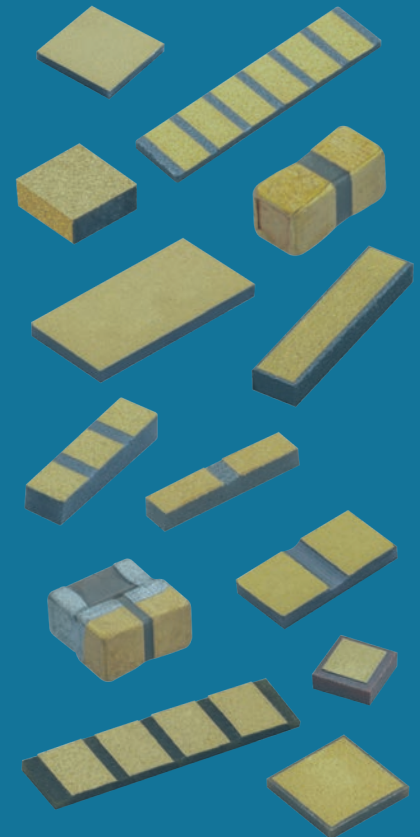


Single Layer Capacitor Products Catalog

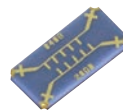
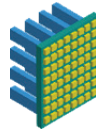
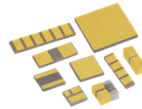


Who We Are

Knowles is a leading manufacturer of specialty electronic components.

We design parts that perform unique, critical functions for innovative technologies. Through extreme reliability, custom engineering, and scalable manufacturing, we enable businesses to succeed in the most demanding applications across MedTech, Defense, and Industrial markets.

Knowles' DLI brand of technologies addresses the complex challenges of implementing high-performance RF/Microwave products across the widest range of specifications.



INTEGRATED MICROWAVE*



1974

- Dielectric Laboratories (DLI) invents the Single Layer Capacitor.

1985

- DLI becomes a part of Dover Corp.

1995

- Phased Array Technology: Plank/Brick Architecture

2011

- Ku Band Filters for Mars Rover Curiosity

2012

- DLI SMD Filter @ Ka Band

2015

- KPD formed into Knowles

2016

- K band Filters, Splitters, Couplers for Satellite Phased Arrays
- Phased Array Technology: Flat Panel/Tile Architecture

2018

- 3GPP Release 15, SA DLI 28, 39GHz, SMD Filters

2019

- Joint Strike Fighter Lots 12, 13 5G in the US
- Auction 101, 28GHz, Auction 102, 24GHz, Auction 103, 37GHz, 39GHz, 47GHz
- DITF Thin Film Acquisition

2020

- 5x Filter Capacity Expansion

2021

- Integrated Microwave Corporation joins the Knowles Family.

2023

- Cornell Dubilier joins the Knowles Family.

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DC BLOCKING CAPACITORS

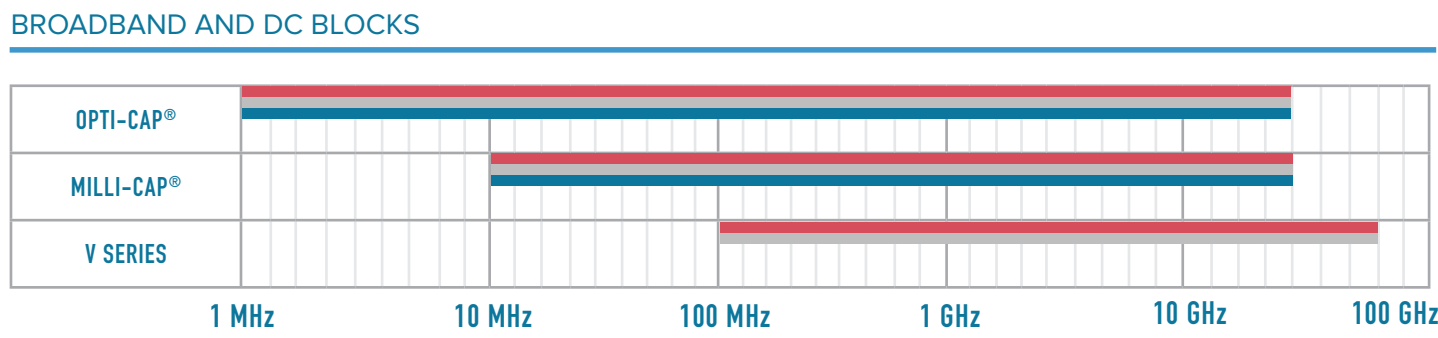
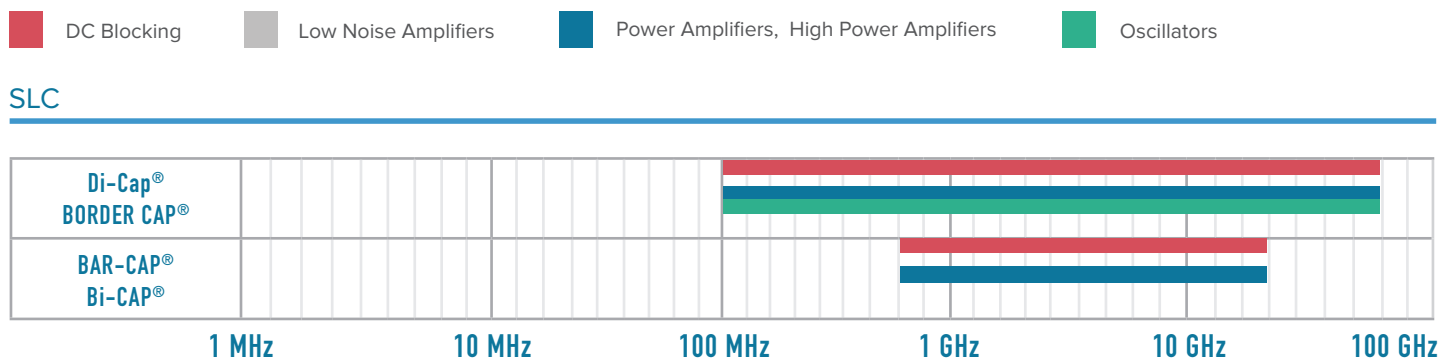
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Simplified Frequency & Product Application Chart



Testing Capabilities for Hi-Rel SLCs*

Knowles' world class engineering team understands the challenges of developing components optimized for demanding applications. We have materials and processes that allow us to work closely with customers to provide recommendations based on tried-and-true components, methods and testing.

Electric Testing	Capacitance	MIL-STD-202, Method 305	Physical Testing	Vibration	MIL-STD-202, Method 201
	Insulation Resistance	MIL-STD-202, Method 302		Resistance to Soldering Heat	MIL-STD-202, Method 210
	Dielectric Withstanding Voltage	MIL-STD-202, Method 301		Acceleration	MIL-STD-202, Method 212
	Quality Factor	MIL-STD-202, Method 306		DPA	EIA-469
	DC Resistance	MIL-STD-202, Method 303A			
	RF Performance over Temperature	-55 to +125°C			
Mechanical Testing	Constant Acceleration	MIL-STD-883, Method 2001	Environmental Testing	Humidity	MIL-STD-202, Method 103
	Mechanical Shock	MIL-STD-883, Method 2002		Immersion	MIL-STD-202, Method 104
	Solderability	MIL-STD-883, Method 2003		Moisture Resistance	MIL-STD-202, Method 106
	Visual	MIL-STD-883, Method 2008		Thermal Shock	MIL-STD-202, Method 107
	External Visual	MIL-STD-883, Method 2009		Temperature Cycling	MIL-STD-883, Method 1010
	Bond Strength	MIL-STD-883, Method 2011		Burn-In	MIL-STD-883, Method 1010
	Die Shear	MIL-STD-883, Method 2019			
	Ball Shear	ASTM 1269			
	Tape Test	ASTM 3339			

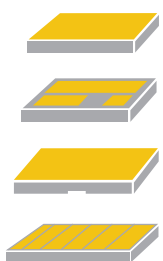
*Our standard components - CSA, CSM, CSB, and CR/CM series – do not receive hi-rel testing.

- C, DF, IR, DWV
- TCC, TVC
- ESR
- Power
- Hot IR
- Cross Section
- Visual Appearance
- Scanning Acoustic Imaging

- Plating Thickness
- Terminal Strength
- Resistance to Soldering Heat
- Life
- Shock & Vibration
- Pulse
- Group B & C



SLC — Specifications

TERMINATION	Capacitor Types	Code	Description (Layers in order from dielectric material to outermost)	
	Di-Cap®, T-Cap®, Bar Cap®, Bi-Cap® and Gap Cap®	P	TiW/NiV/Au	Ni/Au
	Di-Cap® and T-Cap®	T	TiW/NiV/Au-Sn	
	Di-Cap®, T-Cap®, Bar Cap®, Bi-Cap® and Gap Cap®	M	TiW/Au	
	Single Border Cap	B	TiW/NiV/Au	Ni/Au
		C	TiW/Au	
	Double Border Cap	E	TiW/NiV/Au	Ni/Au
		F	TiW/Au	

TEST LEVEL CODES

Code	Description
Commercial Options	
X	100% 4 Side Visual Screening 1% AQL for the electrical parameters Capacitance, Dissipation Factor, Insulation Resistance and Dielectric Withstanding Voltage
Z	100% 4 Side Visual Screening 1% AQL for the electrical parameters Capacitance, Dissipation Factor, Insulation Resistance and Dielectric Withstanding Voltage - Code is used when the required tolerance is tighter than the values listed in the capacitance tables
High Reliability Options	
A	MIL-PRF-49464 Group A 100% Thermal Shock 100%, 100 +0/-4 Hours 100% Electrical Screening 100% 6 Side Visual Screening - Bond Strength - Die Shear Strength - Temperature Coefficient Limits
B	MIL-PRF-49464 Group B - MIL-PRF-49464, Group A - Low Voltage Humidity Immersion - Life
D	Special agreed upon testing to customers' formal specification. Customer Drawing Required! (May include, but is not limited to, one or more of the following common requests.) 10(0) Destructive Bond Pull per MIL-STD-883, Method 2011. 10(0) Die Shear per MIL-STD-883, Method 2019. Consult factory for other alternatives or assistance in specifying custom testing.
E	1% AQL Electrical (CAP/DF/IR/DWV) 100% 6 Sided Visual
H	MIL-PRF-38534 Class H
K	MIL-PRF-38534 Class K

CAPACITANCE TOLERANCE TABLE

Tolerance Code	Tolerance
P	±0.1pF
A	±0.05pF
B	±0.1pF
C	±.25pF
D	±.50pF
J	± 5%
K	± 10%
L	± 15%
M	± 20%
X	GMV
V	+100%, -0%
Z	+80%, -20%
S	Special

ENVIRONMENTAL & PHYSICAL TESTING PROCEDURES

Parameter	Method	MIL-STD-202 Condition
Thermal Shock	107	A, (modified), -55°C to +125°C
Immersion	104	B
Moisture Resistance	106	-
Resistance to Solder Heat	210	C, 260°C for 20 seconds
Life	108	A, 96 Hours @ +125°C.
Barometric Pressure	105	B
Shock, (Specified Pulse)	213	I, 100g's, 6ms.
Vibration, High Frequency	204	G, 30g's peak, 10Hz to 2kHz.

Parameter	Method	MIL-STD-202 Condition
Bond Strength	2011	D, 3 grams min. with .001 dia wire
Die Shear Strength	2019	Limit per MIL-STD-883, Figure 2019-4
Temperature Cycling	1010	C
Mechanical Shock	2002	B, Y1,
Constant Acceleration	2001	3,000g's Y1 direction

All Single Layer Capacitors are Lead Free and RoHS compliant (except Opti-Caps).



SLC — Dielectric Information

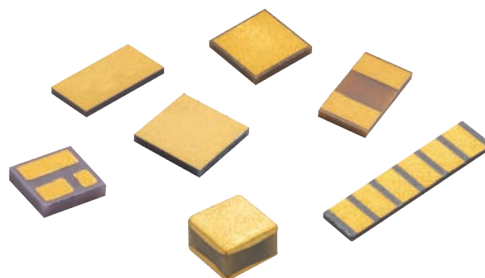
Knowles' DLI Brand of Hi-Rel Single Layer Capacitors are available with any of our proprietary dielectric materials in the following configurations:

BORDER CAP®
Di-CAP®

BAR CAP®
Bi-CAP®

GAP CAP®
T-CAP®

Please consult the following pages for part number identification.



CLASS I DIELECTRIC MATERIALS

Dielectric Code	Relative ϵ_r @ 1 MHz	Temperature Coefficient -55°C to 125°C (ppm/°C Max)	1 MHz Dissipation Factor (% Maximum)	25°C Insulation Resistance (M Ω)	125°C Insulation Resistance (M Ω)	Standard Metal Stack
PI	9.9	P105 $\pm$ 20	0.15	>10 ⁶	>10 ⁵	TiW/NiV/Au
PG	13	P22 $\pm$ 30	0.15	>10 ⁶	>10 ⁵	TiW/NiV/Au
AH	20	P90 $\pm$ 20	0.15	>10 ⁶	>10 ⁵	TiW/NiV/Au
CF	24	0 $\pm$ 15	0.60	>10 ⁶	>10 ⁵	TiW/NiV/Au
NA	22	N30 $\pm$ 15	0.15	>10 ⁶	>10 ⁵	TiW/NiV/Au
CD	37	N20 $\pm$ 15	0.15	>10 ⁶	>10 ⁵	TiW/NiV/Au
NG	43	N220 $\pm$ 60	0.25	>10 ⁶	>10 ⁵	TiW/NiV/Au
CG	70	0 $\pm$ 30	0.70	>10 ⁶	>10 ⁵	TiW/NiV/Au
DB	72	N50 $\pm$ 30	0.15	>10 ⁶	>10 ⁵	TiW/NiV/Au
NP	85	N750 $\pm$ 200	0.50	>10 ⁴	>10 ³	TiW/NiV/Au
NR	160	N1500 $\pm$ 500	0.25	>10 ⁶	>10 ⁵	TiW/NiV/Au
NS	300	N2400 $\pm$ 500	0.70	>10 ⁶	>10 ⁵	TiW/Au
NU	600	N3700 $\pm$ 1000	1.50	>10 ⁶	>10 ⁵	Ni/Au
NV	900	N4700 $\pm$ 1000	1.20	>10 ⁶	>10 ⁵	Ni/Au

CLASS II DIELECTRIC MATERIALS

Dielectric Code	Relative ϵ_r @ 1 MHz	Temperature Coefficient -55°C to 125°C (%)		1 MHz Dissipation Factor (% Maximum)	25°C Insulation Resistance (M Ω)	125°C Insulation Resistance (M Ω)	Standard Metal Stack
		No Bias, Pre Voltage Conditioning	No Bias, Post Voltage Conditioning				
BD	800	$\pm$ 10	$\pm$ 15	2.5	>10 ⁴	>10 ³	Ni/Au
BE	1400	$\pm$ 10	$\pm$ 15	2.5	>10 ⁴	>10 ³	Ni/Au
BL	2000	$\pm$ 15	$\pm$ 25	2.5	>10 ⁵	>10 ⁴	TiW/NiV/Au
BJ	3300	$\pm$ 10	$\pm$ 15	3.0	>10 ⁵	>10 ⁴	Ni/Au
BN	4000	$\pm$ 15	$\pm$ 25	3.0	>10 ⁵	>10 ⁴	Ni/Au
UX	25,000	$\pm$ 15	$\pm$ 25	2.5	>10 ³	>10 ²	TiW/Au

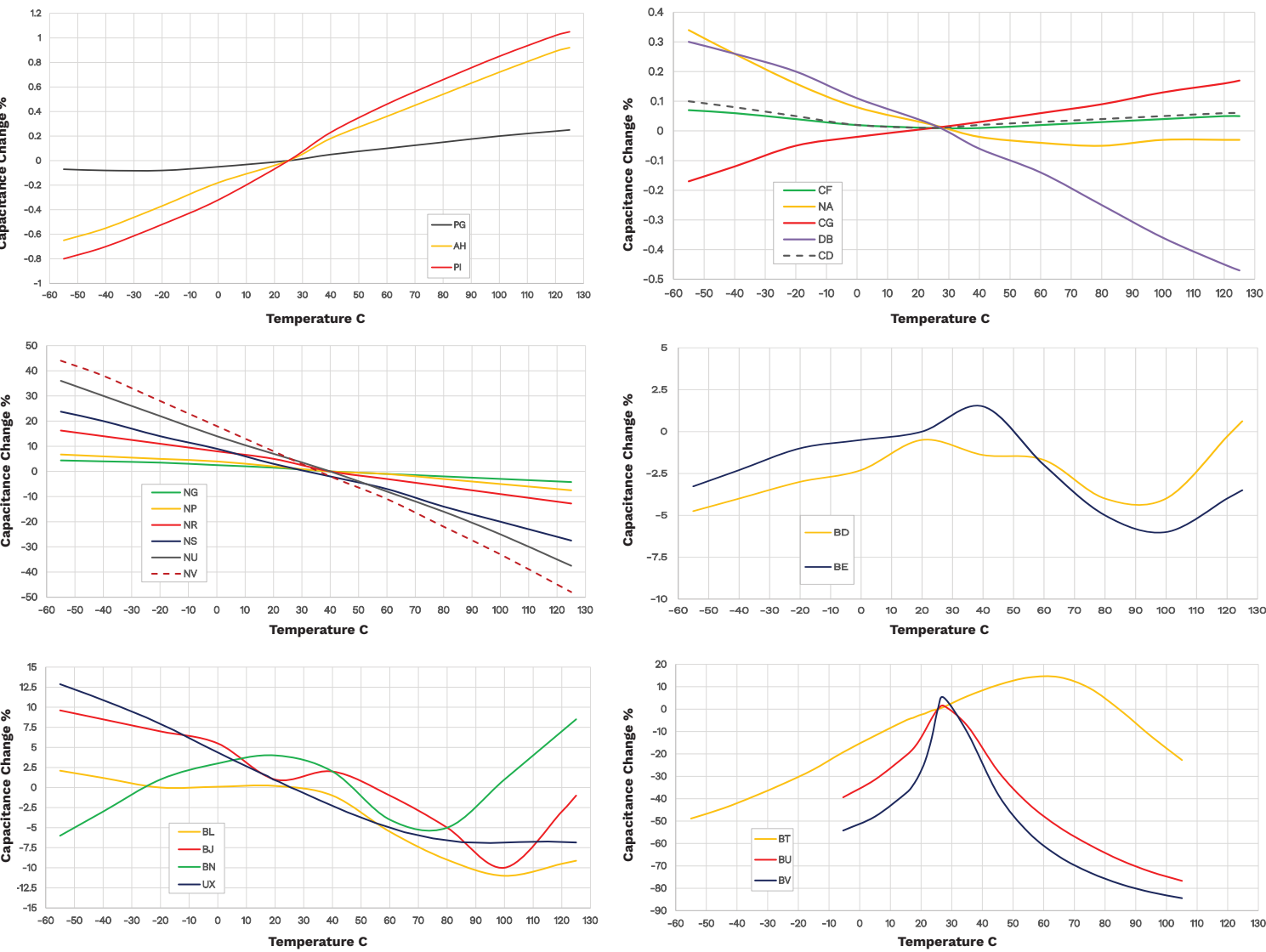
CLASS III DIELECTRIC MATERIALS

BT*	4200	+22, -56% (-55°C to 105°C)		3.0	>10 ⁵	>10 ²	TiW/NiV/Au
BU	8500	+22, -82% (10°C to 85°C)		3.0	>10 ⁵	>10 ⁴	TiW/NiV/Au
BV	13,500	+22, -82% (10°C to 85°C)		3.0	>10 ⁵	>10 ⁴	TiW/NiV/Au

