



#### TERMINAL CODE

- 1 VUPC
- 2 UFO
- 3 UP
- 4 VUP1
- 5 VVPC
- 6 VFO
- 7 VP
- 8 VVP1
- 9 NC
- 10 NC
- 11 NC
- 12 NC
- 13 VNC
- 14 VN1
- 15 NC
- 16 UN
- 17 VN
- 18 WN
- 19 FO

#### Outline Drawing and Circuit Diagram

Dim.	Inches	Millimeters
A	3.54	90.0
B	1.97	50.0
C	0.98	25.0
D	3.15	80.0
E	0.20	5.0
F	0.39	10.0
G	0.08	2.0
H	0.17 Dia.	4.3 Dia.
J	0.81	20.5
K	0.91	23.0

Dim.	Inches	Millimeters
L	0.47	12.0
M	0.012	0.3
N	0.57	14.6
P	0.26	6.7
Q	0.02	0.5
R	0.56	14.2
S	0.02 Sq.	0.5 Sq.
T	0.08	2.0
U	0.51	13.0
V	0.65	16.5



#### Description:

Powerex Intellimod™ Photo Voltaic Intelligent Power Modules are isolated base modules designed for single phase power switching applications. Built-in control circuits provide optimum gate drive and protection for the IGBT and free-wheel diode power devices.

#### Features:

- Complete Output Power Circuit
- Gate Drive Circuit
- Protection Logic
  - Short Circuit
  - Over Temperature Using On-chip Temperature Sensing
  - Under Voltage
- Low Loss Using Full Gate CSTBT IGBT Chip

#### Applications:

- PV Inverters
- PV UPS
- PV Power Supplies

#### Ordering Information:

Example: Select the complete part number from the table below -i.e. PM50B5L1C060 is a 600V, 50 Ampere PV-IPM.

Type	Current Rating Amperes	V <sub>CES</sub> Volts (x 10)
PM	50	60

**PM50B5L1C060**  
**Photo Voltaic IPM**  
**H-Bridge + 1 Chopper**  
 50 Amperes/600 Volts

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

Characteristics	Symbol	PM50B5L1C060	Units
Power Device Junction Temperature	$T_j$	-20 to 150	$^\circ\text{C}$
Storage Temperature	$T_{\text{stg}}$	-40 to 125	$^\circ\text{C}$
Mounting Torque, M4 Mounting Screws (Typical)	—	15	in-lb
Module Weight (Typical)	—	135	Grams
Supply Voltage, Surge (Applied between P-N)	$V_{\text{CC(surge)}}$	500	Volts
Operation of Short Circuit Protections (Applied between P-N, $V_D = 13.5 \sim 16.5\text{V}$ , Inverter Part, $T_j = 125^\circ\text{C}$ Start)	$V_{\text{CC(prot.)}}$	450	Volts
Isolation Voltage (60Hz, Sinusoidal, RMS, Charged Part to Base, AC 1 Minute)	$V_{\text{ISO}}$	2500	Volts

## Inverter Part

Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ )	$V_{\text{CES}}$	600	Volts
Collector Current ( $T_C = 25^\circ\text{C}$ )	$I_C$	50	Amperes
Collector Current (Pulse)	$I_{\text{CRM}}$	100	Amperes
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{\text{tot}}$	168	Watts
Emitter Current ( $T_C = 25^\circ\text{C}$ , FWDi Current)	$I_E$	50	Amperes
Emitter Current (Pulse, FWDi Current)	$I_{\text{ERM}}$	100	Amperes

## Converter Part

Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ )	$V_{\text{CES}}$	600	Volts
Collector Current ( $T_C = 25^\circ\text{C}$ )	$I_C$	50	Amperes
Collector Current (Pulse)	$I_{\text{CRM}}$	100	Amperes
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{\text{tot}}$	168	Watts
Emitter Current ( $T_C = 25^\circ\text{C}$ , FWDi Current)	$I_E$	50	Amperes
Emitter Current (Pulse, FWDi Current)	$I_{\text{ERM}}$	100	Amperes
Diode Forward Current ( $T_C = 25^\circ\text{C}$ )	$I_F$	50	Amperes
Diode Rated DC Reverse Voltage ( $T_C = 25^\circ\text{C}$ )	$V_{\text{R(DC)}}$	600	Volts

