Regulations No.	295T103E	Total Pages	Page
		20	1

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.	NN30295A-EVB

Automotive & Industrial Systems Company
Panasonic Corporation

	2013-05-07
	Revised

Contents

1 Introduction

This user's guide contains background information for the

NN30295A : 6A Synchronous DC-DC Step Down Regulator
comprising of Controller IC and Power MOSFET with I²C Interface

as well as support documentation for the NN30295A Evaluation Board (NN30295A-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

NN30295A 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 variable by I2C control. Maximum current is 6 A.

1.2 Features

— High-speed response step-down DC-DC regulator circuit that employs hysteretic control system
— Integrated Two 25mΩ (Typ) MOSFET for high efficiency at 6A
— Mode Selection Option via I²C:
  (1) Pulse Skip Mode (PSM) with coast mode function for high light load efficiency
  (2) Forced Continuous Conduction Mode (FCCM) for quick load transient response
— Input Voltage Range: AV_{IN}: 4.5V to 5.6V , PV_{IN}: 3.1V to 5.6V , VDD: 1.7V to 3.6V
— Output Voltage Range: 0.6V to 3.5V
— Selectable Switching Frequency 500kHz to 2MHz (7 steps) using I²C; Default = 1MHz
— Adjustable Soft Start (SS) Via External Capacitor
— Low Operating and Standby Quiescent Current
— Open Drain Power Good (PGOOD) Indication for Output Over/Under-Voltage
— Built-in Under Voltage Lockout (UVLO), Thermal Shut Down (TSD), Output Over-voltage Detection (OVD), Under Voltage Detection (UVD), Output Over-Current Protection (OCP) and Short Circuit Protection (SCP) function
— Fast mode I²C interface to control the output voltage level

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-NN30295A	PVIN = 3.1V to 5.6V AVIN = 4.5V to 5.6V *1 VDD=1.7〜3.6V	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

