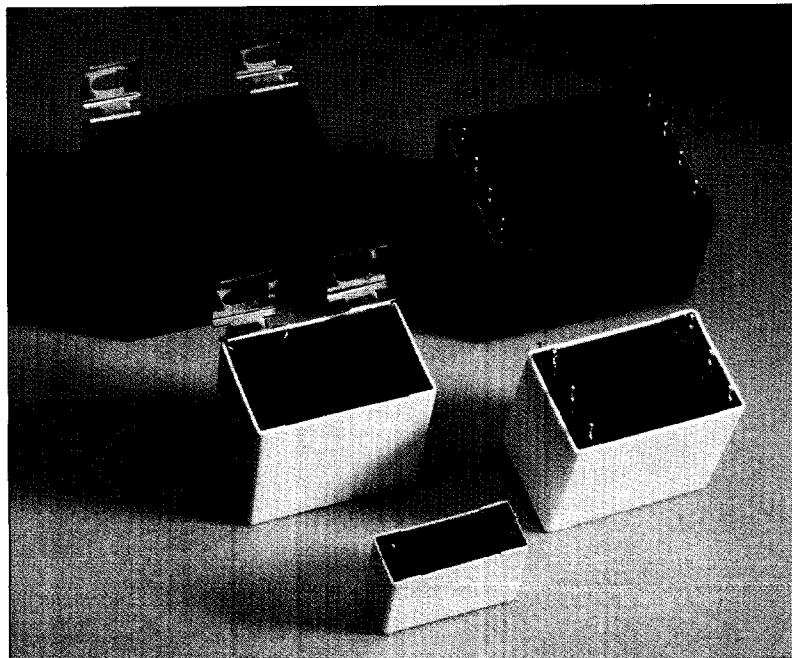


IGBT Snubber Capacitors for Power Electronics

from Aerovox® Group an ISO 9002 Company



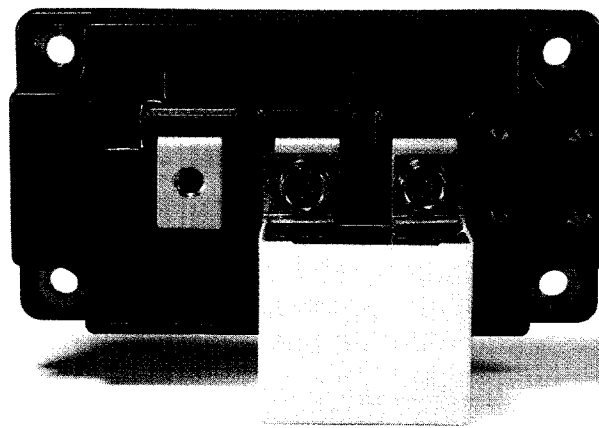
- Low inductance to 12 nanoHenries
- High DV / DT
- Low ESR
- Low loss polypropylene dielectric
- UL 94 V-O flame retardant case and resin
- Terminals
 - Direct mount to IGBT
 - Unique dual in-line package (DIP)
 - Radial wire lead
 - Enhanced solderability
 - (Mil-Std 202 F, Method 208 G)

Why use Snubber Capacitors?

With the evolution of power technology, new higher speed Insulated Gate Bipolar Transistors (IGBTs) make it possible for high power inverters to operate up to 20 kHz or more. IGBTs are replacing the slower Darlington transistors, simplifying circuit design and reducing end product cost. IGBT power modules are now being designed into AC and DC motor drive inverters, uninterruptible power systems, electric vehicles and alternative energy production systems.

Power systems containing IGBTs must be designed so the transient voltage caused by the high di/dt that occurs at gate turn off is minimized. Left uncontrolled, this transient voltage can exceed the blocking voltage rating of the IGBT and cause it to fail. To reduce the transient voltage, either di/dt or the parasitic DC bus inductance of the power circuit must be reduced. This is best achieved by decoupling the parasitic bus inductance using a non-inductive wound film capacitor mounted as near as possible to the IGBT module's terminals.

