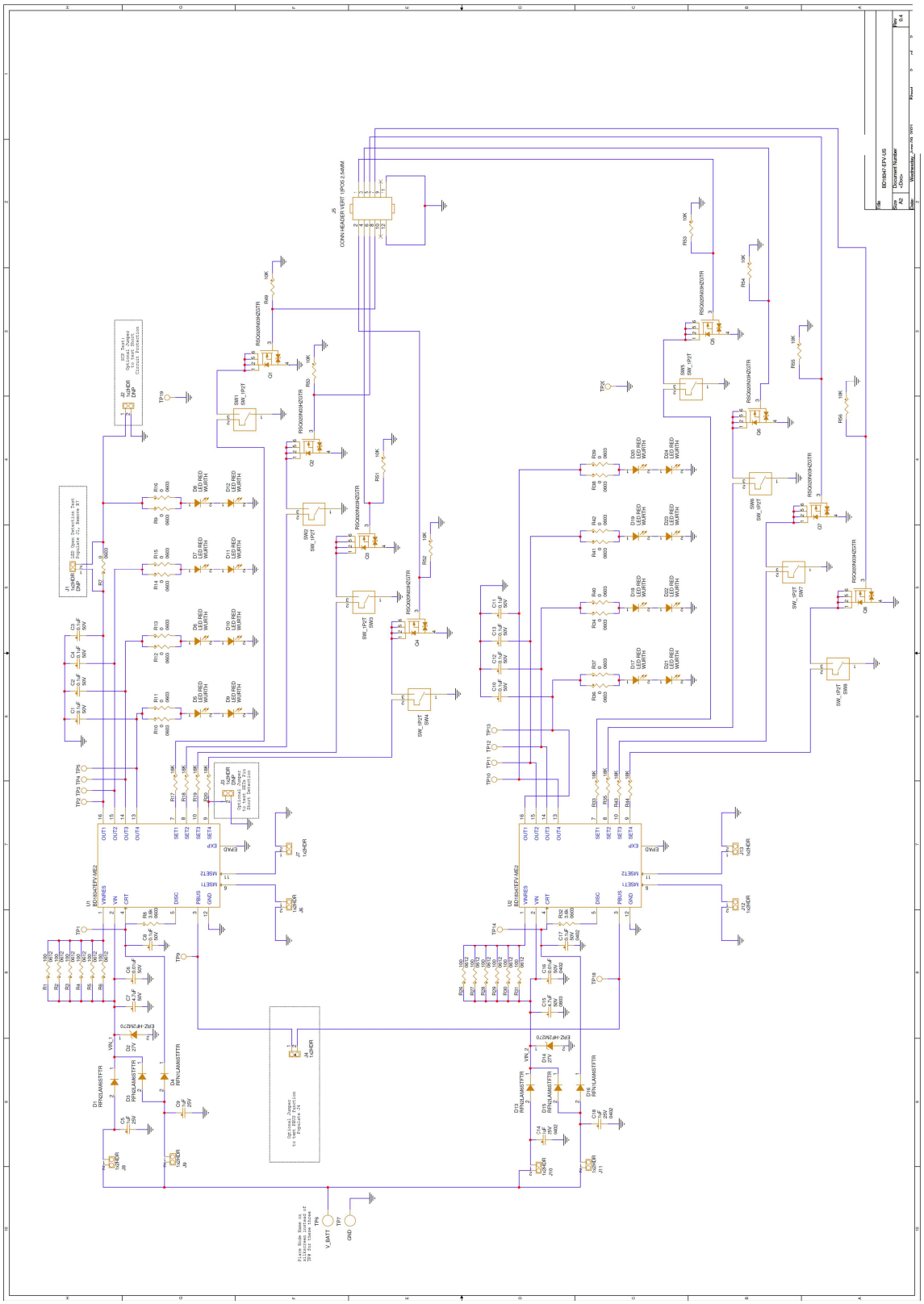

Figure 10. Evaluation board schematic

Parts list

Table 3. Parts list

Reference	Value	Description	Package Reference	Mfg	PART NUMBER
C1,C2,C3,C4,C8, C10,C11,C12,C13,C17	0.1uF	CAP CER 0.1UF 50V X7R 0805	0805	AVX	08055C104MAT2A
C5,C9,C14,C18	1uF	CAP CER 1UF 50V X7R 1206	1206	KEMET	C1206C105K5RACTU
C6,C16	0.01uF	CAP CER SMD 0805 .01UF X7R 5% 50	0805	KEMET	C0805C103J5RAC7210
C7,C15	4.7uF	CAP CER 4.7UF 50V X7R 1206	1206	TDK	C3216X7R1H475K160AE
D1,D3,D13,D15	600V, 1.5A	Diode 600 V 1.5A	SOD-128	ROHM	RFN2LAM6STFTR
D2,D14	27V, 5A	27 V 5 A Varistor	2-SMD, J-Lead	PANASONIC	ERZ-HF2M270
D4,D16	600V, 0.8A	Diode 600 V 0.8A	SOD-128	ROHM	RFN1LAM6STFTR
D5,D6,D7,D8,D9,D10, D11,D12,D17,D18,D19, D20,D21,D22,D23,D24	RED	Red 620nm LED 2.2V	1411	WURTH	150283RS73103
J1,J2,J3,J4,J6,J7,J8, J9,J10,J11,J12,J13	JUMPER	Connector Header Through Hole	2 position 0.100" (2.54mm)	SULLINS	PBC02SAAN
J1,J2,J3,J4,J6,J7,J8, J9,J10,J11,J12,J13	JUMPER	Jumper shorting tin	2 (1 x 2) Position Shunt Connector Black Closed Top	SULLINS	STC02SYAN
J5	JUMPER	Connector Header Through Hole	12 position 0.100" (2.54mm)	3M	929665-02-06-I
Q1,Q2,Q3,Q4, Q5,Q6,Q7,Q8	NFET	N-Channel 30 V 2A (Ta) 950mW	SC-95	ROHM	RSQ020N03HZGTR
R1,R2,R3,R4,R5,R6,R26, R27,R28,R29,R30,R31	100	100 Ohms ±1% 0.75W, 3/4W Chip Resistor Wide	0612/1206-Wide	ROHM	LTR18EZPF1000

Reference	Value	Description	Package Reference	Mfg	PART NUMBER
