

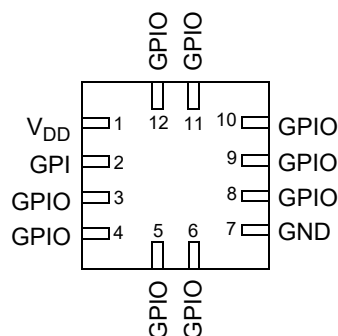
### Features

- Logic & Mixed Signal Circuits
- Highly Versatile Macrocells
- 1.8 V ( $\pm 5\%$ ) to 5 V ( $\pm 10\%$ ) Supply
- Operating Temperature Range:  $-40\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$
- RoHS Compliant / Halogen-Free
- Two Pb-Free 12-pin STQFN Package Options
  - 1.6 x 1.6 x 0.55 mm, 0.4 mm pitch
  - 2 x 2 x 0.55 mm, 0.5 mm pitch

### Applications

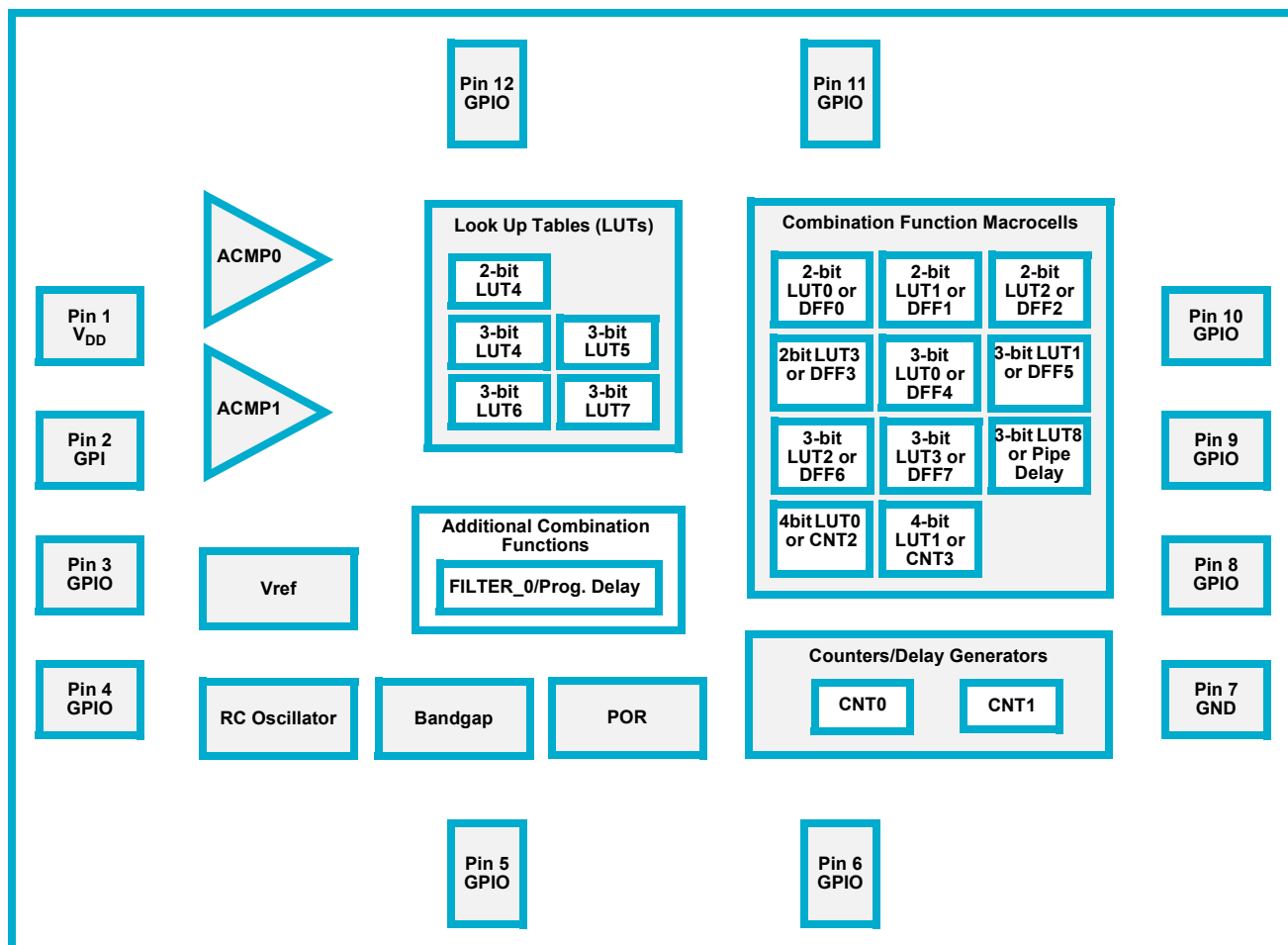
- Personal Computers and Servers
- PC Peripherals
- Consumer Electronics
- Data Communications Equipment
- Handheld and Portable Electronics

### Pin Configuration



**STQFN-12  
(Top View)**

### Block Diagram



## 1.0 Overview

The SLG46120 provides a small, low power component for commonly used mixed-signal functions. The user creates their circuit design by programming the one time Non-Volatile Memory (NVM) to configure the interconnect logic, the I/O Pins and the macrocells of the SLG46120. This highly versatile device allows a wide variety of mixed-signal functions to be designed within a very small, low power single integrated circuit. The macrocells in the device include the following:

- Two Analog Comparators (ACMP)
- Voltage References (Vref)
- Five Combinatorial Look Up Tables (LUTs)
  - One 2-bit LUTs
  - Four 3-bit LUTs
- Twelve Combination Function Macrocell
  - Four Selectable DFF/Latch or 2-bit LUTs
  - Four Selectable DFF/Latch or 3-bit LUTs
  - One Selectable Pipe Delay or 3-bit LUT
    - Pipe Delay – 8 stage / 2 output, one 1 stage fixed output
  - Two Selectable Counter/Delay or 4-bit LUT
  - One Programmable Delay / Deglitch Filter
- Two Counter / Delay Generators (CNT/DLY)
  - One 8-bit counter/delay
  - One 14-bit counter/delay with external clock/reset
- Eight D Flip-Flop / Latches (DFF) (Part of Combination Function Macrocell)
- Pipe Delay – 8 stage/2 output (Part of Combination Function Macrocell)
- One Bandgap
- RC Oscillator (RC OSC)
- Power On Reset (POR)

## 2.0 Pin Description

### 2.1 Functional Pin Description

| Pin # | Pin Name        | Function                                               |
|-------|-----------------|--------------------------------------------------------|
| 1     | V <sub>DD</sub> | Power Supply                                           |
| 2     | GPI             | General Purpose Input                                  |
| 3     | GPIO            | General Purpose I/O or Analog Comparator 0 (+)         |
| 4     | GPIO            | General Purpose I/O or Analog Comparator 0 (-)         |
| 5     | GPIO            | General Purpose I/O                                    |
| 6     | GPIO            | General Purpose I/O or Analog Comparator 1 (+) with OE |
| 7     | GND             | Ground                                                 |
| 8     | GPIO            | General Purpose I/O                                    |
| 9     | GPIO            | General Purpose I/O                                    |
| 10    | GPIO            | General Purpose I/O with OE and Vref output            |
| 11    | GPIO            | General Purpose I/O                                    |
| 12    | GPIO            | General Purpose I/O or External Clock Input            |

### 3.0 User Programmability

Non-volatile memory (NVM) is used to configure the SLG46120's connection matrix routing and macrocells. The NVM is One-Time-Programmable (OTP). However, GreenPAK development tools can be used to configure the connection matrix and macrocells, without programming the NVM, to allow on-chip emulation. This configuration will remain active on the device as long as it remains powered and can be re-written as needed to facilitate rapid design changes.

When a design is ready for in-circuit testing, the same GreenPAK development tools can be used to program the NVM and create samples for small quantity builds. Once the NVM is programmed, the device will retain this configuration for the duration of its lifetime.

Once the design is finalized, the design file can be forwarded to Renesas Electronics Corporation to integrate into the production process.

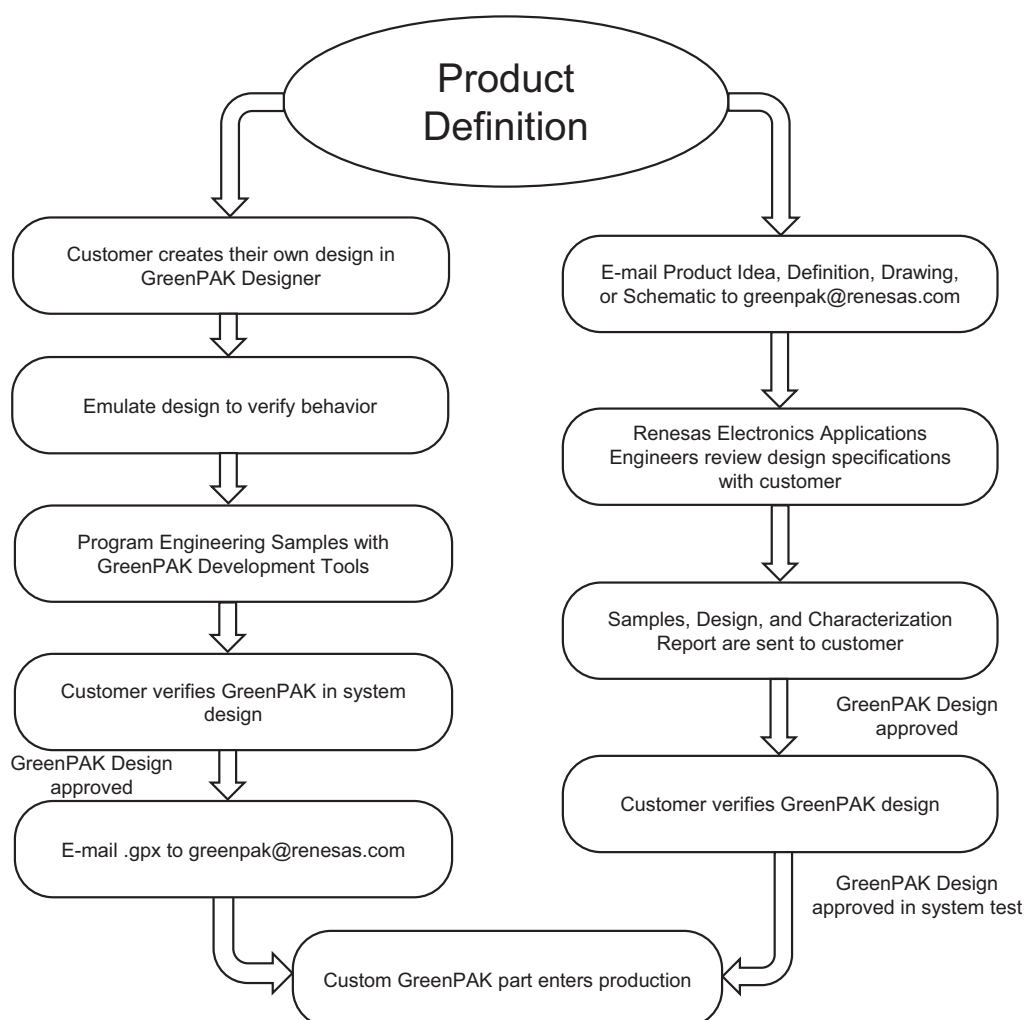


Figure 1. Steps to create a custom GreenPAK device

## 4.0 Ordering Information

| Part Number | Type                                    | Dimensions                |
|-------------|-----------------------------------------|---------------------------|
| SLG46120V   | 12-pin STQFN                            | 1.6 x 1.6 x 0.55 mm, 0.4P |
| SLG46120P   | 12-pin STQFN                            | 2 x 2 x 0.55 mm, 0.5P     |
| SLG46120VTR | 12-pin STQFN - Tape and Reel (3k units) | 1.6 x 1.6 x 0.55 mm, 0.4P |
| SLG46120PTR | 12-pin STQFN - Tape and Reel (3k units) | 2 x 2 x 0.55 mm, 0.5P     |

*Note 1: Use SLG46120V or SLG46120P to order. Shipments are automatically in Tape and Reel.*

*Note 2: "TR" suffix is no longer used. It is a legacy naming convention shown here only for informational purposes.*

## 5.0 Electrical Specifications

### 5.1 Absolute Maximum Conditions

| Parameter                                   |              | Min.      | Max.           | Unit |
|---------------------------------------------|--------------|-----------|----------------|------|
| Supply Voltage on $V_{DD}$ relative to GND  |              | -0.5      | 7              | V    |
| DC Input Voltage                            |              | GND - 0.5 | $V_{DD} + 0.5$ | V    |
| Maximum Average or DC Current (Through pin) | Push-Pull 1x | --        | 12             | mA   |
|                                             | Push-Pull 2x | --        | 17             |      |
|                                             | OD 1x        | --        | 18             |      |
|                                             | OD 2x        | --        | 28             |      |
| Current at Input Pin                        |              | -1.0      | 1.0            | mA   |
| Storage Temperature Range                   |              | -65       | 150            | °C   |
| Junction Temperature                        |              | --        | 150            | °C   |
| ESD Protection (Human Body Model)           |              | 2000      | --             | V    |
| ESD Protection (Charged Device Model)       |              | 1000      | --             | V    |
| Moisture Sensitivity Level                  |              | 1         |                |      |

### 5.2 Electrical Characteristics (1.8 V $\pm 5\%$ $V_{DD}$ )

| Symbol    | Parameter                      | Condition/Note                                                                              | Min.  | Typ.  | Max.     | Unit    |
|-----------|--------------------------------|---------------------------------------------------------------------------------------------|-------|-------|----------|---------|
| $V_{DD}$  | Supply Voltage                 |                                                                                             | 1.71  | 1.80  | 1.89     | V       |
| $I_Q$     | Quiescent Current              | Static Inputs and Outputs (when ACMP, Vref and RC OSC are powered down and non-operational) | --    | 0.5   | --       | $\mu A$ |
| $T_A$     | Operating Temperature          |                                                                                             | -40   | 25    | 85       | °C      |
| $V_{AIR}$ | Analog Input Voltage Range     | Positive Input                                                                              | 0     | --    | $V_{DD}$ | V       |
|           |                                | Negative Input                                                                              | 0     | --    | 1.1      | V       |
| $V_{IH}$  | HIGH-Level Input Voltage       | Logic Input                                                                                 | 1.100 | --    | $V_{DD}$ | V       |
|           |                                | Logic Input with Schmitt Trigger                                                            | 1.270 | --    | $V_{DD}$ | V       |
|           |                                | Low-Level Logic Input                                                                       | 0.980 | --    | $V_{DD}$ | V       |
| $V_{IL}$  | LOW-Level Input Voltage        | Logic Input                                                                                 | --    | --    | 0.690    | V       |
|           |                                | Logic Input with Schmitt Trigger                                                            | --    | --    | 0.440    | V       |
|           |                                | Low-Level Logic Input                                                                       | --    | --    | 0.520    | V       |
| $I_{LKG}$ | Input Leakage (Absolute Value) |                                                                                             | --    | 1     | 1000     | nA      |
| $V_{OH}$  | HIGH-Level Output Voltage      | Push-Pull 1X, Open Drain PMOS 1X, $I_{OH} = 100 \mu A$                                      | 1.680 | 1.790 | --       | V       |
|           |                                | Push-Pull 2X, Open Drain PMOS 2X, $I_{OH} = 100 \mu A$                                      | 1.700 | 1.800 | --       | V       |

| Symbol       | Parameter                                                                            | Condition/Note                                                          | Min.  | Typ.  | Max.         | Unit       |
|--------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-------|-------|--------------|------------|
| $V_{OL}$     | LOW-Level Output Voltage                                                             | Push-Pull 1X,<br>$I_{OL} = 100 \mu A$                                   | --    | 0.020 | 0.030        | V          |
|              |                                                                                      | Push-Pull 2X,<br>$I_{OL} = 100 \mu A$                                   | --    | 0.010 | 0.020        | V          |
|              |                                                                                      | Open Drain NMOS 1X,<br>$I_{OL} = 100 \mu A$                             | --    | 0.010 | 0.020        | V          |
|              |                                                                                      | Open Drain NMOS 2X,<br>$I_{OL} = 100 \mu A$                             | --    | 0.010 | 0.010        | V          |
| $I_{OH}$     | HIGH-Level Output Current<br>(see Note 1)                                            | Push-Pull 1X, Open Drain PMOS 1X,<br>$V_{OH} = V_{DD} - 0.2$            | 1.000 | 1.390 | --           | mA         |
|              |                                                                                      | Push-Pull 2X, Open Drain PMOS 2X,<br>$V_{OH} = V_{DD} - 0.2$            | 2.100 | 2.680 | --           | mA         |
| $I_{OL}$     | LOW-Level Output Current<br>(see Note 1)                                             | Push-Pull 1X,<br>$V_{OL} = 0.15 V$                                      | 0.760 | 1.340 | --           | mA         |
|              |                                                                                      | Push-Pull 2X,<br>$V_{OL} = 0.15 V$                                      | 1.520 | 2.660 | --           | mA         |
|              |                                                                                      | Open Drain NMOS 1X,<br>$V_{OL} = 0.15 V$                                | 1.530 | 2.670 | --           | mA         |
|              |                                                                                      | Open Drain NMOS 2X,<br>$V_{OL} = 0.15 V$                                | 3.060 | 5.136 | --           | mA         |
| $I_{VDD}$    | Maximum Average or DC<br>Current Through $V_{DD}$ Pin<br>(Per chip side, see Note 2) | $T_J = 85^\circ C$                                                      | --    | --    | 73           | mA         |
|              |                                                                                      | $T_J = 110^\circ C$                                                     | --    | --    | 35           | mA         |
| $I_{GND}$    | Maximum Average or DC<br>Current Through GND Pin<br>(Per chip side, see Note 2)      | $T_J = 85^\circ C$                                                      | --    | --    | 92           | mA         |
|              |                                                                                      | $T_J = 110^\circ C$                                                     | --    | --    | 44           | mA         |
| $V_O$        | Maximal Voltage Applied to<br>any PIN in High-Impedance<br>State                     |                                                                         | --    | --    | $V_{DD}+0.3$ | V          |
| $T_{SU}$     | Startup Time                                                                         | From $V_{DD}$ rising past $PON_{THR}$                                   | --    | 0.31  | --           | ms         |
| $PON_{THR}$  | Power On Threshold                                                                   | $V_{DD}$ Level Required to Start Up the Chip                            | 1.180 | 1.353 | 1.516        | V          |
| $POFF_{THR}$ | Power Off Threshold                                                                  | $V_{DD}$ Level Required to Switch Off the<br>Chip                       | 0.730 | 0.914 | 1.103        | V          |
| $R_{PULL}$   | Pull Up or Pull Down<br>Resistance                                                   | 1 M for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$   | --    | 1     | --           | M $\Omega$ |
|              |                                                                                      | 100 k for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$ | --    | 100   | --           | k $\Omega$ |
|              |                                                                                      | 10 k for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$  | --    | 10    | --           | k $\Omega$ |
| $C_{VDD}$    | Decoupling Capacitor                                                                 | Capacitor Value at $V_{DD}$                                             | --    | 0.1   | --           | $\mu F$    |

Note 1: DC or average current through any pin should not exceed value given in Absolute Maximum Conditions.

Note 2: The GreenPAK's power rails are divided in two sides. Pins 2, 3, 4, 5 and 6 are connected to one side, pins 8, 9, 10, 11 and 12 to another.

## 5.3 Electrical Characteristics (3.3 V $\pm 10\%$ V<sub>DD</sub>)

| Symbol           | Parameter                                                                                   | Condition/Note                                                                                    | Min.   | Typ.   | Max.            | Unit    |
|------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------|--------|-----------------|---------|
| V <sub>DD</sub>  | Supply Voltage                                                                              |                                                                                                   | 3.0    | 3.3    | 3.6             | V       |
| I <sub>Q</sub>   | Quiescent Current                                                                           | Static Inputs and Outputs<br>(when ACMP, Vref and RC OSC are<br>powered down and non-operational) | --     | 0.75   | --              | $\mu$ A |
| T <sub>A</sub>   | Operating Temperature                                                                       |                                                                                                   | -40    | 25     | 85              | °C      |
| V <sub>AIR</sub> | Analog Input Voltage Range                                                                  | Positive Input                                                                                    | 0      | --     | V <sub>DD</sub> | V       |
|                  |                                                                                             | Negative Input                                                                                    | 0      | --     | 1.2             | V       |
| V <sub>IH</sub>  | HIGH-Level Input Voltage                                                                    | Logic Input                                                                                       | 1.780  | --     | V <sub>DD</sub> | V       |
|                  |                                                                                             | Logic Input with Schmitt Trigger                                                                  | 2.130  | --     | V <sub>DD</sub> | V       |
|                  |                                                                                             | Low-Level Logic Input                                                                             | 1.130  | --     | V <sub>DD</sub> | V       |
| V <sub>IL</sub>  | LOW-Level Input Voltage                                                                     | Logic Input                                                                                       | --     | --     | 1.210           | V       |
|                  |                                                                                             | Logic Input with Schmitt Trigger                                                                  | --     | --     | 0.950           | V       |
|                  |                                                                                             | Low-Level Logic Input                                                                             | --     | --     | 0.690           | V       |
| I <sub>LKG</sub> | Input Leakage<br>(Absolute Value)                                                           |                                                                                                   | --     | 1      | 1000            | nA      |
| V <sub>OH</sub>  | HIGH-Level Output Voltage                                                                   | Push-Pull 1X, Open Drain PMOS 1X,<br>I <sub>OH</sub> = 3 mA                                       | 2.720  | 3.090  | --              | V       |
|                  |                                                                                             | Push-Pull 2X, Open Drain PMOS 2X,<br>I <sub>OH</sub> = 3 mA                                       | 2.850  | 3.190  | --              | V       |
| V <sub>OL</sub>  | LOW-Level Output Voltage                                                                    | Push-Pull 1X,<br>I <sub>OL</sub> = 3 mA                                                           | --     | 0.180  | 0.280           | V       |
|                  |                                                                                             | Push-Pull 2X,<br>I <sub>OL</sub> = 3 mA                                                           | --     | 0.090  | 0.130           | V       |
|                  |                                                                                             | Open Drain NMOS 1X,<br>I <sub>OL</sub> = 3 mA                                                     | --     | 0.090  | 0.130           | V       |
|                  |                                                                                             | Open Drain NMOS 2X,<br>I <sub>OL</sub> = 3 mA                                                     | --     | 0.050  | 0.070           | V       |
| I <sub>OH</sub>  | HIGH-Level Output Current<br>(see Note 1)                                                   | Push-Pull 1X, Open Drain PMOS 1X,<br>V <sub>OH</sub> = 2.4 V                                      | 6.010  | 10.150 | --              | mA      |
|                  |                                                                                             | Push-Pull 2X, Open Drain PMOS 2X,<br>V <sub>OH</sub> = 2.4 V                                      | 11.460 | 19.610 | --              | mA      |
| I <sub>OL</sub>  | LOW-Level Output Current<br>(see Note 1)                                                    | Push-Pull 1X,<br>V <sub>OL</sub> = 0.4 V                                                          | 4.060  | 6.440  | --              | mA      |
|                  |                                                                                             | Push-Pull 2X,<br>V <sub>OL</sub> = 0.4 V                                                          | 8.130  | 12.360 | --              | mA      |
|                  |                                                                                             | Open Drain NMOS 1X,<br>V <sub>OL</sub> = 0.4 V                                                    | 8.130  | 12.410 | --              | mA      |
|                  |                                                                                             | Open Drain NMOS 2X,<br>V <sub>OL</sub> = 0.4 V                                                    | 16.260 | 22.900 | --              | mA      |
| I <sub>VDD</sub> | Maximum Average or DC<br>Current Through V <sub>DD</sub> Pin<br>(Per chip side, see Note 2) | T <sub>J</sub> = 85 °C                                                                            | --     | --     | 73              | mA      |
|                  |                                                                                             | T <sub>J</sub> = 110 °C                                                                           | --     | --     | 35              | mA      |
| I <sub>GND</sub> | Maximum Average or DC<br>Current Through GND Pin<br>(Per chip side, see Note 2)             | T <sub>J</sub> = 85 °C                                                                            | --     | --     | 92              | mA      |
|                  |                                                                                             | T <sub>J</sub> = 110 °C                                                                           | --     | --     | 44              | mA      |

| Symbol                                                                                                                                                                                                                                                                       | Parameter                                                  | Condition/Note                                                          | Min.  | Typ.  | Max.         | Unit       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------|-------|-------|--------------|------------|
| $V_O$                                                                                                                                                                                                                                                                        | Maximal Voltage Applied to any PIN in High-Impedance State |                                                                         | --    | --    | $V_{DD}+0.3$ | V          |
| $T_{SU}$                                                                                                                                                                                                                                                                     | Startup Time                                               | From $V_{DD}$ rising past $PON_{THR}$                                   | --    | 0.31  | --           | ms         |
| $PON_{THR}$                                                                                                                                                                                                                                                                  | Power On Threshold                                         | $V_{DD}$ Level Required to Start Up the Chip                            | 1.180 | 1.353 | 1.516        | V          |
| $POFF_{THR}$                                                                                                                                                                                                                                                                 | Power Off Threshold                                        | $V_{DD}$ Level Required to Switch Off the Chip                          | 0.730 | 0.914 | 1.103        | V          |
| $R_{PULL}$                                                                                                                                                                                                                                                                   | Pull Up or Pull Down Resistance                            | 1 M for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$   | --    | 1     | --           | M $\Omega$ |
|                                                                                                                                                                                                                                                                              |                                                            | 100 k for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$ | --    | 100   | --           | k $\Omega$ |
|                                                                                                                                                                                                                                                                              |                                                            | 10 k for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$  | --    | 10    | --           | k $\Omega$ |
| $C_{VDD}$                                                                                                                                                                                                                                                                    | Decoupling Capacitor                                       | Capacitor Value at $V_{DD}$                                             | --    | 0.1   | --           | $\mu F$    |
| <p>Note 1: DC or average current through any pin should not exceed value given in Absolute Maximum Conditions.</p> <p>Note 2: The GreenPAK's power rails are divided in two sides. Pins 2, 3, 4, 5 and 6 are connected to one side, pins 8, 9, 10, 11 and 12 to another.</p> |                                                            |                                                                         |       |       |              |            |

## 5.4 Electrical Characteristics (5 V $\pm 10\%$ $V_{DD}$ )

| Symbol    | Parameter                      | Condition/Note                                                                              | Min.  | Typ.  | Max.     | Unit        |
|-----------|--------------------------------|---------------------------------------------------------------------------------------------|-------|-------|----------|-------------|
| $V_{DD}$  | Supply Voltage                 |                                                                                             | 4.5   | 5.0   | 5.5      | V           |
| $I_Q$     | Quiescent Current              | Static Inputs and Outputs (when ACMP, Vref and RC OSC are powered down and non-operational) | --    | 1.0   | --       | $\mu A$     |
| $T_A$     | Operating Temperature          |                                                                                             | -40   | 25    | 85       | $^{\circ}C$ |
| $V_{AIR}$ | Analog Input Voltage Range     | Positive Input                                                                              | 0     | --    | $V_{DD}$ | V           |
|           |                                | Negative Input                                                                              | 0     | --    | 1.2      | V           |
| $V_{IH}$  | HIGH-Level Input Voltage       | Logic Input                                                                                 | 2.640 | --    | $V_{DD}$ | V           |
|           |                                | Logic Input with Schmitt Trigger                                                            | 3.160 | --    | $V_{DD}$ | V           |
|           |                                | Low-Level Logic Input                                                                       | 1.230 | --    | $V_{DD}$ | V           |
| $V_{IL}$  | LOW-Level Input Voltage        | Logic Input                                                                                 | --    | --    | 1.840    | V           |
|           |                                | Logic Input with Schmitt Trigger                                                            | --    | --    | 1.510    | V           |
|           |                                | Low-Level Logic Input                                                                       | --    | --    | 0.780    | V           |
| $I_{LKG}$ | Input Leakage (Absolute Value) |                                                                                             | --    | 1     | 1000     | nA          |
| $V_{OH}$  | HIGH-Level Output Voltage      | Push-Pull 1X, Open Drain PMOS 1X, $I_{OH} = 5$ mA                                           | 4.170 | 4.740 | --       | V           |
|           |                                | Push-Pull 2X, Open Drain PMOS 2X, $I_{OH} = 5$ mA                                           | 4.320 | 4.860 | --       | V           |
| $V_{OL}$  | LOW-Level Output Voltage       | Push-Pull 1X, $I_{OL} = 5$ mA                                                               | --    | 0.230 | 0.330    | V           |
|           |                                | Push-Pull 2X, $I_{OL} = 5$ mA                                                               | --    | 0.120 | 0.160    | V           |
|           |                                | Open Drain NMOS 1X, $I_{OL} = 5$ mA                                                         | --    | 0.120 | 0.160    | V           |
|           |                                | Open Drain NMOS 2X, $I_{OL} = 5$ mA                                                         | --    | 0.070 | 0.090    | V           |

| Symbol       | Parameter                                                                            | Condition/Note                                                          | Min.   | Typ.   | Max.         | Unit          |
|--------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------|--------|--------------|---------------|
| $I_{OH}$     | HIGH-Level Output Current<br>(see Note 1)                                            | Push-Pull 1X, Open Drain PMOS 1X,<br>$V_{OH} = 2.4\text{ V}$            | 21.980 | 29.010 | --           | mA            |
|              |                                                                                      | Push-Pull 2X, Open Drain PMOS 2X,<br>$V_{OH} = 2.4\text{ V}$            | 41.886 | 55.990 | --           | mA            |
| $I_{OL}$     | LOW-Level Output Current<br>(see Note 1)                                             | Push-Pull 1X,<br>$V_{OL} = 0.4\text{ V}$                                | 6.010  | 9.730  | --           | mA            |
|              |                                                                                      | Push-Pull 2X,<br>$V_{OL} = 0.4\text{ V}$                                | 11.590 | 19.460 | --           | mA            |
|              |                                                                                      | Open Drain NMOS 1X,<br>$V_{OL} = 0.4\text{ V}$                          | 11.760 | 19.460 | --           | mA            |
|              |                                                                                      | Open Drain NMOS 2X,<br>$V_{OL} = 0.4\text{ V}$                          | 19.120 | 35.952 | --           | mA            |
| $I_{VDD}$    | Maximum Average or DC<br>Current Through $V_{DD}$ Pin<br>(Per chip side, see Note 2) | $T_J = 85\text{ }^{\circ}\text{C}$                                      | --     | --     | 73           | mA            |
|              |                                                                                      | $T_J = 110\text{ }^{\circ}\text{C}$                                     | --     | --     | 35           | mA            |
| $I_{GND}$    | Maximum Average or DC<br>Current Through GND Pin<br>(Per chip side, see Note 2)      | $T_J = 85\text{ }^{\circ}\text{C}$                                      | --     | --     | 92           | mA            |
|              |                                                                                      | $T_J = 110\text{ }^{\circ}\text{C}$                                     | --     | --     | 44           | mA            |
| $V_O$        | Maximal Voltage Applied to<br>any PIN in High-Impedance<br>State                     |                                                                         | --     | --     | $V_{DD}+0.3$ | V             |
| $T_{SU}$     | Startup Time                                                                         | From $V_{DD}$ rising past $PON_{THR}$                                   | --     | 0.31   | --           | ms            |
| $PON_{THR}$  | Power On Threshold                                                                   | $V_{DD}$ Level Required to Start Up the Chip                            | 1.180  | 1.353  | 1.516        | V             |
| $POFF_{THR}$ | Power Off Threshold                                                                  | $V_{DD}$ Level Required to Switch Off the<br>Chip                       | 0.730  | 0.914  | 1.103        | V             |
| $R_{PULL}$   | Pull Up or Pull Down<br>Resistance                                                   | 1 M for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$   | --     | 1      | --           | M $\Omega$    |
|              |                                                                                      | 100 k for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$ | --     | 100    | --           | k $\Omega$    |
|              |                                                                                      | 10 k for Pull Up: $V_{IN} = GND$ ;<br>for Pull Down: $V_{IN} = V_{DD}$  | --     | 10     | --           | k $\Omega$    |
| $C_{VDD}$    | Decoupling Capacitor                                                                 | Capacitor Value at $V_{DD}$                                             | --     | 0.1    | --           | $\mu\text{F}$ |

Note 1: DC or average current through any pin should not exceed value given in Absolute Maximum Conditions.

Note 2: The GreenPAK's power rails are divided in two sides. Pins 2, 3, 4, 5 and 6 are connected to one side, pins 8, 9, 10, 11 and 12 to another.

