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# MLCC – Tantalum Substitution Common Footprints



# MLCC - TANTALUM

## How To Use This Guide:

Many years ago, IPC set a standard of recommended footprints for most classes of surface mount electronic components, including resistors, capacitors and inductors.

Although many companies develop their own internal footprint guidelines, IPC standards for MLCC and tantalum chip are the starting point. At the time they were developed, there was only one common footprint between MLCC & Ta chip – the 1206 size, which is common to both series.

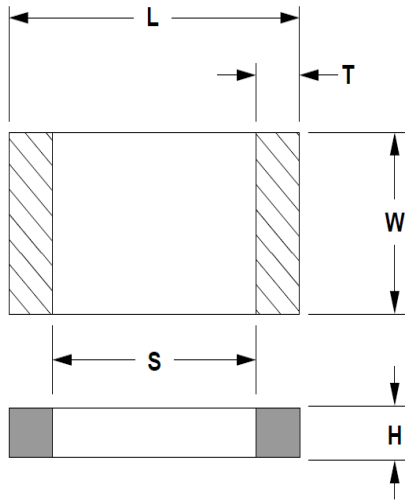
Since that time tantalum chip has added smaller case sizes, designed for compatibility with IPC MLCC footprints. This guide shows, by case size, which tantalum chip series and case sizes fit a common IPC footprint.

As tantalum capacitance / voltage ratings overlap with most Class II ratings (X7R, X5R, X7S etc.), when looking for a substitute first use this guide to establish a footprint compatible tantalum chip series then contact AVX to establish compatible electrical ratings.

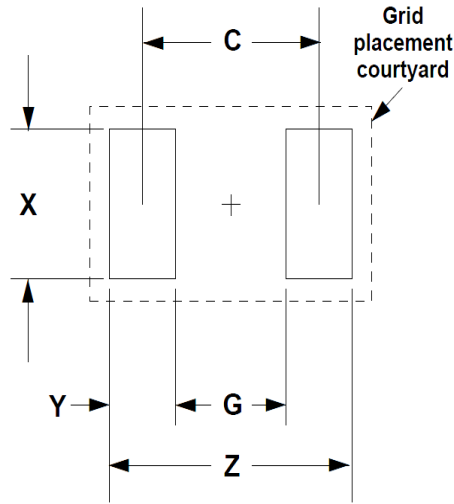
# 0402 | MLCC - TANTALUM

## 0402 MLCC vs Ta / NbO Series Case Sizes

Component: IPC-782-8-2-2



Footprint: IPC-782-8-2-3



Equivalent Footprint Compatibility:

Tantalum Undertab (LGA) Chip:		
Metric	Series	Case
1106-06	F98	U

Polymer Undertab (LGA) Chip:		
Metric	Series	Case
1106-06	F38	U

Microchip:		
Metric	Series	Case
1005-07	TAC	K
1005-07	TLC	K
1005-07	TPC	K

Component Outline:

All dims mm		L		S		W		T		H
Metric	EIA	min	max	min	max	min	max	min	max	max
1005	0402	0.9	1.1	0.3	0.65	0.4	0.6	0.1	0.3	0.6

Footprint:

Metric	EIA	Z (mm)	G (mm)	X (mm)	Y (mm) ref	C (mm) ref	RLP
1005	0402	2.2	0.4	0.7	0.9	1.3	130A

# 0402 | MLCC - TANTALUM

Typical Examples:

