



# Xilinx Solutions for Aerospace & Defense Applications



# Issues and Challenges

- A semiconductor supplier must
  - Have leading edge technology and proven experience
  - Provide long-term supply of components
  - Offer military and radiation tolerant temperature graded parts
  - Provide high reliability / high quality parts that will meet strict design requirements

# Why Xilinx FPGAs are Ideal for Aerospace/Defense Applications

- Increasing demand for reconfigurability
  - Advanced processing
  - Mission re-use
- Decreasing options for advanced systems/performance
  - Cost
  - Performance
  - Component obsolescence
- Xilinx solutions for high performance & reliability

# Xilinx in Space

- Xilinx Flight Heritage
  - MARS2003 Lander (JPL)
    - XQR4062XL : Controlling Pyrotechnics
  - MARS2003 Rover (JPL)
    - XQVR1000 : Motor Control
  - GRACE (NASA)
    - XQR4036XL : Sensor
  - FedSat (Univ. Southern Australia)
    - XQR4036XL
  - OPTUS (Raytheon)
    - XQVR300
- ~50 additional programs in various design phases



# Xilinx in Military and Aerospace

## Electronic Warfare, Missile Guidance and Targeting, RADAR and SONAR

|           |              |         |          |              |
|-----------|--------------|---------|----------|--------------|
| ABRAMS    | ERINTS       | LAMPS   | PATRIOT  | THAADS       |
| AGM - 130 | HELLFIRE     | LANTIRN | SEAWOLF  | TOMAHAWK     |
| AIM9 - X  | HARPOON      | LOS     | SLAM     | TSIP         |
| ATIRCM    | HTI          | LOSAT   | STANDARD | FALCONS EDGE |
| BRADLEY   | IDECM        | MHIP    | STINGER  | ROLAND       |
| CRUSADER  | IRIS         | MLRS    | TAURUS   | EWATS        |
| ALR - 67  | AN/AQR - 22A | JSTARS  | SCINS    | IBAS         |
| ALR - 69  | ARSR - 4     | RAI     | AESA     | ITAS         |
| ALQ - 131 | FLIR         | RUG     | HARM     | ALR-66       |

## Communications, Signal Processing and Intelligence

|         |       |          |           |           |
|---------|-------|----------|-----------|-----------|
| ALADDIN | GPS   | SINGARS  | TTC39     | EPLRS     |
| APSP    | JTIDS | STU - 11 | UYK44     | CORNFIELD |
| AYK14   | KG47  | TACJAM   | MONO LAKE | HAYFIELD  |

## Aerospace, Avionics and Space

|            |          |             |          |               |
|------------|----------|-------------|----------|---------------|
| 737        | A - 10   | EUROFIGHTER | F - 14   | P - 3         |
| 777        | B - 52   | FEDSAT      | F - 15   | RAFAEL        |
| APACHE     | B - 1B   | F - 16      | HC - 130 | SKYBRIDGE     |
| ARIANE 5   | C17A     | F - 18      | JSF      | SPACE SHUTTLE |
| ATF (F-22) | COMANCHE | F - 111     | OPTUS    | TORNADO       |



# Mil/Aero Products

- QPro - What is that?
  - QML Products
    - Military "XQ" (N, M, B, Q, SMD)
    - Rad Tolerant "XQR" (N, M, R, V, SMD)
- Why QPro?
  - Extended Temperature Range
  - Ceramic and Plastic Packages
  - QML Qualified Processes
  - SMD Versions Available
  - Product Lifecycle Management



# Rad-Tolerant vs Military

- Rad-Tolerant devices = Military Devices +
  - Epitaxial Substrate Wafer (2 microns)
    - Used for latch-up immunity
  - Total Ionizing Dose Assurance (per Method 1019)
    - Each wafer lot sampled and characterized for TID
  - Unique Manufacturing Flows

