



The Automotive-Grade Device Handbook



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AUT5V1-1.2

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The chapters in this book, The Automotive-Grade Device Handbook, were revised on the following dates. Where chapters or groups of chapters are available separately, part numbers are listed.

- Chapter 1 Introduction
Revised: *March 2010*
Part Number: *AUT51001-1.2*
- Chapter 2 MAX 7000A Devices
Revised: *March 2010*
Part Number: *AUT51002-1.2*
- Chapter 3 MAX II Devices
Revised: *March 2010*
Part Number: *AUT51003-1.2*
- Chapter 4 Cyclone Devices
Revised: *March 2010*
Part Number: *AUT51004-1.2*
- Chapter 5 Cyclone II Devices
Revised: *March 2010*
Part Number: *AUT51005-1.2*
- Chapter 6 Cyclone IV Devices
Revised: *March 2010*
Part Number: *AUT51008-1.0*
- Chapter 7 HardCopy II Devices
Revised: *March 2010*
Part Number: *AUT51007-1.2*

This handbook provides comprehensive information about the Altera® automotive-grade devices.

How to Contact Altera

For the most up-to-date information about Altera products, refer to the following table.

Contact (1)	Contact Method	Address
Technical support	Website	www.altera.com/support
Technical training	Website	www.altera.com/training
	Email	custrain@altera.com
Product literature	Website	www.altera.com/literature
Altera literature services	Email	literature@altera.com
Non-technical support (General) (Software Licensing) (Quality)	Email	nacomp@altera.com
	Email	authorization@altera.com
	Email	customer-quality@altera.com





Note to table:

(1) You can also contact your local Altera sales office or sales representative.

Typographic Conventions

This document uses the typographic conventions shown below.

Visual Cue	Meaning
Bold Type with Initial Capital Letters	Command names, dialog box titles, checkbox options, and dialog box options are shown in bold, initial capital letters. Example: Save As dialog box.
bold type	External timing parameters, directory names, project names, disk drive names, filenames, filename extensions, and software utility names are shown in bold type. Examples: f_{MAX} , lqdesigns directory, d: drive, chiptrip.gdf file.
<i>Italic Type with Initial Capital Letters</i>	Document titles are shown in italic type with initial capital letters. Example: <i>AN 75: High-Speed Board Design</i> .
<i>Italic type</i>	Internal timing parameters and variables are shown in italic type. Examples: <i>t_{PIA}</i> , <i>n + 1</i> . Variable names are enclosed in angle brackets (< >) and shown in italic type. Example: <file name>, <project name>.pof file.
Initial Capital Letters	Keyboard keys and menu names are shown with initial capital letters. Examples: Delete key, the Options menu.
"Subheading Title"	References to sections in a document and titles of on-line help topics are shown in quotation marks. Example: "Typographic Conventions."

Visual Cue	Meaning
Courier type	Signal and port names are shown in lowercase Courier type. Examples: <code>data1</code> , <code>tdi</code> , <code>input</code> . Active-low signals are denoted by suffix <code>n</code> , e.g., <code>resetn</code> . Anything that must be typed exactly as it appears is shown in Courier type. For example: <code>c:\qdesigns\tutorial\chiptrip.gdf</code> . Also, sections of an actual file, such as a Report File, references to parts of files (e.g., the AHDL keyword <code>SUBDESIGN</code>), as well as logic function names (e.g., <code>TRI</code>) are shown in Courier.
1., 2., 3., and a., b., c., etc.	Numbered steps are used in a list of items when the sequence of the items is important, such as the steps listed in a procedure.
■ ● ●	Bullets are used in a list of items when the sequence of the items is not important.
✓	The checkmark indicates a procedure that consists of one step only.
	The hand points to information that requires special attention.
	The caution indicates required information that needs special consideration and understanding and should be read prior to starting or continuing with the procedure or process.
	The warning indicates information that should be read prior to starting or continuing the procedure or processes.
↵	The angled arrow indicates you should press the Enter key.
	The feet direct you to more information on a particular topic.

Altera Automotive-Grade Devices

The Altera® automotive product portfolio consists of the best-in-class end-application solutions, devices, and development tools supporting the automotive industry. This select group of automotive-grade devices provides engineers with the design flexibility and short time-to-market that programmable logic is well-known for, while meeting the high-quality standards and extended temperature range needed for automotive electronics.

Altera is the only supplier offering both programmable devices and structured ASICs. Whether you need a simple low-cost, low-power glue logic or a complex graphics controller solution driving your in-dash infotainment display, Altera has the reference designs and expertise to help you succeed in the market. The Altera automotive solutions offer the following advantages:

- Reference designs or design examples for infotainment, driver assistance, hybrid engineer control units, and other electronic modules.
- 30–50% lower power consumption in Altera CPLDs and FPGAs compared to competitor products.
- Unique FPGA-to-structured-ASIC flow which Stratix® II devices are converted to HardCopy® II devices resulting in a quick prototyping process, rapid production ramp, and lower costs.
- Extensive range of on-chip functionalities and IP cores. Examples of on-chip functionalities include RAM blocks, DSP blocks, and PLLs. Examples of IP cores include the Nios® II 32-bit embedded soft processor, Controller Area Network (CAN), and Media Oriented Systems Transport (MOST).
- AEC-Q100 qualified devices, TS-16949 certified manufacturing sites, and PPAP documentation.



For more information about the Altera automotive solutions, visit www.altera.com/end-markets/auto/aut-index.html.

This chapter contains the following sections:

- “Altera Automotive Qualifications”
- “Supported Devices”

Altera Automotive Qualifications

The Altera automotive-grade devices offer the same functionalities as commercial and industrial-grade devices, but operate over the full automotive temperature range ($T_{\text{junction}} = -40^{\circ}\text{C}$ to 125°C).

Altera is a member of the Automotive Electronics Council (AEC) and adheres to the automotive quality standard, AEC-Q100.

 For device-specific details on the AEC-Q100 qualification testing, contact Altera at customer-quality@altera.com.

 For more information on the AEC-Q100 qualification, refer to www.aecouncil.com/AECDocuments.html.


Altera is also an ISO-9001 certified supplier. Altera's manufacturing fab partners (TSMC and Wafertech) and its packaging and test partners (ASE and AMKOR) producing automotive-grade products are registered and certified to the ISO and TS-16949 quality standards.

 To view the certificates, refer to www.altera.com/end-markets/auto/quality/aut-quality.html.

Altera performs stringent reliability qualification and monitoring on a product family basis. Altera devices exceed the reliability requirements established by the Electronic Industries Association (EIA) and the Joint Electron Device Engineering Council (JEDEC). JEDEC qualification tests ensure that Altera devices meet or exceed these reliability standards.

 For more information on the reliability qualification and monitoring programs for Altera products, refer to the Altera *Reliability Report*.

All Altera automotive-grade devices have a Production Part Approval Process (PPAP) document.

 For device-specific details on the PPAP documentation, contact Altera at customer-quality@altera.com.

Supported Devices

Altera offers automotive-grade products in the following integrated circuit (IC) categories: CPLDs, FPGAs, and structured ASICs. Also available are configuration IC devices that can be used to program the FPGAs.

Table 1–1 shows the product families offering automotive-grade devices.

Table 1–1. The Altera Automotive-Grade Products *(Note 1)*

Category	Product Family	Description
IC, CPLD	MAX 7000A	High-performance, glue logic CPLDs (5-V I/O compatible)
IC, CPLD	MAX II	High-density, low-power glue logic CPLDs
IC, FPGA	Cyclone	Low-cost, simple FPGAs
IC, FPGA	Cyclone II	Low-cost, feature-rich FPGAs
IC, FPGA	Cyclone IV	Low-cost, lowest-power, feature-rich FPGAs
IC, ASIC	HardCopy II	Low-cost, one-million-gate structured ASICs

Note to Table 1–1:

(1) Refer to the following chapters for the complete list of automotive-grade devices.

