

PRODUCT SELECTOR GUIDE

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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.

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 and other mobile devices.

MachXO Portfolio: Bridging and I/O Expansion FPGAs

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 LatticeECP3 and ECP5 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, and industrial automation.

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 comprises 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.

Making Designs Easy and Agile

Lattice's portfolio of FPGAs, CPLDs and Power and Thermal management devices are supported by complete software tools, intellectual property (IP) cores, reference designs, and development kits for integrating a myriad of systems. From the new MIPI DSI and CSI-2 standards for mobile, to PCIe, memory and more mature interfaces, Lattice simplifies your design efforts by offering proven IP cores and the tools to implement them.

For more information go to LATTICESEMI.COM

FPGA Products

ECP Series - Connectivity and Acceleration FPGAs

| Features | | ECP5™ | | | | | | LatticeECP3™ | | | | | LatticeECP2/M™ | | | | | | | | | | | |
|-----------------------|-------------|--|-----------|-----------|----------|----------|----------|-----------------------------|-----------|-----------|-----------|------------|-------------------|-------------|-------------|-------------|--------------|-------------------|-------------|--------------|-------------|-------------|-------------|--|
| Device | | LFE5UM-25 | LFE5UM-45 | LFE5UM-85 | LFE5U-25 | LFE5U-45 | LFE5U-85 | LFE3-17EA | LFE3-35EA | LFE3-70EA | LFE3-95EA | LFE3-150EA | LFE2M20E/SE | LFE2M35E/SE | LFE2M50E/SE | LFE2M70E/SE | LFE2M100E/SE | LFE2-6E/SE | LFE2-12E/SE | LFE2-20E/SE™ | LFE2-35E/SE | LFE2-50E/SE | LFE2-70E/SE | |
| LUTs | | 24 k | 44 k | 84 k | 24 k | 44 k | 84 k | 17 k | 33 k | 67 k | 92 k | 149 k | 19 k | 34 k | 48 k | 67 k | 95 k | 6 k | 12 k | 21 k | 32 k | 48 k | 68 k | |
| EBR SRAM | # of Blocks | 56 | 108 | 208 | 56 | 108 | 208 | 38 | 72 | 240 | 240 | 372 | 66 | 114 | 225 | 246 | 288 | 3 | 12 | 15 | 18 | 21 | 60 | |
| | kbits | 1008 | 1944 | 3744 | 1008 | 1944 | 3744 | 700 | 1,327 | 4,420 | 4,420 | 6,850 | 1,217 | 2,101 | 4,147 | 4,534 | 5,308 | 55 | 221 | 276 | 332 | 387 | 1,032 | |
| Distrib RAM | kbits | 194 | 351 | 669 | 194 | 351 | 669 | 36 | 68 | 145 | 188 | 303 | 41 | 71 | 101 | 145 | 202 | 12 | 24 | 42 | 64 | 96 | 136 | |
| sysDSP™ Blocks | Multipliers | 28 | 72 | 156 | 28 | 72 | 156 | 24 | 64 | 128 | 128 | 320 | 24 | 32 | 88 | 96 | 168 | 12 | 24 | 28 | 32 | 72 | 88 | |
| SERDES | Max. Chan. | 1/2 | 2/4 | | 0 | | | 4 | | 12 | | 16 | | 4 | | 8 | | 16 | | | | | | |
| | Max. Rate | 3.2 Gbit/s | | | | | | 3.2 Gbit/s | | | | | 3.2 Gbit/s | | | | | | | | | | | |
| PLL + DLL | | 2+2 | 4+4 | | 2+2 | | 4+4 | | 2+2 | 4+2 | 10+2 | | 8+2 | | | | | 2+2 | | 4+2 | | 6+2 | | |
| DDR Support | | DDR2 800, DDR3 800, LPDDR2 800, LPDDR3 800 | | | | | | DDR3 800, DDR2 533, DDR 400 | | | | | DDR2 533, DDR 400 | | | | | DDR2 533, DDR 400 | | | | | | |
| Boot Flash | | External | | | | | | External | | | | | External | | | | | External | | | | | | |
| Dual Boot | | ✓ | | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | | |
| Bit-stream Encryption | | ✓ | | | | | | ✓ | | | | | SE only | | | | | SE only | | | | | | |
| Core Vcc | | 1.1 V | | | | | | 1.2 V | | | | | 1.2 V | | | | | 1.2 V | | | | | | |
| Temp. | C | ✓ | | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | | |
| | I | ✓ | | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | | |
| | AEC-Q100 | ✓ | | | | | | ✓ | | | | | | | | | | | | | | | | |
| 0.5 mm Spacing | | I/O Count / SERDES | | | | | | | | | | | | | | | | | | | | | | |
| csfBGA | 285 | 10 x 10 mm | 118/2 | 118/2 | 118/2 | 118/0 | 118/0 | 118/0 | | | | | | | | | | | | | | | | |
| csBGA | 328 | 10 x 10 mm | | | | | | 116/2 | | | | | | | | | | | | | | | | |
| TQFP | 144 | 20 x 20 mm | | | | | | | | | | | | | | | | 90/0 | 93/0 | | | | | |
| PQFP | 208 | 28 x 28 mm | | | | | | | | | | | | | | | | | 131/0 | 131/0 | | | | |
| 0.8 mm Spacing | | I/O Count / SERDES | | | | | | | | | | | | | | | | | | | | | | |
| caBGA | 381 | 17 x 17 mm | 197/2 | 203/4 | 205/4 | 197/0 | 203/0 | 205/0 | | | | | | | | | | | | | | | | |
| | 554 | 23 x 23 mm | | 245/4 | 259/4 | | 245/0 | 259/0 | | | | | | | | | | | | | | | | |
| | 756 | 27 x 27 mm | | | 365/4 | | | 365/0 | | | | | | | | | | | | | | | | |
| 1.0 mm Spacing | | I/O Count / SERDES | | | | | | | | | | | | | | | | | | | | | | |
| ftBGA | 256 | 17 x 17 mm | | | | | | 133/4 | 133/4 | | | | | | | | | | | | | | | |
| fpBGA | 256 | 17 x 17 mm | | | | | | | | | | | 140/4 | | | | | 190/0 | 193/0 | 193/0 | | | | |
| | 484 | 23 x 23 mm | | | | | | 222/4 | 295/4 | 295/4 | 295/4 | | 304/4 | 303/4 | 270/4 | | | | 297/0 | 331/0 | 331/0 | 339/0 | | |
| | 672 | 27 x 27 mm | | | | | | | 310/4 | 380/8 | 380/8 | 380/8 | | 410/4 | 372/8 | | | | | 402/0 | 450/0 | 500/0 | 500/0 | |
| | 900 | 31 x 31 mm | | | | | | | | | | | | | 410/8 | 416/16 | 416/16 | | | | | | 583/0 | |
| | 1152 | 35 x 35 mm | | | | | | | | | | | | | | 436/16 | 520/16 | | | | | | | |
| | 1156 | 35 x 35 mm | | | | | | | | 490/12 | 490/12 | 586/16 | | | | | | | | | | | | |