R7,R9,R10,R11,R12,R13, R14,R15,R16,R34,R36, R37,R38,R39,R40,R41,R 42	0	0 Ohms Jumper 0.1W, 1/10W Chip Resistor	0603	ROHM	SFR03EZPJ000
R8,R32	3.6k	3.6 kOhms ±1% 0.4W, 2/5W Chip Resistor	0805	ROHM	ESR10EZPF3601
R17,R18,R19,R20, R33,R35,R43,R44	18K	18 kOhms ±1% 0.125W, 1/8W Chip Resistor	0805	ROHM	KTR10EZPF1802
R49,R50,R51,R52 ,R53,R54,R55,R56	10K	10 kOhms ±1% 0.125W, 1/8W Chip Resistor	0805	ROHM	KTR10EZPF1002
SW1,SW2,SW3, SW4,SW5, SW6,SW7,SW8	SW_1P2T	SWITCH SLIDE SPDT 200MA 12V	CL-SB-12B-01_NDC	NIDEC COPAL	CL-SB-12B-01T
TP1,TP2,TP3,TP4,TP5, TP9,TP10,TP11,TP12, TP13,TP14,TP18	Test_Pad	Red PC Test Point	0.040" (1.02mm) Hole Diameter	KEYSTONE	5000
TP6	V_BATT	Binding Post Red	0.086" (2.18mm)	CINCH	111-0702-001
TP7	GND	Binding Post Black	0.086" (2.18mm)	CINCH	111-0703-001
TP19,TP20	Test_Pad	Black PC Test Point	0.040" (1.02mm) Hole Diameter	KEYSTONE	5001
U1,U2	BD18347EF V-ME2	40V 150mA 4ch Constant Current LED Driver	HTSSOP-B16_ROM	ROHM	BD18347EFV-ME2
N/A	N/A	Hex Standoff	0.500" (12.70mm) 1/2"	RAF ELECTRONIC	4534-632-S-28
N/A	N/A	#6-32 Hex Nut 0.245" (6.22mm) Steel	0.245" (6.22mm)	KEYSTONE	4701

Board layout

Evaluation board PCB information

Material	FR-4
Board thickness	1.575mm
Copper thickness	2 oz
Number of layers	2
Board size	60X185mm
Minimum copper width	0.325mm
Minimum air gap	0.350mm
Minimum hole size	0.406mm

The layout of BD18347EFV-M is shown below.

