



VISHAY INTERTECHNOLOGY, INC.

VISHAY THIN FILM LEAD FREE WRAPAROUND PROCESS



Qualification Report # 28249
Vishay Thin Film Lead free wraparound process
Models series: P ns, PTN, L ns, M

Eight lead-free wraparound termination lots consisting of 20,000 units with terminations of 96.5%Sn/3.0% Ag/0.5% Cu were subjected to the following Test:

Qualification DATA FOR : P ns, PTN, L ns & M Series Lead Free Wraps

Eight production lots tested
Standard VTF In-House Process Qualification per MIL-PRF-55342

DATE : 01/29/04

TEST NO. : 28249A

Each Lot

TEST DESCRIPTION	REQ. PARA	METHOD PARA.	SAMPLE SIZE	QTY. ACCEPTED	QTY. REJECTED
SUBGROUP II					
Resistance to Bonding	3.14.2	4.8.8.2	5	5	0
TCR	3.16	4.8.10	5	5	0
Low Temperature Operation	3.11	4.8.5	5	5	0
Short Time Overload	3.12	4.8.6	5	5	0
High Temperature Exposure	3.13	4.8.7	5	5	0
SUBGROUP III					
Resistance to Bonding	3.14.2	4.8.8.2	5	5	0
Moisture Resistance	3.15	4.8.9	5	5	0
SUBGROUP IV					
Life	3.17	4.8.11.1	10	10	0
SUBGROUP VI					
Solder Mounting Integrity	3.19.1	4.8.13.1	5	5	0

Vishay Lead Free Process Evaluation

TIN WHISKER Eval (see SEM Photos attached)					
Thermal Shock	500 cycles @ -55 / +125°C	3	3	0	
Humidity Test	500 hours @ 85 RH / 85°C	3	3	0	

Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group II

Resistance to Bonding

TEST NO.: 28249A

MEASURED WITH: HP3456A

CABLE :

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.

Delta R = $\pm 0.2\%$

RESISTANCE READINGS IN OHMS.

PERFORMED BY:	WL	WL		
DATE:	01/13/04	01/13/04		
SER#	NOM	INITIAL	FINAL	DELTA R%
1	1K	1,000.12	999.94	-0.0177
2	1K	1,000.25	1,000.02	-0.0231
3	1K	1,000.11	999.96	-0.0150
4	1K	1,000.42	1,000.31	-0.0107
5	1K	1,000.08	999.98	-0.0100
6	20K	20,001.86	20,000.10	-0.0088
7	20K	19,989.91	19,988.00	-0.0096
8	20K	19,995.53	19,993.50	-0.0102
9	20K	20,006.46	19,993.30	-0.0658
10	20K	19,997.66	19,996.00	-0.0083
11	255K	254,964.30	255,054.00	0.0352
12	255K	254,955.80	254,980.00	0.0095
13	255K	255,030.50	255,067.00	0.0143
14	255K	254,911.10	254,897.00	-0.0055
15	255K	254,913.70	254,930.00	0.0064
16	150K	150,101.90	150,142.00	0.0267
17	150K	150,003.60	150,021.00	0.0116
18	150K	149,980.30	149,998.00	0.0118
19	150K	150,025.00	150,049.00	0.0160
20	150K	150,022.50	150,062.00	0.0263
21	255K	255,019.10	255,074.00	0.0215
22	255K	254,904.80	254,950.00	0.0177
23	255K	254,911.70	254,935.00	0.0091
24	255K	254,912.90	254,949.00	0.0142
25	255K	254,970.00	255,035.00	0.0255
26	20K	19,993.95	19,992.30	-0.0083
27	20K	19,998.11	19,996.70	-0.0071
28	20K	19,997.91	19,996.80	-0.0056
29	20K	19,998.53	19,997.30	-0.0062
30	20K	19,990.04	19,988.30	-0.0087
31	150K	150,133.60	150,149.00	0.0103
32	150K	150,000.80	150,042.00	0.0275
33	150K	149,989.40	150,014.00	0.0164
34	150K	149,994.00	150,012.00	0.0120
35	150K	150,131.10	150,131.00	-0.0001
36	1K	1,000.39	1,000.27	-0.0120
37	1K	999.98	999.86	-0.0128
38	1K	1,000.22	1,000.05	-0.0175
39	1K	1,000.10	999.93	-0.0163
40	1K	1,000.34	1,000.13	-0.0214
			min.	-0.0658
			max.	0.0352



Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group II
TCR

TEST NO.: 28249A
MEASURED WITH: HP3456A
CABLE :

REMARKS: TCR = ±25 PPM
RESISTANCE READINGS IN OHMS.

