

SMD to Thru-Hole Conversion Kit Manual

Products Serial Number: PGA26E19BA-DB001

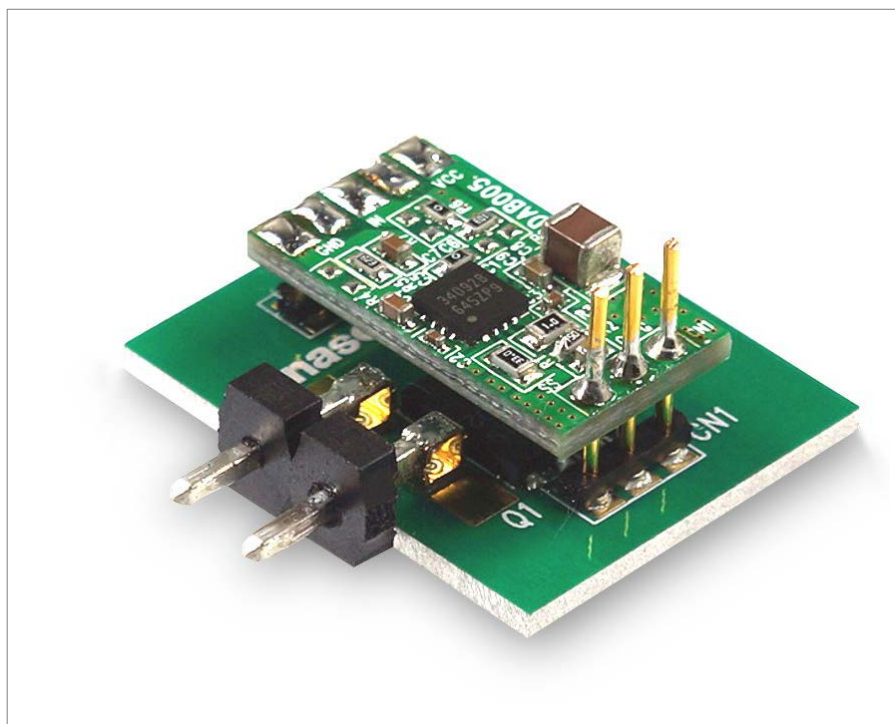
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PGA26E19BA-DB001

SMD to Thru-Hole Conversion Kit featuring:

- PGA26E19BA 600V 190mΩ X-GaN Power Transistor
- AN34092B Single channel X-GaN Gate Driver IC

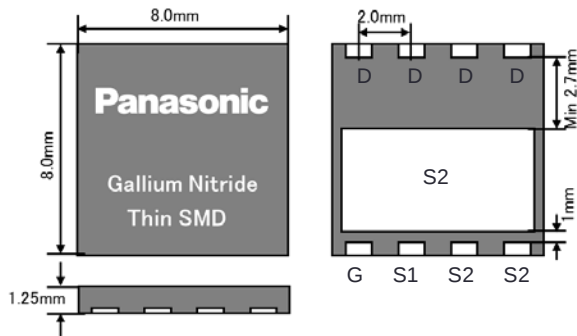


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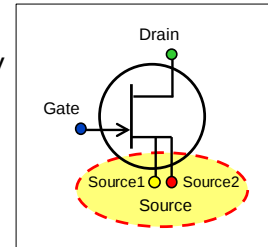
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■ Features

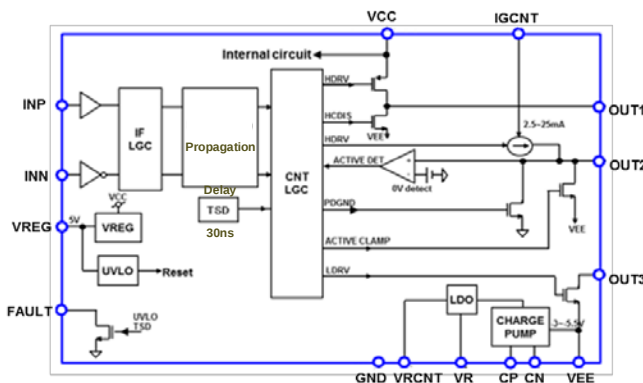
X-GaN Transistor (PGA26E19BA)



- Blocking Voltage: 600V
- Pulse Peak I_{DS} : 23A
- I_{DS} (cont): 13A
- $R_{D(on)}$ max: 190m Ω
- Normally-Off(Enhancement-mode device)



X-GaN Gate Driver (AN34092B)



- Support high switching frequency (~4MHz)
- Achieve safe operation by negative voltage source and active miller clamp
- Facilitate gate drive design with high precision gate current source

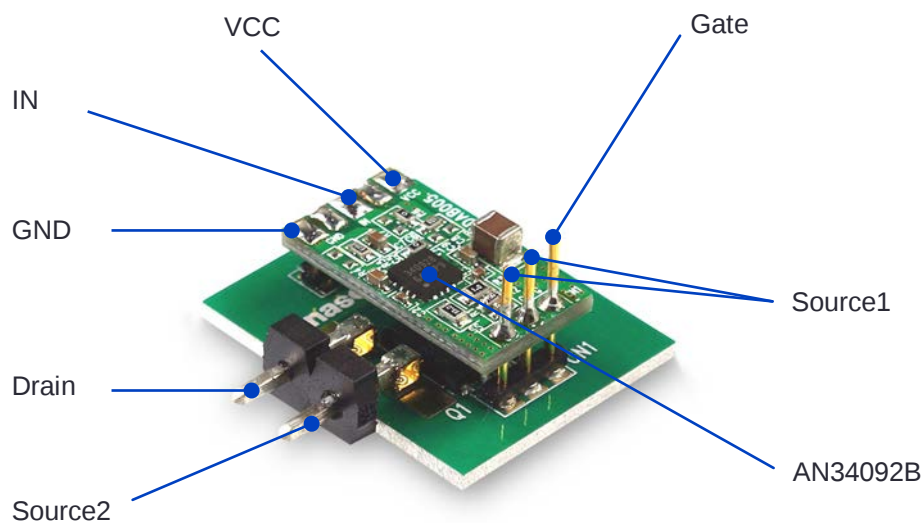


Figure 1: SMD to Thru-Hole Conversion Kit (PGA26E19BA-DB001)

■ Appearance

The SMD to thru-hole conversion kit (PGA26E19BA-DB001) consist of 2 boards i.e. DAB004 (X-GaN power board) and DAB005 (driver circuit board). These two boards are connected to each other to form the overall conversion kit. These two individual board photos are shown on Figure 2 to 5.

