Type AVS

SMT Aluminum Electrolytic Capacitors - General Purpose, 85°C

General Purpose Filtering, Bypassing, Power Supply Decoupling

Type AVS Capacitors are the best value for filter and bypass applications not requiring wide temperature performance or high ripple current. Their vertical cylindrical cases facilitate automatic mounting and reflow soldering and Type AVS offers a significant cost savings over tantalum capacitors.

Highlights

- +85°C, 2000 Hour Load Life
- Capacitance Range: 0.1 µF to 1500 F
- Voltage Range: 4.0 Vdc to 100 Vdc

Specifications

Operating Temperature: -40°C to +85°C
Rated Voltage: 4.0, 6.3, 10, 16, 25, 35, 50, 63 & 100 Vdc
Capacitance: 0.1 µF to 1500 µF
D.F (@ 20°C): See Ratings Table
Capacitance Tolerance: ±20% @ 120 Hz and +20°C
Leakage Current: 0.01 CV or 3 µA @ +20°C, after two minutes (whichever is greater)
Ripple Current Multipliers: **Frequency**

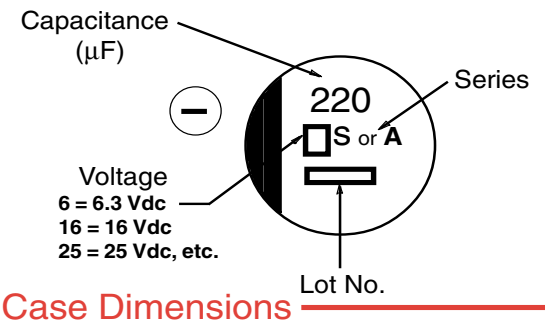
50/60 Hz	120 Hz	1 kHz	10 kHz & up
0.7	1.0	1.3	1.7

Load Life: 2000 h @ +85°C
Δ Capacitance: ± 20%
DF: ≤200% of limit
DCL: ≤100% of limit

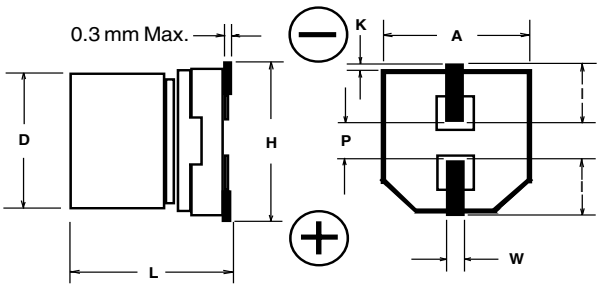
Shelf Life: 1000 h @ +85°C
Δ Capacitance: ± 20%
DF: ≤200% of limit
DCL: ≤100% of limit

Maximum Impedance Ratio @ 120 Hz									
W.V. Vdc)	4	6.3	10	16	25	35	50	63	100
-25°C / +20°C	7	4	3	2	2	2	2	3	3
-40°C / +20°C	15	8	6	4	4	3	3	4	4

AVS Series Marking



Outline Drawing



Case Dimensions

(mm)

Case Code	D ± 0.5	L	A ± 0.2	H (max)	I (ref)	W	P (ref)	K
A	3.0	5.4 +.1,-.2	3.3	4.5	1.5	0.55 ± 0.1	0.6	0.35 + 0.15/-0.20
B	4.0	5.4 +.1,-.2	4.3	5.5	1.8	0.65 ± 0.1	1.0	0.35 + 0.15/-0.20
C	5.0	5.4 +.1,-.2	5.3	6.5	2.2	0.65 ± 0.1	1.5	0.35 + 0.15/-0.20
D	6.3	5.4 +.1,-.2	6.6	7.8	2.6	0.65 ± 0.1	1.8	0.35 + 0.15/-0.20
X	6.3	7.9 ±.3	6.6	7.8	2.6	0.65 ± 0.1	1.8	0.35 + 0.15/-0.20
E	8.0	6.2 ±.3	8.3	9.5	3.4	0.65 ± 0.1	2.2	0.35 + 0.15/-0.20
F	8.0	10.2 ±.3	8.3	10.0	3.4	0.90 ± 0.2	3.1	0.70 ± 0.20
G	10.0	10.2 ±.3	10.3	12.0	3.5	0.90 ± 0.2	4.6	0.70 ± 0.20

