PRODUCT SPECIFICATION

PRODUCT: SMD SOLID TANTALUM CAPACITORS

TYPE: POES Series

CUSTOMER: ______________________

DOC. NO.: T01-00-E-02

Ver.: 2

APPROVED BY CUSTOMER

POE INTERNATIONAL CORPORATION
11F, NO. 480, RUEIGUANG RD., NEIHU CHIU
TAIPEI, 114 TAIWAN, R.O.C.

POE

PASSIVE SYSTEM ALLIANCE PSA

Pan Overseas Electronic

Solid Tantalum Chip Capacitors, Surface Mount

FEATURES

- Molded case available in five case codes.
- Compatible with "High Volume" automatic pick and place equipment.
- Optical character recognition qualified.
- Meets IEC Specification QC300801/US0001 and EIA 535BAAC.

PERFORMANCE/ELECTRICAL CHARACTERISTICS

Operating Temperature: - 55°C to + 85°C. (to + 125°C with voltage derating.)

Capacitance Range: 0.10µF to 680µF.

Capacitance Tolerance: ± 20%, ± 10% standard. (20% only on P)

Compliant Terminations

100% Surge Current Tested (D & E Case Codes).

Voltage Rating: 4 WVDC to 50 WVDC.

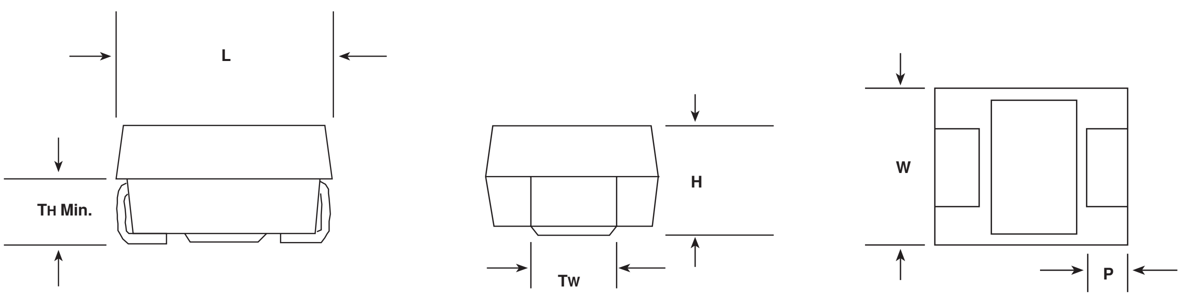
ORDERING INFORMATION

POES	107	M	010	D	X	P	---
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING @ + 85°C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING	
POES POEL	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	M = ± 20% K = ± 10%	This is expressed in volts. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 volts).	See Ratings and Case Code Tables.	X = Solderable coating. Standard.	P = 7" [178mm] reel,* L = 13" [330mm] reel* *cathode nearest sprocket hole.	

Note: Preferred Tolerance and reel sizes are in bold.

We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.

DIMENSIONS in inches [millimeters]



CASE CODE	EIA SIZE	L	W	H	P	TW	T_H (Min.)
A	3216	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343H	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30	0.158 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

For technical questions, contact : poe@pan-overseas.com

Revision June 15, 2004

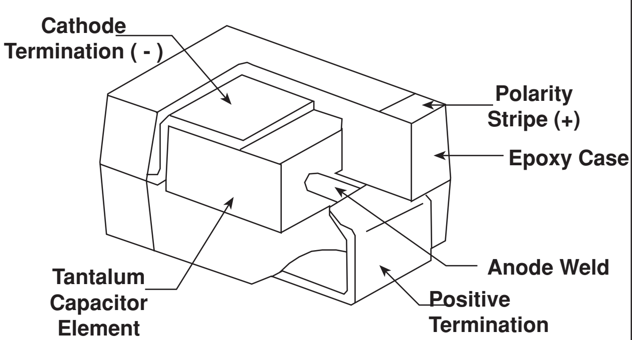
RATINGS AND CASE CODES

µF	4 V		6.3 V		10 V		16 V		20 V		25 V		35 V		50 V	
	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.
0.10													A		A	
0.15													A		B	A
0.22													A		B	A
0.33													A		B	A
0.47											A		B	A	B/C	A
0.68									A		A		B	A	C	B
1.0							A		A		B	A	B	A	C	B
1.5			A		A		A		A		B	A	C	B		C
2.2			A		A		A/B		B	A	B	A	C	B	D	C/D
3.3	A		A		A		A/B		B	A	C	B	C	B	D	C
4.7	A		A/B		A/B		B	A	B/C	A	C	B	D	C	D	
6.8	A		A/B		B	A	B/C	A	C	B	C	B	D	C		D/E
10	A/B		B/C	A	B/C	A	C	A/B	C	B	D	C	D			D/E
15	B	A	B/C	A	C	A/B	C	B	D	B/C	D	C		D/E		
22	B/C	A	C	A/B	C	A/B	D	B/C	D	C		D		D/E		
33	C	A/B	C	A*/B	D	B/C	D	B/C	D	C		D/E		E*		
47	C	A*/B	D	B/C	D	B/C	D	C		D/E		E*				
68	D	B/C	D	B/C	D	B*/C		D		D/E						
100	D	B/C	D/E	B/C		C/D		D/E		E						
150	D	B/C	E	C/D		D/E		D*/E								
220	E	C/D		D/E		D/E										
330		D/E		D/E		E										
470		D/E		E												
680		E														

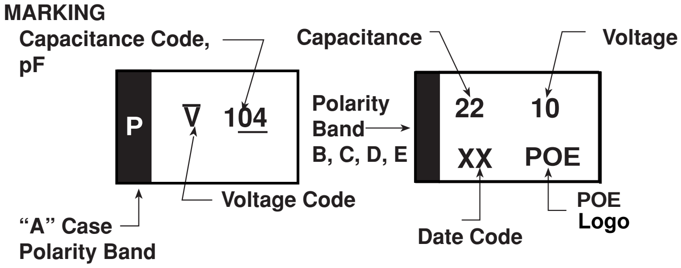
*Preliminary values, contact factory for availability.

CONSTRUCTION AND MARKING

CONSTRUCTION



MARKING



Marking:

Capacitor marking will include an anode (+) polarity band, capacitance in microfarads and the voltage rating of + 85°C. 'A' Case capacitors use a letter code for the voltage and EIA capacitance code.

The POE mark may be included if space permits.

Units rated at 6.3 V shall be marked 6 V.

A manufacturing date code is marked on all case codes.
Call the factory for further explanation.