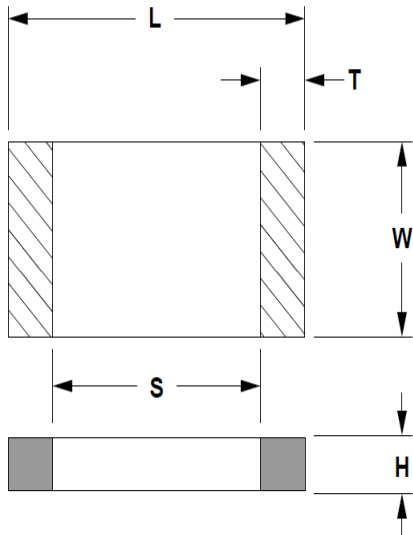
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer
X5R	0.47	4	04024D474MAT2A	F981C474MUA	
X5R	1	4	04024D105MAT2A		F380J105MUA
X5R	2.2	4	04024D225MAT2A	F981A225MUA	
X5R	4.7	4	04024D475MAT2A	F980G475MUA , F980J475MUA	F380J475MUA
X5R	10	4	04024D106MAT2A	F980G106MUA, F980J106MUALZT	
X5R	15	4		F980G226MUALZT	
X5R	22	4	04024D226MAT2A	F980G226MUALZT	
X5R	0.47	6	04026D474MAT2A	F981C474MUA	
X5R	1	6	04026D105MAT2A		F380J105MUA
X5R	2.2	6	04026D225MAT2A	F981A225MUA	
X5R	4.7	6	04026D475MAT2A	F981A475MUALZT, F980J475MUA	F380J475MUA
X5R	10	6	04026D106MAT2A	F980J106MUALZT	
X5R	15	6		F980G226MUALZT	
X5R	22	6	04026D226MAT2A	F980G226MUALZT	
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer
X7R	0.47	6	04026C474MAT2A	F981C474MUA	
X7R	1	6	04026C105MAT2A		F380J105MUA

Do Not Reverse Bias  
MLCC Alternatives

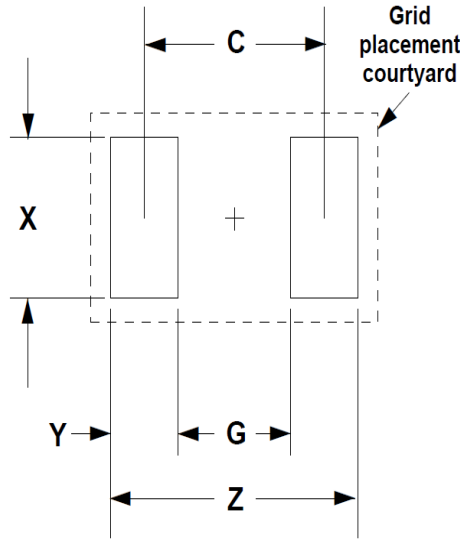
# 0603 | MLCC - TANTALUM

## 0603 MLCC vs Ta / NbO Series Case Sizes

Component: IPC-782-8-2-2



Footprint: IPC-782-8-2-3



Equivalent Footprint Compatibility:

Tantalum Undertab (LGA) Chip:		
Metric	Series	Case
1608-09	F98	M

Polymer Undertab (LGA) Chip:		
Metric	Series	Case
1608-09	F38	M

Microchip:		
Metric	Series	Case
1608-10	TAC	L
1608-08	TAC	J
1608-10	TLC	L
1605-07	TLC	Z
1608-10	TPC	L

Component Outline:

All dims mm		L		S		W		T		H
Metric	EIA	min	max	min	max	min	max	min	max	max
1608	[0603]	1.45	1.75	0.45	0.97	0.65	0.95	0.2	0.5	0.85

Footprint:

Metric	EIA	Z (mm)	G (mm)	X (mm)	Y (mm) ref	C (mm) ref	RLP
1608	[0603]	2.8	0.6	1	1.1	1.7	132A

# 0603 | MLCC - TANTALUM

Typical Examples:

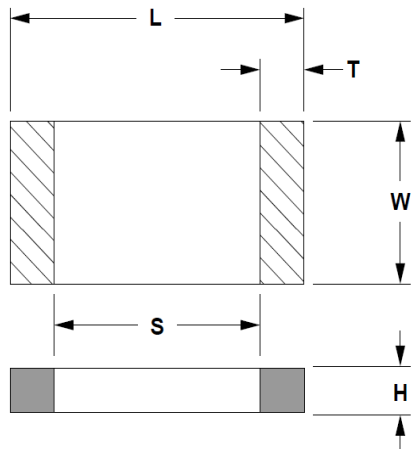
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer
X5R	1	4	06034D105MAT2A	F981C105MMA	
X5R	2.2	4	06034D225MAT2A	F981A225MMA	F381A225MMA
X5R	3.3	4	06034D335MAT2A	↑	↑
X5R	4.7	4	06034D475MAT2A	F980J475MMA	F381A475MMA
X5R	10	4	06034D106MAT2A	F980J106MMA	F380J106MMA
X5R	22	4	06034D226MAT2A	F980G226MMA	F380J226MMA
X5R	47	4	06034D476MAT2A	F980G476MMA	F380J476MMAAXE
X5R	1	6	06036D105MAT2A	F981C105MMA	
X5R	2.2	6	06036D225MAT2A	F981A225MMA	F381A225MMA
X5R	3.3	6	06036D335MAT2A	↑	↑
X5R	4.7	6	06036D475MAT2A	F980J475MMA	F381A475MMA
X5R	10	6	06036D106MAT2A	F980J106MMA	F380J106MMA
X5R	22	6	06036D226MAT2A	F980J226MMA	F380J226MMA
X5R	47	6	06036D476MAT2A	F980J476MMA	F380J476MMAAXE
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer
X7R	0.47	6	06036C474MAT2A	↑	
X7R	1	6	06036C105MAT2A	F981C105MMA	
X7R	2.2	6	06036C225MAT2A	F981A225MMA	F381A225MMA

Do Not Reverse Bias  
MLCC Alternatives

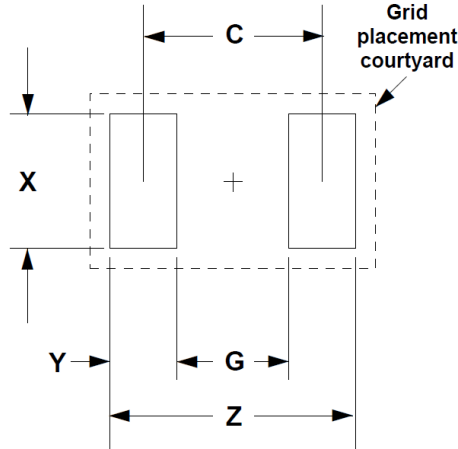
# 0805 | MLCC - TANTALUM

## 0805 MLCC vs Ta / NbO Series Case Sizes

Component: IPC-782-8-2-2



Footprint: IPC-782-8-2-3



### Equivalent Footprint Compatibility:

Tantalum Chip:		
Metric	Series	Case
2012-15	TAJ	P
2012-12	TAJ	R
2012-12	F92	P
2012-15	TLJ	P
2012-12	TLJ	R
2012-15	TPS	P
2012-12	TPS	R

Niobium Oxide (OxiCap):		
Metric	Series	Case
2012-15	NOJ	P
2012-15	NLJ	P

Conductive Polymer:		
Metric	Series	Case
2012-15	TCJ	P
2012-12	TCJ	R
2012-10	TCJ	N

### Component Outline:

All dims mm		L		S		W		T		H
Metric	EIA	min	max	min	max	min	max	min	max	max
2012	[0805]	1.8	2.2	0.3	1.11	1.05	1.45	0.25	0.75	1.1

### Footprint:

Metric	EIA	Z (mm)	G (mm)	X (mm)	Y (mm) ref	C (mm) ref	RLP
2012	[0805]	3.2	0.6	1.5	1.3	1.9	133A

Microchip:		
Metric	Series	Case
2012-15	TAC	R
2012-10	TAC	H
2012-06	TAC	U
2012-15	TLC	R
2012-10	TLC	H
2012-06	TLC	U
2012-15	TPC	R
2012-10	TPC	H

