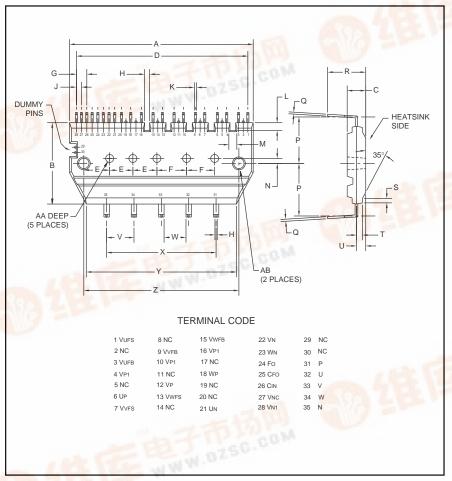


PS20351-G

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

Intellimod[™] Module
Dual-In-Line Intelligent
Power Module
3 Amperes/500 Volts



Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
Dilligiigions	Illulies	Millillerers
Α	1.93	49.0
В	1.20	30.5
С	0.20	5.0
D	1.82	46.23
E	0.25	6.25
F	0.32	8.0
G	0.14	3.556
Н	0.04	1.0
J	0.07	1.778
K	0.02	0.5
L	0.06	1.5
М	0.07 Min.	1.8 Min.
DNE	0.30	0.75

Dimensions	Inches	Millimeters
Р	0.69	17.4
Q	0.02	0.5
R	0.41	10.5
S	0.05	1.2
T	0.05	1.25
Unim	0.10	2.5
V	0.30	7.62
W	0.16 Min.	4.0 Min.
Χ	1.20	30.48
Υ	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 4th 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
- Optimized for 15kHz Operation

Applications:

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

Ordering Information:

PS20351-G is a 500V, 3 Ampere Mini-DIP Intelligent Power Module.





PS20351-G Intellimod™ Module Dual-In-Line Intelligent Power Module 3 Amperes/500 Volts

Absolute Maximum Ratings, $T_{j} = 25^{\circ}\text{C}$ unless otherwise specified

Characteristics	Symbol	PS20351-G	Units
Power Device Junction Temperature*	Тј	-20 to 150	°C
Storage Temperature	T _{stg}	-40 to 125	°C
Heatsink Temperature (See T _f Measure Point Illustration)	T _f	-20 to 100	°C
Mounting Torque, M3 Mounting Screws	_	8.5	in-lb
Module Weight (Typical)	_	20	Grams
Heatsink Flatness	_	-50 to 100	μm
Self-protection Supply Voltage Limit (Short Circuit Protection Capability)**	V _{CC(prot.)}	330	Volts
Isolation Voltage, AC 1 minute, 60Hz Sinusoidal, Connection Pins to Heatsink Plate	V _{ISO}	1500	Volts

^{*}The maximum junction temperature rating of the power chips integrated within the DIP-IPM is 150° C (@T_f $\leq 100^{\circ}$ C). However, to ensure safe operation of the DIP-IPM, the average junction temperature should be limited to $T_{j(avg)} \leq 125^{\circ}$ C (@T_f $\leq 100^{\circ}$ C).

**V_D = $13.5 \sim 16.5$ V, Inverter Part, $T_{j} = 125^{\circ}$ C, Non-repetitive, Less than 2μ S

IGBT Inverter Sector

Collector-Emitter Voltage	V_{CES}	500	Volts
Collector Current, ± (T _C = 25°C)	Ic	3	Amperes
Peak Collector Current, ± (T _C = 25°C, Instantaneous Value (Pulse))	I _{CP}	6	Amperes
Supply Voltage (Applied between P - N)	V _{CC}	350	Volts
Supply Voltage, Surge (Applied between P - N)	V _{CC(surge)}	400	Volts
Collector Dissipation (T _C = 25°C, per 1 Chip)	P _C	17.8	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_{CIN}	-0.5 ~ 5.5	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}	15	mA
Current Sensing Input Voltage (Applied between C _{IN} -V _{NC})	V _{SC}	-0.5 ~ V _D +0.5	Volts

