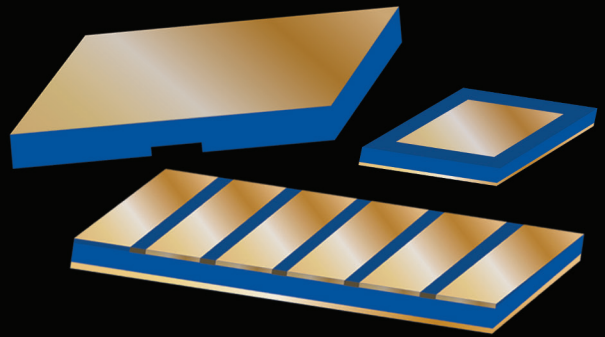
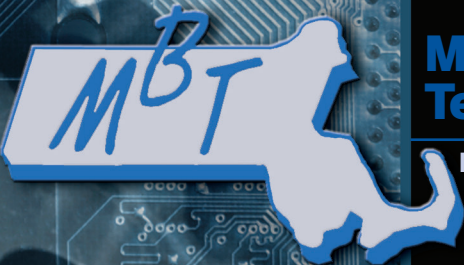


# Single Layer Ceramic Capacitors And Thin Film Product Guide



**Massachusetts Bay  
Technologies**

Motivated by Performance, Focused on Reliability.®



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Founded in March 1999, Massachusetts Bay Technologies, Inc. (MBT) is a company specializing in the design, manufacture of discrete Single Layer Ceramic Capacitors and Thin Film products.

MBT designs and produces all of its Single Layer Ceramic Capacitors and Thin Film products in its 20,000 square foot facility located in Stoughton, MA.

MBT is committed to the continuance of innovations in service to its customers, improvement of design, product performance, and quality control. MBT'S product frequencies range from 100Hz up to and including millimeter wave; our quality devices are used in various industry applications and laboratory research, consumer products, telecommunications, aerospace, and military and space.

This catalog represents our complete line of Single Layer Ceramic Capacitors and Thin Film products.

MBT's consistent objective is to provide a superior product with unsurpassed customer service to our clients. Our engineers and sales representatives are available to discuss your specific design and application need in a professional manner that is both cost and time effective. We look forward to providing you component expertise and quality products.

# MATERIALS AND METALLIZATION

MBT uses a variety of materials in both Class I and Class II categories with dielectric constants ranging from 3.8 to 35,000 to fabricate our SLC's. If you require other dielectric materials please consult the factory.

**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.

Type	Ins. Res. (MEG-OHMS 100VD @25°C)	Temperature Coefficient PPM/°C -55 to 125 °C	Dissipation Factor Constant (@ 10GHZ)	Dielectric (K)	Material
M-20	10 <sup>6</sup>	Negligible	0.0001	3.8	Quartz
M-22	10 <sup>6</sup>	Negligible	0.0001	3.9 (SiO2)	Si
M-25*	10 <sup>6</sup>	Negligible	0.0001	6.6	BeO
M-28*	10 <sup>6</sup>	P120 ±25	0.0001	8.7	AlN
M-30	10 <sup>6</sup>	P180 ±50	0.0006	9.6	Alumina 96
M-35*	10 <sup>6</sup>	P180 ±50	0.0006	9.8	Alumina 99.6
M-37	10 <sup>6</sup>	NPO 0±30	0.0001	12.6	Titanate
M-40	10 <sup>6</sup>	0 ±30	0.0010	20	Titanate
M-50	10 <sup>6</sup>	0 ±30	0.0020	40	Titanate
M-55	10 <sup>6</sup>	0 ±30	0.0050	50	Titanate
M-58	10 <sup>4</sup>	0 ±30	0.0050	84	Titanate
M-70	10 <sup>6</sup>	N1500 ±400	0.0025	150	Titanate

\* Typically used for submounts and substrates only.

**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.

Type	Ins. Res. (MEG-OHMS 100VD @25°C)	Temperature Coefficient PPM/°C -55 to 125 °C	Dissipation Aging Factor (@ 1MHz)	HR/Decade (%)	Dielectric Constant (K)
M-80	10 <sup>5</sup>	5 to -10	0.010	2.0	300
M-90	10 <sup>5</sup>	10 to -10	0.015	3.0	1,100
M-100	10 <sup>5</sup>	3 to -10	0.015	3.5	2,200
M-120	10 <sup>5</sup>	0 to -35	0.020	3.0	4,000
M-130	10 <sup>5</sup>	0 to -60	0.025	3.0	5,000
M-140	10 <sup>5</sup>	0 to -80	0.025	3.0	11,000
M-200	*	15 to -15	0.035	3.0	25,000
M-400	*	15 to -15	0.035	3.0	35,000

\* Please consult the factory for specific ratings to meet your application requirements

**Substrates can be supplied as follows:**

- **Bare**
- **Metallized**
  - gold over platinum, palladium, or nickel
  - silver over platinum
  - custom schemes and patterns to customer specifications

• **Thickness range:**  
3 mils and up

• **Length and Width:**  
up to 4" depending on material

## Standard Electrode Metallizations

### Gold (G):

This metallization consists of a minimum of 70 micro-inches of gold over non-magnetic leachresistant nickel or platinum which is ideal for all wirebonding methodologies. Please consult our factory for optimum metallization options for solder applications.

### Silver (S):

This metallization consists of 20 micro-inches of silver over platinum which is ideal for all solder applications whenever the use of gold is unacceptable.

# RELIABILITY TESTING

Typical MBT commercial testing includes 100% visual, capacitance, dissipation factor, insulation resistance, and dielectric withstanding voltage. MBT SLC's exceed MIL-STD-883 requirements for bond and shear strength both Methods 2011 and 2019. Screening per military specifications is available to meet customers specification. The tables below outline the specific testing performed in accordance with MIL-PRF-38534 and MIL-PRF-49464, and identify the suitable MBT test code. The test code, if required, will be added to the MBT part number. If you have any questions regarding choosing the correct testing please consult the factory.

Test Code	Testing Performed
<b>MT 1</b>	<b>Class H Element Evaluation per MIL-PRF-38534</b>
	100% Capacitance Subgroup 1
	100% Visual inspection Subgroup 2
	Visual Inspection Element Electrical** Subgroup 3*
	Wire Bond Evaluation Subgroup 4

Test Code	Testing Performed
<b>MT 2</b>	<b>Class K Element Evaluation per MIL-PRF-38534</b>
	100% Capacitance Subgroup 1
	100% Visual inspection Subgroup 2
	Temperature Cycle Constant Acceleration Voltage Conditioning Visual Inspection Element Electrical** Subgroup 3*
	Wire Bond Evaluation Subgroup 4

Test Code	Testing Performed
<b>MT 3</b>	<b>Group A Inspection per MIL-PRF-49464</b>
	Thermal Shock Voltage Conditioning Subgroup 1 100% Capacitance 100% Dissipation factor 100% Insulation Resistance 100% Dielectric Withstanding Voltage
	Physical Dimensions Workmanship Subgroup 2
	Bond Strength Die Shear Strength Subgroup 3
	Temperature Coefficient Limits Subgroup 4

Test Code	Testing Performed
<b>MT 4</b>	<b>Group B Inspection per MIL-PRF-49464</b>
	Group A Inspection Temperature Coefficient Limits Immersion Subgroup 1
	Low Voltage Humidity Subgroup 2
	Life Subgroup 3

\*Test samples taken from parts passing Subgroups 1 & 2.