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Type AVS

SMT Aluminum Electrolytic Capacitors - General Purpose, 85°C

Ratings Table

Cap µF	Catalog Number	Max. DCL (µA)	Max. Dissipation Factor @ 120 Hz	Max. ESR @ 120 Hz/20°C (Ohms)	Max. Ripple Current 120 Hz/85°C (mA)	Case Code	Size D x L (mm)	Quantity per Reel
4 Vdc (5 Vdc Surge)								
22	AVS226M04A12T	3.0	0.37	27.9	19	A	3x5.4	2000
33	AVS336M04B12T	3.0	0.35	17.6	26	B	4x5.4	2000
47	AVS476M04B12T	3.0	0.35	12.3	34	B	4x5.4	2000
100	AVS107M04C12T	4.0	0.35	5.8	61	C	5x5.4	1000
220	AVS227M04D16T	8.8	0.35	2.6	82	D	6.3x5.4	1000
6.3 Vdc (8 Vdc Surge)								
22	AVS226M06A12T	3.0	0.35	26.4	20	A	3x5.4	2000
22	AVS226M06B12T	3.0	0.26	19.6	29	B	4x5.4	2000
33	AVS336M06B12T	3.0	0.35	17.6	29	B	4x5.4	2000
47	AVS476M06B12T	3.0	0.35	12.3	36	B	4x5.4	2000
47	AVS476M06C12T	3.0	0.26	9.2	46	C	5x5.4	1000
100	AVS107M06C12T	6.3	0.35	5.8	47	C	5x5.4	1000
100	AVS107M06D16T	6.3	0.26	4.3	71	D	6.3x5.4	1000
220	AVS227M06D16T	13.9	0.35	2.6	74	D	6.3x5.4	1000
330	AVS337M06X16T	20.8	0.26	1.3	150	X	6.3x7.9	900
330	AVS337M06E16T	20.8	0.35	1.8	300	E	8x6.2	1000
470	AVS477M06F24T	29.6	0.35	1.2	380	F	8x10.2	500
1000	AVS108M06F24T	63.0	0.35	0.6	500	F	8x10.2	500
1000	AVS108M06G24T	63.0	0.35	0.6	700	G	10x10.2	500
1500	AVS158M06G24T	94.5	0.35	0.4	700	G	10x10.2	500
10 Vdc (13 Vdc Surge)								
22	AVS226M10B12T	3.0	0.3	22.6	28	B	4x5.4	2000
33	AVS336M10B12T	3.3	0.3	15.1	29	B	4x5.4	2000
33	AVS336M10C12T	3.3	0.2	10.1	43	C	5x5.4	1000
47	AVS476M10C12T	4.7	0.3	10.6	43	C	5x5.4	1000
100	AVS107M10C12T	10.0	0.3	5.0	50	C	5x5.4	1000
100	AVS107M10D16T	10.0	0.2	3.3	70	D	6.3x5.4	1000
220	AVS227M10X16T	22.0	0.2	1.5	150	X	6.3x7.9	900
220	AVS227M10E16T	22.0	0.26	2.0	250	E	8x6.2	1000
330	AVS337M10F24T	33.0	0.26	1.3	330	F	8x10.2	500
470	AVS477M10F24T	47.0	0.26	0.92	330	F	8x10.2	500
470	AVS477M10G24T	47.0	0.26	0.92	400	G	10x10.2	500
1000	AVS108M10G24T	100.0	0.26	0.43	580	G	10x10.2	500
16 Vdc (20 Vdc Surge)								
10	AVS106M16A12T	3.0	0.18	29.9	20	A	3x5.4	2000
10	AVS106M16B12T	3.0	0.16	26.5	28	B	4x5.4	2000
22	AVS226M16B12T	3.5	0.26	19.6	28	B	4x5.4	2000
22	AVS226M16C12T	3.5	0.16	12.1	39	C	5x5.4	1000
33	AVS336M16C12T	5.3	0.26	13.1	35	C	5x5.4	1000
47	AVS476M16C12T	7.5	0.26	9.2	39	C	5x5.4	1000
47	AVS476M16D16T	7.5	0.16	5.6	70	D	6.3x5.4	1000
100	AVS107M16D16T	16.0	0.26	4.3	70	D	6.3x5.4	1000
100	AVS107M16E16T	16.0	0.2	3.3	200	E	8x6.2	1000
220	AVS227M16X16T	35.2	0.16	1.2	150	X	6.3x7.9	900
220	AVS227M16E16T	35.2	0.2	1.5	200	E	8x6.2	1000
220	AVS227M16F24T	35.2	0.2	1.5	280	F	8x10.2	500
330	AVS337M16F24T	52.8	0.2	1.0	320	F	8x10.2	500
330	AVS337M16G24T	52.8	0.2	1.0	380	G	10x10.2	500
470	AVS477M16F24T	75.2	0.2	0.71	320	F	8x10.2	500
470	AVS477M16G24T	75.2	0.2	0.71	420	G	10x10.2	500
25 Vdc (31 Vdc Surge)								
4.7	AVS475M25A12T	3.0	0.16	56.5	12	A	3x5.4	2000
4.7	AVS475M25B12T	3.0	0.14	49.4	22	B	4x5.4	2000
10	AVS106M25B12T	3.0	0.20	33.2	22	B	4x5.4	2000
10	AVS106M25C12T	3.0	0.14	23.2	28	C	5x5.4	1000
22	AVS226M25C12T	5.5	0.20	15.1	35	C	5x5.4	1000
22	AVS226M25D16T	5.5	0.14	10.6	55	D	6.3x5.4	1000
33	AVS336M25C12T	8.3	0.2	10.0	42	C	5x5.4	1000
33	AVS336M25D16T	8.3	0.14	7.0	65	D	6.3x5.4	1000
47	AVS476M25D16T	11.8	0.20	7.1	70	D	6.3x5.4	1000
100	AVS107M25X16T	25.0	0.14	2.3	150	X	6.3x7.9	900
100	AVS107M25E16T	25.0	0.16	2.7	91	E	8x6.2	1000
100	AVS107M25F24T	25.0	0.16	2.7	180	F	8x10.2	500
220	AVS227M25F24T	55.0	0.16	1.2	140	F	8x10.2	500
220	AVS227M25G24T	55.0	0.16	1.2	310	G	10x10.2	500
330	AVS337M25F24T	82.5	0.16	0.8	150	F	8x10.2	500
330	AVS337M25G24T	82.5	0.16	0.8	340	G	10x10.2	500
470	AVS477M25G24T	117.5	0.16	0.6	360	G	10x10.2	500