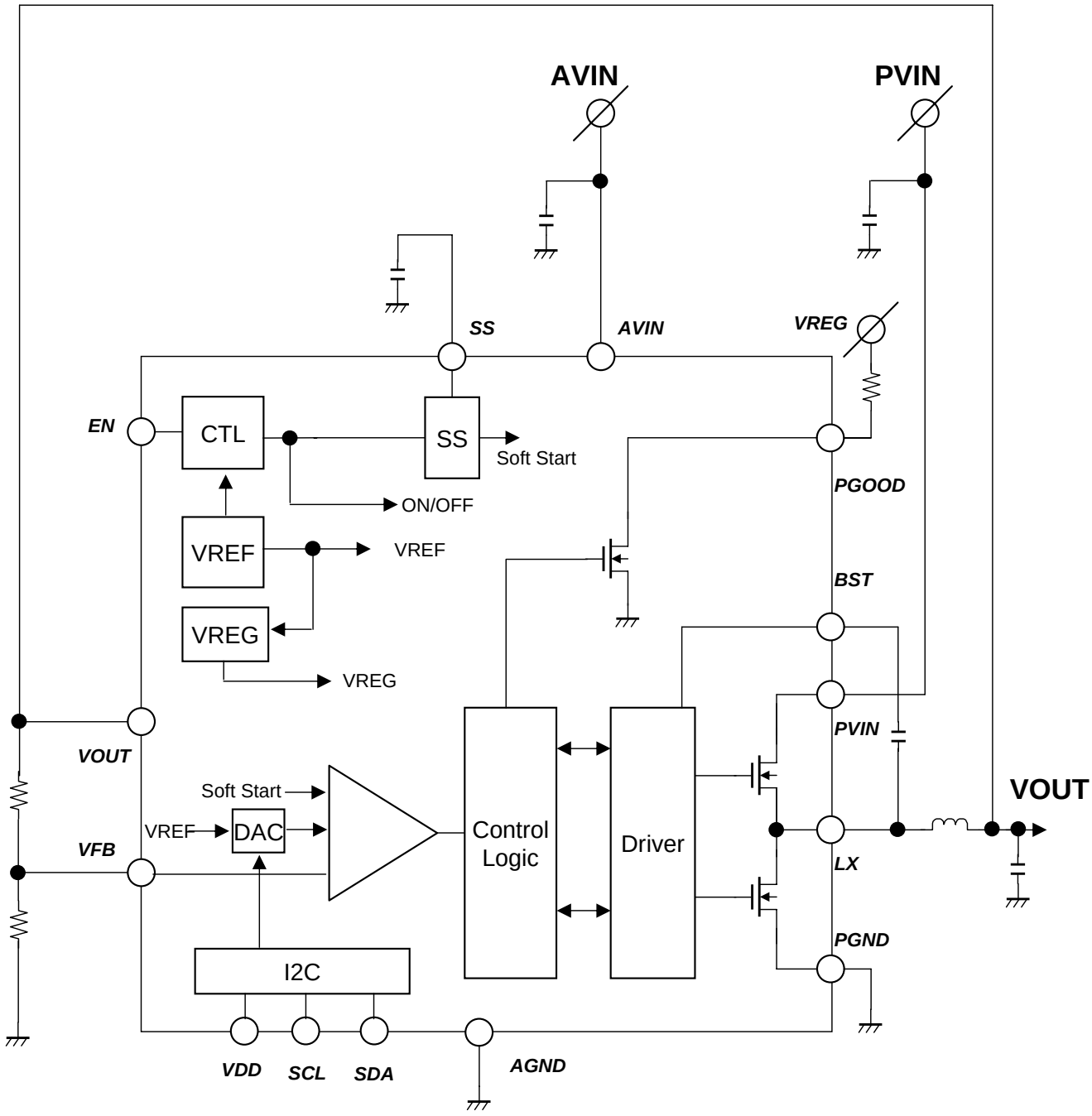


Figure 1. Block Diagram

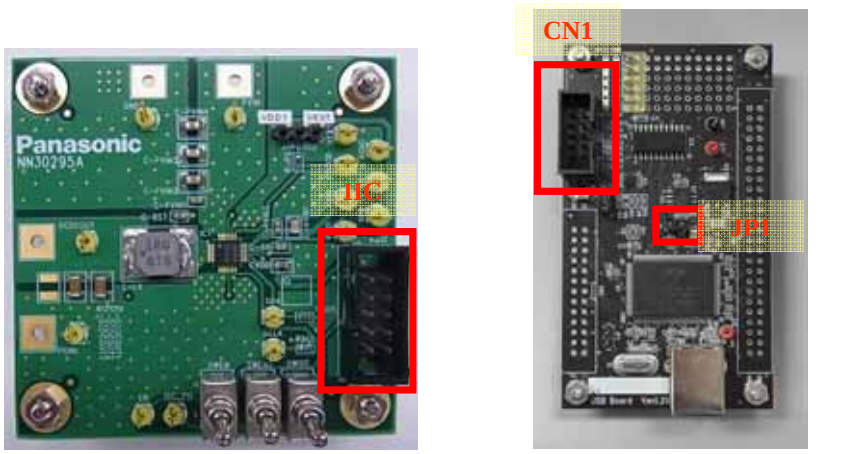
Note: The parameters above is subject to change for improvement without notice.

2 Evaluation Board

This section describes Structure, Connection and Main Test Points of Evaluation Board.

2.1 Structure

Evaluation Board consists of **NN30295A Evaluation Board** and **USB Microcontroller Board** as figure 2.
IIC connector of NN30295A Evaluation Board is connected to CN1 of USB Microcontroller Board by a cable.



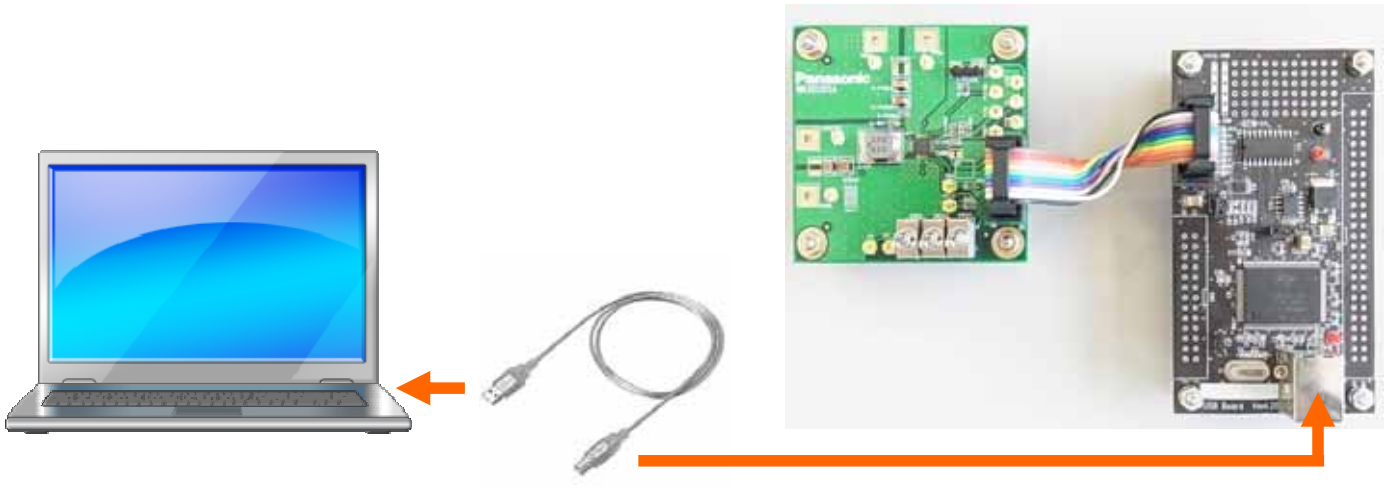
NN30295A Evaluation Board **USB Microcontroller Board**

※1 Only JP1 should be shorted.

Figure 2. Structure of Evaluation Board

2.2 Connection

Evaluation Board should be connected to PC with USB Cable as Figure 3.



PC USB Cable Evaluation Board
(NN30295A Evaluation Board is connected to USB microcontroller Board by a cable)