# Manufacturing Flows

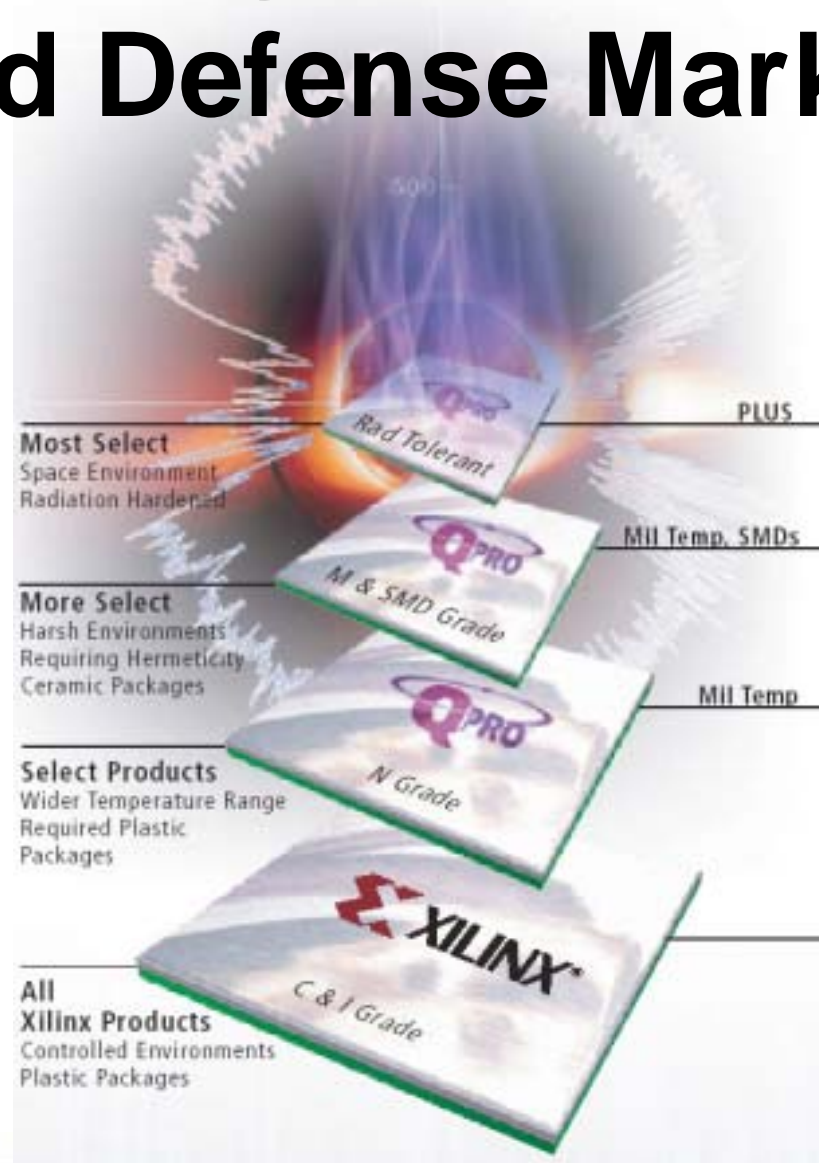
- “M” Grade
  - Mil Temp, Ceramic
- “N” Grade
  - Mil Temp, Plastic
- “R” Grade
  - Rad-Tolerant, Mil Temp, Plastic, Similar to Class-V flow
- “V” Grade
  - Rad-Tolerant, Mil Temp, Ceramic, Similar to Class-V flow
- Standard Microcircuit Drawing (SMD)
  - Mil and Rad-Tolerant Devices, DSCC part number

# Manu. Flow Summary

| Grade     | Temp        | Process    | Mask     |         |         |
|-----------|-------------|------------|----------|---------|---------|
|           |             |            | Hermetic | Plastic | Control |
| C         | 85°C (T j)  | Comm       | X        | X       |         |
| I         | 100°C (T j) | Comm       | X        | X       |         |
| IQ        | 125°C (T j) | Automotive | N/A      | X       | X       |
| N         | 125°C (T j) | QML        | N/A      | X       | X       |
| M         | 125°C (T c) | QML        | X        | N/A     | X       |
| V (space) | 125°C (T c) | QML        | X        | N/A     | X       |
| R (space) | 125°C (T j) | QML        | N/A      | X       | X       |