Document Revision History

Table 1–2 shows the revision history for this document.

Table 1–2. Document Revision History

Date	Version	Changes
March 2010	v1.2	Removed Referenced Documents section.
October 2008	v1.1	Converted to new template.
February 2008	v1.0	Initial release.

Supported Automotive-Grade Devices

Altera offers MAX® 7000A devices in the automotive temperature range. These devices are available only in the –10 speed grade.

Table 2–1 shows the automotive-grade devices in the MAX 7000A family.

Table 2–1. Automotive-Grade MAX 7000A Devices

Device Ordering Code	Package
EPM7032AETA44-10N	44-Pin TQFP
EPM7064AETA44-10N	44-Pin TQFP
EPM7064AETA100-10N	100-Pin TQFP
EPM7128AETA100-10N	100-Pin TQFP
EPM7128AETA144-10N	144-Pin TQFP

This chapter contains the following sections:

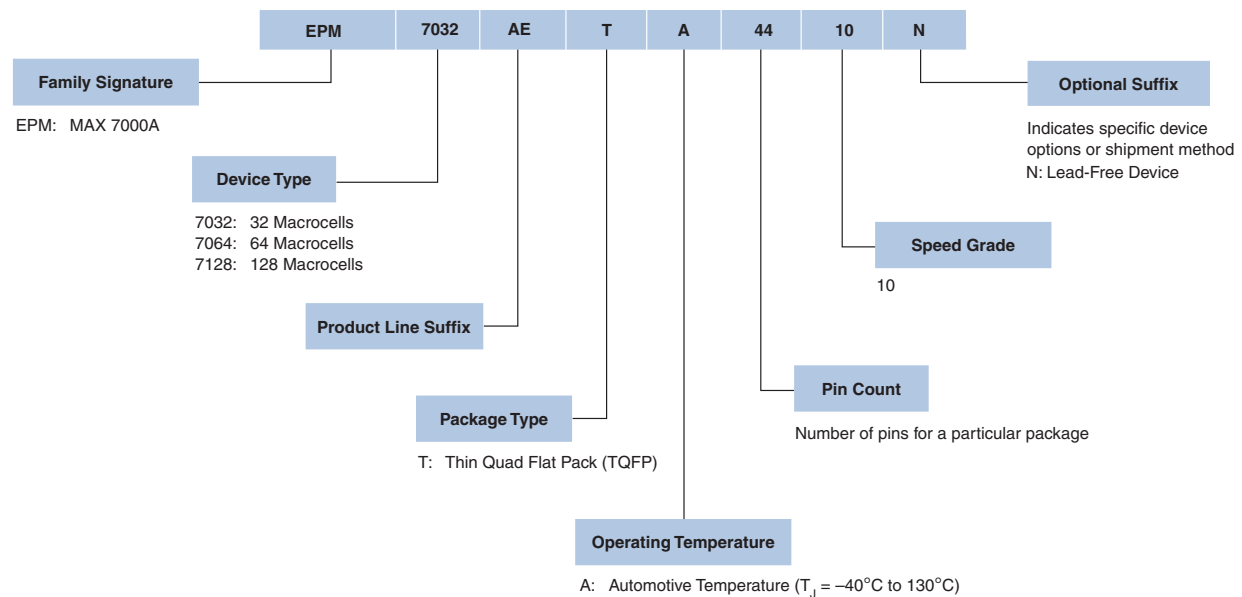
- “Device Ordering Codes”
- “Quartus II Software Support”
- “Power Analysis and Estimation”
- “DC and Timing Specifications”

Device Ordering Codes

Figure 2–1 describes the ordering codes for automotive-grade devices offered in the MAX 7000A family.



For more information about a specific package, refer to the *Altera Device Package Information Data Sheet*.

Figure 2-1. Automotive-Grade MAX 7000A Device Ordering Information

Quartus II Software Support

The Altera® Quartus® II design software supports the MAX 7000A devices in the automotive temperature range. The Quartus II software includes hardware description language (HDL) and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, and device programming.



For more information about the Quartus II software features, refer to the *Quartus II Handbook*.

To target an automotive-grade MAX 7000A device in your design, perform the following steps in the Quartus II software:

1. On the Assignments menu, click **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select **MAX7000AE**.
3. Under Target device, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code, as shown in [Table 2-1](#).



The Quartus II software does not show the “N” suffix, which indicates a lead-free device. For example, the EPM7032AETA44-10N device is shown only as EPM7032AETA44-10.

5. Click **OK**.



Support for the automotive-grade MAX 7000A devices is only available in the Quartus II software version 7.2 SP1 and later.

Power Analysis and Estimation

Altera provides the following power analysis and estimation tools for your design:

- “PowerPlay Early Power Estimator”
- “PowerPlay Power Analyzer”

PowerPlay Early Power Estimator

The PowerPlay Early Power Estimator (EPE) is a power estimation tool that helps you estimate the power consumption of your design during the system planning phase for proper power supply planning and consideration. The EPE allows you to enter design information based on architectural features and calculates the power consumed by each architectural feature. Inputs to the EPE are environmental conditions and device resources (such as clock frequency) that you expect to use in your design. The EPE then calculates the static and dynamic power, current estimates, and thermal analysis for the design.

You can either enter the design information manually into the spreadsheet or import a power estimator file of a fully or partially completed design from the Quartus II software. After importing a file, you can edit some of the input parameters including V_{CCINT} , ambient temperature, airflow, clock frequency, and toggle percentage to suit your system requirements.



The value obtained from the EPE is only an estimation and should not be used as a specification. The accuracy of the EPE results is dependent on how close your input of the design information into the EPE resembles that of the final design.

PowerPlay Power Analyzer


The PowerPlay Power Analyzer tool in the Quartus II software is a power analysis tool that helps you calculate your design power consumption accurately to ensure thermal and power supply budgets are not violated after your design is complete. The PowerPlay Power Analyzer tool requires your design to be synthesized and fitted to the target device. Availability of information such as design resources, how the design is placed and routed on the target device, and the I/O standards assigned to each I/O cell allow the PowerPlay Power Analyzer tool to provide accurate power estimation.


The process of using the PowerPlay Power Analyzer tool consists of three parts: specifying sources of input data, specifying operating conditions, and running the PowerPlay Power Analyzer tool.

The input data consists of the signal activities data (toggle rates and static probabilities) of the compiled design. Signal activity data can be derived from simulation results, user assignment in the Assignment Editor, user-defined default toggle rate, and vectorless estimation.

The operating conditions include device power characteristic, ambient and junction temperature, cooling solution, and board thermal model, all of which can be set in the Quartus II software.

The PowerPlay Power Analyzer tool calculates the dynamic, static and I/O thermal power consumption, current consumed from voltage source, a summary of the signal activities used for analysis, and a confidence metric that reflects the overall quality of the data sources for the signal activities.

 For more information about the Signal Activity Files (.saf) and how to create them, refer to the *Quartus II Simulator* chapter in volume 3 of the *Quartus II Handbook*.

 For more information about the PowerPlay Power Analyzer tool, refer to the *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*.

DC and Timing Specifications

The automotive-grade MAX 7000A devices have the same absolute maximum ratings, recommended operating conditions, and DC electrical characteristics as those published for the MAX 7000A devices in the *MAX 7000A Programmable Logic Device Data Sheet*.

The timing specifications of the automotive-grade MAX 7000A devices are the same as those published for the MAX 7000A devices in the *MAX 7000A Programmable Logic Device Data Sheet*. The automotive-grade devices meet these timing specifications over the automotive temperature range (–40°C to 130°C).

