


### PASSIVATED ASSEMBLED CIRCUIT ELEMENTS

#### Features

- Glass passivated junctions for greater reliability
- Electrically isolated base plate
- Available up to 1200 V<sub>RRM</sub>, V<sub>DRM</sub>
- High dynamic characteristics
- Wide choice of circuit configurations
- Simplified mechanical design and assembly
- UL E78996 approved 

40A

#### Description

The P400 series of Integrated Power Circuits consists of power thyristors and power diodes configured in a single package. With its isolating base plate, mechanical designs are greatly simplified giving advantages of cost reduction and reduced size.

Applications include power supplies, control circuits and battery chargers.

#### Major Ratings and Characteristics

Parameters	P400	Units
$I_D$	40	A
@ T <sub>C</sub>	80	°C
$I_{FSM}$ @ 50Hz	385	A
@ 60Hz	400	A
$I^2t$ @ 50Hz	745	A <sup>2</sup> s
@ 60Hz	680	A <sup>2</sup> s
$I^2\sqrt{t}$	7450	A <sup>2</sup> √s
V <sub>RRM</sub>	400 to 1200	V
V <sub>INS</sub>	2500	V
T <sub>J</sub>	- 40 to 125	°C

## P400 Series

Bulletin I2776 rev. E 04/99

International  
IOR Rectifier

### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

Type number	$V_{RRM}$ maximum repetitive peak reverse voltage V	$V_{RSM}$ maximum non-repetitive peak reverse voltage V	$V_{DRM}$ maximum repetitive peak off-state voltage V	$I_{RRM}$ max. @ $T_J$ max. mA
P401, P421, P431	400	500	400	10
P402, P422, P432	600	700	600	
P403, P423, P433	800	900	800	
P404, P424, P434	1000	1100	1000	
P405, P425, P435	1200	1300	1200	

#### On-state Conduction

Parameter	P400	Units	Conditions
$I_D$ Maximum DC output current	40	A	@ $T_C = 80^\circ\text{C}$ , full bridge circuits
$I_{TSM}$ Max. peak one-cycle non-repetitive on-state or forward current	385	A	$t = 10\text{ms}$ No voltage $t = 8.3\text{ms}$ reapplied $t = 10\text{ms}$ 100% $V_{RRM}$ $t = 8.3\text{ms}$ reapplied Sinusoidal half wave, Initial $T_J = T_{J \text{ max.}}$
	400		
	325		
	340		
$I^2t$ Maximum $I^2t$ for fusing	745	$\text{A}^2\text{s}$	$t = 10\text{ms}$ No voltage $t = 8.3\text{ms}$ reapplied $t = 10\text{ms}$ 100% $V_{RRM}$ $t = 8.3\text{ms}$ reapplied Initial $T_J = T_{J \text{ max.}}$
	680		
	530		
	480		
$I^2/t$ Maximum $I^2/t$ for fusing	7450	$\text{A}^2/\text{s}$	$t = 0.1$ to $10\text{ms}$ , no voltage reapplied $I^2t$ for time $t_x = I^2/t \cdot \sqrt{t_x}$
$V_{T(TO)1}$ Low value of threshold voltage	0.83	V	$(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_{J \text{ max.}}$
$V_{T(TO)2}$ High value of threshold voltage	1.03		$(I > \pi \times I_{T(AV)})$ , $T_J = T_{J \text{ max.}}$
$r_{t1}$ Low level value of on-state slope resistance	9.61	$\text{m}\Omega$	$(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_{J \text{ max.}}$
$r_{t2}$ High level value of on-state slope resistance	7.01		$(I > \pi \times I_{T(AV)})$ , $T_J = T_{J \text{ max.}}$
$V_{TM}$ Max. peak on-state or forward voltage drop $V_{FM}$	1.4	V	$T_J = 25^\circ\text{C}$ , $I_{TM} = \pi \times I_{T(AV)}$ $T_J = 25^\circ\text{C}$ , $I_{TM} = \pi \times I_{F(AV)}$
$di/dt$ Maximum non repetitive rate of rise of turned on current	200	$\text{A}/\mu\text{s}$	$T_J = 125^\circ\text{C}$ from $0.67 V_{DRM}$ $I_{TM} = \pi \times I_{T(AV)}$ , $I_g = 500\text{mA}$ , $t_r < 0.5\mu\text{s}$ , $t_p > 6\mu\text{s}$
$I_H$ Maximum holding current	130	mA	$T_J = 25^\circ\text{C}$ anode supply = 6V, resistive load
$I_L$ Maximum latching current	250	mA	$T_J = 25^\circ\text{C}$ anode supply = 6V, resistive load

