

The Automotive-Grade Device Handbook



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AUT5V1
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Altera Automotive-Grade Devices

Altera® automotive-grade devices are available in CPLD, FPGA, system on a chip (SoC), and ASIC. You can use these devices for high-temperature environments, such as automotive driver assist, infotainment, and e-vehicle.

Related Information

[Automotive page, Altera website](#)

Provides more information about Altera automotive solutions

Altera Automotive Qualifications

Altera automotive-grade devices comply to the following qualifications:

- ISO-26262
- IEC-61508
- AEC-Q100
- ISO-9001
- TS-16949
- Electronic Industries Alliance (EIA)
- Joint Electron Device Engineering Council (JEDEC)

Related Information

[Automotive Quality and Reliability page, Altera website](#)

Provides more information about the certificates.

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Supported Device Families

Table 1-1: Altera Automotive-Grade Device Families

| Category | Product Family | Quartus II Software Support | Description |
|--|----------------------------|-----------------------------|---|
| IC, FPGA | MAX [®] 10 | Version 14.0.2 and later | Low-cost, instant-on, small form factor programmable logic device |
| IC, SoC | Cyclone [®] V SoC | Version 12.1 and later | Low-cost, low-power, user-customizable ARM-based SoC devices |
| IC, FPGA | Cyclone V | Version 11.1 and later | Low-cost, low-power, feature-rich 28 nm FPGAs |
| IC, FPGA | Cyclone IV | Version 9.1 SP2 and later | Low-cost, low-power, feature-rich 60 nm FPGAs (1.2 V) |
| IC, CPLD | MAX V | Version 11.0 and later | High-density, low-power glue logic CPLDs (1.8 V) |
| IC, CPLD | MAX II | Version 7.2 SP1 and later | High-density, low-power glue logic CPLDs (3.3 V, 2.5 V) |
| Volume Production Support for Legacy Device Families | | | |
| Category | Product Family | Quartus II Software Support | Description |
| IC, FPGA | Cyclone III | Version 8.0 to 13.1 | Low-cost, feature-rich 65 nm FPGAs |
| IC, FPGA | Cyclone II | Version 7.2 SP1 to 13.0 | Low-cost, feature-rich 90 nm FPGAs |
| IC, FPGA | Cyclone | Version 7.2 SP1 to 13.0 | Low-cost, glue logic 130 nm FPGAs |
| IC, CPLD | MAX 7000AE | Version 7.2 SP1 to 13.0 | High-performance, glue logic CPLDs (5-V I/O compatible) |

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MAX 10 Devices

Supported Automotive-Grade Devices

Table 2-1: Autotomotive-Grade in MAX 10 Devices

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|-------------------------------|---------|--------------|----------------------------|-------------|
| 10M02SCE144A7G | 10M02SC | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M02SCM153A7G ⁽¹⁾ | 10M02SC | 153-pin MBGA | -40°C to 125°C | -7 |
| 10M02SCU169A7G | 10M02SC | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M02DCU324A7G | 10M02DC | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M02DCV36A7G ⁽¹⁾ | 10M02DC | 36-pin WLCSP | -40°C to 125°C | -7 |
| 10M04SCE144A7G | 10M04SC | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M04SFE144A7G ⁽¹⁾ | 10M04SF | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M04SCM153A7G ⁽¹⁾ | 10M04SC | 153-pin MBGA | -40°C to 125°C | -7 |
| 10M04SCU169A7G | 10M04SC | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M04SFU169A7G ⁽¹⁾ | 10M04SF | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M04DCF256A7G | 10M04DC | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M04DF256A7G ⁽¹⁾ | 10M04DF | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M04DAF256A7G ⁽¹⁾ | 10M04DA | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M04DCU324A7G | 10M04DC | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M04DFU324A7G ⁽¹⁾ | 10M04DF | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M04DAU324A7G ⁽¹⁾ | 10M04DA | 324-pin UBGA | -40°C to 125°C | -7 |

⁽¹⁾ This automotive-grade ordering code might be available upon request. Consult your Altera sales representative to submit your request.

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| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|-------------------------------|---------|--------------|----------------------------|-------------|
| 10M08DCV81A7G ⁽¹⁾ | 10M08DC | 81-pin WLCSP | -40°C to 125°C | -7 |
| 10M08DFV81A7G ⁽¹⁾ | 10M08DF | 81-pin WLCSP | -40°C to 125°C | -7 |
| 10M08SCE144A7G | 10M08SC | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M08SFE144A7G ⁽¹⁾ | 10M08SF | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M08SCM153A7G ⁽¹⁾ | 10M08SC | 153-pin MBGA | -40°C to 125°C | -7 |
| 10M08SCU169A7G | 10M08SC | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M08SFU169A7G ⁽¹⁾ | 10M08SF | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M08DCF256A7G | 10M08DC | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M08DFF256A7G ⁽¹⁾ | 10M08DF | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M08DAF256A7G ⁽¹⁾ | 10M08DA | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M08DCU324A7G | 10M08DC | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M08DFU324A7G ⁽¹⁾ | 10M08DF | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M08DAU324A7G ⁽¹⁾ | 10M08DA | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M08DCF484A7G ⁽¹⁾ | 10M08DC | 484-pin FBGA | -40°C to 125°C | -7 |
| 10M08DFF484A7G ⁽¹⁾ | 10M08DF | 484-pin FBGA | -40°C to 125°C | -7 |
| 10M08DAF484A7G ⁽¹⁾ | 10M08DA | 484-pin FBGA | -40°C to 125°C | -7 |
| 10M16SCE144A7G | 10M16SC | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M16SFE144A7G ⁽¹⁾ | 10M16SF | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M16SCU169A7G | 10M16SC | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M16SFU169A7G ⁽¹⁾ | 10M16SF | 169-pin UBGA | -40°C to 125°C | -7 |
| 10M16DCF256A7G | 10M16DC | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M16DFF256A7G ⁽¹⁾ | 10M16DF | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M16DAF256A7G ⁽¹⁾ | 10M16DA | 256-pin FBGA | -40°C to 125°C | -7 |
| 10M16DCU324A7G | 10M16DC | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M16DFU324A7G ⁽¹⁾ | 10M16DF | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M16DAU324A7G ⁽¹⁾ | 10M16DA | 324-pin UBGA | -40°C to 125°C | -7 |
| 10M16DCF484A7G ⁽¹⁾ | 10M16DC | 484-pin FBGA | -40°C to 125°C | -7 |
| 10M16DFF484A7G ⁽¹⁾ | 10M16DF | 484-pin FBGA | -40°C to 125°C | -7 |
| 10M16DAF484A7G ⁽¹⁾ | 10M16DA | 484-pin FBGA | -40°C to 125°C | -7 |
| 10M25SCE144A7G | 10M25SC | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M25SFE144A7G ⁽¹⁾ | 10M25SF | 144-pin EQFP | -40°C to 125°C | -7 |
| 10M25DCF256A7G | 10M25DC | 256-pin FBGA | -40°C to 125°C | -7 |

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|-------------------------------|---------|--------------|----------------------------|-------------|
| 10M25DFF256A7G ⁽¹⁾ | 10M25DF | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M25DAF256A7G ⁽¹⁾ | 10M25DA | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M25DCF484A7G ⁽¹⁾ | 10M25DC | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M25DFF484A7G ⁽¹⁾ | 10M25DF | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M25DAF484A7G ⁽¹⁾ | 10M25DA | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M25DCF672A7G ⁽¹⁾ | 10M25DC | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M25DFF672A7G ⁽¹⁾ | 10M25DF | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M25DAF672A7G ⁽¹⁾ | 10M25DA | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M40SCE144A7G | 10M40SC | 144-pin EQFP | –40°C to 125°C | -7 |
| 10M40SFE144A7G ⁽¹⁾ | 10M40SF | 144-pin EQFP | –40°C to 125°C | -7 |
| 10M40DCF256A7G | 10M40DC | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M40DFF256A7G ⁽¹⁾ | 10M40DF | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M40DAF256A7G ⁽¹⁾ | 10M40DA | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M40DCF484A7G ⁽¹⁾ | 10M40DC | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M40DFF484A7G ⁽¹⁾ | 10M40DF | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M40DAF484A7G ⁽¹⁾ | 10M40DA | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M40DCF672A7G ⁽¹⁾ | 10M40DC | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M40DFF672A7G ⁽¹⁾ | 10M40DF | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M40DAF672A7G ⁽¹⁾ | 10M40DA | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M50SCE144A7G | 10M50SC | 144-pin EQFP | –40°C to 125°C | -7 |
| 10M50SFE144A7G ⁽¹⁾ | 10M50SF | 144-pin EQFP | –40°C to 125°C | -7 |
| 10M50DCF256A7G | 10M50DC | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M50DFF256A7G ⁽¹⁾ | 10M50DF | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M50DAF256A7G ⁽¹⁾ | 10M50DF | 256-pin FBGA | –40°C to 125°C | -7 |
| 10M50DCF484A7G ⁽¹⁾ | 10M50DC | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M50DFF484A7G ⁽¹⁾ | 10M50DF | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M50DAF484A7G ⁽¹⁾ | 10M50DA | 484-pin FBGA | –40°C to 125°C | -7 |
| 10M50DCF672A7G ⁽¹⁾ | 10M50DC | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M50DFF672A7G ⁽¹⁾ | 10M50DF | 672-pin FBGA | –40°C to 125°C | -7 |
| 10M50DAF672A7G ⁽¹⁾ | 10M50DA | 672-pin FBGA | –40°C to 125°C | -7 |

Package Options and Maximum User I/Os

Table 2-2: Package Options and Maximum User I/Os in MAX 10 Single Power Supply Devices