## Control Part

Supply Voltage (Applied between $V_{\text{UP1}}-V_{\text{UPC}}$ , $V_{\text{VP1}}-V_{\text{VPC}}$ , $V_{\text{N1}}-V_{\text{NC}}$ )	$V_D$	20	Volts
Input Voltage (Applied between $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $U_N-V_N-W_N-B-V_{\text{NC}}$ )	$V_{\text{CIN}}$	20	Volts
Fault Output Supply Voltage (Applied between $U_{\text{FO}}-V_{\text{UPC}}$ , $V_{\text{FO}}-V_{\text{VPC}}$ , $F_O-V_{\text{NC}}$ )	$V_{\text{FO}}$	20	Volts
Fault Output Supply Current (Sink Current at $U_{\text{FO}}$ , $V_{\text{FO}}$ , $F_O$ Terminals)	$I_{\text{FO}}$	20	mA

**PM50B5L1C060**  
**Photo Voltaic IPM**  
**H-Bridge + 1 Chopper**  
 50 Amperes/600 Volts

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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>Inverter Part</b>						
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_D = 15\text{V}, I_C = 50\text{A}, V_{CIN} = 0\text{V},$ Pulsed, $T_j = 25^\circ\text{C}$	—	2.2	2.7	Volts
		$V_D = 15\text{V}, I_C = 50\text{A}, V_{CIN} = 0\text{V},$ Pulsed, $T_j = 125^\circ\text{C}$	—	2.2	2.7	Volts
Emitter-Collector Voltage	$V_{EC}$	$I_E = 50\text{A}, V_D = 15\text{V}, V_{CIN} = 15\text{V}$	—	2.4	3.3	Volts
Switching Times	$t_{on}$		0.1	0.5	1.2	$\mu\text{s}$
	$t_{rr}$	$V_D = 15\text{V}, V_{CIN} = 0 \leftrightarrow 15\text{V}$	—	0.1	0.2	$\mu\text{s}$
	$t_{C(on)}$	$V_{CC} = 300\text{V}, I_C = 50\text{A},$	—	0.15	0.3	$\mu\text{s}$
	$t_{off}$	$T_j = 125^\circ\text{C}, \text{Inductive Load}$	—	1.1	2.0	$\mu\text{s}$
	$t_{C(off)}$		—	0.2	0.4	$\mu\text{s}$
Collector-Emitter Cutoff Current	$I_{CES}$	$V_{CE} = V_{CES}, V_D = 15\text{V}, V_{CIN} = 15\text{V}, T_j = 25^\circ\text{C}$	—	—	1.0	mA
		$V_{CE} = V_{CES}, V_D = 15\text{V},$	—	—	10	mA
		$V_{CIN} = 15\text{V}, T_j = 125^\circ\text{C}$				
<b>Converter Part</b>						
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_D = 15\text{V}, I_C = 50\text{A}, V_{CIN} = 0\text{V},$ Pulsed, $T_j = 25^\circ\text{C}$	—	2.2	2.7	Volts
		$V_D = 15\text{V}, I_C = 50\text{A}, V_{CIN} = 0\text{V},$ Pulsed, $T_j = 125^\circ\text{C}$	—	2.2	2.7	Volts
Emitter-Collector Voltage	$V_{EC}$	$I_E = 50\text{A}, V_D = 15\text{V}, V_{CIN} = 15\text{V}$	—	2.4	3.3	Volts
Diode Forward Voltage	$V_{FM}$	$I_F = 50\text{A}$		2.4	3.3	Volts
Switching Times	$t_{on}$		0.1	0.5	1.2	$\mu\text{s}$
	$t_{rr}$	$V_D = 15\text{V}, V_{CIN} = 0 \leftrightarrow 15\text{V}$	—	0.1	0.2	$\mu\text{s}$
	$t_{C(on)}$	$V_{CC} = 300\text{V}, I_C = 50\text{A},$	—	0.15	0.3	$\mu\text{s}$
	$t_{off}$	$T_j = 125^\circ\text{C}, \text{Inductive Load}$	—	1.1	2.0	$\mu\text{s}$
	$t_{C(off)}$		—	0.2	0.4	$\mu\text{s}$
Collector-Emitter Cutoff Current	$I_{CES}$	$V_{CE} = V_{CES}, V_D = 15\text{V}, V_{CIN} = 15\text{V}, T_j = 25^\circ\text{C}$	—	—	1.0	mA
		$V_{CE} = V_{CES}, V_D = 15\text{V},$	—	—	10	mA
		$V_{CIN} = 15\text{V}, T_j = 125^\circ\text{C}$				