Tantalum Undertab (LGA) Chip:		
Metric	Series	Case
2012-09	TLN	M
2012-10	TLN	N
2012-09	F98	S
2012-09	F98-AS1	S

Conformal Tantalum Chip:		
Metric	Series	Case
2212-12	F95	P
2212-065	F95	R

Polymer Undertab (LGA) Chip:		
Metric	Series	Case
2012-09	F38	S
2012-10	TCN	N
2012-09	TCN	M

# 0805 | MLCC - TANTALUM

Typical Examples:

T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer	Niobium Oxide (Oxicap™)
X5R	4.7	4	08054D475MAT2A	TAJR475M004RNJ, F921A475MAA		NOJP475M006R
X5R	10	4	08054D106MAT2A	TAJR106M004RNJ, F921A106MPA, TPSP106M010R2000		NOJP106M004R
X5R	22	4	08054D226MAT2A	TAJR226M004RNJ, F920J226MPA	F380J226MSA	
X5R	47	4	08054D476MAT2A	F980J476MSA		
X5R	100	4	08054D107MAT2A	F980J107MSA		
X5R	4.7	6	08056D475MAT2A	F921A475MAA		NOJP475M006R
X5R	10	6	08056D106MAT2A	F981C106MSA, F921A106MPA, TPSP106M010R2000		NOJP106R006R
X5R	22	6	08056D226MAT2A	TAJP226M006RNJ, F981A226MSA	F380J226MSA	
X5R	47	6	08056D476MAT2A	F981A476MSA		
X5R	100	6	08056D107MAT2A	F980J107MSA		
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer	Niobium Oxide (Oxicap™)
X7R	10	6	08056C106MAT2A	TAJR106M006RNJ, F921A106MPA, F981C106MSA		NOJP106R006R
X7R	1	10	0805ZC105MAT2A	TAJR105M016RNJ		
X7R	2.2	10	0805ZC225MAT2A	TAJR225M016RNJ		
X7R	4.7	10	0805ZC475MAT2A	F921A475MAA		

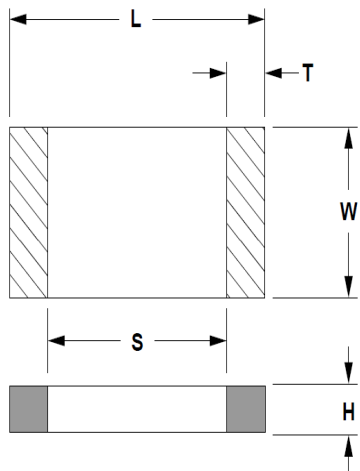
Do Not Reverse Bias  
MLCC Alternatives



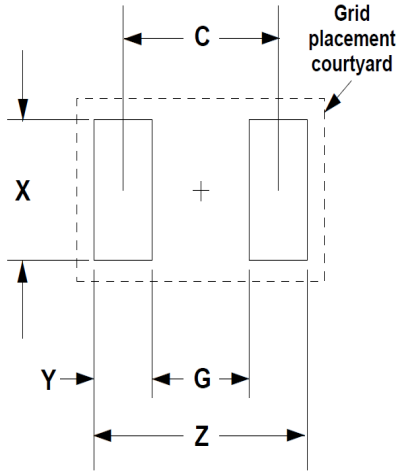
# 1206 | MLCC - TANTALUM

## 1206 MLCC vs Ta / NbO Series Case Sizes

Component: IPC-782-8-2-2



Footprint: IPC-782-8-2-3



Equivalent Footprint Compatibility:

Component Outline:

All dims mm		L		S		W		T		H
Metric	EIA	min	max	min	max	min	max	min	max	max
3216	[1206]	3	3.4	1.5	2.31	1.4	1.8	0.25	0.75	1.35

