

## Power Modules, Passivated Assembled Circuit Elements, 40 A



PACE-PAK (D-19)

### FEATURES

- Glass passivated junctions for greater reliability
- Electrically isolated base plate
- Available up to 1200  $V_{RRM}/V_{DRM}$
- High dynamic characteristics
- Wide choice of circuit configurations
- Simplified mechanical design and assembly
- UL E78996 approved
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

PRIMARY CHARACTERISTICS	
$I_o$	40 A
Type	Modules - thyristor, standard
Package	PACE-PAK (D-19)

### DESCRIPTION

The VS-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			
SYMBOL	CHARACTERISTICS	VALUES	UNITS
$I_o$	80 °C	40	A
$I_{TSM}$ , $I_{FSM}$	50 Hz	385	A
	60 Hz	400	
$I^2t$	50 Hz	745	A <sup>2</sup> s
	60 Hz	680	
$I^2\sqrt{t}$		7450	A <sup>2</sup> √s
$V_{RRM}$	Range	400 to 1200	V
$V_{ISOL}$		2500	V
$T_J$		-40 to +125	°C
$T_{Stg}$			

### ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS			
TYPE NUMBER	$V_{RRM}/V_{DRM}$ , MAXIMUM REPETITIVE PEAK REVERSE AND PEAK OFF-STATE VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V	$I_{RRM}$ MAXIMUM AT $T_J$ MAXIMUM mA
VS-P401, VS-P421, VS-P431	400	500	10
VS-P402, VS-P422, VS-P432	600	700	
VS-P403, VS-P423, VS-P433	800	900	
VS-P404, VS-P424, VS-P434	1000	1100	
VS-P405, VS-P425, VS-P435	1200	1300	



ON-STATE CONDUCTION					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum DC output current at case temperature	I <sub>O</sub>	Full bridge circuits		40	A
				80	°C
Maximum peak, one-cycle non-repetitive on-state or forward current	I <sub>TSM</sub> , I <sub>FSM</sub>	t = 10 ms	No voltage reapplied	385	A
		t = 8.3 ms			
		t = 10 ms	100 % V <sub>RRM</sub> reapplied	325	
		t = 8.3 ms			
Maximum I <sup>2</sup> t for fusing	I <sup>2</sup> t	t = 10 ms	No voltage reapplied	745	A <sup>2</sup> s
		t = 8.3 ms			
		t = 10 ms	100 % V <sub>RRM</sub> reapplied	530	
		t = 8.3 ms			
Maximum I <sup>2</sup> √t for fusing	I <sup>2</sup> √t	t = 0.1 ms to 10 ms, no voltage reapplied I <sup>2</sup> t for time tx = I <sup>2</sup> √t · √tx		7450	A <sup>2</sup> √s
Low level value of threshold voltage	V <sub>T(TO)1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum		0.83	V
High level value of threshold voltage	V <sub>T(TO)2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum		1.03	
Low level value of on-state slope resistance	r <sub>t1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum		9.61	mΩ
High level value of on-state slope resistance	r <sub>t2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum		7.01	
Maximum on-state voltage drop	V <sub>TM</sub>	I <sub>TM</sub> = π × I <sub>T(AV)</sub>	T <sub>J</sub> = 25 °C	1.4	V
Maximum forward voltage drop	V <sub>FM</sub>	I <sub>FM</sub> = π × I <sub>F(AV)</sub>	T <sub>J</sub> = 25 °C	1.4	V
Maximum non-repetitive rate of rise of turned-on current	di/dt	T <sub>J</sub> = 125 °C from 0.67 V <sub>DRM</sub> I <sub>TM</sub> = π × I <sub>T(AV)</sub> , I <sub>g</sub> = 500 mA, t <sub>r</sub> < 0.5 μs, t <sub>p</sub> > 6 μs		200	A/μs
Maximum holding current	I <sub>H</sub>	T <sub>J</sub> = 25 °C anode supply = 6 V, resistive load		130	mA
Maximum latching current	I <sub>L</sub>			250	

BLOCKING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum critical rate of rise of off-state voltage	dV/dt	T <sub>J</sub> = 125 °C, exponential to 0.67 V <sub>DRM</sub> gate open		200	V/μs
Maximum peak reverse and off-state leakage current at V <sub>RRM</sub> , V <sub>DRM</sub>	I <sub>RRM</sub> , I <sub>DRM</sub>	T <sub>J</sub> = 125 °C, gate open circuit		10	mA
Maximum peak reverse leakage current	I <sub>RRM</sub>	T <sub>J</sub> = 25 °C		100	μA
RMS isolation voltage	V <sub>ISOL</sub>	50 Hz, circuit to base, all terminals shorted, T <sub>J</sub> = 25 °C, t = 1 s		2500	V

TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak gate power	P <sub>GM</sub>			8	W
Maximum average gate power	P <sub>G(AV)</sub>			2	
Maximum peak gate current	I <sub>GM</sub>			2	A
Maximum peak negative gate voltage	-V <sub>GM</sub>			10	V
Maximum gate voltage required to trigger	V <sub>GT</sub>	T <sub>J</sub> = - 40 °C		3	V
		T <sub>J</sub> = 25 °C		2	
		T <sub>J</sub> = 125 °C		1	
Maximum gate current required to trigger	I <sub>GT</sub>	T <sub>J</sub> = - 40 °C		90	mA
		T <sub>J</sub> = 25 °C		60	
		T <sub>J</sub> = 125 °C		35	
Maximum gate voltage that will not trigger	V <sub>GD</sub>	T <sub>J</sub> = 125 °C, rated V <sub>DRM</sub> applied		0.2	V
Maximum gate current that will not trigger	I <sub>GD</sub>			2	mA



THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum junction operating and storage temperature range	$T_J, T_{Stg}$		-40 to +125	°C
Maximum thermal resistance, junction to case per junction	$R_{thJC}$	DC operation	1.05	K/W
Maximum thermal resistance, case to heatsink	$R_{thCS}$	Mounting surface, smooth and greased	0.10	
Mounting torque, base to heatsink <sup>(1)</sup>			4	Nm
Approximate weight			58	g
			2.0	oz.
Case style			PACE-PAK (D-19)	

**Note**

(1) 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

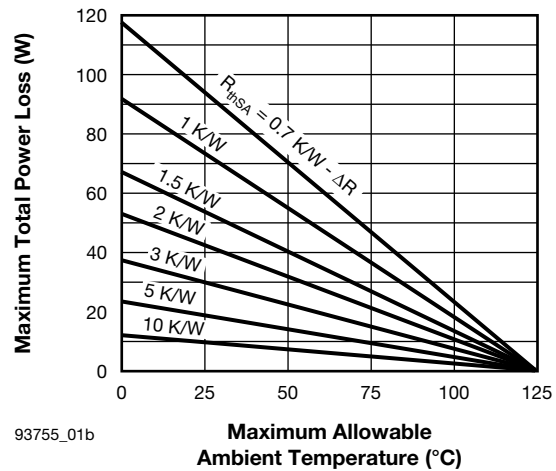
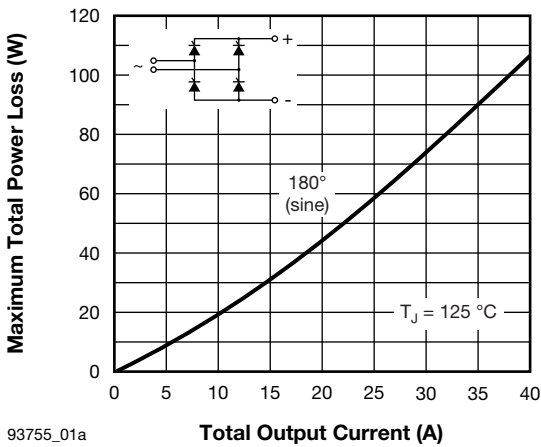


Fig. 1 - Current Ratings Nomogram (1 Module Per Heatsink)