1) No PLL Available

MachXO & LatticeXP series - Bridging and I/O Expansion FPGAs

| Features | | MachXO3™ | | | | | MachXO2™ | | | | | | | | MachXO™ | | | | LatticeXP2™ | | | | | | | | | | |
|--------------------------|------------------|--------------|--------------|------------------|--------------|--------------|--|------------|-----------------------------|-------------|--------------|-------------|--------------|------------------|----------------|-----------|-----------|-----------|----------------|------------|------------|------------|------------|-----------|----------|-----------|-----------|-----------|--|
| Device | | LCMXO3L-640 | LCMXO3L-1300 | LCMXO3L-2100 | LCMXO3L-4300 | LCMXO3L-6900 | 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 | | 640 | 1300 | 2100 | 4300 | 6900 | 256 | 640 | 640 | 1280 | 1280 | 2112 | 2112 | 4320 | 6864 | 256 | 640 | 640 | 640 | 1200 | 1200 | 2280 | 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 | | 64 | 64 | 74 | 92 | 240 | 0 | 18 | 64 | 64 | 74 | 74 | 92 | 92 | 240 | | | | | 9.2 | 27.6 | | | 166 | 221 | 276 | 387 | 885 | |
| Distrib. RAM kbits | | 10 | 10 | 16 | 34 | 54 | 2 | 5 | 5 | 10 | 10 | 16 | 16 | 34 | 54 | 2 | 6.1 | 6.4 | 6.4 | 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 | | 2+1 | | 2+2 | | | | | 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 NVM | | | | | Internal Flash | | | | | | | | Internal Flash | | | | Internal Flash | | | | | | | | | | |
| Dual Boot ⁴ | | ✓ | | | | | ✓ | | | | | | | | ✓ | | | | ✓ | | | | | | | | | | |
| Bit-stream Encryption | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | |
| Embedded Function Blocks | | | | | | | I ² C (2), SPI (1), Timer (1) | | | | | | | | | | | | ✓ | | | | | | | | | | |
| Core Vcc | | 1.2 V | | E | | | | | | ZE & HE | | | | | | ✓ | | ✓ | | ✓ | | ✓ | | | | | | ✓ | |
| 1.8 - 3.3 V | | | | | | | | | | | | HC | | | | | ✓ | | ✓ | | ✓ | | | | | | | HC | |
| 2.5 - 3.3 V | | | | C | | | | | | | | | | | | | | | | HC | | | | | | | | HC | |
| Temp. | | C | | ✓ | | | | | | | | | | | | | | | | ✓ | | | | | | | | ✓ | |
| I | | ✓ | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | ✓ | |
| AEC-Q100 | | | | | | | | | | | | | | | | | | ✓ | | | | ✓ | | | | | | ✓ | |
| 0.4 mm Spacing | | I/O Count | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WLCSP | 25 | 2.5 x 2.5 mm | | | | | | | | 18 | | | | | | | | | | | | | | | | | | | |
| | 36 ² | 2.5 x 2.5 mm | | 28 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 49 ² | 3.2 x 3.2 mm | | 38 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 81 ² | 3.8 x 3.8 mm | | 63 | | | | | | | | | | | | | | | | | | | | | | | | | |
| ucBGA | 64 | 4 x 4 mm | | | | 44 | | | | | | | | | | | | | | | | | | | | | | | |
| 0.5 mm Spacing | | I/O Count | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| QFN | 32 | 5 x 5 mm | | | | 21 | | | | | | | | | | | | | | | | | | | | | | | |
| csBGA | 100 | 8 x 8 mm | | | | | | | | | | | | | | 78 | | 74 | | | | | | | | | | | |
| | 132 | 8 x 8 mm | | | | 55 | | 79 | | 104 | | 104 | | 104 | | | | | | 101 | | | | | | | | | |
| | 184 ¹ | 8 x 8 mm | | | | | | | | | | | | 150 ¹ | | | | | | | | | | | | | | | |
| csfBGA | 121 ² | 6 x 6 mm | | 100 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 132 | 8 x 8 mm | | | | | | | | | | | | | | | | | | | | | | 86 | | | | | |
| | 256 ² | 9 x 9 mm | | 206 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 324 ² | 10 x 10 mm | | 281 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 | | | | | |
| 0.8 mm Spacing | | I/O Count | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| caBGA | 256 | 14 x 14 mm | | 206 ³ | | | | | | 206 | | 206 | | 206 | | | | 159 | | 211 | | | | | | | | | |
| | 324 | 15 x 15 mm | | 279 ³ | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 332 | 17 x 17 mm | | | | | | | | | | | | 274 | | 278 | | | | | | | | | | | | | |
| | 400 | 17 x 17 mm | | 335 ³ | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.0 mm Spacing | | I/O Count | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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.

