

## Solid Tantalum Surface Mount Chip Capacitors, Molded Case, Ultra Flat Low Profile



### PERFORMANCE / ELECTRICAL CHARACTERISTICS

**Operating Temperature:** -55 °C to +125 °C  
(above 85 °C, voltage derating is required)

**Capacitance Range:** 0.1 µF to 220 µF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 2.5 V<sub>DC</sub> to 35 V<sub>DC</sub>

### FEATURES

- Small size, low profile
- Terminations:  
Case UA: 100 % matte tin  
Case UB: Ni / Pd / Au
- Qualified to EIA-717
- MSL level: 1 (UA case size), 3 (UB case size)
- Compatible with “high volume” automatic pick and place equipment
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Industrial
- General purpose

### ORDERING INFORMATION

TMCU	A	1G	107	M	TR	(2)	F
TYPE	CASE CODE	DC VOLTAGE RATING AT +85 °C	CAPACITANCE (µF)	CAPACITANCE TOLERANCE	PACKAGING POLARITY	(OPTIONAL)	TERMINAL CODE
	See Ratings and Case Codes table.	0E = 2.5 V 0G = 4 V 0J = 6.3 V (7 V) 1A = 10 V 1C = 16 V 1D = 20 V 1E = 25 V 1V = 35 V	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	K = ± 10 % M = ± 20 %	TR = 7" reel, cathodes close to perforation side	Halogen-free (special order)	F = lead (Pb)-free terminations

### DIMENSIONS in inches [millimeters]

CASE CODE	EIA SIZE	L	W	H	l	a
UA	3216-12	0.126 ± 0.008 [3.2 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.047 max. [1.2 max.]	0.030 ± 0.012 [0.8 ± 0.3]	0.047 ± 0.008 [1.2 ± 0.2]
UB	3528-12	0.138 ± 0.008 [3.5 ± 0.2]	0.110 ± 0.008 [2.8 ± 0.2]	0.047 max. [1.2 max.]	0.030 ± 0.012 [0.8 ± 0.3]	0.071 ± 0.008 [1.8 ± 0.2]



RATINGS AND CASE CODES								
μF	2.5 V	4 V	6.3 V (7 V)	10 V	16 V	20 V	25 V	35 V
0.10								UA
0.15								UA
0.22								UA
0.33							UA	
0.47							UA	
0.68						UA	UA	
1.0						UA / UB	UA	UA / UB
1.5					UA	UA / UB	UB	UB
2.2					UA / UB	UA / UB	UB	UB
3.3					UA / UB	UA / UB	UB	
4.7				UA	UA / UB	UB	UB	
6.8				UA	UA / UB	UB		
10			UA	UA	UA / UB			
15	UA	UA	UA	UA / UB	UB			
22	UA	UA	UA / UB	UA / UB	UB			
33	UA / UB	UA / UB	UA / UB	UB				
47	UA / UB	UA / UB	UA / UB	UB				
68	UB	UA / UB	UB					
100	UB	UA / UB	UB					
150	UB	UB						
220	UB	UB						

**MARKING**

**CAPACITANCE AND VOLTAGE MARKING**

μF	2.5 V	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V
0.10								VA5
0.15								VE5
0.22								VJ5
0.33							EN5	
0.47							ES5	
0.68						DW5	EW5	
1.0						DA6 <sup>(1)</sup>   A6 <sup>(2)</sup>	EA6	VA6
1.5					CE6	DE6 <sup>(1)</sup>   E6 <sup>(2)</sup>	EE6	VE6
2.2					CJ6 <sup>(1)</sup>   J6 <sup>(2)</sup>	DJ6	EJ6	VJ6
3.3					CN6	DN6	EN6	
4.7				AS6	CS6	DS6	ES6	
6.8				AW6	CW6	DW6		
10			JA7	AA7	CA7			
15	eE7	GE7	JE7	AE7	CE7			
22	eJ7	GJ7	JJ7	AJ7	CJ7			
33	eN7	GN7	JN7	AN7				
47	eS7	GS7	JS7	AS7				
68	eW7	GW7	JW7					
100	eA8	GA8	JA8					
150	eE8	GE8						
220	eJ8	GJ8						

**Notes**

- (1) Marking on UA case  
 (2) Marking on UB case

**DATE CODE**

YEAR	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z
2015	a	b	c	d	e	f	g	h	j	k	l	m
2016	n	p	q	r	s	t	u	v	w	x	y	z



