



**THE DATASHEET OF  
LFE2-12SE-5QN208C**





# PRODUCT SELECTOR GUIDE

MAY 2018

### Customizable Solutions

Lattice Semiconductor leads the industry in ultra-low power, small form factor, customizable solutions for today's quickly changing connected world. From heterogeneous networks and micro servers, to smartphones, tablets and wearables, Lattice FPGAs and CPLDs are at the heart of solutions that give designers the ability to quickly innovate, or build and add features to their systems that uniquely differentiate their products.

**CrossLink Portfolio: Video Interface Bridges** – CrossLink is the industry's first programmable bridging device that resolves interface mismatches between application processors, image sensors, and displays. This makes it the optimal solution for VR headsets, drones, smartphones, tablets, cameras, wearables, human machine interfaces (HMIs), and automotive.

**iCE40 Portfolio: World's Smallest FPGAs** – Lattice's iCE40 family offers the world's smallest FPGAs at very low power enabling flexible and fast customization on standard platforms – perfect for implementing killer features on smartphones, tablets, wearables, IoT edge, and other mobile devices.

**MachXO Portfolio: Control PLD and Bridging** – The award-winning MachXO2 FPGA family and new MachXO3 family – the world's smallest, lowest-cost-per I/O, instant-on programmable platform – can be used to quickly implement system control functions, I/O expansion and bridging in applications such as routers, base stations, servers, storage, industrial, medical and consumer.

**ECP Portfolio: Connectivity and Acceleration FPGAs** – The Lattice ECP3, ECP5 and ECP5-5G families are optimized for data and control path bridge and interfacing, architected with high-performance SERDES, full-featured DSP blocks, and for state-of-the-art memory interfaces for supporting a wide range of applications including wireless and wireline communication, video processing, security and surveillance, industrial automation, and automotive.

### Power and Thermal Management Products

Lattice's Platform Manager 2 devices implement circuit board hardware management functions (Power Management, Control Plane Functions and Thermal Management). The Platform Manager 2 device family is comprised of a Platform Manager 2 device (Programmable Analog + FPGA) and a Programmable Analog Sense and Control device (L-ASC10).

In simpler boards, the Power Management functions can be integrated into Lattice Power Manager II products.

### Standards-Based Products

Lattice enables high-performance digital connectivity for some of the world's biggest brands in mobile, consumer electronic (CE), and PC markets. As the driving force behind global standards including HDMI®, DVI, MHL®, and WirelessHD®, Lattice's understanding of these technologies is second to none.

As a Founder of both the HDMI® and MHL® Specifications, and through extensive experience with compliance and interoperability testing, Lattice is in a unique position to offer tested, field-proven solutions that can be rapidly and reliably integrated into TVs, projectors, A/V receivers, Blu-ray players, set-top boxes, and other digital display and home theater products.

Lattice's mobile semiconductor products are designed for smartphones, tablets, digital cameras, streaming sticks, mobile docks, and other devices where a small form factor and lower power consumption are essential. Lattice offers support for proprietary connectors along with standard micro-USB, USB Type-C, superMHL™, and HDMI connectors.

### SiBEAM

SiBEAM, a Lattice Semiconductor Company, is a pioneer in developing intelligent millimeter-wave technologies for wireless communications. The company was the first to build 60GHz chipsets using standard CMOS technology. SiBEAM is a global leader in driving next-generation architecture and semiconductor implementation of wireless connectivity solutions in the consumer electronics, mobile, enterprise and infrastructure markets.

SiBEAM's WirelessHD transmitter and receiver modules are completely self-contained, autonomous WirelessHD subsystems that connect to a host board and enables. These WirelessHD modules enable a robust high-definition wireless video connectivity between an HDMI® source and a display, delivering a cable-quality connection without wires.

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# FPGA Products

| Device                           | CrossLink™           |                      |                      |                      |                            |
|----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------------|
|                                  | LIF-MD6000-36        | LIF-MD6000-64        | LIF-MD6000-81        | LIF-MD6000-80        | LIA-MD6000-80 <sup>1</sup> |
| LUTs                             | 5936                 | 5936                 | 5936                 | 5936                 | 5936                       |
| Embedded Memory                  | kbits                | 180                  | 180                  | 180                  | 180                        |
| Distrib. RAM                     | kbits                | 47                   | 47                   | 47                   | 47                         |
| GPLL                             | 1                    | 1                    | 1                    | 1                    | 1                          |
| D-PHY PLL                        | 1                    | 2                    | 2                    | 2                    | 2                          |
| Embedded I <sup>2</sup> C Blocks | 2                    | 2                    | 2                    | 2                    | 2                          |
| Embedded RX/TX MIPI D-PHY        | 1 (4 Data + 1 Clock) | 2 (8 Data + 2 Clock) | 2 (8 Data + 2 Clock) | 2 (8 Data + 2 Clock) | 2 (8 Data + 2 Clock)       |
| 48MHz Oscillator                 | 1                    | 1                    | 1                    | 1                    | 1                          |
| 10kHz Oscillator                 | 1                    | 1                    | 1                    | 1                    | 1                          |
| NVCM                             | Yes                  | Yes                  | Yes                  | Yes                  | Yes                        |
| Dual Boot                        | Yes                  | Yes                  | Yes                  | Yes                  | Yes                        |
| Power Management Unit            | Yes                  | Yes                  | Yes                  | Yes                  | Yes                        |
| Low Power Sleep Mode             | Yes                  | Yes                  | Yes                  | Yes                  | Yes                        |
| Typical Operational Power        | 5mW – 135mW          | 5mW – 135mW          | 5mW – 135mW          | 5mW – 135mW          | 5mW – 135mW                |
| Footprint                        | 2.5 mm x 2.5 mm      | 3.5 mm x 3.5 mm      | 4.5 mm x 4.5 mm      | 6.5 mm x 6.5 mm      | 6.5 mm x 6.5 mm            |
| Package Pitch                    | 0.4 mm               | 0.4 mm               | 0.5 mm               | 0.65 mm              | 0.65 mm                    |
| GPIO                             | 7                    | 8                    | 9                    | 8                    | 8                          |
| I/O                              | 17                   | 29                   | 37                   | 36                   | 36                         |

1) Automotive grade.

# FPGA Products

## ECP Series - Connectivity and Acceleration FPGAs

| Features              |             |            | ECP5™-5G                        |             |             | ECP5 Automotive                 |           |          | ECP5™                           |           |           |          |          |          | LatticeECP3™                |           |           |           |           |            |
|-----------------------|-------------|------------|---------------------------------|-------------|-------------|---------------------------------|-----------|----------|---------------------------------|-----------|-----------|----------|----------|----------|-----------------------------|-----------|-----------|-----------|-----------|------------|
| Device                |             |            | LFE5UM5G-25                     | LFE5UM5G-45 | LFE5UM5G-85 | LAE5UM-25                       | LAE5UM-45 | LAE5U-12 | LFE5UM-25                       | LFE5UM-45 | LFE5UM-85 | LFE5U-12 | LFE5U-25 | LFE5U-45 | LFE5U-85                    | LFE3-17EA | LFE3-35EA | LFE3-70EA | LFE3-95EA | LFE3-150EA |
| LUTs                  |             |            | 24 k                            | 44 k        | 84 k        | 24 k                            | 44 k      | 12 k     | 24 k                            | 44 k      | 84 k      | 12 k     | 24 k     | 44 k     | 84 k                        | 17 k      | 33 k      | 67 k      | 92 k      | 149 k      |
| EBR SRAM              | # of Blocks |            | 56                              | 108         | 208         | 56                              | 108       | 32       | 56                              | 108       | 208       | 32       | 56       | 108      | 208                         | 38        | 72        | 240       | 240       | 372        |
|                       | kbits       |            | 1008                            | 1944        | 3744        | 1008                            | 1944      | 576      | 1008                            | 1944      | 3744      | 576      | 1008     | 1944     | 3744                        | 700       | 1,327     | 4,420     | 4,420     | 6,850      |
| Distrib RAM           | kbits       |            | 194                             | 351         | 669         | 194                             | 351       | 97       | 194                             | 351       | 669       | 97       | 194      | 351      | 669                         | 36        | 68        | 145       | 188       | 303        |
| sysDSP™ Blocks        | Multipliers |            | 28                              | 72          | 156         | 28                              | 72        | 28       | 28                              | 72        | 156       | 28       | 28       | 72       | 156                         | 24        | 64        | 128       | 128       | 320        |
| SERDES                | Max. Chan.  |            | 1/2                             | 2/4         |             | 1/2                             | 2/4       | 0        | 1/2                             | 2/4       | 0         | 0        | 0        | 0        | 4                           | 12        | 16        |           |           |            |
|                       | Max. Rate   |            | 5 Gbps                          |             |             | 3.2 Gbps                        |           |          | 3.2 Gbps                        |           |           |          |          |          | 3.2 Gbps                    |           |           |           |           |            |
| PLL + DLL             |             |            | 2+2                             | 4+4         |             | 2+2                             | 4+4       | 2+2      | 2+2                             | 4+4       | 2+2       | 2+2      | 4+4      |          | 2+2                         | 4+2       | 10+2      |           |           |            |
| DDR Support           |             |            | DDR3 800, LPDDR3 800, DDR3L 800 |             |             | DDR3 800, LPDDR3 800, DDR3L 800 |           |          | DDR3 800, LPDDR3 800, DDR3L 800 |           |           |          |          |          | DDR3 800, DDR2 533, DDR 400 |           |           |           |           |            |
| Boot Flash            |             |            | External                        |             |             | External                        |           |          | External                        |           |           |          |          |          | External                    |           |           |           |           |            |
| Dual Boot             |             |            | ✓                               |             |             | ✓                               |           |          | ✓                               |           |           |          |          |          | ✓                           |           |           |           |           |            |
| Multiple Boot         |             |            | ✓                               |             |             | ✓                               |           |          | ✓                               |           |           |          |          |          |                             |           |           |           |           |            |
| Bit-stream Encryption |             |            | ✓                               |             |             | ✓                               |           |          | ✓                               |           |           |          |          |          | ✓                           |           |           |           |           |            |
| Core Vcc              |             |            | 1.2 V                           |             |             | 1.1 V                           |           |          | 1.1 V                           |           |           |          |          |          | 1.2 V                       |           |           |           |           |            |
| Temp.                 | C           |            | ✓                               |             |             |                                 |           |          |                                 |           |           |          |          |          |                             |           |           |           |           |            |
|                       | I           |            | ✓                               |             |             |                                 |           |          |                                 |           |           |          |          |          |                             |           |           |           |           |            |
|                       | AEC-Q100    |            |                                 |             |             | ✓                               |           |          |                                 |           |           |          |          |          |                             | ✓         |           |           |           |            |
| 0.5 mm Spacing        |             |            | I/O Count / SERDES              |             |             | I/O Count / SERDES              |           |          | I/O Count / SERDES              |           |           |          |          |          |                             |           |           |           |           |            |
| csfBGA                | 285         | 10 x 10 mm | 118/2                           | 118/2       | 118/2       |                                 |           |          | 118/2                           | 118/2     | 118/2     | 118/0    | 118/0    | 118/0    |                             |           |           |           |           |            |
| csBGA                 | 328         | 10 x 10 mm |                                 |             |             |                                 |           |          |                                 |           |           |          |          |          | 116/2                       |           |           |           |           |            |
| 0.8 mm Spacing        |             |            | I/O Count / SERDES              |             |             | I/O Count / SERDES              |           |          | I/O Count / SERDES              |           |           |          |          |          |                             |           |           |           |           |            |
| caBGA                 | 256         | 14 x 14 mm |                                 |             |             |                                 |           |          |                                 |           |           | 197/0    | 197/0    | 197/0    |                             |           |           |           |           |            |
|                       | 381         | 17 x 17 mm | 197/2                           | 203/4       | 205/4       | 197/2                           | 203/4     | 197/0    | 197/2                           | 203/4     | 205/4     | 197/0    | 197/0    | 203/0    | 205/0                       |           |           |           |           |            |
|                       | 554         | 23 x 23 mm |                                 | 245/4       | 259/4       |                                 |           |          |                                 | 245/4     | 259/4     |          |          | 245/0    | 259/0                       |           |           |           |           |            |
|                       | 756         | 27 x 27 mm |                                 |             | 365/4       |                                 |           |          |                                 |           | 365/4     |          |          |          | 365/0                       |           |           |           |           |            |
| 1.0 mm Spacing        |             |            | I/O Count / SERDES              |             |             | I/O Count / SERDES              |           |          | I/O Count / SERDES              |           |           |          |          |          |                             |           |           |           |           |            |
| ftBGA                 | 256         | 17 x 17 mm |                                 |             |             |                                 |           |          |                                 |           |           |          |          |          | 133/4                       | 133/4     |           |           |           |            |
| fpBGA                 | 484         | 23 x 23 mm |                                 |             |             |                                 |           |          |                                 |           |           |          |          |          | 222/4                       | 295/4     | 295/4     | 295/4     |           |            |
|                       | 672         | 27 x 27 mm |                                 |             |             |                                 |           |          |                                 |           |           |          |          |          |                             | 310/4     | 380/8     | 380/8     | 380/8     |            |
|                       | 1156        | 35 x 35 mm |                                 |             |             |                                 |           |          |                                 |           |           |          |          |          |                             |           | 490/12    | 490/12    | 586/16    |            |

# FPGA Products

## iCE40 Series - World's Smallest FPGAs

| Features                   | iCE40 UltraPlus |  | iCE40 UltraLite |       | iCE40 Ultra |       |       | iCE40 LM |       |       | iCE40 LP |       |                    |                    |                    | iCE40 HX           |        |        |
|----------------------------|-----------------|--|-----------------|-------|-------------|-------|-------|----------|-------|-------|----------|-------|--------------------|--------------------|--------------------|--------------------|--------|--------|
| Device                     | UP3K            | UP5K   | UL640           | UL1K  | LP1K        | LP2K  | LP4K  | LM1K     | LM2K  | LM4K  | LP384    | LP640 | LP1K               | LP4K               | LP8K               | HX1K               | HX4K   | HX8K   |
| Logic                      | 2800            | 5280   | 640             | 1248  | 1100        | 2048  | 3520  | 1100     | 2048  | 3520  | 384      | 640   | 1280               | 3520               | 8680               | 1280               | 3520   | 7680   |
| NVCM                       | Yes             | Yes  | Yes             | Yes   | Yes         | Yes   | Yes   | No       | No    | No    | Yes      | Yes   | Yes                | Yes                | Yes                | Yes                | Yes    | Yes    |
| Static Power (µA)          | 75              | 75   | 35              | 35    | 71          | 71    | 71    | 100      | 100   | 100   | 21       | 100   | 100                | 250                | 250                | 296                | 1140   | 1140   |
| EBR                        | 80 kb           | 120 kb   | 56 kb           | 56 kb | 64 kb       | 80 kb | 80 kb | 64 kb    | 80 kb | 80 kb | 0        | 64 kb | 64 kb              | 80 kb              | 128 kb             | 64 k               | 80 k   | 128 k  |
| PLL                        | 1               | 1  | 1               | 1     | 1           | 1     | 1     | 1        | 1     | 1     |          |       | 1                  | 2                  | 2                  | 1                  | 2      | 2      |
| ƆC core                    | 2               | 2  | 2               | 2     | 2           | 2     | 2     | 1        | 2     | 2     |          |       |                    |                    |                    |                    |        |        |
| SPI Core                   | 2               | 2  |                 |       | 2           | 2     | 2     | 1        | 2     | 2     |          |       |                    |                    |                    |                    |        |        |
| Strobe (low)               |                 |  |                 |       |             |       |       | 1        | 1     | 1     |          |       |                    |                    |                    |                    |        |        |
| Strobe (high)              |                 |  |                 |       |             |       |       | 1        | 1     | 1     |          |       |                    |                    |                    |                    |        |        |
| Low Power Oscillator       | 1               | 1  | 1               | 1     | 1           | 1     | 1     |          |       |       |          |       |                    |                    |                    |                    |        |        |
| High Frequency Oscillator  | 1               | 1  | 1               | 1     | 1           | 1     | 1     |          |       |       |          |       |                    |                    |                    |                    |        |        |
| 24 mA Drive                | 3               | 3  | 3               | 3     | 3           | 3     | 3     | 3        | 3     | 3     |          | 3     | 3 <sup>3</sup>     |                    |                    |                    |        |        |
| 100 mA + 400 mA Drive      |                 |  | 1               | 1     |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
| 500 mA Drive               |                 |  |                 |       | 1           | 1     | 1     |          |       |       |          |       |                    |                    |                    |                    |        |        |
| Mult 16 x 16, Accum 32 bit | 4               | 8  |                 |       | 2           | 4     | 4     |          |       |       |          |       |                    |                    |                    |                    |        |        |
| PWM Generator              | Yes             | Yes  | Yes             | Yes   | Yes         | Yes   | No    |          |       |       |          |       |                    |                    |                    |                    |        |        |
| <b>0.35 mm Spacing</b>     |                 | <b>Total I/Os (Dedicated I/Os)<sup>4,5</sup></b> |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
| WLCSP                      | 16              | 1.40 x 1.40 mm                                   |                 |       |             |       |       |          |       |       |          |       | 11(1) <sup>1</sup> | 11(1) <sup>1</sup> |                    |                    |        |        |
|                            | 16              | 1.40 x 1.48 mm                                   |                 | 10    | 10          |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
|                            | 25              | 1.71 x 1.71 mm                                   |                 |       |             |       |       | 20(2)    | 20(2) | 20(2) |          |       |                    |                    |                    |                    |        |        |
|                            | 36              | 2.08 x 2.08 mm                                   |                 |       |             | 27(1) | 27(1) | 27(1)    |       |       |          |       |                    |                    |                    |                    |        |        |
| <b>0.4 mm Spacing</b>      |                 | <b>Total I/Os (Dedicated I/Os)<sup>4,5</sup></b> |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
| WLCSP                      | 30              | 2.15 x 2.55 mm                                   | 21              | 21    |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
|                            | 36              | 2.5 x 2.5 mm                                     |                 |       | 26          | 26    |       |          | 30(2) | 30(2) | 30(2)    | 27(2) |                    | 27(2) <sup>1</sup> |                    |                    |        |        |
| ucBGA                      | 49              | 3 x 3 mm   |                 |       |             |       |       | 39(2)    | 39(2) | 39(2) | 39(2)    |       |                    | 37(2) <sup>1</sup> |                    |                    |        |        |
|                            | 81              | 4 x 4 mm   |                 |       |             |       |       |          |       |       |          |       | 65(2)              | 65(2) <sup>2</sup> | 65(2) <sup>2</sup> |                    |        |        |
|                            | 121             | 5 x 5 mm   |                 |       |             |       |       |          |       |       |          |       | 97(2)              | 95(2)              | 95(2)              |                    |        |        |
|                            | 225             | 7 x 7 mm   |                 |       |             |       |       |          |       |       |          |       | 180(2)             | 180(2)             |                    |                    |        | 180(2) |
| <b>0.5 mm Spacing</b>      |                 | <b>Total I/Os (Dedicated I/Os)<sup>4,5</sup></b> |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
| QFN                        | 32              | 5 x 5 mm   |                 |       |             |       |       |          |       |       | 23(2)    |       |                    |                    |                    |                    |        |        |
|                            | 48              | 7 x 7 mm   |                 | 39    |             |       | 39    | 39       | 39    |       |          |       |                    |                    |                    |                    |        |        |
|                            | 84              | 7 x 7 mm   |                 |       |             |       |       |          |       |       |          |       |                    | 69(2) <sup>1</sup> |                    |                    |        |        |
| csBGA                      | 81              | 5 x 5 mm   |                 |       |             |       |       |          |       |       |          |       |                    | 64(2) <sup>1</sup> |                    |                    |        |        |
|                            | 121             | 6 x 6 mm   |                 |       |             |       |       |          |       |       |          |       |                    | 94(2)              |                    |                    |        |        |
| VQFP                       | 100             | 14 x 14 mm                                       |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    | 97(2)              | 97(2)  | 97(2)  |
| TQFP                       | 144             | 20 x 20 mm                                       |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    | 74(2) <sup>1</sup> |        |        |
|                            |                 |  |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    | 98(2)              | 109(2) |        |
| <b>0.8 mm Spacing</b>      |                 | <b>Total I/Os (Dedicated I/Os)<sup>4,5</sup></b> |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        |        |
| caBGA                      | 121             | 9 x 9 mm   |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        | 95(2)  |
| caBGA                      | 256             | 14 x 14 mm                                       |                 |       |             |       |       |          |       |       |          |       |                    |                    |                    |                    |        | 208(2) |

