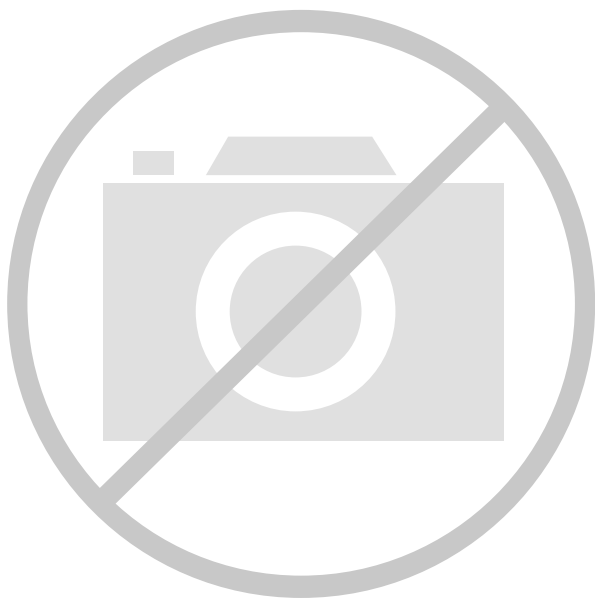




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## Understanding [Embedded - FPGAs \(Field Programmable Gate Array\)](#)

Embedded - FPGAs, or Field Programmable Gate Arrays, are advanced integrated circuits that offer unparalleled flexibility and performance for digital systems. Unlike traditional fixed-function logic devices, FPGAs can be programmed and reprogrammed to execute a wide array of logical operations, enabling customized functionality tailored to specific applications. This reprogrammability allows developers to iterate designs quickly and implement complex functions without the need for custom hardware.

## Applications of Embedded - FPGAs

The versatility of Embedded - FPGAs makes them indispensable in numerous fields. In telecommunications.

### Details

|                                |                                                                                                                                                                               |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Status                 | Obsolete                                                                                                                                                                      |
| Number of LABs/CLBs            | 20000                                                                                                                                                                         |
| Number of Logic Elements/Cells | 80000                                                                                                                                                                         |
| Total RAM Bits                 | 5816320                                                                                                                                                                       |
| Number of I/O                  | 904                                                                                                                                                                           |
| Number of Gates                | -                                                                                                                                                                             |
| Voltage - Supply               | 0.95V ~ 1.26V                                                                                                                                                                 |
| Mounting Type                  | Surface Mount                                                                                                                                                                 |
| Operating Temperature          | 0°C ~ 85°C (TJ)                                                                                                                                                               |
| Package / Case                 | 1704-BBGA, FCBGA                                                                                                                                                              |
| Supplier Device Package        | 1704-OFCBGA (42.5x42.5)                                                                                                                                                       |
| Purchase URL                   | <a href="https://www.e-xfl.com/product-detail/lattice-semiconductor/lfsc3ga80e-7ffn1704c">https://www.e-xfl.com/product-detail/lattice-semiconductor/lfsc3ga80e-7ffn1704c</a> |

## Modes of Operation

Each Slice is capable of four modes of operation: Logic, Ripple, RAM and ROM. Table 2-2 lists the modes and the capability of the Slice blocks.

**Table 2-2. Slice Modes**

|           | Logic              | Ripple                | RAM                  | ROM      |
|-----------|--------------------|-----------------------|----------------------|----------|
| PFU Slice | LUT 4x2 or LUT 5x1 | 2-bit Arithmetic Unit | SPR 16x2<br>DPR 16x2 | ROM 16x2 |

## Logic Mode

In this mode, the LUTs in each Slice are configured as combinatorial lookup tables. A LUT4 can have 16 possible input combinations. Any logic function with four inputs can be generated by programming this lookup table. Since there are two LUT4s per Slice, a LUT5 can be constructed within one Slice. Larger lookup tables such as LUT6, LUT7 and LUT8 can be constructed by concatenating other Slices in the PFU.

## Ripple Mode

Ripple mode allows the efficient implementation of small arithmetic functions. In ripple mode, the following functions can be implemented by each Slice:

- Addition 2-bit
- Subtraction 2-bit
- Up counter 2-bit
- Down counter 2-bit
- Comparator functions of A and B inputs
  - A greater-than-or-equal-to B
  - A not-equal-to B
  - A less-than-or-equal-to B

Ripple Mode includes an optional configuration that performs arithmetic using fast carry chain methods. In this configuration (also referred to as CCU2 mode) two additional signals, Carry Generate and Carry Propagate, are generated on a per slice basis to allow fast arithmetic functions to be constructed by concatenating Slices.

## RAM Mode

In this mode, distributed RAM can be constructed using each LUT block as a 16x1-bit memory. Through the combination of LUTs and Slices, a variety of different memories can be constructed.

The Lattice design tools support the creation of a variety of different size memories. Where appropriate, the software will construct these using distributed memory primitives that represent the capabilities of the Slice. Table 2-3 shows the number of Slices required to implement different distributed RAM primitives. Dual port memories involve the pairing of two Slices, one Slice functions as the read-write port. The other companion Slice supports the read-only port. For more information on RAM mode, please see details of additional technical documentation at the end of this data sheet.

**Table 2-3. Number of Slices Required For Implementing Distributed RAM**

|                  | SPR16x2 | DPR16x2 |
|------------------|---------|---------|
| Number of Slices | 1       | 2       |

Note: SPR = Single Port RAM, DPR = Dual Port RAM

## ROM Mode

The ROM mode uses the same principal as the RAM modes, but without the Write port. Pre-loading is accomplished through the programming interface during configuration.

## PFU Modes of Operation

Slices can be combined within a PFU to form larger functions. Table 2-4 tabulates these modes and documents the functionality possible at the PFU level.

**Table 2-4. PFU Modes of Operation**

| Logic                      | Ripple            | RAM                          | ROM          |
|----------------------------|-------------------|------------------------------|--------------|
| LUT 4x8 or<br>MUX 2x1 x 8  | 2-bit Add x 4     | SPR 16x2 x 4<br>DPR 16x2 x 2 | ROM 16x1 x 8 |
| LUT 5x4 or<br>MUX 4x1 x 4  | 2-bit Sub x 4     | SPR 16x4 x 2<br>DPR 16x4 x 1 | ROM 16x2 x 4 |
| LUT 6x2 or<br>MUX 8x1 x 2  | 2-bit Counter x 4 | SPR 16x8 x 1                 | ROM 16x4 x 2 |
| LUT 7x1 or<br>MUX 16x1 x 1 | 2-bit Comp x 4    |                              | ROM 16x8 x1  |

## Routing

There are many resources provided in the LatticeSC devices to route signals individually or as busses with related control signals. The routing resources consist of switching circuitry, buffers and metal interconnect (routing) segments.

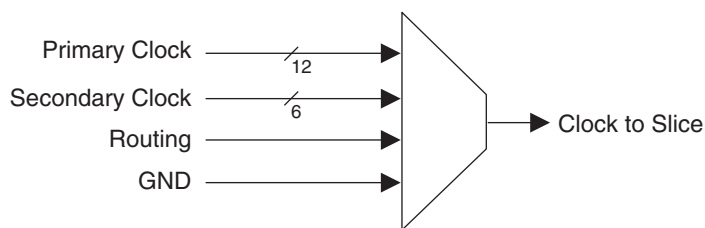
The inter-PFU connections are made with x1 (spans two PFU), x2 (spans three PFU) and x6 (spans seven PFU) resources. The x1 and x2 connections provide fast and efficient connections in horizontal, vertical and diagonal directions. All connections are buffered to ensure high-speed operation even with long high-fanout connections.

