





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

**PM50CL1A060**  
**Intellimod™ L1-Series**  
**Three Phase IGBT Inverter**  
 50 Amperes/600 Volts

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

Characteristics	Symbol	PM50CL1A060	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, M5 Mounting Screws	—	31	in-lb
Mounting Torque, M5 Main Terminal Screws	—	31	in-lb
Module Weight (Typical)	—	380	Grams
Supply Voltage, Surge (Applied between P - N)	$V_{\text{CC(surge)}}$	500	Volts
Supply Voltage Protected by Short Circuit Protection Capability*	$V_{\text{CC(prot.)}}$	400	Volts
Isolation Voltage, AC 1 minute, 60Hz Sinusoidal	$V_{\text{ISO}}$	2500	Volts

**IGBT Inverter Sector**

Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ )	$V_{\text{CES}}$	600	Volts
Collector Current ( $T_C = 25^\circ\text{C}$ ) (Note 1)	$\pm I_C$	50	Amperes
Peak Collector Current ( $T_C = 25^\circ\text{C}$ )	$\pm I_{\text{CP}}$	100	Amperes
Collector Dissipation ( $T_C = 25^\circ\text{C}$ ) (Note 1)	$P_C$	284	Watts

**Control Sector**

Supply Voltage (Applied between $V_{\text{UP1}}-V_{\text{UPC}}$ , $V_{\text{VP1}}-V_{\text{VPC}}$ , $V_{\text{WP1}}-V_{\text{WPC}}$ , $V_{\text{N1}}-V_{\text{NC}}$ )	$V_D$	20	Volts
Input Voltage (Applied between $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $W_P-V_{\text{WPC}}$ , $U_N-V_N$ , $W_N-V_{\text{NC}}$ )	$V_{\text{CIN}}$	20	Volts
Fault Output Supply Voltage (Applied between $U_{\text{FO}}-V_{\text{UPC}}$ , $V_{\text{FO}}-V_{\text{VPC}}$ , $W_{\text{FO}}-V_{\text{WPC}}$ , $F_O-V_{\text{NC}}$ )	$V_{\text{FO}}$	20	Volts
Fault Output Current (Sink Current at $U_{\text{FO}}$ , $V_{\text{FO}}$ , $W_{\text{FO}}$ , $F_O$ Terminals)	$I_{\text{FO}}$	20	mA

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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Collector-Emitter Saturation Voltage	$V_{\text{CE(sat)}}$	$V_D = 15\text{V}$ , $V_{\text{CIN}} = 0\text{V}$ , $I_C = 50\text{A}$ , $T_j = 25^\circ\text{C}$	—	1.75	2.35	Volts
		$V_D = 15\text{V}$ , $V_{\text{CIN}} = 0\text{V}$ , $I_C = 50\text{A}$ , $T_j = 125^\circ\text{C}$	—	1.75	2.35	Volts
Diode Forward Voltage	$V_{\text{EC}}$	$-I_C = 50\text{A}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_D = 15\text{V}$	—	1.7	2.8	Volts
Inductive Load Switching Times	$t_{\text{on}}$		0.3	0.8	2.0	$\mu\text{s}$
	$t_{\text{rr}}$	$V_D = 15\text{V}$ , $V_{\text{CIN}} = 0 \leftrightarrow 15\text{V}$	—	0.4	0.8	$\mu\text{s}$
	$t_{\text{C(on)}}$	$V_{\text{CC}} = 300\text{V}$ , $I_C = 50\text{A}$	—	0.4	1.0	$\mu\text{s}$
	$t_{\text{off}}$	$T_j = 125^\circ\text{C}$	—	1.0	2.3	$\mu\text{s}$
	$t_{\text{C(off)}}$		—	0.3	1.0	$\mu\text{s}$
Collector-Emitter Cutoff Current	$I_{\text{CES}}$	$V_{\text{CE}} = V_{\text{CES}}$ , $V_D = 15\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1.0	mA
		$V_{\text{CE}} = V_{\text{CES}}$ , $V_D = 15\text{V}$ , $T_j = 125^\circ\text{C}$	—	—	10	mA