PERFORMED BY:		WJF			WJF		
DATE:		01/14/04			01/14/04		
SER#	NOM	RES	RES	TCR	RES	RES	TCR
		@+25C	@-55C		@+25C	@+125C	
1	1K	999.98	1,000.72	-9.188	999.98	999.32	-6.640
2	1K	1,000.06	1,000.84	-9.824	1,000.06	999.35	-7.120
3	1K	1,000.00	1,000.78	-9.800	1,000.00	999.28	-7.200
4	1K	1,000.34	1,001.13	-9.797	1,000.34	999.62	-7.208
5	1K	1,000.00	1,000.71	-8.900	999.99	999.35	-6.420
6	20K	20,001.20	19,990.60	6.625	20,001.30	20,017.40	8.049
7	20K	19,989.20	19,986.60	1.626	19,989.20	19,995.60	3.202
8	20K	19,994.50	19,982.40	7.565	19,994.30	20,011.90	8.803
9	20K	19,994.30	19,984.50	6.127	19,994.20	20,009.30	7.552
10	20K	19,996.90	19,992.30	2.875	19,996.70	20,005.40	4.351
11	255K	254,956.00	255,009.00	-2.598	254,955.00	254,936.00	-0.745
12	255K	254,953.00	255,203.00	-12.257	254,956.00	254,713.00	-9.531
13	255K	255,050.00	255,133.00	-4.068	255,037.00	254,951.00	-3.372
14	255K	254,908.00	255,000.00	-4.511	254,916.00	254,908.00	-0.314
15	255K	254,929.00	255,000.00	-3.481	254,919.00	254,878.00	-1.608
16	150K	150,091.00	150,262.00	-14.241	150,093.00	149,951.00	-9.461
17	150K	150,012.00	150,151.00	-11.582	150,009.00	149,899.00	-7.333
18	150K	149,983.00	150,119.00	-11.335	149,981.00	149,867.00	-7.601
19	150K	150,027.00	150,168.00	-11.748	150,025.00	149,923.00	-6.799
20	150K	150,028.00	150,165.00	-11.415	150,021.00	149,916.00	-6.999
21	255K	255,009.00	255,039.00	-1.471	255,007.00	255,023.00	0.627
22	255K	254,934.00	254,995.00	-2.991	254,917.00	254,874.00	-1.687
23	255K	254,915.00	254,989.00	-3.629	254,919.00	254,892.00	-1.059
24	255K	254,921.00	254,933.00	-0.588	254,921.00	254,968.00	1.844
25	255K	254,985.00	255,008.00	-1.128	254,975.00	255,002.00	1.059
26	20K	19,993.20	19,978.50	9.191	19,993.30	20,014.00	10.353
27	20K	19,997.70	20,003.70	-3.750	19,997.90	19,994.80	-1.550
28	20K	19,997.70	20,003.80	-3.813	19,997.50	19,994.30	-1.600
29	20K	19,998.00	19,987.80	6.376	19,997.60	20,013.10	7.751
30	20K	19,989.00	19,972.70	10.193	19,988.60	20,011.60	11.507
31	150K	150,124.00	150,280.00	-12.989	150,127.00	150,018.00	-7.261
32	150K	150,007.00	150,169.00	-13.499	150,012.00	149,890.00	-8.133
33	150K	150,002.00	150,118.00	-9.667	149,997.00	149,873.00	-8.267
34	150K	149,995.00	150,156.00	-13.417	149,999.00	149,874.00	-8.333
35	150K	150,145.00	150,294.00	-12.405	150,132.00	150,005.00	-8.459
36	1K	1,000.30	1,001.12	-10.222	1,000.32	999.59	-7.338
37	1K	999.89	1,000.73	-10.426	999.90	999.15	-7.501
38	1K	1,000.08	1,000.96	-11.012	1,000.08	999.29	-7.929
39	1K	999.97	1,000.76	-9.900	999.95	999.24	-7.120
40	1K	1,000.16	1,000.95	-9.886	1,000.14	999.43	-7.129
				-14.241			-9.531
				10.193			11.507
				-5.374			-2.665

Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group II
Low Temperature Operation

TEST NO.: 28249A
MEASURED WITH: HP3456.
CABLE :

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.
Delta R = $\pm 0.1\%$
RESISTANCE READINGS IN OHMS.

PERFORMED BY: WJF WJF
DATE: 01/19/04 01/19/04

SER#	NOM	INITIAL	FINAL	DELTA R%
1	1K	999.98	999.96	-0.0021
2	1K	1,000.05	1,000.04	-0.0012
3	1K	1,000.00	999.98	-0.0012
4	1K	1,000.34	1,000.33	-0.0014
5	1K	1,000.00	999.99	-0.0012
6	20K	20,001.60	20,001.60	0.0000
7	20K	19,989.40	19,989.40	0.0000
8	20K	19,994.90	19,994.80	-0.0005
9	20K	19,994.70	19,994.70	0.0000
10	20K	19,997.30	19,997.10	-0.0010
11	255K	254,955.00	254,949.00	-0.0024
12	255K	254,953.00	254,945.00	-0.0031
13	255K	255,039.00	255,035.00	-0.0016
14	255K	254,919.00	254,913.00	-0.0024
15	255K	254,925.00	254,914.00	-0.0043
16	150K	150,092.00	150,090.00	-0.0013
17	150K	150,009.00	150,004.00	-0.0033
18	150K	149,985.00	149,979.00	-0.0040
19	150K	150,027.00	150,024.00	-0.0020
20	150K	150,025.00	150,021.00	-0.0027
21	255K	255,009.00	255,005.00	-0.0016
22	255K	254,917.00	254,911.00	-0.0024
23	255K	254,924.00	254,913.00	-0.0043
24	255K	254,920.00	254,917.00	-0.0012
25	255K	254,983.00	254,976.00	-0.0027
26	20K	19,993.40	19,993.60	0.0010
27	20K	19,998.10	19,997.80	-0.0015
28	20K	19,997.90	19,997.60	-0.0015
29	20K	19,998.20	19,998.30	0.0005
30	20K	19,989.30	19,989.50	0.0010
31	150K	150,130.00	150,122.00	-0.0053
32	150K	150,011.00	150,004.00	-0.0047
33	150K	149,999.00	149,991.00	-0.0053
34	150K	150,001.00	149,996.00	-0.0033
35	150K	150,137.00	150,128.00	-0.0060
36	1K	1,000.31	1,000.29	-0.0022
37	1K	999.90	999.88	-0.0021
38	1K	1,000.08	1,000.07	-0.0019
39	1K	999.96	999.94	-0.0018
40	1K	1,000.16	1,000.14	-0.0020
			MIN	-0.0060
			AVG	-0.0021
			MAX	0.0010



Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group II
Short Time Overload

TEST NO.: 28249A
MEASURED WITH: HP3456A
CABLE :

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.
Delta R = ±0.1%
RESISTANCE READINGS IN OHMS.