Snubber capacitors, constructed of polypropylene film dielectric and dual metallized film electrodes, are the optimal capacitor design for IGBT applications. While film/foil capacitors are often used because of their superior current carrying capability, they fail in a short circuit mode which may cause damage to the IGBT module. Aerovox's snubber capaci-



tors combine high current carrying capability with low inductance, low dielectric losses, and capacitance stability across a wide frequency range. They offer the self-healing property of metallized film (not failing in a short circuit mode) with the high peak current carrying capability (dv/dt) of film/foil construction.

Aerovox's snubber capacitors, manufactured with polypropylene film and dual metallized electrodes, available with direct IGBT module terminals, radial wire leads, or a unique printed circuit board dual in-line pin mount, provide the highest electrical performance of any snubber capacitors currently available.

IGBT SNUBBER CAPACITORS for Power Electronics

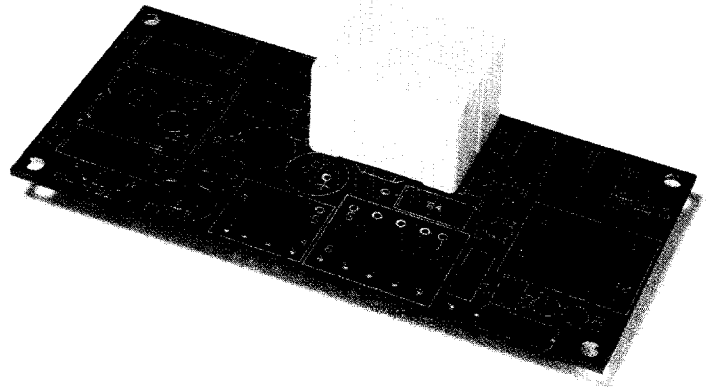
General Description

Dielectric: Polypropylene film with self-healing dual metallized electrodes.

Enclosure: UL 94 V-O flame retardant rectangular plastic case and resin.

Marking: Ink stamped with Aerovox, part number, capacitance value, nominal DC voltage, and date code, at a minimum.

Terminals: Tinned copper, terminal sizes and styles are specified in outline drawings on page 4.



Electrical Characteristics

Capacitance: Values from 0.1 μF to 3 μF are available at $\pm 10\%$ tolerance measured at 1 kHz, 25°C.

Voltage: Available at 1000 and 1600 VDC as standard ratings. (Consult factory for other ratings.)

Temperature: -40° to +85°C. From 85° to 105°C derate DC voltage 1% / °C, AC voltage 1.5% / °C.

Dissipation Factor: <0.1% at 1 kHz, 25°C.

Insulation Resistance: >100,000 megohms x μF at 100 VDC measured after 2 minutes.

Equivalent Series Resistance: Refer to Type RBPS ratings on page 3.

Dielectric Strength: Capacitors will withstand 1.6 x rated voltage for a period of 60 seconds.

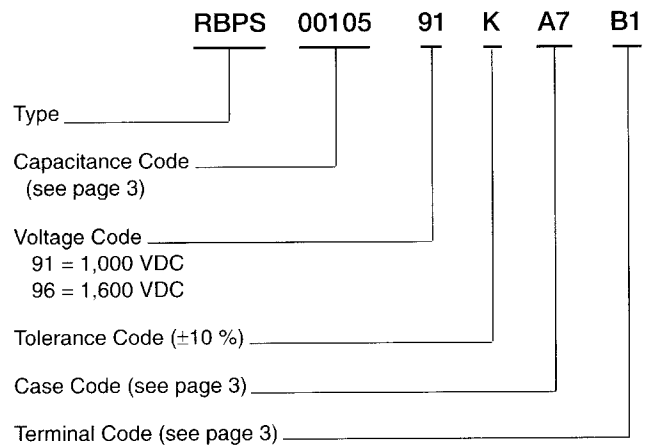
Capacitance Change with Temperature: (-250 ppm \pm 100 ppm) / °C.

Equivalent Series Inductance (ESL): The value is determined by the terminal option selected and is measured at resonant frequency. Refer to table below.