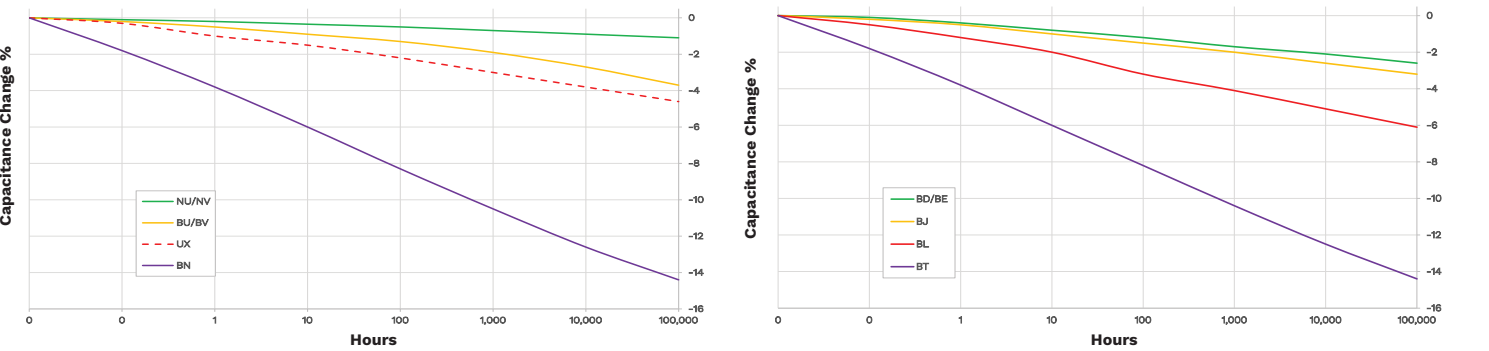
*Not recommended for new designs. Please contact an inside sales representative for additional information.

SLC — Dielectric Information

DIELECTRIC TEMPERATURE CHARACTERISTICS



DIELECTRIC AGING CHARACTERISTICS

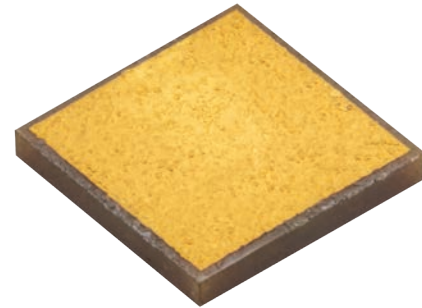


SLC — Border Cap®

DESCRIPTION

SLC with recessed metallization, available with borders on one or both sides. Recessed metallization has been designed to minimize the potential of shorting during attachment (epoxy or solder).

- Available from 0.03pF to 2400pF
- Operating frequency up to 100GHz
- Wire Bondable
- 25, 50 and 100 Volt options
- Customized designs are available, please contact an inside sales representative



FUNCTIONAL APPLICATIONS

- DC Blocking
- Filtering
- RF Bypass
- Tuning and Coupling

TEST LEVEL CODES

Commercial Level	
X	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV)
Z	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV) Tested to tighter tolerance which may require 100% Electrical

HIGH RELIABILITY

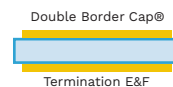
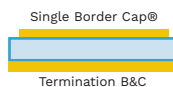
A	MIL-PRF-49464 Group A	B	MIL-PRF-49464 Group B
	• 100% Thermal Shock	D	• MIL-PRF-49464 Group A
	• 100% Voltage Conditioning		• Immersion
	• 100% Electrical (CAP/DF/IR & DWV)	E	• Low Voltage Humidity
	• 100% 6-Side Visual	H	• Life
	• Bond Strength		• Customer Defined
	• Die Shear		• 1% AQL Electrical (CAP/DF/IR/DWV)
	• Temperature Coefficient		• 100% 6 Sided Visual
		K	MIL-PRF-38534 Class H
			MIL-PRF-38534 Class K

VOLTAGE

Code	Voltage
2	25 Volts
5	50 Volts
1	100 Volts

CONFIGURATION

Code	Description
B	Single-Sided
E	Double-Sided



TOLERANCE

Code	Description
P	± 0.01pF
A	± 0.05pF
B	± 0.1pF
C	± 0.25pF
D	± 0.50pF
K	± 10%
L	± 15%
M	± 20%
X	GMV (Guarantee Minimum Value)
Z	+80%, -20%

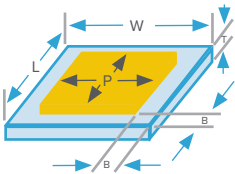
ORDERING INFORMATION — SLC — BORDER CAP®

D	10	BJ	100	K	1	E	X	
Product	Case Size	Material	Capacitance (pF)	Tolerance	Voltage	Termination	Test Level	Packaging
D = Border Cap®	10	See material tables on Page 6.	R03 = 0.03 pF	P = ± 0.01pF	2 = 25V* 5 = 50V 1 = 100V *For Capacitors with UX material only	B = Single Border (TiW/Ni/Au or Ni/Au)	X	B = Black Dotted (Tape Ring)
	12		OR5 = 0.5 pF	A = ± 0.05pF			Z	
	15		1R0 = 1.0 pF	B = ± 0.10pF		C = Single Border (TiW/Au)	A	E = Repopulated (Tape Ring)
	20		5R1 = 5.1 pF	C = ± 0.25pF			B	T = Tape and Reel
	25		100 = 10 pF	D = ± 0.5pF		E = Double Border (TiW/Ni/Au or Ni/Au)	D	
	30		101 = 100 pF	K = ± 10%			E	
	35		152 = 1500 pF	L = ± 15%		F = Double Border (TiW/Au)	H	Leave blank for generic waffle pack.
	40			M = ± 20%			K	See packaging definitions on Page 28.
	40			X = GMV				
	50			Z = +80% -20%				
			Refer to Capacitance range tables for available values. Consult an inside sales rep for custom solutions.				See test level definitions on page 5.	

SLC — Border Cap[®]

DIMENSIONS

STYLE	LENGTH/WIDTH	PAD SIZE	BORDER	THICKNESS
D10	0.010" ± 0.001" (0.254mm ± 0.025mm)	0.008" (0.203mm)	0.001" (0.025mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D12	0.012" ± 0.001" (0.305mm ± 0.025mm)	0.010" (0.254mm)	0.001" (0.025mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D15	0.015" ± 0.001" (0.381mm ± 0.025mm)	0.011" (0.279mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D20	0.020" ± 0.001" (0.508mm ± 0.025mm)	0.016" (0.406mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D25	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.021" (0.533mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D30	0.030" ± 0.001" (0.762mm ± 0.025mm)	0.026" (0.660mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D35	0.035" ± 0.001" (0.889mm ± 0.025mm)	0.031" (0.787mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D40	0.040" ± 0.001" (1.016mm ± 0.025mm)	0.036" (0.914mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)
D50	0.050" ± 0.001" (1.27mm ± 0.025mm)	0.046" (1.168mm)	0.002" (0.051mm)	0.006" ± 0.0025" (0.152mm ± 0.064mm)



*UX material available in 25V (0.006" Thick) and 50V (0.010" Thick)

CAPACITANCE VALUES — SINGLE-SIDED

STYLE	D10			D12			D15			D20			D25			D30			D35			D40			D50		
CAPACITANCE (pF)																											
MATERIAL	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.
PI	0.03	0.05	P	0.05	0.07	P	0.06	0.09	P	0.15	0.15	A	0.2	0.3	A	0.3	0.45	A	0.35	0.6	B	0.5	0.7	B	0.8	1.1	C
PG	0.04	0.06	P	0.06	0.09	P	0.08	0.1	P	0.15	0.2	A	0.25	0.4	A	0.35	0.55	B	0.5	0.8	B	0.65	0.95	B	1	1.5	C
AH	0.06	0.1	P	0.09	0.1	P	0.15	0.2	A	0.25	0.35	A	0.4	0.6	B	0.55	0.9	B	0.75	1.2	C	1	1.4	C	1.5	2.2	C
CF	0.07	0.1	P	0.1	0.15	A	0.15	0.2	A	0.25	0.45	A	0.45	0.7	B	0.65	1	B	0.8	1.3	C	1.1	1.6	C	1.7	2.4	C
NA	0.07	0.1	P	0.15	0.15	A	0.15	0.2	A	0.25	0.45	A	0.45	0.7	B	0.65	1	B	0.85	1.5	C	1.2	1.7	C	1.8	2.7	D
CD	0.15	0.15	A	0.2	0.25	A	0.25	0.35	A	0.45	0.7	B	0.7	1.1	C	0.95	1.6	C	1.4	2.2	C	1.8	2.7	D	2.7	4.3	D
CG	0.25	0.35	A	0.3	0.5	A	0.45	0.7	B	0.8	1.3	C	1.3	2	C	1.8	3	D	2.7	4.3	D	3.3	5.1	D	5.1	8.2	K
DB	0.25	0.35	A	0.35	0.5	A	0.45	0.7	B	0.8	1.3	C	1.3	2.2	C	1.9	3	D	2.7	4.3	D	3.6	5.1	D	5.6	8.2	K
NP	0.25	0.4	A	0.4	0.6	B	0.55	0.85	B	0.95	1.6	C	1.5	2.4	C	2.2	3.6	D	3	5.1	D	4.3	6.2	K	6.2	10	K
NR	0.5	0.8	B	0.7	1.1	C	1	1.6	C	1.8	3	D	3	4.7	D	4.3	6.8	K	6.2	10	K	7.5	11	K	12	18	K
NS	0.9	1.5	C	1.3	2.2	C	1.9	3	D	3.6	5.6	K	5.6	9.1	K	8.2	13	K	11	18	K	15	22	K	22	33	K
NU	1.8	3	D	2.7	4.3	D	3.9	5.6	K	6.8	11	K	11	18	K	16	27	K	22	36	K	30	43	K	47	68	K
NV	2.7	4.3	D	3.9	6.2	K	5.6	8.2	K	10	16	K	16	27	K	24	39	K	33	56	K	43	62	K	68	100	K
BD	2.2	3.3	K	3	5.1	K	4.3	6.8	K	8.2	13	K	13	20	K	18	30	K	27	43	K	33	51	K	51	82	K
BE	3.6	6.2	K	5.6	9.1	K	8.2	12	K	15	22	K	24	36	K	33	56	K	47	75	K	62	91	K	91	130	K
BL	6.2	10	K,M	9.1	13	K,M	13	20	K,M	24	36	K,M	36	56	K,M	56	91	K,M	75	120	K,M	100	130	K,M	150	220	K,M
BJ	10	16	K	15	24	K	20	33	K	39	62	K	62	100	K	91	150	K	120	200	K	160	240	K	270	390	K
BN	13	22	K,M	20	33	K,M	30	43	K,M	51	82	K,M	82	130	K,M	120	200	K,M	160	270	K,M	220	330	K,M	330	510	K,M
BU	27	43	M	36	62	M	56	82	M	100	160	M	150	240	M	220	360	M	300	510	M	430	620	M	620	1000	M
BV	39	68	M	62	100	M	82	130	M	150	240	M	240	390	M	360	560	M	510	820	M	680	1000	M	1000	1500	M

UX MATERIAL CAPCITANCE TABLE (STANDARD M TOLERANCE)

STYLE	D10		D12		D15		D20		D25		D30		D35		D40		D50	
VOLTAGE	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
25V	82	100	120	140	160	200	300	370	490	590	710	860	1000	1200	1300	1600	2000	2400
50V	-	-	-	-	100	140	200	240	300	370	450	540	600	750	800	1000	1300	1500



SLC — Border Cap®

CAPACITANCE VALUES — DOUBLE-SIDED

STYLE	D10			D12			D15			D20			D25			D30			D35			D40			D50		
CAPACITANCE (pF)																											
MATERIAL	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.
PI	0.03	0.04	P	0.04	0.06	P	0.06	0.08	P	0.1	0.15	A	0.2	0.25	A	0.3	0.4	A	0.35	0.55	B	0.45	0.65	B	0.7	1.1	C
PG	0.04	0.06	P	0.06	0.08	P	0.07	0.1	P	0.15	0.2	A	0.25	0.35	A	0.35	0.5	A	0.5	0.7	B	0.6	0.9	B	0.95	1.4	C
AH	0.06	0.09	P	0.09	0.1	P	0.15	0.15	A	0.2	0.3	A	0.4	0.5	A	0.55	0.8	B	0.75	1.1	C	0.9	1.3	C	1.54	2.2	C
CF	0.07	0.1	P	0.1	0.15	A	0.15	0.15	A	0.25	0.35	A	0.45	0.65	B	0.65	0.95	B	0.8	1.3	C	1.1	1.6	C	1.7	2.4	C
NA	0.07	0.1	P	0.09	0.15	A	0.15	0.15	A	0.25	0.35	A	0.45	0.6	B	0.65	0.9	B	0.85	1.2	C	1	1.5	C	1.6	2.4	C
CD	0.15	0.15	A	0.15	0.25	A	0.2	0.3	A	0.4	0.6	B	0.7	1	B	0.95	1.5	C	1.4	2	C	1.7	2.4	C	2.7	3.9	D
CG	0.2	0.3	A	0.3	0.45	A	0.4	0.55	B	0.7	1.1	C	1.3	1.9	C	1.8	2.7	D	2.7	3.9	D	3.3	4.7	D	5.1	7.5	K
DB	0.25	0.35	A	0.35	0.5	A	0.5	0.7	B	0.9	1.3	C	1.3	2.1	C	1.9	3.1	D	2.7	4.3	D	3.6	5.6	K	5.6	9.1	K
NP	0.25	0.4	A	0.4	0.6	B	0.55	0.8	B	1	1.5	C	1.5	2.5	C	2.2	3.7	D	3	5.1	D	4.3	6.8	K	6.8	10	K
NR	0.45	0.7	B	0.65	1.1	C	0.85	1.3	C	1.6	2.4	C	3	4.3	D	4.3	6.2	K	6.2	9.1	K	7.5	11	K	12	16	K
NS	0.85	1.3	C	1.3	2	C	1.6	2.4	D	3	4.7	D	5.6	8.2	K	8.2	12	K	11	16	K	15	20	K	22	33	K
NU	1.7	2.7	D	2.7	3.9	D	3.3	4.7	K	6.2	9.1	K	11	16	K	16	24	K	22	33	K	27	39	K	43	62	K
NV	2.7	3.9	D	3.9	6.2	K	5.1	6.8	K	9.1	13	K	16	24	K	24	36	K	33	51	K	43	62	K	68	100	K
BD	2	3	K	3	4.7	K	3.9	5.6	K	7.5	11	K	12	18	K	18	27	K	24	39	K	33	47	K	51	75	K
BE	3.6	6.2	K	5.1	8.2	K	6.8	10	K	13	20	K	22	33	K	30	51	K	43	68	K	56	82	K	91	130	K
BL	5.6	9.1	K,M	8.2	13	K,M	11	16	K,M	20	30	K,M	33	51	K,M	51	82	K,M	68	110	K,M	91	130	K,M	150	220	K,M
BJ	9.1	15	K	15	22	K	18	27	K	33	51	K	56	82	K	82	130	K	110	180	K	150	220	K	240	360	K
BN	13	20	K,M	20	30	K,M	24	36	K,M	47	68	K,M	75	120	K,M	110	180	K,M	150	240	K,M	200	300	K,M	330	470	K,M
BU	24	39	M	36	56	M	47	68	M	91	130	M	150	220	M	220	330	M	300	470	M	390	560	M	620	910	M
BV	39	62	M	56	91	M	75	110	M	150	220	M	220	360	M	330	510	M	470	750	M	620	910	M	1000	1500	M

UX MATERIAL CAPACITANCE TABLE (STANDARD M TOLERANCE)

STYLE	D10			D12			D15			D20			D25			D30			D35			D40			D50		
VOLTAGE	MIN.	MAX.		MIN.	MAX.		MIN.	MAX.		MIN.	MAX.		MIN.	MAX.		MIN.	MAX.		MIN.	MAX.		MIN.	MAX.		MIN.	MAX.	
25V	75	91		110	130		140	170		270	320		440	540		650	800		900	1100		1200	1500		2000	2400	
50V	-	-		-	-		91	110		170	210		280	340		410	500		560	700		750	900		1200	1500	



SLC — Di-Cap®

DESCRIPTION

High Performance Single Layer Capacitors for RF, Microwave and Millimeter Wave Applications.

