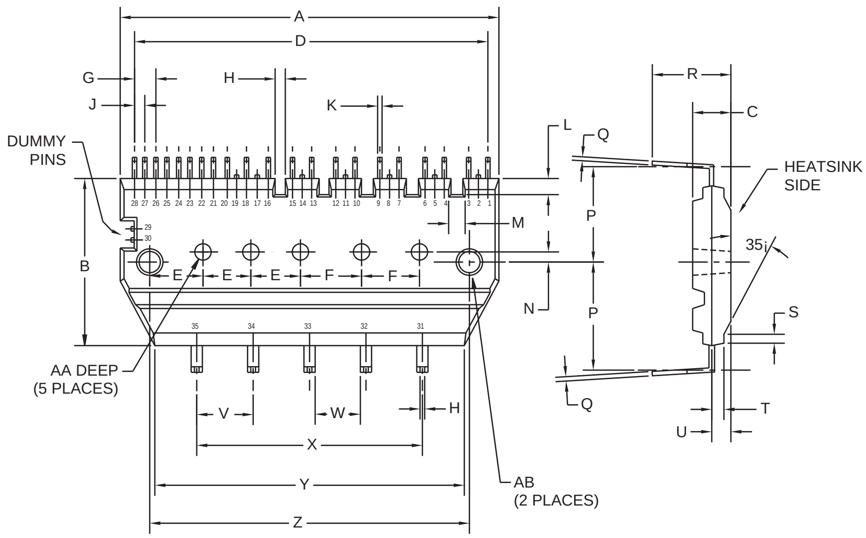
Powerex, Inc., 200 E. Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

PS21562

Intellimod™ Module

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



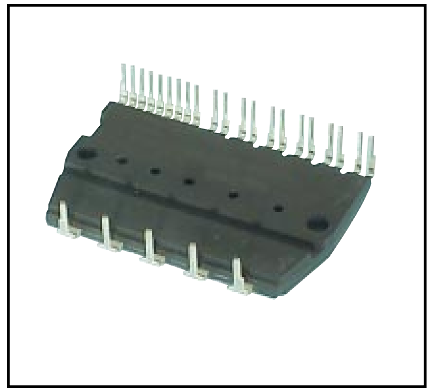
TERMINAL CODE

1 V_{UFS}	8 NC	15 V_{WFB}	22 V_N	29 NC
2 NC	9 V_{VFB}	16 V_{P1}	23 W_N	30 NC
3 V_{UFB}	10 V_{P1}	17 NC	24 F_O	31 P
4 V_{P1}	11 NC	18 W_P	25 C_{FO}	32 U
5 NC	12 V_P	19 NC	26 C_{IN}	33 V
6 U_P	13 V_{WFS}	20 V_{NO}	27 V_{NC}	34 W
7 V_{VFS}	14 NC	21 U_N	28 V_{N1}	35 N

Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	1.93	49.0
B	1.20	30.5
C	0.20	5.0
D	1.82	46.23
E	0.25	6.25
F	0.32	8.0
G	0.14	3.556
H	0.04	1.0
J	0.07	1.778
K	0.02	0.5
L	0.06	1.5
M	0.07 Min.	1.8 Min.
N	0.30	0.75

Dimensions	Inches	Millimeters
P	0.69	17.4
Q	0.02	0.5
R	0.41	10.5
S	0.05	1.2
T	0.05	1.25
U	0.10	2.5
V	0.30	7.62
W	0.16 Min.	4.0 Min.
X	1.20	30.48
Y	1.61	41.0
Z	1.65	42.0
AA	0.08 Dia.	2.0 Dia.
AB	0.13 Dia.	3.3 Dia.



Description:
DIP and Mini 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 5th generation 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

Applications:
- ☐ Washing Machines
- ☐ Refrigerators
- ☐ Air Conditioners
- ☐ Small Servo Motors
- ☐ Small Motor Control

Ordering Information:
PS21562 is a 600V, 5 Ampere Mini DIP Intelligent Power Module.

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

Characteristics	Symbol	PS21562	Units
Power Device Junction Temperature*	T_j	-20 to 125	°C
Module Case Operation Temperature (See T_f Measurement Point Illustration)	T_f	-20 to 100	°C
Storage Temperature	T_{stg}	-40 to 125	°C
Mounting Torque, M3 Mounting Screws	—	8.5	in-lb
Module Weight (Typical)	—	20	Grams
Self-protection Supply Voltage Limit (Short Circuit Protection Capability)**	$V_{CC(prot.)}$	400	Volts
Isolation Voltage, AC 1 minute, 60Hz Sinusoidal, Connection Pins to Heatsink Plate	V_{ISO}	2500	Volts