Figure 3. Connection of Evaluation Board and PC

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

2.3 Appearance

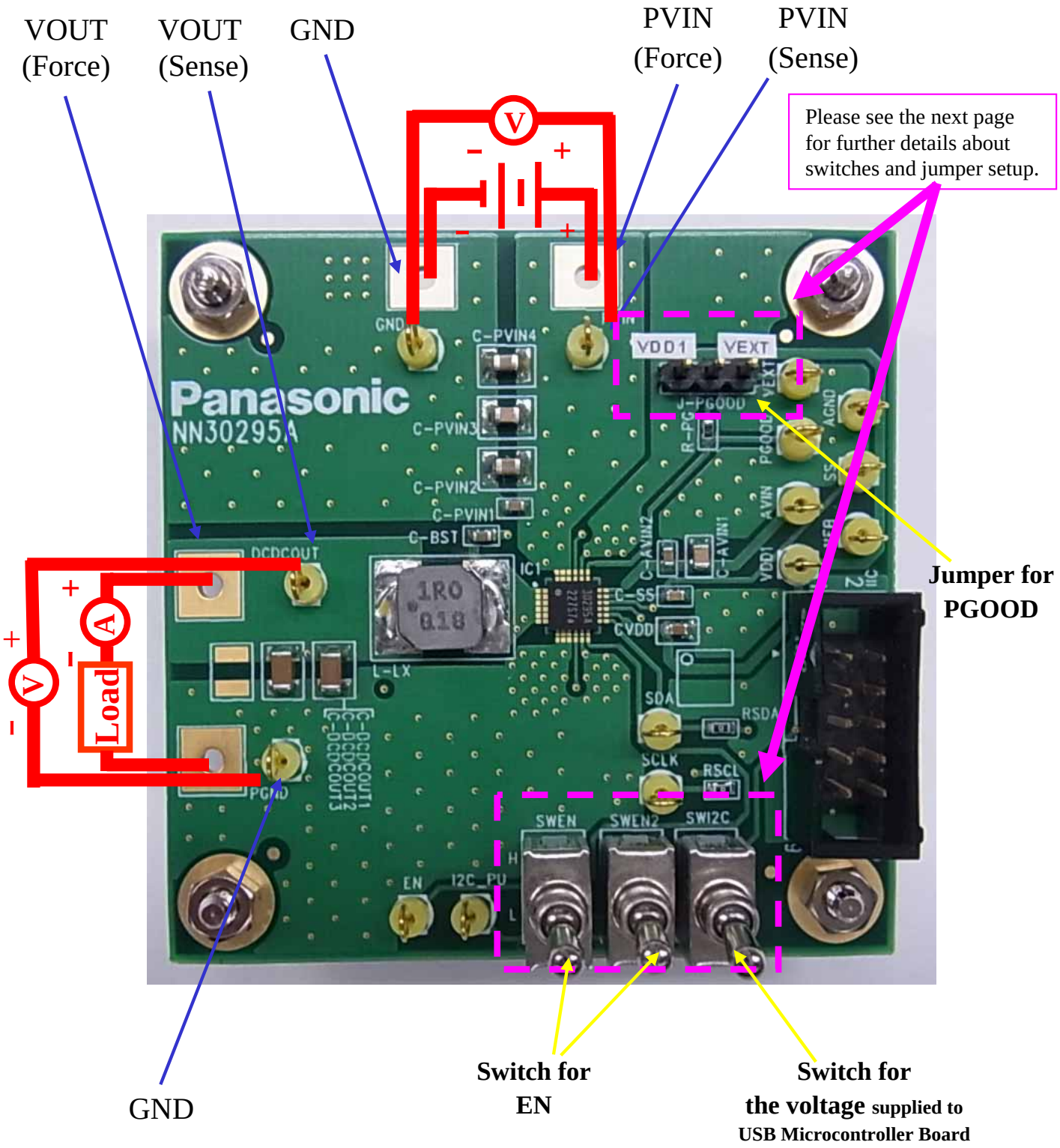


Figure 4. Appearance of Evaluation Board

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

2.4 Switches and Jumper Setup

EN pin, the voltage supplied to USB Microcontroller, and PGOOD pin are able to be controlled by SWEN, SWEN2, SWI2C and J-PGOOD.

SWI2C decides the voltage supplied to USB Microcontroller Board. Set SWI2C "H" for evaluation.

Figure 5. Appearance of SWEN, SWEN2 and SWI2C

Table 2. SWI2C

(Decide the voltage supplied to USB Microcontroller Board)

Supplied from	VDD1	I2C_PU
Switch	SWI2C H L	SWI2C H L

Table 3. SWEN2 (Pull Up Voltage of SWEN)

Supplied from	VDD1	AVIN
Switch	SWI2C H L	SWI2C H L

Table 4. SWEN (Control EN pin)

EN	Enable	Disable
Switch	SWEN H L	SWEN H L

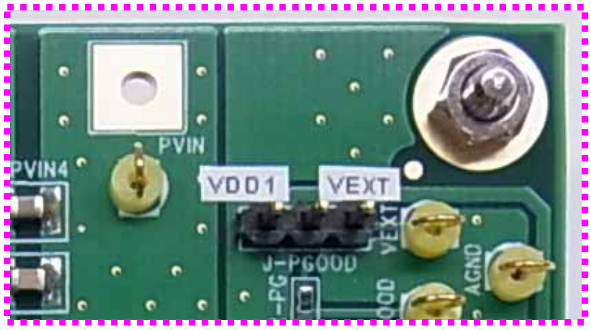


Figure 6. Appearance of J-PGOOD

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

Pull up to	VDD1	open	VEXT
Jumper	J-PGOOD	J-PGOOD	J-PGOOD

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

2.5 Output Voltage Setting

Note) The characteristics listed below are reference values derived from the design of the IC and are not guaranteed.

The output voltage is set by adjusting the value of the external resistors R-FB2 and R-FB3.
The equation below represents the relation between the external resistors and the VOUT.
(V_{IN} = 5 V, I_{OUT} = –1 A, PSM, Fsw = 1 MHz)

$$VOUT = -0.0119 \left(\frac{\text{R-FB2}}{\text{R-FB3}}\right)^2 + 0.616 \left(\frac{\text{R-FB2}}{\text{R-FB3}}\right) + 0.593 \quad \text{- - - - - - - - -} \quad (1)$$

The following table represents the Feedback Resistor (R-FB) settings for common Output Voltages