PGA26E19BA (X-GaN 600V / 190mΩ)

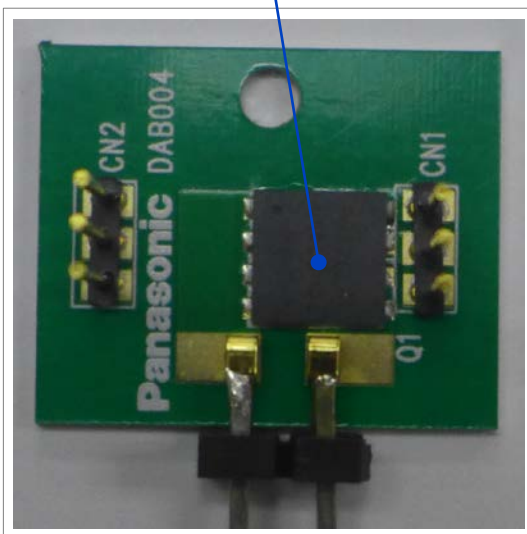


Figure 2: DAB004 board photo (TOP)

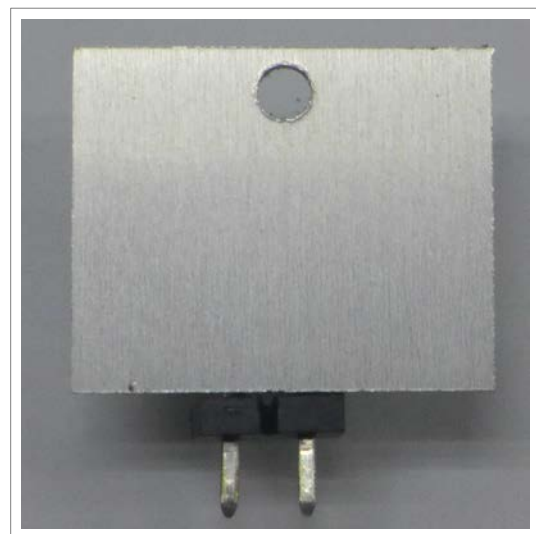


Figure 3: DAB004 board photo (BOTTOM)

AN34092B (X-GaN driver IC)

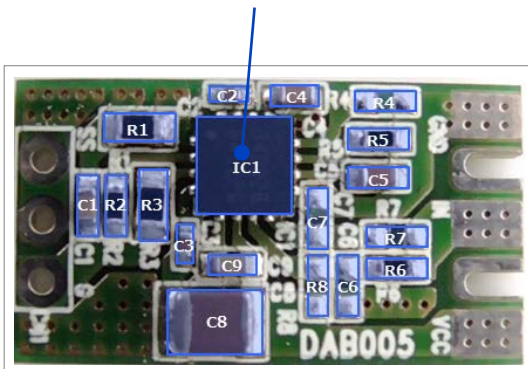


Figure 4: DAB005 board photo (TOP)

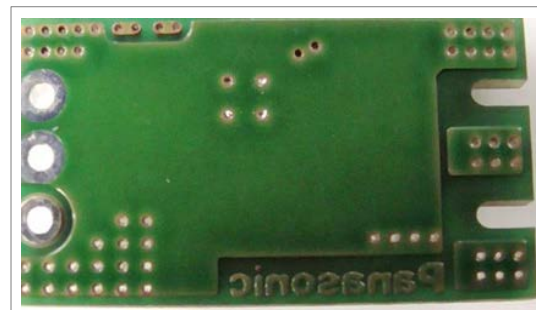


Figure 5: DAB005 board photo (BOTTOM)

■ Description of PGA26E19BA-DB001

PGA26E19BA-DB001 is an SMD to thru-hole conversion kit featuring Panasonic 600V 190mΩ X-GaN power transistor in an 8X8 SMD package (Q1) and AN34092B high-speed single channel X-GaN driver IC (IC1). As shown in Figure 6, this conversion kit consists of an X-GaN power board (DAB004) and driver circuit board (DAB005). It allows users to instantly replace an existing thru-hole package (e.g. TO220 and TO247) power transistor with Panasonic's X-GaN device on their existing power supply application. The output (Drain, Source2) terminal pins are compatible with that of a thru-hole power package. This "plug-and-play" feature provides users with flexible, fast and easy X-GaN performance comparison with SJ-MOS without the need for a new board design. An application example is shown in Figure 12 (page 14) whereby the conversion kit is mounted on an actual power supply in place of a thru-hole package (TO247).

DAB004 is a single layer aluminum based X-GaN power board. Heat sink can be attached easily to the aluminum back surface via screw mounting for enhanced thermal dissipation. The Drain-Source2 pitch of this conversion kit is around 5mm, which is the usual drain-source pitch design for a thru-hole power transistor package. Source2 depicted in Figure 6 is the power loop source terminal which passes high current during power supply operation. DAB004 power board is attached closely to DAB005 driver circuit board so as to minimize gate drive loop parasitic inductance.

DAB005 employs Panasonic AN34092B GaN driver IC for the driving circuit. AN34092B high-speed characteristic (~4MHz) enables fast switching for Panasonic X-GaN power transistor. Low switching loss can be achieved with a fast dv/dt slew rate solution, which differentiates a wide bandgap GaN device with a conventional MOSFET device. In terms of flexibility, users can also easily optimize the dv/dt slew rate design with just a single resistor (R1) change. Source1 in Figure 6 is the source sensing terminal which is connected directly to the ground (GND) of IC1 for prevention of circuit oscillation. For more details about AN34092B driver IC, kindly refer to its product datasheet.