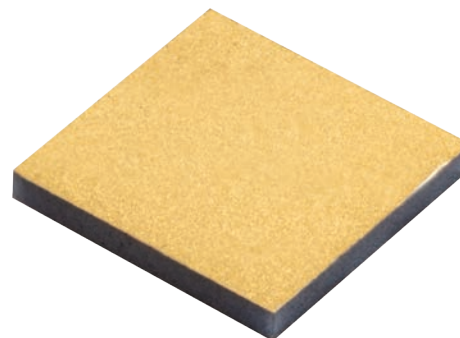
- Available from 0.03pF to 10,000pF
- Operating frequency up to 100GHz
- Wire Bondable
- Customized solutions are available, please contact an inside sales representative

FUNCTIONAL APPLICATIONS

- DC Blocking
- RF Bypassing
- Filtering
- Tuning and Coupling

BENEFITS

- ESD Proof
- Gold metallization for wire bonding
- Rugged construction



TEST LEVEL CODES

Commercial Level	
X	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV)
Z	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV) Tested to tighter tolerance which may require 100% Electrical

VOLTAGE

Code	Voltage
2	25 Volts
5	50 Volts
1	100 Volts

TOLERANCE

Code	Description
P	± 0.01pF
A	± 0.05pF
B	± 0.1pF
C	± 0.25pF
D	± 0.50pF
K	± 10%
L	± 15%
M	± 20%
X	GMV (Guarantee Minimum Value)
Z	+80%, -20%

HIGH RELIABILITY

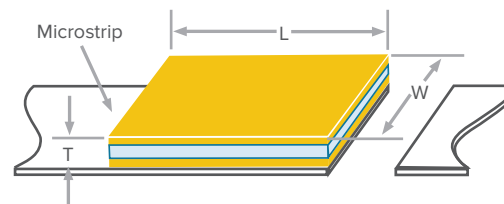
A	MIL-PRF-49464 Group A • 100% Thermal Shock • 100% Voltage Conditioning • 100% Electrical (CAP/DF/IR & DWV)	• 100% 6-Side Visual • Bond Strength • Die Shear • Temperature Coefficient	B	MIL-PRF-49464 Group B • MIL-PRF-49464 Group A • Immersion • Low Voltage Humidity • Life
			D	• Customer Defined
			E	• 1% AQL Electrical (CAP/DF/IR/DMV) • 100% 6 Sided Visual
			H	MIL-PRF-38534 Class H
			K	MIL-PRF-38534 Class K

ORDERING INFORMATION — SLC — Di-CAP®

D	10	CF	OR1	A	5	P	X	
Product	Case Size	Material	Capacitance (pF)	Tolerance	Voltage	Termination	Test Level	Packaging
D = Di-Cap®	10	See material tables on Page 6.	R03 = 0.03 pF	P = ± 0.01pF	2 = 25V* 5 = 50V 1 = 100V *For Capacitors with UX material only	P = Ni/Au or TiW/NiV/Au T = TiW/NiV/Au-Sn M = TiW/Au	X	T = Tape and Reel Leave blank for generic waffle pack. See packaging definitions on Page 28.
	12		OR5 = 0.5 pF	A = ± 0.05pF			Z	
	15		1R0 = 1.0 pF	B = ± 0.10pF			A	
	20		5R1 = 5.1 pF	C = ± 0.25pF			B	
	25		100 = 10 pF	D = ± 0.5pF			D	
	30		101 = 100 pF	K = ± 10%			E	
	35		432 = 4,300 pF	L = ± 15%			H	
	50		Refer to Capacitance range tables for available values. Consult an inside sales rep. for custom solutions.	M = ± 20%			K	
	70			X = GMV				
	90			Z = +80% -20%				

SLC — Di-Cap[®]

STYLE	LENGTH	WIDTH	THICKNESS	
			50 Volt	100 Volt
D10	MIN 0.007" MAX 0.010" (0.254mm MAX.)	0.010" + 0/-0.003" (0.254mm + 0/-0.076mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	-
D12	MIN 0.007" MAX 0.015" (0.381mm MAX.)	0.012" + 0.002"/-0.003" (0.305mm + 0.051mm/-0.076mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	-
D15	MIN 0.008" MAX 0.020" (0.508mm MAX.)	0.015" + 0/-0.003" (0.381mm + 0/-0.076mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)
D20	MIN 0.009" MAX .020" (0.508mm MAX.)	0.020" + 0/-0.003" (0.508mm + 0/-0.076mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)
D25	MIN 0.012" MAX 0.030" (0.762mm MAX.)	0.025" + 0/-0.003" (0.635mm + 0/-0.076mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)
D30	MIN .014" MAX .030" (0.762mm MAX.)	0.030" + 0/-0.003" (0.762mm + 0/-0.076mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)
D35	MIN .020" MAX 0.040" (1.016mm MAX.)	0.035" ± 0.005" (0.889mm ± 0.127mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.007" ± 0.002" (0.178mm ± 0.051mm)
D40	MIN .030" MAX 0.050" (1.270mm MAX.)	0.040" +/- 0.005" (1.016mm +/- 0.127)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.007" ± 0.002" (0.178mm ± 0.051mm)
D50	MIN 0.040" MAX 0.060" (1.524mm MAX.)	0.050" ± 0.010" (1.270mm ± 0.254mm)	-	0.007" ± 0.002" (0.178mm ± 0.051mm)
D70	MIN 0.060" MAX 0.080" (1.778mm MAX.)	0.070" ± 0.010" (1.778mm ± 0.254mm)	-	0.007" ± 0.002" (0.178mm ± 0.051mm)
D90	MIN 0.080" MAX 0.100" (2.54mm MAX.)	0.090" ± 0.010" (2.286mm ± 0.254mm)	-	0.007" ± 0.002" (0.178mm ± 0.051mm)



CAPACITANCE VALUES — 50 VOLT RATED DI-CAP[®]

STYLE	D10			D12			D15			D20			D25			D30			D35			D40		
CAPACITANCE (pF)																								
MATERIAL	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.
PI	0.03	0.05	P	0.04	0.1	P	0.06	0.15	A	0.09	0.2	A	0.2	0.4	A	0.25	0.45	A	0.35	0.85	B	0.36	1.6	C
PG	0.04	0.06	P	0.06	0.1	P	0.08	0.2	A	0.15	0.25	A	0.25	0.5	B	0.3	0.6	B	0.5	1.1	C	0.47	2	C
AH	0.06	0.1	P	0.08	0.2	A	0.15	0.3	A	0.2	0.4	A	0.35	0.8	B	0.45	0.95	B	0.7	1.8	C	0.72	3.2	D
CF	0.07	0.1	P	0.1	0.25	A	0.15	0.35	A	0.2	0.5	B	0.45	0.95	B	0.55	1.1	C	0.85	2	C	0.87	3.8	D
NA	0.06	0.1	P	0.09	0.2	A	0.15	0.3	A	0.2	0.45	B	0.4	0.9	B	0.5	1	B	0.8	1.9	C	0.79	3.5	D
CD	0.1	0.15	A	0.15	0.35	A	0.25	0.55	B	0.35	0.75	B	0.65	1.5	C	0.85	1.8	C	1.3	3.3	D	1.4	5.9	K
CG	0.2	0.35	A	0.3	0.75	B	0.45	1.1	C	0.65	1.4	C	1.2	2.7	C	1.6	3.3	D	2.7	6.2	K	2.5	11	K
DB	0.13	0.46	A	0.16	0.9	B	0.24	1.4	C	0.38	1.9	C	0.66	3.5	D	0.94	4.2	D	1.5	7.3	K	2.6	12	K
NP	0.25	0.4	A	0.35	0.9	B	0.5	1.3	C	0.75	1.8	C	1.5	3.3	D	1.9	3.9	D	3	7.5	K	3.1	14	K
NR	0.45	0.8	B	0.65	1.7	C	1	2.4	C	1.5	3.3	D	2.7	6.2	K	3.6	7.5	K	5.6	13	K	5.8	26	K
NS	0.8	1.5	C	1.2	3	D	1.8	4.7	D	2.7	6.2	K	5.1	12	K	6.8	13	K	11	27	K	10.9	48	K
NU	1.6	3	D	2.4	6.2	K	3.6	9.1	K	5.6	12	K	11	24	K	15	27	K	22	51	K	22	90	K
NV	2.4	4.3	D	3.6	9.1	K	5.6	13	K	8.2	18	K	16	36	K	20	43	K	33	75	K	32	140	K

BD	1.8	3.6	K	3	7.5	K	4.3	11	K	6.2	13	K	12	27	K	16	33	K	27	62	K	25	110	K
BE	3.3	6.2	K	5.1	13	K	7.5	18	K	12	24	K	22	51	K	30	62	K	47	110	K	45	200	K
BL	5.6	10	K,M	8.2	20	K,M	12	30	K,M	24	39	K,M	36	82	K,M	47	91	K,M	75	180	K,M	72	320	K,M
BJ	9.1	16	K	13	33	K	20	51	K	30	68	K	56	130	K	75	160	K	120	270	K	115	530	K
BN	12	22	K,M	18	47	K,M	27	68	K,M	43	91	K,M	82	180	K,M	100	220	K,M	160	390	K,M	160	710	K,M
BU	22	43	M	36	91	M	51	130	M	75	180	M	150	330	M	200	390	M	300	750	M	330	1400	M
BV	36	68	M	56	130	M	82	200	M	120	270	M	240	510	M	300	620	M	510	1200	M	490	2100	M



SLC — Di-Cap[®]

CAPACITANCE VALUES — 100 VOLT RATED Di-CAP[®]

STYLE	D15			D20			D25			D30			D35			D50			D70			D90		
CAPACITANCE (pF)																								
MATERIAL	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.
PI	0.04	0.1	P	0.06	0.1	P	0.15	0.25	A	0.15	0.3	A	0.2	0.55	B	0.5	1.3	C	0.95	2	B,C	1.2	3	B,C
PG	0.06	0.1	P	0.08	0.15	A	0.2	0.35	A	0.2	0.4	A	0.25	0.75	B	0.6	1.7	C	1.2	2.7	B,C	1.5	3.9	B,C
AH	0.08	0.2	A	0.15	0.25	A	0.25	0.5	B	0.35	0.65	B	0.4	1.2	C	0.95	2.7	D	1.9	3.9	B,C	2.4	6.2	C,D
CF	0.1	0.25	A	0.15	0.3	A	0.3	0.65	B	0.4	0.75	B	0.45	1.4	C	1.1	3	D	2.4	4.7	C,D	3	7.5	C,D
NA	0.09	0.2	A	0.15	0.3	A	0.3	0.5	B	0.35	0.7	B	0.45	1.3	C	1.1	3	D	2.2	4.3	C,D	2.7	6.8	C,D
CD	0.15	0.35	A	0.25	0.5	B	0.5	1	B	0.6	1.2	C	0.7	2.2	C	1.7	4.7	D	3.6	7.5	C,D	4.3	12	D,J,K
CG	0.3	0.7	B	0.45	0.95	B	0.95	1.9	C	1.1	2.2	C	1.3	3.9	D	3.3	9.1	K	6.8	13	D,K	8.2	22	J,K
DB	0.3	0.75	B	0.45	1	B	1	1.9	C	1.1	2.2	C	1.4	4.3	D	3.3	9.1	K	6.8	15	D,K	8.2	22	J,K
NP	0.35	0.85	B	0.55	1.2	C	1.2	2.2	C	1.3	2.7	D	1.6	5.1	D	3.9	11	K	8	16	J,K	10	27	J,K
NR	0.65	1.6	C	1	2.2	C	2.2	4.3	D	2.7	5.1	D	3	9.1	K	7.5	20	K	15	33	J,K	20	51	J,K
NS	1.2	3	D	1.9	3.9	D	3.9	8.2	K	4.7	9.1	K	5.6	18	K	15	39	K	30	62	K	36	91	K
NU	2.4	6.2	K	3.9	8.2	K	8.2	16	K	9.1	18	K	12	36	K	30	82	K	56	120	K	68	180	K
NV	3.6	9.1	K	5.6	12	K	12	24	K	15	27	K	18	51	K	43	120	K	91	180	K	100	270	K
BD	3	6.8	K	4.3	9	K	8	18	K	11	22	K	13	39	K	33	91	K	68	130	K	82	220	K
BE	5.1	13	K	8	16	K	15	33	K	20	39	K	24	75	K	62	160	K	120	240	K	150	390	K
BL	8.2	20	K,M	13	27	K,M	24	51	K,M	33	62	K,M	39	120	K,M	100	270	K,M	200	390	K,M	240	620	K,M
BJ	13	33	K	20	47	K	38	82	K	51	100	K	62	180	K	160	430	K	330	680	K	390	1000	K
BN	18	47	K,M	30	62	K,M	56	120	K,M	68	130	K,M	91	270	K,M	220	560	K,M	430	910	K,M	510	1300	K,M
BU	36	82	M	56	120	M	100	220	M	130	270	M	160	510	M	390	1100	M	820	1600	M	1000	2700	M
BV	56	130	M	82	180	M	160	360	M	220	430	M	270	750	M	620	1800	M	1300	2700	M	1600	4300	M

UX MATERIAL CAPCITANCE TABLE

STYLE	D10		D12		D15		D20		D25		D30		D35		D50		D70		D90	
CAPACITANCE (pF)																				
MATERIAL	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
25V	51	75	75	180	110	250	170	340	280	650	390	800	620	1400	1600	3200	3500	5900	6200	10,000
50V	-	-	-	-	-	-	100	200	170	390	240	470	360	850	940	2000	2100	3500	3700	5500

SLC — T-Cap®

DESCRIPTION

High Performance Single Layer Capacitors for RF, Microwave and Millimeter Wave Applications.

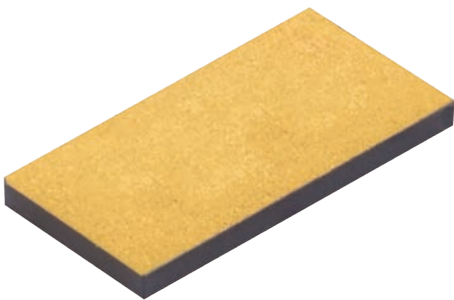
- Wire Bondable: 100μ" Au with a Ni Barrier Layer
- Customized solutions available, please contact an inside sales representative

FUNCTIONAL APPLICATIONS

- DC Blocking
- RF Bypassing
- Filtering
- Tuning
- Insulation
- Submounts
- Stand-Offs

BENEFITS

- Dimensional consistency
- Gold metallization for wire bonding
- Rugged construction



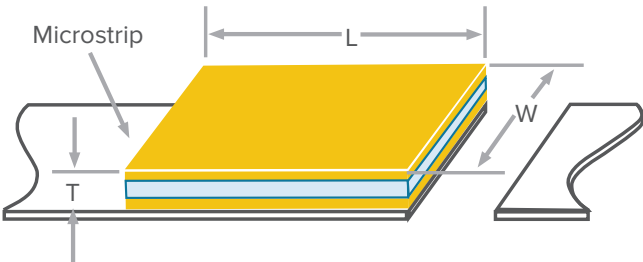
TEST LEVEL CODES

Commercial Level

X	100% 4-Side Visual
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HIGH RELIABILITY

A	MIL-PRF-49464 Group A • 100% Thermal Shock • 100% Voltage Conditioning • 100% 6-Side Visual • Bond Strength • Die Shear • Temperature Coefficient	B	MIL-PRF-49464 Group B • MIL-PRF-49464 Group A • Immersion • Low Voltage Humidity • Life
		D	• Customer Defined
		E	• 6 Sided Visual
		H	MIL-PRF-38534 Class H
		K	MIL-PRF-38534 Class K



ORDERING INFORMATION — SLC — T-CAP®

T	30	BV	30	X	45	P	X	
Product	Width	Material	Length	Tolerance	Thickness	Termination	Test Level	Packaging
T = T-Cap®	Two digit number representing the Width in .001" For Widths >.099", Consult an inside sales rep.	See material tables on Page 6.	Two digit number representing the Length in .001" For Lengths >.099", Consult an inside sales rep.	X = Length & Width: ± .001", Thickness: ± .0005" S = Special	35 – 99 Represents thickness in .0001" K0 = .010" M0 = .020" Examples: 55 = .0055" K2 = .012" M5 = .025"	P = TiW/NiV/Au or Ni/Au T = TiW/NiV/Au-Sn M = TiW/Au	X A B D E H K See test level definitions on page 5.	T = Tape and Reel Leave blank for generic waffle pack. See packaging definitions on Page 28.



SLC — Bar Cap®

DESCRIPTION

- Multiple Decoupling/Blocking Capacitors in a Single Array.
- Operating frequency up to 30GHz
 - Wire Bondable: 100μ" Au with a Ni Barrier Layer
 - Customized solutions available, please contact an inside sales representative

FUNCTIONAL APPLICATIONS

- DC Blocking
- RF Bypassing
- Decoupling
- GaAs ICs

BENEFITS

- Single insertion reduces complexity and cost
- Gold metallization for wire bonding
- Reduce bond wires for improved performance



TEST LEVEL CODES

Commercial Level	
X	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV)

HIGH RELIABILITY

A	MIL-PRF-49464 Group A • 100% Thermal Shock • 100% Voltage Conditioning • 100% Electrical (CAP/DF/IR & DWV) • 100% 6-Side Visual • Bond Strength • Die Shear • Temperature Coefficient	B	MIL-PRF-49464 Group B • MIL-PRF-49464 Group A • Immersion • Low Voltage Humidity • Life
		D	• Customer Defined
		E	• 1% AQL Electrical (CAP/DF/IR/DMV) • 100% 6 Sided Visual
		H	MIL-PRF-38534 Class H
		K	MIL-PRF-38534 Class K

TOLERANCE

Code	Description
Z	+80%, -20%

VOLTAGE

Code	Voltage
2	25 Volts
5	50 Volts
1	100 Volts

ORDERING INFORMATION — SLC — BAR CAP®

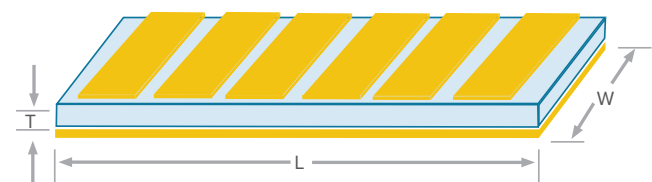
E	40	BU	151	Z	1	P	X	4	
Product	Case Size	Material	Capacitance (pF)	Tolerance	Voltage	Termination	Test Level	Capacitor Quantity (mils)	Packaging
E = Bar Cap®	20 25 30 40	See material tables on Page 6.	800 = 80 pF 101 = 101 pF 121 = 120 pF 151 = 150 pF Consult an inside sales rep for custom solutions.	Z = +80% -20%	2 = 25V 5 = 50V 1 = 100V	P = TiW/NiV/Au M = TiW/Au	A B D H K X See test level definitions on page 5.	3 4 6 Etc.	Leave blank for generic waffle pack. See packaging definitions on Page 28.



