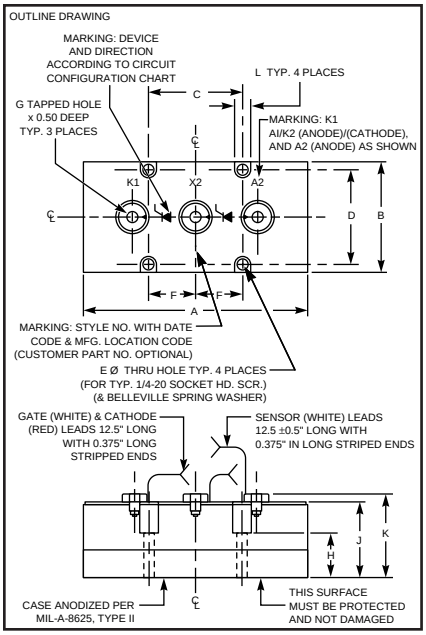
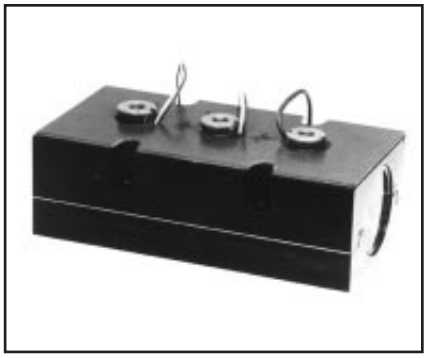
Powerex, Inc., 200 Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

Phase Control Modules

345-800 Amperes/400-3000 Volts



Outline Drawing



POW-R-BRIK™
Phase Control Modules
345-800 Amperes/400-3000 Volts

Z7A Outline

Dimension	Inches	Millimeters
A	6.30	153.16
B	3.02	76.70
C	3.15	80.01
D	2.47	62.73
E	0.328 Dia.	Dia. 8.33
F	1.83	46.48
G	5/16-18 UNC-2B	5/16-18 UNC-2B
H	1.27	32.25
J	2.09	53.08
K	2.25	57.15
L	0.56	14.22

Mounting Bolt (E) Torque Limit is 11 ft.-lb.

Electrical terminal (G) torque limit is 11 ft.-lb. for type Z7A and 20 ft.-lb. for Z9A.

Apply a thin coating of thermal joint compound to heat sink surface prior to module mounting.

Module weights: Z7A weighs 6 lbs. while the Z9A module weighs 11 lbs.

If incoming tests are done for isolation voltage, the voltage should be applied in a slow manner rather than abruptly imposed on the device. The voltage should be applied between the top terminals, which must be shorted together, and the metal case.

The metal case is anodized and provides added voltage isolation capability if not damaged: factory hi-pot test is achieved without the benefit of the anodized coating.

Z9A Outline

Dimension	Inches	Millimeters
A	7.50	190.50
B	3.70	93.98
C	3.15	80.01
D	3.15	80.01
E	0.328 Dia.	Dia. 8.33
F	2.03	51.56
G	3/8-16 UNC-2B	3/8-16 UNC-2B
H	1.51	38.35
J	2.52	64.00
K	2.75	69.85
L	0.56	14.22

Ordering Information:
Select the complete thirteen digit module part number you desire from the Configuration Reference Description.
Example: P3Z7ACT700W16 is a 1600 Volt, 375 Ampere Average, Dual SCR POW-R-BRIK™ Module with the standard thermistor.

Description:
Powerex POW-R-BRIK™ Modules are designed for medium and high current power control applications. POW-R-BRIK™ Modules feature an electrically isolated package that simplifies system packaging, installation and cooling.
POW-R-BRIK™ Modules utilize Compression Bonded Encapsulation (CBE) mounting and double side cooling of the semiconductor elements. The Z7A outline POW-R-BRIK™ uses 33mm or 38mm elements and the Z9A outline POW-R-BRIK™ uses 50mm elements. Standard circuit configurations include Dual SCR, Dual Diode, SCR/Diode, and Diode/SCR. Additional circuit configurations, e.g. Single Element, Common Cathode, Common Anode, and special element types, e.g. Fast Switch SCRs, Fast Recovery Diodes, GTOs, and Transistors are available.