FPGA Products (cont)

iCE40 Series - World's Smallest FPGAs

| Features | | iCE40 UltraLite | | iCE40 Ultra | | | iCE40 LM | | | iCE40 LP | | | | | iCE40 HX | | |
|----------------------------|-----|--|-------|-------------|-------|-------|----------|--------|--------|----------|--------|--------------------|--------------------|--------------------|--------------------|---------|---------|
| Device | | UL640 | UL1K | LP1K | LP2K | LP4K | LM1K | LM2K | LM4K | LP384 | LP640 | LP1K | LP4K | LP8K | HX1K | HX4K | HX8K |
| Logic | | 640 | 1248 | 3520 | 2048 | 3520 | 1100 | 2048 | 3520 | 384 | 640 | 1280 | 3520 | 8680 | 1280 | 3520 | 7680 |
| NVCM | | Yes | Yes | Yes | Yes | Yes | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Static Power | | 35 µA | 35 µA | 71 µA | 71 µA | 71 µA | 100 µA | 100 µA | 100 µA | 21 µA | 100 µA | 100 µA | 250 µA | 250 µA | 296 µA | 1140 µA | 1140 µA |
| EBR | | 56 kb | 56 kb | 80 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 | 2 | 2 | 1 | 2 | 2 |
| I ² C core | | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | | | | | | | | |
| SPI Core | | | | 2 | 2 | 2 | 1 | 2 | 2 | | | | | | | | |
| Strobe (low) | | | | | | | 1 | 1 | 1 | | | | | | | | |
| Strobe (high) | | | | | | | 1 | 1 | 1 | | | | | | | | |
| Low Power Oscillator | | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| High Frequency Oscillator | | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| 24 mA Drive | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | 3 | 3 ³ | | | | | |
| 100 mA + 400 mA Drive | | 1 | 1 | | | | | | | | | | | | | | |
| 500 mA Drive | | | | 1 | 1 | 1 | | | | | | | | | | | |
| Mult 16 x 16, Accum 32 bit | | | | 2 | 4 | 4 | | | | | | | | | | | |
| PWM Generator | | Yes | Yes | Yes | Yes | No | | | | | | | | | | | |
| 0.35 mm Spacing | | Total I/Os (Dedicated I/Os)^{4,5} | | | | | | | | | | | | | | | |
| WLCSP | 16 | 1.40 x 1.40 mm | | | | | | | | | | 11(1) ¹ | 11(1) ¹ | | | | |
| | 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) | | | | | | | | | | |
| 0.4 mm Spacing | | Total I/Os (Dedicated I/Os)^{4,5} | | | | | | | | | | | | | | | |
| WLCSP | 36 | 2.5 x 2.5 mm | 26 | 26 | | | 30(2) | 30(2) | 30(2) | 27(2) | | | 27(2) ¹ | | | | |
| ucBGA | 49 | 3 x 3 mm | | | | | 39(2) | 39(2) | 39(2) | 39(2) | | | 37(2) ¹ | | | | |
| | 81 | 4 x 4 mm | | | | | | | | | | | 65(2) | 65(2) ² | 65(2) ² | | |
| | 121 | 5 x 5 mm | | | | | | | | | | | 97(2) | 95(2) | 95(2) | | |
| | 225 | 7 x 7 mm | | | | | | | | | | | | 180(2) | 180(2) | | 180(2) |
| 0.5 mm Spacing | | Total I/Os (Dedicated I/Os)^{4,5} | | | | | | | | | | | | | | | |
| QFN | 32 | 5 x 5 mm | | | | | | | | 23(2) | | | | | | | |
| | 84 | 7 x 7 mm | | | | | | | | | | | 69(2) ¹ | | | | |
| csBGA | 81 | 5 x 5 mm | | | | | | | | | | | 64(2) ¹ | | | | |
| | 121 | 6 x 6 mm | | | | | | | | | | | 94(2) | | | | |
| | 132 | 8 x 8 mm | | | | | | | | | | | | | 97(2) | 97(2) | 97(2) |
| VQFP | 100 | 14 x 14 mm | | | | | | | | | | | | | 74(2) ¹ | | |
| TQFP | 144 | 20 x 20 mm | | | | | | | | | | | | | 98(2) | 109(2) | |
| 0.8 mm Spacing | | Total I/Os (Dedicated I/Os)^{4,5} | | | | | | | | | | | | | | | |
| 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.

Lattice Power and Thermal Management Products

| Features | Power & Thermal Management | | Power Management | | | | |
|---------------------------------|----------------------------|-----------------------|------------------|------------------|-------------|---------|---------|
| | L-ASC10 | LPTM21 | POWR1220AT8 | POWR101 | POWR1220AT8 | 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 | Yes | Yes | No | No | No | No | No |
| 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 ² C | I ² C/JTAG | I ² C | I ² C | | | |
| Programming Interface | I ² C | I ² 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 | Yes | Yes | No | No | No | No | No |
| Package Options | Digital I/Os | | | | | | |
| 48-pin QFN (7 x 7) | 9(e) | | | | | | |
| 237-Ball ftBGA (1 mm) (17 x 17) | | 95 + 10(d) | | | | | |
| 100-pin TQFP (14 x 14) | | | 22(a) | | | | |
| 48-pin TQFP (7 x 7) | | | | 16(b) | 16(b) | | |
| 32-pin QFN (5 x 5) | | | | | | 7(c) | |
| 24-pin QFN (4 x 4) | | | | | | 7(c) | 7(c) |

- 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 14 (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

