The product specifications described in this book are subject to change without notice for the product which is currently under development. At the final stage of your design, purchasing, or use of the product, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

User's Guide for Evaluation Board

Part No.	NN30321A-EVB

Automotive & Industrial Systems Company
Panasonic Corporation

Contents

1 Introduction

This user's guide contains background information for the

NN30321A : 6A Synchronous DC-DC Step Down Regulator with Integrated Power MOSFET

as well as support documentation for the NN30321A Evaluation Board (NN30321A-EVB). Also included are the schematic, the test set-up, the bill of materials and the Board Layout for the Evaluation Board.

1.1 Overview

NN30321A is a synchronous DC-DC Step Down Regulator (1-ch) with integrated power MOSFETs, which employs hysteretic control system. By this system, when load current changes suddenly, it responds at high speed and minimizes the changes of output voltage. Since it is possible to use capacitors with small capacitance and it is unnecessary to add external parts for system phase compensation, this IC realizes downsizing of set and reducing in the number of external parts.
Output voltage is adjustable by user. Maximum current is 6 A.

1.2 Features

—High-speed response DC-DC Step Down Regulator circuit that employs the hysteretic control system
—Integrated One 20mΩ (Typ) MOSFET and One 10m **Ω** (Typ) MOSFET for high efficiency
—Switchable FCCM (continuous) / SKIP (discontinuous) mode
—Input Voltage Range: 4.5V ~ 28V
—Output Voltage Range: 0.75V ~ 5.5V
—Built-in 0.6V±1% Reference Voltage
—Selectable Switching Frequency 210kHz / 430kHz / 650kHz
—Adjustable Soft Start
—Low Operating and Standby Quiescent Current
—Indication for normal Output Voltage to PGOOD pin
—Built-in Under Voltage Lockout (UVLO), Thermal Shut Down (TSD), Output Over-Voltage Detection (OVD), Output Over-Current Protection (OCP), Short-Circuit Protection (SCP) functions

Input voltage and output current range for the evaluation Board are given in Table 1.

Table 1. Input Voltage and Output Current Summary

Evaluation Board	Input Voltage range	Output Current Range
EVB-NN30321A	PVIN, AVIN = 4.5V to 28V *1 V-EN = 1.5V to 5V	0A to 6A

*1 : PVIN pin and AVIN pin are normally connected on Evaluation Board by 0 ohm resister (R-AVIN).

1.3 Typical Applications

—High Current Distributed Power Systems such as HDDs (Hard Disk Drives), SSDs (Solid State Drives), PCs, Game consoles, Severs, Security Cameras, Network TVs, Home Appliances, OA Equipment etc.

1.4 Package

— 24pin Plastic Quad Flat Non-leaded Package Heat Slug Down (QFN Type)
(Size : 4 × 4 mm, 0.5 mm pitch)

1.5 Type

—Multichip IC

Note: The parameters above is subject to change for improvement without notice.