Footprint:

Metric	EIA	Z (mm)	G (mm)	X (mm)	Y (mm) ref	C (mm) ref	RLP
3216	[1206]	4.4	1.2	1.8	1.6	2.8	134A

Tantalum Chip:

Metric	Series	Case
3216-18	TAJ	A
3216-12	TAJ	S
3216-10	TAJ	K
3216-18	TAJ Auto	A
3216-12	F92	A
3216-18	F93	A
3216-18	F93-BE	A
3216-18	F93-AJ6	A
3216-18	TLJ	A
3216-15	TLJ	G
3216-12	TLJ	S
3216-10	TLJ	K
3216-18	TPS	A
3216-12	TPS	S
3216-18	TPS Auto	A
3216-18	F91-AJ6	A
3216-18	TRJ	A
3216-18	F97	A
3216-18	F97-HT3	A
3216-18	F97-HT5	A
3216-18	TMJ	A
3216-18	THJ	A

Conductive Polymer:

Metric	Series	Case
3216-18	TCJ	A
3216-15	TCJ	G
3216-12	TCJ	S
3216-10	TCJ	K

Tantalum Undertab (LGA) Chip:

Metric	Series	Case
3216-12	TLN	S
3216-10	TLN	K

Polymer Undertab (LGA) Chip:

Metric	Series	Case
3216-12	TCN	S
3216-10	TCN	K
3216-06	TCN	O

Microchip:

Metric	Series	Case
3216-18	TAC	A
3216-08	TAC	V
3216-05	TAC	I
3216-08	TLC	V
3216-06	TLC	D

Conformal Tantalum Chip:

Metric	Series	Case
3217-16	F95	A
3216-12	F95	S
3216-10	F95	Q

Niobium Oxide (OxiCap):

Metric	Series	Case
3216-18	NOJ	A
3216-12	NOJ	S
3216-18	NLJ	A
3216-12	NLJ	S
3216-18	NOS	A

# 1206 | MLCC - TANTALUM

Typical Examples:

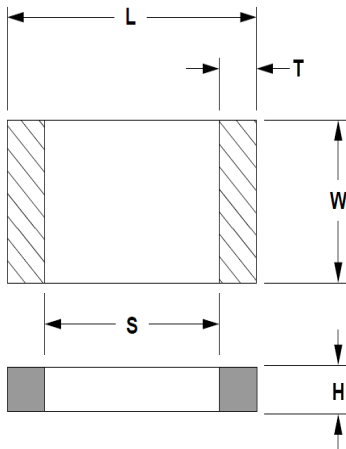
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer	Niobium Oxide (Oxicap™)
X5R	4.7	4	12064D475MAT2A	TAJA475M010RNJ, F931A475MAA		
X5R	10	4	12064D106MAT2A	TAJA106M006RNJ, F930J106MAA, F921C106MAA	TCJA106M006R0300	NOJA106M006R
X5R	22	4	12064D226MAT2A	TAJA226M004RNJ, F930G226MAA, F921A226MAA	TCJ226M004R0300	NOJA226M004R
X5R	47	4	12064D476MAT2A	TAJA476M004RNJ, F930G476MAA	TCJA476M004R0200	NOJA476M006R
X5R	100	4	12064D107MAT2A	TAJA107M004RNJ, F930G107MAA	TCJA106M004R0200	
X5R	3.3	6	12066D335MAT2A	TAJA335M016RNJ, F931C335MAA		
X5R	4.7	6	12066D475MAT2A	TAJA475M010RNJ, F931A475MAA		NOJA475M006R
X5R	10	6	12066D106MAT2A	TAJA106M006RNJ, F930J106MAA, F921C106MAA	TCJA106M006R0300	NOJA106M006R
X5R	22	6	12066D226MAT2A	TAJA226M006RNJ, F930J226MAA, F921A226MAA	TCJA226M006R0300	NOJA226M006R
X5R	47	6	12066D476MAT2A	TAJA476M006RNJ, F930J476MAA	TCJA476M006R0100	
X5R	100	6	12066D107MAT2A	F930J107MAA	TCJA107M006R0100	
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer	Niobium Oxide (Oxicap™)
X7R	22	6	12066C226MAT2A	TAJA226M006RNJ, TPSA225M016R3500, F930J226MAA	TCJA226M006R0300	NOJA226M006R
X7R	1	10	1206ZC105MAT2A	TAJA1055M016RNJ, F931C105MAA		
X7R	2.2	10	1206ZC225MAT2A	TAJA225M016RNJ, TPSA225M016R3500, F931C225MAA		
X7R	4.7	10	12066Z475MAT2A	TAJA475M010RNJ, TPSA475M016R2000, F931A475MAA		NOJA475M006R
X7R	10	10	1206ZC106MAT2A	TAJA106M006RNJ, TPSA106M016R1000, F930J106MAA	TCJA106M006R0300	NOJA106M006R