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**50 Amperes/600 Volts**

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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>Control Part</b>						
Circuit Current	$I_D$	$V_D = 15\text{V}, V_{CIN} = 15\text{V}, V_{N1}-V_{NC}$	—	6.5	12	mA
		$V_D = 15\text{V}, V_{CIN} = 15\text{V}, V_{*P1}-V_{*PC}$	—	1.6	4	mA
Input ON Threshold Voltage	$V_{th(on)}$	Applied between $U_P-V_{UPC}$ ,	1.2	1.5	1.8	Volts
Input OFF Threshold Voltage	$V_{th(off)}$	$V_P-V_{VPC}, U_N- V_N- W_N-Br-V_{NC}$	1.7	2.0	2.3	Volts
Short Circuit Trip Level	SC	$-20^\circ\text{C} \leq T_j \leq 125^\circ\text{C}, V_D = 15\text{V}$	75	—	—	Amperes
Short Circuit Current Delay Time	$t_{off(SC)}$	$V_D = 15\text{V}$	—	0.2	—	$\mu\text{s}$
Over Temperature Protection	OT	Trip Level	135	—	—	$^\circ\text{C}$
(Detect Temperature of IGBT)	$OT_{(hys)}$	Hysteresis	—	20	—	$^\circ\text{C}$
Supply Circuit Under-voltage Protection	$UV_t$	Trip Level	11.5	12.0	12.5	Volts
( $-20^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ )	$UV_r$	Reset Level	—	12.5	—	Volts
Fault Output Current*2	$I_{FO(H)}$	$V_D = 15\text{V}, V_{FO} = 15\text{V}$	—	—	0.01	mA
	$I_{FO(L)}$	$V_D = 15\text{V}, V_{FO} = 15\text{V}$	—	10	15	mA
Fault Output Pulse Width*2	$t_{FO}$	$V_D = 15\text{V}$	1.0	1.8	—	ms

## Thermal Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Case Thermal Resistance	$R_{th(j-c)Q}$	Inverter IGBT (Per 1 Element)*1	—	—	0.74	$^\circ\text{C/Watt}$
	$R_{th(j-c)D}$	Inverter FWDi (Per 1 Element)*1	—	—	0.128	$^\circ\text{C/Watt}$
	$R_{th(j-c)Q}$	Converter IGBT (Per 1 Element)*1	—	—	0.74	$^\circ\text{C/Watt}$
	$R_{th(j-c)D}$	Converter FWDi (Per 1 Element)*1	—	—	0.128	$^\circ\text{C/Watt}$
	$R_{th(j-c)D}$	Converter Diode (Per 1 Element)*1	—	—	0.128	$^\circ\text{C/Watt}$
Contact Thermal Resistance	$R_{th(c-f)}$	Case to Fin (Per 1 Element)*1, Thermal Grease Applied	—	0.060	—	$^\circ\text{C/Watt}$

## Recommended Conditions for Use

Characteristic	Symbol	Condition	Value	Units
Inverter Supply Voltage	$V_{CC}$	Applied across P-N Terminals	$\leq 450$	Volts
Control Supply Voltage*3	$V_D$	Applied between $V_{UP1}-V_{UPC}$ , $V_{VP1}-V_{VPC}, V_{N1}-V_{NC}$	$15.0 \pm 1.5$	Volts
Input ON Voltage	$V_{CIN(on)}$	Applied between $U_P-V_{UPC}$ ,	$\leq 0.8$	Volts
Input OFF Voltage	$V_{CIN(off)}$	$V_P-V_{VPC}, U_N- V_N- W_N-Br-V_{NC}$	$\geq 9.0$	Volts
PWM Input Frequency	$f_{PWM}$	Using Application Circuit Input Signal of IPM, 3-Phase Sinusoidal PWM VVVF Inverter	$\leq 20$	kHz
Arm Shoot-through Blocking Time	$t_{DEAD}$	For IPMs Each Input Signals	$\geq 2.0$	$\mu\text{s}$

\*1 When using this value,  $R_{th(s-a)}$  should be measured just under the chips.

\*2 Fault output is given only when the internal SC, OT and UV protections schemes of either upper or lower device operate to protect it.

Fault output of SC protection given pulse. Fault output of OT, UV protection given pulse while over trip level.

\*3 With ripple satisfying the following conditions:  $dv/dt$  swing  $\leq 5\text{V}/\mu\text{s}$ ; variation  $\leq 2\text{V}$  peak-to-peak.