STANDARD/EXTENDED RATINGS

CAPACITANCE (μF)	CASE CODE	PART NUMBER	Max. DC Leakage @ + 25°C (μA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
4 WVDC @ + 85°C, SURGE = 5.2 V . . . 2.7 WVDC @ + 125°C, SURGE = 3.4 V						
3.3	A	POES335 - 004AX -	0.5	6	7.6	0.10
4.7	A	POES475 - 004AX -	0.5	6	6.3	0.11
6.8	A	POES685 - 004AX -	0.5	6	5.5	0.12
10	A	POES106 - 004AX -	0.5	6	5.1	0.12
10	B	POES106 - 004BX -	0.5	6	3.5	0.16
15	**A**	**POES156 - 004AX -**	**0.6**	**6**	**3.4**	**0.15**
15	B	POES156 - 004BX -	0.6	6	2.9	0.17
22	**A**	**POES226 - 004AX -**	**0.9**	**6**	**2.9**	**0.16**
22	B	POES226 - 004BX -	0.9	6	2.5	0.18
22	C	POES226 - 004CX -	0.9	6	1.8	0.25
33	**A**	**POES336 - 004AX -**	**1.3**	**6**	**2.9**	**0.16**
33	**B**	**POES336 - 004BX -**	**1.3**	**6**	**2.0**	**0.21**
33	C	POES336 - 004CX -	1.3	6	1.8	0.25
47	**B**	**POES476 - 004BX -**	**1.9**	**6**	**1.9**	**0.21**
47	C	POES476 - 004CX -	1.9	6	1.8	0.25
68	**B**	**POES686 - 004BX -**	**2.7**	**6**	**1.9**	**0.21**
68	**C**	**POES686 - 004CX -**	**2.7**	**6**	**1.4**	**0.28**
68	D	POES686 - 004DX -	2.7	6	0.8	0.43
100	**B**	**POES107 - 004BX -**	**4.0**	**8**	**1.8**	**0.22**
100	**C**	**POES107 - 004CX -**	**4.0**	**6**	**0.8**	**0.37**
100	D	POES107 - 004DX -	4.0	6	0.7	0.46
150	**B**	**POES157 - 004BX -**	**6.0**	**14**	**1.6**	**0.23**
150	**C**	**POES157 - 004CX -**	**6.0**	**12**	**0.7**	**0.40**
150	D	POES157 - 004DX -	6.0	8	0.6	0.50
220	**C**	**POES227 - 004CX -**	**8.8**	**8**	**0.7**	**0.40**
220	**D**	**POES227 - 004DX -**	8.8	8	0.6	0.50
220	E	POES227 - 004EX -	8.8	8	0.5	0.57
330	**D**	**POES337 - 004DX -**	**13.2**	**8**	**0.6**	**0.50**
330	**E**	**POES337 - 004EX -**	**13.2**	**8**	**0.5**	**0.57**
470	**D**	**POES477 - 004DX -**	**18.8**	**10**	**0.6**	**0.50**
470	**E**	**POES477 - 004EX -**	**18.8**	**10**	**0.5**	**0.57**
680	**E**	**POES687 - 004EX -**	**27.2**	**12**	**0.5**	**0.57**
6.3 WVDC @ + 85°C, SURGE = 8 V . . . 4 WVDC @ + 125°C, SURGE = 5 V						
2.2	A	POES225 - 6R3AX -	0.5	6	7.6	0.10
3.3	A	POES335 - 6R3AX -	0.5	6	6.3	0.11
4.7	A	POES475 - 6R3AX -	0.5	6	5.5	0.12
6.8	A	POES685 - 6R3AX -	0.5	6	5.0	0.12
6.8	B	POES685 - 6R3BX -	0.5	6	3.4	0.16
10	**A**	**POES106 - 6R3AX -**	**0.6**	**6**	**3.4**	**0.15**
10	B	POES106 - 6R3BX -	0.6	6	2.9	0.17
15	**A**	**POES156 - 6R3AX -**	**0.9**	**6**	**2.9**	**0.16**
15	B	POES156 - 6R3BX -	0.9	6	2.5	0.18
15	C	POES156 - 6R3CX -	0.9	6	1.8	0.25
22	**A**	**POES226 - 6R3AX -**	**1.3**	**6**	**2.9**	**0.16**
22	**B**	**POES226 - 6R3BX -**	**1.3**	**6**	**2.0**	**0.21**
22	C	POES226 - 6R3CX -	1.3	6	1.8	0.25
33	**B**	**POES336 - 6R3BX -**	**2.0**	**6**	**1.9**	**0.21**
33	C	POES336 - 6R3CX -	2.0	6	1.5	0.27
47	**B**	**POES476 - 6R3BX -**	**2.8**	**6**	**1.9**	**0.21**
47	**C**	**POES476 - 6R3CX -**	**2.8**	**6**	**1.4**	**0.28**
47	D	POES476 - 6R3DX -	2.8	6	0.8	0.43
68	**B**	**POES686 - 6R3BX -**	**4.1**	**6**	**1.8**	**0.22**
68	**C**	**POES686 - 6R3CX -**	**4.1**	**6**	**0.8**	**0.37**
68	D	POES686 - 6R3DX -	4.1	6	0.7	0.46
100	**B**	**POES107 - 6R3BX -**	**6.0**	**12**	**1.7**	**0.22**
100	**C**	**POES107 - 6R3CX -**	**6.0**	**6**	**0.8**	**0.37**
100	D	POES107 - 6R3DX -	6.0	6	0.7	0.46
150	**C**	**POES157 - 6R3CX -**	**9.0**	**8**	**0.7**	**0.40**
150	**D**	**POES157 - 6R3DX -**	**9.0**	**8**	**0.6**	**0.50**
150	E	POES157 - 6R3EX -	9.0	8	0.5	0.57
220	**D**	**POES227 - 6R3DX -**	**13.2**	**8**	**0.6**	**0.50**
220	**E**	**POES227 - 6R3EX -**	**13.2**	**8**	**0.5**	**0.57**
330	**D**	**POES337 - 6R3DX -**	**19.8**	**8**	**0.6**	**0.50**
330	**E**	**POES337 - 6R3EX -**	**19.8**	**8**	**0.5**	**0.57**
470	**E**	**POES477 - 6R3EX -**	**28.2**	**10**	**0.5**	**0.57**

*Preliminary values, contact factory for availability. For 10% tolerance, specify "K"; for 20% tolerance, change to "M". **Extended Range ratings in bold print.**

STANDARD/EXTENDED RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER	Max. DC Leakage @ + 25°C (µA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
10 WVDC @ + 85°C, SURGE = 13 V . . . 7 WVDC @ + 125°C, SURGE = 8 V						
1.5	A	POES155 - 010AX -	0.5	6	8.0	0.10
2.2	A	POES225 - 010AX -	0.5	6	6.3	0.11
3.3	A	POES335 - 010AX -	0.5	6	5.5	0.12
4.7	A	POES475 - 010AX -	0.5	6	5.0	0.12
4.7	B	POES475 - 010BX -	0.5	6	3.4	0.16
6.8	**A**	**POES685 - 010AX -**	**0.7**	**6**	**4.2**	**0.13**
6.8	B	POES685 - 010BX -	0.7	6	2.9	0.17
10	**A**	**POES106 - 010AX -**	**1.0**	**6**	**3.4**	**0.15**
10	B	POES106 - 010BX -	1.0	6	2.5	0.18
10	C	POES106 - 010CX -	1.0	6	1.8	0.25
15	**A**	**POES156 - 010AX -**	**1.5**	**6**	**2.9**	**0.16**
15	**B**	**POES156 - 010BX -**	**1.5**	**6**	**2.0**	**0.21**
15	C	POES156 - 010CX -	1.5	6	1.8	0.25
22	**A**	**POES226 - 010AX -**	**2.2**	**8**	**2.5**	**0.17**
22	**B**	**POES226 - 010BX -**	**2.2**	**6**	**1.9**	**0.21**
22	C	POES226 - 010CX -	2.2	6	1.5	0.27
33	**B**	**POES336 - 010BX -**	**3.3**	**6**	**1.9**	**0.21**
33	**C**	**POES336 - 010CX -**	**3.3**	**6**	**1.4**	**0.28**
33	D	POES336 - 010DX -	3.3	6	0.8	0.43
47	**B**	**POES476 - 010BX -**	**4.7**	**6**	**1.8**	**0.22**
47	**C**	**POES476 - 010CX -**	**4.7**	**6**	**1.1**	**0.32**
47	D	POES476 - 010DX -	4.7	6	0.7	0.46
68	**C**	**POES686 - 010CX -**	**6.8**	**6**	**1.0**	**0.33**
68	D	POES686 - 010DX -	6.8	6	0.7	0.46
100	**C**	**POES107 - 010CX -**	**10.0**	**8**	**0.9**	**0.35**
100	**D**	**POES107 - 010DX -**	**10.0**	**8**	**0.6**	**0.50**
150	**D**	**POES157 - 010DX -**	**15.0**	**8**	**0.6**	**0.50**
150	**E**	**POES157 - 010EX -**	**15.0**	**8**	**0.5**	**0.57**
220	**D**	**POES227 - 010DX -**	**22.0**	**8**	**0.6**	**0.50**
220	**E**	**POES227 - 010EX -**	**22.0**	**8**	**0.5**	**0.57**
330	**E**	**POES337 - 010EX -**	**33.0**	**10**	**0.5**	**0.57**
16 WVDC @ + 85°C, SURGE = 20 V . . . 10 WVDC @ + 125°C, SURGE = 12 V						
1.0	A	POES105 - 016AX -	0.5	4	9.3	0.09
1.5	A	POES155 - 016AX -	0.5	6	6.7	0.11
2.2	A	POES225 - 016AX -	0.5	6	5.9	0.11
2.2	B	POES225 - 016BX -	0.5	6	4.6	0.14
3.3	A	POES335 - 016AX -	0.5	6	5.0	0.12
3.3	B	POES335 - 016BX -	0.5	6	3.5	0.16
4.7	**A**	**POES475 - 016AX -**	**0.8**	**6**	**5.0**	**0.12**
4.7	B	POES475 - 016BX -	0.8	6	2.9	0.17
6.8	**A**	**POES685 - 016AX -**	**1.1**	**6**	**4.2**	**0.13**
6.8	B	POES685 - 016BX -	1.1	6	2.5	0.18
6.8	C	POES685 - 016CX -	1.1	6	1.9	0.24
10	**A**	**POES106 - 016AX -**	**1.6**	**6**	**3.0**	**0.16**
10	**B**	**POES106 - 016BX -**	**1.6**	**6**	**2.0**	**0.21**
10	C	POES106 - 016CX -	1.6	6	1.8	0.25
15	**B**	**POES156 - 016BX -**	**2.4**	**6**	**2.0**	**0.21**
15	C	POES156 - 016CX -	2.4	6	1.5	0.27
22	**B**	**POES226 - 016BX -**	**3.5**	**6**	**1.9**	**0.21**
22	**C**	**POES226 - 016CX -**	**3.5**	**6**	**1.4**	**0.28**
22	D	POES226 - 016DX -	3.5	6	0.8	0.43
33	**B**	**POES336 - 016BX -**	**5.3**	**6**	**1.8**	**0.22**
33	**C**	**POES336 - 016CX -**	**5.3**	**6**	**1.1**	**0.32**
33	D	POES336 - 016DX -	5.3	6	0.7	0.46
47	**C**	**POES476 - 016CX -**	**7.5**	**6**	**1.0**	**0.33**
47	D	POES476 - 016DX -	7.5	6	0.7	0.46
68	**D**	**POES686 - 016DX -**	**10.9**	**6**	**0.6**	**0.50**
100	**D**	**POES107 - 016DX -**	**16.0**	**8**	**0.6**	**0.50**
100	**E**	**POES107 - 016EX -**	**16.0**	**8**	**0.6**	**0.52**
150	**E**	**POES157 - 016EX -**	**24.0**	**8**	**0.5**	**0.57**