# Supporting the Aerospace and Defense Market



# Targeting Mil/Aero Devices in Xilinx Development SW

| Max Temp         | +85C       | +100C      | +125C    |
|------------------|------------|------------|----------|
| -6               | -6         | -5         | -4       |
| -5               | -5         | -4         |          |
| -4               | -4         |            |          |
| Speed/Temp Grade | Commercial | Industrial | Military |

- How do I target Mil/Aero devices in Xilinx Development SW?
  - 6.1i has Virtex QPro devices included
  - Otherwise target correct speed grade and pin compatible package
    - E.g. XQ2VR3000CG717 = 2V3000 / -4 / BG728



# Military Products

|                 | VIRTEX       |                |              |                     | VIRTEX E     |                     |                 | VIRTEX II         |                     |                       |
|-----------------|--------------|----------------|--------------|---------------------|--------------|---------------------|-----------------|-------------------|---------------------|-----------------------|
|                 | 100          | 300            | 600          | 1000                | 600E         | 1000E               | 2000E           | 2V1000            | 2V3000              | 2V6000                |
| Plastic Package | PQ240        | PQ240          |              |                     |              |                     |                 | FG456             |                     |                       |
|                 | BG256        | BG352<br>BG432 | BG432        | <u>BG560</u>        | BG432        | <u>BG560</u>        | BG560<br>FG1156 | <u>BG575</u>      | <u>BG728</u>        |                       |
| N-Grade         | YES          | YES            | YES          | YES                 | YES          | YES                 | YES             | YES               | YES                 | YES                   |
| SMD "N"         | N/A          | YES            | YES          | YES                 | N/A          | N/A                 | N/A             | TBD               | TBD                 | TBD                   |
| Ceramic PKG     | <b>CB228</b> | <b>CB228</b>   | <b>CB228</b> | <u><b>CG560</b></u> | <b>CB228</b> | <u><b>CG560</b></u> | <b>N/A</b>      | <u><b>TBD</b></u> | <u><b>CG717</b></u> | <u><b>CF1144*</b></u> |
| M-Grade         | YES          | YES            | YES          | YES                 | YES          | YES                 | N/A             | TBD               | YES                 | N/A                   |
| SMD "Q"         | N/A          | YES            | YES          | YES                 | N/A          | N/A                 | N/A             | TBD               | TBD                 | TBD                   |

Underlined Packages  
Are Plastic and Hermetic footprint compatible

\*Non hermetic





# Mil-Aero Virtex Roadmap

| XQV devices     |              |                |              |              |              |              |                 |           |              |                |
|-----------------|--------------|----------------|--------------|--------------|--------------|--------------|-----------------|-----------|--------------|----------------|
|                 | VIRTEX       |                |              |              | VIRTEX E     |              |                 | VIRTEX II |              |                |
|                 | 100          | 300            | 600          | 1000         | 600E         | 1000E        | 2000E           | 2V1000    | 2V3000       | 2V6000         |
| LC              | 2700         | 6912           | 15552        | 27648        | 15552        | 27648        | 43200           | 11520     | 32256        | 76032          |
| BRAM (Kb)       | 40           | 64             | 96           | 128          | 288          | 384          | 640             | 720       | 1728         | 2592           |
| Plastic Package | PQ240        | PQ240          |              |              |              |              |                 | FG456     |              |                |
|                 | BG256        | BG352<br>BG432 | BG432        | <u>BG560</u> | BG432        | <u>BG560</u> | BG560<br>FG1156 | BG575     | <u>BG728</u> | N/A            |
| N-Grade         | YES          | YES            | YES          | YES          | YES          | YES          | YES             | YES       | YES          | N/A            |
| SMD "N"         | N/A          | YES            | YES          | YES          | N/A          | N/A          | N/A             | TBD       | TBD          | N/A            |
| Ceramic PKG     | <u>CB228</u> | <u>CB228</u>   | <u>CB228</u> | <u>CG560</u> | <u>CB228</u> | <u>CG560</u> | N/A             | TBD       | <u>CG717</u> | <u>CF1144*</u> |
| M-Grade         | YES          | YES            | YES          | YES          | YES          | YES          | N/A             | TBD       | YES          | YES            |
| SMD "Q"         | N/A          | YES            | YES          | YES          | N/A          | N/A          | N/A             | N/A       | TBD          | N/A            |