1.6 Block Diagram

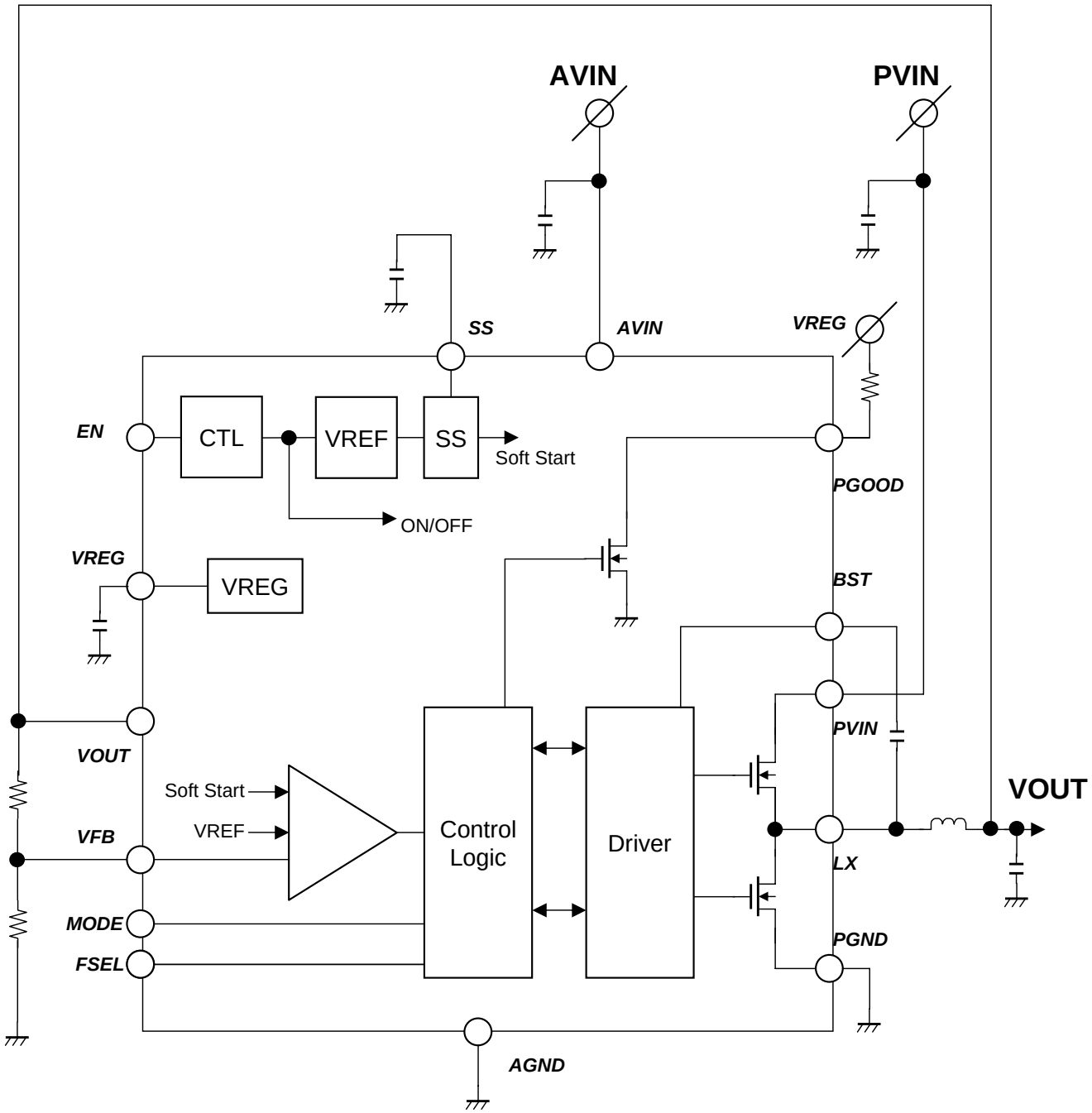


Figure 1. Block Diagram

Note: The parameters above is subject to change for improvement without notice.