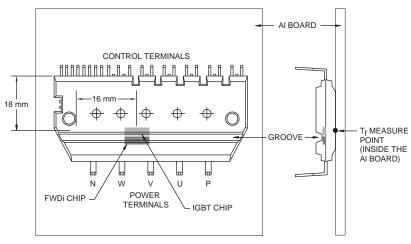


PS20351-G Intellimod™ Module Dual-In-Line Intelligent Power Module 3 Amperes/500 Volts

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

Characteristics	Sym	bol Test Conditions	Min.	Тур.	Max.	Units
IGBT Inverter Sector						
Collector Cutoff Current	I _{CES}	$V_{CE} = V_{CES}, T_j = 25^{\circ}C$	_	_	1.0	mA
		$V_{CE} = V_{CES}$, $T_j = 125$ °C	_	_	10	mA
Diode Forward Voltage	V _E C	$T_j = 25^{\circ}C$, $-I_C = 3A$, $V_{CIN} = 5V$	_	1.90	2.60	Volts
Collector-Emitter Saturation Voltage	V _{CE(sat)}	$I_C = 3A$, $T_j = 25$ °C, $V_D = V_{DB} = 15V$, $V_{CIN} = 0V$	_	1.70	2.35	Volts
		$I_C = 3A$, $T_j = 125^{\circ}C$, $V_D = V_{DB} = 15V$, $V_{CIN} = 0V$	_	1.80	2.45	Volts
Inductive Load Switching Times	ton	$V_{CC} = 300V, V_D = 15V,$	0.10	0.55	1.05	μS
	t _{rr}	I _C = 3A,	_	0.10	_	μS
	t _{C(on)}	 T _j = 125°C,	_	0.15	0.55	μS
	t _{off}	Inductive Load (Upper-Lower Arm),	_	1.00	2.10	μS
	t _{C(off)}	V _{CIN} = 5V(off), 0V(on)	_	0.30	1.20	μS

Tf Measure Point





PS20351-G Intellimod™ Module Dual-In-Line Intelligent Power Module 3 Amperes/500 Volts

Electrical and Mechanical Characteristics, $T_j = 25^{\circ}\text{C}$ unless otherwise specified

Characteristics Symbol		ol Test Conditions	Min.	Тур.	Max.	Units
Control Sector						
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} ,	13.5	15.0	16.5	Volts
		V _{VFB} -V _{VFS} , V _{WFB} -V _{WFS}				
Circuit Current	I _D	V _D = 15V, V _{CIN} = 5V, V _{DB} = 15V,	_	4.25	8.50	mA
		Total of V _{P1} -V _{NC} , V _{N1} -V _{NC}				
	_	$V_D = 15V, V_{CIN} = 0V, V_{DB} = 15V,$	_	4.95	9.70	mA
		Total of V _{P1} -V _{NC} , V _{N1} -V _{NC}				
	_	$V_D = 15V, V_{CIN} = 5V, V_{DB} = 15V,$	_	0.50	1.00	mA
		V _{UFB} -V _{UFS} , V _{VFB} -V _{VFS} , V _{WFB} -V _{WFS}				
	_	$V_D = 15V, V_{CIN} = 0V, V_{DB} = 15V,$	_	0.50	1.00	mA
		$V_{UFB}\text{-}V_{UFS}, V_{VFB}\text{-}V_{VFS}, V_{WFB}\text{-}V_{WFS}$				
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, F_O Circuit: 10k Ω to 5V Pull-up	_	0.8	1.2	Volts
	V _{FO(sat)}	$V_{SC} = 1V$, $I_{FO} = 15mA$	0.8	1.2	1.8	Volts
PWM Input Frequency	f _{PWM}	$T_j \le 125^{\circ}C, T_f \le 100^{\circ}C$	_	15	_	kHz
Allowable Dead Time	t _{DEAD}	Relates to Corresponding Input Signal for	3	_	_	μS
		Blocking Arm Shoot-through ($T_f \le 100^{\circ}C$)				
Short Circuit Trip Level*	V _{SC(ref)}	$T_j = 25^{\circ}C, V_D = 15V^*$	0.45	0.5	0.55	Volts
Supply Circuit Under-voltage	UV _{DBt}	Trip Level, T _j ≤ 125°C	10.0	_	12.0	Volts
	UV _{DBr}	Reset Level, T _j ≤ 125°C	10.5	_	12.5	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**	t _{FO}	C _{FO} = 22nF	1.0	1.8		mS
ON Threshold Voltage (H-side)	V _{th(on)}	Applied between U _P , V _P , W _P -V _{NC}	0.8	1.4	2.0	Volts
OFF Threshold Voltage (H-side)	V _{th(off)}		2.5	3.0	4.0	Volts
ON Threshold Voltage (L-side)	V _{th(on)}	Applied between U _N , V _N , W _N -V _{NC}	0.8	1.4	2.0	Volts
OFF Threshold Voltage (L-side)	V _{th(off)}		2.5	3.0	4.0	Volts