SLC — Bar Cap®

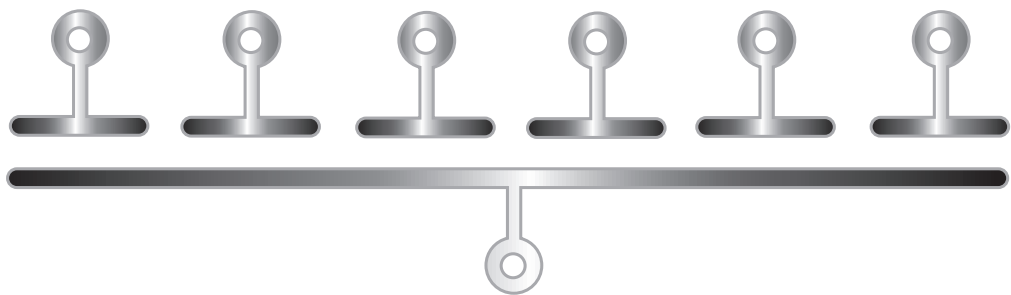
DIMENSIONS

Case Style	No. of Caps	Width	Length	Thickness	Pad Size
E20	3	0.020" ±0.003" (0.508mm ±0.076mm)	0.065" ±0.005" (1.651mm ±0.127mm)	See below	0.020" ±0.0015" (0.508mm ±0.381mm)
	4		0.085" ±0.005" (2.159mm ±0.127mm)		
	6		0.125" ±0.005" (3.175mm ±0.127mm)		
E25	3	0.025" ±0.003" (0.635mm ±0.076mm)	0.065" ±0.005" (1.651mm ±0.127mm)	See below	0.025" ±0.0015" (0.635mm ±0.381mm)
	4		0.085" ±0.005" (2.159mm ±0.127mm)		
	6		0.125" ±0.005" (3.175mm ±0.127mm)		
E30	3	0.030"±0.003" (0.762mm ±0.076mm)	0.065" ±0.005" (1.651mm ±0.127mm)	See below	0.030" ±0.0015" (0.762mm ±0.381mm)
	4		0.085" ±0.005" (2.159mm ±0.127mm)		
	6		0.125" ±0.005" (3.175mm ±0.127mm)		
E40	3	0.040" ±0.003" (1.016mm ±0.076mm)	0.065" ±0.005" (1.651mm ±0.127mm)	See below	0.040" ±0.0015" (1.016mm ±0.381mm)
	4		0.085" ±0.005" (2.159mm ±0.127mm)		
	6		0.125" ±0.005" (3.175mm ±0.127mm)		



Voltage	Thickness
100 V	0.007" ± 0.001" (0.178mm ± 0.025mm)
25 V*	0.006" ± 0.001" (0.152mm ± 0.025mm)
50 V*	0.010" ± 0.001" (0.254mm ± 0.025mm)

*For UX Material Only



SLC — Gap Cap®

DESCRIPTION

Series Configured Capacitor for Microwave Applications. Recessed metallization has been designed to minimize the potential of shorting during attachment (epoxy or solder).

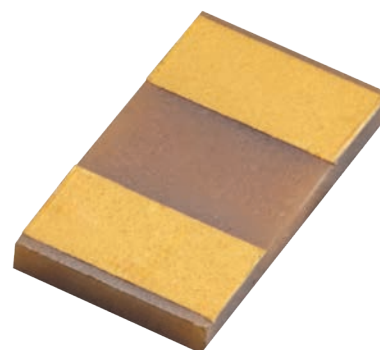
- Available from 0.2pF to 800pF
- Operating frequency up to 30GHz
- Customized solutions

FUNCTIONAL APPLICATIONS

- DC Blocking
- RF Bypassing
- Filtering
- Tuning
- Coupling

BENEFITS

- Eliminates wire bonding
- Coplanar waveguide
- Low insertion loss



TEST LEVEL CODES

Commercial Level

X	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV)
Z	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV) Tested to tighter tolerance which may require 100% Electrical

HIGH RELIABILITY

A	MIL-PRF-49464 Group A • 100% Thermal Shock • 100% Voltage Conditioning • 100% Electrical (CAP/DF/IR & DWV) • 100% 6-Side Visual • Bond Strength • Die Shear • Temperature Coefficient	B	MIL-PRF-49464 Group B • MIL-PRF-49464 Group A • Immersion • Low Voltage Humidity • Life
		D	• Customer Defined
		E	• 1% AQL Electrical (CAP/DF/IR/DMV) • 100% 6 Sided Visual
		H	MIL-PRF-38534 Class H
		K	MIL-PRF-38534 Class K

TOLERANCE

Code	Description
A	± 0.05pF
B	± 0.1pF
C	± 0.25pF
D	± 0.50pF
K	± 10%
L	± 15%
M	± 20%
X	GMV (Guarantee Minimum Value)
Z	+80%, -20%

VOLTAGE

Code	Voltage
2	25 Volts
5	50 Volts

ORDERING INFORMATION — SLC — GAP CAP®

G	10	BU	100	K	5	P	X	05	
Product	Case Size	Material	Capacitance (pF)	Tolerance	Voltage	Termination	Test Level	Gap Width (mils)	Packaging
G = Gap-Cap®	10 15 20 25 30 35 50	See material tables on Page 6.	R01 = 0.01 pF OR5 = 0.5 pF 1R0 = 1.0 pF 5R1 = 5.1 pF 100 = 10 pF 511 = 510 pF Refer to Capacitance range tables for available values. Consult an inside sales rep for custom solutions.	A = ±0.05pF B = ±0.10pF C = ±0.25pF D = ±0.5pF K = ±10% L = ±15% M = ±20% X = GMV Z = +80% -20%	2 = 25V 5 = 50V	P = TiW/NiV/Au or Ni/Au M=TiW/Au	X Z A B D E H K See test level definitions on page 5.	05 08 10 15	Leave blank for generic waffle pack. See packaging definitions on Page 28.

SLC — Gap Cap®

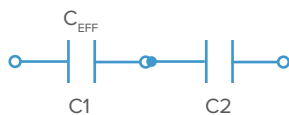
DIMENSIONS — 25 VOLT GAP CAP®

Style	Gap (Nominal)	Width	Length	Thickness
G10	0.005" (0.127mm)	0.010" + 0/-0.003" (0.254mm + 0/-0.076mm)	0.030" MAX. (0.762mm MAX.)	0.004" ± 0.001" (0.102mm ± 0.025mm)
G15	0.008" (0.203mm)	0.015" + 0/-0.003" (0.381mm + 0/-0.076mm)	0.040" MAX. (1.016mm MAX.)	
G20	0.010" (0.254mm)	0.020" + 0/-0.003" (0.508mm + 0/-0.076mm)	0.050" MAX. (1.270mm MAX.)	
G25	0.020" (0.508mm)	0.025" + 0/-0.003" (0.635mm + 0/-0.076mm)	0.060" MAX. (1.524mm MAX.)	
G30		0.030" + 0/-0.003" (0.762mm + 0/-0.076mm)		
G35		0.035" ± 0.005" (0.889mm ± 0.127mm)		
G50		0.050" ± 0.010" (1.27mm ± 0.254mm)	0.080" MAX. (2.032mm MAX.)	0.006" ± 0.001" (0.152mm ± 0.025mm)

DIMENSIONS — 50 VOLT GAP CAP®

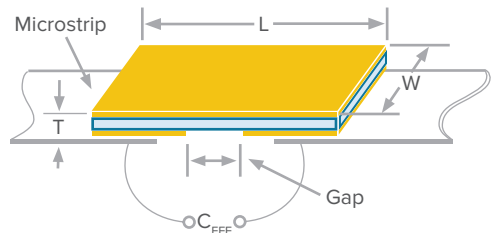
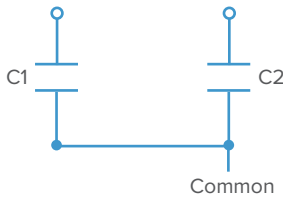
Style	Gap (Nominal)	Width	Length	Thickness
G10	0.005" (0.127mm)	0.010" + 0/-0.003" (0.254mm + 0/-0.076mm)	0.030" MAX. (0.762mm MAX.)	0.006" ± 0.001" (0.152mm ± 0.025mm)
G15	0.008" (0.203mm)	0.015" + 0/-0.003" (0.381mm + 0/-0.076mm)	0.040" MAX. (1.016mm MAX.)	
G20	0.010" (0.254mm)	0.020" + 0/-0.003" (0.508mm + 0/-0.076mm)	0.050" MAX. (1.270mm MAX.)	
G25	0.020" (0.508mm)	0.025" + 0/-0.003" (0.635mm + 0/-0.076mm)	0.080" MAX. (2.032mm MAX.)	
G30		0.030" + 0/-0.003" (0.762mm + 0/-0.076mm)		
G35		0.035" ± 0.005" (0.889mm ± 0.127mm)		
G50		0.050" ± 0.010" (1.27mm ± 0.254mm)		

*UX thickness 0.010" (0.254mm)



$C_{EFF} = \text{SERIES EQUIVALENT}$
 $C1 = C2 \quad C_{EFF} = C1 \div 2$

ALL GAP CAP VALUES ARE LISTED AS C_{EFF}



SLC — Gap Cap®

CAPACITANCE VALUES — 25 VOLT RATED GAP CAP®

STYLE	G10			G15			G20			G25			G30			G35			G50			
CAPACITANCE (pF)																						
MATERIAL	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	
PI	0.02	0.03	A	0.03	0.07	A	0.04	0.10	A	0.05	0.15	A	0.06	0.15	A	0.07	0.20	A	-	-	-	
PG	0.02	0.05	A	0.04	0.10	A	0.05	0.15	A	0.07	0.20	A	0.08	0.25	A	0.09	0.25	A	-	-	-	
AH	0.04	0.08	A	0.06	0.15	A	0.08	0.25	A	0.10	0.30	A	0.15	0.35	A	0.15	0.45	A	-	-	-	
CF	0.04	0.09	A	0.08	0.15	A	0.10	0.30	A	0.15	0.35	A	0.15	0.45	A	0.20	0.50	A	-	-	-	
NA	0.04	0.08	A	0.07	0.15	A	0.09	0.25	A	0.15	0.35	A	0.15	0.40	A	0.15	0.50	A	-	-	-	
CD	0.06	0.10	A	0.15	0.25	A	0.15	0.45	A	0.20	0.60	B	0.25	0.70	B	0.30	0.80	B	-	-	-	
CG	0.15	0.25	A	0.25	0.50	A	0.30	0.90	B	0.35	1.1	B	0.45	1.3	C	0.50	1.6	C	-	-	-	
DB	0.15	0.25	A	0.25	0.55	B	0.30	0.90	B	0.35	1.1	B	0.45	1.4	C	0.50	1.6	C	-	-	-	
NP	0.15	0.30	A	0.30	0.65	B	0.35	1.1	C	0.40	1.3	C	0.55	1.6	C	0.60	1.9	C	-	-	-	
NR	0.25	0.60	A,B	0.50	1.2	B	0.65	2.0	C	0.75	2.4	C	0.95	3.0	D	1.1	3.6	D	-	-	-	
NS	0.50	1.2	B	0.90	2.2	C,K	1.2	3.9	D,K	1.4	4.7	D,K	1.8	5.6	D,K	2.2	6.8	K	-	-	-	
NU	0.95	2.4	C,K	1.8	4.3	C,K	2.4	7.5	D,K	3.0	9.1	D,K	3.6	11	K	4.3	13	K	-	-	-	
NV	1.4	3.6	C,K	2.7	6.8	D,K	3.6	11	D,K	4.3	13	K	5.6	16	K	6.2	20	K	-	-	-	
BD	1.1	2.7	K	2.2	5.1	K	2.7	9.1	K	3.3	11	K	4.3	13	K	5.1	16	K	-	-	-	
BE	2.0	4.7	K	3.9	9.1	K	5.1	16	K	6.2	20	K	7.5	24	K	9.1	27	K	-	-	-	
BL	3.3	7.5	K	6.2	15	K	8.2	24	K	10	30	K	12	39	K	15	43	K	-	-	-	
BJ	5.1	13	K	10	24	K	13	43	K	16	51	K	20	62	K	24	75	K	-	-	-	
BN	7.5	18	K	15	33	K	18	56	K	22	68	K	27	82	K	33	100	K	-	-	-	
BU	15	33	K,M	27	62	K,M	33	110	K,M	43	130	K,M	51	160	K,M	62	180	K,M	-	-	-	
BV	22	51	M	43	100	M	51	160	M	68	200	M	82	240	M	100	300	M	-	-	-	
UX	40	60	M	90	120	M	150	200	M	190	250	M	265	300	M	310	350	M	500	800	M	

CAPACITANCE VALUES — 50 VOLT RATED GAP CAP®

STYLE	610			615			620			625			630			635			650		
CAPACITANCE (pF)																					
MATERIAL	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.	MIN.	MAX.	TOL.
PI	0.02	0.02	A	0.03	0.05	A	0.03	0.08	A	0.04	0.15	A	0.05	0.15	A	0.06	0.20	A	0.07	0.35	A
PG	0.02	0.03	A	0.03	0.06	A	0.04	0.10	A	0.05	0.20	A	0.07	0.25	A	0.07	0.25	A	0.09	0.50	A
AH	0.03	0.05	A	0.05	0.10	A	0.06	0.15	A	0.08	0.30	A	0.10	0.35	A	0.15	0.45	A	0.15	0.75	A,B
CF	0.03	0.06	A	0.06	0.10	A	0.07	0.20	A	0.09	0.35	A	0.15	0.45	A	0.15	0.50	A	0.20	0.90	A,B
NA	0.03	0.05	A	0.05	0.10	A	0.07	0.15	A	0.08	0.35	A	0.15	0.40	A	0.15	0.45	A	0.20	0.85	A,B
CD	0.04	0.09	A	0.08	0.15	A	0.15	0.30	A	0.15	0.55	A	0.20	0.70	A,B	0.20	0.80	A,B	0.30	1.4	A,B
CG	0.08	0.15	A	0.15	0.35	A	0.20	0.60	A	0.30	1.1	A	0.35	1.3	A,B	0.40	1.5	A,B	0.50	2.7	A,B
DB	0.08	0.15	A	0.20	0.35	A	0.25	0.60	A	0.30	1.1	A,B	0.35	1.3	B,C	0.40	1.6	B,C	0.50	2.7	B,C
NP	0.09	0.20	A	0.20	0.40	A	0.25	0.70	B	0.35	1.3	B	0.40	1.6	B,C	0.50	1.9	B,C	0.60	3.3	B,C
NR	0.20	0.40	A	0.35	0.80	B	0.45	1.3	B,C	0.60	2.4	B,C	0.75	3.0	D	0.90	3.6	D	1.2	6.2	D,K
NS	0.35	0.8	C,K	0.65	1.5	C,K	0.85	2.4	C,K	1.1	4.7	C	1.4	5.6	D,K	1.6	6.2	D,K	2.2	11	D,K
NU	0.65	1.6	C,K	1.3	3.0	C,K	1.7	5.1	D,K	2.2	9.1	D,K	3.0	11	K	3.3	13	K	4.3	22	K
NV	0.95	2.4	C,K	2.0	4.7	C,K	2.7	7.5	D,K	3.3	13	D,K	4.3	16	K	5.1	20	K	6.2	33	K
BD	0.75	1.8	K	1.5	3.6	K	2.0	5.6	K	2.7	11	K	3.3	13	K	3.9	15	K	5.1	27	K
BE	2.0	4.6	K	3.8	8.5	K	3.5	13.8	K	5.3	25	K	6.4	30	K	7.4	35	K	26	50	K
BL	2.2	5.1	K	4.3	10	K	6.2	16	K	7.5	30	K	10	36	K	11	43	K	15	75	K
BJ	3.6	8.2	K	7.5	16	K	10	27	K	12	51	K	16	62	K	18	68	K	24	120	K
BN	5.1	12	K	10	22	K	13	39	K	18	68	K	22	82	K	24	100	K	33	160	K
BU	9.1	22	M	20	43	M	24	68	M	33	130	M	43	160	M	47	180	M	62	330	M
BV	15	36	M	30	68	M	39	110	M	51	200	M	68	240	M	75	300	M	100	510	M
UX	-	-	-	60	70	M	90	120	M	140	160	M	180	190	M	200	250	M	380	550	M

SLC — Bi-Cap[®]

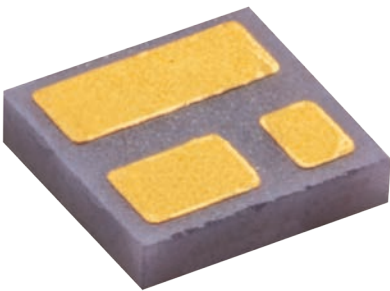
Binary Tunable Caps for Single-Layer Hybrids.

FUNCTIONAL APPLICATIONS

- Matching Networks
- Tank Circuits
- Tuning
- Coupling

BENEFITS

- Small size compatible with microwave geometries
- Hybrid Circuits — engineering designs
- Operating frequency up to 30GHz
- Customized solutions



TEST LEVEL CODES

Commercial Level	
X	100% 4-Side Visual 1% AQL Electrical (CAP/DF/IR & DWV)

HIGH RELIABILITY

A	MIL-PRF-49464 Group A • 100% Thermal Shock • 100% Voltage Conditioning • 100% Electrical (CAP/DF/IR & DWV) • 100% 6-Side Visual • Bond Strength • Die Shear • Temperature Coefficient	B	MIL-PRF-49464 Group B • MIL-PRF-49464 Group A • Immersion • Low Voltage Humidity • Life
		D	• Customer Defined
		E	• 1% AQL Electrical (CAP/DF/IR/DMV) • 100% 6 Sided Visual
		H	MIL-PRF-38534 Class H
		K	MIL-PRF-38534 Class K

TOLERANCE

Code	Description
A	± 0.05pF
B	± 0.10pF
C	± 0.25pF
D	± 0.50pF
K	± 10%
L	± 15%
M	± 20%
X	GMV (Guarantee Minimum Value)
Z	+80%, -20%

VOLTAGE

Code	Voltage
2	25 Volts
5	50 Volts
1	100 Volts

ORDERING INFORMATION — SLC — Bi-CAP[®]

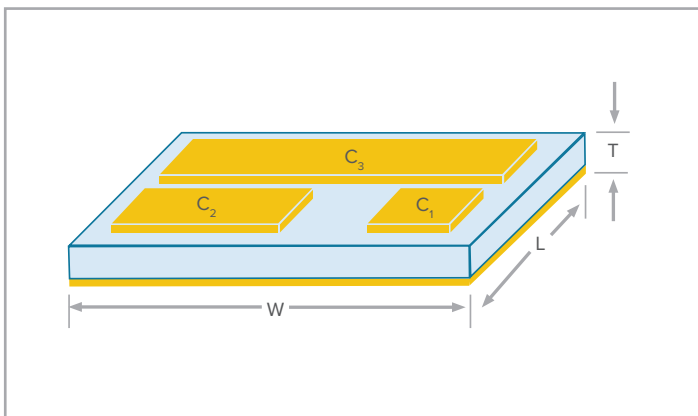
F	15	NR	OR1	M	1	P	X	3	
Product	Case Size	Material	Capacitance (pF)	Tolerance	Voltage	Termination	Test Level	Pad Quantity	Packaging
F = Binary Capacitors	15 20 25 35 40	See material tables on Page 6.	Lowest Value in Series is Part Number R08 = .08 pF OR1 = .1 pF OR2 = .2 pF OR4 = .4 pF OR5 = .5 pF Consult an inside sales rep for custom solutions.	A = ±0.05pF B = ±0.10pF C = ±0.25pF D = ±0.50pF K = ±10% L = ±15% M = ±20% X = GMV Z = +80% -20%	2 = 25V 5 = 50V 1 = 100V	P = TiW/NiV/ Au or Ni/Au M = TiW/Au	X Z A B D E See test level definitions on page 5.	3 4	Leave blank for generic waffle pack. See packaging definitions on Page 28.



