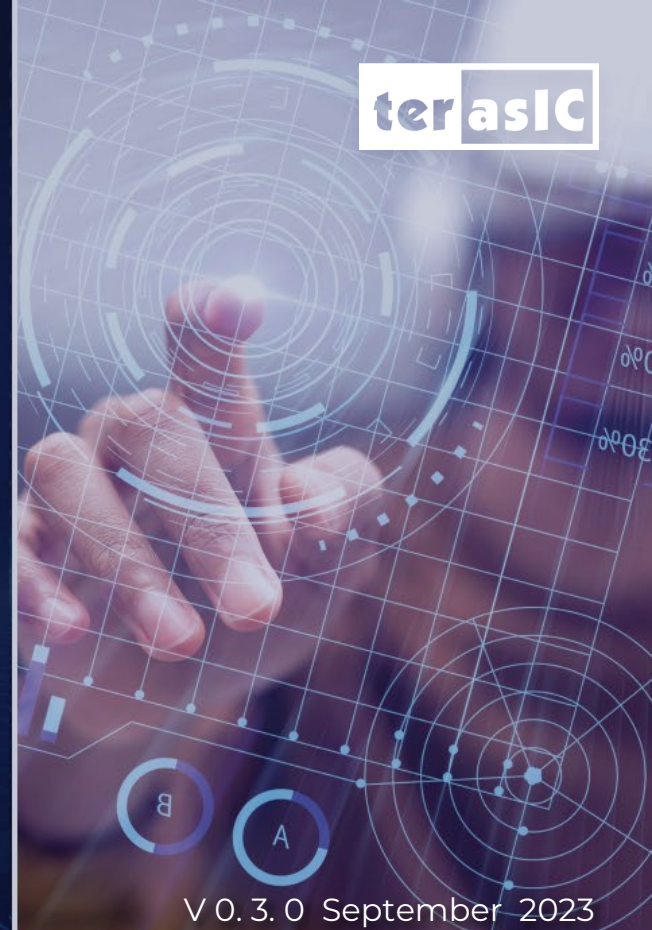
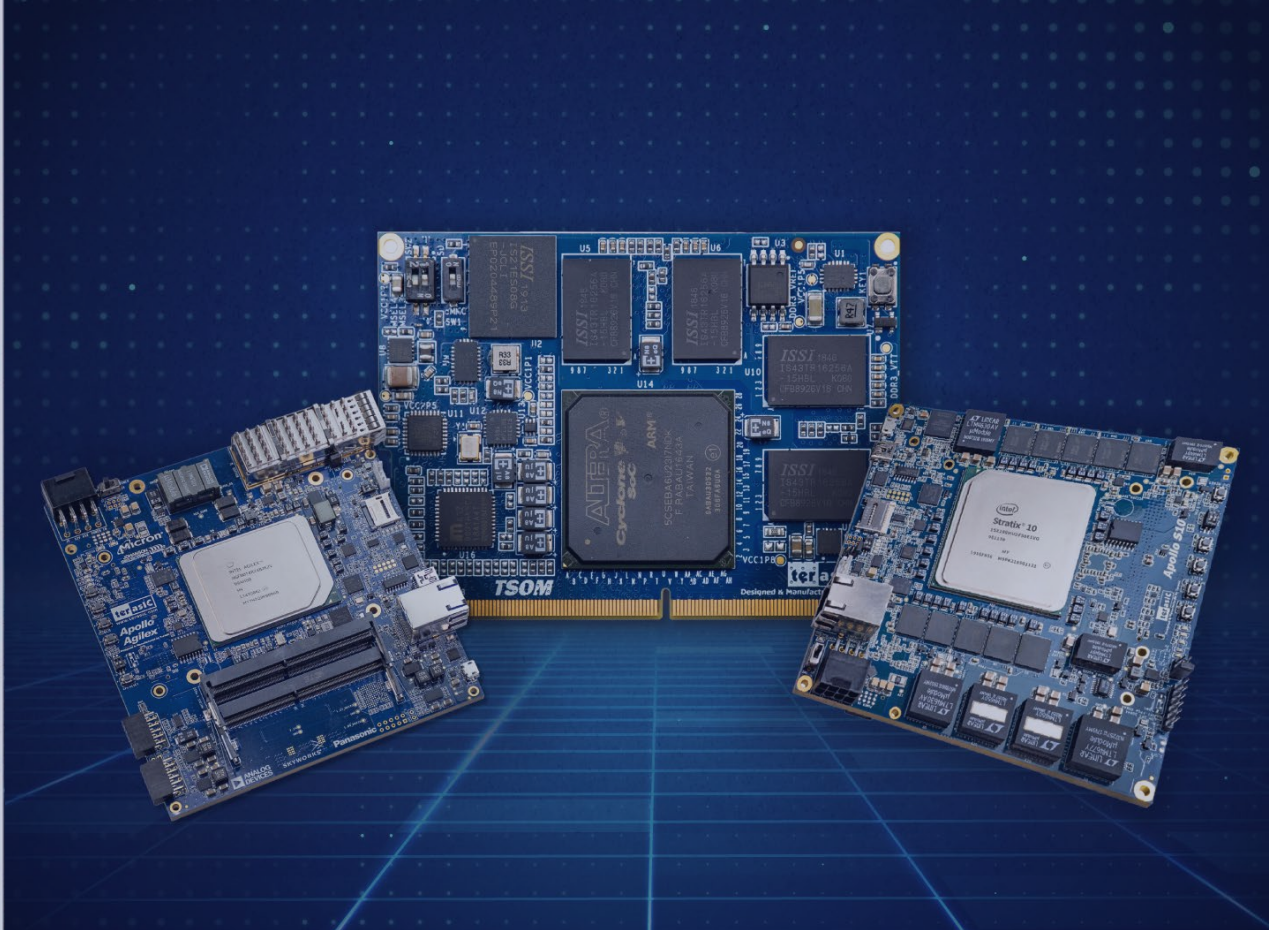
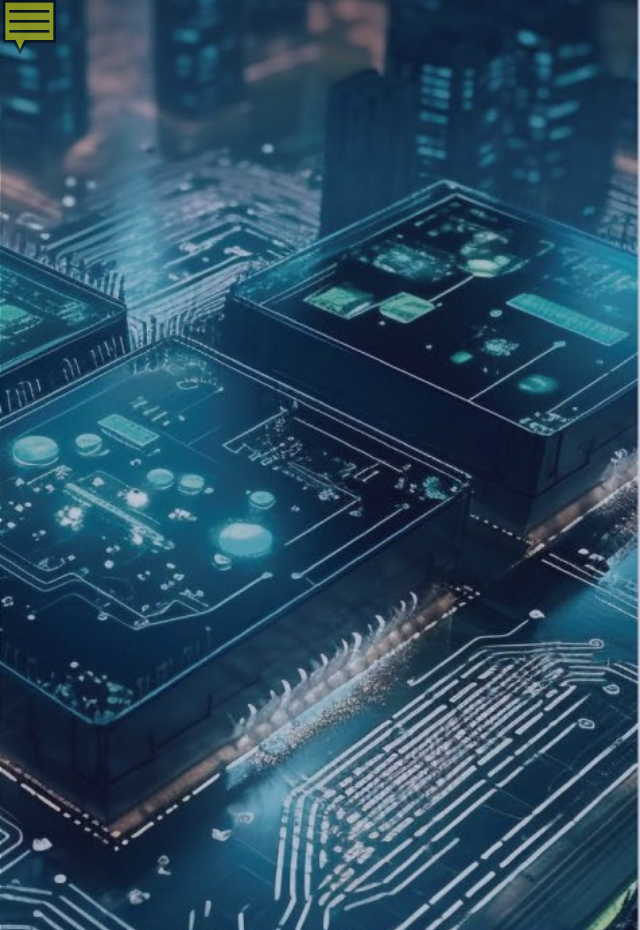
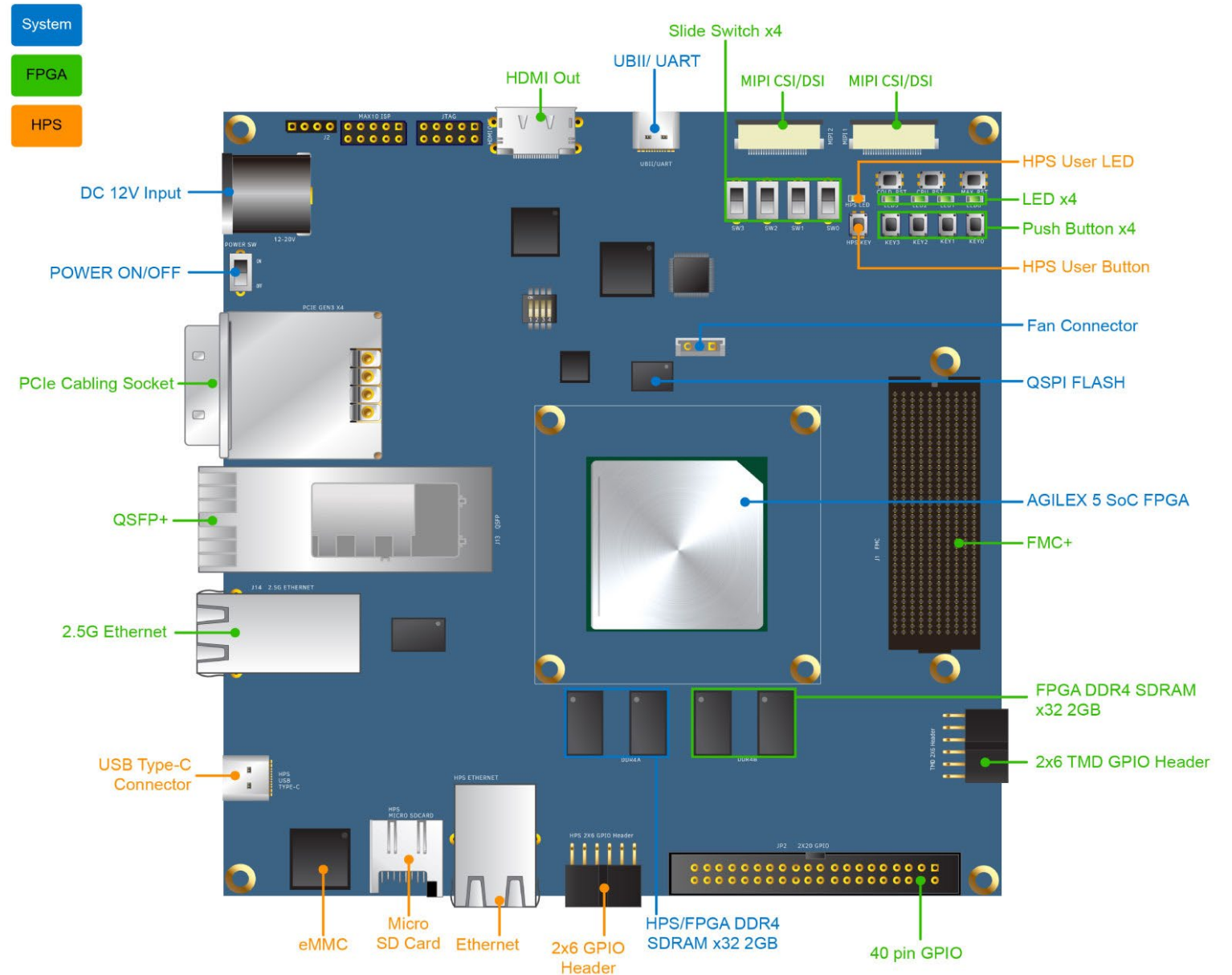
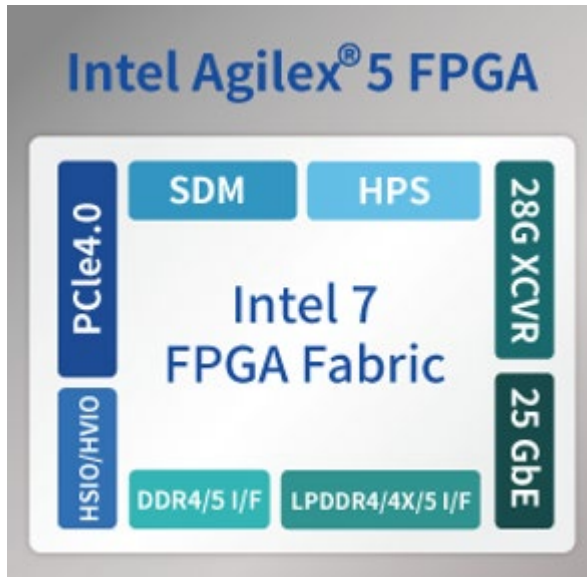