*Preliminary values, contact factory for availability. For 10% tolerance, specify "K"; for 20% tolerance, change to "M". **Extended Range ratings in bold print.**

STANDARD/EXTENDED RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER	Max. DC Leakage @ + 25°C (µA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
20 WVDC @ + 85°C, SURGE = 26 V . . . 13 WVDC @ + 125°C, SURGE = 16 V						
0.68	A	POES684 - 020AX -	0.5	4	10	0.09
1.0	A	POES105 - 020AX -	0.5	4	8.4	0.09
1.5	A	POES155 - 020AX -	0.5	6	6.3	0.11
2.2	**A**	**POES225 - 020AX -**	**0.5**	**6**	**5.9**	**0.11**
2.2	B	POES225 - 020BX -	0.5	6	3.5	0.16
3.3	**A**	**POES335 - 020AX -**	**0.7**	**6**	**5.9**	**0.11**
3.3	B	POES335 - 020BX -	0.7	6	3.0	0.17
4.7	**A**	**POES475 - 020AX -**	**0.9**	**6**	**5.0**	**0.12**
4.7	B	POES475 - 020BX -	0.9	6	2.9	0.17
4.7	C	POES475 - 020CX -	0.9	6	2.3	0.22
6.8	**B**	**POES685 - 020BX -**	**1.4**	**6**	**2.5**	**0.18**
6.8	C	POES685 - 020CX -	1.4	6	1.9	0.24
10	**B**	**POES106 - 020BX -**	**2.0**	**6**	**2.5**	**0.18**
10	C	POES106 - 020CX -	2.0	6	1.7	0.25
15	**B**	**POES156 - 020BX -**	**3.0**	**6**	**2.3**	**0.19**
15	**C**	**POES156 - 020CX -**	**3.0**	**6**	**1.5**	**0.27**
15	D	POES156 - 020DX -	3.0	6	0.9	0.41
22	**C**	**POES226 - 020CX -**	**4.4**	**6**	**1.1**	**0.32**
22	D	POES226 - 020DX -	4.4	6	0.7	0.46
33	C	POES336 - 020CX -	6.6	6	1.0	0.33
33	D	POES336 - 020DX -	6.6	6	0.7	0.46
47	**D**	**POES476 - 020DX -**	**9.4**	**6**	**0.7**	**0.46**
47	**E**	**POES476 - 020EX -**	**9.4**	**6**	**0.6**	**0.52**
68	**D**	**POES686 - 020DX -**	**13.6**	**6**	**0.7**	**0.46**
68	**E**	**POES686 - 020EX -**	**13.6**	**6**	**0.6**	**0.52**
100	**E**	**POES107 - 020EX -**	**20.0**	**8**	**0.5**	**0.57**
25 WVDC @ + 85°C, SURGE = 32 V . . . 17 WVDC @ + 125°C, SURGE = 20 V						
0.47	A	POES474 - 025AX -	0.5	4	12	0.08
0.68	A	POES684 - 025AX -	0.5	4	8.4	0.09
1.0	**A**	**POES105 - 025AX -**	**0.5**	**4**	**7.6**	**0.10**
1.0	B	POES105 - 025BX -	0.5	4	5.0	0.13
1.5	**A**	**POES155 - 025AX -**	**0.5**	**6**	**6.7**	**0.11**
1.5	B	POES155 - 025BX -	0.5	6	4.6	0.14
2.2	**A**	**POES225 - 025AX -**	**0.6**	**6**	**6.3**	**0.11**
2.2	B	POES225 - 025BX -	0.6	6	3.8	0.15
3.3	**B**	**POES335 - 025BX -**	**0.8**	**6**	**3.1**	**0.17**
3.3	C	POES335 - 025CX -	0.8	6	2.3	0.22
4.7	**B**	**POES475 - 025BX -**	**1.2**	**6**	**2.8**	**0.17**
4.7	C	POES475 - 025CX -	1.2	6	2.0	0.24
6.8	**B**	**POES685 - 025BX -**	**1.7**	**6**	**2.4**	**0.19**
6.8	C	POES685 - 025CX -	1.7	6	1.7	0.25
10	**C**	**POES106 - 025CX -**	**2.5**	**6**	**1.5**	**0.27**
10	D	POES106 - 025DX -	2.5	6	1.0	0.39
15	**C**	**POES156 - 025CX -**	**3.8**	**6**	**1.2**	**0.30**
15	D	POES156 - 025DX -	3.8	6	0.8	0.43
22	**D**	**POES226 - 025DX -**	**5.5**	**6**	**0.7**	**0.46**
33	**D**	**POES336 - 025DX -**	**8.3**	**6**	**0.7**	**0.46**
33	**E**	**POES336 - 025EX -**	**8.3**	**6**	**0.6**	**0.52**

Preliminary values, contact factory for availability. For 10% tolerance, specify "K"; for 20% tolerance, change to "M". **Extended Range ratings in bold print.

STANDARD/EXTENDED RATINGS

CAPACITANCE (μF)	CASE CODE	PART NUMBER	Max. DC Leakage @ + 25°C (μA)	Max. DF @ + 25°C 120 Hz (%)	Max. ESR @ + 25°C 100kHz (Ohms)	Max. RIPPLE 100kHz Irms (Amps)
35 WVDC @ + 85°C, SURGE = 46 V . . . 23 WVDC @ + 125°C, SURGE = 28 V						
0.10	A	POES104 - 035AX -	0.5	4	20	0.06
0.15	A	POES154 - 035AX -	0.5	4	18	0.07
0.22	A	POES224 - 035AX -	0.5	4	15	0.07
0.33	A	POES334 - 035AX -	0.5	4	13	0.08
0.47	**A**	**POES474 - 035AX -**	**0.5**	**4**	**10**	**0.09**
0.47	B	POES474 - 035BX -	0.5	4	8	0.10
0.68	**A**	**POES684 - 035AX -**	**0.5**	**4**	**7.6**	**0.10**
0.68	B	POES684 - 035BX -	0.5	4	6.5	0.11
1.0	**A**	**POES105 - 035AX -**	**0.5**	**4**	**7.5**	**0.10**
1.0	B	POES105 - 035BX -	0.5	4	5.0	0.13
1.5	**B**	**POES155 - 035BX -**	**0.5**	**6**	**4.2**	**0.14**
1.5	C	POES155 - 035CX -	0.5	6	3.8	0.17
2.2	**B**	**POES225 - 035BX -**	**0.8**	**6**	**3.8**	**0.15**
2.2	C	POES225 - 035CX -	0.8	6	2.9	0.20
3.3	**B**	**POES335 - 035BX -**	**1.2**	**6**	**3.5**	**0.16**
3.3	C	POES335 - 035CX -	1.2	6	2.1	0.23
4.7	**C**	**POES475 - 035CX -**	**1.6**	**6**	**1.9**	**0.24**
4.7	D	POES475 - 035DX -	1.6	6	1.3	0.34
6.8	**C**	**POES685 - 035CX -**	**2.4**	**6**	**1.8**	**0.25**
6.8	D	POES685 - 035DX -	2.4	6	1.1	0.37
10	D	POES106 - 035DX -	3.5	6	0.8	0.43
15	**D**	**POES156 - 035DX -**	**5.3**	**6**	**0.7**	**0.46**
15	**E**	**POES156 - 035EX -**	**5.3**	**6**	**0.7**	**0.49**
22	**D**	**POES226 - 035DX -**	**7.7**	**6**	**0.6**	**0.52**
22	**E**	**POES226 - 035EX -**	**7.7**	**6**	**0.6**	**0.52**
50 WVDC @ + 85°C, SURGE = 65 V . . . 33 WVDC @ + 125°C, SURGE = 40 V						
0.10	A	POES104 - 050AX -	0.5	4	19	0.06
0.15	**A**	**POES154 - 050AX -**	**0.5**	**4**	**17**	**0.07**
0.15	B	POES154 - 050BX -	0.5	4	14	0.08
0.22	**A**	**POES224 - 050AX -**	**0.5**	**4**	**15**	**0.07**
0.22	B	POES224 - 050BX -	0.5	4	12	0.08
0.33	**A**	**POES334 - 050AX -**	**0.5**	**4**	**14**	**0.07**
0.33	B	POES334 - 050BX -	0.5	4	10	0.09
0.47	**A**	**POES474 - 050AX -**	**0.5**	**4**	**12**	**0.08**
0.47	B	POES474 - 050BX -	0.5	4	8.4	0.10
0.47	C	POES474 - 050CX -	0.5	4	6.7	0.13
0.68	**B**	**POES684 - 050BX -**	**0.5**	**4**	**7.6**	**0.11**
0.68	C	POES684 - 050CX -	0.5	4	5.9	0.14
1.0	**B**	**POES105 - 050BX -**	**0.5**	**4**	**6.7**	**0.11**
1.0	C	POES105 - 050CX -	0.5	4	4.6	0.16
1.5	**C**	**POES155 - 050CX -**	**0.8**	**6**	**3.4**	**0.18**
2.2	**C**	**POES225 - 050CX -**	**1.1**	**6**	**2.9**	**0.20**
2.2	D	POES225 - 050DX -	1.1	6	2.1	0.27
3.3	**C**	**POES335 - 050CX -**	**1.7**	**6**	**2.5**	**0.21**
3.3	D	POES335 - 050DX -	1.7	6	1.7	0.30
4.7	D	POES475 - 050DX -	2.4	6	1.2	0.37
6.8	**D**	**POES685 - 050DX -**	**3.4**	**6**	**0.9**	**0.41**
6.8	**E**	**POES685 - 050EX -**	**3.4**	**6**	**0.9**	**0.43**
10	**D**	**POES106 - 050DX -**	**5.0**	**6**	**0.8**	**0.43**
10	**E**	**POES106 - 050EX -**	**5.0**	**6**	**0.8**	**0.45**