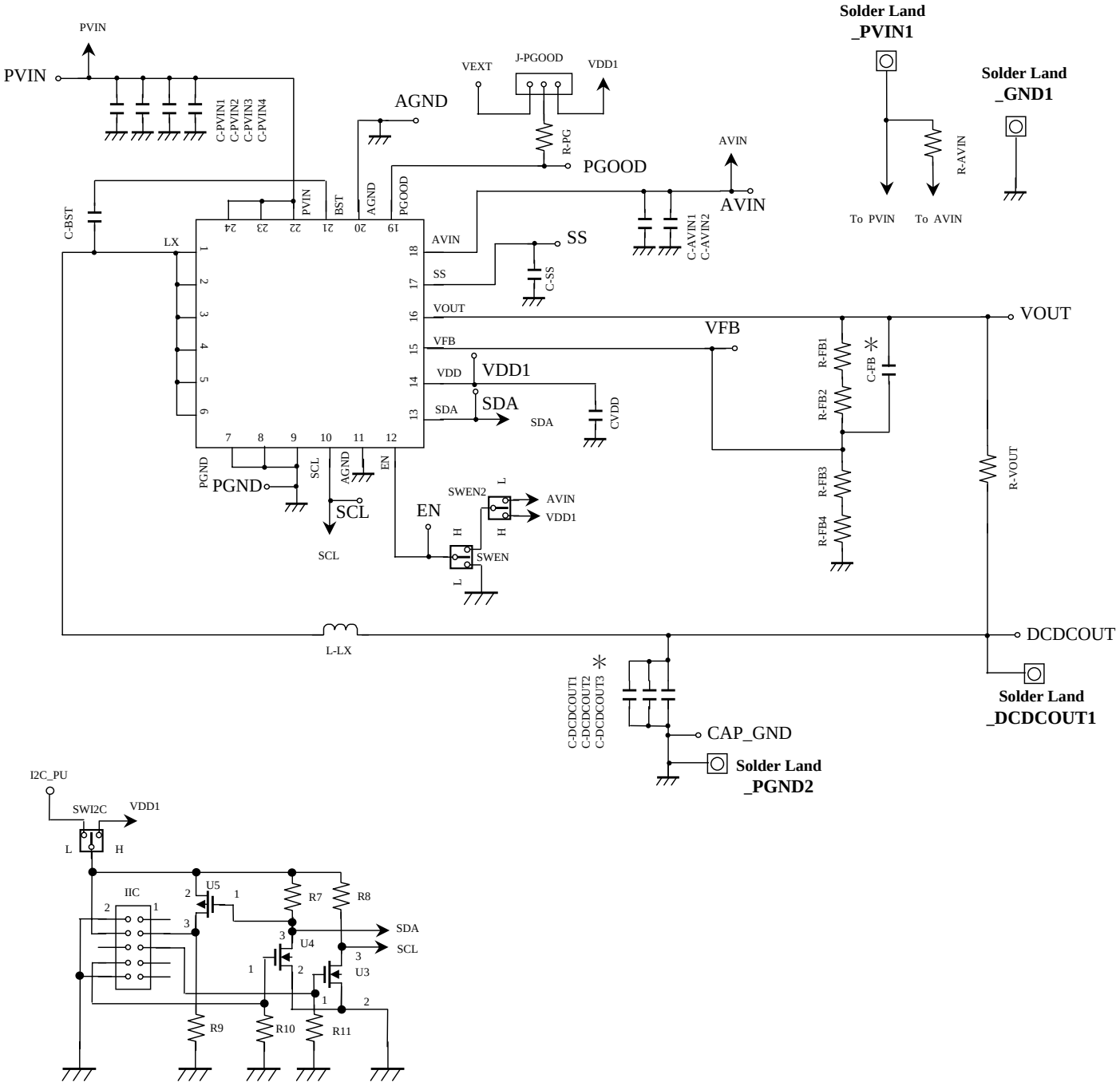
Table : Recommended settings for Common Output Voltages

VOUT [V]	R-FB2 [kΩ]	R-FB3 [kΩ]
1.8	3.0	1.5
1.2	1.0	1.0
1.0	1.0	1.5

Note: R-FB3 can be set to a maximum value of 10kΩ. A larger R-FB3 value will be more susceptible to noise.

VFB comparator threshold is adjusted to ± 1.33%, but the actual output voltage accuracy becomes more than ± 1.33% due to the influence from the circuits other than VFB comparator.
In the case of VOUT=1.0V, the actual output voltage accuracy becomes ±2.0% (VIN=5V, I_{OUT}= –1A, PSM, Fsw=1MHz).

3 Schematic



∗: Not Installed

Figure 7. Evaluation Board Schematic

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

4 Operating Procedure

This section describes how to use Evaluation Board and Serial Controller software.

4.1 Start of Process

1) Connect Evaluation Board to PC with USB Cable. (cf. section 2.2)
2) Supply AVIN: 4.5V ~ 5.6V , PVIN: 3.1V ~ 5.6V , VDD1: 1.7V ~ 3.6V on Evaluation Board.
3) Before using Evaluation Board, Installation of a program to PC is needed.
   Please refer to the file : Install Manual of Serial Controller.pdf
   If this has ever been done, ignore this step.
4) Start up the Serial Controller software : NN30295_Serial Controller ver1.2.exe

4.2 Operating Instructions

Operating Instructions on Operating window of Serial Controller software.