Table 2–2 shows the automotive-grade MAX 7000A device ordering codes and their equivalent timing specifications.

Table 2–2. Automotive-Grade MAX 7000A Device Ordering Codes and Their Equivalent Timing Specifications

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EPM7032AETA44-10N	EPM7032AE	–40°C to 130°C	–10
EPM7064AETA44-10N	EPM7064AE	–40°C to 130°C	–10
EPM7064AETA100-10N	EPM7064AE	–40°C to 130°C	–10
EPM7128AETA100-10N	EPM7128AE	–40°C to 130°C	–10
EPM7128AETA144-10N	EPM7128AE	–40°C to 130°C	–10

Pin-Out Information

For details on the MAX 7000A device pin-outs, refer to the *MAX 7000, MAX 7000A, and MAX 7000B Device Pin-Out Files* web page.

Package and Board Layout Information

For package-related information (for example, dimensions and thermal resistance values) on MAX 7000A devices, refer to the *Altera Device Package Information Data Sheet*.

For PCB design guidelines, refer to *AN114: Designing With High-Density BGA Packages for Altera Devices*.

Document Revision History

Table 2–3 shows the revision history for this document.

Table 2–3. Document Revision History

Date	Version	Changes
March 2010	v1.2	Removed Referenced Documents section.
October 2008	v1.1	Converted to new template.
February 2008	v1.0	Initial release.

Supported Automotive-Grade Devices

Altera offers MAX® II devices in the automotive temperature range. These devices are available only in the –5 speed grade.

Table 3–1 shows the automotive-grade devices in the MAX II family.

Table 3–1. Automotive-Grade MAX II Devices

Device Ordering Code	Package
EPM240T100A5N	100-Pin TQFP
EPM570T100A5N	100-Pin TQFP
EPM570T144A5N	144-Pin TQFP
EPM1270T144A5N	144-Pin TQFP
EPM1270F256A5N	256-Pin FineLine BGA
EPM2210F256A5N	256-Pin FineLine BGA
EPM2210F324A5N	324-Pin FineLine BGA

This chapter contains the following sections:

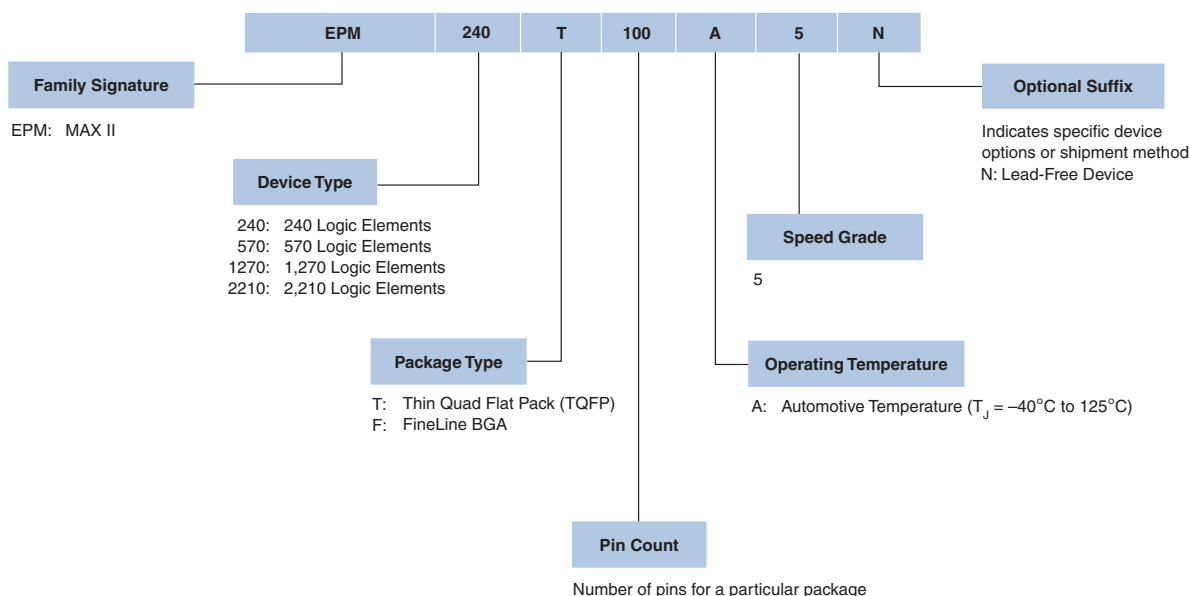
- “Device Ordering Codes”
- “Quartus II Software Support”
- “Power Analysis and Estimation”
- “DC and Timing Specifications”

Device Ordering Codes

Figure 3–1 describes the ordering codes for automotive-grade devices offered in the MAX II family.



For more information about a specific package, refer to the *Package Information* chapter of the *MAX II Device Handbook*.

Figure 3–1. Automotive-Grade MAX II Device Ordering Information

Quartus II Software Support

The Altera® Quartus® II design software supports the MAX II devices in the automotive temperature range. The Quartus II software includes hardware description language (HDL) and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, and device programming.



For more information about the Quartus II software features, refer to the *Quartus II Handbook*.

To target an automotive-grade MAX II device in your design, perform the following steps in the Quartus II software:

1. On the Assignments menu, click **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select **MAX II**.
3. Under Target device, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code, as shown in [Table 3–1](#).



The Quartus II software does not show the “N” suffix, which indicates a lead-free device. For example, the device EPM240T100A5N is shown only as EPM240T100A5.

5. Click **OK**.



Support for the automotive-grade MAX II devices is only available in the Quartus II software version 7.2 SP1 and later.

Power Analysis and Estimation

Altera provides the following power analysis and estimation tools for your design:

- “PowerPlay Early Power Estimator”
- “PowerPlay Power Analyzer”

PowerPlay Early Power Estimator

The PowerPlay Early Power Estimator (EPE) is a power estimation tool that helps you estimate the power consumption of your design during the system planning phase for proper power supply planning and consideration. The EPE allows you to enter design information based on architectural features and calculates the power consumed by each architectural feature. Inputs to the EPE are environmental conditions and device resources (such as clock frequency) that you expect to use in your design. The EPE then calculates the static and dynamic power, current estimates, and thermal analysis for the design.

You can either enter the design information manually into the spreadsheet or import a power estimator file of a fully or partially completed design from the Quartus II software. After importing a file, you can edit some of the input parameters including V_{CCINT} , ambient temperature, airflow, clock frequency, and toggle percentage to suit your system requirements.



The value obtained from the EPE is only an estimation and should not be used as a specification. The accuracy of the EPE results is dependent on how close your input of the design information into the EPE resembles that of the final design.

PowerPlay Power Analyzer


The PowerPlay Power Analyzer tool in the Quartus II software is a power analysis tool that helps you calculate your design power consumption accurately to ensure thermal and power supply budgets are not violated after your design is complete. The PowerPlay Power Analyzer tool requires your design to be synthesized and fitted to the target device. Availability of information such as design resources, how the design is placed and routed on the target device, and the I/O standards assigned to each I/O cell allow the PowerPlay Power Analyzer tool to provide accurate power estimation.


The process of using the PowerPlay Power Analyzer tool consists of three parts: specifying sources of input data, specifying operating conditions, and running the PowerPlay Power Analyzer tool.

The input data consists of the signal activities data (toggle rates and static probabilities) of the compiled design. Signal activity data can be derived from simulation results, user assignment in the Assignment Editor, user-defined default toggle rate, and vectorless estimation.

The operating conditions include device power characteristic, ambient and junction temperature, cooling solution, and board thermal model, all of which can be set in the Quartus II software.