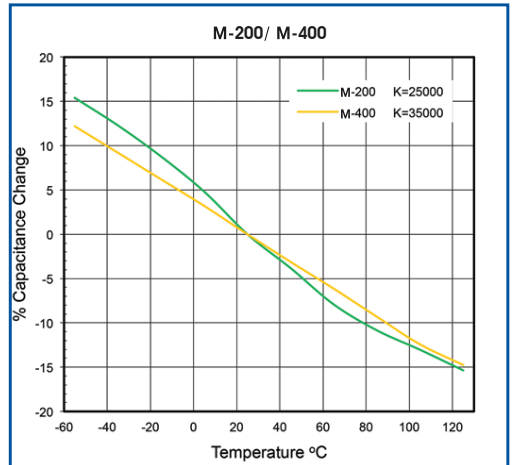
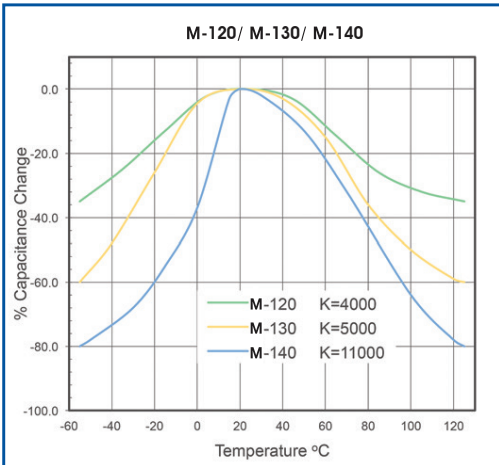
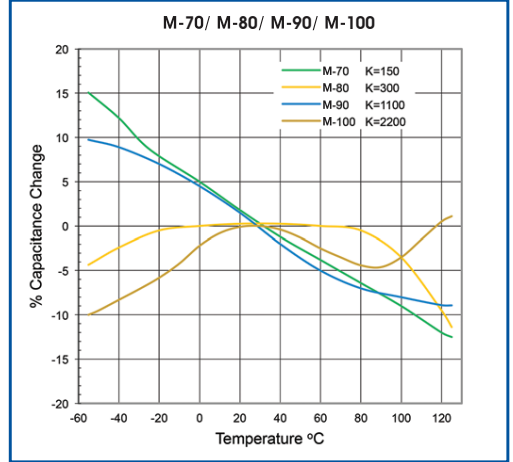
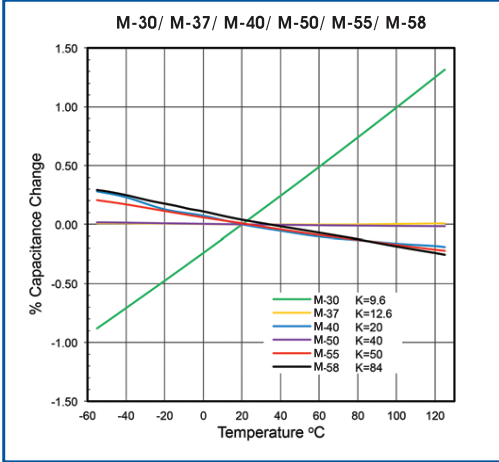
\*\* Element Electrical testing includes Capacitance, Dissipation Factor, Insulation Resistance, and Dielectric Withstanding Voltage.

MIL-STD-883: Test Method Standard, Microcircuits

MIL-PRF-38534: Performance Specification, General Specification for Hybrid Microcircuits

MIL-PRF-49464: Performance Specification, General Specification Capacitors, Chip, Single Layer, Fixed, Parallel Plate, Ceramic Dielectric, Established Reliability

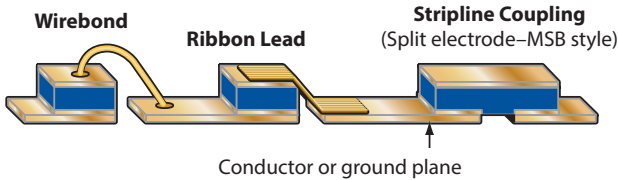
# TEMPERATURE CHARACTERISTICS



# SERIES RESONANT FREQUENCY

The series resonant frequency (SRF) of a single layer chip capacitor is the highest of any discrete lumped constant capacitor. Since connections must be made to the chip, the SRF is lowered and mainly determined by the inductance of the connections (wire or ribbon), the size of the chip, and the location of the connections. Please visit the MBT website for additional information.

## Configurations



## Mounting Methods

- Soldering with the use of pre-tinning and solder reflow, solder preforms, solder paste, etc.
- Eutectic bonding with appropriate metallizations of the surfaces to be joined and the use of compatible interface preforms
- Conductive Epoxy

## Termination Methods

- Soldering of wire or ribbon leads (minimum chip size limited by user's soldering techniques)
- Thermal compression, thermasonic, or ultrasonic bonding with gold wire

## General Electrical Characteristics

### Operating Frequency:

Up to 100 GHz

### Voltage Rating:

Material	Thickness	WVDC
M-20 through M-140 <sup>1</sup>	≤ 5 mils	50
	> 5 mils	100
M-200 and M-400 <sup>2</sup>	5-10 mils	16-100

1. Ratings up to 1,000V and higher available, consult factory
2. Our Ultra-High K X7R material can be rated between 16 and 100WVDC depending on the component thickness and the requirements of your application. Please consult the factory.

