T222 Series Axial MIL–PRF–39003 Polar Miniature (CSR09 Style)

Overview

The KEMET ultra-miniature T222 Series solid tantalum capacitors are especially designed for miniaturization and employ a unique glass-to-metal compression end seal which has no protruding eyelet. This flush end seal construction ideally suits the T222 Series for all miniature high density packaging applications. The capacitors consist of a dry porous tantalum pellet hermetically sealed in a solder coated metal case with solder coated alloy 52 and solder coated nickel. The T222 series is approved to all ratings and failure rates of MIL–PRF–39003/2.

Benefits

- Taped and reeled per EIA Specification RS–296
- Marking per MIL–STD–1285
- Qualified to MIL–PRF–39003 (CSR09 Style)
- Failure rate options: Graded - B, C, D, and G
  Exponential – M, P, R, and S*
- Capacitance values of 0.047 µF to 18 µF
- Tolerances of ± 5%, and ±10%
- Voltage rating of 6 – 75 VDC
- Operating temperature range of −55˚C to +125˚C
- Case sizes: A and B

**Failure rates apply to military products only*

Applications

KEMET ultra-miniature T222 Series solid tantalum capacitors are especially designed for miniaturization.

© KEMET Electronics Corporation • One East Broward Boulevard
Fort Lauderdale, FL 33301 USA • 954-766-2800 • www.kemet.com

Ordering Information

T	222	A	225	K	010	B	S	C
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Failure Rate/Military Product Only	Termination Finish	Specification
T = Tantalum	T222 (CSR09)	A B	First two digits represent significant figures. Third digit specifies number of zeros.	J = ±5% K = ±10%	006 = 6 010 = 10 015 = 15 020 = 20 035 = 35 050 = 50 075 = 75	Graded: B = 0.1%/k hours C = 0.01%/k hours D = 0.001%/k hours G = 1.0%/k hours Exponential: M = 1%/k hours P = 0.1%/k hours R = 0.01%/k hours S = 0.001%/k hours	S = Standard Positive: Alloy 52 (solder-coated) Negative: Solder-coated nickel	Blank = Bulk/Sleeved 7200 = Tape & Reel 7293 & 7443 = Ammo All capacitors are sleeved unless specified.

Ordering Information – T222 (CSR09 Style)

MIL product

M39003	/02	2061	D
Capacitor Class	Slash	Dash Number	Surge Option
Military specification number	Specification sheet number	Failure rate level	D = C-4250 E = C-4251 F = C-4252 H = No C-Spec

Orders should be entered by the military specification number, including the dash number and surge option letter (D, E, F, or H).

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	−55°C to 125°C
Rated Capacitance Range	0.047 – 18 µF at 120 Hz/25°C
Capacitance Tolerance	J Tolerance (5%), K Tolerance (10%)
Rated Voltage Range	6 – 75 V
DF (120 Hz at 25°C)	Refer to Part Number Electrical Specification Table
ESR and Impedance (100 kHz at 25°C)	Refer to Part Number Electrical Specification Table (for reference only)
Leakage Current	Refer to Part Number Electrical Specification Table (at rated voltage up to +85°C and 2/3 of rated voltage applied at 125°C)
Failure Rate (MIL–39003, CSR13 capacitors only)	Approved failure rate: S (0.001%/k hours) – Exponential, D (0.001%/k hours) – Graded

Dimensions – Inches (Millimeters)

Case Size	Uninsulated		Insulated		B Wire Diameter
	D ±0.005 (±0.13)	L	D	L	
A	0.085 (2.16)	0.245+0.015/−0.010 (6.22+0.38/−0.25)	0.090±0.009 (2.29±0.23)	0.250+0.031/−0.015 (6.35+0.79/−0.38)	0.016+0.005/−0.001 (0.41+0.13/−0.03)
B	0.127 (3.23)	0.375±0.015 (9.53±0.38)	0.138±0.010 (3.51±0.25)	0.390±0.015 (9.91±0.38)	0.016+0.005/−0.001 (0.41+0.13/−0.03)