Features:

- ☐ Electrically Isolated Packaging
- ☐ Anodized Aluminum Housing
- ☐ Internal Copper Contacting
- ☐ Gold Element Contacting
- ☐ Internal Temperature Sensor
- ☐ Compression Element Contacting

Applications:

- ☐ AC Motor Starters
- ☐ DC Motor Controls
- ☐ Resistance Welding Controls
- ☐ Mining Power Centers
- ☐ High Voltage Motor Starters
- ☐ Transportation Systems

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POW-R-BRIK™
Phase Control Modules
345-800 Amperes/400-3000 Volts

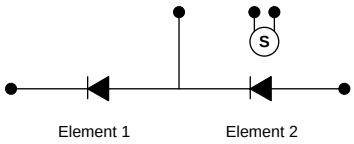
Configuration Reference:
The POW-R-BRIK™ part number system takes the form *P3 Z7A CT7 00 W16* where:

- *P3* is the configuration number. The configurations are shown pictorially in the right hand column.
- *Z7A* is the package type per the outline drawings Z7A and Z9A on this data sheet.
- *CT7* denotes the element code. The Element Code Reference at the end of this data sheet provides information on the standard element codes including the corresponding disc device using the element. Refer to the appropriate disc package data sheets in the Powerex Semiconductor Data Book for additional device specifications.
- *00* denotes special features:
  00 – module includes standard thermistor
  XT – no thermistor
  AA-ZZ – denotes unique customer specification
- *W16* denotes voltage code per the table below. Note that not all voltage ratings are available for every element. Refer to the Element Code Reference for available voltage ranges for a given element.

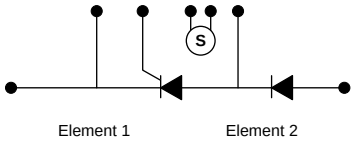
Elements Voltage Rating	Voltage Code
400	V04
600	V06
800	V08
1000	W10
1200	W12
1400	W14
1600	W16
1800	W18
2000	W20
2200	W22
2400	W24
2600	W26
2800	W28
3000	W30

Circuit Configurations:

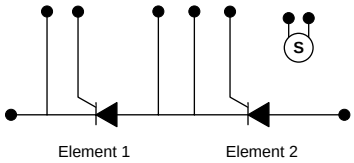
P1 - DIODE
P4 - FAST DIODE*



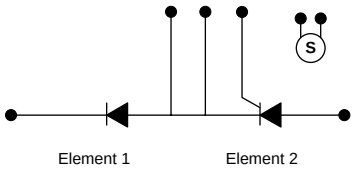
P2 - SCR/DIODE
P5 - FAST SCR/FAST DIODE*



P3 - SCR/SCR
P6 - FAST SCR/FAST SCR*



P7 - DIODE/SCR
P8 - FAST DIODE/FAST SCR*



* Consult Factory for Available Ratings.

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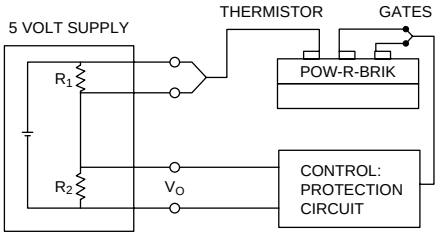
POW-R-BRIK™
Phase Control Modules
345-800 Amperes/400-3000 Volts

Typical Thermistor Circuit

Thermistor temperatures can be measured using the following circuit arrangement in conjunction with a 5 volt source. Resistance values for R_1 and R_2 are specified for two operating temperature ranges.



1. Temperature range, 75°C through 125°C
   R_1 = 3.5K ohms
   R_2 = 840 ohms
   V_0 = 2.5 volts at 100°C

2. Temperature range, 90°C through 140°C
   R_1 = 2.2K ohms
   R_2 = 500 ohms
   V_0 = 2.45 volts at 115°C

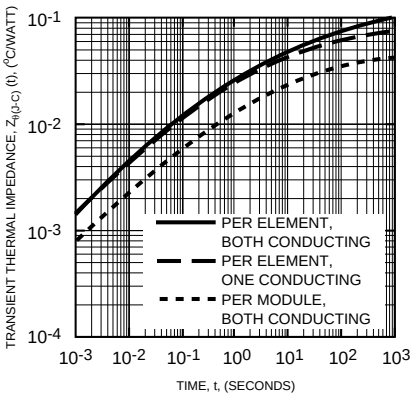
The output signal (V_0) is approximately 30 mv/°C over the temperature range indicated.