CPLD Products

ispMACH 4000 Series

| Features | ispMACH® 4000ZE | | | | ispMACH® 4000V/B/C | | | | | | |
|--------------------------------|---------------------------------------|--|--------|---------|-----------------------------------|---------|---------|---------|---------|---------|---------|
| 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/B=2.5/C=1.8 | | | | | | |
| 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 | |
| 0.4 mm Spacing | | I/O Count + Inputs | | | | | | | | | |
| ucBGA | 64 | 4 x 4 mm | 48 + 4 | | | | | | | | |
| | 132 | 6 x 6 mm | | 96 + 4 | | | | | | | |
| TQFP | 128 | 14 x 14 mm | | | | | 92 + 4 | | | | |
| 0.5 mm Spacing | | I/O Count + Inputs | | | | | | | | | |
| 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 | | | | | |
| 0.8 mm Spacing | | I/O Count + Inputs | | | | | | | | | |
| TQFP | 44 | 10 x 10 mm | | | | | 30 + 2 | 30 + 2 | | | |
| 1.0 mm Spacing | | Total I/Os (Dedicated I/Os)^{4,5} | | | | | | | | | |
| ftBGA | 256 | 17 x 17 mm | | | | | | | 160 + 4 | 192 + 4 | 208 + 4 |

Lattice IP Cores and Reference Designs

Lattice 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. Note that a Diamond Subscription License and the IP license are required to use the IPs for production.

| | IP Core | ECP5 | LatticeECP3 | LatticeECP2/M | LatticeECP2 | MachXO2 | MachXO | LatticeXP2 |
|------------------------------------|--|------|-------------|---------------|-------------|---------|--------|------------|
| Communications | 10 Gigabit Ethernet MAC | ✓ | ✓ | ✓ | ✓ | | | |
| | 2.5 Gb Ethernet MAC | ✓ | | | | | | |
| | 2.5 Gb Ethernet PCS | ✓ | ✓ | | | | | |
| | CPRI | ✓ | ✓ | ✓ | | | | |
| | SGMI and Gigabit Ethernet PCS | ✓ | ✓ | ✓ | | | | |
| | Triple Speed 10/100/1G Ethernet MAC | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | XAUI | ✓ | ✓ | ✓ | | | | |
| Connectivity | PCI Express x1 Endpoint | ✓ | ✓ | ✓ | | | | |
| | PCI Express x2 Endpoint | ✓ | | | | | | |
| | PCI Express x4 Endpoint | ✓ | ✓ | ✓ | | | | |
| | PCI Express Root Complex Lite X1 | | ✓ | ✓ | | | | |
| | PCI Express Root Complex Lite X4 | | ✓ | ✓ | | | | |
| | PCIe w. Multi Function | ✓ | | | | | | |
| | PIPE | | ✓ | | | | | |
| | PCI Master/Target 33 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | PCI Master/Target 66 | | ✓ | ✓ | ✓ | | | ✓ |
| | PCI Target 33 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | PCI Target 66 | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| | Tri-Rate Serial Digital Interface (SDI) PHY | ✓ | ✓ | | | | | |
| | JESD204A | | ✓ | | | | | |
| JESD204B | ✓ | ✓ | | | | | | |
| JESD207 | ✓ | ✓ | | | | | | |
| Digital Signal Processing | 2D Edge Detector | | ✓ | ✓ | ✓ | | | ✓ |
| | 2D FIR Filter | | ✓ | ✓ | ✓ | | | ✓ |
| | 2D Scaler | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | Block Convolutional Encoder | | ✓ | ✓ | ✓ | | | ✓ |
| | Block Viterbi Decoder | | ✓ | ✓ | ✓ | | | ✓ |
| | Cascaded Integrator-Comb (CIC) Filter | | ✓ | ✓ | ✓ | | | ✓ |
| | Color Space Converter | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | CORDIC | | ✓ | ✓ | ✓ | | | ✓ |
| | Deinterlacer | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | Distributed Arithmetic (DA) FIR Filter | | ✓ | ✓ | ✓ | | | ✓ |
| | Divider | | ✓ | ✓ | ✓ | | | ✓ |
| | Dynamic Block Reed-Solomon Decoder | | ✓ | ✓ | ✓ | ✓ | | ✓ |
| | Dynamic Block Reed-Solomon Encoder | | ✓ | ✓ | ✓ | ✓ | | ✓ |
| | FFT Compiler | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | FIR Filter Generator | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | Gamma Corrector | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | Interleaver/De-interleaver | | ✓ | ✓ | ✓ | | | ✓ |
| | Median Filter | | ✓ | ✓ | ✓ | | | ✓ |
| | Numerically-Controlled Oscillator (NCO) | | ✓ | ✓ | ✓ | | | ✓ |
| | Peak Cancellation Crest Factor Reduction (CFR) | ✓ | ✓ | | | | | |
| Processor, Controller & Peripheral | DDR SDRAM Controller | | ✓ | ✓ | ✓ | | | ✓ |
| | DDR SDRAM Controller Pipelined | | | | | ✓ | | |
| | DDR2 SDRAM Controller | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| | DDR2 SDRAM Controller Pipelined | | | | | ✓ | | |
| | DDR3 SDRAM Controller | ✓ | ✓ | | | | | |
| | DDR3 SDRAM PHY | ✓ | ✓ | | | | | |
| | LatticeMico32 - Embedded Processor | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| | LatticeMico8 - Embedded Processor | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | LPDDR SDRAM Controller | | | | | ✓ | | |
| | LPDDR3 SDRAM Controller | ✓ | | | | | | |
| | Scatter Gather DMA | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| Video & Imaging | Display Interface Mux | | | | | ✓ | | |
| | DVB-ASI | | ✓ | | | | | |
| | Video Frame Buffer | ✓ | ✓ | ✓ | ✓ | | | ✓ |

Lattice IP Cores and Reference Designs (cont)

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

Lattice IP Cores and Reference Designs (cont)

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, I²C, SPI, and MIPI solutions. For a complete listing of reference designs from Lattice please go to latticesemi.com/IP.