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Type AVS

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Ratings Table

Cap µF	Catalog Number	Max. DCL (µA)	Max. Dissipation Factor @ 120 Hz	Max. ESR @ 120 Hz/20°C (Ohms)	Max. Ripple Current 120 Hz/85°C (mA)	Case Code	Size D x L (mm)	Quantity per Reel
35 Vdc (44 Vdc Surge)								
2.2	AVS225M35A12T	3.0	0.14	105.6	8	A	3x5.4	2000
3.3	AVS335M35A12T	3.0	0.14	70.4	10	A	3x5.4	2000
4.7	AVS475M35B12T	3.0	0.12	42.4	22	B	4x5.4	2000
10	AVS106M35B12T	3.5	0.16	26.5	22	B	4x5.4	2000
10	AVS106M35C12T	3.5	0.12	19.9	30	C	5x5.4	1000
22	AVS226M35C12T	7.7	0.16	12.1	36	C	5x5.4	1000
22	AVS226M35D16T	7.7	0.12	9.1	60	D	6.3x5.4	1000
33	AVS336M35D16T	11.6	0.16	8.0	60	D	6.3x5.4	1000
33	AVS336M35E16T	11.6	0.14	7.0	130	E	8x6.2	1000
47	AVS476M35D16T	16.5	0.16	5.6	70	D	6.3x5.4	1000
47	AVS476M35E16T	16.5	0.14	4.9	165	E	8x6.2	1000
100	AVS107M35X16T	35.0	0.12	2.0	130	X	6.3x7.9	900
100	AVS107M35F24T	35.0	0.14	2.3	140	F	8x10.2	500
100	AVS107M35G24T	35.0	0.14	2.3	210	G	10x10.2	500
220	AVS227M35F24T	77.0	0.14	1.1	200	F	8x10.2	500
220	AVS227M35G24T	77.0	0.14	1.1	310	G	10x10.2	500
330	AVS337M35G24T	115.5	0.14	0.7	320	G	10x10.2	500
50 Vdc (63 Vdc Surge)								
0.1	AVS104M50A12T	3.0	0.14	2322	1	A	3x5.4	2000
0.1	AVS104M50B12T	3.0	0.12	1990	1	B	4x5.4	2000
0.22	AVS224M50A12T	3.0	0.14	1055	2	A	3x5.4	2000
0.22	AVS224M50B12T	3.0	0.12	905	2	B	4x5.4	2000
0.33	AVS334M50A12T	3.0	0.14	704	3	A	3x5.4	2000
0.33	AVS334M50B12T	3.0	0.12	603	3	B	4x5.4	2000
0.47	AVS474M50A12T	3.0	0.14	494	5	A	3x5.4	2000
0.47	AVS474M50B12T	3.0	0.12	424	5	B	4x5.4	2000
1	AVS105M50A12T	3.0	0.14	232	8	A	3x5.4	2000
1	AVS105M50B12T	3.0	0.12	199	10	B	4x5.4	2000
2.2	AVS225M50A12T	3.0	0.14	106	10	A	3x5.4	2000
2.2	AVS225M50B12T	3.0	0.12	90.5	16	B	4x5.4	2000
3.3	AVS335M50B12T	3.0	0.12	60.3	16	B	4x5.4	2000
4.7	AVS475M50B12T	3.0	0.14	49.4	18	B	4x5.4	2000
4.7	AVS475M50C12T	3.0	0.12	42.4	23	C	5x5.4	1000
10	AVS106M50C12T	5.0	0.14	23.2	27	C	5x5.4	1000
10	AVS106M50D16T	5.0	0.12	19.9	35	D	6.3x5.4	1000
22	AVS226M50D16T	11.0	0.14	10.6	60	D	6.3x5.4	1000
22	AVS226M50E16T	11.0	0.12	9.1	120	E	8x6.2	1000
33	AVS336M50X16T	16.5	0.12	6.0	85	X	6.3x7.9	900
33	AVS336M50E16T	16.5	0.12	6.0	130	E	8x6.2	1000
33	AVS336M50F24T	16.5	0.12	6.0	140	F	8x10.2	500
47	AVS476M50X16T	23.5	0.12	4.2	90	X	6.3x7.9	900
47	AVS476M50F24T	23.5	0.12	4.2	150	F	8x10.2	500
47	AVS476M50G24T	23.5	0.12	4.2	160	G	10x10.2	500
100	AVS107M50F24T	50.0	0.12	2.0	200	F	8x10.2	500
100	AVS107M50G24T	50.0	0.12	2.0	250	G	10x10.2	500
220	AVS227M50G24T	110.0	0.12	0.9	300	G	10x10.2	500
63 Vdc (75 vdc Surge)								
10	AVS106M63D16T	6.3	0.18	29.9	35	D*	6.3x5.7	1000
22	AVS226M63E16T	13.9	0.18	13.6	40	E	8x6.2	1000
22	AVS226M63F24T	13.9	0.18	13.6	40	F	8x10.2	500
33	AVS336M63F24T	20.8	0.18	9.1	45	F	8x10.2	500
47	AVS476M63F24T	29.6	0.18	6.4	45	F	8x10.2	500
100	AVS107M63G24T	63.0	0.18	3.0	60	G	10x10.2	500
100 Vdc (125 Vdc Surge)								
3.3	AVS335M2AE16T	3.3	0.18	90.4	50	E	8x6.2	1000
4.7	AVS475M2AE16T	4.7	0.18	63.5	50	E	8x6.2	1000
4.7	AVS475M2AF24T	4.7	0.18	63.5	80	F	8x10.2	500
10	AVS106M2AE16T	10.0	0.18	29.8	50	E	8x6.2	1000
10	AVS106M2AF24T	10.0	0.18	29.8	85	F	8x10.2	500
22	AVS226M2AF24T	22.0	0.18	13.6	70	F	8x10.2	500
22	AVS226M2AG24T	22.0	0.18	13.6	90	G	10x10.2	500
33	AVS336M2AG24T	33.0	0.18	8.0	90	G	10x10.2	500

*Overall case height (L dimension) is 5.7 mm ±0.3 mm.

Part Numbering System

AVS — **Type**

106 — **Capacitance**
- **104** = 0.1 µF
- **105** = 1.0 µF
- **106** = 10 µF
- **107** = 100 µF
- **108** = 1000 µF

M — **Capacitance Tolerance**
- **M** = ±20%

16 — **Voltage**
- **04** = 4 Vdc
- **06** = 6.3 Vdc
- **10** = 10 Vdc
- **16** = 16 Vdc
- **25** = 25 Vdc
- **35** = 35 Vdc
- **50** = 50 Vdc
- **63** = 63 Vdc
- **2A** = 100 Vdc

B — **Case Code**

12T — **Packaging Information**
- **12** = Carrier Tape Width (mm)
- **T** = Tape & Reel
- **B** = Bulk

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Type AVS
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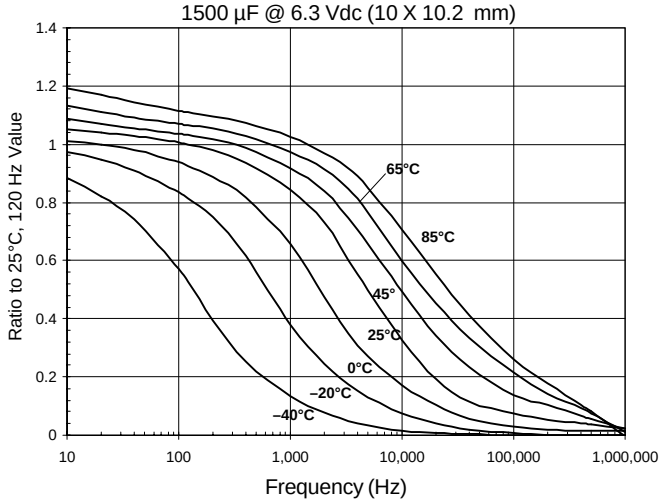
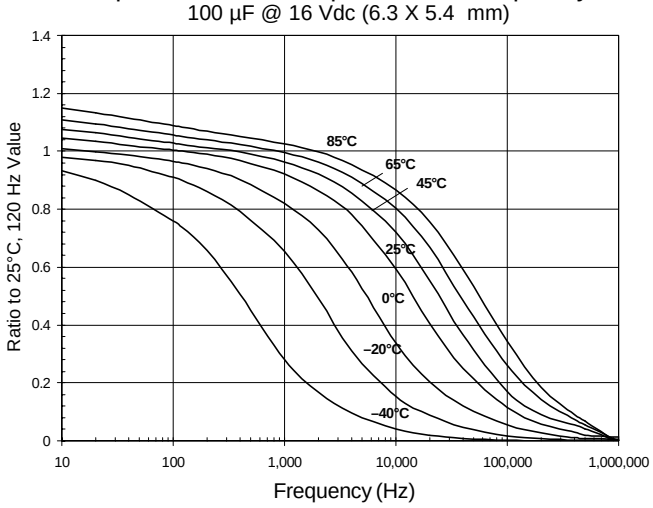
Typical Performance Curves

