



Vishay Dale

## Lead Free Test Data Summary

Thick Film Chip Resistor

Product Type: CRCW Series & D Series

6/9/2003

Vishay Dale Resistors Division

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

**Test Group Descriptions:**Control Group: **Leaded product** testing using **leaded solder** for hot solder dip, and leaded solder paste for board mount.Test Group 1: **Lead free product** testing using **leaded solder** for hot solder dip, and leaded solder paste for board mount.Test Group 2: **Lead free product** testing using **lead free solder** for hot solder dip, and lead free solder paste for board mount.**DOP107-848-CRCW Test Results Summary**

SUPPLIER - Vishay Norfolk		Part Number - CRCW-0805 10 ohm 5%							
NAME OF LABORATORY - Dale Electronics Test Lab		PART NAME - Surface Mount, Thick Film, Resistor						Date 3/17/2003	
DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/FAIL
Board Flex	JIS-C-6429 & JIS-C-5102, 2mm	+/- 10%	Control	30	Pre	-0.009 to 0.048	0.003	0.010	Pass
					Post	-0.001 to 0.012	0.004	0.003	Pass
			Group 1	30	Pre	-0.014 to 0.069	0.008	0.015	Pass
					Post	0.000 to 0.015	0.007	0.003	Pass
			Group 2	30	Pre	0.012 to 0.024	0.018	0.003	Pass
					Post	-0.009 to 0.006	0.000	0.003	Pass
Leach	IPC J-STD-002	95%	Control	15					Pass
			Group 1	15					Pass
			Group 2	15					Pass
Operational Life	MIL-STD-202 Method 108	Catastrophic	Control	77	IR Reflow 1	-0.010 to 0.006	0.000	0.003	Pass
		+/- 100 PPM	Control	77	RTC -55	-27.7 to 83.2	-2.170	12.911	Pass
					RTC 125	-65.0 to 33.6	17.240	12.025	Pass
		Catastrophic	Control	77	IR Reflow 2	-0.005 to 0.012	0.003	0.003	Pass
		+/- 100 PPM	Control	77	RTC -55	-28.2 to 83.8	-1.410	13.397	Pass
					RTC 125	-3.1 to 87.5	19.240	10.721	Pass
					250 Hours	0.006 to 0.012	0.008	0.001	Pass
		+/- 0.5%	Control	77	500 Hours	0.008 to 0.020	0.011	0.001	Pass
					1000 Hours	0.002 to 0.021	0.011	0.002	Pass
					RTC -55	-29.9 to 80.1	-3.050	12.892	Pass
		+/- 100 PPM	Control	77	RTC 125	-3.5 to 85.0	20.000	10.731	Pass
					2000 Hours	0.006 to 0.023	0.013	0.003	Pass
		+/- 0.5%	Control	77	4000 Hours	0.015 to 0.062	0.023	0.006	Pass
					6000 Hours	0.012 to 0.041	0.021	0.005	Pass
					8000 Hours	0.015 to 0.056	0.026	0.008	Pass
10000 Hours									
Catastrophic	Group 1	77	IR Reflow 1	-0.011 to 0.009	0.000	0.003	Pass		
+/- 100 PPM	Group 1	77	RTC -55	-25.4 to 42.2	9.960	14.023	Pass		
			RTC 125	-3.0 to 60.8	31.060	12.933	Pass		

DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL	
Operational Life (cont.)	MIL-STD-202 Method 108	Catastrophic	Group 1	77	IR Reflow 2	-0.012 to .009	0.000	0.004	Pass	
		+/- 100 PPM	Group 1	77	RTC -55	-27.2 to 44.2	10.110	13.965	Pass	
					RTC 125	-2.6 to 58.6	29.910	12.406	Pass	
		+/- 0.5%	Group 1	77	250 Hours	-0.004 to 0.050	0.002	0.005	Pass	
					500 Hours	-0.007 to 0.056	0.004	0.006	Pass	
					1000 Hours	-0.008 to 0.048	0.000	0.007	Pass	
		+/- 100 PPM	Group 1	77	RTC -55	-25.9 to 42.0	9.020	13.725	Pass	
					RTC 125	-2.2 to 62.8	31.880	13.102	Pass	
		+/- 0.5%	Group 1	77	2000 Hours	-0.007 to 0.059	0.002	0.010	Pass	
					4000 Hours	-0.003 to 0.067	0.009	0.011	Pass	
					6000 Hours	-0.017 to 0.066	0.005	0.012	Pass	
					8000 Hours	-0.008 to 0.069	0.008	0.013	Pass	
					10000 Hours					
		Catastrophic	Group 2	77	IR Reflow 1	-0.026 to 0.011	-0.007	0.006	Pass	
		+/- 100 PPM	Group 2	77	RTC -55	-16.6 to 43.5	11.800	11.977	Pass	
					RTC 125	4.3 to 56.8	29.860	10.647	Pass	
		Catastrophic	Group 2	77	IR Reflow 2	-0.019 to 0.016	-0.002	0.007	Pass	
		+/- 100 PPM	Group 2	77	RTC -55	-15.7 to 40.6	10.000	11.042	Pass	
					RTC 125	6.1 to 58.1	30.220	10.881	Pass	
		+/- 0.5%	Group 2	77	250 Hours	-0.012 to 0.005	0.000	0.002	Pass	
500 Hours	-0.022 to 0.037				0.000	0.005	Pass			
1000 Hours	-0.019 to 0.007				-0.002	0.003	Pass			
+/- 100 PPM	Group 2	77	RTC -55	-16.7 to 41.1	10.800	11.741	Pass			
			RTC 125	6.3 to 58.9	30.340	10.655	Pass			
+/- 0.5%	Group 2	77	2000 Hours	-0.024 to 0.012	-0.005	0.005	Pass			
			4000 Hours	-0.033 to 0.018	-0.007	0.006	Pass			
			6000 Hours	-0.035 to 0.027	-0.004	0.008	Pass			
			8000 Hours							
			10000 Hours							
Plating Composition	Analyze	None	Control	30			87.82%Sn 12.18%Pb		Pass	
		>99% Tin	Test	30			99.41%Sn		Pass	
Plating Thickness	Measure	100 u" minimum	Control	29	Nickel	250 u" to 825 u"	381 u"		Pass	
					Tin	238 u" to 575 u"	362 u"		Pass	
		Test	30	Nickel	213 u" to 988 u"	471 u"		Pass		
				Tin	275 u" to 1025 u"	571 u"		Pass		

DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL
Resistance to Solder Heat	MIL-STD-202 Method 210	+/- 0.25%	Control	30		-0.042 to 0.028	-0.010	0.016	Pass
			Group 1	30		-0.022 to 0.038	0.006	0.015	Pass
			Group 2	30		-0.058 to 0.018	-0.003	0.017	Pass
Solderability (215°C)	IPC J-STD-002	95% Coverage	Control	15					Pass
			Group 1	15					Pass
Solderability (235°C)	IPC J-STD-002	95% Coverage	Control	15					Pass
			Group 1	15					Pass
			Group 2	15					Pass
Terminal Strength	JIS-C-6429 & JIS-C-5102	+/- 0.5%	Control	30		-0.005 to 0.003	-0.001	0.001	Pass
			Group 1	30		-0.057 to 0.003	-0.004	0.012	Pass
			Group 2	30		-0.054 to 0.012	-0.008	0.012	Pass
Thermal Shock	MIL-STD-202 Method 107	+/- 0.25%	Control	30		-0.016 to 0.020	-0.001	0.006	Pass
			Group 1	30		-0.034 to -0.012	-0.019	0.004	Pass
			Group 2	30		-0.030 to -0.008	-0.019	0.004	Pass
Vibration	MIL-STD-202 Method 204	Catastrophic	Control	30		-0.004 to 0.006	0.000	0.002	Pass
			Group 1	30		-0.003 to 0.009	0.002	0.003	Pass
			Group 2	30		-0.002 to 0.012	0.002	0.003	Pass
Whisker Test	Periodic observation using 40X magnification for 1 year.	No whiskers	Control @ 25°C	30	Pre				Pass
					1 Week				Pass
					2 Weeks				Pass
					4 Weeks				Pass
					2 Months				Pass
					6 Months				Pass
					8 Months				Pass
					1 Year				Pass
			1 Year, SEM				Pass		
			Control @ 55°C	30	Pre				Pass
					1 Week				Pass
					2 Weeks				Pass
					4 Weeks				Pass
					2 Months				Pass
					6 Months				Pass
					8 Months				Pass
1 Year						Pass			
1 Year, SEM				Pass					

DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL
Whisker Test (cont.)	Periodic observation using 40X magnification for 1 year.	No whiskers	Test @ 25°C	30	Pre				Pass
					1 Week				Pass
					2 Weeks				Pass
					4 Weeks				Pass
					2 Months				Pass
					6 Months				Pass
					8 Months				Pass
					1 Year				Pass
					1 Year, SEM				Pass
			Test @ 55°C	30	Pre				Pass
					1 Week				Pass
					2 Weeks				Pass
					4 Weeks				Pass
					2 Months				Pass
					6 Months				Pass
					8 Months				Pass
					1 Year				Pass
					1 Year, SEM				Pass

**DOP107-VI-2002-21B Test Results Summary**

SUPPLIER - Vishay Beer-Sheva		Part Number - CRCW0402 10 ohm 5%								
NAME OF LABORATORY Reliability Laboratory		PART NAME - Surface Mount, Thick Film, Resistor							Date 5/4/2003	
DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL	
Operational Life	MIL-PRF-55342G Method 4.8.11	+/- 1.0%	Control	38	2000 Hours	-0.013 to 0.201	0.023	0.043	Pass	
			Group 1	38	2000 Hours	-0.037 to 0.022	-0.013	0.010	Pass	
			Group 2	38	2000 Hours	-0.022 to 0.019	-0.003	0.010	Pass	
Thermal Shock	MIL-STD-202 Method 107	+/- 0.25%	Control	15	300 Cycles	-0.023 to 0.020	-0.007	0.011	Pass	
			Group 1	15	300 Cycles	-0.040 to 0.008	-0.022	0.013	Pass	
			Group 2	15	300 Cycles	-0.009 to 0.010	0.000	0.006	Pass	
TCR	MIL-STD-202 Method 304	+/- 200ppm	Control	10	RTC -55	22.8 to 58.8	40.6	10.8	Pass	
					RTC 125	34.0 to 62.5	47.7	8.9	Pass	
			Group 1	10	RTC -55	34.1 to 79.9	59.5	16.2	Pass	
					RTC 125	48.5 to 87.7	71.0	13.7	Pass	
					Group 2	10	RTC -55	-23.3 to 73.0	-5.3	28.6
RTC 125	-5.1 to 83.7	12.8	26.0	Pass						

**DOP107-VI-2002-21B Test Results Summary**

SUPPLIER - Vishay Beer-Sheva		Part Number - CRCW0402 1 Mohm 5%							
NAME OF LABORATORY Reliability Laboratory		PART NAME - Surface Mount, Thick Film, Resistor						Date 5/4/2003	
DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL
Operational Life	MIL-PRF-55342G Method 4.8.11	+/- 1.0%	Control	39	2000 Hours	-0.330 to -0.018	-0.066	0.063	Pass
			Group 1	39	2000 Hours	-0.551 to 0.034	-0.101	0.129	Pass
			Group 2	39	2000 Hours	-0.497 to 0.030	-0.126	0.100	Pass
Thermal Shock	MIL-STD-202 Method 107	+/- 0.25%	Control	15	300 Cycles	-0.009 to 0.027	0.006	0.010	Pass
			Group 1	15	300 Cycles	-0.017 to 0.140	0.012	0.041	Pass
			Group 2	15	300 Cycles	-0.027 to 0.022	-0.002	0.011	Pass
TCR	MIL-STD-202 Method 304	+/- 200ppm	Control	10	RTC -55	-51.0 to -30.0	-40.9	5.9	Pass
					RTC 125	13.5 to 30.5	23.0	4.7	Pass
			Group 1	10	RTC -55	-48.6 to -32.0	-41.8	5.1	Pass
					RTC 125	16.7 to 28.3	23.1	3.9	Pass
			Group 2	10	RTC -55	-21.6 to -12.8	-18.8	2.9	Pass
RTC 125	45.3 to 54.6	48.3	3.0	Pass					