### Dielectric Test Voltage:

250% voltage rating, impervious to static discharge

### Test Frequency:

1 MHz @ 1V (below 1,000pF)

1 KHz @ 1V (above 1,000pF)

## Applications:

- Microwave Integrated Components
- Integrated Circuits
- DC Blocking
- RF Bypass
- Decoupling
- LC Filter
- Tuning

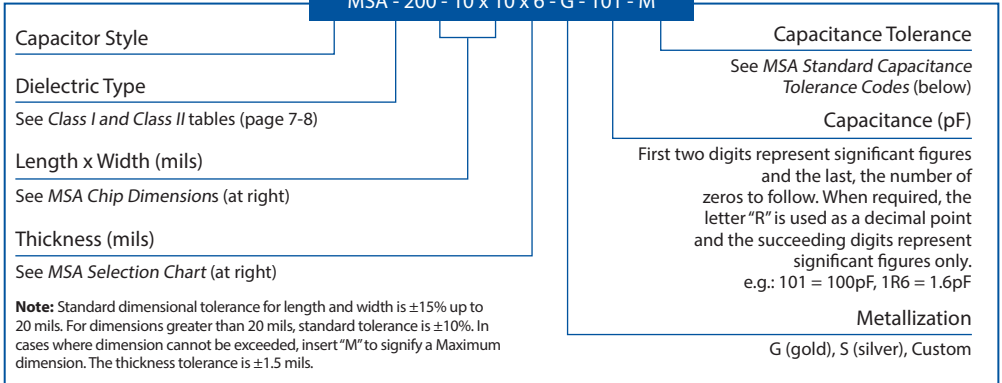
# MSA EDGE-TO-EDGE CAPACITORS

MBT's MSA two-electrode design is the most widely used SLC. The chip size, shape, and electrical properties may be determined from the dielectric material data and the MSA Selection Chart. MBT 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 all solder process. If you require a custom design please consult the factory.

## MSA Part Number Code

Example shown specifies MBT MSA Series, dielectric type M-200, .010" x .010" x .006", gold, 100pF, ±20% tolerance

**MSA - 200 - 10 x 10 x 6 - G - 101 - M**



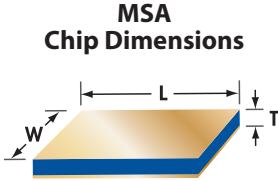
## MSA Standard Capacitance Tolerance Codes

Class I Dielectrics: M-20 thru M-70				Class II Dielectrics: M-80 thru M-400			
Tolerance	Code	Tolerance	Code	Tolerance	Code	Tolerance	Code
±.50pF	D	±20%	M	-20% thru +80%	Z	±20%	M
±.25pF	C	±15%	L	-10% thru +40%	Y	±15%	L
±.10pF	B	±10%	K	-0% thru +100%	V	±10%	K
±.05pF	A	±5%	J	Guaranteed Min. Value	GMV	±5%	J
±.01pF	P	±3%	H				
		±2%	G				

# MSA EDGE-TO-EDGE CAPACITORS (cont)

## MSA Selection Chart

**Note:** Selection Chart is for guidance only. All MBT parts are built to specific customer requirements.



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

### MSA Standard Dimensional Tolerances

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

### MSA Electrode Configuration

Two electrodes



Cap. (pF)	Capacitor Size in mils (mm)									
	10 x 10 (254 x 254) Diel. Thick.	12 x 12 (305 x 305) Diel. Thick.	15 x 15 (381 x 381) Diel. Thick.	20 x 20 (508 x 508) Diel. Thick.	25 x 25 (635 x 635) Diel. Thick.	30 x 30 (762 x 762) Diel. Thick.	35 x 35 (889 x 889) Diel. Thick.	40 x 40 (1,016 x 1,016) Diel. Thick.	50 x 50 (1,27 x 1,27) Diel. Thick.	
0.04	M-30 5	M-30 6	M-30 10							
0.06	M-30 4	M-30 5	M-30 8	M-20 5	M-20 10					
0.08	M-50 10	M-30 4	M-30 6	M-30 10	M-20 7	M-20 9				
0.1	M-50 8	M-50 11	M-30 5	M-30 9	M-20 5	M-20 7	M-20 10			
0.2	M-50 5	M-50 7	M-50 10	M-30 4	M-30 7	M-30 10	M-20 5	M-20 7	M-20 10	
0.3	M-58 6	M-50 4	M-50 6	M-50 11	M-30 4	M-30 7	M-30 9	M-20 5	M-20 7	
0.4	M-58 5	M-58 7	M-50 5	M-50 9	M-50 15	M-50 7	M-50 9	M-30 9	M-20 5	
0.5	M-58 4	M-58 5	M-50 4	M-50 7	M-50 11	M-30 5	M-30 5	M-30 7	M-20 4	
0.6	M-70 6	M-58 5	M-58 7	M-50 6	M-50 10	M-50 15	M-30 4	M-30 6	M-30 9	
0.8	M-80 8	M-70 6	M-58 5	M-50 5	M-50 7	M-50 10	M-50 15	M-30 4	M-30 7	
1	M-80 7	M-70 5	M-58 4	M-58 7	M-50 6	M-50 8	M-50 10	M-30 4	M-30 5	
1.2	M-80 6	M-70 4	M-58 4	M-58 6	M-50 5	M-50 7	M-50 9	M-30 3	M-30 5	
1.5	M-80 5	M-80 7	M-70 5	M-58 5	M-50 4	M-50 6	M-50 7	M-50 10	M-30 4	
1.8	M-80 4	M-80 5	M-70 4	M-58 4	M-58 6	M-50 5	M-50 6	M-50 8	M-50 11	
2	M-80 4	M-80 5	M-70 4	M-70 7	M-58 6	M-50 4	M-50 5	M-50 7	M-50 11	
2.2	M-90 4	M-80 5	M-70 4	M-70 6	M-58 5	M-58 7	M-50 5	M-50 7	M-50 10	
2.7	M-90 8	M-80 4	M-80 6	M-70 5	M-58 4	M-58 6	M-50 4	M-50 5	M-50 8	
3.3	M-90 7	M-90 10	M-80 5	M-70 4	M-70 6	M-58 5	M-58 7	M-50 4	M-50 7	
3.9	M-90 6	M-90 9	M-80 4	M-80 7	M-70 5	M-58 4	M-58 6	M-58 8	M-50 6	
4.7	M-90 5	M-90 7	M-90 11	M-80 6	M-70 4	M-70 6	M-58 5	M-58 6	M-50 5	
5.6	M-90 4	M-90 6	M-90 10	M-80 5	M-80 7	M-70 5	M-58 4	M-58 5	M-50 4	
6.8	M-90 4	M-90 5	M-90 8	M-80 4	M-80 6	M-70 5	M-70 6	M-58 4	M-58 7	
8.2	M-100 6	M-90 4	M-90 7	M-80 4	M-80 5	M-70 4	M-70 5	M-70 7	M-70 10	
10	M-100 5	M-90 4	M-90 5	M-90 9	M-80 4	M-80 6	M-70 4	M-70 5	M-70 8	
12	M-100 4	M-100 6	M-90 5	M-90 8	M-90 11	M-80 5	M-80 7	M-70 4	M-70 7	
15	M-120 6	M-100 5	M-90 4	M-90 6	M-90 10	M-80 4	M-80 6	M-80 7	M-70 6	
18	M-120 5	M-100 4	M-100 6	M-90 5	M-90 8	M-90 11	M-80 4	M-80 6	M-70 5	
20	M-120 5	M-100 4	M-100 6	M-90 5	M-90 8	M-90 11	M-80 4	M-80 5	M-70 4	
22	M-120 4	M-120 6	M-100 5	M-90 4	M-90 7	M-90 9	M-80 4	M-80 5	M-70 4	
27	M-120 4	M-120 5	M-100 4	M-90 4	M-90 6	M-90 8	M-80 3	M-80 4	M-80 6	
33	M-130 4	M-120 4	M-120 6	M-100 6	M-90 5	M-90 6	M-90 11	M-80 4	M-80 5	
39	M-140 6	M-120 4	M-120 5	M-100 5	M-90 4	M-90 5	M-90 7	M-90 10	M-80 4	
47	M-140 5	M-140 7	M-120 5	M-100 4	M-100 6	M-90 5	M-90 6	M-90 8	M-80 4	
56	M-140 4	M-140 6	M-130 5	M-120 7	M-100 5	M-90 4	M-90 5	M-90 7	M-90 10	
68	M-140 4	M-140 5	M-130 4	M-120 6	M-100 5	M-100 6	M-90 4	M-90 6	M-90 9	
82	M-200 7	M-140 4	M-140 7	M-130 6	M-100 4	M-100 5	M-100 7	M-100 10	M-90 7	
100	M-200 6	M-200 8	M-140 6	M-130 5	M-120 6	M-100 5	M-100 6	M-100 8	M-90 6	
120	M-200 5	M-200 7	M-140 5	M-140 8	M-130 6	M-100 4	M-100 5	M-100 7	M-90 5	
150	M-200 4	M-200 5	M-140 4	M-140 7	M-130 5	M-130 7	M-100 4	M-100 5	M-90 4	
180	M-400 4	M-200 5	M-200 7	M-140 6	M-130 4	M-130 6	M-130 8	M-120 8	M-100 7	
200	M-400 4	M-200 4	M-200 6	M-140 5	M-140 8	M-130 5	M-130 7	M-120 7	M-100 6	
220	M-400 4	M-400 5	M-200 6	M-140 4	M-140 7	M-130 5	M-130 6	M-120 6	M-100 6	
270		M-400 4	M-200 5	M-200 8	M-140 6	M-130 4	M-130 5	M-120 5	M-100 5	
330			M-200 4	M-200 7	M-140 5	M-140 7	M-130 4	M-120 4	M-120 7	
390			M-400 4	M-200 6	M-140 4	M-140 6	M-140 7	M-140 10	M-120 6	
470			M-400 4	M-200 5	M-200 7	M-140 5	M-140 6	M-140 8	M-120 5	
560				M-200 4	M-200 6	M-140 4	M-140 5	M-140 7	M-120 4	
680				M-400 5	M-200 5	M-200 8	M-140 5	M-140 6	M-130 4	
820				M-400 4	M-400 6	M-200 6	M-140 4	M-140 5	M-140 7	
1000					M-400 5	M-200 5	M-200 7	M-140 4	M-140 6	
1200					M-400 4	M-200 4	M-200 6	M-200 7	M-140 5	
1500						M-400 5	M-200 5	M-200 6	M-140 4	
1800						M-400 4	M-400 6	M-200 5	M-200 8	
2200							M-400 5	M-200 4	M-200 6	
2700							M-400 4	M-400 5	M-200 5	
3300									M-400 6	