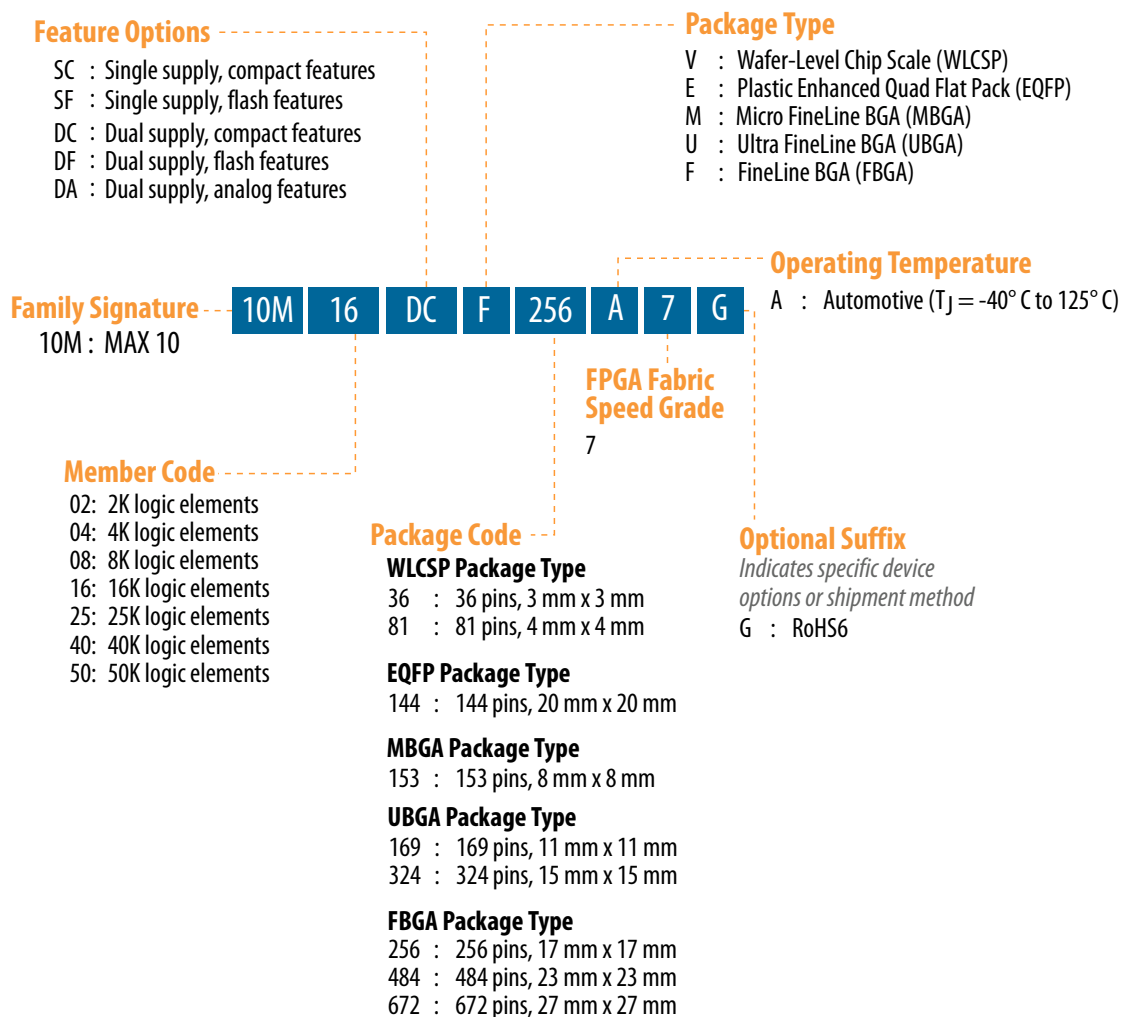
| Device | Package | | | |
|--------|------------|----------------------|----------------------|----------------------|
| | Type | M153 153-pin MBGA | U169 169-pin UBGA | E144 144-pin EQFP |
| | Size | 8 mm × 8 mm | 11 mm × 11 mm | 20 mm × 20 mm |
| | Ball Pitch | 0.5 mm | 0.8 mm | 0.5 mm |
| 10M02 | | 112 | 130 | 101 |
| 10M04 | | 112 | 130 | 101 |
| 10M08 | | 112 | 130 | 101 |
| 10M16 | | — | 130 | 101 |
| 10M25 | | — | — | 101 |
| 10M40 | | — | — | 101 |
| 10M50 | | — | — | 101 |

Table 2-3: Package Options and Maximum User I/Os in MAX 10 Dual Power Supply Devices

| Device | Package | | | | | | |
|--------|---------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | Type | V36 36-pin WLCSP | V81 81-pin WLCSP | U324 324-pin UBGA | F256 256-pin FBGA | F484 484-pin FBGA | F672 672-pin FBGA |
| | Size | 3 mm × 3 mm | 4 mm × 4 mm | 15 mm × 15 mm | 17 mm × 17 mm | 23 mm × 23 mm | 27 mm × 27 mm |
| | Ball Pitch | 0.4 mm | 0.4 mm | 0.8 mm | 1.0 mm | 1.0 mm | 1.0 mm |
| 10M02 | | 27 | — | 160 | — | — | — |
| 10M04 | | — | — | 246 | 178 | — | — |
| 10M08 | | — | 56 | 246 | 178 | 250 | — |
| 10M16 | | — | — | 246 | 178 | 320 | — |
| 10M25 | | — | — | — | 178 | 360 | 380 |
| 10M40 | | — | — | — | 178 | 360 | 500 |
| 10M50 | | — | — | — | 178 | 360 | 500 |

Device Ordering Codes

Figure 2-1: Automotive-Grade Ordering Information for MAX 10 Devices



Cyclone V SoC Devices

Supported Automotive-Grade Devices

Table 2-4: Autotomotive-Grade in Cyclone V SoC Devices

Other automotive-grade product line/package combinations or ordering codes might be available upon request. Consult your Altera sales representative to submit your request.

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| 5CSEBA2U19A7N | 5CSEBA2 | 484-pin UBGA | -40°C to 125°C | -7 |

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| 5CSEBA2U23A7N | 5CSEBA2 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEMA2U23A7N | 5CSEMA2 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEBA4U19A7N | 5CSEBA4 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CSEBA4U23A7N | 5CSEBA4 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEMA4U23A7N | 5CSEMA4 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEBA5U19A7N | 5CSEBA5 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CSEBA5U23A7N | 5CSEBA5 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEMA5U23A7N | 5CSEMA5 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEMA5F31A7N | 5CSEMA5 | 896-pin FBGA | -40°C to 125°C | -7 |
| 5CSEBA6U19A7N | 5CSEBA6 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CSEBA6U23A7N | 5CSEBA6 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEMA6U23A7N | 5CSEMA6 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSEMA6F31A7N | 5CSEMA6 | 896-pin FBGA | -40°C to 125°C | -7 |
| 5CSXFC2C6U23A7N | 5CSXFC2 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSXFC4C6U23A7N | 5CSXFC4 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSXFC5C6U23A7N | 5CSXFC5 | 672-pin UBGA | -40°C to 125°C | -7 |
| 5CSXFC6C6U23A7N | 5CSXFC6 | 672-pin UBGA | -40°C to 125°C | -7 |

Package Options and Maximum User I/Os

Table 2-5: Package Options and Maximum User I/Os in Cyclone V SE Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | | |
|-------------------------|-------------------|-----------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | | | 5CSEA2 | 5CSEA4 | 5CSEA5 | 5CSEA6 |
| | | | (25K LEs) | (40K LEs) | (85K LEs) | (110K LEs) |
| | | | FPGA I/Os / HPS I/Os | | | |
| UBGA-484 | 0.8 | 19 x 19 | 66 / 151 ⁽²⁾ | 66 / 151 ⁽²⁾ | 66 / 151 ⁽²⁾ | 66 / 151 ⁽²⁾ |
| UBGA-672 | 0.8 | 23 x 23 | 145 / 181 ⁽²⁾ | 145 / 181 ⁽²⁾ | 145 / 181 ⁽²⁾ | 145 / 181 ⁽²⁾ |
| FBGA-896 | 1 | 31 x 31 | — | — | 288 / 181 ⁽²⁾ | 288 / 181 ⁽²⁾ |

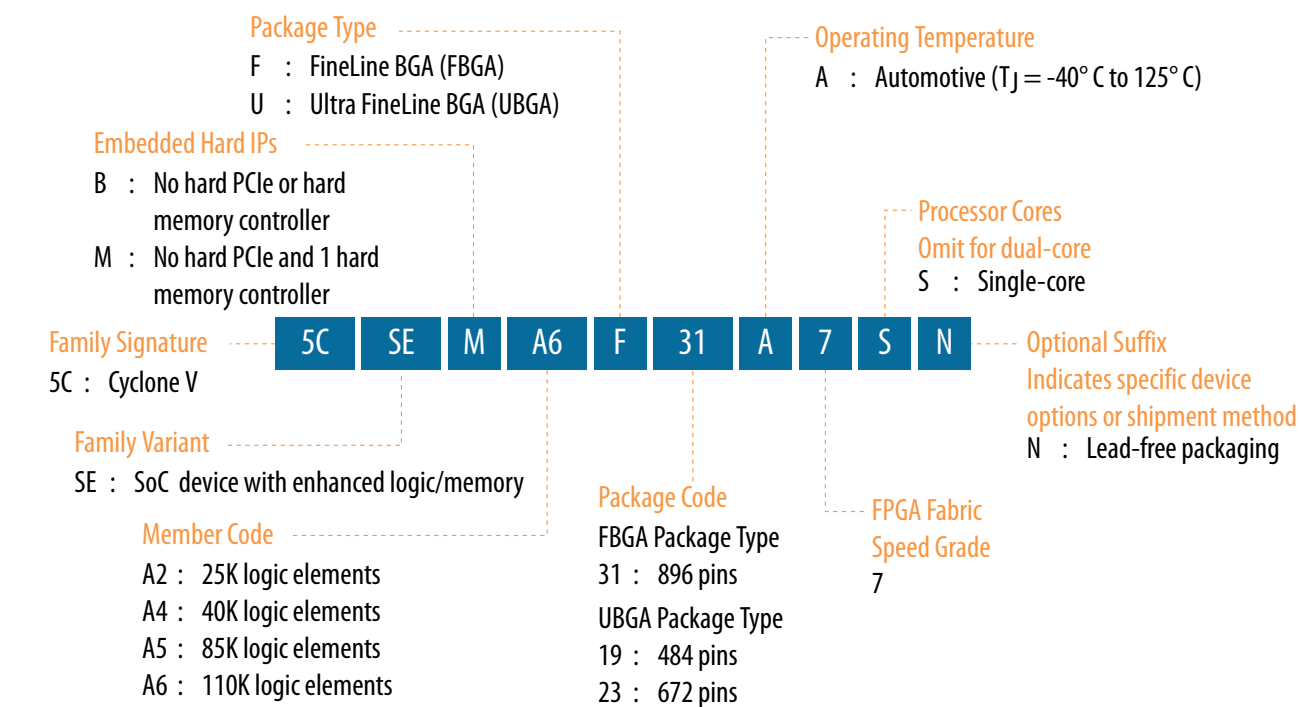
⁽²⁾ Package options available with automotive-grade variants.