Preliminary values, contact factory for availability. For 10% tolerance, specify "K"; for 20% tolerance, change to "M". **Extended Range ratings in bold print.

PERFORMANCE CHARACTERISTICS

1. **Operating Temperature:** Capacitors are designed to operate over the temperature range - 55°C to + 85°C.

1.1 Capacitors may be operated to + 125°C with voltage derating to two-thirds the + 85°C rating.

+ 85°C Rating		+ 125°C Rating	
Working Voltage (V)	Surge Voltage (V)	Working Voltage (V)	Surge Voltage (V)
4	5.2	2.7	3.4
6.3	8	4	5
10	13	7	8
16	20	10	12
20	26	13	16
25	32	17	20
35	46	23	28
50	65	33	40

2. **DC Working Voltage:** The DC working voltage is the maximum operating voltage for continuous duty at the rated temperature.

3. **Surge Voltage:** The surge DC rating is the maximum voltage to which the capacitors may be subjected under any conditions, including transients and peak ripple at the highest line voltage.

3.1 **Surge Voltage Test:** Capacitors shall withstand the surge voltage applied in series with a 33 ohm ± 5% resistor at the rate of one-half minute on, one-half minute off, at + 85°C, for 1000 successive test cycles.

3.2 Following the surge voltage test, the dissipation factor and the leakage current shall meet the initial requirements; the capacitance shall not have changed more than ± 10%.

4. **Capacitance Tolerance**: The capacitance of all capacitors shall be within the specified tolerance limits of the normal rating.

4.1 Capacitance measurements shall be made by means of polarized capacitance bridge. The polarizing voltage shall be of such magnitude that there shall be no reversal of polarity due to the AC component. The maximum voltage applied to capacitors during measurement shall be 2 volts rms at 120 Hz at +25°C. If the AC voltage applied is less than one-half volt rms, no DC bias is required. Accuracy of the bridge shall be within ± 2%.

5. **Capacitance Change With Temperature**: The capacitance change with temperature shall not exceed the following percentage of the capacitance measured at + 25°C:

- 55°C	+ 85°C	+ 125°C
- 10%	+ 10%	+ 12%

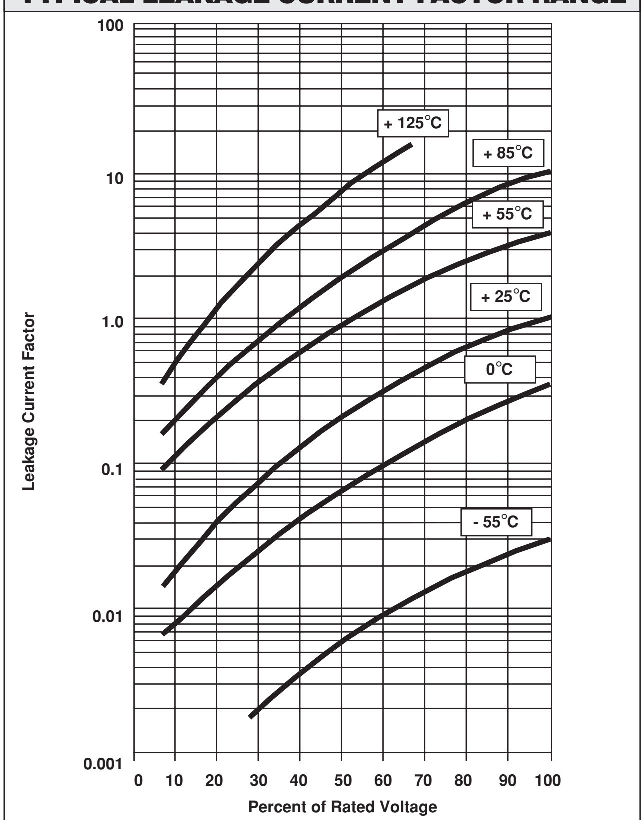
6. **Dissipation Factor:** The dissipation factor, determined from the expression $2\pi fRC$, shall not exceed values listed in the Standard Ratings Table.

6.1 Measurements shall be made by the bridge method at, or referred to, a frequency of 120 Hz and a temperature of + 25°C.

7. **Leakage Current:** Capacitors shall be stabilized at the rated temperature for 30 minutes. Rated voltage shall be applied to capacitors for 5 minutes using a steady source of power (such as a regulated power supply) with 1000 ohm resistor connected in series with the capacitor under test to limit the charging current. Leakage current shall then be measured.

Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor.

TYPICAL LEAKAGE CURRENT FACTOR RANGE



PERFORMANCE CHARACTERISTICS (Continued)

7.1 **At + 25°C,** the leakage current shall not exceed the value listed in the Standard Ratings Table.

7.2 **At + 85°C,** the leakage current shall not exceed 10 times the value listed in the Standard Ratings Table.

7.3 **At + 125°C,** the leakage current shall not exceed 12 times the value listed in the Standard Ratings Table.

8. <u>ESR</u>

8.1 **ESR (Equivalent Series Resistance)** shall not exceed the values listed in the Ratings Table. Measurement shall be made by the bridge method at a frequency of 100kHz and a temperature of +25°C.

9. **Life Test:** Capacitors shall withstand rated DC voltage applied at + 85°C or two-thirds rated voltage applied at + 125°C for 2000 hours.

9.1 Following the life test, the dissipation factor shall meet the initial requirement; the capacitance change shall not exceed ± 10%; the leakage current shall not exceed 125% of the initial requirement.

10. **Vibration Tests**: Capacitors shall be subjected to vibration tests in accordance with the following criteria.

10.1 Capacitors shall be secured for test by means of a rigid mounting using suitable brackets.

10.2 **Low Frequency Vibration:** Vibration shall consist of simple harmonic motion having an amplitude of 0.03" [0.76mm] and a maximum total excursion of 0.06" [1.52mm], in a direction perpendicular to the major axis of the capacitors.

10.2.1 Vibration frequency shall be varied uniformly between the approximate limits of 10 Hz to 55 Hz during a period of approximately one minute, continuously for 1.5 hours.

10.2.2 An oscilloscope or other comparable means shall be used in determining electrical intermittency during the final 30 minutes of the test. The AC voltage applied shall not exceed 2 volts rms.

10.2.3 Electrical tests shall show no evidence of intermittent contacts, open circuits or short circuits during these tests.

10.2.4 Following the low frequency vibration test, capacitors shall meet the original requirements for capacitance, dissipation factor and leakage current.

10.3 **High Frequency Vibration**: Vibration shall consist of a simple harmonic motion having an amplitude of 0.06" [1.52] ± 10% maximum total excursion or 20 g peak whichever is less.

10.3.1 Vibration frequency shall be varied logarithmically from 50 Hz to 2000 Hz and return to 50 Hz during a cycle period of 20 minutes.

10.3.2 The vibration shall be applied for 4 hours in each of 2 directions, parallel and perpendicular to the major axis of the capacitors.

10.3.3 Rated DC voltage shall be applied during the vibration cycling.

10.3.4 An oscilloscope or other comparable means shall be used in determining electrical intermittency during the last cycle. The AC voltage applied shall not exceed 2 volts rms.

10.3.5 Electrical tests shall show no evidence of intermittent contacts, open circuits or short circuits during these tests.

10.3.6 There shall be no mechanical damage to these capacitors as a result of these tests.

10.3.7 Following the high frequency vibration test, capacitors shall meet the original limits for capacitance, dissipation factor and leakage current.

11. **Acceleration Test:**

11.1 Capacitors shall be rigidly mounted by means of suitable brackets.

11.2 Capacitors shall be subjected to a constant acceleration of 100 g for a period of 10 seconds in each of 2 mutually perpendicular planes.