*The maximum junction temperature rating of the power chips integrated within the DIP-IPM is 150°C (@$T_f \le$ 100°C). However, to ensure safe operation of the DIP-IPM, the average junction temperature should be limited to $T_{j(avg)} \le$ 125°C (@$T_f \le$ 100°C).
**V_D = 13.5 ~ 16.5V, Inverter Part, T_j = 125°C, Non-repetitive, Less than 2μs

IGBT Inverter Sector

Collector-Emitter Voltage	V_{CES}	600	Volts
Collector Current (T_f = 25°C)	$\pm I_C$	5	Amperes
Peak Collector Current (T_f = 25°C, <1ms)	$\pm I_{CP}$	10	Amperes
Supply Voltage (Applied between P - N)	V_{CC}	450	Volts
Supply Voltage, Surge (Applied between P - N)	$V_{CC(surge)}$	500	Volts
Collector Dissipation (T_f = 25°C, per 1 Chip)	P_C	16.7	Watts

Control Sector

Supply Voltage (Applied between V_{P1}-V_{NC}, V_{N1}-V_{NC})	V_D	20	Volts
Supply Voltage (Applied between V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS})	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

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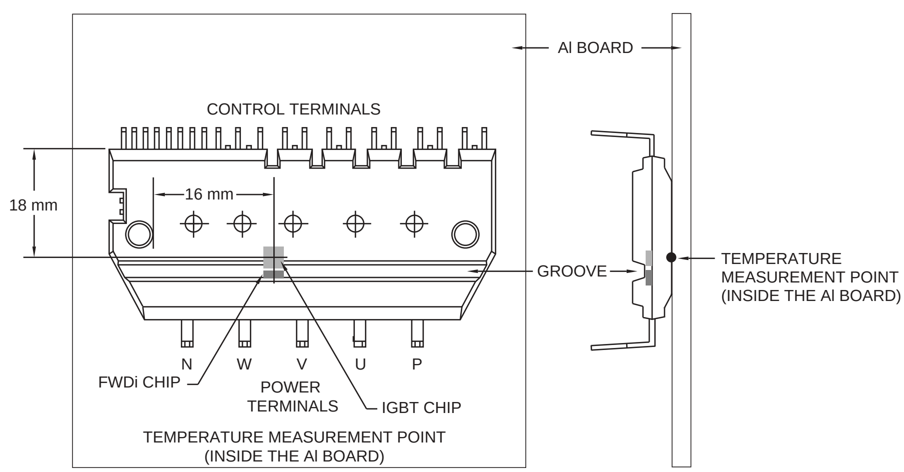
Electrical and Mechanical Characteristics, $T_j = 25°C$ unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
IGBT Inverter Sector						
Collector-Emitter Cutoff Current	I_{CES}	$V_{CE} = V_{CES}$, $T_j = 25°C$	—	—	1.00	mA
		$V_{CE} = V_{CES}$, $T_j = 125°C$	—	—	10	mA
Diode Forward Voltage	V_{EC}	$T_j = 25°C$, $-I_C = 5A$, $V_{IN} = 0V$	—	1.50	2.00	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 5A$, $T_j = 25°C$, $V_D = V_{DB} = 15V$, $V_{IN} = 5V$	—	1.60	2.15	Volts
		$I_C = 5A$, $T_j = 125°C$, $V_D = V_{DB} = 15V$, $V_{IN} = 5V$	—	1.70	2.30	Volts
Inductive Load Switching Times	t_{on}	$V_{CC} = 300V$, $V_D = V_{DB} = 15V$, $I_C = 5A$, $T_j = 125°C$, $V_{IN} = 5 \Leftrightarrow 0V$, Inductive Load (Upper-Lower Arm)	0.50	1.10	1.70	µs
	t_{rr}		—	0.30	—	µs
	$t_{C(on)}$		—	0.40	—	µs
	t_{off}		—	1.30	2.00	µs
	$t_{C(off)}$		—	0.50	0.80	µs