| Name | Reference Design No. | ECP5 | Lattice ECP3 | Mach XO3 | Mach XO2 | Mach XO | Lattice XP2 | iCE40 LP/HX/LM | iCE40 Ultra | WISHBONE Compatible | Format | |
|---|----------------------|------|--------------|----------|----------|---------|-------------|----------------|-------------|---------------------|---------|------|
| | | | | | | | | | | | Verilog | VHDL |
| 7:1 LVDS Video Interface | RD1030 | | ✓ | | | | ✓ | | | | ✓ | ✓ |
| 8b/10b Encoder/Decoder | RD1012 | | ✓ | | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| ADC Interface | RD1089 | | ✓ | | | | | | | | ✓ | ✓ |
| BSCAN - Multiple Boundary Scan Port Addressable Buffer (BSCAN1) | RD1001 | | | | ✓ | ✓ | ✓ | | | | | |
| BSCAN - Multiple Boundary Scan Port Linker (BSCAN 2) | RD1002 | ✓ | | | ✓ | ✓ | ✓ | | | | | |
| Controller Area Network (CAN) Controller | RD1170 | | | | | | | ✓ | | | ✓ | |
| FPGA Loader | AN8077 | | | | ✓ | ✓ | ✓ | | | | | |
| GPIO Expander | RD1065 | | ✓ | | | ✓ | ✓ | | | | ✓ | ✓ |
| HDMI/DVI Interface | RD1097 | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| HiSPi-to-Parallel Sensor Bridge | RD1120 | ✓ | ✓ | ✓ | ✓ | | ✓ | | | | ✓ | ✓ |
| I ² C Bus Controller for Serial EEPROM | RD1006 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| I ² C Master Controller | RD1005 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| I ² C Master Controller | RD1139 | | | | | | | ✓ | | | ✓ | |
| I ² C Master with WISHBONE Controller | RD1046 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| I ² C Slave Controller | RD1140 | | | | | | | ✓ | | | ✓ | |
| I ² C Slave Peripheral Using Embedded Function Block | RD1124 | | | ✓ | ✓ | | | | | ✓ | ✓ | ✓ |
| I ² C Slave to SPI Master Bridge | RD1094 | | | | | ✓ | | | | | ✓ | ✓ |
| I ² C Slave/Peripheral | RD1054 | ✓ | ✓ | | | ✓ | ✓ | | | | ✓ | ✓ |
| I ² C to SPI Bridge | RD1172 | | | | | | | ✓ | | | ✓ | ✓ |
| I2S Controller | RD1101 | | | ✓ | ✓ | ✓ | | | | | ✓ | ✓ |
| I2S Controller | RD1171 | | | | | | | ✓ | | | ✓ | ✓ |
| iCE40 Ultra Barcode Emulation Reference 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 | | | | | | | ✓ | | | ✓ | |
| Keypad Scanner | RD1180 | | | | | | | ✓ | | | | ✓ |
| 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 ² C Embedded Programming Access Firmware | RD1129 | | | | ✓ | | | | | ✓ | ✓ | |
| MachXO2 Soft I ² C Slave with Clock Stretching | 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 | | | | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| 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 | RD1045 | | ✓ | | | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| PWM Fan Controller | RD1060 | | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| PWM Generator | RD1178 | | | | | | | ✓ | | | | ✓ |
| RAM-Type Interface for Embedded User Flash Memory | RD1126 | | | | ✓ | | | | | ✓ | ✓ | |
| RC4 Based PRNG Generator | RD1179 | | | | | | | ✓ | | | | ✓ |
| Read and Write Usercode | RD1041 | | | ✓ | ✓ | ✓ | | | | | ✓ | ✓ |
| RGMI1 to GMII Bridge | RD1022 | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| SD Flash Controller - WISHBONE Compatible | RD1048 | | | | | ✓ | ✓ | | | | ✓ | ✓ |
| SD Host Controller | RD1165 | | | | | | | ✓ | | | ✓ | ✓ |
| SDR SDRAM Controller | RD1174 | | | ✓ | | | | ✓ | | | ✓ | |
| SDR SDRAM Controller – Advanced | RD1010 | ✓ | ✓ | | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| Simple Sigma-Delta ADC | RD1066 | | | | ✓ | ✓ | ✓ | | | | ✓ | ✓ |

Continued on next page

Lattice IP Cores and Reference Designs (cont)

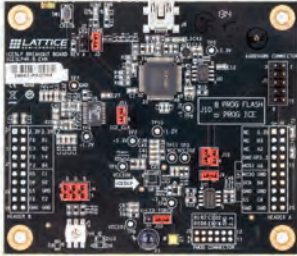
| Name | Reference Design No. | ECP5 | Lattice ECP3 | Mach XO3 | Mach XO2 | Mach XO | Lattice XP2 | iCE40 LP/HX/LM | iCE40 Ultra | WISHBONE Compatible | Format | |
|--|----------------------|------|--------------|----------|----------|---------|-------------|----------------|-------------|---------------------|---------|------|
| | | | | | | | | | | | Verilog | VHDL |
| SMPTE SDI Dual HD from/to 3G Level-B Converter | RD1132 | | ✓ | | | | | | | | ✓ | |
| SPI Master Controller | RD1141 | | | | | | | ✓ | | | ✓ | |
| SPI Peripheral | RD1075 | | | | | ✓ | | | | | ✓ | ✓ |
| SPI Slave Controller | RD1142 | | | | | | | ✓ | | | ✓ | ✓ |
| SPI Slave Peripheral Using the Embedded Function Block | RD1125 | | | ✓ | ✓ | | | | | ✓ | ✓ | ✓ |
| SPI Slave Port Expander | RD1168 | | | | | | | ✓ | | | | ✓ |
| SPI to I ² C Bridge | RD1173 | | | | | | | ✓ | | | ✓ | |
| 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 ² C Bus Controller for Serial EEPROMs | RD1006 | ✓ | ✓ | | ✓ |
| I ² C (Inter-Integrated Circuit) Bus Master | RD1005 | ✓ | | | ✓ |
| I ² 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 | ✓ | | | |

iCE40 Ultra Breakout

Featuring the world's smallest FPGA, optimized for mobile applications. Typical mobile interfaces like RGB & Ir and Torch LEDs are included, as well as access to every device IO.