Table 2-6: Package Options and Maximum User I/Os in Cyclone V SX Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | | |
|-------------------------|-------------------|-----------------|------------------------------|------------------------------|------------------------------|------------------------------|
| | | | 5CSXC2 | 5CSXC4 | 5CSXC5 | 5CSXC6 |
| | | | (25K LEs) | (40K LEs) | (85K LEs) | (110K LEs) |
| | | | FPGA I/Os / HPS I/Os / XCVRs | | | |
| UBGA-672 | 0.8 | 23 x 23 | 145 / 181 / 6 ⁽²⁾ | 145 / 181 / 6 ⁽²⁾ | 145 / 181 / 6 ⁽²⁾ | 145 / 181 / 6 ⁽²⁾ |
| FBGA-896 | 1 | 31 x 31 | — | — | 288 / 181 / 9 ⁽³⁾ | 288 / 181 / 9 ⁽³⁾ |

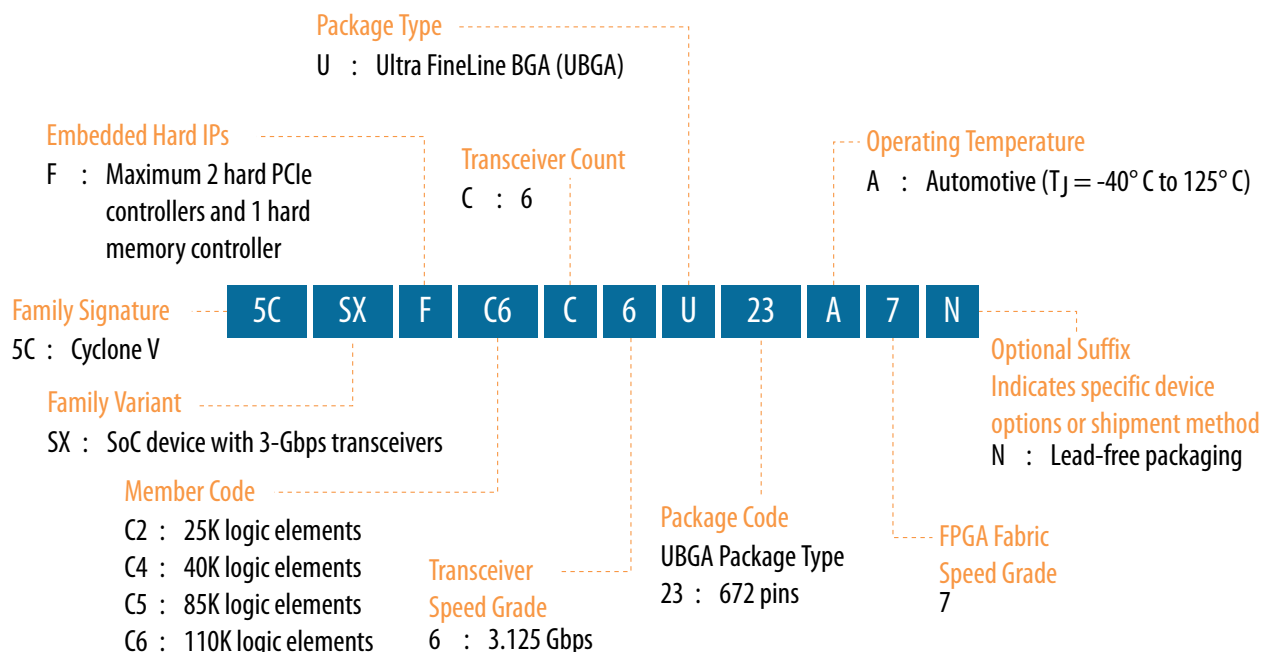
Device Ordering Codes

Figure 2-2: Automotive-Grade Ordering Information for Cyclone V SE Devices



⁽³⁾ These package options are not currently available in automotive-grade but might become available upon request. Consult your Altera sales representative to submit your request.

Figure 2-3: Automotive-Grade Ordering Information for Cyclone V SX Devices



Cyclone V Devices

Supported Automotive-Grade Devices

Table 2-7: Autotomotive-Grade in Cyclone V Devices

Other automotive-grade product line/package combinations or ordering codes might be available upon request. Consult your Altera sales representative to submit your request.

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| 5CEBA2F17A7N | 5CEBA2 | 256-pin FBGA | -40°C to 125°C | -7 |
| 5CEFA2U19A7N | 5CEFA2 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CEBA4F17A7N | 5CEBA4 | 256-pin FBGA | -40°C to 125°C | -7 |
| 5CEFA4U19A7N | 5CEFA4 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CEFA5U19A7N | 5CEFA5 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CEFA7U19A7N | 5CEFA7 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CEFA9U19A7N | 5CEFA9 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGXFC3B6U15A7N | 5CGXFC3 | 324-pin UBGA | -40°C to 125°C | -7 |
| 5CGXFC3B6U19A7N | 5CGXFC3 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGXFC4C6U19A7N | 5CGXFC4 | 484-pin UBGA | -40°C to 125°C | -7 |

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| 5CGXFC5C6U19A7N | 5CGXFC5 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGXFC5C6F23A7N | 5CGXFC5 | 484-pin FBGA | -40°C to 125°C | -7 |
| 5CGXFC7C6U19A7N | 5CGXFC7 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGXFC9A6U19A7N | 5CGXFC9 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGTFD5C5U19A7N | 5CGTFD5 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGTFD7C5U19A7N | 5CGTFD7 | 484-pin UBGA | -40°C to 125°C | -7 |
| 5CGTFD9A5U19A7N | 5CGTFD9 | 484-pin UBGA | -40°C to 125°C | -7 |

Package Options and Maximum User I/Os

Table 2-8: Package Options and Maximum User I/Os in Cyclone V E Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimension s (mm) | Product Line | | | | |
|----------------------------|-------------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | | | 5CEA2 | 5CEA4 | 5CEA5 | 5CEA7 | 5CEA9 |
| | | | (25K LEs) | (49K LEs) | (77K LEs) | (149.5K LEs) | (301K LEs) |
| | | | I/Os | | | | |
| FBGA-256 | 1 | 17 x 17 | 128 ⁽⁴⁾ | 128 ⁽⁴⁾ | — | — | — |
| UBGA-324 | 0.8 | 15 x 15 | 176 ⁽⁵⁾ | 176 ⁽⁵⁾ | — | — | — |
| UBGA-484 | 0.8 | 19 x 19 | 224 ⁽⁴⁾ | 224 ⁽⁴⁾ | 224 ⁽⁴⁾ | 240 ⁽⁴⁾ | — |
| FBGA-484 | 1 | 23 x 23 | 224 ⁽⁵⁾ | 224 ⁽⁵⁾ | 240 ⁽⁵⁾ | 240 ⁽⁵⁾ | 224 ⁽⁵⁾ |
| FBGA-672 | 1 | 27 x 27 | — | — | — | 336 ⁽⁵⁾ | 336 ⁽⁵⁾ |
| FBGA-896 | 1 | 31 x 31 | — | — | — | 480 ⁽⁵⁾ | 480 ⁽⁵⁾ |

Table 2-9: Package Options and Maximum User I/Os in Cyclone V GX Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimension s (mm) | Product Line | | | | |
|----------------------------|-------------------------|---------------------|------------------------|------------------------|------------------------|------------------------|------------|
| | | | 5CGXC3 | 5CGXC4 | 5CGXC5 | 5CGXC7 | 5CGXC9 |
| | | | (31.5K LEs) | (50K LEs) | (77K LEs) | (149.5K LEs) | (301K LEs) |
| | | | I/Os / XCVRs | | | | |
| UBGA-324 | 0.8 | 15 x 15 | 144 / 3 ⁽⁴⁾ | — | — | — | — |
| UBGA-484 | 0.8 | 19 x 19 | 208 / 3 ⁽⁴⁾ | 224 / 6 ⁽⁴⁾ | 224 / 6 ⁽⁴⁾ | 240 / 6 ⁽⁴⁾ | — |

⁽⁴⁾ Package options available with automotive-grade variants.

⁽⁵⁾ These package options are not currently available in automotive-grade but might become available upon request. Consult your Altera sales representative to submit your request.

| Package Type/ Pin Count | Ball Spacing (mm) | Dimension s (mm) | Product Line | | | | |
|----------------------------|-------------------------|---------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|
| | | | 5CGXC3 | 5CGXC4 | 5CGXC5 | 5CGXC7 | 5CGXC9 |
| | | | (31.5K LEs) | (50K LEs) | (77K LEs) | (149.5K LEs) | (301K LEs) |
| | | | I/Os / XCVRs | | | | |
| FBGA-484 | 1 | 23 x 23 | 208 / 3 ⁽⁵⁾ | 240 / 6 ⁽⁵⁾ | 240 / 6 ⁽⁴⁾ | 240 / 6 ⁽⁵⁾ | 224 / 6 ⁽⁵⁾ |
| FBGA-672 | 1 | 27 x 27 | — | 336 / 6 ⁽⁵⁾ | 336 / 6 ⁽⁵⁾ | 336 / 9 ⁽⁵⁾ | 336 / 9 ⁽⁵⁾ |
| FBGA-896 | 1 | 31 x 31 | — | — | — | 480 / 9 ⁽⁵⁾ | 480 / 12 ⁽⁵⁾ |
| FBGA-1152 | 1 | 35 x 35 | — | — | — | — | 560 / 12 ⁽⁵⁾ |

Table 2-10: Package Options and Maximum User I/Os in Cyclone V GT Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | |
|----------------------------|----------------------|--------------------|------------------------|------------------------|-------------------------|
| | | | 5CGTD5 | 5CGTD7 | 5CGTD9 |
| | | | (77K LEs) | (149.5K LEs) | (301K LEs) |
| | | | I/Os / XCVRs | | |
| UBGA-484 | 0.8 | 19 x 19 | 224 / 6 ⁽⁴⁾ | 240 / 6 ⁽⁴⁾ | — |
| FBGA-484 | 1 | 23 x 23 | 240 / 6 ⁽⁵⁾ | 240 / 6 ⁽⁵⁾ | 224 / 6 ⁽⁵⁾ |
| FBGA-672 | 1 | 27 x 27 | 336 / 6 ⁽⁵⁾ | 336 / 9 ⁽⁵⁾ | 336 / 9 ⁽⁵⁾ |
| FBGA-896 | 1 | 31 x 31 | — | 480 / 9 ⁽⁵⁾ | 480 / 12 ⁽⁵⁾ |
| FBGA-1152 | 1 | 35 x 35 | — | — | 560 / 12 ⁽⁵⁾ |

