Technical Brief

Using Extended Temperature Range Devices in Quartus II Software

Introduction

The Altera® MAX® 7000AE, ACEX® 1K, and Cyclone® device families support an extended range of temperatures (see Table 1) to meet the production needs of automotive, communications, military, and industrial applications. Extended temperature support allows design engineers that are working on systems with stringent temperature requirements benefit from the cost and flexibility advantages of programmable logic devices (PLDs). These devices are supported in the Quartus® II software. The support method, called derating, specifies that a device with a particular speed grade and temperature range is qualified to operate at the extended temperature range but with a slower performance (i.e., slower speed grade).

Table 1. Junction Temperature Range for Extended Temperature Devices

Family	Junction Temperature Range
MAX 7000AE	-40°C to 130°C
ACEX 1K	-40°C to 125°C
Cyclone	-40°C to 125°C

Device Support

The device and package combinations shown in Table 2 support the extended temperature range.

Table 2. Extended Temperature Range Device Support

Family	Device	Package
MAX 7000AE	EPM7032AE	44-pin thin quad flat pack (TQFP)
	EPM7064AE	44-pin TQFP 100-pin TQFP
	EPM7128AE	100-pin TQFP 144-pin TQFP
	EPM7256AE	144-pin TQFP 256-pin FineLine BGA
ACEX 1K *(1)*	EP1K10	100-pin TQFP
	EP1K30	144-pin TQFP
	EP1K50	208-pin QFP 256-pin FineLine BGA
	EP1K100	208-pin QFP 256-pin FineLine BGA
Cyclone *(1)*, *(2)*, *(3)*	EP1C3	144-pin TQFP
	EP1C4	324-pin FineLine BGA
	EP1C6	144-pin TQFP 256-pin FineLine BGA
	EP1C12	256-pin FineLine BGA 324-pin FineLine BGA
	EP1C20	400-pin FineLine BGA

Notes to Table 2:

(1) The EPC1LI20 and EPC2LI20 configuration devices support configuration within the extended temperature range for ACEX 1K and Cyclone devices. These configuration devices do not require derating.

(2) The EPCS1SI8 and EPCS4SI8 serial configuration devices support configuration within the extended temperature range for Cyclone devices. These configuration devices do not require derating.

(3) Please see the *Extended Temperature Support for Cyclone Devices* technical brief (**www.altera.com/literature/tb/tb-087.pdf**) for more details.

For MAX 7000AE devices, the extended temperature range devices are supported for -10 speed grade performance. The -10 speed grade extended temperature range performance is achieved through derating of -7 speed grade industrial devices (-I7).

For ACEX 1K devices, the extended temperature range devices are supported for -3 speed grade performance. The -3 speed grade extended temperature range performance is achieved through derating of -2 speed grade industrial devices (-I2).

For Cyclone devices, the extended temperature range devices are supported for -8 speed grade performance. The -8 speed grade extended temperature range performance is achieved through derating of -7 speed grade industrial devices (-I7).

Software Support

When using extended temperature range devices, you must assign the slower commercial speed grade device in the Quartus II software. The compilation result for these device and speed grades shows the guaranteed timing for your extended temperature range device. The software will generate the necessary programming file (e.g., Programmer Object File (**.pof**) or SRAM Object File (**.sof**)). To guarantee this performance at the higher operating temperature, the device ordered and shipped will be a - I7 (MAX 7000AE), - I2 (ACEX 1K), or - I7 (Cyclone). The slower speed grade commercial POF or SOF is compatible with their respective faster industrial speed grade devices. See Table 3 for derating information.

Table 3. Derating for Extended Temperature Families

Family	Speed Grade of Device to Order	Speed Grade of Device to Select in the Quartus II Software	POF/SOF Compatible
MAX 7000AE	-I7	-C10	4
Cyclone	-I7	-C8	4
ACEX 1K	-I2	-C3	4

Table 4 shows the Quartus II target device along with the corresponding faster industrial device that is ordered.

Table 4. Extended Temperature Range Device Software Selection

Family	Industrial Device Ordered and Shipped	Device Selected in Software
MAX 7000AE	EPM7032AETI44-7	EPM7032AETC44-10
	EPM7064AETI44-7	EPM7064AETC44-10
	EPM7064AETI100-7	EPM7064AETC100-10
	EPM7128AETI100-7	EPM7128AETC100-10
	EPM7128AETI144-7	EPM7128AETC144-10
	EPM7256AETI144-7	EPM7256AETC144-10
	EPM7256AEFI256-7	EPM7256AEFC256-10
ACEX 1K	EP1K10TI100-2	EP1K10TC100-3
	EP1K30TI144-2	EP1K30TC144-3
	EP1K50QI208-2	EP1K50QC208-3
	EP1K50FI256-2	EP1K50FC256-3
	EP1K100QI208-2	EP1K100QC208-3
	EP1K100FI256-2	EP1K100FC256-3

Table 4. Extended Temperature Range Device Software Selection

Family	Industrial Device Ordered and Shipped	Device Selected in Software
Cyclone	EP1C3T144I7	EP1C3T144C8
	EP1C4F324I7	EP1C4F324C8
	EP1C6T144I7	EP1C6T144C8
	EP1C6F256I7	EP1C6F256C8
	EP1C12F256I7	EP1C12F256C8
	EP1C12F324I7	EP1C12F324C8
	EP1C20F400I7	EP1C20F400C8

Conclusion

Altera supports extended temperature range MAX 7000AE, ACEX 1K, and Cyclone devices in Quartus II software through a derating strategy enabling customers to target their designs for automotive, communications, military, and industrial applications.

Further Information

- *Extended Temperature Support for Cyclone Devices* technical brief: **www.altera.com/literature/tb/tb-087.pdf**

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