The ispLEVER design tool takes the output of the synthesis tool and places and routes the design. Generally, the place and route tool is completely automatic, although an interactive routing editor is available to optimize the design.

## sysCLOCK Network

The LatticeSC devices have three distinct clock networks for use in distributing high-performance clocks within the device: primary clocks, secondary clocks and edge clocks. In addition to these dedicated clock networks, users are free to route clocks within the device using the general purpose routing. Figure 2-4 shows the clock resources available to each slice.

**Figure 2-4. Slice Clock Selection**



Note: GND is available to switch off the network.

## Primary Clock Sources

LatticeSC devices have a wide variety of primary clock sources available. Primary clocks sources consists of the following:

- Primary clock input pins
- Edge clock input pins
- Two outputs per DLL

**Table 2-5. sysMEM Block Configurations**

| Memory Mode      | Configurations                                                              |
|------------------|-----------------------------------------------------------------------------|
| Single Port      | 16,384 x 1<br>8,192 x 2<br>4,096 x 4<br>2,048 x 9<br>1,024 x 18<br>512 x 36 |
| True Dual Port   | 16,384 x 1<br>8,192 x 2<br>4,096 x 4<br>2,048 x 9<br>1,024 x 18             |
| Pseudo Dual Port | 16,384 x 1<br>8,192 x 2<br>4,096 x 4<br>2,048 x 9<br>1,024 x 18<br>512 x 36 |
| FIFO             | 16,384 x 1<br>8,192 x 2<br>4,096 x 4<br>2,048 x 9<br>1,024 x 18<br>512 x 36 |

## Bus Size Matching

All of the multi-port memory modes support different widths on each of the ports. The RAM bits are mapped LSB word 0 to MSB word 0, LSB word 1 to MSB word 1 and so on. Although the word size and number of words for each port varies, this mapping scheme applies to each port.

## RAM Initialization and ROM Operation

If desired, the contents of the RAM can be pre-loaded during device configuration. By preloading the RAM block during the chip configuration cycle and disabling the write controls, the sysMEM block can also be utilized as a ROM.

## Single, Dual and Pseudo-Dual Port Modes

In all the sysMEM RAM modes the input data and address for the ports are registered at the input of the memory array. The output data of the memory is optionally registered at the output. A clock is required even in asynchronous read mode.

The EBR memory supports two forms of write behavior for dual port operation:

1. **Normal** — data on the output appears only during a read cycle. During a write cycle, the data (at the current address) does not appear on the output.
2. **Write Through** — a copy of the input data appears at the output of the same port.

## FIFO Configuration

The FIFO has a write port with Data-in, WCE, WE and WCLK signals. There is a separate read port with Data-out, RCE, RE and RCLK signals. The FIFO internally generates Almost Full, Full, Almost Empty, and Empty Flags. The Full and Almost Full flags are registered with WCLK. The Empty and Almost Empty flags are registered with RCLK.

**Table 2-6. Input/Output/Tristate Gearing Resource Rules**

| PIO | Input/Output Logic |              |              | Tri-State/Bidi |       |
|-----|--------------------|--------------|--------------|----------------|-------|
|     | x1                 | x2           | x4           | x1             | x2/x4 |
| A   | ?                  | ?            | ?            | ?              | N/A   |
| B   | ?                  | No I/O Logic | No I/O Logic | ?              | N/A   |
| C   | ?                  | ?            | No I/O Logic | ?              | N/A   |
| D   | ?                  | No I/O Logic | No I/O Logic | ?              | N/A   |

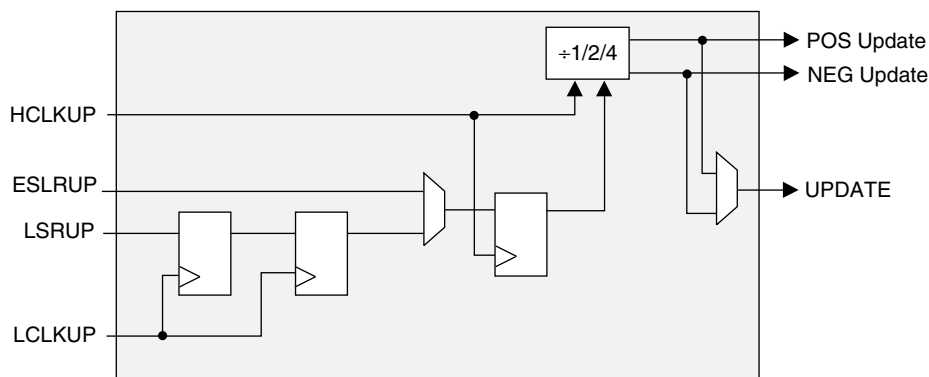
Note: Pin can still be used without I/O logic.

## Control Logic Block

The control logic block allows the modification of control signals selected by the routing before they are used in the PIO. It can optionally invert all signals passing through it except the Global Set/Reset. Global Set/Reset can be enabled or disabled. It can route either the edge clock or the clock to the high-speed clock nets. The clock provided to the PIO by routing is used as the slow-speed clocks. In addition this block contains delays that can be inserted in the clock nets to enable Lattice's unique cycle boosting capability.

## Update Block

The update block is used to generate the POS update and NEG update signals used by the DDR/Shift register blocks within the PIO. Note the update block is only required in shift modes. This is required in order to do the high speed to low speed handoff. One of these update signals is also selected and output from the PIC as the signal UPDATE. It consists of a shift chain that operates off either the high-speed input or output clock. The values of each register in the chain are set or reset depending on the desired mode of operation. The set/reset signal is generated from either the edge reset ELSR or the local reset LSR. These signals are optionally inverted by the Control Logic Block and provided to the update block as ELSRUP and LSRUP. The Lattice design tools automatically configure and connect the update block when one of the DDR or shift register primitives is used.

**Figure 2-25. Update Block**

## PURESPEED I/O Buffer

Each I/O is associated with a flexible buffer referred to as PURESPEED I/O buffer. These buffers are arranged around the periphery of the device in seven groups referred to as Banks. The PURESPEED I/O buffers allow users to implement the wide variety of standards that are found in today's systems including LVCMOS, SSTL, HSTL, LVDS and LVPECL. The availability of programmable on-chip termination for both input and output use, further enhances the utility of these buffers.