1) No PLL available on the 16 WLCSP, 36 ucBGA, 81 csBGA, 84 QFN and 100 VQFP packages.

2) Only one PLL available on the 81 ucBGA package.

3) 24 mA constant current sink available on the 16 WLCSP package only.

4) Total I/Os include dedicated I/Os.

5) Dedicated I/Os are defined to be pins that are dedicated and cannot be used by user logic after configuration.

# FPGA Products

## MachXO3 Series - Bridging and I/O Expansion FPGAs

| Features                 |                  | MachXO3LF™                               |                  |               |               |               |                  | MachXO3L™                                |                  |              |              |              |                  |  |
|--------------------------|------------------|--|------------------|---------------|---------------|---------------|------------------|--|------------------|--------------|--------------|--------------|------------------|--|
| Device                   |                  | LCMXO3LF-640                             | LCMXO3LF-1300    | LCMXO3LF-2100 | LCMXO3LF-4300 | LCMXO3LF-6900 | LCMXO3LF-9400    | LCMXO3L-640                              | LCMXO3L-1300     | LCMXO3L-2100 | LCMXO3L-4300 | LCMXO3L-6900 | LCMXO3L-9400     |  |
| LUTs                     |                  | 640                                      | 1300             | 2100          | 4300          | 6900          | 9400             | 640                                      | 1300             | 2100         | 4300         | 6900         | 9400             |  |
| EBR SRAM                 | # of Blocks      | 2  | 7                | 8             | 10            | 26            | 48               | 2  | 7                | 8            | 10           | 26           | 48               |  |
| kbits                    |                  | 18                                       | 64               | 74            | 92            | 240           | 432              | 18                                       | 64               | 74           | 92           | 240          | 432              |  |
| Distrib. RAM             | kbits            | 5  | 10               | 16            | 34            | 54            | 75               | 5  | 10               | 16           | 34           | 54           | 75               |  |
| UFM                      | kbits            | 24                                       | 64               | 80            | 96            | 256           | 456              |  |                  |              |              |              |                  |  |
| Configuration Memory     |                  | Flash                                    |                  |               |               |               |                  | Internal NVM                             |                  |              |              |              |                  |  |
| Dual Boot <sup>4</sup>   |                  | ✓  |                  |               |               |               |                  | ✓  |                  |              |              |              |                  |  |
| Embedded Function Blocks |                  | I <sup>2</sup> C (2), SPI (1), Timer (1) |                  |               |               |               |                  | I <sup>2</sup> C (2), SPI (1), Timer (1) |                  |              |              |              |                  |  |
| Core Vcc                 | 1.2 V            | E  |                  |               |               |               |                  | E  |                  |              |              |              |                  |  |
|                          | 2.5 - 3.3 V      | C  |                  |               |               |               |                  | C  |                  |              |              |              |                  |  |
| Temp.                    | C                | ✓  |                  |               |               |               |                  | ✓  |                  |              |              |              |                  |  |
|                          | I                | ✓  |                  |               |               |               |                  | ✓  |                  |              |              |              |                  |  |
| 0.4 mm Spacing           |                  | I/O Count                                |                  |               |               |               |                  |  |                  |              |              |              |                  |  |
| WLCSP                    | 36 <sup>1</sup>  | 2.5 x 2.5 mm                             | 28               |               |               |               |                  |  | 28               |              |              |              |                  |  |
|                          | 49 <sup>1</sup>  | 3.2 x 3.2 mm                             |                  | 38            |               |               |                  |  |                  | 38           |              |              |                  |  |
|                          | 81 <sup>1</sup>  | 3.8 x 3.8 mm                             |                  |               | 63            |               |                  |  |                  |              | 63           |              |                  |  |
| 0.5 mm Spacing           |                  | I/O Count                                |                  |               |               |               |                  |  |                  |              |              |              |                  |  |
| csfBGA                   | 121 <sup>1</sup> | 6 x 6 mm                                 | 100              |               |               |               |                  |  | 100              |              |              |              |                  |  |
|                          | 256 <sup>1</sup> | 9 x 9 mm                                 | 206              |               |               |               |                  |  | 206              |              |              |              |                  |  |
|                          | 324 <sup>1</sup> | 10 x 10 mm                               | 281              |               |               |               |                  |  | 281              |              |              |              |                  |  |
| 0.8 mm Spacing           |                  | I/O Count                                |                  |               |               |               |                  |  |                  |              |              |              |                  |  |
| caBGA                    | 256              | 14 x 14 mm                               | 206 <sup>2</sup> |               |               |               | 206 <sup>3</sup> |  | 206 <sup>2</sup> |              |              |              | 206 <sup>3</sup> |  |
|                          | 324              | 15 x 15 mm                               | 279 <sup>2</sup> |               |               |               |                  |  | 279 <sup>2</sup> |              |              |              |                  |  |
|                          | 400              | 17 x 17 mm                               | 335 <sup>2</sup> |               |               |               | 335 <sup>3</sup> |  | 335 <sup>2</sup> |              |              |              | 335 <sup>3</sup> |  |
|                          | 484              | 19 x 19 mm                               |                  |               |               |               | 384 <sup>3</sup> |  |                  |              |              |              | 384 <sup>3</sup> |  |

1) Package is only available for E=1.2 V devices.

2) Package is only available for C=2.5 V/3.3 V devices.

3) Package is available for both E=1.2 V and C=2.5 V/3.3 V devices.

4) Dual Boot supported with external boot Flash.

# FPGA Products

## MachXO & LatticeXP Series - Bridging and I/O Expansion FPGAs

| Features                 |  | MachXO2™                                 |              |             |                             |              |             |              |                  | MachXO™        |           |           |           |           |            | LatticeXP2™    |            |            |           |          |           |           |           |   |    |
|--------------------------|--|--|--------------|-------------|-----------------------------|--------------|-------------|--------------|------------------|----------------|-----------|-----------|-----------|-----------|------------|----------------|------------|------------|-----------|----------|-----------|-----------|-----------|---|----|
| Device                   |  | LCMXO2-256                               | LCMXO2-640   | LCMXO2-640U | LCMXO2-1200                 | LCMXO2-1200U | LCMXO2-2000 | LCMXO2-2000U | LCMXO2-4000      | LCMXO2-7000    | LCMXO256E | LCMXO256C | LCMXO640E | LCMXO640C | LCMXO1200E | LCMXO1200C     | LCMXO2280E | LCMXO2280C | LFXP2-5E  | LFXP2-8E | LFXP2-17E | LFXP2-30E | LFXP2-40E |   |    |
| LUTs                     |  | 256                                      | 640          | 640         | 1280                        | 1280         | 2112        | 2112         | 4320             | 6864           | 256       |           | 640       |           | 1200       |                | 2280       |            | 5 k       | 8 k      | 17 k      | 29 k      | 40 k      |   |    |
| EBR SRAM # of Blocks     |  | 0  | 2            | 7           | 7                           | 8            | 8           | 10           | 10               | 26             |           |           |           |           | 1          | 3              |            |            | 9         | 12       | 15        | 21        | 48        |   |    |
| kbits                    |  | 0  | 18           | 64          | 64                          | 74           | 74          | 92           | 92               | 240            |           |           |           |           | 9.2        | 27.6           |            |            | 166       | 221      | 276       | 387       | 885       |   |    |
| Distrib. RAM kbits       |  | 2  | 5            | 5           | 10                          | 10           | 16          | 16           | 34               | 54             | 2         | 6.1       |           |           | 6.4        | 7.7            |            |            | 10        | 18       | 35        | 56        | 83        |   |    |
| UFM kbits                |  | 0  | 24           | 64          | 64                          | 80           | 80          | 96           | 96               | 256            |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| sysDSP™ Blocks           |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            | 3         | 4        | 5         | 7         | 8         |   |    |
| Multipliers              |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            | 12        | 16       | 20        | 28        | 32        |   |    |
| PLL + DLL                |  |  |              |             | 1+2                         |              | 2+2         |              |                  |                |           |           |           |           | 1+0        |                | 2+0        |            | 2+0       |          | 4+0       |           |           |   |    |
| DDR Support              |  |  |              |             | DDR 266, DDR2 266, LPDDR266 |              |             |              |                  |                |           |           |           |           |            |                |            |            | DDR/2 400 |          |           |           |           |   |    |
| Configuration Memory     |  | Internal Flash                           |              |             |                             |              |             |              |                  | Internal Flash |           |           |           |           |            | Internal Flash |            |            |           |          |           |           |           |   |    |
| Dual Boot <sup>4</sup>   |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| Bit-stream Encryption    |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| Embedded Function Blocks |  | I <sup>2</sup> C (2), SPI (1), Timer (1) |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| Core Vcc                 |  | 1.2 V                                    |              | ZE & HE     |                             |              |             |              |                  |                |           | ✓         |           | ✓         |            | ✓              |            | ✓          |           |          |           |           |           | ✓ |    |
| 1.8 - 3.3 V              |  |  |              |             |                             |              |             |              |                  |                |           | ✓         |           | ✓         |            | ✓              |            | ✓          |           |          |           |           |           |   |    |
| 2.5 - 3.3 V              |  |  |              |             | HC                          |              |             |              |                  |                |           |           |           | HC        |            |                |            |            |           |          |           |           |           |   | HC |
| Temp.                    |  | C  |              |             |                             |              | ✓           |              |                  |                |           |           |           |           |            | ✓              |            |            |           |          |           |           | ✓         |   |    |
| I                        |  |  |              |             |                             |              | ✓           |              |                  |                |           |           |           |           | ✓          |                |            |            |           |          |           |           | ✓         |   |    |
| AEC-Q100                 |  |  |              |             |                             |              |             |              |                  |                |           |           | ✓         |           |            |                | ✓          |            |           |          |           | ✓         |           |   |    |
| <b>0.4 mm Spacing</b>    |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| WLCSP                    |  | 25                                       | 2.5 x 2.5 mm |             |                             |              | 18          |              |                  | 18             |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| 49 <sup>2</sup>          |  | 3.2 x 3.2 mm                             |              |             |                             |              |             | 38           |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| ucBGA                    |  | 64                                       | 4 x 4 mm     |             | 44                          |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| <b>0.5 mm Spacing</b>    |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| QFN                      |  | 32                                       | 5 x 5 mm     |             | 21                          |              |             | 21           |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| 48                       |  | 7 x 7 mm                                 |              | 40          | 40                          |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| 84                       |  | 7 x 7 mm                                 |              |             |                             |              |             |              | 68               |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| csBGA                    |  | 100                                      | 8 x 8 mm     |             |                             |              |             |              |                  |                | 78        | 74        |           |           |            |                |            |            |           |          |           |           |           |   |    |
| 132                      |  | 8 x 8 mm                                 |              | 55          | 79                          |              | 104         | 104          | 104              |                |           |           |           |           | 101        |                |            |            |           |          |           |           |           |   |    |
| 184 <sup>1</sup>         |  | 8 x 8 mm                                 |              |             |                             |              |             |              | 150 <sup>1</sup> |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| 132                      |  | 8 x 8 mm                                 |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           | 86        |           |   |    |
| TQFP                     |  | 100                                      | 14 x 14 mm   |             | 55                          | 78           |             | 79           | 79               |                | 78        | 74        |           |           | 73         |                |            |            |           |          |           |           |           |   |    |
| 144                      |  | 20 x 20 mm                               |              |             |                             | 107          | 107         |              | 111              | 114            | 114       |           |           |           | 113        |                |            |            |           |          | 100       |           |           |   |    |
| <b>0.8 mm Spacing</b>    |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| caBGA                    |  | 256                                      | 14 x 14 mm   |             |                             |              |             | 206          |                  | 206            | 206       |           |           | 159       |            | 211            |            |            |           |          |           |           |           |   |    |
| 332                      |  | 17 x 17 mm                               |              |             |                             |              |             |              |                  | 274            | 278       |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| <b>1.0 mm Spacing</b>    |  |  |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           |           |           |   |    |
| ftBGA                    |  | 256                                      | 17 x 17 mm   |             |                             |              | 206         | 206          |                  | 206            | 206       |           |           | 159       |            | 211            |            |            | 172       | 201      |           |           |           |   |    |
| 324                      |  | 19 x 19 mm                               |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                | 271        |            |           |          |           |           |           |   |    |
| fpBGA                    |  | 484                                      | 23 x 23 mm   |             |                             |              |             |              | 278              | 278            | 334       |           |           |           |            |                |            |            |           |          |           | 358       | 363       |   |    |
| 672                      |  | 27 x 27 mm                               |              |             |                             |              |             |              |                  |                |           |           |           |           |            |                |            |            |           |          |           | 472       | 540       |   |    |

1) Contact your Lattice sales representative for the support of the 184-ball csBGA package, available with the HE option only.  
 2) Package is only available for E=1.2 V devices.  
 3) Package is only available for C=2.5 V/3.3 V devices.  
 4) Dual Boot supported with external boot Flash.