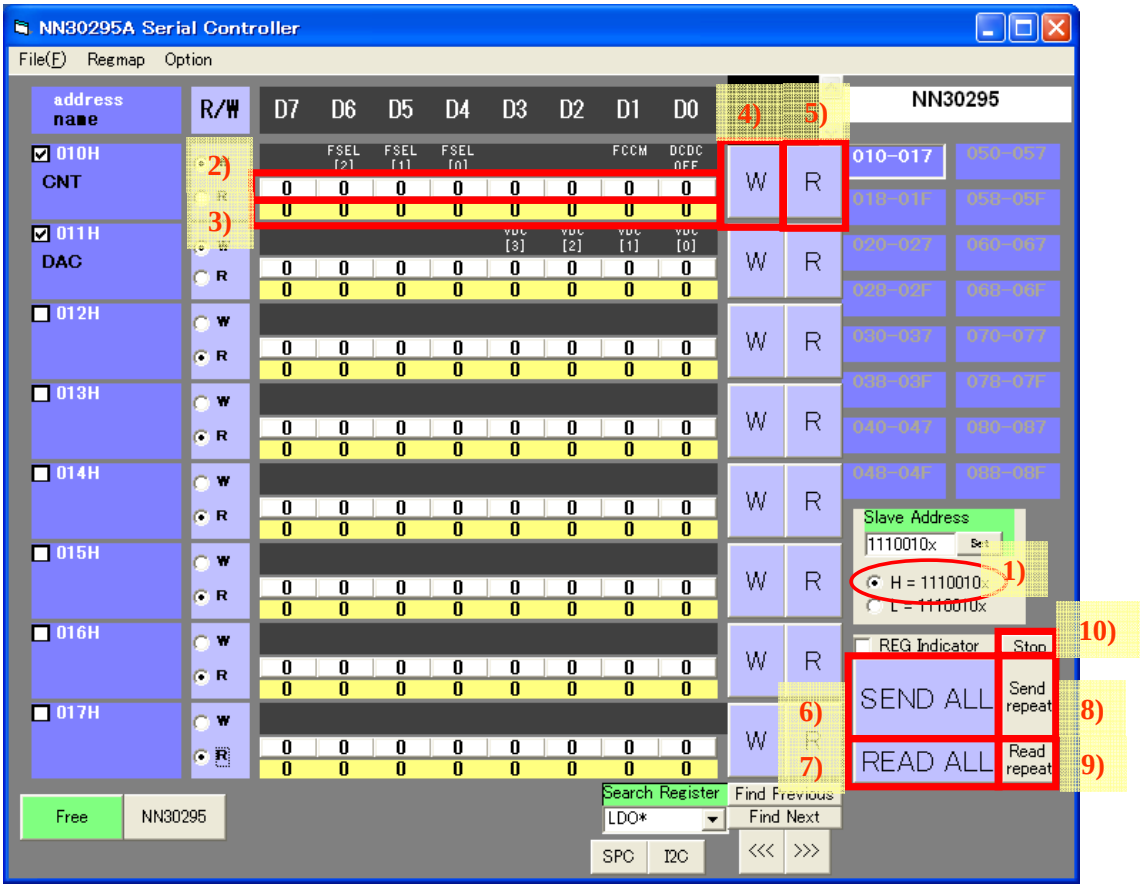


Figure 8. Operating Instructions on Operating Window of Serial Controller Software

1) Slave Address
Set Slave Address of I2C communication. Choose [H=1110010x].

2) Set Write Data
Click the bit data you want to change, the data will be changed 0⇒1 or 1⇒0.

3) Indicate Read Data
8bit binary data read from NN30295A IC is indicated.

4) Write Data (1 Address)
Send the write data set at 2)

5) Read Data (1 Address)
Read 8bit binary data from NN30295A IC and indicate at 3).

6) Write Data (All Address)
Send all write data set in the operating window.

7) Read Data (All Address)
Read all data from NN30295A IC and indicate to the operating window.

8) Write Data (All Address) Repeatedly
Repeat 6) infinitely.

9) Read Data (All Address) Repeatedly
Repeat 7) infinitely.

10) Stop
Stop 8) and 9).

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

4.3 Register Contents

This section describes register contents on operating window of serial controller software.
For further details, please refer to the register map in section 4.4.