Device Ordering Codes

Figure 2-4: Automotive-Grade Ordering Information for Cyclone V E Devices

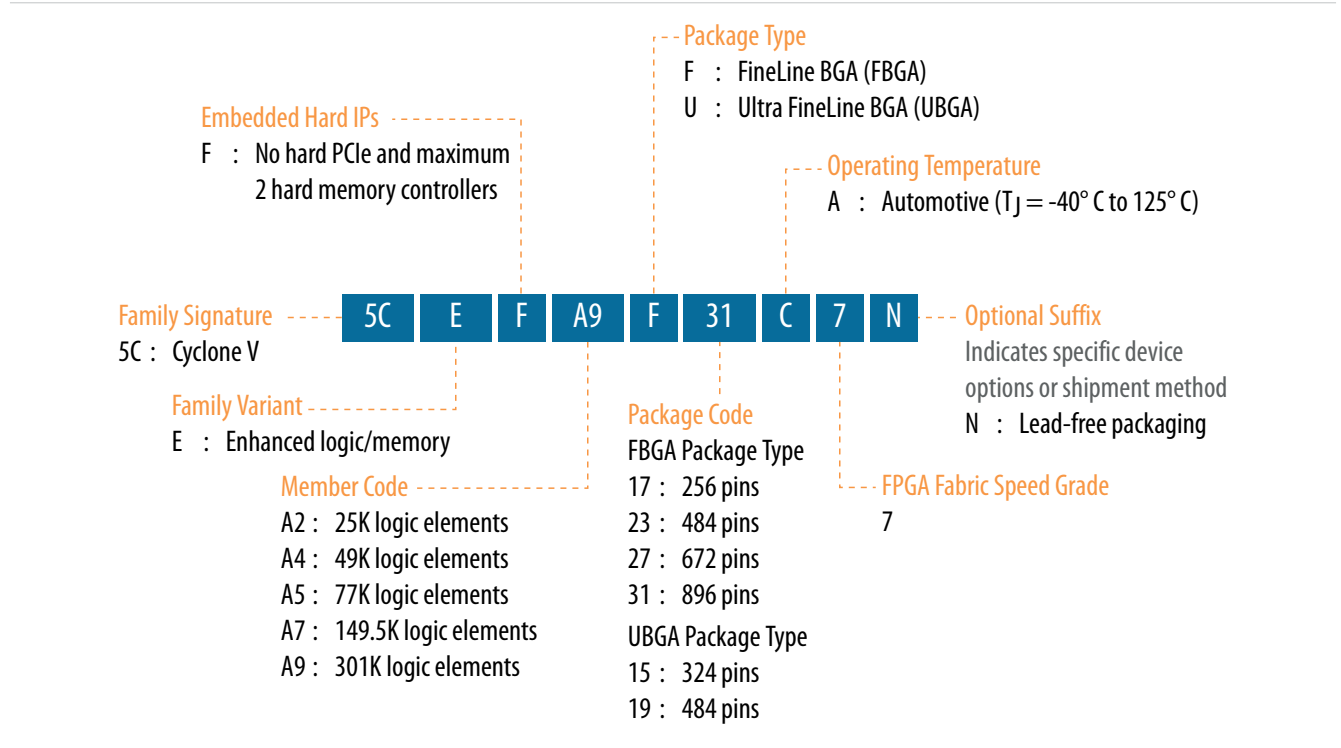


Figure 2-5: Automotive-Grade Ordering Information for Cyclone V GX Devices

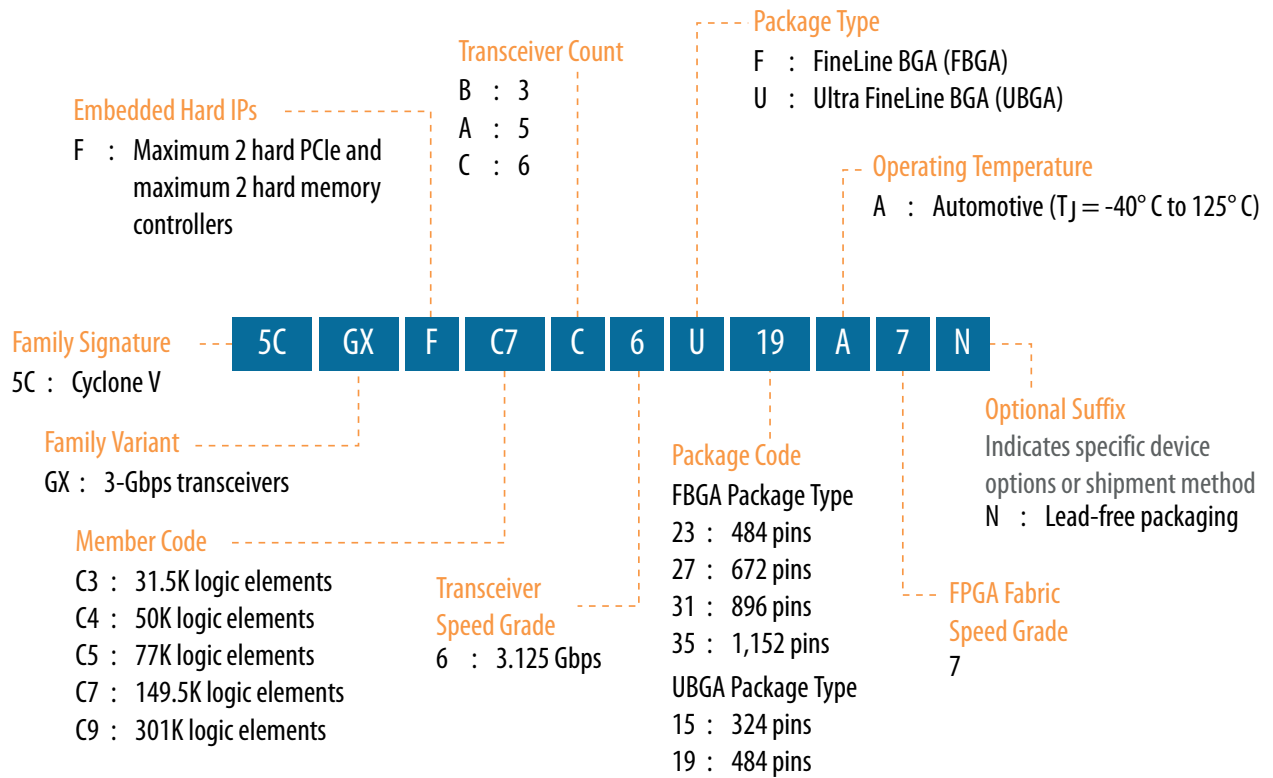
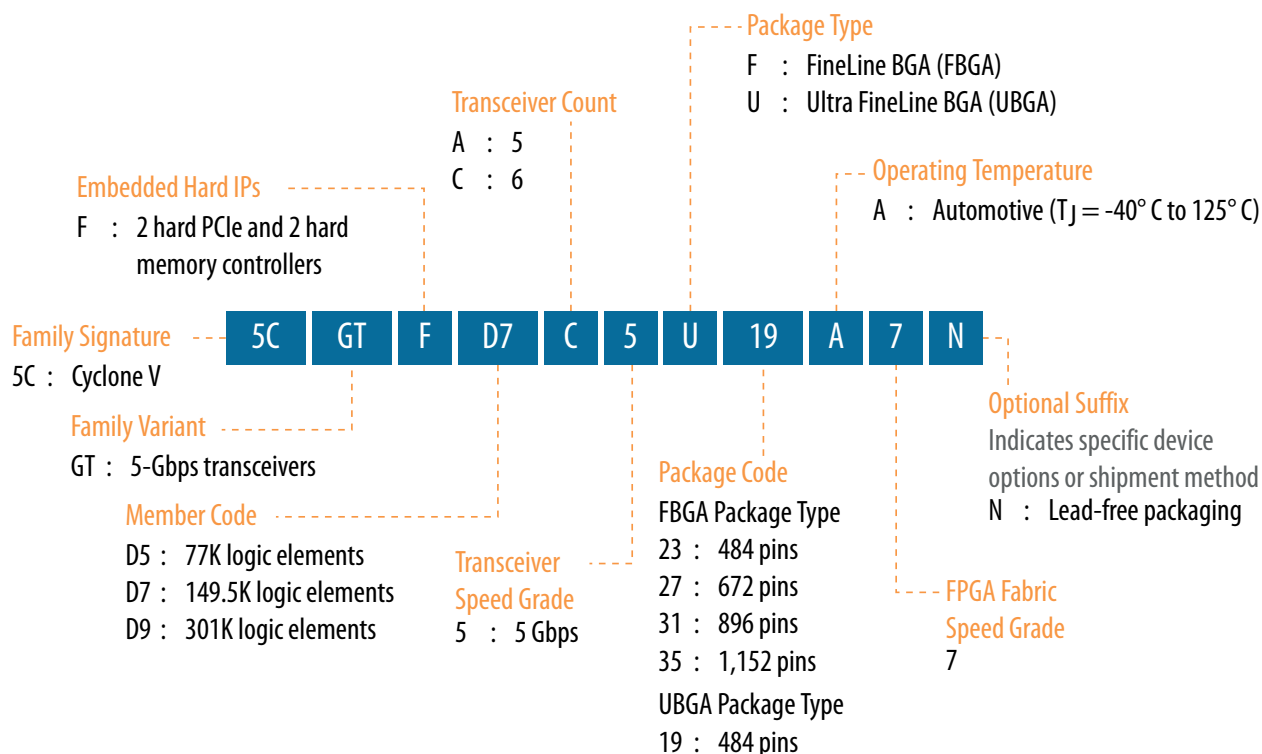


Figure 2-6: Automotive-Grade Ordering Information for Cyclone V GT Devices



Cyclone IV Devices

Supported Automotive-Grade Devices

Table 2-11: Autotomotive-Grade in Cyclone IV Devices

Other automotive-grade product line/package combinations or ordering codes might be available upon request. Consult your Altera sales representative to submit your request.