Table 1 – Ratings & Part Number Reference

Rated Voltage	Rated Cap	Case Size Code	KEMET Part Number	DC Leakage	DF % at 25°C	MIL–PRF–39003 (CSR09) Capacitors							
						Dash Number Reference							
						Failure Rate Level (%/1,000 Hours)							
						MIL–PRF–39003/2J				MIL–PRF–39003/2J			
						Exponential				Graded			
(V) 85°C	µF		(See below for part options)	µA at 25°C Max/5 Minutes	120 Hz Maximum	M (1.0)	P (0.1)	R (0.01)	S (0.001)	G (1)	B (0.1)	C (0.01)	D (0.001)
6	2.7	A	T222A275J006(1)S	0.6	6	1001	1061	1121	1181	5001	2001	3001	4001
6	2.7	A	T222A275K006(1)S	0.6	6	0001	0061	0121	0181	5002	2002	3002	4002
6	18.0	B	T222B186J006(1)S	1.4	6	1002	1062	1122	1182	5003	2003	3003	4003
6	18.0	B	T222B186K006(1)S	1.4	6	0002	0062	0122	0182	5004	2004	3004	4004
10	1.8	A	T222A185J010(1)S	0.6	6	1007	1067	1127	1187	5005	2005	3005	4005
10	1.8	A	T222A185K010(1)S	0.6	6	0007	0067	0127	0187	5006	2006	3006	4006
10	2.2	A	T222A225J010(1)S	0.6	6	1008	1068	1128	1188	5007	2007	3007	4007
10	2.2	A	T222A225K010(1)S	0.6	6	0008	0068	0128	0188	5008	2008	3008	4008
10	10.0	B	T222B106J010(1)S	2.0	6	1009	1069	1129	1189	5009	2009	3009	4009
10	10.0	B	T222B106K010(1)S	2.0	6	0009	0069	0129	0189	5010	2010	3010	4010
10	12.0	B	T222B126J010(1)S	2.0	6	1010	1070	1130	1190	5011	2011	3011	4011
10	12.0	B	T222B126K010(1)S	2.0	6	0010	0070	0130	0190	5012	2012	3012	4012
10	15.0	B	T222B156J010(1)S	2.0	6	1011	1071	1131	1191	5013	2013	3013	4013
10	15.0	B	T222B156K010(1)S	2.0	6	0011	0071	0131	0191	5014	2014	3014	4014
15	1.0	A	T222A105J015(1)S	0.6	6	1012	1072	1132	1192	5015	2015	3015	4015
15	1.0	A	T222A105K015(1)S	0.6	6	0012	0072	0132	0192	5016	2016	3016	4016
15	1.2	A	T222A125J015(1)S	0.6	6	1013	1073	1133	1193	5017	2017	3017	4017
15	1.2	A	T222A125K015(1)S	0.6	6	0013	0073	0133	0193	5018	2018	3018	4018
15	1.5	A	T222A155J015(1)S	0.6	6	1014	1074	1134	1194	5019	2019	3019	4019
15	1.5	A	T222A155K015(1)S	0.6	6	0014	0074	0134	0194	5020	2020	3020	4020
15	8.2	B	T222B825J015(1)S	1.8	6	1015	1075	1135	1195	5021	2021	3021	4021
15	8.2	B	T222B825K075(1)S	1.8	6	0015	0075	0135	0195	5022	2022	3022	4022
20	0.56	A	T222A564J020(1)S	0.6	3	1016	1076	1136	1196	5023	2023	3023	4023
20	0.56	A	T222A564K020(1)S	0.6	3	0016	0076	0136	0196	5024	2024	3024	4024
20	0.68	A	T222A684J020(1)S	0.6	3	1017	1077	1137	1197	5025	2025	3025	4025
20	0.68	A	T222A684K020(1)S	0.6	3	0017	0077	0137	0197	5026	2026	3026	4026
20	0.82	A	T222A824J020(1)S	0.6	3	1018	1078	1138	1198	5027	2027	3027	4027
20	0.82	A	T222A824K020(1)S	0.6	3	0018	0078	0138	0198	5028	2028	3028	4028
20	1.0	A	T222A105J020(1)S	0.6	3	1019	1079	1139	1199	5029	2029	3029	4029
20	1.0	A	T222A105K020(1)S	0.6	3	0019	0079	0139	0199	5030	2030	3030	4030
20	3.3	B	T222B335J020(1)S	1.0	3	1020	1080	1140	1200	5031	2031	3031	4031
20	3.3	B	T222B335K020(1)S	1.0	3	0020	0080	0140	0200	5032	2032	3032	4032
20	3.9	B	T222B395J020(1)S	2.0	3	1021	1081	1141	1201	5033	2033	3033	4033
20	3.9	B	T222B395K020(1)S	2.0	3	0021	0081	0141	0201	5034	2034	3034	4034
20	4.7	B	T222B475J020(1)S	2.0	3	1022	1082	1142	1202	5035	2035	3035	4035
20	4.7	B	T222B475K020(1)S	2.0	3	0022	0082	0142	0202	5036	2036	3036	4036
20	5.6	B	T222B565J020(1)S	2.0	3	1023	1083	1143	1203	5037	2037	3037	4037
20	5.6	B	T222B565K020(1)S	2.0	3	0023	0083	0143	0203	5038	2038	3038	4038
20	6.8	B	T222B685J020(1)S	2.0	3	1024	1084	1144	1204	5039	2039	3039	4039
20	6.8	B	T222B685K020(1)S	2.0	3	0024	0084	0144	0204	5040	2040	3040	4040
35	0.33	A	T222A334J035(1)S	0.6	3	1025	1085	1145	1205	5041	2041	3041	4041
35	0.33	A	T222A334K035(1)S	0.6	3	0025	0085	0145	0205	5042	2042	3042	4042
35	0.39	A	T222A394J035(1)S	0.6	3	1026	1086	1146	1206	5043	2043	3043	4043
35	0.39	A	T222A394K035(1)S	0.6	3	0026	0086	0146	0206	5044	2044	3044	4044
35	0.47	A	T222A474J035(1)S	0.6	3	1027	1087	1147	1207	5045	2045	3045	4045
35	0.47	A	T222A474K035(1)S	0.6	3	0027	0087	0147	0207	5046	2046	3046	4046
35	2.2	B	T222B225J035(1)S	1.4	3	1028	1088	1148	1208	5047	2047	3047	4047
35	2.2	B	T222B225K035(1)S	1.4	3	0028	0088	0148	0208	5048	2048	3048	4048
(V) 85°C	µF	Case Size Code	(See below for part options)	µA at 25°C Max/5 Minutes	120 Hz Maximum	M (1.0)	P (0.1)	R (0.01)	S (0.001)	G (1)	B (0.1)	C (0.01)	D (0.001)
Rated Voltage	Rated Cap		KEMET Part Number	DC Leakage	DF % at 25°C	MIL–PRF–39003 (CSR09) Capacitors							