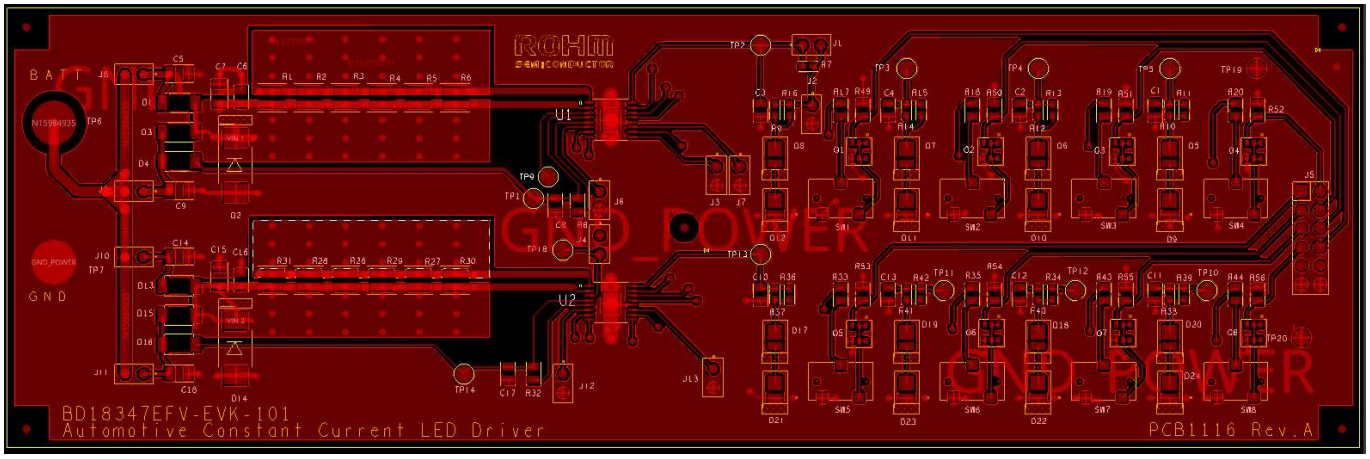

Figure 11. Top Layer and Top Silk Screen

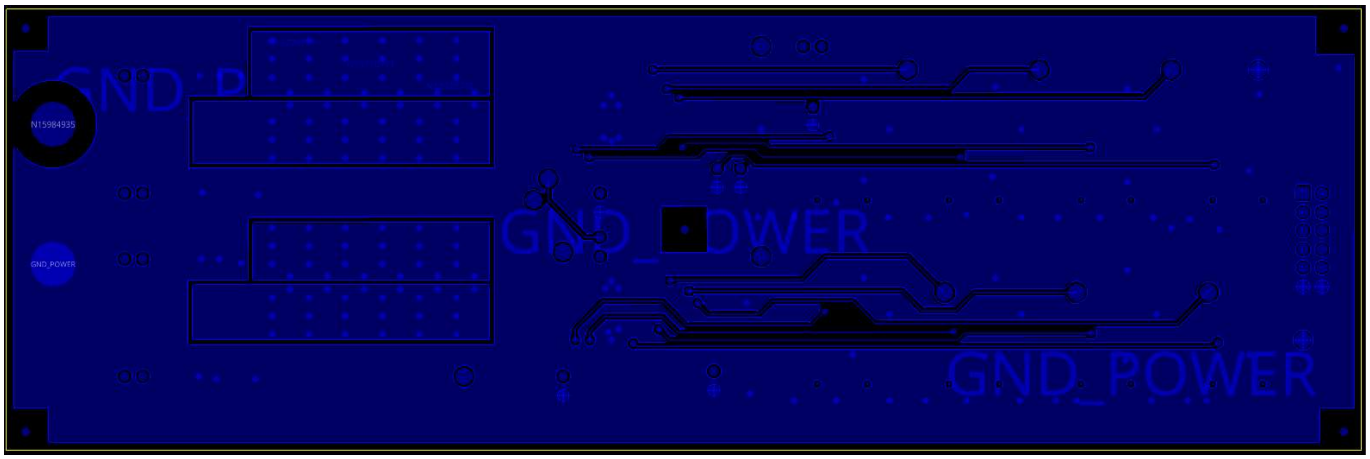

Figure 12. Bottom Layer

Reference application data (Ta=25°C)