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| EP4CE6F17A7N | EP4CE6 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP4CE6E22A7N | EP4CE6 | 144-pin EQFP | -40°C to 125°C | -7 |
| EP4CE10F17A7N | EP4CE10 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP4CE10E22A7N | EP4CE10 | 144-pin EQFP | -40°C to 125°C | -7 |
| EP4CE15F17A7N | EP4CE15 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP4CE15F23A7N | EP4CE15 | 484-pin FBGA | -40°C to 125°C | -7 |
| EP4CE22F17A7N | EP4CE22 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP4CE22E22A7N | EP4CE22 | 144-pin EQFP | -40°C to 125°C | -7 |

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|----------|--------------|----------------------------|-------------|
| EP4CE30F19A7N | EP4CE30 | 324-pin FBGA | -40°C to 125°C | -7 |
| EP4CE30F23A7N | EP4CE30 | 484-pin FBGA | -40°C to 125°C | -7 |
| EP4CE40F19A7N | EP4CE40 | 324-pin FBGA | -40°C to 125°C | -7 |
| EP4CE40F23A7N | EP4CE40 | 484-pin FBGA | -40°C to 125°C | -7 |
| EP4CE40U19A7N | EP4CE40 | 484-pin UBGA | -40°C to 125°C | -7 |
| EP4CGX15BF14A7N | EP4CGX15 | 169-pin FBGA | -40°C to 125°C | -7 |

Package Options and Maximum User I/Os

Table 2-12: Package Options and Maximum User I/Os in Cyclone IV E Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | | | | | | | |
|-------------------------|-------------------|-----------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|
| | | | EP4CE 6 (6.3K LEs) | EP4CE 10 (10.3K LEs) | EP4CE 15 (15.4K LEs) | EP4CE 22 (22.3K LEs) | EP4CE 30 (28.8K LEs) | EP4CE 40 (39.6K LEs) | EP4CE 55 (55.9K LEs) | EP4CE 75 (75.4K LEs) | EP4CE115 (114.5K LEs) |
| | | | I/Os | | | | | | | | |
| EQFP-144 | 0.5 | 22 x 22 | 91 ⁽⁶⁾ | 91 ⁽⁶⁾ | 81 ⁽⁷⁾ | 79 ⁽⁶⁾ | — | — | — | — | — |
| MBGA-164 | 0.5 | 8 x 8 | — | — | 89 ⁽⁷⁾ | — | — | — | — | — | — |
| UBGA-256 | 0.8 | 14 x 14 | 179 ⁽⁷⁾ | 179 ⁽⁷⁾ | 165 ⁽⁷⁾ | 153 ⁽⁷⁾ | — | — | — | — | — |
| FBGA-256 | 1 | 17 x 17 | 179 ⁽⁶⁾ | 179 ⁽⁶⁾ | 165 ⁽⁶⁾ | 153 ⁽⁶⁾ | — | — | — | — | — |
| UBGA-484 | 0.8 | 19 x 19 | — | — | — | — | — | 328 ⁽⁷⁾ | 324 ⁽⁷⁾ | 292 ⁽⁷⁾ | — |
| FBGA-324 | 1 | 19 x 19 | — | — | — | — | 193 ⁽⁶⁾ | 193 ⁽⁶⁾ | — | — | — |
| FBGA-484 | 1 | 23 x 23 | — | — | 343 ⁽⁶⁾ | — | 328 ⁽⁶⁾ | 328 ⁽⁶⁾ | 324 ⁽⁷⁾ | 292 ⁽⁷⁾ | 280 ⁽⁷⁾ |
| FBGA-780 | 1 | 29 x 29 | — | — | — | — | 532 ⁽⁷⁾ | 532 ⁽⁷⁾ | 374 ⁽⁷⁾ | 426 ⁽⁷⁾ | 528 ⁽⁷⁾ |

⁽⁶⁾ Package options available with automotive-grade variants.

⁽⁷⁾ These package options are not currently available in automotive-grade but might become available upon request. Consult your Altera sales representative to submit your request.

Table 2-13: Package Options and Maximum User I/Os in Cyclone IV GX Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | | | | | | | |
|-------------------------|-------------------|-----------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|----------------------|-----------------------|
| | | | EP4CG X15 (14.4K LEs) | EP4CG X22 (21.3K LEs) | EP4CG X30 (29.4K LEs) | EP4CG X50 (49.9K LEs) | EP4CG X75 (73.9K LEs) | EP4CG X110 (109.4K LEs) | EP4CG X150 (149.8K LEs) | EP4CE 75 (75.4K LEs) | EP4CE115 (114.5K LEs) |
| | | | I/Os | | | | | | | | |
| QFN-148 | 0.5 | 11 x 11 | 72 / 2 ⁽⁷⁾ | — | — | — | — | — | — | — | — |
| FBGA-169 | 1 | 14 x 14 | 72 / 2 ⁽⁶⁾ | 72 / 2 ⁽⁷⁾ | 72 / 2 ⁽⁷⁾ | — | — | — | — | — | — |
| FBGA-324 | 1 | 19 x 19 | — | 150 / 4 ⁽⁷⁾ | 150 / 4 ⁽⁷⁾ | — | — | — | — | — | — |
| FBGA-484 | 1 | 23 x 23 | — | — | 290 / 4 ⁽⁷⁾ | 290 / 4 ⁽⁷⁾ | 290 / 4 ⁽⁷⁾ | 270 / 4 ⁽⁷⁾ | 270 / 4 ⁽⁷⁾ | — | — |
| FBGA-672 | 1 | 27 x 27 | — | — | — | 310 / 8 ⁽⁷⁾ | 310 / 8 ⁽⁷⁾ | 393 / 8 ⁽⁷⁾ | 393 / 8 ⁽⁷⁾ | 292 ⁽⁷⁾ | — |
| FBGA-896 | 1 | 31 x 31 | — | — | — | — | — | 475 / 8 ⁽⁷⁾ | 475 / 8 ⁽⁷⁾ | — | — |

Device Ordering Codes

Figure 2-7: Automotive-Grade Ordering Information for Cyclone IV E Devices

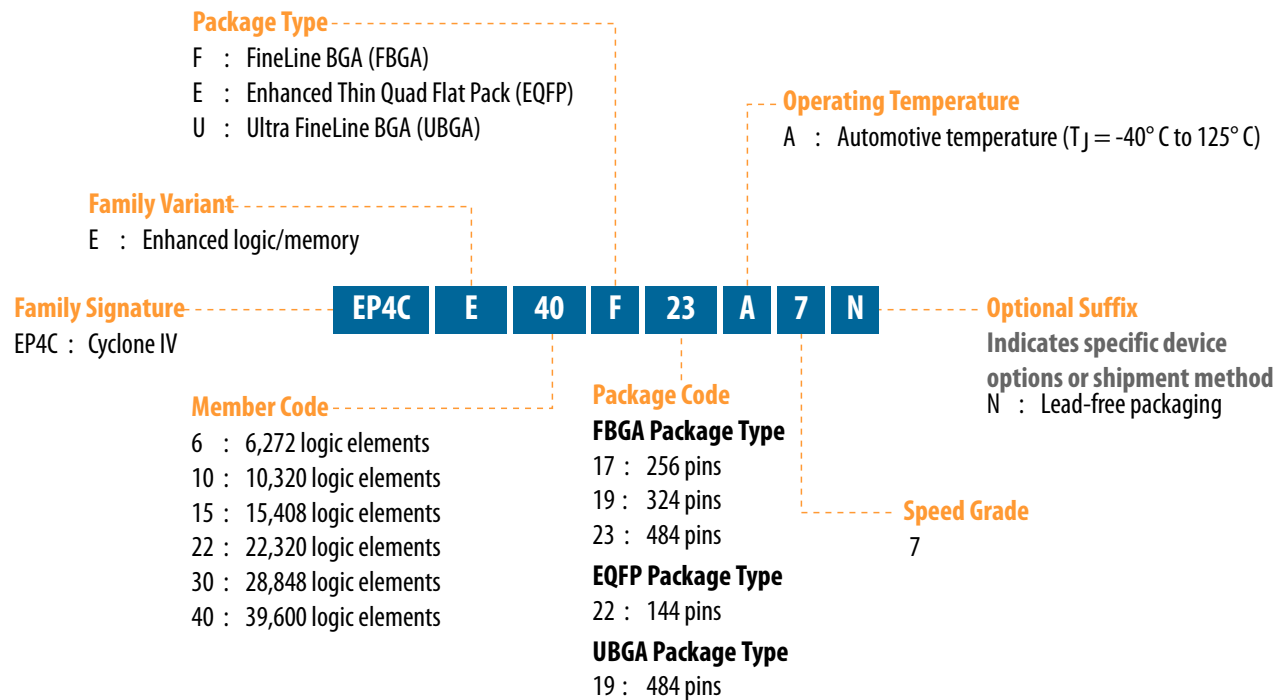
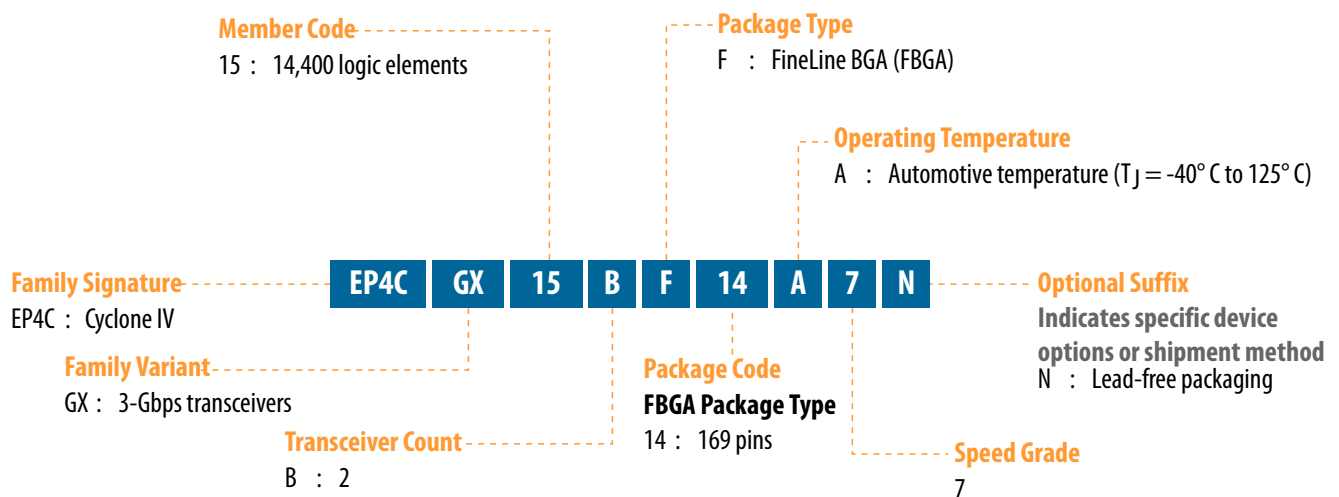


Figure 2-8: Automotive-Grade Ordering Information for Cyclone IV GX Devices



MAX V Devices

Supported Automotive-Grade Devices

Table 2-14: Autotomotive-Grade in MAX V Devices

Other automotive-grade product line/package combinations or ordering codes might be available upon request. Consult your Altera sales representative to submit your request.

