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Enabling Long-Reach MIPI CSI-2 Connectivity in Automotive with MIPI IP
Trends & New Applications

- Transition from Distributed ECUs to centralized Domain Compute Modules
- New applications for ADAS, Infotainment, Connected Car & V2X
- Growing number & types of Sensors: Imaging, Lidar, Radar, Infra-Red
- System & SoC level Functional Safety and Reliably
- Requires High Performance FinFET Class Automotive SoCs
Safety-Critical Automotive Applications Using MIPI

- ADAS & IVI – Rear View, eMirror, Park Assist, Surround View

![Diagram showing ECU/ADAS/IVI components]

Long Reach

Temperature Lifetime Failure rate

Functional Safety

Reliability

Quality
Development Flows for ISO 26262 Functional Safety

• Activities & Work Products for Automotive SoCs & IP
Additional Safety Mechanisms to Meet ASIL B & Beyond

- MIPI CSI-2 Lacks Native Functional Safety Capabilities

Safety Mechanisms to achieve ASIL B Random HW Fault metrics

- Each Safety Mechanism has an associated Reaction Time: Fault Handling Time Interval and Error Flag

<table>
<thead>
<tr>
<th>Parity Protection delivered &amp; checked at user interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity Protection on internal data paths</td>
</tr>
<tr>
<td>ECC for closely coupled SRAMs</td>
</tr>
<tr>
<td>MIPI CSI-2 Protocol</td>
</tr>
<tr>
<td>MIPI D-PHY&lt;sup&gt;SM&lt;/sup&gt;</td>
</tr>
<tr>
<td>MIPI C-PHY&lt;sup&gt;SM&lt;/sup&gt;</td>
</tr>
<tr>
<td>RX</td>
</tr>
<tr>
<td>TX</td>
</tr>
<tr>
<td>Image/Config I/F</td>
</tr>
<tr>
<td>PPI Interface</td>
</tr>
<tr>
<td>User Interface:</td>
</tr>
<tr>
<td>ECC added at data path ports</td>
</tr>
<tr>
<td>Parity added for address ports</td>
</tr>
<tr>
<td>Register Space Protection</td>
</tr>
<tr>
<td>Module Redundancy Protection for critical logic</td>
</tr>
</tbody>
</table>
Safety Manager for SoC-Level Integration

- Monitoring & Managing Functional Safety Capabilities

- Safety Manager monitors & manages all system failures & real-time faults; safe boot & mission-mode testing
Need to Design for Reliability

- Handling the Stringent Operating Conditions

- Environmental
- Temperature
- Noise
- Vibration
- Long term operation
- Field rate (targeting 0%)

**Reliability**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Ambient Operating Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-40°C to +150°C</td>
</tr>
<tr>
<td>1</td>
<td>-40°C to +125°C</td>
</tr>
<tr>
<td>2</td>
<td>-40°C to +105°C</td>
</tr>
<tr>
<td>3</td>
<td>-40°C to +85°C</td>
</tr>
</tbody>
</table>

**AEC-Q100 Qualification**

- Accelerated Lifetime Simulation Tests
  - HTOL
  - ELFR
- Electrical Verification Tests
  - ESD
  - HBM
  - ESD
  - CDM
  - IC
  - Latch Up
  - E D
  - CHAR

**Design**

- AUTO DRC/PDK
- Design Rules
- Mission Profile

**Testing**

- SoC/IP Testchip

**Report**

**AEC-Q100 Standard**

- Sample size
- Type of Tests
- Test time
- Conditions

**Report**

**Mission Profile**

**Design Rules**

**AUTO DRC/PDK**
Need for a Comprehensive Automotive-Grade IP Portfolio

- Saving Time-to-Market

**MIPI Automotive-Grade IP Package**
- 22nm - 16nm - 7nm – 5nm

**Safety**
- Safety Manual
- FMEDA
- FuSa Certificate
- Random
- Systematic
- Work Products

**Reliability**
- Mission Profile
- Auto PDK/Rules
- Grade 2/1
- AEC-Q100 Report

**Quality**
- ISO 9001 Quality Management System
- Quality Manual

**CSi-2 / DSi-2 CONTROLLERS**

**C-PHY / D-PHY**

**Automotive SoC**
- 22nm - 16nm - 7nm – 5nm

**Processing Subsystem**
- x12 64-bit Processors
- LPDDR5/4x
- Cache
- Data path

**Logic Libraries**
- Embedded Memories
- MIPI

**AMBA Interconnect**
- MIPI
- CSI-2
- Data path
- Storage

**Vision Subsystem**
- DSP
- ADCs/DACs
- AI Accelerator

**Display Subsystem**
- Graphics Core
- eDP
- HDMI
- MIPI DSI/DWI

**Connectivity**
- CAN, CAN-FD
- Ethernet AVB/TSN
- MOST
- FlexRay
- PCIe
Valens Design Example
Using Synopsys DesignWare MIPI IP
Valens A-PHY Products

- Valens is the first company to introduce A-PHY℠ compliant products.
- It was important to make sure Valens will work with mature and established IP partner in order to focus our efforts on the core technology and meet its goals.
- Valens selected Synopsys as IP partner for their mature MIPI IP and complete automotive package including safety and AEC-Q100 qualification.
- First samples will be available to leading customers by Q4/2021.
  - VA7031 - CSI-2 extension (Serializer) over MIPI A-PHY channel (Up to 8Gbps)
  - VA7044 - Dual-receiver of CSI-2 (Deserializer) over MIPI A-PHY channel (Up to 8Gbps per port)
  - VA7042 - Quad-receiver of CSI-2 (Deserializer) over MIPI A-PHY channel (Up to 8Gbps per port)
- Valens is already working on the next generation of A-PHY products.
Valens Use of Synopsys DesignWare D-PHY/C-PHY IP
Summary

• Trends in the automotive industry are driving new SoC architectures on more advanced FinFET processes

• MIPI IP in Automotive: safety-critical applications require ASIL B/D ISO 26262 Ready MIPI IP with safety package, enabling designers to save time and improve time-to-market

• IP that meets automotive quality requirements and is AEC-Q100 tested accelerates SoC-level qualification and design

• Synopsys’ automotive-grade MIPI camera and display IP helped accelerate Valens’ Automotive SoC design
DesignWare MIPI IP Portfolio for Automotive SoC

MIPI Automotive-Grade IP Package
In 22nm - 16nm - 7nm
ADDITIONAL RESOURCES

• Web page
  • https://www.synopsys.com/designware-ip/interface-ip/mipi.html

• Web page
  • https://www.synopsys.com/designware-ip/ip-market-segments/automotive.html

• Valens automotive
  • https://www.valens.com/automotive-solutions

• Valens VA70xx
  • https://www.valens.com/va7000-family
THANK YOU!