T_f Measurement Point



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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Control Sector						
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}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	13.0	15.0	18.5	Volts
Circuit Current	I_D	$V_D = V_{DB}$ = 15V, V_{IN} = 5V, Total of V_{P1}-V_{NC}, V_{N1}-V_{NC}	—	—	5.00	mA
		$V_D = V_{DB}$ = 15V, V_{IN} = 0V, Total of V_{P1}-V_{NC}, V_{N1}-V_{NC}	—	—	7.00	mA
		$V_D = V_{DB}$ = 15V, V_{IN} = 5V, V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	—	—	0.40	mA
		$V_D = V_{DB}$ = 15V, V_{IN} = 0V, V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	—	—	0.55	mA
Fault Output Voltage	V_{FOH}	V_{SC} = 0V, F_O Circuit: 10k Ω to 5V Pull-up	4.9	—	—	Volts
	V_{FOL}	V_{SC} = 1V, I_{FO} = 1mA	—	—	0.95	Volts
Input Current	I_{IN}	V_{IN} = 5V	1.0	1.50	2.00	mA
PWM Input Frequency	f_{PWM}	$T_f \leq$ 100°C, $T_j \leq$ 125°C	—	10	—	kHz
Short Circuit Trip Level*	$V_{SC(ref)}$	T_j = 25°C, V_D = 15V	0.43	0.48	0.53	Volts
Supply Circuit Under-voltage Protection	UV_{DBt}	Trip Level, $T_j \leq$ 125°C	10.0	—	12.0	Volts
	UV_{DBr}	Reset Level, $T_j \leq$ 125°C	10.5	—	12.5	Volts
	UV_{Dt}	Trip Level, $T_j \leq$ 125°C	10.3	—	12.5	Volts
	UV_{Dr}	Reset Level, $T_j \leq$ 125°C	10.8	—	13.0	Volts
Fault Output Pulse Width**	t_{FO}	C_{FO} = 22nF	1.0	1.8	—	ms
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	2.3	2.6	Volts
OFF Threshold Voltage	$V_{th(off)}$		0.8	1.4	2.1	Volts

* Short Circuit protection is functioning only at the lower arms. Please select the value of the external shunt resistor such that the SC trip level is less than 8.5A.

**Fault signal is asserted when the lower arm short circuit or control supply under-voltage protective functions operate. The fault output pulse-width t_{FO} depends on the capacitance value of C_{FO} according to the following approximate equation: $C_{FO} = (12.2 \times 10^{-6}) \times t_{FO}$ {F} .

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Thermal Characteristics

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Fin	$R_{th(j-f)Q}$	IGBT Part (Per 1/6 Module)	—	—	6.0	°C/Watt
Thermal Resistance	$R_{th(j-f)D}$	FWDi Part (Per 1/6 Module)	—	—	6.5	°C/Watt

Recommended Conditions for Use

Characteristic	Symbol	Condition	Min.	Typ.	Value	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}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	13.0	15.0	18.5	Volts
Control Supply Variation	ΔV_D, ΔV_{DB}		-1	—	1	V/µs
PWM Input Frequency	f_{PWM}	$T_f \leq 100°C$, $T_j \leq 125°C$	—	10	—	kHz
Allowable rms Current*	I_O	V_{CC} = 300V, V_D = 15V, f_C = 5kHz, PF = 0.8, Sinusoidal, $T_j \leq 125°C$, $T_f \leq 100°C$	—	—	3.0	Arms
Minimum Input Pulse Width**	P_{WIN}	ON / OFF	300	—	—	ns
V_{NC} Variation	V_{NC}	Between V_{NC}-N (Including Surge)	-5.0	—	5.0	Volts
Arm Shoot-through Blocking Time	t_{DEAD}	For Each Input Signal, $T_f < 100°C$	1.5	—	—	µs

* The allowable rms current value depends on the actual application conditions.
**The input pulse width less than P_{WIN} might make no response.