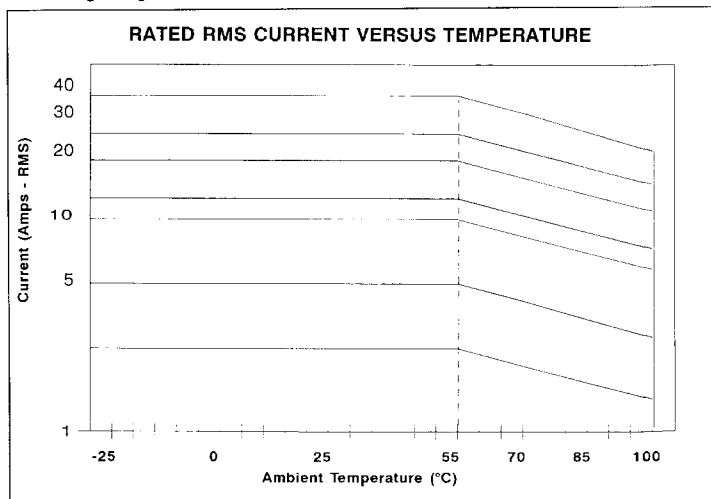
Equivalent Series Inductance		
Terminal Description	Terminal Style	Maximum Inductance nanoHenries
Radial Lead	2L	30
Circuit Mounted, 2 pins per side	2P	15
Circuit Mounted, 3 pins per side	3P	15
Circuit Mounted, 4 pins per side	4P	15
Direct Mounted, 22 to 31 mm centers	B1	20
Direct Mounted, 39 to 48 mm centers	B2	20

Part Numbering System

Example: 1.0 μF 1,000 VDC $\pm 10\%$ Direct Mounted, 22 to 31 mm centers



Ripple Current: The Maximum Rms current is the maximum current flowing through the capacitor at an ambient case temperature of 55°C. This value changes with temperature as shown in the following diagram.



Aerovox® Group
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Test Specifications

Accelerated Life:

Test Conditions DC

- Temperature • 85°C ± 5.0°C
- Applied Voltage • 1.25 x rated DC voltage
- Test Duration • 1,000 hours

Performance Requirements

- Capacitance • Delta of ≤ 5.0%
- ESR • ≤ 125% of initial limit
- Insulation Resistance • > 50% of initial limit

Humidity:

Test Conditions

- Temperature • 40°C ± 3.0°C
- Applied Voltage • Zero voltage
- Humidity • 93% ± 5% RH
- Test Duration • 500 hours

Performance Requirements

- Capacitance • Delta of ≤ 3.0%
- Insulation Resistance • 10% of initial limit
- ESR • ≤ 125% of initial limit

Resistance to Solder Heat:

Test Conditions

- Solder Temperature • 260°C ± 5.0°C
- Test Duration • 10 seconds ± 1 second

Performance Requirements

- Capacitance • Delta of ≤ 2.0%

Accelerated Pulse Handling Capability:

Test Conditions

A capacitor under test will be charged through an impedance of a magnitude greater than the discharging impedance. The capacitor under test will be charged to the rated DC voltage and discharged through an impedance capable of producing a minimum voltage gradient with time (DV/DT). The test will be performed in accordance with the requirements for the voltage gradient multiplier and charge and discharge cycles as listed below.

Voltage Gradient Multiplier	Test Cycles
6x	100
4x	1000
2x	1 million

Example: An RBPS part rated 1.0 µF 1,000 VDC has a DV/DT rating of 600 volts per microsecond. This part would be capable of withstanding 100 cycles at a minimum of 3,600 volts/microsecond, 1,000 cycles at 2,400 volts/microsecond, or 1 million cycles at 1,200 volts/microsecond.