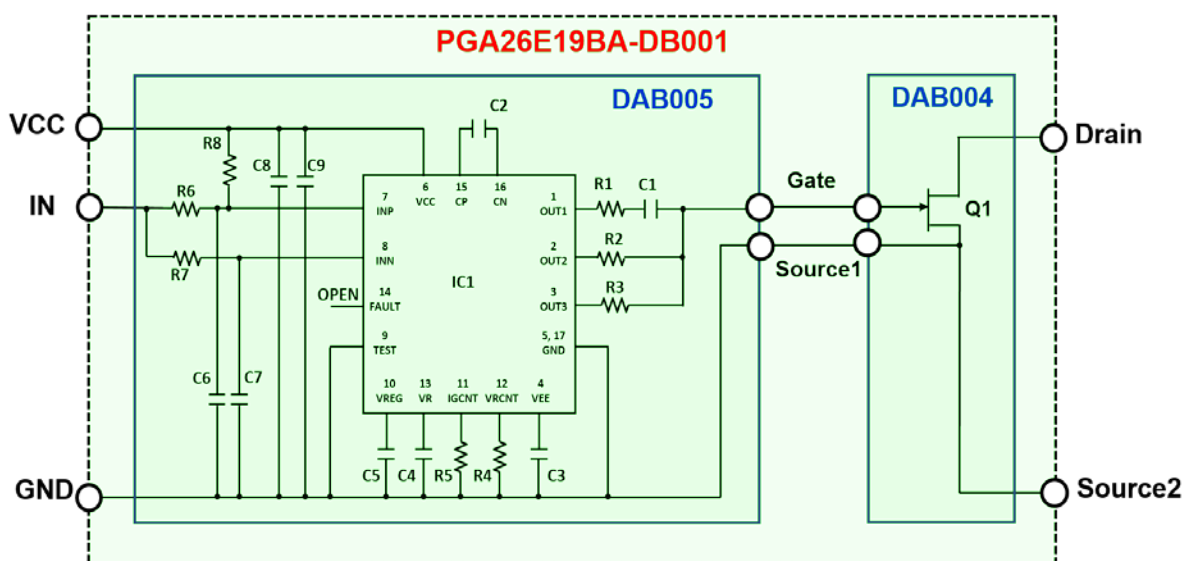


Figure 6: PGA26E19BA-DB001 Block diagram

■ Schematic Diagram

Refer to Figure 7 below for the circuit schematic of the conversion kit. Panasonic X-GaN power transistor (PGA26E19BA) is denoted by Q1. X-GaN driver IC (AN34092B) is denoted by IC1.

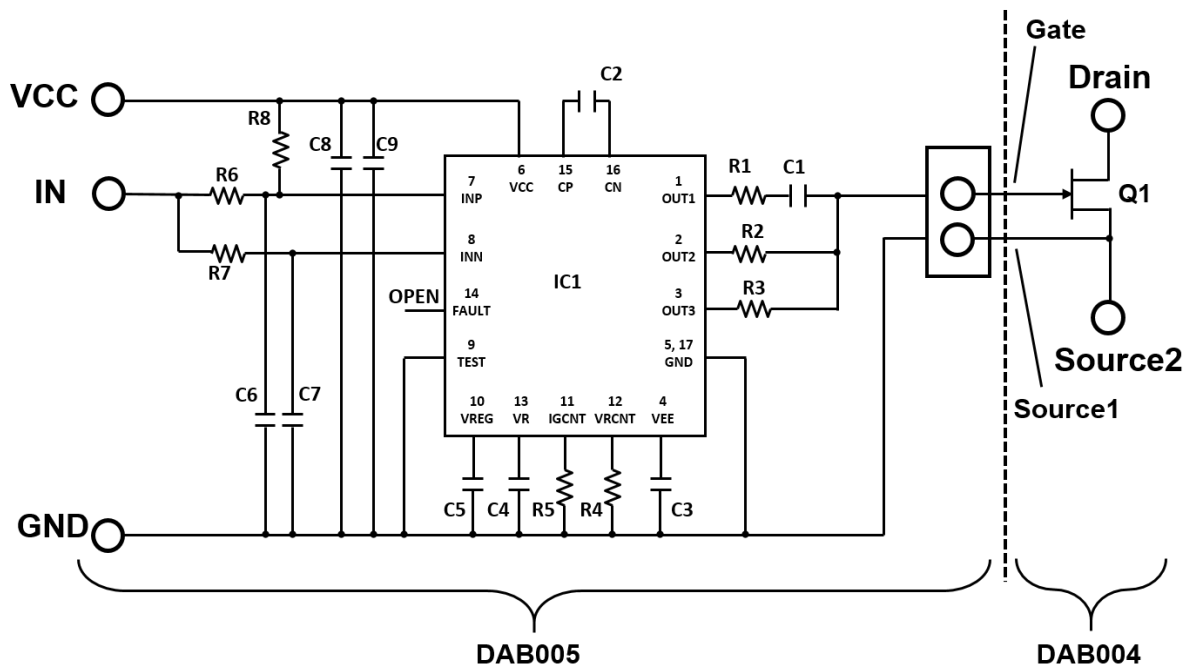


Figure 7: PGA26E19BA-DB001 schematic

■ Bill of Materials

Table 1: Bill of Materials (DAB004)

Parts	Symbol	Specification	Part Number	Manufacturer	Package
Transistor	Q1	600V/190mΩ	PGA26E19BA	Panasonic	DFN 8X8
Pin	CN1	2.54mm pitch/3 pin	HQ-3-15	Mac8	SMD type
Pin	CN2	2.54mm pitch/3 pin	HQ-3-15	Mac8	SMD type