**PURESPEED I/O Differential Electrical Characteristics****LVDS****Over Recommended Operating Conditions**

| Parameter Symbol   | Parameter Description                        | Test Conditions                         | Min.   | Typ. | Max.  | Units      |
|--------------------|----------------------------------------------|-----------------------------------------|--------|------|-------|------------|
| $V_{INP}, V_{INM}$ | Input voltage                                |                                         | 0      | —    | 2.4   | V          |
| $V_{THD}$          | Differential input threshold ( $Q-\bar{Q}$ ) |                                         | +/-100 | —    | —     | mV         |
| $V_{CM}$           | Input common mode voltage                    |                                         | 0.05   | 1.2  | 2.35  | V          |
| $I_{IN}$           | Input current                                | Power on or power off                   | —      | —    | +/-10 | $\mu$ A    |
| $V_{OH}$           | Output high voltage for $V_{OP}$ or $V_{OM}$ | $R_T = 100$ Ohm                         | —      | 1.38 | 1.60  | V          |
| $V_{OL}$           | Output low voltage for $V_{OP}$ or $V_{OM}$  | $R_T = 100$ Ohm                         | 0.9V   | 1.03 | —     | V          |
| $V_{OD}$           | Output voltage differential                  | $(V_{OP} - V_{OM})$ , $R_T = 100$ Ohm   | 250    | 350  | 450   | mV         |
| $\Delta V_{OD}$    | Change in $V_{OD}$ between high and low      |                                         | —      | —    | 50    | mV         |
| $V_{OS}$           | Output voltage offset                        | $(V_{OP} - V_{OM})/2$ , $R_T = 100$ Ohm | 1.125  | 1.20 | 1.375 | V          |
| $\Delta V_{OS}$    | Change in $V_{OS}$ between H and L           |                                         | —      | —    | 50    | mV         |
| $I_{SAB}$          | Output short circuit current                 | $V_{OD} = 0V$ Driver outputs shorted    | —      | —    | 12    | mA         |
| $T_R, T_F$         | Output rise and fall times, 20% to 80%       | —                                       | —      | 500  | ps    | $T_R, T_F$ |

Notes:

1. Data is for 3.5mA differential current drive. Other differential driver current options are available.
2. If the low power mode of the input buffer is used, the minimum  $V_{CM}$  is 600 mV.

**Mini-LVDS****Over Recommended Operating Conditions**

| Parameter Symbol | Description                                         | Min.              | Typ. | Max.              | Units |
|------------------|-----------------------------------------------------|-------------------|------|-------------------|-------|
| $Z_O$            | Single-ended PCB trace impedance                    | 30                | 50   | 75                | ohms  |
| $R_T$            | Differential termination resistance                 | 60                | 100  | 150               | ohms  |
| $V_{OD}$         | Output voltage, differential, $ V_{OP} - V_{OM} $   | 300               | —    | 600               | mV    |
| $V_{OS}$         | Output voltage, common mode, $ V_{OP} + V_{OM} /2$  | 1                 | 1.2  | 1.4               | V     |
| $\Delta V_{OD}$  | Change in $V_{OD}$ , between H and L                | —                 | —    | 50                | mV    |
| $\Delta V_{ID}$  | Change in $V_{OS}$ , between H and L                | —                 | —    | 50                | mV    |
| $V_{THD}$        | Input voltage, differential, $ V_{INP} - V_{INM} $  | 200               | —    | 600               | mV    |
| $V_{CM}$         | Input voltage, common mode, $ V_{INP} + V_{INM} /2$ | $0.3+(V_{THD}/2)$ | —    | $2.1-(V_{THD}/2)$ |       |
| $T_R, T_F$       | Output rise and fall times, 20% to 80%              | —                 | —    | 500               | ps    |
| $T_{ODUTY}$      | Output clock duty cycle                             | 45                | —    | 55                | %     |
| $T_{IDUTY}$      | Input clock duty cycle                              | 40                | —    | 60                | %     |

Note: Data is for 6mA differential current drive. Other differential driver current options are available.

**LFSC/M15, LFSC/M25 Logic Signal Connections: 900 fpBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M15      |            |               | LFSC/M25      |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| W24         | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AC17        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AC18        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AC19        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AD17        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AD18        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AD19        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AC12        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AC13        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AC14        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AD12        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AD13        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| AD14        | VCCAUX        | -          |               | VCCAUX        | -          |               |
| U7          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| U8          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| V7          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| V8          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| W7          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| W8          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| M7          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| M8          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| N7          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| N8          | VCCAUX        | -          |               | VCCAUX        | -          |               |
| H10         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| H21         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| H22         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| H9          | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J11         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J12         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J13         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J14         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J15         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J16         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J17         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J18         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J19         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J20         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J23         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| J24         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| K23         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| K24         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| L22         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| L23         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| M22         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| N22         | VCCIO2        | -          |               | VCCIO2        | -          |               |

**LFSC/M25, LFSC/M40 Logic Signal Connections: 1020 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M25      |            |                             | LFSC/M40      |            |                             |
|-------------|---------------|------------|-----------------------------|---------------|------------|-----------------------------|
|             | Ball Function | VCCIO Bank | Dual Function               | Ball Function | VCCIO Bank | Dual Function               |
| Y24         | PL48C         | 6          |                             | PL61C         | 6          |                             |
| Y23         | PL48D         | 6          |                             | PL61D         | 6          |                             |
| AD29        | PL49A         | 6          |                             | PL62A         | 6          |                             |
| AD30        | PL49B         | 6          |                             | PL62B         | 6          |                             |
| AF28        | PL49C         | 6          |                             | PL62C         | 6          |                             |
| AE28        | PL49D         | 6          |                             | PL62D         | 6          |                             |
| AC28        | PL51A         | 6          |                             | PL65A         | 6          |                             |
| AD28        | PL51B         | 6          |                             | PL65B         | 6          |                             |
| AB26        | PL51C         | 6          |                             | PL65C         | 6          |                             |
| AC26        | PL51D         | 6          | VREF2_6                     | PL65D         | 6          | VREF2_6                     |
| AC32        | PL52A         | 6          |                             | PL66A         | 6          |                             |
| AD32        | PL52B         | 6          |                             | PL66B         | 6          |                             |
| AA24        | PL52C         | 6          |                             | PL66C         | 6          |                             |
| AA23        | PL52D         | 6          |                             | PL66D         | 6          |                             |
| AE30        | PL53A         | 6          |                             | PL67A         | 6          |                             |
| AE29        | PL53B         | 6          |                             | PL67B         | 6          |                             |
| AC25        | PL53C         | 6          |                             | PL67C         | 6          |                             |
| AB25        | PL53D         | 6          |                             | PL67D         | 6          |                             |
| AE31        | PL55A         | 6          |                             | PL69A         | 6          |                             |
| AE32        | PL55B         | 6          |                             | PL69B         | 6          |                             |
| AE26        | PL55C         | 6          | LLC_DLLT_IN_E/LLC_DLLT_FB_F | PL69C         | 6          | LLC_DLLT_IN_E/LLC_DLLT_FB_F |
| AE27        | PL55D         | 6          | LLC_DLLC_IN_E/LLC_DLLC_FB_F | PL69D         | 6          | LLC_DLLC_IN_E/LLC_DLLC_FB_F |
| AF32        | PL56A         | 6          |                             | PL70A         | 6          |                             |
| AF31        | PL56B         | 6          |                             | PL70B         | 6          |                             |
| AC24        | PL56C         | 6          |                             | PL70C         | 6          |                             |
| AD25        | PL56D         | 6          |                             | PL70D         | 6          |                             |
| AG32        | PL57A         | 6          | LLC_DLLT_IN_F/LLC_DLLT_FB_E | PL71A         | 6          | LLC_DLLT_IN_F/LLC_DLLT_FB_E |
| AG31        | PL57B         | 6          | LLC_DLLC_IN_F/LLC_DLLC_FB_E | PL71B         | 6          | LLC_DLLC_IN_F/LLC_DLLC_FB_E |
| AC23        | PL57C         | 6          | LLC_PLLT_IN_B/LLC_PLLT_FB_A | PL71C         | 6          | LLC_PLLT_IN_B/LLC_PLLT_FB_A |
| AD24        | PL57D         | 6          | LLC_PLLC_IN_B/LLC_PLLC_FB_A | PL71D         | 6          | LLC_PLLC_IN_B/LLC_PLLC_FB_A |
| AH32        | XRES          | -          |                             | XRES          | -          |                             |
| AH31        | TEMP          | 6          |                             | TEMP          | 6          |                             |
| AJ32        | PB3A          | 5          | LLC_PLLT_IN_A/LLC_PLLT_FB_B | PB3A          | 5          | LLC_PLLT_IN_A/LLC_PLLT_FB_B |
| AK32        | PB3B          | 5          | LLC_PLLC_IN_A/LLC_PLLC_FB_B | PB3B          | 5          | LLC_PLLC_IN_A/LLC_PLLC_FB_B |
| AF27        | PB3C          | 5          | LLC_DLLT_IN_C/LLC_DLLT_FB_D | PB3C          | 5          | LLC_DLLT_IN_C/LLC_DLLT_FB_D |
| AG28        | PB3D          | 5          | LLC_DLLC_IN_C/LLC_DLLC_FB_D | PB3D          | 5          | LLC_DLLC_IN_C/LLC_DLLC_FB_D |
| AK31        | PB4A          | 5          | LLC_DLLT_IN_D/LLC_DLLT_FB_C | PB4A          | 5          | LLC_DLLT_IN_D/LLC_DLLT_FB_C |
| AL31        | PB4B          | 5          | LLC_DLLC_IN_D/LLC_DLLC_FB_C | PB4B          | 5          | LLC_DLLC_IN_D/LLC_DLLC_FB_C |
| AE25        | PB4C          | 5          |                             | PB4C          | 5          |                             |
| AE24        | PB4D          | 5          |                             | PB4D          | 5          |                             |
| AK30        | PB5A          | 5          |                             | PB5A          | 5          |                             |
| AL30        | PB5B          | 5          |                             | PB5B          | 5          |                             |
| AD23        | PB5C          | 5          |                             | PB5C          | 5          |                             |
| AE23        | PB5D          | 5          | VREF1_5                     | PB5D          | 5          | VREF1_5                     |
| AK29        | PB7A          | 5          |                             | PB7A          | 5          |                             |
| AL29        | PB7B          | 5          |                             | PB7B          | 5          |                             |
| AF26        | PB7C          | 5          |                             | PB7C          | 5          |                             |
| AF25        | PB7D          | 5          |                             | PB7D          | 5          |                             |
| AJ28        | PB8A          | 5          |                             | PB8A          | 5          |                             |
| AK28        | PB8B          | 5          |                             | PB8B          | 5          |                             |