### Blocking

Parameter	P400	Units	Conditions
$dv/dt$ Maximum critical rate of rise of off-state voltage	200	V/ $\mu$ s	$T_J = 125^\circ\text{C}$ , exponential to $0.67 V_{\text{DRM}}$ gate open
$I_{\text{RRM}}$ Max. peak reverse and off-state leakage current at $V_{\text{RRM}}$ , $V_{\text{DRM}}$	10	mA	$T_J = 125^\circ\text{C}$ , gate open circuit
$I_{\text{RRM}}$ Max peak reverse leakage current	100	$\mu$ A	$T_J = 25^\circ\text{C}$
$V_{\text{INS}}$ RMS isolation voltage	2500	V	50Hz, circuit to base, all terminal shorted, $T_J = 25^\circ\text{C}$ , $t = 1\text{s}$

### Triggering

Parameter	P400	Units	Conditions
$P_{\text{GM}}$ Maximum peak gate power	8	W	
$P_{\text{G(AV)}}$ Maximum average gate power	2		
$I_{\text{GM}}$ Maximum peak gate current	2	A	
$-V_{\text{GM}}$ Maximum peak negative gate voltage	10	V	$T_J = -40^\circ\text{C}$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ Anode Supply = 6V resistive load
$V_{\text{GT}}$ Maximum gate voltage required to trigger	3 2 1		
$I_{\text{GD}}$ Maximum gate current required to trigger	90 60 35		
$V_{\text{GD}}$ Maximum gate voltage that will not trigger	0.2	V	$T_J = 125^\circ\text{C}$ , rated $V_{\text{DRM}}$ applied
$I_{\text{GD}}$ Maximum gate current that will not trigger	2	mA	$T_J = 125^\circ\text{C}$ , rated $V_{\text{DRM}}$ applied

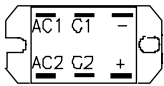
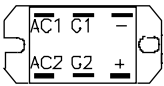
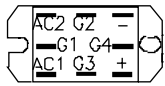
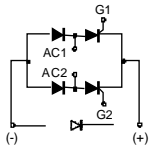
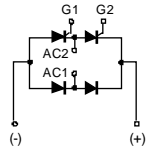
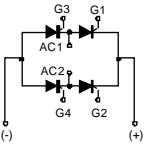
### Thermal and Mechanical Specification

Parameter	P400	Units	Conditions
$T_J$ Max. operating temperature range	-40 to 125	$^\circ\text{C}$	
$T_{\text{stg}}$ Max. storage temperature range	-40 to 125		
$R_{\text{thJC}}$ Max. thermal resistance, junction to case	1.05	K/W	DC operation per junction
$R_{\text{thCS}}$ Max. thermal resistance, case to heatsink	0.10	K/W	Mounting surface, smooth and greased
T Mounting torque, base to heatsink	4	Nm	A mounting compound is recommended and the torque should be checked after a period of 3 hours to allow for the spread of the compound
wt Approximate weight	58 (2.0)	g (oz)	

**P400 Series**

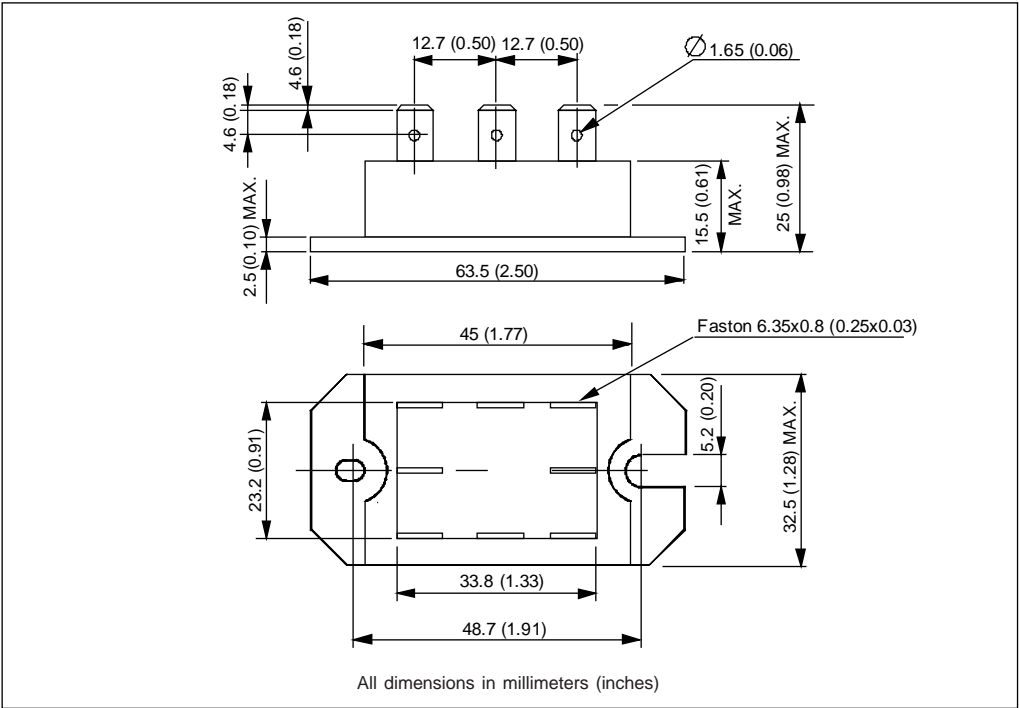
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Circuit Type and Coding \*