11.2.1 The direction of motion shall be parallel to and perpendicular to the longitudinal axis of the capacitors.

11.3 Rated DC voltage shall be applied during acceleration test.

11.3.1 An oscilloscope or other comparable means shall be used in determining electrical intermittency during test. The AC voltage applied shall not exceed 2 volts rms.

11.4 Electrical tests shall show no evidence of intermittent contacts, open circuits or short circuits during these tests.

11.5 There shall be no mechancial damage to these capacitors as a result of these tests.

11.6 Following the acceleration test, capacitors shall meet the original limits for capacitance, dissipation factor and leakage current.

PERFORMANCE CHARACTERISTICS (Continued)

12. Shock Test:

12.1 Capacitors shall be rigidly mounted by means of suitable brackets. The test load shall be distributed uniformly on the test platform to minimize the effects of unbalanced loads.

12.1.1 Test equipment shall be adjusted to produce a shock of 100 g peak with the duration of 6 mS and sawtooth waveform at a velocity change of 9.7 ft./sec.

12.2 Capacitors shall be subjected to 3 shocks applied in each of 3 directions corresponding to the 3 mutually perpendicular axes of the capacitors.

12.3 Rated DC voltage shall be applied during test.

12.3.1 An oscilloscope or other comparable means shall be used in determining electrical intermittency during tests. The replacement voltage applied shall not exceed 2 volts rms.

12.4 Electrical tests shall show no evidence of intermittent contacts, open circuits or short circuits during these tests.

12.5 There shall be no mechanical damage to these capacitors as a result of these tests.

12.6 Following the shock test, capacitors shall meet the original limits for capacitance, dissipation factor and l leakage current.

13. Moisture Resistance:

13.1 Capacitors shall be subjected to temperature cycling at 90% to 95% relative humidity, from + 25°C to +65°C to + 25°C (+ 10°C, - 2°C) over a period of 8 hours per cycle for 1000 hours.

13.2 Following the moisture resistance test, the leakage current and dissipation factor shall meet the initial requirements, and the change in capacitance shall not exceed ± 10%.

14. Thermal Shock:

14.1 Capacitors shall be conditioned prior to temperature cycling for 15 minutes at + 25°C, at less than 50% relative humidity and a barometric pressure at 28 to 31"

14.2 Capacitors shall be subjected to thermal shock in a cycle of exposure to ambient air at :
- 55°C (+ 0°C,- 5°C) for 30 minutes, then
+ 25°C (+10°C, - 5°C) for 5 minutes, then
+ 125°C (+ 3°C, - 0°C) for 30 minutes, then
+ 25°C (+ 10°C, - 5°C) for 5 minutes for 5 cycles.

14.3 Capacitors shall show no evidence of harmful or extensive corrosion, obliteration of marking or other visible damage.

14.4 Following the thermal shock test, capacitors shall meet the original requirements for leakage current and dissipation factor. Capacitance change shall not exceed ± 5% of the original measured value.

15. Soldering Compatibility:

15.1 Resistance to Solder Heat: Capacitors will withstand exposure to + 260°C + 5°C for 10 seconds.

15.1.1 Following the resistance to soldering heat test, capacitance, dissipation factor and DC leakage current shall meet the initial requirement.

15.2 Solderability: Capacitors will meet the solderability requirements of ANSI/J-STD-002, Test B (MIL-STD-202, method and test S.)

16. Terminal Strength: Per UEC-384-3, minimum of 5N shear force.

17. Environmental: Mercury, CFC and ODS materials are not used in the manufacture of these capacitors.

18. Flammability: Encapsulant materials meet UL94 V0 with an oxygen index of 32%.

19. Capacitor Failure Mode: The predominant failure mode for solid tantalum capacitors is increased leakage current resulting in a shorted circuit. Capacitor failure may result from excess forward or reverse DC voltage, surge current, ripple current, thermal shock or excessive temperature. The increase in

20. Surge Current: All D and E case code POES, POEL capacitors are 100% surge current tested at + 25°C and rated voltage. The total series circuit resistance is 0.5 ohms. Each charge cycle of 0.10 seconds is followed by a discharge cycle of 0.10 seconds. Three surge cycles are applied. Each capacitor is tested individually to maximize the peak charging current.

GUIDE TO APPLICATION

1. **A-C 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 Watts @ + 25°C as given in the table in Paragraph Number 5 (Power Dissipation).

R_{ESR} = The capacitor Equivalent Series Resistance at the specified frequency.

2. **A-C 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 Watts @ + 25°C as given in the table in Paragraph Number 5 (Power Dissipation).

R_{ESR} = The capacitor Equivalent Series Resistance at the specified frequency.

Z = The capacitor impedance at the specified frequency.

2.1 The sum of the peak AC voltage plus the DC voltage shall not exceed the DC voltage rating of the capacitor.

2.2 The sum of the negative peak AC voltage plus the applied DC voltage shall not allow a voltage reversal exceeding 10% of the DC rating at + 25°C.

3. **Reverse Voltage:** These capacitors are capable of withstanding peak voltages in the reverse direction equal to 10% of the DC rating at + 25°C, 5% of the DC rating at + 85°C and 1% of the DC rating at +125°C.

4. **Temperature Derating**: If these capacitors are to be operated at temperatures above + 25°C, the permissible rms ripple current or voltage shall be calculated using the derating factors as shown:

Temperature	Derating Factor
+ 25°C	1.0
+ 85°C	0.9
+ 125°C	0.4

5. **Power Dissipation**: Power dissipation will be affected by the heat sinking capability of the mounting surface. Non-sinusoidal ripple current may produce heating effects which differ from those shown. It is important that the equivalent *Irms* value be established when calculating permissible operating levels. (Power Dissipation calculated using + 25°C temperature rise.)

Case Code	Maximum Permissible Power Dissipation @ + 25°C (Watts) in free air
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165

6. **Printed Circuit Board Materials**: Type POES, POEL capacitors are compatible with commonly used printed circuit board materials (alumina substrates, FR4, FR5, G10, PTFE-fluorocarbon and porcelanized steel).

7. **Attachment:**

7.1 **Solder Paste:** The recommended thickness of the solder paste after application is .007" ± .001" [.178mm ± .025mm]. Care should be exercised in selecting the solder paste. The metal purity should be as high as practical. The flux (in the paste) must be active enough to remove the oxides formed on the metallization prior to the exposure to soldering heat. In practice this can be aided by extending the solder preheat time at temperatures below the liquidous state of the solder.

7.2 **Soldering:** Capacitors can be attached by conventional soldering techniques - vapor phase, infrared reflow, wave soldering and hot plate methods. The Soldering Profile chart shows maximum recomended time/temperature conditions for soldering. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature.

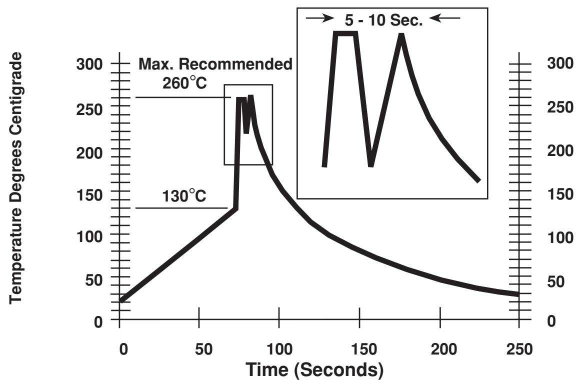
8. **Cleaning (Flux Removal) After Soldering:** The POES, POEL are compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorethane, Terpene and aqueous cleaning media. However, CFC/ODS products are not used in the production of these devices and are not recommended. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

8.1 When using ultrasonic cleaning, the board may resonate if the output power is too high. This vibration can cause cracking or a decrease in the adherence of the termination. DO NOT EXCEED 9W/l @ 40kHz for 2 minutes.

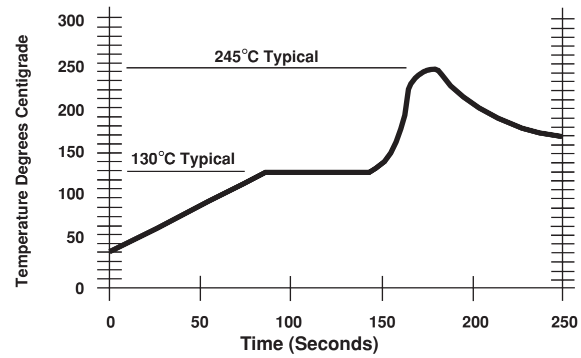
GUIDE TO APPLICATION (Continued)

SOLDERING PROFILE

Recommended Solder Profile — Wave Solder



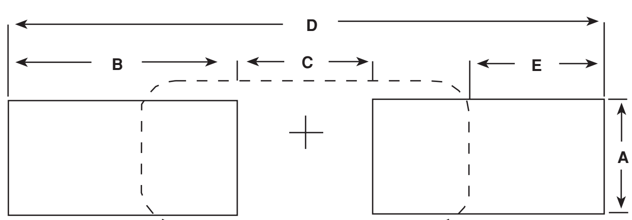
Recommended Solder Profile — Reflow



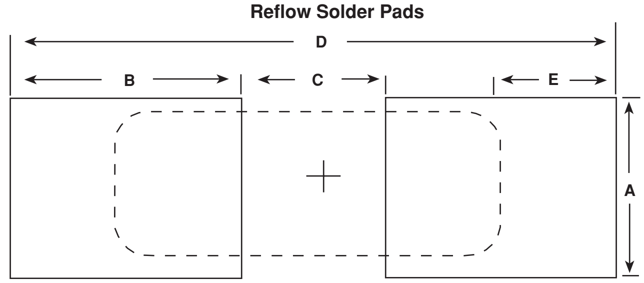
9. **Recommended Mounting Pad Geometries**: Proper mounting pad geometries are essential for successful solder connections. These dimensions are highly process sensitive and should be designed to minimize component rework due to unacceptable solder joints. The dimensional configurations shown are the recommended pad geometries for both wave and reflow soldering techniques. These dimensions are intended to be a starting point for circuit board designers and may be fine tuned if necessary based upon the peculiarities of the soldering process and/or circuit board design.