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| 5M40ZE64A5N | 5M40Z | 64-pin EQFP | -40°C to 125°C | -5 |
| 5M80ZE64A5N | 5M80Z | 64-pin EQFP | -40°C to 125°C | -5 |
| 5M80ZT100A5N | 5M80Z | 100-pin TQFP | -40°C to 125°C | -5 |
| 5M160ZE64A5N | 5M160Z | 64-pin EQFP | -40°C to 125°C | -5 |
| 5M160ZT100A5N | 5M160Z | 100-pin TQFP | -40°C to 125°C | -5 |
| 5M240ZT100A5N | 5M240Z | 100-pin TQFP | -40°C to 125°C | -5 |
| 5M570ZT100A5N | 5M570Z | 100-pin TQFP | -40°C to 125°C | -5 |
| 5M1270ZF256A5N | 5M1270Z | 256-pin FBGA | -40°C to 125°C | -5 |
| 5M1270ZT144A5N | 5M1270Z | 144-pin TQFP | -40°C to 125°C | -5 |

Package Options and Maximum User I/Os

Table 2-15: Package Options and Maximum User I/Os in MAX V Devices

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | | | | | |
|-------------------------|-------------------|-----------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------|---------------------|
| | | | 5M40Z (40K LEs) | 5M80Z (80K LEs) | 5M160Z (160K LEs) | 5M240Z (240K LEs) | 5M570Z (570K LEs) | 5M1270Z (1270K LEs) | 5M2210Z (2210K LEs) |
| | | | I/Os | | | | | | |
| MBGA-64 | 0.5 | 4.5 x 4.5 | 30 ⁽⁸⁾ | 30 ⁽⁸⁾ | — | — | — | — | — |
| EQFP-64 | 0.5 | 7 x 7 | 54 ⁽⁹⁾ | 54 ⁽⁹⁾ | 54 ⁽⁹⁾ | — | — | — | — |
| MBGA-68 | 0.5 | 5 x 5 | — | 52 ⁽⁸⁾ | 52 ⁽⁸⁾ | 52 ⁽⁸⁾ | — | — | — |
| QFP-100 | 0.5 | 14 x 14 | — | 79 ⁽⁹⁾ | 79 ⁽⁹⁾ | 79 ⁽⁹⁾ | 74 ⁽⁹⁾ | — | — |
| MBGA-100 | 0.5 | 6 x 6 | — | — | 79 ⁽⁸⁾ | 79 ⁽⁸⁾ | 74 ⁽⁸⁾ | — | — |

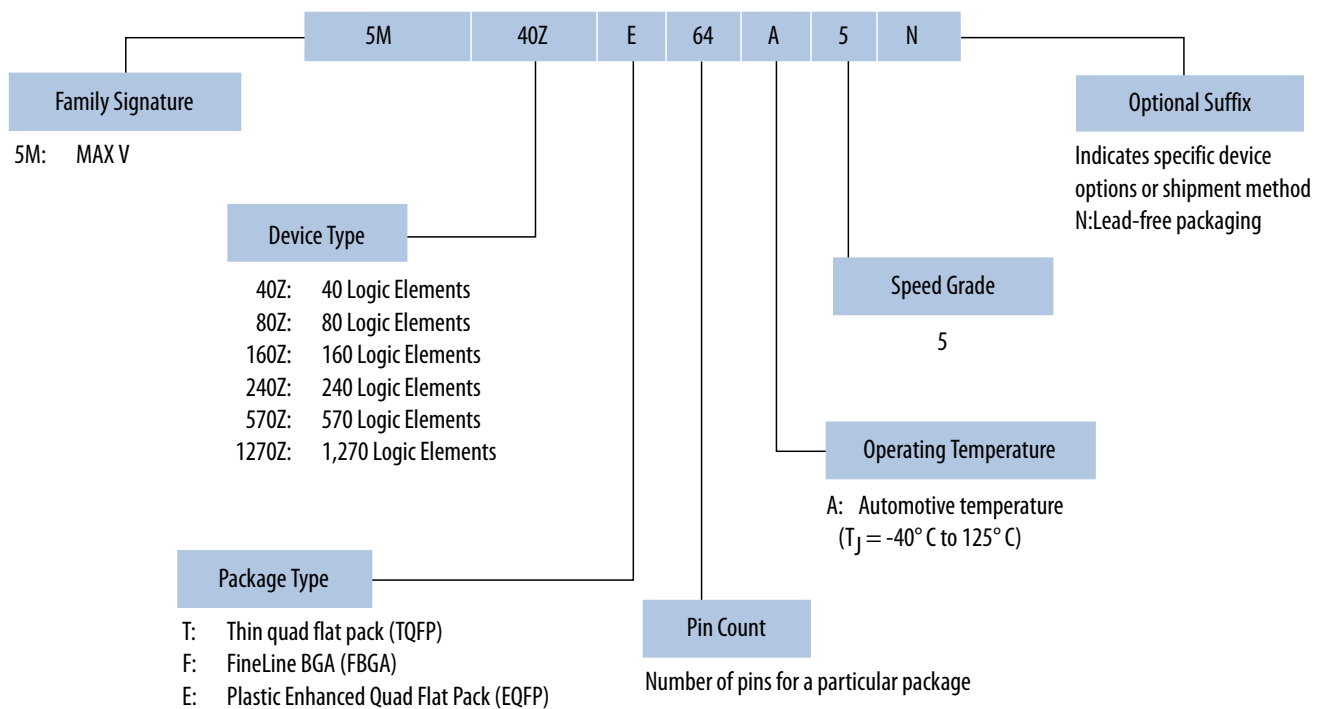
⁽⁸⁾ These package options are not currently available in automotive-grade but might become available upon request. Consult your Altera sales representative to submit your request.

⁽⁹⁾ Package options available with automotive-grade variants.

| Package Type/ Pin Count | Ball Spacing (mm) | Dimensions (mm) | Product Line | | | | | | |
|-------------------------|-------------------|-----------------|-----------------|-----------------|-------------------|--------------------|--------------------|---------------------|---------------------|
| | | | 5M40Z (40K LEs) | 5M80Z (80K LEs) | 5M160Z (160K LEs) | 5M240Z (240K LEs) | 5M570Z (570K LEs) | 5M1270Z (1270K LEs) | 5M2210Z (2210K LEs) |
| | | | I/Os | | | | | | |
| DFP-144 | 0.5 | 20 x 20 | — | — | — | 114 ⁽⁸⁾ | 114 ⁽⁸⁾ | 114 ⁽⁹⁾ | — |
| FBGA-256 | 1 | 17 x 17 | — | — | — | — | 159 ⁽⁸⁾ | 211 ⁽⁹⁾ | 203 ⁽⁸⁾ |
| FBGA-324 | 1 | 19 x 19 | — | — | — | — | — | 271 ⁽⁸⁾ | 271 ⁽⁸⁾ |

Device Ordering Codes

Figure 2-9: Automotive-Grade Ordering Information for MAX V Devices



MAX II Devices

Supported Automotive-Grade Devices

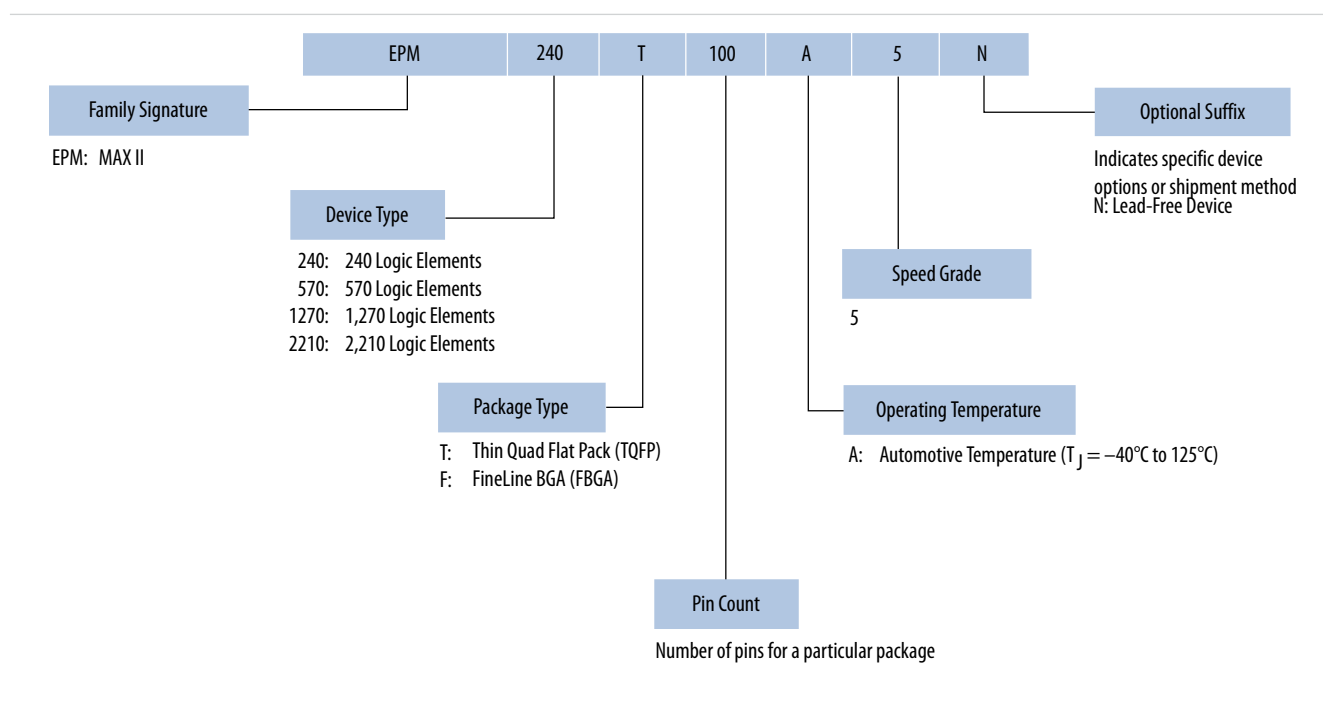
Table 2-16: Autotomotive-Grade in MAX II Devices

Other automotive-grade product line/package combinations or ordering codes might be available upon request. Consult your Altera sales representative to submit your request.