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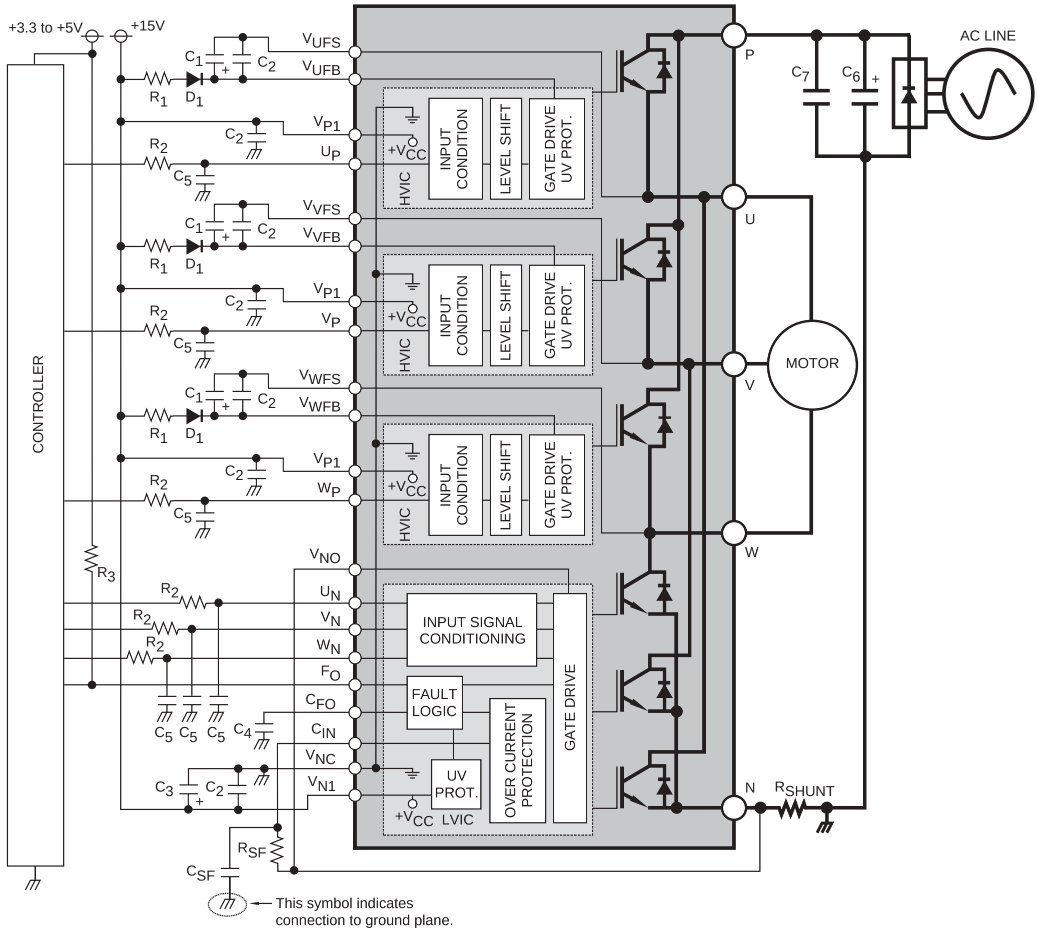
Mini DIP-IPM Application Circuit (Shown Pins Up)



Component Selection:

Dsgn.	Typ. Value	Description
D_1	1A, 600V	Boot strap supply diode – Ultra fast recovery
C_1	10-100uF, 50V	Boot strap supply reservoir – Electrolytic, long life, low Impedance, 105°C (Note 5)
C_2	0.22-2.0uF, 50V	Local decoupling/High frequency noise filters – Multilayer ceramic (Note 8)
C_3	10-100uF, 50V	Control power supply filter – Electrolytic, long life, low Impedance, 105°C
C_4	22nF, 50V	Fault lock-out timing capacitor – Multilayer ceramic (Note 4)
C_5	100pF, 50V	Optional Input signal noise filter – Multilayer ceramic (Note 1)
C_6	200-2000uF, 450V	Main DC bus filter capacitor – Electrolytic, long life, high ripple current, 105°C
C_7	0.1-0.22uF, 450V	Surge voltage suppression capacitor – Polyester/Polypropylene film (Note 9)
C_{SF}	1000pF, 50V	Short circuit detection filter capacitor – Multilayer Ceramic (Note 6, Note 7)
R_{SF}	1.8k ohm	Short circuit detection filter resistor (Note 6, Note 7)
R_{SHUNT}	5-100 mohm	Current sensing resistor - Non-inductive, temperature stable, tight tolerance (Note 10)
R_1	10 ohm	Boot strap supply inrush limiting resistor (Note 5)
R_2	330 ohm	Optional control input pull-up resistor (Note 1, Note 2)
R_3	10k ohm	Fault output signal pull-up resistor (Note 3)

Notes:

1) To prevent input signal oscillations minimize wiring length to controller (~2cm). Additional RC filtering (C5 etc.) may be required. If filtering is added be careful to maintain proper dead time and voltage levels. See application notes for details.
2) Internal HVIC provides high voltage level shifting allowing direct connection of all six driving signals to the controller.
3) F_O output is an open collector type. Pull-up resistor (R3) should be adjusted to current sink capability of the controller.
4) C4 sets the fault output duration and lock-out time. $C4 \approx 12.2E^{-6} \times t_{FO}$, 22nF gives ~1.8ms
5) Boot strap supply component values must be adjusted depending on the PWM frequency and technique.
6) Wiring length associated with R_{SHUNT}, R_{SF}, C_{SF} must be minimized to avoid improper operation of the SC function.
7) R_{SF}, C_{SF} set short circuit protection trip time. Recommend time constant is 1.5us-2.0us. See application notes.
8) Local decoupling/high frequency filter capacitors must be connected as close as possible to the modules pins.
9) The length of the DC link wiring between C6, C7, the DIP's P terminal and the shunt must be minimized to prevent excessive transient voltages. In particular C7 should be mounted as close to the DIP as possible.
10) Use high quality, tight tolorance current sensing resistor. Connect resistor as close as possible to the DIP's N terminal. Be careful to check for proper power rating. See application notes for calculation of resistance value.