# CPLD Products

## ispMACH 4000 Series

| Features                       |                                       |            | ispMACH® 4000ZE                                  |         |                                   |         | ispMACH® 4000V |         |         |         |         |  |
|--------------------------------|---------------------------------------|------------|--|---------|-----------------------------------|---------|----------------|---------|---------|---------|---------|--|
| Parameter                      | 4032ZE                                | 4064ZE     | 4128ZE   | 4256ZE  | 4032                              | 4064    | 4128           | 4256    | 4384    | 4512    |         |  |
| Macrocells                     | 32                                    | 64         | 128  | 256     | 32                                | 64      | 128            | 256     | 384     | 512     |         |  |
| tpd (ns)                       | 4.4                                   | 4.7        | 5.8  | 5.8     | 2.5                               | 2.5     | 2.7            | 3.0     | 3.5     | 3.5     |         |  |
| tco (ns)                       | 3.0                                   | 3.2        | 3.8  | 3.8     | 2.2                               | 2.2     | 2.7            | 2.7     | 2.7     | 2.7     |         |  |
| ts (ns)                        | 2.2                                   | 2.5        | 2.9  | 2.9     | 1.8                               | 1.8     | 1.8            | 2.0     | 2.0     | 2.0     |         |  |
| fMAX (MHz)                     | 260                                   | 241        | 200  | 200     | 400                               | 400     | 333            | 322     | 322     | 322     |         |  |
| Supply Voltage (V)             | ZE=1.8                                |            |  |         | V=3.3                             |         |                |         |         |         |         |  |
| I/O Standard Support           | LVTTTL, LVCMOS3.3/2.5/1.8/1.5, PCI3.3 |            |  |         | LVTTTL, LVCMOS3.3/2.5/1.8, PCI3.3 |         |                |         |         |         |         |  |
| Embedded Oscillator            | ✓                                     | ✓          | ✓  | ✓       |                                   |         |                |         |         |         |         |  |
| 5 V Tolerant I/Os              | ✓                                     | ✓          | ✓  | ✓       | ✓                                 | ✓       | ✓              | ✓       | ✓       | ✓       |         |  |
| Typ. Standby Current (@ 3.3 V) | 10 µA                                 | 11 µA      | 12 µA  | 13 µA   | 11.3 mA                           | 11.5 mA | 11.5 mA        | 12 mA   | 12.5 mA | 13 mA   |         |  |
| Temperature Grades             | C/I                                   | C/I        | C/I  | C/I     | C/I/E/A                           | C/I/E/A | C/I/E/A        | C/I/E   | C/I     | C/I     |         |  |
| <b>0.4 mm Spacing</b>          |                                       |            | <b>I/O Count + Inputs</b>                        |         |                                   |         |                |         |         |         |         |  |
| ucBGA                          | 64                                    | 4 x 4 mm   | 48 + 4   |         |                                   |         |                |         |         |         |         |  |
|                                | 132                                   | 6 x 6 mm   |  | 96 + 4  |                                   |         |                |         |         |         |         |  |
| TQFP                           | 128                                   | 14 x 14 mm |  |         |                                   |         | 92 + 4         |         |         |         |         |  |
| <b>0.5 mm Spacing</b>          |                                       |            | <b>I/O Count + Inputs</b>                        |         |                                   |         |                |         |         |         |         |  |
| TQFP                           | 48                                    | 7 x 7 mm   | 32 + 4   | 32 + 4  |                                   |         | 32 + 4         | 32 + 4  |         |         |         |  |
|                                | 100                                   | 14 x 14 mm |  | 64 + 10 | 64 + 10                           | 64 + 10 |                | 64 + 10 | 64 + 10 |         |         |  |
|                                | 144                                   | 20 x 20 mm |  |         | 96 + 4                            | 96 + 14 |                |         | 96 + 4  | 96 + 14 |         |  |
|                                | 176                                   | 24 x 24 mm |  |         |                                   |         |                |         | 128 + 4 | 128 + 4 | 128 + 4 |  |
| csBGA                          | 64                                    | 5 x 5 mm   | 32 + 4   | 48 + 4  |                                   |         |                |         |         |         |         |  |
|                                | 144                                   | 7 x 7 mm   |  | 64 + 10 | 96 + 4                            | 108 + 4 |                |         |         |         |         |  |
| <b>0.8 mm Spacing</b>          |                                       |            | <b>I/O Count + Inputs</b>                        |         |                                   |         |                |         |         |         |         |  |
| TQFP                           | 44                                    | 10 x 10 mm |  |         |                                   |         | 30 + 2         | 30 + 2  |         |         |         |  |
| <b>1.0 mm Spacing</b>          |                                       |            | <b>Total I/Os (Dedicated I/Os)<sup>4,5</sup></b> |         |                                   |         |                |         |         |         |         |  |
| ftBGA                          | 256                                   | 17 x 17 mm |  |         |                                   |         |                |         | 160 + 4 | 192 + 4 | 208 + 4 |  |

## Power and Thermal Management Products

| Features                        | Power & Thermal Management |                       | Power Management |                  |                 |                |                |
|---------------------------------|----------------------------|-----------------------|------------------|------------------|-----------------|----------------|----------------|
|                                 | L-ASC10                    | LPTM21                | POWR1220AT8      | POWR1014A        | POWR1014        | POWR607        | POWR605        |
| Voltage Monitoring Inputs       | 10                         | 10                    | 12               | 10               | 10              | 6              | 6              |
| Current Monitoring Inputs       | 2                          | 2                     |                  |                  |                 |                |                |
| Temperature Monitoring Inputs   | 2                          | 2                     |                  |                  |                 |                |                |
| Number of Trimming Channels     | 4                          | 4                     | 8                |                  |                 |                |                |
| MOSFET Drives                   | 4                          | 4                     | 4                | 2                | 2               | 2              |                |
| On-Chip Non-Volatile Fault Log  | ✓                          | ✓                     |                  |                  |                 |                |                |
| Number of LUTs                  |                            | 1280                  |                  |                  |                 |                |                |
| Distributed RAM (Kbits)         |                            | 10                    |                  |                  |                 |                |                |
| EBR SRAM (kBits)                |                            | 64                    |                  |                  |                 |                |                |
| Number of EBR Blocks (9 kBits)  |                            | 7                     |                  |                  |                 |                |                |
| Number of PLLs                  |                            | 1                     |                  |                  |                 |                |                |
| Number of Macrocells            |                            |                       | 48               | 24               | 24              | 16             | 16             |
| Communication I/F               | I <sup>2</sup> C           | I <sup>2</sup> C/JTAG | I <sup>2</sup> C | I <sup>2</sup> C |                 |                |                |
| Programming Interface           | I <sup>2</sup> C           | I <sup>2</sup> C/JTAG | JTAG             | JTAG             | JTAG            | JTAG           | JTAG           |
| Operating Voltage               | 3.3                        | 2.8V to 12V           | 3.3V             | 3.3V             | 3.3V            | 3.3V           | 3.3V           |
| In-system Update Support        | ✓                          | ✓                     |                  |                  |                 |                |                |
| Temp.                           | I                          | ✓                     | ✓                | ✓                | ✓               | ✓              | ✓              |
|                                 | AEC-Q100                   |                       |                  | ✓                | ✓               |                |                |
| Package Options                 |                            | Digital I/Os          |                  |                  |                 |                |                |
| 48-pin QFN (7 x 7)              | 9 <sup>5</sup>             |                       |                  |                  |                 |                |                |
| 237-Ball ftBGA (1 mm) (17 x 17) |                            | 95 + 10 <sup>4</sup>  |                  |                  |                 |                |                |
| 100-pin TQFP (14 x 14)          |                            |                       | 22 <sup>1</sup>  |                  |                 |                |                |
| 48-pin TQFP (7 x 7)             |                            |                       |                  | 16 <sup>2</sup>  | 16 <sup>2</sup> |                |                |
| 32-pin QFN (5 x 5)              |                            |                       |                  |                  |                 | 7 <sup>3</sup> |                |
| 24-pin QFN (4 x 4)              |                            |                       |                  |                  |                 | 7 <sup>3</sup> | 7 <sup>3</sup> |

- 1) POWR1220AT8 provides 6 (5V Tolerant) Digital inputs and 16 (5V Tolerant) Open-drain Digital Outputs
- 2) POWR1014 & PWOR1014A provide 4 (5V Tolerant ) Digital inputs and 12 (5V Tolerant ) Open-drain Digital Outputs
- 3) POWR607 & PWOR605 provide 2 (5V Tolerant ) Digital inputs and 5 (5V Tolerant ) Open Drain I/O
- 4) LPTM21 provide 95 (3.3V Tolerant ) Logic I/Os 10 (5V tolerant) open-drain I/Os
- 5) 5V Tolerant Open Drain I/O

# IP Cores and Reference Designs

## IP Cores

Lattice IP Cores are pre-tested, reusable functions, that allow designers to focus on their unique system architectures. These IP cores provide industry-standard functions such as PCI Express, DDR, Ethernet, CPRI, and embedded microprocessors. In addition, a number of independent IP providers have teamed with Lattice to offer additional high quality, reusable IP cores. Partners are selected for their industry leadership, high development standards, and commitment to customer support. For a complete listing of IP cores from Lattice and its 3rd party partners, please go to [latticesemi.com/IP](http://latticesemi.com/IP). Note that a Diamond Subscription License and the IP license are required to use the IPs for production.

|                                 | IP Core   | CrossLink            | iCE40 UltraPlus | ECP5/ ECP5-5G  | ECP3           | ECP2/M         | ECP2           | MachXO2        | MachXO | XP2            |
|---------------------------------|---|----------------------|-----------------|----------------|----------------|----------------|----------------|----------------|--------|----------------|
| Communications                  | 10 Gigabit Ethernet MAC                                     |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        |                |
|                                 | 2.5 Gb Ethernet MAC   |                      |                 | ✓              | ✓              |                |                |                |        |                |
|                                 | 2.5 Gb Ethernet PCS   |                      |                 |                | ✓ <sup>1</sup> |                |                |                |        |                |
|                                 | CPRI  |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> |                |                |        |                |
|                                 | SGMII and Gigabit Ethernet PCS                              |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> |                |                |        |                |
|                                 | Triple Speed 10/100/1G Ethernet MAC                         |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | XAU1  |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> |                |                |        |                |
| Connectivity                    | PCI Express x1 Endpoint                                     |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> |                |                |        |                |
|                                 | PCI Express x2 Endpoint                                     |                      |                 | ✓              |                |                |                |                |        |                |
|                                 | PCI Express x4 Endpoint                                     |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> |                |                |        |                |
|                                 | PCI Express Root Complex Lite X1                            |                      |                 | ✓              | ✓              |                |                |                |        |                |
|                                 | PCI Express Root Complex Lite X4                            |                      |                 | ✓              | ✓              |                |                |                |        |                |
|                                 | PIPE  |                      |                 |                | ✓              |                |                |                |        |                |
|                                 | PCI Master/Target 33  |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓              | ✓      | ✓              |
|                                 | PCI Master/Target 66  |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | PCI Target 33   |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓              | ✓      | ✓              |
|                                 | PCI Target 66   |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                | ✓      | ✓              |
|                                 | Tri-Rate Serial Digital Interface (SDI) PHY                 |                      |                 |                | ✓              |                |                |                |        |                |
|                                 | JESD204A  |                      |                 |                | ✓              |                |                |                |        |                |
|                                 | JESD204B  |                      |                 | ✓              | ✓              |                |                |                |        |                |
| JESD207                         |   |                      | ✓ <sup>1</sup>  | ✓              |                |                |                |                |        |                |
| Digital Signal Processing       | Block Convolutional Encoder                                 |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | Block Viterbi Decoder                                       |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | Cascaded Integrator-Comb (CIC) Filter                       |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | CORDIC  |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | Distributed Arithmetic (DA) FIR Filter                      |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | Divider   |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | Dynamic Block Reed-Solomon Decoder                          |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | FFT Compiler  |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | FIR Filter Generator  |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | Interleaver/De-interleaver                                  |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | Median Filter   |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | Numerically-Controlled Oscillator (NCO)                     |                      |                 |                | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | Peak Cancellation Crest Factor Reduction (CFR)              |                      |                 | ✓              | ✓              |                |                |                |        |                |
|                                 | Processor, Controller & Peripheral                          | DDR SDRAM Controller |                 |                |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |        |                |
| DDR SDRAM Controller Pipelined  |   |                      |                 |                |                |                |                | ✓              |        |                |
| DDR2 SDRAM Controller           |   |                      |                 | ✓ <sup>1</sup> | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
| DDR2 SDRAM Controller Pipelined |   |                      |                 |                |                |                |                | ✓              |        |                |
| DDR3 SDRAM Controller           |   |                      |                 | ✓              | ✓              |                |                |                |        |                |
| DDR3 SDRAM PHY                  |   |                      |                 | ✓              | ✓              |                |                |                |        |                |
| LPDDR SDRAM Controller          |   |                      |                 |                |                |                |                | ✓              |        |                |
| LPDDR3 SDRAM Controller         |   |                      |                 | ✓              |                |                |                |                |        |                |
| sensAI Functions                | Scatter Gather DMA  |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | CNN Accelerator IP  |                      |                 | ✓              |                |                |                |                |        |                |
| Video & Imaging                 | BNN Accelerator IP  |                      | ✓               |                |                |                |                |                |        |                |
|                                 | 1:2 MIPI DSI Display Interface Bridge                       | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | 2:1 MIPI CSI-2 Aggregator Bridge                            | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | 2:2 MIPI DSI Display Interface Bridge                       | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | 2D Edge Detector  |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | 2D FIR Filter   |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | 2D Scaler   |                      |                 | ✓ <sup>1</sup> | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | Color Space Converter                                       |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓              |        | ✓              |
|                                 | CMOS to MIPI CSI-2 Interface Bridge                         | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | Deinterlacer  |                      |                 | ✓ <sup>1</sup> | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | Display Interface Mux                                       |                      |                 |                |                |                |                | ✓ <sup>1</sup> |        |                |
|                                 | DVB-ASI   |                      |                 |                | ✓              |                |                |                |        |                |
|                                 | Gamma Corrector   |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓              |
|                                 | Median Filter   |                      |                 |                | ✓ <sup>1</sup> | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |
|                                 | MIPI DSI to MIPI DSI  | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | MIPI DSI to OpenLDI LVDS Display Interface Bridge           | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | MIPI DSI to RGB Display Interface Bridge                    | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | Open LDI/FPD-Link/LVDS to MIPI DSI Display Interface Bridge | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | RGB to MIPI DSI Display Interface Bridge                    | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | SubLVDS to MIPI CSI-2 Image Sensor Bridge                   | ✓                    |                 |                |                |                |                |                |        |                |
|                                 | Video Frame Buffer  |                      |                 | ✓              | ✓              | ✓ <sup>1</sup> | ✓ <sup>1</sup> |                |        | ✓ <sup>1</sup> |

1) Contact Lattice for version support information.

# IP Cores and Reference Designs

Lattice IP Suites provide many of the IP cores required to develop a total solution for common FPGA applications. In addition, multiple Lattice FPGA families are supported with each IP Suite, so designers can develop solutions across multiple Lattice families, taking advantage of the best features of each. The following table summarizes which IP cores are included in each IP Suite, and which FPGA families are supported.

|  | IP Core                                     | ECP5/<br>ECP5-5G | Lattice<br>ECP3 | Lattice<br>ECP2M | Lattice<br>ECP2 | Mach<br>XO2 | Mach<br>XO | Lattice<br>XP2 | Suite<br>(One Year<br>Subscription) | Annual License<br>Renewal<br>(After First Year) |
|--|---|------------------|-----------------|------------------|-----------------|-------------|------------|----------------|-------------------------------------|---|
| Value Suite                                  | DDR SDRAM Controller                        |                  | ✓               | ✓                | ✓               |             |            | ✓              | Order #:<br>DS-VAL-ST-U1            | Order #:<br>DS-VAL-ST-UR1                       |
|  | DDR2 SDRAM Controller                       | ✓ <sup>1</sup>   | ✓               | ✓                | ✓               | ✓           |            | ✓              |                                     |   |
|  | DDR3 SDRAM Controller                       | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|  | LPDDR SDRAM Controller                      |                  |                 |                  |                 | ✓           |            |                |                                     |   |
|  | LPDDR3 SDRAM Controller                     | ✓                |                 |                  |                 |             |            |                |                                     |   |
|  | FIR Filter Generator                        |                  | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | Triple Speed Ethernet MAC                   | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
| PCI Express Suite                            | PCI Express x1 Endpoint                     | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                | Order #:<br>DS-PCIE-ST-U1           | Order #:<br>DS-PCIE-ST-UR1                      |
|  | PCI Express x2 Endpoint                     | ✓                |                 |                  |                 |             |            |                |                                     |   |
|  | PCI Express x4 Endpoint                     | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|  | PCIe Root Complex Lite x1                   | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|  | PCIe Root Complex Lite x4                   | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|  | Scatter Gather DMA                          | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | PCI Master/Target 33                        |                  | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  | ✓           | ✓          | ✓              |                                     |   |
|  | PCI Master/Target 66                        |                  | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | PCI Target 33                               |                  | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  | ✓           | ✓          | ✓              |                                     |   |
|  | PCI Target 66                               |                  | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             | ✓          | ✓              |                                     |   |
|  | DDR SDRAM Controller                        |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | DDR2 SDRAM Controller                       | ✓ <sup>1</sup>   | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | DDR3 SDRAM Controller                       | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|  | LPDDR SDRAM Controller                      |                  |                 |                  |                 | ✓           |            |                |                                     |   |
| LPDDR3 SDRAM Controller                      | ✓   |                  |                 |                  |                 |             |            |                |                                     |   |
| Ethernet Suite                               | 10 Gigabit Ethernet MAC                     | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            |                | Order #:<br>DS-ETH-ST-U1            | Order #:<br>DS-ETH-ST-UR1                       |
|  | SGMII and Gigabit Ethernet PCS              | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|  | Triple Speed 10/100/1G Ethernet MAC         | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | XAUI  | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|  | Scatter Gather DMA                          | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | DDR SDRAM Controller                        |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | DDR2 SDRAM Controller                       | ✓ <sup>1</sup>   | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
| DDR3 SDRAM Controller                        | ✓   | ✓                |                 |                  |                 |             |            |                |                                     |   |
| Digital Signal Processing (DSP) Design Suite | Block Convolutional Encoder                 |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> | Order #:<br>DS-DSP-ST-U1            | Order #:<br>DS-DSP-ST-UR1                       |
|  | Block Viterbi Decoder                       |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | Cascaded Integrator-Comb (CIC) Filter       |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | CORDIC                                      |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | Distributed Arithmetic (DA) FIR Filter      |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | Dynamic Block Reed-Solomon Decoder          |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | FFT Compiler                                |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | FIR Filter Generator                        |                  | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | Interleaver/De-Interleaver                  |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
| Numerically Controlled Oscillators (NCO)     |   | ✓                | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   |                 |             | ✓          |                |                                     |   |
| Video and Display Suite                      | 2D Edge Detector                            |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> | Order #:<br>DS-VDS-ST-U1            | Order #:<br>DS-VDS-ST-UR1                       |
|  | 2D FIR Filter                               |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | 2D Scaler                                   | ✓ <sup>1</sup>   | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | Color Space Converter                       | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  | ✓           |            | ✓              |                                     |   |
|  | Deinterlacer                                | ✓ <sup>1</sup>   | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|  | Median Filter                               |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | DVB-ASI                                     |                  | ✓               |                  |                 |             |            |                |                                     |   |
|  | Tri-rate Serial Digital Interface (SDI) PHY | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|  | DDR SDRAM Controller                        |                  | ✓ <sup>1</sup>  | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓ <sup>1</sup> |                                     |   |
|  | DDR2 SDRAM Controller                       | ✓ <sup>1</sup>   | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
| DDR3 SDRAM Controller                        | ✓   | ✓                |                 |                  |                 |             |            |                |                                     |   |