Class I Dielectrics

Class II Dielectrics



# MSM MARGIN CAPACITORS

MBT's MSM margin caps have the topside electrode withdrawn from the edges in order to increase distance between electrodes and dramatically decrease the possibilities of shorting when epoxy die-mounting. This style is widely used for optical recognition assembly. If you require a custom design please consult the factory.

## MSM Part Number Code

Example shown: MBT Series MSM, dielectric type M-90, .010" x .010" x .005", gold, 2.7pF, ±20% tolerance

**MSM - 90 - 10 x 10 x 5 - G - 2R7 - M**

Capacitor Style	Capacitance Tolerance
Dielectric Type See <i>Class I and Class II</i> tables (page 9-10)	See <i>MSM Capacitance Tolerance Codes</i> (below)
Length x Width (mils) See <i>MSM Chip Dimensions</i> (at right)	Capacitance (pF)
Thickness (mils) See <i>MSM Selection Chart</i> (at right)	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
Metallization G (gold)	
<b>Note:</b> In cases where dimension cannot be exceeded, insert "M" to signify a Maximum dimension. The thickness tolerance is ±1.5 mils.	

## MSM Standard Capacitance Tolerance Codes

Class I Dielectrics: M-20 thru M-70				Class II Dielectrics: M-80 thru M-400			
Tolerance	Code	Tolerance	Code	Tolerance	Code	Tolerance	Code
±50pF	D	±20%	M	-20% thru +80%	Z	±20%	M
±25pF	C	±15%	L	-10% thru +40%	Y	±15%	L
±10pF	B	±10%	K	-0% thru +100%	V	±10%	K
±0.5pF	A	±5%	J	Guaranteed Min. Value	GMV	±5%	J
±0.1pF	P	±3%	H				
		±2%	G				