(1) To complete KEMET Part Number (T222), insert Graded failure rate - A for Not Applicable, B for 0.1%/k hours, C for 0.01%/k hours , D for 0.001%/k hours or G for 1%/k hours. Designates Reliability Level.

(2) To complete KEMET Part Number (T222), insert Exponential failure rate - M for 1%/k hours, P for 0.1%/k hours, R for 0.01%/k hours, or S for 0.001%/k hours. Designates reliability level.

Table 1 – Ratings & Part Number Reference cont.

Rated Voltage	Rated Cap	Case Size Code	KEMET Part Number	DC Leakage	DF % at 25°C	MIL–PRF–39003 (CSR09) Capacitors							
						Dash Number Reference							
						Failure Rate Level (%/1,000 Hours)							
						MIL–PRF–39003/2J				MIL–PRF–39003/2J			
						Exponential				Graded			
(V) 85°C	µF		(See below for part options)	µA at 25°C Max/5 Minutes	120 Hz Maximum	M (1.0)	P (0.1)	R (0.01)	S (0.001)	G (1)	B (0.1)	C (0.01)	D (0.001)
35	2.7	B	T222B275J035(1)S	1.4	3	1029	1089	1149	1209	5049	2049	3049	4049
35	2.7	B	T222B275K035(1)S	1.4	3	0029	0089	0149	0209	5050	2050	3050	4050
50	0.22	A	T222A224J050(1)S	0.6	3	1030	1090	1150	1210	5051	2051	3051	4051
50	0.22	A	T222A224K050(1)S	0.6	3	0030	0090	0150	0210	5052	2052	3052	4052
50	0.27	A	T222A274J050(1)S	0.6	3	1031	1091	1151	1211	5053	2053	3053	4053
50	0.27	A	T222A274K050(1)S	0.6	3	0031	0091	0151	0211	5054	2054	3054	4054
50	1.5	B	T222B155J050(1)S	1.4	3	1032	1092	1152	1212	5055	2055	3055	4055
50	1.5	B	T222B155K050(1)S	1.4	3	0032	0092	0152	0212	5056	2056	3056	4056
50	1.8	B	T222B185J050(1)S	1.4	3	1033	1093	1153	1213	5057	2057	3057	4057
50	1.8	B	T222B185K050(1)S	1.4	3	0033	0093	0153	0213	5058	2058	3058	4058
75	0.047	A	T222A473J075(1)S	0.6	3	1034	1094	1154	1214	5059	2059	3059	4059
75	0.047	A	T222A473K075(1)S	0.6	3	0034	0094	0154	0214	5060	2060	3060	4060
75	0.056	A	T222A563J075(1)S	0.6	3	1035	1095	1155	1215	5061	2061	3061	4061
75	0.056	A	T222A563K075(1)S	0.6	3	0035	0095	0155	0215	5062	2062	3062	4062
75	0.068	A	T222A683J075(1)S	0.6	3	1036	1096	1156	1216	5063	2063	3063	4063
75	0.068	A	T222A683K075(1)S	0.6	3	0036	0096	0156	0216	5064	2064	3064	4064
75	0.082	A	T222A823J075(1)S	1.8	3	1037	1097	1157	1217	5065	2065	3065	4065
75	0.082	A	T222A823K075(1)S	1.8	3	0037	0097	0157	0217	5066	2066	3066	4066
75	0.10	A	T222A104J075(1)S	0.6	3	1038	1098	1158	1218	5067	2067	3067	4067
75	0.10	A	T222A104K075(1)S	0.6	3	0038	0098	0158	0218	5068	2068	3068	4068
75	0.12	A	T222A124J075(1)S	0.6	3	1039	1099	1159	1219	5069	2069	3069	4069
75	0.12	A	T222A124K075(1)S	0.6	3	0039	0099	0159	0219	5070	2070	3070	7070