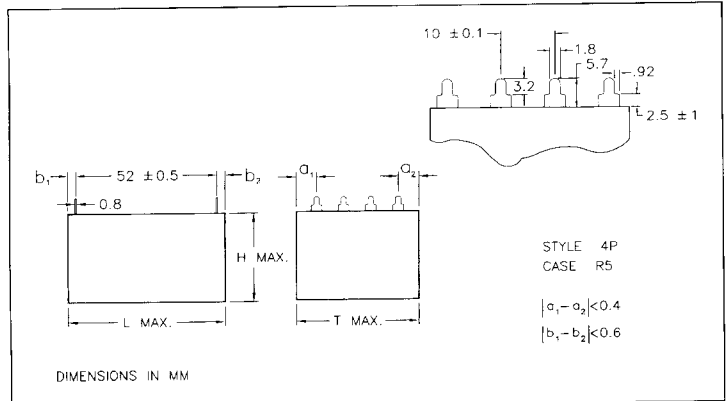
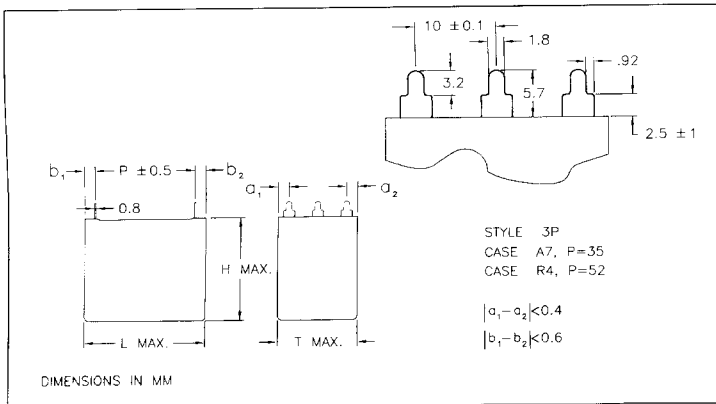
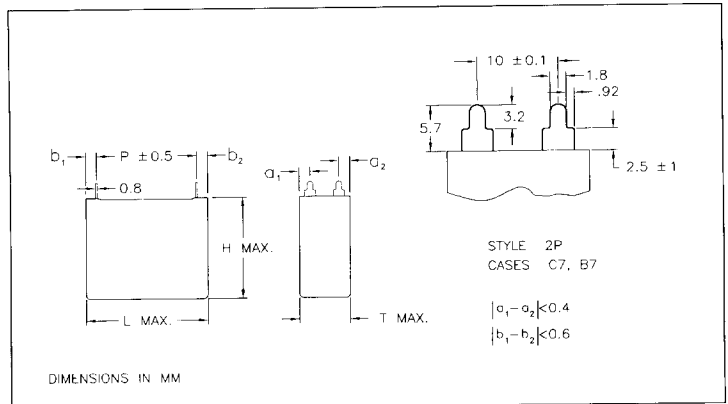
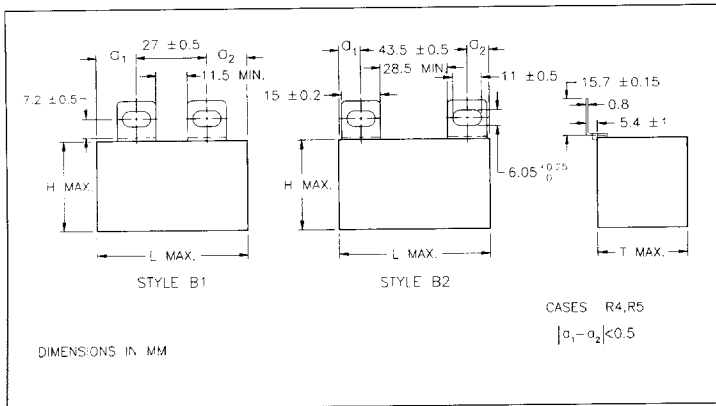
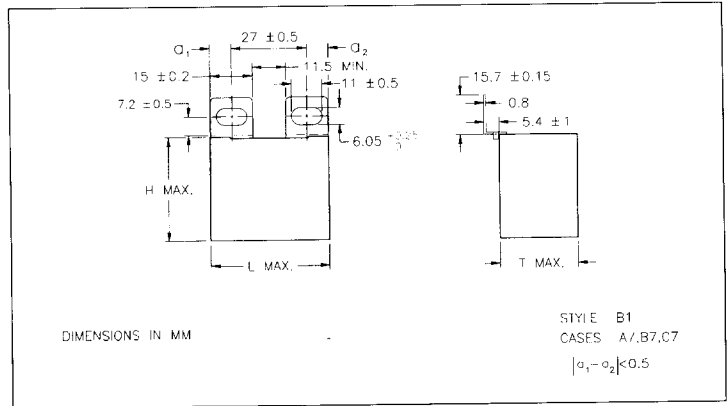
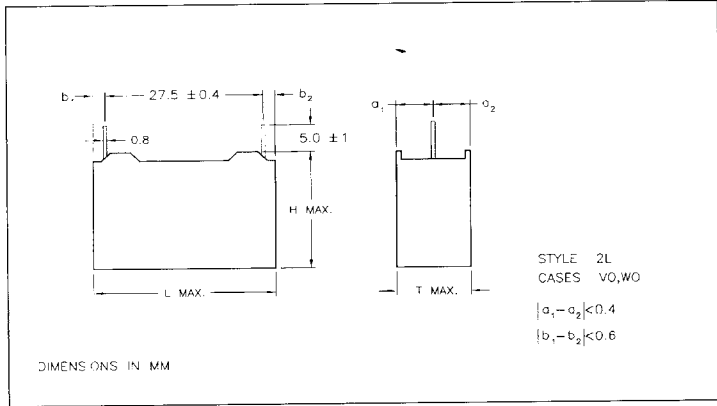
Performance Criteria After Testing