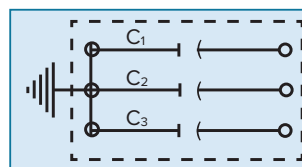
SLC — Bi-Cap[®]

Part Number	No. of Caps	Values (pF)	Voltage (WVDC)	Length	Width	Thickness	Border
F15CGR08M5PX3	3	0.08, 0.15, 0.3	50	0.015" ± 0.001" (0.381mm ± 0.025mm)	0.015" ± 0.001" (0.381mm ± 0.025mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	0.002" (0.051mm)
F15NR0R1M1PX3	3	0.1, 0.2, 0.4	100	0.015" ± 0.001" (0.381mm ± 0.025mm)	0.015" ± 0.001" (0.381mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F20CG0R1M1PX3	3	0.1, 0.2, 0.4	100	0.020" ± 0.001" (0.508mm ± 0.025mm)	0.020" ± 0.001" (0.508mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F20NR0R2M1PX3	3	0.2, 0.4, 0.8	100	0.020" ± 0.001" (0.508mm ± 0.025mm)	0.020" ± 0.001" (0.508mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F25CFR08M5PX3	3	0.08, 0.15, 0.3	50	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.004" ± 0.001" (0.102mm ± 0.025mm)	
F25CG0R2M1PX3	3	0.2, 0.4, 0.8	100	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F25NR0R4M1PX3	3	0.4, 0.8, 1.6	100	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.025" ± 0.001" (0.635mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F35CF0R1M1PX3	3	0.1, 0.2, 0.4	100	0.035" ± 0.001" (0.889mm ± 0.025mm)	0.035" ± 0.001" (0.889mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F35CG0R4M1PX3	3	0.4, 0.8, 1.6	100	0.035" ± 0.001" (0.889mm ± 0.025mm)	0.035" ± 0.001" (0.889mm ± 0.025mm)	0.006" ± 0.001" (0.152mm ± 0.025mm)	
F40NR0R5M1PX4	4	0.5, 1, 2, 4	100	0.040" ± 0.001" (1.016mm ± 0.025mm)	0.040" ± 0.001" (1.016mm ± 0.025mm)	0.0075" ± 0.001" (0.191mm ± 0.025mm)	

DIMENSIONS — Bi-CAP[®]



CIRCUIT DIAGRAM — Bi-CAP[®]



$C_1 = 1$
 $C_2 = 2 \times C_1$
 $C_3 = 4 \times C_1$
 (4 pad - $C_4 = 8 \times C_1$)
 Pads may be used singularly or
 in combination to tune circuit.

SLC — V Series

DESCRIPTION

Class II dielectric material with X7R characteristics for DC Blocking or RF Bypass applications in a broad frequency range.

These high frequency, wire bondable single layer capacitors are perfect for GaN and GaAs amplifier applications where small size and microwave performance is key to a well-performing circuit.

- X7R Temperature Stability
- Excellent High Frequency Response
- Wire Bondable
- RoHS Compliant
- High Capacitance in a Small Footprint
- MSL-1
- Rated Operating/Storage Temp. -55 to +125°C



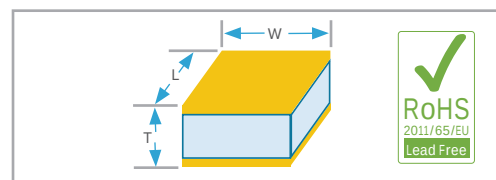
FUNCTIONAL APPLICATIONS

- DC Blocking
- Filtering
- RF Bypassing
- Tuning and Coupling

Part Number	Capacitance	Voltage	Dissipation Factor @ 1MHz	Insulation Resistance @ +25C	Insulation Resistance @ +125C
V30BZ102M6SX	1nF ± 20%	200WVDC	2.5%	10 ³ MΩ	10 ² MΩ
V30BZ222M8SX	2.2nF ± 20%	150WVDC	2.5%	10 ³ MΩ	10 ² MΩ
V30BZ472M1SX	4.7nF ± 20%	100WVDC	2.5%	10 ³ MΩ	10 ² MΩ
V30BZ682M1SX	6.8nF ± 20%	100WVDC	2.5%	10 ³ MΩ	10 ² MΩ
V30BZ103M1SX	10nF ± 20%	100WVDC	2.5%	10 ³ MΩ	10 ² MΩ
V80BZ104M5SX	100nF ± 20%	50WVDC	2.5%	10 ³ MΩ	10 ² MΩ

Metal thickness is min. 100u" of Au over min. 50u" of Ni

Part Number	Length	Width	Thickness
V30BZ102M6SX	0.030" ± 0.003" (0.762mm ± 0.076mm)	0.030" ± 0.003" (0.762mm ± 0.076mm)	0.022" ± 0.003" (0.559mm ± 0.0762mm)
V30BZ222M8SX			
V30BZ472M1SX			
V30BZ682M1SX			
V30BZ103M1SX			
V80BZ104M5SX	0.084" ± 0.004" (2.134" mm ± 0.102")	0.042" ± 0.004" (1.067" mm ± 0.102")	0.024" ± 0.003" (0.610" mm ± 0.076")

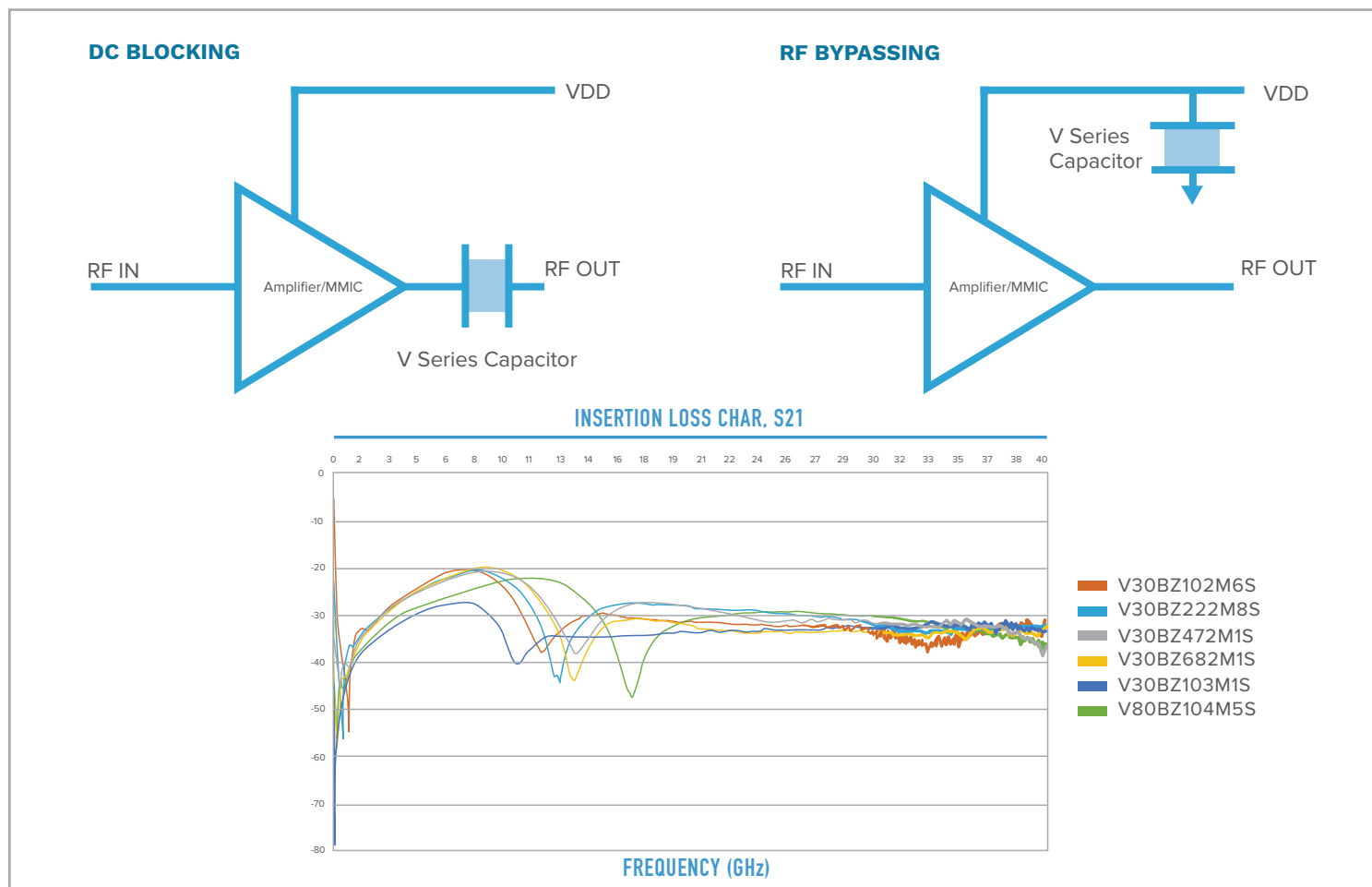


ORDERING INFORMATION — SLC — V SERIES CAPACITORS

V	30	BZ	102	M	5	S	X	
Product	Case Size	Material	Capacitance (nF)	Tolerance	Voltage	Termination	Test Level	Packaging
V = V Series	30 80		102 = 1nF 222 = 2.2nF 472 = 4.7nF 682 = 6.8nF 103 = 10nF 104 = 100nF	M = ± 20%	5 = 50V 1 = 100V 8 = 150V 6 = 200V	S = Ni / Au	X = Commercial A = Group A B = Group B H = Class H K = Class K See test level definitions on page 5.	Available in Waffle Packs.

SLC — V Series

PERFORMANCE CHARACTERISTICS — V SERIES CAPACITORS

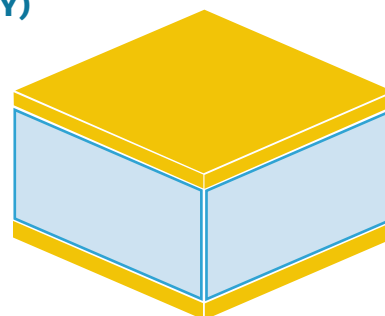


PERFORMANCE CHARACTERISTICS — V SERIES CAPACITORS

RECOMMENDED ATTACHMENT METHOD (CONDUCTIVE EPOXY) ALTERNATIVE ATTACHMENT METHOD (GOLD EUTECTIC)

Bonding can be done with either needle or automatic dispensers.

Epoxy curing defer to the epoxy manufacturer's preferred schedule but typically in the 125°C to 150°C range. Benefits of epoxy include easier repairs, cure doesn't need to be started immediately so multiple substrates may be processed at one time and epoxy is effective in higher frequencies.



Milli-Cap® — DC Broadband Block

FEATURES

- 0201, 0402 and 0602 Footprints
 - Very Low Series Inductance
 - Matches Typical 50Ω Line Widths
 - Single-Piece Construction
 - RoHS Compliant
- Low Loss High Q parts
 - Ultra High Series Resonance
 - Behaves Like an Ideal Capacitor
 - Orientation Insensitive
 - MSL -1

FUNCTIONAL APPLICATIONS

- Test Equipment, Photonics, SONET, TOSA/ROSA, High-Speed Data
- Broadband Microwave/Millimeter Wave
- Transimpedance Amplifiers



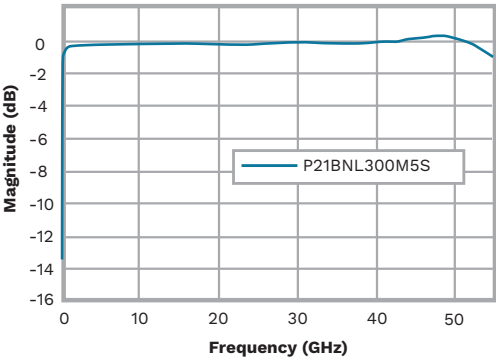
SPECIFICATIONS — MILLI-CAP®

Electrical

Temperature Coefficient of Capacitance	TCC ± 15%
Milli-Cap® Metallization	7.5μ" Au over 50μ" Ni
Capacitance Range	0.5pF to 82pF
Maximum Assembly Process Temperature	250°C
Operating Temperature	X7R: -55°C to 125°C
Storage Temperature	10°C to 30°C

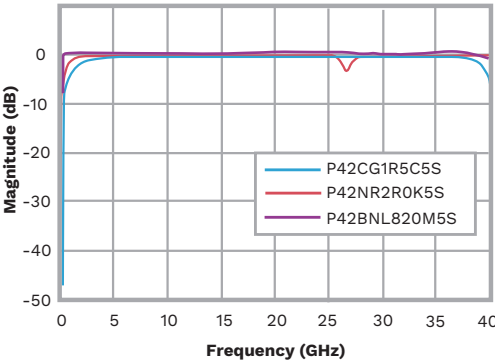
P21

Insertion Loss



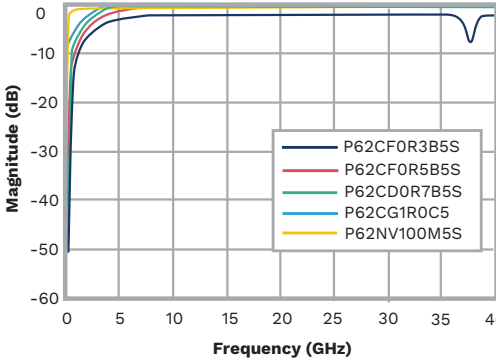
P42

Insertion Loss



P62

Insertion Loss



Milli-Cap® — DC Broadband Block

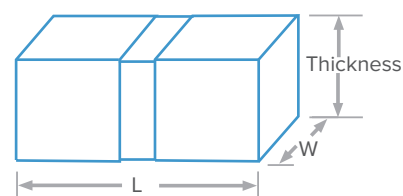
ELECTRICAL CHARACTERISTICS — MILLI-CAP®

Part Number	Value (pF)	Voltage Rating	TCC	Dissipation Factor (Max)	Insulation Resistance (Min)	Frequency Range
P21BNL300M5S	30	50	± 15%	3.5%	10 ⁵ MΩ	20MHz – 50GHz
P42BNL820M5S	82	50	± 15%	3.5%	10 ⁵ MΩ	20MHz – 50GHz
P42NR2R0K5S	2	50	N1500 ± 500ppm/°C	0.25%	10 ⁶ MΩ	4GHz – 20GHz
P42CG1R5C5S	1.5	50	0 ± 30ppm/°C	0.7%	10 ⁶ MΩ	8GHz – 32GHz
P62BNL820M5S	82	50	± 15%	3.5%	10 ⁵ MΩ	20MHz – 50GHz
P62NV100M5S	10	50	N4700 ± 1000ppm/°C	1.2%	10 ⁶ MΩ	4GHz – 20GHz
P62CG1R0C5S	1	50	0 ± 30ppm/°C	0.7%	10 ⁶ MΩ	18GHz – 40GHz
P62CD0R7B5S	0.7	50	N20 ± 15ppm/°C	0.15%	10 ⁶ MΩ	20GHz – 40GHz
P62CF0R5B5S	0.5	50	0 ± 15 ppm/°C	0.6%	10 ⁶ MΩ	28GHz – 40GHz

Packaging: Standard is Waffle packs
Tape & Reel: -T at the end of the part number

DIMENSIONAL SPECIFICATIONS — MILLI-CAP®

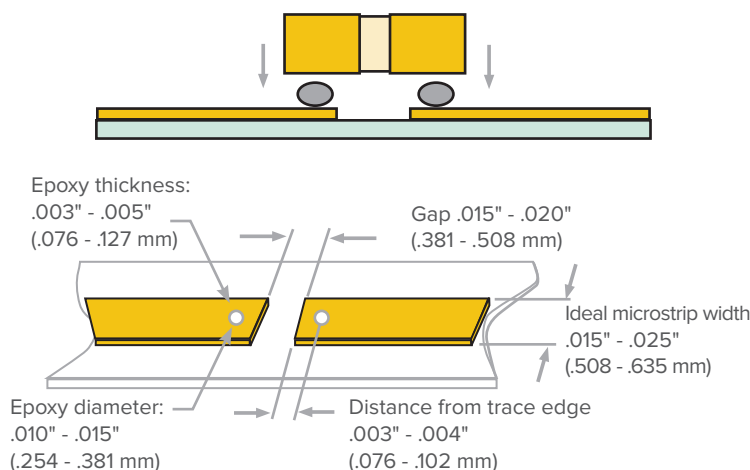
Case Size	Length	Milli-Cap® Width	Thickness
P21 (0201)	0.027" ± 0.004"	0.012" ± 0.002"	0.010" ± 0.002
P42 (0402)	0.038" ± 0.004"	0.020" ± 0.002"	0.020" ± 0.002"
P62 (0602)	0.058" ± 0.004"	0.020" ± 0.002"	0.020" ± 0.002"



ATTACHMENT METHODS — MILLI-CAP®

Recommended attachment to soft or hard substrate using Conductive Epoxy

1. Place a single drop of conductive epoxy onto each microstrip as illustrated; the edge of the epoxy shall be at least .003"-.004" back from the edge of the trace to prevent filling the gap with epoxy.
2. Centering the termination gap of the capacitor within the gap in the microstrip, press with careful, even pressure onto the microstrip ensuring the terminations make good contact with the epoxy drops.
3. Cure according to the epoxy manufacturer's preferred schedule, typically 125°C to 150°C max.
4. After curing, inspect joint for epoxy shorts across the termination and microstrip gaps that would cause a short across the cap.
5. Isopropanol and Methanol are both safe to use to pre-clean Milli-Caps®. Isopropanol and Methanol are not to be used after mounting with conductive epoxy as they act as a solvent.