## 5.5 IDD Estimator

Table 1. Typical Current estimated for each macrocell.

| Symbol | Parameter | Note                          | V <sub>DD</sub> = 1.8 V | V <sub>DD</sub> = 3.3 V | V <sub>DD</sub> = 5.0 V | Unit |
|--------|-----------|-------------------------------|-------------------------|-------------------------|-------------------------|------|
| I      | Current   | Chip Quiescent                | 0.26                    | 0.49                    | 0.76                    | μA   |
|        |           | Vref                          | 55.7                    | 56.0                    | 62.5                    | μA   |
|        |           | Vref Buffer (each)            | 0.6                     | 14.1                    | 14.6                    | μA   |
|        |           | OSC 25 kHz, predivide = 1     | 3.1                     | 4.7                     | 6.4                     | μA   |
|        |           | OSC 25 kHz, predivide = 8     | 3.0                     | 4.3                     | 5.8                     | μA   |
|        |           | OSC 2 MHz, predivide = 1      | 29.3                    | 51.0                    | 79.8                    | μA   |
|        |           | OSC 2 MHz, predivide = 8      | 17.4                    | 23.2                    | 29.0                    | μA   |
|        |           | 1st ACMP used (includes Vref) | 59.6                    | 60.0                    | 66.5                    | μA   |
|        |           | Each additional ACMP add      | 3.9                     | 4.0                     | 4.0                     | μA   |

## 5.6 Timing Estimator

Table 2. Typical Delay estimated for each macrocell.

| Symbol | Parameter | Note                                                     | V <sub>DD</sub> = 1.8 V |         | V <sub>DD</sub> = 3.3 V |         | V <sub>DD</sub> = 5.0 V |         | Unit |
|--------|-----------|----------------------------------------------------------|-------------------------|---------|-------------------------|---------|-------------------------|---------|------|
|        |           |                                                          | rising                  | falling | rising                  | falling | rising                  | falling |      |
| tpd    | Delay     | Digital Input without Schmitt Trigger -- Push Pull       | 44.2                    | 43.5    | 17.8                    | 18.2    | 12.7                    | 13.0    | ns   |
| tpd    | Delay     | Digital Input with Schmitt Trigger -- Push Pull          | 43.3                    | 42.5    | 17.7                    | 18.0    | 12.6                    | 13.0    | ns   |
| tpd    | Delay     | Low Voltage Digital input -- Push Pull                   | 45.6                    | 517.0   | 18.1                    | 215.3   | 12.7                    | 144.9   | ns   |
| tpd    | Delay     | Digital Input without Schmitt Trigger -- NMOS            | —                       | 83.8    | —                       | 29.9    | —                       | 19.5    | ns   |
| tpd    | Delay     | Output enable from pin, OE Hi-Z to 1                     | 44.8                    | —       | 17.9                    | —       | 12.6                    | —       | ns   |
| tpd    | Delay     | Output enable from pin, OE Hi-Z to 0                     | —                       | 43.4    | —                       | 17.7    | —                       | 12.8    | ns   |
| tpd    | Delay     | 2-bit LUT                                                | 18.7                    | 22.1    | 8.0                     | 8.7     | 5.8                     | 6.0     | ns   |
| tpd    | Delay     | Latch (2-bit LUT shared macrocell inputs)                | 26.5                    | 30.8    | 11.3                    | 12.3    | 8.1                     | 8.5     | ns   |
| tpd    | Delay     | 3-bit LUT                                                | 21.3                    | 24.4    | 9.1                     | 9.6     | 6.5                     | 6.6     | ns   |
| tpd    | Delay     | 3-bit LUT (LATCH shared macrocell inputs)                | 26.8                    | 25.4    | 11.2                    | 10.2    | 8.0                     | 7.1     | ns   |
| tpd    | Delay     | Latch with nRST/nSET (3-bit LUT shared macrocell inputs) | 29.7                    | 34.7    | 12.6                    | 13.9    | 9.1                     | 9.6     | ns   |
| tpd    | Delay     | 4-bit LUT (shared macrocell inputs)                      | 34.0                    | 32.6    | 14.4                    | 13.0    | 10.3                    | 9.1     | ns   |
| tpd    | Delay     | 2-bit LUT (Latch shared macrocell inputs)                | 26.8                    | 25.4    | 11.2                    | 10.2    | 8.0                     | 7.1     | ns   |
| tpd    | Delay     | CNT/DLY                                                  | 44.2                    | 38.8    | 18.7                    | 16.4    | 13.3                    | 11.8    | ns   |
| tpd    | Delay     | CNT/DLY (shared macrocell inputs)                        | 43.2                    | 39.7    | 18.4                    | 16.8    | 13.0                    | 12.1    | ns   |
| tpd    | Delay     | CNT3/DLY3 Rising Edge Detect (shared macrocell inputs)   | 38.2                    | —       | 16.0                    | —       | 11.4                    | —       | ns   |
| tpd    | Delay     | CNT3/DLY3 Falling Edge Detect (shared macrocell inputs)  | —                       | 40.4    | —                       | 16.4    | —                       | 11.6    | ns   |
| tpd    | Delay     | CNT3/DLY3 Both Edge Detect (shared macrocell inputs)     | 38.2                    | 40.5    | 15.9                    | 16.5    | 11.3                    | 11.5    | ns   |
| tpd    | Delay     | Filter                                                   | 191.6                   | 193     | 77.4                    | 77.8    | 50.7                    | 52.1    | ns   |

## 5.7 Typical Counter/Delay Offset Measurements

Table 3. Typical Counter/Delay Offset Measurements.

| Parameter               | RC OSC Freq      | RC OSC Power | V <sub>DD</sub> = 1.8 V | V <sub>DD</sub> = 3.3 V | V <sub>DD</sub> = 5.0 V | Unit |
|-------------------------|------------------|--------------|-------------------------|-------------------------|-------------------------|------|
| offset                  | 25 kHz           | auto         | 19                      | 14                      | 12                      | μs   |
| offset                  | 2 MHz            | auto         | 7                       | 4                       | 4                       | μs   |
| frequency settling time | 25 kHz           | auto         | 19                      | 14                      | 12                      | μs   |
| frequency settling time | 2 MHz            | auto         | 14                      | 14                      | 14                      | μs   |
| variable (CLK period)   | 25 kHz           | forced       | 0-40                    | 0-40                    | 0-40                    | μs   |
| variable (CLK period)   | 2 MHz            | forced       | 0-0.5                   | 0-0.5                   | 0-0.5                   | μs   |
| tpd (non-delayed edge)  | 25 kHz/<br>2 MHz | either       | 35                      | 14                      | 10                      | ns   |

## 5.8 Expected Delays and Widths

Table 4. Expected Delays and Widths for Programmable Delay (typical).

| Symbol | Parameter     | Note                                                    | V <sub>DD</sub> = 1.8 V | V <sub>DD</sub> = 3.3 V | V <sub>DD</sub> = 5.0 V | Unit |
|--------|---------------|---------------------------------------------------------|-------------------------|-------------------------|-------------------------|------|
| time1  | Width, 1 cell | PDLY mode:(any)edge detect, edge detect output          | 256.7                   | 120.8                   | 110                     | ns   |
| time1  | Width, 2 cell | PDLY mode:(any)edge detect, edge detect output          | 564.4                   | 262.7                   | 225                     | ns   |
| time1  | Width, 3 cell | PDLY mode:(any)edge detect, edge detect output          | 873.5                   | 405                     | 340                     | ns   |
| time1  | Width, 4 cell | PDLY mode:(any)edge detect, edge detect output          | 1182.3                  | 547.5                   | 450                     | ns   |
| time2  | Delay, 1 cell | PDLY mode:(any)edge detect, edge detect output          | 48.2                    | 20                      | 14                      | ns   |
| time2  | Delay, 2 cell | PDLY mode:(any)edge detect, edge detect output          | 48.2                    | 20.1                    | 14                      | ns   |
| time2  | Delay, 3 cell | PDLY mode:(any)edge detect, edge detect output          | 48.2                    | 20.1                    | 14                      | ns   |
| time2  | Delay, 4 cell | PDLY mode:(any)edge detect, edge detect output          | 48.3                    | 20.1                    | 14                      | ns   |
| time1  | Delay, 1 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 357.9                   | 162.2                   | 110                     | ns   |
| time1  | Delay, 2 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 666.1                   | 304.3                   | 220                     | ns   |
| time1  | Delay, 3 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 974.7                   | 446.3                   | 335                     | ns   |
| time1  | Delay, 4 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 1283.8                  | 588.8                   | 450                     | ns   |
| time1  | Width         | CNT3/DLY3 Rising Edge Detect (shared macrocell inputs)  | 136.6                   | 73.4                    | 140                     | ns   |
| time1  | Width         | CNT3/DLY3 Falling Edge Detect (shared macrocell inputs) | 130.6                   | 71                      | 140                     | ns   |
| time1  | Width         | CNT3/DLY3 Both Edge Detect (shared macrocell inputs)    | 133.05                  | 72                      | 140                     | ns   |

5.9 Typical Pulse Width Performance

Table 5. Typical Pulse Width Performance.

| Parameter            | V <sub>DD</sub> = 1.8 V | V <sub>DD</sub> = 3.3 V | V <sub>DD</sub> = 5.0 V | Unit |
|----------------------|-------------------------|-------------------------|-------------------------|------|
| Filtered Pulse Width | < 150                   | < 55                    | < 35                    | ns   |

## 6.0 Summary of Macrocell Function

### 6.1 I/O Pins

- Digital Input (low voltage or normal voltage, with or without Schmitt Trigger)
- Open Drain NMOS and Open Drain PMOS Outputs
- Push Pull Outputs
- Analog I/O
- 10 k $\Omega$ /100 k $\Omega$ /1 M $\Omega$  pull-up/pull-down resistors

### 6.2 Connection Matrix

- Digital matrix for circuit connections based on user design

### 6.3 Analog Comparators (2 total)

- Selectable hysteresis 0 mV/25 mV/50 mV/200 mV and selectable gain 1x/0.5x/0.33x/0.25x

### 6.4 Voltage Reference

- Used for references on Analog Comparators
- Can also be driven to external pins

### 6.5 Combinational Logic Look Up Tables (LUTs – 5 total)

- One 2-bit Lookup Tables
- Four 3-bit Lookup Tables

### 6.6 Combination Function Macrocells (12 total)

- Four Selectable DFF/Latches or 2-bit LUTs
- Four Selectable DFF/Latches or 3-bit LUTs
- One Selectable Pipe Delay or 3-bit LUT
- Two Selectable CNT/DLYs or 4-bit LUTs
- One Programmable Delay or Deglitch Filter

### 6.7 Delays/Counters (2 total)

- One 8-bit delay/counter with external clock/reset: Range 1-255 clock cycles
- One 14-bit delay/counter with external clock/reset: Range 1-16383 clock cycles

### 6.8 Pipe Delay (Part of Combination Function Macrocell)

- 8 stage / 2 output
- Two 1-8 stage selectable outputs
- One 1 stage fixed output

### 6.9 Additional Logic Functions (Part of Combination Function Macrocell)

- One Deglitch filter macrocell
- One Programmable Delay
  - 163 ns / 305 ns / 446 ns / 588 ns @ 3.3 V
  - Includes Edge Detection function

---

**6.10 RC Oscillator**

- 25 kHz and 2 MHz selectable frequency
- First Stage Clock pre=divider (4): OSC/1, OSC/2, OSC/4, and OSC/8
- Second stage divider control with two outputs, OUT0 and OUT1 (8): selectable (OSC/1, OSC/2, OSC/3, OSC/4, OSC/8, OSC/12, OSC/24, or OSC/64)

**6.11 Power On Reset (POR)**

## 7.0 I/O Pins

The SLG46120 has a total of 10 multi-function I/O pins which can function as either a user defined Input or Output, as well as serving as a special function (such as outputting the voltage reference).

Normal Mode pin definitions are as follows:

- Pin 1:  $V_{DD}$  Power Supply
- Pin 2: General Purpose Input
- Pin 3: General Purpose I/O or Analog Comparator 0 (+)
- Pin 4: General Purpose I/O or Analog Comparator 0 (-)
- Pin 5: General Purpose I/O
- Pin 6: General Purpose I/O or Analog Comparator 1 (+) with OE
- Pin 7: Ground
- Pin 8: General Purpose I/O
- Pin 9: General Purpose I/O
- Pin 10: General Purpose I/O with OE and Vref Output
- Pin 11: General Purpose I/O
- Pin 12: General Purpose I/O or External Clock Input

Of the 10 user defined I/O pins on the SLG46120, all but one of the pins (Pin 2) can serve as both digital input and digital output. Pin 2 can only serve as a digital input pin.

### 7.1 Input Modes

Each I/O pin can be configured as a digital input pin with/without buffered Schmitt Trigger, or can also be configured as a low voltage digital input. Pins 3, 4, and 6 can also be configured to serve as analog inputs to the on-chip comparators.

### 7.2 Output Modes

Pins 3, 4, 5, 6, 8, 9, 10, 11, and 12 can all be configured as digital output pins.

### 7.3 Pull Up/Down Resistors

All I/O pins have the option for user selectable resistors connected to the input structure. The selectable values on these resistors are 10 k $\Omega$ , 100 k $\Omega$  and 1 M $\Omega$ . In the case of Pin 2, the resistors are fixed to a pull-down configuration. In the case of all other I/O pins, the internal resistors can be configured as either pull-up or pull-downs.

### 7.4 3-State Outputs

Pins 6 and 10 of the SLG46120 can each be configured to build separate 3-state outputs using other components from these pins.

**Table 6. 3-State Output Mode Settings (for Pin 6 and 10)**

| Output Enable | Input Mode          | Output Mode |
|---------------|---------------------|-------------|
| 0             | Analog Input/Output | --          |
| 1             | --                  | Push-Pull   |

## 7.5 I/O Register Settings

### 7.5.1 PIN 2 Register Settings

**Table 7. PIN 2 Register Settings**

| Signal Function                          | Register Bit Address | Register Definition                                                                                                                  |
|------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| PIN 2 Mode Control                       | reg <624:623>        | 00: Digital Input without Schmitt Trigger<br>01: Digital Input with Schmitt Trigger<br>10: Low Voltage Digital Input<br>11: Reserved |
| PIN 2 Pull Down Resistor Value Selection | reg <626:625>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                       |

### 7.5.2 PIN 3 Register Settings

**Table 8. PIN 3 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                                                                                                                                   |
|---------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 3 Mode Control                          | reg <629:627>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Analog Input & Open Drain NMOS |
| PIN 3 Pull Up/Down Resistor Value Selection | reg <631:630>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                                        |
| PIN 3 Pull Up/Down Resistor Selection       | reg <632>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                                          |
| PIN3 Driver Strength Selection              | reg <633>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                                        |

## 7.5.3 PIN 4 Register Settings

**Table 9. PIN 4 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                                                                                                                                   |
|---------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 4 Mode Control                          | reg <636:634>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Analog Input & Open Drain NMOS |
| PIN 4 Pull Up/Down Resistor Value Selection | reg <638:637>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                                        |
| PIN 4 Pull Up/Down Resistor Selection       | reg <639>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                                          |
| PIN 4 Driver Strength Selection             | reg <640>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                                        |

## 7.5.4 PIN 5 Register Settings

**Table 10. PIN 5 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                                                                                                                                   |
|---------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 5 Mode Control                          | reg <643:641>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Analog Input & Open Drain NMOS |
| PIN 5 Pull Up/Down Resistor Value Selection | reg <645:644>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                                        |
| PIN 5 Pull Up/Down Resistor Selection       | reg <646>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                                          |
| PIN 5 Driver Strength Selection             | reg <647>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                                        |

## 7.5.5 PIN 6 Register Settings

**Table 11. PIN 6 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                               |
|---------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 6 Mode Control (sig_PIN6_oe =0)         | reg <649:648>        | 00: Digital Input without Schmitt Trigger<br>01: Digital Input with Schmitt Trigger<br>11: Low Voltage Digital Input<br>10: Analog Input / Output |
| PIN 6 Mode Control (sig_PIN6_oe =1)         | reg <651:650>        | 00: Push Pull 1X<br>01: Push Pull 2X<br>10: Open Drain NMOS 1X<br>11: Open Drain NMOS 2X                                                          |
| PIN 6 Pull Up/Down Resistor Value Selection | reg <653:652>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                    |
| PIN 6 Pull Up/Down Resistor Selection       | reg <654>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                      |

## 7.6 PIN 8 Register Settings

**Table 12. PIN 8 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                                                                                                                      |
|---------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 8 Mode Control                          | reg <657:655>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input / Output<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Reserved |
| PIN 8 Pull Up/Down Resistor Value Selection | reg <659:658>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                           |
| PIN 8 Pull Up/Down Resistor Selection       | reg <660>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                             |
| PIN 8 Driver Strength Selection             | reg <661>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                           |

## 7.6.1 PIN 9 Register Settings

**Table 13. PIN 9 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                                                                                                           |
|---------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 9 Mode Control                          | reg <664:662>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Reserved<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Open drain |
| PIN 9 Pull Up/Down Resistor Value Selection | reg <666:665>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                |
| PIN 9 Pull Up/Down Resistor Selection       | reg <667>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                  |
| PIN 8 Driver Strength Selection             | reg <668>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                |

## 7.7 PIN 10 Register Settings

**Table 14. PIN 10 Register Settings**

| Signal Function                              | Register Bit Address | Register Definition                                                                                                                      |
|----------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 10 Mode Control<br>(sig_PIN10_oe =0)     | reg <670:669>        | 00: Digital Input without Schmitt Trigger<br>01: Digital Input with Schmitt Trigger<br>11: Low Voltage Digital Input<br>10: Analog Input |
| PIN 10 Mode Control<br>(sig_PIN10_oe =1)     | reg <672:671>        | 00: Push Pull 1X<br>01: Push Pull 2X<br>10: Open Drain NMOS 1X<br>11: Open Drain NMOS 2X                                                 |
| PIN 10 Pull Up/Down Resistor Value Selection | reg <674:673>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                           |
| PIN 10 Pull Up/Down Resistor Selection       | reg <675>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                             |

## 7.8 PIN 11 Register Settings

**Table 15. PIN 11 Register Settings**

| Signal Function     | Register Bit Address | Register Definition                                                                                                                                                                                                           |
|---------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 11 Mode Control | reg <678:676>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Reserved<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Open drain |

**Table 15. PIN 11 Register Settings**

| Signal Function                              | Register Bit Address | Register Definition                                                            |
|----------------------------------------------|----------------------|--------------------------------------------------------------------------------|
| PIN 11 Pull Up/Down Resistor Value Selection | reg <680:679>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor |
| PIN 11 Pull Up/Down Resistor Selection       | reg <681>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                   |
| PIN 11 Driver Strength Selection             | reg <682>            | 0: 1X<br>1: 2X                                                                 |

## 7.9 PIN 12 Register Settings

Table 16. PIN 12 Register Settings

| Signal Function                              | Register Bit Address | Register Definition                                                                                                                                                                                                           |
|----------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 12 Mode Control                          | reg <685:683>        | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Reserved<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Open drain |
| PIN 12 Pull Up/Down Resistor Value Selection | reg <687:686>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                |
| PIN 12 Pull Up/Down Resistor Selection       | reg <688>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                  |
| PIN 12 Driver Strength Selection             | reg <689>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                |

## 7.10 GPI IO Structure

### 7.10.1 GPI IO Structure (for Pin 2)

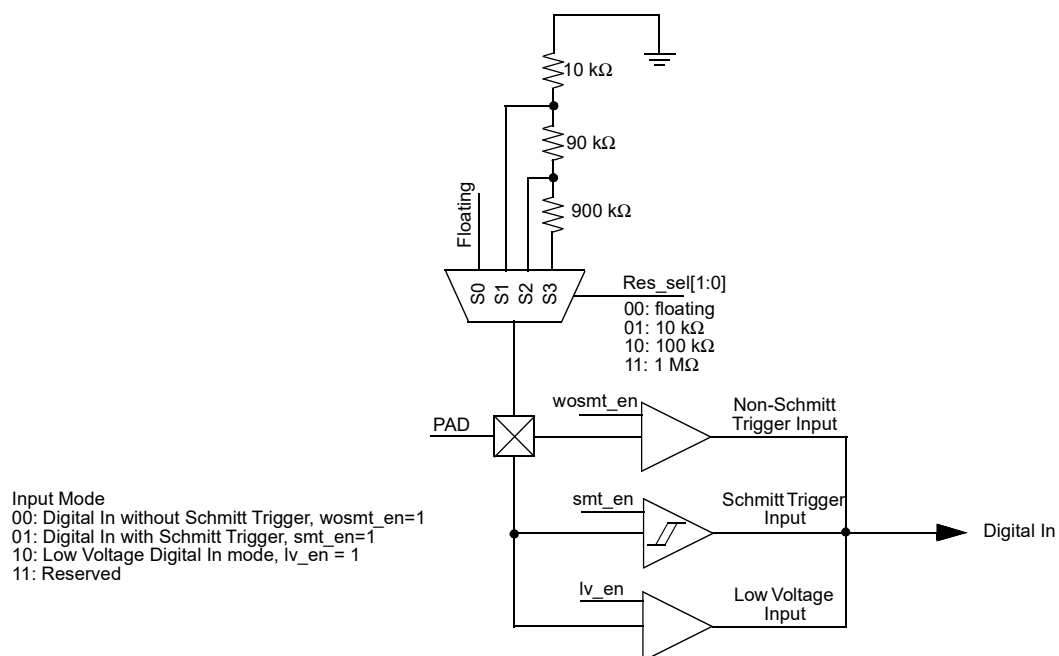


Figure 2. PIN 2 GPI IO Structure Diagram

## 7.11 Matrix OE IO Structure

### 7.11.1 Matrix OE IO Structure (for Pin 6, 10)

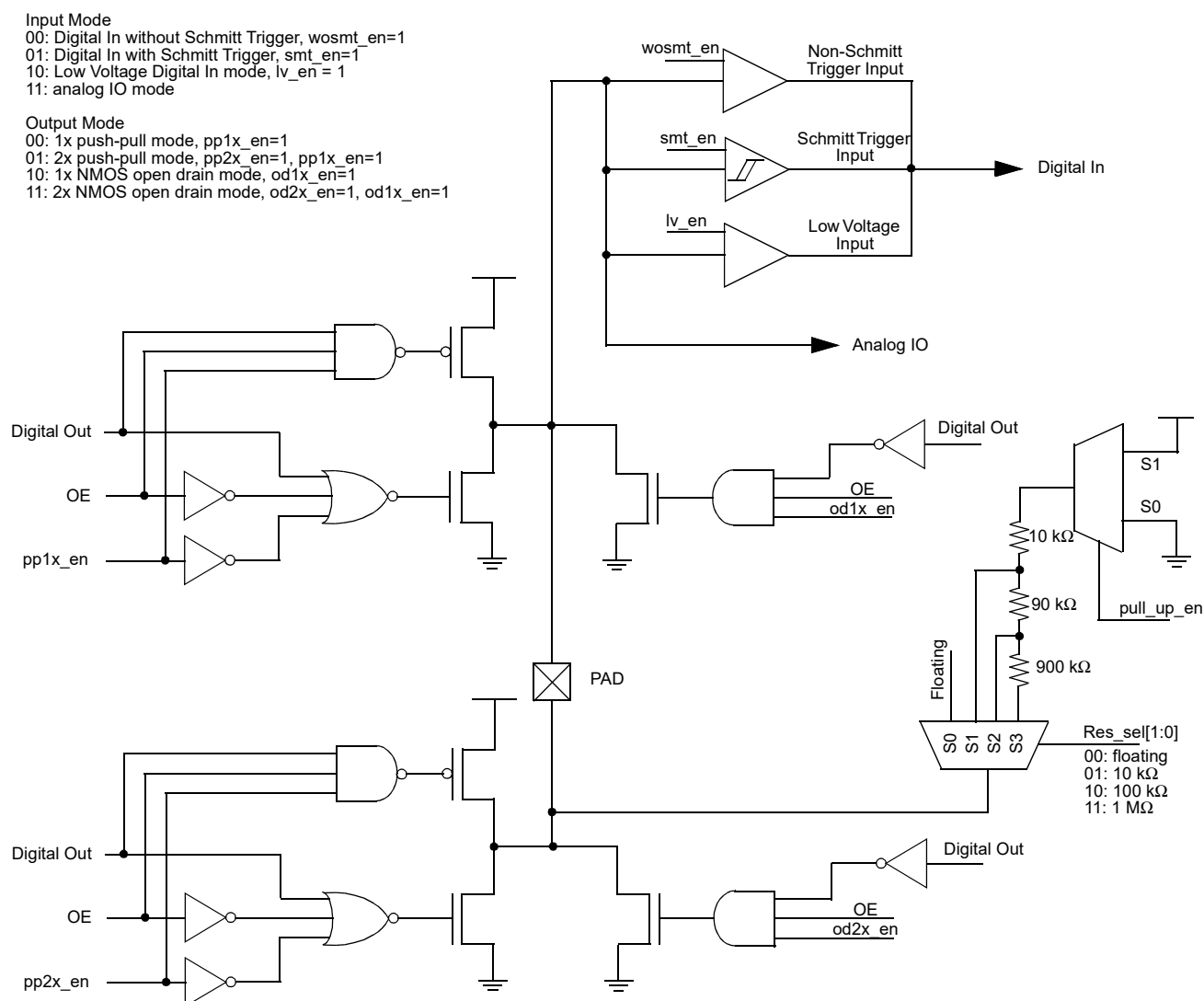


Figure 3. Matrix OE IO Structure Diagram

## 7.12 Register OE IO Structure

### 7.12.1 Register OE IO Structure (for Pins 3, 4, 5, 8, 9, 11, 12)

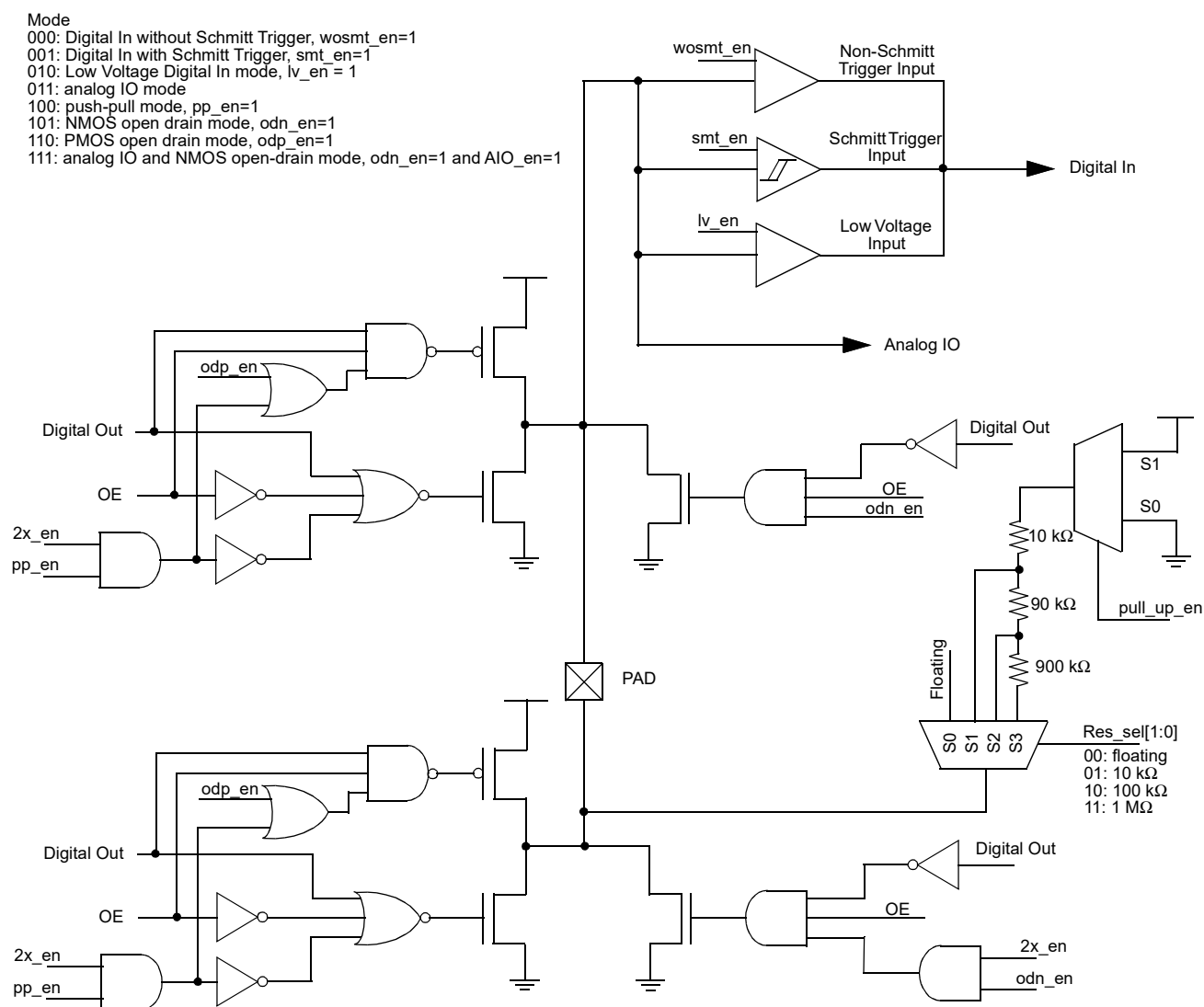


Figure 4. Register OE IO Structure Diagram

8.0 Connection Matrix

The Connection Matrix in the SLG46120 is used to create the internal routing for internal functions of the device once it is programmed. The registers are programmed from the one-time NVM cell during Test Mode Operation. All of the connection points for each logic cell within the SLG46120 have a specific digital bit code assigned to it that is either set to active “High” or inactive “Low” based on the design that is created. Once the 768 register bits within the SLG46120 are programmed a fully custom circuit will be created.

The Connection Matrix has 40 inputs and 64 outputs. Each of the 40 inputs to the Connection Matrix is hard-wired to a particular source macrocell, including I/O pins, LUTs, analog comparators, other digital resources and V<sub>DD</sub> and V<sub>SS</sub>. The input to a digital macrocell uses a 6-bit register to select one of these 40 input lines.

For a complete list of the SLG46120’s register table, see Section 16.0 Appendix A - SLG46120 Register Definition.