# MSM MARGIN CAPACITORS (cont)

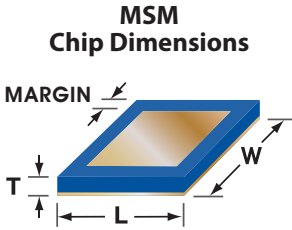
## MSM Selection Chart

**Note:** Selection Chart is for guidance only. All MBT devices are built to specific customer requirements.

Cap. (pF)	Capacitor Size in mils(mm)									
	10 x 10 (254 x 254) Diel. Thick.	12 x 12 (305 x 305) Diel. Thick.	15 x 15 (381 x 381) Diel. Thick.	20 x 20 (508 x 508) Diel. Thick.	25 x 25 (635 x 635) Diel. Thick.	30 x 30 (762 x 762) Diel. Thick.	35 x 35 (889 x 889) Diel. Thick.	40 x 40 (1,016 x 1,016) Diel. Thick.	50 x 50 (1,27 x 1,27) Diel. Thick.	
0.04	M-30 4	M-30 4	M-30 5	M-20 5						
0.06	M-50 10	M-30 4	M-30 6	M-20 5	M-20 8	M-20 10				
0.08	M-50 7	M-50 10	M-30 5	M-30 10	M-20 6	M-20 8	M-20 11			
0.1	M-50 6	M-50 9	M-30 4	M-30 7	M-20 5	M-20 7	M-20 10			
0.2	M-58 4	M-50 4	M-50 5	M-30 4	M-30 5	M-30 7	M-20 4	M-20 5	M-20 10	
0.3	M-70 6	M-58 5	M-50 4	M-50 8	M-30 4	M-30 5	M-30 7	M-20 4	M-20 6	
0.4	M-70 4	M-58 4	M-58 6	M-50 6	M-50 10	M-30 4	M-30 5	M-30 7	M-30 10	
0.5	M-80 5	M-70 4	M-58 5	M-50 4	M-50 7	M-50 10	M-30 4	M-30 6	M-30 10	
0.6	M-80 5	M-70 5	M-58 4	M-50 4	M-50 6	M-50 10	M-30 4	M-30 5	M-30 7	
0.8	M-80 5	M-80 5	M-70 5	M-58 6	M-50 5	M-50 7	M-50 10	M-30 4	M-30 6	
1	M-80 4	M-80 5	M-70 4	M-58 5	M-50 4	M-50 6	M-50 8	M-50 10	M-30 5	
1.2	M-90 6	M-80 5	M-80 7	M-58 4	M-58 7	M-50 5	M-50 7	M-50 10	M-30 4	
1.5	M-90 7	M-80 4	M-80 6	M-70 6	M-58 6	M-58 8	M-50 6	M-50 7	M-50 15	
1.8	M-90 6	M-80 4	M-80 5	M-70 5	M-58 5	M-58 7	M-50 5	M-50 7	M-50 10	
2	M-90 6	M-90 8	M-80 4	M-70 5	M-58 5	M-58 6	M-50 4	M-50 6	M-50 10	
2.2	M-90 5	M-90 7	M-80 4	M-80 7	M-70 7	M-58 6	M-50 4	M-50 5	M-50 10	
2.7	M-90 5	M-90 6	M-80 4	M-80 6	M-70 6	M-58 6	M-58 8	M-50 5	M-50 8	
3.3	M-100 6	M-90 6	M-90 8	M-80 5	M-70 5	M-58 4	M-58 6	M-58 7	M-50 6	
3.9	M-100 5	M-90 5	M-90 7	M-80 4	M-70 4	M-70 6	M-58 5	M-58 6	M-50 5	
4.7	M-100 5	M-90 5	M-90 7	M-80 4	M-80 6	M-70 5	M-58 4	M-58 5	M-58 8	
5.6	M-100 5	M-100 6	M-90 5	M-80 4	M-80 5	M-70 4	M-70 6	M-58 5	M-58 7	
6.8	M-120 5	M-100 6	M-90 5	M-90 8	M-80 5	M-80 7	M-70 5	M-70 7	M-58 6	
8.2	M-120 4	M-100 5	M-90 4	M-90 7	M-80 4	M-80 6	M-70 4	M-70 5	M-58 5	
10	M-120 5	M-100 4	M-100 6	M-90 6	M-80 4	M-80 5	M-80 6	M-70 5	M-58 4	
12	M-120 5	M-120 6	M-100 5	M-90 5	M-90 8	M-80 4	M-80 6	M-70 4	M-70 6	
15	M-120 4	M-120 5	M-100 5	M-90 5	M-90 7	M-80 4	M-80 5	M-80 6	M-70 5	
18	M-130 4	M-130 6	M-120 7	M-100 7	M-90 5	M-90 9	M-80 4	M-80 5	M-70 4	
20	M-140 5	M-130 5	M-120 6	M-100 6	M-90 5	M-90 8	M-80 4	M-80 5	M-70 4	
22	M-140 7	M-130 4	M-120 5	M-100 6	M-90 5	M-90 7	M-90 10	M-80 4	M-80 6	
27	M-140 6	M-130 4	M-130 5	M-100 5	M-90 4	M-90 6	M-90 8	M-80 4	M-80 5	
33	M-140 5	M-140 6	M-130 4	M-100 4	M-100 6	M-90 5	M-90 7	M-90 9	M-80 5	
39	M-140 4	M-140 5	M-130 4	M-120 6	M-100 6	M-90 4	M-90 6	M-90 8	M-80 4	
47	M-200 8	M-140 5	M-140 6	M-120 5	M-100 5	M-100 7	M-90 5	M-90 7	M-90 11	
56	M-200 6	M-140 4	M-140 5	M-130 5	M-100 4	M-100 6	M-90 4	M-90 6	M-90 9	
68	M-200 5	M-200 8	M-140 5	M-130 4	M-120 6	M-100 5	M-90 4	M-90 5	M-90 7	
82	M-400 6	M-200 6	M-140 4	M-130 4	M-120 5	M-100 4	M-100 6	M-90 4	M-90 6	
100	M-400 5	M-200 6	M-140 4	M-140 6	M-130 5	M-120 6	M-100 5	M-100 7	M-90 5	
120		M-200 5	M-200 6	M-140 5	M-130 4	M-130 6	M-100 4	M-100 5	M-90 4	
150		M-200 6	M-200 6	M-140 4	M-140 7	M-130 5	M-130 7	M-100 4	M-100 7	
180		M-400 5	M-200 5	M-140 4	M-140 6	M-130 4	M-130 6	M-100 4	M-100 6	
200				M-400 5	M-140 4	M-140 6	M-130 4	M-130 5	M-120 6	M-100 5
220				M-400 5	M-200 8	M-140 5	M-130 4	M-130 5	M-120 5	M-100 5
270				M-400 5	M-200 6	M-140 4	M-140 7	M-130 4	M-130 6	M-100 4
330					M-200 5	M-140 4	M-140 5	M-140 7	M-130 5	M-120 6
390					M-200 5	M-200 6	M-140 5	M-140 6	M-130 4	M-120 5
470					M-200 4	M-200 6	M-140 4	M-140 5	M-140 7	M-130 5
560					M-400 5	M-400 6	M-140 4	M-140 5	M-140 6	M-130 4
680						M-400 6	M-200 6	M-140 4	M-140 5	M-140 8
820						M-400 5	M-200 5	M-200 8	M-140 4	M-140 7
1000							M-400 6	M-200 6	M-200 8	M-140 6
1200							M-400 5	M-200 5	M-200 7	M-140 5
1500								M-400 6	M-200 5	M-140 4
1800								M-400 5	M-400 6	M-200 7
2200									M-400 5	M-200 6
2700									M-400 5	M-200 5
3300										M-400 5

Class I Dielectrics

Class II Dielectrics



**MSM Chip Dimensions**

**MSM Electrode Configuration**  
Two electrodes



**MSM Standard Dimensional Tolerances**

Length & Width	L or W Tolerance	Margin Nominal	Thickness
≤ .010	±.002	±15%	
.011 thru .029	±.002	±10%	±.0015
≥ .030	±.003	±2mils	