**Table 2 (a): Bill of Materials (DAB005)
for non-inverting input signal [DEFAULT]**

Parts	Symbol	Specification	Part Number	Manufacturer	Package
Driver IC	IC1	-	AN34092B	Panasonic	QFN 4X4
Chip Resistor	R1	33Ω	ERJ6ENF33R0V	Panasonic	SMD2012
	R2	75Ω	ERJ3GEYJ750V	Panasonic	SMD1608
	R3	1Ω	ERJ6GEYJ1R0V	Panasonic	SMD2012
	R4	-	N.M.	-	SMD1608
	R5	82kΩ	ERJ3GEYJ823V	Panasonic	SMD1608
	R6	0Ω	ERJ3GEY0R00V	Panasonic	SMD1608
	R7	-	N.M.	-	SMD1608
	R8	-	N.M.	-	SMD1608
	* C6	10kΩ	ERJ3GEYJ103V	Panasonic	SMD1608
	* C7	0Ω	ERJ3GEY0R00V	Panasonic	SMD1608
Chip Capacitor	C1	330pF/50V	GRM188R71H331KA01	Murata	SMD1608
	C2	0.22uF/25V	GRM155C81E224KE01	Murata	SMD1005
	C3	0.47uF/16V	GRM155C81C474KE01	Murata	SMD1005
	C4	4.7uF/10V	GRM188C71A475KE11	Murata	SMD1608
	C5	1uF/25V	GRM188R71E105KA12	Murata	SMD1608
	C8	10uF/50V	GRM32ER71H106KA12	Murata	SMD3225
	C9	0.1uF/100V	GRM188R72A104KA35	Murata	SMD1608

* Resistors are mounted on C6 and C7 instead of capacitors

■ Bill of Materials (continued)

Table 2 (b): Bill of Materials (DAB005) for inverting input signal use only

Parts	Symbol	Specification	Part Number	Manufacturer	Package
Driver IC	IC1	-	AN34092B	Panasonic	QFN 4X4
Chip Capacitor	R1	33Ω	ERJ6ENF33R0V	Panasonic	SMD2012
	R2	75Ω	ERJ3GEYJ750V	Panasonic	SMD1608
	R3	1Ω	ERJ6GEYJ1R0V	Panasonic	SMD2012
	R4	-	N.M.	-	SMD1608
	R5	82kΩ	ERJ3GEYJ823V	Panasonic	SMD1608
	R6	-	N.M.	-	SMD1608
	R7	0Ω	ERJ3GEY0R00V	Panasonic	SMD1608
	R8	0Ω	ERJ3GEY0R00V	Panasonic	SMD1608
	**C7	10kΩ	ERJ3GEYJ103V	Panasonic	SMD1608
	C1	330pF/50V	GRM188R71H331KA01	Murata	SMD1608
Clip Capacitor	C2	0.22uF/25V	GRM155C81E224KE01	Murata	SMD1005
	C3	0.47uF/16V	GRM155C81C474KE01	Murata	SMD1005
	C4	4.7uF/10V	GRM188C71A475KE11	Murata	SMD1608
	C5	1uF/25V	GRM188R71E105KA12	Murata	SMD1608
	C6	-	N.M.	-	SMD1608
	C8	10uF/50V	GRM32ER71H106KA12	Murata	SMD3225
	C9	0.1uF/100V	GRM188R72A104KA35	Murata	SMD1608

* Resistor is mounted on C7 (10kΩ) instead of capacitor

■ PCB Layout (DAB004)

PCB Specifications:

- Single-sided Aluminum board
- Size: 23mm × 28mm
- Copper thickness: 35um
- Board thickness: 1.6mm