\* $V_D = 13.5 \sim 16.5\text{V}$ , Inverter Part,  $T_j = 125^\circ\text{C}$

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Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>Control Sector</b>						
Circuit Current	$I_D$	$V_D = 15\text{V}, V_{CIN} = 15\text{V}, V_{N1}-V_{NC}$	—	6	12	mA
		$V_D = 15\text{V}, V_{CIN} = 15\text{V}, V_{*P1}-V_{*PC}$	—	2	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	$V_{th(off)}$	$V_P-V_{VPC}, W_P-V_{WPC}, U_N-V_N, W_N-V_{NC}$	1.7	2.0	2.3	Volts
Short Circuit Trip Level	SC	$-20^\circ\text{C} \leq T_j \leq 125^\circ\text{C}, V_D = 15\text{V}$	100	—	—	Amperes
Short Circuit Current Delay Time	$t_{off(SC)}$	$V_D = 15\text{V}$	—	0.2	—	$\mu\text{s}$
Over Temperature Protection (Detect $T_j$ of IGBT Chip)	OT	Trip Level	135	—	—	$^\circ\text{C}$
	$OT_{(hys)}$	Hysteresis Level	—	20	—	$^\circ\text{C}$
Supply Circuit Under-voltage Protection ( $-20 \leq T_j \leq 125^\circ\text{C}$ )	UV	Trip Level	11.5	12.0	12.5	Volts
	$UV_R$	Reset Level	—	12.5	—	Volts
Fault Output Current*	$I_{FO(H)}$	$V_D = 15\text{V}, V_{CIN} = 15\text{V}$	—	—	0.01	mA
	$I_{FO(L)}$	$V_D = 15\text{V}, V_{CIN} = 15\text{V}$	—	10	15	mA
Fault Output Pulse Width*	$t_{FO}$	$V_D = 15\text{V}$	1.0	1.8	—	ms

**Thermal Characteristics**

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Case Thermal Resistance	$R_{th(j-c)Q}$	IGBT (Per 1 Element) (Note 1)	—	—	0.44	$^\circ\text{C}/\text{Watt}$
	$R_{th(j-c)D}$	FWDi (Per 1 Element) (Note 1)	—	—	0.75	$^\circ\text{C}/\text{Watt}$
Contact Thermal Resistance	$R_{th(c-f)}$	Case to Fin Per Module, Thermal Grease Applied (Note 1)	—	—	0.038	$^\circ\text{C}/\text{Watt}$

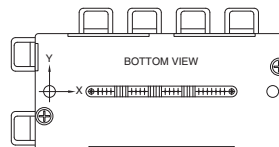
**Recommended Conditions for Use**

Characteristic	Symbol	Condition	Value	Units
Supply Voltage	$V_{CC}$	Applied across P-N Terminals	$\leq 400$	Volts
Control Supply Voltage**	$V_D$	Applied between $V_{UP1}-V_{UPC},$ $V_{VP1}-V_{VPC}, V_{WP1}-V_{WPC}, V_{N1}-V_{NC}$	$15.0 \pm 1.5$	Volts
Input ON Voltage	$V_{CIN(on)}$	Applied between $U_P-V_{UPC},$	$\leq 0.8$	Volts
Input OFF Voltage	$V_{CIN(off)}$	$V_P-V_{VPC}, W_P-V_{WPC}, U_N-V_N, W_N-V_{NC}$	$\geq 9.0$	Volts
PWM Input Frequency	$f_{PWM}$	—	$\leq 20$	kHz
Arm Shoot-through Blocking Time	$t_{DEAD}$	Input Signal	$\geq 2.0$	$\mu\text{s}$

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

\*\* With ripple satisfying the following conditions:  $dv/dt$  swing  $\leq \pm 5\text{V}/\mu\text{s}$ , Variation  $\leq 2\text{V}$  peak to peak.

Note 1:  $T_C$  (under the chip) Measurement Point

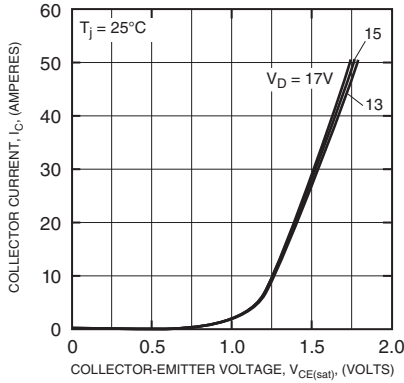


Axis \ Arm	UP		VP		WP		UN		VN		WN	
	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi
X	28.7	28.7	65.4	65.4	85.0	85.0	37.2	37.2	55.8	55.8	75.4	75.4
Y	-6.3	0.2	-6.3	0.2	-6.3	0.2	5.4	-0.9	5.4	-0.9	5.4	-0.9