The PowerPlay Power Analyzer tool calculates the dynamic, static and I/O thermal power consumption, current consumed from voltage source, a summary of the signal activities used for analysis, and a confidence metric that reflects the overall quality of the data sources for the signal activities.

 For more information about the Signal Activity Files (.saf) and how to create them, refer to the *Quartus II Simulator* chapter in volume 3 of the *Quartus II Handbook*.

 For more information about the PowerPlay Power Analyzer tool, refer to the *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*.

DC and Timing Specifications

The automotive-grade MAX II devices have the same absolute maximum ratings, recommended operating conditions, and DC electrical characteristics as those published for the MAX II devices in the *DC and Switching Characteristics* chapter of the *MAX II Device Handbook*.

The timing specifications of the automotive-grade MAX II devices are the same as those published for the MAX II devices in the *DC and Switching Characteristics* chapter of the *MAX II Device Handbook*. The automotive-grade devices meet these timing specifications over the automotive temperature range (–40°C to 125°C).

Table 3–2 shows the automotive-grade MAX II device ordering codes and their equivalent timing specifications.

Table 3–2. Automotive-Grade MAX II Device Ordering Codes and Their Equivalent Timing Specifications

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EPM240T100A5N	EPM240	–40°C to 125°C	–5
EPM570T100A5N	EPM570	–40°C to 125°C	–5
EPM570T144A5N	EPM570	–40°C to 125°C	–5
EPM1270T144A5N	EPM1270	–40°C to 125°C	–5
EPM1270F256A5N	EPM1270	–40°C to 125°C	–5
EPM2210F256A5N	EPM2210	–40°C to 125°C	–5
EPM2210F324A5N	EPM2210	–40°C to 125°C	–5

Pin-Out Information

For details on the MAX II device pin-outs, refer to the *MAX II Device Pin-Out Files* web page.

Package and Board Layout Information

For package-related information (for example, dimensions and thermal resistance values) on MAX II devices, refer to the *Package Information* chapter of the *MAX II Device Handbook*.

For PCB design guidelines, refer to *AN114: Designing With High-Density BGA Packages for Altera Devices*.

If you are designing PCBs with the Cadence® OrCAD® Capture component information system (CIS), you can download the symbol libraries from the *Capture CIS Symbols* web page.

Document Revision History

Table 3–3 shows the revision history for this document.

Table 3–3. Document Revision History

Date	Version	Changes
March 2010	v1.2	Removed Referenced Documents section.
October 2008	v1.1	Converted to new template.
February 2008	v1.0	Initial release.

Supported Automotive-Grade Devices

Altera offers Cyclone® devices in the automotive temperature range. These devices are available only in the –8 speed grade.

Table 4–1 shows the automotive-grade devices in the Cyclone family.

Table 4–1. Automotive-Grade Cyclone Devices

Device Ordering Code	Package
EP1C3T100A8N	100-Pin TQFP
EP1C3T144A8N	144-Pin TQFP

This chapter contains the following sections:

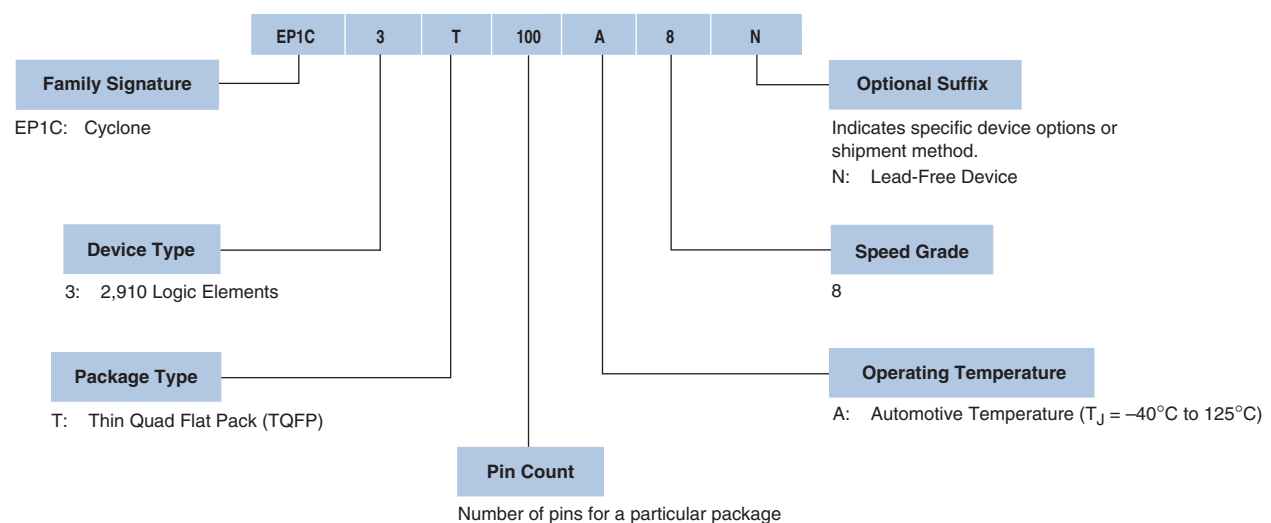
- “Device Ordering Codes”
- “Quartus II Software Support”
- “Power Analysis and Estimation”
- “DC and Timing Specifications”

Device Ordering Codes

Figure 4–1 describes the ordering codes for automotive-grade devices offered in the Cyclone family.

For more information on a specific package, refer to the *Altera Device Package Information Data Sheet*.

Figure 4–1. Automotive-Grade Cyclone Device Ordering Information



Quartus II Software Support

The Altera® Quartus® II design software supports the Cyclone devices in the automotive temperature range. The Quartus II software provides a comprehensive environment for system-on-a-programmable-chip (SOPC) design. It also includes hardware description language (HDL) and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, SignalTap® II logic analyzer, and device configuration.



For more information about the Quartus II software features, refer to the *Quartus II Handbook*.

To target an automotive-grade Cyclone device in your design, perform the following steps in the Quartus II software:

1. On the Assignments menu, click **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select **Cyclone**.
3. Under Target device, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code, as shown in [Table 4-1](#).



The Quartus II software does not show the “N” suffix, which indicates a lead-free device. For example, the EP1C3T100A8N device is shown only as EP1C3T100A8.

5. Click **OK**.



Support for the automotive-grade Cyclone devices is only available in the Quartus II software version 7.2 SP1 and later.

Power Analysis and Estimation

Altera provides the following power analysis and estimation tools for your design:

- “PowerPlay Early Power Estimator”
- “PowerPlay Power Analyzer”

PowerPlay Early Power Estimator

The PowerPlay Early Power Estimator (EPE) is a power estimation tool that helps you estimate the power consumption of your design during the system planning phase for proper power supply planning and consideration. The EPE allows you to enter design information based on architectural features and calculates the power consumed by each architectural feature. Inputs to the EPE are environmental conditions and device resources (such as clock frequency, RAM blocks, and DSP blocks) that you expect to use in your design. The EPE then calculates the static and dynamic power, current estimates, and thermal analysis for the design.

You can either enter the design information manually into the spreadsheet or import a power estimator file of a fully or partially completed design from the Quartus II software. After importing a file, you can edit some of the input parameters including V_{CCINT} , ambient temperature, airflow, clock frequency, and toggle percentage to suit your system requirements.



The value obtained from the EPE is only an estimation and should not be used as a specification. The accuracy of the EPE results is dependent on how close your input of the design information into the EPE resembles that of the final design.



For more information about the EPE, and how to generate and import the power estimator file, refer to the *PowerPlay Early Power Estimator User Guide for Stratix, Stratix GX, and Cyclone FPGAs*.