Features

- iCE5LP-4K FPGA in 0.35 mm pitch 36-ball WLCSP
- RGB LED
- High-brightness "Torch" LED
- Infrared (Ir) LED
- Status LEDs
- Access to all device IO
- On-board 32 Mbit SPI flash for reconfiguration
- Windows & Mac-based GUI for interface to the RGB LED, includes FPGA source code.
- USB A to USB B (mini) Cable for FPGA Power and Programming via a PC

- QuickSTART Guide

Ordering Part Number

ICE5LP4K-B-EVN

iCE40LM4K Sensor

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 and 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

A simple, low-cost board with and iCE40—HX8K FPGA, and generous IO access.



Features

- iCE40HX-8k 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
- 12 MHz oscillator
- Jumpers to select programming the SPI flash or iCE40HX-8k
- USB A to USB B (mini) Cable for FPGA Programming via a PC
- Demo designs available for download

Ordering Part Number

ICE40HX8K-B-EVN

iCE40 16-WLCSP Evaluation Kit

Features the worlds smallest 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
- 27 MHz on-board oscillator
- SMA Connector for external clock input.
- SPI Configuration Flash
- Power & Programming via USB (cable included)

- Windows & Mac-based GUI for interface to the RGB LED, includes FPGA source code.
- USB A to USB B (mini) Cable for FPGA Power and Programming via a PC

Ordering Part Number

ICE40LP1K-SWG16-EVN

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
- 2 x 6 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 12 MHz MEMS oscillator
- Micron 32 Mbit N25Q32 SPI flash
- USB connector provides the power supply
- 16 LVCMOS/LVTTL (3.3 V) digital I/O connections on 0.1" through-hole connections

- IrDA & Tx/Rx Reference Design available for download

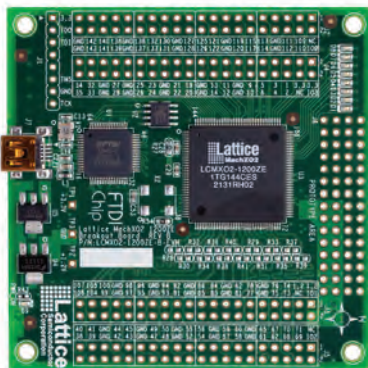
Ordering Part Number

ICE40HX1K-STICK-EVN

MachXO2 Boards and Kits

MachXO2 Breakout Features

- MachXO2 LCMXO2-7000HE
- Access to all device IO via four 2 x 20 expansion header landings for IO, JTAG and external power
- 60-hole prototype area
- USB mini connector for power and programming (cable included)
- Eight general purpose LEDs
- 3.3 V and 1.2 V supply rails



MachXO2 Pico Features

- MachXO2 LCMXO2-1200ZE
- 4-character 16-segment LCD display
- 4 capacitive touch sense buttons
- 1 Mbit 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
- QuickSTART Guide



MachXO2 Control Features

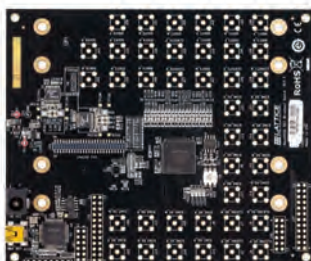
- MachXO2 LCMXO2-4000HC
- Power Manager II ispPAC-POWR1014A
- 128 Mbit LPDDR memory, 4 Mbit SPI Flash
- Current and voltage sensor circuits
- SD memory card socket
- Microphone
- Audio Amplifier and Delta-Sigma ADC
- Up to two DVI sources and one DVI output.
- Up to two Display Inputs (7:1 LVDS) and 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)
- QuickSTART Guide

Ordering Part Number

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

MachXO3L Breakout Boards

Available in two versions; for DSI video applications with 50 pin Harwin Archer connector (pictured), or Breakout with 40 SMA connectors for general LVDS IO evaluation.



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 IO 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 A to USB B (mini) Cable for power and FPGA Programming via a PC
- DC jack for supplemental power input
- QuickSTART Guide

Ordering Part Number

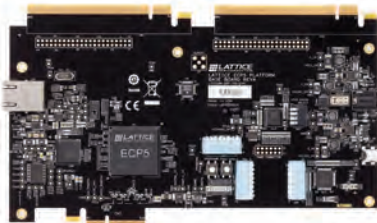
| | |
|-----------------------|-----------------|
| MachXO3L SMA Breakout | LCMXO3L-SMA-EVN |
| MachXO3L DSI Breakout | LCMXO3L-DSI-EVN |

Development Kits

ECP

ECP5 PCI Express Development Kit

For evaluation and development with the ECP5 FPGA, including PCIe and DDR3 on-board.