**LFSC/M25, LFSC/M40 Logic Signal Connections: 1020 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M25      |            |               | LFSC/M40      |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| AB3         | NC            | -          |               | PR58B         | 3          |               |
| AB4         | NC            | -          |               | PR58A         | 3          |               |
| AG4         | NC            | -          |               | PR57D         | 3          |               |
| AG3         | NC            | -          |               | PR57C         | 3          |               |
| AA2         | NC            | -          |               | PR57B         | 3          |               |
| AB2         | NC            | -          |               | PR57A         | 3          |               |
| AA3         | NC            | -          |               | PR56B         | 3          |               |
| AA4         | NC            | -          |               | PR56A         | 3          |               |
| L5          | NC            | -          |               | PR22D         | 2          |               |
| L6          | NC            | -          |               | PR22C         | 2          |               |
| M2          | NC            | -          |               | PR34B         | 2          |               |
| L2          | NC            | -          |               | PR34A         | 2          |               |
| L3          | NC            | -          |               | PR31B         | 2          |               |
| M3          | NC            | -          |               | PR31A         | 2          |               |
| L4          | NC            | -          |               | PR30B         | 2          |               |
| M4          | NC            | -          |               | PR30A         | 2          |               |
| P7          | NC            | -          |               | PR29D         | 2          |               |
| P8          | NC            | -          |               | PR29C         | 2          |               |
| K1          | NC            | -          |               | PR29B         | 2          |               |
| K2          | NC            | -          |               | PR29A         | 2          |               |
| N6          | NC            | -          |               | PR27D         | 2          |               |
| N7          | NC            | -          |               | PR27C         | 2          |               |
| J2          | NC            | -          |               | PR27B         | 2          |               |
| J1          | NC            | -          |               | PR27A         | 2          |               |
| N5          | NC            | -          |               | PR26D         | 2          |               |
| M5          | NC            | -          |               | PR26C         | 2          |               |
| H3          | NC            | -          |               | PR26B         | 2          |               |
| J3          | NC            | -          |               | PR26A         | 2          |               |
| A5          | VDDAX25_R     | -          |               | VDDAX25_R     | -          |               |
| A28         | VDDAX25_L     | -          |               | VDDAX25_L     | -          |               |
| AJ25        | NC            | -          |               | PB21A         | 5          |               |
| AK25        | NC            | -          |               | PB21B         | 5          |               |
| AF20        | NC            | -          |               | PB27C         | 5          |               |
| AG6         | NC            | -          |               | PB62C         | 4          |               |
| AM7         | NC            | -          |               | PB66A         | 4          |               |
| AL7         | NC            | -          |               | PB66B         | 4          |               |
| AD13        | NC            | -          |               | PB66C         | 4          |               |
| AC13        | NC            | -          |               | PB66D         | 4          |               |
| AC20        | NC            | -          |               | PB22C         | 5          |               |
| AD20        | NC            | -          |               | PB22D         | 5          |               |
| AM9         | NC            | -          |               | PB61A         | 4          |               |
| AM8         | NC            | -          |               | PB61B         | 4          |               |
| AF13        | NC            | -          |               | PB61C         | 4          |               |
| AE13        | NC            | -          |               | PB61D         | 4          |               |
| E30         | VCC12         | -          |               | VCC12         | -          |               |
| E29         | VCC12         | -          |               | VCC12         | -          |               |
| E27         | VCC12         | -          |               | VCC12         | -          |               |
| E26         | VCC12         | -          |               | VCC12         | -          |               |
| E25         | VCC12         | -          |               | VCC12         | -          |               |
| E24         | VCC12         | -          |               | VCC12         | -          |               |