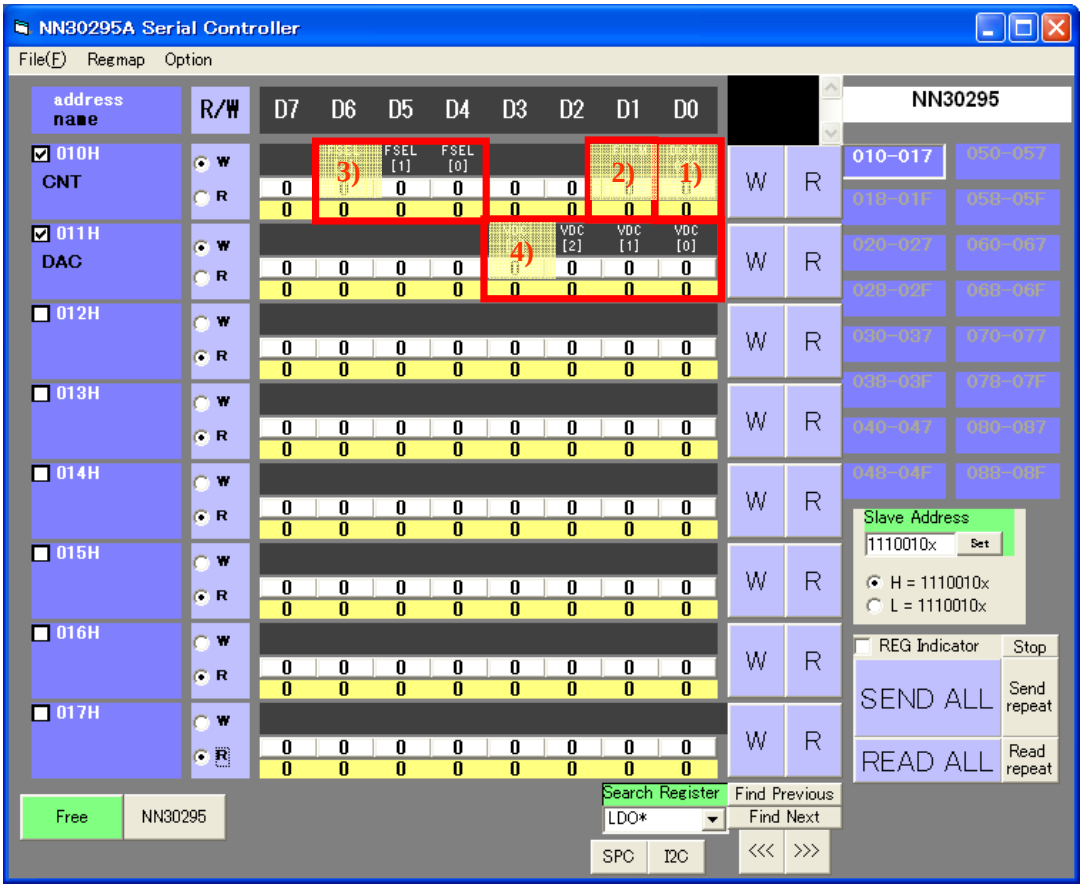


Figure 9. Register Contents on Operating Window of Serial Controller Software

1) Output ON/OFF select register
2) Register for mode (Skip mode or Force CCM Mode)
3) Register for Frequency
4) Register for output voltage setup

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

4.4 Register Map

This section describes resister map and details of resisters.

Table 6. Register Map

Sub Address	R/W	Register Name	Bit	Data							
				D7	D6	D5	D4	D3	D2	D1	D0
10h	R/W	CNT	Name	–	FSEL[2:0]			–	–	FCCM	DCDCOFF
			Default	–	0	0	0	–	–	0	0
11h	R/W	DAC	Name	–	–	–	–	VDC[3:0]			
			Default	–	–	–	–	0	0	0	0

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

Table 7. Register 00h

Sub Address	R/W	Register Name	Bit	Data							
				D7	D6	D5	D4	D3	D2	D1	D0
10h	R/W	CNT	Name	–	FSEL[2:0]			–	–	FCCM	DCDCOFF
			Default	–	0	0	0	–	–	0	0

D6-D4 (FSEL Setting)

FSEL[6:4]			FREQUENCY (MHz)	
D6	D5	D4		
0	0	0	1.00	Default
0	0	1	0.50	
0	1	0	0.75	
0	1	1	1.00	
1	0	0	1.25	
1	0	1	1.50	
1	1	0	1.75	
1	1	1	2.00	

D1: FCCM:

0:Default(Skip Mode)

1.Force CCM Mode

D0: DCDCOFF

0:Default(DCDC On)

1:DCDC Off

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

Table 8. Register 01h

Sub Address	R/W	Register Name	Bit	Data							
				D7	D6	D5	D4	D3	D2	D1	D0
11h	R/W	DAC	Name	–	–	–	–	VDC[3:0]			
			Default	–	–	–	–	0	0	0	0

D3-0 : DCDC Output Voltage Setting Register

VDC1[3:0]				Output Voltage [V]	
D3	D2	D1	D0		
0	0	0	0	1.000	Default
0	0	0	1	0.880	
0	0	1	0	0.895	
0	0	1	1	0.910	
0	1	0	0	0.925	
0	1	0	1	0.940	
0	1	1	0	0.955	
0	1	1	1	0.970	
1	0	0	0	0.985	
1	0	0	1	1.000	
1	0	1	0	1.015	
1	0	1	1	1.030	
1	1	0	0	1.045	
1	1	0	1	1.060	
1	1	1	0	1.075	
1	1	1	1	1.090	

Note) The required output voltage is set by changing the DAC step by 1 bit at a time.
An interval of more than 50us is required at every bit step while changing the DAC.

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

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, 10V, X7R, 10%	0805	Murata	GRM21BR71A106KE51L
C-AVIN2	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-DCDCOUT	2	22uF	Capacitor, Ceramic, 10V, X7R, 10%	1210	Murata	GRM31CR71A226KE15L
C-PVIN1	1	0.1uF	Capacitor, Ceramic, 100V, X7R, 10%	0603	Murata	GRM188R72A104KA35L
C-PVIN2, 3, 4	3	10uF	Capacitor, Ceramic, 10V, X7R, 10%	0805	Murata	GRM21BR71A106KE51L
C-SS	1	10nF	Capacitor, Ceramic, 100V, X7R, 10%	0603	Murata	GRM188R72A103KA01L
CVDD	1	1.0uF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Murata	GRM188R71E105KA12L
C-FB	-	-	-	-	-	-
J-EN, J-FSEL, J-MODE, J-PGOOD	-	-	-	-	-	-
SWEN,SWEN2,SWI2C	3	-	2stateSW_(with_Mid-point)	-	FUJISOKU	ATE1E-2M3-10-Z
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, R-FB4 *2	2	0	Resistor, Chip, 0.1W	0603	Panasonic	ERJ3GEY0R00V
R-FB2 *2	1	1.0k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF1001V
R-FB3 *2	1	1.5k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF1501V
R-VOUT	1	0	Resistor, Chip, 0.1W	0603	Panasonic	ERJ3GEY0R00V
R-PG	1	100k	Resistor, Chip, 0.1W, 1%	0603	Panasonic	ERJ3EKF1003V
U5	1	-	-	-	FAIRCHILD	FDV302P-PBF
U3,U4	2	-	-	-	FAIRCHILD	FDV301N
R7-8	2	4.7K	Resistor, Chip, 0.1W, 5%	0603	Panasonic	ERJ3GEYJ472V
R9	1	1K	Resistor, Chip, 0.1W, 5%	0603	Panasonic	ERJ3GEYJ102V
R10-11	2	10K	Resistor, Chip, 0.1W, 5%	0603	Panasonic	ERJ3GEYJ103V

*2 : These resistors determine output voltage.
The setting in the above table sets the output voltage for 1.0V.
To change the output voltage, it is necessary to change these resistors following Equation (1) in the section 2.5.
*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 10 through Figure 15.

