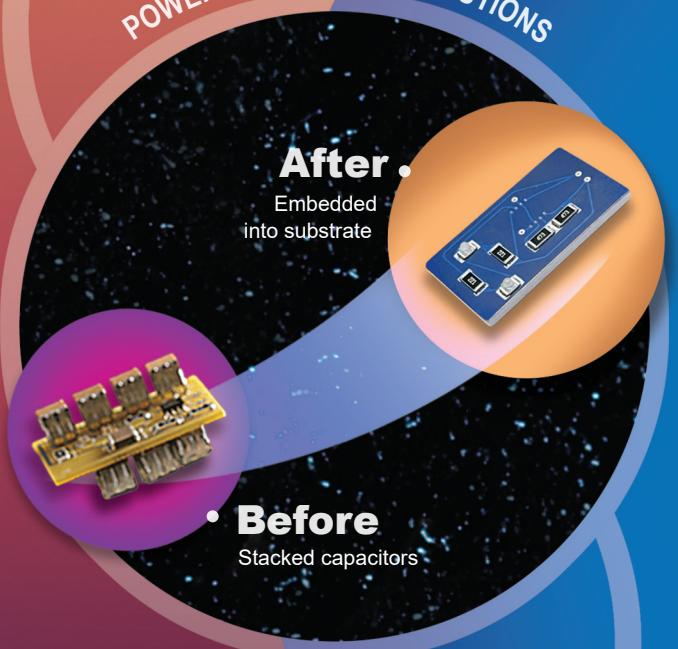
CAPSTRATE®
BULK CAPACITANCE EMBEDDED IN A HIGH-K CERAMIC SUBSTRATE

POWER ELECTRONIC SOLUTIONS



Design Guide

- Customizable to accommodate challenging board layouts "Space Saver"
- Quick turn prototype to high volume production
- Reducing component count and higher reliability
- Unique customer solutions
- One-stop design, manufacturing, and assembly

JOHANSON DIELECTRICS

CapStrates®:

Choosing the correct CapStrate® influences the mechanical and electrical function of a design. Johanson Dielectrics offers ceramic substrates for use in application specific environments. It is recommended to choose the right substrate that meets the required electrical requirements and is suitable for the environment the product will operate in.

Johanson Dielectrics offers a variety of materials with a high dielectric constant (K) that can be used within CapStrate® designs. The dielectric constant is directly related to the amount of bulk capacitance that can be realized and allows for compact form factors.

Table 1: Available CapStrate® & Electrical Properties

CapStrate® Material	X7R	NP0	X8R
Dissipation Factor	<2.5%	<0.15%	<2.5%
Dielectric Strength (V/mil)	200	300	200
Temperature Coefficient	± 15%	0 ± 30 ppm/°C	± 15%
Temperature Range	-55 °C to +125 °C	-55 °C to +125 °C	-55 °C to +150 °C

CapStrate® Sizes & Shapes

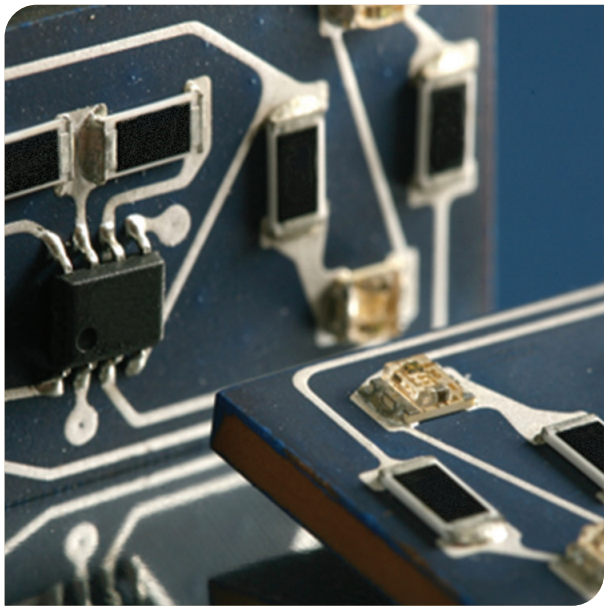
Table 2: Rectangular Dimensions (CapStrate®)

Dimension	Minimum	Maximum	Tolerance
Thickness	0.050" (1.27mm)	0.215" (5.461mm)	+/- 0.005 (0.127mm)
Length	0.20" (5.08mm)	2.00"/1.00" (50.8/25.4mm)	+/- 0.005 (0.127mm)
Width	0.20" (5.08mm)	1.00"/2.00" (25.4/50.8mm)	+/- 0.005 (0.127mm)
Temperature Range	-55 °C to +125 °C	-55 °C to +125 °C	-55 °C to +150 °C

Table 3: Circular Dimensions (CapStrate®)

Dimension	Minimum	Maximum	Tolerance
Thickness	0.050" (1.27mm)	0.215" (5.46mm)	+/- 0.005 (0.127mm)
Diameter	0.20" (5.08mm)	2.00" (50.8mm)	+/- 0.005 (0.127mm)

Integrating Bulk Capacitance



Close up of space saving surface traces and components on a rectangular CapStrate®

The advantages of CapStrate® Dielectrics can be fully realized by replacing discrete capacitors with bulk capacitance from the ceramic substrates. The amount of capacitance that can be utilized varies depending on the design dimensions.

