Secondary Buck DC/DC Converter Series

Single Synchronous Buck DC/DC Converter For Automotive BD9S231NUX-C Evaluation Board

BD9S231NUX-TSB-001 (2.7V to 5.5V Input, 1.2V, 2A Output)

Introduction

This user's guide will provide the necessary steps to operate the Evaluation Board of ROHM's BD9S231NUX-C Buck DC/DC converter. This includes the external parts, operating procedures and application data.

Description

This Evaluation Board was developed for ROHM's single Synchronous buck DC/DC converter BD9S231NUX-C. BD9S231NUX-C is a synchronous buck DC/DC converter with built-in low On Resistance power MOSFETs. BD9S231NUX-C accepts a power supply input range of 2.7V to 5.5V and generates a maximum output current of 2A. BD9S231NUX-C generates an output voltage range of 0.8V to VIN using external resistors. BD9S231NUX-C is a current mode control DC/DC Converter and features high-speed transient response.

Application

Automotive Equipment

Other Electronic Equipment

Recommended Operating Conditions

Table 1. Recommended Operating Conditions

Parameter	Min	Typ	Max	Units	Conditions
Input Voltage	2.7	-	5.5	V	
Output Voltage for BD9S231NUX-C (Note1)	0.8	-	VIN	V	
Output Current Range	-	-	2.0	A	
Switching Frequency	-	2.2	-	MHz	
Maximum Efficiency (Vo=1.8V)	-	88.7	-	%	VIN=5.0V, Io=0.57A, Ta=25°C
Maximum Efficiency (Vo=1.8V)		91.4		%	VIN=3.3V, Io=0.34A, Ta=25°C
Maximum Efficiency (Vo=1.15V)	-	84.3	-	%	VIN=5.0V, Io=0.53A, Ta=25°C
Maximum Efficiency (Vo=1.15V)		87.6		%	VIN=3.3V, Io=0.34A, Ta=25°C

(Note 1) Although the minimum output voltage is configurable up to 0.8 V, it may be limited by the SW min ON pulse width. SW Minimum ON Time that BD9S231NUX-C can output stably in the entire load range is 80ns.Use the value to calculate the input and output conditions that satisfy the equation of 80[ns] $\leqq \frac{Vout}{VIN \times fsw}$.

Evaluation Board

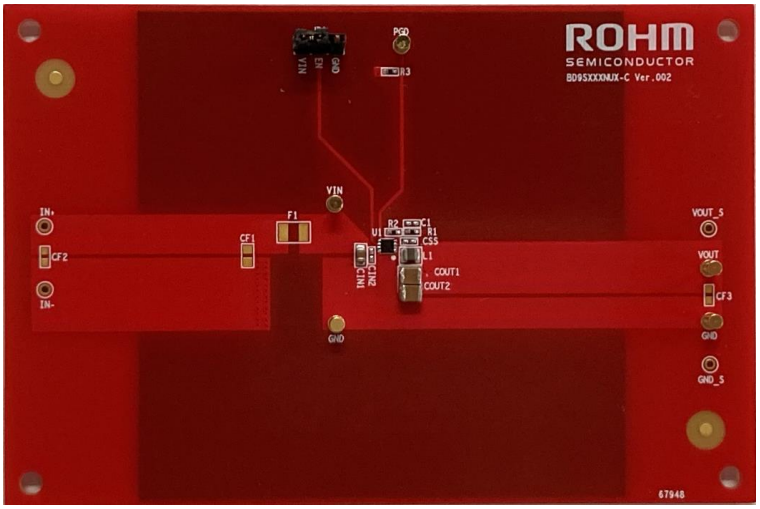


Figure 1. Evaluation Board Top View

(Note) The size of COUT Capacitor is 3216, it is a little bigger than the size of the land pattern on the PCB.

