



应用报告

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所选封装材料的电热特性

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材料		热传导系数 (W/in·°C)			热膨胀系数 (10 ⁻⁶ /°C)			电阻温度系数 (10 ⁻⁶ /°C)	20° C时的电阻系数 (μΩ-cm)
		正常	最低	最高	正常	最低	最高		
元素	铝	6.02	5.63	6.38	23.9	19.4	25	4290	2.66
	铈	0.620	0.481	0.648 ^(β)		8.46	10.8		41.7
	砷	1.28	1.08 ^(α)	1.37 ^(β)	4.7				33.3
	钡	0.468			18				50.0
	铍	5.10	4.04	5.54 ^(β)	12			25000	5.9
	铋	0.201 ^(k)	0.134 ^(a)	0.233 ^(b)	13				106.8
	硼	0.696	0.478 ^(α)	0.808 ^(β)	8.3				1.8 x 10 ^{12(m)}
	镉	2.46 ^(k)	2.11 ^(g)	2.62 ^(d)	29.9			4200	6.83
	钙	5.10	3.20	5.23	22			4160	3.43
	碳	3.70 ^(c)	0.0404 ^(l)	58.9 ^(z)		0.54	4.32		1375 ^(l)
	铯	0.912			97				20.0
	铬	2.38			6.1			3000	13.0
	钴	2.54			12			6040	6.24
	铜	10.2			17			6800	1.673
	镓	1.04 ^(e)	0.404 ^(g)	2.24 ^(f)	18				56.8
	锆	1.53	1.18 ^(α)	1.69 ^(β)	5.9				102 - 107 ^(t)
	金 (10.2 oz. troy/in ³)	8.08			14.2			4000	2.19
	铪	0.584	0.569 ^(α)	0.592 ^(β)	5.9			3800	32.4
	铟	2.08	1.94 ^(α)	2.12 ^(β)	32				8.37
	铀	3.73			6.8			3925	5.3
	铁	2.04	1.85 ^(h)	2.20 ^(β)	11.7			6510	9.71
	铅	0.897	0.874 ^(α)	0.904 ^(β)	29.3			3360	20.65
	镁	3.96			25			16500	4.46
	锰	0.198			22				185
	钼	3.50			5.4				5.17
	镍	2.31	2.10 ^(α)	2.39 ^(β)	13			6900	6.84
	铌	1.36			7.1				12.5
	钨	1.55			4.7			4200	9.5
	钇	1.82			11.9			3770	10.8
	磷		.0064 ^(j)	.307 ^(k)	126				1017
	铂	1.82			8.8			3927	9.83
	镨	1.22			6.7			3950	19.3
	铯	3.81			8.3			4200	4.51
	铷	1.48			90				12.5
	钽	2.97			9.6				76 ^(l)
	硒	0.033 ^(d)	0.013 ^(j)	0.115 ^(g)	38				12 ^(AC)
	硅	3.78	2.1	4.27 ^(β)	3.5 ^{111(AB)}	2.9	7.4		10 ² to 10 ^{8(t)}
	银	10.9			19.6			4100	1.59
	铈	0.899	0.826 ^(α)	0.924 ^(β)					23.0
	硫	0.0069	0.0039 ^(α)	0.0073 ^(β)	65				2 x 10 ^{23(m)}

注意:如无特殊说明,所有素数值均在20°C测量。(α)在100°C。(β)在0°C。(a)∥到三轴。(b)⊥到三轴。(c)平均值;石墨依据品种与特性在2.0至5.6之间变化。热解石墨从0.16至50变化⊥和∥依据层位面。(d)透明。⊥到c轴;多晶体=0.006W/in·°C。(e)∥到a轴。(f)∥到b轴(g)∥到c轴。(h)磁铁。(i)白磷。(j)无定形的。(k)多晶的。(l)0°C时的电阻系数。(m)内在规定。实际指标依纯度而变化。(t)采用10²¹/cm³到10¹⁴/cm³非纯溶液。(z)类型为IIa钻石。(AB)由J. Naylo测量。(AC)透明无定形≈10⁶μΩ-cm。

