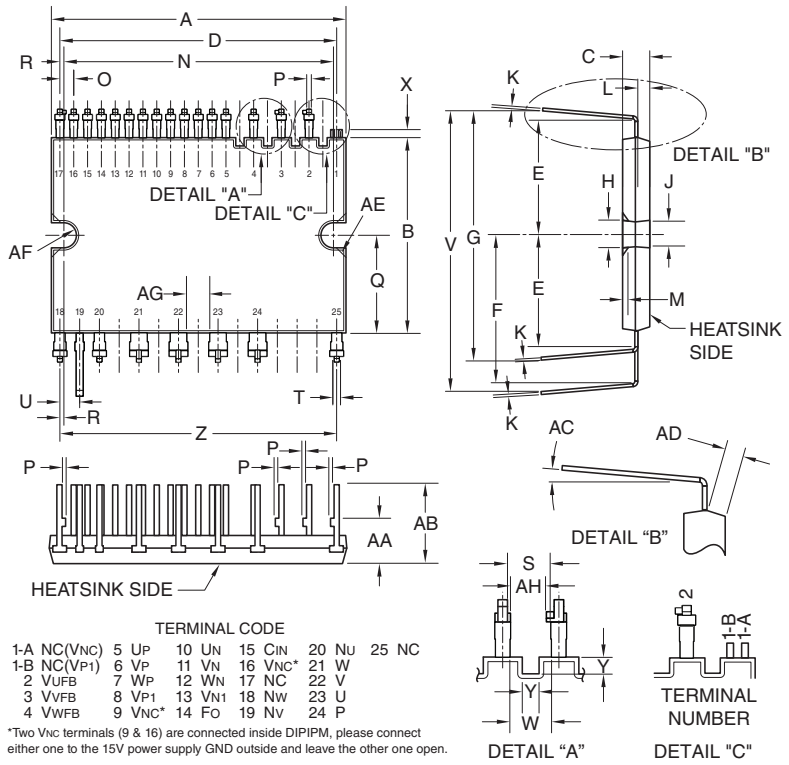
Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697-1800 (724) 925-7272
www.pwrx.com

Intellimod™ Module

Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

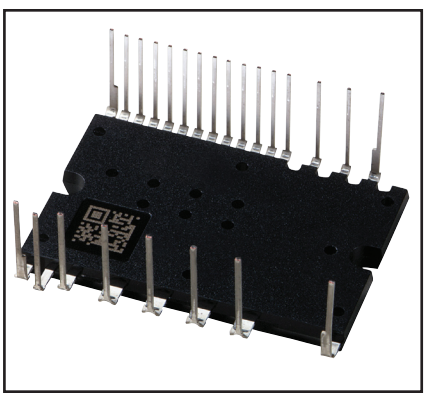
PS219B2-ST



TERMINAL CODE

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

*Two V_{NC} terminals (9 & 16) are connected inside DIPIPM, please connect either one to the 15V power supply GND outside and leave the other one open.



Description:
DIP-IPMs are intelligent power modules that integrate power devices, drivers, and protection circuitry in an ultra compact dual-in-line transfer-mold package for use in driving small three phase motors. Use of 6th generation CSTBT IGBTs, DIP packaging, and application specific HVICs allow the designer to reduce inverter size and overall design time.

Features:
- ☐ Compact Packages
- ☐ Single Power Supply
- ☐ Integrated HVICs
- ☐ Direct Connection to CPU
- ☐ Over-temperature Protection

Applications:
- ☐ Small Servo Motors
- ☐ Small Motor Control

Ordering Information:
PS219B2-ST is a 600V, 5 Ampere short pin DIP Intelligent Power Module.