**LFSC/M40, LFSC/M80 Logic Signal Connections: 1152 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M40      |            |               | LFSC/M80      |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| AH11        | PB57D         | 4          |               | PB79D         | 4          |               |
| AN13        | PB58A         | 4          | PCLKT4_3      | PB80A         | 4          | PCLKT4_3      |
| AN12        | PB58B         | 4          | PCLKC4_3      | PB80B         | 4          | PCLKC4_3      |
| AD14        | PB58C         | 4          | PCLKT4_4      | PB80C         | 4          | PCLKT4_4      |
| AD15        | PB58D         | 4          | PCLKC4_4      | PB80D         | 4          | PCLKC4_4      |
| AP13        | PB61A         | 4          |               | PB73A         | 4          |               |
| AP12        | PB61B         | 4          |               | PB73B         | 4          |               |
| AK13        | PB61C         | 4          |               | PB73C         | 4          |               |
| AK12        | PB61D         | 4          |               | PB73D         | 4          |               |
| AP11        | PB62A         | 4          |               | PB83A         | 4          |               |
| AP10        | PB62B         | 4          |               | PB83B         | 4          |               |
| AN11        | PB63A         | 4          |               | PB99A         | 4          |               |
| AN10        | PB63B         | 4          |               | PB99B         | 4          |               |
| AF14        | PB63C         | 4          |               | PB99C         | 4          |               |
| AF13        | PB63D         | 4          |               | PB99D         | 4          |               |
| AM10        | PB67A         | 4          |               | PB101A        | 4          |               |
| AM9         | PB67B         | 4          |               | PB101B        | 4          |               |
| AE14        | PB67C         | 4          |               | PB101C        | 4          |               |
| AE13        | PB67D         | 4          |               | PB101D        | 4          |               |
| AP9         | PB69A         | 4          |               | PB104A        | 4          |               |
| AP8         | PB69B         | 4          |               | PB104B        | 4          |               |
| AK11        | PB69C         | 4          |               | PB104C        | 4          |               |
| AK10        | PB69D         | 4          |               | PB104D        | 4          |               |
| AL10        | PB70A         | 4          |               | PB107A        | 4          |               |
| AL9         | PB70B         | 4          |               | PB107B        | 4          |               |
| AF12        | PB70C         | 4          |               | PB107C        | 4          |               |
| AF11        | PB70D         | 4          |               | PB107D        | 4          |               |
| AN9         | PB73A         | 4          |               | PB109A        | 4          |               |
| AN8         | PB73B         | 4          |               | PB109B        | 4          |               |
| AG11        | PB73C         | 4          |               | PB109C        | 4          |               |
| AG10        | PB73D         | 4          |               | PB109D        | 4          |               |
| AP7         | PB74A         | 4          |               | PB111A        | 4          |               |
| AP6         | PB74B         | 4          |               | PB111B        | 4          |               |
| AG13        | PB74C         | 4          |               | PB111C        | 4          |               |
| AG12        | PB74D         | 4          |               | PB111D        | 4          |               |
| AN7         | PB75A         | 4          |               | PB113A        | 4          |               |
| AN6         | PB75B         | 4          |               | PB113B        | 4          |               |
| AK9         | PB75C         | 4          |               | PB113C        | 4          |               |
| AK8         | PB75D         | 4          |               | PB113D        | 4          |               |
| AP5         | PB77A         | 4          |               | PB115A        | 4          |               |
| AP4         | PB77B         | 4          |               | PB115B        | 4          |               |
| AD11        | PB77C         | 4          |               | PB115C        | 4          |               |
| AE11        | PB77D         | 4          |               | PB115D        | 4          |               |
| AM7         | PB78A         | 4          |               | PB117A        | 4          |               |
| AM6         | PB78B         | 4          |               | PB117B        | 4          |               |

**LFSC/M40, LFSC/M80 Logic Signal Connections: 1152 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M40      |            |               | LFSC/M80      |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| W13         | VCCAUX        | -          |               | VCCAUX        | -          |               |
| W22         | VCCAUX        | -          |               | VCCAUX        | -          |               |
| Y21         | GND           | -          |               | GND           | -          |               |
| Y25         | GND           | -          |               | GND           | -          |               |
| C18         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| D17         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| F16         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| G19         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| J20         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| K12         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| K15         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| L23         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| Y9          | GND           | -          |               | GND           | -          |               |
| J9          | VCCIO1        | -          |               | VCCIO1        | -          |               |
| E3          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| G6          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| H4          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| K7          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| L3          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| M11         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| N6          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| P4          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| R9          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| AA3         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AB7         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AC10        | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AD4         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AE6         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AG3         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AK4         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| T7          | VCCIO3        | -          |               | VCCIO3        | -          |               |
| U3          | VCCIO3        | -          |               | VCCIO3        | -          |               |
| V4          | VCCIO3        | -          |               | VCCIO3        | -          |               |
| W6          | VCCIO3        | -          |               | VCCIO3        | -          |               |
| Y10         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AD12        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AF15        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AF9         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AH10        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AH16        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AJ13        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AJ7         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AL14        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AL8         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AM11        | VCCIO4        | -          |               | VCCIO4        | -          |               |

**LFSC/M40, LFSC/M80 Logic Signal Connections: 1152 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M40      |            |               | LFSC/M80      |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| AM17        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AM5         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AE20        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AE23        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AE26        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AH22        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AH28        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AJ19        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AJ25        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AL18        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AL24        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AL30        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AM21        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AM27        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AA31        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AB29        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AC24        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AD32        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AE28        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AG31        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AK32        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| T29         | VCCIO6        | -          |               | VCCIO6        | -          |               |
| U31         | VCCIO6        | -          |               | VCCIO6        | -          |               |
| V32         | VCCIO6        | -          |               | VCCIO6        | -          |               |
| W28         | VCCIO6        | -          |               | VCCIO6        | -          |               |
| Y26         | VCCIO6        | -          |               | VCCIO6        | -          |               |
| E31         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| G28         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| H32         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| K29         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| L31         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| M25         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| N28         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| P32         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| R25         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| J25         | VCCIO1        | -          |               | VCCIO1        | -          |               |
| N11         | VTT_2         | 2          |               | VTT_2         | 2          |               |
| R12         | VTT_2         | 2          |               | VTT_2         | 2          |               |
| T12         | VTT_2         | 2          |               | VTT_2         | 2          |               |
| AB11        | VTT_3         | 3          |               | VTT_3         | 3          |               |
| W12         | VTT_3         | 3          |               | VTT_3         | 3          |               |
| Y12         | VTT_3         | 3          |               | VTT_3         | 3          |               |
| AC15        | VTT_4         | 4          |               | VTT_4         | 4          |               |
| AC16        | VTT_4         | 4          |               | VTT_4         | 4          |               |
| AD13        | VTT_4         | 4          |               | VTT_4         | 4          |               |