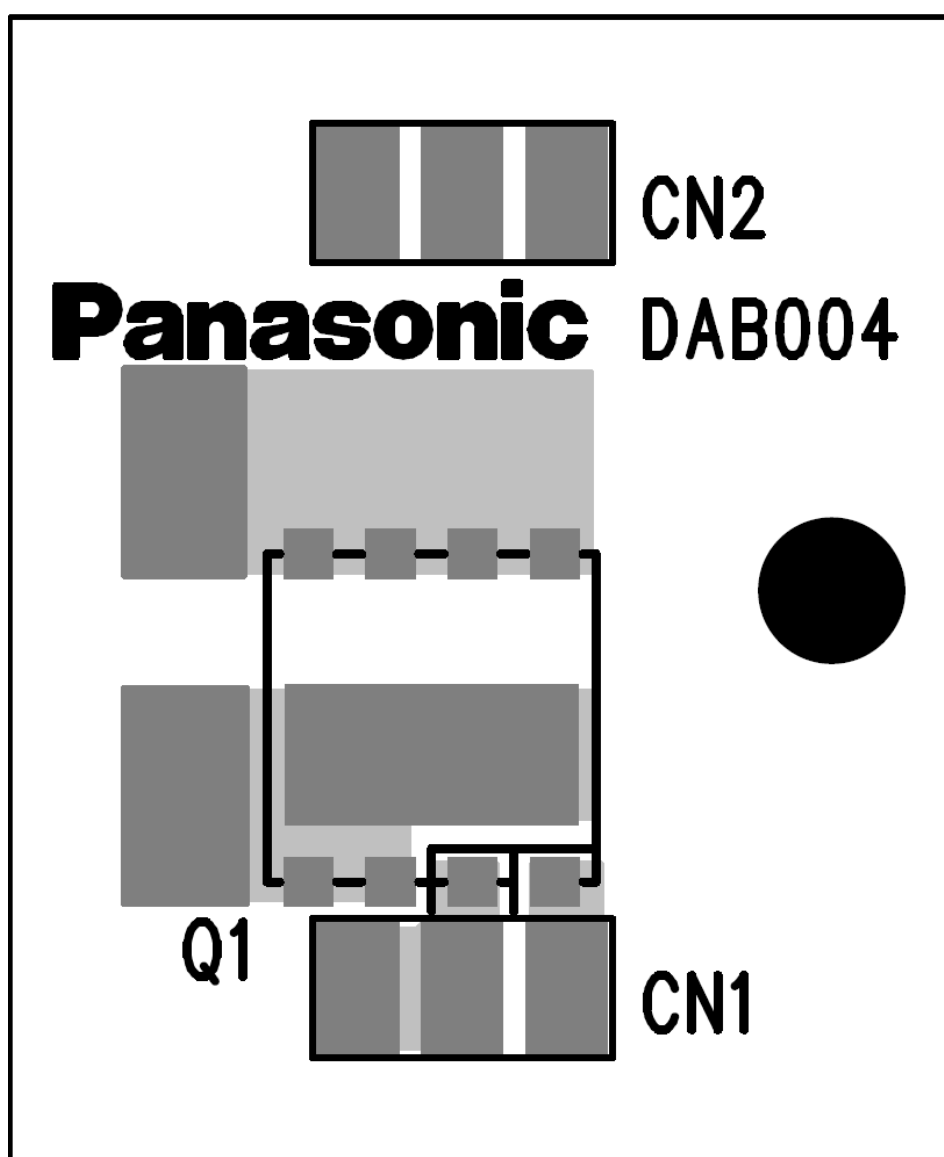


Figure 8: DAB004 PCB Layout

■ PCB Layout (DAB005)

PCB Specifications:

- Double-sided FR-4 board
- Size: 12mm × 21.5mm
- Copper thickness: 70um
- Board thickness: 1.6mm

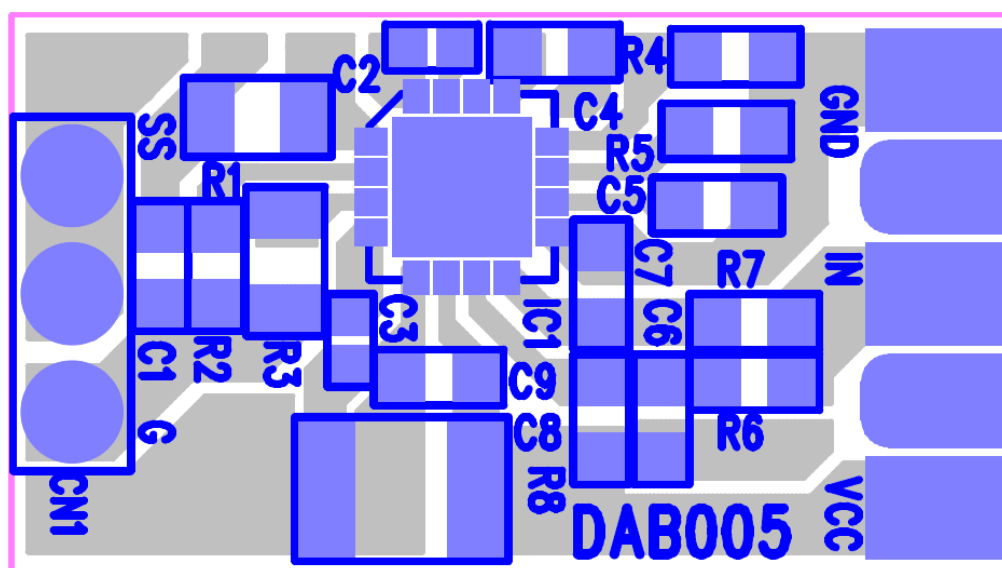


Figure 9: DAB005 top PCB Layout



Figure 10: DAB005 bottom PCB Layout

■ Recommended Operating Conditions

Table 3 shows the recommended operating conditions for Panasonic's SMD to thru-hole conversion kit PGA26E19BA-DB001. All the components used in PGA26E19BA-DB001 are rated for these recommended operating conditions only.

It is necessary to refer to the respective X-GaN transistor and X-GaN driver IC datasheet when using this application manual.

Table 3: Recommended operating conditions for PGA26E19BA-DB001

Parameter	Condition
Input voltage (VPN) -- ①	<600V
Driver IC power supply voltage (VCC) -- ②	12V
External clock voltage (IN) -- ③	5V
Temperature	25°C

①②③ These same operating parameters are illustrated in the test circuits on page 15

■ Mounting Procedures and Illustrations

Connection of PGA26E19BA-DB001 on user's board

1. Remove all the elements of drive circuit for existing SJ-MOS power transistor on user's board such as gate driver, gate resistors, pull-down resistors, speed-up capacitors, diodes.
2. Connect DAB004 to user's board for the 2 terminals as follows:
 - (a) 「Drain terminal of DAB004」 and 「Drain power pattern on user's board」
 - (b) 「Source2 terminal of DAB004」 and 「Source power pattern on user's board」
3. Connect DAB005 to user's board for the 3 terminals as follows:
 - (a) 「IN pad on DAB005」 and 「Controller output signal on user's board」
 - * In case of using the inverting signal, please remove R6 and C6, and then mount R7=0Ω, R8=0Ω and C7=10kΩ. This information can be found on page 9 [Table 2(b)].
 - (b) 「VCC pad on DAB005」 and 「Auxiliary power supply on user's board」
 - (c) 「GND pad on DAB005」 and 「Signal GND on user's board」
4. If heat sink is needed, screw it securely on the back side of DAB004.