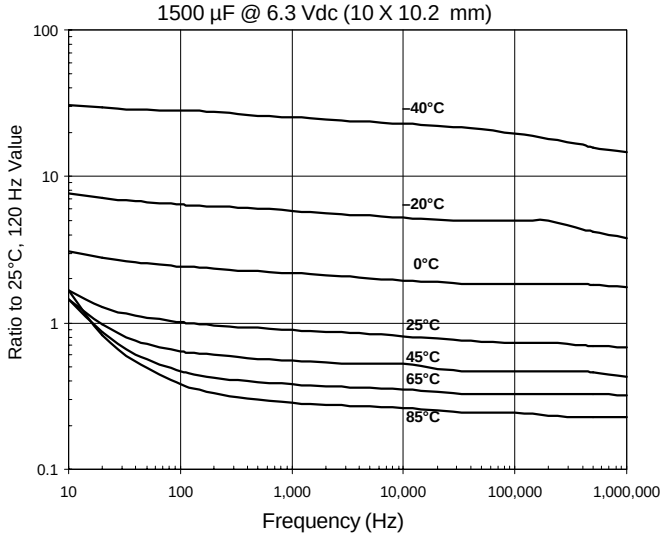
Capacitance vs. Temperature & Frequency
1500 µF @ 6.3 Vdc (10 X 10.2 mm)



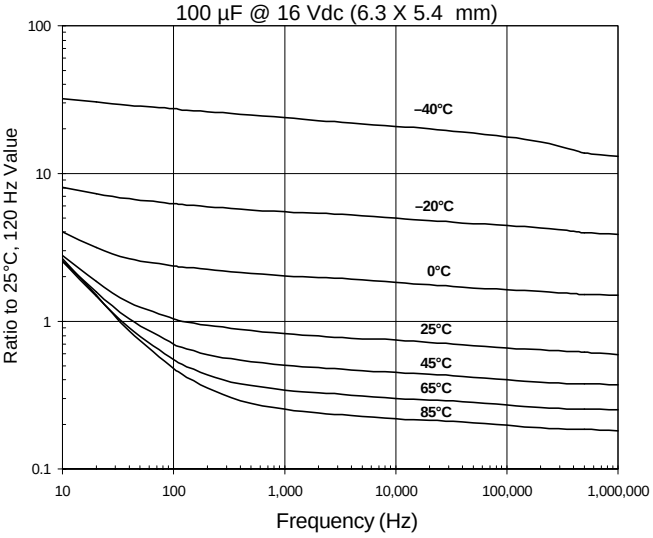
Capacitance vs. Temperature & Frequency
100 µF @ 16 Vdc (6.3 X 5.4 mm)



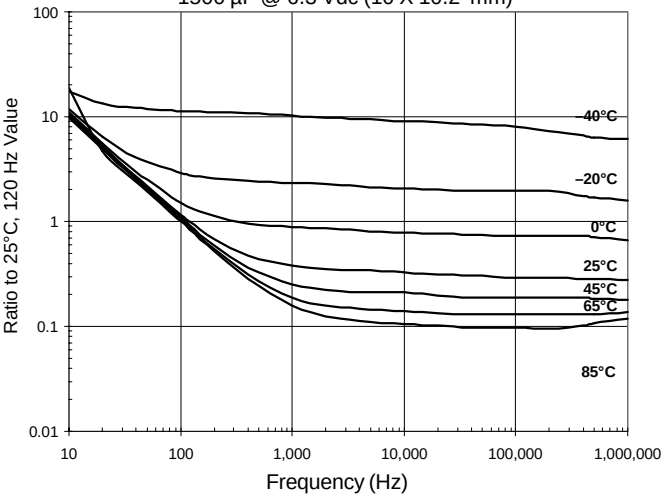
ESR vs. Temperature and Frequency
1500 µF @ 6.3 Vdc (10 X 10.2 mm)



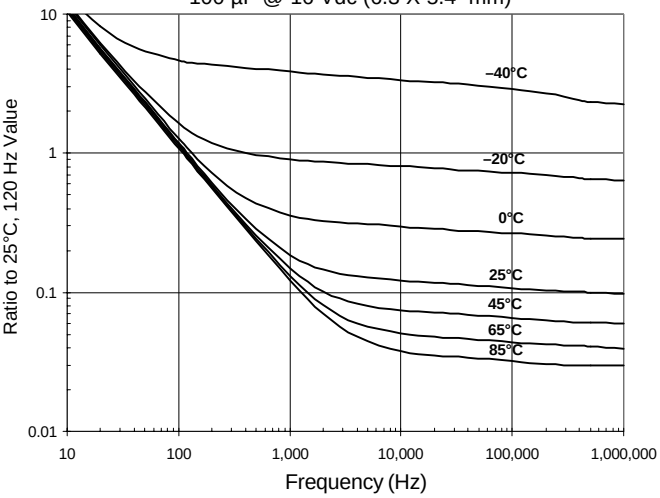
ESR vs. Temperature and Frequency
100 µF @ 16 Vdc (6.3 X 5.4 mm)



Impedance vs. Temperature and Frequency
1500 µF @ 6.3 Vdc (10 X 10.2 mm)



Impedance vs. Temperature and Frequency
100 µF @ 16 Vdc (6.3 X 5.4 mm)