Do Not Reverse Bias  
MLCC Alternatives

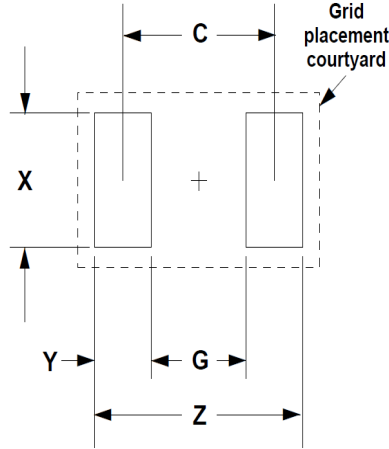
# 1210 | MLCC - TANTALUM

## 1210 MLCC vs Ta / NbO Series Case Sizes

Component: IPC-782-8-2-2



Footprint: IPC-782-8-2-3



Component Outline:

All dims mm		L		S		W		T		H
Metric	EIA	min	max	min	max	min	max	min	max	max
3225	[1210]	3	3.4	1.5	2.31	2.3	2.7	0.25	0.75	1.35

**NOTE:** All equivalent Ta / NbO 3528 case size alternatives listed are 0.2mm - 0.3mm longer than IPC 1210 component length dimension for MLCC; but all fit within the envelope for IPC 1210 (RLP 135A) footprint recommendation below:

Footprint:

Metric	EIA	Z (mm)	G (mm)	X (mm)	Y (mm) ref	C (mm) ref	RLP
3225	[1210]	4.4	1.2	2.7	1.6	2.8	135A

Equivalent Footprint Compatibility:

Tantalum Chip:		
Metric	Series	Case
3528-21	TAJ	B
3528-15	TAJ	H
3528-12	TAJ	T
3528-21	TAJ Auto	B
3428-12	F92	B
3528-21	F93	B
3528-21	F93-BE	B
3528-21	F93-AJ6	B
3528-21	TLJ	B
3528-15	TLJ	H
3528-12	TLJ	T
3528-21	TPS	B
3528-12	TPS	T
3528-21	TPS Auto	B
3528-21	F91	B
3528-21	F91-AJ6	B
3528-21	TRJ	B
3528-21	F97	B
3528-21	F97-HT3	B
3528-21	F97-HT5	B
3528-21	TMJ	B
3528-21	THJ	B
3528-21	THJ-200	B

Conductive Polymer:		
Metric	Series	Case
3528-21	TCJ	B
3528-15	TCJ	H
3528-12	TCJ	T
3528-21	TCQ	B
3528-21	TCR	B

Conformal Tantalum Chip:		
Metric	Series	Case
3528-20	F95	B
3527-12	F95	T
3528-20	Audio F95	B

Niobium Oxide (OxiCap):		
Metric	Series	Case
3528-20	NOJ	B
3527-12	NOJ	T
3528-20	NLJ	B
3527-12	NLJ	T
3528-20	NOS	B
3527-12	NOS	T