# Atum A5 Development Kit

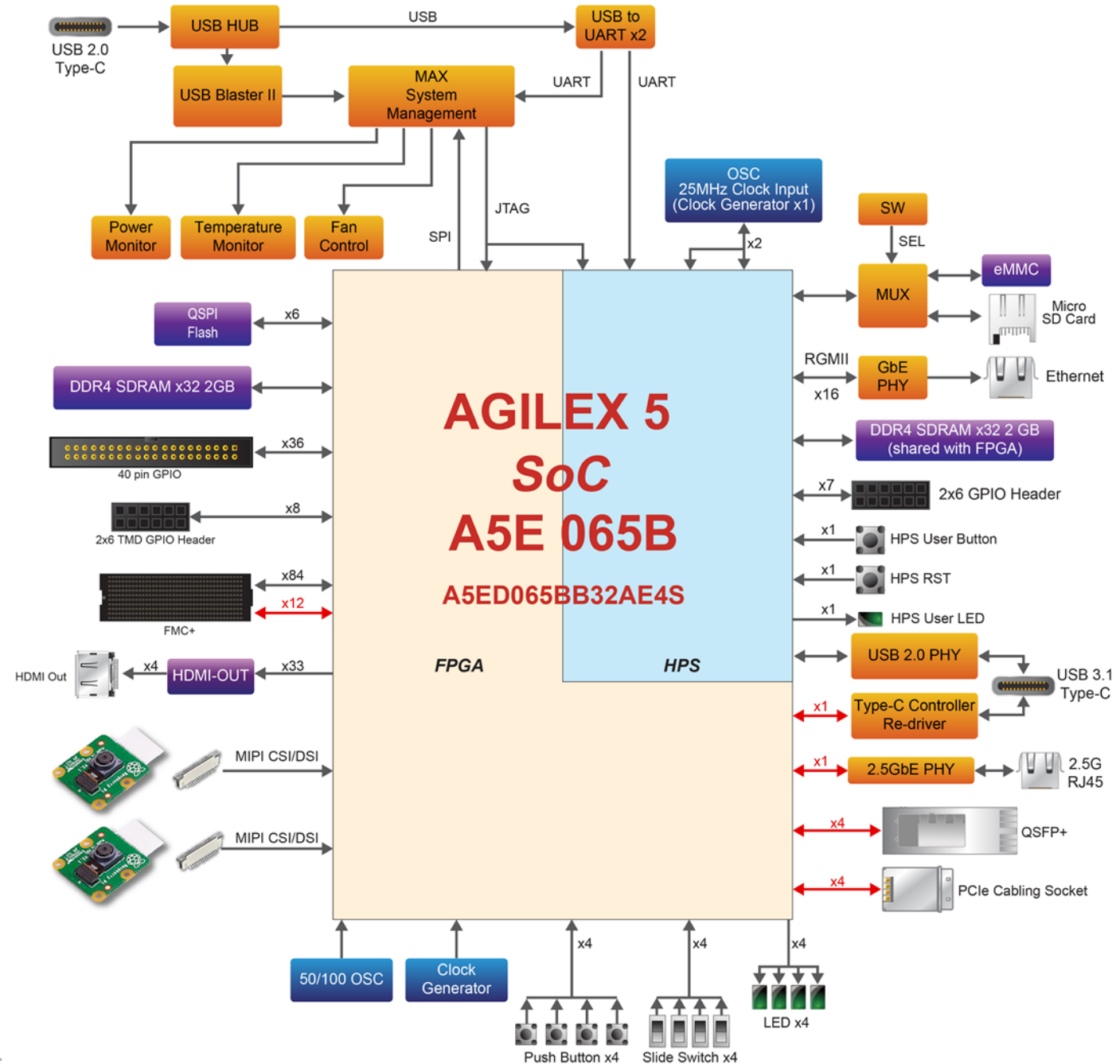
World-Leading FPGA Design Services

# Atum A5 Development Kit





# Block Diagram



# Board Features – 1/4

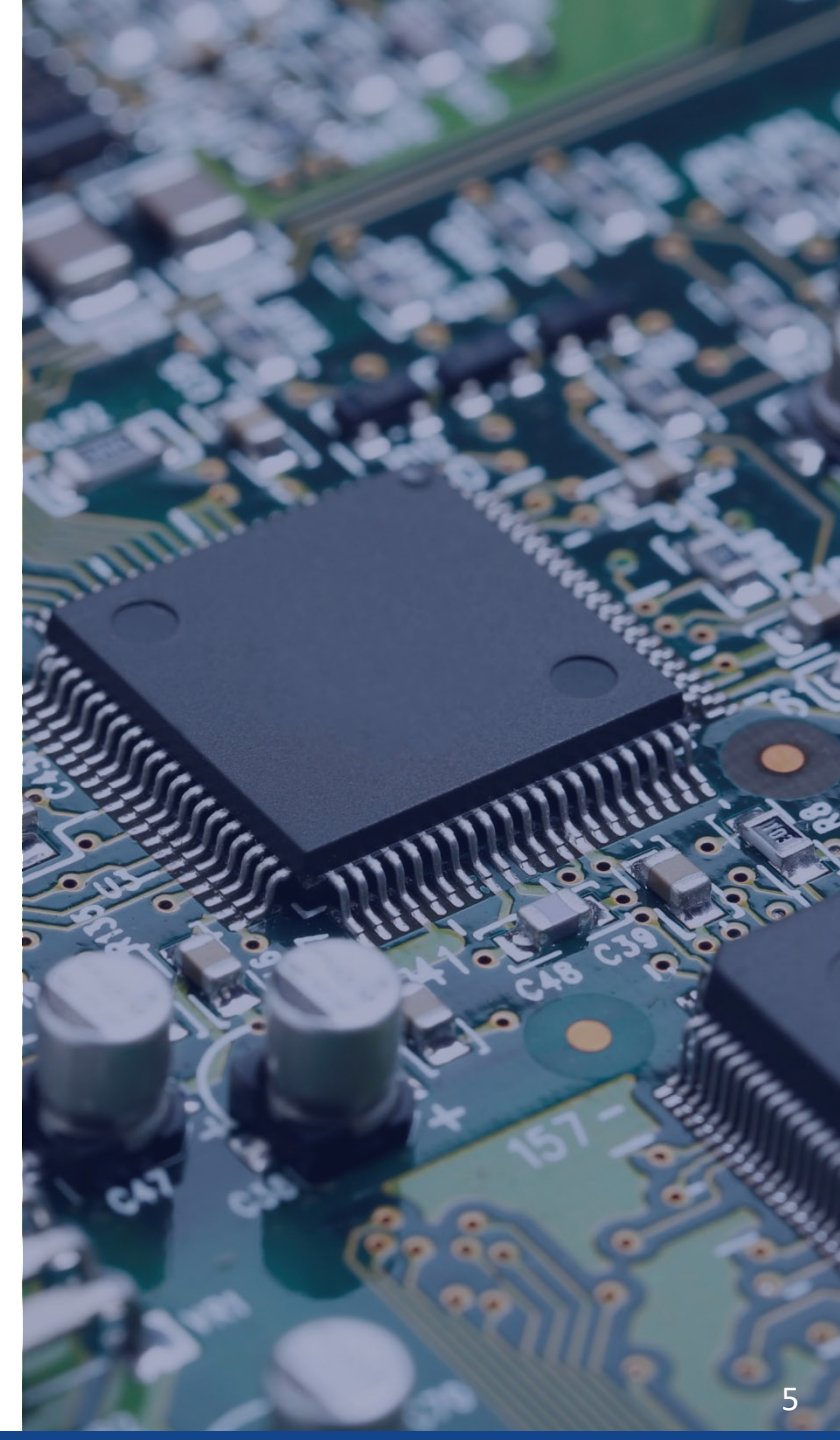
## System :

- FPGA (Agilex 5 First Device) : A5ED065BB32AE4S
  - A5E 065B, 650K LE, B32A Package (32mm x 32mm)
- Board size : 160mm x 155 mm
- Powered by 12V DC
- On-board USB-Blaster II with [Type-C connector](#)
- MSEL [2 : 0] for boot mode configuration – JTAG mode and AS x4 mode
- AS x4 configuration with 512Mbits QSPI Flash
- Board management system
- Active heatsink (optional)

# Board Features – 2/4

## FPGA :

- Fixed 50MHz clock
- User LED x4, button x4, slide switch x4
- Two On-board 2GB DDR4 with 32-bit data bus (no ECC). One shared with HPS.
- 2.5 G Ethernet (use 1 transceiver + 88E2110)
- HDMI OUT (ADV7513; Support 1080P)
- One 3.3V 2 x20 GPIO header
- One 3.3V 2 x6 TMD header
- One HPC FMC+ connector (12 transceivers), support VADJ 1.2V
- Two 2-lane MIPI connectors for Camera/Display
- One QSFP+ connector
- PCIe cabling Gen 3 x4 socket





# Board Features – 3/4

## HPS :

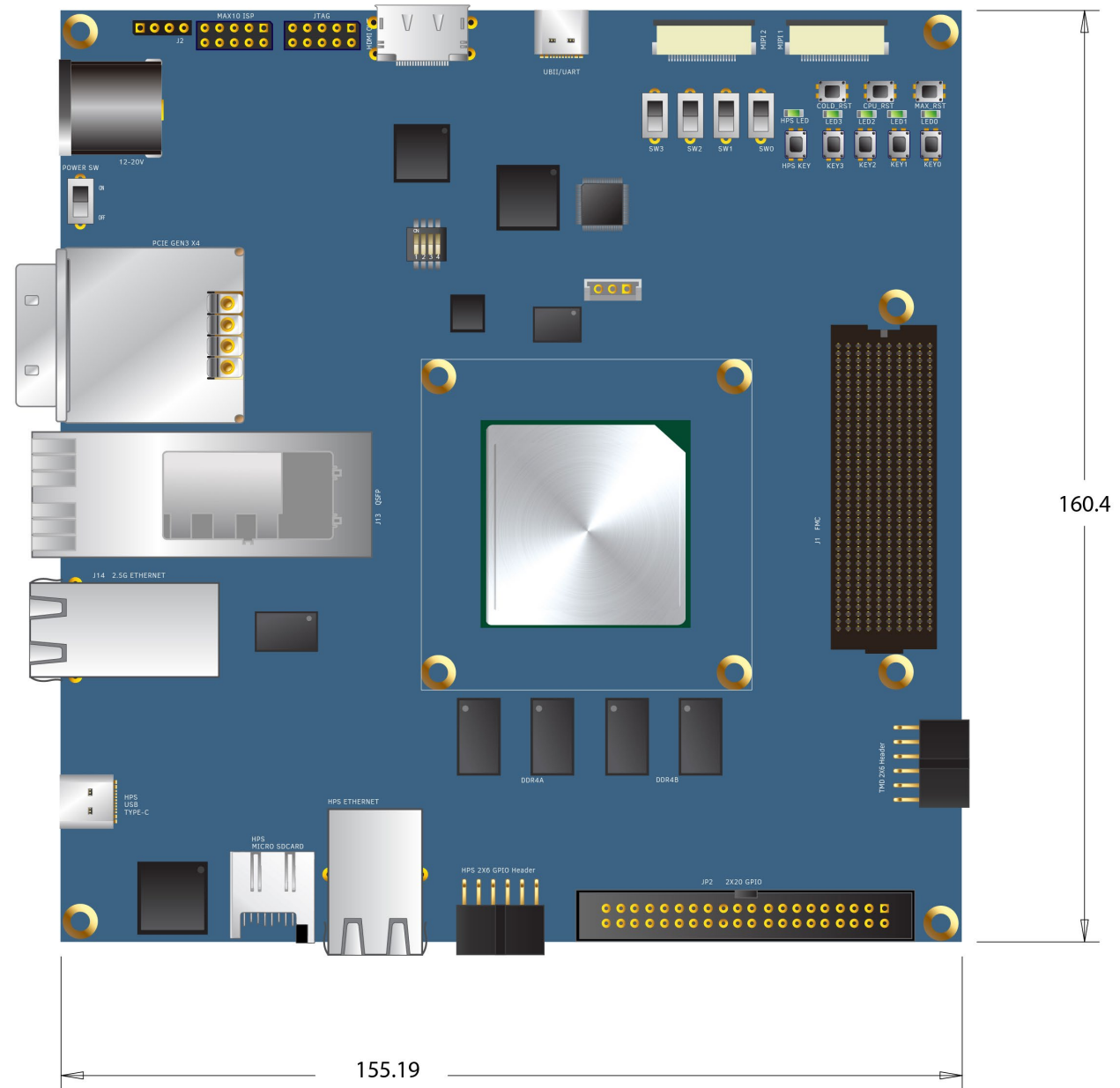
- ARM Cortex Processor with 2 xA55 and 2 xA76
- On-board 2GB DDR4 with 32-bit data bus (no ECC) shared with FPGA.
- 8GB eMMC and MicroSD socket
- Gigabit Ethernet (PHY KSZ9031RNX or 88E1512) with RJ45 port
- USB 3.1 Gen1 (5Gbps; use 1 transceiver) with USB Type-C connector
- UART-to-USB port. Shared USB Type-C connector with USB-Blaster II
- User LED x1, user button x1
- HPS cold reset button
- 2 x6 TMD Header (IO 3.3V, include one I2C BUS)

# Board Features – 4/4

## Board Management:

- Implement in Max 10 device
- Board power monitor
- Board temperature monitor
- Auto fan speed control
- Auto power shutdown when system power and temperature are unmoral
- Agilex 5 can query board information from Max 10 via SPI interface
- Developers can also query board information from Windows via dashboard\_gui.exe software utility provided by Terasic