Features

- ECP5 FPGA: LFE5-85UM in 756 caBGA package
- PCI Express x4 Edge Connector
- Two 44 pin expansion connectors
- RJ45 interface to gigabit for Ethernet to RGMII
- USB Mini for FPGA Programming
- 128 Mbit Serial Flash memory
- 8 GB LPDDR3
- Switches and LEDs for general user input/output
- Easy power measurements via probable powerresistors

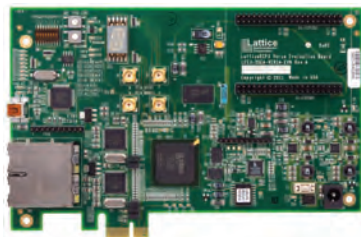
- PCI Express Demos available for download
- USB A to USB B (mini) Cable for FPGA Programming via a PC
- 12 V AC Power Adapter with International Plugs
- QuickSTART Guide

Ordering Part Number

LFE5UM-85F-PB-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 1.1 x1 Edge Connector Interface
 - Two Gigabit Ethernet Ports (RJ45)
 - 4 SMA Connectors for SERDES Access
 - USB Mini for FPGA Programming
 - LatticeECP3 FPGA: LFE3-35EA-FF484
 - 64 Mbit Serial Flash memory
 - 1 GB DDR3 Memory
 - 14 segment alpha-numeric 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 A to USB B (Mini) Cable for FPGA Programming via a PC
- 12 V AC Power Adapter and International Plug Adapters
- QuickSTART Guide

Ordering Part Number

LFE3-35EA-VERSA-EVN

Video

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
- 1080p / 60 frames-per-second
- Extremely Low-latency
- Auto-exposure
- Supports dual-sensors simultaneously
- Direct HDMI/DVI output from FPGA
- On-board Ethernet PHY
- HDR Image processing reference design
- > 120 dB 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 | LCMX02-4000HE-DSIB-EVN |
| CSI2-to-Parallel Bridge | LF-C2P-EVN |
| MT9M024 Sensor NanoVesta | LF-9MT024NV-EVN |
| MN34041 Sensor NanoVesta | LF-PNV-EVN |

Industrial

HMI Development Kit

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



Features

- Includes LatticeECP3 Versa Board
- 480 x 272 Touchscreen included
- SD Card for loading 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 OS or custom coding – all GUI
 - Implement on ECP3 or XO2/3L
 - Only 8 k LUTs of FPGA required
 - Eval version included with the board

- USB A to USB B (mini) Cable for FPGA Programming via a PC
- 12 V AC Power Adapter with International Plugs
- QuickSTART Guide

Ordering Part Number

LFE3-35EA-HMI-DKN

Development Kits

LPTM21

LPTM21 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 monitor & 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

POWR1220

POWR1220 Hercules Development Kit

The Power Manager II Hercules Development Kits are versatile, ready to use hardware platforms for evaluating and designing with Power Manager II devices.



POWR1014

POWR1014 Breakout Board

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



POWR607

POWR607 Board

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



Development Kits

POWR607

POWR605 (ProcessorPM) Development Kit

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



LatticeXP2

LatticeXP2 Brevia2 Development Kit

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



Features

- LatticeXP2 FPGA: LFXP2-5E-6TN144C
- 2 Mbit SPI Flash Memory
- 1 Mbit SRAM
- Programmed via included mini-USB Cable
- 2 x 20 and 2 x 5 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

More

Additional Boards and Kits

Lattice and our hardware partners produce many additional boards with a rich selection of features to match your needs.

To explore our full catalog, download additional information and place an order, visit latticesemi.com/boards

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 download your completed program/configuration. Programming Cables can also be used to help debug your hardware designs with Lattice software like the Reveal Logic Analyzer.

Lattice offers three programming cables to suit your needs.

- **ispDOWNLOAD Parallel Cable (HW-DLN-3C).** This connects to a PC parallel port and is best for basic JTAG programming.
- **ispDOWNLOAD USB Cable (HW-USBN-2A).** In addition to basic programming, use for Reveal Logic analyzer and other debug applications.
- **USB Programming Cable (HW-USBN-2B - pictured).** The latest-generation cable adds I²C programming and various other features.



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

Desktop Programmers

Lattice offers two desktop programmers for prototype “off-board” programming of Lattice products with non-volatile memory elements.

The Lattice Model 300 Desktop Programmer (pictured) supports most Lattice FPGA and CPLD products (1.8 V, 2.5 V, 3.3 V, and 5 V programming voltages).

The iCEprog Desktop Programmer supports all Lattice iCE products.

Operation of the Desktop Programmers is controlled by Lattice’s Diamond Programmer software. A Lattice programming cable is included with each Desktop Programmer to facilitate communication with the PC.

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.



| 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 that are not mounted onto a board.

Socket adapters are available for all Lattice products that include non-volatile memory elements. Socket adapters are generally designed for a device family/package combination. For example, a single Socket Adapter - PN-FT256/LFXP2 - is used to program any LatticeXP2 FPGA device in the 256-ball ftBGA package.

