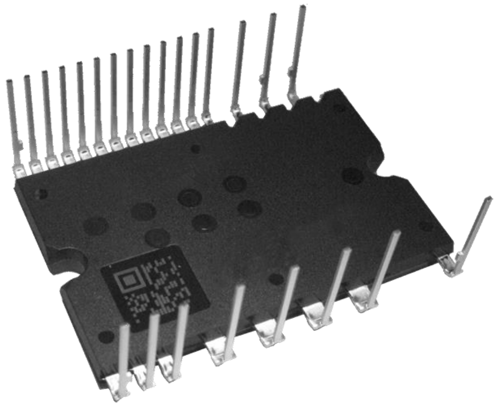
< DIPIPM >

PSF25S92F6-A6

TRANSFER MOLDING TYPE
INSULATED TYPE

OUTLINE



MAIN FUNCTION AND RATINGS

- 3 phase DC/AC inverter
- 600V / 25A (MOSFET)
- N-side MOSFET open source
- Built-in bootstrap diodes with current limiting resistor

APPLICATION

- AC 100~240Vrms(DC voltage:400V or below) class low power motor control

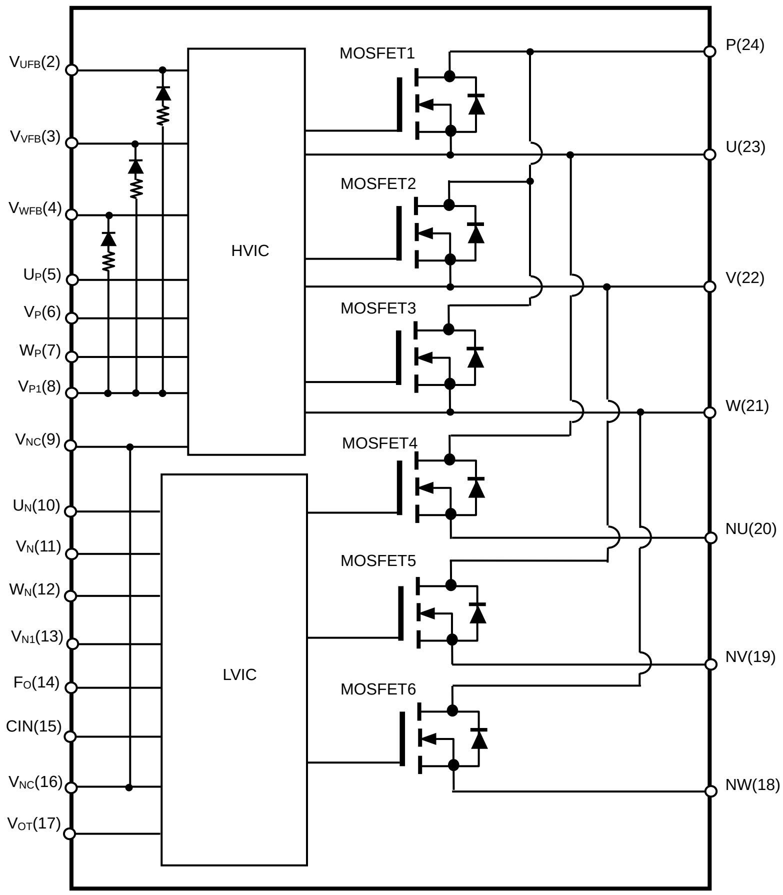
TYPE NAME

PSF25S92F6-A6	With temperature output function

INTEGRATED DRIVE, PROTECTION AND SYSTEM CONTROL FUNCTIONS

- For P-side : Drive circuit, High voltage high-speed level shifting, Control supply under-voltage (UV) protection
- For N-side : Drive circuit, Control supply under-voltage protection (UV), Short circuit protection (SC)
- Fault signaling : Corresponding to SC fault (N-side IGBT), UV fault (N-side supply)
- Temperature output : Outputting LVIC temperature by analog signal
- Input interface : 3, 5V line, Schmitt trigger receiver circuit (High Active)
- UL Recognized : UL1557 File E323585

INTERNAL CIRCUIT



MAXIMUM RATINGS (T_{ch} = 25°C, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
V_{DD}	Supply voltage	Applied between P-NU,NV,NW	450	V
$V_{DD(surge)}$	Supply voltage (surge)	Applied between P-NU,NV,NW	500	V
V_{DSS}	Drain-source voltage		600	V
$\pm I_D$	Each MOSFET drain current	T_c= 25°C (Note 1)	25	A
$\pm I_{DP}$	Each MOSFET drain current (peak)	T_c= 25°C, less than 1ms	50	A
T_{ch}	Channel temperature	(Note 2)	-30~+150	°C

Note1: Pulse width and period are limited due to channel temperature.
Note2: The maximum channel temperature rating of built-in power chips is 150°C(@Tc≤100°C).However, to ensure safe operation of DIPIPM, the average channel temperature should be limited to Tch(Ave)≤125°C (@Tc≤100°C).

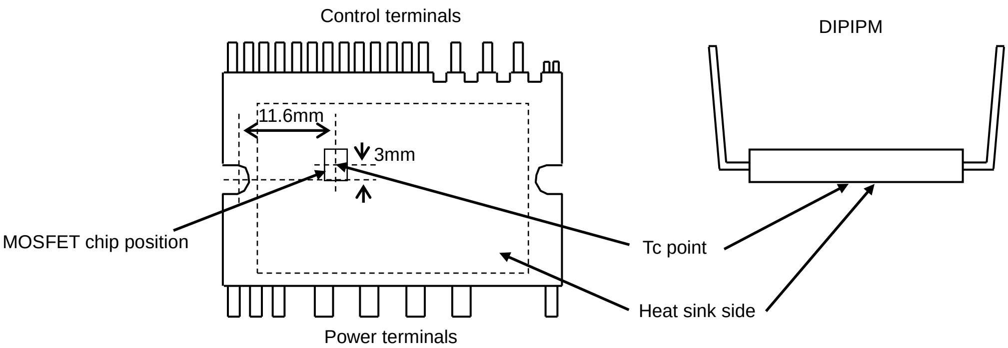
CONTROL (PROTECTION) PART

Symbol	Parameter	Condition	Ratings	Unit
V_D	Control supply voltage	Applied between V_{P1}-V_{NC}, V_{N1}-V_{NC}	24	V
V_{DB}	Control supply voltage	Applied between V_{UFB}-U, V_{VFB}-V, V_{WFB}-W	24	V
V_{IN}	Input voltage	Applied between U_P, V_P, W_P, U_N, V_N, W_N-V_{NC}	-0.5~V_D+0.5	V
V_{FO}	Fault output supply voltage	Applied between F_O-V_{NC}	-0.5~V_D+0.5	V
I_{FO}	Fault output current	Sink current at F_O terminal	1	mA
V_{SC}	Current sensing input voltage	Applied between CIN-V_{NC}	-0.5~V_D+0.5	V