Evaluation Board Schematic

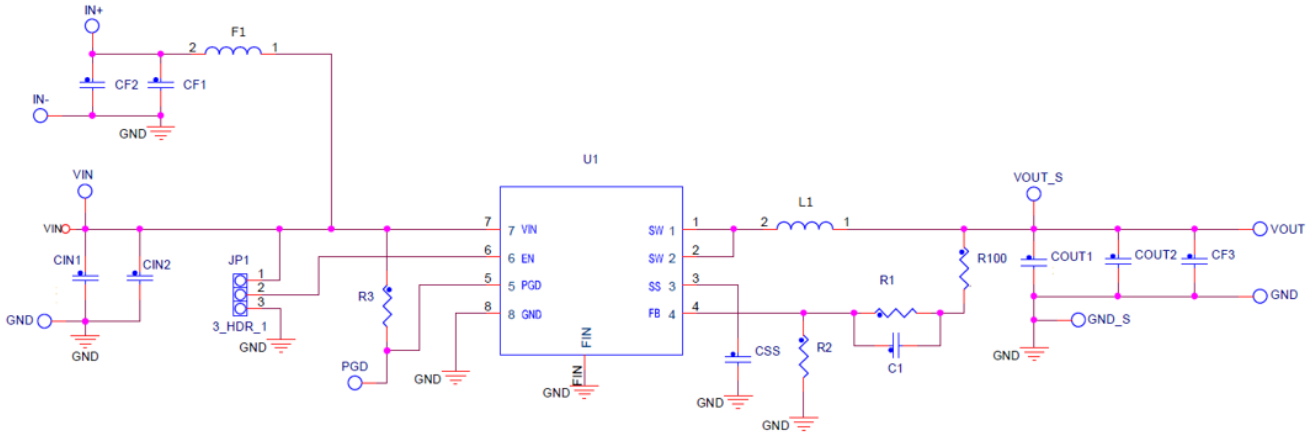


Figure 2. Circuit Diagram

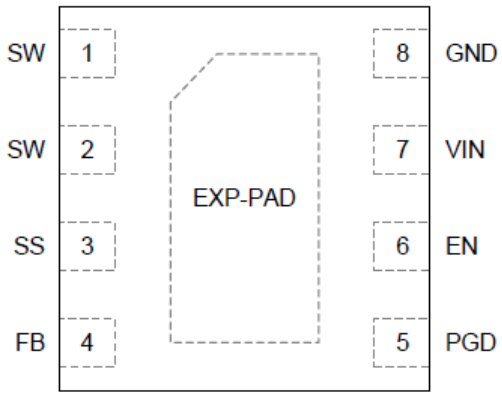
Operating Procedure

1. Turn off EN and connect the GND terminal of the power supply to the GND terminal of Evaluation Board.
2. Connect power supply to the VIN pin of the Evaluation Board.
3. Connect the load to the Evaluation Board's VOUT and GND terminals. When using an electronic load, connect with the load turned off.
4. Connect a voltmeter to the Evaluation Board's VOUT and GND terminals.
5. Turn on the Power supply of VIN. Turn ON the switch of EN terminal.
6. Make sure that the voltmeter is set to measure voltage.
7. Turn on the electronic load.

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

(Note) If EN=High (EN short to VIN) before Power ON, the turn ON and turn OFF is controlled by VIN only.

Pin Configuration



(TOP VIEW)

Figure 3. Pin Configuration

Pin Description

Table 2. VIN and EN Terminal Description

VIN PIN	EN PIN	VOUT
VIN ≧ 2.55V(TYP)	EN ≧ 1.0V	Start up with Soft Start
VIN ≧ 2.55V(TYP)	EN ≦ 0.5V	Shutdown
VIN ≦ 2.45V(TYP)	-	Shutdown

(Note) PGD function is enabled after soft start is completed.

Table 3. EN and PGD Terminal Description

EN PIN	UVLO	TSD	Power Good Function	Power Good Output
EN ≧ 1.0V	Release	Undetected	Enable	High / Low
		Detected	Disable	Low
	Detection	-		Low
EN ≦ 0.5V	-	-		Low

Table 4. FB and PGD Terminal Description

FB PIN	Power Good Output
In the range of 0.8V(TYP) ±7%	HIGH
Out the range of 0.8V(TYP) ±10%	LOW

(Note) PGD pin is an output of open drain MOSFET, and the PGD pin is pulled down with impedance of 60Ω (TYP). It is recommended to use a pull-up resistor of 2kΩ to 100kΩ for the power source.