RECOMMENDED MOUNTING PAD GEOMETRIES in inches [millimeters]

Wave Solder Pads

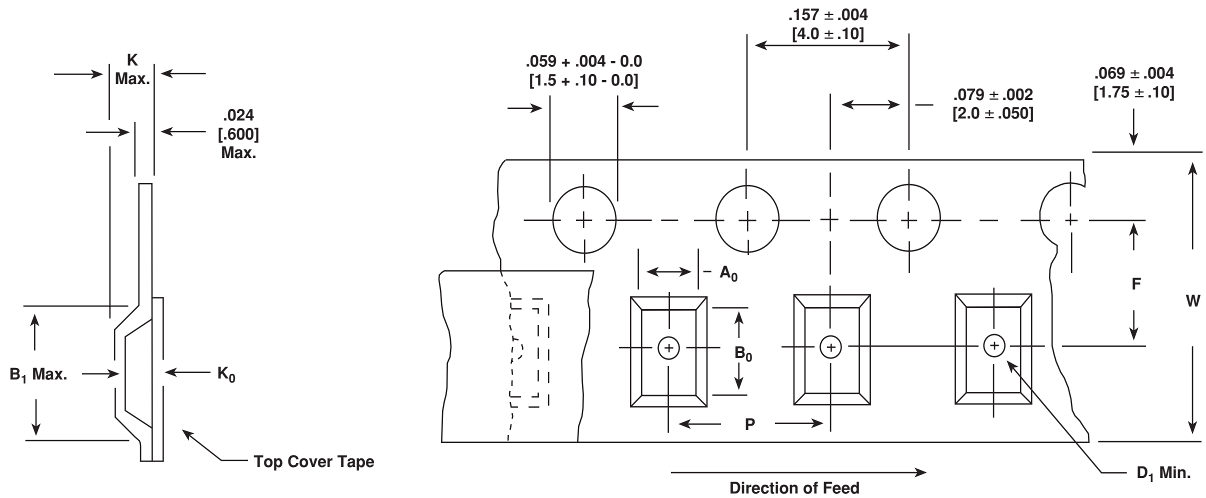


Reflow Solder Pads

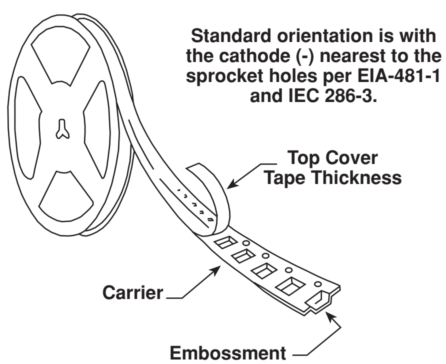


Pad Dimensions (Wave)						Pad Dimensions (Reflow)					
Case Code	A (Min.)	B (Nom.)	C (Nom.)	D (Nom.)	E (Nom.)	Case Code	A (Min.)	B (Nom.)	C (Nom.)	D (Nom.)	E (Nom.)
A	0.034 [0.87]	0.085 [2.15]	0.053 [1.35]	0.222 [5.65]	0.048 [1.23]	A	0.071 [1.80]	0.085 [2.15]	0.053 [1.35]	0.222 [5.65]	0.048 [1.23]
B	0.061 [1.54]	0.085 [2.15]	0.065 [1.65]	0.234 [5.95]	0.048 [1.23]	B	0.110 [2.80]	0.085 [2.15]	0.065 [1.65]	0.234 [5.95]	0.048 [1.23]
C	0.061 [1.54]	0.106 [2.70]	0.124 [3.15]	0.337 [8.55]	0.050 [1.28]	C	0.110 [2.80]	0.106 [2.70]	0.124 [3.15]	0.337 [8.55]	0.050 [1.28]
D	0.066 [1.68]	0.106 [2.70]	0.175 [4.45]	0.388 [9.85]	0.050 [1.28]	D	0.118 [3.00]	0.106 [2.70]	0.175 [4.45]	0.388 [9.85]	0.050 [1.28]
E	0.066 [1.68]	0.106 [2.70]	0.175 [4.45]	0.388 [9.85]	0.050 [1.28]	E	0.118 [3.00]	0.106 [2.70]	0.175 [4.45]	0.388 [9.85]	0.050 [1.28]

TAPE AND REEL PACKAGING in inches [millimeters]

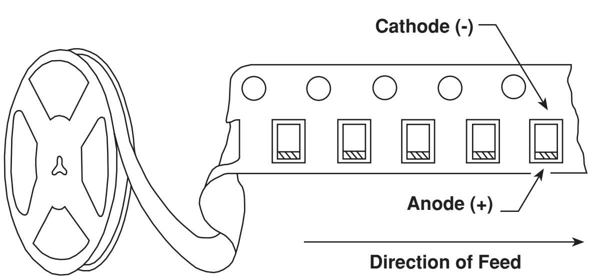


TAPE SIZE	B_1 (Max.)	D_1 (Min.)	F	K (Max.)	P	W	$A_0B_0K_0$
8mm	0.165 [4.2]	0.039 [1.0]	0.138 ± 0.002 [3.5 ± 0.05]	0.094 [2.4]	0.157 ± 0.004 [4.0 ± 1.0]	0.315 ± 0.012 [8.0 ± 0.30]	**Notes:** $A_0B_0K_0$ are determined by component size. The clearance between the component and the cavity must be within 0.002" [0.05mm] minimum to 0.020" [0.50mm] maximum for 8mm tape and 0.002" [0.05mm] minimum to 0.026" [0.65mm] maximum for 12mm tape.
12mm	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.177 [4.5]	0.315 ± 0.004 [8.0 ± 1.0]	0.472 ± 0.012 [12.0 ± 0.30]	



Tape and Reel Specifications: All case codes are available on plastic embossed tape per EIA-481-1. Tape reeling per IEC 286-3 is also available. Standard reel diameter is 13" [330mm]. 7" [178mm] reels are available.

The most efficient packaging quantities are full reel increments on a given reel diameter. The quantities shown allow for the sealed empty pockets required to be in conformance with EIA-481-1. Reel size must be specified in the Pan Overseas Electronic part number.



Case Code	Tape Width	Component Pitch	Units Per Reel 7" [178mm] Reel	13" [330mm] Reel
A	8mm	4mm	2000	9000
B	8mm	4mm	2000	8000
C	12mm	8mm	500	3000
D	12mm	8mm	500	2500
E	12mm	8mm	400	1500

Application Notes
Guidelines for Surface Mounting of Tantalum Chip Capacitors

INTRODUCTION

The increased use of surface mount components has led many users to revise their assembly procedures and specifications for printed circuit boards. This section will review basic principles and recommendations for mounting surface mount capacitors.

Capacitors can be attached by conventional soldering techniques such as vapor phase, infrared reflow, wave soldering and hot plate methods. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature.

RECOMMENDED MOUNTING PAD GEOMETRIES

Proper mounting pad geometries are essential for successful solder connections. The dimensions are highly process sensitive and should be designed to minimize component rework due to unacceptable solder joints.

Recommended pad geometries are shown for both wave and reflow soldering techniques. These dimensions are intended to be a starting point for circuit board designers and may be fine tuned if necessary based upon the peculiarities of the soldering process and/or circuit board design.

The ideal soldering pad should produce an ideal soldering fillet, a satisfactory electrical connection for the component on the board and a mechanically sound structure to handle the stresses which appear during mounting and subsequent use of the board.

It should be remembered that each assembly operation depends on manufacturing tolerances (tolerance of substrate itself and tolerance of placement of the substrate on the mounting equipment, tolerance of the pick-and-place machine itself, etc.). We estimate the total absolute value of this tolerance "e" is 0.010" [0.25].

PAD LAYOUT FOR REFLOW SOLDERING

The "A" width of the pad is equal to the maximum width of the component connection plus the total tolerance of the entire system (e = ± 0.010" [0.25]): manufacturing of substrates and pads, holding systems of the substrate on the equipment, alignment, repeatability of the chip placement, etc...