TOTAL SYSTEM

Symbol	Parameter	Condition	Ratings	Unit
$V_{CC(PROT)}$	Self protection supply voltage limit (Short circuit protection capability)	V_D = 17~19V, Inverter Part T_{ch}= 125°C, non-repetitive, less than 2μs	400	V
T_C	Module case operation temperature	Measurement point of Tc is provided in Fig.1	-30~+100	°C
T_{stg}	Storage temperature		-40~+125	°C
V_{iso}	Isolation voltage	60Hz, Sinusoidal, AC 1min, between connected all pins and heat sink plate	1500	V_{rms}

Fig. 1: T_C MEASUREMENT POINT



THERMAL RESISTANCE

Symbol	Parameter	Condition	Limits Min.	Limits Typ.	Limits Max.	Unit
$R_{th(ch-c)}$	Channel to case thermal resistance	Inverter MOSFET part (per 1/6 module)	-	-	2.0	K/W

Note 3: Grease with good thermal conductivity and long-term endurance should be applied evenly with about +100μm~+200μm on the contacting surface of DIPIPM and heat sink. The contacting thermal resistance between DIPIPM case and heat sink Rth(c-f) is determined by the thickness and the thermal conductivity of the applied grease. For reference, Rth(c-f) is about 0.3K/W (per 1/6 module, grease thickness: 20μm, thermal conductivity: 1.0W/m•K).

ELECTRICAL CHARACTERISTICS (T_{ch} = 25°C, unless otherwise noted)
INVERTER PART

Symbol	Parameter	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
$V_{DS(on)}$	Drain-source on-state voltage	V_D=V_{DB} = 18V, V_{IN}= 5V	I_D = 25A, T_{ch} = 25°C	-	1.30	2.20	V
			I_D = 25A, T_{ch} = 125°C	-	1.30	2.20	V
			I_D =2.5A, T_{ch} = 25°C	-	0.13	0.25	V
$V_{SD(off)}$	Source- drain voltage	V_D=V_{DB} = 18V, V_{IN}= 0V, -I_D= 25A		-	4.00	5.00	V
t_{on}	Switching times	V_{DD}= 300V, V_D= V_{DB}= 18V I_D= 25A, T_{ch}= 125°C, V_{IN}= 0↔5V Inductive Load (upper-lower arm)		1.00	1.50	1.95	μs
$t_{c(on)}$				-	0.25	0.50	μs
t_{off}				-	1.70	2.20	μs
$t_{c(off)}$				-	0.15	0.45	μs
t_{rr}				-	0.05	-	μs
I_{DSS}	Drain-Source cut-off current	V_{DS}=V_{DSS}	T_{ch} = 25°C	-	-	1	mA
			T_{ch} =125°C	-	-	10	mA

CONTROL (PROTECTION) PART

Symbol	Parameter	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
I_D	Circuit current	Total of V_{P1}-V_{NC}, V_{N1}-V_{NC}	V_D=18V, V_{IN}=0V	-	-	3.50	mA
			V_D=18V, V_{IN}=5V	-	-	3.50	mA
I_{DB}		Each part of V_{UFB}-U, V_{VFB}-V, V_{WFB}-W	V_D=V_{DB}=18V, V_{IN}=0V	-	-	0.35	mA
			V_D=V_{DB}=18V, V_{IN}=5V	-	-	0.35	mA
$V_{SC(ref)}$	Short circuit trip level	V_D = 18V (Note 4)		0.455	0.480	0.505	V
UV_{DBt}	P-side Control supply under-voltage protection(UV)	T_{ch} ≤125°C	Trip level	10.0	-	12.0	V
UV_{DBr}			Reset level	10.5	-	12.5	V
UV_{Dt}	N-side Control supply under-voltage protection(UV)		Trip level	10.3	-	12.5	V
UV_{Dr}			Reset level	10.8	-	13.0	V
V_{OT}	Temperature Output	Pull down R=5.1kΩ (Note 5)	LVIC Temperature=90°C	2.63	2.77	2.91	V
			LVIC Temperature=25°C	0.88	1.13	1.39	V
V_{FOH}	Fault output voltage	V_{SC} = 0V, F_O terminal pulled up to 5V by 10kΩ		4.9	-	-	V
V_{FOL}		V_{SC} = 1V, I_{FO} = 1mA		-	-	0.95	V
t_{FO}	Fault output pulse width	(Note 6)		20	-	-	μs
I_{IN}	Input current	V_{IN} = 5V		0.70	1.00	1.50	mA
$V_{th(on)}$	ON threshold voltage	Applied between U_P, V_P, W_P, U_N, V_N, W_N-V_{NC}		-	2.10	2.60	V
$V_{th(off)}$	OFF threshold voltage			0.80	1.50	-	V
$V_{th(hys)}$	ON/OFF threshold hysteresis voltage			0.35	0.65	-	V
V_F	Bootstrap Di forward voltage	I_F=10mA including voltage drop by limiting resistor (Note 7)		0.9	1.3	1.7	V
R	Built-in limiting resistance	Included in bootstrap Di		48	60	72	Ω

Note 4 : SC protection works only for N-side MOSFETs. Please select the external shunt resistance such that the SC trip-level is less than 1.7 times of the current rating.
5 : DIPIPM don't shutdown MOSFETs and output fault signal automatically when temperature rises excessively. When temperature exceeds the protective level that user defined, controller (MCU) should stop the DIPIPM. Temperature of LVIC vs. V_{OT} output characteristics is described in Fig. 3.
6 : Fault signal Fo outputs when SC or UV protection works. Fo pulse width is different for each protection modes. At SC failure, Fo pulse width is a fixed width (=minimum 20μs), but at UV failure, Fo outputs continuously until recovering from UV state. (But minimum Fo pulse width is 20μs.)
7 : The characteristics of bootstrap Di is described in Fig.2.

Fig. 2 Characteristics of bootstrap Di V_F-I_F curve (@Ta=25°C) including voltage drop by limiting resistor (Right chart is enlarged chart.)