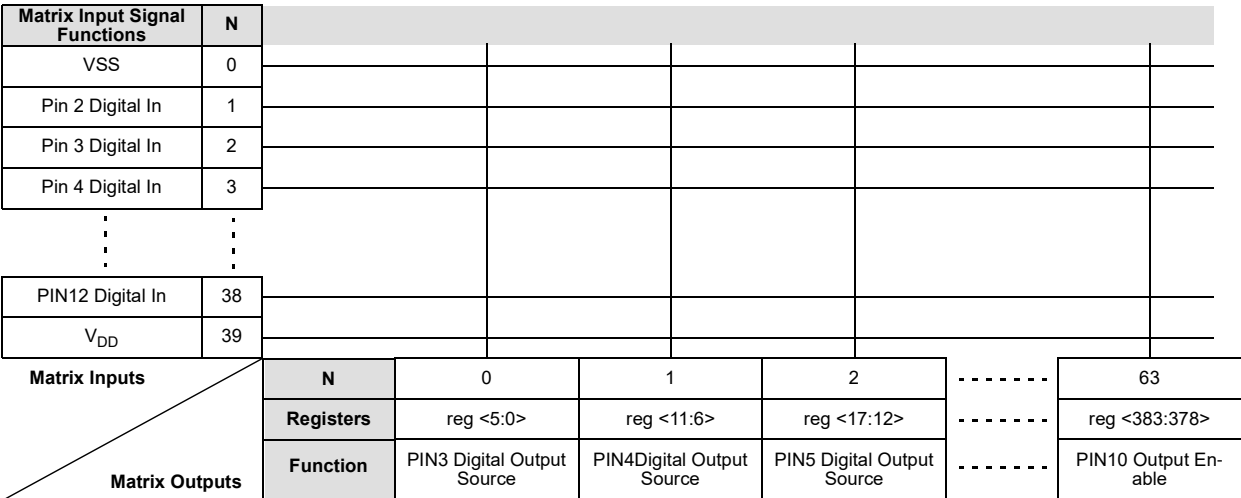


Figure 5. Connection Matrix

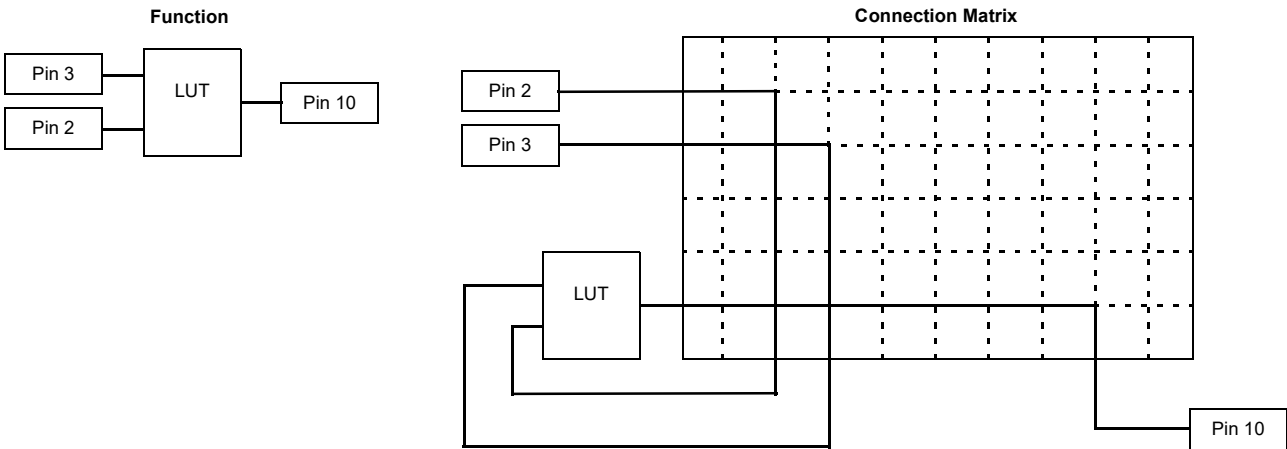


Figure 6. Connection Matrix Example

## 8.1 Matrix Input Table

Table 17. Matrix Input Table

| N  | Matrix Input Signal Function                                                          | Matrix Decode |   |   |   |   |   |
|----|---------------------------------------------------------------------------------------|---------------|---|---|---|---|---|
|    |                                                                                       | 5             | 4 | 3 | 2 | 1 | 0 |
| 0  | VSS                                                                                   | 0             | 0 | 0 | 0 | 0 | 0 |
| 1  | pin2 digital Input                                                                    | 0             | 0 | 0 | 0 | 0 | 1 |
| 2  | pin3 digital Input                                                                    | 0             | 0 | 0 | 0 | 1 | 0 |
| 3  | pin4 digital Input                                                                    | 0             | 0 | 0 | 0 | 1 | 1 |
| 4  | pin5 digital Input                                                                    | 0             | 0 | 0 | 1 | 0 | 0 |
| 5  | pin6 digital Input                                                                    | 0             | 0 | 0 | 1 | 0 | 1 |
| 6  | 2-bit LUT0 output (DFF/LATCH_0 output)                                                | 0             | 0 | 0 | 1 | 1 | 0 |
| 7  | 2-bit LUT1 output (DFF/LATCH_1 output)                                                | 0             | 0 | 0 | 1 | 1 | 1 |
| 8  | 2-bit LUT2 output (DFF/LATCH_2 output)                                                | 0             | 0 | 1 | 0 | 0 | 0 |
| 9  | 2-bit LUT3 output (DFF/LATCH_3 output)                                                | 0             | 0 | 1 | 0 | 0 | 1 |
| 10 | 2-bit LUT4 output                                                                     | 0             | 0 | 1 | 0 | 1 | 0 |
| 11 | sig_1pipe_dly_out (1st stage pipe delay output)                                       | 0             | 0 | 1 | 0 | 1 | 1 |
| 12 | 3-bit LUT0 output (DFF/LATCH_4 output with resetb or seb)                             | 0             | 0 | 1 | 1 | 0 | 0 |
| 13 | 3-bit LUT1 output (DFF/LATCH_5 output with resetb or seb)                             | 0             | 0 | 1 | 1 | 0 | 1 |
| 14 | 3-bit LUT2 output (DFF/LATCH_6 output with resetb or seb)                             | 0             | 0 | 1 | 1 | 1 | 0 |
| 15 | 3-bit LUT3 output (DFF/LATCH_7 output with resetb or seb)                             | 0             | 0 | 1 | 1 | 1 | 1 |
| 16 | 3-bit LUT4 output                                                                     | 0             | 1 | 0 | 0 | 0 | 0 |
| 17 | 3-bit LUT5 output                                                                     | 0             | 1 | 0 | 0 | 0 | 1 |
| 18 | 3-bit LUT6 output                                                                     | 0             | 1 | 0 | 0 | 1 | 0 |
| 19 | 3-bit LUT7 output                                                                     | 0             | 1 | 0 | 0 | 1 | 1 |
| 20 | 3-bit LUT8 output (pipe delay output0)                                                | 0             | 1 | 0 | 1 | 0 | 0 |
| 21 | 4-bit LUT0 output (CNT_DLY2 output (8 bit w/ ext CK,reset))                           | 0             | 1 | 0 | 1 | 0 | 1 |
| 22 | 4-bit LUT1 output (CNT_DLY3 output (8 bit w/ ext CK,reset))                           | 0             | 1 | 0 | 1 | 1 | 0 |
| 23 | CNT_DLY0(14bit) output                                                                | 0             | 1 | 0 | 1 | 1 | 1 |
| 24 | CNT_DLY1 output (8 bit w/ ext CK,reset)                                               | 0             | 1 | 1 | 0 | 0 | 0 |
| 25 | Edge detector output from CNT_DLY4                                                    | 0             | 1 | 1 | 0 | 0 | 1 |
| 26 | ACMP_0 output                                                                         | 0             | 1 | 1 | 0 | 1 | 0 |
| 27 | ACMP_1 output                                                                         | 0             | 1 | 1 | 0 | 1 | 1 |
| 28 | pipe delay output1                                                                    | 0             | 1 | 1 | 1 | 0 | 0 |
| 29 | Programmable delay with edge detector output (Deglitch filter output)                 | 0             | 1 | 1 | 1 | 0 | 1 |
| 30 | internal oscillator output (one of /1, /2, /3, /4, /8, /12, /24, /64 selected by REG) | 0             | 1 | 1 | 1 | 1 | 0 |
| 31 | internal oscillator output (one of /1, /2, /3, /4, /8, /12, /24, /64 selected by REG) | 0             | 1 | 1 | 1 | 1 | 1 |
| 32 | Bandgap OK signal                                                                     | 1             | 0 | 0 | 0 | 0 | 0 |
| 33 | Resetb_core as matrix input                                                           | 1             | 0 | 0 | 0 | 0 | 1 |
| 34 | pin8 digital Input                                                                    | 1             | 0 | 0 | 0 | 1 | 0 |
| 35 | pin9 digital Input                                                                    | 1             | 0 | 0 | 0 | 1 | 1 |

**Table 17. Matrix Input Table**

| N  | Matrix Input Signal Function | Matrix Decode |   |   |   |   |   |
|----|------------------------------|---------------|---|---|---|---|---|
|    |                              | 5             | 4 | 3 | 2 | 1 | 0 |
| 36 | pin10 digital Input          | 1             | 0 | 0 | 1 | 0 | 0 |
| 37 | pin11 digital Input          | 1             | 0 | 0 | 1 | 0 | 1 |
| 38 | Pin12 digital Input          | 1             | 0 | 0 | 1 | 1 | 0 |
| 39 | V <sub>DD</sub>              | 1             | 0 | 0 | 1 | 1 | 1 |

## 8.2 Matrix Output Table

**Table 18. Matrix Output Table**

| Register Bit Address | Matrix Output Signal Function                               | Matrix Output Number |
|----------------------|-------------------------------------------------------------|----------------------|
| reg <5:0>            | Pin 3 digital out source                                    | 0                    |
| reg <11:6>           | Pin 4 digital out source                                    | 1                    |
| reg <17:12>          | Pin 5 digital out source                                    | 2                    |
| reg <23:18>          | Pin 6 digital out source                                    | 3                    |
| reg <29:24>          | Pin 6 output enable                                         | 4                    |
| reg <35:30>          | in0 of 2-bit LUT0 (Clock Input of DFF0)                     | 5                    |
| reg <41:36>          | in1 of 2-bit LUT0 (Data Input of DFF0)                      | 6                    |
| reg <47:42>          | in0 of 2-bit LUT1 (Clock Input of DFF1)                     | 7                    |
| reg <53:48>          | in1 of 2-bit LUT1 (Data Input of DFF1)                      | 8                    |
| reg <59:54>          | in0 of 2-bit LUT2 (Clock Input of DFF2)                     | 9                    |
| reg <65:60>          | in1 of 2-bit LUT2 (Data Input of DFF2)                      | 10                   |
| reg <71:66>          | in0 of 2-bit LUT3 (Clock Input of DFF3)                     | 11                   |
| reg <77:72>          | in1 of 2-bit LUT3 (Data Input of DFF3)                      | 12                   |
| reg <83:78>          | in0 of 2-bit LUT4                                           | 13                   |
| reg <89:84>          | in1 of 2-bit LUT4                                           | 14                   |
| reg <95:90>          | Pin 11 digital out source                                   | 15                   |
| reg <101:96>         | Pin 12 digital out source                                   | 16                   |
| reg <107:102>        | in0 of 3-bit LUT0 (Clock Input of DFF4 with nReset/nSet)    | 17                   |
| reg <113:108>        | in1 of 3-bit LUT0 (Data input of DFF4 with nReset/nSet)     | 18                   |
| reg <119:114>        | in2 of 3-bit LUT0 (Resetb or Setb of DFF4 with nReset/nSet) | 19                   |
| reg <125:120>        | in0 of 3-bit LUT1 (Clock Input of DFF5 with nReset/nSet)    | 20                   |
| reg <131:126>        | in1 of 3-bit LUT1 (Data input of DFF5 with nReset/nSet)     | 21                   |
| reg <137:132>        | in2 of 3-bit LUT1 (Resetb or Setb of DFF5 with nReset/nSet) | 22                   |
| reg <143:138>        | in0 of 3-bit LUT2 (Clock Input of DFF6 with nReset/nSet)    | 23                   |
| reg <149:144>        | in1 of 3-bit LUT2 (Data input of DFF6 with nReset/nSet)     | 24                   |
| reg <155:150>        | in2 of 3-bit LUT2 (Resetb or Setb of DFF6 with nReset/nSet) | 25                   |
| reg <161:156>        | in0 of 3-bit LUT3 (Clock Input of DFF7 with nReset/nSet)    | 26                   |
| reg <167:162>        | in1 of 3-bit LUT3 (Data input of DFF7 with nReset/nSet)     | 27                   |
| reg <173:168>        | in2 of 3-bit LUT3 (Resetb or Setb of DFF7 with nReset/nSet) | 28                   |
| reg <179:174>        | in0 of 3-bit LUT4                                           | 29                   |
| reg <185:180>        | in1 of 3-bit LUT4                                           | 30                   |
| reg <191:186>        | in2 of 3-bit LUT4                                           | 31                   |
| reg <197:192>        | in0 of 3-bit LUT5                                           | 32                   |
| reg <203:198>        | in1 of 3-bit LUT5                                           | 33                   |
| reg <209:204>        | in2 of 3-bit LUT5                                           | 34                   |
| reg <215:210>        | in0 of 3-bit LUT6                                           | 35                   |
| reg <221:216>        | in1 of 3-bit LUT6                                           | 36                   |
| reg <227:222>        | in2 of 3-bit LUT6                                           | 37                   |

**Table 18. Matrix Output Table**

| Register Bit Address | Matrix Output Signal Function                                                   | Matrix Output Number |
|----------------------|---------------------------------------------------------------------------------|----------------------|
| reg <233:228>        | in0 of 3-bit LUT7                                                               | 38                   |
| reg <239:234>        | in1 of 3-bit LUT7                                                               | 39                   |
| reg <245:240>        | in2 of 3-bit LUT7                                                               | 40                   |
| reg <251:246>        | in0 of 3-bit LUT8 (Input of pipe delay)                                         | 41                   |
| reg <257:252>        | in1 of 3-bit LUT8 (Resetb of pipe delay)                                        | 42                   |
| reg <263:258>        | in2 of 3-bit LUT8 (Clock of pipe delay)                                         | 43                   |
| reg <269:264>        | in0 of 4-bit LUT0 (Input for Delay2 ext. clock or Counter2 8bit external Clock) | 44                   |
| reg <275:270>        | in1 of 4-bit LUT0 (Input for delay2 or counter2 reset input)                    | 45                   |
| reg <281:276>        | in2 of 4-bit LUT0                                                               | 46                   |
| reg <287:282>        | in3 of 4-bit LUT0                                                               | 47                   |
| reg <293:288>        | in0 of 4-bit LUT1 (Input for Delay3 ext. clock or Counter3 8bit external Clock) | 48                   |
| reg <299:294>        | in1 of 4-bit LUT1 (Input for delay3 or counter3 reset input)                    | 49                   |
| reg <305:300>        | in2 of 4-bit LUT1                                                               | 50                   |
| reg <311:306>        | in3 of 4-bit LUT1                                                               | 51                   |
| reg <317:312>        | Input for delay0 or counter0 (14bits) external clock                            | 52                   |
| reg <323:318>        | Input for Delay1 ext. clock or Counter1 8bit external Clock                     | 53                   |
| reg <329:324>        | Input for delay1 or counter1 reset input                                        | 54                   |
| reg <335:330>        | Not used                                                                        | 55                   |
| reg <341:336>        | pdb for ACMP0                                                                   | 56                   |
| reg <347:342>        | pdb for ACMP1                                                                   | 57                   |
| reg <353:348>        | Input for programmable delay for edge detector (Deglitch filter input)          | 58                   |
| reg <359:354>        | Power down for osc. (higher priority) (high = power down).                      | 59                   |
| reg <365:360>        | Pin 8 digital out source                                                        | 60                   |
| reg <371:366>        | Pin 9 digital out source                                                        | 61                   |
| reg <377:372>        | Pin 10 digital out source                                                       | 62                   |
| reg <383:378>        | Pin 10 output enable                                                            | 63                   |

## 9.0 Combinatorial Logic

Combinatorial logic is supported via five Lookup Tables (LUTs) within the SLG46120. There is one 2-bit LUT and four 3-bit LUTs. The device also includes 11 Combination Function Macrocells that can be used as LUTs. For more details, please see Section 10.0 Combination Function Macrocells.

Inputs/Outputs for the four LUTs are configured from the connection matrix with specific logic functions being defined by the state of NVM bits. The outputs of the LUTs can be configured to any user defined function, including the following standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR).

### 9.1 2-Bit LUT

The one 2-bit LUT takes in two input signals from the connection matrix and produce a single output, which goes back into the connection matrix.

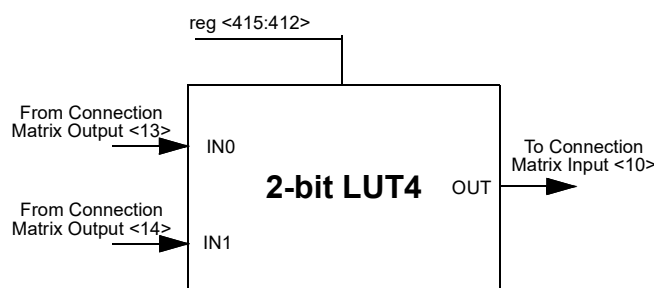


Figure 7. 2-bit LUT4

Table 19. 2-bit LUT4 Truth Table.

| IN1 | IN0 | OUT          |
|-----|-----|--------------|
| 0   | 0   | reg <412>reg |
| 0   | 1   | reg <413>reg |
| 1   | 0   | reg <414>reg |
| 1   | 1   | reg <415>reg |

Each 2-bit LUT uses a 4-bit register signal to define their output functions;

*2-Bit LUT4 is defined by reg <415:412>*

The table below shows the register bits for the standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR) that can be created within each of the two 2-bit LUT logic cells.

Table 20. 2-bit LUT Standard Digital Functions.

| Function | MSB |   |   | LSB |
|----------|-----|---|---|-----|
| AND-2    | 1   | 0 | 0 | 0   |
| NAND-2   | 0   | 1 | 1 | 1   |
| OR-2     | 1   | 1 | 1 | 0   |
| NOR-2    | 0   | 0 | 0 | 1   |
| XOR-2    | 0   | 1 | 1 | 0   |
| XNOR-2   | 1   | 0 | 0 | 1   |

## 9.2 3-Bit LUT

The four 3-bit LUTs each take in three input signals from the connection matrix and produce a single output, which goes back into the connection matrix.

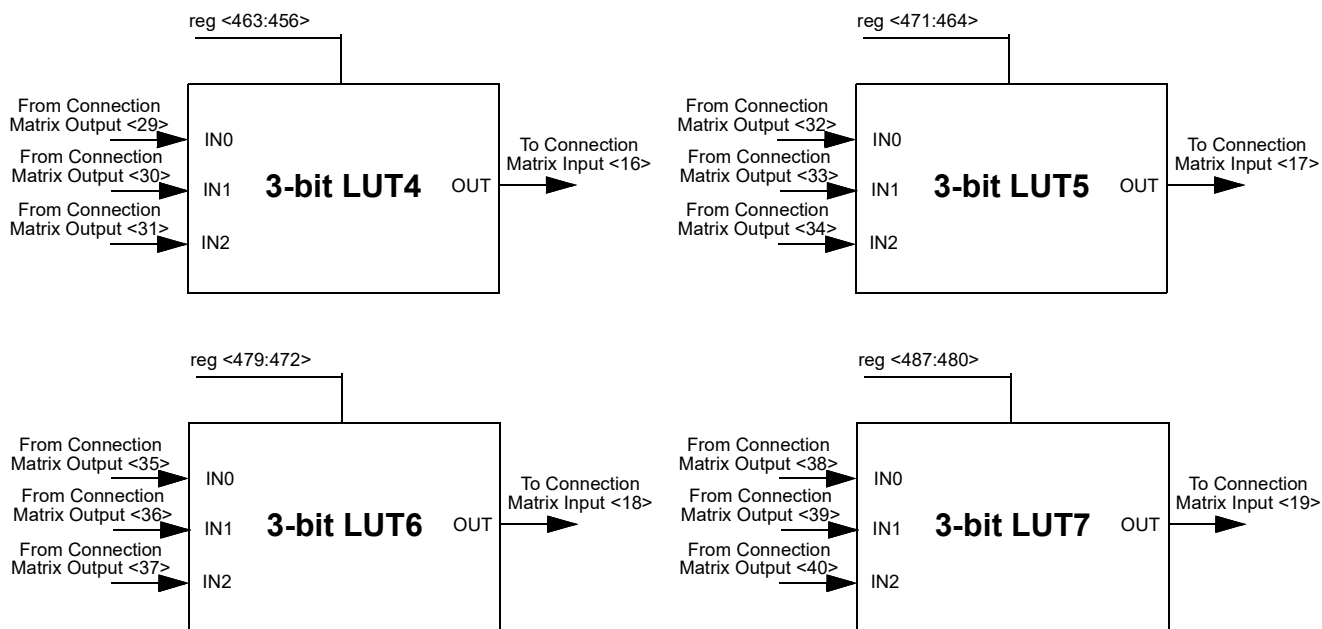


Figure 8. 3-bit LUTs

Table 21. 3-bit LUT4 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <456> |
| 0   | 0   | 1   | reg <457> |
| 0   | 1   | 0   | reg <458> |
| 0   | 1   | 1   | reg <459> |
| 1   | 0   | 0   | reg <460> |
| 1   | 0   | 1   | reg <461> |
| 1   | 1   | 0   | reg <462> |
| 1   | 1   | 1   | reg <463> |

Table 22. 3-bit LUT5 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <464> |
| 0   | 0   | 1   | reg <465> |
| 0   | 1   | 0   | reg <466> |
| 0   | 1   | 1   | reg <467> |
| 1   | 0   | 0   | reg <468> |
| 1   | 0   | 1   | reg <469> |
| 1   | 1   | 0   | reg <470> |
| 1   | 1   | 1   | reg <471> |

Table 23. 3-bit LUT6 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <472> |
| 0   | 0   | 1   | reg <473> |
| 0   | 1   | 0   | reg <474> |
| 0   | 1   | 1   | reg <475> |
| 1   | 0   | 0   | reg <476> |
| 1   | 0   | 1   | reg <477> |
| 1   | 1   | 0   | reg <478> |
| 1   | 1   | 1   | reg <479> |

Table 24. 3-bit LUT7 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <480> |
| 0   | 0   | 1   | reg <481> |
| 0   | 1   | 0   | reg <482> |
| 0   | 1   | 1   | reg <483> |
| 1   | 0   | 0   | reg <484> |
| 1   | 0   | 1   | reg <485> |
| 1   | 1   | 0   | reg <486> |
| 1   | 1   | 1   | reg <487> |

Each 3-bit LUT uses a 8-bit register signal to define their output functions;

*3-Bit LUT4 is defined by reg <456:463>*

*3-Bit LUT5 is defined by reg <471:464>*

*3-Bit LUT6 is defined by reg <479:472>*

*3-Bit LUT7 is defined by reg <487:480>*

The table below shows the register bits for the standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR) that can be created within each of the two 3-bit LUT logic cells.

**Table 25. 3-bit LUT Standard Digital Functions.**

| Function | MSB |   |   |   |   |   |   | LSB |
|----------|-----|---|---|---|---|---|---|-----|
| AND-3    | 1   | 0 | 0 | 0 | 0 | 0 | 0 | 0   |
| NAND-3   | 0   | 1 | 1 | 1 | 1 | 1 | 1 | 1   |
| OR-3     | 1   | 1 | 1 | 1 | 1 | 1 | 1 | 0   |
| NOR-3    | 0   | 0 | 0 | 0 | 0 | 0 | 0 | 1   |
| XOR-3    | 1   | 0 | 0 | 1 | 0 | 1 | 1 | 0   |
| XNOR-3   | 0   | 1 | 1 | 0 | 1 | 0 | 0 | 1   |

## 10.0 Combination Function Macrocells

The SLG46120 has twelve combination function macrocells that can serve more than one logic or timing function. In eleven of these cases, they can serve as a Look Up Table (LUT), or as another logic or timing function. In the last case, it can serve as either a programmable delay or deglitch filter. See the list below for the functions that can be implemented in these macrocells.

- Four macrocells that can serve as either 2-bit LUTs or as D Flip Flops
- Four macrocells that can serve as either 3-bit LUTs or as D Flip Flops
- One macrocell that can serve as either 3-bit LUT or as Pipe Delay
- Two macrocells that can serve as either 4-bit LUTs or as 8-Bit Counter / Delays
- One macrocell that can serve as either a Programmable Delay or as a Deglitch Filter

Inputs/Outputs for the eleven combination function macrocells are configured from the connection matrix with specific logic functions being defined by the state of NVM bits.

When used as a LUT to implement combinatorial logic functions, the outputs of the LUTs can be configured to any user defined function, including the following standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR).

When used as a D Flip Flop / Latch, the source and destination of the inputs and outputs for the DFF/Latches are configured from the connection matrix. All DFF/Latch macrocells have user selection for initial state, and all have the option to connect both the Q and Q Bar outputs to the connection matrix. The macrocells DFF2, DFF3 have an additional input from the matrix that can serve as a nSet or nReset function to the macrocell.

The operation of the D Flip-Flop and Latch will follow the functional descriptions below:

DFF: CLK is rising edge triggered, then  $Q = D$ ; otherwise Q will not change

Latch: if  $CLK = 0$ , then  $Q = D$

### 10.1 2-Bit LUT or D Flip Flop Macrocells

There are four macrocells that can serve as either 2-bit LUTs or as D Flip Flops. When used to implement LUT functions, the 2-bit LUTs each take in two input signals from the connection matrix and produce a single output, which goes back into the connection matrix. When used to implement D Flip Flop function, the two input signals from the connection matrix go to the data (d) and clock (clk) inputs for the Flip Flop, with the output going back to the connection matrix.

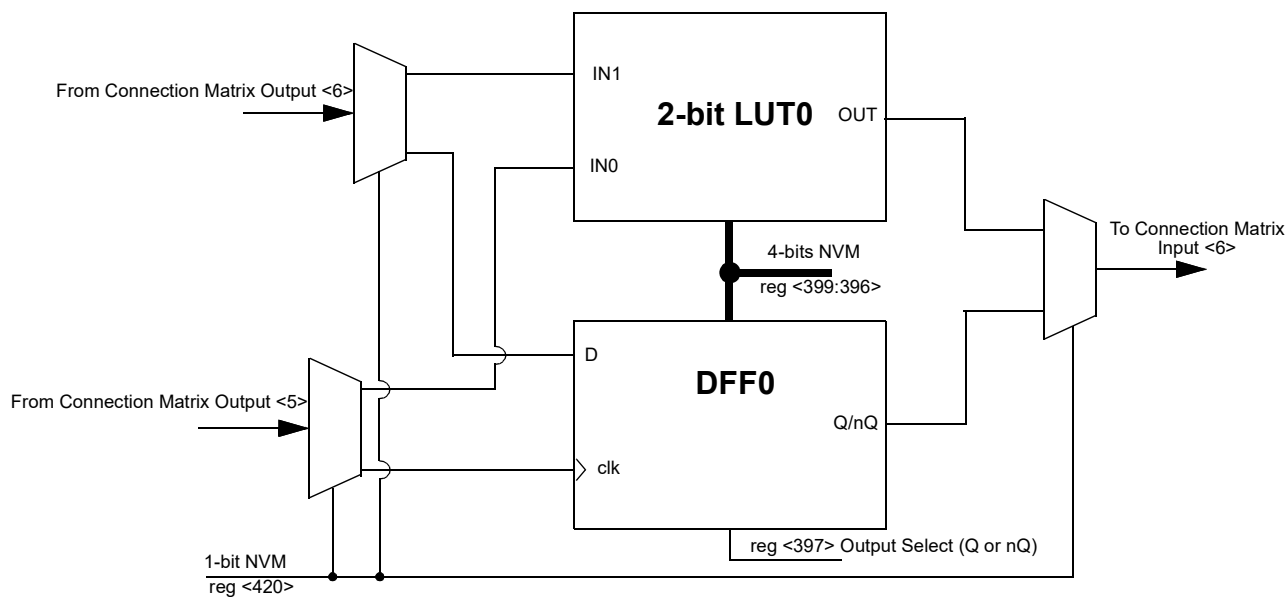


Figure 9. 2-bit LUT0 or DFF0

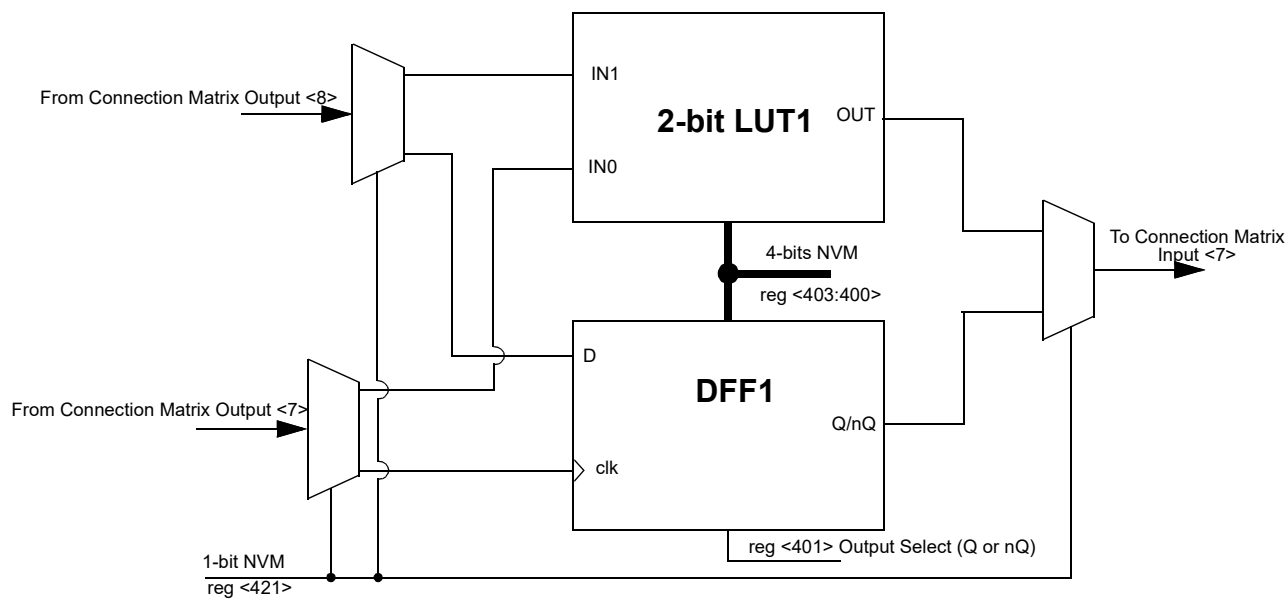


Figure 10. 2-bit LUT1 or DFF1

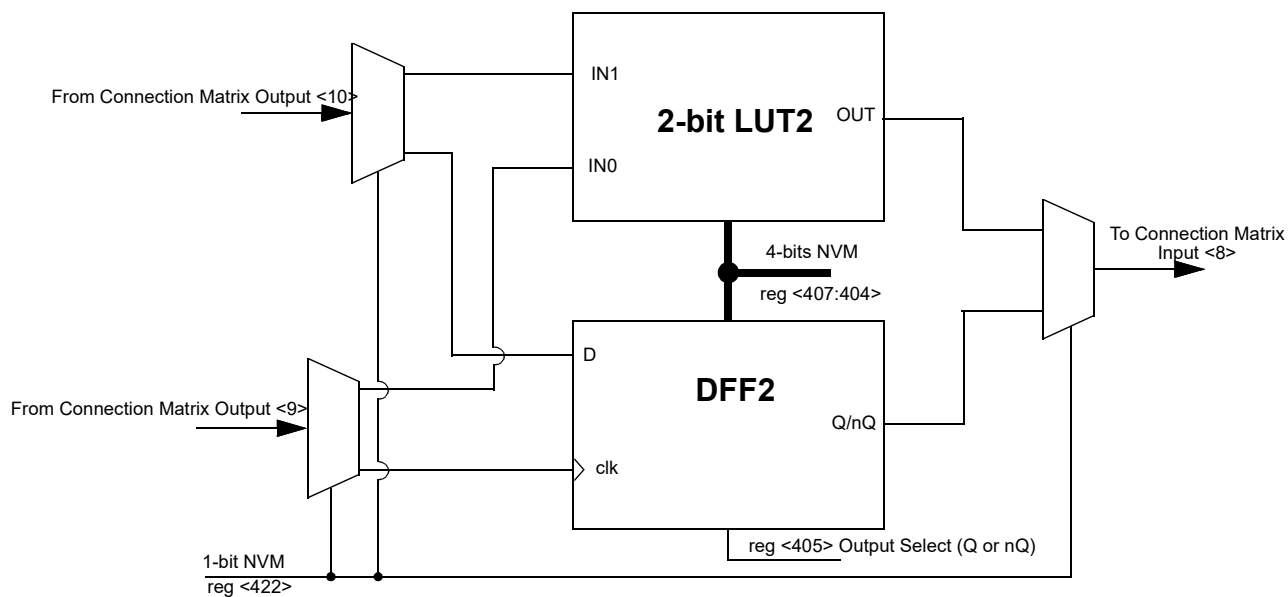


Figure 11. 2-bit LUT2 or DFF2

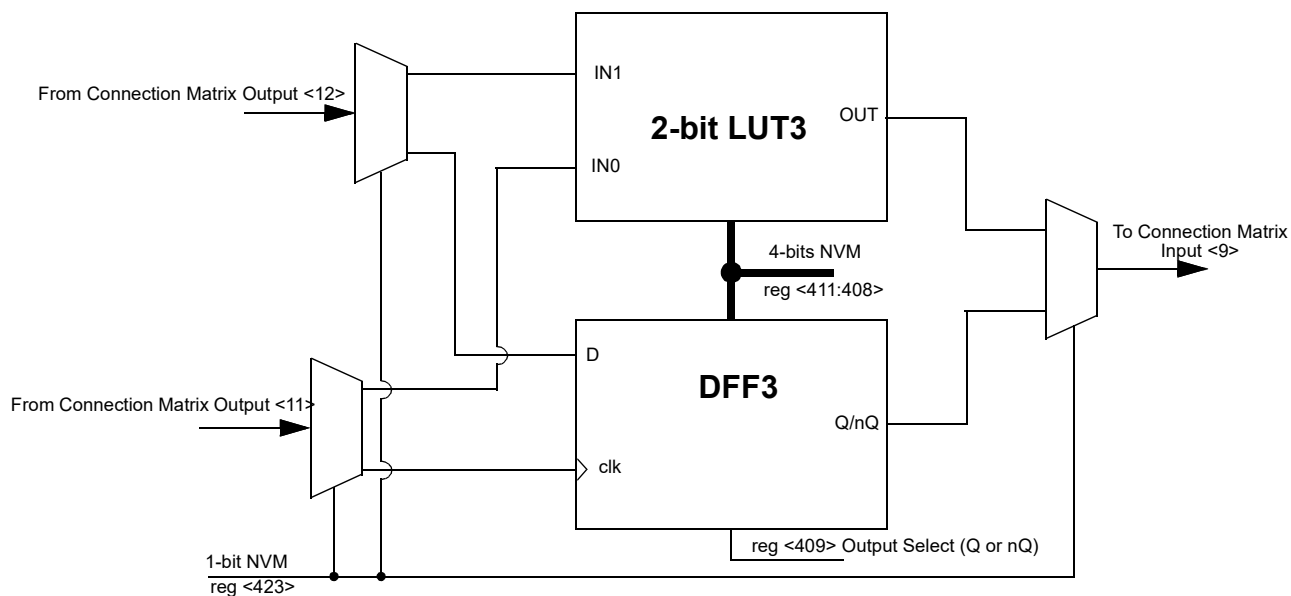


Figure 12. 2-bit LUT3 or DFF3

## 10.1.1 2-Bit LUT or D Flip Flop Macrocells Used as 2-Bit LUTs

**Table 26. 2-bit LUT0 Truth Table.**

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <396> |
| 0   | 1   | reg <397> |
| 1   | 0   | reg <398> |
| 1   | 1   | reg <399> |

**Table 27. 2-bit LUT1 Truth Table.**

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <400> |
| 0   | 1   | reg <401> |
| 1   | 0   | reg <402> |
| 1   | 1   | reg <403> |

**Table 28. 2-bit LUT3 Truth Table.**

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <404> |
| 0   | 1   | reg <405> |
| 1   | 0   | reg <406> |
| 1   | 1   | reg <407> |

**Table 29. 2-bit LUT4 Truth Table.**

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <408> |
| 0   | 1   | reg <409> |
| 1   | 0   | reg <410> |
| 1   | 1   | reg <411> |

Each Macrocell, when programmed for a LUT function, uses a 4-bit register to define their output function:

*2-Bit LUT0 is defined by reg <399:396>*

*2-Bit LUT1 is defined by reg <403:400>*

*2-Bit LUT2 is defined by reg <407:404>*

*2-Bit LUT3 is defined by reg <411:408>*

## 10.1.2 2-Bit LUT or D Flip Flop Macrocells Used as D Flip Flop Register Settings

**Table 30. DFF0 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                  |
|------------------------------|----------------------|--------------------------------------|
| DFF0 or Latch select         | reg <396>            | 0: DFF function<br>1: Latch function |
| DFF0 output select           | reg <397>            | 0: Q output<br>1: nQ output          |
| DFF0 initial polarity select | reg <398>            | 0: Low<br>1: High                    |
| 2-bit LUT0 data              | reg <399:396>        | 2-bit LUT0 data                      |
| 2-bit LUT0 or DFF0 select    | reg <420>            | 0: 2-bit LUT0<br>1: DFF0             |

**Table 31. DFF1 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                  |
|------------------------------|----------------------|--------------------------------------|
| DFF1 or Latch select         | reg <400>            | 0: DFF function<br>1: Latch function |
| DFF1 output select           | reg <401>            | 0: Q output<br>1: nQ output          |
| DFF1 initial polarity select | reg <402>            | 0: Low<br>1: High                    |
| 2-bit LUT1 data              | reg <403:400>        | 2-bit LUT1 data                      |
| 2-bit LUT1 or DFF1 select    | reg <421>            | 0: 2-bit LUT1<br>1: DFF1             |

**Table 32. DFF2 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                  |
|------------------------------|----------------------|--------------------------------------|
| DFF2 or Latch select         | reg <404>            | 0: DFF function<br>1: Latch function |
| DFF2 output select           | reg <405>            | 0: Q output<br>1: nQ output          |
| DFF2 initial polarity select | reg <406>            | 0: Low<br>1: High                    |
| 2-bit LUT2 data              | reg <407:404>        | 2-bit LUT0 data                      |
| 2-bit LUT2 or DFF2 select    | reg <422>            | 0: 2-bit LUT2<br>1: DFF2             |

**Table 33. DFF3 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                  |
|------------------------------|----------------------|--------------------------------------|
| DFF3 or Latch select         | reg <408>            | 0: DFF function<br>1: Latch function |
| DFF3 output select           | reg <409>            | 0: Q output<br>1: nQ output          |
| DFF3 initial polarity select | reg <410>            | 0: Low<br>1: High                    |
| 2-bit LUT3 data              | reg <411:408>        | 2-bit LUT1 data                      |
| 2-bit LUT3 or DFF3 select    | reg <423>            | 0: 2-bit LUT3<br>1: DFF3             |

## 10.2 3-Bit LUT or D Flip Flop with Set/Reset Macrocells

There are four macrocells that can serve as either 3-bit LUTs or as D Flip Flops. When used to implement LUT functions, the 3-bit LUTs each take in three input signals from the connection matrix and produce a single output, which goes back into the connection matrix. When used to implement D Flip Flop function, the three input signals from the connection matrix go to the data (d) and clock (clk) and Set/Reset (nRST/nSET) inputs for the Flip Flop, with the output going back to the connection matrix.