Recommended attachment to soft or hard substrate using Solder

1. Place a single drop of solder paste onto each micro strip as illustrated; the edge of the solder shall be at least .001"-.002" back from the edge of the trace to prevent filling the gap with solder.
2. Centering the termination gap of the capacitor within the gap in the microstrip, press with careful, even pressure onto the microstrip ensuring the terminations make good contact with the drops of solder paste.
3. Reflow according to the solder manufacturer's preferred profile, ensuring the reflow temperature does not exceed 250°C.
4. After the reflow step is completed, inspect joint for voids or excess flux and non-reflowed solder balls that can degrade performance or cause shorts across the gaps. Proper cleaning after the reflow process is crucial to avoiding performance degradation and discovering poor solder joints. Isopropanol and Methanol are both safe to use with soldered Milli-Caps®.

Opti-Cap® — Ultra Broadband DC Blocking

FEATURES

- X7R temperature and voltage stability
- Resonance free DC blocking to >40GHz
- SMT by solder or epoxy bonding
- RoHS Compliant
- Low frequency stability over temperature
- Very low series inductance
- 0201, 0402 and 0602 footprints
- MSL -1

FUNCTIONAL APPLICATIONS

- Test Equipment, Photonics, SONET, TOSA/ROSA, High-Speed Data
- Broadband Microwave/Millimeter Wave
- Transimpedance Amplifiers

BENEFITS

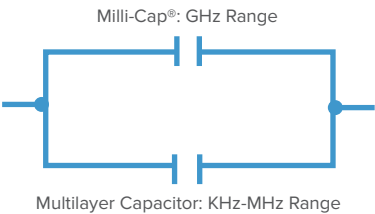
- Eliminates wire bonding
- Coplanar waveguide
- Low insertion loss



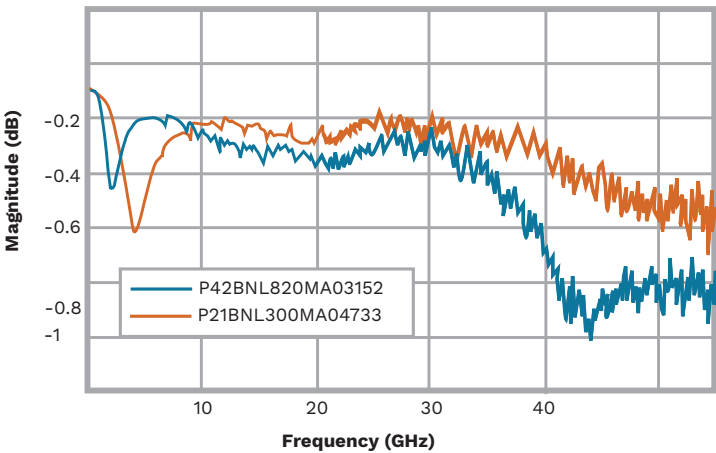
SPECIFICATIONS — OPTI-CAP®

Electrical

Temperature Coefficient of Capacitance	X5R: -55°C to +85°C (TCC ± 15%) X7R: -55°C to +125°C (TCC ± 15%)
Capacitance Range	1.5nF to 220nF
Maximum Assembly Process Temperature	250°C



INSERTION LOSS



ELECTRICAL CHARACTERISTICS — OPTI-CAP®

Part Number	Capacitance		Voltage Rating	TCC	DF (MAX)	IR (MIN)	Frequency Range
	MLC	Milli-Cap®					
P21BNL300MA04733	100nF	30pF	10V	X5R	3.5%	>10 ² MΩ	16KHz - >40GHz
P21BNL300MA04282	22nF	30pF					
P21BNL300MA03976	10nF	30pF					
P21BNL300MA04678	1.5nF	30pF	25V	X7R			
P42BNL820MA03152	220nF	82pF	10V	X5R			
P42BNL820MA04679	22nF	82pF	50V	X7R			
P62BNL820MA02636	100nF	82pF	25V	X7R			



Opti-Cap® — Ultra Broadband DC Blocking

DIMENSIONAL SPECIFICATIONS — OPTI-CAP®

Case Size	Milli-Cap®			MLC		
	Length	Width	Thickness	Length	Width	Thickness
P21 (0201)	0.027" ± 0.004"	0.012" ± 0.002"	0.010" ± 0.002"	0.022" ± 0.002"	0.010" ± 0.001"	0.010" ± 0.002"
P42 (0402)	0.038" ± 0.004"	0.020" ± 0.002"	0.020" ± 0.002"	0.040" ± 0.002"	0.020" ± 0.002"	0.020" ± 0.002"
P62 (0602)	0.058" ± 0.004"	0.020" ± 0.002"	0.020" ± 0.002"	0.067" ± 0.004"	0.031" ± 0.004"	0.031" ± 0.005"

Packaging: Standard is Waffle packs
Tape & Reel: -T at the end of the part number

ATTACHMENT METHODS — OPTI-CAP®

Recommended attachment to soft or hard substrate using Conductive Epoxy

1. Place a single drop of conductive epoxy onto each microstrip as illustrated; the edge of the epoxy shall be at least .003"-.004" back from the edge of the trace to prevent filling the gap with epoxy.
2. Centering the termination gap of the capacitor within the gap in the microstrip, press with careful, even pressure onto the microstrip ensuring the terminations make good contact with the epoxy drops.
3. Cure according to the epoxy manufacturer's preferred schedule, typically 125°C to 150°C max.
4. After curing, inspect joint for epoxy shorts across the termination and microstrip gaps that would cause a short across the cap.

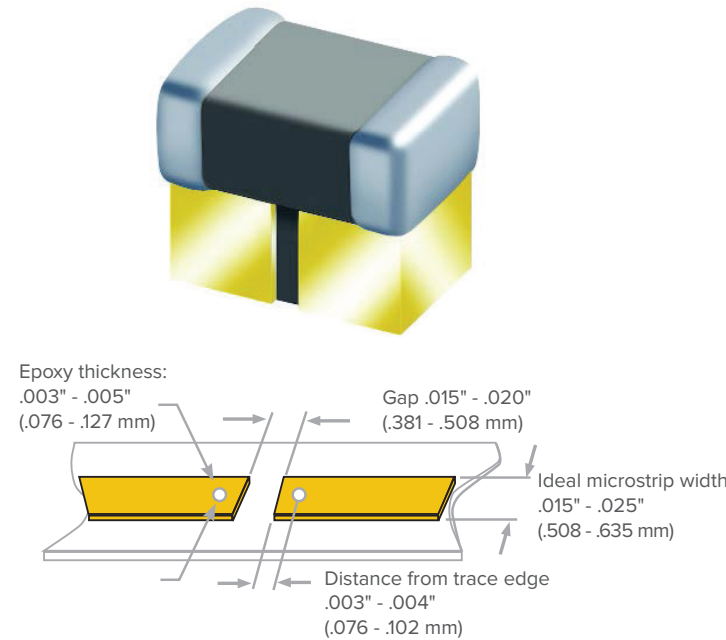
Isopropanol and Methanol are both safe to use to pre-clean Opti-Caps®, Isopropanol, and Methanol are not to be used after mounting with conductive epoxy as they act as a solvent!

Recommended attachment to soft or hard substrate using Solder

1. Place a single drop of solder paste onto each microstrip as illustrated; the edge of the solder shall be at least .001"-.002" back from the edge of the trace to prevent filling the gap with solder.
2. Centering the termination gap of the capacitor within the gap in the microstrip, press with careful, even pressure onto the microstrip ensuring the terminations make good contact with the drops of solder paste.

3. Reflow according to the solder manufacturer's preferred profile, ensuring the reflow temperature does not exceed 250°C.
4. After the reflow step is completed, inspect joint for voids or excess flux and non-reflowed solder balls that can degrade performance or cause shorts across the gaps. Proper cleaning after the reflow process is crucial to avoiding performance degradation and discovering poor solder joints.

Isopropanol and Methanol are both safe to use with soldered Opti-Caps®.



SLC — Packaging & Kits

WAFFLE PACKAGING

Available in a wide variety of standard design waffle packs in various materials depending on the application. Typical material offerings are antistatic and gel pack, which can contain up to 400 pieces depending on component dimension. Custom waffle packs, including Lid Clip System (LCS2), are available.

TAPE AND REEL

Tape and reel packaging solutions are available for a variety of our SLC case sizes. Utilizing the latest technology and equipment to provide our customers the highest quality products, our standard SMD tape and reel packaging meets or exceeds EIA standards. Custom tape and reel packaging are available.

ON TAPE RING

SLCs are repopulated on blue membrane tape and photon ring assembly to maximize efficiency and minimize product cost. Used in high volume applications, the repopulated capacitors provide for more efficient component placement and fewer "pick and place" machine change-outs. The repopulated capacitors meet GMV capacitance value, are 100% visually acceptable and can be repopulated in custom shapes and sizes on a 6-inch photon tape ring.

"BLACK DOTTED" ON TAPE RING

Black dotted" SLCs on membrane tape and photon ring assembly. For high volume applications utilizing visual recognition, a less expensive alternative is the use of "black dotted" capacitors provided on saw dice membrane tape. The non- "black dotted" capacitors meet GMV capacitance value and a minimum of 75% visually acceptable product is guaranteed.

STORAGE

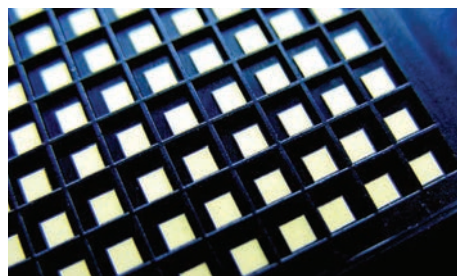
SLCs are solderable for a minimum of 1 year from date of shipment if properly stored in their original packaging. For extended periods, storage in a dry nitrogen environment is recommended. Product supplied on membrane tape and photon ring should be stored in the original container and in an environmentally controlled area where temperature and humidity are maintained. It is recommended not to store the product in direct light as this can negatively impact the adhesion properties of the tape.

HANDLING

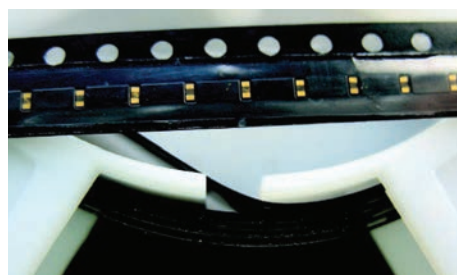
SLCs should be handled carefully during component transfer or placement, preventing damage to the gold and ceramic surfaces. The capacitors should be handled with precision stainless steel tweezers or a vacuum wand. Contacting the capacitor with bare hands should be avoided as resulting contaminants will affect the performance of the component.

SAMPLE KITS

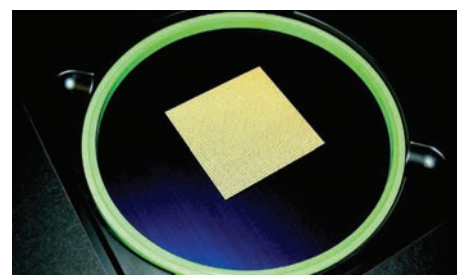
You can streamline your design process and build prototypes with a sample kit from Knowles. Please contact us for more information and to order.



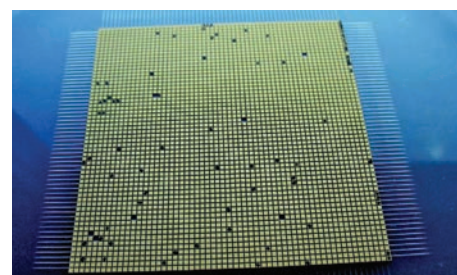
SLC Waffle Packaging



SLC Tape and Reel



SLC on Tape Ring

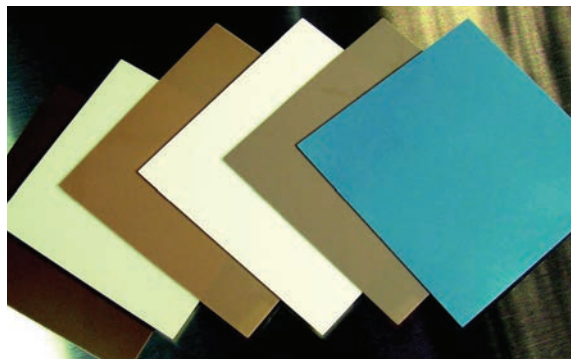


Black Dotted



Materials and Metallization for CSA, CSM, CSB, and CR/CM Series

Knowles utilizes an extensive variety of materials in both Class I and Class II categories with dielectric constants ranging from 3.8 to 35,000 to fabricate our components. CSA, CSM, CSB, and CR/CM series are only available with commercial testing. For extra testing requirements, contact us.



CLASS I DIELECTRIC MATERIALS:

This class of dielectrics consists of material exhibiting very low losses, extremely low or closely controlled temperature coefficients, negligible voltage and frequency coefficients, negligible aging effects and high insulation and dielectric breakdown.

CLASS I DIELECTRIC MATERIALS

Type	Ins. Res (MEG-OHMS 100VDC @ 25°)	Temperature Coefficient PPM°C -55 to 125°C	Dissipation Factor (@ 1MHz)	Dielectric Constant (K)	Material
C-20	10 ⁶	Negligible	0.0003	3.8	Quartz
C-28		P120 ± 25	0.0003	8.7	AlN
C-30		P180 ± 50	0.0018	9.6	Alumina 96
C-35		P180 ± 50	0.0018	9.8	Alumina 99.6
C-37		NPO 0 ± 30	0.0003	12.6	Titanate
C-40		0 ± 30	0.0003	20	Titanate
C-50		0 ± 30	0.006	40	Titanate
C-55		0 ± 30	0.015	50	Titanate
C-CH		0 ± 30	0.0050	93	Titanate
C-NR		N1500 ± 500	0.0025	160	Titanate

STANDARD ELECTRODE METALLIZATIONS

GOLD (G): This metallization consists of a minimum of 100 micro-inches of gold over TiW, which is ideal for all wire bonding methodologies. Please contact us for optimum metallization options for solder applications.

CLASS II DIELECTRIC MATERIALS:

This class of material is characterized by high dielectric constants, increased losses, and higher temperature coefficients. These properties are inherent with this class of material, but the high dielectric constants permit the use of smaller size to achieve low series inductance and meet dimensional requirements. Capacitors made with these materials are often used for coupling of microstrip line circuits where the small chip size is necessary. Used as bypass capacitors, the small size provides low series inductance and dielectric losses are typically of little concern.

CLASS II DIELECTRIC MATERIALS

Type	Ins. Res (MEG-OHMS 100VDC @ 25°)	Temperature Coefficient (%) -55 to 125°C	Dissipation Factor (@ 1MHz)	Aging (%) HR/ Decade	Dielectric Constant (K)
C-80	10 ⁵	5 to -10	0.03	2.0	350
C-BD	10 ⁴	-10 to 10	0.025	3.0	800
C-BE	10 ⁴	-10 to 10	0.025	3.0	1,400
C-100	10 ⁵	3 to -10	0.045	3.5	2,200
C-120	10 ⁵	0 to -35	0.06	3.0	3,500
C-BN	10 ⁵	-15 to 15	0.03	3.0	4,000
C-140	10 ⁵	0 to -80	0.045	3.0	11,000
C-200	10 ³	-15 to 15	0.1	3.0	25,000
C-400	10 ³	-15 to 15	0.1	3.0	35,000

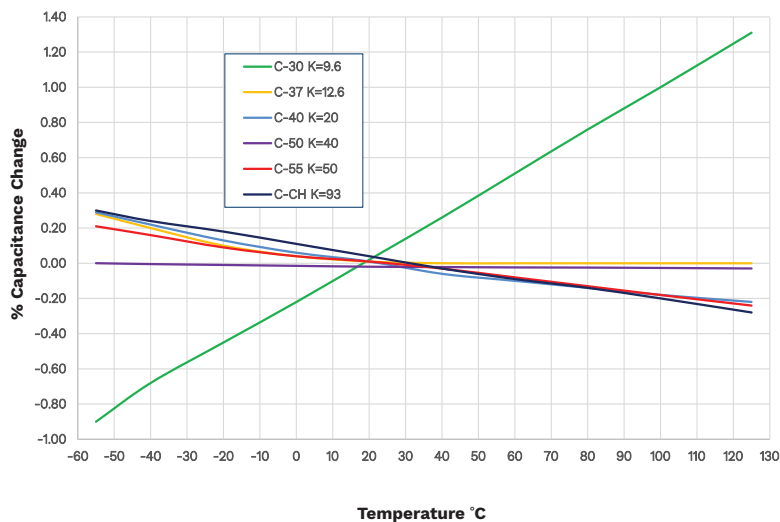
* Please contact us for specific ratings to meet your application requirements.

Note: MHz @1V <100pF, 1KHz @1V >100pF Voltage Rating: ≤5 mils thick-50 WVDC (25 WVDC for 200 material), >5 mils thick-100 WVDC (50 WVDC for 200 material).

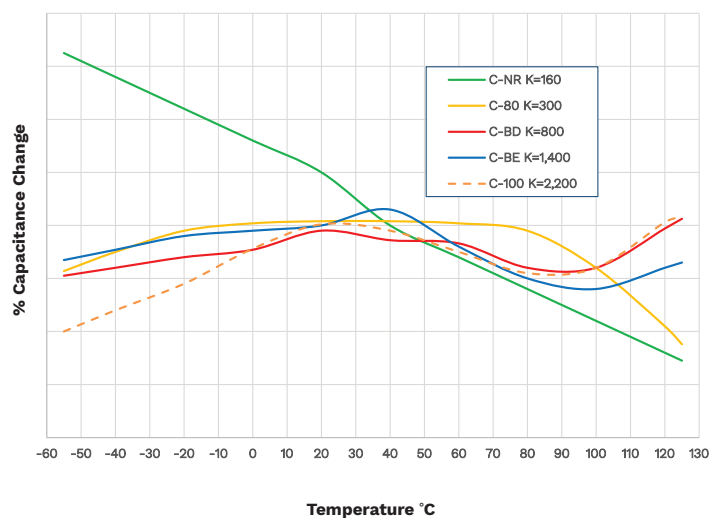
Insulation Resistance tested at 50 volts for all materials except C-200. C-200 tested at WVDC that is 16-25V for ≤6 mils thick and 25-50V for >6 mils.