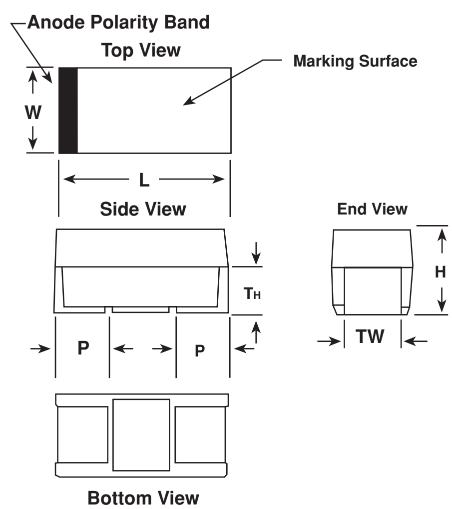
The "D" overall length of the pads is equal to the maximum length of the component plus the "E" zone, necessary to the formation of the soldering fillet. Here we may take into account the tolerance "e" of the system. During reflow, the component tends to center itself on the pads, so, some users don't take into account the tolerance of the system. "D (minimum)" represents this dimension without the tolerance "e" factor and "D (nominal)" takes this factor into account.

The "C" length between the pads is a very critical dimension which has to be maintained; if not, "tombstoning" might occur. We may have to change the dimensions of the pads, however, the "C" dimension should be kept the same.

In the applicable EIA standards, there are recommendations concerning the "E" zone, the outside part of the pads used to form the soldering fillet (0.197" [0.5] ≤ E ≤ 0.039" [1.0]). For the calculation of the "D (minimum)" value, we have chosen "E1" = 0.197" [0.5] and "E2" = .039" [1.0] for the "D (nominal)" value.

PAD LAYOUT FOR REFLOW SOLDERING

For a POES Tantalum Chip Capacitor

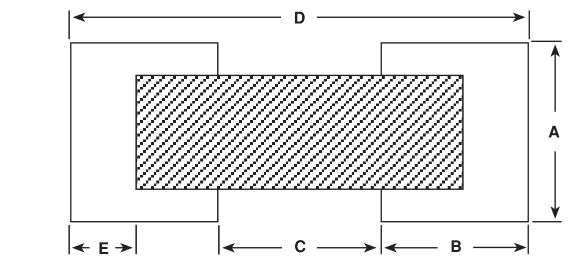


in inches [millimeters]

Case	A	B	C	D
T_WMax.	0.091 [2.3]	0.091 [2.3]	0.091 [2.3]	0.098 [2.5]
LMax.	0.134 [3.4]	0.146 [3.7]	0.248 [6.3]	0.299 [7.6]
LNom.	0.126 [3.2]	0.138 [3.5]	0.236 [6.0]	0.287 [7.3]
PMax.	0.043 [1.1]	0.043 [1.1]	0.063 [1.6]	0.063 [1.6]
PNom.	0.031 [0.8]	0.031 [0.8]	0.051 [1.3]	0.051 [1.3]
T_H Min.	0.028 [0.7]	0.028 [0.7]	0.039 [1.0]	0.039 [1.0]

PAD DIMENSIONS

For a POES Tantalum Chip Capacitor



[Numbers in brackets indicate millimeters]

Case	A	B	C	D
A (Min.)	0.071 [1.8]	0.110 [2.8]	0.110 [2.8]	0.118 [3.0]
B (Min.)	0.059 [1.5]	0.059 [1.5]	0.083 [2.1]	0.083 [2.1]
B (Nom.)	0.083 [2.1]	0.083 [2.1]	0.106 [2.7]	0.106 [2.7]
C	0.051 [1.3]	0.063 [1.6]	0.122 [3.1]	0.173 [4.4]
D (Min.)	0.173 [4.4]	0.185 [4.7]	0.287 [7.3]	0.339 [8.6]
D (Nom.)	0.220 [5.6]	0.232 [5.9]	0.335 [8.5]	0.386 [9.8]
E (Min.)	0.020 [0.5]	0.020 [0.5]	0.020 [0.5]	0.020 [0.5]
E (Nom.)	0.047 [1.2]	0.047 [1.2]	0.051 [1.3]	0.051 [1.3]

The calculation formula for the pad layout:

A (Min.) = Tw (Max.) + 2e
B (Min.) = [D (Min.) - C]/2
B (Nom.) = [D (Nom.) - C]/2
C = L (Nom.) - 2P (Nom.) - e
D (Min.) = L (Max.) + 2 E_1
D (Nom.) = L (Max.) + 2 E_2 + e
E (Min.) = [D (Min.) - L (Max.)]/2
E (Nom.) = [D (Nom.) - L (Nom.)]/2

REFLOW SOLDER PROCESS

Two reflow processes are commonly used, vapor phase and infrared reflow. Both reflow solder processes require the application of solder paste prior to component placement.

The thickness of the soldering paste deposited or applied by screen printing is generally equal to .008" [0.2]. This thickness, related to the surface of the pad, determines the quantity of solder which will form the joint during the reflow. This reflow has to be sufficient to obtain an ideal solder fillet at a 45° angle.

Care should be exercised in selecting the solder paste. The metal purity should be as high as practical. The flux (in the paste) must be active enough to remove the oxides formed on the metallization prior to the exposure to soldering heat. In practice this can be aided by extending the solder preheat time at temperatures below the liquidous state of the solder.

The Vapor Phase Reflow Solder Process uses fluorocarbon liquids, boiled to produce a vapor saturated atmosphere, at a temperature slightly higher than the boiling point of the liquid and high enough to reflow the solder.

The Infrared Reflow Solder Process uses heat energy produced by an infrared radiation source and by convection (natural or forced). In such a system, the heat time is dependent of the absorption coefficient of the material surfaces and of the thermal mass of all the components in relation to the surface available to the infrared radiation.

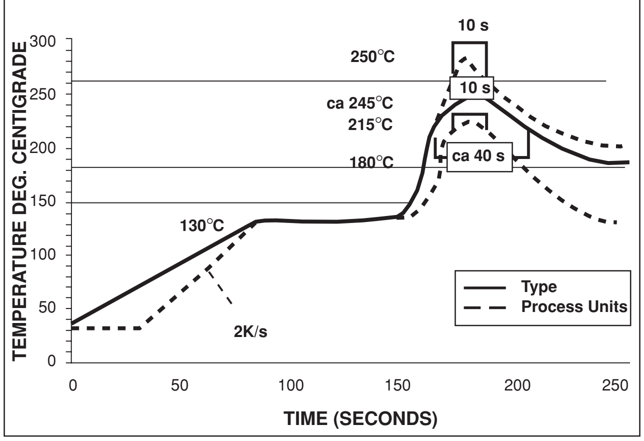
The temperature of the components in an infrared oven is not precisely defined and temperature measurements should be taken on the capacitors themselves when they are going through the oven. The temperature of small components may reach + 280°C when they are soldered at the same time as larger ones. The parameters which act on the temperature of the components are:

— Time and power
— Mass of the component
— Size of the component
— Dimensions of the substrate
— Absorption coefficient of the surfaces
— Density of the components
— Wave length of the radiation source
— Ratio between radiated energy and convection energy

A standard profile of this process is given in the graph shown:

A preheat period is necessary for the evaporation of all the volatile solvents contained in the solder paste before the action of the flux. It initializes the action of the flux on the solder and also on the metallic surfaces of the component terminations and substrate.

REFLOW SOLDER STANDARD TEMPERATURE PROFILE



RECOMMENDATIONS:

1. Preheat the substrate (to eliminate all traces of humidity on the substrate) before applying the solder paste - 4 hours at + 65°C minimum.
2. In case of a double side mounting, do not clean the substrate after the first pass. This may induce a high humidity level which will affect the quality of the solder during the second pass through.
3. Minimal solder fillets are always preferable. Solder paste should not creep very high on the terminations.
4. Good fillets are produced by a good wetting of the terminations (verify the angles resulting from wetting).
5. The mechanical adhesion of the part on the substrate is primarily produced by the solder of the terminations directly in contact with the substrate.

PAD LAYOUT FOR WAVE SOLDERING

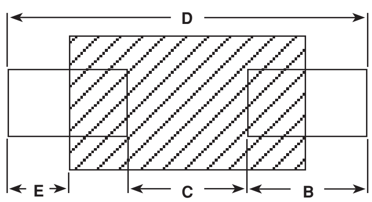
The pad layout is similar to that for reflow soldering except for the "A" dimension, which is reduced by two-thirds because the components are completely dipped into the solder bath, providing enough material to achieve the solder fillet.

Processing should avoid too much solder in the termination zone in order to limit the mechanical stresses during the assembly and use of the component. Hot air flow wave soldering may help reduce the dimensions of the solder fillet.

The components are glued before soldering which prohibits movement during processing. The "D" dimension must include the tolerance of the system.