2 Evaluation Board

2.1 Appearance

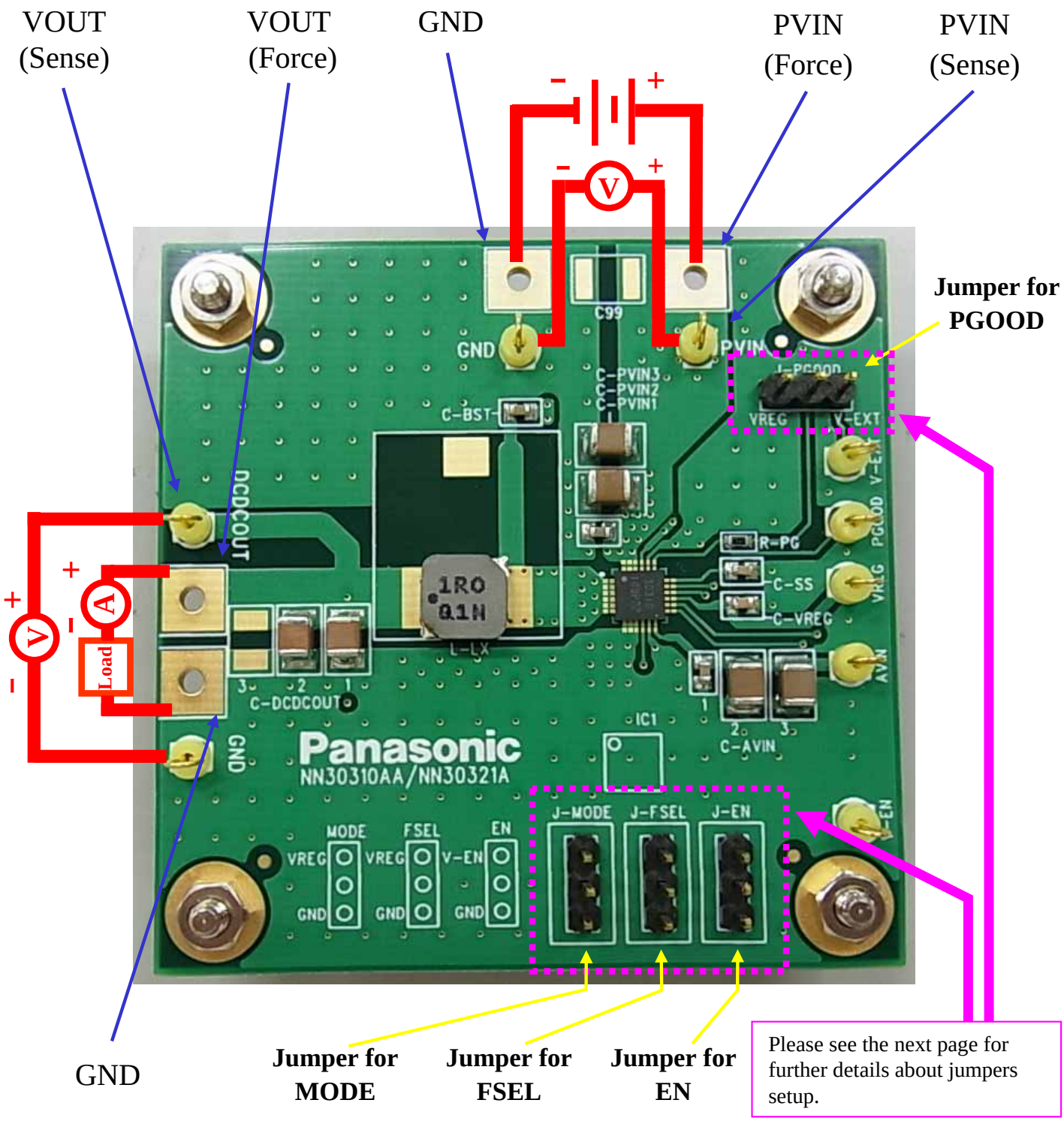


Figure 2. Appearance of Evaluation Board

Note: The parameters above is subject to change for improvement without notice.

2.2 Jumpers Setup

MODE pin, FSEL pin, EN pin, PGOOD pin are able to be controlled by J-MODE, J-FSEL, J-EN, J-PGOOD.

Figure 3. Appearance of J-EN, J-MODE, J-FSEL

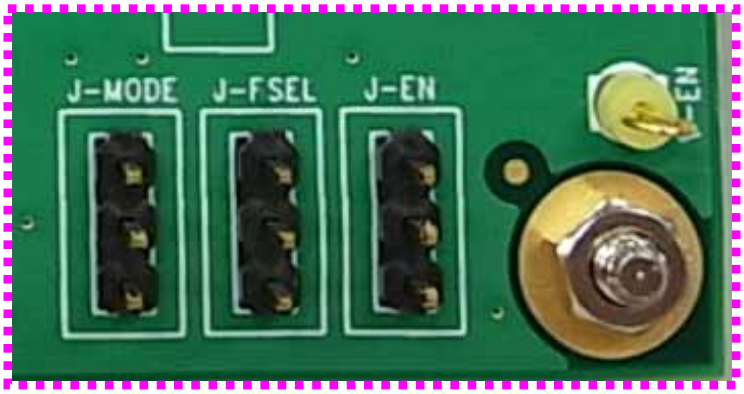


Table 2. J-MODE (Control modes)

Jumper	J-MODE 	J-MODE 
Mode	FCCM	SKIP

Table 3. J-FSEL (Control SW frequency)

Jumper	J-FSEL 	J-FSEL 	J-FSEL 
Frequency	210kHz	650kHz	430kHz

Table 4. J-EN (Control enable/disable)