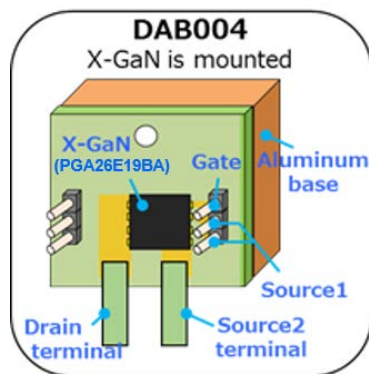


Figure 11 (a): DAB004 image

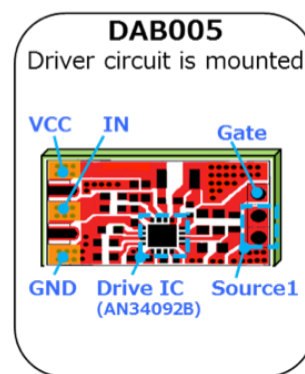


Figure 11 (b): DAB005 image

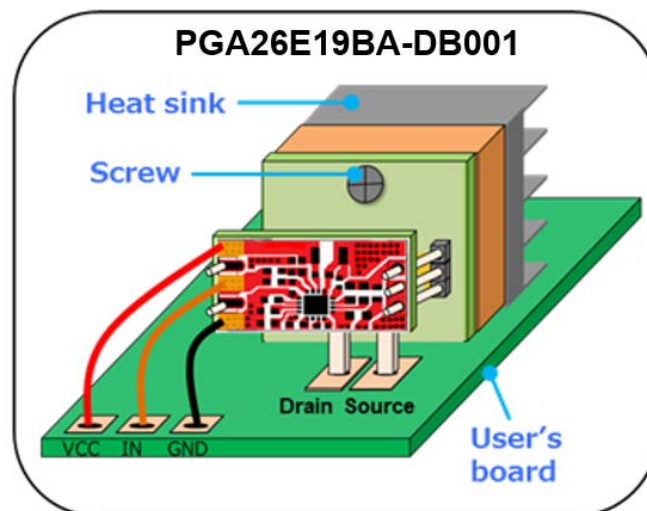


Figure 11 (c): Fully mounted image

■ Mounting Procedures and Illustrations (continued)

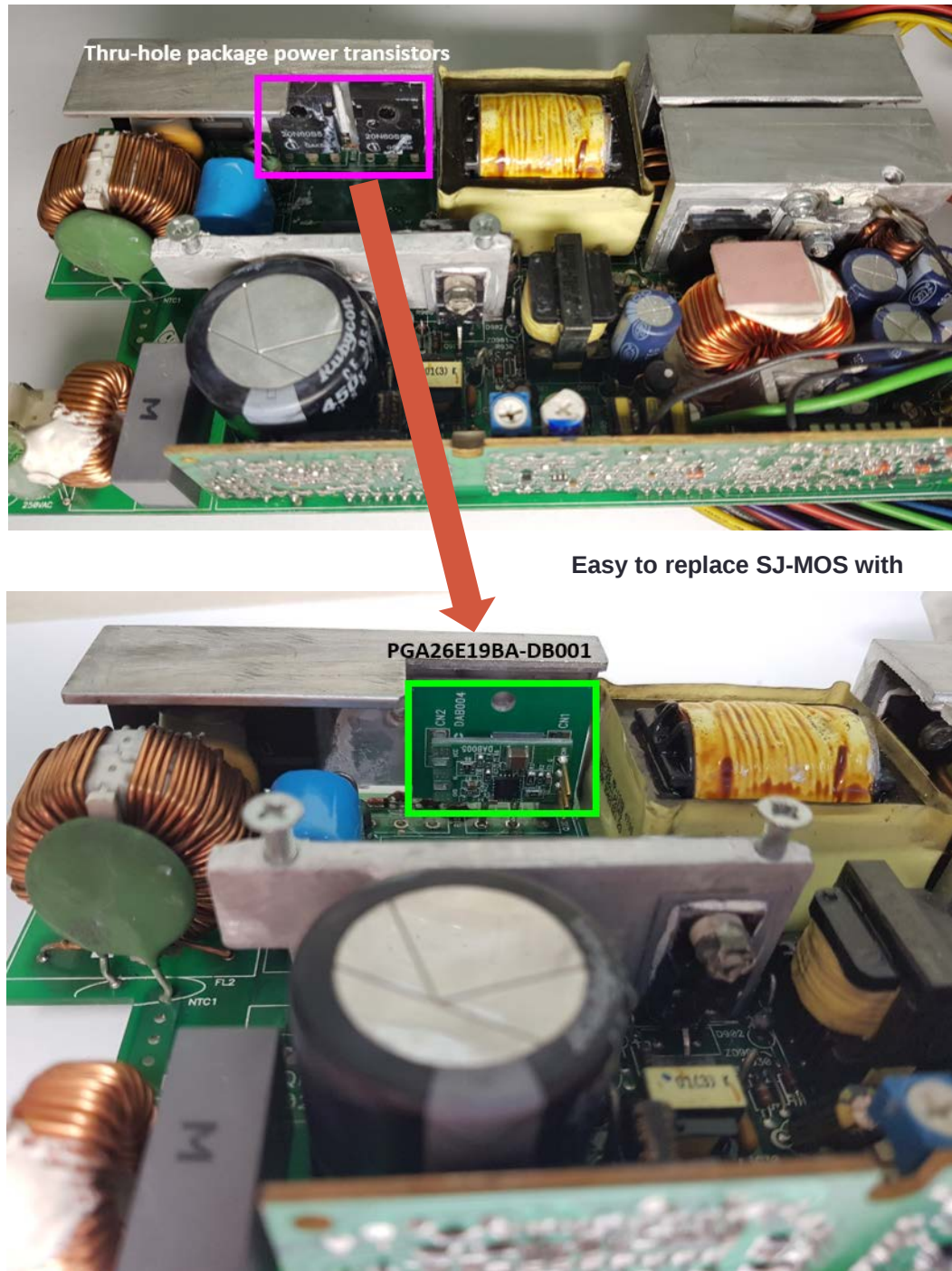


Figure 12: For illustration purpose, PGA26E19BA-DB001 is conveniently mounted on an actual power supply

Note:

1. Use the conversion kit within the ratings described in the device product standards.
2. This conversion kit is not isolated.
3. Check your connection carefully.

Double Pulse Switching Test

Figure13 shows the circuit schematic and the connections for the conversion kit (PGA26E19BA-DB001) on a simple chopper circuit configuration. The purpose of this test is to confirm the kit operation. The conversion kit is powered by a 12V VCC voltage. A pulse generator is used to generate a double pulse input. Drain-source voltage (V_{DS}) output slew rate is shown in Figure 15. Typical turn on/off waveforms (V_{GS} , V_{DS} and I_L) are shown in Figure 16. Note that the dv/dt and waveform data presented is for reference use only and measured data maybe different depending on actual evaluation environment.