PowerPlay Power Analyzer

The PowerPlay Power Analyzer tool in the Quartus II software is a power analysis tool that helps you calculate your design power consumption accurately to ensure thermal and power supply budgets are not violated after your design is complete. The PowerPlay Power Analyzer tool requires your design to be synthesized and fitted to the target device. Availability of information such as design resources, how the design is placed and routed on the target device, and the I/O standards assigned to each I/O cell allow the PowerPlay Power Analyzer tool to provide accurate power estimation.

The process of using the PowerPlay Power Analyzer tool consists of three parts: specifying sources of input data, specifying operating conditions, and running the PowerPlay Power Analyzer tool.

The input data consists of the signal activities data (toggle rates and static probabilities) of the compiled design. Signal activity data can be derived from simulation results, user assignment in the Assignment Editor, user-defined default toggle rate, and vectorless estimation.

The operating conditions include device power characteristic, ambient and junction temperature, cooling solution, and board thermal model, all of which can be set in the Quartus II software.

The PowerPlay Power Analyzer tool calculates the dynamic, static and I/O thermal power consumption, current consumed from voltage source, a summary of the signal activities used for analysis, and a confidence metric that reflects the overall quality of the data sources for the signal activities.



For more information about the Signal Activity Files (.saf) and how to create them, refer to the *Quartus II Simulator* chapter in volume 3 of the *Quartus II Handbook*.



For more information about the PowerPlay Power Analyzer tool, refer to the *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*.

DC and Timing Specifications

The automotive-grade Cyclone devices have the same absolute maximum ratings, recommended operating conditions, and DC electrical characteristics as those published for the Cyclone devices in the *DC and Switching Characteristics* chapter of the *Cyclone Device Handbook*. For the maximum power-up current (I_{CCINT}) required to power up an automotive-grade Cyclone device, use the value specified for the corresponding industrial-grade device.

The timing specifications of the automotive-grade Cyclone devices are the same as those published for the Cyclone devices in the *DC and Switching Characteristics* chapter of the *Cyclone Device Handbook*. The automotive-grade devices meet these timing specifications over the automotive temperature range (–40°C to 125°C).

Table 4–2 shows the automotive-grade Cyclone device ordering codes and their equivalent timing specifications.

Table 4–2. Automotive-Grade Cyclone Device Ordering Codes and Their Equivalent Timing Specifications

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EP1C3T100A8N	EP1C3	–40°C to 125°C	–8
EP1C3T144A8N	EP1C3	–40°C to 125°C	–8

Pin-Out Information

For details on the Cyclone device pin-outs, refer to the *Cyclone Device Pin-Out Files* web page.

Package and Board Layout Information

For package-related information (for example, dimensions and thermal resistance values) on Cyclone devices, refer to the *Package Information for Cyclone Devices* chapter of the *Cyclone Device Handbook*.

For PCB design guidelines, refer to *AN114: Designing With High-Density BGA Packages for Altera Devices*.

If you are designing PCBs with the Cadence® OrCAD® Capture component information system (CIS), you can download the symbol libraries from the *Capture CIS Symbols* web page.

Document Revision History

Table 4–3 shows the revision history for this document.

Table 4–3. Document Revision History

Date	Version	Changes
March 2010	v1.2	Removed Referenced Documents section.
October 2008	v1.1	Converted to new template.
February 2008	v1.0	Initial release.

Supported Automotive-Grade Devices

Altera offers Cyclone® II devices in the automotive temperature range. These devices are available in the –7 speed grade.

Table 5–1 shows the automotive-grade devices in the Cyclone II family.

Table 5–1. Automotive-Grade Cyclone II Devices

Device Ordering Code	Package
EP2C5AT144A7N	144-Pin TQFP
EP2C5AF256A7N	256-Pin FineLine BGA
EP2C8AF256A7N	256-Pin FineLine BGA
EP2C15AF256A7N	256-Pin FineLine BGA
EP2C15AF484A7N	484-Pin FineLine BGA
EP2C20AF256A7N	256-Pin FineLine BGA
EP2C20AF484A7N	484-Pin FineLine BGA

This chapter contains the following sections:

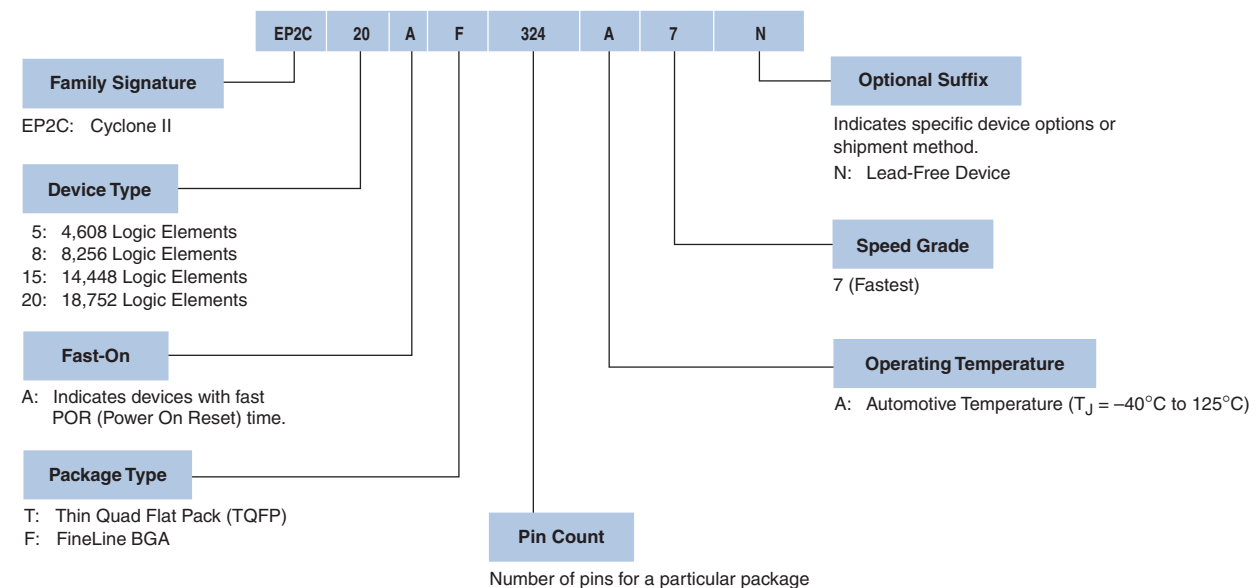
- “Device Ordering Codes”
- “Quartus II Software Support”
- “Power Analysis and Estimation”
- “DC and Timing Specifications”

Device Ordering Codes

Figure 5–1 describes the ordering codes for automotive-grade devices offered in the Cyclone II family.



For more information on a specific package, refer to the *Altera Device Package Information Data Sheet*.

Figure 5–1. Automotive-Grade Cyclone II Device Ordering Information

Quartus II Software Support

The Altera® Quartus® II design software supports the Cyclone II devices in the automotive temperature range. The Quartus II software provides a comprehensive environment for system-on-a-programmable-chip (SOPC) design. It also includes hardware description language (HDL) and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, SignalTap® II logic analyzer, and device configuration.



For more information about the Quartus II software features, refer to the *Quartus II Handbook*.

To target an automotive-grade Cyclone II device in your design, perform the following steps in the Quartus II software:

1. On the Assignments menu, click **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select **Cyclone II**.
3. Under Target device, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code, as shown in [Table 5–1](#).



The Quartus II software does not show the “N” suffix, which indicates a lead-free device. For example, the EP2C5AT144A7N device is shown only as EP2C5AT144A7.

5. Click **OK**.



Support for the automotive-grade Cyclone II devices is only available in the Quartus II software version 7.2 SP1 and later.