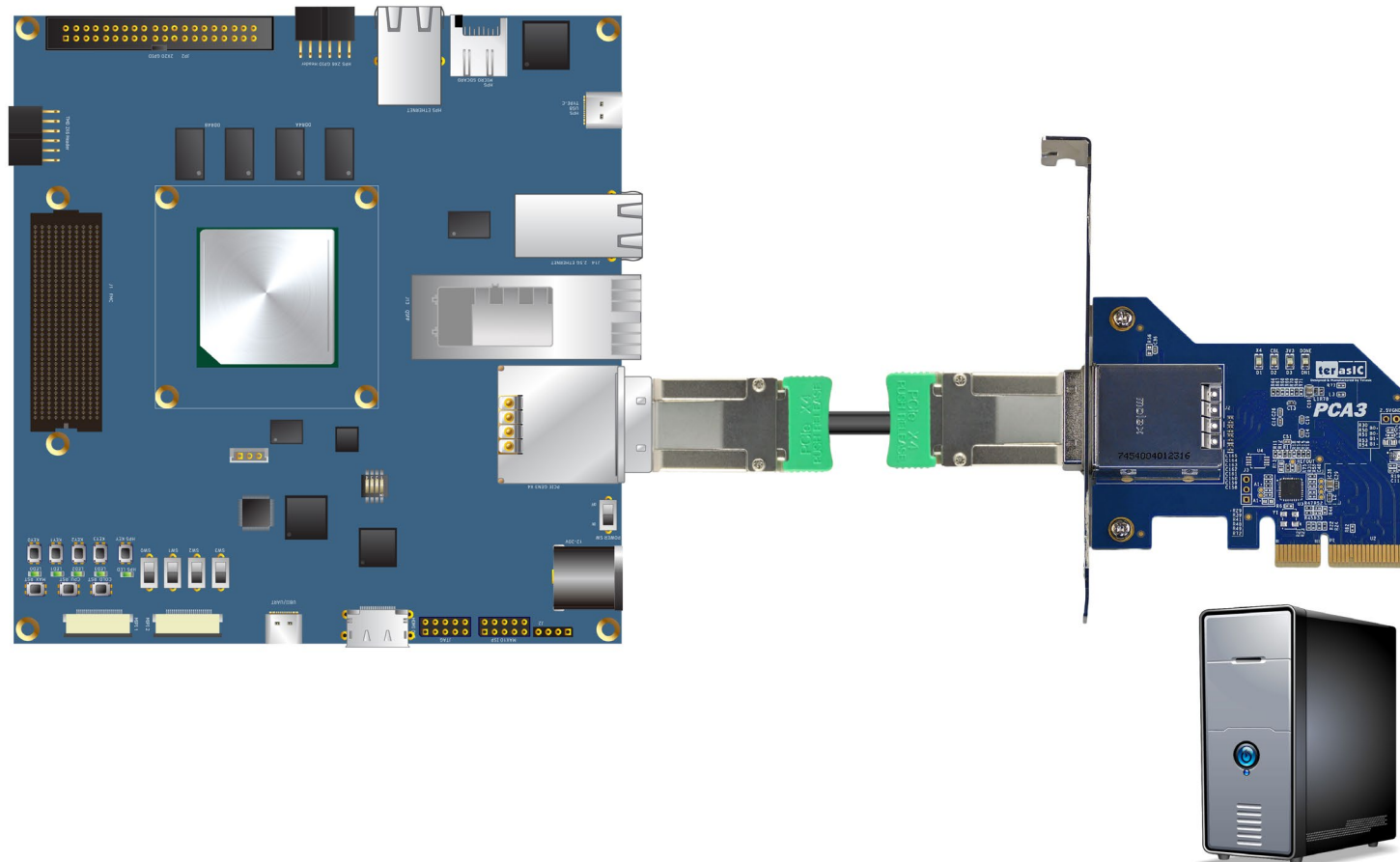
# Board Size





# PCIe Gen3 x4 Cabling Socket

- A Complete PCIe reference Design
- Use a PCIe x4 cable to connect to PC via Terasic PCA3 card



# HPS : Wi-Fi and Bluetooth

- Atum A5 Linux BSP includes drivers developed for Terasic Wi-Fi and Bluetooth USB Dongle.
- A Type-C to Type-A host cable is used for Atum A5's Type-C connector.

## USB Bluetooth Dongle

### Specifications:

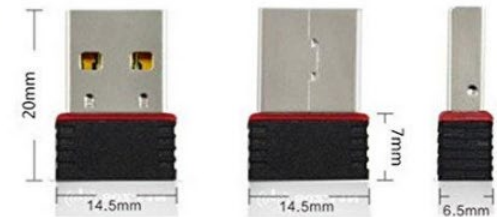
- Bluetooth v 4.0+EDR
- Class 1, wireless range of up to 50m



## USB WiFi Dongle

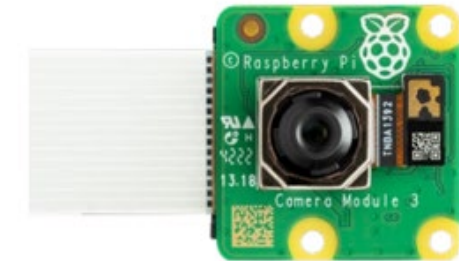
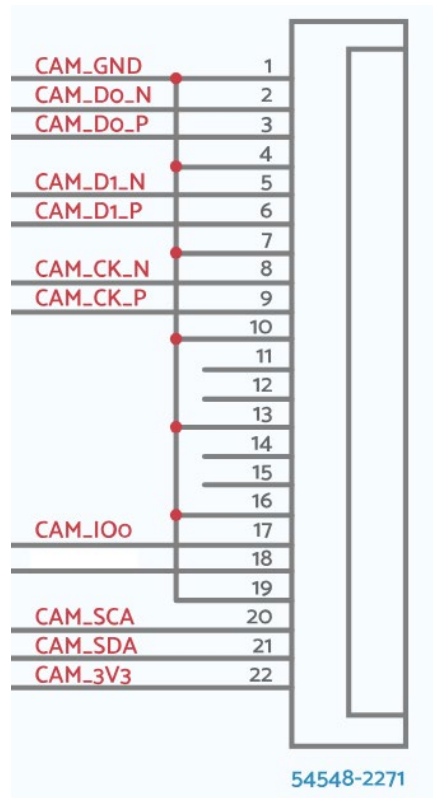
### Specifications:

- Type: WiFi USB Dongle
- WIFI Transmission Protocol: 802.11b/n/g
- Transmission Rate: 150Mbps
- Interface: USB 2.0
- Dimensions: 20mm x 14.5mm x 6.5mm
- Weight: 12 g



# MIPI Connector

- 22-Pin Header: include 1 clock and 2 data
- Support CSI-2: Raspberry Pi camera module + Camera Cable
- Support DSI-2: Raspberry Pi MIPI Displayer module + Display Cable





# QSFP+ Port

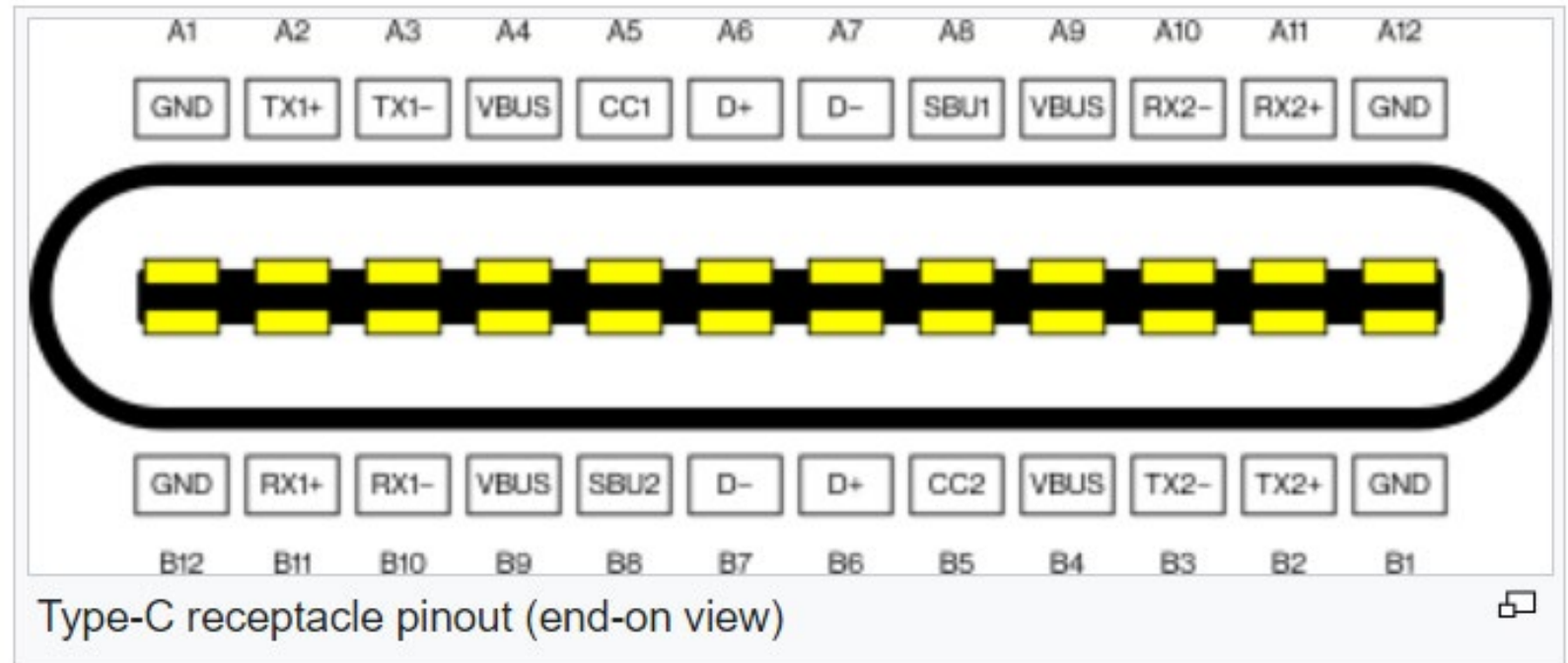
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- Support 40G Ethernet
- Support DAC/AOC cable



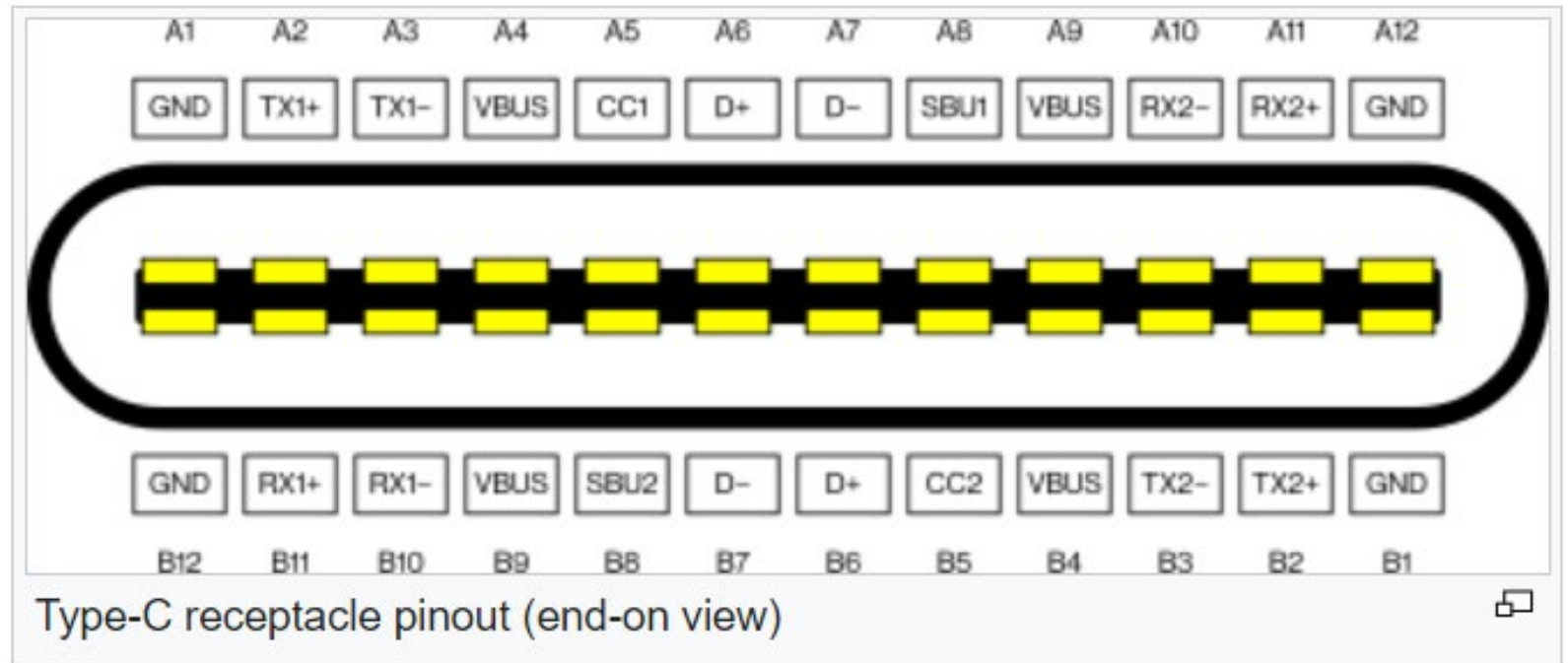
## UBII/UART USB Type-C

- USB 2.0
- Not support power delivery



## | HPS USB Type-C

- USB 3.2 Gen 1x1 (USB 3.1 Gen 1)
- Support 5Gbps super speed
- Support dual role (Support 5V/0.5A for USB Host mode.)
- Not support power delivery