PAD DIMENSIONS

For a Type POES Tantalum Chip Capacitor



[Numbers in brackets indicate millimeters]

Case	A	B	C	D
A (Min.)	0.047 [1.2]	0.075 [1.9]	0.075 [1.9]	0.079 [2.0]
B (Min.)	0.063 [1.6]	0.063 [1.6]	0.087 [2.2]	0.087 [2.2]
B (Nom.)	0.083 [2.1]	0.083 [2.1]	0.106 [2.7]	0.106 [2.7]
C	0.051 [1.3]	0.063 [1.6]	0.122 [3.1]	0.173 [4.4]
D (Min.)	0.181 [4.6]	0.193 [4.9]	0.295 [7.5]	0.346 [8.8]
D (Nom.)	0.220 [5.6]	0.232 [5.9]	0.335 [8.5]	0.386 [9.8]
E (Min.)	0.024 [0.6]	0.024 [0.6]	0.024 [0.6]	0.024 [0.6]
E (Nom.)	0.047 [1.2]	0.047 [1.2]	0.051 [1.3]	0.051 [1.3]

The calculation formula for the pad layout:

A (Min.)	=	(Tw (Max.) + 2 e) x 0.67
B (Min.)	=	[D (Min.) - C]/2
B (Nom.)	=	[D (Nom.) - C]/2
C	=	L (Nom.) - 2P (Nom.) - e
D (Min.)	=	L (Max.) + 2 E_1 + e
D (Nom.)	=	L (Max.) + 2 E_2 + e
E (Min.)	=	[D (Min.) - L (Max).]/2
E (Nom.)	=	[D (Nom.) - L (Nom.)]/2

WAVE SOLDERING PROCESS

Wave soldering includes the five steps shown:

— Drying
— Fluxing
— Preheating
— Soldering

1. Drying:
The goal of drying is to eliminate water from the substrate. This is dependent on prior steps, particularly on the storage conditions. It may be optional.

2. Fluxing:
The goal of the fluxing operation is to improve the wetting by:
— Deoxidation of metallic parts,
— Decreasing the surface tension produced in contact with the solder wave,
— Preservation of the board from oxidation between the flux and the wave soldering operation.

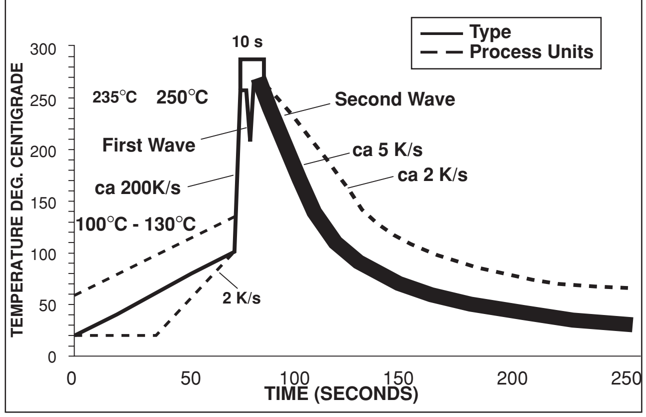
The choice of the flux (resin, organic or inorganic) will determine cleaning solvents employed.

3. Preheat:
This step is intended:
— To evaporate the volatile products contained in the flux.
— To take the flux to its activation temperature,
— To limit the thermal shock, which acts on the boards and the components.

The preheating may be accomplished by hot air or infrared processes.

4. Soldering:
The soldering of surface mounted components requires the use of a wave which insures sufficient flow of the solder between the components and which, however, minimize solder fillet and bridging. The graph indicates a standard temperature profile used in this process:

WAVE SOLDER STD. TEMPERATURE PROFILE



Recommendations:

1. Preheat both substrate and components.
2. Do not use a standard wave normally used for boards with leaded components. These waves are not optimized for solder boards with surface mount components.
3. The temperature gradient between preheat and wave soldering must be smaller than + 100°C.
4. Terminations must go through the wave simultaneously.
5. Optimal conditions: Travel through the wave from + 240°C to + 250°C for 3 to 5 seconds.
6. Verify that the upper side temperature of the board does not exceed + 150°C.
7. Do not increase the wave temperature to improve solderability.
8. Do not increase the time to improve solderability.
9. Do not increase the temperature to reduce solder balls or bridges.
10. Check wave profiles frequently.
11. Use hot air at + 275°C blowing on the solder joints immediately after the wave, in order to minimize bridging and to reduce the solder fillet size. Hot air should be applied to the substrate when the temperature is approx. + 230°C.
12. Control cooling speed between 2°C and 5°C per second.

REWORK AND REPAIR TECHNIQUES:

Occasionally rework or repair will be required. For example:
1. Repair to correct too much or not enough solder.
2. Realignment of the component when it has been misplaced in wet solder paste or in wet adhesive or even during the solder operation itself.
3. Replacement of the component because of placement error or failure.
   The standards for visual inspection have to be defined very precisely for points 1 and 2. The following must be kept in mind:

A. Are the risks of repair larger than the risks involved in not repairing?
B. The repair process must yield products which will meet the standard specifications on a regular basis.
C. Do not include repair in your process specification. Any repair must be an exception.

ADDING SOLDER

If there is not enough solder, inspect for the cause:
1. Not enough solder or improper paste screening (reflow solder).
2. Shadowing of terminations in wave soldering due to the carrier tray, other components, a too close termination or a ripple in the solder wave.
3. Non-wetting of pads or terminations.

Use an iron with enough wattage. A good method of judge-ment is to control the time to reflow the solder: Less than 1 to 1.5 seconds, the tip temperature is excessive; more than 3 to 3.5 seconds, either the tip temperature is insufficient or the tip is cooling when applied to the circuit board. An iron which regulates the temperature is required. Apply a small amount of flux to the component termination and the pad layout (the new synthetic no residue fluxes are excellent). After tinning, the iron tip should be placed on the circuit pad at the edge furthest from the component. The operation must be done in 1.5 to 3 seconds. If it is necessary to keep the iron on longer than 3 seconds, the component should be replaced. The solder should be added at the solder iron tip and will flow from the pad to the termination of the component. Be careful not to add too much solder. Direct contact with the component may cause damage and subsequent failure.

REMOVING SOLDER

Bridges, splatter and solder spikes are examples of excess solder conditions.

Our recommendations concerning the soldering iron apply here as well: time on the solder joint not to exceed 3 secs., do not touch the component or its termination. Use a copper braid solder wick or a vacuum solder pump to remove the excess solder. Use of hot gas nozzles or other complex tools should be restricted to removal of component itself.

REALIGNMENT

This should be done rarely because it is usually preferable to replace the component. If misalignment appears after placement in molten solder paste, it is easy to correct by lifting the part with a vacuum nozzle and realigning it. But it is always better to correct the cause of the problem at the placement machine, solder paste screening, etc.

For wave soldering, an alignment defect is even easier to correct before curing of the adhesive. At that time, the part should be removed with most of the adhesive. Add new adhesive and place a new part. Use of too much adhesive will result in definitive solder defects (open circuit). For misalign-ment noted after curing of the adhesive, the only solution is to replace it with a new part.

REPLACEMENT

This operation must be done in less than 6 seconds in order not to damage the pad layout on the boards. Twisting and pulling forces are transmitted to the pads during the removal of a component. Again, strict temperature control is required.

For parts glued with adhesive, the solder must first be removed by means of copper braid solder wicks or a vacuum pump. Replacement must be done with a new part, after a careful cleaning of the substrate.

CLEANING

After mounting, components and boards are normally cleaned. Cleaning methods are the same for traditional leaded components but the geometry or the assembly of surface mount components make the cleaning more difficult to achieve. Most of the components (resistor or capacitor chips) have no cleaning stand offs and are applied directly on the board.

Commonly used are solvents such as TES, TMS, Prelete, Chlorethane, Terpene and aqueous cleaning media. However, CFC/ODS products are not used in the production of these devices and are not recommended. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

When using ultrasonic cleaning, the board may resonate if the output power is too high. This vibration can cause cracking or a decrease in the adherence of the termination.

STANDARD TESTS

A number of standards (particularly CECC, IEC, MIL) have used tests which are applicable to surface mount components. The tables summarize common test conditions which are pertinent to soldering.

RESISTANCE TO SOLDER HEAT

Conditions		Simulated Process
°C	Seconds	
260 ± 5	10 ± 1	Double wave infrared
260 ± 5	5 ± 1	Single wave infrared
215 ± 3	40 ± 1	Vapor phase infrared

SOLDERABILITY AND LEACHING RESISTANCE

Parameter Tested	Conditions		Simulated Process
	°C	Seconds	
Wetting	235 ± 5	2 ± 0.2	Wave
	215 ± 3	3 ± 0.3	Infrared Vapor phase Wave
Dewetting	260 ± 5	10 ± 1	
Leaching	260 ± 5	30 ± 1	Wave

CLEANING CONDITIONS

Process		Conditions	Cleaning Solvents
Liquid	Boiling	40 - 80°C/4 min.	• Deionized water • Ethanol • Isopropanol • Halogenated Hydrocarbons
	Ultrasonic	45°C/2 min. 9 W/l/40kHz	
	Steam	80°C/30 sec.	
	Spray	45°C/16 bar	