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|---------|--------------|----------------------------|-------------|
| EPM240T100A5N | EPM240 | 100-pin TQFP | -40°C to 125°C | -5 |
| EPM570F100A5N | EPM570 | 100-pin FBGA | -40°C to 125°C | -5 |
| EPM570T100A5N | EPM570 | 100-pin TQFP | -40°C to 125°C | -5 |
| EPM570T144A5N | EPM570 | 144-pin TQFP | -40°C to 125°C | -5 |
| EPM1270T144A5N | EPM1270 | 144-pin TQFP | -40°C to 125°C | -5 |
| EPM1270F256A5N | EPM1270 | 256-pin FBGA | -40°C to 125°C | -5 |
| EPM2210F256A5N | EPM2210 | 256-pin FBGA | -40°C to 125°C | -5 |
| EPM2210F324A5N | EPM2210 | 324-pin FBGA | -40°C to 125°C | -5 |

Device Ordering Codes

Figure 2-10: Automotive-Grade Ordering Information for MAX II Devices



Cyclone III Devices (Legacy Support)

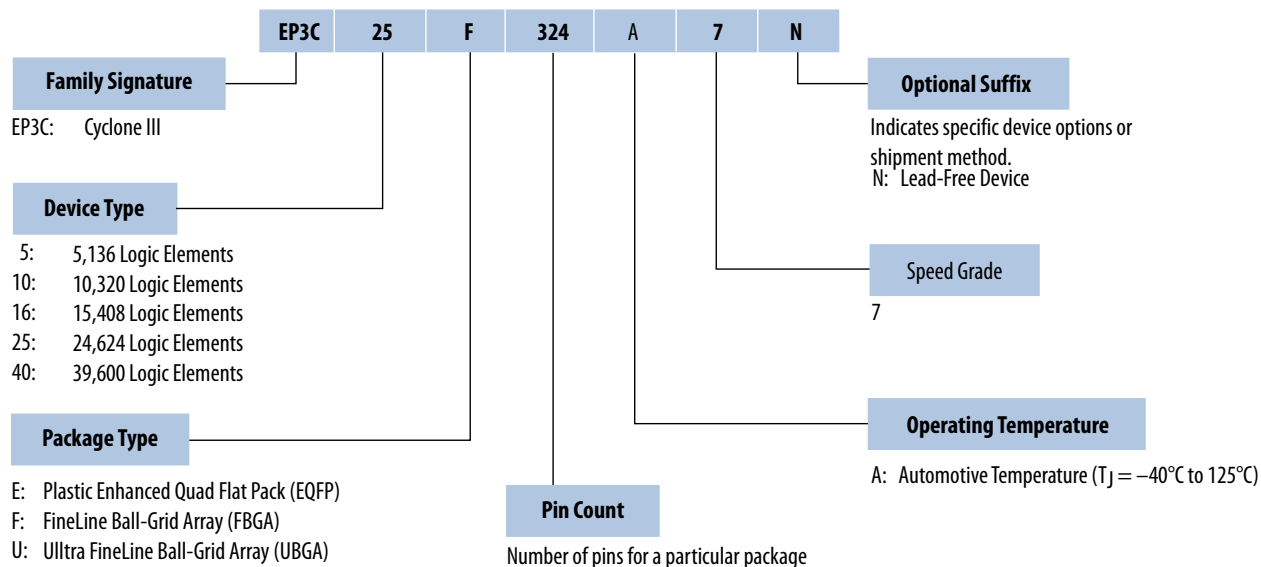
Supported Automotive-Grade Devices

Table 2-17: Autotomotive-Grade in Cyclone III Devices

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|--------|--------------|----------------------------|-------------|
| EP3C5E144A7N | EP3C5 | 144-pin EQFP | –40°C to 125°C | –7 |
| EP3C5F256A7N | EP3C5 | 256-pin FBGA | –40°C to 125°C | –7 |
| EP3C5U256A7N | EP3C5 | 256-pin UBGA | –40°C to 125°C | –7 |
| EP3C10E144A7N | EP3C10 | 144-pin EQFP | –40°C to 125°C | –7 |
| EP3C10F256A7N | EP3C10 | 256-pin FBGA | –40°C to 125°C | –7 |
| EP3C10U256A7N | EP3C10 | 256-pin UBGA | –40°C to 125°C | –7 |
| EP3C16E144A7N | EP3C16 | 144-pin EQFP | –40°C to 125°C | –7 |
| EP3C16F256A7N | EP3C16 | 256-pin FBGA | –40°C to 125°C | –7 |
| EP3C16U256A7N | EP3C16 | 256-pin UBGA | –40°C to 125°C | –7 |
| EP3C16F484A7N | EP3C16 | 484-pin FBGA | –40°C to 125°C | –7 |
| EP3C16U484A7N | EP3C16 | 484-pin UBGA | –40°C to 125°C | –7 |
| EP3C25E144A7N | EP3C25 | 144-pin EQFP | –40°C to 125°C | –7 |
| EP3C25F256A7N | EP3C25 | 256-pin FBGA | –40°C to 125°C | –7 |
| EP3C25U256A7N | EP3C25 | 256-pin UBGA | –40°C to 125°C | –7 |
| EP3C25F324A7N | EP3C25 | 324-pin FBGA | –40°C to 125°C | –7 |
| EP3C40F324A7N | EP3C40 | 324-pin FBGA | –40°C to 125°C | –7 |
| EP3C40F484A7N | EP3C40 | 484-pin FBGA | –40°C to 125°C | –7 |
| EP3C40U484A7N | EP3C40 | 484-pin UBGA | –40°C to 125°C | –7 |

Device Ordering Codes

Figure 2-11: Automotive-Grade Ordering Information for Cyclone III Devices



Cyclone II Devices (Legacy Support)

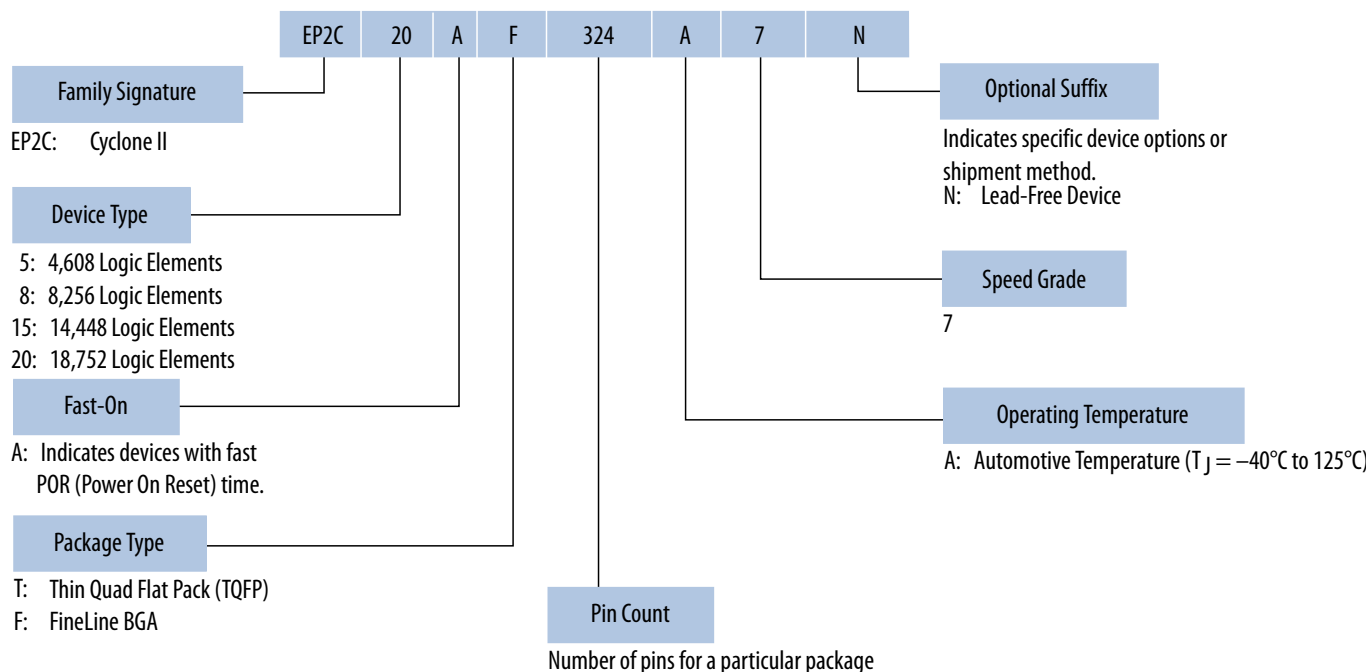
Supported Automotive-Grade Devices

Table 2-18: Autotomotive-Grade in Cyclone II Devices

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|--------|--------------|--|-------------|
| EP2C5AT144A7N | EP2C5 | 144-pin TQFP | -40°C to 125°C | -7 |
| EP2C5AF256A7N | EP2C5 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP2C8AF256A7N | EP2C8 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP2C15AF256A7N | EP2C15 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP2C15AF484A7N | EP2C15 | 484-pin FBGA | -40°C to 125°C | -7 |
| EP2C20AF256A7N | EP2C20 | 256-pin FBGA | -40°C to 125°C | -7 |
| EP2C20AF484A7N | EP2C20 | 484-pin FBGA | -40°C to 125°C | -7 |

Device Ordering Codes

Figure 2-12: Automotive-Grade Ordering Information for Cyclone II Devices



Cyclone Devices (Legacy Support)

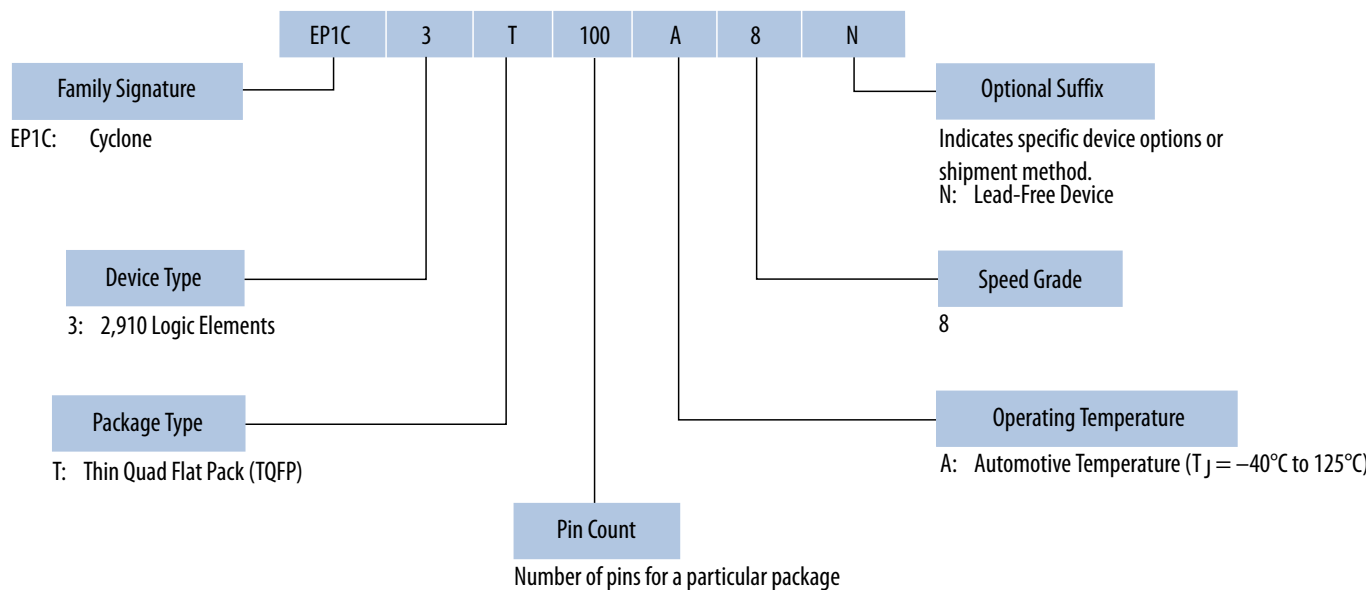
Supported Automotive-Grade Devices

Table 2-19: Autotomotive-Grade in Cyclone Devices

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|--------|--------------|--|-------------|
| EP1C3T100A8N | EP1C3 | 100-pin TQFP | -40°C to 125°C | -8 |
| EP1C3T144A8N | EP1C3 | 144-pin TQFP | -40°C to 125°C | -8 |