PS219B2-AST – long pin type
PS219B2-CST – zigzag pin type

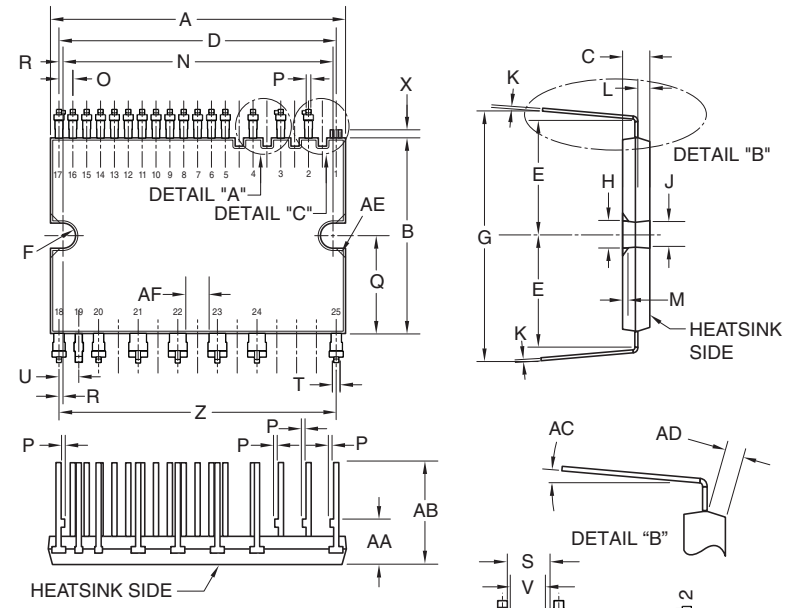
Outline Drawing and Circuit Diagram

Dim.	Inches	Millimeters
A	1.50±0.02	38.0±0.5
B	0.94±0.02	24.0±0.5
C	0.14	3.5
D	1.40	35.56
E	0.57±0.02	14.4±0.5
F	0.74±0.02	18.9±0.5
G	1.15±0.02	29.2±0.5
H	0.14	3.5
J	0.13	3.3
K	0.016	0.4
L	0.06±0.02	1.5±0.05
M	0.031	0.8
N	1.38±0.019	35.0±0.3
O	0.07±0.008	1.778±0.2
P	0.02	0.5
Q	0.47	12.0
R	0.011	0.28

Dim.	Inches	Millimeters
S	0.1046	2.656
T	0.024	0.6
U	0.1±0.008	2.54±0.2
V	1.33±0.02	33.7±0.5
W	0.1085	2.756
X	0.04	1.0
Y	0.05	1.2
Z	1.40	35.56
AA	0.22±0.02	5.5±0.5
AB	0.37±0.02	9.5±0.5
AC	0 ~ 5°	0 ~ 5°
AD	0.06 Min.	1.5 Min.
AE	0.05	1.2
AF	0.063 Rad.	1.6 Rad.
AG	0.118 Min.	3.0 Min.
AH	0.098 Min.	2.5 Min.

PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

PS219B2-AST



TERMINAL CODE

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

*Two V_{NC} terminals (9 & 16) are connected inside DIPIPM, please connect either one to the 15V power supply GND outside and leave the other one open.

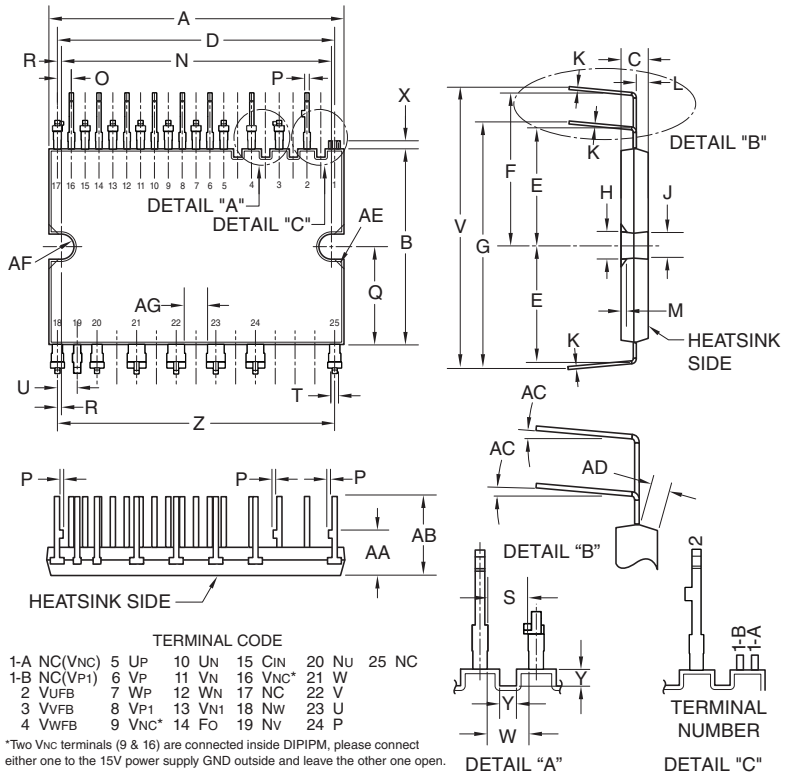
Outline Drawing and Circuit Diagram

Dim.	Inches	Millimeters
A	1.50±0.02	38.0±0.5
B	0.94±0.02	24.0±0.5
C	0.14	3.5
D	1.40	35.56
E	0.57±0.02	14.4±0.5
F	0.063 Rad.	1.6 Rad.
G	1.16±0.02	29.4±0.5
H	0.14	3.5
J	0.13	3.3
K	0.016	0.4
L	0.06±0.02	1.5±0.05
M	0.031	0.8
N	1.38±0.019	35.0±0.3
O	0.07±0.008	1.778±0.2
P	0.02	0.5
Q	0.47	12.0

Dim.	Inches	Millimeters
R	0.011	0.28
S	0.1046	2.656
T	0.024	0.6
U	0.1±0.008	2.54±0.2
V	0.098 Min.	2.5 Min.
W	0.1085	2.756
X	0.04	1.0
Y	0.05	1.2
Z	1.40	35.56
AA	0.22±0.02	5.5±0.5
AB	0.55±0.02	14.0±0.5
AC	0 ~ 5°	0 ~ 5°
AD	0.06 Min.	1.5 Min.
AE	0.05	1.2
AF	0.118 Min.	3.0 Min.

PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

PS219B2-CST



TERMINAL CODE

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

*Two V_{NC} terminals (9 & 16) are connected inside DIPIPM, please connect either one to the 15V power supply GND outside and leave the other one open.

Outline Drawing and Circuit Diagram

Dim.	Inches	Millimeters
A	1.50±0.02	38.0±0.5
B	0.94±0.02	24.0±0.5
C	0.14	3.5
D	1.40	35.56
E	0.57±0.02	14.4±0.5
F	0.74±0.02	18.9±0.5
G	1.15±0.02	29.2±0.5
H	0.14	3.5
J	0.13	3.3
K	0.016	0.4
L	0.06±0.02	1.5±0.05
M	0.031	0.8
N	1.38±0.019	35.0±0.3
O	0.07±0.008	1.778±0.2
P	0.02	0.5
Q	0.47	12.0

Dim.	Inches	Millimeters
R	0.011	0.28
S	0.1046	2.656
T	0.024	0.6
U	0.1±0.008	2.54±0.2
V	1.33±0.02	33.7±0.5
W	0.1085	2.756
X	0.04	1.0
Y	0.05	1.2
Z	1.40	35.56
AA	0.22±0.02	5.5±0.5
AB	0.37±0.02	9.5±0.5
AC	0 ~ 5°	0 ~ 5°
AD	0.06 Min.	1.5 Min.
AE	0.05	1.2
AF	0.063 Rad.	1.6 Rad.
AG	0.118 Min.	3.0 Min.

PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

Absolute Maximum Ratings, T_j = 25°C unless otherwise specified

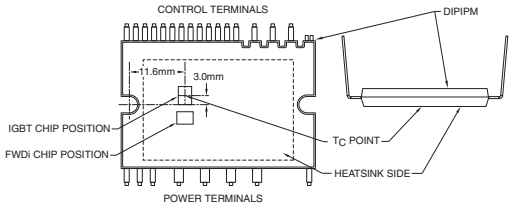
Characteristics	Symbol	PS219B2-ST, PS219B2-AST, PS219B2-CST	Units
Inverter Part			
Supply Voltage (Applied between P-NU, NV, NW)	V_{CC}	450	Volts
Supply Voltage, Surge (Applied between P-NU, NV, NW)	$V_{CC(surge)}$	500	Volts
Collector-Emitter Voltage	V_{CES}	600	Volts
Each IGBT Collector Current (T_C = 25°C)	$\pm I_C$	5	Amperes
Each Peak Collector Current (T_C = 25°C, Less than 1ms)	$\pm I_{CP}$	10	Amperes
Collector Dissipation (T_C = 25°C, per 1 Chip)	P_C	21.3	Watts
Power Device Junction Temperature*1	T_j	-20 ~ +150	°C
Control (Protection) Part			
Control Supply Voltage (Applied between V_{P1}-V_{NC}, V_{N1}-V_{NC})	V_D	20	Volts
Control Supply Voltage (Applied between V_{UFB}-U, V_{VFB}-V, V_{WFB}-W)	V_{DB}	20	Volts
Input Voltage (Applied between U_P, V_P, W_P-V_{NC}, U_N, V_N, W_N-V_{NC})	V_{IN}	-0.5 ~ V_D+0.5	Volts
Fault Output Supply Voltage (Applied between F_O-V_{NC})	V_{FO}	-0.5 ~ V_D+0.5	Volts
Fault Output Current (Sink Current at F_O Terminal)	I_{FO}	1	mA
Current Sensing Input Voltage (Applied between C_{IN}-V_{NC})	V_{SC}	-0.5 ~ V_D+0.5	Volts
Total System			
Self-protection Supply Voltage Limit, Short Circuit Protection Capability (V_D = 13.5 ~ 16.5V, Inverter Part, T_j = 125°C, Non-repetitive less than 2µs)	$V_{CC(prot.)}$	400	Volts
Module Case Operating Temperature*2	T_C	-20 ~ +100	°C
Storage Temperature	T_{stg}	-40 ~ +125	°C
Isolation Voltage, 60Hz, Sinusoidal 1 Minute, All Connected Pins to Heatsink Plate	V_{ISO}	1500	V_{rms}

Thermal Resistance

Junction to Case*3	$R_{th(j-c)Q}$	Inverter IGBT Part (Per 1/6 Module)	—	—	4.7	°C/Watt
	$R_{th(j-c)D}$	Inverter FWDi Part (Per 1/6 Module)	—	—	5.4	°C/Watt

*1 The maximum junction temperature rating of the power chips integrated within the DIPIPM is 150°C (@T_C ≤ 100°C). However, to ensure safe operation of the DIPIPM, the average junction temperature should be limited to $T_{j(avg)}$ ≤ 25°C (@T_C ≤ 100°C).

*2 TC measurement point



*3 Good thermal grease with long-term quality should be applied evenly with +100µm ~ +200µm on the contacting surface of the DIPIPM and heatsink. The contacting thermal resistance between DIPIPM case and heatsink ($R_{th(c-f)}$) is determined by the thickness and the thermal conductivity of the applied grease. For reference, $R_{th(c-f)}$ (per 1/6 module) is about 0.3°C/W when the grease thickness is 20µm and the thermal conductivity is 1.0W/mK.