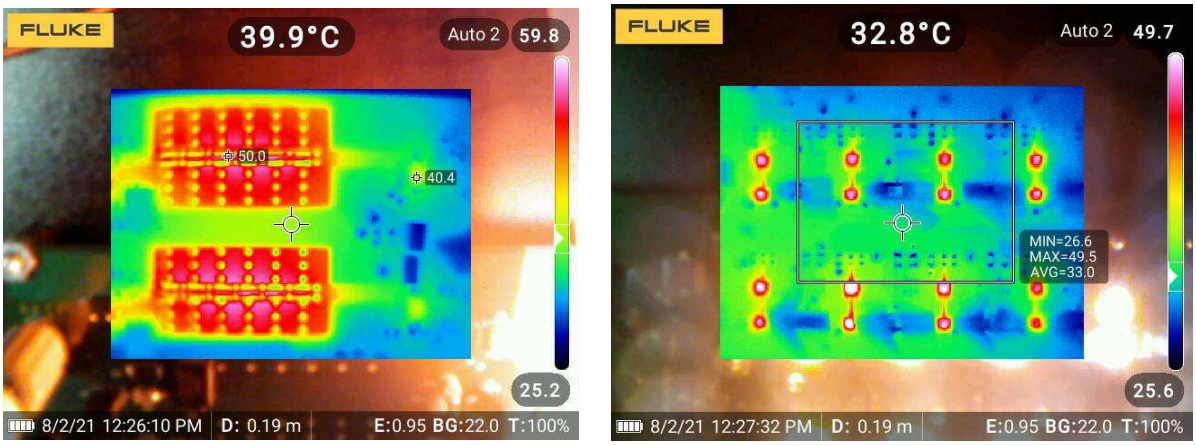

Figure 13. Thermal profile front side Left and Right Side of EVK (100% Duty, VIN = 12V)

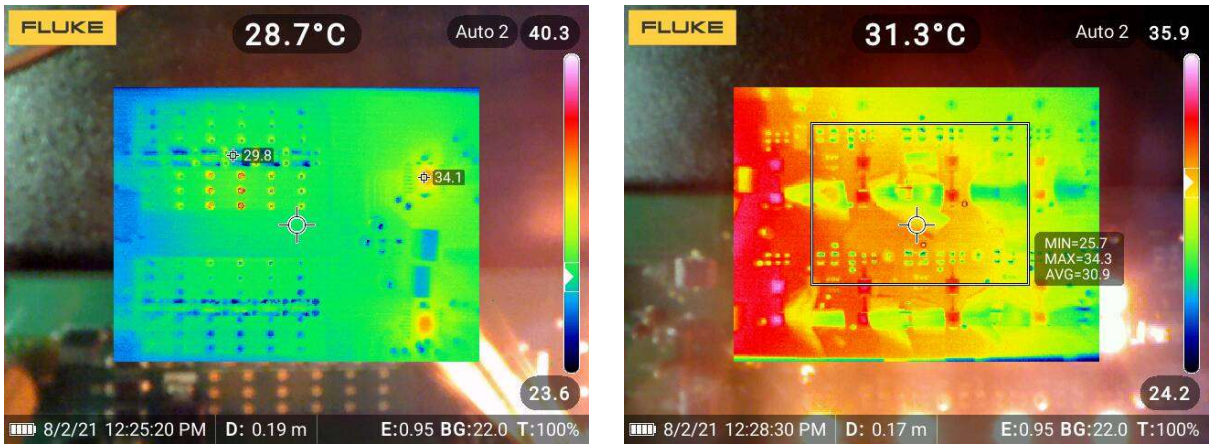

Figure 14. Thermal profile front side Left and Right Side of EVK (10% Duty, Global Dimming, VIN = 12V)