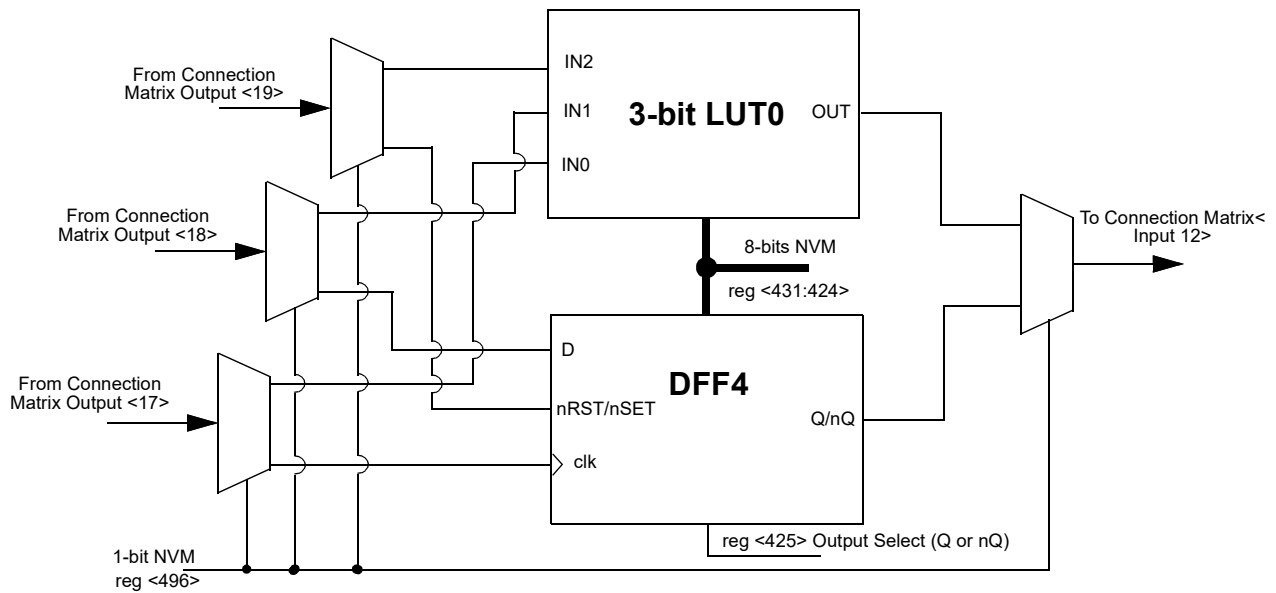


Figure 13. 3-bit LUT0 or DFF4

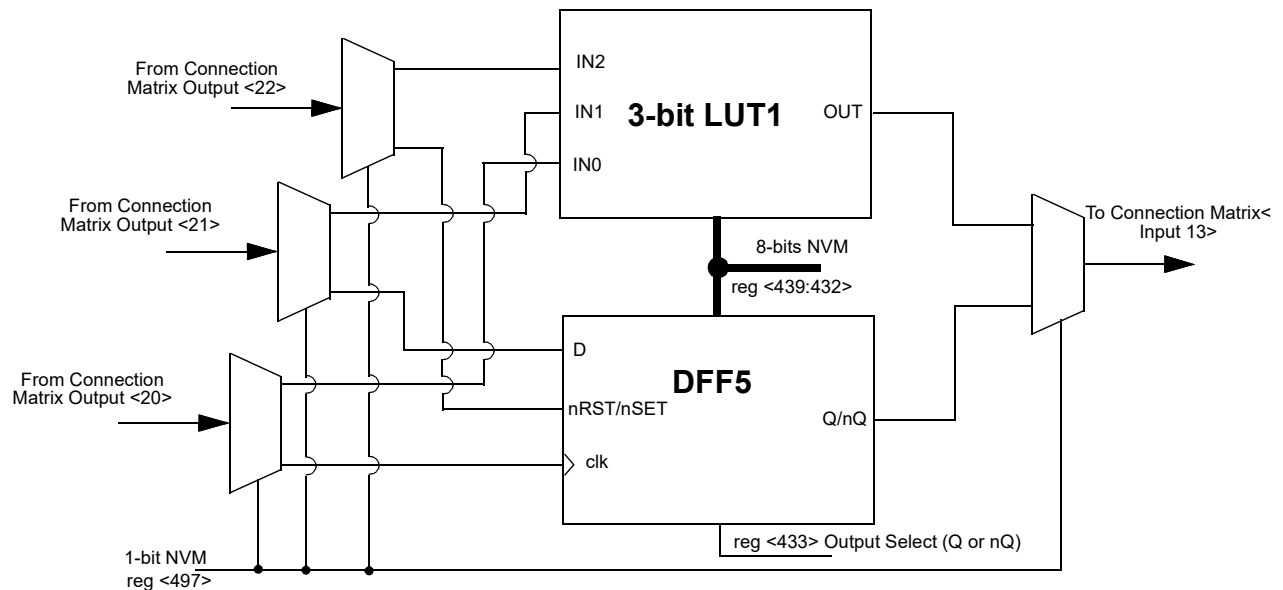


Figure 14. 3-bit LUT1 or DFF5

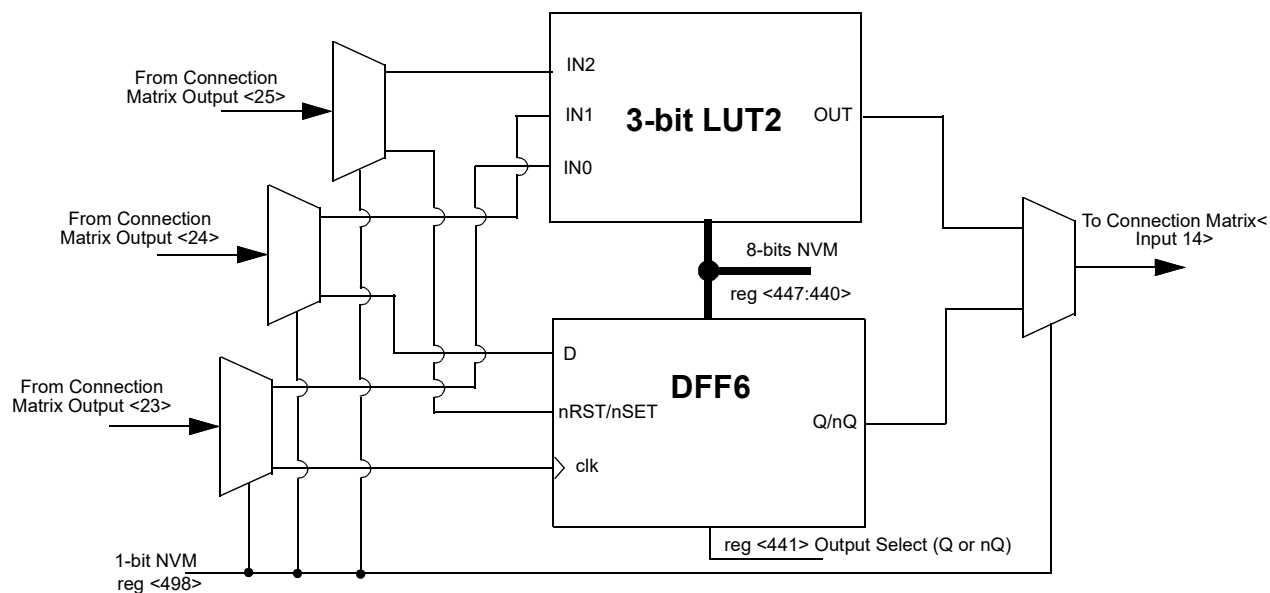


Figure 15. 3-bit LUT2 or DFF6

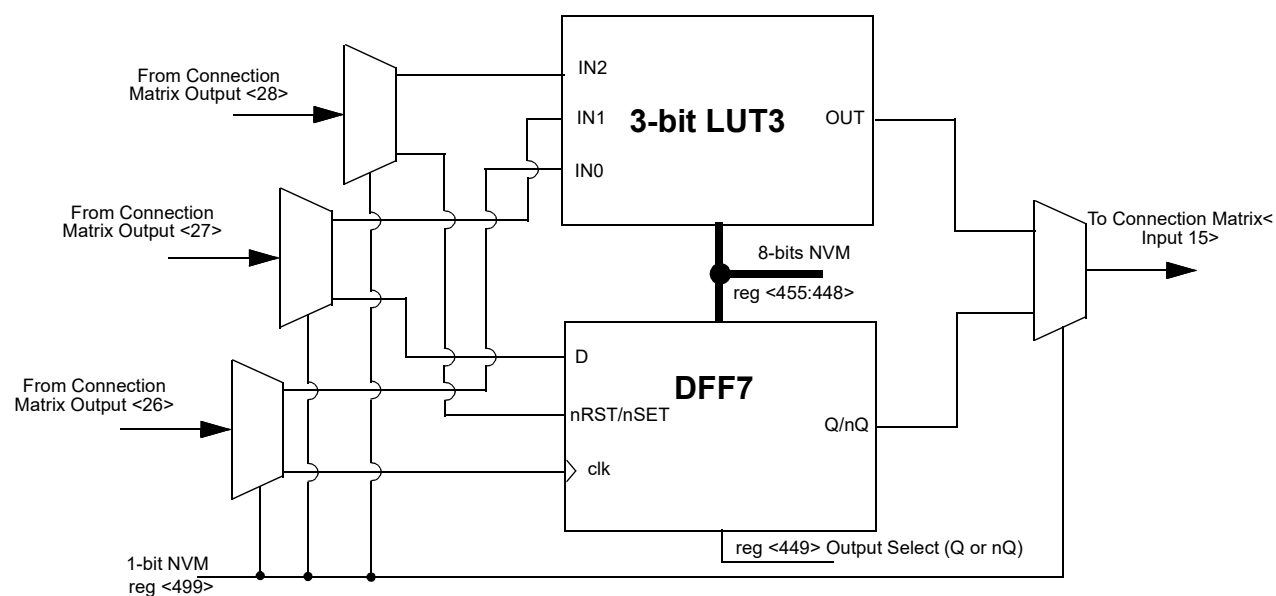


Figure 16. 3-bit LUT3 or DFF7

## 10.2.1 3-Bit LUT or D Flip Flop Macrocells Used as 3-Bit LUTs

**Table 34. 3-bit LUT0 Truth Table.**

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <424> |
| 0   | 0   | 1   | reg <425> |
| 0   | 1   | 0   | reg <426> |
| 0   | 1   | 1   | reg <427> |
| 1   | 0   | 0   | reg <428> |
| 1   | 0   | 1   | reg <429> |
| 1   | 1   | 0   | reg <430> |
| 1   | 1   | 1   | reg <431> |

**Table 35. 3-bit LUT1 Truth Table.**

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <432> |
| 0   | 0   | 1   | reg <433> |
| 0   | 1   | 0   | reg <434> |
| 0   | 1   | 1   | reg <435> |
| 1   | 0   | 0   | reg <436> |
| 1   | 0   | 1   | reg <437> |
| 1   | 1   | 0   | reg <438> |
| 1   | 1   | 1   | reg <439> |

**Table 36. 3-bit LUT2 Truth Table.**

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <440> |
| 0   | 0   | 1   | reg <441> |
| 0   | 1   | 0   | reg <442> |
| 0   | 1   | 1   | reg <443> |
| 1   | 0   | 0   | reg <444> |
| 1   | 0   | 1   | reg <445> |
| 1   | 1   | 0   | reg <446> |
| 1   | 1   | 1   | reg <447> |

**Table 37. 3-bit LUT3 Truth Table.**

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <448> |
| 0   | 0   | 1   | reg <449> |
| 0   | 1   | 0   | reg <450> |
| 0   | 1   | 1   | reg <451> |
| 1   | 0   | 0   | reg <452> |
| 1   | 0   | 1   | reg <453> |
| 1   | 1   | 0   | reg <454> |
| 1   | 1   | 1   | reg <455> |

Each Macrocell, when programmed for a LUT function, uses a 8-bit register to define their output function:

*3-Bit LUT0 is defined by reg <431:424>*

*3-Bit LUT1 is defined by reg <439:432>*

*3-Bit LUT2 is defined by reg <447:440>*

*3-Bit LUT3 is defined by reg <455:448>*

## 10.2.2 3-Bit LUT or D Flip Flop Macrocells Used as D Flip Flop Register Settings

**Table 38. DFF4 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                                  |
|------------------------------|----------------------|------------------------------------------------------|
| DFF4 or Latch select         | reg <424>            | 0: DFF function<br>1: Latch function                 |
| DFF4 output select           | reg <425>            | 0: Q output<br>1: nQ output                          |
| DFF4 rstb/setb Select        | reg <426>            | 1: setb from matrix out<br>0: resetb from matrix out |
| DFF4 initial polarity select | reg <427>            | 0: Low<br>1: High                                    |
| 3-bit LUT0 data              | reg <431:424>        | 3-bit LUT0 data                                      |
| 3-bit LUT0 or DFF4 select    | reg <496>            | 0: 3-bit LUT0<br>1: DFF4                             |

**Table 39. DFF5 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                                  |
|------------------------------|----------------------|------------------------------------------------------|
| DFF5 or Latch Select         | reg <432>            | 0: DFF function<br>1: Latch function                 |
| DFF5 Output Select           | reg <433>            | 0: Q output<br>1: nQ output                          |
| DFF5 rstb/setb Select        | reg <434>            | 1: setb from matrix out<br>0: resetb from matrix out |
| DFF5 initial polarity select | reg <435>            | 0: Low<br>1: High                                    |
| 3-bit LUT1 data              | reg <439:432>        | 3-bit LUT1 data                                      |
| 3-bit LUT1 or DFF5 select    | reg <487>            | 0: 3-bit LUT1<br>1: DFF5                             |

**Table 40. DFF6 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                                  |
|------------------------------|----------------------|------------------------------------------------------|
| DFF6 or Latch select         | reg <440>            | 0: DFF function<br>1: Latch function                 |
| DFF6 output select           | reg <441>            | 0: Q output<br>1: nQ output                          |
| DFF6 rstb/setb Select        | reg <442>            | 1: setb from matrix out<br>0: resetb from matrix out |
| DFF6 initial polarity select | reg <443>            | 0: Low<br>1: High                                    |
| 3-bit LUT2 data              | reg <447:440>        | 3-bit LUT2 data                                      |
| 3-bit LUT2 or DFF6 select    | reg <498>            | 0: 3-bit LUT2<br>1: DFF6                             |

**Table 41. DFF7 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                                  |
|------------------------------|----------------------|------------------------------------------------------|
| DFF7 or Latch Select         | reg <448>            | 0: DFF function<br>1: Latch function                 |
| DFF7 Output Select           | reg <449>            | 0: Q output<br>1: nQ output                          |
| DFF7 rstb/setb Select        | reg <450>            | 1: setb from matrix out<br>0: resetb from matrix out |
| DFF7 initial polarity select | reg <451>            | 0: Low<br>1: High                                    |
| 3-bit LUT3 data              | reg <455:448>        | 3-bit LUT3 data                                      |
| 3-bit LUT3 or DFF7 select    | reg <499>            | 0: 3-bit LUT3<br>1: DFF7                             |



## 10.3.1 3-Bit LUT or Pipe Delay Macrocells Used as 3-Bit LUTs

**Table 42. 3-bit LUT8 Truth Table.**

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <488> |
| 0   | 0   | 1   | reg <489> |
| 0   | 1   | 0   | reg <490> |
| 0   | 1   | 1   | reg <491> |
| 1   | 0   | 0   | reg <492> |
| 1   | 0   | 1   | reg <493> |
| 1   | 1   | 0   | reg <494> |
| 1   | 1   | 1   | reg <495> |

Each Macrocell, when programmed for a LUT function, uses a 8-bit register to define their output function:

*3-Bit LUT8 is defined by reg <495:488>*

## 10.3.2 3-Bit LUT or Pipe Delay Macrocells Used as Pipe Delay Register Settings

**Table 43. Pipe Delay Register Settings**

| Signal Function                        | Register Bit Address | Register Definition            |
|----------------------------------------|----------------------|--------------------------------|
| OUT0 select                            | reg <490:488>        | data (pipe number)             |
| OUT1 select                            | reg <493:491>        | data (pipe number)             |
| Unused if Pipe Delay selected          | reg <495:494>        | Unused                         |
| 3-bit LUT8 or pipe delay output select | reg <500>            | 0: 3-bit LUT8<br>1: pipe delay |

#### 10.4 4-Bit LUT or 8- Bit Counter / Delay Macrocells

There are two macrocells that can serve as either a 4-bit LUT or as a Counter / Delay. When used to implement LUT functions, the 4-bit LUT takes in four input signals from the connection matrix and produces a single output, which goes back into the connection matrix. When used to implement 8-Bit Counter / Delay function, two of the four input signals from the connection matrix go to the external clock (ext\_clk) and reset (DLY\_n/CNT\_Reset) for the counter/delay, with the output going back to the connection matrix.

*Note: Counters initialize with counter data=0 after POR. .*

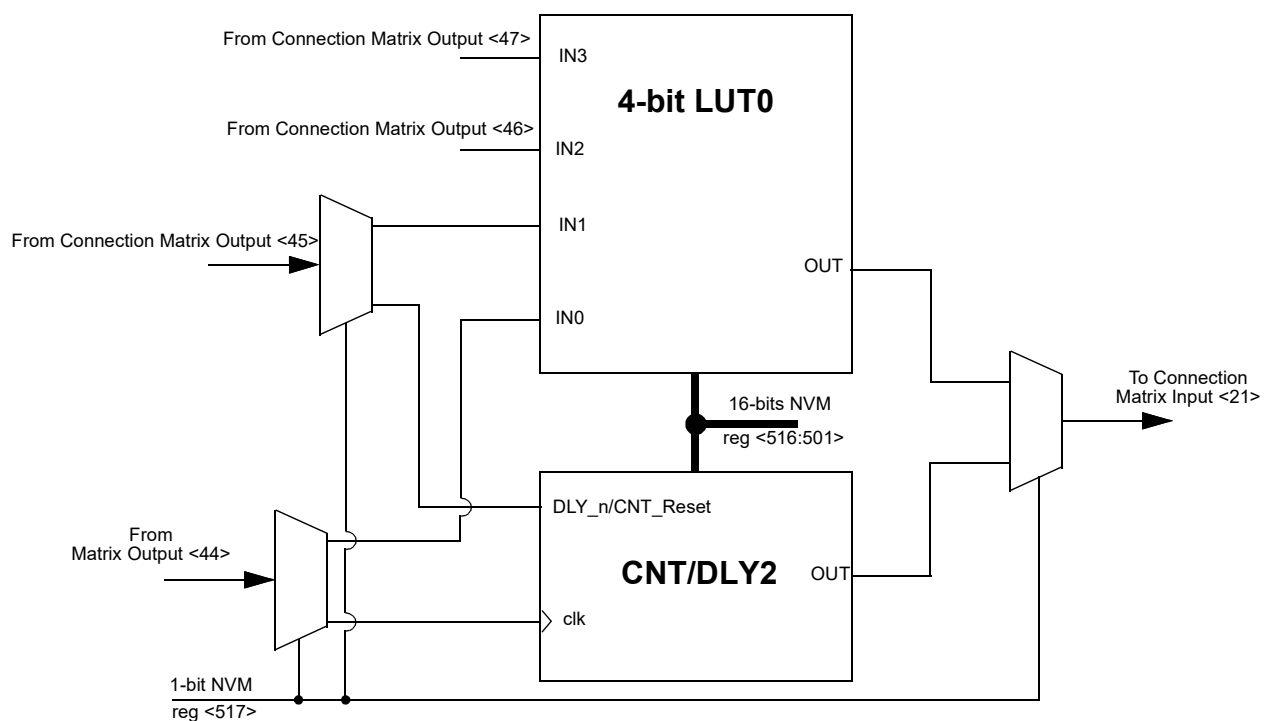


Figure 18. 4-bit LUT0 or CNT/DLY2

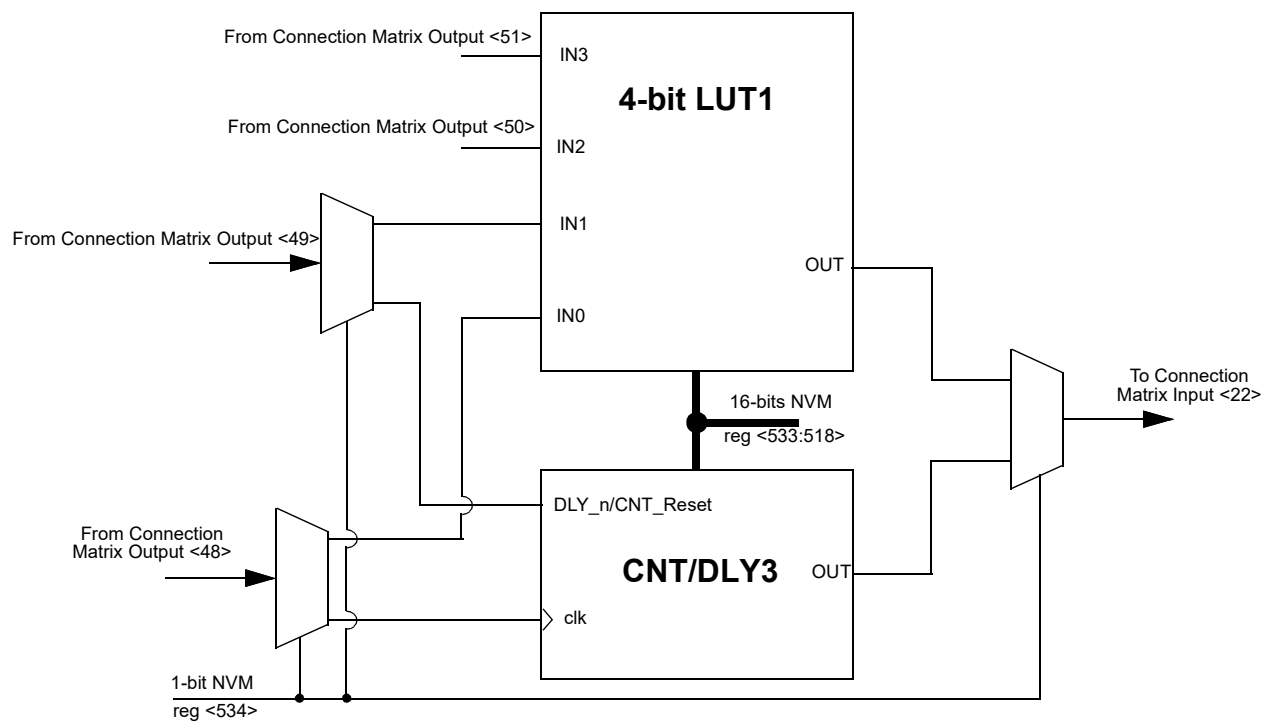


Figure 19. 4-bit LUT1 or CNT/DLY3

## 10.4.1 4-Bit LUT or 8-Bit Counter / Delay Macrocell Used as 4-Bit LUTs

**Table 44. 4-bit LUT0 Truth Table.**

| IN3 | IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----|-----------|
| 0   | 0   | 0   | 0   | reg <501> |
| 0   | 0   | 0   | 1   | reg <502> |
| 0   | 0   | 1   | 0   | reg <503> |
| 0   | 0   | 1   | 1   | reg <504> |
| 0   | 1   | 0   | 0   | reg <505> |
| 0   | 1   | 0   | 1   | reg <506> |
| 0   | 1   | 1   | 0   | reg <507> |
| 0   | 1   | 1   | 1   | reg <508> |
| 1   | 0   | 0   | 0   | reg <509> |
| 1   | 0   | 0   | 1   | reg <510> |
| 1   | 0   | 1   | 0   | reg <511> |
| 1   | 0   | 1   | 1   | reg <512> |
| 1   | 1   | 0   | 0   | reg <513> |
| 1   | 1   | 0   | 1   | reg <514> |
| 1   | 1   | 1   | 0   | reg <515> |
| 1   | 1   | 1   | 1   | reg <516> |

**Table 45. 4-bit LUT1 Truth Table.**

| IN3 | IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----|-----------|
| 0   | 0   | 0   | 0   | reg <518> |
| 0   | 0   | 0   | 1   | reg <519> |
| 0   | 0   | 1   | 0   | reg <520> |
| 0   | 0   | 1   | 1   | reg <521> |
| 0   | 1   | 0   | 0   | reg <522> |
| 0   | 1   | 0   | 1   | reg <523> |
| 0   | 1   | 1   | 0   | reg <524> |
| 0   | 1   | 1   | 1   | reg <525> |
| 1   | 0   | 0   | 0   | reg <526> |
| 1   | 0   | 0   | 1   | reg <527> |
| 1   | 0   | 1   | 0   | reg <528> |
| 1   | 0   | 1   | 1   | reg <529> |
| 1   | 1   | 0   | 0   | reg <530> |
| 1   | 1   | 0   | 1   | reg <531> |
| 1   | 1   | 1   | 0   | reg <532> |
| 1   | 1   | 1   | 1   | reg <533> |

Each Macrocell, when programmed for a LUT function, uses a 16-bit register to define their output function:

*4-Bit LUT0 is defined by reg <516:501>*

*4-Bit LUT1 is defined by reg <533:518>*

**Table 46. 4-bit LUT Standard Digital Functions.**

| Function | MSB |   |   |   |   |   |   |   |   |   |   |   |   |   |   | LSB |
|----------|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|
| AND-4    | 1   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0   |
| NAND-4   | 0   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1   |
| OR-4     | 1   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0   |
| NOR-4    | 0   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1   |
| XOR-4    | 0   | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0   |
| XNOR-4   | 1   | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1   |

## 10.4.2 4-Bit LUT or 8-Bit Counter / Delay Macrocells Used as 8-Bit Counter / Delay Register Settings

**Table 47. CNT/DLY2 Register Settings**

| Signal Function                                  | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                     |
|--------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/delay2 Mode Selection                    | reg <501>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                        |
| Counter/delay2 Clock Source Select               | reg <504:502>        | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter1 Overflow                                                                                                                                    |
| Counter/delay2 Control Data                      | reg <512:505>        | 1-255: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                                                                                                                                                     |
| Delay2 Mode Select or asynchronous counter reset | reg <514:513>        | 00: Delay on both falling and rising edges (for delay & counter reset)<br>01: Delay on falling edge only (for delay & counter reset Delay)<br>10: on rising edge only (for delay & counter reset)<br>11: No delay on either falling or rising edges / high level reset for counter mode |
| 4-bit LUT0 or Counter2 select                    | reg <517>            | 0: 4-bit LUT0<br>1: Counter2                                                                                                                                                                                                                                                            |

**Table 48. CNT/DLY3 Register Settings**

| Signal Function                                  | Register Bit Address | Register Definition                                                                                                                                                                                                                                 |
|--------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/delay3 Mode Selection                    | reg <518>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                    |
| Counter/delay3 Clock Source Select               | reg <521:519>        | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter2 Overflow                                                                                                |
| Counter/delay3 Control Data                      | reg <529:522>        | 1-255: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                                                                                                                 |
| Delay3 Mode Select or asynchronous counter reset | reg <531:530>        | 00: Delay on both falling and rising edges (for delay & counter reset)<br>01: Delay on falling edge only (for delay & counter reset Delay)<br>10: On rising edge only (for delay & counter reset)<br>11: No delay on either falling or rising edges |
| 4-bit LUT1 or Counter3 select                    | reg <534>            | 0: 4-bit LUT1<br>1: Counter3                                                                                                                                                                                                                        |

## 10.5 Programmable Delay / Edge Detector

The SLG46120 has a programmable time delay logic cell available that can generate a delay that is selectable from one of four timings (time1) configured in the GreenPAK Designer. The programmable time delay cell can generate one of four different delay patterns, rising edge detection, falling edge detection, both edge detection and both edge delay. These four patterns can be further modified with the addition of delayed edge detection, which adds an extra unit of delay as well as glitch rejection during the delay period. See the timing diagrams below for further information.

*Note: The input signal must be longer than the delay, otherwise it will be filtered out.*

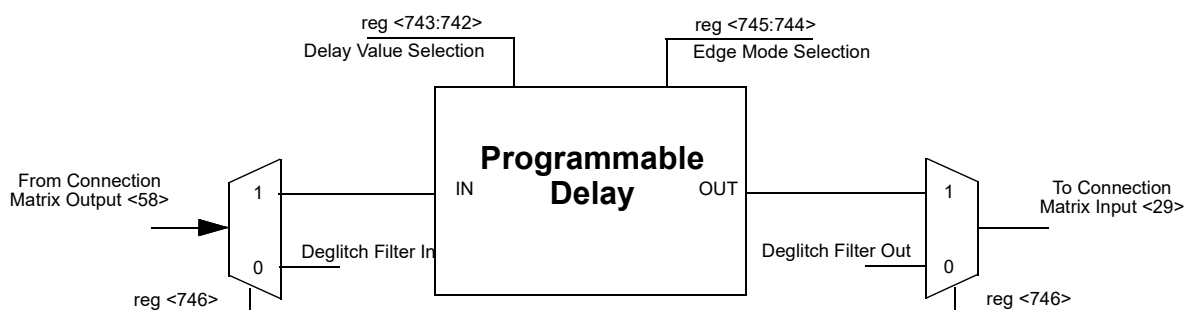


Figure 20. Programmable Delay

## 10.6 Programmable Delay Timing Diagram - Edge Detector Output

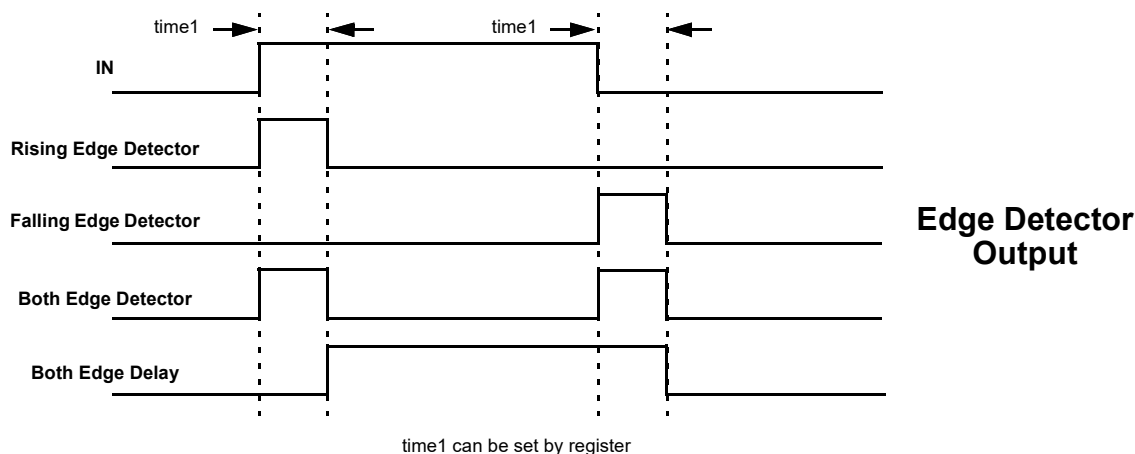


Figure 21. Edge Detector Output

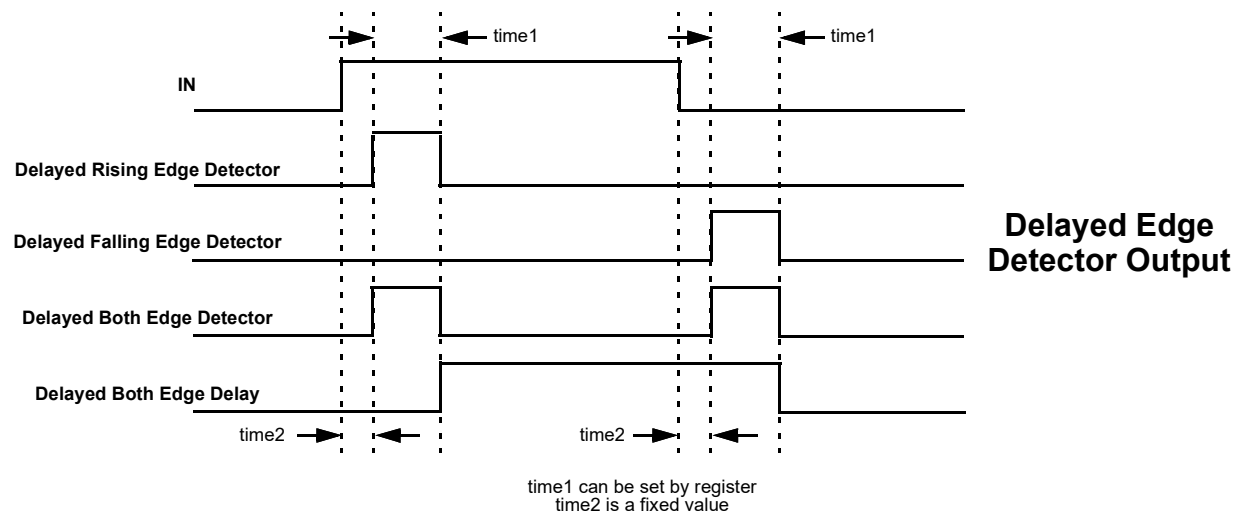


Figure 22. Delayed Edge Detector Output

Note: For delays and widths refer to Table 4.