Electrical and Mechanical Characteristics, T_j = 25°C unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Inverter Part						
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_D = V_{DB}$ = 15V, I_C = 5A, V_{IN} = 5V, T_j = 25°C	—	1.50	2.00	Volts
		$V_D = V_{DB}$ = 15V, I_C = 5A, V_{IN} = 5V, T_j = 125°C	—	1.60	2.10	Volts
Diode Forward Voltage	V_{EC}	$-I_C$ = 5A, V_{IN} = 0V	—	1.70	2.20	Volts
Switching Times	t_{on}	V_{CC} = 300V, $V_D = V_{DB}$ = 15V, I_C = 5A, T_j = 125°C, V_{IN} = 0 ⇔ 5V, Inductive Load	0.75	1.35	1.95	µs
	t_{rr}		—	0.30	—	µs
	$t_{C(on)}$		—	0.35	0.55	µs
	t_{off}		—	1.40	2.00	µs
	$t_{C(off)}$		—	0.30	0.60	µs
Collector-Emitter Cutoff Current	I_{CES}	$V_{CE} = V_{CES}$, T_j = 25°C	—	—	1.0	mA
		$V_{CE} = V_{CES}$, T_j = 125°C	—	—	10	mA
Control (Protection) Part						
Circuit Current	I_D	V_{IN} = 0V, V_D = 15V, Total of V_{P1}-V_{NC}, V_{N1}-V_{NC}	—	—	2.80	mA
		V_{IN} = 5V, V_D = 15V, Total of V_{P1}-V_{NC}, V_{N1}-V_{NC}	—	—	2.80	mA
	I_{DB}	V_{IN} = 0V, $V_D = V_{DB}$ = 15V, Each Part of V_{UFB}-U, V_{VFB}-V, V_{WFB}-W	—	—	0.10	mA
		V_{IN} = 5V, $V_D = V_{DB}$ = 15V, Each Part of V_{UFB}-U, V_{VFB}-V, V_{WFB}-W	—	—	0.10	mA
Fault Output Voltage	V_{FOH}	V_{SC} = 0V, F_O Terminal Pull-up to 5V by 10kΩ	4.9	—	—	Volts
	V_{FOL}	V_{SC} = 1V, I_{FO} = 1mA	—	—	0.95	Volts
Input Current	I_{IN}	V_{IN} = 5V	0.70	1.00	1.50	mA
Short Circuit Trip Level	$V_{SC(ref)}$	V_D = 15V*4	0.43	0.48	0.53	Volts
Over-Temperature Protection	OT_t	Trip Level	100	120	140	°C
(V_D = 15V, At Temperatue of LVIC)*6	OT_{rh}	Trip/Reset Hysteresis	—	10	—	°C
Control Supply	UV_{DBt}	Trip Level, T_j ≤ 125°C	7.0	10.0	12.0	Volts
Under-voltage Protection	UV_{DBr}	Reset Level, T_j ≤ 125°C	7.0	10.0	12.0	Volts
	UV_{Dt}	Trip Level, T_j ≤ 125°C	10.3	—	12.5	Volts
	UV_{Dr}	Reset Level, T_j ≤ 125°C	10.8	—	13.0	Volts
Fault Output Pulse Width*5	t_{FO}		20	—	—	µs
ON Threshold Voltage	$V_{th(on)}$	Applied between U_P, V_P, W_P-V_{NC}, U_N, V_N, W_N-V_{NC}	—	2.1	2.6	Volts
OFF Threshold Voltage	$V_{th(off)}$		0.8	1.3	—	Volts
ON/OFF Threshold Hysteresis Voltage	$V_{th(hys)}$		0.35	0.65	—	Volts
Bootstrap Diode Forward Voltage*7	V_F	I_F = 10mA, Including Voltage Drop by Limiting Resistor	1.1	1.7	2.3	Volts
Built-in Limiting Resistance	R	For Bootstrap Circuit	80	100	120	Ω

*4 Short Circuit protection is functioning only for N-side IGBTs. Please select the value of the external shunt resistor such that the S_C trip level is less than 1.7 times the current rating.

*5 Fault signal, F_O, outputs when S_C or U_V protection works. F_O pulse width is different for each protection mode. At S_C failure, F_O pulse width is a fixed width (=min. 20µs), however, at U_V failure, F_O outputs continuously until recovering from U_V state. Minimum F_O pulse width is 20µs.

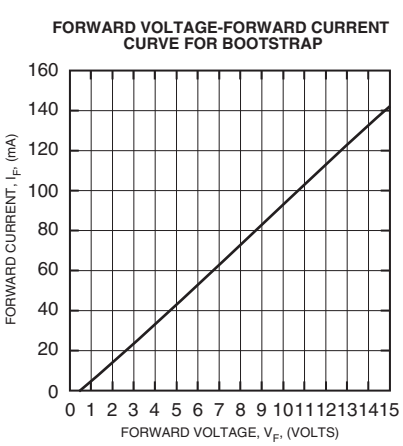
*6 When the LVIC temperature exceeds OT trip temperature level (OT_t), OT protection works and F_O outputs. In that case if the heatsink dropped off or is loosely fitted, do not use the DIPIPM. There is a possiblity that the junction temperature of the power chips has exceeded maximum T_j (150°C).