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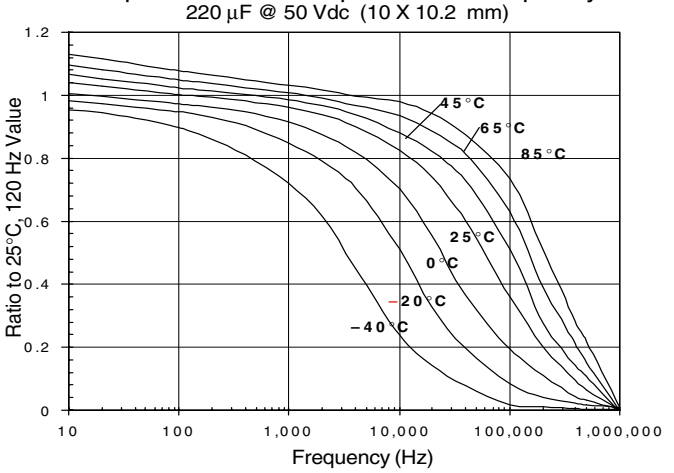
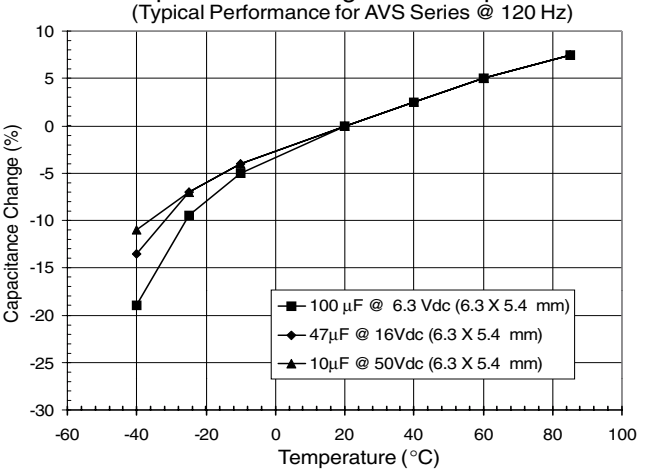
Typical Performance Curves

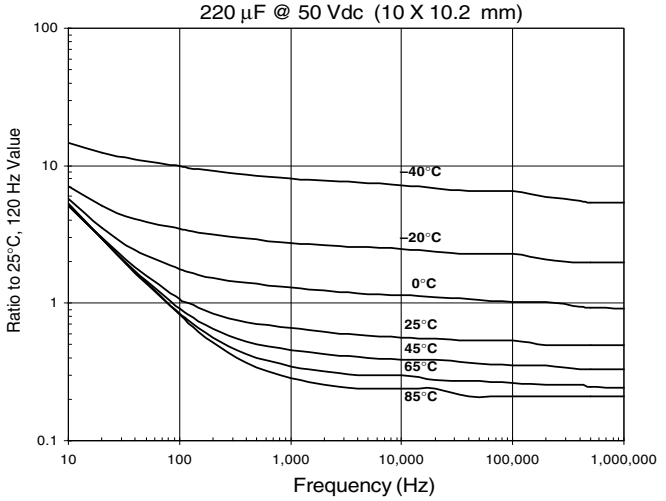
Capacitance vs. Temperature & Frequency
220 µF @ 50 Vdc (10 X 10.2 mm)



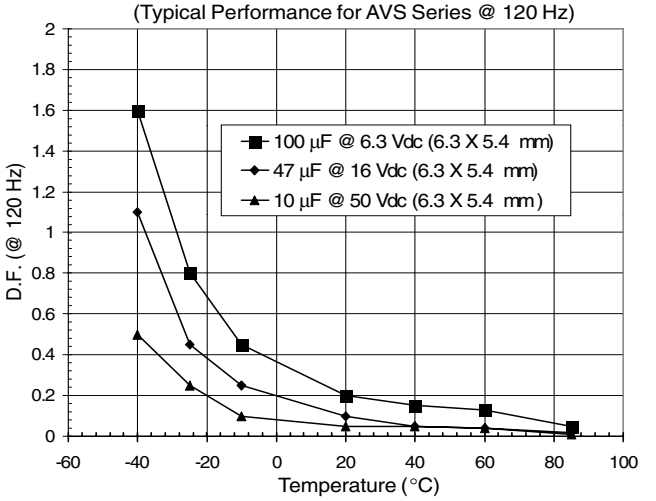
Capacitance Change with Temperature
(Typical Performance for AVS Series @ 120 Hz)



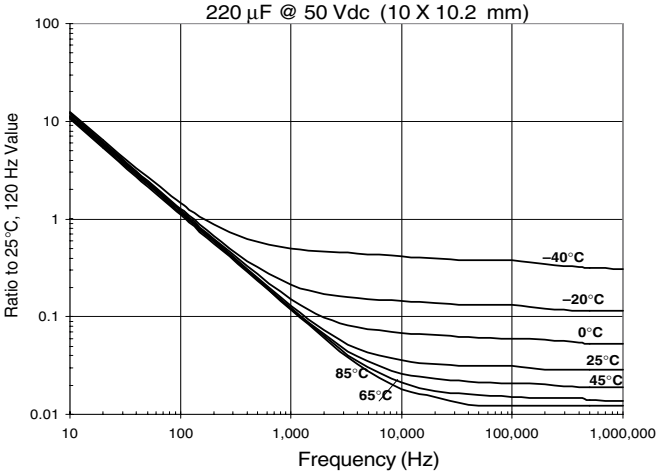
ESR vs. Temperature and Frequency
220 µF @ 50 Vdc (10 X 10.2 mm)



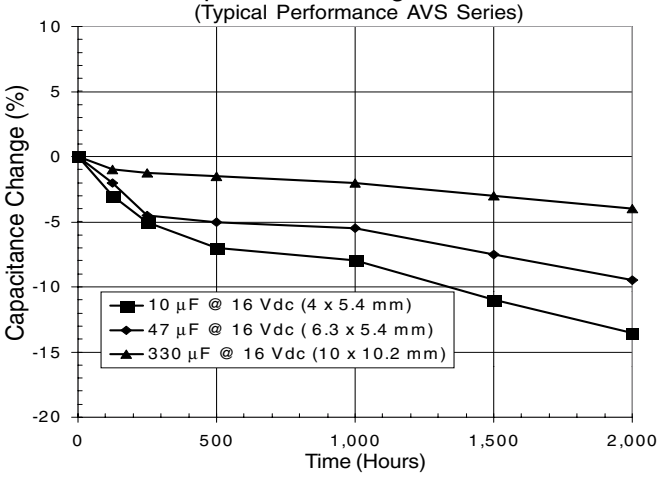
Dissipation Factor vs. Temperature
(Typical Performance for AVS Series @ 120 Hz)



Impedance vs. Temperature and Frequency
220 µF @ 50 Vdc (10 X 10.2 mm)



Capacitance Change vs. Time
(Typical Performance AVS Series)