PERFORMED BY: WJF WJF
DATE: 01/19/04 01/19/04

SER#	NOM	INITIAL	FINAL	DELTA R%
1	1K	999.96	999.94	-0.0024
2	1K	1,000.04	1,000.02	-0.0019
3	1K	999.98	999.96	-0.0020
4	1K	1,000.33	1,000.31	-0.0021
5	1K	999.99	999.97	-0.0021
6	20K	20,001.60	20,001.40	-0.0010
7	20K	19,989.40	19,988.90	-0.0025
8	20K	19,994.80	19,994.60	-0.0010
9	20K	19,994.70	19,994.40	-0.0015
10	20K	19,997.10	19,996.80	-0.0015
11	255K	254,949.00	254,946.00	-0.0012
12	255K	254,945.00	254,944.00	-0.0004
13	255K	255,035.00	255,033.00	-0.0008
14	255K	254,913.00	254,913.00	0.0000
15	255K	254,914.00	254,913.00	-0.0004
16	150K	150,090.00	150,088.00	-0.0013
17	150K	150,004.00	150,003.00	-0.0007
18	150K	149,979.00	149,978.00	-0.0007
19	150K	150,024.00	150,022.00	-0.0013
20	150K	150,021.00	150,018.00	-0.0020
21	255K	255,005.00	255,002.00	-0.0012
22	255K	254,911.00	254,911.00	0.0000
23	255K	254,913.00	254,912.00	-0.0004
24	255K	254,917.00	254,916.00	-0.0004
25	255K	254,976.00	254,972.00	-0.0016
26	20K	19,993.60	19,993.20	-0.0020
27	20K	19,997.80	19,997.40	-0.0020
28	20K	19,997.60	19,997.20	-0.0020
29	20K	19,998.30	19,998.00	-0.0015
30	20K	19,989.50	19,989.20	-0.0015
31	150K	150,122.00	150,120.00	-0.0013
32	150K	150,004.00	150,002.00	-0.0013
33	150K	149,991.00	149,974.00	-0.0113
34	150K	149,996.00	149,994.00	-0.0013
35	150K	150,128.00	150,127.00	-0.0007
36	1K	1,000.29	1,000.27	-0.0016
37	1K	999.88	999.86	-0.0015
38	1K	1,000.07	1,000.07	0.0004
39	1K	999.94	1,000.02	0.0082
40	1K	1,000.14	1,000.13	-0.0012
			MIN	-0.0113
			AVG	-0.0013
			MAX	0.0082

Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group II

High Temperature Exposure

TEST NO.: 28249A

MEASURED WITH: HP3456A

CABLE :

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.

Delta R = $\pm 0.1\%$

RESISTANCE READINGS IN OHMS.

PERFORMED BY:

WL

WJF

DATE:

01/29/04

02/03/04

SER#	NOM	INITIAL	FINAL	DELTA R%
1	1K	999.97	1,000.15	0.0184
2	1K	1,000.06	1,000.25	0.0190
3	1K	1,000.00	1,000.15	0.0151
4	1K	1,000.35	1,000.51	0.0163
5	1K	1,000.02	1,000.20	0.0183
6	20K	20,000.70	20,002.60	0.0095
7	20K	19,988.80	19,990.10	0.0065
8	20K	19,994.00	19,995.60	0.0080
9	20K	19,993.80	19,995.60	0.0090
10	20K	19,996.50	19,998.50	0.0100
11	255K	254,956.00	254,969.00	0.0051
12	255K	254,959.00	254,974.00	0.0059
13	255K	255,041.00	255,054.00	0.0051
14	255K	254,923.00	254,932.00	0.0035
15	255K	254,922.00	254,937.00	0.0059
16	150K	150,095.00	150,127.00	0.0213
17	150K	150,008.00	150,039.00	0.0207
18	150K	149,988.00	150,017.00	0.0193
19	150K	150,023.00	150,059.00	0.0240
20	150K	150,027.00	150,059.00	0.0213
21	255K	255,008.00	255,019.00	0.0043
22	255K	254,919.00	254,925.00	0.0024
23	255K	254,921.00	254,933.00	0.0047
24	255K	254,924.00	254,930.00	0.0024
25	255K	254,985.00	254,992.00	0.0027
26	20K	19,992.60	19,993.80	0.0060
27	20K	19,997.50	19,999.60	0.0105
28	20K	19,997.40	19,999.60	0.0110
29	20K	19,997.40	19,999.70	0.0115
30	20K	19,988.50	19,990.30	0.0090
31	150K	150,123.00	150,160.00	0.0246
32	150K	150,007.00	150,043.00	0.0240
33	150K	149,995.00	150,030.00	0.0233
34	150K	150,000.00	150,034.00	0.0227
35	150K	150,137.00	150,172.00	0.0233
36	1K	1,000.29	1,000.49	0.0202
37	1K	999.89	1,000.08	0.0195
38	1K	1,000.10	1,000.33	0.0228
39	1K	1,000.06	1,000.25	0.0195
40	1K	1,000.16	1,000.35	0.0185

MIN 0.0024
 AVG 0.0136
 MAX 0.0246



Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group III

Resistance to Bonding

TEST NO.: 28249A

MEASURED WITH: HP3458A

CABLE :

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.

Delta R = $\pm 0.2\%$

RESISTANCE READINGS IN OHMS.