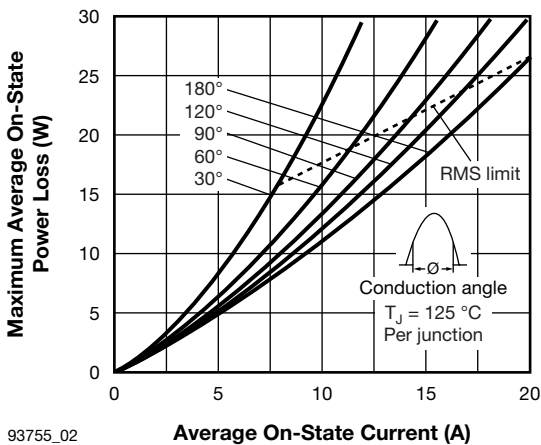


Fig. 2 - On-State Power Loss Characteristics

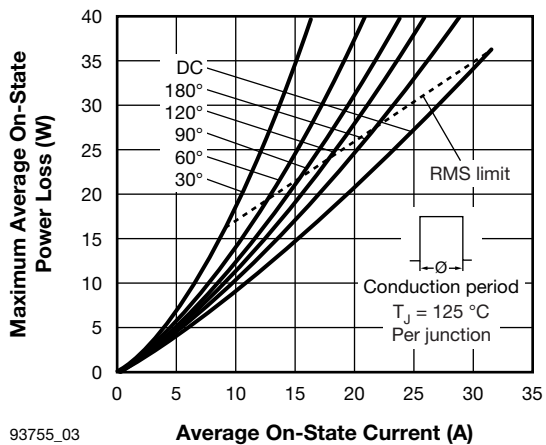
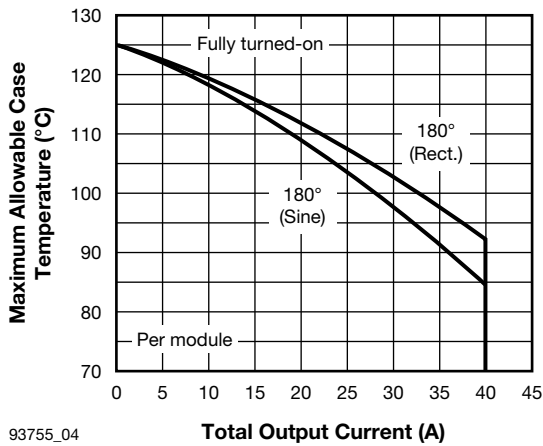
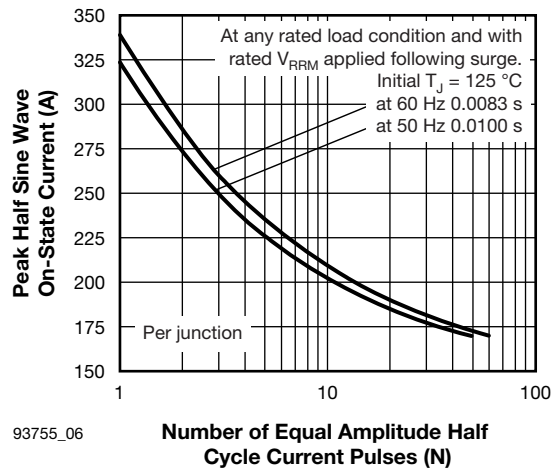