所选封装材料的电热特性（续表）

材料		热传导系数 (W/in-℃)			热膨胀系数 (10 – 6 / ℃)			电阻温度系数 (10-6 / ℃)	20℃时的 电阻系数 (μΩ-cm)
		正常	最低	最高	正常	最低	最高		
元素	钽	1.46			6.5			3830	12.4
	碲	0.150			17				2 x 10 ⁵
	锡	1.70 ^(k)	1.31 ^(g)	1.89 ^(d)	23	20	25	4700	11.5
	钛 ^(k)	0.556	0.526 ^(α)	0.569 ^(β)	8.5				47.8
	钨	4.39	4.14	4.50	4.3	4.2	4.5	5240	5.6
	钒	0.780			7.7				24.8-26.0
	锌 ^(k)	2.95				17	40	4190	5.8
	锆	0.576	0.554	0.589	5.6			4400	41.0
有机物	环氧树脂		0.0042	0.035		11.0	60		10 ^{21(m)}
	玻璃态环氧树脂(PC-G10)	0.08			(n)	10 ⁽ⁿ⁾	15 ⁽ⁿ⁾		10 ^{21(m)}
	聚酰亚胺	0.0039				34	40		10 ^{24(m)}
	尼龙		0.0054	0.0085		82.8	128		10 ^{20(m)}
	聚对二甲苯	0.0032				35	69		10 ^{22(m)}
	硅橡胶	0.0053	0.004	0.008	930				3 x 10 ^{15(m)}
	聚四氟乙烯		0.0056	0.0296	83	50	162		10 ^{24(m)}
	聚酯薄膜		0.0045	0.0073		60	95		10 ^{21(m)}
杂项	空气	0.00066							
	Al ₂ O ₃	0.53 ^(v)	0.42 ^(w)	0.85 ^(x)	6.7 ^(v)	6.5	7.3		5 x 10 ^{21(m)}
	黄铜(p)	2.95				18	21	2000	6.4
	BeO	6.0	5.5	7.1	8.0	6.5	8.7		10 ^{22(m)}
	共融合金 (Au-Si) MP 370° C	5.5			13.7				2.53
	共融合金(Au-Sn) MP 280° C	6.4			16				2.6
	共融合金(Au-Ge) MP 356° C	6.7			12.6				2.6
	铁酸盐	0.085		0.159		8	12		127 x 106
	玻璃(y)		0.010	0.037		0.55	12.4		10 ^{24(m)}
	合金	0.425			5.5				49.0
	合金-42	0.28			4.9				78
	锰铜	0.564	0.523	0.635	18.7			± 15	44
	云母	0.011	0.009	0.017		32.4	48.6		10 ^{21(m)}
	石英 (SiO ₂)	0.035	0.19 ^{(β)(d)}	0.37 ^{(β)(g)}	0.55				10 ^{24(m)}
	蓝宝石	0.821	0.691	1.0	6.67 ^(q)	5.0 ^(r)	8.33 ^(s)		10 ^{25(m)}
	焊锡 (60/40)	1.0			23				13.5
	钢 (1008)	1.2			12			6510	11
	不锈钢	0.35 ³⁰³	0.30 ³¹⁰	0.94 ⁵⁰¹	18 ³⁰⁴			170 ^(AA)	112 ^(AA)

注意:如无特殊说明,所有素数值均在20℃ 测量。(α) 在100℃。(β)在 0℃。(d) ⊥到c轴。(e) ||到a轴。(f) ||到b轴。(g) ||到c轴。(k) 多晶的。(m) 内在规定。实际指标依纯度而变化。(n) 在纵轴40-300。(p) 铜锌合金(q) 50℃时||到c轴。(r) 50℃时⊥c轴。(s) 500℃时||到c轴。(v) 96%。(w) 90%。(x) 99.5%。(y)参见石英。(AA) 镍镉合金 60% Ni, 25% Fe, 15% Cr。

热到系数(K) 的转换

原始单位	转换单位						例如 232 (BTU/hr-ft-°F) x 0.0440 = 10.2 (watt/°C-in) 例如 ℃/W = $\frac{\text{Length (in)}}{\text{Area (in}^2\text{)} \cdot \text{K (W/in-}^\circ\text{C)}}$
	cal s-cm-℃	watt cm-℃	watt in-℃	BTU hr-ft-°F	kg-cal hr-m-℃	watt m-℃	
1 cal/s-cm-℃	1.0	4.186	10.63	241.9	360.0	418.6	
1 watt/cm-℃	0.2389	1.0	2.540	578	86.00	100	
1 watt/in-℃	0.09405	0.3937	1.0	22.75	33.86	39.37	
1 BTU/hr-ft-°F	4.134(10-3)	0.01730	0.0440	1.0	1.488	1.730	
1 kg-cal/hr-m-℃	2.778(10-3)	0.01163	0.0295	0.672	1.0	1.163	
1 watt/m-℃	0.002389	0.01	0.0254	0.578	0.8600	1.0	

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