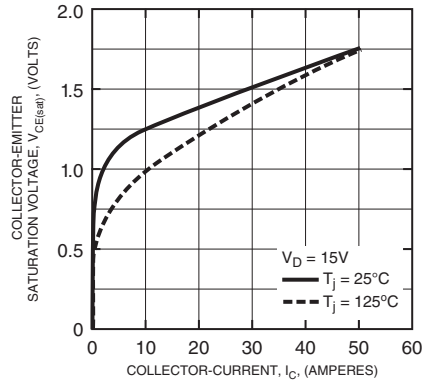


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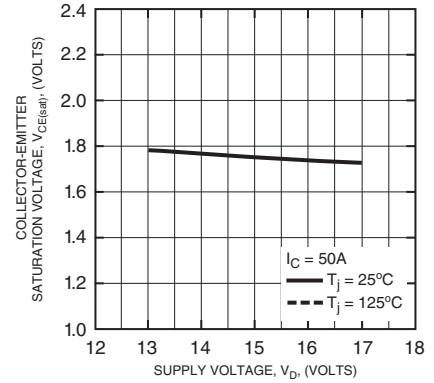
**OUTPUT CHARACTERISTICS (TYPICAL)**



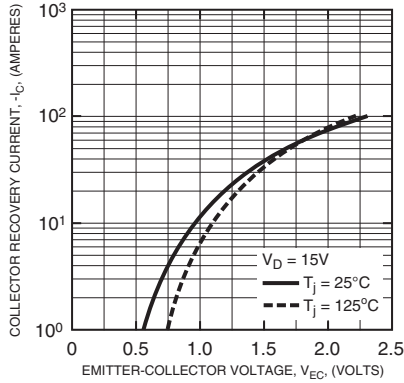
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



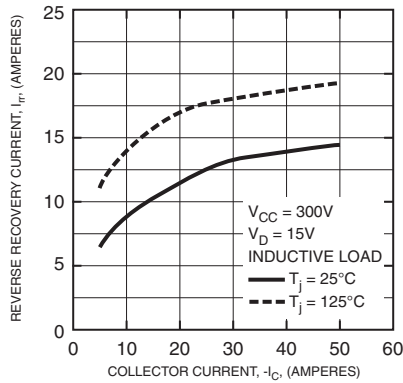
**COLLECTOR-EMITTER SATURATION VOLTAGE VS. SUPPLY VOLTAGE CHARACTERISTICS (TYPICAL)**



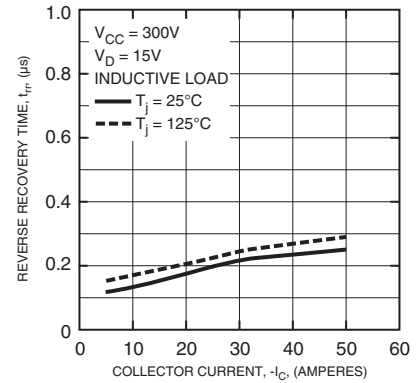
**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



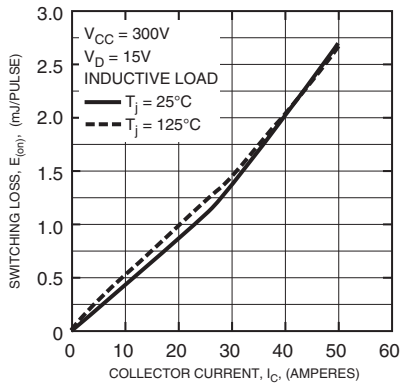
**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



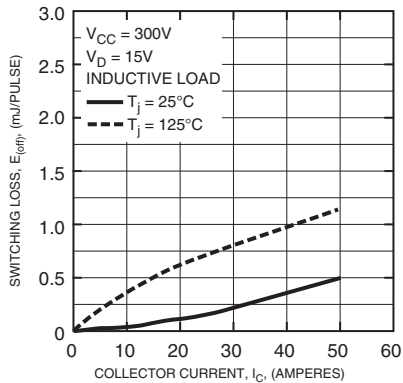
**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



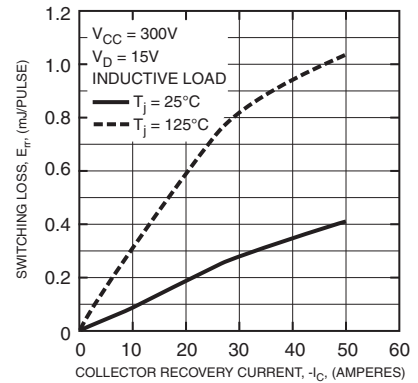
**SWITCHING LOSS (ON) VS. COLLECTOR CURRENT (TYPICAL)**



**SWITCHING LOSS (OFF) VS. COLLECTOR CURRENT (TYPICAL)**



**SWITCHING RECOVERY LOSS CHARACTERISTICS (TYPICAL)**



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