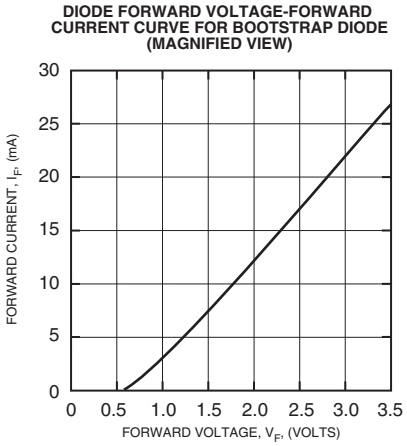
PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

Mechanical Characteristics and Ratings

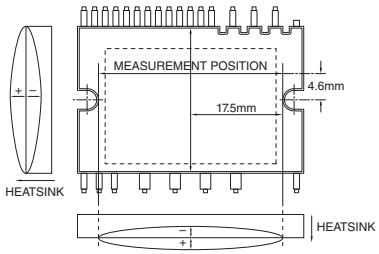
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Mounting Torque		M3 Mounting Screws*8	5.2	6.1	6.9	in-lb
Terminal Pulling Strength		Control Terminal: Weight 4.9N	10	—	—	s
		Power Terminal: Weight 9.8N				
Terminal Bending Strength		Control Terminal: Weight 2.45N	2	—	—	times
		Power Terminal: Weight 4.9N				
		90 Degree Bend				
Module Weight (Typical)			—	8.5	—	Grams
Heatsink Flatness*9			-50	—	+100	µm

*7 Bootstrap Diode (@T_a = 25°C) Characteristics





*8 Plain washers (ISO 7089-7094) are recommended.
*9 Flatness measurement position.