**LFSC/M115 Logic Signal Connections: 1152 fcBGA<sup>1, 2</sup>**

| Ball Number | LFSC/M115     |            |                    |
|-------------|---------------|------------|--------------------|
|             | Ball Function | VCCIO Bank | Dual Function      |
| L21         | PT55D         | 1          | A16/MPI_ADDR30     |
| L20         | PT55C         | 1          | D13/MPI_DATA13     |
| D20         | PT55B         | 1          | A15/MPI_ADDR29     |
| E20         | PT55A         | 1          | A17/MPI_ADDR31     |
| L19         | PT54D         | 1          | A19/MPI_TSI_Z1     |
| K19         | PT54C         | 1          | A20/MPI_BDIP       |
| D21         | PT54B         | 1          | A18/MPI_TSI_Z0     |
| E21         | PT54A         | 1          | MPI_TEA            |
| M20         | PT51D         | 1          | D14/MPI_DATA14     |
| M19         | PT51C         | 1          | DP1/MPI_PAR1       |
| F21         | PT51B         | 1          | A21/MPI_BURST      |
| G21         | PT51A         | 1          | D15/MPI_DATA15     |
| H24         | B_REFCLKP_L   | -          |                    |
| J24         | B_REFCLKN_L   | -          |                    |
| L22         | VCC12         | -          |                    |
| E26         | B_VDDIB3_L    | -          |                    |
| G22         | VCC12         | -          |                    |
| E22         | B_HDINP3_L    | -          | PCS 361 CH 3 IN P  |
| F22         | B_HDINN3_L    | -          | PCS 361 CH 3 IN N  |
| A21         | B_HDOUTP3_L   | -          | PCS 361 CH 3 OUT P |
| L24         | VCC12         | -          |                    |
| B21         | B_HDOUTN3_L   | -          | PCS 361 CH 3 OUT N |
| D22         | B_VDDOB3_L    | -          |                    |
| B22         | B_HDOUTN2_L   | -          | PCS 361 CH 2 OUT N |
| D23         | B_VDDOB2_L    | -          |                    |
| A22         | B_HDOUTP2_L   | -          | PCS 361 CH 2 OUT P |
| K24         | VCC12         | -          |                    |
| F23         | B_HDINN2_L    | -          | PCS 361 CH 2 IN N  |
| E23         | B_HDINP2_L    | -          | PCS 361 CH 2 IN P  |
| D26         | B_VDDIB2_L    | -          |                    |
| G23         | VCC12         | -          |                    |
| D27         | B_VDDIB1_L    | -          |                    |
| G24         | VCC12         | -          |                    |
| E24         | B_HDINP1_L    | -          | PCS 361 CH 1 IN P  |
| F24         | B_HDINN1_L    | -          | PCS 361 CH 1 IN N  |
| A23         | B_HDOUTP1_L   | -          | PCS 361 CH 1 OUT P |
| L25         | VCC12         | -          |                    |
| B23         | B_HDOUTN1_L   | -          | PCS 361 CH 1 OUT N |
| D24         | B_VDDOB1_L    | -          |                    |
| B24         | B_HDOUTN0_L   | -          | PCS 361 CH 0 OUT N |
| D25         | B_VDDOB0_L    | -          |                    |
| A24         | B_HDOUTP0_L   | -          | PCS 361 CH 0 OUT P |
| K25         | VCC12         | -          |                    |

**LFSC/M115 Logic Signal Connections: 1152 fcBGA<sup>1, 2</sup>**

| Ball Number | LFSC/M115     |            |               |
|-------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function |
| L5          | PR38B         | 2          |               |
| K5          | PR38A         | 2          |               |
| G2          | PR34B         | 2          |               |
| F2          | PR34A         | 2          |               |
| F1          | PR30B         | 2          |               |
| E1          | PR30A         | 2          |               |
| A2          | GND           | -          |               |
| A33         | GND           | -          |               |
| AA15        | GND           | -          |               |
| AA20        | GND           | -          |               |
| AA32        | GND           | -          |               |
| AA4         | GND           | -          |               |
| AB28        | GND           | -          |               |
| AB6         | GND           | -          |               |
| AC11        | GND           | -          |               |
| AC18        | GND           | -          |               |
| AC25        | GND           | -          |               |
| AD23        | GND           | -          |               |
| AD3         | GND           | -          |               |
| AD31        | GND           | -          |               |
| AE12        | GND           | -          |               |
| AE15        | GND           | -          |               |
| AE29        | GND           | -          |               |
| AE7         | GND           | -          |               |
| AE9         | GND           | -          |               |
| AF20        | GND           | -          |               |
| AF26        | GND           | -          |               |
| AG32        | GND           | -          |               |
| AG4         | GND           | -          |               |
| AH13        | GND           | -          |               |
| AH19        | GND           | -          |               |
| AH25        | GND           | -          |               |
| AH7         | GND           | -          |               |
| AJ10        | GND           | -          |               |
| AJ16        | GND           | -          |               |
| AJ22        | GND           | -          |               |
| AJ28        | GND           | -          |               |
| AK3         | GND           | -          |               |
| AK31        | GND           | -          |               |
| AL11        | GND           | -          |               |
| AL17        | GND           | -          |               |
| AL21        | GND           | -          |               |
| AL27        | GND           | -          |               |

**LFSC/M115 Logic Signal Connections: 1152 fcBGA<sup>1, 2</sup>**

| Ball Number | LFSC/M115     |            |               |
|-------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function |
| AH16        | VCCIO4        | -          |               |
| AJ13        | VCCIO4        | -          |               |
| AJ7         | VCCIO4        | -          |               |
| AL14        | VCCIO4        | -          |               |
| AL8         | VCCIO4        | -          |               |
| AM11        | VCCIO4        | -          |               |
| AM17        | VCCIO4        | -          |               |
| AM5         | VCCIO4        | -          |               |
| AE20        | VCCIO5        | -          |               |
| AE23        | VCCIO5        | -          |               |
| AE26        | VCCIO5        | -          |               |
| AH22        | VCCIO5        | -          |               |
| AH28        | VCCIO5        | -          |               |
| AJ19        | VCCIO5        | -          |               |
| AJ25        | VCCIO5        | -          |               |
| AL18        | VCCIO5        | -          |               |
| AL24        | VCCIO5        | -          |               |
| AL30        | VCCIO5        | -          |               |
| AM21        | VCCIO5        | -          |               |
| AM27        | VCCIO5        | -          |               |
| AA31        | VCCIO6        | -          |               |
| AB29        | VCCIO6        | -          |               |
| AC24        | VCCIO6        | -          |               |
| AD32        | VCCIO6        | -          |               |
| AE28        | VCCIO6        | -          |               |
| AG31        | VCCIO6        | -          |               |
| AK32        | VCCIO6        | -          |               |
| T29         | VCCIO6        | -          |               |
| U31         | VCCIO6        | -          |               |
| V32         | VCCIO6        | -          |               |
| W28         | VCCIO6        | -          |               |
| Y26         | VCCIO6        | -          |               |
| E31         | VCCIO7        | -          |               |
| G28         | VCCIO7        | -          |               |
| H32         | VCCIO7        | -          |               |
| K29         | VCCIO7        | -          |               |
| L31         | VCCIO7        | -          |               |
| M25         | VCCIO7        | -          |               |
| N28         | VCCIO7        | -          |               |
| P32         | VCCIO7        | -          |               |
| R25         | VCCIO7        | -          |               |
| J25         | VCCIO1        | -          |               |
| N11         | VTT_2         | 2          |               |