Jumper	J-EN 	J-EN 
Status	enable	disable

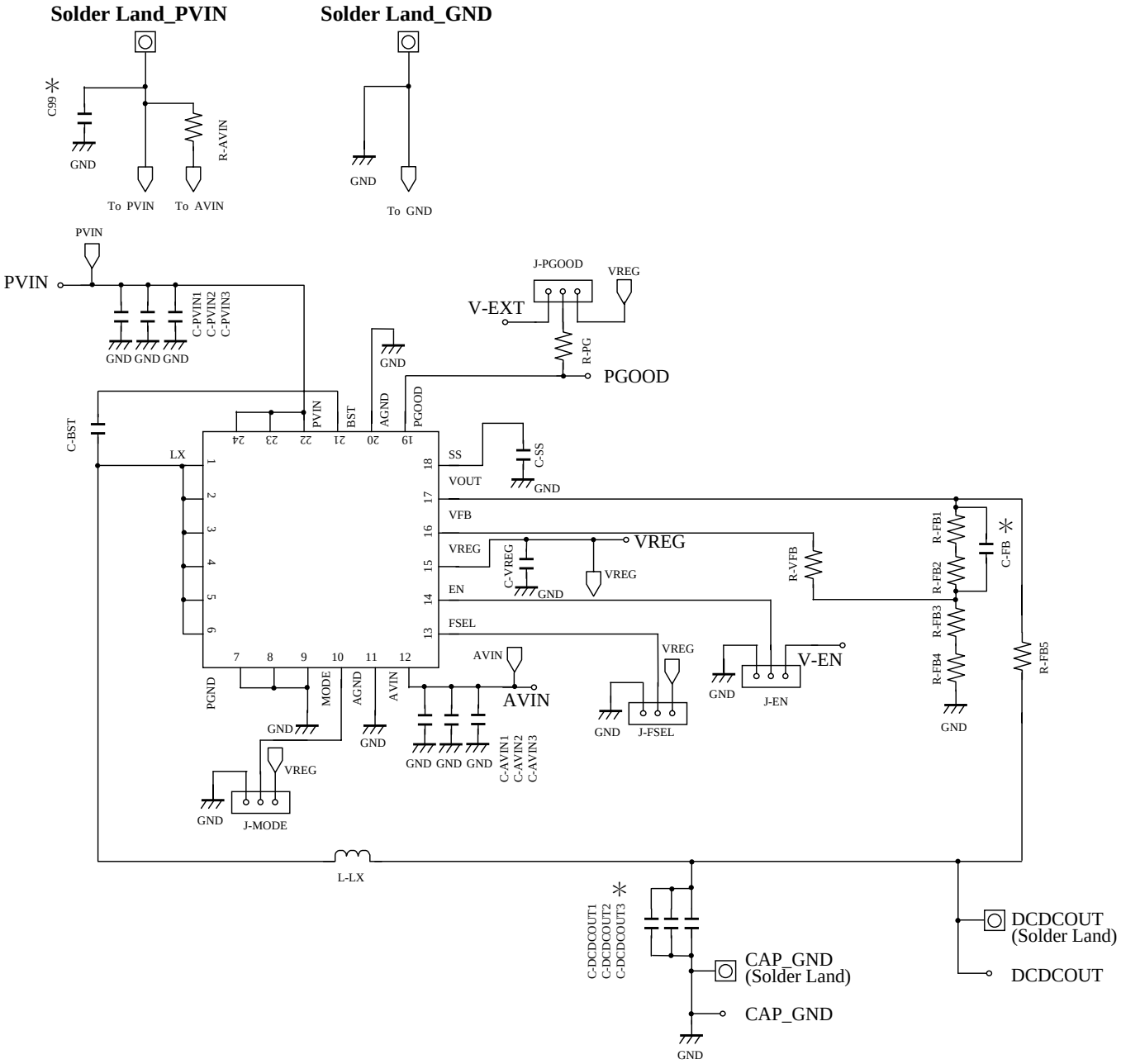
Figure 4. Appearance of J-PGOOD

Table 5. J-PGOOD (Control the Voltage PGOOD pin pulled up to)

Jumper	J-PGOOD 	J-PGOOD 
Pull up to	VREG	V-EXT

Note: The parameters above is subject to change for improvement without notice.

3 Schematic



✳: Not Installed

Figure 5. Evaluation Board Schematic

Note: The parameters above is subject to change for improvement without notice.

4 Test Setup

This section describes how to properly connect, set up and use the Evaluation Board.

4.1 Main Test Points and Jumpers

The Evaluation Board is provided with test points and jumpers as shown in Table 6.
A power supply cable of supplying sufficient current must be connected to the pad PVIN. The load must be connected to the pad DCDCOUT. Wire lengths must be minimized to reduce losses in the wires.
Test point PVIN provides a place to monitor the input voltages with GND providing a convenient ground reference.
Test point DCDCOUT is used to monitor the output voltage with GND as the ground reference.
Jumper Setup is shown in Table 7.

Table 6. Function of Main Test points and Jumpers

	Reference Designator	Default	Function
Main Test Points	PVIN	-	PVIN test point at PVIN connector
	DCDCOUT	-	DCDCOUT test point at DCDCOUT connector
	V-EN	-	Test point supplying voltage to EN pin
Jumpers	J-MODE	VREG	3-pin headers to choose mode. Connect MODE to GND to choose SKIP mode, to VREG to choose FCCM mode.
	J-FSEL	-	3-pin headers to choose frequency. Connect FSEL to GND to choose 430kHz, open to choose 650kHz, to VREG to choose 210kHz
	J-EN	V-EN	3-pin headers for enable of NN30321A. Connect EN to GND to disable, to V-EN to enable.
	J-PGOOD	open	3-pin headers for pull-up of PGOOD. Connect to VREG to allow pull up to VREG pin, to V-EXT to allow pull up to V-EXT pin.