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# IP Cores and Reference Designs

|                          | IP Core                             | ECP5/<br>ECP5-5G | Lattice<br>ECP3 | Lattice<br>ECP2M | Lattice<br>ECP2 | Mach<br>XO2 | Mach<br>XO | Lattice<br>XP2 | Suite<br>(One Year<br>Subscription) | Annual License<br>Renewal<br>(After First Year) |
|--------------------------|-------------------------------------|------------------|-----------------|------------------|-----------------|-------------|------------|----------------|-------------------------------------|---|
| Connectivity<br>IP Suite | DDR3 SDRAM Controller               | ✓                | ✓               |                  |                 |             |            |                | Order #:<br>DS-CONN-ST-U            | Order #:<br>DS-CONN-ST-UR                       |
|                          | LPDDR3 SDRAM Controller             | ✓                |                 |                  |                 |             |            |                |                                     |   |
|                          | PCI Express x1 Endpoint             | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|                          | PCI Express x2 Endpoint             | ✓                |                 |                  |                 |             |            |                |                                     |   |
|                          | PCI Express x4 Endpoint             | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|                          | PCIe Root Complex Lite x1           | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|                          | PCIe Root Complex Lite x4           | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|                          | 10 Gigabit Ethernet MAC             | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            |                |                                     |   |
|                          | SGMII and Gigabit Ethernet PCS      | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|                          | Triple Speed 10/100/1G Ethernet MAC | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|                          | XAUI                                | ✓                | ✓               | ✓ <sup>1</sup>   |                 |             |            |                |                                     |   |
|                          | Scatter Gather DMA                  | ✓                | ✓               | ✓ <sup>1</sup>   | ✓ <sup>1</sup>  |             |            | ✓              |                                     |   |
|                          | CPRI                                | ✓                | ✓               | ✓                |                 |             |            |                |                                     |   |
|                          | JESD204B                            | ✓                | ✓               |                  |                 |             |            |                |                                     |   |
|                          | DDR3 PHY                            | ✓                | ✓               |                  |                 |             |            |                |                                     |   |

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# IP Cores and Reference Designs

## Reference Designs

Lattice Reference Designs are reusable as-is codes that allow designers to quickly build their unique applications. These reference designs provide functions such as 7:1 LVDS, Barcode Emulation, Sensor Interfacing & Preprocessing, I<sup>2</sup>C, SPI, and MIPI solutions. For a complete listing of reference designs from Lattice, please go to [latticesemi.com/IP](http://latticesemi.com/IP).

| Name   | Reference Design No. | ECP5/<br>ECP5-5G | Lattice<br>ECP3 | Mach<br>XO3 | Mach<br>XO2 | Mach<br>XO | Lattice<br>XP2 | iCE40<br>LP/HX/LM | iCE40<br>Ultra | iCE40<br>UltraPlus | Format  |      |
|--|----------------------|------------------|-----------------|-------------|-------------|------------|----------------|-------------------|----------------|--------------------|---------|------|
|  |                      |                  |                 |             |             |            |                |                   |                |                    | Verilog | VHDL |
| 7:1 LVDS Video Interface   | RD1030               | ✓                | ✓               |             | ✓           |            | ✓              |                   |                |                    | ✓       | ✓    |
| 8:1 Microphone Aggregation   | UG-02035             |                  |                 |             |             |            |                |                   |                | ✓                  |         |      |
| 8b/10b Encoder/Decoder   | RD1012               | ✓                | ✓               | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| ADC Interface  | RD1089               |                  | ✓               |             |             |            |                |                   |                |                    | ✓       | ✓    |
| Audio Interface Bridging   | UG-02008             |                  |                 |             |             |            |                |                   |                | ✓                  |         |      |
| BSCAN - Multiple Boundary Scan Port<br>Addressable Buffer (BSCAN1)                       | RD1001               |                  |                 |             | ✓           | ✓          | ✓              |                   |                |                    |         |      |
| BSCAN - Multiple Boundary Scan Port Linker<br>(BSCAN 2)                                  | RD1002               | ✓                |                 |             | ✓           | ✓          | ✓              |                   |                |                    |         |      |
| Controller Area Network (CAN) Controller   | RD1170               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| Face Detection Using BNN Accelerator IP  | FPGA-RD-02034        |                  |                 |             |             |            |                |                   |                | ✓                  | ✓       |      |
| Face Tracking Using CNN Accelerator IP   | FPGA-RD-02037        | ✓                |                 |             |             |            |                |                   |                |                    | ✓       |      |
| FPGA Loader  | AN8077               |                  |                 |             | ✓           | ✓          | ✓              |                   |                |                    |         |      |
| GPIO Expander  | RD1065               |                  | ✓               |             |             | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| Graphics Acceleration  | UG-02026             |                  |                 |             |             |            |                |                   |                | ✓                  |         |      |
| HDMI/DVI Interface   | RD1097               | ✓                | ✓               |             |             |            |                |                   |                |                    | ✓       | ✓    |
| HiSPi-to-Parallel Sensor Bridge  | RD1120               | ✓                | ✓               | ✓           | ✓           |            | ✓              |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C Bus Controller for Serial EEPROM  | RD1006               | ✓                | ✓               | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C Master Controller   | RD1005               | ✓                | ✓               | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C Master Controller   | RD1139               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| I <sup>2</sup> C Master with WISHBONE Controller   | RD1046               | ✓                | ✓               | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C Slave Controller  | RD1140               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| I <sup>2</sup> C Slave Peripheral Using Embedded Function<br>Block - WISHBONE Compatible | RD1124               |                  |                 | ✓           | ✓           |            |                |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C Slave to SPI Master Bridge  | RD1094               |                  |                 |             |             | ✓          |                |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C Slave/Peripheral  | RD1054               | ✓                | ✓               |             |             | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> C to SPI Bridge   | RD1172               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       | ✓    |
| I <sup>2</sup> S Controller  | RD1101               |                  |                 | ✓           | ✓           | ✓          |                |                   |                |                    | ✓       | ✓    |
| I <sup>2</sup> S Controller  | RD1171               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       | ✓    |
| I3C Host/Device  |                      |                  |                 |             |             |            |                |                   |                | ✓                  |         |      |
| iCE40 Ultra Barcode Emulation Reference<br>Design  | UG73                 |                  |                 |             |             |            |                |                   | ✓              | ✓                  | ✓       |      |
| iCE40 Ultra Pedometer  | UG76                 |                  |                 |             |             |            |                |                   | ✓              | ✓                  | ✓       |      |
| iCE40 Ultra RGB LED Controller   | UG75                 |                  |                 |             |             |            |                |                   | ✓              | ✓                  | ✓       |      |
| iCE40 Ultra Self-Learning IR Remote  | UG74                 |                  |                 |             |             |            |                |                   | ✓              | ✓                  | ✓       |      |
| iCE40LM Barcode Emulation  | RD1191               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| iCE40LM Phillips IR Rx   | RD1192               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| iCE40LM Sensor Interfacing and Preprocessing   | RD1189               |                  |                 |             |             |            |                | ✓                 | ✓              | ✓                  | ✓       |      |
| iCE40LM Sony IR Tx Reference Design  | RD1190               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| Key Phrase Detection Using BNN Accelerator IP  | FPGA-RD-02033        |                  |                 |             |             |            |                |                   |                | ✓                  | ✓       |      |
| Keypad Scanner   | RD1180               |                  |                 |             |             |            |                | ✓                 |                |                    |         | ✓    |
| LatticeMico32 - Embedded Processor -<br>WISHBONE Compatible                              |                      | ✓                | ✓               | ✓           | ✓           |            | ✓              |                   |                |                    | ✓       | ✓    |
| LatticeMico8 - Embedded Processor -<br>WISHBONE Compatible                               |                      | ✓                | ✓               | ✓           | ✓           |            | ✓              |                   |                |                    | ✓       | ✓    |
| LatticeMico8 Microcontroller User's Guide  | RD1026               |                  |                 | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| LatticeMico8 to WISHBONE Interface Adapter   | RD1043               |                  |                 |             |             | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| LED/OLED Driver  | RD1103               |                  |                 | ✓           | ✓           | ✓          |                |                   |                |                    | ✓       |      |
| LPC Bus Controller   | RD1049               |                  | ✓               |             | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| MachXO2 Display Interface  | RD1093               |                  |                 |             | ✓           |            |                |                   |                |                    | ✓       | ✓    |
| MachXO2 I <sup>2</sup> C Embedded Programming Access<br>Firmware - WISHBONE Compatible   | RD1129               |                  |                 |             | ✓           |            |                |                   |                |                    | ✓       |      |
| MachXO2 Soft I <sup>2</sup> C Slave<br>with Clock Stretching - WISHBONE Compatible       | RD1186               |                  |                 |             | ✓           |            |                |                   |                |                    | ✓       |      |
| MDIO Peripheral - WISHBONE Compatible  | RD1074               |                  | ✓               |             |             | ✓          |                |                   |                |                    | ✓       | ✓    |
| MIPI CSI-2-to-CMOS Parallel Sensor Bridge  | RD1146               |                  |                 | ✓           | ✓           |            |                |                   |                |                    | ✓       |      |
| MIPI DPHY Interface IP   | RD1182               | ✓                | ✓               | ✓           | ✓           |            |                |                   |                |                    | ✓       |      |
| MIPI DSI RX to Parallel Bridge   | RD1185               |                  |                 | ✓           | ✓           |            |                |                   |                |                    | ✓       |      |
| MxN Channel PWM  | RD1175               |                  |                 |             |             |            |                | ✓                 |                |                    |         | ✓    |
| NAND Flash Controller  | RD1055               |                  |                 |             | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |

Continued on next page

# IP Cores and Reference Designs

| Name   | Reference Design No. | ECP5/<br>ECP5-5G | Lattice<br>ECP3 | Mach<br>XO3 | Mach<br>XO2 | Mach<br>XO | Lattice<br>XP2 | iCE40<br>LP/HX/LM | iCE40<br>Ultra | iCE40<br>UltraPlus | Format  |      |
|--|----------------------|------------------|-----------------|-------------|-------------|------------|----------------|-------------------|----------------|--------------------|---------|------|
|  |                      |                  |                 |             |             |            |                |                   |                |                    | Verilog | VHDL |
| Object Counting Using CNN Accelerator IP                                     | FPGA-RD-02036        | ✓                |                 |             |             |            |                |                   |                |                    | ✓       |      |
| Panasonic Area Sensor-to-Parallel Bridge                                     | RD1121               |                  |                 |             | ✓           |            | ✓              |                   |                |                    | ✓       |      |
| Parallel to MIPI CSI-2 TX Bridge   | RD1183               |                  |                 | ✓           | ✓           |            |                |                   |                |                    | ✓       |      |
| Parallel to MIPI DSI TX Bridge   | RD1184               |                  |                 | ✓           | ✓           |            |                |                   |                |                    | ✓       |      |
| PCI Target 32 bit/33 MHz   | RD1008               |                  | ✓               |             | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| PCI/WISHBONE Bridge - WISHBONE Compatible                                    | RD1045               |                  | ✓               |             |             | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| PWM Fan Controller - WISHBONE Compatible                                     | RD1060               |                  |                 | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| PWM Generator  | RD1178               |                  |                 |             |             |            |                | ✓                 |                |                    |         | ✓    |
| RAM-Type Interface for Embedded User Flash Memory - WISHBONE Compatible      | RD1126               |                  |                 |             | ✓           |            |                |                   |                |                    |         |      |
| RC4 Based PRNG Generator   | RD1179               |                  |                 |             |             |            |                | ✓                 |                |                    |         | ✓    |
| Read and Write Usercode  | RD1041               |                  |                 | ✓           | ✓           | ✓          |                |                   |                |                    | ✓       | ✓    |
| RGMII to GMII Bridge   | RD1022               | ✓                | ✓               |             |             |            |                |                   |                |                    | ✓       | ✓    |
| Sensor Data Buffer   | UG-02011             |                  |                 |             |             |            |                |                   |                | ✓                  |         |      |
| SD Flash Controller - WISHBONE Compatible                                    | RD1048               |                  |                 |             |             | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| SD Host Controller   | RD1165               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       | ✓    |
| SDR SDRAM Controller   | RD1174               |                  |                 | ✓           |             |            |                | ✓                 |                |                    | ✓       |      |
| SDR SDRAM Controller – Advanced  | RD1010               | ✓                | ✓               |             | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| Simple Sigma-Delta ADC   | RD1066               |                  |                 |             | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| SMPTE SDI Dual HD from/to 3G Level-B Converter                               | RD1132               |                  | ✓               |             |             |            |                |                   |                |                    | ✓       |      |
| Speed Sign Detection Using CNN Accelerator IP                                | FPGA-RD-02035        | ✓                |                 |             |             |            |                |                   |                |                    | ✓       |      |
| SPI Master Controller  | RD1141               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| SPI Peripheral   | RD1075               |                  |                 |             |             | ✓          |                |                   |                |                    | ✓       | ✓    |
| SPI Slave Controller   | RD1142               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       | ✓    |
| SPI Slave Peripheral Using the Embedded Function Block - WISHBONE Compatible | RD1125               |                  |                 | ✓           | ✓           |            |                |                   |                |                    | ✓       | ✓    |
| SPI Slave Port Expander  | RD1168               |                  |                 |             |             |            |                | ✓                 |                |                    |         | ✓    |
| SPI to I <sup>2</sup> C Bridge   | RD1173               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |
| SPI to MIPI-DSI Bridge   |                      |                  |                 |             |             |            |                |                   |                | ✓                  |         |      |
| SPI to UART Expander   | RD1143               |                  |                 |             |             |            |                | ✓                 |                |                    |         | ✓    |
| SPI Wishbone Compatible  | RD1044               |                  |                 | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| Sub-LVDS Serial to CMOS Parallel Sensor Bridge                               | RD1130               |                  |                 |             | ✓           |            |                |                   |                |                    | ✓       |      |
| Sub-LVDS-to-Parallel Sensor Bridge   | RD1122               | ✓                | ✓               |             | ✓           |            | ✓              |                   |                |                    | ✓       | ✓    |
| UART - WISHBONE Compatible   | RD1042               |                  |                 | ✓           | ✓           | ✓          | ✓              |                   |                |                    | ✓       | ✓    |
| UART (Universal Asynchronous Receiver/ Transmitter)                          | RD1011               |                  |                 |             |             | ✓          | ✓              |                   |                |                    |         | ✓    |
| UART 16550 Transceiver   | RD1138               |                  |                 |             |             |            |                | ✓                 |                |                    | ✓       |      |

## ispMACH 4000 Reference Designs

| Name   | Reference Design Number | WISHBONE Compatible | Format  |      |          |
|--|-------------------------|---------------------|---------|------|----------|
|  |                         |                     | Verilog | VHDL | BLIF NGO |
| 8b/10b Encoder/Decoder   | RD1012                  |                     |         |      | ✓        |
| GPIO Expander  | RD1065                  |                     | ✓       | ✓    |          |
| I <sup>2</sup> C Bus Controller for Serial EEPROMs             | RD1006                  | ✓                   | ✓       |      | ✓        |
| I <sup>2</sup> C (Inter-Integrated Circuit) Bus Master         | RD1005                  | ✓                   |         |      | ✓        |
| I <sup>2</sup> C (Inter-Integrated Circuit) Slave / Peripheral | RD1054                  | ✓                   |         |      |          |
| LPC (Low Pin Count) Bus Controller                             | RD1049                  | ✓                   | ✓       |      | ✓        |
| Multiple Scan Port Addressable Buffer (BSCAN1)                 | RD1001                  | ✓                   |         |      |          |
| Multiple Scan Port Linker (BSCAN 2)                            | RD1002                  |                     |         |      | ✓        |
| PCI Target 32 bit/33 MHz                                       | RD1008                  |                     | ✓       | ✓    |          |
| PWM Fan Controller   | RD1060                  |                     | ✓       | ✓    |          |
| Read and Write Usercode  | RD1041                  |                     | ✓       | ✓    |          |
| SDR SDRAM Controller - Advanced                                | RD1010                  | ✓                   | ✓       |      | ✓        |
| SPI GPIO Expander  | RD1073                  |                     | ✓       |      |          |
| SPI Controller - WISHBONE Compatible                           | RD1044                  | ✓                   | ✓       | ✓    |          |
| SPI (Serial Peripheral Interface) Peripheral                   | RD1075                  | ✓                   | ✓       |      | ✓        |
| UART (Universal Asynchronous Receiver/ Transmitter)            | RD1011                  | ✓                   |         |      |          |

## IP Cores and Reference Designs

Hardware Management IPs, that are integrated in the Platform Designer tool, simplify implementation of functions, such as Fault Logging, Fan Controller and PMBus Controller through a simple GUI interface.