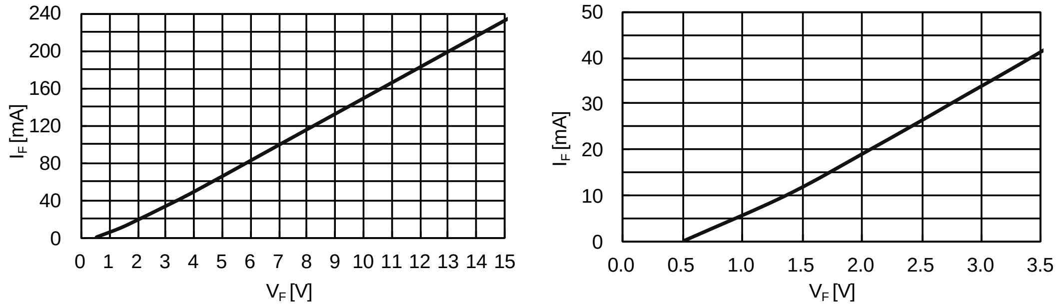


Fig. 3 Temperature of LVIC vs. V_{OT} output characteristics

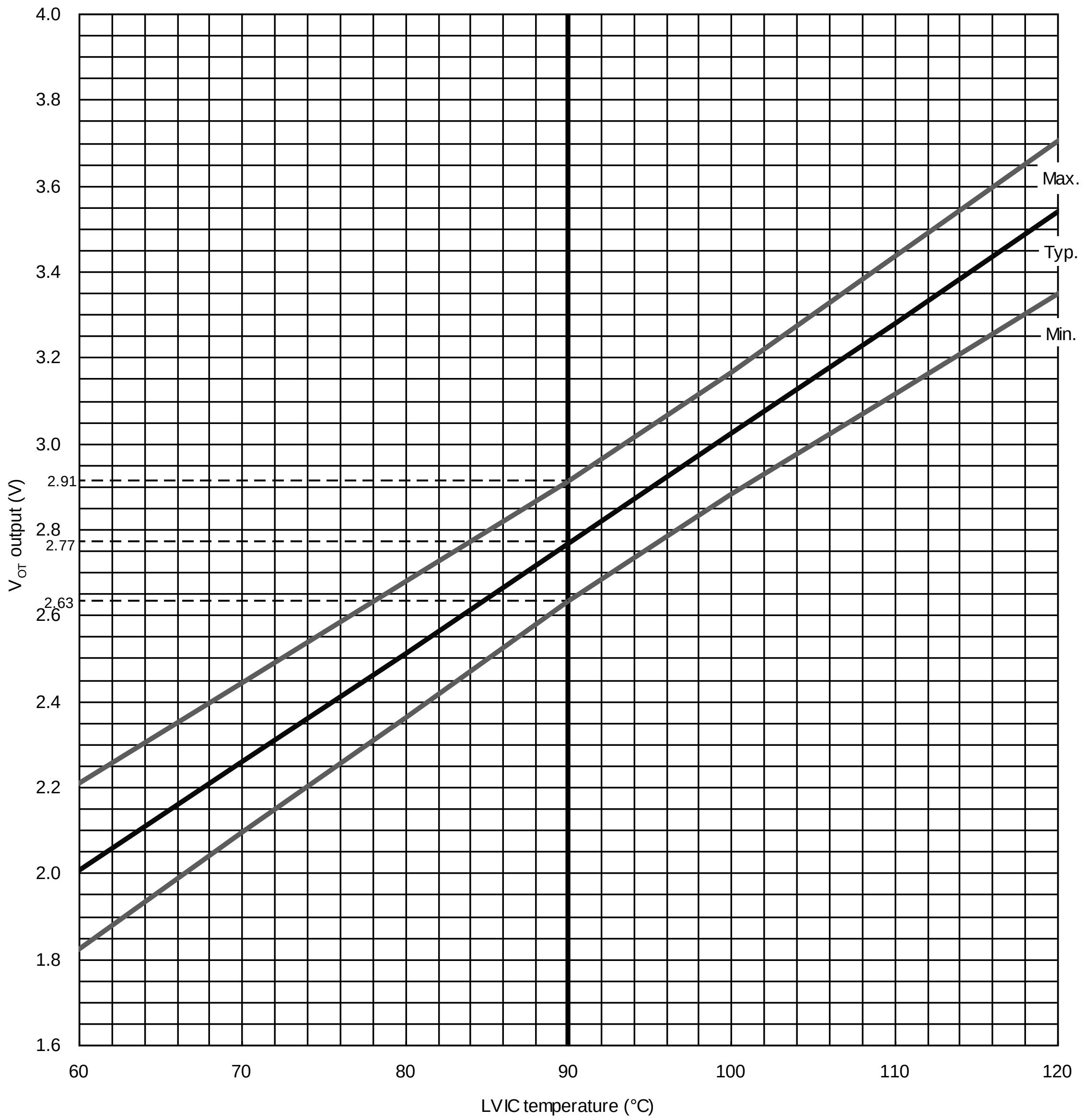
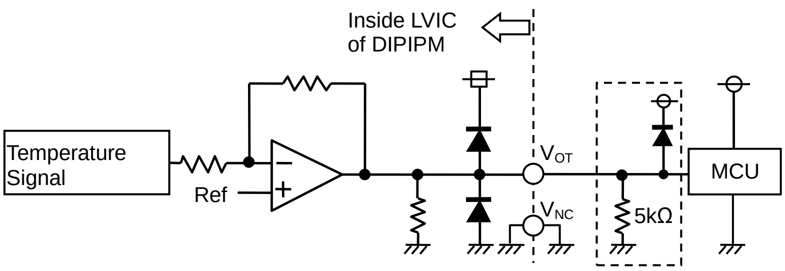


Fig. 4 V_{OT} output circuit



(1) It is recommended to insert 5kΩ (5.1kΩ is recommended) pull down resistor for getting linear output characteristics at low temperature below room temperature. When the pull down resistor is inserted between V_{OT} and V_{NC}(control GND), the extra circuit current, which is calculated approximately by V_{OT} output voltage divided by pull down resistance, flows as LVIC circuit current continuously. In the case of using V_{OT} for detecting high temperature over room temperature only, it is unnecessary to insert the pull down resistor.

(2) In the case of using V_{OT} with low voltage controller like 3.3V MCU, V_{OT} output might exceed control supply voltage 3.3V when temperature rises excessively. If system uses low voltage controller, it is recommended to insert a clamp Di between control supply of the controller and V_{OT} output for preventing over voltage destruction.