Table 7. Jumper Setup

Jumper	Setup	Mode	Setup	Mode	Setup	Mode
J-MODE		FCCM mode		SKIP mode		
J-FSEL		210kHz		650kHz		430kHz
J-EN		enable		disable		
J-PGOOD		Pull up to VREG		Pull up to V-EXT		

Note: The parameters above is subject to change for improvement without notice.

4.2 Output Voltage Setpoint

To change the output voltage of the Evaluation Board, it is necessary to change the value of resister R-FB1~R-FB4. The values of R-FB1~R-FB4 for a specific output value can be calculated using Equation (1).

For output voltage from 0.75V to 5.5V:

$$Vout = \left(\frac{(R\text{-}FB1 + R\text{-}FB2 + R\text{-}FB3 + R\text{-}FB4)}{(R\text{-}FB3 + R\text{-}FB4)} \right) \times 0.6 \quad \text{- - - - - - - - -} \quad (1)$$

Table 8 lists the R-FB1~R-FB4 values for some common output voltage.

Table 8. Output Voltages

Output Voltage (V)	R-FB1(k ohm)	R-FB2(k ohm)	R-FB3(k ohm)	R-FB4(k ohm)
1.00	1.0	0	1.5	0
1.05	1.2	0	1.6	0
1.20	1.5	0	1.5	0
1.80	1.0	1.0	1.0	0
2.50	4.7	1.0	1.8	0
3.30	3.3	1.2	1.0	0
5.00	10.0	1.0	1.5	0

5 Bill of Materials

Table 9 presents the bill of materials for the Evaluation Board.

Table 9. Evaluation Board Bill of Materials

Reference Designator	QTY	Value	Description	Size *3	Manufacturer	Part Number
C-AVIN1	1	10uF	Capacitor, Ceramic, 50V, X7R, 20%	1210	TAIYO YUDEN	UMK325AB7106MM-T
C-AVIN2	1	10uF	Capacitor, Ceramic, 50V, X7R, 20%	1210	TAIYO YUDEN	UMK325AB7106MM-T
C-AVIN3	1	0.1uF	Capacitor, Ceramic, 100V, X7R, 10%	0603	Murata	GRM188R72A104KA35L
C-BST	1	0.1uF	Capacitor, Ceramic, 100V, X7R, 10%	0603	Murata	GRM188R72A104KA35L
C-DCDCOUT1	1	22uF	Capacitor, Ceramic, 25V, X7R, 10%	1210	Murata	GRM32ER71E226KE15L
C-DCDCOUT2	1	22uF	Capacitor, Ceramic, 25V, X7R, 10%	1210	Murata	GRM32ER71E226KE15L
C-DCDCOUT3	-	-	-	-	-	-
C-PVIN1	1	10uF	Capacitor, Ceramic, 50V, X7R, 20%	1210	TAIYO YUDEN	UMK325AB7106MM-T
C-PVIN2	1	10uF	Capacitor, Ceramic, 50V, X7R, 20%	1210	TAIYO YUDEN	UMK325AB7106MM-T
C-PVIN3	1	0.1uF	Capacitor, Ceramic, 100V, X7R, 10%	0603	Murata	GRM188R72A104KA35L
C-SS	1	10nF	Capacitor, Ceramic, 100V, X7R, 10%	0603	Murata	GRM188R72A103KA01L
C-VREG	1	1.0uF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Murata	GRM188R71E105KA12L
L-LX	1	1.0uH	Inductor, 8.1A, 6.9mΩ	0.276× 0.260 inch	Panasonic	ETQP3W1R0WFN
R-AVIN	1	0	Resistor, Chip, 0.1W	0603	Panasonic	ERJ3GEY0R00V
R-FB1 *2	1	3.3k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF3301V
R-FB2 *2	1	1.2k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF1201V
R-RB3 *2	1	1.0k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF1001V
R-FB4 *2	1	0	Resistor, Chip, 0.1W	0603	Panasonic	ERJ3GEY0R00V
R-VFB	1	0	Resistor, Chip, 0.1W	0603	Panasonic	ERJ3GEY0R00V
R-FB5	1	0	Resistor, Chip, 0.1W	0603	Panasonic	ERJ3GEY0R00V
R-PG	1	100k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF1003V
C99	-	-	-	-	-	-

*2 : These resistors determine output voltage.
The setting in the above table sets the output voltage for 3.3V.
To change the output voltage, it is necessary to change these resistors following Equation (1) in the section 4.2.
*3 : These values comply with EIA standards.

Note: The parameters above is subject to change for improvement without notice.

6 Board Layout

The board layout for the evaluation board is shown in Figure 6 through Figure 11.