Power Analysis and Estimation

Altera provides the following power analysis and estimation tools for your design:

- “PowerPlay Early Power Estimator”
- “PowerPlay Power Analyzer”

PowerPlay Early Power Estimator

The PowerPlay Early Power Estimator (EPE) is a power estimation tool that helps you estimate the power consumption of your design during the system planning phase for proper power supply planning and consideration. The EPE allows you to enter design information based on architectural features and calculates the power consumed by each architectural feature. Inputs to the EPE are environmental conditions and device resources (such as clock frequency, RAM blocks, and DSP blocks) that you expect to use in your design. The EPE then calculates the static and dynamic power, current estimates, and thermal analysis for the design.

You can either enter the design information manually into the spreadsheet or import a power estimator file of a fully or partially completed design from the Quartus II software. After importing a file, you can edit some of the input parameters including V_{CCINT} , ambient temperature, airflow, clock frequency, and toggle percentage to suit your system requirements.



The value obtained from the EPE is only an estimation and should not be used as a specification. The accuracy of the EPE results is dependent on how close your input of the design information into the EPE resembles that of the final design.



For more information about the EPE, and how to generate and import the power estimator file, refer to the *PowerPlay Early Power Estimator User Guide for Cyclone II FPGAs*.

PowerPlay Power Analyzer


The PowerPlay Power Analyzer tool in the Quartus II software is a power analysis tool that helps you calculate your design power consumption accurately to ensure thermal and power supply budgets are not violated after your design is complete. The PowerPlay Power Analyzer tool requires your design to be synthesized and fitted to the target device. Availability of information such as design resources, how the design is placed and routed on the target device, and the I/O standards assigned to each I/O cell allow the PowerPlay Power Analyzer tool to provide accurate power estimation.


The process of using the PowerPlay Power Analyzer tool consists of three parts: specifying sources of input data, specifying operating conditions, and running the PowerPlay Power Analyzer tool.

The input data consists of the signal activities data (toggle rates and static probabilities) of the compiled design. Signal activity data can be derived from simulation results, user assignment in the Assignment Editor, user-defined default toggle rate, and vectorless estimation.

The operating conditions include device power characteristic, ambient and junction temperature, cooling solution, and board thermal model, all of which can be set in the Quartus II software.

The PowerPlay Power Analyzer tool calculates the dynamic, static and I/O thermal power consumption, current consumed from voltage source, a summary of the signal activities used for analysis, and a confidence metric that reflects the overall quality of the data sources for the signal activities.

 For more information about the Signal Activity Files (.saf) and how to create them, refer to the *Quartus II Simulator* chapter in volume 3 of the *Quartus II Handbook*.

 For more information about the PowerPlay Power Analyzer tool, refer to the *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*.

DC and Timing Specifications

The automotive-grade Cyclone II devices have the same absolute maximum ratings, recommended operating conditions, and DC electrical characteristics as those published for the Cyclone II devices in the *DC Characteristics and Timing Specifications* chapter of the *Cyclone II Device Handbook*.

For on-chip series termination (R_s OCT), use the tolerance values for extended-temperature devices as the tolerance values for the automotive-grade Cyclone II devices.

 Refer to the *DC Characteristics and Timing Specifications* chapter of the *Cyclone II Device Handbook* for the timing specifications of the automotive-grade Cyclone II devices.

The automotive-grade devices meet these timing specifications over the automotive temperature range (-40°C to 125°C). The fast corner timing specifications of the automotive-grade Cyclone II devices are the same as those of their corresponding industrial-grade devices.

Table 5-2 shows the automotive-grade Cyclone II device ordering codes and their equivalent timing specifications.

Table 5-2. (Part 1 of 2) Automotive-Grade Cyclone II Device Ordering Codes and Their Equivalent Timing Specifications

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EP2C5AT144A7N	EP2C5	-40°C to 125°C	-7 of automotive grade
EP2C5AF256A7N	EP2C5	-40°C to 125°C	-7 of automotive grade
EP2C8AF256A7N	EP2C8	-40°C to 125°C	-7 of automotive grade
EP2C15AF256A7N	EP2C15	-40°C to 125°C	-7 of automotive grade

Table 5–2. (Part 2 of 2)Automotive-Grade Cyclone II Device Ordering Codes and Their Equivalent Timing Specifications

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EP2C15AF484A7N	EP2C15	–40°C to 125°C	–7 of automotive grade
EP2C20AF256A7N	EP2C20	–40°C to 125°C	–7 of automotive grade

Pin-Out Information

For details on the Cyclone II device pin-outs, refer to the [Cyclone II Device Pin-Out Files](#) web page.

Package and Board Layout Information

For package-related information (for example, dimensions and thermal resistance values) on Cyclone II devices, refer to the [Package Information for Cyclone II Devices](#) chapter of the *Cyclone II Device Handbook*.

For PCB design guidelines, refer to [AN114: Designing With High-Density BGA Packages for Altera Devices](#).

If you are designing PCBs with the Cadence® OrCAD® Capture component information system (CIS), you can download the symbol libraries from the [Capture CIS Symbols](#) web page.

Document Revision History

[Table 5–3](#) shows the revision history for this document.

Table 5–3. Document Revision History

Date a	Version	Changes
March 2010	v1.2	Removed Referenced Documents section.
October 2008	v1.1	<ul style="list-style-type: none"> Converted to new template. Updated “DC and Timing Specifications” section.
February 2008	v1.0	Initial release.

Supported Automotive-Grade Devices

Altera offers Cyclone® IV devices in the automotive temperature range. These devices are available only in the –7 speed grade.

Table 6–1 shows the automotive-grade devices in the Cyclone IV family.

Table 6–1. Automotive-Grade Cyclone IV Devices

Device Ordering Code	Package
EP4CE6E22A7N	144-Pin EQFP
EP4CE10E22A7N	144-Pin EQFP
EP4CE22E22A7N	144-Pin EQFP
EP4CE6F17A7N	256-Pin FBGA
EP4CE10F17A7N	256-Pin FBGA
EP4CE15F17A7N	256-Pin FBGA
EP4CE22F17A7N	256-Pin FBGA
EP4CE15F23A7N	484-Pin FBGA
EP4CE30F23A7N	484-Pin FBGA
EP4CE40F23A7N	484-Pin FBGA

This chapter contains the following sections:

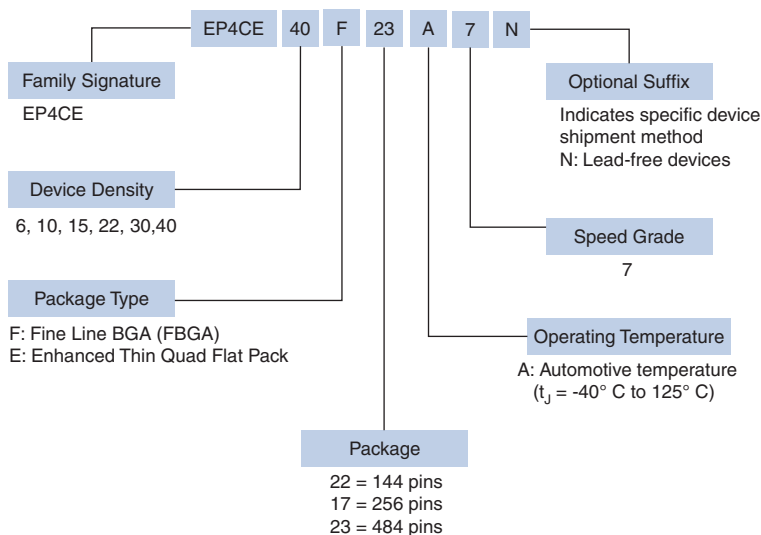
- “Device Ordering Codes”
- “Quartus II Software Support”
- “Power Analysis and Estimation”
- “DC and Timing Specifications”

Device Ordering Codes

Figure 6-1 describes the ordering codes for automotive-grade devices offered in the Cyclone IV family.