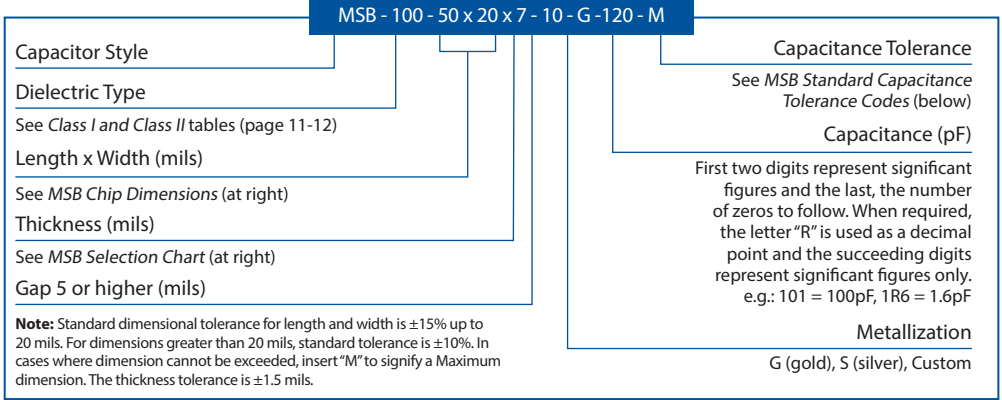
All dimensions given are inches

# MSB DUAL-PAD CAPACITORS

MBT's dual pad capacitors offer a single full electrode on one side of the capacitor and split electrodes on the other side. This is a three-terminal capacitor which can be used as two capacitors with a common electrode, or as a 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. If you require a custom design please consult the factory.

## MSB Part Number Code

Example shown: MBT Series MSB, dielectric type M-100, .050" x .020" x .007", .01" gap, gold, 12pF, ±20% tolerance



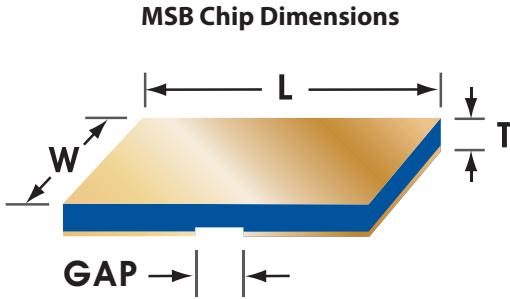
## MSB Standard Capacitance Tolerance Codes

Class I Dielectrics: M-20 thru M-70				Class II Dielectrics: M-80 thru M-200			
Tolerance	Code	Tolerance	Code	Tolerance	Code	Tolerance	Code
±20%	M	±10%	K	±20%	M	-10% thru +40%	Y
±15%	L	±5%	J	±15%	L	-20% thru +80%	Z
				±10%	K	-0% thru +100%	V
						Guaranteed Min. Value	GMV

# MSB DUAL-PAD CAPACITORS (cont)

## MSB Selection Chart

**Note:** Selection Chart is for guidance only. All MBT devices are built to specific customer requirements.



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.

### MSB Electrode Configuration

Split electrodes



Cap. (pF)	Chip Size in mils (mm)							
	20x10 (508 x 254) 5 mil Gap		40x20 (1,016 x 508) 10 mil Gap		60x30 (1,524 x 762) 10 mil Gap		80x40 (2,032 x 1,016) 20 mil Gap	
	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.
0.06	M-50	6	M-30	6	M-20	6	M-20	8
0.08	M-50	4	M-30	4	M-20	4	M-20	7
0.1	M-58	7	M-50	15	M-30	8	M-20	5
0.2	M-70	6	M-50	7	M-30	4	M-30	7
0.3	M-80	8	M-50	5	M-50	10	M-30	4
0.4	M-80	6	M-58	7	M-50	8	M-50	15
0.5	M-80	5	M-58	6	M-50	7	M-50	10
0.6	M-80	4	M-58	5	M-50	6	M-50	9
0.8	M-90	11	M-70	6	M-50	4	M-50	7
1	M-90	9	M-70	5	M-58	7	M-50	6
1.2	M-90	7	M-70	4	M-58	6	M-50	5
1.5	M-90	6	M-80	7	M-58	5	M-58	8
1.8	M-90	5	M-80	6	M-58	4	M-58	6
2	M-90	4	M-80	5	M-58	4	M-58	6
2.2	M-90	4	M-80	5	M-70	6	M-58	5
2.7	M-100	7	M-80	4	M-70	5	M-58	4
3.3	M-100	6	M-90	11	M-70	4	M-70	6
3.9	M-100	5	M-90	9	M-80	7	M-70	5
4.7	M-100	4	M-90	8	M-80	5	M-70	4
5.6	M-120	6	M-90	6	M-80	5	M-80	7
6.8	M-120	5	M-90	5	M-80	4	M-80	6
8.2	M-130	5	M-90	4	M-90	11	M-80	5
10	M-130	4	M-100	7	M-90	9	M-80	4
12	M-140	8	M-100	6	M-90	7	M-90	11
15	M-140	6	M-100	5	M-90	6	M-90	9
18	M-140	5	M-100	4	M-90	5	M-90	8
20	M-140	5	M-120	7	M-90	4	M-90	7
22	M-140	4	M-120	6	M-90	4	M-90	6
27	M-200	8	M-120	5	M-100	7	M-90	5
33	M-200	6	M-130	5	M-100	6	M-100	9
39	M-200	5	M-130	4	M-100	5	M-100	8
47	M-400	6	M-140	8	M-100	4	M-100	6
56	M-400	5	M-140	7	M-120	6	M-100	5
68	M-400	4	M-140	5	M-120	5	M-120	8
82			M-140	4	M-130	5	M-130	8
100			M-200	8	M-130	4	M-130	7
120			M-200	7	M-140	8	M-130	6
150			M-200	5	M-140	6	M-130	5
180			M-200	5	M-140	5	M-140	8
200			M-400	6	M-140	5	M-140	7
220			M-400	5	M-200	9	M-140	7
270			M-400	4	M-200	8	M-140	6
330					M-200	6	M-140	5
390					M-200	5	M-200	9
470					M-400	6	M-200	7
560					M-400	5	M-200	6
680					M-400	4	M-200	5
820							M-400	6
1000							M-400	5
1200							M-400	4

Class I Dielectrics

Class II Dielectrics

# MR/MM ROW CAPACITORS

MBT Row Capacitors are used where arrays of capacitors are needed, typically for decoupling/bypass of certain 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. If you require a custom design please consult the factory.