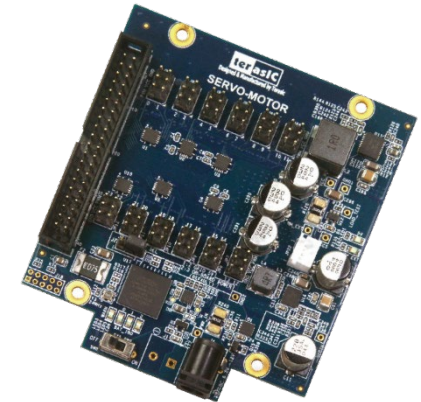
# Daughter Card Family Supported by Atum A5

1. 2x20 GPIO Daughter Cards
2. FMC+ Daughter Cards
3. New Daughter Cards Under Development



# 2x20 GPIO Connector

Support Terasic 2x20 GPIO daughter cards



**D8M :**  
8 Mega Pixel Camera

**MTL2 :**  
7"800x480 LCD with  
Multi-Touch

**LT24 :**  
2.4" LCD Display

**RFS2 :**  
Wifi and Bluetooth

**SMK :**  
Server Motor Controller

## 2 x 6 TMD GPIO Connector

- Support TMD GPIO daughter cards :
  - BTS-TMD : Bluetooth module supporting SPP profile



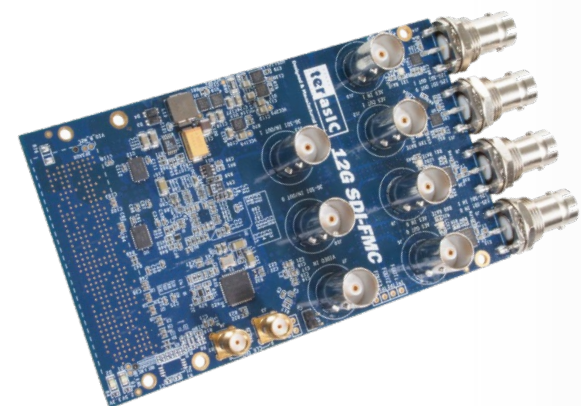




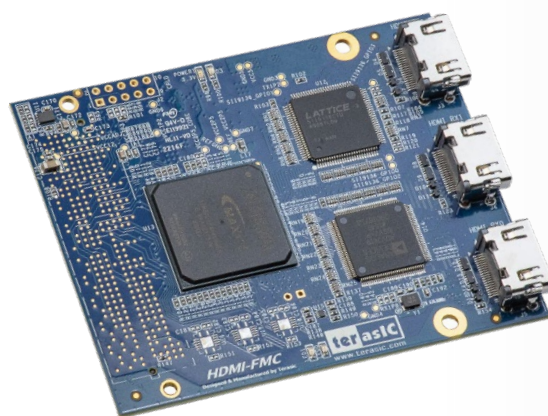
# FMC+ Connector

Support Terasic FMC daughter cards

**12G SDI-FMC**



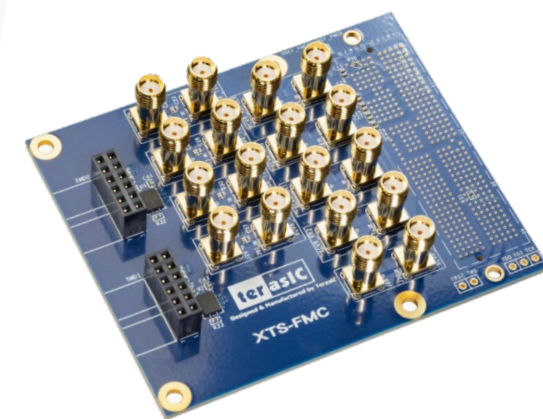
**HDMI-FMC :**  
**4K x 2K@30Mhz**



**P16E-FMCP :**  
**FMC+ to PCIe x16 edge**



**XTS-FMC :**  
**transceiver to**  
**SMA connectors**



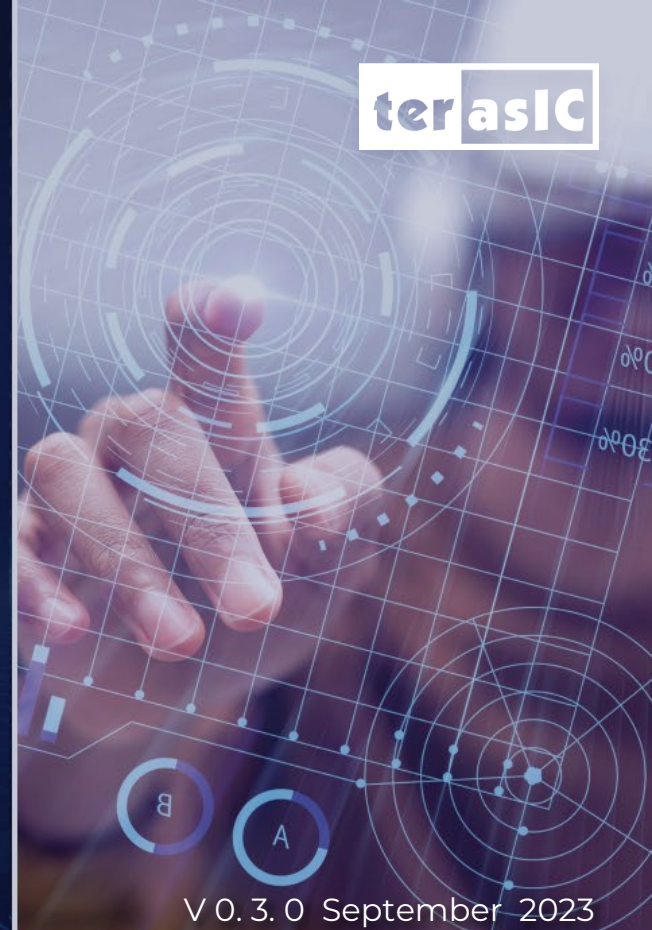
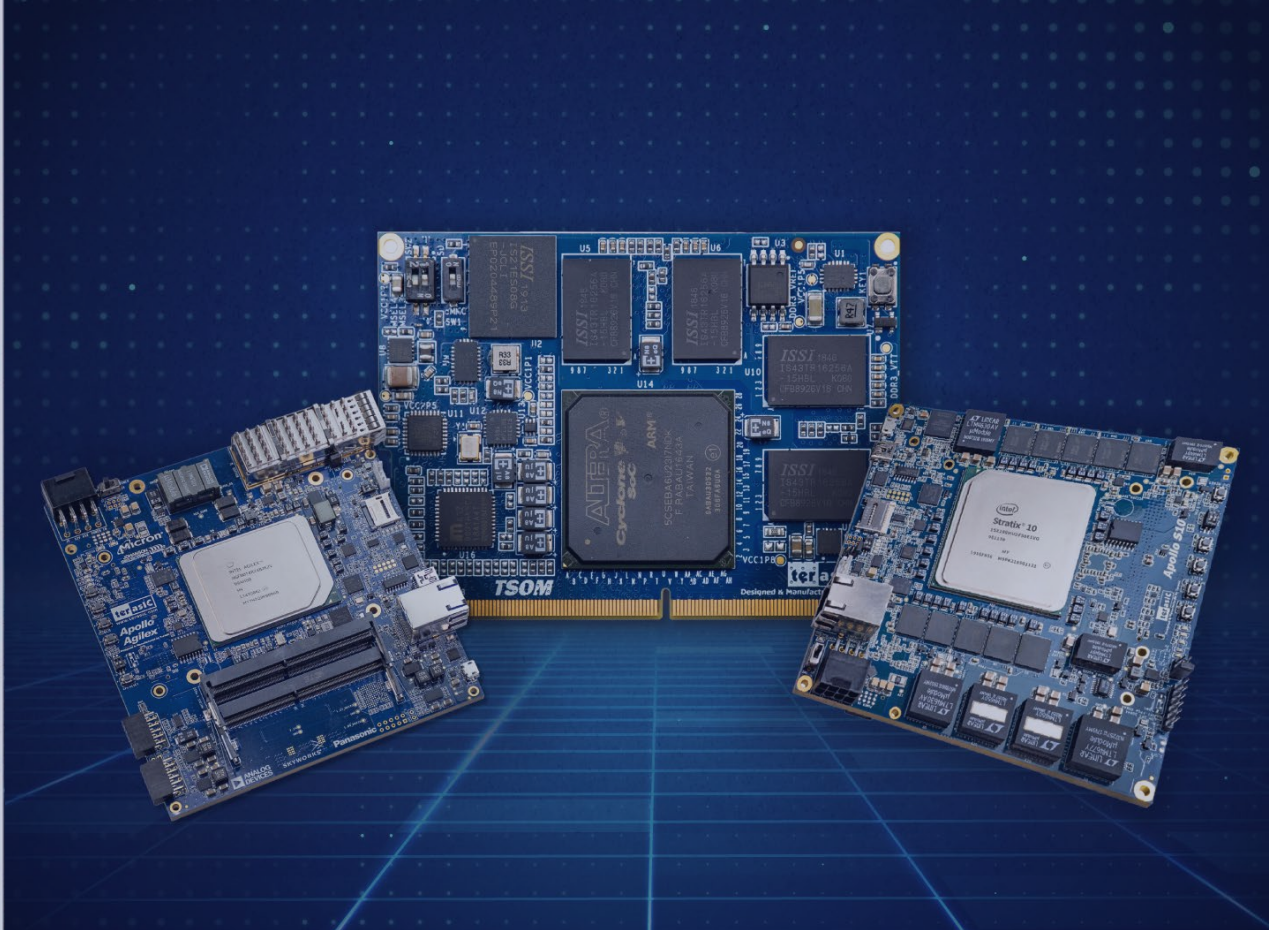
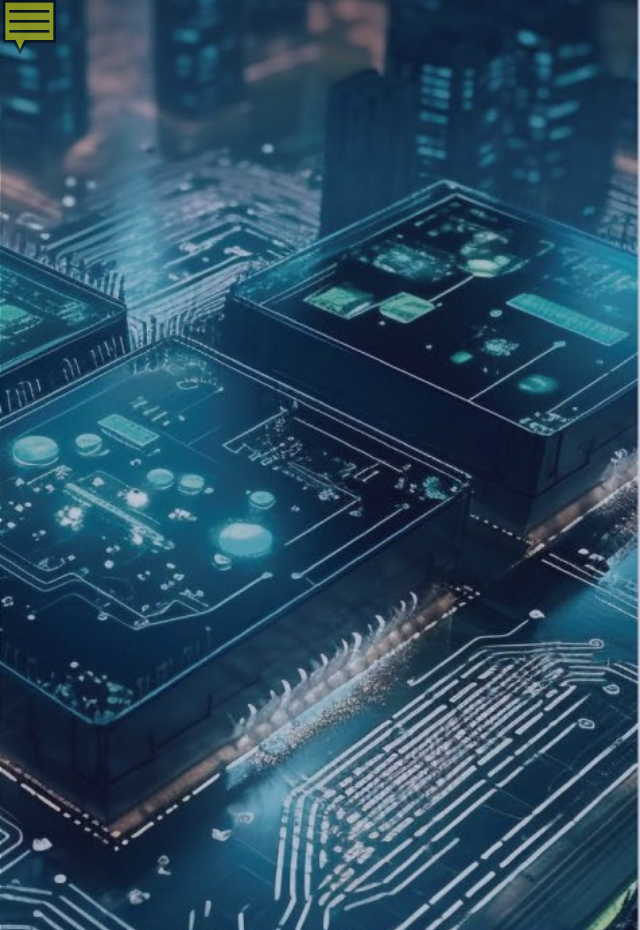