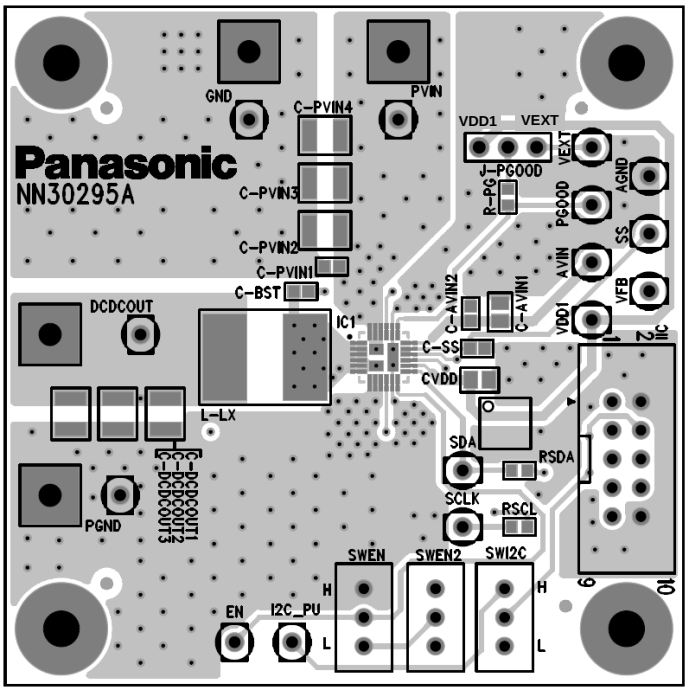


Figure 10. Top Layer with silk screen (Top View)

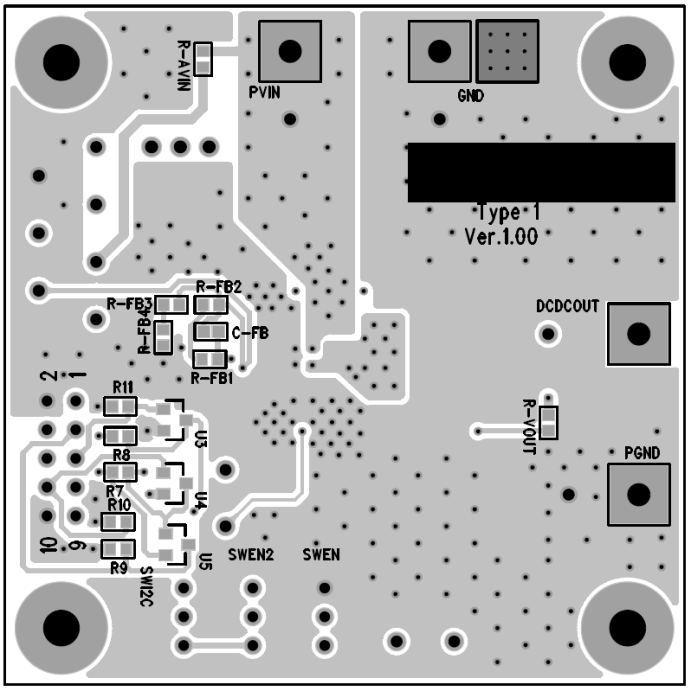


Figure 11. Bottom Layer with silk screen (Bottom View)

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

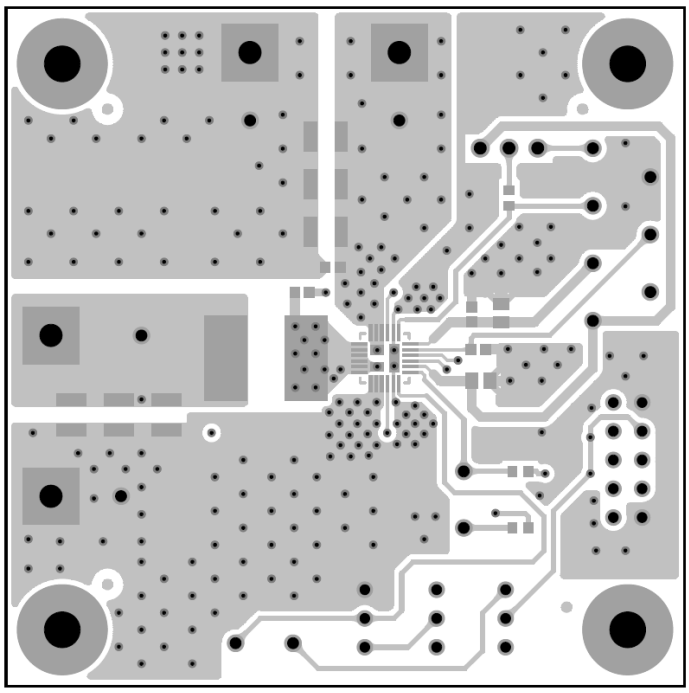


Figure 12. Top Layer (Top View)