## 10.6.1 Programmable Delay Register Settings

**Table 49. Programmable Delay Register Settings**

| Signal Function                                                                                        | Register Bit Address | Register Definition                                                                                    |
|--------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------|
| Programmable delay or filter output select                                                             | reg <746>            | 0: programmable delay output<br>1: filter output                                                       |
| Select the edge mode of programmable delay & edge detector                                             | reg <745:744>        | 00: Rising Edge Detector<br>01: Falling Edge Detector<br>10: Both Edge Detector<br>11: Both Edge Delay |
| Delay value select for programmable delay & edge detector (V <sub>DD</sub> = 3.3 V, typical condition) | reg <743:742>        | 00: 163 ns<br>01: 305 ns<br>10: 446 ns<br>11: 588 ns                                                   |

### 10.7 Deglitch Filter

The SLG46120 has an additional logic function that is connected directly to the Connection Matrix inputs and outputs. There is one deglitch filter.

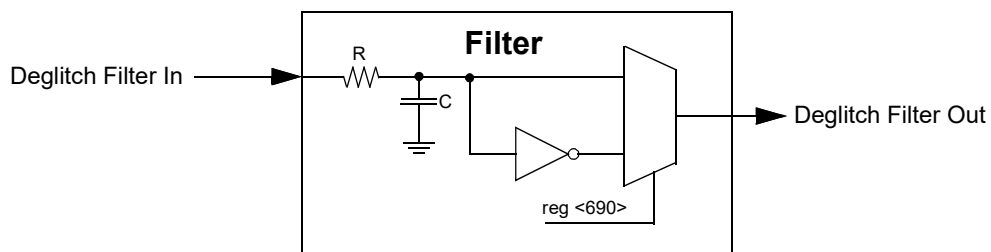


Figure 23. Deglitch Filter

# 11.0 Analog Comparators (ACMP)

There are two Analog Comparator (ACMP) macrocells in the SLG46120. In order for the ACMP cells to be used in a GreenPAK design, the power up signals (ACMP0\_pdb and ACMP1\_pdb) need to be active. By connecting to signals coming from the Connection Matrix, it is possible to have each ACMP be on continuously, off continuously, or switched on periodically based on a digital signal coming from the Connection Matrix. When ACMP is powered down, output is low.

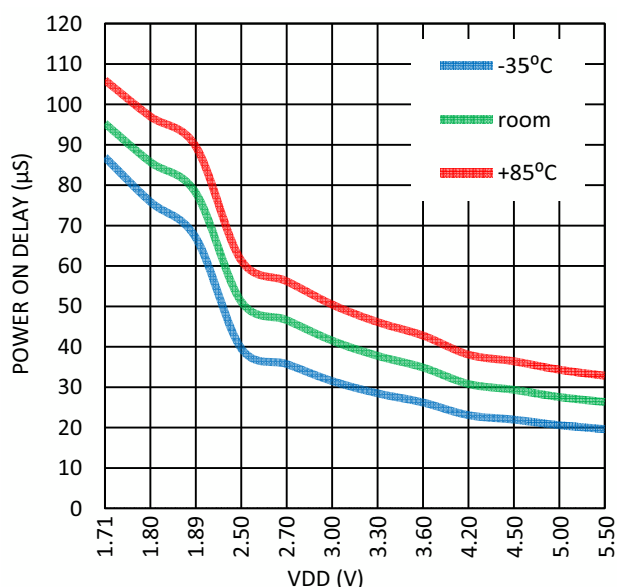
Each of the ACMP cells has a positive input signal that can be provided by a variety of external sources, and can also have a selectable gain stage before connection to the analog comparator. Each of the ACMP cells has a negative input signal that is either created from an internal VREF or provided by way of the external sources.

Each of the ACMP cells has a selection for the bandwidth of the input signal, which can be used to save power when low bandwidth signals are input into the analog comparator. And if input frequency > 200 kHz, the output will retain its previous value. Each cell also has a hysteresis selection, to offer hysteresis of 0 mV, 25 mV, 50 mV or 200 mV.

During powerup, the ACMP output will remain low, and then become valid 110  $\mu$ s (max) after POR signal goes high, see *Figure 24*.

*Note: Applies to first time power ON.*

*Note: Regulator and Charge Pump set to automatic ON/OFF.*



**Figure 24. Maximum Power On Delay vs. VDD.**

Each of the ACMP cells has a positive input signal that can be provided by a variety of external sources, and can also have a selectable gain stage (1X, 0.5X, 0.33X, 0.25X) before connection to the analog comparator. The Gain divider is unbuffered and consists of 250 K $\Omega$  (typ.) resistors, see *Table 50*. For gain divider accuracy refer to *Table 51*. IN- voltage range: 0 - 1.2 V. Can use Vref selection  $V_{DD}/4$  and  $V_{DD}/3$  to maintain this input range.

**Table 50. Gain Divider Input Resistance (typ).**

| Gain             | 1X   | 0.5X | 0.33X | 0.25X |
|------------------|------|------|-------|-------|
| Input Resistance | 100M | 1M   | 0.75M | 1M    |

**Table 51. Gain Divider Accuracy.**

| Gain     | 0.5X   | 0.33X  | 0.25X   |
|----------|--------|--------|---------|
| Accuracy | ±0.6 % | ±0.9 % | ±0.28 % |

Each of the ACMP cells has a negative input signal that is either created from an internal VREF or provided by the external reference/source. Internal Vref accuracy is optimized near 1000 mV selection.

*Note: Power supply control options have influence on the ACMP operation.*

*Note: Any ACMP powered on enables the BandGap internal circuit as well. An analog voltage will appear on Vref (even when the Force BandGap option is set as Disabled).*

Analog comparators have the following configurable options:

- Hysteresis: Input signal hysteresis options are Disable, 25 mV, 50 mV, 200 mV.
- Low Bandwidth: Enable, Disable;
- IN+ Gain: 1X, 0.5X, 0.33X, 0.25X;
- IN+ source:
  - ACMP0 IN+ options are PIN 3,  $V_{DD}$ ;
  - ACMP1 IN+ options are PIN 6, ACMP0 IN+;
- IN- source:
  - ACMP0 IN- options are 24 internal reference sources (50 mV – 1200 mV) and  $V_{DD}/3$ ,  $V_{DD}/4$ , PIN 4;
  - PWR UP=0 – ACMP is powered down; PWR UP=1 – ACMP is powered up.

All ACMPs can have a common negative input. This can be achieved by configuring ACMP0 PIN 4 analog I/O connection.

# 11.1 ACMP0 Block Diagram

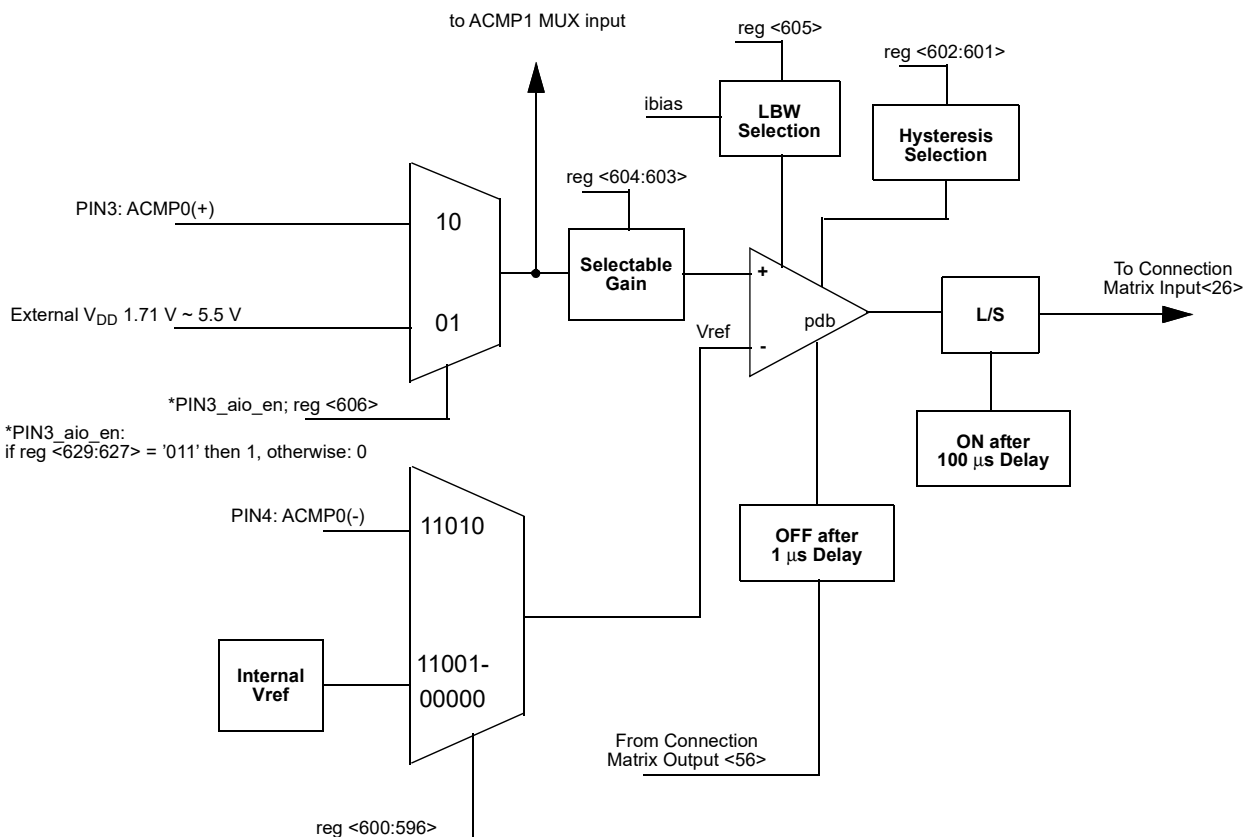


Figure 25. ACMP0 Block Diagram

# 11.2 ACMP0 Register Settings

Table 52. ACMP0 Register Settings

| Signal Function         | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACMP0 In Voltage Select | reg <600:596>        | 00000: 50 mV      00001: 100 mV<br>00010: 150 mV    00011: 200 mV<br>00100: 250 mV    00101: 300 mV<br>00110: 350 mV    00111: 400 mV<br>01000: 450 mV    01001: 500 mV<br>01010: 550 mV    01011: 600 mV<br>01100: 650 mV    01101: 700 mV<br>01110: 750 mV    01111: 800 mV<br>10000: 850 mV    10001: 900 mV<br>10010: 950 mV    10011: 1 V<br>10100: 1.05 V    10101: 1.1 V<br>10110: 1.15 V    10111: 1.2 V<br>11000: V <sub>DD</sub> /3    11001: V <sub>DD</sub> /4<br>11010: EXT_VREF (PIN4) |
| ACMP0 Hysteresis Enable | reg <602:601>        | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                                            |

Table 52. ACMP0 Register Settings

| Signal Function                                             | Register Bit Address | Register Definition                              |
|-------------------------------------------------------------|----------------------|--------------------------------------------------|
| ACMP0 Positive Input Divider                                | reg <604:603>        | 00: 1.00X<br>01: 0.50X<br>10: 0.33X<br>11: 0.25X |
| ACMP0 Low Bandwidth (Max: 1 MHz) Enable                     | reg <605>            | 0: Off<br>1: On                                  |
| ACMP0 positive input source select PIN3 and V <sub>DD</sub> | reg <606>            | 0: Pin3<br>1: V <sub>DD</sub>                    |

### 11.3 ACMP1 Block Diagram

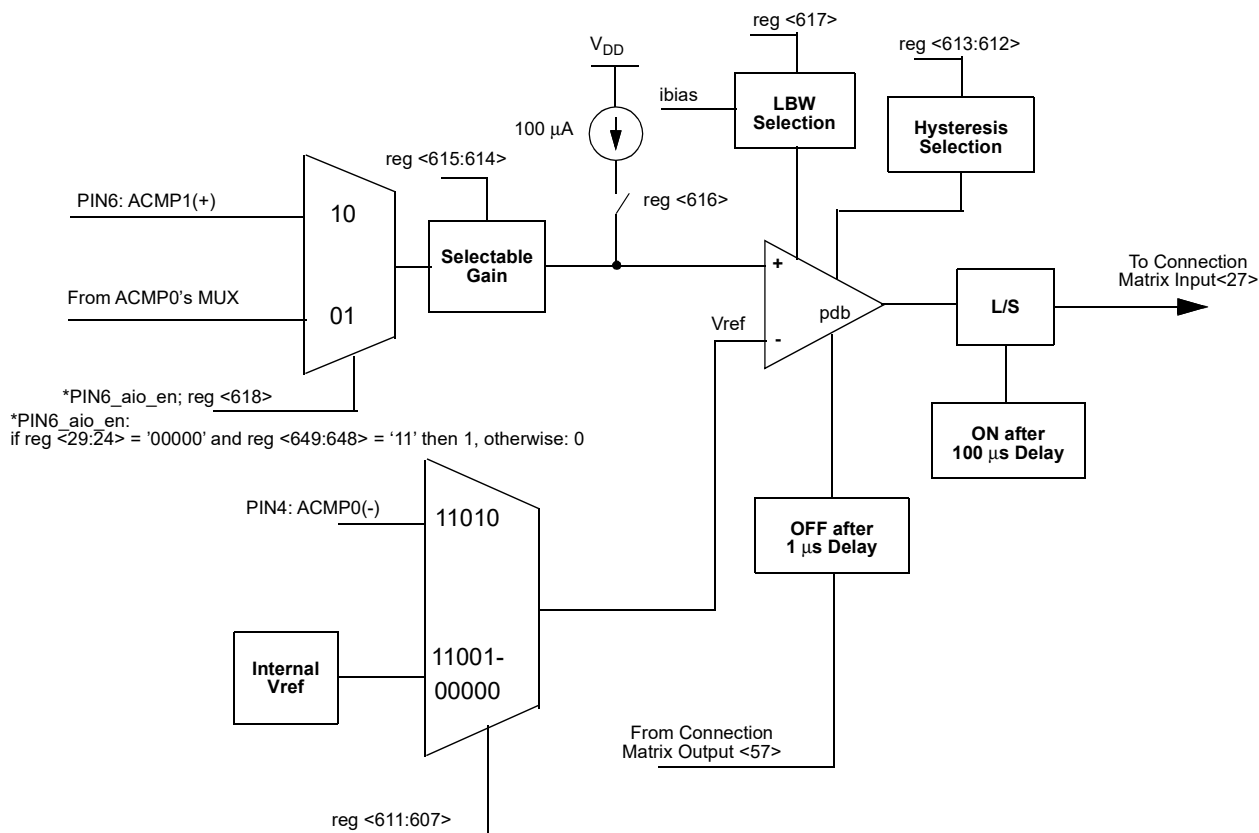


Figure 26. ACMP1 Block Diagram

## 11.4 ACMP1 Register Settings

Table 53. ACMP1 Register Settings

| Signal Function                                  | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACMP1 In Voltage Select                          | reg <611:607>        | 00000: 50 mV      00001: 100 mV<br>00010: 150 mV    00011: 200 mV<br>00100: 250 mV    00101: 300 mV<br>00110: 350 mV    00111: 400 mV<br>01000: 450 mV    01001: 500 mV<br>01010: 550 mV    01011: 600 mV<br>01100: 650 mV    01101: 700 mV<br>01110: 750 mV    01111: 800 mV<br>10000: 850 mV    10001: 900 mV<br>10010: 950 mV    10011: 1 V<br>10100: 1.05 V    10101: 1.1 V<br>10110: 1.15 V    10111: 1.2 V<br>11000: $V_{DD}/3$ 11001: $V_{DD}/4$<br>11010: EXT_VREF (PIN4) |
| ACMP1 Hysteresis Enable                          | reg <613:612>        | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                         |
| ACMP1 Positive Input Divider                     | reg <615:614>        | 00: 1.00X<br>01: 0.50X<br>10: 0.33X<br>11: 0.25X                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ACMP1 100 $\mu$ A Current Source Option          | reg <616>            | 1: Disable<br>0: Enable                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ACMP1 Low Bandwidth (Max: 1 MHz) Enable          | reg <617>            | 1: On<br>0: Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ACMP1 positive input source select PIN3 and Pin6 | reg <618>            | 0: Pin6<br>1: Pin3                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

# 11.5 Typical Performance Characteristics

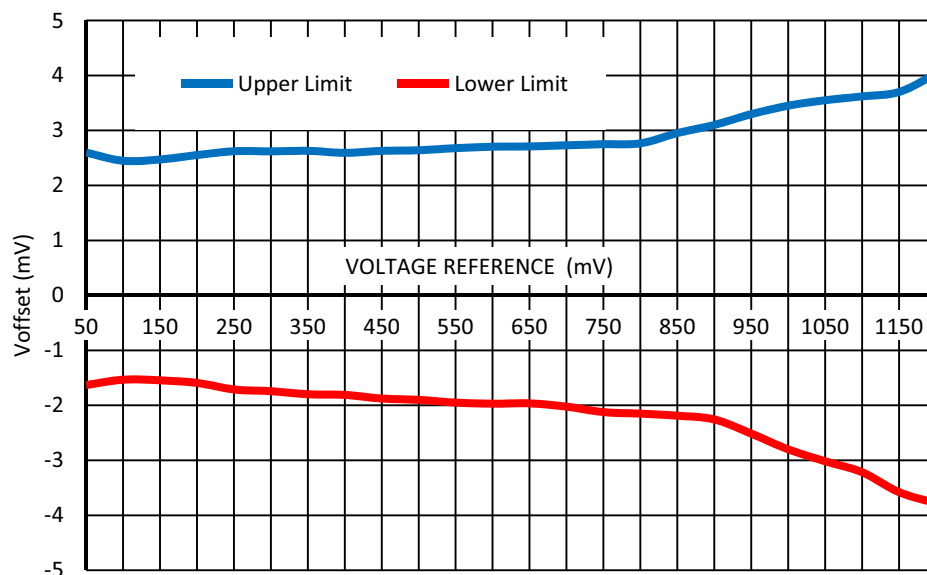


Figure 27. Typical Input Voltage Offset vs. Voltage Reference at room temperature, LBW Mode – Disable,  $V_{hys}=0$  mV,  $V_{DD}=(1.7 - 5.5)$  V.

Note: when  $V_{DD} < 1.8$  V voltage reference should not exceed 1100 mV.

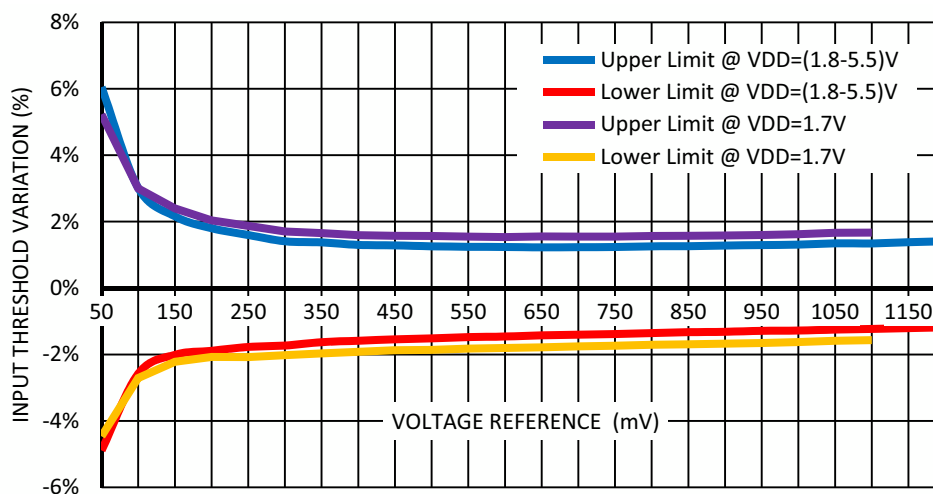


Figure 28. Typical Input Threshold Variation (including Vref variation, ACMP offset) vs. Voltage reference at room temperature, LBW Mode – Disable,  $V_{hys}=0$  mV.

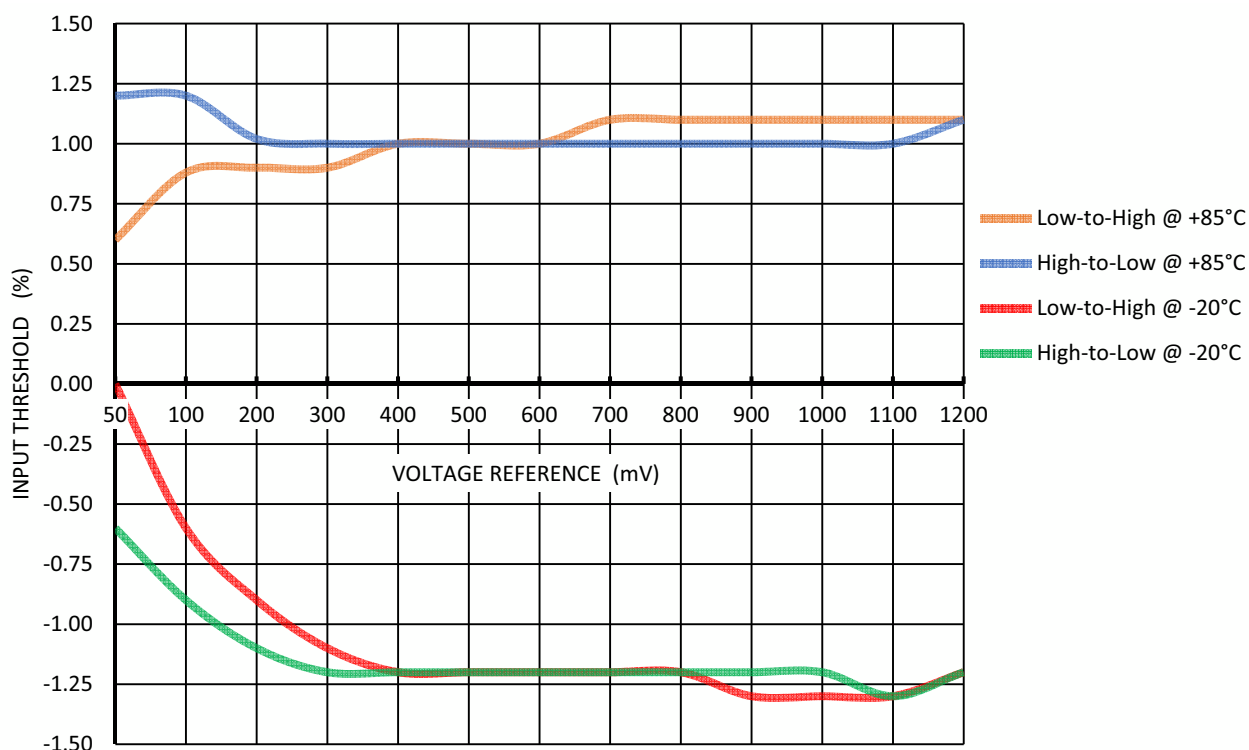


Figure 29. Input Threshold Ratio vs. Voltage Reference at  $V_{DD} = (1.71 - 5.5)$  V,  $V_{hys} = 0$ , Gain = 1

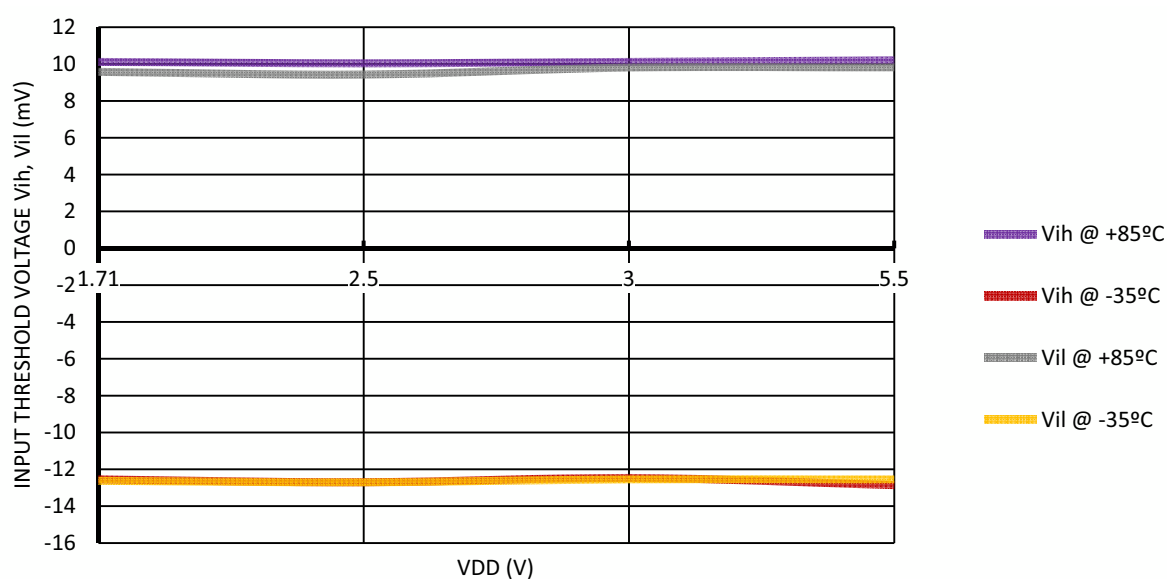


Figure 30. Input Threshold Voltage  $V_{ih}$ ,  $V_{il}$  vs.  $V_{DD}$  at  $V_{ref} = 1000$  mV, Gain = 1

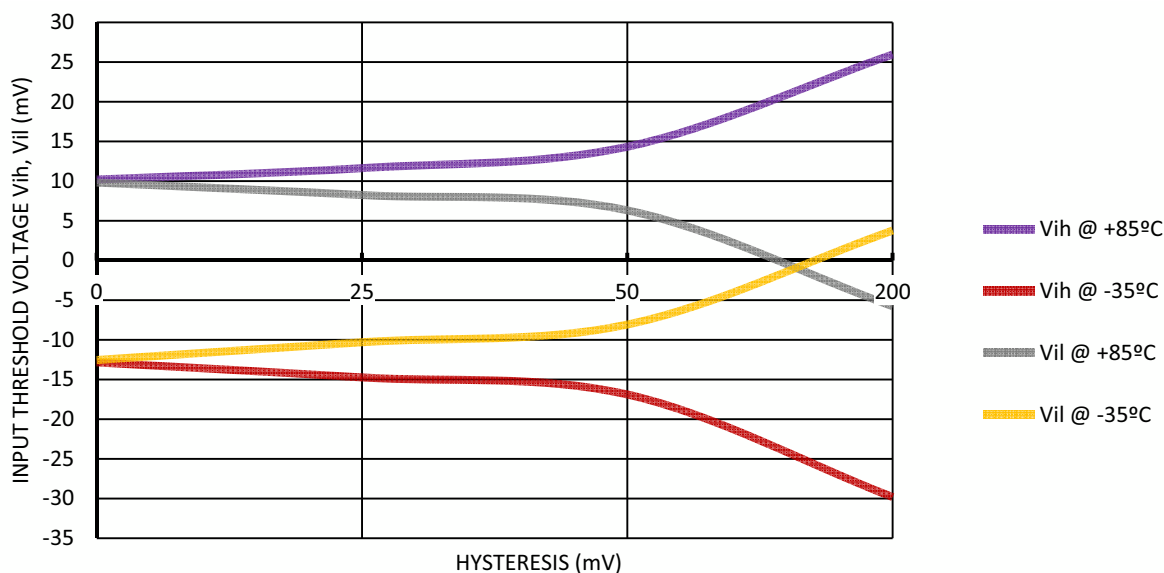


Figure 31. Input Threshold Voltage  $V_{ih}$ ,  $V_{il}$  vs. Hysteresis at  $V_{DD} = 5.5$  V,  $V_{ref} = 1000$  mV, Gain = 1

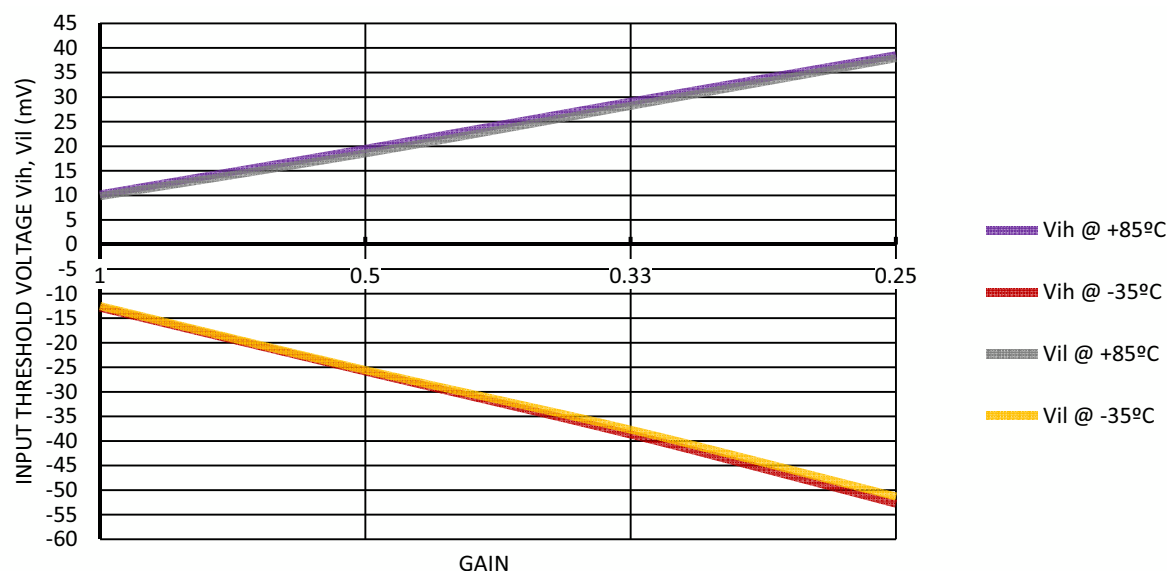
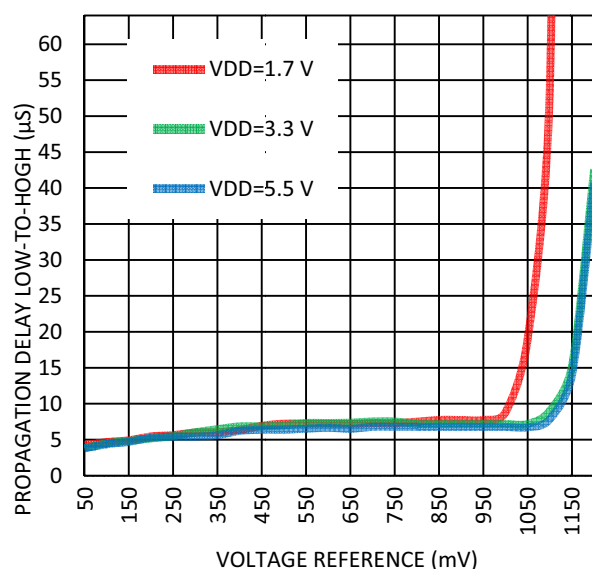


Figure 32. Input Threshold Voltage  $V_{ih}$ ,  $V_{il}$  vs. Gain at Hysteresis = 0,  $V_{DD} = 5.5$  V,  $V_{ref} = 1000$  mV

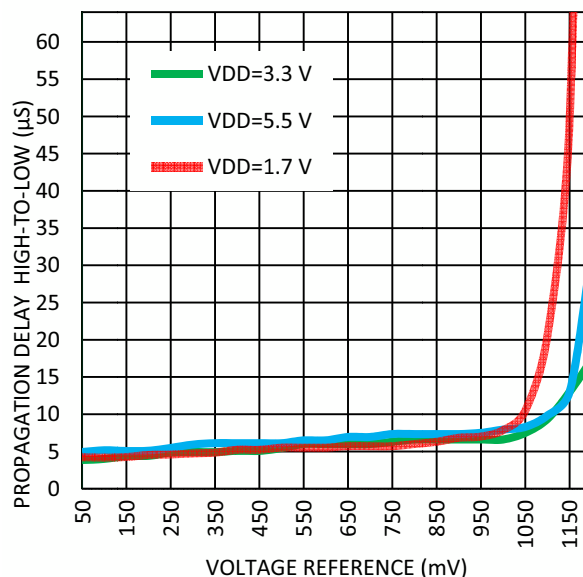
Table 54. Built-in Hysteresis Tolerance.

| V <sub>hys</sub> (mV) | V <sub>DD</sub> =(1.7-1.8) V   |       |                                  |       |                                   |       | V <sub>DD</sub> =(1.89-5.5) V  |       |                                  |       |                                   |       |
|-----------------------|--------------------------------|-------|----------------------------------|-------|-----------------------------------|-------|--------------------------------|-------|----------------------------------|-------|-----------------------------------|-------|
|                       | V <sub>ref</sub> = (50-500) mV |       | V <sub>ref</sub> = (550-1000) mV |       | V <sub>ref</sub> = (1050-1200) mV |       | V <sub>ref</sub> = (50-500) mV |       | V <sub>ref</sub> = (550-1000) mV |       | V <sub>ref</sub> = (1050-1200) mV |       |
|                       | min                            | max   | min                              | max   | min                               | max   | min                            | max   | min                              | max   | min                               | max   |
| 25                    | 18.9                           | 26.4  | 17.3                             | 26.1  | 13.0                              | 24.6  | 18.8                           | 26.5  | 17.8                             | 26.1  | 15.6                              | 25.5  |
| 50                    | 40.3                           | 50.4  | 37.9                             | 50.1  | 28.9                              | 47.7  | 40.3                           | 50.5  | 39.5                             | 50.1  | 34.5                              | 49.5  |
| 200                   | 180.5                          | 208.4 | 172.9                            | 210.7 | 153.5                             | 217.2 | 180.6                          | 207.7 | 180.2                            | 210.8 | 166.5                             | 211.9 |

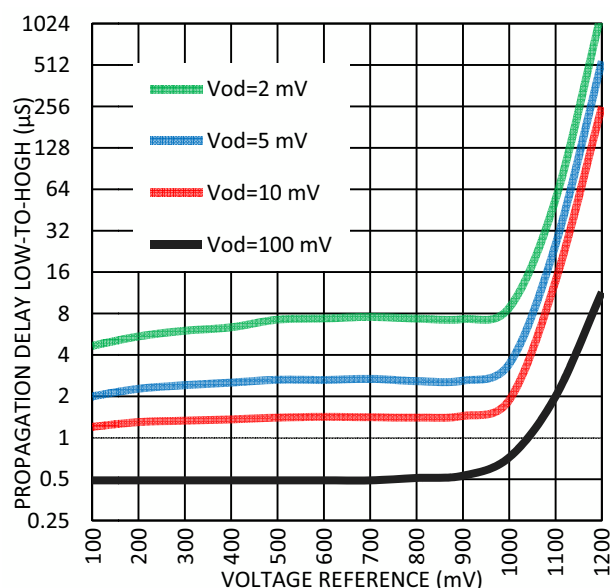
# 11.6 Timing Characteristics



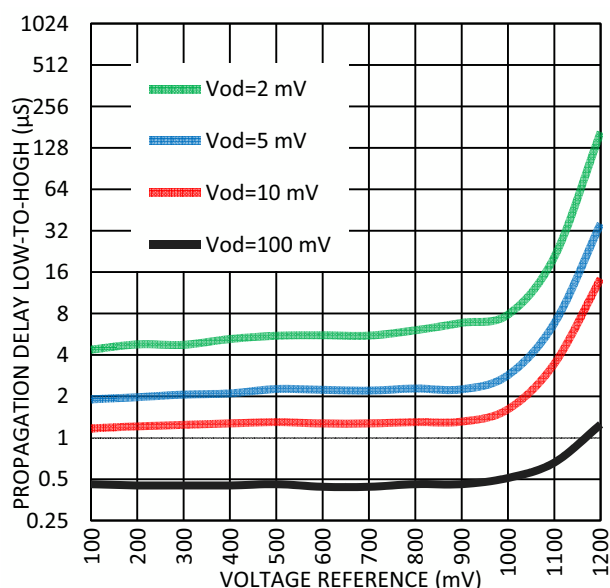
**Figure 33. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{od} = 2 \text{ mV}$ .**



**Figure 35. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{od} = 2 \text{ mV}$ .**



**Figure 34. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.71 - 1.89) \text{ V}$ .**



**Figure 36. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.71 - 1.89) \text{ V}$ .**

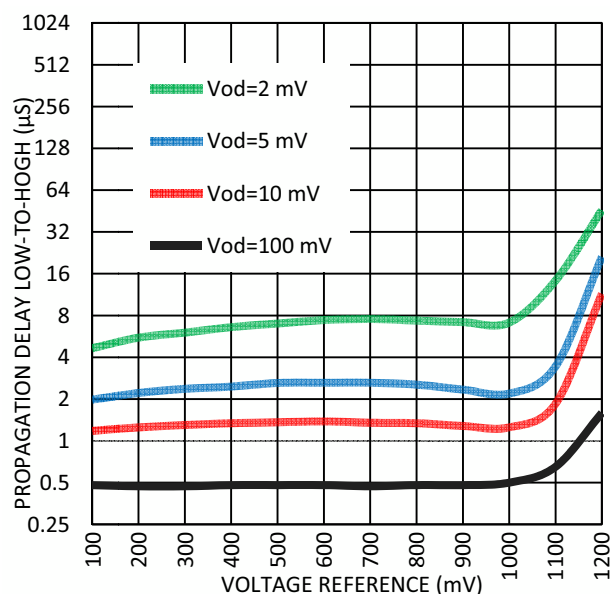


Figure 37. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.89 - 3.6) V$ .