# **Deliver Innovation**

for the Future FPGA World





# Atum A5 Development Kit

## Additional Information

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# FPGA Selection

- Device : A5E065B
- B32A package : 120 HVIO, 384 HSIO, 192 VLDS, 24 transceiver

| Series   |                | Device   | Package                                                                        |                                                                                               |                                       |                                       |                                       |                                        |
|----------|----------------|----------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|
|          |                |          | Key: HVIO / HSIO / LVDS / Transceivers                                         |                                                                                               |                                       |                                       |                                       |                                        |
|          |                |          | Ball Pitch: 0.5 mm<br>Grid Array Pattern: Standard<br>MBGA: Micro Fineline BGA | Minimum Ball Pitch: 0.65 mm<br>Grid Array Pattern: Balls Anywhere<br>BBGA: Balls Anywhere BGA |                                       |                                       |                                       |                                        |
|          |                |          | M16A<br>896-pin MBGA<br>16 mm × 16 mm                                          | B15A<br>324-pin BBGA<br>15 mm × 15 mm                                                         | B18A<br>474-pin BBGA<br>18 mm × 18 mm | B23B<br>795-pin BBGA<br>23 mm × 23 mm | B23A<br>839-pin BBGA<br>23 mm × 23 mm | B32A<br>1591-pin BBGA<br>32 mm × 32 mm |
| E-Series | Device Group A | A5E 013A |                                                                                |                                                                                               |                                       |                                       | ↑ 120 / 96 / 48 / 4                   | ↑ 200 / 192 / 96 / 4                   |
|          |                | A5E 028A |                                                                                |                                                                                               |                                       |                                       | 120 / 96 / 48 / 12                    | 200 / 192 / 96 / 12                    |
|          |                | A5E 043A |                                                                                |                                                                                               |                                       |                                       | 120 / 96 / 48 / 12                    | 120 / 384 / 192 / 16                   |
|          |                | A5E 052A |                                                                                |                                                                                               |                                       |                                       | 120 / 96 / 48 / 12                    | 120 / 384 / 192 / 24                   |
|          |                | A5E 065A |                                                                                |                                                                                               |                                       |                                       | 120 / 96 / 48 / 12                    | 120 / 384 / 192 / 24                   |
|          | Device Group B | A5E 005B |                                                                                | ↕ 80 / 62 / 31 / 0                                                                            | ↕ 160 / 52 / 26 / 0                   | ↕ 160 / 96 / 48 / 0                   |                                       |                                        |
|          |                | A5E 007B |                                                                                | ↕ 80 / 62 / 31 / 0                                                                            | ↕ 160 / 52 / 26 / 0                   | 160 / 96 / 48 / 0                     |                                       |                                        |
|          |                | A5E 008B | ↕ 40 / 192 / 96 / 4                                                            |                                                                                               |                                       | 160 / 192 / 96 / 0                    | 120 / 96 / 48 / 4                     | 200 / 192 / 96 / 4                     |
|          |                | A5E 013B | ↕ 40 / 192 / 96 / 4                                                            |                                                                                               |                                       | 160 / 192 / 96 / 0                    | 120 / 96 / 48 / 4                     | 200 / 192 / 96 / 4                     |
|          |                | A5E 028B | ↕ 40 / 192 / 96 / 8                                                            |                                                                                               |                                       | ↕ 160 / 192 / 96 / 0                  | 120 / 96 / 48 / 12                    | 200 / 192 / 96 / 12                    |
|          |                | A5E 043B |                                                                                |                                                                                               |                                       |                                       | 120 / 96 / 48 / 12                    | 120 / 384 / 192 / 16                   |
|          |                | A5E 052B |                                                                                |                                                                                               |                                       |                                       | 120 / 96 / 48 / 12                    | 120 / 384 / 192 / 24                   |
|          |                | A5E 065B |                                                                                |                                                                                               |                                       |                                       | ↓ 120 / 96 / 48 / 12                  | ↓ 120 / 384 / 192 / 24                 |

↑ Conditional pin migration path



# FPGA OPN: A5ED065BB32AE4S (Order Part Number)

## Ordering Part Number (OPN) Structure Intel Agilex® 5 FPGAs E-Series

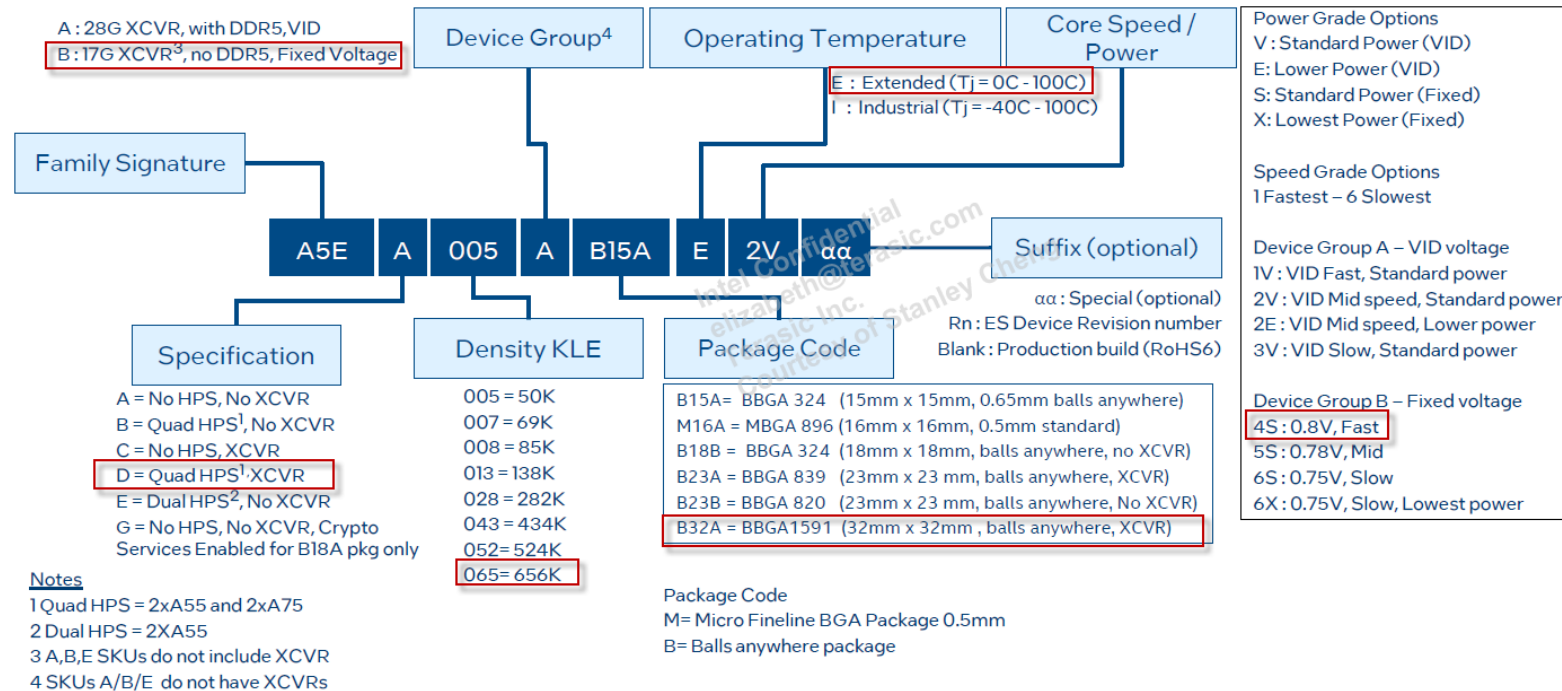
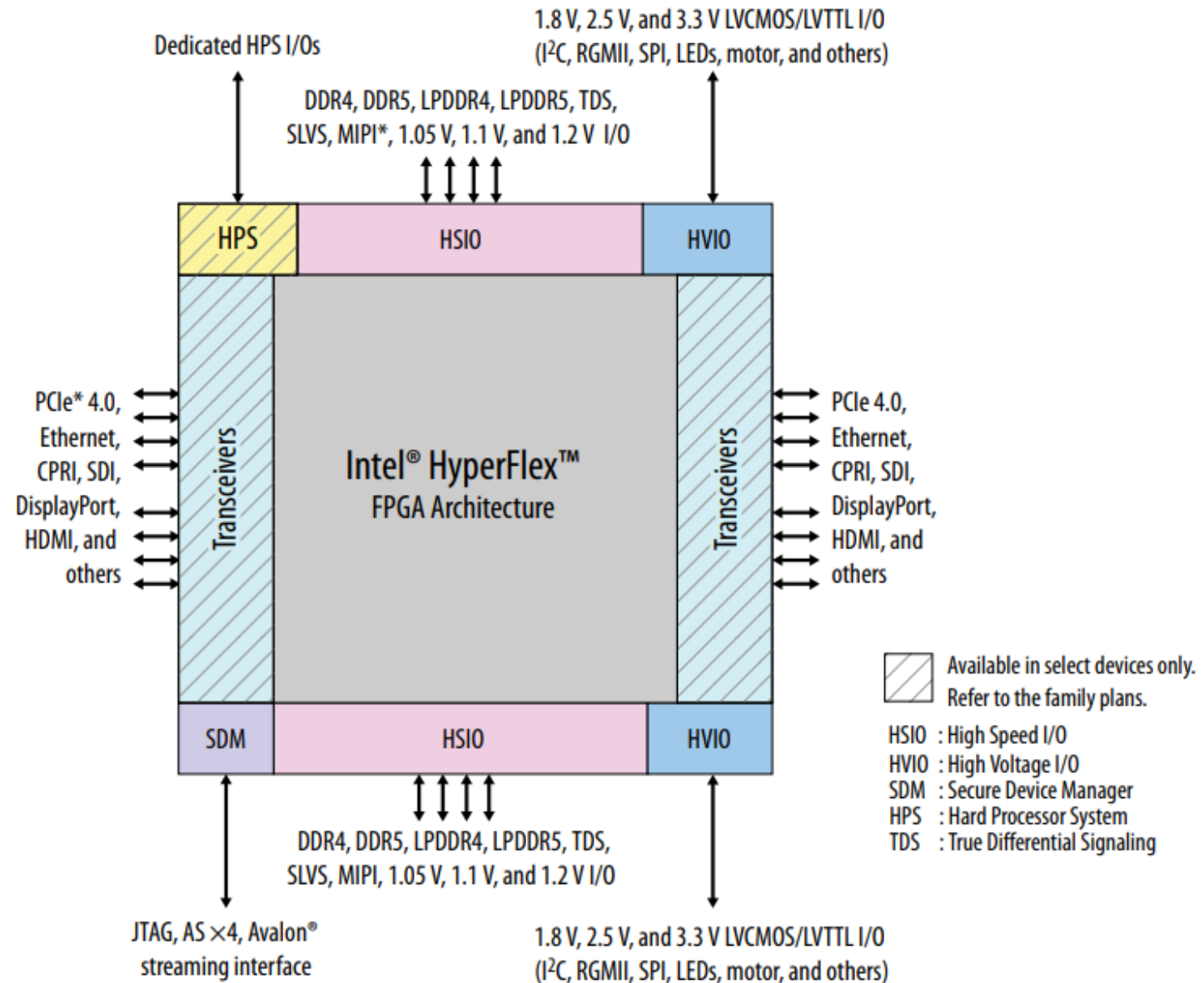