Tables 4 and 5 reference the maximum amount of capacitance that can be designed for dimensional, substrate and voltage constraints.

Typical voltage ratings vary from 100 to 1000V, however, engineers are invited to discuss special voltage requirements not listed below.

Table 4: Rectangular Bulk Capacitance (CapStrate®)

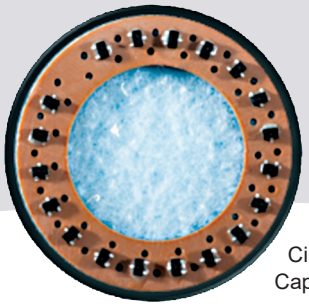
NP0	Length	Width	Thickness	100V	250V	500V	1000V
Maximum Size	2.00" (50.8mm)	1.00" (25.4mm)	0.150" (3.81mm)	5000nF	2500nF	1400nF	940nF
Minimum Size	0.20" (5.08mm)	0.20" (5.08mm)	0.050" (1.27mm)	30nF	9nF	5nF	2.8nF

X7R	Length	Width	Thickness	100V	250V	500V	1000V
Maximum Size	2.00" (50.8mm)	1.00" (25.4mm)	0.150" (3.81mm)	120000nF	60000nF	25000nF	8000nF
Minimum Size	0.20" (5.08mm)	0.20" (5.08mm)	0.050" (1.27mm)	800nF	200nF	70nF	20nF

X8R	Length	Width	Thickness	100V	250V	500V	1000V
Maximum Size	2.00" (50.8mm)	1.00" (25.4mm)	0.150" (3.81mm)	84000nF	42000nF	17500nF	5600nF
Minimum Size	0.20" (5.08mm)	0.20" (5.08mm)	0.050" (1.27mm)	560nF	140nF	49nF	14nF

Integrating Bulk Capacitance & Capacitancy Density

- Custom Geometry
- Increased Bulk Capacitance
- High Voltage Capabilities
- Reduction in Size



Circular CapStrate®

Table 5: Circular Bulk Capacitance (CapStrate®)

NP0	Diameter	Thickness	100V	250V	500V	1000V	1000V
Maximum Size	2.00" (50.8mm)	0.150" (3.81mm)	7600nF	3800nF	2600nF	1400nF	940nF
Minimum Size	0.20" (5.08mm)	0.050" (1.27mm)	25nF	6nF	3nF	1.7nF	2.8nF

X7R	Diameter	Thickness	100V	250V	500V	1000V	1000V
Maximum Size	2.00" (50.8mm)	0.150" (3.81mm)	180000nF	95000nF	40000nF	12000nF	8000nF
Minimum Size	0.20" (5.08mm)	0.050" (1.27mm)	550nF	140nF	45nF	15nF	20nF

X8R	Diameter	Thickness	100V	250V	500V	1000V	1000V
Maximum Size	2.00" (50.8mm)	0.150" (3.81mm)	126000nF	66500nF	28000nF	8400nF	5600nF
Minimum Size	0.20" (5.08mm)	0.050" (1.27mm)	385nF	98nF	31.5nF	10.5nF	14nF

Additional sizes and form factors not listed are possible. Contact Johanson to assess the feasibility of your design. Reference table 6 for the maximum capacitance density that can be used for a given substrate. **Capacitance density, below, is presented in nF/(mils)^3. This is the maximum amount of capacitance available in a given volume.**

Table 6: Max Capacitance Density

Rectangular	X7R	NP0	X8R	Circular	X7R	NP0	X8R
100V	4.00E-04	1.67E-05	2.80E-04	100V	3.82E-04	1.61E-02	1.13E-02
250V	2.00E-04	8.33E-06	1.40E-04	250V	2.02E-04	8.10E-03	5.67E-03
500V	8.33E-05	4.67E-06	5.83E-05	500V	8.49E-05	5.51E-03	3.86E-03
1000V	2.67E-05	3.13E-06	1.87E-05	1000V	2.54E-05	2.97E-03	2.08E-03

Metallization/Solder Pads

Johanson Dielectrics offers a variety of metallization schemes that are high reliability conductors. These metals can be utilized as conductors, solder pads, or methods of thermal transfer. Designers should select the available metal based on the metallization properties that best suit their design. Careful selection of particular metallizations is dependent on requirements for solderability, temperature resistance, and electrical performance.