**LFSC/M80, LFSC/M115 Logic Signal Connections: 1704 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M80      |            |               | LFSC/M115     |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| P38         | PL26B         | 7          |               | PL40B         | 7          |               |
| N35         | PL26C         | 7          |               | PL40C         | 7          |               |
| N36         | PL26D         | 7          |               | PL40D         | 7          |               |
| N39         | PL29A         | 7          |               | PL43A         | 7          |               |
| P39         | PL29B         | 7          |               | PL43B         | 7          |               |
| R34         | PL29C         | 7          | VREF1_7       | PL43C         | 7          | VREF1_7       |
| T34         | PL29D         | 7          | DIFFR_7       | PL43D         | 7          | DIFFR_7       |
| L41         | PL30A         | 7          |               | PL44A         | 7          |               |
| M41         | PL30B         | 7          |               | PL44B         | 7          |               |
| W29         | PL30C         | 7          |               | PL44C         | 7          |               |
| Y29         | PL30D         | 7          |               | PL44D         | 7          |               |
| L42         | PL31A         | 7          |               | PL45A         | 7          |               |
| M42         | PL31B         | 7          |               | PL45B         | 7          |               |
| U32         | PL31C         | 7          |               | PL45C         | 7          |               |
| V32         | PL31D         | 7          |               | PL45D         | 7          |               |
| R37         | PL33A         | 7          |               | PL47A         | 7          |               |
| T37         | PL33B         | 7          |               | PL47B         | 7          |               |
| M36         | PL33C         | 7          |               | PL47C         | 7          |               |
| M37         | PL33D         | 7          |               | PL47D         | 7          |               |
| P40         | PL34A         | 7          |               | PL48A         | 7          |               |
| N40         | PL34B         | 7          |               | PL48B         | 7          |               |
| R35         | PL34C         | 7          |               | PL48C         | 7          |               |
| T35         | PL34D         | 7          |               | PL48D         | 7          |               |
| N41         | PL35A         | 7          |               | PL49A         | 7          |               |
| P41         | PL35B         | 7          |               | PL49B         | 7          |               |
| V33         | PL35C         | 7          |               | PL49C         | 7          |               |
| U33         | PL35D         | 7          |               | PL49D         | 7          |               |
| R38         | PL37A         | 7          |               | PL51A         | 7          |               |
| T38         | PL37B         | 7          |               | PL51B         | 7          |               |
| R36         | PL37C         | 7          |               | PL51C         | 7          |               |
| T36         | PL37D         | 7          |               | PL51D         | 7          |               |
| N42         | PL38A         | 7          |               | PL52A         | 7          |               |
| P42         | PL38B         | 7          |               | PL52B         | 7          |               |
| Y31         | PL38C         | 7          |               | PL52C         | 7          |               |
| AA31        | PL38D         | 7          |               | PL52D         | 7          |               |
| U37         | PL39A         | 7          |               | PL53A         | 7          |               |
| V37         | PL39B         | 7          |               | PL53B         | 7          |               |
| U34         | PL39C         | 7          |               | PL53C         | 7          |               |
| V34         | PL39D         | 7          |               | PL53D         | 7          |               |
| U39         | PL41A         | 7          |               | PL55A         | 7          |               |
| T39         | PL41B         | 7          |               | PL55B         | 7          |               |
| V35         | PL41C         | 7          |               | PL55C         | 7          |               |
| W35         | PL41D         | 7          |               | PL55D         | 7          |               |
| R41         | PL42A         | 7          |               | PL56A         | 7          |               |
| T41         | PL42B         | 7          |               | PL56B         | 7          |               |

**LFSC/M80, LFSC/M115 Logic Signal Connections: 1704 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M80      |            |               | LFSC/M115     |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| AC24        | GND           | -          |               | GND           | -          |               |
| AC26        | GND           | -          |               | GND           | -          |               |
| AC35        | GND           | -          |               | GND           | -          |               |
| AC8         | GND           | -          |               | GND           | -          |               |
| AD12        | GND           | -          |               | GND           | -          |               |
| AD16        | GND           | -          |               | GND           | -          |               |
| AD18        | GND           | -          |               | GND           | -          |               |
| AD20        | GND           | -          |               | GND           | -          |               |
| AD23        | GND           | -          |               | GND           | -          |               |
| AD25        | GND           | -          |               | GND           | -          |               |
| AD27        | GND           | -          |               | GND           | -          |               |
| AD31        | GND           | -          |               | GND           | -          |               |
| AE17        | GND           | -          |               | GND           | -          |               |
| AE19        | GND           | -          |               | GND           | -          |               |
| AE24        | GND           | -          |               | GND           | -          |               |
| AE26        | GND           | -          |               | GND           | -          |               |
| AE3         | GND           | -          |               | GND           | -          |               |
| AE39        | GND           | -          |               | GND           | -          |               |
| AF18        | GND           | -          |               | GND           | -          |               |
| AF20        | GND           | -          |               | GND           | -          |               |
| AF23        | GND           | -          |               | GND           | -          |               |
| AF25        | GND           | -          |               | GND           | -          |               |
| AF36        | GND           | -          |               | GND           | -          |               |
| AF7         | GND           | -          |               | GND           | -          |               |
| AG11        | GND           | -          |               | GND           | -          |               |
| AG16        | GND           | -          |               | GND           | -          |               |
| AG19        | GND           | -          |               | GND           | -          |               |
| AG24        | GND           | -          |               | GND           | -          |               |
| AG27        | GND           | -          |               | GND           | -          |               |
| AG32        | GND           | -          |               | GND           | -          |               |
| AH15        | GND           | -          |               | GND           | -          |               |
| AH28        | GND           | -          |               | GND           | -          |               |
| AH4         | GND           | -          |               | GND           | -          |               |
| AH40        | GND           | -          |               | GND           | -          |               |
| AJ35        | GND           | -          |               | GND           | -          |               |
| AJ8         | GND           | -          |               | GND           | -          |               |
| AK12        | GND           | -          |               | GND           | -          |               |
| AK31        | GND           | -          |               | GND           | -          |               |
| AL13        | GND           | -          |               | GND           | -          |               |
| AL19        | GND           | -          |               | GND           | -          |               |
| AL24        | GND           | -          |               | GND           | -          |               |
| AL3         | GND           | -          |               | GND           | -          |               |
| AL30        | GND           | -          |               | GND           | -          |               |
| AL39        | GND           | -          |               | GND           | -          |               |
| AM16        | GND           | -          |               | GND           | -          |               |

**LFSC/M80, LFSC/M115 Logic Signal Connections: 1704 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M80      |            |               | LFSC/M115     |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| L8          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| M3          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| P7          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| R4          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| T12         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| U8          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| V3          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| W11         | VCCIO2        | -          |               | VCCIO2        | -          |               |
| Y7          | VCCIO2        | -          |               | VCCIO2        | -          |               |
| AB3         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AC7         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AD11        | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AE4         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AF8         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AG12        | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AH3         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AJ7         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AK11        | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AL4         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AM8         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AP3         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AR7         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AU4         | VCCIO3        | -          |               | VCCIO3        | -          |               |
| AL16        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AM13        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AM19        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AR11        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AR17        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AT14        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AT20        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AT8         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AW15        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AW21        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AW9         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AY12        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AY18        | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AY6         | VCCIO4        | -          |               | VCCIO4        | -          |               |
| AL27        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AM24        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AM30        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AR26        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AR32        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AT23        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AT29        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AT35        | VCCIO5        | -          |               | VCCIO5        | -          |               |