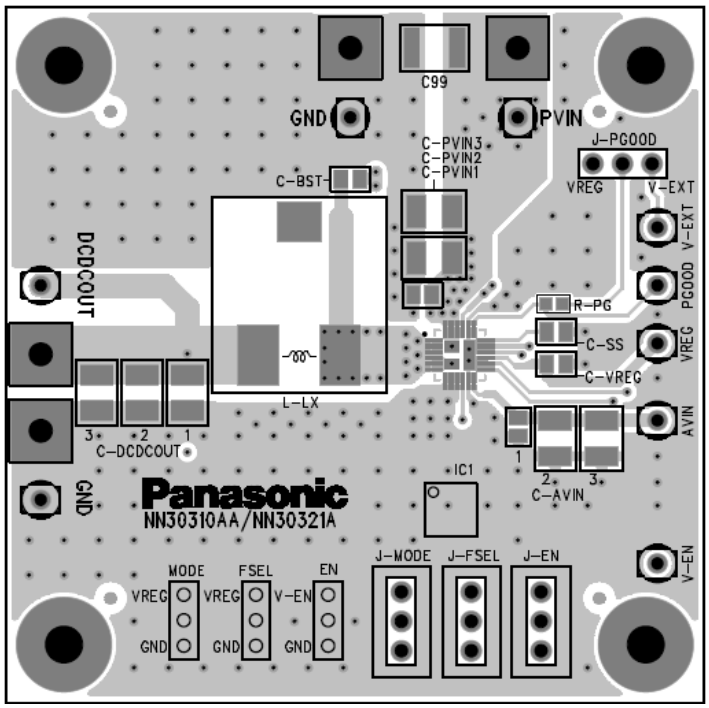


Figure 6. Top Layer with silk screen (Top View)

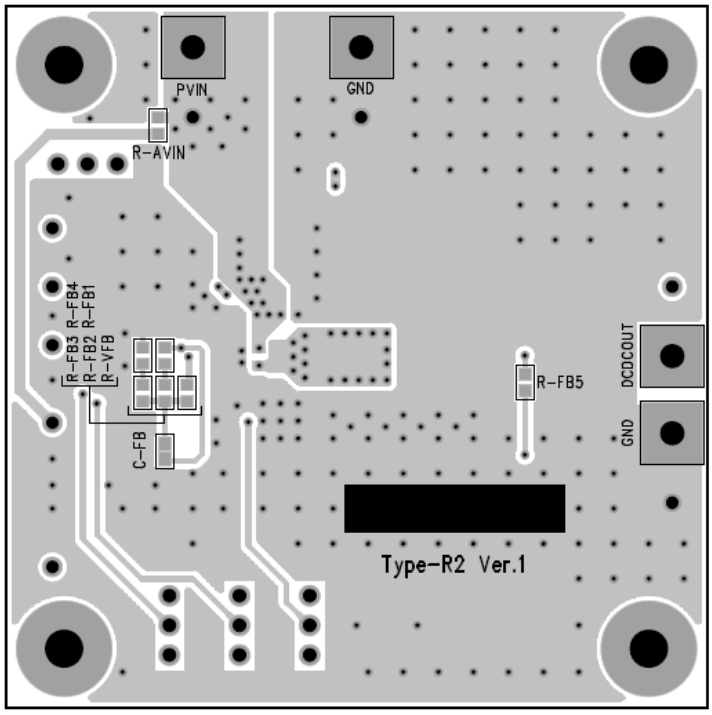


Figure 7. Bottom Layer with silk screen (Bottom View)

Note: The parameters above is subject to change for improvement without notice.

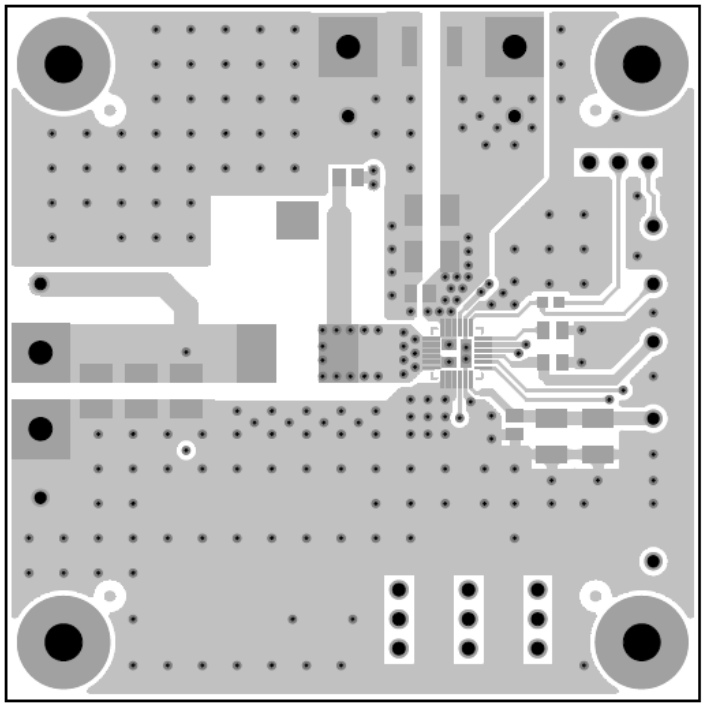


Figure 8. Top Layer (Top View)