POW-R-BRIK™ Thermistor Characteristics

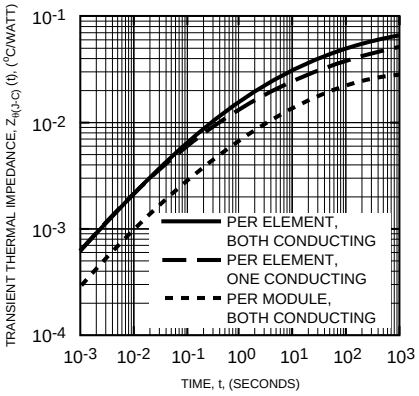
Thermistor Resistance Ohms ①	Thermistor Temp. °C ②	Element Average Temperature Steady State °C (Min.) ③	Element Average Temperature Dynamic °C (Max.)
12093	40	43	50
7337	50	53	60
4990	60	63	70
3324	70	73	80
2262	80	83	90
1569	90	93	100
1316	95	98	105
1109	100	103	110
938	105	108	115
797	110	113	120
680	115	118	125
582	120	123	130
500	125	128	135
431	130	133	140

① Curve matched ±2% over temperature range of +40°C to +125°C. Resistance tolerance specified at +125°C, ±6%.
② Without self heating, 10mW maximum thermistor dissipation.
③ Use "Sensor at T_j" ohms from characteristics for recommended steady state overload trip resistance.

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (JUNCTION-TO-CASE) Z7A



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (JUNCTION-TO-CASE) Z9A



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POW-R-BRIK™
Phase Control Modules
345-800 Amperes/400-3000 Volts

Maximum Ratings and Electrical Characteristics

	Voltage Gate Current, Speed of Element*													Isolation Voltage**		Strike Distance	
	Voltage					Gate		Current				Speed					
Part Number	V_{DRM}/V_{RRM} ① E1 (V)	E2 (V)	V_{RSM} E1 (V)	E2 (V)	dv/dt ①② (V/μs)	V_{GT} (V)	I_{GT} (mA)	di/dt ③④ (A/μs)	I_{DRM}/I_{RRM} ① E1 (mA)	E2 (mA)	I_{TSM}/I_{FSM} ⑤ E1 (kA)	E2 (kA)	SCR t_q (μs)	Diode t_{rr} (μs)	V_{RMS} (V)	I_{RMS} (mA)	Terminals to Case (In.)	K_1/A_1 K_2/A_2 (In.)
Diode/Diode																		
P1Z7AAR700W_ _	3000	3000	3100	3100	—	—	—	—	50	50	7	7	—	15	3000	1.10	0.70	1.00
P1Z7ABR700W_ _	2200	2200	2300	2300	—	—	—	—	50	50	9	9	—	10	2500	0.92	0.70	1.00
P1Z9AAR900W_ _	3000	3000	3100	3100	—	—	—	—	150	150	16	16	—	20	3000	1.70	1.00	1.15
P1Z9ACR900W_ _	1200	1200	1300	1300	—	—	—	—	150	150	30	30	—	15	2500	1.50	1.00	1.15
P1Z9ADR900V_ _	600	600	700	700	—	—	—	—	150	150	50	50	—	10	2500	1.50	1.00	1.15
Half Control SCR/Rectifier ①																		
P2Z7ABB700W_ _	2200	2200	2300	2300	300	3	150	600	30	30	9	9	150	10	2500	0.92	0.70	1.00
P2Z7ACB700W_ _	1600	1600	1700	1700	300	3	150	600	30	30	10	14	150	8	2500	0.92	0.70	1.00
P2Z9AAA900W_ _	3000	3000	3100	3100	300	3	200	600	150	150	15	16	400	20	3000	1.70	1.00	1.15
P2Z9ABA900W_ _	2000	2000	2100	2100	300	3	200	600	75	75	17	16	250	20	2500	1.50	1.00	1.15
P2Z9ACA900W_ _	1600	1600	1700	1700	300	3	200	600	75	75	25	16	150	20	2500	1.50	1.00	1.15
Full Control SCR/SCR																		
P3Z7ABT700W_ _	2200	2200	2300	2300	300	3	150	600	30	30	9	9	150	—	2500	0.92	0.70	1.00
P3Z7ACT700W_ _	1600	1600	1700	1700	300	3	150	600	30	30	10	10	150	—	2500	0.92	0.70	1.00
P3Z7AAT800W_ _	3000	3000	3100	3100	300	3	150	600	35	35	9	9	200	—	2500	0.92	0.70	1.00
P3Z7ABT800W_ _	2200	2200	2300	2300	300	3	150	600	35	35	12	12	200	—	2500	0.92	0.70	1.00
P3Z7ACT800W_ _	1400	1400	1500	1500	300	3	150	600	35	35	15	15	200	—	2500	0.92	0.70	1.00
P3Z9AAT900W_ _	3000	3000	3100	3100	300	3	200	600	150	150	15	15	400	—	3000	1.70	1.00	1.15
P3Z9ABT900W_ _	2000	2000	2100	2100	300	3	200	600	75	75	17	17	250	—	2500	1.50	1.00	1.15
P3Z9ACT900W_ _	1600	1600	1700	1700	300	3	200	600	75	75	25	25	150	—	2500	1.50	1.00	1.15
Half Control Rectifier/SCR ⑧																		
P7Z7ABB700W_ _	2200	2200	2300	2300	300	3	150	600	30	30	9	9	150	10	2500	0.92	0.70	1.00
P7Z7ABC700W_ _	1600	1600	1700	1700	300	3	150	600	30	30	14	10	150	8	2500	0.92	0.70	1.00
P7Z9AAA900W_ _	3000	3000	3100	3100	300	3	200	600	150	150	16	15	400	20	3000	1.70	1.00	1.15
P7Z9AAB900W_ _	2000	2000	2100	2100	300	3	200	600	75	75	16	17	250	20	2500	1.50	1.00	1.15
P7Z9AAC900W_ _	1600	1600	1700	1700	300	3	200	600	75	75	16	25	150	20	2500	1.50	1.00	1.15