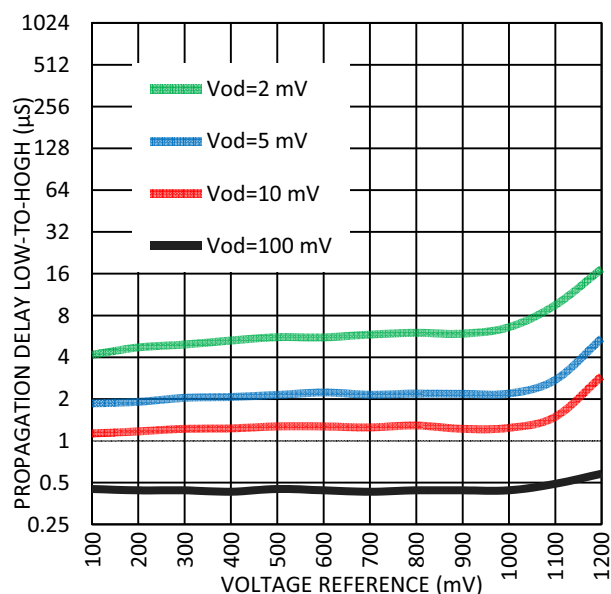


Figure 39. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.89 - 3.6) V$ .

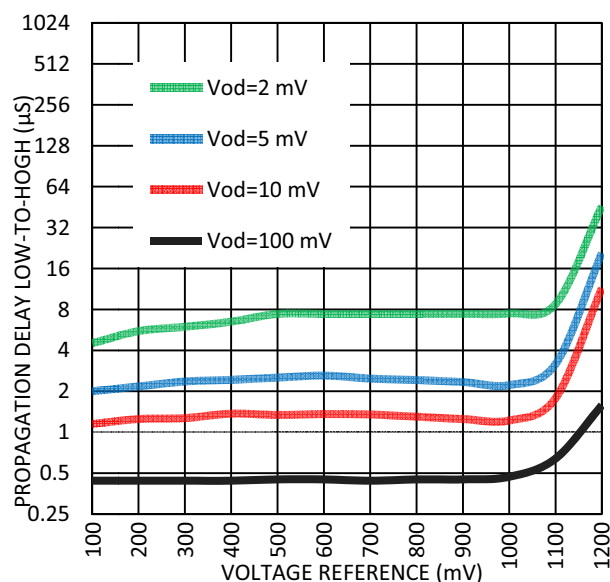


Figure 38. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{DD} = (3.6 - 5.5) V$ .

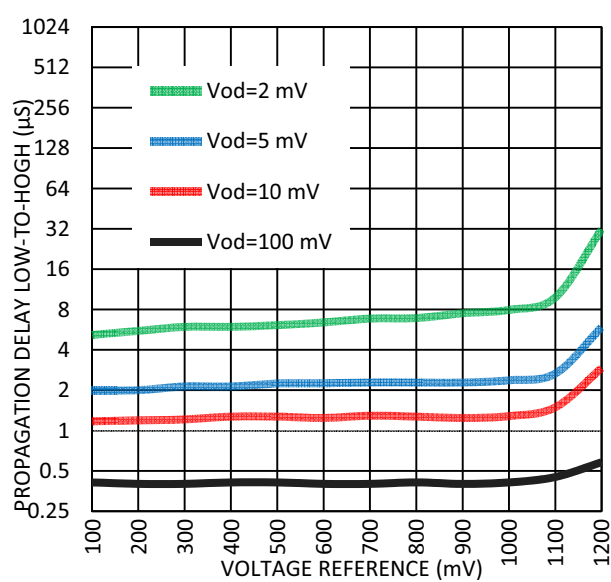


Figure 40. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{DD} = (3.6 - 5.5) V$ .

## 12.0 Counters/Delay Generators (CNT/DLY)

There are two configurable counters/delay generators in the SLG46120. CNT/DLY0 is 14-bit and CNT/DLY1 is 8-bit. For flexibility, each of these macrocells has a large selection of internal and external clock sources, as well as the option to chain from the output of the previous (N-1) CNT/DLY macrocell, to implement longer count / delay circuits.

One of the counter/delay generator macrocells (CNT/DLY1) has two inputs from the connection matrix, one for Delay Input/Reset Input (Delay\_In/Reset\_In), and one for an external counter/clock source.

Note that there are also two Combination Function Macrocells that can be implemented as either 4-bit LUTs or 8-bit counter / delays, For more information please see Section 10.4 4-Bit LUT or 8- Bit Counter / Delay Macrocells.

*Note: Counters initialize with counter data=0 after POR.*

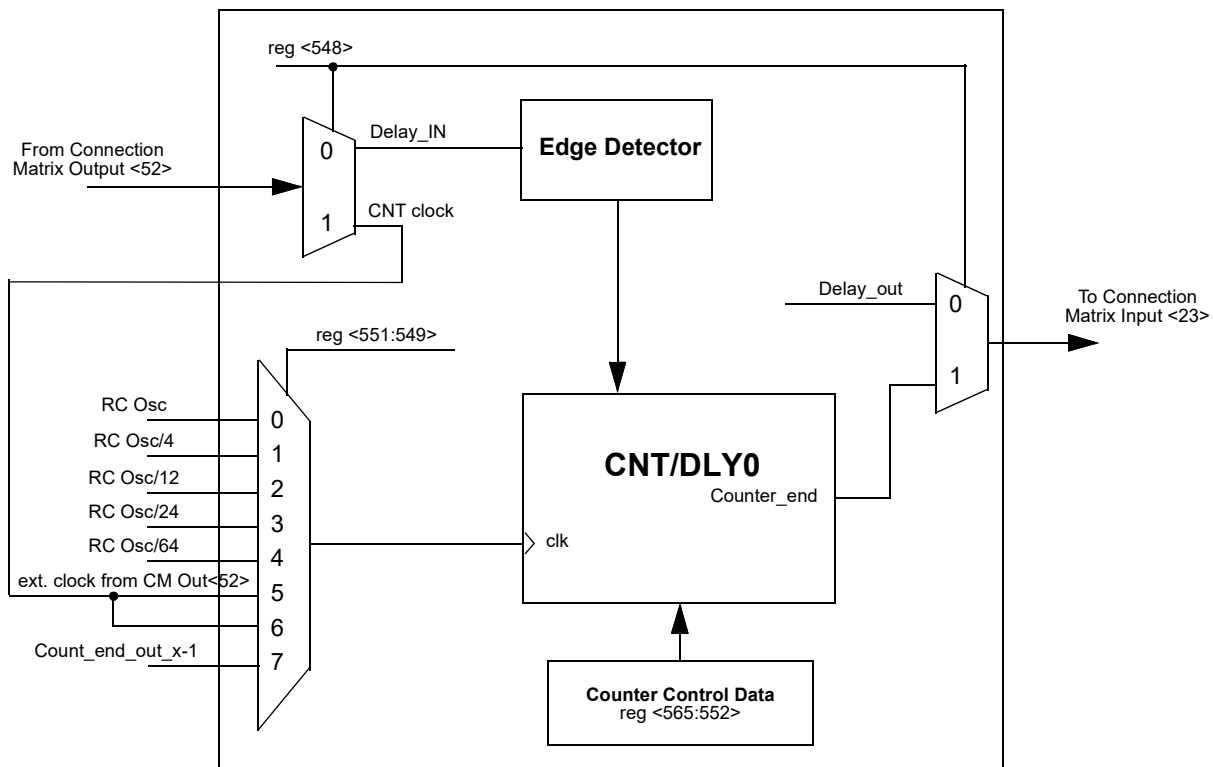


Figure 41. CNT/DLY0

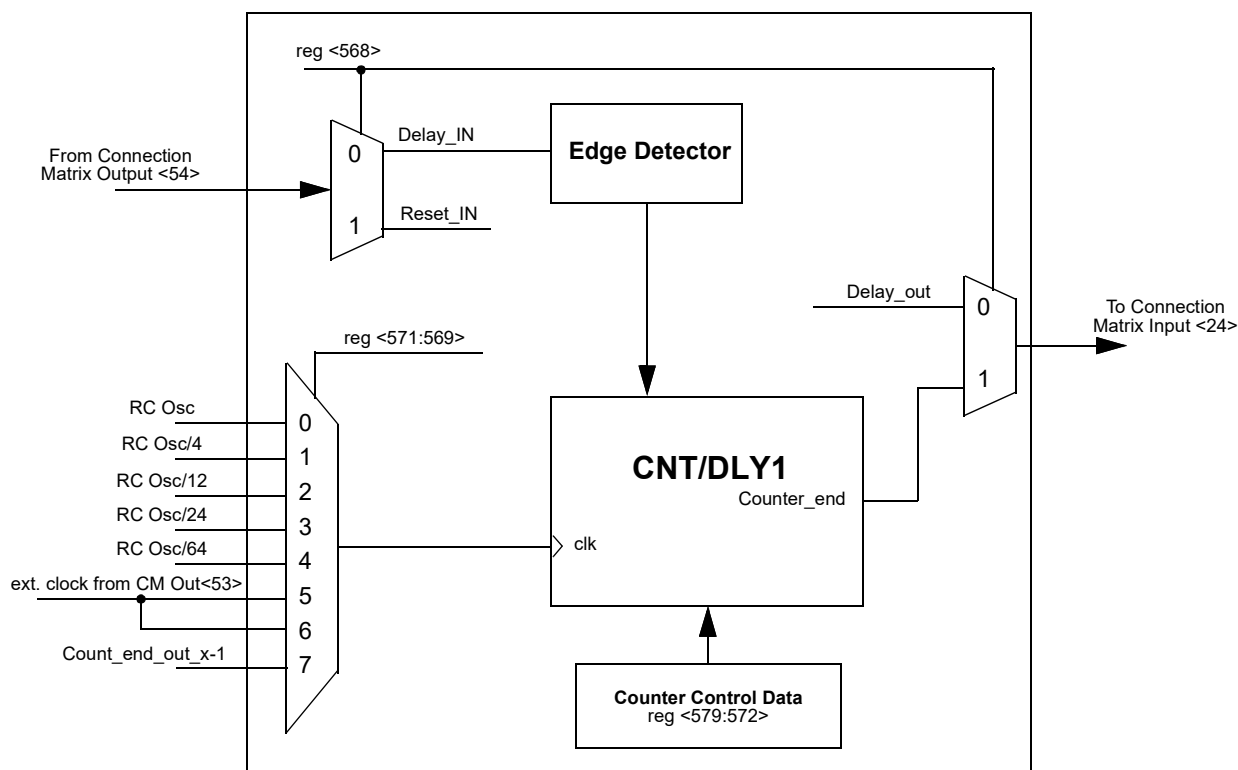


Figure 42. CNT/DLY1

## 12.1 CNT/DLY0 Register Settings

Table 55. CNT/DLY0 Register Settings

| Signal Function                                                              | Register Bit Address | Register Definition                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/Delay0 Mode Select                                                   | reg <548>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                    |
| Counter/Delay0 Clock Source Select (external clock is only for counter mode) | reg <551:549>        | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock (Counter Mode only)<br>110: Reserved<br>111: Counter3 Overflow (reg<534>=1)                                                               |
| Counter0 Control Data/Delay0 Time Control                                    | reg <565:552>        | 1-16383: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                  |
| Delay0 Mode Select or asynchronous counter reset                             | reg <567:566>        | 00: Delay on both falling and rising edges (for delay & counter reset)<br>01: Delay on falling edge only (for delay & counter reset)<br>10: Delay on rising edge only (for delay & counter reset)<br>11: No delay on either falling or rising edges |

## 12.2 CNT/DLY1 Register Settings

**Table 56. CNT/DLY1 Register Settings**

| Signal Function                                                                 | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/Delay1 Mode Select                                                      | reg <568>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                        |
| Counter/Delay1 Clock Source Select<br>(external clock is only for counter mode) | reg <571:569>        | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter0 Overflow                                                                                                                                    |
| Counter1 Control Data/Delay1 Time Control                                       | reg <579:572>        | 1-255: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                                                                                                                                                     |
| Delay1 Mode Select or asynchronous counter reset                                | reg <581:580>        | 00: Delay on both falling and rising edges (for delay & counter reset)<br>01: Delay on falling edge only (for delay & counter reset)<br>10: Delay on rising edge only (for delay & counter reset)<br>11: No delay on either falling or rising edges / high level reset for counter mode |

## 13.0 Voltage Reference (VREF)

### 13.1 Voltage Reference Overview

The SLG46120 has a Voltage Reference Macrocell to provide references to the four analog comparators. This macrocell can supply a user selection of fixed voltage references,  $/3$  and  $/4$  reference off of the  $V_{DD}$  power supply to the device, and externally supplied voltage references from Pin 4. The macrocell also has the option to output reference voltages on pins 10. See table below for the available selections for each analog comparator. Also see *Figure 43.* below, which shows the reference output structure.

### 13.2 VREF Selection Table

Table 57. VREF Selection Table.

| SEL<4:0> | CMP0_VREF        | CMP1_VREF        |
|----------|------------------|------------------|
| 11010    | ext. Vref (PIN4) | ext. Vref (PIN4) |
| 11001    | $V_{DD} / 4$     | $V_{DD} / 4$     |
| 11000    | $V_{DD} / 3$     | $V_{DD} / 3$     |
| 10111    | 1.20 V           | 1.20 V           |
| 10110    | 1.15 V           | 1.15 V           |
| 10101    | 1.10 V           | 1.10 V           |
| 10100    | 1.05 V           | 1.05 V           |
| 10011    | 1.00 V           | 1.00 V           |
| 10010    | 0.95 V           | 0.95 V           |
| 10001    | 0.90 V           | 0.90 V           |
| 10000    | 0.85 V           | 0.85 V           |
| 01111    | 0.80 V           | 0.80 V           |
| 01110    | 0.75 V           | 0.75 V           |
| 01101    | 0.70 V           | 0.70 V           |
| 01100    | 0.65 V           | 0.65 V           |
| 01011    | 0.60 V           | 0.60 V           |
| 01010    | 0.55 V           | 0.55 V           |
| 01001    | 0.50 V           | 0.50 V           |
| 01000    | 0.45 V           | 0.45 V           |
| 00111    | 0.40 V           | 0.40 V           |
| 00110    | 0.35 V           | 0.35 V           |
| 00101    | 0.30 V           | 0.30 V           |
| 00100    | 0.25 V           | 0.25 V           |
| 00011    | 0.20 V           | 0.20 V           |
| 00010    | 0.15 V           | 0.15 V           |
| 00001    | 0.10 V           | 0.10 V           |
| 00000    | 0.05 V           | 0.05 V           |

| $V_{DD}$      | Practical VREF Range | Note                                                                   |
|---------------|----------------------|------------------------------------------------------------------------|
| 2.0 V - 5.5 V | 50 mV ~1.2 V         |                                                                        |
| 1.7 V - 2.0 V | 50 mV ~1.1 V         | Higher than 1.1 V negative input, the comparator may show wrong result |

### 13.3 VREF Block Diagram

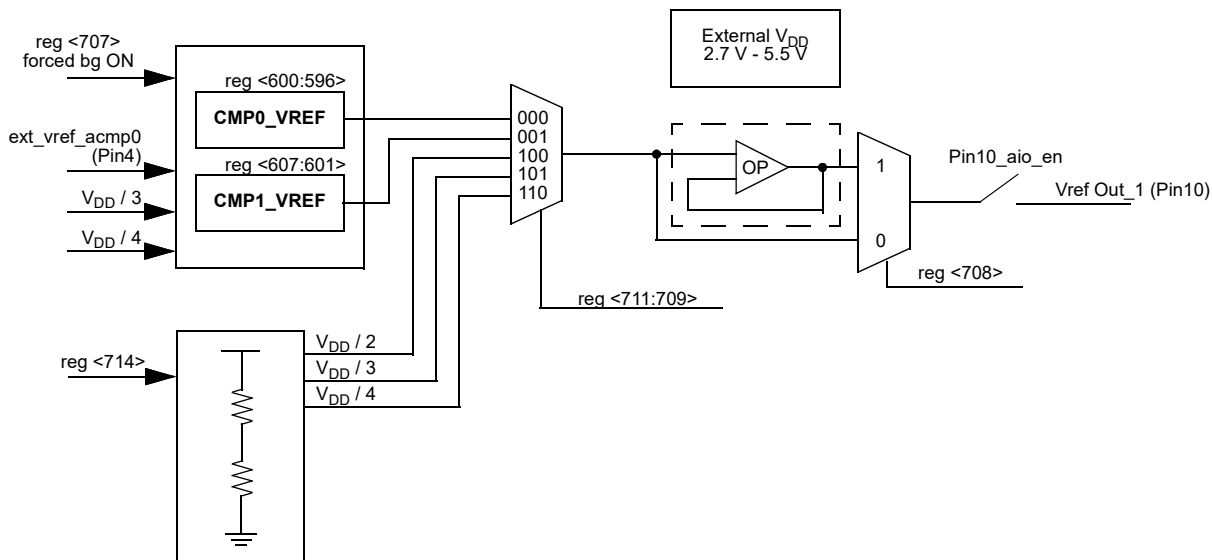


Figure 43. Voltage Reference Block Diagram

## 14.0 RC Oscillator (RC Osc)

### 14.1 RC Oscillator Overview

The SLG46120 has two internal RC oscillators, one that runs at 25 kHz and one that runs at 2 MHz. When using the chip internal RC OSC, a choice is available to “Force Power On”, meaning that the RC OSC will always run, or “Auto Power On”, meaning that the RC OSC will have an associated startup and settling time associated with it (offset). *Figure 44.* and *Figure 45.* show maximum power on delay vs.  $V_{DD}$ .

*Note: RC OSC power setting: “Auto Power On”.*

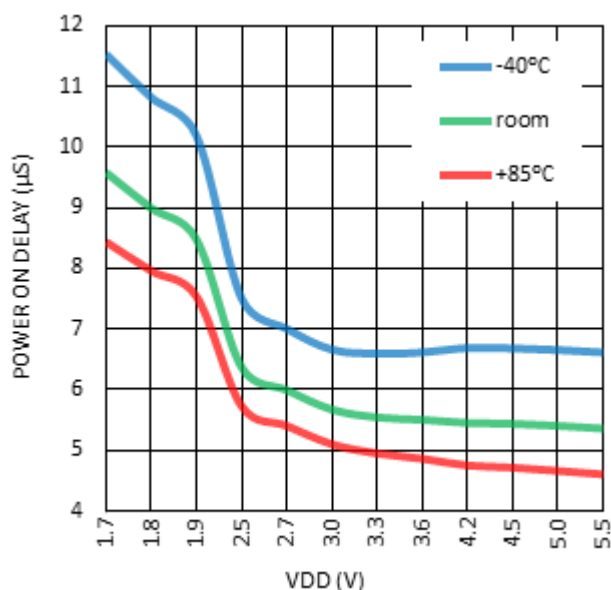


Figure 44. Maximum Power On Delay vs.  $V_{DD}$ , RC OSC = 2 MHz.

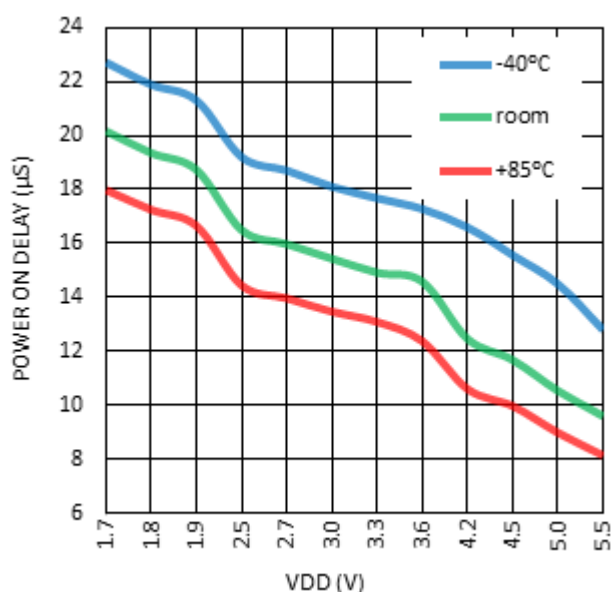


Figure 45. Maximum Power On Delay vs.  $V_{DD}$ , RC OSC = 25 kHz.

The user can select one of these fundamental frequencies for the RC OSC Macrocell, or the fundamental frequency can also come from an external clock input (Pin 12). There are two divider stages that allow the user flexibility for introducing clock signals on various Connection Matrix Input lines. The first stage divider (also known as the clock pre-divider) allows the selection of /1, /2, /4 or /8 divide down frequency from the fundamental. There are two second stage divider controls (OUT0 and OUT1). Each has its own input of one frequency from the first stage divider, and outputs two different frequencies on Connection Matrix Input lines <30>, and <31>. See *Figure 46.* below for details of the frequencies for each of these five Connection Matrix Inputs.

If PWR DOWN input of oscillator is LOW, the oscillator will be turned on. If PWR DOWN input of oscillator is HIGH the oscillator will be turned off. The PWR DOWN signal has the highest priority.

## 14.2 RC OSC Block Diagram

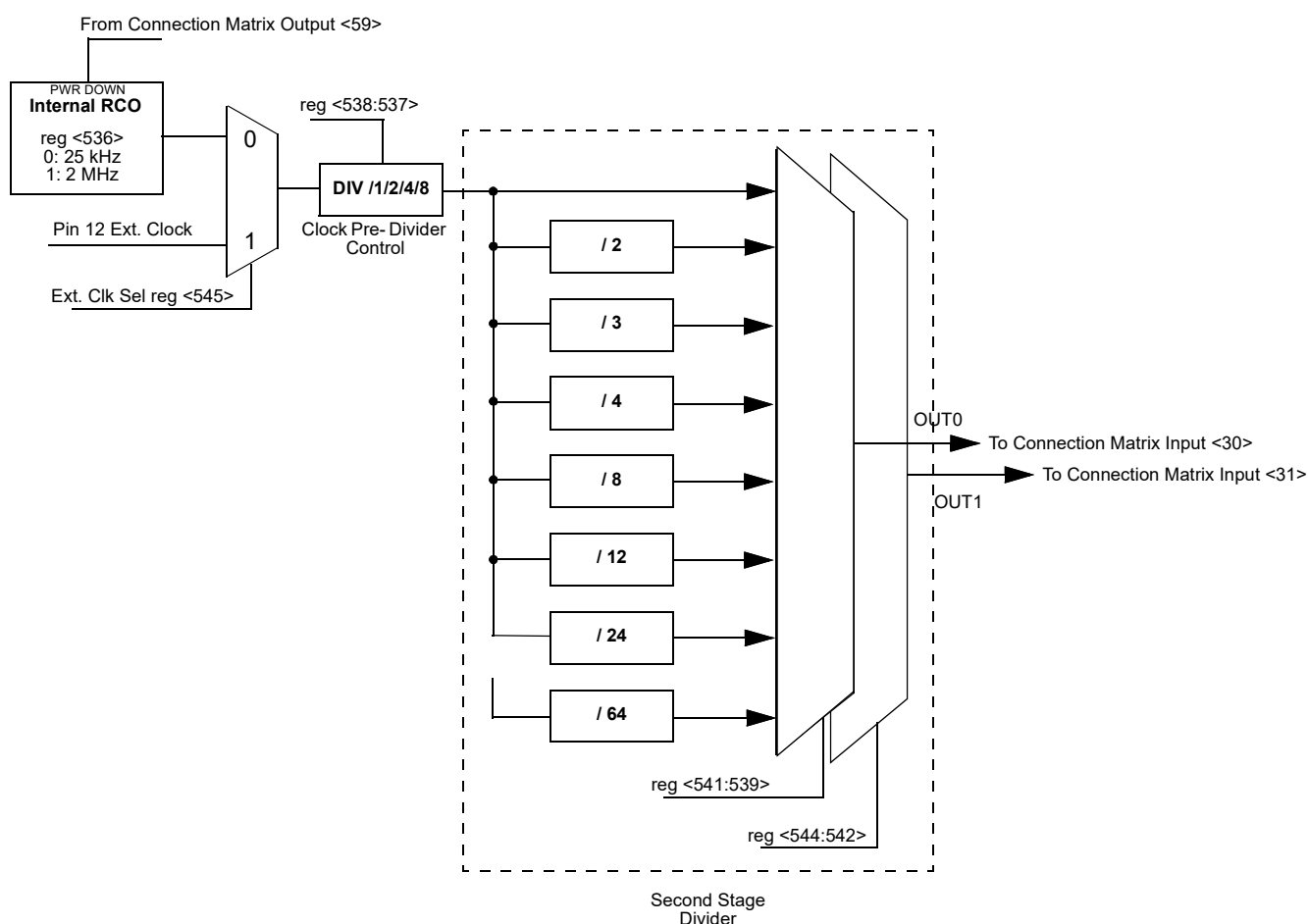


Figure 46. RC OSC Block Diagram

## 15.0 Power-On Reset (POR)

The SLG46120 has a power-on reset (POR) macrocell to ensure correct device initialization and operation of all macrocells in the device. The purpose of the POR circuit is to have consistent behavior and predictable results when the  $V_{DD}$  power is first ramping to the device, and also while the  $V_{DD}$  is falling during power-down. To accomplish this goal, the POR drives a defined sequence of internal events that trigger changes to the states of different macrocells inside the device, and finally to the state of the I/O pins. This application note is created to explain the whole process of POR operation and GreenPAK chip behavior during the time while it is powering up and powering down.

### 15.1 General Operation

The SLG46120 is guaranteed to be powered down and nonoperational when the  $V_{DD}$  voltage (voltage on PIN1) is less than 0.6 V, but not less than -0.6 V. Another essential condition for the chip to be powered down is that no voltage higher (see Note 1) than the  $V_{DD}$  voltage is applied to any other PIN. For example, if  $V_{DD}$  voltage is 0.3 V, applying a voltage higher than 0.3 V to any other PIN is incorrect, and can lead to incorrect or unexpected device behavior.

*Note 1. There is a 0.6 V margin due to forward drop voltage of the ESD protection diodes.*

To start the POR sequence in the SLG46120, the voltage applied on the  $V_{DD}$  should be higher than the Power\_ON threshold (see Note 2). The full operational  $V_{DD}$  range for the SLG46120 is 1.71 V – 5.5 V (1.8 V  $\pm$ 5 % - 5 V  $\pm$ 10 %). This means that the  $V_{DD}$  voltage must ramp up to the operational voltage value, but the POR sequence will start earlier, as soon as the  $V_{DD}$  voltage rises to the Power\_ON threshold. After the POR sequence has started, the SLG46120 will have a typical period of time to go through all the steps in the sequence (noted in the datasheet for that device), and will be ready and completely operational after the POR sequence is complete.

*Note 2. The Power\_ON threshold can vary by PVT, but typically it is 1.6 V.*

To power down the chip the  $V_{DD}$  voltage should be lower than the operational and to guarantee that chip is powered down it should be less than 0.6 V.

All PINs are in high impedance state when the chip is powered down and while the POR sequence is taking place. The last step in the POR sequence releases the I/O structures from the high impedance state, at which time the device is operational. The pin configuration at this point in time is defined by the design programmed into the chip. Also as it was mentioned before the voltage on PINs can't be bigger than the  $V_{DD}$ , this rule also applies to the case when the chip is powered on.

## 15.2 POR Sequence

The POR system generates a sequence of signals that enable certain macrocells. The sequence is shown in *Figure 47*.

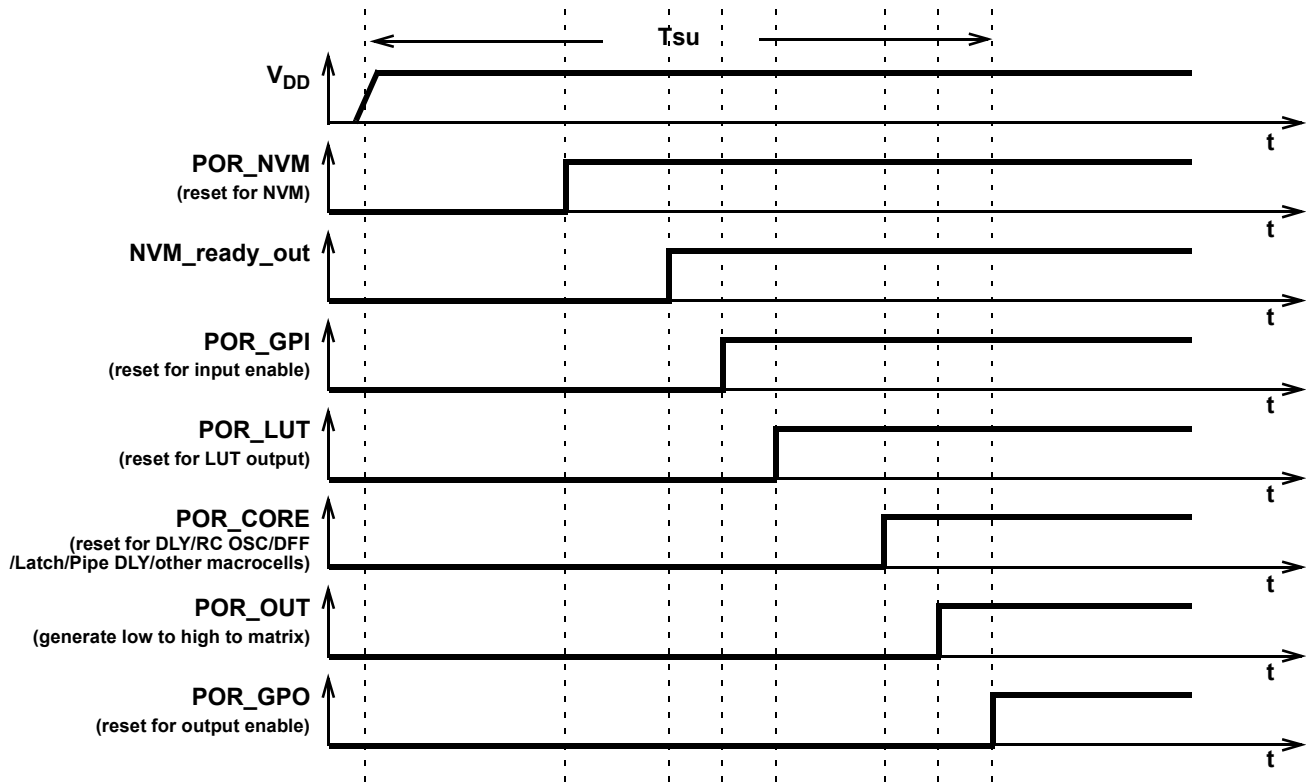


Figure 47. POR sequence

As can be seen from *Figure 47*, after the  $V_{DD}$  has started ramping up and crosses the Power\_ON threshold, first, the on-chip NVM memory is reset. Next the chip reads the data from NVM, and transfers this information to SRAM registers that serve to configure each macrocell, and the Connection Matrix which routes signals between macrocells. The third stage causes the reset of the input pins, and then to enable them. After that, the LUTs are reset and become active. After LUTs the Delay cells, RC OSC, DFFs, Latches and Pipe Delay are initialized. Only after all macrocells are initialized internal POR signal (POR macrocell output) goes from LOW to HIGH. The last portion of the device to be initialized are the output PINs, which transition from high impedance to active at this point.