Typical Temperature Characteristics

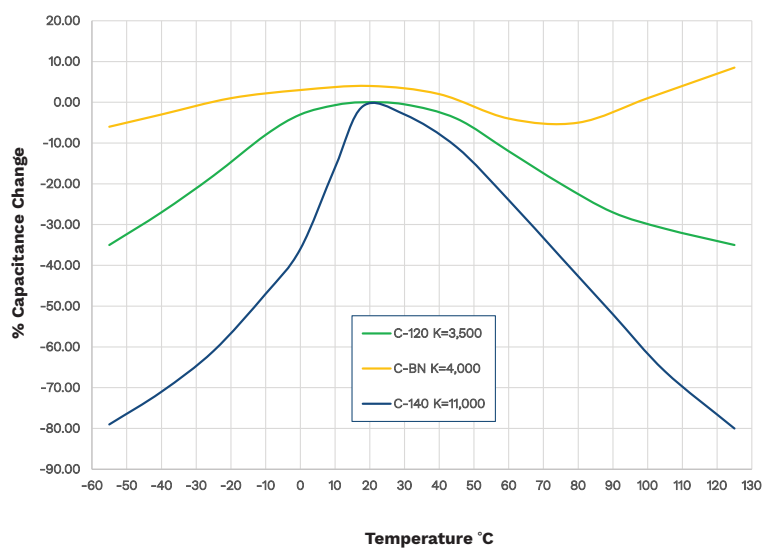
C-30/C-37/C-40/C-50/C-55/C-CH



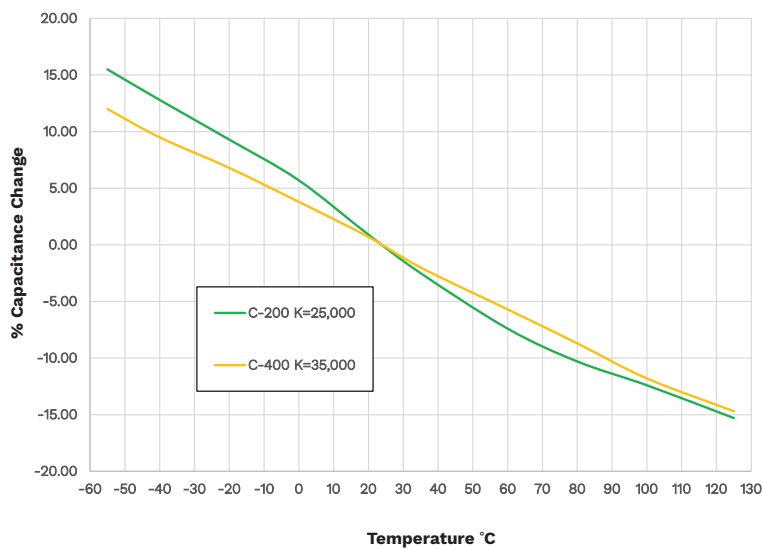
C-NR/C-80/C-BD (C-BE)/C-100



C-120/C-BN/C-140



C-200/C-400



CSA Series — Edge-to-Edge Capacitors

This classic two-electrode design is the simplest and most widely used. The chip size, shape and electrical properties may be determined from the dielectric material data and the CSA Selection Chart. Knowles is the leader in supplying the LC filter market with custom value parallel plate capacitors. We manufacture tight tolerance, custom filter capacitors to the required size, shape and value for minimization of post build tuning requirements. Thicknesses of up to 25+ mils are available, utilizing temperature-stable low-loss materials and special terminations to improve the solder process.

DESCRIPTION

- Capacitance: 0.04 to 10,000 picofarads and beyond
- Square or rectangle, length or width .008" and up



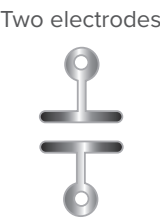
CSA STANDARD CAPACITANCE TOLERANCE CODES

Class I Dielectrics: C-20 thru C-NR		Class II Dielectrics: C-80 thru C-400	
Tolerance	Code	Tolerance	Code
±.50pF	D	-20% thru +80%	Z
±.25pF	C	Guaranteed Min. Value	GMV
±.10pF	B	± 20%	M
±.05pF	A	± 15%	L
±.01pF	P	± 10%	K
		± 5%	J
± 20%	M		
± 15%	L		
± 10%	K		
± 5%	J		
		Voltage	Material Type
		25 V	For materials C-200 and C-400
		50 V	For materials C-20 through C-140

CSA STANDARD DIMENSIONAL TOLERANCES

Material	L or W Dimension	Thickness	Tolerance
C-20 through C-140	< 20 mils	± 1.5 mils	± 15%
	≥ 20 mils		± 10%
C-200 and C-400	≤ 15 mils		± 2 mils
	>15 mils; ≤ 30 mils		± 3 mils
	> 30 mils		± 5 mils

CSA ELECTRODE CONFIGURATION



CSA CHIP DIMENSIONS



To determine rectangular chip dimensions, divide the total chip area by the required length or width to obtain the remaining dimension.

ORDERING INFORMATION — CSA SERIES — EDGE-TO-EDGE CAPACITORS

CSA Cap Style	200 Dielectric Type	10 x 10 Length x Width (mils)	x 6 Thickness (mils)	G Metallization	101 Capacitance (pF)	M Capacitance Tolerance
CSA	See Class I and Class II tables (page 29)	See CSA Chip Dimensions (page 32)	See CSA Selection Chart (page 32)	G = Gold S = Silver Custom	First two digits represent significant figures and the last, the number of zeros to follow. When required, the letter "R" is used as a decimal point and the succeeding digits represent significant figures only. e.g.: 101 = 100pF, 1R6 = 1.6pF	See CSA Standard Capacitance Tolerance Codes (Above)

Example shown is CSA series, dielectric type C-200, .010" x .010" x .005", gold, 100pF, ±20% tolerance
Packaging is standard waffle pack.



CSA Series — Edge-to-Edge Capacitors

CSA SELECTION CHART

This chart is for guidance only. All CSA Series parts are built to specific customer requirements.

Capacitor Size in Mils

MATERIAL	10x10			12x12			15x15			20x20			25x25			30x30			35x35			40x40			50x50		
	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance
C-20	0.01	0.02		0.01	0.03		0.02	0.04		0.03	0.08		0.05	0.12		0.07	0.17		0.10	0.23		0.13	0.30		0.20	0.48	
C-28	0.03	0.04		0.03	0.06		0.04	0.10		0.07	0.17		0.12	0.27		0.17	0.39		0.23	0.53		0.30	0.70		0.47	1.1	
C-30	0.03	0.05	P	0.03	0.07	P	0.05	0.11	A	0.08	0.19	A	0.13	0.30	A	0.19	0.43	A	0.25	0.59	B	0.33	0.77	B	0.51	1.2	C
C-35	0.03	0.05	P	0.03	0.07	P	0.05	0.11	A	0.08	0.20	A	0.13	0.31	A	0.19	0.45	A	0.26	0.61	B	0.34	0.79	B	0.53	1.2	C
C-37	0.04	0.06	P	0.04	0.09	P	0.06	0.14	A	0.11	0.25	A	0.17	0.39	A	0.24	0.57	B	0.33	0.77	B	0.43	1.0	C	0.68	1.6	C
C-40	0.06	0.10	P	0.06	0.14	A	0.10	0.23	A	0.17	0.40	A	0.27	0.63	B	0.39	0.90	B	0.53	1.2	C	0.69	1.6	C	1.1	2.5	C
C-50	0.12	0.20	A	0.12	0.29	A	0.19	0.45	A	0.34	0.80	B	0.54	1.3	C	0.77	1.8	C	1.1	2.5	C	1.4	3.2	D	2.1	5.0	D
C-55	0.15	0.25	A	0.15	0.36	A	0.24	0.56	B	0.43	1.0	B	0.67	1.6	C	0.96	2.3	C	1.3	3.1	D	1.7	4.0	D	2.7	6.3	K
CH	0.27	0.45	A	0.28	0.65	B	0.43	1.0	C	0.77	1.8	C	1.2	2.8	D	1.7	4.1	D	2.4	5.5	K	3.1	7.2	K	4.8	11	K
NR	0.48	0.80	B	0.49	1.2	C	0.77	1.8	C	1.4	3.2	D	2.1	5.0	D	3.1	7.2	K	4.2	9.8	K	5.5	13	K	8.6	20	K
C-80	1.1	1.8	C	1.1	2.5	D	1.7	3.9	D	3.0	7.0	K	4.7	11	K	6.8	16	K	9.2	21	K	12	28	K	19	44	K
BD	2.4	4.0	D	2.5	5.8	K	3.9	9.0	K	6.9	16	K	11	25	K	15	36	K	21	49	K	27	64	K	43	100	K
BE	4.2	7.0	K	4.3	10	K	6.8	16	K	12	28	K	19	44	K	27	63	K	37	86	K	48	112	K	75	175	K
C-100	6.6	11	K	6.8	16	K	11	25	K	19	44	K	29	69	K	42	99	K	58	135	K	75	176	K	118	275	K
C-120	11	18	K	11	25	K	17	39	K	30	70	K	47	109	K	68	158	K	92	214	K	120	280	K	188	438	K
BN	13	21	K	13	30	K	20	47	K	36	84	K	56	131	K	81	189	K	110	257	K	144	336	K	225	525	K
C-140	33	55	M	34	79	M	53	124	M	94	220	M	147	344	M	212	495	M	289	674	M	377	880	M	589	1375	M
C-200	75	113	M	77	162	M	121	253	M	214	450	M	335	703	M	482	1013	M	656	1378	M	857	1800	M	1339	2813	M
C-400	100	158	M	110	227	M	169	354	M	300	630	M	469	1000	M	675	1418	M	919	1929	M	1200	2520	M	1875	3938	M



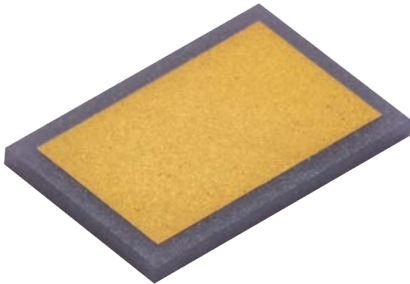
CSM Series — Margin Capacitors

Margin caps have the topside electrode withdrawn from the edges in order to increase the distance between electrodes and dramatically decrease the possibilities of shorting when epoxy die-mounting. This style is also widely used for optical recognition-based assembly.

Increased margin sizes and special terminations are available for high power LC filter applications.

DESCRIPTION

- Margin capacitors can be customized to any sized square or rectangle



CSM STANDARD CAPACITANCE TOLERANCE CODES

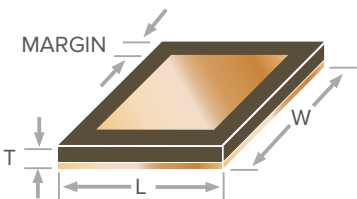
Class I Dielectrics: C-20 thru C-NR		Class II Dielectrics: C-80 thru C-400	
Tolerance	Code	Tolerance	Code
±.50pF	D	-20% thru +80%	Z
±.25pF	C	Guaranteed Min. Value	GMV
±.10pF	B	± 20%	M
±.05pF	A	± 15%	L
±.01pF	P	± 10%	K
		± 5%	J
± 20%	M		
± 15%	L		
± 10%	K		
± 5%	J		

Voltage	Material Type
25 V	For materials C-200 and C-400
50 V	For materials C-20 through C-140

CSM STANDARD DIMENSIONAL TOLERANCES

Length & Width	L or W Tolerance	Margin Nominal	Thickness
≤.010	± .002	.001	± .0015
.011 thru .029	± .002	.002	
≥.030	± .003	.002	
All dimensions given are inches			

CSM CHIP DIMENSIONS



CSM ELECTRODE CONFIGURATION

Two electrodes



ORDERING INFORMATION — CSM SERIES — MARGIN CAPACITORS

CSM Style	BE Dielectric Type	10 x 10 Length x Width (mils)	x 5 Thickness (mils)	G Metallization	3R9 Capacitance (pF)	M Capacitance Tolerance
CSM	See Class I and Class II tables (page 29)	See CSM Chip Dimensions (page 34)	See CSM Selection Chart (page 34)	G = Gold	First two digits represent significant figures and the last, the number of zeros to follow. When required, the letter "R" is used as a decimal point and the succeeding digits represent significant figures only. e.g.: 101 = 100pF, 1R6 = 1.6pF	See CSM Standard Capacitance Tolerance Codes (above)

Example shown is CSM Series, dielectric type C-BE, .010" x .010" x .005", gold, 3.9pF, ±20% tolerance

Packaging is standard waffle pack.



CSM Series — Margin Capacitors

CSM SELECTION CHART

This chart is for guidance only. All CSM Series parts are built to specific customer requirements.

Capacitor Size in Mils

MATERIAL	10x10			12x12			15x15			20x20			25x25			30x30			35x35			40x40			50x50		
	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance
C-20	0.02	0.03		0.02	0.04		0.02	0.05		0.04	0.08		0.06	0.13		0.09	0.19		0.11	0.26		0.15	0.34		0.23	0.53	
C-28	0.03	0.05		0.04	0.07		0.05	0.10		0.08	0.18		0.12	0.28		0.18	0.42		0.24	0.57		0.31	0.75		0.48	1.2	
C-30	0.03	0.05	P	0.04	0.08	P	0.05	0.11	A	0.09	0.20	A	0.14	0.31	A	0.19	0.46	A	0.26	0.63	B	0.34	0.83	B	0.53	1.3	C
C-35	0.03	0.06	P	0.04	0.08	P	0.05	0.11	A	0.09	0.20	A	0.14	0.32	A	0.20	0.47	A	0.27	0.65	B	0.35	0.85	B	0.55	1.3	C
C-37	0.04	0.07	P	0.05	0.10	A	0.06	0.14	A	0.11	0.25	A	0.17	0.41	A	0.25	0.60	B	0.34	0.82	B	0.44	1.1	C	0.69	1.7	C
C-40	0.06	0.11	A	0.07	0.16	A	0.10	0.21	A	0.17	0.40	A	0.27	0.64	B	0.39	0.94	B	0.53	1.3	C	0.69	1.7	C	1.1	2.7	D
C-50	0.12	0.21	A	0.14	0.31	A	0.18	0.42	A	0.33	0.78	B	0.52	1.3	C	0.76	1.9	C	1.0	2.6	D	1.4	3.4	D	2.1	5.4	K
C-55	0.15	0.27	A	0.17	0.39	A	0.23	0.52	B	0.41	0.98	B	0.65	1.6	C	0.95	2.3	C	1.3	3.2	D	1.7	4.2	D	2.7	6.7	K
CH	0.26	0.47	A	0.31	0.69	B	0.41	0.93	B	0.74	1.8	C	1.2	2.8	D	1.7	4.2	D	2.3	5.7	K	3.0	7.6	K	4.8	12	K
NR	0.47	0.84	B	0.54	1.2	C	0.72	1.7	C	1.3	3.1	D	2.1	5.0	K	3.0	7.4	K	4.1	10	K	5.4	13	K	8.4	21	K
C-80	1.0	1.8	C	1.2	2.7	D	1.6	3.6	D	2.8	6.8	K	4.5	11	K	6.5	16	K	9.0	22	K	12	30	K	18	47	K
BD	2.3	4.2	D	2.7	6.1	K	3.6	8.3	K	6.5	16	K	10	25	K	15	37	K	20	51	K	27	68	K	42	107	K
BE	4.0	7.3	K	4.7	11	K	6.2	14	K	11	27	K	18	44	K	26	65	K	36	89	K	47	118	K	74	188	K
C-100	6.3	12	K	7.3	17	K	9.8	23	K	18	43	K	28	69	K	41	101	K	56	140	K	74	197	K	116	295	K
C-120	10	18	K	12	27	K	16	36	K	28	68	K	45	119	K	65	174	K	89	241	K	126	320	K	184	506	K
BN	12	22	K	14	32	K	19	43	K	34	81	K	54	140	K	78	206	K	114	284	K	149	377	K	235	597	K
C-140	32	57	M	37	84	M	51	113	M	92	213	M	146	345	M	212	507	M	291	701	M	382	930	M	600	1473	M
C-200	72	106	M	83	155	M	111	197	M	202	366	M	321	586	M	466	859	M	638	1182	M	837	1558	M	1316	2467	M
C-400	100	150	M	117	217	M	155	275	M	284	512	M	450	821	M	652	1203	M	893	1655	M	1171	2181	M	1843	3454	M



CSB Series — Dual-Pad Capacitors

A single full electrode is provided on one side of the capacitor and split electrodes on the other side. This is a three-terminal capacitor that can be used as two capacitors with a common electrode, or as serially connected capacitors so that connections may be made on one side of the chip only (surface-mount). This design is often used in microstrip coupling to eliminate lead inductance and raise the self resonance frequency.

DESCRIPTION

- Capacitance: 0.02pF picofarads and up
- Chip shapes: dual pads with gap
- Gap widths: 5, 10, 15, 20 mil or custom



CSB STANDARD CAPACITANCE TOLERANCE CODES

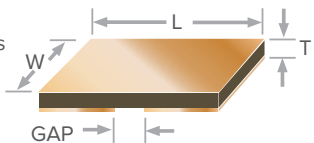
Class I Dielectrics: C-20 thru C-NR		Class II Dielectrics: C-80 thru C-400	
Tolerance	Code	Tolerance	Code
± 20%	M	-20% thru +80%	Z
		Guaranteed Min. Value	GMV
± 15%	L	± 20%	M
		± 15%	L
± 10%	K	± 10%	K

CSB STANDARD DIMENSIONAL TOLERANCES

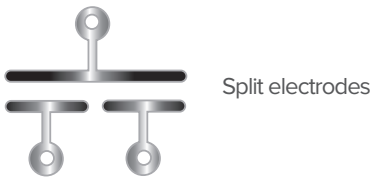
Length & Width (mils)	L or W Tolerance	Thickness (mils)
≤ 20	± 15%	± 1.5
> 20	± 10%	

CSB CHIP DIMENSIONS

This component functions as two capacitors operating in series, each of which is twice the desired equivalent capacitance. Allow us to custom design for your application.