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT +25 °C ( $\mu$ A)	MAX. DF AT +25 °C, 120 Hz (%)	MAX. ESR AT +25 °C, 100 kHz ( $\Omega$ )	MAX. RIPPLE, 100 kHz I <sub>RMS</sub> (A)
<b>2.5 V<sub>DC</sub> AT +85 °C; 1.6 V<sub>DC</sub> AT +125 °C</b>						
15	UA	TMCUA0E156(1)TRF	0.5	8	3.0	0.161
22	UA	TMCUA0E226(1)TRF	0.6	8	1.8	0.208
33	UA	TMCUA0E336(1)TRF	1.7	12	1.8	0.208
33	UB	TMCUB0E336(1)TRF	0.8	12	1.7	0.238
47	UA	TMCUA0E476(1)TRF	2.4	18	1.8	0.208
47	UB	TMCUB0E476(1)TRF	1.2	12	1.7	0.238
68	UB	TMCUB0E686(1)TRF	1.7	15	1.7	0.238
100	UB	TMCUB0E107(1)TRF	5.0	20	1.1	0.295
150	UB	TMCUB0E157(1)TRF	7.5	30	1.1	0.295
220	UB	TMCUB0E227(1)TRF	11.0	30	1.1	0.295
<b>4 V<sub>DC</sub> AT +85 °C; 2.5 V<sub>DC</sub> AT +125 °C</b>						
15	UA	TMCUA0G156(1)TRF	0.6	8	3.0	0.161
22	UA	TMCUA0G226(1)TRF	0.9	8	1.8	0.208
33	UA	TMCUA0G336(1)TRF	2.6	12	1.8	0.208
33	UB	TMCUB0G336(1)TRF	1.3	12	1.7	0.238
47	UA	TMCUA0G476(1)TRF	3.8	18	1.8	0.208
47	UB	TMCUB0G476(1)TRF	1.9	12	1.7	0.238
68	UA	TMCUA0G686(1)TRF	5.4	30	4.0	0.140
68	UB	TMCUB0G686(1)TRF	2.7	15	1.7	0.238
100	UA	TMCUA0G107MTRF	20.0	30	2.9	0.164
100	UB	TMCUB0G107(1)TRF	8.0	20	1.1	0.295
150	UB	TMCUB0G157(1)TRF	12.0	30	1.1	0.295
220	UB	TMCUB0G227MTRF	17.6	30	1.1	0.295
<b>6.3 V<sub>DC</sub> (7 V<sub>DC</sub>) AT +85 °C; 4 V<sub>DC</sub> AT +125 °C</b>						
10	UA	TMCUA0J106(1)TRF	0.7	8	4.0	0.140
15	UA	TMCUA0J156(1)TRF	1.1	8	2.9	0.164
22	UA	TMCUA0J226(1)TRF	2.8	12	2.9	0.164
22	UB	TMCUB0J226(1)TRF	1.4	10	1.7	0.238
33	UA	TMCUA0J336(1)TRF	4.2	20	2.9	0.164
33	UB	TMCUB0J336(1)TRF	2.3	10	1.7	0.238
47	UA	TMCUA0J476MTRF	5.9	20	2.9	0.164
47	UB	TMCUB0J476(1)TRF	3.3	12	1.7	0.238
68	UB	TMCUB0J686(1)TRF	8.6	20	1.7	0.238
100	UB	TMCUB0J107MTRF	12.6	20	1.1	0.295
<b>10 V<sub>DC</sub> AT +85 °C; 6.3 V<sub>DC</sub> AT +125 °C</b>						
4.7	UA	TMCUA1A475(1)TRF	0.5	6	4.0	0.140
6.8	UA	TMCUA1A685(1)TRF	0.7	6	4.0	0.140
10	UA	TMCUA1A106(1)TRF	1.0	8	4.0	0.140
15	UA	TMCUA1A156(1)TRF	3.0	12	2.9	0.164
15	UB	TMCUB1A156(1)TRF	1.5	10	2.8	0.185
22	UA	TMCUA1A226MTRF	4.4	18	2.9	0.164
22	UB	TMCUB1A226(1)TRF	2.2	10	1.7	0.238
33	UB	TMCUB1A336(1)TRF	6.6	12	1.7	0.238
47	UB	TMCUB1A476MTRF	9.4	30	1.7	0.238
<b>16 V<sub>DC</sub> AT +85 °C; 10 V<sub>DC</sub> AT +125 °C</b>						
1.5	UA	TMCUA1C155(1)TRF	0.5	6	8.8	0.094
2.2	UA	TMCUA1C225(1)TRF	0.5	6	7.7	0.101
2.2	UB	TMCUB1C225(1)TRF	0.5	6	6.6	0.121
3.3	UA	TMCUA1C335(1)TRF	0.5	6	7.7	0.101
3.3	UB	TMCUB1C335(1)TRF	0.5	6	4.0	0.155
4.7	UA	TMCUA1C475(1)TRF	0.8	8	4.0	0.140
4.7	UB	TMCUB1C475(1)TRF	0.8	6	4.0	0.155

**Notes**

- Part number definition:  
(1) Tolerance: For 10 % tolerance, specify "K"; for 20 % tolerance, change to "M"
- Termination code "F":  
Case UA: 100 % tin; case UB: Ni / Pd / Au