**LFSC/M80, LFSC/M115 Logic Signal Connections: 1704 fcBGA<sup>1, 2</sup> (Cont.)**

| Ball Number | LFSC/M80      |            |               | LFSC/M115     |            |               |
|-------------|---------------|------------|---------------|---------------|------------|---------------|
|             | Ball Function | VCCIO Bank | Dual Function | Ball Function | VCCIO Bank | Dual Function |
| AW25        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AW31        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AW37        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AY22        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AY28        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AY34        | VCCIO5        | -          |               | VCCIO5        | -          |               |
| AB39        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AC36        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AD32        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AE40        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AF35        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AG31        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AH39        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AJ36        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AK32        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AL40        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AM35        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AP39        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AR36        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AU40        | VCCIO6        | -          |               | VCCIO6        | -          |               |
| AA40        | VCCIO7        | -          |               | VCCIO7        | -          |               |
| H36         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| J40         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| L35         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| M39         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| P36         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| R40         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| T31         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| U35         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| V39         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| W32         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| Y36         | VCCIO7        | -          |               | VCCIO7        | -          |               |
| AA14        | VTT_2         | 2          |               | VTT_2         | 2          |               |
| AA15        | VTT_2         | 2          |               | VTT_2         | 2          |               |
| R12         | VTT_2         | 2          |               | VTT_2         | 2          |               |
| V14         | VTT_2         | 2          |               | VTT_2         | 2          |               |
| AB14        | VTT_3         | 3          |               | VTT_3         | 3          |               |
| AB15        | VTT_3         | 3          |               | VTT_3         | 3          |               |
| AE14        | VTT_3         | 3          |               | VTT_3         | 3          |               |
| AJ13        | VTT_3         | 3          |               | VTT_3         | 3          |               |
| AH21        | VTT_4         | 4          |               | VTT_4         | 4          |               |
| AJ18        | VTT_4         | 4          |               | VTT_4         | 4          |               |
| AJ19        | VTT_4         | 4          |               | VTT_4         | 4          |               |
| AJ20        | VTT_4         | 4          |               | VTT_4         | 4          |               |
| AJ21        | VTT_4         | 4          |               | VTT_4         | 4          |               |

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## Thermal Management

Thermal management is recommended as part of any sound FPGA design methodology. To assess the thermal characteristics of a system, Lattice specifies a maximum allowable junction temperature in all device data sheets. Designers must complete a thermal analysis of their specific design to ensure that the device and package do not exceed the junction temperature limits. Refer to the Thermal Management document to find the device/package specific thermal values.

### For Further Information

For further information regarding Thermal Management, refer to the following located on the Lattice website at [www.latticesemi.com](http://www.latticesemi.com).

- Thermal Management document
- Technical Note TN1101 - Power Estimation and Management for LatticeSC Devices
- Power Calculator tool included with Lattice's ispLEVER design tool, or as a standalone download from [www.latticesemi.com/software](http://www.latticesemi.com/software)

**Lead-Free Packaging****Commercial**

| Part Number        | Grade | Package         | Balls | Temp. | LUTs (K) |
|--------------------|-------|-----------------|-------|-------|----------|
| LFSC3GA15E-7FN256C | -7    | Lead-Free fpBGA | 256   | COM   | 15.2     |
| LFSC3GA15E-6FN256C | -6    | Lead-Free fpBGA | 256   | COM   | 15.2     |
| LFSC3GA15E-5FN256C | -5    | Lead-Free fpBGA | 256   | COM   | 15.2     |
| LFSC3GA15E-7FN900C | -7    | Lead-Free fpBGA | 900   | COM   | 15.2     |
| LFSC3GA15E-6FN900C | -6    | Lead-Free fpBGA | 900   | COM   | 15.2     |
| LFSC3GA15E-5FN900C | -5    | Lead-Free fpBGA | 900   | COM   | 15.2     |

| Part Number           | Grade | Package         | Balls | Temp. | LUTs (K) |
|-----------------------|-------|-----------------|-------|-------|----------|
| LFSCM3GA15EP1-7FN256C | -7    | Lead-Free fpBGA | 256   | COM   | 15.2     |
| LFSCM3GA15EP1-6FN256C | -6    | Lead-Free fpBGA | 256   | COM   | 15.2     |
| LFSCM3GA15EP1-5FN256C | -5    | Lead-Free fpBGA | 256   | COM   | 15.2     |
| LFSCM3GA15EP1-7FN900C | -7    | Lead-Free fpBGA | 900   | COM   | 15.2     |
| LFSCM3GA15EP1-6FN900C | -6    | Lead-Free fpBGA | 900   | COM   | 15.2     |
| LFSCM3GA15EP1-5FN900C | -5    | Lead-Free fpBGA | 900   | COM   | 15.2     |

| Part Number                       | Grade | Package                            | Balls | Temp. | LUTs (K) |
|-----------------------------------|-------|------------------------------------|-------|-------|----------|
| LFSC3GA25E-7FN900C                | -7    | Lead-Free fpBGA                    | 900   | COM   | 25.4     |
| LFSC3GA25E-6FN900C                | -6    | Lead-Free fpBGA                    | 900   | COM   | 25.4     |
| LFSC3GA25E-5FN900C                | -5    | Lead-Free fpBGA                    | 900   | COM   | 25.4     |
| LFSC3GA25E-7FFN1020C <sup>1</sup> | -7    | Lead-Free Organic fcBGA            | 1020  | COM   | 25.4     |
| LFSC3GA25E-6FFN1020C <sup>1</sup> | -6    | Lead-Free Organic fcBGA            | 1020  | COM   | 25.4     |
| LFSC3GA25E-5FFN1020C <sup>1</sup> | -5    | Lead-Free Organic fcBGA            | 1020  | COM   | 25.4     |
| LFSC3GA25E-7FFAN1020C             | -7    | Lead-Free Organic fcBGA Revision 2 | 1020  | COM   | 25.4     |
| LFSC3GA25E-6FFAN1020C             | -6    | Lead-Free Organic fcBGA Revision 2 | 1020  | COM   | 25.4     |
| LFSC3GA25E-5FFAN1020C             | -5    | Lead-Free Organic fcBGA Revision 2 | 1020  | COM   | 25.4     |

1. Converted to organic flip-chip BGA package revision 2 per [PCN #02A-10](#).

| Part Number                          | Grade | Package                            | Balls | Temp. | LUTs (K) |
|--------------------------------------|-------|------------------------------------|-------|-------|----------|
| LFSCM3GA25EP1-7FN900C                | -7    | Lead-Free fpBGA                    | 900   | COM   | 25.4     |
| LFSCM3GA25EP1-6FN900C                | -6    | Lead-Free fpBGA                    | 900   | COM   | 25.4     |
| LFSCM3GA25EP1-5FN900C                | -5    | Lead-Free fpBGA                    | 900   | COM   | 25.4     |
| LFSCM3GA25EP1-7FFN1020C <sup>1</sup> | -7    | Lead-Free Organic fcBGA            | 1020  | COM   | 25.4     |
| LFSCM3GA25EP1-6FFN1020C <sup>1</sup> | -6    | Lead-Free Organic fcBGA            | 1020  | COM   | 25.4     |
| LFSCM3GA25EP1-5FFN1020C <sup>1</sup> | -5    | Lead-Free Organic fcBGA            | 1020  | COM   | 25.4     |
| LFSCM3GA25EP1-7FFAN1020C             | -7    | Lead-Free Organic fcBGA Revision 2 | 1020  | COM   | 25.4     |
| LFSCM3GA25EP1-6FFAN1020C             | -6    | Lead-Free Organic fcBGA Revision 2 | 1020  | COM   | 25.4     |
| LFSCM3GA25EP1-5FFAN1020C             | -5    | Lead-Free Organic fcBGA Revision 2 | 1020  | COM   | 25.4     |

1. Converted to organic flip-chip BGA package revision 2 per [PCN #02A-10](#).