Lattice Reference Designs are reusable as-is codes that allow designers to quickly build their unique applications. These reference designs provide functions such as I<sup>2</sup>C, SPI, BSCAN and LPC Bus Controller interface solutions. For a complete listing of reference designs from Lattice, please go to [latticesemi.com/IP](http://latticesemi.com/IP).

### Hardware Management IPs

| IP Core                  | MachXO2+<br>L-ASC10 | PLATFORM<br>MANAGER 2 | Format |         |             |                |
|--------------------------|---------------------|-----------------------|--------|---------|-------------|----------------|
|                          |                     |                       | VHDL   | Verilog | LogiBuilder | Analog Circuit |
| Fault Logging            | ✓                   | ✓                     | ✓      | ✓       |             |                |
| Hot Swap Controller      | ✓                   | ✓                     | ✓      | ✓       |             | ✓              |
| Fan Controller           | ✓                   | ✓                     | ✓      | ✓       |             |                |
| PMBus Controller         | ✓                   |                       | ✓      | ✓       | ✓           |                |
| Trim & Margin            | ✓                   | ✓                     |        |         |             | ✓              |
| Power & Reset Sequencing | ✓                   | ✓                     | ✓      | ✓       | ✓           |                |
| Voltage Scaling & VID    | ✓                   | ✓                     | ✓      | ✓       |             | ✓              |

### Hardware Management Reference Designs

| Name  | Reference<br>Design No. | MachXO2+<br>L-ASC10 | PLATFORM<br>MANAGER 2 | Format |         |
|---|-------------------------|---------------------|-----------------------|--------|---------|
|   |                         |                     |                       | VHDL   | Verilog |
| BSCAN - Multiple Boundary Scan Port Addressable Buffer (BSCAN1) | RD1001                  | ✓                   | ✓                     | ✓      | ✓       |
| BSCAN - Multiple Boundary Scan Port Linker (BSCAN 2)            | RD1002                  | ✓                   | ✓                     | ✓      | ✓       |
| FPGA Loader   | AN8077                  | ✓                   | ✓                     | ✓      | ✓       |
| I <sup>2</sup> C Bus Controller for Serial EEPROM               | RD1006                  | ✓                   | ✓                     | ✓      | ✓       |
| I <sup>2</sup> C Master Controller                              | RD1005                  | ✓                   | ✓                     | ✓      | ✓       |
| I <sup>2</sup> C Slave Peripheral Using Embedded Function Block | RD1124                  | ✓                   | ✓                     | ✓      | ✓       |
| I2S Controller  | RD1101                  | ✓                   | ✓                     | ✓      | ✓       |
| LPC Bus Controller  | RD1049                  | ✓                   | ✓                     | ✓      | ✓       |
| MachXO2 I <sup>2</sup> C Embedded Programming Access Firmware   | RD1129                  | ✓                   | ✓                     | ✓      | ✓       |
| MachXO2 Soft I <sup>2</sup> C Slave with Clock Stretching       | RD1186                  | ✓                   | ✓                     | ✓      | ✓       |
| NAND Flash Controller   | RD1055                  | ✓                   | ✓                     | ✓      | ✓       |
| PWM Fan Controller  | RD1060                  | ✓                   | ✓                     | ✓      | ✓       |
| RAM-Type Interface for Embedded User Flash Memory               | RD1126                  | ✓                   | ✓                     | ✓      | ✓       |
| Read and Write Usercode   | RD1041                  | ✓                   | ✓                     | ✓      | ✓       |

## CrossLink LIF-MD6000 Master Link Board

Enables designers to streamline development process and evaluate key connectivity features of the CrossLink FPGA.



### Features

- Contains the Lattice CrossLink LIF-MD6000 in 81-ball csfBGA package
- Contains four connectors for interfacing to MIPI D-PHY and high speed programmable I/Os
- Includes 0.1" header board, SMA board and LEDs for interfacing and control
- Provides easy programming interface via USB with FTDI device

### Ordering Part Number

LIF-MD6000-ML-EVN

## CrossLink LIF-MD6000 I/O Link Boards

Allows designers to easily interface to the LIF-MD6000 Master Link Board from a variety of signal sources and sinks using standard SMA connectors.



### Features

- I/O Link Boards for use with Lattice LIF-MD6000 Master Link Board for SMA or low speed peripheral connections
- Contains one SMA board and one 0.1" header board

### Ordering Part Number

LIFMD-IOL-EVN

## CrossLink LIF-MD6000 Raspberry Pi Boards

Allows designers to easily interface to the LIF-MD6000 Master Link Board from a Raspberry Pi and/or a Raspberry Pi camera.



### Features

- LIF-MD6000 Raspberry Pi Boards for use with LIF-MD6000 Master Link Board and Raspberry Pi 2
- Contains one Raspberry Pi Camera Link Board and one Raspberry Pi AP Link Board

- Raspberry Pi Camera Link Board has connectors to interface to two Raspberry Pi cameras

### Ordering Part Number

LIFMD-RPI-EVN

## iCE40 UltraPlus Mobile Development Platform

Enables designers to evaluate key connectivity features of the iCE40 UltraPlus FPGA as well as processing features utilizing multiple DSPs, integrated RAM, and FPGA fabric.



### Features

- x1 MIPI DSI interface up to 108 Mbps
- 4x Microphone bridging (2x I2S mics and 2x PDM mics)
- Compass sensor (LSM303), pressure sensor (BMP180), gyro sensor (LSM330), and accelerometer (LIS2D12)
- 640 x 480 Image sensor (OVM7692)
- BLE module to transfer any captured data from iCE40 UltraPlus wirelessly
- iCE40 UltraPlus can be programmed via on-board SPI Flash or via USB port

### Ordering Part Number

iCE40UP5K-MDP-EVN

## iCE40 UltraPlus Breakout Board

Enables designers to evaluate key connectivity features of the iCE40 UltraPlus FPGA. The breakout board brings out all I/Os and allows the FPGA to be programmed over a USB connector.



### Features

- iCE40 UltraPlus (iCE40UP5K) device in a 48-pin QFN package
- High-current LED output
- iCE40UP5K application based current measurements
- Standard USB cable for device programming
- RoHS-compliant packaging and process
- Pre-loaded RGB LED Demo
- Software run GUI
- USB Connector Cable

### Ordering Part Number

iCE40UP5K-B-EVN

## iCE40 Ultra Mobile Development Platform

iCE40 Ultra Mobile Development Platform enables rapid implementation and development of several always-on functions popular in mobile platforms.



### Features

- iCE40 Ultra FPGA (iCE5LP4KSWG36)
- USB programming/interface
- High-current LED output
- Infrared transmit and receive
- RGB LED control
- Numerous Sensors
  - Two I2S MICs
  - Proximity sensor
  - Temperature Sensors
  - Barometric pressure sensor
  - Accelerometer
  - Gyroscope
  - Magnetometer
  - Humidity sensor
  - Hall sensor
  - Fingerprint sensor
- On-board oscillator

### Ordering Part Number

iCE5LP4K-MDP-EVN

## iCE40 Ultra Breakout Board

Featuring an ultra-small FPGA optimized for mobile applications. Typical mobile interfaces like RGB, IR and high current Torch LEDs are included, as well as access to every device I/O.



### Features

- iCE5LP4K FPGA in 0.35 mm pitch, 36-ball WLCSP
- RGB LED
- High-brightness “torch” LED
- Infrared (IR) LED
- Status LEDs
- Access to all device I/Os
- On-board 32Mbit SPI Flash for reconfiguration
- Windows- & Mac-based GUI for interface to the RGB LED, includes FPGA source code
- USB Type-A to Type-B (mini) cable for FPGA power and programming via PC

### Ordering Part Number

ICE5LP4K-B-EVN

## iCE40 UltraLite Breakout Board

Featuring the world’s smallest FPGA optimized for mobile applications. Typical mobile interfaces like RGB, IR and high current Torch LEDs are included, as well as access to every device I/O.



### Features

- iCE40UL1K (iCE401K-CM36A) device in a 36-ball BGA package
- Layout example of a board using 0.40 mm pitch BGA package
- High current LED output
- Infrared transmit capability for remote control functions
- iCE40UL1K application-based current measurements
- Standard USB cable for device programming
- RoHS-compliant packaging and process
- Preloaded RGB LED Demo
- Software-run GUI
- USB connector cable

### Ordering Part Number

ICE40UL1K-B-EVN

## iCE40 Ultra Wearable Development Platform

Peripheral and sensor-rich development platform with iCE40 Ultra and MachXO2 in a wearable watch form factor.



### Features

- Approximately (WxLxH) 1.50”x1.57”x0.87” form factor with wrist strap
- iCE40 Ultra iCE5LP4K and MachXO2 LCMXO2-2000ZE
- LG 1.54” 240x240 single-lane MIPI DSI display
- Bluetooth low-energy module
- Sensors: Heart-rate/SpO2, skin temperature, pressure and accelerometer/gyroscope
- 2 user LEDs, RGB LEDs, high-current white LED and high-current IR LED
- Stereo MEMs PDM microphones
- 32Mbit Quad SPI-flash
- 27MHz Oscillator
- Power via built-in 3.7V, 250mAh lithium-

- polymer battery or mini-USB cable
- FTDI 2232HQ USB device allows programming of FPGA and Flash
- Reference design available for download:
  - Parallel RGB to MIPI DIS bridging
  - Health monitoring\*
  - Pedometer\*
  - IR transmitter\*
  - Flashlight\*

\* Reference Android APK available to interface with mobile phone over Bluetooth

### Ordering Part Number

ICE5LP4K-WDEV-EVN

# Development Kits

## iCE40 USB Type-C Demo Kit

iCE40 USB Type-C Demo kit enables demonstration and development of Downstream Facing Ports (DFP), Upstream Facing Ports (UFP) and Dual Role Ports (DRP) capabilities.



### Features

- Supports Cable Configuration
  - UFP/DFP/DRP modes supported
  - Dead battery mode supported
- Supports Power Delivery
  - Dual voltage output \*
  - Power and data role swaps \*
  - Display port alternate mode \*
  - Vendor defined messages \*
- UART Monitor of USB Type-C interface \*
- Pre-configured bit streams allow rapid testing of common functions
- Source code licensed free of charge to qualified customers

- Note: Some demonstration modes for this product require an available Type-C port on external hardware (PC, tablet, etc.) not included in this kit. Consult the product documentation to make sure you have the required hardware.

\* Requires iCE40LP8K-USBC-EVN

| Ordering Part Number               |                    |
|------------------------------------|--------------------|
| iCE40 Ultra USB Type-C Demo Kit V2 | iCE5LP4K-USBC-EVN  |
| iCE40LP8K USB Type-C Demo Kit V2   | iCE40LP8K-USBC-EVN |

## iCE40LM4K Sensor Evaluation Kit

A rich assortment of sensors for FPGA development in mobile applications. Interfaces to Snapdragon development board.



### Features

- iCE40LM4K FPGA in 25-WLCSP (0.35 mm ball pitch)
- Infrared transmit and Receive
- Numerous Sensors
  - Proximity sensor
  - RGB Color, Infrared, and Temperature Sensors
  - Barometric pressure sensor
  - Accelerometer
  - Gyro Magnetometer/compass/accelerometer
  - Humidity & Temp sensor
  - Hall Sensor

- High current LED output
- Barcode LED/emulation
- VLT Adapter board for connection to Snapdragon APQ8060A
- Configuration SPI Flash
- USB A to USB B (mini) Cable for Power and Programming via a PC

| Ordering Part Number |
|----------------------|
| ICE40LM4K-S-EVN      |

## iCE40-HX8K Breakout Board

A simple, low-cost board with an iCE40-HX8K FPGA, and generous I/O access.



### Features

- iCE40-HX8K CT256 device
- 8 user-accessible LEDs
- SPI Flash for programming configuration
- 40-pin 0.1" header for user connectivity
- 0.1" holes for user connectivity
- FTDI 2232H for USB interface
- 12MHz oscillator
- Jumpers to select programming of the SPI Flash or iCE40-HX8K
- USB Type-A to Type-B (mini) cable for FPGA programming via PC
- Demo designs available for download

| Ordering Part Number |
|----------------------|
| ICE40HX8K-B-EVN      |

## iCE40LP1K Evaluation Kit

Featuring our ultra-small FPGA – 1K LUTs in a 16-ball WLCSP package (0.35 mm-ball pitch), only 1.4 mm x 1.48 mm, RGB LED control, GUI available for PC or Mac interface.



### Features

- iCE40LP1K in 16-WLCSP package (0.35 mm-ball pitch)
- High current tri-color LED (RGB)
- Infrared transmit LED
- Barcode emulation LED
- 27MHz on-board oscillator
- SMA connector for external clock input
- SPI configuration Flash
- USB Type-A to Type-B (mini) cable for FPGA power and programming via PC

### Ordering Part Number

ICE40LP1K-SWG16-EVN

## iCEprog Desktop Programmer

The iCEprog Desktop Programmer supports programming of the OTP fuses of Lattice iCE products (NVCM programming). It can also be used for SPI programming of iCE devices.



### Features

- Support for all Lattice programmable products
  - 1.2V to 3.3V programming (HW-USBN-2B)
  - 1.2V to 5V programming (All other cables)
- Ideal for design prototyping and debugging
- Connect to multiple PC interfaces
  - USB (v.1.0, v.2.0)
  - PC Parallel Port

- Easy-to-use programming connectors
  - Versatile flywire, 2 x 5 (.100") or 1 x 8 (.100") connectors
  - 6 feet (2 meters) or more of programming cable length (PC to DUT)
- Lead-free, RoHS-compliant construction

### Ordering Part Number

ICEPROGM1050-01

## iCEstick Evaluation Kit

Low-cost evaluation of the iCE40 FPGA, in a convenient USB drive form factor. Includes Pmod™ connector for versatile interfacing.



### Features

- USB thumb drive form factor
- iCE40HX-1K on board
- 2x6 position Digilent Pmod™ connector for multiple peripheral connections
- Vishay TFDU4101 IrDA transceiver
- FTDI 2232H USB device allows iCE-device programming and UART interface to a PC
- Five user LEDs
- Discera 12MHz MEMS oscillator

- Micron 32Mbit N25Q32 SPI Flash
- USB connector provides the power supply
- 16 LVCMOS/LVTTL (3.3V) digital I/O connections on 0.1" through-hole connections
- IrDA & Tx/Rx reference designs available for download

### Ordering Part Number

ICE40HX1K-STICK-EVN

## MachXO3-9400 Development Board

The MachXO3-9400 Development Board is a full-featured board allowing the evaluation of MachXO3 in hardware management with L-ASC10 and I/O expansion applications utilizing the on-board connectors for Arduino and Raspberry Pi.



### Features

- MachXO3LF-9400C-484caBGA and L-ASC10 devices with multiple prototyping and breakout areas
- Arduino and Raspberry Pi development board connectors
- LEDs and switches for demos and evaluation
- On-board FTDI device supports JTAG programming and I<sup>2</sup>C Interfacing over USB cable
- Footprint support for CrossLink I/O link connectors and ASC expansion board connectors

### Ordering Part Number

LCMXO3LF-9400C-ASC-B-EVN

## MachXO3L / MachXO3LF Starter Kit

The MachXO3L(F) Starter Kit is a basic breakout board to allow simple evaluation and development of MachXO3L(F) based designs. It includes the LCMXO3L(F)-6900C-5BG256C device.



### Features

- MachXO3 FPGA – LCMXO3L(F)-6900C-5BG256C
- USB Type-B (mini) connector (program/power)
- Pre-programmed example design (available on latticesemi.com)
- Eight LEDs
- 4-position DIP switch
- 40-hole prototyping area
- Four 2x20 expansion header landings for general I/O, JTAG and external power
- 1x8 expansion header landing for JTAG
- 1x6 expansion header landing for SPI/ I<sup>2</sup>C
- SPI Flash for external boot or dual boot
- 3.3V and 1.2V supply rails

### Ordering Part Number

LCMXO3L-6900C-S-EVN

LCMXO3LF-6900C-S-EVN

## MachXO3L Breakout Board

Focusing on evaluating high-speed source synchronous interfaces with the Lattice MachXO3L-2100 and MachXO3L-6900 products in both 49-ball WLCSP and 256-ball caBGA packages respectively.