75	0.15	A	T222A154J075(1)S	0.6	3	1040	1100	1160	1220	5071	2071	3071	4071
75	0.15	A	T222A154K075(1)S	0.6	3	0040	0100	0160	0220	5072	2072	3072	4072
75	0.18	A	T222A184J075(1)S	0.6	3	1041	1101	1161	1221	5073	2073	3073	4073
75	0.18	A	T222A184K075(1)S	0.6	3	0041	0101	0161	0221	5074	2074	3074	4074
75	0.22	B	T222B224J075(1)S	1.0	3	1042	1102	1162	1222	5075	2075	3075	4075
75	0.22	B	T222B224K075(1)S	1.0	3	0042	0102	0162	0222	5076	2076	3076	4076
75	0.27	B	T222B274J075(1)S	2.0	3	1043	1103	1163	1223	5077	2077	3077	4077
75	0.27	B	T222B274K075(1)S	2.0	3	0043	0103	0163	0223	5078	2078	3078	4078
75	0.33	B	T222B334J075(1)S	2.0	3	1044	1104	1164	1224	5079	2079	3079	4079
75	0.33	B	T222B334K075(1)S	2.0	3	0044	0104	0164	0224	5080	2080	3080	4080
75	0.39	B	T222B394J075(1)S	2.0	3	1045	1105	1165	1225	5081	2081	3081	4081
75	0.39	B	T222B394K075(1)S	2.0	3	0045	0105	0165	0225	5082	2082	3082	4082
75	0.47	B	T222B474J075(1)S	2.0	3	1046	1106	1166	1226	5083	2083	3083	4083
75	0.47	B	T222B474K075(1)S	2.0	3	0046	0106	0166	0226	5084	2084	3084	4084
75	0.56	B	T222B564J075(1)S	0.6	3	1047	1107	1167	1227	5085	2085	3085	4085
75	0.56	B	T222B564K075(1)S	0.6	3	0047	0107	0167	0227	5086	2086	3086	4086
75	0.68	B	T222B684J075(1)S	0.6	3	1048	1108	1168	1228	5087	2087	3087	4087
75	0.68	B	T222B684K075(1)S	0.6	3	0048	0108	0168	0228	5088	2088	3088	4088
75	0.82	B	T222B824J075(1)S	0.6	3	1049	1109	1169	1229	5089	2089	3089	4089
75	0.82	B	T222B824K075(1)S	0.6	3	0049	0109	0169	0229	5090	2090	3090	4090
75	1.0	B	T222B105J075(1)S	1.4	3	1050	1110	1170	1230	5091	2091	3091	4091
75	1.0	B	T222B105K075(1)S	1.4	3	0050	0110	0170	0230	5092	2092	3092	4092
75	1.2	B	T222B125J075(1)S	1.4	3	1051	1111	1171	1231	5093	2093	3093	4093
75	1.2	B	T222B125K075(1)S	1.4	3	0051	0111	0171	0231	5094	2094	3094	4094
(V) 85°C	µF	Case Size Code	(See below for part options)	µA at 25°C Max/5 Minutes	120 Hz Maximum	M (1.0)	P (0.1)	R (0.01)	S (0.001)	G (1)	B (0.1)	C (0.01)	D (0.001)
Rated Voltage	Rated Cap		KEMET Part Number	DC Leakage	DF % at 25°C	MIL–PRF–39003 (CSR09) Capacitors							

(1) To complete KEMET Part Number (T222), insert Graded failure rate - A for Not Applicable, B for 0.1%/k hours, C for 0.01%/k hours , D for 0.001%/k hours or G for 1%/k hours. Designates Reliability Level.
(2) To complete KEMET Part Number (T222), insert Exponential failure rate - M for 1%/k hours, P for 0.1%/k hours, R for 0.01%/k hours, or S for 0.001%/k hours. Designates reliability level.