Table 5. FB and Protection Description

EN Pin	FB PIN	Protection	Protection item
EN ≧ 1.0V	FB ≧0.6V(TYP)	Enabled	-
	FB ≦0.56V(TYP) and remains 1ms(TYP)		SCP
	FB ≧0.88V(TYP)		OVP
EN ≦ 0.5V	-	Disabled	-

(Note) When the FB pin voltage has fallen to 0.56 V (TYP) or less and remained there for 1ms (TYP), SCP stops the operation for 14ms (TYP) and subsequently initiates a restart.
When the FB pin voltage becomes over or equal to 0.88 V (TYP), which is Output Over Voltage Protection Detection Voltage, the MOSFETs on the output stage are turned OFF to prevent the increase in the output voltage.

Parts list

Table 6. Parts list (VOUT=1.0V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1 (Note1)	1005	7.5 kΩ, 1 %, 1/16 W	MCR01MZPF7501	Chip Resistor	ROHM
R2 (Note1)	1005	30 kΩ, 1 %, 1/16 W	MCR01MZPF3002	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1					
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

Table 7. Parts list (VOUT=1.15V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1 (Note1)	1005	27 kΩ, 1 %, 1/16 W	MCR01MZPF2702	Chip Resistor	ROHM
R2 (Note1)	1005	62 kΩ, 1 %, 1/16 W	MCR01MZPF6202	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

(Note) Please increase COUT1 and COUT2 to 47uF (3225) if BD9S231NUX is used for Traveo Ⅱ model of Cypress semiconductor.

Table 8. Parts list (VOUT=1.2V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1 (Note1)	1005	10 kΩ, 1 %, 1/16 W	MCR01MZPF1002	Chip Resistor	ROHM
R2 (Note1)	1005	20 kΩ, 1 %, 1/16 W	MCR01MZPF2002	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

Table 9. Parts list (VOUT=1.5V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1 (Note1)	1005	16 kΩ, 1 %, 1/16 W	MCR01MZPF1602	Chip Resistor	ROHM
R2 (Note1)	1005	18 kΩ, 1 %, 1/16 W	MCR01MZPF1802	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

Table 10. Parts list (VOUT=1.8V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22 µF, X7R, 6.3 V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1 (Note1)	1005	30 kΩ, 1 %, 1/16 W	MCR01MZPF3002	Chip Resistor	ROHM
R2 (Note1)	1005	24 kΩ, 1 %, 1/16 W	MCR01MZPF2402	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

(Note1) VOUT= $\frac{R1+R2}{R2} \times 0.8$ [V]

Please use R_1 and R_2 under the following condition in order to prevent the output from rising due to leakage current.

R1+R2 ≦ 95kohm

(Note) The size of COUT Capacitor is 3216, it is a little bigger than the size of the land pattern on the PCB.

(Note) CSS, C1, COUT2, CIN2, CF1, CF2, F1, CF3 patterns are only optional. They can be utilized for adjusting the characteristics constants.

Board Layout

Evaluation Board PCB information

Number of Layers	Material	Board Size	Copper Thickness
4	FR4	114.3mm x 76.2mm x 1.6mm	2oz(70μm) / 1oz (35μm) / 1oz (35μm) / 2oz(70μm)

The layout of BD9S231NUX-C is shown below.

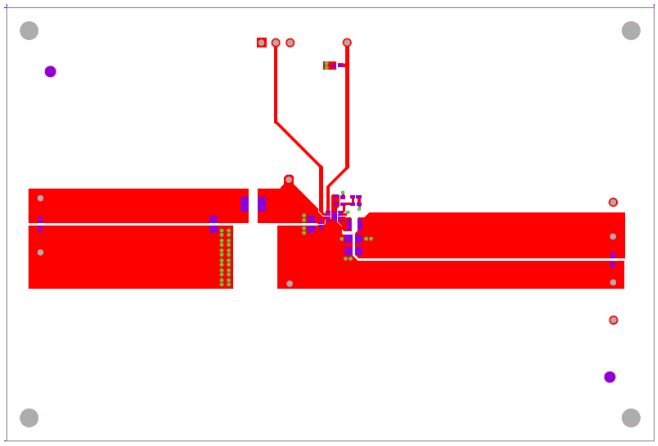


Figure 4. Top Layer Layout
(Top View)