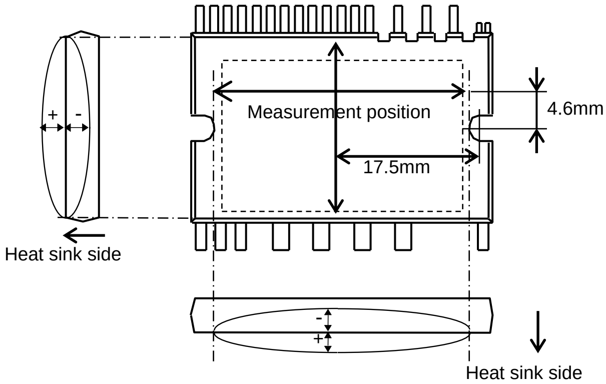
(3) In the case of not using V_{OT}, leave V_{OT} output NC (No Connection).

Refer the application note for Super Mini DIPIPM Ver.6 series about the usage of V_{OT}.

MECHANICAL CHARACTERISTICS AND RATINGS

Parameter	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
Mounting torque	Mounting screw : M3 (Note 8)	Recommended 0.69N·m	0.59	0.69	0.78	N·m
Terminal pulling strength	Control terminal: Load 4.9N Power terminal: Load 9.8N	JEITA-ED-4701	10	-	-	s
Terminal bending strength	Control terminal: Load 2.45N Power terminal: Load 4.9N 90deg. bend	JEITA-ED-4701	2	-	-	times
Weight			-	8.5	-	g
Heat radiation part flatness	(Note 9)		-50	-	100	μm

Note 8: Plain washers (ISO 7089~7094) are recommended.
Note 9: Measurement point of heat radiation part flatness

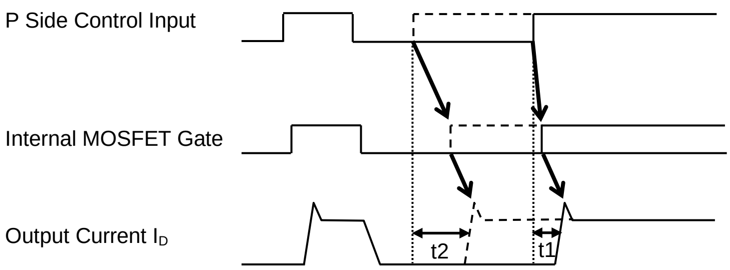


RECOMMENDED OPERATION CONDITIONS

Symbol	Parameter	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
V_{DD}	Supply voltage	Applied between P-NU, NV, NW		0	300	400	V
V_D	Control supply voltage	Applied between V_{P1}-V_{NC}, V_{N1}-V_{NC}		17.0	18.0	19.0	V
V_{DB}	Control supply voltage	Applied between V_{UFB}-U, V_{VFB}-V, V_{WFB}-W		15.0	18.0	22.0	V
ΔV_D, ΔV_{DB}	Control supply variation			-1	-	+1	V/μs
t_{dead}	Arm shoot-through blocking time	For each input signal		1.5	-	-	μs
f_{PWM}	PWM input frequency	$T_C \le 100°C$, $T_{ch} \le 125°C$		-	5	20	kHz
I_O	Allowable r.m.s. current	V_{DD} = 300V, V_D = V_{DB}=18V, P.F = 0.8, Sinusoidal PWM $T_C \le 100°C$, $T_{ch} \le 125°C$ (Note10)	f_{PWM}= 5kHz	-	-	16.0	Arms
			f_{PWM}= 15kHz	-	-	12.0	Arms
PWIN(on)	Minimum input pulse width	(Note 11)		0.7	-	-	μs
PWIN(off)	Minimum input pulse width	200V≤V_{DD}≤350V, 17V≤V_D≤19V, 15V≤V_{DB}≤22V, -30°C≤Tc≤100°C, N-line wiring inductance less than 10nH (Note 12)	Between rated current and 1.7 times of rated current	1.5	-	-	μs
V_{NC}	V_{NC} variation	Between V_{NC}-NU, NV, NW (including surge)		-5.0	-	+5.0	V
T_{ch}	Channel temperature			-30	-	+125	°C

Note 10: In the case of turning on the MOSFET into which free-wheeling current is flowing. Allowable r.m.s. current depends on the actual application conditions.
11: DIPIPM might not make response if the input signal pulse width is less than PWIN(on).
12: IPM might make delayed response or no response for the input signal with off pulse width less than PWIN(off). Please refer below about delayed response.

Delayed Response against Shorter Input Off Signal than PWIN(off) (P-side only)

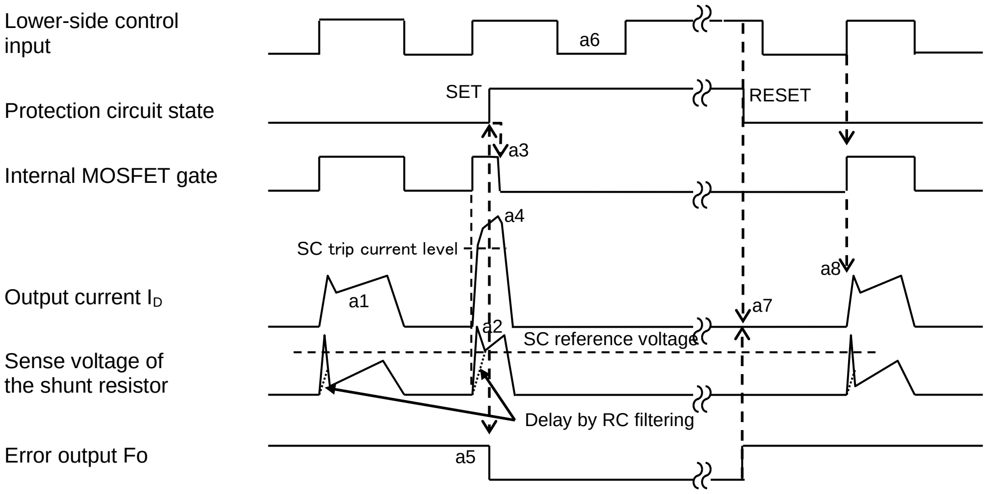


Real line: off pulse width > PWIN(off); turn on time t1
Broken line: off pulse width < PWIN(off); turn on time t2
(t1:Normal switching time)