Microchip:		
Metric	Series	Case
3528-15	TAC	B
3528-12	TAC	T
3528-12	TLC	T

# 1210 | MLCC - TANTALUM

Typical Examples:

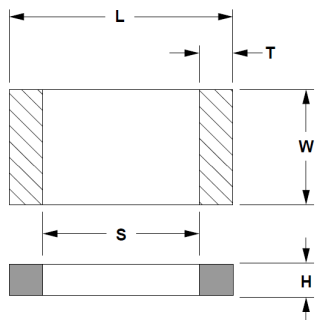
T.C	Cap (uF)	Voltage (V)	MLCC	Tantalum	Conductive Polymer	Niobium Oxide (Oxicap™)
X5R	4.7	4	12104D475MAT2A	TAJB475M016RNJ, TPSB475M016R0800, F931D475MBA	TCJB475M025R0150	
X5R	22	4	12104D226MAT2A	TAJB226M010RNJ, TPSB226M016R0400, F931A226MBA	TCJB226M010R0300	NOJB226M004R
X5R	47	4	12104D476MAT2A	TAJB476M010RNJ, F920G476MBA	TCJB476M010R0070	NOJB476M004R
X5R	100	4	12104D107MAT2A	TAJB107M010RNJ, TPSB107M006R0400, F930J107MBA	TCJB107M006R0040	NOJB107M004R
X5R	1	6	12106D105MAT2A	TAJB105M035RNJ	TCJB105M050R0300	
X5R	4.7	6	12106D475MAT2A	TAJB475M016RNJ, TPSB475M016R0800, F931D475MBA	TCJB475M025R0150	
X5R	10	6	12106D106MAT2A	TAJB106M016RNJ, F931C106MBA	TCJB106M016R0100	NOJB106M010R
X5R	22	6	12106D226MAT2A	TAJB226M010RNJ, TPSB226M016R0400, F931A226MBA	TCJB226M016R0150	NOJB226M006R
X5R	47	6	12106D476MAT2A	TAJB476M010RNJ, F930J476MBA	TCJB476M010R0070	NOJB476M006R
X5R	100	6	12106D107MAT2A	TAJB107M010RNJ, TPSB107M006R0400, F930J107MBA	TCJB107M006R0040	NOJB107M006R

Do Not Reverse Bias  
MLCC Alternatives

# APPENDIX | MLCC - TANTALUM

## APPENDIX: IPC MLCC Recommendations

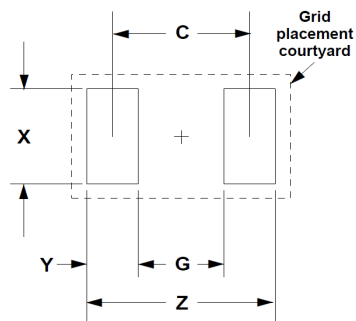
**3.3.3.4 Land Pattern Registration** Each land pattern has received a registration number. The RLP (Registered Land Pattern) number is a three digit number with a set of numbers assigned to land patterns for a particular family of components. The original number assigned to a particular component, uses that analysis shown for the specific section (sections 8 through 16). The analyses assume certain tolerances for board fabrication, placement machine accuracy and minimum desired solder joint. Changes in the assumptions will result in a revision letter to the number. Thus the first change to RLP 106 would be identified as RLP 106A, the second change would be RLP 106B etc. The letters x, y & z are reserved for user modifications to the standard land pattern. If a company wishes to change the approved standard land pattern the user would identify his customized version as RLP 106X, RLP 106Y or RLP 106Z. It should be recognized that X, Y & Z type RLP's reflect unique land patterns and will differ company to company.