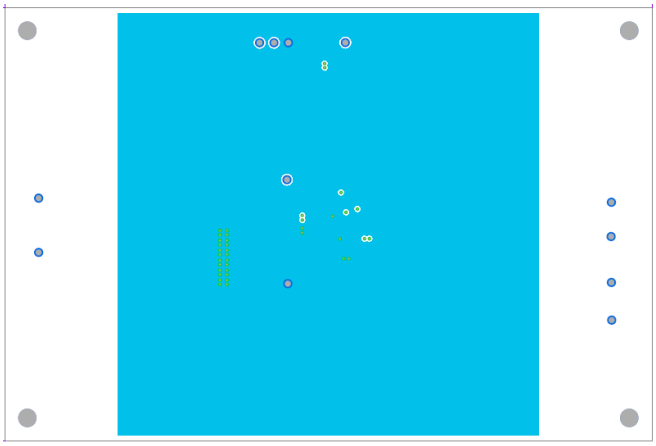


Figure 5. Middle1 Layer Layout
(Top View)

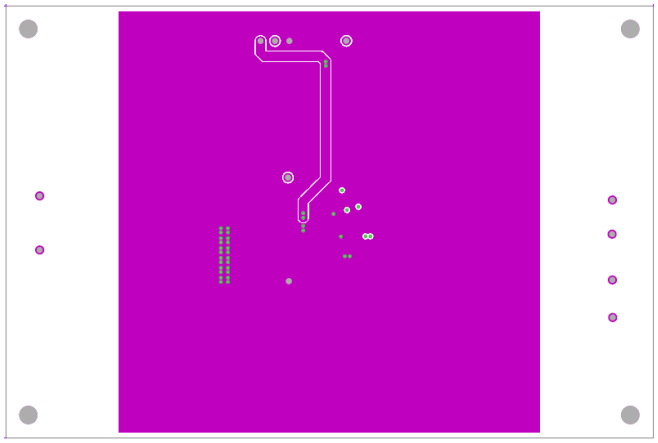


Figure 6. Middle2 Layer Layout
(Top View)

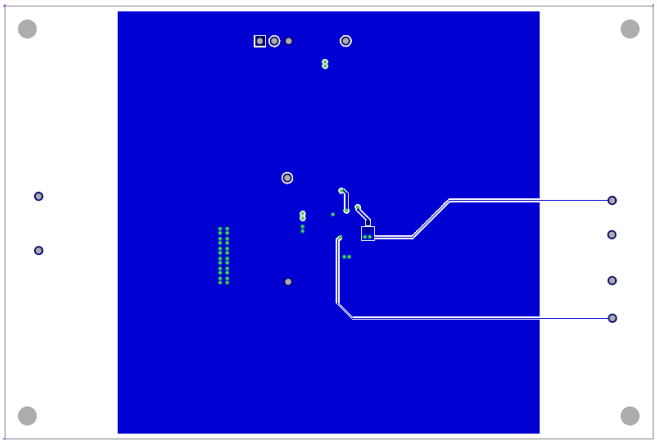


Figure 7. Bottom Layer Layout
(Top View)

Reference application data (BD9S231NUX-C)

(VIN=VEN, VOUT=1.15V, COUT=22uFx2, Ta=25°C)