PERFORMED BY:	WJF	WJF
DATE:	01/27/04	01/27/04

SER#	NOM	INITIAL	FINAL	DELTA R%
41	1K	1,000.25	1,000.08	-0.0173
42	1K	1,000.51	1,000.12	-0.0393
43	1K	1,000.25	1,000.08	-0.0170
44	1K	1,000.45	1,000.29	-0.0160
45	1K	1,000.22	1,000.05	-0.0172
46	20K	19,999.03	19,999.31	0.0014
47	20K	19,992.95	19,993.21	0.0013
48	20K	19,993.35	19,991.64	-0.0086
49	20K	19,992.45	19,991.16	-0.0065
50	20K	19,996.60	19,996.57	-0.0002
51	255K	254,995.80	254,990.10	-0.0022
52	255K	254,964.10	254,943.80	-0.0080
53	255K	254,934.70	254,933.80	-0.0004
54	255K	254,915.60	254,916.90	0.0005
55	255K	255,001.80	255,014.00	0.0048
56	150K	150,034.50	150,045.50	0.0073
57	150K	150,134.60	150,144.90	0.0069
58	150K	150,119.80	150,139.00	0.0128
59	150K	149,981.40	149,997.10	0.0105
60	150K	150,068.40	150,083.40	0.0100
61	255K	255,038.00	255,052.90	0.0058
62	255K	254,979.10	254,997.20	0.0071
63	255K	254,963.90	255,015.30	0.0202
64	255K	254,935.10	254,957.10	0.0086
65	255K	254,927.10	254,939.90	0.0050
66	20K	19,997.79	19,998.07	0.0014
67	20K	19,998.95	19,998.73	-0.0011
68	20K	20,000.31	20,000.66	0.0017
69	20K	20,001.97	20,001.78	-0.0009
70	20K	19,989.97	19,990.00	0.0002
71	150K	150,148.90	150,161.70	0.0085
72	150K	150,075.50	150,091.30	0.0105
73	150K	150,019.80	150,033.70	0.0093
74	150K	150,082.10	150,096.30	0.0095
75	150K	149,970.60	149,984.90	0.0095
76	1K	1,000.07	999.96	-0.0116
77	1K	1,000.21	1,000.06	-0.0142
78	1K	1,000.81	999.89	-0.0914
79	1K	1,000.17	1,000.00	-0.0161
80	1K	1,000.31	1,000.04	-0.0262

Vishay Thin Film Lead Free Wraparound Process

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VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group III
Moisture Resistance

TEST NO.: 28249A
MEASURED WITH: HP3456A
CABLE : II

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.
Delta R = ±0.2%
RESISTANCE READINGS IN OHMS.

PERFORMED BY: WJF WJF
DATE: 03/12/04 03/22/04

SER#	NOM	INITIAL	FINAL	DELTA R%
41	1K	999.99	1,000.05	0.0055
42	1K	1,000.04	1,000.10	0.0054
43	1K	1,000.02	1,000.13	0.0110
44	1K	1,000.23	1,000.49	0.0259
45	1K	1,000.00	1,000.08	0.0081
46	20K	19,997.50	19,997.70	0.0010
47	20K	19,991.50	19,991.80	0.0015
48	20K	19,989.80	19,990.40	0.0030
49	20K	19,989.60	19,989.90	0.0015
50	20K	19,994.90	19,995.30	0.0020
51	255K	254,969.00	254,970.00	0.0004
52	255K	254,930.00	254,930.00	0.0000
53	255K	254,916.00	254,918.00	0.0008
54	255K	254,904.00	254,900.00	-0.0016
55	255K	255,001.00	255,002.00	0.0004
56	150K	150,033.00	150,034.00	0.0007
57	150K	150,135.00	150,138.00	0.0020
58	150K	150,124.00	150,128.00	0.0027
59	150K	149,984.00	149,990.00	0.0040
60	150K	150,068.00	150,075.00	0.0047
61	255K	255,036.00	255,037.00	0.0004
62	255K	254,989.00	254,987.00	-0.0008
63	255K	254,995.00	254,999.00	0.0016
64	255K	254,938.00	254,940.00	0.0008
65	255K	254,933.00	254,932.00	-0.0004
66	20K	19,996.60	19,996.80	0.0010
67	20K	19,997.30	19,997.50	0.0010
68	20K	19,999.20	19,999.80	0.0030
69	20K	20,000.30	20,001.20	0.0045
70	20K	19,988.60	19,989.10	0.0025
71	150K	150,148.00	150,146.00	-0.0013
72	150K	150,079.00	150,086.00	0.0047
73	150K	150,024.00	150,030.00	0.0040
74	150K	150,086.00	150,094.00	0.0053
75	150K	149,974.00	149,982.00	0.0053
76	1K	999.91	999.93	0.0021
77	1K	1,000.02	1,000.05	0.0035
78	1K	999.84	999.89	0.0051
79	1K	999.96	1,000.02	0.0054
80	1K	1,000.02	1,000.49	0.0476
			min.	-0.0016
			max.	0.0476