Fig. 5 Timing Charts of the DIPIPM Protective Functions

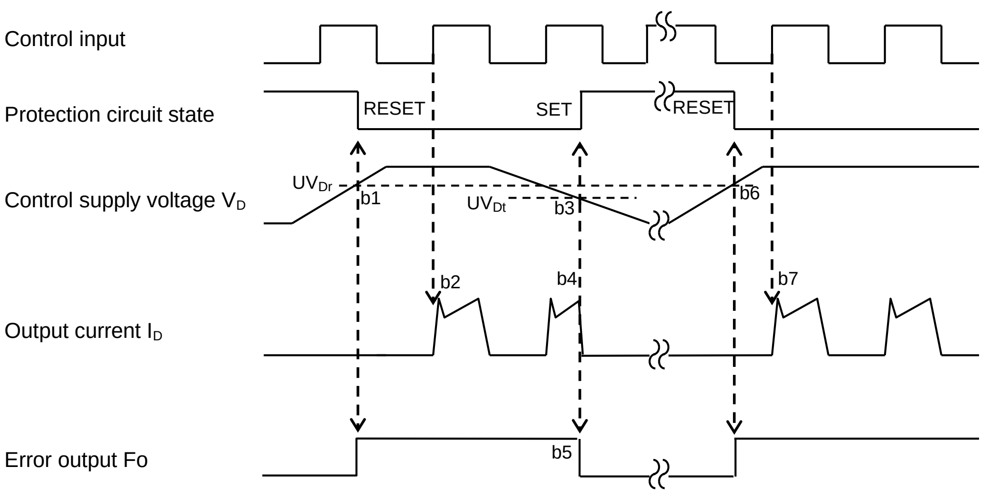
[A] Short-Circuit Protection (N-side only with the external shunt resistor and RC filter)

a1. Normal operation: MOSFET ON and outputs current.
a2. Short circuit current detection (SC trigger)
(It is recommended to set RC time constant 1.5~2.0μs so that MOSFET shut down within 2.0μs when SC.)
a3. All N-side MOSFET's gates are hard interrupted.
a4. All N-side MOSFETs turn OFF.
a5. F_O outputs for t_{Fo}=minimum 20μs.
a6. Input = “L”: MOSFET OFF
a7. Fo finishes output, but MOSFETs don't turn on until inputting next ON signal (L→H).
(MOSFET of each phase can return to normal state by inputting ON signal to each phase.)
a8. Normal operation: MOSFET ON and outputs current.



[B] Under-Voltage Protection (N-side, UV_D)

b1. Control supply voltage V_D exceeds under voltage reset level (UV_{Dr}), but MOSFET turns ON by next ON signal (L→H).
(MOSFET of each phase can return to normal state by inputting ON signal to each phase.)
b2. Normal operation: MOSFET ON and outputs current.
b3. V_D level drops to under voltage trip level. (UV_{Dt}).
b4. All N-side MOSFETs turn OFF in spite of control input condition.
b5. Fo outputs for t_{Fo}=minimum 20μs, but output is extended during V_D keeps below UV_{Dr}.
b6. V_D level reaches UV_{Dr}.
b7. Normal operation: MOSFET ON and outputs current.



[C] Under-Voltage Protection (P-side, UV_{DB})

c1. Control supply voltage V_{DB} rises. After the voltage reaches under voltage reset level UV_{DBr}, MOSFET turns on by next ON signal (L→H).
c2. Normal operation: MOSFET ON and outputs current.
c3. V_{DB} level drops to under voltage trip level (UV_{DBt}).
c4. MOSFET of the corresponding phase only turns OFF in spite of control input signal level, but there is no F_O signal output.
c5. V_{DB} level reaches UV_{DBr}.
c6. Normal operation: MOSFET ON and outputs current.