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

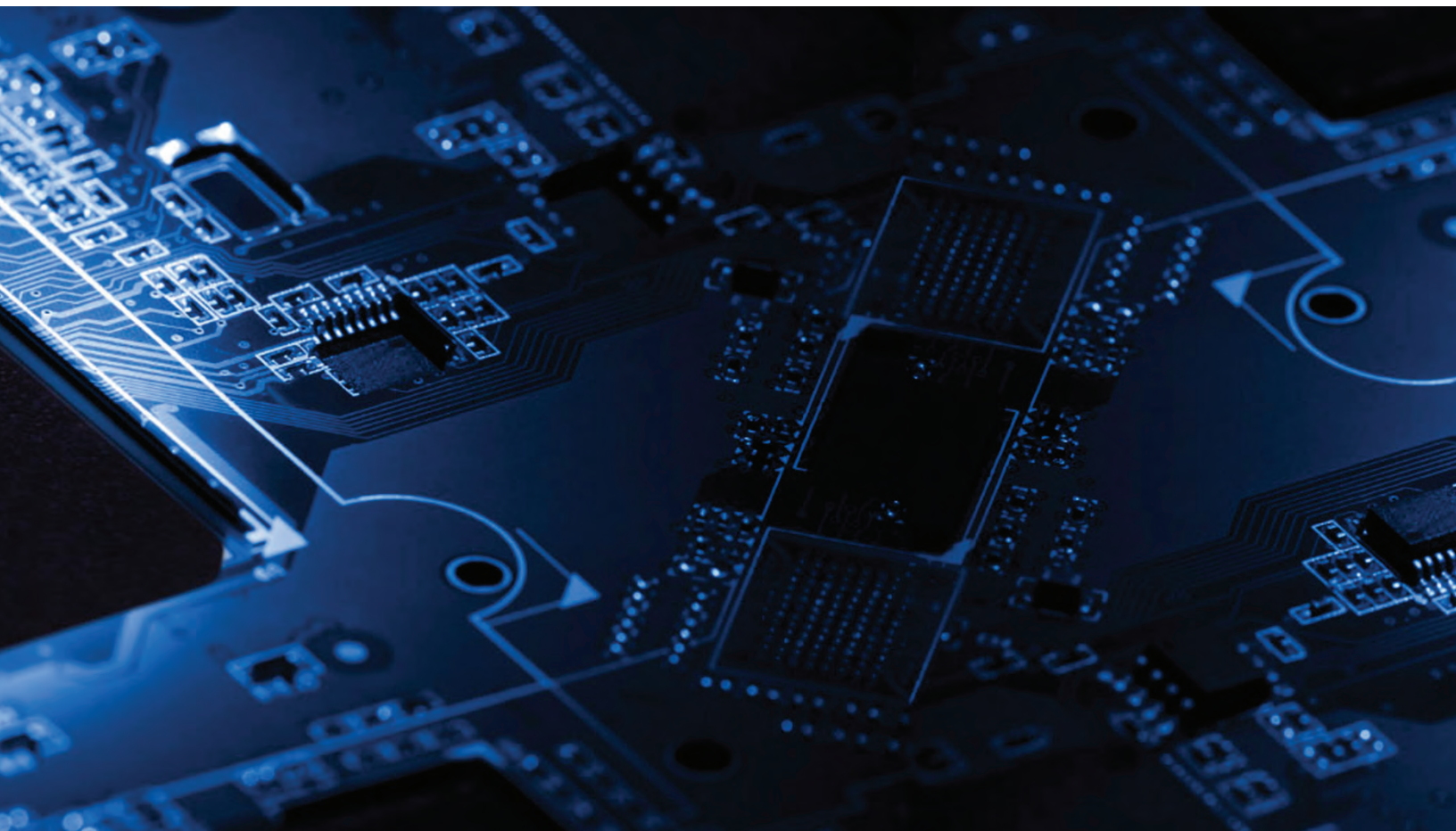
More information and a complete list of Lattice Socket Adapter products is available for download on the Lattice website.



FPGA and CPLD Design Software

Complete Design Flows - High Ease of Use

| | | Lattice Diamond™ (Subscription License) Windows/Linux | Lattice Diamond™ (Free) Windows/Linux | ispLEVER™ Classic (Free) Windows | iCEcube2™ (Free) Windows/Linux | PAC-Designer |
|--|--|---|---|--|--------------------------------------|---|
| Device Families | ECP5 | ✓ | | | | |
| | LatticeECP3 | ✓ | | | | |
| | LatticeECP2M/S | ✓ | | | | |
| | LatticeECP2S | ✓ | | | | |
| | MachXO2 | ✓ | ✓ | | | |
| | MachXO3 | ✓ | ✓ | | | |
| | MachXO | ✓ | ✓ | | | |
| | LatticeXP2 | ✓ | ✓ | | | |
| | LatticeXP | ✓ | ✓ | | | |
| | LatticeECP2 | ✓ | ✓ | | | |
| | iCE40 | | | | ✓ | |
| | ispMACH 4000B/CV/ZE | | | ✓ | | |
| | Platform Manager 2 | Lattice Diamond Supports Platform Manager 2 & L-ASC10 | Lattice Diamond (free) supports designing with Platform Manager 2 and L-ASC10 | | | PAC-Designer supports Power manager II products |
| | L-ASC10Power Manager II | Lattice Diamond Supports Platform Manager 2 & L-ASC10 | Lattice Diamond (free) supports designing with Platform Manager 2 and L-ASC10 | | | PAC-Designer supports Power manager II products |
| Software Features | Design Exploration | ✓ | ✓ | | ✓ | |
| | Project Management | ✓ | ✓ | ✓ | ✓ | |
| | VHDL & Verilog Support | ✓ | ✓ | ✓ | ✓ | |
| | EDIF Support | ✓ | ✓ | ✓ | ✓ | |
| | Schematic Support | ✓ | ✓ | ✓ | ✓ | |
| | ABEL | | | ✓ | | ABEL language is supported in PAC-Designer software |
| | Synopsys® Synplify Pro™ for Lattice-Synthesis | ✓ | ✓ | ✓ | ✓ | |
| | Lattice Synthesis Engine (LSE) | MachXO2/MachXO Only | MachXO2/MachXO Only | | ✓ | |
| | IP and Module Configuration | ✓ | ✓ | Module Only | Module Only | |
| | Power Estimation & Calculation | ✓ | ✓ | | ✓ | |
| | Timing Analysis | ✓ | ✓ | ✓ | ✓ | |
| | Integrated HDL 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 | ✓ | | |
| Operating Systems | Windows 7/8/XP/Vista (32 bit and 64 bit) | ✓ | ✓ | ✓ | ✓ | |
| | Linux (Red Hat Enterprise v4, v5, v6; 32 bit and 64 bit) | ✓ | ✓ | | ✓ | |
| Licensing & Updates | License Terms | One Year Subscription | One Year – Renewable | One Year – Renewable | One Year – Renewable | |
| | Node-Locked License | ✓ | ✓ | ✓ | ✓ | |
| | Floating License | ✓ | | | ✓ | |



Software Licensing

Email: lic_admn@latticesemi.com

Web: latticesemi.com/licensing

Technical Support

Email: techsupport@latticesemi.com

Web: latticesemi.com/support

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- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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