### Features

- Two MachXO3L FPGAs
  - XO3L-6900E in 256caBGA
  - XO3L-2100E in 49WLCSP
- Two optional configurations:
  - 50-pin Harwin Archer connector for interface to DSI screen (screen not included)
  - 40 SMA connectors for LVDS I/O evaluation
- Generous prototyping/breakout access
- Switches and LEDs for user input and feedback
- Discrete resistors to support SLVS, subLVDS or DPHY Tx, and DPHY Rx, LP mode

- USB Type-A to Type-B (mini) cable for FPGA power and programming via PC
- DC jack for supplemental power input

### Ordering Part Number

|                       |                 |
|-----------------------|-----------------|
| MachXO3L SMA Breakout | LCMXO3L-SMA-EVN |
| MachXO3L DSI Breakout | LCMXO3L-DSI-EVN |

## MachXO2 Boards and Kits

### MachXO2 Breakout Board Features

- MachXO2 LCMXO2-7000HE
- Access to all device I/O via four 2x20 expansion header landings for I/O, JTAG and external power
- 60-hole prototype area
- USB Type-B (mini) connector for power and programming (cable included)
- Eight general purpose LEDs
- 3.3V and 1.2V supply rails



### MachXO2 Pico Development Kit Features

- MachXO2 LCMXO2-1200ZE
- 4-character, 16-segment LCD display
- 4 capacitive touch sense buttons
- 1Mbit SPI Flash
- I2C temperature sensor
- Current and voltage sensor circuits
- Expansion header for JTAG, I2C
- Standard USB cable for device programming and I2C communication
- RS-232/USB & JTAG/USB interface
- RoHS-compliant packaging and process
- Watch battery



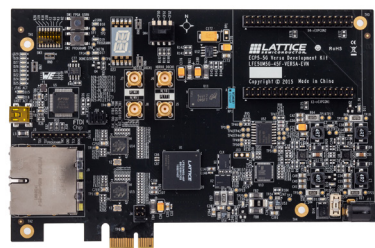
### MachXO2 Control Development Kit Features

- MachXO2 LCMXO2-4000HC
- Power Manager II ispPAC-POWR1014A
- 128Mbit LPDDR memory, 4Mbit SPI Flash
- Current and voltage sensor circuits
- SD memory card socket
- Microphone
- Audio amplifier and Delta-Sigma ADC
- Up to two DVI sources and one DVI output.
- Up to two Display inputs (7:1 LVDS) and one Display output (7:1 LVDS)
- Audio output channel
- Expansion header for JTAG, SPI, I2C and PLD I/Os.
- LEDs & switches
- Standard USB cable for device programming
- RS-232/USB & JTAG/USB interface
- RoHS-compliant packaging and process
- AC adapter (international plugs)

| Ordering Part Number    |                      |
|-------------------------|----------------------|
| Breakout Board          | LCMXO2-7000HE-B-EVN  |
| Pico Development Kit    | LCMXO2-1200ZE-P1-EVN |
| Control Development Kit | LCMXO2-4000HC-C-EVN  |

## ECP5 and ECP5-5G Versa Development Kits

For evaluation and development with the ECP5 and ECP5-5G FPGAs, including PCI Express, Gigabit Ethernet, DDR3 and generic SERDES performance.



### Features

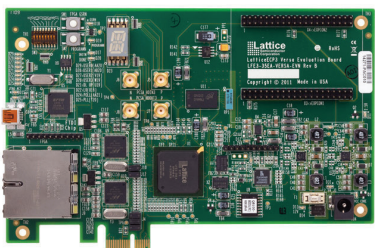
- Half-length PCI Express form factor: allows demonstration of PCI Express x1 interconnection
- Electrical testing of one full-duplex SERDES channel via SMA connections
- USB Type-B connection for UART and device programming
- Two RJ45 interfaces to 10/100/1000 Ethernet to RGMII
- On-board boot Flash: 128Mbit Serial SPI Flash
- DDR3-1866 memory components (64Mbit/x16)

- Expansion mezzanine interconnection for prototyping
- 14-segment alphanumeric display
- Switches, LEDs and displays for demo purposes
- Diamond® programming support
- On-board reference clock sources

| Ordering Part Number   |  |
|------------------------|--|
| LFE5UM-45F-VERSA-EVN   |  |
| LFE5UM5G-45F-VERSA-EVN |  |

## LatticeECP3 Versa Development Kit

Industry's lowest cost platform for designing PCI Express and Gigabit Ethernet based systems. The kit includes free demos and reference designs.



### Features

- The LatticeECP3 Versa Evaluation Board:
  - PCI Express 1.1x1 Edge connector interface
  - Two Gigabit Ethernet ports (RJ45)
  - 4 SMA connectors for SERDES access
  - USB Type-B (mini) for FPGA programming
  - LatticeECP3 FPGA: LFE3-35EA-FF484
  - 64Mbit Serial Flash memory
  - 1GB DDR3 Memory
  - 14 segment alphanumeric display
  - Switches and LEDs for demos
- SERDES Eye Quality Demo

- 4 PCI Express Demos
- Gigabit Ethernet MAC Demo using Mico32
- DDR3 Memory Controller Demo
- Available on Windows and Linux platforms
- USB Type-A to Type-B (mini) cable for FPGA programming via PC
- 12V AC power adapter and international plug adapters

| Ordering Part Number |  |
|----------------------|--|
| LFE3-35EA-VERSA-EVN  |  |

## Embedded Vision Development Kit

Embedded Vision Development Kit with dual-camera to HDMI bridging, features CrossLink, ECP5 and Sil1136 devices. The kit's modular platform simplifies development and offers flexibility for design expansion.



### Features

- All-inclusive demo system with on-board video sources
- CrossLink LIF-MD6000 input board with two Sony IMX 214 high-speed MIPI D-PHY interface camera sensors
- ECP5 processor board with pre-loaded high definition Image Signal Processing IP(HD ISP)
- Sil1136, non-HDCP, output board connects any HDMI
- Includes 0.1" header prototyping
- Easy programming interface via USB with FTDI device
- Modular Video Interface Platform (VIP) allows mixing and matching of input and output boards.
- Develop custom video interface solutions for embedded vision and machine learning using Lattice Diamond Software.

### Ordering Part Number

LF-EVDK1-EVN

## DisplayPort VIP Input Board

DisplayPort VIP Input Board, expands video connectivity to the Embedded Vision Development Kit with the inclusion of DisplayPort RX and embedded DisplayPort RX.



### Features

- Supports DisplayPort 1.4 up to 2.7 Gbps
- Integrated Texas Instruments SN75DP130 DisplayPort 1:1 Redriver
- Mini DisplayPort (mDP) connector
- Two 60-pin rugged high-speed headers
- Modular Video Interface Platform (VIP) with eDP RX feature support
- Develop custom video interface solutions for embedded vision and machine learning using Lattice Diamond Software

### Ordering Part Number

DP-VIP-I-EVN

## DisplayPort VIP Output Board

DisplayPort VIP Output Board, expands video connectivity to the Embedded Vision Development Kit with the inclusion of DisplayPort TX and embedded DisplayPort TX.



### Features

- Supports DisplayPort 1.4 up to 2.7 Gbps
- Integrated Texas Instruments SN75DP130 DisplayPort 1:1 Redriver
- Mini DisplayPort (mDP) connector
- Two 60-pin rugged high-speed headers
- Modular Video Interface Platform (VIP) with eDP TX feature support
- Develop custom video interface solutions for embedded vision and machine learning using Lattice Diamond Software

### Ordering Part Number

DP-VIP-O-EVN

## USB3-GbE VIP IO Board

USB3-GbE VIP IO Board provides USB 3.1 and Gigabit Ethernet connectivity by converting the output of the ECP5 VIP Processor Board into a standard USB 3.1 and Gigabit Ethernet interface.



### Features

- Two Unified 60-pin high speed connectors
- On board Cypress FX3 USB 3.1 controller
- Compliant with USB 3.1 specification revision 1.0
- Supports standard USB 3.0 interface
- On board industrial grade TI DP83867IR Gigabit Ethernet PHY
- Supports 10/100/1000 Ethernet

### Ordering Part Number

USB3-VIP-EVN

## MicroSD Card Adapter

MicroSD Card Adapter complements the VIP by providing mass storage capabilities to the ECP5 VIP Processor Board.



### Features

- MicroSD adapter for seamless connection to ECP5 VIP Processor Board
- Includes 8GB MicroSD card
- Includes SD card adapter

### Ordering Part Number

MICROSD-ADP-EVN

## HDMI VIP Input Bridge Board

The HDMI VIP Input Bridge Board complements the Embedded Vision Development Kit by providing two selectable HDMI input signals for fast prototyping. The board converts two unencrypted HDMI input video signals into a parallel RGB video format.



### Features

- 2 switchable HDMI input signal
- Contains the Lattice Si1127A
- Transfer of non-HDCP input data
- Support of 1080p @ 60 Hz HDMI-compliant digital audio and video
- Can be used as stand-alone board or combined with the Embedded Vision Development Kit

### Ordering Part Number

HDMI-VIP-IB-EVN

## HDR-60 Video Camera System

This is a family of inter-connectable boards that showcase the video processing capabilities of the LatticeECP3 FPGA in a compact standard format.



### Features

- LatticeECP3-70 in 484 fpBGA package
- Production-ready HDR camera design
- 1080p60 frames per second (fps)
- Extremely low-latency
- Autoexposure
- Supports dual-sensors simultaneously
- Direct HDMI/DVI output from FPGA
- On-board Ethernet PHY
- HDR image processing reference design
- > 120dB HDR Performance
- Additional image processing IP library
- Image shows HDR-60, plus Dual-Sensor interface and two NanoVesta sensor boards

| Ordering Part Number          |                        |
|-------------------------------|------------------------|
| HDR-60 with MT9M024 NanoVesta | LFE3-70EA-HDR60-DKN    |
| HDR-60 without NanoVesta      | LFE3-70EA-HDR60-EVN    |
| Dual Sensor Interface         | LCMXO2-4000HE-DSIB-EVN |
| CSI2-to-Parallel Bridge       | LF-C2P-EVN             |
| MT9M024 Sensor NanoVesta      | LF-9MT024NV-EVN        |
| MN34041 Sensor NanoVesta      | LF-PNV-EVN             |

## Lattice USB3 Video Bridge Development Kit

This is a production-ready, high-definition video capture and conversion system, based on the LatticeECP3™ FPGA family.



### Features

- Production-ready USB3 audio/video bridging reference design
- 1080p video streaming over USB 3.0 at 60fps
- HDMI 1.4a audio and video capture
- SD-, HD-, 3G-SDI audio and video capture
- Supports video capture from external MIPI CSI-2, SubLVDS or Parallel sensors
- Reference design provides fast USB 3.0 UVC and UAC class data packing

- Plug and play operations as a video capture device on multiple standard platforms (Windows, MacOS, Linux)
- Complete reference design schematics and documentation available

| Ordering Part Number |  |
|----------------------|--|
| LFE3-17EA-USB3-EVN   |  |

## Platform Manager 2 Development Kit

The Platform Manager 2 Development Kit is a versatile, ready-to-use hardware platform for evaluating and designing with Platform Manager 2 and L-ASC10 devices. This kit includes a board, programming cable, and assorted example designs and documentation available for download. You can implement and debug your hardware management functions (power, thermal and control plane management) and test them out with this kit.



### Features

- LPTM21 (Platform Manager 2 device) & L-ASC10 (Hardware Management expander)
- Temperature monitoring/measurement, with temperature control using fan (included)
- Fault logging under various types of hardware management faults
- 4 potentiometers & 2 POLs for sequencing, VID/Voltage scaling, margining, fault creation
- Background programming support with Dual boot from golden image stored on the SPI Flash
- Hardware management expansion through external L-ASC10 boards
- 3-digit LCD for additional code debug support

### L-ASC10 Breakout Board

The L-ASC10 (ASC) Breakout Board is a versatile hardware platform for evaluation and design with L-ASC10 devices. The board is designed to work alongside the Platform Manager 2 Development Kit.

### Features

- L-ASC10 (Hardware Management Expander)
- 2 potentiometers for sequencing & fault creation
- 9 LEDs for sequencing
- Temperature monitor & measurement with 2 on-board temperature sensors
- Connector for use with Platform Manager 2 Development Kit

| Ordering Part Number               |                |
|------------------------------------|----------------|
| Platform Manager 2 Development Kit | LPTM-BPM-EVN   |
| L-ASC10 Breakout Board             | LPTM-ASC-B-EVN |

# Development Kits

POWR1220

## Power Manager II Hercules Development Kit

The Hercules Development Kit is an easy-to-use platform for evaluating and designing with the Power Manager II ispPAC®-POWR1220AT8 and MachXO™2280.



### Features

#### The Hercules Evaluation Board with the following circuits:

- ispPAC-POWR1220AT8 Power Manager II device
- MachXO 2280 programmable logic device
- ispMACH® 4000 programmable logic device
- USB interface for JTAG, I2C, and SPI
- Main and external 12V supply connections
- 12V Hot Swap for Hot Swap demo
- 12V OR'ing for redundant power supply demo

- 1.2V DC-DC supply for margin, trim, and VID Demos
- SPI memory for fault logging demo
- 3-digit LCD display
- Various LEDs and switches for status and control

### Ordering Part Number

PAC-POWR1220AT8-HS-EVN (Standard)

POWR1014

## POWR1014 Breakout Board

The POWR1014A Breakout Board is a simple, low-cost board that provides convenient access to densely-spaced I/Os. Each I/O on the device is connected to 100-mil header holes.



### Features

- Power Manager II - POWR1014A-02TN48I device/package
- Pre-programmed hardware test program (Source is downloadable)
- LEDs expansion header landings prototyping area
- USB Type-B (mini) connector for programming and power
- JTAG header landing

### Ordering Part Number

Ordering Part Number: POWR1014A-B-EVN

POWR607

## POWR607/6AT6 Evaluation Board

The POWR607/6AT6 Evaluation Board is an easy-to-use platform for evaluating and designing with the Lattice Power Manager II devices, POWR607 and POWR6AT6.



### Features

- Power Manager II ispPAC® -POWR607
- Power Manager II ispPAC®-POWR6AT6
- LEDs for general purpose I/O, power indicators, and watchdog timer interrupt indication
- Slide potentiometer
- USB Type-B(mini) connector for power and programming
- 2x14 expansion header for general I/O, voltage monitor inputs, and power supply trim outputs
- Thru-hole and surface mount prototyping area for custom design verification

- Push buttons for reset and watchdog timer trigger
- 4-bit DIP switch for watchdog timer period programming and reset pulse stretch enable
- JTAG and I<sup>2</sup>C header landings for JTAG cable programming and I<sup>2</sup>C interface (cables not included).

### Ordering Part Number

Ordering Part number: PACPOWR607-P-EVN

POWR605

## ProcessorPM Development Kit

This kit is a versatile, ready-to-use hardware platform for evaluating and designing with POWR605 (ProcessorPM) power management devices.



### Features

- Power Manager II ProcessorPM-POWR605
- Power Manager II ispPAC®-POWR6AT6
- LEDs for general purpose I/O, power indicators, and watchdog timer interrupt indication
- Slide potentiometer
- USB Type-B(mini) connector for power and programming
- 2x14 expansion header for general I/O, voltage monitor inputs, and power supply trim outputs
- Thru-hole and surface mount prototyping area for custom design verification

- Push buttons for reset and watchdog timer trigger
- 4-bit DIP switch for watchdog timer period programming and reset pulse stretch enable
- JTAG and I<sup>2</sup>C header landings for JTAG cable programming and I<sup>2</sup>C interface (cables not included)

### Ordering Part Number

PACPOWR605-P-EVN

# Development Kits

LatticeXP2

## LatticeXP2 Brevia2 Development Kit

Easy-to-use, low-cost platform for evaluating and designing with LatticeXP2 FPGAs.



### Features

- LatticeXP2 FPGA: LFXP2-5E-6TN144C
- 2Mbit SPI Flash memory
- 1Mbit SRAM
- Programmed via included mini-USB Cable
- 2x20 and 2x5 expansion headers
- Push buttons for general purpose I/O and reset
- 4-bit DIP Switch for user-defined inputs
- 8 Status LEDs for user-defined outputs

| Ordering Part Number |
|----------------------|
| LFXP2-5E-B2-EVN      |

Industrial

## HMI Development Kit

An FPGA-based Human Machine Interface kit with touchscreen. Scalable firmware and software makes adapting to your target system easy.



### Features

- Includes LatticeECP3 Versa Board
- 480 x 272 touchscreen included
- SD card for loading of new projects
- Licensable HMI-on-chip (HoC) solution features
  - Scalable IP for high-end graphics
  - Fast response times
  - Easy design/re-configuration via GUI
  - No O/S or custom coding – all GUI
  - Implement on ECP3 or MachXO2/3L
  - Only 8K LUTs of FPGA required
  - Eval version included with the board

| Ordering Part Number |
|----------------------|
| LFE3-35EA-HMI-DKN    |

ASSP Video

## SiI9630 evaluation kit

This is an evaluation kit for SiI9630, HDMI/MHL transceiver solution. Input can be eTMDS or HDMI while output can be MHL or HDMI. The evaluation kit allows HDCP decryption and encryption to be evaluated, DSC compression to be evaluated, and MHL/HDMI transmission up to 4K60 444 video resolution.



### Features

- Dual-Mode MHL or HDMI Transmitter
- Input: HDMI or eTMDS (Up to 4K60 444)
- Output: MHL (Up to 4K60 444) or HDMI (Up to 4K60 444)
- Header pins available to measure power consumption
- DSC encoder support
- RGB/YCbCr/xvYCC support

| Ordering Part Number |
|----------------------|
| CP9630               |

## SiI9396 evaluation kit

This is an evaluation kit for SiI9396, which is a DSC decompression IC supporting HDMI and MHL up to 4K60 444.



### Features

- Dual inputs (MHL or HDMI)
  - HDMI can support up to 4K60 444
  - MHL1/2 can support up to 1080p60
  - MHL3 can support up to 4K30 422pp
- Output support for HDMI2.0 up to 4K60 444
- DSC decompression supported
- CSC & chroma down/up-sampling support, RGB/YCbCr/xvYCC support
- Two LED supported
  - LED1: Green, ON – source connected
  - LED2: Red, ON – Power error

| Ordering Part Number |
|----------------------|
| CP9396               |

# Programming Hardware

## Programming Cables

Lattice Programming Cables are used to communicate between a PC and a Lattice device on a target board or system. The most common application is to program a Lattice device. Programming Cables can also be used to help debug your hardware designs via Lattice software tools.

- **USB Programming Cable (HW-USBN-2B – pictured).** The latest-generation Programming Cable adds I<sup>2</sup>C programming and various other features.
- **Parallel Cable (HW-DLN-3C).** This connects to a PC parallel port and is best for basic JTAG programming.



| Ordering Part Number       |            |
|----------------------------|------------|
| ispDOWNLOAD Parallel Cable | HW-DLN-3C  |
| USB Programming Cable      | HW-USBN-2B |

## Smart Sockets

Lattice Smart Sockets are an all-in-one solution for prototype programming of the latest Lattice products.