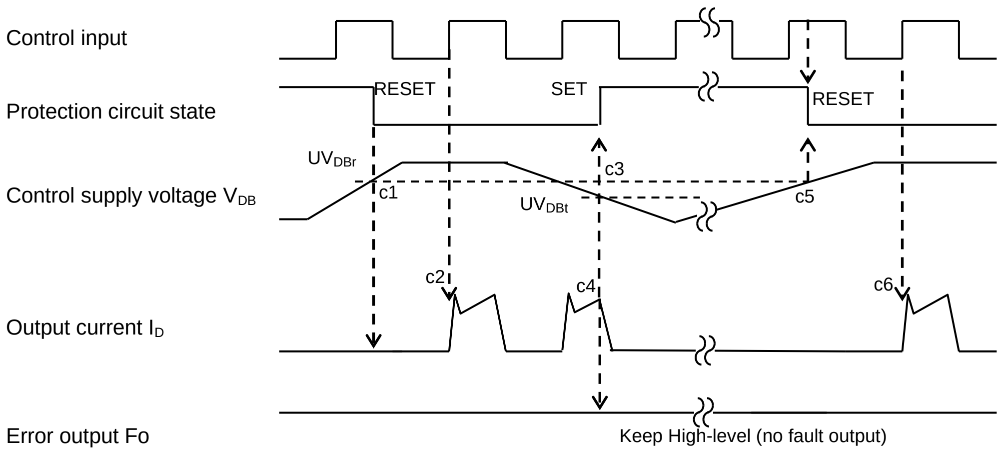
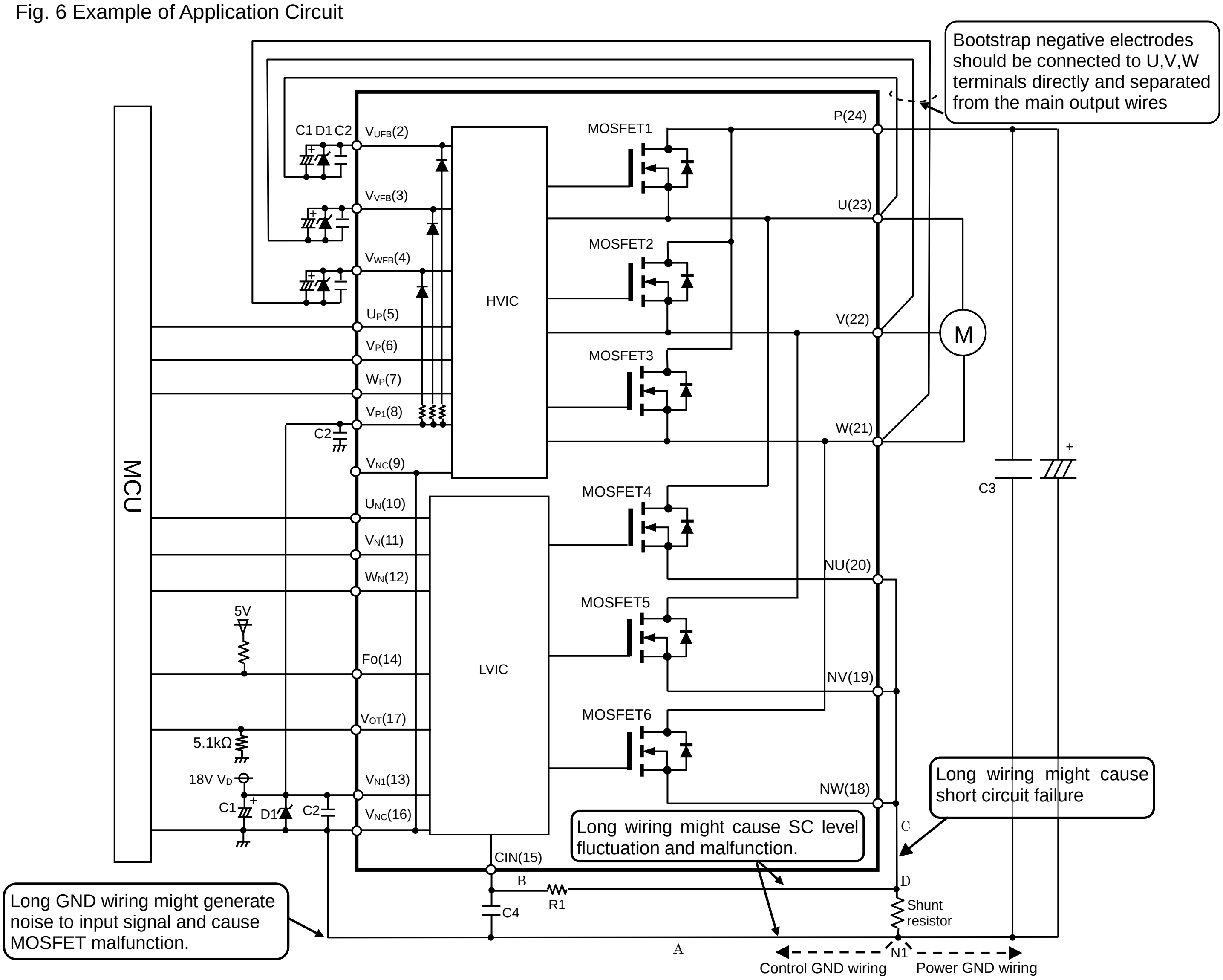
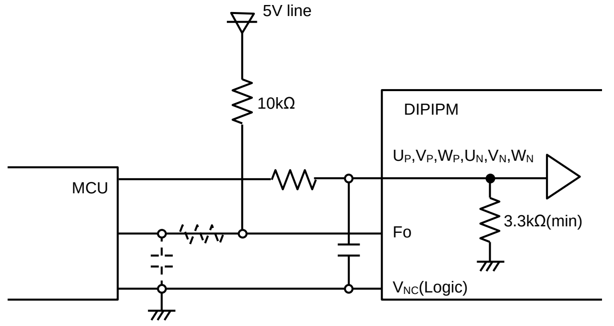


Fig. 6 Example of Application Circuit



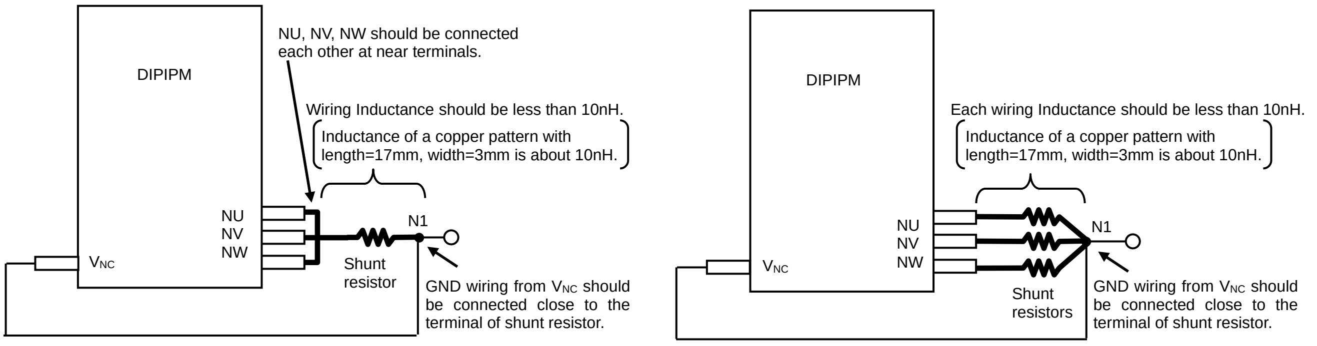
(1) If control GND is connected with power GND by common broad pattern, it may cause malfunction by power GND fluctuation. It is recommended to connect control GND and power GND at only a point N1 (near the terminal of shunt resistor).
(2) It is recommended to insert a Zener diode D1 (24V/1W) between each pair of control supply terminals to prevent surge destruction.
(3) To prevent surge destruction, the wiring between the smoothing capacitor and the P, N1 terminals should be as short as possible. Generally a 0.1-0.22μF snubber capacitor C3 between the P-N1 terminals is recommended.
(4) R1, C4 of RC filter for preventing protection circuit malfunction is recommended to select tight tolerance, temp-compensated type. The time constant R1C4 should be set so that SC current is shut down within 2μs. (1.5μs~2μs is general value.) SC interrupting time might vary with the wiring pattern, so the enough evaluation on the real system is necessary.
(5) To prevent malfunction, the wiring of A, B, C should be as short as possible.
(6) The point D at which the wiring to CIN filter is divided should be near the terminal of shunt resistor. NU, NV, NW terminals should be connected at near NU, NV, NW terminals.
(7) All capacitors should be mounted as close to the terminals as possible. (C1: good temperature, frequency characteristic electrolytic type and C2:0.22μ-2μF, good temperature, frequency and DC bias characteristic ceramic type are recommended.)
(8) Input drive is High-active type. There is a minimum 3.3kΩ pull-down resistor in the input circuit of IC. To prevent malfunction, the wiring of each input should be as short as possible. When using RC coupling circuit, make sure the input signal level meet the turn-on and turn-off threshold voltage.
(9) Fo output is open drain type. It should be pulled up to MCU or control power supply (e.g. 5V,18V) by a resistor that makes I_{Fo} up to 1mA. (I_{FO} is estimated roughly by the formula of control power supply voltage divided by pull-up resistance. In the case of pulled up to 5V, 10kΩ (5kΩ or more) is recommended.)
(10) Thanks to built-in HVIC, direct coupling to MCU without any opto-coupler or transformer isolation is possible.
(11) Two V_{NC} terminals (9 & 16 pin) are connected inside DIPIPM, please connect either one to the 18V power supply GND outside and leave another one open.
(12) If high frequency noise superimposed to the control supply line, IC malfunction might happen and cause DIPIPM erroneous operation. To avoid such problem, line ripple voltage should meet dV/dt ≤+/-1V/μs, Vripple≤2Vp-p.
(13) For DIPIPM, it isn't recommended to drive same load by parallel connection with other phase MOSFET or other DIPIPM.