^{*} Short Circuit protection operates only at the low-arms. Please select the value of the external shunt resistor such that the SC trip level is less than 5.1A.

**Fault signal is asserted when the low-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 x 10⁻⁶) x t_{FO} {F}.



PS20351-G Intellimod™ Module Dual-In-Line Intelligent Power Module 3 Amperes/500 Volts

Thermal Characteristics

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Heatsink	$R_{th(j-f)Q}$	Each IGBT	_	_	7.0	°C/Watt
	R _{th(i-f)D}	Each FWDi	_	_	8.0	°C/Watt

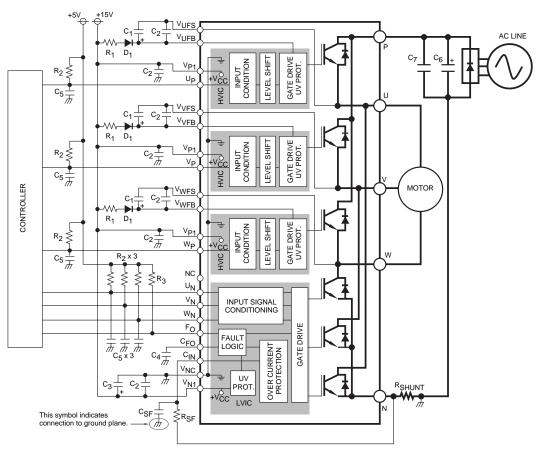
Recommended Conditions for Use

Characteristic	Symbol	Condition	Min.	Typ.	Value	Units
Supply Voltage	V _{CC}	Applied between P-N Terminals	0	280	330	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} ,	13.5	15.0	16.5	Volts
		V_{VFB} - V_{VFS} , V_{WFB} - V_{WFS}				
Control Supply dv/dt	dV _D /dt, dV _{DB} /dt		-1	_	1	V/μs
Input ON Voltage	V _{CIN(on)}	Applied between Up, Vp, Wp-V _{NC}			0 ~ 0.65	Volts
Input OFF Voltage	V _{CIN(off)}	Applied between U _N , V _N , W _N -V _{NC}			4.0 ~ 5.5	Volts
PWM Input Frequency	f _{PWM}	T _j ≤ 125°C, T _f ≤ 100°C	_	15	_	kHz
Arm Shoot-through Blocking Time	t _{DEAD}	For Each Input Signal	3	_	_	μS



PS20351-G Intellimod™ Module Dual-In-Line Intelligent Power Module 3 Amperes/500 Volts

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	1-100uF, 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	100-1000pF, 50V	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)
RSHUNT	5-100mohm	Current sensing resistor - Non-inductive, temperature stable, tight tolerance (Note 10)
R ₁	1-100 ohm	Boot strap supply inrush limiting resistor (Note 5)
R ₂	4.7k ohm	Control input pull-up resistor (Note 1, Note 2)
R ₃	5.1k ohm	Fault output signal pull-up resistor (Note 3)

- 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. 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. This signal should be pulled high with 5.1k ohm resistor (R3).

 4) C4 sets the fault output duration and lock-out time. C4 ≈ 12.2E⁻⁶ x 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 RSHUNT. RSF. CSF must be minimized to avoid improper operation of the OC function. 7) RSF, CSF set over current 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.