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT +25 °C ( $\mu$ A)	MAX. DF AT +25 °C, 120 Hz (%)	MAX. ESR AT +25 °C, 100 kHz ( $\Omega$ )	MAX. RIPPLE, 100 kHz I <sub>RMS</sub> (A)
<b>16 V<sub>DC</sub> AT +85 °C; 10 V<sub>DC</sub> AT +125 °C</b>						
6.8	UA	TMCUA1C685(1)TRF	1.1	12	4.0	0.140
6.8	UB	TMCUB1C685(1)TRF	1.1	6	4.0	0.155
10	UA	TMCUA1C106MTRF	1.6	18	3.3	0.154
10	UB	TMCUB1C106(1)TRF	1.6	8	2.8	0.185
15	UB	TMCUB1C156(1)TRF	4.8	12	2.8	0.185
22	UB	TMCUB1C226MTRF	7.0	18	1.7	0.238
<b>20 V<sub>DC</sub> AT +85 °C; 13 V<sub>DC</sub> AT +125 °C</b>						
0.68	UA	TMCUA1D684(1)TRF	0.5	4	19.8	0.063
1.0	UA	TMCUA1D105(1)TRF	0.5	4	16.5	0.069
1.0	UB	TMCUB1D105(1)TRF	0.5	4	8.8	0.104
1.5	UA	TMCUA1D155(1)TRF	0.5	6	16.5	0.069
1.5	UB	TMCUB1D155(1)TRF	0.5	6	8.8	0.104
2.2	UA	TMCUA1D225(1)TRF	0.5	6	7.7	0.101
2.2	UB	TMCUB1D225(1)TRF	0.5	6	6.6	0.121
3.3	UA	TMCUA1D335MTRF	0.7	6	7.7	0.101
3.3	UB	TMCUB1D335(1)TRF	0.7	6	4.0	0.155
4.7	UB	TMCUB1D475(1)TRF	0.9	6	4.0	0.155
6.8	UB	TMCUB1D685MTRF	1.4	6	2.8	0.185
<b>25 V<sub>DC</sub> AT +85 °C; 16 V<sub>DC</sub> AT +125 °C</b>						
0.33	UA	TMCUA1E334(1)TRF	0.5	4	26.4	0.054
0.47	UA	TMCUA1E474(1)TRF	0.5	4	22.0	0.060
0.68	UA	TMCUA1E684(1)TRF	0.5	8	19.8	0.063
1.0	UA	TMCUA1E105(1)TRF	0.5	8	16.5	0.069
1.5	UB	TMCUB1E155(1)TRF	0.5	6	8.8	0.104
2.2	UB	TMCUB1E225(1)TRF	0.6	6	6.6	0.121
3.3	UB	TMCUB1E335(1)TRF	0.8	6	4.0	0.155
4.7	UB	TMCUB1E475MTRF	1.2	6	4.0	0.155
<b>35 V<sub>DC</sub> AT +85 °C; 22 V<sub>DC</sub> AT +125 °C</b>						
0.10	UA	TMCUA1V104(1)TRF	0.5	4	40.0	0.044
0.15	UA	TMCUA1V154(1)TRF	0.5	4	40.0	0.044
0.22	UA	TMCUA1V224(1)TRF	0.5	4	40.0	0.044
1.0	UA	TMCUA1V105MTRF	0.5	8	16.5	0.069
1.0	UB	TMCUB1V105(1)TRF	0.5	6	8.8	0.104
1.5	UB	TMCUB1V155(1)TRF	0.5	6	8.8	0.104
2.2	UB	TMCUB1V225MTRF	0.8	6	6.6	0.121

**Notes**

- Part number definition:  
(1) Tolerance: For 10 % tolerance, specify "K"; for 20 % tolerance, change to "M"
- Termination code "F":  
Case UA: 100 % tin; case UB: Ni / Pd / Au

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below +85 °C)	
CAPACITOR VOLTAGE RATING	OPERATING VOLTAGE
2.5	1.2
4.0	2.0
6.3 (7.0)	3.1 (3.5)
10	5.0
16	8.0
20	10.0
25	12.5
35	17.5



POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT +25 °C (W) IN FREE AIR
UA	0.078
UB	0.096

STANDARD PACKAGING QUANTITY	
CASE CODE	UNITS PER 7" REEL
UA	3000
UB	3000

PERFORMANCE CHARACTERISTICS						
ITEM	CONDITION	POST TEST PERFORMANCE				
			Specified initial value	-55 °C	+85 °C	+125 °C
Temperature characteristics	Measure the specified characteristics in each stage	Capacitance change	-	-12 % to 0 %	0 % to 10 %	0 % to 12 %
		Dissipation factor (%), maximum	4	5	4	5
			6	8	6	6
			8	12	10	12
			10	14	12	14
			12	16	14	16
			18	34	20	22
			20	38	22	24
			30	60	30	40
		Leakage current	Refer to Standard Ratings table	-	1000 % specified initial value or less	1250 % specified initial value or less
Solder heat resistance	Solder Dip 260 °C ± 5 °C, 10 s ± 1 s Reflow 260 °C, 10 s ± 1 s	Capacitance change	Within ± 5 % of initial value			
		Dissipation factor	Initial specified value or less			
		Leakage current	Initial specified value or less			
Moisture resistance no load	Leave at 40 °C and 90 % to 95 % RH for 500 h	Capacitance change	Within ± 10 % of initial value			
		Dissipation factor	Initial specified value or less			
		Leakage current	Initial specified value or less			
High temperature load	85 °C. The rated voltage is applied for 2000 h	Capacitance change	Within ± 10 % of initial value			
		Dissipation factor	Initial specified value or less			
		Leakage current	Shall not exceed 125 % of initial specified value			
Thermal shock	Leave at -55 °C, normal temperature, 125 °C, and normal temperature for 30 min., 3 min, 30 min, and 3 min. Repeat this operation 5 times running.	Capacitance change	Within ± 5 % of initial value			
		Dissipation factor	Initial specified value or less			
		Leakage current	Initial specified value or less			
Moisture resistance load	Leave at 40 °C and 90 % to 95 % RH. The rated voltage applied for 500 h	Capacitance change	Within ± 10 % of initial value			
		Dissipation factor	Shall not exceed 150 % of initial specified value			
		Leakage current	Shall not exceed 200 % of initial specified value			
Failure rate	85 °C. The rated voltage is applied through a protective resistor of 1 Ω/V.	1 % / 1000 h				