For more information on a specific package, refer to the *Altera Device Package Information Data Sheet*.

Figure 6-1. Automotive-Grade Cyclone IV Device Ordering Information



Quartus II Software Support

The Altera® Quartus® II design software supports the Cyclone IV devices in the automotive temperature range. The Quartus II software provides a comprehensive environment for system-on-a-programmable-chip (SOPC) design. It also includes hardware description language (HDL) and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, SignalTap® II logic analyzer, and device configuration.

For more information about the Quartus II software features, refer to the *Quartus II Handbook*.

To target an automotive-grade Cyclone IV device in your design, perform the following steps in the Quartus II software:

1. On the Assignments menu, click **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select **Cyclone IV**.
3. Under Target device, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code, as shown in Table 6-1.



The Quartus II software does not show the “N” suffix, which indicates a lead-free device. For example, the EP4CE6F17A7N device is shown only as EP4CE6F17A7.

5. Click **OK**.



Support for the automotive-grade Cyclone IV devices is only available in the Quartus II software version v9.1 SP2 and later.

Power Analysis and Estimation

Altera provides the following power analysis and estimation tools for your design:

- “PowerPlay Early Power Estimator”
- “PowerPlay Power Analyzer”

PowerPlay Early Power Estimator

The PowerPlay Early Power Estimator (EPE) is a power estimation tool that helps you estimate the power consumption of your design during the system planning phase for proper power supply planning and consideration. The EPE allows you to enter design information based on architectural features and calculates the power consumed by each architectural feature. Inputs to the EPE are environmental conditions and device resources (such as clock frequency, RAM blocks, and DSP blocks) that you expect to use in your design. The EPE then calculates the static and dynamic power, current estimates, and thermal analysis for the design.

You can either enter the design information manually into the spreadsheet or import a power estimator file of a fully or partially completed design from the Quartus II software. After importing a file, you can edit some of the input parameters including V_{CCINT} , ambient temperature, airflow, clock frequency, and toggle percentage to suit your system requirements.



The value obtained from the EPE is only an estimation and should not be used as a specification. The accuracy of the EPE results is dependent on how close your input of the design information into the EPE resembles that of the final design.



For more information about the EPE, and how to generate and import the power estimator file, refer to the *PowerPlay Early Power Estimator User Guide*.

PowerPlay Power Analyzer

The PowerPlay Power Analyzer tool in the Quartus II software is a power analysis tool that helps you calculate your design power consumption accurately to ensure thermal and power supply budgets are not violated after your design is complete. The PowerPlay Power Analyzer tool requires your design to be synthesized and fitted to the target device. Availability of information such as design resources, how the design is placed and routed on the target device, and the I/O standards assigned to each I/O cell allow the PowerPlay Power Analyzer tool to provide accurate power estimation.

The process of using the PowerPlay Power Analyzer tool consists of three parts: specifying sources of input data, specifying operating conditions, and running the PowerPlay Power Analyzer tool.

The input data consists of the signal activities data (toggle rates and static probabilities) of the compiled design. Signal activity data can be derived from simulation results, user assignment in the Assignment Editor, user-defined default toggle rate, and vectorless estimation.

The operating conditions include device power characteristic, ambient and junction temperature, cooling solution, and board thermal model, all of which can be set in the Quartus II software.

The PowerPlay Power Analyzer tool calculates the dynamic, static and I/O thermal power consumption, current consumed from voltage source, a summary of the signal activities used for analysis, and a confidence metric that reflects the overall quality of the data sources for the signal activities.



For more information about the Signal Activity Files (.saf) and how to create them, refer to the *Quartus II Simulator* chapter in volume 3 of the *Quartus II Handbook*.



For more information about the PowerPlay Power Analyzer tool, refer to the *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*.

DC and Timing Specifications

The automotive-grade Cyclone IV devices have the same absolute maximum ratings, recommended operating conditions, and DC electrical characteristics as those published for the Cyclone IV devices in the *DC and Switching Characteristics* chapter in volume 3 of the *Cyclone IV Device Handbook*.

The on-chip series termination (R_s OCT) specifications of the automotive-grade Cyclone IV devices are the same as those of their corresponding industrial-grade Cyclone IV devices. The switching characteristics of the automotive-grade devices are the same as those of the Cyclone IV devices with -8 speed grade published in the *DC and Switching Characteristics* chapter in volume 3 of the *Cyclone IV Device Handbook*.



Refer to the *DC and Switching Characteristics* chapter in the volume 3 of the *Cyclone IV Device Handbook* for the timing specifications of the automotive-grade Cyclone IV devices.

The automotive-grade devices meet these timing specifications over the automotive temperature range (-40°C to 125°C).

Table 6-2 shows the automotive-grade Cyclone IV device ordering codes and their equivalent timing specifications.

Table 6-2. Automotive-Grade Cyclone IV Device Ordering Codes and Their Equivalent Timing Specifications (Part 1 of 2)

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EP4CE6F17A7N	EP4CE6	-40°C to 125°C	-7 of automotive grade
EP4CE6E22A7N	EP4CE6	-40°C to 125°C	-7 of automotive grade

Table 6–2. Automotive-Grade Cyclone IV Device Ordering Codes and Their Equivalent Timing Specifications (Part 2 of 2)

Automotive-Grade Device Ordering Code	Device Timing Specification		
	Device	Temperature Range	Speed Grade
EP4CE10F17A7N	EP4CE10	–40°C to 125°C	–7 of automotive grade
EP4CE10E22A7N	EP4CE10	–40°C to 125°C	–7 of automotive grade
EP4CE15F17A7N	EP4CE15	–40°C to 125°C	–7 of automotive grade
EP4CE15F23A7N	EP4CE15	–40°C to 125°C	–7 of automotive grade
EP4CE22F17A7N	EP4CE22	–40°C to 125°C	–7 of automotive grade
EP4CE22E22A7N	EP4CE22	–40°C to 125°C	–7 of automotive grade
EP4CE30F23A7N	EP4CE30	–40°C to 125°C	–7 of automotive grade
EP4CE40F23A7N	EP4CE40	–40°C to 125°C	–7 of automotive grade

Pin-Out Information

For details on the Cyclone IV device pin-outs, refer to the [Cyclone IV Device Pin-Out Files](#) web page.

Package and Board Layout Information

For package-related information (for example, dimensions and thermal resistance values) on Cyclone IV devices, refer to the [Altera Device Package InformationData Sheet](#).

For PCB design guidelines, refer to [AN114: Designing With High-Density BGA Packages for Altera Devices](#).

If you are designing PCBs with the Cadence® OrCAD® Capture component information system (CIS), you can download the symbol libraries from the [Capture CIS Symbols](#) web page.

Document Revision History

[Table 6–3](#) shows the revision history for this document.

Table 6–3. Document Revision History

Date	Version	Changes Made
March 2010	v1.0	Initial release.

Supported Automotive-Grade Devices

Altera offers HardCopy® II devices in the automotive temperature range. [Table 7–1](#) shows the automotive-grade devices in the HardCopy II family.

Table 7–1. Automotive-Grade HardCopy II Devices

Device Ordering Code	Package
HC210WF484 (1)	484-Pin FineLine BGA

Note to Table 7–1:

(1) The HC210W device is in a wire bond package.