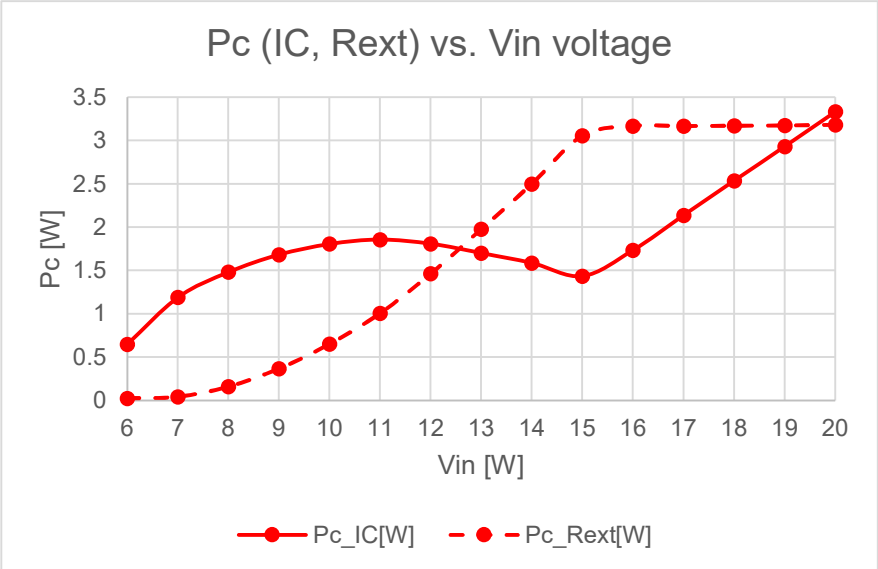

Figure 15. Energy Sharing Control

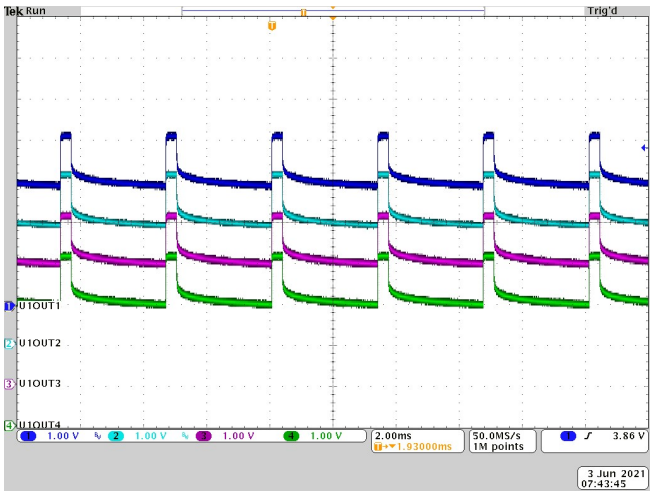

Figure 16. U1 in Normal Mode (MSET2=Ground)

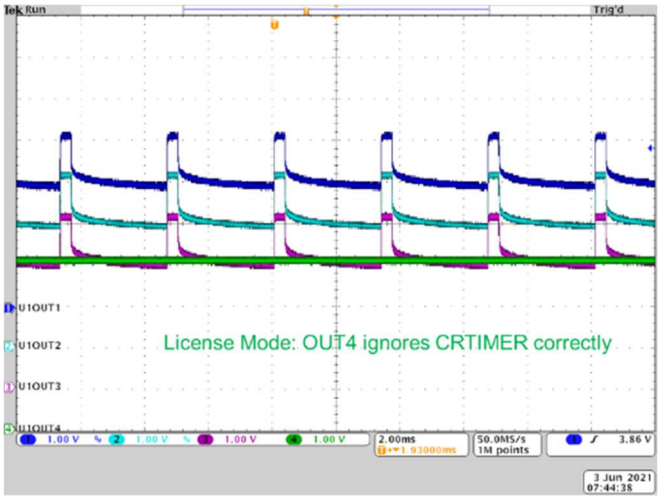

Figure 17. U1 in License Mode (MSET2=Open)