**Note**

- Test conditions per JIS C5101-1



# Guide for Tantalum and Niobium Solid Electrolyte Chip Capacitors

## INTRODUCTION

Tantalum electrolytic capacitors are the preferred choice in applications where volumetric efficiency, stable electrical parameters, high reliability, and long service life are primary considerations. The stability and resistance to elevated temperatures of the tantalum / tantalum oxide / manganese dioxide system make solid tantalum capacitors an appropriate choice for today's surface mount assembly technology.

Vishay Sprague has been a pioneer and leader in this field, producing a large variety of tantalum capacitor types for consumer, industrial, automotive, military, and aerospace electronic applications.

Tantalum is not found in its pure state. Rather, it is commonly found in a number of oxide minerals, often in combination with Columbium ore. This combination is known as "tantalite" when its contents are more than one-half tantalum. Important sources of tantalite include Australia, Brazil, Canada, China, and several African countries. Synthetic tantalite concentrates produced from tin slags in Thailand, Malaysia, and Brazil are also a significant raw material for tantalum production.

Electronic applications, and particularly capacitors, consume the largest share of world tantalum production. Other important applications for tantalum include cutting tools (tantalum carbide), high temperature super alloys, chemical processing equipment, medical implants, and military ordnance.

Vishay Sprague is a major user of tantalum materials in the form of powder and wire for capacitor elements and rod and sheet for high temperature vacuum processing.

## THE BASICS OF TANTALUM CAPACITORS

Most metals form crystalline oxides which are non-protecting, such as rust on iron or black oxide on copper. A few metals form dense, stable, tightly adhering, electrically insulating oxides. These are the so-called "valve" metals and include titanium, zirconium, niobium, tantalum, hafnium, and aluminum. Only a few of these permit the accurate control of oxide thickness by electrochemical means. Of these, the most valuable for the electronics industry are aluminum and tantalum.

Capacitors are basic to all kinds of electrical equipment, from radios and television sets to missile controls and automobile ignitions. Their function is to store an electrical charge for later use.

Capacitors consist of two conducting surfaces, usually metal plates, whose function is to conduct electricity. They are separated by an insulating material or dielectric. The dielectric used in all tantalum electrolytic capacitors is tantalum pentoxide.

Tantalum pentoxide compound possesses high-dielectric strength and a high-dielectric constant. As capacitors are being manufactured, a film of tantalum pentoxide is applied to their electrodes by means of an electrolytic process. The film is applied in various thicknesses and at various voltages and although transparent to begin with, it takes on different colors as light refracts through it. This coloring occurs on the tantalum electrodes of all types of tantalum capacitors.

Rating for rating, tantalum capacitors tend to have as much as three times better capacitance / volume efficiency than aluminum electrolytic capacitors. An approximation of the capacitance / volume efficiency of other types of capacitors may be inferred from the following table, which shows the dielectric constant ranges of the various materials used in each type. Note that tantalum pentoxide has a dielectric constant of 26, some three times greater than that of aluminum oxide. This, in addition to the fact that extremely thin films can be deposited during the electrolytic process mentioned earlier, makes the tantalum capacitor extremely efficient with respect to the number of microfarads available per unit volume. The capacitance of any capacitor is determined by the surface area of the two conducting plates, the distance between the plates, and the dielectric constant of the insulating material between the plates.

### COMPARISON OF CAPACITOR DIELECTRIC CONSTANTS

DIELECTRIC	$\epsilon$ DIELECTRIC CONSTANT
Air or vacuum	1.0
Paper	2.0 to 6.0
Plastic	2.1 to 6.0
Mineral oil	2.2 to 2.3
Silicone oil	2.7 to 2.8
Quartz	3.8 to 4.4
Glass	4.8 to 8.0
Porcelain	5.1 to 5.9
Mica	5.4 to 8.7
Aluminum oxide	8.4
<b>Tantalum pentoxide</b>	<b>26</b>
Ceramic	12 to 400K

In the tantalum electrolytic capacitor, the distance between the plates is very small since it is only the thickness of the tantalum pentoxide film. As the dielectric constant of the tantalum pentoxide is high, the capacitance of a tantalum capacitor is high if the area of the plates is large:

$$C = \frac{eA}{t}$$

where

C = capacitance

e = dielectric constant

A = surface area of the dielectric

t = thickness of the dielectric

Tantalum capacitors contain either liquid or solid electrolytes. In solid electrolyte capacitors, a dry material (manganese dioxide) forms the cathode plate. A tantalum lead is embedded in or welded to the pellet, which is in turn connected to a termination or lead wire. The drawings show the construction details of the surface mount types of tantalum capacitors shown in this catalog.

## SOLID ELECTROLYTE TANTALUM CAPACITORS

Solid electrolyte capacitors contain manganese dioxide, which is formed on the tantalum pentoxide dielectric layer by impregnating the pellet with a solution of manganous nitrate. The pellet is then heated in an oven, and the manganous nitrate is converted to manganese dioxide.