Vishay Thin Film Lead Free Wraparound Process

Vishay

111	150K	150,011.00	150,001.00	-0.0067	149,999.00	-0.0080	149,997.00	-0.0093	150,005.00	-0.0040
112	150K	149,990.00	149,981.00	-0.0060	149,980.00	-0.0067	149,979.00	-0.0073	149,986.00	-0.0027
113	150K	149,969.00	149,968.00	-0.0007	149,967.00	-0.0013	149,967.00	-0.0013	149,971.00	0.0013
114	150K	150,087.00	150,090.00	0.0020	150,090.00	0.0020	150,091.00	0.0027	150,093.00	0.0040
115	150K	150,120.00	150,121.00	0.0007	150,120.00	0.0000	150,120.00	0.0000	150,125.00	0.0033
116	150K	150,073.00	150,072.00	-0.0007	150,070.00	-0.0020	150,070.00	-0.0020	150,074.00	0.0007
117	150K	149,974.00	149,972.00	-0.0013	149,970.00	-0.0027	149,971.00	-0.0020	149,974.00	0.0000
118	150K	150,097.00	150,099.00	0.0013	150,096.00	-0.0007	150,099.00	0.0013	150,099.00	0.0013
119	150K	150,137.00	150,142.00	0.0033	150,140.00	0.0020	150,142.00	0.0033	150,143.00	0.0040
120	150K	150,074.00	150,067.00	-0.0047	150,064.00	-0.0067	150,069.00	-0.0033	150,070.00	-0.0027
::										
121	255K	255,059.00	255,044.00	-0.0059	255,047.00	-0.0047	255,034.00	-0.0098	255,051.00	-0.0031
122	255K	254,928.00	254,916.00	-0.0047	254,922.00	-0.0024	254,918.00	-0.0039	254,928.00	0.0000
123	255K	255,131.00	255,120.00	-0.0043	255,124.00	-0.0027	255,119.00	-0.0047	255,127.00	-0.0016
124	255K	255,003.00	254,996.00	-0.0027	254,999.00	-0.0016	254,997.00	-0.0024	255,003.00	0.0000
125	255K	254,917.00	254,913.00	-0.0016	254,915.00	-0.0008	254,915.00	-0.0008	254,917.00	0.0000
126	255K	254,977.00	254,981.00	0.0016	254,984.00	0.0027	254,980.00	0.0012	254,985.00	0.0031
127	255K	254,922.00	254,921.00	-0.0004	254,922.00	0.0000	254,921.00	-0.0004	254,925.00	0.0012
128	255K	254,918.00	254,911.00	-0.0027	254,912.00	-0.0024	254,913.00	-0.0020	254,915.00	-0.0012
129	255K	255,065.00	255,049.00	-0.0063	255,056.00	-0.0035	255,059.00	-0.0024	255,060.00	-0.0020
130	255K	254,921.00	254,903.00	-0.0071	254,908.00	-0.0051	254,909.00	-0.0047	254,914.00	-0.0027
131	20K	19,993.70	19,994.40	0.0035	19,995.30	0.0080	19,996.10	0.0120	19,997.50	0.0190
132	20K	19,996.80	19,998.60	0.0090	19,999.50	0.0135	20,000.20	0.0170	20,001.80	0.0250
133	20K	20,000.50	20,002.20	0.0085	20,003.30	0.0140	20,004.20	0.0185	20,005.60	0.0255
134	20K	19,996.20	19,998.40	0.0110	19,999.00	0.0140	19,999.90	0.0185	20,001.50	0.0265
135	20K	19,999.40	20,001.40	0.0100	20,002.40	0.0150	20,003.10	0.0185	20,004.30	0.0245
136	20K	19,993.40	19,995.10	0.0085	19,995.80	0.0120	19,996.70	0.0165	19,998.10	0.0235
137	20K	19,999.30	20,001.20	0.0095	20,001.80	0.0125	20,002.60	0.0165	20,004.10	0.0240
138	20K	19,997.00	19,999.10	0.0105	19,999.70	0.0135	20,000.70	0.0185	20,001.90	0.0245
139	20K	19,992.10	19,993.30	0.0060	19,993.80	0.0085	19,994.40	0.0115	19,995.30	0.0160
140	20K	19,994.10	19,995.60	0.0075	19,996.10	0.0100	19,996.80	0.0135	19,998.00	0.0195
141	150K	150,070.00	150,071.00	0.0007	150,062.00	-0.0053	150,066.00	-0.0027	150,072.00	0.0013
142	150K	150,078.00	150,074.00	-0.0027	150,071.00	-0.0047	150,072.00	-0.0040	150,079.00	0.0007
143	150K	150,125.00	150,121.00	-0.0027	150,118.00	-0.0047	150,120.00	-0.0033	150,125.00	0.0000
144	150K	149,996.00	149,993.00	-0.0020	149,990.00	-0.0040	149,994.00	-0.0013	149,999.00	0.0020
145	150K	150,001.00	150,000.00	-0.0007	149,999.00	-0.0013	150,000.00	-0.0007	150,003.00	0.0013
146	150K	150,046.00	150,048.00	0.0013	150,044.00	-0.0013	150,047.00	0.0007	150,052.00	0.0040
147	150K	150,006.00	150,006.00	0.0000	150,002.00	-0.0027	150,005.00	-0.0007	150,011.00	0.0033
148	150K	150,067.00	150,066.00	-0.0007	150,062.00	-0.0033	150,065.00	-0.0013	150,071.00	0.0027
149	150K	150,044.00	150,038.00	-0.0040	150,036.00	-0.0053	150,039.00	-0.0033	150,046.00	0.0013
150	150K	150,009.00	150,002.00	-0.0047	149,998.00	-0.0073	150,003.00	-0.0040	150,010.00	0.0007
151	1K	999.92	1,000.01	0.0086	1,000.03	0.0103	1,000.12	0.0200	1,000.30	0.0379
152	1K	999.95	1,000.03	0.0080	1,000.07	0.0117	1,000.13	0.0181	1,000.23	0.0279
153	1K	1,000.01	1,000.10	0.0094	1,000.14	0.0133	1,000.21	0.0204	1,000.31	0.0304
154	1K	1,000.00	1,000.11	0.0117	1,000.14	0.0147	1,000.24	0.0247	1,000.33	0.0333
155	1K	999.99	1,000.08	0.0091	1,000.12	0.0134	1,000.18	0.0194	1,000.27	0.0283
156	1K	1,000.13	1,000.24	0.0114	1,000.26	0.0136	1,000.34	0.0217	1,000.45	0.0324
157	1K	999.97	1,000.09	0.0120	1,000.09	0.0125	1,000.21	0.0246	1,000.29	0.0327
158	1K	999.90	1,000.01	0.0104	1,000.00	0.0095	1,000.08	0.0175	1,000.15	0.0249
159	1K	999.96	1,000.05	0.0089	1,000.05	0.0088	1,000.11	0.0150	1,000.18	0.0215
160	1K	1,000.03	1,000.11	0.0078	1,000.11	0.0079	1,000.16	0.0129	1,000.23	0.0193
		MIN		-0.0094		-0.0098		-0.0098		-0.0075
		AVG		0.0026		0.0044		0.0068		0.0115
		MAX		0.0120		0.0170		0.0247		0.0379

Vishay Thin Film Lead Free Wraparound Process

Vishay



VISHAY THIN FILM QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION Group IV
Life

TEST NO.: 28249A
MEASURED WITH: HP3456A
CABLE :

REMARKS: ABSOLUTE TOLERANCE = See data explanation sheet.
Delta R = ±0.5%
RESISTANCE READINGS IN OHMS.