Figure 1. Intel Agilex 5 FPGAs and SoCs Block Diagram

# FPGA Block Diagram



# FPGA Power and Performance

## Optimized for Power and Size

Up to

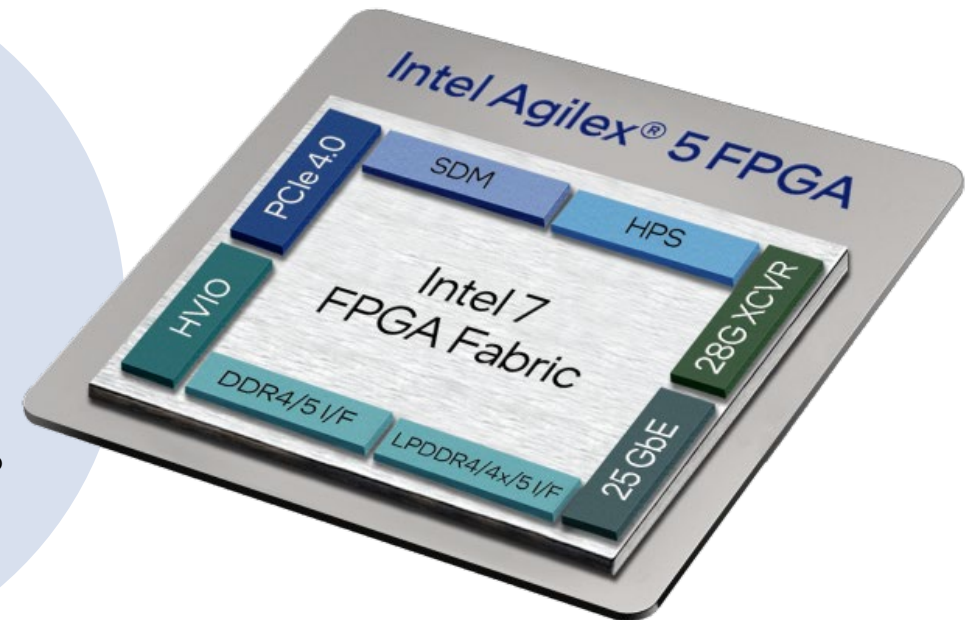
**50%**

Lower total power consumption vs  
Cyclone V FPGAs

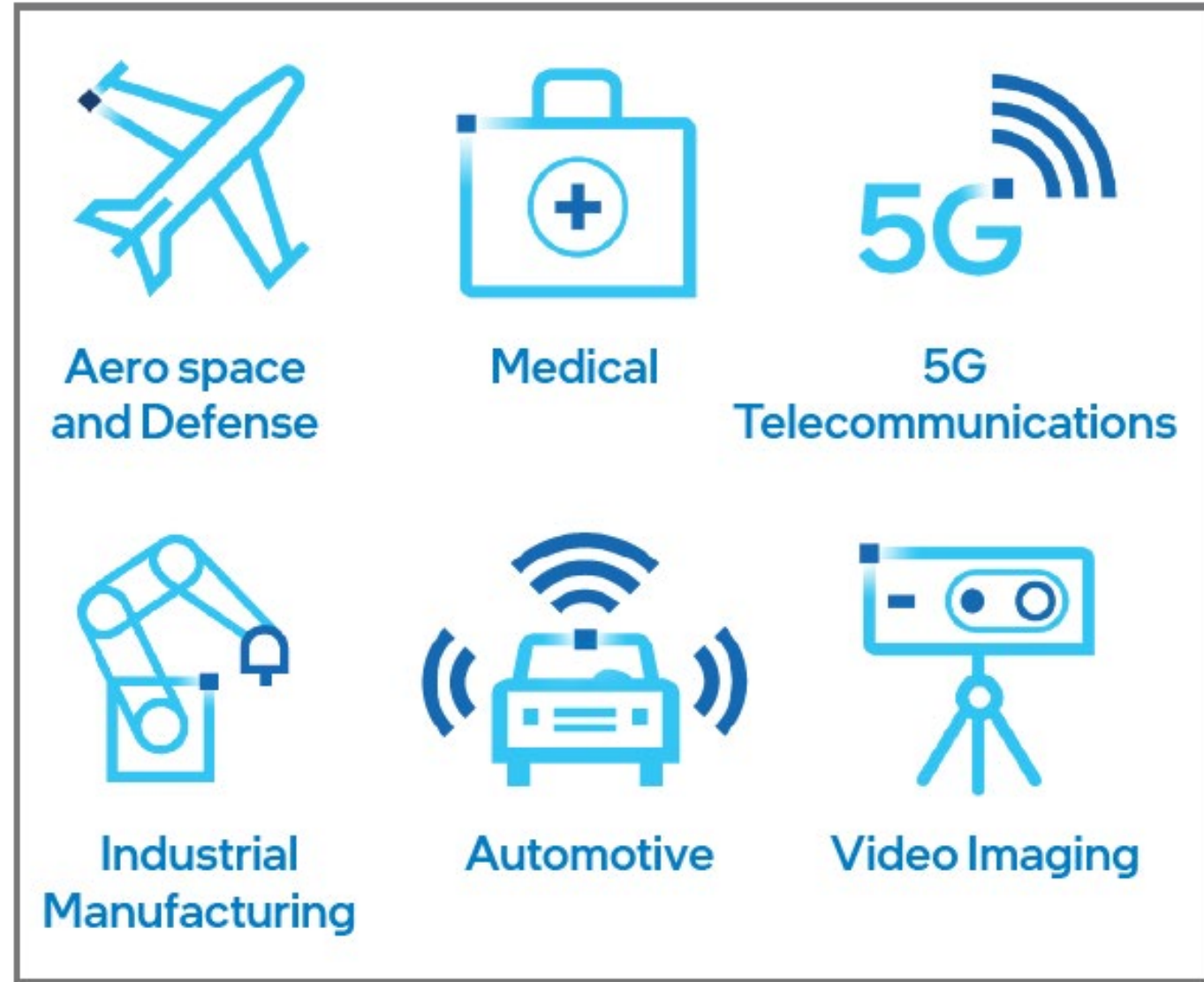
Up to

**2.5x**

Fabric performance compared to  
Cyclone V FPGAs



# | FPGA Sample Use Cases



**Figure 5.** Example applications for Intel Agilex 5 FPGAs E-series



# Enhanced DSP with AI Tensor Block

| Applications          | Multiplier                | Capabilities per DSP Block   |                                    | Improvement* |
|-----------------------|---------------------------|------------------------------|------------------------------------|--------------|
|                       |                           | Earlier Intel Agilex Devices | Enhanced DSP with AI Tensor Block* |              |
| AI, Signal Processing | INT8                      | 4 OPS                        | 20 OPS                             | 5X           |
|                       | INT9                      | 4 Multipliers                | 6 Multipliers                      | 50%          |
| Signal Processing     | 16-bit Complex Multiplier | Needs 2 DSP Blocks           | 1 DSP Block                        | 2X           |

**Table 1.** The Enhanced DSP with AI Tensor block provides an order of magnitude increase in AI and DSP compute density.

\*Available in Intel Agilex® 5 FPGAs D-Series and Intel Agilex® 5 FPGAs E-Series.

# DDR4 Performance

- FPGA/HPS DDR4 controller speed is FPGA core speed dependent :
- FPGA core speed 4 : 1200MHz (2400MT/s)
- FPGA core speed 5 : 933MHz (1866MT/s)
- FPGA core speed 6 : 800MHz (1600MT/s)

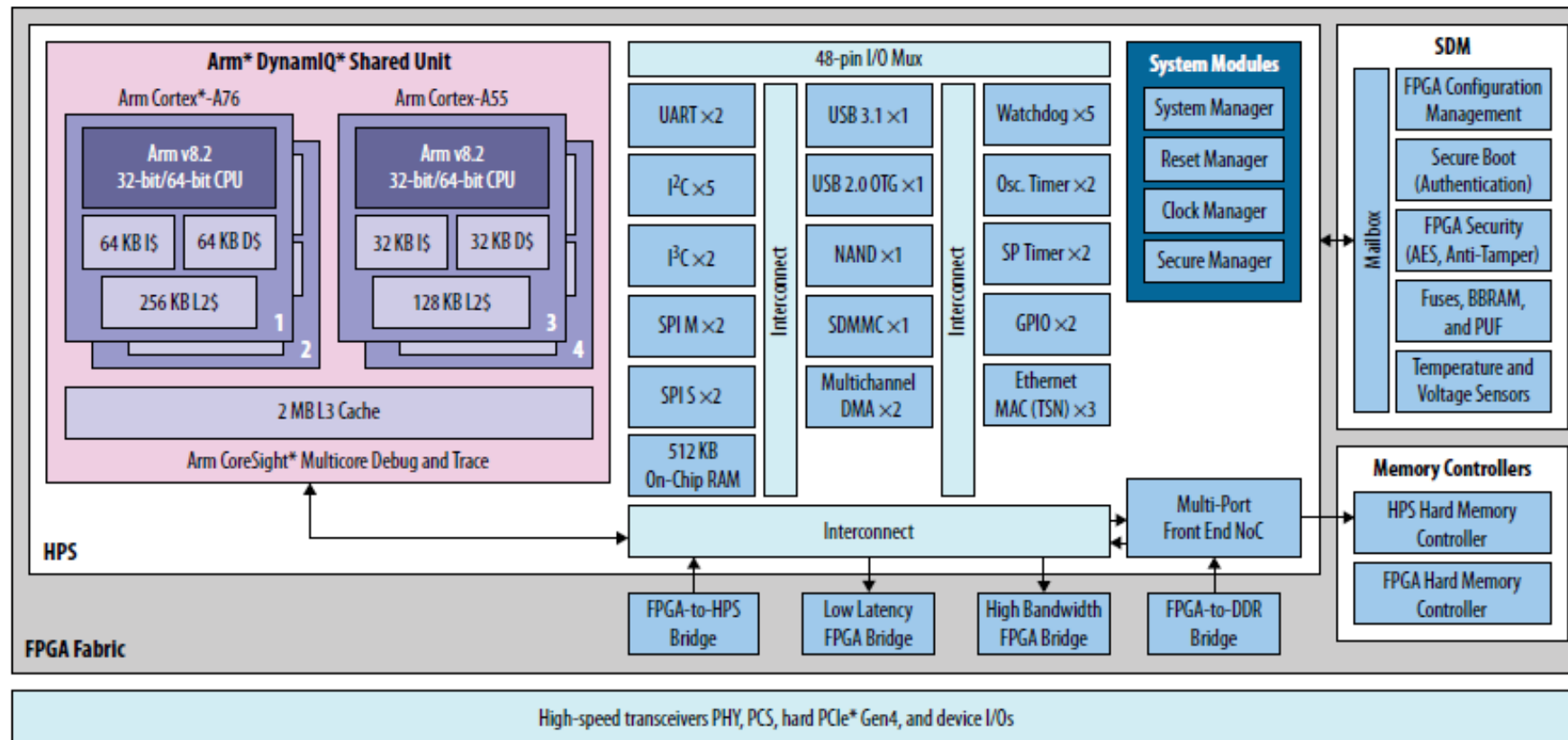
**Table 17.** E-Series FPGAs External Memory Interface Performance

| Interface Protocol | Memory Controller | Interface Performance (Mbps) |                | Maximum Width (Bits) |
|--------------------|-------------------|------------------------------|----------------|----------------------|
|                    |                   | Device Group A               | Device Group B |                      |
| DDR4               | Hard              | 2,667                        | 2,400          | 32                   |
| DDR5               | Hard              | 3,600                        | —              | 40                   |
| LPDDR4             | Hard              | 3,733                        | 2,667          | 32                   |
| LPDDR5             | Hard              | 3,733                        | 2,400          | 32                   |

# HPS Block Diagram Embedded multicore Arm processors :

- Dual-core 64-bit Arm Cortex-A76, up to 1.4 GHz
- Dual-core 64-bit Arm Cortex-A55, up to 1.25 GHz

**Figure 8. Intel Agilex 5 SoCs HPS Block Diagram**





# ARM Architecture/Performance

**Table 9. E-Series FPGA Family Plan—Transceivers and HPS**

The values in this table are maximum resources or performance.

| Device Group Type | Device   | Transceiver (10) | PCIe 4.0 ×4 | Gigabit Ethernet <sup>(11)</sup> (MAC & PCS) | HPS                                                                                                                                       |                                                                                                                                                                                                                                                                                   |
|-------------------|----------|------------------|-------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   |          |                  |             |                                              | Processor                                                                                                                                 | Cache Size                                                                                                                                                                                                                                                                        |
| Device Group A    | A5E 013A | 4                | 1           | 1                                            | <ul style="list-style-type: none"> <li>Dual core Arm Cortex-A76 up to 1.8 GHz</li> <li>Dual core Arm Cortex-A55 up to 1.5 GHz</li> </ul>  | <ul style="list-style-type: none"> <li>Shared: 2 MB L3</li> <li>Cortex-A76: <ul style="list-style-type: none"> <li>— 64 KB L1</li> <li>— 256 KB L2</li> </ul> </li> <li>Cortex-A55: <ul style="list-style-type: none"> <li>— 32 KB L1</li> <li>— 128 KB L2</li> </ul> </li> </ul> |
|                   | A5E 028A | 12               | 3           | 3                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 052A | 24               | 6           | 4                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 065A | 24               | 6           | 6                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 043A | 16               | 4           | 4                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
| Device Group B    | A5E 005B | —                | —           | —                                            | —                                                                                                                                         | —                                                                                                                                                                                                                                                                                 |
|                   | A5E 007B | —                | —           | —                                            | —                                                                                                                                         | —                                                                                                                                                                                                                                                                                 |
|                   | A5E 008B | 4                | 1           | 1                                            | <ul style="list-style-type: none"> <li>Dual core Arm Cortex-A76 up to 1.4 GHz</li> <li>Dual core Arm Cortex-A55 up to 1.25 GHz</li> </ul> | <ul style="list-style-type: none"> <li>Shared: 2 MB L3</li> <li>Cortex-A76: <ul style="list-style-type: none"> <li>— 64 KB L1</li> <li>— 256 KB L2</li> </ul> </li> <li>Cortex-A55: <ul style="list-style-type: none"> <li>— 32 KB L1</li> <li>— 128 KB L2</li> </ul> </li> </ul> |
|                   | A5E 013B | 4                | 1           | 1                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 028B | 12               | 3           | 3                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 043B | 16               | 4           | 4                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 052B | 24               | 6           | 6                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |
|                   | A5E 065B | 24               | 6           | 6                                            |                                                                                                                                           |                                                                                                                                                                                                                                                                                   |

ARM Cortex A55 and A76 are 64-bit processors which implement ARM v8.2 architecture instruction set. The core supports unprivileged 32-bit applications, but privileged applications must utilize the 64-bit ARMv8-A ISA.

\*P.S Cyclone V SoC User ARM Codex A9 is a 32-bit processor which implements ARM v7 architecture instruction set.

# HPS Differences

- New Controller : USB 3.1 Gen1, I3C Controller

| Feature                    | Cyclone®V /<br>Arria® V | Intel® Arria® 10 | Intel® Stratix® 10/<br>Intel Agilex® 7 | Intel Agilex® 5                                              |
|----------------------------|-------------------------|------------------|----------------------------------------|--------------------------------------------------------------|
| Micro Processor Unit (MPU) | Single/Dual Cortex-A9   | Dual Cortex-A9   | Quad Cortex-A53                        | Dual Cortex-A76 and Dual Cortex-A55 with DynamIQ Shared Unit |
| On-Chip RAM                | 64KB                    | 256KB            | 256KB                                  | 512KB                                                        |
| USB 3.1 Gen 1 Controller   | No                      | No               | No                                     | 1, New/Upgraded                                              |
| USB 2.0 OTG Controller     | 2                       | 2                | 2                                      | 1                                                            |
| I3C Controller             | No                      | No               | No                                     | 2, New/Upgraded                                              |