① Applies for zero or negative gate bias.
② Higher dv/dt ratings available, consult factory.
③ With recommended gate drive.
④ Per JEDEC standard RS-397, 5.2.2.6.
⑤ Per JEDEC RS-397, 5.2.2.1.
⑥ Bottom side cooled.
⑦ Consult recommended mounting procedures.
⑧ Designs are available for "Current Source Inverter" applications, consult factory.
⑨ Reflects substantial derating necessary with single 0.08°C/W or 0.10°C/W sink.
* Element location indicated by E1 or E2.
** Hi-Pot. 60Hz, 1 min. test

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POW-R-BRIK™
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345-800 Amperes/400-3000 Volts

Part Number	Current and Thermal Ratings of Module								Circuit Currents					Element Data Model*	
	Current			Thermal					Units per Sink →	1 AC Switch	3 AC Switch⑨	2 1∅ Bridge	3 3∅ Bridge⑨		
	$I_{T(av)}$⑥ (A)	@T_C (°C)	Maximum Power Dissipation (W)	T_j (°C)	Sensor @T_j (Ω)	$R_{\theta(J-C)}$ per Module (°C/W)	$R_{\theta(C-S)}$ per Module⑦ (°C/W)	$R_{\theta(C-A)}$ (°C/W)	T_A (°C)	I_{RMS} (A)	I_{RMS} (A)	I_{DC} (A)	I_{DC} (A)	E1	E2
Diode/Diode															
P1Z7AAR700W_ _	355	105	1125	150	315	0.04	0.010	0.10	40	—	—	385	400	AR7	AR7
P1Z7ABR700W_ _	435	105	1125	150	315	0.04	0.010	0.10	40	—	—	440	465	BR7	BR7
P1Z9AAR900W_ _	590	105	1500	150	315	0.03	0.008	0.08	40	—	—	570	600	AR9	AR9
P1Z9ACR900W_ _	740	105	1500	150	315	0.03	0.008	0.08	40	—	—	670	705	CR9	CR9
P1Z9ADR900V_ _	800	110	1330	150	315	0.03	0.008	0.08	40	—	—	775	805	DR9	DR9
Half Control SCR/Diode ⑧															
P2Z7ABB700W_ _	380	85	1100	130	530	0.04	0.010	0.10	40	560	275	330	350	BT7	BR7
P2Z7ACB700W_ _	395	85	1100	130	530	0.04	0.010	0.10	40	590	290	345	365	CT7	BR7
P2Z9AAA900W_ _	430	85	1325	125	640	0.03	0.008	0.08	40	630	310	370	390	AT9	AR9
P2Z9ABA900W_ _	520	85	1465	130	530	0.03	0.008	0.08	40	740	365	435	460	BT9	AR9
P2Z9ACA900W_ _	590	85	1465	130	530	0.03	0.008	0.08	40	800	385	470	495	CT9	AR9
Full Control SCR/SCR															
P3Z7ABT700W_ _	345	85	1095	130	530	0.04	0.010	0.10	40	505	250	300	315	BT7	BT7
P3Z7ACT700W_ _	375	85	1095	130	530	0.04	0.010	0.10	40	550	270	320	335	CT7	CT7
P3Z7AAT800W_ _	300	85	1095	130	530	0.04	0.010	0.10	40	445	220	255	265	AT8	AT8
P3Z7ABT800W_ _	390	85	1095	130	530	0.04	0.010	0.10	40	560	275	330	345	BT8	BT8
P3Z7ACT800W_ _	450	85	1095	130	530	0.04	0.010	0.10	40	630	300	385	405	CT8	CT8
P3Z9AAT900W_ _	355	85	1295	125	640	0.03	0.008	0.08	40	535	260	310	330	AT9	AT9
P3Z9ABT900W_ _	470	85	1460	130	530	0.03	0.008	0.08	40	675	335	400	420	BT9	BT9
P3Z9ACT900W_ _	600	85	1460	130	530	0.03	0.008	0.08	40	815	375	460	480	CT9	CT9
Half Control SCR/Diode ⑧															
P7Z7ABB700W_ _	380	85	1100	130	530	0.04	0.010	0.10	40	560	275	330	350	BR7	BT7
P7Z7ABC700W_ _	395	85	1100	130	530	0.04	0.010	0.10	40	590	290	345	365	BR7	CT7
P7Z9AAA900W_ _	430	85	1325	125	640	0.03	0.008	0.08	40	630	310	370	390	AR9	AT9
P7Z9AAB900W_ _	520	85	1465	130	530	0.03	0.008	0.08	40	740	365	435	460	AR9	BT9
P7Z9AAC900W_ _	590	85	1465	130	530	0.03	0.008	0.08	40	800	385	470	495	AR9	CT9