The pellet is next coated with graphite, followed by a layer of metallic silver, which provides a conductive surface between the pellet and the leadframe.

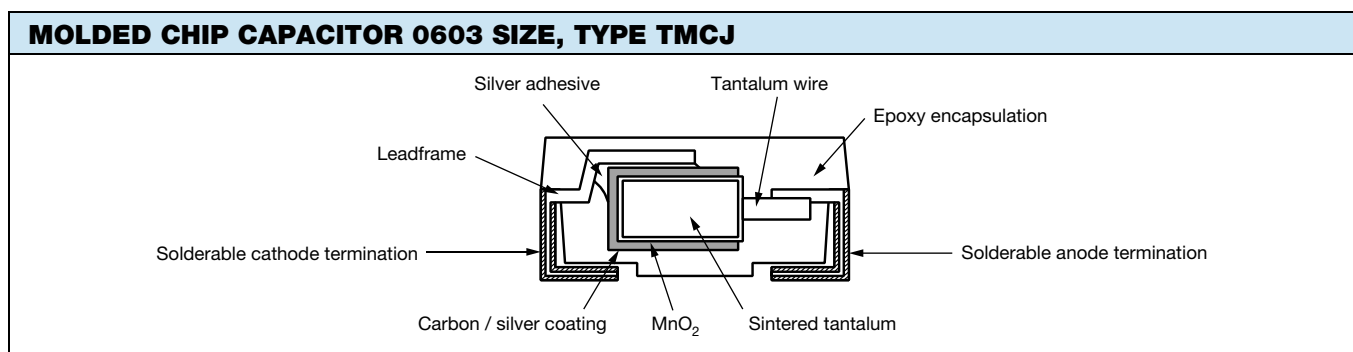
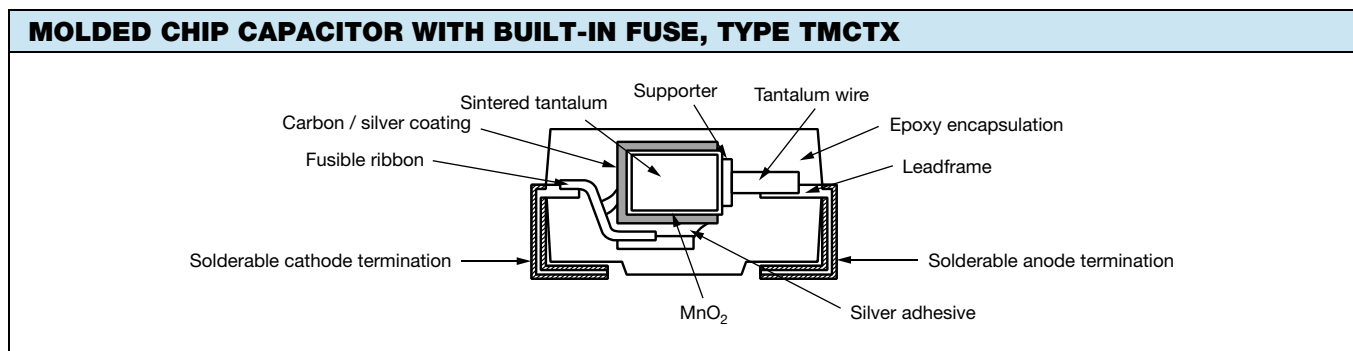
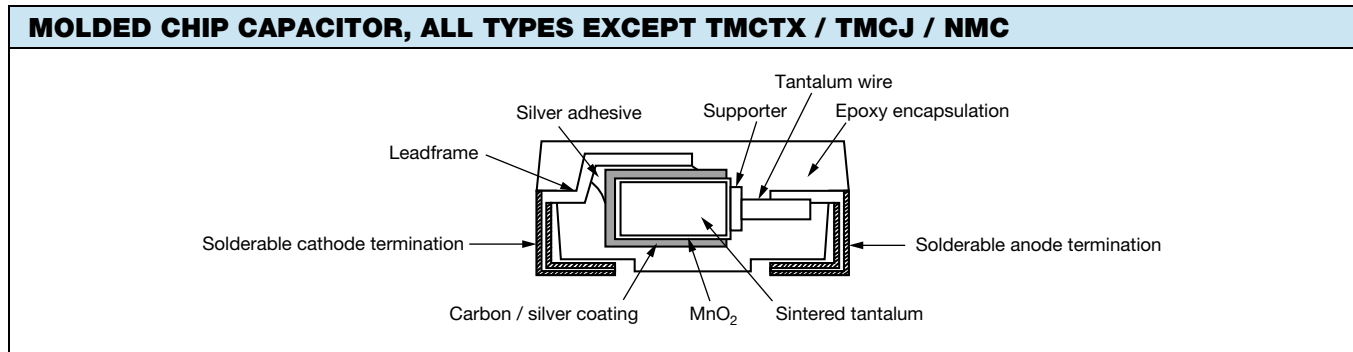
Molded chip tantalum capacitor encases the element in plastic resins, such as epoxy materials. After assembly, the capacitors are tested and inspected to assure long life and reliability. It offers excellent reliability and high stability for consumer and commercial electronics with the added feature of low cost.