Underlined Packages  
Are Plastic and Hermetic footprint compatible

\*Non hermetic





# Rad-Tolerant Devices

|             | RT VIRTEX    |              |              | RT VIRTEX II |              |               |
|-------------|--------------|--------------|--------------|--------------|--------------|---------------|
|             | V300         | V600         | V1000        | 2V1000       | 2V3000       | 2V6000        |
| Plastic     | PQ240        |              |              | FG456        |              |               |
| Package     | BG352        | BG432        | <u>BG560</u> | BG575        | <u>BG728</u> |               |
|             | BG432        |              |              |              |              |               |
| N-Grade     | Yes          | Yes          | Yes          | Yes          | Yes          | Yes           |
| R-Grade     | Yes          | Yes          | Yes          | Yes          | Yes          | Yes           |
| Ceramic PKG | <u>CB228</u> | <u>CB228</u> | <u>CG560</u> |              | <u>CG717</u> | <u>CF1144</u> |
| M-Grade     | Yes          | Yes          | Yes          | N/A          | Yes          | Yes           |
| V-Grade     | Yes          | Yes          | Yes          | N/A          | Yes          | N/A           |

Underlined Packages  
Are Plastic and Hermetic footprint compatible

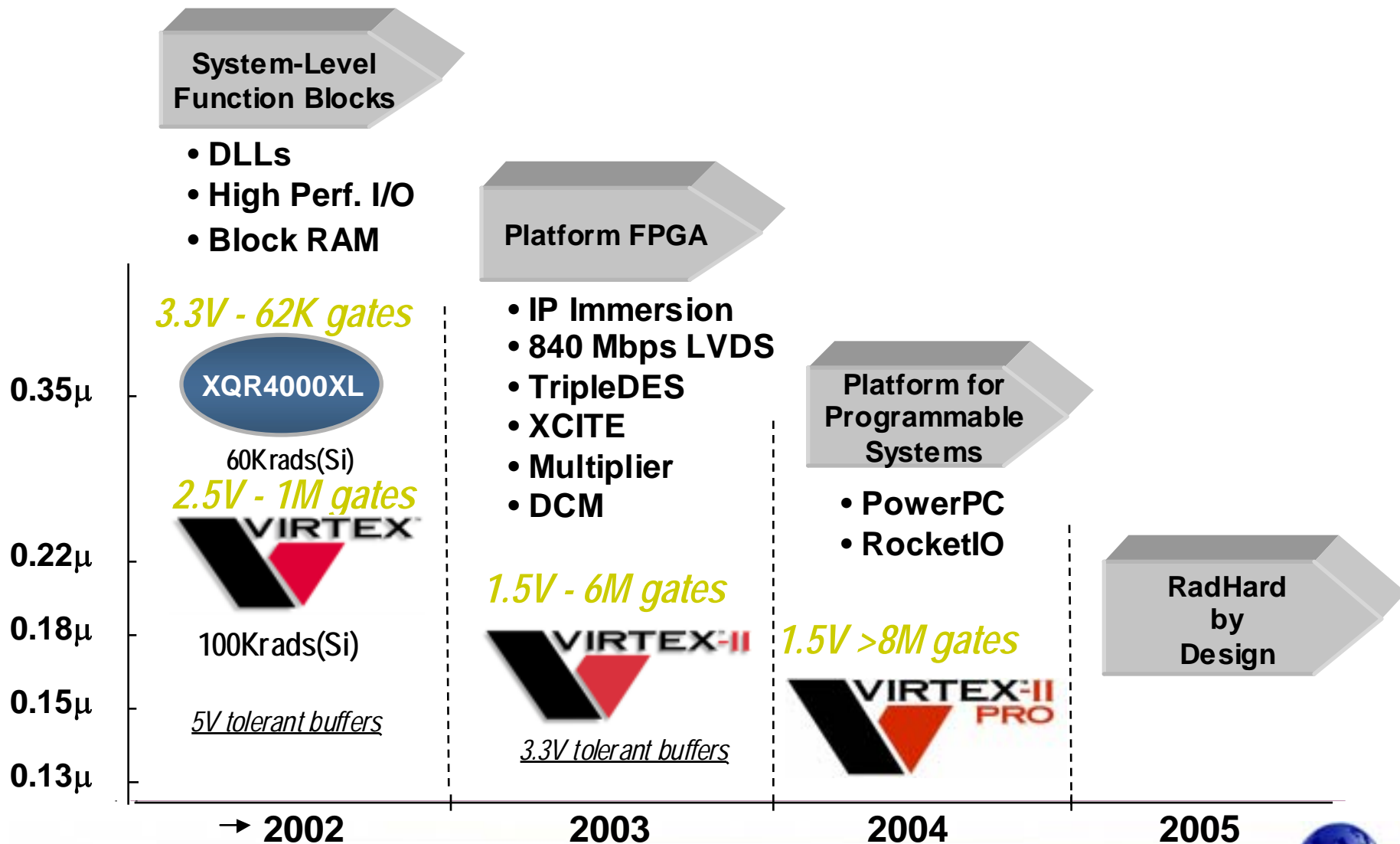




# Rad-Tolerant PROMs

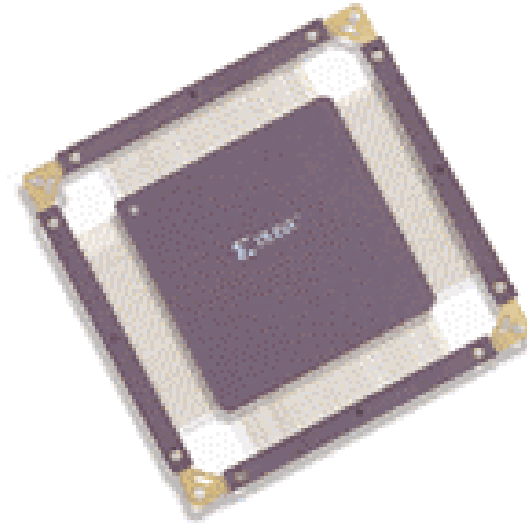
- XQR18V04
  - 4Mbit In-System Reprogrammable PROM
  - Latch Up and SEU Immune
  - TID (TBD)
  - Operating Temp Range: -55 to +100degC
- XQR1701L
  - One Time Programmable PROM
  - Latch Up and SEU Immune
  - 60KRads
- XQR17V16
  - 16Mbit One Time Programmable PROM
  - Latch Up and SEU Immune
  - Rad Specs TBD (Q1'04)