Fig. 7 MCU I/O Interface Circuit



Note)
Design for input RC filter depends on PWM control scheme used in the application and wiring impedance of the printed circuit board.
DIPIPM input signal interface integrates a minimum 3.3kΩ pull-down resistor. Therefore, when inserting RC filter, it is necessary to satisfy turn-on threshold voltage requirement.
Fo output is open drain type. It should be pulled up to control power supply (e.g. 5V, 18V) with a resistor that makes Fo sink current I_{Fo} 1mA or less. In the case of pulled up to 5V supply, 10kΩ（5kΩ or more）is recommended.

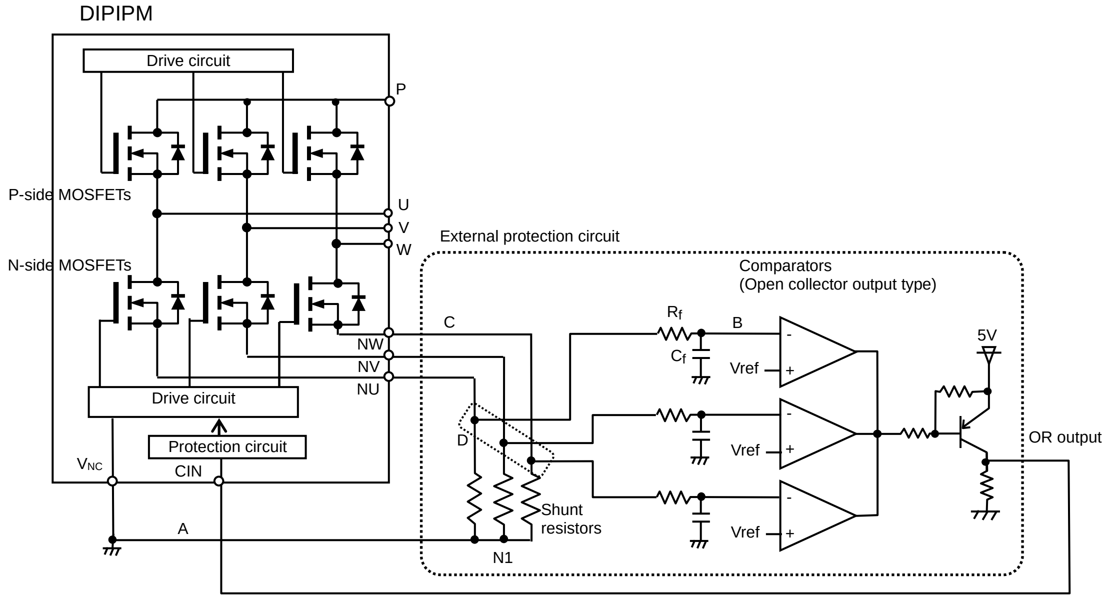
Fig. 8 Pattern Wiring Around the Shunt Resistor



Low inductance shunt resistor like surface mounted (SMD) type is recommended.

Fig. 9 Pattern Wiring Around the Shunt Resistor (for the case of open emitter)

When DIPIPM is operated with three shunt resistors, voltage of each shunt resistor cannot be input to CIN terminal directly. In that case, it is necessary to use the external protection circuit as below.



(1) It is necessary to set the time constant R_fC_f of external comparator input so that IGBT stops within 2μs when short circuit occurs.
SC interrupting time might vary with the wiring pattern, comparator speed and so on.
(2) It is recommended for the threshold voltage Vref to set to the same rating of short circuit trip level (Vsc(ref): typ. 0.48V).
(3) Select the external shunt resistance so that SC trip-level is less than specified value (=1.7 times of rating current).
(4) To avoid malfunction, the wiring A, B, C should be as short as possible.
(5) The point D at which the wiring to comparator is divided should be close to the terminal of shunt resistor.
(6) OR output high level when protection works should be over 0.505V (=maximum Vsc(ref) rating).

Fig. 10 (Reference Figure) PCB Through-hole Pattern
Recommended through-hole locations and diameter layout for PSF**S92F6-A6 [Dimension: mm]