Table 7: Metallization Schemes Available

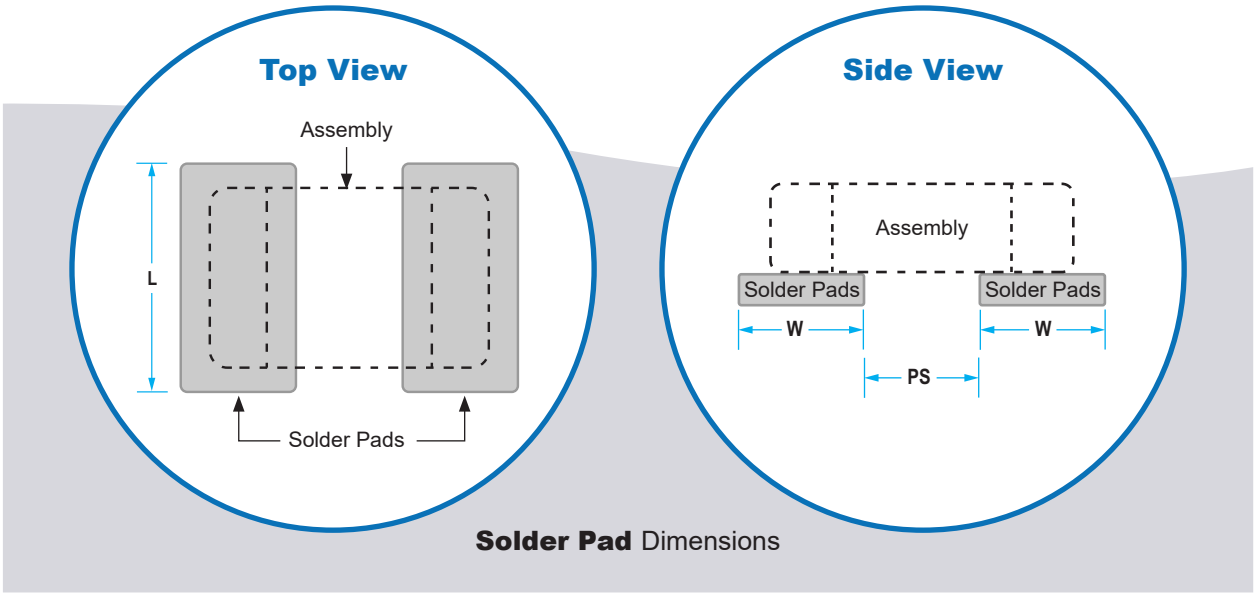
Dielectric	Ag / Pt	Ni / Au	Ag / Ni / Au
X7R	X	X	-
X8R	X	X	-
NP0	X	-	X

Table 8: Metallization Properties

Material Property	Ag / Pt	Ni / Au	Ag / Ni / Au
Recommended Thickness	14µm	7-12µ"	Contact Factory
Max Solder Temp	218°C	260°C	230°C

Table 9: Solder Pad Dimensions

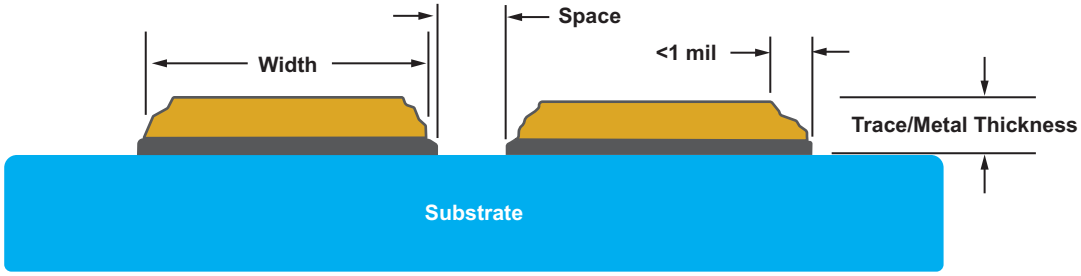
Metallization	**Length** (Minimum)	**Width** (Minimum)	**Pad Spacing** (Minimum)
Ag/Pt	0.015" (0.381mm)	0.010" (0.254mm)	0.007" (0.178mm)
Ni/Au	0.015" (0.381mm)	0.010" (0.254mm)	0.007" (0.178mm)
Ag/Ni/Au	0.015" (0.381mm)	0.010" (0.254mm)	0.007" (0.178mm)