Fig. 3 - On-State Power Loss Characteristics



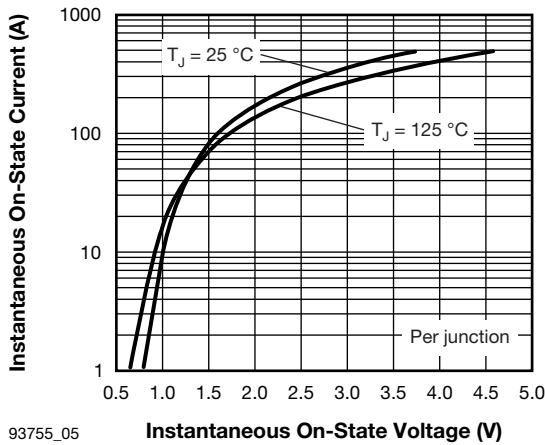
93755\_04

Fig. 4 - Current Ratings Characteristics



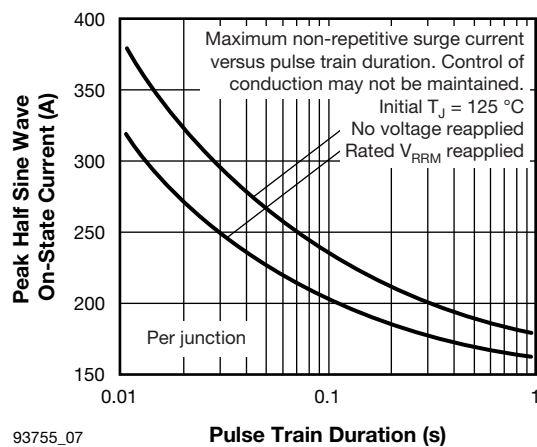
93755\_06

Fig. 6 - Maximum Non-Repetitive Surge Current



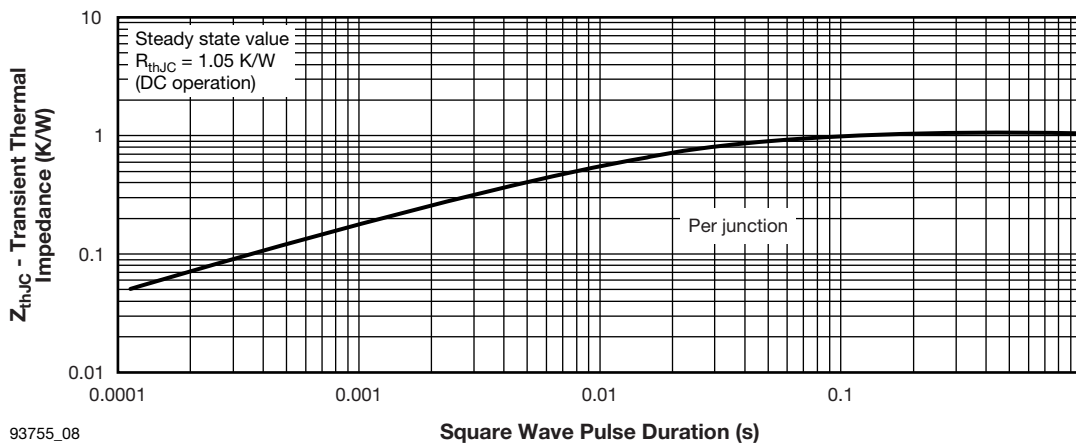
93755\_05

Fig. 5 - On-State Voltage Drop Characteristics



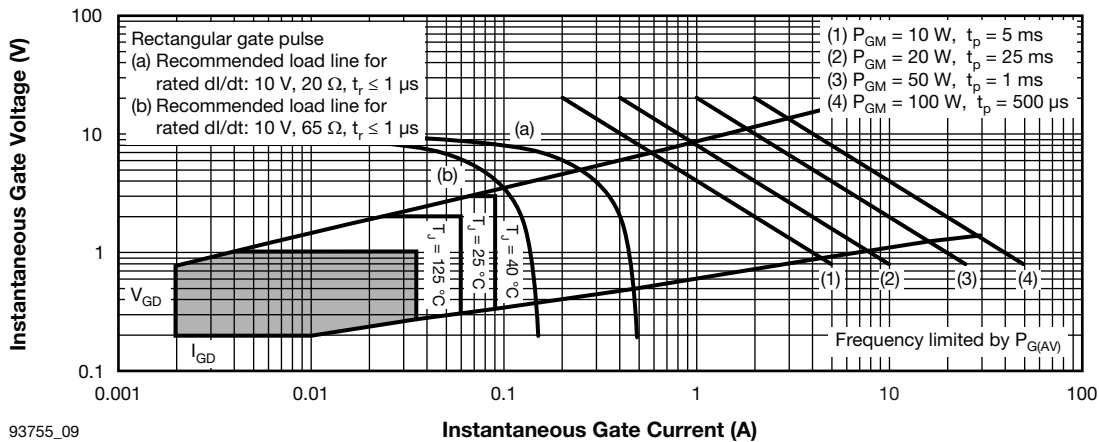
93755\_07

Fig. 7 - Maximum Non-Repetitive Surge Current



93755\_08

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



93755\_09

Fig. 9 - Gate Characteristics

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>P</b>	<b>4</b>	<b>0</b>	<b>2</b>	<b>K</b>	<b>W</b>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

- 1** - Vishay Semiconductors product
- 2** - Module type
- 3** - Current rating  
1 = 25 A DC (P100 series)  
4 = 40 A DC (P400 series)
- 4** - Circuit configuration  
0 = single phase, hybrid bridge common cathode  
2 = single phase, hybrid bridge doubler connection  
3 = single phase, all SCR bridge
- 5** - Voltage code  
1 = 400 V  
2 = 600 V  
3 = 800 V  
4 = 1000 V  
5 = 1200 V
- 6** - K = optional voltage suppression
- 7** - W = optional freewheeling diode

CIRCUIT CONFIGURATION			
CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	SCHEMATIC DIAGRAM	TERMINAL POSITIONS
Single phase, hybrid bridge common cathode	0		
Single phase, hybrid bridge doubler connection	2		
Single phase, all SCR bridge	3		

CODING (1)					
CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	BASIC SERIES	WITH VOLTAGE SUPPRESSION	WITH FREEWHEELING DIODE	WITH BOTH VOLTAGE SUPPRESSION AND FREEWHEELING DIODE
Single phase, hybrid bridge common cathode	0	P40.	P40.K	P40.W	P40.KW
Single phase, hybrid bridge doubler connection	2	P42.	P42.K	-	-
Single phase, all SCR bridge	3	P43.	P43.K	-	-

**Note**

(1) To complete code refer to Voltage Ratings table, i.e.: for 600 V P40.W complete code is P402W

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95335">www.vishay.com/doc?95335</a>





## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.