PERFORMED BY:	WL	WJF	WJF	WJF	WJF	WJF				
DATE:	01/14/04	01/26/04	02/05/04	02/26/04	04/08/04					
SER#	NOM	INITIAL	250 hrs.	DELTA R%	500 hrs.	DELTA R%	1,000 hrs.	DELTA R%	2,000 hrs.	DELTA R%
81	1K	1,000.03	1,000.11	0.0076	1,000.20	0.0164	1,000.22	0.0186	1,000.28	0.0249
82	1K	1,000.06	1,000.13	0.0069	1,000.19	0.0128	1,000.21	0.0144	1,000.26	0.0196
83	1K	999.90	999.96	0.0060	1,000.02	0.0120	1,000.04	0.0141	1,000.09	0.0187
84	1K	1,000.12	1,000.19	0.0068	1,000.25	0.0128	1,000.27	0.0148	1,000.31	0.0192
85	1K	1,000.21	1,000.28	0.0067	1,000.34	0.0128	1,000.36	0.0152	1,000.40	0.0192
86	1K	1,000.00	1,000.08	0.0080	1,000.17	0.0170	1,000.19	0.0190	1,000.24	0.0245
87	1K	999.93	1,000.01	0.0074	1,000.07	0.0138	1,000.09	0.0154	1,000.12	0.0193
88	1K	999.90	999.98	0.0086	1,000.06	0.0158	1,000.08	0.0182	1,000.13	0.0229
89	1K	999.98	1,000.04	0.0056	1,000.09	0.0110	1,000.12	0.0133	1,000.16	0.0174
90	1K	1,000.07	1,000.13	0.0060	1,000.19	0.0117	1,000.22	0.0144	1,000.27	0.0196
91	20K	19,995.10	19,996.40	0.0065	19,997.40	0.0115	19,998.20	0.0155	19,999.60	0.0225
92	20K	19,994.90	19,995.60	0.0035	19,996.40	0.0075	19,997.30	0.0120	19,998.90	0.0200
93	20K	19,997.40	19,998.80	0.0070	19,999.90	0.0125	20,000.70	0.0165	20,002.10	0.0235
94	20K	19,995.90	19,996.80	0.0045	19,997.70	0.0090	19,998.40	0.0125	19,999.60	0.0185
95	20K	19,994.10	19,995.20	0.0055	19,996.10	0.0100	19,997.00	0.0145	19,998.20	0.0205
96	20K	19,999.10	20,000.80	0.0085	20,002.10	0.0150	20,002.50	0.0170	20,003.60	0.0225
97	20K	20,000.70	20,001.80	0.0055	20,002.70	0.0100	20,003.20	0.0125	20,004.50	0.0190
98	20K	19,988.10	19,988.90	0.0040	19,989.30	0.0060	19,989.60	0.0075	19,990.40	0.0115
99	20K	19,991.70	19,992.70	0.0050	19,993.30	0.0080	19,993.70	0.0100	19,994.80	0.0155
100	20K	19,995.80	19,996.40	0.0030	19,997.10	0.0065	19,997.40	0.0080	19,998.50	0.0135
101	255K	254,985.00	254,972.00	-0.0051	254,969.00	-0.0063	254,971.00	-0.0055	254,979.00	-0.0024
102	255K	254,968.00	254,954.00	-0.0055	254,952.00	-0.0063	254,955.00	-0.0051	254,961.00	-0.0027
103	255K	254,930.00	254,929.00	-0.0004	254,929.00	-0.0004	254,930.00	0.0000	254,935.00	0.0020
104	255K	254,926.00	254,928.00	0.0008	254,934.00	0.0031	254,934.00	0.0031	254,937.00	0.0043
105	255K	254,942.00	254,938.00	-0.0016	254,936.00	-0.0024	254,938.00	-0.0016	254,942.00	0.0000
106	255K	254,945.00	254,921.00	-0.0094	254,920.00	-0.0098	254,922.00	-0.0090	254,926.00	-0.0075
107	255K	254,920.00	254,916.00	-0.0016	254,919.00	-0.0004	254,919.00	-0.0004	254,925.00	0.0020
108	255K	254,949.00	254,947.00	-0.0008	254,943.00	-0.0024	254,945.00	-0.0016	254,953.00	0.0016
109	255K	254,990.00	254,984.00	-0.0024	254,984.00	-0.0024	254,986.00	-0.0016	254,992.00	0.0008
110	255K	254,945.00	254,934.00	-0.0043	254,937.00	-0.0031	254,938.00	-0.0027	254,945.00	0.0000



Vishay Thin Film Lead Free Wraparound Process

Vishay

VTF QUALITY ASSURANCE DEPARTMENT

TEST: QUALIFICATION GROUP VI Solder Mount Integrity

TEST NO.: 28249A

MEASURED WITH:

CONDITIONS: REQ. 3.19.1 METHOD 4.8.13.1

REMARKS: Passed = OK

PERFORMED BY: WL

DATE: 01/16/04

SER#	STATUS	SER#	STATUS
201	Passed	221	Passed
202	Passed	222	Passed
203	Passed	223	Passed
204	Passed	224	Passed
205	Passed	225	Passed
206	Passed	226	Passed
207	Passed	227	Passed
208	Passed	228	Passed
209	Passed	229	Passed
210	Passed	230	Passed
211	Passed	231	Passed
212	Passed	232	Passed
213	Passed	233	Passed
214	Passed	234	Passed
215	Passed	235	Passed
216	Passed	236	Passed
217	Passed	237	Passed
218	Passed	238	Passed
219	Passed	239	Passed
220	Passed	240	Passed



UNIVERSITY AT BUFFALO
STATE UNIVERSITY OF NEW YORK



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B1 Squire Hall
Buffalo New York 14214
(716) 829-3561
Fax (716) 829-3006



Analysis Report for Vishay Thin Film

Date: 5/26/04

To: Brett Shipley

From: Peter J. Bush

Charge #:

Subject: Thermocycled lead free samples

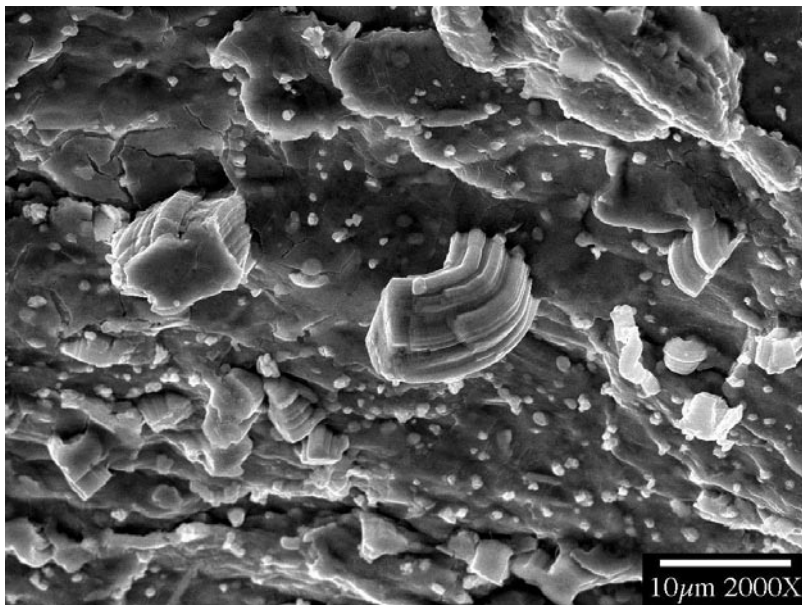
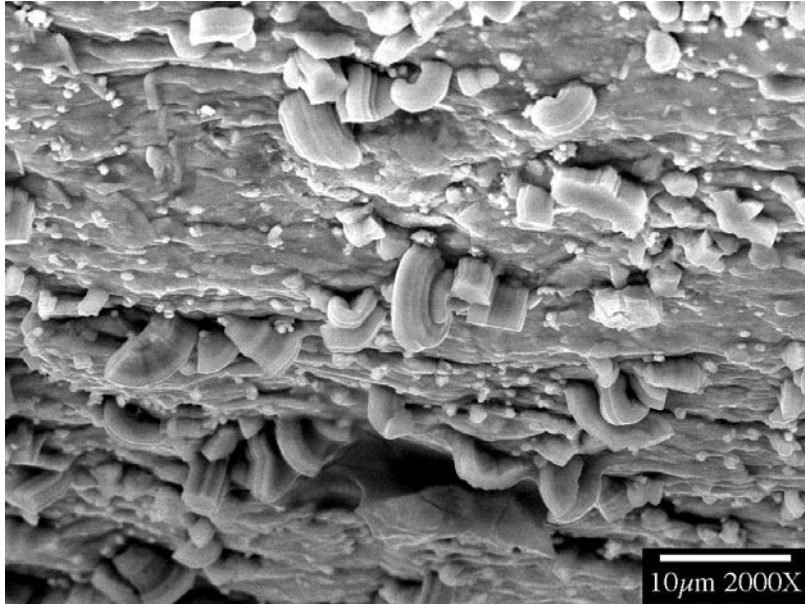
Description of Sample:

Six samples of Sn96Ag3Cu0.5 surface mount resistors.
500 hrs 85c/85RH + 500 cycles -55-125c

Analysis Findings:

Three out of the six samples exhibited whisker growth. The whiskers were short and typical in morphology for whiskers grown by thermocycling. Maximum length observed 10 microns. The whiskers were all on the ends the chips. Grain changes and recrystallization were observed, again typical of thermocycled pure tin finishes.

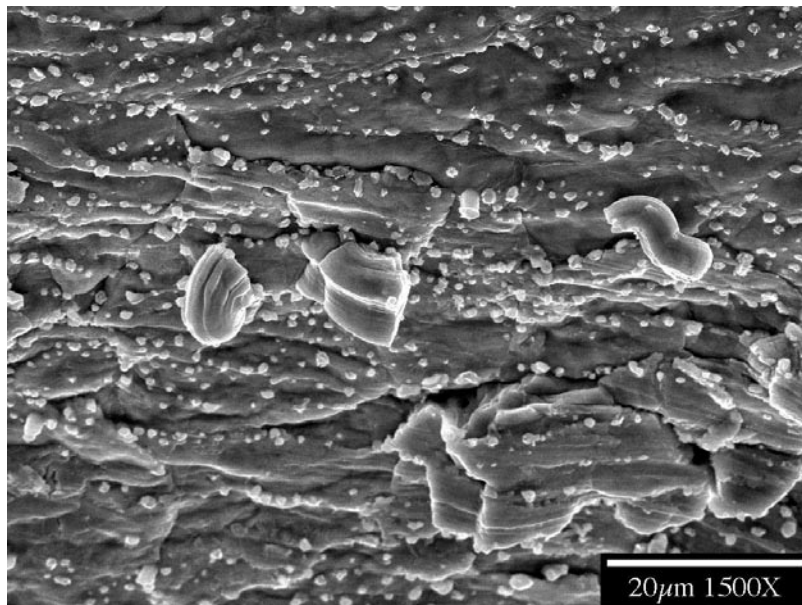
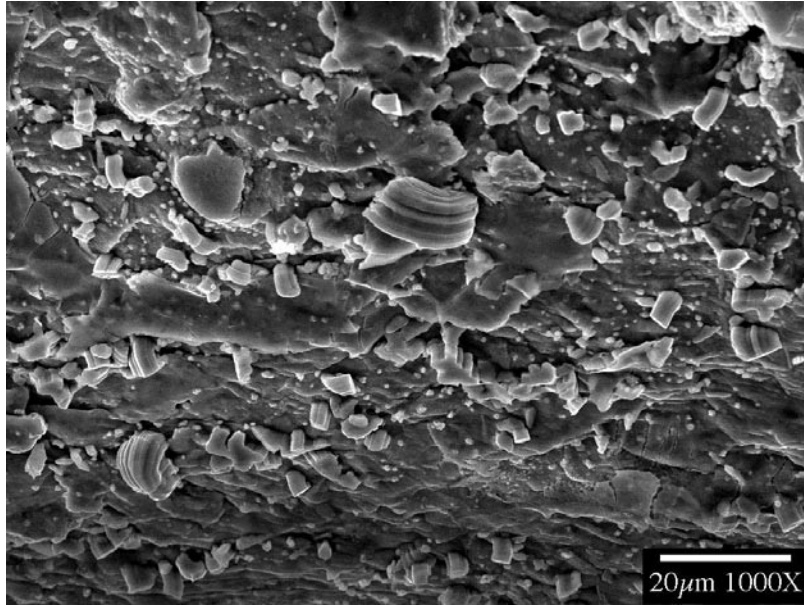
Whiskers of this type have been observed to grow up to 50 microns after thermocycling for 3000 cycles under similar conditions.