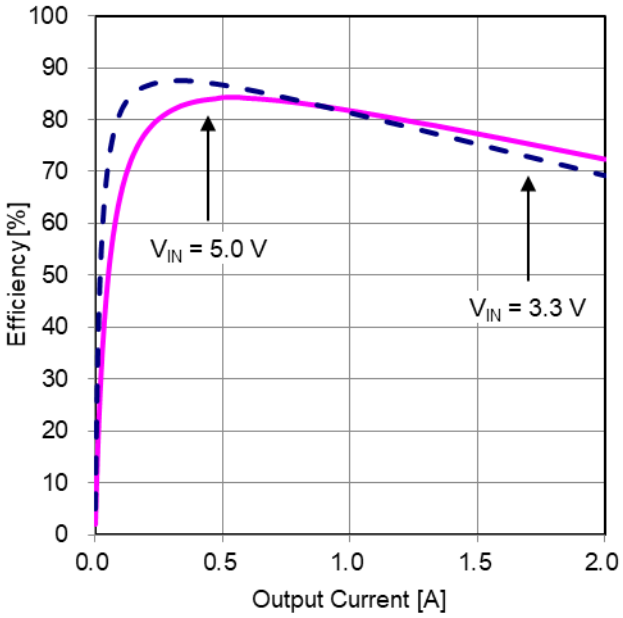


Figure 8. Efficiency vs Output Current

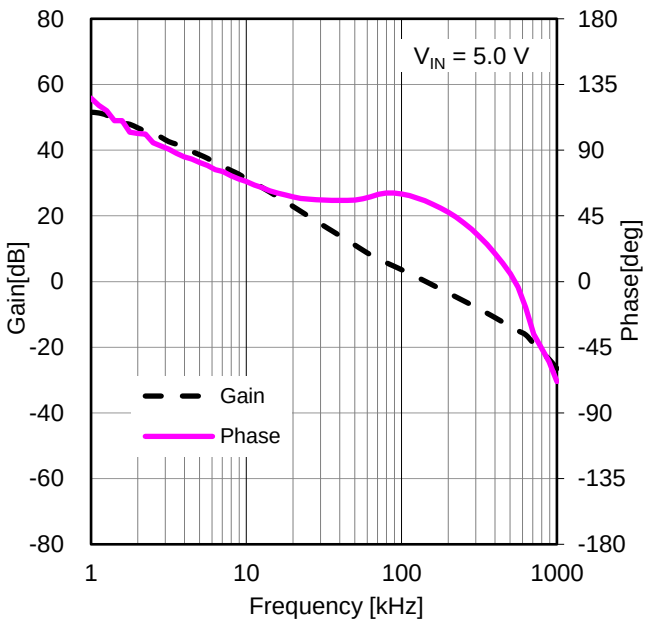


Figure 9. Frequency Characteristics

(I_{OUT}=2 A)

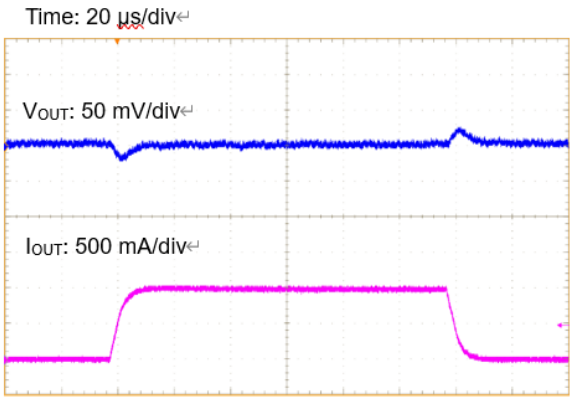


Figure 10. Load Transient Response

(I_{OUT} = 0 A ↔ 1 A)

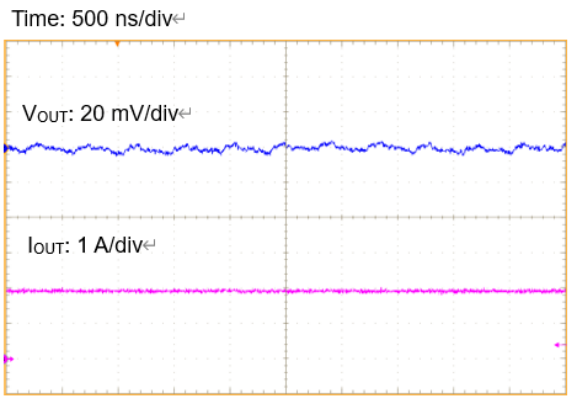


Figure 11. Output Ripple Voltage

(I_{OUT} = 2 A)

Revision History

Date	Revision Number	Description
31. Mar. 2021	001	Initial release
19. Dec. 2024	002	Add the VOUT setting value of Test Board to sub tittle

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