Surface mount designs of "Solid Tantalum" capacitors use lead frames as shown in the accompanying drawings.

## TANTALUM CAPACITORS FOR ALL DESIGN CONSIDERATIONS

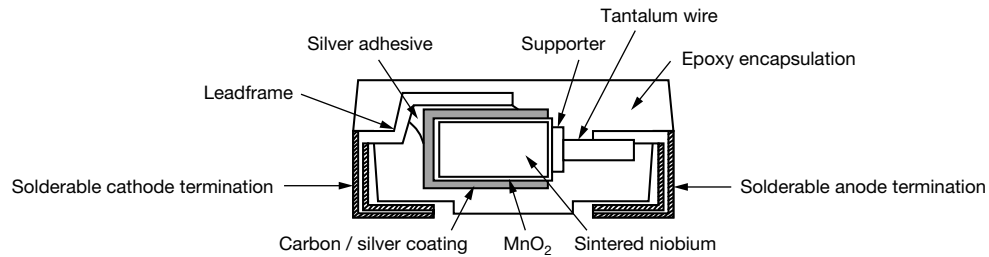
Solid electrolyte designs are the least expensive for a given rating and are used in many applications where their very small size for a given unit of capacitance is of importance. Also important are their good low temperature performance characteristics and freedom from corrosive electrolytes.

Datasheets covering the various types and styles of capacitors for consumer and entertainment electronics and industry applications are available where detailed performance characteristics must be specified.





### MOLDED CHIP CAPACITOR NIOBIUM, TYPE NMC



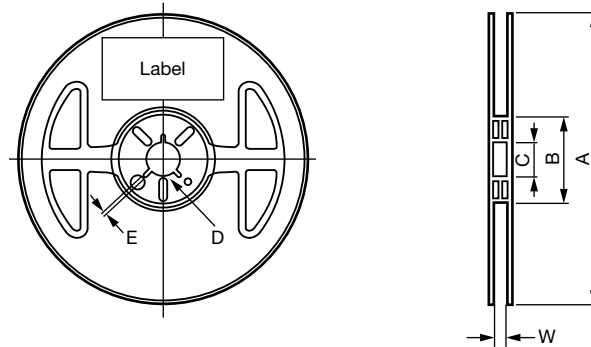
### SOLID TANTALUM CAPACITORS - MOLDED CASE

SERIES	TMCS	TMCM	TMCR	TMCU	TMCP	TMCJ
PRODUCT IMAGE						
TYPE	Solid tantalum surface mount chip capacitors, molded case					
FEATURES	Standard industrial grade	Standard industrial grade extended range	Low ESR	Low profile	0805 size	0603 size
TEMPERATURE RANGE	-55 °C to +125 °C					
CAPACITANCE RANGE	0.1 µF to 68 µF	0.47 µF to 470 µF	10 µF to 330 µF	0.1 µF to 220 µF	0.1 µF to 47 µF	0.68 µF to 22 µF
VOLTAGE RANGE	4 V to 35 V	2.5 V to 35 V	7 V to 35 V	2.5 V to 35 V	2.5 V to 25 V	2.5 V to 20 V
CAPACITANCE TOLERANCE	± 10 %, ± 20 %					± 20 %
LEAKAGE CURRENT	0.01 CV or 0.5 µA, whichever is greater					
DISSIPATION FACTOR	4 % to 6 %	4 % to 30 %	6 % to 30 %	4 % to 30 %	6 % to 30 %	20 %
CASE SIZES	A, B, C, E	A, B, C, E	B, C, E	UA, UB	P	J
TERMINATION FINISH	100 % tin			Case UA: 100 % tin Case UB: Ni / Pd / Au	100 % tin	

<b>SOLID TANTALUM CAPACITORS - MOLDED CASE</b>			
SERIES	TMCTX	TMCH	THC
PRODUCT IMAGE			
TYPE	Solid tantalum surface mount chip capacitors, molded case		
FEATURES	Built-in fuse	High reliability	High reliability, high temperature +150 °C
TEMPERATURE RANGE	-55 °C to +125 °C		-55 °C to +150 °C
CAPACITANCE RANGE	1.0 µF to 68 µF	0.1 µF to 100 µF	0.33 µF to 47 µF
VOLTAGE RANGE	10 V to 35 V	4 V to 35 V	10 V to 35 V
CAPACITANCE TOLERANCE	± 10 %, ± 20 %		
LEAKAGE CURRENT	0.01 CV or 0.5 µA, whichever is greater	0.005 CV or 0.25 µA, whichever is greater	
DISSIPATION FACTOR	4 % to 6 %	4 % to 8 %	4 % to 6 %
CASE SIZES	B, C, E, F	A, B, C, E, P	A, B, C, E
TERMINATION FINISH	100 % tin		