CSB ELECTRODE CONFIGURATION



ORDERING INFORMATION — CSB SERIES — EDGE-TO-EDGE CAPACITORS

CSB Style	100 Dielectric Type	50 x 20 Length x Width (mils)	x 7 Thickness (mils)	10 Gap (mils)	6 Metallization	120 Capacitance (pF)	M Capacitance Tolerance
CSB	See Class I and Class II tables (page 29)	See CSB Chip Dimensions (page 36)	See CSB Selection Chart (page 36)	5 or higher	G = Gold S = Silver Custom	First two digits represent significant figures and the last, the number of zeros to follow. When required, the letter "R" is used as a decimal point and the succeeding digits represent significant figures only. e.g.: 101 = 100pF, 1R6 = 1.6pF	See CSB Standard Capacitance Tolerance Codes (above)

Example shown is CSB Series, dielectric type C-100, .050" x .020" x .007",.01" gap, gold, 12pF, ±20% tolerance
Packaging is standard waffle pack.

CSB Series — Dual-Pad Capacitors

CSB SELECTION CHART

This chart is for guidance only. All CSB Series parts are built to specific customer requirements.

Capacitor Size in Mils

MATERIAL	20x10			40x20			60x30			80x40		
	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance	MIN.	MAX.	Tolerance
C-30	0.02	0.03	P	0.04	0.07	P	0.06	0.09	P	0.12	0.18	A
C-37	0.03	0.03	P	0.06	0.09	P	0.08	0.12	A	0.15	0.23	A
C-40	0.04	0.05	P	0.09	0.14	A	0.14	0.2	A	0.24	0.37	A
C-50	0.06	0.1	A	0.18	0.29	A	0.26	0.39	A	0.48	0.74	B
C-55	0.07	0.1	A	0.23	0.37	A	0.33	0.48	A	0.61	0.9	B
C-CH	0.14	0.2	A	0.43	0.68	B	0.62	0.9	B	1.13	1.7	C
C-NR	0.2	0.4	B	0.68	1.1	B	1	1.4	C	1.8	2.8	C
C-80	0.5	0.9	K	1.4	2.2	K	2	2.9	K	3.7	5.5	K
C-BD	1.1	2	K	3.7	5.8	K	5.3	7.8	K	9.7	14	K
C-BE	1.9	3.5	K	5.6	9	K	8.3	12	K	15	23	K
C-100	3.1	5.5	K	10	16	K	15	21	K	26	41	K
C-120	4.8	8.7	K	16	26	K	23	34	K	43	65	K
C-BN	5.5	9.9	K	20	32	K	29	43	K	53	82	K
C-140	17	30	M	49	80	M	72	110	M	140	200	M
C-200	34	62	M	114	180	M	160	250	M	300	460	M
C-400	48	87	M	160	260	M	230	340	M	430	650	M

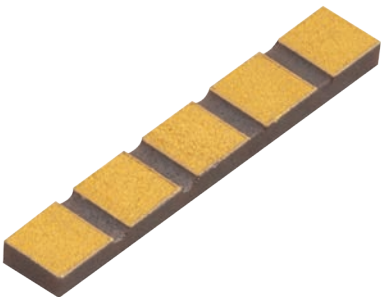


CR/CM Series — Row Capacitors

Row capacitors are used where arrays of capacitors (not necessarily identical) are needed, usually for decoupling/bypass of GaAs integrated circuits. Standard arrays can contain up to 10 capacitors from 0.04pF on up. Typical overall dimensions range from 20 x 10 mils on up. Parts can be fully customized to meet the requirements of your application to provide the shortest lead length possible.

DESCRIPTION

Row caps (CR) are also available with margins (CM) surrounding the edges to help prevent epoxy shorts and aid optical recognition systems.



CR/CM STANDARD CAPACITANCE TOLERANCE CODES

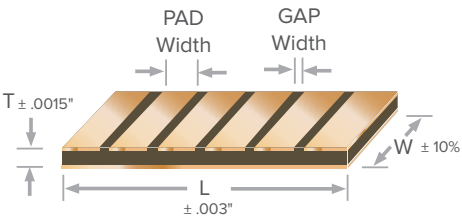
Class I Dielectrics: C-20 thru C-NR		Class II Dielectrics: C-80 thru C-400	
Tolerance	Code	Tolerance	Code
± 20%	M	-20% thru +80%	Z
± 15%	L	Guaranteed Min. Value	GMV
± 10%	K	± 20%	M
		± 15%	L
		± 10%	K

CR/CM SERIES

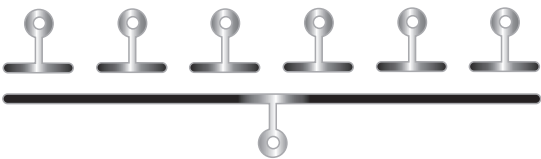
All CR/CM Series parts are built to specific customer requirements.

Please contact an inside sales representative for additional information.

CR6 CHIP DIMENSIONS



CR/CM ELECTRODE CONFIGURATION



ORDERING INFORMATION — CR/CM SERIES — ROW CAPACITORS

CR	6	BN	105 x 25	x 4	5	G	101	Z
Cap Style	No. of Caps	Dielectric Type	Length x Width (mils)	Thickness (mils)	Gap (mils)	Metallization	Capacitance (pF)	Capacitance Tolerance
CR = Row CM = Margin	-	See Class I and Class II tables (page 29)	See CR/CM Chip Dimensions (page 38)	See CR/CM Chip Dimensions (page 38)		G = Gold Custom	First two digits represent significant figures and the last, the number of zeros to follow. When required, the letter "R" is used as a decimal point and the succeeding digits represent significant figures only. e.g.: 101 = 100pF, 1R6 = 1.6pF	See CR/CM Standard Capacitance Tolerance Codes (above)

Example shown is CR Series, dielectric type C-BN, 105" X .025" X .004", gold, 100pF, +80 to -20% tolerance, 6 pad. chip

Packaging is standard waffle pack.

High-K Ceramic Substrates & Plates

High-K substrates are used for circuit miniaturization.
Knowles offers complete fabrication services.

CASE SIZES AND TOLERANCES

For custom sizes, please contact us.

Case Size (Inches)	Length (Inches)	Width (Inches)	L&W Tolerance ±(Inches)	Thickness Tolerance ±(Inches)
10	1.000	1.000	.050	.002
15	1.000	1.500	.050	.002
20	2.000	2.000	.050	.002
25	2.500	2.500	.050	.002
30	3.000	3.000	.050	.002
40	4.000	4.000	.050	.002



MATERIAL SPECIFICATIONS

Material Code	Relative ϵ_R^* @ 1 MHz	TCC* Loss ppm/°C	Coefficient of Tangent* % Max	Thermal Expansion ppm/°K	Conductivity W/m-°K
QZ	3.82	Fused Quartz	0.0015 (@ 1MHz) 0.033 (@ 24 GHz)	0.55	1.28
AG	8.85	Aluminum Nitride	0.10	4.6	140 - 180
PI	9.9	Alumina 99.6%	0.15	6.5 - 7.5	27
PG	13	P22 ± 30	0.15	7.6	-
AH	20	P90 ± 20	0.15	9.6	1.56
NA	22	N30 ± 15	0.15	10.1	1.56
CF	24	0 ± 15	0.60	9.0	1.56
CD	37	N20 ± 15	0.15	5.8	1.59
CG	70	0 ± 30	0.70	9.0	1.59
NR	160	N1500 ± 500	0.25	10.0	2.72

*Unless otherwise specified, K dielectric measurement at approximately 5 GHz. †For the temperature range -55 to 125°C.

High-K Ceramic Substrates & Plates

METALLIZATION

Code	Description
M	300 Angstroms TiW, 100 μ in. min. Au
N	300 Angstroms TiW, 50 μ in. min. NiV, 100 μ in. min. Au
P	75 μ in. min. Nickel, 100 μ in. min. Au
T	300 Angstroms min. TiW, 50 μ in. min. NiV, 300 μ in. min. Au-Sn
D	Special customer drawing required

SURFACE FINISH

Code	Roughness R	Material Process
X	>50 μ in.	As-Fired
Y	20 μ in.	Machined
Z	<5 μ in.	Polished
S	Special customer drawing required	

SCREENING OPTIONS

Test Code	Test/Inspection	Sample Size	Description
X	Visual Mechanical	100%	Verify that the required area is available and continuous (Broken corners allowable).
D	Customer Defined	-	Special customer drawing required
	Kent Test	10% of lot	K and Loss.

ORDERING INFORMATION — SLC — HIGH-K CERAMIC SUBSTRATES & PLATES

H Product	20 Case Size	CG Material	250 Thickness	D Thickness Tolerance	Z Surface Finish	N Metallization	X Screening
H = Substrate	10 15 20 25 30 40	See material table on page 38.	Thickness Code. A three-digit code representing the thickness in mils. Examples: Code 100 = .010", Code 155 = .0155", Code 250 = .025" Please consult with an applications engineer for thicknesses < .010"	Thickness Tolerance Codes D = $\pm .0005$ – Machined or Polished E = $\pm .001$ – Standard	X Y Z S See table above.	See table above.	X D See screening options above.

SLC — Heatsinks, Standoffs & Submounts

HEATSINKS

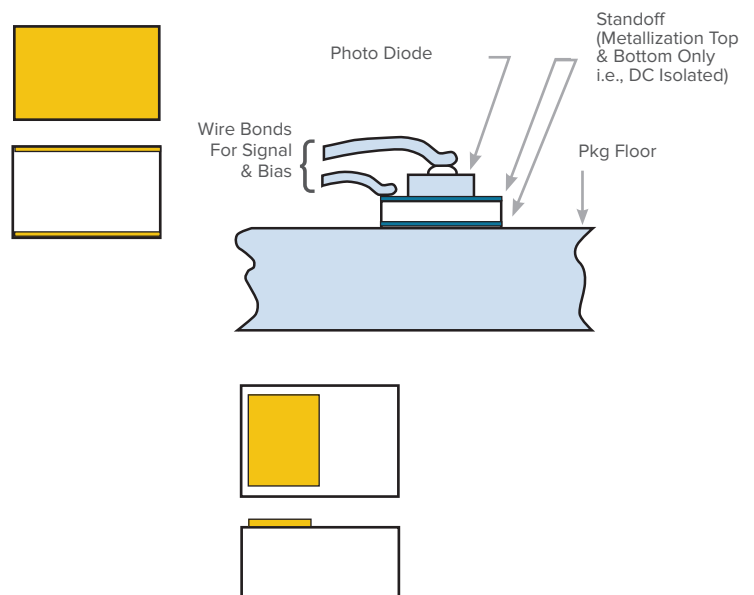
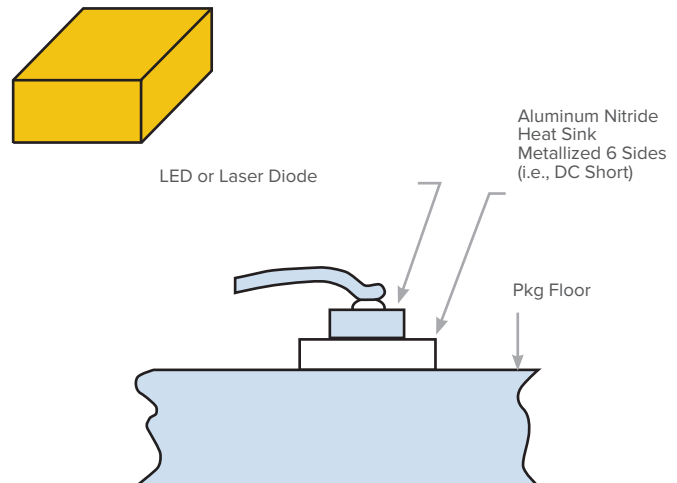
- Knowles is able to guarantee Au coverage on the 4 sides while guaranteeing minimum Au thickness on top and bottom
- Heatsinks allow for high thermal conductivity and are electrically conductive (DC short)
- Typically used with LEDs or laser diodes

STANDOFFS

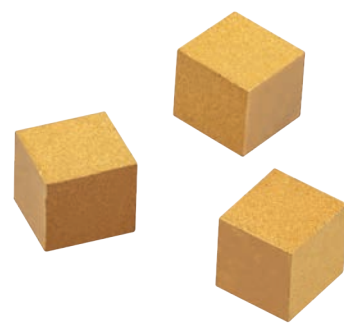
- A Standoff is much like a Heatsink; however it is typically metallized on only the top and bottom surfaces
- Each device is custom tailored to the customer's specifications and is typically used with LEDs or Photo Diodes (works as a photo detector, light is allowed in through fibers)

SUBMOUNTS

- Submounts are ceramic LED package bases that minimize thermal resistance between LED junctions and adjacent components
- By reducing junction temperatures, an LED will produce increased efficiency, brightness, color and reliability
- Each device is custom tailored to the customer's specifications



SLC — Heatsinks & Standoffs



MATERIAL SPECIFICATIONS

Material Code	Relative ϵ_R^* @ 5 GHz	TCC† Loss ppm/°C	Coefficient of Tangent* % Max	Thermal Expansion ppm/°K	Conductivity W/m-°K
AG	8.85 ± 0.35 (@ 1MHz)	Aluminum Nitride	0.10	4.6	140 - 180
PI	9.9 ± 0.15 (@ 1MHz)	Alumina 99.6%	0.01	6.5 - 7.5	27

*Unless otherwise specified, K dielectric measurement at approximately 5 GHz. †For the temperature range -55 to 125°C. **Material only provided metallized.

SURFACE FINISH

Code	Roughness R	Material Process
X	>50µ in.	As-Fired
Y	20µ in.	Machined
Z	<5µ in.	Polished
S	Special customer drawing required	

METALLIZATION

Code	Description
M	300 Angstroms TiW, 100 µ in. min. Au
P	75 µ in. min. Nickel, 100 µ in. min. Au
E	Metallized and etched per customer drawing
T	300 Angstroms min. TiW, 50 µ in. min. NiV, 300 µ in. min. Au-Sn
D	Special customer drawing required

ORDERING INFORMATION — SLC — HEATSINKS & STANDOFFS

S Product	20 Case Size	AG Material	250 Thickness	D Thickness Tolerance	Z Surface Finish	N Metallization	X Test Level
S= Heatsinks & Standoffs	10 15 20 25 30 40	See material table above	Thickness Code. A three-digit code representing the thickness in mils. Examples: Code 100 = .010", Code 155 = .0155", Code 250 = .025" Please consult with an applications engineer for thicknesses < .010"	Thickness Tolerance Codes D = ± .0005 – Machined or Polished E = ± .001 – Standard	X Y Z S See table above.	See table above.	X D See test level definitions above.

SBT Series — Submounts

Submount materials include quartz, alumina, and aluminum nitride.

Applications include heat sinks, standoffs, height matching, bonding pads and jumpers.

Custom sizes and shapes are available to your design specifications in thicknesses from 4 to 30 mils. For a thickness greater than 30 mils, please contact an inside sales representative.



SUBMOUNT MATERIAL PROPERTIES CHART

	Quartz	Alumina	AlN
Material Code	C-20	C-30/35	C-28
Coefficient of Thermal Expansion (ppm/°C)	6	6.7	4.6
Thermal Conductivity (W/m-k)	1.6	26	170

ORDERING INFORMATION — SBT SERIES — SUBMOUNTS

SBT	-	28	-	20 x 20	x 6	-	G	-	S	5
Cap Style		Material		Length x Width (mils)*	Thickness (mils)		Metallization		Cut to Size	Thickness Tolerance
SBT = Edge-to-edge plated or bare		See Submount Material Properties Chart above		-	4 to 30 mils		G = Gold B = Bare Custom		-	(only utilized if <.001"; figure represents tenths of a mil)

*Standard dimensional tolerance is .001" for length, width, and thickness. Tighter Thickness tolerances down to .0005" are available.
Example shown is SBT Series, dielectric type C-28, .020" x .020" x .006", gold, cut to size, .0005" thickness tolerance



MST Series — Mounting Shorts

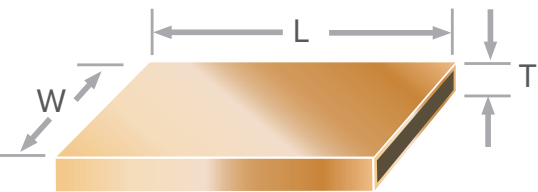
Alumina mounting shorts (or Aluminum Nitride for improved thermal properties), with metallization on the top, bottom and two of four sides, allow placement of a wirebond anywhere in the circuit, replacing the need for gold terminations on the substrate. They also can be used to raise the ground plane, reducing lead length for reduced inductance for high-speed/frequency applications, or to dissipate heat from under an IC or laser chip.

DESCRIPTION

- Instant bonding pads
- Fully conductive
- Height matching
- Replaces moly-tabs
- Any size available, as small as 0.007" x 0.007"

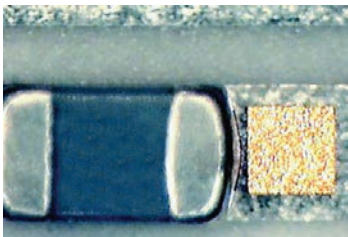


MST CHIP DIMENSIONS

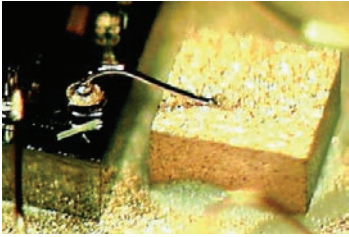


Dimensional Tolerance: Standard is .001" for length, width and thickness.

WIREBOND



RAISED PLANE



Our ceramic mounting shorts are excellent replacements for kovar and moly-tabs. These ceramic shorts have a much sharper edge and are flat stable bases for mounting semiconductors.

ORDERING INFORMATION — MST SERIES — MOUNTING SHORTS

MST	-	30	-	25	x 20	x 6	-	6	-	S	5
Cap Style		Material		Length (mils)	Width (unmetallized side) (mils)	Thickness* (mils)		Metallization		Cut to Size	Thickness Tolerance
MST		C-28 C-30 C-35		-	-	4 to 30 mils		G = Gold Custom		-	(only utilized if <.001"; figure represents tenths of a mil)

Example shown is Series MST, dielectric type C-30, .025" x .020" x .006", gold, cut to size, .0005" thickness tolerance

*For a thickness >30 mils, please contact an inside sales representative



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