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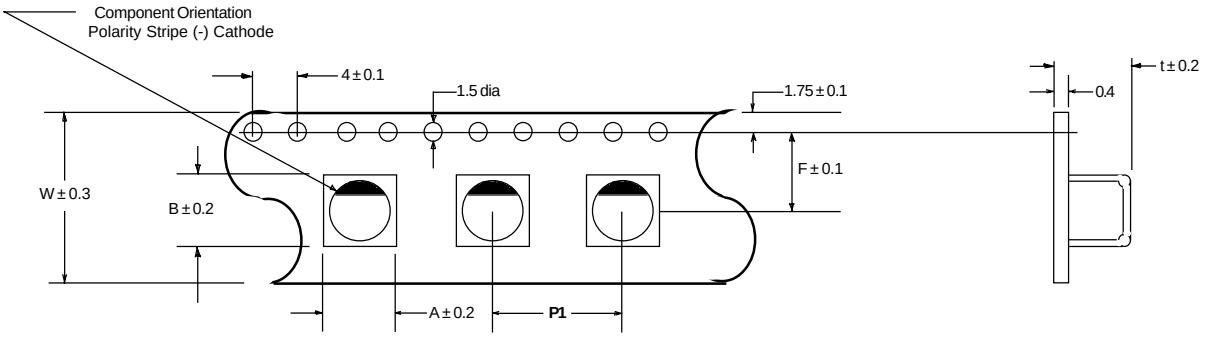
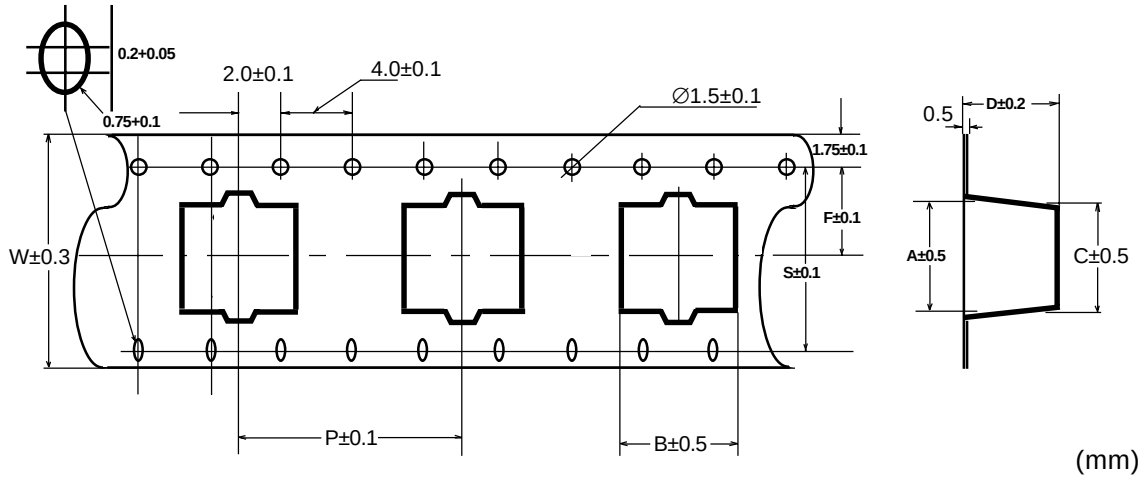
AVS, AHA, AFC, AFK, AHD, AEB Tape and Reel Specifications

Tape Specifications



(mm)

Case Code	W	A	B	P1	F	t
A	12.0	3.4	3.5	8.0	5.5	5.8
B	12.0	4.7	4.6	8.0	5.5	5.8
C	12.0	6.0	6.0	12.0	5.5	5.8
D	16.0	7.0	7.0	12.0	7.5	5.8
X	16.0	7.0	7.0	12.0	7.5	8.4
E	16.0	8.7	8.7	12.0	7.5	6.8
F	24.0	8.7	8.7	16.0	11.5	11.0
G	24.0	10.7	10.7	16.0	11.5	11.0



(mm)

Case Code	W	A	B	C	D	F	P	S
J	32.0	10.7	10.7	14.5	14.5	14.2	20.0	28.4
K	32.0	10.7	10.7	14.5	18.5	14.2	20.0	28.4
H	32.0	14.0	14.0	18.0	14.5	14.2	24.0	28.4
L	32.0	14.0	14.0	18.0	17.5	14.2	24.0	28.4
P	44.0	17.5	17.5	23.0	17.5	20.2	28.0	40.4
R	44.0	19.5	19.5	26.0	17.5	20.2	32.0	40.4
S	44.0	19.5	19.5	26.0	22.5	20.2	32.0	40.4
U	44	17.5	17.5	23	22.5	20.2	28	40.4

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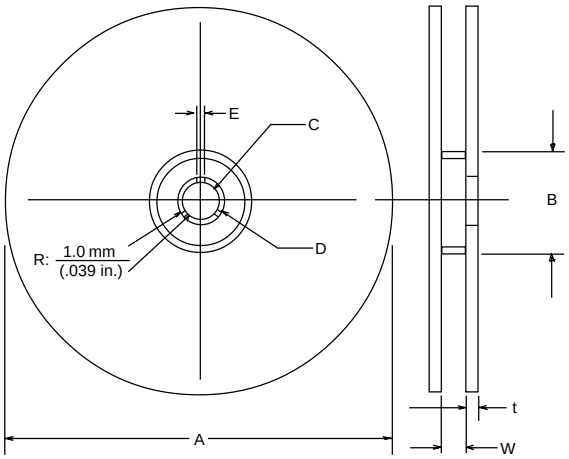
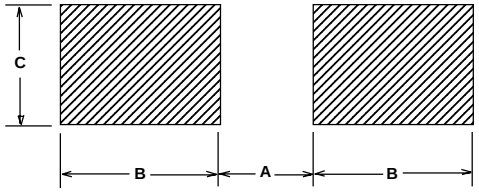
Reel Specifications



(mm)

Case Code	A	B	C	D	E	W	t
A, B size	380±2	50 min	13.0±0.5	21.0±0.8	2.0±0.5	14±1	3.0
C, D, E, X size	380±2	50 min	13.0±0.5	21.0±0.8	2.0±0.5	18±1	3.0
F, G size	380±2	50 min	13.0±0.5	21.0±0.8	2.0±0.5	26±1	3.0
J, K, H, L size	330±2	50 min	13.0±0.5	21.0±0.8	2.0±0.5	34±1	3.0
P, R, S, U size	330±2	50 min	13.0±0.5	21.0±0.8	2.0±0.5	46±1	3.0

Land Pattern:



(mm)