Device Ordering Codes

Figure 2-13: Automotive-Grade Ordering Information for Cyclone Devices



MAX 7000A Devices (Legacy Support)

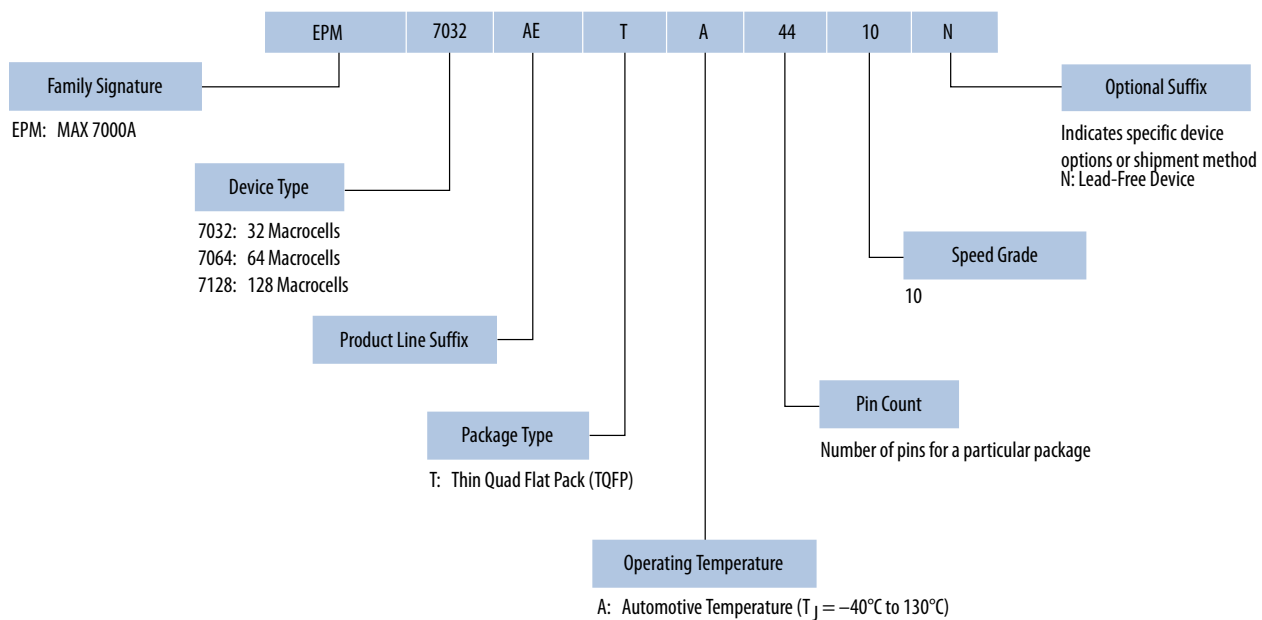
Supported Automotive-Grade Devices

Table 2-20: Automotive-Grade in MAX 7000A Devices

| Device Ordering Code | Device | Package | Junction Temperature Range | Speed Grade |
|----------------------|-----------|--------------|--|-------------|
| EPM7032AETA44-10N | EPM7032AE | 44-pin TQFP | -40°C to 130°C | -10 |
| EPM7064AETA44-10N | EPM7064AE | 44-pin TQFP | -40°C to 130°C | -10 |
| EPM7064AETA100-10N | EPM7064AE | 100-pin TQFP | -40°C to 130°C | -10 |
| EPM7128AETA100-10N | EPM7128AE | 100-pin TQFP | -40°C to 130°C | -10 |
| EPM7128AETA144-10N | EPM7128AE | 144-pin TQFP | -40°C to 130°C | -10 |

Device Ordering Codes

Figure 2-14: Automotive-Grade Ordering Information for MAX 7000A Devices



2014.09.22

AUT5V1



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The Altera Quartus® II design software supports the automotive-grade devices in the automotive temperature range. The Quartus II software provides a comprehensive environment for SoC design. It also includes HDL and schematic design entry, compilation and logic synthesis, full simulation and advanced timing analysis, SignalTap™ II logic analyzer, and device configuration.

To target an automotive-grade device in your design in the Quartus II software, follow these steps:

1. Click **Assignments** > **Device**. The **Settings** dialog box appears.
2. In the **Family** drop-down list, select your device.
3. Under **Target device**, select **Specific device selected in 'Available devices' list**.
4. In the **Available devices** list, select the appropriate ordering code.

Note: The Quartus II software does not show the “N” suffix, which indicates a lead-free device. For example, the 5CGXFC3B6U15A7N device is shown only as 5CGXFC3B6U15A7.

5. Click **OK**.

Legacy support for the following automotive-grade devices in Altera Quartus II software requires special approval. Contact the nearest Altera sales representative to submit your request.

- Cyclone III
- Cyclone II
- Cyclone
- MAX 7000AE

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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 digital signal processing [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 depends 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 respective user guides.

Related Information

- **PowerPlay Early Power Estimator User Guide**
Applicable to Cyclone III, Cyclone IV, Cyclone V, Cyclone V SoC devices.
- **PowerPlay Early Power Estimator for Altera CPLDs User Guide**
Applicable to MAX II and MAX V devices.
- **PowerPlay Early Power Estimator User Guide For Stratix, Stratix GX & Cyclone FPGAs**
Applicable to Cyclone devices.

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

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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 the following three parts:

- Specifying sources of input data
- Specifying operating conditions
- 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.

Related Information

[PowerPlay Power Analysis chapter, Quartus II Handbook](#)



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The automotive-grade devices have the same values for the following specifications as published in the respective device datasheets :

- Absolute maximum ratings
- Recommended operating conditions
- DC electrical characteristics
- Timing specifications over the automotive temperature range

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 on-chip series termination (R_S OCT) specifications for the following automotive-grade devices are as follows:

- Automotive-grade Cyclone III, Cyclone IV, Cyclone V, and Cyclone V SoC devices—same as the corresponding industrial-grade devices
- Automotive-grade Cyclone II devices—same as the corresponding extended-temperature devices

The switching characteristics of the automotive-grade Cyclone III, Cyclone IV, Cyclone V, and Cyclone V SoC devices are the same as the devices with –8 speed grade as published in the respective device datasheets.

Related Information

- [MAX 7000A Programmable Logic Device Data Sheet](#)
- [DC and Switching Characteristics chapter, Cyclone Device Handbook](#)
- [DC Characteristics and Timing Specifications chapter, Cyclone II Device Handbook](#)
- [Cyclone III Device Datasheet](#)
- [Cyclone IV Device Datasheet](#)
- [Cyclone V Device Datasheet](#)
- [DC and Switching Characteristics chapter, MAX II Device Handbook](#)
- [DC and Switching Characteristics for MAX V Devices](#)
- [MAX 10 FPGA Device Datasheet](#)

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For more information about the device pin-outs, refer to the respective device pin-out files.

Related Information

[Pin-Out Files for Altera Devices page](#)

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Altera provides information on package and PCB design guidelines.

Related Information

- **[Package and Thermal Resistance page, Altera website](#)**
Provides more information about the package-related information and Package Information Datasheet for Altera Devices.
- **[AN114: Designing With High-Density BGA Packages for Altera Devices](#)**
Provides more information about the PCB design guidelines
- **[Cadence Capture CIS and Allegro PCB Symbols and Footprints page](#)**
Provides more information about designing PCBs with the Cadence OrCAD capture component information system and symbols libraries.

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Additional Information for the Automotive-Grade Device Handbook



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Document Revision History for the Automotive-Grade Device Handbook

| Date | Version | Changes |
|----------------|------------|--|
| September 2014 | 2014.09.22 | <ul style="list-style-type: none">Added MAX 10 devices.Removed HardCopy[®] II devices.Updated the Quartus II software support versions for the legacy device families.<ul style="list-style-type: none">Cyclone III—Version 8.0 to 13.1Cyclone II—Version 7.2 SP1 to 13.0Cyclone—Version 7.2 SP1 to 13.0MAX 7000AE—Version 7.2 SP1 to 13.0Added new automotive-grade devices for the following device families:<ul style="list-style-type: none">Cyclone V—5CGXFC5C6F23A7NCyclone IV—EP4CE40U19A7N and EP4CGX15BF14A7NMAX V—5M40ZE64A5N, 5M80ZT100A5N, and 5M160ZT100A5NAdded Cyclone IV GX ordering information diagram.Updated HPS I/O count for Cyclone V SE and SX devices. |
| September 2013 | 3.4 | <ul style="list-style-type: none">Updated Table 3–2, Table 3–3, and Table 3–4.Updated Figure 3–1, Figure 3–2, and Figure 3–3. |
| June 2013 | 3.3 | Updated Table 3–1 and Table 3–5. |
| May 2013 | 3.2 | <ul style="list-style-type: none">Updated Figure 3–2, Figure 3–3, Figure 4–1, and Figure 5–1.Updated Table 3–1, Table 3–5, Table 4–2, Table 5–1, and Table 5–3. |
| February 2013 | 3.1 | Updated Table 2–2, Table 2–3, Table 3–2, Table 3–3, Table 3–4, Table 4–2, Table 4–3, and Table 5–2. |

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| Date | Version | Changes |
|---------------|---------|---|
| January 2013 | 3.0 | <ul style="list-style-type: none"> Added Cyclone V and Cyclone V SoC devices. Added Table 4–2, Table 4–3, and Table 5–2. Updated Table 4–1, Table 4–4, Table 6–1, and Table 6–2. Updated Figure 4–1. Listed the following devices under legacy support: <ul style="list-style-type: none"> Cyclone III Cyclone II Cyclone MAX 7000A |
| May 2011 | 2.0 | <ul style="list-style-type: none"> Added MAX V devices. Updated part number for Cyclone III, Cyclone IV, and HardCopy II devices. Template conversion. Minor text edits. |
| March 2010 | 1.2 | <ul style="list-style-type: none"> Added Cyclone IV devices. Removed Referenced Documents section. |
| October 2008 | 1.1 | <ul style="list-style-type: none"> Updated DC and Timing Specifications section. Converted to new template. |
| February 2008 | 1.0 | Initial release. |

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