## MR/MM Part No. Code

Example shown: MBT Series MR, dielectric type M-130, .105" x .025", gold, 100pF, +80 to -20% tolerance, 6 cap. chip

**MR6 - 130 - 105 x 20 x 4 - 5 - G - 101 - Z**

Capacitor Style

MR or MM  
R: Row  
M: Margin

Number of Capacitors

Dielectric Type

See *Class I and Class II* tables (page 13-14)

Length x Width (mils)

See *MR/MM Chip Dimensions* (at right)

Thickness (mils)

Gap Width (mils)

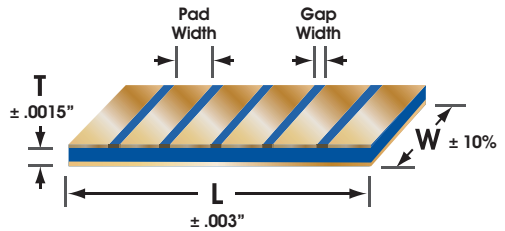
Metallization – G (gold) or Custom

Capacitance (pF) (Per Pad)

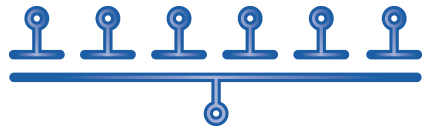
First two digits represent significant figures and the last, the number of zeros to follow. When required, the letter "R" is used as a decimal point and the succeeding digits represent significant figures only, e.g.: 1R6 = 1.6pF

Capacitance Tolerance

## MR6 Chip Dimensions



## MR/MM Electrode Configuration



# MR/MM ROW CAPACITORS (cont)

## MR/MM Selection Chart

**Note:** Selection Chart is for guidance only. The square area and capacitance parameters are for a single pad. All MBT devices are built to specific customers requirements.

### MR/MM Standard Capacitance Tolerance Codes

#### Class I Dielectrics: M-20 thru M-70

Tolerance	Code
±20%	M
±15%	L
±10%	K

#### Class II Dielectrics: M-80 thru M-400

Tolerance	Code
±20%	M
±15%	L
±10%	K
-10% thru +40%	Y
-20% thru +80%	Z
-0% thru +100%	V
Guaranteed Min. Value	GMV

Cap. (pF)	Pad Size in mils(mm)																				
	10 x 10 (254 x 254)		12 x 12 (305 x 305)		15 x 15 (381 x 381)		20 x 20 (508 x 508)		25 x 25 (635 x 635)		30 x 30 (762 x 762)		35 x 35 (889 x 889)		40 x 40 (1,016 x 1,016)		50 x 50 (1,27 x 1,27)				
	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.	Dielt.	Thick.			
0.04	M-30	5	M-30	6	M-30	10															
0.06	M-30	4	M-30	5	M-30	8	M-20	5	M-20	10											
0.08	M-50	10	M-30	4	M-30	6	M-30	10	M-20	7	M-20	9									
0.1	M-50	8	M-50	11	M-30	5	M-30	9	M-20	5	M-20	7	M-20	10							
0.2	M-50	5	M-50	7	M-50	10	M-30	4	M-30	7	M-30	10	M-20	5	M-20	7	M-20	10			
0.3	M-58	6	M-50	4	M-50	6	M-50	11	M-30	4	M-30	7	M-30	9	M-20	5	M-20	7	M-20	10	
0.4	M-58	5	M-58	7	M-50	5	M-50	9	M-50	15	M-30	5	M-30	7	M-30	9	M-20	5	M-20	7	
0.5	M-58	4	M-58	5	M-50	4	M-50	7	M-50	11	M-30	5	M-30	5	M-30	7	M-20	4	M-20	4	
0.6	M-70	6	M-58	5	M-58	7	M-50	6	M-50	10	M-50	15	M-30	4	M-30	6	M-30	6	M-30	9	
0.8	M-80	8	M-70	6	M-58	5	M-50	5	M-50	7	M-50	10	M-50	15	M-30	4	M-30	4	M-30	7	
1	M-80	7	M-70	5	M-58	4	M-58	7	M-50	6	M-50	8	M-50	10	M-30	4	M-30	4	M-30	5	
1.2	M-80	6	M-70	4	M-58	4	M-58	6	M-50	5	M-50	7	M-50	9	M-30	3	M-30	3	M-30	5	
1.5	M-80	5	M-80	7	M-70	5	M-58	5	M-50	4	M-50	6	M-50	7	M-50	10	M-30	4	M-30	4	
1.8	M-80	4	M-80	5	M-70	4	M-58	4	M-58	6	M-50	5	M-50	6	M-50	8	M-50	8	M-50	11	
2	M-80	4	M-80	5	M-70	4	M-70	7	M-58	6	M-50	4	M-50	5	M-50	7	M-50	7	M-50	11	
2.2	M-90	4	M-80	5	M-70	4	M-70	6	M-58	5	M-58	7	M-50	5	M-50	7	M-50	7	M-50	10	
2.7	M-90	8	M-80	4	M-80	6	M-80	6	M-58	4	M-58	6	M-50	4	M-50	5	M-50	5	M-50	8	
3.3	M-90	7	M-90	10	M-80	5	M-70	4	M-70	6	M-58	5	M-58	7	M-50	4	M-50	4	M-50	7	
3.9	M-90	6	M-90	9	M-80	4	M-80	7	M-70	5	M-58	4	M-58	6	M-58	8	M-58	8	M-58	6	
4.7	M-90	5	M-90	7	M-90	11	M-80	6	M-70	4	M-70	6	M-58	5	M-58	6	M-58	6	M-58	5	
5.6	M-90	4	M-90	6	M-90	10	M-80	5	M-80	7	M-70	5	M-58	4	M-58	5	M-58	5	M-58	4	
6.8	M-90	4	M-90	5	M-90	8	M-80	4	M-80	6	M-70	5	M-70	6	M-58	4	M-58	4	M-58	7	
8.2	M-100	6	M-90	4	M-90	7	M-80	4	M-80	5	M-70	4	M-70	5	M-70	7	M-70	7	M-70	10	
10	M-100	5	M-90	4	M-90	5	M-90	9	M-80	4	M-80	6	M-70	4	M-70	5	M-70	5	M-70	8	
12	M-100	4	M-100	6	M-90	5	M-90	8	M-90	11	M-80	5	M-80	7	M-70	4	M-70	4	M-70	7	
15	M-120	6	M-100	5	M-90	4	M-90	6	M-90	10	M-80	4	M-80	6	M-80	7	M-70	7	M-70	6	
18	M-120	5	M-100	4	M-100	6	M-90	5	M-90	8	M-90	11	M-80	4	M-80	6	M-80	6	M-70	5	
20	M-120	5	M-100	4	M-100	6	M-90	5	M-90	8	M-90	11	M-80	4	M-80	5	M-70	4	M-70	4	
22	M-120	4	M-120	6	M-100	5	M-90	4	M-90	7	M-90	9	M-80	4	M-80	5	M-70	4	M-70	4	
27	M-120	4	M-120	5	M-100	4	M-90	4	M-90	6	M-90	8	M-80	3	M-80	4	M-80	4	M-80	6	
33	M-130	4	M-120	4	M-120	6	M-100	6	M-90	5	M-90	6	M-90	11	M-80	4	M-80	4	M-80	5	
39	M-140	6	M-120	4	M-120	5	M-100	5	M-90	4	M-90	5	M-90	7	M-90	10	M-80	4	M-80	4	
47	M-140	5	M-140	7	M-120	5	M-100	4	M-100	6	M-90	5	M-90	6	M-90	8	M-80	4	M-80	4	
56	M-140	4	M-140	6	M-130	5	M-120	7	M-100	5	M-90	4	M-90	5	M-90	7	M-90	7	M-90	10	
68	M-140	4	M-140	5	M-130	4	M-120	6	M-100	5	M-100	6	M-90	4	M-90	6	M-90	6	M-90	9	
82	M-200	7	M-140	4	M-140	7	M-130	6	M-100	4	M-100	5	M-100	7	M-100	10	M-100	10	M-90	7	
100	M-200	6	M-200	8	M-140	6	M-130	5	M-120	6	M-100	5	M-100	6	M-100	8	M-100	8	M-90	6	
120	M-200	5	M-200	7	M-140	5	M-140	8	M-130	6	M-100	4	M-100	5	M-100	7	M-100	7	M-90	5	
150	M-200	4	M-200	5	M-140	4	M-140	7	M-130	5	M-130	7	M-100	4	M-100	5	M-100	5	M-90	4	
180	M-400	4	CM-200	5	M-200	7	M-140	6	M-130	4	M-130	6	M-130	8	M-120	8	M-100	7	M-100	7	
200	M-400	4	M-200	4	M-200	6	M-140	5	M-140	8	M-130	5	M-130	7	M-120	7	M-100	6	M-100	6	
220	M-400	4	M-400	5	M-200	6	M-140	4	M-140	7	M-130	5	M-130	6	M-120	6	M-100	5	M-100	5	
270			M-400	4	M-200	5	M-200	8	M-140	6	M-130	4	M-130	5	M-120	5	M-100	5	M-100	5	
330					M-200	4	M-200	7	M-140	5	M-140	7	M-130	4	M-120	4	M-120	7	M-120	7	
390					M-400	4	M-200	6	M-140	4	M-140	6	M-140	7	M-140	10	M-120	6	M-120	6	
470					M-400	4	M-200	5	M-200	7	M-140	5	M-140	6	M-140	8	M-140	8	M-120	5	
560							M-200	4	M-200	6	M-140	4	M-140	5	M-140	7	M-140	7	M-120	4	
680							M-400	5	M-200	5	M-200	8	M-140	5	M-140	6	M-130	4	M-130	4	
820							M-400	4	M-400	6	M-200	6	M-140	4	M-140	5	M-140	7	M-140	7	
1000									M-400	5	M-200	5	M-200	7	M-140	4	M-140	4	M-140	6	
1200										M-400	4	M-200	4	M-200	6	M-200	7	M-140	5	M-140	5
1500												M-400	5	M-200	5	M-200	6	M-140	4	M-140	4
1800													M-400	4	M-400	6	M-200	5	M-200	8	
2200														M-400	5	M-200	4	M-200	6	M-200	6
2700															M-400	4	M-400	5	M-200	5	
3300																				M-400	6