# Transceiver Configure

- Transceiver Port

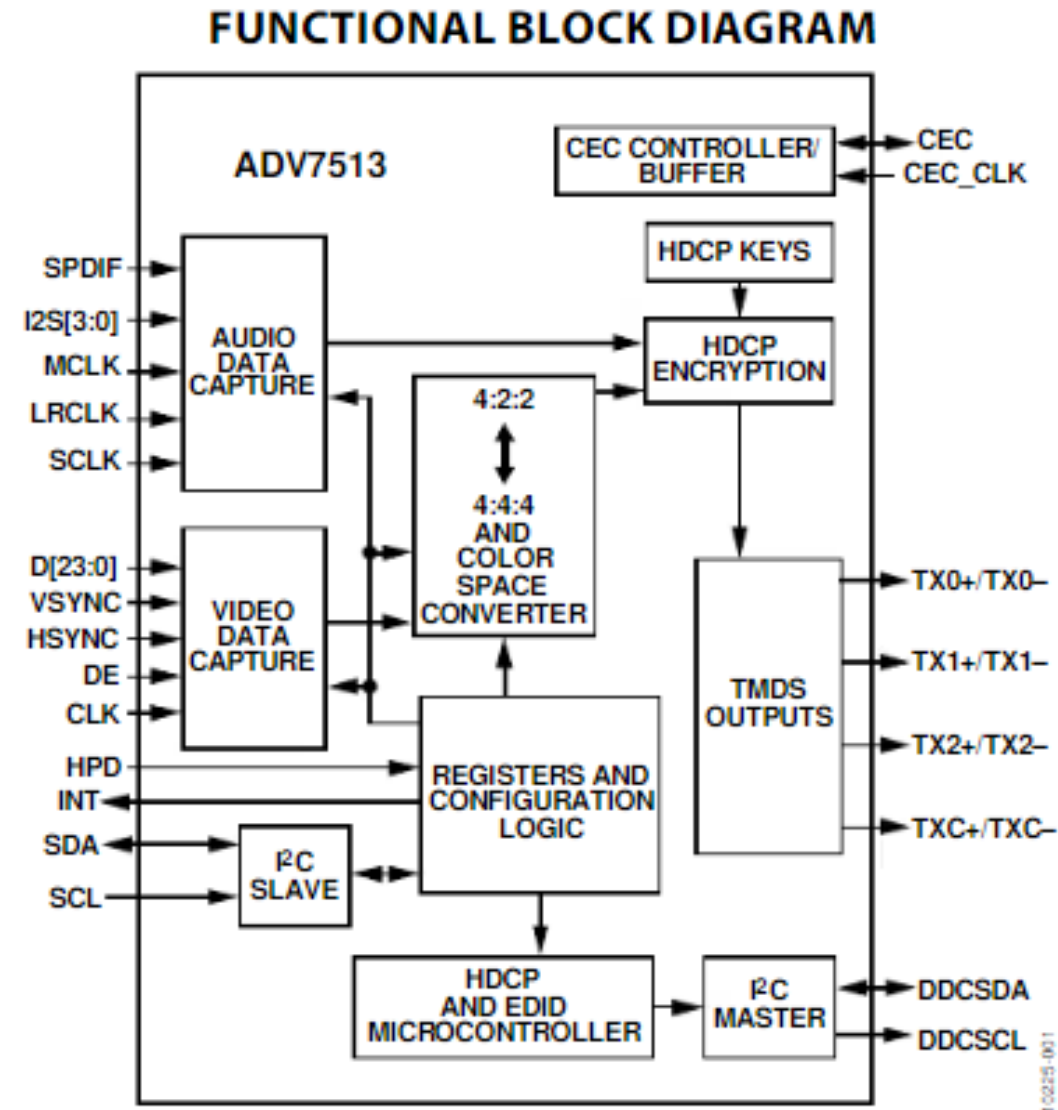
| Transceiver Port | Channel Number | Ref Clock (MHz) | Bank    |
|------------------|----------------|-----------------|---------|
| PCIe Gen3x4      | 4              |                 | 1A      |
| QSFP+            | 4              |                 | 1B      |
| USB 3.1          | 1              | 100             | 1C      |
| 2.5G Ethernet    | 1              | 125             | 1C      |
| FMC+             | 12             |                 | 4 A/B/C |

- Transceiver Ref. Clock

| Transceiver Bank | CH1 REF CLOCK (MHz)        | RX REF CLOCK (MHz) |
|------------------|----------------------------|--------------------|
| 1A               | 100 (from external)        | 100                |
| 1B               | 156.25                     | 184.32             |
| 1C               | 100                        | 125                |
| 4A               | From FMC+ MC_GBTCLK0_M2C_P | 148.5              |
| 4B               | From FMC+ MC_GBTCLK1_M2C_P | 135 (TBD)          |
| 4C               | From FMC+ MC_GBTCLK2_M2C_P | 100                |

# HDMI OUT

- ADI ADV7513 HDMI transmitter
- Incorporates HDMI v1.4 features, including 3D video support
- 165 MHz supports all video formats up to 1080p and UXGA





# QSFP+ Port

- Support 40G Ethernet
- Support DAC/AOC cable



# FMC+ Connector Pinout (vita 57.4 Compliant)

- High pin count
- Support VADJ 1.2V
- Only support 12 transceiver pairs due to insufficient pin count

| 14 x 40 | M          | L             | K            | J            | H            | G          | F         | E         | D             | C         | B             | A         | Z                  | Y          |
|---------|------------|---------------|--------------|--------------|--------------|------------|-----------|-----------|---------------|-----------|---------------|-----------|--------------------|------------|
| 1       | GND        | RES1          | VREF_B_M2C   | GND          | VREF_A_M2C   | GND        | PG_M2C    | GND       | PG_C2M        | GND       | CLK_DIR       | GND       | HSPEC_PRSENT_M2C_L | GND        |
| 2       | DP23_M2C_P | GND           | GND          | CLK3_BIDIR_P | PRSENT_M2C_L | CLK1_M2C_P | GND       | HA01_P_CC | GND           | DP0_C2M_P | GND           | DP1_M2C_P | GND                | DP23_C2M_P |
| 3       | DP23_M2C_N | GND           | GND          | CLK3_BIDIR_N | GND          | CLK1_M2C_N | GND       | HA01_N_CC | GND           | DP0_C2M_N | GND           | DP1_M2C_N | GND                | DP23_C2M_N |
| 4       | GND        | GBTCLK4_M2C_P | CLK2_BIDIR_P | GND          | CLK0_M2C_P   | GND        | HA00_P_CC | GND       | GBTCLK0_M2C_P | GND       | DP9_M2C_P     | GND       | DP22_C2M_P         | GND        |
| 5       | GND        | GBTCLK4_M2C_N | CLK2_BIDIR_N | GND          | CLK0_M2C_N   | GND        | HA00_N_CC | GND       | GBTCLK0_M2C_N | GND       | DP9_M2C_N     | GND       | DP22_C2M_N         | GND        |
| 6       | DP22_M2C_P | GND           | GND          | HA03_P       | GND          | LA00_P_CC  | GND       | HA05_P    | GND           | DP0_M2C_P | GND           | DP2_M2C_P | GND                | DP21_C2M_P |
| 7       | DP22_M2C_N | GND           | HA02_P       | HA03_N       | LA02_P       | LA00_N_CC  | HA04_P    | HA05_N    | GND           | DP0_M2C_N | GND           | DP2_M2C_N | GND                | DP21_C2M_N |
| 8       | GND        | GBTCLK3_M2C_P | HA02_N       | GND          | LA02_N       | GND        | HA04_N    | GND       | LA01_P_CC     | GND       | DP8_M2C_P     | GND       | DP20_C2M_P         | GND        |
| 9       | GND        | GBTCLK3_M2C_N | GND          | HA07_P       | GND          | LA03_P     | GND       | HA09_P    | LA01_N_CC     | GND       | DP8_M2C_N     | GND       | DP20_C2M_N         | GND        |
| 10      | DP21_M2C_P | GND           | HA06_P       | HA07_N       | LA04_P       | LA03_N     | HA08_P    | HA09_N    | GND           | LA06_P    | GND           | DP3_M2C_P | GND                | DP10_M2C_P |
| 11      | DP21_M2C_N | GND           | HA06_N       | GND          | LA04_N       | GND        | HA08_N    | GND       | LA05_P        | LA06_N    | GND           | DP3_M2C_N | GND                | DP10_M2C_N |
| 12      | GND        | GBTCLK2_M2C_P | GND          | HA11_P       | GND          | LA08_P     | GND       | HA13_P    | LA05_N        | GND       | DP7_M2C_P     | GND       | DP11_M2C_P         | GND        |
| 13      | GND        | GBTCLK2_M2C_N | HA10_P       | HA11_N       | LA07_P       | LA08_N     | HA12_P    | HA13_N    | GND           | GND       | DP7_M2C_N     | GND       | DP11_M2C_N         | GND        |
| 14      | DP20_M2C_P | GND           | HA10_N       | GND          | LA07_N       | GND        | HA12_N    | GND       | LA09_P        | LA10_P    | GND           | DP4_M2C_P | GND                | DP12_M2C_P |
| 15      | DP20_M2C_N | GND           | GND          | HA14_P       | GND          | LA12_P     | GND       | HA16_P    | LA09_N        | LA10_N    | GND           | DP4_M2C_N | GND                | DP12_M2C_N |
| 16      | GND        | SYNC_C2M_P    | HA17_P_CC    | HA14_N       | LA11_P       | LA12_N     | HA15_P    | HA16_N    | GND           | GND       | DP6_M2C_P     | GND       | DP13_M2C_P         | GND        |
| 17      | GND        | SYNC_C2M_N    | HA17_N_CC    | GND          | LA11_N       | GND        | HA15_N    | GND       | LA13_P        | GND       | DP6_M2C_N     | GND       | DP13_M2C_N         | GND        |
| 18      | DP14_C2M_P | GND           | GND          | HA18_P       | GND          | LA16_P     | GND       | HA20_P    | LA13_N        | LA14_P    | GND           | DP5_M2C_P | GND                | DP14_M2C_P |
| 19      | DP14_C2M_N | GND           | HA21_P       | HA18_N       | LA15_P       | LA16_N     | HA19_P    | HA20_N    | GND           | LA14_N    | GND           | DP5_M2C_N | GND                | DP14_M2C_N |
| 20      | GND        | REFCLK_C2M_P  | HA21_N       | GND          | LA15_N       | GND        | HA19_N    | GND       | LA17_P_CC     | GND       | GBTCLK1_M2C_P | GND       | GBTCLK5_M2C_P      | GND        |
| 21      | GND        | REFCLK_C2M_N  | GND          | HA22_P       | GND          | LA20_P     | GND       | HB03_P    | LA17_N_CC     | GND       | GBTCLK1_M2C_N | GND       | GBTCLK5_M2C_N      | GND        |
| 22      | DP15_C2M_P | GND           | HA23_P       | HA22_N       | LA19_P       | LA20_N     | HB02_P    | HB03_N    | GND           | LA18_P_CC | GND           | DP1_C2M_P | GND                | DP15_M2C_P |
| 23      | DP15_C2M_N | GND           | HA23_N       | GND          | LA19_N       | GND        | HB02_N    | GND       | LA23_P        | LA18_N_CC | GND           | DP1_C2M_N | GND                | DP15_M2C_N |
| 24      | GND        | REFCLK_M2C_P  | GND          | HB01_P       | GND          | LA22_P     | GND       | HB05_P    | LA23_N        | GND       | DP9_C2M_P     | GND       | DP10_C2M_P         | GND        |
| 25      | GND        | REFCLK_M2C_N  | HB00_P_CC    | HB01_N       | LA21_P       | LA22_N     | HB04_P    | HB05_N    | GND           | GND       | DP9_C2M_N     | GND       | DP10_C2M_N         | GND        |
| 26      | DP16_C2M_P | GND           | HB00_N_CC    | GND          | LA21_N       | GND        | HB04_N    | GND       | LA26_P        | LA27_P    | GND           | DP2_C2M_P | GND                | DP11_C2M_P |
| 27      | DP16_C2M_N | GND           | GND          | HB07_P       | GND          | LA25_P     | GND       | HB09_P    | LA26_N        | LA27_N    | GND           | DP2_C2M_N | GND                | DP11_C2M_N |
| 28      | GND        | SYNC_M2C_P    | HB06_P_CC    | HB07_N       | LA24_P       | LA25_N     | HB08_P    | HB09_N    | GND           | GND       | DP8_C2M_P     | GND       | DP12_C2M_P         | GND        |
| 29      | GND        | SYNC_M2C_N    | HB06_N_CC    | GND          | LA24_N       | GND        | HB08_N    | GND       | TCK           | GND       | DP8_C2M_N     | GND       | DP12_C2M_N         | GND        |
| 30      | DP17_C2M_P | GND           | GND          | HB11_P       | GND          | LA29_P     | GND       | HB13_P    | TDI           | SCL       | GND           | DP3_C2M_P | GND                | DP13_C2M_P |
| 31      | DP17_C2M_N | GND           | HB10_P       | HB11_N       | LA28_P       | LA29_N     | HB12_P    | HB13_N    | TDO           | SDA       | GND           | DP3_C2M_N | GND                | DP13_C2M_N |
| 32      | GND        | RES2          | HB10_N       | GND          | LA28_N       | GND        | HB12_N    | GND       | 3P3VAUX       | GND       | DP7_C2M_P     | GND       | DP16_M2C_P         | GND        |
| 33      | GND        | RES3          | GND          | HB15_P       | GND          | LA31_P     | GND       | HB19_P    | TMS           | GND       | DP7_C2M_N     | GND       | DP16_M2C_N         | GND        |
| 34      | DP18_C2M_P | GND           | HB14_P       | HB15_N       | LA30_P       | LA31_N     | HB16_P    | HB19_N    | TRST_L        | GA0       | GND           | DP4_C2M_P | GND                | DP17_M2C_P |
| 35      | DP18_C2M_N | GND           | HB14_N       | GND          | LA30_N       | GND        | HB16_N    | GND       | GA1           | 12P0V     | GND           | DP4_C2M_N | GND                | DP17_M2C_N |
| 36      | GND        | 12P0V         | GND          | HB18_P       | GND          | LA33_P     | GND       | HB21_P    | 3P3V          | GND       | DP6_C2M_P     | GND       | DP18_M2C_P         | GND        |
| 37      | GND        | 12P0V         | HB17_P_CC    | HB18_N       | LA32_P       | LA33_N     | HB20_P    | HB21_N    | GND           | 12P0V     | DP6_C2M_N     | GND       | DP18_M2C_N         | GND        |
| 38      | DP19_C2M_P | GND           | HB17_N_CC    | GND          | LA32_N       | GND        | HB20_N    | GND       | 3P3V          | GND       | GND           | DP5_C2M_P | GND                | DP19_M2C_P |
| 39      | DP19_C2M_N | GND           | GND          | VIO_B_M2C    | GND          | VADJ       | GND       | VADJ      | GND           | 3P3V      | GND           | DP5_C2M_N | GND                | DP19_M2C_N |
| 40      | GND        | 12P0V         | VIO_B_M2C    | GND          | VADJ         | GND        | VADJ      | GND       | 3P3V          | GND       | RES0          | GND       | 3P3V               | GND        |