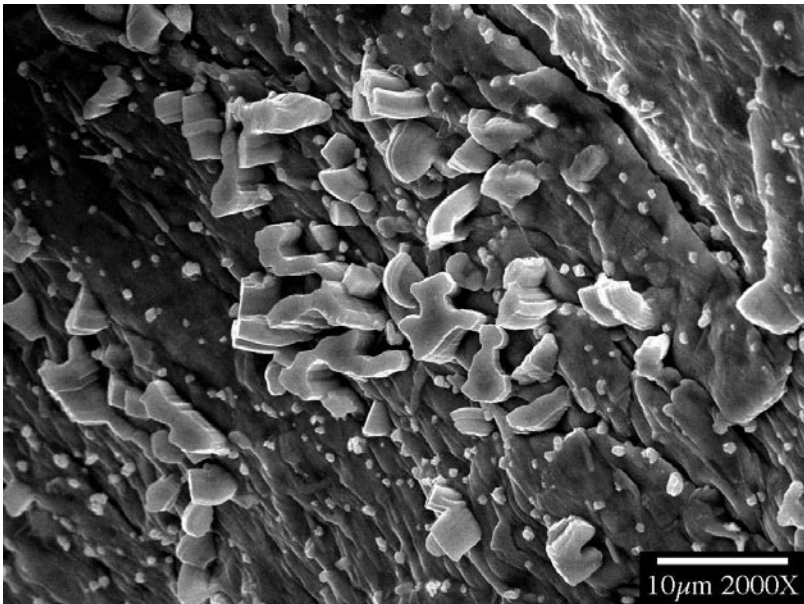
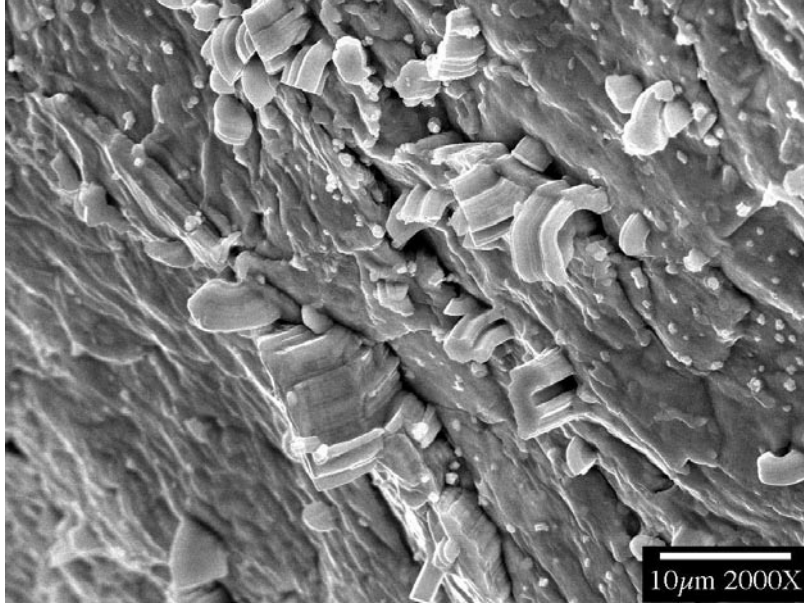


Longest whisker observed.

Vishay Thin Film Lead Free Wraparound Process

Vishay







Qualification Report # 28249
Vishay Thin Film Lead free wraparound process
Models series: P ns, PTN, L ns, M



Eight lead-free wraparound termination lots consisting of 20,000 units with terminations of 96.5%Sn/3.0% Ag/0.5% Cu were subjected to the following Test:

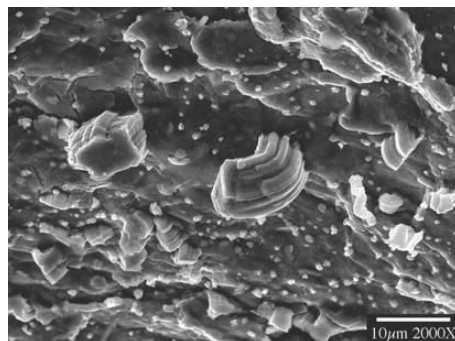
Table 1

Eight production lots tested
 Standard VTF In-House Process Qualification per MIL-PRF-55342

TEST DESCRIPTION	REQ. PARA	METHOD PARA.	SAMPLE SIZE	QTY. ACCEPTED	QTY. REJECTED
SUBGROUP II					
Resistance to Bonding	3.14.2	4.8.8.2	5	5	0
TCR	3.16	4.8.10	5	5	0
Low Temperature Operation	3.11	4.8.5	5	5	0
Short Time Overload	3.12	4.8.6	5	5	0
High Temperature Exposure	3.13	4.8.7	5	5	0
SUBGROUP III					
Resistance to Bonding	3.14.2	4.8.8.2	5	5	0
Moisture Resistance	3.15	4.8.9	5	5	0
SUBGROUP IV					
Life	3.17	4.8.11.1	10	10	0
SUBGROUP VI					
Solder Mounting Integrity	3.19.1	4.8.13.1	5	5	0

Vishay Lead Free Process Evaluation

TIN WHISKER Eval (SEM Photo)					
Thermal Shock	500 cycles @ -55 / +125°C	3	3	0	
Humidity Test	500 hours @ 85 RH / 85°C	3	3	0	



Longest Whisker Observed

Conclusion: Whisker growth was observed. No whiskers exceeded 10 µm. Parts are within allowable whisker length compliance for NEMI limits

Vishay Thin Film, Inc.

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ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS



Vishay Thin Film Lead Free Wraparound Process

Vishay

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