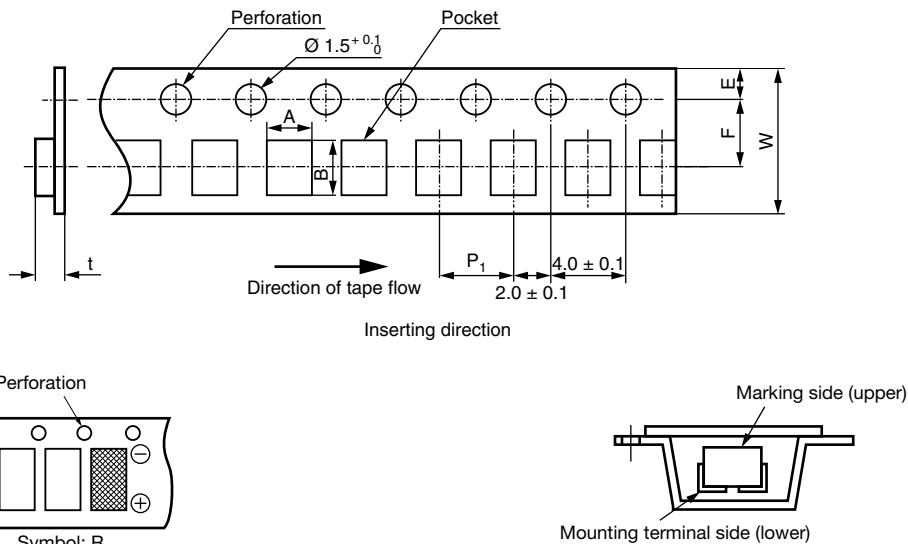
<b>SOLID NIOBIUM CAPACITORS - MOLDED CASE</b>		
SERIES	NMC	NMCU
PRODUCT IMAGE		
TYPE	Solid niobium surface mount chip capacitors, molded case	
FEATURES	Flame retardant	Flame retardant, low profile
TEMPERATURE RANGE	-55 °C to +105 °C	
CAPACITANCE RANGE	10 µF to 470 µF	4.7 µF to 47 µF
VOLTAGE RANGE	2.5 V to 10 V	
CAPACITANCE TOLERANCE	± 20 %	
LEAKAGE CURRENT	0.02 CV or less	
DISSIPATION FACTOR	8 % to 30 %	30 %
CASE SIZES	A, B, C, E	UA, UB
TERMINATION FINISH	100 % tin	Case UA: 100 % tin Case UB: Ni / Pd / Au

### PLASTIC TAPE AND REEL PACKAGING DIMENSIONS in millimeters



CASE CODE	J, P, A, UA, B, UB	C, E, F
<b>TAPE WIDTH</b>	<b>8</b>	<b>12</b>
A + 0 / - 3		Ø 180
B + 1 / 0		Ø 60
C ± 0.2		Ø 13
D ± 0.5		Ø 21
E ± 0.5		2.0
W ± 0.3	9.0	13.0

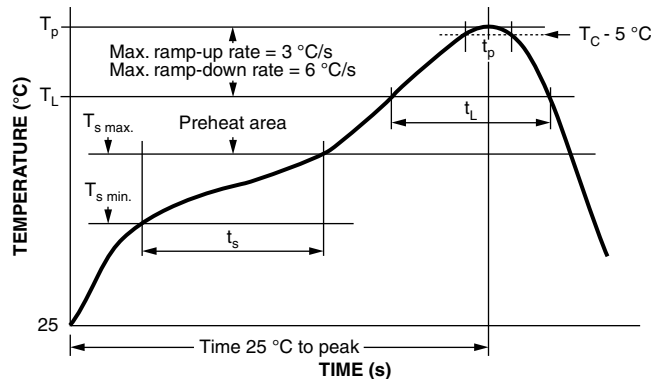
### TAPE SIZE in millimeters



CASE CODE	A ± 0.2	B ± 0.2	W ± 0.3	F ± 0.1	E ± 0.1	P <sub>1</sub> ± 0.1	t <sub>max.</sub>
J	1.0	1.8	8.0	3.5	1.75	4.0	1.3
P	1.4	2.2	8.0	3.5	1.75	4.0	1.6
A	1.9	3.5	8.0	3.5	1.75	4.0	2.5
UA	1.9	3.5	8.0	3.5	1.75	4.0	1.7
B	3.1	3.8	8.0	3.5	1.75	4.0	2.5
UB	3.1	3.8	8.0	3.5	1.75	4.0	1.7
C	3.7	6.3	12.0	5.5	1.75	8.0	3.1
E	4.8	7.7	12.0	5.5	1.75	8.0	3.4
F	6.2	7.5	12.0	5.5	1.75	8.0	4.1

**RECOMMENDED REFLOW PROFILES**

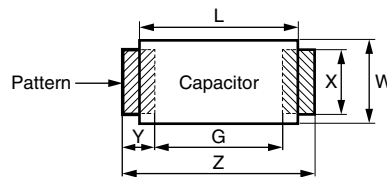
Capacitors should withstand reflow profile as per J-STD-020 standard



PROFILE FEATURE	LEAD (Pb)-FREE ASSEMBLY
<b>Preheat / soak</b>	
Temperature min. ( $T_{s \text{ min.}}$ )	130 °C
Temperature max. ( $T_{s \text{ max.}}$ )	160 °C
Time ( $t_s$ ) from ( $T_{s \text{ min.}}$ to $T_{s \text{ max.}}$ )	60 s to 120 s
<b>Ramp-up</b>	
Ramp-up rate ( $T_L$ to $T_p$ )	3 °C/s max.
Liquidus temperature ( $T_L$ )	200 °C
Time ( $t_L$ ) maintained above $T_L$	50 s max.
Peak package body temperature ( $T_p$ ) max.	Depends on case size - see table below
Time ( $t_p$ ) within 5 °C of the peak maximum temperature	10 s max.
Ramp-down rate ( $T_p$ to $T_L$ )	6 °C/s max.
Time from 25 °C to peak temperature	8 min max.