Ripple Current/Ripple Voltage

Permissible AC ripple voltage is related to the ESR of the capacitor and the power dissipation capabilities of a particular case size.
Thermal capacities for the various case sizes have been determined empirically and are listed below.

Temperature Compensation Multipliers for Maximum Power Dissipation		
T ≤ 25°C	T ≤ 85°C	T ≤ 125°C
1.00	0.90	0.40

T= Environmental Temperature

Permissible AC ripple current can be determined by the following:

$I(max) = Z \sqrt{P\ max/R}$

P max = maximum watts
R = ESR at specified frequency (ohms)
I = rms ripple current (amperes)
Z = capacitor impedance in ohms at the specified frequency

Case Size	Maximum Power Dissipation (P max)	T2XX
A	0.09	0.070
B	0.100	0.090
C	0.125	–
D	0.180	–

Maximum Power Dissipation: 25°C Ambient

Optimum Solder Wave Profile

Reverse Voltage

Although these are polar capacitors, some degree of transient voltage reversal is permissible, as seen below. The capacitors should not be operated continuously in reverse mode, even within these limits.

Temperature	Pecentage of Rated Voltage
+25°C	15
+85°C	5
+125°C	1

Mounting

All encased capacitors will pass the Resistance to Soldering Heat Test of MIL–STD–202, Method 210, Condition C. This test simulates wave solder of topside board mount product. This demonstration of resistance to solder heat is in accordance with what is believed to be the industry standard. More severe treatment must be considered reflective of an improper soldering process. The above figure is a recommended solder wave profile for both axial and radial leaded solid tantalum capacitors.

Construction

Capacitor Marking

A & B Case

Date Code	3 Digit	4 Digit
Year	9 = 2019 0 = 2020 1 = 2021 2 = 2022 3 = 2023	19 = 2019 20 = 2020 21 = 2021 22 = 2022 23 = 2023
Week	01 = 1st week of the year to 52 = 52nd week of the year	

Storage

Tantalum hermetically sealed capacitors should be stored in normal working environments. While the capacitors themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature – reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 60% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulphur bearing compounds. For optimized solderability capacitors stock should be used promptly, preferably within three years of receipt.

Tape & Reel Packaging Information

KEMET offers standard reeling of Solid Tantalum Capacitors for automatic insertion or lead forming machines per EIA Specification RS–296E.

Table 2 – Packaging Quantity

Case Size	Standard Bulk Quantity
A/B	50/Tray
A	300/Box
B	150/Box

Figure 2

Figure 3

Table 3 – Tape Dimensions

Component Body Diameter	Component Pitch "A"	Inside Tape Spacing "B" ±1.5 mm (0.059")		
	0.020" or (±0.5 mm)	I	II	III
0" (0 mm) to 0.197" (5 mm)	0.200" or (5 mm)	2.062"	2.500"	2.874"
0.197" (5.01 mm) to 0.394" (10 mm)	0.400 or (10 mm)	(52.4 mm)	(63.5 mm)	(73 mm)

Capacitors are reeled so that positive leads are oriented as shown in Figure 3. Kraft paper (50lb. test minimum) is inserted between the layers of capacitors wound on reels for component pitch ≤ 0.200" sizes and corrugated paper (70 lb. test minimum), single faced is inserted for component pitch ≥ 0.400" sizes. Capacitor lead length may extend only a maximum of 0.031" (0.8 mm) beyond the tape's edges. Capacitors are centered in a row between the two tapes and will deviate only ±0.031" (0.79 mm) from the row center. Figures 1 and 2 show the KEMET standard chipboard tape reel. A minimum of 36" (91.5 cm) leader tape is provided at each end of the reeled capacitors. Universal splicing clips are used to connect the tape.

KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit www.kemet.com/sales.

Disclaimer

YAGEO Corporation and its affiliates do not recommend the use of commercial or automotive grade products for high reliability applications or manned space flight.

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.

KEMET is a registered trademark of KEMET Electronics Corporation.