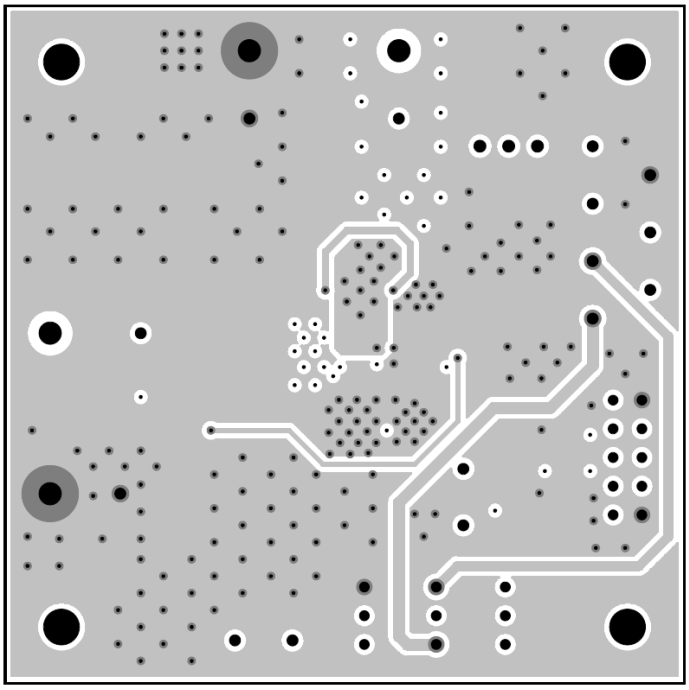


Figure 13. Layer 2 (Top View)

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

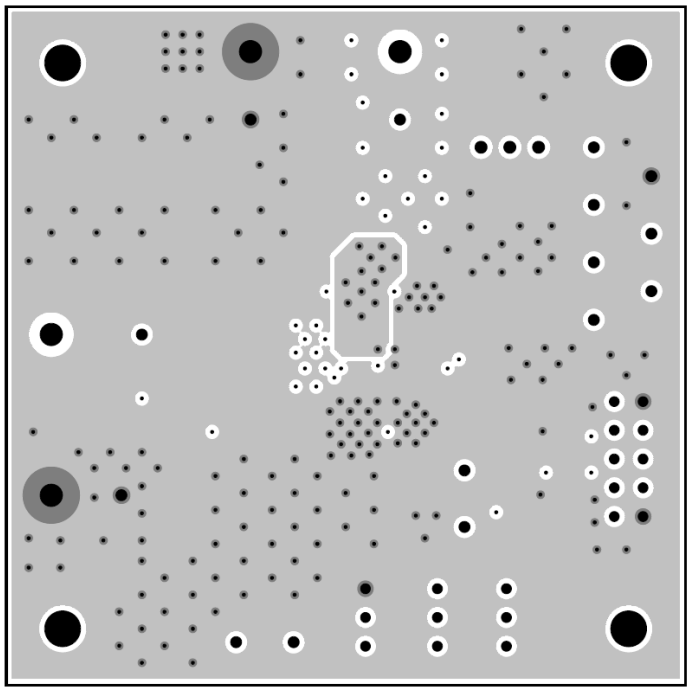


Figure 14. Layer 3 (Top View)

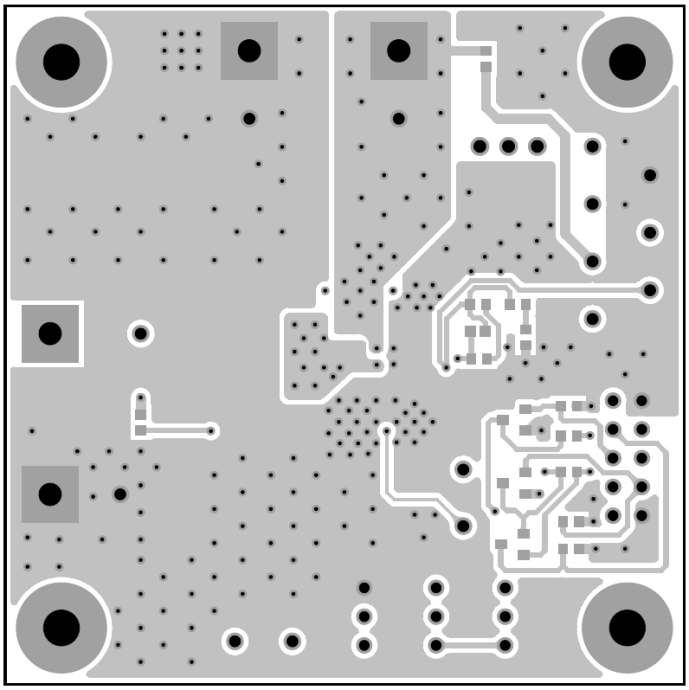


Figure 15. Bottom Layer (Top View)

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.

Request for your special attention and precautions in using the technical information and semiconductors described in this book

(1) If any of the products or technical information described in this book is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially, those with regard to security export control, must be observed.

(2) The technical information described in this book is intended only to show the main characteristics and application circuit examples of the products. No license is granted in and to any intellectual property right or other right owned by Panasonic Corporation or any other company. Therefore, no responsibility is assumed by our company as to the infringement upon any such right owned by any other company which may arise as a result of the use of technical information described in this book.

(3) The products described in this book are intended to be used for general applications (such as office equipment, communications equipment, measuring instruments and household appliances), or for specific applications as expressly stated in this book.
Consult our sales staff in advance for information on the following applications:
- Special applications (such as for airplanes, aerospace, automotive equipment, traffic signaling equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.

It is to be understood that our company shall not be held responsible for any damage incurred as a result of or in connection with your using the products described in this book for any special application, unless our company agrees to your using the products in this book for any special application.

(4) The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

(5) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.
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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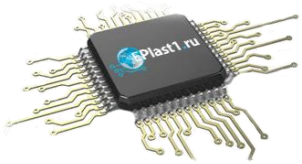
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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