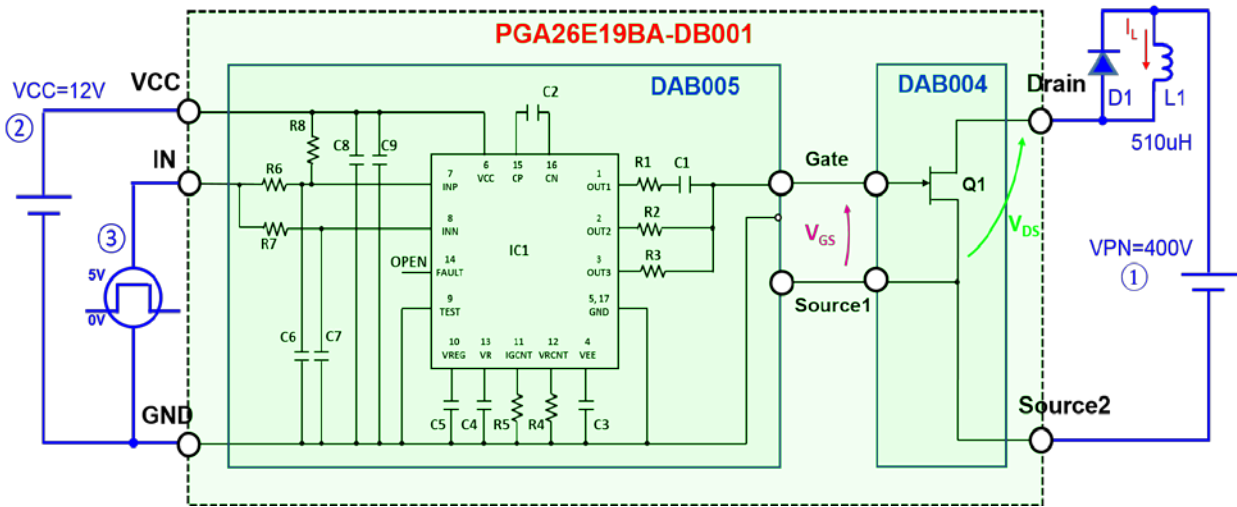


Figure 13: PGA26E19BA-DB001 in a simple chopper circuit

Condition:

$V_{PS}=400V$, $V_{CC}=12V$, $R_1=33\Omega$, $R_2=75\Omega$, $R_3=1\Omega$, $C_1=330pF$

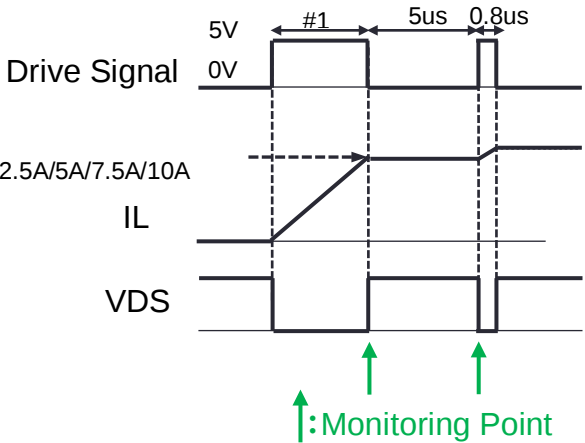


Figure 14: Double pulse profile

IL	#1
2.5A	3.4us
5A	6.8us
7.5A	10.2us
10A	14us

Table 4: Double pulse setting

■ Double Pulse Switching Test (continued)