# Rad Tolerant Roadmap

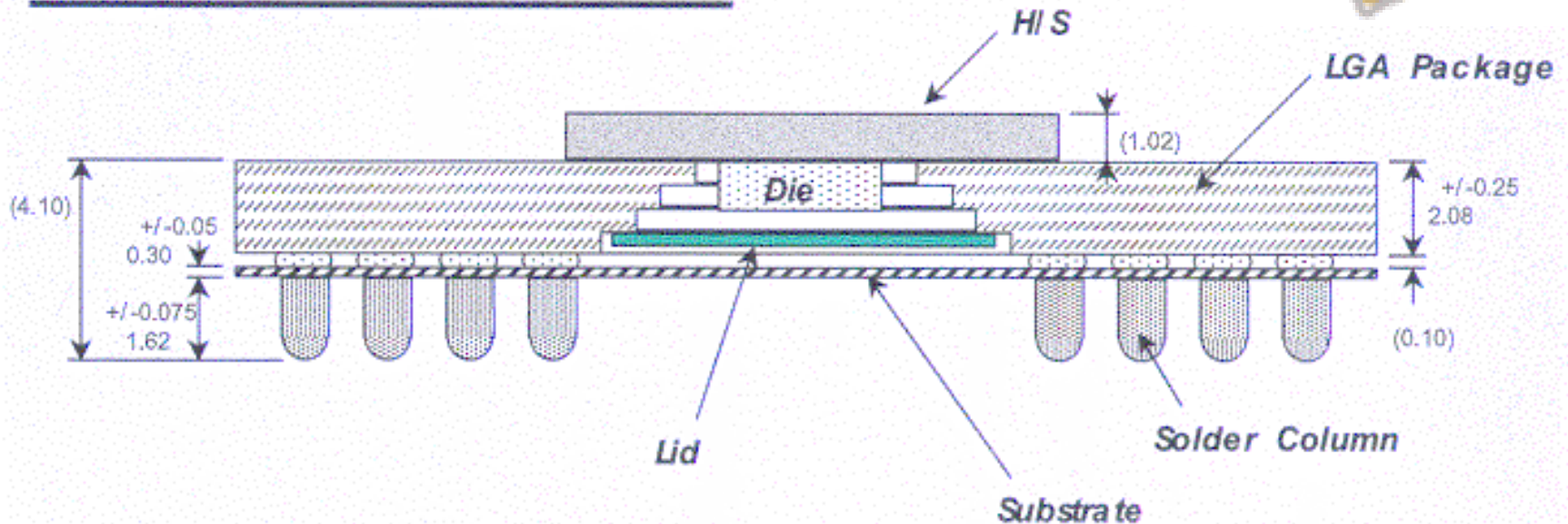


# Hermetic Packages

CB228 / Ceramic top-Braized QFP



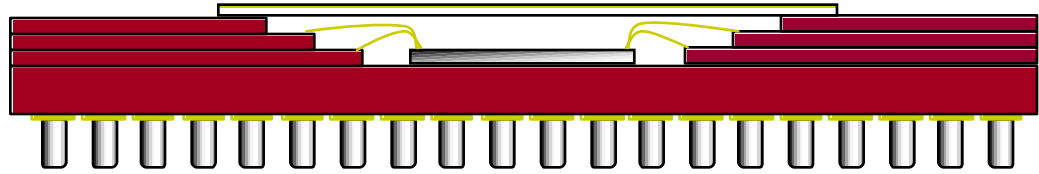
CG560 Reference sketch



# Virtex-II Ceramic Packages (under development)

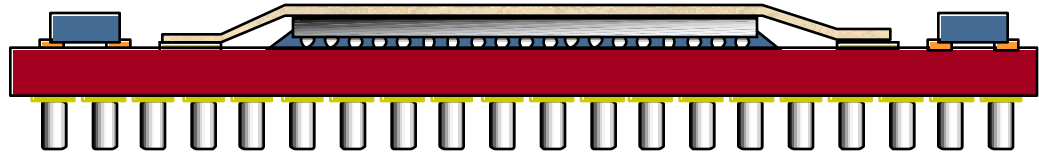
- CG717

- 35 x 35mm body, 1.27mm pitch, cavity-up
- Footprint compatible with the [BG728](#)
- Developed for the 2V3000
- Wire Bond, gold
- Au-Sn lid (hermetically sealed).



- CF1144

- 35 x 35mm body, 1.00mm pitch
- Footprint compatible with the [FF1152](#)
- Developed for the 2V6000
- Flipchip with high lead balls.



# Virtex-II Collateral Summary



- Product Release Collateral
  - QPro & Rad Hard Data Sheets
  - CG/CF Package Data Sheet and User's Guide
  - PROM Data Sheet Revisions
- Product Applications Collateral
  - Application Note: Configuration & SEU Management "Core"
  - Application Note: Custom TMR circuits for Virtex-II
  - Application Note: TMRTool Flow for EDK (Microblaze)
  - DOC: TMRTool User's Guide
  - Military and Aerospace Classes in Development
    - Avionics, Aerospace and TMR
- Software Support & Development
  - TMRTool: Beta Release Program
  - Scrubgen: Bitstream Support for Virtex-II Scrubbing



# Xilinx Mil/Aero Solutions

- QPro Product Line
  - Most comprehensive line of FPGAs rated for military and aerospace applications
    - High-density: up to 6 million gates
    - Voltage range: 1.5V – 5V
    - Plastic and ceramic packages available
    - Military to radiation tolerant grades available
  - Xilinx is committed to this market and provides long term support for all Xilinx FPGAs/CPLDs, including QPro product line
- Resources
  - Dedicated team to support the design needs for aerospace/defense applications
  - Online resources available at [www.xilinx.com/esp/aero\\_defense](http://www.xilinx.com/esp/aero_defense)