	Circuit"0"	Circuit"2"	Circuit"3"
Terminal Positions			
Schematic diagram			
	SinglePhase Hybrid Bridge Common Cathode	SinglePhase Hybrid Bridge Doubler	SinglePhase AllSCR Bridge
Basic series	P40.	P42.	P43.
With voltage suppression	P40.K	P42.K	P43.K
With free-wheeling diode	P40.W	-	-
With both voltage suppression and free-wheeling diode	P40.KW	-	-

\* To complete code refer to voltage ratings table, i.e.: for 600V P410.W complete code is P402W

Outline Table



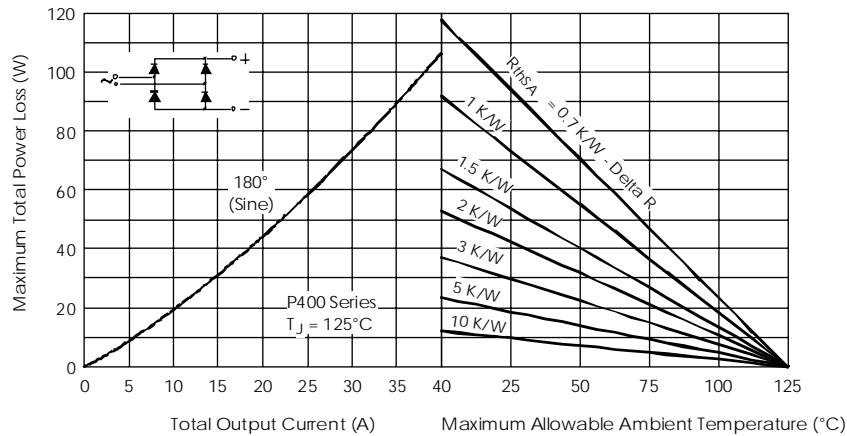


Fig. 1 - Current Ratings Nomogram (1 Module Per Heatsink)