- Capacitance • Delta ≤ 3%
- ESR • Absolute value ≤ 150% of original measured value

Type RBPS Rated 1000 VDC (530 VAC @ 60 Hz)							
Capacitance		Case Code	DV / DT V/ µ sec	I _{peak} Amps	I _{rms} Max Amps @55°C	ESR Max @100 kHz mOhms	Terminal Option(s)
(µF)	Code						
.10	00104	V0	1000	100	5.3	16	2L
.15	00154	V0	1000	150	5.5	15	2L
.22	00224	W0	1000	220	6.6	12	2L
.27	00274	C7	700	245	10.0	12	2P, B1
.33	00334	C7	700	300	10.9	10	2P, B1
.39	00394	C7	700	310	11.5	9	2P, B1
.47	00474	C7	700	375	12.2	8	2P, B1
.56	00564	B7	700	450	14.0	8	2P, B1
.68	00684	B7	700	450	15.0	8	2P, B1
.75	00754	B7	700	525	15.0	8	2P, B1
.82	00824	A7	600	490	17.2	8	3P, B1
1.00	00105	A7	600	600	18.4	7	3P, B1
1.20	00125	A7	500	600	18.5	7	3P, B1
1.50	00155	R4	500	750	21.7	7	3P, B1, B2
1.75	01754	R4	500	875	22.0	7	3P, B1, B2
2.00	00205	R4	450	900	22.5	7	3P, B1, B2
2.20	00225	R5	450	990	26.0	7	4P, B1, B2
2.50	00255	R5	400	1000	27.0	7	4P, B1, B2
3.00	00305	R5	400	1200	30.0	6	4P, B1, B2

Type RBPS Rated 1600 VDC (630 VAC @ 60 Hz)							
Capacitance		Case Code	DV / DT V/ µ sec	I _{peak} Amps	I _{rms} Max Amps @55°C	ESR Max @100 kHz mOhms	Terminal Option(s)
(µF)	Code						
.10	00104	W0	1200	120	5.7	16	2L
.15	00154	C7	1000	150	8.9	15	2P, B1
.22	00224	C7	1000	220	10.0	12	2P, B1
.27	00274	B7	850	230	12.0	12	2P, B1
.33	00334	B7	850	280	13.4	10	2P, B1
.39	00394	A7	850	330	16.0	9	3P, B1
.47	00474	A7	850	400	17.2	8	3P, B1
.56	00564	A7	850	475	17.5	8	3P, B1
.68	00684	R4	700	475	20.0	8	3P, B1, B2
.75	00754	R4	600	450	20.5	8	3P, B1, B2
.82	00824	R4	600	490	21.0	8	3P, B1, B2
1.00	00105	R4	600	600	21.7	7	3P, B1, B2
1.20	00125	R5	600	720	26.0	7	4P, B1, B2
1.50	00155	R5	600	900	28.0	7	4P, B1, B2