# FMC+ Features

| GROUP  | Signal                                     | Count    |
|--------|--------------------------------------------|----------|
| FPGA   | Generic Transceiver                        | 12 pairs |
|        | Generic Transceiver REFCLK (input to FPGA) | 2 pairs  |
|        | Generic I/O and LVDS (*)                   | 160 pins |
|        | Side-bank Differential Clocks              | 8 pairs  |
|        | Side-bank 3.3V I/O, SCL/SDA                | 2 pins   |
|        | Side-bank Reserved 3.3V I/O, RES0(**)      | 1 pins   |
| HPS    | Generic I/O                                | 0        |
|        | Dedicated I/O                              | 0        |
| System | JTAG                                       | 5 pins   |

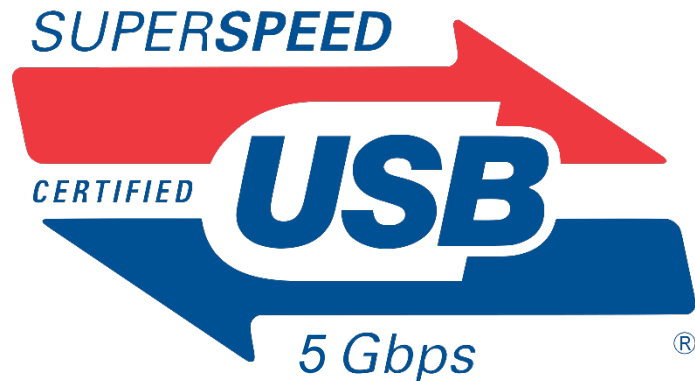
## Note

- \* LVDS direction not VITA compatible
- \*\* RES0 connect to FPGA PCIe dedicated reset pin

# Upgraded Signaling Controllers

## 1 x USB 3.1 Gen 1 controller

- Supports both Device and Host controller modes
- Supports up to 5 Gbps ( SuperSpeed ) when configured for USB 3.1 and interfaced with the transceiver
- Supports up to 480 Mbps (High Speed) when configured for USB 2.0 and interfaced with the HPS I/O



## 2 x I3C controllers

- One configured as the primary host
- One configured as the secondary host
- Hardware assisted device role switching
- Supports FM, FM+ and SDR data rates up to 12.5 Mbps

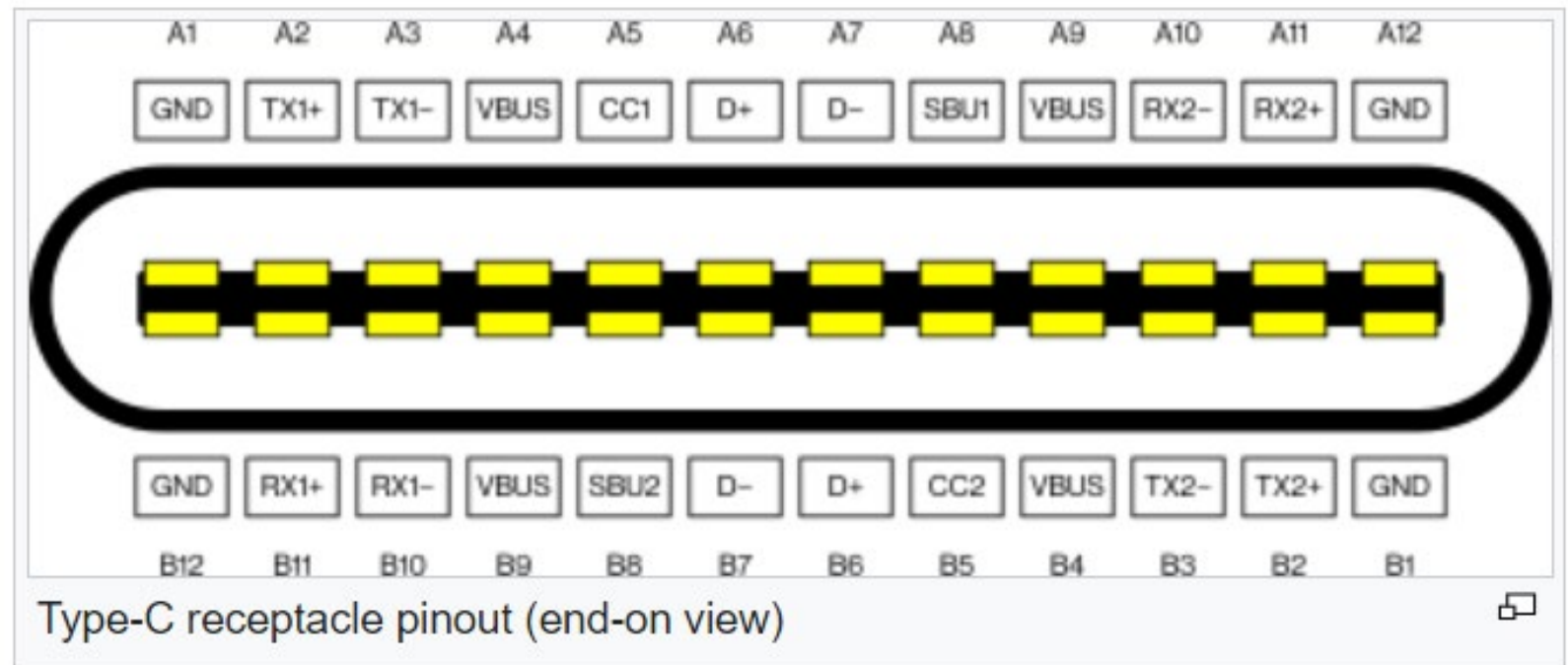
## 2 x DMA controllers

- Four channels each
- Can be configured for secure or non-secure access to HPS resources
- Supports up to 48 peripheral handshake interfaces



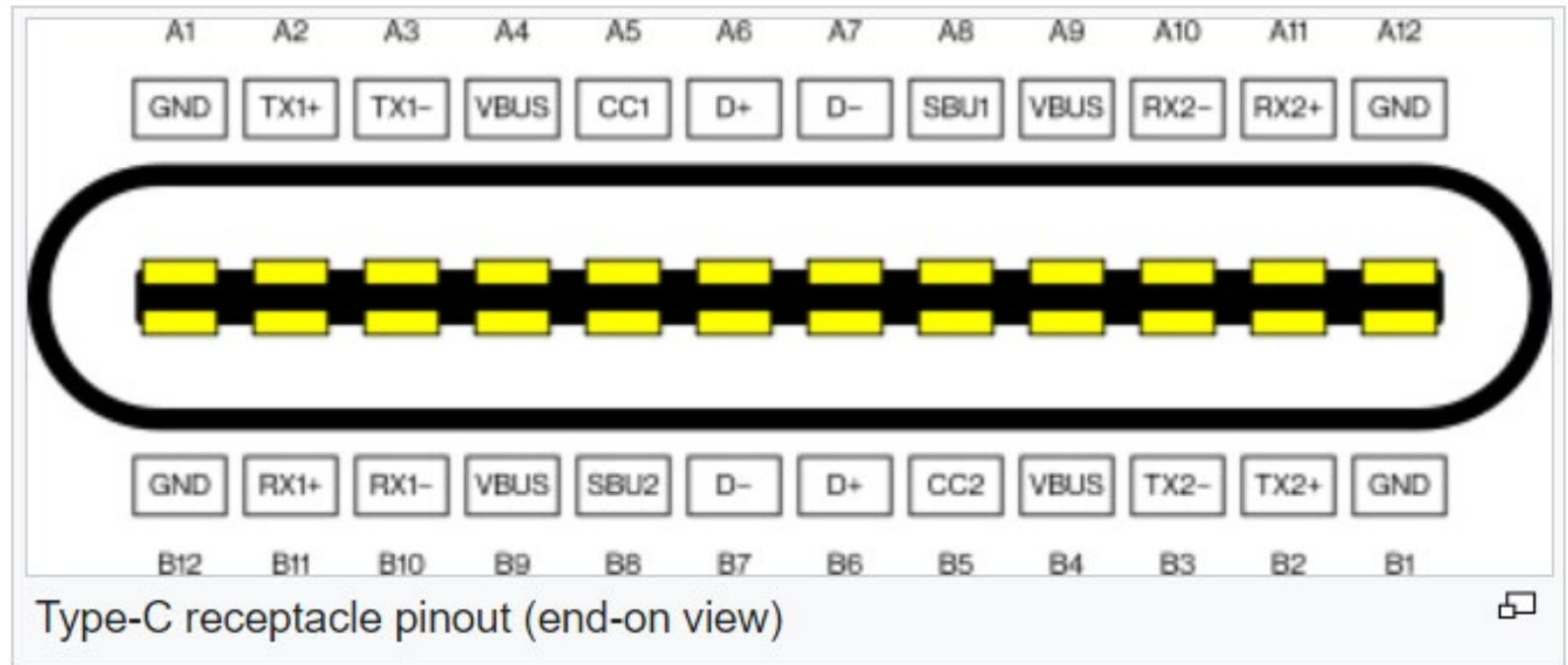
## UBII/UART USB Type-C

- USB 2.0
- Not support power delivery



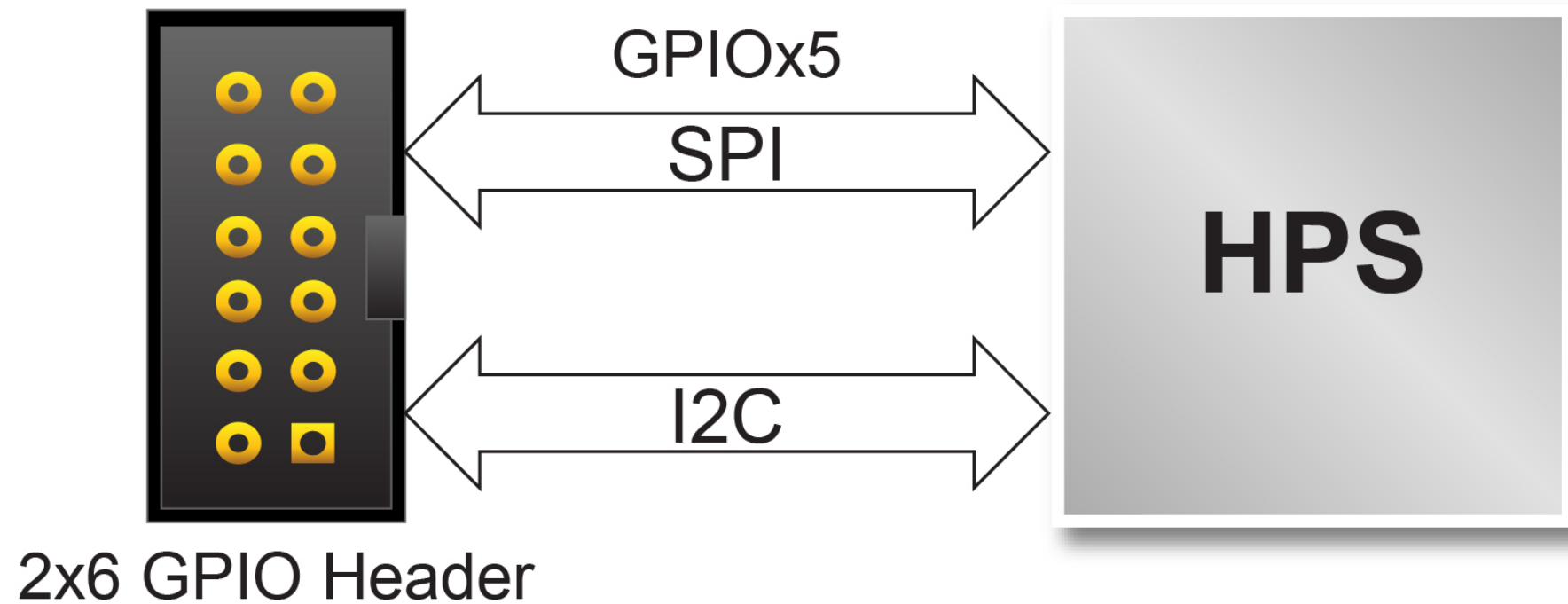
## | HPS USB Type-C

- USB 3.2 Gen 1x1 (USB 3.1 Gen 1)
- Support 5Gbps super speed
- Support dual role (Support 5V/0.5A for USB Host mode.)
- Not support power delivery



# HPS : 2x6 GPIO Header

- IO 3.3V
- Offer I2C interface



# Power Supply

- 4-pin power connector
- DC 12V 10A 120W





# Software Support

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- FPGA/HPS Demo Code
- Linus BSP
- Open FPGA Stack (TBD)
- OneAPI (TBD)