Case Code	A	B	C
A	0.6	2.2	1.5
B	1.0	2.5	1.6
C	1.5	2.8	1.6
D	2.2	3.0	1.6
E	2.2	4.5	1.6
F	3.2	4.0	2.0
G	4.6	4.3	2.0
J, K	4	4.5	2.0
H	4.0	5.7	2.0
L	4.0	5.7	2.0
P	6.0	6.5	2.5
R, U	6.0	6.5	2.5
S	6.0	7.5	2.5

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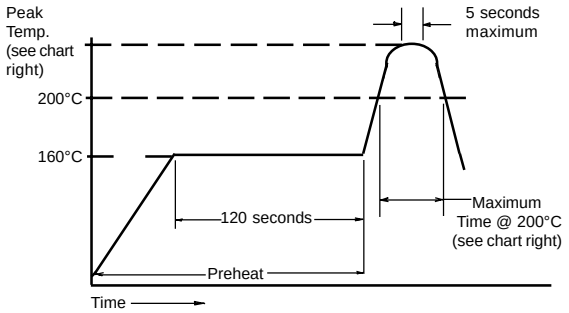
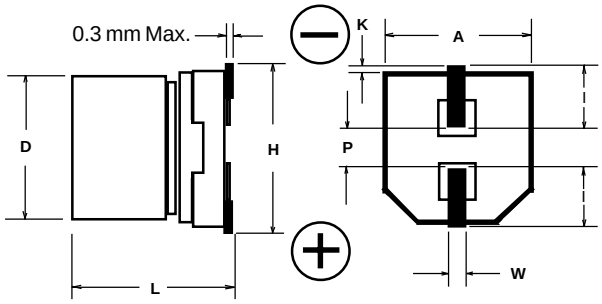
AVS, AHA, AFC, AFK, AHD, AEB Reflow Solder & Case Dimensions

Reflow Soldering Temperature Profile:



Case Code	Peak Temp (°C)	Max. Time @ 200°C (Sec.)
A, B, C, D, X	240	40
E, F, G, H J, K, L, P R, S, U	230	30

Outline Drawing



Case Dimensions

(mm)

Case Code	D ± 0.5	L	A ± 0.2	H (max)	I (ref)	W	P (ref)	K
A	3.0	5.4 +.1,-.2	3.3	4.5	1.5	0.55 ± 0.1	0.6	0.35 + 0.15/-0.20
B	4.0	5.4 +.1,-.2	4.3	5.5	1.8	0.65 ± 0.1	1.0	0.35 + 0.15/-0.20
C	5.0	5.4 +.1,-.2	5.3	6.5	2.2	0.65 ± 0.1	1.5	0.35 + 0.15/-0.20
D	6.3	5.4 +.1,-.2	6.6	7.8	2.4	0.65 ± 0.1	1.8	0.35 + 0.15/-0.20
X	6.3	7.9 ±.3	6.6	7.8	2.6	0.65 ± 0.1	1.8	0.35 + 0.15/-0.20
E	8.0	6.2 ±.3	8.3	9.5	3.4	0.65 ± 0.1	2.2	0.35 + 0.15/-0.20
F	8.0	10.2 ±.3	8.3	10	3.4	0.90 ± 0.2	3.2	0.70 ± 0.20
G	10.0	10.2 ±.3	10.3	12	3.5	0.90 ± 0.2	4.6	0.70 ± 0.20
H	12.5	13.5 ± .5	13.5	15	4.7	0.9 ±0.3	4.4	0.70 ± 0.30
J	10	13.5	10.3	12	3.5	0.9 ±0.2	4.6	0.70 ± 0.20
K	10	17.5	10.3	12	3.5	0.9 ±0.2	4.6	0.70 ± 0.20
L	12.5	16.5 ± .5	13.5	15.0	4.7	0.9±0.3	4.4	0.70 ± 0.30
P	16.0	16.5 ± .5	17.0	19.0	5.5	1.2±0.3	6.7	0.70 ± 0.30
R	18.0	16.5 ± .5	19.0	21.0	6.5	1.2±0.3	6.7	0.70 ± 0.30
S	18.0	21.5 ± .5	19.0	21.0	6.5	1.2±0.3	6.7	0.70 ± 0.30
U	16.0	21.5	17.0	19.0	6.7	1.2±0.3	6.7	0.70 ± 0.30

*5.8 +0.1,-0.2 for AFK and AHD Series

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V-Chip Cleaning and Coating Guide

Cleaning

Below is a table discribing the usable solvents for cleaning a PC board containing V-Chips.

Table 1

Solvent type	Name	Manufacturer	Recommended use level	Symtoms of Damage
Water Base				
Water	Distilled Water		1	None
Alkaline	Aqua Cleaner 210SEP	Sanei	2	None, though marking ink may fade
Surface active agent	Pine Alpha ST-100S	Aralaw a Kasei Kogyo	2	
	Clean-thru 750H	Kao Corporation	2	
	Clean-thru 750L		2	
	Clean-thru 710M		2	
	Sun-elec B-12	Sanyo Kasei	2	
	DK be-clean CW-5790	Dai-Ichi Kogyo Seiyaku	2	
Solvent Base				
Petroleum based	Cold-cleaner P3-375	Henkel Hakusui	3	swellling on sealing rubber rinse and dry well after cleaning
	Techno-cleaner 219	Seiwa Sangyo	3	
hydrocarbon	Axarel 32	Mitsui DFC	3	
Alcohol base	Isopropyl Alcohol		1	None
Silicon base	Techno-care FRW-17	Toshiba Corporation	3	None if used in combination
	Techno-care FRW-17		3	
	(Techno-care FRV-100)		3	
Halogenated hydrocarbon	Asashi-clean AK-225AES	Ashahi Glass	3	Contains CFC's subject to environmental regulations
	HCFC141B-MS	Dalkin Kogyo	3	
Telpen base	Telpen-cleaner EC-7R	Nippon Alpha Metals	3	swelled seal

Use level Number	Recommendation
1	Cleaning is possible
2	Cleaning is possible (markings may fade)
3	Cleaning is possible (Use caution. 1 and 2 are better choices)

V-Chips may be immersed for 5 minutes, safely, in Level 1&2 solvents. Use Level 3 solvents with caution.

Do not use chlorine-based halogenated cleaning solvents, adhesives or coating agents.

When halogenated chlorine-based solvents are used in the cleaning process, free clorine is liberated from the solvent. This chlorine causes corrosion and deterioration of the aluminum inside the capacitor

Dangers of “Free-Chlorine”:

After the solvent dries, the chlorine remains on the capacitor seal, the chlorine slowly permeates into the capacitor element causing corrosion and damage that happens slowly. It may take some time before a failure is apparent. A representation of the chemical reaction is on the following page.