IGBT SNUBBER CAPACITORS for Power Electronics



Case Codes and Dimensions (mm)				
Case Code	T	H	L	P
V0	11.0	20.0	32.1	27.5
W0	13.0	22.0	32.1	27.5
C7	17.0	28.0	42.7	35.0
B7	22.1	30.1	42.7	35.0
A7	28.2	37.3	42.7	35.0
R4	29.2	41.2	58.5	52.0
R5	46.0	36.0	58.7	52.0

Represented by:

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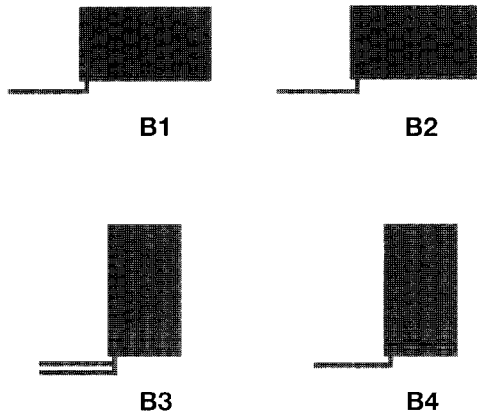
IGBT Snubber Capacitors for Power Electronics

New IGBT Snubber Capacitors

Aerovox has added 630 VDC and 1250 VDC snubber capacitors to the RBPS product line. The 630 VDC RBPS offers a smaller package for lower voltage snubber applications. The 1250 VDC RBPS fills the gap between the 1000 VDC and 1600 VDC products already available in the RBPS line.

Aerovox's new IGBT Snubber capacitors also offer a new terminal style that allows for 90° (perpendicular) positioning on the IGBT as compared to the direct mount models (B1 and B2). This new terminal style is available in case sizes A7, B7 and C7.

Terminal options in the new design are an offset style (B3) that is a requirement for a proper fit on some IGBTs, and terminals (B4) that are positioned an even distance from the capacitor.



See the reverse side of this data sheet for detailed drawings of Aerovox's new IGBT capacitors.