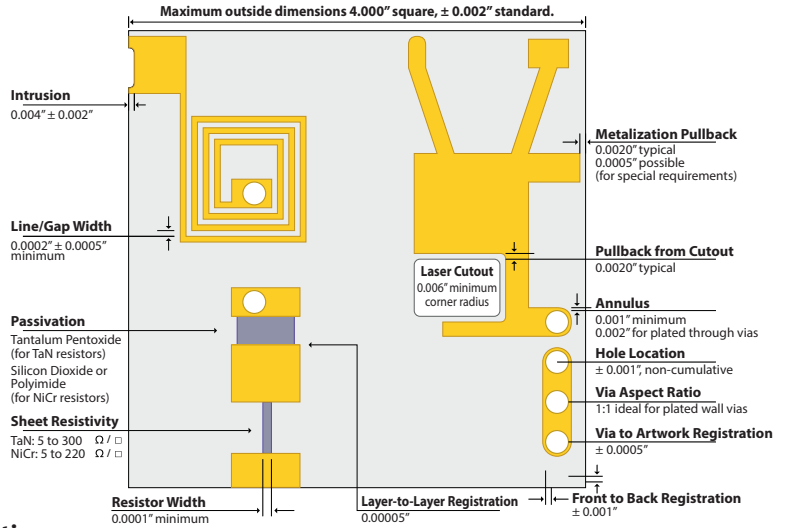
Class I Dielectrics

Class II Dielectrics

# MBT THIN FILM DESIGN GUIDELINE DIMENSIONS AND TOLERANCES

## MBT Design Guideline Dimensions and Tolerances

MBT's thin film manufacturing methods guarantee to meet the toughest thin film design goals. Our state of the art thin film manufacturing capabilities and experienced thin film team allow us to meet and exceed your most demanding standard or custom thin film requirements.



## General Characteristics

<b>Resistance Tolerance</b>	±0.01% to ±20%
<b>Resistance Ratio</b>	±0.01% available
<b>TCR Tracking</b>	± 2 ppm/°C
<b>Termination Material</b>	Gold (Standard)
<b>Wafer Size</b>	Up to 4 in × 4 in
<b>Line Width Definition (Resistor)</b>	0.1 mils
<b>Line Width Definition (Conductor)</b>	0.2 mils
<b>Metals Available</b>	Gold, Nickel, NiChrome, Palladium, Platinum, Tantalum, Tantalum Nitride, Titanium, Titanium Tungsten (TiW), Silver
<b>Specialty Materials</b>	Metalization available on 1 – 6 sides Through-holes (vias), edge wraps, and custom laser cutouts
<b>Lift-off Process</b>	Lift-off patterning available

## Substrate Characteristics

Substrate Material	Available Thickness (standard)	Dielectric Constant (at 1 MHz)	Thermal Conductivity (W · m <sup>-1</sup> · K <sup>-1</sup> )
Quartz	0.005 in – 0.010 in	3.8	1.38
Silicon	0.005 in – 0.010 in	N/A (SiO <sub>2</sub> K=3.8)	149 (SiO <sub>2</sub> 1.38)
Beryllium Oxide (BeO)	0.005 in – 0.025 in	6.6	285
Aluminum Nitride (AlN)	0.005 in – 0.025 in	8.7	170
Alumina (Al <sub>2</sub> O <sub>3</sub> )	0.005 in – 0.025 in	9.8	26.9

## Conductor Materials

Material	Standard Thickness
Sputtered Gold (Au)	0.005 in – 0.010 in
Plated Gold (Au)	0.005 in – 0.010 in

## Resistive Material Characteristics

Material	Sheet Resistivity	Passivation	Standard TCR	Optional TCR
Tantalum Nitride	5 Ω/sq – 300 Ω/sq	Ta <sub>2</sub> O <sub>5</sub> (Self-Passivating)	± 150 ppm/°C	± 50 ppm/°C
NiChrome	5 Ω/sq – 250 Ω/sq	SiO <sub>2</sub>	± 25 ppm/°C	± 5 ppm/°C



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