The typical time that takes to complete the POR sequence varies by device type in the GreenPAK family. It also depends on many environmental factors, such as: slew rate,  $V_{DD}$  value, temperature and even will vary from chip to chip (process influence).

### 15.3 Macrocells Output States During POR Sequence

To have a full picture of SLG46120 operation during powering and POR sequence, review the overview the macrocell output states during the POR sequence (*Figure 48.* describes the output signals states).

First, before the NVM has been reset, all macrocells have their output set to logic LOW (except the output PINs which are in high impedance state). Before the NVM is ready, all macrocell outputs are unpredictable (except the output PINs). On the next step, some of the macrocells start initialization: input pins output state becomes LOW; LUTs also output LOW. Only P DLY macrocell configured as edge detector becomes active at this time. After that input PINs are enabled. Next, only LUTs are configured. Next, all other macrocells are initialized. After macrocells are initialized, internal POR matrix signal switches from LOW to HIGH. The last are output PINs that become active and determined by the input signals.

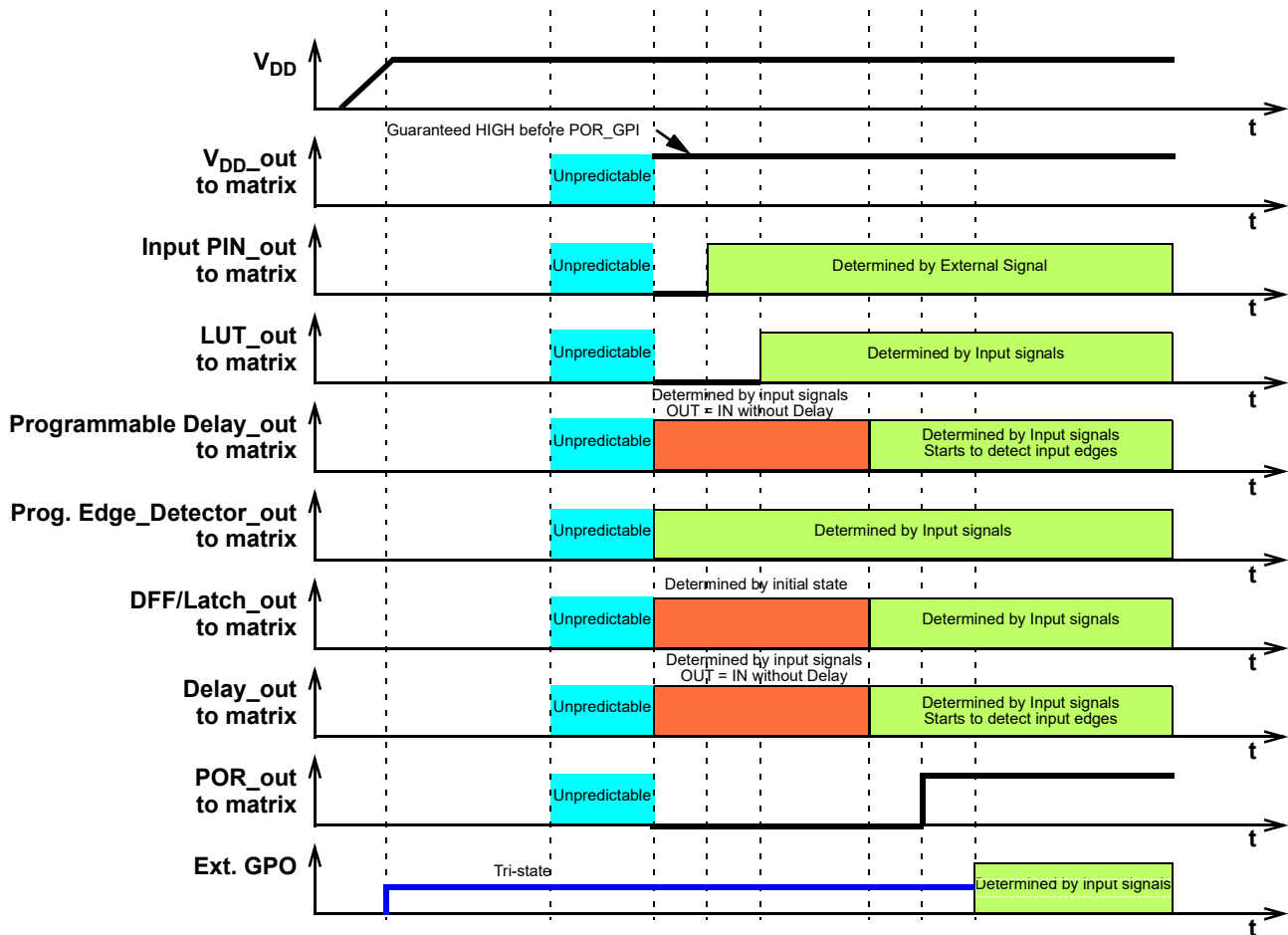


Figure 48. Internal Macrocell States during POR sequence

## 16.0 Appendix A - SLG46120 Register Definition

| Register Bit Address | Signal Function                                       | Register Bit Definition |
|----------------------|-------------------------------------------------------|-------------------------|
| reg<5:0>             | Matrix Out: PIN3 Digital Output Source                |                         |
| reg<11:6>            | Matrix Out: PIN4 Digital Output Source                |                         |
| reg<17:12>           | Matrix Out: PIN5 Digital Output Source                |                         |
| reg<23:18>           | Matrix Out: PIN6 Digital Output Source                |                         |
| reg<29:24>           | Matrix Out: Output Enable of PIN6                     |                         |
| reg<35:30>           | Matrix Out: In0 of 2-bit LUT0 or Clock Input of DFF0  |                         |
| reg<41:36>           | Matrix Out: In1 of 2-bit LUT0 or Data Input of DFF0   |                         |
| reg<47:42>           | Matrix Out: In0 of 2-bit LUT1 or Clock Input of DFF1  |                         |
| reg<53:48>           | Matrix Out: In1 of 2-bit LUT1 or Data Input of DFF1   |                         |
| reg<59:54>           | Matrix Out: In0 of 2-bit LUT2 or Clock Input of DFF2  |                         |
| reg<65:60>           | Matrix Out: In1 of 2-bit LUT2 1 or Data Input of DFF2 |                         |
| reg<71:66>           | Matrix Out: In0 of 2-bit LUT3 or Clock Input of DFF3  |                         |
| reg<77:72>           | Matrix Out: In1 of 2-bit LUT3 1 or Data Input of DFF3 |                         |
| reg<83:78>           | Matrix Out: In0 of 2-bit LUT4                         |                         |
| reg<89:84>           | Matrix Out: In1 of 2-bit LUT4                         |                         |
| reg<95:90>           | Matrix Out: PIN11 Digital Output Source               |                         |
| reg<101:96>          | Matrix Out: PIN12 Digital Output Source               |                         |
| reg<107:102>         | Matrix Out: In0 of 3-bit LUT0 or Clock Input of DFF4  |                         |
| reg<113:108>         | Matrix Out: In1 of 3-bit LUT0 or Data Input of DFF4   |                         |
| reg<119:114>         | Matrix Out: In2 of 3-bit LUT0 or Resetb Input of DFF4 |                         |
| reg<125:120>         | Matrix Out: In0 of 3-bit LUT1 or Clock Input of DFF5  |                         |
| reg<131:126>         | Matrix Out: In1 of 3-bit LUT1 or Data Input of DFF5   |                         |
| reg<137:132>         | Matrix Out: In2 of 3-bit LUT1 or Resetb(Setb) of DFF5 |                         |
| reg<143:138>         | Matrix Out: In0 of 3-bit LUT2 or Clock Input of DFF6  |                         |
| reg<149:144>         | Matrix Out: In1 of 3-bit LUT2 or Data Input of DFF6   |                         |
| reg<155:150>         | Matrix Out: In2 of 3-bit LUT2 or Resetb Input of DFF6 |                         |
| reg<161:156>         | Matrix Out: In0 of 3-bit LUT3 or Clock Input of DFF7  |                         |
| reg<167:162>         | Matrix Out: In1 of 3-bit LUT3 or Data Input of DFF7   |                         |
| reg<173:168>         | Matrix Out: In2 of 3-bit LUT3 or Resetb(Setb) of DFF7 |                         |
| reg<179:174>         | Matrix Out: In0 of 3-bit LUT4                         |                         |
| reg<185:180>         | Matrix Out: In1 of 3-bit LUT4                         |                         |
| reg<191:186>         | Matrix Out: In2 of 3-bit LUT4                         |                         |
| reg<197:192>         | Matrix Out: In0 of 3-bit LUT5                         |                         |
| reg<203:198>         | Matrix Out: In1 of 3-bit LUT5                         |                         |
| reg<209:204>         | Matrix Out: In2 of 3-bit LUT5                         |                         |
| reg<215:210>         | Matrix Out: In0 of 3-bit LUT6                         |                         |
| reg<221:216>         | Matrix Out: In1 of 3-bit LUT6                         |                         |
| reg<227:222>         | Matrix Out: In2 of 3-bit LUT6                         |                         |
| reg<233:228>         | Matrix Out: In0 of 3-bit LUT7                         |                         |
| reg<239:234>         | Matrix Out: In1 of 3-bit LUT7                         |                         |
| reg<245:240>         | Matrix Out: In2 of 3-bit LUT7                         |                         |

| Register Bit Address      | Signal Function                                                          | Register Bit Definition              |
|---------------------------|--------------------------------------------------------------------------|--------------------------------------|
| reg<251:246>              | Matrix Out: In0 of 3-bit LUT8 or Input of Pipe delay                     |                                      |
| reg<257:252>              | Matrix Out: In1 of 3-bit LUT8 or Resetb of Pipe delay                    |                                      |
| reg<263:258>              | Matrix Out: In2 of 3-bit LUT8 or Clock of Pipe delay                     |                                      |
| reg<269:264>              | Matrix Out: In0 of 4-bit LUT0 or Input for delay2(outer2) external clock |                                      |
| reg<275:270>              | Matrix Out: In1 of 4-bit LUT0 or Input for delay2 data(counter2 reset)   |                                      |
| reg<281:276>              | Matrix Out: In2 of 4-bit LUT0                                            |                                      |
| reg<287:282>              | Matrix Out: In3 of 4-bit LUT0                                            |                                      |
| reg<293:288>              | Matrix Out: In0 of 4-bit LUT1 or Input for delay3(outer3) external clock |                                      |
| reg<299:294>              | Matrix Out: In1 of 4-bit LUT1 or Input for delay3 data(counter3 reset)   |                                      |
| reg<305:300>              | Matrix Out: In2 of 4-bit LUT1                                            |                                      |
| reg<311:306>              | Matrix Out: In3 of 4-bit LUT1                                            |                                      |
| reg<317:312>              | Matrix Out: Input for delay0 data(counter0 external clock)               |                                      |
| reg<323:318>              | Matrix Out: Input for delay1(counter1) external clock                    |                                      |
| reg<329:324>              | Matrix Out: Input for delay1 data(counter1 reset)                        |                                      |
| reg<335:330>              | Matrix Out: Not used                                                     |                                      |
| reg<341:336>              | Matrix Out: pdb(power down) for ACMP0                                    |                                      |
| reg<347:342>              | Matrix Out: pdb(power down) for ACMP1                                    |                                      |
| reg<353:348>              | Matrix Out: Input for programmable delay (deglitch filter input)         |                                      |
| reg<359:354>              | Matrix Out: Power down for osc (1: Power down)                           |                                      |
| reg<365:360>              | Matrix Out: PIN8 Digital Output Source                                   |                                      |
| reg<371:366>              | Matrix Out: PIN9 Digital Output Source                                   |                                      |
| reg<377:372>              | Matrix Out: PIN10 Digital Output Source                                  |                                      |
| reg<383:378>              | Matrix Out: Output Enable of PIN10                                       |                                      |
| reg<389:384>              | Reserved                                                                 |                                      |
| reg<395:390>              | Reserved                                                                 |                                      |
| <b>2-bit LUT0 or DFF0</b> |                                                                          |                                      |
| reg<399:396>              | 2-bit LUT0 data or the following                                         |                                      |
| reg<396>                  | DFF0 or Latch select                                                     | 0: DFF function<br>1: Latch function |
| reg<397>                  | DFF0 output select                                                       | 0: Q output<br>1: nQ output          |
| reg<398>                  | DFF0 initial polarity select                                             | 0: Low<br>1: High                    |
| <b>2-bit LUT1 or DFF1</b> |                                                                          |                                      |
| reg<403:400>              | 2-bit LUT1 data or the following                                         | 0: DFF function<br>1: Latch function |
| reg<400>                  | DFF1 or Latch select                                                     | 0: DFF function<br>1: Latch function |
| reg<401>                  | DFF1 output select                                                       | 0: Q output<br>1: nQ output          |

| Register Bit Address           | Signal Function                  | Register Bit Definition                                  |
|--------------------------------|----------------------------------|----------------------------------------------------------|
| reg<402>                       | DFF1 initial polarity select     | 0: Low<br>1: High                                        |
| <b>2-bit LUT2 or DFF2</b>      |                                  |                                                          |
| reg<407:404>                   | 2-bit LUT2 data or the following |                                                          |
| reg<404>                       | DFF2 or Latch select             | 0: DFF function<br>1: Latch function                     |
| reg<405>                       | DFF2 output select               | 0: Q output<br>1: nQ output                              |
| reg<406>                       | DFF2 initial polarity select     | 0: Low<br>1: High                                        |
| <b>2-bit LUT3 or DFF3</b>      |                                  |                                                          |
| reg<411:408>                   | 2-bit LUT3 data or the following |                                                          |
| reg<408>                       | DFF3 or Latch select             | 0: DFF function<br>1: Latch function                     |
| reg<409>                       | DFF3 output select               | 0: Q output<br>1: nQ output                              |
| reg<410>                       | DFF3 initial polarity select     | 0: Low<br>1: High                                        |
| <b>2-bit LUT4</b>              |                                  |                                                          |
| reg<415:412>                   | 2-bit LUT4 data                  |                                                          |
| reg<419:416>                   | Reserved                         |                                                          |
| <b>2-bit LUT0/DFF_0 Select</b> |                                  |                                                          |
| reg<420>                       | 2-bit LUT0 or DFF0 select        | 0: 2-bit LUT0<br>1: DFF0                                 |
| reg<421>                       | 2-bit LUT1 or DFF1 select        | 0: 2-bit LUT1<br>1: DFF1                                 |
| reg<422>                       | 2-bit LUT2 or DFF2 select        | 0: 2-bit LUT2<br>1: DFF2                                 |
| reg<423>                       | 2-bit LUT3 or DFF3 select        | 0: 2-bit LUT3<br>1: DFF3                                 |
| <b>3-bit LUT0 or DFF4</b>      |                                  |                                                          |
| reg<431:424>                   | 3-bit LUT0 data or the following |                                                          |
| reg<424>                       | DFF4 or Latch select             | 0: DFF function<br>1: Latch function                     |
| reg<425>                       | DFF4 output select               | 0: Q output<br>1: nQ output                              |
| reg<426>                       | DFF4 rstb/setb select            | 0: rstb from matrix output<br>1: setb from matrix output |
| reg<427>                       | DFF4 initial polarity select     | 0: Low<br>1: High                                        |
| <b>3-bit LUT1 or DFF5</b>      |                                  |                                                          |
| reg<439:432>                   | 3-bit LUT1 data or the following |                                                          |
| reg<432>                       | DFF5 or Latch select             | 0: DFF function<br>1: Latch function                     |
| reg<433>                       | DFF5 output select               | 0: Q output<br>1: nQ output                              |
| reg<434>                       | DFF5 rstb/setb select            | 0: rstb from matrix output<br>1: setb from matrix output |

| Register Bit Address                    | Signal Function                        | Register Bit Definition                                    |
|-----------------------------------------|----------------------------------------|------------------------------------------------------------|
| reg<435>                                | DFF5 initial polarity select           | 0: Low<br>1: High                                          |
| <b>3-bit LUT2 or DFF6</b>               |                                        |                                                            |
| reg<447:440>                            | 3-bit LUT2 data or the following       |                                                            |
| reg<440>                                | DFF6 or Latch select                   | 0: DFF function<br>1: Latch function                       |
| reg<441>                                | DFF6 output select                     | 0: Q output<br>1: nQ output                                |
| reg<442>                                | DFF6 rstb/setb select                  | 0: resetb from matrix output<br>1: setb from matrix output |
| reg<443>                                | DFF6 initial polarity select           | 0: Low<br>1: High                                          |
| <b>3-bit LUT3 or DFF7</b>               |                                        |                                                            |
| reg<455:448>                            | 3-bit LUT3 data or the following       |                                                            |
| reg<448>                                | DFF7 or Latch select                   | 0: DFF function<br>1: Latch function                       |
| reg<449>                                | DFF7 output select                     | 0: Q output<br>1: nQ output                                |
| reg<450>                                | DFF7 rstb/setb select                  | 0: resetb from matrix output<br>1: setb from matrix output |
| reg<451>                                | DFF7 initial polarity select           | 0: Low<br>1: High                                          |
| <b>3-bit LUT4</b>                       |                                        |                                                            |
| reg<463:456>                            | 3-bit LUT4 data                        |                                                            |
| <b>3-bit LUT5</b>                       |                                        |                                                            |
| reg<471:464>                            | 3-bit LUT5 data                        |                                                            |
| <b>3-bit LUT6</b>                       |                                        |                                                            |
| reg<479:472>                            | 3-bit LUT6 data                        |                                                            |
| <b>3-bit LUT7</b>                       |                                        |                                                            |
| reg<487:480>                            | 3-bit LUT7 data                        |                                                            |
| <b>3-bit LUT8 or pipe number select</b> |                                        |                                                            |
| reg<495:488>                            | 3-bit LUT8 data or the following       |                                                            |
| reg<490:488>                            | OUT0 select                            | data (pipe number)                                         |
| reg<493:491>                            | OUT1 select                            | data (pipe number)                                         |
| reg<495:494>                            | Unused if Pipe Delay selected          | Unused                                                     |
| <b>LUT3/DFF Select</b>                  |                                        |                                                            |
| reg<496>                                | 3-bit LUT0 or DFF4 select              | 0: 3-bit LUT0<br>1: DFF4                                   |
| reg<497>                                | 3-bit LUT1 or DFF5 select              | 0: 3-bit LUT1<br>1: DFF5                                   |
| reg<498>                                | 3-bit LUT2 or DFF6 select              | 0: 3-bit LUT3<br>1: DFF6                                   |
| reg<499>                                | 3-bit LUT3 or DFF7 select              | 0: 3-bit LUT4<br>1: DFF7                                   |
| reg<500>                                | 3-bit LUT8 or pipe delay output select | 0: 3-bit LUT8<br>1: pipe delay                             |

| Register Bit Address                | Signal Function                                  | Register Bit Definition                                                                                                                                                                                                                                               |
|-------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4-bit LUT0 or Counter/Delay2</b> |                                                  |                                                                                                                                                                                                                                                                       |
| reg<516:501>                        | 4-bit LUT0 data or the following                 |                                                                                                                                                                                                                                                                       |
| reg<501>                            | Counter/delay2 mode selection                    | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                      |
| reg<504:502>                        | Counter/delay2 Clock Source select               | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter1 Overflow                                                                                                                  |
| reg<512:505>                        | Counter/delay2 Control Data                      | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                      |
| reg<514:513>                        | Delay2 Mode Select or asynchronous counter reset | 00: on both falling and rising edges (for delay & counter reset)<br>01: on falling edge only (for delay & counter reset)<br>10: on rising edge only (for delay & counter reset)<br>11: no delay on either falling or rising edges / high level reset for counter mode |
| reg<517>                            | 4-bit LUT0 or Counter2 select                    | 0: 4-bit LUT0<br>1: Counter2                                                                                                                                                                                                                                          |
| <b>4-bit LUT1 or Counter/Delay3</b> |                                                  |                                                                                                                                                                                                                                                                       |
| reg<533:518>                        | 4-bit LUT1 data or the following                 |                                                                                                                                                                                                                                                                       |
| reg<518>                            | Counter/delay3 mode selection                    | 0: Delay Mode 1: Counter Mode                                                                                                                                                                                                                                         |
| reg<521:519>                        | Counter/delay3 Clock Source select               | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter2 Overflow                                                                                                                  |
| reg<529:522>                        | Counter/delay3 Control Data                      | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                      |
| reg<531:530>                        | Delay3 Mode Select or asynchronous counter reset | 00: on both falling and rising edges (for delay & counter reset)<br>01: on falling edge only (for delay & counter reset)<br>10: on rising edge only (for delay & counter reset)<br>11: no delay on either falling or rising edges                                     |
| reg<534>                            | 4-bit LUT1 or Counter3 select                    | 0: 4-bit LUT1<br>1: Counter3                                                                                                                                                                                                                                          |
| <b>RC Osc</b>                       |                                                  |                                                                                                                                                                                                                                                                       |
| reg<535>                            | Force RC oscillator on                           | 0: Auto Power on<br>1: Force Power on                                                                                                                                                                                                                                 |
| reg<536>                            | RC Oscillator frequency control                  | 0: 25 kHz<br>1: 2 MHz                                                                                                                                                                                                                                                 |
| reg<538:537>                        | Osc clock pre-divider                            | 00:div1<br>01:div2<br>10: div4<br>11: div8                                                                                                                                                                                                                            |

| Register Bit Address   | Signal Function                                                              | Register Bit Definition                                                                                                                                                                                                           |
|------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| reg<541:539>           | Internal Oscillator frequency divider control 0                              | 000: OSC/1<br>001: OSC/2<br>010: OSC/3<br>011: OSC/4<br>100: OSC/8<br>101: OSC/12<br>110: OSC/24<br>111: OSC/64                                                                                                                   |
| reg<544:542>           | Internal Oscillator frequency divider control 1                              | 000: OSC/1<br>001: OSC/2<br>010: OSC/3<br>011: OSC/4<br>100: OSC/8<br>101: OSC/12<br>110: OSC/24<br>111: OSC/64                                                                                                                   |
| reg<545>               | External Clock Source Select                                                 | 0: Internal Oscillator<br>1: External Clock from Pin12                                                                                                                                                                            |
| reg<546>               | Manufacturing test mode                                                      |                                                                                                                                                                                                                                   |
| reg<547>               | Reserved                                                                     |                                                                                                                                                                                                                                   |
| <b>Counter/Delay 0</b> |                                                                              |                                                                                                                                                                                                                                   |
| reg<548>               | Counter/delay0 mode selection                                                | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                  |
| reg<551:549>           | Counter/delay0 Clock Source select (external clock is only for counter mode) | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter3 Overflow                                                                              |
| reg<565:552>           | Counter0 Control Data/Delay0 Time Control                                    | 1-16383: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                                                                                             |
| reg<567:566>           | Delay0 Mode Select or asynchronous counter reset                             | 00: on both falling and rising edges (for delay & counter reset)<br>01: on falling edge only (for delay & counter reset)<br>10: on rising edge only (for delay & counter reset)<br>11: no delay on either falling or rising edges |
| <b>Counter/Delay 1</b> |                                                                              |                                                                                                                                                                                                                                   |
| reg<568>               | Counter/delay1 mode selection                                                | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                  |
| reg<571:569>           | Counter/delay1 Clock Source select                                           | 000: Internal OSC Clock<br>001: OSC/4<br>010: OSC/12<br>011: OSC/24<br>100: OSC/64<br>101: External Clock<br>110: Reserved<br>111: Counter0 Overflow                                                                              |
| reg<579:572>           | Counter1 Control Data/Delay1 Time Control                                    | 1-255: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                                                                                               |

| Register Bit Address | Signal Function                                      | Register Bit Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| reg<581:580>         | Delay1 Mode Select or asynchronous counter reset     | 00: on both falling and rising edges(for delay & counter reset)<br>01: on falling edge only (for delay & counter reset)<br>10: on rising edge only (for delay & counter reset)<br>11: no delay on either falling or rising edges / high level reset for counter mode                                                                                                                                                                                                           |
| reg<595:582>         | Reserved                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>ACMP0</b>         |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| reg<600:596>         | ACMP0 IN voltage select                              | 00000: 50 mV    00001: 100 mV<br>00010: 150 mV    00011: 200 mV<br>00100: 250 mV    00101: 300 mV<br>00110: 350 mV    00111: 400 mV<br>01000: 450 mV    01001: 500 mV<br>01010: 550 mV    01011: 600 mV<br>01100: 650 mV    01101: 700 mV<br>01110: 750 mV    01111: 800 mV<br>10000: 850 mV    10001: 900 mV<br>10010: 950 mV    10011: 1 V<br>10100: 1.05 V    10101: 1.1 V<br>10110: 1.15 V    10111: 1.2 V<br>11000: $V_{DD}/3$ 11001: $V_{DD}/4$<br>11010: EXT_VREF(PIN4) |
| reg<602:601>         | ACMP0 hysteresis Enable                              | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                      |
| reg<604:603>         | ACMP0 positive Input divider                         | 00: 1.0X<br>01: 0.5X<br>10: 0.33X<br>11: 0.25X                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| reg<605>             | ACMP0 low bandwidth (typ: Max.1 MHz) enable.         | 0: off<br>1: on                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| reg<606>             | ACMP0 positive input source select PIN3 and $V_{DD}$ | 0: PIN3<br>1: $V_{DD}$                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>ACMP1</b>         |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| reg<611:607>         | ACMP1 IN voltage select                              | 00000: 50 mV    00001: 100 mV<br>00010: 150 mV    00011: 200 mV<br>00100: 250 mV    00101: 300 mV<br>00110: 350 mV    00111: 400 mV<br>01000: 450 mV    01001: 500 mV<br>01010: 550 mV    01011: 600 mV<br>01100: 650 mV    01101: 700 mV<br>01110: 750 mV    01111: 800 mV<br>10000: 850 mV    10001: 900 mV<br>10010: 950 mV    10011: 1 V<br>10100: 1.05 V    10101: 1.1 V<br>10110: 1.15 V    10111: 1.2 V<br>11000: $V_{DD}/3$ 11001: $V_{DD}/4$<br>11010: EXT_VREF(PIN4) |
| reg<613:612>         | ACMP1 hysteresis Enable                              | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                      |

| Register Bit Address | Signal Function                                  | Register Bit Definition                                                                                                                                                                                                                          |
|----------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| reg<615:614>         | ACMP1 positive Input divider                     | 00: 1.0X<br>01: 0.5X<br>10: 0.33X<br>11: 0.25X                                                                                                                                                                                                   |
| reg<616>             | ACMP1 100 uA current source option               | 0: disable<br>1: enable                                                                                                                                                                                                                          |
| reg<617>             | ACMP1 low bandwidth (typ: Max.1Mhz) enable.      | 0: off<br>1: on                                                                                                                                                                                                                                  |
| reg<618>             | ACMP1 positive input source select PIN6 and PIN3 | 0: PIN3<br>1: PIN6                                                                                                                                                                                                                               |
| reg<622:619>         | Reserved                                         | Reserved                                                                                                                                                                                                                                         |
| <b>PIN 2</b>         |                                                  |                                                                                                                                                                                                                                                  |
| reg<624:623>         | PIN2 mode control                                | 00: Digital Input without Schmitt Trigger<br>01: Digital Input with Schmitt Trigger<br>10: Low Voltage Digital Input<br>11: Reserved                                                                                                             |
| reg<626:625 >        | PIN2 pull down resistor value selection          | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                    |
| <b>PIN 3</b>         |                                                  |                                                                                                                                                                                                                                                  |
| reg<629:627 >        | PIN3 mode control                                | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Analog Input & Open drain |
| reg<631:630 >        | PIN3 pull up/down resistor value selection       | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                    |
| reg<632>             | PIN3 pull up/down resistor select                | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                       |
| reg<633>             | PIN3 driver strength selection                   | 0: 1X<br>1: 2X                                                                                                                                                                                                                                   |
| <b>PIN 4</b>         |                                                  |                                                                                                                                                                                                                                                  |
| reg<636:634>         | PIN4 mode control                                | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Analog Input & Open drain |
| reg<638:637>         | PIN4 pull up/down resistor value selection       | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                    |
| reg<639>             | PIN4 pull up/down resistor select                | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                       |

| Register Bit Address | Signal Function                            | Register Bit Definition                                                                                                                                                                                                                          |
|----------------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| reg<640>             | PIN4 driver strength selection             | 0: 1X<br>1: 2X                                                                                                                                                                                                                                   |
| <b>PIN 5</b>         |                                            |                                                                                                                                                                                                                                                  |
| reg<643:641>         | PIN5 mode control                          | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Analog Input & Open drain |
| reg<645:644>         | PIN5 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                    |
| reg<646>             | PIN5 pull up/down resistor select          | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                       |
| reg<647>             | PIN5 driver strength selection             | 0: 1X<br>1: 2X                                                                                                                                                                                                                                   |
| <b>PIN 6</b>         |                                            |                                                                                                                                                                                                                                                  |
| reg<649:648>         | PIN6 mode control (sig_pin6_oe =0)         | 00: Digital Input without Schmitt Trigger<br>01: Digital Input with Schmitt Trigger<br>10: Low Voltage Digital Input<br>11: Analog Input / Output                                                                                                |
| reg<651:650>         | PIN6 mode control (sig_pin6_oe =1)         | 00: Push Pull 1X<br>01: Push Pull 2X<br>10: Open Drain NMOS 1X<br>11: Open Drain NMOS 2X                                                                                                                                                         |
| reg<653:652>         | PIN6 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                    |
| reg<654>             | PIN6 pull up/down resistor select          | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                       |
| <b>PIN8</b>          |                                            |                                                                                                                                                                                                                                                  |
| reg<657:655>         | PIN8 mode control                          | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Analog Input / Output<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Reserved         |
| reg<659:658>         | PIN8 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                    |
| reg<660>             | PIN8 pull up/down resistor select          | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                       |
| reg<661>             | PIN8 driver strength selection             | 0: 1X<br>1: 2X                                                                                                                                                                                                                                   |