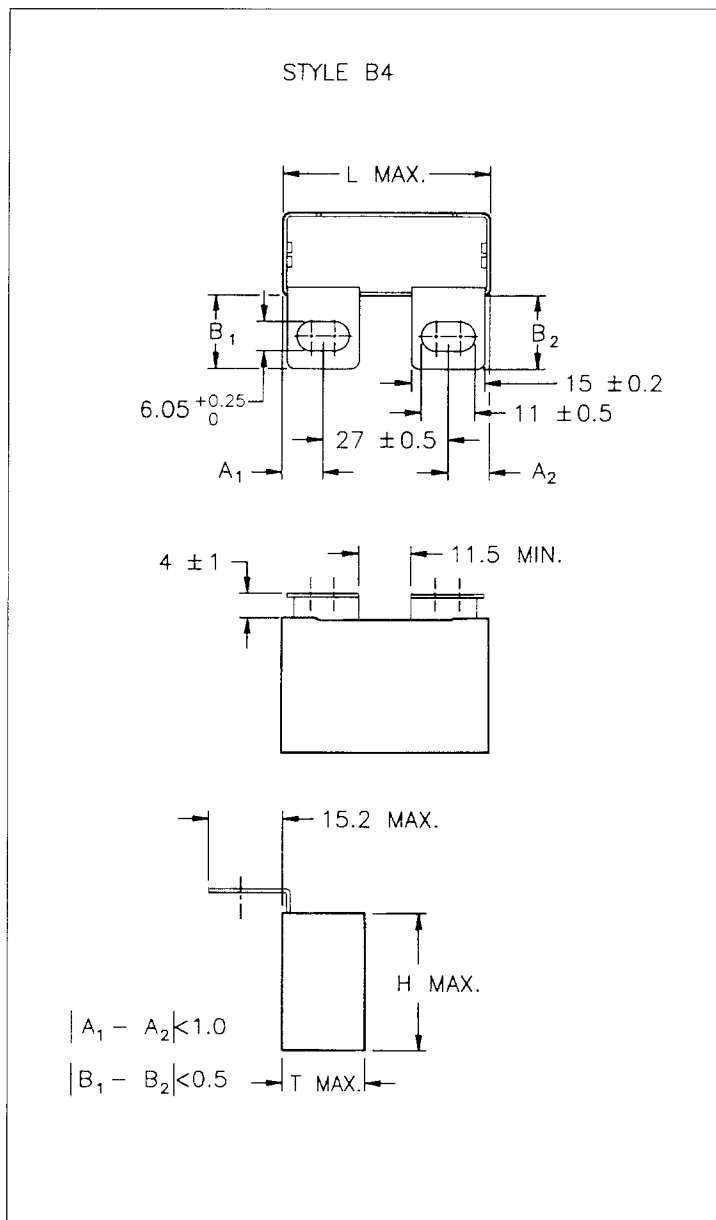
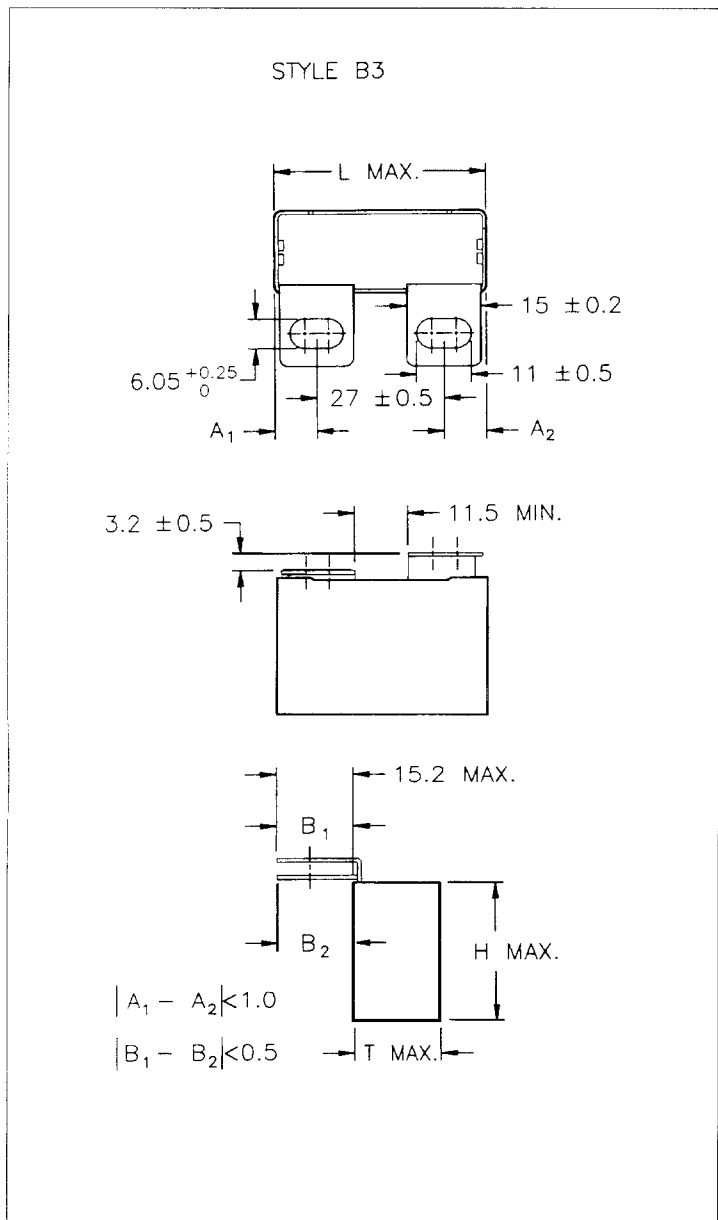
New Terminal Options				
Case Code	Terminal Code	Maximum Inductance nanoHenries	Terminal Codes	Maximum Induction nanoHenries
W0	2L	30		
C7	2P	15	B1, B3, B4	20
B7	2P	15	B1, B3, B4	20
A7	3P	15	B1, B3, B4	20
R4	3P	15	B1, B2	20
R5	4P	15	B1, B2	20