**DOP107-VI-2002-21B Test Results Summary**

SUPPLIER - Vishay Beer-Sheva		Part Number - CRCW0805 10 ohm 5%								
NAME OF LABORATORY Reliability Laboratory		PART NAME - Surface Mount, Thick Film, Resistor							Date 5/4/2003	
DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL	
Operational Life	MIL-PRF-55342G Method 4.8.11	+/- 0.5%	Control	38	2000 Hours	-0.002 to 0.051	0.010	0.012	Pass	
			Group 1	38	2000 Hours	-0.032 to 0.079	0.014	0.021	Pass	
			Group 2	38	2000 Hours	-0.006 to 0.071	0.010	0.017	Pass	
Thermal Shock	MIL-STD-202 Method 107	+/- 0.25%	Control	15	300 Cycles	-0.011 to 0.015	-0.003	0.006	Pass	
			Group 1	15	300 Cycles	-0.023 to -0.008	-0.016	0.004	Pass	
			Group 2	15	300 Cycles	-0.034 to 0.000	-0.013	0.008	Pass	
TCR	MIL-STD-202 Method 304	+/- 200ppm	Control	10	RTC -55	-4.1 to 49.2	22.3	15.6	Pass	
					RTC 125	20.5 to 58.9	41.8	12.0	Pass	
			Group 1	10	RTC -55	-25.5 to 49.2	3.3	26.1	Pass	
					RTC 125	-3.4 to 59.4	20.1	22.4	Pass	
					Group 2	10	RTC -55	48.1 to 78.4	59.9	10.4
RTC 125	58.9 to 86.3	70.6	9.3	Pass						
Shear	CECC 00802, B2	N/A	Control	15					Pass	
			Group 1	15					Pass	
			Group 2	15					Pass	

**DOP107-VI-2002-21B Test Results Summary**

SUPPLIER - Vishay Beer-Sheva		Part Number - CRCW0805 1 Mohm 5%								
NAME OF LABORATORY Reliability Laboratory		PART NAME - Surface Mount, Thick Film, Resistor							Date 5/4/2003	
DESCRIPTION	TEST CONDITIONS	LIMIT	TEST GROUP	QTY. TESTED	PARAMETERS	RANGE	MEAN	STD. DEV.	PASS/ FAIL	
Operational Life	MIL-PRF-55342G Method 4.8.11	+/- 0.5%	Control	39	2000 Hours	-0.159 to 0.016	-0.063	0.031	Pass	
			Group 1	39	2000 Hours	-0.127 to -0.022	-0.063	0.031	Pass	
			Group 2	39	2000 Hours	-0.179 to -0.035	-0.098	0.034	Pass	
Thermal Shock	MIL-STD-202 Method 107	+/- 0.25%	Control	15	300 Cycles	-0.005 to 0.015	0.001	0.006	Pass	
			Group 1	15	300 Cycles	-0.011 to 0.010	0.003	0.005	Pass	
			Group 2	15	300 Cycles	-0.048 to -0.009	-0.021	0.012	Pass	
TCR	MIL-STD-202 Method 304	+/- 200ppm	Control	10	RTC -55	-37.5 to -23.9	-31.6	4.3	Pass	
					RTC 125	38.0 to 50.4	42.4	3.7	Pass	
			Group 1	10	RTC -55	-22.8 to -12.2	-18.7	3.3	Pass	
					RTC 125	48.4 to 59.0	52.5	3.0	Pass	
					Group 2	10	RTC -55	-21.6 to -12.8	-18.8	2.9
RTC 125	45.5 to 54.8	48.5	3.0	Pass						
Shear	CECC 00802, B2	N/A	Control	15					Pass	
			Group 1	15					Pass	
			Group 2	15					Pass	