Component:

Metric	EIA	L		S		W		T		H
		min	max	min	max	min	max	min	max	max
1005	[0402]	0.9	1.1	0.3	0.65	0.4	0.6	0.1	0.3	0.6
1310	[0504]	1.02	1.32	0.26	0.72	0.77	1.27	0.13	0.38	1.02
1608	[0603]	1.45	1.75	0.45	0.97	0.65	0.95	0.2	0.5	0.85
2012	[0805]	1.8	2.2	0.3	1.11	1.05	1.45	0.25	0.75	1.1
3216	[1206]	3.0	3.4	1.5	2.31	1.4	1.8	0.25	0.75	1.35
3225	[1210]	3.0	3.4	1.5	2.31	2.3	2.7	0.25	0.75	1.35
4532	[1812]	4.2	4.8	2.3	3.46	3.0	3.4	0.25	0.95	1.35
4564	[1825]	4.2	4.8	2.3	3.46	6.0	6.8	0.25	0.95	1.1

Footprint:



Metric	EIA	Z (mm)	G (mm)	X (mm)	Y (mm) ref	C (mm) ref	RLP*
1005	[0402]	2.2	0.4	0.7	0.9	1.3	130A
1310	[0504]	2.4	0.4	1.3	1.0	1.4	131A
1608	[0603]	2.8	0.6	1.0	1.1	1.7	132A
2012	[0805]	3.2	0.6	1.5	1.3	1.9	133A
3216	[1206]	4.4	1.2	1.8	1.6	2.8	134A
3225	[1210]	4.4	1.2	2.7	1.6	2.8	135A
4532	[1812]	5.8	2.0	3.4	1.9	3.9	136A
4564	[1825]	5.8	2.0	6.8	1.9	3.9	137A

\* RLP = IPC Registered Land Pattern Number

# Specification Comparison – 1210 Equivalent

Attributes	MLCC		Standard Ta Chip		Polymer Ta Chip		NbO Chip OxiCap®	
	Commercial	AEC-Q200	Commercial	AEC-Q200	Commercial	AEC-Q200	Commercial	AEC-Q200
Max Capacitance 1210	100uF	10uF	150uF	100uF	220uF	47uF	47uF	47uF
Voltage Range 1210	4v - 50v	16v - 100v	4v - 50v	4v - 50v	4v - 50v	4v - 50v	4v - 10v	4v - 10v
Typical ESR 1210	7 - 15mOhms	10 - 40mOhms	300 - 800mOhms	300 - 800mOhms	30 - 200mOhms	70 - 250mOhms	300 - 600mOhms	300 - 600mOhms
Temperature Range	-55°C - +85°C	-55°C - +125 / +150°C	-55°C - +125°C	-55°C - +125 / +200°C	-55°C - +105 / +125°C	-55°C - +125°C	-55°C - +105°C	-55°C - +125°C
Base Reliability	1% / 1000hrs	1% / 1000hrs	1% / 1000hrs	(0.05 - 1%) / 1000hrs	1% / 1000hrs	1% / 1000hrs	0.02 - 0.05% / 1000hrs	0.02 - 0.05% / 1000hrs
Primary Failure Mode	Short	Short	Short	Short	Short	Short	Resistive	Resistive
Lifetime (10% Cap loss @ Tmax / Vmax)	Indefinite	Indefinite	Indefinite	Indefinite	10,000hrs	10,000hrs	Indefinite	Indefinite
Recommended Voltage Derating	20%	20%	50%	50%	20%	20%	20%	20%
<b>Disadvantages</b>	<b>Commercial</b>	<b>AEC-Q200</b>	<b>Commercial</b>	<b>AEC-Q200</b>	<b>Commercial</b>	<b>AEC-Q200</b>	<b>Commercial</b>	<b>AEC-Q200</b>
Voltage Coefficient	Cap Loss vs V	Cap Loss vs V						
Piezo Noise	@ Audio Frequencies	@ Audio Frequencies						
Reverse Voltage			Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed



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**THANK YOU**

