



TECHNICAL INFORMATION

MOLDED SURFACE MOUNT TANTALUM CAPACITORS vs CONFORMALLY COATED CAPACITORS

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Abstract:

Molded and conformal surface mount tantalum capacitors have identical physical and electrical parameters. However, molded devices feature a better design and have many application advantages because of their uniform size, flat top with complete identification marking, and compliant leads. Hearing aid manufacturers – and other businesses – that require the most from each unit of volume along with long-term reliability in their products have found molded tantalum capacitors meet their requirements.

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Molded Tantalum Capacitors

Usage of surface mount components instead of leaded devices has grown exponentially in recent years as through-hole PCBs are replaced by smaller one- and two-sided surface mount hybrids. The increasing attention devoted to surface mount components has spurred new developments in the devices. One important trend is that molded tantalum capacitors are taking the place of conformally coated capacitors in numerous applications.

One such application is in-the-canal hearing aids—in which the entire unit is placed into the ear canal—that are achieving popularity in the U.S. market. Because the hearing aids are so small—size varies with customer—capacitor size is a critical design factor.

When creating circuits for in-the-canal hearing aids, larger capacitance values were required of the hybrid circuit for signal filtering than were available within hybrids that met the severe size constraints of the application. Miniaturized surface mount tantalum capacitors—with 0.100 x 0.050 x 0.050" to 0.285 x 0.150 x 0.110" case sizes—became the only choice to meet reduced dimensional requirements of the in-the-canal hearing aids.

When selecting surface mount tantalum capacitors for the new generation of hearing aids, manufacturers specify surface mount tantalums with a molded construction, rather than conformally coated capacitors used in previous years. Molded construction offers size uniformity and repeatability, a flat top, improved reactions to solder reflow conditions, and other benefits.

Construction

Molded tantalum capacitors and conformally coated devices have essentially identical physical dimensions and electrical parameters and are interchangeable from a board layout viewpoint. Both are equivalent to MIL-C-55365/4 CWR06 (conformally coated) and CWR09 (molded) styles and have the same eight case sizes, which are shown in Table 1. However, differences in usability between the two are extensive due to the capacitors' different constructions.

Until reaching the stage of a finished anode pellet, molded and conformal capacitors can be manufactured using similar techniques. To produce a molded construction, the pellet is attached to a lead frame in two locations; the tantalum anode riser wire is welded to one half of the lead frame, while the cathode is attached to the other half, usually by a conductive epoxy. The unit then is molded, marked on top with capacitance, voltage, and a polarity stripe, and electrically tested.

Conformal construction involves attaching two end caps or clips to the pellet: one cap is welded to the anode riser wire, and the other is attached by various means to the cathode at the opposite end of the pellet. The device then is coated with an epoxy (a cautionary note: the interface of the end clips to the epoxy is sensitive to thermal stresses). Next, the anode is marked by a protruding anode riser wire or colored dot, and the unit is electrically tested.

One reason to choose a molded component instead of a conformally coated device is the molded unit's size uniformity and repeatability. Modern transfer molding processes permit complete component body uniformity not available in conformally coated devices because the tantalum pellet is coated directly on these parts and coating thickness varies since there is nothing to control it—as a mold controls molded parts. In-the-canal hearing aids cannot accommodate large size fluctuations because all available space has been allocated.

In addition, molded parts feature a flat top design for use with automatic and manual pick and place machines because the flat top's smooth surface results in little chance of a missed or crooked pickup. A conformally coated unit's irregular surface increases the likelihood of problems during the pick and place process. Flat tops also permit manufacturers to mark each part with capacitance, voltage, and polarity stripes, while

conformal parts can be marked only to identify polarity due to their irregular surfaces. For companies that manually assemble circuits these markings on molded parts are invaluable for in-process and inspection purposes.

Perhaps the most important reason many hearing aid manufacturers select molded tantalum capacitors is the device's favorable reaction to solder reflow conditions. A molded part's terminations are forgiving of inherent thermal mismatches between component and substrate because thermomechanical stresses during reflow are absorbed by the molded component's compliant leads.

Conformal devices are notorious for developing cracks around their end caps during solder reflow because since caps are welded to conformal parts, they are rigid and have little "give." When the board and part are heated, the two expand at different rates and caps are literally pulled off or develop cracks.

Cleaning

Following solder reflow, surface mount assemblies are cleaned. If the conformally coated device has

cracked due to the thermomechanical stresses involved in the attachment process, the cleaning solution may contaminate and degrade the device's electrical performance. The molded chip's compliant leads prevent this type of defect. If both chips are intact until the cleaning process, the molded device has a greater chance of resisting moisture and contamination than the conformal capacitor, although neither is hermetically sealed, because the conformal device's coating may be incomplete or have voids.

TABLE 1 - CASE SIZES OF MOLDED AND CONFORMALLY COATED CAPACITORS

	L	W	H	Pads
Case size	±0.015 (0.38)	±0.015 (0.38)	±0.015 (0.38)	±0.005 (0.13)
A	0.100 (2.54)	0.050 (1.27)	0.050 (1.27)	0.030 (0.76)
B	0.150 (3.81)	0.050 (1.27)	0.050 (1.27)	0.030 (0.76)
C	0.200 (5.08)	0.050 (1.27)	0.050 (1.27)	0.030 (0.76)
D	0.150 (3.81)	0.100 (2.54)	0.050 (1.27)	0.030 (0.76)
E	0.200 (5.08)	0.100 (2.54)	0.050 (1.27)	0.030 (0.76)
F	0.220 (5.59)	0.135 (3.43)	0.070 (1.78)	0.030 (0.76)
G	0.265 (6.73)	0.110 (2.79)	0.110 (2.79)	0.050 (1.27)
H	0.285 (7.24)	0.150 (3.81)	0.110 (2.79)	0.050 (1.27)

CAP-VOLTAGE MATRIX

	4	6	10	15	20	25	35	50
0.1								A
0.15								A
0.22							A	B
0.33						A		B
0.47					A		B	C
0.68				A	B	B	C	D
1			A		B	C	D	E
1.5		A		B	C	D	E	F
2.2	A		B	C	D	E		F
3.3		B	C	D	E		F	G
4.7	B	C	D	E		F	G	H
6.8	C	D	E		F	G	H	
10	D	E		F		G		
15	E		F		G	H		
22		F		G	H			
33	F		G	H				
47		G	H					
68	G	H						
100	H							

Conclusion

Molded and conformal surface mount tantalum capacitors have identical physical and electrical parameters. However, molded devices feature a better design and have many application advantages because of their uniform size, flat top with complete identification marking, and compliant leads. Hearing aid manufacturers – and other businesses – that require the most from each unit of volume along with long-term reliability in their products have found molded tantalum capacitors meet their requirements.

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