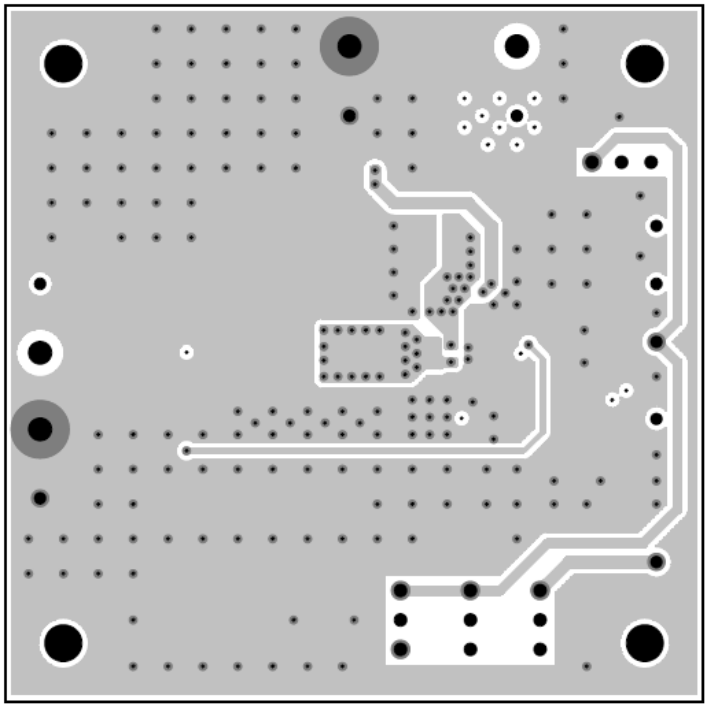


Figure 9. Layer 2 (Top View)

Note: The parameters above is subject to change for improvement without notice.

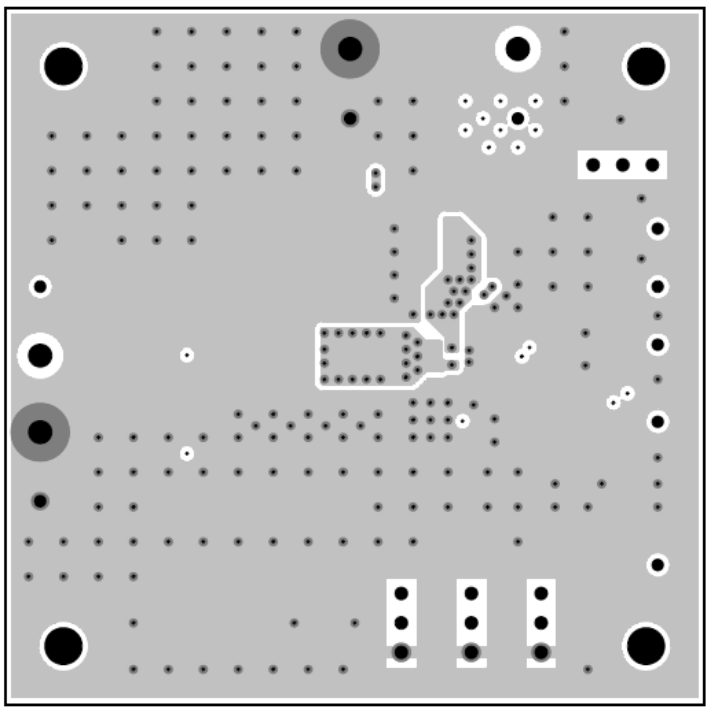


Figure 10. Layer 3 (Top View)