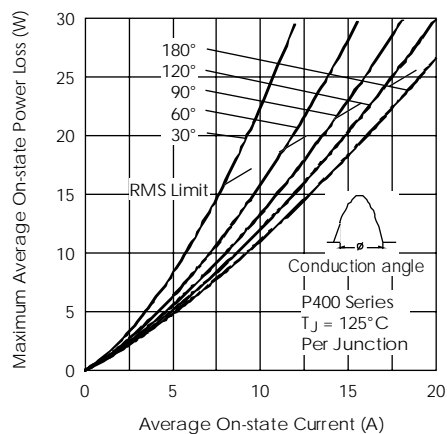


Fig. 2 - On-state Power Loss Characteristics

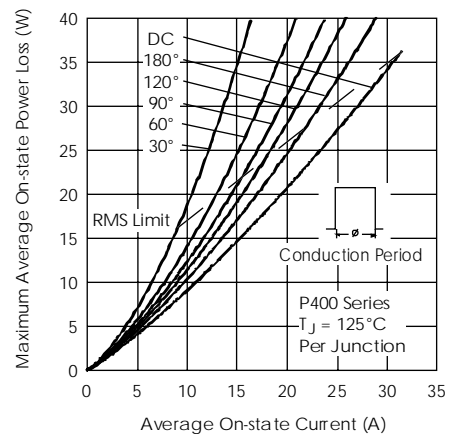


Fig. 3 - On-state Power Loss Characteristics

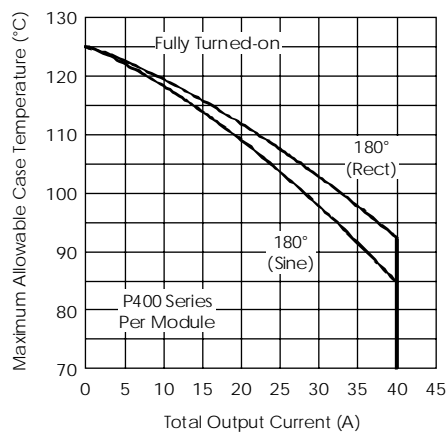


Fig. 4 - Current Ratings Characteristics

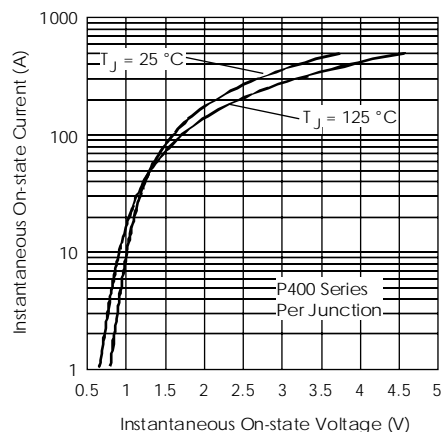


Fig. 5 - On-state Voltage Drop Characteristics

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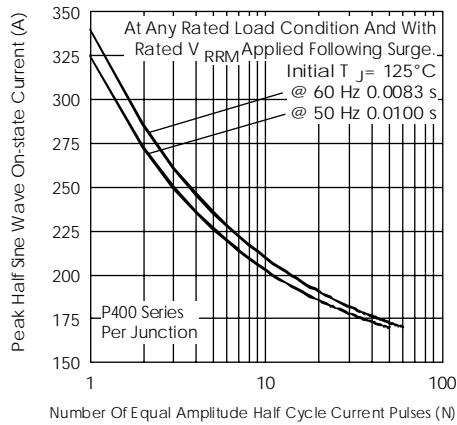


Fig. 6 - Maximum Non-Repetitive Surge Current

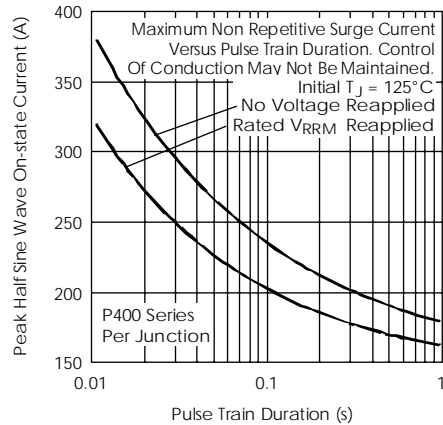


Fig. 7 - Maximum Non-Repetitive Surge Current

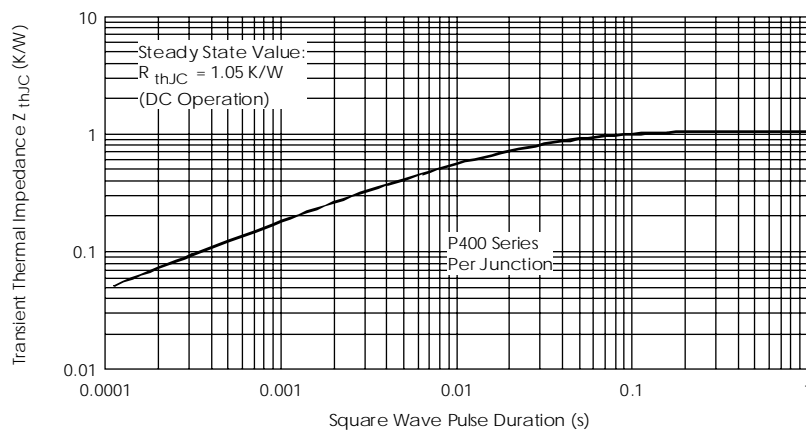


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

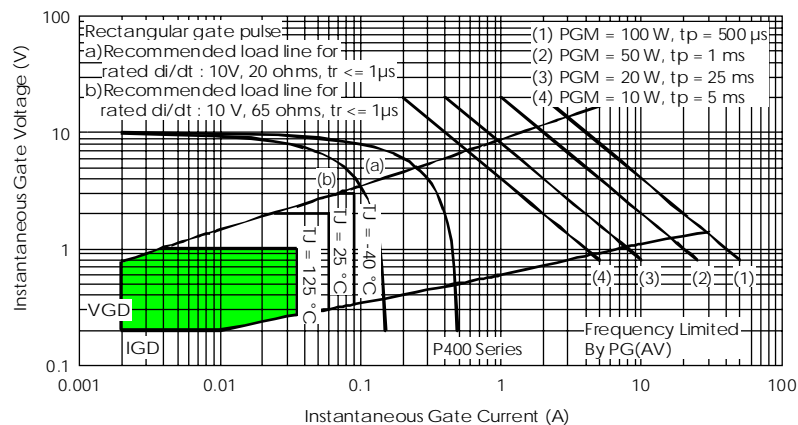


Fig. 9 - Gate Characteristics