① Applies for zero or negative gate bias.
② Higher dv/dt ratings available, consult factory.
③ With recommended gate drive.
④ Per JEDEC standard RS-397, 5.2.2.6.
⑤ Per JEDEC RS-397, 5.2.2.1.
⑥ Bottom side cooled.
⑦ Consult recommended mounting procedures.
⑧ Designs are available for "Current Source Inverter" applications, consult factory.
⑨ Reflects substantial derating necessary with single 0.08°C/W or 0.10°C/W sink.
* Reference element data model on the following page.

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Element Code Reference

Element Code	Element Type	Comparable Disc Device	Available Voltage Range	Coefficients for V_{TM}, V_F, Model① ② A	B	C	D
AR7	33mm Diode	R7S0 _ _ 08XX00	2200-3000	0.89605	-0.08108	0.00045	0.02836
BR7	33mm Diode	R7S0 _ _ 12XX00	1200-2200	0.63200	-0.02192	0.00013	0.02065
CR7③	33mm Diode	R7S0 _ _ 16XX00	800-1200	0.45000	0.02800	0.00008	0.01128
AR9	50mm Diode	R9G0 _ _ 12XX00	2200-3000	0.39964	0.05540	0.00024	0.00319
CR9	50mm Diode	R9G0 _ _ 18XX00	800-1200	0.60627	-0.00168	0.00005	0.00766
DR9	50mm Diode	R9G0 _ _ 22XX00	400-800	0.46319	0.02950	0.00006	0.00061
BT7	33mm SCR	T7S0 _ _ 6504DN	1400-2200	0.74419	0.00380	0.000325	0.01882
CT7	33mm SCR	T7S0 _ _ 7504DN	800-1600	0.58729	0.06654	0.000416	0.00060
AT8	38mm SCR	T820 _ _ 6003DH	2200-3000	1.02841	0.13475	0.001179	-0.03631
BT8	38mm SCR	T820 _ _ 7503DH	1200-2200	0.88287	-0.07743	0.00010	0.03081
CT8	38mm SCR	T820 _ _ 9003DH	800-1400	1.08412	-0.13881	-0.00013	0.03756
AT9	50mm SCR	T9G0 _ _ 0803DH	2200-3000	1.43303	-0.10092	0.000620	0.01789
BT9	50mm SCR	T9G0 _ _ 1003DH	1200-2000	0.96195	-0.08755	0.000074	0.03286
CT9	50mm SCR	T9G0 _ _ 1203DH	800-1600	0.55570	0.05740	0.000135	0.00104
9HP③	50mm SCR	T9GH _ _ 0903DH	1200-2200	0.95642	-0.00285	0.000225	-0.00178

① V_{TM}, $V_F = A + B \times LN(I) + C \times I + D \times \sqrt{I}$ (I = Amps Peak)
② Coefficients are for T_j = 130°C, 50A through 3000A Peak
③ Module ratings for these elements are not shown, consult factory.