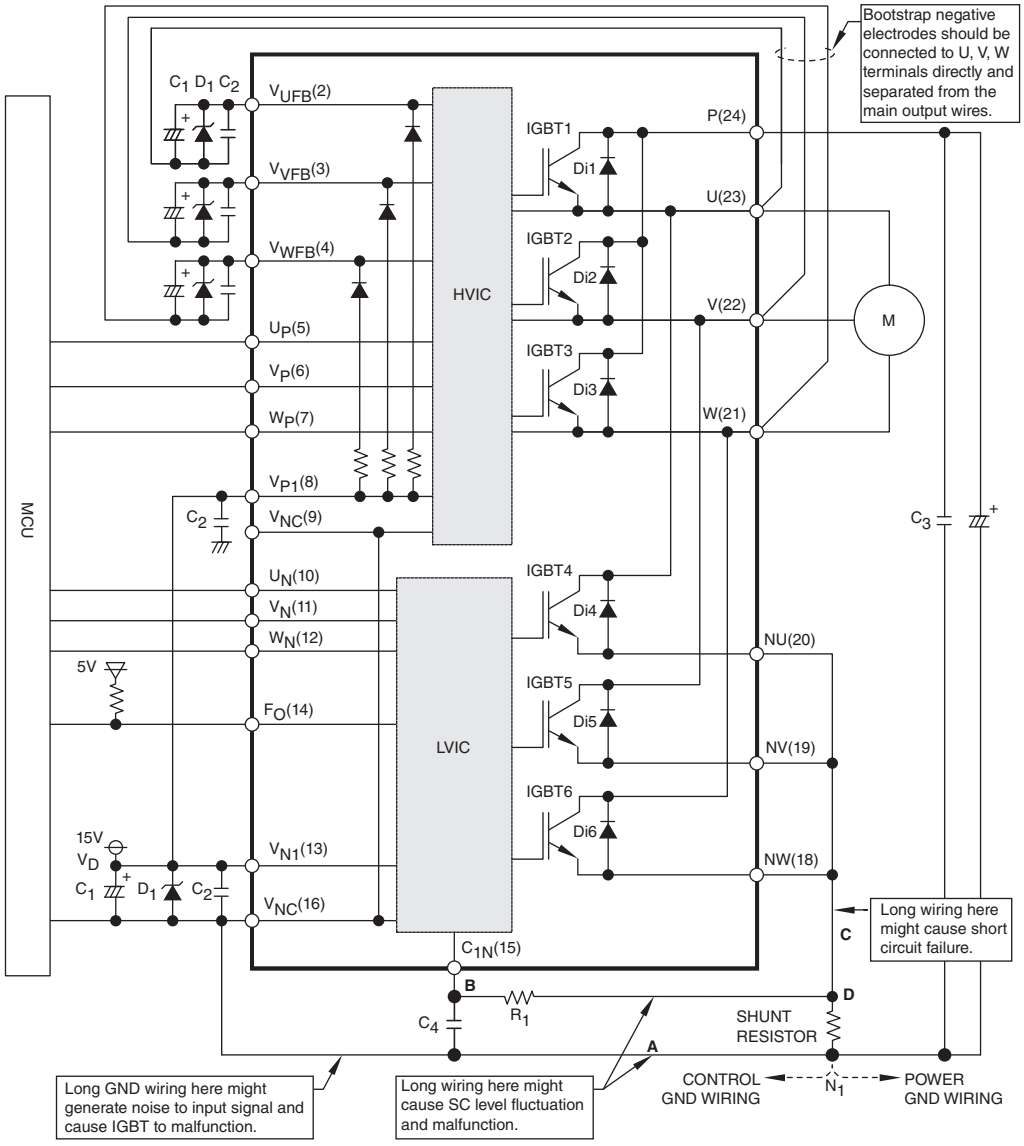
Recommended Conditions for Use

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC}	Applied between P-N Terminals	0	300	400	Volts
Control Supply Voltage	V_D	Applied between V_{P1}-V_{NC}, V_{N1}-V_{NC}	13.5	15.0	16.5	Volts
	V_{DB}	Applied between V_{UFB}-U, V_{VFB}-V, V_{WFB}-W	13.0	15.0	18.5	Volts
Control Supply Variation	ΔV_D, ΔV_{DB}		-1	—	1	V/µs
Arm Shoot-through Blocking Time	t_{DEAD}	For Each Input Signal, $T_C \leq 100°C$	1.0	—	—	µs
Allowable Minimum Input Pulse Width*11	$P_{WIN(on)}$		0.7	—	—	µs
	$P_{WIN(off)}$		0.7	—	—	µs
V_{NC} Voltage Variation	V_{NC}	Between V_{NC}-NU, NV, NW (Including Surge)	-5.0	—	5.0	Volts
Junction Temperature	T_j		-20	—	125	°C

*11 DIPIPM may not respond if the input signal pulse is less than $P_{WIN(on)}$, $P_{WIN(off)}$.

PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

Application Circuit

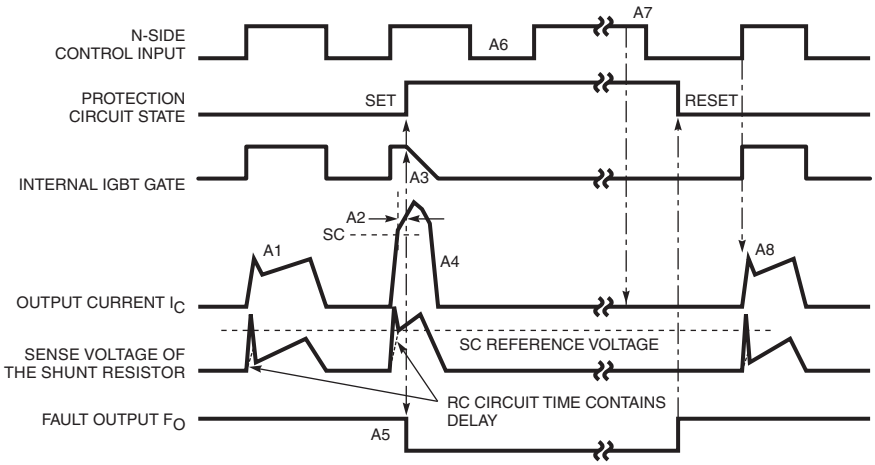


Notes:
1) It is recommended to connect Control GND wiring and Power GND wiring only at point N_1 (near terminal of shunt resistor) to prevent a malfunction by Power GND fluctuations.
2) It is recommended to insert a Zener diode D1 (24V/1W) between each pair of control supply terminals to prevent surge destruction.
3) To prevent surge destruction, the wiring between the DC bus smoothing capacitor and the P, N_1 terminals should be as short as possible. Generally a 0.1-0.22μF snubber capacitor C3 between the P-N_1 terminals is recommended.
4) Time constant of R_1, C_4 for SC protection circuit should be selected so that protection works within 2μs. (Recommended value: ≤2μs) SC interrupting time might vary with the wiring pattern. Tight tolerance, temp-compensated type, is recommended for R_1, C_4.
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 C_{IN} 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 types recommended.)
8) Input drive is active-high type. There is a 3.3kΩ (Min.) 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 meets the turn-on and turn-off threshold voltage.
9) F_O output is open drain type. It should be pulled up to MCU or control power supple (e.g. 5V) by resistor makes I_{FO} up to 1mA.
10) Direct coupling to the MCU without any opto-coupler or transformer isolation is possible because the HVIC is inside the module.
11) Two V_{NC} terminals (9 & 16 pin) are connected inside the DIPIPM. Be sure to connect either one to the 15V power supply GND outside and leave the other one open.
12) IC malfunction can occur and cause the DIPIPM to operate erroneously when high frequency noise is superimposed on the control supply line. To avoid such problem, the line ripple voltage should meet dV/dt ≤ ±1V/μs and V_{ripple} ≤ 2Vp-p.

PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

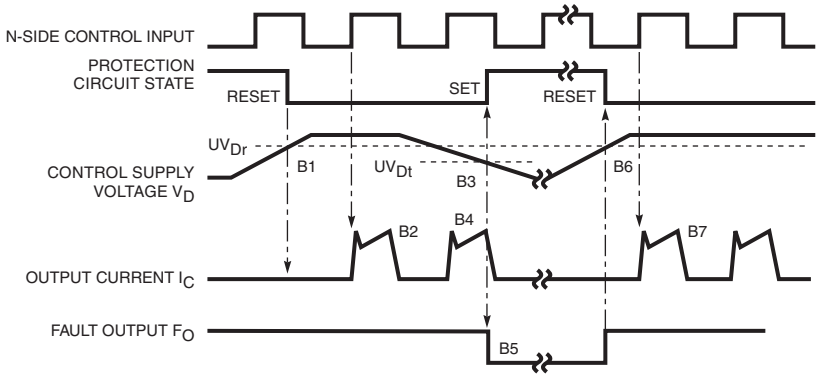
Protection Function Timing Diagrams

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



A1: Normal operation – IGBT turn on and conducting current.
A2: Short-circuit current detected (SC trigger).
A3: All N-side IGBT gate hard interrupted.
A4: All N-side IGBTs turn off.
A5: F_O output with a fixed pulse width of $t_{FO(min)}$ = 20µs.
A6: Input "L" – IGBT off.
A7: Input "H" – IGBT off in spite of "H" input.
A8: Normal operation – IGBT on and conducting current.

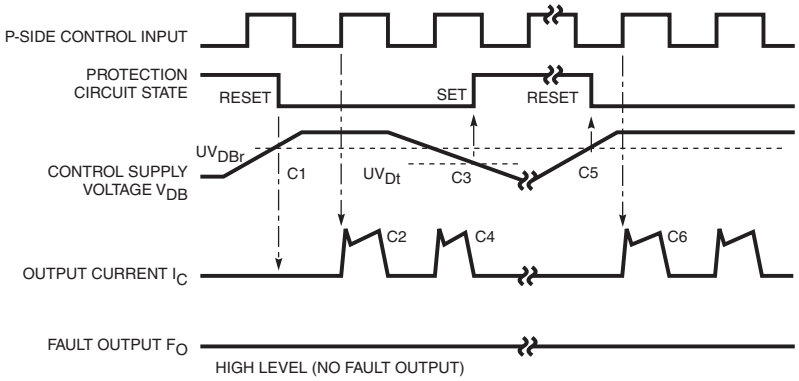
Under-Voltage Protection (N-side, UV_D)



B1: Control supply voltage rise – After the voltage level reaches UV_{Dr}, the drive circuit begins to work at the rising edge of the next input signal.
B2 : Normal operation – IGBT turn on and conducting current.
B3: Under-voltage trip (UV_{Dt}).
B4: All N-side IGBTs turn off regardless of the control input level.
B5: F_O output during under-voltage period, however, the minimum pulse width is 20µs.
B6: Under-voltage reset (UV_{Dr}).
B7: Normal operation – IGBT turn on and conducting current.

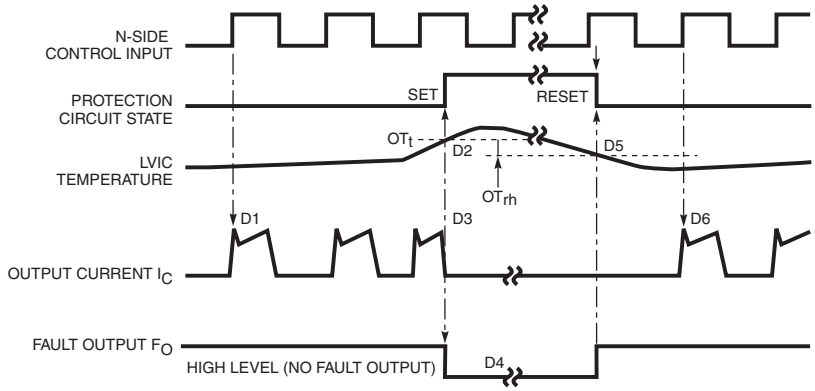
Protection Function Timing Diagrams

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



C1: Control supply voltage rises – After the voltage level reaches UV_{DBr}, the drive circuit begins to work at the rising edge of the next input signal.
C2: Normal operation – IGBT turn on and conducting current.
C3: Under-voltage trip (UV_{DBt}).
C4: IGBT stays off regardless of the control input level, but there is no F_O signal output.
C5: Under-voltage reset (UV_{Dr}).
C6: Normal operation – IGBT turn on and conducting current.