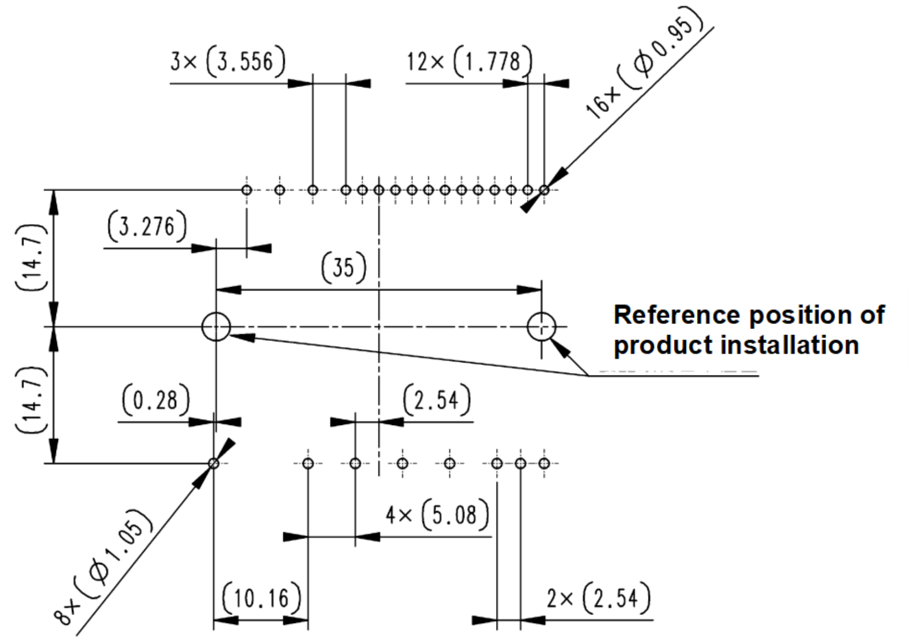
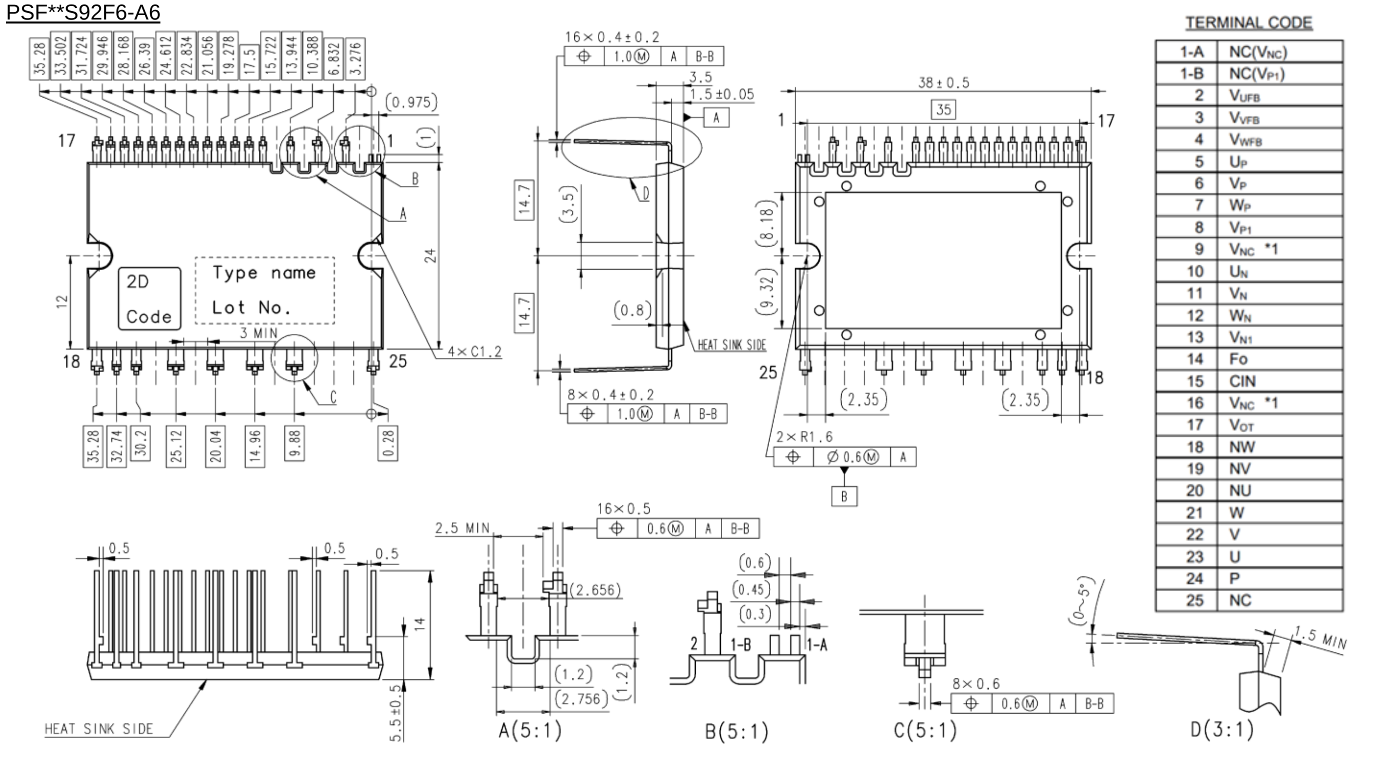


Fig. 11 Package Outlines [Dimension: mm]

PSF**S92F6-A6



TERMINAL CODE

1-A	NC(V_{NC})
1-B	NC(V_{P1})
2	V_{UFB}
3	V_{VFB}
4	V_{WFB}
5	U_P
6	V_P
7	W_P
8	V_{P1}
9	V_{NC} *1
10	U_N
11	V_N
12	W_N
13	V_{N1}
14	Fo
15	CIN
16	V_{NC} *1
17	V_{OT}
18	NW
19	NV
20	NU
21	W
22	V
23	U
24	P
25	NC

1) 9 & 16 pins (V_{NC}) are connected inside DIPIPM, please connect either one to the control power supply GND outside and leave another one open.

Important Notice

The information contained in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. This product has to be used within its specified maximum ratings, and is subject to customer’s compliance with any applicable legal requirement, norms and standards.
Except as otherwise explicitly approved by Mitsubishi Electric Corporation in a written document signed by authorized representatives of Mitsubishi Electric Corporation, our products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

In usage of power semiconductor, there is always the possibility that trouble may occur with them by the reliability lifetime such as Power Cycle, Thermal Cycle or others, or when used under special circumstances (e.g. condensation, high humidity, dusty, salty, highlands, environment with lots of organic matter / corrosive gas / explosive gas, or situations which terminals of semiconductor products receive strong mechanical stress). Therefore, please pay sufficient attention to such circumstances. Further, depending on the technical requirements, our semiconductor products may contain environmental regulation substances, etc. If there is necessity of detailed confirmation, please contact our nearest sales branch or distributor.

The contents or data contained in this datasheet are exclusively intended for technically trained staff. Customer's technical departments should take responsibility to evaluate the suitability of Mitsubishi Electric Corporation product for the intended application and the completeness of the product data with respect to such application. In the customer's research and development, please evaluate it not only with a single semiconductor product but also in the entire system, and judge whether it's applicable. As required, pay close attention to the safety design by installing appropriate fuse or circuit breaker between a power supply and semiconductor products to prevent secondary damage. Please also pay attention to the application note and the related technical information.

Keep safety first in your circuit designs!

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

- These materials are intended as a reference to assist our customers in the selection of the Mitsubishi Electric Semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.
- Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
- All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Electric Semiconductor product distributor for the latest product information before purchasing a product listed herein.
  The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
  Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Electric Semiconductor home page (http://www.MitsubishiElectric.com/semiconductors/).
- When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
- Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Electric Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
- The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.
- If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
  Any diversion or re-export contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
- Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Electric Semiconductor product distributor for further details on these materials or the products contained therein.