These complete solutions include all the functionality of a Desktop Programmer + Socket Adapter combination in a single board. All that's needed is a simple connection to your PC via USB (cable included).

More information about Lattice Smart Sockets is on the Lattice website at [www.latticesmi.com/sockets](http://www.latticesmi.com/sockets).



## Desktop Programmers

Lattice offers two desktop programmers for prototype programming of Lattice products.

A Socket Adapter is required for the specific device/package you wish to program. These are available separately, and are designed specifically for one Desktop Programmer or the other.

The Lattice Model 300 Desktop Programmer (pictured) supports most Lattice FPGA and CPLD products.

The iCEprog Desktop Programmer supports all Lattice iCE products.



| Ordering Part Number         |                 |
|------------------------------|-----------------|
| Model 300 Desktop Programmer | PDS4102-PM300N  |
| iCEprog Desktop Programmer   | ICEPROGM1050-01 |

## Socket Adapters

Lattice Socket Adapters are used in conjunction with a Lattice Desktop programmer to facilitate low-volume, manual programming of Lattice devices.

Socket adapters are generally designed to support a device family/package combination.

iCE Socket Adapters work only with the iCEprog Desktop Programmer. All other Lattice Socket Adapters work only with the Model300 Desktop Programmer.

More information and a complete list of Lattice Socket Adapter products is available at [www.latticesmi.com/sockets](http://www.latticesmi.com/sockets).



# FPGA and CPLD Design Software

| Complete Design Flows - High Ease of Use     |  | Lattice Radiant (Free) Windows/Linux | Lattice Diamond™ (Subscription License) Windows/Linux              | Lattice Diamond™ (Free) Windows/Linux        | ispLEVER™ Classic (Free) Windows | iCEcube2™ (Free) Windows/Linux | PAC-Designer |
|--|--|--------------------------------------|--|--|----------------------------------|--------------------------------|--------------|
| Device Families                              | ECP5UM5G   |                                      | ✓  |  |                                  |                                |              |
|  | ECP5U  |                                      | ✓  | ✓  |                                  |                                |              |
|  | ECP5UM   |                                      | ✓  |  |                                  |                                |              |
|  | LatticeECP3  |                                      | ✓  |  |                                  |                                |              |
|  | LatticeECP2M/S   |                                      | ✓  |  |                                  |                                |              |
|  | LatticeECP2S   |                                      | ✓  |  |                                  |                                |              |
|  | MachXO2  |                                      | ✓  | ✓  |                                  |                                |              |
|  | MachXO3  |                                      | ✓  | ✓  |                                  |                                |              |
|  | MachXO   |                                      | ✓  | ✓  |                                  |                                |              |
|  | LatticeXP2   |                                      | ✓  | ✓  |                                  |                                |              |
|  | LatticeXP  |                                      | ✓  | ✓  |                                  |                                |              |
|  | LatticeECP2  |                                      | ✓  | ✓  |                                  |                                |              |
|  | iCE40  |                                      |  |  |                                  | ✓                              |              |
|  | iCE40 UltraPlus  | ✓                                    |  |  |                                  |                                |              |
|  | ispMACH 4000B/C/V/ZE                                     |                                      |  |  | ✓                                |                                |              |
|  | Platform Manager 2                                       |                                      | ✓  | ✓  |                                  |                                |              |
|  | L-ASC10  |                                      | ✓  | ✓  |                                  |                                |              |
| Power Manager II                             |  |                                      |  |  |                                  | ✓                              |              |
| Software Features                            | Design Exploration                                       | ✓                                    | ✓  | ✓  |                                  | ✓                              |              |
|  | Project Management                                       | ✓                                    | ✓  | ✓  | ✓                                | ✓                              |              |
|  | VHDL & Verilog Support                                   | ✓                                    | ✓  | ✓  | ✓                                | ✓                              |              |
|  | EDIF Support   | ✓                                    | ✓  | ✓  | ✓                                | ✓                              |              |
|  | Schematic Support  | ✓                                    | ✓  | ✓  | ✓                                |                                |              |
|  | ABEL   |                                      |  |  | ✓                                |                                | ✓            |
|  | Synopsys® Synplify Pro™ for Lattice-Synthesis            | ✓                                    | ✓  | ✓  | ✓                                |                                |              |
|  | Lattice Synthesis Engine (LSE)                           | ✓                                    | MachXO/XO2/XO3<br>Lattice ECP2/ECP3/<br>ECP5/<br>ECP5-5G/ECP2M/XP2 | MachXO/XO2/<br>XO3 LatticeECP2/<br>ECP5U/XP2 | ispMACH 4000<br>only             | ✓                              |              |
|  | IP and Module Configuration                              | ✓                                    | ✓  | ✓  | Module Only                      | Module Only                    |              |
|  | Power Estimation & Calculation                           | ✓                                    | ✓  | ✓  |                                  | ✓                              |              |
|  | Timing Analysis  | ✓                                    | ✓  | ✓  | ✓                                | ✓                              |              |
|  | Floorplanning  | ✓                                    | ✓  | ✓  | ✓                                | ✓                              |              |
|  | EPIC Device Editor                                       | ✓                                    | ✓  | ✓  | ORCA FPGA Only                   |                                |              |
| On-Chip Debug                                | ✓  | ✓                                    | ✓  | ispXPGA Only                                 |                                  |                                |              |
| TCL Scripting Dictionaries                   | ✓  | ✓                                    | ✓  |  |                                  |                                |              |
| Aldec® Active-HDL Lattice Edition Simulation | ✓  | Windows Only                         | Windows Only   | Windows Only                                 | Windows Only                     |                                |              |
| Operating Systems                            | Windows 7/8 (32 bit and 64 bit)                          | ✓                                    | ✓  | ✓  | Windows 7/XP                     | ✓                              |              |
|  | Linux (Red Hat Enterprise v4, v5, v6; 32 bit and 64 bit) | ✓                                    | ✓  | ✓  |                                  | ✓                              |              |
| Licensing & Updates                          | License Terms  | One Year – Renewable                 | One Year – Renewable   | One Year – Renewable                         | One Year – Renewable             | One Year – Renewable           |              |
|  | Node-Locked License                                      | ✓                                    | ✓  | ✓  | ✓                                | ✓                              |              |
|  | Floating License   |                                      | ✓  |  |                                  | ✓                              |              |

## Neural Network Compiler for senseAI Stack

| Target             | Ubuntu Linux | Microsoft Windows | CMD Line | GUI | Tensor Flow Input | Caffe Input | License |
|--------------------|--------------|-------------------|----------|-----|-------------------|-------------|---------|
| CNN Accelerator IP | 16.04        | 7, 10             | ✓        | ✓   | ✓                 | ✓           | Free    |
| BNN Accelerator IP | 16.04        |                   | ✓        |     |                   | ✓           | Free    |

# Connectivity ASSPs

| Port Processors                      | Sil9777      | Sil9575      | Sil9573      | Sil9535      | Sil9533    |
|--------------------------------------|--------------|--------------|--------------|--------------|------------|
| HDMI® Input                          | 4            | 6            | 6            | 4            | 3          |
| MHL® Input                           | 2            | 2            | 2            | 2            | 2          |
| HDMI Output                          | 3            | 2            | 2            | 1            | 1          |
| InstaPort™ S                         |              | ✓            | ✓            | ✓            | ✓          |
| InstaPrevue™                         |              | ✓            | ✓            | ✓            | ✓          |
| Hardware HDCP Repeater               | ✓            | ✓            | ✓            | ✓            | ✓          |
| HDCP Upstream Authentication Support | ✓            | ✓            | ✓            | ✓            | ✓          |
| HDMI Bandwidth                       | 18 Gbps      | 9 Gbps       | 9 Gbps       | 9 Gbps       | 9 Gbps     |
| Audio Return Channel                 | ✓            | ✓            | ✓            | ✓            | ✓          |
| Maximum HDMI Resolution              | 4K60 4:4:4   | 4K60 4:2:0   | 4K60 4:2:0   | 4K60 4:2:0   | 4K60 4:2:0 |
| Maximum MHL Resolution               | 4K30         | 1080p30      | 1080p30      | 1080p60      | 1080p60    |
| HDCP 1.4 support                     | ✓            | ✓            | ✓            | ✓            | ✓          |
| HDCP 2.2 support                     | ✓            |              |              |              |            |
| Audio Extraction (I2S x 4)           | ✓            | ✓            | ✓            | ✓            | ✓          |
| Pre-programmed HDCP keys             | ✓            | ✓            | ✓            | ✓            | ✓          |
| CEC Processor                        |              | ✓            | ✓            |              | ✓          |
| OSD controller                       |              | ✓            | ✓            | ✓            |            |
| Integrated NVRAM EDID                |              | ✓            | ✓            | ✓            | ✓          |
| Package                              | 208-pin LQFP | 176-pin TQFP | 176-pin TQFP | 100-pin TQFP | 88-pin QFN |
| Package Size                         | 28 x 28 mm   | 20 x 20 mm   | 20 x 20 mm   | 14 x 14 mm   | 10 x 10 mm |
| Starter Kit                          | CP9777       | CP9575HDMI   | CP9575HDMI   | CP9535       | CP9533     |

| Video Processors                     | Sil9612    | Sil9616      |
|--------------------------------------|------------|--------------|
| HDMI® Input                          | 1          | 1            |
| MHL® Input                           | 1          | 1            |
| HDMI Output                          | 1          | 1            |
| Parallel Video Input                 |            | ✓            |
| Parallel Video Output                |            | ✓            |
| OSD controller                       | ✓          | ✓            |
| Hardware HDCP Repeater               | ✓          | ✓            |
| HDCP Upstream Authentication Support | ✓          | ✓            |
| HDMI Bandwidth                       | 9 Gbps     | 9 Gbps       |
| Audio Return Channel                 | ✓          | ✓            |
| Maximum HDMI Resolution              | 4K60 4:2:0 | 4K60 4:2:0   |
| Maximum MHL Resolution               | 1080p60    | 1080p60      |
| HDCP 1.4 support                     | ✓          | ✓            |
| Audio Extraction (I2S x 4)           | ✓          | ✓            |
| Pre-programmed HDCP keys             | ✓          | ✓            |
| CEC Processor                        | ✓          | ✓            |
| Package                              | 76-pin QFN | 176-pin TQFP |
| Package Size                         | 9 x 9 mm   | 20 x 20 mm   |
| Starter Kit                          | CP9612     | CP9616       |

| Analog Front End      | Sil8784                  | Sil8788    |
|-----------------------|--------------------------|------------|
| Component Video Input | ✓                        | ✓          |
| Composite Video Input | ✓                        | ✓          |
| D-Connector Support   | ✓                        |            |
| VGA Support           | ✓                        |            |
| SCART Support         | ✓                        |            |
| Parallel Video Output |                          | ✓          |
| HDMI Output           | ✓                        |            |
| MHL Output            | ✓                        |            |
| SPDIF Audio Input     | ✓                        |            |
| I2S Audio Input       | ✓                        |            |
| Package               | 88-pin QFN               | 88-pin QFN |
| Package Size          | 10 x 10 mm               | 10 x 10 mm |
| Starter Kit           | CP8784MHL/<br>CP8784HDMI | CP8788     |

## Connectivity ASSPs

| TV Port Processors                   | Sil9777     | Sil9687A     | Sil9589-3    | Sil9587-3    | Sil9489A       | Sil9396    | Sil9381A       |
|--------------------------------------|-------------|--------------|--------------|--------------|----------------|------------|----------------|
| HDMI® Input                          | 4           | 4            | 5            | 4            | 5              | 1          | 4              |
| superMHL Input                       |             |              |              |              |                | 1          |                |
| MHL® Input                           | 2           | 1            | 1            | 1            | 1              | 1          | 1              |
| HDMI Output                          | 3           | 1            | 1            | 1            | 2              | 1          | 1              |
| superMHL™ Output                     |             |              |              |              |                | 1          |                |
| InstaPort™                           |             | InstaPort™ S | InstaPort™ S | InstaPort™ S | InstaPort™ S   |            | InstaPort™ S   |
| Hardware HDCP Repeater               | HDCP 2.2    |              |              |              | HDCP 1.4       | HDCP 2.2   |                |
| HDCP Upstream Authentication Support | HDCP 2.2    |              | HDCP 1.4     | HDCP 1.4     | HDCP 1.4       | HDCP 2.2   |                |
| HDMI Bandwidth                       | 18 Gbps     | 9 Gbps       | 9 Gbps       | 9 Gbps       | 6 Gbps         | 18 Gbps    | 6 Gbps         |
| Audio Return Channel                 | ✓           | ✓            | ✓            | ✓            | ✓              |            | ✓              |
| Maximum HDMI Resolution              | 4K60 4:4:4  | 4K60 4:2:0   | 4K60 4:2:0   | 4K60 4:2:0   | 1080p60 36-bit | 4K60 4:4:4 | 1080p60 36-bit |
| Maximum MHL Resolution               | 4K30        | 1080p60      | 1080p30      | 1080p30      | 1080p30        | 4K30       | 1080p30        |
| HDCP 1.4 support                     | ✓           | ✓            | ✓            | ✓            | ✓              | ✓          | ✓              |
| HDCP 2.2 support                     | ✓           |              |              |              |                | ✓          |                |
| Pre-programmed HDCP keys             | ✓           | ✓            | ✓            | ✓            | ✓              | ✓          | ✓              |
| CEC Processor                        |             |              | ✓            | ✓            | ✓ (2)          |            | ✓              |
| Integrated NVRAM EDID                | SPI Flash   | ✓            | ✓            | ✓            | ✓              | SPI Flash  | ✓              |
| Package                              | 208-pin QFP | 76-pin QFN   | 100-pin QFP  | 88-pin QFN   | 128-pin QFP    | 76-pin QFN | 88-pin QFN     |
| Package Size                         | 28 x 28 mm  | 9 x 9 mm     | 14 x 14 mm   | 10 x 10 mm   | 14 x 14 mm     | 9 x 9 mm   | 10 x 10 mm     |
| Starter Kit                          | CP9777      | CP9687A      | CP9589-3     | CP9587-3     | CP9489A        | CP9396     | CP9381A        |

| HDMI Receiver                              | Sil1127A       | Sil9127A       | Sil9233A       | Sil9679               | Sil5293                                     |
|--|----------------|----------------|----------------|-----------------------|---|
| HDMI® Input Type                           | HDMI1.3        | HDMI1.3        | HDMI1.4        | HDMI2.0, 300MHz       | HDMI 1.4b                                   |
| Number of HDMI Inputs                      | 2              | 2              | 4              | 1                     | 1   |
| MHL® Input                                 |                |                |                | MHL3.0                | MHL2  |
| RGB/YCbCr Output                           | Up to 36-bit   | Up to 36-bit   | Up to 36-bit   |                       | Up to 24-bit                                |
| HDMI Output                                |                |                |                | HDMI2.0               |   |
| Max Video Resolution                       | 1080p60 36-bit | 1080p60 36-bit | 1080p60 36-bit | 4K60 4:2:0            | 1080p30 HDMI<br>1080p60 MHL<br>1080p30 SALT |
| HDCP support                               |                | HDCP 1.1       | HDCP 1.4       | HDCP 1.4/<br>HDCP 2.2 | HDCP 1.4                                    |
| Pre-programmed HDCP keys                   |                | ✓              | ✓              | ✓                     | ✓   |
| Audio Extraction (I2S) 192kHz              | 2-ch           | 2-ch           | 8-ch           |                       | ✓   |
| S/PDIF                                     | ✓              | ✓              | ✓              | ✓                     | ✓   |
| High Bit Rate Audio (Dolby TrueHD, DTS-HD) | ✓              | ✓              | ✓              | ✓                     |   |
| I²C Interface                              | ✓              | ✓              | ✓              | ✓                     | ✓   |
| Integrated NVRAM EDID                      | ✓              | ✓              | ✓              | SRAM EDID             |   |
| HDCP Repeater support                      |                |                | ✓              |                       |   |
| Package                                    | 128-pin TQFP   | 128-pin TQFP   | 144-pin TQFP   | 76-pin QFN            | 72-pin QFN                                  |
| Package Size                               | 14 x 14 mm     | 14 x 14 mm     | 20 x 20 mm     | 9 x 9 mm              | 10 x 10 mm                                  |
| Starter Kit                                | CP1127HDMI     | CP9127HDMI     | CP9233HDMI     | Yes                   | Yes   |