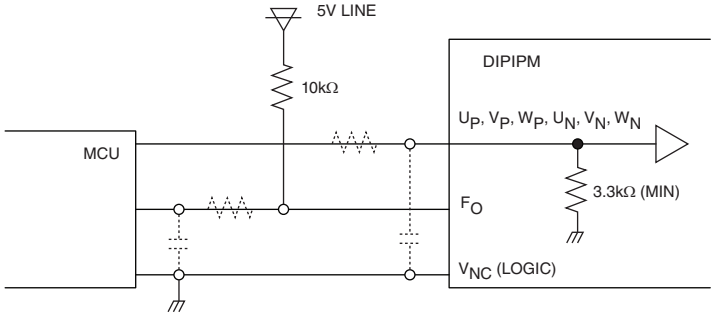
Over-Temperature Protection (N-side, OT)



D1: Normal operation – IGBT turn on and conducting current.
D2: LVIC temperature exceeds over-temperature tril level (OT_t).
D3: All N-side IGBTs turn OFF iin spite of control input condition.
D4: F_O outputs during over-temperature period, however, the minimum pulse width is 20µs.
D5: LVIC temperature is lower than over-temperature reset level.
D6: Circuits start to operate normally when next input is applied.

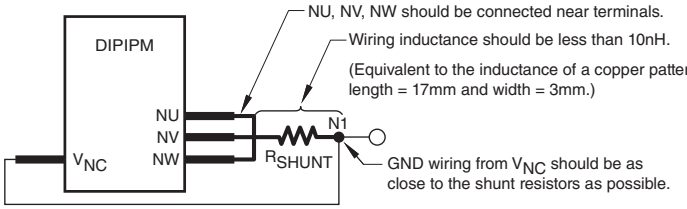
PS219B2-ST, PS219B2-AST, PS219B2-CST
Intellimod™ Module
Dual-In-Line Intelligent Power Module
5 Amperes/600 Volts

Typical Interface Circuit

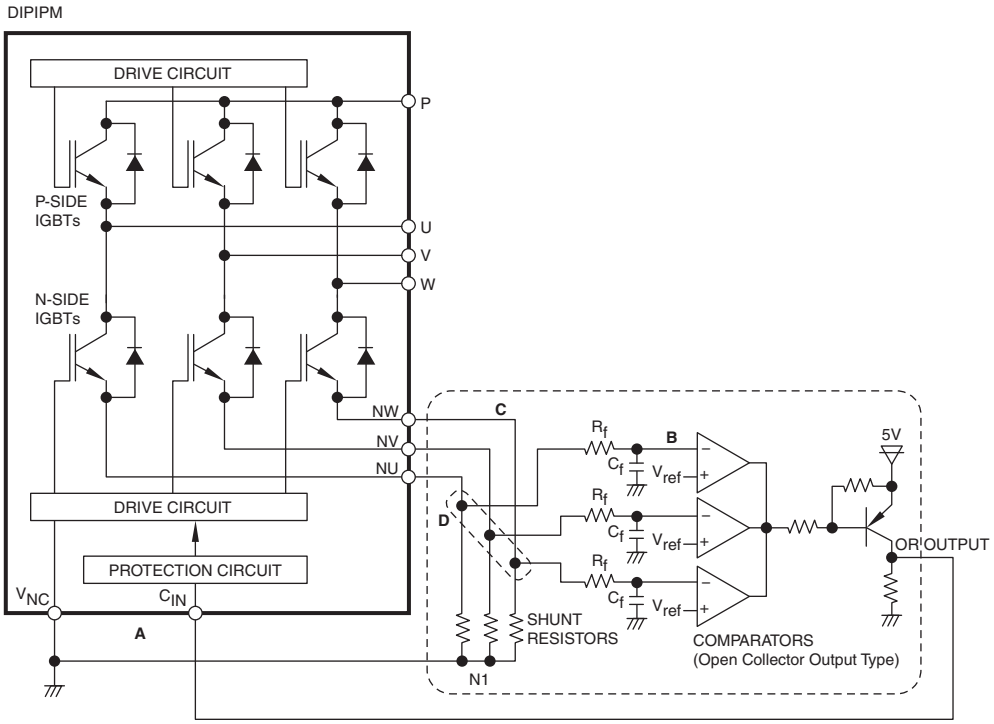


NOTE: RC coupling at each input (parts shown dotted) may change depending on the PWM control scheme used in the application and the wiring impedance of the printed circuit board. The DIPIPM input signal section integrates a 3.3kΩ (min) pull-down resistor. Therefore, when using an external filtering resistor, care must be taken to satisfy the turn-on threshold voltage requirement.

Pattern Wiring Around Shunt Resistor



External S_C Protection Circuit Using Three Shunt Resistors



Notes:
1) It is necessary to set the time constraint R_f, C_f of external comparator input so that the IGBT stops within 2µs when short circuit occurs. SC interrupting time can vary with the wiring pattern, comparator speed and so on.
2) The threshold voltage V_{ref} should be set up as the same rating as the short circuit trip level ($V_{SC(ref)}$, typically 0.48V).
3) Select the external shunt resistance so that the SC trip-level is less than specified value (≤1.7 times current rating).
4) Wiring A, B, and C should be as short as possible to avoid a malfunction.
5) Where the wiring to the comparator is divided, point D, should be near the shunt resistor terminal.
6) OR output high level should be over 0.53V (= maximum $V_{SC(ref)}$).