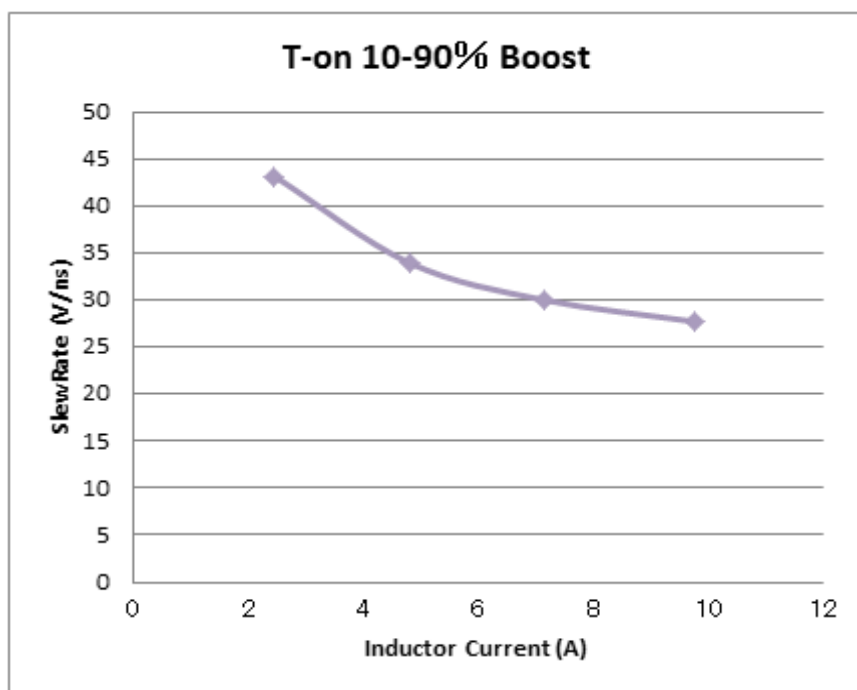


Figure 15(a): Drain-source voltage (V_{DS}) output turn-on slew rate

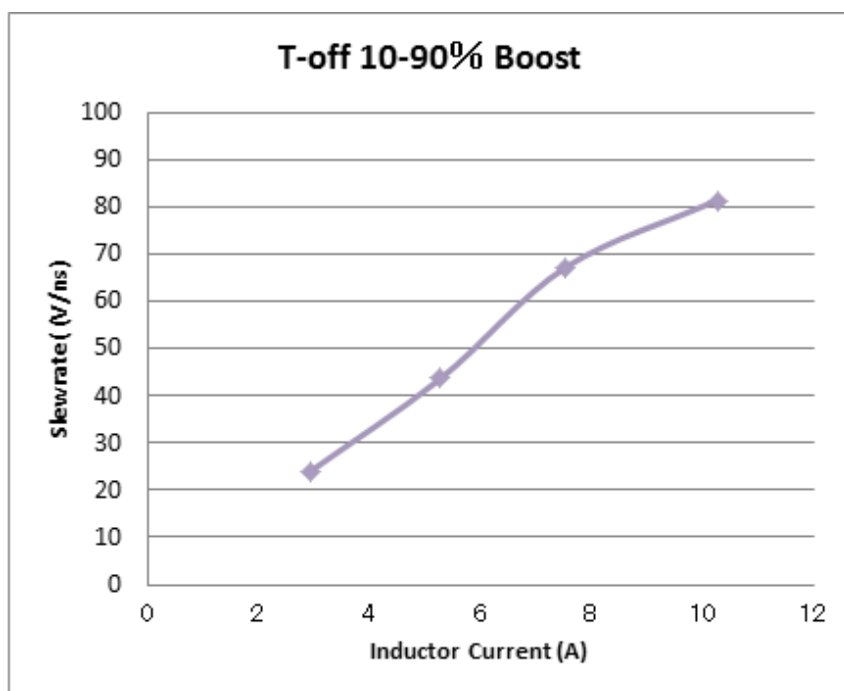


Figure 15(b): Drain-source voltage (V_{DS}) output turn-off slew rate

Double Pulse Switching Test (continued)

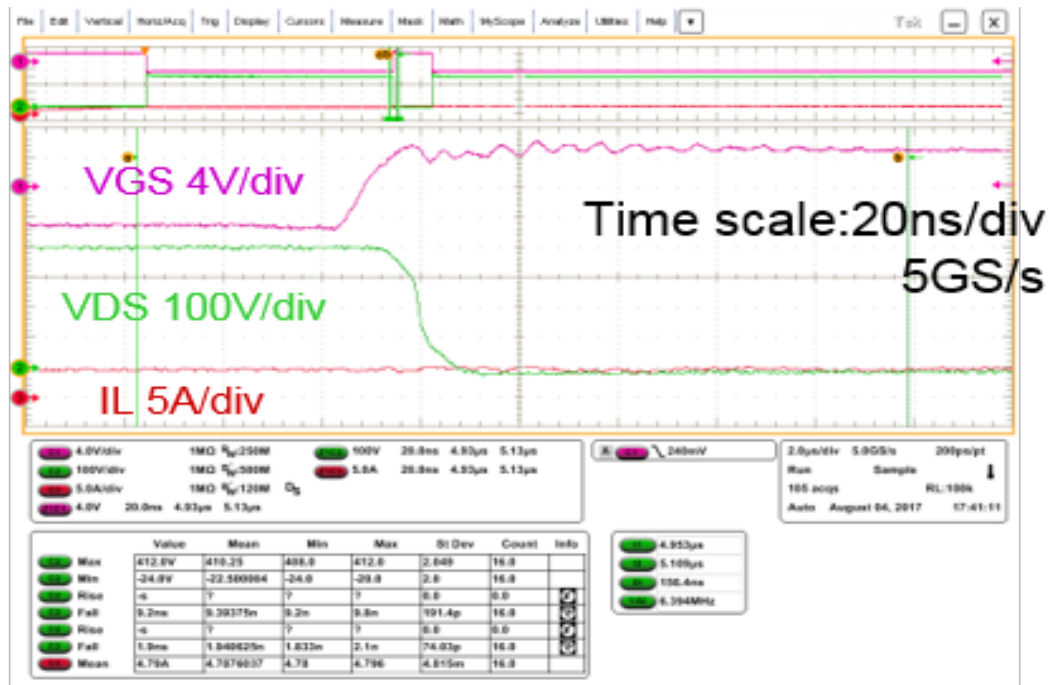


Figure 16(a): Typical turn-on waveform



Figure 16(b): Typical turn-off waveform

■ Important Notice

Please read and understand the following items, "Restriction", and "Caution" before using the conversion kit:

Restriction

- The conversion kit is intended for use as engineering development, verification or evaluation purposes only.
- This conversion kit is not intended for a finished end-product fit for general consumer use. The kit should not be used as all or part of a production unit.
- Do not operate in condition other than the recommended settings.
- The conversion kit must be used only by qualified engineers and technicians that have electronics training, familiar with handling of high-voltage electrical systems and observe good engineering practice standards.
- The conversion kit is meant to be operated in lab environment under the safe conditions.
- Please use a protective case (accessory) during evaluation.
- All of the specifications and evaluation data in this manual are for reference only and not guaranteed. The information may subject to change without notice. Please contact to Panasonic representative for the latest information.
- The user assumes all responsibility and liability for proper and safe handling of this conversion kit. Further, the user indemnifies Panasonic from all claims arising from the handling or use of the conversion kits.
- The technical information described in this document 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 document.

Caution

- The conversion kit carries hazardous high voltage. Do not touch when power is applied, otherwise, it may cause severe injury, disability or death.
- Electric charge may be accumulated in the capacitors. To prevent electrical shock, please ensure all the capacitors are properly discharged before touching the conversion kit.
- It is the user's responsibility to confirm that the voltages, isolation requirements, and rated value are identified and understood, prior to handling the conversion kit.
- Do not leave the conversion kit unattended while power is applied and do not perform other activity near the conversion kit while power is applied.
- This board contains parts that are susceptible to damage by electrostatic discharge (ESD). It is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge when using the conversion kit.
- Should the conversion kit does not meet the specification indicated in the application note, the board may be exchanged with a new one within 30 days from the date of delivery. When exchanging the conversion kit, please return the board with all items included.
- The warranty on this conversion kit is considered void once a part on the board is removed or modified.
- The conversion kit does not fall within the scope of the technical requirements of the following directives or other related directives:
 - Restriction of Hazardous Substances (RoHS)
 - Directive on Waste Electrical and Electronic Equipment (WEEE)
 - Mandatory conformity marking for products sold in the European Economic Area (CE)
 - Federal Communications Commission (FCC)
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