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V-Chip Cleaning and Coating Guide

Free-chlorine Diagram:

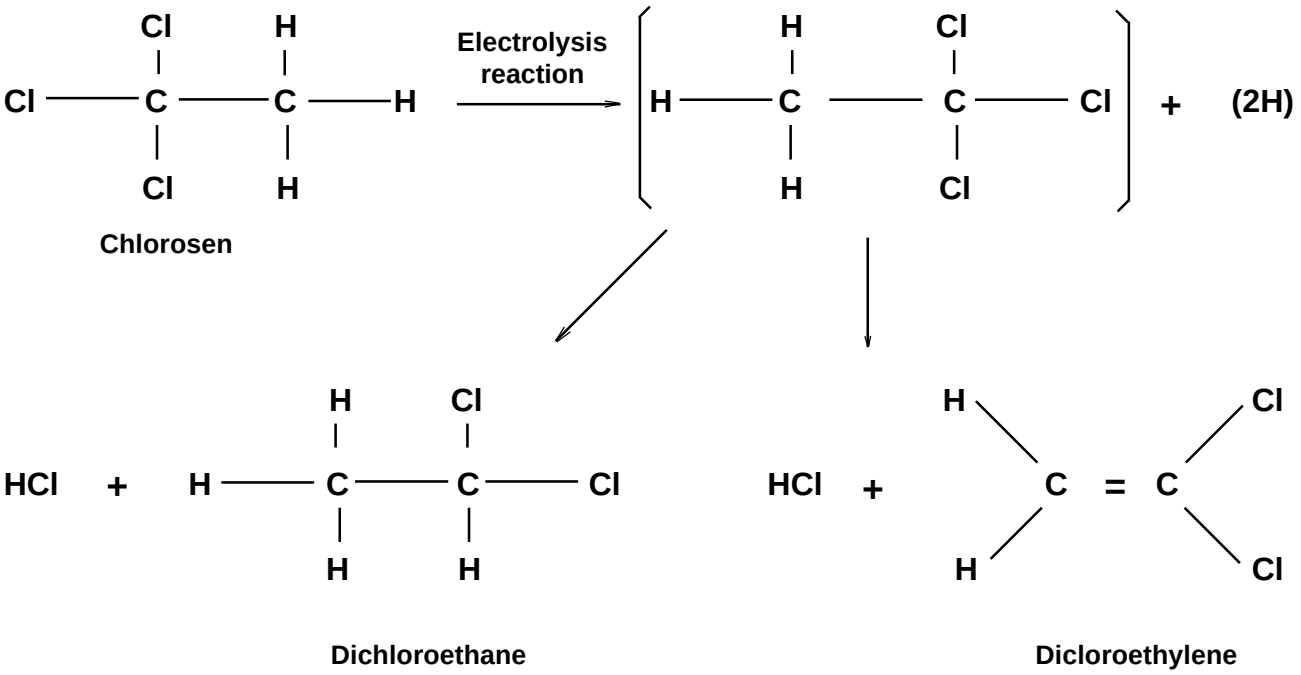

Fig. 1 Decomposed reaction of cleaning solvents (Free-chlorine)

Reaction of Free-chlorine and Aluminum

Combined free chlorine and hydrogen become hydrochloric acid, but it has high dissociation and most of it becomes chlorine ions. These chlorine ions react with the aluminum. The order of the reactions is represented below.

1.) Hydration of oxide film

$$AlO_3 + 3H_2O \longrightarrow 2Al(OH)_3$$

2.) Reaction of hydrated oxide film and chlorine (Dissolution of film)

$$Al(OH)_3 + 3HCl \longrightarrow AlCl_3 + 3H_2O$$

3.) Reaction of aluminum and hydrochloric acid (Dissolution of aluminum)

$$Al + 3HCl \longrightarrow AlCl_3 + 3/2H_2$$

4.) Precipitation of aluminum hydroxide

$$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl$$

The entire reaction can be summerized as the following:

$$Al + Al_2O_3 + 3HCl_3 + 3H_2O \longrightarrow 2Al(OH)_3 + AlCl_3 + AlCl_3 + H3/2\uparrow$$

Therefore the compounds produced by the reactions are aluminum hydroxide and hydrochloric acid from reaction #4; the hydrochloric acid is not consumed and acts as a catalyst.

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V-Chip Cleaning and Coating Guide

Solvents that should not be used

Table 2

Composition	Boiling Point (°C)	Common Name
1.1.1-Trichloroethane	74.1	Chlorosen
Trichloroethylene	87.2	Trichlene
Tetrachloroethylene	121.1	Perchloroethylene

Additional Cleaning Notes:

1.) Solvents containing CFC's destroy the ozone layer and should be avoided to protect the global environment.

2.) To avoid solvent residue between the capacitor's seal and the PC board, make sure the assembly is dried thoroughly immediately after cleaning.

Coating

Below is a list of coatings that are safe for use with V-Chips

Table 3

Manufacturer	Material	Coating Material Name
Hitachi Chemical	Acrylic	Taffi-1141, Taffi-1147
	Urethane	Taffi-1154
Boxy Brown	Acrylic	Humi Seal 1B66
	Urethane	Humi Seal 1A27
Dow Corning	Silicon	Perugan Z, Perugan C
Nihon Zeon	Urethane	Quinate System 160B

Influence of Coating Materials

Coating materials are typically used for insulation, waterproofing, dustproofing and rustproofing. When coating materials are selected there are factors to prevent internal corrosion (chlorine reaction with aluminum) while the capacitor is functioning. The following steps will help prevent this damage to the capacitor.

A.) Corrosion Reaction

Avoid halogen solvents which permeate the capacitor's seal, releasing chlorine which reacts with the aluminum inside the capacitor.

B.) Selecting a Coating Material

It is necessary to select a coating material that contains no chlorine.

The coating consists of the main ingredient which could be urethane resin, acrylic resin or other polymer, a solvent and other additives such as flameproofing agents.

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The coating's solvent dries and diffuses into the rubber seal of the capacitor, therefore halogenated hydrocarbon solvents containing chloride should not be used.

Similar to the solvent, additives can permeate into the capacitor through the rubber seal. Ingredients in many additives might not be listed, therefore use caution when choosing an additive.

C.) Other Concerns

Solvents and additives are subject to change without notice. Make sure ingredients are identified.

Avoid coating a substrate after cleaning it with a halogenated hydrocarbon. The coating will prevent the remaining solvent from diffusing which may cause corrosion.

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