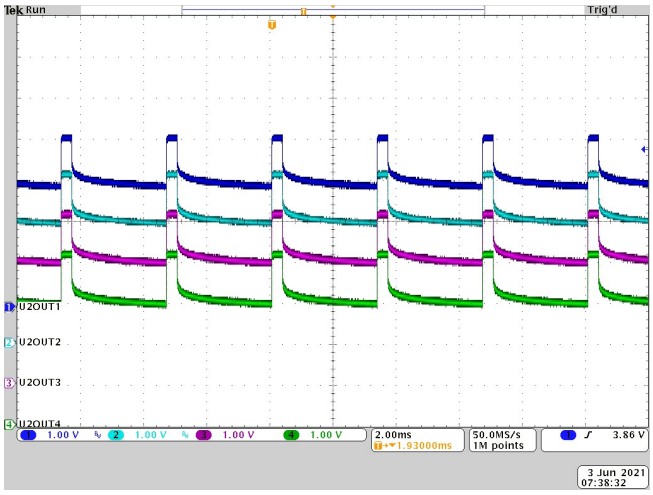

Figure 18. U2 in Normal Mode (MSET2=Ground)

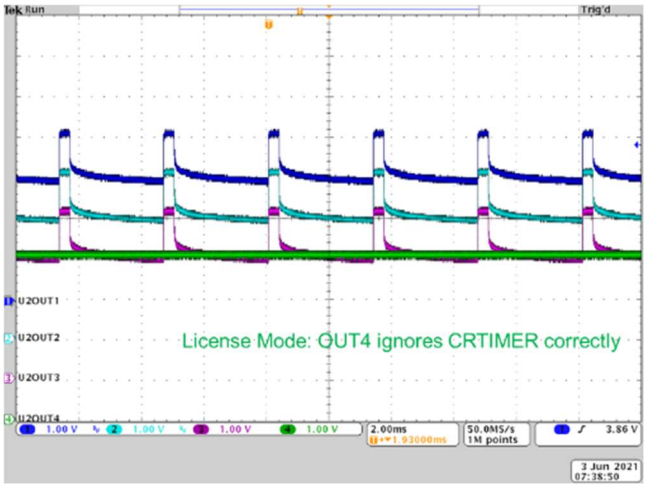

Figure 19. U2 in License Mode (MSET2=Open)

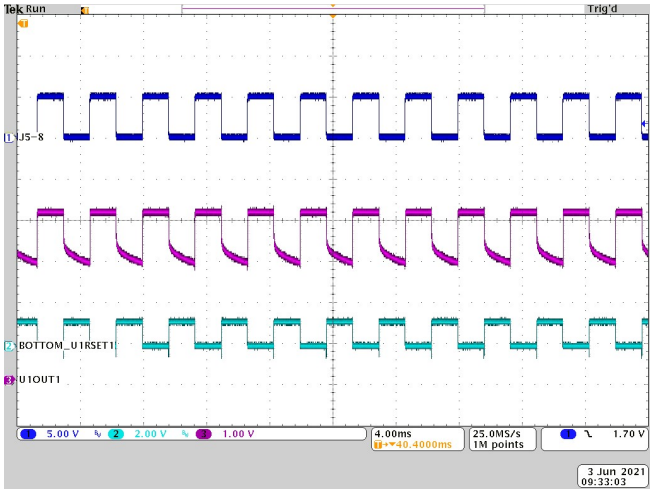

Figure 20. U1 OUT1 in Individual PWM (50% duty)

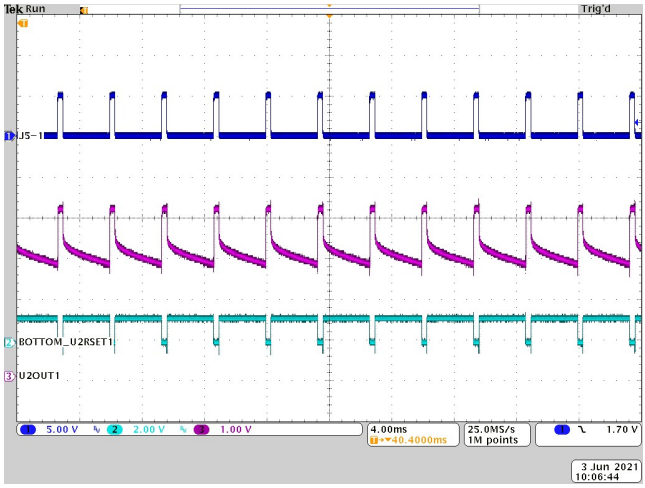

Figure 21. U2 OUT1 in Individual PWM (10% duty)

Revision history

Date	Revision number	Description
November 1, 2021	001	Initial release

Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
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7) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

8) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

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ROHM SEMICONDUCTOR

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