# Connectivity ASSPs

| HDMI Transmitter                           | Sil9022A                                     | Sil9024A                                     | Sil1136      | Sil9136-3    | Sil9334          | Sil9678               | Sil7172      | Sil164       |
|--|--|--|--------------|--------------|------------------|-----------------------|--------------|--------------|
| HDMI® Output Type                          | HDMI1.3                                      | HDMI1.3                                      | HDMI1.4      | HDMI1.4      | HDMI1.4          | HDMI2.0               | iTMDS        | DVI          |
| Number of HDMI Outputs                     | 1  | 1  | 1            | 1            | 1                | 1                     |              |              |
| RGB/YCbCr Input                            | 24-bit / 16-bit                              | 24-bit / 16-bit                              | Up to 48-bit | Up to 48-bit | Up to 36-bit     |                       | Dual 36-bit  | Up to 24-bit |
| HDMI Input                                 |  |  |              |              |                  | HDMI2.0               |              |              |
| Max Video Resolution                       | 1080p60 4:4:4                                | 1080p60 4:4:4                                | 4K30 4:4:4   | 4K30 4:4:4   | 1080p60 (225MHz) | 4K60 4:2:0            | 1080p60      | 1080p60      |
| HDMI Bandwidth                             | 4.9 Gbps                                     | 4.9 Gbps                                     | 9 Gbps       | 9 Gbps       | 6.75 Gbps        | 9 Gbps                | 6.75 Gbps    | 4.95 Gbps    |
| HDCP support                               |  | HDCP 1.3                                     |              | HDCP 1.2     | HDCP 1.4         | HDCP 1.4/<br>HDCP 2.2 | HDCP 1.1     |              |
| Pre-programmed HDCP keys                   |  | ✓  |              | ✓            | ✓                | ✓                     | ✓            | ✓            |
| Audio Insertion (I2S x 4) 192kHz           | ✓  | ✓  | ✓            | ✓            | ✓                |                       |              |              |
| S/PDIF                                     | ✓  | ✓  | ✓            | ✓            | ✓                | ✓                     |              |              |
| High Bit Rate Audio (Dolby TrueHD, DTS-HD) |  |  | ✓            | ✓            | ✓                | ✓                     |              |              |
| I²C Interface                              | ✓  | ✓  | ✓            | ✓            | ✓                | ✓                     | ✓            | ✓            |
| Package                                    | 81-ball VFBGA<br>72-pin QFN<br>49-ball VFBGA | 81-ball VFBGA<br>72-pin QFN<br>49-ball VFBGA | 100-pin TQFP | 100-pin TQFP | 100-pin TQFP     | 76-pin QFN            | 129-Pin LQFP | 64-Pin TQFP  |
| Package Size                               | 4 x 4 mm (VFBGA)<br>10 x 10 mm (QFN)         | 4 x 4 mm (VFBGA)<br>10 x 10 mm (QFN)         | 14 x 14 mm   | 14 x 14 mm   | 14 x 14 mm       | 9 x 9 mm              | 14 x 20 mm   | 12 x 12 mm   |
| Starter Kit                                |  |  | CP1136HDMI   | CP9136HDMI-3 | CP9334           | CP9678                |              |              |

| MHL Transmitters                  | Sil8334       | Sil8620             | Sil8240      | Sil8346      | Sil8348      | Sil8630              | Sil9630              | Sil8558          |
|-----------------------------------|---------------|---------------------|--------------|--------------|--------------|----------------------|----------------------|------------------|
| HDMI input                        |               | ✓                   |              |              |              | ✓                    | ✓                    | ✓                |
| eTMDS input                       | ✓             | ✓                   | ✓            |              |              | ✓                    | ✓                    | ✓                |
| MIPI DSI input                    |               |                     |              |              |              |                      |                      |                  |
| Parallel Digital Video Input      |               |                     |              | ✓            | ✓            |                      |                      |                  |
| MHL output                        | MHL1          | MHL3                | MHL2         | MHL2         | MHL2         | superMHL             | superMHL             | MHL2             |
| Integrated Analog Switch          | USB ID & Data |                     | USB ID       |              |              | MHL Demux for Type-C | MHL Demux for Type-C | USB, UART, audio |
| MAX video resolution              | 1080p30       | 4K30                | 1080p60      | 1080p60      | 1080p60      | 4K60                 | 4K60                 | 1080p60          |
| 720p adaptive Scaler              |               |                     |              |              |              |                      |                      |                  |
| HDCP decryption on input          | Pass through  | HDCP1.4             |              |              |              | HDCP1.4              | HDCP1.4              | HDCP1.4          |
| HDCP encryption on output         | Pass through  | HDCP1.4/<br>HDCP2.2 | HDCP1.4      | HDCP1.4      |              | HDCP1.4/<br>HDCP2.2  | HDCP1.4/<br>HDCP2.2  | HDCP1.4          |
| Dolby Digital                     | ✓             | ✓                   | ✓            | ✓            | ✓            | ✓                    | ✓                    |                  |
| DTS digital Audio                 | ✓             | ✓                   | ✓            | ✓            | ✓            | ✓                    | ✓                    |                  |
| Object Audio - Dolby Atmos, DTS:X |               |                     |              |              |              | ✓                    | ✓                    |                  |
| 8-ch I2S interface @ 192KHz       |               |                     |              |              |              |                      |                      |                  |
| Package                           | 49ball VFBGA  | 64ball VFBGA        | 49ball VFBGA | 64ball VFBGA | 64ball VFBGA | 64ball VFBGA         | 64ball BGA           | 64ball VFBGA     |
| Package size                      | 4 x 4 mm      | 4 x 4 mm            | 3.5 x 3.5 mm | 4.5 x 4.5 mm | 4.5 x 4.5 mm | 4 x 4 mm             | 6.5 x 6.5 mm         | 4 x 4 mm         |
| Starter Kit                       | CP8334        | CP8620              | CP8240       | CP8346       | CP8348       | CP8630               | CP9630               | CP8558           |

# Connectivity ASSPs

| MHL Bridges                       | Sil9292      | Sil9293A        | Sil9296    | Sil9394               | Sil9396<br>Sil9393    | Sil1296    | Sil1292A                    | Sil9617                  |
|-----------------------------------|--------------|-----------------|------------|-----------------------|-----------------------|------------|-----------------------------|--------------------------|
| MHL input                         | MHL1         | MHL2            | MHL2       | MHL3                  | superMHL              | MHL2.0     | MHL1                        | MHL2                     |
| HDMI input                        |              | HDMI1.4         |            |                       | HDMI2.0               | HDMI1.4    | HDMI1.4                     | 2x HDMI1.4               |
| eTMDS input                       |              |                 |            |                       | ✓                     |            |                             |                          |
| HDMI output                       | HDMI1.4      |                 | HDMI1.4    | HDMI1.4               | HDMI2.0               |            | HDMI1.4                     | HDMI1.4                  |
| Other Video Output                |              | Parallel 24-bit |            |                       | superMHL              | VGA        |                             |                          |
| MAX video resolution              | 1080p30      | 1080p60         | 1080p60    | 4K30                  | 4K60                  | 1080p60    | 1080p30 MHL<br>1080p60 HDMI | 1080p60 MHL<br>4K30 HDMI |
| HDCP decryption on input          | Pass through | HDCP 1.4        | HDCP 1.4   | HDCP 1.4/<br>HDCP 2.2 | HDCP 1.4/<br>HDCP 2.2 |            | Pass through                | HDCP 1.3                 |
| HDCP encryption on output         | Pass through |                 | HDCP 1.4   | HDCP 1.4/<br>HDCP 2.2 | HDCP 1.4/<br>HDCP 2.2 |            | Pass through                | HDCP 1.3                 |
| HDCP 2.3 support                  |              |                 |            |                       | Sil9393               |            |                             |                          |
| Dolby Digital / DTS digital Audio |              | ✓               |            | ✓                     | ✓                     | ✓          |                             |                          |
| Object Audio - Dolby Atmos, DTS:X |              | ✓               |            |                       | ✓                     |            |                             |                          |
| 8-ch I2S interface @ 192KHz       |              | ✓               |            | ✓                     | ✓                     |            |                             |                          |
| 8ch TDM                           |              | ✓               |            |                       |                       | ✓          |                             |                          |
| Package                           | 40-pin QFN   | 72-pin QFN      | 49-pin QFN | 76-pin QFN            | 76-pin QFN            | 72-pin QFN | 40-pin QFN                  | 76-pin MQFN              |
| Package size                      | 6 x 6 mm     | 10 x 10 mm      | 7 x 7 mm   | 9 x 9 mm              | 9 x 9 mm              | 10 x 10 mm | 6 x 6 mm                    | 9 x 9 mm                 |
| Starter Kit                       | CP9292       | CP9293          | CP9296     | CP9394                | CP9396 / 9393         | CP1296     | CP1292                      | CP9617                   |

| USB Switches/<br>Type-C Port Controllers | Sil6031                    | Sil7024                     | Sil7033                                 | Sil7014                                   | LIF-UC110                            | LIF-UC140                       |
|--|----------------------------|-----------------------------|---|---|--------------------------------------|---------------------------------|
| Type-C                                   |                            | ✓                           | ✓                                       | ✓   | ✓                                    | ✓                               |
| Main function                            | USB2.0/MHL/<br>UART switch | CC/PD PHY +<br>MHL/debug    | CC/PD PHY + MHL/<br>debug/USB3.1 switch | CC/PD PHY + HPD<br>generator + AUX switch | CC/PD port<br>controller for charger | Full CC/PD port control-<br>ler |
| SuperSpeed switch                        |                            | Gen 1                       | Gen 1                                   |   |                                      |                                 |
| HPD generator                            |                            |                             | ✓                                       | ✓   | ✓                                    | ✓                               |
| High speed video switch                  | MHL1/2/3/<br>superMHL      | MHL1/2/3/<br>superMHL/x 2DP | MHL1/2/3/<br>superMHL/x 2DP             | DP AUX                                    |                                      |                                 |
| Billboard support                        |                            | ✓                           | ✓                                       | ✓   |                                      | ✓                               |
| BMC                                      |                            | ✓                           | ✓                                       | ✓   | ✓                                    | ✓                               |
| VDM                                      |                            | ✓                           | ✓                                       | ✓   | ✓                                    | ✓                               |
| Package                                  | 24 -pin QFN                | 32 -pin QFN                 | 36ball BGA                              | 24 -pin QFN                               | 48 -pin QFN                          | 81ball BGA                      |
| Package size                             | 3 x 3 mm                   | 4 x 4 mm                    | 3 x 3 mm                                | 3 x 3 mm                                  | 7 x 7 mm                             | 4 x 4 mm                        |
| Starter kit                              | CP7033                     | CP7033                      | CP7033                                  | CP7033                                    | iCE5LP4K-USBC-EVN                    | iCE40LP8K-USBC-EVN              |

| HDMI eARC ASSPs             | Sil9437    | Sil9438    |
|-----------------------------|------------|------------|
| eARC Bridges                | Sil9437    | Sil9438    |
| HDMI 2.1 eARC               | Input      | Output     |
| HDMI 2.1 eARC Data Channel  | Input      | Output     |
| HDMI 1.4 ARC fall-back      | Input      | Output     |
| SPDIF                       | Output     | Input      |
| 8-ch I2S interface @ 192KHz | Output     | Input      |
| Package                     | 32-pin QFN | 32-pin QFN |
| Pin Pitch                   | 0.4mm QFN  | 0.4mm QFN  |
| Package Size                | 4 x 4 mm   | 4 x 4 mm   |
| Starter Kit                 | CP9437     | CP9438     |

## WirelessHD® Modules

WirelessHD transmitter and receiver modules are completely self-contained, autonomous WirelessHD subsystems that connect to a host board and provide wireless video connectivity between an HDMI® source and a display. The modules eliminate the complexity associated with radio performance, regulatory requirements, and compliance to standards in wireless system design. The module-to-system interface carries video, audio, power, and control signals. SiBEAM offers three programming cables to suit your needs.



MOD6320-T & MOD6321-R

### Features

- WirelessHD 1.1 compliant device
- 60 GHz interference free link for up to 4 Gbps video data rate
- Small form factor module
- MOD6320-T / MOD6321-R supports maximum video resolution 1080p/60Hz
- MOD6320-4K-T / MOD6321-4K-R supports maximum resolution 1080p/120Hz or 4K30 when used with SiI9396 HDMI bridge
- Average 5 ms video latency, ideal for real-time video delivery
- Support for surround sound audio
- Support for CEC or AVC commands
- HDCP content protection
- Automated advanced power control, for energy saving operation

| Ordering Part Number                                     |                                    |
|--|------------------------------------|
| Wireless Transmitter                                     | MOD6320-T / MOD6320-4K-T           |
| Wireless Transmitter with Cable                          | MOD6320-T-C / MOD6320-4K-T-C       |
| Wireless Receiver  | MOD6321-R / MOD6321-4K-R           |
| Wireless Receiver with Cable                             | MOD6321-R-C / MOD6321-4K-R-C       |
| Wireless Receiver (Dual Polarization Antenna)            | MOD6321-R-12 / MOD6321-4K-R-12     |
| Wireless Receiver (Dual Polarization Antenna) with Cable | MOD6321-R-12-C / MOD6321-4K-R-12-C |

## Full HD Wireless Video Evaluation Kit

A wireless video transmitter and receiver pair that is simple and intuitive to set up. The kit includes software tools to configure and monitor wireless performance.



Wireless HD 1080P

### Features

- WirelessHD 1.1 compliant
- HDMI 1.4b and HDCP 1.4 compliant input and output
- HDCP 2.2 compliant wireless link protection
- Audio and video transmission up to 1080p/60 Hz, 4:4:4
- “Blu-ray quality” video
- Sub-frame latency video transmission
- Range up to 10 meters in-room.
- Operates at 5 V
- Includes a Windows software application for status monitoring and network management

| Ordering Part Number |
|----------------------|
| SK63223A             |

## Ultra HD Wireless Video Evaluation Kit

A wireless video transmitter and receiver pair that is simple and intuitive to set up. The kit includes software tools to configure and monitor wireless performance.



Wireless HD 4K30

### Features

- WirelessHD 1.1 compliant
- HDMI 2.0 and HDCP 2.2 compliant input and output
- HDCP 2.2 compliant wireless link protection
- Audio and video transmission up to 1080p/120 Hz or 4K/30 Hz
- Input and output chroma format: 4:4:4; wireless link chroma format: 4:2:0
- “Blu-ray quality” video
- Sub-frame latency video transmission
- Range up to 10 meters in-room.
- Operates at 5 V
- Includes a Windows software application for status monitoring and network management

| Ordering Part Number |
|----------------------|
| SK63224              |

## GigaRay Modules

The GigaRay MOD65412 module set is a complete, easy to integrate baseband and RF solution for wireless access and backhaul.



### Features

- 60 GHz band – license free in most regions
- Up to 200 m @ 1 Gbps TCP/IP throughput; up to 300 m @ 300 Mbps TCP/IP throughput
- High speed electronic beam-steering with wide beam steering range: +/- 45 degrees horizontal
- SB6541-based PCIe half-height minicard baseband module
- Si16342-based RF module with PCB antenna and integrated EMI shield / heatsink
- Linux device driver

### Ordering Part Number

MOD65412

## GigaRay Evaluation Kit

The mini-PC based GigaRay SK65415 evaluation kit can be used standalone with keyboard, mouse and display, or connected to a separate terminal using an Ethernet cable. The evaluation kit includes software tools for link configuration, performance measurement, statistics logging, beam display and software upgrade.



### Features

- Industrial mini PC with Intel Core i5 dual-core processor, 64GB SSD, 4GB memory
- Integrated MOD65412 baseband and RF module set
- Fedora 19 Linux distribution
- Evaluation software and performance measurement utilities

### Ordering Part Number

SK65415

## GigaRay Development Kit

The GigaRay SK65412 development kit is comprised of the MOD65412 module set and a 150 mm Flat Printed Cable that connects the modules, allowing rapid development.



### Features

- MOD65412 baseband and RF module set
- 150 mm Flat Printed Cable
- Linux device driver

### Ordering Part Number

SK65412

## Snap™ Modules

Lattice Snap modules are completely self-contained, wireless connector solution enabling designer to quickly and efficiently implement short-range, 60 GHz wireless data transfers.



### Features

- Compliant with international regulatory requirements
- Simultaneous wireless transfer of standard protocols such as USB 2.0 (LS, FS, HS), USB 3.1 gen 1, and I<sup>2</sup>C
- 12 Gbps full-duplex wireless data link
- Flexible connector placement with broad fire and edge fire options
- No firmware/drivers required
- Requires a single 3.3 V power rail, connectivity to a USB 3.1 host/ device controller, and an I<sup>2</sup>C connection

### Ordering Part Number

|                                       |         |
|---------------------------------------|---------|
| Edge Fire Module, on USB host side    | MOD6210 |
| Edge Fire Module, on USB device side  | MOD6211 |
| Broad Fire Module, on USB host side   | MOD6212 |
| Broad Fire Module, on USB device side | MOD6213 |

## Edge to Edge Evaluation Kit

A wireless connector pair that is simple and intuitive to set up. Built-in antennas, which are compliant with international regulatory requirements, propagate 60 GHz wireless data from the edge of the module on either side. The kit includes software tools to monitor wireless performance, as well as all of the cables required to get it up and running.



### Features

- MOD6210 host side module and system board
- MOD6211 device side module and system board
- 1x USB Type-A to micro-USB Type-B cable (with USB 3.0 signaling)
- 2x USB Type-A to micro-USB Type-B cable (without USB 3.0 signaling)
- 1x USB 3.0 compatible memory stick
- Windows utility for debugging the wireless link (executable can be found on the memory stick)

### Ordering Part Number

SK621011

## Broad Side to Broad Side Evaluation Kit

A wireless connector pair that is simple and intuitive to set up. Built-in antennas, which are compliant with international regulatory requirements, propagate 60 GHz wireless data from the top side of the module on either side. The kit includes software tools to monitor wireless performance, as well as all of the cables required to get it up and running.



### Features

- MOD6212 host side module and system board
- MOD6213 device side module and system board
- 2x USB Type-A to micro-USB Type-B cable (with USB 3.0 signaling)
- 2x USB Type-A to micro-USB Type-B cable (without USB 3.0 signaling)
- 1x USB 3.0 compatible memory stick
- Windows utility for debugging the wireless link (executable can be found on the memory stick)

### Ordering Part Number

SK621213



### Software Licensing

Email: [lic\\_admn@latticesemi.com](mailto:lic_admn@latticesemi.com)

Web: [latticesemi.com/licensing](http://latticesemi.com/licensing)

### Technical Support



[latticesemi.com/support](http://latticesemi.com/support)

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