Standard Ratings

Type RBPS Rated 630 VDC (400 VAC @ 60 Hz)							
Capacitance		Case Code	DV / DT V/ μ sec	I_{peak} Amps	I_{rms} Max Amps @55°C	ESR Max @100 kHz mOhms	Terminal Codes
(μ F)	Code						
.33	00334	C7	600	200	10.9	9	2P,B1,B3,B4
.39	00394	C7	600	235	11.5	9	2P,B1,B3,B4
.47	00474	C7	550	235	12.2	8	2P,B1,B3,B4
.56	00564	C7	500	280	13.0	8	2P,B1,B3,B4
.68	00684	C7	450	300	14.0	8	2P,B1,B3,B4
.75	00754	C7	400	300	15.0	8	2P,B1,B3,B4
.82	00824	B7	400	330	16.0	8	2P,B1,B3,B4
1.00	00105	B7	400	400	18.0	7	2P,B1,B3,B4
1.20	00125	A7	400	480	19.0	7	3P,B1,B3,B4
1.50	00155	A7	400	600	20.0	7	3P,B1,B3,B4
1.75	01754	A7	400	700	21.0	7	3P,B1,B3,B4
2.00	00205	A7	400	800	22.0	7	3P,B1,B3,B4
2.20	00225	R4	280	615	24.0	7	3P,B1,B2
2.50	00255	R4	250	625	26.0	7	3P,B1,B2
3.00	00305	R4	250	750	28.0	7	3P,B1,B2
4.00	00405	R5	250	1000	30.0	6	4P,B1,B2
5.00	00505	R5	250	1250	35.0	6	4P,B1,B2

Type RBPS Rated 1250 VDC (550 VAC @ 60 Hz)							
Capacitance		Case Code	DV / DT V/ μ sec	I_{peak} Amps	I_{rms} Max Amps @55°C	ESR Max @100 kHz mOhms	Terminal Codes
(μ F)	Code						
0.10	00104	W0	1200	120	5.7	16	2L
0.15	00154	C7	1000	150	8.9	15	2P,B1,B3,B4
0.22	00224	C7	1000	220	10.0	12	2P,B1,B3,B4
0.27	00274	C7	900	245	11.0	12	2P,B1,B3,B4
0.33	00334	C7	800	265	12.0	10	2P,B1,B3,B4
0.39	00394	B7	770	300	14.0	9	2P,B1,B3,B4
0.47	00474	B7	650	305	17.0	8	2P,B1,B3,B4
0.56	00564	A7	650	365	17.5	8	3P,B1,B3,B4
0.68	00684	A7	650	440	20.0	8	3P,B1,B3,B4
0.75	00754	A7	650	490	20.0	8	3P,B1,B3,B4
0.82	00824	A7	650	530	21.0	8	3P,B1,B3,B4
1.00	00105	A7	650	650	22.0	7	3P,B1,B3,B4
1.20	00125	R4	550	660	25.0	7	3P,B1,B2
1.50	00155	R4	500	750	26.0	7	3P,B1,B2
1.75	01754	R5	500	875	27.0	7	4P,B1,B2
2.00	00205	R5	475	950	28.0	7	4P,B1,B2
2.20	00225	R5	475	1045	30.0	6	4P,B1,B2

IGBT Snubber Capacitors for Power Electronics



See catalog for details of other terminal options.

Case Codes and Dimensions (mm)				
Case Code	T	H	L	P
W0	13.0	22.0	32.1	27.5
C7	17.0	28.0	42.7	35.0
B7	22.1	30.1	42.7	35.0
A7	28.2	37.3	42.7	35.0
R4	29.2	41.2	58.5	52.0
R5	46.0	36.0	58.7	52.0