This chapter contains the following sections:

- “Device Ordering Codes”
- “Quartus II Software Support”
- “Power Analysis and Estimation”
- “DC and Timing Specifications”

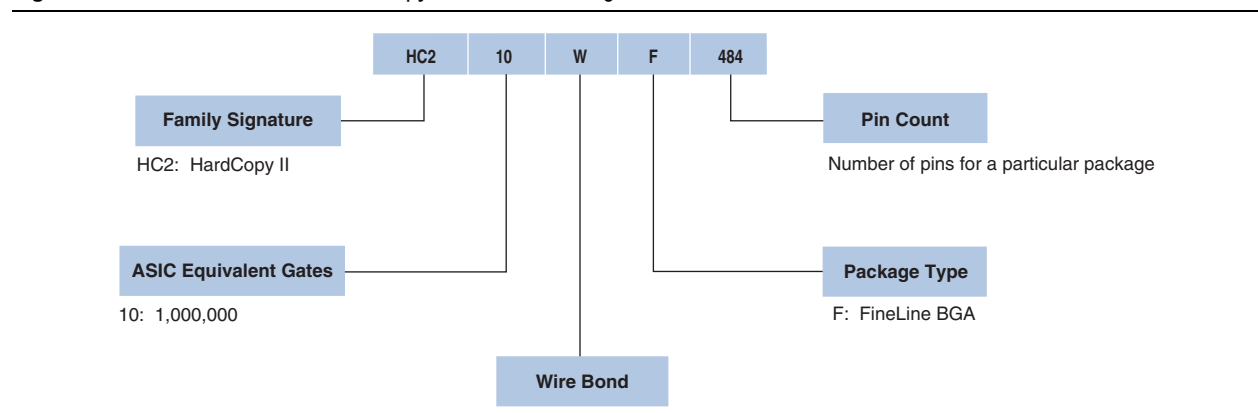
Device Ordering Codes

[Figure 7–1](#) describes the ordering codes for automotive-grade devices offered in the HardCopy II family.



For more information on a specific package, refer to the [Altera Device Package Information Data Sheet](#).

Figure 7–1. Automotive-Grade HardCopy II Device Ordering Information



Quartus II Software Support

The Altera® Quartus® II design software supports the HardCopy II devices in the automotive temperature range. The Quartus II software provides a comprehensive environment for system-on-a-programmable-chip (SOPC) design. It also includes hardware description language (HDL) and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, SignalTap® II logic analyzer, and device configuration.



For more information about using the Quartus II software for the HardCopy II development flow and settings, refer to the *Quartus II Support for HardCopy II Devices* chapter in volume 1 of the *HardCopy Series Handbook*.

To target an automotive-grade HardCopy II device in your design, perform the following steps in the Quartus II software:

1. On the Assignments menu, click **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select **HardCopy II**.
3. Under Target device, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code, as shown in [Table 7-1](#).
5. Click **OK**.



Support for the automotive-grade HardCopy II devices is only available in the Quartus II software version 7.2 SP1 and later.

Power Analysis and Estimation

Altera provides the following power analysis and estimation tools for your design:

- “PowerPlay Early Power Estimator”
- “PowerPlay Power Analyzer”

PowerPlay Early Power Estimator

The PowerPlay Early Power Estimator (EPE) is a power estimation tool that helps you estimate the power consumption of your design during the system planning phase for proper power supply planning and consideration. The EPE allows you to enter design information based on architectural features and calculates the power consumed by each architectural feature. Inputs to the EPE are environmental conditions and device resources (such as clock frequency) that you expect to use in your design. The EPE then calculates the static and dynamic power, current estimates, and thermal analysis for the design.

You can either enter the design information manually into the spreadsheet or import a power estimator file of a fully or partially completed design from the Quartus II software. After importing a file, you can edit some of the input parameters including V_{CCINT} , ambient temperature, airflow, clock frequency, and toggle percentage to suit your system requirements.



The value obtained from the EPE is only an estimation and should not be used as a specification. The accuracy of the EPE results is dependent on how close your input of the design information into the EPE resembles that of the final design.

PowerPlay Power Analyzer

The PowerPlay Power Analyzer tool in the Quartus II software is a power analysis tool that helps you calculate your design power consumption accurately to ensure thermal and power supply budgets are not violated after your design is complete. The PowerPlay Power Analyzer tool requires your design to be synthesized and fitted to the target device. Availability of information such as design resources, how the design is placed and routed on the target device, and the I/O standards assigned to each I/O cell allow the PowerPlay Power Analyzer tool to provide accurate power estimation.

The process of using the PowerPlay Power Analyzer tool consists of three parts: specifying sources of input data, specifying operating conditions, and running the PowerPlay Power Analyzer tool.

The input data consists of the signal activities data (toggle rates and static probabilities) of the compiled design. Signal activity data can be derived from simulation results, user assignment in the Assignment Editor, user-defined default toggle rate, and vectorless estimation.

The operating conditions include device power characteristic, ambient and junction temperature, cooling solution, and board thermal model, all of which can be set in the Quartus II software.

The PowerPlay Power Analyzer tool calculates the dynamic, static and I/O thermal power consumption, current consumed from voltage source, a summary of the signal activities used for analysis, and a confidence metric that reflects the overall quality of the data sources for the signal activities.



For more information about the Signal Activity Files (.saf) and how to create them, refer to the *Quartus II Simulator* chapter in volume 3 of the *Quartus II Handbook*.

For more information about the PowerPlay Power Analyzer tool, refer to the *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*.

DC and Timing Specifications

The automotive-grade HardCopy II devices have the same absolute maximum ratings, recommended operating conditions, and DC electrical characteristics as their equivalent industrial-grade devices. The timing specifications is equivalent to the speed grade of the prototype FPGA, except when noted as part of the HardCopy II timing specification design review process.

The operating junction temperature, T_j , for the automotive-grade HardCopy II devices is from -40°C to 125°C . For more information about the DC characteristics of the industrial-grade HardCopy II devices, refer to the *DC and Switching Specifications and Operating Conditions* chapter in volume 1 of the *HardCopy Series Handbook*. However, the following exceptions apply:

- The delay-locked loop (DLL) frequency range is bounded by the minimum frequencies listed in [Table 7-2](#).

[Table 7-2](#) shows the minimum DLL frequency for each frequency mode.

Table 7-2. Minimum DLL Frequency

Mode	Frequency (MHz)
Frequency Mode 0	120
Frequency Mode 1	170
Frequency Mode 2	220
Frequency Mode 3	270

- Non-calibrated on-chip termination (OCT) is bounded by:
 - $\pm 40\%$ for series resistance.
 - $\pm 50\%$ for 1.2-V series resistance.
- Hot-socketing DC limit is raised to 350 μA .
- The I/O f_{MAX} values of automotive-grade HardCopy II devices are 15% lower than their equivalent industrial-grade HardCopy II devices and correspond to the commercial-grade Stratix II devices of -5 speed. The I/O f_{MAX} values of the industrial-grade HardCopy II devices will be updated in a later revision of the [DC and Switching Specifications and Operating Conditions](#) chapter in volume 1 of the *HardCopy Series Handbook*.



For the maximum I/O clock toggle rate specifications in commercial-grade Stratix II devices of -5 speed, refer to the [DC and Switching Characteristics](#) chapter in volume 1 of the *Stratix II Device Handbook*.

- For LVDS I/O of 2.5 V, the minimum V_{OCM} is 1.1 V and the minimum V_{OD} is 240 mV.

Pin-Out Information

For details on the HardCopy II device pin-outs, refer to the [HardCopy Device Pin-Out Files](#) web page.

Package and Board Layout Information

For package-related information (for example, dimensions and thermal resistance values) on HardCopy II devices, refer to the [Altera Device Package Information Data Sheet](#).

For PCB design guidelines, refer to [AN114: Designing With High-Density BGA Packages for Altera Devices](#).

Document Revision History

Table 7-3 shows the revision history for this document.

Table 7-3. Document Revision History

Date	Version	Changes
March 2010	v1.2	Removed Referenced Documents section.
October 2008	v1.1	Converted to new template.
February 2008	v1.0	Initial release.