Solder Pad Dimensions

Table 10: Standard Conductor Traces & Tolerances

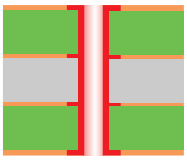
Metallization	Line Width / Space (Minimum)	Line Width / Space Tolerance (Minimum)	Trace / Metal Thickness
Ag/Pt	0.007" (0.178mm)	0.003"-0.005" (0.076-0.127mm)	0.014" (0.356mm)
Ni/Au	0.007" (0.178mm)		0.014" (0.356mm)
Ag/Ni/Au	0.007" (0.178mm)		0.014" (0.356mm)



Vias Definition & Dimensions

Vias are used to connect different layers in the CapStrate® as a means of an electrical or thermal connection. Johanson Dielectrics offers plated through-hole vias for designers to use.

Table 11: Via Mechanical Dimensions

Via Style	Hole Diameter (Minimum)	Hole to Hole (Minimum Spacing)	Via to Edge (Minimum Spacing)	Plated Through-hole
Plated Through-hole	0.028" (0.771mm)	0.012" (0.305mm)	0.015" (0.381mm)	

Design Submissions

"We encourage all designers to submit their drawings or ideas for quick and easy feedback."

Assembly Services

available in-house

Includes: but is not limited to, soldering resistors, inductors, wires and transistors. One-stop design, manufacturing, and assembly ensures customers receive completed product, without the hassle of developing an assembly stations.

How to Submit Custom CapStrate® Designs. . .

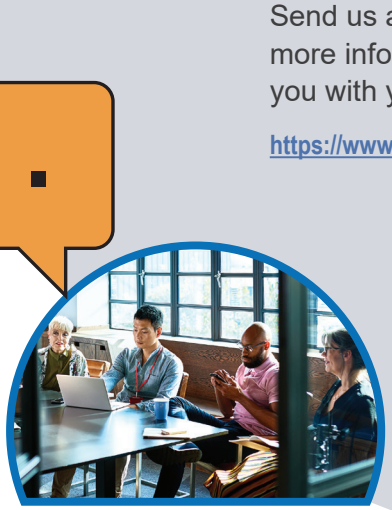
- Follow Johanson's design guidelines and standard specifications.
- Provide CAD data in multiple layers.
- Identify "A" side and "B" side for double-patterned circuits.
- Provide tolerances and annotation
- List CapStrate® type, dimensions, and rated voltage.
- Specify metallizations, thickness and tolerances, pads.
- Specify conductor traces, type, spacing, and tolerances.
- List any environmental or electrical testing needed.
- Other inspection or acceptance criteria.

Don't miss the opportunity to work with our outstanding design engineers.

Send us a message or visit our website for more information. We look forward to assisting you with your unique design requirements.

https://www.johansondielectrics.com/ask-a-question

Contact Johanson today!



Team Johanson here to help.

Testing Capabilities

Johanson Dielectrics has a specialized high-reliability department with extensive in-house testing capabilities. Our testing includes, but is not limited to the following:

Electrical & Mechanical Inspections

- **100% Visual Inspection**
- **DWV, Voltage Breakdown**
- **Capacitance, Dissipation Factor**
- **Resistance & Continuity Testing**
- **Temperature Voltage Coefficient** (TVC)
- **Temperature Capacitance Coefficient** (TCC)

Environmental Testing

- **Bond Pull Test**
- **Temperature Cycling**
- **Resistance to Solder Heat**
- **Shock and Vibration Testing**

Analytical Testing

- **SEM Inspection**
- **Solderability Testing**
- **Destructive Physical Analysis**

In-house testing capabilities & high-reliability department.

Quality Commitments JOHANSON DIELECTRICS

Commitments and Certifications We are committed to making products of the highest quality, performance, and value. Our new design and manufacturing facility employs state of the art equipment and practices. All employees participate in quality awareness and SPC training classes, and our quality system is certified to ISO 9001.

RoHS Standard parts supplied by Johanson Dielectrics, Inc. are fully compliant to the European Union Directives 2002/95/EC, 2011/65/EU, and Annex II (EU) 2015/863 of the European Parliament and of the Council of 31 March 2015 on the Restriction of the use of certain Hazardous Substances in electrical and electronics equipment (RoHS Directives).

REACH Parts (articles) supplied by Johanson Dielectrics meet the requirements for REACH and do not contain any of the SVHC chemicals listed above the levels mandated by the ECHA.

* Johanson Dielectrics has made every effort to present data that represents the actual performance of the part. Johanson Dielectrics reserves the right to make design changes without notice.

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