



# APEX Series Device Thermal Resistance

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Data Sheet

Tables 1 through 2 in this data sheet provide  $\theta_{JA}$  (junction-to-ambient thermal resistance) and  $\theta_{JC}$  (junction-to-case thermal resistance) values for the Altera® APEX™ series devices available in Ball-Grid Array (BGA), FineLine® BGA (FBGA), Pin-Grid Array (PGA), Thin Quad Flat Pack (TQFP), and Plastic Quad Flat Pack (PQFP).



For additional packaging information, refer to the *Altera Device Packaging Data Sheet*.

**Table 1. Thermal Resistance of APEX II Devices**

Device	Pin Count	Package	$\theta_{JC}$ (° C/W)	$\theta_{JA}$ (° C/W) Still Air	$\theta_{JA}$ (° C/W) 100 ft./min.	$\theta_{JA}$ (° C/W) 200 ft./min.	$\theta_{JA}$ (° C/W) 400 ft./min.
EP2A15	672	Flip Chip FBGA (Cu lid)	0.22	10.8	8.8	7.4	6.2
		Flip Chip FBGA (AlSiC lid)	0.34	11.6	9.6	8.0	6.6
	724	Flip Chip BGA (Cu lid)	0.23	9.7	7.7	6.4	5.3
		Flip Chip BGA (AlSiC lid)	0.35	10.0	8.2	6.6	5.4
EP2A25	672	FBGA (Cu lid)	0.17	10.7	8.7	7.2	6.1
		Flip Chip FBGA (AlSiC lid)	0.26	11.5	9.6	8.0	6.6
	724	Flip Chip BGA (Cu lid)	0.17	9.6	7.6	6.2	5.2
		Flip Chip BGA (AlSiC lid)	0.27	10.0	8.2	6.6	5.4
	1020	Flip Chip FBGA (Cu lid)	0.17	9.8	7.8	6.4	5.3
		Flip Chip FBGA (AlSiC lid)	0.27	10.4	8.5	6.9	5.7
EP2A40	672	Flip Chip FBGA (Cu lid)	0.24	10.0	8.2	6.9	5.9
		Flip Chip FBGA (AlSiC lid)	0.2	10.0	8.2	6.9	5.9
	724	Flip Chip BGA (Cu lid)	0.15	9.5	7.5	6.1	5.1
		Flip Chip BGA (AlSiC lid)	0.19	9.5	7.5	6.1	5.1
	1,020	Flip Chip FBGA (Cu lid)	0.15	9.7	7.7	6.3	5.2
		Flip Chip FBGA (AlSiC lid)	0.19	9.7	7.7	6.3	5.2

**Table 1. Thermal Resistance of APEX II Devices (Continued)**

Device	Pin Count	Package	$\theta_{JC}$ (° C/W)	$\theta_{JA}$ (° C/W) Still Air	$\theta_{JA}$ (° C/W) 100 ft./min.	$\theta_{JA}$ (° C/W) 200 ft./min.	$\theta_{JA}$ (° C/W) 400 ft./min.
EP2A70	724	Flip Chip BGA (Cu lid)	0.10	9.3	7.3	6.0	4.9
		Flip Chip BGA (AlSiC lid)	0.14	10.0	7.9	6.4	5.3
	1,508	Flip Chip FBGA (Cu lid)	0.10	8.8	6.8	5.5	4.5
		Flip Chip FBGA (AlSiC lid)	0.14	9.3	7.3	5.8	4.7

**Table 2. Thermal Resistance of APEX 20K & APEX 20KE Devices**

Device	Pin Count	Package	$\theta_{JC}$ (° C/W)	$\theta_{JA}$ (° C/W) Still Air	$\theta_{JA}$ (° C/W) 100 ft./min.	$\theta_{JA}$ (° C/W) 200 ft./min.	$\theta_{JA}$ (° C/W) 400 ft./min.
EP20K30E	144	TQFP	8.0	29.0	28.0	26.0	25.0
	208	PQFP	5.0	30.0	29.0	27.0	22.0
	144	FBGA	14.0	36.0	34.0	32.0	29.0
	324	FBGA	9.0	31.0	29.0	28.0	25.0
EP20K60E	144	TQFP	7.0	28.0	26.0	25.0	24.0
	144	FBGA	11.0	33.0	32.0	30.0	27.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	240	PQFP	4.0	26.0	24.0	21.0	17.0
	324	FBGA	7.0	29.0	28.0	26.0	24.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EP20K100	144	TQFP	7.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
	240	PQFP	4.0	25.0	23.0	20.0	17.0
	324	FBGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EP20K100E	144	TQFP	7.0	26.0	25.0	24.0	23.0
	144	FBGA	9.0	32.0	30.0	29.0	26.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
	240	PQFP	4.0	25.0	23.0	20.0	17.0
	324	FBGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0