**PEAK PACKAGE BODY TEMPERATURE ( $T_p$ )**

CASE CODE	PEAK PACKAGE BODY TEMPERATURE ( $T_p$ )
	LEAD (Pb)-FREE PROCESS
J, P, UA, A, UB, B, C	260 °C
E, F	250 °C

**PAD DIMENSIONS** in millimeters


CASE / DIMENSIONS	CAPACITOR SIZE		PAD DIMENSIONS			
	L	W	G (max.)	Z (min.)	X (min.)	Y (Ref.)
J	1.6	0.8	0.7	2.5	1.0	0.9
P	2.0	1.25	0.5	2.6	1.2	1.05
UA, A	3.2	1.6	1.1	3.8	1.5	1.35
UB, B	3.5	2.8	1.4	4.1	2.7	1.35
C	5.8	3.2	2.9	6.9	2.7	2.0
E	7.3	4.3	4.1	8.2	2.9	2.05
F	7.3	5.8	4.1	8.2	4.0	2.05

## GUIDE TO APPLICATION

- AC Ripple Current:** the maximum allowable ripple current shall be determined from the formula:

$$I_{RMS} = \sqrt{\frac{P}{R_{ESR}}}$$

where,

P = power dissipation in W at +25 °C as given in the tables in the product datasheets.

R<sub>ESR</sub> = the capacitor equivalent series resistance at the specified frequency.

- AC Ripple Voltage:** the maximum allowable ripple voltage shall be determined from the formula:

$$V_{RMS} = Z \sqrt{\frac{P}{R_{ESR}}}$$

or, from the formula:

$$V_{RMS} = I_{RMS} \times Z$$

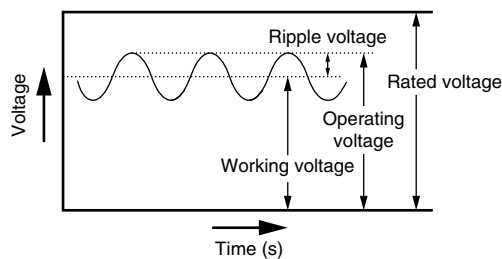
where,

P = power dissipation in W at +25 °C as given in the tables in the product datasheets.

R<sub>ESR</sub> = The capacitor equivalent series resistance at the specified frequency.

Z = The capacitor impedance at the specified frequency.

- The tantalum capacitors must be used in such a condition that the sum of the working voltage and ripple voltage peak values does not exceed the rated voltage as shown in figure below.



- Temperature Derating:** power dissipation is affected by the heat sinking capability of the mounting surface. If these capacitors are to be operated at temperatures above +25 °C, the permissible ripple current (or voltage) shall be calculated using the derating coefficient as shown in the table below:

MAXIMUM RIPPLE CURRENT TEMPERATURE DERATING FACTOR		
TEMPERATURE	TMC	NMC
≤ 25 °C	1.0	1.0
85 °C	0.9	0.9
105 °C	0.65	0.4
125 °C	0.4	-

- Reverse Voltage:** the capacitors are not intended for use with reverse voltage applied. If the application of an reverse voltage is unavoidable, it must not exceed the following values:

At 25 °C: 10 % of the rated voltage or 1 V, whichever is smaller.

At 85 °C: 5 % of the rated voltage or 0.5 V, whichever is smaller.

- Mounting Precautions:**

- Limit Pressure on Capacitor Installation with Mounter:** pressure must not exceed 4.9 N with a tool end diameter of 1.5 mm when applied to the capacitors using an absorber, centering tweezers, or similar (maximum permitted pressurization time: 5 s). An excessively low absorber setting position would result in not only the application of undue force to the capacitors but capacitor and other component scattering, circuit board wiring breakage, and / or cracking as well, particularly when the capacitors are mounted together with other chips having a height of 1 mm or less.

- Flux Selection**

- 5.2.1 Select a flux that contains a minimum of chlorine and amine.

- 5.2.2 After flux use, the chlorine and amine in the flux remain must be removed.

- 5.3 **Cleaning After Mounting:** the following solvents are usable when cleaning the capacitors after mounting. Never use a highly active solvent.

- Halogen organic solvent (HCFC225, etc.)
- Alcoholic solvent (IPA, ethanol, etc.)
- Petroleum solvent, alkali saponifying agent, water, etc.

Circuit board cleaning must be conducted at a temperature of not higher than 50 °C and for an immersion time of not longer than 30 minutes. When an ultrasonic cleaning method is used, cleaning must be conducted at a frequency of 48 kHz or lower, at an vibrator output of 0.02 W/cm<sup>3</sup>, at a temperature of not higher than 40 °C, and for a time of 5 minutes or shorter.

### Notes

- Care must be exercised in cleaning process so that the mounted capacitor will not come into contact with any cleaned object or the like or will not get rubbed by a stiff brush or similar. If such precautions are not taken particularly when the ultrasonic cleaning method is employed, terminal breakage may occur.
- When performing ultrasonic cleaning under conditions other than stated above, conduct adequate advance checkout.



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