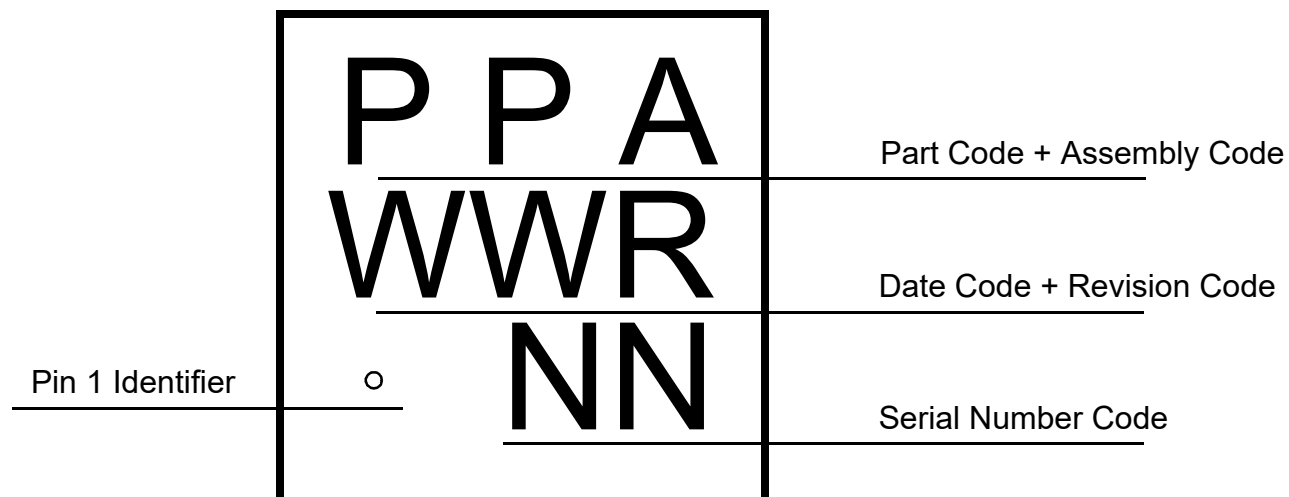
| Register Bit Address | Signal Function                             | Register Bit Definition                                                                                                                                                                                                       |
|----------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PIN 9</b>         |                                             |                                                                                                                                                                                                                               |
| reg<664:662>         | PIN9 mode control                           | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Reserved<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Open drain |
| reg<666:665>         | PIN9 pull down resistor value selection     | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                 |
| reg<667>             | PIN9 pull up/down resistor select           | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                    |
| reg<668>             | PIN9 driver strength selection              | 0: 1X<br>1: 2X                                                                                                                                                                                                                |
| <b>PIN 10</b>        |                                             |                                                                                                                                                                                                                               |
| reg<670:669>         | PIN10 mode control (sig_pin10_oe =0)        | 00: Digital Input without Schmitt Trigger<br>01: Digital Input with Schmitt Trigger<br>10: Low Voltage Digital Input<br>11: Analog Input / Output                                                                             |
| reg<672:671>         | PIN10 mode control (sig_pin10_oe =1)        | 00: Push Pull 1X<br>01: Push Pull 2X<br>10: Open Drain NMOS 1X<br>11: Open Drain NMOS 2X                                                                                                                                      |
| reg<674:673>         | PIN10 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                 |
| reg<675>             | PIN10 pull up/down resistor select          | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                    |
| <b>PIN 11</b>        |                                             |                                                                                                                                                                                                                               |
| reg<678:676>         | PIN11 mode control                          | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Reserved<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Open drain |
| reg<680:679>         | PIN11 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                 |
| reg<681>             | PIN11 pull up/down resistor select          | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                    |
| reg<682>             | PIN11 driver strength selection             | 0: 1X<br>1: 2X                                                                                                                                                                                                                |

| Register Bit Address | Signal Function                                                            | Register Bit Definition                                                                                                                                                                                                       |
|----------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PIN 12</b>        |                                                                            |                                                                                                                                                                                                                               |
| reg<685:683>         | PIN12 mode control                                                         | 000: Digital Input without Schmitt Trigger<br>001: Digital Input with Schmitt Trigger<br>010: Low Voltage Digital Input<br>011: Reserved<br>100: Push Pull<br>101: Open Drain NMOS<br>110: Open Drain PMOS<br>111: Open drain |
| reg<687:686>         | PIN12 pull up/down resistor value selection                                | 00: floating<br>01: 10k<br>10: 100K<br>11: 1M                                                                                                                                                                                 |
| reg<688>             | PIN12 pull up/down resistor select                                         | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                    |
| reg<689>             | PIN12 driver strength selection                                            | 0: 1X<br>1: 2X                                                                                                                                                                                                                |
| Reg<690>             | Pipe delay OUT1 polarity select bit                                        | 0: Non-inverted<br>1: Inverted                                                                                                                                                                                                |
| reg<698:691>         | 8-bit pattern id                                                           |                                                                                                                                                                                                                               |
| reg<699>             | filter0 output polarity select                                             | 0: Non-inverting<br>1: Inverting                                                                                                                                                                                              |
| reg<701:700>         | Reserved                                                                   | Reserved                                                                                                                                                                                                                      |
| reg<702>             | GPIO quick charge enable                                                   | 0: Disable<br>1: Enable                                                                                                                                                                                                       |
| reg<706:703>         | Reserved                                                                   | Reserved                                                                                                                                                                                                                      |
| reg<707>             | Force bandgap on                                                           | 0: Auto-mode<br>1: Enable                                                                                                                                                                                                     |
| reg<708>             | VREF1 Output Active Buffer Control                                         | 0: Disabled<br>1: Enabled                                                                                                                                                                                                     |
| reg<711:709>         | VREF1 Output Source Select                                                 | 000: ACMP0 reference voltage<br>001: ACMP1 reference voltage<br>100: $V_{DD}/2$<br>101: $V_{DD}/3$<br>110: $V_{DD}/4$                                                                                                         |
| reg<712>             | NVM data read disable                                                      | 0: Disable (read enable)<br>1: Enable (read disable)                                                                                                                                                                          |
| reg<713>             | NVM power down (or NVM data programming disable)                           | 0: None (or programming enable)<br>1: Power Down (or programming disable)                                                                                                                                                     |
| reg<714>             | Power Divider Power                                                        | 0: Power down<br>1: Power On                                                                                                                                                                                                  |
| reg<715>             | POR Auto Power detect                                                      | 0: Enable<br>1: Disable                                                                                                                                                                                                       |
| reg<716>             | Charge pump for analog macrocell enable (when $V_{DD} \leq 2.7$ V turn on) | 0: Disable (automatic on/off control)<br>1: Enable (always on)                                                                                                                                                                |
| reg<717>             | $V_{DD}$ bypass enable                                                     | 0: Regulator auto on<br>1: Regulator off ( $V_{DD}$ bypass)                                                                                                                                                                   |
| reg<718>             | PIN2 edge detect mode                                                      | 0: rising edge<br>1: falling edge                                                                                                                                                                                             |
| reg<719>             | Bypass the pin2                                                            | 0: PIN2 edge active<br>1: PIN2 high active                                                                                                                                                                                    |

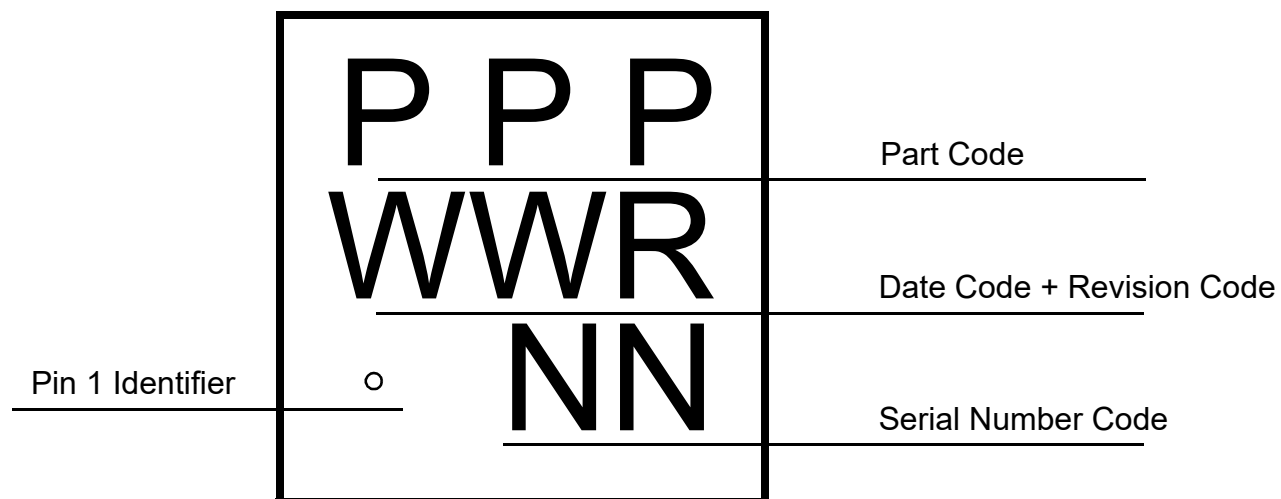
| Register Bit Address | Signal Function                                                                                          | Register Bit Definition                                                                                |
|----------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| reg<720>             | PIN2 reset enable                                                                                        | 0: Disable<br>1: Enable                                                                                |
| reg<721>             | Reserved                                                                                                 | Reserved                                                                                               |
| reg<727:722>         | Reserved                                                                                                 | Reserved                                                                                               |
| reg<735:728>         | Reserved                                                                                                 | Reserved                                                                                               |
| reg<741:736>         | Reserved                                                                                                 | Reserved                                                                                               |
| reg<743:742>         | Delay value select for programmable delay & edge detector ( $V_{DD} = 3.3\text{ V}$ , typical condition) | 00: 163 ns<br>01: 305 ns<br>10: 446 ns<br>11: 588 ns                                                   |
| reg<745:744>         | Select the edge mode of programmable delay & edge detector                                               | 00: rising edge detector<br>01: falling edge detector<br>10: both edge detector<br>11: both edge delay |
| reg<746>             | programmable delay or filter output select                                                               | 0: programmable delay output<br>1: filter output                                                       |
| reg<751:747>         | Reserved                                                                                                 | Reserved                                                                                               |
| reg<757:752>         | Reserved                                                                                                 | Reserved                                                                                               |
| reg<758>             | Reserved                                                                                                 | Reserved                                                                                               |
| reg<759>             | Reserved                                                                                                 | Reserved                                                                                               |
| reg<767:760>         | Reserved                                                                                                 | Reserved                                                                                               |

## 17.0 Package Top Marking System Definition

### 17.1 Before February 1, 2021

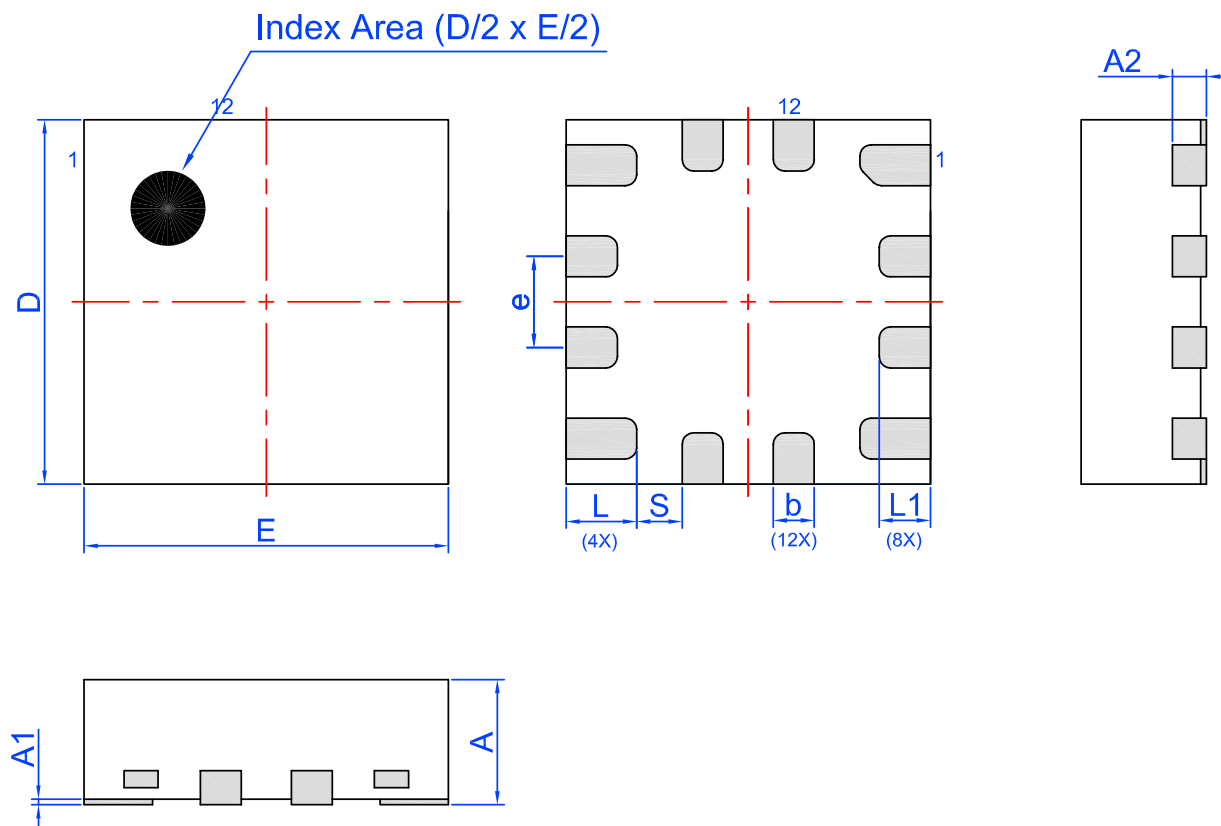


### 17.2 After February 1, 2021



# 18.0 Package Drawing and Dimensions

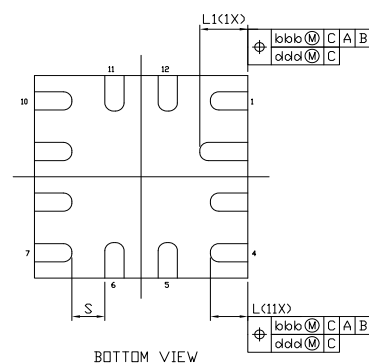
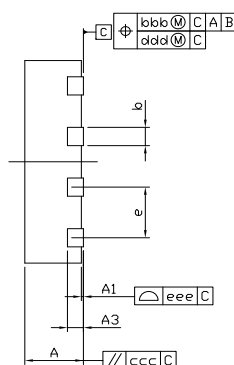
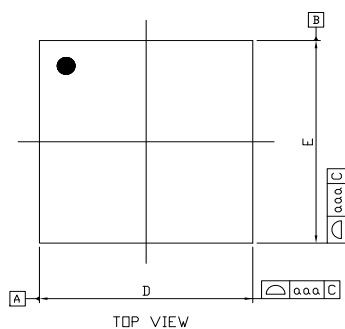
## 18.1 12 Lead STQFN FCA Package 1.6 x 1.6 mm



Unit: mm

| Symbol | Min      | Nom. | Max   | Symbol | Min     | Nom.  | Max   |
|--------|----------|------|-------|--------|---------|-------|-------|
| A      | 0.50     | 0.55 | 0.60  | D      | 1.55    | 1.60  | 1.65  |
| A1     | 0.005    | -    | 0.060 | E      | 1.55    | 1.60  | 1.65  |
| A2     | 0.10     | 0.15 | 0.20  | L      | 0.26    | 0.31  | 0.36  |
| b      | 0.13     | 0.18 | 0.23  | L1     | 0.175   | 0.225 | 0.275 |
| e      | 0.40 BSC |      |       | S      | 0.2 REF |       |       |

# 18.2 12 Lead STQFN FCA Package 2 x 2 mm



SIDE VIEW

CONTROLLING DIMENSION : MM

| SYMBOLS | MILLIMETER |      |      | INCH      |       |       |
|---------|------------|------|------|-----------|-------|-------|
|         | MIN.       | NDM. | MAX. | MIN.      | NDM.  | MAX.  |
| A       | 0.50       | 0.55 | 0.60 | 0.020     | 0.022 | 0.024 |
| A1      | 0.00       | 0.02 | 0.05 | 0.000     | 0.001 | 0.002 |
| A3      | 0.10       | 0.15 | 0.20 | 0.004     | 0.006 | 0.008 |
| b       | 0.13       | 0.18 | 0.23 | 0.005     | 0.007 | 0.009 |
| D       | 1.95       | 2.00 | 2.05 | 0.077     | 0.079 | 0.081 |
| E       | 1.95       | 2.00 | 2.05 | 0.077     | 0.079 | 0.081 |
| e       | 0.50 BSC   |      |      | 0.020 BSC |       |       |
| L       | 0.30       | 0.35 | 0.40 | 0.012     | 0.014 | 0.016 |
| L1      | 0.40       | 0.45 | 0.50 | 0.016     | 0.018 | 0.020 |
| S       | 0.31 REF   |      |      | 0.012 REF |       |       |
| aaa     | 0.07       |      |      | 0.003     |       |       |
| bbb     | 0.07       |      |      | 0.003     |       |       |
| ccc     | 0.10       |      |      | 0.004     |       |       |
| ddd     | 0.05       |      |      | 0.002     |       |       |
| eee     | 0.08       |      |      | 0.003     |       |       |

\*A1\* MAX LEAD COPLANARITY 0.05mm  
STANDARD TOLERANCE : ±0.05

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
3. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

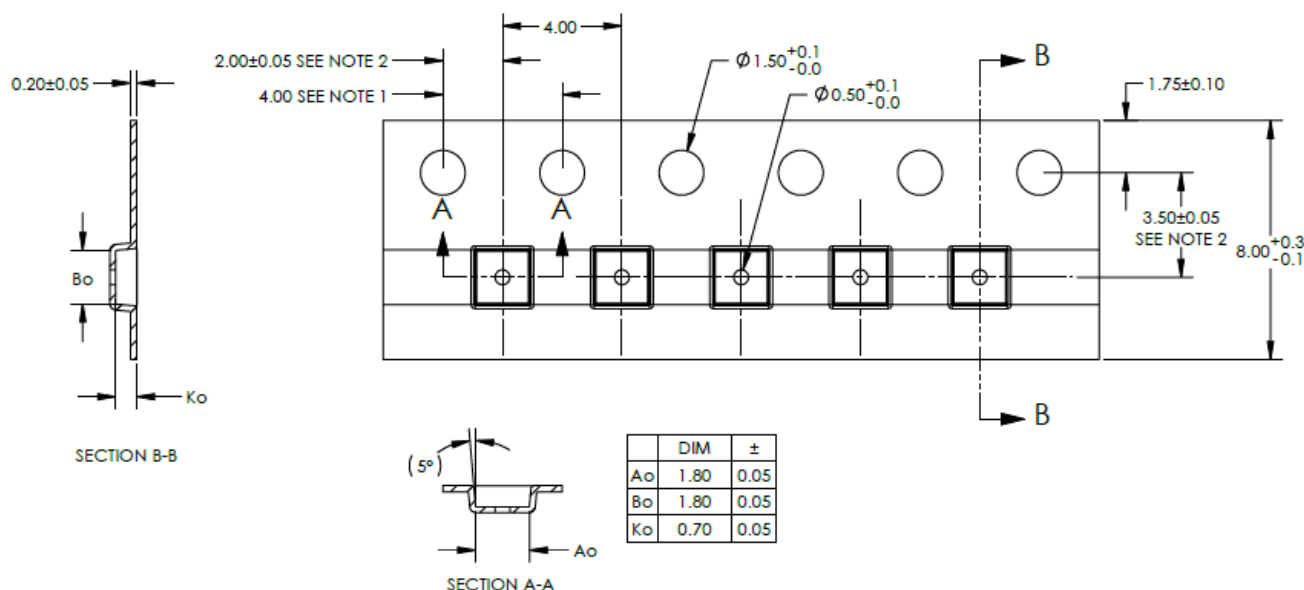
## 19.0 Tape and Reel Specifications

| Package Type             | # of Pins | Nominal Package Size [mm] | Max Units |         | Reel & Hub Size [mm] | Leader (min) |             | Trailer (min) |             | Tape Width [mm] | Part Pitch [mm] |
|--------------------------|-----------|---------------------------|-----------|---------|----------------------|--------------|-------------|---------------|-------------|-----------------|-----------------|
|                          |           |                           | per Reel  | per Box |                      | Pockets      | Length [mm] | Pockets       | Length [mm] |                 |                 |
| STQFN 12L FCA 0.4P Green | 12        | 1.6x1.6x0.55              | 3000      | 3000    | 178/60               | 100          | 400         | 100           | 400         | 8               | 4               |
| STQFN 12L FCA 0.5P Green | 12        | 2x2x0.55                  | 3000      | 3000    | 7'-2.4'hub           | 100          | 400         | 100           | 400         | 8               | 4               |

### 19.1 Carrier Tape Drawing and Dimensions

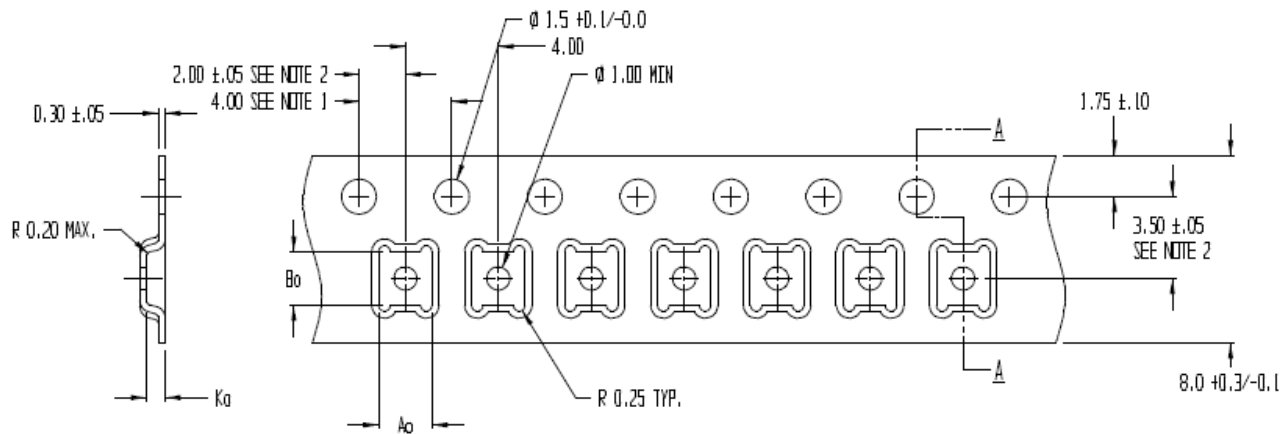
#### 19.1.1 1.6 x 1.6 mm Package

| Package Type             | Pocket BTM Length [mm] | Pocket BTM Width [mm] | Pocket Depth [mm] | Index Hole Pitch [mm] | Pocket Pitch [mm] | Index Hole Diameter [mm] | Index Hole to Tape Edge [mm] | Index Hole to Pocket Center [mm] | Tape Width [mm] |
|--------------------------|------------------------|-----------------------|-------------------|-----------------------|-------------------|--------------------------|------------------------------|----------------------------------|-----------------|
|                          | A0                     | B0                    | K0                | P0                    | P1                | D0                       | E                            | F                                | W               |
| STQFN 12L FCA 0.4P Green | 1.80<br>±0.05 mm       | 1.80<br>±0.05 mm      | 0.70<br>±0.05 mm  | 4                     | 4                 | 1.5                      | 1.75                         | 3.5                              | 8               |



19.1.2 2 x 2 mm Package

| Package Type                   | PocketBTM Length [mm] | PocketBTM Width [mm] | Pocket Depth [mm] | Index Hole Pitch [mm] | Pocket Pitch [mm] | Index Hole Diameter [mm] | Index Hole to Tape Edge [mm] | Index Hole to Pocket Center [mm] | Tape Width [mm] |
|--------------------------------|-----------------------|----------------------|-------------------|-----------------------|-------------------|--------------------------|------------------------------|----------------------------------|-----------------|
|                                | A0                    | B0                   | K0                | P0                    | P1                | D0                       | E                            | F                                | W               |
| STQFN 12L<br>FCA 0.5P<br>Green | 2.3                   | 2.3                  | 0.8               | 4                     | 4                 | 1.5                      | 1.75                         | 3.5                              | 8               |



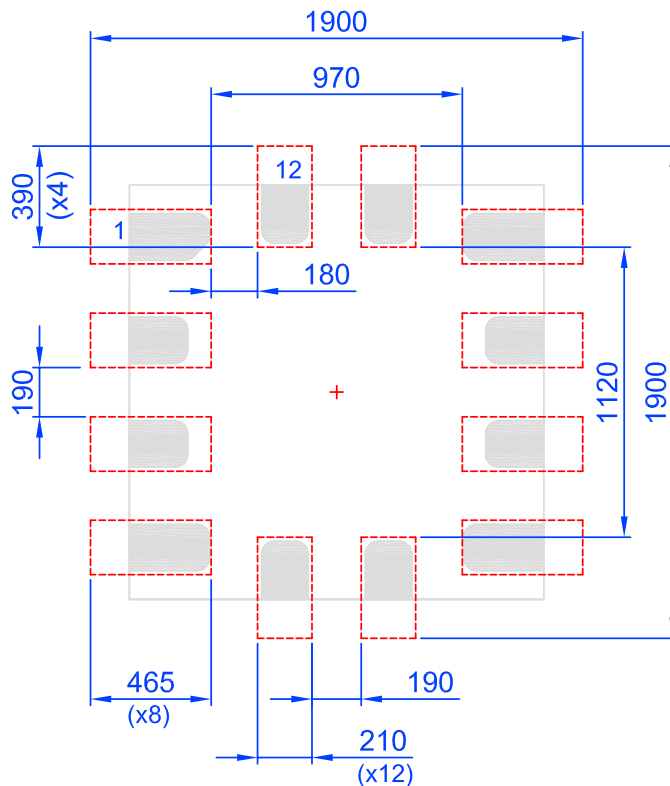
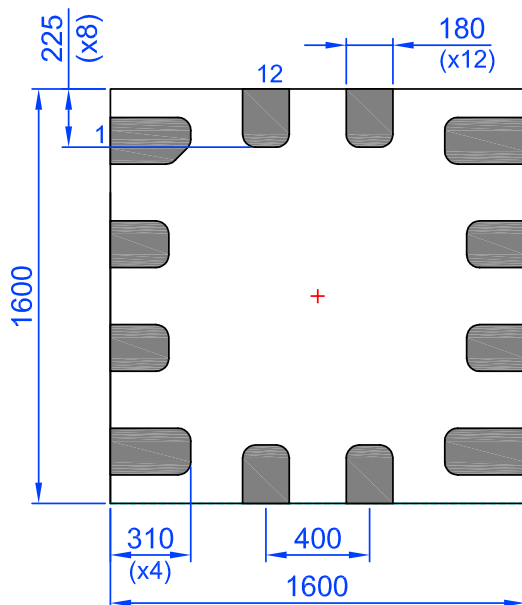
## 20.0 Recommended Land Pattern

### 20.1 12 Lead STQFN FCA Package 1.6 x 1.6 mm

 Exposed Pad  
(PKG face down)

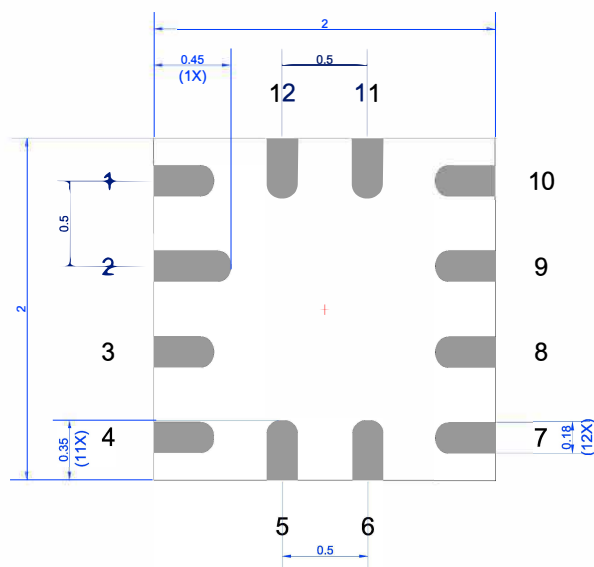
 Recommended Land Pattern  
(PKG face down)

Units:  $\mu\text{m}$

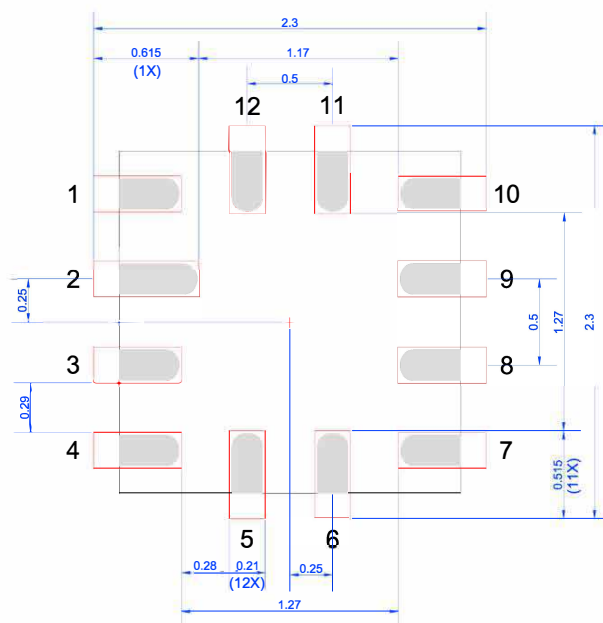


## 20.2 12 Lead STQFN FCA Package 2 x 2 mm

Expose Pad  
(Package face down)



Recommended Landing Pattern  
(Package face down)



## 21.0 Recommended Reflow Soldering Profile

Please see IPC/JEDEC J-STD-020: latest revision for reflow profile based on package volume of 1.408 mm<sup>3</sup> (nominal) and 2.2 mm<sup>3</sup> (nominal) respectively. More information can be found at [www.jedec.org](http://www.jedec.org).

## 22.0 Revision History

| Date       | Version | Change                                                                                                                                                                                                                                                                                                                                                                             |
|------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3/6/2026   | 1.20    | Updated ACMP1 Block Diagram                                                                                                                                                                                                                                                                                                                                                        |
| 2/20/2026  | 1.19    | Updated IO pins description<br>Updated Functional and Programming Pin Description<br>Updated ACMP1 Block Diagram<br>Added subsection 3-State Outputs to I/O Pins section<br>Corrected figure Internal Macrocell States during POR Sequence<br>Updated LUT block names to match with Go Configure™ Software Hub                                                                     |
| 7/9/2024   | 1.18    | Updated registers <173:102> in Matrix Output Table                                                                                                                                                                                                                                                                                                                                 |
| 8/14/2023  | 1.17    | Updated tables Electrical Characteristics<br>Fixed typos                                                                                                                                                                                                                                                                                                                           |
| 3/10/2023  | 1.16    | Added notes to section Ordering Information                                                                                                                                                                                                                                                                                                                                        |
| 3/4/2022   | 1.15    | Added R <sub>PUP</sub> and R <sub>PDWN</sub> in section Electrical Specifications<br>Renesas rebranding                                                                                                                                                                                                                                                                            |
| 9/3/2021   | 1.14    | Updated Carrier Tape Drawing and Dimensions for 1.6 x 1.6 mm Package<br>Updated Tape and Reel Specifications<br>Updated tables CNT/DLY Register Settings<br>Corrected registers [512:505], [529:522], [565:552], [579:572] in Appendix A - SLG46120 Register Definition<br>Updated tables DFF4 Register Settings, DFF6 Register Settings<br>Updated Package Drawing and Dimensions |
| 2/2/2021   | 1.13    | Fixed typos<br>Updated section Package Top Marking System Definition<br>Added note for CNTs<br>Corrected registers [579:569], [565:549], [529:519], [512:502]                                                                                                                                                                                                                      |
| 8/15/2019  | 1.12    | Fixed typos<br>Added package option for “P” package                                                                                                                                                                                                                                                                                                                                |
| 11/13/2018 | 1.11    | Updated to Dialog style                                                                                                                                                                                                                                                                                                                                                            |
| 9/28/2018  | 1.10    | Updated IDD Estimator (Chip Quiescent current)<br>Fixed typos                                                                                                                                                                                                                                                                                                                      |
| 2/27/2018  | 1.09    | Fixed typos                                                                                                                                                                                                                                                                                                                                                                        |
| 10/10/2017 | 1.08    | Updated Electrical Spec<br>Fixed typos<br>Updated POR sequence                                                                                                                                                                                                                                                                                                                     |
| 7/7/2017   | 1.07    | Updated Section Programmable Delay / Edge Detector<br>Fixed typos<br>Updated Electrical Spec                                                                                                                                                                                                                                                                                       |
| 12/22/2016 | 1.06    | Fixed typos<br>Updated Silego Website & Support                                                                                                                                                                                                                                                                                                                                    |
| 5/30/2016  | 1.05    | Updated Silego Website & Support<br>Updated Programmable Delay information<br>Added PON <sub>THR</sub> and POFF <sub>THR</sub> in Electrical Spec                                                                                                                                                                                                                                  |
| 10/28/2015 | 1.04    | Updated Absolute maximum conditions                                                                                                                                                                                                                                                                                                                                                |
| 10/20/2015 | 1.03    | Fixed typos                                                                                                                                                                                                                                                                                                                                                                        |
| 8/11/2015  | 1.02    | Fixed Programmable delay values in Section 7.0                                                                                                                                                                                                                                                                                                                                     |
| 7/23/2015  | 1.01    | Updated User Programmability<br>Updated Register Table for clarification                                                                                                                                                                                                                                                                                                           |
| 5/26/2015  | 1.0     | Production Release                                                                                                                                                                                                                                                                                                                                                                 |
| 5/21/2015  | 0.59    | Updated ACMP Diagrams and added Timing Characteristics Diagrams                                                                                                                                                                                                                                                                                                                    |
| 4/23/2015  | 0.58    | Updated ACMP section                                                                                                                                                                                                                                                                                                                                                               |

| Date      | Version | Change                                                                                                                                                   |
|-----------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4/9/2015  | 0.57    | Updated Tsu condition and value                                                                                                                          |
| 3/27/2015 | 0.56    | Updated ACMP section<br>Updated RC Oscillator section                                                                                                    |
| 3/10/2015 | 0.55    | Added Connection Matrix Example                                                                                                                          |
| 3/9/2015  | 0.54    | Added POR section                                                                                                                                        |
| 2/10/2015 | 0.53    | Fixed Preliminary watermark                                                                                                                              |
| 1/14/2015 | 0.52    | Added IDD Estimator, Timing Estimator, Expected Delays sections                                                                                          |
| 12/3/2014 | 0.51    | Updated Electrical Characteristics VIH/VIL/VOH/VOL values                                                                                                |
| 9/26/2014 | 0.50    | Preliminary Release                                                                                                                                      |
| 9/24/2014 | 0.27    | Fixed typos                                                                                                                                              |
| 8/11/2014 | 0.26    | Updated package information<br>Added Recommended Land Pattern                                                                                            |
| 7/29/2014 | 0.25    | Fixed ESD information                                                                                                                                    |
| 6/20/2014 | 0.24    | Updated Electrical Specifications VIH/VIL levels<br>Fixed typos                                                                                          |
| 5/21/2014 | 0.23    | Updated block diagram<br>Fixed typos<br>Updated Pipe Delay information<br>Moved Programmable Delay and Deglitch Filter to Combination Macrocells section |
| 4/29/2014 | 0.22    | Added ESD Ratings and MSL to Absolute Maximum Conditions                                                                                                 |
| 4/15/2014 | 0.21    | Updated block diagrams and timing diagrams for clarity                                                                                                   |
| 2/12/2014 | 0.2     | Added Macrocell Function Sections                                                                                                                        |
| 1/16/2014 | 0.11    | Added Register Table                                                                                                                                     |
| 9/16/2013 | 0.1     | Initial release                                                                                                                                          |

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