**Table 2. Thermal Resistance of APEX 20K & APEX 20KE Devices (Continued)**

Device	Pin Count	Package	$\theta_{JC}$ (° C/W)	$\theta_{JA}$ (° C/W) Still Air	$\theta_{JA}$ (° C/W) 100 ft./min.	$\theta_{JA}$ (° C/W) 200 ft./min.	$\theta_{JA}$ (° C/W) 400 ft./min.
EP20K160E	144	TQFP	6.0	25.0	24.0	23.0	22.0
	208	PQFP	5.0	28.0	26.0	23.0	19.0
	240	PQFP	4.0	24.0	21.0	19.0	16.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	24.0	23.0	22.0	21.0
EP20K200	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	21.0	19.0	17.0	15.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	22.0	21.0	20.0	19.0
EP20K200E	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	22.0	19.0	18.0	16.0
	356	BGA	2.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	23.0	22.0	21.0	20.0
	652	BGA	1.0	12.0	11.0	10.0	9.0
	672	FBGA	5.0	21.0	20.0	19.0	18.0
EP20K200C	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	22.0	19.0	18.0	16.0
	356	BGA	2.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	23.0	22.0	21.0	20.0
EP20K300E	240	PQFP	3.0	19.0	18.0	16.0	15.0
	652	BGA	1.0	12.0	11.0	10.0	9.0
	672	FBGA	5.0	20.0	19.0	18.0	17.0
EP20K400	652	BGA	0.5	9.0	8.0	7.0	6.0
	655	PGA	1.0	8.0	7.0	6.0	4.0
	672	FBGA	0.36	11.6	9.6	7.9	6.5
	672	FBGA w/ fin (1)	0.5	7.0	4.0	3.0	2.6
EP20K400E EP20K400C	652	BGA	0.5	9.0	8.0	7.0	6.0
	672	FBGA (Cu lid)	0.25	10.9	8.8	7.4	6.3
		FBGA (AlSiC lid)	0.38	11.7	9.7	8.0	6.7
672	FBGA w/ fin (1)	0.5	7.0	4.0	3.0	2.6	

**Table 2. Thermal Resistance of APEX 20K & APEX 20KE Devices (Continued)**

Device	Pin Count	Package	$\theta_{JC}$ (° C/W)	$\theta_{JA}$ (° C/W) Still Air	$\theta_{JA}$ (° C/W) 100 ft./min.	$\theta_{JA}$ (° C/W) 200 ft./min.	$\theta_{JA}$ (° C/W) 400 ft./min.
EP20K600E EP20K600C	652	BGA	0.5	9.0	8.0	7.0	6.0
	672	FBGA (Cu lid)	0.18	10.8	8.7	7.3	6.1
		FBGA (AlSiC lid)	0.28	11.6	9.6	7.9	6.5
	672	FBGA w/ fin (1)	0.5	5.0	3.0	3.0	2.0
	1,020	FBGA (Cu lid)	0.19	9.9	7.8	6.5	5.4
		FBGA (AlSiC lid)	0.29	10.4	8.4	6.8	5.6
	1,020	FBGA w/ fin (1)	0.5	5.0	3.0	3.0	2.0
EP20K1000E EP20K1000C	652	BGA (Cu lid)	0.12	8.3	7.0	5.6	4.5
		BGA (AlSiC lid)	0.2	9.3	7.4	6.0	4.9
	652	FBGA w/ fin (1)	0.5	4.0	3.0	3.0	2.0
	672	FBGA (Cu lid)	0.12	10.6	8.6	7.2	6.0
		FBGA (AlSiC lid)	0.2	11.4	9.4	7.7	6.3
	672	FBGA w/ fin (1)	0.5	6.0	4.0	3.0	2.0
	1,020	FBGA (Cu lid)	0.12	9.7	7.7	6.3	5.2
		FBGA (AlSiC lid)	0.19	10.2	8.2	6.6	5.4
	1,020	FBGA w/ fin (1)	0.5	5.0	3.0	2.0	2.0
EP20K1500E	652	BGA (Cu lid)	0.10	8.2	6.9	5.5	4.4
		BGA (AlSiC lid)	0.15	9.2	7.3	5.8	4.8
	652	FBGA	0.1	9.2	7.3	5.8	4.8
	652	FBGA w/ fin (1)	0.5	4.0	3.0	2.5	2.0
	1,020	FBGA (Cu lid)	0.10	9.6	7.6	6.2	5.1
		FBGA (AlSiC lid)	0.15	10.1	8.1	6.4	5.3
	1,020	FBGA w/ fin (1)	0.5	5.0	3.0	2.5	2.0

**Note to Table 2:**

- (1) "fin" is an extra heat sink that customers can add to the device. Several vendors make heat sinks, and they all have different sizes. Altera performed the thermal calculations in Table 2 using the following fin specifications: width: 0.25 mm; height: 7.0 mm; pitch: 1.5 mm; base thickness: 0.5 mm.



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