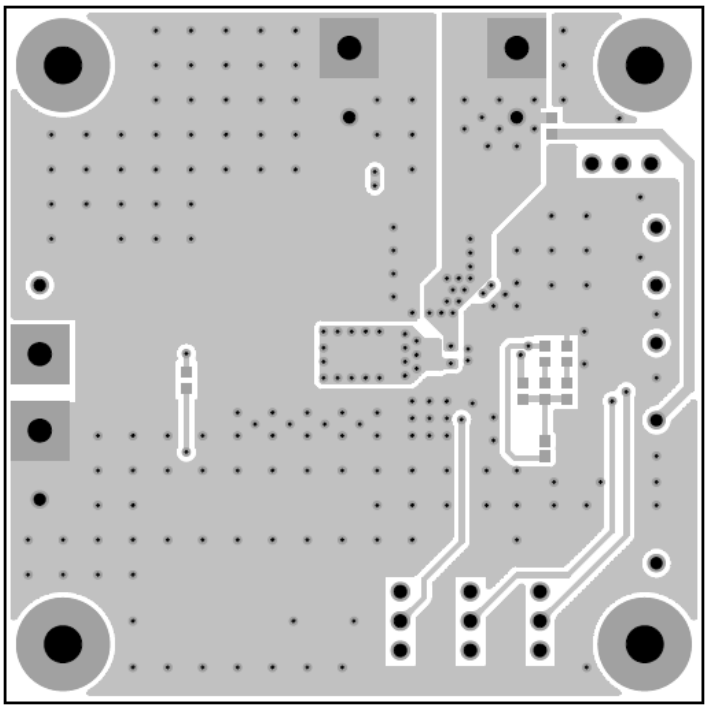


Figure 11. Bottom Layer (Top View)

Note: The parameters above is subject to change for improvement without notice.

IMPORTANT NOTICE

1. When using the IC for new models, verify the safety including the long-term reliability for each product.
2. When the application system is designed by using this IC, please confirm the notes in this book.
   Please read the notes to descriptions and the usage notes in the book.
3. This IC is intended to be used for general electronic equipment.
   Consult our sales staff in advance for information on the following applications: Special applications in which exceptional quality and reliability are required, or if the failure or malfunction of this IC may directly jeopardize life or harm the human body.
   Any applications other than the standard applications intended.
   (1) Space appliance (such as artificial satellite, and rocket)
   (2) Traffic control equipment (such as for automotive, airplane, train, and ship)
   (3) Medical equipment for life support
   (4) Submarine transponder
   (5) Control equipment for power plant
   (6) Disaster prevention and security device
   (7) Weapon
   (8) Others : Applications of which reliability equivalent to (1) to (7) is required
   Our company shall not be held responsible for any damage incurred as a result of or in connection with the IC being used for any special application, unless our company agrees to the use of such special application.
   However, for the IC which we designate as products for automotive use, it is possible to be used for automotive.
4. This IC is neither designed nor intended for use in automotive applications or environments unless the IC is designated by our company to be used in automotive applications.
   Our company shall not be held responsible for any damage incurred by customers or any third party as a result of or in connection with the IC being used in automotive application, unless our company agrees to such application in this book.
5. Please use this IC in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Our company shall not be held responsible for any damage incurred as a result of our IC being used by our customers, not complying with the applicable laws and regulations.
6. Pay attention to the direction of the IC. When mounting it in the wrong direction onto the PCB (printed-circuit-board), it might be damaged.
7. Pay attention in the PCB (printed-circuit-board) pattern layout in order to prevent damage due to short circuit between pins. In addition, refer to the Pin Description for the pin configuration.
8. Perform visual inspection on the PCB before applying power, otherwise damage might happen due to problems such as solder-bridge between the pins of the IC. Also, perform full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the IC during transportation.
9. Take notice in the use of this IC that it might be damaged when an abnormal state occurs such as output pin-VCC short (Power supply fault), output pin-GND short (Ground fault), or output-to-output-pin short (load short). Safety measures such as installation of fuses are recommended because the extent of the above-mentioned damage will depend on the current capability of the power supply.
10. The protection circuit is for maintaining safety against abnormal operation. Therefore, the protection circuit should not work during normal operation.
    Especially for the thermal protection circuit, if the area of safe operation or the absolute maximum rating is momentarily exceeded due to output pin to VCC short (Power supply fault), or output pin to GND short (Ground fault), the IC might be damaged before the thermal protection circuit could operate.
11. Unless specified in the product specifications, make sure that negative voltage or excessive voltage are not applied to the pins because the IC might be damaged, which could happen due to negative voltage or excessive voltage generated during the ON and OFF timing when the inductive load of a motor coil or actuator coils of optical pick-up is being driven.
12. Product which has specified ASO (Area of Safe Operation) should be operated in ASO
13. Verify the risks which might be caused by the malfunctions of external components.
14. Connect the metallic plates (fins) on the back side of the LSI with their respective potentials (AGND, PVIN, LX). The thermal resistance and the electrical characteristics are guaranteed only when the metallic plates (fins) are connected with their respective potentials.

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Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

(6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.

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